Summary of Results

The principal purpose of this study is to assess surface water availability relative to current municipal, industrial, agricultural, and thermal power water uses throughout Georgia. Water availability is defined as the natural hydrologic capacity to meet water demands without depletion of instream flows below the minimum flow provisions in current state or federal policy. These minimum instream flow requirements are subsequently referred to in this report as the *flow regime*. This study effectively compares water supply (natural or unimpaired flow) and water demand (water uses listed above) as the basis for assessment of the amount of water that can be consumed without substantially altering the flow regime and opportunities for instream and downstream uses supported by that flow regime.

Current water use assessments have been conducted statewide based on hydrologic water availability and in some cases natural stream flows augmented by releases from upstream reservoirs. The period of analysis for the resource assessment is 1939 through 2007. This 69-year period includes at least six severe, multi-year, widespread regional droughts. Droughts define limits of water availability, and hence the determination of water shortages is based on low-flow, as opposed to high-flow, conditions.

The surface water availability assessment builds upon previous water use inventory and unimpaired flow development components of the overall study, both of which are summarized in subsequent sections of this report. Definitions pertinent to water availability analysis are defined in detail in Section 8 of this report, with the most essential terms extracted below as follows:

§ *Unimpaired flows* are historically observed flows with effects of reservoir regulation, reservoir surface precipitation and evaporation, and water consumed by municipal and industrial, thermal power and agricultural water uses removed.

§ *Basic nodes* are locations of interest on rivers or major tributary streams where unimpaired flows have been derived.

§ *Planning nodes* are basic nodes where water availability is assessed; one or more basic nodes may be interspersed between planning nodes. Planning nodes are located to avoid separation of major utility withdrawals and returns, and to avoid separation of planning regions and municipalities served by multiple water utilities.

§ *Study basins* are the six major composite river basins designated by GA EPD for consumptive-use assessment, delineated based on hydrologic, topographic, water resource development, water uses and other important considerations in regional planning.

§ *Sub-basins* are intervening watersheds between planning nodes, or total drainage area above the most upstream planning node.

§ *Local drainage areas (LDAs)* are intervening watersheds between basic nodes, or total drainage area above the most upstream basic node.

§ *Net (consumptive) water use* is aggregated withdrawals less returns upstream of or between planning nodes.

This Report summarizes the results of surface water availability assessments in all of Georgia's study basins. Assumptions and criteria pertinent to the analysis fall into three major categories subsequently described: water uses, unimpaired flows and flow regimes.

Water Uses

"Current" water uses are assumed to be represented by maximum observed monthly net reach water use, aggregated across all use categories, from 2002 through 2007. Net reach water use includes direct withdrawals and returns to surface waters, as well as *groundwater* effects – the depletion of surface water flow by groundwater withdrawals. Groundwater effects in this study are confined primarily to southwestern Georgia portions of the ACF (Apalachicola-Chattahoochee-Flint) study basin, described in more detail in Section 2 of this report.

Unimpaired Flows

Unimpaired flows are observed flows with most of the easily measured human influences removed, including flow regulation by and net evaporation from reservoirs, water withdrawals and wastewater returns by categories listed above, and groundwater pumping to the extent surface water flows are reduced. Because little quantitative data on effects of urban development and stormwater collection systems exist, these human influences are not easily measured and consequently not removed from historical flow records. Unimpaired flows rather than observed flows were applied in this study because of the need for a common benchmark, with the effects of water withdrawals and other management activities removed.

Methods, procedures, and assumptions for unimpaired flow development are described in Section 4 of this report.

Flow Regimes

Georgia's interim instream flow protection policy is articulated in DNR rule 391-3-6-.07 (4) (b) 9 (iii) (II), which authorizes EPD to require instream flow protection for certain surface water withdrawal permits. Minimum flow requirements used in the analysis, whether monthly or daily, were drawn from Georgia's interim instream flow protection strategy or from the reservoir release policies applicable to federal and non-federal reservoirs. All input in regard to potential flow regimes were refined by EPD to be consistent with existing DNR rules and accommodate existing water-use permits streamflow regulation effects of large storage reservoirs operated by the Corps, Tennessee Valley Authority, and non-federal hydroelectric power producers. These inferences are predicated on the assumption that federal and non-federal reservoirs are operated in accordance with existing federal policy or Federal Energy Regulatory Commission (FERC) license requirements, respectively. Metrics on flow regimes adopted for this study for determination of water availability are briefly summarized as follows:

Unregulated nodes (no storage reservoirs upstream): Cumulative unimpaired monthly 7Q10 (1 in 10 year 7-day low flow for each month of the year) or cumulative unimpaired daily flow, whichever is less. Adjusted flow regimes are the lesser of minimum monthly 7Q10s and daily cumulative unimpaired flows.

Regulated and semi-regulated nodes (storage reservoirs upstream): For regulated and semi-regulated streams, flow regimes are determined from applicable existing instream flow requirements, including minimum reservoir releases and/or downstream flow operational requirements of FERC licenses or water control plans. In the absence of such requirements at any node, there is no required flow regime.

Water Availability Measures

The methodology employed in this study prioritizes water use over satisfying flow regime, meaning that water use is curtailed only when stream flow is insufficient, irrespective of flow regime violations. All water use categories were met with 100 percent reliability and curtailed equally across the board when stream flow limited.

Assessment of water availability at planning nodes is made in one of two manners in this study, one for unregulated nodes and the other for regulated and semi-regulated nodes. For unregulated nodes, availability is a measurement of gaps between adjusted flow regimes and simulated flow remaining after water diversions and water returns. For regulated and semi-regulated nodes, water availability is determined by compliance with a select set of criteria. These criteria are: average demand shortage, average at-site flow requirement shortfall, minimum reservoir storage (shown both in terms of volume and percent of storage), and average basinwide flow requirement shortfall. The average at-site flow requirements, if present, are determined as described above for regimes at regulated and semi-regulated node flow.

For unregulated nodes, gaps are characterized based on the magnitude of flow regime shortfalls (the difference between the adjusted flow regime and the simulated flows estimated by the modeling tool when simulated flows are less than the adjusted flow regime), increased frequency of flow regime shortfalls, and ratios of shortfall to adjusted flow regime by month. For regulated and semi regulated nodes, when upstream reservoir physical storage is sufficient to meet flow regimes as well as consumptive uses, shortfalls in availability are assumed to be zero, even if no storage is allocated in the reservoir for water supply. Following this rule, neither flow regime nor water demand shortfall would be simulated to occur as long as conservation storage remains in the reservoir. Storage represents aggregate total conservation storage within the reach, i.e. the sum of federal and non-federal reservoir storage between planning nodes.

Findings

The majority of the 39 planning nodes distributed among the state's six study basins are regulated or partially regulated. Under the methods and assumptions adopted for this assessment, the analysis disclosed few gaps (shortfalls) at these locations. Shortfalls were found to only occur in unregulated portions of the Flint, Tennessee, Ogeechee, Coosa, Tallapoosa, Ochlocknee, Suwannee, Satilla, and the St. Mary basins. Severity of gaps is measured by the magnitude and/or frequency of adjusted flow regime shortfalls with current water uses.

Shortfall statistics for all study basins are summarized in Table 1, headings of which are defined as follows:

Number of Nodes - The total number of planning nodes in the study basin.

Nodes with Shortfalls – The number of planning nodes with shortfalls (only planning nodes are examined for shortfalls).

Shortfall Duration – At any given planning node, the length of shortfall is the longest running shortfall, as a percent of the total length of the period of record, of all the shortfalls at that node. For this table, as opposed to listing the length of shortfall at every planning node, just the maximum and minimum shortfall is presented to show the range of lengths of shortfalls throughout the basin.

Average Shortfall – At any given planning node, the average stream flow during all shortfalls at that node. For this table, as opposed to listing the average shortfall at every planning node, just the maximum and minimum shortfall is presented to show the range of average shortfalls throughout the basin.

Table 1 Shortfall Statistics

Number of Nodes	Nodes with Shortfalls	Shortfall Duration (Percent of time)	Average Shortfall (cfs)
Ochlocknee - Suwannee - Satilla - St. Mary Study Basin			
8	7	3-20	<1-44
Tennessee Study Basin			
6	2	1-6	3-6
Oconee – Ocmulgee – Altamaha Study Basin			
6	0	0	0
Savannah – Ogeechee Study Basin			
8	3	4-18	5-20
Alabama – Coosa – Tallapoosa Study Basin			
5	3	6-7	3-9
Apalachicola – Chattahoochee – Flint Study Basin			
6	2	2-12	<1-314

The methods and procedures applied to the current gap analysis are robust and flexible, and are highly adaptable to future water use assessments and water management planning. For example, priorities and demand reductions can be varied to explore tradeoffs between reliabilities of flow regime and water supply, and among different water use categories as well. An array of management practices can also be investigated to evaluate the management alternatives.