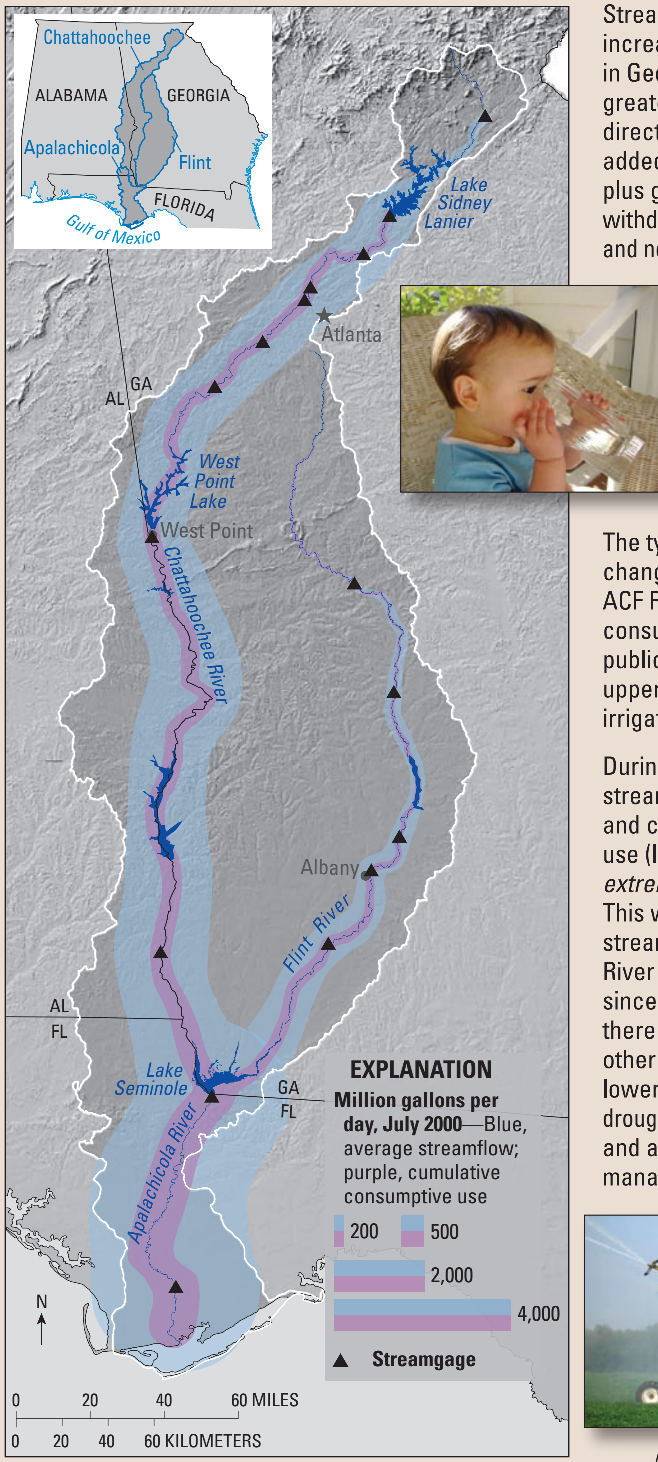
How Much Water Is in the Apalachicola, Chattahoochee, and Flint Rivers, and How Much Is Used?

Questions of how much water is in the Apalachicola, Chattahoochee, and Flint (ACF) Rivers and how much is used do not have simple answers. The answers depend on the location in the river basin and on the year and season (as discussed on the first two pages of this fact sheet). Location is important because as one moves from upstream to downstream in a typical river, additions to streamflow from tributaries plus ground water and subtractions of streamflow from consumptive use are cumulative, with increasing total amounts in the downstream direction. Time is important because streamflow and consumptive use can vary by hundreds of percent from year to year and season to season at a given location; consumptive use typically is highest during droughts and summer months when streamflow typically is low.

Consumptive use is defined herein as the difference between the amount of water withdrawn from and the amount returned to a river. These amounts depend on several factors, particularly the type of water use, which varies from region to region (as discussed on the third page). Streamflow during low-flow periods comes primarily from ground water and can be affected by ground-water pumping (as discussed on the last page).

This fact sheet uses detailed consumptive water-use data for 1994–2001 that are not available for most watersheds in Georgia (Fanning, 2003; U.S. Army Corps of Engineers [USACE], 2004; James Hathorn, USACE, written commun., December 2006). The year 2000 is used herein for several examples because of the available consumptive-use data and because this was an extreme drought year. Additional research and information (as discussed on the last page) are needed to support reliable, fact-based water management and planning for the Georgia Comprehensive Statewide Water Management Plan (accessed March 2007 at *http://www.gadnr.org/gswp/*).

Streamflow and Water Use Change with Location



Streamflow generally increases with basin size in Georgia rivers, becoming greater in the downstream direction with cumulative added flows from tributaries plus ground water. Water withdrawn from a river reach and not returned (consumptive water use) is unavailable for all downstream reaches. The cumulative consumptive use also increases in the downstream direction. The type of water use also changes with location. In the ACF River Basin, the largest consumptive uses are public water supply in the upper part of the basin and irrigation in the lower part.

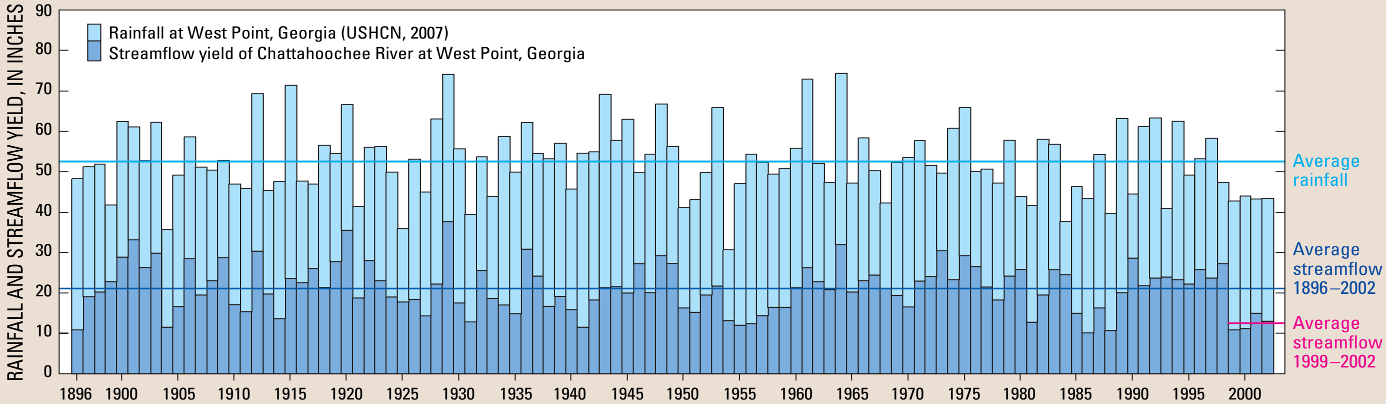
Photograph by Paul D. Ankcorn, USGS

During July 2000, average streamflow (left, blue bar) and cumulative consumptive use (left, purple bar) reflect *extreme* drought conditions. This was the lowest July streamflow in Apalachicola River leaving Lake Seminole since recordkeeping began there during 1929; though other months have had even lower streamflow. Extreme droughts are rare but recurring and are the focus of water management and planning.

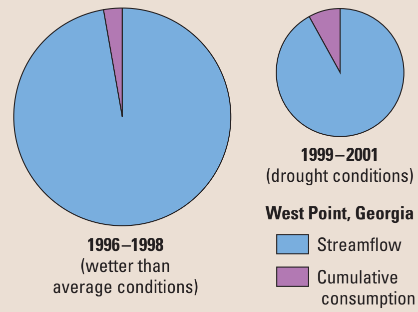
Photograph by Alan M. Cressler, USGS

Center-pivot irrigation

Streamflow and Water Use Change Year to Year...



Streamflow changes from year to year, often by large amounts, with changing annual rainfall. Thus, long-term average streamflow is not a good measure of the reliability of a water supply. Average streamflow for the driest four consecutive years (1999–2002) since 1896 is only 59 percent of the long-term average streamflow for the Chattahoochee River at West Point. Also, the percentage of rainfall that becomes streamflow is lower in dry years because of increased evapotranspiration, soil infiltration, and other factors. Average streamflow yield (streamflow divided by the basin area) was only 29 percent of the average rainfall from 1999 to 2002, compared to 50 percent during the 4 years of highest streamflow from 1900 to 1903. Rainfall at West Point is related to, but is not the same as, rainfall across the entire Chattahoochee River Basin above West Point. The Chattahoochee River has been regulated upstream from West Point by Lake Lanier since 1956 and by West Point Lake since 1974. While these reservoirs affect daily, monthly, and seasonal streamflow, they have little effect on annual streamflow at West Point.

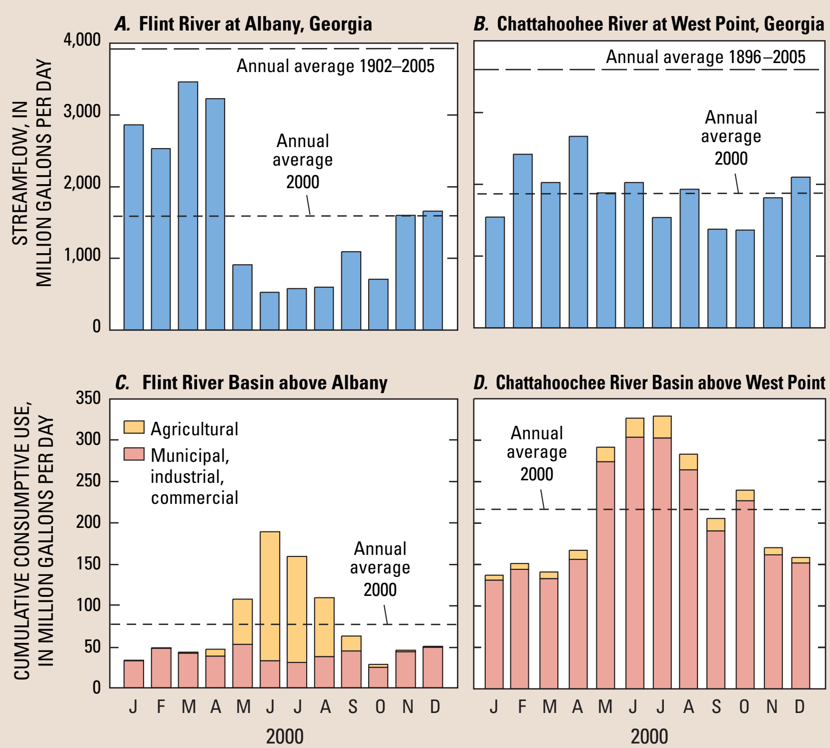


Consumptive water use also changes from year to year, with increased use during dry years primarily for increased irrigation. During the 1999–2001 drought years, cumulative consumptive use above West Point was about 60 percent greater than during the previous 3 wetter-than-average years. This represents an increase of about 230 percent in consumptive use relative to streamflow, because streamflow decreases (smaller overall pie) while consumptive use increases during drought years.

...and Seasonally

Streamflow changes seasonally in unregulated streams such as the Flint River at Albany, Georgia (*A*, at right), where average streamflow from June to August 2000 was only 34 percent of the annual average for 2000 and only 14 percent of the long-term average. Streamflow changes can be moderated by reservoir operations that store water during wet months and release additional water during dry months, as for the Chattahoochee River at West Point *(B)*.

Consumptive use also is seasonal and increases during dry summer months. Cumulative consumptive use from the Flint River above Albany, Georgia, is primarily for irrigation, and average consumptive use during June and July 2000 was more than 2.2 times the annual average for 2000 *(C)*. Cumulative consumptive use from the Chattahoochee River above West Point is primarily nonagricultural, and average consumptive use during June and July 2000 was more than 1.5 times the annual average for 2000 *(D)*. The annual and seasonal variability of streamflow and the fact that consumptive use increases during times of decreased streamflow are critical considerations in water-management planning.



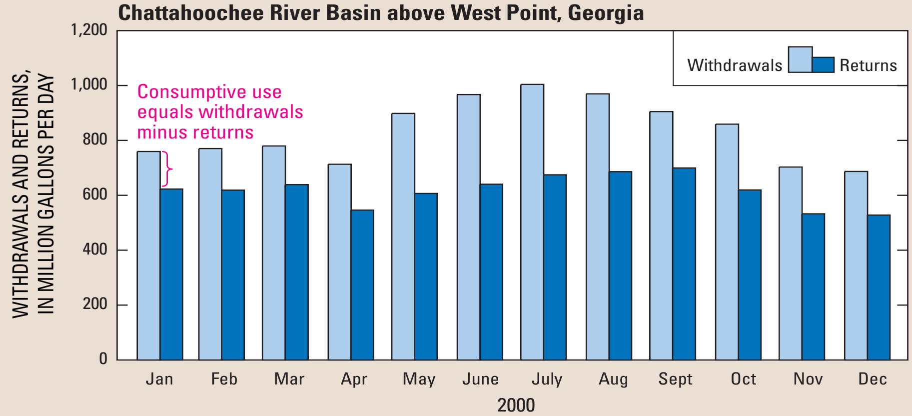
What Is Consumptive Use?

Consumptive water use for a river can be defined simply as the difference between the amount of water withdrawn and the amount of water returned to that river. This water remains in the hydrologic cycle, but is no longer available to the stream during an accounting period. Consumed water may include evapotranspiration (as for irrigation and some septic tank usage), interbasin transfers, or ground-water recharge. The cumulative consumptive use for a specific river reach is not only the water withdrawn from that reach, but the sum of all water consumed upstream from that location.

Estimated monthly consumption for the Chattahoochee River Basin above West Point during 2000 varied from 18 to 34 percent of water withdrawals for all water uses, and from 35 to 58 percent of water withdrawals for nonthermoelectric-power water uses.

Surface-water withdrawal data have been collected and compiled for nonagricultural use for several years in Georgia. Return-flow data can be inflated by contributions from combined sewer overflows. The data shown here (from U.S. Army Corps of Engineers, 2004) contain estimated values for some unreported withdrawals and returns, and have unknown accuracy. The lack of reliable water-use data is a major hindrance to water management and planning in Georgia.

Surface-water withdrawals and returns, Chattahoochee River Basin above West Point, Georgia

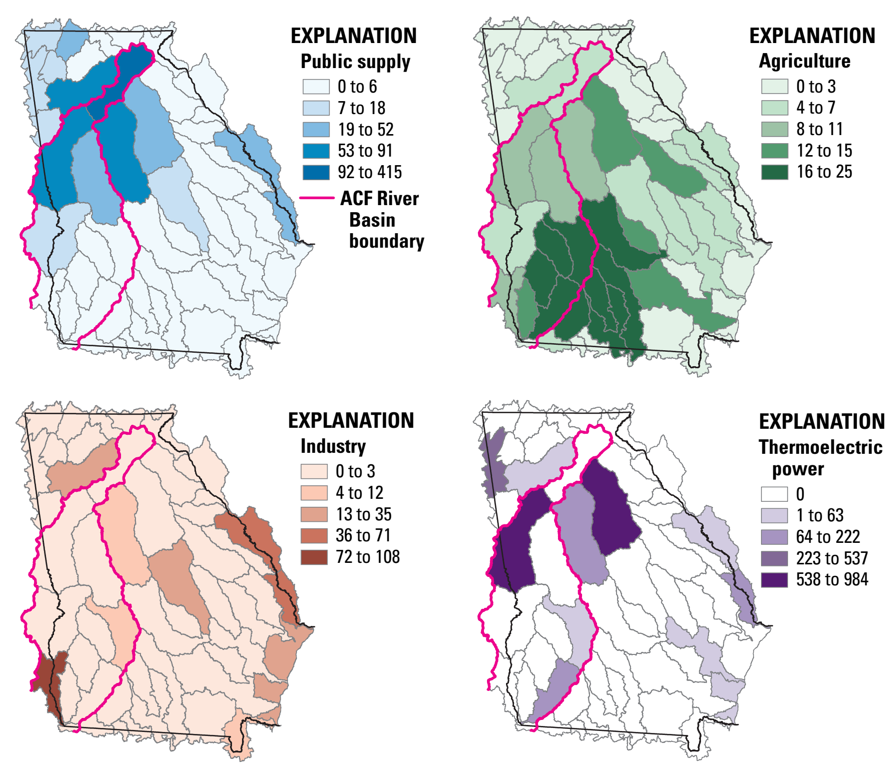


How Are Streamflow Withdrawals Used?

Streamflow is withdrawn for different uses that tend to be focused in specific regions. Public-supply water withdrawals are greatest in population centers in the upper part of the ACF River Basin, and supply primarily domestic, commercial, and industrial uses. Agricultural withdrawals are primarily for irrigation and are greatest in the lower part of the ACF River Basin. Locations of industrial and thermoelectric-power withdrawals depend on plant locations. Many of these plants are in coastal and northeastern Georgia, with few in the ACF River Basin.

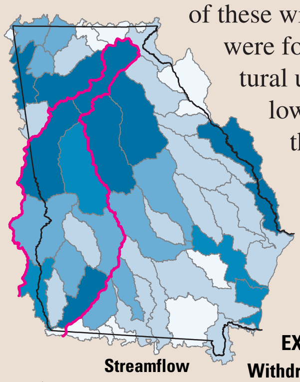
The maps (at right) show the regional distribution of streamflow withdrawals (not consumptive use) for different uses during 2000. Much of the streamflow withdrawn for public supply is returned to the stream; but this percentage depends on conservation practices, septic tank usage, plant technologies, system leakage, interbasin transfers, and other factors. Water for cooling in thermoelectric-power plants accounts for more than one-half of all streamflow withdrawals in the ACF River Basin during 2000; however, on average only 5 percent of this water was consumed. The percent of consumptive use in a particular thermoelectric-power or industrial plant depends on plant technology and varies from 1 to 100 percent (Fanning, 2003; Julia L. Fanning, U.S. Geological Survey, written commun., 2007). In contrast, most agricultural withdrawals do not return to the stream and usually are regarded as 100 percent consumptive.

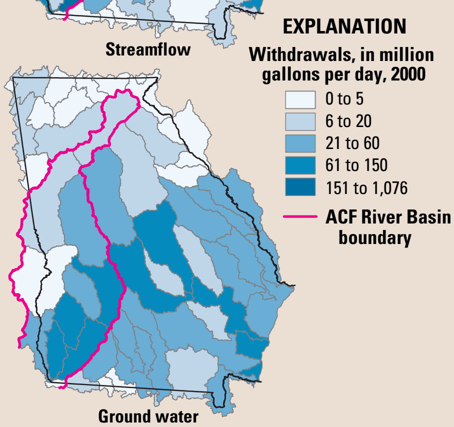
Streamflow withdrawals during 2000, in million gallons per day



How Does Ground Water Affect Streamflow?

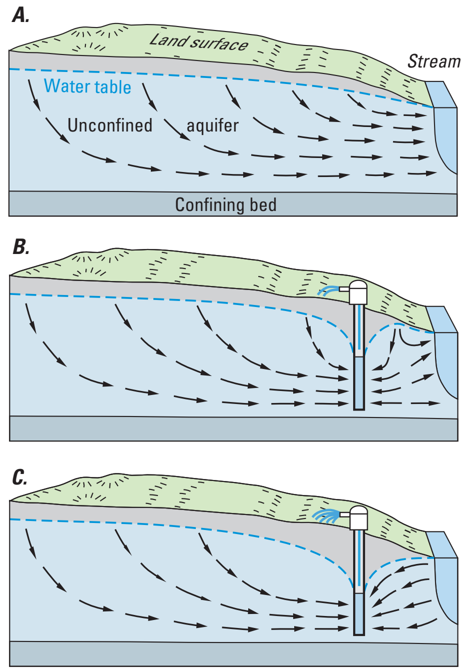
Ground water is an important water source in the ACF River Basin, especially in the lower part of the basin, where aquifers are highly productive. Ground water provided 37 percent of all non-thermoelectric water withdrawals in the ACF River Basin during 2000, and most of these withdrawals were for agricultural use in the lower part of the basin (see maps).





Information on how much ground water is in the ACF River Basin and how much is used is essential to sound water management; however, this information is not available throughout the basin. Ground-water modeling studies have quantified ground-water supplies in the lower ACF River Basin; however, these results do not extend to the northern parts of the basin. In addition, ground-water use is difficult to quantify because reporting requirements have not been implemented for agricultural withdrawals.

Additional ground-water modeling studies and ground-water-use data are needed to provide information on overall water availability and use in the ACF River Basin.



Modified from Winter and others, 1998

Ground water interacts with streams in Georgia. During extended low-flow periods, all the streamflow—excluding return flows and regulated flows—typically comes from ground water. *(A)* Under typical conditions, water flows through the ground and into streams (arrows show direction of flow). During periods of low rainfall and high ground-water pumping, *(B)* the amount of ground water flowing into streams is reduced and *(C)* increased pumping can induce streamflow into the aquifer. Ground-water modeling studies have provided insight into the effect of pumping on streamflow in the lower ACF River Basin. Ground-water modeling results for October 1999 indicate that irrigation pumping reduced the ground water flowing into streams by 56 million gallons per day (Jones and Torak, 2006).

Information Needs

A factual basis for water management and planning requires a broad range of information that is not readily known. Although streamflow and surface-water use have been investigated for the ACF River Basin more than for most river basins in Georgia, additional investigation and data collection are needed to:

- Reliably and consistently define consumptive water use for all uses;
- Determine ecological flow needs, particularly for threatened and endangered species;
- Evaluate water-quality trends and effects from return flows;
- Quantify surface-water and ground-water interactions;
- Evaluate and project trends in water resources with seasonal, annual, and long-term climate change; and
- Evaluate effects of additional reservoirs and interbasin transfers on water supply.

The reliability of Georgia's Comprehensive Statewide Water Management Plan, and its effectiveness in drought periods, may depend on investigation of these critical questions and on the accuracy of the answers.

References

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In cooperation with the
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