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Extreme Drought to Extreme Floods: Summary of Hydrologic Conditions in Georgia, 2009

The United States Geological Survey (USGS) Georgia Water Science Center (WSC) maintains a long-term hydrologic monitoring network of more than 317 real-time streamgages, more than 180 groundwater wells of which 31 are real-time, and 10 lake-level monitoring stations. One of the many benefits of data collected from this monitoring network is that analysis of the data provides an overview of the hydrologic conditions of rivers, creeks, reservoirs, and aquifers in Georgia.

Hydrologic conditions are determined by statistical analysis of data collected during the current water year[1] (WY) and comparison of the results to historical data collected at long-term stations. During the 2009 WY Georgia experienced a dramatic change from drought conditions to above-normal streamflows. Maps *A–D* indicate that during the first half of the 2009 WY, most streams in Georgia had flows much below normal, but by the end of the year, the majority of streams had flows much above normal. At the start of the 2009 WY, new historic minimum streamflows were recorded at several streamgages with 20 or more years of record, and reservoirs approached historic low elevations. South Georgia received drought relief as a result of historic flooding from March 27–April 3, 2009. North Georgia experienced historic flooding during September 16–22, 2009. During these flood events, Georgia WSC hydrographers verified peak streamflows and flood levels, and this information was shared with Federal, State, and local agencies for use in protecting life and property. New record peak flows were observed in many creeks and rivers throughout the State during these epic floods, and reservoir and lake elevations approached full pool. Extreme hydrologic conditions, both drought and floods, in the 2009 WY emphasizes the need for accurate, timely data to help make informed decisions by state and local authorities regarding the management and conservation of Georgia's water resources for the protection of life.

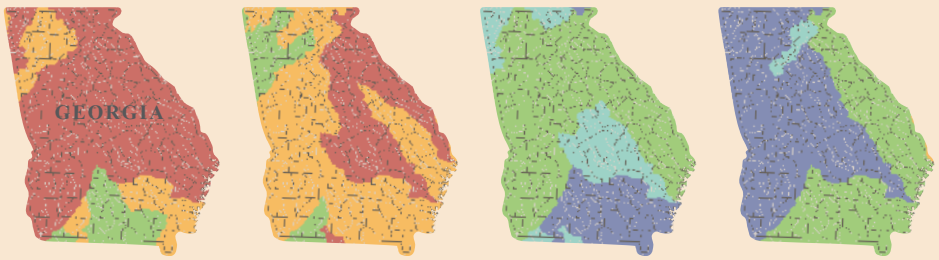
Lake Lanier reached an all-time historic low elevation of 1,050.79 feet on December 26, 2007, nearly 21 feet below full pool. From December 2008 through September 2009 the lake elevation increased more than 18 feet after Georgia received above normal precipitation and experienced two historic flood events. Photos by USGS.

On June 10, 2009, Governor Perdue met with the State Drought Response Committee and announced that the Environmental Protection Division issued a non-drought schedule for outdoor water use for the first time since June 2006 (State of Georgia, 2010). This announcement was made as a result of substantial rainfalls and improved water supplies in Georgia. Under a non-drought schedule, household outdoor water use is allowed 3 days a week.

Streamflow And Groundwater Data

Daily, monthly, and yearly streamflow and groundwater statistics from the 2009 USGS Annual Data Report (ADR; U.S. Geological Survey, 2010a) were used to develop this summary. The ADRs for WYs 1999–2009 can be accessed online at *http://ga.water.usgs.gov/publications/pubswdr.html*. A digital map is available at this site to interface with current and historical data, graphics, and photographs from the Georgia WSC monitoring network.

Quarterly Hydrologic Conditions in Georgia for 2009, Based on 7-Day Average Streamflows

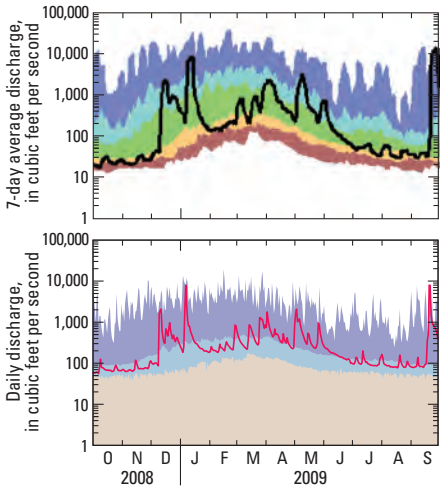


These maps represent hydrologic conditions in the context of available historical data. The colors represent current 7-day average streamflow as a percentile class of long-term averages. Only stations having at least 30 years of record were used (U.S. Geological Survey, 2010b). Because of persistent drought conditions that began in spring 2006, streamflow conditions at the beginning of the 2009 WY in the State were "much below normal" (map *A*). Steady rainfall and spring flooding in south Georgia brought much-needed relief, and 7-day average streamflow conditions improved from "below normal" to "above normal" (map *B*, *C*). By September 30, 2009, the end of the water year, the 7-day average streamflows throughout most of Georgia were "much above normal" (map *D*).

[1]Water year is the period October 1 through September 30 and is designated by the year in which it ends. For example, the 2009 water year began on October 1, 2008, and ended on September 30, 2009.

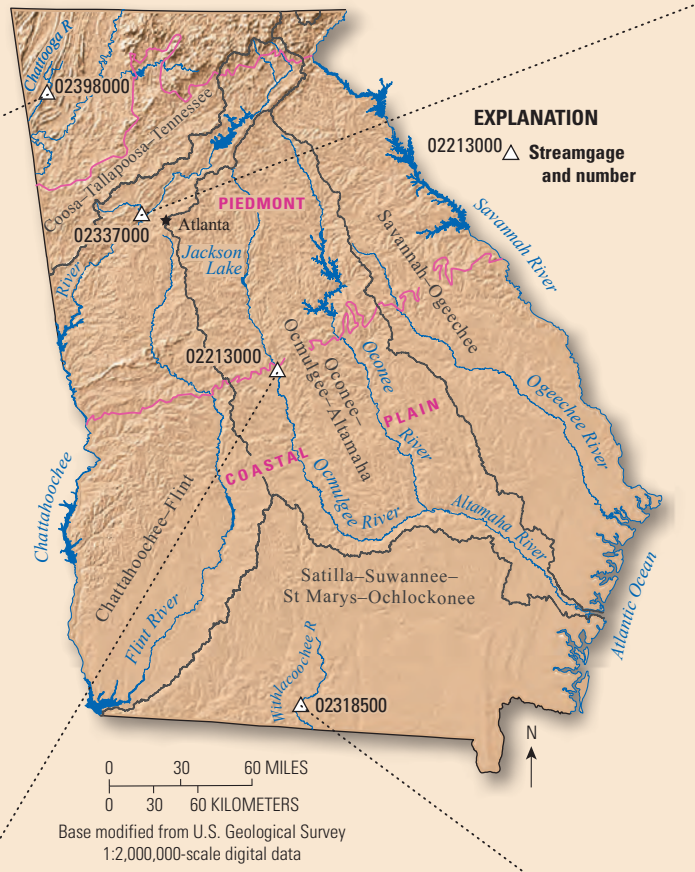
Chattooga River at Summerville 02398000

Chattooga River at Summerville, Georgia. Photo by USGS.



The Chattooga River flows in the northwest corner of Georgia into Alabama and is an inflow to Wiess Lake in Alabama (U.S. Geological Survey, 1975). At the beginning of the 2009 WY, the 7-day average streamflow was "much below normal," and near-historic minimum daily values were observed. In December 2008, 7-day average streamflow conditions changed from "much below normal" to "normal." During the September 2009 flood in northern Georgia, streamflow conditions were "much above normal," and the annual peak flow exceeded the 2-percent annual exceedance probability (50-year recurrence interval).

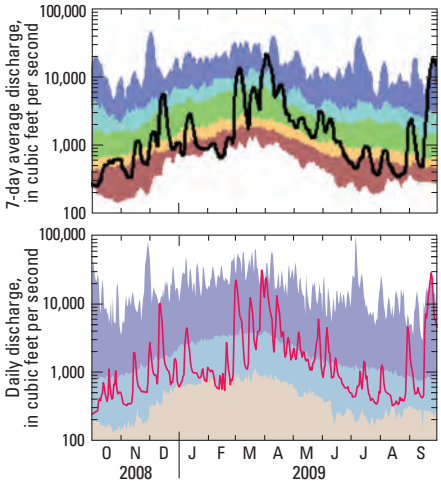
Daily Discharge and 7-Day Average Streamfow Conditions, 2009 Water Year



Base modified from U.S. Geological Survey 1:2,000,000-scale digital data

Ocmulgee River at Macon 02213000

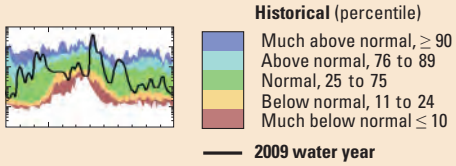
Ocmulgee River at Macon, Georgia. Photo by USGS.



The Ocmulgee River flows out of Jackson Lake and joins the Oconee River to form the Altamaha River (U.S. Geological Survey, 1975). In 2009, new record daily low streamflows were observed for the month of February. During the historic floods in March–April and September 2009, however, record high streamflows were observed when 7-day average streamflows were "much above normal" and daily streamflows were near record maximum.

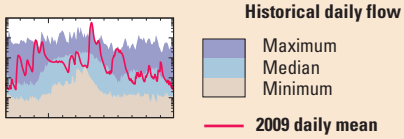
7-Day Average Discharge

Hydrographs show the 7-day averages for 2009 as compared to historical 7-day averages. Data are categorized in percentile ranges from "much above normal" (greater than the 90th percentile) to "much below normal" (less than the 10th percentile; U.S. Geological Survey, 2009b).



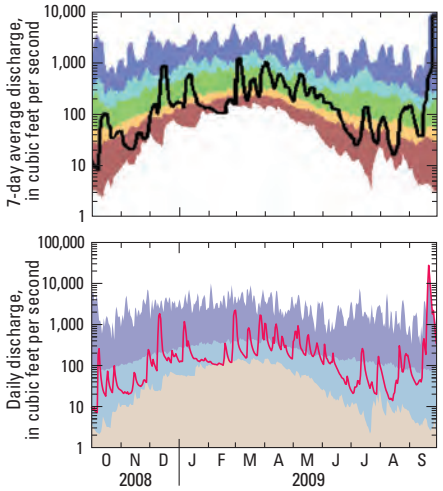
Daily Discharge

Hydrographs show 2009 daily-mean streamflow, in cubic feet per second, as compared to historical maximum, median, and minimum streamflow for the entire period of record (U.S. Geological Survey, 2009a).



Sweetwater Creek near Austell 02337000

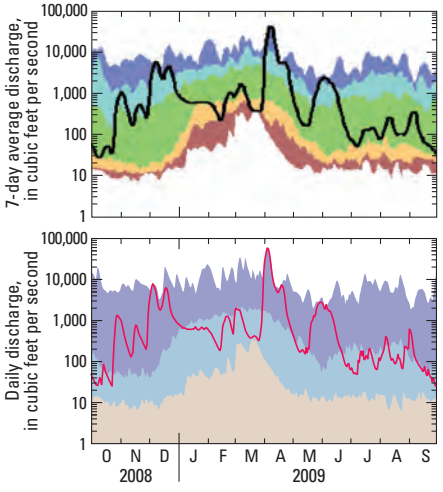
Sweetwater Creek near Austell, Georgia. Photo by USGS.



Sweetwater Creek is a major tributary of the Chattahoochee River (U.S. Geological Survey, 1975). For most of the 2009 WY, 7-day average streamflow fluctuated between "much below normal" and "normal" conditions. New record daily low streamflows were observed for the month of February. During the September 2009 flood, a new annual peak flow for the period of record was recorded on Sweetwater Creek. This peak flow exceeded the 0.2-percent annual exceedance probability (500-year recurrence interval). During the peak of this historic flood, the Interstate 20 bridge crossing over Sweetwater Creek 300 feet downstream from the USGS streamgage was inundated and closed to traffic.

Withlacoochee River at US 84 near Quitman 02318500

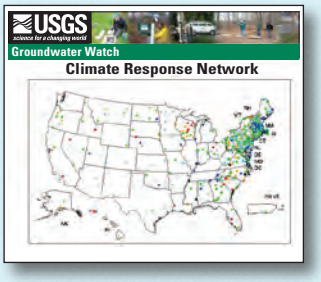
Withlacoochee River at U.S. 84 near Quitman, Georgia. Photo by USGS.



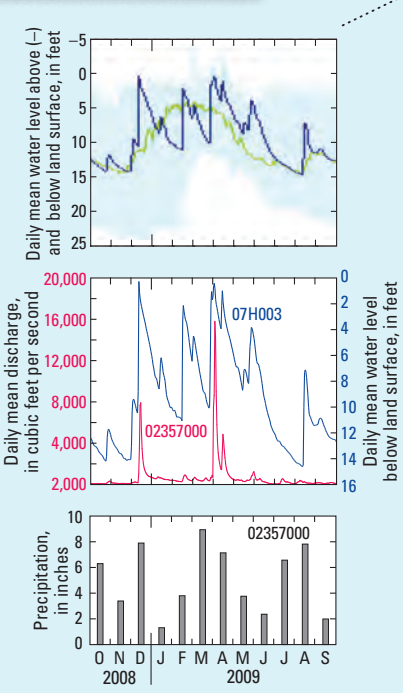
The Withlacoochee River flows in the Ochlockonee River basin in the southern coastal plain of Georgia (U.S. Geological Survey, 1975). For most of the 2009 WY, 7-day average streamflow conditions were "normal." The March–April 2009 flood produced a record high 7-day average streamflow, and the highest annual peak flow at this site since 1948. During the flood peak, the water surface was flowing 5 to 6 feet above U.S. Highway 84 when USGS field crews measured the streamflow by boat.

Climate Response Network

The USGS maintains a network of groundwater wells to monitor the effects of droughts and other climate variability on groundwater levels. These wells are part of the Climate Response Network, which is designed to measure the effects of climate on groundwater levels in unconfined aquifers or near-surface confined aquifers where pumping or other human influences on groundwater levels are minimal (U.S. Geological Survey, 2007, 2009a). The national network consists of about 130 wells, of which 15 are located in Georgia. Information obtained for the 2009 WY from four of these wells is summarized in this section. These wells are monitored as part of the USGS Groundwater Resources and Cooperative Water Programs. Current conditions of groundwater wells in the Climate Response Network can be accessed online at *http://groundwaterwatch.usgs.gov*.

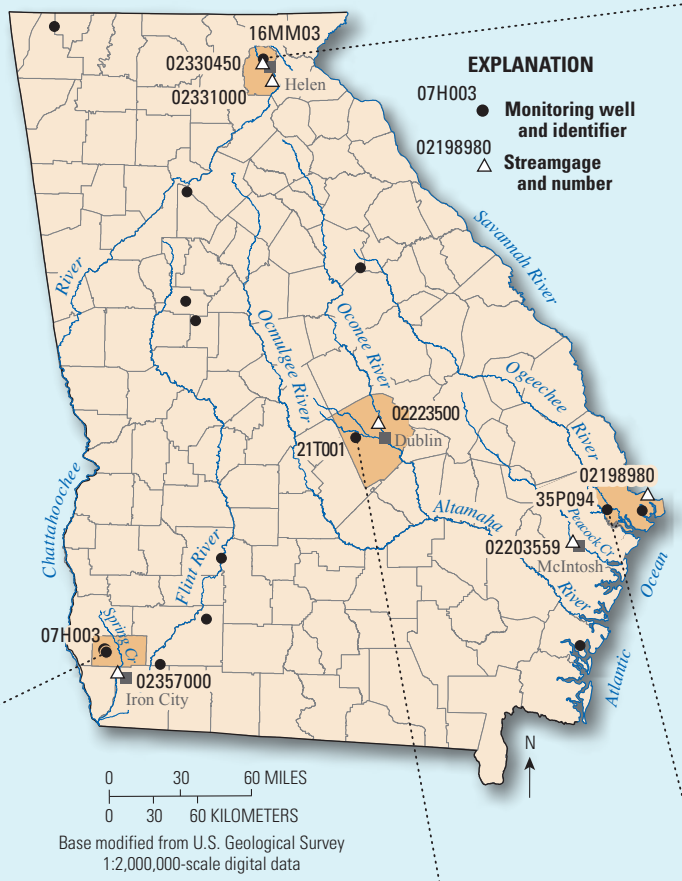


Well 07H003 is in Miller County in southwestern Georgia and is completed in the surficial aquifer. The water level in this well generally rises rapidly during wet periods and declines slowly during dry periods. The water level in well 07H003 responds to seasonal change similarly to streamflow at the nearby streamgage on Spring Creek near Iron City (02357000), which indicates atmospheric, surface-water, and groundwater interactions. During the March–April 2009 flood, the streamgage on Spring Creek recorded the second highest peak flow in 65 years of record (18,500 cubic feet per second, ft^3/s) at this site, and water levels in well 07H003 increased above the historic median and remained there for the remainder of the 2009 WY.

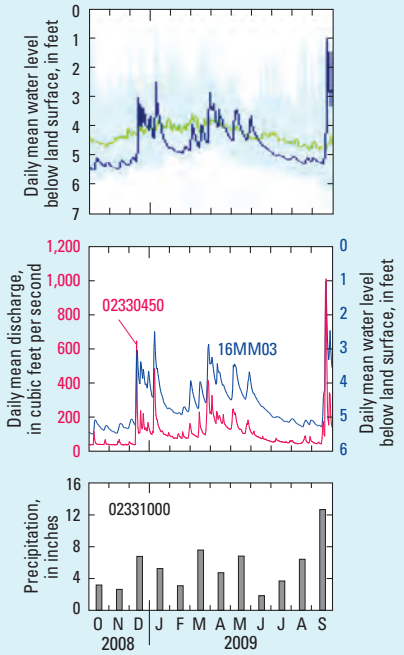


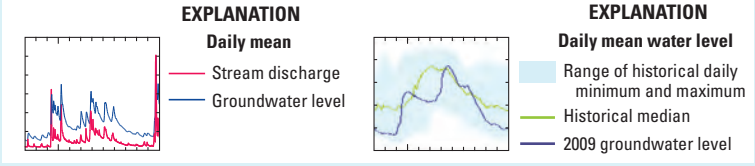
Georgia's Climate Response Network

Hydrographs are presented on the Climate Response Network Web site for wells with at least 5 years of continuous data. The 2009 WY data are shown here for selected wells.

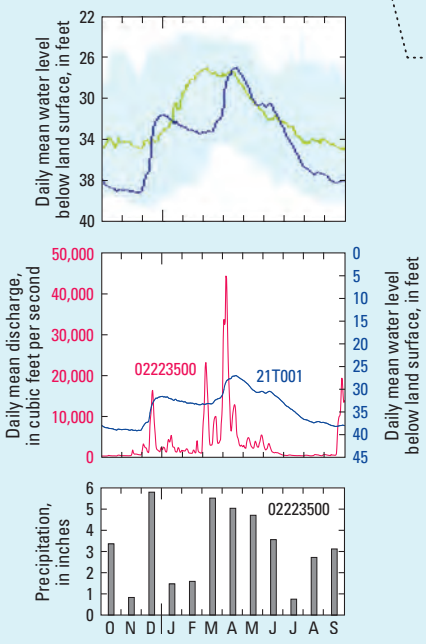


Well 16MM03 is in White County in northeastern Georgia and is completed in the crystalline-rock aquifer. Water is stored in the regolith and fractures, and the water level is affected by precipitation and evapotranspiration (Cressler and others, 1983). Precipitation can cause a rapid water-level rise in wells tapping aquifers overlain by thin regolith (Peck and others, 2009). The water level in well 16MM03 responds to seasonal change similarly to streamflow at the nearby streamgage Chattahoochee River at Helen (02330450), which indicates atmospheric, surface-water, and groundwater interactions. The water level in well 16MM03 rarely rose above the historic daily median during the 2009 WY. The highest water level below land surface occurred in September 2009 when the area received more than 12 inches of precipitation during the month, most of which occurred near the end of September and contributed to the flooding.

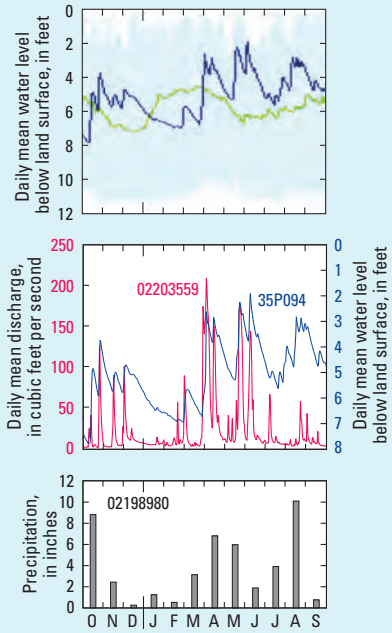




Well 21T001 is in Laurens County in east-central Georgia and is completed in a semiconfined part of the Upper Floridan aquifer. Water levels in semiconfined parts of the aquifer fluctuate seasonally in response to variations in precipitation, evapotranspiration, and natural drainage or discharge (Peck and others, 2009). The water level in well 21T001 responds to seasonal change similarly to streamflow at the nearby streamgage on Oconee River near Dublin (02223500), which indicates atmospheric, surface-water, and groundwater interactions. At the beginning of WY 2009, water levels in well 21T001 were well below the historic daily median. During the March–April 2009 flood, the streamgage on the Oconee River recorded the second highest peak flow in 10 years (46,400 ft³/s), and water levels in well 21T001 increased above the historic median and remained there until June 2009 before dipping below the historic daily median for the remainder of the water year.



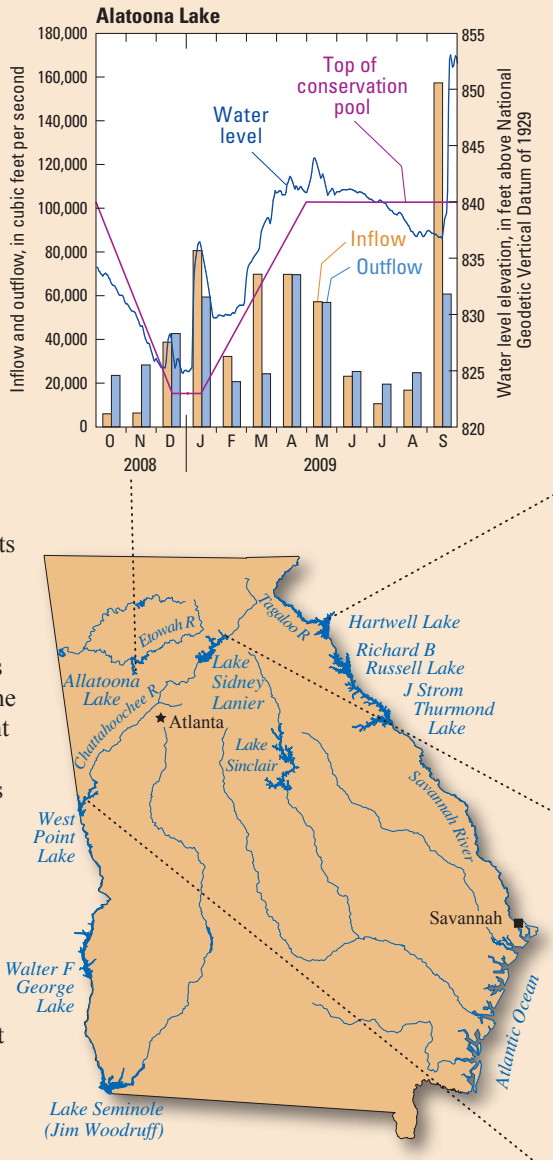
Well 35P094 is in Chatham County in southeastern Georgia and is completed in the surficial aquifer. Water levels in this well generally rise rapidly during wet periods and decline slowly during dry periods. The water level in well 35P094 responds to seasonal change similarly to streamflow at the nearby streamgage on Peacock Creek at McIntosh (02203559), which indicates atmospheric, surface-water, and groundwater interactions. During the March–April 2009 flood, the Peacock Creek streamgage recorded the highest peak flow at this site for the 2009 WY (210 ft³/s), and water levels in well 35P094 increased above the historic median and remained there for the remainder of the 2009 WY.

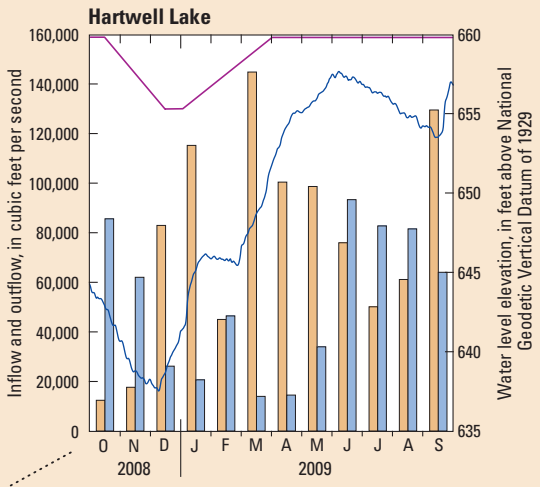


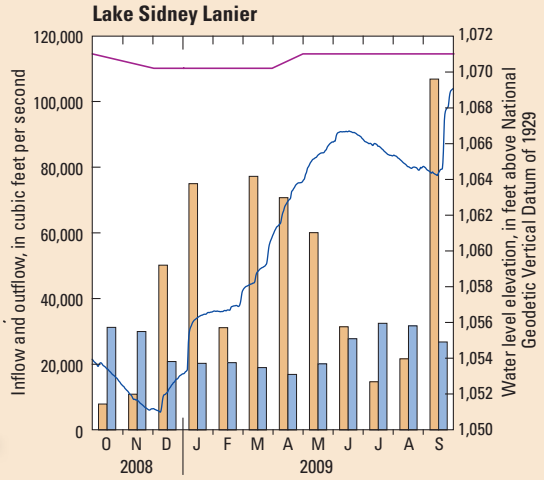
Lakes and Reservoirs

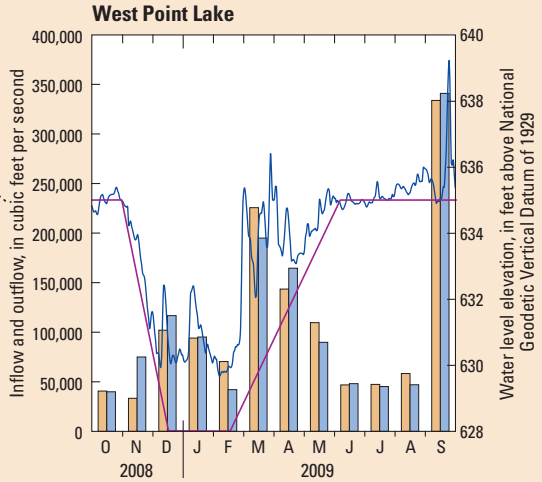
Major lakes and reservoirs throughout Georgia are managed primarily by the U.S. Army Corps of Engineers and Georgia Power Company to provide water for public and industrial use, flood protection, power generation, wildlife management, and recreation. Managing lakes and reservoirs requires computer models that predict changes in climate and water demands and rely on USGS data. During the first half of the 2009 WY, lakes and reservoirs in Georgia continued to have record minimum levels as a result of the lengthy drought that began in 2006. Emergency water-conservation efforts by both State and local authorities were in place at the beginning of the 2009 WY. After an extremely wet spring, however, State climatologists declared an end to the drought and the entire State returned to a non-drought outdoor watering schedule in June 2009 as lake and reservoir elevations approached full pool.

Lake Sidney Lanier (Lake Lanier) on the Chattahoochee River is the primary drinking-water source for the Atlanta metropolitan area. Lake Lanier is the most upstream reservoir in a series of reservoirs that include West Point Lake, Walter F. George Lake, and Lake Seminole. Lake Lanier had 80 percent more inflow than outflow during the 2009 WY, and lake elevation increased more than 18 feet from December 2008 through September 2009. Flooding in the watershed in September 2009 contributed a large amount of inflow—50 percent more than in June, July, and August combined, and the lake elevation increased 4.5 feet from September 19 to September 30. Approximately 150 river miles downstream, the elevation of West Point Lake also increased 4 feet during the September floods, but released discharge was nearly equal to the inflow, which resulted in the lake elevation being maintained at pre-flood levels. The volume of Lake Lanier is nearly 14 times greater than the volume of West Point Lake, which remains near full pool elevation even in times of drought. West Point Dam provides flood protection and hydroelectric power to Troup County, and construction was authorized by the Flood Control Act of 1962 (U.S. Army Corps of Engineers, 2009b).









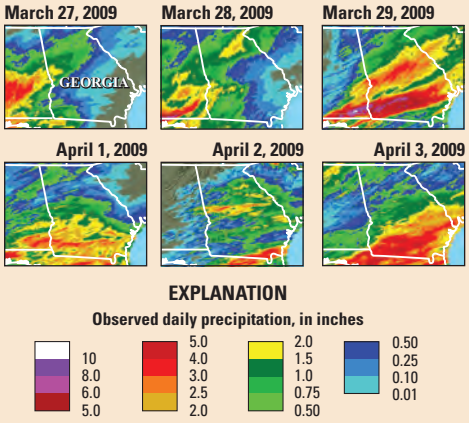
(Data from U.S. Army Corps of Engineers, 2009a)

Hartwell Lake is on the border between Georgia and South Carolina on the Savannah and Tugaloo Rivers. Hartwell is the most upstream reservoir on the Savannah River. Water is released to the downstream reservoirs, Richard B. Russell and J. Strom Thurmond. These three lakes on the Savannah River are managed by the U.S. Army Corps of Engineers for water supply, power generation, and water-quality needs of the Savannah River from below Thurmond Dam all the way to Savannah, Georgia, and the Atlantic Ocean (U.S. Army Corps of Engineers, 2009c). On December 9, 2008, Hartwell Lake reached an all-time historic low elevation of 637.49 feet. Shortly thereafter, however, lake elevation began to rise (from December 2008 through June 2009), and Hartwell Lake had nearly 2.6 times more inflow than outflow; lake elevation increased more than 20 feet.

Allatoona Lake is on the Etowah River and is managed by the U.S. Army Corps of Engineers. During the 2009 WY, Allatoona Lake had 20 percent more inflow than outflow, and lake elevation increased more than 27.5 feet from December 2008 through September 2009. The September 2009 flooding in the watershed contributed a large amount of inflow. Nearly 50 percent more inflow occurred in September than in May, June, July, and August combined, and lake elevation increased 13 feet from September 19 to September 30.

Flooding in South Georgia, March–April 2009

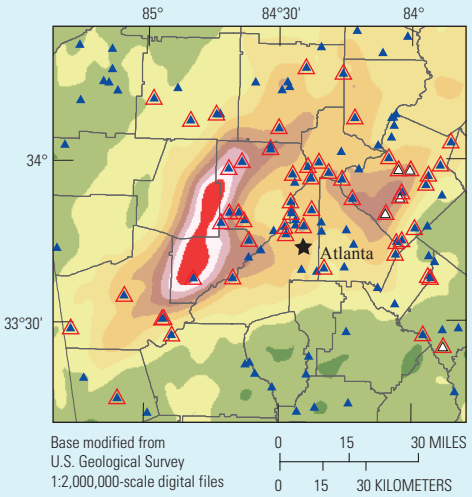
Flooding in South Georgia during March–April 2009 resulted in the highest streamflows recorded since 1948 on several rivers and since 1929 on a few others. Rainfall totals ranged from 5.6 to 14.0 inches during the 6-day event across southern Georgia (National Weather Service, 2010a). Seven USGS field crews worked extensively for 10 days and made 84 flood measurements in south Georgia. These measurements were used to extend or verify the highest streamflow ratings. Six streamgages in the flooded area had peak streamflows that exceeded the 1-percent annual exceedance probability (100-year recurrence interval). The Federal Emergency Management Agency declared 46 counties in Georgia as disaster areas as a result of the flooding (U.S. Geological Survey, 2009b).



Flooding in North Georgia, September 2009

Flooding in North Georgia occurred over several days, during September 18–22, 2009, as a result of precipitation totals that were as high as 20 inches in some areas. Georgia WSC field crews were mobilized and made 118 discharge measurements before, during, and after (September 16–30, 2009) the flood. These measurements were made in a timely manner sometimes during perilous peak-flow or close to peak-flow conditions and were used to extend or verify streamflow ratings. Although 20 USGS streamgages throughout the northern part of the State were destroyed during the flood, all were restored to active status within 5 days. At several streamgages, temporary instrumentation was installed hundreds of feet away from the main channel. Peak flows that exceeded the 0.2-percent annual exceedance probability (500-year recurrence interval) were recorded at 15 streamgages throughout the flooded area (U.S. Geological Survey, 2010c).

The Federal Emergency Management Agency reported that nearly $220 million in flood damage claims were submitted as a result of this flood event, and 14 counties declared Federal disaster areas (The Atlanta Journal-Constitution, 2009). Eleven fatalities were attributed to this flood, many of which occurred during early morning hours when drivers attempted to cross flooded roads. Significant damage to hundreds of roads and bridges across the region severely affected traffic conditions for months after the event (National Weather Service, 2010b).



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By Andrew E. Knaak, Timothy K. Pojunas, and Michael F. Peck

For more information contact:
Director, USGS Georgia Water Science Center
3039 Amwiler Road, Suite 130
Atlanta, Georgia 30360
770-903-9100
http://ga.water.usgs.gov/