Appendix B

SAVANNAH RIVER BASIN COMPREHENSIVE STUDY
Integrated Feasibility Study and Draft Environmental Assessment

ENGINEERING

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ENGINEERING APPENDIX

1 Purpose

The Savannah River Basin Comprehensive Study (SRBCS) Interim Study purpose is to address the current and future needs of the basin for flood risk management (FRM), hydropower, water supply, fish and wildlife management, recreation, and other water resource related issues. This is the second interim study under the SRBCS and the intent of the effort is to reevaluate the Drought Contingency Plan (DCP) that was developed in 2006 in order to determine if modifications are warranted to better preserve conservation storage.

The following outlines the models, alternatives, data sets, outputs, assumptions, and other key information utilized to support the plan formulation for the study that results in a selected alternative for the study. The results of this study may require updates to the current drought control pan and the Savannah River Basin Water Control Manual.

2 Data Used in the Study

Two drought periods affected the basin following the initial DCP development in 2006. Based on the severity of the droughts, the inflow data sets required updating to ensure adequate data to model the impacts of the drought of record for the study. Based on these needs, the following data sets were developed for the interim study.

2.1 Unimpaired Inflow Data Set

The Unimpaired Inflow Data Sets are developed by DNR-GA, specifically Georgia Environmental Protection Division (EPD) and are provided to USACE for modeling of alternatives associated with the Comprehensive Study. Updates for the interim study include the following:

a. Daily values of local inflow
   Savannah River Basin Comprehensive Study II: 2009 – 2013 Unimpaired Flow Data Extension
b. Covered sub-basin inflow from the top of the Savannah basin to Clyo

2.2 Water Use Data

Water use Data Sets for the Savannah River Basin are developed by GADNR-EPD and are provided to USACE for modeling of alternatives associated with the Comprehensive Study. Data provided for the interim study include the following:

a. States provided water use data
b. 35 year horizon (2050)
c. Contained both withdrawals and returns to each reach of the river

3 Models used in this study

The Savannah River Basin includes mountainous areas into North Carolina down to the harbor and tidal estuary at the city of Savannah. Due to the changes in flow regime and data needed for the formulation of a comprehensive basin study, a series of computer models was utilized to evaluate alternatives. The following are the models utilized in this interim of the Comprehensive Study.

a. HEC-HEC-ResSim (Savannah District, USACE-SAS)
b. EPD-Riv1 (Department of Natural Resources,GADNR-EPD)
c. Harbor Model, EFDC (Department of Natural Resources,DNR-SC)
d. HEC-EFM (The Nature Conservancy,TNC)

These models were used in a sequential manner. HEC-ResSim was used by USACE to model the reservoir operations. The output of HEC-ResSim was passed to Georgia DNR who used the RIV-1 model to capture impacts to the riverine stretch between Thurmond Dam and Clyo. The output of RIV-1 was again passed on to South Carolina DNR who used EFDC to evaluate impacts to water quality in the Savannah Harbor. Ultimately all of the results were run by TNC who used HEC-EFM to evaluate the ecosystem responses to the alternatives.

4 Model Certification

Models utilized in studies and design require USACE certification or approval of use by the Community of Practice associated with the model. The following shows the status of the models listed above for use in the Comprehensive Study. All models used in this study were either Community of Practice preferred or allowed for use.

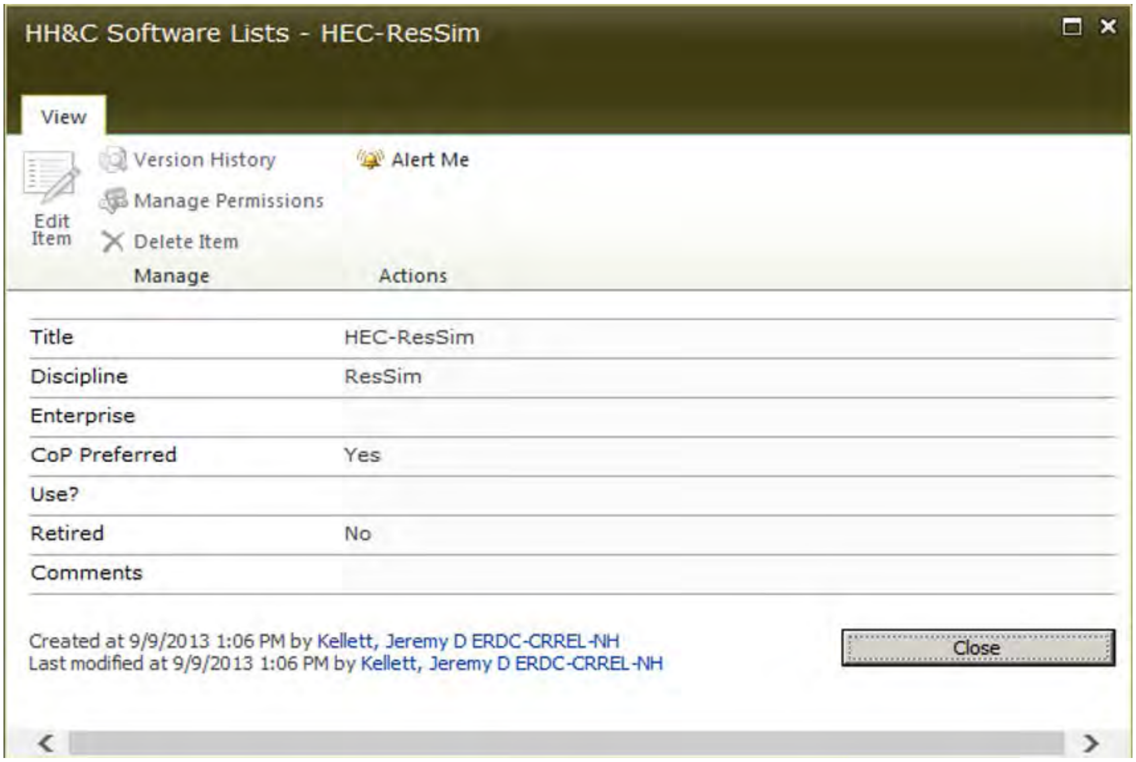


Plate 4-1 (Status of HH&C Software, HEC ResSim)

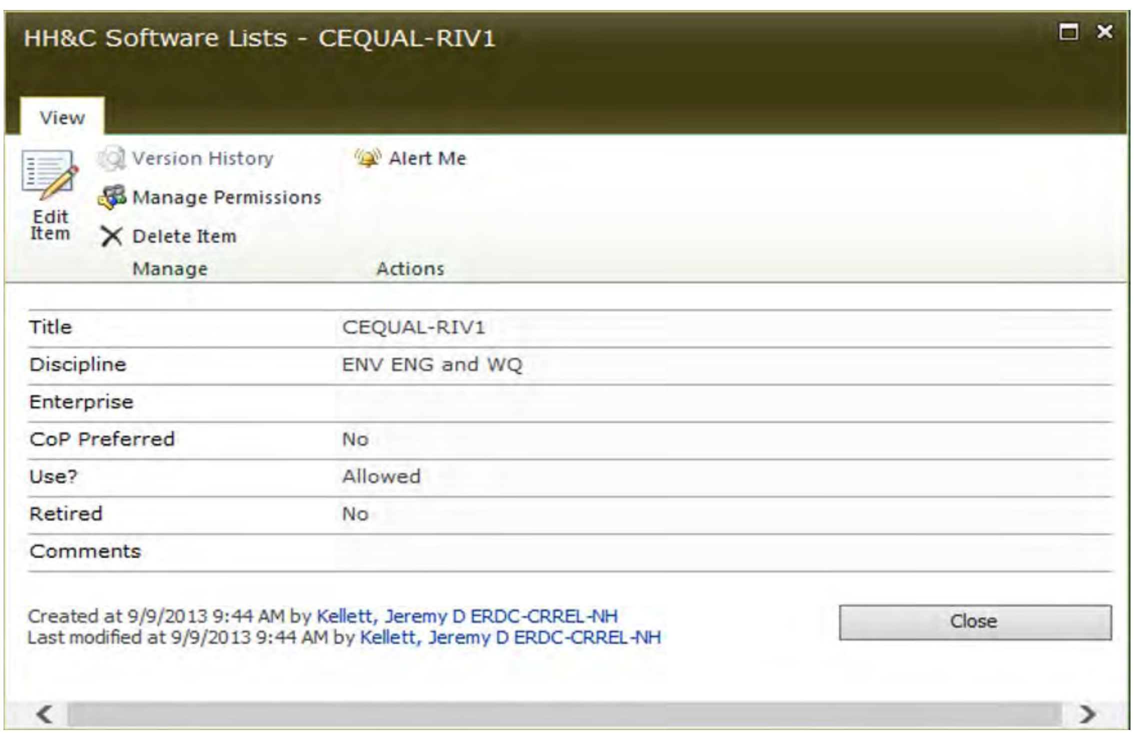
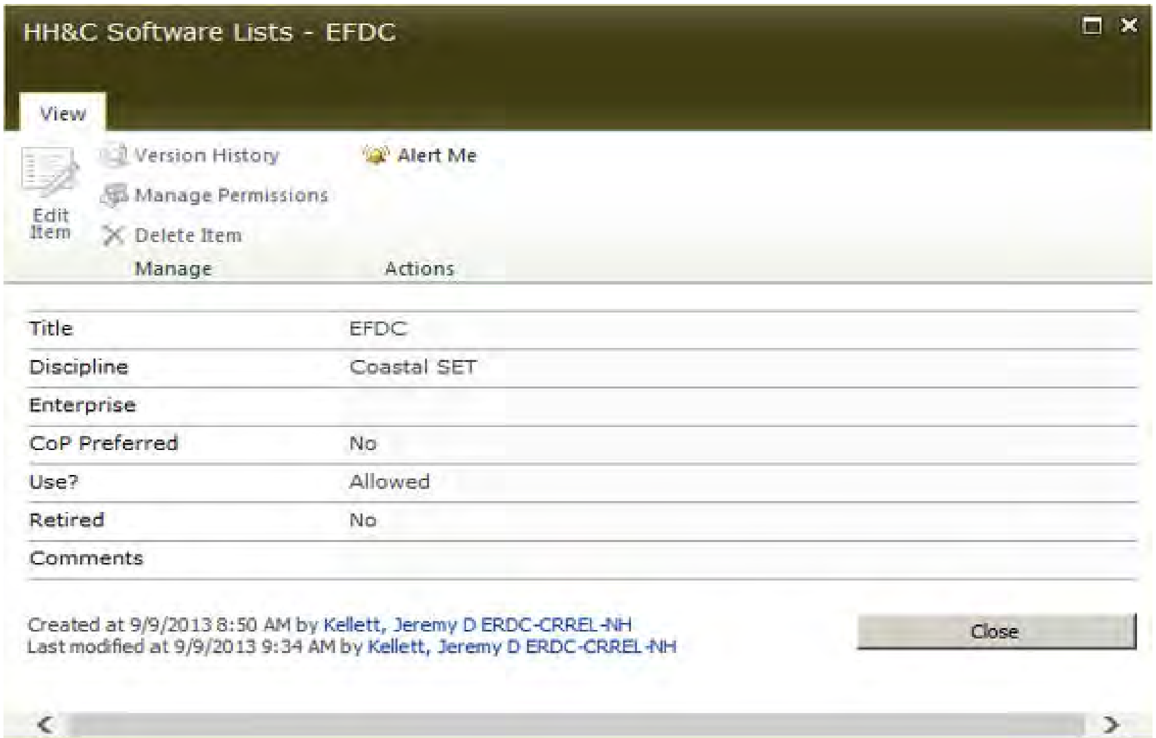


Plate 4-2 (Status of HH&C Software, CEQUAL – RIV1)


HH&C Software Lists - EFDC

View

Edit Item | Version History | Manage Permissions | Delete Item | Manage | Alert Me | Actions

Title	EFDC
Discipline	Coastal SET
Enterprise	
CoP Preferred	No
Use?	Allowed
Retired	No
Comments	

Created at 9/9/2013 8:50 AM by Kellett, Jeremy D ERDC-CRREL-NH
Last modified at 9/9/2013 9:34 AM by Kellett, Jeremy D ERDC-CRREL-NH

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Plate 4-3 (Status of HH&C Software, EFDC)


HH&C Software Lists - WASP

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Edit Item | Version History | Manage Permissions | Delete Item | Manage | Alert Me | Actions

Title	WASP
Discipline	ENV ENG and WQ
Enterprise	
CoP Preferred	Yes
Use?	
Retired	No
Comments	

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Plate 4-4 (Status of HH&C Software, WASP)

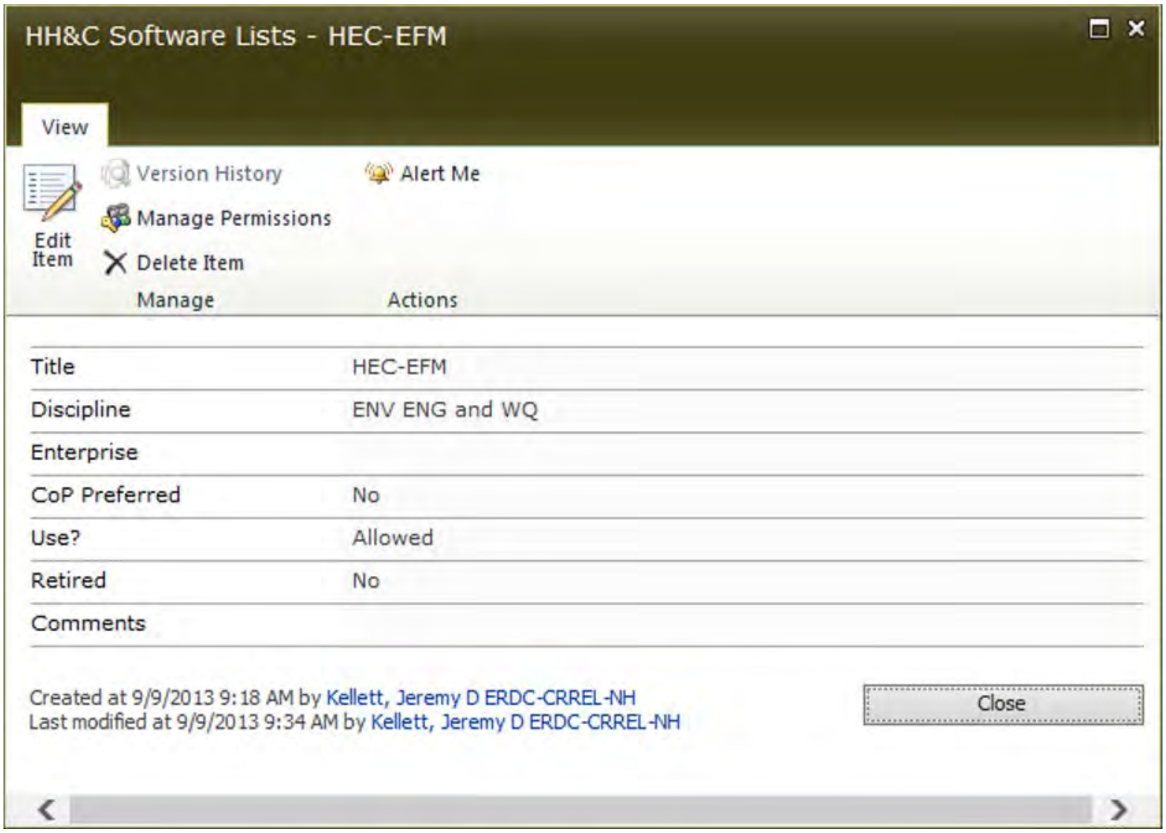


Plate 4-5 (Status of HH&C Software, HEC-EFM)

5 Description of Models

5.1.1 HEC-ResSim (Version 3.3.0.333 used for study)

The HEC-ResSim software was developed by the U.S. Army Corps of Engineers to model reservoir operations at one or more reservoirs for a variety of operational goals and constraints. The software simulates reservoir operations for flood management, low flow augmentation and water supply for planning studies, detailed reservoir regulation plan investigations, and real-time decision support. The following describes the major features of HEC-ResSim:

- Graphical User Interface
- Map-Based Schematic
- Rule-Based Operations

5.1.2 Graphical User Interface

Designed to follow Windows® software development standards, HEC-ResSim's interface does not require extensive tutorials to learn to use. Familiar data entry features make model development easy, and localized "mini plots" graph the data entered in most tables so that errors can be seen and corrected quickly. A variety of default plots and reports, along with tools to create customized plots and reports, facilitate output analysis.

5.1.3 Map-Based Schematic

HEC-ResSim provides a realistic view of the physical river/reservoir system using a map-based schematic with a set of element drawing tools. Also, with the hierarchical outlet structure, the modeler can represent each outlet of the reservoir rather the being limited to a single composite outlet definition.

Schematic - The program's user interface allows the user to draw the network schematic either as a stick figure or an overlay on one or more geo-referenced maps of the watershed.

Drawing Tools **-** HEC-ResSim represents a system of reservoirs as a network composed of four types of physical elements: junctions, routing reaches, diversions, and reservoirs. By combining these elements, the HEC-ResSim modeler is able to build a network capable of representing anything from a single reservoir on a single stream to a highly developed and interconnected system like that of California's central valley.

A reservoir is the most complex element of the reservoir network and is composed of a pool and a dam. HEC-ResSim assumes that the pool is level (i.e., it has no routing behavior) and its hydraulic behavior is completely defined by an elevation-storage-area table. The real complexity of HEC-ResSim's reservoir network begins with the dam.

Hierarchical Outlet Structure - The dam is the root of an outlet hierarchy or "tree" which allows the user to describe the different outlets of the reservoir in as much detail as is deemed necessary. There are two basic and two advanced outlet types. The basic outlet types are controlled and uncontrolled. An uncontrolled outlet can be used to represent an outlet of the reservoir, such as an overflow spillway, that has no control structure to regulate flow. Controlled outlets can be used to represent any outlet capable of regulating flow, such as a gate or valve. The advanced outlet types are power plant and pump, both of which are controlled outlets with additional features to represent their special purposes. The power plant has the ability to compute energy production. The pump is even more specialized because its flow direction is opposite that of the other outlet types, and it can draw water up into the reservoir from the pool of another reservoir. The pump outlet type was added to enable the user to model pump-back operation in hydropower systems, although hydropower is not required for its operation.

5.1.4 Rule-Based Operations

Most reservoirs are constructed for one or more of the following purposes: flood control, power generation, navigation, water supply, recreation, and environmental quality. These purposes typically define the goals and constraints that describe the reservoir's release objectives. Other factors that may influence these objectives include: time of year, hydrologic conditions, water temperature, current pool elevation (or zone), and simultaneous operations by other reservoirs in a system. HEC-ResSim is unique among reservoir simulation models because it attempts to reproduce the decision making process that human reservoir operators must use to set releases. It uses an original rule-based description of the operational goals and constraints that reservoir operators must consider when making release decisions. As HEC-ResSim has developed advanced features such as outlet prioritization, scripted state variables, and conditional logic have made it possible to model more complex systems and operational requirements.

USACE, Savannah District used HEC-ResSim to mimic the operations of the USACE and Duke Energy Savannah River Projects. HEC-ResSim was set to operate on a daily time-step using an unimpaired inflow dataset (UIF) developed by GADNR-EPD. These inflows extended from January 1939 to December 2013. Different alternatives were developed within in HEC-ResSim to mimic the set of study Alternatives that the Comprehensive Study partners came up with. Each HEC-ResSim Alternative has its own rule set which defined the behavior/operation of each project in the system. Initially the team came up with four alternatives focused on different goals. These would be evaluated prior to defining the final two alternatives which were based on features of the first four. HEC-ResSim operates on a user prioritized set of rules. Each rule has its own objective. Some rules can coincide with other rules without violating each other. However, many rules will often conflict with each other and the rule highest in the priority stack will be met. Rules lower in the priority stack will only be met if conditions of the higher priority rules have already been met and the lower rule does not cause the higher priority rules to be violated.

5.2 RIV-1

RIV-1 is a dynamic, one-dimensional (longitudinal), water quality model for unsteady flows in rivers and streams. The model has both hydrodynamic and water quality components. Output from the hydrodynamic solution is used to drive the water quality model. The hydrodynamic code uses a four-point implicit Newton-Raphson procedure to solve the nonlinear St. Venant equation. Numerical accuracy for the advection of sharp gradients is preserved in the water quality code through the use of the explicit two-point, fourth-order accurate, Holly-Preissmann scheme. Water quality constituents include temperature, dissolved oxygen, carbonaceous biochemical oxygen demand, organic nitrogen, ammonia nitrogen, nitrate nitrogen, orthophosphate phosphorus, coliform bacteria, dissolved iron, and dissolved manganese. The effects of algae and macrophytes are also included. The model allows simulation of branched river systems with multiple hydraulic control structures, such as run-of-the-river dams, waterway locks and dams, and reregulation dams. The model was developed to simulate the transient water quality conditions associated with highly unsteady flows that can occur on regulated streams.

Hydrodynamics

RIV1H solves the fully dynamic equations for continuity and momentum; thus it has wide-ranging capabilities with good resolution (Environmental Laboratory 1990). Because the hydrodynamic solution of RIV1H can be executed independently of the water quality solution, the complete time series of flow and elevation can be stored and used as input information for the water quality transport calculations. Therefore, RIV1H was capable of simulating the flood and peaking hydropower releases from Thurmond Dam that create rapidly varying flows, elevations, and water quality.

Water Quality

CE-QUAL-RIV1 was developed for the water quality simulation of riverine systems with highly unsteady flow. The River Model's water quality simulations focused on DO and the parameters and kinetics of classical Streeter-Phelps theory that affect DO. The following parameters were included in the River Model's water quality simulations:

- Water Temperature
- Carbonaceous Biochemical Oxygen Demand (CBOD)
- Organic Nitrogen
- Ammonia
- Nitrate
- Organic Phosphorus
- Ortho Phosphorus
- Dissolved Oxygen

RIV-1 addressed concerns that changes in operation will have impacts on permitted municipal and industrial water users.

5.3 EFDC Hydrodynamic Model

The three-dimensional hydrodynamics of Savannah Harbor was modeled using EFDC. EFDC is a hydrodynamic and water quality modeling package for simulating one-dimensional, two-dimensional, and three-dimensional flow and transport in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands, and near shore to shelf scale coastal regions. The EFDC model was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications and is considered public domain software (Hamrick 1992).

The physics of the EFDC model, and many aspects of the computational scheme, are equivalent to the widely used Blumberg-Mellor model (Blumberg & Mellor 1987) and the USACE CH3D or Chesapeake Bay model (Johnson et al. 1993). The EFDC model solves the three-dimensional, vertically hydrostatic, free surface, turbulent averaged equations of motion for a variable density fluid. Dynamically coupled transport equations for turbulent kinetic energy, turbulent length scale, salinity, and temperature are also solved. The two turbulence parameter transport equations implement the Mellor-Yamada level 2.5 turbulence closure scheme (Mellor & Yamada 1982; Galperin et al. 1988).

The EFDC model uses Cartesian or curvilinear, orthogonal horizontal coordinates. The numerical scheme employed in EFDC to solve the equations of motion uses second order accurate spatial finite differencing on a staggered grid. The model's time integration employs a second order accurate three-time level, finite difference scheme with an internal-external mode splitting procedure to separate the internal shear, or baroclinic mode, from the external free surface gravity wave, or barotropic mode.

The EFDC model uses a Z-grid, where the external mode solution is semi-implicit, and simultaneously computes the two-dimensional surface elevation field by a preconditioned conjugate gradient procedure. The external solution is completed by the calculation of the depth average barotropic velocities using the new surface elevation field. The model's semi-implicit external solution allows large time steps that are constrained only by the stability criteria of the explicit central difference or high order upwind advection scheme (Smolarkiewicz and Margolin 1993) used for the nonlinear accelerations. Horizontal boundary conditions for the external mode solution include options for simultaneously specifying the surface elevation only, the characteristic of an incoming wave (Bennett & McIntosh 1982), free radiation of an outgoing wave (Bennett 1976; Blumberg & Kantha 1985), or the normal volumetric flux on arbitrary portions of the boundary.

5.3.1 Savannah Hydrodynamic Model History

Tetra Tech was contracted by the USACE Savannah District in 2004 to enhance the existing three-dimensional hydrodynamic model (EFDC) and the water quality model

(WASP) application for the Savannah River and Harbor. Tetra Tech had originally developed the EFDC hydrodynamic model and supported the USEPA Region 4 on the WASP model for developing the TMDL for DO in the harbor. Hydrodynamic and water quality models of the Savannah Harbor was originally completed in 2004 for the development of a DO TMDL.

The enhanced hydrodynamic and water quality models were used to assess the environmental impacts of SHEP, being led by the USACE Savannah District and the Georgia Ports Authority (GPA). The models were developed in consideration of the following efforts: (1) USACE Savannah Harbor Ecosystem Restoration Project, (2) finalization of the USEPA Region 4 DO TMDL, and (3) the states of Georgia and South Carolina issuing NPDES permits. Therefore, federal and state agency review of model development and performance was critical to the success of using one model in Savannah Harbor for environmental decision making.

The effort to develop an enhanced grid was initiated on September 29, 2004 to improve the representation of the estuary system and navigation channel from the original TMDL model grid. The enhanced grid is designed to allow evaluation of various scenarios such as deepening of the navigation channel and physical modifications to certain cuts and channels in the river and estuary. The major enhancements included developing a finer model grid, updating the bathymetric data used by the model, and an alternate approach for the model calculation of the river-marsh interactions. The same models, EFDC and WASP, were used on the TMDL grid and the enhanced grid.

The setup, calibration, and confirmation of the original EFDC and WASP Savannah Harbor models are well documented in the Tetra Tech January 30, 2006, modeling report (Tetra Tech 2006). After two years of intense efforts by several modelers and many agency meetings, final acceptance letters approving the use of the model were received from the EPA Region 4, Georgia Environmental Protection Division (GADNR-EPD), South Carolina Department of Health and Environmental Control (SCDNR-DHEC), National Marine Fisheries, and the United States Fish and Wildlife Service (USFW) in March 2006. Other reviewers of the enhanced models included the Harbor Committee (MACTEC as their consultant), the USACE Engineer Research and Development Center (ERDC), and the USGS.

In 2009, the DO water quality criteria for the State of Georgia changed, and the EPA Region 4 began development of a new DO TMDL for the Savannah Harbor. EPA Region 4 determined a need for converting the Savannah Harbor sigma grid of the enhanced model to a Z-grid. The compressed vertical layers in the Little Back River portion of the model caused unrealistic DO concentrations in the surface and bottom layers. The Z-grid allowed a different number of vertical layers throughout the model domain based on river and estuary depth. The sigma enhanced grid was six vertical layers and was converted to a Z-grid with a maximum of five vertical layers in the navigation channel and a minimum of one vertical layer in the Middle, Little Back, and

Upper Savannah Rivers. The 2010 Savannah Harbor Z-grid model contained 608 horizontal cells and 1,778 total cells when including the vertical cells.

The marsh areas were revised from the sigma grid model (Tetra Tech 2006) to include the areas downstream of Fort Jackson, along with one area upstream near the I-95 Bridge. To address seasonality of the marsh loads, a reference paper was used that measured dissolved inorganic carbon (DIC) in tidal freshwater marshes in Virginia and the adjacent estuary. The paper is titled “Transport of dissolved inorganic carbon from a tidal freshwater marsh to the York River Estuary” by Scott C. Neubauer and Iris C. Anderson from the Virginia Institute of Marine Science, School of Marine Science, College of William and Mary.

The original flow, velocity, elevation and temperature predictions were calculated using the EFDC hydrodynamic model and calibrated to the extensive 1997 and 1999 data sets (Tetra Tech 2006). The EFDC model inputs were updated to reflect more recent information. This information includes new flow gages by USGS in the harbor, longterm DO data at the USACE Dock, updates to the boundary conditions, connection to EPD’s river model, and updates to water quality kinetics.

The USGS collected detailed (15 minute) water surface elevation, velocity and flow data during the fall and winter of 2008 – 2009 at the Middle and Back Rivers near the Houlihan Bridge crossings at Stations MR-10 and LBR-15 respectively. These data were used to improve the hydrodynamic predictive ability of the model in the Middle and Back Rivers.

GADNR- EPD had developed a hydrodynamic and water quality model (GADNR-EPD RIV1 Model) for the Savannah River from Thurmond Dam to Clyo. This model was used to transport the oxygen demanding substances from the upper watershed to the Harbor Model. The River Model provided the flow, DO, temperature, carbonaceous biochemical oxygen demand (CBOD, fast and slow) and NH3 boundary conditions for the calibrated and TMDL Harbor Model. (USEPA 2010)

The main changes to the water quality portion of the 2006 Savannah Harbor model (Tetra Tech 2006) were an update of the reaeration approach and a fine tuning of the CBOD decay rates. The main modeling parameters impacting the DO balance of the Harbor are the reaeration rate, the SOD rate and the oxygen demanding substances (BOD and NH3) decay rates.

In conjunction with 2010 Savannah Harbor model, a watershed model was constructed to simulate hydrologic runoff and water quality response to recorded precipitation events. This type of dynamic watershed representation illuminates the relationship between instream flows and the hydrologic processes that influence the quantity and timing of water movement throughout the watershed. Results from the watershed model were then loaded into the EFDC and WASP models. Several scenarios were run with the LSPC watershed model, including existing conditions, removal of point sources, all forested land uses, and conversion of urban and agricultural land uses to wetlands.

The development of 2010 Savannah Harbor TDML model underwent an extensive review process. The formation of a modeling group of technical experts from the USEPA, GADNR-EPD, SCDNR-DHEC, Savannah Harbor Committee, and Central Savannah River Association, along with input from the Savannah District, was organized to lend their expertise in modeling and specific knowledge of the Savannah River and Harbor ecosystem to the 2010 Savannah Harbor model. The modeling subgroup expertise was used over the 2007 to 2010 period to update and improve the 2010 Savannah Harbor TMDL.

5.3.2 WASP Water Quality Model

The Water Quality Analysis Simulation Program Version 7.0 (WASP7) was used for the water quality model based on its comparative advantages explained below. WASP7 is an enhanced Windows version of the USEPA WASP (Di Toro et al. 1983; Connolly and Winfield 1984; Ambrose et al. 1993), with many upgrades to the user's interface and the model's capabilities. The major upgrades to WASP have been the addition of multiple BOD components, addition of sediment diagenesis routines, and addition of periphyton routines. WASP7 has features including a pre-processor, a rapid data processor, and a graphical post-processor that enables the modeler to run WASP more quickly and easily and evaluate model results both numerically and graphically. With WASP7, model execution can be performed up to ten times faster than the previous USEPA DOS version of WASP. Nonetheless, WASP7 uses the same algorithms to solve water quality problems as those used in the DOS version of WASP. The hydrodynamic file generated by EFDC is compatible with WASP7 and it transfers segment volumes, velocities, temperature and salinity, as well as flows between segments. The time step is also set in WASP7 based on the hydrodynamic simulation.

WASP7 helps users interpret and predict water quality responses to natural phenomena and man-made pollution for various pollution management decisions. WASP7 is a dynamic compartment-modeling program for aquatic systems, including both the water column and the underlying benthos. The time-varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange are represented in the basic program. Water quality processes are represented in special kinetic subroutines that are either chosen from a library or written by the user. WASP is structured to permit easy substitution of kinetic subroutines into the overall package to form problem-specific models. WASP7 comes with two such models, TOXI for toxicants and EUTRO for conventional water quality.

WASP has a long history of application to various problems. Some applications have been validated with field data, or verified by model experiments and reviewed by independent experts. Earlier versions of WASP have been used to examine eutrophication of Tampa Bay; phosphorus loading to Lake Okeechobee; eutrophication of the Neuse River and Estuary (Wool et al. 2003); eutrophication and polychlorinated biphenyl pollution of the Great Lakes (Thomann 1975; Thomann et al. 1976; Di Toro and Connolly 1980), eutrophication of the Potomac Estuary (Thomann and Fitzpatrick 1982), Kepone pollution of the James River Estuary (O'Connor et al. 1983), and volatile organic pollution of the Delaware Estuary (Ambrose 1987). In addition to these, numerous applications are listed in Di Toro et al. 1983.

5.3.3 Model Linkage

EFDC and WASP7 were used to simulate the hydrodynamics and water quality of the Savannah Harbor. Savannah River and open ocean measured hydrodynamic boundary conditions provided stream flows, temperature, water surface elevation, and salinity to the EFDC model. DO and ammonia (NH3) water quality concentrations were provided to the WASP estuary model. EFDC and WASP were linked through the hydrodynamic linkage file. The EFDC hydrodynamic linkage file provides the inter-cell flow and velocities, as well as cell volume, temperature and salinity at each simulation time step, representing the circulation and transport patterns in the estuary. This file was used subsequently by the water quality model WASP7 to evaluate the fate and transport of the different variables under analysis. Figure 5-1 illustrates the interaction among the two models.

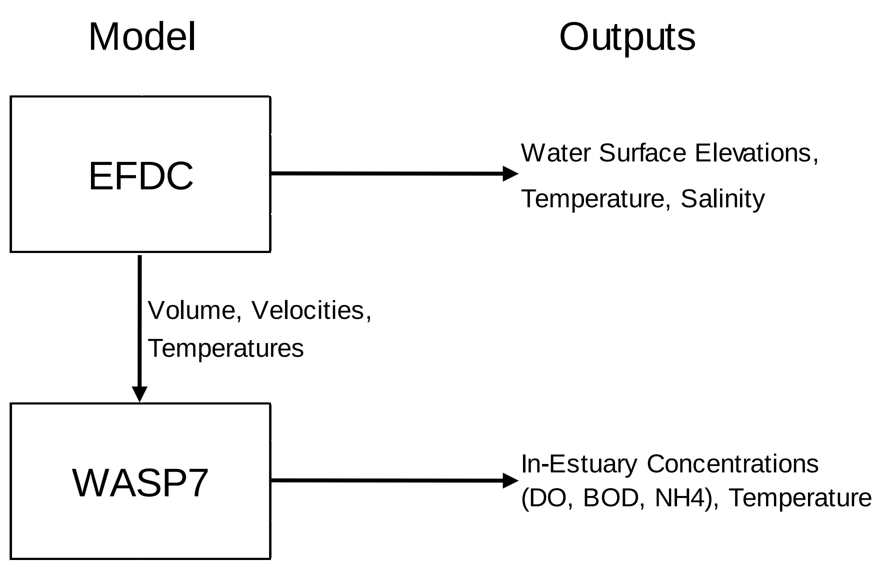


Figure 5-1(Model linkage between EFDC and WASP)

5.4 HEC-EFM

HEC-EFM, Ecosystem Functions Model, is a statistical analysis tool used for the post-processing of data to determine ecosystem responses to changes in the flow regime of a river or connected wetland.

a. Statistical analyses of relationships between hydrology and ecology
b. Hydraulic modeling
c. Geographic Information Systems (GIS) modules to display results and other relevant spatial data. Was to visualize and define existing ecologic conditions, highlight critical habitat, and assess and rank alternatives according to predicted changes in different aspects of the ecosystem.

6 Metrics/Objectives

A series of metrics were developed by the study team that focused on different aspects of the projects. The metrics can be grouped into the following categories. Each Project purpose was weighted equally. All seven alternatives, including the NAA, were ranked from 1 to 7, with 1 being the highest positive impact and 7 being the highest negative impact. The team then combined the purpose impact rankings and averaged them by alternative to determine the final impact ranking of each alternative. See main report, Section 5 Table 30, for details.

1. Hydropower
    a. USACE System Hydropower
    b. Augusta Canal Hydropower
2. Environmental Pool Management
    a. In-Lake Fish Spawn
    b. Downstream Environment
3. Water Supply
    a. In-Lake
    b. Downstream
4. Water Quality
    a. Downstream
5. Recreation
    a. Balancing of Pools
    b. Impacts to Boat Ramps
    c. Impacts to Beaches
6. Navigation
    a. N/A
7. Flood Reduction
    a. In-Lake, Time in Flood Pools

Below is the initial list of the metrics proposed by study sponsors; refined and later used to develop a method of comparison of the alternatives.

Requested Metric (Green EPD, Blue SCDNR, Black SAS)
Exceedance curve of reservoir elevation (Jocassee, Keowee, Hartwell, Russell, Thurmond)
Exceedance curve of reservoir release (Thurmond)
Minimum lake elevation (Jocassee, Keowee, Hartwell, Russell, Thurmond)
Power generation (Bad Creek, Jocassee, Keowee, Hartwell, Russell, Thurmond)
Pumping (Bad Creek, Jocassee, Russell)
Power generation (Bad Creek, Jocassee, Keowee, Hartwell, Russell, Thurmond)
Lake recreational impact (Jocassee, Keowee, Hartwell, Russell, Thurmond)
Lake recreational impact (Jocassee, Keowee, Hartwell, Russell, Thurmond)
Numbers of days in different drought trigger levels (Hartwell, Thurmond)
Lake levels or flows are lower than the lowest level or flow at which water supply intake becomes inoperable
Identify lake elevations level at intakes (some highest intakes may not be critical)
Identify critical elevation/flow for intakes
Number of days that critical water supply intake becomes inoperable (Hartwell, Russell, Thurmond)
Number of days when power contracts are not met by the Corps projects
Power shortages (total Megawatts) for the Corps projects
Cost of replacement power purchased by SEPA
Total power generation by the Duke projects
Inability to maintain stable lake levels during lake spawning periods (defer to biologists)
Number of days boat ramps and docks are unusable (# ramps x days) in Hartwell and Thurmond
Number of days some percentage of ramps and docks are unusable in Hartwell and Thurmond
Are there critical lake elevations for safe boating?
Are there critical lake elevations for fishing?
Number of days lake levels are below any intakes and critical intakes
Number of days swimming areas are closed due to low water in Hartwell and Thurmond
Stream flow exceedance at Augusta diversion dam
Flow exceedance through the Augusta Canal
Stream flow exceedance at Augusta gage (downstream of the shoals)
Frequency analysis for Augusta Canal and Shoals
Number of days when flows in the shoals are less than recommended; (FERC Agreement)
Stream flow exceedance at Burtons Ferry and Clyo
Effect on the DO in the River

Effect on water temperature in the River
Number of days Augusta Canal would have to cut back on hydropower to meet shoals minimum
Number of days Augusta would need to run diesel pumps to pull raw water due to implementation FERC Agreement
Number of days river levels are below any intakes and critical intakes
Number of days boat access ramps in river are unusable (# ramps x days)
Number of days DO standards are not met in river
Impacts to fish spawning/habitat in shoals
Number of days DO standards are not met in river (per node)
Number of days when flow of river is less than 7Q10
Effect on the downstream fish spawning downstream of the New Savannah Bluff Lock and Dam
Effect on the DO in the Harbor
Effect on temperature in the Harbor
Effect on salinity in the Harbor
Effect on the downstream fish spawning in the Harbor
Effect on the downstream fish populations in the Harbor
Number of days City of Savannah would be impacted by high salinity levels in Abercorn Creek
Number of days DO standards are not met in estuary
Salinity levels in river near Savannah National Wildlife Refuge freshwater intakes
Number of days DO standards are not met in estuary (per node)
Location of fresh/saline water interface near coast for wetland analysis
Number of days Savannah intake (Abercorn Creek) exceeds desirable salinity levels

Figure 6-1 (Summary list of the metrics)

6.1 Flood Management

The system has specific flood management rules for each project. These rules can be broken into two categories. The first set of rules are focused on managing releases to preserve the integrity of the dam. The second set of rules focuses on minimizing downstream damages. The impact of these rules are not obvious during drought periods, however become evident during wet periods. The same Flood Management rules are present in all of the alternatives. The different alternatives impact the timing and magnitude of releases from the projects. The conservation of water in the reservoirs sometimes caused potential increase in flood impacts. The metric chosen to compare alternatives was the number of days that the pools rose into their flood control zones. Since the time window selected for the study was a drought period, 1999-2013, estimated damages were not computed or used as a basis of comparison for each alternative.

6.2 Hydropower Objectives

6.2.1 Energy

All of the alternatives include Hydropower Energy objectives for the USACE projects. The Savannah River system has a monthly varying weekly generation target. The table below describes the target.

Southeastern Power Administration			
Weekly Minimum Energy Requirements (MWH)			
	Savannah	RBR Pumps	Savannah Total
January	22,033	5,200	27,233
February	21,514	5,200	26,714
March	18,069	2,600	20,669
April	18,504	0	18,504
May	19,348	2,600	21,948
June	20,735	5,200	25,935
July	25,995	5,200	31,195
August	26,835	5,200	32,035
September	25,485	5,200	30,685
October	22,104	5,200	27,304
November	21,084	5,200	26,284
December	21,904	5,200	27,104

Table 5-1 (SEPA Weekly Minimum Energy Requirements)

Energy production from the Duke Energy projects was not considered as a metric as most of the Duke hydropower comes from pump energy which varies with market conditions rather than pool elevation.

6.2.2 Capacity

The system also has Hydropower Capacity objectives. Typically, each plant has to meet the ability to generate at full capacity for four hours per day five days per week. We chose not to write specific capacity rules in HEC-ResSim. Rather the HEC-ResSim output for each alternative was evaluated to determine if each project was able to meet capacity objective.

6.2.3 Augusta Canal Generation requirements

Water Demand for Canal Hydropower Users

Canal User	Rated HP	100%		90%		80%		70%	
		cfs	kw	cfs	kw	cfs	kw	cfs	kw
Waterworks		900	N/A	900	N/A	900	N/A	900	N/A
Sibley (3 units)	3832	1024	1900	920	1700	819.2	1520	716.8	1275
King (2 units)	3300	881	1950	790	1750	704.8	1560	616.7	1355
Enterprise (2 units)	1906	560	1000	500	890	448	800	392	675
Total	9038	3365	4850	3110	4340	2872	3880	2625.5	3305
Loss in kw production/hour	N/A	0	0	0	510	493	970	739.5	1545
Daily replacement cost/kw	N/A	N/A	0		$979	N/A	$1,862	N/A	$2,966

Table provided by Augusta Canal Authority

6.3 Environmental Pool Management

6.3.1 Pool Balancing

HEC-ResSim allows the ability to balance project pools by zone.

In the conservation pool, the rules set up in the alternatives attempt to maintain a foot for foot balance between the Hartwell and Thurmond projects balance their pools foot for foot in the top 15 feet, and then by the amount of depth left in the conservation pools. The Russell pool is set up to make full use of its conservation pool and not to balance until the Hartwell and Thurmond pools are essentially empty.

The balancing strategy in the Flood Pools, the zone above the conservation pools, changes by storing flood water in the upstream projects in an attempt to prevent the Thurmond project from exceeding the top of its flood pool and to minimize damaging flows downstream of Thurmond. This strategy also allows the Thurmond project to empty first. HEC-ResSim Model attempts to cap Thurmond releases in order to keep streamflow at Augusta below 20,000 cfs when the Thurmond pool is above guide curve and below summer full pool. The target transitions to 30,000 cfs when the Thurmond pool rises above the summer full pool elevation, 330 ft-msl.

6.3.2 Pool balancing across systems of Projects.

Duke Energy has a system of three projects upstream of the Hartwell project. The Duke projects are required to balance their conservation storage with the three downstream USACE projects through the implementation of a storage balance agreement between USACE, Duke Energy, and SEPA. In HEC-ResSim, system storage rules are configured by finding a corresponding set of storages at the upstream projects that provide the desired storage balance with the downstream projects to meet the storage balance agreement. Additional rules within HEC-ResSim were developed to define the rate at which the Duke Projects release storage to come back into balance with the USACE projects. Typically the Duke projects do not release storage to the USACE system unless they are required to per the storage balance agreement. The same system balancing rules exist in all the alternatives. Since pool balancing was a forced function in the HEC-ResSim model, it was not chosen as a metric of comparison.

6.3.3 Fish Spawn

In-Lake fish spawn objectives were built into the HEC-ResSim model. The in-lake fish spawn guidance is to attempt to not allow the pool to fall more than ½ foot during the spawning period. The spawning period for the Savannah River Projects is typically the the April-May timeframe. The metric used for evaluation was a simple count of the number of times that the spawning rules were violated.

Downstream fish spawn objectives were not built into the HEC-ResSim model except for ALT-3. In that alternative, the downstream set of rules was configured defining a spawning season maximum and minimum flow for different reaches of the river. Rules defining the seasonal timing, maximum and minimum flow targets a maximum rate of rise and fall was developed.

6.3.4 Augusta Shoals

The Augusta Shoals is an environmentally sensitive area of the river. A FERC agreement was developed between the States and the City of Augusta setting minimum flow requirements for the Augusta Shoals. The minimum flow target varies based on Tiers, seasonal levels of minimum flow requirement based on the magnitude of the Thurmond release. HEC Res-Sim was coded to set a varying minimum flow target at the Augusta Shoals, as seen in the table below.

FERC AGREEMENT (AUGUSTA CANAL)

	Thurmond Outflow		1-Feb	1-Apr	1-May	16-May	1-Jun	1-Jan
	(CFS)		31-Mar	30-Apr	15-May	31-May	31-Dec	31-Jan
	Min	Max	**Minimum Shoals Flow (CFS)**					
Tier 4	0	3600	1800	1800	1500	1500	1500	1500
Tier 3	3600	4499	2000	2000	1500	1500	1500	1500
Tier 2	4500	5377	2300	2200	1800	1800	1500	1500
Tier 1	5400	1000000	3300	3300	2500	1900	1900	1900

Figure 6-2 (FERC Agreement, Augusta Canal)

This flow target was always met by the model by adjusting the inflows into the Augusta Canal. When drought flows were encountered, flows into the canal were reduced potentially impacting the hydropower facilities on the canal.

6.4 Water Supply

The States of Georgia and South Carolina conducted population and water use projections. Based on these projections, inputs into HEC-ResSim were coded to reflect the projected water supply demands at 2050. Both seasonally varying withdrawals and returns were modeled in HEC-ResSim by applying the projected withdrawals and returns to the different stream reaches through the Savannah basin. Typically water supply intakes are placed at levels that would not be impacted even at the lowest ranges of the conservation pool. A 3600 cfs minimum flow requirement was placed on the Augusta Gage at the New Savannah Bluff Lock and Dam NSBLD, to ensure that the downstream water supply intakes were always met.

In-Lake water supply metrics were determined to compare how often pool elevations had dropped to levels that impact water supply intakes.

Downstream water supply metrics were determined to compare how often river elevations had dropped to levels that impact downstream water supply intakes. A comparison between current and 2050 water supply demands is shown below in table 6.4-1.

EPD's Current Day (2008-2013) average net consumptive water use in cfs (GA+SC) per State Water Plan.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
Bad Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jocassee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KEOWEE_R	84.88	83.61	81.97	85.72	87.96	103.88	102.65	95.33	93.22	84.36	76.46	80.52	1060.57
HARTWL_R	20.94	25.80	24.77	28.24	33.71	42.75	43.76	42.96	39.92	35.01	33.41	23.62	394.88
RBR_R	-6.29	-5.82	-6.26	-4.51	-2.64	-2.04	-2.35	-1.68	-1.62	-2.51	-3.68	-6.65	-46.05
THRMND_R	3.14	4.28	3.48	4.97	8.10	10.53	9.38	9.87	8.63	5.18	4.86	3.48	75.89
BELL	1.53	1.51	1.37	2.18	2.92	3.57	3.63	3.46	2.77	2.47	2.67	1.58	29.65
AUGUSTA	-1.57	-8.28	-4.51	16.86	36.47	39.34	34.30	29.82	37.46	31.04	16.93	-3.79	224.06
MILLHAVN	3.99	3.65	3.21	8.45	10.90	7.76	9.08	9.08	7.60	6.56	5.08	2.51	77.86
BURTONS	76.38	62.71	65.52	66.41	70.99	72.96	75.64	66.50	62.14	74.45	81.13	74.79	849.62
CLYO	-2.47	-3.62	-2.86	-0.97	1.12	1.06	0.53	-0.35	0.50	-0.43	-0.83	-1.83	-10.15
SAVANNAH	32.35	35.38	30.55	40.84	51.26	64.66	65.60	51.41	58.49	52.27	44.94	33.35	561.10
													3217.44

EPD's 2050 projected net consumptive water use in cfs (GA+SC) per State Water Plan.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
Bad Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jocassee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KEOWEE_R	85.96	85.51	80.87	64.59	85.18	125.39	124.31	119.25	100.36	75.19	69.91	72.40	1088.92
HARTWL_R	51.23	48.71	48.36	56.51	81.18	79.49	81.54	85.86	78.51	72.88	72.63	49.07	805.97
RBR_R	-6.79	-8.49	-5.10	-2.51	2.71	3.78	2.44	0.37	-0.44	-0.71	-1.77	-7.28	-23.78
THRMND_R	8.61	9.77	11.86	14.14	22.32	20.05	21.40	24.38	19.68	13.10	12.94	11.20	189.44
BELL	-18.35	-16.25	-19.58	-10.77	-5.46	-2.32	-3.22	-4.58	-5.92	-7.08	-5.50	-7.62	-106.65
AUGUSTA	-16.56	-27.25	-17.49	16.64	65.85	38.01	58.78	59.14	47.09	21.77	10.70	-12.87	243.82
MILLHAVN	5.62	10.08	8.32	15.09	21.99	22.27	21.79	16.48	11.34	7.82	8.45	5.25	154.49
BURTONS	79.40	89.01	94.05	123.14	111.61	128.39	108.39	132.32	114.66	136.81	97.75	105.89	1321.41
CLYO	-0.60	0.34	0.53	3.67	7.76	4.91	4.66	2.37	1.44	0.02	0.34	-0.84	24.60
SAVANNAH	46.81	40.48	46.73	57.04	72.71	57.23	74.80	81.95	70.51	72.79	58.56	47.09	726.72
													4424.94

EPD Delta (2050 - Current Day) average net consumptive water use in cfs (GA+SC) per State Water Plan.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
Bad Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jocassee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KEOWEE_R	1.08	1.90	-1.10	-21.13	-2.78	21.51	21.66	23.93	7.14	-9.17	-6.55	-8.13	28.35
HARTWL_R	30.29	22.91	23.60	28.28	47.47	36.74	37.78	42.90	38.59	37.87	39.22	25.44	411.09
RBR_R	-0.50	-2.67	1.16	2.00	5.35	5.82	4.80	2.05	1.19	1.79	1.91	-0.63	22.26
THRMND_R	5.47	5.49	8.37	9.17	14.22	9.51	12.02	14.51	11.05	7.93	8.09	7.72	113.55
BELL	-19.88	-17.77	-20.94	-12.95	-8.38	-5.90	-6.85	-8.03	-8.69	-9.54	-8.17	-9.20	-136.30
AUGUSTA	-14.99	-18.98	-12.98	-0.22	29.38	-1.33	24.48	29.33	9.63	-9.27	-6.23	-9.08	19.76
MILLHAVN	1.63	6.43	5.11	6.64	11.08	14.52	12.71	7.41	3.74	1.26	3.36	2.74	76.63
BURTONS	3.02	26.30	28.53	56.73	40.62	55.43	32.74	65.82	52.52	62.35	16.62	31.11	471.79
CLYO	1.87	3.96	3.39	4.64	6.64	3.85	4.13	2.72	0.94	0.45	1.17	1.00	34.75
SAVANNAH	14.45	5.10	16.18	16.21	21.46	-7.43	9.21	30.54	12.03	20.52	13.62	13.74	165.62

Figure 6-3 (Comparison of Current and 2050 Water Supply Demands)

6.5 Water Quality

Water quality metrics focused on water temperature, dissolved oxygen in the riverine reach between Thurmond Dam and Clyo. The States currently permit downstream municipal and industrial water withdrawal users based on a minimum release of 3600 cfs at Thurmond plus some intervening local inflow between Thurmond Dam and the downstream location of that user. After using the withdrawn water, these users often return a portion of the water to the river. The States focus is to limit the quantity of the return to a level that does not cause water quality problems. These water quality metrics attempted to capture impacts to the states permitted water users along the river. A metric capturing changes in salinity and dissolved oxygen was also added through the Harbor reach.

6.6 Recreation

A series of metrics were developed to estimate impacts to the recreational interests on the projects. The availability of the USACE facilities were weighted based on a day use economic factor, and estimated annual visitation. The total recreational benefit was based on a combination of the following two features.

1. Impacts on boat usage was estimated based on availability of usable boat ramps.
    a. Elevation for each USACE boat ramp was collected.
    b. Elevation for downstream boat ramps was collected
2. Impacts on beach usage was estimated based on availability of usable beaches in the 3 USACE projects. Typically beach closures occur at six feet below summer full pool.

The HEC-ResSim model outputs the daily pool elevations and the ability to access these facilities on a daily basis was counted. The difference between alternatives was then compared.

6.7 Navigation

The Savannah River below Augusta remains a congressionally authorized navigation project. However, due to the lack of commercial use, it has fallen into inactive status and is no longer maintained. Any navigation is now considered incidental to flood management. The flow window for navigation occurs when releases from Thurmond are between 10,000 cfs and 20,000 cfs. Flows greater than 20,000 cfs can cause river stages that prevent barge traffic from passing under some of the bridges and safely navigating the lower river.

7 Alternatives

7.1 Summary of Alternatives

Four alternatives were initially selected by the sponsors for analysis. The alternatives covered a wide range of objectives, hoping to determine some of the infrastructure and environmental breakpoints in the system. The last 2 alternatives were developed after the initial alternatives had been modelled and output had been analyzed.

Level	NAA	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
1	Thurmond target 4200 cfs if BR>10% Qin Thurmond target 4000 cfs if BR<=10% Qin	Thurmond target 3800 cfs (Feb - Apr) Thurmond target 3500 (May - Jan)	Thurmond target 4000 cfs at 326	Dry Ecosystem Flow Prescription Thurmond target 4200 cfs if BR >10% Qin Thurmond target 4000 cfs if BR<=10% Qin	Thurmond target 3600 cfs Thurmond target 3100 cfs (Nov - Jan)	Modified Dry Ecosystem Flow Prescription Thurmond target 4000 cfs Thurmond Max 2800 (Nov - Jan)	Modified Dry Ecosystem Flow Prescription Thurmond target 6875 cfs Thurmond Max 2800 (Nov - Jan)
2	Thurmond target 4000 cfs if BR >10% Qin Thurmond target 3800 cfs if BR<=10% Qin Thurmond target 3600 cfs (Nov - Jan)	Thurmond target 2800 (Feb - Apr) Thurmond target 2500 (May - Jan)	Thurmond target 3800 cfs at 324 Thurmond target 3600 cfs (Nov - Jan)	Drought Ecosystem Flow Prescription Thurmond target 4000 cfs if BR>10% Qin Thurmond target 3800 cfs if BR<=10% Qin Thurmond target 3600 cfs (Nov - Jan)	Thurmond target 3600 cfs Thurmond target 3100 cfs (Nov - Jan)	Modified Drought Ecosystem Flow Prescription Thurmond target 3800 cfs Thurmond Max 2800 (Nov - Jan)	Morified Drought Ecosystem Flow Prescription Thurmond target 5875 cfs Thurmond Max 2800 (Nov - Jan)
3	Thurmond target 3800 cfs Thurmond target 3100 cfs Nov - Jan	Thurmond target 1800 (Feb - Apr) Thurmond target 1500 May - Jan	Thurmond target 3600 cfs at 322 Thurmond target 3100 cfs Nov - Jan	Drought Ecosystem Flow Prescription Thurmond target 3800 cfs Thurmond target 3100 cfs Nov - Jan	Thurmond target 3600 cfs Thurmond target 3100 cfs Nov - Jan	Modified Drought Ecosystem Flow Prescription Thurmond target 3600 cfs Thurmond Max 2800 (Nov - Jan)	Morified Drought Ecosystem Flow Prescription Thurmond target 4875 cfs Thurmond Max 2800 (Nov - Jan)
4	Thurmond target 3600 cfs Thurmond target 3100 cfs	Thurmond target 3600 cfs Thurmond target 3100 cfs	Thurmond target 3600 cfs Thurmond target 3100 cfs	Thurmond target 3600 cfs Thurmond target 3100 cfs	Thurmond target 3600 cfs Thurmond target 3100 cfs	Thurmond target 3600 cfs Thurmond target 2800 (Nov - Jan)	Thurmond target 3600 cfs Thurmond target 2800 (Nov - Jan)

10% Qin is defined as the 10th percentile flow at the Broad River (BR) near Bell piedmont reference streamgage for reservoir inflow
Alt 1 Extreme Flow Reductions (Levels 1,2,3)
Alt 2, NAA with Level 3 raised to 322
Alt 3, NAA Level 3 at 646 Environmental Rules for Levels 0 thru 3
Alt 4, NAA with Level 3 at 646, 3600 cfs Spec flow in Levels 1 and below with 3100 Nov thru Jan in Levels 1and below
Alts 5, Similar to Alt 3 but removed Environmental rules when not in drought.
Alts 5, adaptive 2800 cfs Max Target at JST (Levels 1, 2, 3)
Alts 5, added SRS min 3600 cfs at Waynesboro
Alts 5, Rate of Rise/Rate of Fall 500 cfs/day at flows below 3600 cfs (applies to Thurmonds Outflow)
Alts 5, Millhaven Min 3400 cfs except 2000 cfs 15Oct - 31Jan. 5000 cfs pulse on 1st and 15th of each month, with (4 day 12000 cfs pulse 15 May in Level 1 only)
Alts 5, Shoals Min 1500 cfs, 2000 cfs in Feb and March
Alt 6, Alt 5 with increased Drought Trigger Flow Restrictions targeting a minumum of 10% Conservation Storage Remaining

Figure 7-1 (Summary of Alternatives)

7.2 NAA (No Action Alternative)

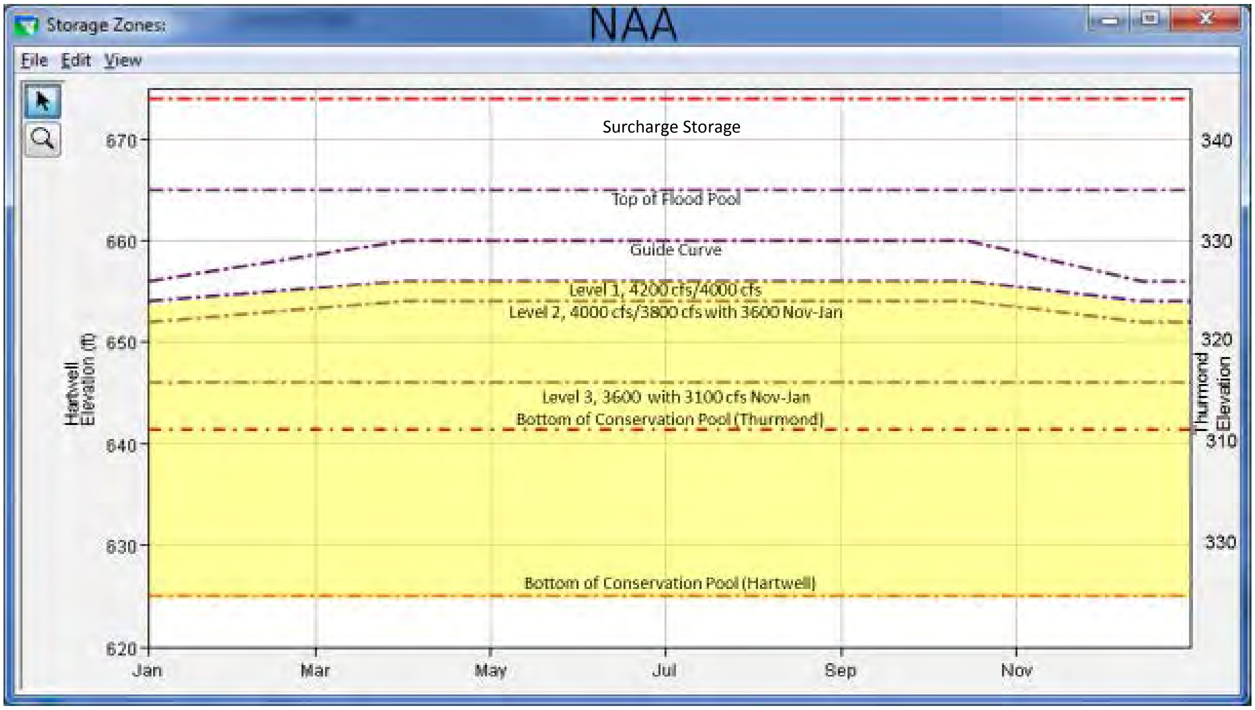


Figure 7-2 (No Action Alternative (NAA))

The No action alternative (NAA) is based on the operating rules currently in practice implemented with the 2012 Savannah River Basin Drought Management Plan. The initial rule of HEC-ResSim is to operate to get the pools to their respective guide curves. Additional rules are then created to target various objectives. These rules are set up in a prioritized stack. In all of the Comp Study alternatives, the highest priority is given to the rules defining operation while in the flood pool. The lower priority is given to minimum and maximum flow requirements which then take priority over the Drought Rules. The Drought Rules take priority over the System Hydropower rules. A special drought rule existing only in NAA focuses on the flow at the Broad River gage and allows for an additional 200 cfs reduction if the 28 day average flow at that gage falls below the 10^{th} percentile. Initial HEC-RES-Sim runs indicated that the Broad river Gage factor, currently in use, had little impact on the timing of when the pools went into and out of drought and was therefore dropped from the other alternatives.

During drought, the trigger flow restriction will be initiated when either Hartwell or Thurmond decline thru a drought trigger level. As pools recover the Thurmond flow restriction will not reset to the next higher level of restrictions until both the Hartwell and Thurmond pools have risen 2 feet above the trigger level that set the restriction. As an example, once in level 2, level 2 flow restrictions will not be reset to the Level 1 flow restrictions until both Hartwell and Thurmond pools have risen 2 feet above their level 2 triggers. All trigger levels will follow this same transition behavior. It is important to note that the same System Power rules and Russell Pump rules appear in all of the alternatives. All alternatives target a maximum channel capacity of 30,000 cfs at Augusta, a minimum release requirement of 3,600 cfs at Thurmond, as well as a minimum of 3,600 cfs at the Augusta gage. The 3,600 cfs minimum release requirement at Thurmond drops to 3,100 cfs between Nov 1 and 01 Feb if in Drought Level 3.

7.3 ALT-1 (Extreme Low Flow)

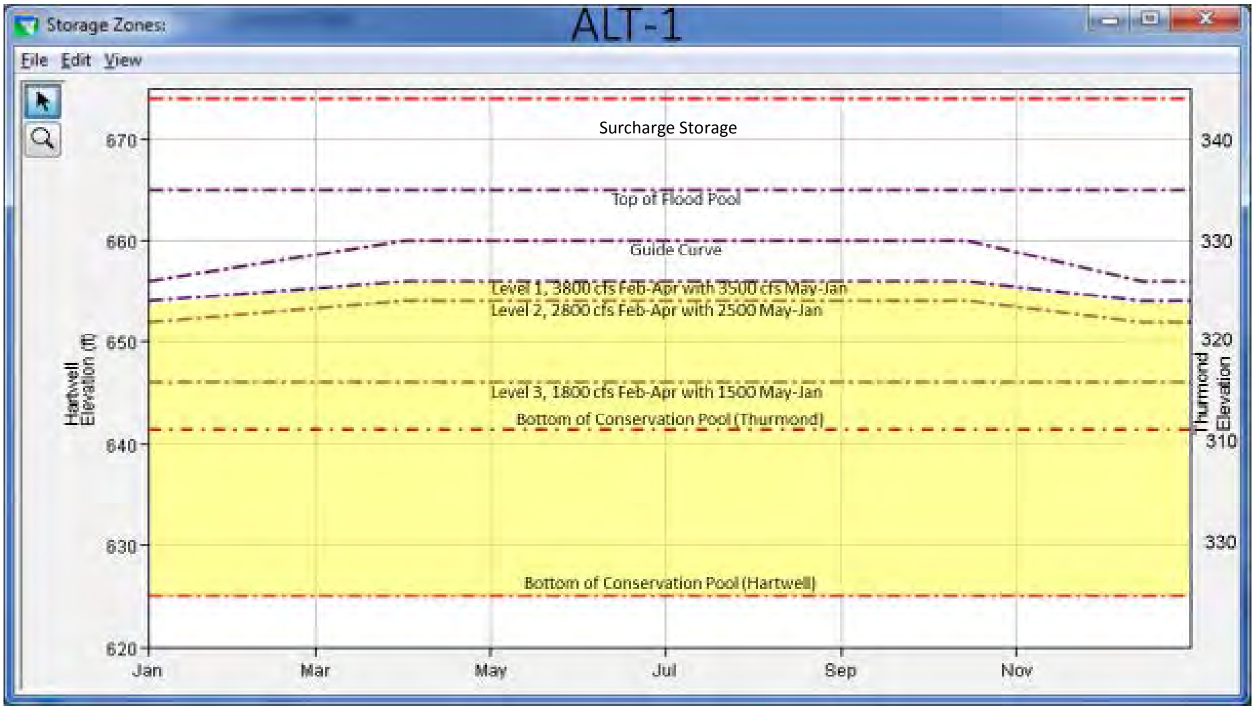


Figure 7-3 (Alternative 01, Extreme Low Flow)

Alternative 1 is the extreme low flow alternative. It is designed to target releases well below currently acceptable levels as an attempt to define the impacts of extreme low flows. It was also intended to help determine the break point between acceptable and unacceptable impacts to the authorized project purposes. The Minimum flow requirement of 3,600 cfs at Augusta was removed from this alternative to allow downstream flow to drop to unacceptable levels. ALT-1 targets flows of 3,800 cfs in Level 1 during the spawning season FEB-APR, and flows of 3,500 cfs the rest of the year. Once in level 2, ALT-1 targets flows of 2,800 cfs during the spawning season and flows of 2,500 cfs the rest of the year. Similarly in level 3 this alternative targets flows of 1,800 cfs during the spawning season and flows of 1,500 cfs the rest of the year. These rules are set at a higher priority than the system power rules which allows them to be implemented fully.

7.4 ALT-2 (Simplify NAA and Raise Level 3)

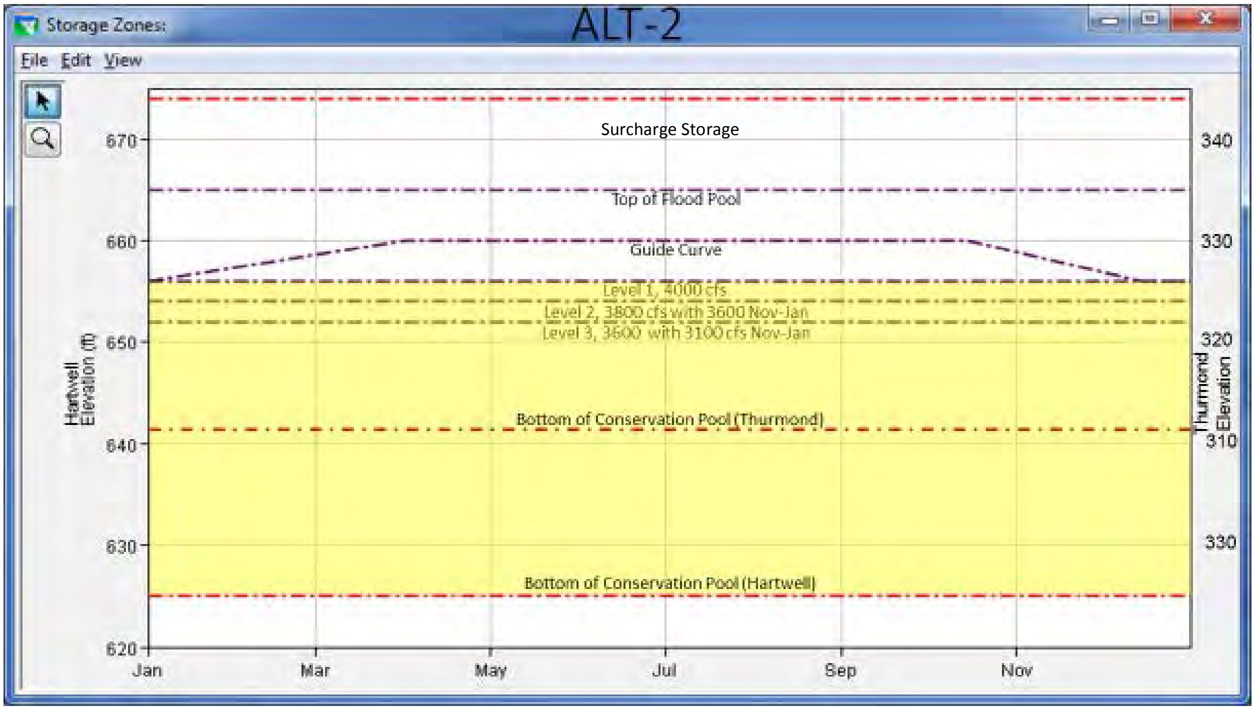


Figure 7-4 (Alternative 2, Simplify NAA and Raise Level 3)

ALT-2 attempts to simplify the NAA by flattening the trigger levels and to raise Trigger Level 3 to two feet below Trigger Level 2. This alternative also dropped use of the Broad river Gage as an indicator of drought. The ALT-2 flow targets chosen is the low side of the NAA Broad River variable targets with 4,000 cfs in level 1. Level 2 targets 3,800 cfs in level 2 with a wintertime flow reduction to 3,600 cfs Nov thru Jan. The Level 3 target is 3,600 cfs in level 2 with a wintertime flow reduction to 3,100 cfs Nov thru Jan. This alternative will have the same language as the NAA allowing up to 2 weeks to coordinate the transition of flow from one level to the next. This will be especially important as the pool rises from level 1 to the guide curve. As the pool rises above the guide curve drought operation is suspended and a transition to flood management will be implemented.

7.5 ALT-3 (Environmental Objectives)

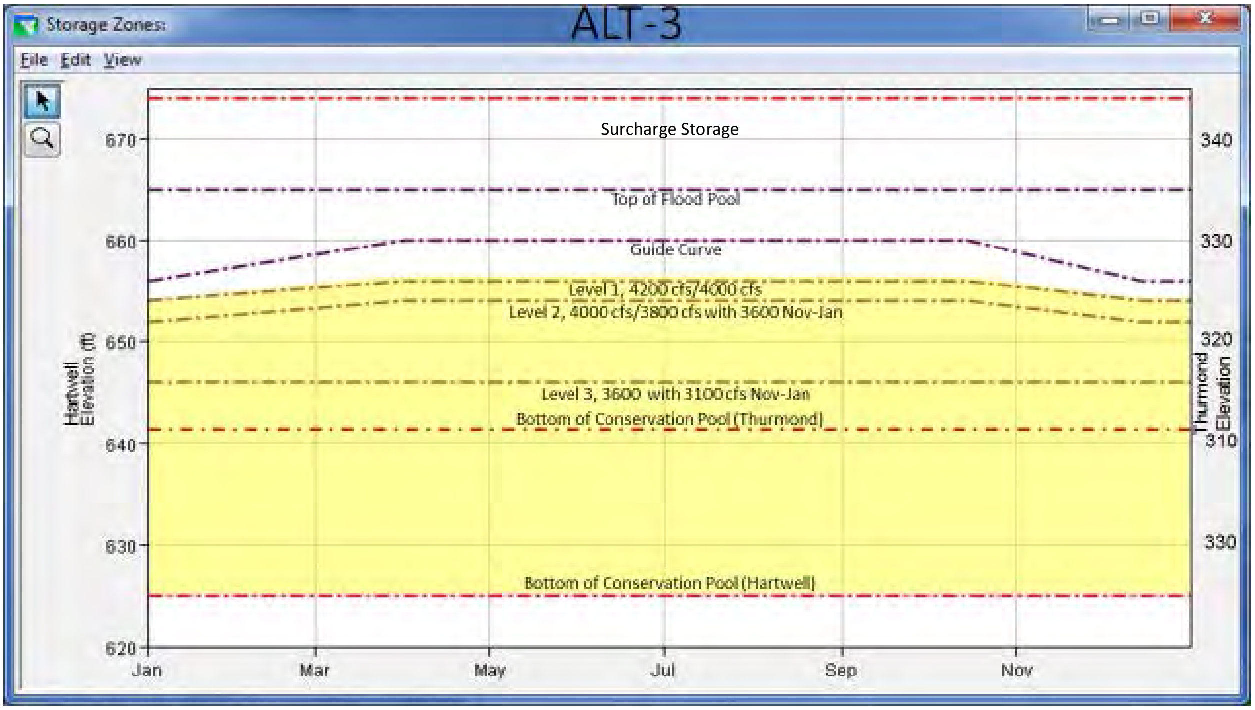


Figure 7-5 (Alternative 3, Environmental Objectives)

Alternative 3 is the environmental Flow alternative that based its objectives on the desired flow prescriptions that came out of the environmental flow workshop.

The flow prescription was initially derived in 2003 by a group of environmental scientists and biologists in conjunction with the Sustainable Rivers Project between The Nature Conservancy TNC, and USACE. The flow prescription is a set of recommendations that have never been formally implemented. Several attempts to achieve some of the goals of the prescription were tested through deviations from water control plan. Most of the focus was spent on higher flows as an attempt to enhance upstream fish migration over the NSBLD.

With the addition on TNC as a Savannah Comp study partner, the impacts of such a flow prescription could be studied. A workshop was held as part the interim study 2, to update the flow prescription. The flow prescription wad split up into groups representing periods of Wet, Average, Dry, and Drought flow conditions.

Wet State

Shoals

Flow Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Min Base Flow; Thurmond >4500-5399	1900	3300			2500	1900						
Max Base Flow												
Ramping / Variation Rate (+/- cfs)	(-)1000 cfs											
Pulse Flows												
Flood Flows	30000 cfs peak flow (at Thurmond) once every five years; 2-3 d											

Base flows reflect WUA analyses and Augusta FERC Settlement flows. These flows maintain resident fisheries, spider lily, and native mussel populations. Flood recommendation of 30,000 cfs carried upward from floodplain and estuary groups, purpose is to move sediments downstream to maintain coastal marshes

Floodplain

Flow Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Min Base Flow	See May-Oct	6500-8200	See May-Oct	6500-8200	Deliver run-of-river mimicking Broad River (GA) gage					6500-8200	See May-Oct	
Max Base Flow				10000								
Ramping / Variation Rate (+/- cfs)		(+/-) 500		(+/-) 500						(+/-) 500		
Pulse Flows			>17000 cfs; 14d									
Flood Flows	Deliver 35,000 cfs pulses as wet periods and opportunity allows (excluding shortnose sturgeon and robust redhorse spawns, as conditions allow)											

Justifications for base flows include unimpeded floodplain drainage, shallow-slow fish guild habitat. Pulses needed for fish access to floodplain, nutrient and woody debris movement, larval fish and tree seed transport, cutoff channel recharge, and bird habitat. Inter-annual variability of pulses impt to inverts, birds, tree seeding. Flood rec based on need for sediment redistribution.

Estuary

Flow Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Min Base Flow	5000		6000							5000		
Max Base Flow	7500 cfs											
Ramping / Variation Rate (+/- cfs)												
Pulse Flows	7500; 7d		30,000 cfs; 14d / 7500; 7d			7500; 7d						
Flood Flows	30000 cfs peak flow (at Thurmond) once every five years; 2-3 d											

Base flows will maintain freshwater marsh conditions; time variations up to 7500 cfs to retard spring tides when possible. Pulse justifications include freshening tidal marsh in early growing season, nutrient inputs, seed dispersal, striped bass spawn and egg suspension, and control oyster and blue crab parasites. Flood flow rec. to support nearshore marine fish productivity, sediment and nutrient replenishment, species mixing, and turbidity protection for young fish.

blank	No recommendation
(red)	Base Flow
(green)	Max flow - do not exceed
(blue)	Pulse / flood (unsustained / periodic)
(orange)	Variation above min flow with natural ramp and frequency

Figure 7-6 (Wet States, 2009-2013 Unimpaired Flow Data Extension)

Average State

Shoals

Flow Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Min Base Flow; Thurmond >4500-5399	1500	2300		2200	2500	1500						
Min Base Flow; Thurmond $\geq$3600-4499	1500	2000			2500	1500						
Max Base Flow					20,000 cfs max; 2-3d							
Ramping / Variation Rate (+/- cfs)	(-)1000 cfs											
Pulse Flows												
Flood Flows	30000 cfs peak flow (at Thurmond) once every five years; 2-3 d											

Base flows reflect WUA analyses and Augusta FERC Settlement flows, with an enhanced flow period Apr-May to maximize robust redhorse and resident sucker habitat during spawning. These flows also maintain resident fisheries, spider lily, and native mussel populations. Flood recommendation of 30,000 cfs carried upward from floodplain and estuary groups, purpose is to move sediments downstream to maintain coastal marshes

Floodplain

Flow Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Min Base Flow		6500-8200		6500-8200						6500-8200		
Max Base Flow				10000								
Ramping / Variation Rate (+/- cfs)		(+/-) 500		(+/-) 500						(+/-) 500		
Pulse Flows			>17000 cfs; 14d									
Flood Flows	30000 cfs peak flow (at Thurmond) once every five years; 2-3 d											

Justifications for base flows include unimpeded floodplain drainage, shallow-slow fish guild habitat. Pulses needed for fish access to floodplain, nutrient and woody debris movement, larval fish and tree seed transport, cutoff channel recharge, and bird habitat. Inter-annual variability of pulses impt to inverts, birds, tree seeding. Flood rec based on need for sediment redistribution.

Estuary

Flow Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Min Base Flow	5000		6000							5000		
Max Base Flow	7500 cfs											
Ramping / Variation Rate (+/- cfs)												
Pulse Flows	7500; 7d		14-16000 cfs; 14d / 7500; 7d			7500; 7d						
Flood Flows	30000 cfs peak flow (at Thurmond) once every five years; 2-3 d											

Base flows will maintain freshwater marsh conditions; time variations up to 7500 cfs to retard spring tides when possible. Pulse justifications include freshening tidal marsh in early growing season, nutrient inputs, seed dispersal, striped bass spawn and egg suspension, and control oyster and blue crab parasites. Flood flow rec. to support nearshore marine fish productivity, sediment and nutrient replenishment, species mixing, and turbidity protection for young fish.

blank	No recommendation
(red)	Base Flow
(green)	Max flow - do not exceed
(blue)	Pulse / flood (unsustained / periodic)
(orange)	Variation above min flow with natural ramp and frequency

Figure 7-7 (Average States, 2009-2013 Unimpaired Flow Data Extension)

<table>
<tr><th></th><th></th><th>Flow Type</th><th colspan="2">Jan</th><th colspan="2">Feb</th><th colspan="2">Mar</th><th colspan="2">Apr</th><th colspan="2">May</th><th colspan="2">June</th><th colspan="2">July</th><th colspan="2">Aug</th><th colspan="2">Sept</th><th colspan="2">Oct</th><th colspan="2">Nov</th><th colspan="2">Dec</th></tr>
<tr><td rowspan="19">Dry State</td><td rowspan="7">Shoals</td><td>Min Base Flow; Thurmond ≥3600</td><td colspan="2">1500</td><td colspan="6">2000</td><td colspan="16">1500</td></tr>
<tr><td>Min Base Flow; Thurmond ≤3600</td><td colspan="2">1500</td><td colspan="6">1800</td><td colspan="16">1500</td></tr>
<tr><td>Max Base Flow</td><td colspan="8"></td><td colspan="4">20,000 cfs max; 2-3d</td><td colspan="12"></td></tr>
<tr><td>Ramping / Variation Rate (+/- cfs)</td><td colspan="24">(-)1000 cfs</td></tr>
<tr><td>Pulse Flows</td><td colspan="24"></td></tr>
<tr><td>Flood Flows</td><td colspan="24"></td></tr>
<tr><td></td><td colspan="24">Justifications for shoal recommendations include baseflow conditions that maintain inundation of spider lily colonies, instream conditions for resident fish and mussels, and alosine and robust redhorse passage and spawning. All Shoal group CFS numbers are flows in the shoals <u>after</u> accounting for City of Augusta diversions.</td></tr>
<tr><td rowspan="6">Floodplain</td><td>Min Base Flow</td><td colspan="5"></td><td colspan="14">≤4000 (may include periods as low as 2000 cfs)</td><td colspan="5"></td></tr>
<tr><td>Max Base Flow</td><td colspan="5"></td><td colspan="14">10000</td><td colspan="5"></td></tr>
<tr><td>Ramping / Variation Rate (+/- cfs)</td><td colspan="2"></td><td colspan="3">(+/-) 500</td><td colspan="2"></td><td colspan="2">(+/-) 500</td><td colspan="9"></td><td colspan="3">(+/-) 500</td><td colspan="3"></td></tr>
<tr><td>Pulse Flows</td><td colspan="24">4000-10000 cfs; 1-2d at ~ 1 pulse per month</td></tr>
<tr><td>Flood Flows</td><td colspan="24"></td></tr>
<tr><td></td><td colspan="24">Justification driven by floodplain tree establishment - requirement for dry period for seedlings. Floodplain working group acknowledged paucity of knowledge on floodplain elevations, flow thresholds, and tree seedling tolerances to flooding once established. Group also acknowledged challenge of running long periods of ~3000 cfs vs assimilative capacity requirements.</td></tr>
<tr><td rowspan="6">Estuary</td><td>Min Base Flow</td><td colspan="5">5000</td><td colspan="14">6000</td><td colspan="5">5000</td></tr>
<tr><td>Max Base Flow</td><td colspan="24">7500 cfs</td></tr>
<tr><td>Ramping / Variation Rate (+/- cfs)</td><td colspan="24"></td></tr>
<tr><td>Pulse Flows</td><td colspan="4">7500; 7d</td><td colspan="6">(1) 12000 cfs; 14 d. / 7500; 7d</td><td colspan="14">7500; 7d</td></tr>
<tr><td>Flood Flows</td><td colspan="24">30000 cfs peak flow (at Thurmond) once every five years; 2-3 d</td></tr>
<tr><td></td><td colspan="24">Justfications for base flow included maitaining position of freshwater emergent marshes for their plant diversity and fish use. Pulses recommended to offset effects of harbor deepening, nutrient input, seed dispersal, striped bass spawn and egg suspension, and to control oyster and blue crab parasites.</td></tr>
</table>

blank	No recommendation
(red)	Base Flow
(green)	Max flow - do not exceed
(blue)	Pulse / flood (unsustained / periodic)
(orange)	Variation above min flow with natural ramp and frequency

Figure 7-8 (Dry States, 2009-2013 Unimpaired Flow Data Extension)

<table>
<tr><th></th><th></th><th>Flow Type</th><th colspan="2">Jan</th><th colspan="2">Feb</th><th colspan="2">Mar</th><th colspan="2">Apr</th><th colspan="2">May</th><th colspan="2">June</th><th colspan="2">July</th><th colspan="2">Aug</th><th colspan="2">Sept</th><th colspan="2">Oct</th><th colspan="2">Nov</th><th colspan="2">Dec</th></tr>
<tr><td rowspan="20">Drought State</td><td rowspan="8">Shoals</td><td>Min Base Flow (4 in 10 years)</td><td colspan="2">1500</td><td colspan="6">3300</td><td colspan="2">2500</td><td colspan="14">1500</td></tr>
<tr><td>Min Base Flow; Thurmond ≥3600</td><td colspan="2">1500</td><td colspan="6">2000</td><td colspan="16">1500</td></tr>
<tr><td>Min Base Flow; Thurmond ≤3600</td><td colspan="2">1500</td><td colspan="6">1800</td><td colspan="16">1500</td></tr>
<tr><td>Max Base Flow</td><td colspan="8"></td><td colspan="4">20,000 cfs max; 2-3d</td><td colspan="12"></td></tr>
<tr><td>Ramping / Variation Rate (+/- cfs)</td><td colspan="24">(-)1000 cfs</td></tr>
<tr><td>Pulse Flows</td><td colspan="24"></td></tr>
<tr><td>Flood Flows</td><td colspan="24"></td></tr>
<tr><td></td><td colspan="24">Base flows are tied to drought years. So, 4 in 10 means 4 in 10 drought years. The remaining 6 of 10 are tied directly to the Augusta FERC settlement flows. All flows reflect what is actually in the shoals . Ramping rates are recommendations of the Shoals group (+/-1000 cfs at all times) further conditioned by Floodplain group recommendations to minimize subdaily variation to +/-500 cfs during shortnose sturgeon and robust redhorse spawning.</td></tr>
<tr><td rowspan="6">Floodplain</td><td>Min Base Flow</td><td colspan="5"></td><td colspan="14">≤4000 (may include periods as low as 2000 cfs)</td><td colspan="5"></td></tr>
<tr><td>Max Base Flow</td><td colspan="5"></td><td colspan="14">10000</td><td colspan="5"></td></tr>
<tr><td>Ramping / Variation Rate (+/- cfs)</td><td colspan="2"></td><td colspan="3">(+/-) 500</td><td colspan="2"></td><td colspan="2">(+/-) 500</td><td colspan="9"></td><td colspan="3">(+/-) 500</td><td colspan="3"></td></tr>
<tr><td>Pulse Flows</td><td colspan="24">4000-6000 cfs; 1-2d; ~1 per month</td></tr>
<tr><td>Flood Flows</td><td colspan="24"></td></tr>
<tr><td></td><td colspan="24">Justification driven by floodplain tree establishment - requirement for dry period for seedlings. Min base flow is based purely on floodplain reach ecology; Group recognizes that harbor DO constraints may inhibit ability to drop below 3000 cfs. One-day pulses of 4-6000 cfs reconnect and recharge DO in 90% of cutoff channel habitats; match timing to high tide when possible to retard salinity intrusion in harbor.</td></tr>
<tr><td rowspan="6">Estuary</td><td>Min Base Flow</td><td colspan="5">4000</td><td colspan="14">5000</td><td colspan="5">4000</td></tr>
<tr><td>Max Base Flow</td><td colspan="24"></td></tr>
<tr><td>Ramping / Variation Rate (+/- cfs)</td><td colspan="24"></td></tr>
<tr><td>Pulse Flows</td><td colspan="4">7500; 7d</td><td colspan="6">(1) 12000 cfs; 14 d. / 7500; 7d</td><td colspan="14">7500; 7d</td></tr>
<tr><td>Flood Flows</td><td colspan="24"></td></tr>
<tr><td></td><td colspan="24">Flows at Clyo. Pulse flow for freshwater flow input to freshwater marshes; preferably early growing season to retard salt-tolerant species, and to coincide with striped bass spawning. Monitoring the relationship between flows and spawning success for striped bass could refine the timing of this pulse.</td></tr>
</table>

blank	No recommendation
(red)	Base Flow
(green)	Max flow - do not exceed
(blue)	Pulse / flood (unsustained / periodic)
(orange)	Variation above min flow with natural ramp and frequency

Figure 7-9 (Drought States, 2009-2013 Unimpaired Flow Data Extension)

All of the standard max flow and min flow rules were initially input into the HEC-ResSim model per the NAA configuration. The environmental rules were then added at a higher priority than other project purposes while in the conservation pool. The initial runs fully drafted the pools, indicating that the system had insufficient conservation storage to achieve the environmental objectives as defined in the environmental flows prescription. The environmental rules were then refined with the help of TNC and the following rules made it into the final ALT-3 run.

The "Wet" group occurs when the system was above the guide curve.

The "Average" group occurs when the system was below Guide curve but above Drought Trigger Level 1.

The "Dry" group occurs when the system was in Drought Trigger Level 1.

The "Drought" group occurs when the system was in Drought Trigger Level 2 or Drought Trigger Level 3.

The "Wet" Group (System is in Flood Pools)

Rates of decrease in the Thurmond release targeted 1,000 cfs/day, when Thurmond was releasing between 2,000 cfs and 6,000 cfs, which focused on the shoals.

Seasonal Pulses at Clyo targeted releases of as much as 30,000 cfs for up to 15 days.

Seasonal Pulses at Millhaven targeted 2 week release of 17,000 cfs for up to 2 weeks during spring fish spawn.

Seasonally varying minimum flow limits were set for the Augusta Shoals ranging from 1,900 cfs to 3,300 cfs.

Seasonally varying minimum flow limits of 7,500 cfs were set for the Millhaven.

Seasonally varying minimum flow limits were set for the Clyo ranging from 5,000 cfs to 6,000 cfs.

Seasonally varying maximum flow limits of as low as 10,000 cfs were set for the Millhaven to coincide with spring fish spawn.

A max flow limit of 7,500 cfs was set at Clyo attempting to preserve as much water in the reservoirs when it was not needed to meet the other environmental flow objectives.

The "Average" Group (System is not in Flood Pools but above Drought Level 1 Status)

Rates of decrease in the Thurmond release targeted 1,000 cfs/day, when Thurmond was releasing between 2,000 cfs and 6,000 cfs, which focused on the shoals.

Seasonal Pulses at Clyo targeted releases of as much as 15,000 cfs for up to 15 days.

Seasonal Pulses at Millhaven targeted 2 week release of 17,000 cfs for up to 2 weeks during spring fish spawn.

Seasonally varying minimum flow limits were set for the Augusta Shoals ranging from 1,500 cfs to 2,500 cfs.

Seasonally varying minimum flow limits of 7,500 cfs were set for the Millhaven.

Seasonally varying minimum flow limits were set for the Clyo ranging from 5,000 cfs to 6,000 cfs.

Seasonally varying maximum flow limits of as low as 20,000 cfs were added for the Augusta Shoals to coincide with spring fish spawn.

Seasonally varying maximum flow limits of as low as 10,000 cfs were set for the Millhaven to coincide with spring fish spawn.

A max flow limit of 7,500 cfs was set at Clyo attempting to preserve as much water in the reservoirs when it was not needed to meet the other environmental flow objectives.

The "Dry" Group (System is Drought Level 1 Status)

Rates of decrease in the Thurmond release targeted 1,000 cfs/day, when Thurmond was releasing between 2,000 cfs and 6,000 cfs, which focused on the shoals.

Rates of change rules, focusing on the Millhaven objectives, were placed on the Thurmond release targeting 500 cfs/day, when Thurmond was releasing less than 5,000 cfs and 1,000 cfs/day, when Thurmond was releasing between 5,000 cfs and 10,000 cfs, and 2,500 cfs/day when Thurmond was releasing more than 10,000 cfs.

A single 4 day Pulse at Clyo targeted releases of as much as 12,000 cfs in May.

Monthly 1 day Pulses at Millhaven targeted releases of 5,000 cfs.

Seasonally varying minimum flow limits were set for the Augusta Shoals ranging from 1,500 cfs to 2,000 cfs.

Seasonally varying minimum flow limits were set for the Millhaven ranging from 2,000 cfs to 3,400 cfs.

Seasonally varying minimum flow limits were set for the Clyo ranging from 5,000 cfs to 6,000 cfs.

Seasonally varying maximum flow limits of as low as 20,000 cfs were added for the Augusta Shoals to coincide with spring fish spawn.

Seasonally varying maximum flow limits of 4,000 cfs were set for the Millhaven between 15 March and 01 October.

A max flow limit of 7,500 cfs was set at Clyo attempting to preserve as much water in the reservoirs when it was not needed to meet the other environmental flow objectives.

The "Drought" Group (System is Drought Level 2 or 3 Status)

Rates of decrease in the Thurmond release targeted 1,000 cfs/day, when Thurmond was releasing between 2,000 cfs and 6,000 cfs, which focused on the shoals.

Rates of change rules, focusing on the Millhaven objectives, were placed on the Thurmond release targeting 500 cfs/day, when Thurmond was releasing less than 5,000 cfs and 1,000 cfs/day, when Thurmond was releasing between 5,000 cfs and 10,000 cfs, and 2,500 cfs/day when Thurmond was releasing more than 10,000 cfs.

Seasonal Pulses at Clyo targeting releases of as much as 12,000 cfs in May.

Monthly 1 day Pulses at Millhaven targeted releases of 5,000 cfs.

Seasonally varying minimum flow limits were set for the Augusta Shoals ranging from 1,500 cfs to 2,000 cfs.

Seasonally varying minimum flow limits were set for the Millhaven ranging from 2,000 cfs to 3,400 cfs.

Seasonally varying minimum flow limits were set for the Clyo ranging from 4,000 cfs to 5,000 cfs.

Seasonally varying maximum flow limits of as low as 20,000 cfs were added for the Augusta Shoals to coincide with spring fish spawn.

Seasonally varying maximum flow limits of 3,600 cfs were set for the Millhaven between 15 March and 01 October.

The drought triggers and associated rules matched the NAA, however were applied at a lower priority than the environmental rules. The drought rules were met only when they did not violate the higher priority environmental rules. The Hydropower objectives were placed at the lowest priority and were met only when they did not violate the higher priority environmental or drought rules.

7.6 ALT-4 (3600 cfs at Level 1 with wintertime reductions)

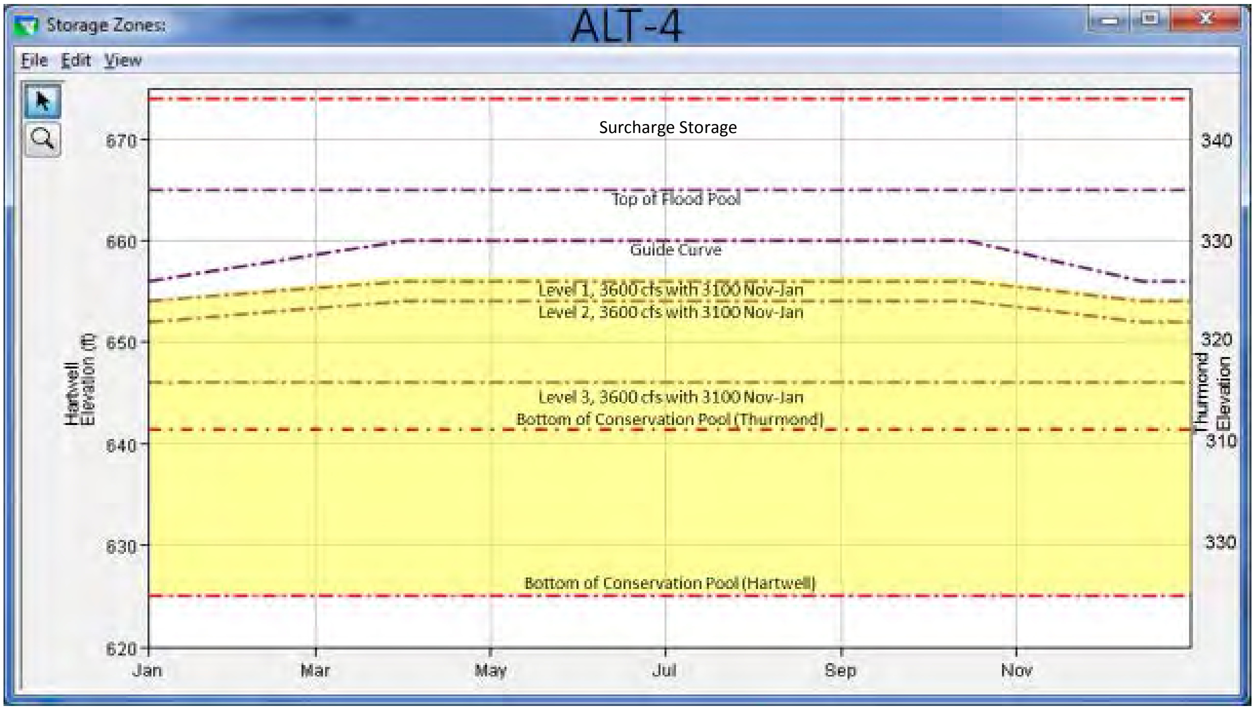


Figure 7-10 (Alternative 04, 3600 cfs at Level 1 with wintertime reductions)

This alternative follows the same trigger level elevations as NAA but goes to and maintains a Thurmond release of 3,600 cfs at and below Trigger Level 1. A wintertime Flow reduction at Thurmond to 3,100 cfs is added between November 1 and January 31.

7.7 ALT-5 (Attempts to combine the best features of Alt-2 and Alt-3)

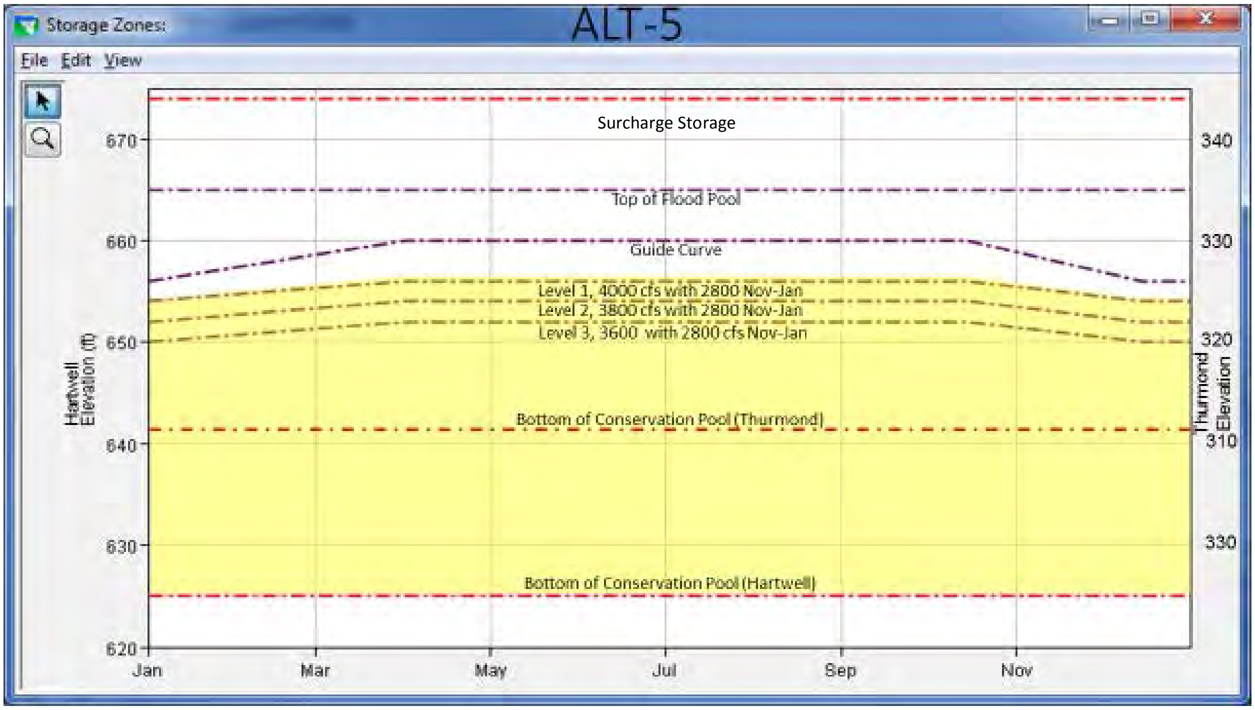


Figure 7-11 (Alternative 05, Combine features of Alternatives 2 & 3)

ALT-5 has the starts with the same drought trigger levels and rules as ALT-3. However, seasonally varying Drought Trigger Level 3 is raised to two feet below Level 2. The Normal Drought Flow targets were dropped 200 cfs from ALT-3 to 4,000 cfs, 3,800 cfs, and 3,600 cfs for levels 1, 2, and 3. The wintertime flow reduction was also lowered to 2,800 cfs Nov thru Jan. The Augusta minimum flow of 3,600 cfs was retained.

7.8 ALT-6 (Alt 5 with additional drought rules to pull pools to 10% remaining)

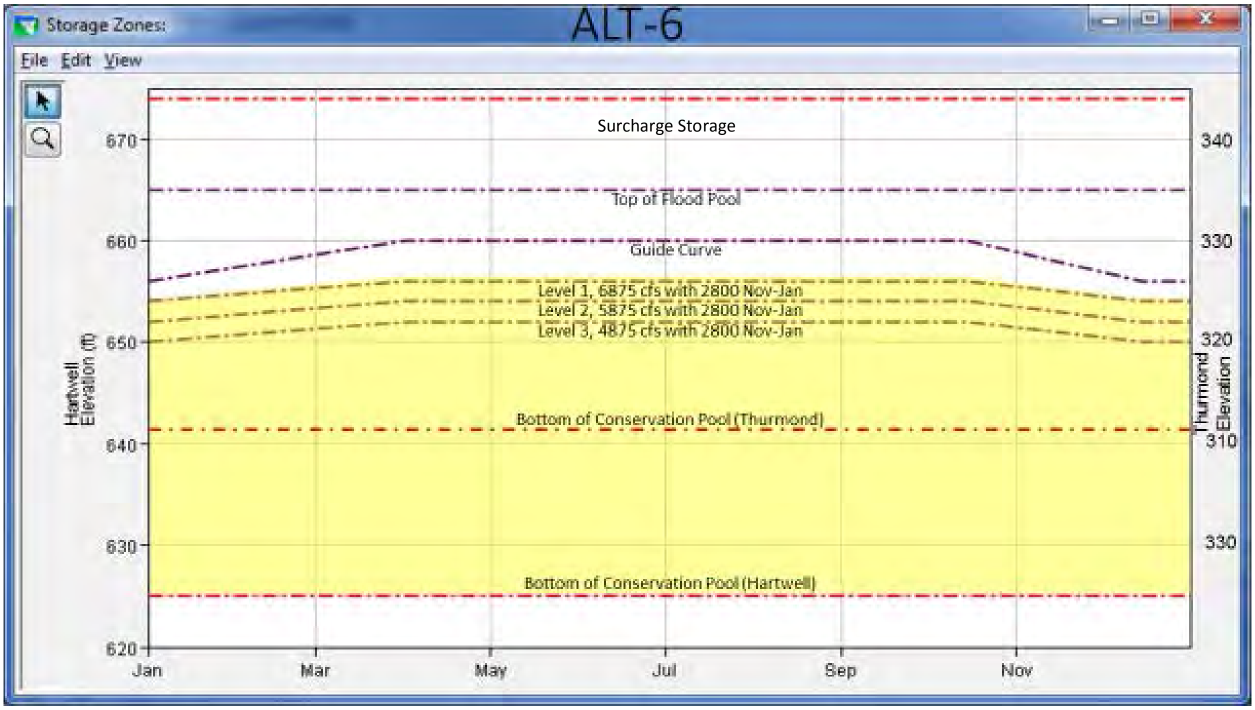


Figure 7-12 (Alternative 06, Alternative 5 with additional drought rules to pull pools to 10% remaining)

Alt-6 is based on the same Trigger Level elevations as Alt-5 with higher drought flow requirements in Levels 1, Level 2, and Level 3. The higher drought flow requirements were placed higher in the priority stack than the environmental pulse requirements to ensure that they were met. These targets were determined by iteratively increasing the drought trigger flow requirements as an attempt to force the use of 90 % of the conservation storage.

8 HEC-RESSIM OUTPUT ANALYSIS

Output was analyzed looking at a time window of January 1999 thru December 2013. This time window provided a window that a comparison of River and Harbor impacts could be evaluated. The output from HEC-ResSim was primarily used to evaluate impacts on the pools and reaches in the river above the Augusta node at the New Savannah Bluff Lock and Dam.

Basic statistics of HEC-ResSim output for key control points are shown below.

BASIC STATISTICS
1/1/1999 - 12/26/2013

		Hartwell Pool (FT_MSL)	Russell Pool (FT_MSL)	Thurmond Pool (FT_MSL)	Jocassee Pool (FT_MSL)	Keowee Pool (FT_MSL)	Keowee Outflow (CFS)	Hartwell Outflow (CFS)	Russell Outflow (CFS)	Thurmond Outflow (CFS)	Stevens Creek Outflow (CFS)	Shoals Flow (CFS)	Augusta Canal Flow (CFS)	Augusta Flow (CFS)	Waynesboro Flow (CFS)	Millhaven Flow (CFS)	Clyo Flow (CFS)	Days in Zone-1	Days in Zone-.5	Days in Zone 0	Days in Zone 1	Days in Zone 2	Days in Zone 3
NAA	Max	665.03	479.98	335.23	1110.00	800.00	11351	34974	39895	36619	37868	30868	7000	38728	38331	38110	55315	383	815	1757	790	995	734
NAA	Min	646.48	471.50	317.57	1096.95	794.35	0	0	0	0	3239	1500	1600	3600	3600	3732	3911						
NAA	Average	656.14	474.43	326.11	1107.02	798.18	742	3113	6929	5942	6399	3269	3130	6684	6678	7585	8404						
NAA	Median	656.48	474.51	326.38	1108.92	797.96	546	2801	7361	4200	4524	1905	2700	4743	4881	5744	6378						
NAA	10% Percentile	651.40	473.57	321.74	1101.64	795.80	0	0	0	3600	3724	1520	2100	3729	3867	4431	4681						
NAA	25% Percentile	653.67	474.08	323.75	1104.57	796.66	0	0	1978	3800	4026	1551	2300	4098	4172	4889	5252						
NAA	80% Percentile	659.51	475.00	329.25	1110.00	800.00	1267	4753	11531	6614	7089	3323	4500	7435	7450	8690	9858						
NAA	90% Percentile	660.00	475.00	330.00	1110.00	800.00	1822	6636	12851	10151	10898	6398	4500	11506	11682	13325	14529						
ALT1	Max	665.03	479.98	335.20	1110.00	800.00	11351	34972	38153	35887	37136	30136	7000	37996	37563	37393	55313	410	937	2072	1267	788	0
ALT1	Min	651.89	471.50	322.27	1101.55	795.76	0	0	0	0	2511	1500	1000	2481	2530	2729	2983						
ALT1	Average	657.01	474.31	326.94	1108.10	798.55	741	3113	7150	5939	6396	3417	2979	6681	6675	7692	8400						
ALT1	Median	656.98	474.50	326.86	1109.75	798.68	499	2838	7123	4252	4600	1917	2700	4782	4982	6054	6507						
ALT1	10% Percentile	653.64	473.47	323.81	1104.23	796.56	0	0	0	2500	2874	1522	1300	3072	3085	3749	3987						
ALT1	25% Percentile	654.98	473.73	325.05	1106.25	797.16	0	0	2465	3500	3706	1553	2100	3759	3852	4674	4890						
ALT1	75% Percentile	659.29	474.82	329.04	1110.00	800.00	1139	4300	11235	6309	6711	3159	4500	6981	7067	8248	9080						
ALT1	90% Percentile	660.00	475.00	330.00	1110.00	800.00	1869	6753	14249	10989	12008	7508	4500	12529	12207	14040	15234						
ALT2	Max	665.03	479.98	335.22	1110.00	800.00	11351	34974	38348	36500	37749	30749	7000	38609	38199	38053	55315	393	831	1581	869	930	870
ALT2	Min	647.50	471.50	318.47	1097.58	794.57	0	0	0	0	3390	1500	1600	3600	3600	3783	3910						
ALT2	Average	656.33	474.44	326.30	1107.23	798.27	742	3117	7045	5955	6412	3336	3076	6696	6690	7707	8416						
ALT2	Median	656.68	474.51	326.67	1109.43	798.12	546	2754	7388	4000	4403	1866	2600	4612	4809	5779	6316						
ALT2	10% Percentile	651.75	473.57	321.99	1101.92	795.87	0	0	0	3600	3670	1520	2000	3690	3787	4493	4624						
ALT2	25% Percentile	653.94	474.09	324.06	1104.87	796.75	0	0	2156	3600	3935	1550	2300	4014	4082	4928	5193						
ALT2	75% Percentile	659.26	474.77	329.03	1110.00	800.00	1108	4294	11312	6058	6436	2520	4200	6703	6838	7930	8694						
ALT2	90% Percentile	660.00	475.00	330.00	1110.00	800.00	1826	6747	13099	10711	11525	7025	4500	12128	11875	13803	14841						
ALT3	Max	665.02	480.00	334.24	1110.00	800.00	11351	34948	34714	29948	30012	23978	7000	30000	30000	35563	55247	627	309	1502	1279	1722	35
ALT3	Min	645.90	471.50	317.10	1096.88	794.33	0	0	0	0	3131	1500	1600	3600	3600	3587	3844						
ALT3	Average	655.83	474.41	325.69	1106.65	797.89	742	3114	7008	5950	6407	3258	3149	6691	6685	7592	8411						
ALT3	Median	656.11	474.51	326.00	1107.61	797.58	541	2605	7271	4200	4800	1900	2800	5075	5152	6026	6683						
ALT3	10% Percentile	651.13	473.48	321.50	1101.77	795.83	0	0	0	3520	3620	1500	2000	3600	3638	4210	4477						
ALT3	25% Percentile	653.42	474.23	323.57	1104.09	796.52	0	0	1384	3600	3808	1534	2200	3932	4022	4662	5061						
ALT3	75% Percentile	658.58	474.91	327.87	1110.00	800.00	1156	4462	10705	6104	6482	2540	4300	6708	6890	7923	8818						
ALT3	90% Percentile	660.00	475.02	329.91	1110.00	800.00	1815	7278	13473	10112	10866	6366	4500	11492	11534	13187	14599						
ALT4	Max	665.03	479.97	335.54	1110.00	800.00	11351	34975	41343	45972	47221	40221	7000	48081	47769	47329	55314	398	860	1932	1039	1245	0
ALT4	Min	648.03	471.50	318.98	1098.74	794.94	0	0	0	0	3390	1500	1600	3600	3600	3753	3910						
ALT4	Average	656.57	474.35	326.51	1107.57	798.37	742	3114	7050	5944	6401	3349	3052	6685	6680	7696	8405						
ALT4	Median	656.73	474.51	326.67	1109.75	798.31	524	2836	7342	3905	4416	1910	2600	4649	4835	5900	6432						
ALT4	10% Percentile	652.40	473.51	322.59	1102.69	796.11	0	0	0	3485	3606	1522	1900	3600	3658	4343	4434						
ALT4	25% Percentile	654.47	473.83	324.63	1105.53	796.95	0	0	2192	3600	3793	1552	2200	3862	3917	4721	4951						
ALT4	75% Percentile	659.24	474.70	328.97	1110.00	800.00	1143	4254	11243	6111	6544	2592	4300	6791	6879	8019	8819						
ALT4	90% Percentile	660.00	475.00	330.00	1110.00	800.00	1888	6695	13293	10699	11532	7032	4500	11987	11928	13748	14774						
ALT5	Max	665.03	479.98	335.22	1110.00	800.00	20414	34957	39997	36279	37528	30528	7000	38388	37991	37772	55417	418	659	1746	772	754	1125
ALT5	Min	643.44	471.50	314.95	1094.13	793.37	0	0	0	0	2773	1500	900	3600	3612	3700	4119						
ALT5	Average	655.60	474.42	325.79	1106.46	797.98	742	3118	6834	5952	6410	3172	3238	6694	6689	7595	8414						
ALT5	Median	656.12	474.51	326.66	1108.62	797.87	549	2838	7541	4600	4900	1871	3100	5054	5107	5914	6405						
ALT5	10% Percentile	650.00	473.56	320.36	1099.99	795.30	0	0	0	3600	3829	1500	2200	3934	3986	4693	5022						
ALT5	25% Percentile	652.92	474.03	323.03	1103.48	796.34	0	0	1724	3880	4245	1536	2400	4370	4433	5082	5467						
ALT5	75% Percentile	659.09	474.62	329.08	1110.00	800.00	1111	4291	10636	5496	5898	2337	3800	6248	6292	7496	8607						
ALT5	90% Percentile	660.00	475.00	329.95	1110.00	800.00	1777	6623	12417	9811	10599	6099	4500	11157	11000	12811	14099						
ALT6	Max	664.99	478.23	330.91	1110.00	800.00	21411	29419	21965	30059	30063	23978	7000	30000	29997	32768	37366	317	573	1238	319	473	2554
ALT6	Min	627.99	471.50	312.36	1081.35	790.32	0	0	0	0	2773	1500	900	3600	3613	3731	4156						
ALT6	Average	651.64	474.52	322.65	1102.07	796.48	740	3113	6401	5933	6391	2983	3407	6675	6669	7576	8395						
ALT6	Median	652.88	474.51	322.99	1104.27	796.58	615	2921	7056	4875	5178	1900	3500	5340	5364	6207	6713						
ALT6	10% Percentile	641.43	473.74	314.33	1091.40	792.52	0	0	0	3600	3900	1500	2300	4004	4097	4957	5395						
ALT6	25% Percentile	646.88	474.50	317.23	1095.57	793.86	0	0	1632	4600	4791	1540	2800	4854	4899	5531	5882						
ALT6	75% Percentile	658.27	474.78	328.18	1110.00	800.00	1102	4389	9848	5875	6328	2600	4000	6749	6858	7769	8732						
ALT6	90% Percentile	659.97	475.00	329.73	1110.00	800.00	1689	7058	11694	8808	9563	5063	4500	10109	10090	11899	13244						

Table 8-1 (Basic Statistics)

Tables 8-2 to 8-6 Provide frequency analysis of pool elevations.

JOCASSEE POOL-ELEV (FT-MSL) 01/01/1999 - 12/26/2013														
	COUNT VALUES LESS THAN							PERCENT OF TIME LESS THAN						
Elevation	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
1110	3512	3353	3460	3882	3469	3556	3987	64.16%	61.25%	63.21%	70.92%	63.37%	64.96%	72.84%
1109	2750	2412	2676	3265	2568	2809	3464	50.24%	44.06%	48.89%	59.65%	46.91%	51.32%	63.28%
1108	2533	1983	2435	2930	2289	2578	3332	46.27%	36.23%	44.48%	53.53%	41.82%	47.10%	60.87%
1107	2276	1617	2182	2498	2021	2324	3177	41.58%	29.54%	39.86%	45.63%	36.92%	42.46%	58.04%
1106	2035	1278	1944	2198	1637	2119	3024	37.18%	23.35%	35.51%	40.15%	29.91%	38.71%	55.24%
1105	1600	856	1422	1819	1140	1842	2818	29.23%	15.64%	25.98%	33.23%	20.83%	33.65%	51.48%
1104	1134	468	1002	1314	804	1546	2701	20.72%	8.55%	18.30%	24.00%	14.69%	28.24%	49.34%
1103	777	279	720	898	579	1203	2575	14.19%	5.10%	13.15%	16.40%	10.58%	21.98%	47.04%
1102	601	47	553	587	414	915	2488	10.98%	0.86%	10.10%	10.72%	7.56%	16.72%	45.45%
1101	449	0	349	401	244	760	2413	8.20%	0.00%	6.38%	7.33%	4.46%	13.88%	44.08%
1100	269	0	211	302	126	548	2276	4.91%	0.00%	3.85%	5.52%	2.30%	10.01%	41.58%
1099	192	0	133	201	17	427	2150	3.51%	0.00%	2.43%	3.67%	0.31%	7.80%	39.28%
1098	126	0	36	93	0	310	1998	2.30%	0.00%	0.66%	1.70%	0.00%	5.66%	36.50%
1097	2	0	0	16	0	227	1749	0.04%	0.00%	0.00%	0.29%	0.00%	4.15%	31.95%
1096	0	0	0	0	0	153	1484	0.00%	0.00%	0.00%	0.00%	0.00%	2.80%	27.11%
1095	0	0	0	0	0	68	1228	0.00%	0.00%	0.00%	0.00%	0.00%	1.24%	22.43%
1094	0	0	0	0	0	0	1005	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	18.36%
1093	0	0	0	0	0	0	776	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	14.18%
1092	0	0	0	0	0	0	581	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.61%
1091	0	0	0	0	0	0	522	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.54%
1090	0	0	0	0	0	0	446	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.15%
1089	0	0	0	0	0	0	387	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.07%
1088	0	0	0	0	0	0	323	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.90%
1087	0	0	0	0	0	0	259	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.73%
1086	0	0	0	0	0	0	196	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.58%
1085	0	0	0	0	0	0	133	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.43%
1084	0	0	0	0	0	0	54	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.99%
1083	0	0	0	0	0	0	35	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.64%
1082	0	0	0	0	0	0	16	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.29%
1081	0	0	0	0	0	0	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-2 (Jocassee Pool Frequency Analysis)

KEOWEE POOL-ELEV (FT-MSL) 01/01/1999 - 12/26/2013														
	COUNT VALUES LESS THAN							PERCENT OF TIME LESS THAN						
Elevation	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
800	3156	3008	3044	3676	3104	3212	3729	57.65%	54.95%	55.61%	67.15%	56.70%	58.68%	68.12%
799	2985	2813	2903	3522	2896	3054	3638	54.53%	51.39%	53.03%	64.34%	52.90%	55.79%	66.46%
798	2761	2410	2676	3265	2571	2826	3474	50.44%	44.03%	48.89%	59.65%	46.97%	51.63%	63.46%
797	1925	1163	1784	2093	1472	2030	2923	35.17%	21.25%	32.59%	38.24%	26.89%	37.08%	53.40%
796	650	153	598	666	494	998	2508	11.87%	2.80%	10.92%	12.17%	9.02%	18.23%	45.82%
795	182	0	121	196	11	420	2146	3.32%	0.00%	2.21%	3.58%	0.20%	7.67%	39.20%
794	0	0	0	0	0	152	1462	0.00%	0.00%	0.00%	0.00%	0.00%	2.78%	26.71%
793	0	0	0	0	0	0	786	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	14.36%
792	0	0	0	0	0	0	343	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.27%
791	0	0	0	0	0	0	74	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.35%
790	0	0	0	0	0	0	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-3 (Keowee Pool Frequency Analysis)

HARTWELL POOL-ELEV (FT-MSL) 01/01/1999 - 12/26/2013														
	COUNT VALUES LESS THAN							PERCENT OF TIME LESS THAN						
Elevation	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
666	5474	5474	5474	5474	5474	5474	5474	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
665	5473	5473	5473	5473	5473	5473	5474	99.98%	99.98%	99.98%	99.98%	99.98%	99.98%	100.00%
664	5444	5444	5444	5455	5444	5441	5464	99.45%	99.45%	99.45%	99.65%	99.45%	99.40%	99.82%
663	5424	5424	5425	5433	5424	5422	5458	99.09%	99.09%	99.10%	99.25%	99.09%	99.05%	99.71%
662	5405	5404	5405	5417	5404	5400	5450	98.74%	98.72%	98.74%	98.96%	98.72%	98.65%	99.56%
661	5364	5364	5367	5357	5367	5355	5418	97.99%	97.99%	98.05%	97.86%	98.05%	97.83%	98.98%
660	4769	4683	4717	4752	4732	4802	4957	87.12%	85.55%	86.17%	86.81%	86.45%	87.72%	90.56%
659	3948	3881	3911	4236	3919	4035	4363	72.12%	70.90%	71.45%	77.38%	71.59%	73.71%	79.70%
658	3491	3340	3421	3888	3357	3604	3985	63.77%	61.02%	62.50%	71.03%	61.33%	65.84%	72.80%
657	2981	2743	2891	3418	2869	3255	3671	54.46%	50.11%	52.81%	62.44%	52.41%	59.46%	67.06%
656	2500	2056	2376	2628	2317	2605	3330	45.67%	37.56%	43.41%	48.01%	42.33%	47.59%	60.83%
655	2004	1380	1918	2124	1686	2170	3166	36.61%	25.21%	35.04%	38.80%	30.80%	39.64%	57.84%
654	1546	728	1409	1694	1080	1764	2919	28.24%	13.30%	25.74%	30.95%	19.73%	32.23%	53.32%
653	1072	308	946	1162	729	1396	2757	19.58%	5.63%	17.28%	21.23%	13.32%	25.50%	50.37%
652	728	11	631	819	437	1083	2538	13.30%	0.20%	11.53%	14.96%	7.98%	19.78%	46.36%
651	430	0	363	478	228	780	2367	7.86%	0.00%	6.63%	8.73%	4.17%	14.25%	43.24%
650	231	0	168	227	113	546	2121	4.22%	0.00%	3.07%	4.15%	2.06%	9.97%	38.75%
649	131	0	98	125	35	311	1881	2.39%	0.00%	1.79%	2.28%	0.64%	5.68%	34.36%
648	86	0	23	70	0	216	1639	1.57%	0.00%	0.42%	1.28%	0.00%	3.95%	29.94%
647	22	0	0	35	0	139	1398	0.40%	0.00%	0.00%	0.64%	0.00%	2.54%	25.54%
646	0	0	0	6	0	91	1170	0.00%	0.00%	0.00%	0.11%	0.00%	1.66%	21.37%
645	0	0	0	0	0	55	974	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	17.79%
644	0	0	0	0	0	18	770	0.00%	0.00%	0.00%	0.00%	0.00%	0.33%	14.07%
643	0	0	0	0	0	0	663	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	12.11%
642	0	0	0	0	0	0	587	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.72%
641	0	0	0	0	0	0	527	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.63%
640	0	0	0	0	0	0	487	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.90%
639	0	0	0	0	0	0	435	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.95%
638	0	0	0	0	0	0	385	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.03%
637	0	0	0	0	0	0	348	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.36%
636	0	0	0	0	0	0	307	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.61%
635	0	0	0	0	0	0	239	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.37%
634	0	0	0	0	0	0	165	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.01%
633	0	0	0	0	0	0	119	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.17%
632	0	0	0	0	0	0	81	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.48%
631	0	0	0	0	0	0	53	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.97%
630	0	0	0	0	0	0	42	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77%
629	0	0	0	0	0	0	29	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.53%
628	0	0	0	0	0	0	1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
627	0	0	0	0	0	0	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-4 (Hartwell Pool Frequency Analysis)

RUSSELL POOL-ELEV (FT-MSL)
01/01/1999 - 12/26/2013

	COUNT VALUES LESS THAN							PERCENT OF TIME LESS THAN						
Elevation	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
480	5474	5474	5474	5468	5474	5474	5474	100.00%	100.00%	100.00%	99.89%	100.00%	100.00%	100.00%
479	5442	5443	5442	5457	5447	5436	5474	99.42%	99.43%	99.42%	99.69%	99.51%	99.31%	100.00%
478	5435	5434	5434	5455	5438	5428	5470	99.29%	99.27%	99.27%	99.65%	99.34%	99.16%	99.93%
477	5409	5408	5408	5424	5418	5402	5468	98.81%	98.79%	98.79%	99.09%	98.98%	98.68%	99.89%
476	5371	5373	5371	5389	5377	5373	5439	98.12%	98.15%	98.12%	98.45%	98.23%	98.15%	99.36%
475	4363	4230	4276	4189	4318	4373	4344	79.70%	77.27%	78.11%	76.53%	78.88%	79.89%	79.36%
474	1271	1777	1284	1132	1553	1330	732	23.22%	32.46%	23.46%	20.68%	28.37%	24.30%	13.37%
473	156	296	155	351	251	164	29	2.85%	5.41%	2.83%	6.41%	4.59%	3.00%	0.53%
472	36	89	34	100	67	31	9	0.66%	1.63%	0.62%	1.83%	1.22%	0.57%	0.16%
471	0	0	0	0	0	0	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-5 (Russell Pool Frequency Analysis)

THURMOND POOL-ELEV (FT-MSL)
01/01/1999 - 12/26/2013

	COUNT VALUES LESS THAN							PERCENT OF TIME LESS THAN						
Elevation	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
336	5474	5474	5474	5474	5474	5474	5474	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
335	5471	5472	5472	5474	5470	5472	5474	99.95%	99.96%	99.96%	100.00%	99.93%	99.96%	100.00%
334	5467	5468	5467	5472	5467	5467	5474	99.87%	99.89%	99.87%	99.96%	99.87%	99.87%	100.00%
333	5463	5463	5463	5467	5465	5463	5474	99.80%	99.80%	99.80%	99.87%	99.84%	99.80%	100.00%
332	5462	5462	5462	5459	5464	5462	5474	99.78%	99.78%	99.78%	99.73%	99.82%	99.78%	100.00%
331	5456	5456	5456	5448	5458	5456	5474	99.67%	99.67%	99.67%	99.53%	99.71%	99.67%	100.00%
330	4913	4819	4873	5021	4880	5014	5144	89.75%	88.03%	89.02%	91.72%	89.15%	91.60%	93.97%
329	4141	4066	4082	4545	4133	4009	4398	75.65%	74.28%	74.57%	83.03%	75.50%	73.24%	80.34%
328	3487	3426	3457	4177	3451	3365	4033	63.70%	62.59%	63.15%	76.31%	63.04%	61.47%	73.68%
327	3039	2824	2948	3592	2918	2868	3630	55.52%	51.59%	53.85%	65.62%	53.31%	52.39%	66.31%
326	2508	2056	2345	2677	2306	2471	3320	45.82%	37.56%	42.84%	48.90%	42.13%	45.14%	60.65%
325	1965	1330	1877	2090	1645	2131	3094	35.90%	24.30%	34.29%	38.18%	30.05%	38.93%	56.52%
324	1502	644	1322	1636	1050	1677	2890	27.44%	11.76%	24.15%	29.89%	19.18%	30.64%	52.80%
323	1023	189	901	1116	660	1360	2739	18.69%	3.45%	16.46%	20.39%	12.06%	24.84%	50.04%
322	665	0	548	739	414	992	2451	12.15%	0.00%	10.01%	13.50%	7.56%	18.12%	44.78%
321	334	0	276	357	174	719	2235	6.10%	0.00%	5.04%	6.52%	3.18%	13.13%	40.83%
320	188	0	126	174	64	437	2008	3.43%	0.00%	2.30%	3.18%	1.17%	7.98%	36.68%
319	116	0	38	96	1	277	1803	2.12%	0.00%	0.69%	1.75%	0.02%	5.06%	32.94%
318	27	0	0	41	0	185	1518	0.49%	0.00%	0.00%	0.75%	0.00%	3.38%	27.73%
317	0	0	0	0	0	112	1303	0.00%	0.00%	0.00%	0.00%	0.00%	2.05%	23.80%
316	0	0	0	0	0	56	1039	0.00%	0.00%	0.00%	0.00%	0.00%	1.02%	18.98%
315	0	0	0	0	0	1	742	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	13.55%
314	0	0	0	0	0	0	412	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.53%
313	0	0	0	0	0	0	81	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.48%
312	0	0	0	0	0	0	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-6 (Thurmond Pool Frequency Analysis)

Tables 8-7 to 8-6 Provide basic frequency analysis of streamflow at key control points.

THURMOND OUTFLOW (CFS) 01/01/1999 - 12/26/2013															
	COUNT VALUES LESS THAN							PERCENT OF TIME LESS THAN							
Flow	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
20000	5358	5352	5354	5363	5358	5358	5411	97.88%	97.77%	97.81%	97.97%	97.88%	97.88%	98.85%
19500	5349	5340	5343	5342	5346	5349	5398	97.72%	97.55%	97.61%	97.59%	97.66%	97.72%	98.61%
19000	5324	5316	5318	5314	5321	5331	5390	97.26%	97.11%	97.15%	97.08%	97.20%	97.39%	98.47%
18500	5309	5298	5299	5291	5302	5309	5372	96.99%	96.78%	96.80%	96.66%	96.86%	96.99%	98.14%
18000	5283	5273	5273	5260	5273	5284	5348	96.51%	96.33%	96.33%	96.09%	96.33%	96.53%	97.70%
17500	5261	5248	5244	5235	5248	5260	5328	96.11%	95.87%	95.80%	95.63%	95.87%	96.09%	97.33%
17000	5236	5221	5215	5207	5224	5234	5308	95.65%	95.38%	95.27%	95.12%	95.43%	95.62%	96.97%
16500	5217	5201	5196	5195	5203	5217	5291	95.31%	95.01%	94.92%	94.90%	95.05%	95.31%	96.66%
16000	5200	5179	5177	5181	5183	5202	5279	94.99%	94.61%	94.57%	94.65%	94.68%	95.03%	96.44%
15500	5173	5148	5145	5156	5153	5181	5260	94.50%	94.04%	93.99%	94.19%	94.14%	94.65%	96.09%
15000	5151	5124	5123	5141	5133	5161	5242	94.10%	93.61%	93.59%	93.92%	93.77%	94.28%	95.76%
14500	5126	5101	5101	5125	5109	5141	5222	93.64%	93.19%	93.19%	93.62%	93.33%	93.92%	95.40%
14000	5109	5080	5079	5107	5091	5123	5203	93.33%	92.80%	92.78%	93.30%	93.00%	93.59%	95.05%
13500	5090	5060	5062	5087	5069	5107	5187	92.99%	92.44%	92.47%	92.93%	92.60%	93.30%	94.76%
13000	5065	5036	5040	5066	5047	5086	5163	92.53%	92.00%	92.07%	92.55%	92.20%	92.91%	94.32%
12500	5041	5006	5015	5047	5022	5068	5145	92.09%	91.45%	91.61%	92.20%	91.74%	92.58%	93.99%
12000	5017	4977	4989	5032	4997	5039	5117	91.65%	90.92%	91.14%	91.93%	91.29%	92.05%	93.48%
11500	4997	4955	4969	5001	4975	5016	5099	91.29%	90.52%	90.77%	91.36%	90.88%	91.63%	93.15%
11000	4976	4927	4949	4979	4945	4995	5085	90.90%	90.01%	90.41%	90.96%	90.34%	91.25%	92.89%
10500	4947	4894	4917	4948	4911	4970	5062	90.37%	89.40%	89.82%	90.39%	89.72%	90.79%	92.47%
10000	4907	4843	4873	4917	4869	4933	5038	89.64%	88.47%	89.02%	89.82%	88.95%	90.12%	92.04%
9500	4871	4807	4833	4875	4833	4902	5005	88.98%	87.82%	88.29%	89.06%	88.29%	89.55%	91.43%
9000	4815	4731	4774	4827	4781	4846	4945	87.96%	86.43%	87.21%	88.18%	87.34%	88.53%	90.34%
8500	4749	4664	4708	4776	4719	4801	4895	86.76%	85.20%	86.01%	87.25%	86.21%	87.71%	89.42%
8000	4702	4599	4653	4702	4660	4760	4848	85.90%	84.02%	85.00%	85.90%	85.13%	86.96%	88.56%
7500	4628	4517	4581	4608	4571	4717	4815	84.55%	82.52%	83.69%	84.18%	83.50%	86.17%	87.96%
7000	4506	4392	4461	4517	4453	4640	4751	82.32%	80.23%	81.49%	82.52%	81.35%	84.76%	86.79%
6500	4326	4191	4288	4319	4271	4538	4450	79.03%	76.56%	78.33%	78.90%	78.02%	82.90%	81.29%
6000	4092	3949	4075	4022	4043	4405	4347	74.75%	72.14%	74.44%	73.47%	73.86%	80.47%	79.41%
5500	3839	3658	3853	3721	3767	4111	3924	70.13%	66.82%	70.39%	67.98%	68.82%	75.10%	71.68%
5000	3588	3344	3616	3310	3495	3571	3476	65.55%	61.09%	66.06%	60.47%	63.85%	65.24%	63.50%
4500	3274	2907	3308	2928	3132	2306	1167	59.81%	53.11%	60.43%	53.49%	57.22%	42.13%	21.32%
4000	1796	2577	2194	2256	2798	1494	870	32.81%	47.08%	40.08%	41.21%	51.11%	27.29%	15.89%
3500	343	731	424	442	551	115	146	6.27%	13.35%	7.75%	8.07%	10.07%	2.10%	2.67%
3000	4	731	3	79	3	17	16	0.07%	13.35%	0.05%	1.44%	0.05%	0.31%	0.29%
2500	3	3	3	20	3	11	14	0.05%	0.05%	0.05%	0.37%	0.05%	0.20%	0.26%
2000	3	3	3	9	3	9	12	0.05%	0.05%	0.05%	0.16%	0.05%	0.16%	0.22%
1500	3	3	3	6	3	7	8	0.05%	0.05%	0.05%	0.11%	0.05%	0.13%	0.15%
1000	3	3	3	5	3	7	8	0.05%	0.05%	0.05%	0.09%	0.05%	0.13%	0.15%
500	3	3	3	4	3	5	5	0.05%	0.05%	0.05%	0.07%	0.05%	0.09%	0.09%
0	0	0	0	0	0	0	0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-7 (Thurmond Outflow Frequency Analysis)

SHOALS FLOW (CFS) 01/01/1999 - 12/26/2013															
	COUNT VALUES LESS THAN								PERCENT OF TIME LESS THAN						
Flow	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6		NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
20000	5375	5369	5370	5377	5374	5374	5427		98.19%	98.08%	98.10%	98.23%	98.17%	98.17%	99.14%
19500	5372	5366	5367	5374	5371	5370	5425		98.14%	98.03%	98.05%	98.17%	98.12%	98.10%	99.10%
19000	5369	5363	5364	5372	5368	5364	5421		98.08%	97.97%	97.99%	98.14%	98.06%	97.99%	99.03%
18500	5364	5357	5359	5369	5363	5360	5418		97.99%	97.86%	97.90%	98.08%	97.97%	97.92%	98.98%
18000	5362	5355	5357	5366	5361	5358	5417		97.95%	97.83%	97.86%	98.03%	97.94%	97.88%	98.96%
17500	5360	5352	5354	5365	5358	5358	5416		97.92%	97.77%	97.81%	98.01%	97.88%	97.88%	98.94%
17000	5358	5350	5352	5364	5356	5357	5415		97.88%	97.73%	97.77%	97.99%	97.84%	97.86%	98.92%
16500	5353	5346	5348	5361	5352	5354	5414		97.79%	97.66%	97.70%	97.94%	97.77%	97.81%	98.90%
16000	5350	5343	5346	5358	5350	5352	5411		97.73%	97.61%	97.66%	97.88%	97.73%	97.77%	98.85%
15500	5348	5342	5344	5357	5347	5349	5409		97.70%	97.59%	97.63%	97.86%	97.68%	97.72%	98.81%
15000	5308	5301	5304	5310	5308	5314	5385		96.97%	96.84%	96.89%	97.00%	96.97%	97.08%	98.37%
14500	5260	5250	5251	5246	5252	5264	5339		96.09%	95.91%	95.93%	95.83%	95.94%	96.16%	97.53%
14000	5222	5206	5204	5202	5208	5223	5302		95.40%	95.10%	95.07%	95.03%	95.14%	95.41%	96.86%
13500	5188	5169	5168	5174	5172	5200	5283		94.78%	94.43%	94.41%	94.52%	94.48%	94.99%	96.51%
13000	5171	5148	5150	5156	5154	5187	5267		94.46%	94.04%	94.08%	94.19%	94.15%	94.76%	96.22%
12500	5158	5132	5134	5140	5140	5172	5256		94.23%	93.75%	93.79%	93.90%	93.90%	94.48%	96.02%
12000	5145	5120	5121	5130	5128	5159	5247		93.99%	93.53%	93.55%	93.72%	93.68%	94.25%	95.85%
11500	5131	5101	5105	5113	5112	5146	5228		93.73%	93.19%	93.26%	93.41%	93.39%	94.01%	95.51%
11000	5116	5085	5084	5101	5096	5132	5215		93.46%	92.89%	92.88%	93.19%	93.09%	93.75%	95.27%
10500	5097	5070	5068	5085	5077	5113	5198		93.11%	92.62%	92.58%	92.89%	92.75%	93.41%	94.96%
10000	5079	5046	5047	5075	5056	5098	5180		92.78%	92.18%	92.20%	92.71%	92.36%	93.13%	94.63%
9500	5061	5024	5029	5060	5037	5080	5164		92.46%	91.78%	91.87%	92.44%	92.02%	92.80%	94.34%
9000	5041	5006	5012	5039	5019	5063	5145		92.09%	91.45%	91.56%	92.05%	91.69%	92.49%	93.99%
8500	5016	4981	4990	5018	4993	5044	5123		91.63%	90.99%	91.16%	91.67%	91.21%	92.14%	93.59%
8000	4996	4953	4969	5002	4969	5021	5103		91.27%	90.48%	90.77%	91.38%	90.77%	91.72%	93.22%
7500	4975	4925	4946	4980	4947	4999	5078		90.88%	89.97%	90.35%	90.98%	90.37%	91.32%	92.77%
7000	4956	4908	4924	4956	4923	4978	5056		90.54%	89.66%	89.95%	90.54%	89.93%	90.94%	92.36%
6500	4933	4867	4890	4932	4894	4947	5026		90.12%	88.91%	89.33%	90.10%	89.40%	90.37%	91.82%
6000	4891	4822	4852	4902	4850	4919	4997		89.35%	88.09%	88.64%	89.55%	88.60%	89.86%	91.29%
5500	4850	4770	4801	4862	4808	4886	4969		88.60%	87.14%	87.71%	88.82%	87.83%	89.26%	90.77%
5000	4807	4720	4762	4821	4772	4846	4922		87.82%	86.23%	86.99%	88.07%	87.18%	88.53%	89.92%
4500	4744	4657	4696	4767	4711	4799	4866		86.66%	85.07%	85.79%	87.08%	86.06%	87.67%	88.89%
4000	4674	4584	4631	4710	4644	4748	4808		85.39%	83.74%	84.60%	86.04%	84.84%	86.74%	87.83%
3500	4605	4501	4564	4629	4561	4696	4749		84.12%	82.23%	83.38%	84.56%	83.32%	85.79%	86.76%
3000	4246	4066	4228	4206	4189	4366	4192		77.57%	74.28%	77.24%	76.84%	76.53%	79.76%	76.58%
2500	4108	3920	4091	4011	4051	4269	4046		75.05%	71.61%	74.74%	73.27%	74.00%	77.99%	73.91%
2000	3125	3088	3126	3141	3094	3323	3243		57.09%	56.41%	57.11%	57.38%	56.52%	60.71%	59.24%
1500	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1000	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
500	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-8 (Augusta Shoals Flow Frequency Analysis)

AUGUSTA CANAL FLOW (CFS) 01/01/1999 - 12/26/2013															
	COUNT VALUES LESS THAN								PERCENT OF TIME LESS THAN						
Flow	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6		NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
20000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
19500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
19000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
18500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
18000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
17500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
17000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
16500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
16000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
15500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
15000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
14500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
14000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
13500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
13000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
12500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
12000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
11500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
11000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
10500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
10000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
9500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
9000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
8500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
8000	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
7500	5474	5474	5474	5474	5474	5474	5474		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
7000	5458	5459	5458	5470	5458	5459	5467		99.71%	99.73%	99.71%	99.93%	99.71%	99.73%	99.87%
6500	5458	5459	5458	5470	5458	5459	5467		99.71%	99.73%	99.71%	99.93%	99.71%	99.73%	99.87%
6000	5340	5332	5336	5342	5338	5342	5402		97.55%	97.41%	97.48%	97.59%	97.52%	97.59%	98.68%
5500	5340	5332	5336	5342	5338	5342	5402		97.55%	97.41%	97.48%	97.59%	97.52%	97.59%	98.68%
5000	5340	5332	5336	5342	5338	5342	5402		97.55%	97.41%	97.48%	97.59%	97.52%	97.59%	98.68%
4500	4203	4091	4191	4192	4160	4448	4393		76.78%	74.74%	76.56%	76.58%	76.00%	81.26%	80.25%
4000	3998	3875	4009	3930	3958	4247	4055		73.04%	70.79%	73.24%	71.79%	72.31%	77.58%	74.08%
3500	3622	3466	3682	3276	3574	3324	2710		66.17%	63.32%	67.26%	59.85%	65.29%	60.72%	49.51%
3000	3167	3093	3278	2895	3198	2402	1688		57.86%	56.50%	59.88%	52.89%	58.42%	43.88%	30.84%
2500	1802	2475	2040	2176	2530	1409	926		32.92%	45.21%	37.27%	39.75%	46.22%	25.74%	16.92%
2000	367	970	538	321	650	215	120		6.70%	17.72%	9.83%	5.86%	11.87%	3.93%	2.19%
1500	0	640	0	0	0	4	4		0.00%	11.69%	0.00%	0.00%	0.00%	0.07%	0.07%
1000	0	0	0	0	0	1	1		0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.02%
500	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-9 (Augusta Canal Flow Frequency Analysis)

AUGUSTA FLOW (CFS) 01/01/1999 - 12/26/2013															
COUNT VALUES LESS THAN									PERCENT OF TIME LESS THAN						
Flow	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6		NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
20000	5182	5157	5164	5162	5166	5183	5265		94.67%	94.21%	94.34%	94.30%	94.37%	94.68%	96.18%
19500	5167	5142	5149	5152	5152	5176	5257		94.39%	93.93%	94.06%	94.12%	94.12%	94.56%	96.04%
19000	5157	5132	5137	5144	5139	5167	5247		94.21%	93.75%	93.84%	93.97%	93.88%	94.39%	95.85%
18500	5144	5117	5120	5136	5124	5161	5242		93.97%	93.48%	93.53%	93.83%	93.61%	94.28%	95.76%
18000	5141	5114	5118	5127	5122	5158	5235		93.92%	93.42%	93.50%	93.66%	93.57%	94.23%	95.63%
17500	5134	5103	5111	5115	5111	5151	5227		93.79%	93.22%	93.37%	93.44%	93.37%	94.10%	95.49%
17000	5123	5091	5098	5107	5101	5143	5221		93.59%	93.00%	93.13%	93.30%	93.19%	93.95%	95.38%
16500	5113	5081	5085	5102	5089	5131	5208		93.41%	92.82%	92.89%	93.20%	92.97%	93.73%	95.14%
16000	5106	5073	5079	5088	5083	5119	5199		93.28%	92.67%	92.78%	92.95%	92.86%	93.51%	94.98%
15500	5090	5061	5063	5075	5070	5109	5187		92.99%	92.46%	92.49%	92.71%	92.62%	93.33%	94.76%
15000	5075	5042	5044	5059	5056	5095	5169		92.71%	92.11%	92.14%	92.42%	92.36%	93.08%	94.43%
14500	5058	5027	5030	5045	5037	5076	5149		92.40%	91.83%	91.89%	92.16%	92.02%	92.73%	94.06%
14000	5041	5005	5014	5030	5021	5061	5131		92.09%	91.43%	91.60%	91.89%	91.72%	92.46%	93.73%
13500	5014	4981	4990	5005	4993	5041	5112		91.60%	90.99%	91.16%	91.43%	91.21%	92.09%	93.39%
13000	4988	4951	4960	4991	4965	5022	5096		91.12%	90.45%	90.61%	91.18%	90.70%	91.74%	93.09%
12500	4971	4925	4941	4978	4949	4998	5069		90.81%	89.97%	90.26%	90.94%	90.41%	91.30%	92.60%
12000	4951	4905	4917	4950	4927	4970	5038		90.45%	89.61%	89.82%	90.43%	90.01%	90.79%	92.04%
11500	4926	4871	4888	4926	4899	4948	5007		89.99%	88.98%	89.29%	89.99%	89.50%	90.39%	91.47%
11000	4896	4834	4854	4900	4869	4918	4981		89.44%	88.31%	88.67%	89.51%	88.95%	89.84%	90.99%
10500	4861	4788	4813	4876	4818	4894	4958		88.80%	87.47%	87.92%	89.08%	88.02%	89.40%	90.57%
10000	4809	4731	4766	4830	4774	4851	4917		87.85%	86.43%	87.07%	88.24%	87.21%	88.62%	89.82%
9500	4753	4673	4717	4779	4723	4803	4870		86.83%	85.37%	86.17%	87.30%	86.28%	87.74%	88.97%
9000	4691	4594	4654	4729	4660	4755	4809		85.70%	83.92%	85.02%	86.39%	85.13%	86.87%	87.85%
8500	4605	4511	4579	4648	4570	4689	4733		84.12%	82.41%	83.65%	84.91%	83.49%	85.66%	86.46%
8000	4523	4421	4499	4555	4478	4616	4640		82.63%	80.76%	82.19%	83.21%	81.80%	84.33%	84.76%
7500	4407	4293	4383	4421	4356	4518	4504		80.51%	78.43%	80.07%	80.76%	79.58%	82.54%	82.28%
7000	4231	4113	4220	4218	4182	4408	4260		77.29%	75.14%	77.09%	77.06%	76.40%	80.53%	77.82%
6500	4015	3882	4015	3957	3964	4236	3975		73.35%	70.92%	73.35%	72.29%	72.42%	77.38%	72.62%
6000	3744	3598	3759	3643	3698	3938	3634		68.40%	65.73%	68.67%	66.55%	67.56%	71.94%	66.39%
5500	3422	3264	3478	3233	3393	3446	3061		62.51%	59.63%	63.54%	59.06%	61.98%	62.95%	55.92%
5000	3044	2926	3146	2667	3069	2647	1776		55.61%	53.45%	57.47%	48.72%	56.07%	48.36%	32.44%
4500	2354	2458	2590	2190	2561	1592	947		43.00%	44.90%	47.31%	40.01%	46.78%	29.08%	17.30%
4000	1085	1833	1301	1493	1781	691	542		19.82%	33.49%	23.77%	27.27%	32.54%	12.62%	9.90%
3500	0	775	0	0	0	0	0		0.00%	14.16%	0.00%	0.00%	0.00%	0.00%	0.00%
3000	0	493	0	0	0	0	0		0.00%	9.01%	0.00%	0.00%	0.00%	0.00%	0.00%
2500	0	1	0	0	0	0	0		0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%
2000	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1500	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1000	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
500	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0	0	0	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8-10 (Augusta Flow Frequency Analysis)

Savannah River at Augusta	01/01/1999 to 12/26/2013						
	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
Days Over 10000 cfs	665	743	708	644	700	623	557
Days Over 20000 cfs	137	144	141	129	138	140	77
Days Over 30000 cfs	6	8	6	0	6	6	0
Flood Damage Reduction							
Average of Days Over 30000 cfs	37646	37326	37385	0	46593	37289	0
Rank Based on Average of Flows over 30000 cfs	6	4	5	1	7	3	1
Percent Difference in (Average of Days Over 30000 cfs) from NAA	0.00%	-0.90%	-0.70%	-100.00%	23.80%	-0.90%	-100.00%
Navigation							
Days between 10000 cfs and 20000 cfs	528	599	567	515	562	483	480
Rank Based on number of days Flows between 10000 cfs and 20000 cfs	4	1	2	5	3	6	7
Percent Difference in (Days between 10000 cfs and 20000 cfs) from NAA	0%	13%	7%	-2%	6%	-9%	-9%

Table 8-11 (FDR and Navigation Metrics)

Tables 8-12 thru 8-21 summarize how often fish spawn objectives were met.

ALTERNATIVE NAA (Jocassee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	44%	0%	44%	44%
Max Delta Down	0.50	675	630	45	675	630	14	14	14	14	13	13	45	45	298	0	298	298
Max Delta Up	1.00		93%	7%	100%	93%												
Guide Curve	1110.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							14	14	14	14	13	13						

ALTERNATIVE ALT1 (Jocassee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	53%	0%	53%	53%
Max Delta Down	0.50	675	623	52	675	623	16	14	13	13	12	12	52	52	359	0	359	359
Max Delta Up	1.00		92%	8%	100%	92%												
Guide Curve	1110.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	14	13	13	12	12						

ALTERNATIVE ALT2 (Jocassee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	47%	0%	47%	47%
Max Delta Down	0.50	675	641	34	675	641	16	14	14	14	13	13	34	34	317	0	317	317
Max Delta Up	1.00		95%	5%	100%	95%												
Guide Curve	1110.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	14	14	14	13	13						

ALTERNATIVE ALT3 (Jocassee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	27%	0%	27%	27%
Max Delta Down	0.50	675	565	110	675	565	14	14	13	13	10	9	110	110	183	0	183	183
Max Delta Up	1.00		84%	16%	100%	84%												
Guide Curve	1110.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							14	14	13	13	10	9						

ALTERNATIVE ALT4 (Jocassee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	46%	0%	46%	46%
Max Delta Down	0.50	675	645	30	675	645	16	14	14	13	13	13	30	30	312	0	312	312
Max Delta Up	1.00		96%	4%	100%	96%												
Guide Curve	1110.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	14	14	13	13	13						

ALTERNATIVE ALT5 (Jocassee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	42%	0%	42%	42%
Max Delta Down	0.50	675	643	32	675	643	15	15	15	14	13	13	32	32	281	0	281	281
Max Delta Up	1.00		95%	5%	100%	95%												
Guide Curve	1110.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	15	14	13	13						

ALTERNATIVE ALT6 (Jocassee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	29%	0%	29%	29%
Max Delta Down	0.50	675	559	116	675	559	15	14	11	11	10	10	116	116	197	0	197	197
Max Delta Up	1.00		83%	17%	100%	83%												
Guide Curve	1110.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	14	11	11	10	10						

Table 8-12 (Fish Spawn Metrics Evaluation, Jocassee)

ALTERNATIVE NAA (Keowee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	60%	0%	60%	60%
Max Delta Down	0.50	675	675	0	675	675	15	15	15	15	15	15	0	0	408	0	408	408
Max Delta Up	1.00		100%	0%	100%	100%												
Guide Curve	800.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	15	15	15	15						

ALTERNATIVE ALT1 (Keowee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	68%	0%	68%	68%
Max Delta Down	0.50	675	674	1	675	674	15	15	15	15	15	15	1	1	460	0	460	460
Max Delta Up	1.00		100%	0%	100%	100%												
Guide Curve	800.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	15	15	15	15						

ALTERNATIVE ALT2 (Keowee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	66%	0%	66%	66%
Max Delta Down	0.50	675	675	0	675	675	15	15	15	15	15	15	0	0	444	0	444	444
Max Delta Up	1.00		100%	0%	100%	100%												
Guide Curve	800.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	15	15	15	15						

ALTERNATIVE ALT3 (Keowee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	33%	0%	33%	33%
Max Delta Down	0.50	675	652	23	675	652	17	15	14	14	12	12	23	23	220	0	220	220
Max Delta Up	1.00		97%	3%	100%	97%												
Guide Curve	800.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							17	15	14	14	12	12						

ALTERNATIVE ALT4 (Keowee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	65%	0%	65%	65%
Max Delta Down	0.50	675	675	0	675	675	15	15	15	15	15	15	0	0	442	0	442	442
Max Delta Up	1.00		100%	0%	100%	100%												
Guide Curve	800.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	15	15	15	15						

ALTERNATIVE ALT5 (Keowee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	55%	0%	55%	55%
Max Delta Down	0.50	675	675	0	675	675	15	15	15	15	15	15	0	0	374	0	374	374
Max Delta Up	1.00		100%	0%	100%	100%												
Guide Curve	800.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	15	15	15	15						

ALTERNATIVE ALT6 (Keowee Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	40%	0%	40%	40%
Max Delta Down	0.50	675	611	64	675	611	15	14	14	12	12	11	64	64	270	0	270	270
Max Delta Up	1.00		91%	9%	100%	91%												
Guide Curve	800.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	14	14	12	12	11						

Table 8-13 (Fish Spawn Metrics Evaluation, Keowee)

ALTERNATIVE NAA (Hartwell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	32%	1%	32%	31%
Max Delta Down	0.50	675	625	50	669	619	15	15	14	14	12	11	50	56	213	6	213	207
Max Delta Up	1.00		93%	7%	99%	92%												
Guide Curve	660.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	14	14	12	9						

ALTERNATIVE ALT1 (Hartwell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	41%	1%	41%	41%
Max Delta Down	0.50	675	623	52	669	617	15	15	15	15	11	9	52	58	280	6	280	274
Max Delta Up	1.00		92%	8%	99%	91%												
Guide Curve	660.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	15	15	11	7						

ALTERNATIVE ALT2 (Hartwell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	37%	1%	37%	36%
Max Delta Down	0.50	675	627	48	669	621	15	15	14	14	12	11	48	54	250	6	250	244
Max Delta Up	1.00		93%	7%	99%	92%												
Guide Curve	660.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	14	14	12	9						

ALTERNATIVE ALT3 (Hartwell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	28%	1%	28%	27%
Max Delta Down	0.50	675	627	48	668	620	15	14	13	13	13	13	48	55	186	7	186	179
Max Delta Up	1.00		93%	7%	99%	92%												
Guide Curve	660.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	14	13	13	13	11						

ALTERNATIVE ALT4 (Hartwell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	36%	1%	36%	35%
Max Delta Down	0.50	675	628	47	669	622	15	15	15	14	12	10	47	53	243	6	243	237
Max Delta Up	1.00		93%	7%	99%	92%												
Guide Curve	660.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	15	15	14	12	8						

ALTERNATIVE ALT5 (Hartwell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	30%	1%	30%	29%
Max Delta Down	0.50	675	605	70	667	597	15	14	13	13	12	9	70	78	203	8	203	195
Max Delta Up	1.00		90%	10%	99%	88%												
Guide Curve	660.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	14	13	13	12	7						

ALTERNATIVE ALT6 (Hartwell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations		Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	24%	1%	24%	23%
Max Delta Down	0.50	675	569	106	666	560	16	14	13	11	10	8	106	115	164	9	164	155
Max Delta Up	1.00		84%	16%	99%	83%												
Guide Curve	660.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	14	13	11	10	6						

Table 8-14 (Fish Spawn Metrics Evaluation, Hartwell)

ALTERNATIVE NAA (Russell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	32%	0%	32%	32%
Max Delta Down	0.50	675	602	73	672	599	16	16	12	11	10	8	73	76	218	3	218	215
Max Delta Up	1.00		89%	11%	100%	89%												
Guide Curve	475.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	16	12	11	10	7						

ALTERNATIVE ALT1 (Russell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	41%	0%	41%	41%
Max Delta Down	0.50	675	575	100	672	572	13	12	12	11	10	9	100	103	277	3	277	274
Max Delta Up	1.00		85%	15%	100%	85%												
Guide Curve	475.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							13	12	12	11	10	8						

ALTERNATIVE ALT2 (Russell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	37%	0%	37%	36%
Max Delta Down	0.50	675	611	64	672	608	16	15	13	11	9	9	64	67	249	3	249	246
Max Delta Up	1.00		91%	9%	100%	90%												
Guide Curve	475.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	15	13	11	9	8						

ALTERNATIVE ALT3 (Russell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	32%	0%	32%	31%
Max Delta Down	0.50	675	568	107	673	566	16	11	11	11	9	7	107	109	213	2	213	211
Max Delta Up	1.00		84%	16%	100%	84%												
Guide Curve	475.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							17	11	11	11	9	5						

ALTERNATIVE ALT4 (Russell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	35%	0%	35%	34%
Max Delta Down	0.50	675	641	34	672	638	16	15	14	13	11	9	34	37	235	3	235	232
Max Delta Up	1.00		95%	5%	100%	95%												
Guide Curve	475.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	15	14	13	11	8						

ALTERNATIVE ALT5 (Russell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	38%	0%	38%	37%
Max Delta Down	0.50	675	592	83	672	589	19	14	11	10	10	7	83	86	255	3	255	252
Max Delta Up	1.00		88%	12%	100%	87%												
Guide Curve	475.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							19	14	11	10	10	6						

ALTERNATIVE ALT6 (Russell Elevation)
01/01/1999 - 12/26/2013 , (14.99) Years

															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	38%	0%	38%	38%
Max Delta Down	0.50	675	650	25	672	647	17	16	15	12	10	7	25	28	259	3	259	256
Max Delta Up	1.00		96%	4%	100%	96%												
Guide Curve	475.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							17	16	15	12	9	7						

Table 8-15 (Fish Spawn Metrics Evaluation, Russell)

ALTERNATIVE NAA (Thurmond Elevation) 01/01/1999 - 12/26/2013 , (14.99) Years															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	28%	0%	28%	28%
Max Delta Down	0.50	675	603	72	675	603	14	14	14	13	12	11	72	72	189	0	189	189
Max Delta Up	1.00		89%	11%	100%	89%												
Guide Curve	330.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							14	14	14	13	12	11						

ALTERNATIVE ALT1 (Thurmond Elevation) 01/01/1999 - 12/26/2013 , (14.99) Years															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	39%	0%	39%	39%
Max Delta Down	0.50	675	588	87	675	588	14	14	14	12	11	10	87	87	260	0	260	260
Max Delta Up	1.00		87%	13%	100%	87%												
Guide Curve	330.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							14	14	14	12	11	10						

ALTERNATIVE ALT2 (Thurmond Elevation) 01/01/1999 - 12/26/2013 , (14.99) Years															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	32%	0%	32%	32%
Max Delta Down	0.50	675	599	76	675	599	15	14	14	14	11	9	76	76	213	0	213	213
Max Delta Up	1.00		89%	11%	100%	89%												
Guide Curve	330.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	14	14	14	11	9						

ALTERNATIVE ALT3 (Thurmond Elevation) 01/01/1999 - 12/26/2013 , (14.99) Years															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	16%	0%	16%	16%
Max Delta Down	0.50	675	435	240	675	435	16	11	9	7	5	5	240	240	107	0	107	107
Max Delta Up	1.00		64%	36%	100%	64%												
Guide Curve	330.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	11	9	7	5	5						

ALTERNATIVE ALT4 (Thurmond Elevation) 01/01/1999 - 12/26/2013 , (14.99) Years															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	31%	0%	31%	31%
Max Delta Down	0.50	675	587	88	675	587	15	13	13	12	11	11	88	88	208	0	208	208
Max Delta Up	1.00		87%	13%	100%	87%												
Guide Curve	330.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							15	13	13	12	11	11						

ALTERNATIVE ALT5 (Thurmond Elevation) 01/01/1999 - 12/26/2013 , (14.99) Years															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	23%	0%	23%	23%
Max Delta Down	0.50	675	623	52	675	623	16	15	15	13	11	10	52	52	153	0	153	153
Max Delta Up	1.00		92%	8%	100%	92%												
Guide Curve	330.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	15	15	13	11	10						

ALTERNATIVE ALT6 (Thurmond Elevation) 01/01/1999 - 12/26/2013 , (14.99) Years															Time in FC	Days > Max while in Spawn	%Time in FC while Above Target Min	%Time in FC while above Target Min
Start	Apr 01	Spawn (Days)					Sequential Count (periodsAbove Min)						Violations					
End	May 15	Total	>Min	<Min	<Max	>Min,<Max	> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days	<Min	<Min,>Max	15%	0%	15%	15%
Max Delta Down	0.50	675	551	124	675	551	16	15	12	10	8	8	124	124	100	0	100	100
Max Delta Up	1.00		82%	18%	100%	82%												
Guide Curve	330.00						Sequential Count (periods between Max & Min)											
							> 7 Days	> 14 Days	> 21 Days	> 28 Days	> 35 Days	> 42 Days						
							16	15	12	10	8	8						

Table 8-16 (Fish Spawn Metrics Evaluation, Thurmond)

		ALTERNATIVE NAA (Shoals Flow) 01/01/1999 - 12/26/2013 , (14.99) Years										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000	Sequential Count Periods (Days)														
Min Limit	1500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	8%	0%	92%	100%	92%
	Periods	13	13	12	12	12	12	11	8	8	8	52	0	623	675	623

		ALTERNATIVE ALT1 (Shoals Flow) 01/01/1999 - 12/26/2013 , (14.99) Years										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000	Sequential Count Periods (Days)														
Min Limit	1500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	9%	0%	91%	100%	91%
	Periods	12	12	11	11	11	11	9	9	8	8	60	0	615	675	615

		ALTERNATIVE ALT2 (Shoals Flow) 01/01/1999 - 12/26/2013 , (14.99) Years										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000	Sequential Count Periods (Days)														
Min Limit	1500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	9%	0%	91%	100%	91%
	Periods	13	13	12	12	12	12	11	9	8	8	60	0	615	675	615

		ALTERNATIVE ALT3 (Shoals Flow) 01/01/1999 - 12/26/2013 , (14.99) Years										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000	Sequential Count Periods (Days)														
Min Limit	1500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	6%	0%	94%	99%	94%
	Periods	14	13	12	12	12	11	10	10	9	8	41	0	634	666	634

		ALTERNATIVE ALT4 (Shoals Flow) 01/01/1999 - 12/26/2013 , (14.99) Years										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000	Sequential Count Periods (Days)														
Min Limit	1500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	9%	0%	91%	100%	91%
	Periods	14	14	12	12	12	12	11	10	7	7	59	0	616	674	616

		ALTERNATIVE ALT5 (Shoals Flow) 01/01/1999 - 12/26/2013 , (14.99) Years										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000	Sequential Count Periods (Days)														
Min Limit	1500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	7%	0%	93%	100%	93%
	Periods	14	14	14	13	13	13	12	12	11	11	46	0	629	675	629

		ALTERNATIVE ALT6 (Shoals Flow) 01/01/1999 - 12/26/2013 , (14.99) Years										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000	Sequential Count Periods (Days)														
Min Limit	1500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	4%	0%	96%	100%	96%
	Periods	14	14	14	13	13	13	12	12	12	12	28	0	647	675	647

Table 8-17 (Fish Spawn Metrics Evaluation, Shoals)

ALTERNATIVE NAA (Augusta Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000															
Min Limit	3600	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	15%	0%	85%	96%	85%
	Periods	19	13	9	9	8	7	6	6	6	6	101	0	574	649	574

ALTERNATIVE ALT1 (Augusta Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000															
Min Limit	3600	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	18%	1%	82%	96%	82%
	Periods	19	9	5	5	5	5	4	4	4	4	123	6	552	645	552

ALTERNATIVE ALT2 (Augusta Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000															
Min Limit	3600	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	16%	0%	84%	95%	84%
	Periods	17	12	9	9	8	8	6	6	6	6	111	0	564	640	564

ALTERNATIVE ALT3 (Augusta Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000															
Min Limit	3600	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	11%	0%	89%	94%	89%
	Periods	20	14	11	10	9	8	6	5	3	3	77	0	598	632	598

ALTERNATIVE ALT4 (Augusta Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000															
Min Limit	3600	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	17%	0%	83%	94%	83%
	Periods	19	11	7	6	5	5	4	4	4	4	112	0	563	632	563

ALTERNATIVE ALT5 (Augusta Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000															
Min Limit	3600	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	12%	0%	88%	99%	88%
	Periods	17	12	11	10	8	8	8	8	6	6	83	0	592	667	592

ALTERNATIVE ALT6 (Augusta Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	10000															
Min Limit	3600	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	10%	0%	90%	98%	90%
	Periods	25	18	11	10	9	9	8	6	6	6	66	0	609	659	609

Table 8-18 (Fish Spawn Metrics Evaluation, Augusta)

ALTERNATIVE NAA (Waynesboro Flow) 01/01/1999 - 12/26/2013 , (14.99) Years												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	12000	Sequential Count Periods (Days)														
Min Limit	4000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	11%	10%	89%	90%	89%
	Periods	25	18	14	12	11	8	7	6	6	4	75	70	600	605	600

ALTERNATIVE ALT1 (Waynesboro Flow) 01/01/1999 - 12/26/2013 , (14.99) Years												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	12000	Sequential Count Periods (Days)														
Min Limit	4000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	13%	12%	87%	88%	87%
	Periods	23	15	12	11	10	8	7	6	5	3	86	79	589	596	589

ALTERNATIVE ALT2 (Waynesboro Flow) 01/01/1999 - 12/26/2013 , (14.99) Years												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	12000	Sequential Count Periods (Days)														
Min Limit	4000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	12%	13%	88%	87%	88%
	Periods	22	17	15	13	11	8	6	5	5	3	81	89	594	586	594

ALTERNATIVE ALT3 (Waynesboro Flow) 01/01/1999 - 12/26/2013 , (14.99) Years												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	12000	Sequential Count Periods (Days)														
Min Limit	4000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	8%	12%	92%	88%	92%
	Periods	17	13	13	13	12	10	10	10	9	9	55	81	620	594	620

ALTERNATIVE ALT4 (Waynesboro Flow) 01/01/1999 - 12/26/2013 , (14.99) Years												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	12000	Sequential Count Periods (Days)														
Min Limit	4000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	12%	15%	88%	85%	88%
	Periods	21	15	15	12	11	7	5	4	4	3	79	101	596	574	596

ALTERNATIVE ALT5 (Waynesboro Flow) 01/01/1999 - 12/26/2013 , (14.99) Years												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	12000	Sequential Count Periods (Days)														
Min Limit	4000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	9%	12%	91%	88%	91%
	Periods	17	15	13	12	12	10	7	7	7	5	60	83	615	592	615

ALTERNATIVE ALT6 (Waynesboro Flow) 01/01/1999 - 12/26/2013 , (14.99) Years												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	12000	Sequential Count Periods (Days)														
Min Limit	4000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	7%	12%	93%	88%	93%
	Periods	20	15	13	12	11	8	8	7	7	5	45	82	630	593	630

Table 8-19 (Fish Spawn Metrics Evaluation, Waynesboro)

ALTERNATIVE NAA (Millhaven Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	15000															
Min Limit	4500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	8%	4%	92%	96%	92%
	Periods	16	15	13	12	12	11	11	9	8	8	55	24	620	651	620

ALTERNATIVE ALT1 (Millhaven Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	15000															
Min Limit	4500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	11%	4%	89%	96%	89%
	Periods	16	14	13	12	12	10	10	9	8	7	72	26	603	649	603

ALTERNATIVE ALT2 (Millhaven Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	15000															
Min Limit	4500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	10%	0%	90%	100%	90%
	Periods	14	14	14	13	13	12	11	8	8	8	70	2	605	673	605

ALTERNATIVE ALT3 (Millhaven Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	15000															
Min Limit	4500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	7%	2%	93%	98%	93%
	Periods	21	18	15	13	13	12	11	10	10	10	49	13	626	662	626

ALTERNATIVE ALT4 (Millhaven Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	15000															
Min Limit	4500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	10%	3%	90%	97%	90%
	Periods	14	14	13	13	12	11	11	9	9	9	68	20	607	655	607

ALTERNATIVE ALT5 (Millhaven Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	15000															
Min Limit	4500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	8%	3%	92%	97%	92%
	Periods	15	15	14	14	14	13	12	10	10	10	55	19	620	656	620

ALTERNATIVE ALT6 (Millhaven Flow)
01/01/1999 - 12/26/2013 , (14.99) Years

		Sequential Count Periods (Days)										Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
Start	Apr 01															
End	May 15															
Max Limit	15000															
Min Limit	4500	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	5%	1%	95%	99%	95%
	Periods	16	15	14	14	14	12	12	12	12	12	34	7	641	668	641

Table 8-20 (Fish Spawn Metrics Evaluation, Millhaven)

												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
		ALTERNATIVE NAA (Clyo Flow)														
Start	Apr 01	01/01/1999 - 12/26/2013 , (14.99) Years														
End	May 15															
Max Limit	35000	Sequential Count Periods (Days)														
Min Limit	5000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	2%	5%	98%	95%	98%
	Periods	17	16	15	15	15	12	11	11	11	10	13	36	662	639	662

												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
		ALTERNATIVE ALT1 (Clyo Flow)														
Start	Apr 01	01/01/1999 - 12/26/2013 , (14.99) Years														
End	May 15															
Max Limit	35000	Sequential Count Periods (Days)														
Min Limit	5000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	2%	5%	98%	95%	98%
	Periods	18	17	15	15	15	12	11	11	11	10	13	32	662	643	662

												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
		ALTERNATIVE ALT2 (Clyo Flow)														
Start	Apr 01	01/01/1999 - 12/26/2013 , (14.99) Years														
End	May 15															
Max Limit	35000	Sequential Count Periods (Days)														
Min Limit	5000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	2%	4%	98%	96%	98%
	Periods	15	15	15	15	14	13	12	12	12	11	13	28	662	647	662

												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
		ALTERNATIVE ALT3 (Clyo Flow)														
Start	Apr 01	01/01/1999 - 12/26/2013 , (14.99) Years														
End	May 15															
Max Limit	35000	Sequential Count Periods (Days)														
Min Limit	5000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	1%	7%	99%	93%	99%
	Periods	16	15	14	14	14	13	12	11	11	11	9	46	666	629	666

												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
		ALTERNATIVE ALT4 (Clyo Flow)														
Start	Apr 01	01/01/1999 - 12/26/2013 , (14.99) Years														
End	May 15															
Max Limit	35000	Sequential Count Periods (Days)														
Min Limit	5000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	2%	9%	98%	91%	98%
	Periods	16	15	14	14	14	13	11	10	10	10	13	58	662	617	662

												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
		ALTERNATIVE ALT5 (Clyo Flow)														
Start	Apr 01	01/01/1999 - 12/26/2013 , (14.99) Years														
End	May 15															
Max Limit	35000	Sequential Count Periods (Days)														
Min Limit	5000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	2%	3%	98%	97%	98%
	Periods	17	16	16	15	15	13	12	11	11	11	12	21	663	654	663

												Spawn Days Greater Than Max	Spawn Days Less Than Min	Spawn Days Less Than Max	Spawn Days Greater Than Min	Spawn Days Between Max & Min
		ALTERNATIVE ALT6 (Clyo Flow)														
Start	Apr 01	01/01/1999 - 12/26/2013 , (14.99) Years														
End	May 15															
Max Limit	35000	Sequential Count Periods (Days)														
Min Limit	5000	> 1 Days	> 5 Days	> 10 Days	> 15 Days	> 20 Days	> 25 Days	> 30 Days	> 35 Days	> 40 Days	> 44 Days	1%	0%	99%	100%	99%
	Periods	16	16	15	15	15	15	14	14	13	13	5	3	670	672	670

Table 8-21 (Fish Spawn Metrics Evaluation, Clyo)

Tables 8-22 and 8-23 summarize pool elevation metric covering Beach and Ramp availability.

ALL RAMPS

	Lanes	days	Available Lane Days
Hartwell	111	5473	607503

Number of lane-days when lane is not useable — 01/01/1999 - 12/26/2013 (5473 Days)

Hartwell	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
Number of days ramp is not unuseable	69255	49642	64925	77684	59683	81807	171852
% time ramps unusable	11.40%	8.17%	10.69%	12.79%	9.82%	13.47%	28.29%
Delta % time ramps unusable		3.23%	0.71%	-1.39%	1.58%	-2.07%	-16.89%

	Lanes	days	Available Lane Days
Thurmond	99	5473	541827

Number of lane-days when lane is not useable — 01/01/1999 - 12/26/2013 (5473 Days)

Thurmond	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
Number of days ramp is unuseable	28722	13205	25546	31514	20809	38268	111174
% time ramps unusable	5.30%	2.44%	4.71%	5.82%	3.84%	7.06%	20.52%
Delta % time ramps unusable		2.86%	0.59%	-0.52%	1.46%	-1.76%	-15.22%

BoatRamp Average Visitation	Annual	Daily	User Value Day	Years	Days
Hartwell	2318568	6352	$ 8.89	15	5400
Thurmond	1950967	5345	$ 8.89		

Number of days when lane is not useable

		NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
	Hartwell	616	441	577	691	531	727	1528
	Thurmond	286	132	255	314	207	381	1108
Potential Revenue	Hartwell	$ 304,945,686	$ 304,945,686	$ 304,945,686	$ 304,945,686	$ 304,945,686	$ 304,945,686	$ 304,945,686
	Thurmond	$ 256,597,594	$ 256,597,594	$ 256,597,594	$ 256,597,594	$ 256,597,594	$ 256,597,594	$ 256,597,594
Potential Missed opportunity	Hartwell	$ 37,134,114	$ 27,053,080	$ 34,889,191	$ 41,666,711	$ 32,183,679	$ 43,624,085	$ 94,445,563
	Thurmond	$ 19,275,380	$ 8,994,761	$ 17,255,844	$ 21,049,076	$ 13,962,454	$ 24,773,165	$ 66,582,743
Estimated Recreational Benefit	Hartwell	$ 267,811,572	$ 277,892,606	$ 270,056,495	$ 263,278,975	$ 272,762,007	$ 261,321,601	$ 210,500,123
	Thurmond	$ 237,322,214	$ 247,602,833	$ 239,341,750	$ 235,548,518	$ 242,635,140	$ 231,824,429	$ 190,014,851
Difference from NAA	Hartwell		$10,081,034	$2,244,923	($4,532,597)	$4,950,435	($6,489,971)	($57,311,449)
	Thurmond		$10,280,619	$2,019,536	($1,773,696)	$5,312,925	($5,497,785)	($47,307,363)
Combined			$20,361,652	$4,264,459	($6,306,293)	$10,263,360	($11,987,756)	($104,618,812)

MARINAS ONLY

	Lanes	days	Available Lane Days
Hartwell	6	5473	32838

Number of lane-days when lane is not useable — 01/01/1999 - 12/26/2013 (5473 Days)

Hartwell	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
Number of days ramp is not unuseable	0	0	0	0	0	65	3590
% time ramps unusable	0.00%	0.00%	0.00%	0.00%	0.00%	0.20%	10.93%
Delta % time ramps unusable		0.00%	0.00%	0.00%	0.00%	-0.20%	-10.93%

	Lanes	days	Available Lane Days
Thurmond	4	5473	21892

Number of lane-days when lane is not useable — 01/01/1999 - 12/26/2013 (5473 Days)

Thurmond	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
Number of days ramp is unuseable	28	0	0	68	0	340	4293
% time ramps unusable	0.13%	0.00%	0.00%	0.31%	0.00%	1.55%	19.61%
Delta % time ramps unusable		0.13%	0.13%	-0.18%	0.13%	-1.43%	-19.48%

BoatRamp Average Visitation	Annual	Daily	User Value Day	Years	Days
Hartwell	2318568	343	$ 8.89	15	5400
Thurmond	1950967	216	$ 8.89		

Number of days when lane is not useable

		NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
	Hartwell	0	0	0	0	0	65	3591
	Thurmond	28	0	0	68	0	340	4295
Potential Revenue	Hartwell	$ 16,483,551	$ 16,483,551	$ 16,483,551	$ 16,483,551	$ 16,483,551	$ 16,483,551	$ 16,483,551
	Thurmond	$ 10,367,580	$ 10,367,580	$ 10,367,580	$ 10,367,580	$ 10,367,580	$ 10,367,580	$ 10,367,580
Potential Missed opportunity	Hartwell	$ -	$ -	$ -	$ -	$ -	$ 33,081	$ 2,180,288
	Thurmond	$ 13,444	$ -	$ -	$ 32,651	$ -	$ 163,253	$ 2,061,309
Estimated Recreational Benefit	Hartwell	$ 16,483,551	$ 16,483,551	$ 16,483,551	$ 16,483,551	$ 16,483,551	$ 16,450,470	$ 14,303,262
	Thurmond	$ 10,354,135	$ 10,367,580	$ 10,367,580	$ 10,334,929	$ 10,367,580	$ 10,204,327	$ 8,306,270
		$ 26,837,686	$ 26,851,130	$ 26,851,130	$ 26,818,480	$ 26,851,130	$ 26,654,796	$ 22,609,533
Difference from NAA	Hartwell		$0	$0	$0	$0	($33,081)	($2,180,288)
	Thurmond		$13,444	$13,444	($19,206)	$13,444	($149,809)	($2,047,865)
Combined			$13,444	$13,444	($19,206)	$13,444	($182,890)	($4,228,153)

Table 8-22 (Boat Ramp Access Metrics Evaluation)

Beach Impacts - Days closed due to elevation (01/01/1999 - 12/26/2013)

	Beach Closure Elevation	Alternative NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
HARTWELL								
	654	1546 Days	728 Days	1409 Days	1694 Days	1080 Days	1764 Days	2919 Days
23 Beaches		35558 Beach*Days	16744 Beach*Days	32407 Beach*Days	38962 Beach*Days	24840 Beach*Days	40572 Beach*Days	67137 Beach*Days
RUSSELL								
	469	0 Days	0 Days	0 Days	0 Days	0 Days	0 Days	0 Days
2 Beaches		0 Beach*Days	0 Beach*Days	0 Beach*Days	0 Beach*Days	0 Beach*Days	0 Beach*Days	0 Beach*Days
THURMOND								
	324	1502 Days	644 Days	1322 Days	1636 Days	1050 Days	1677 Days	2890 Days
64 Beaches		96128 Beach*Days	41216 Beach*Days	84608 Beach*Days	104704 Beach*Days	67200 Beach*Days	107328 Beach*Days	184960 Beach*Days

Table 8-23 (Beach Access Metrics Evaluation)

Table 8-23 summarizes upstream critical criteria and how often pools fell below these criteria

01/01/1999 - 12/26/2013	Lowest Intake Elevation	Average Annual Days below Critical Elevation						
	Inoperable at:							
HARTWELL		**NAA**	**ALT 1**	**ALT2**	**ALT3**	**ALT4**	**ALT5**	**ALT6**
Clemson University Agriculture	653	71	21	63	77	49	93	184
Clemson University	623.5	0	0	0	0	0	0	0
City of Lavonia 636 with extension to 634	634	0	0	0	0	0	0	11
Clemson Golf Course	633	0	0	0	0	0	0	8
City of Hartwell	620	0	0	0	0	0	0	0
Anderson County Joint Municipal Water Supply	615.3	0	0	0	0	0	0	0
Milliken Company	611	0	0	0	0	0	0	0
J.P. Stevens Company	600	0	0	0	0	0	0	0
RUSSELL		**NAA**	**ALT1**	**ALT2**	**ALT3**	**ALT4**	**ALT5**	**ALT6**
RBR State Park Golf Course	468.8	0	0	0	0	0	0	0
City of Elberton	465	0	0	0	0	0	0	0
Santee Cooper(Rainey Facility)	462	0	0	0	0	0	0	0
City of Abbeville	457.5	0	0	0	0	0	0	0
Calhoun Falls	457	0	0	0	0	0	0	0
Mohawk Industries	454.75	0	0	0	0	0	0	0
THURMOND		**NAA**	**ALT1**	**ALT2**	**ALT3**	**ALT4**	**ALT5**	**ALT6**
Savannah Lakes (Monticello Golf Course)	324	100	43	88	109	70	112	193
Savannah Lakes Tara Golf Course)	324	100	43	88	109	70	112	193
Hickory Knobb State Park Golf Course	324	100	43	88	109	70	112	193
City of Lincolnton	307	0	0	0	0	0	0	0
City of Thompson/McDuffee County	304	0	0	0	0	0	0	0
Columbia County	304	0	0	0	0	0	0	0
City of Washington	307	0	0	0	0	0	0	0
City of McCormick	300	0	0	0	0	0	0	0

Table 8-24 (In-Lake Water Supply Intake Metrics Evaluation)

Table 8-24 summarizes upstream critical criteria and the percent of time that pools fell below these criteria

01/01/1999 - 12/26/2013	Lowest Intake Elevation	% of Time Below Critical Elevation						
	Inoperable at:							
HARTWELL		**NAA**	**ALT 1**	**ALT2**	**ALT3**	**ALT4**	**ALT5**	**ALT6**
Clemson University Agriculture	**653**	1%	0%	1%	1%	1%	2%	3%
Clemson University	**623.5**	0%	0%	0%	0%	0%	0%	0%
City of Lavonia 636 with extension to 634	**634**	0%	0%	0%	0%	0%	0%	0%
Clemson Golf Course	**633**	0%	0%	0%	0%	0%	0%	0%
City of Hartwell	**620**	0%	0%	0%	0%	0%	0%	0%
Anderson County Joint Municipal Water Supply	**615.3**	0%	0%	0%	0%	0%	0%	0%
Milliken Company	**611**	0%	0%	0%	0%	0%	0%	0%
J.P. Stevens Company	**600**	0%	0%	0%	0%	0%	0%	0%
RUSSELL		**NAA**	**ALT 1**	**ALT2**	**ALT3**	**ALT4**	**ALT5**	**ALT6**
RBR State Park Golf Course	**468.8**	0%	0%	0%	0%	0%	0%	0%
City of Elberton	**465**	0%	0%	0%	0%	0%	0%	0%
Santee Cooper(Rainey Facility)	**462**	0%	0%	0%	0%	0%	0%	0%
City of Abbeville	**457.5**	0%	0%	0%	0%	0%	0%	0%
Calhoun Falls	**457**	0%	0%	0%	0%	0%	0%	0%
Mohawk Industries	**454.75**	0%	0%	0%	0%	0%	0%	0%
THURMOND		**NAA**	**ALT 1**	**ALT2**	**ALT3**	**ALT4**	**ALT5**	**ALT6**
Savannah Lakes (Monticello Golf Course)	**324**	2%	1%	2%	2%	1%	2%	4%
Savannah Lakes Tara Golf Course)	**324**	2%	1%	2%	2%	1%	2%	4%
Hickory Knobb State Park Golf Course	**324**	2%	1%	2%	2%	1%	2%	4%
City of Lincolnton	**307**	0%	0%	0%	0%	0%	0%	0%
City of Thompson/McDuffee County	**304**	0%	0%	0%	0%	0%	0%	0%
Columbia County	**304**	0%	0%	0%	0%	0%	0%	0%
City of Washington	**307**	0%	0%	0%	0%	0%	0%	0%
City of McCormick	**300**	0%	0%	0%	0%	0%	0%	0%

Table 8-25 (In-Lake Water Supply Intake Metrics Evaluation, Percentiles)

Table 8-25 summarizes downstream critical criteria and how often streamflow or river stages fell below these criteria

01/01/1999 - 12/26/2013	Requirement		Flow Index	Average Annual Days below Critical Flow						
Downstream	Elev	Flow	Location	NAA	ALT 1	A L T 2	AL T 3	AL T 4	AL T 5	AL T 6
Augusta-Richmond County (Diesel Pumps)	119.5	1500	Augusta Shoals	0	0	0	0	0	0	0
Augusta-Richmond County (Hydromechanical Pumps)		900	Augusta Canal	0	0	0	0	0	0	0
City of North Augusta	108	3100	Augusta	0	38	0	0	0	0	0
Kimberly Clark Corporation Beech Island	109	3100	Augusta	0	38	0	0	0	0	0
SCE&G Urguhart Station	111	3100	Augusta	0	38	0	0	0	0	0
DSM Chemicals Augusta, Inc.	103.9	3100	Augusta	0	38	0	0	0	0	0
PCS Nitrogen Fertilizer, L.P.	103.9	3100	Augusta	0	38	0	0	0	0	0
General Chemical Corp., Augusta Plant	111	3100	Augusta	0	38	0	0	0	0	0
D/S of NSBL&D (Cretaceous Sand)		3600	Augusta	0	61	0	0	0	0	0
International Paper Corporation - Augusta Mill	94	3600	Augusta	0	61	0	0	0	0	0
DOE Savannah River Operation (Westinghouse SRS G Area Misc Ind)	79	3600	Waynesboro	0	57	0	0	0	0	0
Southern Nuclear Operating Co., Inc. (Vogtle)	70	2600	Waynesboro	0	2	0	0	0	0	0
Georgia Power Co - Plant McIntosh	7.5	4000	Clyo	1	37	1	2	1	0	0
GA Pacific (Fort James Operating Company)	5.16	4000	Clyo	1	37	1	2	1	0	0
Beaufort Jasper W&SA Main Plant	3	4000	Clyo	1	37	1	2	1	0	0
Savannah City Water Supply	-10.22	4000	Clyo	1	37	1	2	1	0	0
Tronox Pigments (Savannah), Inc.	-4.1	4000	Clyo	1	37	1	2	1	0	0
Weyerhaeuser Company	-10.5	4000	Clyo	1	37	1	2	1	0	0
International Paper Corporation	-5	4000	Clyo	1	37	1	2	1	0	0

Table 8-26 (Downstream Water Supply Intake Metrics Evaluation)

Table 8-26 summarizes critical downstream criteria and the percent of time streamflow or river stages fell below these criteria

01/01/1999 - 12/26/2013	Requirement		Flow Index	% of Time Below Critical Flow						
Downstream	Elev	Flow (CFS)	Location	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
Augusta-Richmond County (Diesel Pumps)	119.5	1500	Augusta Shoals	0	0	0	0	0	0	0
Augusta-Richmond County (Hydromechanical Pumps)		900	Augusta Canal	0	0	0	0	0	0	0
City of North Augusta	108	3100	Augusta	0	10.5	0	0	0	0	0
Kimberly Clark Corporation Beech Island	109	3100	Augusta	0	10.5	0	0	0	0	0
SCE&G Urguhart Station	111	3100	Augusta	0	10.5	0	0	0	0	0
DSM Chemicals Augusta, Inc.	103.9	3100	Augusta	0	10.5	0	0	0	0	0
PCS Nitrogen Fertilizer, L.P.	103.9	3100	Augusta	0	10.5	0	0	0	0	0
General Chemical Corp., Augusta Plant	111	3100	Augusta	0	10.5	0	0	0	0	0
D/S of NSBL&D (Cretaceous Sand)		3600	Augusta	0	16.6	0	0	0	0	0
International Paper Corporation - Augusta Mill	94	3600	Augusta	0	16.6	0	0	0	0	0
DOE Savannah River Operation (Westinghouse SRS G Area Misc Ind)	79	3600	Waynesboro	0	15.6	0	0	0	0	0
Southern Nuclear Operating Co., Inc. (Vogtle)	70	2600	Waynesboro	0	0.6	0	0	0	0	0
Georgia Power Co - Plant McIntosh	7.5	4000	Clyo	0.2	10.2	0.2	0.5	0.2	0	0
GA Pacific (Fort James Operating Company)	5.16	4000	Clyo	0.2	10.2	0.2	0.5	0.2	0	0
Beaufort Jasper W&SA Main Plant	3	4000	Clyo	0.2	10.2	0.2	0.5	0.2	0	0
Savannah City Water Supply	-10.22	4000	Clyo	0.2	10.2	0.2	0.5	0.2	0	0
Tronox Pigments (Savannah), Inc.	-4.1	4000	Clyo	0.2	10.2	0.2	0.5	0.2	0	0
Weyerhaeuser Company	-10.5	4000	Clyo	0.2	10.2	0.2	0.5	0.2	0	0
International Paper Corporation	-5	4000	Clyo	0.2	10.2	0.2	0.5	0.2	0	0

Table 8-27 (Downstream Water Supply Intake Metrics Evaluation, Percentiles)

Tables 8-27 and 8-28 illustrate hydropower impacts.

USACE Hydropower Value (01/01/1999 - 12/26/2013)

	Hartwell Generation (MW-Hours)	Russell Generation (MW-Hours)	Thurmond Generation (MW-Hours)	USACE System Energy Contracted (MW-Hours)	USACE System Energy Generated (MW-Hours)	USACE SYS Contract Energy Generated (MW-Hours)	USACE System Surplus Energy Generated (MW-Hours)	USACE System SHORT Energy Purchased (MW-Hours)	USACE System Pumping Total (Unit-Hours) (MW-HR)	USACE System Contract Energy Generated (Dollars)	USACE System Surplus Energy Generated (Dollars)
NAA	5,765,659	10,311,374	8,040,082	20,571,477	24,117,115	20,388,537	3,629,494	99,085	63,163	251,390,655	44,751,657
ALT1	5,789,061	10,560,879	8,072,243	20,571,477	24,422,183	20,321,397	3,968,120	132,666	66,568	250,562,828	48,926,922
ALT2	5,778,563	10,471,359	8,065,553	20,571,477	24,315,475	20,400,256	3,822,138	93,081	65,111	251,535,163	47,126,961
ALT3	5,751,862	10,444,666	8,030,830	20,571,477	24,227,358	20,191,180	3,840,687	195,492	64,471	248,957,248	47,355,667
ALT4	5,778,431	10,451,272	8,038,329	20,571,477	24,268,033	20,403,238	3,773,049	91,746	64,791	251,571,924	46,521,689
ALT5	5,756,348	10,190,176	8,037,956	20,571,477	23,984,480	20,341,864	3,520,245	122,371	61,378	250,815,183	43,404,627
ALT6	5,626,242	9,783,182	7,857,172	20,571,477	23,266,595	20,438,501	2,753,810	74,284	54,934	252,006,722	33,954,483

	USACE System SHORT Energy Purchased (Dollars)	USACE System Pumping Costs (Dollars)	USACE System ENERGY Value (Dollars)	USACE System ENERGY Value Delta NAA (Dollars)	USACE Marketed Capacity Value (Dollars)	USACE System Capacity Shortage (Dollars)	USACE System Capacity Value (Dollars)	USACE System Capacity Value Delta NAA (Dollars)	USACE System Hydropower Value (Dollars)	USACE System Hydropower Value Delta NAA (Dollars)
NAA	6,928,641	2,161,189	287,052,482	$ 0	1,114,713,606	57,941,470	1,056,772,136	$ 0	$ 1,343,824,619	$ 0
ALT1	10,495,861	2,269,353	286,724,536	$ (327,946)	1,114,713,606	62,831,843	1,051,881,763	$ (4,890,374)	$ 1,338,606,299	$ (5,218,320)
ALT2	6,662,099	2,234,233	289,765,792	$ 2,713,310	1,114,713,606	60,030,988	1,054,682,618	$ (2,089,518)	$ 1,344,448,410	$ 623,792
ALT3	16,281,173	2,187,507	277,844,235	$ (9,208,247)	1,114,713,606	61,617,318	1,053,096,289	$ (3,675,848)	$ 1,330,940,523	$ (12,884,095)
ALT4	7,371,142	2,214,751	288,507,720	$ 1,455,238	1,114,713,606	59,997,332	1,054,716,275	$ (2,055,862)	$ 1,343,223,995	$ (600,624)
ALT5	9,475,501	2,097,394	282,646,916	$ (4,405,566)	1,114,713,606	55,188,475	1,059,525,131	$ 2,752,994	$ 1,342,172,047	$ (1,652,572)
ALT6	5,600,400	1,893,766	278,467,039	$ (8,585,443)	1,114,713,606	53,512,423	1,061,201,183	$ 4,429,046	$ 1,339,668,222	$ (4,156,397)

Table 8-28 (USACE Hydropower Metrics Evaluation)

AUGUSTA CANAL HYDROPOWER IMPACTS							
1/1/1999 - 12/26/2013							
	NAA	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6
Count							
FLow> 3365	1,910	2,057	1,844	2,250	1,953	2,296	3,122
3368>Flow>3110	146	132	135	109	135	317	268
3110>Flow>2872	460	322	370	345	308	660	549
2872>Flow>2625.5	488	231	330	259	234	399	334
2625.5>Flow	2,194	2,616	2,503	2,355	2,698	1,607	1,044
Estimated Impaact (Dollars)							
FLow> 3365	$0	$0	$0	$0	$0	$0	$0
3368>Flow>3110	$0	$0	$0	$0	$0	$0	$0
3110>Flow>2872	$450,340	$315,238	$362,230	$337,755	$301,532	$646,140	$537,471
2872>Flow>2625.5	$908,656	$430,122	$614,460	$482,258	$435,708	$742,938	$621,908
2625.5>Flow	$6,507,404	$7,759,056	$7,423,898	$6,984,930	$8,002,268	$4,766,362	$3,096,504
Total Impacts	$7,866,400	$8,504,416	$8,400,588	$7,804,943	$8,739,508	$6,155,440	$ 4,255,883
Total Impacts/Year	$104,928	$113,438	$112,053	$104,108	$116,574	$82,106	$56,768
Delta NAA	$0	$8,510	$7,125	($820)	$11,646	($22,822)	($48,160)

Table 8-29 (Augusta Canal Hydropower Metrics Evaluation)

SEPA Capacity Pricing $ 4.81 per KW-MONTH

	Marketed Installed Capacity (MW)	Installed Capacity (KW)	Monthly Capacity Value	Annual Capacity Value
Hartwell	396 MW	396000 KW	$ 1,904,760	$ 22,857,120
Russell	605 MW	605000 KW	$ 2,910,050	$ 34,920,600
Thurmond	288 MW	288000 KW	$ 1,385,280	$ 16,623,360
			$ 6,200,090	$ 74,401,080

SEPA Energy Pricing

	SEPA ENERGY price to customer ($/MW-HR)	SEPA Off-Peak Energy Costs ($/MW-HR)	SEPA On-Peak Energy Costs ($/MW-HR)	Savannah System Weekly Minimum Energy (MW-HR)
Jan	$ 12.33	$ 38.39	$ 80.54	$ 27,233
Feb	$ 12.33	$ 39.72	$ 70.87	$ 26,714
Mar	$ 12.33	$ 32.85	$ 69.02	$ 20,669
Apr	$ 12.33	$ 35.44	$ 62.54	$ 18,504
May	$ 12.33	$ 24.87	$ 61.67	$ 21,948
Jun	$ 12.33	$ 30.85	$ 104.11	$ 25,935
Jul	$ 12.33	$ 33.13	$ 99.58	$ 31,195
Aug	$ 12.33	$ 36.98	$ 84.06	$ 32,035
Sep	$ 12.33	$ 29.92	$ 64.34	$ 30,685
Oct	$ 12.33	$ 31.86	$ 56.46	$ 27,304
Nov	$ 12.33	$ 34.61	$ 68.78	$ 26,284
Dec	$ 12.33	$ 36.23	$ 73.58	$ 27,104

Table 8-30 (SEPA Capacity and Energy Pricing)

9 Savannah River Basin Comprehensive Study II: 2009 – 2013 Unimpaired Flow Data Extension

(Draft Report)

March 2015

Georgia Environmental Protection Division

Introduction

The unimpaired flow (UIF) data time series in Savannah River basin were initially developed for the period from 1939 through 2007 during the first round of Georgia State Water Plan (Georgia DNR, 2010), and subsequently extended through 2008 with additional two new nodes at Jocassee and Keowee. As a big portion of Georgia's contribution to the Savannah River Basin Comprehensive Study Phase II, Georgia Environmental Protection Division (GADNR-EPD) is responsible for extending the Savannah River Basin UIF through 2013. Duke Energy has made an effort of extending UIF through 2011 but it is not officially available to GADNR-EPD. GADNR-EPD's effort of extending UIF in the Savannah River Basin is for the period of 2009-2013.

This report briefly describes data, methods, and procedures applied to the UIF extension to the period of 2009-2013 in the Savannah River basin. The UIF extension is essentially based on the methods, assumptions, and procedures used in the development of 1939-2008 UIF data in the Savannah River basin (GADNR, 2010). Due to the availability and quality of new data and tools, some adjustments however have been made during the UIF extension.

The UIFs have been extended for the period of 2009-2013 at following nodes: Jocassee (combining Bad Creek), Keowee, Hartwell, Russell, Thurmond (including Bell flow), Augusta, Burtons Ferry, Millhaven, Clyo, and Savannah.

Data, Methods, and Procedures

UIF data were developed from stream flow data, reservoir physical, operational, meteorological data, and water use data. Stream flow data were downloaded from U.S. Geological Survey (USGS) website. Federal reservoir physical data (e.g. stage-storage-area curves) and operational data (including pool elevation, release, and pumping data) were downloaded from US Army Corps of Engineers (Corps) website. Private reservoir physical data (e.g. stage-storage-area curves) and operational data (including pool elevation, release, and pumping data) were obtained from Duke Energy and Georgia Power in electronic format. Reservoir meteorological data (including precipitation and evaporation data) were developed by GADNR-EPD. Water use data were obtained from both Georgia and South Carolina (in electronic format).

The general processes of 2009-2013 UIF extension are listed as follows:

1. Compile all necessary input data, such as stream flow data, net consumptive water use data, reservoir holdout data and net reservoir/evaporation effect data.

2. Calculate the impaired local incremental flow (LIF) by subtracting (routed) upstream observed flow from downstream observed flow.

3. Compute the local unimpaired flow (UIF) by adding back net consumptive water use and net reservoir/evaporation effect to LIF.

The details of above processes can be found in 1939-2007 UIF report (GADNR, 2010).

Approach Adjustments

While the 2009-2013 UIF extension follows the major approaches and procedures used in the development of the 1939-2008 UIF data, several approach adjustments have been made during the UIF extension due to the availability and quality of new data and tools. The adjustments include: 1. Reservoir precipitation data development. 2. Flow routing between cascading reservoirs. 3. Reservoir inflow and local incremental flow computation. 4. Negative local UIF adjustment. The following paragraphs describe the details of these adjustments.

1. Reservoir precipitation data development

Reservoir precipitation data are used to compute the net evaporation effect for a reservoir along with the evaporation data. In the development of 1939-2008 UIF, reservoir precipitation data were developed from Mean Area Precipitation (MAP) time series that were developed from National Climatic Data Center's (NCDC's) precipitation data and a long-term average ratio between MAP and PRISM (Georgia DNR, 2010).

Due to the lack of tools of generating MAP time series, such as MAP Generator, GADNR-EPD used a different approach, Inverse Distance Weighting method, to develop the reservoir precipitation data for the 2009-2013 UIF extension. Inverse Distance Weighting is a type of deterministic method for multivariate interpolation with a known scattered set of points. The assigned values to unknown points are calculated with a distance weighted average of the values available at the known points.

Using Inverse Distance Weighting approach, precipitation data at a reservoir centroid was set as the representative value and it was calculated as the weighted average of surrounding weather station precipitation data based on the distance from each surrounding weather station to the reservoir centroid. This Inversion Distance Weighting method is applied to Jocassee, Keowee, Hartwell, Russell, and Thurmond, and four, five, six, four, and four surrounding weather stations were used for each reservoir, respectively.

2. Flow routing between cascading reservoirs

In Savannah River basin, the studied major reservoirs are in a cascading order as shown in Fig. 1. In the development of UIF for 1939-2008, the release from an upstream reservoir was routed down to calculate the local incremental flow at the downstream reservoir node. While stream flow routing is necessary for the pre-reservoir period, there is no such a need for the post-reservoir period since the UIF time series were developed on the daily basis and the flow travel time from an upstream reservoir to the downstream reservoir is less than a day. Therefore, for the 2009-2013 UIF extension, flow routing was not required for reservoir nodes and the release from an upstream reservoir was directly used to calculate the local incremental flow at the downstream reservoir node. This adjustment was applied at Keowee, Hartwell, Russell, and Thurmond nodes. At all other unregulated nodes, stream flow routing was required and original routing parameters and coefficients were preserved.

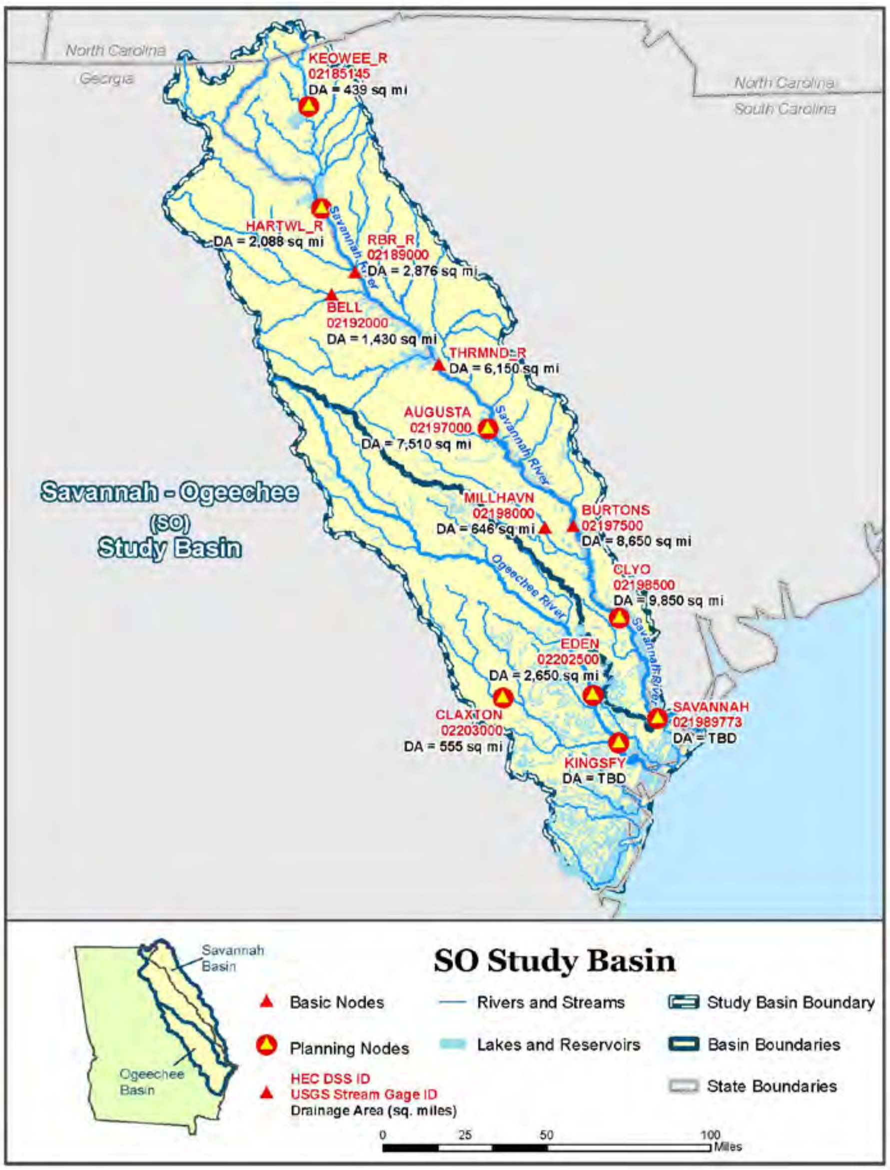


Figure 1. (Node schematic in Savannah and Ogeechee River basin (GADNR, 2010)).

<u>3. Reservoir inflow and local incremental flow computation</u>

Reservoir inflow is a key component of UIF data. In the development of UIF for 1939-2008, two different approaches were used to compute reservoir inflows. For Jocassee and Keowee, the reservoir inflows were computed from storage change between two adjacent days and releases. For Hartwell, Russell and Thurmond, the better quality controlled USACE net inflows data were used. This USACE inflow was then adjusted to remove accumulated bias from the time series by comparing the annual accumulated change in storage computed using the USACE inflow and outflow with the observed change in storage over a year (Georgia DNR, 2010).

During the 2009-2013 UIF extension, the reservoir inflows were computed straightforwardly from storage change and release for all five major reservoirs in the basin given continuous quality-controlled reservoir operational data time series for 2009-2013. After reservoir inflows were computed, the local incremental flow at a downstream node was obtained by subtracting the upstream flow/release from the downstream reservoir inflow.

One special character in Savannah River basin is that Bad Creek-Jocassee-Keowee and Russell-Thurmond are two pump-back systems. During the reservoir local incremental flow (LIF) computation, it was found that reservoir pumping data may introduce much uncertainty and may yield a large numbers of negatives LIFs and consequent negative UIFs. In order to reduce the effect of pumping data, the monthly cumulative LIF was computed first, then was redistributed into daily values according to the flow pattern of a nearby reference gage for each individual reservoir. If a monthly cumulative LIF was negative, then it was evenly redistributed into daily instead of using the flow pattern of the reference gage. This approach was applied to Jocassee, Keowee, Russ, and Thurmond. The comparison in negative UIFs at pump-back system reservoir nodes shows that the redistribution approach reduced negative UIFs in both frequency and degree (Table 1.).

Table 1. Comparison of raw negative UIFs for 2009-2013 period.

	Count of negative UIFs		**Average negative UIFs (cfs)**		**Extreme negative UIF (cfs)**	
Reservoir / Node	**Observed daily data**	**Redistributed daily data**	**Observed daily data**	**Redistributed daily data**	**Observed daily data**	**Redistributed daily data**
Jocassee	526	299	-311	-146	-1747	-558
Keowee	302	153	-1054	-487	-10748	-2113
Russell	891	861	-459	-289	-4789	-1966
Thurmond	184	51	-1050	-681	-24515	-3042

<u>4. Negative local UIF adjustment</u>

Several factors, such as under-estimate of reservoir net evaporation loss, imperfect stream flow routing process, possible pump-back data effect, and possible natural flow loss (e.g. downstream observed flow without significant water use is less than upstream observed flow), may result in some negative local UIFs. The treatment of negative local

UIFs were different between 2009-2013 UIF extension and the original 1939-2008 UIF development.

In 1939-2008 UIF, all negative local UIFs were removed by different adjustments, including local adjustment, annual adjustment, and period of record adjustment. Details of these adjustment approaches can be found in 1939-2007 UIF report (GADNR, 2010). The adjustment of negative UIFs is essentially a temporal redistribution of the UIF while keeping the mass balance.

In 2009-2013 UIF, negative local UIFs were carefully reviewed and adjusted or not adjusted at all depending on the possible major causes of negatives. Several types of treatments are list as follows:

1. At Hartwell node, the very few negative local UIFs that occurred in dry seasons are very likely due to an under-estimate of net evaporation loss. Those negatives were removed by local adjustment approach.

2. At Jocassee, Keowee, Russell and Thurmond nodes, the negative local UIFs are very likely due to a combination of an under-estimate of net evaporation loss and the imperfect pump-back data. Some of the pump-back data could not be reconciled with project elevation (and thus storage) data. For example, on March 2, 2012, Thurmond has a release of 3896 cfs, a pump-back of 5247 cfs, receives a release of 7522 cfs from Russell, and a change of storage of -30600 acre-feet. Simple mathematic calculation indicates that the reservoir received –13810 cfs during the day with a precipitation event. EPD staff speculated that the pump-back flow values were calculated from recorded energy consumption, instead of physically measured. The imperfect relationship between energy consumption and flow may have led to overestimate of pumped flow, which in turn leads to negative inflow to the reservoirs. Those negatives were not adjusted.

3. At unregulated nodes, some negative UIFs were caused by imperfect numerical stream flow routing and others appeared to be natural flow loss, which is indicated by observed data, such as that the downstream observed flow is less than upstream observed flow without significant water use at downstream node. For the negatives due to imperfect stream flow routing, local adjustment approach was applied to remove the negatives. For the negatives appeared to be natural flow loss, negative UIFs were not adjusted. The time series of natural flow loss at associated nodes are included in UIF dss files.

   Natural flow loss can be categorized into three cases. The first case is the flow loss due to gage data. For example, the observed data show the persistent differences between Thurmond release and observed Augusta flow, with latter one being lower for several months in 2012 (Fig 2). This type of flow loss may not be real since there is no evidence showing natural flow loss occurred between Thurmond and Augusta. The reason of such flow difference is not clear and further investigation of observed data is needed. The second case is the real natural flow loss during high flow period. For example, the observed data show Burtons Ferry gage flow has been lower than the upstream Augusta gage flow in several months of high flow period (Fig 3). EPD staff believed it was due to flood plain connection and water lost during the overbank flow period has not come back to the main channel. The third case is the real natural flow loss during low flow period. For example, the observed data show Clyo gage flow has been persistently lower than flow observed at upstream Burton Ferry gage in several months in low flow period (Fig 4). The hydrographs clearly show that flow peaks and valleys at Clyo were delayed compared to that at Burtons Ferry while the flow magnitudes at Clyo were persistently lower than that at Burtons Ferry. Such flow loss could be due to stream flow recharging to a local surficial aquifer.

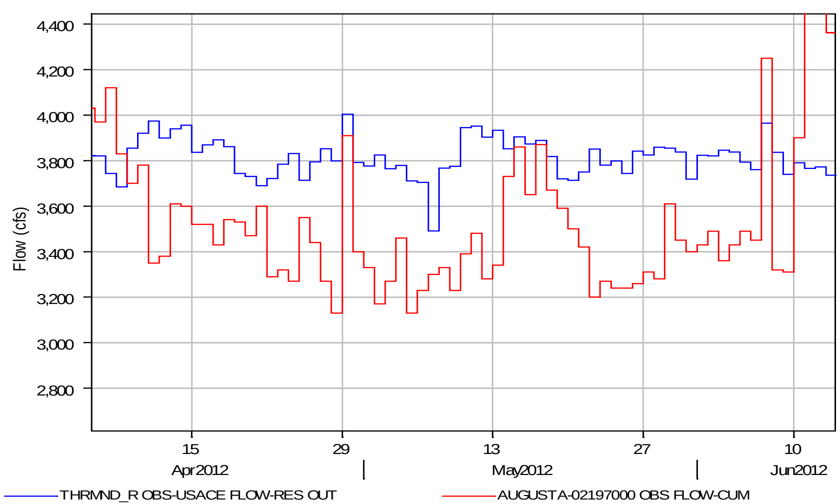


Figure 1. (Flow loss at Augusta node.)

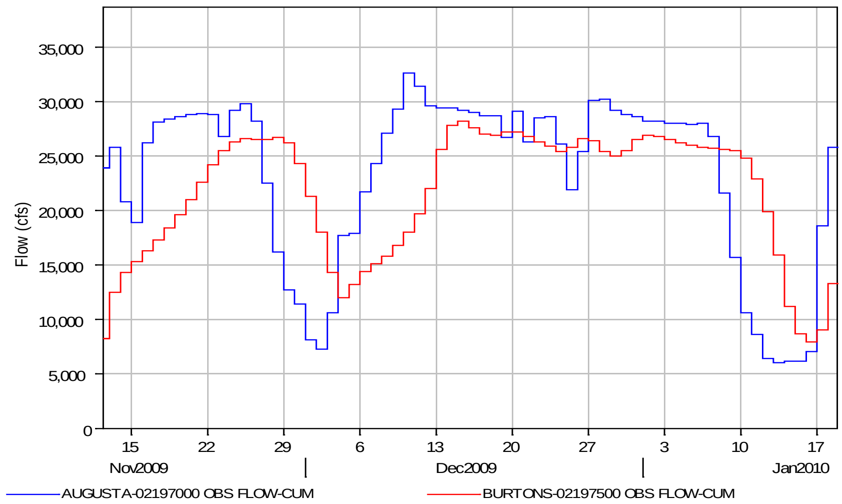


Figure 2. (Natural flow loss at Burtons Ferry node.)

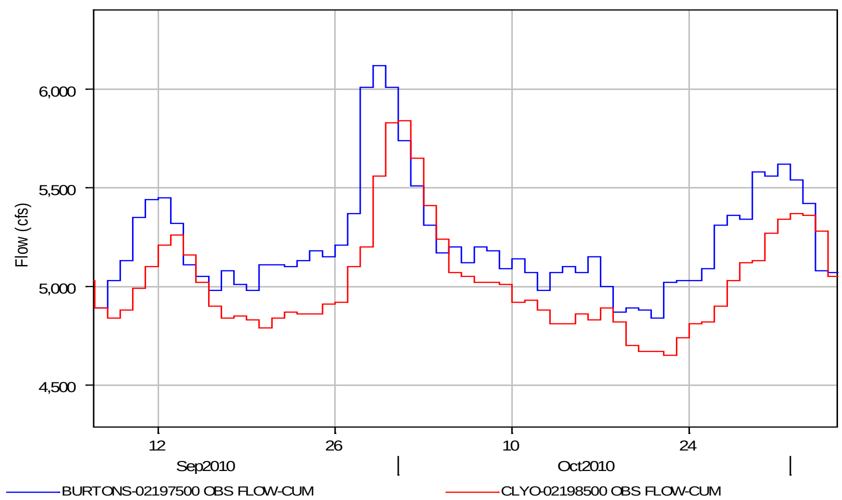


Figure 3. (Natural flow loss at Cylo node.)

Preliminary Product

The preliminary product of 2009-2013 UIF extension includes the time series of local unimpaired flow (UIF) for each node in Savannah River basin (see SO-UIFX4.dss). The 2009-2013 UIF time series were also appended to the original 1939-2008 UIF time series (see SO-UIFX4-Merged.dss). Tables 2 and 3 show the time series of the local UIF for each node. Table 4 shows the descriptions of all the time series in SO-UIFX4.dss and SO-UIFX4-Merged.dss.

There are some differences in node configurations between Georgia EPD and Corps HEC-ResSim model. As shown in Table 5, ResSim configuration include Bad Creek node while Georgia EPD's configuration does not. Georgia EPD's configuration includes Bell node on Broad River and Millhaven node on Brier Creek while ResSim configuration does not. Due to the difference in node configuration and for ResSim modeling purpose, Jocassee and Bad Creek combined UIF is split into Bad Creek UIF and Jocassee UIF by 1% and 99% respectively. The Bell-Thurmond sub-basin UIF and Millhaven (on Brier Creek)-Clyo sub-basin UIF are also developed for the same reason. The suggested local UIFs for the nodes in HEC-ResSim model are listed in Table 6.

During the review of the original 1939-2008 UIF data, EPD staff found that water use in Keowee node was credited back to Hartwell node, resulting in an over-estimate of Hartwell local UIF. This over-estimate of Hartwell local UIF has been corrected for the 1939-2008 period (see SO-UIFX4-Merged.dss).

Table 2. Savannah River basin 2009-2013 UIF time series (see SO-UIFX4.dss).

Reservoir/Node	DSS Part: B	DSS Part: F
Jocassee and Bad Creek Combined	KEOWEE_R-JOCASS_R	UNIMP*
Keowee	KEOWEE_R	UNIMP*
Hartwell	HARTWL_R	UNIMP-0ADJ LOC*
Russell	RBR_R	UNIMP*
Thurmond[1]	THRMND_R	UNIMP*
Augusta	AUGUSTA	UNIMP-0ADJ LOC*
Burtons Ferry	BURTONS	UNIMP-0ADJ LOC*
Millhaven (Brier Crk)	MILLHAVN	UNIMP*
Clyo	CLYO	UNIMP-0ADJ LOC*
Savannah	SAVANNAH	UNIMP*

[1] Thurmond UIF includes Bell flow.

Table 3. Savannah River basin 1939-2013 UIF time series (see SO-UIFX4-Merged.dss).

Reservoir/Node	DSS Part: B	DSS Part: F	DSS Part: F	DSS Part: F
		1939-2008	2009-2013	1939-2013
Jocassee and Bad Creek Combined	KEOWEE_R-JOCASS_R	UNIMP-0ADJ ANNUAL*	UNIMP*	UNIMP-MERGED-EPD2014
Keowee	KEOWEE_R	UNIMP-0ADJ ANNUAL*	UNIMP*	UNIMP-MERGED-EPD2014
Hartwell	HARTWL_R	UNIMP-0ADJ LOC*	UNIMP-0ADJ LOC*	UNIMP-MERGED-EPD2014
Russell	RBR_R	RDIST UNIMP-0ADJ POR*	UNIMP*	UNIMP-MERGED-EPD2014
Thurmond[1]	THRMND_R	RDIST UNIMP-0ADJ ANNUAL*	UNIMP*	UNIMP-MERGED-EPD2014
Augusta	AUGUSTA	UNIMP-0ADJ ANNUAL*	UNIMP-0ADJ LOC*	UNIMP-MERGED-EPD2014
Burtons Ferry	BURTONS	UNIMP-0ADJ ANNUAL*	UNIMP-0ADJ LOC*	UNIMP-MERGED-EPD2014
Millhaven (Brier Crk)	MILLHAVN	UNIMP*	UNIMP*	UNIMP-MERGED-EPD2014
Clyo	CLYO	UNIMP-0ADJ POR*	UNIMP-0ADJ LOC*	UNIMP-MERGED-EPD2014
Savannah	SAVANNAH	UNIMP*	UNIMP*	UNIMP-MERGED-EPD2014

[1]Thurmond and Bell UIFs were separated for 1939-2008 and not separated for 2009-2013.

Table 4. Descriptions of time series (see SO-UIFX4.dss and SO-UIFX4-Merged.dss).

DSS Part: C	DSS Part: F	Description
FLOW-DIV NET	COMP-REACH TOTAL	Net consumptive water use
FLOW-LOC INC	COMP-MERGED-EPD2014	Impaired local incremental flow
FLOW-LOC INC	UNIMP-RAW-MERGED-EPD2014	Raw unimpaired local incremental flow
FLOW-LOC INC	UNIMP-MERGED-EPD2014	Adjusted unimpaired local incremental flow
FLOW-COMB-INC	UNIMP-MERGED-EPD2014	Sub-basin unimpaired local incremental flow
FLOW-LOC INC	NATURAL LOSS	Natural flow loss
EVAPNET-RATE	POST-PRE RES	Differential net reservoir evaporation rate
FLOW-EVAPNET	POST-PRE RES	Differential net reservoir evaporation effect
FLOW-NET RE	COMP 1DAY	Net reservoir effect
FLOW-HOLDOUT	COMP 1DAY	Reservoir storage change between two consecutive days
EVAPNET-RATE	POST RES	Net reservoir evaporation rate
FLOW-EVAPNET	POST RES	Net reservoir evaporation effect
FLOW-NET RE	COMP 1DAY	Net reservoir effect
FLOW-LOC INC	OBS, or FILLED, or COMP	Impaired LIF
FLOW-LOC INC	UNIMP	Raw Local UIF without any adjustment
FLOW-LOC INC	UNIMP-0ADJ LOC	Local UIF with the removal of negatives using local adjustment approach[1]
FLOW-LOC INC	UNIMP-0ADJ ANNUAL	Local UIF with the removal of negatives using annual adjustment approach[1]

FLOW-LOC INC	UNIMP-0ADJ POR	Local UIF with the removal of negatives using period of record adjustment approach[1]

[1] Details of adjustment approaches see 1939-2007 UIF report (GADNR, 2010).

Table 5. Node configurations of Gerogia EPD and Corps HEC-ResSim model.

DSS Part: B	Georgia EPD Node	HEC-ResSim Node
KEOWEE_R-JOCASS_R	Jocassee and Bad Creek Combined	Bad Creek
KEOWEE_R-JOCASS_R	Jocassee and Bad Creek Combined	Jocassee
KEOWEE_R	Keowee	Keowee
HARTWL_R	Hartwell	Hartwell
RBR_R	Russell	Russell
BELL	Bell	N/A
THRMND_R	Thurmond	Thurmond
AUGUSTA	Augusta	Augusta
BURTONS	Burtons Ferry	Millhaven on Savannah River
MILLHAVN	Millhaven on Brier Creek	N/A
CLYO	Clyo	Clyo

Table 6. Suggested local UIF time series for HEC-ResSim model (see SO-UIFX4-Merged.dss).

HEC-ResSim Node	DSS Part: B	DSS Part: C	DSS Part: F
Bad Creek[1]	BADCREEK	FLOW-LOC INC	UNIMP-MERGED-EPD2014
Jocassee[2]	JOCASSEE	FLOW-LOC INC	UNIMP-MERGED-EPD2014
Keowee	KEOWEE_R	FLOW-LOC INC	UNIMP-MERGED-EPD2014

Hartwell	HARTWL_R	FLOW-LOC INC	UNIMP-MERGED-EPD2014
Russell	RBR_R	FLOW-LOC INC	UNIMP-MERGED-EPD2014
Thurmond[3]	THRMND_R	FLOW-COMB INC	UNIMP-MERGED-EPD2014
Augusta	AUGUSTA	FLOW-LOC INC	UNIMP-MERGED-EPD2014
Millhaven	BURTONS	FLOW-LOC INC	UNIMP-MERGED-EPD2014
Clyo[4]	CLYO	FLOW-COMB INC	UNIMP-MERGED-EPD2014

[12]Bad Creek and Jocassee local UIF in ResSim model are 1% and 99% of Jocassee and Bad Creek combined UIF respectively.
[3]Thurmond local UIF in ResSim model is Bell-Thurmond sub-basin combined UIF.
[4]Clyo local UIF in ResSim model is Millhaven-Clyo sub-basin combined UIF.

Verification

After the preliminary 2009-2013 UIFs were developed, both Savannah HEC-ResSim model and Excel Spreadsheet model were used to verify the preliminary UIF data at the reservoir nodes. The verification is essentially the mass balance check, using developed UIFs and observed data to back-calculate the reservoir elevation. The verifications using the both models show similar results.

In HEC-ResSim model, release overrides (forced release) option was used and simulated reservoir elevations were compared with observed ones. Verification for 2009-2013 period was divided into two periods, 2009-2012 and 2012-2013, since the current Savannah ResSim version (Version 3.2.1.76 Build 3.2.1.76R, 64-bits) cannot handle the release overrides for more than four years. The comparisons of reservoir elevations between ResSim simulated and observed show very close match of the two (Figs 5-9).

Limitations

Several factors, such as under-estimate of reservoir net evaporation loss, imperfect stream flow routing process, possible pump-back data effect, and possible natural flow loss that of real or perceived loss of flow due to gage data (e.g. downstream observed flow without significant water use is less than upstream observed flow), may result in some negative local UIFs. There are several ways to further improve UIF development, including obtaining a better estimate of precipitation\evaporation data, better stream flow routing, and better quality-controlled observed data (e.g. pumping data). Field investigation will also be helpful to exclude or confirm the natural flow loss.

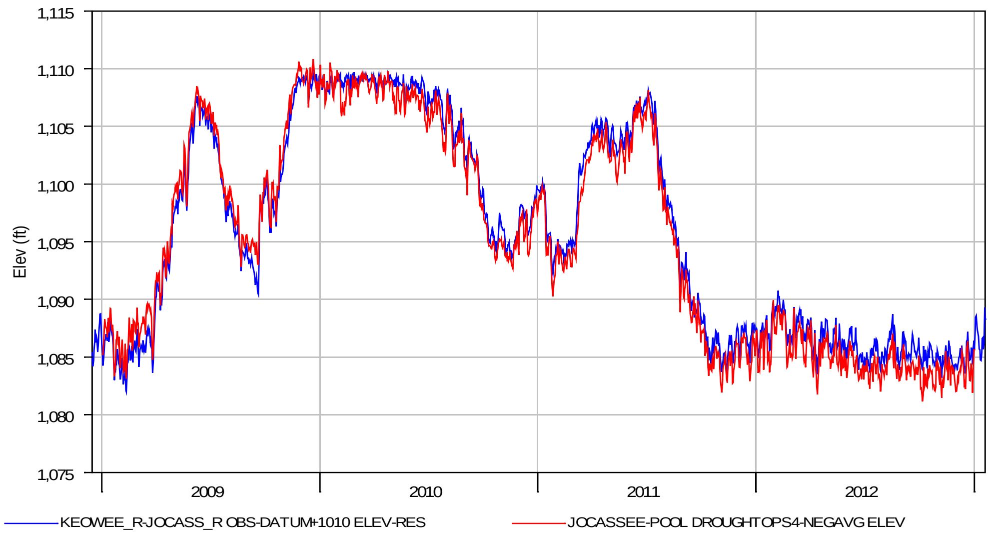


Figure 4a. (Comparison of Jocassee elevation (2009-2012): simulated (red) and observed (blue)).

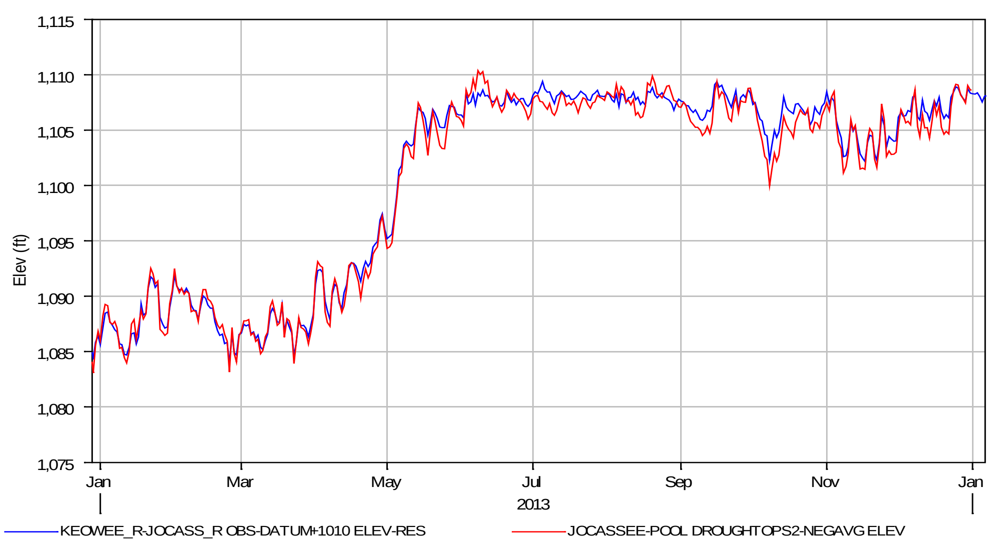


Figure 5b. (Comparison of Jocassee elevation (2013): simulated (red) and observed (blue)).

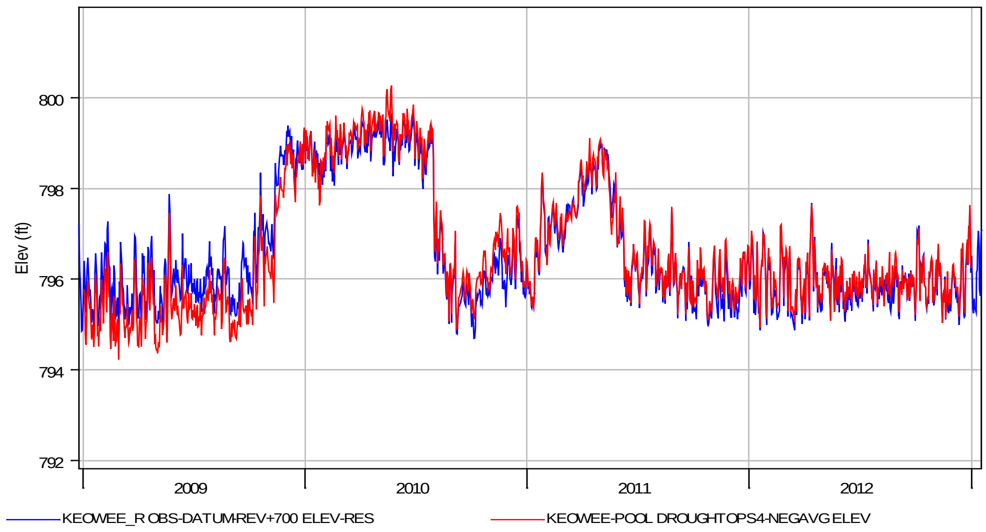


Figure 6a. (Comparison of Keowee elevation (2009-2012): simulated (red) and observed (blue).)

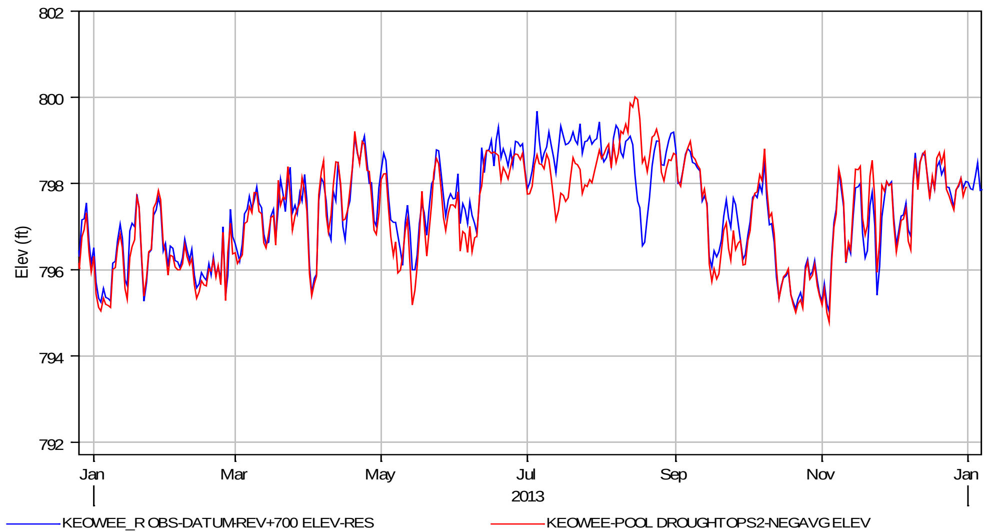


Figure 7b. (Comparison of Keowee elevation (2013): simulated (red) and observed (blue).)

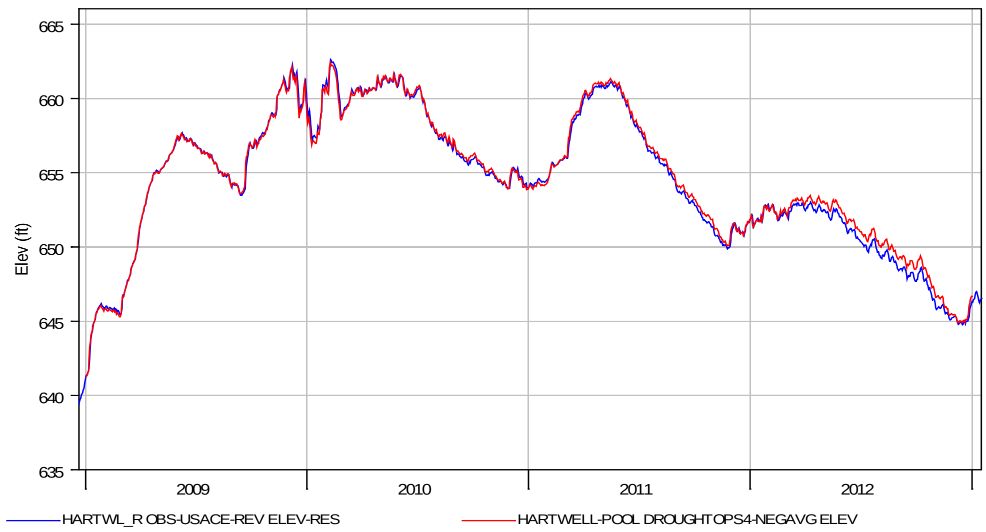


Figure 8a. (Comparison of Hartwell elevation (2009-2012): simulated (red) and observed (blue).)

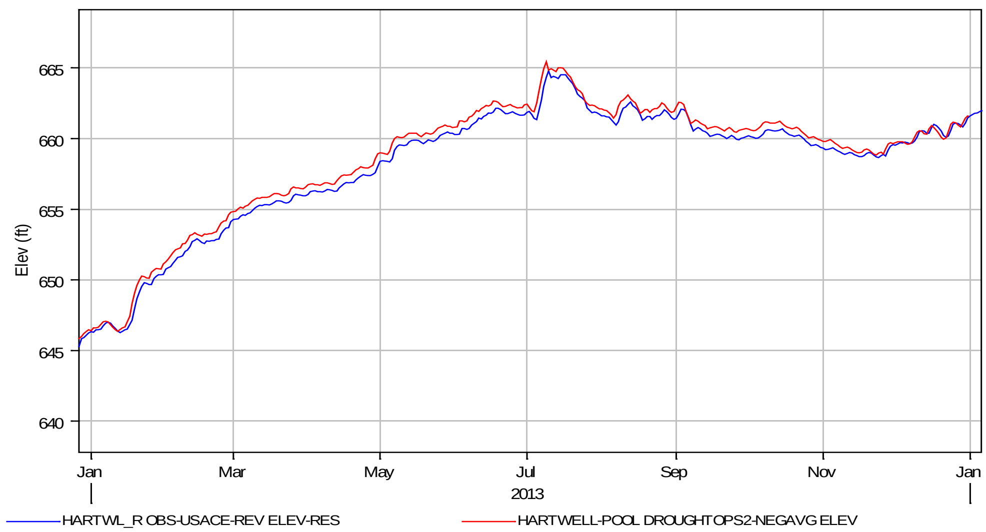


Figure 9b. (Comparison of Hartwell elevation (2013): simulated (red) and observed (blue).)

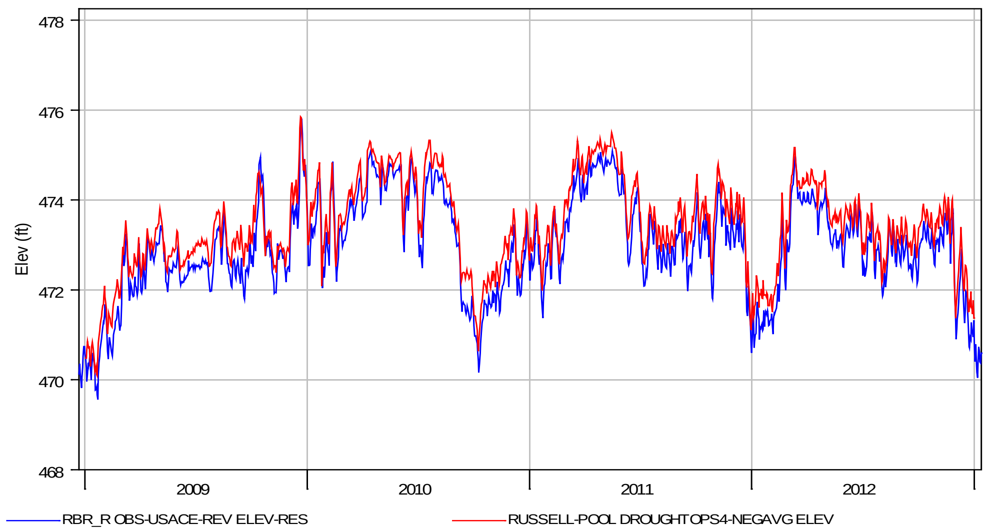


Figure 10a. (Comparison of Russell elevation (2009-2012): simulated (red) and observed (blue)).

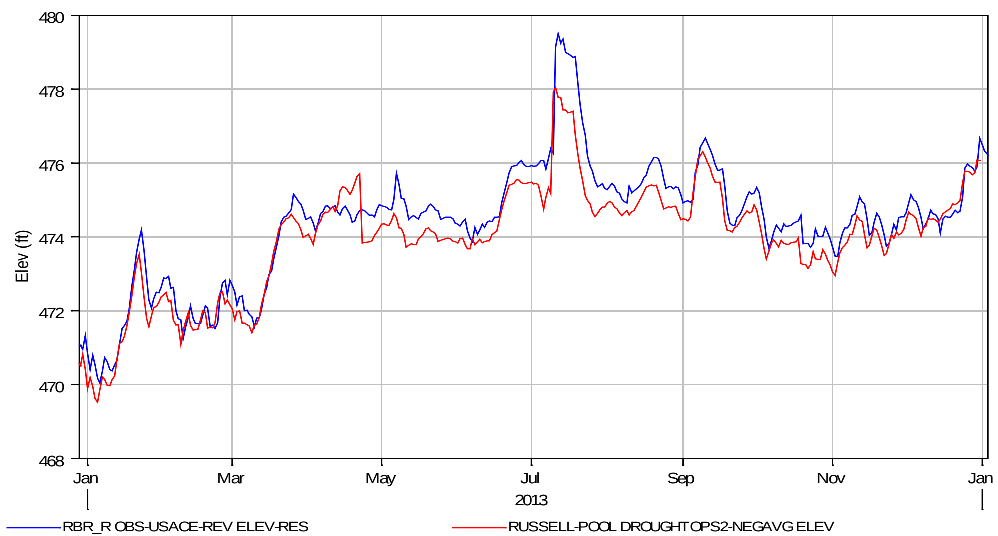


Figure 11b. (Comparison of Russell elevation (2013): simulated (red) and observed (blue)).

Figure 12a. (Comparison of Thurmond elevation (2009-2012): simulated (red) and observed (blue)).

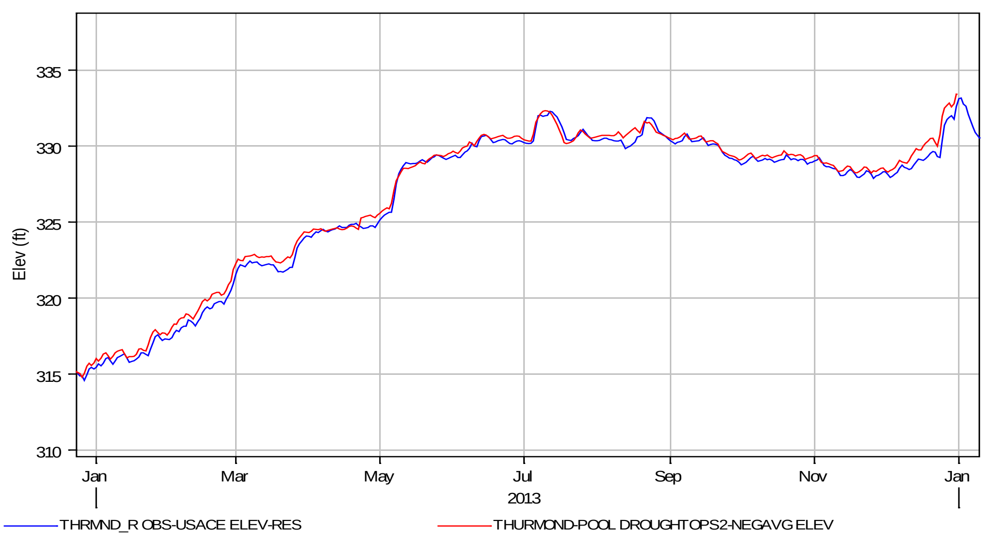


Figure 13b. (Comparison of Thurmond elevation (2013): simulated (red) and observed (blue)).

Reference

Georgia Department of Natural Resources (Georgia DNR) (2010). Unimpaired Flow Data
Report Surface Water - Availability Modeling and Technical Analysis for State-wide Water
Management Plan, Prepared by ARCADIS U.S. Inc., Atlanta, Georgia.

Deliverable

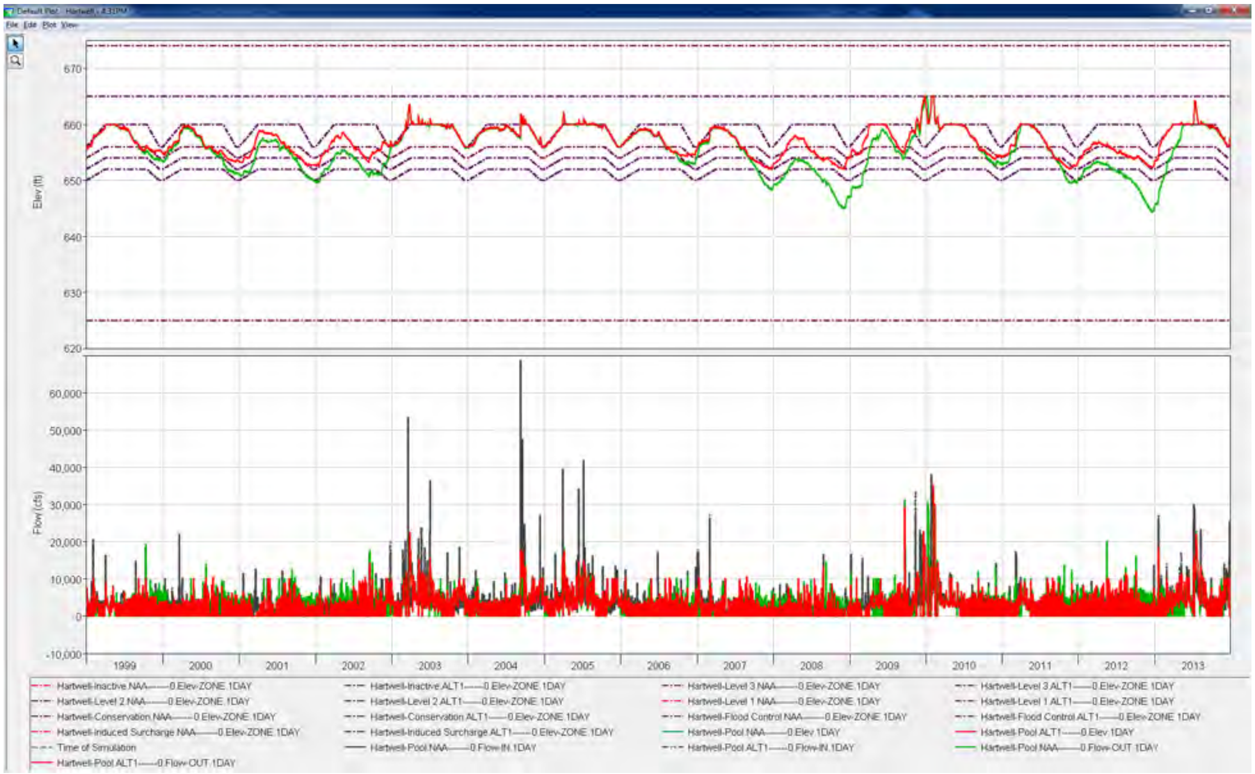
A data disk is delivered including following items:

1. A draft report named as SO-UIF-X4-Rpt-draft-20150325.doc
2. A DSS file contains 2009-2013 UIF data named as SO-UIFX4.dss.
3. A DSS file contains 1939-2013 UIF data named as SO-UIFX4-Merged.dss

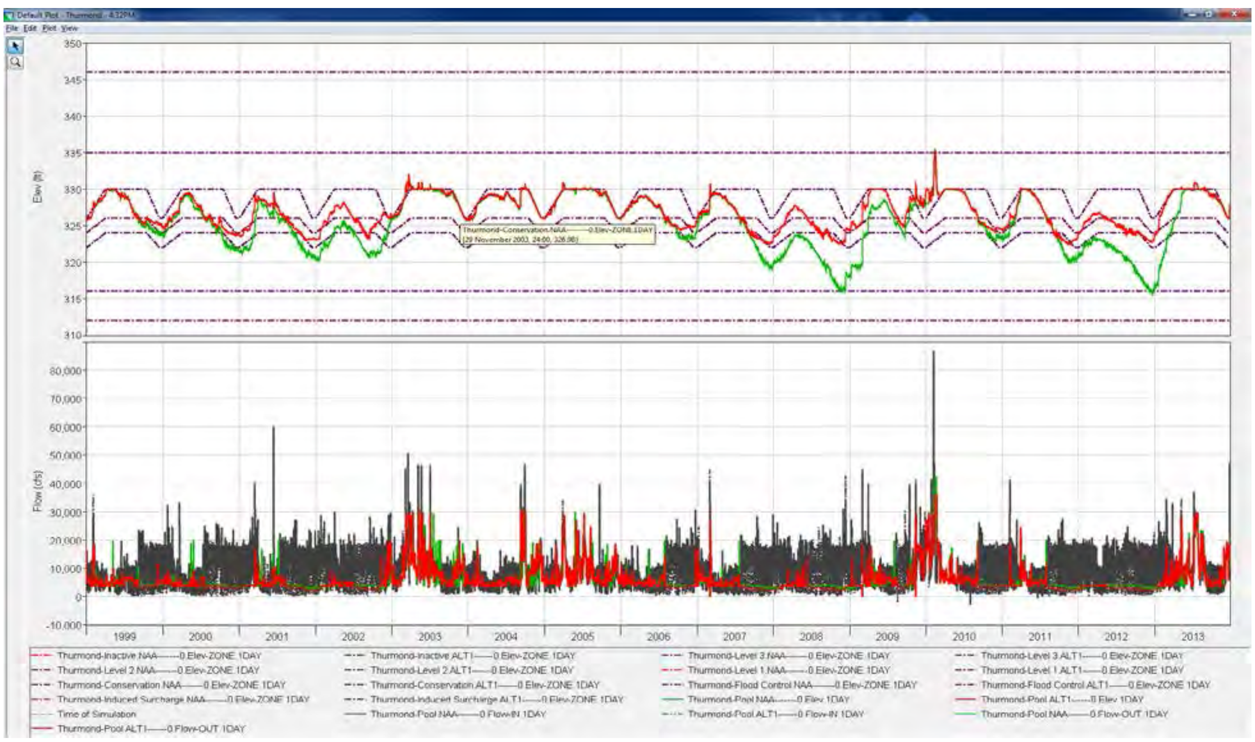
11 Annex C - Savannah River Basin Comprehensive Study II: HEC-ResSim Model Output

HEC-RESSIM GRAPHICAL OUTPUT

NAA vs ALT1

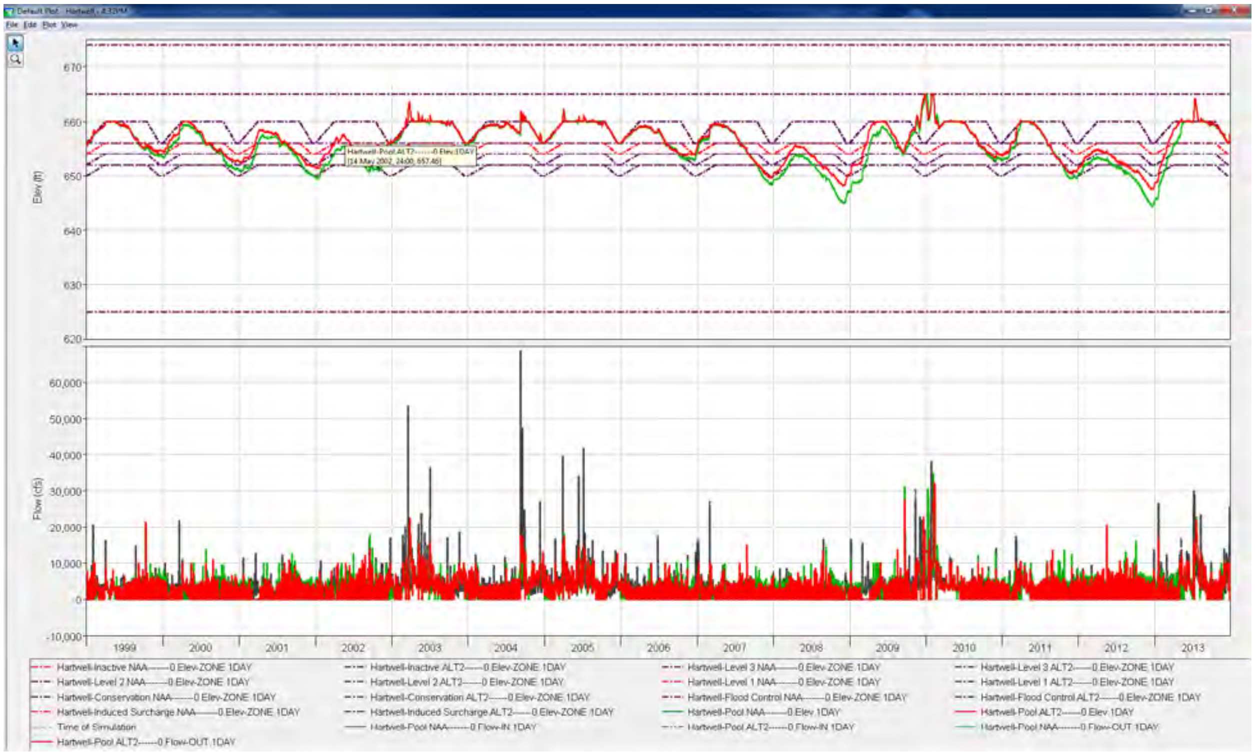


Annex C- Screen 1 (NAA vs ALT1, Hartwell)

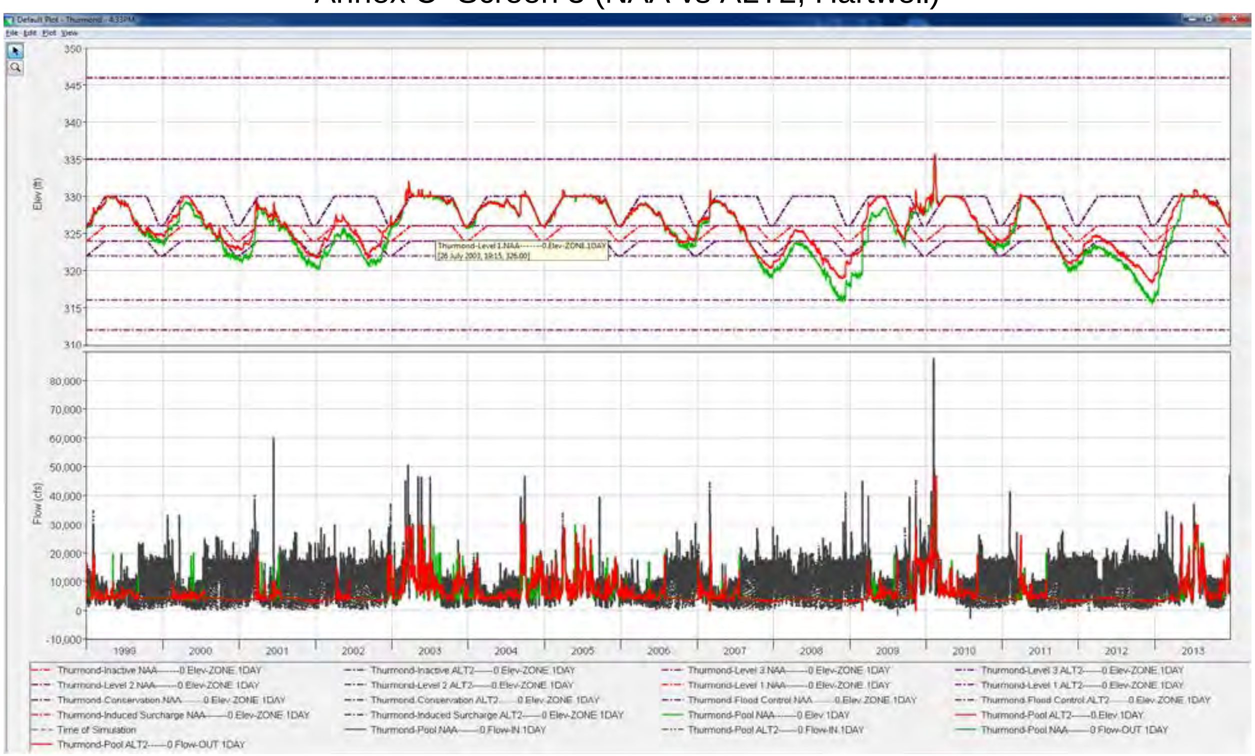


Annex C- Screen 2 (NAA vs ALT1, Thurmond)

NAA vs ALT2

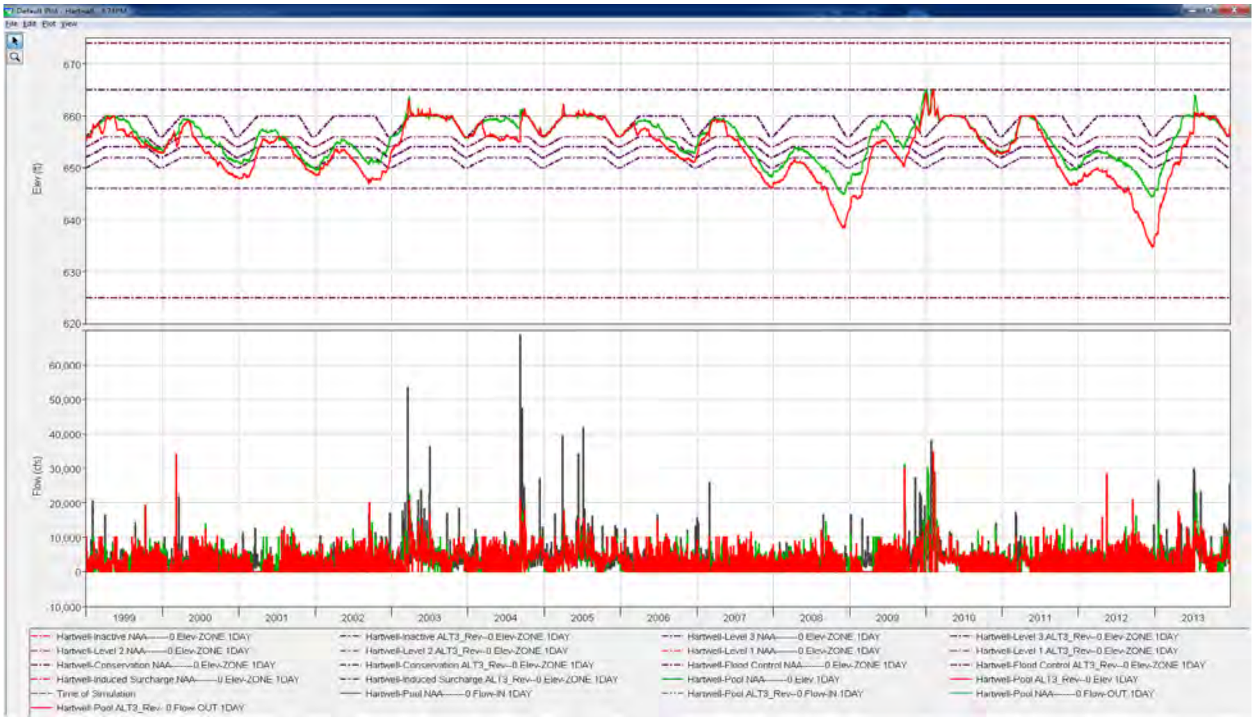


Annex C- Screen 3 (NAA vs ALT2, Hartwell)

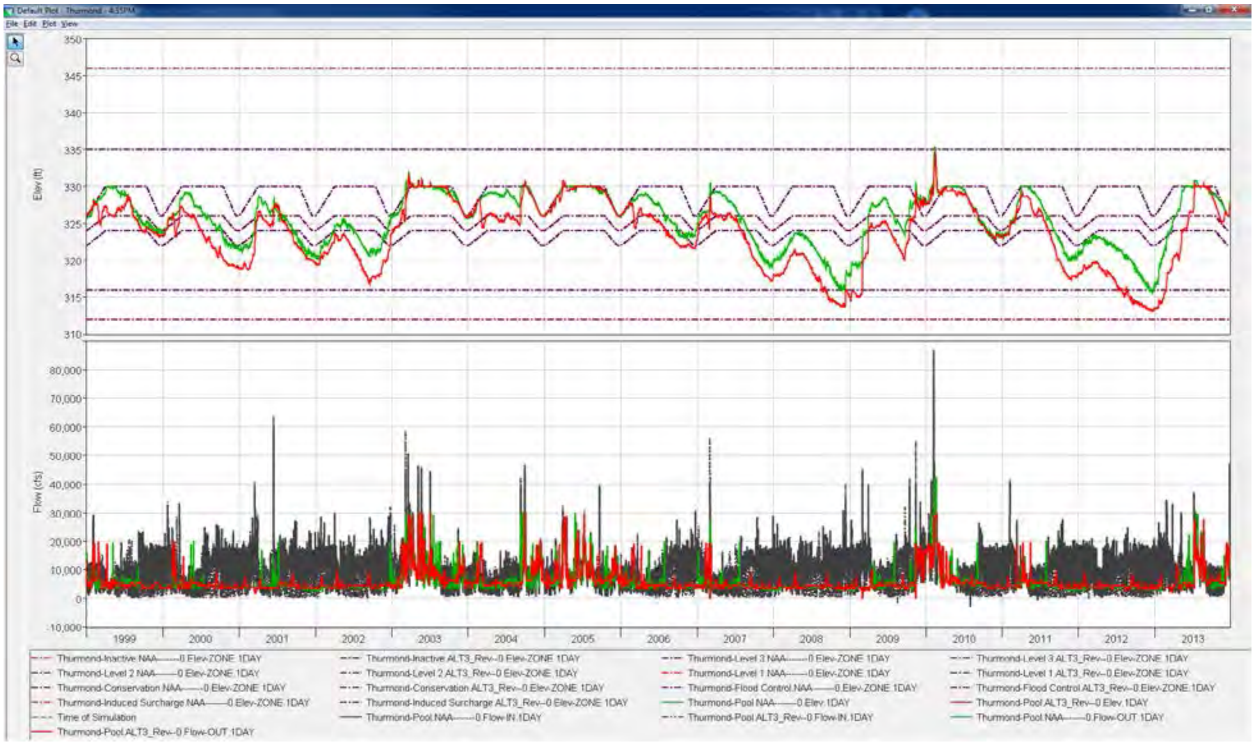


Annex C- Screen 4 (NAA vs ALT2, Thurmond)

NAA vs ALT3

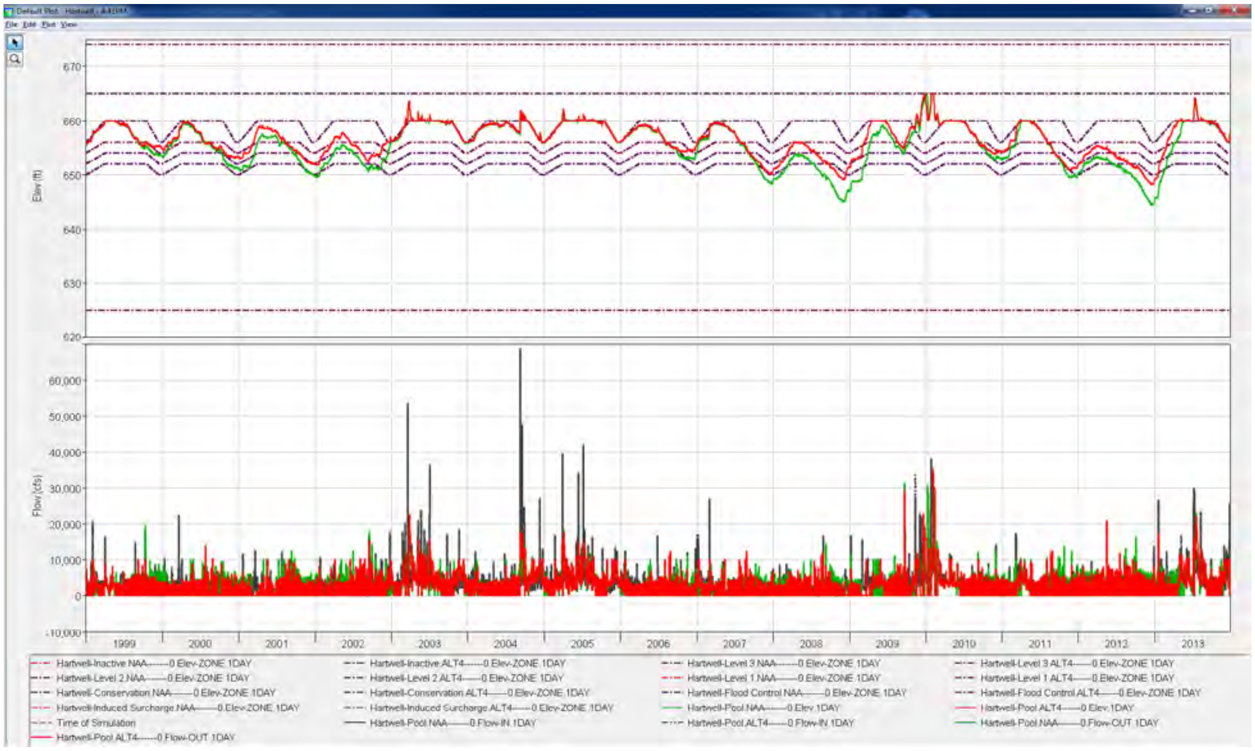


Annex C- Screen 5 (NAA vs ALT3, Hartwell)

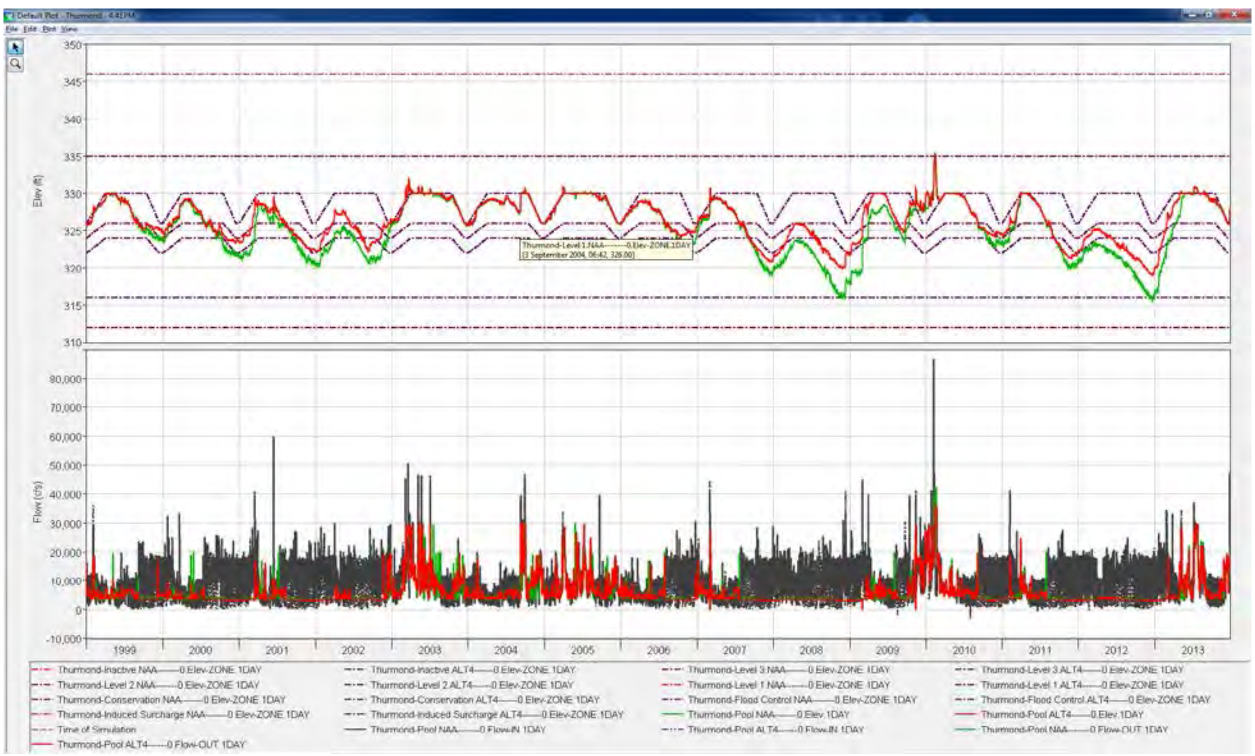


Annex C- Screen 6 (NAA vs ALT3, Thurmond)

NAA vs ALT4

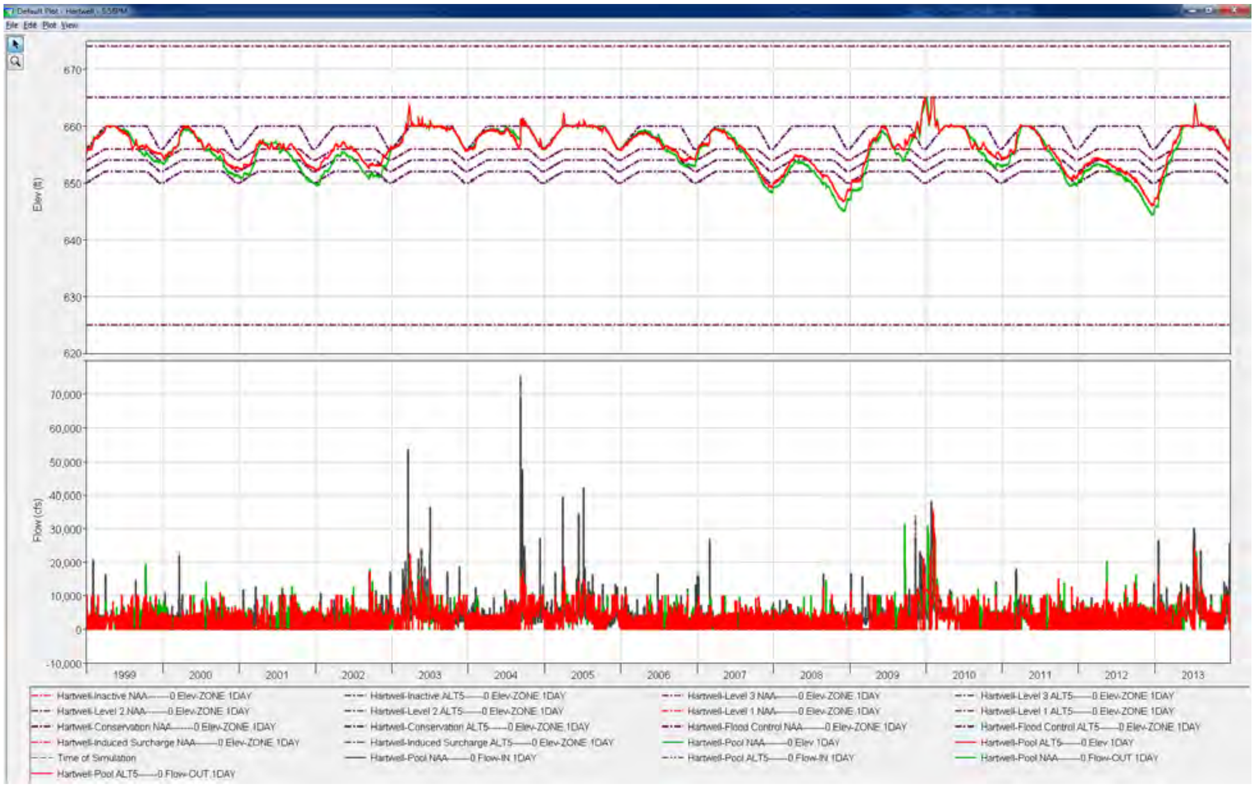


Annex C- Screen 7 (NAA vs ALT1, Hartwell)

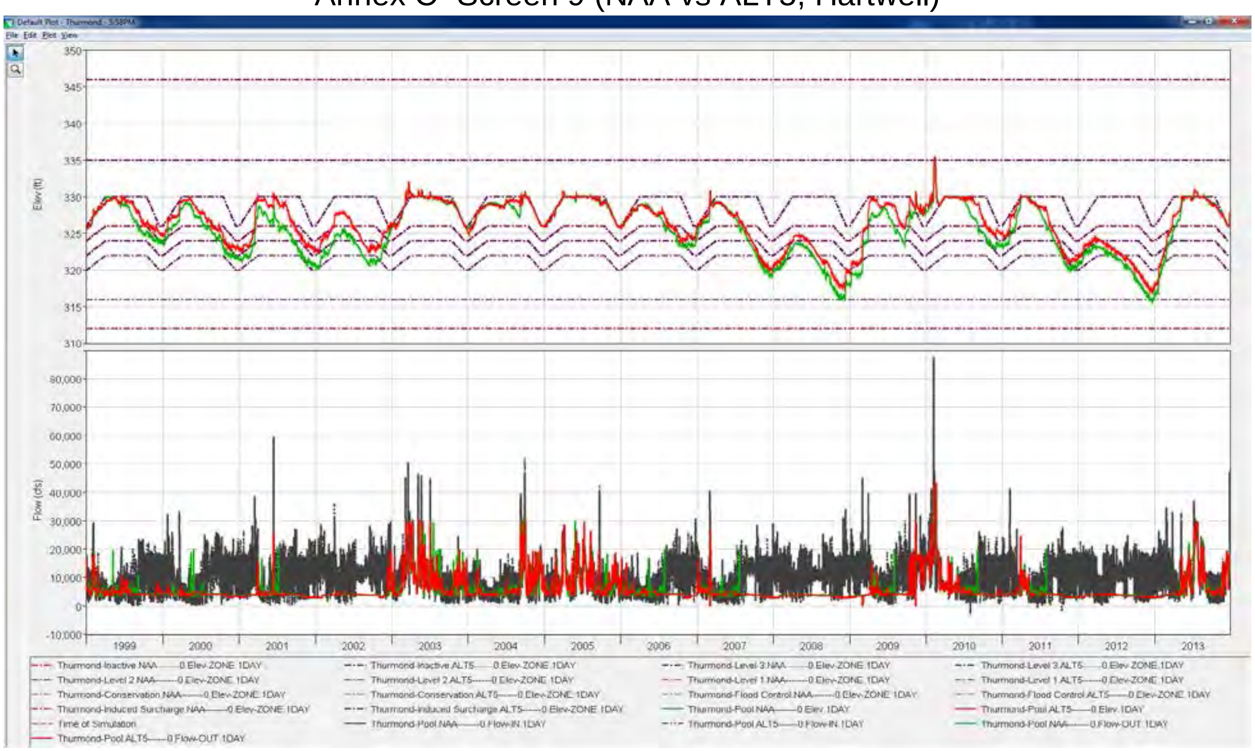


Annex C- Screen 8 (NAA vs ALT1, Thurmond)

NAA vs ALT5

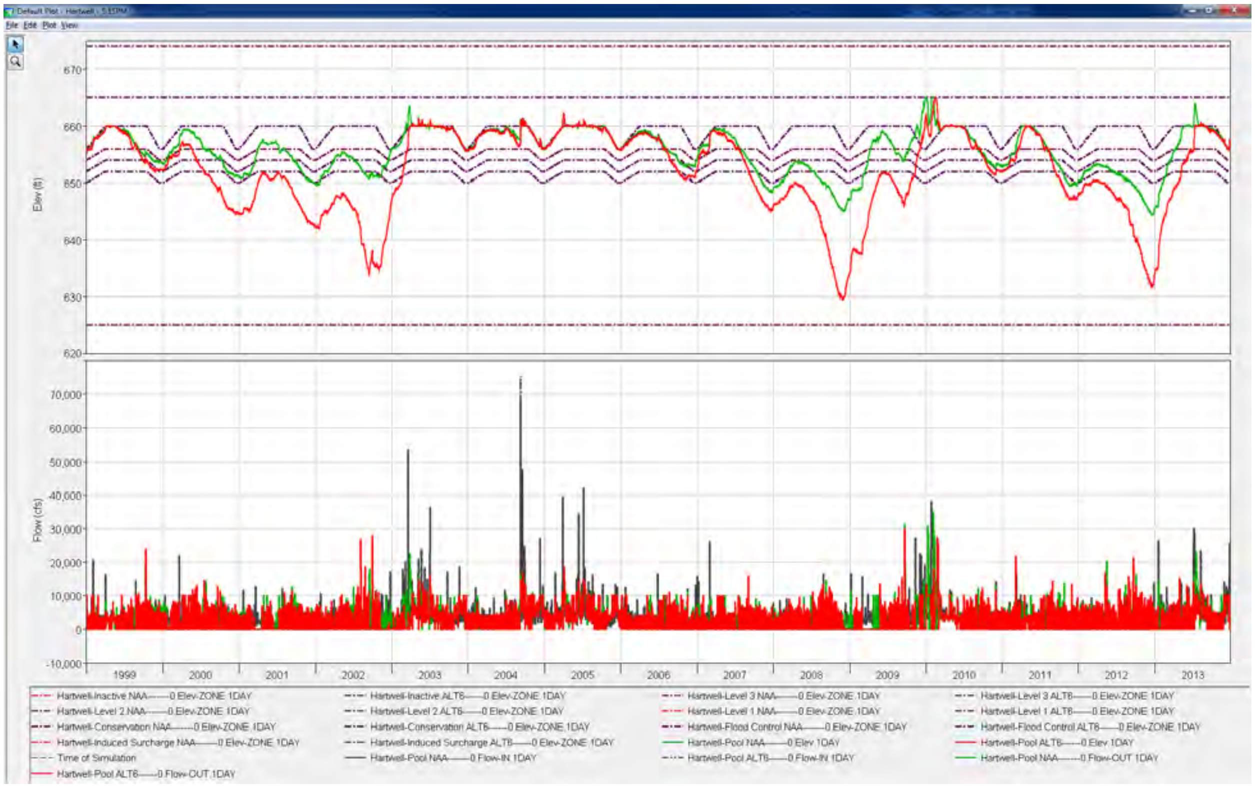


Annex C- Screen 9 (NAA vs ALT5, Hartwell)

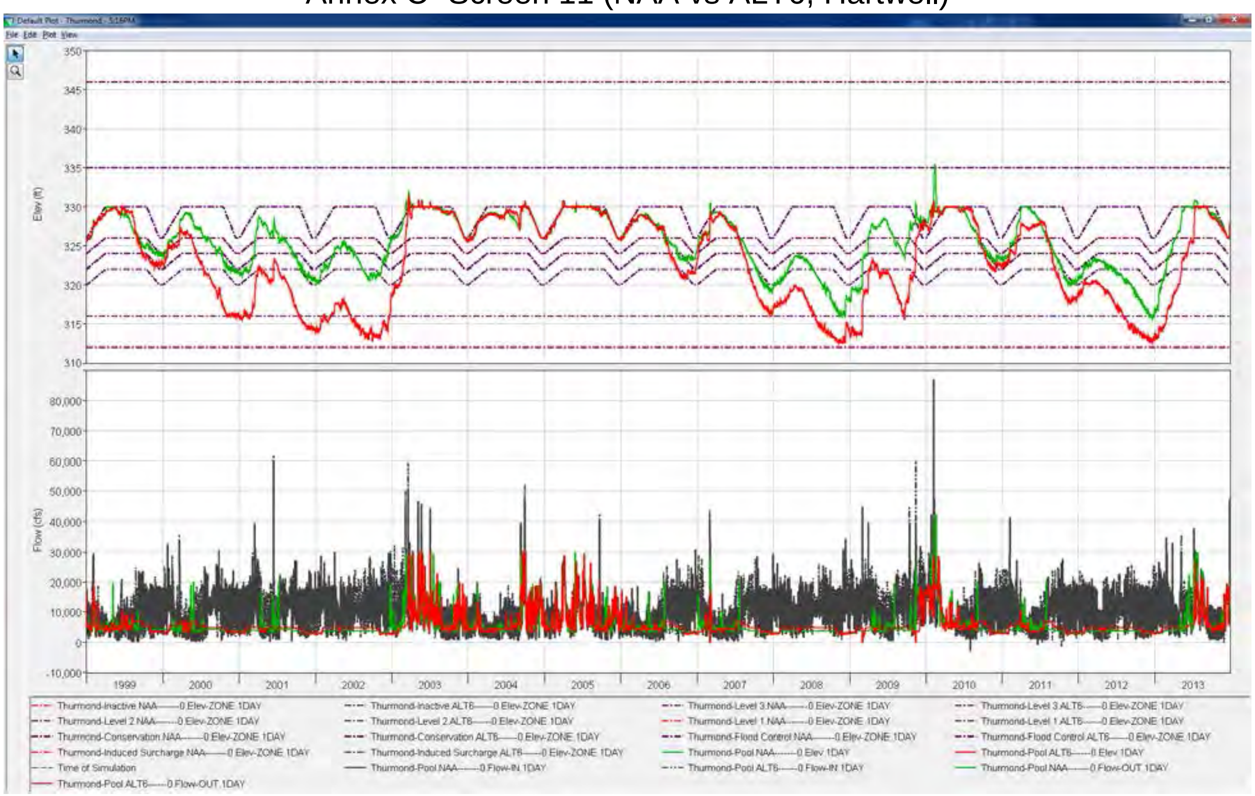


Annex C- Screen 10 (NAA vs ALT5, Thurmond)

NAA vs ALT6



Annex C- Screen 11 (NAA vs ALT6, Hartwell)



Annex C- Screen 12 (NAA vs ALT6, Thurmond)

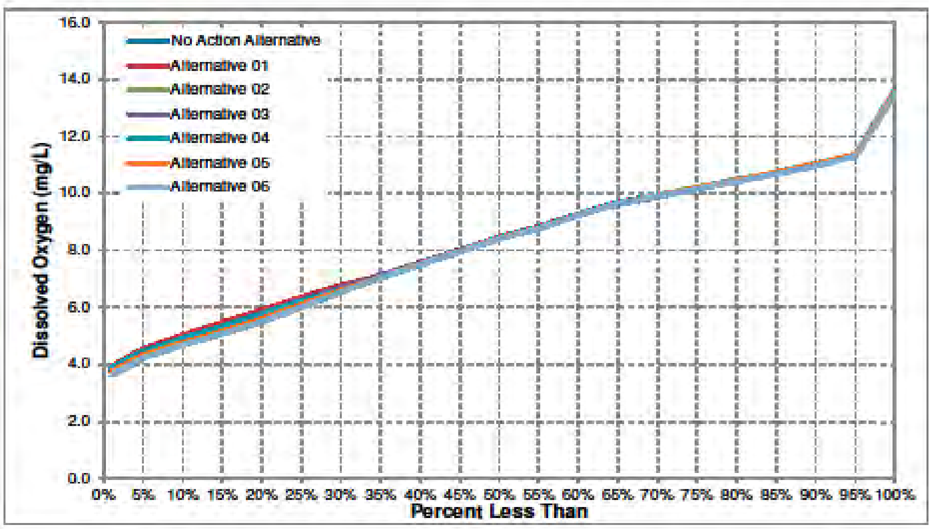
12 Annex D - Savannah River Basin Comprehensive Study II: Riv-1 Output

RIV-1 OUTPUT ANALYSIS

Riv-1 output data was analyzed looking at a time window of January 1999 thru December 2013. The modeling effort and analysis of output for RIV-1 was performed by Georgia DNR. The following are the output plot from the RIV-1 modeling effort.

Highway 28 Dissolved Oxygen Exceedance For Study Alternatives

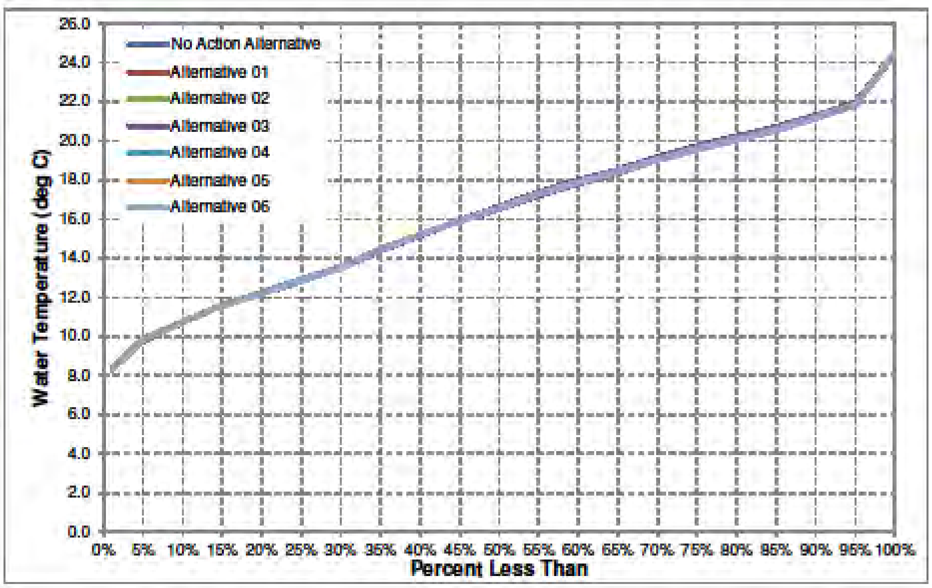
	Highway 28 Dissolved Oxygen (mg/L)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Minimum:	3.0	3.0	3.0	3.1	3.0	2.9	2.7
1%	3.8	3.9	3.9	3.9	3.9	3.7	3.6
5%	4.4	4.5	4.4	4.5	4.5	4.3	4.2
10%	4.8	5.0	4.8	4.9	4.9	4.8	4.7
15%	5.3	5.5	5.3	5.3	5.3	5.2	5.1
20%	5.7	5.9	5.7	5.8	5.8	5.6	5.5
25%	6.1	6.3	6.2	6.3	6.2	6.1	6.0
30%	6.6	6.8	6.6	6.7	6.6	6.6	6.5
35%	7.0	7.1	7.0	7.1	7.0	7.1	7.1
40%	7.5	7.5	7.5	7.6	7.5	7.5	7.5
45%	8.0	8.0	8.0	8.0	8.0	8.0	7.9
50%	8.4	8.5	8.4	8.4	8.4	8.4	8.4
55%	8.8	8.8	8.8	8.8	8.8	8.8	8.7
60%	9.2	9.3	9.3	9.2	9.3	9.2	9.2
65%	9.7	9.7	9.7	9.6	9.7	9.6	9.6
70%	9.9	9.9	9.9	9.9	9.9	9.9	9.9
75%	10.2	10.2	10.2	10.2	10.2	10.2	10.2
80%	10.5	10.4	10.5	10.4	10.5	10.5	10.4
85%	10.7	10.7	10.7	10.7	10.7	10.7	10.7
90%	11.0	11.0	11.0	11.0	11.0	11.0	11.0
95%	11.3	11.3	11.3	11.3	11.3	11.3	11.3
100%	13.6	13.6	13.6	13.6	13.6	13.6	13.5



Annex D- Screen 1 (Highway 28 Dissolved Oxygen Exceedance)

Highway 28 Water Temperature Exceedance For Study Alternatives

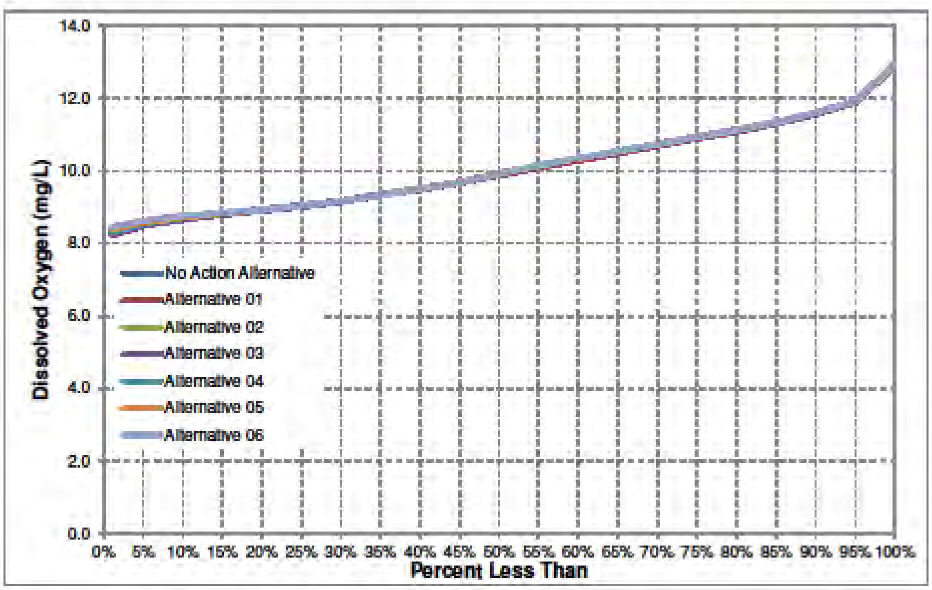
	Highway 28 Water Temperature (deg C)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Maximum:	24.5	24.5	24.5	24.5	24.5	24.5	24.5
1%	8.4	8.4	8.4	8.4	8.4	8.4	8.3
5%	9.9	9.8	9.9	9.8	9.9	9.9	9.8
10%	10.7	10.8	10.7	10.7	10.7	10.7	10.7
15%	11.6	11.6	11.6	11.6	11.6	11.6	11.6
20%	12.2	12.2	12.2	12.2	12.2	12.2	12.2
25%	12.9	12.9	12.9	12.9	12.9	12.9	12.9
30%	13.6	13.5	13.6	13.6	13.6	13.6	13.5
35%	14.4	14.4	14.4	14.4	14.4	14.5	14.4
40%	15.2	15.2	15.2	15.2	15.2	15.2	15.2
45%	15.9	15.9	15.9	15.9	15.9	15.9	15.9
50%	16.6	16.5	16.6	16.7	16.5	16.6	16.6
55%	17.3	17.2	17.3	17.4	17.3	17.3	17.3
60%	17.9	17.8	17.8	18.0	17.8	17.9	17.9
65%	18.4	18.4	18.4	18.5	18.4	18.4	18.5
70%	19.1	19.1	19.0	19.1	19.1	19.0	19.0
75%	19.6	19.6	19.6	19.7	19.6	19.6	19.5
80%	20.1	20.2	20.2	20.2	20.2	20.1	20.1
85%	20.6	20.7	20.6	20.7	20.6	20.5	20.5
90%	21.2	21.3	21.2	21.3	21.2	21.2	21.2
95%	21.9	21.9	21.8	21.9	21.9	21.9	21.8
100%	24.5	24.5	24.5	24.5	24.5	24.5	24.5



Annex D- Screen 2 (Highway 28 Water Temperature Exceedance)

Augusta Node Dissolved Oxygen Exceedance For Study Alternatives

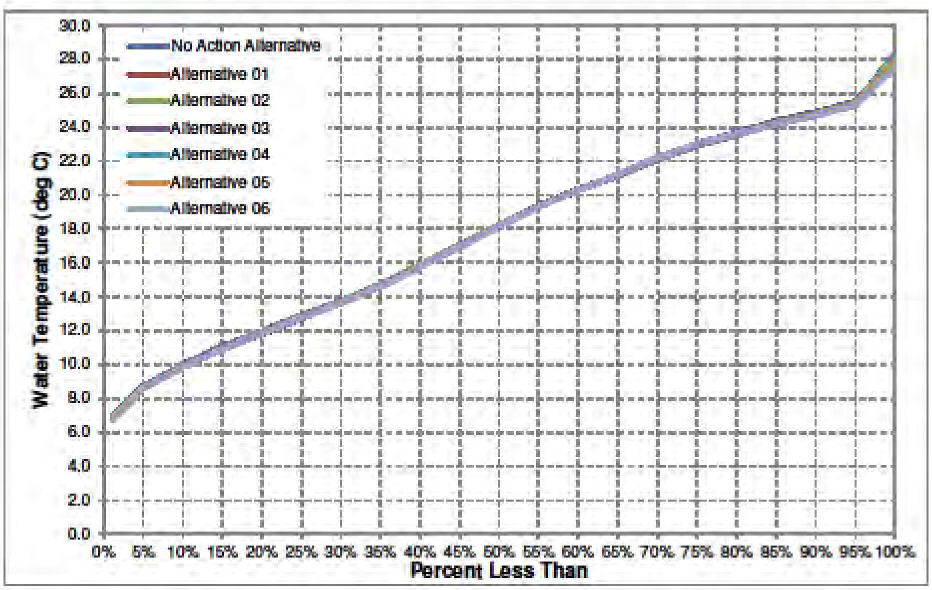
	Augusta Node Dissolved Oxygen (mg/L)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Minimum:	8.0	8.0	8.0	8.1	8.0	8.2	8.3
1%	8.3	8.3	8.3	8.2	8.3	8.4	8.4
5%	8.5	8.5	8.6	8.5	8.5	8.6	8.6
10%	8.7	8.7	8.7	8.6	8.7	8.7	8.7
15%	8.8	8.8	8.8	8.8	8.8	8.8	8.8
20%	8.9	8.9	8.9	8.9	8.9	8.9	8.9
25%	9.0	9.0	9.0	9.0	9.1	9.0	9.0
30%	9.2	9.1	9.2	9.1	9.2	9.2	9.2
35%	9.3	9.3	9.4	9.3	9.3	9.3	9.3
40%	9.5	9.5	9.5	9.5	9.5	9.5	9.5
45%	9.7	9.7	9.7	9.7	9.7	9.7	9.7
50%	9.9	9.9	9.9	9.9	9.9	9.9	9.9
55%	10.1	10.1	10.1	10.1	10.1	10.1	10.1
60%	10.3	10.3	10.3	10.3	10.3	10.3	10.4
65%	10.5	10.5	10.5	10.5	10.5	10.5	10.5
70%	10.7	10.7	10.7	10.7	10.7	10.7	10.7
75%	10.9	10.9	10.9	10.9	10.9	10.9	10.9
80%	11.1	11.1	11.1	11.1	11.1	11.1	11.1
85%	11.3	11.3	11.3	11.3	11.3	11.4	11.3
90%	11.6	11.6	11.6	11.6	11.6	11.6	11.6
95%	11.9	11.9	11.9	11.9	11.9	11.9	11.9
100%	12.9	12.9	12.9	12.9	12.9	12.9	12.9



Annex D- Screen 3 (Augusta Node Dissolved Oxygen Exceedance)

Augusta Node Water Temperature Exceedance For Study Alternatives

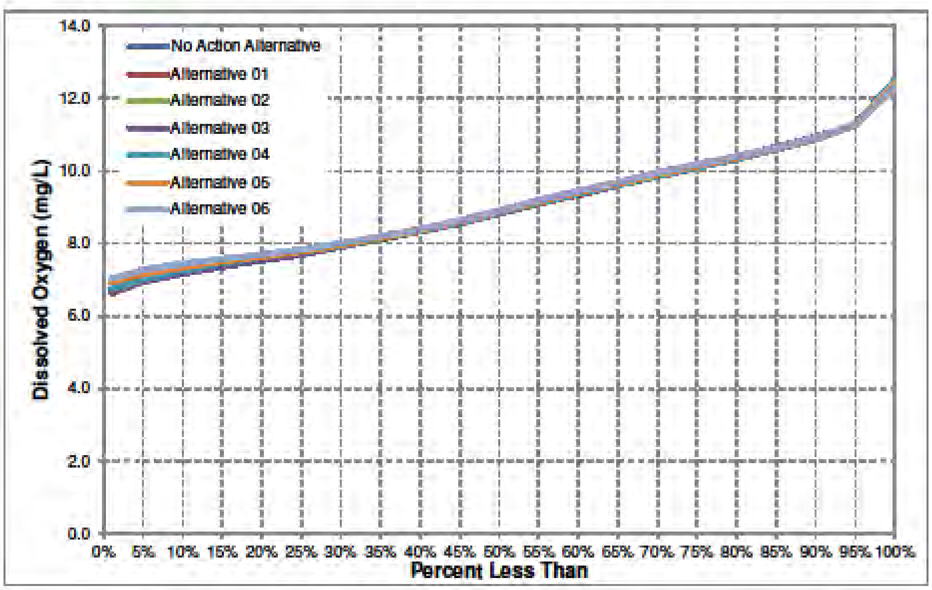
	Augusta Node Water Temperature (deg C)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Maximum:	28.3	28.3	28.3	28.1	28.3	28.0	27.6
1%	6.8	7.0	7.0	6.7	7.0	6.7	6.7
5%	8.6	8.7	8.7	8.6	8.7	8.6	8.6
10%	10.0	10.0	10.0	9.9	10.0	9.9	9.9
15%	11.0	11.1	11.0	10.9	11.1	10.9	10.9
20%	11.9	12.0	12.0	11.8	12.0	11.9	11.9
25%	12.8	12.9	12.9	12.8	12.9	12.8	12.8
30%	13.7	13.8	13.7	13.7	13.8	13.7	13.6
35%	14.7	14.8	14.7	14.6	14.8	14.7	14.6
40%	15.8	15.8	15.9	15.8	15.9	15.8	15.8
45%	17.0	17.0	17.0	17.0	17.0	17.0	16.9
50%	18.2	18.2	18.2	18.2	18.2	18.2	18.2
55%	19.3	19.4	19.3	19.3	19.3	19.3	19.3
60%	20.3	20.3	20.3	20.3	20.3	20.3	20.3
65%	21.2	21.2	21.1	21.2	21.2	21.2	21.2
70%	22.1	22.1	22.1	22.2	22.1	22.2	22.2
75%	22.9	23.0	22.9	23.0	22.9	23.0	23.0
80%	23.5	23.6	23.5	23.7	23.6	23.6	23.6
85%	24.2	24.3	24.2	24.4	24.3	24.3	24.2
90%	24.8	24.8	24.8	24.9	24.8	24.8	24.7
95%	25.4	25.4	25.3	25.5	25.4	25.4	25.3
100%	28.3	28.3	28.3	28.1	28.3	28.0	27.6



Annex D- Screen 4 (Augusta Node Water Temperature Exceedance)

Waynesboro Node Dissolved Oxygen Exceedance For Study Alternatives

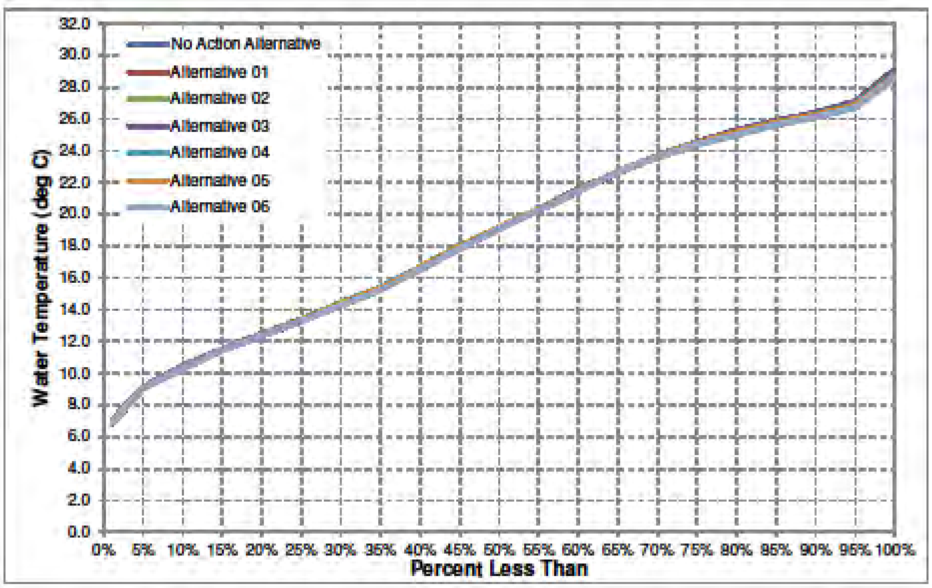
	Waynesboro Node Dissolved Oxygen (mg/L)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Minimum:	6.3	6.2	6.3	6.2	6.3	6.6	6.8
1%	6.8	6.7	6.8	6.6	6.8	6.9	7.0
5%	7.1	7.0	7.1	7.0	7.0	7.2	7.3
10%	7.3	7.2	7.3	7.2	7.3	7.3	7.4
15%	7.5	7.4	7.5	7.4	7.5	7.5	7.6
20%	7.6	7.6	7.6	7.5	7.6	7.6	7.7
25%	7.8	7.7	7.8	7.7	7.8	7.8	7.8
30%	7.9	7.9	7.9	7.9	7.9	8.0	8.0
35%	8.2	8.1	8.2	8.2	8.2	8.2	8.2
40%	8.4	8.3	8.4	8.4	8.4	8.4	8.4
45%	8.6	8.6	8.6	8.6	8.6	8.6	8.6
50%	8.9	8.8	8.8	8.9	8.8	8.9	8.9
55%	9.1	9.1	9.1	9.2	9.1	9.2	9.2
60%	9.4	9.3	9.4	9.4	9.4	9.4	9.5
65%	9.6	9.6	9.6	9.6	9.6	9.6	9.7
70%	9.9	9.9	9.9	9.9	9.9	9.9	10.0
75%	10.1	10.1	10.1	10.1	10.1	10.1	10.2
80%	10.3	10.3	10.3	10.4	10.3	10.4	10.4
85%	10.6	10.6	10.6	10.7	10.6	10.6	10.6
90%	10.9	10.9	10.9	10.9	10.9	10.9	10.9
95%	11.3	11.3	11.3	11.3	11.3	11.3	11.3
100%	12.5	12.5	12.3	12.3	12.5	12.4	12.3



Annex D- Screen 5 (Waynesboro Node Dissolved Oxygen Exceedance)

Waynesboro Water Temperature Exceedance For Study Alternatives

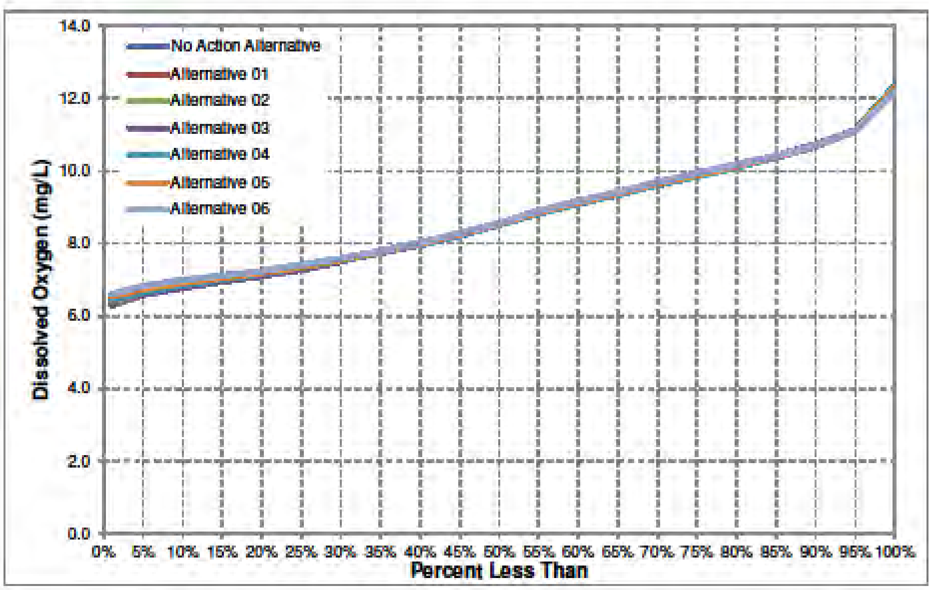
	Waynesboro Water Temperature (deg C)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Maximum:	28.7	28.9	28.7	29.1	28.8	28.7	28.7
1%	6.9	7.0	7.0	6.8	7.0	6.8	6.8
5%	9.1	9.1	9.1	9.0	9.1	9.1	9.1
10%	10.4	10.4	10.4	10.3	10.4	10.3	10.3
15%	11.5	11.5	11.5	11.4	11.5	11.5	11.4
20%	12.4	12.5	12.4	12.3	12.4	12.4	12.3
25%	13.3	13.4	13.4	13.3	13.4	13.4	13.3
30%	14.4	14.4	14.4	14.3	14.4	14.4	14.3
35%	15.4	15.4	15.4	15.3	15.4	15.4	15.2
40%	16.6	16.6	16.6	16.6	16.7	16.6	16.5
45%	18.0	18.0	18.0	18.0	18.0	18.0	17.8
50%	19.1	19.1	19.2	19.2	19.2	19.2	19.1
55%	20.3	20.3	20.3	20.3	20.3	20.3	20.2
60%	21.5	21.6	21.5	21.5	21.5	21.4	21.4
65%	22.7	22.6	22.6	22.6	22.6	22.7	22.7
70%	23.6	23.7	23.6	23.7	23.6	23.7	23.6
75%	24.4	24.4	24.3	24.5	24.3	24.5	24.4
80%	25.1	25.2	25.1	25.3	25.1	25.2	25.0
85%	25.8	25.8	25.8	25.9	25.8	25.8	25.6
90%	26.2	26.3	26.2	26.4	26.3	26.2	26.1
95%	26.9	26.9	26.9	27.1	26.9	26.9	26.7
100%	28.7	28.9	28.7	29.1	28.8	28.7	28.7



Annex D- Screen 6 (Waynesboro Water Temperature Exceedance)

Millhaven Node Dissolved Oxygen Exceedance For Study Alternatives

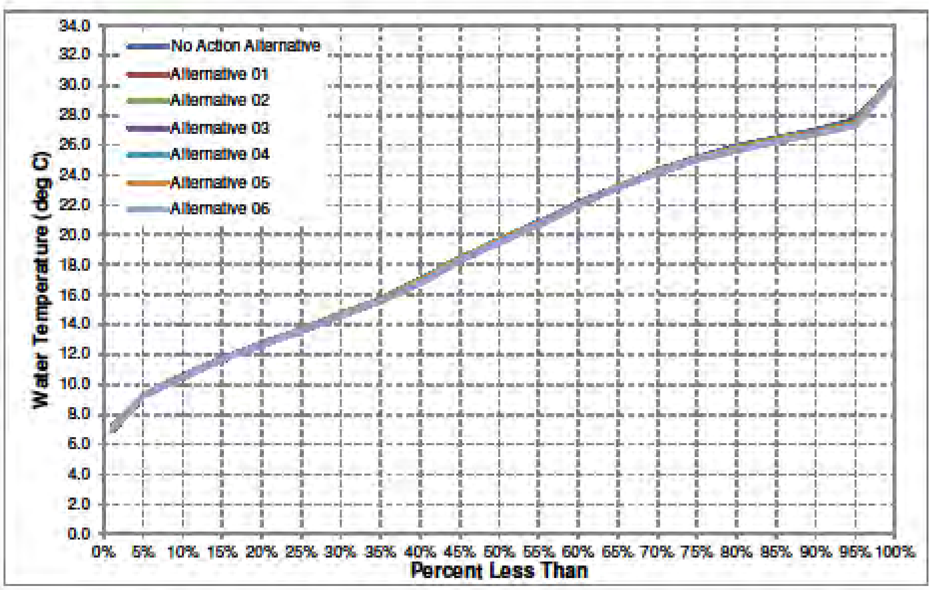
	Millhaven Node Dissolved Oxygen (mg/L)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Minimum:	6.1	6.0	6.1	6.0	6.0	6.2	6.3
1%	6.4	6.4	6.4	6.3	6.4	6.5	6.6
5%	6.7	6.6	6.7	6.6	6.7	6.8	6.8
10%	6.9	6.8	6.9	6.8	6.9	6.9	7.0
15%	7.0	7.0	7.0	7.0	7.0	7.1	7.1
20%	7.2	7.2	7.2	7.1	7.2	7.2	7.2
25%	7.3	7.3	7.3	7.3	7.3	7.4	7.4
30%	7.5	7.5	7.5	7.5	7.5	7.5	7.6
35%	7.8	7.7	7.8	7.8	7.7	7.8	7.8
40%	8.0	8.0	8.0	8.0	8.0	8.0	8.0
45%	8.2	8.2	8.2	8.2	8.2	8.3	8.3
50%	8.5	8.5	8.5	8.6	8.5	8.5	8.6
55%	8.8	8.8	8.8	8.9	8.8	8.9	8.9
60%	9.1	9.1	9.1	9.1	9.1	9.1	9.2
65%	9.4	9.3	9.4	9.4	9.3	9.4	9.4
70%	9.6	9.6	9.6	9.6	9.6	9.7	9.7
75%	9.9	9.8	9.8	9.9	9.9	9.9	9.9
80%	10.1	10.1	10.1	10.2	10.1	10.1	10.2
85%	10.4	10.4	10.4	10.4	10.4	10.4	10.4
90%	10.7	10.7	10.7	10.7	10.7	10.7	10.7
95%	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100%	12.4	12.4	12.2	12.4	12.4	12.3	12.2



Annex D- Screen 7 (Millhaven Node Oxygen Exceedance)

Millhaven Node Water Temperature Exceedance For Study Alternatives

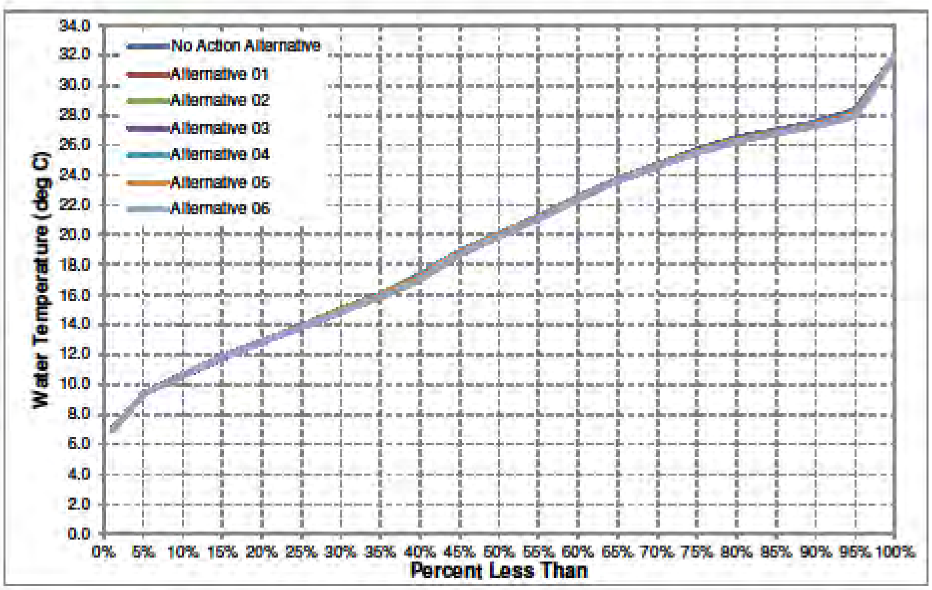
	Millhaven Water Temperature (deg C)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Maximum:	30.6	30.6	30.6	30.6	30.6	30.5	30.5
1%	7.0	7.1	7.0	6.9	7.0	7.0	7.0
5%	9.3	9.3	9.3	9.2	9.3	9.3	9.2
10%	10.6	10.6	10.6	10.5	10.6	10.5	10.5
15%	11.7	11.7	11.7	11.6	11.7	11.6	11.7
20%	12.6	12.7	12.7	12.6	12.7	12.7	12.6
25%	13.6	13.7	13.6	13.6	13.7	13.6	13.5
30%	14.7	14.7	14.7	14.6	14.7	14.7	14.6
35%	15.7	15.7	15.7	15.7	15.7	15.7	15.6
40%	17.0	17.0	17.0	16.9	17.0	16.9	16.8
45%	18.4	18.4	18.4	18.4	18.4	18.4	18.3
50%	19.6	19.6	19.6	19.6	19.7	19.6	19.5
55%	20.8	20.8	20.8	20.7	20.8	20.8	20.7
60%	22.0	22.1	22.0	22.0	22.1	22.0	22.0
65%	23.2	23.2	23.2	23.2	23.2	23.2	23.2
70%	24.2	24.3	24.2	24.3	24.2	24.2	24.2
75%	25.0	25.1	25.0	25.1	25.0	25.1	25.0
80%	25.7	25.8	25.7	25.9	25.7	25.8	25.6
85%	26.4	26.4	26.3	26.5	26.4	26.4	26.2
90%	26.8	26.9	26.8	27.0	26.9	26.8	26.7
95%	27.5	27.5	27.4	27.7	27.6	27.5	27.3
100%	30.6	30.6	30.6	30.6	30.6	30.5	30.5



Annex D- Screen 8 (Millhaven Node Water Temperature Exceedance)

River Mile 87 Water Temperature Exceedance For Study Alternatives

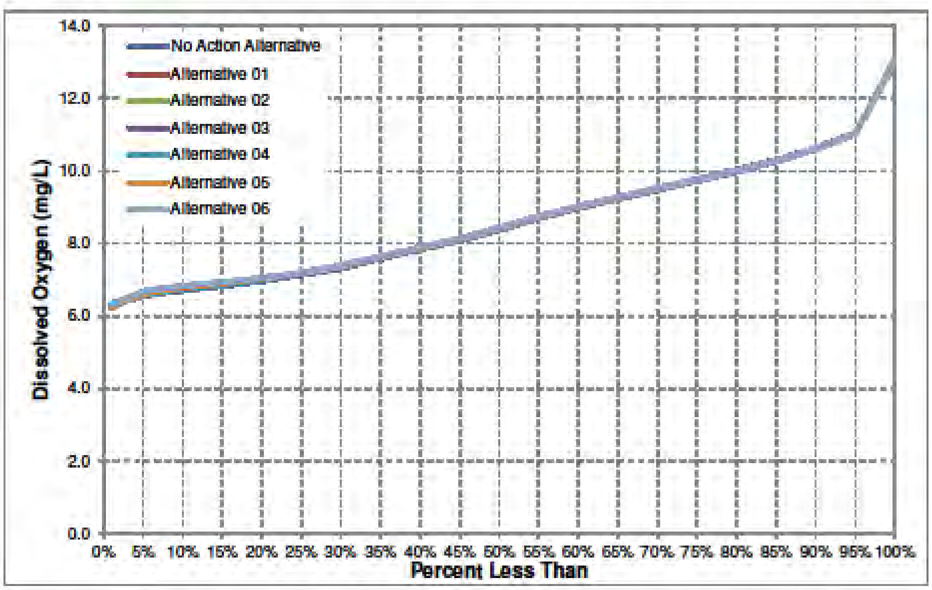
	River Mile 87 Water Temperature (deg C)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Maximum:	32.0	32.0	32.0	32.0	32.0	32.0	32.0
1%	6.9	6.9	6.9	6.9	6.9	6.9	6.9
5%	9.3	9.3	9.3	9.3	9.3	9.3	9.3
10%	10.6	10.6	10.6	10.6	10.7	10.6	10.6
15%	11.8	11.9	11.9	11.8	11.9	11.8	11.8
20%	12.9	12.9	12.9	12.8	12.9	12.8	12.8
25%	13.9	13.9	13.9	13.9	13.9	13.9	13.8
30%	15.0	15.0	15.0	14.9	15.0	15.0	14.9
35%	16.0	16.0	16.0	16.0	16.0	16.0	15.8
40%	17.2	17.3	17.3	17.2	17.3	17.2	17.0
45%	18.8	18.8	18.8	18.8	18.8	18.8	18.7
50%	20.0	20.0	20.0	19.9	20.0	20.0	19.9
55%	21.2	21.2	21.2	21.1	21.2	21.2	21.1
60%	22.4	22.5	22.5	22.4	22.5	22.4	22.4
65%	23.7	23.7	23.7	23.6	23.7	23.6	23.6
70%	24.6	24.7	24.6	24.7	24.6	24.6	24.5
75%	25.5	25.6	25.5	25.7	25.5	25.6	25.5
80%	26.3	26.4	26.3	26.5	26.3	26.3	26.2
85%	26.9	27.0	26.9	27.0	26.9	26.8	26.8
90%	27.4	27.4	27.4	27.5	27.4	27.4	27.3
95%	28.1	28.1	28.1	28.3	28.2	28.1	27.9
100%	32.0	32.0	32.0	32.0	32.0	32.0	32.0



Annex D- Screen 9 (River Mile 87 Water Temperature Exceedance)

Clyo Node Dissolved Oxygen Exceedance For Study Alternatives

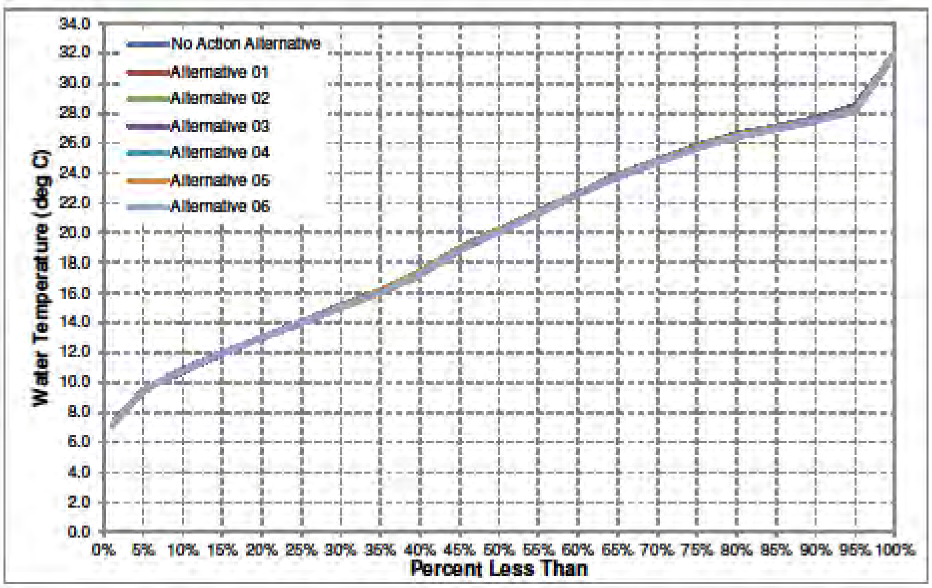
	Clyo Node Dissolved Oxygen (mg/L)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Minimum:	5.7	5.7	5.7	5.7	5.7	5.7	5.7
1%	6.3	6.3	6.3	6.3	6.3	6.2	6.3
5%	6.6	6.6	6.6	6.6	6.6	6.6	6.7
10%	6.8	6.7	6.8	6.7	6.8	6.8	6.8
15%	6.9	6.9	6.9	6.8	6.9	6.9	6.9
20%	7.0	7.0	7.0	7.0	7.0	7.0	7.1
25%	7.2	7.2	7.2	7.1	7.2	7.2	7.2
30%	7.4	7.4	7.4	7.3	7.4	7.4	7.4
35%	7.6	7.6	7.6	7.6	7.6	7.6	7.6
40%	7.9	7.8	7.9	7.9	7.8	7.9	7.9
45%	8.1	8.1	8.1	8.1	8.1	8.1	8.1
50%	8.4	8.4	8.4	8.4	8.4	8.4	8.4
55%	8.7	8.7	8.7	8.7	8.7	8.7	8.8
60%	9.0	9.0	9.0	9.0	9.0	9.0	9.0
65%	9.2	9.2	9.2	9.2	9.2	9.3	9.3
70%	9.5	9.5	9.5	9.5	9.5	9.5	9.5
75%	9.7	9.7	9.7	9.8	9.7	9.8	9.8
80%	10.0	10.0	10.0	10.0	10.0	10.0	10.0
85%	10.3	10.3	10.3	10.3	10.3	10.3	10.3
90%	10.6	10.6	10.6	10.6	10.6	10.6	10.6
95%	11.0	11.0	11.0	11.0	11.0	11.0	11.0
100%	13.0	13.0	13.0	13.0	13.0	13.1	13.1



Annex D- Screen 10 (Clyo Node Dissolved Oxygen Exceedance)

Clyo Water Temperature Exceedance For Study Alternatives

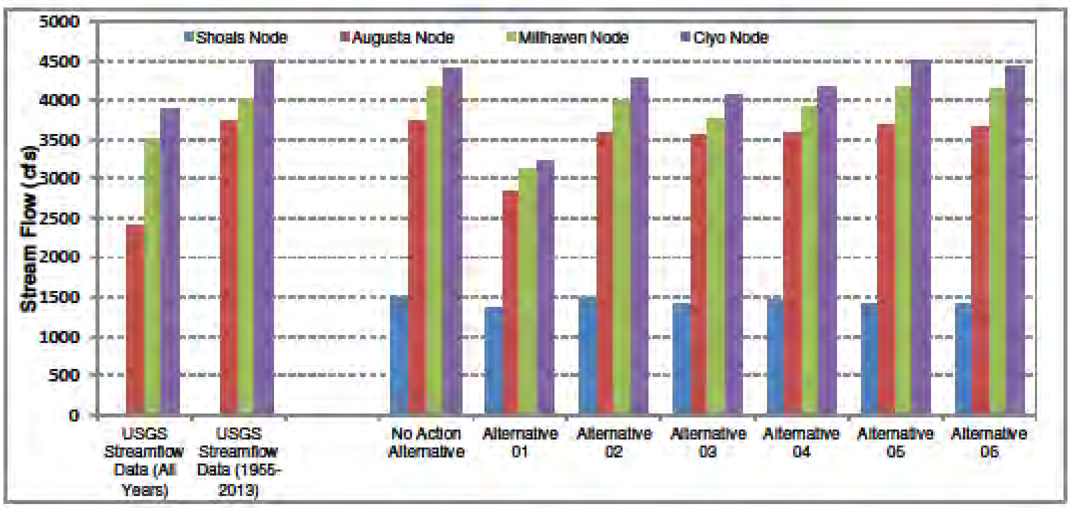
	Clyo Water Temperature (deg C)						
Percentile	No Action Alternative	Alternative 01	Alternative 02	Alternative 03	Alternative 04	Alternative 05	Alternative 06
Maximum:	32.1	32.1	32.1	32.0	32.1	32.0	32.0
1%	7.2	7.2	7.2	7.1	7.2	7.1	7.1
5%	9.5	9.4	9.5	9.5	9.5	9.4	9.5
10%	10.8	10.9	10.8	10.8	10.9	10.8	10.8
15%	12.0	12.0	12.0	11.9	12.0	12.0	12.0
20%	13.0	13.0	13.0	13.0	13.0	13.0	13.0
25%	14.0	14.0	14.0	14.0	14.0	14.0	14.0
30%	15.1	15.2	15.2	15.1	15.2	15.1	15.0
35%	16.1	16.2	16.2	16.1	16.2	16.1	16.0
40%	17.3	17.4	17.4	17.4	17.4	17.4	17.2
45%	18.9	18.9	19.0	18.9	19.0	18.9	18.8
50%	20.1	20.1	20.2	20.1	20.2	20.1	20.0
55%	21.4	21.4	21.4	21.3	21.4	21.3	21.3
60%	22.6	22.6	22.6	22.6	22.6	22.6	22.6
65%	23.8	23.9	23.8	23.8	23.9	23.8	23.7
70%	24.8	24.8	24.7	24.9	24.8	24.8	24.7
75%	25.7	25.8	25.7	25.8	25.7	25.8	25.7
80%	26.5	26.6	26.5	26.6	26.5	26.5	26.4
85%	27.0	27.1	27.0	27.1	27.0	27.0	26.9
90%	27.6	27.6	27.6	27.7	27.6	27.5	27.5
95%	28.3	28.3	28.3	28.5	28.3	28.2	28.1
100%	32.1	32.1	32.1	32.0	32.1	32.0	32.0



Annex D- Screen 11 (Clyo Node Water Temperature Exceedance)

Savannah River Basin Phase 2 Comprehensive Study
Comparison of 7Q10 Stream Flows For Study Alternatives

Location:	Shoals Node	Augusta Node	Millhaven Node	Clyo Node
	Computed 7Q10 Stream Flows (cfs)			
USGS Streamflow Data (All Years)	—	2397	3499	3888
USGS Streamflow Data (1955-2013)	—	3746	4028	4513
No Action Alternative	1477	3747	4174	4409
Alternative 01	1359	2851	3119	3236
Alternative 02	1483	3589	3989	4265
Alternative 03	1416	3557	3767	4062
Alternative 04	1467	3575	3905	4159
Alternative 05	1425	3696	4172	4512
Alternative 06	1417	3670	4142	4432



Annex D- Screen 12 (Savannah River Basin, Phase 2 Comparison of 7Q10 Stream Flows)

Savannah River Basin Phase 2 Comprehensive Study
Water Quality Modeling Results

90% Exceedance Dissolved Oxygen Concentrations at Selected Locations for Period 1999 Through 2013

Location:	Highway 28	Augusta	Waynesboro	Millhaven	River Mile 87	Clyo
NAA	4.8	8.7	7.3	6.9	6.6	6.8
ALT01	5.0	8.7	7.2	6.8	6.6	6.7
ALT02	4.8	8.7	7.3	6.9	6.6	6.8
ALT03	4.9	8.6	7.2	6.8	6.5	6.7
ALT04	4.9	8.7	7.3	6.9	6.6	6.8
ALT05	4.8	8.7	7.3	6.9	6.6	6.8
ALT06	4.7	8.7	7.4	7.0	6.7	6.8

Dissolved oxygen concentration in milligrams per liter.

Minimum Dissolved Oxygen Concentrations at Selected Locations for Period 1999 Through 2013

Location:	Highway 28	Augusta	Waynesboro	Millhaven	River Mile 87	Clyo
NAA	3.0	8.0	6.3	6.1	5.2	5.7
ALT01	3.0	8.0	6.2	6.0	5.2	5.7
ALT02	3.0	8.0	6.3	6.1	5.2	5.7
ALT03	3.1	8.1	6.2	6.0	5.2	5.7
ALT04	3.0	8.0	6.3	6.0	5.2	5.7
ALT05	2.9	8.2	6.6	6.2	5.2	5.7
ALT06	2.7	8.3	6.8	6.3	5.2	5.7

Dissolved oxygen concentration in milligrams per liter.

Annex D- Screen 13 (Savannah River Basin, Phase 2 Water Quality Modeling)

Savannah River Basin Phase 2 Comprehensive Study
Hydrodynamic Modeling Results

90% Exceedance Water Surface Elevations at Georgia Boat Ramps for Period 1939 Through 2013

Location:	New Savannah Bluff Lock and Dam	Yuchi WMA - Brighams Landing	Burton's Ferry Landing (US 301)	Tuckahoe WMA - Possum Eddy	Tuckahoe WMA - Dick's Lookout	Tuckahoe WMA - Miller Lake	Poor Robins Landing	Blue Springs Landing	Tuckasee King	Ebenezer Landing
NAA	97.4	77.9	56.6	52.0	50.0	45.8	35.0	29.5	17.5	9.4
ALT01	96.9	77.5	56.1	51.5	49.5	45.3	34.5	29.2	17.1	9.0
ALT02	97.2	77.8	56.4	51.9	49.8	45.6	34.9	29.5	17.4	9.3
ALT03	97.3	77.8	56.5	51.9	49.9	45.7	34.9	29.5	17.4	9.4
ALT04	97.0	77.6	56.2	51.6	49.5	45.4	34.6	29.3	17.2	9.1
ALT05	97.8	78.0	56.8	52.3	50.2	46.0	35.2	29.7	17.7	9.7
ALT06	98.1	78.3	57.1	52.6	50.5	46.3	35.5	30.0	17.9	10.0

Water surface elevations are in feet.

Minimum Water Surface Elevations at Georgia Boat Ramps for Period 1939 Through 2013

Location:	New Savannah Bluff Lock and Dam	Yuchi WMA - Brighams Landing	Burton's Ferry Landing (US 301)	Tuckahoe WMA - Possum Eddy	Tuckahoe WMA - Dick's Lookout	Tuckahoe WMA - Miller Lake	Poor Robins Landing	Blue Springs Landing	Tuckasee King	Ebenezer Landing
NAA	96.1	75.2	55.2	50.4	48.4	44.1	33.3	28.2	16.1	7.5
ALT01	94.6	73.4	53.5	48.5	46.6	42.3	31.5	26.9	14.2	5.8
ALT02	96.1	74.9	54.8	50.1	48.2	44.0	33.2	28.2	16.0	7.4
ALT03	96.1	74.7	54.7	49.9	47.9	43.5	32.8	27.9	15.7	7.0
ALT04	96.1	74.8	54.8	49.9	48.0	43.6	32.9	27.9	15.8	7.0
ALT05	96.4	75.1	55.2	50.4	48.4	44.1	33.4	28.3	16.1	7.5
ALT06	96.4	75.2	55.2	50.5	48.5	44.2	33.5	28.3	16.2	7.7

Water surface elevations are in feet.

90% Exceedance Water Surface Elevations at Georgia Boat Ramps for Period 1999 Through 2013

Location:	New Savannah Bluff Lock and Dam	Yuchi WMA - Brighams Landing	Burton's Ferry Landing (US 301)	Tuckahoe WMA - Possum Eddy	Tuckahoe WMA - Dick's Lookout	Tuckahoe WMA - Miller Lake	Poor Robins Landing	Blue Springs Landing	Tuckasee King	Ebenezer Landing
NAA	97.0	77.5	56.0	51.4	49.3	45.0	34.3	29.0	16.9	8.6
ALT01	95.7	74.7	54.9	50.2	48.2	44.0	33.3	28.3	16.1	7.6
ALT02	96.8	77.5	55.9	51.2	49.2	44.9	34.2	28.9	16.8	8.4
ALT03	96.5	77.3	55.7	51.0	49.0	44.7	34.0	28.7	16.6	8.2
ALT04	96.6	77.3	55.7	51.0	49.0	44.7	33.9	28.7	16.6	8.2
ALT05	97.0	77.7	56.3	51.7	49.6	45.4	34.6	29.3	17.2	9.0
ALT06	97.1	77.8	56.6	52.1	50.0	45.8	35.0	29.8	17.5	9.5

Water surface elevations are in feet.

Minimum Water Surface Elevations at Georgia Boat Ramps for Period 1999 Through 2013

Location:	New Savannah Bluff Lock and Dam	Yuchi WMA - Brighams Landing	Burton's Ferry Landing (US 301)	Tuckahoe WMA - Possum Eddy	Tuckahoe WMA - Dick's Lookout	Tuckahoe WMA - Miller Lake	Poor Robins Landing	Blue Springs Landing	Tuckasee King	Ebenezer Landing
NAA	96.1	75.2	55.2	50.5	48.5	44.3	33.6	28.5	16.4	8.0
ALT01	94.6	73.5	53.6	48.6	46.8	42.6	31.8	27.1	14.5	6.0
ALT02	96.1	75.1	55.1	50.3	48.4	44.1	33.4	28.3	16.1	7.5
ALT03	96.1	74.8	54.8	50.0	48.1	43.9	33.2	28.1	16.0	7.4
ALT04	96.1	75.0	54.9	50.1	48.2	44.0	33.3	28.3	16.1	7.5
ALT05	96.4	75.1	55.2	50.4	48.4	44.2	33.5	28.3	16.2	7.6
ALT06	96.4	75.2	55.2	50.5	48.5	44.3	33.5	28.4	16.3	7.7

Water surface elevations are in feet.

Annex D- Screen 14 (Savannah River Basin, Phase 2 Hydrodynamic Modeling)

Savannah River Basin Phase 2 Comprehensive Study
Hydrodynamic Modeling Results

90% Exceedance Water Surface Elevations at South Carolina Boat Ramps for Period 1939 Through

Location:	Thurmond Dam	Furys Ferry	Stevens Creek	Riverview Park	Jackson	Steel Creek	Little Hell	Johnsons	Cohens Bluff	Stokes Bluff
NAA	184.9	184.8	184.8	116.3	88.3	73.9	67.9	60.2	48.2	18.1
ALT01	184.4	184.3	184.3	116.0	87.8	73.5	67.5	59.7	47.7	17.8
ALT02	184.8	184.7	184.7	116.2	88.1	73.7	67.8	60.0	48.1	18.1
ALT03	184.8	184.7	184.7	116.2	88.2	73.8	67.8	60.1	48.1	18.1
ALT04	184.6	184.5	184.5	116.0	87.8	73.5	67.6	59.8	47.8	17.8
ALT05	185.1	185.0	185.0	116.5	88.7	74.1	68.2	60.4	48.4	18.4
ALT06	185.4	185.2	185.2	116.7	89.0	74.4	68.5	60.7	48.8	18.6

Water surface elevations are in feet.

Minimum Water Surface Elevations at South Carolina Boat Ramps for Period 1939 Through 2013

Location:	Thurmond Dam	Furys Ferry	Stevens Creek	Riverview Park	Jackson	Steel Creek	Little Hell	Johnsons	Cohens Bluff	Stokes Bluff
NAA	183.7	183.6	183.6	115.3	86.7	71.9	66.7	58.9	46.7	16.7
ALT01	178.7	178.5	178.5	113.8	85.4	70.2	65.2	57.3	45.0	14.7
ALT02	183.7	183.6	183.6	115.3	86.7	71.5	66.3	58.5	46.6	16.6
ALT03	183.2	183.2	183.2	115.2	86.7	71.4	66.2	58.5	46.2	16.3
ALT04	183.7	183.6	183.6	115.3	86.7	71.5	66.3	58.5	46.3	16.3
ALT05	183.3	183.3	183.3	115.5	86.7	71.8	66.6	58.9	46.7	16.7
ALT06	183.3	183.3	183.3	115.5	86.7	71.9	66.7	58.9	46.8	16.8

Water surface elevations are in feet.

90% Exceedance Water Surface Elevations at South Carolina Boat Ramps for Period 1999 Through

Location:	Thurmond Dam	Furys Ferry	Stevens Creek	Riverview Park	Jackson	Steel Creek	Little Hell	Johnsons	Cohens Bluff	Stokes Bluff
NAA	184.6	184.5	184.5	116.0	87.8	73.4	67.4	59.7	47.6	17.5
ALT01	181.4	181.3	181.3	115.0	86.4	71.5	66.3	58.7	46.5	16.7
ALT02	184.3	184.2	184.2	115.8	87.6	73.4	67.3	59.6	47.5	17.4
ALT03	184.1	184.0	183.9	115.6	87.3	73.1	67.1	59.3	47.2	17.2
ALT04	184.0	183.9	183.9	115.6	87.4	73.2	67.1	59.4	47.3	17.2
ALT05	184.6	184.5	184.5	116.0	87.9	73.6	67.6	59.9	47.9	17.8
ALT06	184.7	184.6	184.6	116.1	88.1	73.8	67.9	60.2	48.3	18.2

Water surface elevations are in feet.

Minimum Water Surface Elevations at South Carolina Boat Ramps for Period 1999 Through 2013

Location:	Thurmond Dam	Furys Ferry	Stevens Creek	Riverview Park	Jackson	Steel Creek	Little Hell	Johnsons	Cohens Bluff	Stokes Bluff
NAA	183.7	183.6	183.6	115.3	87.1	71.9	66.7	58.9	46.8	17.0
ALT01	178.7	178.5	178.5	113.8	85.4	70.3	65.3	57.4	45.2	15.0
ALT02	183.7	183.6	183.6	115.3	87.0	71.8	66.6	58.8	46.7	16.7
ALT03	183.5	183.4	183.4	115.2	86.7	71.5	66.3	58.5	46.5	16.6
ALT04	183.7	183.6	183.6	115.3	87.0	71.7	66.5	58.6	46.5	16.7
ALT05	183.3	183.3	183.3	115.5	87.1	71.8	66.6	58.9	46.8	16.8
ALT06	183.3	183.3	183.3	115.5	87.1	71.9	66.7	58.9	46.8	16.8

Water surface elevations are in feet.

Annex D- Screen 15 (Savannah River Basin, Phase 2 Hydrodynamic Modeling Cont.)

Savannah River Basin Phase 2 Comprehensive Study
Hydrodynamic Modeling Results

90% Exceedance Stream Flows at Selected Locations for Period 1939 Through 2013

Location: Description:	Thurmond Dam	Columbia County Withdrawal	Stevens Creek Node ResSim	Edgefield County Withdrawal	Augusta Canal Diversion Withdrawal	Shoals Node ResSim	Augusta Withdrawal	North Augusta Withdrawal	Augusta - Hicks Plant Withdrawal	SCE&G Urquhart Withdrawal	DSM/PCS Nitrogen Withdrawal	Kimberly Clark - Beech Island Withdrawal	Augusta Node ResSim	International Paper Withdrawal	RM 183 (Fritz Cut, Angling Area) TNC	RM 177 (Spawning Bar) TNC	Savannah River Site Withdrawal	SCE&G SRS Area D Power Plant Withdrawal	Waynesboro Node ResSim	Plant Vogtle Withdrawal	RM 136 (Prime Mussel Habitat) TNC	Millhaven Node ResSim	RM 112 (Cutoff Channel Oxbow Habitat) TNC	RM 104 (Cohen's Bluff) TNC	Clyo Node ResSim	Savannah Electric - Plant McIntosh Withdrawal	Georgia Pacific Corporation Withdrawal	RM 41 Oxbow Habitat TNC
NAA	3800	4084	4213	4214	2858	1581	1594	1595	4162	4227	4235	4243	4281	4198	4273	4274	4609	4609	4623	4642	4730	4888	4886	4919	5311	5403	5415	5415
ALT01	3500	3727	3853	3854	2685	1591	1605	1607	3798	3860	3868	3876	3910	3832	3902	3902	4236	4236	4245	4260	4359	4524	4519	4551	4966	5060	5072	5072
ALT02	3600	4001	4076	4076	2796	1577	1590	1591	4038	4090	4098	4107	4134	4052	4128	4127	4475	4475	4485	4503	4603	4764	4766	4799	5226	5314	5329	5328
ALT03	3600	3895	4063	4063	2817	1576	1587	1588	4045	4114	4121	4136	4173	4100	4176	4179	4520	4520	4532	4554	4646	4807	4805	4841	5285	5381	5397	5398
ALT04	3600	3787	3922	3922	2735	1592	1604	1605	3875	3938	3941	3948	3969	3889	3954	3957	4294	4294	4304	4322	4418	4588	4584	4609	5021	5118	5132	5133
ALT05	3963	4275	4451	4451	3013	1574	1584	1585	4417	4482	4486	4499	4541	4463	4534	4534	4827	4827	4835	4850	4938	5082	5079	5111	5514	5606	5621	5622
ALT06	4240	4634	4712	4712	3104	1588	1601	1602	4652	4701	4711	4726	4762	4675	4764	4769	5110	5110	5116	5134	5216	5354	5348	5388	5771	5859	5872	5871

Streamflow units are cubic feet per second (cfs).

Minimum Stream Flows at Selected Locations for Period 1939 Through 2013

Location: Description:	Thurmond Dam	Columbia County Withdrawal	Stevens Creek Node ResSim	Edgefield County Withdrawal	Augusta Canal Diversion Withdrawal	Shoals Node ResSim	Augusta Withdrawal	North Augusta Withdrawal	Augusta - Hicks Plant Withdrawal	SCE&G Urquhart Withdrawal	DSM/PCS Nitrogen Withdrawal	Kimberly Clark - Beech Island Withdrawal	Augusta Node ResSim	International Paper Withdrawal	RM 183 (Fritz Cut, Angling Area) TNC	RM 177 (Spawning Bar) TNC	Savannah River Site Withdrawal	SCE&G SRS Area D Power Plant Withdrawal	Waynesboro Node ResSim	Plant Vogtle Withdrawal	RM 136 (Prime Mussel Habitat) TNC	Millhaven Node ResSim	RM 112 (Cutoff Channel Oxbow Habitat) TNC	RM 104 (Cohen's Bluff) TNC	Clyo Node ResSim	Savannah Electric - Plant McIntosh Withdrawal	Georgia Pacific Corporation Withdrawal	RM 41 Oxbow Habitat TNC
NAA	0	2989	3489	3489	2247	468	477	505	2755	2857	2909	2972	3182	3119	3335	3245	3668	3668	3704	3721	3766	3831	3824	3832	3951	3986	3990	3990
ALT01	0	2276	2600	2600	1566	237	378	366	2088	2213	2270	2318	2427	2324	2392	2375	2618	2618	2620	2623	2631	2644	2638	2648	2762	2787	2791	2791
ALT02	0	3249	3488	3487	2307	659	638	658	2936	3001	3041	3089	3182	3119	3335	3245	3516	3516	3526	3525	3518	3531	3527	3567	3891	3921	3927	3927
ALT03	0	2642	3333	3329	2113	449	529	559	2536	2715	2760	2906	3329	3243	3354	3245	3418	3418	3433	3442	3447	3478	3475	3466	3605	3631	3636	3637
ALT04	0	3249	3488	3487	2250	534	544	566	2765	2848	2891	2939	3214	3161	3345	3245	3503	3503	3504	3505	3506	3511	3504	3515	3621	3655	3661	3661
ALT05	0	2811	3381	3382	2380	723	770	783	2944	3243	3267	3295	3571	3490	3505	3245	3655	3655	3670	3675	3709	3787	3782	3802	3980	4009	4013	4014
ALT06	0	2811	3381	3382	2349	708	760	769	2984	3249	3319	3401	3532	3430	3505	3245	3668	3668	3721	3729	3771	3831	3827	3855	4064	4104	4110	4109

Streamflow units are cubic feet per second (cfs).

90% Exceedance Stream Flows at Selected Locations for Period 1999 Through 2013

Location: Description:	Thurmond Dam	Columbia County Withdrawal	Stevens Creek Node ResSim	Edgefield County Withdrawal	Augusta Canal Diversion Withdrawal	Shoals Node ResSim	Augusta Withdrawal	North Augusta Withdrawal	Augusta - Hicks Plant Withdrawal	SCE&G Urquhart Withdrawal	DSM/PCS Nitrogen Withdrawal	Kimberly Clark - Beech Island Withdrawal	Augusta Node ResSim	International Paper Withdrawal	RM 183 (Fritz Cut, Angling Area) TNC	RM 177 (Spawning Bar) TNC	Savannah River Site Withdrawal	SCE&G SRS Area D Power Plant Withdrawal	Waynesboro Node ResSim	Plant Vogtle Withdrawal	RM 136 (Prime Mussel Habitat) TNC	Millhaven Node ResSim	RM 112 (Cutoff Channel Oxbow Habitat) TNC	RM 104 (Cohen's Bluff) TNC	Clyo Node ResSim	Savannah Electric - Plant McIntosh Withdrawal	Georgia Pacific Corporation Withdrawal	RM 41 Oxbow Habitat TNC
NAA	3600	3824	3916	3915	2701	1545	1555	1556	3868	3904	3905	3911	3932	3840	3917	3915	4209	4209	4219	4236	4317	4457	4453	4465	4707	4753	4762	4762
ALT01	2500	2778	2961	2961	2283	1536	1547	1548	2982	3056	3053	3049	3051	2977	3047	3047	3346	3346	3356	3372	3467	3632	3634	3654	3984	4046	4051	4051
ALT02	3600	3680	3763	3763	2635	1548	1558	1559	3709	3753	3754	3754	3766	3686	3776	3777	4128	4128	4140	4156	4237	4365	4359	4376	4615	4651	4656	4656
ALT03	3520	3622	3659	3659	2559	1531	1538	1538	3604	3636	3636	3639	3638	3543	3610	3609	3940	3940	3949	3965	4041	4181	4168	4188	4457	4504	4511	4511
ALT04	3485	3571	3652	3652	2563	1553	1562	1562	3624	3651	3651	3654	3655	3567	3648	3649	3987	3987	3994	4011	4084	4220	4218	4235	4428	4469	4473	4472
ALT05	3600	3799	3911	3910	2729	1532	1540	1541	3887	3936	3937	3940	3946	3870	3958	3957	4352	4352	4367	4386	4490	4665	4663	4688	5009	5049	5054	5054
ALT06	3600	3844	3973	3973	2772	1539	1547	1549	3978	4034	4029	4033	4020	3962	4059	4057	4551	4551	4560	4585	4705	4923	4923	4956	5347	5427	5439	5440

Streamflow units are cubic feet per second (cfs).

Minimum Stream Flows at Selected Locations for Period 1999 Through 2013

Location: Description:	Thurmond Dam	Columbia County Withdrawal	Stevens Creek Node ResSim	Edgefield County Withdrawal	Augusta Canal Diversion Withdrawal	Shoals Node ResSim	Augusta Withdrawal	North Augusta Withdrawal	Augusta - Hicks Plant Withdrawal	SCE&G Urquhart Withdrawal	DSM/PCS Nitrogen Withdrawal	Kimberly Clark - Beech Island Withdrawal	Augusta Node ResSim	International Paper Withdrawal	RM 183 (Fritz Cut, Angling Area) TNC	RM 177 (Spawning Bar) TNC	Savannah River Site Withdrawal	SCE&G SRS Area D Power Plant Withdrawal	Waynesboro Node ResSim	Plant Vogtle Withdrawal	RM 136 (Prime Mussel Habitat) TNC	Millhaven Node ResSim	RM 112 (Cutoff Channel Oxbow Habitat) TNC	RM 104 (Cohen's Bluff) TNC	Clyo Node ResSim	Savannah Electric - Plant McIntosh Withdrawal	Georgia Pacific Corporation Withdrawal	RM 41 Oxbow Habitat TNC
NAA	0	3296	3489	3489	2394	565	556	582	2822	2900	2950	3011	3182	3119	3335	3408	3685	3685	3704	3721	3766	3831	3826	3851	4217	4297	4306	4306
ALT01	0	2276	2600	2600	1566	237	378	366	2088	2213	2270	2318	2427	2324	2392	2375	2652	2652	2657	2661	2680	2696	2686	2718	2928	2956	2960	2960
ALT02	0	3261	3488	3487	2307	659	638	658	2936	3001	3041	3089	3182	3119	3335	3408	3630	3630	3639	3647	3679	3733	3729	3760	3973	3996	4000	4000
ALT03	0	2981	3423	3422	2162	449	529	559	2588	2715	2760	2906	3329	3243	3354	3330	3418	3418	3433	3451	3507	3520	3520	3564	3864	3883	3886	3886
ALT04	0	3261	3488	3487	2307	549	567	594	2798	2880	2929	2988	3214	3161	3345	3359	3588	3588	3589	3591	3604	3626	3608	3632	3973	3996	4000	4000
ALT05	0	2811	3381	3382	2407	853	889	928	3226	3417	3431	3449	3571	3490	3545	3548	3655	3655	3670	3675	3709	3787	3782	3802	4055	4083	4087	4088
ALT06	0	2811	3381	3382	2414	806	838	847	3227	3401	3410	3419	3532	3430	3553	3552	3703	3703	3721	3729	3771	3831	3827	3855	4115	4148	4153	4154

Streamflow units are cubic feet per second (cfs).

Annex D- Screen 16 (Savannah River Basin, Phase 2 Hydrodynamic Modeling Cont.)

Annex D- Screen 17 (Savannah River Basin Map)

Savannah River Basin Phase 2 Comprehensive Study
Hydrodynamic Modeling Results

90% Exceedance Water Surface Elevations at Selected Locations for Period 1939 Through 2013

Location: Description:	Thurmond Dam	Columbia County Withdrawal	Stevens Creek Node ResSim	Edgefield County Withdrawal	Augusta Canal Diversion Withdrawal	Shoals Node ResSim	Augusta Withdrawal	North Augusta Withdrawal	Augusta - Hicks Plant Withdrawal	SCE&G Urquhart Withdrawal	DSM/PCS Nitrogen Withdrawal	Kimberly Clark - Beech Island Withdrawal	Augusta Node ResSim	International Paper Withdrawal	RM 183 (Fritz Cut, Angling Area) TNC	RM 177 (Spawning Bar) TNC	Savannah River Site Withdrawal	SCE&G SRS Area D Power Plant Withdrawal	Waynesboro Node ResSim	Plant Vogtle Withdrawal	RM 136 (Prime Mussel Habitat) TNC	Millhaven Node ResSim	RM 112 (Cutoff Channel/ Oxbow Habitat) TNC	RM 104 (Cohen's Bluff) TNC	Clyo Node ResSim	Savannah Electric - Plant McIntosh Withdrawal	Georgia Pacific Corporation Withdrawal	RM 41 Oxbow Habitat TNC
NAA	184.9	184.8	184.8	154.3	147.0	139.5	116.7	116.3	116.2	116.2	116.1	116.1	97.7	96.6	95.4	92.3	82.9	82.9	79.6	79.3	69.9	57.1	53.2	48.2	17.3	8.8	7.5	6.4
ALT01	184.4	184.3	184.3	154.3	147.1	139.5	116.5	116.0	115.9	115.9	115.8	115.8	97.2	96.1	94.9	91.9	82.4	82.4	79.2	78.9	69.5	56.7	52.7	47.7	17.0	8.3	7.1	5.9
ALT02	184.8	184.7	184.7	154.3	147.0	139.5	116.7	116.2	116.1	116.1	116.0	116.0	97.5	96.4	95.2	92.1	82.7	82.7	79.5	79.1	69.8	57.0	53.0	48.1	17.3	8.7	7.4	6.3
ALT03	184.8	184.7	184.7	154.4	147.0	139.5	116.7	116.2	116.1	116.1	116.1	116.0	97.6	96.5	95.3	92.2	82.8	82.8	79.5	79.2	69.8	57.0	53.1	48.1	17.3	8.8	7.5	6.4
ALT04	184.6	184.5	184.5	154.3	147.1	139.5	116.6	116.0	116.0	115.9	115.9	115.8	97.3	96.2	95.0	91.9	82.4	82.4	79.3	78.9	69.6	56.7	52.8	47.8	17.1	8.4	7.2	6.0
ALT05	185.1	185.0	185.0	154.3	147.0	139.5	116.9	116.5	116.4	116.4	116.3	116.2	98.1	97.0	95.8	92.6	83.2	83.2	79.9	79.5	70.2	57.4	53.4	48.4	17.5	9.0	7.8	6.6
ALT06	185.4	185.2	185.2	154.3	147.1	139.5	117.0	116.7	116.6	116.5	116.5	116.4	98.3	97.3	96.1	92.9	83.6	83.6	80.2	79.8	70.5	57.7	53.8	48.8	17.8	9.4	8.1	7.0

Water surface elevations are in feet.

Minimum Water Surface Elevations at Selected Locations for Period 1939 Through 2013

Location: Description:	Thurmond Dam	Columbia County Withdrawal	Stevens Creek Node ResSim	Edgefield County Withdrawal	Augusta Canal Diversion Withdrawal	Shoals Node ResSim	Augusta Withdrawal	North Augusta Withdrawal	Augusta - Hicks Plant Withdrawal	SCE&G Urquhart Withdrawal	DSM/PCS Nitrogen Withdrawal	Kimberly Clark - Beech Island Withdrawal	Augusta Node ResSim	International Paper Withdrawal	RM 183 (Fritz Cut, Angling Area) TNC	RM 177 (Spawning Bar) TNC	Savannah River Site Withdrawal	SCE&G SRS Area D Power Plant Withdrawal	Waynesboro Node ResSim	Plant Vogtle Withdrawal	RM 136 (Prime Mussel Habitat) TNC	Millhaven Node ResSim	RM 112 (Cutoff Channel/ Oxbow Habitat) TNC	RM 104 (Cohen's Bluff) TNC	Clyo Node ResSim	Savannah Electric - Plant McIntosh Withdrawal	Georgia Pacific Corporation Withdrawal	RM 41 Oxbow Habitat TNC
NAA	183.7	183.6	183.6	154.1	144.2	138.2	115.6	115.3	115.2	115.1	115.1	115.1	96.4	95.3	94.0	90.8	81.3	81.3	77.7	77.2	68.8	55.8	51.6	46.7	16.0	6.8	5.5	4.5
ALT01	178.7	178.5	178.5	154.0	144.1	137.8	114.5	113.8	113.7	113.7	113.7	113.6	95.1	93.6	92.4	89.5	79.6	79.6	75.9	75.5	67.3	54.1	49.7	45.0	14.1	5.0	3.8	2.8
ALT02	183.7	183.6	183.6	154.1	144.2	138.4	115.7	115.3	115.2	115.1	115.1	115.1	96.4	95.3	94.0	90.8	81.0	81.0	77.4	76.9	68.5	55.4	51.2	46.6	15.9	6.7	5.4	4.4
ALT03	183.2	183.2	183.2	154.1	144.2	138.2	115.4	115.2	115.2	115.1	115.1	115.1	96.5	95.3	94.0	90.8	80.9	80.9	77.2	76.8	68.4	55.3	51.1	46.2	15.7	6.3	5.0	4.0
ALT04	183.7	183.6	183.6	154.1	144.2	138.3	115.5	115.3	115.2	115.1	115.1	115.1	96.5	95.2	94.0	90.8	81.0	81.0	77.3	76.8	68.5	55.3	51.1	46.3	15.7	6.3	5.0	4.0
ALT05	183.3	183.3	183.3	154.1	144.3	138.5	115.8	115.5	115.5	115.4	115.4	115.4	96.8	95.4	94.0	90.8	81.2	81.2	77.6	77.1	68.7	55.7	51.6	46.7	16.0	6.8	5.5	4.5
ALT06	183.3	183.3	183.3	154.1	144.2	138.5	115.8	115.5	115.4	115.4	115.4	115.3	96.8	95.4	94.0	90.8	81.3	81.3	77.7	77.2	68.8	55.8	51.7	46.8	16.1	7.0	5.7	4.6

Water surface elevations are in feet.

90% Exceedance Water Surface Elevations at Selected Locations for Period 1999 Through 2013

Location: Description:	Thurmond Dam	Columbia County Withdrawal	Stevens Creek Node ResSim	Edgefield County Withdrawal	Augusta Canal Diversion Withdrawal	Shoals Node ResSim	Augusta Withdrawal	North Augusta Withdrawal	Augusta - Hicks Plant Withdrawal	SCE&G Urquhart Withdrawal	DSM/PCS Nitrogen Withdrawal	Kimberly Clark - Beech Island Withdrawal	Augusta Node ResSim	International Paper Withdrawal	RM 183 (Fritz Cut, Angling Area) TNC	RM 177 (Spawning Bar) TNC	Savannah River Site Withdrawal	SCE&G SRS Area D Power Plant Withdrawal	Waynesboro Node ResSim	Plant Vogtle Withdrawal	RM 136 (Prime Mussel Habitat) TNC	Millhaven Node ResSim	RM 112 (Cutoff Channel/ Oxbow Habitat) TNC	RM 104 (Cohen's Bluff) TNC	Clyo Node ResSim	Savannah Electric - Plant McIntosh Withdrawal	Georgia Pacific Corporation Withdrawal	RM 41 Oxbow Habitat TNC
NAA	184.6	184.5	184.5	154.2	146.9	139.5	116.5	116.0	115.9	115.9	115.9	115.8	97.3	96.1	94.9	91.9	82.3	82.3	79.2	78.8	69.5	56.6	52.5	47.6	16.7	7.9	6.6	5.5
ALT01	181.4	181.3	181.3	154.2	146.8	139.5	116.0	115.0	115.0	114.9	114.9	114.9	96.1	94.7	93.5	90.5	80.8	80.8	77.2	76.7	68.4	55.5	51.4	46.5	16.0	6.9	5.6	4.5
ALT02	184.3	184.2	184.2	154.2	146.9	139.5	116.4	115.8	115.7	115.7	115.7	115.6	97.1	95.9	94.7	91.7	82.2	82.2	79.1	78.7	69.4	56.5	52.4	47.5	16.7	7.7	6.5	5.3
ALT03	184.1	183.9	183.9	154.2	146.8	139.5	116.3	115.6	115.6	115.5	115.5	115.5	96.9	95.7	94.5	91.5	81.9	81.9	78.9	78.5	69.1	56.2	52.2	47.2	16.5	7.5	6.3	5.2
ALT04	184.0	183.9	183.9	154.2	146.9	139.5	116.3	115.7	115.6	115.6	115.5	115.5	96.9	95.7	94.5	91.5	82.0	82.0	78.9	78.6	69.2	56.3	52.2	47.3	16.5	7.5	6.2	5.1
ALT05	184.6	184.5	184.5	154.2	146.8	139.5	116.6	116.0	116.0	115.9	115.9	115.8	97.3	96.2	95.0	91.9	82.5	82.5	79.4	79.0	69.7	56.8	52.9	47.9	17.0	8.3	7.0	5.9
ALT06	184.7	184.6	184.6	154.3	146.8	139.5	116.6	116.1	116.0	116.0	116.0	115.9	97.4	96.3	95.1	92.1	82.8	82.8	79.6	79.2	69.9	57.2	53.2	48.3	17.4	8.8	7.6	6.4

Water surface elevations are in feet.

Minimum Water Surface Elevations at Selected Locations for Period 1999 Through 2013

Location: Description:	Thurmond Dam	Columbia County Withdrawal	Stevens Creek Node ResSim	Edgefield County Withdrawal	Augusta Canal Diversion Withdrawal	Shoals Node ResSim	Augusta Withdrawal	North Augusta Withdrawal	Augusta - Hicks Plant Withdrawal	SCE&G Urquhart Withdrawal	DSM/PCS Nitrogen Withdrawal	Kimberly Clark - Beech Island Withdrawal	Augusta Node ResSim	International Paper Withdrawal	RM 183 (Fritz Cut, Angling Area) TNC	RM 177 (Spawning Bar) TNC	Savannah River Site Withdrawal	SCE&G SRS Area D Power Plant Withdrawal	Waynesboro Node ResSim	Plant Vogtle Withdrawal	RM 136 (Prime Mussel Habitat) TNC	Millhaven Node ResSim	RM 112 (Cutoff Channel/ Oxbow Habitat) TNC	RM 104 (Cohen's Bluff) TNC	Clyo Node ResSim	Savannah Electric - Plant McIntosh Withdrawal	Georgia Pacific Corporation Withdrawal	RM 41 Oxbow Habitat TNC
NAA	183.7	183.6	183.6	154.1	144.2	138.3	115.7	115.3	115.2	115.1	115.1	115.1	96.4	95.3	94.2	91.3	81.3	81.3	77.7	77.2	68.8	55.8	51.7	46.8	16.3	7.3	6.0	4.9
ALT01	178.7	178.5	178.5	154.0	144.1	137.8	114.5	113.8	113.7	113.7	113.7	113.6	95.1	93.6	92.4	89.5	79.6	79.6	76.0	75.5	67.4	54.1	49.8	45.2	14.4	5.3	4.0	3.0
ALT02	183.7	183.6	183.6	154.1	144.3	138.4	115.7	115.3	115.2	115.1	115.1	115.1	96.4	95.3	94.2	91.2	81.2	81.2	77.6	77.1	68.7	55.6	51.5	46.7	16.0	6.8	5.5	4.5
ALT03	183.5	183.4	183.4	154.1	144.2	138.2	115.4	115.2	115.2	115.1	115.1	115.1	96.5	95.3	94.0	90.9	80.9	80.9	77.3	76.8	68.5	55.3	51.2	46.5	15.9	6.7	5.4	4.3
ALT04	183.7	183.6	183.6	154.1	144.2	138.3	115.6	115.3	115.2	115.1	115.1	115.1	96.5	95.2	94.1	91.2	81.1	81.1	77.5	77.0	68.6	55.5	51.3	46.5	16.0	6.8	5.5	4.5
ALT05	183.3	183.3	183.3	154.1	144.4	138.7	116.0	115.5	115.5	115.4	115.4	115.4	96.8	95.6	94.3	91.3	81.2	81.2	77.6	77.1	68.7	55.7	51.6	46.8	16.1	6.9	5.7	4.6
ALT06	183.3	183.3	183.3	154.1	144.3	138.6	115.9	115.5	115.4	115.4	115.4	115.3	96.8	95.6	94.4	91.3	81.3	81.3	77.7	77.2	68.8	55.8	51.7	46.8	16.2	7.0	5.8	4.7

Water surface elevations are in feet.

Annex D- Screen 18 (Savannah River Basin, Phase 2 Hydrodynamic Modeling Cont.)

Savannah River Basin Phase 2 Comprehensive Study
Water Quality Modeling Results

10% Exceedance Water Temperature at Selected Locations for Period 1999 Through 2013

Location:	Highway 28	Augusta	Waynesboro	Millhaven	River Mile 87	Clyo
NAA	21.2	24.8	26.2	26.8	27.4	27.6
ALT01	21.3	24.8	26.3	26.9	27.4	27.6
ALT02	21.2	24.8	26.2	26.8	27.4	27.6
ALT03	21.3	24.9	26.4	27.0	27.5	27.7
ALT04	21.2	24.8	26.3	26.9	27.4	27.6
ALT05	21.2	24.8	26.2	26.8	27.4	27.5
ALT06	21.2	24.7	26.1	26.7	27.3	27.5

Water temperature in degrees Celsius.

Maximum Water Temperature at Selected Locations for Period 1999 Through 2013

Location:	Highway 28	Augusta	Waynesboro	Millhaven	River Mile 87	Clyo
NAA	24.5	28.3	28.7	30.6	32.0	32.1
ALT01	24.5	28.3	28.9	30.6	32.0	32.1
ALT02	24.5	28.3	28.7	30.6	32.0	32.1
ALT03	24.5	28.1	29.1	30.6	32.0	32.0
ALT04	24.5	28.3	28.8	30.6	32.0	32.1
ALT05	24.5	28.0	28.7	30.5	32.0	32.0
ALT06	24.5	27.6	28.7	30.5	32.0	32.0

Water temperature in degrees Celsius.

Annex D- Screen 19 (Savannah River Basin, Phase 2 Hydrodynamic Modeling Cont.)

13 Annex E - Savannah River Basin Comprehensive Study II: EFDC Output

EFDC OUTPUT ANALYSIS

EFDC output data was analyzed looking at a time window of January 1999 thru December 2013. The modeling effort and analysis of output for EFDC was performed by SouthCarolina DNR.

Salinity and Dissolved Oxygen Zone Analysis - Savannah Harbor 2015 SHEP Model Summary

The 2015 SHEP Savannah Harbor model was used to compile these results. All input conditions, parameters and kinetics were kept the same for all the runs and analyses. The only difference is the RIV1 flow, temperature, Daily Dissolved Oxygen, CBOD and Nitrogen values provide for the No Action Alternative (NAA) and the four alternatives – 01, 02 , 03 and 04. The model was run for 15 years – 1999 thru 2013. Alternatives 6 and 7 are also included.

Salinity, Daily Dissolved Oxygen, Temperature and Chloride results were compile and outputted at the average and 90 percentile (10 Percentile for Daily Dissolved Oxygen) levels. The results were compile and summarized by the 26 zones that were specified in the Savannah Harbor Draft EIS. The Zone descriptions are located in Section 5.

A chloride analysis was completed for the upper harbor/river area near the Savannah Water Intake, including number of days chloride levels were predicted to be above 12 mg/L.

The complete summary of every Zone and parameter results are located in the accompanying spreadsheet – SHEP NAA & Alternative 01- 04 Monthly Results – 1999-2013 Harbor Model.xlsx

The following zones have been identified as being indicators of the change in Harbor conditions due change in headwater conditions as indicated by each Alternative.

For the main Channel, Zones FR2, FR3, FR4 and FR5 represent the area of the Daily Dissolved Oxygen sag or the place where the lowest Daily Dissolved Oxygen levels occur.

For the Little Back, Back and Middle Rivers, Zones LBR1, LBR2, MR4 and MR5 as areas around the Fish and Wildlife Sanctuary where both Daily Dissolved Oxygen and Salinity are important.

Results for these critical zones are presented in this report.

13.1 Salinity Analysis by Zone

13.1.1 Average Salinity

Figure 5-1 (Average Salinity – NAA)

Average Salinity - NAA								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.2	2.5	0.2	13.3	10.2	7.6	6.5
Feb	0.2	0.3	3.5	0.4	14.5	11.4	8.9	7.6
Mar	0.3	0.5	4.4	0.5	15.7	12.7	10.1	8.7
Apr	0.1	0.1	1.5	0.1	10.3	7.2	5.1	4.5
May	0.1	0.1	1.9	0.1	12.1	8.9	6.4	5.5
Jun	0.0	0.0	1.2	0.0	10.9	7.7	5.3	4.6
Jul	0.1	0.2	2.9	0.2	13.9	10.9	8.3	7.2
Aug	0.4	0.5	3.8	0.6	14.9	12.0	9.3	8.1
Sep	0.2	0.2	1.9	0.3	10.7	7.8	5.7	4.9
Oct	0.2	0.3	2.6	0.3	13.1	10.0	7.4	6.3
Nov	0.5	0.7	4.3	0.8	15.8	12.7	10.1	8.7
Dec	0.2	0.3	2.2	0.3	11.8	8.8	6.4	5.5
Annual	0.2	0.3	2.7	0.3	13.1	10.0	7.6	6.5

Figure 5-2 (Average Salinity - Alternative 01)

Average Salinity - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.2	0.3	2.5	0.4	13.1	9.9	7.3	6.2
Feb	0.1	0.2	1.9	0.2	12.0	8.8	6.3	5.3
Mar	0.1	0.1	1.5	0.1	11.0	7.9	5.5	4.7
Apr	0.1	0.1	1.8	0.1	11.4	8.3	6.0	5.2
May	0.1	0.2	2.8	0.3	13.4	10.3	7.8	6.7
Jun	0.2	0.3	2.7	0.3	12.7	9.6	7.3	6.3
Jul	0.2	0.3	2.8	0.3	12.8	9.7	7.4	6.5
Aug	0.3	0.5	3.7	0.5	14.0	10.9	8.6	7.6
Sep	0.4	0.6	4.5	0.7	15.3	12.4	10.0	8.8
Oct	0.5	0.7	4.7	0.8	15.7	12.9	10.4	9.1
Nov	0.5	0.6	3.9	0.7	14.8	11.7	9.1	7.9
Dec	0.3	0.5	2.9	0.5	13.0	9.8	7.4	6.4
Annual	0.3	0.4	3.0	0.4	13.3	10.2	7.8	6.7

Figure 5-3 (Average Salinity - Alternative 02)

Average Salinity - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.2	0.3	2.5	0.3	12.9	9.7	7.2	6.2
Feb	0.4	0.5	3.5	0.6	14.4	11.3	8.7	7.5
Mar	0.5	0.7	4.2	0.8	15.6	12.5	9.9	8.6
Apr	0.1	0.2	1.5	0.2	10.2	7.1	5.0	4.4
May	0.2	0.2	2.1	0.3	11.9	8.7	6.2	5.4
Jun	0.1	0.1	1.4	0.1	10.7	7.5	5.1	4.5
Jul	0.3	0.4	3.0	0.4	13.8	10.8	8.2	7.1
Aug	0.4	0.6	3.7	0.6	14.9	11.9	9.3	8.0
Sep	0.2	0.2	1.9	0.3	10.7	7.8	5.7	4.9
Oct	0.2	0.3	2.6	0.3	13.1	10.0	7.4	6.4
Nov	0.5	0.7	4.3	0.8	15.8	12.7	10.1	8.7
Dec	0.2	0.3	2.2	0.3	11.8	8.8	6.4	5.5
Annual	0.3	0.4	2.7	0.4	13.0	9.9	7.5	6.4

Figure 5-4 (Average Salinity - Alternative 04)

Average Salinity - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.3	0.4	2.5	0.4	12.9	9.7	7.1	6.0
Feb	0.2	0.2	2.1	0.3	11.9	8.8	6.2	5.3
Mar	0.1	0.2	1.7	0.2	11.2	8.1	5.7	4.9
Apr	0.2	0.2	2.1	0.3	11.6	8.6	6.2	5.3
May	0.3	0.4	3.0	0.4	13.5	10.4	7.9	6.8
Jun	0.3	0.4	2.8	0.4	12.8	9.7	7.3	6.4
Jul	0.3	0.4	2.9	0.5	12.8	9.6	7.3	6.5
Aug	0.4	0.5	3.4	0.6	13.7	10.7	8.3	7.4
Sep	0.4	0.6	3.7	0.6	14.7	11.8	9.3	8.2
Oct	0.4	0.6	3.7	0.6	15.0	12.1	9.6	8.3
Nov	0.4	0.5	3.3	0.6	14.3	11.2	8.6	7.4
Dec	0.3	0.4	2.6	0.5	12.6	9.5	7.0	6.0
Annual	0.3	0.4	2.8	0.4	13.1	10.0	7.6	6.5

Figure 5-5 (Average Salinity - Alternative 05)

Average Salinity - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.3	0.3	2.6	0.4	13.1	9.9	7.2	6.1
Feb	0.2	0.2	2.0	0.3	11.9	8.8	6.2	5.3
Mar	0.1	0.2	1.7	0.2	11.3	8.2	5.7	4.9
Apr	0.2	0.2	2.1	0.3	11.8	8.7	6.3	5.4
May	0.3	0.3	2.8	0.4	13.3	10.1	7.6	6.6
Jun	0.3	0.4	2.9	0.4	13.1	10.0	7.6	6.6
Jul	0.3	0.4	3.1	0.5	13.0	9.9	7.6	6.7
Aug	0.3	0.4	3.0	0.4	13.2	10.1	7.7	6.8
Sep	0.3	0.3	3.1	0.4	14.0	11.0	8.5	7.5
Oct	0.3	0.4	3.2	0.5	14.4	11.6	8.9	7.7
Nov	0.4	0.5	3.1	0.5	14.1	11.0	8.4	7.2
Dec	0.3	0.3	2.4	0.4	12.3	9.2	6.7	5.8
Annual	0.3	0.3	2.7	0.4	13.0	9.9	7.4	6.4

Figure 5-6 (Average Salinity - Alternative 06)

Average Salinity - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.3	0.4	2.6	0.4	13.2	10.0	7.3	6.2
Feb	0.1	0.2	1.8	0.2	11.7	8.5	5.9	5.0
Mar	0.1	0.1	1.5	0.1	11.0	7.8	5.3	4.6
Apr	0.1	0.2	2.0	0.2	11.8	8.6	6.2	5.3
May	0.3	0.3	2.8	0.4	13.3	10.2	7.7	6.6
Jun	0.2	0.3	2.8	0.4	12.9	9.8	7.4	6.5
Jul	0.3	0.4	2.9	0.4	12.9	9.7	7.4	6.5
Aug	0.2	0.3	2.7	0.3	12.8	9.7	7.3	6.4
Sep	0.2	0.2	2.6	0.3	13.4	10.5	7.9	6.9
Oct	0.2	0.2	2.7	0.3	13.7	10.8	8.2	7.1
Nov	0.3	0.4	2.9	0.4	13.9	10.9	8.2	7.0
Dec	0.2	0.3	2.3	0.4	12.4	9.3	6.7	5.8
Annual	0.2	0.3	2.5	0.3	12.8	9.7	7.1	6.2

13.1.2 Average Salinity Delta Change from NAA

Figure 5-7 (Average Delta Salinity Increase from NAA Alternative 01)

Average Delta Salinity Increase from NAA - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.2	0.0	0.2	-0.2	-0.3	-0.3	-0.3
Feb	-0.1	-0.2	-1.6	-0.2	-2.5	-2.6	-2.6	-2.3
Mar	-0.3	-0.4	-3.0	-0.4	-4.7	-4.8	-4.6	-4.0
Apr	0.0	0.0	0.4	0.0	1.1	1.1	0.9	0.7
May	0.1	0.1	0.9	0.1	1.3	1.4	1.4	1.2
Jun	0.2	0.2	1.4	0.2	1.8	1.9	2.0	1.7
Jul	0.1	0.1	-0.1	0.1	-1.1	-1.2	-0.9	-0.7
Aug	-0.1	-0.1	0.0	-0.1	-0.9	-1.0	-0.7	-0.4
Sep	0.3	0.4	2.6	0.4	4.5	4.5	4.3	3.9
Oct	0.3	0.4	2.1	0.4	2.6	2.9	2.9	2.7
Nov	-0.1	-0.1	-0.4	-0.1	-1.0	-1.0	-1.0	-0.8
Dec	0.1	0.2	0.7	0.2	1.2	1.1	1.0	0.9
Annual	0.1	0.1	0.3	0.1	0.2	0.2	0.2	0.2

Figure 5-8 (Average Delta Salinity Increase from NAA Alternative 02)

Average Delta Salinity Increase from NAA - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.1	0.0	0.2	-0.5	-0.5	-0.4	-0.3
Feb	0.2	0.2	0.0	0.2	-0.1	-0.1	-0.1	-0.1
Mar	0.2	0.2	-0.2	0.3	-0.1	-0.1	-0.2	-0.1
Apr	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1	-0.1
May	0.1	0.1	0.2	0.1	-0.1	-0.1	-0.1	-0.1
Jun	0.0	0.0	0.1	0.1	-0.1	-0.2	-0.1	-0.1
Jul	0.2	0.2	0.1	0.2	-0.1	-0.1	-0.1	-0.1
Aug	0.1	0.1	-0.1	0.1	0.0	0.0	-0.1	0.0
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1	-0.1

Figure 5-9 (Average Delta Salinity Increase from NAA Alternative 03)

Average Delta Salinity Increase from NAA - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.1	-0.1	0.1	-0.3	-0.4	-0.4	-0.4
Feb	-0.1	-0.2	-1.7	-0.2	-2.6	-2.7	-2.7	-2.4
Mar	-0.3	-0.4	-2.9	-0.4	-4.5	-4.6	-4.4	-3.9
Apr	0.0	0.0	0.5	0.1	1.5	1.5	1.2	1.0
May	0.1	0.2	1.0	0.2	1.4	1.5	1.6	1.3
Jun	0.2	0.3	1.7	0.3	2.1	2.2	2.3	2.0
Jul	0.1	0.1	-0.1	0.2	-1.1	-1.2	-0.9	-0.7
Aug	-0.1	-0.2	-0.5	-0.2	-1.3	-1.5	-1.2	-0.9
Sep	0.1	0.2	1.6	0.2	3.8	3.7	3.4	3.0
Oct	0.1	0.1	1.0	0.1	1.7	2.0	2.0	1.8
Nov	-0.3	-0.3	-1.1	-0.4	-1.6	-1.6	-1.6	-1.5
Dec	0.0	0.0	0.3	0.0	0.9	0.8	0.7	0.5
Annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 5-10 (Average Delta Salinity Increase from NAA Alternative 04)

Average Delta Salinity Increase from NAA - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.2	0.2	0.0	0.2	-0.5	-0.5	-0.6	-0.5
Feb	0.0	-0.1	-1.5	-0.1	-2.6	-2.6	-2.7	-2.3
Mar	-0.2	-0.3	-2.7	-0.4	-4.5	-4.6	-4.4	-3.8
Apr	0.1	0.1	0.6	0.2	1.3	1.4	1.1	0.9
May	0.2	0.3	1.1	0.3	1.4	1.5	1.5	1.3
Jun	0.3	0.3	1.6	0.4	1.9	2.0	2.1	1.8
Jul	0.2	0.2	0.0	0.3	-1.2	-1.3	-0.9	-0.7
Aug	0.0	0.0	-0.3	0.0	-1.2	-1.3	-1.0	-0.7
Sep	0.3	0.3	1.7	0.3	4.0	3.9	3.6	3.3
Oct	0.2	0.3	1.1	0.3	1.9	2.1	2.1	1.9
Nov	-0.1	-0.2	-1.0	-0.2	-1.4	-1.5	-1.5	-1.3
Dec	0.1	0.1	0.4	0.1	0.8	0.7	0.6	0.5
Annual	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0

Figure 5-11 (Average Delta Salinity Increase from NAA Alternative 05)

Average Delta Salinity Increase from NAA - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.2	0.2	0.0	0.2	-0.3	-0.3	-0.4	-0.4
Feb	0.0	-0.1	-1.5	-0.1	-2.6	-2.6	-2.7	-2.4
Mar	-0.2	-0.3	-2.7	-0.4	-4.5	-4.5	-4.4	-3.8
Apr	0.1	0.1	0.6	0.2	1.5	1.5	1.2	1.0
May	0.2	0.2	0.9	0.3	1.2	1.3	1.3	1.1
Jun	0.3	0.3	1.7	0.4	2.2	2.3	2.3	2.0
Jul	0.2	0.2	0.1	0.3	-0.9	-0.9	-0.6	-0.5
Aug	-0.1	-0.2	-0.8	-0.2	-1.7	-1.8	-1.6	-1.3
Sep	0.1	0.1	1.1	0.1	3.2	3.2	2.8	2.5
Oct	0.1	0.1	0.6	0.1	1.3	1.6	1.5	1.4
Nov	-0.2	-0.2	-1.1	-0.3	-1.7	-1.7	-1.7	-1.5
Dec	0.0	0.0	0.1	0.1	0.5	0.5	0.3	0.2
Annual	0.1	0.0	-0.1	0.1	-0.1	-0.1	-0.2	-0.1

Figure 5-12 (Average Delta Salinity Increase from NAA Alternative 06)

Average Delta Salinity Increase from NAA - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.2	0.2	0.1	0.3	-0.2	-0.2	-0.3	-0.3
Feb	-0.1	-0.2	-1.7	-0.2	-2.8	-2.9	-3.0	-2.6
Mar	-0.2	-0.4	-2.9	-0.4	-4.8	-4.9	-4.8	-4.2
Apr	0.1	0.1	0.5	0.1	1.5	1.4	1.1	0.9
May	0.2	0.2	0.9	0.3	1.2	1.3	1.3	1.1
Jun	0.2	0.3	1.5	0.3	2.0	2.1	2.1	1.8
Jul	0.1	0.2	-0.1	0.2	-1.1	-1.2	-0.9	-0.7
Aug	-0.2	-0.2	-1.1	-0.2	-2.1	-2.3	-2.1	-1.7
Sep	0.0	0.0	0.7	0.0	2.7	2.6	2.2	2.0
Oct	0.0	0.0	0.1	-0.1	0.6	0.9	0.7	0.7
Nov	-0.2	-0.3	-1.4	-0.3	-1.8	-1.8	-1.9	-1.7
Dec	0.0	0.0	0.1	0.0	0.6	0.5	0.3	0.2
Annual	0.0	0.0	-0.3	0.0	-0.3	-0.4	-0.4	-0.4

13.1.3 90 Percentile Salinity

Figure 5-13 (90 Percentile Salinity - NAA)

90 Percentile Salinity - NAA								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.2	0.4	4.0	0.4	15.4	12.6	10.0	8.5
Feb	0.5	0.7	5.3	0.8	16.6	13.7	11.1	9.7
Mar	0.6	0.9	6.3	1.0	17.7	14.7	12.1	10.6
Apr	0.2	0.4	4.1	0.4	15.8	12.8	10.0	8.7
May	0.2	0.3	3.7	0.4	15.2	12.1	9.3	8.2
Jun	0.0	0.1	2.6	0.1	14.4	11.4	8.5	7.3
Jul	0.3	0.5	4.6	0.6	16.2	13.4	10.7	9.2
Aug	0.7	0.9	5.4	1.1	17.1	14.3	11.7	10.2
Sep	0.5	0.6	3.9	0.7	15.6	12.6	9.9	8.7
Oct	0.5	0.6	4.0	0.8	15.7	12.7	10.0	8.6
Nov	0.8	1.1	5.5	1.3	17.3	14.5	11.9	10.2
Dec	0.7	0.9	4.7	0.9	16.7	13.8	11.0	9.5
Annual	0.4	0.6	4.5	0.7	16.1	13.2	10.5	9.1

Figure 5-14 (90 Percentile Salinity - Alternative 01)

90 Percentile Salinity - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.8	1.1	5.0	1.1	17.0	13.7	11.0	9.4
Feb	0.4	0.6	4.0	0.7	15.8	12.6	9.8	8.2
Mar	0.2	0.3	3.2	0.3	14.7	11.7	8.8	7.4
Apr	0.3	0.4	3.9	0.5	15.5	12.6	9.8	8.4
May	0.5	0.7	4.9	0.7	16.4	13.5	10.8	9.4
Jun	0.5	0.7	4.9	0.7	16.2	13.2	10.7	9.3
Jul	0.8	1.1	6.4	1.2	17.3	14.3	12.0	10.6
Aug	0.9	1.2	7.0	1.4	18.0	15.1	12.8	11.2
Sep	1.2	1.5	7.8	1.8	18.6	15.7	13.5	11.9
Oct	1.4	1.8	7.6	1.9	18.8	16.0	13.5	12.0
Nov	1.3	1.7	7.0	1.7	18.7	15.4	12.9	11.3
Dec	1.0	1.3	6.3	1.4	18.0	14.9	12.2	10.7
Annual	0.8	1.0	5.6	1.1	17.1	14.0	11.5	10.0

Figure 5-15 (90 Percentile Salinity - Alternative 02)

90 Percentile Salinity - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.4	0.6	3.9	0.7	15.3	12.4	9.7	8.3
Feb	0.7	0.9	5.0	1.1	16.4	13.5	11.0	9.6
Mar	0.9	1.1	5.7	1.4	17.5	14.6	12.0	10.5
Apr	0.4	0.5	3.9	0.6	15.7	12.8	9.8	8.6
May	0.4	0.6	3.9	0.7	15.1	11.9	9.2	8.2
Jun	0.2	0.2	2.9	0.3	14.3	11.3	8.4	7.2
Jul	0.5	0.7	4.4	0.9	16.1	13.3	10.5	9.1
Aug	0.8	1.0	5.2	1.2	17.0	14.2	11.6	10.2
Sep	0.5	0.6	3.9	0.7	15.6	12.6	9.9	8.6
Oct	0.5	0.6	4.1	0.8	15.7	12.8	10.0	8.6
Nov	0.8	1.1	5.5	1.3	17.3	14.5	11.9	10.3
Dec	0.7	0.9	4.7	0.9	16.7	13.8	11.1	9.5
Annual	0.6	0.7	4.4	0.9	16.1	13.1	10.4	9.1

Figure 5-16 (90 Percentile Salinity - Alternative 03)

90 Percentile Salinity - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.5	0.7	4.2	0.8	16.0	12.8	9.9	8.4
Feb	0.4	0.6	3.8	0.7	15.4	12.2	9.4	7.8
Mar	0.2	0.3	3.1	0.3	14.7	11.7	8.8	7.4
Apr	0.3	0.4	4.0	0.5	15.7	12.8	9.9	8.7
May	0.4	0.6	4.7	0.7	16.3	13.4	10.7	9.2
Jun	0.6	0.8	4.9	0.9	16.2	13.4	10.8	9.4
Jul	0.8	1.0	5.7	1.2	17.1	14.1	11.6	10.2
Aug	0.7	0.9	5.8	1.0	17.1	14.3	11.7	10.2
Sep	0.7	0.9	5.5	1.0	17.2	14.4	11.8	10.3
Oct	0.7	0.9	5.2	1.0	17.1	14.3	11.7	10.0
Nov	0.6	0.9	5.2	0.9	17.2	14.1	11.5	9.7
Dec	0.5	0.7	4.6	0.8	16.7	13.6	10.9	9.1
Annual	0.5	0.7	4.7	0.8	16.4	13.4	10.7	9.2

Figure 5-17 (90 Percentile Salinity - Alternative 04)

90 Percentile Salinity - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.6	0.8	4.4	1.0	16.3	13.0	10.1	8.5
Feb	0.5	0.7	4.0	0.8	15.6	12.4	9.7	8.0
Mar	0.3	0.5	3.3	0.6	14.7	11.8	8.9	7.4
Apr	0.5	0.6	3.9	0.7	15.5	12.5	9.8	8.5
May	0.6	0.8	4.6	1.0	16.5	13.5	10.7	9.4
Jun	0.6	0.8	4.8	1.0	16.0	13.1	10.6	9.2
Jul	0.9	1.2	5.8	1.4	17.2	14.3	11.9	10.5
Aug	0.9	1.2	5.9	1.4	17.5	14.7	12.1	10.8
Sep	0.8	1.1	5.6	1.3	17.5	14.7	12.3	10.6
Oct	0.8	1.0	5.2	1.1	17.4	14.7	12.0	10.3
Nov	0.8	1.0	5.1	1.2	17.3	14.4	11.7	9.9
Dec	0.7	1.0	4.7	1.1	16.7	13.8	11.1	9.3
Annual	0.7	0.9	4.8	1.0	16.5	13.6	10.9	9.4

Figure 5-18 (90 Percentile Salinity - Alternative 05)

90 Percentile Salinity - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.6	0.8	4.1	1.0	16.0	12.8	9.8	8.3
Feb	0.4	0.6	3.6	0.7	15.3	12.1	9.1	7.6
Mar	0.3	0.4	3.3	0.6	14.7	11.8	8.9	7.5
Apr	0.4	0.6	3.9	0.7	15.6	12.6	9.8	8.5
May	0.5	0.7	4.5	0.9	16.1	13.1	10.4	9.0
Jun	0.6	0.8	4.6	1.0	15.7	12.8	10.2	8.9
Jul	0.7	0.9	4.9	1.1	16.4	13.5	10.9	9.6
Aug	0.6	0.8	4.6	0.9	16.4	13.3	10.6	9.4
Sep	0.5	0.7	4.6	0.9	16.4	13.5	10.9	9.5
Oct	0.6	0.8	4.6	0.9	16.6	13.8	11.1	9.5
Nov	0.7	0.9	4.9	1.1	17.1	14.1	11.4	9.7
Dec	0.6	0.8	4.4	1.0	16.5	13.4	10.7	9.0
Annual	0.6	0.7	4.3	0.9	16.1	13.1	10.3	8.9

Figure 5-19 (90 Percentile Salinity - Alternative 06)

90 Percentile Salinity - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.6	0.8	4.1	1.0	15.9	12.6	9.7	8.2
Feb	0.4	0.5	3.3	0.5	14.6	11.5	8.5	7.1
Mar	0.2	0.3	2.9	0.4	14.0	10.9	7.9	6.8
Apr	0.4	0.5	3.7	0.7	15.3	12.3	9.4	8.1
May	0.5	0.7	4.2	0.8	15.8	12.9	10.1	8.6
Jun	0.5	0.7	4.5	0.9	15.7	12.8	10.2	8.9
Jul	0.6	0.8	4.7	1.0	16.0	13.0	10.3	9.1
Aug	0.5	0.6	4.3	0.8	15.6	12.6	9.9	8.8
Sep	0.4	0.5	4.1	0.7	15.6	12.7	9.9	8.7
Oct	0.4	0.5	3.8	0.6	15.6	12.8	10.1	8.6
Nov	0.7	0.9	4.7	1.0	16.7	13.9	11.0	9.3
Dec	0.6	0.8	4.3	0.9	16.3	13.1	10.5	8.9
Annual	0.5	0.6	4.0	0.8	15.6	12.6	9.8	8.4

13.1.4 90 Percentile Salinity Delta Change from NAA

Figure 5-20 (90 Percentile Delta Salinity Increase from NAA Alternative 01)

90 Percentile Delta Salinity Increase from NAA - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.5	0.7	0.9	0.7	1.6	1.1	1.1	0.9
Feb	-0.1	-0.1	-1.4	-0.2	-0.8	-1.1	-1.3	-1.4
Mar	-0.4	-0.6	-3.1	-0.7	-3.0	-3.0	-3.4	-3.2
Apr	0.1	0.1	-0.2	0.1	-0.3	-0.3	-0.2	-0.3
May	0.3	0.4	1.2	0.3	1.2	1.4	1.5	1.2
Jun	0.4	0.6	2.2	0.7	1.8	1.8	2.3	1.9
Jul	0.5	0.6	1.8	0.7	1.1	0.8	1.3	1.3
Aug	0.1	0.3	1.6	0.3	0.9	0.8	1.1	1.1
Sep	0.7	0.9	3.9	1.1	3.0	3.1	3.6	3.2
Oct	0.9	1.2	3.5	1.1	3.1	3.2	3.5	3.4
Nov	0.5	0.6	1.5	0.4	1.4	0.9	1.0	1.1
Dec	0.3	0.4	1.6	0.4	1.3	1.1	1.2	1.2
Annual	0.3	0.4	1.1	0.4	0.9	0.8	1.0	0.9

Figure 5-21 (90 Percentile Delta Salinity Increase from NAA Alternative 02)

90 Percentile Delta Salinity Increase from NAA - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.2	0.2	-0.1	0.3	-0.1	-0.2	-0.2	-0.2
Feb	0.2	0.2	-0.3	0.3	-0.1	-0.1	-0.1	-0.1
Mar	0.3	0.3	-0.6	0.3	-0.1	-0.1	-0.2	-0.1
Apr	0.2	0.2	-0.2	0.2	-0.2	0.0	-0.2	-0.1
May	0.2	0.3	0.2	0.3	-0.1	-0.2	-0.1	-0.1
Jun	0.2	0.2	0.2	0.2	-0.1	-0.1	0.0	-0.1
Jul	0.2	0.2	-0.2	0.3	-0.1	-0.1	-0.2	-0.1
Aug	0.1	0.1	-0.1	0.1	-0.1	-0.1	-0.1	0.0
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0
Annual	0.1	0.1	-0.1	0.2	-0.1	-0.1	-0.1	-0.1

Figure 5-22 (90 Percentile Delta Salinity Increase from NAA Alternative 03)

90 Percentile Delta Salinity Increase from NAA - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.3	0.3	0.2	0.4	0.6	0.2	-0.1	-0.1
Feb	-0.1	-0.1	-1.5	-0.2	-1.2	-1.5	-1.7	-1.8
Mar	-0.4	-0.6	-3.2	-0.7	-3.0	-3.0	-3.4	-3.1
Apr	0.1	0.1	-0.1	0.1	-0.2	-0.1	0.0	0.0
May	0.2	0.3	1.0	0.3	1.1	1.3	1.3	1.0
Jun	0.5	0.7	2.3	0.8	1.8	2.0	2.4	2.0
Jul	0.4	0.6	1.2	0.6	0.9	0.7	0.9	1.0
Aug	-0.1	-0.1	0.5	-0.1	0.0	0.0	-0.1	0.0
Sep	0.2	0.3	1.6	0.3	1.6	1.8	1.9	1.7
Oct	0.2	0.2	1.2	0.2	1.4	1.6	1.7	1.4
Nov	-0.2	-0.2	-0.3	-0.4	-0.1	-0.4	-0.4	-0.5
Dec	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.4
Annual	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.1

Figure 5-23 (90 Percentile Delta Salinity Increase from NAA Alternative 04)

Average Delta Salinity Increase from NAA - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.2	0.2	0.0	0.2	-0.5	-0.5	-0.6	-0.5
Feb	0.0	-0.1	-1.5	-0.1	-2.6	-2.6	-2.7	-2.3
Mar	-0.2	-0.3	-2.7	-0.4	-4.5	-4.6	-4.4	-3.8
Apr	0.1	0.1	0.6	0.2	1.3	1.4	1.1	0.9
May	0.2	0.3	1.1	0.3	1.4	1.5	1.5	1.3
Jun	0.3	0.3	1.6	0.4	1.9	2.0	2.1	1.8
Jul	0.2	0.2	0.0	0.3	-1.2	-1.3	-0.9	-0.7
Aug	0.0	0.0	-0.3	0.0	-1.2	-1.3	-1.0	-0.7
Sep	0.3	0.3	1.7	0.3	4.0	3.9	3.6	3.3
Oct	0.2	0.3	1.1	0.3	1.9	2.1	2.1	1.9
Nov	-0.1	-0.2	-1.0	-0.2	-1.4	-1.5	-1.5	-1.3
Dec	0.1	0.1	0.4	0.1	0.8	0.7	0.6	0.5
Annual	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0

Figure 5-24 (90 Percentile Delta Salinity Increase from NAA Alternative 05)

90 Percentile Delta Salinity Increase from NAA - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.3	0.4	0.1	0.6	0.6	0.2	-0.1	-0.2
Feb	0.0	-0.1	-1.7	-0.1	-1.3	-1.6	-2.0	-2.1
Mar	-0.3	-0.4	-3.0	-0.5	-2.9	-2.9	-3.2	-3.1
Apr	0.2	0.2	-0.2	0.3	-0.3	-0.2	-0.1	-0.2
May	0.3	0.4	0.8	0.6	0.9	1.0	1.1	0.7
Jun	0.6	0.7	2.0	0.9	1.3	1.4	1.7	1.6
Jul	0.3	0.4	0.4	0.5	0.2	0.1	0.3	0.4
Aug	-0.2	-0.2	-0.8	-0.2	-0.7	-1.0	-1.2	-0.8
Sep	0.1	0.1	0.7	0.2	0.8	0.9	1.0	0.8
Oct	0.1	0.2	0.6	0.2	0.9	1.1	1.1	0.8
Nov	-0.1	-0.1	-0.6	-0.2	-0.2	-0.4	-0.6	-0.5
Dec	0.0	0.0	-0.3	0.0	-0.2	-0.4	-0.4	-0.4
Annual	0.1	0.1	-0.2	0.2	-0.1	-0.2	-0.2	-0.2

Figure 5-25 (90 Percentile Delta Salinity Increase from NAA Alternative 06)

90 Percentile Delta Salinity Increase from NAA - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.3	0.4	0.1	0.6	0.5	0.0	-0.2	-0.3
Feb	-0.1	-0.2	-2.1	-0.3	-2.0	-2.2	-2.6	-2.5
Mar	-0.4	-0.6	-3.4	-0.6	-3.7	-3.8	-4.2	-3.8
Apr	0.2	0.2	-0.4	0.3	-0.5	-0.6	-0.6	-0.6
May	0.3	0.4	0.5	0.5	0.6	0.8	0.8	0.4
Jun	0.5	0.6	1.9	0.8	1.3	1.4	1.7	1.6
Jul	0.3	0.3	0.1	0.4	-0.2	-0.4	-0.3	-0.2
Aug	-0.2	-0.3	-1.1	-0.3	-1.5	-1.7	-1.8	-1.4
Sep	-0.1	-0.1	0.1	0.0	0.0	0.1	0.0	0.1
Oct	-0.1	-0.1	-0.2	-0.2	-0.1	0.0	0.0	0.0
Nov	-0.1	-0.2	-0.8	-0.3	-0.6	-0.6	-0.9	-0.9
Dec	-0.1	0.0	-0.4	0.0	-0.4	-0.7	-0.5	-0.6
Annual	0.0	0.0	-0.5	0.1	-0.5	-0.6	-0.7	-0.7

13.2 Dissolved Oxygen

13.2.1 Surface Daily Dissolved Oxygen Analysis

13.2.1.1 Average Surface Daily Dissolved Oxygen

Figure 5-26 (Surface Average Dissolved Oxygen – NAA)

Average Dissolved Oxygen - NAA								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.1	10.1	9.7	10.1	8.3	8.5	8.8	9.0
Feb	9.9	9.9	9.6	9.9	8.4	8.6	8.9	9.0
Mar	9.1	8.9	8.8	9.1	7.7	8.0	8.2	8.3
Apr	7.9	7.7	7.5	7.9	6.5	6.7	7.0	7.1
May	6.7	6.4	6.2	6.7	5.1	5.3	5.6	5.7
Jun	6.1	5.7	5.6	6.1	4.5	4.7	4.9	5.0
Jul	5.9	5.4	5.2	5.9	4.1	4.4	4.6	4.7
Aug	5.8	5.3	5.1	5.8	3.8	4.1	4.3	4.4
Sep	6.5	6.0	5.6	6.5	4.2	4.4	4.7	4.8
Oct	7.1	6.9	6.4	7.0	4.9	5.0	5.3	5.5
Nov	8.5	8.4	7.9	8.4	6.3	6.5	6.8	7.0
Dec	9.6	9.5	9.1	9.5	7.7	8.0	8.2	8.4
Annual	7.8	7.5	7.2	7.8	6.0	6.2	6.5	6.6

Figure 5-27 (Surface Average Dissolved Oxygen – Alternative 01)

Average Dissolved Oxygen - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.1	10.1	9.7	10.1	8.3	8.5	8.8	9.0
Feb	9.9	9.8	9.6	9.9	8.4	8.6	8.9	9.0
Mar	9.1	8.9	8.8	9.1	7.7	8.0	8.3	8.3
Apr	7.9	7.7	7.6	8.0	6.5	6.8	7.0	7.1
May	6.7	6.4	6.2	6.8	5.2	5.4	5.6	5.7
Jun	6.2	5.7	5.6	6.2	4.5	4.8	5.0	5.1
Jul	5.9	5.3	5.2	6.0	4.1	4.3	4.6	4.7
Aug	5.7	5.2	4.9	5.8	3.8	4.0	4.2	4.3
Sep	6.3	5.8	5.3	6.3	4.0	4.2	4.4	4.5
Oct	6.9	6.7	6.1	6.8	4.7	4.8	5.0	5.2
Nov	8.4	8.3	7.7	8.3	6.2	6.4	6.6	6.8
Dec	9.5	9.4	9.0	9.5	7.6	7.9	8.2	8.3
Annual	7.7	7.5	7.1	7.7	5.9	6.1	6.4	6.5

Figure 5-28 (Surface Average Dissolved Oxygen – Alternative 02)

Average Dissolved Oxygen - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.1	10.1	9.7	10.1	8.3	8.6	8.9	9.1
Feb	9.9	9.8	9.6	9.8	8.3	8.6	8.9	9.0
Mar	8.9	8.8	8.7	8.9	7.6	7.8	8.1	8.2
Apr	7.9	7.7	7.5	7.9	6.5	6.7	7.0	7.1
May	6.7	6.5	6.3	6.7	5.2	5.4	5.6	5.7
Jun	6.1	5.7	5.6	6.1	4.4	4.7	4.9	5.0
Jul	5.9	5.4	5.3	5.9	4.0	4.3	4.6	4.7
Aug	5.9	5.4	5.2	5.9	3.9	4.2	4.4	4.5
Sep	6.5	6.1	5.8	6.5	4.3	4.5	4.8	4.9
Oct	7.2	7.0	6.6	7.1	5.0	5.2	5.4	5.6
Nov	8.6	8.5	8.0	8.5	6.4	6.7	7.0	7.1
Dec	9.6	9.5	9.2	9.5	7.8	8.1	8.4	8.5
Annual	7.8	7.5	7.3	7.7	6.0	6.2	6.5	6.6

Figure 5-29 (Surface Average Dissolved Oxygen – Alternative 03)

Average Dissolved Oxygen - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.1	10.1	9.7	10.1	8.3	8.5	8.8	9.0
Feb	9.9	9.9	9.6	9.9	8.4	8.6	8.9	9.0
Mar	9.1	8.9	8.8	9.1	7.7	8.0	8.2	8.3
Apr	7.9	7.7	7.5	7.9	6.5	6.7	7.0	7.1
May	6.7	6.4	6.2	6.7	5.1	5.3	5.6	5.7
Jun	6.1	5.7	5.6	6.1	4.5	4.7	4.9	5.0
Jul	5.9	5.4	5.2	5.9	4.1	4.4	4.6	4.7
Aug	5.8	5.3	5.1	5.8	3.8	4.1	4.3	4.4
Sep	6.5	6.0	5.6	6.5	4.2	4.4	4.7	4.8
Oct	7.1	6.9	6.4	7.0	4.9	5.0	5.3	5.5
Nov	8.5	8.4	7.9	8.4	6.3	6.5	6.8	7.0
Dec	9.6	9.5	9.1	9.5	7.7	8.0	8.2	8.4
Annual	7.8	7.5	7.2	7.8	6.0	6.2	6.5	6.6

Figure 5-30 (Surface Average Dissolved Oxygen – Alternative 04)

Average Dissolved Oxygen - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.1	10.1	9.7	10.1	8.3	8.6	8.9	9.0
Feb	9.9	9.8	9.6	9.9	8.4	8.6	8.9	9.0
Mar	9.1	8.9	8.8	9.1	7.7	8.0	8.2	8.3
Apr	7.9	7.7	7.6	7.9	6.5	6.8	7.0	7.1
May	6.7	6.5	6.3	6.7	5.2	5.4	5.6	5.7
Jun	6.2	5.8	5.7	6.2	4.5	4.8	5.0	5.1
Jul	5.9	5.4	5.3	5.9	4.1	4.4	4.6	4.7
Aug	5.8	5.3	5.1	5.8	3.8	4.1	4.3	4.4
Sep	6.4	6.0	5.7	6.4	4.2	4.4	4.6	4.8
Oct	7.0	6.9	6.4	7.0	4.9	5.0	5.3	5.4
Nov	8.5	8.4	7.9	8.4	6.3	6.5	6.8	7.0
Dec	9.5	9.5	9.1	9.5	7.7	8.0	8.3	8.4
Annual	7.7	7.5	7.3	7.7	6.0	6.2	6.5	6.6

Figure 5-31 (Surface Average Dissolved Oxygen – Alternative 05)

Average Dissolved Oxygen - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.11	10.08	9.72	10.07	7.44	7.35	7.50	7.56
Feb	9.90	9.85	9.61	9.89	7.52	7.43	7.58	7.65
Mar	9.04	8.93	8.77	9.05	6.88	6.78	6.89	6.93
Apr	7.86	7.68	7.52	7.87	5.82	5.68	5.71	5.73
May	6.78	6.52	6.35	6.79	4.76	4.56	4.48	4.47
Jun	6.07	5.68	5.54	6.08	3.95	3.69	3.57	3.54
Jul	5.81	5.31	5.16	5.85	3.45	3.17	3.03	3.01
Aug	5.86	5.40	5.21	5.90	3.35	3.05	2.90	2.89
Sep	6.52	6.12	5.85	6.56	3.80	3.51	3.39	3.37
Oct	7.14	6.96	6.56	7.09	4.49	4.23	4.15	4.12
Nov	8.49	8.40	7.95	8.43	5.67	5.50	5.53	5.54
Dec	9.58	9.54	9.20	9.55	6.85	6.72	6.84	6.89
Annual	7.76	7.54	7.29	7.76	5.33	5.14	5.13	5.14

Figure 5-32 (Surface Average Dissolved Oxygen – Alternative 06)

Average Dissolved Oxygen - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.10	10.07	9.70	10.06	7.43	7.34	7.49	7.55
Feb	9.95	9.89	9.67	9.94	7.52	7.43	7.58	7.65
Mar	9.13	9.01	8.87	9.14	6.89	6.80	6.91	6.96
Apr	7.92	7.74	7.58	7.93	5.83	5.69	5.72	5.74
May	6.79	6.52	6.35	6.80	4.75	4.55	4.48	4.46
Jun	6.11	5.74	5.60	6.13	3.97	3.72	3.60	3.58
Jul	5.88	5.39	5.25	5.93	3.47	3.19	3.06	3.05
Aug	5.95	5.50	5.33	6.00	3.40	3.10	2.97	2.97
Sep	6.61	6.23	5.98	6.66	3.87	3.59	3.48	3.47
Oct	7.26	7.08	6.73	7.24	4.57	4.31	4.25	4.23
Nov	8.51	8.43	8.00	8.46	5.71	5.53	5.56	5.58
Dec	9.57	9.52	9.19	9.54	6.83	6.70	6.82	6.87
Annual	7.81	7.59	7.35	7.82	5.35	5.16	5.16	5.18

13.2.1.2 Average Surface Daily Dissolved Oxygen Delta

Figure 5-33 (Average Delta Surface Dissolved Oxygen Increase from NAA - Alternative 01)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aug	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1
Sep	-0.1	-0.2	-0.3	-0.2	-0.2	-0.2	-0.3	-0.3
Oct	-0.2	-0.2	-0.3	-0.2	-0.2	-0.2	-0.3	-0.3
Nov	-0.1	-0.1	-0.2	-0.1	-0.1	-0.2	-0.2	-0.2
Dec	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Annual	0.0	-0.1	-0.1	0.0	0.0	-0.1	-0.1	-0.1

Figure 5-34 (Average Delta Surface Dissolved Oxygen Increase from NAA - Alternative 02)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Feb	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.1
Mar	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1
Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0
Jun	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
Jul	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Aug	0.1	0.1	0.2	0.0	0.1	0.1	0.1	0.1
Sep	0.0	0.1	0.2	0.0	0.1	0.1	0.1	0.1
Oct	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Nov	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Dec	0.0	0.0	0.1	0.0	0.1	0.2	0.2	0.1
Annual	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0

Figure 5-35 (Average Delta Surface Dissolved Oxygen Increase from NAA - Alternative 03)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 5-36 (Average Delta Surface Dissolved Oxygen Increase from NAA - Alternative 04)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
May	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1
Jul	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0
Sep	-0.1	0.0	0.1	-0.1	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0

Figure 5-37 (Average Delta Surface Dissolved Oxygen Increase from NAA - Alternative 05)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Jun	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1
Aug	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.2
Sep	0.1	0.2	0.3	0.1	0.2	0.2	0.2	0.2
Oct	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2
Nov	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1
Dec	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1
Annual	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1

Figure 5-38 (Average Delta Surface Dissolved Oxygen Increase from NAA - Alternative 06)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1
Mar	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Apr	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1
May	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Jun	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1
Jul	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Aug	0.2	0.3	0.4	0.2	0.2	0.3	0.3	0.3
Sep	0.2	0.3	0.4	0.2	0.3	0.4	0.4	0.4
Oct	0.2	0.3	0.4	0.2	0.3	0.3	0.4	0.4
Nov	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1
Dec	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1
Annual	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2

13.2.1.3 10 Percentile Surface Average Daily Dissolved Oxygen

Figure 5-39 (10 Percentile Surface Dissolved Oxygen – NAA)

10 Percentile Dissolved Oxygen - NAA								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	9.1	9.1	8.8	9.1	7.5	7.6	7.9	8.0
Feb	9.1	9.0	8.7	9.0	7.5	7.6	7.9	8.0
Mar	8.1	8.0	7.8	8.1	6.7	6.8	7.1	7.1
Apr	7.0	6.8	6.6	7.0	5.6	5.6	5.8	5.9
May	6.0	5.5	5.2	5.9	4.4	4.4	4.5	4.7
Jun	5.4	4.8	4.6	5.3	3.4	3.5	3.7	3.9
Jul	5.3	4.6	4.4	5.3	3.2	3.3	3.4	3.6
Aug	5.3	4.6	4.1	5.2	3.0	3.1	3.2	3.4
Sep	5.8	5.2	4.7	5.8	3.5	3.6	3.7	3.9
Oct	6.3	6.1	5.6	6.3	4.2	4.2	4.4	4.6
Nov	7.7	7.6	7.0	7.7	5.6	5.6	5.8	6.1
Dec	8.4	8.4	7.9	8.3	6.4	6.5	6.7	6.9
Annual	7.0	6.6	6.3	6.9	5.1	5.2	5.4	5.5

Figure 5-40 (10 Percentile Surface Dissolved Oxygen – Alternative 01)

10 Percentile Dissolved Oxygen - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	9.1	9.1	8.7	9.1	7.4	7.5	7.8	7.9
Feb	9.0	8.9	8.6	9.0	7.4	7.5	7.7	7.9
Mar	8.1	8.0	7.8	8.1	6.7	6.8	7.0	7.2
Apr	7.0	6.8	6.6	7.0	5.6	5.6	5.9	6.0
May	5.9	5.5	5.2	5.9	4.3	4.3	4.5	4.7
Jun	5.4	4.8	4.6	5.4	3.5	3.6	3.8	4.0
Jul	5.3	4.6	4.1	5.2	3.1	3.2	3.3	3.4
Aug	5.2	4.4	3.8	5.1	2.9	2.9	3.0	3.2
Sep	5.5	4.8	4.2	5.5	3.3	3.2	3.3	3.4
Oct	6.0	5.7	4.9	5.8	3.8	3.8	3.8	3.9
Nov	7.5	7.4	6.7	7.4	5.2	5.3	5.4	5.6
Dec	8.2	8.2	7.5	8.1	6.2	6.1	6.3	6.5
Annual	6.9	6.5	6.1	6.8	4.9	5.0	5.1	5.3

Figure 5-41 (10 Percentile Surface Dissolved Oxygen – Alternative 02)

10 Percentile Dissolved Oxygen - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	9.1	9.1	8.8	9.0	7.5	7.7	7.9	8.0
Feb	9.0	8.9	8.6	8.9	7.5	7.6	7.8	8.0
Mar	7.8	7.6	7.4	7.8	6.4	6.5	6.7	6.8
Apr	6.9	6.8	6.6	6.9	5.5	5.6	5.8	5.9
May	5.9	5.6	5.4	5.9	4.3	4.4	4.6	4.7
Jun	5.4	4.9	4.7	5.4	3.5	3.6	3.8	3.9
Jul	5.3	4.7	4.5	5.3	3.2	3.3	3.5	3.6
Aug	5.3	4.7	4.4	5.2	3.0	3.2	3.3	3.5
Sep	5.8	5.3	5.0	5.7	3.6	3.7	3.8	4.0
Oct	6.4	6.2	5.7	6.3	4.2	4.3	4.5	4.7
Nov	7.7	7.6	7.2	7.7	5.6	5.8	6.0	6.2
Dec	8.4	8.4	7.9	8.3	6.5	6.6	6.8	7.0
Annual	6.9	6.6	6.4	6.9	5.1	5.2	5.4	5.5

Figure 5-42 (10 Percentile Surface Dissolved Oxygen – Alternative 03)

10 Percentile Dissolved Oxygen - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	9.1	9.1	8.8	9.1	7.5	7.6	7.9	8.0
Feb	9.1	9.0	8.7	9.0	7.5	7.6	7.9	8.0
Mar	8.1	8.0	7.8	8.1	6.7	6.8	7.1	7.1
Apr	7.0	6.8	6.6	7.0	5.6	5.6	5.8	5.9
May	6.0	5.5	5.2	5.9	4.4	4.4	4.5	4.7
Jun	5.4	4.8	4.6	5.3	3.4	3.5	3.7	3.9
Jul	5.3	4.6	4.4	5.3	3.2	3.3	3.4	3.6
Aug	5.3	4.6	4.1	5.2	3.0	3.1	3.2	3.4
Sep	5.8	5.2	4.7	5.8	3.5	3.6	3.7	3.9
Oct	6.3	6.1	5.6	6.3	4.2	4.2	4.4	4.6
Nov	7.7	7.6	7.0	7.7	5.6	5.6	5.8	6.1
Dec	8.4	8.4	7.9	8.3	6.4	6.5	6.7	6.9
Annual	7.0	6.6	6.3	6.9	5.1	5.2	5.4	5.5

Figure 5-43 (10 Percentile Surface Dissolved Oxygen – Alternative 04)

10 Percentile Dissolved Oxygen - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	9.1	9.1	8.8	9.1	7.5	7.7	7.9	8.1
Feb	9.0	8.9	8.6	9.0	7.4	7.6	7.8	8.0
Mar	8.1	8.0	7.8	8.1	6.7	6.9	7.1	7.2
Apr	7.0	6.8	6.7	7.0	5.6	5.7	5.9	6.0
May	5.9	5.6	5.4	5.9	4.4	4.5	4.6	4.7
Jun	5.4	4.9	4.7	5.3	3.5	3.6	3.8	3.9
Jul	5.3	4.6	4.4	5.3	3.2	3.2	3.4	3.5
Aug	5.2	4.6	4.3	5.1	3.0	3.1	3.2	3.4
Sep	5.7	5.2	4.9	5.7	3.4	3.5	3.7	3.9
Oct	6.3	6.2	5.7	6.3	4.2	4.3	4.4	4.6
Nov	7.6	7.5	7.1	7.6	5.5	5.7	5.8	6.1
Dec	8.4	8.4	7.9	8.3	6.4	6.5	6.6	6.9
Annual	6.9	6.6	6.4	6.9	5.1	5.2	5.4	5.5

Figure 5-44 (10 Percentile Surface Dissolved Oxygen – Alternative 05)

10 Percent Dissolved Oxygen - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	9.1	9.1	8.8	9.1	7.5	7.7	7.9	8.1
Feb	9.0	9.0	8.7	9.0	7.5	7.6	7.8	8.0
Mar	8.1	8.0	7.9	8.1	6.8	7.0	7.2	7.3
Apr	7.0	6.8	6.7	7.0	5.6	5.7	5.9	6.0
May	6.1	5.7	5.5	6.0	4.5	4.6	4.8	4.9
Jun	5.5	5.0	4.8	5.4	3.5	3.6	3.8	4.0
Jul	5.4	4.8	4.6	5.4	3.2	3.4	3.6	3.8
Aug	5.4	4.8	4.7	5.4	3.2	3.4	3.7	3.8
Sep	6.0	5.5	5.2	5.9	3.7	3.9	4.1	4.3
Oct	6.5	6.3	5.9	6.4	4.4	4.5	4.6	4.9
Nov	7.7	7.6	7.2	7.6	5.6	5.7	5.9	6.2
Dec	8.5	8.5	8.0	8.4	6.5	6.6	6.8	7.0
Annual	7.0	6.8	6.5	7.0	5.2	5.3	5.5	5.7

Figure 5-45 (10 Percentile Surface Dissolved Oxygen – Alternative 06)

10 Percent Dissolved Oxygen - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	9.1	9.1	8.8	9.1	7.5	7.7	8.0	8.1
Feb	9.2	9.1	8.8	9.1	7.6	7.9	8.1	8.3
Mar	8.3	8.1	8.0	8.3	6.9	7.2	7.4	7.5
Apr	7.0	6.8	6.7	7.0	5.6	5.8	6.0	6.1
May	6.2	5.8	5.7	6.1	4.6	4.7	4.9	5.0
Jun	5.5	5.0	4.8	5.4	3.7	3.8	4.0	4.2
Jul	5.5	4.9	4.7	5.5	3.3	3.5	3.7	3.9
Aug	5.6	5.0	4.8	5.5	3.3	3.5	3.8	4.0
Sep	6.1	5.7	5.4	6.1	3.9	4.0	4.3	4.5
Oct	6.6	6.4	6.1	6.5	4.5	4.7	4.9	5.1
Nov	7.8	7.7	7.3	7.7	5.8	5.9	6.2	6.4
Dec	8.5	8.5	8.1	8.4	6.5	6.6	6.9	7.1
Annual	7.1	6.8	6.6	7.1	5.3	5.4	5.7	5.8

13.2.1.4 Delta Surface 10 Percentile Daily Dissolved Oxygen

Figure 5-46 (10 Percentile Delta Surface Dissolved Oxygen Increase from NAA – Alternative 01)

10 Percentile Delta Dissolved Oxygen Increase from NAA - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.1
Feb	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
May	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1
Jun	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Jul	0.0	0.0	-0.3	-0.1	-0.1	-0.1	-0.2	-0.1
Aug	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3
Sep	-0.3	-0.4	-0.5	-0.3	-0.2	-0.3	-0.4	-0.4
Oct	-0.4	-0.4	-0.7	-0.5	-0.4	-0.5	-0.6	-0.7
Nov	-0.2	-0.2	-0.3	-0.2	-0.3	-0.4	-0.4	-0.5
Dec	-0.2	-0.2	-0.4	-0.2	-0.3	-0.4	-0.4	-0.4
Annual	-0.1	-0.1	-0.2	-0.1	-0.1	-0.2	-0.2	-0.2

Figure 5-47 (10 Percentile Delta Surface Dissolved Oxygen Increase from NAA – Alternative 02)

10 Percentile Delta Dissolved Oxygen Increase from NAA - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0
Mar	-0.3	-0.4	-0.4	-0.3	-0.3	-0.3	-0.4	-0.3
Apr	-0.1	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0
May	-0.1	0.0	0.2	-0.1	0.0	0.0	0.0	0.0
Jun	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.0
Jul	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Aug	0.0	0.1	0.4	0.0	0.0	0.1	0.1	0.1
Sep	0.0	0.1	0.3	0.0	0.1	0.1	0.1	0.1
Oct	0.0	0.1	0.2	0.0	0.0	0.1	0.1	0.1
Nov	0.0	0.1	0.2	0.0	0.1	0.1	0.2	0.1
Dec	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1
Annual	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0

Figure 5-48 (10 Percentile Delta Surface Dissolved Oxygen Increase from NAA – Alternative 03)

10 Percentile Delta Dissolved Oxygen Increase from NAA - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 5-49 (10 Percentile Delta Surface Dissolved Oxygen Increase from NAA – Alternative 04)

10 Percentile Delta Dissolved Oxygen Increase from NAA - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
Feb	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Apr	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1
May	-0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1
Jul	-0.1	0.0	0.1	-0.1	0.0	-0.1	-0.1	-0.1
Aug	-0.1	0.0	0.2	-0.1	0.0	0.0	0.0	-0.1
Sep	-0.1	0.0	0.2	-0.1	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0
Nov	-0.1	0.0	0.1	-0.1	0.0	0.0	0.0	0.0
Dec	-0.1	0.0	0.0	-0.1	-0.1	0.0	-0.1	-0.1
Annual	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0

Figure 5-50 (10 Percentile Delta Surface Dissolved Oxygen Increase from NAA – Alternative 05)

10 Percent Delta Dissolved Oxygen Increase from NAA - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Feb	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1
Apr	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1
May	0.1	0.2	0.3	0.1	0.1	0.2	0.2	0.2
Jun	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Jul	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.2
Aug	0.1	0.3	0.6	0.2	0.2	0.4	0.4	0.4
Sep	0.2	0.3	0.6	0.2	0.3	0.3	0.4	0.4
Oct	0.1	0.1	0.3	0.1	0.2	0.2	0.3	0.3
Nov	0.0	0.0	0.2	0.0	0.0	0.1	0.1	0.1
Dec	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Annual	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2

Figure 5-51 (10 Percentile Delta Surface Dissolved Oxygen Increase from NAA – Alternative 06)

10 Percent Delta Dissolved Oxygen Increase from NAA - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Feb	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.2
Mar	0.2	0.1	0.2	0.2	0.3	0.3	0.3	0.4
Apr	0.0	0.1	0.1	0.0	0.1	0.2	0.2	0.2
May	0.2	0.3	0.5	0.2	0.2	0.3	0.3	0.3
Jun	0.1	0.1	0.2	0.1	0.2	0.3	0.3	0.3
Jul	0.1	0.2	0.3	0.2	0.1	0.2	0.3	0.3
Aug	0.3	0.4	0.7	0.3	0.3	0.4	0.5	0.5
Sep	0.3	0.4	0.7	0.3	0.4	0.5	0.6	0.6
Oct	0.2	0.3	0.5	0.2	0.4	0.5	0.5	0.5
Nov	0.1	0.1	0.3	0.0	0.2	0.3	0.3	0.3
Dec	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2
Annual	0.1	0.2	0.3	0.1	0.2	0.3	0.3	0.3

13.2.2 Water Column Average Daily Dissolved Oxygen

13.2.2.1 Average Daily Dissolved Oxygen

Figure 5-52 (Water Column Average Dissolved Oxygen – NAA)

Average Dissolved Oxygen - NAA								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.11	10.07	9.71	10.08	7.42	7.31	7.45	7.51
Feb	9.90	9.83	9.61	9.89	7.48	7.38	7.53	7.58
Mar	9.04	8.91	8.76	9.06	6.85	6.74	6.84	6.88
Apr	7.88	7.67	7.49	7.90	5.80	5.65	5.67	5.69
May	6.73	6.42	6.20	6.75	4.70	4.48	4.40	4.37
Jun	6.07	5.65	5.47	6.11	3.92	3.66	3.53	3.50
Jul	5.84	5.31	5.14	5.91	3.46	3.18	3.04	3.02
Aug	5.76	5.23	4.96	5.81	3.28	2.96	2.79	2.77
Sep	6.41	5.94	5.55	6.45	3.69	3.38	3.22	3.20
Oct	7.05	6.83	6.32	7.02	4.39	4.12	4.01	3.96
Nov	8.47	8.36	7.85	8.43	5.63	5.44	5.45	5.46
Dec	9.54	9.48	9.09	9.52	6.79	6.65	6.75	6.79
Annual	7.73	7.48	7.18	7.74	5.28	5.08	5.06	5.06

Figure 5-53 (Water Column Average Dissolved Oxygen – Alternative 01)

Average Dissolved Oxygen - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.09	10.05	9.67	10.06	7.41	7.29	7.42	7.48
Feb	9.89	9.82	9.58	9.89	7.47	7.36	7.50	7.55
Mar	9.05	8.92	8.78	9.08	6.85	6.74	6.84	6.88
Apr	7.91	7.70	7.53	7.94	5.81	5.66	5.69	5.71
May	6.75	6.44	6.22	6.79	4.71	4.50	4.41	4.39
Jun	6.11	5.68	5.51	6.17	3.95	3.69	3.57	3.54
Jul	5.84	5.29	5.10	5.92	3.45	3.16	3.02	3.00
Aug	5.67	5.11	4.78	5.72	3.23	2.90	2.71	2.68
Sep	6.26	5.75	5.24	6.28	3.57	3.25	3.06	3.02
Oct	6.86	6.64	6.02	6.80	4.28	3.98	3.84	3.78
Nov	8.36	8.24	7.65	8.30	5.55	5.35	5.35	5.35
Dec	9.48	9.42	9.00	9.44	6.75	6.61	6.70	6.74
Annual	7.69	7.42	7.09	7.70	5.25	5.04	5.01	5.01

Figure 5-54 (Water Column Average Dissolved Oxygen – Alternative 02)

Average Dissolved Oxygen - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.11	10.08	9.75	10.07	7.48	7.39	7.55	7.61
Feb	9.89	9.83	9.61	9.88	7.51	7.43	7.58	7.64
Mar	9.03	8.92	8.77	9.04	6.87	6.77	6.88	6.93
Apr	7.87	7.69	7.54	7.88	5.82	5.69	5.71	5.74
May	6.73	6.46	6.28	6.73	4.73	4.52	4.44	4.42
Jun	6.09	5.71	5.57	6.11	3.95	3.70	3.58	3.56
Jul	5.85	5.37	5.23	5.90	3.48	3.21	3.08	3.07
Aug	5.76	5.29	5.10	5.79	3.31	3.00	2.84	2.83
Sep	6.41	5.99	5.71	6.43	3.72	3.43	3.29	3.27
Oct	7.06	6.87	6.45	7.00	4.43	4.17	4.08	4.04
Nov	8.47	8.38	7.93	8.41	5.67	5.49	5.52	5.54
Dec	9.54	9.49	9.14	9.49	6.82	6.70	6.81	6.86
Annual	7.73	7.51	7.26	7.73	5.32	5.12	5.11	5.12

Figure 5-55 (Water Column Average Dissolved Oxygen – Alternative 03)

Average Dissolved Oxygen - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.11	10.09	9.73	10.08	7.46	7.37	7.52	7.59
Feb	9.96	9.90	9.70	9.95	7.54	7.45	7.61	7.67
Mar	9.12	9.01	8.89	9.13	6.92	6.83	6.95	7.00
Apr	7.88	7.71	7.54	7.89	5.82	5.68	5.71	5.74
May	6.81	6.54	6.38	6.82	4.76	4.56	4.49	4.48
Jun	6.01	5.63	5.50	6.02	3.93	3.66	3.53	3.51
Jul	5.66	5.14	5.01	5.67	3.38	3.08	2.92	2.90
Aug	5.67	5.18	4.99	5.68	3.24	2.92	2.75	2.73
Sep	6.27	5.83	5.52	6.27	3.63	3.32	3.16	3.13
Oct	7.08	6.90	6.50	7.03	4.44	4.18	4.09	4.05
Nov	8.48	8.39	7.95	8.42	5.68	5.51	5.54	5.55
Dec	9.57	9.53	9.19	9.54	6.84	6.71	6.83	6.88
Annual	7.72	7.49	7.24	7.71	5.30	5.11	5.09	5.10

Figure 5-56 (Water Column Average Dissolved Oxygen – Alternative 04)

Average Dissolved Oxygen - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.10	10.07	9.72	10.06	7.45	7.36	7.51	7.58
Feb	9.87	9.81	9.58	9.85	7.50	7.42	7.56	7.63
Mar	9.04	8.92	8.77	9.04	6.87	6.77	6.88	6.93
Apr	7.89	7.71	7.55	7.89	5.83	5.70	5.73	5.75
May	6.72	6.45	6.28	6.72	4.72	4.52	4.44	4.42
Jun	6.11	5.73	5.61	6.13	3.97	3.72	3.60	3.58
Jul	5.84	5.36	5.22	5.89	3.48	3.21	3.08	3.07
Aug	5.72	5.24	5.05	5.74	3.29	2.97	2.81	2.79
Sep	6.36	5.93	5.64	6.38	3.69	3.39	3.24	3.22
Oct	7.02	6.83	6.40	6.95	4.41	4.15	4.04	4.01
Nov	8.43	8.34	7.88	8.37	5.65	5.47	5.49	5.51
Dec	9.52	9.48	9.13	9.48	6.82	6.69	6.81	6.86
Annual	7.72	7.49	7.24	7.71	5.31	5.11	5.10	5.11

Figure 5-57 (Water Column Average Dissolved Oxygen – Alternative 05)

Average Dissolved Oxygen - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.11	10.08	9.72	10.07	7.44	7.35	7.50	7.56
Feb	9.90	9.85	9.61	9.89	7.52	7.43	7.58	7.65
Mar	9.04	8.93	8.77	9.05	6.88	6.78	6.89	6.93
Apr	7.86	7.68	7.52	7.87	5.82	5.68	5.71	5.73
May	6.78	6.52	6.35	6.79	4.76	4.56	4.48	4.47
Jun	6.07	5.68	5.54	6.08	3.95	3.69	3.57	3.54
Jul	5.81	5.31	5.16	5.85	3.45	3.17	3.03	3.01
Aug	5.86	5.40	5.21	5.90	3.35	3.05	2.90	2.89
Sep	6.52	6.12	5.85	6.56	3.80	3.51	3.39	3.37
Oct	7.14	6.96	6.56	7.09	4.49	4.23	4.15	4.12
Nov	8.49	8.40	7.95	8.43	5.67	5.50	5.53	5.54
Dec	9.58	9.54	9.20	9.55	6.85	6.72	6.84	6.89
Annual	7.76	7.54	7.29	7.76	5.33	5.14	5.13	5.14

Figure 5-58 (Water Column Average Dissolved Oxygen – Alternative 06)

Average Dissolved Oxygen - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.10	10.07	9.70	10.06	7.43	7.34	7.49	7.55
Feb	9.95	9.89	9.67	9.94	7.52	7.43	7.58	7.65
Mar	9.13	9.01	8.87	9.14	6.89	6.80	6.91	6.96
Apr	7.92	7.74	7.58	7.93	5.83	5.69	5.72	5.74
May	6.79	6.52	6.35	6.80	4.75	4.55	4.48	4.46
Jun	6.11	5.74	5.60	6.13	3.97	3.72	3.60	3.58
Jul	5.88	5.39	5.25	5.93	3.47	3.19	3.06	3.05
Aug	5.95	5.50	5.33	6.00	3.40	3.10	2.97	2.97
Sep	6.61	6.23	5.98	6.66	3.87	3.59	3.48	3.47
Oct	7.26	7.08	6.73	7.24	4.57	4.31	4.25	4.23
Nov	8.51	8.43	8.00	8.46	5.71	5.53	5.56	5.58
Dec	9.57	9.52	9.19	9.54	6.83	6.70	6.82	6.87
Annual	7.81	7.59	7.35	7.82	5.35	5.16	5.16	5.18

13.2.2.2 Delta Water Column Average Daily Dissolved Oxygen Increase from NAA

Figure 5-59 (Average Delta, Water Column Dissolved Oxygen Increase from NAA – Alternative 01)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	-0.02	-0.02	-0.03	-0.02	-0.01	-0.02	-0.02	-0.03
Feb	-0.01	-0.01	-0.02	-0.01	-0.01	-0.02	-0.03	-0.03
Mar	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.00
Apr	0.03	0.03	0.04	0.04	0.01	0.01	0.02	0.02
May	0.02	0.02	0.02	0.03	0.01	0.01	0.02	0.02
Jun	0.04	0.04	0.04	0.06	0.02	0.03	0.03	0.03
Jul	0.00	-0.02	-0.04	0.01	-0.01	-0.01	-0.02	-0.02
Aug	-0.08	-0.12	-0.17	-0.09	-0.05	-0.07	-0.08	-0.09
Sep	-0.14	-0.19	-0.31	-0.17	-0.11	-0.13	-0.16	-0.17
Oct	-0.19	-0.19	-0.31	-0.22	-0.12	-0.13	-0.17	-0.18
Nov	-0.11	-0.11	-0.20	-0.13	-0.08	-0.09	-0.11	-0.11
Dec	-0.06	-0.06	-0.09	-0.07	-0.03	-0.04	-0.05	-0.05
Annual	-0.04	-0.05	-0.09	-0.05	-0.03	-0.04	-0.05	-0.05

Figure 5-60 (Average Delta, Water Column Dissolved Oxygen Increase from NAA – Alternative 02)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.00	0.01	0.05	-0.01	0.06	0.08	0.10	0.10
Feb	-0.01	0.00	0.00	-0.02	0.03	0.04	0.05	0.06
Mar	-0.01	0.01	0.01	-0.02	0.02	0.03	0.03	0.04
Apr	0.00	0.02	0.04	-0.02	0.02	0.04	0.05	0.05
May	0.00	0.04	0.09	-0.03	0.03	0.04	0.04	0.05
Jun	0.02	0.06	0.10	0.00	0.03	0.04	0.05	0.06
Jul	0.01	0.06	0.09	-0.01	0.02	0.03	0.04	0.05
Aug	0.01	0.06	0.14	-0.02	0.03	0.04	0.05	0.06
Sep	0.00	0.05	0.16	-0.02	0.04	0.05	0.06	0.07
Oct	0.01	0.04	0.13	-0.02	0.04	0.06	0.07	0.08
Nov	0.00	0.02	0.08	-0.02	0.04	0.05	0.07	0.07
Dec	-0.01	0.01	0.04	-0.02	0.03	0.05	0.06	0.07
Annual	0.00	0.03	0.08	-0.02	0.03	0.05	0.06	0.06

Figure 5-61 (Average Delta, Water Column Dissolved Oxygen Increase from NAA – Alternative 03)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.01	0.02	0.03	0.00	0.04	0.06	0.07	0.08
Feb	0.06	0.07	0.09	0.06	0.05	0.07	0.08	0.09
Mar	0.07	0.09	0.12	0.07	0.07	0.09	0.11	0.12
Apr	0.01	0.04	0.05	-0.01	0.02	0.03	0.04	0.05
May	0.08	0.12	0.18	0.06	0.06	0.08	0.10	0.11
Jun	-0.06	-0.02	0.03	-0.09	0.00	0.00	0.00	0.01
Jul	-0.18	-0.17	-0.13	-0.24	-0.08	-0.10	-0.11	-0.11
Aug	-0.08	-0.05	0.03	-0.13	-0.04	-0.04	-0.04	-0.04
Sep	-0.14	-0.11	-0.03	-0.18	-0.06	-0.06	-0.06	-0.06
Oct	0.03	0.07	0.18	0.01	0.04	0.06	0.08	0.09
Nov	0.01	0.04	0.10	-0.01	0.05	0.07	0.08	0.09
Dec	0.03	0.04	0.10	0.02	0.05	0.07	0.09	0.09
Annual	-0.01	0.01	0.06	-0.04	0.02	0.03	0.04	0.04

Figure 5-62 (Average Delta, Water Column Dissolved Oxygen Increase from NAA – Alternative 04)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	-0.01	0.00	0.02	-0.02	0.04	0.05	0.06	0.07
Feb	-0.03	-0.02	-0.03	-0.04	0.02	0.03	0.04	0.04
Mar	-0.01	0.01	0.01	-0.02	0.02	0.03	0.04	0.04
Apr	0.01	0.04	0.06	-0.01	0.03	0.05	0.06	0.07
May	-0.01	0.03	0.08	-0.04	0.02	0.03	0.04	0.05
Jun	0.04	0.09	0.14	0.02	0.05	0.06	0.07	0.08
Jul	0.00	0.05	0.08	-0.03	0.02	0.03	0.04	0.05
Aug	-0.04	0.01	0.09	-0.07	0.01	0.01	0.01	0.02
Sep	-0.05	-0.01	0.09	-0.08	0.00	0.01	0.02	0.02
Oct	-0.03	0.00	0.08	-0.07	0.01	0.03	0.04	0.04
Nov	-0.04	-0.01	0.03	-0.06	0.02	0.03	0.04	0.04
Dec	-0.02	0.00	0.03	-0.03	0.03	0.05	0.06	0.07
Annual	-0.02	0.02	0.06	-0.04	0.02	0.03	0.04	0.05

Figure 5-63 (Average Delta, Water Column Dissolved Oxygen Increase from NAA – Alternative 05)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.00	0.01	0.01	-0.01	0.03	0.04	0.05	0.06
Feb	0.00	0.01	0.01	-0.01	0.03	0.05	0.06	0.07
Mar	0.00	0.02	0.01	-0.01	0.03	0.04	0.04	0.05
Apr	-0.02	0.01	0.03	-0.03	0.02	0.03	0.04	0.04
May	0.05	0.09	0.15	0.04	0.06	0.07	0.09	0.10
Jun	0.00	0.04	0.07	-0.03	0.03	0.03	0.03	0.04
Jul	-0.03	0.00	0.02	-0.07	-0.01	-0.01	-0.01	0.00
Aug	0.11	0.17	0.26	0.09	0.07	0.08	0.11	0.13
Sep	0.11	0.18	0.31	0.11	0.11	0.13	0.16	0.18
Oct	0.09	0.12	0.24	0.07	0.09	0.11	0.14	0.15
Nov	0.02	0.04	0.10	0.00	0.04	0.06	0.07	0.08
Dec	0.04	0.05	0.11	0.03	0.06	0.08	0.10	0.10
Annual	0.03	0.06	0.11	0.01	0.05	0.06	0.07	0.08

Figure 5-64 (Average Delta, Water Column Dissolved Oxygen Increase from NAA – Alternative 06)

Average Delta Dissolved Oxygen Increase from NAA - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	-0.01	0.00	-0.01	-0.02	0.01	0.03	0.04	0.04
Feb	0.05	0.05	0.06	0.04	0.03	0.05	0.06	0.07
Mar	0.08	0.10	0.11	0.08	0.04	0.06	0.07	0.08
Apr	0.04	0.07	0.09	0.03	0.03	0.04	0.05	0.06
May	0.06	0.10	0.15	0.04	0.05	0.07	0.08	0.09
Jun	0.04	0.09	0.13	0.02	0.05	0.06	0.07	0.08
Jul	0.04	0.08	0.11	0.02	0.01	0.01	0.02	0.04
Aug	0.20	0.27	0.37	0.19	0.12	0.14	0.18	0.20
Sep	0.20	0.28	0.44	0.21	0.18	0.21	0.26	0.28
Oct	0.21	0.25	0.41	0.22	0.17	0.20	0.24	0.26
Nov	0.04	0.07	0.15	0.03	0.07	0.09	0.11	0.12
Dec	0.03	0.04	0.10	0.02	0.04	0.06	0.07	0.08
Annual	0.08	0.12	0.17	0.07	0.07	0.08	0.10	0.12

13.2.2.3 Number of Days Daily Dissolved Oxygen below 5 mg/l

The total number of Zone-Days below 5 mg/l is calculated by adding up the number of days below 5 mg/l Daily Dissolved Oxygen for each separate zone. Also provided are the total number of days for just the most critical zone FR4, which had the largest amount of days below 5 Daily Dissolved Oxygen and the number of days below 5 Daily Dissolved Oxygen for the critical zones. As a point of reference the total number of days is about 142350 for 1999 – 2013.

Figure 5-65 Number of Days Daily Dissolved Oxygen below 5 m/gL

Alternative	Total Zone-Days < 5	Delta Change from NAA
NAA	40104	
Alt01	41667	1563
Alt02	38768	-1336
Alt03	39996	-108
Alt04	39235	-869
Alt05	38043	-2061
Alt06	36670	-3434

Figure 5-66 Number of Days Daily Dissolved Oxygen below 5 m/gL for FR6

Alternative	Total Zone-Days < 5 for FR6	Delta Change from NAA
NAA	2849	
Alt01	2874	25
Alt02	2793	-56
Alt03	2789	-60
Alt04	2794	-55
Alt05	2803	-46
Alt06	2778	-71

13.2.2.4 Number of Days Daily Dissolved Oxygen below 5 mg/L by Zone

Figure 5-67 (Number of Days, Dissolved Oxygen below 5 mg/L – NAA)

Number of Days Below 5 mg/L - NAA								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	19	65	76	77
May	0	12	32	1	310	382	383	383
Jun	9	108	184	8	462	466	466	463
Jul	24	124	201	21	456	457	456	454
Aug	5	170	257	5	466	466	466	466
Sep	0	15	100	0	443	443	443	442
Oct	0	0	8	0	403	437	438	436
Nov	0	0	0	0	32	76	85	83
Dec	0	0	0	0	0	0	0	0
Annual	38	429	782	35	2591	2792	2813	2804

Figure 5-68 (Number of Days, Dissolved Oxygen below 5 mg/L – Alternative 01)

Number of Days Below 5 mg/L - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	17	68	79	81
May	0	12	34	1	308	379	382	384
Jun	0	92	181	0	461	466	466	463
Jul	22	121	188	24	456	457	456	454
Aug	20	210	286	29	466	466	466	466
Sep	2	63	186	4	443	443	443	442
Oct	0	6	61	5	416	437	438	437
Nov	0	0	0	0	56	111	117	118
Dec	0	0	0	0	0	0	0	0
Annual	44	504	936	63	2623	2827	2847	2845

Figure 5-69 (Number of Days, Dissolved Oxygen below 5 mg/L – Alternative 02)

Number of Days Below 5 mg/L - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	15	54	63	67
May	0	10	11	1	295	365	374	382
Jun	9	76	138	10	462	470	469	464
Jul	20	103	158	24	456	457	456	454
Aug	4	149	228	6	466	466	466	466
Sep	0	11	53	0	442	443	442	442
Oct	0	0	3	0	390	430	432	430
Nov	0	0	0	0	28	59	63	62
Dec	0	0	0	0	0	0	0	0
Annual	33	349	591	41	2554	2744	2765	2767

Figure 5-70 (Number of Days, Dissolved Oxygen below 5 mg/L – Alternative 03)

Number of Days Below 5 mg/L - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	11	55	64	69
May	0	9	10	3	292	364	374	370
Jun	19	103	156	32	462	473	475	464
Jul	59	185	238	71	456	457	456	454
Aug	37	177	237	58	466	466	466	466
Sep	0	23	103	0	445	446	446	446
Oct	0	0	7	0	382	423	429	429
Nov	0	0	0	0	27	55	60	58
Dec	0	0	0	0	0	0	0	0
Annual	115	497	751	164	2541	2739	2770	2756

Figure 5-71 (Number of Days, Dissolved Oxygen below 5 mg/L – Alternative 04)

Number of Days Below 5 mg/L - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	11	57	68	69
May	0	10	15	2	298	364	372	376
Jun	9	77	129	10	462	469	469	464
Jul	29	102	150	32	456	457	456	454
Aug	10	169	232	25	466	466	466	466
Sep	0	16	81	0	442	443	443	442
Oct	0	0	5	0	398	430	431	429
Nov	0	0	0	0	31	73	75	73
Dec	0	0	0	0	0	0	0	0
Annual	48	374	612	69	2564	2759	2780	2773

Figure 5-72 (Number of Days, Dissolved Oxygen below 5 mg/L – Alternative 05)

Number of Days Below 5 mg/L - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	14	57	64	67
May	0	11	14	1	285	362	364	366
Jun	8	56	114	9	468	482	482	481
Jul	5	121	202	7	458	458	456	455
Aug	2	92	169	3	466	466	466	466
Sep	0	0	16	0	440	441	441	440
Oct	0	0	4	0	387	421	429	426
Nov	0	0	0	0	29	61	64	64
Dec	0	0	0	0	0	0	0	0
Annual	15	280	519	20	2547	2748	2766	2765

Figure 5-73 (Number of Days, Dissolved Oxygen below 5 mg/L – Alternative 06)

Number of Days Below 5 mg/L - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	8	47	55	58
May	0	6	7	0	294	380	385	386
Jun	7	51	81	13	468	478	477	478
Jul	0	99	155	2	462	461	461	459
Aug	2	51	143	3	466	466	466	466
Sep	0	0	5	0	439	441	441	440
Oct	0	0	0	0	371	409	415	412
Nov	0	0	0	0	21	45	47	45
Dec	0	0	0	0	0	0	0	0
Annual	9	207	391	18	2529	2727	2747	2744

13.2.2.5 Change in Number of Days below 5 mg/L from NAA

Figure 5-74 (Change in Number of Days below 5 mg/L from NAA – Alternative 01)

Change in Number of Days Below 5 mg/L from NAA - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	-2	3	3	4
May	0	0	2	0	-2	-3	-1	1
Jun	-9	-16	-3	-8	-1	0	0	0
Jul	-2	-3	-13	3	0	0	0	0
Aug	15	40	29	24	0	0	0	0
Sep	2	48	86	4	0	0	0	0
Oct	0	6	53	5	13	0	0	1
Nov	0	0	0	0	24	35	32	35
Dec	0	0	0	0	0	0	0	0
Annual	6	75	154	28	32	35	34	41

Figure 5-75 (Change in Number of Days below 5 mg/L from NAA – Alternative 02)

Change in Number of Days Below 5 mg/L from NAA - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	-4	-11	-13	-10
May	0	-2	-21	0	-15	-17	-9	-1
Jun	0	-32	-46	2	0	4	3	1
Jul	-4	-21	-43	3	0	0	0	0
Aug	-1	-21	-29	1	0	0	0	0
Sep	0	-4	-47	0	-1	0	-1	0
Oct	0	0	-5	0	-13	-7	-6	-6
Nov	0	0	0	0	-4	-17	-22	-21
Dec	0	0	0	0	0	0	0	0
Annual	-5	-80	-191	6	-37	-48	-48	-37

Figure 5-76 (Change in Number of Days below 5 mg/L from NAA – Alternative 03)

Change in Number of Days Below 5 mg/L from NAA - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	-8	-10	-12	-8
May	0	-3	-22	2	-18	-18	-9	-13
Jun	10	-5	-28	24	0	7	9	1
Jul	35	61	37	50	0	0	0	0
Aug	32	7	-20	53	0	0	0	0
Sep	0	8	3	0	2	3	3	4
Oct	0	0	-1	0	-21	-14	-9	-7
Nov	0	0	0	0	-5	-21	-25	-25
Dec	0	0	0	0	0	0	0	0
Annual	77	68	-31	129	-50	-53	-43	-48

Figure 5-77 (Change in Number of Days below 5 mg/L from NAA – Alternative 04)

Change in Number of Days Below 5 mg/L from NAA - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	-8	-8	-8	-8
May	0	-2	-17	1	-12	-18	-11	-7
Jun	0	-31	-55	2	0	3	3	1
Jul	5	-22	-51	11	0	0	0	0
Aug	5	-1	-25	20	0	0	0	0
Sep	0	1	-19	0	-1	0	0	0
Oct	0	0	-3	0	-5	-7	-7	-7
Nov	0	0	0	0	-1	-3	-10	-10
Dec	0	0	0	0	0	0	0	0
Annual	10	-55	-170	34	-27	-33	-33	-31

Figure 5-78 (Change in Number of Days below 5 mg/L from NAA – Alternative 05)

Change in Number of Days Below 5 mg/L from NAA - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	-5	-8	-12	-10
May	0	-1	-18	0	-25	-20	-19	-17
Jun	-1	-52	-70	1	6	16	16	18
Jul	-19	-3	1	-14	2	1	0	1
Aug	-3	-78	-88	-2	0	0	0	0
Sep	0	-15	-84	0	-3	-2	-2	-2
Oct	0	0	-4	0	-16	-16	-9	-10
Nov	0	0	0	0	-3	-15	-21	-19
Dec	0	0	0	0	0	0	0	0
Annual	-23	-149	-263	-15	-44	-44	-47	-39

Figure 5-79 (Change in Number of Days below 5 mg/L from NAA – Alternative 06)

Change in Number of Days Below 5 mg/L from NAA - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	-11	-18	-21	-19
May	0	-6	-25	-1	-16	-2	2	3
Jun	-2	-57	-103	5	6	12	11	15
Jul	-24	-25	-46	-19	6	4	5	5
Aug	-3	-119	-114	-2	0	0	0	0
Sep	0	-15	-95	0	-4	-2	-2	-2
Oct	0	0	-8	0	-32	-28	-23	-24
Nov	0	0	0	0	-11	-31	-38	-38
Dec	0	0	0	0	0	0	0	0
Annual	-29	-222	-391	-17	-62	-65	-66	-60

13.2.3 Bottom Daily Dissolved Oxygen

13.2.3.1 Bottom Daily Dissolved Oxygen by Critical Zone

Figure 5-80 (Average Bottom Dissolved Oxygen by Critical Zone – NAA)

Average Bottom Dissolved Oxygen - NAA								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.09	10.05	9.70	10.07	6.58	6.53	6.53	6.51
Feb	9.89	9.81	9.59	9.88	6.63	6.57	6.55	6.56
Mar	9.02	8.89	8.74	9.05	6.08	5.97	5.89	5.87
Apr	7.85	7.64	7.45	7.89	5.18	4.97	4.77	4.71
May	6.74	6.45	6.21	6.78	4.32	3.97	3.62	3.47
Jun	6.01	5.59	5.38	6.08	3.56	3.10	2.63	2.44
Jul	5.77	5.25	5.04	5.88	3.07	2.54	2.01	1.81
Aug	5.69	5.17	4.86	5.78	2.93	2.35	1.79	1.58
Sep	6.35	5.90	5.47	6.43	3.33	2.81	2.30	2.09
Oct	7.01	6.80	6.27	6.99	4.02	3.64	3.28	3.09
Nov	8.45	8.33	7.83	8.41	5.06	4.83	4.65	4.54
Dec	9.53	9.46	9.08	9.51	5.97	5.85	5.77	5.73
Annual	7.70	7.45	7.13	7.73	4.73	4.43	4.15	4.03

Figure 5-81 (Average Bottom Dissolved Oxygen by Critical Zone – Alternative 01)

Average Bottom Dissolved Oxygen - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.07	10.03	9.74	8.10	6.71	6.61	6.61	6.60
Feb	9.88	9.80	9.53	8.19	6.77	6.66	6.64	6.65
Mar	9.03	8.90	8.57	7.48	6.19	6.05	5.98	5.97
Apr	7.88	7.67	7.22	6.23	5.27	5.04	4.87	4.82
May	6.76	6.47	5.81	4.83	4.38	4.03	3.70	3.56
Jun	6.06	5.63	4.86	3.93	3.63	3.18	2.75	2.60
Jul	5.77	5.24	4.37	3.38	3.13	2.61	2.13	1.96
Aug	5.60	5.05	4.15	3.03	2.96	2.39	1.88	1.69
Sep	6.20	5.71	4.86	3.34	3.32	2.80	2.33	2.13
Oct	6.82	6.60	5.89	4.14	4.02	3.62	3.26	3.07
Nov	8.34	8.22	7.71	5.85	5.11	4.85	4.66	4.56
Dec	9.47	9.40	9.07	7.42	6.08	5.92	5.85	5.82
Annual	7.66	7.39	6.82	5.49	4.80	4.48	4.22	4.12

Figure 5-82 (Average Bottom Dissolved Oxygen by Critical Zone – Alternative 02)

Average Bottom Dissolved Oxygen - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.13	10.11	9.76	10.09	6.61	6.56	6.57	6.58
Feb	9.92	9.87	9.64	9.90	6.65	6.60	6.59	6.61
Mar	9.17	9.06	8.91	9.18	6.09	5.99	5.92	5.91
Apr	7.92	7.74	7.59	7.92	5.19	4.99	4.81	4.76
May	6.72	6.45	6.27	6.72	3.99	3.60	3.22	3.07
Jun	6.18	5.82	5.69	6.19	3.58	3.12	2.66	2.49
Jul	5.87	5.39	5.26	5.91	3.08	2.55	2.03	1.85
Aug	5.65	5.17	4.99	5.67	2.95	2.37	1.82	1.62
Sep	6.33	5.88	5.59	6.35	3.35	2.84	2.34	2.14
Oct	6.94	6.75	6.32	6.88	4.04	3.67	3.32	3.14
Nov	8.35	8.26	7.79	8.29	5.08	4.87	4.70	4.60
Dec	9.50	9.45	9.07	9.45	5.94	5.83	5.77	5.75
Annual	7.72	7.50	7.24	7.71	4.71	4.42	4.15	4.04

Figure 5-83 (Average Bottom Dissolved Oxygen by Critical Zone – Alternative 03)

Average Bottom Dissolved Oxygen - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.12	10.09	9.78	10.09	6.61	6.56	6.57	6.58
Feb	9.93	9.86	9.66	9.92	6.65	6.60	6.59	6.61
Mar	9.15	9.04	8.89	9.17	6.09	5.99	5.92	5.91
Apr	7.88	7.69	7.53	7.89	5.19	4.99	4.81	4.76
May	6.73	6.45	6.27	6.74	3.99	3.60	3.22	3.07
Jun	6.11	5.73	5.58	6.14	3.58	3.12	2.66	2.49
Jul	5.82	5.33	5.18	5.89	3.08	2.55	2.03	1.85
Aug	5.64	5.15	4.95	5.68	2.95	2.37	1.82	1.62
Sep	6.33	5.88	5.59	6.37	3.35	2.84	2.34	2.14
Oct	6.95	6.75	6.34	6.90	4.04	3.67	3.32	3.14
Nov	8.37	8.27	7.83	8.31	5.08	4.87	4.70	4.60
Dec	9.50	9.44	9.07	9.45	5.94	5.83	5.77	5.75
Annual	7.71	7.47	7.22	7.71	4.71	4.42	4.15	4.04

Figure 5-84 (Average Bottom Dissolved Oxygen by Critical Zone – Alternative 04)

Average Bottom Dissolved Oxygen - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.11	10.08	9.75	10.06	6.60	6.56	6.58	6.58
Feb	10.00	9.95	9.77	10.00	6.64	6.59	6.57	6.59
Mar	9.16	9.08	8.99	9.19	6.08	5.98	5.91	5.91
Apr	7.86	7.71	7.56	7.87	5.20	4.99	4.81	4.76
May	6.90	6.69	6.56	6.90	4.34	4.01	3.67	3.53
Jun	5.90	5.56	5.43	5.90	3.57	3.11	2.64	2.47
Jul	5.40	4.92	4.77	5.40	3.05	2.50	1.97	1.77
Aug	5.52	5.08	4.91	5.52	2.91	2.33	1.77	1.56
Sep	6.08	5.68	5.41	6.07	3.33	2.80	2.30	2.09
Oct	7.08	6.94	6.62	7.02	4.04	3.66	3.31	3.14
Nov	8.47	8.40	8.03	8.40	5.09	4.87	4.70	4.61
Dec	9.58	9.55	9.27	9.54	5.99	5.88	5.82	5.79
Annual	7.67	7.47	7.26	7.66	4.74	4.44	4.17	4.07

Figure 5-85 (Average Bottom Dissolved Oxygen by Critical Zone – Alternative 05)

Average Bottom Dissolved Oxygen - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.10	10.06	9.71	10.06	6.61	6.57	6.58	6.58
Feb	9.89	9.83	9.60	9.88	6.66	6.61	6.61	6.63
Mar	9.02	8.90	8.75	9.04	6.11	6.01	5.94	5.93
Apr	7.84	7.65	7.48	7.85	5.20	5.00	4.82	4.76
May	6.77	6.50	6.32	6.78	4.35	4.02	3.68	3.54
Jun	6.01	5.62	5.46	6.05	3.59	3.14	2.67	2.49
Jul	5.75	5.24	5.06	5.81	3.08	2.55	2.02	1.83
Aug	5.81	5.33	5.12	5.87	2.96	2.39	1.84	1.65
Sep	6.47	6.07	5.79	6.53	3.38	2.88	2.38	2.19
Oct	7.11	6.92	6.52	7.06	4.06	3.69	3.34	3.17
Nov	8.47	8.37	7.93	8.41	5.08	4.86	4.70	4.60
Dec	9.57	9.51	9.19	9.54	6.00	5.89	5.82	5.79
Annual	7.73	7.50	7.25	7.74	4.76	4.47	4.20	4.10

Figure 5-86 (Average Bottom Dissolved Oxygen by Critical Zone – Alternative 06)

Average Bottom Dissolved Oxygen - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.08	10.05	9.69	10.05	6.38	6.31	6.29	6.29
Feb	9.93	9.87	9.66	9.93	6.71	6.67	6.68	6.68
Mar	9.11	8.99	8.85	9.13	6.44	6.36	6.32	6.33
Apr	7.89	7.70	7.54	7.91	5.68	5.53	5.40	5.38
May	6.78	6.51	6.33	6.80	4.80	4.54	4.27	4.18
Jun	6.06	5.68	5.51	6.10	4.04	3.65	3.25	3.10
Jul	5.82	5.32	5.15	5.90	3.25	2.74	2.22	2.04
Aug	5.90	5.44	5.25	5.97	2.97	2.42	1.87	1.68
Sep	6.56	6.18	5.92	6.64	3.10	2.55	2.02	1.83
Oct	7.23	7.05	6.70	7.21	3.70	3.27	2.83	2.67
Nov	8.49	8.40	7.98	8.44	4.53	4.24	3.97	3.84
Dec	9.55	9.50	9.18	9.52	5.55	5.39	5.28	5.22
Annual	7.78	7.56	7.31	7.80	4.76	4.47	4.20	4.10

13.2.3.2 Delta Change in Bottom Daily Dissolved Oxygen

Figure 5-87 (Average Bottom Delta Change Dissolved Oxygen Increase from NAA – Alternative 01)

Average Delta Bottom Dissolved Oxygen Increase from NAA - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	-0.02	-0.02	-0.03	-0.02	0.14	0.09	0.08	0.09
Feb	-0.01	-0.01	-0.02	-0.01	0.13	0.08	0.08	0.09
Mar	0.01	0.01	0.02	0.01	0.10	0.07	0.09	0.10
Apr	0.03	0.03	0.04	0.04	0.09	0.07	0.10	0.11
May	0.03	0.02	0.03	0.04	0.06	0.05	0.08	0.09
Jun	0.04	0.04	0.03	0.06	0.06	0.07	0.12	0.15
Jul	0.00	-0.01	-0.04	0.01	0.05	0.07	0.12	0.15
Aug	-0.09	-0.12	-0.18	-0.09	0.03	0.04	0.09	0.11
Sep	-0.15	-0.19	-0.32	-0.17	-0.01	-0.01	0.03	0.05
Oct	-0.19	-0.20	-0.31	-0.23	0.01	-0.01	-0.01	-0.01
Nov	-0.11	-0.11	-0.21	-0.13	0.06	0.03	0.03	0.03
Dec	-0.06	-0.06	-0.09	-0.07	0.12	0.08	0.08	0.09
Annual	-0.04	-0.05	-0.09	-0.05	0.07	0.05	0.07	0.09

Figure 5-88 (Average Bottom Delta Change Dissolved Oxygen Increase from NAA – Alternative 02)

Average Delta Bottom Dissolved Oxygen Increase from NAA - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.04	0.06	0.06	0.02	0.03	0.04	0.05	0.06
Feb	0.03	0.05	0.05	0.02	0.01	0.02	0.04	0.05
Mar	0.15	0.17	0.17	0.13	0.01	0.02	0.03	0.04
Apr	0.07	0.10	0.14	0.04	0.02	0.03	0.04	0.06
May	-0.02	0.00	0.06	-0.05	-0.32	-0.38	-0.40	-0.40
Jun	0.17	0.23	0.30	0.11	0.02	0.02	0.03	0.04
Jul	0.09	0.14	0.23	0.03	0.01	0.01	0.02	0.03
Aug	-0.04	0.00	0.13	-0.10	0.02	0.02	0.03	0.04
Sep	-0.02	-0.02	0.12	-0.08	0.02	0.03	0.04	0.05
Oct	-0.07	-0.05	0.05	-0.11	0.03	0.04	0.04	0.06
Nov	-0.09	-0.07	-0.03	-0.12	0.03	0.04	0.05	0.06
Dec	-0.03	-0.01	-0.01	-0.06	-0.03	-0.01	0.00	0.02
Annual	0.02	0.05	0.11	-0.01	-0.01	-0.01	0.00	0.01

Figure 5-89 (Average Bottom Delta Change Dissolved Oxygen Increase from NAA – Alternative 03)

Average Delta Bottom Dissolved Oxygen Increase from NAA - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.03	0.04	0.08	0.03	0.03	0.04	0.05	0.06
Feb	0.04	0.05	0.06	0.03	0.01	0.02	0.04	0.05
Mar	0.13	0.15	0.15	0.12	0.01	0.02	0.03	0.04
Apr	0.03	0.05	0.08	0.01	0.02	0.03	0.04	0.06
May	-0.01	0.01	0.06	-0.04	-0.32	-0.38	-0.40	-0.40
Jun	0.10	0.14	0.19	0.06	0.02	0.02	0.03	0.04
Jul	0.04	0.08	0.14	0.01	0.01	0.01	0.02	0.03
Aug	-0.05	-0.02	0.09	-0.09	0.02	0.02	0.03	0.04
Sep	-0.03	-0.01	0.12	-0.06	0.02	0.03	0.04	0.05
Oct	-0.06	-0.05	0.07	-0.09	0.03	0.04	0.04	0.06
Nov	-0.08	-0.06	0.00	-0.10	0.03	0.04	0.05	0.06
Dec	-0.03	-0.02	-0.01	-0.05	-0.03	-0.01	0.00	0.02
Annual	0.01	0.03	0.09	-0.02	-0.01	-0.01	0.00	0.01

Figure 5-90 (Average Bottom Delta Change Dissolved Oxygen Increase from NAA – Alternative 04)

Average Delta Bottom Dissolved Oxygen Increase from NAA - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.01	0.03	0.06	-0.01	0.02	0.04	0.05	0.07
Feb	0.11	0.13	0.18	0.12	0.01	0.02	0.01	0.03
Mar	0.14	0.19	0.25	0.13	0.00	0.01	0.02	0.04
Apr	0.01	0.07	0.11	-0.02	0.02	0.03	0.04	0.05
May	0.16	0.24	0.36	0.13	0.03	0.03	0.05	0.07
Jun	-0.11	-0.03	0.05	-0.18	0.01	0.01	0.01	0.02
Jul	-0.37	-0.33	-0.27	-0.48	-0.03	-0.04	-0.05	-0.04
Aug	-0.17	-0.09	0.06	-0.25	-0.02	-0.03	-0.03	-0.02
Sep	-0.27	-0.22	-0.06	-0.36	-0.01	-0.01	-0.01	0.00
Oct	0.07	0.14	0.35	0.03	0.02	0.02	0.04	0.05
Nov	0.02	0.07	0.20	-0.01	0.03	0.04	0.06	0.07
Dec	0.06	0.09	0.19	0.04	0.02	0.04	0.05	0.06
Annual	-0.03	0.02	0.12	-0.07	0.01	0.01	0.02	0.03

Figure 5-91 (Average Bottom Delta Change Dissolved Oxygen Increase from NAA – Alternative 05)

Average Delta Bottom Dissolved Oxygen Increase from NAA - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.00	0.01	0.02	-0.01	0.03	0.04	0.05	0.07
Feb	0.00	0.01	0.01	-0.01	0.02	0.04	0.06	0.07
Mar	0.00	0.01	0.01	-0.01	0.03	0.03	0.05	0.06
Apr	-0.01	0.01	0.03	-0.04	0.02	0.03	0.05	0.06
May	0.03	0.06	0.12	0.01	0.03	0.04	0.06	0.08
Jun	0.00	0.03	0.08	-0.04	0.03	0.04	0.04	0.05
Jul	-0.02	-0.01	0.03	-0.07	0.01	0.00	0.00	0.02
Aug	0.12	0.16	0.27	0.09	0.03	0.04	0.05	0.07
Sep	0.12	0.17	0.32	0.11	0.05	0.06	0.07	0.10
Oct	0.09	0.12	0.25	0.07	0.04	0.05	0.06	0.09
Nov	0.02	0.04	0.10	0.00	0.02	0.03	0.05	0.06
Dec	0.04	0.05	0.11	0.03	0.03	0.04	0.05	0.06
Annual	0.03	0.05	0.11	0.01	0.03	0.04	0.05	0.07

Figure 5-92 (Average Bottom Delta Change Dissolved Oxygen Increase from NAA – Alternative 06)

Average Delta Bottom Dissolved Oxygen Increase from NAA - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	-0.01	0.00	-0.01	-0.02	-0.20	-0.21	-0.23	-0.23
Feb	0.05	0.05	0.06	0.05	0.07	0.10	0.12	0.12
Mar	0.08	0.09	0.11	0.08	0.35	0.39	0.43	0.46
Apr	0.04	0.06	0.09	0.03	0.50	0.56	0.63	0.67
May	0.05	0.07	0.13	0.02	0.49	0.56	0.65	0.71
Jun	0.05	0.08	0.13	0.02	0.48	0.55	0.63	0.65
Jul	0.05	0.07	0.11	0.02	0.18	0.19	0.21	0.23
Aug	0.21	0.27	0.39	0.20	0.04	0.06	0.08	0.10
Sep	0.21	0.28	0.45	0.21	-0.23	-0.26	-0.29	-0.26
Oct	0.21	0.25	0.42	0.22	-0.32	-0.37	-0.44	-0.42
Nov	0.04	0.06	0.16	0.03	-0.53	-0.59	-0.67	-0.70
Dec	0.03	0.04	0.10	0.02	-0.42	-0.45	-0.49	-0.51
Annual	0.08	0.11	0.18	0.07	0.03	0.04	0.05	0.07

13.3 Daily Average Temperature

13.3.1 Temperature by Zone

Figure 5-93 (Average Temperature – NAA)

Average Temperature - NAA								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.7	10.8	10.9	10.8	11.3	11.2	11.1	11.1
Feb	12.3	12.4	12.3	12.3	12.1	12.1	12.1	12.2
Mar	16.1	16.2	16.1	16.0	15.6	15.7	15.8	15.8
Apr	20.4	20.7	20.6	20.3	20.1	20.1	20.2	20.2
May	24.5	25.0	24.9	24.5	24.4	24.3	24.4	24.4
Jun	27.6	28.2	28.1	27.5	27.9	27.8	27.8	27.7
Jul	29.2	29.8	29.8	29.2	29.9	29.7	29.7	29.6
Aug	28.9	29.5	29.7	28.9	30.0	29.8	29.7	29.6
Sep	26.0	26.5	26.8	26.0	27.7	27.4	27.2	27.1
Oct	21.2	21.6	22.1	21.3	23.3	23.0	22.8	22.6
Nov	15.9	16.1	16.5	15.9	17.8	17.5	17.2	17.1
Dec	12.3	12.4	12.6	12.3	13.4	13.3	13.1	13.0
Annual	20.4	20.8	20.9	20.4	21.1	21.0	20.9	20.9

Figure 5-94 (Average Temperature – Alternative 01)

Average Temperature - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.9	10.9	11.0	10.9	11.4	11.3	11.2	11.2
Feb	12.3	12.4	12.3	12.3	12.1	12.1	12.2	12.2
Mar	16.0	16.2	16.1	16.0	15.6	15.7	15.8	15.8
Apr	20.3	20.7	20.6	20.3	20.1	20.1	20.2	20.2
May	24.4	24.9	24.8	24.4	24.4	24.3	24.3	24.3
Jun	27.5	28.1	28.1	27.5	27.9	27.7	27.7	27.7
Jul	29.2	29.8	29.9	29.2	29.9	29.7	29.7	29.6
Aug	29.0	29.6	29.8	29.0	30.1	29.9	29.8	29.7
Sep	26.2	26.7	27.1	26.2	27.8	27.6	27.4	27.3
Oct	21.5	21.8	22.4	21.5	23.5	23.3	23.0	22.9
Nov	16.0	16.2	16.7	16.0	17.9	17.6	17.4	17.2
Dec	12.3	12.4	12.7	12.4	13.5	13.3	13.1	13.1
Annual	20.5	20.8	21.0	20.5	21.2	21.1	21.0	20.9

Figure 5-95 (Average Temperature – Alternative 02)

Average Temperature - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	11.1	11.1	11.2	11.1	11.6	11.5	11.4	11.3
Feb	12.4	12.5	12.4	12.4	12.2	12.2	12.2	12.3
Mar	16.5	16.7	16.6	16.5	16.1	16.1	16.3	16.3
Apr	20.6	21.0	20.9	20.6	20.4	20.4	20.5	20.5
May	24.6	25.1	25.0	24.6	24.6	24.5	24.6	24.6
Jun	27.9	28.5	28.4	27.8	28.2	28.1	28.1	28.1
Jul	29.3	30.0	30.0	29.3	30.2	30.0	29.9	29.8
Aug	28.6	29.2	29.3	28.6	29.8	29.6	29.5	29.4
Sep	25.8	26.2	26.5	25.7	27.4	27.2	27.0	26.8
Oct	20.9	21.3	21.7	20.9	23.0	22.7	22.4	22.3
Nov	15.7	15.8	16.2	15.7	17.5	17.2	16.9	16.8
Dec	12.3	12.4	12.6	12.4	13.4	13.2	13.0	12.9
Annual	20.5	20.8	20.9	20.5	21.2	21.1	21.0	20.9

Figure 5-96 (Average Temperature – Alternative 03)

Average Temperature - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.9	10.9	11.0	10.9	11.4	11.3	11.2	11.2
Feb	12.2	12.3	12.3	12.2	12.1	12.1	12.1	12.1
Mar	16.0	16.2	16.1	16.0	15.6	15.7	15.8	15.8
Apr	20.4	20.7	20.6	20.3	20.1	20.1	20.2	20.2
May	24.4	24.9	24.7	24.3	24.4	24.3	24.4	24.3
Jun	27.7	28.3	28.2	27.6	28.0	27.9	27.9	27.8
Jul	29.6	30.2	30.1	29.5	30.2	30.0	30.0	29.9
Aug	29.1	29.7	29.8	29.0	30.2	30.0	29.9	29.8
Sep	26.2	26.7	27.0	26.2	27.9	27.6	27.5	27.3
Oct	21.2	21.6	22.0	21.2	23.3	23.0	22.7	22.6
Nov	15.9	16.1	16.5	15.9	17.8	17.5	17.2	17.0
Dec	12.3	12.4	12.6	12.3	13.4	13.2	13.0	12.9
Annual	20.5	20.8	20.9	20.5	21.2	21.1	21.0	20.9

Figure 5-97 (Average Temperature – Alternative 04)

Average Temperature - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.9	10.9	11.0	10.9	11.4	11.3	11.2	11.2
Feb	12.3	12.4	12.4	12.3	12.1	12.1	12.2	12.2
Mar	16.1	16.2	16.2	16.0	15.6	15.7	15.8	15.8
Apr	20.4	20.7	20.6	20.4	20.2	20.2	20.3	20.3
May	24.5	25.0	24.9	24.5	24.4	24.4	24.5	24.5
Jun	27.6	28.2	28.1	27.5	27.9	27.8	27.8	27.8
Jul	29.3	29.9	29.9	29.2	30.0	29.8	29.7	29.7
Aug	29.0	29.6	29.7	29.0	30.1	29.9	29.8	29.7
Sep	26.1	26.6	26.9	26.1	27.8	27.5	27.3	27.2
Oct	21.3	21.7	22.1	21.3	23.4	23.1	22.8	22.7
Nov	16.0	16.1	16.5	16.0	17.8	17.5	17.3	17.1
Dec	12.3	12.4	12.6	12.3	13.4	13.3	13.1	13.0
Annual	20.5	20.8	20.9	20.5	21.2	21.1	21.0	20.9

Figure 5-98 (Average Temperature – Alternative 05)

Average Temperature - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.8	10.9	11.0	10.9	11.4	11.3	11.2	11.1
Feb	12.3	12.3	12.3	12.2	12.1	12.1	12.1	12.1
Mar	16.0	16.2	16.1	16.0	15.6	15.7	15.8	15.8
Apr	20.4	20.7	20.6	20.4	20.1	20.2	20.3	20.3
May	24.4	24.9	24.8	24.4	24.4	24.3	24.4	24.4
Jun	27.6	28.2	28.1	27.6	27.9	27.8	27.8	27.8
Jul	29.4	30.0	30.0	29.3	30.1	29.9	29.8	29.8
Aug	28.9	29.5	29.6	28.8	30.1	29.8	29.7	29.6
Sep	25.9	26.4	26.7	25.9	27.6	27.4	27.1	27.0
Oct	21.3	21.6	22.0	21.2	23.3	23.0	22.7	22.5
Nov	15.9	16.1	16.5	16.0	17.8	17.5	17.2	17.1
Dec	12.3	12.4	12.6	12.3	13.4	13.2	13.0	13.0
Annual	20.4	20.8	20.8	20.4	21.2	21.0	20.9	20.9

Figure 5-99 (Average Temperature – Alternative 06)

Average Temperature - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	10.9	10.9	11.0	10.9	11.4	11.3	11.2	11.2
Feb	12.2	12.3	12.3	12.2	12.1	12.1	12.1	12.1
Mar	15.9	16.0	16.0	15.8	15.5	15.5	15.6	15.7
Apr	20.3	20.6	20.5	20.3	20.1	20.1	20.1	20.2
May	24.4	24.9	24.8	24.4	24.4	24.3	24.4	24.4
Jun	27.6	28.1	28.1	27.5	27.9	27.8	27.8	27.7
Jul	29.3	29.9	29.9	29.2	30.0	29.8	29.8	29.7
Aug	28.7	29.3	29.4	28.6	30.0	29.7	29.5	29.4
Sep	25.8	26.3	26.5	25.7	27.5	27.2	27.0	26.8
Oct	21.1	21.5	21.8	21.1	23.2	22.8	22.5	22.3
Nov	15.9	16.1	16.5	15.9	17.8	17.5	17.2	17.0
Dec	12.3	12.4	12.6	12.3	13.4	13.2	13.0	13.0
Annual	20.4	20.7	20.8	20.3	21.1	20.9	20.8	20.8

13.3.2 Delta Change in Temperature

Figure 5-100 (Average Delta Temperature Increase from NAA – Alternative 01)

Average Delta Temperature Increase from NAA - Alternative 01								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1
Jun	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aug	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sep	0.2	0.2	0.3	0.2	0.1	0.2	0.2	0.2
Oct	0.2	0.2	0.3	0.2	0.2	0.2	0.3	0.3
Nov	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2
Dec	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
Annual	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Figure 5-101 (Average Delta Temperature Increase from NAA – Alternative 02)

Average Delta Temperature Increase from NAA - Alternative 02								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Feb	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Mar	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Apr	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
May	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2
Jun	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3
Jul	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Aug	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2
Sep	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
Oct	-0.3	-0.3	-0.4	-0.3	-0.3	-0.3	-0.3	-0.3
Nov	-0.2	-0.2	-0.3	-0.2	-0.3	-0.3	-0.3	-0.3
Dec	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0
Annual	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1

Figure 5-102 (Average Delta Temperature Increase from NAA – Alternative 03)

Average Delta Temperature Increase from NAA - Alternative 03								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Feb	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.1
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.1
Jun	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Jul	0.4	0.4	0.3	0.3	0.2	0.3	0.3	0.3
Aug	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.2
Sep	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Oct	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Annual	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1

Figure 5-103 (Average Delta Temperature Increase from NAA – Alternative 04)

Average Delta Temperature Increase from NAA - Alternative 04								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1
May	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jul	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1
Aug	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Sep	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Oct	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Nov	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1

Figure 5-104 (Average Delta Temperature Increase from NAA – Alternative 05)

Average Delta Temperature Increase from NAA - Alternative 05								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0
Jun	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jul	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.2
Aug	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
Sep	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1
Oct	0.0	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.1
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 5-105 (Average Delta Temperature Increase from NAA – Alternative 06)

Average Delta Temperature Increase from NAA - Alternative 06								
Date	LBR1	LBR2	MR4	MR5	FR2	FR3	FR4	FR5
Jan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Feb	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0
Mar	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.2
Apr	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
May	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0
Jun	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
Jul	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1
Aug	-0.2	-0.2	-0.3	-0.2	-0.1	-0.1	-0.2	-0.2
Sep	-0.2	-0.2	-0.3	-0.3	-0.2	-0.2	-0.3	-0.3
Oct	-0.1	-0.2	-0.3	-0.2	-0.2	-0.2	-0.3	-0.3
Nov	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1

13.4 Chlorides – Abercorn Creek

Chlorides at Savannah Water Intake on Abercorn Creek and at the junction of Abercorn Creek and Savannah River were calculated from the Harbor Model prediction of salinity at these areas. The conversion formula of Chlorides = Salinity / 0.0018066 was used to determine the Chloride level.

13.4.1 Average Chloride Levels

Figure 5-106 (Average Chloride Levels – NAA)

Chlorides (mg/L) - NAA		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.198	4.845
Feb	0.066	2.405
Mar	0.031	1.102
Apr	0.095	2.353
May	0.266	5.094
Jun	0.326	6.048
Jul	0.496	8.135
Aug	0.532	9.174
Sep	0.522	9.010
Oct	0.525	9.244
Nov	0.611	9.501
Dec	0.336	6.518
Annual	0.334	6.119

Figure 5-107 (Average Chloride Levels – Alternative 01)

Chlorides (mg/L) - Alternative 01		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.559	9.325
Feb	0.113	3.049
Mar	0.037	1.157
Apr	0.080	2.067
May	0.267	4.843
Jun	0.250	4.928
Jul	0.688	9.492
Aug	1.148	15.622
Sep	2.289	25.811
Oct	2.955	32.573
Nov	2.505	27.646
Dec	1.357	17.515
Annual	1.021	12.836

Figure 5-108 (Average Chloride Levels – Alternative 02)

Chlorides (mg/L) - Alternative 02		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.224	5.619
Feb	0.077	2.836
Mar	0.041	1.588
Apr	0.127	3.491
May	0.337	6.941
Jun	0.377	7.416
Jul	0.569	9.536
Aug	0.642	11.543
Sep	0.635	11.459
Oct	0.638	11.618
Nov	0.707	11.628
Dec	0.399	8.169
Annual	0.398	7.654

Figure 5-109 (Average Chloride Levels – Alternative 03)

Chlorides (mg/L) - Alternative 03		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.108	2.366
Feb	0.434	7.610
Mar	0.695	12.045
Apr	0.095	1.789
May	0.048	1.512
Jun	0.012	0.339
Jul	0.146	3.284
Aug	0.714	11.760
Sep	0.200	3.714
Oct	0.146	4.278
Nov	1.019	18.071
Dec	0.427	7.330
Annual	0.337	6.175

Figure 5-110 (Average Chloride Levels – Alternative 04)

Chlorides (mg/L) - Alternative 04		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.276	6.442
Feb	0.109	3.541
Mar	0.056	1.868
Apr	0.132	3.483
May	0.355	7.378
Jun	0.305	6.556
Jul	0.693	10.538
Aug	0.931	14.805
Sep	0.899	14.834
Oct	0.899	14.846
Nov	0.985	15.184
Dec	0.528	9.856
Annual	0.514	9.111

Figure 5-111 (Average Chloride Levels – Alternative 05)

Chlorides (mg/L) - Alternative 05		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.223	5.663
Feb	0.083	2.964
Mar	0.049	1.780
Apr	0.111	3.223
May	0.337	6.543
Jun	0.328	6.585
Jul	0.335	7.620
Aug	0.230	6.072
Sep	0.299	6.687
Oct	0.501	9.007
Nov	0.795	12.593
Dec	0.334	6.739
Annual	0.302	6.290

Figure 5-112 (Average Chloride Levels – Alternative 06)

Chlorides (mg/L) - Alternative 06		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.224	5.851
Feb	0.023	1.413
Mar	0.014	0.815
Apr	0.062	2.367
May	0.223	5.400
Jun	0.266	5.423
Jul	0.223	5.814
Aug	0.151	4.410
Sep	0.121	3.607
Oct	0.115	3.412
Nov	0.661	10.087
Dec	0.316	6.278
Annual	0.200	4.573

13.4.2 Delta Change in Chlorides from NAA

Figure 5-113 (Average Chloride Levels Delta Change from NAA – Alternative 01)

Chlorides (mg/L) - Alternative 01 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.362	4.480
Feb	0.046	0.643
Mar	0.006	0.055
Apr	-0.015	-0.286
May	0.001	-0.251
Jun	-0.076	-1.119
Jul	0.192	1.358
Aug	0.616	6.448
Sep	1.767	16.801
Oct	2.429	23.328
Nov	1.893	18.146
Dec	1.022	10.996
Annual	0.687	6.717

Figure 5-114 (Average Chloride Levels Delta Change from NAA – Alternative 02)

Chlorides (mg/L) - Alternative 02 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.026	0.775
Feb	0.011	0.431
Mar	0.010	0.486
Apr	0.031	1.138
May	0.071	1.848
Jun	0.051	1.368
Jul	0.073	1.401
Aug	0.110	2.369
Sep	0.113	2.449
Oct	0.113	2.374
Nov	0.096	2.128
Dec	0.063	1.651
Annual	0.064	1.535

Figure 5-115 (Average Chloride Levels Delta Change from NAA – Alternative 03)

Chlorides (mg/L) - Alternative 03 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	-0.090	-2.478
Feb	0.368	5.205
Mar	0.664	10.944
Apr	-0.001	-0.564
May	-0.219	-3.582
Jun	-0.314	-5.709
Jul	-0.350	-4.850
Aug	0.182	2.586
Sep	-0.322	-5.295
Oct	-0.379	-4.966
Nov	0.407	8.570
Dec	0.091	0.812
Annual	0.003	0.056

Figure 5-116 (Average Chloride Levels Delta Change from NAA – Alternative 04)

Chlorides (mg/L) - Alternative 04 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.079	1.598
Feb	0.043	1.136
Mar	0.025	0.766
Apr	0.036	1.129
May	0.089	2.284
Jun	-0.021	0.508
Jul	0.197	2.403
Aug	0.399	5.631
Sep	0.377	5.825
Oct	0.374	5.601
Nov	0.373	5.683
Dec	0.193	3.338
Annual	0.180	2.992

Figure 5-117 (Average Chloride Levels Delta Change from NAA – Alternative 05)

Chlorides (mg/L) - Alternative 05 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.024	0.796
Feb	0.014	0.493
Mar	0.018	0.677
Apr	0.015	0.890
May	0.072	1.478
Jun	0.008	0.591
Jul	-0.161	-0.497
Aug	-0.295	-3.023
Sep	-0.220	-2.313
Oct	-0.037	-0.331
Nov	0.182	3.059
Dec	0.001	0.255
Annual	-0.032	0.173

Figure 5-118 (Average Chloride Levels Delta Change from NAA – Alternative 06)

Chlorides (mg/L) - Alternative 06 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek	Savannah River at Abercorn Creek
Jan	0.025	0.983
Feb	-0.046	-1.058
Mar	-0.017	-0.288
Apr	-0.033	0.034
May	-0.042	0.335
Jun	-0.054	-0.572
Jul	-0.274	-2.304
Aug	-0.375	-4.684
Sep	-0.398	-5.392
Oct	-0.423	-5.926
Nov	0.048	0.552
Dec	-0.017	-0.206
Annual	-0.134	-1.544

13.4.3 Average Chloride Levels – Days when Chlorides greater than 12

Figure 5-119 (Days When Average Chloride Levels > 12 - NAA)

Chlorides (mg/L) - NAA		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	65
Feb	0	35
Mar	0	13
Apr	0	26
May	0	62
Jun	0	89
Jul	0	111
Aug	0	121
Sep	0	113
Oct	0	126
Nov	0	133
Dec	0	97
Annual	0	991

Figure 5-120 (Days When Average Chloride Levels > 12 – Alternative 01)

Chlorides (mg/L) - Alternative 01		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	37
Feb	1	132
Mar	9	236
Apr	7	52
May	0	17
Jun	0	3
Jul	0	68
Aug	24	237
Sep	0	17
Oct	0	109
Nov	30	313
Dec	23	134
Annual	94	1355

Figure 5-121 (Days When Average Chloride Levels > 12 – Alternative 02)

Chlorides (mg/L) - Alternative 02		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	46
Feb	0	159
Mar	0	247
Apr	0	38
May	0	26
Jun	0	11
Jul	0	81
Aug	0	182
Sep	0	41
Oct	0	61
Nov	0	235
Dec	0	107
Annual	0	1234

Figure 5-122 (Days When Average Chloride Levels > 12 – Alternative 03)

Chlorides (mg/L) - Alternative 03		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan		77
Feb	0	10
Mar	0	21
Apr	0	36
May	0	82
Jun	2	148
Jul	0	186
Aug	2	201
Sep	2	239
Oct	0	194
Nov	0	177
Dec	0	107
Annual	6	1478

Figure 5-123 (Days When Average Chloride Levels > 12 – Alternative 04)

Chlorides (mg/L) - Alternative 04		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	83
Feb	0	47
Mar	0	17
Apr	0	39
May	0	96
Jun	0	107
Jul	0	116
Aug	2	165
Sep	0	199
Oct	0	203
Nov	0	201
Dec	0	144
Annual	2	1417

Figure 5-124 (Days When Average Chloride Levels > 12 – Alternative 05)

Chlorides (mg/L) - Alternative 05		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	78
Feb	0	35
Mar	0	17
Apr	0	33
May	0	70
Jun	0	92
Jul	0	111
Aug	0	81
Sep	0	89
Oct	0	106
Nov	2	169
Dec	0	96
Annual	2	977

Figure 5-125 (Days When Average Chloride Levels > 12 – Alternative 06)

Chlorides (mg/L) - Alternative 06		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	68
Feb	0	15
Mar	0	14
Apr	0	33
May	0	78
Jun	1	135
Jul	0	147
Aug	2	184
Sep	3	218
Oct	0	194
Nov	0	173
Dec	0	121
Annual	6	1380

13.4.4 Delta Change in Chlorides from NAA

Figure 5-126 (Delta Change in Chloride Levels from NAA – Alternative 01)

Chlorides (mg/L) - Alternative 01 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	-28
Feb	1	97
Mar	9	223
Apr	7	26
May	0	-45
Jun	0	-86
Jul	0	-43
Aug	24	116
Sep	0	-96
Oct	0	-17
Nov	30	180
Dec	23	37
Annual	94	364

Figure 5-127 (Delta Change in Chloride Levels from NAA – Alternative 02)

Chlorides (mg/L) - Alternative 02 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	-19
Feb	0	124
Mar	0	234
Apr	0	12
May	0	-36
Jun	0	-78
Jul	0	-30
Aug	0	61
Sep	0	-72
Oct	0	-65
Nov	0	102
Dec	0	10
Annual	0	243

Figure 5-128 (Delta Change in Chloride Levels from NAA – Alternative 03)

Chlorides (mg/L) - Alternative 03 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	12
Feb	0	-25
Mar	0	8
Apr	0	10
May	0	20
Jun	2	59
Jul	0	75
Aug	2	80
Sep	2	126
Oct	0	68
Nov	0	44
Dec	0	10
Annual	6	487

Figure 5-129 (Delta Change in Chloride Levels from NAA – Alternative 04)

Chlorides (mg/L) - Alternative 04 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	18
Feb	0	12
Mar	0	4
Apr	0	13
May	0	34
Jun	0	18
Jul	0	5
Aug	2	44
Sep	0	86
Oct	0	77
Nov	0	68
Dec	0	47
Annual	2	426

Figure 5-130 (Delta Change in Chloride Levels from NAA – Alternative 05)

Chlorides (mg/L) - Alternative 05 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	13
Feb	0	0
Mar	0	4
Apr	0	7
May	0	8
Jun	0	3
Jul	0	0
Aug	0	-40
Sep	0	-24
Oct	0	-20
Nov	2	36
Dec	0	-1
Annual	2	-14

Figure 5-131 (Delta Change in Chloride Levels from NAA – Alternative 06)

Chlorides (mg/L) - Alternative 06 Delta change from NAA		
Date	Savannah Water Intake - Abercorn Creek Days > 12	Savannah River at Abercorn Creek Days > 12
Jan	0	3
Feb	0	-20
Mar	0	1
Apr	0	7
May	0	16
Jun	1	46
Jul	0	36
Aug	2	63
Sep	3	105
Oct	0	68
Nov	0	40
Dec	0	24
Annual	6	389

13.5 Savannah Harbor Zone Information- Location and Model Grid Cells

Table 80 provides the grid coordinates of the zones and Figure 1 through Figure 6 shows the location of the zones.

Figure 5-132 (Grid Coordinates of the Zones)

Zone #	Zone Name	Savannah Zones.docx				SHEP 2006				SHEP 2015			
		I beg	J beg	I end	J end	I beg	J beg	I end	J end	I beg	J beg	I end	J end
1	FR1	13	26	17	40	13	26	15	40	9	26	11	40
2	FR2	13	41	17	52	13	41	17	50	9	41	13	50
3	FR3	13	53	17	59	13	51	15	59	9	51	11	59
4	FR4	13	60	17	66	13	60	15	66	9	60	11	66
5	FR5	13	67	17	72	13	67	15	72	9	67	11	74
6	FR6	13	73	17	80	13	73	15	80	9	75	13	80
7	FR7	13	81	17	93	13	81	15	93	9	83	12	96
8	FR8	13	94	17	97	13	94	15	97	9	97	12	100
9	FR9	13	98	15	111	13	98	15	111	9	107	11	120
10	FR10	13	112	15	120	13	112	15	120	9	121	13	130
11	FR11	13	121	14	127	13	121	14	127	8	131	11	148
12	MR1	18	82	21	82	18	82	21	82	12	84	17	84
13	MR2	21	83	21	86	21	83	21	86	17	85	17	89
14	MR3	26	94	26	104	26	94	26	104	22	97	22	113
15	MR4	26	105	26	122	26	105	26	122	22	114	22	131
16	MR5	15	123	26	123	15	123	26	123	16	132	20	138
17	MR6	20	118	20	119	20	118	20	119	5	126	5	131
18	LBR1	27	123	38	123	27	123	38	123	23	132	33	132
19	LBR2	39	106	39	123	39	106	39	123	36	115	34	132
20	LBR3	30	86	30	109	30	86	30	109	26	88	26	118
21	BR1	30	59	34	63	30	59	32	63	26	59	28	63
22	BR2	30	64	34	70	30	64	32	70	26	64	28	70
23	BR3	30	71	32	85	30	71	30	85	26	71	26	87
24	SCh1	9	20	11	38	9	20	11	38	5	20	7	38
25	SCh2	7	45	12	46	7	45	12	46	3	45	8	46
26	SR	13	128	15	166	13	128	14	166	9	149	10	189

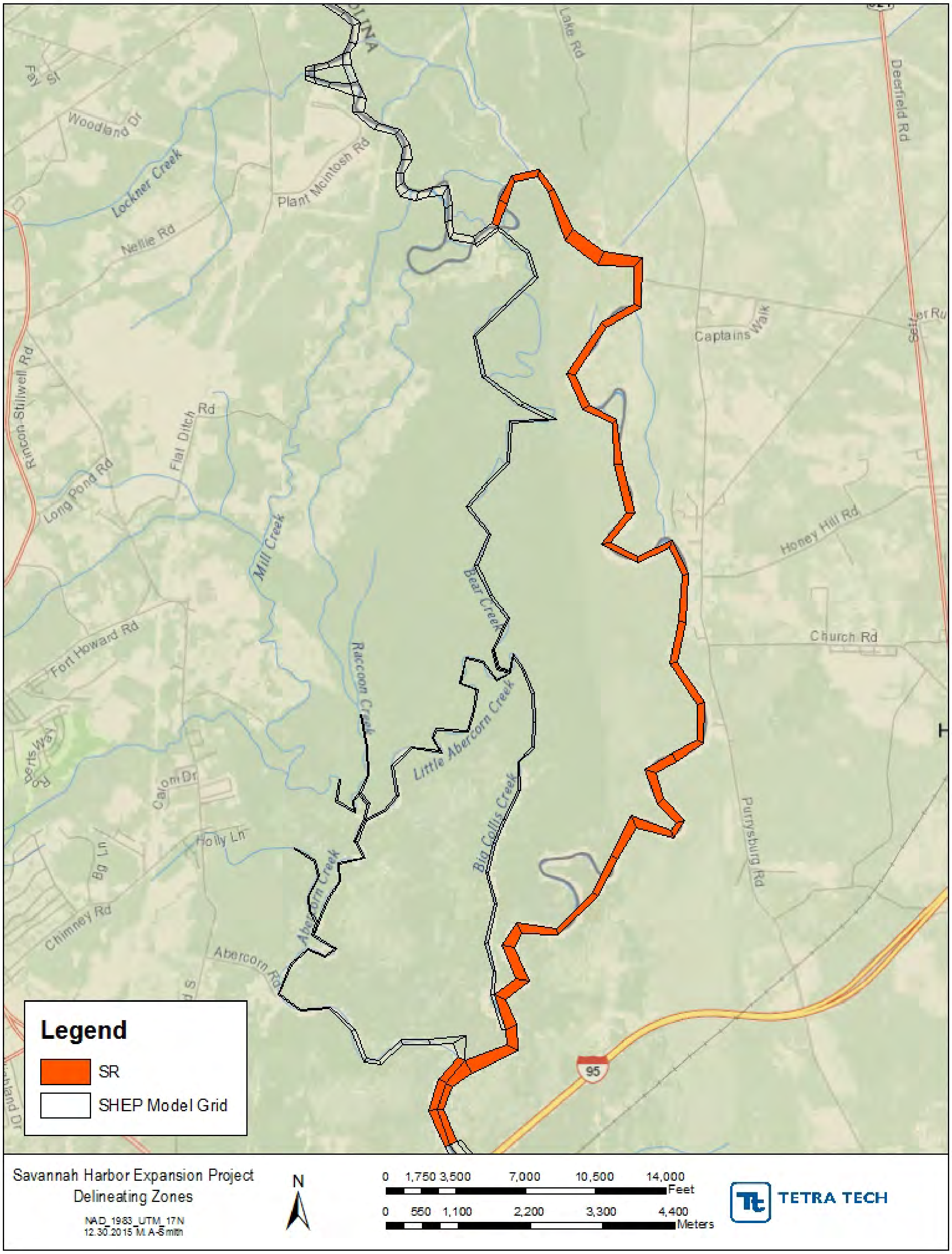


Figure 1 (Location of the Zones for Savannah River)

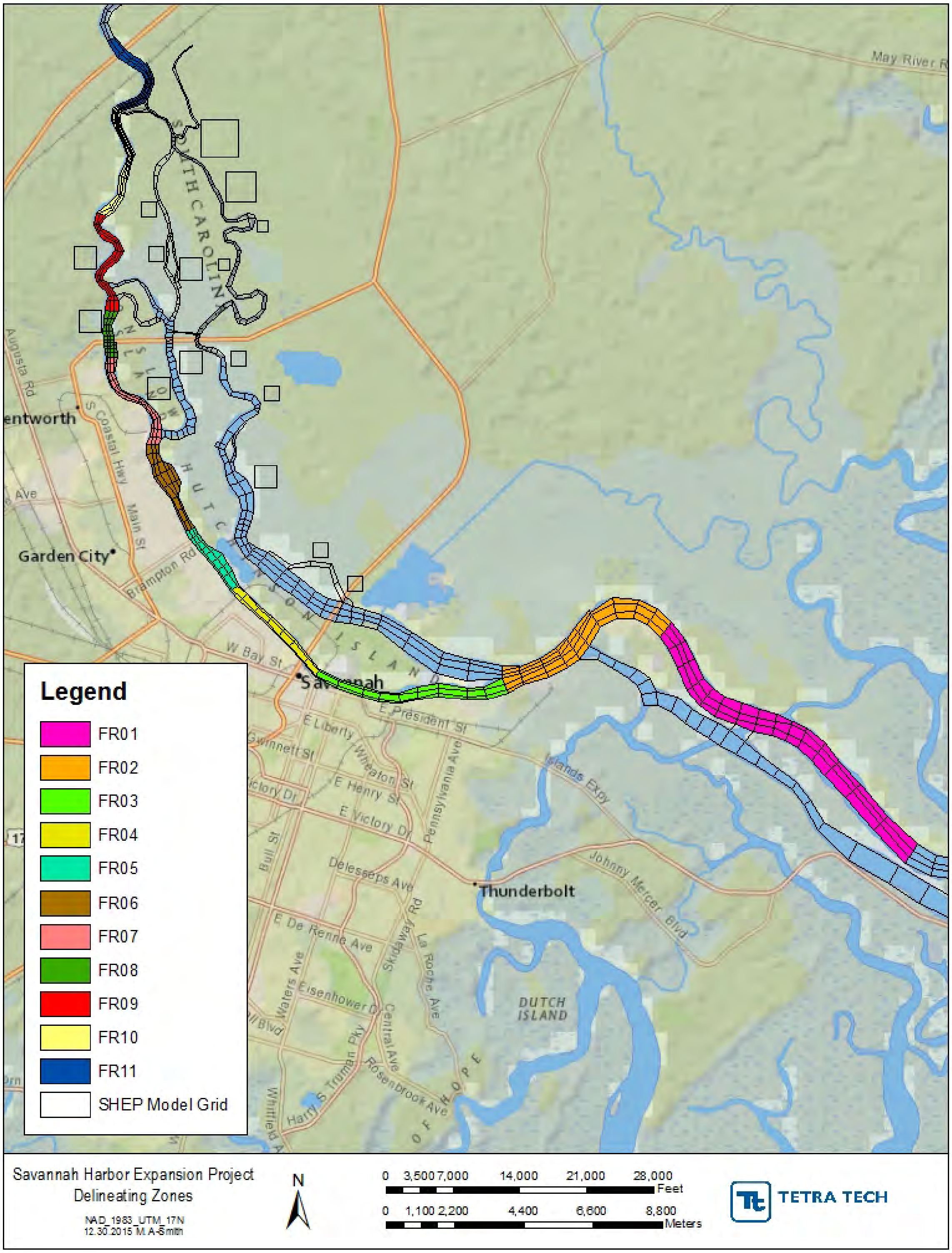


Figure 2 (Location of the Zones for Front River)

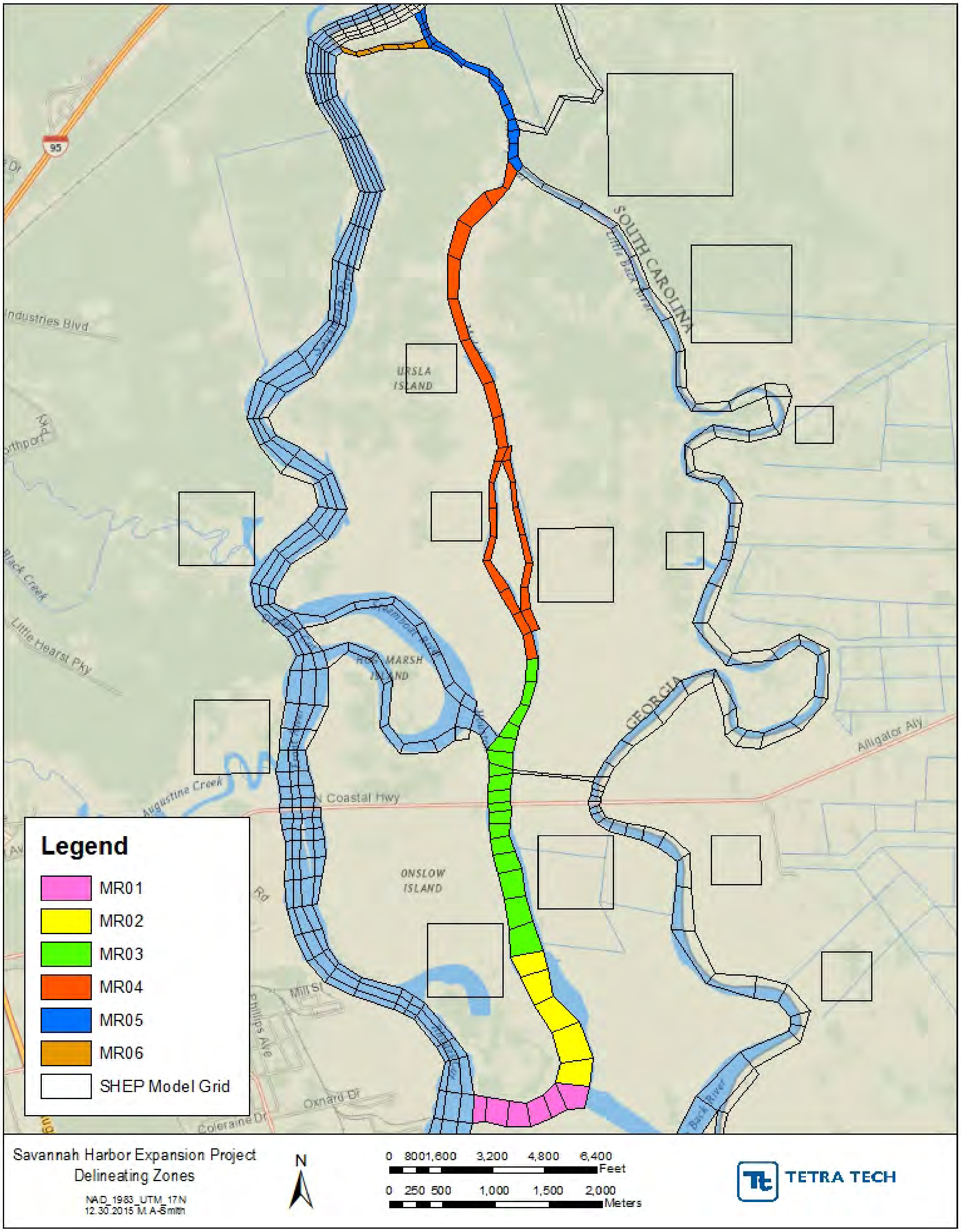


Figure 3 (Location of the Zones for Middle River)

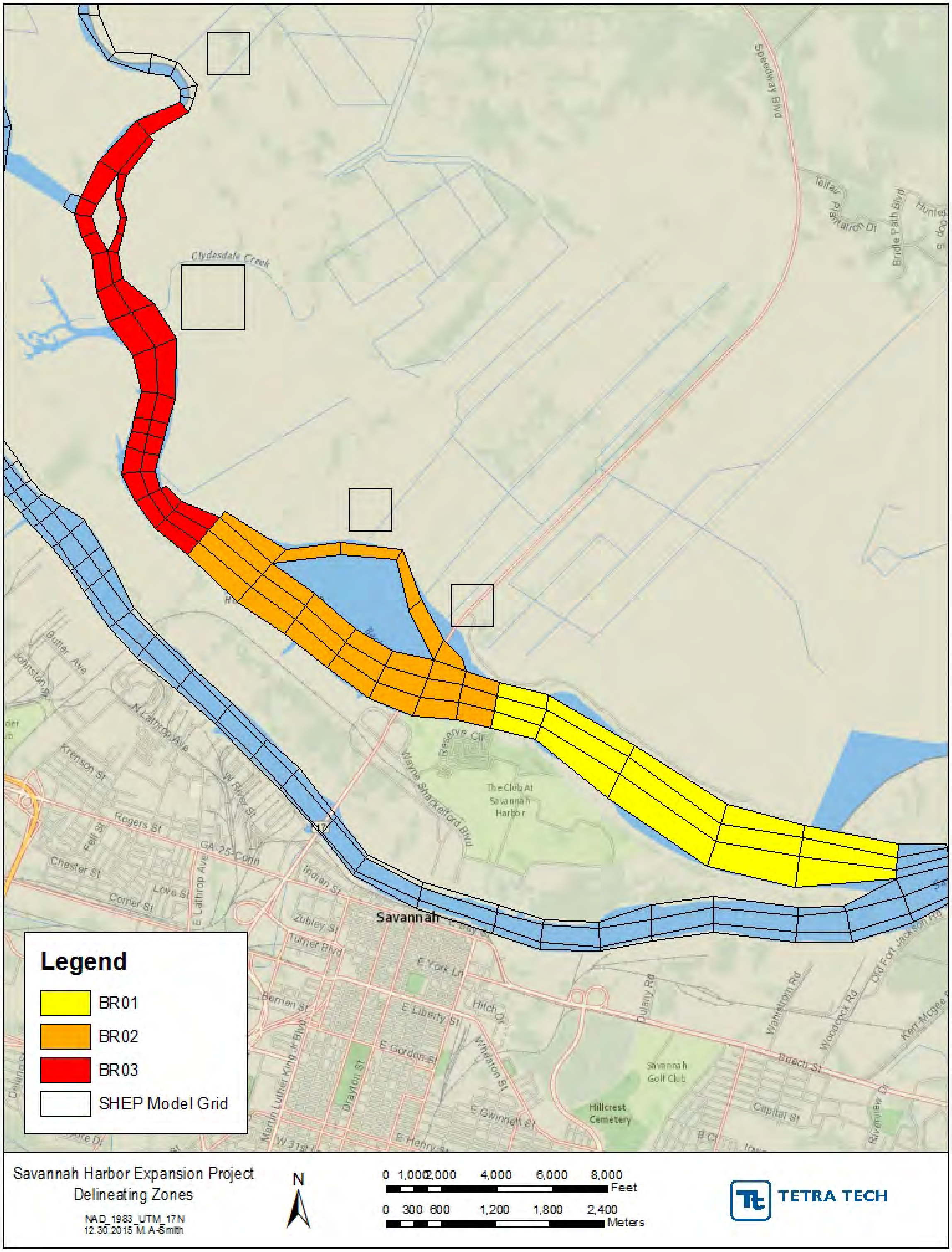


Figure 4 (Location of the Zones for Back River)

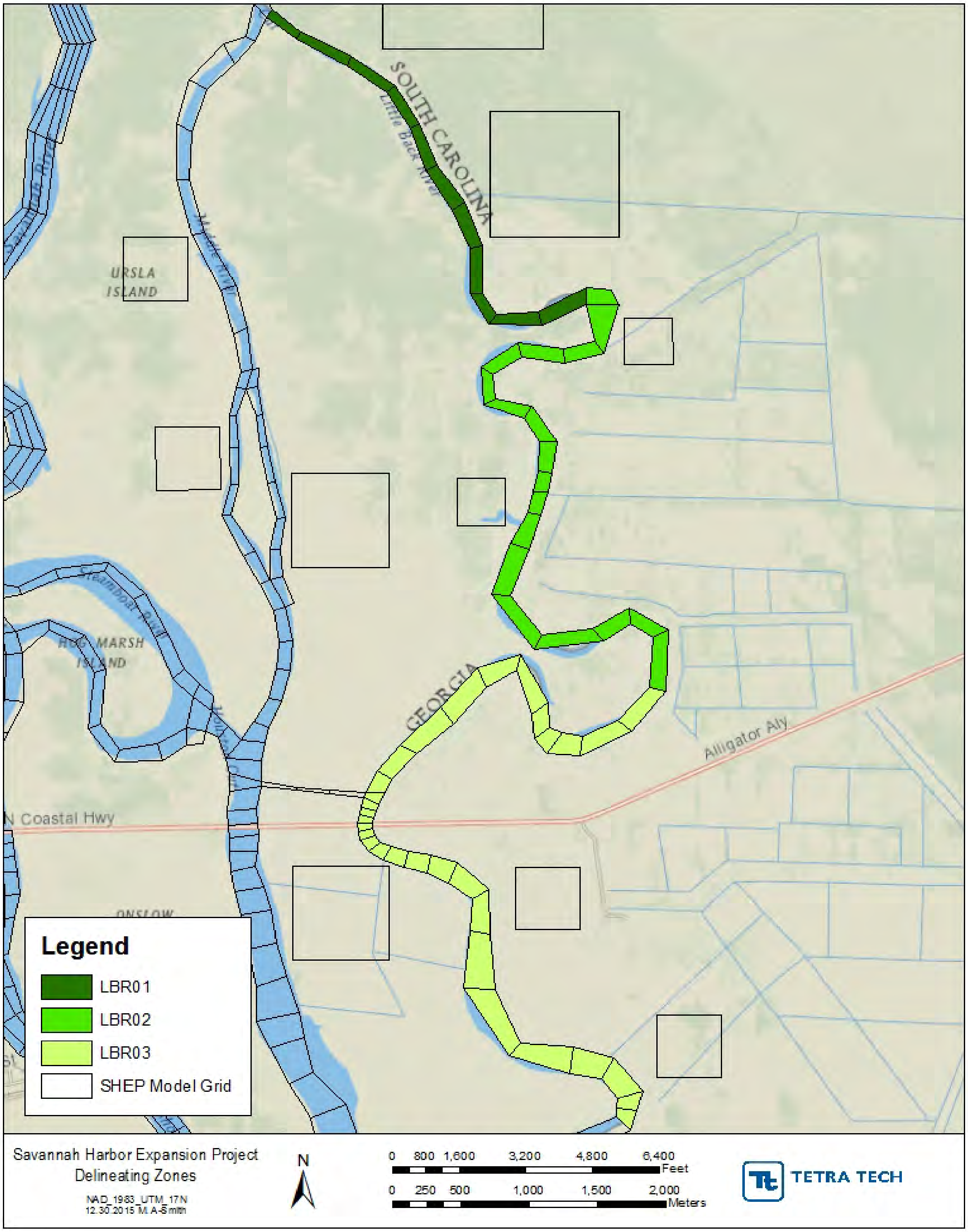


Figure 5. (Location of the Zones for Little Back River)

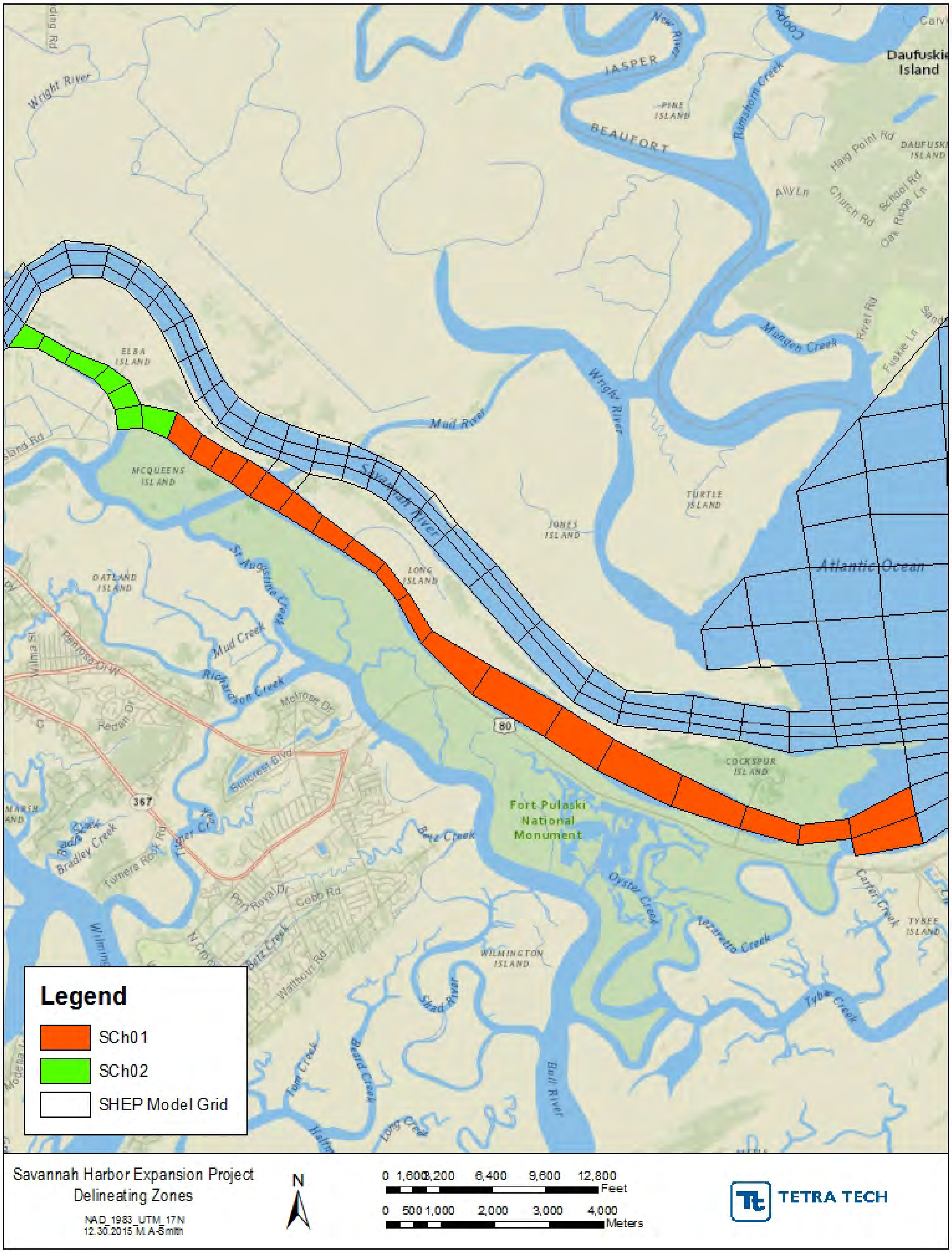


Figure 6. (Location of the Zones for South Channel)

14 Annex F - CLIMATE CHANGE

USACE screening level climate change vulnerability assessment (VA) tool was utilized to assess the potential impacts and likelihood of climate change impacts to this region. The tool operates on a HUC-4 level spatial scale, and it used to quickly assess climate change vulnerably. The tool can be found on https://maps.crrel.usace.army.mil/apex/f?p=170 .

The parameters that were used in the Climate Change analysis are as follows:

Division: South Atlantic

District: Savannah

Business lines:

Flood Risk Reduction

Ecosystem Restoration

Hydropower

Navigation

Recreation

Water Supply

Climactic Data Source: CMIP-5 (2014)

Analysis Threshold: 20%

ORness: .7[1]

[1] Specifies how risk-averse the analysis should be. Value should be between 0.5 and 1.0. Higher ORness values weigh the more vulnerable indicators more heavily, resulting in greater perceived vulnerability overall (more risk-averse). Lower ORness values weigh all indicators in a business line more equally, resulting in lower perceived vulnerability overall because less vulnerable indicators average out more vulnerable indicators (less risk-averse). Typical value is 0.7

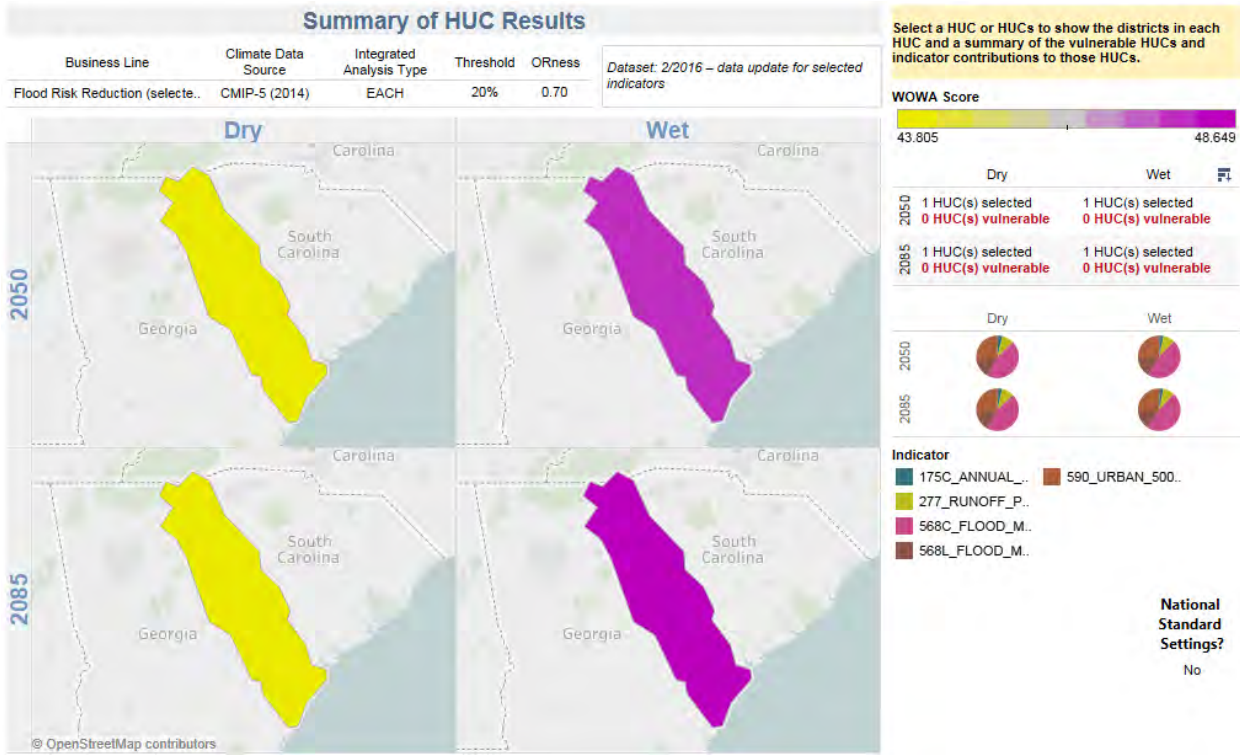


Figure 6-1 (HUC0306 Summary Results (Flood Risk Reduction))

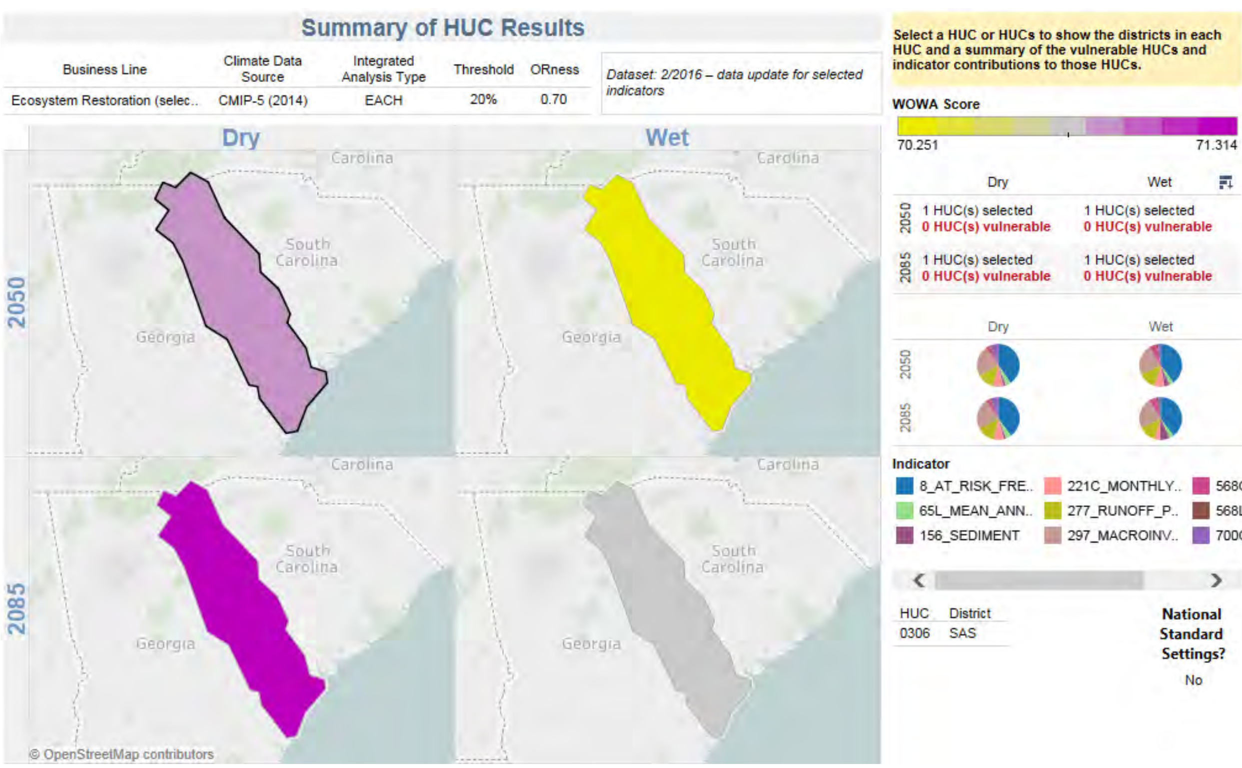


Figure 6-2 (HUC0306 Summary Results (Ecosystem Restoration))

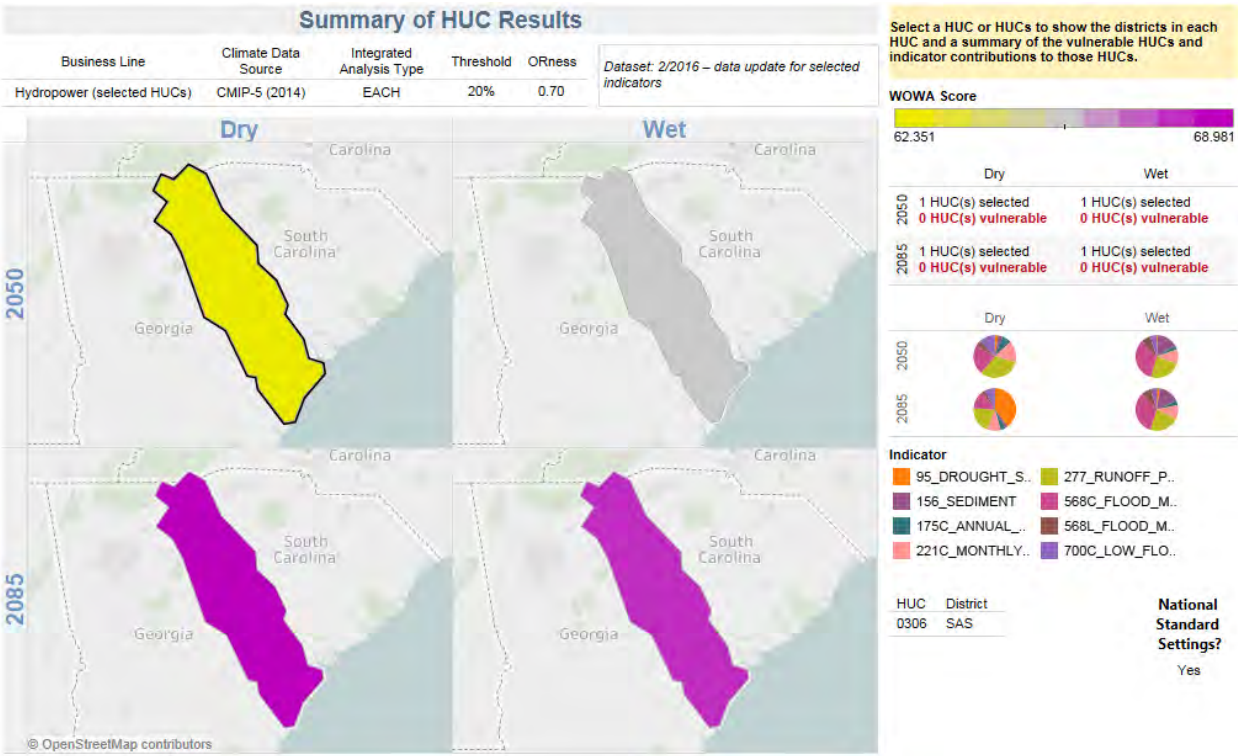


Figure 6-3 (HUC0306 Summary Results (Hydropower))

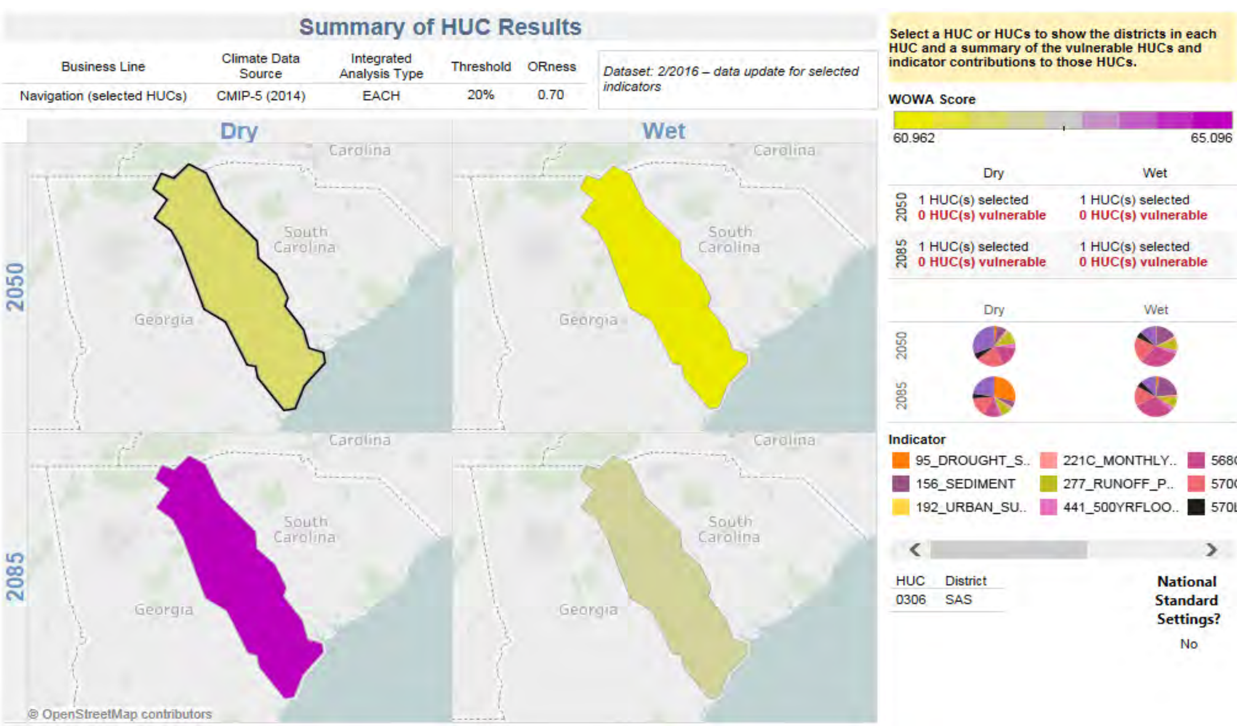


Figure 6-4 (HUC0306 Summary Results (Navigation))

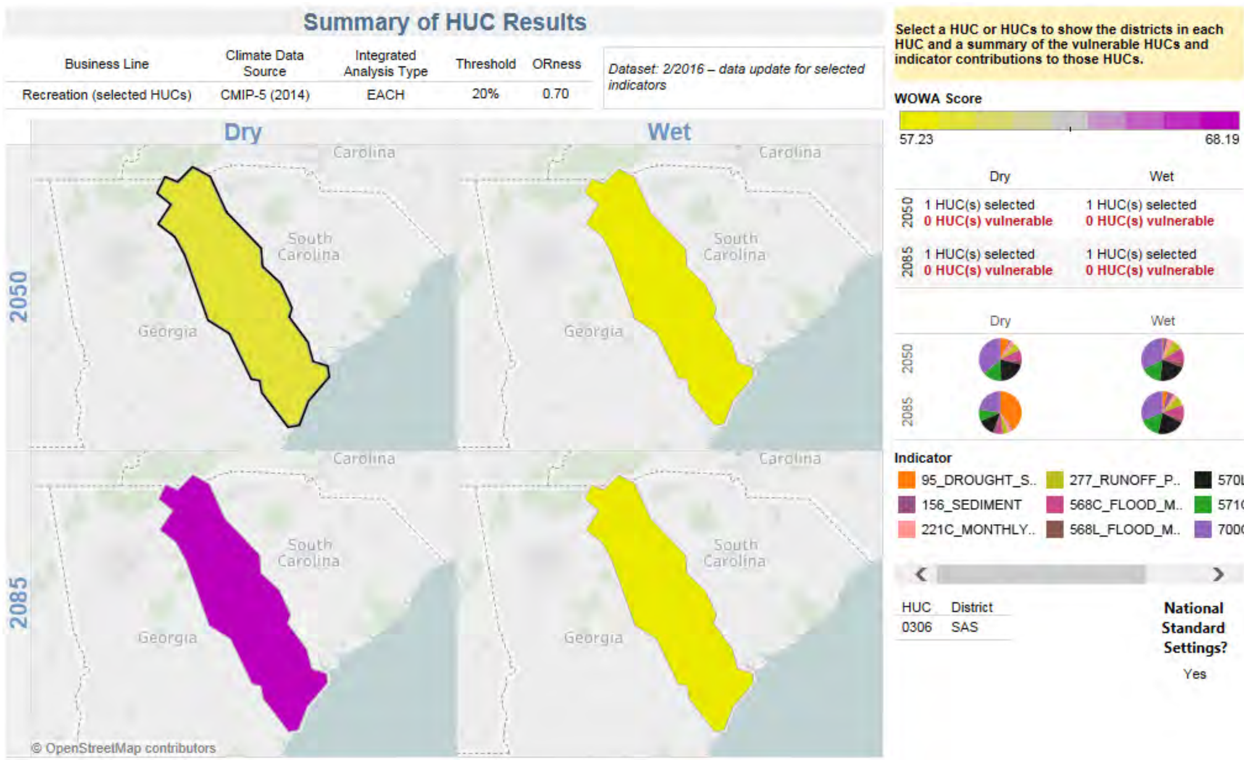


Figure 6-5 (HUC0306 Summary Results (Recreation))

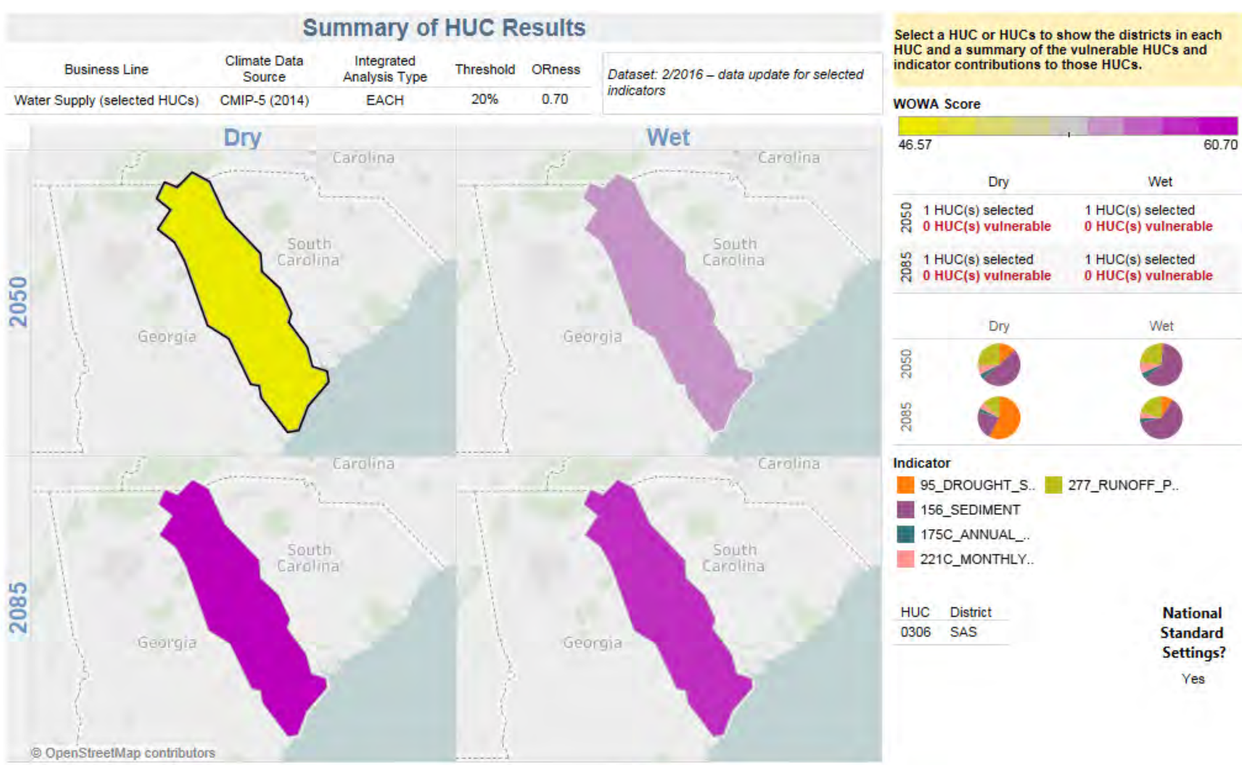


Figure 6-6 (HUC0306 Summary Results (Water Supply))

WOWA Scores[2]						
	DRY			WET		
	2050	2085	% Change	2050	2085	%Change
Flood Risk Reduction:	43.805	44.203	0.91%	47.728	48.649	1.93%
Ecosystem Restoration:	70.932	71.314	0.54%	70.251	70.833	0.83%
Hydropower:	62.351	68.981	10.63%	56.676	67.718	19.48%
Navigation:	62.320	65.096	4.45%	60.962	62.70	2.85%
Recreation:	59.17	68.19	15.24%	57.67	57.23	-0.76%
Water Supply:	46.57	60.70	30.34%	55.98	58.03	3.66%

Table F-1: HUC0306 Summary Results

Conclusion: None of the Business Lines exceeded the default 20% threshold at 2050 or at 2085. The Savannah-Ogeechee watershed is at a relatively low risk for impacts to climate compared to the rest of the continental United States.

[2] WOWA stands for "Weighted Ordered Weighted Average," which reflects the aggregation approach used to get the final score for each HUC. After normalization and standardization of indicator data, the data are weighted with "importance weights" determined by the Corps (the first "W"). Then, for each HUC-epoch-scenario, all indicators in a business line are ranked according to their weighted score, and a second set of weights (which are the OWA weights," are applied, based on the specified ORness level. This yields a single aggregate score for each HUC-epoch-scenario called the WOWA score. WOWA contributions/indicator contributions are calculated after the aggregation to give a sense of which indicators dominate the WOWA score at each HUC.

The WOWA Score of the Savannah-Ogeechee watershed is a standardized way to compare climate change vulnerability to other basins throughout the United States.

Figure shows how the project basin is related to the rest of the country.

The Savannah-Ogeechee watershed is at a relatively low risk for impacts to climate change within Flood Risk Reduction projects, compared to the rest of the continental United States.

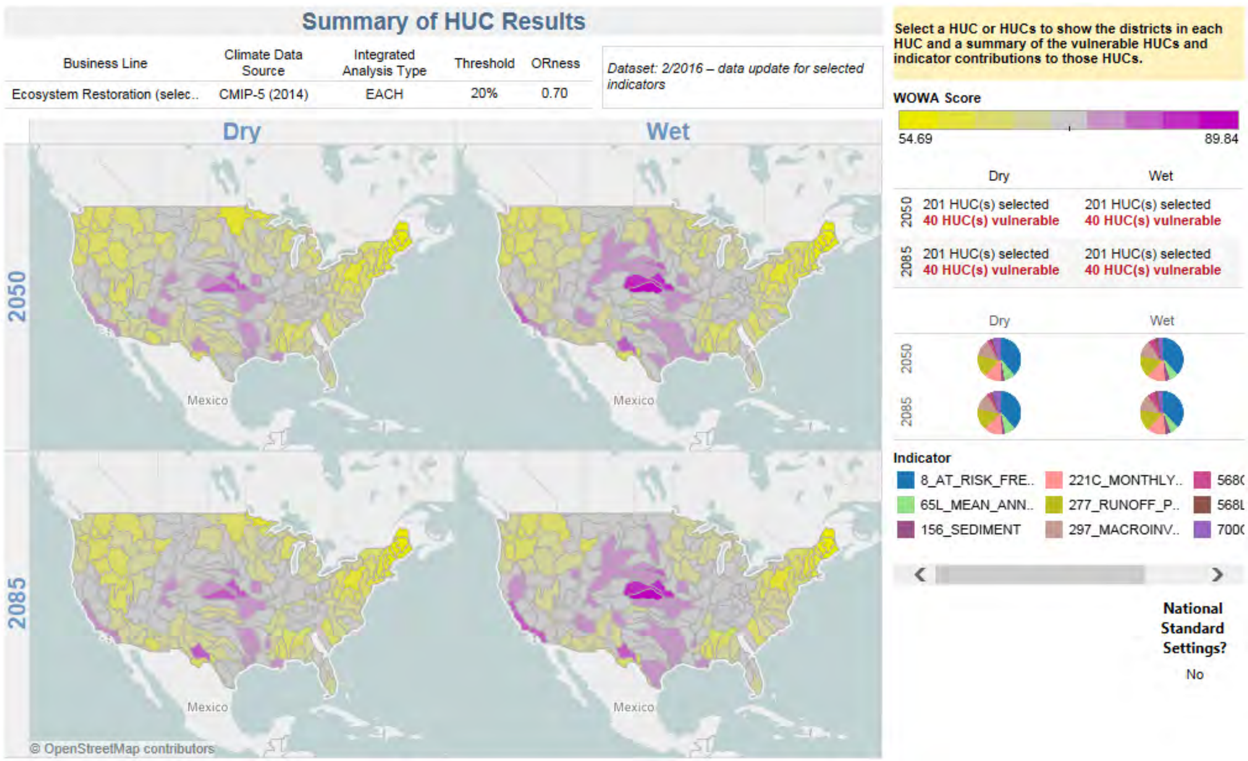


Figure 6-7 (Nationwide HUC Comparison (Ecosystem Restoration))

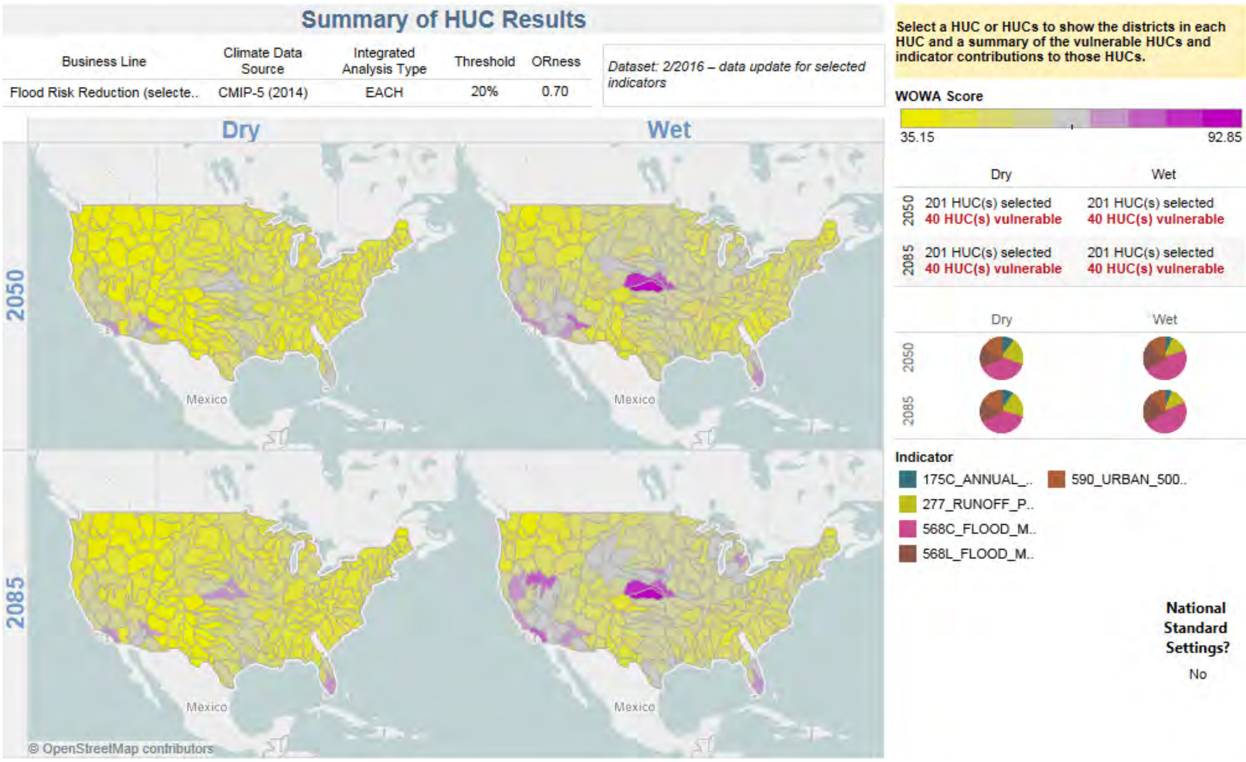


Figure 6-8 (Nationwide HUC Comparison (Flood Risk Management))

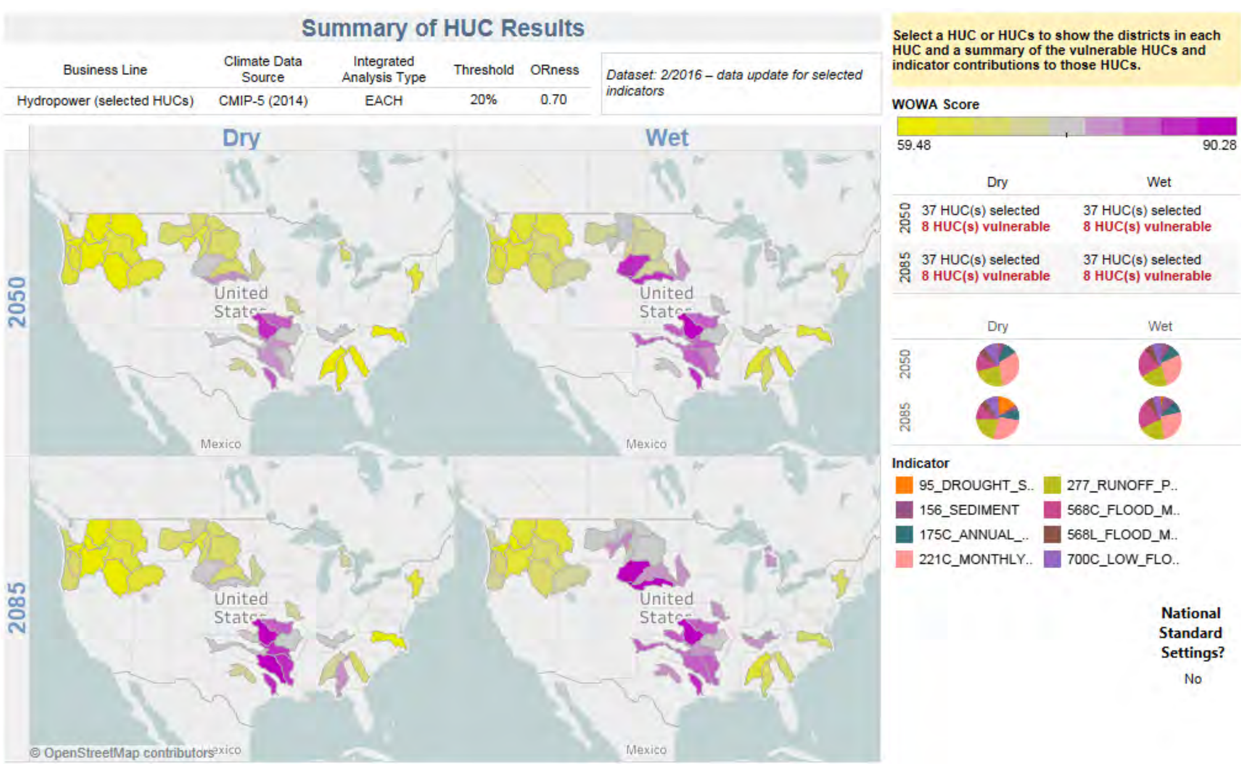


Figure 6-9 (Nationwide HUC Comparison (Hydropower))

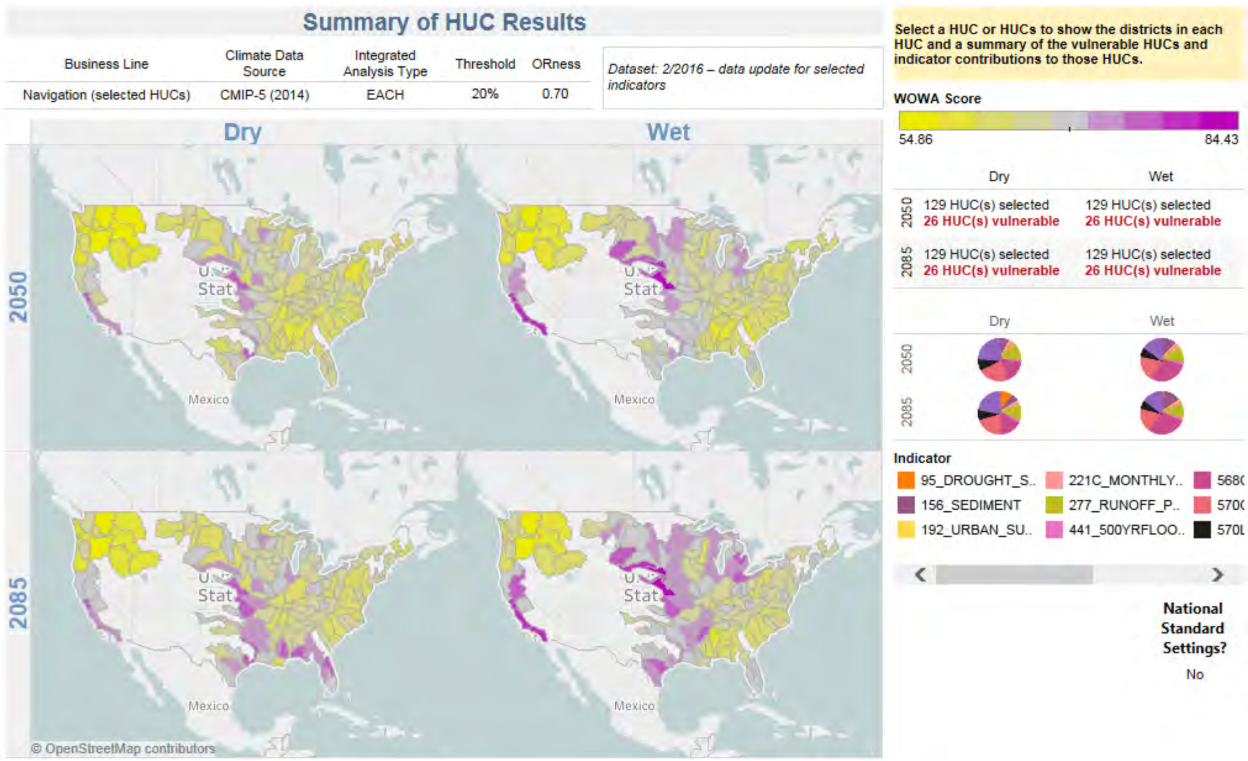


Figure 6-10 (Nationwide HUC Comparison (Navigation))

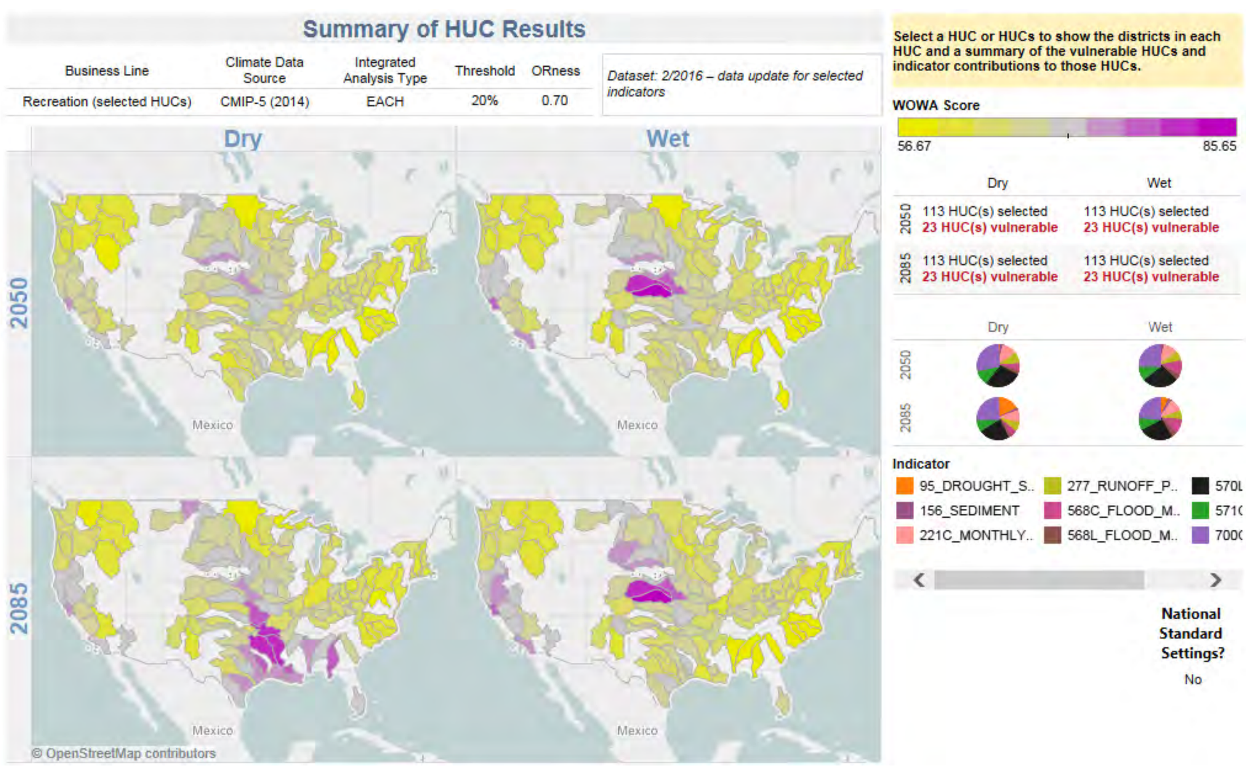


Figure 6-11 (Nationwide HUC Comparison (Recreation))

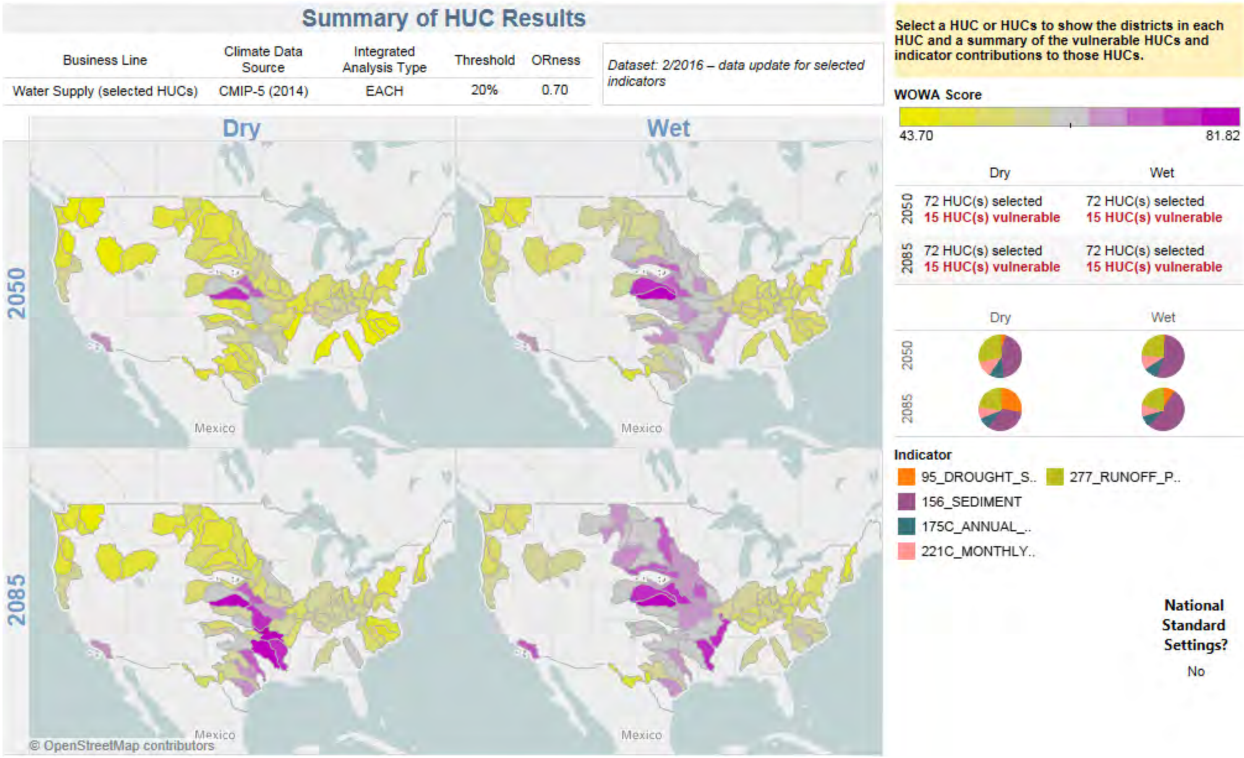


Figure 6-12 (Nationwide HUC Comparison (Water Supply))