

# *WATER IN ALABAMA, 1987*



*Geological Survey of Alabama  
Circular 122E*

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John Wesley Hall's Mill, Tannehill  
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**GEOLOGICAL SURVEY OF ALABAMA**

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**WATER RESOURCES DIVISION**

James D. Moore  
Director

**CIRCULAR 122E**

**WATER IN ALABAMA, 1987**

By

James D. Moore

Tuscaloosa, Alabama  
1988



## GEOLOGICAL SURVEY OF ALABAMA

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Honorable Guy Hunt  
Governor of Alabama  
Montgomery, Alabama

Dear Governor Hunt:

I have the honor to transmit herewith a report entitled "Water in Alabama, 1987," by James D. Moore. The report is published as Circular 122E of the Geological Survey of Alabama.

The report discusses the hydrologic conditions in Alabama during 1987. It presents information on ground-water levels, streamflows, water quality, water use, water laws, water problems, and current research investigations. Information contained in the report should be useful to anyone interested in the development and conservation of Alabama's water resources.

Respectfully,

A handwritten signature in cursive script that reads "Ernest A. Mancini".

Ernest A. Mancini  
State Geologist



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# **WATER IN ALABAMA, 1987**

By

James D. Moore

## **INTRODUCTION**

Large quantities of fresh ground and surface water are available in most areas of Alabama. Because of this abundance of fresh water, there has been little emphasis in the past on water conservation. However, as the demand increases, overdevelopment of the water resources and water-use conflicts are likely to become more numerous. Since 1955, per capita use of water has increased by approximately 150 percent. In 1987, an average of 8.1 billion gallons per day (bgd) of water was withdrawn for use from surface and underground sources.

The Water Resources 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 systems, and minimize water contamination. The basic-data collection program is implemented through a statewide network of stream-gaging stations, 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. Soil Conservation Service, and sometimes local governing bodies, maintain water resources programs, collect basic hydrologic data, and conduct research investigations on the water resources of Alabama. However, the emphasis of this report is on the activities and programs of the Geological Survey of Alabama. Figure 1 shows the status of county water-availability reports by the Geological Survey of Alabama.

Water-resources data and water-use information are used by Geological Survey of Alabama staff members in answering information requests, by personnel from other governmental agencies, and by the public. This report and its companion basic data volumes, Circulars 112, "Ground-Water Levels in Alabama," and 116, "Surface Water in Alabama," are intended for use as comprehensive references to water data collected by the Geological Survey of Alabama and cooperating agencies.

## **CLIMATIC CONDITIONS**

Alabama's climate is humid subtropical, with mild winters, hot summers, and precipitation during all months of the year. Average annual temperatures range from 60°F in northern Alabama to 68°F in southwestern Alabama (fig. 2). 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 reported an average monthly temperature below freezing (Lineback and others, 1974).

Rainfall in Alabama usually is abundant. The average annual precipitation ranges from a low of 48 inches in west-central and east-central Alabama to a high of 68 inches near the coast (fig. 3).

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 southernmost part of the state. For most years, the southern half of the state receives no snowfall.

During dry years the southeastern part of the state, which normally receives the least amount of rainfall, may have only 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 1987, dry conditions prevailed throughout most of Alabama. Total annual precipitation in 1987 for selected sites is shown on figure 4. Only three stations, in Baldwin, Bibb, and Montgomery Counties, reported above normal rainfall. The station at Fairhope in Baldwin County recorded a rainfall amount of 15.83 inches above normal. Rainfall amounts at other stations were as



Figure 1.--Status of water-availability reports in Alabama.

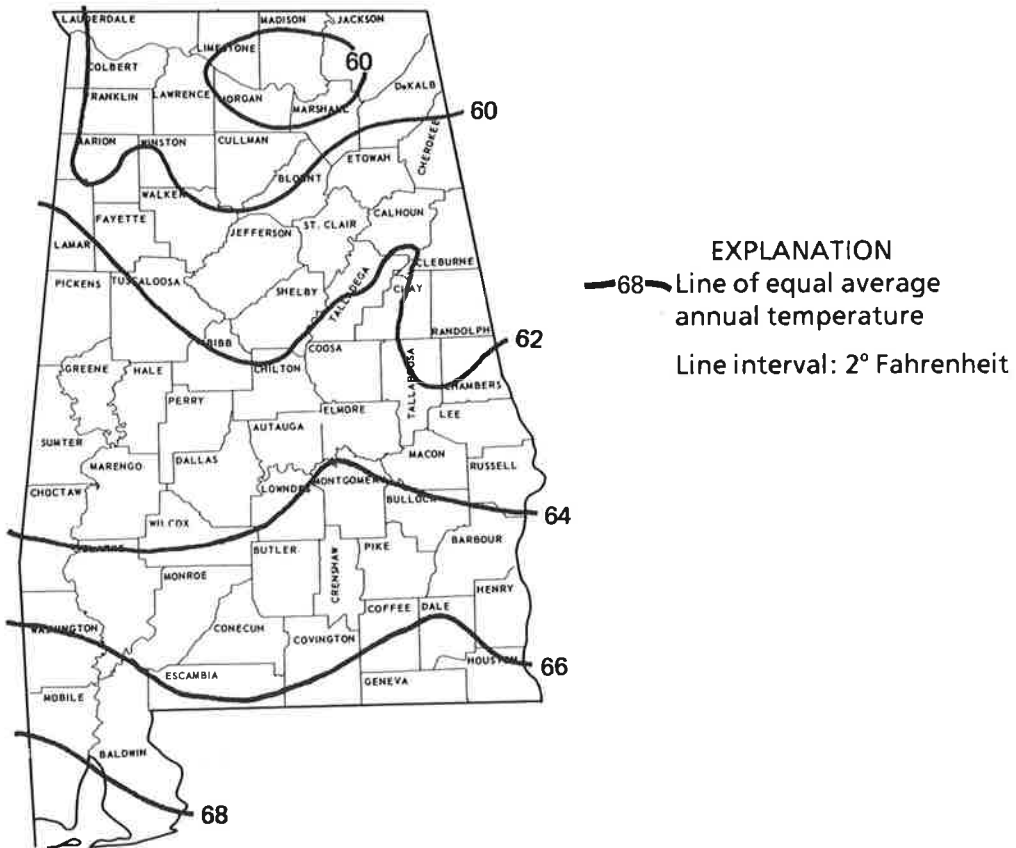


Figure 2.--Average annual temperatures (from Lineback and others, 1974).

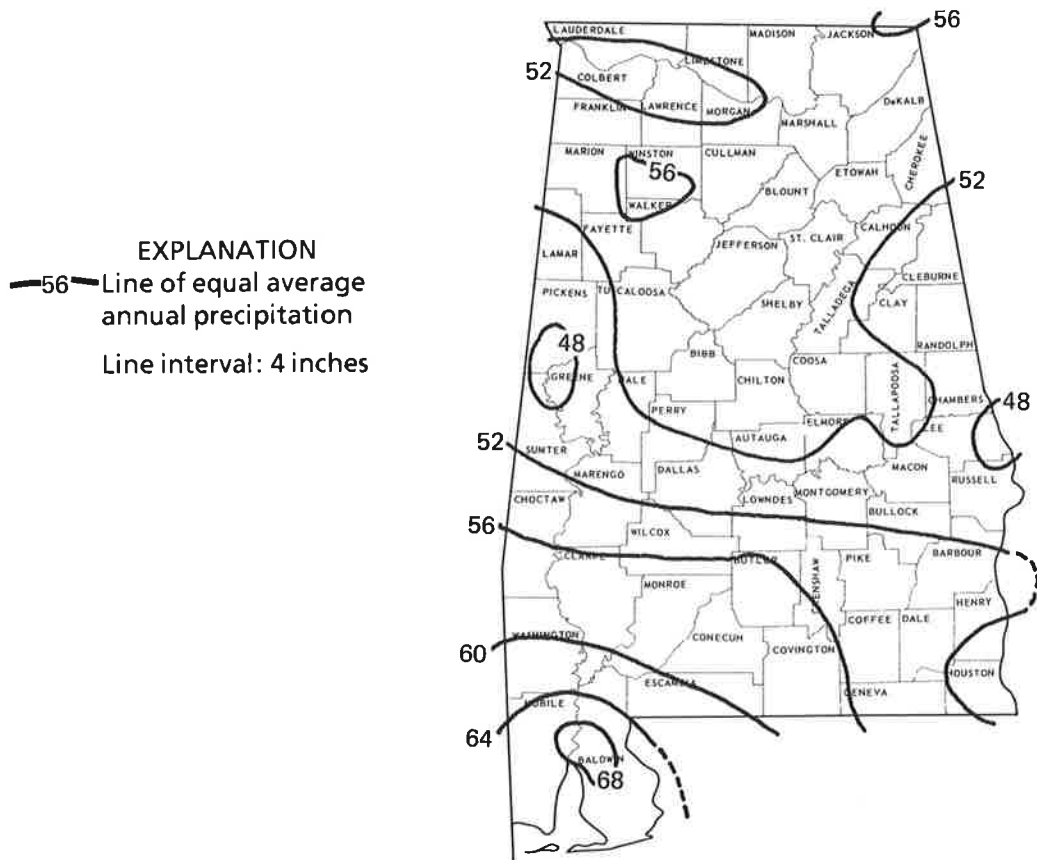


Figure 3.--Average annual precipitation (from Lineback and others, 1974).

much as 24.54 inches below normal (fig. 5). Several stations reported rainfall amounts of more than 15 inches below normal. The lowest rainfall amounts occurred in a wide band across the central part of the state. Lower than normal precipitation has occurred in many areas of the state since 1983. In 1984, all areas of the state except the northeastern part had lower than normal rainfall; rainfall amounts were 5 to 7 inches below normal in the southern and eastern parts of the state. In 1985, rainfall deficiencies occurred in all areas of the state except southwestern Alabama, which received an excess of almost 11 inches of rainfall, primarily as a result of Hurricane Juan. In the remainder of the state, rainfall deficiencies were from about 2½ to over 10 inches, with the greatest deficiencies occurring in east-central Alabama. Drought conditions became more severe in 1986. Rainfall deficiencies for the period January through September 1986 were 10 to over 20 inches for most of the state. Again, the areas with the greatest deficiencies included east-central Alabama. During the last 3 months of 1986, the amount of rainfall increased over all of the state. Because of heavy rainfalls in November, some areas in southwestern, south-central, and east-central Alabama had above normal rainfall for 1986. Following these heavy rainfalls, dry conditions returned and remained throughout most of 1987.

Only a part of the state's precipitation results in runoff. Much of the water either evaporates, enters the soil zone where it is retained as soil moisture or is transpired by plants, or enters the ground-water system. By comparing figure 3 and figure 6, it is possible to see 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. Also, there are uncounted wells throughout the state that supply rural domestic users and semipublic facilities such as campgrounds and marinas.

Approximately 44 percent of the population of Alabama uses ground water as a source for domestic supplies. Ground water is also used for irrigation, livestock, industrial, and commercial supplies. The general availability of ground water from aquifers in different parts of the state is shown in figure 7. 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 terranes in the state provides different conditions for ground-water occurrence. The general geology of the state is shown on plate 1.

## WATER LEVELS

The Geological Survey of Alabama maintains a statewide network of wells to monitor ground-water levels in the important aquifers (pl. 2). A few wells are equipped with continuous water-level recorders. Approximately 460 wells are used for determining ground-water levels in the fall and spring of each year, which are the normal low and high water level periods of the year. Water-level measurements in these semiannual observation wells are made either with electric tapes or steel tapes 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 summary of the water-level information for the fall of 1987 is provided in appendix 1 of this report.

Deficiencies in precipitation during the past few years have resulted in less recharge to the aquifer systems and lower than normal water levels in many areas of the state. In 1987, record low water levels were measured in 34 percent of the semiannual observation wells. Record low water levels occurred in all areas of the state except for the northeastern and north-central parts, including Madison, Jackson, De Kalb, Marshall, Morgan, Blount, Lauderdale, Walker, Jefferson, and Cullman Counties. Record high water levels, however, occurred in about 10 percent of the wells. The high water levels occurred in all areas of the state. Figure 8 is hydrographs of the lowest daily ground-water levels in selected wells for water year 1987, which extends from October 1, 1986, through September 30, 1987.

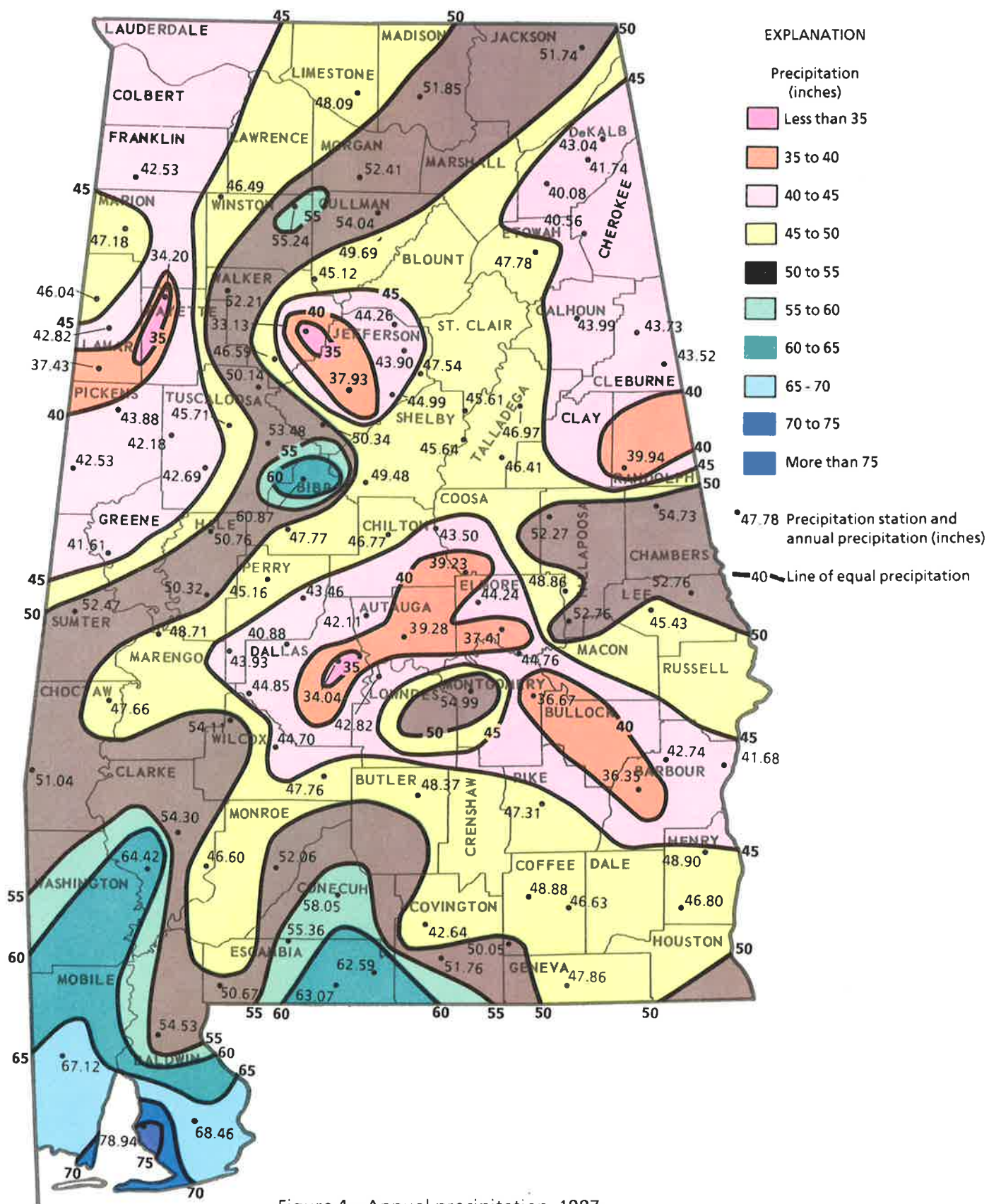


Figure 4.--Annual precipitation, 1987.



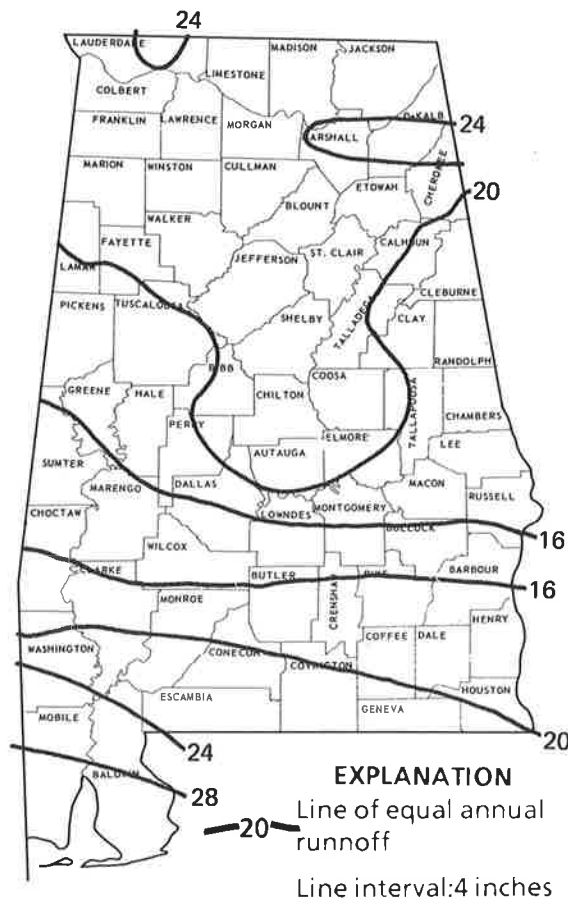


Figure 6.--Average annual runoff (from Lineback and others, 1974).

These hydrographs show the seasonal fluctuations in the ground-water table. High ground-water levels generally occur in March or April and low ground-water levels generally occur in September or October. The hydrographs also show short-term water-level fluctuations in response to changes in recharge or discharge of ground water.

### WATER-LEVEL TRENDS

Many municipalities in Alabama, primarily those in the coastal plain, depend on ground water either as the primary water source or as the 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 over 100 feet. In most other areas of the state, surface-water sources supply most of the water, and ground water level declines are not as common. Water-level trends at selected sites are shown by the long-term hydrographs in figure 9. The hydrograph for the well developed in the Nanafalia aquifer in Choctaw County shows that the water level has been declining since the beginning of record in July 1981. Most of the hydrographs show seasonal water-level fluctuations. Seasonal water-level fluctuations generally range from less than 1 foot in some wells to over 10 feet in other wells. Water levels are generally highest in March and April and lowest in September and October. More information on water levels is provided in a series of reports by the Geological Survey of Alabama entitled "Ground-Water Levels in Alabama."

### SPRING DISCHARGES

The Geological Survey of Alabama measures the discharge of 50 to 60 springs in Alabama during the fall of each year. Spring-discharge information for selected springs is provided in appendix 1, and

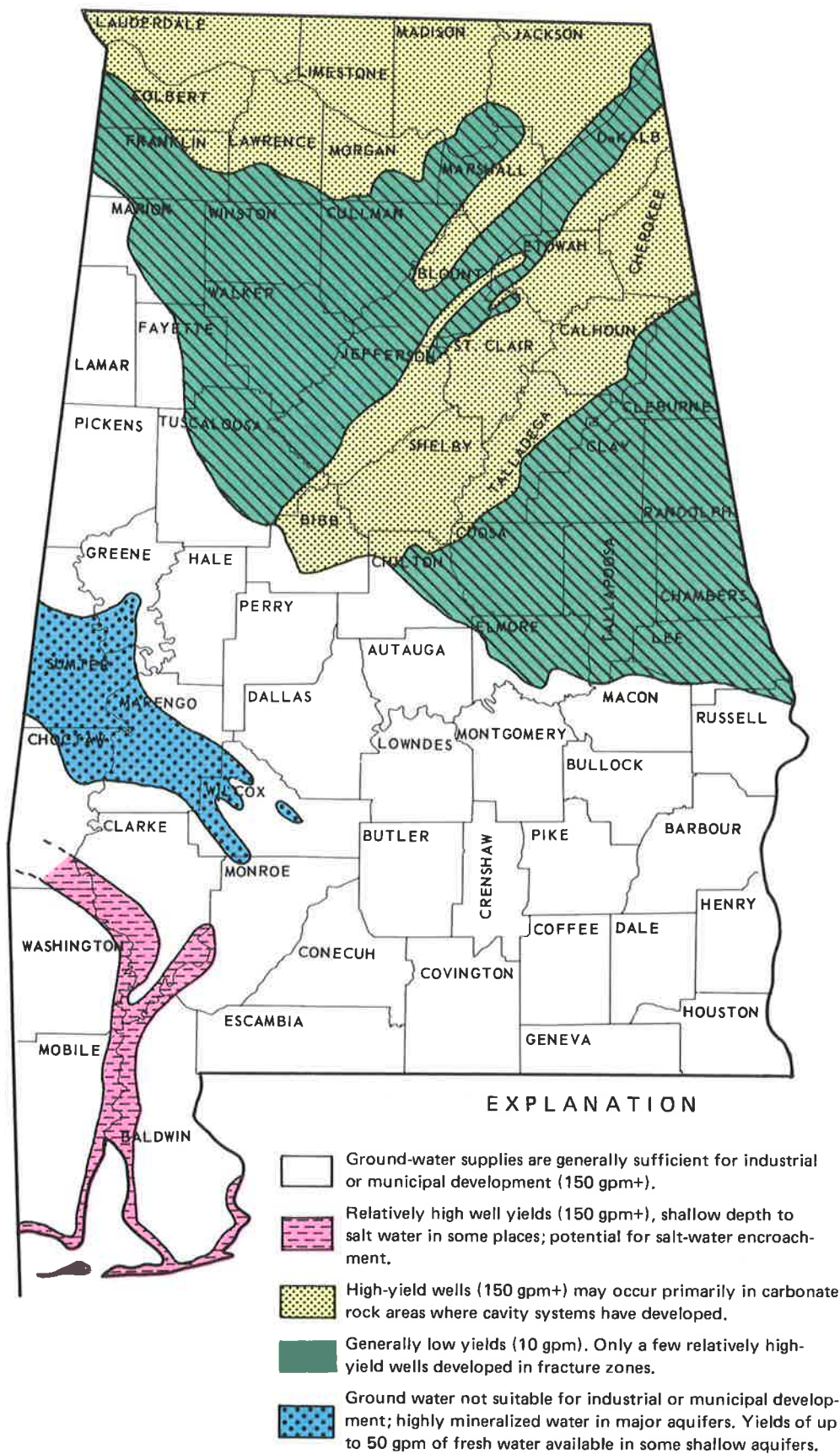


Figure 7.--Potential yields of aquifers in Alabama.

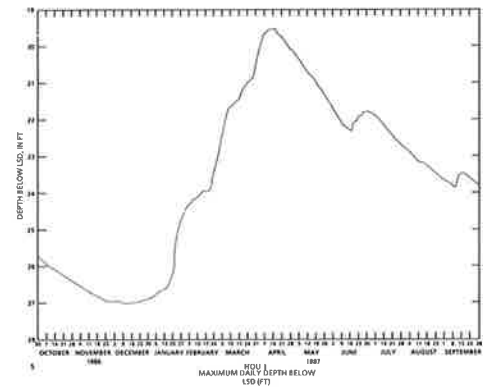
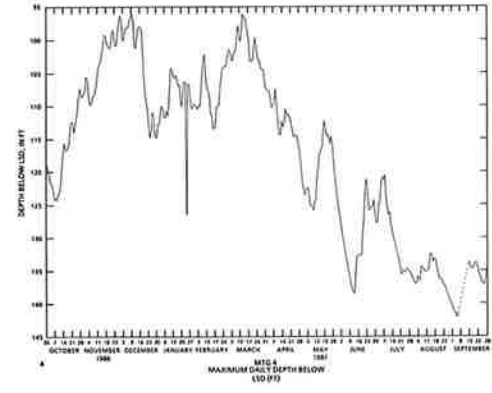
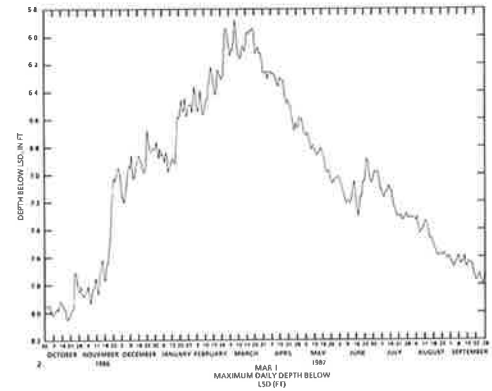
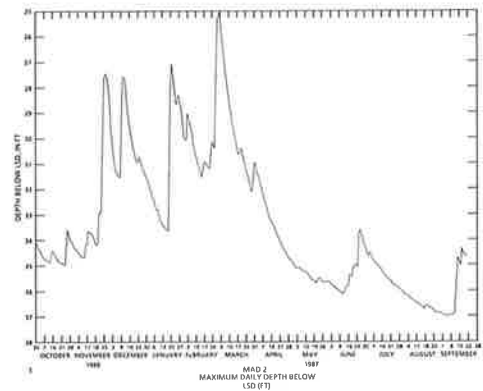


Figure 8.--Lowest daily ground-water levels for selected wells in water year 1987.



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

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 (ft<sup>3</sup>/s). Table 1 is a summary of 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 1987. The lowest mean daily discharges of streams in Alabama occurred in early October during water year 1987. The highest mean daily stream discharges for the 1987 water year generally were in February and March.

Table 1.--Low-flow (7-day Q<sub>2</sub> and Q<sub>10</sub>) values and average discharge values for selected streams in Alabama

Station number	Location of station	Discharge		Low flow		
		Years of record <sup>1</sup>	Average discharge for period of record (ft <sup>3</sup> /s)	Years of record <sup>1</sup>	7-day Q <sub>2</sub> (ft <sup>3</sup> /s)	7-day Q <sub>10</sub> (ft <sup>3</sup> /s)
02361000	Choctawhatchee River near Newton	56	968	55	150	88
02369800	Blackwater River near Bradley	19	145	18	33	22
02371500	Conecuh River at Brantley	49	665	47	55	30
02411000	Coosa River at Jordan Dam	62	16,450	61	2,570	1,780
02413300	Little Tallapoosa River near Newell	11	611	10	84	55
02418500	Tallapoosa River below Tallassee	58	4,818	57	670	155
02425000	Cahaba River near Marion Junction	34	2,885	33	414	315
02428400	Alabama River at Claiborne Lock and Dam	11	34,350	10	6,550	6,000
02442500	Luxapallila Creek at Millport	10	370	9	64	41
02446500	Sipsey River near Elrod	43	781	42	53	29
02447025	Tombigbee River at Gainesville Lock and Dam	8	12,190	8	415	245
02448500	Noxubee River at Geiger	42	1,581	41	60	34
02450180	Mulberry Fork near Arkadelphia	10	834	9	18	15
02450250	Sipsey Fork near Grayson	20	167	19	3.7	2.6
02456500	Locust Fork at Sayre	48	1,456	47	52	30
02466030	Black Warrior River at Selden Lock and Dam	10	9,612	9	990	635
02469761	Tombigbee River at Coffeetown Lock and Dam	26	30,050	25	2,360	1,590
03574500	Paint Rock River near Woodville	50	680	43	13	5.3
03575500	Tennessee River at Whitesburg	62	43,020	59	16,000	7,100
03575830	Indian Creek near Madison	18	62.6	13	4.2	3.1
03589500	Tennessee River at Florence	92	51,610	92	14,300	7,550

<sup>1</sup>"Years of record" indicates years for which discharge information was available. It does not necessarily indicate consecutive years of record. Data available through 1985 were used in determining low-flow values and through 1986 in determining average discharge values.

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 Q<sub>2</sub> and 7-day Q<sub>10</sub>, respectively. The 7-day Q<sub>2</sub> 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 of normal flow. This value also provides an estimate of the amount of flow generally available without the need for storage. The 7-day Q<sub>10</sub> is the lowest flow for 7 consecutive days that may be expected to occur once in 10 years. The 7-day Q<sub>2</sub> and 7-day Q<sub>10</sub> values for some of the major streams and rivers in Alabama are provided in table 1. The reliability of low-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.

The U.S. Geological Survey maintains computer files of streamflow data and publishes daily values for gaging stations in its annual Water Data Reports for the state. These data are also

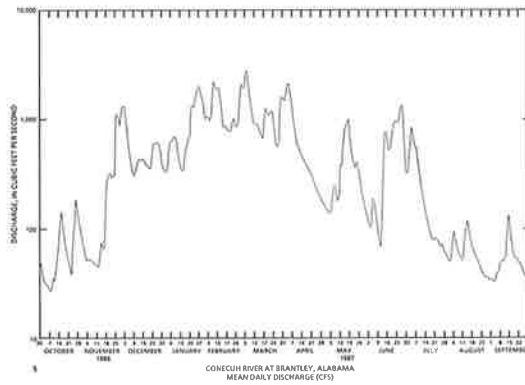
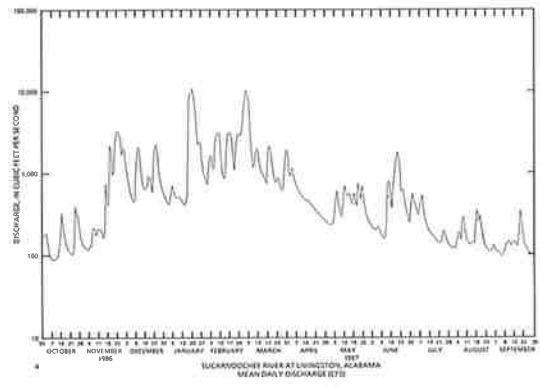
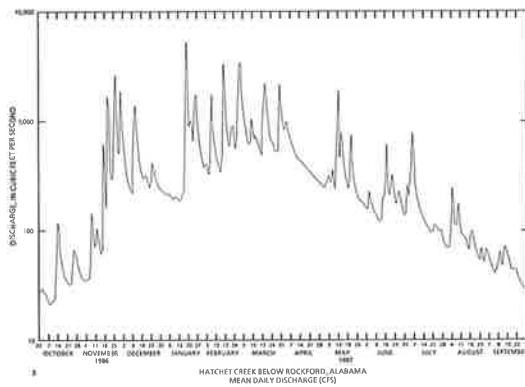
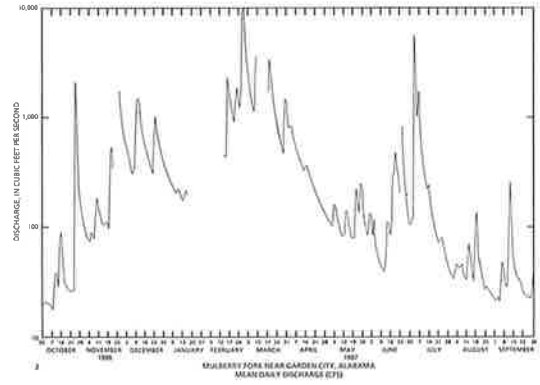
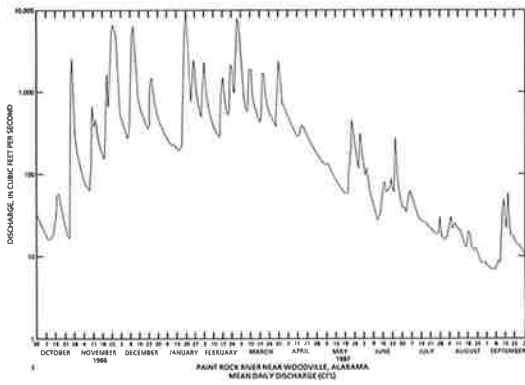


Figure 11.--Mean daily discharges for selected streams in water year 1987.

summarized each year by the Geological Survey of Alabama in Circular 116, "Surface Water in Alabama."

## 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, the Safe Drinking Water Act, and the Clean Water Act.

The Comprehensive, Environmental Response, Compensation, and Liability Act provides a 5-year reauthorization of a hazardous waste cleanup program, which had officially expired in October 1985 (Virginia Water Resources Research Center, 1986a). The act provides \$9 billion for the cleanup of toxic wastes and requires that the U.S. Environmental Protection Agency ensure that the long-term cleanup commence at a minimum of 375 new sites. Other provisions of the bill are as follows:

- Health assessments are required for most hazardous waste disposal sites.
- The U.S. Environmental Protection Agency 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 \$100 million research, demonstration, and training program on new cleanup technologies was established.
- A \$98 million research program to detect and evaluate waste hazards and their health effects was included.
- Authority was given to the U.S. Environmental Protection Agency 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 U.S. Environmental Protection Agency 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 for \$16.3 billion in grants for water projects such as dams, ports, harbors, and waterways. The act requires that state and local governments share in both the decisionmaking and funding for the public works projects.

The Safe Drinking Water Act provides for the development of State programs that are designed for the protection of water resources (Virginia Water Resources Research Center, 1986a). The act authorized the use of \$170 million for development of these programs in fiscal year 1987 (Alabama Association for Water Pollution Control, 1986). Some of the provisions of the act are listed below:

- The U.S. Environmental Protection Agency is required to issue permanent standards for 83 drinking water contaminants within 3 years and an additional 25 contaminants by 1991.
- The U.S. Environmental Protection Agency is required to issue criteria for using filtration technology for some public water systems.
- States are required to develop a ground water protection program to control contamination at wellheads by 1989.
- An aquifer protection program authorizes grants for states to designate sole-source aquifers.
- The U.S. Environmental Protection Agency is 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 that exceeds 8 percent is prohibited in the construction of all water-supply systems. A new U.S. Environmental Protection regulation will require water suppliers to notify customers about any amount of lead in their water and to provide information about

health effects of lead. The new regulation will become effective in June 1988. On February 4, 1987, over the President's veto, the House and Senate passed legislation to review and amend the Clean Water Act. Reauthorization of the act calls for phasing out the grants program for municipal sewage treatment plant construction. However, funding will be provided to help capitalize state revolving loan funds to replace the grants. The act also established a permit program for stormwater runoff for municipalities and industry. The U.S. Environmental Protection Agency is required to complete the formulation of regulations for stormwater permits within two years of enactment (February 1989). Municipalities must apply for a permit by February 1990, and the permit must be issued or denied by February 1991 (Water Log, 1987). The act also requires that states inform the U.S. Environmental Protection Agency which water bodies will not attain or maintain state water quality standards due to point source discharges of toxic pollutants. States must identify the errant point sources and submit a pollution control strategy to the U.S. Environmental Protection Agency.

## GROUND-WATER REGULATIONS

In recent years, protection of ground-water resources has become a major issue in legislative actions. In late 1984, Congress enacted amendments to the Resource Conservation and Recovery Act that were designed to improve the act and to reduce some of its inconsistencies. Also, Congress created a National Ground Water Commission to study problems and policy issues (Bird, 1985).

In August 1984, the U.S. Environmental Protection Agency established its national ground-water protection strategy. As part of the strategy, the U.S. Environmental Protection Agency recommends that state governments have the primary responsibility for establishment of ground-water protection policies and for implementation of these policies. The strategy is intended to assist states in developing ground-water management programs and to assist in improving coordination among existing U.S. Environmental Protection Agency programs (Bird, 1985).

As a result of the increased emphasis on ground-water protection, the Alabama Department of Environmental Management is proposing bills that will give the agency authority to regulate facilities and activities that pose a threat to the quality of ground water. Similar bills did not pass in the 1987 legislative session. The proposed bills will require that persons who have polluted ground water must return the ground water to a reusable state and must provide an alternate supply to those using the ground water as a drinking water source. Provisions of the bill will require that ground waters of the state be classified according to the water's most practical use and importance as a source of drinking water and that ground water-quality standards be established for each ground-water classification. Regulation, permit, or certification fees will be required for some facilities and activities, and penalties may be imposed for violations of provisions in the bill.

The proposed bill, Environmental Licensing and Standards Act of 1988, authorizes the Alabama Department of Environmental Management to establish licensing programs for installers of underground storage tanks, injection wells, and monitoring wells. The bill proposes to establish construction standards for monitoring wells and will require the closure of abandoned wells and boreholes that are not presently addressed under existing statutes.

The proposed bill, Alabama Underground Storage Tank and Wellhead Protection Act of 1988, will provide the authority for the Alabama Department of Environmental Management to operate the underground storage tank regulatory program and wellhead protection program in Alabama in lieu of federal regulation. The bill will authorize the Alabama Department of Environmental Management to promulgate rules and regulations governing underground storage tanks and to seek approval from the U.S. Environmental Protection Agency to operate the state program. The bill also will allow the Alabama Department of Environmental Management to establish rules and regulations to protect wellhead areas around public water supply wells.

At the present time, ground-water laws are poorly defined in Alabama. However, the "reasonable use" rule generally applies to ground water in Alabama. This rule recognizes the right

of a landowner to a reasonable and beneficial use of the waters upon or underneath his land, provided the waters are not wasted or do not cause injury to others.

State permits for water-well development in Alabama are not required for the well owners, except in the Coastal Area Zone. In this zone, which includes coastal areas with surface elevations of 10 feet or less, permits are required for development of wells producing 50 gallons per minute or more. Well drillers, however, are required by the Alabama Department of Environmental Management to submit in quadruplicate a form (ADEM Form 60 1/83, Report of Drilled Well) for each water well drilled in the state. A copy of this form is reproduced in appendix 2. Completed copies of the form must be provided to the Public Water Supply Section of the Alabama Department of Environmental Management and to the Water Resources Division of the Geological Survey of Alabama, where they are then filed as part of the water-information records of the state. Water wells in Alabama must be drilled by drillers licensed by the Alabama Department of Environmental Management. A list of water-well drillers licensed in Alabama in 1988 is provided in appendix 3.

The Public Water Supply Section of the Water Division of the Alabama Department of Environmental Management regulates public water supplies. A public water supply system is one that provides or sells water to the public for human consumption and has at least 15 service connections or regularly serves an average of 25 people at least 60 days during the year. Self-supplied industrial/commercial and agricultural users of ground water generally are not regulated by the state. However, some local governing bodies in Alabama have some control over ground-water management in their areas of jurisdiction; some cities have adopted ordinances that require a permit for the construction and operation of a water-supply well. A list of Federal and State agencies responsible for ground-water regulation is given in appendix 4.

## SURFACE-WATER REGULATIONS

In Alabama, court decisions involving the use and ownership of water and lands overlain by water have been 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 loosely to the rule of "reasonable use."

The "reasonable use" rule allows the use of waters for agricultural, industrial, mining, and other purposes, provided water is not wasted or allowed to cause damage to others. A landowner may not divert, dam, or otherwise alter the course of a stream flowing across his 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 have responsibility for enforcement of 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 is responsible for regulating oil and gas exploration and development activities that may affect the quality of water. The State Department of Conservation and Natural Resources is responsible for enforcement of water-safety traffic laws on waterways and impoundments, and for regulating activities that may affect the quality of water in wildlife refuges and game management areas.

The Alabama Legislature recently passed a bill that created the Alabama Water Pollution Control Authority, which will provide aid to public bodies such as counties, cities, and state agencies in financing wastewater treatment facilities. The Authority will establish a revolving loan fund to be

operated by the Alabama Department of Environmental Management. The fund will be established under requirements of the Federal Clean Water Act.

Amendments to the Alabama Hazardous Waste Management Act have been made. As amended, the Act makes the Alabama statute consistent with the federal requirements so that portions of the hazardous waste program can be operated 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 provides that hazardous waste transportation permits may be issued for periods up to three years. However, these permits can be revoked or modified at any time.

## WATER MANAGEMENT

There has been no water management legislation in Alabama. However, water managers and governing bodies are beginning to agree that a water management plan is needed. Recent water-use conflicts and quantity and quality of water problems have resulted in greater concerns about the lack of water management laws.

During 1986, both the Alabama Department of Environmental Management and consultants for the Alabama Farm Bureau Federation prepared draft legislation for water management plans. The draft of the proposed legislation by the Alabama Farm Bureau Federation included only a ground water management plan. The bill prepared by the Alabama Department of Environmental Management provided a water management plan for ground and surface water. Both proposed bills designated the Alabama Department of Environmental Management as the state regulatory agency responsible for formulating and implementing the state's water management plan. These bills were intended to provide for the most beneficial, reasonable, and prudent utilization of the water resources and to prevent any detrimental usage of these resources. These bills received little support and were not introduced in the state legislative session of 1987. Also, the bills were not introduced to the Alabama Legislature in 1988. In 1986, a joint resolution of the Alabama Legislature created an Environmental Planning Council for the state. The Council includes representatives of state and federal agencies, environmental and industrial associations, academic institutions, labor and public officials, and private citizens. The Council was charged with developing a long-range environmental plan that will address issues related to water, air, solid and hazardous wastes, and land-use planning. Committees and task forces that were established by the Council have prepared a preliminary list of environmental goals and methods of achieving the goals for the state. A major emphasis of the plan is on conservation and management of the state's water resources. The plan recommends that the state develop strategies or programs for water-use, water-quality, and drought management. After the environmental plan has been completed, the Alabama Legislature will consider legislative actions for achieving the goals outlined in the plan.

## WATER QUALITY

### WATER-QUALITY 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 sets of standards for each type of use.

Water-quality standards are set and enforced for various water uses by Federal, State, and local government regulations. The most important of these regulations are those dealing with drinking water standards for public supply. Public water supplies must meet the standards for contaminant limits established by the Safe Drinking Water Act, Primary Drinking Water Regulations, Title 40, Part 141 of the Federal Code, and the National Revised Primary Drinking Water Regulations (U.S. Environmental Protection Agency, 1983, p. 45502-45521). These standards, shown in table 2, are specified by both the U.S. Environmental Protection Agency and the State of Alabama. For waters subject to these standards, samples must be collected and sent for analysis to the Public Water Supply Section, Water Division, of the Alabama Department of Environmental Management at intervals specified by the state.

Table 2.--Drinking water regulations  
(provided by the U.S. Environmental Protection Agency, 1986)

NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS		
Arsenic	0.05	mg/L (milligrams per liter)
Barium	1.0	mg/L
Cadmium	0.010	mg/L
Chromium	0.05	mg/L
Lead	0.05	mg/L
Mercury	0.002	mg/L
Nitrate (as N)	10	mg/L
Selenium	0.01	mg/L
Silver	0.05	mg/L
Fluoride (revised)	4	mg/L
Endrin	0.0002	mg/L
Lindane	0.004	mg/L
Methoxychlor	0.1	mg/L
Toxaphene	0.005	mg/L
2,4 - D	0.1	mg/L
2,4,5 - TP Silvex	0.01	mg/L
Coliform bacteria	< 1/100	ml (milliliter)
Radium - 226 + radium - 228	5	pCi/L (picoCuries/liter)
Gross alpha particle activity	15	pCi/L
Beta particle and photon radioactivity	4	millirem (annual dose equivalent)
Turbidity	1	Tu (Turbidity units) (up to 5 Tu)
Trihalomethanes (the sum of the concentrations of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform))		
	0.10	mg/L
Sodium Monitoring and Reporting		
Corrosion Monitoring and Distribution System Composition		
NATIONAL SECONDARY DRINKING WATER REGULATIONS		
Chloride	250	mg/L
Color	15	color units
Copper	1	mg/L
Corrosivity	Non-corrosive	
Foaming Agents	0.5	mg/L
Iron	0.3	mg/L
Manganese	0.05	mg/L
Odor	3	threshold odor number
pH	6.5-8.5	
Sulfate	250	mg/L
TDS (Total Dissolved Solids)	500	mg/L
Zinc	5	mg/L
Fluoride	2	mg/L

The U.S. Environmental Protection Agency also updates drinking-water standards as necessary. In April 1986, the agency revised the maximum allowable concentration of fluoride in public water supplies. The new maximum concentration level of 4 milligrams per liter (mg/L) became effective on October 2, 1987. Previous maximum allowable fluoride levels ranged from 1.4 to 2.4 mg/L, depending on the local average maximum daily air temperature. The agency also established a secondary maximum contaminate level for fluoride of 2 mg/L to protect against objectionable dental fluorosis. The secondary regulations are Federal guidelines for the protection of public welfare. The agency has recently established maximum contaminant levels for eight volatile organic chemicals in

drinking water. The new limits will become effective on January 9, 1989. The chemicals are benzene, carbon tetrachloride, trichloroethylene, vinyl chloride, p-dichlorobenzene, 1,1,1-trichloroethane, 1,1,-dichloroethylene, and 1,2-dichloroethane. Monitoring requirements for 51 other compounds have also been proposed for public water supply systems. The Alabama Department of Environmental Management presently is modifying the state's regulations for public water supplies. These regulations, which will incorporate the Environmental Protection Agency's new water quality regulations, should be established by the end of 1988.

Recommended maximum contaminant levels for 37 chemicals (plus two by-products) and four microbiological contaminants will also be proposed by the U.S. Environmental Protection Agency. Twenty-six synthetic organic chemicals and 11 inorganic chemicals are included in the list of contaminants.

A new regulation of the Environmental Protection Agency will require water suppliers to notify customers about any amount of lead in their water and to provide details about lead's health effects. Previously, suppliers had to notify customers only if the amount of lead in the water exceeded the current federal standard of 0.05 milligrams per liter. The new regulation will become effective in June 1988.

## WATER-SAMPLE COLLECTION

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 semiannually at most sites. A few sites have continuous water-quality monitors that record specific conductance and temperature values. Also, water samples are collected during research investigations at selected sites.

The Alabama Department of Environmental Management requires that all public water supply systems collect bacteriological samples and have them analyzed by a certified laboratory at least once each month. They also require public water supply systems to sample for heavy metals once each year from surface-water sources and every 3 years from ground-water sources. Systems using surface water are required to analyze samples for selected herbicides and pesticides every 3 years. Table 3 provides a brief summary of sampling frequencies required for different contaminants. Most public-supply systems maintain their own sampling and analysis program at more frequent intervals than is required by the state.

## GROUND- AND SURFACE-WATER QUALITY

Ground water is more likely to have a higher mineral content than surface water because it moves much more slowly and has more time to react with minerals present in the rocks through which it moves. Ground water is likely to be much less variable in quality over a period of time for a particular site than surface water. However, ground-water quality is variable with depth and location throughout Alabama, depending on the composition of the rocks comprising an aquifer, the depth of water within an aquifer, and local hydrogeologic conditions. The results of chemical analyses of ground-water samples from selected sites are given in appendix 5, and the locations of these sites are shown in plate 4. A comparison of analyses results with the drinking-water standards (table 3) reveals that few water-quality problems exist in the wells sampled. The most common problems are excessive hardness, high concentrations of iron, chlorides and dissolved solids, and low pH (high acidity). These water-quality problems are attributable to natural geohydrologic conditions.

Surface water at a given site may be highly variable in quality throughout the year, partly because of variations in flow due to climatic conditions, impounding, or diversion of water. Surface water is also accessible to pollutants of all types, especially those generated by man. 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 from selected streams are

Table 3.--Sampling frequencies and locations for community and noncommunity water supplies  
(from Alabama Department of Environmental Management, 1982)

Community water system <sup>1</sup>	Noncommunity water system <sup>2</sup>
<p><b>Inorganic Contaminants</b> Surface water: 1-year intervals. Ground water: 3-year intervals.</p> <p><b>Organic Contaminants</b> Surface water: 3-year intervals unless otherwise specified by ADEM. Ground water: none, unless specified by ADEM. Communities that have a population of 10,000 or more and disinfect their water must analyze for total trihalomethanes at quarterly intervals.</p> <p><b>Microbiological Contaminants</b> Surface and ground water: required number of samples per month set by ADEM for each system, based on population served; samples taken at points representative of distribution system.</p> <p><b>Turbidity Levels</b> Surface and ground water: minimum 1 per day, at a representative entry point to the distribution system.</p> <p><b>Radioactivity Levels</b> Surface and ground water: natural and man-made radionuclides--4 consecutive quarterly samples or the average of 4 quarterly samples--other sampling intervals at discretion of ADEM.</p>	<p><b>Inorganic Contaminants</b> Surface and ground water: nitrates--intervals specified by Alabama Department of Environmental Management (ADEM).</p> <p><b>Organic Contaminants</b> Surface and ground water: at intervals specified by ADEM for each system.</p> <p><b>Microbiological Contaminants</b> Surface and ground water: minimum of 2 samples per month during each month the system provides water: taken at points representative of distribution system.</p> <p><b>Turbidity Levels</b> Surface and ground water: minimum 1 per day, at a representative entry point to the distribution system; sampling frequency may be reduced at discretion of ADEM.</p> <p><b>Radioactivity Levels</b> Surface and ground water: natural and man-made radionuclides--4 consecutive quarterly samples or the average of 4 quarterly samples--other sampling intervals at discretion of ADEM.</p>

<sup>1</sup>A public-supply system that has at least 15 service connections or serves at least 25 people year-round.

<sup>2</sup>A public-supply system that serves at least 25 people per day at least 60 days per year.

given in appendix 6, and the locations of sample-collection sites are shown in plate 4. Water in the streams was generally of good chemical quality. The specific conductance of most of the streams was less than 250 micromhos per centimeter ( $\mu\text{mhos/cm}$ ), and the total dissolved solids were generally less than 150 mg/L. However, some of the water was slightly acidic (less than pH 7), and almost half of the streams had water with high concentrations of iron (greater than 300 micrograms per liter ( $\mu\text{g/L}$ )).

Although the water quality in streams is generally good, 54 stream segments, with a total length of 499 miles, do not meet the Federal standards for fish and wildlife (James McIndoe, 1988, Alabama Department of Environmental Management, personal communication). These stream segments, however, represent only 1.2 percent of Alabama's 40,600 miles of waterways. Charles Horn (1986, Alabama Department of Environmental Management, personal communication) indicated that substandard wastewater treatment facilities contributed to the poor quality of water in many of the stream segments with classifications below fish and wildlife standards. Of the state's 248 wastewater treatment facilities, 83 were not in compliance with federal guidelines in February 1988 (Jerry Bohannon, 1988, Alabama Department of Environmental Management, personal communication). However, the number of facilities that are in noncompliance has decreased from 115 since 1985. By the summer of 1988, approximately 10 additional sites will meet federal requirements.

## WATER USE

In 1987, an estimated 8.1 bgd of water was withdrawn from surface- and ground-water sources for use in Alabama. This figure represents approximately 2,000 gallons per day (gpd) for every

person in the state. These values are estimates based on a partial survey of public water systems and power generation water use values for 1987. All other values for water uses were determined for the 1985 statewide water use survey.

Water use is divided into two main categories: withdrawal or off-stream use, where water is withdrawn from its natural setting in streams, lakes, or aquifers prior to being used; and nonwithdrawal or in-stream 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 12 shows the percentages of withdrawal use by category for 1980 and 1987.

## WITHDRAWAL USE

The six withdrawal-use categories are public water systems, self-supplied industrial/commercial, agricultural, self-supplied domestic, power generation, and mining. Figure 13 shows comparative amounts of withdrawal use in million gallons per day (mgd) for 1980 through 1987.

### PUBLIC WATER SYSTEMS

Public water systems served an estimated 88 percent of the people of Alabama in 1987. Water use by public supply systems increased from 624.68 mgd in 1986 to 629.23 mgd in 1987. The population-served values, as well as the water-use values, were obtained from records supplied by the Public Water Supply Department of the Alabama Department of Environmental Management and by individual water systems. Withdrawal-use figures for public supply systems are usually accurate because withdrawals are measured; however, where system values were not available for 1987, a per capita use value of 110 gpd was used to estimate a system's withdrawal or the system's 1985 value was used.

### SELF-SUPPLIED INDUSTRIAL/COMMERCIAL

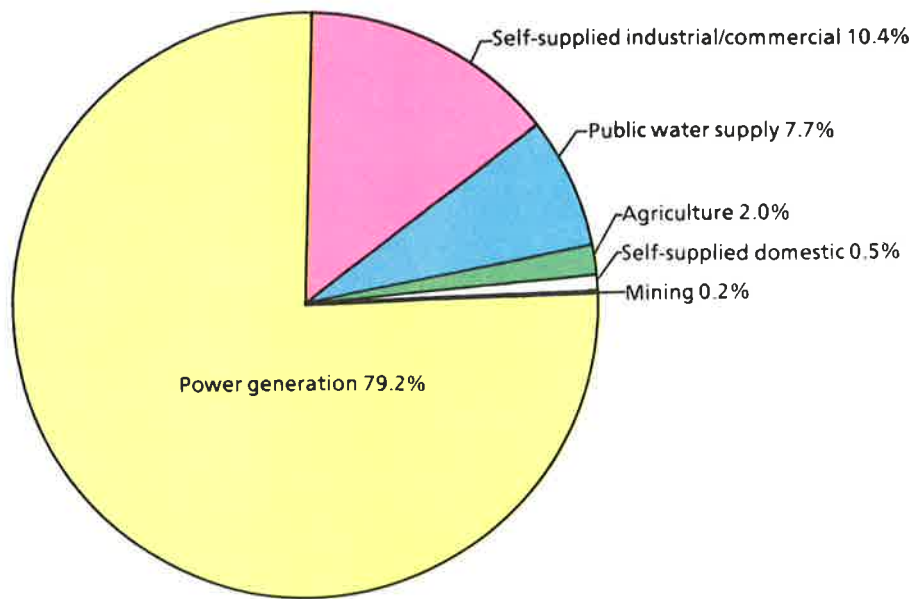
Self-supplied industrial/commercial water use during 1985 was estimated at approximately 842 mgd. Although lower than the estimated 1980 value (fig.13), this value is in agreement with estimates developed by the U.S. Department of Commerce, Bureau of the Census. Industrial plant closures and different methods for estimating water use are the primary reasons for the apparent reduction in water use.

### AGRICULTURAL

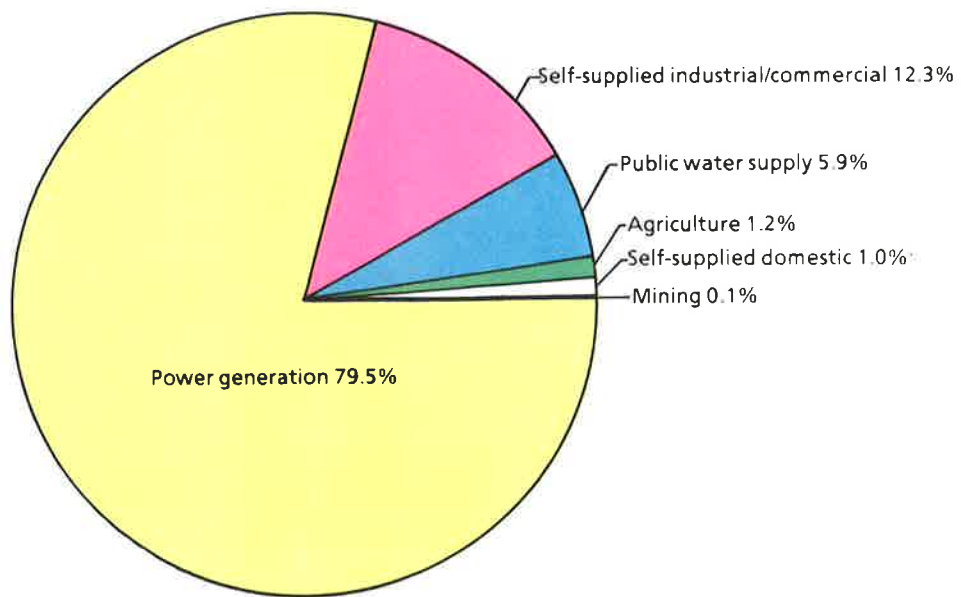
Agricultural uses are divided into irrigation and nonirrigation uses. Nonirrigation use includes water for livestock operations and for catfish farming. Irrigation continues to increase, indicating that farmers are using irrigation as a method of crop insurance, particularly during dry periods. Counties in south Alabama have the most intensive irrigation. Water-use values in figure 13 for agricultural use were based on 1985 irrigation water use and 1984 livestock water use. The total agricultural use in 1985 was estimated at 164.91 mgd.

### SELF-SUPPLIED DOMESTIC

Water-use values for this category must be estimated. The number of people served by public water systems was subtracted from the total population for 1985 to determine the self-supplied domestic population. The 1985 population values were determined by the U.S. Department of Commerce, Bureau of the Census. Water-use values were estimated by using an average figure of 75 gpd per person, which is considered a more realistic value than the 110 gpd figure used prior to 1982. (Adjustment for this difference should be made when comparing 1982, 1983, 1984, and 1985 water use to that in previous years.) It is estimated that 13 percent of Alabama's population was self-supplied during 1985 and withdrew an estimated 38.63 mgd from ground-water sources.

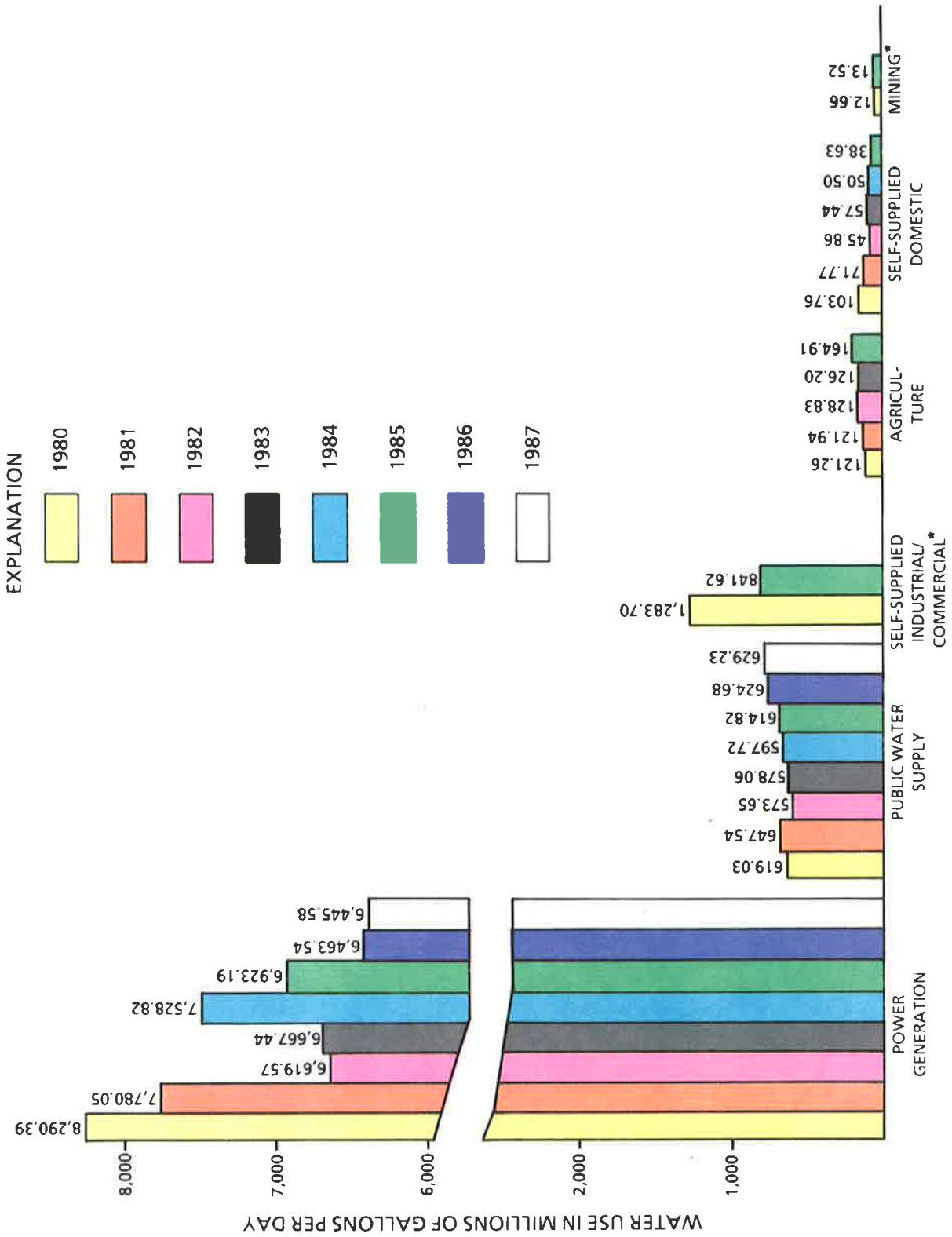


1987  
Withdrawal Use



1980  
Withdrawal Use

Figure 12.--Percentages of total withdrawal water use, 1980 and 1987.



\*Estimated for 1980 and 1985 only

Figure 13.--Comparative withdrawal water use, 1980-87.

## **POWER GENERATION**

Water use by nuclear and fossil fuel power generation plants in Alabama accounted for 6,445.58 mgd, or about 79 percent, of the entire withdrawal water use. Water use for power generation declined from 1986 to 1987, primarily due to a decrease in water use at the Farley Nuclear Power Plant. Power production in 1987 was approximately 56 million megawatt hours.

## **MINING**

The amount of water withdrawn for mining was not sufficient to constitute a major water use. During 1985 approximately 13.52 mgd was withdrawn for washing coal, sand, and gravel, and for enhanced recovery of hydrocarbons. Much of this water was recycled.

## **NONWITHDRAWAL USE**

Nonwithdrawal or in-stream 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 used many times over as it moves downstream.

## **HYDROELECTRIC POWER GENERATION**

The 21 hydroelectric power generating facilities operating in Alabama in 1985 used a reported 113,717 mgd of water to produce 7.0 million megawatt hours of electricity. Complete water use values are not available for 1987; however, 7.4 million megawatt hours of electricity was produced. Therefore, a small increase in water use would be expected for 1987. There is virtually no consumptive use of water by hydroelectric generating plants; water used at one plant is available for other uses downstream.

## **SEWAGE TREATMENT**

The total estimated discharge by sewage treatment facilities in Alabama was approximately 320 mgd during 1985. Discharge data from the Alabama Department of Environmental Management records, supplemented by discharge records from operators of sewage treatment facilities, were used to estimate the 1985 discharge value. However, many discharges are not metered; therefore, the actual value may be higher.

## **NAVIGATION**

There are 14 locks operating on four lock-and-dam navigation systems 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 a low of 9 million gallons (mg) at 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 297 mg. During 1984, the latest year for which data are available, there were 39,836 lockages, which required a total of approximately 847 billion gallons. Lockage is a sequential use of water, in that the same water is used downstream.

## **RECREATION/PRESERVATION**

Although recreation/preservation is not considered a major water-use category, it is important to the state's economy. Alabama has no natural large lakes, but many impoundments developed for navigation and hydroelectric power generation 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 recreational 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 Gunterville, Wheeler, Wilson, Pickwick, and Bear Creek Lakes and associated property to be approximately 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 is estimated to be 20 million.

## WATER PROBLEMS

### DROUGHTS

A drought is generally defined as a deficiency in precipitation for an extended period of time. The severity of a drought is dependent 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.

Recent major droughts that have affected Alabama occurred in 1954, 1968, 1980-81, and 1986. The drought of 1986, which affected much of the southeastern United States, is considered to be the most severe drought in over 100 years of record.

Changes in the severity of a drought are generally based on the Drought Severity or Palmer Index. This index indicates prolonged abnormal conditions of dryness or wetness. Index values are dependent upon amounts of precipitation, soil moisture, recharge, runoff, and evapotranspiration. Figure 14, which is based on the long-term Drought Severity Index, shows the severity of drought conditions for September 12, 1987. During the fall of 1987, moderate and severe drought conditions were present in the northern half of the state. The southern part of the state had near normal moisture conditions, except for areas near the coast, which had abnormally large amounts of rainfall.

### FLOODING

Flooding is one of the most severe water-related problems. In many cases, flooding cannot be controlled in any way other than by construction of dams and flood-control impoundments. However, construction of buildings in flood prone areas often can be avoided. Flat, open flood plains appear to be attractive, easily developed sites for building, but these areas are particularly susceptible to flooding.

Olin (1984) provides methods and equations for estimating the magnitude and frequency of floods for streams in Alabama with drainage areas of 1 to 22,000 mi<sup>2</sup>. Also, the relation of maximum floods of record to drainage areas for different streams in Alabama is given as a guide in estimating potential maximum floods.

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, delineating areas of danger from floods, 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 (FEMA) 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

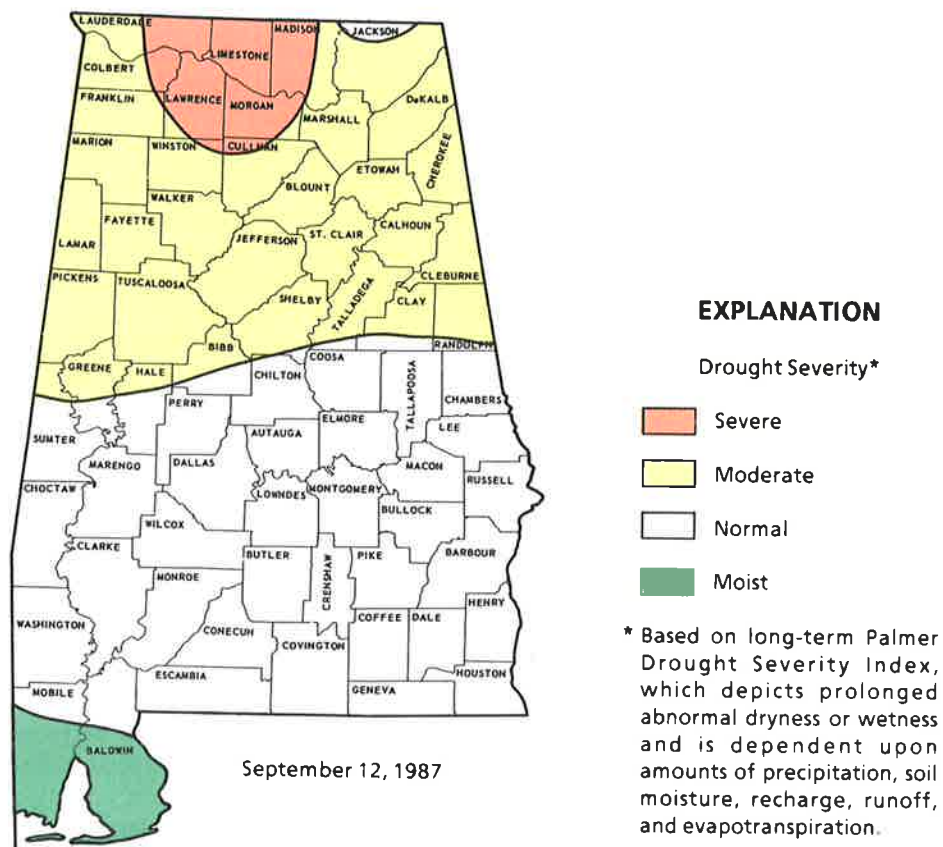


Figure 14.--Drought severity in September 1987.

500-year flood boundaries and other flood prone areas but not necessarily all areas subject to flooding.

## WATER QUALITY

Naturally occurring conditions such as excessive chloride, iron, and hardness are the most common water-quality problems affecting ground-water supplies. High chloride content makes water unfit for most uses. A high concentration of chlorides 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, has 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 February 1988, there were 35,292 underground storage tanks at 12,904 sites in Alabama. Several of these tanks are leaking. Between mid-1986 and the end of 1987, reports on 43 leaking tanks were received by the Alabama Department of Environmental Management (Steve Emery, 1988, Alabama Department of Environmental Management, personal communication).

Seepage from landfills is another source of contamination. As of February 1988, 269 county, municipal, and industrial landfills were being operated in Alabama (Donald Parrish, 1988, Alabama Department of Environmental Management, personal communication). Ground-water quality is being monitored in the vicinity of many of these landfills. Results of chemical analyses of water samples collected from monitor wells have indicated changes in ground-water quality at some landfills. Leachate from landfills also 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 March 1988, ground-water contamination had been detected at 32 of the 77 hazardous waste facilities identified under the Federal Resource Conservation and Recovery Act (Fred Mason, 1988, Alabama Department of Environmental Management, personal communication). Approximately 500 hazardous waste sites in Alabama have been identified as part of the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (Joe Downey, 1988, Alabama Department of Environmental Management, personal communication). Preliminary assessments have been completed at all of these sites.

As of September 30, 1987, the Department of Defense, as part of its Environmental Restoration Program, had identified 69 sites of hazardous and toxic wastes at 11 military installations in Alabama (U.S. Department of Defense, 1988). Investigations by the Department of Defense indicate that ground-water contamination has occurred at 16 of the sites. Cleanup of the contaminants is underway or has been completed at 12 of the 16 sites.

The Environmental Protection Agency evaluates hazardous waste sites and ranks the sites according to their adverse effects on human health and the environment. Sites with a Hazard Ranking System score of 28.5 or greater are eligible for inclusion on the National Priorities List. Eight sites in Alabama have been included on the list.

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.

Streams draining undeveloped areas generally contain water of good chemical quality, but streams draining areas of municipal and industrial development may contain water of poor quality. Major sources of stream pollution include industrial waste discharges, discharges from wastewater treatment plants, and nonpoint discharge from urban areas, mining operations, and agricultural areas. The most recent estimates by the Alabama Department of Environmental Management indicate that 66.8 percent of the streams that have poorer quality water than their designated use standard are contaminated by municipal sources, 19.8 percent are contaminated by industrial sources, and 13.4 percent are contaminated by nonpoint sources. In the past, little emphasis has been placed on the control of contamination from nonpoint sources of pollution. However, recent amendments to the Federal Clean Water Act require that each state assess the impacts of nonpoint sources of pollution on water quality. Therefore, the Alabama Department of Environmental Management has initiated an assessment process to identify areas affected by nonpoint sources of pollution and to identify the sources of pollution.

## OVERDEVELOPMENT OF GROUND WATER

Water shortages induced or enhanced by man's activities are, in contrast, usually only locally severe. The most common is the decline in ground-water levels caused by overpumping. 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 generally 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 occurs in the vicinity of large pumping centers.

## RESEARCH INVESTIGATIONS

The Water Resources Division of the Geological Survey of Alabama initiated or completed several research projects in 1987. 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 many different applications.

### OIL-FIELD MONITORING PROGRAM

In 1984, a program to monitor water quality in selected streams in the oil- and gas-field areas of Alabama was initiated by the Geological Survey of Alabama and the State Oil and Gas Board. In 1985, the program was expanded to include coalbed methane gas fields. The purpose of the project is to detect spills and unauthorized discharges of brines from oil and gas exploration and production. In 1987, fourteen continuous-record "minimonitor" recorders were located on streams draining oil- and gas-field areas. The locations of minimonitor sites are shown in plate 4. These recorders detect the presence of mineralized water in streams by measuring the water's specific conductance. Hourly specific conductance and temperature readings are recorded on punch tapes, which are collected at regular intervals by Geological Survey of Alabama and State Oil and Gas Board personnel.

These stations have proved effective in detecting accidental pipeline breaks, overflow from tank batteries, and other unauthorized discharges into surface-water systems. In 1987, fifteen suspected spills were detected by the minimonitors. These spills were reported to the State Oil and Gas Board.

### SALTWATER ENCROACHMENT STUDY, SOUTHERN BALDWIN COUNTY

Ground water is the principal source of water in southern Baldwin County for municipal and domestic supplies, industrial needs, and irrigation. In some areas, especially near the coast, high chloride concentrations have begun to appear in wells. The Geological Survey of Alabama conducted a study in this area in 1984 to determine the extent of saltwater encroachment and to describe the hydrogeology and water quality of the freshwater aquifer zones. Three areas were found to be affected by saltwater contamination, all near the Gulf of Mexico. Results of this study were published in 1985 as Bulletin 126 of the Geological Survey of Alabama.

In October 1986, the Geological Survey of Alabama initiated a project to develop a ground water model for southern Baldwin County. The model will assist developers and planners in managing the ground-water resources to prevent further saltwater encroachment. Basic hydrologic data collection for use in preparation of the model was completed in 1987.

### WATER TEMPERATURES IN ALABAMA

In 1987, the Geological Survey of Alabama and the Energy Division of the Alabama Department of Economic and Community Affairs completed a study of temperatures of surface and ground waters in Alabama. Results of the study can be used in determining the feasibility of utilizing water-source air-conditioning systems in different parts of the state. Temperature curves were prepared and the yearly maximum, mean, and minimum temperatures for selected streams were determined. Ground water temperature data for selected depth intervals in different areas of the state were presented on maps.

### WATER-QUALITY ASSESSMENT OF THE NORTH ALABAMA JUNCTION ABANDONED MINE LAND RECLAMATION PROJECT AREA

In September 1986, the Geological Survey of Alabama in cooperation with the state Department of Industrial Relations initiated a water-quality assessment of an abandoned mine land reclamation area in east-central Tuscaloosa County, Alabama. The specific objectives of the assessment are to identify water-quality and related problems prior to reclamation, provide recommendations on

measures that might be taken to lessen the effects of these problems, and document changes in water quality that occur as a result of reclamation. Reclamation of the abandoned mine lands was completed in 1987. In 1988, water-quality changes as a result of reclamation will be determined.

## COUNTY WATER-AVAILABILITY REPORTS

Water-availability reports or maps for all counties in Alabama, except Jackson and De Kalb, have been published. However, most of the information in the published reports was collected in the mid-to late-1960's. New information for De Kalb, Jackson, Lawrence, Lowndes, Talladega, and Tuscaloosa Counties was collected in 1987. 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.

## BLACK WARRIOR BASIN EVALUATION

In 1987, the Geological Survey of Alabama and the State Oil and Gas Board initiated a study of geologic and hydrologic parameters that control the occurrence, movement, and production of coalbed gas in the Black Warrior Basin. Known parameters that control and influence gas production will be used to develop models that will predict areas of favorable coalbed gas production in undeveloped basins.

A similar study is being conducted in the San Juan or Piceance Creek Basin by the Colorado Geological Survey. These studies are components of a larger project that is being managed by the Bureau of Economic Geology at the University of Texas at Austin. The project is being funded by the Gas Research Institute.

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## GLOSSARY

- ACRE-FOOT** - A unit of measurement of water volume that represents 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 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 fair 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. Discharge is commonly reported in cubic feet per second (ft<sup>3</sup>/s).
- DRAINAGE BASIN** - The area around a surface-water drainage system that contributes runoff from precipitation 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 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 of plants.
- ft<sup>3</sup>/s (cubic feet per second)** - The volume of water flowing at a velocity of 1 foot per 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. It is due to 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.
- HYDROGRAPH** - A graph which shows the change in ground-water level 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 the ground water at higher levels in 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 under pressure.
- 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.
- 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 of containing interstices. It is expressed as the ratio (as a percentage) of the volume of the interstices to the total volume of the rocks.
- 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 static 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  $Q_2$  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  $Q_{10}$  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 that has a pressure equal to atmospheric pressure. It is the surface that separates the zone of saturation and the zone of aeration. It 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 from soils or rocks.

## APPENDIX 1

### WATER LEVELS AND SPRING DISCHARGES, FALL 1987

#### Explanation

Abbreviations: cfs, cubic feet per second; gpm, gallons per minute; LSD, land-surface datum.

Method of measurement: S, steel tape; E, electric line; C, current meter; AL, air line; SI, shut-in pressure; CT, container and timer; ES, estimated.

Quality of measurement: E, excellent; G, good; F, fair; P, poor.



## Water levels and spring discharges, fall 1987

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Autauga	A-2	S	10-13-87	216.18	+ 1.51	-0.43	E	--
	D-7	S	10-15-87	+ 1.07	+ .18	-.01	E	--
	E-8	S	10-15-87	129.85	+ 5.05	+ 5.57	E	--
	G-7	S	10-13-87	206.49	-16.4	--	E	--
	I-37	S	10-16-87	87.34	--	-8.04	E	--
	I-38	S	10-13-87	--	--	--	--	Not measured.
	J-18	S	10-13-87	27.26	-4.99	-.84	E	--
	L-10	S	10-15-87	10.22	-5.02	-1.04	E	--
	N-7	S	10-15-87	5.53	-2.77	-.47	E	--
	O-17	S	10-15-87	94.43	-1.34	+ 1.10	E	--
	O-19	S	10-15-87	49.57	-1.93	+ 1.41	E	--
	P-25	S	10-13-87	140.79	-5.75	--	E	--
	Q-28	S	10-16-87	150.17	-3.27	-2.84	E	--
	R-57	S	10-13-87	31.26	-7.71	-2.07	E	--
	R-62	S	10-16-87	122.65	-26.35	-6.60	E	--
	T-8	S	10-13-87	15.60	-3.79	-2.86	E	--
T-14	S	10-13-87	22.53	-3.74	-3.73	E	--	
U-5	S	10-15-87	123.26	-2.08	-.04	E	--	
Baldwin	G-01	S	10-6-87	109.49	+ .86	-5.57	G	--
	M-6	--	--	--	--	--	--	Destroyed.
	U-01	S	10-6-87	60.59	+ 5.93	+ 7.20	E	--
	U-02	--	--	--	--	--	--	Not measured.
	LL-6	S	10-6-87	148.13	-.63	+ 4.43	E	Pump off 14 hours.
	PP-6	S	10-5-87	40.54	-4.60	-2.42	E	Pump off 5 hours.
	UU-7 (Bal-1)	S	10-5-87	19.19	+ 2.90	+ 5.24	E	--
DDD-02	S	10-6-87	3.20	-1.11	-.28	E	Pump off 14 hours.	
Barbour	F-6	S	10-21-87	214.60	--	-2.35	E	--
	P-2	S	10-21-87	70.71	-1.24	+ .07	E	--
	S-3	S	10-21-87	140.60	+ 1.99	+ 2.80	G	Pump off 24 hours.
	T-2	S	10-21-87	18.41	-5.76	-.06	E	--
	V-1	S	10-21-87	172.99	-9.41	--	E	--
	V-02	S	10-21-87	186.51	--	--	E	Pump off 23 hours.
	EE-8	S	10-21-87	251.62	-6.71	--	E	Pump off 3 hours.
	FF-8*	C	11-3-87	2.13/956	--	-1.59/-713	F	Blue Spring.
Bibb	Bib-1	S	10-7-87	30.72	-4.65	+ .29	E	--
	C-01	S	10-7-87	80.54	-7.05	+ 10.8	E	--
	C-02*	--	--	--	--	--	--	Not measured Big Spring.
	L-1*	C	10-19-87	51/224	--	-.7/-314	F	Williams Spring.

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Bibb (cont'd)	L-4	S	10-7-87	131.98	-.9	+ .34	E	--
	Q-7	S	10-7-87	30.33	-2.34	+ .39	E	--
	T-6	S	10-7-87	43.30	-2.28	+ 1.55	E	--
	V-1*	C	10-7-87	23.4/10,500	--	+ .31/+ 155	E	Lightsey's Spring.
	W-3	S	10-7-87	119.53	+ 2.04	+ 2.87	E	--
Blount	D-2	--	--	--	--	--	--	Destroyed.
	D-5*	C	10-9-87	.57/256	--	+ .02/+ 6	--	Blue Spring.
	J-4*	C	10-9-87	4.50/2,020	--	-1.07/-480	F	Warren (Big) Spring.
	M-3	S	10-9-87	10.99	-3.27	-2.22	G	--
	T-3*	C	11-18-87	.11/49	--	-.12/-54	F	Walker Spring.
Bullock	B-3	S	10-27-87	17.32	-13.77	+ 18.56	G	Pump off 15 minutes.
	F-1	S	10-27-87	425.75	-33.25	-35.5	F	--
	I-1	S	10-27-87	--	--	--	--	Dry at 20.8 feet.
	L-2	S	10-27-87	398.72	+ 1.33	+ .46	G	--
	L-11	S	10-27-87	366.38	-10.00	-6.45	G	--
	N-7	S	10-27-87	175.09	-.04	-2.15	G	--
	P-2	S	10-27-87	335.14	-2.92	-2.13	E	--
	P-4	S	10-27-87	47.10	-1.00	+ .22	E	--
	U-15	S	10-27-87	179.62	-17.52	-17.45	E	--
Butler	C-5	S	10-8-87	13.24	-1.24	+ .62	E	--
	C-7	S	10-8-87	60.91	-.63	+ .75	E	--
	E-5	S	10-14-87	96.55	-2.80	-1.88	E	--
	F-8	S	10-14-87	77.95	+ .14	+ .45	E	--
	K-2	S	10-8-87	67.60	-3.35	+ 3.25	E	--
	M-3	S	10-14-87	84.25	-1.96	-1.08	E	--
	P-1	S	10-14-87	90.03	-.77	-.26	E	--
	P-3	S	10-14-87	13.51	-6.51	+ .07	E	--
	Q-14	--	10-14-87	--	--	--	--	Not measured.
	R-9	S	10-14-87	244.71	-4.26	-3.26	E	Pump off 13 hours.
	S-6	S	10-14-87	35.70	+ 1.57	+ 2.05	E	--
	T-3	E	10-14-87	146.99	+ .81	+ .91	E	--
	V-6	--	--	--	--	--	--	Discontinued.
	W-11	AL	10-13-87	302	-8.8	-10.16	F	--
Calhoun	F-68*	C	10-29-87	2.19/985	--	-.13/-55	F	Seven Springs.
	G-02	C	10-20-87	86/385	--	--	F	Webster Chapel Spring.
	I-33	S	10-29-87	13.79	-6.68	-.77	E	--
	L-1*	C	10-29-87	2.15/965	--	+ .04/+ 15	E	Not measured. Germania Spring.
	L-21*	--	--	--	--	--	--	Not measured. Big Spring.

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Calhoun (cont'd)	L-73	--	10-29-87	--	--	--	--	Not measured.
	M-91*	C	10-29-87	3.77/1,700	--	+ .99/+ 508	G	McCullars Spring.
	N-01	S	10-5-87	4.94	-1.11	- .33	E	--
	V-01	S	10-28-87	47.38	-14.13	- .82	E	--
	W-12*	C	10-20-87	40.3/18,000	--	-8.82/-3,958	G	Coldwater Spring.
Chambers	B-01	S	10-28-87	34.48	-1.88	+ 1.45	E	--
	L-1	S	10-28-87	--	--	--	--	Dry at 22.1 feet.
	N-01	S	10-28-87	35.65	+ .09	+ 2.4	E	--
	Q-01	S	10-28-87	9.46	-6.56	-3.53	--	--
	W-01	S	10-28-87	34.69	-3.86	+ 3.00	E	--
Cherokee	D-4*	--	10-29-87	--	--	--	--	Not measured. Berry Spring.
	F-4	S	10-29-87	41.67	-30.07	-17.62	--	--
	G-9*	C	10-29-87	1.47/660	--	-1.06/-476	--	Congo Spring.
	J-12	S	10-29-87	12.60	-9.84	-6.13	G	--
	O-15	S	10-29-87	13.96	-10.64	-6.66	--	--
	R-01*	--	--	--	--	--	--	Not measured. Stanford Spring.
Chilton	V-01	S	10-29-87	26.79	-5.46	+ .38	E	--
	F-4	S	10-7-87	43.15	- .88	+ 1.15	E	--
	O-1	S	10-7-87	133.60	-7.82	-3.77	E	--
	O-2	S	10-6-87	53.08	-3.36	+ 2.91	E	--
	R-01	S	10-6-87	20.58	-7.47	+ .29	E	--
Choctaw	X-5	S	10-6-87	50.50	-5.03	+ 3.53	E	--
	J-3	S	10-26-87	83.24	-5.08	+ 1.72	E	--
	M-01	S	10-26-87	61.91	- .56	-2.58	E	Pump off 5 hours.
	X-6	S	10-26-87	19.78	- .99	+ 2.03	E	--
	BB-2	S	10-26-87	2.54	- .95	+ .33	G	--
	CC-2	S	10-26-87	57.14	-1.56	+ .75	E	--
Clarke	CC-6	S	10-26-87	14.62	-1.15	+ .11	E	--
	H-1	S	10-5-87	22.84	-2.64	+ 1.88	E	--
	H-2	CT	10-5-87	+ 1.88	- .97	+ .21	E	Flows 1.8 gpm.
	O-12	S	10-5-87	111.20	-28.38	-18.28	F	Pumping level.
	R-2	S	10-5-87	48.40	-12.43	-11.18	F	--
	U-2	--	10-5-87	--	--	--	--	Not measured.
	EE-1	S	10-5-87	79.92	-3.77	-2.67	G	--
	HH-6*	C	11-8-87	1.81/812	--	--	F	Hoven Spring.
Clay	JJ-01	S	10-5-87	14.65	-3.48	- .25	E	--
	PP-9	S	10-5-87	10.68	-1.20	+ 1.01	E	--
	G-01	S	10-28-87	32.03	-10.93	+ 3.19	E	--

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Clay (cont'd)	I-17	S	10-28-87	7.68	-5.58	-.53	E	--
	V-12	S	10-28-87	9.33	-6.9	-2.41	E	--
Cleburne	B-01	S	10-29-87	34.63	-10.43	-.28	E	--
	H-01	S	10-28-87	47.67	-14.94	+1.76	E	--
	O-15	S	10-28-87	49.99	-5.38	--	E	--
	R-01	S	10-28-87	25.67	-8.82	+.85	E	--
	Y-01*	--	--	--	--	--	--	Not measured. Cheaha Spring.
Coffee	A-7	S	10-7-87	65.55	-2.03	-.53	E	--
	A-9	S	10-7-87	95.51	-2.46	-.28	E	--
	F-1	S	10-8-87	95.88	-2.98	-.68	E	--
	F-6	S	10-7-87	162.15	-4.72	-3.08	E	--
	J-6	S	10-8-87	294.07	-5.77	--	E	Pump off 4½ hours.
	K-4	S	10-8-87	11.32	-3.05	-.11	E	Pump off 4 hours.
	L-6	S	10-8-87	72.48	-.7	0.0	E	--
	L-8	S	10-8-87	202.3	-7.1	-7.17	E	Pump off 3 hours.
	N-6	S	10-8-87	163.1	-1.4	-1.53	E	--
	O-8	--	--	--	--	--	--	Discontinued.
	Q-4	S	10-7-87	238.8	-6.10	-1.65	E	--
	Q-5	S	10-8-87	178.55	-4.95	-1.59	E	--
	Q-7	S	10-7-87	62.35	-3.55	-1.05	E	--
T-1	S	10-8-87	53.98	-2.00	+.82	E	--	
T-7	S	10-8-87	99.1	-2.93	-.07	E	Pump off 12 hours.	
Colbert	E-69	S	10-5-87	38.87	-4.44	-1.67	F	--
	E-70*	C	10-5-87	41/184	--	-.61/-274	G	Buzzard Roost Spring.
	H-80	S	10-5-87	16.01	-2.22	-3.34	E	--
	M-20*	C	11-16-87	28.71/12,872	--	--	F	Tuscumbia Spring.
	M-147	S	10-5-87	18.59	-3.87	-2.23	E	--
	M-161	S	10-5-87	75.04	-17.44	-13.85	G	--
Conecuh	E-1	S	10-7-87	79.94	-1.66	-.25	E	--
	G-6	--	--	--	--	--	--	Destroyed.
	M-01	S	10-7-87	134.79	--	-.30	E	Pump off 2½ hours.
	S-2	--	10-7-87	--	--	--	--	Not measured.
	T-3	--	--	--	--	--	--	Destroyed.
	EE-21	S	10-7-87	10.47	-1.07	+.14	E	--
Coosa	C-2	S	10-6-87	3.88	-3.51	+1.83	E	--
	F-01	S	10-6-87	11.61	-.72	-.18	E	--
	M-2	S	10-6-87	25.81	-7.49	+.5	E	--
Covington	C-1	E	10-7-87	190.2	-1.08	+.05	E	--
	M-4	S	10-7-87	117.27	-1.90	+.42	E	--

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Covington (cont'd)	M-5	S	10-7-87	71.36	-3.61	-.97	E	--
	M-8	S	10-8-87	251.30	-10.10	-19.87	G	Pump off 9½ hours.
	N-3	S	10-7-87	78.69	-22.59	-13.09	E	Pump off 16 hours.
	S-2	S	10-7-87	67.77	-1.57	+.27	E	--
	S-4	S	10-7-87	93.18	+.12	+.80	E	--
	Q-4	S	10-7-87	120.90	-.55	-.79	E	--
	U-1	S	10-7-87	57.80	-2.71	+.74	E	--
	X-3	S	10-7-87	76.17	-2.67	+.23	E	--
	Z-4	S	10-7-87	68.81	-1.21	+.41	E	--
	AA-1	S	10-7-87	79.70	-1.04	-.04	E	--
	CC-3	S	10-7-87	32.85	-1.74	+1.17	E	--
	CC-4	S	10-7-87	31.65	+3.35	+7.40	E	--
	CC-5	S	10-7-87	95.69	+5.16	+3.81	G	Pump off 2½ hours.
DD-3	S	10-7-87	92.71	-2.81	-1.19	E	--	
Crenshaw	H-4	S	10-8-87	96.50	-.5	-.42	E	--
	I-2	S	10-8-87	105.00	-1.68	+1.15	E	--
	K-7	S	10-8-87	85.52	+6.21	+5.88	E	--
	L-5	S	10-9-87	216.75	-3.7	-4.08	E	Pump off 24 hours.
	S-1	S	10-8-87	120.8	-2.52	+1.23	E	--
	S-2	S	10-8-87	44.54	-1.3	+.09	E	--
	T-6	S	10-8-87	47.20	-2.57	+1.52	E	--
	T-9	S	10-13-87	55.60	-1.68	+3.85	E	Pump off 4 hours.
Cullman	S-3	--	--	--	--	--	--	Destroyed.
	I-01	S	11-3-87	32.11	--	--	E	--
	V-01	S	11-3-87	9.18	-4.40	--	E	--
	BB-01	S	11-3-87	47.83	--	--	E	--
Dale	B-8	E	10-5-87	171.15	+1.43	+.1	E	--
	C-3	S	10-5-87	180.38	-2.38	+1.57	E	--
	D-4	S	10-6-87	159.14	+.47	-1.19	E	--
	D-5	S	10-7-87	153.50	4.84	-2.15	E	--
	E-3	S	10-6-87	83.39	-.06	+.5	F	--
	E-12	E	10-6-87	260.43	-1.8	-.41	E	--
	F-8	S	10-6-87	114.80	-2.67	-1.45	E	--
	F-14	E	10-6-87	84.7	-2.2	-.65	E	--
	F-16	S	10-6-87	326.73	-8.7	-8.4	E	--
	F-17	--	10-6-87	--	--	--	--	Not measured.
	F-22	S	10-6-87	269.70	-1.5	-.7	E	--
	G-9	S	10-5-87	1.68	0.0	+.2	E	--
L-2	S	10-6-87	56.79	-2.64	-.24	E	--	

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Dale (cont'd)	M-3	S	10-6-87	113.75	-9.15	-2.18	E	--
	M-18	AL	10-6-87	202.74	-15.48	-12.74	E	--
	N-6	S	10-6-87	189.30	-1.03	-1.41	E	--
	N-8	S	10-6-87	94.98	-1.88	-.48	E	--
	N-10	S	10-6-87	179.78	-5.36	-1.33	E	--
	O-12	S	10-6-87	269.4	+ 6	--	E	Pump off 4 hours.
	P-4	S	10-7-87	36.99	-.04	-.19	E	--
	P-7	S	10-7-87	270.4	--	-10.01	E	Pump off 11 hours.
Dallas	C-10	S	10-15-87	94.35	-1.87	-.34	E	--
	G-2	S	10-15-87	42.27	-1.32	-.08	E	--
	H-4	S	10-15-87	38.62	-1.68	-1.18	E	--
	J-21	S	10-15-87	35.64	+ 4.36	+ 1.47	E	Pump off 14 hours.
	J-25	--	--	--	--	--	--	Discontinued.
	K-5	S	10-14-87	6.38	-2.49	-.01	E	--
	S-3	S	10-15-87	74.07	-2.12	-2.57	E	--
	U-2	S	10-15-87	59.18	-1.42	-.44	E	--
	AA-1	S	10-14-87	6.00	-1.18	-.16	E	--
	FF-6	S	10-15-87	11.73	-2.86	+ .55	E	--
	GG-2	--	10-14-87	--	--	--	--	Not measured.
HH-1	S	10-14-87	48.60	-1.43	+ 1.30	G	--	
De Kalb	J-3*	C	10-8-87	1.36/610	--	-.49/220	E	Phillips Spring.
	J-10	S	10-8-87	23.40	-14.63	-5.40	E	--
	J-12*	C	11-18-87	1.16/519	--	+ .20/+ 90	F	Dixie Brown Spring.
	N-3*	C	10-8-87	.94/422	--	-1.41/-633	G	Allen Spring.
	P-2	S	10-8-87	31.24	-9.86	--	E	--
	R-01*	ES	11-87	--	--	--	--	Dry Reed Spring.
V-6	S	10-8-87	--	--	--	--	Dry at 27 feet.	
Elmore	Elm-1	S	10-19-87	11.59	-4.16	-.72	E	--
	F-4	S	10-19-87	70.77	+ .7	+ 2.88	E	--
	G-8	S	10-14-87	39.75	+ 22.42	-.38	G	--
	N-2	S	10-19-87	26.37	-3.9	+ 1.34	E	--
	P-3	S	10-28-87	139.50	+ 2.87	+ 2.25	G	--
	R-1	S	10-14-87	45.33	-4.16	+ 10.56	G	--
	R-4	S	10-14-87	26.54	-7.11	-.94	G	--
	R-5	S	10-14-87	29.75	-3.50	+ .64	G	--
	R-8	S	10-16-87	179.92	-15.77	-7.95	G	--
	R-13	S	10-14-87	48.41	-5.38	+ 1.09	G	--
	R-16	--	10-14-87	--	--	--	--	Not measured.
R-01	S	10-14-87	94.80	-15.30	-6.81	G	--	

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Elmore (cont'd)	S-5	S	10-16-87	41.03	-12.29	-2.54	G	--
	U-14	S	10-28-87	8.93	-3.74	-.78	E	Pump off 10 minutes
Escambia	A-27*	--	10-6-87	--	--	--	--	No flow. McCreary Spring.
	O-95	--	10-6-87	--	--	--	--	Not measured.
	Q-77	S	10-6-87	43.59	-.89	+ .63	E	--
	Q-78	S	10-6-87	111.96	-.56	+ .54	E	--
	V-37	SI	10-6-87	+ 5.28	-.46	+ 1.38	E	Shut-in for 10 minutes.
	X-117	S	10-6-87	8.33	-1.93	-.04	E	--
	Z-71	S	10-6-87	44.17	-.95	+ 2.38	E	Pump off 3 hours.
Etowah	C-16	S	10-8-87	18.20	-9.91	-7.69	E	--
	D-01	S	10-9-87	18.24	-16.28	--	E	--
	H-3	--	--	--	--	--	--	Destroyed.
	H-25*	C	11-18-87	.23/105	--	+ .24/+ 105	F	Cove Spring.
	N-16*	C	10-20-87	1.80/807	--	-1.04/-467	F	Tawana Spring.
Fayette	C-9	S	10-22-87	63.06	-1.24	-.38	E	--
	D-3	S	10-22-87	83.85	-4.11	+ 2.05	E	--
	K-1	S	10-22-87	36.06	+ 5.89	-3.87	E	--
Franklin	O-27	S	10-27-87	31.85	-9.9	-1.41	E	--
	P-01	S	10-27-87	38.99	-2.05	0.0	E	--
	R-5*	C	11-16-87	.1/45	--	-.03/-13	F	Good Spring.
Geneva	B-2	S	10-20-87	58.41	+ .78	+ 2.49	G	--
	C-2	S	10-8-87	21.72	--	-1.32	E	--
	E-30	--	10-8-87	--	--	--	--	Not measured.
	H-8	S	10-8-87	50.36	-.16	-1.36	E	--
	I-7	S	10-8-87	79.22	-.83	+ 4.28	E	Pump off 13 hours.
	J-1*	C	10-8-87	.685/304	--	--	G	Coffee Springs.
	J-4	S	10-8-87	71.71	-2.16	-.40	E	--
	L-5	S	10-20-87	39.00	+ .56	+ 9.35	E	Pump off 6 hours.
	L-6	S	10-20-87	51.53	+ 1.08	+ 5.47	E	Pump off 6 hours.
	L-7	S	10-20-87	24.11	-1.29	+ 4.48	E	--
	N-9	S	10-20-87	78.77	-6.19	+ 7.13	E	Pump off 5 hours.
	Q-9	S	10-20-87	23.55	-.58	+ 2.85	E	--
	R-10	S	10-8-87	17.89	-1.69	+ 1.16	E	--
	R-11	--	10-8-87	+ 2.40	-2.60	-2.75	E	--
	R-16	S	10-8-87	98.01	-1.38	+ 9.58	E	Pump off 18 hours.
	R-17	S	10-6-87	86.82	-.29	+ 2.33	E	--
S-8	S	10-8-87	94.40	-4.62	+ 3.12	E	Pump off 18 hours.	
T-9	S	10-8-87	32.24	-.62	+ .59	E	--	

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Geneva (cont'd)	X-4	S	10-8-87	95.50	-1.09	+ .71	E	--
	AA-2	S	10-20-87	60.38	-1.33	+ 3.79	G	--
Greene	A-1	S	10-15-87	10.81	-1.64	--	E	--
	F-1	S	10-15-87	43.45	-1.90	-.62	E	--
	J-4	S	10-15-87	4.67	-1.85	-.22	E	--
	M-14	S	10-15-87	.59	.91	.59	E	--
	Q-6	S	10-15-87	38.97	-5.25	-1.08	--	--
	R-9	S	10-15-87	7.36	-1.75	-.27	E	--
	R-12	S	10-15-87	89.06	+ 4.64	+ 2.53	E	--
	V-11	S	10-15-87	151.69	+ 5.10	+ 2.93	E	--
	DD-9	S	10-15-87	26.17	-1.40	-.05	E	--
EE-2	S	10-15-87	34.57	-.93	+ .13	E	--	
Hale	C-3	S	10-8-87	9.94	-.97	-.02	E	--
	E-5	--	10-8-87	--	--	--	--	Not flowing.
	E-7	S	10-8-87	12.83	-4.70	+ .37	E	--
	I-7	S	10-8-87	55.73	+ 10.27	+ 14.43	E	--
	J-14	S	10-8-87	11.87	-4.66	+ 1.24	E	--
	O-25	S	10-8-87	60.05	-1.24	+ .59	E	--
	R-2	S	10-8-87	38.43	-9.95	-4.13	F	--
	R-13	S	10-8-87	59.55	-5.49	-1.18	E	--
S-13	SI	10-8-87	+ 6.34	-6.33	+ .64	F	--	
Henry	A-3	S	10-20-87	15.13	-2.64	--	E	--
	F-4	--	10-20-87	--	--	--	--	Not measured.
	J-1	S	10-20-87	137.08	-2.18	-.68	E	--
	J-7	S	10-21-87	201.20	+ 1.88	+ 8.50	E	Pump off 10 hours.
	K-3	S	10-20-87	197.03	-2.76	-.58	E	--
	K-5	S	10-21-87	215.20	-7.45	-5.19	E	Pump off 10 hours.
	N-7	S	10-20-87	20.98	-1.73	+ 1.62	E	--
	N-8	S	10-20-87	222.30	-6.71	-2.20	G	--
	P-5	S	10-20-87	147.26	-3.31	+ .31	G	--
V-3	S	10-20-87	227.07	-8.23	-2.57	E	--	
X-1	S	10-20-87	276.70	-5.40	-9.54	E	--	
Houston	A-4	S	10-5-87	130.60	-.37	+ 1.3	E	--
	H-4	S	10-6-87	70.01	-1.06	+ 1.10	E	--
	I-8	S	10-5-87	42.00	-5.31	+ .34	E	--
	I-11	S	10-7-87	322.90	-9.7	-12.1	E	Pump off 12 hours.
	I-14	S	10-6-87	251.03	-4.5	-4.04	E	--
	I-18	S	10-7-87	319.90	-13.5	--	E	--
	J-3	S	10-7-87	308.1	+ 10.7	13.2	E	Pump off 21 hours.

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Houston (cont'd)	J-8	A	10-7-87	155	+ 3	+ 5	E	Pump off 4 hours.
	K-12	S	10-7-87	29.40	-5.47	+ 2.94	E	Pump off 1 hour.
	K-15	--	10-7-87	--	--	--	--	Not measured.
	N-14	S	10-7-87	135.5	-3.63	-3.13	E	--
	O-12	S	10-5-87	26.60	-18.77	+ .30	E	--
	Q-4	S	10-5-87	52.18	--	-.24	E	--
	Q-6	--	10-5-87	--	--	--	--	Not measured.
	Q-7	S	10-5-87	74.92	-.14	+ 2.55	E	--
	R-6	S	10-5-87	32.45	-17.58	+ 6.12	E	--
	R-7	S	10-5-87	32.70	-2.08	+ 3.72	E	--
	S-8	S	10-5-87	16.65	-4.55	+ 2.18	E	--
	T-6*	O	10-5-87	--	--	--	--	No flow. Bazemore Spring.
	T-10	S	10-5-87	31.72	-14.12	+ 5.58	E	--
	U-7	S	10-5-87	31.50	-12.44	+ 6.41	E	--
	U-8	S	10-5-87	46.18	-13.35	+ 2.45	E	--
X-2	S	10-5-87	39.33	-8.57	+ .96	E	--	
AA-1	S	10-5-87	39.32	-2.32	+ 3.37	E	--	
Jackson	Jac-2	S	10-8-87	19.81	-11.64	-8.09	E	--
	M-3	S	10-8-87	11.20	-4.79	-4.10	E	--
	N-2*	C	10-8-87	47/211	--	-7.66/-3,440	E	Brown Spring.
	N-100	S	10-8-87	40.91	-3.15	-3.33	E	--
	HH-3	S	10-8-87	76.25	--	--	E	--
Jefferson	B-1	S	10-5-87	12.27	-7.69	+ .52	E	--
	L-5	S	10-5-87	79.97	-24.22	-3.62	E	Pump off 30 minutes.
	M-9*	C	10-5-87	.805/361	--	+ .275/+ 123	E	Robinwood Spring.
	T-02	S	10-5-87	31.94	-4.13	-.79	E	--
	Y-1*	ES	11-19-87	--	--	-.22/-99	--	Dry. Rowan Spring.
	Z-01*	ES	11-19-87	--	--	--	--	Dry. Weems Spring.
Lamar	LL-9	S	10-5-87	7.59	-5.71	-.23	E	--
	E-13	--	--	--	--	--	--	Discontinued. Well is dry.
	K-13	S	10-22-87	30.33	-1.99	-2.04	G	--
	L-7	S	10-22-87	64.14	-7.24	-2.43	G	--
	O-9	S	10-22-87	36.29	-1.76	-.02	E	--
	Q-5	S	10-22-87	25.19	-2.80	+ 1.14	E	--
Lauderdale	S-2	S	10-22-87	15.05	--	--	E	--
	Lau-2	S	10-5-87	14.71	-1.93	-.07	E	--
	C-60	S	10-5-87	82.60	-10.95	+ .60	E	--
	O-180	S	10-5-87	8.09	+ .73	+ 3.25	E	--

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Lauderdale (cont'd)	S-39*	C	10-5-87	.52/233	--	+ .02/+ 9	E	Blowing Spring.
	S-71	S	10-5-87	52.78	-8.41	-6.96	E	--
Lawrence	Law-2	S	10-6-87	50.98	-21.2	-3.78	E	--
	Law-3	S	10-6-87	11.00	-3.26	-.45	--	--
	G-39*	--	10-6-87	--	--	--	--	Estimated 25 to 30 gpm. Wheeler Spring.
	H-16	S	10-6-87	30.92	-25.11	-2.27	E	--
	O-36	S	10-6-87	12.87	-7.08	+ .62	--	--
Lee	C-01	S	10-27-87	17.18	-2.6	+ 2.41	E	--
	H-01	S	10-28-87	22.30	-10.17	+ .48	E	--
	J-6*	C	10-27-87	1.81/815	--	+ .26/+ 115	E	Spring Villa Spring.
	K-01	S	10-27-87	25.95	-7.34	-1.93	E	--
	O-01	S	10-27-87	40.62	-6.52	+ 5.30	E	--
	U-2	S	10-27-87	57.93	-8.3	+ .13	E	--
Limestone	A-1*	C	10-7-87	.23/103	--	-.51/-229	--	Blowing Spring.
	A-42	S	10-7-87	22.18	-9.64	-3.75	E	--
	B-02*	--	--	--	--	--	--	Discontinued. Lerner Spring.
	H-31*	E	10-6-87	.01/5	--	0	G	Old Limestone Church Spring.
	I-40	S	10-6-87	51.54	-6.92	-1.54	G	--
	J-169	E	10-6-87	75.90	+ 1.30	+ 3.10	G	--
	M-2	S	10-5-87	50.55	-.86	--	E	--
	Q-01*	ES	11-17-87	.1/45	--	+ .1/+ 45	F	Green Briar Spring.
Lowndes	B-3	S	10-14-87	9.61	-3.2	-1.68	E	--
	F-3	--	--	--	--	--	--	Discontinued.
	J-14	S	10-14-87	60.23	-3.45	-1.94	E	--
	L-12	S	10-14-87	119.2	-8.25	-9.33	E	Pump off 2½ hours.
Macon	H-12	S	10-28-87	63.16	+ 10.14	+ 16.68	E	--
	I-4	S	10-28-87	139.10	-15.85	-.88	E	Pump off 10 minutes.
	N-14	S	10-28-87	24.10	-3.00	+ .39	E	Pump off 10 minutes.
	P-7	S	10-28-87	33.31	-2.27	-6.2	E	--
	U-4	--	10-28-87	--	--	--	--	Dry at 107 feet.
	W-21	S	10-28-87	88.05	-7.33	-5.7	E	--
Madison	Mad-3	S	10-7-87	19.37	-7.57	-2.89	E	--
	Mad-4	S	10-7-87	72.07	-26.76	-6.28	E	--
	B-16	S	10-7-87	75.38	-10.66	-10.68	E	--
	E-13	S	10-7-87	22.48	-10.76	-5.34	--	--
	M-38*	C	10-7-87	.79/355	--	--	E	Acuff Spring.
	M-185*	C	11-3-87	.16/72	--	-4.19/+ 1,880	F	Huntsville Big Spring.

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Madison (cont'd)	P-01	S	10-7-87	82.88	-11.73	+ 1.16	E	--
	Z-12*	C	10-7-87	.97/354	--	-4.18/-1,956	--	New Hope Spring.
Marengo	Mag-2	S	10-26-87	32.64	-7.29	-6.80	E	--
	A-16	S	10-26-87	58.99	-.68	+ .92	G	--
	F-30	S	10-26-87	32.54	--	+ 4.15	G	--
	G-26	S	10-26-87	46.37	-2.66	--	E	--
	I-1	--	--	--	--	--	--	Discontinued.
	I-62	S	10-26-87	80.40	-4.45	-4.17	E	Pump off 15 minutes.
	L-01	--	10-26-87	--	--	--	--	Not measured.
	M-8	S	10-26-87	71.36	-1.17	+ 2.54	E	--
	R-8	S	10-26-87	21.79	-2.98	-1.84	E	--
	R-9	S	10-26-87	42.37	--	+ .55	E	--
	V-17	S	10-26-87	66.69	-1.57	+ 19.31	E	--
	CC-4	S	10-26-87	83.49	-1.04	+ .44	E	--
	DD-10	S	10-26-87	37.59	-3.28	-14.89	F	--
	EE-20	S	10-26-87	--	--	--	--	Not measured.
GG-5	S	10-26-87	26.94	-1.00	-.60	E	--	
Marion	C-01*	--	--	--	--	--	--	Not measured. Little Spring.
	H-2	S	10-23-87	77.25	-5.68	-6.26	--	--
	J-7	S	10-27-87	124.69	--	-36.24	--	Pump off 30 minutes.
	J-01	S	10-27-87	--	--	--	--	Not measured.
	M-11	S	10-23-87	33.73	-3.30	+ .98	G	--
	T-4	S	10-23-87	47.56	-3.14	-.87	E	--
Marshall	P-4	S	10-9-87	10.29	+ 1.16	+ 1.21	E	--
	U-11*	C	10-9-87	.93/417	--	--	G	Big Spring.
Mobile	D-2	--	10-5-87	--	--	--	--	Not measured.
	V-1	S	10-5-87	15.21	-3.16	+ 2.24	E	--
	W-2	S	10-5-87	135.16	+ .08	--	E	--
	GG-1	S	10-5-87	52.77	-1.42	+ 1.06	E	--
	KK-05	S	10-5-87	53.86	-.61	+ .94	E	--
	LL-2	S	10-5-87	7.90	-3.87	-.68	E	--
	MM-2	S	10-5-87	18.38	-2.20	+ .81	E	--
	UU-3	S	10-5-87	4.89	-1.09	-1.54	E	--
Monroe	B-2	S	10-6-87	190.40	--	--	E	--
	E-4	--	10-6-87	--	--	--	--	Not measured.
	E-5	S	10-7-87	74.79	--	-1.47	E	--
	J-6	--	10-6-87	--	--	--	--	Not measured.
	J-7	S	10-6-87	128.92	-.51	+ .50	E	--
	O-3	S	10-6-87	249.64	+ 1.43	+ .20	E	--

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Monroe (cont'd)	U-4	S	10-7-87	354.01	--	--	E	Pump off 15 hours.
	U-5	S	10-6-87	35.50	-.65	+.68	E	--
	Z-13	S	10-6-87	67.72	+.50	+1.98	E	--
	GG-01	S	10-6-87	117.00	-2.44	-.17	E	--
Montgomery	Mtg-2	S	10-13-87	104.65	-4.55	-5.33	E	--
	H-6	S	10-15-87	93.75	-2.68	-.41	E	--
	N-11	S	10-13-87	55.96	-3.51	-1.55	E	--
	T-01	S	10-14-87	93.54	-7.07	-2.74	E	--
	X-2	S	10-9-87	16.29	-14.54	-4.82	E	--
	X-13	S	10-9-87	195.93	-2.23	-0.53	E	--
	Z-9	S	10-13-87	--	--	--	E	Dry at 34 ft.
	Z-14	S	10-13-87	252.04	-.94	-1.58	E	--
	AA-25	S	10-13-87	326.95	-5.35	-2.05	E	--
AA-26	S	10-13-87	35.85	-3.5	-.38	E	--	
Morgan	Mor-6	E	10-6-87	63.30	-36.22	-20.63	E	--
	B-344	S	10-6-87	31.39	-14.27	+1.85	E	--
	K-1*	--	10-6-87	--	--	--	--	Not measured. Cave Spring.
	O-26	S	10-6-87	9.02	-4.70	-1.08	E	--
	R-157*	C	10-6-87	.24/108	--	-3.09/-1,387	G	Hughes Spring.
Perry	B-1	S	10-8-87	48.46	-.74	+1.84	E	--
	F-3	S	10-8-87	16.19	-2.58	+.31	E	--
	H-5	S	10-8-87	30.28	-8.19	-.13	E	--
	L-3	S	10-8-87	7.16	-1.24	+.98	E	--
	M-5	S	10-9-87	172.00	-8.58	+3.15	--	Pump off 2 hours.
	R-2	SI	10-8-87	+10.26	-2.99	-.84	--	--
Pickens	D-10	S	10-16-87	21.25	-6.91	+.97	E	--
	G-5	S	10-16-87	19.04	-4.95	+.78	E	--
	I-22	S	10-16-87	40.41	-1.77	-.27	E	--
	K-5	S	10-16-87	82.59	-1.42	-.50	E	--
	M-15	S	10-16-87	63.41	-1.84	+.29	E	--
	M-18	S	10-16-87	13.13	-10.49	-1.14	E	--
	S-1	S	10-16-87	73.58	-1.59	-.48	E	--
	U-5	S	10-16-87	86.85	-.88	-2.05	E	--
	U-6	S	10-16-87	21.15	-2.54	+.43	E	--
X-23	S	10-16-87	17.74	-1.64	+.71	G	--	
Pike	D-7	S	10-21-87	45.40	-.34	-.13	E	--
	D-11	S	10-21-87	181.85	-.46	-.09	E	--
	G-2	S	10-21-87	27.36	-.36	-2.55	E	--
	I-13	S	10-21-87	160.40	+.26	+.85	E	--

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Pike (cont'd)	J-7	--	10-21-87	--	--	--	--	Not measured.
	O-6	S	10-21-87	145.50	-1.97	-.84	E	--
	P-15	S	10-21-87	95.88	-2.68	-.28	G	--
	Q-8	S	10-21-87	363.77	-4.07	+ 2.32	E	--
	Q-10 (R-01)	--	10-21-87	--	--	--	--	Not measured.
	T-3	S	10-21-87	62.07	-2.27	-.12	E	--
Randolph	C-01	S	10-28-87	45.31	-3.82	+ 1.03	E	--
	K-5	S	10-28-87	32.37	-7.42	+ 1.35	E	--
	O-01	S	10-28-87	15.78	-6.75	-.9	E	--
Russell	C-3	S	10-27-87	22.28	-7.1	+ 15.53	E	--
	G-1	S	10-27-87	39.30	-1.78	+ 1.65	E	--
	I-16	S	10-27-87	27.55	-12.04	-.48	E	--
	L-1	S	10-27-87	50.48	+ .82	+ .14	E	--
	M-13	S	10-27-87	77.60	-1.76	-1.27	E	--
	X-5	S	10-27-87	207.77	-3.12	-21.27	G	--
St. Clair	E-5*	--	10-5-87	--	--	--	--	Not measured. Muckleroy Spring.
	L-17	S	10-5-87	8.98	-6.62	-5.16	E	--
	M-2*	C	11-19-87	.41/185	--	--	F	Springville Spring.
	S-14	S	10-5-87	9.37	-7.35	-5.72	E	--
	X-2*	--	--	--	--	--	--	Not measured. Town Spring.
	Z-4 Z-01*	S --	10-5-87 --	9.99 --	-4.77 --	-4.07 --	E --	-- Not measured. Weems Spring.
Shelby	G-12	S	10-7-87	49.44	-29.32	+ 2.14	E	--
	J-15	S	10-7-87	3.15	-1.38	+ 4.20	E	--
	AA-7*	C	10-19-87	.31/139	--	--	F	Little (or Shoal Creek) Spring.
	GG-3*	C	10-7-87	1.98/890	--	+ 1.65/+ 742	F	Bay Spring.
	II-4	S	10-7-87	16.92	-3.75	+ .91	E	--
Sumter	B-3	S	10-23-87	14.55	-1.28	-1.19	E	--
	E-10	S	10-23-87	9.51	-.22	+ .36	E	--
	I-8	SI	10-15-87	+ 8.46	--	+ .46	--	--
	I-14	S	10-23-87	39.27	-1.14	+ .32	E	--
	M-6	S	10-23-87	61.19	-.98	+ .90	F	--
	S-1	S	10-23-87	18.03	-.7	+ .11	G	--
	X-1	S	10-23-87	16.95	+ 8.85	-.16	G	--
	W-1 HH-2	S S	10-23-87 10-23-87	2.00 24.74	+ .76 -1.28	-.2 + .67	G E	-- --

## Water levels and spring discharges, fall 1987--continued

County	Well or spring (*) no.	Method of measurement	Date	Depth (ft) to water below or above (+) land-surface datum or spring discharge (cfs/gpm)	Change in water levels (ft) or spring discharge (cfs/gpm) since:		Quality of measurement	Remarks
					Spring 1987	Fall 1986		
Talladega	Tal-2	S	10-6-87	36.78	-23.76	-3.37	G	--
	F-7	S	10-6-87	107.98	-12.41	+ 3.75	E	--
	G-14*	C	10-6-87	4.48/2,010	--	0/0	E	Cedar Spring.
	N-01	S	10-6-87	98.63	-20.83	+ 9.8	E	Pump off 30 minutes.
	R-2*	C	10-6-87	80/357	--	+ .28/+ 124	G	Grogan Spring.
	V-14*	C	10-6-87	2.15/965	--	+ 1.99/+ 893	P	Tallaseehatchee Spring.
Tallapoosa	B-01	S	10-19-87	34.54	-5.74	+ 3.04	E	--
	L-01	S	10-19-87	30.27	+ 1.44	+ 3.99	E	--
	N-01	S	10-19-87	77.80	+ 8.77	+ 1.15	E	--
Tuscaloosa	Tus-1	S	11-3-87	27.21	-1.65	--	E	--
	Tus-5	S	10-16-87	23.89	-2.56	+ .30	E	--
	E-20	S	10-22-87	34.75	-.45	-4.82	E	--
	Y-14*	C	11-2-87	1.22/548	--	-.32/-142	G	Tannehill Spring.
	FF-20	S	10-16-87	18.58	-7.37	+ 2.66	E	--
	LL-16*	C	10-17-87	17.10/7,676	--	+ 4.49/+ 2,016	G	Big Sandy Spring.
	SS-14	SI	10-15-87	+ 4.47	-.97	+ .22	E	--
Walker	F-4	--	--	--	--	--	--	Discontinued.
	I-1	S	10-29-87	44.89	+ 50	+ 2.20	G	--
	D-01	S	10-29-87	87.85	-9.35	--	G	--
	T-01	S	10-29-87	37.07	-10.30	--	G	--
Washington	H-1	S	10-5-87	12.22	-1.49	-.26	E	--
	P-4	S	10-5-87	108.48	--	-2.23	E	--
	EE-1	--	10-5-87	--	--	--	--	Not measured.
Wilcox	H-17	S	10-15-87	165.60	-11.7	-11.05	E	--
	H-20	S	10-15-87	20.77	-6.88	+ 2.43	E	--
	T-3	S	10-14-87	22.30	-7.91	-1.28	E	--
	T-10	--	10-14-87	--	--	--	--	Not measured.
Winston	L-01	--	--	--	--	--	--	Discontinued.
	J-01	S	11-3-87	56.93	--	--	E	--
	O-01	S	10-29-87	109.29	-15.59	--	G	--
	M-01	E	10-29-87	83.4	--	--	F	--

## **APPENDIX 2**

### **WELL FORMS**





## 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 \_\_\_\_\_ 1/4 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 3**

### **STATE OF ALABAMA LICENSED WATER WELL DRILLERS AS OF MARCH 1988**

Pursuant to the provisions of the Alabama Environmental Management Act, Code of Alabama 1975, § 22-22A-5 (1) (1984), 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. All driller licenses expire September 30, 1988.



**A-1 DRILLING SERVICE**

Rt. 2, Box 366  
 Laurel, MS 39440  
 601/428-1435  
 (Washington/Mobile Co.)  
 (Wilbur T. Baughman)

**ABERNATHY WELL DRILLING**

P.O. Box 5344  
 Rome, GA 30161  
 404/291-2065  
 (Cherokee/Calhoun Co.)  
 (Winston A. Sirmans)

**ACME DRILLING CO.**

P.O. Box 88  
 River Falls, AL 36476  
 205/222-7452  
 (Covington Co.)  
 (Marvin Haveard)

**ADAMS-MASSEY CO.**

309 N. Park St.  
 Carrollton, GA 30117  
 404/832-3132  
 (Winnie A. Massey)

**ALABAMA DRILLING DIVISION  
OF MELZER EXPLORATION**

Rt. 1, Box 90  
 Waverly, AL 36879  
 205/864-8028  
 (Chambers Co.)  
 (Linn G. Melzer)

**ALLEN & WILLIS DRILLING CO.**

Rt. 1, Box 52  
 Faunsdale, AL 36738  
 205/628-6398  
 (Dallas/Perry/Clarke Co.)  
 (Thomas B. Willis)

**ALMS PUMP SERVICE, INC.**

201 East Michigan Rd.  
 Foley, AL 36535  
 205/943-1249  
 (Baldwin Co.)  
 (Leon Alms)

**AMERICAN DRILLING CO.**

P.O. Box 907  
 Alabaster, AL 35007  
 205/663-0139  
 (Shelby Co.)  
 (Michael M. Harden)

**G. H. ANDERSON**

1113 North Main Ave.  
 Sylacauga, AL 35150  
 205/245-4186  
 (Talladega Co.)

**ANDERSON DRILLING CO.**

Rt. 3, Box 65  
 Grove Hill, AL 36451  
 205/275-8726  
 (Clarke/Monroe Co.)  
 (Joe Anderson, Jr.)

**DELMA BAIRD**

Rt. 2, Box 73  
 Arley, AL 35541  
 205/384-4923  
 (Winston Co.)

**BALLARD WELL DRILLING CO.**

Hwy. 22 East  
 Alexander City, AL 35010  
 205/234-6850  
 (Donald C. Ballard)

**BARBAREE WELL DRILLING**

1116 Talbotton Rd.  
 Columbus, GA 31904  
 404/568-0192  
 (Daniel Barbaree)

**BAY HARDWARE**

P.O. Box 357  
 Grand Bay, AL 36541  
 205/865-6711  
 (Mobile Co.)  
 (R. M. Duck)

**JAMES E. BEARDEN**

5312 Hwy. 280 South  
 Birmingham, AL 35243  
 205/991-5467  
 (Shelby Co.)

**MACK H. BEASLEY WATER  
WELL SERVICE**

Rt. 3, Box 976  
 Jay, FL 32565  
 904/675-6577  
 (Santa Rosa Co., Florida)

**BLACK BELT DRILLING**

Rt. 1, Box 311  
 Forkland, AL 36740  
 205/289-0399  
 (Greene Co.)  
 (James W. Bird)

**WAYNE M. BLAIR**

103 Salter St.  
 Evergreen, AL 36401  
 205/578-2352  
 (Conecuh Co.)

**RALPH BLAND DRILLING**

Rt. 2, Box 94-B  
 Empire, AL 35063  
 205/648-5292  
 (Ralph W. Bland)

**BRUCE BOND**

Rt. 3, Box 286  
 Andalusia, AL 36420  
 205/493-3785  
 (Covington Co.)

**BRADLEY DRILLING**

1501 Kirk St.  
 Pensacola, FL 32505  
 904/432-2496  
 (Baldwin/Mobile Co.)  
 (Alvin Bradley)

**BRADY WELL & PUMP WORKS**

Rt. 3, Box 99  
 Selma, AL 36701  
 205/874-6801  
 (Dallas Co.)  
 (R. A. Brady, Jr.)

**BRADY'S WELL DRILLING**

Rt. 1, Box 188  
 Ashland, AL 36251  
 205/354-5839  
 (Clay/Randolph Co.)  
 (Billy J. Brady)

**BRANTON BROTHERS WELL DRILLING**

Rt. 8, Box 200  
Dothan, AL 36301  
205/677-5489  
(Houston Co.)  
(Terry Branton)

**BUIE SERVICE CO.**

Rt. 1, Box 12  
Webb, AL 36376  
205/792-7754  
(Houston Co.)  
(Byrd Buie)

**BURMAH TECHNICAL SERVICES, INC.**

P.O. Drawer 2609  
Gulfport, MS 39505  
601/863-3036  
(David H. Malchow)

**BYRD PUMP CO.**

P.O. Box 371  
Atmore, AL 36504  
205/368-4584  
(Escambia/Baldwin Co.)  
(Troy E. Byrd)

**C & C DRILLING**

Rt. 5, Box 417  
Jasper, AL 35501  
205/387-7006  
(Walker Co.)  
(James E. Chamness)

**CAHABA VALLEY WELLS**

Rt. 6, Box 257  
Selma, AL 36701  
205/872-7832  
(Perry/Dallas Co.)  
(Pettus Suttle)

**CAMPBELL WELL DRILLING**

111 West Pine St.  
Scottsboro, AL 35768  
205/574-2352/2189  
(Jackson Co.)  
(Kermit Campbell)

**CARR'S WELL SERVICE**

Rt. 1, Box 150  
Buckatunna, MS 39322  
601/648-2537  
(Washington Co.)  
(A. Gilbert Carr)

**CHAMPION DRILLING CO.**

P.O. Box 565  
Thomasville, AL 36784  
205/636-2374/4605  
(Clarke Co.)  
(Marcus Champion)

**CHAMPION WELL & PUMP SERVICE**

818 Veterans Memorial Pkwy.  
Lanett, AL 36836  
205/576-3333/3100  
(Chambers/Randolph Co.)  
(William B. Champion)

**CLYDE'S WELL SERVICE**

Rt. 3, Box 518  
Jay, FL 32565  
904/675-6230  
(Baldwin/Houston Co.)  
(Lewis Clyde Johnson)

**COAST WATER WELL SERVICE**

6601 Baker Rd.  
Ocean Springs, MS 39564  
601/875-0260  
(Mobile/Baldwin Co.)  
(H. O. Ridgdell, Jr.)

**COFFEY WELL SERVICE**

Rt. 3, Box 458  
Jay, FL 32565  
904/675-6676  
(Santa Rosa Co., Florida)  
(George H. Coffey)

**JOEL A. COLEY**

Rt. 1, Box 50  
Forkland, AL 36470  
205/289-1868  
(Greene Co.)

**EDDIE W. COLVARD**

Rt. 1, Box 452  
Pisgah, AL 35765  
205/451-3720  
(Jackson Co.)

**D & H WELL CO.**

8630 Howells Ferry Rd.  
Semmes, AL 36575  
205/649-6912/1793  
(Mobile/Baldwin Co.)  
(Henry Havens)

**C. B. DALRYMPLE**

Rt. 3, Box 94  
Crossville, AL 35962  
205/659-2666

**DAWES WELL SERVICE**

Rt. 2, Box 279  
Mobile, AL 36609  
205/666-3733  
(Mobile Co.)  
(H. R. Porter)

**DELTA WELL DRILLING**

1454 Morlee Dr. W.  
Mobile, AL 36618  
205/344-1296  
(Mobile Co.)  
(Roger W. Few)

**DENSMORE DRILLING**

3029 Nixon Rd.  
Bessemer, AL 35020  
205/428-7241  
(Jefferson Co.)  
(William V. Densmore)

**DEPENDABLE DRILLING CO.**

744 Date Circle  
Bessemer, AL 35023  
205/491-9627  
(Neil W. McCarty)

**DINGLER DRILLING CO.**

916 Terry Rd.  
Anniston, AL 36201  
205/237-1177  
(Jerre Dingler)

**DIXIE DRILLING CORP.**

1940 Pinson Valley Pkwy.  
Birmingham, AL 35217  
205/849-5411  
(Walker Co.)  
(Russell Borin)

**DIXIE WELL BORING**

1254 Bartley Rd.  
LaGrange, GA 30240  
404/884-5756  
(Lee/Macon/Russell Co.)  
(Arthur W. Watson)

**HAWLEY DODSON & SON**

P.O. Box 585  
Fayetteville, TN 37334  
615/433-4201  
(Madison/Etowah Co.)  
(Hawley & Charles Dodson)

**DUGGER WELL DRILLING**

P.O. Box 42  
Robertsdale, AL 36567  
205/947-7789  
(Baldwin/Mobile Co.)  
(Larry Wayne Dugger)

**THOMAS CLAYTON DUNCAN**

Rt. 3, Box 482  
Jasper, AL 35501  
205/387-2318  
(Walker Co.)

**ENGLISH WELL DRILLING CO.**

P.O. Box 367  
Elba, AL 36323  
205/897-2428  
(Coffee Co.)  
(Foy W. English)

**FAIR PARK EQUIPMENT CO.**

Rt. 8, Box 14  
Talladega, AL 35160  
205/362-7019  
(Talladega Co.)  
(William W. Gilbert)

**FELTMAN DRILLING CO.**

Rt. 1, Box 232  
Carbon Hill, AL 35549  
205/622-3563  
(Walker Co.)  
(Billy Feltman)

**FINCH WELL CO.**

Box 230, Ave. D.  
Mobile, AL 36608  
205/633-4006  
(Mobile Co.)  
(Willis E. Finch)

**FRENCH WELL DRILLING**

205 S. 9th St.  
Gadsden, AL 35901  
205/547-8375  
(Etowah Co.)  
(W. C. French)

**FLO DRILLING & PUMP**

Rt. 5, Box 90  
Brewton, AL 36426  
205/876-4976  
(Escambia Co.)  
(Travis Lambeth)

**FRYFOGLE WATER WELL SERVICE**

Rt. 8, Box 3  
Lucedale, MS 39452  
601/947-3262  
(Anthony & Pal Fryfogle)

**GERALD GARMANY**

Rt. 2, Box 233  
Fort Payne, AL 35967  
205/657-4477

**DAN GARY WELL DRILLING**

Rt. 1, Box 164  
Geneva, AL 36340  
205/684-3203  
(Geneva/Coffee Co.)

**J. R. GOODWIN**

1131 Cedar Springs Rd.  
Weaver, AL 36277  
205/820-2258  
(Talladega Co.)  
(Jimmie R. Goodwin)

**GOTHARD & SONS CONTRACTING**

Rt. 3, Box 400-A  
Montgomery, AL 36108  
205/263-2258  
(G. S. Gothard, Sr.)

**GRAVES WELL DRILLING**

P.O. Drawer 168  
Sylacauga, AL 35150  
205/249-4371  
(Talladega Co.)  
(Stanley L. Graves)

**I. D. GRIFFIN WATER WELL CO.**

P.O. Box 67  
Geneva, AL 36340  
205/684-2475  
(Geneva Co.)

**GRIFFIN WELL CO.**

Rt. 1, Box 148-A  
Wilmer, AL 36587  
205/649-2888  
(Mobile Co.)  
(John R. Griffin)

**TOM GRIFFITH WATER WELL & CONDUCTOR SERVICE**

320 Mayson St.  
Columbia, MS 39429  
601/736-2646  
(Baldwin/Escambia Co.)

**GRINER DRILLING SERVICE**

P.O. Drawer 825  
Columbia, MS 39429  
601/736-6347  
(Escambia/Mobile/Clarke Co.)  
(Charles H. Griner)

**HACODA DRILLING CO.**

Rt. 2, Box 10  
Floral, AL 36442  
205/858-6294  
(Covington Co.)  
(Vernon Robbins)

**HOWARD HALE WELL BORING & DRILLING**

P.O. Box 935  
LaGrange, GA 30241  
404/882-1510

**HAMMETT DRILLING CO.**

Rt. 2, Box 203  
Andalusia, AL 36420  
205/222-3652  
(Covington Co.)  
(Marvin E. Hammett)

**HANCOCK & CHESTNUT  
DRILLING**

Rt. 6, Box 317  
Fort Payne, AL 35967  
205/523-3386  
(De Kalb Co.)  
(Ted E. Chestnut)

**HANNERS & DAVIS DRILLING**

Rt. 2, Box 227  
Lineville, AL 36266  
205/396-5382  
(Clay Co.)  
(James L. Hanners &  
Dale Davis)

**HEART OF DIXIE WELL  
DRILLING**

Rt. 2, Box 14C  
Alpine, AL 35014  
205/268-2006  
(Talladega Co.)  
(Guy Smith)

**HELMS WELL DRILLING**

1805 S. Hwy. 100  
Bowdon, GA 30108  
404/258-7749  
(Cleburne/Randolph Co.)  
(Donald L. Helms)

**HERNDON WELL & SUPPLY**

P.O. Box 37  
Shannon, MS 38868  
601/767-9777  
(Lee Co., Mississippi)  
(Robert L. Herndon)

**HICKS DRILLING CO.**

Rt. 1, Box 276  
Mount Hope, AL 35651  
205/974-6283  
(Lawrence Co.)  
(Walter C. Hicks)

**HUGHES WATER WELL CO.**

3205 Cromwell Dr.  
Dothan, AL 36301  
205/794-3764  
(Houston Co.)  
(Bobby Joe Hughes)

**RUBEN HUGHES WATER WELL**

Rt. 1, Box 310  
Geneva, AL 36340  
205/684-9814  
(Geneva Co.)  
(Ruben H. Hughes)

**HUGHES WELL DRILLING**

Rt. 1, Box 331  
Chancellor, AL 36316  
205/347-9758/1147  
(Coffee Co.)  
(Edgar & Jerry Hughes)

**A. D. & HAYWARD HUGHES  
WELL DRILLING**

Rt. 1, Box 320  
Chancellor, AL 36316  
205/347-2989/8762  
(Coffee Co.)  
(Alvie D. Hughes)

**J. R. HUGHES WELL DRILLING**

Rt. 2, Box 36  
New Brockton, AL 36351  
205/347-7303 or 894-2380  
(Coffee Co.)

**JOHN D. HUGHES WELLS &  
PUMPS**

820 Ouida St.  
Enterprise, AL 36330  
205/347-9757  
(Coffee Co.)  
(James Wendell Hughes)

**WILLIAM O. HUMPHREY**

Rt. 3, Box 263  
Boaz, AL 35957  
205/593-8801  
(Etowah Co.)

**HURST WELL DRILLING**

Rt. 3, Box 102-A  
Lineville, AL 36266  
205/488-5547  
(Clay Co.)  
(Pat Hurst)

**JACKSON DRILLING CO.**

Rt. 2, Box 385  
Haleyville, AL 35565  
205/486-5452  
(Marion/Winston Co.)  
(O'Neal Jackson)

**CHARLES G. KITCHENS WELL  
DRILLING**

Rt. 1, Box 349  
Parrish, AL 35580  
205/686-7811  
(Walker Co.)

**KNOX DRILLING CO.**

P.O. Box 83  
Haleyville, AL 35565  
205/486-3128  
(Winston Co.)  
(Albert D. Knox)

**LAW ENGINEERING, INC.**

P.O. Box 10244  
Birmingham, AL 35202  
205/252-9901  
(John Mack Harris)

**LAYNE-CENTRAL CO.**

P.O. Box 17700  
Pensacola, FL 32522  
904/432-5101  
(Alan Symons)

**LEMLEY DRILLING**

Rt. 1, Box 594  
Woodville, AL 35776  
205/728-2526  
(Marshall Co.)  
(James D. Lemley)

**LITTLE DRILLING**

Rt. 1, Box 42-A  
Hillsboro, AL 35643  
205/974-8996  
(Lawrence Co.)  
(Al Little)

**R. E. MABRY WELL & PUMP  
SERVICE**

P.O. Box 131  
Georgetown, GA 31754  
912/334-8855  
(Ronald Eugene Mabry)

**McCORMACK DRILLING CO.**

Rt. 3, Box 770  
Leighton, AL 35646  
205/446-5625  
(Colbert Co.)  
(Hubert McCormack)

**McDONALD-HILL, INC.**

P.O. Box 1510  
Meridian, MS 39302  
601/693-3401  
(Lauderdale Co., Mississippi)  
(Jerry Hill)

**MICHAEL DRILLING CO.**

Rt. 4, Box 220  
Rogersville, AL 35652  
205/247-5531  
(Lauderdale Co.)  
(James C. Michael)

**MID-SOUTH DRILLING CO.**

Rt. 1, Box 36-F  
Carrollton, AL 35447  
205/367-8496  
(Pickens Co.)  
(Louis Reece)

**MILLER DRILLING CO.**

P.O. Box 706  
Lawrenceburg, TN 38464  
615/762-7548  
(Lawrence Co., Tennessee)  
(G. E. Miller)

**JAMES MILLS WELL & WATER SUPPLY**

Rt. 3, Box 105  
Pikeville, TN 37367  
615/881-3364

**MIZELL DRILLING SERVICE**

Rt. 2, Box 831  
Trinity, AL 35673  
205/355-0684  
(Wayne Mizell)

**MONITOR TESTING CORP.**

P.O. Box 750  
New Ellenton, SC 29809  
803/652-2718  
(David N. Cabit)

**R. H. MORGAN**

Rt. 2, Box 457  
Somerville, AL 35670  
205/498-2472  
(Morgan/Marshall Co.)

**MUTTS WELL DRILLING**

Rt. 9, Box 325  
Athens, AL 35611  
205/232-2855  
(Limestone Co.)  
(Marvin Adams)

**ODOM WELL DRILLING**

Rt. 4, Box 81  
Jacksonville, AL 36265  
205/820-2590  
(Calhoun Co.)  
(Charles Odom)

**OTWELL WELLS**

Rt. 1, Box 140  
Ranburne, AL 36237  
205/568-3792  
(Cleburne/Randolph Co.)  
(Gary F. Otwell)

**PATE'S DRILLING & WELL SERVICE**

Rt. 2, Box 55  
Castleberry, AL 36432  
205/966-2184  
(Conecuh/Escambia Co.)  
(John D. Pate)

**JIMMY D. PEEK**

Route 1  
Pisgah, AL 35765  
205/451-7211  
(Jackson/De Kalb Co.)

**ROBERT L. PEEK**

Route 2  
Pisgah, AL 35765  
205/451-3546

**J. V. PEEL DRILLING**

Rt. 1, Box 635  
Maylene, AL 35114  
205/426-3606  
(Shelby Co.)  
(Jim Virgil Peel)

**PENSACOLA TESTING LABORATORIES**

217 E. Brent Lane  
Pensacola, FL 32503  
904/477-5100  
(Escambia/Baldwin Co.)  
(Don C. Crutchfield)

**POPE ENGINEERING & TESTING**

2463 Eslava Creek Pkwy.  
Mobile, AL 36606  
205/471-3458  
(Mobile Co.)  
(William I. Pope)

**POWELL DRILLING CO.**

P.O. Box 155  
Rutledge, AL 36071  
205/335-5365  
(Crenshaw Co.)  
(Alton E. Powell)

**VERTICE ALLEN POWELL**

P.O. Box 87  
Uriah, AL 36480  
205/862-2500  
(Monroe Co.)

**J. M. PRESLEY, JR.**

Rt. 4, Box 165  
Enterprise, AL 36330  
205/347-2829  
(Coffee Co.)

**W. PRESNALL, INC.**

Rt. 1, Box 418  
Grove Hill, AL 36451  
205/246-4055  
(Clarke Co.)  
(Willie B. Presnall)

**RADFORD & SON**

Rt. 2, Box 87  
Selma, AL 36701  
205/872-1651  
(Dallas Co.)  
(Jonnie Radford)

**RAFTER 5 SERVICE CO.**

P.O. Box 114  
Aliceville, AL 35442  
205/373-8428  
(Pickens Co.)  
(Charles A. Shaul)

**W. H. RICHEY**  
Rt. 7, Box 522  
Russellville, AL 35653  
205/332-0688  
(Colbert/Franklin Co.)

**THOMAS ROSSI**  
Rt. 2, Box 331-A  
Sulligent, AL 35586  
205/698-8757  
(Lamar Co.)

**ROWE DRILLING CO.**  
P.O. Box 1363  
Tallahassee, FL 32302  
904/576-1271  
(Leon Co., Florida)  
(H. Lamar Rowe)

**RUTHERFORD WELL BORING**  
P.O. Box 903  
Clanton, AL 35045  
205/755-2525  
(Chilton Co.)  
(Talmadge Rutherford)

**JOHNNY M. SANFORD**  
Rt. 5, Box 609-A  
Anniston, AL 36201  
205/831-8753  
(Cleburne Co.)

**RONNIE SAPP PLUMBING &  
WELL DRILLING CO.**  
P.O. Box 243  
MacClenny, FL 32063  
904/259-6934  
(Ronald Heyward Sapp)

**SEGARS DRILLING CO.**  
Rt. 6, Box 384  
Albertville, AL 35950  
205/878-8813  
(Larry G. Segars)

**SELVAGE DRILLING CO.**  
Rt. 3, Box 278  
Scottsboro, AL 35768  
205/728-4388  
(Jackson/Marshall Co.)  
(M. C. Selvage)

**GEORGE SHUNIAK**  
Rt. 1, Box 588  
Ohatchee, AL 36271  
205/892-0364  
(Calhoun Co.)

**SIMMONS WELL DRILLING**  
Rt. 3, Box 105  
Boaz, AL 35957  
205/593-3435  
(Etowah Co.)  
(Marvin Simmons)

**SISSON ENTERPRISES, INC.**  
Rt. 1, Box 223A  
Caryville, FL 32427  
904/535-2416  
(Arthur L. Sisson)

**SMITH ARTESIAN WELL**  
Rt. 3, Box 272  
Phenix City, AL 36867  
205/297-1884  
(Randy Smith)

**DONALD SMITH CO.**  
Rt. 3, Box 1  
Headland, AL 36345  
205/693-2969  
(Henry Co.)

**LARRY SMITH**  
Rt. 2, Box 4-A  
Headland, AL 36345  
205/794-5825  
(Henry Co.)

**TEDDY SMITH WELL DRILLING**  
713 Main St.  
Headland, AL 36345  
205/693-5050  
(Henry/Dale Co.)  
(Teddy D. Smith)

**TERRY'S WELL DRILLING**  
5001 Chimes Way  
Pensacola, FL 32505  
904/432-6508  
(R. Terry Woodward)

**THOMASON WELL DRILLING**  
713 Edge St.  
Ft. Walton Beach, FL 32548  
904/862-4613  
(Okaloosa Co., Florida)  
(J. E. Thomason)

**VICKERY WELL DRILLING**  
P.O. Box 839  
Double Springs, AL 35553  
205/489-5563  
(Ricky Vickery)

## **APPENDIX 4**

### **FEDERAL AND STATE AGENCIES RESPONSIBLE FOR WATER REGULATION IN ALABAMA**



**Appendix 4.--Federal and State agencies responsible for water regulation 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 Environmental Management  
1751 Federal Drive  
Montgomery, Alabama 36130

Alabama Surface Mine Reclamation Commission  
P.O. Box 1027  
Jasper, Alabama 35501

State Oil and Gas Board  
P.O. Box 0  
420 Hackberry Lane  
Tuscaloosa, Alabama 35486-9780



## **APPENDIX 5**

### **RESULTS OF CHEMICAL ANALYSES OF WATER SAMPLES FROM SELECTED WELLS IN ALABAMA**



Appendix 5A.--Selected wells for water-sample collection  
(See plate 4 for well locations.)

Site no.	Owner	Use	Identifying number	Depth (feet)	Aquifer
1	Citronelle	PWS <sup>1</sup>	D-3	735	Miocene-Pliocene
2	Atmore	PWS	Z-71	130	Miocene-Pliocene
3	Theodore	PWS	KK-1	148	Miocene-Pliocene
4	Dauphin Island	PWS	Well #2 (UU-2)	305	Miocene-Pliocene
5	Orange Beach	PWS	ZZ-8	120	Miocene-Pliocene
6	Brewton	PWS	O-95	661	Lisbon
8	Brewton Airport	PWS	V-37	435	Ocala Limestone
9	Evergreen	PWS	S-2	180	Tallahatta
10	Butler	PWS	Well #4	708	Nanafalia
11	Andalusia	PWS	Antioch Road Well (M-8)	1,090	Nanafalia
12	Geneva	PWS	Well #3 (R-11)	1,040	Nanafalia
13	Monroeville	PWS	Hammond Street Well (U-4)	1,240	Nanafalia
14	Jackson	PWS	HH-6	Spring	Crystal River
15	Elba	PWS	Well #2 (K-4)	585	Clayton Limestone
16	Ozark	PWS	F-16	880	Ripley
17	Greenville	PWS	H-12	577	Ripley
18	Troy	PWS	Well #2 (J-8)	519	Ripley
19	Luverne	PWS	Well #1 (L-5)	567	Ripley
20	Camden	PWS	O-38	441	Ripley
21	Clayton	PWS	S-1	195	Ripley
22	Dothan	PWS	Well #23 (I-19)	860	Ripley
23	Private owner (C. A. Boyd)	Stock	J-8	940	Eutaw
24	Montgomery	PWS	Well #40 (K-95)	275	Eutaw
25	Linden	PWS	L-26	1,240	Eutaw
26	Eutaw	PWS	R-12	429	Eutaw
27	Montgomery	PWS	Well #13 (J-31)	631	Tuscaloosa Group
28	Vernon	PWS	K-13	335	Tuscaloosa Group
29	Hayneville	PWS	L-12	1,061	Tuscaloosa Group
30	Union Springs	PWS	Well #2 (L-3)	1,105	Tuscaloosa Group
31	Aliceville	PWS	W-30	521	Tuscaloosa Group
32	Olympia Spa	Mineral pool	Q-6	2,924	Tuscaloosa Group
33	Brydie Farms	Stock	AA-33	750	Tuscaloosa Group
34	Coker	PWS	FF-51	182	Tuscaloosa Group
35	Moundville	PWS	B-20	233	Tuscaloosa Group
36	Eufaula	PWS	V-1	1,752	Tuscaloosa Group
37	State of Alabama (Marion Fish Hatchery)	Fish	I-9	773	Tuscaloosa Group
38	Troy	PWS	Well #4 (J-11)	2,240	Tuscaloosa Group
39	Hamilton	PWS	I-13	632	Pottsville
40	Gold Kist Poultry	Industrial	X-2	450	Pottsville
41	Hanceville	PWS	W-9	363	Pottsville

<sup>1</sup>PWS - Public Water Supply

## Appendix 5A.--Selected wells for water-sample collection--continued

Site no.	Owner	Use	Identifying number	Depth (feet)	Aquifer
42	Town Creek	PWS	Well #1	90	Bangor Limestone
43	Irondale	PWS	Well #5 (W-4)	250	Bangor Limestone
44	Ardmore	PWS	Well #1 (A-13)	133	Tuscumbia Limestone
45	Rogersville	PWS	T-32	150	Tuscumbia Limestone
46	Stevenson	PWS	N-40	165	Tuscumbia Limestone
47	Trussville	PWS	Well #4 (L-2)	215	Tuscumbia Limestone
48	Huntsville	PWS	Dallas Wells (N-51)	105	Tuscumbia Limestone
49	Centreville	PWS	P-5	200	Cambrian, Ordovician
50	Oneonta	PWS	P-7	175	Cambrian, Ordovician
51	Rockford	PWS	M-2	300	Piedmont
72	Orange Beach	PWS	DDD-03	450	Miocene-Pliocene
99	Gulf Shores	PWS	DDD-21	225	Miocene-Pliocene
100	Dauphin Island	PWS	UU-4	300	Miocene-Pliocene
101	M & T Chemical	Industrial	L-05	100	Quaternary
102	Alabama Boys Ranch	PWS	GG-2	1,260	Eutaw
103	Alton Powell	Private	Shed well	500	Ripley
104	Eldridge	PWS	F-4	1,400	Pottsville
105	Musgrove Country Club	Private	I-1	350	Pottsville
106	Hugh Groce	Private	M-13	465	Eutaw
107	Fruithurst	PWS	J-3	350	Piedmont
108	Wedowee	PWS	K-2	116	Piedmont
109	Wadley	PWS	U-8	100	Piedmont
110	Jemison	PWS	Well #1	100	Piedmont
111	Barfield School	PWS	Well #1	100	Piedmont
112	Huntsville	PWS	X-44	100	Tuscumbia Limestone
113	Headland	PWS	X-1	663	Clayton Limestone
114	Alton Powell	Private	K-7	226	Clayton Limestone
115	W. H. Griffin	Private	H-2	250	Tusahoma
116	Fulton	PWS	O-12	267	Lisbon
117	Alabama Point	PWS	Well #2	392	Miocene-Pliocene
118	Foley	PWS	UU-17 (#9)	138	Miocene-Pliocene
119	Loxley	PWS	KK-05	184	Miocene-Pliocene
120	Malbis	PWS	CC-10	498	Miocene-Pliocene
121	Bay Minette	PWS	U-02	175	Miocene-Pliocene
122	Chatom	PWS	P-3	298	Miocene-Pliocene
123	Camp Alamisco	Private	H-01	539	Piedmont
125	Orange Beach	PWS	DDD-018	250	Miocene-Pliocene

Appendix 5B.--Results of chemical analyses of water samples from selected wells, May-June 1987

Parameter	Site numbers												
	1	2	3	4	5	6	8	9	10	11	12	13	
Date	6/23	6/25	6/23	6/23	6/24	6/25	6/25	6/9	6/8	6/9	6/9	6/9	
Time	1120	0940	1330	1430	1120	1050	1105	0909	1035	1008	1315	0806	
Specific conductance $\mu\text{mhos/cm}$	233	28	541	1260	95	281	283	270	583	1093	1454	684	
Temperature ( $^{\circ}\text{C}$ )	23	22	24	24	22	26	25	21	24	27	27	29	
Bicarbonate (mg/L)	120	6	200	220	6	170	180	160	270	260	240	340	
Carbonate (mg/L)	0	0	6	0	0	0	0	0	12	6	0	12	
Alkalinity as $\text{CaCO}_3$ (mg/L)	98	5	170	180	5	140	150	130	240	230	200	300	
pH	8.2	5.6	8.7	6.9	5.3	7.7	7.1	6.6	8.8	8.4	8.2	8.7	
Silica (mg/L)	17	12	18	22	10	41	26	20	18	21	19	18	
Calcium (mg/L)	0.8	1.5	4.0	36	1.6	33	18	47	1.3	6.9	12	2.5	
Magnesium (mg/L)	0.3	0.9	0.4	2.7	2.1	6.5	9.0	1.9	0.2	2.9	6.0	0.7	
Sodium (mg/L)	60	2.8	130	190	13	18	32	3.5	140	240	290	180	
Potassium (mg/L)	1.3	0.3	1.4	12	0.5	4.4	7.2	1.9	0.9	7.0	8.4	1.9	
Sulfate (mg/L)	2.4	ND	5.6	ND	1.6	11	9.6	8.4	0.8	27	30	33	
Chloride (mg/L)	16	3.2	71	310	23	2.0	2.4	1.4	46	200	300	50	
Fluoride (mg/L)	0.20	<0.05	0.40	0.24	ND	0.08	0.47	0.05	0.25	1.27	0.88	0.25	
Nitrate as N (mg/L)	0.02	0.74	0.01	0.04	0.66	0.01	0.01	0.02	ND	0.08	0.03	0.02	
Nitrite as N (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Ammonia as N (mg/L)	0.01	0.01	0.48	2.05	0.01	0.16	0.25	0.06	0.46	0.64	0.70	0.63	
Total Kjeldahl Nitrogen as N (mg/L)	0.24	0.10	0.58	2.05	0.12	0.26	0.38	0.19	0.51	0.75	0.88	0.75	
Phosphorus as P (mg/L)	0.14	ND	0.22	0.01	ND	ND	0.01	ND	0.44	0.01	0.01	0.09	
Orthophosphate as P (mg/L)	0.14	ND	0.22	ND	ND	ND	ND	ND	0.39	0.01	0.01	0.08	
Arsenic ( $\mu\text{g/L}$ )	1	ND	1	9	2	1	1	ND	ND	2	2	ND	
Barium ( $\mu\text{g/L}$ )	<5	20	20	290	40	<5	20	10	<5	10	<5	10	
Cadmium ( $\mu\text{g/L}$ )	ND	ND	ND	<0.5	<0.5	ND	ND	<0.5	ND	<0.5	<0.5	<0.5	
Chromium ( $\mu\text{g/L}$ )	ND	<0.5	ND	ND	ND	<0.5	ND	<0.5	ND	<0.5	<0.5	<0.5	
Cobalt ( $\mu\text{g/L}$ )	<0.5	1	ND	ND	2	1	2	1	ND	1	<0.5	<0.5	
Iron ( $\mu\text{g/L}$ )	410	40	20	1,900	90	50	40	60	10	20	320	10	
Lead ( $\mu\text{g/L}$ )	1	2	4	9	1	1	1	2	2	11	12	4	
Manganese ( $\mu\text{g/L}$ )	50	10	20	180	70	10	<5	10	<5	<5	20	<5	
Mercury ( $\mu\text{g/L}$ )	ND	ND	ND	0.10	<0.05	ND	ND	ND	ND	0.10	0.20	ND	
Selenium ( $\mu\text{g/L}$ )	3	ND	7	9	<0.5	ND	ND	1	ND	1	1	6	
Silver ( $\mu\text{g/L}$ )	<0.5	ND	<0.5	<0.5	ND	ND	ND	ND	<0.5	1	<0.5	1	
Strontium ( $\mu\text{g/L}$ )	30	10	120	430	10	410	100	210	40	740	2,100	140	
Zinc ( $\mu\text{g/L}$ )	ND	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	
Total dissolved solids (mg/L)	157	27	335	706	58	200	193	163	352	640	785	466	
Hardness as $\text{CaCO}_3$ (mg/L)	3	7	12	200	13	110	82	130	4	29	55	9	

## Appendix 5B.--Results of chemical analyses of water samples from selected wells, May-June 1987--continued

Parameter	Site numbers														
	14	15	16	17	18	19	20	21	22	23	24	25			
Date	6/23	6/9	6/9	6/11	6/11	6/11	6/8	6/10	6/10	6/8	6/11	6/8			
Time	0950	1103	1449	0957	0829	0914	1506	0946	1438	0912	1126	1329			
Specific conductance $\mu\text{mhos/cm}$	146	395	300	520	285	543	760	106	291	1,840	413	2,330			
Temperature ( $^{\circ}\text{C}$ )	16	23	24	22	21	22	22	24	25	22	20	14			
Bicarbonate (mg/L)	90	220	160	250	190	300	330	40	180	380	250	160			
Carbonate (mg/L)	0	0	10	11	0	7	20	0	0	0	14	0			
Alkalinity as $\text{CaCO}_3$ (mg/L)	74	180	150	220	160	260	310	33	150	3310	230	130			
pH	7.2	8.2	8.8	8.8	7.5	8.4	8.8	6.3	7.7	8.3	8.8	8.3			
Silica (mg/L)	10	18	13	12	18	14	14	18	21	14	18	14			
Calcium (mg/L)	30	19	3.1	2.8	19	5.8	2.4	18	33	3.6	2.9	5.3			
Magnesium (mg/L)	1.9	6.7	1.1	1.0	3.3	2.3	0.7	0.8	5.8	0.8	0.4	1.2			
Sodium (mg/L)	2.5	65	78	140	58	140	200	3.4	24	400	130	330			
Potassium (mg/L)	0.6	4.6	4.0	2.2	4.8	2.5	1.8	3.5	2.4	3.3	0.8	3.0			
Sulfate (mg/L)	4.2	16	12	33	7.1	38	37	2.0	14	ND	9.4	0.6			
Chloride (mg/L)	2.8	11	3.8	28	2.2	18	66	5.8	4.9	360	8.7	410			
Fluoride (mg/L)	0.05	0.20	0.27	0.90	0.83	0.15	1.44	0.05	0.15	1.87	0.58	3.00			
Nitrate as N (mg/L)	0.72	ND	0.02	0.12	0.17	0.01	0.01	5.58	0.02	ND	0.02	ND			
Nitrite as N (mg/L)	ND	ND	ND	ND	0.27	ND	ND	ND	ND	ND	0.02	ND			
Ammonia as N (mg/L)	ND	0.18	0.16	0.39	0.11	0.41	0.59	ND	0.08	1.02	0.18	0.91			
Total Kjeldahl Nitrogen as N (mg/L)	0.18	0.32	0.32	0.66	0.38	0.55	0.65	0.30	0.28	1.10	0.38	1.00			
Phosphorus as P (mg/L)	ND	ND	0.02	0.01	0.01	0.02	0.02	0.01	ND	0.13	0.06	0.05			
Orthophosphate as P (mg/L)	ND	ND	0.02	0.01	0.01	0.02	0.02	0.01	ND	0.12	0.06	0.05			
Arsenic ( $\mu\text{g/L}$ )	3	2	2	2	2	3	1	ND	2	1	<0.5	2			
Barium ( $\mu\text{g/L}$ )	20	<5	ND	<5	20	10	<5	20	60	50	<5	40			
Cadmium ( $\mu\text{g/L}$ )	ND	<0.5	<0.5	ND	<0.5	<0.5	ND	<0.5	ND	ND	<0.5	ND			
Chromium ( $\mu\text{g/L}$ )	<0.5	ND	ND	<0.5	<0.5	ND	<0.5	1	ND	<0.5	ND	ND			
Cobalt ( $\mu\text{g/L}$ )	<0.5	ND	ND	ND	ND	ND	<0.5	<0.5	ND	ND	ND	ND			
Iron ( $\mu\text{g/L}$ )	ND	20	10	80	10	10	10	10	30	60	ND	50			
Lead ( $\mu\text{g/L}$ )	ND	2	2	1	<0.5	2	4	3	2	13	<0.5	14			
Manganese ( $\mu\text{g/L}$ )	<5	<5	<5	10	<5	<5	<5	<5	<5	10	10	10			
Mercury ( $\mu\text{g/L}$ )	ND	ND	ND	ND	ND	0.10	0.10	ND	ND	0.20	ND	0.20			
Selenium ( $\mu\text{g/L}$ )	4	<0.5	ND	ND	<0.5	ND	ND	ND	ND	26	ND	ND			
Silver ( $\mu\text{g/L}$ )	<0.5	<0.5	<0.5	<0.5	<0.5	1	1	<0.5	<0.5	<0.5	<0.5	1			
Strontium ( $\mu\text{g/L}$ )	70	540	180	240	450	470	160	20	400	230	130	360			
Zinc ( $\mu\text{g/L}$ )	ND	ND	ND	ND	<5	ND	ND	<5	10	ND	ND	ND			
Total dissolved solids (mg/L)	96	249	204	355	208	376	505	96	194	971	294	846			
Hardness as $\text{CaCO}_3$ (mg/L)	83	75	12	11	61	24	9	49	62	13	9	18			

Appendix 5B.--Results of chemical analyses of water samples from selected wells, May-June 1987--continued

Parameter	Site numbers											
	26	27	28	29	30	31	32	33	34	35	36	37
Date	6/8	6/11	6/2	6/11	6/10	6/2	6/10	6/8	6/2	6/12	6/10	6/12
Time	0803	1147	1015	1042	0902	0852	1329	0823	0749	1112	0801	0951
Specific conductance $\mu$ mhos/cm	1,023	400	98	286	244	185	9,560	8,710	168	27	392	206
Temperature ( $^{\circ}$ C)	19	16	18	27	26	19	31	24	11	20	30	22
Bicarbonate (mg/L)	220	190	40	130	110	94	140	40	84	11	160	120
Carbonate (mg/L)	0	31	0	6	6	0	4	0	0	0	24	0
Alkalinity as CaCO <sub>3</sub> (mg/L)	180	210	33	110	97	77	120	30	69	9	170	98
pH	8.3	9.3	6.4	8.6	8.8	7.6	8.5	6.8	6.8	5.8	9.3	7.9
Silica (mg/L)	13	14	12	15	16	13	21	14	19	20	19	13
Calcium (mg/L)	5.3	1.5	2.4	1.7	3.2	3.1	12	140	13	2.0	1.1	33
Magnesium (mg/L)	0.9	0.2	1.6	0.1	0.2	0.9	8.7	28	5.0	0.9	0.1	5.7
Sodium (mg/L)	200	110	2.0	70	62	32	1,900	1,700	2.9	1.4	86	2.8
Potassium (mg/L)	3.0	0.5	3.7	0.9	3.9	3.4	11	13	4.4	3.2	3.2	3.9
Sulfate (mg/L)	ND	17	4.4	7.6	27	4.4	ND	ND	12	0.5	7.2	4.6
Chloride (mg/L)	160	5.9	1.2	16	3.6	1.9	2,600	2,800	2.0	2.0	6.7	0.4
Fluoride (mg/L)	1.22	0.70	0.05	0.17	0.05	0.13	2.00	0.70	0.15	2.05	0.42	0.05
Nitrate as N (mg/L)	0.02	ND	0.02	0.02	0.02	ND	2.85	ND	0.01	0.04	0.04	ND
Nitrite as N (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ammonia as N (mg/L)	0.58	0.19	0.01	0.18	0.26	0.27	ND	3.40	0.01	ND	0.29	0.01
Total Kjeldahl Nitrogen as N (mg/L)	0.66	0.24	0.04	0.38	0.46	0.29	0.32	3.40	0.03	0.10	0.54	0.07
Phosphorus as P (mg/L)	0.04	0.07	ND	0.01	ND	0.05	ND	ND	0.01	ND	0.05	0.01
Orthophosphate as P (mg/L)	0.04	0.07	ND	0.01	ND	0.05	ND	ND	0.01	ND	0.05	0.01
Arsenic ( $\mu$ g/L)	ND	3	1	1	ND	1	33	51	1	<0.5	1	3
Barium ( $\mu$ g/L)	20	10	20	<5	<5	20	120	1,900	320	40	ND	520
Cadmium ( $\mu$ g/L)	ND	ND	<0.5	<0.5	<0.5	<0.5	ND	ND	<0.5	ND	<0.5	ND
Chromium ( $\mu$ g/L)	ND	ND	<0.5	ND	ND	ND	ND	<0.5	<0.5	<0.5	ND	<0.5
Cobalt ( $\mu$ g/L)	ND	<0.5	1	ND	ND	1	ND	11	2	ND	ND	<0.5
Iron ( $\mu$ g/L)	220	ND	12,000	10	10	80	50	2,700	5,200	10	ND	120
Lead ( $\mu$ g/L)	3	24	1	<0.5	1	ND	90	84	1	ND	4	ND
Manganese ( $\mu$ g/L)	10	<5	750	10	<5	30	<5	50	390	<5	<5	100
Mercury ( $\mu$ g/L)	ND	ND	ND	ND	0.10	ND	0.60	0.30	ND	ND	<0.05	ND
Selenium ( $\mu$ g/L)	4	ND	1	ND	ND	<0.5	ND	8	ND	4	ND	5
Silver ( $\mu$ g/L)	<0.5	<0.5	ND	<0.5	<0.5	ND	1	1	<0.5	<0.5	<0.5	ND
Strontium ( $\mu$ g/L)	230	40	30	40	50	130	2,800	9,100	570	40	30	440
Zinc ( $\mu$ g/L)	ND	ND	10	ND	ND	ND	ND	<5	10	<5	ND	ND
Total dissolved solids (mg/L)	492	274	47	182	170	105	4,640	4,720	105	36	227	122
Hardness as CaCO <sub>3</sub> (mg/L)	17	5	13	5	9	11	66	460	53	9	3	110

Appendix 5B.--Results of chemical analyses of water samples from selected wells, May-June 1987--continued

Parameter	Site numbers												
	38	39	40	41	42	43	44	45	46	47	48	49	
Date	6/11	6/2	6/4	6/4	6/2	6/5	6/3	6/3	5/19	6/5	6/3	6/12	
Time	0840	1219	1446	0902	1542	1255	0930	0822	1230	1106	1114	0906	
Specific conductance $\mu\text{mhos/cm}$	535	234	353	404	527	264	193	186	309	298	341	206	
Temperature ( $^{\circ}\text{C}$ )	30	11	18	18	18	19	16	16	16	18	17	19	
Bicarbonate (mg/L)	230	130	200	210	200	150	76	80	170	160	160	150	
Carbonate (mg/L)	16	0	0	0	0	0	0	0	0	0	0	0	
Alkalinity as $\text{CaCO}_3$ (mg/L)	210	110	160	170	160	120	62	66	140	130	130	120	
pH	9.0	7.2	7.1	7.3	6.9	6.1	6.4	6.9	7.1	7.8	6.8	6.8	
Silica (mg/L)	19	21	22	35	10	13	11	11	8.5	11	10	11	
Calcium (mg/L)	1.3	2.2	3.2	2.6	7.2	4.6	2.4	2.2	5.0	5.1	5.0	3.0	
Magnesium (mg/L)	0.2	6.6	7.2	11	2.5	1.8	3.4	5.5	7.3	2.7	5.0	1.2	
Sodium (mg/L)	130	12	26	35	4.5	1.9	2.8	1.7	1.8	1.5	2.2	2.6	
Potassium (mg/L)	0.8	2.9	1.3	1.8	4.1	0.8	0.8	3.6	0.5	0.8	0.7	0.8	
Sulfate (mg/L)	28	ND	3.2	18	8.6	4.2	8.8	1.8	9.2	4.4	5.2	3.8	
Chloride (mg/L)	7.2	1.4	4.1	5.3	7.8	1.6	5.2	1.7	2.3	1.4	3.3	2.2	
Fluoride (mg/L)	0.77	0.05	0.07	0.10	0.05	0.05	ND	<0.05	0.06	<0.05	<0.05	0.05	
Nitrate as N (mg/L)	ND	0.01	0.04	ND	4.78	0.22	1.53	1.94	1.64	0.42	2.50	0.57	
Nitrite as N (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Ammonia as N (mg/L)	0.22	0.06	0.34	0.24	0.01	ND	ND	ND	ND	0.01	ND	ND	
Total Kjeldahl Nitrogen as N (mg/L)	0.46	0.06	0.49	0.30	0.14	0.14	0.04	0.01	0.05	0.42	0.05	0.06	
Phosphorus as P (mg/L)	0.13	0.01	0.03	0.01	0.04	0.05	0.03	0.03	ND	0.02	0.01	0.01	
Orthophosphate as P (mg/L)	0.13	0.01	0.03	0.01	0.03	0.05	0.02	0.02	ND	0.02	0.01	ND	
Arsenic ( $\mu\text{g/L}$ )	2	<0.5	ND	1	ND	ND	ND	ND	2	ND	1	3	
Barium ( $\mu\text{g/L}$ )	10	40	940	560	30	20	<5	10	50	10	20	100	
Cadmium ( $\mu\text{g/L}$ )	<0.5	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	
Chromium ( $\mu\text{g/L}$ )	2	ND	1	<0.5	1	<0.5	1	1	<0.5	1	1	<0.5	
Cobalt ( $\mu\text{g/L}$ )	ND	1	<0.5	ND	1	<0.5	1	1	1	ND	1	<0.5	
Iron ( $\mu\text{g/L}$ )	120	60	510	770	<5	ND	10	10	10	<5	<5	ND	
Lead ( $\mu\text{g/L}$ )	2	1	1	ND	ND	ND	ND	ND	1	ND	ND	1	
Manganese ( $\mu\text{g/L}$ )	10	60	160	140	<5	<5	10	<5	<5	10	<5	<5	
Mercury ( $\mu\text{g/L}$ )	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Selenium ( $\mu\text{g/L}$ )	ND	<0.5	1	3	ND	1	ND	<0.5	3	1	ND	7	
Silver ( $\mu\text{g/L}$ )	<0.5	<0.5	<0.5	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	
Strontium ( $\mu\text{g/L}$ )	40	130	550	290	100	30	30	20	220	40	90	60	
Zinc ( $\mu\text{g/L}$ )	ND	10	40	30	30	ND	30	ND	40	<5	20	ND	
Total dissolved solids (mg/L)	317	120	195	236	229	120	100	95	171	154	166	139	
Hardness as $\text{CaCO}_3$ (mg/L)	4	82	110	110	190	144	74	78	160	140	150	120	

Appendix 5B.--Results of chemical analyses of water samples from selected wells, May-June 1987--continued

Parameter	Site numbers													
	50	51	72	99	100	101	102	103	104	105	106	107		
Date	6/4	6/11	6/24	6/24	6/23	6/23	5/12	6/11	5/21	5/21	5/14	5/8		
Time	1310	1335	1330	1420	1435	1200	1039	0932	0922	0831	1339	0841		
Specific conductance $\mu$ mhos/cm	322	947	111	61	1,400	19	1,460	497	491	461	188	153		
Temperature (°C)	17	19	24	23	24	22	28	22	18	21	24	17		
Bicarbonate (mg/L)	170	20	54	12	230	6	97	230	280	440	50	78		
Carbonate (mg/L)	0	0	0	0	0	0	0	0	14	20	0	0		
Alkalinity as CaCO <sub>3</sub> (mg/L)	140	16	44	10	190	5	80	200	260	390	41	64		
pH	7.0	5.8	6.7	5.7	6.9	6.0	8.3	8.7	8.9	8.8	7.9	6.7		
Silica (mg/L)	10	23	25	9.0	19	11	16	13	12	14	64	29		
Calcium (mg/L)	32	6.5	10	1.2	47	0.9	35	3.8	2.0	6.5	23	18		
Magnesium (mg/L)	15	1.7	1.4	1.1	34	0.4	1.8	0.9	0.5	2.1	0.8	4.1		
Sodium (mg/L)	2.8	10	8.1	6.8	200	2.1	510	130	120	170	13	13		
Potassium (mg/L)	0.9	2.3	2.3	0.3	13	0.5	4.2	2.2	0.7	1.3	5.1	1.0		
Sulfate (mg/L)	4.6	2.2	6.2	1.7	ND	1.6	ND	40	ND	ND	30	1.6		
Chloride (mg/L)	2.3	9.6	5.4	11	340	2.7	750	28	2.8	2.2	4.0	4.5		
Fluoride (mg/L)	0.05	<0.05	<0.05	<0.05	0.25	ND	0.25	0.20	0.17	0.37	0.13	0.08		
Nitrate as N (mg/L)	1.28	3.58	0.02	0.10	0.01	0.10	0.11	0.02	0.01	0.02	0.06	1.57		
Nitrite as N (mg/L)	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND		
Ammonia as N (mg/L)	0.04	ND	0.06	0.01	1.90	0.01	0.84	0.38	0.06	0.46	ND	ND		
Total Kjeldahl Nitrogen as N (mg/L)	0.15	0.17	0.15	0.08	1.90	0.17	0.92	0.56	0.13	0.54	0.12	0.10		
Phosphorus as P (mg/L)	ND	0.02	ND	ND	0.02	0.01	0.01	0.01	0.05	0.18	0.05	0.05		
Orthophosphate as P (mg/L)	ND	0.02	ND	ND	0.01	ND	0.01	0.01	0.05	0.18	0.04	0.04		
Arsenic ( $\mu$ g/L)	1	1	2	ND	ND	1	<0.5	ND	3	4	ND	1		
Barium ( $\mu$ g/L)	10	70	100	20	340	20	100	ND	10	50	40	20		
Cadmium ( $\mu$ g/L)	ND	ND	<0.5	<0.5	ND	ND	ND	<0.5	ND	4	<0.5	<0.5		
Chromium ( $\mu$ g/L)	1	ND	ND	ND	ND	1	1	<0.5	ND	ND	ND	<0.5		
Cobalt ( $\mu$ g/L)	ND	<0.5	ND	ND	ND	<0.5	ND	ND	ND	ND	1	<0.5		
Iron ( $\mu$ g/L)	<5	20	2,100	4,400	2,000	20	20	30	10	30	90	20		
Lead ( $\mu$ g/L)	1	1	4	1	7	ND	26	2	1	ND	1	2		
Manganese ( $\mu$ g/L)	<5	30	60	120	200	<5	30	<5	10	10	30	ND		
Mercury ( $\mu$ g/L)	ND	0.10	ND	ND	0.10	ND	ND	<0.05	ND	0.10	ND	ND		
Selenium ( $\mu$ g/L)	<0.5	ND	<0.5	ND	7	1	4	ND	ND	ND	<0.5	2		
Silver ( $\mu$ g/L)	<0.5	ND	<0.5	ND	<0.5	<0.5	1	1	<0.5	<0.5	ND	<0.5		
Strontium ( $\mu$ g/L)	30	110	60	<5	470	<5	1,800	260	30	90	300	140		
Zinc ( $\mu$ g/L)	20	ND	50	ND	ND	ND	30	ND	10	20	20	10		
Total dissolved solids (mg/L)	157	81	85	37	767	23	1,370	341	290	433	165	117		
Hardness as CaCO <sub>3</sub> (mg/L)	140	23	9	8	270	4	95	13	7	25	61	62		

## Appendix 5B.--Results of chemical analyses of water samples from selected wells, May-June 1987---continued

Parameter	Site numbers												
	108	109	110	111	112	113	114	115	116	117	118	119	
Date	5/7	5/7	5/7	5/7	6/3	5/14	6/11	5/12	6/8	6/23	6/24	6/24	
Time	1458	1416	1151	1542	1146	0953	0930	1350	1238	1400	1000	0910	
Specific conductance $\mu\text{mhos/cm}$	41	180	59	77	304	377	541	394	278	482	50	24	
Temperature ( $^{\circ}\text{C}$ )	18	18	19	18	17	23	27	19	22	24	22	21	
Bicarbonate (mg/L)	10	82	10	47	140	200	230	220	170	160	4	9	
Carbonate (mg/L)	0	0	0	0	0	0	6	8	0	0	0	0	
Alkalinity as $\text{CaCO}_3$ (mg/L)	8	67	8	39	110	160	200	200	140	130	3	7	
pH	5.7	6.8	5.5	7.1	6.8	7.7	8.6	8.7	7.0	7.9	5.4	5.7	
Silica (mg/L)	11	45	18	40	11	28	13	15	51	40	8.6	21	
Calcium (mg/L)	2.7	17	3.9	11	43	61	5.6	4.0	39	1.2	1.4	1.5	
Magnesium (mg/L)	1.7	7.8	2.3	1.8	5.0	6.2	1.0	0.7	7.1	0.2	1.7	0.6	
Sodium (mg/L)	6.7	8.9	6.4	9.6	2.4	6.3	130	87	13	110	4.5	2.3	
Potassium (mg/L)	1.3	1.7	2.3	2.5	0.7	2.4	2.1	1.6	3.0	1.4	0.5	0.4	
Sulfate (mg/L)	0.8	1.2	2.7	11	1.0	15	40	14	21	3.0	1.2	ND	
Chloride (mg/L)	3.8	6.4	7.2	0.8	4.4	3.8	28	19	2.2	80	6.6	2.4	
Fluoride (mg/L)	<0.05	0.05	0.05	0.11	1.39	3.55	0.17	0.10	0.10	0.24	ND	ND	
Nitrate as N (mg/L)	1.56	2.10	1.84	0.02	2.55	0.02	0.01	0.01	ND	0.02	1.60	0.02	
Nitrite as N (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	
Ammonia as N (mg/L)	0.01	ND	0.01	ND	ND	ND	0.36	0.48	0.14	0.48	0.01	ND	
Total Kjeldahl Nitrogen as N (mg/L)	0.16	0.12	0.12	0.11	0.08	0.23	0.61	0.64	0.29	0.55	0.16	0.14	
Phosphorus as P (mg/L)	ND	0.03	ND	0.05	0.02	0.02	0.01	0.17	0.18	0.34	ND	ND	
Orthophosphate as P (mg/L)	ND	ND	ND	ND	0.02	0.02	0.01	0.15	0.15	0.34	ND	ND	
Arsenic ( $\mu\text{g/L}$ )	ND	ND	ND	ND	1	1	2	ND	ND	1	2	2	
Barium ( $\mu\text{g/L}$ )	ND	10	10	ND	10	10	<5	<5	60	10	40	10	
Cadmium ( $\mu\text{g/L}$ )	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	2	ND	ND	<0.5	<0.5	
Chromium ( $\mu\text{g/L}$ )	1	9	<0.5	<0.5	<0.5	ND	ND	<0.5	<0.5	<0.5	<0.5	<0.5	
Cobalt ( $\mu\text{g/L}$ )	1	1	2	<0.5	1	ND	ND	ND	<0.5	ND	1	<0.5	
Iron ( $\mu\text{g/L}$ )	10	10	90	860	ND	20	10	20	910	210	50	60	
Lead ( $\mu\text{g/L}$ )	2	2	2	7	ND	ND	<0.5	6	ND	2	6	1	
Manganese ( $\mu\text{g/L}$ )	30	<5	70	20	ND	ND	<0.05	20	310	10	40	<5	
Mercury ( $\mu\text{g/L}$ )	0.10	ND	ND	0.10	ND	ND	<0.05	ND	0.10	ND	0.1	ND	
Selenium ( $\mu\text{g/L}$ )	ND	ND	ND	ND	2	2	ND	2	2	6	ND	ND	
Silver ( $\mu\text{g/L}$ )	ND	ND	ND	ND	ND	ND	1	<0.5	<0.5	<0.5	ND	ND	
Strontium ( $\mu\text{g/L}$ )	20	50	20	70	50	340	260	110	660	20	10	20	
Zinc ( $\mu\text{g/L}$ )	10	<5	10	210	<5	30	ND	20	10	ND	20	ND	
Total dissolved solids (mg/L)	40	138	56	100	149	225	339	258	210	315	34	33	
Hardness as $\text{CaCO}_3$ (mg/L)	14	75	19	35	130	180	18	13	130	4	11	6	

Appendix 5B.--Results of chemical analyses of water samples from selected wells, May-June 1987--continued

Parameter	Site numbers							
	120	121	122	123	125			
Date	6/24	6/25	6/23	6/11	6/24			
Time	0850	0900	1030	1440	1130			
Specific conductance, $\mu$ mhos/cm	54	58	256	144	47			
Temperature ( $^{\circ}$ C)	23	22	22	21	23			
Bicarbonate (mg/L)	14	7	180	87	3			
Carbonate (mg/L)	0	0	0	0	0			
Alkalinity as CaCO <sub>3</sub> (mg/L)	11	6	150	71	2			
pH	6.4	5.4	7.4	8.1	5.3			
Silica (mg/L)	21	10	23	32	11			
Calcium (mg/L)	3.4	1.9	17	18	1.5			
Magnesium (mg/L)	1.8	0.9	6.1	2.4	1.6			
Sodium (mg/L)	4.1	7.9	30	13	4.9			
Potassium (mg/L)	1.7	0.4	3.7	0.9	0.2			
Sulfate (mg/L)	7.5	1.2	7.4	0.4	0.5			
Chloride (mg/L)	2.6	9.4	2.4	0.3	6.6			
Fluoride (mg/L)	0.05	<0.05	0.09	1.23	0.05			
Nitrate as N (mg/L)	0.02	1.66	ND	0.02	1.81			
Nitrite as N (mg/L)	ND	ND	ND	ND	ND			
Ammonia as N (mg/L)	0.01	0.02	0.17	ND	0.01			
Total Kjeldahl Nitrogen as N (mg/L)	0.20	0.09	0.26	0.08	0.19			
Phosphorus as P (mg/L)	ND	ND	0.03	ND	ND			
Orthophosphate as P (mg/L)	ND	ND	0.03	ND	ND			
Arsenic ( $\mu$ g/L)	2	ND	3	2	ND			
Barium ( $\mu$ g/L)	50	20	100	ND	40			
Cadmium ( $\mu$ g/L)	<0.5	<0.5	<0.5	ND	<0.5			
Chromium ( $\mu$ g/L)	<0.5	ND	<0.5	<0.5	ND			
Cobalt ( $\mu$ g/L)	1	<0.5	<0.5	ND	ND			
Iron ( $\mu$ g/L)	620	240	10	ND	10			
Lead ( $\mu$ g/L)	ND	1	ND	ND	1			
Manganese ( $\mu$ g/L)	40	20	40	<5	20			
Mercury ( $\mu$ g/L)	<0.05	ND	ND	ND	0.10			
Selenium ( $\mu$ g/L)	ND	ND	2	ND	ND			
Silver ( $\mu$ g/L)	ND	ND	ND	ND	ND			
Strontium ( $\mu$ g/L)	120	<5	270	70	10			
Zinc ( $\mu$ g/L)	ND	50	ND	<5	ND			
Total dissolved solids (mg/L)	49	42	178	111	36			
Hardness as CaCO <sub>3</sub> (mg/L)	16	8	68	55	10			



## **APPENDIX 6**

**RESULTS OF CHEMICAL ANALYSES OF WATER SAMPLES FROM  
SELECTED STREAMS IN ALABAMA**



**Appendix 6A.--Surface water quality sites  
(See plate 4 for site locations.)**

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

Appendix 6B.--Results of chemical analyses of water samples from selected streams, May-June 1987

Parameter	Site numbers											
	1	2	3	4	5	6	7	8	9	10	11	12
Date	5/14	5/13	5/13	5/13	5/13	5/18	5/18	5/26	5/14	5/12	5/27	5/15
Time	0853	1508	1152	1101	1035	1621	1332	1557	1446	0854	1204	1017
Flow (cfs)	561	77.0	541	193	256	29.0	148	247	264	142	47.3	236
Specific conductance $\mu$ mhos/cm	65	187	70	82	348	43	210	39	73	35	170	223
Temperature (°C)	22	21	22	23	21	25	23	25	26	21	24	23
Dissolved Oxygen (mg/L)	7.9	8.3	7.5	8.0	7.4	7.4	6.8	8.1	8.6	8.8	6.5	7.2
Bicarbonate (mg/L)	30	2	38	42	13	7	130	16	30	10	58	86
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0
Alkalinity as CaCO <sub>3</sub> (mg/L)	25	2	31	34	11	6	110	13	25	8	48	70
pH	7.2	4.8	7.5	7.1	6.6	6.5	7.5	6.5	7.5	6.9	6.6	8.0
Silica (mg/L)	7.6	8.0	7.5	10	8.2	2.4	7.0	12	9.0	12	8.0	6.6
Calcium (mg/L)	9.1	1.8	13	9.6	8.3	3.7	32	2.9	7.5	3.1	19	24
Magnesium (mg/L)	1.4	0.6	1.0	1.7	0.7	1.5	6.8	1.3	2.8	1.3	4.2	7.3
Sodium (mg/L)	2.3	1.9	2.4	8.3	2.0	1.8	2.2	4.3	3.9	2.0	7.1	7.6
Potassium (mg/L)	0.9	0.3	1.3	1.3	0.8	1.4	1.3	0.8	1.8	1.5	2.6	3.0
Sulfate (mg/L)	1.8	2.0	1.8	2.8	2.0	9.4	4.2	1.6	4.4	2.6	21	30
Chloride (mg/L)	2.6	2.0	2.0	4.9	1.6	0.8	1.2	1.6	3.2	1.2	2.6	4.0
Fluoride (mg/L)	0.05	<0.05	0.10	0.07	0.05	<0.05	0.08	0.05	0.12	<0.05	0.28	0.15
Nitrate as N (mg/L)	0.18	0.16	0.22	0.20	0.15	0.40	0.35	0.34	0.45	0.24	0.47	0.90
Nitrite as N (mg/L)	0.01	ND	0.01	0.01	0.01	ND	0.01	ND	0.01	ND	0.02	0.07
Ammonia as N (mg/L)	0.02	0.01	0.02	0.02	0.03	0.07	0.05	0.03	0.04	ND	0.11	0.22
Total Kjeldahl Nitrogen as N (mg/L)	0.50	0.40	0.42	0.41	0.46	0.20	0.30	0.18	0.34	0.15	0.65	0.46
Phosphorus as P (mg/L)	0.01	ND	0.01	0.02	0.01	0.03	ND	0.02	0.01	0.01	0.01	0.16
Orthophosphate as P (mg/L)	0.01	ND	0.01	0.01	0.01	ND	ND	0.01	0.01	ND	0.01	0.14
Arsenic ( $\mu$ g/L)	1	<0.5	3	1	3	3	2	ND	<0.5	<0.5	4	3
Barium ( $\mu$ g/L)	50	20	40	70	100	30	30	20	90	40	230	30
Cadmium ( $\mu$ g/L)	<0.5	<0.5	<0.5	<0.5	1	1	<0.5	<0.5	ND	ND	<0.5	ND
Chromium ( $\mu$ g/L)	<0.5	<0.5	<0.5	<0.5	5	<0.5	<0.5	ND	<0.5	<0.5	1	ND
Cobalt ( $\mu$ g/L)	<0.5	2	<0.5	1	<0.5	1	<0.5	ND	<0.5	<0.5	ND	<0.5
Iron ( $\mu$ g/L)	1,700	240	1,100	1,200	2,800	40	100	850	700	500	220	80
Lead ( $\mu$ g/L)	ND	2	4	2	10	2	3	1	2	1	<0.5	2
Manganese ( $\mu$ g/L)	20	30	20	40	150	30	30	70	20	20	90	10
Mercury ( $\mu$ g/L)	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium ( $\mu$ g/L)	2	1	5	1	2	ND	ND	2	<0.5	1	1	1
Silver ( $\mu$ g/L)	ND	ND	<0.5	<0.5	ND	ND	ND	<0.5	ND	<0.5	ND	ND
Strontium ( $\mu$ g/L)	20	10	30	70	50	30	70	40	30	20	70	50
Zinc ( $\mu$ g/L)	30	70	30	30	80	30	30	20	30	30	60	30
Total dissolved solids (mg/L)	41	18	49	60	31	26	120	34	49	30	95	129
Total Suspended Solids (mg/L)	12	3	51	6	23	1	25	20	40	14	265	8

Appendix 6B.--Results of chemical analyses of water samples from selected streams, May-June 1987--continued

Parameter	Site numbers											
	13	14	15	16	17	18	19	20	21	22	23	24
Date	5/12	6/25	5/12	5/20	5/18	5/15	5/15	5/12	5/13	5/19	5/19	5/19
Time	0757	1500	1234	1730	1019	1148	1227	1420	0900	1250	0927	1422
Flow (cfs)	908	96.8	90.0	80.7	258	46.0	446	3.52	365	30.0	15.8	60.0
Specific conductance $\mu$ mhos/cm	174	286	73	120	420	162	196	68	26	252	76	174
Temperature (°C)	21	30	22	26	24	24	23	22	21	23	21	25
Dissolved Oxygen (mg/L)	9.2	6.8	6.6	7.8	6.1	8.5	8.3	8.1	8.4	6.8	7.0	6.2
Bicarbonate (mg/L)	120	160	25	26	110	22	37	36	6	150	15	160
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0
Alkalinity as CaCO <sub>3</sub> (mg/L)	98	130	21	21	90	18	30	30	5	120	12	130
pH	8.2	7.6	7.1	6.4	7.9	6.8	6.9	7.0	5.8	7.6	6.5	7.0
Silica (mg/L)	6.2	12	11	7.3	10	8.2	3.2	12	7.6	4.0	4.6	4.3
Calcium (mg/L)	33	52	8.1	8.4	40	6.7	15	12	2.3	41	6.5	47
Magnesium (mg/L)	10	1.9	2.2	6.7	13	5.2	8.4	0.9	0.7	6.2	2.3	6.3
Sodium (mg/L)	5.1	3.3	5.6	2.9	26	15	7.9	2.5	2.9	2.2	2.8	1.6
Potassium (mg/L)	2.1	1.2	1.8	1.5	8.5	1.6	2.0	0.9	0.7	0.8	1.9	0.7
Sulfate (mg/L)	20	12	13	31	67	34	48	4	3	10	12	11
Chloride (mg/L)	2.3	2.8	3.0	1.1	21	12	3.2	1.5	3.2	1.6	3.9	1.1
Fluoride (mg/L)	0.05	0.15	0.08	0.05	0.67	0.05	0.06	0.05	0.07	0.10	0.05	0.08
Nitrate as N (mg/L)	0.38	0.16	0.17	0.27	5.50	0.18	0.63	0.05	0.15	0.31	0.84	0.37
Nitrite as N (mg/L)	ND	ND	0.01	ND	0.16	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Ammonia as N (mg/L)	0.05	ND	0.08	0.02	0.20	0.04	0.07	0.02	0.02	0.03	0.03	0.01
Total Kjeldahl Nitrogen as N (mg/L)	0.21	0.28	0.72	0.28	0.20	0.23	0.24	0.45	0.39	0.25	0.24	0.18
Phosphorus as P (mg/L)	0.03	0.02	0.02	0.02	0.98	0.01	0.01	0.02	0.01	ND	0.02	0.01
Orthophosphate as P (mg/L)	0.02	0.01	0.01	ND	0.98	ND	ND	0.01	ND	ND	0.01	ND
Arsenic ( $\mu$ g/L)	1	1	<0.5	2	6	2	3	1	1	2	2	ND
Barium ( $\mu$ g/L)	40	30	30	40	40	110	20	40	20	40	60	40
Cadmium ( $\mu$ g/L)	<0.5	<0.5	<0.5	ND	<0.5	ND	ND	<0.5	1	1	1	2
Chromium ( $\mu$ g/L)	<0.5	2	<0.5	ND	<0.5	ND	ND	1	<0.5	<0.5	<0.5	ND
Cobalt ( $\mu$ g/L)	ND	<0.5	1	<0.5	1	<0.5	<0.5	ND	<0.5	<0.5	<0.5	1
Iron ( $\mu$ g/L)	50	40	790	840	10	440	10	780	570	40	290	30
Lead ( $\mu$ g/L)	1	1	1	ND	<0.5	1	<0.5	2	2	2	9	1
Manganese ( $\mu$ g/L)	10	20	60	70	10	80	10	50	40	20	40	30
Mercury ( $\mu$ g/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium ( $\mu$ g/L)	2	1	ND	4	ND	3	2	2	2	2	4	2
Silver ( $\mu$ g/L)	ND	ND	ND	<0.5	<0.5	ND	ND	ND	ND	ND	<0.5	ND
Strontium ( $\mu$ g/L)	50	190	110	30	80	40	60	70	20	260	50	210
Zinc ( $\mu$ g/L)	40	40	30	30	70	30	40	60	30	30	30	40
Total dissolved solids (mg/L)	140	165	58	73	264	94	109	52	24	141	45	152
Total Suspended Solids (mg/L)	11	18	73	4	13	8	11	76	14	7	1	10

Appendix 6B.--Results of chemical analyses of water samples from selected streams, May-June 1987--continued

Parameter	Site numbers											
	25	26	27	28	29	30	31	32	33	34	35	36
Date	5/19	5/20	5/20	5/20	5/19	5/14	5/13	5/20	5/18	5/26	5/15	5/27
Time	1502	0945	1425	1203	1603	1017	1341	1616	1507	1350	0930	1025
Flow (cfs)	135	8.36	32.1	13.0	6.48	122	11.0	58.0	209	253	65.0	61.9
Specific conductance $\mu$ mhos/cm	144	236	69	230	331	53	35	32	125	40	212	150
Temperature (°C)	24	24	26	18	20	22	23	25	23	23	23	24
Dissolved Oxygen (mg/L)	8.7	3.4	6.9	7.5	8.7	8.2	8.0	8.0	6.6	9.1	6.7	5.5
Bicarbonate (mg/L)	44	130	14	120	180	18	16	12	71	14	98	58
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0
Alkalinity as CaCO <sub>3</sub> (mg/L)	36	110	11	98	150	15	13	10	58	11	80	48
pH	7.2	6.9	6.5	6.6	6.9	6.8	6.9	6.3	7.2	6.6	8.0	6.9
Silica (mg/L)	7.4	4.6	2.6	5.4	9.6	9.0	5.6	8.2	9.8	14	4.4	7.0
Calcium (mg/L)	21	41	5.0	39	57	5.9	6.3	2.5	15	3.1	35	16
Magnesium (mg/L)	4.0	3.0	2.2	2.2	6.1	1.3	0.9	1.0	6.2	1.1	1.2	4.4
Sodium (mg/L)	1.5	3.9	2.2	2.7	2.8	3.1	1.6	1.6	1.9	4.1	5.4	6.1
Potassium (mg/L)	1.3	1.5	1.5	1.3	0.7	0.9	0.4	1.0	1.2	0.8	2.2	2.2
Sulfate (mg/L)	3.2	3.8	9.8	7.2	7.4	2.6	1.9	2.0	3.4	1.4	14	13
Chloride (mg/L)	1.8	3.7	1.8	3.4	3.6	3.2	1.6	1.0	0.6	1.2	5.0	2.2
Fluoride (mg/L)	0.05	0.07	0.05	0.06	0.07	0.13	<0.05	0.05	0.05	0.05	0.22	0.10
Nitrate as N (mg/L)	1.06	0.83	0.50	0.42	2.40	0.66	0.16	0.28	0.28	0.06	0.35	0.29
Nitrite as N (mg/L)	0.02	0.01	ND	0.01	ND	0.02	ND	ND	0.01	ND	0.03	ND
Ammonia as N (mg/L)	0.06	0.13	0.01	0.02	ND	0.03	0.07	0.03	0.08	ND	0.12	0.05
Total Kjeldahl Nitrogen as N (mg/L)	0.25	0.41	0.23	0.18	0.22	0.03	0.52	0.22	0.22	0.05	0.56	0.44
Phosphorus as P (mg/L)	0.22	0.01	0.05	0.03	0.06	0.02	ND	0.04	0.01	0.01	0.03	0.01
Orthophosphate as P (mg/L)	0.02	0.01	ND	ND	0.01	0.02	ND	ND	0.01	ND	0.02	ND
Arsenic ( $\mu$ g/L)	1	1	2	1	1	1	ND	2	1	2	3	<0.5
Barium ( $\mu$ g/L)	30	40	20	60	50	50	20	10	20	20	60	100
Cadmium ( $\mu$ g/L)	3	ND	ND	<0.5	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND	<0.5
Chromium ( $\mu$ g/L)	<0.5	1	ND	ND	<0.5	<0.5	1	ND	<0.5	<0.5	<0.5	<0.5
Cobalt ( $\mu$ g/L)	ND	<0.5	ND	ND	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	ND
Iron ( $\mu$ g/L)	60	60	100	10	10	110	580	610	150	460	200	100
Lead ( $\mu$ g/L)	1	ND	ND	ND	1	<0.5	3	ND	<0.5	ND	1	ND
Manganese ( $\mu$ g/L)	20	100	50	320	<5	20	40	60	30	20	10	50
Mercury ( $\mu$ g/L)	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium ( $\mu$ g/L)	3	2	3	3	3	<0.5	1	1	ND	2	1	2
Silver ( $\mu$ g/L)	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.5
Strontium ( $\mu$ g/L)	50	90	30	90	130	30	10	10	50	30	170	30
Zinc ( $\mu$ g/L)	30	30	30	40	40	30	30	20	30	20	40	40
Total dissolved solids (mg/L)	67	129	34	122	187	38	27	24	74	30	117	81
Total Suspended Solids (mg/L)	8	9	4	28	9	26	13	5	10	5	115	50

Appendix 6B.--Results of chemical analyses of water samples from selected streams, May-June 1987--continued

Parameter	Site numbers										
	37	38	39	40	41	42	43	44	45	46	47
Date	5/12	5/21	5/18	5/26	5/26	5/18	5/26	5/21	5/26	5/27	5/27
Time	0924	1202	1134	0948	1045	0849	0812	1251	0904	0954	0929
Flow (cfs)	87.0	247	117	852	12.0	305	343	160	1,010	38.0	120
Specific conductance $\mu$ mhos/cm	286	37	148	87	250	480	36	36	148	231	150
Temperature (°C)	20	24	24	25	27	22	22	24	25	25	24
Dissolved Oxygen (mg/L)	8.4	6.8	8.7	6.8	7.6	6.7	6.4	8.2	7.2	7.0	6.6
Bicarbonate (mg/L)	10	14	44	31	98	150	12	18	62	120	56
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0	0	0
Alkalinity as CaCO <sub>3</sub> (mg/L)	8	11	36	25	80	120	10	15	52	98	46
pH	6.8	6.3	6.9	6.9	7.1	7.9	6.5	6.3	7.1	7.2	6.8
Silica (mg/L)	10	7.8	3.4	12	9.8	10	7.0	10	10	3.8	8.8
Calcium (mg/L)	2.4	2.6	16	9.2	37	45	3.0	2.5	20	35	14
Magnesium (mg/L)	1.0	1.1	2.8	1.6	4.0	15	0.9	1.1	2.4	5.0	5.3
Sodium (mg/L)	1.9	2.8	6.6	5.8	8.7	33	4.4	2.2	6.6	4.9	8.2
Potassium (mg/L)	1.2	1.0	3.7	1.5	2.3	5.7	1.4	1.2	1.8	3.5	1.8
Sulfate (mg/L)	1.6	2.2	13	7.9	32	93	4.4	3.8	13	12	20
Chloride (mg/L)	0.9	1.9	6.9	2.9	5.9	25	2.4	2.2	4.3	2.6	2.6
Fluoride (mg/L)	0.05	<0.05	0.13	0.08	0.18	0.82	0.07	0.05	0.09	0.05	0.06
Nitrate as N (mg/L)	0.12	0.38	2.48	0.19	0.11	1.74	0.04	0.34	0.27	0.06	0.75
Nitrite as N (mg/L)	ND	ND	0.02	0.01	0.01	0.04	ND	ND	0.01	ND	0.04
Ammonia as N (mg/L)	0.04	0.05	0.10	0.11	0.01	0.04	0.19	0.03	0.03	0.03	0.13
Total Kjeldahl Nitrogen as N (mg/L)	0.29	0.30	0.38	0.46	0.46	0.38	0.72	0.18	0.32	0.17	0.28
Phosphorus as P (mg/L)	0.01	ND	0.11	0.03	0.03	ND	0.12	0.01	ND	ND	0.12
Orthophosphate as P (mg/L)	ND	ND	0.11	0.01	0.01	0.72	0.12	ND	ND	ND	0.09
Arsenic ( $\mu$ g/L)	2	2	4	4	1	7	4	3	2	ND	2
Barium ( $\mu$ g/L)	40	20	30	80	70	30	200	30	70	70	60
Cadmium ( $\mu$ g/L)	ND	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	ND	<0.5	<0.5	<0.5
Chromium ( $\mu$ g/L)	<0.5	<0.5	<0.5	1	<0.5	ND	1	<0.5	1	<0.5	<0.5
Cobalt ( $\mu$ g/L)	1	ND	<0.5	<0.5	1	1	2	1	1	ND	ND
Iron ( $\mu$ g/L)	110	670	110	1,000	310	40	920	780	570	20	110
Lead ( $\mu$ g/L)	1	ND	ND	1	3	ND	1	1	3	<0.5	1
Manganese ( $\mu$ g/L)	270	190	50	20	150	130	670	230	50	60	70
Mercury ( $\mu$ g/L)	ND	ND	ND	ND	ND	0.10	ND	ND	ND	ND	ND
Selenium ( $\mu$ g/L)	1	3	ND	3	1	2	1	3	6	1	2
Silver ( $\mu$ g/L)	ND	<0.5	<0.5	ND	<0.5	<0.5	<0.5	<0.5	ND	ND	ND
Strontium ( $\mu$ g/L)	30	10	30	80	300	130	40	10	130	40	50
Zinc ( $\mu$ g/L)	40	30	30	40	30	40	20	30	40	10	60
Total dissolved solids (mg/L)	24	28	85	57	149	302	30	33	90	126	92
Total Suspended Solids (mg/L)	12	47	8	98	30	52	550	14	73	22	24



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