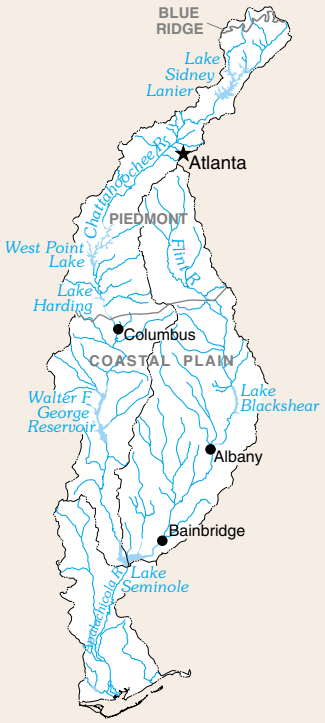
In 1994, six reservoirs located in the ACF River Basin were selected for sediment coring as part of a NAWQA pilot program designed to relate effects of land-use changes through time to historical water quality of the impounded watersheds. The reservoirs sampled are situated along the main stems of the Chattahoochee and Flint Rivers. Their watersheds have different predominant land uses and dates of dam completion. Thus, not only can the temporal history of the age-dated cores be related to historical land-use changes, but the effects of upstream impoundments on the sediment chemistry in older reservoirs located downstream can be used to infer the source areas for selected pollutants.

Reservoirs are efficient sediment traps. Sediments deposited in a reservoir retain a physical and chemical history of the effects of human activities on the reservoir watershed. Detailed analysis of sediment cores collected from reservoirs allow scientists to reconstruct historical trends in stream-water quality. When accompanied by historic patterns of urban growth, industrial activity, and agricultural land-use, the results of this synthesis provide an invaluable tool for long-term environmental assessment.

Sediment cores were collected and age-dated by methods described in Van Metre and others (1997) and analyzed for organochlorine compounds and trace elements. The years 1952 and 1963–64 were assigned to depths in sediment cores from the four older reservoirs on the basis of patterns in radioactive cesium (^{137}Cs) concentrations; higher concentrations correspond to past periods of above-ground hydrogen-bomb testing. Ages of dam completion were assigned to cores from all the reservoirs (except Lake Harding) by locating transitions between stream and reservoir sediments.

Six major reservoirs in the ACF River Basin were used to evaluate historical trends in water quality. **Lake Sidney Lanier**, which is on the Chattahoochee River about 45 miles upstream from Atlanta, was impounded by the U.S. Army Corps of Engineers (Corps) in 1956, primarily for flood control and hydropower generation. Although the predominant land uses are forest and pasture, much of the pasture land is used for the disposal of chicken litter. Urban growth in the Lake Sidney Lanier watershed has increased pollutant loads to the reservoir, as has extensive land clearing for subdivisions in rapidly developing suburban settings.



West Point Lake was constructed by the Corps in 1974 and is located approximately 60 miles downstream from Atlanta. Urban and suburban growth in the Metropolitan Atlanta area accelerated beginning in the late 1970's and has continued at a rapid pace to the present.

Lake Harding, on the Chattahoochee River downstream from Atlanta (105 miles) and upstream from Columbus (18 miles), is the oldest reservoir of the six ACF reservoirs studied. Georgia Power Company constructed the Lake Harding dam in 1926 for hydropower generation.

The Chattahoochee River is a navigable waterway from Columbus downstream to Lake Seminole. Part of this navigation channel includes **Walter F. George Reservoir**, located approximately 35 miles downstream from Columbus and constructed by the Corps in 1963 for flood control, hydropower generation, and navigation. Although the surrounding land largely is forested with some cropland and pasture, the urban influence of Columbus also affects the water quality and sediment chemistry of this reservoir.

Lake Blackshear, the first impoundment on the Flint River, is almost 200 miles downstream from the Flint River's headwaters at Atlanta's Hartsfield International Airport. This reservoir was filled in 1927 upon completion of Warwick Dam by the Crisp County Power Commission. Although the Flint River watershed begins in Atlanta, Lake Blackshear's water quality is little affected by urban land use. The Piedmont portion of the Lake Blackshear watershed largely is a patchwork of forest, cropland, and pasture; the Coastal Plain portion is predominantly cropland and pecan groves. However, extensive wetland riparian buffers intercept runoff along most of the Coastal Plain reach of the Flint River, thus mitigating the impact of agriculture on the reservoir's water quality.

The terminal reaches of both the Chattahoochee and Flint Rivers are impounded behind Jim Woodruff Dam, completed in 1954 by the Corps to form **Lake Seminole,** approximately 133 miles downstream from Columbus and 74 miles downstream from Albany. Bainbridge is located on the Flint River arm of the reservoir. Lake Seminole is used for flood control, hydropower generation, and navigation. Although much of Lake Seminole's watershed is predominantly cropland, the land area adjacent to the reservoir largely is forested. There is some urban influence on the water quality of the Flint arm from Albany and Bainbridge.

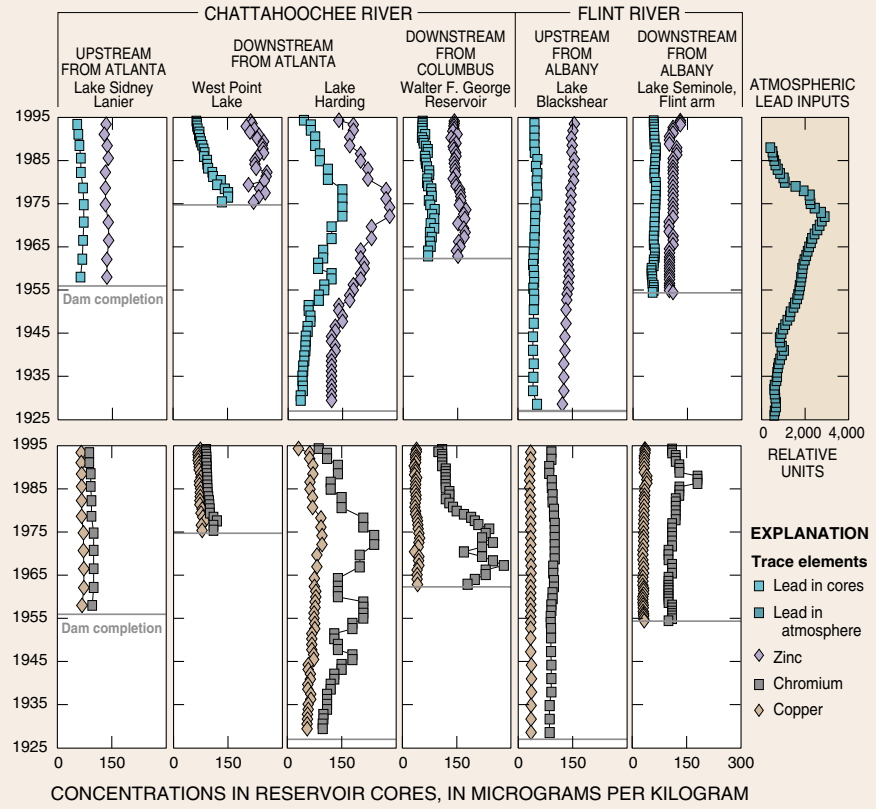
RESERVOIR (YEAR COMPLETED)	PREDOMINANT LAND USE	CORE THICKNESS, IN INCHES	SEDIMENTATION RATE, IN INCHES PER YEAR[1]
Lake Sidney Lanier (1956)—Chattahoochee River arm	Forested, poultry	8.7	0.22
West Point Lake (1974)	Urban	27.6	1.41
Lake Harding[2] (1926)	Urban	88.6	1.35
Walter F. George Reservoir (1962)	Urban	58.3	1.82
Lake Blackshear (1927)	Cropland	27.6	0.41
Lake Seminole (1954)—Flint River arm	Cropland	38.6	0.96

[1] Sedimentation rates are assumed to be linear and are based on core length (not dry mass of deposited material).
[2] Pre-reservoir surface was not reached in Lake Harding. An age was assigned to the bottom of the core on the basis of the deposition rate for the 1952 to 1963–64 core interval.

Age-dated depth profiles of lead, zinc, chromium, and copper concentrations in sediment cores show historical patterns of upstream urban and industrial activity, upstream reservoir construction, and regional atmospheric deposition. West Point Lake, Lake Harding, and Walter F. George Reservoir reveal a more complex history of trace-element pollution because they are most directly affected by upstream urban and industrial activities.

In Lake Harding sediments, lead and zinc concentrations began to increase beginning in the mid-1940's and more than doubled by the mid-1970's. Copper concentrations gradually increased through this same period. However, chromium concentrations peaked about 1945, during the mid-1950's, and again during the mid-1970's, with the highest concentrations measured during this latter period. Although industrial growth and development in Metropolitan Atlanta is a source for much of the increased deposition of metals to Lake Harding, additional emissions outside the ACF River Basin also contributed through regional atmospheric transport and deposition. Concentrations of all four metals generally decreased between the mid-1970's and the time the cores were collected in 1994. This recent trend coincides with the completion of West Point Dam and provides evidence that, with the exception of chromium, much of the pollutant load to Lake Harding prior to West Point's completion was derived from Metropolitan Atlanta.

Chromium concentrations in Lake Harding and Walter F. George Reservoir cores were the highest among the six reservoirs sampled. Concentrations in the Walter F. George core peaked during the late 1960's and again during the mid-1970's and then decreased in similar fashion to the pattern described for Lake Harding. However, concentrations of chromium in post-1975 sediments in both of these reservoirs are larger than those measured in West Point Lake, indicating that local sources downstream from Atlanta are contributing part of the chromium load. Industrial effluent from the textile industry has been a major source of chromium (Förstner and Wittman, 1979), and there are several textile mills that discharge to the Chattahoochee River just upstream from Lake Harding and Walter F. George Reservoir.



Sediments in reservoirs located downstream from urban areas reveal a more complex history of trace-element deposition and generally higher concentrations than sediments in reservoirs with primarily rural land uses. Changes in lead concentrations in sediment cores closely track historical lead inputs to the atmosphere.

Except for zinc in West Point Lake and zinc and copper in Walter F. George Reservoir, trace-element concentrations generally decreased after 1975 in all three urban reservoirs. The Clean Air and Clean Water Act legislation, requiring improved waste treatment and reduction strategies, were enacted about this time. Thus, some of the decrease in trace-element deposition to these reservoirs relates to compliance with these laws. This is particularly true for lead. Leaded gasoline use peaked in 1972 and then declined through 1982 when lead compounds were banned from use in all new vehicles sold in the United States. This trend is shown by atmospheric lead inputs (Eisenreich and others, 1986) and in the reservoir cores, particularly West Point Lake and Lake Harding. The largest lead concentrations in reservoir sediments and the steepest lead declines are seen in the reservoirs closest to urban areas or with urban land areas upstream (Callender and Van Metre, 1997).

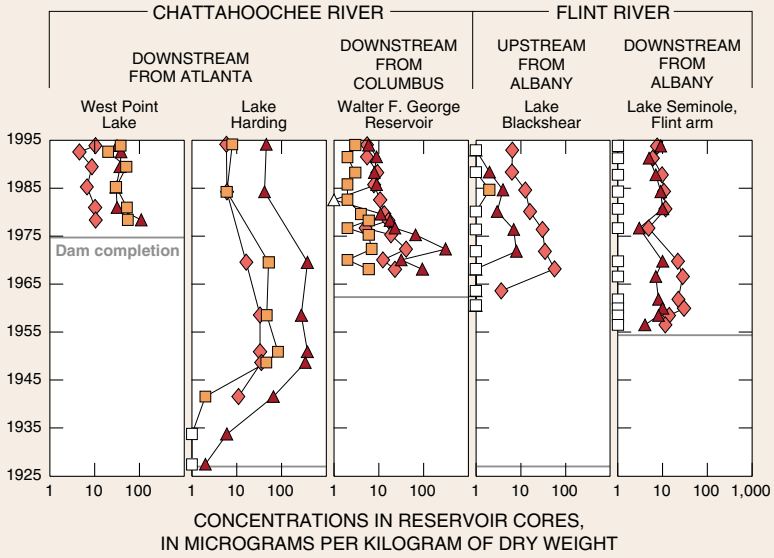
Lake Sidney Lanier, Lake Blackshear, and Lake Seminole, in contrast with the urban reservoirs, are less directly affected by local sources of pollutants. Historical trends in trace-element concentrations in these reservoirs largely relate to changes in the regional patterns of atmospheric deposition.

Sediment cores were analyzed for organochlorine insecticides, polychlorinated naphthalenes (PCNs), and polychlorinated biphenyls (PCBs). The only compounds detected in the cores were chlordane, DDT and its degradation products (DDD and DDE), and PCBs. Historical patterns in reservoir sediment concentrations of these compounds provide a record of changes in their use in urban and agricultural settings within the ACF River Basin.

Chlordane was extensively used through the late 1980's as a termiticide. Measurable concentrations of chlordane in the Lake Harding core first occurred during the early 1940's, indicating that chlordane use in Metropolitan Atlanta began shortly after it was first produced as an insecticide. Chlordane concentrations in Lake Harding sediments increased through the early 1950's, remained at their highest levels through the early 1970's, and then decreased by about a factor of 10 between the mid-1980's and the time of sampling. Although use of chlordane was banned in 1988, the decrease in the recent section of core from Lake Harding probably is related more to the completion of West Point Dam and subsequent trapping of chlordane-contaminated sediments in West Point Lake. This interpretation is consistent with chlordane concentrations in the West Point Lake core being larger than post-1975 concentrations in the Lake Harding core. The Walter F. George Reservoir core had smaller but still measurable concentrations of chlordane, indicating that chlordane was also used in the Columbus area. Sale of chlordane for agricultural use ceased in 1974, and only one sample from Lake Blackshear and no samples from Lake Seminole had detectable concentrations of chlordane.

DDT was widely used throughout the ACF River Basin as an insecticide in urban and agricultural settings until its use was banned in 1973. Based on historical patterns in the cores (excluding West Point Lake), it appears that urban and agricultural use of DDT peaked in the early 1950's and late 1960's, respectively. However, DDT continues to be deposited at similar concentrations in each of the reservoirs.

PCBs were first commercially produced in 1929 and widely used in transformers, capacitors, and electromagnets and as heat-transfer and hydraulic fluids until their manufacture was banned in 1979. PCB concentrations in the Lake Harding core began to increase shortly after the reservoir was created, reached maximum levels during the late 1940's through the late 1960's, and then decreased to much lower concentrations by the mid-1980's. The largest PCB concentration in the West Point Lake core occurred about 1976. Concentrations in more recent sections of the core were approximately one-third of the maximum, indicating that PCB use was prevalent in Metropolitan Atlanta up to the time of the ban. Concentrations of PCBs in the Walter F. George Reservoir core decreased during the late 1970's. The patterns in these three urban reservoirs could be due to a combination of local sources and regional atmospheric transport. One of the two facilities that manufactured PCBs in the United States was located in Anniston, Alabama, to the northwest of these reservoirs. Historical patterns in the much smaller concentrations measured in the Lake Blackshear and Lake Seminole cores probably relate to regional patterns in atmospheric transport and deposition of PCBs.



Although organochlorine-pesticide and PCB concentrations in reservoirs sediments have declined significantly since being banned, they continue to be present in sediments deposited as recently as 1994. Concentrations of chlordane and PCBs in some fish species in the Chattahoochee River downstream from Metropolitan Atlanta currently exceed safe levels for human consumption (Georgia Department of Natural Resources, 1997). The slow rate of decline of chlordane and PCB concentrations in sediments deposited in West Point Lake indicate that these fish-consumption advisories may continue into the future.