NATIONAL WATER-QUALITY ASSESSMENT IN GEORGIA—2001–2011

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Abstract. The National Water-Quality Assessment (NAWQA) is an ongoing program by the U.S. Geological Survey to assess the Nation's water-quality conditions and trends and to examine processes that control water quality. The NAWQA program is entering its second decade with program changes such as a decreased number of study areas and a focus on studies that provide understanding of factors that control water quality. NAWQA activities in Georgia include studies of surface- and ground-water trends, mercury bioaccumulation, drinking-source water quality, effects of urban development on streams, and effects of nutrient enrichment on streams.

OVERVIEW OF THE NATIONAL WATER-QUALITY ASSESSMENT

NAWQA is a federally funded, congressionally mandated program that began full implementation in 1991. The primary objectives of the NAWQA program are to:

1. Determine the status of the Nation's surface and ground-water resources.

2. Examine long-terms trends in water-quality conditions.

3. Examine the human and natural processes that control water quality (Gilliom and others, 1995).

The first decade of the NAWQA program (Cycle I), from 1991 to 2001, focused primarily on the status of water-quality conditions through an intensive program of sediment, surface-water, and ground-water chemistry sampling, as well as aquatic community and habitat sampling. The original design for NAWQA was planned for these studies to be conducted in 60 study units, defined by watershed or aquifer boundaries and ranging in size from about 10,000 to 50,000 square miles (mi^2) (Fig. 1). Because of limited financial and laboratory resources, intensive sampling was divided into 3 rounds—20 study units during 1991–93, 20 during 1994–96, and 20 during 1997–2000. The high-intensity sampling periods were followed by a 6-year low-intensity sampling phase. Areas within each study unit designated for sampling were selected primarily by land use. For example, watersheds were defined as dominantly agricultural, forested, urban, or mixed, and shallow ground-water studies targeted urban and agricultural areas. Specific emphasis in Cycle I was placed on studies of nutrients in agricultural areas, pesticides in urban and agricultural settings, and volatile organic compounds in urban areas. Cycle I data and reports for Georgia are available on the World Wide Web at URL: http://ga.water.usgs.gov/nawqa/ and http://fl.water.usgs.gov/Gafl/gafl.html.

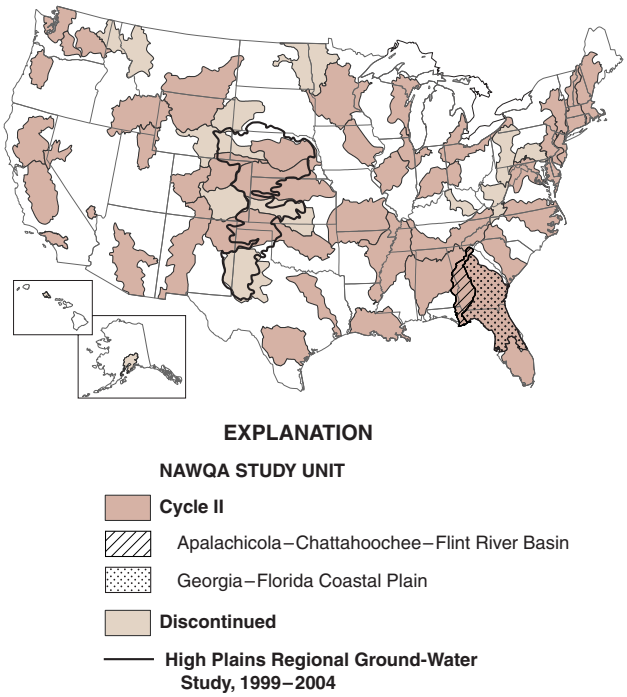

Figure 1. National Water-Quality Assessment program (Cycle II) study units (modified from Gilliom and others, 2001).

During NAWQA Cycle II (2001–11), emphasis is being placed on sampling for water-quality trends and on studies designed to understand the processes that control water quality and affect aquatic communities (Gilliom and others, 2001). Resources allocated to determining the status of water quality are limited to filling in data gaps from Cycle I. Another major change from Cycle I is the elimination or combination of study units due to funding limitations. Because of these resource limitations, the number of study units planned for Cycle II has been reduced to 42, which represents approximately 60 percent of the Nation's drinking and irrigation water uses (Gilliom and others, 2001).

NAWQA CYCLE II ACTIVITIES IN GEORGIA

Two study units are currently active in Georgia during Cycle II—the Apalachicola-Chattahoochee-Flint (ACF) River Basin and the Georgia-Florida Coastal Plain (GAFL) study units (Fig. 2). Most of the Cycle II activities in Georgia are being conducted in the ACF River Basin study unit. Cycle II activities include studies of surface- and ground-water trends, mercury bioaccumulation, drinking-water source sampling, and studies designed to provide a better understanding of the processes controlling water quality (Table 1).

Trends

Continued sampling of selected Cycle I surface-water sites and resampling of Cycle I ground-water sites will allow the evaluation of trends in water quality for Cycle II. Surface-water trend sites generally were sampled continuously during Cycle I and typically include three small (10–500 mi^2) basins representing forested, agricultural, and urban land uses, and one large watershed (500–85,000 mi^2) representing mixed land use. Well networks resampled during Cycle II include major aquifers, shallow aquifers, and flow-system studies.

Surface-Water Trends. Six surface-water trend sites are being sampled in Georgia during Cycle II—Sope Creek near Marietta, Chattahoochee River near Whitesburg, Hillabahatchee Creek near Franklin, Lime Creek near Cobb, Little River near Tifton, and Withlacoochee River near Quitman. Four of the trend sites are located in the ACF River Basin study unit and two are located in the Georgia-Florida Coastal Plain (Fig. 2). Water-quality sampling frequency varies during Cycle II, ranging from weekly to monthly. Ecology sampling is conducted on an annual basis at each of the six sites. New surface-water trend sites in the ACF River Basin have replaced two of the Cycle I sites. The original Cycle I reference site was located on Snake Creek and was subsequently changed to Hillabahatchee Creek because a reservoir was constructed upstream of the Snake Creek site. The Cycle I agricultural trend site was relocated from Aycocks Creek to Lime Creek because intermittent flow at Aycocks Creek complicates trend analysis.

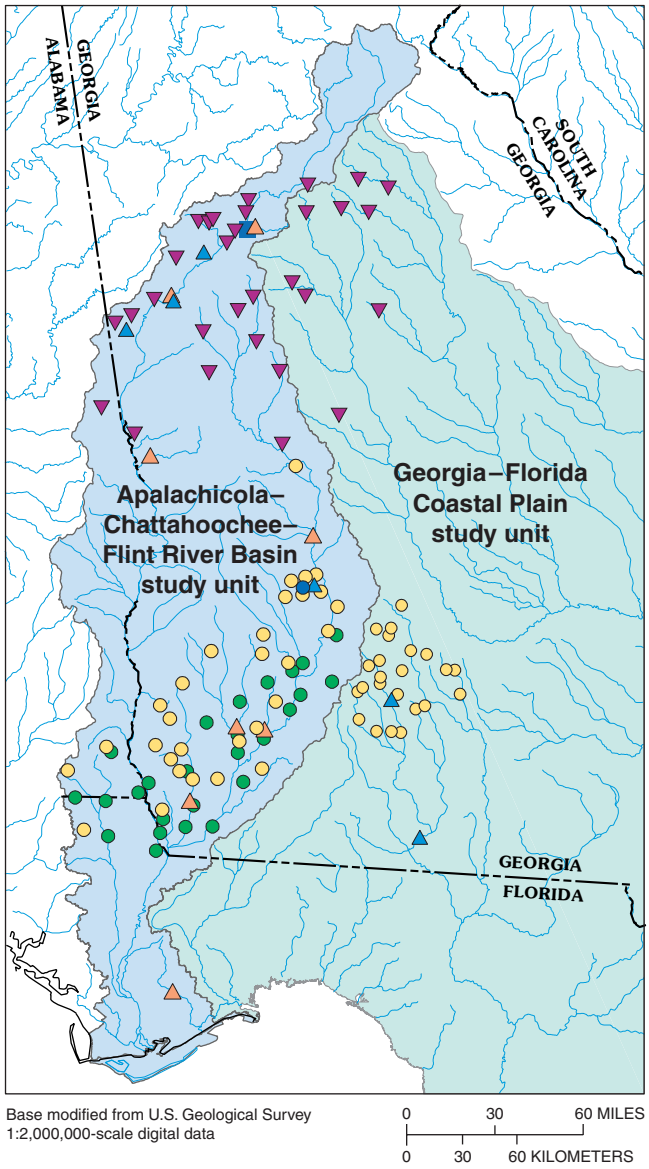

Figure 2. National Water-Quality Assessment program (Cycle II) sample sites in Georgia.

Table 1. Summary of NAWQA Cycle II activities in Georgia 2001–2011

[ACF, Apalachicola-Chattahoochee-Flint River Basin; GAFL, Georgia-Florida Coastal Plain]

Study	Number of sites or wells	Sampling year(s)	Sampling planned
Surface-water trends	4 ACF; 2 GAFL	2001–2011	Weekly to monthly sampling of field parameters, sulfide, chloride, nutrients, pesticides, dissolved and particulate organic carbon, and suspended sediment in water; annual sampling for algae, invertebrates, fish, and habitat; continuous measurement of streamflow, temperature, and specific conductivity.
Ground-water trends—Upper Floridan aquifer	30 ACF	2002	One sample collected for field parameters, major ions, nutrients, pesticides, volatile organic compounds, bacteria, radon, and trace metals; water level measured during sampling.
Ground-water trends—Agricultural land-use study	30 ACF; 30 GAFL	2002	One sample collected for field parameters, major ions, pesticides, nutrients, and age dating; water level measured during sampling.
Ground-water trends—Flow-system study	20 ACF	2004	One sample collected for field parameters, pesticides, nutrients, and age dating; water level measured during sampling.
Mercury bioaccumulation	8 ACF; 1 GAFL	2002	Synoptic sample for mercury in sediment, water, and fish tissue; sulfate, suspended sediment, and organic carbon in water.
Drinking-water sampling	1 ACF	2003–2004	Weekly to monthly sampling for field parameters, pesticides, volatile organic compounds, organic carbon, bacteria, fuel oxygenate degradates/by-products, and wastewater tracers.
Process study—Urban land-use study	30 ACF	2003	Bimonthly sampling at 9 sites and 2 synoptic samplings at 21 sites for field parameters, sulfide, chloride, nutrients, pesticides, sediment, bacteria, dissolved and particulate organic carbon synoptic sampling for algae, invertebrates, fish, and habitat; continuous measurement of stage and water temperature; semipermeable membrane devices analyzed for semivolatile organics, polyaromatic hydrocarbons, and toxicity.
Process study—Nutrient enrichment study	20 ACF	2004	Synoptic sampling for field parameters, nutrients, organic carbon, chlorophyll A, and algal biomass; algae and macroinvertebrates; 24-hour continuous measurement of dissolved oxygen concentration to estimate stream metabolism.

Ground-Water Trends. Four ground-water studies are being conducted in Georgia during Cycle II. Three of the studies are in the ACF River Basin study unit and one in the GAFL. A major aquifer study (MAS) of the Upper Floridan aquifer in southeast Georgia included 30 wells that were sampled in 2002 (Table 1). The study included public water-supply, domestic-water supply, irrigation, and monitoring wells. Most of these wells also were sampled during Cycle I. Two separate agricultural land-use studies resampled wells installed by the ACF River Basin and GAFL study units during Cycle I. These wells were all completed in the water-table aquifer and generally are located within, or immediately adjacent to, row-crop agricultural fields. A total of 60 wells were sampled in the ACF River Basin and GAFL for this study in 2002. In the ACF River Basin study unit, a ground-water flow-system study that began in Cycle I will be resampled during Cycle II. This study is designed to investigate the transport and environmental fate of agricultural chemicals applied to row crops. It includes a series of wells at different depths located along a ground-water flowpath, which starts in an upland field and ends where shallow ground-water discharges to a small stream (Lime Creek in east central Georgia). Work on the flow-system study began during Cycle I, including installation of a series of wells and water sampling. Plans for Cycle II are to add additional wells in the floodplain at greater depth and to sample approximately 20 new or existing wells during 2003.

Mercury Bioaccumulation

Mercury is a common contaminant of water and readily accumulates in fish tissue, accounting for the majority of fish consumption advisories in the United States (U.S. Environmental Protection Agency, 2002). Many states currently sample fish tissue for mercury. To complement this sampling and provide a uniform, national picture of mercury contamination and bioaccumulation, the NAWQA program sampled sediment, water, and fish tissue for total mercury and methylmercury. In Georgia, ten sites were sampled in 2002, eight in the ACF River Basin, and two in the GAFL. Watersheds were selected for sampling to provide a variety of land uses and differing amounts of wetlands.

Drinking-Water Sampling

As part of the effort to understand potential effects on humans, sources of drinking water are being sampled on a regular basis to assess the potential contaminants in drinking-water supplies. In Georgia, water samples are being collected from the Chattahoochee River adjacent to the city of Atlanta drinking-water intake, the source of drinking-water supply for approximately 600,000 people in the Atlanta metropolitan area. Samples are being collected monthly and during conditions when contaminants are likely to be found at high levels—primarily during runoff events and during extreme low-flow events. Samples will be collected in both 2003 and 2004 (Table 1).

Process Studies

As part of the NAWQA Cycle II goal to establish links between contaminants, transport of contaminants, and effects of contaminants on humans and ecosystems, five topics of regional and national importance for study have been identified (Wilber and Couch, 2002). These studies include:

1. Effects of nutrient enrichment on streams.
2. Sources, transport, and fate of agricultural chemicals.
3. Transport of contaminants to water supply wells.
4. Effects of urbanization on streams.
5. Bioaccumulation of mercury in aquatic organisms.

Studies 1 and 4 will be addressed in Georgia during Cycle II.

Nutrient Enrichment Study. This study will examine how biological communities (primarily algae and invertebrates) and community functions (metabolism and nutrient uptake) respond to different levels of nutrient enrichment in agricultural settings (Wilber and Couch, 2002). Studies are planned for five study units nationwide during 2001–04. Additional areas of the nation will be sampled in 2005–11.

Each study will sample a network of sites that represent a gradient of nutrient conditions resulting from nonpoint agricultural sources. Sites will be selected to minimize the effects of hydrology, geology, soils, and human inputs to provide the best chance of observing the results of nutrient enrichment. Three approaches will be used:

1. A large-scale synoptic sampling along a nutrient gradient.
2. A small-scale study of nutrient dynamics and stream metabolism.
3. Extrapolation of results from monitored to unmonitored sites.

Approximately 20 sites will be sampled as part of the synoptic and metabolism studies in Georgia. These sites will be located in row-crop agricultural areas in southwestern Georgia. Site reconnaissance will be conducted during 2003 with sampling planned for 2004.

Urban Land-Use Study. This study will determine how hydrology, water chemistry, aquatic habitat, and biological communities in streams change as watersheds become more urban. Currently, urban studies are planned for five study units during 2001–04. In Georgia, work began during 2002 and is focused on the Atlanta metropolitan area. Sites were selected to represent the full range of urban intensity, from forested to fully developed and to be similar in size, geology, and hydrology, so that these factors will not influence the results of the study. Field work is planned for 2003 and includes water chemistry, ecological, and hydrologic data collection (Table 1). The study will examine specific land-use factors that affect ecological communities in urbanizing areas. The site-selection process is described in more detail in Hopkins (2003) and description of the urban land-use study design is given in Gregory and Bryant (2003).

Low-Intensity Phase. During 2005–11, data-collection activities in Georgia will be limited to collection of stream water samples at trend sites on a bimonthly basis and annual ecological sampling. In addition, ground-water samples will be collected quarterly at selected surficial aquifer sites to examine seasonal trends in water chemistry. Other activities during this period include data analysis, report writing, and data archival.

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