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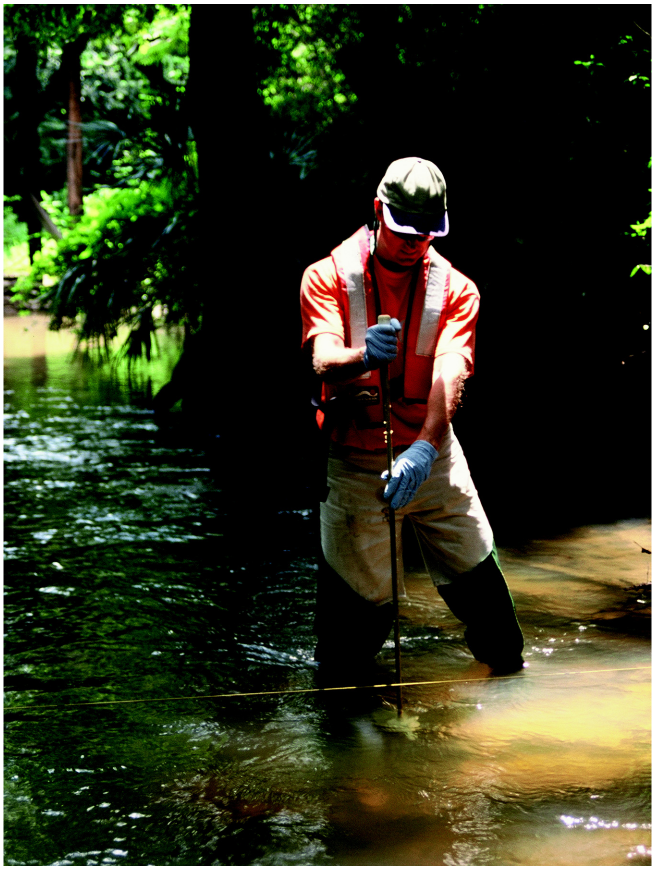
Survey Notes

Spring 2004 U.S. Geological Survey—Alabama District



USGS hydrologist, Brian Atkins, stream sampling in Alabama.

Inside this Issue

Chief's Welcome to our Update

By Athena Clark, Alabama District Chief

Several years ago, the Alabama District had a newsletter that shared information with other agencies with environmental interests across the State of Alabama. Through this current update, we hope to briefly share with you some of the information gleaned during our more recent activities. While this note highlights only a few areas of study, we hope to contribute to your knowledge of some of the information sources available to you through the USGS. We hope our effort here supports you with sound and reliable information in the challenges you face with environmental issues. Many of the topics featured in this update have much more detailed information available, so please contact us or check our Web site (*http://al.water.usgs.gov*).

We would like to supply many of our readers with an e-mail of this update, so please send us your e-mail address to *www.al.s.notes@usgs.gov*. Simply e-mail us or use the mail-in card provided. If we have helped you with a useful article, please pass the Survey Notes along to a friend or colleague. Our goal is to bring information to those who need it. Drop us a note with any comments you may have.

Celebrating World Water Monitoring Day

On October 21, 2003, World Water Monitoring Day was celebrated in Tarrant at Tarrant Community Park on Highway 79 near Birmingham. Tarrant High School students, city officials, scientists, local residents, and the Black Warrior–Cahaba Rivers Land Trust participated in a variety of water-monitoring activities to celebrate the event. The participants tested Fivemile Creek for bacteria to ensure the stream's health for humans. They probed the stream's sediments looking for invertebrates and the signs of a healthy ecosystem. Some participants used state-of-the-art scientific instruments to measure water properties such as dissolved oxygen, pH, turbidity, specific conductance, and water temperature. These tests provide information on the overall health of the stream and the fish and animals that rely on it.

Wendy Allen Jackson, director of the Land Trust, showcased the greenway that will extend from Tarrant Park along Fivemile Creek. The greenway will improve water quality in the watershed and protect the habitat for animals that rely on the creek. USGS Alabama District Chief, Athena Clark, said, "Only a couple of years ago, Tarrant Park was the site of a flood that ravaged nearby mobile homes. Now, through the hard work of the community, the re-establishment of this natural park will one day be the kick-off point for hiking along the banks of the creek. That's a big accomplishment, and we're happy to support their efforts."

Tarrant High School students looking for invertebrates.

Flood of May 2003

By Jymalyn Redmond

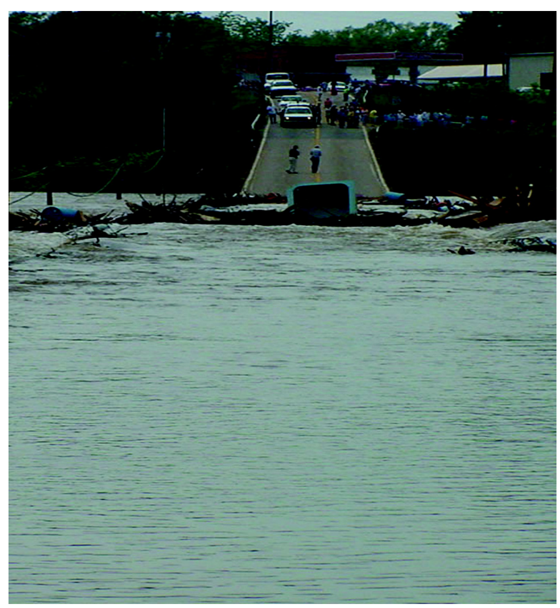
Flooding occurred in parts of Alabama during early May as the result of supercell thunderstorms that moved in from Mississippi and continued across the State with additional cell development. Before it was over, there were several tornadoes, wind damage, hail, and incredible amounts of rain. The north and northeastern sections of metro Birmingham were hit especially hard. Flooding was reported across the entire width of Alabama, from where the storms entered Lamar County to where they exited in Cleburne and Randolph Counties in the east. The rainfall from this event was the highest on record at the Ketona gage on Fivemile Creek near Tarrant. Rainfall was recorded at 10.5 inches in a 10-hour period, with an amazing 5.5 inches in a 1-hour period. The torrential rains resulted in the highest stage, 19.14 feet gage datum, since records began in 1953. This flood easily surpassed the previous record stage of 17.28 feet recorded in 2000. These floodwaters inundated local roads, including Highway 79. Flooding was especially intense and devasting in Brookside.

When flooding threatens, know how to access the USGS Web site to get current streamflow data!

http://al.water.usgs.gov/

Flooding hit eastern Alabama as well, even closing part of Interstate 85 near the Georgia–Alabama border. Record water levels were recorded at Wadley, in southwestern Randolph County, where the city became nearly isolated by the flooded Tallapoosa River. The Highway-22 bridge that connects Wadley to other cities and towns to the east became completely submerged. All together, 38 counties were designated disaster areas, and $46.5 million will be needed to support the relief efforts in these counties.

In spite of these major events, the USGS worked around the clock to keep the streamgaging network in Alabama up and running. The USGS operates stream stage and discharge gaging stations at 182 locations throughout Alabama. Many of these stations have 10 years or more of record and established flood-frequency durations. Data for these stations and for all real-time stations in Alabama are available at the Current Streamflow Conditions link on the USGS Alabama District Web site at *http://al.water.usgs.gov/* on the Internet.



Flooding on the Tallapoosa River at Wadley, Alabama, at the Highway-22 bridge, May 2003.

The Mobile River Gage

By Darrell Lambeth and Will Mooty

In cooperation with the Alabama Department of Environmental Management and the U.S. Army Corps of Engineers, the USGS constructed a streamflow-monitoring gage on the Mobile River near Bucks, Alabama. This gage is the first of possibly more gages in the Mobile Delta area that will be used to more accurately define flow regimes into Mobile Bay.

The Mobile River was the largest ungaged river in the United States. Having an estimated mean daily discharge of 62,000 cubic feet per second, it has the fourth largest discharge behind the Mississippi, Columbia, and St. Lawrence Rivers. Currently, streamgaging stations are installed on the Alabama and Tombigbee Rivers upstream from the confluence of the Mobile River.

From it's confluence, the Mobile River runs approximately 6 miles and splits into the Tensaw and Mobile arms. It is about 39 miles to Mobile Bay down the Mobile arm. Daily tidal variations are seen as far upstream as the Tombigbee River at Coffeeville and the Alabama River at Choctaw Bluff. Until recently, tidal influences on streamflow made it difficult to accurately measure streamflow using traditional methods. Advancements in equipment in the last 5 years using acoustic Doppler technology have made such measurements more feasible.

Currently, a velocity meter is installed at Bucks on the west side of the Mobile River in the main channel. The meter measures an index velocity at a predetermined position in the channel at fixed time intervals. A stage sensor also records the river level at the same interval. Cross-section surveys at the site are used to develop a stage-area relation. Discharge measurements will be made periodically by boat at the site using an acoustic Doppler current profiler (ADCP). The measured discharge is divided by the area from the stage-area relation to compute a mean velocity for that measurement. After several discharge measurements have been made at various flows, a relation between the measured index velocities (from the velocity sensor) and the mean velocities (from the discharge measurements) will be developed. This relation will be used to predict mean velocity using the index velocity readings. By multiplying the predicted mean velocity by the area (from the stage-area relation), discharge can be computed on a near real-time basis.

When discharge measurements are made at the Bucks gage, concurrent discharge measurements also will be made on the Tensaw and Mobile Rivers just downstream from the split at Mount Vernon. These measurements will be used to determine if there is a relation between the discharge on the Mobile River at Bucks and the fraction of the total flow at Mount Vernon in the Tensaw and Mobile Rivers.

The flow computed at the Mobile River gage at Bucks will be valuable for determining flow into Mobile Bay. The data will be displayed from the Alabama link on the USGS Web site at *http://waterdata.usgs.gov/nwis/*. Initially, only river-level data will be displayed until sufficient discharge measurements have been made to compute the flow at the new gage.

Gage location at Bucks, Alabama, on the Mobile River.

Ups and Downs—The Gaging Network

By Rick Treece

Two streamgaging stations located near the Alabama–Georgia State boundary were discontinued as of March 1, 2004, due to lack of funding. These stations (Tallapoosa River below Tallapoosa, Ga., and Little Tallapoosa River below Bowdon, Ga.) have been operated by the Alabama District Office in Montgomery since 1999. These gages are considered to be important sources of streamflow information for researchers and resource managers in both States. New sources of funding are being explored to continue their operation. Also, a gage on Choccolocco Creek at Oxford, Ala., was discontinued this year. Additions to the surface-water network include Flint Creek near Falkville, which is a re-activation of a streamgaging station that was operated from 1952 to 1970 and again from 1992 to 1999.

National Water-Quality Assessment (NAWQA) Program—Mobile River Basin

By Brian Atkins

During the past 25 years, industry and government made large financial investments that resulted in better water quality across the Nation; however, many water-quality concerns remain. In 1991, the USGS began implementation of the National Water-Quality Assessment (NAWQA) Program. This program differs from other national water-quality assessment studies in that the NAWQA program integrates monitoring of surface- and ground-water quality with the study of aquatic ecosystems.

Assessing the quality of water in every location of the Nation is not practical; therefore, the NAWQA Program studies are conducted within Study Units. The Mobile River basin (MOBL) NAWQA study began in 1997 (fig. 1). Water-quality issues in the upper Mobile River basin are numerous and diverse. Some of the water-quality issues being studied in the MOBL are related to the occurrence and distribution of nutrients, pesticides, and other organic compounds in surface and ground water and the effects of urbanization on aquatic ecosystems. Two studies that have been completed by the MOBL Study-Unit team are highlighted on the following pages in brief summaries:

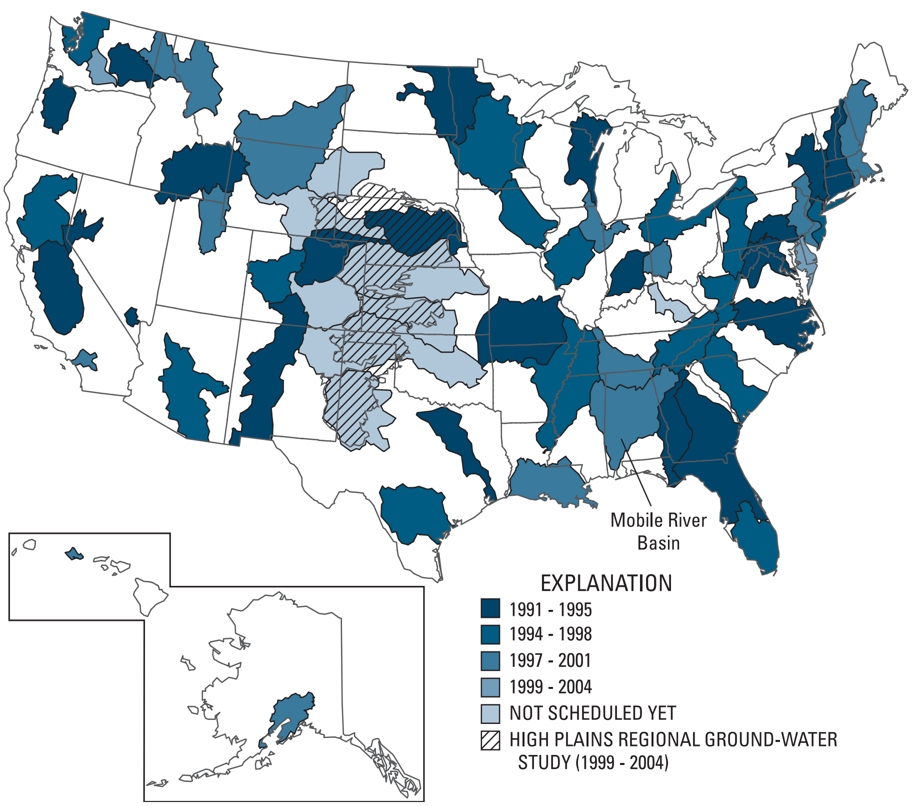


Figure 1. Location of Study Units of the U.S. Geological Survey's National Water-Quality Assessment Program, including the Mobile River Basin.

Cooperator Highlights

The Fivemile Creek Greenway Partnership and the Black Warrior–Cahaba Rivers Land Trust are among the new USGS cooperators for 2003–04. These two organizations are spearheading an effort to restore Fivemile Creek in Jefferson County to its place as an important asset in daily lives of those who live and work along the creek in northern Jefferson County. The Greenway master plan includes the goal of establishing a 24-mile greenway along the banks of Fivemile Creek from Tarrant City to the confluence of the stream with the Black Warrior River near Graysville. Over 600 acres between the creek and Highway 79 have been acquired in the Tarrant City area that is slated for use as a park and the starting point for a hiking trail. Additional acreage also has been acquired in Graysville. Over 3 miles of the greenway are in the acquisition stage with offers of additional donations of another 3 miles in the Fultondale area.

The USGS will assist the effort by providing baseline water-quality information for the area of stream near the park in Tarrant City. The information will be increasingly important as the number of visitors to the stream increase as the park and extended greenway become more accessible to the public. The efforts this summer and early next year will focus on water quality and the health of the aquatic communities in the area of the recent land acquisition. The Ketona streamgaging station, adjacent to the park, will be monitored for additional water-quality properties during the summer months when the park usage will peak.

Organochlorine Compounds and Trace Elements in Fish Tissue and Streambed Sediment in the Mobile River Basin, Alabama, Mississippi, and Georgia, 1999

By Humbert Zappia

During the summer of 1998, as part of the NAWQA Program, a survey was conducted to determine which organochlorine compounds and trace elements occur in fish tissues and streambed sediments in the Mobile River basin, which includes parts of Alabama, Mississippi, Georgia, and Tennessee. The data collected were compared to guidelines related to wildlife, land use, and to 1991 and 1994 NAWQA Study-Unit data.

Twenty-one sites were sampled in subbasins of the Mobile River basin, ranging in size from about 9 to 22,000 square miles. The major land-use categories in these subbasins were urban, agriculture, and forest.

Organochlorine compounds were widespread spatially in the Mobile River basin. At least one organochlorine compound was reported at the majority of sampling sites (84 percent) and in a majority of whole-fish (80 percent) and streambed-sediment (52 percent) samples. Multiple organochlorine compounds were reported at 75 percent of the sites where fish tissues were collected and at many of the streambed-sediment sampling sites (45 percent). Most of the concentrations reported, however, were less than 5 micrograms per kilogram in fish-tissue samples and less than 1 microgram per kilogram in streambed-sediment samples.

The majority of trace elements analyzed in fish-liver tissue (86 percent) and streambed-sediment (98 percent) samples were reported during this study. Multiple trace elements were reported in all samples and at all sites.

> Based on comparisons of concentrations of organochlorine compounds and trace elements in fish-tissue and streambed-sediment samples in relation to published guidelines, the potential exists for adverse effects to wildlife at 15 (72 percent) of the sites sampled. The potential for adverse effects at these sites is because of the presence of residues or breakdown products related to polychlorinated biphenyls (PCB's), chlordane, dichlorodiphenyltrichloroethane (DDT), chromium, lead, and zinc.

The relation of trace elements to land use is not as clear as the relation of organochlorine compounds to land use. This lack of clarity may be due to the possibility of geologic sources of trace elements in the Mobile River basin and to the ubiquitous nature of many of these trace elements. However, there may be a correlation between the amount of urban land use and concentrations of antimony, cadmium, lead, and zinc in streambed-sediment samples from the Mobile River basin.

USGS fish sampling in the Mobile River basin.

In general, concentrations of organochlorine compounds and trace elements and the frequency with which they were reported in the Mobile River basin are similar to or less than those reported by 1991 and 1994 NAWQA Study Units; however, exceptions do exist to this generality.

The higher reporting frequencies and concentrations of heptachlor epoxide, *p,p*'-DDT, and trans-chlordane in samples from the Mobile River basin are probably due to the greater use of these compounds locally than nationally. The reason for the higher reporting frequency of PCB's is less clear, but may be due to the production of these compounds within the basin.

The higher frequency with which some trace elements were reported in fish-liver tissue and streambed-sediment samples in the Mobile River basin may be due to geology or anthropomorphic activities. Higher boron concentrations locally are probably due to anthropomorphic activities, because there are no major geological sources for boron in the Mobile River basin. Potential sources locally for most of these trace elements include irrigation drainage water (mercury), coal combustion (mercury and nickel), metallurgy (barium, boron, chromium, and nickel), soaps (boron), and the wood and pulp industry (barium and chromium). Other sources that could affect samples from the Mobile River basin are the Black Warrior coal fields (aluminum and mercury) in the northwestern part of the basin, which are known to have elevated levels of mercury, and barite deposits (barium) in east-central Alabama.

The full text of this report is available online at *http://water.usgs.gov/pubs/wri/wri02-4160/*.

Ground-Water Quality Beneath an Urban Residential and Commercial Area, Montgomery, Alabama, 1999–2000

By James Robinson

The Black Warrior River aquifer, which is composed of the Coker, Gordo, and Eutaw Formations, supplies more than 50 percent of the ground water used for public water supply in the Mobile River basin. The city of Montgomery, Alabama, is partially built on a recharge area for the Black Warrior River aquifer, and is one of many major population centers that depend on the Black Warrior River aquifer for public water supply. To represent the baseline ground-water quality in the Black Warrior River aquifer, water samples were collected from 30 wells located in a low-density residential or rural setting; 9 wells were completed in the Coker Formation, 9 wells in the Gordo Formation, and 12 wells in the Eutaw Formation. To describe the ground-water quality beneath Montgomery, Alabama, water samples also were collected from 30 wells located in residential and commercial areas of Montgomery; 16 wells were completed in the Eutaw Formation, 8 wells in alluvial deposits, and 6 wells in terrace deposits. The alluvial and terrace deposits directly overlie the Eutaw Formation with little or no hydraulic separation. Ground-water samples collected from both the rural and urban wells were analyzed for physical properties, major ions, nutrients, metals, volatile organic compounds, and pesticides. Samples from the urban wells also were analyzed for bacteria, chlorofluorocarbons, dissolved gases, and sulfur hexafluoride. Ground-water quality beneath the urban area was compared to baseline water quality in the Black Warrior River aquifer.

Compared to the rural wells, ground-water samples from urban wells contained greater concentrations or more frequent detections of chloride and nitrate, and the trace metals aluminum, chromium, cobalt, copper, nickel, and zinc. Pesticides and volatile organic compounds were detected more frequently and in greater concentrations in ground-water samples collected from urban wells than in ground-water samples from rural wells.

The Spearman rho test was used to check for statistically significant covariance among urban ground-water quality and land-use type. The number of pesticides and volatile organic compounds detected and concentrations of nickel increased as the percentage of residential land use increased. Greater nickel concentrations also were associated with a greater number of volatile organic compounds detected. As the percentage of commercial land use increased, the numbers of pesticides and volatile organic compounds detected decreased. The number of pesticides detected in the urban ground-water samples increased as concentrations of nitrite plus nitrate increased; the number of pesticides detected and the concentrations of nitrite plus nitrate decreased as the age of the ground water increased. These correlations may indicate that, with time, pesticides and nitrate are removed from the ground-water system by physical, chemical, or biological processes.

The effects of surficial geology on the occurrence of pesticides and volatile organic compounds was investigated by calculating frequencies of detection. The detection frequency for pesticides was greater in urban samples collected from wells where the surficial geology is sand than in urban samples collected from wells where the surficial geology is clay. The frequency of detection of volatile organic compounds did not show this relation.

The full text of this report is available online at *http://water.usgs.gov/pubs/wri/wri024052/*.

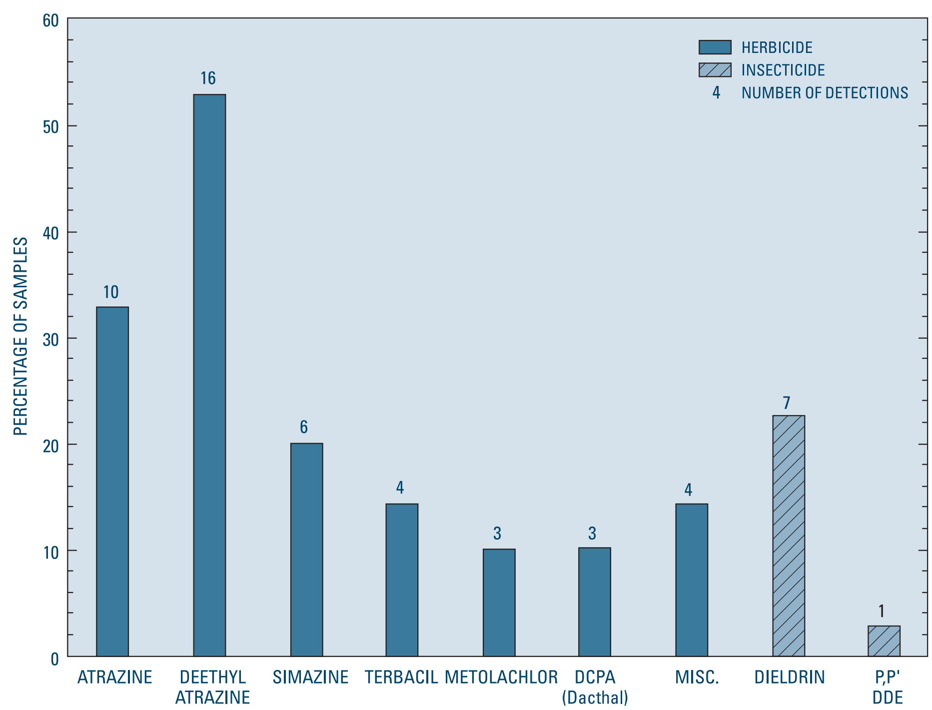


Figure 2. Detection frequencies of pesticides in ground-water samples collected from urban wells in Montgomery, Alabama.

Cooperator Highlights

During the past year, the Central Alabama Regional Planning and Development Commission in partnership with the USGS received support from the Alabama Clean Water Partnership for the development of the Lower Coosa River Basin Management Plan. The development plan will provide a basinwide strategy, developed in conjunction with citizens, stakeholders, and local officials, that will assist in maintaining and restoring the biological integrity of the waters in the lower Coosa River basin. The management plan will outline protective and corrective measures necessary to address existing nonpoint-source pollution problems and prevent future problems. The area the plan will cover is approximately 2,000 square miles of land and water surrounding the Coosa River from just north of the confluence of the Coosa River with Tallasseehatchee Creek to the confluence of the Coosa and Tallapoosa Rivers south of the City of Wetumpka.

The USGS commitment in 2003–04 consists of matching resources, data collection and interpretation, and study design support. Water-quality, biological, and habitat data will be collected from 12 streams in the lower Coosa drainage. These data will be used to lend insights into the effects of nonpoint sources and to develop a baseline dataset. The streams are representative of those tributaries of the lower Coosa River that drain forested, agricultural, urban, and silvicultural land uses.

Survey Notes

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(Click on one of the links under Publications and Products from the USGS Alabama District Web site to view one of the following reports)

Johnson, Gregory C., Kidd, Robert E., Journey, Celeste A., Zappia, Humbert, and Atkins, J. Brian, 2002, Environmental Setting and Water-Quality Issues of the Mobile River Basin, Alabama, Georgia, Mississippi, and Tennessee: U.S. Geological Survey Water-Resources Investigations Report 02-4162, 62 p.

Journey, C.A., and Gill, A.C., 2001, Assessment of Water-Quality Conditions in the J.B. Converse Lake Watershed, Mobile County, Alabama, 1990–98: U.S. Geological Survey Water-Resources Investigations Report 01-4225, 131 p.

McPherson, Ann K., Moreland, Richard S., and Atkins, J. Brian, 2003, Occurrence and Distribution of Nutrients, Suspended Sediment, and Pesticides in the Mobile River Basin, Alabama, Georgia, Mississippi, and Tennessee, 1999–2001: U.S. Geological Survey Water-Resources Investigations Report 03-4203, 101 p.

Robinson, James L., 2002, Ground-Water Quality Beneath an Urban Residential and Commercial Area, Montgomery, Alabama, 1999–2000: U.S. Geological Survey Water-Resources Investigations Report 02-4052, 37 p.

Robinson, James L., 2003, Comparison Between Agricultural and Urban Ground-Water Quality in the Mobile River Basin, 1999–2001: U.S. Geological Survey Water-Resources Investigations Report 03-4182, 38 p.

Zappia, H., 2002, Organochlorine Compounds and Trace Elements in Fish Tissue and Streambed Sediment in the Mobile River Basin, Alabama, Mississippi, and Georgia, 1998: U.S. Geological Survey Water-Resources Investigations Report 02-4160, 85 p.

Survey Notes

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