WATER IN ALABAMA, 1995

GEOLOGICAL SURVEY OF ALABAMA
CIRCULAR 122M

STATE OF ALABAMA
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March 10, 1999

The Honorable Don Siegelman
Governor of Alabama
Montgomery, Alabama

Dear Governor Siegelman:

It is with pleasure that I transmit herewith a report entitled "Water in Alabama, 1995," by David C. Kopaska-Merkel and James D. Moore. The report is published as Circular 122M of the Geological Survey of Alabama.

The report presents information on hydrologic conditions in Alabama, 1995. Included are data on ground-water levels, streamflow, water quality, water use, water laws, water problems, and current water-resources investigations. The report is useful to persons interested in the development, conservation, and management of Alabama's valuable water resources.

Respectfully,

Donald F. Oltz
State Geologist

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WATER IN ALABAMA, 1995

By

David C. Kopaska-Merkel and James D. Moore

INTRODUCTION

Alabama has abundant surface-water and ground-water resources. However, these resources are being depleted or contaminated in some local areas of the state. An increased awareness of these problems in recent years has resulted in many new federal and state regulations to protect water resources, as well as increased public participation in water-quality protection. Much of the emphasis has been placed on the protection of ground-water resources, identification of nonpoint sources of pollution, and the establishment of new maximum contaminant levels for public drinking water supplies. Since 1955, per capita use of water has increased by about 150 percent in Alabama. In 1995, an average of 9.68 billion gallons per day (bgd) of water was withdrawn for use from surface and underground sources.

The Hydrogeology Division of the Geological Survey of Alabama is responsible for a number of programs to monitor the use, quality, and quantity of surface and ground waters in the state and to collect basic data necessary to develop new water supplies, expand current water systems, and minimize water contamination. The basic data collection program is implemented through a statewide network of observation wells and water-quality sampling stations. Data on streamflow, ground-water levels, and water quality collected through this program form the basis for many water-related research activities. Other agencies, including the Alabama Department of Environmental Management, the U.S. Geological Survey, the Tennessee Valley Authority, the U.S. Department of Agriculture Natural Resources Conservation Service, and some local governing bodies maintain water-resources programs, collect basic hydrologic data, and conduct research investigations on the water resources of Alabama. However, this report emphasizes the activities and programs of the Geological Survey of Alabama.

Water-resources data and water-use information are used by Geological Survey of Alabama staff in answering information requests and in providing assistance to those who plan to develop or expand supply systems or to those who need information about protecting or managing the state's surface-water and ground-water resources.

CLIMATIC CONDITIONS

Alabama's climate is humid subtropical, with mild winters and hot summers. Average annual temperatures range from 58°F in northeastern Alabama to about 68°F in southwestern Alabama (fig. 1). Average January temperatures range from 44°F in the northern part of the state to 54°F near the Gulf Coast, and average July temperatures range from 81°F in northern and coastal Alabama to 82°F in central Alabama. No climatic data station in the state has an average monthly temperature below freezing.

Rainfall in Alabama usually is abundant and is distributed throughout the year. Average annual precipitation ranges from a low of 49 inches in the Montgomery area to a high of 66 inches near the coast (fig. 2).

Very little snow falls in Alabama in normal years; average annual snowfall ranges from 5 inches in the Tennessee Valley region to less than 1 inch in the southern part of the state. During most years, the southern half of the state receives no snowfall.
During severe droughts, the dry part of the state, which extends across the state from southern Pickens County to Barbour County, may have as little as 30 inches of precipitation. During wet years, however, precipitation in coastal Alabama, which normally receives the greatest amount of rainfall, may be more than 90 inches.

During 1995, rainfall was highly variable throughout the state. Rainfall amounts ranged from 44.26 inches at a station in Montgomery County to 95.77 inches at a station in Escambia County (fig. 3). The largest amounts of rainfall occurred in the extreme southern part of the state (fig. 3). Rainfall in most of the state was slightly above normal during 1995 (fig. 4). Rainfall deficiencies were less than 10 inches throughout the state. In the southern part of

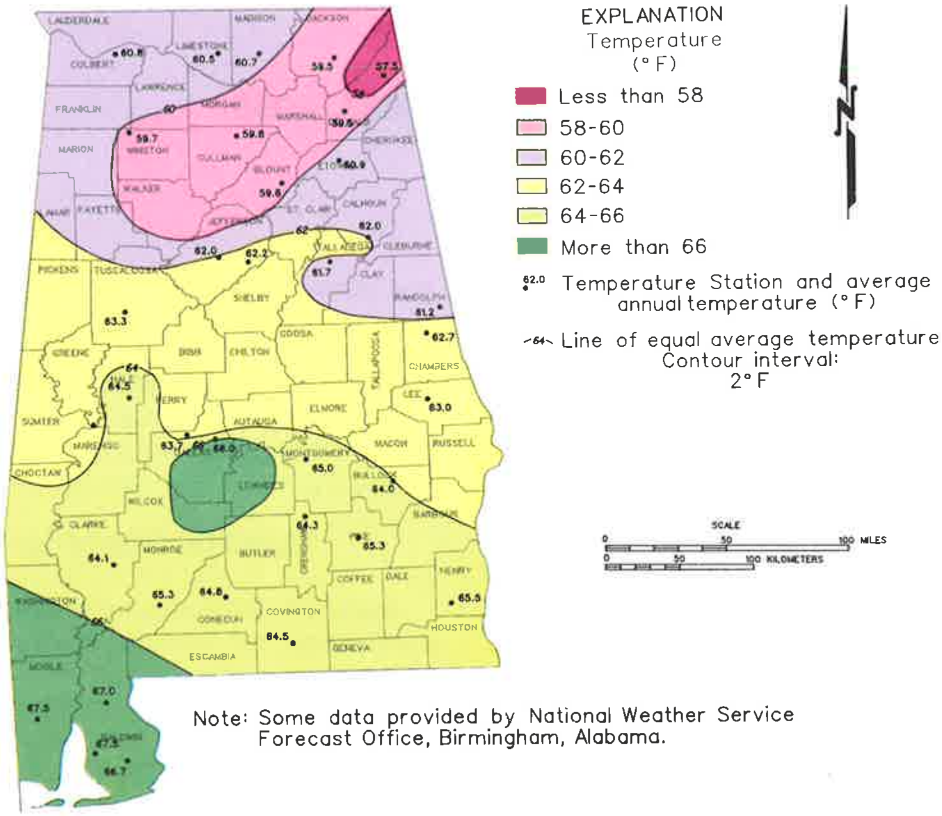


Figure 1.--Average annual temperatures (U.S. Department of Commerce, 1989).

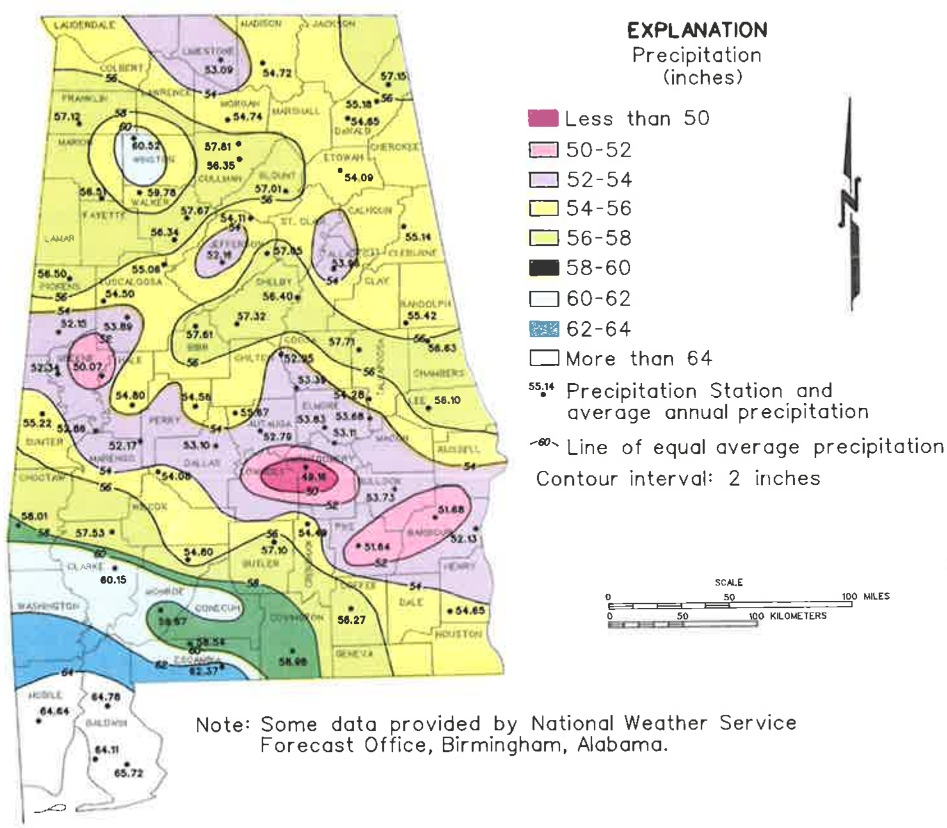


Figure 2.--Average annual precipitation (U.S. Department of Commerce, 1989).

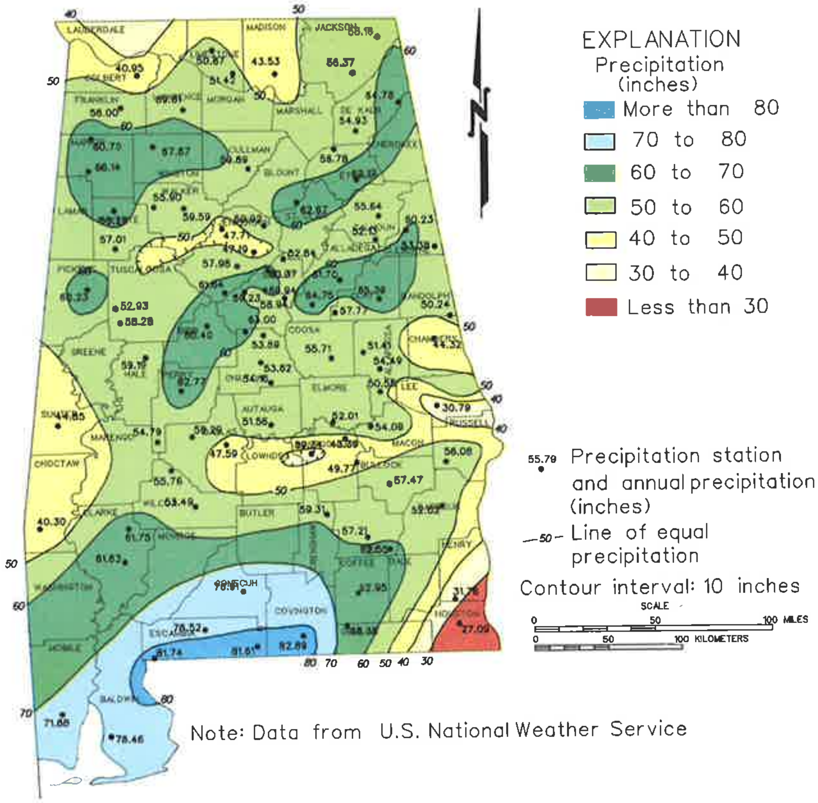


Figure 3.--Annual precipitation, 1995.

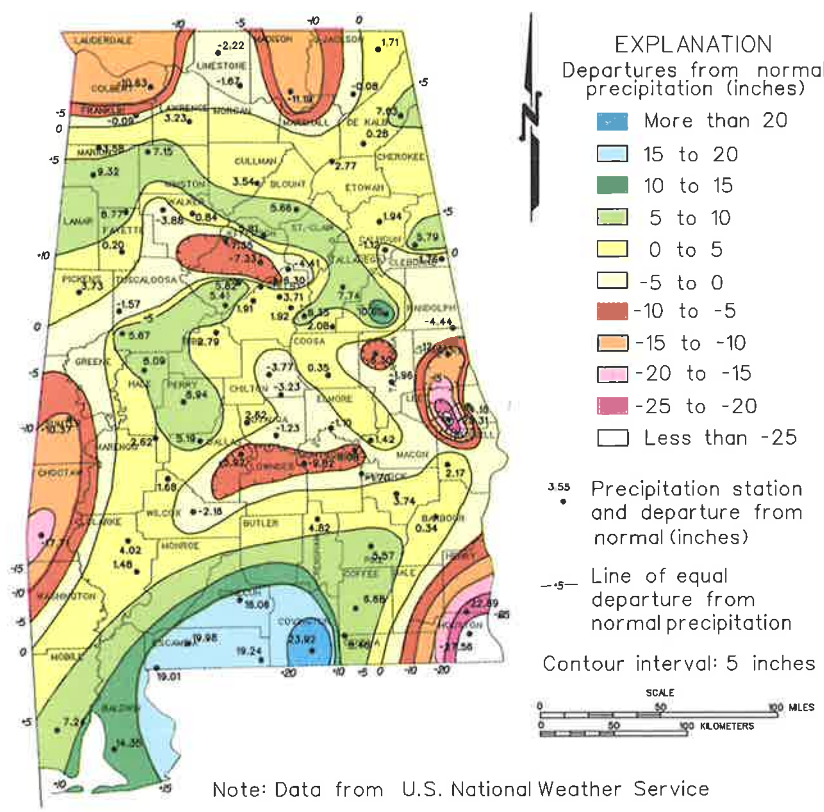


Figure 4.--Departures from normal precipitation, 1995.

the state, rainfall amounts of 10 or more inches above normal were common. One station in central Baldwin County recorded rainfall of 27.08 inches above normal for the year.

Only a part of the state's precipitation results in runoff (fig. 5). Much of the water either evaporates, enters the soil zone where it is retained as soil moisture or is taken up and transpired by plants, or enters the ground-water system. A comparison of figures 2 and 5 shows the large difference in the average amount of precipitation and the amount that can be accounted for as runoff.

GROUND WATER

Ground water is a reliable source of water for many people in Alabama. Several large cities and many smaller towns use ground water for municipal supply, especially in south Alabama where ground water is readily available and of good quality. Many wells throughout the state supply water for rural domestic users and semipublic facilities such as campgrounds and marinas.

Approximately 44 percent of the population of Alabama uses ground water for domestic supplies. The general availability of ground water from aquifers in different parts of the state is shown in figure 6. The water-bearing characteristics of aquifers are controlled by geologic factors such as the type, permeability, and structure of rocks comprising the aquifers. Each of the general geologic areas in the state provides different conditions for ground-water occurrence (pl. 1).

WATER LEVELS

The Geological Survey of Alabama maintains a statewide network of wells to monitor ground water level fluctuations in important aquifers (pl. 2). Twenty of these wells are equipped with continuous water-level recorders, and 402 wells were used for determining ground-water levels in the fall of 1995, which is normally the low water level period of the year. Water-level measurements in the periodic observation wells are made either with steel tapes or electric tapes so that reliable measurements can be made to as many significant figures as can be read accurately. Data from each well are published each year by the Geological Survey of Alabama in Circular 112, Ground-Water Levels in Alabama. A

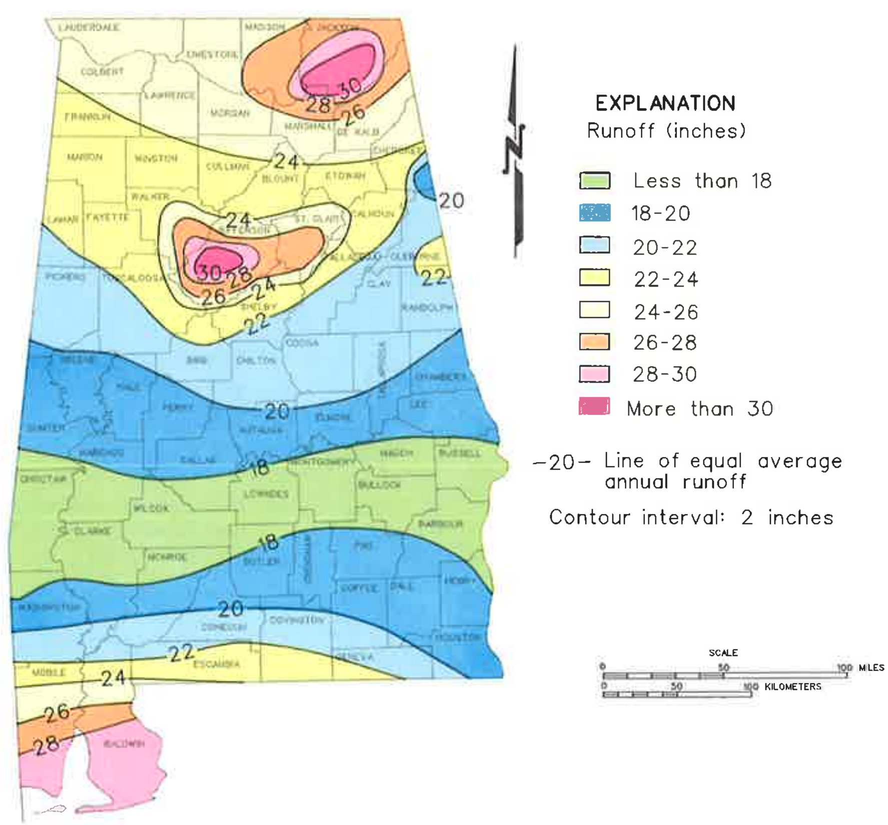
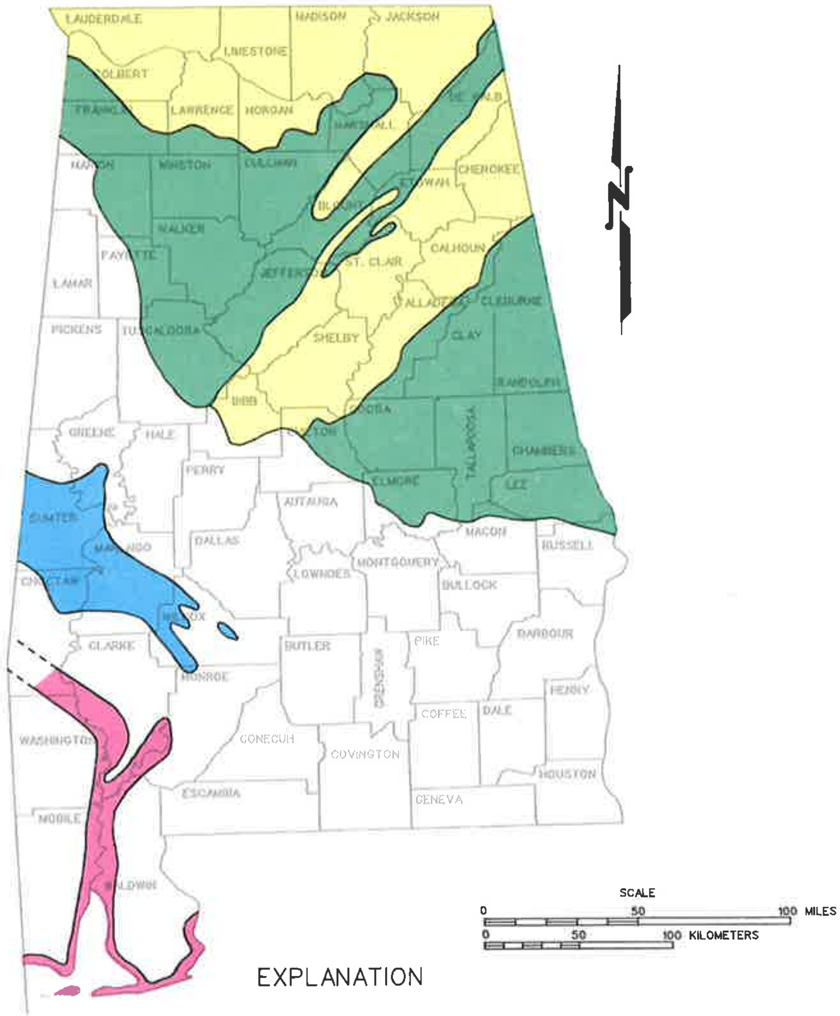


Figure 5.--Average annual runoff in Alabama (modified from U.S. Geological Survey, 1985).



EXPLANATION

Ground-water supplies are generally sufficient for industrial or municipal development (150 gpm+).

Relatively high well yields (150gpm+); shallow depths to saltwater in some places; potential for saltwater encroachment.

High-yield wells (150gpm+) may occur primarily in carbonate rock areas where cavity systems have developed.

Generally low yields (10gpm). Only a few relatively high-yield wells developed in fracture zones.

Ground water not suitable for industrial or municipal development; highly mineralized water in major aquifers. Yields of up to 5 gpm of freshwater available in some shallow aquifers.

Figure 6.--Potential yields of aquifers in Alabama.

summary of the water-level information for the fall of 1995 is provided in appendix A of this report. During the low water-level period of 1995, record low water levels were recorded in about 15 percent of the wells (fig. 7). These wells were widely distributed throughout the state. Only a few of the wells recorded record high water levels, which typically do not occur in the fall. Because of the dry summer of 1995, water levels in the fall of 1995 were generally lower than during the fall of 1994. About 68 percent of the wells had water levels lower in the fall of 1995 than in the fall of 1994, which followed a relatively wet summer. Figure 8 shows hydrographs of the lowest daily ground-water levels in selected wells for water year 1995.

These hydrographs show the seasonal ground-water level fluctuations and short-term water-level fluctuations in response to changes in recharge or discharge of ground water. High ground-water levels generally occur in March or April, and low ground-water levels generally occur in September or October. However, during water year 1995 water levels were highest in some wells in February and May.

WATER-LEVEL TRENDS

Many municipalities in Alabama, primarily those in the coastal plain, depend on ground water either as the primary or sole water source. In the coastal plain, where pumpage has steadily increased for many years, water levels have declined in the vicinity of the major pumping centers. Water-level declines range from a few feet to more than 150 feet. An analysis of water-level data for 65 wells completed in the Eutaw aquifer indicated that water levels in wells completed downdip of the outcrop area are declining at an average rate of 10 inches per year. Increasing pumpage of ground water in areas of concentrated population and limited aquifer performance in southeast Alabama have resulted in dramatically depressed water levels near the cities of Dothan, Troy, and Ozark.

Numerous, smaller areas of declining ground-water levels also occur throughout southeast Alabama due to overpumpage of single isolated wells. Water levels in the Nanafalia aquifer near the city of Dothan are approximately 150 feet below initial levels prior to any pumpage. Water levels in this area continue to decline at the rate of about 4 feet per year. Water levels are also declining in the Providence-Ripley aquifer system near the city of Troy and the Nanafalia and Clayton aquifer systems near the city of Ozark. Current water levels at Ozark are about 125 feet below water levels prior to any pumpage. Water levels in this area are declining at a rate of 2.5 feet per year. Water levels at Troy are approximately 70 feet below pre-pumping levels. The rate of water level decline in this area is about 2.6 feet per year. Water-level trends at selected sites are shown by the long-term hydrographs in figure 9. Despite local ground-water level decline in major aquifers in the Alabama coastal plain, these same aquifers exhibit stable water levels in many regions away from the influence of major pumping centers.

The hydrograph for the well developed in the Nanafalia aquifer in Choctaw County shows that the water level has declined about 20 feet since the beginning of record in July 1981. At the beginning of 1986, the rate of water-level decline in this well increased from one-third foot per year to 2 1/3 feet per year. The water level in the well completed in the Nanafalia aquifer in Butler County has declined about 3.5 feet since 1976. However, most of that decline occurred from 1980 to 1982, and the current rate of decline is small. The water level in the well completed in the Eutaw aquifer in Greene County has declined about 11 feet during the last 20 years. No water-level decline is apparent at the observation well completed in the Fort Payne Chert in Limestone County or at the observation well completed in the Crystal River Formation in Houston County. Most of the hydrographs show seasonal water-level fluctuations, which generally range from less than 1 foot in some wells to more than 10 feet in other wells. More information on water levels is provided in Geological Survey of Alabama Circular 112, an annual report entitled Ground-Water Levels in Alabama.

SPRING DISCHARGES

The Geological Survey of Alabama measured the discharges of 37 springs in Alabama during the fall of 1995. Spring discharge information is provided in appendix A, and the locations of the springs are shown on plate 2. A comparison of the spring discharge information in appendix A reveals that the discharge of individual springs is highly variable. The amount of discharge depends largely on the amount of rainfall preceding discharge measurements. Rainfall amounts were less in the fall of 1995 than in the fall of 1994, but spring discharges were about the same. This is because the fall 1995 rainfall deficit was mainly in the northern Coastal Plain, but most monitored springs are in other parts of the state. Of the 36 springs measured in both the fall of 1994 and fall of 1995, 19 (53 percent) had larger discharges

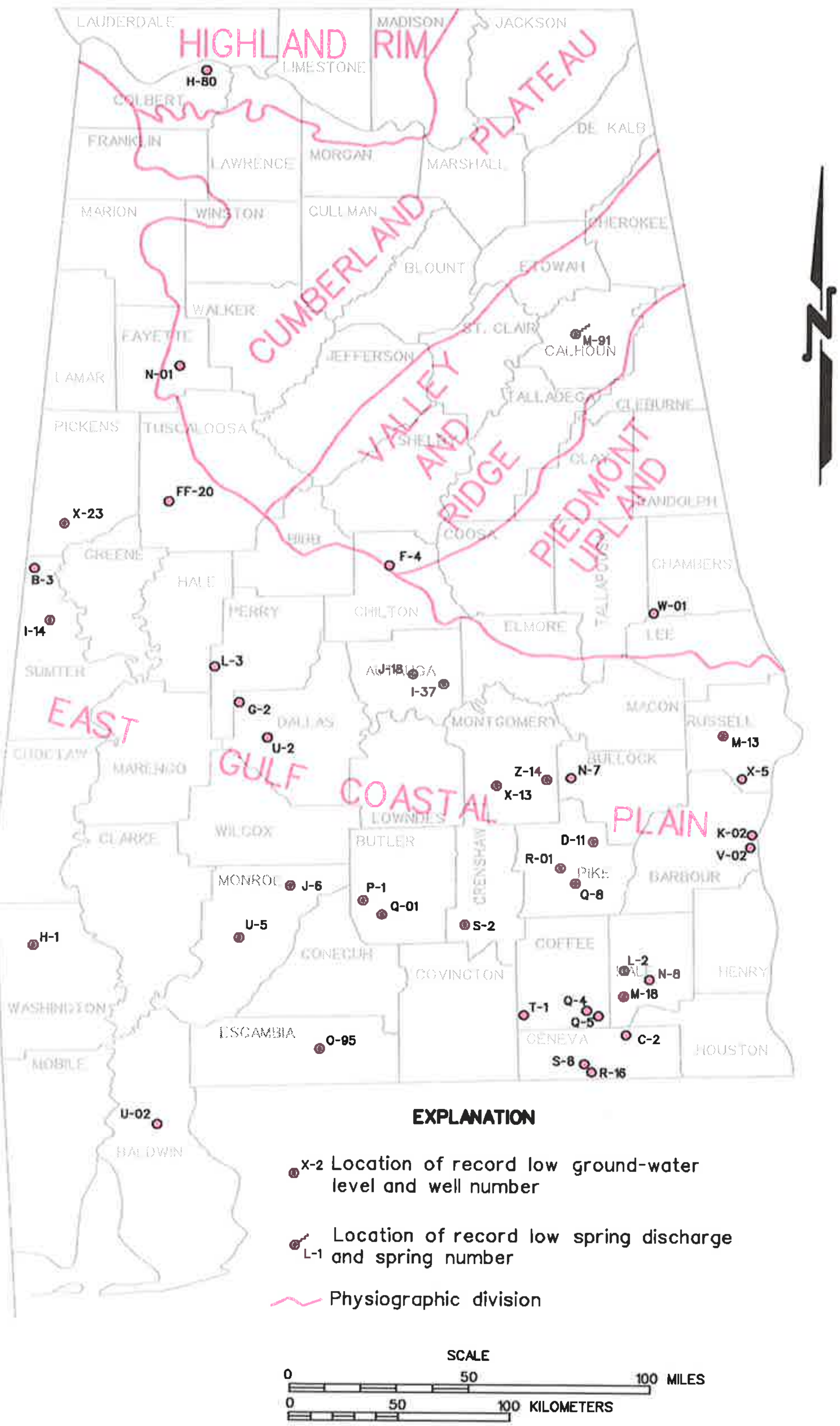


Figure 7.--Locations of record low ground-water levels in observation wells and record low discharges in springs, water year 1995.

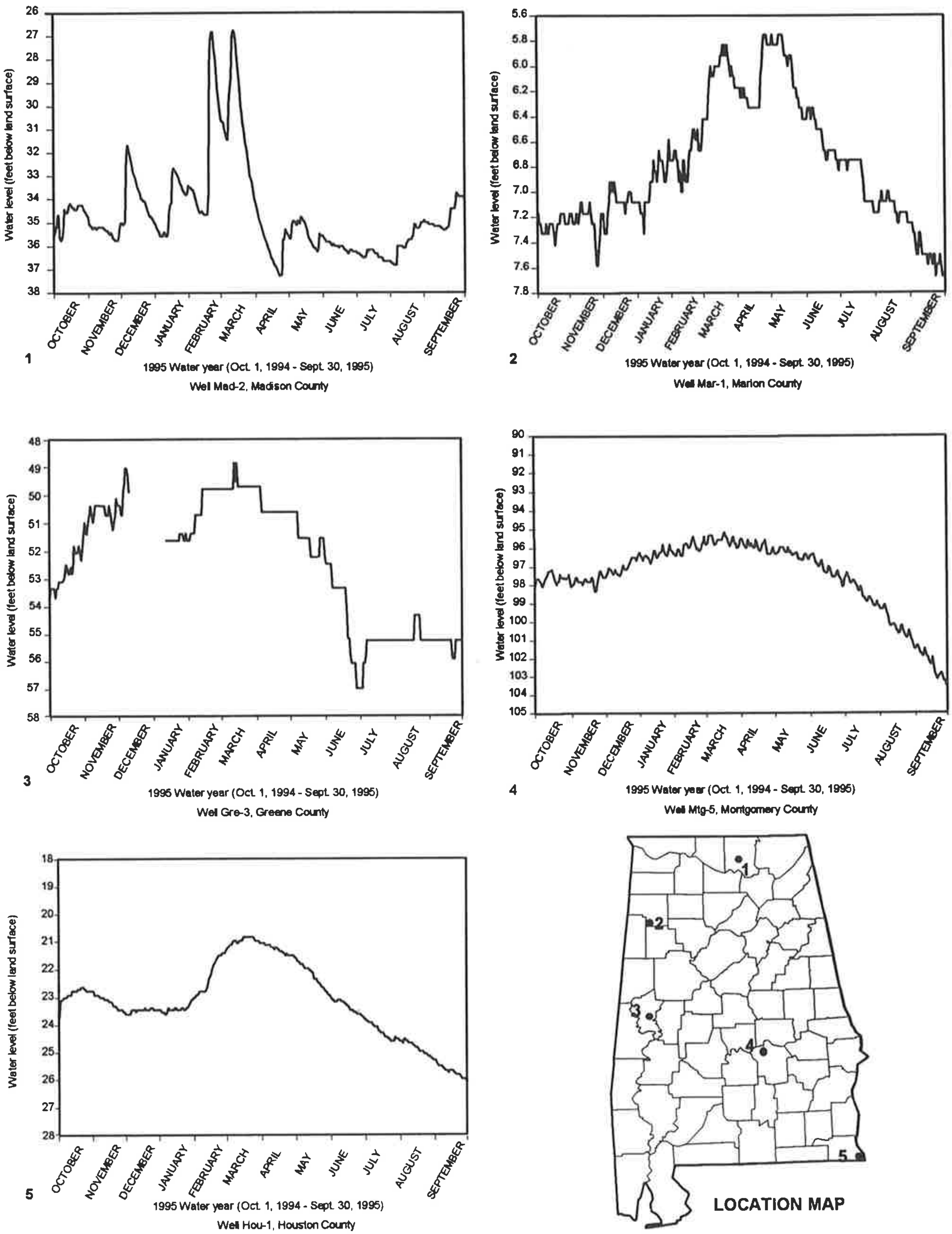


Figure 8.--Lowest daily ground-water levels for selected wells in water year 1995.

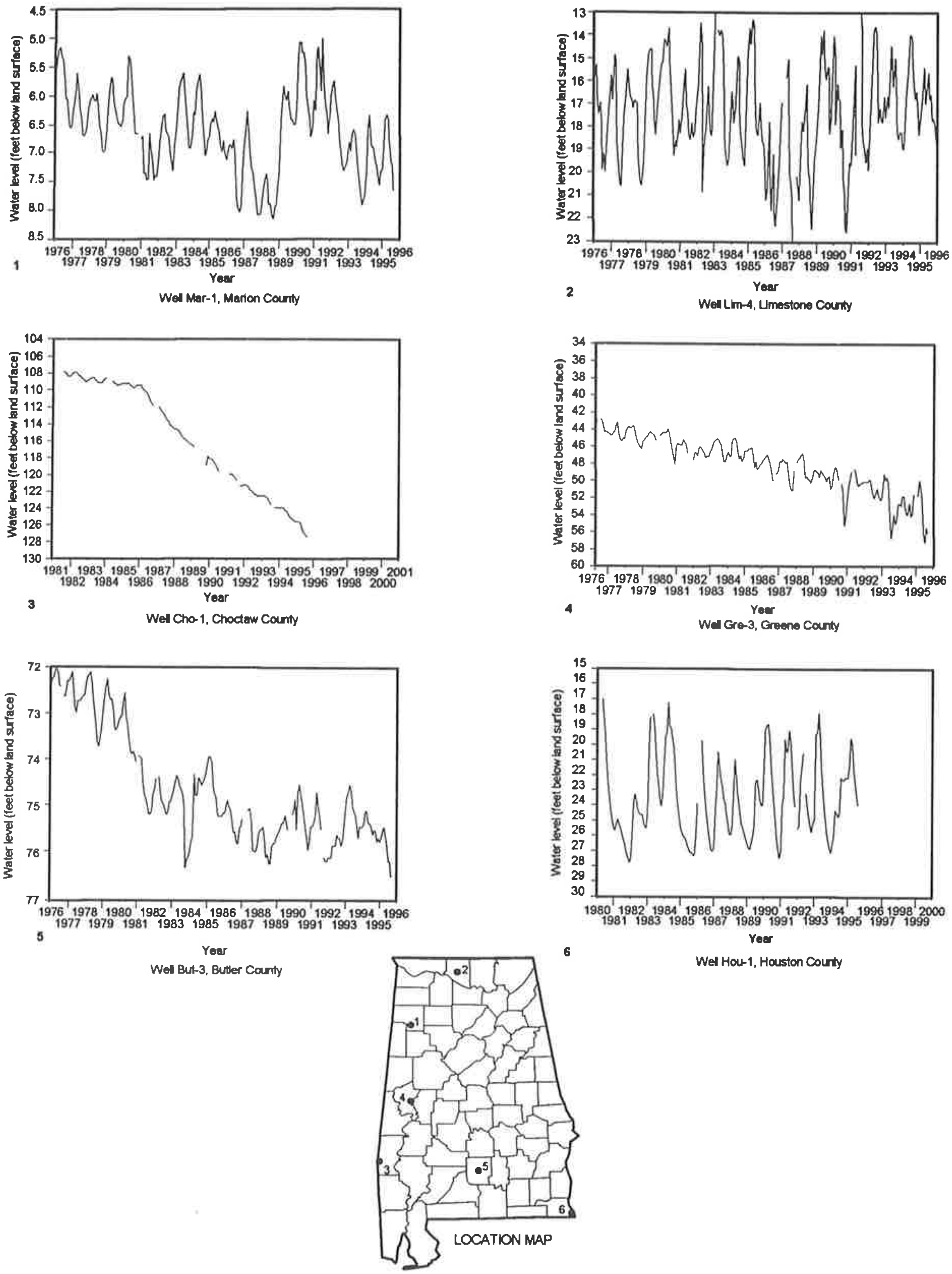


Figure 9.--Long-term hydrographs of monthly low water levels in selected wells.

in 1995. Although discharges are normally low in the fall, two springs had record high discharges in the fall of 1995. Only one spring (McCullars Spring in Calhoun County) had a record low discharge in the fall of 1995 (fig. 7).

SURFACE WATER

Alabama has abundant surface-water resources. The state contains 14 major river systems or basins, 47,077 miles of perennial rivers and streams, 28,479 miles of intermittent streams, 32 miles of ditches and canals, 490,472 acres of ponds, lakes, and reservoirs, 3,600,000 acres of freshwater wetlands, 27,600 acres of coastal wetlands, 610 square miles of estuaries in coastal Alabama, and a coastal shoreline (including Mobile Bay and island shorelines) of 337 miles (Alabama Department of Environmental Management, 1994a). These resources have been developed extensively for many uses. Streams and reservoirs provide water for domestic consumption, irrigation, industrial uses, transportation, power generation, waste dilution, and recreation. Surface water supplies drinking water to about 56 percent of the state's population.

Streamflow information is needed for the proper construction of bridges, dams, causeways, and other structures. To use and develop surface-water resources effectively and to plan for land use and construction in areas affected by watercourses, several kinds of surface-water data are required. Among the most important of these are data on streamflow duration, average annual discharge, low flow, seasonal distribution of flow, and maximum stream stage. To obtain streamflow information, the U.S. Geological Survey, in cooperation with the Alabama Department of Environmental Management, maintains a network of gaging stations on streams throughout Alabama (pl. 3). Stream-discharge measurements also are made at various sites by other agencies, including the Geological Survey of Alabama.

HYDROLOGIC REGIONS

The state is divided into hydrologic regions, which correspond to river drainage basins and groups of basins (fig. 10). Hydrologic regions may contain several major river basins; subregions correspond to the drainage area of a major river; and accounting units correspond to the basins of major tributaries. Each unit is assigned a two-digit number, which are combined in sequence from larger to smaller basins, enabling an eight-digit number to delineate the position of a tributary basin within a major river basin and a multiple-river basin. This numbering system is used by the U.S. Geological Survey, U.S. Department of Agriculture Natural Resources Conservation Service, and Alabama Department of Environmental Management.

Within accounting units, gaging stations are assigned arbitrary numbers in downstream order along the main stream. No distinction in numbering is made between partial-record stations, where limited streamflow data are collected periodically, and continuous-record stations, where systematic observations of gage height and/or discharge are measured continuously.

STREAMFLOW

Streamflow is monitored at several gaging stations throughout the state by the U.S. Geological Survey. These stations may vary from complex installations containing continuous recorders, flow-through sampling chambers, climatological instruments, and small automatic laboratories, to simple gage-height scales marked on spillway walls or other structures. The most common type of station includes a continuous recorder, which generally is mounted on a galvanized pipe on a stream bank or attached to a bridge. Automated continuous recorders may provide either a graph of stage measurements or a tape with values represented by punch holes at selected timed intervals; nonrecording gages are read directly.

Large streams and rivers are well distributed throughout the state, and their average discharges range from less than 200 to more than 52,000 cubic feet per second (ft3/s). Table 1 summarizes streamflow data for gaging stations on selected streams. Figure 11 shows the mean daily discharges at gaging stations on selected streams in Alabama for water year 1995. The lowest discharges of streams in Alabama generally occur in September or October, and the highest discharges generally occur in March or April.

During the 1995 water year (October 1, 1994, to September 30, 1995) the maximum flows recorded on the Conecuh River at Brantley, Sucarnoochee River at Livingston, Hatchett Creek below Rockford, Mulberry Fork near Garden City, and Paint Rock River near Woodville were in March 1995.

During this same period, the minimum flow on the Conecuh River at Brantley was in September 1995, Sucarnoochee River at Livingston was in September 1995, Hatchett Creek below Rockford was in September 1995, Mulberry Fork near Garden

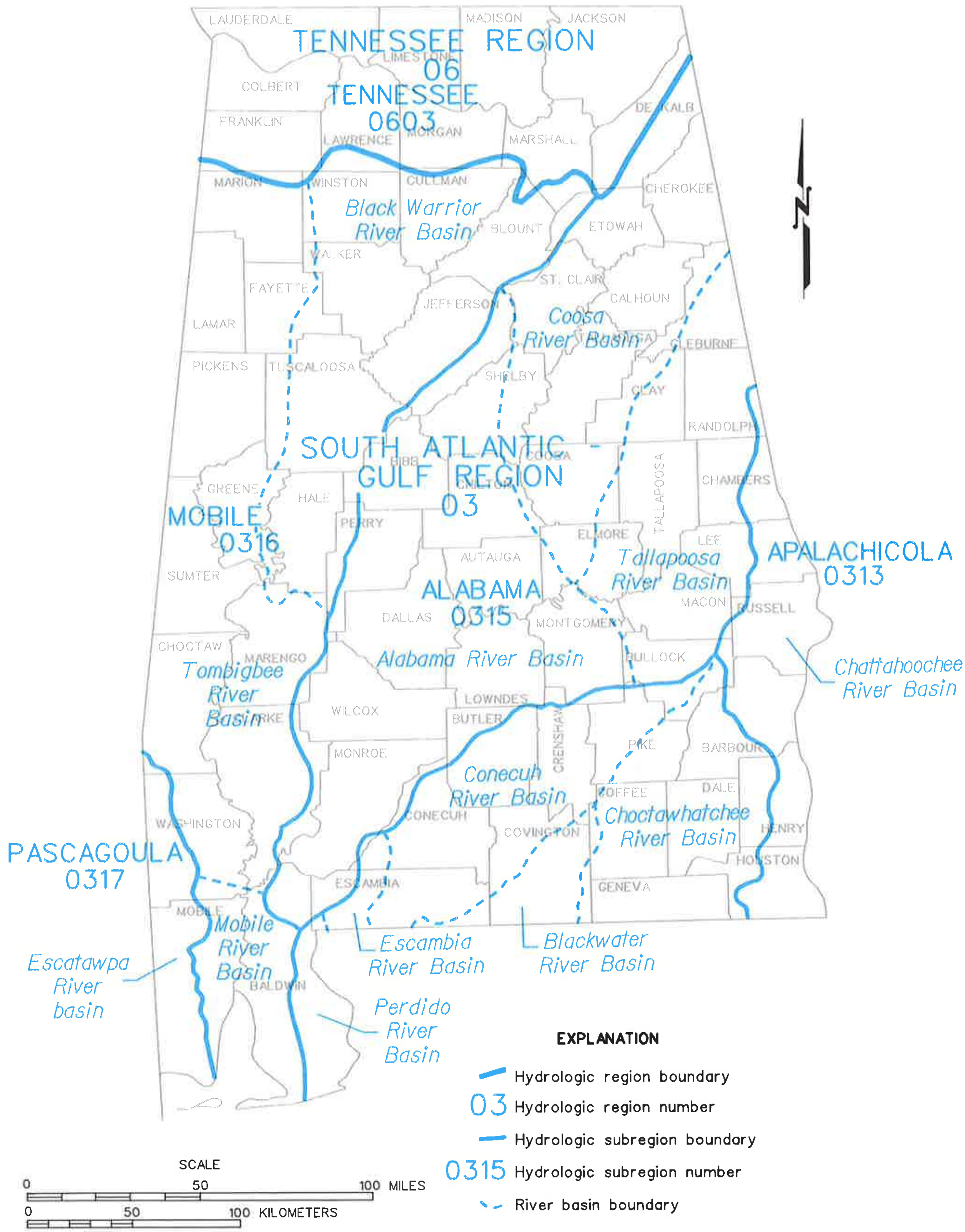


Figure 10.--Hydrologic regions and principal river basins in Alabama.

Table 1.--Mean, maximum, and minimum streamflow for water year 1995 and recurrence intervals at selected streamflow stations in Alabama (Information provided by the U.S. Geological Survey, Alabama District)

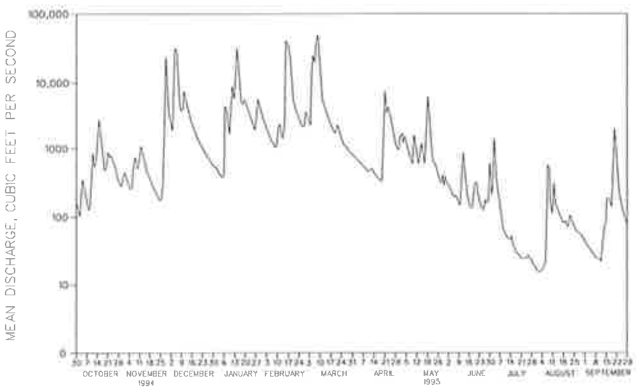
			Mean		Maximum		Minimum	
Station name	Station number	Years of record (years)	Yearly mean (ft³/s)	Percent of long-term average	Peak discharge (ft³/s)	Recurrence interval (years)	7-day average (ft³/s)	Recurrence interval (years)
Uchee creek near Fort Mitchell	02342500	49	307	70	6,180	<2	7.6	<20
Choctawhatchee River near Newton	02361000	65	764	80	9,790	<2	111	<5
Conecuh River at Brantley	02371500	58	538	82	4,860	<2	38	<5
Murder Creek at Evergreen	02374500	58	266	94	3,360	<2	93	<2
Fish River near Silver Hill	02378500	25	112	101	1,610	<2	64	<2
Big Wills Creek near Reece City	02401000	36	323	107	6,770	<5	50	<2
Kelly Creek near Vincent	02405500	27	334	104	5,120	<2	3.4	<2
Coosa River at Jordan Dam near Wetumpka	0241100	71	14,230	87	97,800	<2	regulated	regulated
Tallapoosa River near Heflin	02412000	43	581	85	7,930	<2	48	<5
Mulberry Creek at Jones	02422500	53	236	76	3,960	<2	38	<20
Cahaba River at Centreville	02424000	68	1,584	99	18,200	<2	169	<5
Buttahatchee River below Hamilton	02438000	25	566	107	13,300	<2	73	<2
Sipsey River near Elrod	02446500	52	788	99	7,240	<2	55	<2
Sipsey Fork near Grayson	02450250	29	169	101	10,000	<5	2.0	<10
Locust Fork at Sayre	02456500	57	1,314	91	17,200	<2	48	<2
Black Warrior River at Northport	02465000	75	7,218	91	74,200	--	regulated	regulated
Tombigbee River at Demopolis Lock & Dam near Coatopa	02467000	67	25,090	106	171,000	--	regulated	regulated
Chickasaw Creek near Kushla	02471001	44	285	104	5,820	<5	67	<2
Paint Rock River near Woodville	03574500	59	418	61	6,110	<2	9.7	<5
Tennessee River at Whitesburg	03575500	59	39,840	92	164,000	--	regulated	regulated
Big Nance Creek at Courtland	03586500	48	257	92	6,920	<5	9.4	<2

City was in September 1995, and Paint Rock River near Woodville was in August 1995. Data commonly used to assess streamflow characteristics are given in table 1. This table documents pertinent streamflow data for 21 surface water sites monitored by U.S. Geological Survey automatic recording instrumentation.

For the 1995 water year, streamflow was slightly below normal for most of the state with 14 of 21 streamflow stations having yearly means averaging less than the long-term means (Pearman and others, 1995). Pearman and others (1995) indicated that no streamflow stations had mean annual flows as high as 110 percent of the long-term means. In general, streamflows in October, November, and February were above normal throughout the state (Pearman and others, 1995). Streamflow in the months of January and April through September were below normal (Pearman and others, 1995).

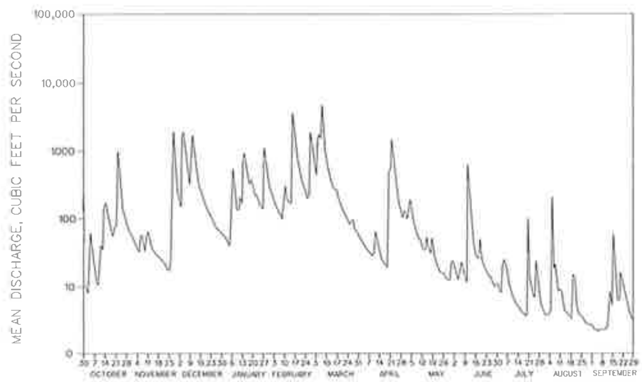
Baseflows of streams throughout the state were normal with 9 of the 17 unregulated stations shown in table 1 having minimum 7-day average discharges with less than a 2-year recurrence interval. Instantaneous maximum peak discharges during water year 1995 were within historical extremes. All of the stations identified in table 1 had maximum peak discharges with recurrence intervals of 5 years or less (Pearman and others, 1995).

Information on natural low flows of streams is necessary in planning for water-supply availability, disposal of waste effluents into streams, hydroelectric power generation, and wildlife management. The most commonly used values are the annual 7-day low flows of 2-year and 10-year recurrence intervals, called the 7-day Q2 and 7-day Q10, respectively. The 7-day Q2 represents the median low flow, or the lowest flow to which the stream will decline during 7 consecutive days on an average of once every 2 years. This value also provides an estimate of the amount of flow generally available without the need for storage (fig. 12). The 7-day Q10 is the lowest flow for 7 consecutive days that may be expected to occur once in 10 years. The reliability of mean, maximum, and minimum flow values is dependent upon the length of the period of record for which discharge records are available. Usually, the longer the period of record, the more reliable the low-flow values. Low-flow values, especially those determined for extensive periods of record, change very little from year to year except when affected by extreme drought or flood conditions.



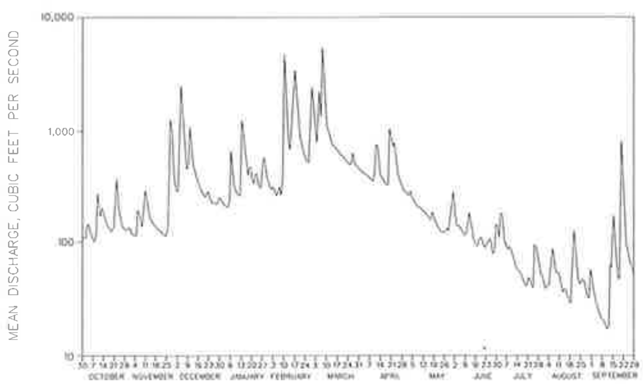
1

PAINT ROCK RIVER NEAR WOODVILLE, ALABAMA
MEAN DAILY DISCHARGE (CFS)



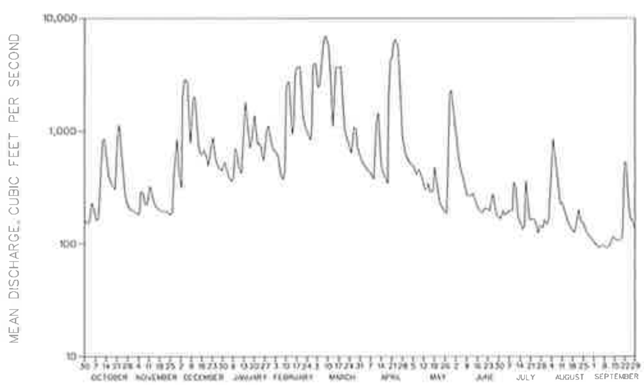
2

MULBERRY FORK NEAR GARDEN CITY, ALABAMA
MEAN DAILY DISCHARGE (CFS)



3

HATCHET CREEK BELOW ROCKFORD, ALABAMA
MEAN DAILY DISCHARGE (CFS)



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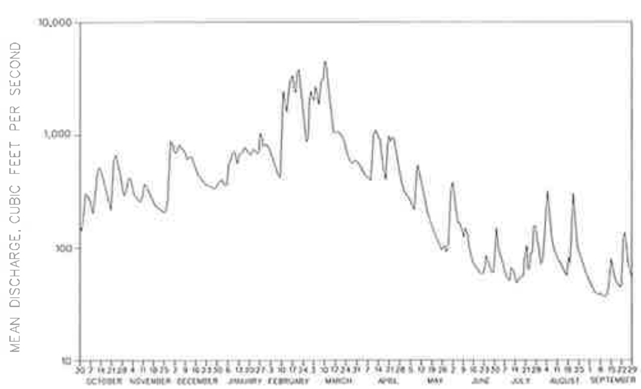
SUCARNOOCHEE RIVER AT LIVINGSTON, ALABAMA
MEAN DAILY DISCHARGE (CFS)



5

CONECUH RIVER AT BRANTLEY, ALABAMA
MEAN DAILY DISCHARGE (CFS)

Note: Streamflow data provided by the U.S. Geological Survey.

Figure 11.--Mean daily discharges for selected streams in water year 1995.

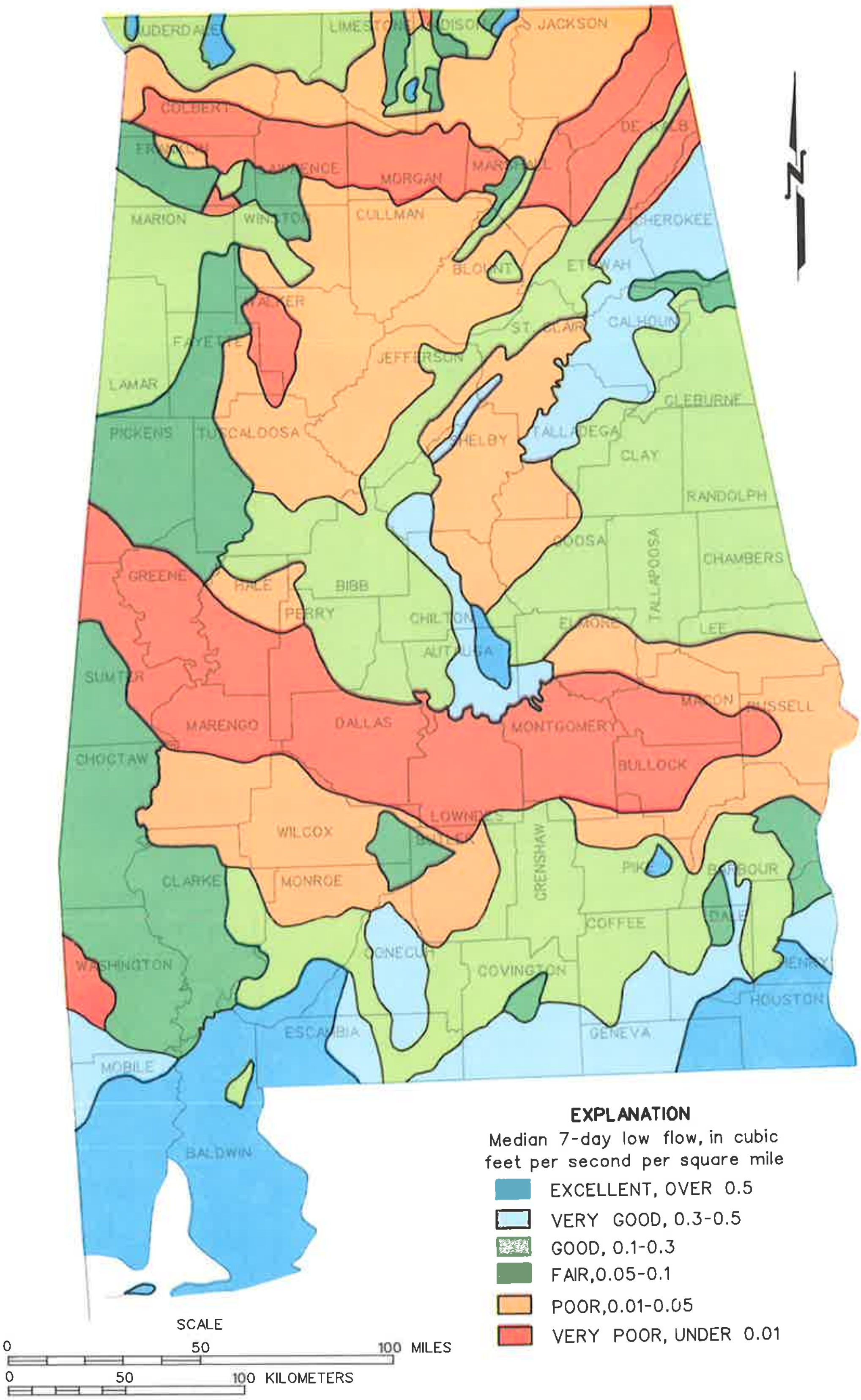


Figure 12.--Areal variation in median 7-day low flow of minor streams (modified from Peirce, 1967).

The U.S. Geological Survey maintains computer files of streamflow data, and prior to the 1994 water year the U.S. Geological Survey published daily values for gaging stations in annual water data reports and water-supply papers for the state. Beginning with the 1994 water year, streamflow data from the U.S. Geological Survey became available on Compact Disk - Read Only Memory (CD-ROM).

WATER REGULATIONS

FEDERAL LEGISLATION

Major pieces of legislation passed in recent years include the Comprehensive Environmental Response, Compensation, and Liability Act (known as the Superfund law), the Water Resources Development Act, amendments to the Safe Drinking Water Act, the Clean Water Act, and the Resource Conservation and Recovery Act.

The Comprehensive Environmental Response, Compensation, and Liability Act provides funds for the cleanup of toxic wastes and requires that the U.S. Environmental Protection Agency (USEPA) ensure that the long-term cleanup commence at a minimum of 375 new sites nationwide. In Alabama, 13 sites are on the National Priorities List (NPL) (USEPA, 1996, written commun.). Site investigations or remediation actions are underway at these sites. Other provisions of the bill include the following:

- Health assessments are required for most hazardous-waste disposal sites.
- The USEPA must compile a toxicological profile for each of the 275 most commonly found waste-site chemicals affecting health.
- The statute of limitations for health-related claims now starts at the time of illness instead of the time of exposure.
- A research, demonstration, and training program on new cleanup technologies was established.
- A research program to detect and evaluate waste hazards and their health effects was included.
- Authority was given to the USEPA to study indoor air problems, particularly problems associated with radon.
- Industries are required to disclose information concerning production and disposal of hazardous wastes.
- Citizens are allowed to sue the USEPA and private parties to force compliance with hazardous-waste regulations.
- Disposal of cleanup wastes at leaking hazardous-waste disposal facilities is prohibited.

The Water Resources Development Act provides grants for water projects such as dams, ports, harbors, and waterways. Other goals are, in the short term, to prevent any overall net loss of the nation's remaining wetlands, and in the long term, to increase the quality and quantity of wetlands (Saner and Pontius, 1991). The act requires that state and local governments share in both the decision making and funding for the public-works projects.

The Safe Drinking Water Act provides for the development of state programs designed for the protection of water resources (Virginia Water Resources Research Center, 1986a). Some of the provisions of the act are listed below:

- The USEPA was required to issue permanent standards for drinking water contaminants.
- The USEPA was required to issue criteria for using filtration technology for some public water systems.
- States were required to develop a ground-water protection program to control contamination at wellheads.
- An aquifer-protection program authorized grants for states to designate sole- source aquifers.
- The USEPA was required to issue new rules for injecting wastes below drinking-water sources.
- The use of solder and flux with a lead content that exceeds 0.2 percent and pipe with a lead content that exceeds 8 percent is prohibited in the construction of all water-supply systems. A new USEPA regulation requires water suppliers to notify customers about any amount of lead in their water and to provide information about health effects of lead.
- Operators or owners of community water systems must follow revised public notification regulations in notifying customers of any violations of water standards (Pontius, 1990).
- The USEPA was required to develop a drinking-water priority list, which is a list of contaminants known or anticipated to occur in public water supplies. USEPA has delayed revising this list pending SDWA reauthorization (AWWA, 1996a).

At the beginning of 1993, drinking water limits had been set for 84 contaminants. Monitoring of contaminants under Phase II regulations will be concluded within a 9-year compliance cycle, which contains three 3-year compliance periods. The first 3-year compliance period began on January 1, 1993. The states will determine the year in which a water system begins its compliance period, with one-third of the water systems initiating monitoring in each year over the first 3-year period.

Amendments to the Safe Drinking Water Act in 1986 directed the USEPA to set revised primary drinking-water regulations for lead and copper. A final rule on the regulations was published on June 7, 1991, and corrections were issued on July 15, 1991, June 29, 1992, and June 30, 1994. The interim maximum contaminant level for lead was replaced by a treatment technique requirement consisting of corrosion control, public education, and lead service line removal. The maximum contaminant level goal for lead was set at zero. Monitoring for lead and copper is required every 6 months, and the monitoring schedule is based on water-system size. For systems serving more than 50,000 people, monitoring was initiated in January 1992; systems serving 3,301 to 50,000 people began monitoring in July 1992; and systems serving less than 3,301 people began monitoring in July 1993. Water samples are to be collected at the taps of selected homes where residents use water from the water-supply systems. If water systems maintain lead and copper concentrations that are below action levels (0.015 mg/L for lead and 1.3 mg/L for copper), sample collection frequencies and the number of sampling sites can be reduced with state approval. However, if action levels are exceeded, measured in the ninetieth percentile at the customer's tap, treatment techniques are required. The action level is the concentration above which a utility must take additional action to reduce lead and copper levels and inform consumers about the actions they can take to lower exposure to lead in water (Pontius, 1992). USEPA is considering revisions to lead and copper regulations in 1996, and is accepting comments until July 11. These revisions would eliminate certain requirements and promote consistent implementation (USEPA, 1996a).

President Clinton signed the Safe Drinking Water Act on August 6, 1996. The revised law tightens drinking water standards and establishes a fund that permits the federal government to lend states more than $1 billion per year to improve water purification systems. Alabama will probably receive $12,558,800 in fiscal year 1997, which represents approximately 1 percent of funding available (after set-asides) under this program. Most of the state revolving load fund dollars are intended to be lent to public water systems. This program permits considerable flexibility in use of these funds by the states to support source-water protection efforts. In Alabama, 10 percent of the money will be used for wellhead protection projects under the source water protection program, and an additional 15 percent will be used for other source water protection, including surface water protection. The wellhead protection funds will be distributed as grants on a 50/50 match basis; details of the use of the other source water protection funds have not been determined at the time of writing (Tim Johnson, Alabama Department of Environmental Management, verbal commun., 1997). For further information please contact Joe Alan Power at the Alabama Department of Environmental Management (334-271-7774). The law also requires water systems to notify users within 24 hours of violations of water-quality standards, and mandates annual reports on the quality of tap water. Other provisions of the law include new risk-based and cost-benefit analysis based methods of determining maximum contaminant levels, as well as providing millions of dollars per year for projects. These projects include development of regulations and treatment methods, technical assistance to small public water systems, ground-water protection through underground injection control, creation of a new source water quality assessment program (Alabama and other states with primacy have the option of developing their own programs), and other technical and financial assistance for water infrastructure. The full text of the SDWA as amended in 1996 can be found on the Internet at http://www.epa.gov/OW/OGWDW.

In late 1992 and much of 1993, the USEPA conducted a regulatory negotiation process to develop regulations for disinfectants (D) and disinfectant byproducts (DBP's). As a result, three regulatory rules were developed and are summarized here from Pontius (1993b, 1997).

The D-DBP Rule applies to all community and nontransient noncommunity water systems that treat their water with a chemical disinfectant and will be developed in two stages. In stage one, a maximum contaminant level (MCL) will be set for total trihalomethanes at 80 micrograms per liter (μg/L) and for the total of five haloacetic acids (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid) at 60 μg/L. MCL's will be set for bromate at 0.01 milligrams per liter (mg/L) and for chlorite at 1.0 mg/L. Compliance with the MCL's will be based on the running annual averages. Under stage one, maximum residual disinfectant levels (MRDL's) will be established for chlorine at 4.0 mg/L, monochloramine at 4.0 mg/L, and chlorine dioxide at 0.8 mg/L. Compliance with the MRDL's is based on the running annual averages, which are computed quarterly. The anticipated time of promulgation of the stage one rule is November 1998.

Under stage two of the D-DBP Rule, additional DBP's will be considered, and the requirements established under stage one may be revised following the collection of additional information. The MCL's for total trihalomethanes and the five haloacetic acids will be 40 and 30 µg /L, respectively, in stage two. The stage two rule is anticipated for promulgation in May 2002.

The Enhanced Surface Water Treatment Rule (ESWTR) was developed to provide protection from the microbe Cryptosporidium, which is not addressed in the current Surface Water Treatment Rule (SWTR). Under the ESWTR, a maximum contaminant level goal (MCLG) of zero will be set for Cryptosporidium and a sanitary survey will be required every 5 years. An interim ESWTR was proposed for promulgation for systems serving more than 10,000 people in December 1996, and a final ESWTR for all systems was to be promulgated in December 1998. However, because of delayed promulgation of the ICR (see next paragraph) the interim ESWTR will not be finalized until at least the year 2000 (AWWA, 1996b).

USEPA promulgated the drinking water Microbial and Disinfection By-Products Monitoring Rule, better known as the Information Collection Rule (ICR), in May 1996 after a year and a half delay. This regulation requires large water systems to begin monitoring by January 1997. The ICR was designed to gather water-quality and operational data for use in developing the parameters to be addressed by the Enhanced Surface Water Treatment Rule, the Groundwater Disinfection Rule, and the Disinfection By-Products Rule. Surface-water systems serving more than 100,000 people and ground-water systems serving more than 50,000 people must analyze raw and finished water for such parameters as pH, temperature, turbidity, total organic carbon, protozoa, viruses, and selected disinfection by-products and disinfection residuals. After 18 months of monitoring, systems may be required to conduct pilot studies to demonstrate proper treatment techniques for controlling any contaminants found (Joe Power, 1996, Alabama Department of Environmental Management, written commun.; Environmental Protection, 1996a; Laughlin, 1996). A Surface Water Treatment Rule (SWTR) was promulgated on June 29, 1989, to require ground-water systems whose source is under the direct influence of surface water, and all surface-water systems to comply with provisions of the SWTR. Under the rule, direct influence is defined as any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as Giardia lambia, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH, which closely correlate to climatological or surface water conditions. In Alabama, the Alabama Department of Environmental Management will determine on a case-by-case basis if ground waters are under the influence of surface water. However, the public water-supply systems have the responsibility to provide information necessary for the Alabama Department of Environmental Management to make that determination.

On February 4, 1987, the U.S. House and Senate passed legislation to review and amend the Clean Water Act. Reauthorization of the act called for phasing out the grants program for municipal sewage treatment plant construction. However, funding was provided to help capitalize state revolving loan funds to replace the grants. Now, these funds can be used for other kinds of water-quality projects. The act also established a new nonpoint-source program that requires states to develop nonpoint-source management programs. Section 319 of the Clean Water Act provides funds to help states clean up or prevent nonpoint-source pollution. This program has in the past been competitive, but USEPA has suggested that, beginning in fiscal year 1997, each state would receive a predictable amount of funds based on a formula (Canody, 1996b). A provision of the act protects wetlands by establishing a "dredge and fill" material permit program. It is administered by the U.S. Army Corps of Engineers and authorizes the issuance of permits for the discharge of dredged or fill material at specified disposal sites. The permit process requires consideration of public interest with respect to conservation, general environmental concerns, and water supply (Saner and Pontius, 1991). USEPA is now encouraging the use of general permits guided by watershed-scale resource evaluation and planning (USEPA, 1996b). In November 1990, the USEPA issued new regulations for "large" and "medium" sized municipalities and counties to limit pollution from storm-water runoff. The regulations apply to more than 100,000 industrial plants, 173 municipalities, and 47 counties with populations of over 100,000. The industrial plants and local governments must now obtain a permit under the National Pollutant Discharge Elimination System for their storm-water discharges. This is a requirement of a new section of the Water Quality Act of 1987, which is an amendment to the Clean Water Act of 1987. The new storm-water regulations for municipalities and urban counties consist of two parts. Part one requires identification of storm-water outfalls and sources of pollutants in storm water and the development of programs that control storm-water pollution. Part one was completed in November 1991 for municipalities and counties with populations greater than 250,000 and in May 1992 for municipalities and counties with populations between 100,000 and 250,000. Part two was completed one year after part one, and requires the development of a comprehensive storm-water control program (USEPA, 1991b).

The number and complexity of regulations are increasing as modifications and amendments are added to the Safe Drinking Water Act and the Clean Water Act. As a result, violations of the acts are likely to increase, and the USEPA may seek to impose severe penalties on water utilities that do not comply with provisions of the acts. However, the USEPA recently announced a new policy permitting greater flexibility in compliance for small public water systems (those serving fewer than 2,500 residents). If the state regulatory authority offers compliance assistance to communities, following USEPA guidelines, then the communities can prioritize water problems instead of being required to solve all of them at once. Also, penalties can be waived and USEPA will defer to the state if the communities are making good faith efforts to achieve compliance (Canody, 1996c).

The SDWA provides for civil and in some cases criminal enforcement action to be taken against water suppliers that fail to meet drinking-water regulations. Civil actions may consist of administrative actions, court actions, and suits by citizens. Under extreme conditions, the USEPA may levy a penalty of up to $5,000 per day. In an effort to streamline the enforcement efforts of the USEPA, an Office of Environment and Compliance Assurance has been formed and is now in operation (Rubin, 1994).

In September 1988, the USEPA's Office of Underground Storage Tanks published its final rule on the use of underground storage tanks. This rule was established as part of the Resource Conservation and Recovery Act of 1984. By December 1993, leak detection systems were required at all underground storage tanks. The USEPA will require corrective action if leaks are detected. A corrective action plan for a site will require a determination of the physical and chemical nature of the released substance, a hydrogeologic evaluation of the area, a determination of the proximity, quality, and uses of nearby water supplies, and an estimation of the potential for human exposure. In September 1995, the USEPA ruled that lenders holding security interests in property on which petroleum UST's are located will be exempt from all federal UST requirements, if the lender holds only an ownership interest. This rule is intended to encourage lending for UST cleanup and for redevelopment of contaminated land (Seppa, 1996).

On October 9, 1991, under Subtitle D of the Resource Conservation and Recovery Act, the USEPA promulgated regulations concerning the design, operation, and closure of municipal solid waste landfills. Compliance deadlines were October 9, 1993, for facilities accepting more than 100 tons per day and April 9, 1994, for those accepting lesser amounts. The regulations require the states to adopt and enforce regulations on liner and leachate-collection system design, gas monitoring, and financial assurance upon closure of landfills. However, regardless of state regulations, landfill owners and operators are required to comply with federal regulations. In states with unapproved regulations, the federal regulations require that liners have at least one 30-mil flexible membrane liner and a 2-foot-thick layer of compacted soil with a permeability of no more that 1x10-7 centimeter per second (Woods, 1992).

The USEPA plans to set guidelines for "delisting" low-risk solid wastes that contain very small amounts of hazardous materials. The assessment will be based on specific levels for each hazardous constituent, which will be determined using risk analysis that incorporates information about potential exposure pathways. Delisted wastes will require less expensive treatment under RCRA (Environmental Protection, 1996b).

The USEPA has also proposed a rule to outlaw five pesticides in states that fail to implement management plans for the purpose of isolating those chemicals from ground water. The pesticides are atrazine, alachlor, metolachlor, simazine, and cyanazine. Public comment will be accepted until October 4, 1996, according to the American Water Works Association (AWWA, 1996c).

In 1990, Congress passed the Pollution Prevention Act, which declares that a national policy of the United States is to prevent or reduce pollution at the source whenever feasible (Mooney, 1992). A reduction in pollution is any practice that reduces the amount of a hazardous substance, pollutant, or contaminant entering a water stream or released to the environment prior to recycling, treatment, or disposal, and which reduces the hazards to public health or the environment (Mooney, 1992). The act requires each company that files an annual Section 313 toxic chemical release form to also submit a toxic chemical source reduction and recycling report. The report identifies the company's present and planned pollution-prevention efforts.

The USEPA announced an order approving the use of Colilert as an acceptable test for Escherichia coli (E. coli). This order was published in the Federal Register in June 1992 and took effect 30 days later. One of the major delays in approving Colilert involved a change in the test, which replaced the inorganic buffer with an organic buffer. After additional study, the USEPA ruled that the change would simplify the procedure and should not reduce the test's effectiveness. The USEPA suggests that laboratories perform parallel testing for several months to verify the effectiveness and accuracy of Colilert and other approved methods (AWWA, 1992b).

The AWWA has urged utilities to begin monitoring for atrazine and alachlor, two of the most widely used synthetic organic chemicals. These chemicals are used primarily for weed control for corn, soybeans, and sorghum and account for about 40 percent of all agri-chemicals used in the United States. The USEPA has specified that the maximum allowable concentration for atrazine is 3 μg/L and for alachlor is 2 μg/L. The maximum contaminant levels for these two herbicides took effect on July 1, 1992, although the standardized monitoring framework promulgated by the USEPA for all contaminants did not become effective until January 1, 1993 (AWWA, 1992a).

The Environmental Monitoring and Assessment Program (EMAP) is a new USEPA program intended to monitor ecological status and trends to identify emerging environmental problems before they become critical. The goal of EMAP is to provide a framework for monitoring the nation's ecological resources so that program managers and the public can evaluate the success of current policies and programs.

Implementation of EMAP would accomplish the following three objectives:

- Estimate the current status and extent of ecological resources on a regional basis and identify changes and trends that may be potentially harmful.
- Monitor indicators of pollution and habitat conditions and possible associations between natural ecological and anthropogenic conditions.
- Provide periodic summaries and interpretive status reports to the resource managers and to interested individuals.

It is the intention of EMAP to:

- Provide monitoring to document trends.
- Provide consistent national water-quality coverage.
- Provide reliable baseline scientific data.
- Develop appropriate indicators and monitoring methods (USEPA, 1992b).

The USEPA in recent years has emphasized watershed management as a way to increase efficiency, cut costs, and improve water-quality protection. This has resulted in greater flexibility for states that are implementing watershed-management programs (USEPA, 1996b). One way in which the USEPA is encouraging improved watershed management is within watershed pollution credit trading (Environmental Protection, 1996c). Entities that reduce pollutant levels below required levels can sell or trade credits to other entities in the same watershed. USEPA expects this practice to create economic incentives as well as facilitate compliance with water-quality regulations with a minimum of financial hardship.

The Farm Bill, passed in compromise form on March 21, 1996, creates the Environmental Quality Incentive Program. This program includes funding for a new Livestock Environmental Assistance Program, which provides for livestock producers and others to protect source-water quality. The Farm Bill also includes funds for the Conservation Reserve Program and funds to help farmers and ranchers improve water quality and reduce erosion. The Farm Bill limited long-term contracts under the Wetlands Reserve Program to one-third of the authorized 975,000 acres (Groundwater Foundation, 1996b).

In October of 1996 the USEPA concluded the public comment period for a new program entitled "Hardship Grants Program for Rural Communities." This $50 million grant program is designed to help rural and disadvantaged communities with fewer than 3,000 residents address wastewater treatment needs. This program is funded by federal money reserved for the State Revolving Fund program, and will be administered in conjunction with that program. Information about this program may be found on the Internet at http://www.epa.gov/OWM/hardship.html, or by calling USEPA at (202) 260-2268.

At the time of writing the House had passed the Leaking Underground Storage Tank Trust (LUST) Fund Amendments Act, H.R. 3391, and the bill had been referred to a Senate committee. The bill would require the federal government to turn over to the states nearly 85 percent of the LUST funds, permitting the states greater flexibility in their use.

SUPERFUND SITES

A total of 109 hazardous waste sites in Alabama were evaluated by Alabama Department of Environmental Management under cooperative agreement with the USEPA in 1993-94 (Alabama Department of Environmental Management, 1994b). As of March 1996, there were 13 sites in Alabama on the USEPA's National Priorities List for cleanup (Debbie Jourdan, USEPA, 1997, written commun.). The National Priorities List sites are eligible for attention under the Federal Superfund law for long-term cleanup. The locations of the sites are shown in figure 13, and each site is described below. Site descriptions are based on information provided by the USEPA (Debbie Jourdan, USEPA, 1996, written commun.).

In 1995 USEPA launched a new program to evaluate high-cost superfund cleanup projects with the goal of reducing the overall program cost. Projects that are estimated to cost over $30 million, or that are estimated to cost over $10 million and 50 percent greater than the least costly alternative that meets cleanup requirements, will be reviewed for ways to reduce costs.

Figure 13.--Location of sites on the Superfund List (National Priorities List).

A recent decision of the U.S. Court of Appeals for the Second Circuit (Schiavone vs. Pearce) may affect Alabama Superfund Sites. The court ruled that Superfund liability incurred by subsidiary corporations may be imposed on their parent corporations.

ALABAMA ARMY AMMUNITION PLANT

The Alabama Army Ammunition Plant (AAAP) encompasses about 5,170 acres east of the Coosa River and 4 miles north of Childersburg, Talladega County. The plant was established in 1941 to manufacture explosives including trinitrotoluene (TNT), dinitrotoluene, nitrocellulose, and tetryl. The Army ceased operations at this site in 1945, but the plant was on standby status until 1973, when it was declared excess property. Most of the structures used in the manufacturing process have been demolished or destroyed. Sources of contamination include disposal sites as well as spills and general wastes. Land use around the site is primarily recreational, industrial, agricultural, and undeveloped. Present uses of the site include timber cutting and deer hunting.

The surrounding area is sparsely populated, though three tree farms border the site and a small residential community is located several thousand feet to the southeast next to Talladega Creek. In 1990, the USEPA began an investigation to determine if the Army had adequately cleaned up a part of the site called Area A according to the statutory requirements. This investigation was completed in 1993, but studies of the nature and extent of ground-water contamination continue in Area A. Contaminated soil in Area A has been excavated and disposed of by incineration. This activity was completed in 1994. Previous investigations in Area B indicated ground-water contamination of nitroaromatic compounds in excess of the federal drinking water standards. Surface water also had concentrations of nitroaromatics and lead exceeding drinking water quality standards. The U.S. Army is investigating water contamination in Area B; this study is scheduled to be completed in 1996. Late in 1994, the USEPA completed a contaminant study in the TNT process areas. Design of the remedy selected for this area, which will involve soil excavation and incineration, was scheduled for completion in 1995.

ANNISTON ARMY DEPOT—SOUTHEAST INDUSTRIAL AREA

The Anniston Army Depot (AAD) comprises about 600 acres in the southeastern part of the Nichols Industrial Complex, in southwestern Calhoun County. This area consists of several shipping and warehouse buildings used since 1948 for the repair and modification of combat vehicles and artillery equipment. The depot's initial mission was limited to storing ammunition as well as refurbishing, testing, and decommissioning combat vehicles and various types of military equipment. A 1979 study revealed that on-site disposal of wastes generated by chemical cleaning, painting, and plating operations resulted in ground-water contamination. As a result of this investigation, a 2-million gallon lagoon and a landfill operation were closed.

About 39,000 people live near the site in Anniston. The southeast industrial area is drained by Dry Creek, which flows into Choccolocco Creek, a tributary of the Coosa River. Coldwater Spring is located adjacent to Dry Creek, approximately 1.5 miles south of the depot boundary. The spring is the primary source of drinking water for about 72,000 people in Calhoun County.

Chemical analysis of the ground water has indicated excessive amounts of heavy metals, chlorinated solvents, and volatile organic compounds. These contaminants include chromium, methylene chloride, trichloroethylene (TCE), phenols, and dichloroethylene.

Two separate soil removing operations have been conducted by the U.S. Army, and the wastes were disposed of in a permitted treatment facility. This operation was completed in 1983. The U.S. Army installed a stripper in 1987 to treat 400,000 to 900,000 gallons per day of ground water pumped from beneath the Metal Finishing Facility. Sixteen extraction wells were installed in 1988, which were used to evaluate the site characterization and ground-water extraction system design and optimization.

The Army has taken several steps to improve conditions at the AAD such as excavating and removing contaminated soil and installing an air stripping treatment system to pump and treat contaminated ground water. Cleanup activities continue. Results of a remedial investigation initiated in 1990 are due in 1996.

CIBA-GEIGY CORPORATION-McINTOSH PLANT

The Ciba-Geigy Corporation plant is a 1,500-acre site in McIntosh, Washington County. The plant produces industrial organic chemicals, pesticides, agricultural chemicals, and synthetic resins. Wastes were originally disposed of in unlined pits and in an open burn area. Currently, disposal of wastes is carried out under USEPA requirements. The original disposal areas are contaminated with DDT, lindane and other pesticides, metals, and volatile organic compounds.

Contaminated areas are divided into the shallow ground water, wetlands area and dilute ditch, deep aquifer and soil, and the bluff line. The Ciba-Geigy Corporation began studying the nature and extent of contamination of the wetlands area and dilute ditch in 1992, and the USEPA was to propose a cleanup plan in 1995.

A study of contamination in the deep aquifer and soil was completed in 1991, and the remedy design phase is scheduled for completion in 1996. Cleanup alternatives selected include: excavation and on-site thermal treatment of highly contaminated soil and sludge, stabilizing/solidifying moderately contaminated soil and sludge and disposing of it in an on-site USEPA-approved landvault(s), in situ soil flushing combined with extraction wells to clean up remaining areas where the risk-based cleanup levels were not previously achieved, backfilling excavated areas, operating and maintaining landvault(s) for at least 30 years, and establishing institutional controls for land and ground-water use. Innovative technologies such as in situ vacuum extraction or in situ bioremediation may also be used. Completion of the design phase is expected in 1996.

Cleanup of the shallow ground water has included the removal and treatment of contaminated ground water by on-site biological waste-water treatment. The treated water is discharged into the Tombigbee River. The treatment system, which is successfully containing the contamination on site, is expected to operate for more than 10 years.

In 1992, Ciba-Geigy Corporation completed a study of contamination of the bluff line. The selected cleanup remedy includes excavating contaminated soil, removing contaminants through thermal treatment, stabilizing/solidifying the soil, backfilling and revegetating the excavated areas. Design of the remedy is scheduled for completion in 1996.

INTERSTATE LEAD COMPANY

The Interstate Lead Company (ILCO) is located in Leeds, Jefferson County, Alabama. ILCO owned and operated an 8.5-acre lead battery reclamation facility and secondary lead smelter, which generated, treated, stored, and disposed of wastes containing lead. Slag from reclamation operations was used as fill at several public and privately owned facilities in the area. An unnamed tributary to Dry Creek, adjacent to the main facility and parking lot, contains lead-contaminated sediments. Lead and cadmium were detected in ground water at the site in 1985. Chromium, nickel, and arsenic are also present in the ground water as well as in the soils. Lead and other heavy metals occur in streams draining the site. In 1992, ILCO closed the facility and the USEPA initiated a cleanup program. The USEPA spent about $8,000,000 on the cleanup, which was expected to be completed by summer 1993. In late 1993, the USEPA conducted a detailed study of the main facility to determine what additional cleanup action is needed to minimize long-term threats to people or the environment. In September 1996 USEPA selected stabilization with off-site disposal of treated material as the final remedy. Design activities for additional sites are underway, and cleanup of these is scheduled to begin in 1998.

MONARCH TILE MANUFACTURING, INC.

Proposed for addition to the National Priorities List in 1993, Monarch Tile Manufacturing, Inc., is a site of ceramic tile and glazes production at Florence, Alabama. Initial operation of the plant was by Stylon Corp., between 1954 and 1973. When Stylon went bankrupt in 1973, Monarch Tile leased, then purchased the plant in 1988. Both Monarch and Stylon used zinc contaminated with lead, cadmium, and barium as ceramic colorants. This hazardous waste, and other produced hazardous liquid wastes, were routed to a separator, then to settling ponds. Excess fluids were allowed to enter ditches.

In 1990, the Alabama Department of Environmental Management detected zinc, cadmium, lead, nickel, chromium, and barium in sediment samples taken at a ditch leading from the plant to Cox Creek, and zinc was found in Cox Creek itself. The Florence Water Department has a water intake located where Cox Creek and Cypress Creek intersect.

USEPA proposed needed cleanup action for public comment in the spring of 1996 and Monarch Tile has agreed to take any necessary cleanup action on plant property. USEPA endorsed the cleanup action in 1996, and the action should be completed in 1997.

OLIN CORPORATION-McINTOSH PLANT

The Olin Corporation (McIntosh Plant) site was placed on the Superfund National Priorities List in 1984. Between 1952 and 1982, Olin Corporation operated a mercury cell chlor-alkali plant on a part of the site. In 1954, Olin acquired adjacent Alabama Chemical and started producing pentachloronitrobenzene (PENB). Later, in 1973, the plant was expanded to produce trichloroacetonitrite (TCAN) and Terrazole (Betty Winter, USEPA, 1995, written commun.). Part of the plant operations were shut down in 1982. However, it continues to blend hydrazine and to produce chlorine, caustic soda, sodium hydrochlorite and sodium chloride. Heavy metals and chlorinated compounds were initially discovered in shallow ground water at the site in 1980 as a result of monitoring. Site investigations were completed in 1993, and a remedy was selected in 1994. The remedy includes pumping and treating contaminated ground water, extending and upgrading existing caps to include the old plant landfill, and monitoring and maintaining the existing caps. Design activities were scheduled to begin in 1995. Also, contamination in the river valley surrounding the plant was evaluated, and a remedy was selected and proposed for public comment in early 1997. USEPA determined that site contamination is not currently affecting the river system.

PERDIDO GROUND-WATER CONTAMINATION

The 15-acre Perdido Site was contaminated as a result of a train derailment in 1965 on the Louisville and Nashville Railroad (now owned by CSX Transportation, Inc.). Approximately 7,600 gallons of benzene was spilled into the drainage ditches and seeped into the underlying aquifer. The contaminated area is about 300 yards downgradient of the derailment site, and contamination of nine wells has been confirmed. Baldwin County Health officers recommended that residents within a 1-mile radius of the derailment use alternate water supplies.

In 1988, the USEPA selected a plan to clean up the ground water that included well extraction and treatment of the water by air stripping. The spent benzene-contaminated air would be treated by activated carbon absorption. The treated water then will be returned to the aquifer. CSX completed construction of the treatment facilities in 1992, and treatment will continue until acceptable levels for contaminants are reached.

REDSTONE ARSENAL (U.S. ARMY/NASA)

Redstone Arsenal is a major U.S. Army/NASA complex located at Huntsville in northeast Alabama. It includes 38,300 acres, of which 36,459 acres (95 percent) is controlled by the Department of the Army. The George C. Marshall Space Flight Center (NASA) leases the remaining 1,841 acres. Land uses include industrial siting, agriculture, woodland, and wildlife.

The arsenal was placed on the National Priorities List in 1994. Present uses include development of solid rocket propellants and the manufacture of iron carbonyl. Past industrial uses include the production of DDT, rockets, chlorine, and commercial chemicals and pesticides. Between 1942 and 1945 (World War II) chemical munitions were produced at the arsenal. Following the war, captured German chemical agents and surplus U.S. Army chemical munitions and agents were stored at the arsenal. In total, approximately 198 solid waste management units or areas of concern have been identified at Redstone Arsenal. The USEPA is considering various alternatives to clean up the hazardous wastes. Contaminated ground water is being pumped and treated in two small areas of the arsenal, and two other contaminant sources have been capped. Initial site investigations have begun to determine the nature and extent of contamination.

Hazardous wastes produced at Redstone Arsenal include DDT. Waste water with DDT residues was discharged to Huntsville Branch. Because of this practice, an 11-mile stretch of surface water, including Huntsville Spring Branch, Indian Creek, and the Tennessee River near Triana (see TRIANA/ TENNESSEE RIVER) was placed on the National Priorities List in 1983. In 1983, Olin-Mathieson Chemical Co., the principal DDT manufacturer, began cleanup operations in affected areas under a U.S. Justice Department Consent Decree.

REDWING CARRIERS, INC. (SARALAND)

Between 1961 and 1971, Redwing Carriers, Inc., a chemical carrier, operated a 5-acre site near Saraland for parking and washing trucks. The trucks transported a variety of substances, including asphalt, diesel fuel, pesticides, oil, and sulfuric acid. In 1971, the parking and washing area was sold, covered, and graded, and an apartment complex was built on the site. Tar-like material began oozing to the surface at numerous locations, including a courtyard and parking lot. The USEPA detected volatile organic compounds in the soil and the leachate coming from the tar-like material. After the initial investigation by the USEPA, the company periodically inspected the site and removed and disposed of any tar that rose to the surface. The company no longer performs this clean-up activity, and in July and August of 1995 USEPA removed accumulated tarry material and drums that had been left at the apartment complex.

Redwing Carriers completed an evaluation of site contamination in 1992. Site remediation will include excavation and off-site disposal of source material and contaminated soils and on-site pumping and treating of contaminated ground water in the upper aquifer under the site.

In July 1993, the USEPA issued a Unilateral Administrative Order directing private parties to design the cleanup remedy selected by the USEPA. Design completion was expected in 1995, and cleanup was expected to begin in 1995. However, the private parties failed to complete the cleanup remedy design. USEPA is currently conducting additional sampling preparatory to completing the remedy design. The design was completed in September of 1996. In October of 1996 USEPA began removing sludge, sediment and contaminated soil from the site, requiring temporary relocation of about 160 residents. USEPA estimated that the cleanup would take about two months and cost $3 million, including the temporary relocation costs.

STAUFFER CHEMICAL COMPANY-
COLD CREEK PLANT

The Stauffer Chemical Company-Cold Creek Plant site consists of four solid waste units, or source areas, and a 650-acre wetland known as Cold Creek Swamp. The plant manufactures triocarbamate pesticides. Triocarbamates have been detected in ground water, and mercury is present in sediment and fish in Cold Creek Swamp. In 1991, the company agreed to investigate the nature and extent of contamination at Cold Creek Swamp and to determine long-term cleanup remedies. The study was completed in 1993. The USEPA has selected a cleanup remedy for Cold Creek Swamp. Design of the remedy began in 1994 and is scheduled for completion in 1997. A remedy for contamination at the four solid waste units was selected in 1995, and consisted of landfill operation and cap maintenance for two units, no further action for one unit, and excavation, on-site biotreatment, and capping for the fourth unit. Design of this remedy was expected to begin early in 1997. Cleanup of the ground water began in 1993 and continues.

STAUFFER CHEMICAL COMPANY-LeMOYNE PLANT

The Stauffer Chemical Company-LeMoyne Plant site is adjacent to the Stauffer Chemical Company-Cold Creek Plant site, another Superfund site, and affects Cold Creek Swamp. In the 1950's, the plant manufactured carbon disulfide and carbon tetrachloride, and, later, in the 1960's, chlorine and caustic soda, using the mercury cell process. Stauffer then used an on-site landfill located east of the manufacturing facility, between the plant and the Mobile River. The landfill contained drums of organic compounds, solvents, heavy metals, acids, and bases.

The landfill for the Cold Creek and the LeMoyne Plant sites was constructed in native clay and was covered with a plastic cap. Vegetation has been planted at the site, and the landfill area has been fenced. Wastes were also held in clay-lined ponds on site and discharged to Cold Creek Swamp. The two Stauffer plants have been graded, planted with grass, fenced, and are being monitored.

In 1989, the USEPA selected methods to treat contaminated ground water at the Stauffer site. The remedy consisted of modifying the existing interception and treatment system (expected completion date is 1997). Additional monitoring and extraction wells were used and ground-water movement was to be monitored to determine the adequacy of the remedial action. Also, studies for source treatment were to be conducted.

An investigation of 14 solid-waste management units is being conducted. A remedy is expected to be selected early in 1997. Prior investigations have revealed volatile organic compounds (VOC's), including carbon disulfide, in ground water of the site. Mercury has been found in the sediments of Cold Creek Swamp. Design activity for the Cold Creek Swamp remedy are scheduled for completion in 1997.

T H AGRICULTURAL AND NUTRITION COMPANY-MONTGOMERY

The T H Agricultural and Nutrition Company site is located in Montgomery County and consists of 16 acres in two separate parcels. T H Agriculture was responsible for disposing of insecticides, herbicides and other chemical wastes in the pits behind the plant site. Lead and cadmium were detected in ground water at the site in 1985. Chromium, nickel, and arsenic are also present in the ground water as well as the soils. Lead and other heavy metals are present in streams draining the site. In 1981, T H Agriculture voluntarily agreed to remove 2,900 cubic yards of contaminated soils to a federally approved facility regulated by the Alabama Department of Environmental Management (ADEM). The site also includes a second parcel which originally housed chemical formulation and distribution operations. That parcel is currently leased by a chemical warehouse distribution center.

The present lessee, ELF Atochem, has agreed to implement a detailed study of both parcels of land to determine the extent of contamination. The site is contaminated with lindane, toxaphene, DDT, and other pesticides. Lindane has been detected in ground water on-site and off-site. An interim cleanup remedy consisting of containment of contaminated ground water was selected in 1995. Cleanup design is underway by the private parties and was to have been completed in 1997.

TRIANA/TENNESSEE RIVER

The Triana/Tennessee River site occupies roughly 1,400 acres near the small town of Triana in southeast Madison County. DDT was manufactured for commercial use by the Olin Corporation at Redstone Arsenal (RSA) in Huntsville between 1947 and 1970. The manufacturing, handling, and disposal practices at the facility led to the discharge of DDT residues into the Huntsville Spring Branch-Indian Creek tributary system, which flows into the Tennessee River. An estimated 475 tons of DDT residue accumulated in the sediment of the tributary system. The plant was closed and demolished in 1971, but the area remains contaminated with DDT. The rural area surrounding the site has a population of 500 residents. The community has been affected by the contamination because the residents use locally caught fish for food. Until the introduction of a water supply system in 1967, some residents used water from Indian Creek and the Tennessee River for home consumption.

The Olin Corporation submitted its final engineering design for cleaning up the site in 1986. Monitoring shows ongoing reduction in levels of DDT in selected fish species. Fish, water, and sediment monitoring will continue at the site. The USEPA conducted a 5-year review of the site and found that cleanup is effective in reducing DDT contamination. USEPA will conduct a second five-year review in 1997. Targeted cleanup standards must be complied with by 1998.

ALABAMA REGULATIONS

Laws regulating ownership and use of water in Alabama are not well defined. However, the "reasonable use" rule generally applies to ground-water use in Alabama. This rule recognizes the right of a landowner to a reasonable and beneficial use of the waters upon or beneath his or her land, provided the waters are not wasted and do not cause injury to others.

The use and ownership of surface water and submerged lands are based on the distinction between navigable and nonnavigable waters (Griggs, 1978). The legal title to waters and streambeds of navigable waterways is retained by the state, in trust for the people of Alabama. The legislature has authority to make laws pertaining to the use of public waters and lands underlying them and to establish authorities that can regulate use of these waters. Title to nonnavigable waters and streambeds may be vested in private owners, subject to the rule of "reasonable use." Under this rule, a landowner may not divert, dam, or otherwise alter the course of a stream flowing across his or her land, unless these operations neither deprive upstream or downstream owners of their right to use the water, nor adversely affect the lands of other owners. Permits may be required from appropriate state and federal agencies prior to construction of impoundments. The title to land bounded by a nonnavigable watercourse includes the bed of the stream to the center of the main channel, unless the landowner's instrument of title limits the boundary to the bank or to another designated point.

Several state agencies enforce different sets of regulations involving water. The Alabama Department of Environmental Management is responsible for regulating the quality of public drinking-water supplies and for water-pollution control. The Alabama Surface Mine Reclamation Commission is responsible for regulating mining activities that may affect the quality of water, and the State Oil and Gas Board regulates oil and gas exploration and development activities that may affect the quality of water. The State Department of Conservation and Natural Resources enforces water-safety traffic laws on waterways and impoundments and regulates activities that may affect the quality of water in wildlife refuges and game management areas. The Office of Water Resources of the Alabama Department of Economic and Community Affairs (ADECA) is responsible for water-use planning. Appendix D lists federal and state agencies responsible for water regulation and water-use planning.

State permits for water-well development in Alabama are not required from the well owners, except in the Coastal Zone. Well drillers, however, are required by the Alabama Department of Environmental Management to submit a form (Alabama Department of Environmental Management Form 60 1/83, Report of Drilled Well) for each water well drilled in the state except for nonpublic supply wells in Baldwin County. A copy of this form is reproduced in appendix B. Completed copies of the form must be provided to the Public Water Supply Section of the Alabama Department of Environmental Management and to the Hydrogeology Division of the Geological Survey of Alabama, where they are then filed as part of the water-information records of the state. Water well drillers in Alabama, except in Baldwin County, must be licensed by the Alabama Department of Environmental Management. Appendix C provides a list of water-well drillers licensed in Alabama in 1995.

The Public Water Supply Section of the Water Division of the Alabama Department of Environmental Management regulates public water supplies. Public water systems include community, nontransient noncommunity, and noncommunity supply systems. A community water system is defined as a water-supply system that has at least 15 service connections for year-round residents or regularly provides water to at least 25 year-round residents. A nontransient noncommunity water system is defined as a public water supply system that serves at least 25 of the same individuals a minimum of 6 months per year. A noncommunity water system is a public supply system that does not meet the requirements of either a community water system or a nontransient noncommunity water system (Alabama Department of Environmental Management, 1992e). More than 600 community water systems, 200 noncommunity water systems and about 100 nontransient, noncommunity water systems are permitted in Alabama. These water systems provide water to approximately 3.5 million of Alabama's citizens (Alabama Department of Environmental Management, 1994c). Self-supplied industrial/commercial and agricultural users of ground water generally are not regulated by the state. However, some local governing bodies in Alabama partially control ground-water management in their areas of jurisdiction. Also, some cities have adopted ordinances that require a permit for the construction and operation of a water-supply well.

The Alabama Department of Environmental Management administers regulatory aspects of the

Alabama Coastal Area Plan designed to prevent adverse impacts on Alabama's coastal resources, particularly water. Under provisions of the plan, development of wells in the coastal zone, which includes areas with land-surface elevations of 10 feet or less, must be permitted.

Revisions in the state's coastal management regulations in 1994 include: a reduction from 25 to 5 acres in the threshold size of commercial and residential developments; a requirement to characterize the sediments and benthic macroinvertebrate community within a specified distance of a waste-water discharge; and treating pilings as "fill" to prevent adverse impacts on the flow or circulation of coastal waters and on wetlands (Alabama Department of Environmental Management, 1994b).

The Alabama Water Pollution Control Authority, created by legislative act, provides aid to public bodies such as counties, cities, and state agencies in financing waste water treatment facilities. The Authority established a revolving loan fund that will provide low-interest loans to cities in need of new or improved sewage treatment systems. The fund was established under requirements of the Federal Clean Water Act. In 1994-95, nine cities were awarded a total of $41.4 million in low-interest loans from the fund for the construction and improvement of waste-water treatment systems. Since the program began in 1989, $346 million has been awarded (ADEM, 1996b).

The Alabama Hazardous Waste Management Act has been amended so that the Alabama statute is consistent with federal requirements. This amendment allows portions of the hazardous-waste program to operate in lieu of the federal program. The act excludes from coverage those wastes that have not been specified under the Federal Resource Conservation and Recovery Act. It also states that hazardous-waste transportation permits may be issued for periods up to 3 years. However, these permits can be revoked or modified at any time.

The Alabama Legislature has passed several acts related to water. Some of these acts have been described briefly in Water Log, a quarterly publication that reports on legal issues affecting the Mississippi-Alabama coastal area (McLaughlin, 1988). The Alabama Agricultural Nonpoint Source Financial Assistance Act of 1988 was enacted to assist in controlling the contamination of water in Alabama's lakes, streams, rivers, aquifers, and estuaries. The act provides for the Alabama Soil and Water Conservation Committee and Soil and Water Conservation Districts to administer a federal cost-share program established by the legislature in 1986. The program provides financial assistance to land users to control soil erosion, prevent water pollution, and improve forests.

After the Alabama Underground Storage Tank and Wellhead Protection Act was authorized in 1988, the Alabama Department of Environmental Management promulgated rules concerning underground storage tanks and established a state program regulating the storage tanks in lieu of a federal program. To provide revenue for regulation, an annual fee of $15.00 per regulated tank was authorized. The USEPA approved the state congressional act. The deadline for upgrade, replacement, or closure of underground storage tanks not meeting the requirements of the 1988 law is December 1998. ADEM believes that thousands of UST owners or operators may not have begun taking steps to achieve compliance, and anticipates a rush to meet the December 1998 deadline that could overload the resources of equipment vendors, installers, and tank removers.

The Alabama Department of Environmental Management also promulgates rules to establish wellhead protection areas near public water supply wells and springs. These rules help prevent ground-water contamination that might adversely affect human health. Penalties will be levied for violations of the act. To fulfill part of the requirements of the act, the Alabama Department of Environmental Management established the Alabama Wellhead Protection Program Development Committee in 1990 to develop a regulatory program for wellhead protection in Alabama. The program furnishes guidelines to protect public water systems that provide ground water to almost half the water users in Alabama. It further helps municipal and rural areas identify potential problems and helps ameliorate those problems. Under the state program, wellhead-protection duties of state agencies, local governments, and public water systems are identified, and public water systems having a ground-water source may be required to develop and implement a local wellhead-protection program. As part of the original local wellhead-protection program, the Alabama Department of Environmental Management specified the following requirements: (1) the delineation of a wellhead-protection area for each ground-water source, (2) an inventory of potential contamination sources that could impact each ground-water source, (3) a management plan for potential contamination sources, and (4) a contingency plan that describes procedures and identifies alternate water sources in the event of an emergency or interruption of public water used from a ground-water source. Under modified requirements of the wellhead-protection program, ADEM no longer requires the development of a management plan. Wellhead Protection Program studies have been completed for dozens of public water-supply systems.

One hundred and fifty-three of the 361 community public water systems that use ground water as a water source have been placed on a Priority I list by ADEM. These 153 systems are required to implement a wellhead-protection program within three years. Priority I status is based upon detection of contamination; identification of ground-water sources as vulnerable to contamination based on hydrogeologic factors, shallow well construction, and sole-source water supplies. Systems placed on the Priority I list have the option of presenting additional information to ADEM if they believe they should not be on the list. ADEM hopes to finalize Priority II and III lists in 1998 and 2001, respectively. Systems placed on these lists will also have three years from the date of notification to implement a wellhead-protection program (Alabama Department of Environmental Management, 1995b).

The American Water Works Association is developing a Wellhead Protection Award Program to recognize public water supply systems that have implemented exemplary wellhead-protection programs. Up to three systems per state are eligible for the annual award, and they may be self-nominated, nominated by any AWWA member, ADEM, USEPA, or members of the National Rural Water Association (Power, 1996).

The Alabama Underground Storage Tank Trust Fund was established by the Alabama legislature in 1988 to provide evidence of financial responsibility for owners and operators of tanks. The trust fund can be used for the cleanup of sites where leaks from underground storage tanks have contaminated soil and ground water. An annual fee of $100.00 per tank is assessed to maintain the trust fund.

As a result of storm-water regulations established by the USEPA, the Alabama Department of Environmental Management is requiring large (populations of more than 250,000) and medium (populations of 100,000 to 250,000) municipalities and surrounding unincorporated areas to submit storm-water control plans (Alabama Department of Environmental Management, 1991). Also subject to the storm-water regulations are some industries, including chemical and petroleum companies, ship and boat manufacturers, landfills, recycling facilities, hazardous-waste treatment, storage, and disposal facilities, wood processors, some power-generating facilities, certain transportation facilities, and some construction activities.

Storm-water discharge should be sampled and measured during a storm event. A storm event is one where 0.6 inch of precipitation falls a minimum of 72 hours after a previous event. Where feasible the variance in the duration and total rainfall should not be greater than 50 percent of the average median rainfall event in that area (Woltz and others, 1992). Storm-water permit applications that must be submitted to the Alabama Department of Environmental Management must include provisions to assist existing storm-water management practices and plans for reducing pollution in runoff.

WATER MANAGEMENT

Water-use conflicts, water-quality problems, recent droughts, and proposed reallocations of water in streams that enter Alabama from Georgia have resulted in critical concerns about the lack of water management in Alabama. Because of these concerns, the Alabama Water Resources Study Commission was created in 1989 by Executive Order to address water-related problems. The Commission was directed specifically to address the following issues:

In relation to water-resources issues, to determine the role and future direction of the state relative to local governments, the federal government, and the private sector;

- To study and determine the extent to which the level of water usage is creating problems relative to long-term water availability and equitable access to water supplies;
- To determine the status of long-range trends in water resources, including both utilization and water supplies;
- To compare Alabama's water-planning process, coordination, and laws with those of other states and to recommend changes that may be required for current and future water-resource needs; and
- To develop appropriate policies for water sources and future uses, to include public and industrial supplies, irrigation, storage ponds, storage reservoirs, power generation, navigation, and recreation.

The commission appointed a Technical Advisory Committee consisting of representatives from 10 federal and 15 state agencies to make recommendations on water resources planning and management. To provide assistance to the Technical

Advisory Committee and the Commission, 12 study committees, consisting of a total of 270 members from federal, state, and private entities, were formed to identify water-related problems, prepare status reports on existing water conditions, identify data sources, project future needs, and develop goals and objectives. The commission's final report "Water for a Quality of Life: An Executive Summary" was completed on October 10, 1990.

In 1991, the Governor of Alabama directed by Executive Order that the Director of the ADECA establish an Office of Water Resources in the department. The Office of Water Resources was commissioned to develop comprehensive plans and strategies for the use of the state's water resources. The Office of Water Resources was also requested to assess areas of the state analytically to determine if available water supplies are sufficient to satisfy existing and future demands. The Office of Water Resources was officially created on February 23, 1993, when the legislature passed the Alabama Water Resources Act. The act identified the functions and duties of the Office of Water Resources, summarized as follows:

- Monitoring and managing the water resources of the state;
- Developing state policy relative to water resources;
- Developing long-term strategic plans for the use of water resources;
- Implementing comprehensive quantitative water-resources programs, projects,
- and plans;
- Serving as a repository for water data;
- Encouraging efficient uses of water;
- Participating on behalf of the state in discussions between the state and other entities concerning water resources, hydrologic events, and water-conservation programs;
- Entering into agreements or contracts with other entities;
- Holding public hearings and requesting public comments;
- Applying for, accepting, and disbursing advances, loans, grants, and contributions;
- Sponsoring, encouraging, and facilitating plans, projects, policies, and programs for the conservation, coordination, protection, development, and management of the water resources;
- Conducting education and public enlightenment programs about water;
- Acting on behalf of the state in negotiation and consummation of any compact with other states; and
- Participating on behalf of the state in all studies, investigations, and analyses regarding the water resources of the state.

The Alabama Water Resources Act also created the 19-member Alabama Water Resources Commission. The Commission will (1) advise the Governor and the presiding officers of the House and Senate about water-related matters, (2) provide guidance to the Chief of the Office of Water Resources, (3) assist in formulating policies, plans, and programs of the Office of Water Resources, (4) establish, adopt, modify, repeal, or promulgate rules or regulations pursuant to the Alabama Water Resources Act, (5) advise the Office of Water Resources to implement policies, plans, and programs governing the waters of the state, and (6) hear and determine appeals of administrative actions of the Office of Water Resources.

The Alabama Water Resources Act directed the Alabama Water Resources Commission to adopt rules and regulations for the operation of the commission and for governing declarations of beneficial water use and certificates of water use not later than one year from February 23, 1993. The rules and regulations were adopted on December 9, 1993, and became effective on February 22, 1994. The Alabama Water Resources Act requires all public water-supply systems and any person who diverts, withdraws, or consumes more than 100,000 gallons of water each day to submit a Declaration of Beneficial Use to the Office of Water Resources. However, no Declaration of Beneficial Use will be required for in-stream uses of water or for impoundments less than 100 acres in size that are confined upon one's property or are solely used for recreational purposes.

The Office of Water Resources will issue a Certificate of Use to water users after they submit a Declaration of Beneficial Use. Each year, water users who are required to submit a Declaration of Beneficial Use must report the amount of water consumed, diverted, or withdrawn each month as a condition of reissuance of the Certificate of Use. This certificate will be issued for a period ranging from 5 to 10 years, at the discretion of the Division Chief of the Office of Water Resources.

Water users required to file a Declaration of Beneficial Use who either fail to file or provide false information are violating the Alabama Water Resources Act. Violations of the act after issuance of the Certificate of Use could result in suspension, revocation, termination, or modification of the

Certificate of Use. Violations of the Act may result in civil penalties that are assessed by the Office of Water Resources. The penalties will not exceed $1,000 for each violation; however, each day a violation continues constitutes a separate violation. The maximum penalty will not exceed $25,000 in any calendar year.

Regulations regarding disposal of sewage sludge were changed by the Alabama Environmental Management Commission (AEMC) in July 1995. The changes affect sludge generated by municipal and semi-public/private waste-water treatment systems, but not industrial waste-water treatment facilities. The changes would require a permit from ADEM for the use and disposal of sewage sludge to comply with existing federal requirements, which should result in USEPA delegating authority to ADEM to implement the "Part 503" rule concerning sludge disposal. Permitting requirements would include sampling and analysis of the sludge prior to use and disposal; limiting of specified pollutants in the sludge and monitoring to ensure compliance; implementing certain operational practices; and record-keeping and reporting. The new ADEM requirements could necessitate hydrogeological studies in some cases. The AEMC also changed regulations affecting National Pollutant Discharge Elimination System permits and State Indirect Discharge permits (Alabama Department of Environmental Management, 1995a).

The Comprehensive Water Resources Study of the Alabama-Coosa-Tallapoosa and Apalachicola-Chattahoochee-Flint River Basins, jointly conducted by Alabama, Georgia, Florida, and the U. S. Army Corps of Engineers, was initiated to craft an equitable plan for the development of water resources shared among the three named states. The project has been divided into four categories: process support elements, water availability, water demand, and comprehensive management strategy. Substantial progress has been made in all of these areas, and the expected completion date for the study is September 1996. The study group has released a lengthy status report, which details progress to date. This report can be obtained in the State of Alabama from Mr. Walter B. Stevenson, Jr., Chief, Office of Water Resources, Department of Economic and Community Affairs, P. O. Box 5690, Montgomery, Alabama 36103-5690.

Traditionally, water management at the state and local level has been heavily supported, financially and otherwise, by USEPA. This will continue, but the USEPA is redirecting its focus towards statutory responsibilities, such as drinking water standards, and away from non-mandated prevention programs, such as wellhead protection, source-water protection, and the comprehensive state ground-water protection program. This redirection of federal resources is a response to USEPA budget limitations. At the same time, USEPA is expanding cost-effective support of state and local water activities in various ways, such as through use of the Internet. The USEPA can be reached at http://www.epa.gov. There, the USEPA has a variety of services available, including a feature called "Surf Your Watershed." This page (http://www.epa.gov/surf) allows one to find information about any of more than 2,000 identified watersheds in the United States. Another new USEPA program is a cooperative venture with the American Water Works Association (AWWA). The AWWA, at the request of the USEPA, has developed an awards program called the AWWA Exemplary Wellhead Protection Program Award, which is designed to recognize outstanding water systems that have instituted wellhead protection programs. For information, contact Susan Blount, AWWA water resources engineer at (303) 347-6181 or Mark Grace, AWWA section services representative, at (303) 347-6193.

DRINKING WATER STANDARDS

The quality or chemical character of water is the most important factor affecting its use. A water supply must meet, or be amenable to treatment to meet, certain standards for each type of use.

Water-quality regulations are set and enforced for various water uses by federal, state, and local governments. The most important regulations are those dealing with drinking-water standards for public supply (table 2). Public water supplies must meet the standards for contaminant limits established by the Safe Drinking Water Act of 1974.

The USEPA has the primary responsibility for establishing and enforcing water-quality regulations. However, Alabama has received primacy for enforcing drinking-water regulations by adopting regulations at least as stringent as the federal standards. Revisions to the Safe Drinking Water Act in 1986 mandated that certain regulations be modified and that the number of regulated contaminants be increased. Alabama's Primary Drinking Water Standards are enforced by the Alabama Department of Environmental Management. These standards include monitoring and contaminant-level requirements for selected inorganic, organic, microbiological, and radionuclide contaminants.

Table 2.--Alabama's drinking water standards (modified from Alabama Department of Environmental Management, 1992a)

Data are given in milligrams per liter (mg/L) unless otherwise indicated; mL=milliliters; tu=turbidity unit; pCi/L=picoCurie per liter; mrem=millirem (one thousandth of a rem).

Primary Drinking Water Standards

Inorganic chemicals	Level
Antimony	0.006
Arsenic	.05
Asbestos	7 million fibers at least 10 micrometers long/liter
Barium	2.0
Beryllium	.004
Cadmium	.005
Chromium	.1
Cyanide	.2
Fluoride	4.0
Lead	.015
Mercury	.002
Nickel	.1
Nitrate (as N)	10
Nitrite (as N)	1
Total Nitrate/Nitrite (as N)	10
Selenium	.05
Sulfate	500
Thallium	.002

Organic chemicals	Level	Organic chemicals	Level
Nonvolatile synthetic		Nonvolatile synthetic	
Alachlor (Lasso)	0.002	Oxamyl (vydate)	0.2
Aldicarb	.003	Picloram	.5
Aldicarb sulfone	.002	Simazine	.004
Aldicarb sulfoxide	.004	2, 3, 7,8-TCDD (dioxin)	3×10^{-8}
Atrazine	.003	Trihalomethanes (total) (the annual average of quarterly samples)	.1
Carbofuran	.04		
Chlordane	.002	Volatile synthetic	
1, 2-Dibromo-3-chloropropane	.0002	Benzene	.005
2, 4-D	.07	Carbon tetrachloride	.005
Endrin	.002	1, 2-Dichloroethane	.005
Ethylene dibromide	.0005	Trichloroethylene	.005
Heptachlor	.0004	Para-Dichlorobenzene	.075
Heptachlor epoxide	.0002	1, 1-Dichloroethylene	.007
Lindane	.0002	1, 1, 1-Trichloroethane	.2
Methoxychlor	.04	Vinyl chloride	.002
Polychlorinated biphenyls	.0005	Cis-1, 2-Dichloroethylene	.07
Pentachlorophenol	.001	1, 2-Dichloropropane	.005
Toxaphene	.003	Ethylbenzene	.7
2, 4, 5-TP (Silvex)	.05	Monochlorobenzene	.1
Benzo(a)pyrene	.0002	o-Dichlorobenzene	.6
Dalapon	.2	Styrene	.1
Di(2-ethylhexyl) adipate	.4	Tetrachloroethylene	.005
Di(2-ethylhexyl) phthalate	.006	Toluene	1
Dinoseb	.007	Trans-1, 2-Dichloroethylene	.1
Diquat	.02	Xylene (total)	10
Endothall	.1	Dichloromethane	.005
Glyphosate	.7	1, 2, 4-Trichlorobenzene	.07
Hexachlorobenzene	.001	1, 1, 2-Trichloroethane	.005
Hexachlorocyclopentadiene	.05		

Turbidity	
Surface water	<0.5 tu in 95% of filtered samples each month
Ground water	<5.0 tu in treated water

Table 2.--Alabama's drinking water standards (modified from Alabama Department of Environmental Management, 1992a)--Continued

Microbiological	Total coliform bacteria in less than 5.0 percent of samples for systems collecting 40 or more samples. Total coliform bacteria in not more than one sample per month for systems collecting less than 40 samples per month.
Radionuclides	
Natural	
Gross alpha particle (including radium-226, but excluding radon and uranium)	15 pCi/L
Combined radium-226 and radium-228	5 pCi/L
Manmade	
Tritium	20,000 pCi/L
Strontium 90	8 pCi/L
Beta particle and photon radioactivity	4 mrem/yr
Special monitoring requirements Unregulated synthetic organic chemicals Aldrin Butachlor Carbaryl Dicamba Dieldrin 3-Hydroxycarbofuran Methomyl Metolachlor Metribuzin Propachlor Unregulated volatile organic chemicals Chloroform Bromodichloromethane Chlorodibromomethane Bromoform 1, 1-Dichloropropene 1, 1-Dichloroethane 1, 1, 2, 2-Terachloroethane 1, 3-Dichloropropane Chloromethane Bromomethane 1, 2, 3-Trichlorobenzene n-Propylbenzene	**Special monitoring requirements** Unregulated volatile organic chemicals Isopropylbenzene Tert-Butylbenzene Sec-Butylbenzene Fluorotrichloromethane Dichlorodifluoromethane Bromochloromethane n-Butylbenzene Naphthalene Hexachlorobutadiene 1, 3, 5-Trimethylbenzene p-Isopropyltoluene 2, 2-Dichloropropane 1, 2, 4 Trimethylbenzene 1, 2, 3-Trichlorobenzene 1, 2, 3-Trichloropropane 1, 1, 1, 2-Tetrachloroethane Chloroethane m-Dichlorobenzene o-Chlorotoluene p-Chlorotoluene Bromobenzene 1, 3-Dichloropropene Dibromomethane

Secondary Drinking Water Standards

Constituent or property	Level	Special Monitoring Requirements for Corrosivity Characteristics
Aluminum	0.2	pH
Chloride	250	Total alkalinity
Color	15 units	Carbon dioxide
Copper	1	Sodium
Foaming agents	.5	Sulfates
Iron	.3	Calcium
Manganese	.05	Magnesium
Odor	3 threshold odor number	Hardness
Silver	.1	Temperature
Sulfate	250	Specific conductance or total dissolved solids
Total dissolved solids	500	
Zinc	5	

The Alabama Department of Environmental Management adopted revised Division 7 Drinking Water Standards effective January 2, 1996. These regulations require monitoring for 17 inorganic contaminants, although a statewide waiver for asbestos monitoring has been granted. Regulations also require raw and finished water monitoring for bacteriological quality on a monthly basis and for turbidity when there is a suspected turbidity problem or if a surface source is involved. Community and nontransient-noncommunity systems must also monitor for 36 synthetic organic contaminants (SOCs). However, a statewide waiver for dioxin has been issued. Twenty-one volatile organic contaminants (VOCs) must be monitored and systems serving more than 10,000 people must monitor for total trihalomethanes. Five radiological related contaminants are monitored and special lead and copper monitoring is required for all systems. Associated corrosion indicator parameters such as pH, alkalinity, total solids, and hardness may be required if necessary to demonstrate that water is non-corrosive. Ten unregulated SOCs and 35 unregulated VOCs must be monitored as the regulated contaminants are monitored.

A monitoring waiver program has been initiated that allows water systems to request reduced monitoring if they can demonstrate that the water source is not vulnerable to contamination. Those wells showing no indication of contamination and that are constructed in non-vulnerable formations have received a monitoring waiver from the once every three year time frame to once every six years when the water-supply permit is due for renewal. Systems with sources deemed to be vulnerable either due to location, contaminants being present in the recharge area, or contaminants found through monitoring must continue to monitor at the frequency established by the regulations, which may be as often as quarterly (Joe Power, 1996, Alabama Department of Environmental Management, written commun.).

The USEPA has established secondary maximum contaminant levels for selected constituents and some aesthetic properties (taste, color, and odor) of water. These secondary standards are guidelines for states and are not federally enforceable. Secondary standards apply to constituents or properties that pose no known threat to human health. As part of the new regulations for secondary maximum contaminant levels, monitoring for sulfates is now required for public water-supply systems. This requirement is included as part of the special monitoring for corrosivity characteristics.

The USEPA's secondary maximum contaminant levels for fluoride (2.0 mg/L) and pH (6.5 to 8.5) have not been adopted by Alabama, but other secondary maximum contaminant levels established by the USEPA have been included in Alabama's regulations. For waters subject to public water-supply regulations, samples must be collected at specified intervals and analyzed by a laboratory certified by the Alabama Department of Environmental Management. The Alabama Department of Environmental Management has released a list of Certified Chemical Laboratories located both in Alabama and out of the state (app. E and F, respectively).

The USEPA has proposed revisions to its drinking-water policy. These revisions include the following:

- Developing new safety standards for Cryptosporidium and similar microbes, with emphasis on risk assessment and the scientific basis for standards,
- Simplifying chemical monitoring regulations,
- Encouraging public water systems to focus on maximizing risk reduction, and
- Encouraging development of affordable water-treatment technology.

The proposed revisions maintain USEPA's emphasis on preventing pollution at the source, but would permit greater flexibility in partnerships with state and local government (Groundwater Foundation, 1996a).

GROUND-WATER AND SURFACE-WATER QUALITY

The Geological Survey of Alabama maintains water-quality sampling stations on streams and rivers and at wells and springs throughout the state (pl. 4). Stations are maintained to provide long-term records of water quality in the major aquifers and streams. Water samples are collected annually at most sites. A few sites have continuous water-quality monitors that record specific conductance, pH, dissolved oxygen, and temperature values. Also, water samples are collected at selected sites during water-resources investigations. Ground water is likely to have a higher mineral content than surface water. This is because ground water moves slowly through the subsurface and has more time to react with minerals with which it comes in contact. Ground water is also likely to be less variable in quality than surface water. Natural factors affecting ground-water quality include the amount of time the water has been underground, the composition of the rocks comprising an aquifer, and local hydrogeologic conditions. The results of chemical analyses of ground-water samples collected at selected sites in 1995 are provided in appendix G, and the locations of these sites are shown on plate 4. A comparison of analytical results with the drinking-water standards (table 2) revealed that few natural water-quality problems exist for the wells and springs sampled. The common problems are excessive hardness, high concentrations of iron, chlorides and dissolved solids, and low water pH (high acidity).

The hardness of ground water at the monitoring sites ranged from 1.30 mg/L as $CaCO_3$ to 271 mg/L as $CaCO_3$; the median value was 51.1 mg/L as $CaCO_3$. Iron concentration at the sites ranged from less than 4.0 µg/L to 27,700 µg/L, and the median value was 19.5 µg/L. Chloride concentration at the sites ranged from 1.00 mg/L to 2,720 mg/L, and had a median value of 4.35 mg/L. Total dissolved solids concentrations ranged from less than 10 mg/L to 5,230 mg/L, and the median value was 153 mg/L. Water at the monitoring sites ranged from acidic to basic with pH values ranging from 4.6 to 9.2. The median pH value was 7.0. These values are comparable with those measured in 1994, indicating that no major changes have occurred in the quality of water at monitored sites. No measured parameters exceeded the primary drinking-water standards (table 2).

Surface water at a given site may be highly variable in quality throughout the year, partly because of variation in flow, climatic changes, impounding, or use and return of water. Surface water is also accessible to pollutants of all types, especially those generated by people. Streambeds are less likely to contain concentrations of highly reactive natural minerals because alluvial processes tend to remove these minerals quickly and leave only the more chemically inert minerals in the streambed. The results of chemical analyses of surface-water samples collected at selected stream sites in 1995 are given in appendix H, and the locations of the sample-collection sites are shown on plate 4.

Water at stream monitoring sites was acidic ($pH<7$) to basic ($pH>7$) with pH values ranging from 4.8 to 8.5. The median pH value was 7.0. Iron concentration at the sites ranged from 5.7 µg/L to 2,010 µg/L, and the median value was 326 µg/L. Dissolved oxygen content at the sites ranged from 3.3 mg/L to 9.7 mg/L, and the median value was 7.1 mg/L. Chloride concentrations in the streams were low, ranging from 1.27 mg/L to 35.7 mg/L, and the median value was 3.97 mg/L. Total dissolved solids content ranged from less than 10 mg/L to 374 mg/L; the median value was 103 mg/L.

Water-quality activities concerned primarily with anthropogenic contaminants and effects were reported by the Alabama Department of Environmental Management in the biennial report to Congress (ADEM, 1996c).

WATER USE

In 1995, an estimated 7.097 bgd of water was withdrawn from surface- and ground-water sources for use in Alabama. This figure represents about 1,723 gallons per day (gpd) for each person in the state. These estimates are based on a comprehensive survey of water users in Alabama (Mooty, written commun., 1998). Figure 14 compares 1980, 1985, 1990, and 1995 withdrawals.

Water use is divided into two categories: withdrawal or offstream use, where water is withdrawn from its natural setting in streams, lakes, or aquifers prior to being used, and nonwithdrawal or instream use, where water is used without being withdrawn from its natural setting. Data were estimated for 10 categories of use in Alabama, 6 of which were withdrawal uses and 4 of which were nonwithdrawal uses. Figure 15 shows the percentages of withdrawal use by category for 1980 and 1995.

Water-use data for 1995 were reported by Mooty (written commun., 1998).

WITHDRAWAL USE

The six withdrawal-use categories are public water systems, self-supplied industrial/commercial, agricultural, self-supplied domestic, power generation, and mining. Figure 14 shows comparative amounts of withdrawal use in million gallons per day (mgd) for selected years. Figure 15 shows the percentages of total withdrawals of water. Withdrawal water use in 1995 is estimated at 7.097 bgd.

PUBLIC WATER SYSTEMS

Public water systems served 3.93 million people in Alabama in 1995. Estimated water use by public supply systems increased from 748.50 mgd in 1994 to 812.53 mgd in 1995, an increase of about 8.6 percent.

SELF-SUPPLIED INDUSTRIAL/COMMERCIAL

Self-supplied industrial/commercial water use during 1995 was estimated to be 738.02 mgd. In

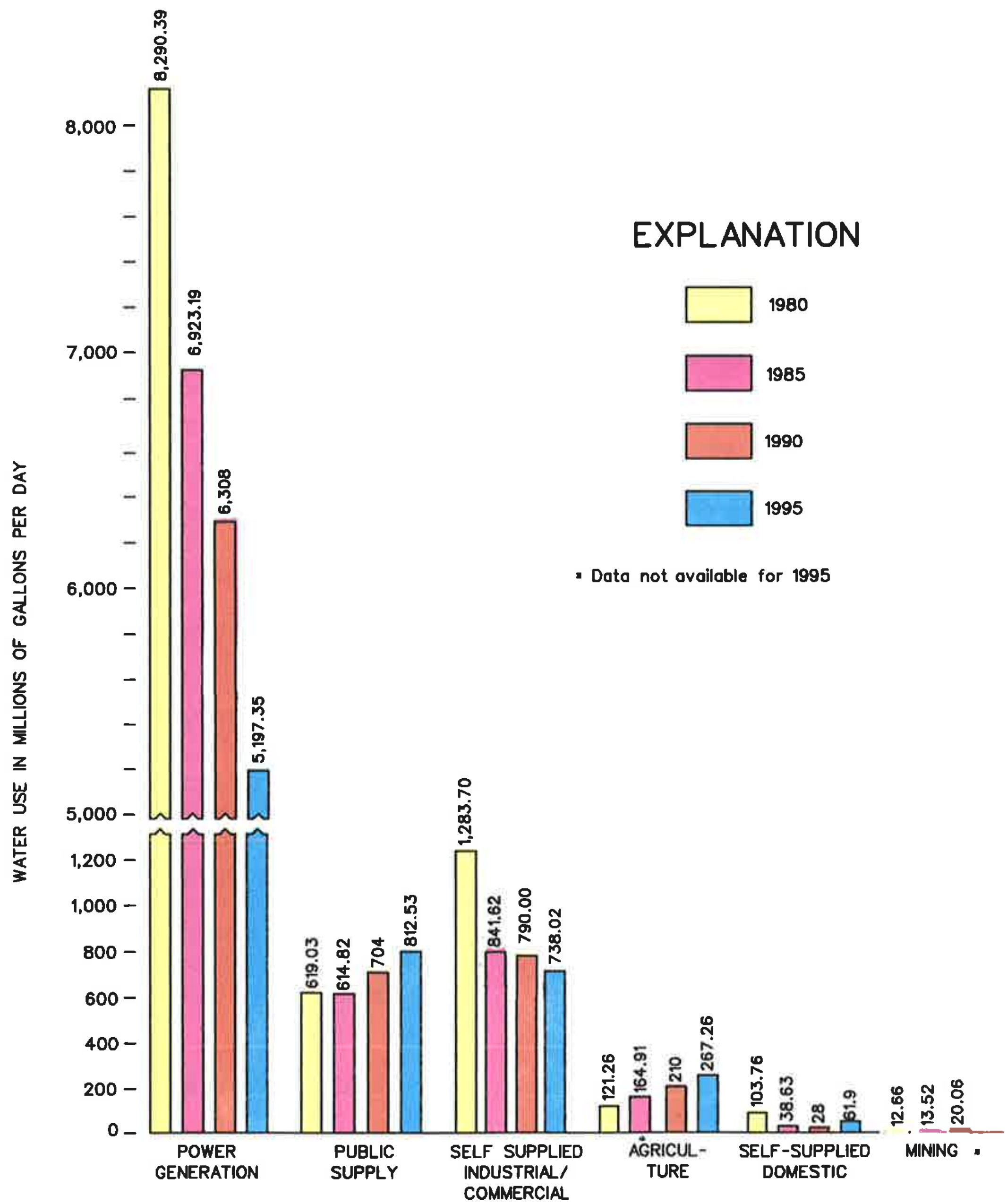
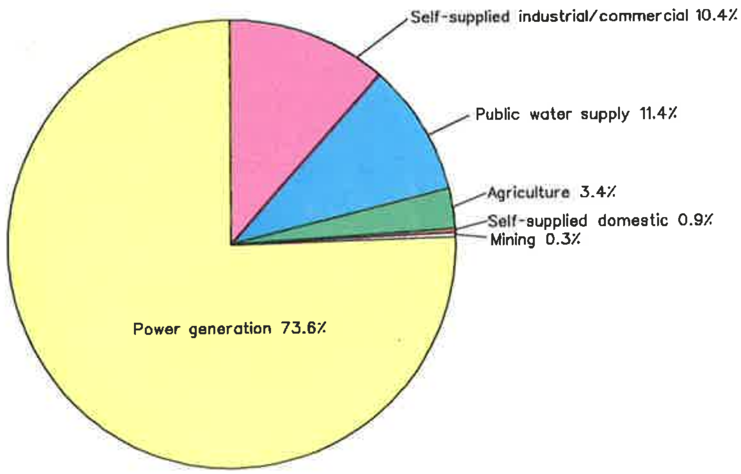
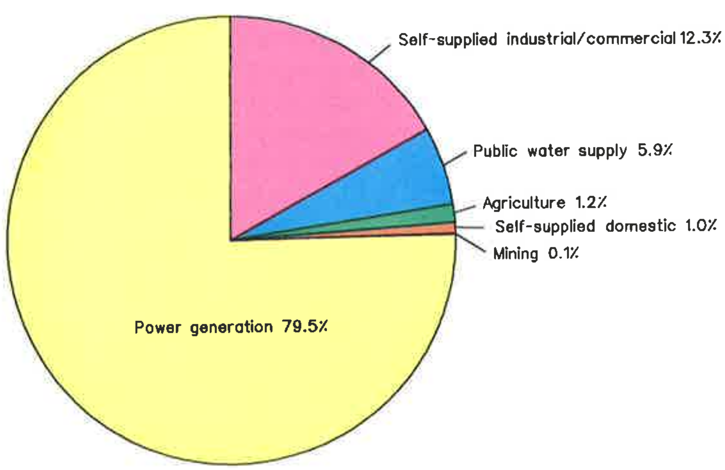


Figure 14.--Comparative withdrawal water use for selected years.



1995
WITHDRAWAL USE



1980
WITHDRAWAL USE

Figure 15.--Percentages of total withdrawal water use, 1980 and 1995.

1990 an estimated 790 mgd was withdrawn, which was lower than the estimated 1985 amount (fig. 14). Industrial plant closures and different methods for estimating water use are the primary reasons for the apparent reduction.

AGRICULTURAL

Agricultural uses are divided into irrigation and nonirrigation uses. Nonirrigation uses include water for livestock operations and for catfish farming. Irrigation agricultural water use was estimated at 138.53 mgd. Irrigation has increased in recent years, indicating that farmers are using irrigation as a method of crop insurance, particularly during dry periods. Nonirrigation agricultural water use was estimated at 128.73 mgd. Total agricultural use was estimated at 267.26 mgd, which is a significant increase over previous estimates. Only part of the increase can be due to increased irrigation; much of the change probably results from improved methods of estimating water use.

SELF-SUPPLIED DOMESTIC

Self-supplied domestic water use is estimated at 61.9 mgd for 1995, all from ground-water sources. This estimate is far higher than previous estimates, due to improved methods of estimating water use.

POWER GENERATION

Water use by nuclear and fossil fuel power generation plants in Alabama accounted for approximately 5,197.35 mgd or about 73 percent of the entire 1995 withdrawal water use (fig. 14). Power production in 1995 was estimated to be 84 million megawatt hours.

MINING

The amount of water withdrawn for mining was insufficient to constitute a major water use. An estimated 20.06 mgd was withdrawn in 1995 for washing coal, sand, and gravel, and for enhanced recovery of hydrocarbons. Much of this water was recycled. Water produced by coalbed methane production wells has increased the mining water use value in recent years.

NONWITHDRAWAL USE

Nonwithdrawal or instream uses of water comprised 4 of the 10 categories inventoried. These are hydroelectric power generation, sewage treatment, navigation, and recreation/preservation. Water for these uses is not removed from its natural setting and is often reused many times as it moves downstream.

HYDROELECTRIC POWER GENERATION

The 21 hydroelectric power generating facilities operating in Alabama in 1995 used 157,487.33 mgd of water to produce an estimated 9.5059 million megawatt hours of electricity. There is virtually no consumptive use of water by hydroelectric generating plants; water used at a plant is available for other uses downstream.

SEWAGE TREATMENT

The total discharge by sewage treatment facilities in Alabama for 1995 was not estimated. The estimate of 450 mgd during 1992 is considered valid for 1995. Discharge data from the Alabama Department of Environmental Management records were used to estimate the 1992 discharge value. The actual value may be different from the estimate, however, because many discharges are not metered.

NAVIGATION

Fourteen locks are located on four waterways in Alabama. These locks have inside dimensions ranging from 84 x 100 feet to 110 x 600 feet. Water requirements for a single lockage range from 13.8 million gallons (mg) at the new (July 1991) Oliver Lock on the Black Warrior River to 50 mg at Wilson Lock on the Tennessee River. The combined volume of all locks in Alabama is approximately 301 mg. The number of lockages for 1995 is not available; however, during 1991, an estimated 41,000 lockages required about 1,200 billion gallons of water. Lockage is a sequential use of water, which means that the same water is used downstream.

RECREATION/PRESERVATION

Although not considered a major water-use category, recreation/preservation is important to the state's economy. Alabama has no natural large lakes, but many impoundments developed for navigation, hydroelectric power generation, and public water supply provide habitats for fish and wildlife and are used as recreational areas. They support a significant part of the state's economy by providing a basis for the tourist industry, sales of recreation equipment, and habitats and spawning areas for commercial game and fish.

Recreation/preservation use is usually estimated by the number of annual visits per facility. The Tennessee Valley Authority estimates annual recreational use at its Guntersville, Wheeler, Wilson, Pickwick, and Bear Creek Lakes and associated property to be about 21 million visits. The number of annual visits to state-operated parks and recreational areas is estimated to be 8 million, and to the U.S. Army Corps of Engineers' facilities about 20 million.

WATER PROBLEMS

DROUGHTS

A drought is defined as a deficiency in precipitation for an extended period of time. The severity of a drought depends on the duration and geographical extent of the precipitation deficiency, on the amount of the rainfall deficiency, and on the effects the drought has on human activities. The effects of a drought vary with different water users. Water users who rely on water supplies with limited storage may be severely affected by rainfall deficiencies of only a few weeks. Also, lack of rain for a few weeks during the growing season may reduce crop yields and possibly destroy crops. However, lack of precipitation for a few weeks, or even months, may have no appreciable effect on water users who obtain water supplies from large streams or large ground-water reservoirs.

Major droughts affected Alabama in 1954, 1968, 1980-81, 1986, and 1988. The drought of 1986, which affected much of the southeastern United States, is considered to be the most severe drought in the area in more than 100 years of record.

The Palmer Drought Severity Index can be used to indicate prolonged abnormal conditions of dryness or wetness. Index values depend upon amounts of precipitation, soil moisture, recharge, runoff, and evapotranspiration. Figure 16, which is based on the long-term Drought Severity Index, shows the changes in moisture conditions in Alabama during 1995. Severe drought conditions were present in northeastern and east-central Alabama from July to early September 1995. The drought, which was alleviated by September rainfall, was ended by Hurricane Opal. Most of northwestern, western, and southern Alabama were under near normal moisture conditions for most of the year.

FLOODING

Flooding is one of the most severe water-related problems. Construction of buildings in flood-prone areas can be avoided to reduce the destruction by floods. Flat, open flood plains appear to be attractive, easily developed sites for building, but these areas are particularly susceptible to flooding. In many cases, flooding cannot be controlled; in other cases, construction of dams and flood-control impoundments may alleviate some flooding problems. Although properly constructed and maintained dams can mitigate flood damage, Alabama does not require that dams be inspected or maintained. Neglected dams can fail under stress, causing property damage or loss of life. While all major dams in Alabama, such as power-generation structures, are closely monitored, small private dams may not receive adequate inspection.

Olin (1984) provided methods and equations for estimating the magnitude and frequency of floods for streams in Alabama with drainage areas of 1 to 22,000 square miles. Also, the relationship of maximum floods of record to drainage areas for different streams in Alabama is given as a guide in estimating potential maximum floods.

Olin and Atkins (1988) used computer programs to estimate flood hydrographs for ungaged rural and urban streams in Alabama with drainage areas less than 500 square miles. Their report also provided equations for estimating basin lag time and flood volume for the ungaged streams.

The U.S. Geological Survey has published flood-prone area maps for many areas in Alabama (pl. 5). Comparison of building-site maps and flood-prone area maps and delineating areas susceptible to flooding should be a prerequisite to any construction near rivers.

In addition to information from the U.S. Geological Survey, flood information can be obtained from the U.S. Army Corps of Engineers and the Tennessee Valley Authority. Flood easement information also can be obtained from the Alabama Power Company for streams and reservoirs regulated by the Alabama Power Company. The Federal Emergency Management Agency has prepared flood-insurance rate maps as part of the National Flood Insurance Program for several areas in the state. These maps, although prepared for flood-insurance purposes, show 100-year and 500-year flood boundaries and other flood-prone areas, but not necessarily all areas subject to flooding. During August and October of 1995 two hurricanes struck Alabama, causing intense precipitation, flooding, storm surge, and wind damage. Hurricane Erin crossed Alabama from east to west on August 4 and 5. Storm-related precipitation in south Alabama was as high as 7.68 inches on August 4 in Escambia

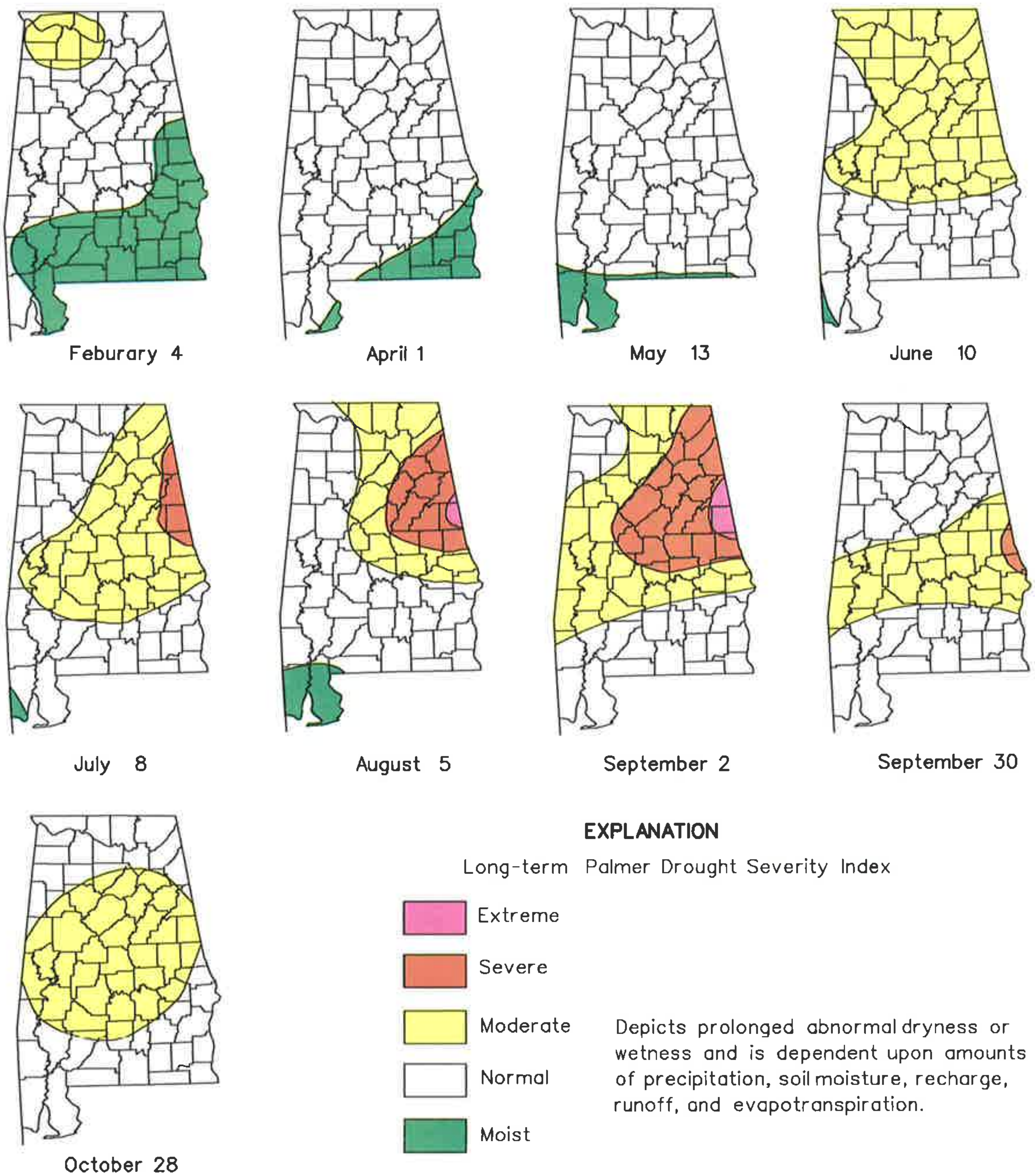


Figure 16.--Changes in drought severity during 1995.

County. Hurricane Opal made landfall on October 4 in southeast Alabama and moved north across the state (U.S. Department of Commerce, 1995a, b, c). Opal was blamed for 9 deaths and $3 billion worth of damage in Florida, Georgia, and Alabama. Some of the effects of Opal are still visible in southeast Alabama.

WATER QUALITY

The quality of surface waters in Alabama is considered "generally good"; a major part of the water meets applicable water-quality standards or supports designated water uses. Alabama Department of Environmental Management's 1996 Water Quality Report to Congress notes that for assessed surface waters, 62 percent of stream miles, 66 percent of lake areas, 27 percent of estuarine miles, and 100 percent of the state's Gulf coastal waters are totally supportive of the Alabama Department of Environmental Management designated water uses (ADEM, 1996c). Causes for nonsupportive status include excessive organic enrichment, which depletes dissolved oxygen, and siltation from agricultural and silvicultural practices. Of the state's 264 municipal waste water treatment facilities, 31 did not comply with federal guidelines in December 1995 (Robert Bretzer, 1996, Alabama Department of Environmental Management, written commun.). However, the number of facilities not in compliance has decreased from 115 since 1985.

As of December 31, 1995, the state had 299 semipublic and private waste water treatment plants of which 7 were under Administrative Order for noncompliance (Robert Bretzer, 1996, Alabama Department of Environmental Management, written commun.). The total number of plants has decreased in recent years, but the number of plants under Administrative Order for noncompliance has not changed since 1993.

In 1996 there were 30 permitted municipal solid-waste landfills (MSWFS) in Alabama (Center for Environmental Research and Service, 1996). This compares to 104 landfills operating in 1989. Landfill closures were the result of implementation of subtitle D, which governs installation of liners to prevent water pollution and ground-water monitoring to detect water pollution. Ground-water quality is being monitored in the vicinity of many of these landfills. Results of chemical analyses of water samples collected from monitoring wells have indicated changes in ground-water quality at some landfills. Leachates from landfills also can contaminate surface-water bodies. Common contaminants include iron, manganese, lead, chromium, and organic chemicals.

Ground-water contamination has been detected at several hazardous-waste treatment, storage, or disposal facilities in Alabama. As of February 1995, 74 facilities had ground-water monitoring systems. Contamination had been detected at 47 of those facilities. Corrective action is being taken at 11 facilities (Fred Mason, 1995, Alabama Department of Environmental Management, written commun.).

More than 600 abandoned or inactive hazardous-substance sites have been identified and are being evaluated under the provisions of the Federal Comprehensive Environmental Response, Compensation and Liabilities Act. The Alabama Department of Environmental Management and the U.S. Environmental Protection Agency rank sites according to their potential to affect human health or the environment adversely. Sites with a Hazard Ranking System score of 28.5 or greater are eligible for inclusion on the National Priorities List. Currently, 13 sites in Alabama are part of the National Priorities List.

The Department of Defense, as a part of its Environmental Restoration Program, has identified more than 480 solid-waste sites at 18 active or former military installations in Alabama. Ground-water contamination is known to exist at a majority of the sites. Assessment and corrective actions are actively underway at most of these sites (Larry Bryant, 1996, Alabama Department of Environmental Management, written commun.).

A potential water-quality problem in coastal areas is saltwater encroachment. Excessive pumpage of ground water in areas where the saltwater/freshwater interface is very close to the surface may draw saltwater into freshwater aquifers, effectively destroying them for many years.

Major sources of stream pollution include industrial waste discharges, discharges from waste-water-treatment plants, and nonpoint discharge from urban areas, mining operations, and agricultural areas. The Alabama Department of Environmental Management (Charles Horn, 1995, verbal commun.) indicates that a major problem for waters not meeting the applied standards of the state and federal Clean Water Acts is nonpoint source pollution. Of the more than 1,000 complaints regarding water-quality problems received by the Alabama Department of Environmental Management in 1993-94, 44 percent were nonpoint-source related (Alabama Department of Environmental Management, 1994a).

Onsite sewage systems, including septic systems, are a major source of nonpoint-source pollution. USEPA Region 4, which includes Alabama, has more onsite sewage systems than any other region. A project to test innovative peat biofilters in septic systems was recently completed in coastal Alabama by the Alabama Department of Public Health and the Baldwin County Health Department. The project was funded by the USEPA. The peat biofilters may prevent sewage-system failures in places where the water table is high, and thus reduce water pollution (Canody, 1996a).

In contrast to nonpoint-source pollution, point-source pollution is relatively easy to prevent because sources are few and known. For instance, the Alabama Department of Environmental Management reports that, for the fifth straight year, dioxin concentrations downstream from Alabama's 10 bleached kraft paper mills are well below the USEPA's action level of 7 parts per trillion, and nearly half of analyzed samples had no detectable dioxin.

On September 24, 1996, a report detailing legal releases of toxic chemicals into U.S. rivers was published by the Environmental Working Group and the Public Interest Research Organization. The report indicated that Alabama ranked 6th during the study period (1990 through 1994) among the 50 states, with the first-rank state having the greatest amount of toxic chemicals released into rivers. Despite the large volumes of chemicals released to Alabama's rivers, of the total 77,274 stream miles in the state, 99.5 percent meet the fishable/swimmable goals of the Clean Water Act (ADEM, 1996d), and only 1.2 percent are not maintaining standards for one or more of the criteria necessary to support these designated uses. All dischargers to state waters are required to remove 85 percent of pollutants, but most industries remove 90 to 95 percent.

Naturally occurring chloride, iron, and hardness in water are common water-quality problems for ground-water supplies in Alabama. High chloride content makes water unfit for most uses. A high concentration of chloride in drinking water imparts a salty taste and can cause physiological damage. Excessive hardness inhibits the action of cleaning agents, causes scum in bathtubs, scale in hot-water tanks and lines, and problems in the processing of food and in some industrial processes. Excessive iron in water causes staining of plumbing fixtures and laundry, an objectionable taste, and may form scale or sludge in pipes, pumps, and water heaters. Some aquifers produce water with a rotten-egg odor caused by hydrogen sulfide. Naturally occurring trace metals such as arsenic have been detected in water in Alabama. Low concentrations of chemical pollutants also have been found by the Alabama Department of Environmental Management in a few wells serving public drinking-water systems.

Leaking underground storage tanks are major sources of ground-water contamination. As of April 1994, there were 24,000 active underground storage tanks registered in Alabama. Many of these tanks are leaking. The Alabama Department of Environmental Management has received about 2,000 notifications of releases of contaminants from underground storage tanks that require investigative or remedial action (Dorothy Malaier, 1994, Alabama Department of Environmental Management, verbal commun.). Money is available to reimburse many underground storage tank cleanup operations through the Alabama Tank Trust Fund and may amount to several hundred thousand dollars per site.

Although minor variations exist from one state to the next, all states have apparently recognized common steps necessary for environmental remediation at contaminated underground storage tank sites. These steps include the following measures:

- Initial abatement measures to prevent the further spreading of contaminants;
- Initial (comprehensive) site assessment to evaluate the scientific factors present at the site, including hydrogeology, soils, public water supplies, etc.;
- Corrective (remedial) action plan to identify specific steps that will protect the health and well-being of people who live or work near the site;
- Remediation (corrective action) or implementation of the corrective action plan; and
- Monitoring the effectiveness of the action prior to application to the state to discontinue the treatment program and closure of the storage tank.

Each state has its own criteria for reimbursement eligibility. The State of Alabama will cover $1 million for the combined cleanup and any third party claims. The deductible is $5,000 per facility and per third-party claim, and the fund maximum is $10 million (Dunn, 1993).

In 1992, a study was conducted jointly by the Alabama Department of Environmental Management, the Alabama Rural Water Association and the USEPA's National Air and Radiation Environmental Laboratory to obtain base-line data on radon levels in the municipal ground-water supplies of the state prior to implementation of drinking-water standards for radon. Radon levels from 166 municipal wells and springs were found to exceed the proposed USEPA drinking-water standards of 300 picocuries per liter (pCi/L).

Radon is an invisible, tasteless, and odorless gas that forms naturally from the decomposition of elemental uranium in rock. From the subsurface, radon may migrate upwards and enter an enclosed structure-such as a house-through cracks in the foundation or slab, or radon may enter a house in conjunction with the ground-water supply via shower heads, spigots, or other artificial points of discharge in the home. Radon gas in the home is generally not considered a health risk if consumed in drinking water, but excessively high levels of radon gas in the home can cause damage to lung tissue and increase the risk of lung cancer. Radon is responsible for an estimated 7,000 to 30,000 deaths a year in the United States (Alabama Department of Public Health, 1992).

The 1993 study focused on municipal ground-water sources only, because surface-water sources would release radon naturally to the air prior to distribution. For the study 869 sources of ground water were sampled during a 10-month period, including 830 community wells and springs and 39 wells used by schools. The 166 ground-water sources with radon levels in excess of 300 pCi/L were spread throughout 43 counties.

A secondary level of sampling encompassed 28 systems that exhibited levels of 1,000 pCi/L or more. This sampling program was designed to determine if any of the remedial actions taken had been successful in decreasing these elevated values. Little decrease in radon concentration resulted from treatment and transport of municipal ground-water supplies.

In 1992, the Alabama Department of Environmental Management (1993) initiated copper and lead testing of large and medium-sized public water-supply systems in Alabama. Results of the initial round of testing indicated that only 5 of more than 200 systems exceed the action levels, where a system is determined to have exceeded an action level if 10 percent or more of the samples taken from throughout the system exceed 15 parts per billion (ppb) of lead or 1,300 ppb of copper.

Large public water systems serving more than 50,000 people were required to monitor for lead and copper at single-family residences with lead service lines, or with copper plumbing and lead solder installed after 1982. Alabama has 11 systems that fall within this category. Three rounds of testing indicated that none of the systems exceed copper and lead action levels.

In 1993, the initial round of lead and copper testing for medium-sized water systems (those serving from 3,300 to 50,000 persons) indicated that Daphne (Baldwin County) exceeded the action level for lead, and four systems (Hale County, Beauregard {Lee County}, and Green Hill and Rogersville {Lauderdale County}) exceeded the action level for copper. These systems, for finished water, are now (1995) in compliance (Lillian Tisdale, Alabama Department of Environmental Management, 1995, verbal commun).

Water systems exceeding the lead action level are required to implement additional measures, including provision of optimal corrosion control, source monitoring, public education, and replacement of lead service lines. Systems that exceed the action level for copper must implement optimal corrosion control and source monitoring.

Initial testing of the state's small water systems (serving less than 3,000 customers) and nontransient, noncommunity water systems (small industries, schools, day-care centers, etc.) for lead and copper will be completed in 1995. As a group, these water systems include approximately 400 communities and contain by far the largest number of water systems in Alabama.

OVERDEVELOPMENT OF GROUND WATER

Water shortages induced or enhanced by human activities commonly are only locally severe. The most common is the decline in ground-water levels caused by over pumping. Several cities in Alabama, especially in the southern part of the state, derive their water supplies from wells. Increased pumpage to keep pace with demand from an increasing number of water users and water uses has caused water-level declines in the immediate vicinity of these cities. Most of the cities use more than one well to supply the water needs. Therefore, pumpage from the wells may have resulted in well interference, where the drawdown in each well is increased as a result of pumpage at other wells. In such cases, large depressions in the potentiometric surface and decreased well yields occur in the vicinity of large pumping centers. Some cities that have been rapidly depleting ground-water supplies in certain aquifers have begun to seek out alternate sources of water or have adopted aquifer-development strategies that can mitigate this problem.

The USEPA has initiated a program titled Protecting the Nation's Groundwater: EPA's Strategy for the 1990's. This effort includes the

Comprehensive State Ground Water Protection Programs (CSGWPP) that consist of strategic activities designed to protect the nation's ground water.

Alabama was chosen as the lead state in Region 4 by the USEPA and was the site of the initial pilot project in the region. A water program advisory committee was formed in December 1992 to prepare Alabama's ground-water protection plan. The core program was completed and submitted to the USEPA in March 1994 and was endorsed by the USEPA in November 1994. Four other states have received USEPA endorsement, and an additional 13 states have submitted or are preparing draft CSGWPP documents.

Although the CSGWPP is not mandated by law, the USEPA hopes that the states will participate voluntarily to ensure a coherent and comprehensive approach to protecting the nation's ground-water resources. The benefits to be derived from the CSGWPP include:

- Better coordination of current federal, state, tribal, and local ground-water related programs resulting in more effective and consistent ground-water protection;
- Better resources within the constraints of federal hazardous waste, pesticide, and solid waste laws; and
- More consistent deference to state priorities when implementing federal ground-water related laws.

SPECIAL PROJECTS

The Hydrogeology Division of the Geological Survey of Alabama initiated and/or completed several special projects in 1995. These projects, along with ongoing annual and semiannual water-resources programs to measure ground-water levels, monitor water quality, and measure surface-water discharge, provide water-resources data useful for a wide range of applications.

FISH RIVER WATERSHED

The Fish River Watershed project was initiated in 1993 as a multi-agency effort to establish an integrated holistic approach to water management of the Weeks Bay Watershed, of which Fish River Watershed is a part. In 1992, Weeks Bay was classified as an Outstanding National Resource Water with recognized nonpoint source pollution threats by the federal government.

In January 1994, a cooperative effort between the Geological Survey of Alabama and Alabama Department of Environmental Management was initiated. The objectives are to evaluate biological and water quality in the Fish River Watershed as a prelude to expanding monitoring (1995) and best management practice (BMP) implementation at farms in the Weeks Bay Watershed to control nonpoint source water pollution.

The watershed was evaluated because of the potential for environmental impacts caused by the application of agricultural chemicals and urban development. These activities have had a possible negative impact on the 153-square mile watershed area. An environmental assessment and investigation have been undertaken to ascertain the historical and the present impact to the environment.

Ten surface water sites were established, and water quality samples were collected and analyzed monthly for a one year period (1994) in an attempt to document the effect of urbanization and land use on this rapidly growing predominantly rural area. These analyses will provide the baseline data necessary to assess the effects of land use on the environment.

In addition to water samples, macroinvertebrates were collected and identified on a regular basis to assess the effects of water quality on living organisms at the same sites used for water quality assessment.

FLINT CREEK GEOGRAPHIC INFORMATION SYSTEM

The Flint Creek Geographic Information System project was initiated in 1993 and consists of the development of a fully integrated Geographic Information System (GIS) for the 465-square mile Flint Creek watershed. System users input, store, manipulate, and output (in the form of maps, charts, tables, etc.) all spatially referenced data collected for the study area as part of the Flint Creek water quality project. Data are being added to the database by keyboard input, from digital data files, and by digitization from existing maps. The database is organized as a set of thematic layers so that various data associated with different feature types can be independently accessed, managed, and analyzed. Ultimately, data layers will include such themes as public land survey, hydrography, transportation, topography, soil types, geology, land use, public water supply sources, contaminant sources, and water quality sample site locations. Other data layers can easily be added to the GIS as appropriate. This GIS will greatly facilitate ongoing multidisciplinary, multi-agency research efforts in the Flint Creek watershed by providing a rapid cost effective means of accessing and analyzing ground-water and surface-water qualitative as well as quantitative data collected for the project.

FLINT CREEK WATERSHED

The Flint Creek study was initiated in 1992 and involves federal, state, and local agencies in a focused attempt to resolve water quality problems in an entire watershed. This Watershed Protection Approach (WPA) will evaluate all aspects of water quality and determine the most practical and economical method of solving water quality problems.

The Flint Creek Watershed is one of the two watersheds in the state for which the integrated, holistic approach to watershed management is being undertaken. The other watershed is the Weeks Bay Watershed, of which Fish River Watershed, discussed herein, is a part.

A WPA requires the following specific steps:

- Identify watershed use impairments
- Initiate monitoring as needed
- Define problems, causes, and sources
- Develop control strategies (i.e., point and nonpoint sources)
- Evaluate impacts from other media
- Develop ecological criteria as indicators of success
- Provide for public participation

Fifty-one (51) wells and springs and 14 surface-water sites in the watershed have been monitored since January 1993 as part of the Flint Creek Watershed project. Biological as well as chemical characteristics of water, such as pH, specific conductance, water temperature, and nutrients are determined. Continuous recording of pH, temperature, specific conductance and dissolved oxygen content of water at two surface-water sites is also conducted.

HYDROGEOLOGIC CROSS SECTIONS

In 1992, work was initiated on a series of subsurface hydrogeologic cross sections for the Coastal Plain of Alabama. These cross sections are being prepared as a companion to Special Map 231, Aquifers in Alabama. Well cuttings from about 60 wells are being examined to define the subsurface hydrogeologic relationship of these units and to correlate the subsurface units to formally described surface units of the Alabama Coastal Plain.

COUNTY WATER AVAILABILITY REPORTS

Water-availability reports or maps for all counties in Alabama have been published. However, most of the data in the published reports were collected in the mid- to late-1960's. New data for Covington, Geneva, and Winston Counties have been collected, and updated water-availability reports for these counties are being published as part of the Special Map series of the Geological Survey of Alabama. These reports will briefly describe the geology, water availability, and water quality in each county. An updated water-availability report for Etowah County was published in 1995.

DELINEATION OF WELLHEAD PROTECTION AREAS

Section 1428 of the 1986 Amendments to the Safe Drinking Water Act of 1974 requires states to develop and submit a program to the USEPA designed to protect wellhead areas of public water supply systems. A committee comprised of several state, federal, and local organizations prepared Alabama's Wellhead Protection Program, which is administered by the Alabama Department of Environmental Management. Public water systems that use ground water are required to prepare a Wellhead Protection Plan (WHPP). As part of the plan, the water systems must delineate wellhead protection areas and identify sources of potential contamination in the wellhead protection areas. Wellhead protection areas encompass those parts of the well recharge areas that are believed to charge wells within a specified amount of time or are of a specified minimum size.

The Geological Survey of Alabama in cooperation with the Alabama Department of Environmental Management and public water supply systems has conducted several wellhead protection projects. During 1995, studies were conducted in Hokes Bluff (Etowah County), Enterprise, Eufaula, Ozark, Alabaster, and Oxford (southeast Alabama), Douglas (Marshall County), Holtville (Elmore County), West Dallas (Dallas County), Movico, Chastang, Bucks (Mobile County), Dothan (Houston County), Lemoyne (Mobile County), West Blocton (Bibb County), and Madison County. These cities and public water supply systems can then develop and implement controls through management plans for potential contamination sources and prepare contingency plans for emergency and long range water supply needs. Guidebooks and an instructional video are available through the Geological Survey of Alabama to assist other public water supply systems in developing wellhead protection plans.

DELINEATION OF CAVE RECHARGE AREAS IN MADISON COUNTY

The Geological Survey of Alabama, in cooperation with the U.S. Department of the Interior, Fish and Wildlife Service, is continuing a project to delineate the recharge areas and identify the major point sources of recharge into the subterranean drainage systems in part of Madison County. Caves in these drainage systems serve as habitats for a diverse fauna. A comparison of aquatic organism surveys conducted during the periods 1968-73, 1985-87, and 1988 has revealed a dramatic decline in the number of cave organisms. Prior to this study, two of the caves (Bobcat and Shelta) were the only known habitats for the endangered Alabama cave shrimp, Palaemonias alabamae. However, the Alabama cave shrimp has not been observed in Shelta Cave since 1973. Results of water-quality analyses by the Tennessee Valley Authority in 1987 indicated that water in Shelta Cave had become contaminated by the pesticides heptachlor epoxide and dieldrin and the heavy metal cadmium.

In 1992, more than 50 caves were visited in Madison County and adjoining counties to determine if hydrologic conditions in any of the caves were suitable habitat for the Alabama cave shrimp. During these visits, three additional caves were found to contain small colonies of the shrimp in the southeastern part of the county. Additionally, four new sightings of the Alabama cave shrimp have been reported, but these occurrences have not yet been confirmed. Results of this study may be used to develop management guidelines for the aquifers to maintain and protect water quality in the Alabama cave shrimp habitat.

REGIONAL AQUIFER STUDIES

The Geological Survey of Alabama has initiated hydrogeologic investigations of selected major aquifer systems in the state. During 1992, a study was initiated and is continuing on the Ripley aquifer, an important source of ground water across the entire state in the central Coastal Plain. Work was also initiated and is continuing on the Coker and Gordo aquifers of the Tuscaloosa Group, two important aquifers along the northern tier of the Coastal Plain in central Alabama.

Geologic descriptions, water-bearing properties, hydraulic characteristics, water availability, water quality, and water use will be discussed in the reports. Information available in these reports will be useful in the development and management of the state's ground-water resources.

HYDROGEOLOGIC AND WATER-USE DATA FOR SOUTHERN BALDWIN COUNTY

This project, begun in 1994, provides hydrogeologic and water-use data for a 628-square mile part of Baldwin County, Alabama, south of Interstate 10 to use in the protection and management of the area's ground-water resources. The population and water needs of this part of Baldwin County have expanded dramatically in the past 15 years since Hurricane Frederic. Included in a report for the project (Chandler, Gillett, and DeJarnette, 1996) are records, hydrogeologic data, and water-use data for 369 wells. The data were collected as part of past and current water-resources studies by Hydrogeology Division personnel. Potential management applications of the data are wellhead protection and computer modeling of solute (contaminant) transport and ground water flow in the project area.

NONPOINT SOURCE PESTICIDE MONITORING

Nonpoint source pesticide monitoring in Alabama is coordinated by the Alabama Department of Environmental Management. The monitoring program is designed to determine the nature and extent of the ground-water pesticide problem, if any. The Alabama Department of Environmental Management, in cooperation with the Alabama Department of Agriculture and Industries, and the Geological Survey of Alabama, initiated a project in 1992 to sample springs in agricultural areas of Alabama for pesticides. Sixty-seven springs were sampled between June 1, 1992, and May 31, 1993. Twenty-four percent of the springs tested positive for pesticides, compared to an overall detection rate of 25 percent of residential wells sampled by ADEM (Alabama Department of Environmental Management, 1994a-c). As part of this study, the Geological Survey of Alabama developed a protocol to identify springs susceptible to pesticide contamination (Mann and Chandler, 1994). The purpose of the study was to monitor the presence of agricultural pesticides in selected springs and to determine the vulnerability of springs to contamination. The study objectives were to determine specific sites for long-term monitoring and to develop and implement a State Pesticide Management Plan. The project provided base line water quality data in specific ground-water basins at locations in the state particularly susceptible to nonpoint source contamination. Pesticide occurrence in wells in Alabama has also been studied. Most recently, in 1995 ADEM conducted pesticide monitoring in private wells in Madison, Limestone, and Houston Counties (ADEM, 1996c). In the Madison-Limestone study, 220 wells were sampled and maximum contaminant limits were exceeded twice for atrazine and twice for alachlor; the Houston County study yielded similar results (ADEM, 1996c).

OLIVER POOL WATER QUALITY ASSESSMENT

Water quality was documented in a 1992 study of the 790-acre William Bacon Oliver Lake of the Black Warrior River in the vicinity of Tuscaloosa. The following data were collected for eight sites in and near Oliver Lake: (1) continuous measurements of specific conductance and pH at Oliver Lock and Dam; (2) discharge; (3) oxygen profiles (upper, middle, and lower pool sites); (4) comprehensive water analyses; (5) bottom sediment analyses for trace metals; and (6) biological information that will be used to assess the relative condition of local fish communities.

Six of these sites are located within Oliver pool at significant locations relative to the larger surface water inflows. One additional site is located upstream above the Holt Lock and Dam, and one is located downstream below the new Oliver Lock and Dam (2,600 feet downstream from the old Oliver Lock and Dam). A summary report on the study's results has been prepared.

CHARACTERIZATION OF THE WATER RESOURCES OF THE CHOCTAWHATCHEE-PEA RIVERS WATERSHED

The Geological Survey of Alabama initiated a project in 1994 to characterize and evaluate the water resources of the Choctawhatchee-Pea Rivers watershed. The major objective of the first phase of the project was to identify, locate, and assemble into a data base all available, relevant surface-water data, including runoff, streamflow, water-quality, and water-use information; relevant ground-water data, including aquifer characteristics, stratigraphic and structural data, water levels, recharge rates, water-quality, and water-use information; and rainfall data, including precipitation rates, amounts, and distribution. In the last phases of the project, collected data will be integrated and used to develop predictive water-budget models of the region to serve as the basis for effective watershed management. The models will incorporate interrelationships among ground-water storage, surface-water storage, precipitation, streamflow, overland runoff, recharge, evaporation, aquifer characteristics and properties, ground- and surface-water use, and future water-use demands. The models will be used to identify the nature, location, and magnitude of potential flood, drought, or water-supply problems in the watershed. Modeling results can then be used to develop potential solutions to these problems.

GROUND-WATER BOOKLET

The Geological Survey of Alabama and the Alabama Department of Environmental Management initiated in 1995 a cooperative project to produce an informative booklet about ground water. This booklet is intended to provide information about ground-water resources, use, contamination, and protection in Alabama. The booklet is a nontechnical distillation of up-to-date technical information, and should be useful to adults, high-school students, and middle-school students. The book is currently undergoing pre-publication review by ground-water experts and others.

LIGHTWOOD KNOT CREEK WATER-QUALITY EVALUATION

A seven-year project to evaluate the effects of best management practices (BMPs) on tributaries of Lightwood Knot Creek in Covington County was initiated in 1995. This case study will evaluate the effectiveness of chicken-farming BMPs to be instituted in the study area. Automatic sampling stations at four sites collect water quality data every fifteen minutes, and water samples are collected every 36 hours. Additional water samples are collected during storms. The amounts of sediment transported by the streams are measured weekly. This unprecedented level of monitoring will facilitate interpretation of the causes of long-term and transient changes in water quality. The BMPs to be evaluated include the composting of dead chickens and other practices intended to reduce contaminant runoff into small streams. If the BMPs prove effective, then the results of this study can provide a paradigm for water-quality control in chicken-farming areas throughout southern Alabama and elsewhere.

REDSTONE ARSENAL LANDFILL SITE INVESTIGATION

During 1995 and 1996 the Geological Survey of Alabama conducted an evaluation of the ground-water system underlying a landfill site on the Redstone Arsenal in Madison County. Site stratigraphy was evaluated, water-bearing units were identified, and ground-water flow directions were determined in order to identify source(s) of ground-water contamination in the area. Water levels were measured in 76 monitoring wells on and near the site throughout the spring of 1996 and site geology was characterized through detailed study of logs of monitoring wells. More than 100 maps and well hydrographs were used to characterize the complex ground-water system at the site.

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GLOSSARY

ACRE-FOOT - A unit of measurement of water volume; the quantity of water required to cover 1 acre to a depth of 1 foot.

AQUICLUDE - Relatively impermeable rock that acts as the upper or lower boundary of an aquifer. It can slowly absorb water but does not readily transmit water to wells or springs.

AQUIFER - A formation, part of a formation, or a group of formations that is saturated and will yield useful amounts of water to wells and springs.

ARTESIAN WATER - Ground water that is in an aquifer confined by an impermeable bed or beds and under sufficient pressure to cause the water levels in wells to rise above the base of the overlying confining bed.

ARTESIAN WELL - Well deriving water from an artesian or confined water body.

AVERAGE DISCHARGE - The arithmetic average of the average annual discharges for all complete water years of record.

BASE FLOW - The sustained flow of a stream during dry weather conditions. Generally the base flow is composed of effluent ground water.

BASIC HYDROLOGIC DATA - Data collected during inventories of water and related land features, and records on water-related processes. The data include records of precipitation, streamflow, ground-water levels, and water quality.

CONDENSATION - The process by which a substance changes from the vapor state into the liquid or solid state.

CONE OF DEPRESSION - The depression in the water level or potentiometric surface of ground water caused by pumping a well or pit. The greatest amount of depression occurs near the discharge well or pit. The cone defines the area of influence of pumpage.

CONFINED WATER - Ground water occurring under pressure greater than atmospheric pressure. The boundary of the upper surface of the water is an impermeable bed or a bed with a permeability significantly less than the permeability of the bed in which the water occurs.

CONFINING BED - A relatively impermeable bed adjacent to and confining water in an aquifer.

DAILY DISCHARGE - The volume of water flowing past a point within a 24-hour period. Daily discharge is normally reported as the mean discharge for 24 hours.

DAILY GAGE HEIGHT- Gage height is the mean gage height for 24 hours or the value that occurs at a specified time during the day.

DEPLETION - The removal of ground water from an aquifer at a rate greater than that of recharge.

DISCHARGE - The volume of water passing a specified point within a specified period of time, or the volume of water withdrawn from a well within a specified period of time. Frequently discharge is reported in cubic feet per second (ft3/s).

DRAINAGE BASIN - For surface water, the area around a surface-water drainage system that contributes runoff from precipitation to the system. A ground-water drainage basin is the volume around a ground-water drainage system that contributes water to the system.

DRAINAGE DIVIDE - The boundary or rim separating two drainage basins.

DRAWDOWN - The amount of decline in the water level or the reduction in hydrostatic pressure in a well caused by ground-water discharge.

EVAPORATION - The process by which a substance passes from a liquid or solid state to a vapor state.

EVAPOTRANSPIRATION - The combined processes by which water is lost from the land area by evaporation from water surfaces and moist soil and by transpiration from plants.

ft3/s (CFS) - The volume of water flowing in one second through a cross section with an area of 1 square foot.

FRESHWATER - Water with a low salinity or with a low dissolved-solids content.

GAGE HEIGHT OR STAGE - The height of a water surface above an arbitrarily established datum plane. Gage height and stage are synonymous terms.

GROUND WATER - The part of subsurface water that is in the zone of saturation. However, the term is used by some to refer to all water beneath the surface.

GROUND-WATER DISCHARGE - The removal of water by any means from the zone of saturation.

GROUND-WATER RECHARGE - The process by which water is added to the zone of saturation.

HARDNESS - The property of water that prevents lathering of soaps and causes the formation of insoluble residues when soap is used. It causes scale to form in vessels in which water has evaporated and is caused by the presence of some cations, primarily calcium and magnesium.

HEAD - The pressure of a fluid on an area at a given point caused by the height of the fluid surface above that point. A more general definition is the energy contained in a water mass, produced by elevation, pressure, or velocity.

HYDROGRAPH - A graph which shows the change in ground-water level, stream discharge, or other characteristics of water with time.

HYDROLOGIC BUDGET - An accounting of the inflow to, outflow from, and storage in a hydrologic unit such as an aquifer, drainage basin, or reservoir.

HYDROLOGIC CYCLE - A term to denote the sequence of events in the circulation of water from the sea, through the atmosphere, to the land, and back to the sea.

HYDROLOGY - The science that deals with the properties, circulation, and distribution of water on and under the earth's surface and in the atmosphere.

HYDROSTATIC HEAD - The height of a vertical column of water with a unit cross-sectional area having a weight equal to the hydrostatic pressure at a point.

HYDROSTATIC LEVEL - The level to which water will rise in a well under a full pressure head. This level defines the potentiometric surface. Same as STATIC LEVEL.

HYDROSTATIC PRESSURE - The pressure caused by the weight of water above the zone of saturation.

INFILTRATION - The movement of water into soils or into interstices or cracks in rocks.

INFILTRATION RATE - The rate at which soils or interstices in rocks under specified conditions can absorb water. It is expressed as depth of water per unit of time.

IMPERMEABLE - A term used in describing a substance that does not allow the transmittal of fluids. Also used to describe substances that allow little fluid transmittal.

MAXIMUM DISCHARGE - The instantaneous maximum streamflow. These values are commonly determined from records of surface-water elevation (stage, gage height) and the use of streamflow rating charts.

MAXIMUM GAGE HEIGHT - The maximum instantaneous gage height (stage).

MOISTURE - Water that is diffused in the atmosphere or in the ground.

PERCHED AQUIFER - An aquifer containing perched ground water.

PERCHED GROUND WATER - Ground water that is separated from an underlying main body of ground water by an unsaturated zone capped by an impermeable layer. Generally the impermeable layer is of limited lateral extent.

PERCHED WATER TABLE - The water table of a body of perched ground water. See PERCHED GROUND WATER.

PERCOLATION - The movement of water, generally downward, by the force of gravity or under hydrostatic pressure, through the interstices of rocks or soils, but not through large openings such as caves.

PERMEABILITY - The ability of a porous rock or soil to transmit fluids without impairment of the structure of the rock or soil.

POROSITY - The property of a rock or soil containing interstices. It is expressed as the ratio (as a percentage) of the volume of the interstices to the total volume of the rock or soil.

POTABLE WATER - Water that is safe and palatable for human consumption.

POTENTIOMETRIC MAP - A map showing the elevation of the potentiometric surface of an aquifer.

POTENTIOMETRIC SURFACE - The imaginary surface representing the total head of ground water in an aquifer. It is defined by the level to which water will rise in wells.

RECHARGE - The process by which water is added to the zone of saturation.

RECHARGE AREA - The area where water enters the soil and moves downward to the zone of saturation.

SALINITY - The quantity of dissolved salts in water measured by weight in parts per thousand with the qualifications that all carbonate has been converted to oxide, all bromide and iodide have been converted to chloride, and all organic matter has been oxidized.

SALTWATER ENCROACHMENT - The displacement of freshwater in an aquifer by saltwater because of the greater density of saltwater. The encroachment occurs when the total head of the saltwater exceeds that of the freshwater.

7-day Q2 LOW FLOW - The lowest mean discharge during 7 consecutive days of a year that will be expected to occur once every 2 years.

7-day Q10 LOW FLOW - The lowest mean discharge during 7 consecutive days of a year that will be expected to occur once every 10 years.

SOIL MOISTURE - Water in the upper part of the zone of aeration, which is just beneath the land surface.

SPECIFIC CAPACITY - The rate of discharge of water from a well per unit of drawdown. It is generally expressed in gallons per minute per foot of drawdown.

SPECIFIC DISCHARGE - The rate of discharge of ground water through a unit cross-sectional area of the aquifer measured perpendicular to the direction of flow.

SPECIFIC YIELD - The ratio of the volume of water that a saturated soil or rock will yield by gravity to the volume of the rock or soil.

SPRING - A place where ground water flows naturally from a soil or rock onto the land surface or into a surface-water body.

STAGE - See GAGE HEIGHT.

STATIC HEAD - The height above a standard datum of the surface of a column of water that can be supported by the static pressure at a given point. It is the sum of the elevation head and the pressure head.

STATIC LEVEL - See HYDROSTATIC LEVEL. Also, static level refers to the water level in a well that is not affected by ground-water withdrawal.

SUBSURFACE WATER - All water occurring below the surface of the earth and within bodies of surface waters.

TRANSPIRATION - The process by which water is absorbed by roots of plants and then evaporated into the atmosphere at the surfaces of the plants.

UNCONFINED WATER - Ground water that is not confined under pressure by relatively impermeable rocks. It has a free-water surface.

UNSATURATED ZONE - The zone between the land surface and the water table. The water is under pressure less than atmospheric pressure.

WATER TABLE - The surface of a ground-water body at which pressure equals atmospheric pressure. It is the surface that separates the zone of saturation and the zone of aeration, and is defined by the level at which water will stand in a well completed in an unconfined aquifer.

WATER YEAR - October 1 to September 30.

WELL - A pit, hole, or tunnel constructed in the ground for the purpose of obtaining water or other fluids from soils or rocks or for the purpose of injecting fluids into soils or rocks.

APPENDIX A

WATER LEVELS AND SPRING DISCHARGES, FALL 1995

Explanation

Abbreviations: cfs, cubic feet per second; gpm, gallons per minute.

Method of measurement: S, steel tape; E, electric line; C, current meter; A, air line; SI, Shut-in pressure; ES, estimated.

Note: -- indicates no data available.

See plate 2 for locations of wells and springs.

Appendix A.—Water levels and spring discharges, fall 1995

County	Well or spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Autauga	A-2	S	10/20/95	216.08	1.38	--	--
	D-7	--	10/20/95	--	--	--	Discontinued.
	E-8	S	10/30/95	132.87	0.03	--	--
	G-7	--	10/20/95	--	--	--	Not measured.
	I-37	S	10/19/95	99.07	-2.50	--	--
	I-38	--	10/20/95	--	--	--	Not measured.
	J-18	--	10/20/95	--	--	--	Not measured.
	L-10	S	10/30/95	8.12	1.38	--	--
	N-7	S	10/30/95	6.78	-0.36	--	--
	O-17	S	10/19/95	98.15	-2.49	--	--
	O-19	S	10/30/95	50.73	1.49	--	--
	P-25	--	10/20/95	--	--	--	Not measured.
	Q-28	S	10/20/95	153.02	--	--	Pump off 12 hours.
	R-57	S	10/19/95	31.00	-1.70	--	--
	R-62	S	10/19/95	84.66	-1.28	--	--
	T-8	--	10/20/95	--	--	--	Not measured.
	T-14	--	10/20/95	--	--	--	Not measured.
	U-5	S	10/19/95	125.36	-2.98	--	--
Baldwin	G-01	S	10/24/95	108.30	0.58	--	--
	U-01	S	10/25/97	66.55	0.40	--	Pump off several days.
	U-02	S	10/25/97	84.09	-2.08	--	Pump off 4 hours.
	KK-05	S	10/24/95	59.09	0.79	--	Pump off overnight.
	LL-6	--	10/25/95	--	--	--	Not measured.
	PP-6	S	10/25/95	34.64	0.56	--	Pump off overnight.
	UU-7 (Bal-1)	S	10/25/95	20.85	0.85	--	--
	DDD-02	--	10/24/95	--	--	--	Not measured.
Barbour	F-6	S	11/02/95	174.01	--	--	--
	K-02	S	11/02/95	216.23	-19.89	--	Pump off 16 hours.
	P-2	S	11/02/95	70.65	-0.51	--	--
	S-3	--	11/02/95	--	--	--	Discontinued.
	T-2	S	11/02/95	18.12	-1.05	--	--
	V-02	S	11/02/95	216.44	-17.45	--	Pump off 16 hours.
	EE-8	--	11/02/95	--	--	--	--
	FF-8	--	--	--	--	--	Not measured. Blue Spring.
Bibb	C-01	S	11/02/95	74.94	0.8	--	--
	C-02	C	11/02/95	0.65/290	-0.17/-78	--	Big Spring.
	L-1	C	11/02/95	3.73/1,670	0.75/332	--	Williams Spring. West Blocton Pumps 1,100 gpm.
	L-4	S	11/02/95	108.32	-7.15	--	--
	0-5 (Bib-1)	S	10/20/95	31.40	-0.85	--	--
	Q-7	S	10/20/95	29.25	0.84	--	--
	T-6	S	10/20/95	42.98	0.31	--	--
	V-1	C	11/02/95	38.5/17,300	11.04/4,970	--	Lightsey Spring.
	W-3	S	11/02/95	117.38	3.05	--	--
Blount	D-5	C	11/03/95	1.09/380	0.36/52	--	Blue Spring.
	E-1	S	11/03/95	18.09	3.36	--	--
	J-4	C	11/03/95	4.68/2,078	-0.66/-296	--	Warren (Big) Spring.
	M-3	S	11/01/95	3.91	7.08	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Bullock	F-1	S	10/31/95	--	--	--	Water level too deep to measure.
	G-2	S	10/31/95	149.22	-19.95	--	--
	L-2	--	10/31/95	--	--	--	Not measured.
	L-11	S	10/31/95	--	--	--	Dry.
	N-7	S	10/31/95	195.2	-1.1	--	--
	P-4	S	10/30/95	46.8	-0.94	--	--
	U-01	S	10/30/95	165.8	0.2	--	--
Butler	C-5	S	10/25/95	12.94	-0.69	--	--
	E-5	S	10/25/95	95.08	0.68	--	--
	F-8	S	10/25/95	78.03	-8.11	--	Pumped recently.
	K-2	S	10/25/95	67.81	-1.92	--	--
	M-3	S	10/25/95	82.10	-0.40	--	--
	P-1	S	10/30/95	97.19	-3.79	--	--
	P-3	S	10/30/95	12.26	-0.04	--	--
	Q-01	S	10/30/95	244.59	-3.29	--	--
	R-9	S	10/30/95	256.69	-3.49	--	Off 17 hours.
	S-6	S	10/25/95	38.55	-0.13	--	--
	T-3	S	10/25/95	144.82	-0.50	--	--
	W-11	--	10/25/95	--	--	--	Not measured.
Calhoun	F-68	C	10/23/97	6.07/2,720	0.21/89	--	Seven Springs. West Calhoun County pumps 1,000 gpm.
	G-01	C	10/23/97	3.25/1,460	-1.39/-623	--	Webster's Chapel Spring. West Calhoun County pumps 500 gpm.
	I-33	S	10/23/97	7.77	1.35	--	--
	L-1	C	10/23/97	5.23/2,350	0.83/374	--	--
	L-21	C	10/23/97	3.26/1,460	-0.04/-22	--	--
	L-74	S	10/23/97	13.69	0.74	--	--
	M-91	C	10/23/97	0.40/180	-1.96/-880	--	McCullar Springs.
	N-01	S	10/23/97	4.20	-0.35	--	--
	W-01	S	10/23/97	42.14	5.18	--	--
	W-12	C	10/23/97	28.96/13,000	-17.64/-7,923	--	Coldwater Spring. Anniston pumps 10,000 gpm.
Chambers	B-01	S	10/26/97	34.91	-1.94	--	--
	L-1	S	10/26/97	21.78	-1.05	--	--
	N-01	S	10/26/97	35.39	-1.26	--	--
	Q-01	S	10/25/97	5.37	-0.85	--	--
	W-01	S	10/26/97	39.59	-4.67	--	--
Cherokee	D-4	C	10/24/97	5.92/2,660	-0.48/-213	--	Berry Spring.
	F-4	S	10/24/97	18.24	-6.47	--	--
	G-9	C	10/24/97	3.86/1,730	-0.07/-36	--	Congo Spring.
	J-12	S	10/24/97	8.00	-4.68	--	--
	O-15	S	10/24/97	6.89	-4.04	--	--
	R-01	C	10/24/97	0.2/85	0.08/32	--	Stanford Spring.
	V-01	S	10/24/97	25.03	-0.47	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Chilton	F-4	S	10/27/95	48.60	-3.83	--	--
	O-2	S	10/20/95	56.19	0.69	--	--
	R-01	S	10/20/95	17.31	0.98	--	--
	X-5	S	10/20/95	53.04	-0.66	--	--
Choctaw	J-3	S	10/20/95	83.12	-1.51	--	--
	M-01	S	10/20/95	72.85	3.26	--	Pump off overnight.
	X-6	S	10/20/95	20.10	9.67	--	--
	BB-2	S	10/20/95	2.72	-0.44	--	--
	CC-2	S	10/20/95	57.17	0.96	--	--
	CC-6	S	10/20/95	13.53	-0.07	--	--
Clarke	H-1	S	10/20/95	22.99	-0.02	--	--
	H-2	P	10/20/95	+1.73	-0.04	--	Flowing 1.33 gpm.
	O-12	--	10/20/95	--	--	--	Not measured.
	R-2	S	10/20/95	29.12	0.88	--	--
	U-2	S	10/23/95	110.15	-1.16	--	Pump off overnight.
	EE-1	S	10/23/95	65.83	-0.63	--	--
	HH-6	--	--	--	--	--	Hover Spring. Not measured.
	JJ-01	S	10/23/95	13.06	0.18	--	--
	PP-9	S	10/23/95	9.64	-0.21	--	--
Clay	G-01	S	10/25/95	30.17	-3.12	--	--
	I-17	S	10/25/95	5.59	0.15	--	--
	V-12	S	10/25/95	4.18	-1.46	--	--
Cleburne	B-01	S	10/24/95	29.11	-0.64	--	--
	H-01	S	10/24/95	42.38	-7.52	--	--
	O-15	S	10/25/95	46.24	-2.34	--	--
	S-01	S	10/25/95	20.35	1.40	--	--
	Y-01	--	--	--	--	--	Discontinued.
Coffee	A-7	S	10/27/95	65.18	-0.45	--	--
	A-9	S	10/27/95	95.81	-0.08	--	--
	F-1	S	10/26/95	98.18	-2.40	--	--
	F-6	S	10/26/95	164.59	-4.04	--	--
	J-6	S	10/13/95	279.10	11.70	--	Pump off overnight.
	K-4	S	10/13/95	18.39	-3.24	--	--
	L-6	S	10/26/95	70.79	-0.52	--	--
	L-8	--	10/27/95	--	--	--	Not measured.
	N-6	S	10/26/95	164.85	-3.10	--	--
	Q-4	S	10/27/95	254.00	--	--	--
	Q-5	--	10/27/95	--	--	--	Not measured.
	Q-7	S	10/27/95	63.65	-3.42	--	--
	T-1	S	10/27/95	54.08	-2.01	--	--
	T-7	S	10/26/95	101.88	-5.08	--	Pump off 4 hours.
Colbert	E-69	S	10/27/95	29.37	-1.71	--	--
	E-70	C	10/27/95	0.90/404	-0.96/-431	--	Buzzard Roost Spring.
	H-80	S	11/01/95	16.52	-1.85	--	--
	M-20	C	10/27/95	52.67/23,640	-16.80/-7,538	--	Tuscumbia Spring.
	M-147	S	10/27/95	8.09	9.86	--	--
	M-161	S	10/27/95	66.92	-5.26	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Conecuh	E-1	S	10/25/97	84.07	-0.84	--	--
	M-01	S	10/26/97	145.23	12.90	--	Pump off 18 hours.
	S-2	S	10/26/97	65.05	-0.06	--	Pump off 18 hours.
	T-01	S	10/25/97	39.05	-0.28	--	--
	EE-21	S	10/25/97	10.88	0.32	--	--
Coosa	C-2	S	10/25/97	1.87	0.05	--	--
	F-01	S	10/25/97	11.49	-0.70	--	--
	M-2	S	10/25/97	17.97	18.40	--	Pump off 3.5 hours.
Covington	C-1	S	10/26/97	189.08	-0.39	--	--
	M-4	--	10/26/97	--	--	--	Not measured.
	M-5	S	10/26/97	68.82	-1.34	--	--
	M-8	S	10/27/97	249.62	-1.44	--	--
	N-3	S	10/27/97	71.50	3.24	--	--
	Q-4	S	10/26/97	121.62	-0.51	--	--
	S-2	S	10/26/97	67.16	-0.58	--	--
	S-4	S	10/26/97	92.83	0.49	--	--
	U-1	S	10/26/97	53.93	0.79	--	--
	Z-4	S	10/26/97	71.29	-2.54	--	--
	AA-1	S	10/26/97	79.69	-0.24	--	--
	CC-3	S	10/26/97	30.02	0.47	--	--
	CC-4	S	10/26/97	34.89	1.45	--	--
	CC-5	S	10/26/97	89.91	-0.03	--	Pump off more than 12 hours.
	DD-3	--	10/26/97	--	--	--	Not measured.
Crenshaw	H-4	S	10/25/97	93.57	-1.54	--	--
	I-2	S	10/25/97	104.20	-2.55	--	--
	K-7	S	10/25/97	93.62	-6.57	--	--
	L-5	S	10/25/97	224.76	-6.61	--	Pump off 12 hours.
	S-1	S	10/26/97	122.70	-0.98	--	--
	S-2	S	10/26/97	47.27	-1.12	--	--
	T-6	S	10/26/97	48.64	0.26	--	--
	T-9	S	10/26/97	56.77	5.89	--	Pump off 4 hours.
Cullman	I-01	--	11/01/95	--	--	--	Not measured.
	V-02	S	11/01/95	9.73	-2.54	--	--
	BB-02	S	11/01/95	19.07	0.09	--	--
Dale	B-8	S	10/11/95	169.65	-1.62	--	--
	C-3	S	10/11/95	178.68	-0.18	--	--
	D-4	S	10/13/95	160.68	1.18	--	--
	D-5	A	10/13/95	150	--	--	--
	E-3	S	10/11/95	84.56	-0.87	--	--
	E-12	--	10/12/95	--	--	--	Not measured.
	F-8	S	10/11/95	114.79	-1.91	--	--
	F-14	S	10/11/95	74.42	-4.49	--	--
	F-16	S	10/11/95	338.53	-6.44	--	--
	F-17	A	10/11/95	296.45	-4.61	--	Pump off 23 hours.

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Dale-Cont'd	F-22	S	10/11/95	269.17	1.03	--	--
	G-9	S	10/11/95	5.85	7.71	--	--
	L-2	S	10/12/95	65.46	-4.26	--	--
	M-3	--	--	--	--	--	Not measured.
	M-18	A	10/12/95	207.04	-9.24	--	Pump off for months.
	N-6	S	10/12/95	187.44	-0.45	--	--
	N-8	S	10/12/95	106.62	-4.22	--	--
	N-10	S	10/12/95	193.02	-4.32	--	--
	O-12	--	10/12/95	--	--	--	Not measured.
	P-4	--	11/01/95	--	--	--	Not measured.
	P-7	S	11/01/95	282.25	-6.43	--	--
Dallas	C-10	S	10/18/95	95.55	-0.73	--	--
	G-2	S	10/18/95	47.46	-2.00	--	--
	H-4	S	10/18/95	39.40	1.28	--	
	J-03	S	10/19/95	26.27	7.99	--	Pump off 12 hours.
	K-5	--	10/18/95	--	--	--	Well discontinued.
	S-3	S	10/19/95	72.72	-1.44	--	--
	U-2	S	10/19/95	63.73	-1.76	--	--
	AA-1	S	10/20/95	10.50	-1.13	--	--
	GG-2	S	10/20/95	129.05	-1.37	--	--
	HH-1	S	10/2095	48.72	-0.60	--	--
DeKalb	J-3	C	11/13/95	2.35/1,055	1.57/705	--	Phillips Spring.
	J-10	S	11/13/95	7.46	-1.09	--	--
	N-3	C	11/13/95	8.40/3,793	-0.19/-85	--	Allen Spring.
	P-2	S	11/06/95	22.89	-5.59	--	--
	V-6	S	11/13/95	20.86	-2.55	--	--
	EE-01	--	11/13/95	--	--	--	
Elmore	F-04	S	10/30/95	69.25	--	--	First measurement.
	J-6 (Elm-1)	S	10/30/95	15.70	0.64	--	--
	N-2	S	10/30/95	25.79	0.27	--	--
	P-3	S	10/30/95	145.01	-0.83	--	--
	R-5	S	10/30/95	30.00	-0.10	--	--
	R-13	S	10/30/95	48.71	-0.40	--	--
	S-5	S	10/30/95	48.09	-6.19	--	--
	U-14	S	10/30/95	6.86	2.15	--	--
Escambia	A-27	C	10/25/95	0.91/408	0.43/193	--	McCreary Spring.
	O-95	S	10/25/95	46.76	-8.52	--	Pump off 4 hours.
	Q-77	S	10/25/95	46.00	0.48	--	--
	Q-78	S	10/25/95	114.59	0.30	--	--
	V-37	--	10/25/95	--	--	--	Destroyed.
	Z-71	S	10/25/95	42.03	1.10	--	Pump off 12 hours.
Etowah	B-12	S	11/13/95	16.55	2.32	--	--
	C-16	S	11/13/95	3.58	3.61	--	--
	D-01	S	11/13/95	1.77	2.44	--	--
Fayette	C-9	S	10/19/95	59.05	0.45	--	--
	D-3	S	10/19/95	84.97	-0.95	--	--
	K-1	S	10/19/95	33.52	-2.75	--	--
	N-01	S	10/19/95	36.66	-1.15	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Franklin	O-27	S	10/19/95	30.10	-4.61	--	--
	P-01	S	10/19/95	36.63	1.46	--	--
Geneva	B-2	S	10/30/95	58.65	-3.03	--	--
	C-2	S	10/30/95	33.67	-2.81	--	--
	H-8	S	10/26/95	47.82	-0.33	--	--
	I-7	--	10/30/95	--	--	--	Not measured.
	J-1	C	10/30/95	0.91/408	0.02/9	--	Coffee Springs.
	J-4	--	10/30/95	--	--	--	Not measured.
	L-5	S	10/31/95	47.06	-7.58	--	Pump off 16 hours.
	L-6	S	10/31/95	55.08	-13.03	--	Pump off 16 hours.
	L-7	S	10/31/95	27.41	-5.39	--	--
	N-9	--	10/31/97	--	--	--	Not measured.
	Q-9	S	10/30/95	24.39	-3.97	--	--
	R-10	S	10/31/95	12.26	2.84	--	--
	R-11	S	10/31/95	--	--	--	Not measured.
	R-16	S	10/31/95	118.66	-0.58	--	Pump off short time.
	R-17	S	10/12/95	87.02	-4.62	--	--
	S-8	P	10/31/95	107.10	-7.00	--	--
	T-9	S	10/30/95	33.06	-0.80	--	--
	X-4	S	10/30/95	96.00	-1.86	--	--
	AA-2	S	10/30/95	63.28	-4.57	--	--
Greene	F-1	S	10/16/95	42.57	-0.45	--	--
	J-4	S	10/16/95	6.22	-0.26	--	--
	M-14	--	10/16/95	--	--	--	Casing broken; not measured.
	Q-6	S	10/16/95	31.47	0.62	--	--
	R-9	S	10/16/95	9.93	-0.76	--	--
	R-12	S	10/16/95	100.70	8.20	--	--
	DD-9	S	10/16/95	28.92	-1.63	--	--
	EE-2	S	10/16/95	36.61	-1.03	--	--
Hale	C-3	S	10/20/95	10.70	-0.18	--	--
	E-5	S	10/20/95	0.0	--	--	--
	E-7	S	10/20/95	9.80	-1.41	--	--
	I-7	S	10/20/95	56.96	0.37	--	--
	J-14	S	10/20/95	10.47	0.47	--	--
	O-25	S	10/20/95	60.99	-1.51	--	--
	R-2	S	10/20/95	24.69	0.03	--	--
	R-13	S	10/20/95	66.88	-7.82	--	--
	S-13	S	10/20/95	+3.65	0.75	--	Flowing well.
Henry	A-3	--	11/02/95	--	--	--	Not measured.
	F-4	S	11/02/95	350.33	-3.38	--	--
	J-1	S	11/02/95	140.46	-3.59	--	--
	J-7	S	11/02/95	204.60	-9.04	--	Pump off 11 hours.
	K-3	S	11/02/95	197.70	-1.81	--	--
	K-5	S	11/02/95	215.76	-6.18	--	Pump off more than 6 hours.
	N-7	S	11/01/95	21.71	-1.77	--	--
	N-8	S	11/01/95	229.90	-3.12	--	--
	P-5	S	10/02/95	155.76	-2.07	--	--
	V-3	S	11/01/95	243.73	-6.27	--	--
	X-1	S	11/01/95	283.35	1.36	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Houston	A-4	S	11/01/95	140.65	-1.80	--	--
	G-02	S	10/12/95	266.63	-4.32	--	--
	H-4	S	10/12/95	69.31	-2.65	--	--
	I-8	S	11/01/95	36.77	0.37	--	--
	I-11	S	11/01/95	316.18	-45.79	--	Pump off 18 hours.
	I-18	S	11/01/95	335.87	-4.37	--	Pump off 18 hours.
	J-3	S	11/01/95	333.20	-3.66	--	--
	J-8	--	11/01/95	--	--	--	Not measured.
	K-12	S	11/01/95	60.83	-0.26	--	Pump off 5 hours.
	K-15	--	10/31/95	--	--	--	Not measured.
	N-14	S	11/01/95	112.56	-10.51	--	Pump off 5 hours.
	O-12	S	10/31/95	25.52	-9.99	--	--
	Q-6	S	10/31/95	89.00	-0.33	--	--
	Q-7	S	10/31/95	78.75	-4.04	--	--
	R-6	S	10/30/95	32.47	-11.30	--	--
	R-01	S	10/30/95	31.58	-3.16	--	--
	S-8	S	10/31/95	16.34	-2.83	--	--
	T-10	S	10/31/95	30.25	9.17	--	--
	U-7	S	10/31/95	34.55	-13.30	--	--
	U-8	S	10/31/95	46.28	-11.06	--	--
	X-2	S	10/31/95	39.44	-12.01	--	--
	AA-1	S	10/31/95	39.62	-3.97	--	--
Jackson	M-3	S	11/06/95	5.19	-0.24	--	--
	N-2	C	11/06/95	11.88/5,332	-3.90/-1,750	--	Brown Spring.
	N-100	S	11/06/95	35.56	2.72	--	--
	AA-11 (Jac-2)	S	11/06/95	10.48	-4.79	--	--
	HH-3	--	11/06/95	--	--	--	No access to well.
Jefferson	B-1	S	10/20/95	5.48	3.00	--	--
	L-5	S	10/20/95	56.42	2.51	--	--
	M-5	C	10/20/95	1.24/560	0.43/195	--	Robinwood Spring.
	T-02	S	10/20/95	29.85	-0.92	--	--
	Y-1	C	10/20/95	0.83/374	-2.14/-960	--	Rowan Spring.
	LL-9	S	10/20/95	3.88	0.23	--	--
Lamar	E-10	S	10/18/95	12.17	3.25	--	--
	K-13	S	10/18/95	27.19	0.59	--	--
	L-7	--	10/18/95	--	--	--	Discontinued.
	O-9	S	10/18/95	34.64	1.07	--	--
	Q-5	S	10/18/95	22.00	-0.50	--	--
Lauderdale	C-60	S	10/27/95	82.30	-1.32	--	--
	O-175 (Lau-2)	S	10/28/95	--	--	--	Not measured.
	O-180	S	10/27/95	10.08	-1.44	--	--
	S-39	C	10/29/95	0.14/60	-0.004/-5	--	Blowing Spring.
	S-71	S	11/02/95	57.31	-7.77	--	--
Lawrence	F-32 (Law-2)	S	11/01/95	41.95	-1.00	--	--
	G-39	C	11/01/95	1.08/485	-3.46/-1,553	--	Wheeler Spring.
	H-16	S	11/01/95	21.40	-14.53	--	--
	O-36	S	11/01/95	6.83	2.12	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Lawrence-Con'd	T-9 (Law-3)	S	11/01/95	9.07	-2.77	--	--
Lee	C-01	--	10/26/95	--	--	--	Destroyed.
	H-01	S	10/26/95	20.60	-2.57	--	--
	J-6	C	10/26/95	3.60/1,620	0.65/295	--	Spring Villa Spring.
	K-01	S	10/26/95	22.93	-2.15	--	--
	O-01	S	10/26/95	44.12	-3.77	--	--
	R-06	S	10/26/95	26.52	-2.99	--	--
Limestone	A-1	C	10/31/95	1.09/490	0.004/3	--	Blowing Spring.
	A-42	S	11/02/95	13.57	0.26	--	--
	I-40	S	11/02/95	45.62	-4.13	--	--
	J-169	S	11/02/95	--	--	--	Discontinued.
	M-2	S	11/02/95	52.50	35.50	--	--
Lowndes	B-3	S	10/20/95	11.87	-0.97	--	--
	J-14	S	10/20/95	65.35	-3.05	--	--
	L-12	S	10/20/95	129.73	-5.03	--	--
Macon	H-12	S	11/01/95	39.76	2.65	--	--
	I-4	S	11/01/95	127.35	6.44	--	--
	N-14	S	10/30/95	23.28	-0.81	--	--
	P-7	S	11/01/95	22.91	1.24	--	--
	W-21	S	11/01/95	93.99	20.33	--	--
Madison	B-16	S	11/03/95	60.32	2.85	--	--
	N-01 (Mad-2)	S	11/02/95	69.29	-0.65	--	--
	P-01	S	11/02/95	78.52	2.45	--	--
	R-01 (Mas-3)	S	11/02/95	13.80	3.25	--	--
	Z-12	C	11/03/95	16.48/7,398	11.57/5,805	--	New Hope Spring.
Marengo	A-16	S	10/18/95	64.87	-1.57	--	--
	F-30	S	10/18/95	33.86	-0.77	--	--
	G-26	S	10/18/95	52.80	-2.18	--	--
	I-62	S	10/18/95	84.88	-1.82	--	--
	M-8	S	10/18/95	74.27	-1.75	--	--
	R-9	S	10/18/95	27.96	-4.16	--	--
	S-10 (Mag-2)	S	10/18/95	37.51	-7.48	--	Pumped recently.
	V-17	S	10/18/95	83.20	15.80	--	--
	CC-4	S	10/18/95	82.29	-0.21	--	--
	DD-10	S	10/18/95	48.53	-2.01	--	--
	EE-20	S	10/18/95	24.84	0.26	--	--
	GG-5	S	10/18/95	29.36	-0.51	--	--
Marion	H-2	S	10/18/95	77.00	-4.20	--	--
	J-7	S	10/19/95	69.67	48.93	--	Pump off for months.
	M-11	S	10/19/95	32.60	0.39	--	--
	T-4	S	10/18/95	45.38	0.96	--	--
Marshall	O-01	S	11/03/95	--	--	--	Flowing.
	O-02	S	11/03/95	12.50	1.74	--	--
	O-03	S	11/03/95	11.10	1.18	--	--
	P-4	S	11/03/95	11.14	-0.64	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Mobile	D-2	S	10/24/95	272.81	-0.26	--	Pump off overnight.
	V-1	S	10/24/95	14.92	1.87	--	--
	W-2	S	10/24/95	125.11	0.99	--	--
	GG-1	S	10/24/95	54.32	0.83	--	--
	KK-05	S	10/24/95	69.22	-4.14	--	Pump off 4+ hours.
	MM-2	S	10/24/95	18.12	-0.82	--	--
	UU-2	S	10/24/95	7.64	-4.48	--	Pump off 3 hours.
Monroe	B-2	S	10/27/95	197.33	-1.34	--	Pump had been running.
	E-5	S	10/27/95	54.80	-0.50	--	--
	J-6	S	10/27/95	219.99	--	--	--
	J-7	S	10/27/95	137.16	-1.72	-4.42	--
	O-3	S	10/23/95	250.73	-0.14	--	--
	U-4	S	10/30/95	376.75	-4.53	--	--
	U-5	S	10/23/95	38.71	-0.04	--	--
	GG-01	S	10/24/95	115.82	-0.73	--	--
	HH-02	S	10/24/95	78.12	-13.66	--	--
Montgomery	H-6	--	10/30/95	--	--	--	Not measured.
	K-83	--	10/30/95	--	--	--	Not measured.
	N-5	--	10/30/95	--	--	--	Not measured.
	P-01	--	10/30/95	--	--	--	Not measured.
	X-2	S	10/30/95	4.89	1.10	--	--
	X-13	S	10/30/95	207.24	-3.17	--	--
	Z-14	S	10/30/95	263.64	-2.57	--	--
	AA-25	S	10/30/95	333.08	8.22	--	--
	AA-26	S	10/30/95	33.68	-0.13	--	--
Morgan	B-344 (Mor-2)	S	11/02/95	24.74	-4.55	--	--
	B-04 (Mor-6)	S	11/02/95	31.33	0.27	--	--
	0-26	S	11/01/95	4.53	-0.68	--	--
	R-157	C	11/02/95	12.38/5,556	--	--	Hughes Spring.
Perry	B-1	S	10/20/95	47.38	1.10	--	--
	F-3	S	10/20/95	15.35	-0.13	--	--
	H-5	S	10/20/95	23.88	1.42	--	--
	L-3	S	10/20/95	13.07	-2.89	--	--
	M-5	S	10/20/95	141.5	34.50	--	--
	R-2	S	10/20/95	+10.80	-0.40	--	Flowing well.
Pickens	D-10	S	10/11/95	22.07	-1.35	--	--
	G-5	S	10/11/95	12.89	3.36	--	--
	I-22	--	10/11/95	--	--	--	Not measured.
	K-5	S	10/11/95	82.50	0.03	--	--
	M-18	S	10/11/95	9.48	-0.25	--	--
	R-02	S	10/11/95	63.00	0.62	--	Well number corrected from M-15.
	S-1	S	10/11/95	74.60	0.44	--	--
	U-5	--	10/11/95	--	--	--	Discontinued.
	X-23	S	10/11/95	42.60	-13.66	--	--
Pike	D-7	S	10/26/95	41.50	0.80	--	--
	D-11	S	10/26/95	190.02	-3.33	--	--
	G-2	S	10/26/95	25.03	-0.88	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since: Fall 1994	Spring 1994	Remarks
Pike-Con'd	I-13	S	10/25/95	172.61	-2.92	--	--
	O-6	S	10/26/95	144.05	-0.28	--	--
	P-15	S	10/26/95	96.98	-5.15	--	--
	Q-8	S	10/26/95	370.85	4.61	--	--
	R-01	S	10/13/95	395.10	-9.20	--	Pump off 15 hours.
	T-3	S	10/26/95	--	--	--	Not measured.
Randolph	C-01	S	10/25/95	45.76	-1.58	--	--
	K-5 (Ran-1)	--	10/25/95	--	--	--	Not measured. Now equipped with continuous recorder.
	O-01	S	10/25/95	13.25	-3.30	--	--
Russell	C-3	S	11/01/95	18.44	-1.96	--	--
	G-1	S	11/01/95	39.34	-0.57	--	--
	I-16	S	11/01/95	31.60	-0.62	--	--
	L-1	S	11/01/95	48.88	-0.04	--	--
	M-13	S	10/31/95	85.64	-52.86	--	--
	X-5	S	10/31/95	245.40	-7.60	--	--
St. Clair	E-5	C	10/23/95	5.57/2.500	-15.68/-7,041	--	Muckleroy Spring.
	L-17	S	10/20/95	6.65	-4.57	--	--
	M-8	C	10/20/95	2.68/1,200	0.56/248	--	Springville Spring.
	S-14	S	10/20/95	1.73	-1.40	--	--
	X-2	C	10/10/95	0.02/10	-0.46/-207	--	Spring discharge is overflow from small lake. Town Spring.
	Z-4	C	10/20/95	8.70	2.85	--	--
	Z-01	C	10/20/95	1.41/635	-0.36/-160	--	Weems Spring.
Shelby	G-12	S	10/27/95	42.91	-5.26	--	--
	J-15	S	10/27/95	4.37	1.03	--	New measuring point 0.2 feet above land surface.
	AA-7	C	10/27/95	2.82/1,270	0.03/17	--	Not pumping. Little Spring.
	GG-3	C	11/01/95	4.18/1,880	0.41/187	--	Bay Spring.
	II-4	S	10/27/95	13.18	1.16	--	--
Sumter	B-3	S	10/18/95	16.00	-0.33	--	--
	E-10	S	10/18/95	8.52	0.52	--	--
	I-14	S	10/18/95	44.01	-2.55	--	--
	S-1	S	10/18/95	20.11	-0.23	--	--
	Y-1	--	10/18/95	--	--	--	Not measured.
	HH-2	S	10/18/95	24.39	-0.07	--	--
Talladega	F-7	S	10/27/95	98.61	3.42	--	--
	G-14	C	10/27/95	6.22/2,790	0.42/185	--	Cedar Spring.
	N-01	S	10/26/95	90.75	-18.61	--	--
	R-2	C	10/27/95	2.54/1,140	0.86/386	--	Grogan Spring.
	V-14	C	10/27/95	1.77/800	-0.52/-228	--	Tallaseehatchee Spring.
	AA-19 (Tal-2)	S	10/26/95	31.66	-13.45	--	--
Tallapoosa	A-02	S	10/25/95	33.74	-2.40	--	--
	L-01	S	10/25/95	30.14	-2.10	--	--
	N-01	S	10/25/95	67.69	1.26	--	--
Tuscaloosa	A-03	S	10/25/95	18.65	-3.72	--	--
	E-20	S	10/18/95	32.19	0.33	--	--
	O-02	S	10/16/95	16.95	-2.71	--	--

Appendix A.—Water levels and spring discharges, fall 1995—Continued

County	Well or Spring no.	Method of measure-ment	Date	Depth (ft) to water level below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water level (ft) or spring discharge (cfs/gpm) since:		Remarks
					Fall 1994	Spring 1994	
Tuscaloosa-Con'd	Y-14	C	10/12/95	5.44/2,442	1.75/786	--	--
	EE-44 (Tus-1)	S	01/09/96	27.03	0.48	--	--
	FF-9 (Tus-5)	--	10/11/95	--	--	--	Not measured
	F-20	S	10/11/95	24.02	-5.87	--	--
	LL-16	--	--	--	--	--	Big Sandy Spring. Not measured.
	SS-14	S	10/16/95	+4.54	--	--	--
Walker	D-02	--	10/25/95	--	--	--	Not measured. Previously published as D-01.
	I-1	S	10/25/95	39.62	-0.12	--	--
	T-01	S	10/25/95	25.30	0.67	--	--
Washington	H-1	S	10/23/95	13.0	-1.61	--	--
	P-4	S	10/23/95	106.42	-0.11	--	Pump off at least overnight.
	EE-1	--	10/23/95	--	--	--	Not measured.
Wilcox	H-17	--	10/20/95	--	--	--	Not measured.
	H-20	S	10/20/95	20.80	-1.11	--	--
	O-38	--	10/20/95	--	--	--	Not measured.
	T-3	S	10/20/95	19.86	1.76	--	--
	GG-15	S	10/20/95	68.51	-0.53	--	--
Winston	G-01	S	10/19/95	43.98	2.99	--	--
	J-01	S	10/19/95	55.94	1.04	--	--
	O-01	S	10/19/95	153.90	5.80	--	--

APPENDIX B

WELL FORMS

REPORT OF DRILLED WELL

DRILLING CONTRACTOR | License Number | Address | Zip Code | Date

PROPERTY OWNER | Address (mailing) | Zip Code

WELL LOCATION | County | Section | ¼ Section | Township | Range ---or:

Distance and direction from nearest town, community, road junction or other reference point

WELL WILL BE USED FOR: ☐ Private supply ☐ Public supply ☐ Industrial supply ☐ Test well ☐ Irrigation Other: ____________

Estimated starting date | Drilling method (check) Cable tool, Rotary, Jetted, Bored, Other: ____________ | Diameter of well | Estimated depth

SIGNATURE of Drilling Contractor

Total Depth ____________ Completion Date ____________

Inter-val	Description of cuttings	Inter-val	Description of cuttings

Completion date: report depths below ground level

Pump

Type: ☐ Turb. ☐ Subm. ☐ Jet ☐ Cyl.; Other: ____________

Intake depth ____________ H.P. ____________ Yield ____________ gpm

Capacity

Tested by: ☐ pumping ☐ air lift ☐ bailer ☐ none

Measured Static Water Level ____________ ft.

Measured pumping level ____________ ft. after

____________ hrs. pumping ____________ gpm

Development time prior to testing ____________ hrs.

Finish

☐ Open hole ☐ Screened ☐ Slotted pipe ☐ Gravel pk.

Interval(s) screened: ____________ to ____________ ft;

____________ to ____________; ____________ to ____________ ft.

Packer(s) set at ____________ and ____________ ft.

Screen: diam. ____________; Size openings ____________

Casing

Interval cased	Diam. (Inches)	*Type pipe	*Type couplings	Interval grouted

*Couplings: Threaded & Coupled (T&C) Welded (W) Threaded & coupled & welded (TC&W)

Other: ____________

*Pipe: Black; PVC; Galv.; Other: ____________

Quality

Water analysis obtained? (check) ☐ No ☐ Bacteriological ☐ Chemical

Analysis by: ☐ Ala Geol. Surv. ☐ U.S. Geol. Surv. ☐ Ala Health Dept. ☐ Private lab.

Signed:

*For deeper well please attach continuation sheet.

ADEM Form 60 1/83

NOTIFICATION OF INTENT TO DRILL A WATER WELL

DRILLING CONTRACTOR License Number Address Zip Code Date

PROPERTY OWNER Address (mailing) Zip Code

WELL LOCATION County Section ¼ Section Township Range — —-or:

Distance and direction from nearest town, community, road junction or other reference point

WELL WILL BE USED FOR:

☐ Private supply ☐ Public supply ☐ Industrial supply ☐ Test well

☐ Irrigation Other: ____________

Estimated starting date

Drilling method: (check) Cable tool Rotary Jetted Bored Other: ____________

Diameter of well

Estimated depth

ADEM Form 60 1/83

SIGNATURE of Drilling Contractor

(Tear here for mailing.)

FIRST CLASS POSTAGE

SANITARIAN

____________ **County Health Department**

____________, **Alabama**

APPENDIX C

STATE OF ALABAMA
LICENSED WATER WELL DRILLERS, 1995

Pursuant to the provisions of the Alabama Environmental Management Act, Code of Alabama 1975, Section 22-22A-5(1) (1984 and 1988 cum. supp.), the following have been granted a license by the Alabama Department of Environmental Management Water Well Standards Program to drill water wells within the State of Alabama.

Appendix C.--State of Alabama licensed water well drillers, 1995

AAA WATER WELL DRILLING
Rt. 2, Box 228
Fort Payne, AL 35967
205/657-4471
(Gerald L. Garmany)

A-1 DRILLING SERVICE, INC.
1553 Highway 84 E
Laurel, MS 39440
601/428-1435
(Wilbur T. Baughman)

A. D. & HAYWARD HUGHES WELL DRILLING
Rt. 1, Box 320
Chancellor, AL 36316
334/347-8762
(Alvie D. Hughes)

A. E. DRILLING SERVICES, INC.
Two United Way
Greenville, S.C.
803/288-1986
(Mark Lassiter)

ADAM-MASSEY COMPANY
309 N. Park Street
Carrollton, GA 30117
770/832-3132
(James C. Adams)

AL LITTLE DRILLING
7036 County Road 217
Hillsboro, AL 35643
205/974-8996
(Al Little)

ALA PENN DRILLING
8860 Mudd Street
Ohatchee, AL 35643
334/892-0366
(George Shuniak)

ALABAMA POWER CO.
P. O. Box 2641
Birmingham, AL 35291
205/250-1642
(Harold D. Rigsby)

ALLEN & WILLIS DRILLING CO.
Rt. 1, Box 52
Faunsdale, AL 36738
334/628-6398
(Thomas B. Willis)

ALLIANCE ENVIRONMENTAL SERVICES, INC.
174 Misty Oak Lane
Aiken, SC 29803
803/652-0828
(David N. Boggs)

ALMS PUMP SERVICE, INC.
201 E. Michigan Ave.
Foley, AL 36535
334/943-1249
(Michael Alms)

AMERICAN DRILLING, INC.
14811 North 12th Street
Lutz, Florida 33549
813/971-8148
(Jerry A. Howell)

ANDERSON DRILLING CO.
Rt. 3, Box 65
Grove Hill, AL 36451
334/275-8726
(Joe Anderson, Jr.)

ANDERSON ENGINEERING CONSULTANTS
10205 Rockwood Road
Little Rock, AR 72204
501/455-4545
(Scott W. Anderson)

BALLARD WELL DRILLING CO.
456 11th Avenue, South
Alexander City, Alabama 35010
334/234-6850
(Donald C. Ballard)

BAMA PUMP & WELL
13900 Tanner Williams Road
Wilmer, AL 36587
334/649-9040
(Michael L. Shumock)

BINGHAM DRILLING COMPANY
Route 2, Box 121
Eddyville, KY 42038
502/388-2515
(Roy E. Bingham)

BLAIR DRILLING
103 Salter St.
Evergreen, AL 36401
334/578-2353
(Wayne M. Blair)

BOONES WATER WELL SERVICE
Route 2, Box 168M
Bonifay, FL 32425
904/263-1411
(James E. Boone)

BRADY WELL & PUMP WORKS
2525 Dallas County Road 80
Selma, AL 36703
334/874-6801
(R. A. Brady, Jr.)

BRANTON BROTHERS WELL DRILLING
755 Malvern Road
Dothan, AL 36301
334/677-5489
(Terry C. Branton)

BURNETT CONTRACTING & DRILLING COMPANY
P. O. Box 5863
Lakeland, FL 33807
(Leonard Burnett)

JIM L. CALHOUN
3396 Stefani Road
Cantonment, FL 32533
(Jim L. Calhoun)

CHAMPION DRILLING CO., INC.
P. O. Box 565
Thomasville, AL 36784
334/576-5555
(Richard M. Champion)

CHAMPION WATER SYSTEMS, INC.
818 Veterans Memorial Parkway
Lanett, AL 36863
334/576-5555
(Frank L. Champion)

CLARDY WELL SERVICE
203 Ellis Road
Columbus, MS 39702
601/328-3168
(Donald B. Clardy)

CLAYTON DUNCAN DRILLING
Rt. 3, Box 482
Jasper, AL 35501
205/387-2318
(Thomas Clayton Duncan)

Appendix C.--State of Alabama licensed water well drillers, 1995—Continued

CLYDE'S WELL SERVICE
4537 Jay Barlow Road
Jay, FL 32565
904/675-6230
(Lewis Clyde Johnson)

COAST WATER WELL SERVICE, INC.
6601 Baker Rd.
Ocean Springs, MS 39564
601/875-0260
(H. O. Ridgdell, Jr.)

COCHRAN DRILLING SERVICE
2703 Old Richton Road
Petal, MS 39465
601/583-9213
(Earnest L. Cochran)

COLEY WELL DRILLING
Rt. 1, Box 410
Forkland, AL 36470
205/289-1868
(Joel A. Coley)

CUSTOM DRILLING SERVICES, INC.
330 G. Winston Creek Parkway
Lakeland, FL 33809
813/686-1399
(Wayne D. Smith)

D & H WELL CO.
8630 Howells Ferry Rd.
Semmes, AL 36575
334/649-6912
(Henry Havens)

DAN GRAY WELL DRILLING
Rt. 1, Box 164
Geneva, AL 36340
334/684-3203
(Dan Gary)

DAVID MILLS WELL DRILLING
Rt. 3, Box 111
Pikeville, TN 37367
423/881-3273
(David A. Mills)

DAVIS WELL COMPANY
40 Sommerset Drive
Phenix City, AL 36869
334/291-1047
(Larry W. Davis)

DELMA BAIRD WELL DRILLING
Rt. 2, Box 73
Arley, AL 35541
205/384-4923
(Delma Baird)

DEPENDABLE DRILLING CO.
7760 William Howton Road
Mulga, AL 35118
205/436-4886
(Neil W. McCarty)

DIXIE DRILLING CORPORATION
1940 Pinson Valley Parkway
Birmingham, AL 35217
205/849-5411
(Russell F. Boren)

DIXIE WELL BORING COMPANY, INC.
1254 Bartley Road
LaGrange, GA 30240
706/884-5756
(Arthur W. Watson)

DOHERTY DRILLING COMPANY
P.O. Box 2311
Laurel, MS 39442
601/428-1496
(Eddie M. Doherty)

DONALD SMITH COMPANY, INC.
Rt. 3, Box 1
Headland, AL 36345
334/693-2969
(Donald E. Smith)

DRILL SOUTH
100 River Point Corporate Center
Birmingham, AL 35243
205/967-6834
(John M. Harris)

EDGAR & JERRY HUGHES WELL DRILLING
Rt. 1, Box 331
Chancellor, AL 36316
334/347-9758
(Edgar Hughes)

ENVIRONMENTAL DRILLING SERVICE, INC.
4712 Old Winter Garden Road
Orlando, FL 32811-1740
407/295-3532
(Douglas A. Leonhardt)

EVERETTE LEAVINS SR. WELL DRILLING CO.
Rt. 1, Box 442
Westville, FL 32464
904/965-2122
(Everette Leavins)

F. L. JOHNSTON WELL DRILLING
P. O. Box 85
Gainesville, AL 35464
334/652-9862
(Forrest L. Johnston)

FELTMAN DRILLING CO.
Rt. 1, Box 232-B
Carbon Hill, AL 35549
205/622-3563
(Billy R. Feltman)

FRYFOGLE WATER WELL SERVICE
194 Depot Road
Lucedale, MS 39452
601/947-3262
(Pal R. Fryfogle)

FUGRO GEOSCIENCES, INC.
6105 Rookin
Houston, TX 77074
713/778-5580
(Beaumon Rogers)

G & E SERVICES, INC.
12751 Smith Young Road
Mobile, AL 36695
334/633-9791
(Charles E. Wychoff)

Appendix C.--State of Alabama licensed water well drillers, 1995—Continued

GEOLOGICAL & ENVIRONMENTAL SERVICES, INC.
1350 Livingston Lane
Suite A
Jackson, MS 39213
601/366-3734
(Daren J. Bracey)

GEOTECHNICAL ENGINEERING-TESTING, INC.
904 Butler Dr.
Mobile, AL 36693
334/666-7197
(Lynn C. Doyle)

GEOTEK DRILLING COMPANY, INC.
8321 Oak Ridge Higheay
Knoxville, TN 37921
615/690-0128
(Joe G. Wilkinson)

GOTHARD & SONS CONTRACTORS, IN.C
1125 Cantelon Road
Montgomery, AL 36108
334/263-9949
(Sherrill P. Gothard)

GRAVES DRILLING SERVICES, INC.
7724 Atomic Road
Jackson, SC 29831
803/471-3353
(Zane Eaton)

GRAVES SERVICE CO., INC.
1843 Highway 290, West
Harpersville, AL 35078
334/678-2024
(Don R. Harvard)

GREENE's WATER WELLS, INC.
Route 4, Box 952
Gray, GA 31032-9454
912/986-3192
A. J. Greene)

GRINER DRILLING SERVICE, INC.
1014 Highway 98 Bypass
Columbia, MS 39429
601/366-3734
(Charles H. Griner)

GROSCH IRRIGATION CO., INC.
103 Taylor Lane
E. Dublin, GA 31021
912/275-0013
(Wayne A. Grosch)

GROUNDWATER PROTECTION, INC.
12249 Nations Ford Road
Pineville, NC 28134
704/588-5412
(Curt A. Benson)

GULF ATLANTIC DRILLING, INC.
2140 N E 36th Avenue
Suite 300
Ocala, FL 34470-3103
904/867-0377
(Michael C. Rice)

HACODA DRILLING CO.
Rt. 2, Box 10
Florala, AL 36442
334/858-6294
(Vernon Robbins)

HAMMETT DRILLING CO., INC.
Rt. 2, Box 10
Florala, AL 35442
334/222-3562
(Marvin E. Hammett)

HANNERS & DAVIS WELL DRILLING
Rt. 2, Box 206
Delta, AL 36258
334/488-5914
(James L. Hanners)

HARRINGTON DRILLING COMPANY
381 West Seneca Road
Lumberton, MS 39455
601/796-8570
(Al Harrington)

HAWLEY DODSON & SON
P. O. Box 585
Fayetteville, TN 37334
615/433-4201
(Charles Dodson)

HERNDON WELL & SUPPLY, INC.
P. O. Box 37
Shannon, MS 38868
601/767-9777
(Robert E. Herndon)

HUGHES WELL DRILLING
P.O. Box 746
Geneva, AL 36340
334/684-9859
(Ronnie Hughes)

HURLEY DRILLING
8737 Camp Piers Road
Bessemer, AL 35023
(James H. Hurley)

HURST WELL DRILLING
9841 County Road 31
Lineville, AL 36266
205/488-5547
(Pat Hurst)

J & J DRILLING & WATER SYSTEMS
P.O. Box 280
Valley, AL 36854
334/768-3506
(Lonnie J. Granger)

J. M. PRESLEY WELL DRILLING
Rt. 4, Box 165
Enterprise, AL 36330
334/347-2829
(J. M. Presley, Jr.)

JIM's WELL SERVICE
P. O. Box 93
Flomaton, AL 36441
334/296-3696
(Jimmy H. Cofield)

JIMMY PEEK WELL DRILLING
Rt. 1, P. O. Box 228-B
Pisgah, AL 35765
205/451-7211
(Jimmy D. Peek)

Appendix C.--State of Alabama licensed water well drillers, 1995—Continued

JOHN H. DAVIS PUMP & WELL DRILLING CO.
23150 Wilson Road
Loxley, AL 36551
334/947-5090
(John H. Davis)

JOHNSON WELL DRILLING
7900 Moye Lane
Foley, AL 36535
334/943-8050
(Malcom C. Johnson)

KELLY ENVIRONMENTAL DRILLING, INC.
713 Edge Street
Ft. Walton, FL 32548
904/863-8446
(James M. Kelly)

KEN CHANEY's WELL DRILLING
Rt. 2, Box 245
Fort Payne, AL 35967
205/657-3899
(Charles K. Chaney)

McCORMACK DRILLING CO.
Rt. 3, Box 770
Leighton, AL 35646
205/446-5625
(Hubert McCormack)

McDONALD AND HILL, INC.
P. O. Box 1510
Meridian, MS 36302-1510
601/693-3401
(Jerry Hill)

J. R. HUGHES WELL DRILLING AND REPAIR
Rt. 2, Box 36
New Brockton, AL 36351
334/894-2380
(J. R. Hughes)

J. V. PEEL DRILLING
3367 Highway 13
Maylene, AL 35114
205/426-3605
(Jim V. Peel)

JACKSON DRILLING CO.
Rt. 2, Box 385
Haleyville, AL 35565
205/486-5452
(O'Neal Jackson)

JAMES MILLS WELL DRILLING
Rt. 3, Box 105
Pikeville, TN 37367
615/881-3364
(James Mills)

KNOX DRILLING COMPANY, INC.
P.O. Box 83
Haleyville, AL 35565
205/486-3128
(Albert D. Knox)

MICHAEL DRILLING CO.
Rt. 4, Box 220
Rogersville, AL 35652
205/247-5531
(James C. Michael)

MID-SOUTH DRILLING CO.
Rt. 1, Box 36-F
Carrollton, AL 35447
205/367-8496
(Louis Reece)

MILLER DRILLING COMPANY, INC.
P. O. Box 18383
Huntsville, AL 35801
205/534-0073
(James Burkett

MIXON FOUNDATION & DRILLING, INC.
6006 N. Renellie Drive
Tampa, FL 33614
813/872-6556
(William D. Mixon)

MIZELL DRILLING SERVICE
1158 Kirby Bridge Road
Danville, AL 35619
334/355-0684
(Wayne Mizell)

MORPHIS BROTHERS, INC.
P. O. Box 169
Trout, LA 71371
318/992-6195
(Larry R. Morphis)

MOTE & GARNER
6888 Tyree Road
Winston, GA 30187
404/942-2287
(William J. Garner)

MUTT'S WELL DRILLING
2107 Elkton Road
Athens, AL 35611
205/232-2855
(Marvin Adams)

OAKLEY DRILLING COMPANY
1430 Bethel Road
Pulaski, TN 38478
615/363-6478
(Charles E. Oakley)

OTWELL WELLS
Rt. 1, Box 209
Ranburne, AL 36273
205/586-5929
(Lynn Otwell)

OWENS WELL DRILLING
554 County Road 119
Fort Payne, AL 35967
205/657-3395
(Rodney Owens)

PARKER WELL COMPANY, INC.
Rt. 1, Box 435
Warm Springs, GA 31830
706/655-3833
(Marcus A. Parker)

PARKS & PARKS WELL SERVICE, INC.
P. O. Drawer 32
Houston, MS 38851
(Hubert D. Parks)

PATE'S DRILLING & WELL SERVICE
Rt. 2, Box 55
Castleberry, AL 36432
334/966-2184
(John D. Pate)

PENSACOLA TESTING LAB, INC.
217 E. Brent Lane
Pensacola, FL 32503
904/477-5100
(Don C. Crutchfield)

POPE ENGINEERING & TESTING LABS, INC.
2463 Eslava Creek Parkway
Mobile, AL 36606
334/471-3458
(William I. Pope)

APPENDIX D

FEDERAL AND STATE AGENCIES RESPONSIBLE FOR WATER REGULATION IN ALABAMA

Appendix D.--Federal and State agencies responsible for water regulations in Alabama

FEDERAL

U.S. Environmental Protection Agency
345 Courtland Street, N.E.
Atlanta, Georgia 30365

STATE

Alabama Department of Conservation and Natural Resources
64 North Union Street
Montgomery, Alabama 36104

Alabama Department of Economic and Community Affairs
401 Adams Avenue
P.O. Box 5690
Montgomery, Alabama 36103-5690

Alabama Department of Environmental Management
1751 Cong. W. L. Dickinson Drive
Montgomery, Alabama 36130

Alabama Surface Mining Commission
P.O. Box 1027
Jasper, Alabama 35501

State Oil and Gas Board
P. O. Box O
420 Hackberry Lane
Tuscaloosa, Alabama 35486-9780

APPENDIX E

LABORATORIES IN ALABAMA CERTIFIED BY ADEM FOR CHEMICAL ANALYSIS OF DRINKING WATER

Certifications expire March 31, 1996

Explanation

IORG: Inorganic chemicals

TTHM: Total trihalomethanes

VOCS: Volatile organic chemicals

GCMS: Herbicides and pesticides by gas chromatograph and gas chromatograph mass spectrometry

OSOC: Other synthetic organic chemicals

HPLC: Herbicides and pesticides by high performance liquid chromatography

RADS: Radionuclides

Appendix E—Laboratories in Alabama certified by ADEM for chemical analysis of drinking water

Lab name, address	Contact person	Telephone	Type of certification						
			IORG	TTHM	VOCS	GCMS	OSOC	HPLC	RADS
Ala. Dept. of Environ. Mgmt. 1751 Cong. W. L. Dickinson Drive Montgomery, AL 36130	Benny Laughlin	(334) 271-7985	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alabama Power Company P. O. Box 2641-C GSC #8 Birmingham, AL 35291	W. S. Hill	(205) 664-6081	Yes	Yes	Yes	Yes	Yes	Yes	No
Analytical Systems 437 Industrial Lane Birmingham, AL 35219	John Sutherland	(205) 940-7700	No	Yes	Yes	Yes	Yes	No	No
Birmingham Water Works Laboratory P. O. Box C-110 Birmingham, AL 35283	Bill Wingate	(205) 251-3261	Yes	Yes	No	No	No	No	No
Deep South Laboratory 225 Oxmoor Circle, Suite 708 Birmingham, AL 35209	James Sciple	(205) 945-8360	Yes	Yes	Yes	No	Yes	No	No
Environchem 4320 Midmost Drive Mobile, AL 36609	Robert Mohr	(334) 344-9106	No	Yes	Yes	No	No	No	No
Environmental Service Laboratories P.O. Box 1053 Decatur, AL 35602	Stan Magnusson	(205) 350-3385	No	Yes	No	No	No	No	No
Geological Survey of Alabama P. O. Box O Tuscaloosa, AL 35486	Robert Meintzer	(205) 349-2852	Yes	No	No	No	No	No	No
Guardian Systems 305 Ashville Road Leeds, AL 35094	Jerry Horncastle	(205) 699-6647	Yes	Yes	Yes	No	No	No	No
Huntsville Utilities Laboratories P. O. Box 2048 Huntsville, AL 35804	William E. Courtney	(205) 553-0300	Yes	No	No	No	No	No	No
Mid South Testing Lab 220 Beltline Road., SW Decatur, AL 35602	Bill Hollerman	(205) 350-0846	Yes	Yes	Yes	No	Yes	No	No
Quality Analytical Laboratories, Inc. 2567 Fairlane Drive Montgomery, AL 36116	Craig O. Vinson	(334) 271-2440	Yes	No	No	No	No	No	No
Redstone Arsenal Northup Grumman BAMSI P.O. Box 8300 Redstone Arsenal, AL 35808	Jimmie G. Reid	(205) 876-5574	No	Yes	No	No	No	No	No
Savannah Laboratories & Environmental Services P. O. Box 9248 Mobile, AL 36691	Jessee L. Smith	(334) 666-6633	Yes	Yes	Yes	Yes	Yes	No	No

Appendix E—Laboratories in Alabama certified by ADEM for chemical analysis of drinking water—Continued

Lab name, address	Contact person	Telephone	Type of certification						
			IORG	TTHM	VOCS	GCMS	OSOC	HPLC	RADS
Southeastern Analytical Services 1004 Oster Drive Suite 1 Huntsville, AL 35816	Guy E. Graves	(205) 536-8110	Yes	Yes	Yes	Yes	Yes	Yes	No
Southern Research Institute 2000 9th Avenue, South Birmingham, AL 35205	Ruby James	(205) 581-2000	Yes	Yes	Yes	No	No	No	No
Stillbrook Environmental Testing Laboratory 305 Crawford Street Fairfield, AL 35064	Mark Sutterland	(205) 788-1750	Yes	Yes	Yes	Yes	No	No	No
Tuscaloosa Testing Laboratory 3516 Greensboro Avenue Tuscaloosa, AL 35401	Jack E. Davis	(205) 345-0816	Yes	Yes	Yes	Yes	Yes	Yes	No
Technical Micronics Control 210 Wynn Drive Huntsville, AL 35807	Bharathi Ujjani	(205) 837-4430	No	Yes	Yes	Yes	Yes	No	No

APPENDIX F

LABORATORIES OUT-OF-STATE CERTIFIED BY ADEM FOR CHEMICAL ANALYSIS OF DRINKING WATER

Certifications expire March 31, 1996

Explanation

IORG:	Inorganic chemicals
TTHM:	Total trihalomethanes
VOCS:	Volatile organic chemicals
GCMS:	Herbicides and pesticides by gas chromatograph and gas chromatograph mass spectrometry
OSOC:	Other synthetic organic chemicals
HPLC:	Herbicides and pesticides by high performance liquid chromatography
RADS:	Radionuclides

Appendix F.--Laboratories out-of-state certified by ADEM for chemical analysis of drinking water

Lab name, address	Contact person	Telephone	Type of Certification						
			IORG	TTHM	VOCS	GCMS	OSOC	HPLC	RADS
Analytical Industrial Research Laboratory 4295 Cromwell Road Suite 611 Chattanooga, TN 37421	Joe Owens	(915) 894-8102	Yes	Yes	Yes	Yes	Yes	No	No
ATEC Associates, Inc. 1300 Williams Drive Suite A Marietta, GA 30066	Jason Holliday	(404) 427-9456	No	Yes	Yes	No	No	No	No
ATEL Aqua Tech Environmental Laboratories P. O. Box 436 Marion, OH 43301	Michael Davis	(614) 382-5991	Yes	Yes	Yes	Yes	Yes	Yes	No
American Analytical & Technical Services 11950 Industriplex Blvd. Baton Rouge, LA 70809	Doni Moore	(504) 753-8659	Yes	Yes	Yes	No	No	No	No
American Environmental Network 11 East Olive Road Pensacola, FL 32514	Kelly S. Swanson	(904) 474-1001	Yes	Yes	Yes	No	No	No	No
Analytical Services, Inc. 110 Technology Parkway Norcross, GA 30092	Roy-Keith Smith	(412) 733-1161	Yes	Yes	Yes	No	No	No	No
Broward Testing Laboratory 4416 N.E. 11th Avenue Ft. Lauderdale, FL 33334	Gary Meyer	(800) 456-3330	Yes	Yes	Yes	Yes	Yes	Yes	No
Ceimic Corporation 10 Dean Knauss Drive Narragansett, RI 02882	Carla J. Rodman	(401) 782-8900	Yes	Yes	Yes	No	No	No	No
Controls for Environmental Pollution P.O. Box 5351 Sante Fe, NM 87502	Gail Griego	(505) 982-9841	Yes	No	No	No	No	No	Yes
Core (Pace)Lab Env. Testing Service 5460 Beaumont Center Blvd. Tampa, FL 36634	Norma J. Plants	(813) 884-8268	Yes	Yes	Yes	Yes	No	No	No
Department of the Air Force Air Force Occupational and Environmental Health Brooks Air Force Base, TX 78235	Lt. Col. Kenny D. Locke	(512) 536-3626	Yes	Yes	Yes	Yes	No	No	Yes

Appendix F.--Laboratories out-of-state certified by ADEM for chemical analysis of drinking water—Continued

Lab name, address	Contact person	Telephone	Type of certification						
			IORG	TTHM	VOCS	GCMS	OSOC	HPLC	RADS
Department of the Army U.S. Army Environmental Hygiene Agency Aberdeen Proving Ground, MD 21010	Richard W. Puzniak	(301) 671-3269	Yes	Yes	Yes	No	No	No	Yes
Environmental Health Laboratories 110 S. Hill Street South Bend, IN 46617	Dale R. Piechocki	(219) 233-4777	Yes	Yes	Yes	Yes	Yes	Yes	No
Environmental Physics, Inc. P. O. Box 30172 Charleston, SC 29417	James B. Westmoreland	(803) 556-8171	No	No	No	No	No	No	Yes
Environmental Science & Engineering, Inc. P. O. Box 1703 Gainesville, FL 32602	Portia O. Pisigan	(352) 332-3318	Yes	Yes	Yes	No	No	No	No
Environmental Testing & Consulting, Inc. 2924 Walnut Grove Road Memphis, TN 38111	Richard Medina	(901) 327-2750	Yes	Yes	Yes	No	No	No	No
General Engineering Laboratory P. O. Box 30712 Charleston, SC 29417	Barbara A. Sigmon	(803) 556-8171	Yes	No	No	No	No	No	No
Heritage Environmental Services, Inc. 7901 West Morris Street Indianapolis, IN 46231	Brenda E. Roush	(800) 827-0498	Yes	Yes	Yes	Yes	No	No	Yes
IEA, Inc. 3000 Weston Parkway Cary, NC 27513	Linda F. Mitchell	(919) 677-0090	Yes	Yes	Yes	No	No	No	No
KNL Laboratory Services P. O. Box 1833 Tampa, FL 33601	Cheryl Hicks	(813) 229-2879	No	No	No	No	No	No	Yes
Lancaster Laboratories 2425 New Holland Pike Lancaster, PA 17605	Susan B. Shorter	(717) 656-2300	Yes	Yes	Yes	Yes	Yes	Yes	No
Law Environmental, Inc. 7215 Pine Forest Road Pensacola, FL 32317	Burnie Fuson	(904) 944-9463	Yes	Yes	Yes	No	No	No	No

Appendix F.--Laboratories out-of-state certified by ADEM for chemical analysis of drinking water—Continued

Lab name, address	Contact person	Telephone	Type of certification						
			IORG	TTHM	VOCS	GCMS	OSOC	HPLC	RADS
Montgomery Watson Laboratories 555 East Walnut Street Pasadena, CA 91101	Nilda Cox	(818) 568-0281	No	Yes	Yes	Yes	Yes	Yes	Yes
NEI of Pennsylvania 1850 Gravers Road Norristown, PA 19401	Rocco Alessandro	(215) 275-0281	Yes	Yes	Yes	No	No	No	Yes
National Testing Laboratories, Inc. 6151 Wilson Mills Road Cleveland, OH 44143	E. W. Tone	(216) 449-2525	No	Yes	Yes	Yes	No	No	No
OHM Analytical Division P. O. Box 551 Findlay, OH 15839	Anne T. Sidney	(419) 423-3526	No	Yes	Yes	No	Yes	No	No
Orlando Laboratories P. O. Box 149127 Orlando, FL 32814	Sharon Kunsman	(407) 896-6645	Yes	Yes	Yes	No	No	No	Yes
P. E. LaMoreaux and Associates P. O. Box 6719 Lakeland, FL 33807	Amal Mostafa	(813) 646-8526	Yes	Yes	Yes	Yes	Yes	Yes	No
Pace Analytical Services, Inc. 161 James Dr. West Suite 100 St. Rose, LA 70087	Elaine Wild	(504) 469-0333	Yes	Yes	No	No	No	No	No
Pace, Incorporated 1710 Douglas Drive North Minneapolis, MN 55422	David W. Mack	(612) 544-5543	Yes	No	Yes	No	No	No	No
Precision Environmental Laboratory 10200 USA Today Way Miramar, FL 33025	Theresa Giglio	(305) 954-4314	Yes	Yes	Yes	Yes	No	No	No
Professional Service Industries, Inc. 4820 West 15th Street Lawrence, KS 66049	Dawn D. Thomas	(913) 749-2381	Yes	Yes	Yes	Yes	No	No	No
Quality Analytical Laboratories P. O. Box 370 Alachua, FL 32615	Karen Daniels	(904) 462-3050	No	Yes	Yes	No	No	No	No

Appendix F.--Laboratories out-of-state certified by ADEM for chemical analysis of drinking water—Continued

Lab name, address	Contact person	Telephone	Type of Certification						
			IORG	TTHM	VOCS	GCMS	OSOC	HPLC	RADS
Quanterra Environmental Services 4101 Shuffel Drive, NW North Canton, OH 44720	Ruby J. Weber	(216) 497-0772	Yes	Yes	Yes	No	No	No	No
Quanterra Environmental Services 5910 Breckenridge Pkw. Suite H Tampa, FL 33610	Kevin M. Bull	(813) 621-0784	No	Yes	Yes	No	No	No	No
Resource Consultants, Inc. P. O. Box 1848 Brentwood, TN 37024	Mary Louise Linn	(615) 373-5040	Yes	Yes	Yes	No	No	No	No
Roy F. Weston Analytical Laboratory 208 Welsh Pool Road Lionville, PA 19341	Dianne S. Therry	(215) 524-7360	Yes	Yes	Yes	Yes	No	No	No
Savannah Laboratories 6712 Benjamin Road Suite 100 Tampa, FL 33634	Steven H. Worrell	(813) 885-7427	Yes	Yes	Yes	No	No	No	Yes
Savannah Laboratories & Environmental Services P. O. Box 13056 Tallahassee, FL 32317	Pamela Staerker	(904) 878-3994	No	Yes	Yes	Yes	Yes	Yes	No
Savannah Laboratories & Environmental Services 414 SW 12th Avenue Deerfield Beach, FL 33442	William Pingpang	(305) 421-7400	Yes	Yes	Yes	Yes	No	No	No
Southwest Laboratory of Oklahoma, Inc. 1700 West Albany Broken Arrow, OK 74012	Donna Newton	(918) 251-2858	Yes	Yes	Yes	No	No	No	No
Triangle Laboratories P. O. Box 13485 Research Triangle Park, NC 27709	Wanda J. Dean	(919) 544-5729	No	No	No	No	No	No	No
V.O.C. Analytical 877 Northwest 61st Street, Suite 202 Fort Lauderdale, FL 33309	Jeffery Glass	(305) 938-8823	Yes	Yes	Yes	No	No	No	No
Weston-Gulf Coast Laboratories 2417 Bond Street University Park, IL 60466	Donna J. McCarthy	(708) 534-5200	Yes	Yes	Yes	No	No	No	No

APPENDIX G

GROUND-WATER QUALITY SITES AND RESULTS OF CHEMICAL ANALYSES OF WATER SAMPLES, 1995

Abbreviations: cfs, cubic feet per second; µS/cm, microsiemens per centimeter; °C, degrees Centigrade; mg/L, milligrams per liter; µg/L, micrograms per liter; ND, not detected; NTU, nephelometric turbidity units.

Notes: See plate 4 for locations of wells and springs. Spring discharge data presented in appendix A.

[1] = value equals or exceeds primary drinking water standards

[2] = value equals or exceeds secondary drinking water standards

Appendix G-1.--Ground-water quality sites

Site No.	Well owner or spring name	Use	Identifying number and county	Depth (feet)	Water-bearing unit
1	Citronelle	PWS	D-3, Mobile	735	Miocene-Pliocene Series
2	Atmore	PWS	Z-71, Escambia	130	Miocene-Pliocene Series
3	Theodore	PWS	KK-1, Mobile	148	Miocene-Pliocene Series
4	Dauphin Island	PWS	UU-2 (Well #2) Mobile	305	Miocene-Pliocene Series
5	Orange Beach	PWS	ZZ-8, Baldwin	120	Miocene-Pliocene Series
6	Brewton	PWS	O-95, Escambia	661	Lisbon Formation
7	Fairhope	PWS	NN-04, Baldwin	230	Miocene-Pliocene Series
8	Brewton Airport	PWS	V-37, Escambia	435	Ocala Limestone
9	Evergreen	PWS	S-2, Conecuh	180	Tallahatta Formation
10	Butler	PWS	M-01 (Well #4), Choctaw	708	Nanafalia Formation
11	Andalusia	PWS	M-8, Antioch Road Well, Covington	1,090	Nanafalia Formation
12	Geneva	PWS	R-11 (Well #3), Geneva	1,040	Nanafalia Formation
13	Monroeville	PWS	U-4, Hammond Street Well, Monroe	1,240	Nanafalia Formation
14	Jackson	PWS	HH-6, Clarke	Spring	Crystal River Formation
15	Elba	PWS	K-4 (Well #2), Coffee	585	Clayton Formation
16	Ozark	PWS	F-16, Dale	880	Ripley Formation
17	Greenville	PWS	H-4, (Well #3), Butler	633	Ripley Formation
18	Troy	PWS	J-8 (Well #2), Pike	519	Ripley Formation
19	Luverne	PWS	L-5 (Well #1), Crenshaw	567	Ripley Formation
20	Camden	PWS	O-38, Wilcox	441	Ripley Formation
21	Clayton	PWS	S-1, Barbour	195	Ripley Formation
22	Dothan	PWS	I-19 (Well #23), Houston	860	Ripley Formation
24	Montgomery	PWS	K-95 (Well #40), Montgomery	275	Eutaw Formation
25	Linden	PWS	L-26, Marengo	1.240	Eutaw Formation
26	Eutaw	PWS	R-12, Greene	429	Eutaw Formation
27	Montgomery	PWS	J-31 (Well #13), Montgomery	631	Tuscaloosa Group
28	Vernon	PWS	K-13, Lamar	335	Tuscaloosa Group
29	Haynesville	PWS	L-12, Lowndes	1,061	Tuscaloosa Group
30	Union Springs	PWS	L-3 (Well #2), Bullock	1,105	Tuscaloosa Group
31	Aliceville	PWS	W-30, Pickens	521	Tuscaloosa Group
32	Olympia Spa	Mineral Pool	Q-6, Houston	2,924	Tuscaloosa Group
34	Coker	PWS	FF-51, Tuscaloosa	182	Tuscaloosa Group
35	Moundville	PWS	B-20, Hale	233	Tuscaloosa Group
36	Eufaula	PWS	V-1, Barbour	1,752	Tuscaloosa Group
37	State of Alabama (Marion Fish Hatchery)	Fish	I-9, Perry	773	Tuscaloosa Group
38	Troy	PWS	J-11 (Well #4), Pike	2,240	Tuscaloosa Group
40	Gold Kist Poultry	Industrial	X-2, Marshall	450	Pottsville Formation
43	Irondale	PWS	W-4 (Well #5), Jefferson	250	Bangor Limestone
44	Ardmore	PWS	A-13 (Well #1), Limestone	133	Tuscumbia Limestone
45	Rogersville	PWS	T-32, Lauderdale	150	Tuscumbia Limestone
46	Stevenson	PWS	N-40, Jackson	165	Tuscumbial Limestone
47	Trussville	PWS	L-2 (Well #4), Jefferson	215	Tuscumbia Limestone
48	Huntsville	PWS	N-51, Dallas Wells, Madison	105	Tuscumbia Limestone
49	Centreville	PWS	P-5, Bibb	200	Cambrian and Ordovician rocks
50	Oneonta	PWS	P-7, Blount	175	Cambrian and Ordovician rocks
51	Rockford	PWS	M-2, Coosa	300	Piedmont rocks
52	Hughes & Hughes	Industrial	G-03 (H-32-4), Lamar	--	Coker Formation
53	L. C. Boney	Private	BB-1 (W-124), Choctaw	205	Gosport Sand-Lisbon Formation
54	Exxon	Industrial/fire protection	X-02 (W-176), Escambia	302	Miocene Series

Appendix G-1.--Ground-water quality sites—Continued

Site No.	Well owner or spring name	Use	Identifying number and county	Depth (feet)	Water-bearing unit
55	Bladon Springs State Park	PWS	FF-01, Choctaw	200	Hatchetigbee Formation
56	Blue Springs State Park	PWS	FF-8, Barbour	Spring	Clayton Formation
57	Bucks Pocket State Park	PWS	Q-01, De Kalb	190	Bangor Limestone
58	Chattahoochee State Park	PWS	W-01, Houston	100	Crystal River Formation
59	Cheaha State Park	PWS	Y-02, Cleburne	520	Cheaha Quartzite Member
60	Chickasaw State Park	PWS	L-09, Marengo	1,253	Eutaw Formation
61	Ft. Morgan State Park (Manager's Well)	Irrigation	HHH-03, Baldwin	30	Coastal deposits
62	Ft. Toulouse-Jackson State Park	PWS	Q-02, Elmore	146	Tuscaloosa Group
63	Claude D. Kelly State Park	PWS	H-07, Escambia	20	Miocene Series
64	Little River State Forest	PWS	QQ-01, Monroe	50	Miocene Series
65	Rickwood Caverns State Park	Supplementary supply	W-5, Blount	Cave	Bangor Limestone
66	Roland Cooper State Park	PWS	G-27, Wilcox	120	Ripley Formation
67	Geneva State Forest	PWS	H-8, Geneva	290	Lisbon Formation
69	Town Creek Fishing Center (Lake Guntersville State Park)	PWS	I-18, Marshall	90	Bangor Limestone
70	Madrid Rest Area (U.S. 231 at ALA/FLA)	PWS	AA-1, Houston	126	Lisbon Formation
73	Big Spring near Green Pond	PWS	C-01, Bibb	Spring	Cambrian and Ordovician rocks
74	Williams Spring near West Blocton	PWS	L-1, Bibb	Spring	Knox Group undifferentiated
75	Seven Springs at Seven Springs	PWS	F-68, Calhoun	Spring	Newala and Longview Limestones
76	Websters Spring near Websters Chapel	PWS	Q-01, Calhoun	Spring	Cambrian and Ordovician rocks
77	Big Spring at Jacksonville	PWS	L-21, Calhoun	Spring	Conasauga Formation
78	Germania Spring north of Jacksonville	PWS	L-1, Calhoun	Spring	Conasauga Formation
79	Coldwater Spring near Anniston	PWS	W-12, Calhoun	Spring	Knox Group undifferentiated
80	Stanford Spring near Mt. Zion Church	PWS	R-01, Cherokee	Spring	Conasauga Formation
82	Cove Spring near Walnut Grove	PWS	H-25, Etowah	Spring	Bangor Limestone (?)
83	Jeffers Spring at Glencoe	PWS	N-25, Etowah	Spring	Knox Group undifferentiated
84	Tawana Spring near Hokes Bluff	PWS	N-16, Etowah	Spring	Knox Group undifferentiated
85	Good Spring near Vina	PWS	R-5, Franklin	Spring	Tuscaloosa Group
86	Little Spring near Hodges	PWS	C-01, Marion	Spring	Gordo Formation
87	Green Briar Spring at Green Briar	PWS	Q-01, Limestone	Spring	Tuscumbia Limestone
89	Springville Springs at Springville	PWS	M-8, St. Clair	Spring	Knox Group undifferentiated
91	Little Spring at Montevallo	PWS	AA-7, Shelby	Spring	Brierfield Dolomite
92	Rowan Springs at Leeds	PWS	Y-1, Jefferson	Spring	Chickamauga Limestone
93	Weems Spring near Leeds	PWS	Z-01, St. Clair	Spring	Knox Group undifferentiated
94	Tuscumbia Springs at Tuscumbia	PWS	M-20, Colbert	Spring	Tuscumbia Limestone
95	Cheaha State Park Spring	PWS	Y-01, Cleburne	Spring	Cheaha Quartzite Member
96	Dixie Brown Spring near Valley Head	PWS	J-4, De Kalb	Spring	Chickamauga Limestone

Appendix G-1.--Ground-water quality sites—Continued

Site No.	Well owner or spring name	Use	Identifying number and county	Depth (feet)	Water-bearing unit
97	Bridgeport Spring near Bridgeport	PWS	C-4, Jackson	Spring	Bangor Limestone
98	Allgood Spring	PWS	T-2, Blount	Spring	Knox Group undifferentiated
99	Gulf Shores	PWS	DDD-21, Baldwin	225	Miocene-Pliocene Series
104	Eldridge	PWS	F-4, Walker	1,400	Pottsville Formation
108	Wedowee	PWS	K-6, Randolph	93	Piedmont rocks
110	Jemison	PWS	F-4 (Well #1), Chilton	100	Piedmont rocks
112	Huntsville	PWS	X-44, Madison	100	Tuscaloosa Group
113	Headland	PWS	X-1, Henry	663	Clayton Formation
114	Alton Powell	Private	K-7, Crenshaw	226	Clayton Formation
115	W. H. Griffin	Private	H-2, Clarke	250	Tuscahoma Sand
116	Fulton	PWS	O-12, Clarke	267	Lisbon Formation
117	Alabama Port	PWS	TT-01 (Well #2), Mobile	392	Miocene-Pliocene Series
118	Foley	PWS	UU-17 (Well #9), Baldwin	138	Miocene-Pliocene Series
119	Loxley	PWS	KK-05, Baldwin	184	Miocene-Pliocene Series
120	Malbis	PWS	CC-10, Baldwin	498	Miocene-Pliocene Series
121	Bay Minette	PWS	U-02, Baldwin	175	Miocene-Pliocene Series
122	Clanton	PWS	P-3, Washington	298	Miocene-Pliocene Series
123	Camp Alamisco	Private	N-01, Tallapoosa	539	Piedmont rocks
124	Gulf Shores State Park (Golf Course Well)	Irrigation	DDD-05, Baldwin	620	Miocene Series
125	Orange Beach	PWS	DDD-04, Baldwin	144	Miocene-Pliocene Series
126	Daphne	PWS	LL-04, Baldwin	452	Miocene-Pliocene Series
127	Satsuma	PWS	S-3, Mobile	117	Quaternary
128	Hurtsboro	PWS	O-3, Russell	500	Eutaw

Appendix G-2.--Results of chemical analyses of water samples, 1995
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		1	2	3	4	5	6
Date Time		08/01/95 1155	08/22/95 820	08/01/95 1450	08/01/95 1555	08/02/95 1105	08/22/95 940
Specific conductance (µS/cm)	00094	162	31	265	1,910	63	276
Temperature (°C)	00010	29	21	27	26	25	25
Turbidity (NTU)	16542	8	<1	<1	<1	<1	1
Bicarbonate (mg/L)	00440	124	2	199	216	2	167
Carbonate (mg/L)	00445	<1	<1	3	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	102	2	167	177	2	137
pH (units)	00400	7.7	5.3	8.4	7.1	5.1	6.3
Silica (mg/L)	00955	13.30	9.88	14.60	15.00	8.70	36.40
Calcium (mg/L)	00915	0.352	0.923	3.49	49.5	1.65	30.8
Magnesium (mg/L)	00925	0.1	0.57	0.34	35.5	3.22	6.1
Sodium (mg/L)	00930	52.9	2.49	116	187	14.2	17.1
Potassium (mg/L)	00935	1.5	<0.6	1.7	13.3	0.6	4.6
Sulfate (mg/L)	00945	1.22	0.40	3.35	<.2	1.74	8.10
Chloride (mg/L)	00940	15.80	4.05	72.30	376.00[2]	30.10	2.38
Bromide (mg/L)	71870	<0.07	<0.07	0.07	0.84	<0.07	<0.07
Fluoride (mg/L)	00950	0.211	<0.02	0.443	0.273	<0.02	<0.02
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	<0.01	0.792	0.133	0.117	1.96	<0.01
Ammonia as N (mg/L)	00608	0.02	<.01	0.503	1.82	0.016	0.161
Total Kjeldahl nitrogen as N (mg/L)	00625	0.09	<.07	0.48	1.83	<.07	0.12
Orthophosphate as P (mg/L)	00671	0.26	<.08	0.28	<.08	<.08	<.08
Total phosphorus as P (mg/L)	00666	0.21	<.09	0.19	0.12	0.9	<.09
Aluminum (µg/L)	01106	48	<30	43	<30	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	2.80	17.10	14.70	243.00	50.20	<1
Beryllium (µg/L)	01010	<.4	<.4	<.4	<.4	<.4	<.4
Boron (µg/L)	01020	149	<10	427	267	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	16	18	<10
Copper (µg/L)	01040	11.60	<5	<5	<5	9.00	<5
Iron (µg/L)	01046	236	6.8	19.5	363[2]	30.8	34.9
Lead (µg/L)	01049	1.60	1.70	<0.9	<0.9	<0.9	<0.9
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	4.70	5.00	13.00	185.00[2]	91.30[2]	4.00
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	0.1	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	20.8	7.1	114	504	26.2	424
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	<4	16.80	5.80	<4	15.60	<4
Total dissolved solids (mg/L)	04764	181	<10	330	834[2]	88	260
Hardness as CaCO3 (mg/L)	00900	1	5	10	271	17	103

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		7	8	9	10	11	12
Date Time		08/22/95 1406	08/22/95 1010	08/22/95 1420	07/31/95 1325	08/22/95 1315	08/15/95 1340
Specific conductance (µS/cm)	00094	44	295	237	534	1,100	1,390
Temperature (°C)	00010	25	29	22	26	27	31
Turbidity (NTU)	16542	<1	1	72	<1	10	<1
Bicarbonate (mg/L)	00440	<1	172	152	291	314	240
Carbonate (mg/L)	00445	<1	<1	<1	3	<1	1
Alkalinity as CaCO3 (mg/L)	00411	<2	141	125	242	258	198
pH (units)	00400	4.7	6.6	5.9	8.2	7.0	7.6
Silica (mg/L)	00955	7.98	20.20	17.10	15.00	17.70	18.20
Calcium (mg/L)	00915	2.11	16.2	46.6	0.846	5.81	10.5
Magnesium (mg/L)	00925	2.88	8.15	1.68	0.14	2.74	5.5
Sodium (mg/L)	00930	4.52	31.9	3.31	128	272	276
Potassium (mg/L)	00935	1.3	7.1	0.7	<0.6	4.7	5.1
Sulfate (mg/L)	00945	1.62	10.00	6.13	<0.2	20.60	23.80
Chloride (mg/L)	00940	11.10	3.04	2.54	48.50	238.00	336.00[2]
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	0.13	0.81	1.21
Fluoride (mg/L)	00950	<0.02	0.449	0.056	0.22	1.51	0.792
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	4.15	0.175	<0.01	0.14	0.167	<0.01
Ammonia as N (mg/L)	00608	0.01	0.126	<0.01	0.465	0.669	0.743
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	0.14	<0.07	0.48	0.62	0.64
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	0.50	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	0.13	<0.09	<0.09	027	<0.09	<0.09
Aluminum (µg/L)	01106	39	<30	<30	31	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	76.00	11.60	11.70	3.60	3.80	7.10
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	26	<10	426	200	367
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	19	<10	<10	<10	<10	<10
Copper (µg/L)	01040	6.50	5.00	5.30	<5	9.10	10.00
Iron (µg/L)	01046	18.1	37	18.9	37.3	57.1	99.2
Lead (µg/L)	01049	<0.9	1.00	<0.9	<0.9	1.40	<0.9
Lithium (µg/L)	01130	<8	21	9	14	<8	<8
Manganese (µg/L)	01056	19.20	1.70	0.90	3.30	1.30	1.70
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	0.17	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	24.3	466	184	26.5	872	1,940
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	3.20	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	14.10	269.00	7.00	<4	12.10	<4
Total dissolved solids (mg/L)	04764	42	249	206	370	736[2]	828[2]
Hardness as CaCO3 (mg/L)	00900	17	75	124	3	27	51

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		13	14	15	16	17	18
Date		08/21/95	08/03/95	08/15/95	08/16/95	08/22/95	08/15/95
Time		1520	850	945	1040	1600	745
Specific conductance (µS/cm)	00094	753	100	336	286	640	275
Temperature (°C)	00010	29	23	29	28	24	26
Turbidity (NTU)	16542	2	2	1	1	30	<1
Bicarbonate (mg/L)	00440	358	82	211	171	288	190
Carbonate (mg/L)	00445	1	<1	<1	7	1	<1
Alkalinity as CaCO3 (mg/L)	00411	295	67	173	149	237	156
pH (units)	00400	7.7	7.0	7.3	8.8	7.6	6.8
Silica (mg/L)	00955	17.00	8.67	18.00	11.10	11.20	16.90
Calcium (mg/L)	00915	2.29	27.5	21.2	2.65	2.12	16.7
Magnesium (mg/L)	00925	0.58	1.71	7.27	0.9	0.77	3.09
Sodium (mg/L)	00930	178	1.83	47.5	62.9	148	45.5
Potassium (mg/L)	00935	1.5	<0.6	1.9	1.0	2.3	4.1
Sulfate (mg/L)	00945	24.00	3.91	11.30	8.85	38.00	4.51
Chloride (mg/L)	00940	53.60	3.52	7.81	4.35	54.30	3.11
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	0.23	<0.07
Fluoride (mg/L)	00950	0.289	0.061	0.874	0.232	0.165	0.143
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	0.0655	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.048	0.759	0.035	<0.01	<0.01	0.013
Ammonia as N (mg/L)	00608	0.646	<0.01	0.017	0.188	0.451	0.427
Total Kjeldahl nitrogen as N (mg/L)	00625	0.53	<0.07	<0.07	0.15	0.44	0.36
Orthophosphate as P (mg/L)	00671	0.20	<0.08	0.30	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	0.1	<0.09	0.4	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	<30	<30	<30	<30	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	13.60	17.50	7.70	1.20	5.21	15.60
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	157	12	41	134	370	89
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	9.30	<5	10.70	14.00	<5	11.10
Iron (µg/L)	01046	32.1	9	19.8	<4	74.8	7.3
Lead (µg/L)	01049	5.8	<0.9	<0.9	<0.9	<0.9	<0.9
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	5.10	1.10	3.00	<0.8	1.70	1.60
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	104	59.2	596	142	202	463
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	5.50	<4	7.80	<4	<4	<4
Total dissolved solids (mg/L)	04764	427	87	257	207	470	220
Hardness as CaCO3 (mg/L)	00900	8	76	84	10	9	55

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		19	20	21	22	24	25
Date Time		08/14/95 1545	08/21/95 1410	08/17/95 900	08/16/95 850	08/14/95 1200	08/03/95 1213
Specific conductance (µS/cm)	00094	551	723	77	277	406	2,350
Temperature (°C)	00010	26	25	24	27	25	28
Turbidity (NTU)	16542	2	4	1	<1	<1	1
Bicarbonate (mg/L)	00440	228	368	13	172	285	638
Carbonate (mg/L)	00445	1	1	<1	<1	6	8
Alkalinity as CaCO3 (mg/L)	00411	238	303	11	141	241	533
pH (units)	00400	7.9	7.6	6.3	6.8	8.5	8.3
Silica (mg/L)	00955	12.90	13.10	13.50	18.40	16.30	12.90
Calcium (mg/L)	00915	4.69	1.59	8.41	31.2	2.17	4.46
Magnesium (mg/L)	00925	2.02	0.58	0.87	5.45	0.27	0.94
Sodium (mg/L)	00930	126	196	2.33	22.5	114	512
Potassium (mg/L)	00935	1.5	1.6	0.9	2.3	1.2	1.3
Sulfate (mg/L)	00945	30.30	28.50	0.70	9.98	7.47	<0.2
Chloride (mg/L)	00940	20.50	67.80	6.32	3.38	9.76	448.00[2]
Bromide (mg/L)	71870	<0.07	0.14	<0.07	<0.07	<0.07	3.84
Fluoride (mg/L)	00950	<0.02	1.33	0.05	0.09	0.567	2.85
Cyanide (mg/L)	00720	<0.004	<0.004	0.122	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	<0.01	<0.01	2.65	<0.01	<0.01	0.061
Ammonia as N (mg/L)	00608	0.468	0.611	<0.01	0.057	0.198	1.2
Total Kjeldahl nitrogen as N (mg/L)	00625	0.39	0.54	<0.07	<0.07	0.16	0.81
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	0.16	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	0.11	<0.09
Aluminum (µg/L)	01106	<30	46	<30	<30	42	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	5.90	8.80	23.10	23.30	6.70	23.00
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	131	680	<10	27	202	1,170
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	12.90	<5	7.20	<5	5.60	<5
Iron (µg/L)	01046	27.6	21.8	<4	17	6.23	204
Lead (µg/L)	01049	<0.09	1.60	17.40[1]	<0.09	<0.09	<0.09
Lithium (µg/L)	01130	<8	<8	10	<8	15	<8
Manganese (µg/L)	01056	2.20	<0.8	1.60	1.60	1.10	16.70
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	455	135	16.6	457	107	236
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	11.10	<4	7.30	6.80	<4	4.70
Total dissolved solids (mg/L)	04764	392	443	83	194	332	1,320[2]
Hardness as CaCO3 (mg/L)	00900	21	7	25	101	7	15

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued

(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		26	27	28	29	30	31
Date Time		08/21/95 830	08/14/95 1144	08/29/95 1200	08/14/95 1415	08/17/95 930	07/31/95 930
Specific conductance (µS/cm)	00094	828	331	78	257	226	123
Temperature (°C)	00010	23	30	22	31	29	22
Turbidity (NTU)	16542	<1	<1	<1	<1	1	<1
Bicarbonate (mg/L)	00440	210	193	22	133	112	91
Carbonate (mg/L)	00445	<1	8	<1	2	2	<1
Alkalinity as CaCO3 (mg/L)	00411	172	168	18	112	94	75
pH (units)	00400	7.0	8.8	5.7	8.4	8.4	7.3
Silica (mg/L)	00955	10.60	11.90	12.60	13.00	13.60	10.90
Calcium (mg/L)	00915	4.21	2.17	1.61	3.53	2.32	2.38
Magnesium (mg/L)	00925	0.74	0.23	1.39	0.09	0.11	0.55
Sodium (mg/L)	00930	193	81.6	1.83	59.8	50.3	30.3
Potassium (mg/L)	00935	2.8	5.0	4.0	1.1	0.9	2.0
Sulfate (mg/L)	00945	<0.2	12.80	<0.2	6.00	20.30	4.09
Chloride (mg/L)	00940	169.00	11.90	1.44	18.30	5.51	1.94
Bromide (mg/L)	71870	1.59	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	1.24	0.789	0.102	0.199	0.101	0.158
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	<0.01	0.061	0.037	<0.01	<0.01	<0.01
Ammonia as N (mg/L)	00608	0.608	0.208	0.012	0.21	0.271	0.257
Total Kjeldahl nitrogen as N (mg/L)	00625	0.57	0.16	<0.07	0.19	0.20	0.21
Orthophosphate as P (mg/L)	00671	<0.08	0.15	<0.08	<0.08	<0.08	0.15
Total phosphorus as P (mg/L)	00666	0.12	0.11	0.25	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	<30	<30	<30	<30	<30	31
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	21.30	3.80	31.50	10.10	3.90	20.30
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	182	284	<10	14	15	22
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	10.70	8.60	7.60
Iron (µg/L)	01046	72	16.6	11,200[2]	158	10.4	79.6
Lead (µg/L)	01049	<0.9	3.40	<0.9	15.80[1]	<0.9	<0.9
Lithium (µg/L)	01130	12	18	<8	32	8	10
Manganese (µg/L)	01056	10.00	<0.8	679.00[2]	36.60	2.10	22.70
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	211	35.2	14.7	40	63	121
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	9.30	5.60	19.20	9.40	<4	5.10
Total dissolved solids (mg/L)	04764	525[2]	282	32	203	157	120
Hardness as CaCO3 (mg/L)	00900	14	6	10	9	6	8

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		32	34	35	36	37	38
Date Time		08/16/95 1330	07/31/95 800	08/24/95 920	08/17/95 750	08/23/95 1315	08/15/95 800
Specific conductance (µS/cm)	00094	8,610	124	35	359	180	467
Temperature (°C)	00010	31	22	20	32	25	35
Turbidity (NTU)	16542	19	<1	<1	<1	4	<1
Bicarbonate (mg/L)	00440	641	60	11	201	132	252
Carbonate (mg/L)	00445	9	<1	<1	3	<1	3
Alkalinity as CaCO3 (mg/L)	00411	536	49	9	168	108	210
pH (units)	00400	8.3	6.1	5.4	8.3	6.3	8.2
Silica (mg/L)	00955	17.40	18.60	17.80	16.60	12.30	16.60
Calcium (mg/L)	00915	16.2	12.4	1.7	0.822	30.7	0.575
Magnesium (mg/L)	00925	8.63	4.41	0.88	0.08	5.6	<0.06
Sodium (mg/L)	00930	1,830	2.32	1.13	79.6	2.48	107
Potassium (mg/L)	00935	11.2	2.6	3.1	<0.6	3.8	<0.6
Sulfate (mg/L)	00945	1.58	8.69	2.34	4.72	3.34	19.40
Chloride (mg/L)	00940	2,720.00[2]	2.24	1.72	9.10	1.70	8.38
Bromide (mg/L)	71870	14.20	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	2.57	0.16	0.036	0.381	0.107	0.753
Cyanide (mg/L)	00720	0.0334	<0.004	<0.004	0.0355	<0.004	<0.004
Nitrate as N (mg/L)	00618	1.49	0.143	0.047	<0.01	<0.01	0.016
Ammonia as N (mg/L)	00608	1.43	0.051	<0.01	0.268	0.015	0.264
Total Kjeldahl nitrogen as N (mg/L)	00625	1.37	0.07	<0.07	0.23	<0.07	0.22
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	0.20
Total phosphorus as P (mg/L)	00666	<0.09	0.57	<0.09	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	50	<30	<30	<30	<30	57
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	89.60	249.00	69.50	1.10	512.00	1.00
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	5,410	<10	<10	114	<10	275
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	6.90	5.50	<5	6.90	5.00	<5
Iron (µg/L)	01046	151	9,920[2]	18.6	<4	183	11
Lead (µg/L)	01049	<0.9	<0.9	2.80	<0.9	1.60	<0.9
Lithium (µg/L)	01130	118	14	<8	14	<8	<8
Manganese (µg/L)	01056	44.10	363.00[2]	3.60	1.40	88.90[2]	4.60
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	2,940	524	47.4	14.6	405	19.6
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	<4	31.40	20.30	<4	13.00	<4
Total dissolved solids (mg/L)	04764	5,230[2]	91	25	69	117	320
Hardness as CaCO3 (mg/L)	00900	79	50	8	2	101	1

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		40	43	44	45	46	47
Date Time		08/08/95 715	09/20/95 1325	08/09/95 1215	09/28/95 1015	08/08/95 1440	09/20/95 1435
Specific conductance (µS/cm)	00094	333	222	119	140	292	205
Temperature (°C)	00010	20	22	20	20	20	21
Turbidity (NTU)	16542	<1	<1	<1	1	<1	13
Bicarbonate (mg/L)	00440	188	155	69	87	193	127
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	155	127	57	71	159	104
pH (units)	00400	7.5	6.5	6.4	6.8	7.3	6.5
Silica (mg/L)	00955	17.60	11.10	9.16	10.60	6.85	8.81
Calcium (mg/L)	00915	32.6	47.6	22.2	20.8	59.2	47.7
Magnesium (mg/L)	00925	6.76	1.76	3.17	5.35	6.27	1.71
Sodium (mg/L)	00930	25.8	1.55	2.64	1.45	1.5	1.83
Potassium (mg/L)	00935	1.8	0.7	<0.6	<0.6	1.3	<0.6
Sulfate (mg/L)	00945	6.00	5.65	4.94	1.74	9.15	4.95
Chloride (mg/L)	00940	5.68	2.79	4.93	2.70	3.34	2.05
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	<0.02	0.085	0.021	0.052	0.104	0.235
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	0.0068	<0.004
Nitrate as N (mg/L)	00618	<0.01	0.333	1.48	2.01	1.07	0.314
Ammonia as N (mg/L)	00608	0.229	0.017	0.017	<0.01	<0.01	<0.01
Total Kjeldahl nitrogen as N (mg/L)	00625	0.26	<0.07	<0.07	<0.07	<0.07	<0.07
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	45	32	66.2	<30	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	780.00	16.50	5.80	4.60	31.20	9.10
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	40	<10	<10	<10	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	9.10	<5	29.90
Iron (µg/L)	01046	318[2]	17.6	21.2	<4	12.5	13.9
Lead (µg/L)	01049	<0.9	1.50	<0.9	<0.9	<0.9	2.60
Lithium (µg/L)	01130	16	<8	12	<8	<8	<8
Manganese (µg/L)	01056	194.00[2]	<0.8	1.10	<0.8	1.20	<0.8
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	492	27.7	21.6	25	203	32.7
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	10.00	32.00	34.20	<4	5.20	6.30
Total dissolved solids (mg/L)	04764	196	171	93	96	192	199
Hardness as CaCO3 (mg/L)	00900	110	126	69	74	174	126

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		48	49	50	51	52	53
Date Time		08/08/95 715	09/20/95 1325	08/09/95 1215	09/28/95 1015	08/08/95 1440	09/20/95 1435
Specific conductance (µS/cm)	00094	304	214	226	394	40	954
Temperature (°C)	00010	19	21	21	20	22	24
Turbidity (NTU)	16542	1	<1	7	95	3	11
Bicarbonate (mg/L)	00440	168	144	167	46	9	704
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	3
Alkalinity as CaCO3 (mg/L)	00411	138	118	137	38	7	586
pH (units)	00400	7.1	6.3	7.3	7.1	5.0	8.2
Silica (mg/L)	00955	8.06	9.15	8.63	18.00	15.60	40.90
Calcium (mg/L)	00915	58.5	29.9	32.6	7.56	1.27	2.46
Magnesium (mg/L)	00925	6.46	12.5	15.2	1.85	0.77	0.98
Sodium (mg/L)	00930	2.95	1.97	2.31	13.4	1.09	247
Potassium (mg/L)	00935	1.5	0.8	1.1	2.7	3.0	2.5
Sulfate (mg/L)	00945	26.10	2.53	3.82	3.67	6.20	<0.2
Chloride (mg/L)	00940	4.80	3.70	3.76	16.30	1.16	5.23
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	<0.02	0.067	<0.02	0.155	0.066	0.959
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	2.43	0.582	1.27	<0.01	0.021	<0.01
Ammonia as N (mg/L)	00608	0.025	0.013	<0.01	0.277	<0.01	0.527
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	<0.07	<0.07	0.25	<0.07	0.74
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	0.38
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	0.2	<0.09	0.23
Aluminum (µg/L)	01106	<30	<30	<30	48	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	27.40	94.40	21.10	18.40	31.30	3.70
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	<10	<10	<10	874
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	6	<6	<6	<6	<6
Cobalt (µg/L)	01035	11	<10	<10	<10	<10	<10
Copper (µg/L)	01040	6.70	<5	<5	<5	<5	<5
Iron (µg/L)	01046	6.9	<4	7.4	27,700[2]	452[2]	31.3
Lead (µg/L)	01049	<0.9	<0.9	12.40	1.90	1.30	<0.9
Lithium (µg/L)	01130	<8	13	<8	18	<8	26
Manganese (µg/L)	01056	<0.8	<0.8	1.50	342.00[2]	23.50	2.30
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	227	44.6	26.4	80	8.8	43.5
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	5.20	<4	4.10	20.10	21.10	<4
Total dissolved solids (mg/L)	04764	216	118	155	147	16	687[2]
Hardness as CaCO3 (mg/L)	00900	173	126	144	27	6	10

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		54	55	56	57	58	59
Date Time		08/22/95 905	07/31/95 1500	08/16/95 1700	08/08/95 920	08/16/95 1500	09/19/95 1345
Specific conductance (µS/cm)	00094	104	93	285	189	157	35
Temperature (°C)	00010	29	29	27	21	25	20
Turbidity (NTU)	16542	<1	<1	3	<1	2	3
Bicarbonate (mg/L)	00440	29	57	132	82	77	16
Carbonate (mg/L)	00445	<1	3	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	24	51	108	67	64	13
pH (units)	00400	6.1	8.9	6.7	7.0	7.9	5.9
Silica (mg/L)	00955	21.10	13.50	15.60	4.08	5.71	6.94
Calcium (mg/L)	00915	3.03	19.8	44.1	26.2	31.9	2.06
Magnesium (mg/L)	00925	1.79	0.65	1.49	2.92	0.71	1.11
Sodium (mg/L)	00930	2.8	1.73	1.43	6.15	5.8	3.13
Potassium (mg/L)	00935	2.0	<0.6	0.9	2.3	0.9	0.6
Sulfate (mg/L)	00945	<0.2	2.32	5.06	7.52	0.34	7.62
Chloride (mg/L)	00940	1.94	3.51	2.60	10.90	4.94	1.66
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.096	0.097	0.036	0.082	0.036	0.045
Cyanide (mg/L)	00720	<0.004	<0.004	0.0935	0.0042	<0.004	<0.004
Nitrate as N (mg/L)	00618	<0.01	0.17	0.723	0.954	4.91	0.125
Ammonia as N (mg/L)	00608	<0.01	<0.01	<0.01	<0.01	<0.01	0.036
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Orthophosphate as P (mg/L)	00671	<0.08	0.30	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	0.24	<0.09	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	<30	33	<30	<30	<30	41
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	29.10	8.70	23.60	48.00	8.40	9.20
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	<10	<10	13	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	8	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	9.50	<5	<5	5.70	<5
Iron (µg/L)	01046	11,200[2]	<4	4.5	22.1	13.5	1,340[2]
Lead (µg/L)	01049	2.70	<0.9	1.00	<0.9	<0.9	<0.9
Lithium (µg/L)	01130	8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	236.00[2]	<8	4.00	<8	2.70	662.00[2]
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	30.8	23.6	74.8	75	62	8.3
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	<4	<4	9.30	5.80	117.00	80.60
Total dissolved solids (mg/L)	04764	44	66	159	102	153	19
Hardness as CaCO3 (mg/L)	00900	15	52	116	78	83	10

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		60	61	62	63	64	65
Date Time		08/03/95 1235	08/01/95 920	08/14/95 1015	08/21/95 1650	08/21/95 1620	08/09/95 840
Specific conductance (µS/cm)	00094	947	68	147	25	23	445
Temperature (°C)	00010	28	30	30	21	22	23
Turbidity (NTU)	16542	7	<1	1	2	2	1
Bicarbonate (mg/L)	00440	739	18	52	12	4	216
Carbonate (mg/L)	00445	15	4	<1	<1	<1	1
Alkalinity as CaCO3 (mg/L)	00411	624	18	43	10	3	176
pH (units)	00400	8.5	9.2	6.2	5.3	5.2	7.6
Silica (mg/L)	00955	13.20	11.70	35.80	7.92	8.37	7.78
Calcium (mg/L)	00915	4.62	8.71	8024	0.476	0.725	57.9
Magnesium (mg/L)	00925	1.04	1.21	0.82	0.52	0.47	3.57
Sodium (mg/L)	00930	362	4.84	11.7	2.32	1.67	43.1
Potassium (mg/L)	00935	1.1	1.2	2.7	<0.6	<0.6	1.0
Sulfate (mg/L)	00945	<0.2	4.47	6.30	0.40	0.34	12.30
Chloride (mg/L)	00940	131.00	9.32	6.69	3.53	2.88	49.90
Bromide (mg/L)	71870	1.17	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	3.76	0.771	<0.02	0.052	<0.02	<0.02
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.028	0.982	<0.01	0.426	0.493	0.1
Ammonia as N (mg/L)	00608	0.613	<0.01	1.31	<0.01	<0.01	<0.01
Total Kjeldahl nitrogen as N (mg/L)	00625	0.49	<0.7	2.07	<0.07	<0.07	<0.07
Orthophosphate as P (mg/L)	00671	0.15	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	0.1	<0.09	0.1	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	<30	53	<30	<30	<30	52.7
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	14.60	25.00	19.40	19.60	17.50	36.30
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	1,060	11	15	<10	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	12	17	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	42.00	68.70	<5
Iron (µg/L)	01046	25.1	6.5	742[1]	8.1	34.7	15.9
Lead (µg/L)	01049	<0.9	<0.9	<0.9	2.40	5.50	<0.9
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	4.10	1.30	40.80	3.10	4.30	<0.8
Mercury (µg/L)	06354	<0.8	<0.8	<0.8	<0.8	<0.8	0.16
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	244	16.4	203	4.7	12.2	175
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	4.20	<4	18.40	21.80	12.40	26.80
Total dissolved solids (mg/L)	04764	894[2]	74	144	<10	<10	292
Hardness as CaCO3 (mg/L)	00900	16	27	24	3	4	160

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		66	67	69	70	73	74
Date Time		09/21/95 1320	08/15/95 1200	08/08/95 825	08/16/95 1240	09/21/95 1415	09/25/95 920
Specific conductance (µS/cm)	00094	572	204	299	230	210	379
Temperature (°C)	00010	23	26	24	27	21	17
Turbidity (NTU)	16542	18	5	<1	1	1	3
Bicarbonate (mg/L)	00440	324	128	189	145	149	155
Carbonate (mg/L)	00445	<1	<1	1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	266	105	156	119	122	127
pH (units)	00400	7.3	7.3	7.7	7.2	6.9	7.1
Silica (mg/L)	00955	13.80	24.50	18.40	22.40	9.62	9.22
Calcium (mg/L)	00915	5.4	22.6	37.2	39.3	40.3	31.4
Magnesium (mg/L)	00925	2.2	12.6	13.6	5.92	3.53	10.9
Sodium (mg/L)	00930	160	1.45	5.2	2.41	1.34	1.09
Potassium (mg/L)	00935	2.5	0.9	0.6	1.4	1.0	1.2
Sulfate (mg/L)	00945	71.70	9.96	8.40	8.53	2.79	2.45
Chloride (mg/L)	00940	10.20	1.67	1.59	2.41	1.74	5.59
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.936	0.144	0.284	0.131	0.057	0.039
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.091	0.033	0.181	<0.01	0.164	0.514
Ammonia as N (mg/L)	00608	0.441	0.026	0.021	<0.01	<0.01	0.01
Total Kjeldahl nitrogen as N (mg/L)	00625	0.53	<0.07	<0.07	<0.07	<0.07	<0.07
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	0.11	0.26
Aluminum (µg/L)	01106	<30	<30	<30	<30	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	28.80	2.10	128.00	12.90	15.00	16.90
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	619	<10	49	<10	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	13	<10
Copper (µg/L)	01040	<5	9.90	9.70	<5	<5	<5
Iron (µg/L)	01046	19.7	59.3	8.7	93.1	<4	8.8
Lead (µg/L)	01049	<0.9	<0.9	1.90	<0.9	<0.9	<0.9
Lithium (µg/L)	01130	<8	<8	19	<8	<8	<8
Manganese (µg/L)	01056	1.40	3.30	1.10	6.30	<0.8	<0.8
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	562	70.3	1,940	198	49.2	57.5
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	<4	11.60	227.00	5.50	<4	8.80
Total dissolved solids (mg/L)	04764	397	176	195	180	113	170
Hardness as CaCO3 (mg/L)	00900	23	108	151	123	115	123

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		75	76	77	78	79	80
Date		09/18/95	09/18/95	09/18/95	09/18/95	09/18/95	09/19/95
Time		1445	1530	1230	1335	1040	1020
Specific conductance (µS/cm)	00094	185	169	213	181	172	223
Temperature (°C)	00010	19	18	21	20	20	18
Turbidity (NTU)	16542	1	1	1	1	<1	<1
Bicarbonate (mg/L)	00440	147	124	145	129	124	161
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	121	102	119	106	102	132
pH (units)	00400	6.5	6.5	6.5	6.6	6.6	6.6
Silica (mg/L)	00955	8.87	8.63	10.70	15.90	13.10	8.20
Calcium (mg/L)	00915	31	26.8	24.7	22.3	22.5	28.8
Magnesium (mg/L)	00925	9.49	8.24	13.9	12.3	11	15.2
Sodium (mg/L)	00930	0.67	0.76	1.56	1.36	1.14	0.84
Potassium (mg/L)	00935	<0.6	<0.6	2.1	1.4	2.3	1.7
Sulfate (mg/L)	00945	1.63	1.39	1.84	3.23	2.03	2.02
Chloride (mg/L)	00940	1.42	1.31	2.38	1.32	1.41	1.48
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.058	0.045	0.071	0.109	<0.02	<0.02
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.288	0.412	0.609	0.122	0.241	0.404
Ammonia as N (mg/L)	00608	<0.01	<0.01	0.024	<0.01	<0.01	<0.01
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	<30	<30	<30	<30	<30	56
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	73.00	65.80	20.40	19.80	24.30	12.60
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	<10	11	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	<5	<5	<5
Iron (µg/L)	01046	9.6	12.9	10.1	53.1	4.13	8.79
Lead (µg/L)	01049	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Lithium (µg/L)	01130	<8	39	<8	10	11	<8
Manganese (µg/L)	01056	<0.8	<0.8	1.00	.090	1.20	<0.8
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	20.9	19.5	21.9	24.7	31.6	19.6
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	<4	<4	<4	<4	<4	<4
Total dissolved solids (mg/L)	04764	104	84	84	74	64	100
Hardness as CaCO3 (mg/L)	00900	117	101	119	106	102	135

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		82	83	84	85	86	87
Date Time		08/07/95 1725	09/18/95 1620	09/18/95 1555	09/27/95 1700	09/27/95 1400	08/09/95 1035
Specific conductance (µS/cm)	00094	203	223	175	17	22	157
Temperature (°C)	00010	18	19	19	17	18	20
Turbidity (NTU)	16542	2	1	1	1	<1	4
Bicarbonate (mg/L)	00440	157	149	132	15	6	85
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	129	122	108	12	5	70
pH (units)	00400	7.4	6.5	6.6	5.2	5.6	6.8
Silica (mg/L)	00955	8.16	9.01	10.30	8.97	8.72	8.20
Calcium (mg/L)	00915	50.7	34.9	27.3	0.986	0.967	28.20
Magnesium (mg/L)	00925	2.17	10.1	9.56	0.36	0.82	4.42
Sodium (mg/L)	00930	1.25	0.97	0.75	0.9	1.36	1.47
Potassium (mg/L)	00935	0.8	<0.6	<0.6	<0.6	1.2	1.2
Sulfate (mg/L)	00945	2.74	2.25	1.49	0.59	0.40	1.03
Chloride (mg/L)	00940	2.13	1.59	1.10	1.29	2.91	4.18
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.05	0.053	0.098	0.031	<0.02	0.063
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	0.004	<0.004
Nitrate as N (mg/L)	00618	0.536	0.415	0.169	0.147	1.14	4.51
Ammonia as N (mg/L)	00608	<0.01	<0.01	<0.01	<0.01	<0.01	0.019
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	0.27	<0.07	<0.07	<0.07	<0.07
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	<30	<30	<30	<30	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	12.00	67.20	115.00	6.00	14.10	19.50
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	11	<10	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	4.40	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	<5	17.00	5.00
Iron (µg/L)	01046	8.7	42.8	63.6	6.47	<4	77.1
Lead (µg/L)	01049	<0.9	<0.9	<0.9	<0.9	<0.9	11.50
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	<0.8	<0.8	<0.8	6.60	3.00	4.10
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	80.1	25.4	28.7	4.2	8.7	38.1
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	<4	<4	<4	<4	<4	9.40
Total dissolved solids (mg/L)	04764	163	101	80	27	42	124
Hardness as CaCO3 (mg/L)	00900	139	129	108	4	6	89

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		89	91	92	93	94	95
Date Time		09/29/95 1515	09/25/95 1100	09/21/95 1135	09/21/95 1030	09/28/95 830	09/19/95 1355
Specific conductance (µS/cm)	00094	233	430	238	228	419	76
Temperature (°C)	00010	19	19	19	20	19	20
Turbidity (NTU)	16542	19	4	<1	<1	4	<1
Bicarbonate (mg/L)	00440	164	205	162	140	221	38
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	135	168	133	115	181	31
pH (units)	00400	6.9	7.0	6.7	5.5	6.6	6.0
Silica (mg/L)	00955	8.13	8.28	8.98	10.40	9.12	7.58
Calcium (mg/L)	00915	30.1	51.3	38.1	47.7	69.9	6.79
Magnesium (mg/L)	00925	14.2	16.4	9.28	2.56	2.61	0.86
Sodium (mg/L)	00930	0.85	1.96	1.27	1.7	5.71	10.3
Potassium (mg/L)	00935	0.6	2.8	0.9	1.5	1.9	0.7
Sulfate (mg/L)	00945	1.89	30.90	2.38	8.94	5.96	1.88
Chloride (mg/L)	00940	1.62	4.56	4.34	6.62	10.10	9.11
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.062	0.063	0.845	1.3	0.171	0.189
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.349	0.731	0.539	0.38	2.5	0.236
Ammonia as N (mg/L)	00608	<0.01	0.127	0.016	<0.01	<0.01	<0.01
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	0.16	<0.07	<0.07	0.12	<0.07
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	0.22	<0.09	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	<30	43	<30	<30	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	11.20	25.30	37.40	34.00	34.50	10.80
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	<10	<10	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	17	16	<10	<10
Copper (µg/L)	01040	<5	<5	22.20	8.10	6.60	18.80
Iron (µg/L)	01046	5.1	54.6	9.29	7.3	5.7	122
Lead (µg/L)	01049	<0.9	1.50	1.20	1.20	<0.9	<0.9
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	<0.8	39.20	<0.8	<0.8	2.50	10.70
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	24.7	55.3	31.3	56.6	109	10.3
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	5.80	5.60	13.80	<4	<4	18.20
Total dissolved solids (mg/L)	04764	165	261	141	130	360	21
Hardness as CaCO3 (mg/L)	00900	134	196	133	130	185	21

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		96	97	98	99	104	108
Date Time		08/08/95 1325	08/08/95 1550	08/07/95 1530	08/01/95 920	09/27/95 1120	09/19/95 1545
Specific conductance (µS/cm)	00094	183	240	155	36	419	117
Temperature (°C)	00010	20	18	21	25	21	25
Turbidity (NTU)	16542	<1	17	2	<1	1	<1
Bicarbonate (mg/L)	00440	144	172	121	9	298	41
Carbonate (mg/L)	00445	<1	1	<1	<1	12	<1
Alkalinity as CaCO3 (mg/L)	00411	118	142	99	7	259	34
pH (units)	00400	7.4	7.8	7.2	6.0	8.8	6.2
Silica (mg/L)	00955	7.76	7.59	8.03	7.66	11.30	20.40
Calcium (mg/L)	00915	29.7	45.1	21.3	0.918	1.45	14.6
Magnesium (mg/L)	00925	11.1	8.02	11.2	1.08	0.36	1.61
Sodium (mg/L)	00930	0.52	2.48	2.11	6.53	120	6.17
Potassium (mg/L)	00935	0.6	0.8	0.6	0.8	<0.6	2.0
Sulfate (mg/L)	00945	1.39	8.78	1.69	2.24	<0.2	15.10
Chloride (mg/L)	00940	1.02	1.19	3.00	12.00	4.21	7.28
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.057	0.131	<0.02	0.036	0.195	0.049
Cyanide (mg/L)	00720	0.0048	0.0058	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.168	0.124	0.025	<0.01	<0.01	0.36
Ammonia as N (mg/L)	00608	<0.01	<0.01	<0.01	0.022	0.28	<0.01
Total Kjeldahl nitrogen as N (mg/L)	00625	0.07	0.09	<0.07	<0.07	0.29	<0.07
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	0.1	<0.09	0.11	<0.09	<0.09
Aluminum (µg/L)	01106	<30	<30	<30	<30	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	31.50	25.80	10.00	22.80	9.70	14.20
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	<10	10	91	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	6.7	<6	7	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	14	<10	<10
Copper (µg/L)	01040	<5	<5	<5	<5	5.30	14.60
Iron (µg/L)	01046	10.6	18.4	15.1	1,980[2]	24.2	28
Lead (µg/L)	01049	2.10	<0.9	<0.9	1.10	<0.9	<0.9
Lithium (µg/L)	01130	<8	12	25	<8	<8	<8
Manganese (µg/L)	01056	2.80	<0.8	3.80	105.00[2]	4.50	15.30
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	21.3	216	14.8	8.9	24.3	96
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	4.90	5.00	<4	99.20	<4	23.10
Total dissolved solids (mg/L)	04764	127	157	112	61	332	49
Hardness as CaCO3 (mg/L)	00900	120	146	99	7	5	43

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		110	113	114	115	116	117
Date Time		09/25/95 1200	08/16/95 930	08/14/95 1615	07/31/95 1540	08/03/95 1000	08/01/95 1515
Specific conductance (µS/cm)	00094	414	347	266	385	177	312
Temperature (°C)	00010	19	27	26	22	25	26
Turbidity (NTU)	16542	<1	1	1	3	<1	<1
Bicarbonate (mg/L)	00440	15	212	180	232	163	147
Carbonate (mg/L)	00445	<1	<1	<1	<1	1	<1
Alkalinity as CaCO3 (mg/L)	00411	12	174	148	194	134	121
pH (units)	00400	7.1	7.1	7.2	8.3	7.7	7.7
Silica (mg/L)	00955	15.70	20.40	27.40	13.40	48.20	36.70
Calcium (mg/L)	00915	2.44	59.5	46.2	2.94	38	0.714
Magnesium (mg/L)	00925	1.78	5.63	4.38	0.7	6.95	0.18
Sodium (mg/L)	00930	4.78	5.57	10.6	90.4	11.3	92.8
Potassium (mg/L)	00935	2.1	1.9	0.9	0.7	1.9	1.6
Sulfate (mg/L)	00945	5.41	14.40	10.40	14.10	16.10	0.38
Chloride (mg/L)	00940	7.74	3.26	1.82	18.70	5.54	77.20
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.071	0.073	<0.02	<0.02	<0.02	0.207
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	1.75	<0.01	0.128	<0.01	<0.01	<0.01
Ammonia as N (mg/L)	00608	<0.01	<0.01	0.068	0.471	<0.01	0.526
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	<0.07	<0.07	0.40	<0.07	0.49
0.27O0.22r0.34thophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	0.27	0.22	0.34
Total phosphorus as P (mg/L)	00666	0.14	<0.09	<0.09	<0.09	0.2	0.37
Aluminum (µg/L)	01106	52	<30	<30	<30	<30	40
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	40.80	38.10	4.00	6.10	30.10	7.60
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	<10	174	17	331
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	10	<10
Copper (µg/L)	01040	<5	5.40	7.00	<5	22.10	<5
Iron (µg/L)	01046	62.4	202	196	11.5	7.9	38.4
Lead (µg/L)	01049	1.40	1.00	<0.9	<0.9	<0.9	3.40
Lithium (µg/L)	01130	9	18	<8	<8	27	20
Manganese (µg/L)	01056	40.80	2.40	4.80	18.20	0.80	6.50
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	14.4	344	385	118	575	20.5
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	21.30	14.00	39.90	<4	<4	<4
Total dissolved solids (mg/L)	04764	78	221	333	265	186	325
Hardness as CaCO3 (mg/L)	00900	13	172	134	10	124	3

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		118	119	120	121	122	123
Date Time		08/02/95 1158	08/02/95 1700	08/02/95 1504	08/02/95 1735	08/01/95 1030	09/25/95 1545
Specific conductance (µS/cm)	00094	25	7	50	15	173	351
Temperature (°C)	00010	25	--	28	25	25	21
Turbidity (NTU)	16542	<1	<1	2	2	<1	1
Bicarbonate (mg/L)	00440	<1	6	36	5	172	91
Carbonate (mg/L)	00445	<1	<1	4	<1	<1	1
Alkalinity as CaCO3 (mg/L)	00411	<2	5	31	4	141	75
pH (units)	00400	4.6	5.3	8.6	4.9	7.0	8.0
Silica (mg/L)	00955	7.62	12.10	18.80	7.85	19.50	27.70
Calcium (mg/L)	00915	1.13	0.907	10.8	0.885	20.7	18.9
Magnesium (mg/L)	00925	1.54	0.45	1.39	0.78	6.88	2.24
Sodium (mg/L)	00930	4.19	1.72	3.29	3.17	30.5	12.5
Potassium (mg/L)	00935	<0.6	<0.6	1.1	<0.6	4.0	1.6
Sulfate (mg/L)	00945	2.15	1.16	8.92	0.97	5.82	6.26
Chloride (mg/L)	00940	7.59	2.97	5.39	5.10	2.96	3.35
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	<0.02	<0.02	<0.02	<0.02	0.1	0.99
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	3.93	0.028	<0.01	0.935	0.02	0.02
Ammonia as N (mg/L)	00608	<0.01	<0.01	<0.01	<0.01	0.17	<0.01
Total Kjeldahl nitrogen as N (mg/L)	00625	0.28	<0.07	<0.07	<0.07	0.13	<0.07
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	0.15	<0.09	<0.09	<0.09	<0.09	0.12
Aluminum (µg/L)	01106	<30	<30	<30	<30	45	44
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	37.30	8.10	28.10	21.00	75.80	1.30
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	11	<10	<10	15	37	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	15	<10	<10	<10	<10	<10
Copper (µg/L)	01040	12.60	6.30	<5	6.00	<5	<5
Iron (µg/L)	01046	14.4	30.2	22.8	19.3	15.9	17.3
Lead (µg/L)	01049	1.60	<0.09	<0.9	<0.9	<0.9	<0.9
Lithium (µg/L)	01130	<8	<8	<8	<8	8	23
Manganese (µg/L)	01056	44.10	1.30	7.30	8.20	33.90	3.60
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	13.6	9	112	8.1	267	72.5
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	3.40	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	34.00	4.80	<4	28.50	4.30	13.30
Total dissolved solids (mg/L)	04764	51	<10	53	25	187	145
Hardness as CaCO3 (mg/L)	00900	9	4	33	5	80	57

Appendix G-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix G-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		124	125	126	127	128	
Date Time		08/02/95 1007	08/02/95 1125	08/02/95 1540	08/01/95 1345	08/17/95 1015	
Specific conductance (µS/cm)	00094	50	35	45	80	183	
Temperature (°C)	00010	29	25	27	25	26	
Turbidity (NTU)	16542	4	<1	<1	15	<1	
Bicarbonate (mg/L)	00440	41	2	29	22	110	
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	
Alkalinity as CaCO3 (mg/L)	00411	34	2	24	18	90	
pH (units)	00400	6.2	4.8	6.4	7.4	6.8	
Silica (mg/L)	00955	27.70	8.78	25.50	13.40	35.10	
Calcium (mg/L)	00915	12.1	1.77	6.22	1.46	28.6	
Magnesium (mg/L)	00925	1.72	4.12	1.59	0.8	0.21	
Sodium (mg/L)	00930	5.4	5.3	6.12	22.7	11	
Potassium (mg/L)	00935	2.8	<0.6	1.1	1.3	2.7	
Sulfate (mg/L)	00945	1.88	0.65	3.69	3.50	8.67	
Chloride (mg/L)	00940	7.13	11.00	7.20	22.50	4.22	
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	
Fluoride (mg/L)	00950	<0.02	<0.02	0.305	<0.02	0.04	
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	0.0316	
Nitrate as N (mg/L)	00618	<0.01	4.96	1.44	0.055	<0.01	
Ammonia as N (mg/L)	00608	<0.01	0.012	0.019	0.043	0.051	
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	<0.07	<0.07	0.09	<0.07	
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	0.20	<0.08	<0.080	
Total phosphorus as P (mg/L)	00666	0.1	0.14	0.23	<0.09	<0.09	
Aluminum (µg/L)	01106	<30	<30	<30	<30	<30	
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	
Barium (µg/L)	01005	60.00	72.10	20.10	24.60	52.40	
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	
Boron (µg/L)	01020	13	10	16	85	<10	
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	
Cobalt (µg/L)	01035	11	19	<10	<10	<10	
Copper (µg/L)	01040	5.10	5.60	5.70	<5	8.60	
Iron (µg/L)	01046	19	30.1	14..5	472[2]	21.2	
Lead (µg/L)	01049	<0.9	<0.9	2.80	<0.9	<0.9	
Lithium (µg/L)	01130	15	<8	<8	<8	<8	
Manganese (µg/L)	01056	122.00[2]	65.30[2]	1.20	26.50	4.70	
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	
Selenium (µg/L)	01145	<3	<3	3.80	<3	<3	
Silver (µg/L)	01075	<20	<20	<20	<20	<20	
Strontium (µg/L)	01080	81.2	30.5	75.4	33.4	701	
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	
Tin (µg/L)	01100	<50	<50	<50	<50	<50	
Vanadium (µg/L)	01085	4.30	<3	<3	<3	<3	
Zinc (µg/L)	01090	5.90	83.60	65.60	22.40	<4	
Total dissolved solids (mg/L)	04764	93	81	56	103	165	
Hardness as CaCO3 (mg/L)	00900	37	21	22	7	73	

APPENDIX H

SURFACE-WATER QUALITY SITES AND RESULTS OF CHEMICAL ANALYSES OF WATER SAMPLES, 1995

Abbreviations: µS/cm, microsiemens per centimeter;
°C, degrees Centigrade; mg/L, milligrams per liter;
µg/L, micrograms per liter; ND, not detected;
NTU, nephelometric turbidity units.

Notes: See plate 4 for locations of surface water sampling sites. Discharge information for some sites is available from U.S. Geological Survey and Hydrogeology Division files.

[1] = value equals or exceeds primary drinking water standards

[2] = value equals or exceeds secondary drinking water standards

Appendix H-1.—Surface water quality sites

Sites	Station number	Location	County
1	02361000	Choctawhatchee River near Newton	Dale
2	02369800	Blackwater River near Bradley	Escambia
3	02372250	Patasaliga Creek near Brantley	Crenshaw
4	02373000	Sepulga River near McKenzie	Conecuh
5	02374500	Murder Creek near Evergreen	Conecuh
6	02399200	Little River near Blue Pond	Cherokee
7	02401390	Big Canoe Creek near Ashville	St. Clair
8	02412000	Tallapoosa River near Heflin	Cleburne
9	02419000	Uphapee Creek near Tuskegee	Macon
10	02422500	Mulberry Creek at Jones	Choctaw
11	02423630	Shades Creek near Greenwood	Jefferson
12	02423647	Cahaba River near West Blocton	Bibb
13	02424000	Cahaba River at Centreville	Bibb
14	02425500	Cedar Creek at Minter near Carlowville	Dallas
15	02427700	Turkey Creek at Kimbrough	Wilcox
16	02453000	Blackwater Creek near Manchester	Walker
17	02460500	Village Creek near Adamsville	Jefferson
18	02464000	North River near Samantha	Tuscaloosa
19	02465005	Black Warrior River at Tuscaloosa	Tuscaloosa
20	02469800	Satilpa Creek near Coffeeville	Clarke
21	02471001	Chickasaw Creek near Kushla	Mobile
22	03572110	Crow Creek near Bass	Jackson
23	03572900	Town Creek near Geraldine	DeKalb
24	03574500	Paint Rock River near Woodville	Jackson
25	03575000	Flint River near Chase	Madison
26	03586500	Big Nance Creek near Courtland	Lawrence
27	03591800	Bear Creek near Hackleburg	Marion
28	03592200	Cedar Creek near Pleasant Site	Franklin
29	03575860	Huntsville Spring Branch at Huntsville	Madison
30	02343300	Abbie Creek near Haleburg	Henry
31	02364570	Panther Creek near Hacoda	Geneva
32	02450825	Clear Creek near New Church near Poplar Springs	Winston
33	02400100	Terrapin Creek at Ellisville	Cherokee
34	02408540	Hatchet Creek below Rockford	Coosa
35	02421000	Catoma Creek near Montgomery	Montgomery
36	02423425	Cahaba River near Cahaba Heights	Shelby
37	02424940	Oakmulgee Creek near Augustin	Dallas
38	02439000	Buttahatchee River near Sulligent	Lamar
39	02450180	Mulberry Fork near Arkadelphia	Blount
40	02467500	Sucarnoochee River at Livingston	Sumter
41	02468500	Chickasaw Bogue Creek near Linden	Marengo
42	02462000	Valley Creek near Oak Grove	Jefferson
43	02449245	Brush Creek near Eutaw	Greene
44	02442500	Luxapalilla Creek near Millport	Lamar
45	02448500	Noxubee River near Geiger	Sumter
46	02423410	Little Cahaba River below Lake Purdy	Shelby
47	02423380	Cahaba River near Mountain Brook	Jefferson

Appendix H-2.--Results of chemical analyses of water samples, 1995
(See appendix H-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		1	2	3	4	5	6
Date Time		08/16/95 1115	08/22/95 1105	08/14/95 1700	08/22/95 1400	08/22/95 1545	08/08/95 1125
Specific conductance (µS/cm)	00094	76	37	125	64	114	33
Temperature (°C)	00010	28	25	28	30	27	29
Dissolved oxygen (mg/L)	00299	7.8	7.2	7.1	6.0	7.3	6.9
Turbidity (NTU)	16542	20	10	10	13	9	19
Bicarbonate (mg/L)	00440	38	<1	68	24	29	12
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	31	<2	56	20	24	10
pH (units)	00400	7.3	4.8	7.4	5.9	6.0	6.9
Silica (mg/L)	00955	5.66	8.17	8.91	11.90	9.19	1.51
Calcium (mg/L)	00915	10.10	1.34	19.40	6.70	9.27	3.06
Magnesium (mg/L)	00925	1.62	0.60	1.33	1.36	0.90	1.23
Sodium (mg/L)	00930	2.20	3.00	3.31	3.94	3.27	1.59
Potassium (mg/L)	00935	2.5	0.6	1.6	1.5	1.0	1.7
Sulfate (mg/L)	00945	1.58	1.72	2.12	3.43	2.21	5.74
Chloride (mg/L)	00940	4.03	2.63	3.97	4.34	4.47	1.46
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.167	0.101	0.069	0.056	0.091	0.049
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	0.0124
Nitrate as N (mg/L)	00618	0.496	0.176	0.243	0.423	0.161	0.2
Ammonia as N (mg/L)	00608	<0.01	<0.01	0.033	0.017	<0.01	0.027
Total Kjeldahl nitrogen as N (mg/L)	00625	0.16	0.32	0.20	0.23	<0.01	0.027
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	<0.09	0.11
Aluminum (µg/L)	01106	94	221[2]	48	60	40	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	19.30	15.60	19.70	29.40	24.60	24.20
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	<10	<10	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	3.40	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	10.10	<5	<5
Iron (µg/L)	01046	697[2]	571[2]	565[2]	1,230[2]	910[2]	81.7
Lead (µg/L)	01049	<0.9	1.3	<0.9	1.60	<0.9	<0.9
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	16.80	30.70	81.70[2]	122.00[2]	90.20[2]	35.70
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	20	<20	<20	20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	51.7	26.6	55.8	66.8	27.3	19.1
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	3.50	<3	<3
Zinc (µg/L)	01090	<4	15.40	5.50	18.70	8.00	<4
Chemical oxygen demand (mg/L)	00340	<35	63	<35	<35	58	<35
Total dissolved solids (mg/L)	04764	78	<10	130	29	35	33
Total suspended solids (mg/L)	00530	10	6	8	<4	10	10
Hardness as CaCO3 (mg/L)	00900	32	6	54	22	27	13

Appendix H-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix H-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		7	8	9	10	11	12
Date		09/20/95	09/25/95	09/25/95	09/23/95	09/20/95	09/25/95
Time		1625	1220	1650	1023	935	1015
Specific conductance (µS/cm)	00094	226	26	295	40	214	197
Temperature (°C)	00010	22	21	20	28	21	19
Dissolved oxygen (mg/L)	00299	4.9	7.9	9.3	7.4	5.3	7.3
Turbidity (NTU)	16542	13	66	8	19	30	100
Bicarbonate (mg/L)	00440	146	13	57	11	89	64
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	120	11	47	9	73	53
pH (units)	00400	7.0	8.0	8.1	6.0	6.4	7.5
Silica (mg/L)	00955	7.54	9.28	9.40	10.50	5.10	5.80
Calcium (mg/L)	00915	33.90	2.30	10.20	2.40	23.80	18.40
Magnesium (mg/L)	00925	8.12	1.09	5.12	1.08	4.56	4.71
Sodium (mg/L)	00930	2.42	2.07	13.10	1.41	12.20	5.34
Potassium (mg/L)	00935	1.5	1.5	4.3	1.2	3.0	3.7
Sulfate (mg/L)	00945	3.25	2.84	12.50	2.50	16.20	19.80
Chloride (mg/L)	00940	2.31	2.22	14.40	2.68	12.90	4.64
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.099	0.086	0.212	0.04	0.282	0.16
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.068	0.194	0.701	0.188	0.254	0.938
Ammonia as N (mg/L)	00608	0.02	0.052	0.051	0.028	0.037	0.102
Total Kjeldahl nitrogen as N (mg/L)	00625	0.09	0.17	0.25	<0.07	0.12	0.37
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	0.09	<0.08	<0.08	0.11
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	<0.09	0.14
Aluminum (µg/L)	01106	50	115	<30	<30	143	133
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	3.00	<2
Barium (µg/L)	01005	26.80	9.60	35.20	18.10	35.80	31.60
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	17	48	<10	21	14
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	<5	<5	<5
Iron (µg/L)	01046	54.2	548[2]	257	385[2]	262	241
Lead (µg/L)	01049	1.20	<0.9	<0.9	<0.9	1.20	1.30
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	38.40	47.20	57.90[2]	21.40	95.90[2]	12.10
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	57.3	14.1	28.4	26.8	80.8	42
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	3.60	3.40	<3	<3	<3	<3
Zinc (µg/L)	01090	6.20	<4	4.50	<4	7.80	<4
Chemical oxygen demand (mg/L)	00340	<35	<35	<35	<35	<35	<35
Total dissolved solids (mg/L)	04764	190	12	132	82	201	152
Total suspended solids (mg/L)	00530	11	43	11	19	14	42
Hardness as CaCO3 (mg/L)	00900	118	10	47	10	78	65

Appendix H-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix H-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		13	14	15	16	17	18
Date Time		08/24/95 1030	08/23/95 830	08/21/95 1205	09/28/95 1615	08/07/95 1200	09/27/95 1000
Specific conductance (µS/cm)	00094	238	139	186	123	43	175
Temperature (°C)	00010	28	28	27	24	31	17
Dissolved oxygen (mg/L)	00299	7.0	6.7	5.8	9.4	--	7.3
Turbidity (NTU)	16542	19	63	73	7	11	9
Bicarbonate (mg/L)	00440	122	71	52	16	140	37
Carbonate (mg/L)	00445	<1	<1	<1	<1	1	<1
Alkalinity as CaCO3 (mg/L)	00411	100	58	43	13	116	31
pH (units)	00400	6.5	6.3	6.1	7.2	8.0	8.2
Silica (mg/L)	00955	0.65	7.07	12.80	7.52	5.30	6.59
Calcium (mg/L)	00915	25.00	20.60	13.80	7.22	38.00	3.99
Magnesium (mg/L)	00925	9.94	0.96	3.00	4.85	11.70	2.54
Sodium (mg/L)	00930	9.13	1.79	8.20	2.07	26.00	28.60
Potassium (mg/L)	00935	2.8	1.3	2.1	1.8	7.9	1.7
Sulfate (mg/L)	00945	20.70	5.67	10.60	29.90	51.60	32.80
Chloride (mg/L)	00940	8.03	1.83	8.01	1.56	28.80	16.40
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	0.08	<0.07
Fluoride (mg/L)	00950	0.154	0.122	0.121	0.051	0.847	0.052
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	0.0119	<0.004
Nitrate as N (mg/L)	00618	<0.01	0.106	<0.01	0.271	1.54	0.097
Ammonia as N (mg/L)	00608	0.014	0.05	<0.01	<0.01	0.067	0.014
Total Kjeldahl nitrogen as N (mg/L)	00625	0.51	0.53	0.21	0.22	0.50	0.24
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	0.32	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	0.35	<0.09
Aluminum (µg/L)	01106	<30	49	<30	69	55	98
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	3.50	<2
Barium (µg/L)	01005	32.60	13.30	43.20	17.60	26.90	15.90
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	15	<10	113	17
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	<5	6.50	8.10
Iron (µg/L)	01046	63.6	326[2]	851[2]	326[2]	2,010[2]	403[2]
Lead (µg/L)	01049	<0.9	1.40	<0.9	<0.9	2.00	1.40
Lithium (µg/L)	01130	10	<8	<8	<8	<8	10
Manganese (µg/L)	01056	2.20	9.50	102.00[2]	54.30[2]	48.30	34.80
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	74.4	116	188	36.3	76.3	41.7
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	3.50	<3	<3	<3	<3
Zinc (µg/L)	01090	<4	<4	5.20	<4	67.80	4.30
Chemical oxygen demand (mg/L)	00340	<35	<35	<35	63	<35	<35
Total dissolved solids (mg/L)	04764	119	92	60	80	258	147
Total suspended solids (mg/L)	00530	18	46	4	<4	9	<4
Hardness as CaCO3 (mg/L)	00900	103	56	47	38	143	20

Appendix H-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix H-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		19	20	21	22	23	24
Date		08/29/95	07/31/95	08/01/95	08/09/95	08/08/95	08/09/95
Time		1420	1615	1240	1430	1010	1540
Specific conductance (µS/cm)	00094	275	124	16	209	103	258
Temperature (°C)	00010	30	27	29	21	26	28
Dissolved oxygen (mg/L)	00299	7.2	--	--	8.7	7.8	5.7
Turbidity (NTU)	16542	10	24	4	82	82	35
Bicarbonate (mg/L)	00440	72	74	4	143	30	159
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	59	61	3	118	25	131
pH (units)	00400	6.5	7.3	6.9	7.5	7.1	7.6
Silica (mg/L)	00955	3.75	14.00	7.09	5.74	1.94	6.64
Calcium (mg/L)	00915	19.80	22.30	1.32	42.00	9.14	44.50
Magnesium (mg/L)	00925	11.30	1.44	0.60	4.63	2.59	6.16
Sodium (mg/L)	00930	22.10	2.51	2.36	0.99	4.45	1.29
Potassium (mg/L)	00935	2.8	<0.6	0.8	1.9	4.8	1.5
Sulfate (mg/L)	00945	74.70	3.97	1.72	8.49	13.30	9.17
Chloride (mg/L)	00940	8.68	2.62	3.48	1.27	6.00	2.15
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.185	0.075	0.037	0.06	0.16	0.1
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	0.0122	<0.004
Nitrate as N (mg/L)	00618	0.198	0.12	0.194	0.486	0.587	0.155
Ammonia as N (mg/L)	00608	0.017	0.048	0.027	0.135	0.174	0.049
Total Kjeldahl nitrogen as N (mg/L)	00625	<0.07	0.15	0.17	0.29	0.75	0.18
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	<30	<30	139	93	83	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	37.50	20.10	25.20	18.80	56.00	22.10
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	11	<10	<10	<10	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	6
Cobalt (µg/L)	01035	<10	7.30	<10	<10	5.70	6.10
Copper (µg/L)	01040	<5	<5	<5	<5	<5	<5
Iron (µg/L)	01046	<4	7.30	465[2]	81.9	348[2]	36.5
Lead (µg/L)	01049	1.10	<0.9	<0.9	<0.9	1.10	2.00
Lithium (µg/L)	01130	11	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	7.20	81.40[2]	14.80	22.30	61.80[2]	21.70
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	102	122	21.5	195	44.9	225
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	<4	<4	8.70	<4	14.30	<4
Chemical oxygen demand (mg/L)	00340	<35	<35	<35	<35	48	<35
Total dissolved solids (mg/L)	04764	157	113	49	175	62	167
Total suspended solids (mg/L)	00530	6	14	4	27	91	35
Hardness as CaCO3 (mg/L)	00900	96	62	6	124	34	137

Appendix H-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix H-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		25	26	27	28	29	30
Date		08/09/95	09/28/95	09/27/95	09/27/95	08/10/95	08/16/95
Time		1625	1130	1530	1645	840	1625
Specific conductance (µS/cm)	00094	69	235	73	210	335	80
Temperature (°C)	00010	27	17	20	21	20	27
Dissolved oxygen (mg/L)	00299	6.7	3.6	8.8	7.0	--	7.1
Turbidity (NTU)	16542	125	2	4	10	<1	25
Bicarbonate (mg/L)	00440	38	130	28	137	216	27
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	31	107	23	112	177	22
pH (units)	00400	7.2	7.0	7.0	6.2	6.9	7.9
Silica (mg/L)	00955	5.10	6.50	3.08	8.55	8.22	7.13
Calcium (mg/L)	00915	10.30	39.80	8.24	40.50	67.30	5.58
Magnesium (mg/L)	00925	1.86	3.45	2.30	2.27	7.40	1.43
Sodium (mg/L)	00930	0.87	6.40	1.57	1.85	3.04	5.85
Potassium (mg/L)	00935	3.6	2.5	1.6	1.0	<0.6	2.7
Sulfate (mg/L)	00945	3.93	12.20	8.36	1.25	9.12	1.84
Chloride (mg/L)	00940	2.58	6.68	2.41	3.46	6.57	5.24
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.066	0.15	0.095	0.066	0.083	0.076
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.683	0.448	0.289	0.327	2.82	0.914
Ammonia as N (mg/L)	00608	0.097	0.103	<0.01	0.418	0.027	0.245
Total Kjeldahl nitrogen as N (mg/L)	00625	0.48	0.39	0.49	0.59	0.10	0.34
Orthophosphate as P (mg/L)	00671	0.17	<0.08	<0.08	<0.08	<0.08	0.19
Total phosphorus as P (mg/L)	00666	0.14	<0.09	<0.09	<0.09	<0.09	<0.09
Aluminum (µg/L)	01106	257[2]	36	<30	<30	36.3	103
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	<2	<2
Barium (µg/L)	01005	23.80	28.80	14.00	19.00	23.50	15.50
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	11	15	<10	<10	<10	<10
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	11.10	6.60	8.70	6.90	6.50	<5
Iron (µg/L)	01046	157	275	147	993[2]	5.7	417[2]
Lead (µg/L)	01049	<0.9	1.20	<0.9	<0.9	<0.9	<0.9
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	<8
Manganese (µg/L)	01056	20.60	180.00[2]	48.80	453.00[2]	<0.8	23.90
Mercury (µg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	22.5	100	25.7	91.1	180	32.4
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (µg/L)	01090	6.50	<4	<4	<4	4.74	9.40
Chemical oxygen demand (mg/L)	00340	<35	<35	<35	<35	<35	<35
Total dissolved solids (mg/L)	04764	75	191	69	153	236	67
Total suspended solids (mg/L)	00530	50	4	<4	<4	<4	10
Hardness as CaCO3 (mg/L)	00900	33	114	30	111	199	20

Appendix H-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix H-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		31	32	33	34	35	36
Date Time		08/15/95 1120	09/28/95 1400	09/19/95 930	09/25/95 1320	08/14/95 1315	09/20/95 1040
Specific conductance (μS/cm)	00094	53	38	108	206	234	288
Temperature (°C)	00010	26	22	21	18	30	23
Dissolved oxygen (mg/L)	00299	6.0	9.7	7.1	8.1	5.0	6.2
Turbidity (NTU)	16542	4	13	14	12	5	12
Bicarbonate (mg/L)	00440	18	13	60	12	119	106
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	<1
Alkalinity as CaCO3 (mg/L)	00411	15	11	49	10	98	87
pH (units)	00400	6.7	7.2	6.4	8.5	6.9	6.6
Silica (mg/L)	00955	6.79	8.65	9.18	10.50	6.63	7.34
Calcium (mg/L)	00915	5.14	2.70	12.00	2.89	40.40	26.10
Magnesium (mg/L)	00925	0.78	1.13	4.85	1.06	1.07	6.86
Sodium (mg/L)	00930	1.20	1.44	1.84	1.87	5.74	16.90
Potassium (mg/L)	00935	0.6	1.0	<0.6	2.3	2.8	5.3
Sulfate (mg/L)	00945	0.45	2.17	3.94	5.16	12.20	20.30
Chloride (mg/L)	00940	2.75	1.90	1.59	1.54	6.49	13.00
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Fluoride (mg/L)	00950	0.027	0.087	<0.02	0.045	0.3	0.319
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	00618	0.05	0.245	0.206	0.196	0.135	2.49
Ammonia as N (mg/L)	00608	0.029	<0.01	0.024	0.012	0.227	0.091
Total Kjeldahl nitrogen as N (mg/L)	00625	0.38	0.14	0.08	0.19	0.60	0.43
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	<0.08	0.83
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	<0.09	0.75
Aluminum (μg/L)	01106	82	<30	55	133	41	47
Antimony (μg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (μg/L)	01000	<2	<2	<2	<2	5.60	3.20
Barium (μg/L)	01005	9.60	12.00	19.20	19.20	30.40	23.00
Beryllium (μg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (μg/L)	01020	<10	<10	13	<10	24	65
Cadmium (μg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (μg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (μg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (μg/L)	01040	<5	<5	<5	<5	<5	<5
Iron (μg/L)	01046	565[2]	676[2]	215	269	74.2	24.4
Lead (μg/L)	01049	<0.9	<0.9	<0.9	1.40	<0.9	1.00
Lithium (μg/L)	01130	28	<8	<8	8	<8	<8
Manganese (μg/L)	01056	30.10	74.10[2]	14.80	25.70	93.30[2]	54.80[2]
Mercury (μg/L)	06354	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Molybdenum (μg/L)	01060	<20	<20	<20	<20	<20	<20
Nickel (μg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (μg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (μg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (μg/L)	01080	17.8	12.7	29.4	17.4	216	43.5
Thallium (μg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (μg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (μg/L)	01085	<3	<3	<3	<3	<3	<3
Zinc (μg/L)	01090	7.20	<4	<4	34.00	7.97	11.10
Chemical oxygen demand (mg/L)	00340	48	54	<35	<35	<35	<35
Total dissolved solids (mg/L)	04764	84	34	42	69	124	246
Total suspended solids (mg/L)	00530	<4	4	8	9	5	10
Hardness as CaCO3 (mg/L)	00900	16	11	50	12	106	94

Appendix H-2.--Results of chemical analyses of water samples, 1995—Continued
(See appendix H-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		37	38	39	40	41	42
Date		08/23/95	08/29/95	08/09/95	07/31/95	08/03/95	08/07/95
Time		1115	1040	805	1135	1130	1100
Specific conductance (µS/cm)	00094	23	40	121	36	179	58
Temperature (°C)	00010	28	26	28	25	29	30
Dissolved oxygen (mg/L)	00299	7.7	6.3	--	6.1	5.2	7.6
Turbidity (NTU)	16542	13	23	109	129	29	83
Bicarbonate (mg/L)	00440	7	16	37	26	125	148
Carbonate (mg/L)	00445	<1	<1	<1	<1	1	2
Alkalinity as CaCO3 (mg/L)	00411	6	13	30	21	103	123
pH (units)	00400	5.9	6.0	7.0	7.5	7.8	8.2
Silica (mg/L)	00955	8.12	6.82	2.89	10.30	8.70	5.23
Calcium (mg/L)	00915	1.37	3.09	13.10	4.71	29.00	46.00
Magnesium (mg/L)	00925	0.69	1.20	2.03	1.26	2.33	11.90
Sodium (mg/L)	00930	1.27	2.00	4.02	2.70	20.90	58.30
Potassium (mg/L)	00935	1.27	2.00	4.02	2.70	1.5	8.1
Sulfate (mg/L)	00945	2.02	2.33	10.60	3.32	5.67	110.00
Chloride (mg/L)	00940	1.91	2.37	5.48	2.52	24.00	35.60
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	0.14	0.20
Fluoride (mg/L)	00950	0.033	0.113	0.239	0.111	0.251	1.63
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	0.0124
Nitrate as N (mg/L)	00618	0.087	0.222	1.87	0.123	0.216	5.16
Ammonia as N (mg/L)	00608	0.015	0.057	0.165	0.026	0.016	0.05
Total Kjeldahl nitrogen as N (mg/L)	00625	0.20	<0.07	0.86	0.11	0.46	0.51
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	0.30	<0.08	<0.08	0.74
Total phosphorus as P (mg/L)	00666	0.1	<0.09	0.16	<0.09	<0.09	0.57
Aluminum (µg/L)	01106	<30	<30	62.9	<30	<30	<30
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	<3
Arsenic (µg/L)	01000	<2	<2	<2	<2	2.40	3.80
Barium (µg/L)	01005	15.70	16.40	30.50	19.40	19.60	26.40
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Boron (µg/L)	01020	<10	<10	21	<10	55	464
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	<3
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	<6
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	<10
Copper (µg/L)	01040	<5	<5	<5	5.00	<5	<5
Iron (µg/L)	01046	743[2]	495[2]	132	570[2]	104	26.3
Lead (µg/L)	01049	<0.9	<0.9	<0.9	0.90	<0.9	<0.9
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	43
Manganese (µg/L)	01056	67.80[2]	134.00[2]	33.60	35.70	268.00[2]	13.50
Mercury (µg/L)	06354	<0.08	0.13	<0.08	<0.08	<0.08	<0.08
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	51
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	<20
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	<3
Silver (µg/L)	01075	<20	<20	<20	<20	<20	<20
Strontium (µg/L)	01080	14.8	20	34	48.5	234	127
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	<2
Tin (µg/L)	01100	<50	<50	<50	<50	<50	<50
Vanadium (µg/L)	01085	4.10	6.50	<3	<3	<3	9.80
Zinc (µg/L)	01090	<4	<4	<4	<4	<4	<4
Chemical oxygen demand (mg/L)	00340	<35	<35	<35	<35	<35	<35
Total dissolved solids (mg/L)	04764	78	12	103	111	167	374
Total suspended solids (mg/L)	00530	10	14	51	24	19	6
Hardness as CaCO3 (mg/L)	00900	6	13	41	17	82	164

Appendix H-2.--Results of chemical analyses of water samples, 1995—Continued

(See appendix H-1 for site descriptions and locations)

Parameter	Parameter code	Site numbers					
		43	44	45	46	47	
Date		08/21/95	08/29/95	07/31/95	09/20/95	09/20/95	
Time		900	1250	1010	1150	1225	
Specific conductance (µS/cm)	00094	312	48	121	227	422	
Temperature (°C)	00010	27	25	27	23	22	
Dissolved oxygen (mg/L)	00299	3.3	8.2	5.4	6.6	7.4	
Turbidity (NTU)	16542	13	16	95	12	33	
Bicarbonate (mg/L)	00440	88	10	72	132	124	
Carbonate (mg/L)	00445	<1	<1	<1	<1	<1	
Alkalinity as CaCO3 (mg/L)	00411	72	8	59	108	102	
pH (units)	00400	6.3	5.8	7.5	6.6	6.7	
Silica (mg/L)	00955	10.60	8.88	9.16	8.53	6.12	
Calcium (mg/L)	00915	13.90	2.08	17.90	33.40	33.40	
Magnesium (mg/L)	00925	3.18	0.81	1.88	6.28	11.00	
Sodium (mg/L)	00930	30.50	1.74	5.06	2.74	31.20	
Potassium (mg/L)	00935	2.6	2.0	<0.6	3.4	6.5	
Sulfate (mg/L)	00945	3.74	2.51	3.91	7.64	49.90	
Chloride (mg/L)	00940	35.70	2.61	4.64	3.45	33.80	
Bromide (mg/L)	71870	<0.07	<0.07	<0.07	<0.07	<0.07	
Fluoride (mg/L)	00950	0.304	0.099	0.123	0.096	0.212	
Cyanide (mg/L)	00720	<0.004	<0.004	<0.004	<0.004	<0.004	
Nitrate as N (mg/L)	00618	<0.01	0.235	0.143	0.153	2.75	
Ammonia as N (mg/L)	00608	0.018	0.015	0.036	0.073	0.059	
Total Kjeldahl nitrogen as N (mg/L)	00625	0.41	<0.07	0.21	0.16	0.32	
Orthophosphate as P (mg/L)	00671	<0.08	<0.08	<0.08	<0.08	0.33	
Total phosphorus as P (mg/L)	00666	<0.09	<0.09	<0.09	<0.09	0.25	
Aluminum (µg/L)	01106	<30	31	<30	41	64	
Antimony (µg/L)	01095	<3	<3	<3	<3	<3	
Arsenic (µg/L)	01000	<2	<2	<2	2.90	3.00	
Barium (µg/L)	01005	36.50	13.50	32.90	35.50	39.80	
Beryllium (µg/L)	01010	<0.4	<0.4	<0.4	<0.4	<0.4	
Boron (µg/L)	01020	46	<10	11	<10	40	
Cadmium (µg/L)	01025	<3	<3	<3	<3	<3	
Chromium (µg/L)	01030	<6	<6	<6	<6	<6	
Cobalt (µg/L)	01035	<10	<10	<10	<10	<10	
Copper (µg/L)	01040	<5	<5	6.70	<5	<5	
Iron (µg/L)	01046	430[2]	398[2]	200	65.5	43.6	
Lead (µg/L)	01049	1.20	1.40	<0.9	1.60	<0.9	
Lithium (µg/L)	01130	<8	<8	<8	<8	<8	
Manganese (µg/L)	01056	859.00[2]	113.00[2]	11.30	60.20[2]	69.90[2]	
Mercury (µg/L)	06354	0.18	<0.08	<0.08	<0.08	<0.08	
Molybdenum (µg/L)	01060	<20	<20	<20	<20	<20	
Nickel (µg/L)	01065	<20	<20	<20	<20	<20	
Selenium (µg/L)	01145	<3	<3	<3	<3	<3	
Silver (µg/L)	01075	<20	<20	<20	<20	<20	
Strontium (µg/L)	01080	263	12.4	118	29.3	81.6	
Thallium (µg/L)	10157	<2	<2	<2	<2	<2	
Tin (µg/L)	01100	<50	<50	<50	<50	<50	
Vanadium (µg/L)	01085	<3	<3	4.70	3.40	<3	
Zinc (µg/L)	01090	<4	8.10	8.90	9.40	10.20	
Chemical oxygen demand (mg/L)	00340	65	<35	<35	<35	<35	
Total dissolved solids (mg/L)	04764	143	10	101	184	328	
Total suspended solids (mg/L)	00530	14	14	41	9	5	
Hardness as CaCO3 (mg/L)	00900	48	9	53	109	129	

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