GROUNDWATER CONDITIONS IN GEORGIA, 2003

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Abstract. The U.S. Geological Survey continuously monitors groundwater levels in a network of wells completed in major aquifers in Georgia. This network includes 18 wells in the surficial aquifer, 15 wells in the upper and lower Brunswick aquifers, 64 wells in the Upper Floridan aquifer, 13 wells in the Lower Floridan aquifer and underlying units, 12 wells in the Claiborne aquifer, 1 well in the Gordon aquifer, 11 wells in the Clayton aquifer, 12 wells in the Cretaceous aquifer system, 2 wells in Paleozoic-rock aquifers, and 7 wells in crystalline-rock aquifers. Data from these 155 wells were evaluated to determine whether mean-annual groundwater levels were either within, below, or above the normal range during 2003, based on summary statistics for the period of record. Information from these summaries indicates that water levels in 120 of the 155 wells (77 percent) monitored during 2003 ranged from predominantly normal to above normal.

INTRODUCTION

Monitoring groundwater levels is important for management of water resources. The U.S. Geological Survey (USGS)—in cooperation with State, Federal, and local agencies—collects and disseminates groundwater-level data from a network of wells completed in major aquifers in Georgia (Fig. 1). This paper presents an overview of groundwater levels in selected aquifers in Georgia during 2003 based on continuous water-level measurements obtained from 155 wells. All wells are equipped with electronic data recorders that register at 60-minute intervals and are retrieved monthly. Eighteen of the wells are equipped with real-time satellite telemetry that transmits data every 4 hours. Telemetered data are displayed on the USGS Georgia District Web site at *http://water.usgs.gov/ga/nwis/current?type=gwx*

Method of Study

Monthly median water levels for 2003 were compared to period-of-record monthly normal water levels to determine if water levels were either above normal, below normal, or normal. In this paper, the normal range is defined as those monthly water-level observations that lie between the 25th and 75th percentiles (first and third quartiles), also known as the interquartile range, for the period of record (Leeth and others, 2003). This can be shown by examining a graphical representation of these values known as a boxplot (Fig. 2.). The results of comparing monthly median water levels for 2003 with period-of-record monthly normal water levels are graphically depicted on maps (Fig. 1) by either an up arrow—2003 monthly mean water levels above period-of-record normal range; a down arrow—2003 monthly mean water levels below period-of-record normal range; or a circle—2003 monthly mean water levels within the period-of-record normal range.

Occurrence of Groundwater

Contrasting geologic features and landforms of the physiographic provinces in Georgia affect the occurrence of groundwater in the State. Surficial aquifers are present in each physiographic province and generally are under water-table (unconfined) conditions. The most productive water-bearing units are in the Coastal Plain in the southern half of the State and include, in order of increasing depth, the surficial and Brunswick aquifer systems (Clarke, 2003); Upper and Lower Floridan aquifers; Claiborne, Gordon, and Clayton aquifers; and Cretaceous aquifer system. In the Piedmont and Blue Ridge Provinces in northern Georgia, groundwater occurs in the regolith and in fractures in crystalline bedrock (referred to as “crystalline-rock aquifers”). In the Valley and Ridge and Appalachian Plateau Provinces, groundwater occurs largely in secondary openings in folded and faulted sedimentary and metasedimentary rocks (referred to as “Paleozoic-rock aquifers”).

Changes in groundwater levels are caused by changes in aquifer storage—when recharge exceeds discharge, groundwater levels rise, and when discharge exceeds recharge, groundwater levels decline. Recharge varies in response to precipitation and surface-water infiltration to an aquifer. Discharge occurs as natural flow from an aquifer to streams and springs, as evapotranspiration, and as withdrawal from wells. Water levels typically show a cyclic pattern of seasonal fluctuation, with higher water levels in the winter and spring due to greater recharge, and lower water levels in the summer and fall due to less recharge, greater evapotranspiration, and increased pumpage. Groundwater pumpage is the most significant human activity that affects the amount of groundwater in storage and rate of discharge from an aquifer (Taylor and Alley, 2001).

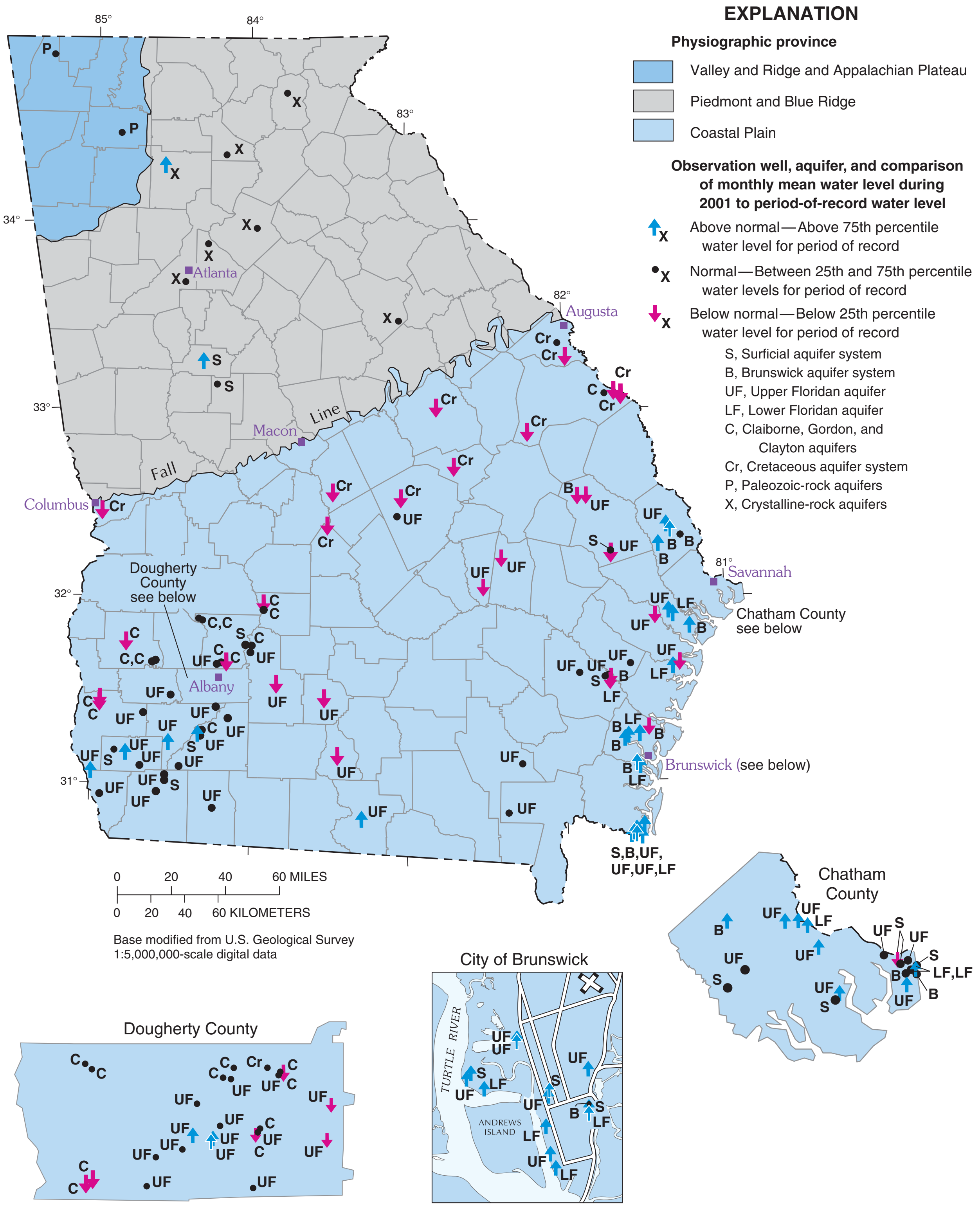

Figure 1. **Physiographic provinces, observation wells, and aquifer; and comparison of monthly mean water level during 2003 to period-of-record water level.**

GROUNDWATER LEVELS, 2003

During early 2003, groundwater levels in all aquifers monitored in Georgia continued to rise. This rise began about mid-2002, after a prolonged decline as a result of drought. During 2003, groundwater levels in the statewide network were either normal or above normal in 77 percent of the wells, and below normal in 23 percent of the wells (Table 1). Water levels in the northern half of the State were either normal or above normal during 2003, as were most of the water levels in the southern half of the State (76 percent of the wells). Variations in water levels between these areas reflect differences in the proximity of a well to aquifer recharge areas, differences in groundwater pumpage and the areal coverage of the monitoring network. Water in the surficial aquifer system typically is in contact with the atmosphere (referred to as either an unconfined or water-table aquifer), but locally may be under pressure exerted by overlying strata (referred to as a confined aquifer). Where unconfined, water levels change quickly in response to recharge and discharge. Consequently, hydrographs from these wells show a strong relation to climate. During 2003, water levels in 17 of the 18 wells in the surficial aquifer system were within the normal range, indicating good recovery from the effects of drought. Water in the Brunswick aquifer system is confined. During 2003, water levels in 12 wells in the Brunswick aquifer system ranged from normal to above normal range, and 3 wells ranged below normal. These variations reflect differences in local pumping, interaquifer leakage, and recharge.

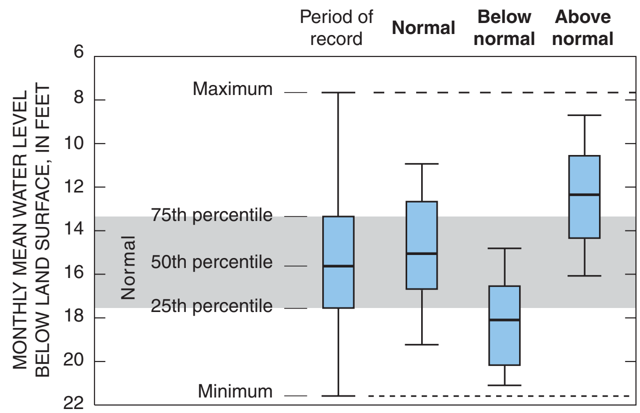

Figure 2. Boxplot showing normal, below normal, and above normal water-level range and maximum and minimum water level.

Table 1. Percentage of water levels in the normal to above normal range and below the normal range, by aquifer or aquifer system, and geographic region, Georgia, 2003.

	Water levels normal or above normal		Water levels below normal		Total number of wells
	Number of wells	**Percent of total**	**Number of wells**	**Percent of total**	
By aquifer or aquifer system					
Surficial aquifer system	17	94	1	6	18
Brunswick aquifer system	12	80	3	20	15
Upper Floridan aquifer	53	83	11	17	64
Lower Floridan aquifer	12	92	1	8	13
Claiborne and Gordon aquifers	10	77	3	23	13
Clayton aquifer	5	45	6	55	11
Cretaceous aquifer system	2	17	10	83	12
Paleozoic-rock aquifer	2	100	0	0	2
Crystalline-rock aquifer	7	100	0	0	7
Total	**120**	**77**	**35**	**23**	**155**
By geographic region					
North of Fall Line	11	100	0	0	11
South of Fall Line	109	76	35	24	144

The Upper Floridan aquifer is confined throughout most of its extent (Fig. 1), except where it either crops out or is near land surface and in areas of karst topography in parts of southwestern and south-central Georgia. During 2003, groundwater levels in the Upper Floridan aquifer ranged mostly from normal to above normal (83 percent). Below normal water levels were observed near pumping areas in the southwestern, south-central, east-central, and coastal parts of the State. In most parts of coastal Georgia, water levels in the Upper Floridan aquifer were either normal or above normal, except in areas where agricultural pumpage is prevalent. Water is confined and influenced mostly by pumpage in the Lower Floridan aquifer and underlying units in coastal Georgia. Water levels were either within or above the normal range in 12 of the 15 wells monitored during 2003. During 2003, the Lower Floridan was not widely used in coastal Georgia; therefore, pumping effects were minimal. The Claiborne and Gordon aquifers in southwest and east-central Georgia can be either confined or unconfined. During 2003, water levels were below normal in 3 of the 12 Claiborne aquifer wells and 1 Gordon aquifer well, likely reflecting localized effects of pumping. Water is confined and influenced mostly by pumping in the Clayton aquifer in southwest Georgia. Water levels in the Clayton aquifer were below normal in 6 of the 11 wells, reflecting effects of pumping from this aquifer.

In the Cretaceous aquifer system, groundwater is mostly confined but can be unconfined in stream valleys. Water levels were below the normal range in 10 of 12 wells during 2003, reflecting declines related to groundwater pumpage. This condition (with most water levels below normal) is in contrast to all of the other aquifers monitored in the State.

Water occurs under confined conditions in the Paleozoic-rock aquifers of northwestern Georgia. Water levels in the two wells were in the normal range during 2003. In the crystalline-rock aquifers of the Piedmont and Blue Ridge Provinces, water is present in discontinuous joints and fractures and may be either confined or unconfined. Crystalline-rock aquifers typically have local extent and can be highly affected by localized water use and climate. Water levels, in the crystalline rock aquifers of the Piedmont and Blue Ridge, were either above or within the normal range during 2003.

LITERATURE CITED

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