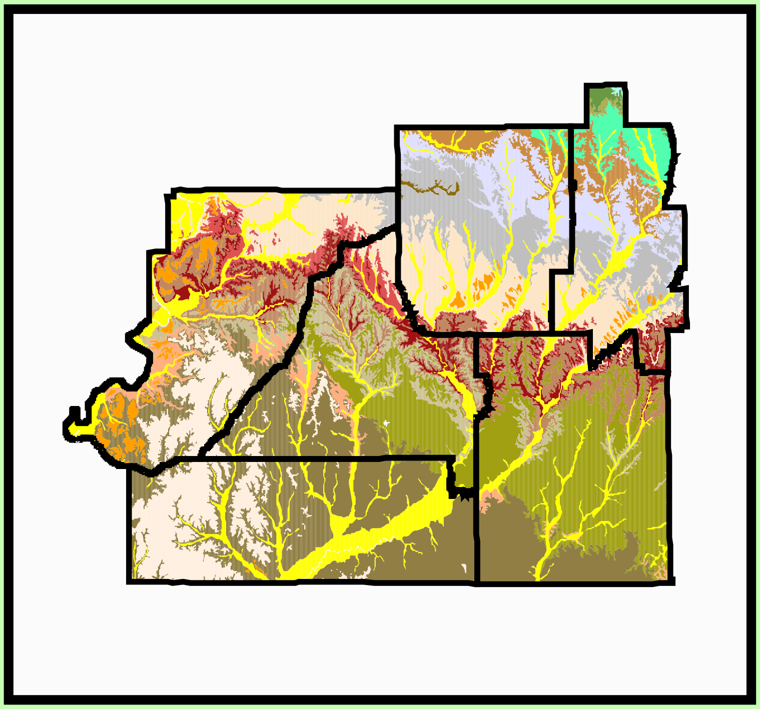
# HYDROGEOLOGY AND VULNERABILITY TO CONTAMINATION OF MAJOR AQUIFERS IN ALABAMA: AREA 11



*GEOLOGICAL SURVEY OF ALABAMA*
*CIRCULAR 199 E*
*2004*

# *GEOLOGICAL SURVEY OF ALABAMA*

***Berry H. (Nick) Tew, Jr,***
*State Geologist*

*420 Hackberry Lane*
*P.O. Box 869999*
*Tuscaloosa, Alabama 35486-6999*
*Phone (205)349-2852*
*Fax (205)349-2861*
*www.gsa.state.al.us*

February 27, 2004

The Honorable Bob Riley
Governor of Alabama
Montgomery, Alabama

Dear Governor Riley:

It is with pleasure that I make available to you and the citizens of Alabama the publication "Hydrogeology and Vulnerability of Major Aquifers to Contamination in Alabama: Area 11," by Blakeney Gillett, Dorothy E. Raymond and James D. Moore. It is published as Circular 199E of the Geological Survey of Alabama and is the result of a cooperative effort between the Survey and the Alabama Department of Environmental Management.

The publication contains information on the geology, characteristics of the major aquifers, and public supply wells in Butler, Conecuh, Covington, Crenshaw, Escambia, and Monroe Counties. This report is the fourth in a 13-part series that will ultimately cover the entire state. These studies will provide vital information to engineers, geologists, resource managers, city planners, and others regarding the ground water resources of Alabama.

Respectfully,

Berry H. (Nick) Tew, Jr.
State Geologist

GEOLOGICAL SURVEY OF ALABAMA

Berry H.(Nick) Tew, Jr.
State Geologist

WATER INVESTIGATIONS DIVISION

**CIRCULAR 199E**

# HYDROGEOLOGY AND VULNERABILITY TO CONTAMINATION OF MAJOR AQUIFERS IN ALABAMA: AREA 11

By
Blakeney Gillett, Dorothy E. Raymond,
and James D. Moore

Prepared by the Geological Survey of Alabama in cooperation with
the Alabama Department of Environmental Management

Tuscaloosa, Alabama
2004

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# HYDROGEOLOGY AND VULNERABILITY TO CONTAMINATION OF MAJOR AQUIFERS IN ALABAMA: AREA 11

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## ABSTRACT

The Geological Survey of Alabama (GSA), in cooperation with the Alabama Department of Environmental Management (ADEM), is revising and expanding a series of reports that delineates the major aquifers in Alabama and characterizes their vulnerability to contamination. The original reports were prepared by the U.S. Geological Survey in cooperation with ADEM. The state is divided into 13 areas that are addressed in separate reports. The hydrogeology and vulnerability to contamination of the major aquifers in Area 11, which includes Butler, Conecuh, Covington, Crenshaw, Escambia, and Monroe Counties, are described in this report, currently available only in digital format.

The aquifers in the study area are the Ripley aquifer, the Clayton aquifer, the Nanafalia aquifer, the Lisbon aquifer, the Crystal River aquifer, the Miocene-Pliocene aquifer, and the watercourse aquifer. Rock units comprising these aquifers crop out in and north of the study area.

The Ripley aquifer consists of permeable beds in the Selma Group (primarily the Ripley Formation). The Clayton aquifer consists of permeable sediments of the Midway Group, primarily the Clayton Formation. The Nanafalia aquifer consists of permeable units of the lower Wilcox Group in the subsurface. The Lisbon aquifer includes the upper part of the Tuscahoma Sand, the Hatchetigbee Formation, the Claiborne Group, and the Moodys Branch Formation of the Jackson Group. The Crystal River aquifer includes the upper part of the Jackson Group and much of the lower Oligocene Vicksburg Group. The Miocene-Pliocene aquifer consists predominantly of the Citronelle Formation and the undifferentiated deposits of the Miocene Series, and locally includes the Paynes Hammock Sand and Chickasawhay Limestone of upper Oligocene age.

Water in these aquifers is generally unconfined in the outcrop areas of the rock units and is under artesian conditions downdip. The largest pumping centers are at Andalusia and Monroeville. Ground water use at Andalusia is more than 2.15 million gallons per day. Ground water use at Monroeville is about 2.37 million gallons per day. Estimated ground water withdrawal for all uses in the area is about 30.35 million gallons per day (Mooty and Richardson, 1998).

Ground water withdrawals have caused depressions in the potentiometric surface of the Lisbon aquifer in the vicinities of Andalusia and Opp. Depressions have also formed in the potentiometric surfaces of the Nanafalia aquifer in the vicinities of Luverne, Andalusia, Beatrice, and Monroeville, and of the Ripley aquifer at Greenville.

The recharge areas for all the major aquifers in the study area are vulnerable to contamination from the surface. Large parts of the recharge areas, however, are located in

rural areas that are used for timberlands, farms, and pastures and are several miles from pumping centers.

Pumping of public water supply wells and irrigation wells can increase the potential for contamination of aquifers if not properly planned, managed, and monitored. Pumping of large quantities of ground water creates cones of depression, increases flow gradients, and draws ground water and any associated contaminants toward pumping wells.

## INTRODUCTION

The U.S. Geological Survey, in cooperation with ADEM, conducted a series of geohydrologic studies in Alabama to delineate the major aquifers and their recharge areas and to define areas susceptible to contamination from the surface. Different authors studied each of the 13 areas of the state. Castleberry and others (1989) summarized the characteristics of the aquifers in Area 11, which includes Butler, Conecuh, Covington, Crenshaw, Escambia, and Monroe Counties. The present study is a cooperative effort between GSA and ADEM to update and supplement the results of the previous study and to provide the hydrogeologic information in a digital format on a CD-ROM that can be easily accessed by anyone with a computer. In addition to the document you are now reading, the CD-ROM for Area 11 also contains a GIS database and a copy of the program ARC Explorer from ESRI, Inc. The GIS database includes all of the data used to make the maps that appear as plates in this report. The file Readme, located in the root directory of this CD-ROM, provides information about how to access the GIS database using ARC Explorer.

The extent to which Area 11 is dependent on ground water is not fully addressed in this report, which discusses only public water supply wells. The numerous domestic supply wells that are present throughout the area are not discussed individually.

### ACKNOWLEDGMENTS

The authors thank the well drillers and managers and operators of water supply systems in Butler, Conecuh, Covington, Crenshaw, Escambia, and Monroe Counties for information they provided about their wells. In addition, Sonja Massey, Fred Mason, and Enid Bittner of ADEM provided assistance and suggestions in the preparation of this report. Geographic Information Systems (GIS) support was provided by Ruth T. Collier, Douglas R. Taylor, and Gary Crawford of the GSA. Their efforts are greatly appreciated.

### PURPOSE AND SCOPE

The purposes of this report are to (1) describe the hydrogeology of the study area; (2) delineate, redefine, and describe the major aquifers and their recharge areas; (3) delineate areas that are vulnerable to contamination; (4) delineate the Source Water Assessment Areas or Wellhead Protection Areas as defined under §335-7-5 and §335-7-12 of ADEM's administrative code and as currently identified in the study area; (5) identify the locations of public supply wells in the study area; and (6) provide all hydrogeologic data in a digital GIS format that can be readily accessed by scientists and the public.

The Geologic Map of Alabama (Szabo and Copeland, 1988) at a scale of 1:250,000 provides new geologic data from which to update the previous aquifer susceptibility map by

Castleberry and others (1989). In the study by Castleberry and others (1989) all wells used for municipal and rural public water supplies were inventoried. For the present study, water-level data from the GSA's regular monitoring program and historical water-level data were used to prepare generalized potentiometric surface maps of the aquifers. Areas vulnerable to contamination were delineated from topographic maps and geologic maps. Wellhead protection area boundaries came from reports submitted to ADEM by public water supply systems that have completed wellhead protection projects.

## LOCATION AND EXTENT OF THE STUDY AREA

Area 11 is in southwestern Alabama and includes Butler, Conecuh, Covington, Crenshaw, Escambia, and Monroe Counties (plate 1). These counties have a combined land area of about 5,252 square miles (Castleberry and others, 1989). The area includes the cities of Andalusia, Greenville, Evergreen, Monroeville, Luverne, Atmore, Brewton, and Opp and numerous other small towns and communities. The total population of the area was 111,480 in 1995 (Mooty and Richardson, 1998). Although predominantly rural, significant urban and suburban areas are present. All the population is dependent on ground water for household use.

## PREVIOUS INVESTIGATIONS

Numerous reports describe the geology and hydrology of the study area. Michael Tuomey published information on the geology of the area as early as 1858 in the second biennial report of the Geological Survey of Alabama. The Geological Survey of Alabama published a detailed description of the geology of Alabama and a geologic map in 1926 (Adams and others, 1926). In 1988, the Geological Survey of Alabama published a new geologic map for the state that provides the most up-to-date mapping of the geology of the six-county area (Szabo and Copeland, 1988) (plate 1).

The earliest information on ground water in the study area was published in 1907 (Smith, 1907). Other reports that contain information on the geology and ground water resources of the area are *Geologic Map of the Tertiary Formations of Alabama* (MacNeil, 1946a); *Geology and Ground-Water Resources of Escambia County, Alabama* (Cagle and Newton, 1963); *Geologic Map of Butler County, Alabama* (Reed, Newton, and Scott, 1967); *Water Availability Map of Butler County, Alabama* (Reed, Scott, Golden, and Avrett, 1967); *Geologic Map of Crenshaw County, Alabama* (McWilliams, Newton, and Scott, 1968); *Water Availability Map of Crenshaw County, Alabama* (McWilliams, Scott, Golden, and Avrett, 1968); *Geologic Map of Conecuh County, Alabama* (Reed, 1968); *Water Availability Map of Conecuh County, Alabama* (Reed and others, 1968; *Geologic Map of Covington County, Alabama* (Turner and Scott, 1968); *Water Availability Map of Covington County, Alabama* (Turner and others, 1968); *Geology of Monroe County, Alabama* (Scott, 1971); *Water Availability of Monroe County, Alabama* (Scott and others, 1972); *Water Content and Potential Yield of Significant Aquifers in Alabama* (Barksdale and others, 1976); *Map of Fresh and Slightly Saline Ground-Water Resources in the Coastal Plain of Alabama* (Ellard,1977); *Configuration of the Base of the Miocene Series* (Moore and Raymond, 1985); *Watercourse Aquifers in Alabama* (Moore and Hunter, 1991); and *Aquifers in Alabama* (Moore, 1992).

## PHYSICAL FEATURES

Area 11 includes parts of seven physiographic districts within the East Gulf Coastal Plain section of the Coastal Plain physiographic province (fig. 1). The northernmost part of Crenshaw County is in the Black Prairie district. This district consists of an undulating, deeply weathered plain developed primarily on marl. Drainage in the area is northward to the Alabama River.

The northeastern part of Butler County and the northern part of Crenshaw County are in the Chunnenuggee Hills district (fig. 1). This area is characterized by sandy cuestas that have fairly steep northward-facing escarpments and gently to moderately rolling backslopes. The land surface in the area ranges from about 350 to 600 feet above sea level. Drainage in the area is northward to the Alabama River along the escarpments of the cuestas, but is southward to the Conecuh River along the backslopes.

The northeastern part of Monroe County, the northern part of Conecuh and Covington Counties, the central part of Crenshaw County, and all except the northernmost part of Butler County are in the Southern Red Hills district. This area is characterized by a southward gently sloping upland of moderate relief. The land surface in the area ranges from about 100 feet above sea level in northern Monroe County to about 450 feet above sea level south of the town of Luverne. Drainage in the area is southward to the Conecuh River and northwest and westward to the Alabama River.

The westernmost part of Monroe County is in the Alluvial Plain district. This area is characterized by broad, flat flood plains and terraces and is periodically inundated by floods on the Alabama River. The land surface ranges from about 25 feet above sea level in southwestern Monroe County to about 120 feet above sea level in northwestern Monroe County.

The north central part of Monroe County and the northwestern and eastern parts of Conecuh County are in the Lime Hills district. This area consists mainly of a rugged hilly terrain. The land surface ranges from about 100 feet above sea level in creek valleys to as much as 450 feet above sea level on hilltops. Drainage in the area is westward to the Alabama River and southward to the Conecuh River.

The east central part of Monroe County, the northeastern part of Escambia County, and the central parts of Conecuh and Covington Counties are in the Dougherty Plain district. This area is dominated by low cuestas underlain by weathered limestone (residuum). The land surface ranges from 100 to 400 feet above sea level. Drainage is westward to the Alabama River, southward and northward to the Conecuh River, and southward and westward to the Yellow River. The southern parts of Covington and Monroe Counties, the southwestern part of Conecuh County, and all of Escambia County, except the northeasternmost part, are in the Southern Pine Hills district. This area is characterized by upland in the north with relief of up to 250 feet and it slopes gradually to the south where the relief is less than 100 feet. The land surface ranges from 35 to 400 feet above sea level. Drainage is westward to the Alabama River, southward and northward to the Conecuh River, and southward to the Yellow River.

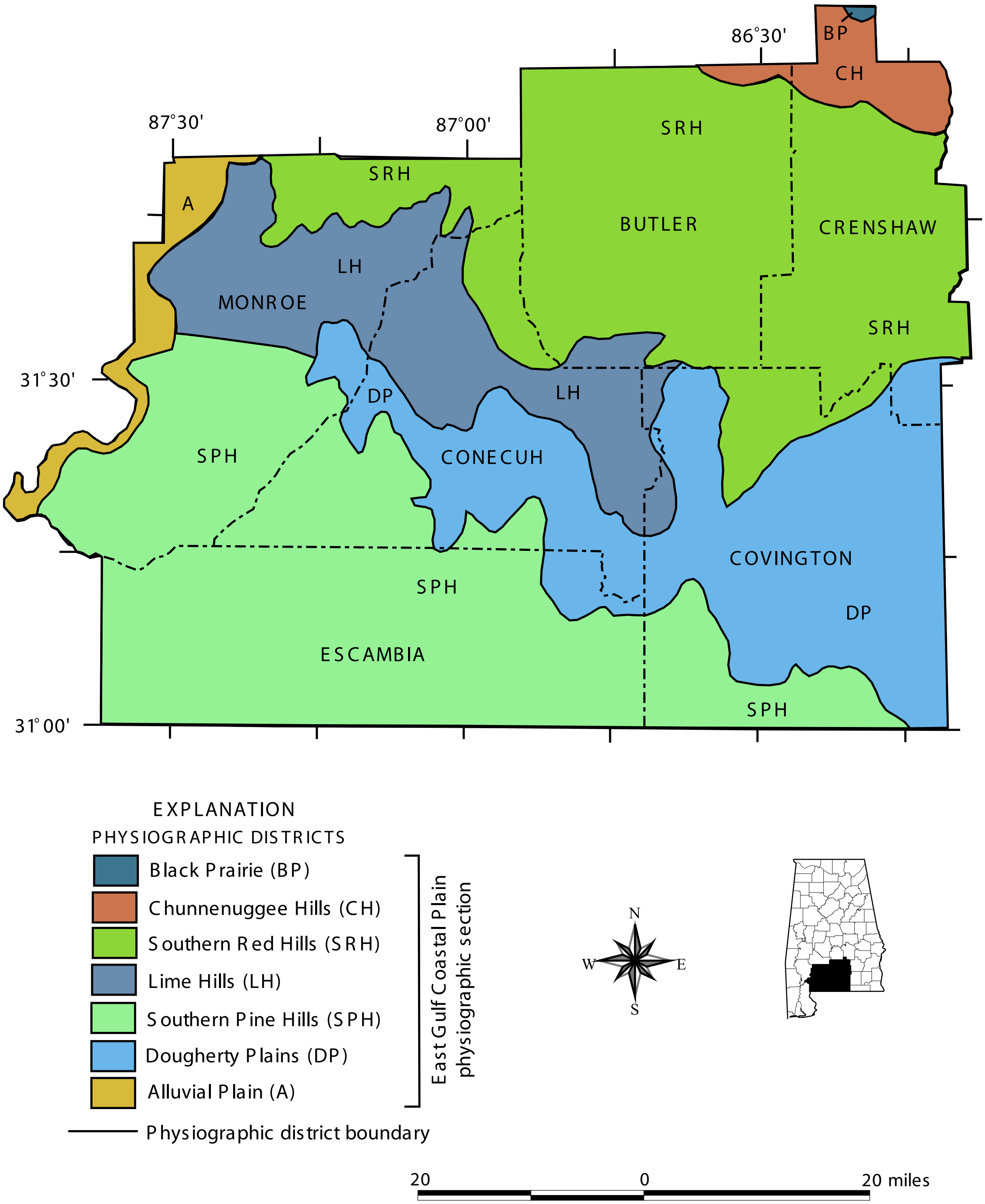



Figure 1.— Physiographic divisions of Area 11 (Sapp and Emplaincourt, 1975).

## STRATIGRAPHY

Geologic units that crop out in and underlie the study area range in age from Cretaceous to Quaternary (table 1, plate 1). Unconsolidated sedimentary deposits of Late Cretaceous age crop out in northern Crenshaw County and northeastern Butler County. Sedimentary rocks of Tertiary age crop out in all but the northeasternmost part of the study area. Alluvial and terrace deposits of Quaternary age overlie older sedimentary rocks in and adjacent to the flood plains of the Alabama and Conecuh Rivers and larger streams in the study area. Figure 2 is a cross section illustrating the generalized subsurface geology and major aquifers in the area. A summary of the thickness, lithology, and water-bearing properties of each geologic unit and major aquifer underlying the study area is given in table 1. Stratigraphy of the units underlying the study area is given below.

The geologic map provided in plate 1 was compiled from maps at scales of 1:250,000 by Szabo and Copeland (1988a, b) and 1:500,000 by Osborne and others (1989) and is the most accurate mapping currently available for Area 11.

Geologic units strike northwestward and dip southwestward about 30 to 40 feet per mile (fig. 3) except in areas affected by folding and faulting. Structural features in the study area include the Pollard and Foshee fault systems and the Conecuh ridge (fig. 4). The Pollard and Foshee fault systems were caused by the movement of salt in the subsurface adjacent to basement faults related to the formation of the Gulf of Mexico. Oil and gas fields are associated with these fault systems.

### CRETACEOUS SYSTEM

Sedimentary deposits of Late Cretaceous age crop out in Butler and Crenshaw Counties and underlie the entire study area (plates 1, 2, 3; fig. 2). These deposits include the Demopolis Chalk, Ripley Formation, Prairie Bluff Chalk, and Providence Sand of the Selma Group (Eargle, 1950; Szabo and Copeland, 1988). Area 11 is an area of major facies changes in Upper Cretaceous sediments.

#### SELMA GROUP

##### DEMOPOLIS CHALK

The Demopolis Chalk overlies the Mooreville Chalk in the subsurface and crops out in the northernmost part of Crenshaw County (plate 1; fig. 2). The Demopolis is about 400 to 450 feet thick, but only the upper 25 to 35 feet of the unit is exposed in the study area. The unit generally consists of chalk, marl, calcareous clay, and sandy clay (Eargle, 1950). The Demopolis Chalk is relatively impermeable and is not a source of water in the study area (fig. 2). The unit is a lower confining layer for the Ripley aquifer.

##### RIPLEY FORMATION

The Ripley Formation overlies the Demopolis Chalk and crops out in northern Crenshaw County (plate 1; fig. 2) and north of the study area. In the subsurface, the formation is about 250 feet thick in the western part of the study area and about 300 feet thick in the eastern part (Castleberry and others, 1989). Thickness is 125 to 200 feet in

Table 1.—Geologic units in Area 11 and their water-bearing properties (modified from Castleberry and others, 1989)

| System | Series/ Group | Geologic units | Aquifer[1] | Thickness (feet) | Lithology | Water-bearing properties | Quality of water |
|---|---|---|---|---|---|---|---|
| Quaternary | Holocene and Pleistocene | Alluvium and terrace deposits | Watercourse | 5-50 | Silt, clay, sand, and gravel, varicolored, unconsolidated. | Potential source of large water supplies in the flood plains of the Alabama and Conecuh Rivers, but is not developed for public water supply. | Generally soft but may contain iron in excess of 0.3 mg/L. |
| Tertiary | Pliocene and Miocene | Citronelle Formation and Miocene undifferentiated | Miocene-Pliocene | 50-650 | Gravel, sand, and clay; sand, medium to coarse, gravelly; micaceous silty fine sand; mottled sandy clay; and silty fine-grained sandstone; deeply weathered silty, sandy clay with fractured chert boulders forms residuum in updip exposures. | Wells produce 50 to 500 gallons per minute (gpm) from the Miocene Series, which is a major aquifer south and east of Area 11. The Citronelle is not a major aquifer because of its thinness but is hydraulically connected to the Miocene. | Soft to moderately hard, generally contains iron in excess of 0.3 mg/L. |
| | Oligocene; Vicksburg Group | Oligocene Series | Crystal River | 50-200 | Limestone, fossiliferous, and carbonaceous sandy clay; deeply weathered to silty sandy clay updip.<br>Limestone, fossiliferous, indurated to soft; deeply weathered to clay with fractured chert boulders updip. | Source of water supply in southeast Covington County; wells produce 250 gpm. | Soft to very hard, locally contains iron in excess of 0.3 mg/L. |
| | Eocene; Jackson Group | Yazoo Clay; Crystal River Fm. | | 35-140 | Limestone, sparsely glauconitic, and sandy in upper part; updip areas weather to residual clay and sand with chert boulders. Yazoo Clay is a sandy, silty clay and silty sand; updip areas weather to a residual clay and sand with chert boulders. | Yazoo Clay is relatively impermeable and is not a source of ground water. Overlying limestone is a source of water supply in southeastern Covington County; wells developed in conjunction with the Oligocene Series produce as much as 750 gpm. | Generally moderately hard, iron content may locally exceed 0.3 mg/L. |
| | Eocene; Claiborne Group | Moodys Branch Formation of the Jackson Group, Gosport Sand, and Lisbon Formation | Lisbon | 20-315 | Moodys Branch is fine to coarse, glauconitic, fossiliferous, calcareous sand and sandy limestone that weather to sand and clay with chert boulders updip. Gosport and Lisbon are fine to coarse sand and sandy clay. | Source of water supply in eastern Escambia County and southern Covington County; wells produce as much as 350 gpm; not a major aquifer in the western part of Area 11 because the unit becomes less permeable. | Soft to hard, locally contains iron in excess of 0.3 mg/L. Lower sands contain more than 1,000 mg/L total dissolved solids in southwestern part of Monroe County. |

[1] Black indicates an aquiclude or aquitard.

Table 1.—Geologic units in Area 11 and their water-bearing properties-Continued

| System | Series/Group | | Geologic units | Aquifer[1] | Thickness (feet) | Lithology | Water-bearing properties | Quality of water |
|---|---|---|---|---|---|---|---|---|
| Tertiary | Eocene | Claiborne Group | Tallahatta Formation | Lisbon<br><br>Lisbon | 40-260 | Claystone, thin-bedded to massive, siliceous, aluminous, interbedded with thin layers of clay, sandy clay, and sand; upper and lower zones of coarse sand; middle zone of thin-bedded siltstone, clay, and claystone. | Source of water supply in central Conecuh County, eastern Escambia County, and Covington County; wells produce as much as 350 gpm. | Soft to moderately hard, iron content is generally less than 0.3 mg/L. Not a major aquifer in the western-most part of Area 11 because water contains more than 1,000 mg/L total dissolved solids. |
| | | Wilcox Group | Hatchetigbee Formation | | 5-275 | Sand and clay, varicolored, laminated to thin-bedded, and carbonaceous. | Relatively impermeable; not a source of ground water in this area. | Soft to hard, iron content is generally less than 0.3 mg/L. |
| | | | Bashi Marl Mbr. | Lisbon | 20 | Abundantly glauconitic fossiliferous fine sand; calcareous fossiliferous sandstone. | A few wells are developed in conjunction with the rest of the Lisbon aquifer in Covington County. | |
| | Paleocene | | Tuscahoma Sand | Nanafalia | 120-375 | Clay, carbonaceous, micaceous, and laminated to massive, and very fine to coarse sand; lower zone of massive to laminated medium to coarse sand in western part of area. | Relatively impermeable. Locally is a source of ground water in Covington County; some wells are developed in conjunction with the rest of the Nanafalia aquifer. | Soft to very hard; iron content may be in excess of 0.3 mg/L; locally hydrogen sulfide odor. |
| | | | Nanafalia Formation: Grampian Hills Mbr. | | 90-110 | Siltstone, silt, and sandy clay. | Relatively impermeable; not a source of ground water. | Soft to moderately hard, iron content is locally less than 0.3 mg/L. |
| | | | Nanafalia Formation: "Ostrea thirsae beds" | | 20-40 | Clay, with fine to medium sand and abundant Odontogryphaea thirsae (Gabb) and other fossils. | Relatively impermeable; not a source of ground water. | |
| | | | Nanafalia Formation: Gravel Creek Mbr. | Nanafalia | 0-45 | Sand, gravelly, micaceous, coarse. | Source of large water supplies in Monroe, Covington, and Butler Counties. Wells produce 75 to 925 gpm. Not an aquifer in southern Monroe County because unit becomes relatively impermeable. | Water in Escambia and southern Conecuh, Monroe, and Covington Counties contains more than 250 mg/L of chlorides. |
| | | Midway Group | Naheola Formation | | 20 | Clay, carbonaceous, and sandy; micaceous clay and silt. | Relatively impermeable; not a source of ground water. | |
| | | | Porters Creek Formation | | 70-250 | Sand, fine to medium; fine fossiliferous clayey sand and silt; and limestone. | Source of water supply only in southern Crenshaw County; wells developed in conjunction with Clayton produce 600 gpm. | Moderately hard to very hard, may contain iron in excess of 0.3 mg/L in some areas. |

1 Black indicates an aquiclude or aquitard.

Table 1.--Geologic units in Area 11 and their water-bearing properties-Continued

| System | Series/ Group | | Geologic units | Aquifer[1] | Thickness (feet) | Lithology | Water-bearing properties | Quality of water |
|---|---|---|---|---|---|---|---|---|
| Tertiary | Paleocene | Midway Group | Clayton Formation | Clayton | 50-170 | Sand, fine to medium; fine fossiliferous clayey sand and silt; and limestone. | Wells produce 140 to 190 gpm in the eastern part of Area 11; relatively impermeable west of Greenville. | Water is moderately hard to hard; locally contains iron in excess of 0.3 mg/L. |
| Cretaceous | Upper Cretaceous | Selma Group | Providence Sand | | 0-150 | Sand in upper part, fine to coarse, and gravelly; lower part is laminated fine sand and silty clay, locally lignitic at base. | Not a major aquifer in Area 11; east of Area 11 the upper sands of the Providence are a major aquifer. | Water generally is soft; contains iron in excess of 0.3 mg/L. |
| | | | Prairie Bluff Chalk | | 25-180 | Clay, sandy, and calcareous; fossiliferous sandy chalk. | Relatively impermeable; not a source of ground water. | |
| | | | Ripley Formation | Ripley | 125-300 | Sand, sandy clay, and calcareous sandstone; fossiliferous sand and sandy chalk. | Source of water in Crenshaw, Butler, and northeasternmost Monroe Counties; wells produce 200 to 600 gpm. | Water in Conecuh, Covington, Escambia and southern Monroe Counties contains more than 1,000 mg/L of chlorides. Locally contains iron in excess of 0.3 mg/L. |
| | | | Demopolis Chalk | | 400-450 | Chalk, marl, calcareous clay, and sandy clay. | Relatively impermeable; not a source of ground water. | |

1 Black indicates an aquiclude or aquitard.

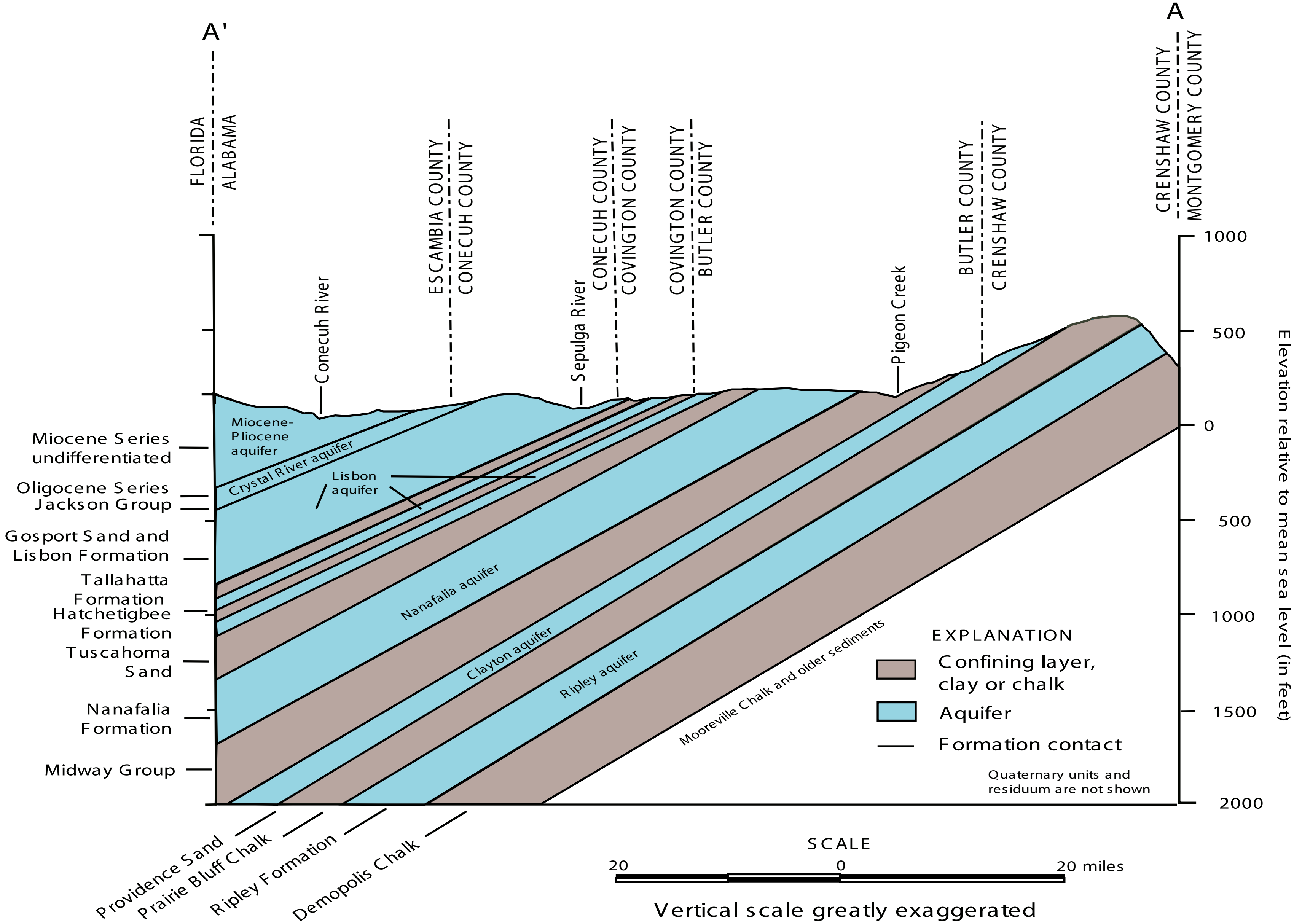



Figure 2.–Generalized subsurface section of the major aquifers in Area 11 (trace of section on plate 1) (modified from Castleberry, and others, 1989).

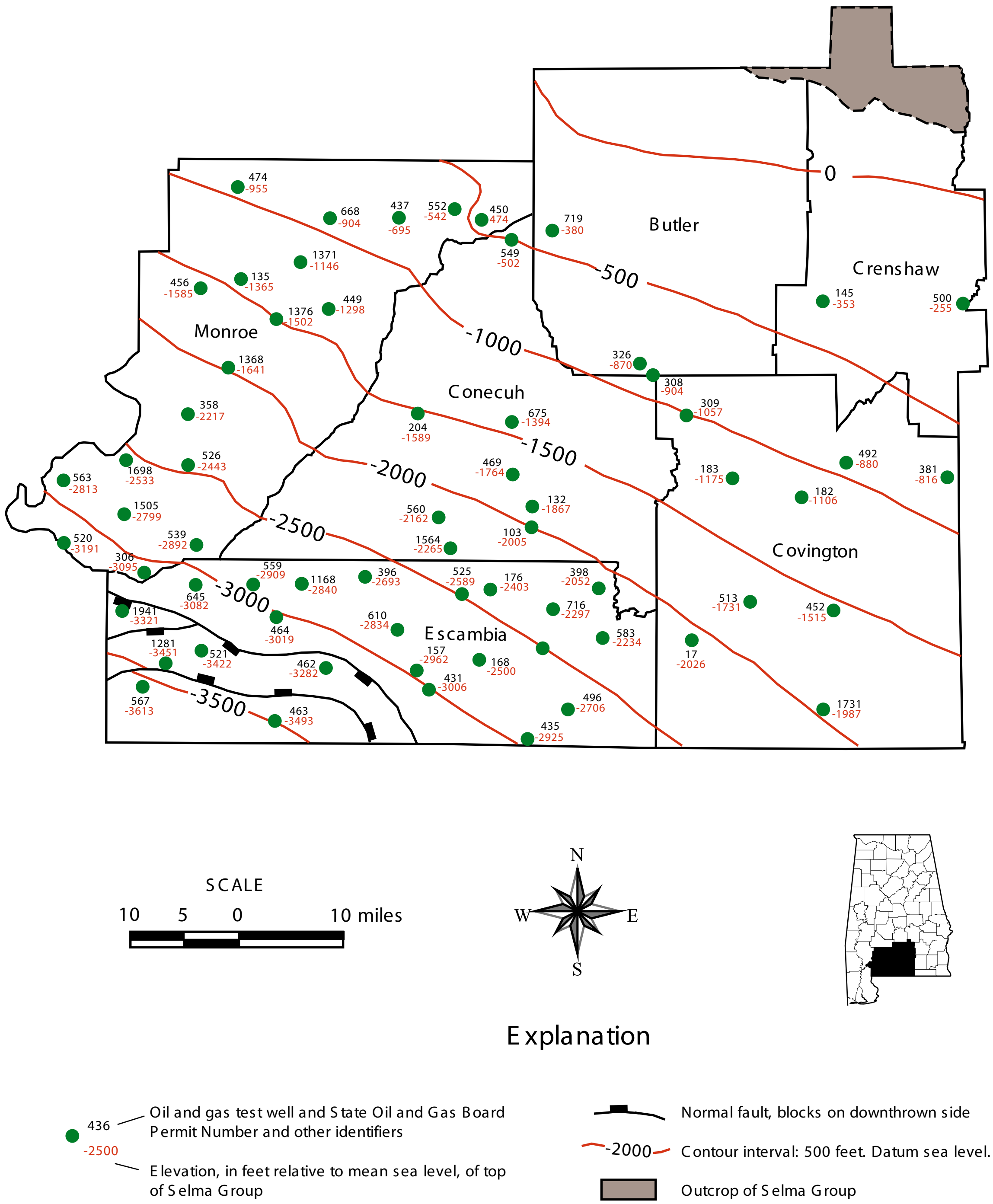



Figure 3. — Configuration of the top of the Selma Group in Area 11 (from Moffett and others, 1984).

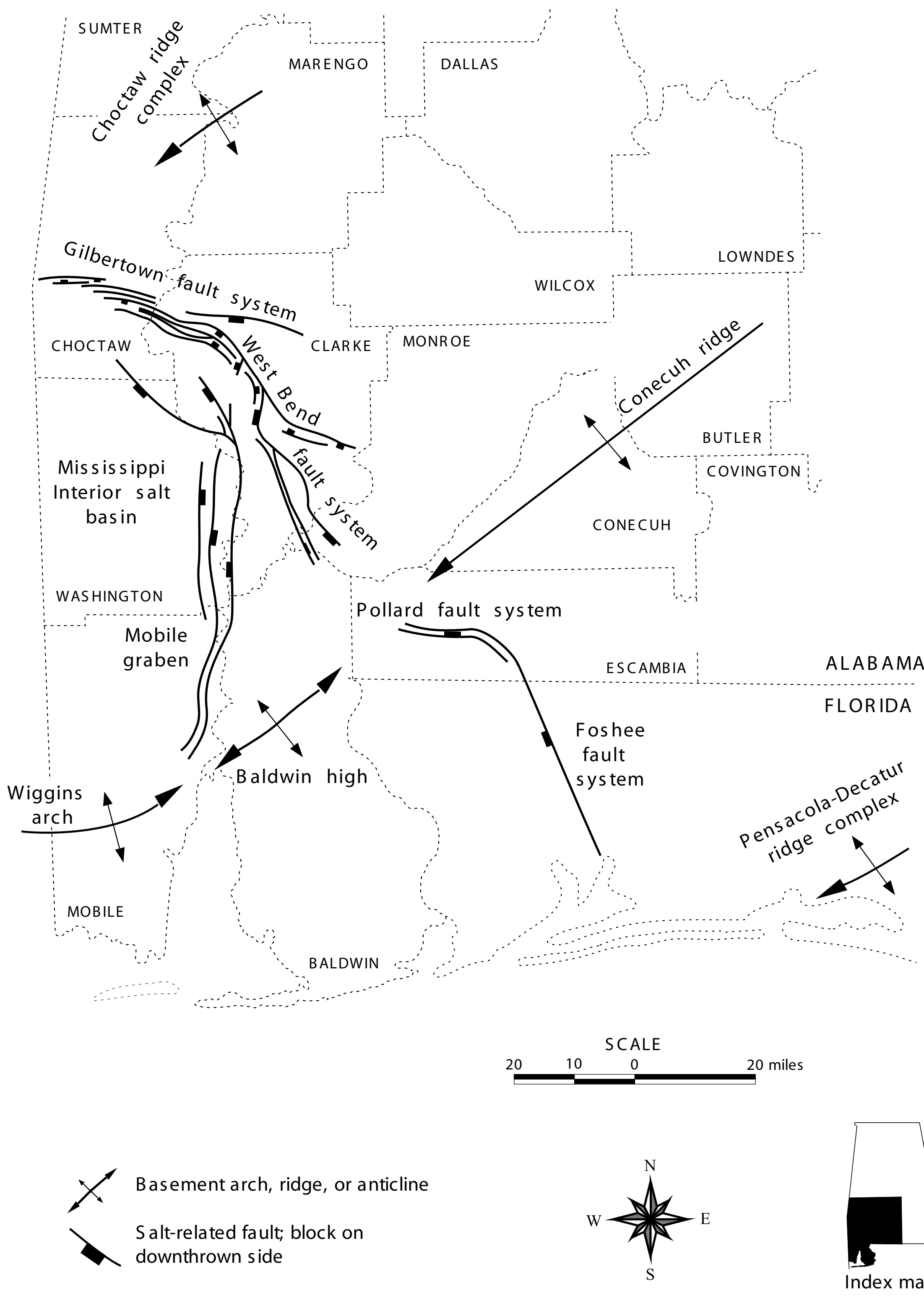



Figure 4. — Structural features of southwest Alabama (Moore, 1971).

northern Butler County (plate 2). In the western part of the study area, the Ripley is composed of sand, sandy clay, and calcareous sandstone (Eargle, 1950). In the eastern part of the area, the lower 100 feet of the unit consists mainly of fossiliferous sand, calcareous sandstone, and sandy chalk; the upper part consists predominantly of sand, sandy clay, silty fossiliferous clay, and calcareous sandstone beds.

Sand of the lower part of the Ripley is correlative with the Cusseta Sand Member of the Ripley in Montgomery County to the north (McWilliams, Newton, and Scott, 1968). The same authors stated that the upper clayey Ripley Sand in Crenshaw County has been mapped as Prairie Bluff to the north.

## PRAIRIE BLUFF CHALK

The Prairie Bluff Chalk overlies the Ripley Formation and crops out in northern Crenshaw County (plate 1; fig. 2). The Prairie Bluff consists of calcareous sandy clay and fossiliferous sandy chalk (Eargle, 1950). Castleberry and others (1989) reported this unit ranges in thickness from 25 feet in the western part of the study area to about 95 feet in eastern Crenshaw County. The Prairie Bluff changes facies eastward where it grades laterally into the Providence Sand. Cross sections A-A′ and B-B′ (plates 2, 3) illustrate a thickness of about 180 feet for the Prairie Bluff in the subsurface in Butler County in well BUTH-01 in Greenville and thinning toward the east in favor of the Providence Sand. Widely varying reported thicknesses for the Prairie Bluff result from the fact that the Prairie Bluff appears to interfinger with the Providence Sand and possibly the Ripley in the study area (McWilliams, Newton, and Scott, 1968). Subsurface studies in progress by Charles Smith (oral communication, 2000) of the Geological Survey of Alabama indicate that surface and subsurface strata presently mapped as Prairie Bluff in the study area may be in part equivalent to lower Providence Sand (plate 3). The Prairie Bluff is relatively impermeable and is not an aquifer in the study area (plate 2).

## PROVIDENCE SAND

The Providence Sand overlies the Prairie Bluff Chalk at the surface and grades laterally into the Prairie Bluff in the subsurface in the study area. Both units were mapped by Szabo and Copeland (1988) in northeastern Butler and northern Crenshaw Counties in Area 11 (plate 1; fig. 2). Stratigraphic relationships between the Providence and Prairie Bluff are not clear, and some geologists (McWilliams, Newton, and Scott, 1968) have mapped no Prairie Bluff and much Providence Sand in Crenshaw County. In this report the mapping of Szabo and Copeland (1988) is followed. However, recent subsurface studies by Charles Smith (oral communication, 2000) indicate possible future stratigraphic revision and have influenced correlation in cross section B-B′ (plate 3).

In outcrop in Crenshaw County the lower part of the formation consists of laminated fine sand and silty clay that is lignitic locally and that thickens westward; the upper part consists of fine to coarse gravelly sand that thickens eastward. Reinhardt and Gibson (1980) reported the upper locally fossiliferous sands also thicken downdip in the subsurface. The Providence is about 150 feet thick in the eastern part of the study area and is absent west of Greenville in Butler County (plates 2, 3)

## TERTIARY SYSTEM

A thick sequence of Tertiary sediment underlies the study area. Units cropping out in and underlying the study area include the Midway, Wilcox, Claiborne, and Jackson Groups; the Oligocene Series undifferentiated and the Miocene Series undifferentiated. Quaternary rocks include the Citronelle Formation and alluvial and terrace deposits (plate 1; fig. 2).

Tertiary sediment overlie the Providence Sand in northern Crenshaw County and northeastern Butler County and overlie the Prairie Bluff Chalk westward from the town of Greenville in Butler County. These formations generally strike west-northwestward and dip southward and southwestward 30 to 50 feet per mile (plates 1, 2; fig. 2).

### PALEOCENE SERIES

#### MIDWAY GROUP

The Midway Group of Paleocene age includes the Clayton Formation, the Porters Creek Formation, and the Naheola Formation (MacNeil, 1946a, b) and overlies the Providence Sand and Prairie Bluff Chalk. The units crop out in northern Butler and north-central Crenshaw Counties (plate 1). The Midway appears to thin to the southeast. In northwestern Monroe County (plate 4, P456) the Midway Group is over 750 feet thick and consists of over 500 feet of Naheola, 200 feet of Porters Creek, and 50 feet of Clayton (Charles Smith, 1999, unpublished data). However, in the COVK-02 well in Opp the Midway is only about 125 feet thick. Formations within the Midway are not differentiated in the southeastern part of Area 11 (southern Covington County).

The Clayton Formation generally consists of fine to medium sand and fine fossiliferous clayey sand and silt in eastern exposures in the study area (MacNeil, 1946b). West of Greenville, the Clayton generally contains beds of limestone, sand, silt, and clay and is relatively impermeable. The Clayton is about 100 feet thick in eastern Crenshaw County, is about 170 feet in Butler County, but is about 50 feet thick in northwestern Monroe County (plates 2, 3, 4, 5).

The Porters Creek Formation is a fine to medium micaceous clayey sand, sandy clay, and silt (MacNeil, 1946b). The formation is sandier and contains some limestone locally in central Monroe (plate 3, MONI-03), northern Covington (plate 3, COVB-02), and Crenshaw Counties and may be used locally as a source of small amounts of water in these areas. In the subsurface in well P456 northwest of Monroeville in Monroe County, the Porters Creek consists of about 200 feet of clay and minor amounts of sand, limestone, glauconite, and sideritic claystone (plate 4). The Porters Creek ranges in thickness from 70 feet in east-central Crenshaw County to more than 250 feet in the subsurface in the southern part of the study area. The formation appears to thin southward and eastward.

The Naheola Formation overlies the Porters Creek Formation. The Naheola typically consists of about 20 feet of carbonaceous sandy clay and micaceous clay and silt in Area 11 (MacNeil, 1946b). The Naheola generally is divided into a lower Oak Hill Member of dark-gray carbonaceous clay interbedded with muscovitic quartzose silt to sand and an upper Coal Bluff Marl Member of fossiliferous, glauconitic, and muscovitic sand and sandy marl. A thin lignite bed at the top of the Oak Hill Member separates the upper and lower members.

In outcrop this formation is very thin to absent in all but the north-westernmost part of Butler County. However, in well Permit 456 (plate 4) in northwest Monroe County, the Naheola is over 500 feet thick (Charles Smith, 1999, unpublished data). Baker and Smith (1999) reported about 150 feet of Naheola in the subsurface in the vicinity of Beatrice in Monroe County.

## WILCOX GROUP

The Wilcox Group of Eocene and Paleocene age includes the Nanafalia Formation, the Salt Mountain Limestone, the Tuscahoma Sand, and the Hatchetigbee Formation (plates 1, 2, 3, 4, 5). The Nanafalia and the Hatchetigbee serve as aquifers in the study area, but most of the Tuscahoma is an aquiclude (fig. 2).

### *NANAFALIA FORMATION*

The Nanafalia Formation overlies the Midway Group and crops out in a northwest-trending belt that extends through southern Crenshaw County, central Butler County, and northeasternmost Monroe County (plate 1). The formation was named for exposures at Nanafalia Landing on the Tombigbee River in southwestern Marengo County (Smith, 1886). The Nanafalia was formally divided into three units by LaMoreaux and Toulmin (1959).

The Nanafalia has a basal zone of coarse gravelly micaceous sand known as the Gravel Creek Sand Member (MacNeil, 1946). This member ranges in thickness from 0 to 40 feet in central Crenshaw County. The Gravel Creek Sand Member thins towards the center of the study area and is absent from Greenville to about 3 miles west of Rutledge. Baker and Smith (1999) reported 40 to 45 feet of Gravel Creek in northern Monroe County. The Gravel Creek Sand Member is overlain by a unit informally called the "*Ostrea thirsae* beds," which consists of 20 to 40 feet of fine to medium glauconitic sand and sandy clay that contains the abundant small oyster *Odontogryphaea thirsae* (Gabb) and other fossils (plate 3). This unit is overlain by the Grampian Hills Member, which consists of 90 to 110 feet of siltstone, silt, and calcareous sandy clay.

The Salt Mountain Limestone, known only from the subsurface in Area 11, is equivalent to the middle part of the Nanafalia (plates 2, 3, 4, 5) and consists of white, massive, indurated fossiliferous limestone and irregular beds of soft friable limestone. Thickness of the Nanafalia ranges from about 100 feet in outcrop in Clarke County to over 600 feet in the subsurface in Escambia County (plate 2).

### *TUSCAHOMA SAND*

The Tuscahoma Sand crops out southwest of the Nanafalia Formation in northern Monroe and Conecuh Counties, and southern Butler and Crenshaw Counties (plate 1). The formation was named for exposures at Tuscahoma Landing on the Tombigbee River 7 miles southeast of Butler in Choctaw County, Alabama. The Tuscahoma generally consists of olive-gray to brown laminated to thin-bedded carbonaceous micaceous clay and silt and light-gray to grayish-brown very fine to fine sand. LaMoreaux and Toulmin (1959) report thin discontinuous beds of lignite in the upper part of the formation. Medium to coarse massive to laminated sands are locally present in the middle and lower parts of the formation. These sands generally pinch out to the east across Alabama (Toulmin, 1977). Where present, the sands serve as a source of water supply (plate 5, COVN-1). The Tuscahoma ranges in thickness from 120 feet at exposures in eastern Crenshaw County to 275 feet at outcrops in northern Monroe County. Generally, the formation thickens to the southwest and is over 375 feet thick in Escambia County (plate 2).

## EOCENE SERIES

### HATCHETIGBEE FORMATION

The Hatchetigbee Formation of the Wilcox Group overlies the Tuscahoma Sand and crops out in a narrow northwest-trending belt in northern Covington County, southern Crenshaw and Butler Counties, and northern Conecuh and Monroe Counties (plates 1, 2, 3, 4, 5; fig. 2). The formation was named for exposures at Hatchetigbee Bluff on the Tombigbee River in Washington County, Alabama (Smith, 1886). The Bashi Marl Member at the base of the Hatchetigbee consists of highly glauconitic fossiliferous sand and fossiliferous calcareous sandstone generally less than 20 feet in thickness. The Hatchetigbee consists of gray carbonaceous and lignitic thin-bedded to laminated clay and sand, glauconitic fossiliferous sand, and fossiliferous calcareous sandstone (MacNeil, 1946; Baker and Smith, 1999). The formation ranges in thickness from 5 feet in the eastern part of the study area to about 275 feet near the Alabama River.

### CLAIBORNE GROUP

The Claiborne Group of Eocene age consists of the Tallahatta Formation, Lisbon Formation, and Gosport Sand. These formations, along with the overlying Moodys Branch Formation, serve as a major aquifer (Lisbon aquifer) in the study area (fig. 2).

The Tallahatta Formation overlies the Hatchetigbee Formation and crops out in a narrow belt in north-central Monroe County, southern Butler and Crenshaw Counties, and northern Conecuh and Covington Counties (plates 1, 2; fig. 2). The formation is not mapped separately from the Lisbon Formation east of the Conecuh River because of the lithologic similarity of the two units. The formation was named for the Tallahatta Hills in central Choctaw County (Dall, 1898). The outcrop of the Tallahatta is characterized by a rugged topography with steep hills forming a north-facing escarpment. The formation consists of white to light-gray thin-bedded indurated siliceous claystone interbedded with thin lenses of clay, sandy clay, sand, indurated sandstone, and coarse-grained sand layers in the top and bottom of the formation (MacNeil, 1946; Baker and Smith, 1999). These sand layers are 15 to 20 feet thick in the vicinity of Evergreen, but are not consistent throughout the study area. Downdip the formation contains thin-bedded sandy fossiliferous limestone. The thickness of the Tallahatta in outcrop ranges from 40 feet in parts of Monroe County to 120 feet in parts of Butler County. The unit thickens in the subsurface to as much as 260 feet (plate 2).

The Lisbon Formation overlies the Tallahatta and crops out in a northwestward-trending belt in central Monroe and Conecuh, southern Butler and Crenshaw, and northern Covington Counties (plates 1, 2). The Lisbon is named for Lisbon Bluff on the Alabama River at Claiborne, Monroe County. The Lisbon is generally a light- to yellowish-gray calcareous glauconitic sand and sandy clay. To the west and south limestone replaces the clastics in the Lisbon in the study area, becoming dominant in Escambia County (plate 2). The Gosport Sand, which overlies the Lisbon, is a calcareous fossiliferous glauconitic sand named for Gosport Bluff on the Alabama River in Monroe and Clarke Counties. The Gosport does not crop out extensively east of the Conecuh River and in that area the Gosport and the Lisbon are mapped with the Tallahatta Formation. Combined thickness of the Lisbon and Gosport is 15 feet in outcrop to about 280 feet in the subsurface downdip (plate 2).

### JACKSON GROUP

The Jackson Group of Eocene age is comprised of the Moodys Branch Formation, the Yazoo Clay, and the Crystal River Formation. The formations overlie the Lisbon and Gosport Formations and crop out in an irregular northwestward-trending belt in southeastern and western Covington County and central Conecuh and Monroe Counties (plates 1, 2). In updip areas of Conecuh and Covington Counties the formations weather to residual clay and sand containing chert boulders and are mapped on the geologic map as part of an undifferentiated unit of residuum (plates 1, 2).

The Moodys Branch is a greenish-gray fine to coarse glauconitic calcareous fossiliferous sand in the western part of the study area and is a glauconitic fossiliferous sandy limestone in the eastern part of the study area (Castleberry and others, 1989). The formation ranges in thickness from about 5 feet near the Alabama River to as much as 110 feet in the central and eastern parts of the study area (plates 1, 2).

The Yazoo Clay is primarily sandy, silty clay with interbeds of silty sand and marl. The Yazoo thins from 50 feet in the eastern part of the study area to 10 feet in Monroe County. The Yazoo grades eastward and southward into the calcareous marine facies of the Crystal River Formation (plate 2). In Escambia County the formation grades into over 70 feet of fossiliferous limestone and some sand assigned to the Crystal River Formation (plate 2, P436).

The Crystal River Formation overlies and grades into the Yazoo Clay in Area 11 and consists of sparsely glauconitic fossiliferous sandy limestone (plate 5) throughout the study area (MacNeil, 1946; Toulmin, 1977; Huddlestun and Toulmin, 1965; Huddlestun, 1965). In outcrop the formation thickens eastward from 25 feet in Monroe County to about 90 feet in Covington County. Southward in the subsurface in Escambia and Covington Counties, the formation reaches 120 feet or more in thickness (plates 2, 5).

## OLIGOCENE SERIES

The Oligocene Series crops out in an irregular northwestward-trending belt in southeastern and western Covington County, northeasternmost Escambia County, southwestern and western Conecuh County, and central Monroe County (plate 1). The Oligocene Series is comprised of the Vicksburg Group (Red Bluff Clay, Bumpnose Limestone, Marianna Limestone, and Byram Formation) and the Chickasawhay Limestone and Paynes Hammock Sand. These units are not differentiated over much of the study area where they are mapped together at the surface as residuum (plates 1, 4, 5). In this area outcrops are deeply weathered making differentiation of units difficult. Collectively, in the subsurface these units consist of indurated to soft fossiliferous limestone in the lower part and carbonaceous sandy clay and fossiliferous limestone in the upper part (MacNeil, 1946). Total thickness ranges from 50 feet at the surface to 200 feet in the subsurface.

## MIOCENE-PLIOCENE SERIES UNDIFFERENTIATED

Sediments of the Miocene-Pliocene Series overlie the Oligocene sediments and crop out in southern Monroe, Conecuh, and Covington Counties and most of Escambia County (plate 1, fig. 2). The Miocene-Pliocene Series undifferentiated consists of medium to coarse gravelly sand, fine micaceous silty sand, mottled sandy clay, and fine-grained silty sandstone (MacNeil, 1946; Castleberry and others, 1989). Updip deeply weathered beds of this geologic unit are mapped as residuum (plate 1). The Miocene Series ranges from 50 feet in updip areas to as much as 650 feet in thickness in southwestern Escambia County.

## PLIOCENE-PLEISTOCENE SERIES

### CITRONELLE FORMATION

The Citronelle Formation of Pliocene age overlies the Miocene Series and crops out in southern Monroe, Conecuh, and Covington Counties, and western and southern Escambia County (plate 1). The Citronelle consists of gravel, sand, and sandy clay (MacNeil, 1946). The formation ranges in thickness from 5 to 50 feet.

## QUATERNARY SYSTEM

Quaternary alluvial deposits overlie older formations in the western and south-central part of the study area (plate 1).

## PLEISTOCENE SERIES

### HIGH TERRACE DEPOSITS

High terrace deposits unconformably overlie older sediments along the major rivers. These deposits are remnants of old alluvial deposits that now form relatively flat uplands in several parts of the study area. The high terrace deposits are up to 40 feet thick and consist of varicolored silt, sand, clay, and gravel.

## PLEISTOCENE AND HOLOCENE SERIES

### ALLUVIAL AND LOW TERRACE DEPOSITS

Alluvial and low terrace deposits overlie older sediments along streams in the study area. The deposits underlie the flood plains or former flood plains of the streams and rivers and consist of sand, silt, gravel, and clay. Such alluvial deposits occur in the flood plains of the Alabama and Conecuh Rivers (plate 1). Terrace and alluvial deposits are undifferentiated on the geologic map because lithologies are similar. The alluvial and terrace deposits generally range in thickness from 10 to 50 feet.

## HYDROGEOLOGY

Geologic units that crop out in and underlie Area 11 contain beds of permeable sand and limestone that serve as reservoirs for water. These permeable beds, called "aquifers" when saturated with water, dip southwestward and supply water to wells in and downdip from their outcrop areas (fig. 2). Water in these aquifers, with the exception of the watercourse aquifer, generally occurs under water table conditions in outcrop and becomes confined downdip. The watercourse aquifer is unconfined. In their outcrop areas, the aquifers also provide the low flow for streams.

Where relatively impermeable beds overlie aquifers, ground water becomes confined under pressure and aquifers become artesian. The surface to which ground water will rise under artesian pressure in a well is called the potentiometric surface. If the potentiometric surface is above the ground surface, the well will flow naturally.

Ground water of adequate quantity and quality for domestic use generally can be obtained at depths of 100 feet or less in most parts of Area 11. Large yield wells (greater than 50 gallons per minute (gpm)) are generally deeper than 100 feet. The shallowest wells are commonly completed in the Miocene-Pliocene aquifer. The deepest well in Area 11 is located in Monroeville and is completed to a depth of 1,394 feet in the Nanafalia aquifer.

The major aquifers in the study area are, in ascending order, the Ripley aquifer, the Nanafalia aquifer, the Lisbon aquifer, the Crystal River aquifer, and the Miocene-Pliocene aquifer (plate 6; table 1). The Clayton aquifer, which overlies the Ripley aquifer, is a minor aquifer in the area. These aquifers underlie the entire study area. Their outcrop areas includes southern Lowndes and Montgomery Counties north of the study area as well as Butler, Conecuh, Covington, Crenshaw, Escambia, and Monroe Counties located within the study area. In most of the study area, water in these aquifers is confined.

The Ripley aquifer consists of the Ripley Formation and a few thin sand intervals in the upper Providence Sand. Clays in the lower part of the Providence confine the underlying Ripley aquifer. Overlying the Providence Sand is the Clayton Formation. Only two public supply wells in Area 11 are completed in the Clayton aquifer, one in Rutledge and the other in Glenwood, both in eastern Crenshaw County (plate 1, well numbers CREK-5 and CREN-3). Both of these wells produce a limited amount of water from limestone intervals of the Clayton. The Naheola Formation and the Porters Creek Formation separate the Clayton aquifer from the overlying Nanafalia aquifer, and generally form an aquiclude. Locally, these formations may produce minor amounts of water and where this occurs they are considered part of the Clayton aquifer.

The Nanafalia aquifer consists of the Nanafalia Formation and the lower part of the Tuscahoma Sand. The Salt Mountain Limestone, a subsurface equivalent of part of the Nanafalia Formation, is also part of the Nanafalia aquifer. The Nanafalia aquifer is separated from the overlying Lisbon aquifer by impermeable beds of the Tuscahoma Sand.

The Lisbon aquifer includes the uppermost part of the Tuscahoma Sand, sands in the Hatchetigbee and Tallahatta Formations, the Lisbon Formation, the Gosport Sand, and the Moodys Branch Formation. Impermeable sediments of the overlying Jackson Group and the basal Vicksburg Group confine the Lisbon aquifer. Most of the Vicksburg Group and locally parts of the Jackson Group are included in the Crystal River aquifer in the study area. The Miocene-Pliocene aquifer is comprised of the Citronelle Formation, the Miocene Series undifferentiated, and the Upper Oligocene Series (the Paynes Hammock Sand and the Chickasawhay Limestone). In the subsurface in part of Escambia County, the impermeable Bucatunna Clay Member (Byram Formation, Oligocene Vicksburg Group) hydraulically separates the Miocene-Pliocene aquifer from the underlying Crystal River aquifer.

Maps of the potentiometric surfaces of the major aquifers were constructed from available data (plates 7, 8, 9, 10, 11). Recharge areas for the major aquifers and areas vulnerable to contamination from the surface are shown on plate 6. Also shown on plate 6 are locations of active public water supply wells and locations of selected large wells in the study area. Areas of major withdrawals, commonly indicated by depressions in the potentiometric surfaces, are shown in plates 7 through 11. Well construction information, water levels, and other pertinent well data are given in tables 2 and 3.

## RIPLEY AQUIFER

The Ripley aquifer generally consists of the Ripley Formation and a few thin sand intervals in the upper Providence Sand. The Ripley aquifer is one of the major aquifers in the study area (plate 7; fig. 2); however, analyses of aquifer tests performed on the Providence in the Luverne area indicate a low hydraulic conductivity, which suggests the few thin sands in the Providence are not likely to yield the large quantities of water needed for most public supply wells. In fact, clays in the lower part of the Providence, in combination with the Prairie Bluff Chalk, provide additional confinement for the underlying Ripley aquifer.

Of the six counties included in this report, only Butler and Crenshaw Counties have wells completed in the Ripley aquifer. In Butler County, this aquifer is the principal source of water for the city of Greenville, the town of Georgiana, and the Butler County Water Authority. The town of Fort Deposit, north of the study area in Lowndes County, has wells located in northern Butler County completed in the Ripley aquifer (Scott and others, 1986). In Crenshaw County, the towns of Luverne and Rutledge, the South Crenshaw County Water and Fire Protection Authority, and Quint-Mar Water and Fire Protection Authority, are supplied by the Ripley aquifer.

Wells developed solely in the Ripley aquifer produce from 200 to 600 gpm. The specific capacity of city supply wells completed solely in the Ripley ranges from 1.7 to 14.0 gallons per minute per foot of drawdown (gpm/ft dd) and averages 7.3 gpm/ft dd.

The Ripley aquifer has not been developed as a source of water supply south of Georgiana in Butler County or south of Luverne in Crenshaw County. Available data indicate that the Ripley aquifer may be a source of potable water in northeasternmost Monroe County, but the water in northwestern and southern Monroe County may contain more than 1,000 milligrams per liter (mg/L) of chlorides (Scott and others, 1972).

## CLAYTON AQUIFER

The Clayton Formation is a minor source of water in the eastern part of the study area, and the unit is relatively impermeable west of Greenville.  The towns of Rutledge and

Glenwood are the only communities in Area 11 with wells completed in the Clayton aquifer. These wells, developed in the limestones of the Clayton Formation, produce from 140 to 180 gpm in central Crenshaw County. East of the study area in Dale and Houston Counties, wells developed solely in the Clayton produce as much as 1,000 gpm.

The Porters Creek Formation is not a major source of water in the study area (plate 6) and generally is an aquiclude. West of Crenshaw County the Porters Creek is relatively impermeable and is not a source of ground water. The lower Naheola Formation, which overlies the Porters Creek, is relatively impermeable and is not an aquifer in the study area.

## NANAFALIA AQUIFER

The Nanafalia aquifer (plate 8; fig. 2) includes the Nanafalia Formation, the basal sand of the Tuscahoma Sand, and the Salt Mountain Limestone. The Nanafalia aquifer is a source of water for the towns of Brantley, McKenzie, Owassa, Brownville, Evergreen, Andalusia, Dozier, Beatrice, Monroeville, Vredenburgh, and Opp.

The Nanafalia aquifer is one of the major water sources in Area 11 (plates 1, 2) and is one of the most productive aquifers in the Alabama Coastal Plain. Near the outcrop, the formation serves as the source of water for numerous private wells. Downdip, the Nanafalia is a source of supply for large-capacity municipal wells. In Beatrice in northern Monroe County, water for public supply wells is derived exclusively from the middle and lower units of the Nanafalia Formation (Baker and Smith, 1999). The formation is not a major source of water in southern Conecuh and Monroe Counties because chloride concentrations in the water exceed 250 mg/L (Reed and others, 1968; Scott and others, 1972).

Wells developed solely in the Nanafalia Formation produce from 75 gpm at Beatrice to as much as 1,016 gpm at Evergreen in Conecuh County. In central Covington County, wells developed in the Nanafalia aquifer produce as much as 1,000 gpm.

The Tuscahoma Sand is not a major source of water in most of Area 11, but a few wells tap the basal sand of the unit in conjunction with the Nanafalia Formation. Clay in the upper part of the Tuscahoma constitutes a confining layer between the Nanafalia and the overlying Lisbon aquifer in most parts of Area 11. In the Andalusia area, however, the Tuscahoma Sand has proven to be a fairly good aquifer yielding over 500 gpm to two of Andalusia's public supply wells, COVN-1 and COVM-03 (plates 4, 5). In this area, the Tuscahoma appears to be isolated from both the overlying Lisbon aquifer and the underlying Nanafalia aquifer.

## LISBON AQUIFER

The Bashi Marl Member of the Hatchetigbee Formation, the upper and lower Tallahatta Formation, the Lisbon Formation, and the Gosport Sand combine with the overlying Moodys Branch Formation to form the Lisbon aquifer. The Lisbon aquifer is a major source of ground water in the southeastern part of the study area. In the western part of the study area, the Lisbon Formation and the Gosport Sand contain more clay and silt and are not a major source of water. The Lisbon aquifer is the sole source of water for the towns of Castleberry, Fairview, Ridge Road, and East Brewton, and is a major source of water for the towns of Evergreen, Opp, Andalusia, Brewton, and Florala, and for the

Covington County Water Commission. Wells developed solely in the Lisbon aquifer in the southeastern part of Area 11 produce as much as 750 gpm. East Brewton's well ESCO-02 has a specific capacity of 31.4 gpm/ft dd and is capable of producing more than 750 gpm. The Lisbon aquifer is also a major source of water east of Area 11.

A few wells are developed in sand beds of the Bashi Marl Member at the base of the Hatchetigbee Formation in conjunction with the Lisbon aquifer and may yield up to 10 gpm to drilled shallow wells (Scott and others, 1972). However, the remainder of the Hatchetigbee Formation is relatively impermeable and is not a major source of ground water in this part of Alabama.

The Tallahatta Formation is a minor source of water in the southern part of the study area and is considered to be a part of the Lisbon aquifer. The Tallahatta is the sole source of water for the town of River Falls in Covington County. The River Falls well, COVN-02, had a specific capacity of 0.86 gpm/ft dd when drilled in 1966 and was test pumped at 108 gpm. No other public supply wells in Area 11 are completed in the Tallahatta. The Tallahatta is not a major source of water in Butler, Crenshaw, or Conecuh Counties because of its limited areal extent and thinness. In Monroe County thin sands of the formation supply up to 10 gpm of good quality water to dug and shallow drilled wells.

## CRYSTAL RIVER AQUIFER

The Crystal River aquifer in Alabama consists of the Crystal River Formation of the Jackson Group and limestones of the lower Oligocene Series (plates 1, 2; fig. 2). The aquifer is a major source of water in the southeastern part of Area 11. The Yazoo Clay of the Jackson Group underlies the Crystal River aquifer, separating it from the Lisbon aquifer. The Crystal River aquifer is a source of water for Repton, the Covington County Water Commission, McCall, Brewton, Atmore, Riverview, Florala, and Lockhart.

Wells developed solely in the limestones of the Crystal River Formation produce as much as 250 gpm. Wells developed in the lower Oligocene in conjunction with the Crystal River have specific capacities ranging from 1.03 to 750 gpm/ft dd. Florala's northernmost well, COVCC-5, was pumped for 21 days at 750 gpm with only 1 foot of drawdown. Most wells completed in the Crystal River aquifer do not have yields of this magnitude without penetrating large solution openings in the limestone. The Florala well, COVCC-3, also completed in the Crystal River aquifer, had a reported drawdown of 8 feet when pumped at 410 gpm, or a specific capacity of 82 gpm/ft dd.

## MIOCENE-PLIOCENE AQUIFER

The Miocene-Pliocene aquifer includes the Citronelle Formation, the Miocene Series undifferentiated, and Upper Oligocene sediments (the Paynes Hammock Sand and the Chickasawhay Limestone), and is hydraulically separated from the underlying Crystal River aquifer by the relatively impermeable Bucatunna Clay Member of the Oligocene Byram Formation. The Miocene-Pliocene aquifer is a major source of water in southern Monroe County and Escambia County. This aquifer is the sole source of water for the towns of Frisco City, Excel, and Uriah in Monroe County, and McCall, Huxford, Pollard, Flomaton, Freemanville, and Canoe in Escambia County. Most of the Atmore wells are completed in the Miocene-Pliocene aquifer, but some produce from the Crystal River aquifer. Wells developed solely in the Miocene-Pliocene aquifer produce from 50 to 1,000 gpm.

The Citronelle Formation is not a major source of water because of the unit's thinness; however, the Citronelle is hydraulically connected to the underlying Miocene-Pliocene aquifer in the study area and is considered part of the Miocene-Pliocene aquifer.

## WATERCOURSE AQUIFER

The watercourse aquifer is comprised of alluvial and terrace deposits adjacent to major streams in the study area. These deposits are potential sources of large water supplies in the flood plains of the Alabama and Conecuh Rivers, but are not developed for public supply wells.

## RECHARGE AND MOVEMENT OF GROUND WATER

The source of recharge to the aquifers is rainfall, which averages 60 inches per year (in./yr) in the study area. A large part of the rainfall, about 20 in./yr, runs off during and immediately after storms or is returned to the atmosphere by evaporation and transpiration by trees and other plants. A small amount of rainfall infiltrates the subsurface as recharge to the aquifers. On the basis of low flow of streams, recharge to the major aquifers is at least 3 to 4 inches per year (Castleberry, Moreland, and Scott, 1989). The recharge area for the Ripley aquifer is in Crenshaw and Butler Counties and slightly north of Area 11 in Lowndes and Montgomery Counties (plate 7). The recharge area for the Nanafalia aquifer is in Crenshaw, Butler, Conecuh, and Monroe Counties (plate 8); and the recharge area for the Lisbon aquifer is in Monroe, Conecuh, and Covington Counties (plate 9). The recharge areas for the Miocene-Pliocene and Crystal River aquifers in Area 11 are in Covington, Escambia, Conecuh, and Monroe Counties (plates 10, 11). These recharge areas consist of rolling sand hills, weathered silty clay terraces, and carbonate terranes. The land is part wooded and part cultivated. Water moves down the hydraulic gradient from areas of recharge to areas of natural discharge or areas of ground water withdrawals. The direction of movement generally is perpendicular to the potentiometric contour lines shown in plates 7 through 11.

The amount of water that infiltrates the soil depends on the hydraulic conductivity and permeability of the soil, the amount of water present in the soil during rainfall, and the slope of the land surface. Infiltration is greater in a flat area underlain by gravel and coarse sand sediments than in an area with a sloping land surface that is underlain by dense clay.

Remnants of high terrace deposits overlie parts of the recharge areas. These terrace remnants form relatively flat, permeable landscapes that impede runoff and probably increase recharge to the aquifers. Alluvial deposits overlie the major aquifers along the flood plains of the major rivers.

## NATURAL DISCHARGE AND GROUND WATER WITHDRAWALS

Ground water is discharged primarily to streams, water bodies, and wells. Ground water discharges through seeps and springs to provide the base (dry weather) flow of streams. Some ground water discharges directly to the rivers that have entrenched into the aquifers. This natural discharge is especially notable in Butler, Conecuh, and Escambia Counties where southward flowing streams have cut deeply into the aquifers. Discharge to streams also can occur by upward leakage through confining beds between aquifers.

Ground water also is discharged through wells, primarily around large communities. The larger communities in the study area include the cities of Andalusia and Monroeville (plates 6, 8, 9). Andalusia's well system pumped over 2.15 million gallons per day (mgd) in 1998, and Monroeville's well system pumped over 2.37 mgd (1998).

Other large pumping centers and their estimated water use (1998) are Fort Deposit (whose wells are located in Butler County), 0.3 mgd; Greenville, 1.28 mgd; Butler County Water Authority, 0.9 mgd; Union Camp Corporation, 0.24 mgd; Evergreen, 1.45 mgd; Opp, 1.8 mgd; Covington County Water Department, 0.73 mgd; public water systems in Crenshaw County, 1.73 mgd; Atmore, 2.32 mgd; and Brewton, 0.62 mgd. The total water use for public water supplies in 1998 in the area is estimated to be 21.44 mgd (Durham, 2000).

Ground water is used for irrigation in southern parts of the study area. Maximum withdrawals for agricultural uses including irrigation (3.07 mgd) and livestock are estimated to be about 4.08 mgd in 1995. Withdrawals for irrigation are sporadic, depending on rainfall deficiencies during the growing season. Estimated total ground water use for self-supplied domestic wells in the study area is about 2.74 mgd. This estimate is based on the percentage of each county that is not supplied by public water systems, the rural population in each county, and an estimated per-capita water use of 75 gallons per day (Mooty and Richardson, 1998).

Available data indicate that ground water withdrawals for self-supplied industrial uses total 2.56 mgd. This total does not include water supplied to industries by public water systems. Total withdrawals of ground water for all uses in the study area in 1995 are estimated to be about 30.35 mgd, which is about 23 percent of the total water use (133.91mgd) in Area 11.

Water in the major aquifers in Area 11 is generally confined. The potentiometric surfaces of the Ripley, Nanafalia, Lisbon, Miocene-Pliocene, and Crystal River aquifers are shown in plates 7, 8, 9, 10, and 11, respectively. Areas of major withdrawals, as indicated by depressions in the potentiometric surfaces, are shown in plates 7 through 11. Well construction information, water levels, and other pertinent well data are given in tables 2 and 3.

## EFFECTS OF WITHDRAWALS FROM THE AQUIFERS

Large withdrawals of water from an aquifer may cause a depression in the potentiometric surface of the aquifer. The extent of the depression depends on the amount of water withdrawn and the water-bearing characteristics of the aquifer. Large, long-term withdrawals of water from the major aquifers in the study area have resulted in significant lowering of the potentiometric surfaces or formation of depressions in the potentiometric surfaces of ground water in the Ripley, Nanafalia, and Lisbon aquifers in Area 11 (plates 7, 8, 9). Particularly, the Nanafalia and Ripley aquifers have well-developed depressions in their potentiometric surfaces around Monroeville, Beatrice, Andalusia, and Greenville (plates 7, 8). No significant depression is apparent in the potentiometric surfaces of the

Miocene-Pliocene and Crystal River aquifers (plates 10, 11). Depressions have formed in the Lisbon aquifer in the vicinities of Andalusia and Opp (plate 9).

## GROUND WATER QUALITY

Major aquifers in the study area generally yield water of suitable quality for many uses. Water with dissolved solids content less than 500 mg/L can be found throughout the area. Locally, iron in excess of 0.3 mg/L may occur in waters from the Nanafalia aquifer, Lisbon aquifer, Crystal River aquifer, and alluvial deposits.

The Ripley aquifer is utilized in Area 11 only in northern Crenshaw and Butler Counties. In southern Crenshaw County and south of Butler County the water from the Ripley contains excessive chlorides (greater than 250 mg/L). Water from the Ripley aquifer near its outcrop is generally soft and increases in hardness downdip, where it also commonly contains greater than 0.3 mg/L of iron.

The Nanafalia aquifer is utilized as a source of water supply in all counties of Area 11 except Escambia County. Water quality is generally good; however, chloride levels increase downdip. Water from the Nanafalia aquifer in southern Conecuh and Covington Counties and all of Escambia County has greater than 250 mg/L of chlorides, making it undesirable for most uses. In the southern half of Area 11, the Lisbon aquifer is used extensively. Water quality in the Lisbon is good. Most water from this aquifer is soft and low in iron content. Locally, however, iron content may exceed the recommended 0.3 mg/L limit. The overlying Crystal River aquifer has good quality water; however, it tends to be hard to very hard. The iron content of the water from the Crystal River is generally low.

Unlike the Crystal River water, water from the Miocene deposits generally contains more than 0.3 mg/L of iron. This water is generally soft to moderately hard, except in areas of heavy pumpage in Escambia County. In the vicinity of Brewton, Flomaton, and Pollard, levels of hardness are anomalously high compared to water in the Miocene deposits elsewhere in the county. This increase in hardness is believed to result from upwelling of water from the underlying Oligocene limestone formations.

The depth at which ground water has a total dissolved solids content in excess of 10,000 mg/L in Area 11 is illustrated in figure 5. Generally, beneath this depth water in aquifers is not suitable for most uses.

## VULNERABILITY OF THE AQUIFERS TO CONTAMINATION

Aquifer vulnerability is a difficult concept to evaluate owing to the complexity and variability of the geology and aquifers involved. Aquifers are vulnerable to contaminants from both surface and subsurface sources.

Numerous surface sources of potential contamination include point sources such as gasoline tanks, chemical spills, pipeline and sewer leaks, treatment lagoons, and industrial sites. Potential nonpoint sources of pollution include agricultural areas, residential areas with septic tanks, and urban areas.

Some types of contaminants such as petroleum products are lighter than water and float on the water table. These are referred to as light nonaqueous phased liquids

(LNAPL's). Other chemicals such as chlorinated hydrocarbons are denser than water and can sink through the aquifer and accumulate and migrate on subsurface confining units. These chemical contaminants are referred to as dense nonaqueous phased liquids (DNAPL's). Some contaminants dissolve in or mix with water and neither float nor sink but move with the ground water. Also, naturally occurring contamination such as saline ground water may encroach into freshwater aquifers from downdip or from other water-bearing units.

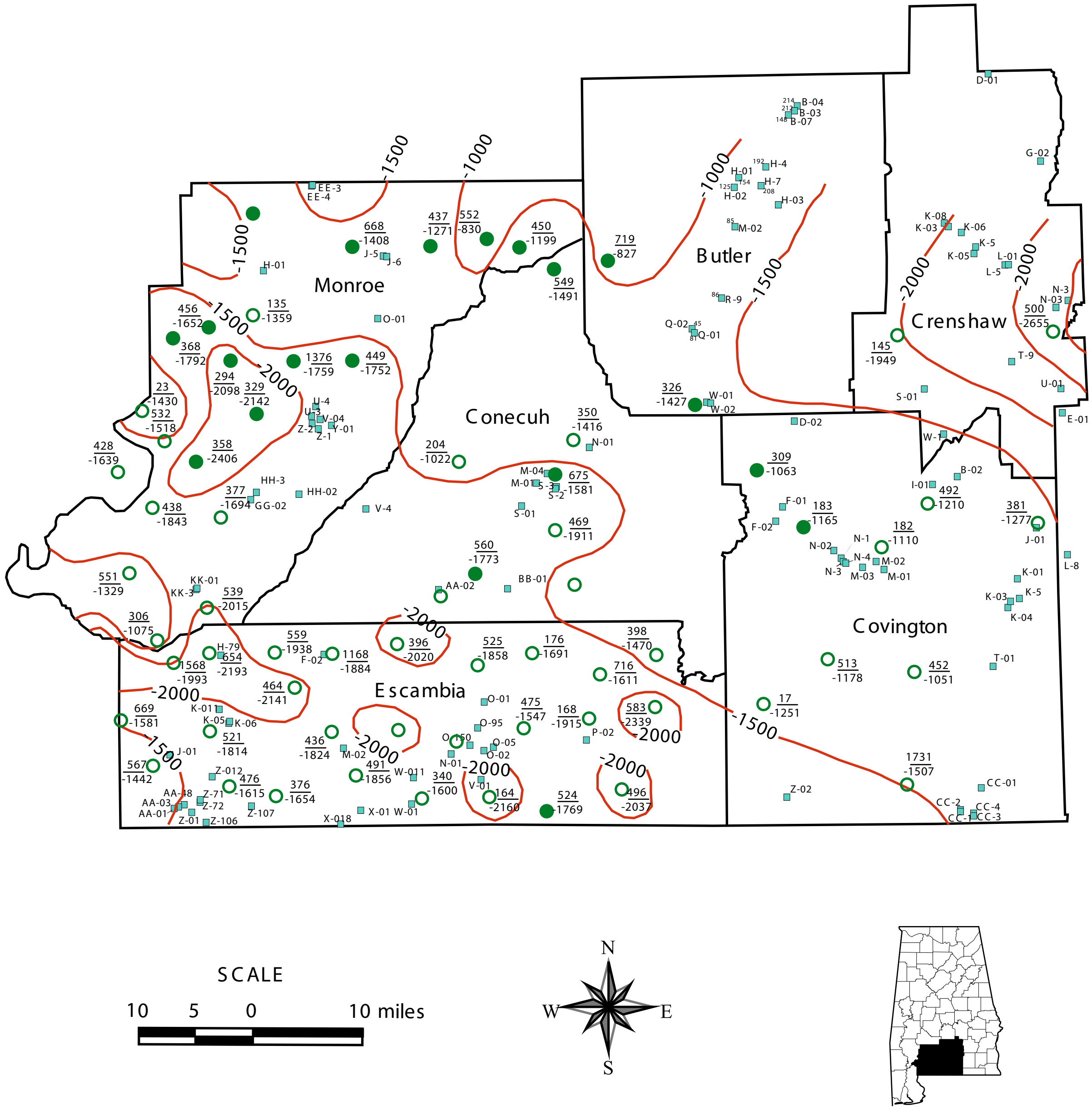
Outcrops of all aquifers in Alabama are vulnerable to contamination from surface sources of pollution. The extent to which an aquifer may become contaminated is determined by the nature of the contaminant and the hydrogeologic characteristics of the aquifer. Hydrogeologic characteristics vary from aquifer to aquifer and even within individual aquifers, they can vary with the permeabilities of the units making up the aquifer. Unconfined aquifers with high permeabilities have high recharge rates (typically more than 6 inches per year) and contaminants from the surface may not be filtered adequately as water moves toward the water table. The most vulnerable aquifers in Alabama are either unconsolidated sand and gravel or carbonate rocks that contain numerous solutionally enlarged joints and fractures. Thick relatively impermeable units such as clay or chalk typically overlie aquifers least vulnerable to contamination. These impermeable units are either aquicludes or aquitards.

Vulnerability may also vary within aquifers. Aquifers are most vulnerable in their outcrops where water-table conditions exist. Where aquifers become confined downdip, their vulnerability to surface contamination decreases as they are protected by aquicludes or aquitards that retard the vertical downward movement of contaminants. Although this confinement affords some protection to the aquifer, no aquifer is immune to contamination from poorly constructed wells and bad management practices. Pumping of large quantities of ground water by public supply wells, industrial supply wells, or irrigation wells creates cones of depression, increases flow gradients, and draws ground water and any associated contamination, where present, toward the pumping wells. In south Alabama and coastal areas some aquifers are especially vulnerable to natural sources of contamination such as salt water from the Gulf of Mexico and mineralized ground water in other parts of the aquifers.

General guidelines (shown below) have been established to assist in identifying aquifers as having high, moderate, or low vulnerability to contamination. These guidelines differ from those used by the USGS in the original report. Most of the factors listed below apply particularly to the vulnerability of the aquifer in the outcrop area. Not all factors are required for any one aquifer to be assigned to a particular vulnerability category. A few factors pertain only to possible contamination from natural sources of contamination at depth or downdip.

High vulnerability to contamination

- Aquifer is unconfined, unconsolidated, highly permeable, and has high recharge rates (typically greater than 6 inches per year)
- Aquifer is not confined by thick homogeneous impermeable units or is semiconfined




## Explanation

436 — State Oil and Gas Board Permit Number and other identifiers

1824 — Elevation, in feet below mean sea level, of ground water with approximately 10,000 mg/L of total dissolved solids as NaCl at 25ºC (77ºF)

○ Elevation calculated from borehole geophysical logs

● Elevation interpolated from calculated values which were derived from borehole geophysical logs of permeable units above and below a thick (>100 ft) unit with low permeability

—2000— Elevation, in feet below mean sea level, of ground water with approximately 10,000 mg/L of total dissolved solids as NaCl at 25ºC (77ºF). Contour interval 500 feet.

▪ Z-02 Public water supply well and number

Figure 5.— Depth to ground water containing more than 10,000 mg/L of total dissolved solids in Area 11 (modified from Epsman and others, 1983, and Hinkle and Sexton, 1988).

- Aquifer is comprised of rocks that contain solution cavities and/or fractures that allow rapid ground water movement and high recharge rates
- Aquifer has a freshwater/salt-water interface in close proximity to the area of concern
- Aquifer is penetrated by faults that provide an avenue for entrance of contaminated water from the surface or from another aquifer

Moderate vulnerability to contamination

- Aquifer is unconfined, is consolidated rock, has low permeability, and has low to moderate recharge rates (typically 1 to 6 inches per year)
- Aquifer has no solution cavity development
- Aquifer is overlain by thick, cumulatively impermeable, or discontinuous I mpermeable units sufficient to provide some protection to the aquifer
- Aquifer is comprised of fractured rock, but fractures are of limited extent and connectivity and are not enlarged
- Aquifer is confined by aquitards that transmit water, but not in quantities sufficient for development

Low vulnerability to contamination

- Aquifer is well confined by aquicludes that are laterally continuous, are thick, lack connected fracture networks, have low recharge rates (less than 1 inch per year), and are incapable of transmitting significant quantities of water
- Area of concern is a significant distance from the freshwater/salt-water interface of the aquifer

Detailed site-specific hydrogeologic investigations should be implemented to accurately determine an aquifer's vulnerability to contamination. Long-term aquifer testing is needed to determine the aquifer's hydrologic characteristics and the hydraulic properties of confining beds.

All areas of recharge for the major aquifers in the study area are vulnerable to surface contamination (plate 6). The relative slope of the land and the permeability of overlying soils affect the rate of infiltration; however, the characteristics of the underlying sediments determine whether water that has filtered through the soil layer continues downward or changes direction and moves laterally. Clay units generally retard the downward movement of water and act as barriers between aquifers. The exact nature of a clay unit —its thickness, its uniformity, and its areal extent— determines whether the unit acts as a barrier to ground water movement or merely as a deterrent.

In northeastern Crenshaw County, the Demopolis Chalk underlies the Ripley aquifer. The Mooreville Chalk underlies the Demopolis Chalk. These two chalk units are 930 feet thick in the Ft. Deposit area in southern Lowndes County. These massive chalk units provides excellent protection for the underlying formations from contamination from the surface. For this reason, areas in the outcrop of the Demopolis Chalk are considered to have a low vulnerability to contamination from the surface (plates 1,6).

Overlying the Ripley aquifer is the Providence Sand. In northern Crenshaw County the Providence reaches about 100 feet in thickness and does not contain much sand. Cross sections A-A′ and B-B′ on plates 2 and 3 show electric logs of the Providence Sand.

Interpretations of electric logs indicate some thin sand units in the upper part of the Providence, but none in the lower part. The Providence is not a massive confining unit like the Demopolis, however. Electric logs suggest the Providence to be sandy clay with some limestone. Limestone can have solution openings that may allow ground water movement. Therefore, the Providence outcrop area is considered moderately vulnerable to contamination from the surface.

The Porters Creek is an aquitard and crops out in north Butler and Crenshaw Counties. In west Alabama the Porters Creek is a clay unit. In eastern Area 11, the Porters Creek is used for domestic water supply and is part of the Clayton aquifer. This unit has a significant amount of clay, but it contains thin sand interbeds that allow some downward movement of ground water. Therefore, on plate 6 the Porters Creek (geologic formation shown on plate 1) is shown as an aquiclude but is classified as moderately vulnerable to contamination from the surface. In the subsurface downdip, the Porters Creek is less sandy and provides confinement at the base of the Nanafalia aquifer.

Overlying the Nanafalia aquifer is the Tuscahoma Sand. To the west, the Tuscahoma is predominantly a clay unit. In Area 11, the Tuscahoma appears to become more sandy to the east. In the Andalusia area, well COVN-1 produces over 500 gpm from the Tuscahoma (plate 4). Well COVN-3 also produces over 500 gpm. Cross-section D-D' (plate 4) shows several sands that may be water bearing. Even though the Tuscahoma provides confinement for the underlying Nanafalia aquifer, it is considered highly vulnerable to contamination because of the productive sands in its upper part.

The Jackson Group, which includes the Moodys Branch Formation and the Yazoo Clay, is only 50 feet thick and yields adequate quantities of water to several domestic wells close to the outcrop. Cross-section D-D' (plate 4) shows that some sands are present in the Moodys Branch Formation. Evergreen’s public supply well CONS-3 is screened in the Moodys Branch and yields about 300 gpm. The Yazoo Clay is the confining unit for the Moodys Branch and the underlying Lisbon aquifer. The Yazoo is about 25 feet thick. Although this clay partially confines the underlying aquifer, it is not thick enough to provide adequate protection for underlying aquifers. Therefore, areas underlain by the Yazoo Clay are classified as highly vulnerable to contamination from the surface (plate 6).

In the southwestern part of Area 11, the Miocene-Pliocene units are exposed at the surface. The area underlain by the Miocene-Pliocene aquifer is classified as highly vulnerable to contamination from surface sources because of the unconsolidated nature of the aquifer, its exposure at the surface, and the absence of a continuous protective clay layer (plate 6). Downdip, individual water-bearing sand units in the Miocene-Pliocene aquifer become more confined by interbedded clays that are relatively impermeable compared to the sands. Therefore, deeper parts of the aquifer may be moderately vulnerable to contamination from surface sources (plate 2).

Terrace and alluvial deposits along the Alabama, Conecuh, and Choctawhatchee Rivers overlie and are hydraulically connected with all the major aquifers in the study area. Because of this interconnection, ground water in areas along the flood plains of the Alabama, Conecuh, and Choctawhatchee Rivers is highly vulnerable to contamination.

## PUBLIC SUPPLY WELLS

In Area 11, 110 public water supply wells provide water for 43 water systems (table 2, plates 7, 8, 9, 10, 11). Depths of public supply wells range from 90 feet for Canoe Water and Fire Protection Authority's well ESCZ-107 to 1,394 feet for Monroeville Water Service's well MONZ-2.

## WELLHEAD PROTECTION AREAS

Public water supply systems that use ground water serve about 40 percent of the population of Alabama (Mooty and Richardson, 1998). Programs that protect ground water sources from potential contamination are known as Wellhead Protection Programs (WHPPs). Alabama's WHPP is the result of 1986 amendments to the Safe Drinking Water Act originally enacted by Congress in 1974. The 1986 amendments directed the states to develop plans and programs to protect areas providing ground water to public water supply wells or springs. Source Water Protection Programs are required for all public water supply systems. Under ADEM's existing WHPP, local wellhead protection plans (LWHPP) are not required. However, the Source Water Assessment Program (SWAP) requires a Source Water Assessment Area (SWAA) delineation, contaminant source inventory within each SWAA, a susceptibility analysis of each contaminant source in the inventory, and public notification of the condition of raw water supplies, including their vulnerability to contamination. The SWAAs are identified surface areas where potential contaminants are most likely to migrate into the ground resulting in contamination of public water supply wells or springs and are delineated by using hydrogeologic conditions or time of travel criteria. The terms SWAA and WHPA can be used to identify the same area around a public water supply well or spring and are used synonymously in this report.

A total of 10 public water supply systems currently have ADEM approved WHPAs or SWAAs delineated in Area 11 (plate 12). In Butler County, only Butler County Water Authority has an established WHPA. McCall Water System, Inc., has one WHPA defined around their well in Conecuh County (CONAA-02) and one around one of their three wells in Escambia County (ESCF-02). Covington County Water Commission has established WHPAs. In Crenshaw County, only South Crenshaw County Water & Fire Protection Authority has defined WHPAs. Systems in Escambia County with WHPAs are Ridge Road Water System and Quint-Mar Water & Fire Protection Authority. Systems in Monroe County with WHPAs are Excel Water System and Monroeville Water Service. Locations and boundaries of the WHPAs are shown on plate 12.

# SUMMARY AND CONCLUSIONS

The major aquifers in Area 11 in southern Alabama are the Ripley, Nanafalia, Lisbon, Crystal River, Miocene-Pliocene, and watercourse aquifers. The recharge areas for the aquifers are primarily in Butler, Conecuh, Covington, Crenshaw, Escambia, Lowndes, Monroe, and Montgomery Counties. The aquifers consist of sand and gravel beds and some limestone (Crystal River). Water in the aquifers generally occurs under artesian conditions.

The Miocene-Pliocene aquifer is a major source of water supply in Escambia and Monroe Counties. The aquifer is used by the towns of McCall, Huxford, Freemanville, Pollard, Canoe, Flomaton, Frisco City, Excel, and Uriah, and by the city of Atmore.

The Crystal River aquifer is a source of water supply in Covington County. It is the sole source of supply for the town of Lockhart, and contributes to the water supply for Repton, the Covington County Water Commission, Florala, McCall, Brewton, Atmore, and Riverview.

The Lisbon aquifer is pumped extensively in the central and eastern parts of the study area. It is a major source of water supply for the towns of Evergreen, Fairview, Castleberry, River Falls, Brewton, East Brewton, Ridge Road Water System, and Opp, the Covington County Water Commission, and the city of Andalusia. The Lisbon also is used in conjunction with the Crystal River aquifer at Florala.

The Nanafalia aquifer is a major source of public water supply in Monroe, Covington, Butler, and Crenshaw Counties. It is the sole source of water supply for the towns of Monroeville, Beatrice, and Vredenburgh, and a major source of water for the towns of McKenzie, Brantley, Rutledge, Glenwood, Dozier, and Opp, and the city of Andalusia.

The Ripley aquifer is a major source of water in Butler and Crenshaw Counties. The Ripley is the principal source of water for Greenville, Georgiana, and the Butler County Water Authority. This aquifer is a major source of water for the towns of Luverne and Rutledge and the South Crenshaw County and Quint-Mar Water and Fire Protection Authorities. The town of Fort Deposit (located in Lowndes County) also pumps water solely from the Ripley in northern Butler County.

The largest pumping centers in the study area are Andalusia and Monroeville. Water use in Andalusia is 2.15 mgd and at Monroeville, 2.37 mgd. Total ground water withdrawal for all uses in the study area was about 30.35 mgd in 1998.

Large long-term withdrawals of ground water have resulted in the formation of depressions in the potentiometric surfaces of the Lisbon, Nanafalia and Ripley aquifers. Depressions have developed in the potentiometric surface of the Lisbon aquifer in the vicinities of Andalusia and Opp. Depressions have also formed in the potentiometric surface of the Nanafalia aquifer in the vicinities of Luverne, Andalusia, Beatrice, and Monroeville. Ground water withdrawals in the vicinity of Greenville have formed a depression in the potentiometric surface of the Ripley aquifer.

All the recharge areas for the major aquifers are vulnerable to contamination from the surface. However, recharge areas throughout most of the study area are used for timberlands, farms, and pastures and are generally several miles from pumping centers. Areas highly vulnerable to contamination are the aquifer recharge areas and areas covered by thin or discontinuous clay layers. In the northern part of Area 11, the Providence Sand provides moderate protection from downward movement of any possible contaminants, and the Demopolis Chalk in the extreme northeastern part of Crenshaw County provides a very high degree of protection to underlying aquifers. These areas are defined as areas of moderate and low vulnerability, respectively.

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## RELATED LINKS

http://www.adem.state.al.us/
Alabama Department of Environmental Management (ADEM)
ADEM administers all major federal environmental laws, including the Clean Air, Clean Water and Safe Drinking Water acts and federal solid and hazardous waste laws. Information regarding ADEM news, regulations, funded programs, and status of filings are available on this site.

http://www.epa.gov/OW
United States Environmental Protection Agency (EPA)
This is the home page of the EPA Office of Water. Information includes America's water resources, environmental programs and partnerships, monitoring, data, and tools, you and clean water, regulations and legislation, information resources, etc. Pages for EPA Water are maintained as well: Wetlands, Oceans, and Watersheds, Science and Technology, Wastewater Management, Groundwater and Drinking Water, etc. The various regional programs are also covered as well as EMAP Estuaries.

http://www.ga.nrcs.usda.gov/al/
United States Department of Agriculture (USDA)
The Natural Resources Conservation Service (NRCS) is the USDA agency that works at the local level to help people conserve all natural resources on private lands. USDA provides soil information and other agricultural information, including maps of soil types.

http://www.ngwa.org/
National Ground Water Association (NGWA)
NGWA operates the National Ground Water Information Center ®, the largest non-governmental clearinghouse on ground water science and well technology in the world, with more than 40,000 volumes. Ground Water On-Line ®, a nearly 80,000 citation bibliographic database of ground water literature is available at no cost to NGWA members. A database of standards, guidelines, criteria, practices and procedures is also available at the Web site.

http://www.gsa.state.al.us
Geological Survey of Alabama (GSA)
The Geological Survey of Alabama, established in 1848, is a data gathering and research agency that explores and evaluates the mineral, water, energy, biological, and other natural resources of the State of Alabama and conducts basic and applied research in these fields as a public service to citizens of the State.

http://water.usgs.gov/
United States Geological Survey (USGS)
This site is the http server Water Division home page. It contains links to information from the water, geologic, and mapping divisions. USGS fact sheets, information releases, publications, data products, etc. are available. Information on GIS and the National Spatial Data Infrastructure is also included. Contact information for USGS resources (maps, etc.) Is given as well as the USGS telephone book. Links to other USGS sites on-line are available.

http://www.uwin.siu.edu:80/dir_search/index.html
Universities Water Information Network (UWIN)
UWIN maintains several databases for providing water information. Over 100 different water related links are listed by categories.

http://gwpc.site.net/
Ground Water Protection Council (GWPC)
The Ground Water Protection Council is a nonprofit (501(c)3) organization whose members consist of state and federal ground water agencies, industry representatives, environmentalists and concerned citizens, all of whom come together within the GWPC organization to mutually work toward the protection of the nation's ground water supplies.

http://www.gwrtac.org
Ground-Water Remediation Technologies Analysis Center (GWRTAC)
The Ground-Water Remediation Technologies Analysis Center compiles, analyzes, and disseminates information on innovative ground-water remediation technologies. GWRTAC prepares reports by technical teams selectively chosen from Concurrent Technologies Corporation (CTC), the University of Pittsburgh, and other supporting institutions, and also maintains an active outreach program.

http://www.fws.gov/
U.S. Fish & Wildlife Service (FWS)
This site has general information, news releases, and employment information for the Fish and Wildlife Services. Pages on FWS activities such as Conservation Programs, Endangered Species, Contaminants, Federal Aid to States, Fire Management, Fisheries, Migratory Birds and Waterfowl, National Wildlife Refuge System, Wetlands, Wildlife Law, and Wildlife Species are included. Pages for the various FWS Regions are also incorporated.

http://hermes.ecn.purdue.edu:8001/server/water/water.html
National Extension Water Quality Database
This site allows for searches in a database that has 2,500 abstracts and 1,500 documents on all aspects of water quality. The documents are full text and list available contacts. Also available are Quick Time Movies.

http://www.TheHydrogeologist.com/
This page is a collection of hundreds of links to hydrogeological organizations, software and data repositories, publications, and other resources of potential use to hydrogeologists.

http://www.nws.noaa.gov/oh/
The Office of Hydrology serves as a primary link between the National Weather Service Headquarters and the hydrologic field service programs. Activities include development of hydrologic models, hydrologic data for rivers and flood forecasts, warnings, and water supply forecasts. Current and Historical Data include floods, hydrologic conditions, and water supply outlooks. Data systems available online are HADS (a real time hydrological and meteorological data acquisition and distribution system) and INFLOWS (Integrated Flood Observing and Warning System). Full text handbooks, reports, and user manuals are available. Information on forecast systems are also available.

EXPLANATION FOR TABLE 2

SYSTEM, water system name.
PWS ID, public water system identification number as assigned by the ADEM.
SE ID, source identification number assigned by the ADEM. New wells may not have SE ID's assigned at press time.
GSA ID, well identification number assigned by the GSA and shown on plates.
DEPTH, total depth of well in feet. Number in parentheses denotes total depth of test well drilled at the same location.
YEAR DRILLED, the year the well was completed and ready for operation.
DRILLING CONTRACTOR, name of driller.
ALTITUDE, elevation of land surface in feet above mean sea level.
AQUIFER, Qalt, alluvial and terrace deposits of Quaternary age; Tmu, undifferentiated Pliocene, Miocene and Oligocene deposits of Tertiary age; Tcr, Crystal River Formation; Tt, Tuscahoma Sand; Tl, Lisbon Formation; Tgl, Lisbon and Gosport Sand; Tnf, Nanafalia Formation; Tcl, Clayton Formation; Kr, Ripley Formation.
WATER LEVEL, water level in feet below land surface. The date the measurement was made is shown below the measurement. Measurements with a plus sign, indicate water levels above land surface.
WELL CONSTRUCTION, YIELD, REMARKS, gpm (gallons per minute).

Table 2.–Records of public water-supply wells in Area 11

BUTLER COUNTY

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Fort Deposit Water & Sewer Board | 846 | 1 | BUTB-03 | 500 | 1970 | Acme Drilling Co. | 452 | Kr | 240 1970 | Casing: 12 in. from 0 to 390 ft, 6 in. from 403 to 408 ft. Screen: 6 in. from 390 to 403 ft and 408 to 444 ft. Drawdown 37 ft when pumped 8 hrs at 302 gpm in 1970. Owner's well no. 1. |
| Fort Deposit Water & Sewer Board | 846 | 2 | BUTB-04 | 562 | 1970 | Acme Drilling Co. | 520 | Kr | 306 1970 | Casing: 12 in. from 0 to 461 ft. Screen: 6 in. from 461 to 521 ft. Drawdown 34 ft when pumped 8 hrs at 302 gpm in 1970. Owner's well no. 2. |
| Fort Deposit Water & Sewer Board | 846 | 3 | BUTB-07 | 647 | 1991 | Rowe Drilling Co. | 530 | Kr | 382 8/1991 | Casing: 26 in. from 0 to 340 ft, 10 in. from 0 to 450 ft, 465 to 485 ft, and 555 to 565 ft. Screen: 10 in. from 450 to 465 ft and 485 to 555 ft. Drawdown 59 ft when pumped 24 hrs at 457 gpm in 1991. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Greenville Water Works | 125 | 2 | BUTH-7 | 671 | 1955 | Layne Central Co. | 397 | Kr | 189 1956 | Casing: 12 in. from 0 to 503 ft; 8 in. from 443 to 508 ft and 568 to 601 ft. Screen: 8 in. from 508 to 568 ft and 601 to 661 ft. Drawdown 62 ft when pumped at 500 gpm in 1956. |
| Greenville Water Works | 125 | 3 | BUTH-4 | 633 | 1961 | Layne Central Co. | 469 | Kr | 277 3/10/61 | Casing: 16 in. from 0 to 518 ft, 8 in. from 518 to 522 ft and 542 to 563 ft. Screen: 8 in. from 522 to 542 ft and 563 to 623 ft. Drawdown 88 ft when pumped 8 hrs at 500 gpm in 1961. |
| Greenville Water Works | 125 | 4 | BUTH-01 | 690 (711) | 1972 | Layne Central Co. | 410 | Kr | 256 3/29/72 | Casing: 16 in. from 0 to 575 ft, 8 in. from 500 to 580 ft. Screen: 8 in. from 580 to 680 ft. Drawdown 36 ft when pumped 8 hrs at 503 gpm in 1972. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Butler County Water Authority | 1507 | 1 | BUTH-02 | 718 (820) | 1979 | Layne Central Co. | 380 | Kr | 255 1979 | Casing: 16 in. from 0 to 560 ft, 8 in. from 490 to 565 ft, 580 to 615 ft, and 675 to 683 ft. Screen: 8 in. from 565 to 580 ft, 615 to 675 ft, and 683 to 708 ft. Drawdown 55 ft when pumped 24 hrs at 530 gpm in 1979. |
| Butler County Water Authority | 1507 | 2 | BUTR-9 | 848 | 1968 | Layne Central Co. | 333 | Kr | 175 3/68 246.7 11/28/84 | Casing: 12 in. from 0 to 793 ft, 6 in. from 718 to 798 ft. Screen: 6 in. from 798 to 838 ft. Drawdown 47 ft when pumped 8 hrs at 250 gpm in 1968. Also known as the Chapman well. |
| Butler County Water Authority | 1507 | 3 | BUTH-03 | 712 | 1989 | Weldon Drilling Company, Inc. | 380 | Kr | | Casing: 16 in. from 0 to 530 ft; 8 in. from 485 to 535 ft. Screen: 8 in. from 535 to 701 ft. |
| Butler County Water Authority | 1507 | | BUTM-02 | 820 | 1998 | Donald Smith Company, Inc. | 395 | Kr | 306 7/22/96 | Casing: 18 in. from 0 to 630 ft, 12 in. from 580 to 635 ft; 8 in. from 715 to 740 ft, 820 to 830 ft. Screen: 8 in. from 635 to 715 ft and 740 to 820 ft. City well 4. Also known as the Pettibone well or Wauld well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Georgiana Water Works & Sewer Board | 123 | 1 | BUTQ-01 | 1,081 | 1971 | Acme Drilling | 290 | Kr | 178 7/1971 244.59 10/30/95 | Casing: 18 in. from 0 to 40 ft, 12 in. from 0 to 976 ft, 6 in. from 897 to 975 ft. Screen: 6 in. from 975 to 1,076 ft. Drawdown 36 ft when pumped 8 hrs at 360 gpm in 1971. Also known as the old well. |
| Georgiana Water Works & Sewer Board | 123 | 2 | BUTQ-14 | 927 (1,067) | 1981 | Powell Drilling Co. | 289 | Kr | 179 2/1982 208.10 4/10/91 | Casing: 12 in. from 0 to 917 ft. Screen: 6 in. from 916 to 927 ft. Drawdown 56 ft when pumped 24 hrs at 615 gpm in 1982. Also known as the new well. |
| McKenzie Water Board | 128 | 1 | BUTW-11 | 769 | 1965 | Acme Drilling | 453 | Tnf | 277.65 11/10/83 | Casing: 12 in. from 0 to 738 ft, 6 in. from 691 to 738 ft. Screen: 6 in. from 738 to 763 ft. Drawdown 38 ft when pumped 8 hrs at 354 gpm in 1965. |
| McKenzie Water Board | 128 | 2 | BUTW-01 | 761 | 1978 | Acme Drilling | 427 | Tnf | 256 1978 | Casing: 12 in. from 0 to 728 ft, 6 in. from 670 to 728 ft. Screen: 6 in. from 728 to 758 ft. Drawdown 37 ft when pumped 8 hrs at 290 gpm in 1978. |

Table 2.–Records of public water-supply wells in Area 11–Continued

**CONECUH COUNTY**

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Owassa-Brownsville Water Authority | 393 | 1 | CONN-01 | 997 | 1989 | Griner Drilling Service, Inc. | 408 | Tnf | 251.73 1/9/89 | Casing: 16 in. from 0 to 916 ft, 8 in. from 851.5 to 925 ft and from 966.7 to 974.6 ft. Screen: 8 in. from 925 to 966.7 ft and 974.5 to 992 ft. Drawdown 21 ft when pumped 24 hrs at 600 gpm in 1989. |
| Evergreen Water Works | 338 | 1 | CONS-3 | 455 | 1939 | Layne-Central Co. | 314 | Tl | 83 1939 | Casing: 12 in. from 0 to 170 ft, 8 in. from 166 to 193 ft. Screen: 8 in. from 193 to 223 ft. Pumped at 300 gpm in 1965. |
| Evergreen Water Works | 338 | 2 | CONS-2 | 198 | 1956 | Layne-Central Co. | 298 | Tl | 99.15 8/29/67 | Casing: 16 in. from 0 to 145 ft., 10 in. from 98 to 150 ft. Screen: 10 in. from 150 to 180 ft. Drawdown 22 ft when pumped 8 hrs at 363 gpm in 1956. |
| Evergreen Water Works | 338 | 3 | CONM-01 | 1,095 | 1973 | Layne-Central Co. | 300 | Tnf | 102 1973 | Casing: 18 in. from 0 to 965 ft, 10 in. from 885 to 970 ft and 1,000 to 1,035 ft. Screen: 10 in. from 970 to 1,000 ft and 1,035 to 1,085 ft. Drawdown 28 ft when pumped 12 hrs at 754 gpm in 1973. City's Bates Road well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Evergreen Water Works | 338 | 4 | CONM-04 | 1,060 | 1990 | Griner Drilling Service, Inc. | 326 | Tnf | 171.22 5/1/90 | Casing: 18 in. from 0 to 912 ft, 10 in. from 852 to 922 ft, 950 to 958 ft, 980 to 996 ft, 1,016 to 1,026 ft, and 1,050 to 1,060 ft. Screen: 10 in. from 922 to 950 ft, 958 to 980 ft, 996 to 1,016 ft, and 1,026 to 1,050 ft. Drawdown 88 ft when pumped 24 hrs at 1,016 gpm in 1990. City's Industrial Park well. |
| Fairview Water System | 339 | 1 | CONS-01 | 200 | 1972 | Acme Drilling | 195 | Tl | 31 1972 | Casing: 12 in. from 0 to 170 ft, 6 in. from 122 to 166 ft. Screen: 6 in. from 166 to 196 ft. Drawdown 8 ft when pumped 4 hrs at 305 gpm in 1972. |
| Repton Water Works | 344 | 1 | CONV-4 | 204 | 1962 | Layne-Central Co. | 354 | Tcr | 102 1962 | Casing: 12 in. from 0 to 172 ft, 8 in. from 129 to 174 ft. Screen: 6 in. from 174 to 204 ft. Drawdown 19 ft when pumped 2 hrs at 104 gpm in 1962. |
| Castleberry Water System | 337 | 1 | CONBB-01 | 336 | 1978 | Layne-Central Co. | 164 | Tl | +18.0 11/9/78 | Casing: 6 in. from 0 to 286 ft. Screen: 6 in. from 286 to 326 ft. Drawdown 27 ft when pumped 15 hrs at 350 gpm in 1978. |

Table 2.–Records of public water-supply wells in Area 11–Continued

**COVINGTON COUNTY**

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Covington County Water Commission | 361 | 2 | COVB-02 | 962 | 1989 | Layne-Central Co. | 430 | Tnf | 229 8/16/89 | Casing: 16 in. from 0 to 640 ft; open hole below casing. Drawdown 36 ft when pumped 26 hrs at 752 gpm in Aug. 1989. Also known as the Rose Hill well and city well no. 1. |
| Covington County Water Commission | 361 | 3 | COVF-02 | 1,115 | 1989 | Layne-Central Co. | 385 | Tnf | 222 11/2/89 | Casing: 16 in. from 0 to 975 ft, 8 in. from 915 to 980 ft, 1,050 to 1,064 ft, 6 in. from 1,084 to 1,094 ft. Screen: 8 in. from 980 to 1,050 ft and 1,064 to 1,084 ft. Drawdown 88 ft when pumped 24 hrs at 457 gpm in Nov. 1989. Also known as the Loango well and city well no. 2. |
| Covington County Water Commission | 361 | 4 | COVZ-02 | 472 | 1992 | Donald Smith Co. | 275 | Tcr | 84 5/20/92 | Casing: 12 in. from 0 to 360 ft; open hole below casing. Drawdown 24 ft when pumped 36 hrs at 100 gpm in May 1992. Also known as the Wing well and city well no. 3. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Covington County Water Commission | 361 | 5 | COVD-02 | 1,247 | 1994 | Donald Smith Company, Inc. | 475 | Tnf | 240 12/20/93 | Casing: 12 in. from 0 to 850 ft, 6 in. from 860 to 1,090 ft, 1,100 to 1,110 ft, 1,130 to 1,140 ft. Screen: 6 in. from 850 to 860 ft, 1,090 to 1,100 ft, 1,110 to 1,130 ft, and 1,140 to 1,160 ft. Drawdown 34 ft when pumped 24 hrs at 200 gpm on Dec. 20, 1993. Also known as the Boykin well and city well no. 4. |
| Covington County Water Commission | 361 | | COVT-02 | 390 (500) | 1997 | Donald Smith Company, Inc | 340 | Tl | 102 11/11/96 | Casing: 16 in. from 0 to 240 ft, 10 in. from 200 to 245 ft, 8 in. from 260 to 280 ft, 290 to 300 ft, 310 to 345 ft, and 380 to 390 ft. Screen: 8 in. from 245 to 260 ft, 280 to 290 ft, 300 to 310 ft, and 345 to 380 ft. Drawdown 78 ft when pumped 33 hrs at 201 gpm in Nov. 1996. City's Onycha well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Andalusia Water Works | 356 | 1 | COVM-8 | 1,105 | 1977 | Layne-Central Co. | 345 | Tnf | 191 12/77 | Casing: 18 in. from 0 to 985 ft, 10 in. from 915 to 990 ft and 1,000 to 1,010 ft. Screen: 10 in. from 990 to 1,000 ft and 1,010 to 1,090 ft. Drawdown 35 ft when pumped 8 hrs at 754 gpm in 1977. City well no. 8. |
| Andalusia Water Works | 356 | 2 | COVM-02 | 1,128 | 1969 | Layne-Central Co. | 350 | Tnf | 160 1970 | Casing: 18 in. from 0 to 1,009 ft, 8 in. from 929 to 1,014 ft. Screen: 10 in. from 1,014 to 1,074 ft. Drawdown 87 ft when pumped 8 hrs at 750 gpm in 1970. City well no. 7. |
| Andalusia Water Works | 356 | 3 | COVN-4 | 926 | 1964 | Layne-Central Co. | 185 | Tnf | 7.4 1965 | Casing: 18 in. from 0 to 376 ft, 10 in. from 321 to 381 ft and from 421 to 856 ft. Screen: 10 in. from 381 to 421 and 856 to 916 ft. Drawdown 79 ft when pumped 3 hrs at 754 gpm in 1964.City well no. 9. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Andalusia Water Works | 356 | 4 | COVM-03 | 1,019 | 1987 | Griner Drilling Service, Inc. | 253 | Tnf | 133.08 4/1/87 | Casing: 24 in. from 0 to 910 ft, 16 in. from 831 to 922 ft. Screen from 922 to 1,012 ft. Drawdown 82 ft when pumped 24 hrs at 503 gpm on 4/1/87. City well no. 5. |
| Andalusia Water Works | 356 | 5 | COVN-1 | 686 | 1949 | Layne-Central Co. | 160 | Tl | +30 7/27/49 | Casing: 18 in. from 0 to 332 ft, 10 in. from 277 to 343 ft, 373 to 383 ft, 423 to 455 ft, and 485 to 493 ft. Screen: 10 in. from 343 to 373 ft, 383 to 423 ft, and 455 to 485 ft. Drawdown 142 ft when pumped at 510 gpm in 1949. City well no. 4. |
| Andalusia Water Works | 356 | 6 | COVN-3 | 523 (621) | 1948 | Layne-Central Co. | 170 | Tl | +30 3/5/48 | Casing: 18 in. from 0 to 357 ft, 10 in. from 305 to 364 ft, 409 to 449 ft, and 519 to 523 ft. Screen: 10 in. from 364 to 409 ft and 449 to 519 ft. Drawdown 184 ft when pumped at 510 gpm in 1948. City well no. 6. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Andalusia Water Works | 356 | 7 | COVI-01 | 875 (1,000) | 1995 | Donald Smith Company, Inc. | 390 | Tnf | 176 5/10/95 | Casing: 16 in. from 0 to 620 ft. Open hole below casing. Drawdown 147 ft when pumped 30 hrs at 1,016 gpm on 5/10/95. City well no. 10. |
| Red Level Water Works | 378 | 1 | COVF-01 | 145 (940) | 1981 | Donald Smith Company, Inc. | 360 | Tl | 65 3/1/81 | Casing: 16 in. from 0 to 110 ft, 8 in. from 70 to 115 ft. Screen: 8 in. from 115 to 145 ft. Drawdown 24 ft when pumped 24 hrs at 150 gpm on 3/1/81. |
| Opp Utilities Board | 375 | 1 | COVK-03 | 279 | 1958 | Layne-Central Co. | 290 | Tl | 35 4/1/58 | Casing: 18 in. from 0 to 80 ft, 10 in. from 0 to 109 ft, 8 in. from 109 to 110 ft, 120 to 145 ft, and 160 to 178 ft. Screen: 8 in. from 110 to 120 ft, 145 to 160 ft, and 178 to 208 ft. Also known as Monroe St. well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Opp Utilities Board | 375 | 2 | COVK-5 | 194 | 1962 | Layne-Central Co. | 309 | Tl | 59 1/1/62 | Casing: 24 in. from 0 to 127 ft, 18 in. from 0 to 130 ft, 10 in. from 130 to 132 ft, 142 to 150 ft, and 170 to 175 ft. Screen: 10 in. from 132 to 142 ft, 150 to 170 ft, and 175 to 185 ft. Drawdown 55 ft when pumped 8 hrs at 329 gpm in 1962. Also known as Park well. |
| Opp Utilities Board | 375 | 3 | COVK-01 | 596 | 1967 | Layne-Central Co. | 335 | Tnf | 124 11/3/67 | Casing: 24 in. from 0 to 155 ft, 12 in. from 93 to 449 ft, 8 in. from 449 to 450 ft and 500 to 510 ft. Screen: 8 in. from 450 to 500 ft. Drawdown 138 ft when pumped 8 hrs at 302 gpm in 1967. Also known as Hwy 331 well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Opp Utilities Board | 375 | 4 | COVK-04 | 252 (414) | 1971 | Killough Drilling Co. | 270 | Tl | 20.05 4/15/83 | Casing: 16 in. from 0 to 125 ft, 8 in. from 95 to 130 ft, 6 in. from 140 to 150 ft, 165 to 180 ft, 200 to 212 ft. Screen: 6 in. from 130 to 140 ft, 150 to 165 ft, and 180 to 200 ft. Drawdown 72 ft when pumped 21 hrs at 246 gpm on 6/17/71. Also known as the 8th St. well. |
| Opp Utilities Board | 375 | 5 | COFL-8 | 910 | 1974 | Layne-Central Co. | 372 | Tnf | 156 10/2/74 184.45 4/26/85 212.95 10/1/90 | Casing: 16 in. from 0 to 680 ft. Open hole below casing. Drawdown 128 ft when pumped at 1,043 gpm in 1974. Well is located in Coffee County outside of Area 11 in Area 12. Information on this well is given to complete the list of Opp's public supply wells. Also known as the Hwy 84 well. |
| Opp Utilities Board | 375 | 6 | COVJ-01 | 903 | 1994 | Donald Smith Company, Inc. | 385 | Tnf | 210 1994 | Casing: 16 in. from 0 to 680 ft. Open hole below casing. Drawdown 113 ft when pumped 33 hrs at 1,016 gpm on 10/27/93. Also known as the Friendship well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| River Falls Water System | 379 | 2 | COVN-02 | 260 (324) | 1966 | Acme Drilling Co. | 160 | Tth | flow 1966 | Casing: 7 in. from 0 to 208 ft, 4 in. from 172 to 208 ft, 227 to 232 ft, 237 to 241 ft, and 256 to 260 ft. Screen: 4 in. from 208 to 227 ft, 232 to 237 ft, and 241 to 256 ft. Drawdown 126 ft when pumped 8 hrs at 108 gpm in 1966. |
| Florala Water Works and Sewer Board | 363 | 1 | COVCC-5 | 315 (703) | 1977 | Acme Drilling Co. | 300 | Tcr | 96 6/20/77 | Casing: 18 in. from 0 to 140 ft, 16 in. from 92 to 142 ft. Open hole below casing. Drawdown 1 ft when pumped 21 days at 750 gpm in 1977. This well is currently unused. |
| Florala Water Works and Sewer Board | 363 | | COVCC-4 | 601 | 1961 | Layne-Central, Inc. | 265 | Tl | 38 1947 38.6 11/8/84 | Casing: 16 in. from 0 to 320 ft, 8 in. from 277 to 339 ft, 369 to 469 ft, 484 to 510 ft, 530 to 560 ft, and 570 to 582 ft. Screen: 8 in. from 339 to 369 ft, 469 to 484 ft, 510 to 530 ft, 560 to 570 ft, and 582 to 592 ft. Drawdown 68 ft when pumped 8 hrs at 350 gpm in 1947. City well 2. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Florala Water Works and Sewer Board | 363 | | COVCC-3 | 316 | 1903 | Layne-Central, Inc | 262 | Tcr | 39<br>3/30/61<br>31.8<br>6/9/87 | Casing: 18 in. from 0 to 186 ft. Open hole below casing. Drawdown 5 ft when pumped 8 hrs at 410 gpm in 1961. City well 3. |
| Lockhart Water Works | 372 | 1 | COVCC-1 | 360 | 1903 | | 280 | Tcr | 70<br>1/1/63 | Casing: 4 in. from 0 to 110 ft. Open hole below casing. Well pumped at 250 gpm in 1965. Also known as the big well. |
| Lockhart Water Works | 372 | 2 | COVCC-2 | 360 | 1902 | | 292 | Tcr | 70<br>1/1/63<br>80.48<br>4/13/83 | Well construction unknown. Well pumped at 145 gpm in 1965. |

Table 2.–Records of public water-supply wells in Area 11–Continued

**CRENSHAW COUNTY**

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Quint-Mar Water and Fire Protection Authority | 1508 | 1 | CREK-08 | 560 | 1977 | Layne-Central Co. | 380 | Kr | 211<br>2/23/78 | Casing: 12 in. from 0 to 475 ft, 6 in. from 425 to 475 ft. Screen: 6 in. from 475 to 555 ft. Drawdown 125 ft when pumped 24 hrs at 305 gpm in1978. Also known as the Welch well. |
| Quint-Mar Water and Fire Protection Authority | 1508 | 2 | CREK-03 | 535 | 1983 | Powell Drilling Company, Inc. | 380 | Kr | 232<br>8/4/83 | Casing: 16 in. from 0 to 471 ft, 8 in. from 426 to 472 ft. Screen: 8 in. from 472 to 533 ft. Drawdown 73 ft when pumped 24 hrs at 250 gpm in 1983. |
| Quint-Mar Water and Fire Protection Authority | 1508 | 3 | CREK-06 | 526<br>(710) | 1988 | Griner Drilling Service, Inc. | 365 | Kr | 237<br>8/10/88<br>244.4<br>2/28/89 | Casing: 16 in. from 0 to 492 ft, 8 in. from 431 to 501 ft. Screen: 8 in. from 501 to 562 ft. Drawdown 78 ft when pumped 24 hrs at 375 gpm in 1988. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Quint-Mar Water and Fire Protection Authority | 1508 | 4 | CREG-02 | 363 | 1974 | Powell Drilling Company, Inc. | 360 | Kr | 147 2/13/74 | Casing: 8 in. from 0 to 314 ft, 3-in. from 290 to 315 ft, 325 to 338 ft, 348 to 349 ft, and 360 to 363 ft. Screen: 3-in. from 315 to 325 ft, 338 to 348 ft, and 349 to 360 ft. Drawdown 40 ft when pumped 16 hrs at 150 gpm in 1974. |
| Quint-Mar Water and Fire Protection Authority | 1508 | | CRED-01 | 290 | 1967 | Powell Drilling Company, Inc. | 480 | Kr | 75 1967 | Casing: 6 in. from 0 to 264 ft, 4 in. from 254 to 264 ft. Screen: 4 in. from 264 to 285 ft. Drawdown 75 ft when pumped 24 hrs at 125 gpm in 1967. Also known as the Lapine well. |
| Rutledge Water Works | 392 | 1 | CREK-05 | 605 | 1984 | Powell Drilling Company, Inc. | 370 | Kr | 224 9/4/84 | Casing: 16 in. from 0 to 514 ft, 8 in. from 464 to 517 ft and 537 to 554 ft. Screen: 8 in. from 517 to 537 ft and 554 to 585 ft. Drawdown 49 ft when pumped 24 hrs at 351 gpm in Sept. 1984. |
| Rutledge Water Works | 392 | 2 | CREK-5 | 245 | 1963 | Powell Drilling Company, Inc. | 355 | Tcl | 70 4/22/63 | Casing: 8 in. from 0 to 157 ft. Open hole below casing. Drawdown 79 ft when pumped 12 hrs at 181 gpm in 1963. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Luverne Water and Sewer Department | 390 | 1 | CREL-5 | 578 | 1953 | Layne-Central Co. | 340 | Kr | 97<br>1/6/53<br>224<br>3/23/94<br>222.4<br>10/13/98 | Casing: 16 in. from 0 to 492 ft, 8 in. from 432 to 497 ft. Screen: 8 in. from 497 to 567 ft. Drawdown 65 ft when pumped 8 hrs at 530 gpm in 1953. Also known as city well 1. |
| Luverne Water and Sewer Department | 390 | 2 | CREL-01 | 600<br>(630) | 1967 | Layne-Central Co. | 340 | Kr | 147<br>3/31/67 | Casing: 16 in. from 0 to 515 ft, 8 in. from 455 to 520 ft. Screen: 8 in. from 520 to 590 ft. Drawdown 59 ft when pumped 8 hrs at 503 gpm in 1967. Also known as city well 2. |
| Glenwood Water Works | 388 | 1 | CREN-3 | 202 | 1963 | Campbell Drilling Co. | 285 | Tcl | flow<br>1963 | Casing: 8 in. from 0 to 75 ft. Open hole below casing. Drawdown 33.4 ft when pumped 2.5 hrs at 142 gpm in 1963. |
| South Crenshaw County Water & Fire Protection Authority | 397 | 1 | CREU-01 | 525 | 1986 | Donald Smith Company, Inc. | 500 | Tnf | 280<br>1986 | Casing: 12 in. from 0 to 440 ft, 8 in. from 400 to 445 ft, 6 in. from 445 to 455 ft and 475 to 485 ft. Screen: 6 in. from 455 to 475 ft and 485 to 525 ft. Drawdown 69 ft when pumped 24 hrs at 355 gpm in 1985. Also known as the Bullock no. 1 well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| South Crenshaw County Water & Fire Protection Authority Crenshaw | 397 | 2 | CREN-03 | 260 | 1986 | Donald Smith Company, Inc. | 270 | Kr | 23 1986 | Casing: 12 in. from 0 to 169 ft, 8 in. from 120 to 170 ft, 6 in. from 220 to 235 ft. Screen: 6 in. from 170 to 220 ft and 235 to 245 ft. Also known as the North well. |
| South Crenshaw County Water & Fire Protection Authority | 397 | 3 | COFE-01 | 715 | 1989 | Donald Smith Company, Inc. | 500 | Tnf | 239 1989 | Casing: 12 in. from 0 to 625 ft; 6 in. from 555 to 640 ft. Screen: 6 in. from 640 to 700 ft. Drawdown 59 ft when pumped 24 hrs at 300 gpm in 1989. Also known as Bullock no. 2 well. Well is located in Coffee County, outside Area 11. Information on this well is given to complete the list of South Crenshaw County's public water supply wells. |
| South Crenshaw County Water & Fire Protection Authority | 397 | 4 | CRES-01 | 720 | 1995 | Donald Smith Company, Inc. | 480 | Tnf | 278 4/8/95 | Casing: 16 in. from 0 to 510 ft. Open hole below casing. Drawdown 137 ft when pumped 32 hrs at 500 gpm in 1995. Also known as the Dozier well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Brantley Water Works | 385 | 1 | CRET-9 | 258 (1,010) | 1975 | Layne Central Company | 310 | Tnf | 53 7/1/75 62.66 10/18/94 | Casing: 30 in. from 0 to 25 ft, 24 in. from 0 to 140 ft, 16 in. from 95 to 143 ft, 8 in. from 143 to 145 ft, 185 to 200 ft, 220 to 230 ft, and 250 to 258 ft. Screen: 8 in. from 145 to 185 ft, 200 to 220 ft, and 230 to 250 ft. Drawdown 51 ft when pumped 3 hrs at 439 gpm in 1975. |
| Dozier Water Works | 387 | 1 | CREW-1 | 586 | 1975 | Acme Drilling Company | 239 | Tnf | +3 1956 | Casing: 8 in. from 0 to 319 ft. Open hole below casing. Drawdown 33 ft when pumped 14 hrs at 600 gpm in 1956. |

Table 2.–Records of public water-supply wells in Area 11–Continued

**ESCAMBIA COUNTY**

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| McCall Water Systems, Inc. | 566 | 1 | ESCW-011 | 680 | 1973 | Tom Smith Artesian Well Company | 190 | Tcr | 80 1973 | Casing: 8 in. from 0 to 619 ft, 4 in. from 561 to 630 ft. Screen: 5-in. from 630 to 680 ft. Drawdown 140 ft when pumped 8 hrs at 250 gpm in 1973. |
| McCall Water Systems, Inc. | 566 | 2 | ESCM-02 | 277 (802) | 1982 | Graves Well Drilling Company, Inc. | 220 | Tmu | 108.33 6/22/82 | Casing: 16 in. from 0 to 223.5 ft, 8 in. from 197 to 223 ft. Screen: 8 in. from 223 to 275.3 ft. Drawdown 26 ft when pumped 21 hrs at 760 gpm in 1982. |
| McCall Water Systems, Inc. | 566 | 4 | ESCF-02 | 600 (743) | 1996 | Griner Drilling Service, Inc. | 355 | Tmu, Tcr | 169 3/21/97 | Casing: 30 in. from 0 to 250 ft, 16 in. from 0 to 497 ft. Open hole below casing. Drawdown 111 ft when pumped 32 hrs at 250 gpm in Sept. 1996. |
| McCall Water Systems, Inc. | 566 | 5 | CONAA-02 | 355 (406) | 1996 | Griner Drilling Service, Inc. | 350 | Tcr | 171 10/22/96 | Casing: 16 in. from 0 to 246 ft. Open hole below casing. Drawdown 54 ft when pumped 12 hrs at 200 gpm in 1996. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Huxford Water & Fire Protection Authority | 563 | 1 | ESCH-79 | 233 | 1970 | Mason Supply Company | 335 | Tmu | 134<br>1970 | Casing: 6 in. from 0 to 199 ft; 4 in. from 197 to 202 ft. Screen: 4 in. from 202 to 232 ft. Drawdown 11.5 ft when pumped 4 hrs at 135 gpm in 1970. |
| Brewton Water Works | 555 | 1 | ESCO-150 | 731 | 1954 | Layne Central Company | 162 | Tl | 31<br>1955 | Casing: 16 in. from 0 to 596 ft; 10 in. from 563 to 600 ft and 650 to 691 ft. Screen: 10 in. from 600 to 650 ft and 691 to 721 ft. Drawdown 130 ft when pumped 8 hrs at 750 gpm in 1955. Also known as the ALCO well. |
| Brewton Water Works | 555 | 2 | ESCO-95 | 665 | 1948 | Layne Central Company | 151 | Tl | 22.5<br>2/3/57<br>38.25<br>10/27/94 | Casing: 16 in. from 0 to 512 ft; 10 in. from 452 to 517 ft, 537 to 560 ft, 590 to 641 ft, and 661 to 665 ft. Screen: 10 in. from 517 to 537 ft, 560 to 590 ft, and 641 to 661 ft. Drawdown 231 ft when pumped at 745 gpm in 1948. Also known as the hospital well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Brewton Water Works | 555 | 3 | ESCO-01 | 785 | 1974 | Layne Central Company | 200 | Tgl | 61<br>1975 | Casing: 18 in. from 0 to 565 ft; 10 in. from 565 to 570 ft, 590 to 620 ft, 640 to 666 ft, and 681 to 710 ft. Screen: 10 in. from 570 to 590 ft, 620 to 640 ft, 666 to 681 ft, and 710 to 770 ft. Drawdown 55 ft when pumped 8 hrs at 805 gpm in 1974. Also known as North Tank well. |
| Brewton Water Works | 555 | 4 | ESCN-01 | 505 | 1993 | Griner Drilling Service, Inc. | 167 | Tcr | 85<br>1994 | Casing: 18 in. from 0 to 425 ft; 10 in. from 373 to 434 ft. Screen: 10 in. from 434 to 505 ft. Drawdown 237 ft when pumped 24 hrs at 201 gpm in 1993. Also known as Industrial Park well. |
| Atmore Utilities Board | 553 | 1 | ESCZ-71 | 130 | 1935 | Gray Artesian Well | 287 | Tmu | 48<br>1945<br>41.67<br>11/6/84<br>42.87<br>10/16/98 | Casing: 8 in. from 0 to 92 ft. Open hole below casing. Pump capacity 250 gpm. Also known as the Trammel St. well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Atmore Utilities Board | 553 | 2 | ESCAA-48 | 193 | 1967 | Layne Central Company | 292 | Tmu | 58<br>1968 | Casing: 24 in. from 0 to 109 ft; 16 in. from 0 to 113 ft. Screen: 12 in. from 113 to 183 ft. Drawdown 26.5 ft when pumped 8 hrs at 800 gpm in 1968. Also known as Carpet Rd. well. |
| Atmore Utilities Board | 553 | 3 | ESCZ-01 | 182<br>(400) | 1980 | Acme Drilling Company | 280 | Tmu | 22<br>1/16/80 | Casing: 24 in. from 0 to 117 ft; 16 in. from 57 to 115 ft. Screen: 12 in. from 115 to 180 ft. Drawdown 46 ft when pumped 8 hrs at 351 gpm in 1980. Also known as the Fillmore Plant well. |
| Atmore Utilities Board | 553 | 4 | ESCZ-106 | 180 | 1960 | Layne Central Company | 269 | Tmu | 23<br>9/24/59 | Casing: 24 in. from 0 to 103 ft; 16 in. from 0 to 113 ft. Screen: 12 in. from 113 to 167 ft. Drawdown 35 ft when pumped 8 hrs at 1,022 gpm in 1960. Also known as Lindberg Plant well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Atmore Utilities Board | 553 | 5 | ESCZ-72 | 129 | 1932 | Layne Central Company | 285 | Tmu | 18 8/21/45 | Casing: 18 in. from 0 to 21 ft; 8 in. from 0 to 100 ft. Screen: 8 in. from 100 to 129 ft. Pump capacity 500 gpm in 1945. Also known as S. Trammel St. well. |
| Atmore Utilities Board | 553 | 6 | ESCAA-03 | 153 (400) | 1980 | Acme Drilling Company | 290 | Tmu | 47 1980 | Casing: 14 in. from 0 to 120 ft; 10 in. from 65 to 119 ft. Screen: 8 in. from 119 to 149 ft. Drawdown 28 ft when pumped 24 hrs at 570 gpm in 1980. Also known as Dees Dr. well. |
| Atmore Utilities Board | 553 | 7 | ESCAA-01 | 162 | 1980 | Acme Drilling Company | 290 | Tmu | 47 1980 | Casing: 14 in. from 0 to 130 ft; 10 in. from 82 to 129 ft. Screen: 8 in. from 129 to 160 ft. Drawdown 23 ft when pumped 24 hrs at 465 gpm in 1980. Also known as Byrne's Dr. well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Atmore Utilities Board | 553 | 10 | ESCK-06 | 362 | 1967 | Layne Central Company | 290 | Tcr | 108 1969 | Casing: 18 in. from 0 to 282 ft; 10 in. from 240 to 283 ft and 303 to 332 ft. Screen: 10 in. from 283 to 303 ft and 332 to 352 ft. Drawdown 27 ft when pumped 8 hrs at 400 gpm in 1969. Also known as Holman Prison well no. 1. |
| Atmore Utilities Board | 553 | 11 | ESCK-05 | 362 | 1967 | Layne Central Company | 290 | Tcr | 103 1969 | Casing: 18 in. from 0 to 289 ft; 10 in. from 240 to 292 ft and 302 to 322 ft. Screen: 10 in. from 292 to 302 ft and 322 to 352 ft. Drawdown 25 ft when pumped 8 hrs at 402 gpm in 1969. Also known as Holman Prison well no. 2. |
| Atmore Utilities Board | 553 | 12 | ESCK-011 | 515 | 1992 | Griner Drilling Service, Inc. | 307 | Tcr | 123 7/2/92 | Casing: 18 in. from 0 to 297 ft; 10 in. from 240 to 307 ft and 347 to 370 ft. Screen: 10 in. from 307 to 347 ft and 370 to 390 ft. Drawdown 120 ft when pumped 9 hrs at 603 gpm on 7/3/92. Also known as Fountain Prison well no. 1. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| East Brewton Water & Sewer Board | 558 | 1 | ESCO-02 | 725 | 1974 | Layne Central Company | 95 | Tgl | +22 1975 | Casing: 18 in. from 0 to 615 ft; 10 in. from 540 to 620 ft and 670 to 690 ft. Screen: 10 in. from 620 to 670 and 690 to 710 ft. Drawdown 16 ft when pumped 4 hrs at 503 gpm in 1975. Also known as city well no. 1. |
| East Brewton Water & Sewer Board | 558 | | ESCO-05 | 800 | 1987 | Griner Drilling Service, Inc. | 165 | Tgl | 55 4/16/98 | Casing: 18 in. from 0 to 672 ft; 10 in. from 599 to 682 ft, 702 to 706 ft, and 724 to 744 ft. Screen: 10 in. from 682 to 702 ft, 706 to 724 ft, and 744 to 756 ft. Drawdown 97 ft when pumped 10 hrs at 752 gpm in 1997. Also known as city well no. 3. |
| Ridge Road Water System | | | ESCP-02 | 580 (890) | 1997 | Griner Drilling Service, Inc. | 100 | Tgl | +14 6/2/98 | Casing: 16 in. from 0 to 530 ft; 8 in. from 480 to 540 ft. Screen: 8 in. from 540 to 580 ft. Drawdown 60 ft when pumped 24 hrs at 450 gpm in 1998. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Freemanville Water System | 561 | 1 | ESCJ-01 | 262 | 1982 | Griner Drilling Service, Inc. | 297 | Tmu | 49 9/21/82 | Casing: 18 in. from 0 to 222 ft; 10 in. from 167 to 232 ft. Screen: 10 in. from 232 to 262 ft. Drawdown 45 ft when pumped 5 hrs at 536 gpm in 1982. |
| Freemanville Water System | 561 | 2 | ESCZ-012 | 214 | 1989 | Weldon Drilling Co. | 300 | Tmu | 60 1989 | Casing: 18 in. from 0 to 179 ft; 8 in. from 0 to 182 ft. Screen: 8 in. from 182 to 214 ft. Drawdown 52 ft when pumped 24 hrs at 450 gpm on 7/25/89. |
| Pollard Water System | 546 | 1 | ESCW-01 | 260 (800) | 1981 | Acme Drilling Company | 60 | Tmu | +1 1981 | Casing: 12 in. from 0 to 233 ft; 6 in. from 192 to 232.5 ft. Screen: 6 in. from 232.5 to 258 ft. Drawdown 26 ft when pumped 24 hrs at 383 gpm on 9/10/81. |
| Canoe Water & Fire Protection Authority | 557 | 1 | ESCZ-107 | 90 | 1967 | Spiller Well & Pump Co. | 289 | Tmu | 39 1967 | Casing: 6 in. from 0 to 70 ft; 4 in. from 68 to 70 ft. Screen: 4 in. from 70 to 90 ft. Drawdown 24 ft when pumped 8 hrs at 160 gpm in 1967. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Flomaton Water Works | 559 | 2 | ESCX-01 | 293 | 1973 | Alton Powell Drilling Company | 180 | Tmu | 143 1973 | Casing: 12 in. from 0 to 215 ft; 8 in. from 175 to 218 ft; 6 in. from 229 to 234 ft, 255 to 266 ft, and 286 to 288 ft. Screen: 6 in. from 218 to 229 ft, 234 to 255 ft, and 266 to 286 ft. |
| Flomaton Water Works | 559 | 3 | ESCX-018 | 269 | 1982 | Acme Drilling Company | 220 | Tmu | 124 1982 | Casing: 12 in. from 0 to 230 ft; 8 in. from 185 to 226 ft. Screen: 6 in. from 226 to 266 ft. Drawdown 16 ft when pumped 24 hrs at 457 gpm in 1982. |
| Riverview Water Works | 570 | 1 | ESCV-01 | 444 | 1972 | Acme Drilling Company | 75 | Tcr | flow 1972 | Casing: 6 in. from 0 to 362 ft; 4 in. from 318 to 362 ft. Screen: 4 in. from 362 to 442 ft. Drawdown 52 ft when pumped 3 hrs at 232 gpm in 1972. |

Table 2.–Records of public water-supply wells in Area 11–Continued

**MONROE COUNTY**

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Beatrice Water System | 1044 | 1 | MONJ-5 | 448 | 1961 | Layne Central Company | 258 | Tnf | 13<br>1961 | Casing: 8 in. from 0 to 424 ft; 6 in. from 0 to 428 ft. Screen: 6 in. 428 to 448 ft. Drawdown 109 ft when pumped 9 hrs at 50 gpm in 1961. |
| Beatrice Water System | 1044 | 2 | MONJ-6 | 460 | 1961 | Layne Central Company | 264 | Tnf | 107<br>1/12/61<br>126.8<br>6/16/67 | Casing: 8 in. from 0 to 378 ft; 4.5 in. from 348 to 381 ft and 401 to 440 ft. Screen: 4.5 in. from 381 to 401 ft and 440 to 460 ft. Drawdown 150 ft when pumped 9 hrs at 50 gpm in 1961. |
| Excel Water System | 1046 | 1 | MONHH-2 | 133 | 1965 | Alton Powell Drilling Company | 403 | Tmu | 47<br>1965 | Casing: 12 in. from 0 to 59 ft; 8 in. from 0 to 110 ft; 6 in. from 103 to 112 ft, 118 to 120 ft. Screen: 6 in. from 112 to 118 ft and 120 to 130 ft. Drawdown 8 ft when pumped 7 hrs at 167 gpm in 1965. |
| Excel Water System | 1046 | | MONHH-02 | 150 | 1996 | Rowe Drilling Company | 405 | Tmu | 76<br>12/4/96 | Casing: 16 in. from 0 to 120 ft; 8 in. from 0 to 125 ft. Screen: 6 in. from 125 to 150 ft. Drawdown 19.4 ft when pumped 24 hrs at 230 gpm in 1996. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Frisco City Water System | 1047 | 1 | MONHH-3 | 132 | 1962 | Acme Drilling Company | 413 | Tmu | 63 1962 | Casing: 18 in. from 0 to 100 ft; 12 in. from 56 to 100 ft. Screen: 12 in. from 100 to 130 ft. Drawdown 41 ft when pumped 2 hrs at 450 gpm in 1962. |
| Frisco City Water System | 1047 | 2 | MONGG-02 | 139 | 1970 | Acme Drilling Company | 405 | Tmu | 87 4/1/70 | Casing: 18 in. from 0 to 108 ft; 12 in. from 65 to 105 ft. Screen: 12 in. from 105 to 135 ft. Drawdown 15 ft when pumped 6 hrs at 351 gpm in 1970. |
| Monroeville Water Service | 1052 | 1 | MONU-4 | 1,295 | 1974 | Layne Central Company | 350 | Tnf | 302 1974 | Casing: 18 in. from 0 to 1,135 ft; 10 in. from 1,040 to 1,135 ft, 1,180 to 1,190 ft, 1,225 to 1,240 ft. Screen: 10 in. from 1,140 to 1,180 ft, 1,190 to 1,225 and 1,240 to 1,275 ft. Drawdown 134 ft when pumped 2 hrs at 981 gpm in 1974. Also known as the Hammond St. well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Monroeville Water Service | 1052 | 2 | MONV-04 | 1,290 | 1979 | Layne Central Company | 310 | Tnf | 354 1979 | Casing: 18 in. from 0 to 1,135 ft; 10 in. from 1,045 to 1,140 ft, 1,190 to 1,200 ft, 1,240 to 1,250 ft. Screen: 10 in. from 1,140 to 1,190 ft, 1,200 to 1,240 ft, and 1,250 to 1,275 ft. Drawdown 92 ft when pumped 12 hrs at 818 gpm in 1981. Also known as the Ivy St. well. |
| Monroeville Water Service | 1052 | 3 | MONZ-1 | 1,387 | 1965 | Layne Central Company | 425 | Tnf | 313 1967 | Casing: 16 in. from 0 to 1,240 ft; 10 in. from 1,160 to 1,243 ft and 1,273 to 1,317 ft. Screen: 10 in. from 1,243 to 1,273 ft and 1,317 to 1,387 ft. Drawdown 401 ft when pumped 24 hrs at 933 gpm in 1965. Also known as the Drewry well. |
| Monroeville Water Service | 1052 | 4 | MONU-3 | 1,365 | 1955 | Layne Central Company | 414 | Tnf | 272 1955 | Casing: 16 in. from 0 to 1,190; 10 in. from 1,110 to 1,195 ft and 1,215 to 1,285 ft. Screen: 10 in. from 1,195 to 1,215 ft and 1,285 to 1,365 ft. Drawdown 132 ft when pumped 8 hrs at 900 gpm in 1955. Also known as Cherry St. well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Monroeville Water Service | 1052 | 5 | MONZ-2 | 1,394 | 1953 | Layne Central Company | 427 | Tnf | 260 1953 | Casing: 16 in. from 0 to 1,247 ft; 10 in. from 1,167 to 1,252 ft and 1,292 to 1,354 ft. Screen: 10 in. from 1,252 to 1,292 and 1,354 to 1,394 ft. Drawdown 145 ft when pumped 8 hrs at 900 gpm in 1953. Also known as the Poplar St. well. |
| Monroeville Water Service | 1052 | 6 | MONY-01 | 1,270 | 1991 | Layne Central Company | 340 | Tnf | 359 12/4/98 | Casing: 18 in. from 0 to 1,110 ft; 10 in. from 1,035 to 1,114 ft, 1,154 to 1,180 ft, 1,215 to 1,235 ft, and 1,255 to 1,270 ft. Screen: 10 in. from 1,114 to 1,154 ft, 1,180 to 1,215 ft, and 1,235 to 1,255 ft. Drawdown 145 ft when pumped 8 hrs at 1,205 gpm in 1991. Also known as the Rose Drive well. |
| Southwest Alabama Water & Fire Protection Authority | 1426 | 2 | MONO-01 | 840 | 1989 | Weldon Drilling Company, Inc. | 430 | Tnf | 319 1989 | Casing: 12 in. from 0 to 710 ft; 6 in. from 687 to 720 ft and 760 to 790 ft. Screen: 6 in. from 720 to 760 ft and 790 to 830 ft. Drawdown 320 ft when pumped at 320 gpm in 1991. Also known as the Tunnel Springs well. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Southwest Alabama Water & Fire Protection Authority | 1426 | 3 | MONH-01 | 925 | 1994 | Griner Drilling Company, Inc. | 430 | Tnf | 363 10/31/94 | Casing: 12 in. from 0 to 800 ft; 6 in. from 750 to 810 ft and 830 to 905 ft. Screen: 6 in. from 810 to 830 ft and 905 to 925 ft. Drawdown 108 ft when pumped 7 days at 200 gpm in Nov. 1994. Also known as the Franklin well. |
| Uriah Water System | 1056 | 1 | MONKK-3 | 171 | 1922 | Logan Drilling Co. | 352 | Tmu | 105 1962 | Casing: 4 in. from 0 to unknown depth. Well pumped at 56 gpm in 1962. |
| Uriah Water System | 1056 | 2 | MONKK-01 | 280 | 1969 | T. F. Mason | 350 | Tmu | 130 1970 | Casing: 14 in. from 0 to 44 ft; 8 in. from 0 to 260 ft; 6 in. from 255 to 265 ft. Screen: 6 in. from 265 to 280 ft. Drawdown 17 ft when pumped 8 hrs at 104 gpm in 1970. |
| Vredenburgh Water System | 1048 | 1 | MONE-4 | 274 | 1948 | Layne Central Company | 146 | Tnf | 55 1984 | Casing: 12 in. from 0 to 235 ft; 6 in. from 180 to 240 ft. Screen: 6 in. from 240 to 270 ft. Drawdown 10 ft when pumped 4 hrs at 150 gpm in 1948. |

Table 2.–Records of public water-supply wells in Area 11–Continued

| System | PWS ID | SE ID | GSA ID | Depth | Year drilled | Drilling contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Vredenburgh Water System | 1048 | 2 | MONE-3 | 320 | 1912 | Gray Artesian Well | 146 | Tnf | 38 5/28/46 | Casing: 10 in. from 0 to 85 ft. Open hole below casing. Pump capacity 150 gpm in 1946. |

EXPLANATION FOR TABLE 3

WELL OWNER, water system name or owner's name.
WELL NO, well identification number used in Water Resources Investigation Report 88-4107 and shown on plates.
GSA ID, well identification number assigned by the GSA.
DEPTH, total depth of well in feet. Number in parentheses denotes total depth of test well drilled at the same location.
YEAR DRILLED, the year the well was completed and ready for operation.
DRILLING CONTRACTOR, name of driller.
ALTITUDE, elevation of land surface in feet above mean sea level.
AQUIFER, Tmu, undifferentiated Pliocene, Miocene and Oligocene deposits of Tertiary age; Tcr, Crystal River Formation; Tl, Lisbon Formation; Tgl, Lisbon and Gosport Sand; Tt, Tuscahoma Sand; Tnf, Nanafalia Formation; Kr, Ripley Formation.
WATER LEVEL, water level in feet below land surface. The date the measurement was made is shown below the measurement.
WELL CONSTRUCTION, YIELD, REMARKS, gpm (gallons per minute).

Table 3.–Records of selected wells and inactive public water-supply wells in Area 11

**BUTLER COUNTY**

| Well Owner | Well no. | GSA ID | Depth | Year drilled | Drilling Contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|
| Greenville Water Works | 10 | BUTH-12 | 577 (598) | 1942 | Layne Central Company, Inc. | 379 | Kr | 232.4 5/2/80 | Casing: 12 in. from 0 to 460 ft; 8 in. from 404 to 473 ft and 493 to 525 ft. Screen: 8 in. from 473 to 493 ft and 525 to 577 ft. Drawdown 156 ft when pumped 24 hrs at 575 gpm in 1967. |
| Union Camp | 18 | BUTQ-4 | 865 | | Layne Central Company, Inc. | 272 | Kr | 91.0 10/30/65 | Casing: 16 in. from 0 to 740 ft; 8 in. from 656 to 761 ft. Screen: 8 in. from 761 to 861 ft. Drawdown 57 ft when pumped 12 hrs at 614 gpm in 1965. |
| Union Camp | 19 | BUTQ-03 | 837 | 1968 | Layne Central Company, Inc. | 265 | Kr | 99 02/01/68 | Casing: 20 in. from 0 to 722 ft; 10 in. from 642 to 727 ft. Screen: 10 in. from 727 to 827 ft. Pump capacity 602 gpm in 1968. |
| Town of Garland | 30 | BUTX-4 | 280 | 1911 | | 213 | Tt | +2.8 5/26/64 | Casing: 4 in. to unknown depth. Finish unknown. Well had a measured flow of 1.5 gpm on 5/26/64. |
| McKenzie Water Board | 37 | BUTW-5 | 766 | 1945 | W. J. Bozeman | 453 | Tnf | 240 1/28/53 | Casing: 8 in. from 0 to 90 ft; 6 in. from 90 to 740 ft. Screen: 5.625-in. from 740 to 750 ft and 4.5-in. from 750 to 760 ft. Drawdown 60 ft when pumped 24 hrs at 50 gpm in 1964. |

Table 3.–Records of selected wells and inactive public water-supply wells in Area 11–Continued

**CONECUH COUNTY**

| Well Owner | Well no. | GSA ID | Depth | Year drilled | Drilling Contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|
| Alabama Highway Department | 54 | CONAA-01 | 300 | 1968 | Acme Drilling Company | 340 | Tmu | 137.8 6/13/68 | Casing: 6 in. from 0 to 155 ft. Open hole below casing. Drawdown 9.3 ft when pumped 24 hrs at 30 gpm in June 1968. |
| Alabama Highway Department | 55 | CONT-01 | 258 | 1968 | Acme Drilling Company | 231 | Tmu, Tcr | | Casing: 6 in. from 0 to 252 ft. Screen: 6 in. from 252 to 262 ft. Estimated yield 50 gpm. |

**COVINGTON COUNTY**

| Well Owner | Well no. | GSA ID | Depth | Year drilled | Drilling Contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|
| Andalusia Water Works | 62 | COVM-4 | 331 (1,084) | 1942 | Layne Central Company, Inc. | 325 | Tl | 115.7 11/8/84 | Casing: 18 in. from 0 to 120 ft; 8 in. from 0 to 132 ft, 152 to 157 ft, 177 to 185 ft, 195 to 211 ft, 231 to 248 ft, 268 to 321 ft. Screen: 8 in. from 132 to 152 ft, 157 to 177 ft, 185 to 195 ft, 211 to 231 ft, 248 to 268 ft, and 321 to 331 ft. Estimated yield 80 to 100 gpm in 1965. |
| Alabama Highway Department | 81 | COVU-01 | 173 | 1975 | Alabama Highway Department | 260 | Tcr | 57.7 11/8/84 | Casing: 4 in. from 0 to 143 ft. Screen: 143 to 173 ft. Drawdown 1.7 ft when pumped 15 hrs at 38 gpm on 3/13/75. |

Table 3.–Records of selected wells and inactive public water-supply wells in Area 11–Continued

**CRENSHAW COUNTY**

| Well Owner | Well no. | GSA ID | Depth | Year drilled | Drilling Contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|
| Luverne Water and Sewer Board | 22 | CREL-6 | 345 | 1943 | Gray Artesian Well Co. | 343 | Tnf | 34 11/1/43 | Casing: 12 in. from 0 to 90 ft. Open hole below casing. Drawdown 80 ft when pumped 48 hrs at 250 gpm in 1943. |
| Brantley Water Works | 27 | CRET-5 | 201 | 1945 | L. A. Killough, Jr | 291 | Tnf | 34 1964 | Casing: 6 in. from 0 to 178 ft. Open hole below casing. Drawdown 32 ft when pumped 12 hrs at 156 gpm in 1946. |

**ESCAMBIA COUNTY**

| Well Owner | Well no. | GSA ID | Depth | Year drilled | Drilling Contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|
| Alabama Department of Corrections | 71 | ESCK-04 | 179 | 1981 | Graves Well Drilling Company, Inc. | 311 | Tmu | 45 1981 | Casing: 12 in. from 0 to 130 ft; 8 in. from 0 to 137 ft. Screen: 6 in. from 137 to 179 ft. Capacity 400 gpm in 1986. |
| Alabama Department of Corrections | 72 | | 203 | 1941 | Gray Artesian Company, Inc. | 311 | Tmu | 90 | Casing: 22 in. from 0 to 89 ft; 12 in. from 0 to 123 ft. Screen: 12 in. from 123 to 203 ft. Drawdown 70 ft when pumped at 312 gpm in 1941. |

Table 3.–Records of selected wells and inactive public water-supply wells in Area 11–Continued

**MONROE COUNTY**

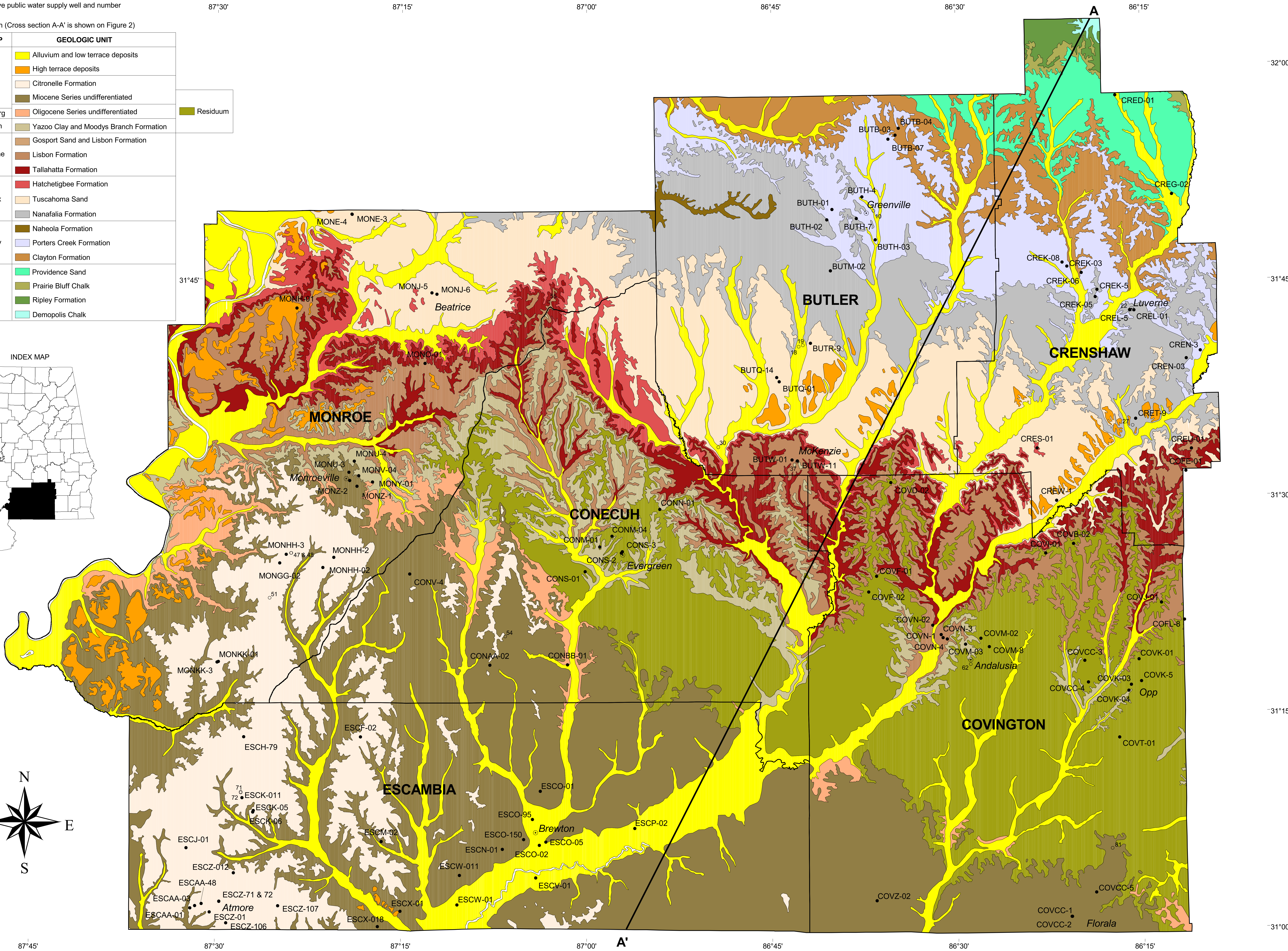
| Well Owner | Well no. | GSA ID | Depth | Year drilled | Drilling Contractor | Altitude | Aquifer | Water level Date measured | Well construction, yield, remarks |
|---|---|---|---|---|---|---|---|---|---|
| Frisco City Water Works | 47 | MONZ-12 | 124 | 1935 | Gray Artesian Company, Inc. | 412 | Tmu | 67.7 6/13/67 | Casing: 10 in. from 0 to 124 ft. Perforated from 86 to 124 ft. Drawdown 5.5 ft when pumped at 106 gpm in 1935. |
| Frisco City Water Works | 48 | MONZ-13 | 129 | 1953 | Gray Artesian Company, Inc. | 412 | Tmu | 73 4/8/53 | Casing: 16 in. from 0 to 86 ft; 10 in. from 65 to 89 ft. Screen: 8 in. from 89 to 129 ft. Drawdown 18 ft when pumped 18 hrs at 300 gpm in 1953. |
| Uriah Water System | 51 | MONGG-7 | 165 | 1964 | Etheridge Plumbing | 391 | Tmu | 119 1964 | Casing: 6 in. from 0 to 143 ft. Screen: 4.5 in. from 143 to 165 ft. Drawdown 9 ft when pumped 36 hrs at 104 gpm in 1964. |

**EXPLANATION**

- CONV-4 ● Public water supply well and number
- 51 ○ Selected and inactive public water supply well and number
- ⊙ County Seat
- A—A' Line of cross section (Cross section A-A' is shown on Figure 2)

| SYSTEM | SERIES | GROUP | GEOLOGIC UNIT |
|---|---|---|---|
| Quaternary | Holocene and Pleistocene | | Alluvium and low terrace deposits |
| | | | High terrace deposits |
| Tertiary | Pliocene and Miocene | | Citronelle Formation |
| | | | Miocene Series undifferentiated |
| | Oligocene | Vicksburg | Oligocene Series undifferentiated |
| | Eocene | Jackson | Yazoo Clay and Moodys Branch Formation |
| | | Claiborne | Gosport Sand and Lisbon Formation |
| | | | Lisbon Formation |
| | | | Tallahatta Formation |
| | | Wilcox | Hatchetigbee Formation |
| | | | Tuscahoma Sand |
| | Paleocene | | Nanafalia Formation |
| | | Midway | Naheola Formation |
| | | | Porters Creek Formation |
| | | | Clayton Formation |
| Cretaceous | Upper | Selma | Providence Sand |
| | | | Prairie Bluff Chalk |
| | | | Ripley Formation |
| | | | Demopolis Chalk |

Residuum




SCALE
10 0 10 Miles

# GEOLOGY AND LOCATIONS OF HYDROGEOLOGIC CROSS SECTION AND PUBLIC WATER SUPPLY WELLS IN AREA 11

*Geology modified from Szabo and Copeland (1988a, b)*

*Compiled by Dorothy Raymond*

*2002*

GEOLOGICAL SURVEY OF ALABAMA
Founded 1848

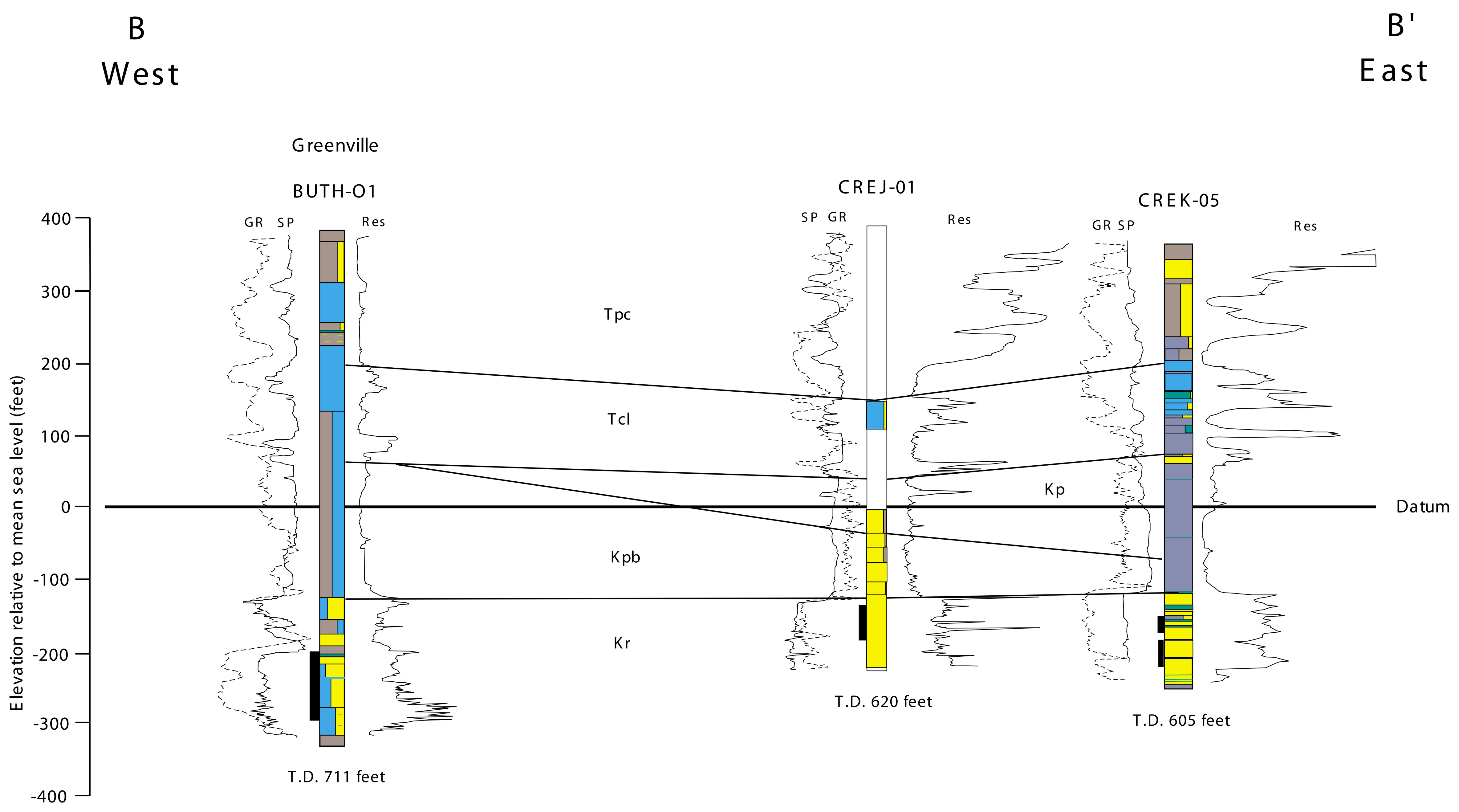
Berry H. (Nick) Tew, Jr.
State Geologist

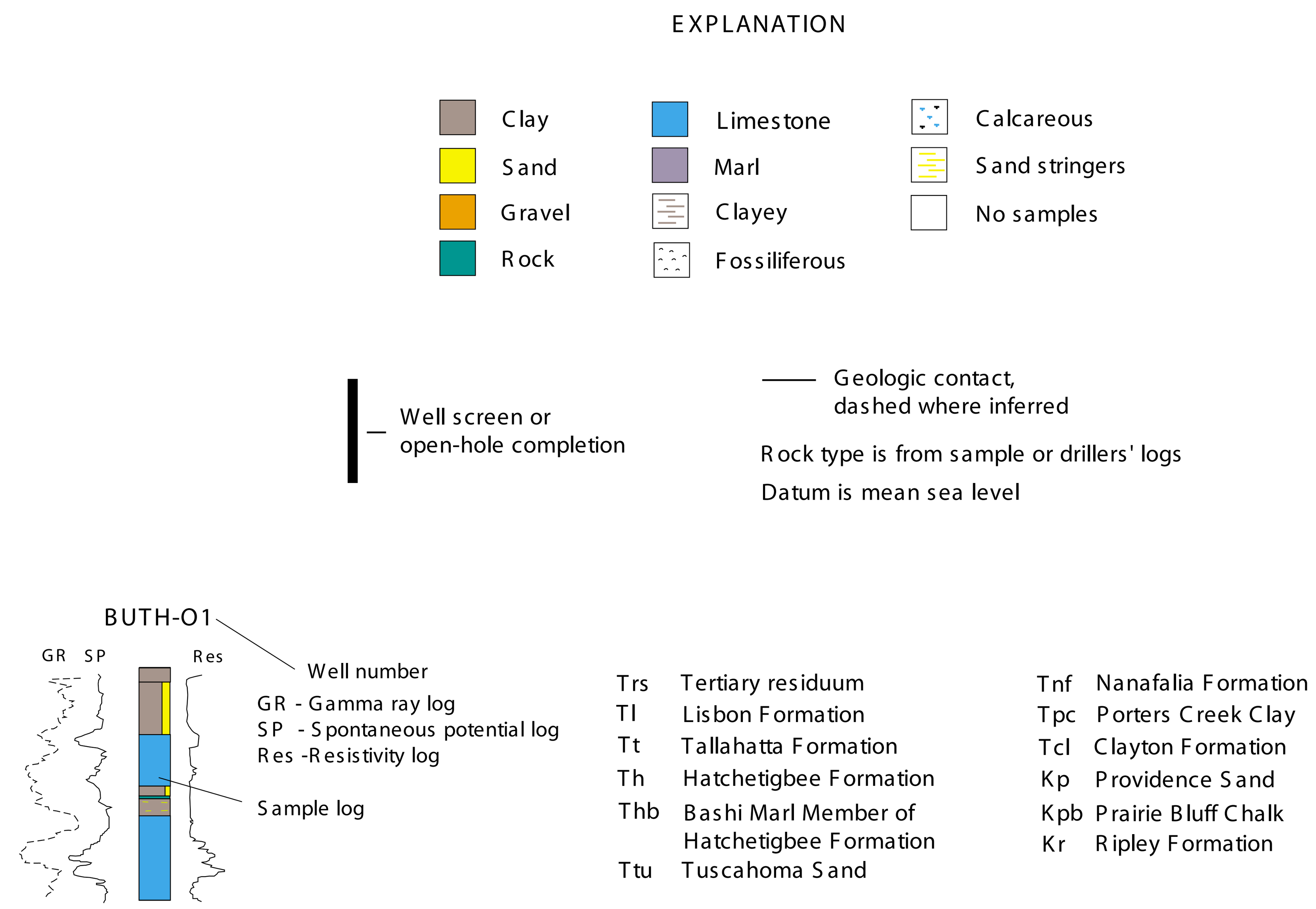
*GIS by Ruth T. Collier and Gary W. Crawford*

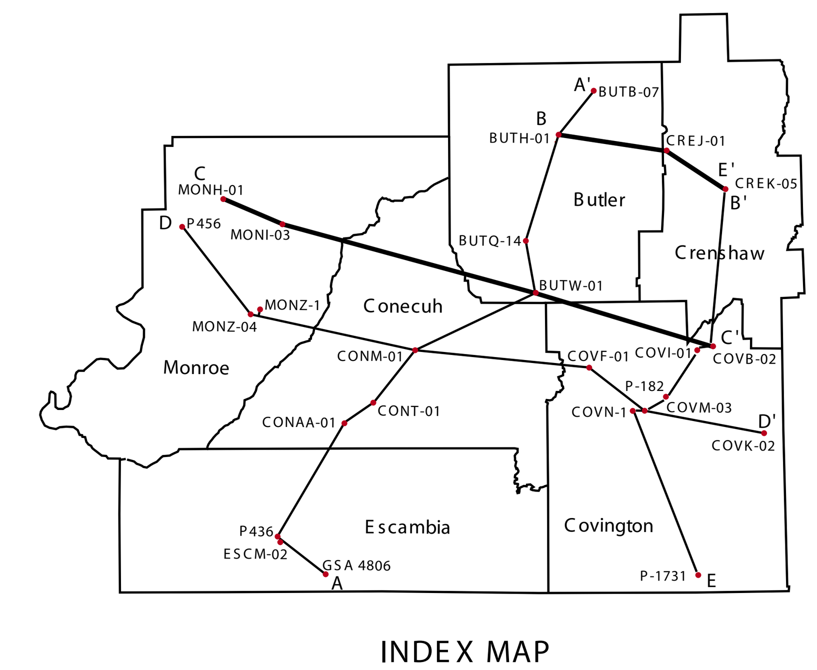

# *HYDROGEOLOGIC CROSS SECTION A - A', AREA 11*

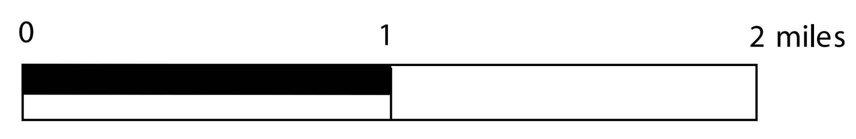
*By*
*Dorothy E. Raymond*
*2003*

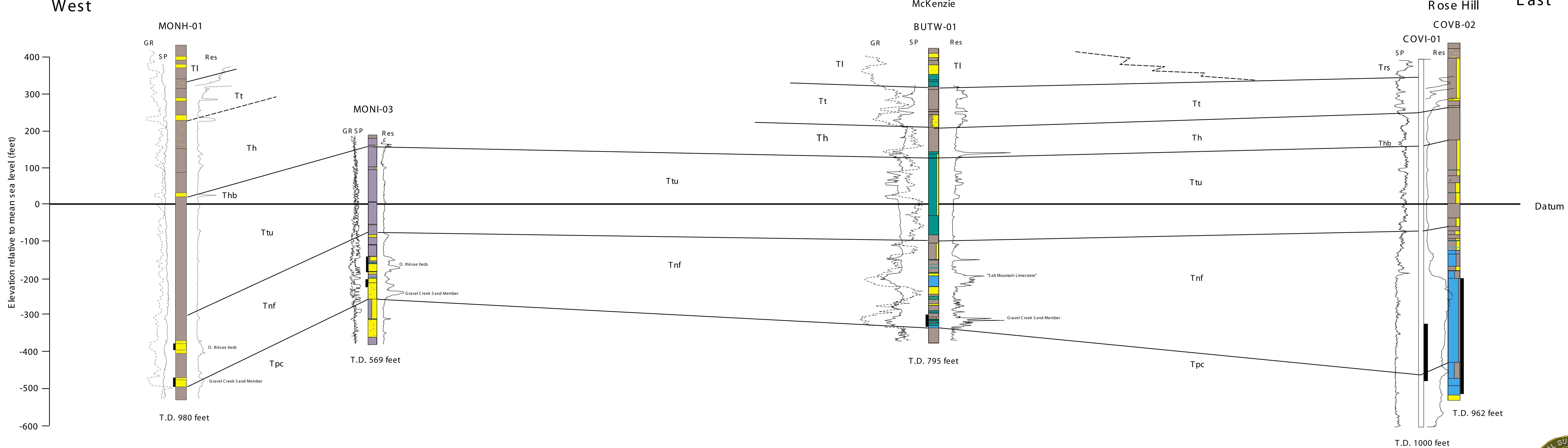
**BERRY H. (NICK) TEW, JR.**
***State Geologist***




# HYDROGEOLOGIC CROSS SECTIONS B- B' AND C-C', AREA 11

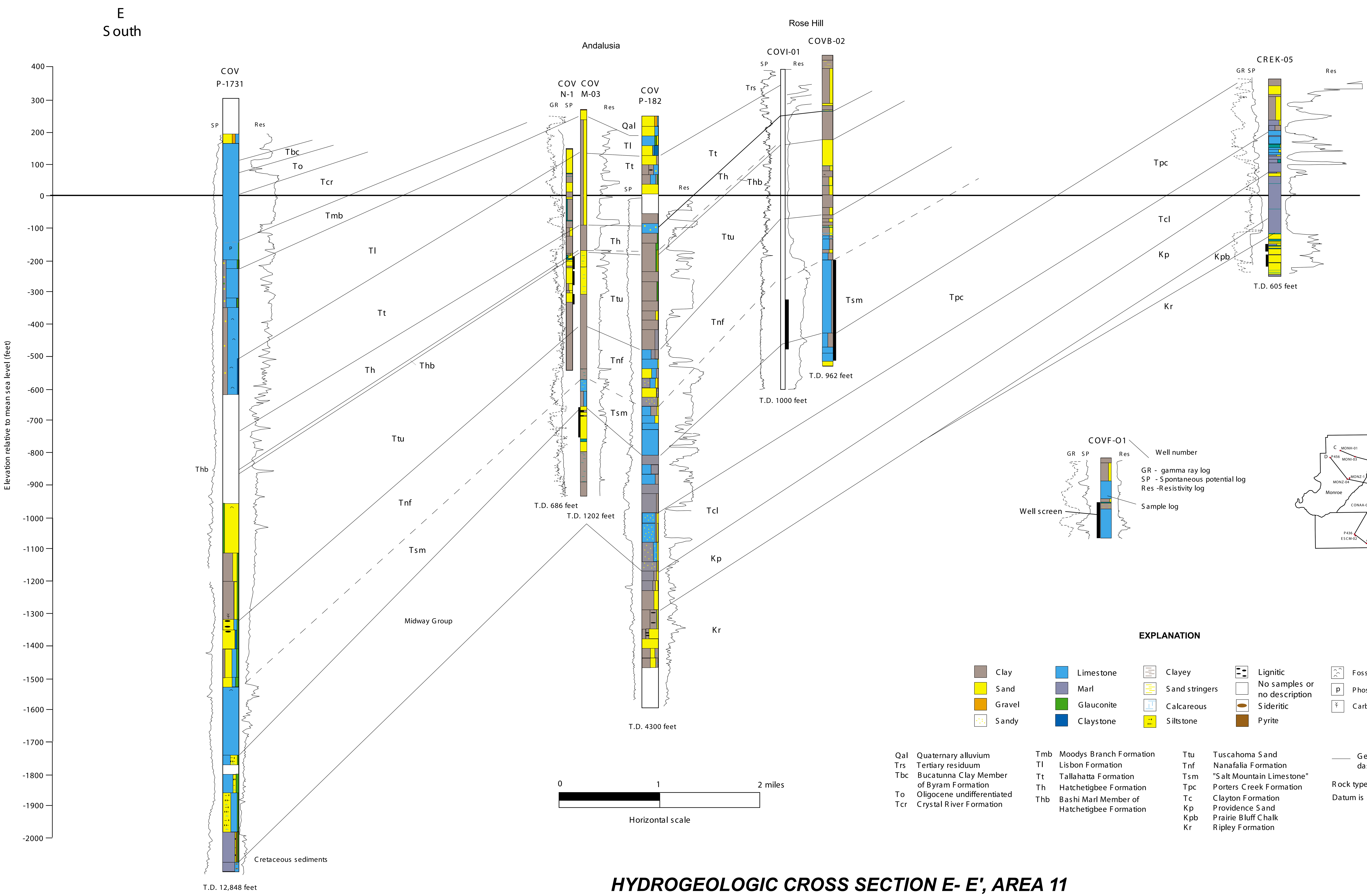
By
Dorothy E. Raymond
2003

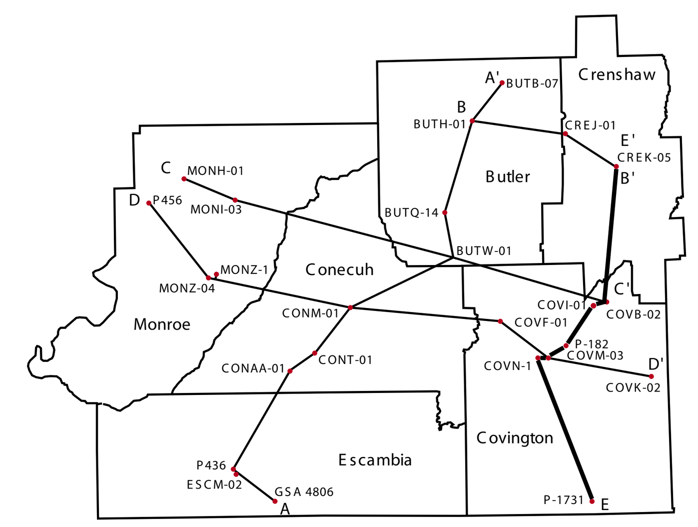
BERRY H. (NICK) TEW, JR.
State Geologist


# HYDROGEOLOGIC CROSS SECTION D- D', AREA 11

*By*
*Dorothy E. Raymond and Charles C. Smith*
*2003*

**BERRY H. (NICK) TEW, JR.**
**State Geologist**




Index map

**EXPLANATION**

Clay, Sand, Gravel, Sandy, Limestone, Marl, Glauconite, Claystone, Clayey, Sand stringers, Calcareous, Siltstone, Lignitic, No samples or no description, Sideritic, Pyrite, Fossiliferous, Phosphatic, Carbonaceous, woody

| | |
|---|---|
| Qal | Quaternary alluvium |
| Trs | Tertiary residuum |
| Tbc | Bucatunna Clay Member of Byram Formation |
| To | Oligocene undifferentiated |
| Tcr | Crystal River Formation |
| Tmb | Moodys Branch Formation |
| Tl | Lisbon Formation |
| Tt | Tallahatta Formation |
| Th | Hatchetigbee Formation |
| Thb | Bashi Marl Member of Hatchetigbee Formation |
| Ttu | Tuscahoma Sand |
| Tnf | Nanafalia Formation |
| Tsm | "Salt Mountain Limestone" |
| Tpc | Porters Creek Formation |
| Tc | Clayton Formation |
| Kp | Providence Sand |
| Kpb | Prairie Bluff Chalk |
| Kr | Ripley Formation |

Geologic contact, dashed where inferred

Rock type is from sample or drillers' logs

Datum is mean sea level

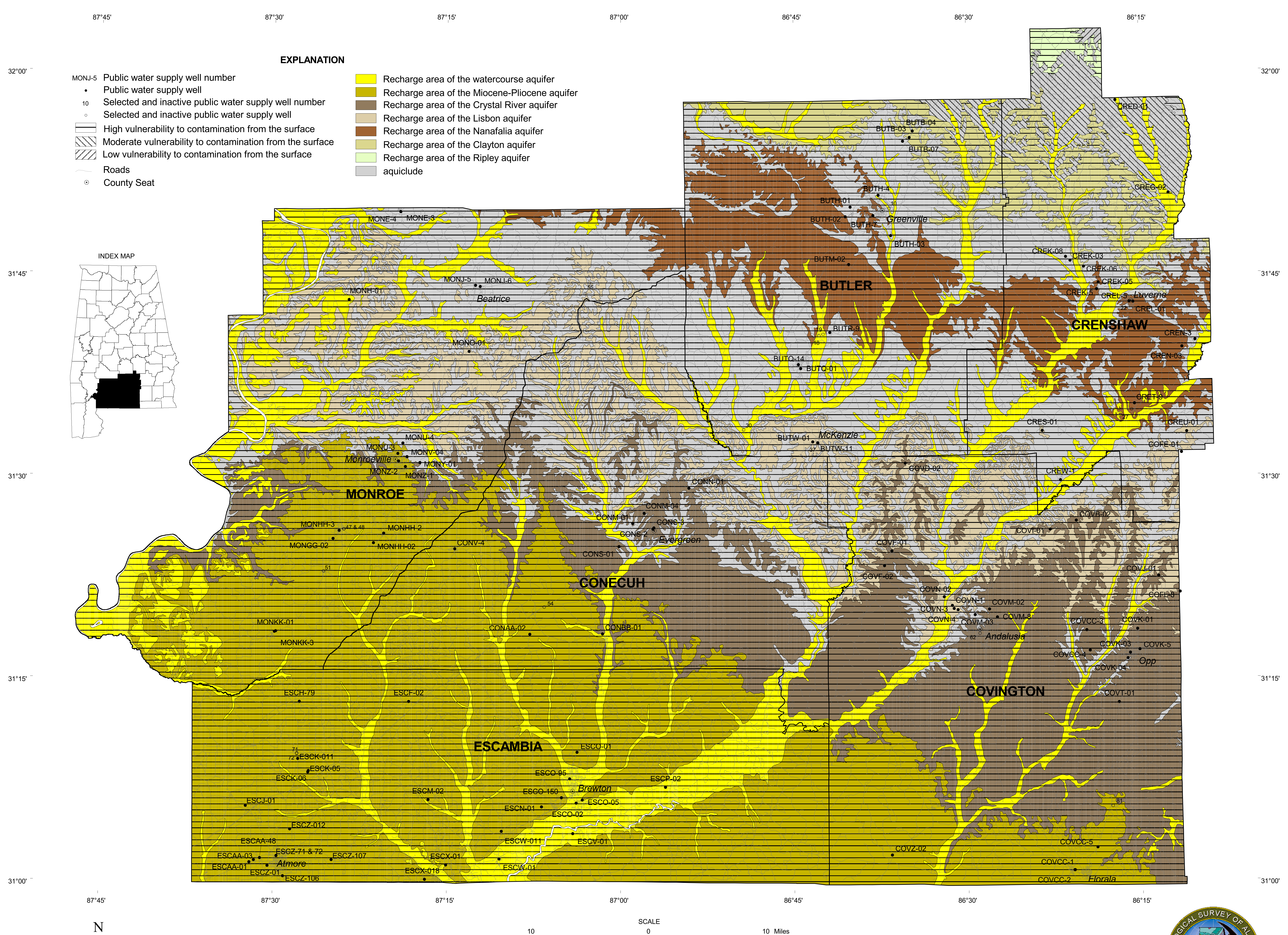
0 1 2 miles

Horizontal scale

# HYDROGEOLOGIC CROSS SECTION E- E', AREA 11

*By*
*Dorothy E. Raymond and Charles C. Smith*
*2003*

*BERRY H. (NICK) TEW, JR.*
*State Geologist*



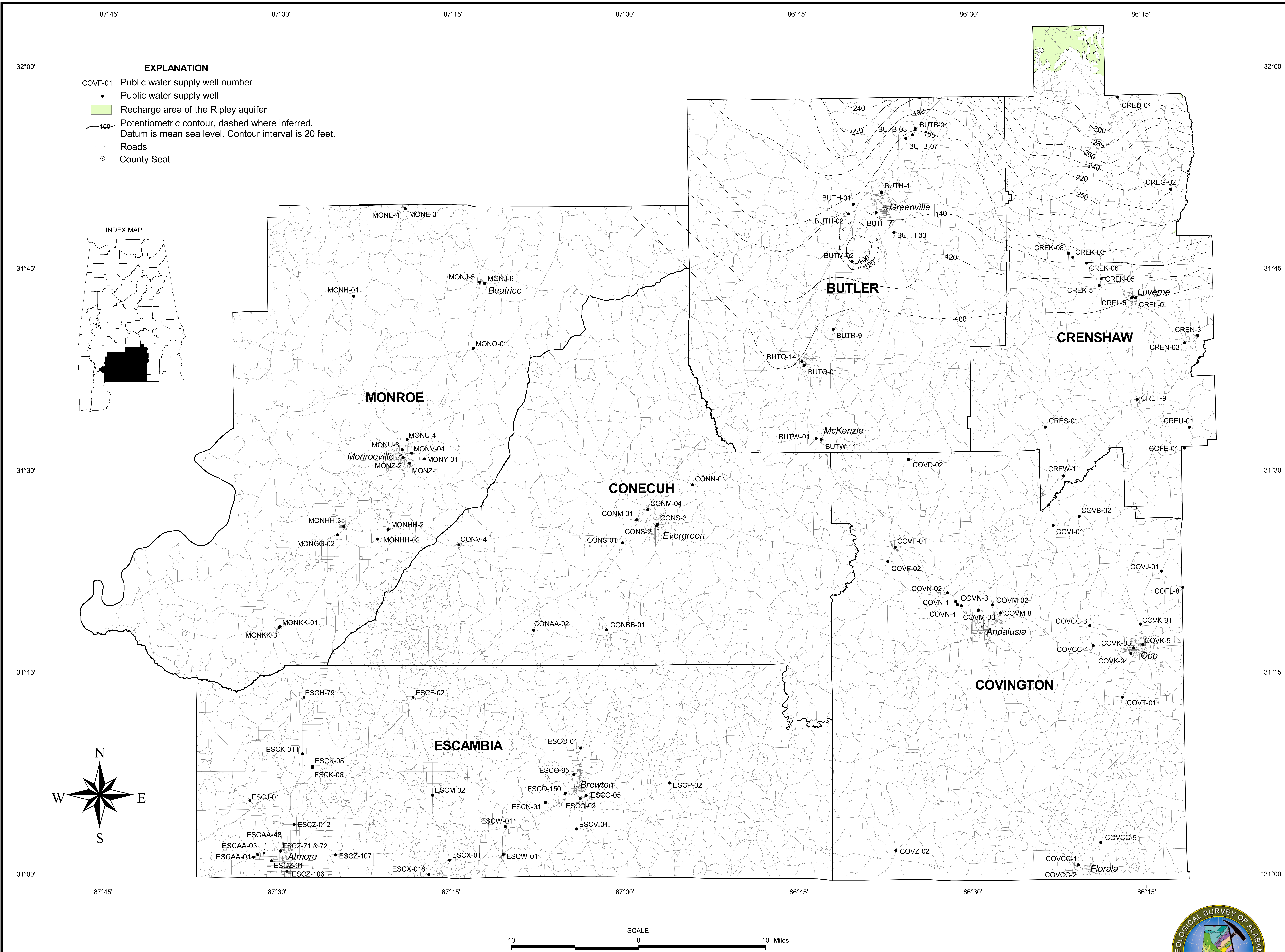

# AQUIFER RECHARGE AREAS, AREAS OF VULNERABILITY, AND LOCATIONS OF PUBLIC WATER SUPPLY WELLS IN AREA 11

By Blakeney Gillett

2002

Berry H. (Nick) Tew, Jr.
*State Geologist*

GIS by Douglas R. Taylor and Ruth T. Collier



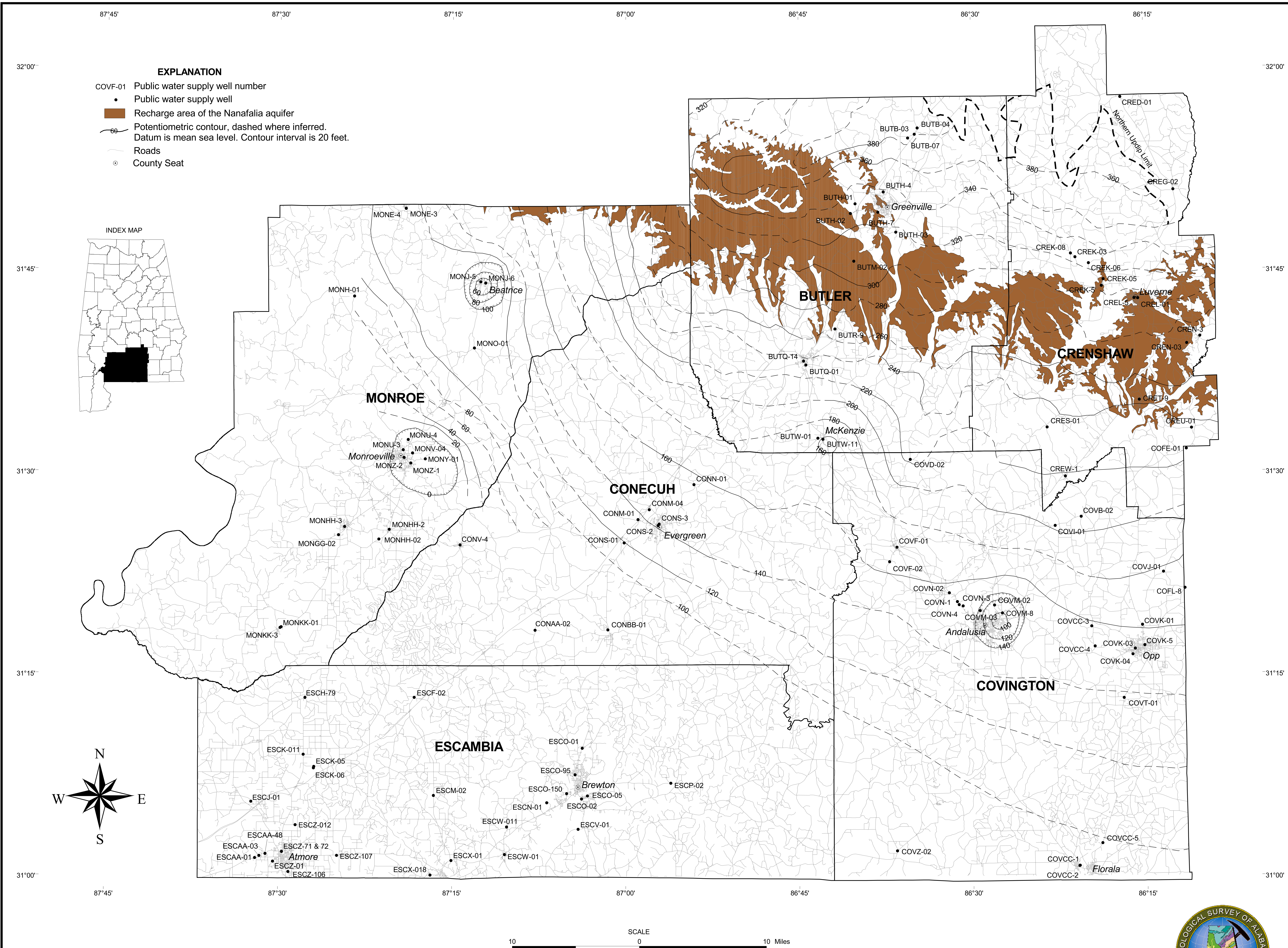

# CONFIGURATION OF THE POTENTIOMETRIC SURFACE OF THE RIPLEY AQUIFER IN AREA 11

By Blakeney Gillett

2002

Berry H. (Nick) Tew, Jr.
State Geologist

GIS by Ruth T. Collier and Gary W. Crawford




# CONFIGURATION OF THE POTENTIOMETRIC SURFACE OF THE NANAFALIA AQUIFER IN AREA 11

By Blakeney Gillett

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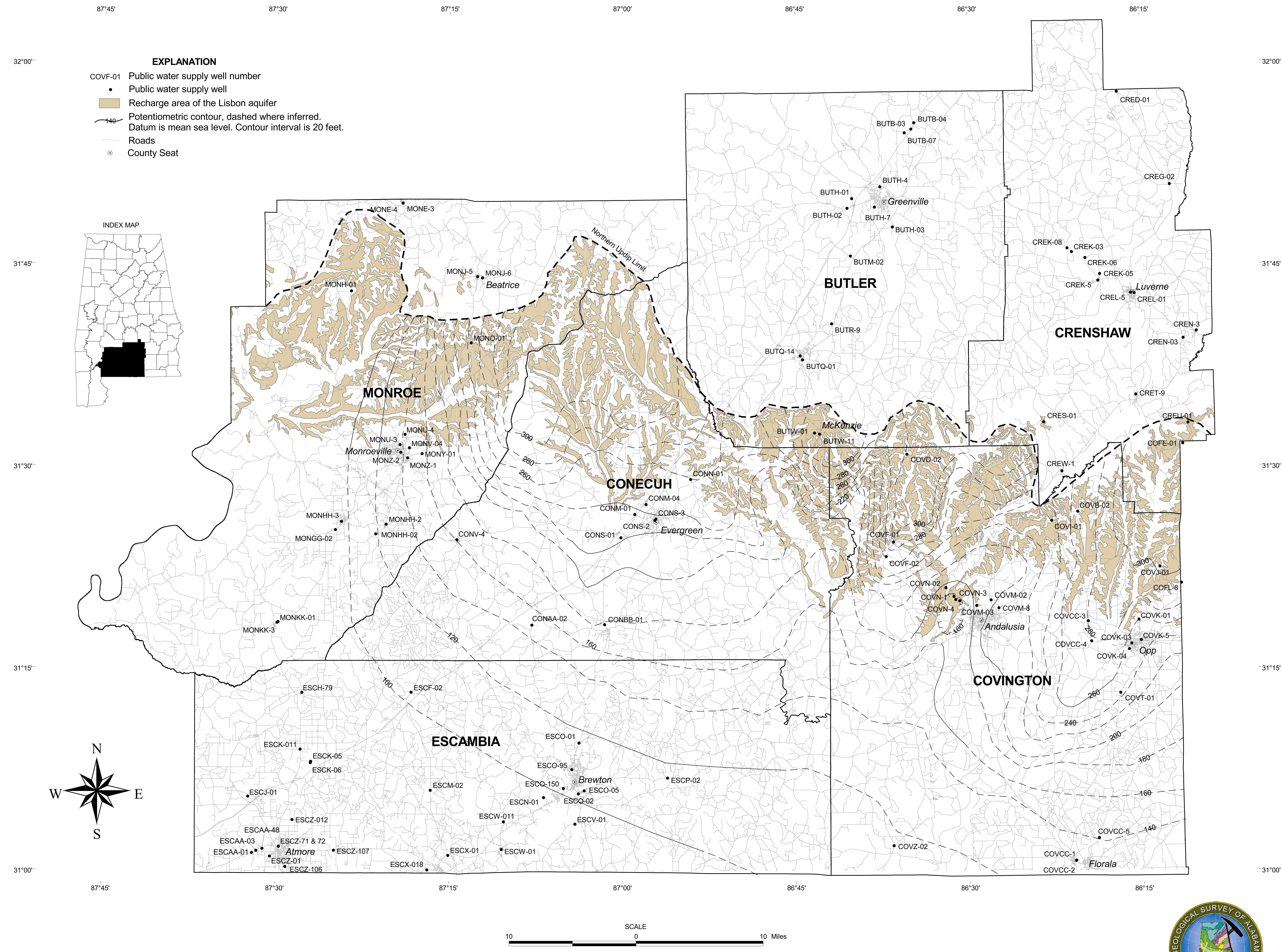
Berry H. (Nick) Tew, Jr.
State Geologist

GIS by Ruth T. Collier and Gary W. Crawford




# CONFIGURATION OF THE POTENTIOMETRIC SURFACE OF THE LISBON AQUIFER IN AREA 11

By Blakeney Gillett

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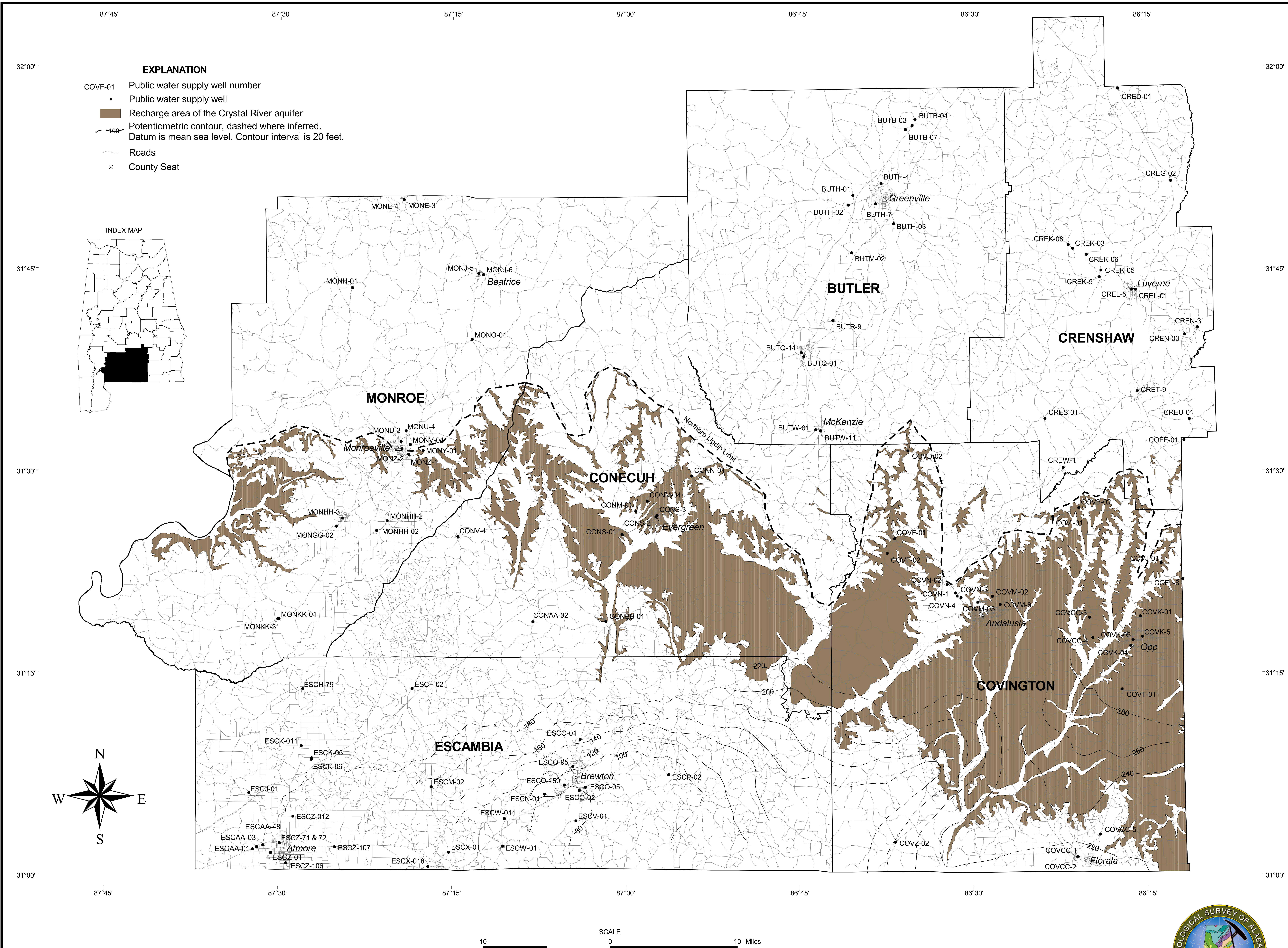
Berry H. (Nick) Tew, Jr.
State Geologist

GIS by Ruth T. Collier and Gary W. Crawford



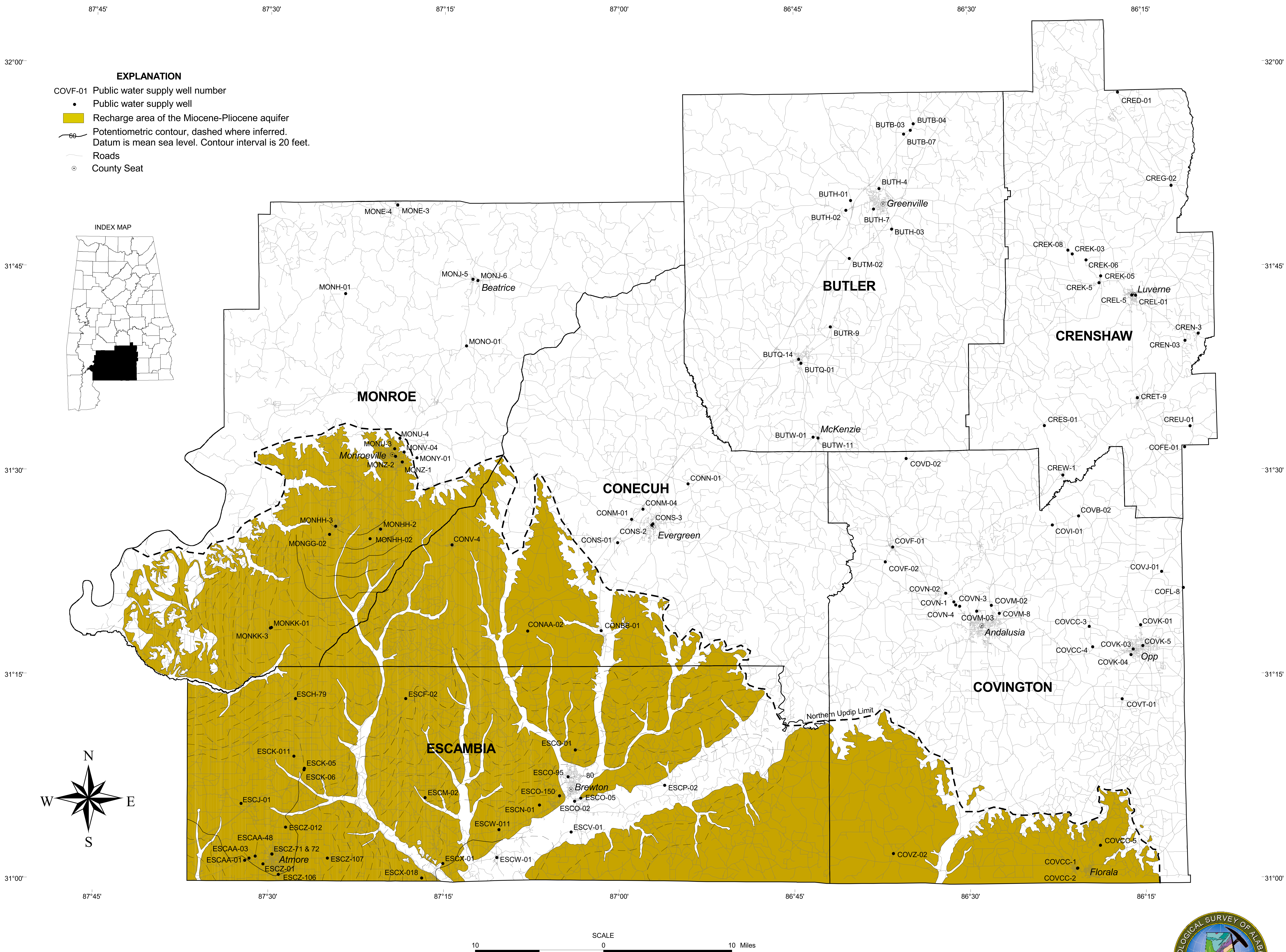

# CONFIGURATION OF THE POTENTIOMETRIC SURFACE OF THE CRYSTAL RIVER AQUIFER IN AREA 11

By Blakeney Gillett

2002

BERRY H. (NICK) TEW, JR.
State Geologist

GIS by Ruth T. Collier and Gary W. Crawford



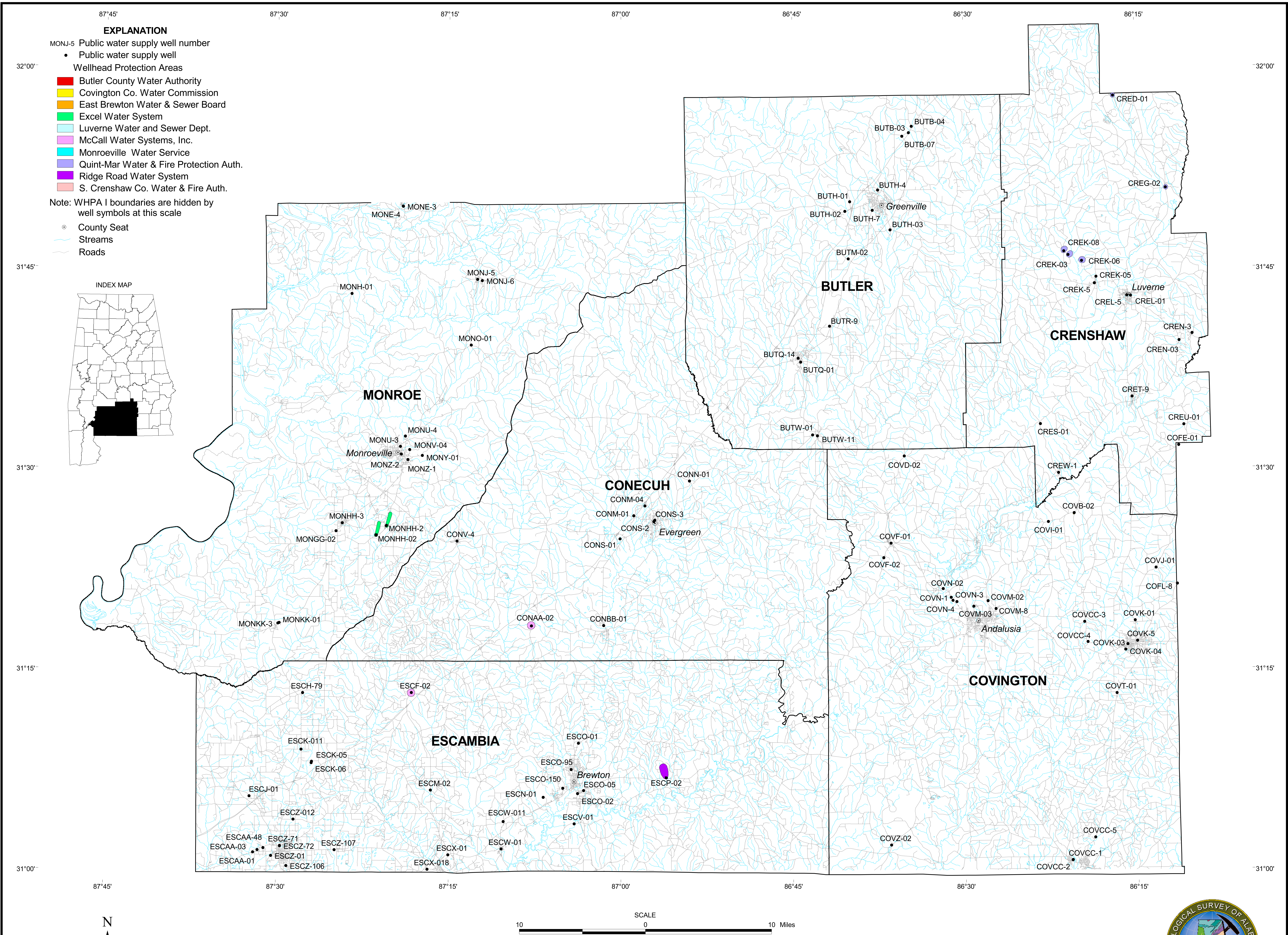

# CONFIGURATION OF THE POTENTIOMETRIC SURFACE OF THE MIOCENE-PLIOCENE AQUIFER IN AREA 11

By Blakeney Gillett

2002

Berry H. (Nick) Tew, Jr.
State Geologist

GIS by Ruth T. Collier and Gary W. Crawford




# LOCATIONS OF PUBLIC WATER SUPPLY WELLS AND WELLHEAD PROTECTION AREAS DELINEATED IN AREA 11

By Blakeney Gillett

2002

Berry H. (Nick) Tew, Jr.
State Geologist

GIS by Ruth T. Collier