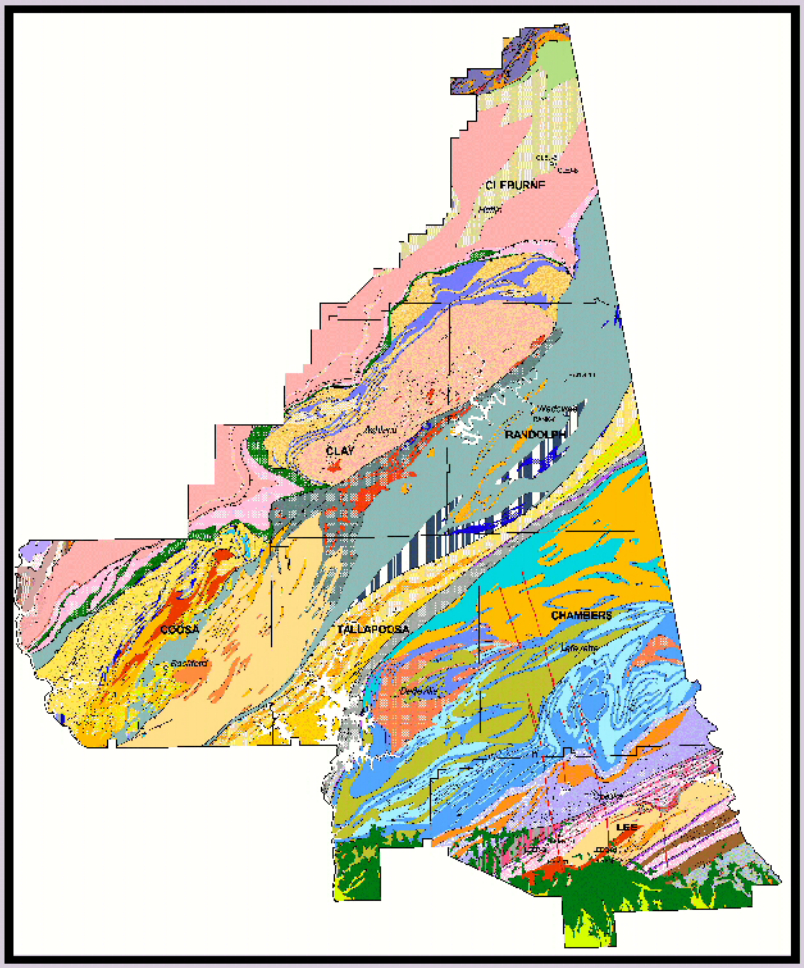
HYDROGEOLOGY AND VULNERABILITY TO CONTAMINATION OF MAJOR AQUIFERS IN ALABAMA: AREA 5



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GEOLOGICAL SURVEY OF ALABAMA

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HYDROGEOLOGY DIVISION

COMPACT DISC 3

HYDROGEOLOGY AND VULNERABILITY TO CONTAMINATION OF MAJOR AQUIFERS IN ALABAMA: AREA 5

By

David C. Kopaska-Merkel, Lewis S. Dean,
and James D. Moore

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

Tuscaloosa, Alabama
2000

GEOLOGICAL SURVEY OF ALABAMA

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April 28, 2000

The Honorable Don Siegelman
Governor of Alabama
Montgomery, Alabama

Dear Governor Siegelman:

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: Area 5," by David C. Kopaska-Merkel, Lewis S. Dean, and James D. Moore. The report, published as Compact Disc 3, is one of a series of reports that describe all major aquifers in the state. They are the first publications offered on compact disc by the Geological Survey of Alabama.

This publication presents information on the geology and characteristics of the major aquifers and public-supply wells in Chambers, Clay, Cleburne, Coosa, Lee, Randolph, and Tallapoosa Counties. Information contained in this report is critical to engineers, resource managers, city planners, and others responsible for conserving and protecting Alabama's ground water resources.

Respectfully,

Donald F. Oltz
State Geologist

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HYDROGEOLOGY AND VULNERABILITY TO CONTAMINATION OF MAJOR AQUIFERS IN ALABAMA : AREA 5

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David C. Kopaska-Merkel, Lewis S. Dean, and James D. Moore

ABSTRACT

The Geological Survey of Alabama (GSA), in cooperation with the Alabama Department of Environmental Management (ADEM), is revising and expanding a series of hydrogeologic studies that describes the major aquifers in Alabama and their vulnerability to contamination. The original reports were prepared by the U.S. Geological Survey in cooperation with ADEM. Alabama is divided into 13 areas that are addressed in separate reports. The hydrogeology and vulnerability to contamination of the major aquifers in Area 5, which includes Chambers, Clay, Cleburne, Coosa, Lee, Randolph, and Tallapoosa Counties, are described in this report.

Ground water does not supply a large part of the municipal public water used in Area 5. In 1995, ground water withdrawals for public supply in Area 5 were about 1.40 million gallons per day. This figure represents about one-half of 1 percent of daily ground water withdrawals for public supply in Alabama in 1995, whereas Area 5 contains about 5 percent of the state's population. Most cities and towns in Area 5 that formerly used ground water now use surface water. The water-bearing deposits in Area 5, which include sedimentary rocks, unconsolidated deposits, and igneous and metamorphic rocks, have lower yields than aquifers in other parts of the state.

Ground water in Area 5 is naturally rich in dissolved iron; iron concentrations in ground water exceed the secondary drinking-water maximum contaminant level of 0.3 mg/L in much of the region. Other natural sources of ground water contamination in Area 5 are only locally significant.

All of Area 5 is considered to be an aquifer recharge area. Small areas in the west and north where surficial rocks are insufficiently permeable to function as aquifers may nevertheless permit recharge to nearby permeable rocks. The soils throughout most of the study area are permeable and allow fairly rapid infiltration of surface water. Areas that are highly faulted and valley areas where ground water is at or near the land surface are potentially more vulnerable to contamination from the surface. Shallow aquifers in Area 5 are highly vulnerable to surface sources of contamination throughout their entire outcrop area.

Aquifers become less vulnerable to contamination from the surface with an increasing degree of confinement by impermeable layers (such as shale). However, even deep aquifers can be vulnerable to natural sources of contamination such as mineralized ground water.

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 contamination toward pumping wells.

INTRODUCTION

The U.S. Geological Survey, in cooperation with ADEM, conducted a series of hydrogeologic studies in Alabama to delineate the major aquifers and their recharge areas and to define areas susceptible to surface contamination. Each of the 13 areas of the state was studied by different authors. Area 5 includes Chambers, Clay, Cleburne, Coosa, Lee, Randolph, and Tallapoosa Counties. Kidd (1989) summarized the characteristics for aquifers in Area 5. GSA, in cooperation with ADEM, is updating and adding to the results of the past study, and is providing the hydrogeologic information in a digital format that can be easily accessed.

In addition to the document you are now reading, the CD-ROM for Area 2 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.

ACKNOWLEDGMENTS

The authors thank the well drillers, managers, and operators of water supply systems in Area 5 for information they provided about public water supply wells. In addition, Sonja Massey, Fred Mason, Chris Griffin, 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 and Douglas R. Taylor 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 geographic information systems (GIS) format that can be readily accessed.

The revised Geologic Map of Alabama (Osborne and others, 1988) at a scale of 1:250,000 provided new geologic data from which to update the previous Area 5 aquifer susceptibility map (Kidd, 1989). Plate 1 reproduces that portion of the Geologic Map of Alabama that encompasses Area 5. In the study by Kidd (1989) all wells used for municipal and rural public water supplies were inventoried, water levels were measured in these wells where possible, and data on water use were compiled. For the present study, public water supply wells were reinventoried, and their locations, as well as aquifer recharge areas, are shown on plate 2. Areas vulnerable to contamination from surface sources were delineated from topographic maps, geologic maps, and field investigations (plate 2). Water-quality data from the GSA's regular monitoring program and historical water-quality data were used to prepare a generalized map of iron concentration in shallow ground water (plate 3); iron in ground water is one of the most common water-quality problems in Alabama. Data were inadequate to prepare a meaningful potentiometric-surface or water-table map. Because shallow ground water in the area is unconfined, the water-table surface typically conforms to the shape of the land surface. No currently valid delineated Wellhead Protection Area occurs in Area 5. Hydrogeologic cross sections are used, where appropriate, to illustrate the distribution and relationships of aquifers in the subsurface. Plate 4 reproduces the map of aquifer recharge areas and well locations that accompanied the USGS report on aquifer vulnerability in Area 5 (Kidd, 1989) and Table 3 reproduces the table of well data that was included in that report. These data are included because the well data reported by Kidd (1989) may be valuable to users of this CD-ROM, and Kidd's report is no longer readily available.

LOCATION AND EXTENT OF THE STUDY AREA

Area 5 is in east-central Alabama and comprises an area of about 4,314 square miles (plate 1; fig. 1). Included are the towns of Alexander City, Ashland, Auburn, Dadeville, Heflin, Lafayette, Lanett, Opelika, Roanoke, Rockford, and Wedowee, as well as numerous other small towns and communities. The total population of the seven-county area, which is primarily rural with localized light industry, was about 230,000 in 1995 (Mooty and Richardson, 1998).

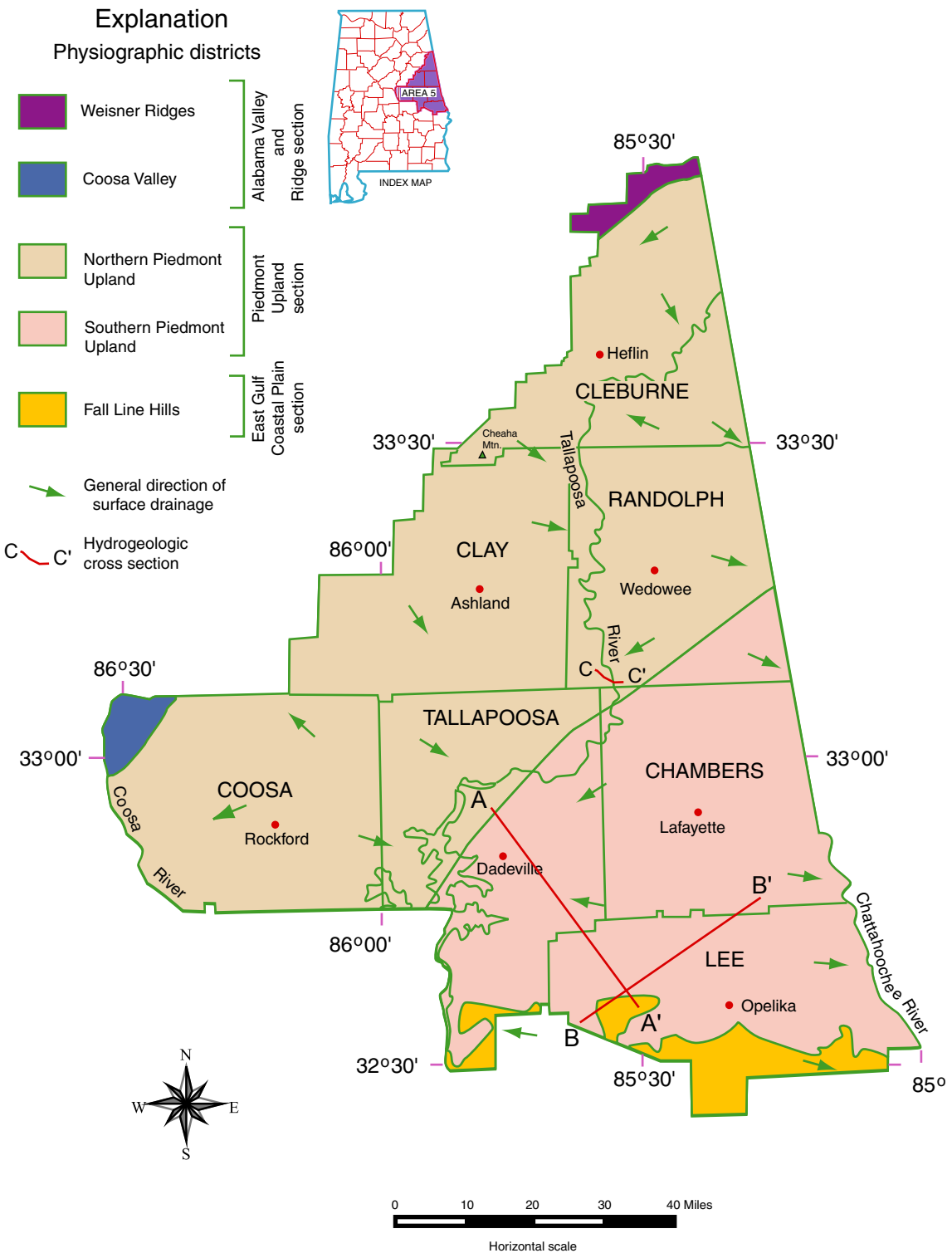


Figure 1.–Physiography and surface drainage of the study area and locations of hydrogeologic cross sections (modified from Sapp and Emplaincourt, 1975). Cross sections AA' and BB' are figure 6-A and cross section CC' is figure 6-B.

PREVIOUS INVESTIGATIONS

Numerous reports describe the geology and hydrology of the study area. A detailed description of the geology of Alabama and a geologic map were published by GSA in 1926 (Adams and others, 1926). Adams (1933) subdivided the crystalline rocks into informal belts and formal lithologic units. Baker (1957) described the geology and ground water hydrology of the Piedmont area. Joiner and others (1967) and Scarbrough and others (1969) used geophysical methods to prospect for ground water in the Piedmont area. Steltenpohl and others (1990) provided an updated description of the geology of the Inner Piedmont area.

Studies of the availability of water in each county in the study area include work by Lines and Scott (1972), Chandler and others (1972), Scott and Lines (1972), Chandler and Lines (1974, 1978a,b), and Lines and Chandler (1975). Chandler (1976) summarized the aquifer systems in the Piedmont and related well yield to rock type. Much of the present report is based on data published in these water availability studies. Guthrie and others (1994) conducted an evaluation of ground water yields in crystalline bedrock wells of the Alabama Piedmont.

In 1988, GSA published a new geologic map of Alabama at a scale of 1:250,000. This map provides the most up-to-date mapping of the geology of the entire study area (Osborne and others, 1988).

PHYSICAL FEATURES

Area 5 lies in parts of three physiographic provinces: Valley and Ridge, Piedmont, and Coastal Plain (fig. 1). Northernmost Cleburne County is in the Weisner Ridges district of the Alabama Valley and Ridge section of the Valley and Ridge Province (Sapp and Emplaincourt, 1975). The Weisner Ridges district is characterized by maturely dissected faulted and folded mountains formed on sandstone and shale separated by narrow valleys underlain by carbonate rocks. Altitudes of the valley floors are about 800 feet above sea level, and the mountain ridges range from 1,300 to 1,500 feet above sea level.

The extreme northwestern corner of Coosa County is in the Coosa Valley district of the Alabama Valley and Ridge section of the Valley and Ridge Province. The Coosa Valley is underlain by sandstone, shale, limestone, and chert, and forms a mature plain with little surface relief. Altitudes range from 400 to 500 feet above sea level. Surface drainage in both districts is southwestward to the Coosa River (fig. 1).

More than 90 percent of the study area is in the Piedmont Upland section of the Piedmont Province. The section has been further divided into the Northern Piedmont

Upland district to the northwest and the Southern Piedmont Upland district to the southeast (Sapp and Emplaincourt, 1975).

The Northern Piedmont Upland district is a well-dissected upland developed on metamorphosed sedimentary and igneous rocks. The land surface ranges from about 1,100 feet above sea level in northern Cleburne County to about 500 feet above sea level in the south near Mitchell Lake. Talladega Mountain forms a prominent northeastward-trending ridge that includes Cheaha Mountain (2,407 feet above sea level), the highest point in Alabama (fig. 1). All of Clay County, most of Cleburne, Randolph, and Coosa Counties, most of Tallapoosa County west of the Tallapoosa River, and the northwestern corner of Chambers County are in the Northern Piedmont Upland district (fig. 1). Surface drainage in the district is toward the Tallapoosa River, which generally flows south; to the Coosa River in the southwest; and to the Chattahoochee River to the east (fig. 1).

Physiography changes gradually in a transition zone between the Northern Piedmont Upland district and the Southern Piedmont Upland district. The Southern Piedmont Upland district has the rolling topography characteristic of a dissected peneplain in a stage of advanced erosional maturity (Chandler and Lines, 1974). The land surface of the district ranges in altitude from about 500 to 900 feet above sea level and averages about 800 feet above sea level. Most of Chambers and Lee Counties, the southeastern part of Randolph County, and most of Tallapoosa County east of the Tallapoosa River are in this district. Surface drainage in the district generally is southwestward to the Tallapoosa River and southeastward to the Chattahoochee River.

The third physiographic province in the study area is the Coastal Plain. The Fall Line Hills district of the East Gulf Coastal Plain section is characterized by relatively flat to gently rolling uplands and broad, gently sloping valleys (Sapp and Emplaincourt, 1975). The land surface ranges in altitude from about 350 to 650 feet above sea level and local relief is commonly less than 100 feet. Surface drainage is southward and southeastward to the Chattahoochee River, and southward and southwestward to the Tallapoosa River. The southernmost part of Lee County is in the Fall Line Hills district.

STRATIGRAPHY

Rocks that crop out in and underlie the study area range in age from Precambrian to Holocene (Osborne and others, 1988). Generalized geology of the study area is shown on figure 2; a more detailed geologic map is on plate 1. Metamorphic and igneous rocks of Precambrian to late Paleozoic age crop out in more than 90 percent of the study area. Sedimentary rocks of Paleozoic age crop out in the northernmost part of the study area in northern Cleburne County and in the northwestern corner of Coosa County. Unconsolidated sediments of Late Cretaceous age crop out in the southernmost

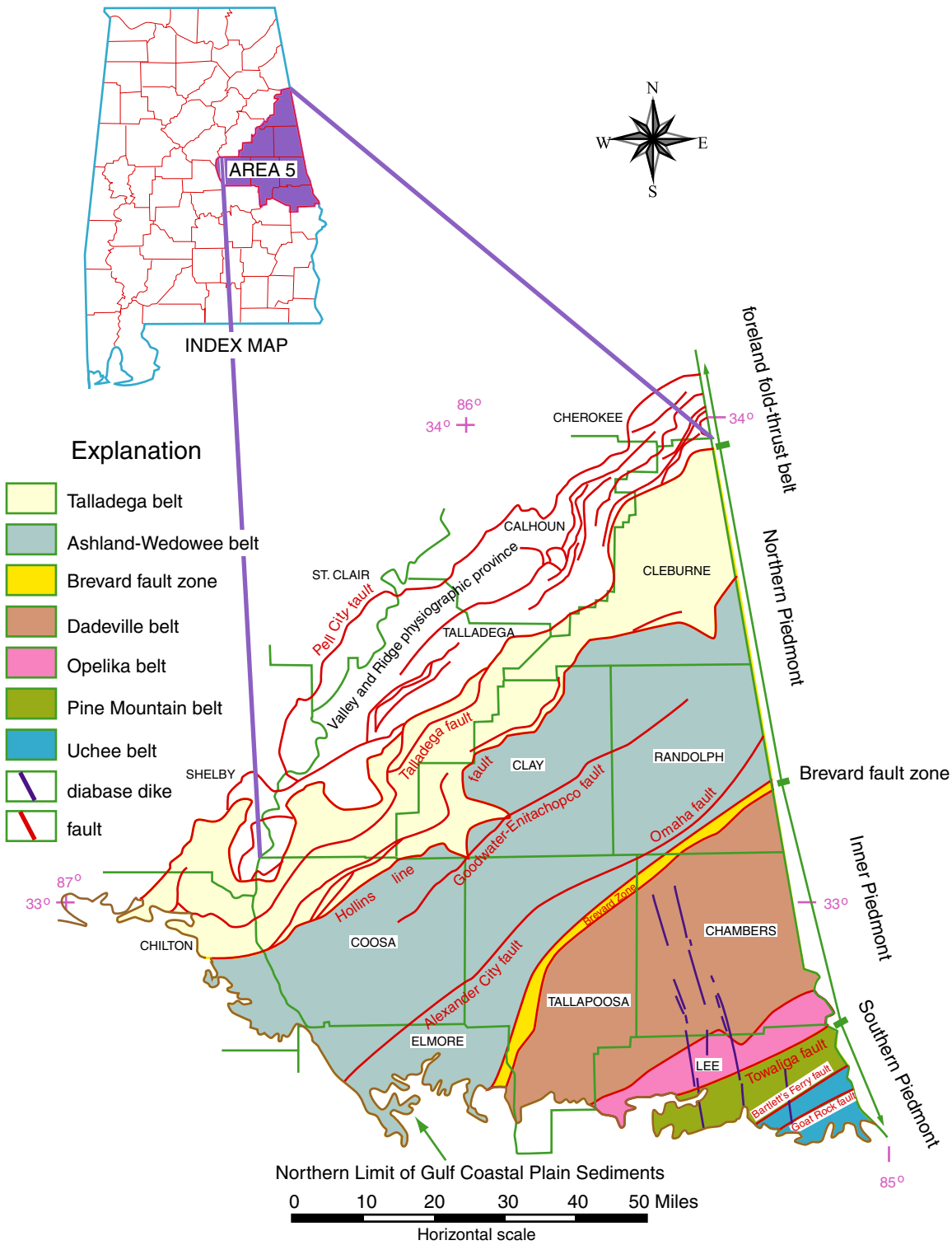


Figure 2.–Generalized geology of the study area (modified from Osborne and others, 1988). The six belts of the Piedmont Upland section of the Piedmont physiographic province and the Brevard zone consist of metamorphic and igneous rocks of Precambrian to late Paleozoic age.

Table 1.--Generalized section of geologic units and their water-bearing properties (modified from Osborne and others, 1988; Kidd, 1989)

System	Geologic unit	Lithology	Aquifer	Water-bearing properties
Quaternary	Alluvial and terrace deposits	Sand, poorly sorted; clay; silt; and gravel	Watercourse	Not tapped by any public-supply wells in the study area. Limited areal extent.
Cretaceous	Eutaw Formation	Interbedded sand and clay	Eutaw	Not tapped by any public-supply wells in the study area.
	Tuscaloosa Group	Poorly sorted clay, sand, and gravel	Gordo	Generally yields less than 10 gpm. A major aquifer south of the study area.
		Poorly sorted clay, sand, and gravel	Coker	Generally yields less than 10 gpm. A major aquifer south of the study area.
Mississippian	Parkwood Formation and Floyd Shale undifferentiated	Shale	Confining units	Not tapped by any public-supply wells in the study area.
Ordovician	Newala Limestone	Limestone	Valley and Ridge	
Cambrian-Ordovician	Knox Group undifferentiated	Dolomite, limestone, and chert	Valley and Ridge	
Cambrian	Conasauga Formation	Dolomite and chert	Valley and Ridge	
	Rome Formation	Mudstone, shale, siltstone, and limestone	Confining unit	
	Shady Dolomite	Dolomite and chert	Metased. & metavolcanic	
	Chilhowee Group undifferentiated	Conglomerate, mudstone, and sandstone	Metased. & metavolcanic	
	Weisner and Wilson Ridge Formations undifferentiated	Sandstone, conglomerate, and mudstone	Metased. & metavolcanic	
	Nichols Formation	Mudstone	Confining unit	
	Cochran Formation	Sandstone, conglomerate, and siltstone	Metased. & metavolcanic	
Group or Complex				
	Hillabee Greenstone	Greenstone interlayered with phyllite and dacite	Metased. & metavolcanic	Yields less than 15 gpm.
Talladega Group	Jemison Chert and Chulafinnee Schist undifferentiated	Chert, phyllite, and schist	Metased. & metavolcanic	Yields less than 30 gpm.
	Butting Ram Sandstone	Sandstone and conglomerate	Metased. & metavolcanic	

	Lay Dam Formation	Phyllite, siltstone, quartzite, and conglomerate	Metased. & metavolcanic	
	Cheaha Quartzite Member of Lay Dam Formation	Quartzite and conglomerate	Metased. & metavolcanic	
	Heflin Phyllite	Siltstone and sandstone	Metased. & metavolcanic	
Sylacauga Marble Group	Gooch Branch Chert	Marble and chert	Valley and Ridge	Not tapped by any public-supply wells.
	Shelvin Rock Church Formation	Marble	Valley and Ridge	
	Fayetteville Phyllite	Phyllite and slate	Valley and Ridge	
	Jumbo Dolomite	Marble	Valley and Ridge	
Kahatchee Mountain Group	Wash Creek Slate	Slate, siltstone, and sandstone	Metased. & metavolcanic	
	Kalona Quartzite Member of Wash Creek Slate	Quartzite and conglomerate	Metased. & metavolcanic	
	Stumps Creek Formation	Siltstone	Metased. & metavolcanic	
	Waxahatchee Slate	Siltstone, slate, and quartzite	Metased. & metavolcanic	
Higgins Ferry Group		Gneiss, schist, and quartzite	Metased. & metavolcanic	Generally yields 10 to 15 gpm.
Poe Bridge Mountain Group		Schist, gneiss, and quartzite	Metased. & metavolcanic	
Hatchet Creek Group	Pinchoulee Gneiss	Gneiss and schist	Metased. & metavolcanic	
	Hanover Schist	Schist and quartzite	Metased. & metavolcanic	
Mad Indian Group		Gneiss and schist	Metased. & metavolcanic	
Wedowee Group	Wedowee Group undifferentiated	Schist, gneiss, quartzite, and phyllite	Metased. & metavolcanic	Generally yields 15 gpm; yields greater than 50 gpm reported.
	Hackneyville Schist	Schist and quartzite	Metased. & metavolcanic	
	Cornhouse Schist	Schist	Metased. & metavolcanic	
Emuckfaw Group	Emuckfaw Group undifferentiated	Schist and quartzite	Metased. & metavolcanic	
	Glenloch Schist	Schist	Metased. & metavolcanic	
	Mitchell Dam Amphibolite	Amphibolite	Metased. & metavolcanic	
	Ketchepedrakee Amphibolite	Amphibolite	Metased. & metavolcanic	
	Beaverdam Amphibolite	Amphibolite	Metased. & metavolcanic	
	Ultramafic rock	Pyroxenite	Metased. & metavolcanic	
	Elkahatchee Quartz Diorite Gneiss	Quartz diorite gneiss	Metagranite	Yields 1-30 gpm. Not used as public water-supply source.
	Rockford Granite	Granite, granodiorite, and trondhjemite	Metagranite	
	Hissop Granite	Granite and granodiorite	Metagranite	
	Almond Trondhjemite	Trondhjemite	Metagranite	

	Zana Granite	Granite	Metagranite	
	Kowaliga Gneiss	Gneiss	Metagranite	
	Bluff Springs Granite	Quartz diorite	Metagranite	
Jacksons Gap Group	Jacksons Gap Group undifferentiated	Schist, phyllite and quartzite	Metased. & metavolcanic	Generally yields less than 25 gpm.
	Tallassee Metaquartzite	Quartzite	Metased. & metavolcanic	
Dadeville Complex	Agricola Schist	Schist and amphibolite	Metagranite	
	Ropes Creek Amphibolite	Amphibolite	Metased. & metavolcanic	
	Waresville Schist	Schist and amphibolite	Metased. & metavolcanic	
	Waverly Gneiss	Gneiss, amphibolite, schist, and quartzite	Metagranite	
	Mafic and ultramafic rock	Pyroxenite and amphibolite	Metased. & metavolcanic	
	Camp Hill Granite Gneiss	Granite gneiss	Metagranite	
	Rock Mills Granite Gneiss	Granite gneiss	Metagranite	
Opelika Complex	Loachapoka Schist	Schist and quartzite	Metased. & metavolcanic	Insufficient yields for public supplies.
	Auburn Gneiss	Schist and gneiss	Metased. & metavolcanic	
	Bottle Granite	Granite	Metased. & metavolcanic	
Pine Mountain Group	Manchester Schist	Schist and quartzite	Metased. & metavolcanic	Generally yields less than 25 gpm. Yields more than 2,000 gpm reported.
	Chewacla Marble	Marble	Metased. & metavolcanic	
	Hollis Quartzite	Quartzite	Metased. & metavolcanic	
Wacoochee Complex	Halawaka Schist	Schist and gneiss	Metased. & metavolcanic	
	Whatley Mill Gneiss	Gneiss	Metased. & metavolcanic	
	Phelps Creek Gneiss	Granite gneiss	Metased. & metavolcanic	
	Motts Gneiss	Gneiss and amphibolite	Metased. & metavolcanic	Not tapped by any public-supply wells.
	Moffits Mill Schist	Schist and quartzite	Metased. & metavolcanic	
Uchee Complex	Phenix City Gneiss	Gneiss and amphibolite	Metased. & metavolcanic	
	Hospilika Granite	Granodiorite	Metased. & metavolcanic	
	Mylonite and blastomylonite	Schist and gneiss	Metased. & metavolcanic	
	Blastomylonite	Schist and gneiss	Metased. & metavolcanic	
	Crushed schistose rock	Schist	Metased. & metavolcanic	
	Diabase	Tholeiitic +/- olivine diabase dikes	Mafic igneous	Not tapped by any public-supply wells.

part of the study area in southern Lee and Tallapoosa Counties. Quaternary alluvial deposits are found along major streams throughout the study area (plate 1).

IGNEOUS AND METAMORPHIC ROCKS OF PRECAMBRIAN TO LATE PALEOZOIC AGE

Most of the study area is underlain by igneous and metamorphic rocks of the Alabama Piedmont, whose age, structure, and stratigraphic relationships are complex. Adams and others (1926) originally defined the stratigraphy by grouping the rocks into informal metamorphic belts and formal units. Osborne and others (1988) and Steltenpohl and others (1990) regrouped and renamed many Piedmont rocks using their structural, mineralogical, and textural variations. The formal named stratigraphic units are described briefly in table 1. The Piedmont region of the study area is subdivided into three major tectonic belts: the Northern, Inner, and Southern Piedmonts. Each of these can be subdivided into two belts. The Northern Piedmont contains the Talladega and Ashland-Wedowee belts, the Inner Piedmont contains the Dadeville and Opelika belts, and the Southern Piedmont contains the Pine Mountain and Uchee belts (fig. 2). Each tectonic belt is distinct in terms of rock type associations and metamorphic grade and is separated from the others by regional synmetamorphic to postmetamorphic fault zones (Guthrie and others, 1994).

Several major faults and lines of metamorphic discontinuity cut the metamorphic units originally described by Adams (Neathery and Tull, 1975). The Talladega fault separates the Piedmont from the Valley and Ridge province to the northwest (fig. 2). The Hollins line fault, Alexander City-Omaha fault system, and Goodwater-Enitachopco fault system, are major faults or metamorphic discontinuities in the northern part of the study area (fig. 2). These structures are interpreted as major structural discontinuities resulting from the movement of metamorphic rock of one grade over that of another grade (Steltenpohl and Moore, 1988).

The Brevard fault zone, Towaliga fault zone, and Goat Rock fault zone are major structural features in the southern half of the study area (fig. 2). The Brevard and Goat Rock faults dip southeast. The Towaliga fault zone dips northwest (Steltenpohl, 1988).

The rocks in Area 5 are predominantly clastic sediments that have been altered by several stages of regional metamorphism to slate, schist, phyllite, quartzite, gneiss, and marble. In some areas, these rocks have been intruded by mafic and felsic igneous rocks (Neathery and Tull, 1975). Rocks in the study area have been assigned ages ranging from Precambrian to late Paleozoic (Osborne and others, 1988).

Bedrock is exposed at the surface in some areas, but most of the study area is covered by regolith. Regolith, also known as saprolite, is decomposed untransported material that has weathered from the bedrock and which retains some of the characteristics of the original material. Regolith extends to depths of 50 to 100 feet in many parts of Area 5.

TALLADEGA BELT

The Talladega belt is located between the Talladega fault and the Hollins line fault and extends from Cleburne County in the northeast through western Clay County to Coosa County in the southwest (fig. 2). The Talladega belt is underlain by low-rank metamorphosed sedimentary rocks that form a continuous northeast-southwest-oriented belt 8 to 22 miles wide. The Talladega belt consists predominantly of slate and phyllite with some marble, dolomite, and quartzite of the Hillabee Greenstone, Talladega Group, Heflin Phyllite, Sylacauga Marble Group, and Kahatchee Mountain Group (Osborne and others, 1988). The phyllites are strongly schistose and consist of about 50 percent quartz and variable amounts of feldspar, chlorite, muscovite, and epidote. Foliations in the rocks generally dip southeastward at angles of 30 to 60 degrees. The average thickness of regolith overlying the slate ranges from about 20 feet on hilltops and hillsides to about 35 feet in valleys.

The Hillabee Greenstone of the Talladega belt is a sinuous belt of chlorite-epidote-hornblende schist and quartz dacite that extends from southeastern Cleburne County southwestward through Clay and Coosa Counties. Part of the outcrop is coincident with the trace of the Hollins line fault in Cleburne, Clay, and Coosa Counties (Osborne and others, 1988). The Hillabee averages less than one-quarter mile in outcrop width. Locally, the strike varies by nearly 90 degrees from its general northeast-southwest direction, and the rocks generally dip southeastward at about 40 degrees.

ASHLAND-WEDOWEE BELT

The Ashland-Wedowee belt is in the central part of the study area and extends from southern Coosa County across northwestern Tallapoosa County into eastern Clay County and Randolph and southern Cleburne Counties. The high-grade metasedimentary rocks in this belt include the Higgins Ferry, Poe Bridge Mountain, Hatchet Creek, Mad Indian, Wedowee, and Emuckfaw Groups (Osborne and others, 1988). Metavolcanic rocks include amphibolite and ultramafic rocks. Foliations of metasedimentary rocks generally dip southeastward from 30 to 90 degrees. Regolith thickness of 50 feet or more is common on upland draws and on concave slopes adjacent to streams.

Metagranite comprises about one-third of the Ashland-Wedowee belt. The Elkahatchee Quartz Diorite Gneiss, the largest granitic mass in Alabama, is 6 to 10 miles wide and 40 miles long. The outcrop of the Elkahatchee trends northeast from south-central Coosa County and northwestern Tallapoosa County to the southern part of Clay County. Associated granitic intrusions occur along strike into Clay and Randolph Counties (plate 1). Granitic rocks consist of the minerals microcline, orthoclase, plagioclase, quartz, biotite, and muscovite (Osborne and others, 1988). Regolith ranges in thickness from 10 to 50 feet.

A belt of metagranite (the Kowaliga Gneiss) crops out about 5 miles southeast of the Elkahatchee Quartz Diorite Gneiss. This rock unit extends in a narrowing belt from southwestern Tallapoosa County northeastward into northeast Tallapoosa County.

DADEVILLE BELT

The Dadeville belt is located in southeastern Tallapoosa and northwestern Lee Counties and trends northeast across Chambers County into the southeastern corner of Randolph County (fig. 2). Foliation planes of the rocks generally dip southeastward 30 to 60 degrees. The Dadeville belt consists primarily of micaceous gneiss and schist and some hornblende gneiss. The micaceous gneiss contains scattered feldspathic porphyroblasts and feldspathic bands. The Dadeville belt contains scattered metagranite units. A series of ultramafic rocks have intruded the micaceous and hornblende gneisses in some areas (Steltenpohl and others, 1990).

OPELIKA BELT

The Opelika belt is located immediately to the southeast of the Dadeville belt and is about 5 to 6 miles wide. The rocks extend from western Lee County northeastward to eastern Chambers County (fig. 2). These rocks consist primarily of biotite gneiss and augen gneiss and include some granite gneiss and migmatites in southeastern Chambers County. Diabase dikes cut across the belt about 2.5 miles northeast of Auburn (Steltenpohl and others, 1990).

PINE MOUNTAIN BELT

The rocks of the Pine Mountain belt crop out southeast of the Opelika belt in Lee County (fig. 2). The Pine Mountain belt is about 10 miles wide and trends northeastward. Foliation planes of the metamorphic rocks dip southeastward. These rocks consist predominantly of garnetiferous-biotite schist and quartz-muscovite schist with some granite gneiss, biotite augen gneiss, quartzites, and dolomitic marble (Steltenpohl, 1988). Regolith thickness ranges from 10 to 200 feet and averages about 50 feet.

UCHEE BELT

The rocks of the Uchee belt crop out in Lee County southeast of the Pine Mountain belt (fig. 2). These rocks are predominantly biotite and hornblende gneiss and granite gneiss. Mylonitization is common in the granitic gneiss and may have been caused by movement on the Goat Rock fault (Deininger and others, 1964).

SEDIMENTARY ROCKS OF PALEOZOIC AGE

Paleozoic rocks of Cambrian age crop out northwest of the Talladega fault in northernmost Cleburne County (plate 1). The Chilhowee Group consists of quartzite, sandstone, conglomerate, and sandy shale. Quartzite of the Weisner Formation of the Chilhowee Group forms prominent ridges because it is both hard and resistant to erosion. The Shady Dolomite overlies the Weisner and crops out in several narrow bands. The Shady consists of fine-grained medium- to thick-bedded limestone and dolomite (Osborne and others, 1988).

The Newala Limestone of Ordovician age and the Floyd Shale and Parkwood Formation of Mississippian age crop out in the extreme northwestern corner of Coosa County (plate 1). The Newala consists of micritic limestone and dolomite. The Floyd Shale is composed of dark-gray shale interbedded with some argillaceous limestone. The Parkwood Formation consists of interbedded shale and fine-grained, argillaceous sandstone (Osborne and others, 1988).

SEDIMENTARY DEPOSITS OF CRETACEOUS AGE

Deposits of the Tuscaloosa Group of Late Cretaceous age are exposed in the southernmost part of the study area in southern Tallapoosa and Lee Counties (plate 1). Tuscaloosa Group sediments unconformably overlie older igneous and metamorphic rocks. The Tuscaloosa consists of poorly sorted deltaic or nonmarine clay, sand, and gravel, and contains silt-size weathered feldspar (Osborne and others, 1988). The Tuscaloosa dips south-southeastward at about 30 to 50 feet per mile and reaches a maximum thickness in Area 5 of 300 feet. The outcrop area of the Tuscaloosa Group in Area 5 is part of the recharge area of two major aquifers (the Coker and Gordo aquifers) that are part of the Tuscaloosa Group south of Area 5 (plate 2).

Deposits of the Eutaw Formation of Late Cretaceous age are exposed in small areas in the southernmost part of Area 5 in southwestern Lee County (plate 1). The Eutaw Formation conformably overlies the Tuscaloosa Group. In Area 5 the Eutaw consists of barrier and backbarrier marine clay, sand, and gravel (Osborne and others,

1988; Cook, 1993). The Eutaw dips south-southeastward about 30 to 50 feet per mile and is 100 to 150 feet thick in Area 5.

SEDIMENTARY DEPOSITS OF QUATERNARY AGE

Quaternary alluvial deposits overlie older formations along major streams throughout the study area. Only major deposits of Quaternary alluvium are shown on the geologic map (plate 1); most outcrops of Quaternary alluvium in Area 5 are narrow and the deposits are very thin. The alluvium is irregularly stratified, locally derived fluvial sediment consisting of clay, silt, sand and pebbles with locally abundant cobbles, boulders, and heavy minerals (Osborne and others, 1988).

HYDROGEOLOGY

Three ground water provinces are recognized in the study area: (1) Piedmont—containing metasedimentary and metavolcanic, metagranite, and mafic igneous aquifers; (2) Coastal Plain—containing the Coker, Gordo, Eutaw, and Watercourse aquifers; and (3) Valley and Ridge—containing the Valley and Ridge aquifer system (Moore, 1998). The areal extents of these ground water provinces are similar to those of the physiographic provinces of the same names (fig. 1; plate 2). The Piedmont ground water province occupies nearly all of Area 5. The Coastal Plain ground water province in Area 5 is confined to the southern parts of Tallapoosa and Lee Counties, and the Valley and Ridge ground water province in Area 5 occupies small areas of northwestern Coosa and northern Cleburne Counties.

The igneous and metamorphic rocks of the Piedmont in the study area typically yield small quantities of water (fig. 3). These aquifers are unconfined heterogeneous two-component systems consisting of fractured crystalline bedrock and overlying regolith (fig. 4) (Guthrie and others, 1994). Primary porosity in the metamorphic rocks generally is less than 1 percent; secondary fracture porosity in bedrock locally greatly exceeds primary bedrock porosity. Regolith porosity values may approach 50 percent. The basal portions of regolith zones generally are the most productive aquifers. However, these productive aquifers generally are separated from one another by surface drainage divides, and adjacent basins tend not to be hydraulically connected (Kidd, 1989). Annual ground water recharge in the Piedmont ranges from about 5.9 to about 7.3 inches per year.

Most Piedmont aquifers are structurally and hydrologically complex (figs. 5,6), and most relationships between well yield and potential controlling factors such as well depth are highly variable. However, a recent study suggested some general relationships (Guthrie and others, 1994). Well yield is statistically independent of

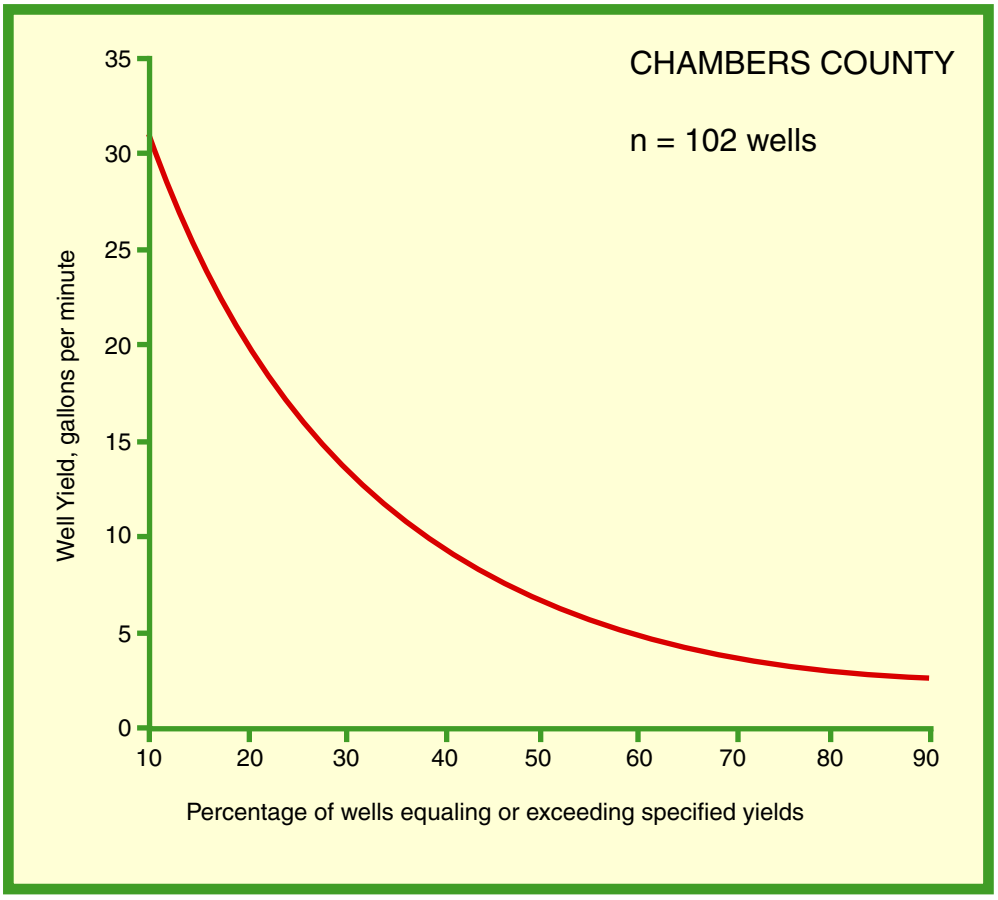


Figure 3.–Percentage of wells in Chambers County having yields equal to or greater than specified values (modified from Chandler and Lines, 1974). Well yields from the Piedmont in other counties in Area 5 are similar to those from Chambers County.

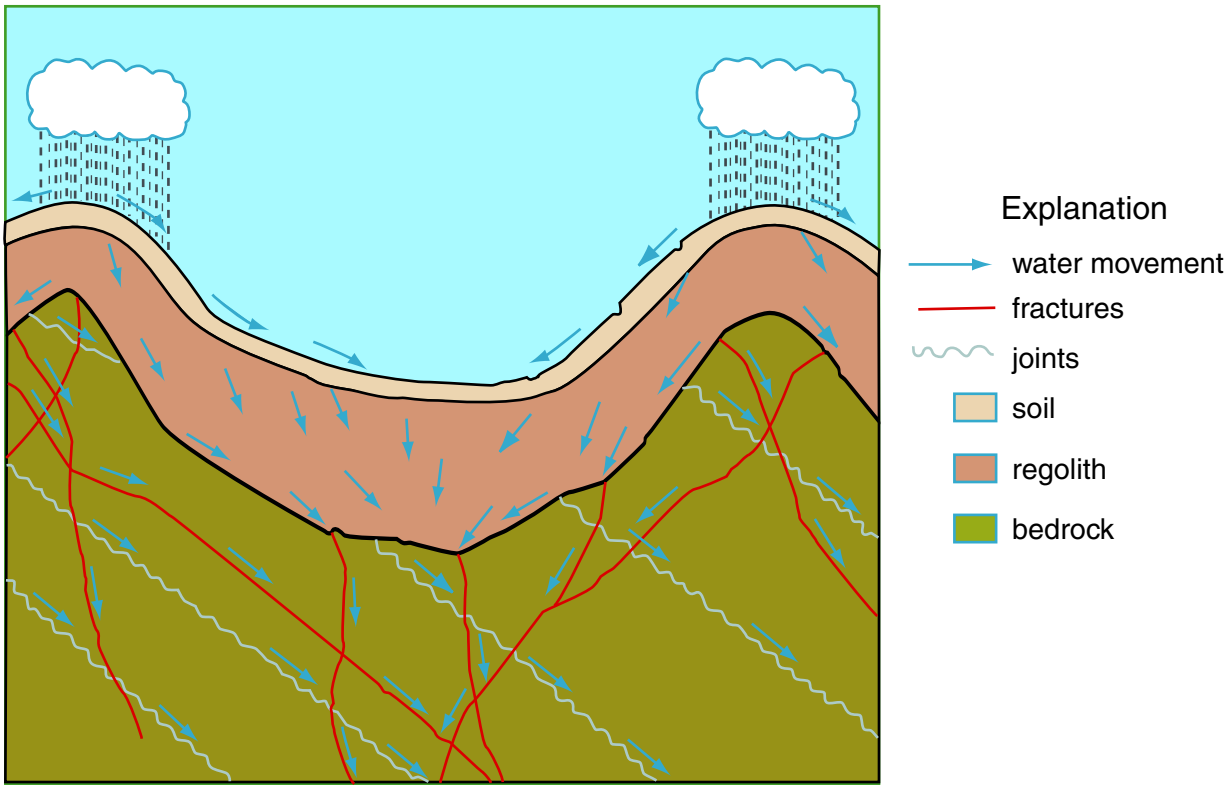
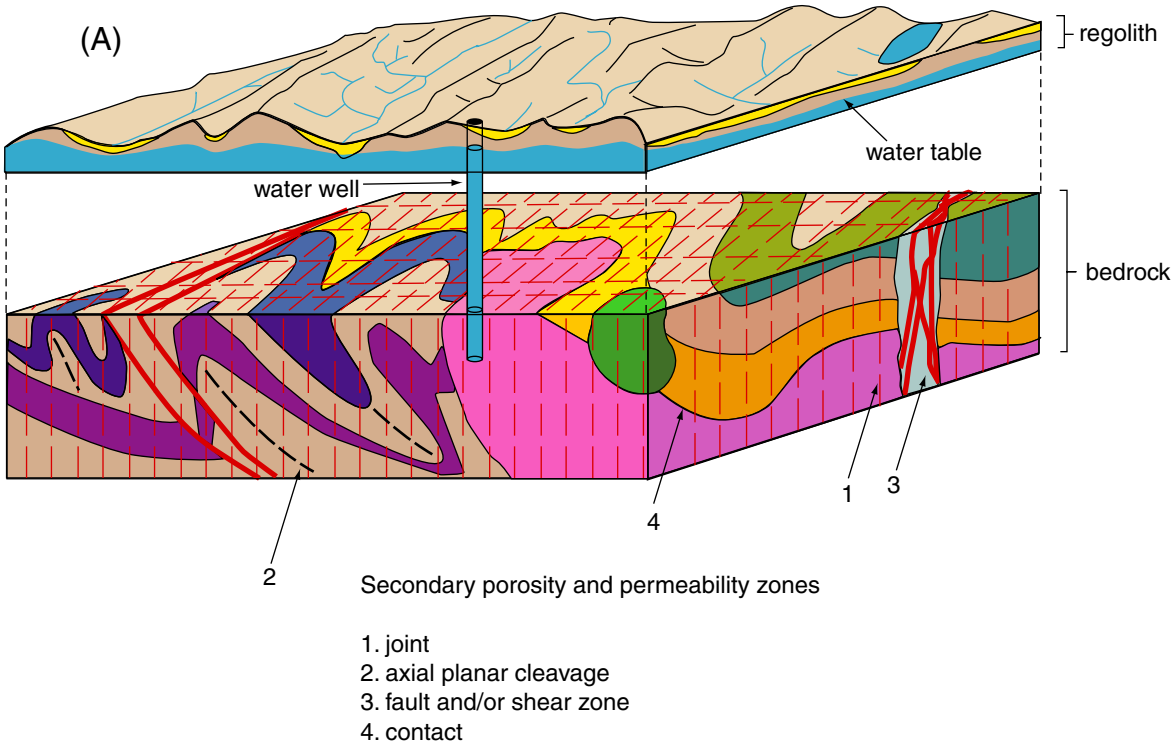


Figure 4.–Schematic diagram showing general occurrence and movement of water in Area 5 (modified from Kidd, 1989).



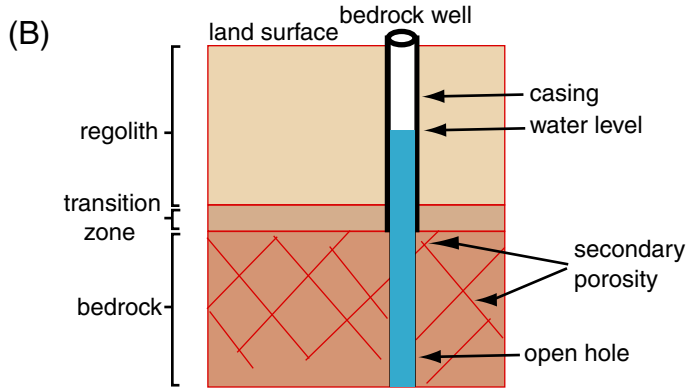


Figure 5.–Generalized hydrologic system in the Piedmont. (A) Two-component unconfined aquifer system. (B) Closeup of bedrock well illustrating relationship of casing depth and regolith thickness. Secondary porosity in bedrock consissts of open joints and fractures as ell as other openings formed as bedrock begins to weather to regolith (modified from Guthrie and others, 1994).

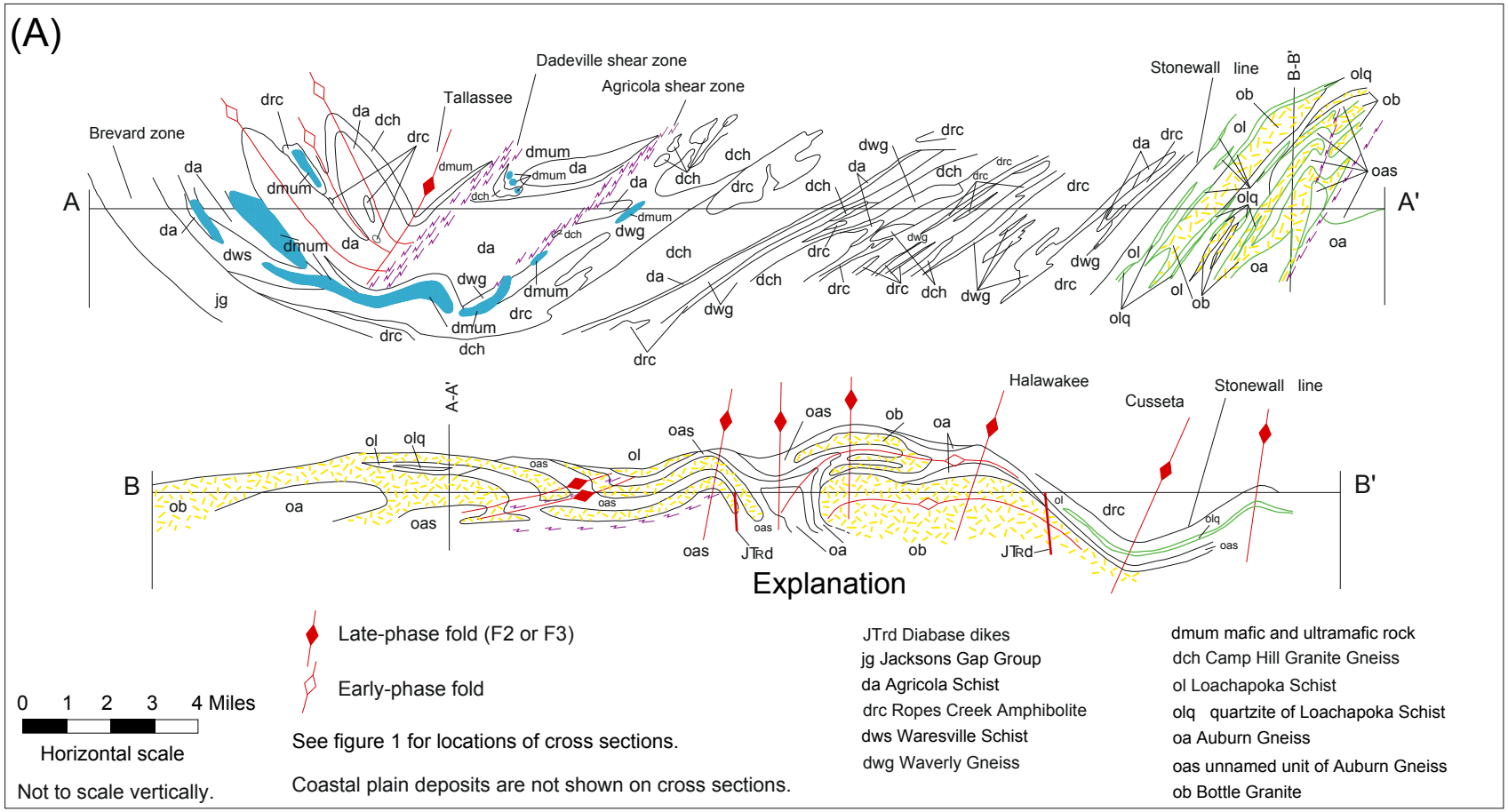


Figure 6.–Generalized hydrogeologic cross sections illustrating complexity of bedrock stratigraphy in Area 5. (A) Example from Inner Piedmont, Alabama (modified from Steltenpohl and others, 1990).

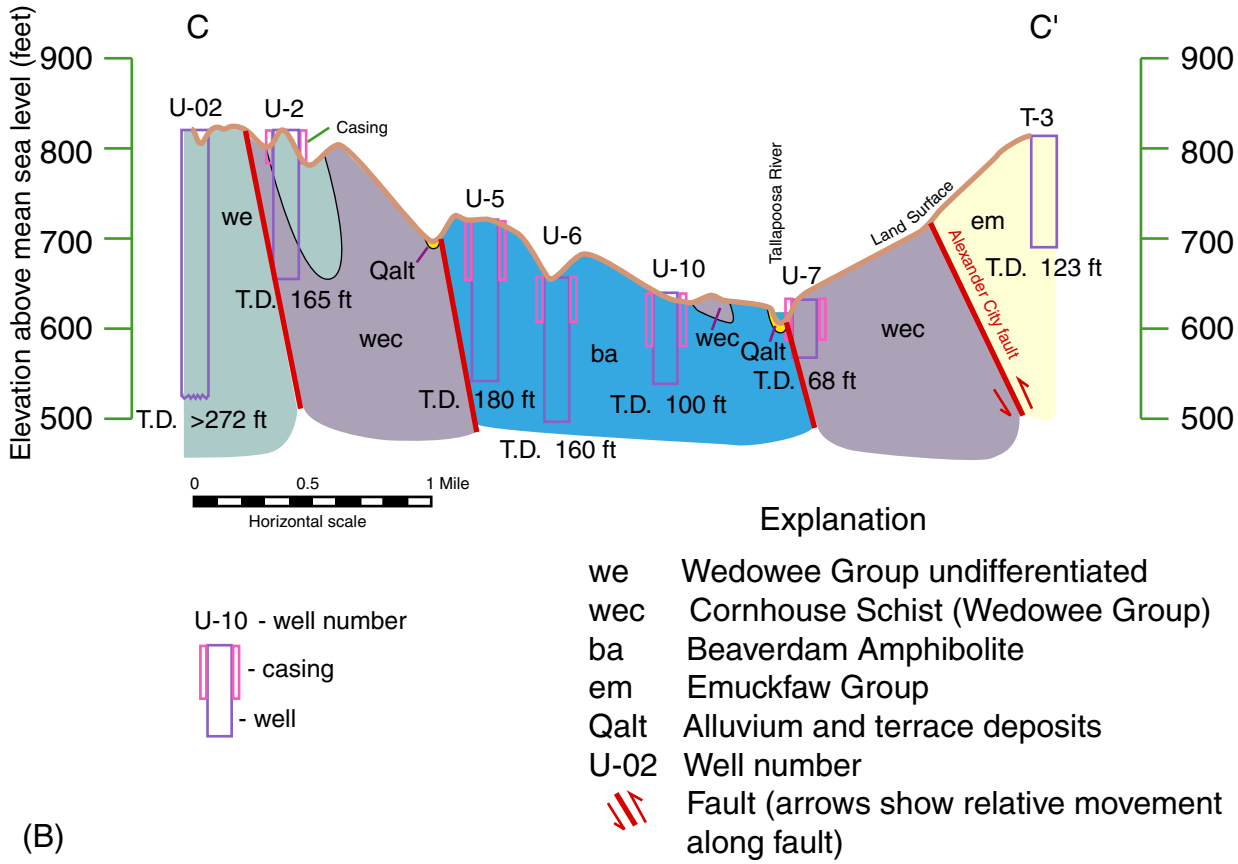


Figure 6.–(B) Example from southern Randolph County, Alabama (modified from Baker and Raymond, 1990). Lines of cross sections shown on figure 1.

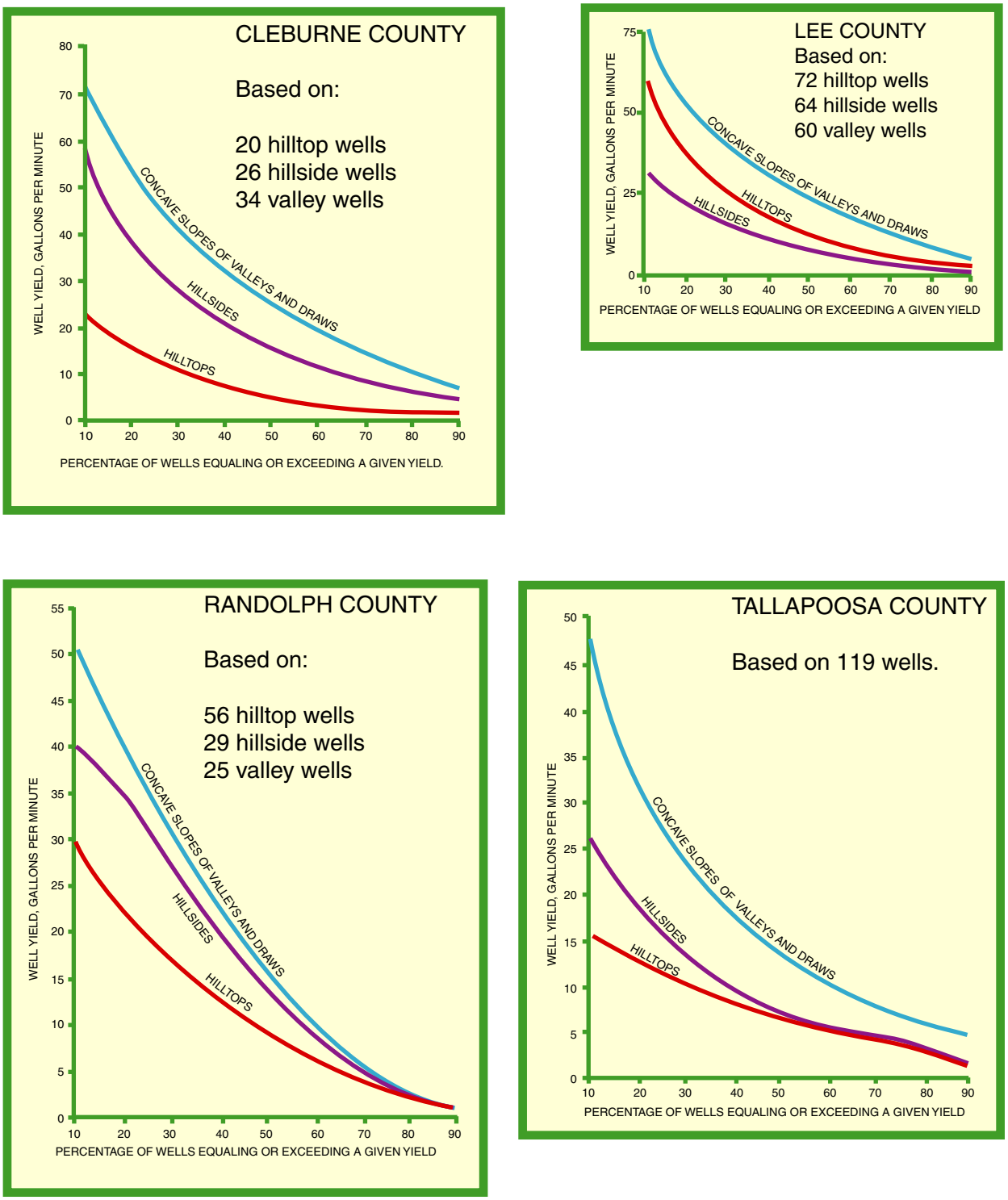


Figure 7.–Relationship between well location and well yield for four counties in Area 5 (modified from Scott and Lines, 1972; Lines and Chandler, 1975; and Chandler and Lines, 1978a,b).

EXPLANATION FOR TABLE 2

SYSTEM, water system name.
PWS ID, Public water system identification number as assigned by the Alabama Department of Environmental Management.
SE ID, Source identification number as assigned by the Alabama Department of Environmental Management.
GSA ID, Well identification number assigned by the Geological Survey of Alabama (GSA).
DEPTH, total depth of well in feet.
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: hp, Heflin Phyllite; wwm, Whatley Mill Gneiss; bm, blastomylonite, mylonite gneiss; at, Almond Trondhjemite; we, Wedowee Group.
WATER LEVEL, water level in feet below land surface.
DATE MEASURED, Date of water-level measurement.
WELL CONSTRUCTION, YIELD, REMARKS, gpm is gallons per minute.

Table 2.--Records of public water supply wells in Area 5

CLEBURNE COUNTY

System	PWS ID	SE ID	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer(1)	Water level (feet)	Date measured	Well construction, yield, remarks
Town of Fruithurst	278	1	CLEJ-3	350	1968	Adams-Massey	1,075	hp	22	1968	Casing: 6-in. from surface to 63 ft; none below. Reported drawdown 255 ft after 24 hrs pumping 25 gpm on 10-10-68.
Town of Fruithurst	278	2	CLEJ-5	352	1968	Adams-Massey	1,042	hp	4	1968	Casing: 6-in. from surface to 48 ft; none below. Reported drawdown 254 ft after 24 hrs pumping 20 gpm on 11-21-68.

Table 2.--Records of public water supply wells in Area 5--Continued

LEE COUNTY

System	PWS ID	SE ID	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer(1)	Water level (feet)	Date measured	Well construction, yield, remarks
Town of Beauregard	805	2	LEER-01	148	1980	Graves Well Drilling Co.	550	wwm	25.25	1980	Casing: 12-in. from surface to 108 ft; none below. Reported drawdown 17 ft after 48 hrs pumping 300 gpm on 11-21-80. City Well 2.
Town of Beauregard	805	3	LEEQ-02	165	1981	Graves Well Drilling Co.	585	wwm	16	1981	Casing: 12-in. from surface to 82 ft; 8-in. to 124 ft; none below. Reported yield 300 gpm. City Well 3.
City of Auburn	804	5	LEER-10				605	bm			Supplements surface water supply. Reported to pump continuously at 40 gpm in 1998. City Well 1.
City of Auburn	804	2	LEER-2	140	1920		610	bm	flowing	1968	Well flows when not being pumped. Supplements surface water supply. Reported to pump continuously at 65 gpm in 1968 and at 40 gpm in 1998. City Well 2.
Town of Beauregard	805	1	LEEQ-01	191	1975	Graves Well Drilling Co.	580	wwm	16.75	1975	Casing: 8-in. from surface to 100 ft; none below. Reported drawdown 41 ft after 60 hrs pumping 200 gpm on 9-16-75. City Well 1.

Table 2.--Records of public water supply wells in Area 5--Continued

RANDOLPH COUNTY

System	PWS ID	SE ID	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer(1)	Water level (feet)	Date measured	Well construction, yield, remarks
Town of Wedowee	1131	2	RANK-6	93	1966	Ballard and Son	810	at	19.4	1970	Casing: 6-in. from surface to 35 ft; none below. Drawdown 4.6 ft after 2 1/2 hrs pumping 65 gpm on 3-31-70.
Town of Woodland	1132	1	RANG-10	250	1971	Ballard and Son	943	we	0.22	01/27/1972	Casing: 6-in. from surface to 20 ft; none below. Drawdown 92.13 ft after 3 1/2 hrs pumping 66 gpm on 1-27-72. Pumping at 115 gpm 6-29-98.

(1) hp = Heflin Phyllite; wwm = Whatley Mill Gneiss; bm = blastomylonite, mylonite gneiss; at = Almond Trondhjemite; we = Wedowee Group

regolith thickness, but yields are highest in valleys (where regolith tends to be thicker) and lowest on hilltops (fig. 7) (Guthrie and others, 1994). Also, valleys have relatively high water tables, and well yields tend to be higher where water tables are closer to the surface (Guthrie and others, 1994). Statistical analysis of Piedmont aquifers by Guthrie and others (1994) suggested that the relatively weak correlation of well yield to variables such as topographic position and water-table depth, coupled with the complex geologic structure of the region, hinders attempts to predict well yield.

The average yield from wells having a median depth of 135 feet that tap the igneous and metamorphic rocks of the study area is about 10 gpm. Wells with high yields (greater than 50 gpm) are found in zones where fractures control surface drainage. In some cases these high-yield zones can be related to lineaments identified on LANDSAT satellite imagery (Guthrie and others, 1994). Fewer than 10 percent of wells yield 50 gpm or more (Guthrie and others, 1994). For example, figure 3 illustrates the frequency distribution of well yield in Chambers County, in which only 10 percent of wells yield more than 30 gpm. Because accessible ground water is not abundant in Area 5, most municipal supplies rely on surface water. Consequently, none of the geologic units in the study area are considered major aquifers for municipal public supply (Kidd, 1989).

None of the sedimentary rocks of the Valley and Ridge or unconsolidated sediments of the Coastal Plain are tapped by public-supply wells in the study area.

Because essentially all aquifers in Area 5 are unconfined, recharge areas coincide with aquifer outcrop areas, resulting in enhanced aquifer vulnerability. Recharge areas for the aquifers and areas where the aquifers are vulnerable to contamination from the surface are shown on plate 2. Also shown on plate 2 are locations of public water supply wells. Construction details of wells, water levels, and other pertinent well data are given in table 2. Table 3 provides similar information for selected inactive public water supply wells and selected other wells. The locations of these wells are shown on plate 4, which is reproduced from Kidd (1989).

AQUIFER SYSTEMS

Rocks and sediments exposed at the surface in Area 5 have been divided into eight aquifers and aquifer systems. Aquifers in the Piedmont hydrogeologic province are the metagranite aquifers, the metasedimentary and metavolcanic aquifers, and the mafic igneous aquifers. In the Valley and Ridge hydrogeologic province in Area 5 ground water is found in lithologically diverse, structurally complex units grouped together as the Valley and Ridge aquifer system. Aquifers in the Coastal Plain hydrogeologic province in Area 5 are the Watercourse aquifer, the Coker aquifer, and the Gordo aquifer (plate 2). The Piedmont aquifers are discussed in detail below. However, because

Valley and Ridge and Coastal Plain aquifers occupy only small parts of Area 5 they are not described in detail here.

METAGRANITE AQUIFERS

The metagranite aquifers include a heterogeneous group of granitic and metagranitic rocks in the southern part of the Northern Piedmont (Ashland-Wedowee belt) and the Inner Piedmont (Dadeville belt; fig. 2; plate 2). These rocks were classified by Guthrie and others (1994) as "felsic intrusive," "metamorphic mafic-ultramafic," and "gneiss" hydrogeologic units. The metagranite aquifers occupy nearly a quarter of the area of the Piedmont, including high-yield zones in the vicinity of Rockford, near Dadeville, and in northern Elmore County, which is in Area 8 (fig. 8) (Guthrie and others, 1994). These aquifers are therefore important components of the regional ground water system. Lithologic and hydrogeologic characteristics of formal rock units classified as metagranite aquifers are summarized in table 1.

The "felsic intrusive" and "gneiss" components of the metagranite aquifers are characterized by relatively low well yields (median yields of 6 and 7 gpm, respectively) when compared to metasedimentary and metavolcanic aquifers (for example, the median yield from "phyllite + quartzite + slate" aquifers [see next section] is 19 gpm) (Guthrie and others, 1994). However, the "metamorphic mafic-ultramafic" hydrogeologic unit has a relatively high median yield of 15 gpm. Also, Guthrie and others (1994) found only a few statistically significant differences in well yield among hydrogeologic units because well yields from individual hydrogeologic units vary considerably and the ranges of well yield from different hydrogeologic units overlap. Overall, the metagranite aquifers do not differ significantly from the metasedimentary and metavolcanic aquifers in well yield (Guthrie and others, 1994).

Wells completed in metagranite of the Elkahatchee Quartz Diorite Gneiss and associated rocks of the Ashland-Wedowee belt range from less than 100 to more than 500 feet in depth. The town of Rockford formerly obtained water from two wells that produced 15 and 33 gpm from depths of 237 and 300 feet, respectively (table 2). Rockford now obtains water from Alexander City, which uses surface-water sources.

Public water supplies for the town of Wedowee were formerly obtained from metagranite aquifers in the Ashland-Wedowee belt. Wedowee now uses surface water for its supply. Some of Wedowee's wells reportedly produced from phyllite, which is a metasedimentary aquifer. However, Wedowee's well field lies within a region dominated by metagranite aquifers, and at the mapping scale of plate 2, all of Wedowee's wells are assigned to that aquifer system. Wedowee's wells range from 100 to 325 feet in depth and generally yielded from 15 to 65 gpm.

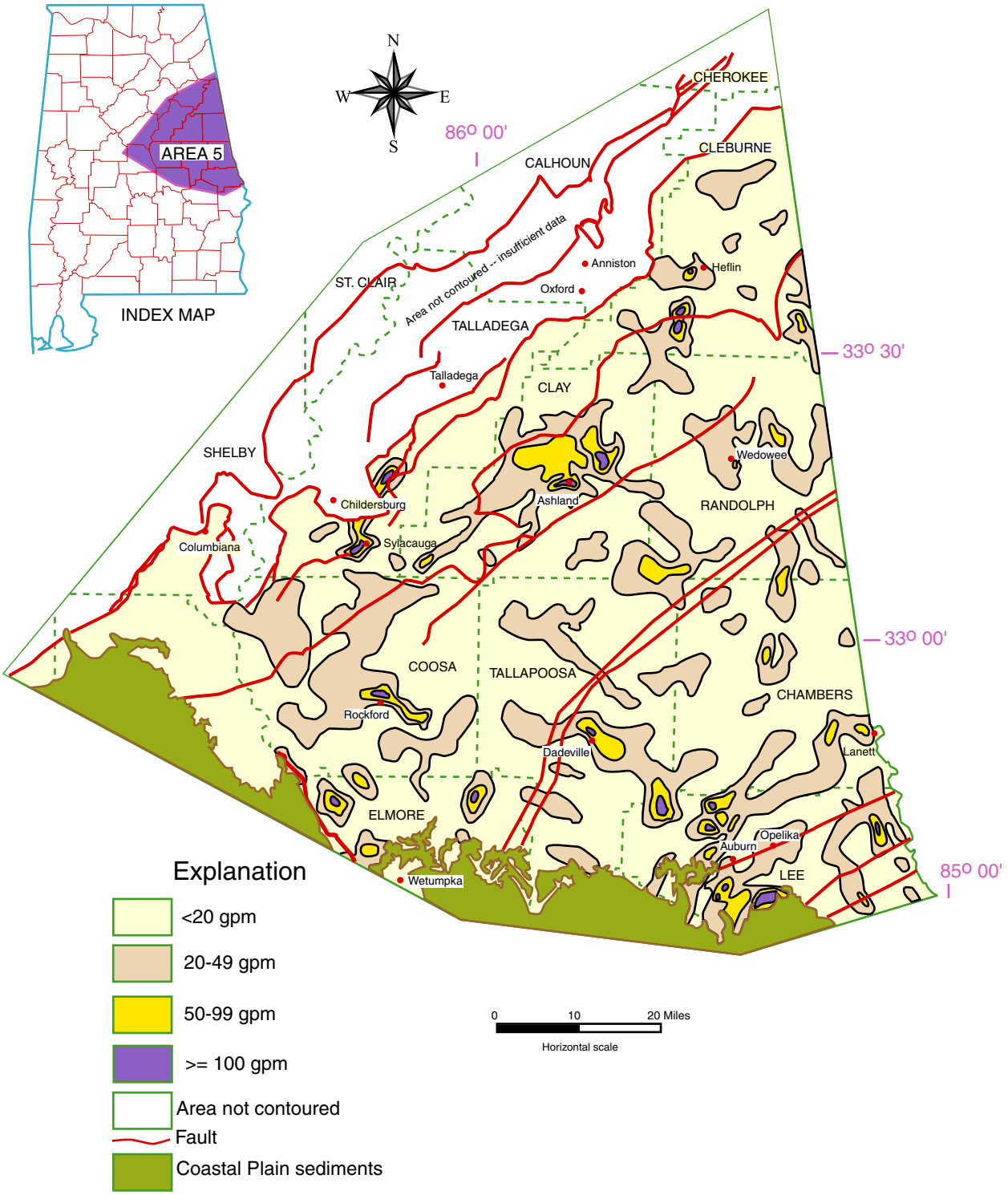


Figure 8.–Distribution of well yields and high-yield zones in the Alabama Piedmont and adjacent areas of the Valley and Ridge province (modified from Guthrie and others, 1994).

Metagranite aquifers in the Ashland-Wedowee belt are tapped by many wells for industrial use and at recreation sites, schools, churches, and camps, but are not used as municipal water supplies owing to small yields.

The average thickness of regolith overlying metagranite aquifers of the Dadeville belt is about 50 feet. Wells developed in saturated regolith may yield as much as 50 gpm but generally yield less than 10 gpm. Well depths range from 35 to 500 feet.

The Dadeville belt is tapped by many wells for industrial use and at recreation sites, schools, churches, and camps, but is not used as a municipal water supply owing to small yields (table 1).

METASEDIMENTARY AND METAVOLCANIC AQUIFERS

The metasedimentary and metavolcanic aquifers occupy about three-quarters of the Piedmont and are the most geologically diverse of the three Piedmont aquifer groups. Metasedimentary and metavolcanic aquifers are found in all six Piedmont tectonic belts, though the Dadeville belt is dominated by metagranite aquifers. The metasedimentary and metavolcanic aquifers were classified by Guthrie and others (1994) as "phyllite + quartzite + slate," "schist," "metagraywacke," "dolomite marble," and "mylonite" hydrogeologic units. High-yield zones are more common in the Southern Piedmont (southeast of the double red line of the Brevard Zone on figure 8) than in the Northern Piedmont, but do not correspond to particular rock types or hydrogeologic units (fig. 8). Instead, high-yield zones develop in regional fracture systems that crosscut hydrogeologic unit boundaries and even metamorphic belts (fig. 2) (Guthrie and others, 1994). Lithologic and hydrogeologic characteristics of formal rock units classified as metasedimentary and metavolcanic aquifers are summarized in table 1.

Median well yields of different kinds of metasedimentary and metavolcanic aquifers range from 9 gpm for mylonite to 19 gpm for phyllite + quartzite + slate and dolomite marble (Guthrie and others, 1994). Phyllite + quartzite + slate yield significantly more water than do gneiss or felsic intrusive rocks of the metagranite aquifers. However, other differences are not statistically significant because of high within-group variation in well yield and substantial overlap of well yield range between different hydrogeologic units.

Public-supply wells completed in the Talladega belt range from 100 to 540 feet in depth and yield less than 30 gpm (table 2). Fruithurst in Cleburne County used two wells in the 1980s for public supply. These wells produced less than 25 gpm each from a depth of 350 feet. Wells in the Hillabee Greenstone have been used as a public source of water in the past, but are no longer used for that purpose because of small yields (generally less than 10 gpm).

Public water supplies for the towns of Lineville, Ashland, Wadley, and Woodland were formerly obtained from metasedimentary and metavolcanic rocks in the Ashland-Wedowee belt. These towns now use surface water for their supplies. The Ashland-Wedowee belt is tapped by many wells for industrial use and at recreation sites, schools, churches, and camps, but is not used for municipal water supply owing to small yields (table 1). Public-supply wells completed in this belt range from 100 to 350 feet in depth and generally yield from 10 to 15 gpm.

Rocks in the Opelika belt do not yield sufficient quantities of water for public supplies, but do supply water to some domestic wells.

Wells in the Pine Mountain belt generally yield less than 25 gpm each, but one well yielded more than 2,000 gpm (Scott and Lines, 1972). This well may penetrate either solution cavities in dolomite or large fractures in quartzite. Well depths range from about 150 to 300 feet. The towns of Auburn, Smiths, and Beauregard have wells completed in rocks of the Pine Mountain belt. Beauregard maintains three wells (ADEM system identifier #805) for water supply. A spring that discharges from carbonate rocks of the Pine Mountain belt was used at one time as an emergency water supply by Opelika (Kidd, 1989). Auburn and Opelika now use surface water as their principal water supply.

No public-supply wells tap rocks of the Uchee belt.

MAFIC IGNEOUS AQUIFERS

The mafic igneous aquifers consist of intrusive dikes composed of diabase that trend north to north-northwest and crop out in Lee and Chambers Counties (plate 2). The dikes are much younger than the surrounding rock and were emplaced after the host rocks were deformed during mountain building. Because the mafic igneous aquifers are extremely restricted in areal extent, they are only locally important sources of ground water. However, the bedrock of the mafic igneous aquifers weathers readily, hence relatively high-yield wells can be completed locally in these aquifers. The mafic igneous aquifers are the “igneous, mafic intrusive” hydrogeologic unit of Guthrie and others (1994). No public-supply wells tap the mafic igneous aquifers.

VALLEY AND RIDGE AQUIFER SYSTEM

The Valley and Ridge aquifer system occupies small parts of Area 5 in northwestern Coosa and northern Cleburne Counties and is not tapped by any public-supply wells in Area 5. Formations included in this aquifer system are the Weisner Quartzite; Shady Dolomite; Conasauga Formation; Copper Ridge and Chepultepec Dolomites; the Longview, Newala, Lenoir, and Little Oak Limestones; and the Sylacauga Marble

Group. The Valley and Ridge aquifer system is the Knox-Shady aquifer of Planert and Pritchett (1989) and the Valley and Ridge aquifer system of Moore (1998). The Valley and Ridge aquifer system includes carbonate units that contain high-permeability dissolution channels. Folded and faulted strata of the Valley and Ridge aquifer system are found in a structurally complex area of parallel ridges and valleys, some of which are separated by major thrust faults.

COKER AQUIFER

The Coker aquifer occupies a small part of Area 5 in southern Lee and Tallapoosa Counties but is not tapped by any public-supply wells in Area 5. The Coker consists of structurally undisturbed clay, sand, and gravel. Wells in this aquifer in Area 5 produce less than 10 gpm from beds of sand and gravel.

GORDO AQUIFER

The Gordo aquifer occupies a small part of Area 5 in southern Lee County but is not tapped by any public-supply wells in Area 5. The Gordo consists of structurally undisturbed clay, sand, and gravel. Sand and gravel beds of the Gordo generally produce less than 10 gpm of water to wells in Area 5.

EUTAW AQUIFER

The Eutaw aquifer occupies a small part of Area 5 in southern Lee County but is not tapped by any public-supply wells in Area 5. The Eutaw consists of structurally undisturbed sand and clay.

WATERCOURSE AQUIFER

The Watercourse aquifer occupies a small part of Area 5 in southern Tallapoosa County but is not tapped by any public-supply wells in Area 5. The Watercourse aquifer consists of sand, gravel, and clay deposits located along modern and ancient watercourses.

RECHARGE AND MOVEMENT OF GROUND WATER

The source of recharge to aquifers is precipitation, mostly rain supplemented by occasional snow. Average annual precipitation for Area 5 is about 52 inches per year, but a large part runs off during and directly after rainstorms (Chandler, 1976). Most of the remainder is returned to the atmosphere by evaporation and transpiration of trees and other plants; a small part infiltrates to the water table and recharges aquifers.

Chandler (1976) estimated recharge to aquifers in the study area to be about 6 inches per year. Because some aquifer recharge areas in Area 5 are narrow (plate 2), precipitation falling on the recharge area of one aquifer may contribute indirectly to recharge of adjacent aquifers.

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 where the land surface is horizontal and underlain by gravel or coarse sand than where a sloping land surface is underlain by dense clay.

NATURAL DISCHARGE AND GROUND WATER WITHDRAWALS

Discharge from the aquifers in the study area occurs as seeps and springs at the land surface that provide base flow to streams, and as withdrawals from wells. The small areal extent of individual aquifers and the limited depth of ground water circulation in Area 5 result in relatively rapid movement of ground water from areas of recharge to areas of discharge.

Little ground water is used for public water supplies in Area 5. Many cities and towns in the area that formerly used ground water now use surface-water sources because of the limited amount of ground water production from wells, and because of water-quality problems associated with ground water in the area. Ground water quality problems are chiefly excessive iron content and hardness, but rapid recharge in Area 5 increases the risk of harm caused by ground water contamination from the surface.

Ground water withdrawals in million gallons per day (mgd) for public water systems in the study area in 1995 by county were Chambers, 0; Clay, 0; Cleburne, 0.07; Coosa, 0; Lee, 1.3; Randolph, 0.02; and Tallapoosa, 0.01. The total amount of ground water used for public supply in the study area was 1.40 mgd in 1995 (Mooty and Richardson, 1998). Ground water is also used for domestic, stock, industrial, and irrigation purposes. Total ground water withdrawals for all uses in the study area in 1995 were 7.36 mgd (Mooty and Richardson, 1998), compared with 8.60 mgd in 1985 (Kidd, 1989). Ground water withdrawals by public water systems increased substantially between 1985 and 1995 however because of greater ground water use for public water supply in Lee County.

EFFECTS OF WITHDRAWALS FROM THE AQUIFERS

Large long-term withdrawals of water from aquifers may result in the formation of conical depressions in the potentiometric surfaces of the aquifers near the wells (fig. 9). The extent of the depression depends on the amount of water withdrawn and the water-bearing characteristics of the rocks or sediments. Depressions in the potentiometric surfaces of confined aquifers caused by pumpage could induce recharge by vertical leakage from overlying saturated zones. However, most aquifers in Area 5 are not confined and do not underlie other saturated zones. Recharge could also be induced by pumpage in areas along major rivers where aquifers are hydraulically connected to streams, although recharge induced by pumpage can be a vehicle for ground water contamination. However, because few water users in Area 5 rely on ground water for large amounts of water, Area 5 has no known major depressions in potentiometric surfaces. In addition, most aquifers in Area 5 that are separated by topographic divides are hydrologically isolated from one another. Hence, large long-term ground water withdrawal from a well is likely to affect only nearby wells, if any.

GROUND WATER QUALITY

Ground water in Area 5 is generally of high quality. Known water-quality problems include locally hard water (Lines and Scott, 1972; Chandler and Lines, 1974) and high iron concentrations in some areas (plate 3; fig. 10) (Lines and Scott, 1972; Chandler and others, 1972; Chandler and Lines, 1974, 1978b). In Area 5, high iron concentrations in ground water are associated with iron-rich igneous rocks such as diorite, metamorphic rocks such as schist and gneiss, and metasediments such as slate and phyllite (Lines and Scott, 1972; Chandler and others, 1972). However, most iron-rich ground water in Area 5 is found in metasedimentary and metavolcanic aquifers, especially in the Talladega and Ashland-Wedowee Belts of the Northern Piedmont in Coosa, Clay, Cleburne, Randolph, and northwestern Tallapoosa Counties (plate 3). Water with iron concentrations in excess of 0.3 mg/L is considered objectionable because it stains plumbing fixtures and laundry. This problem is particularly severe and widespread in Clay, Coosa, and Randolph Counties (Scott and Lines, 1972; Lines and Chandler, 1975; Chandler and Lines, 1978a; plate 3). The U.S. Environmental Protection Agency (EPA) has defined 0.3 mg/L of dissolved iron as a secondary maximum contaminant level allowed in drinking water. The State of Alabama has adopted this value as part of its regulations for public water supplies.

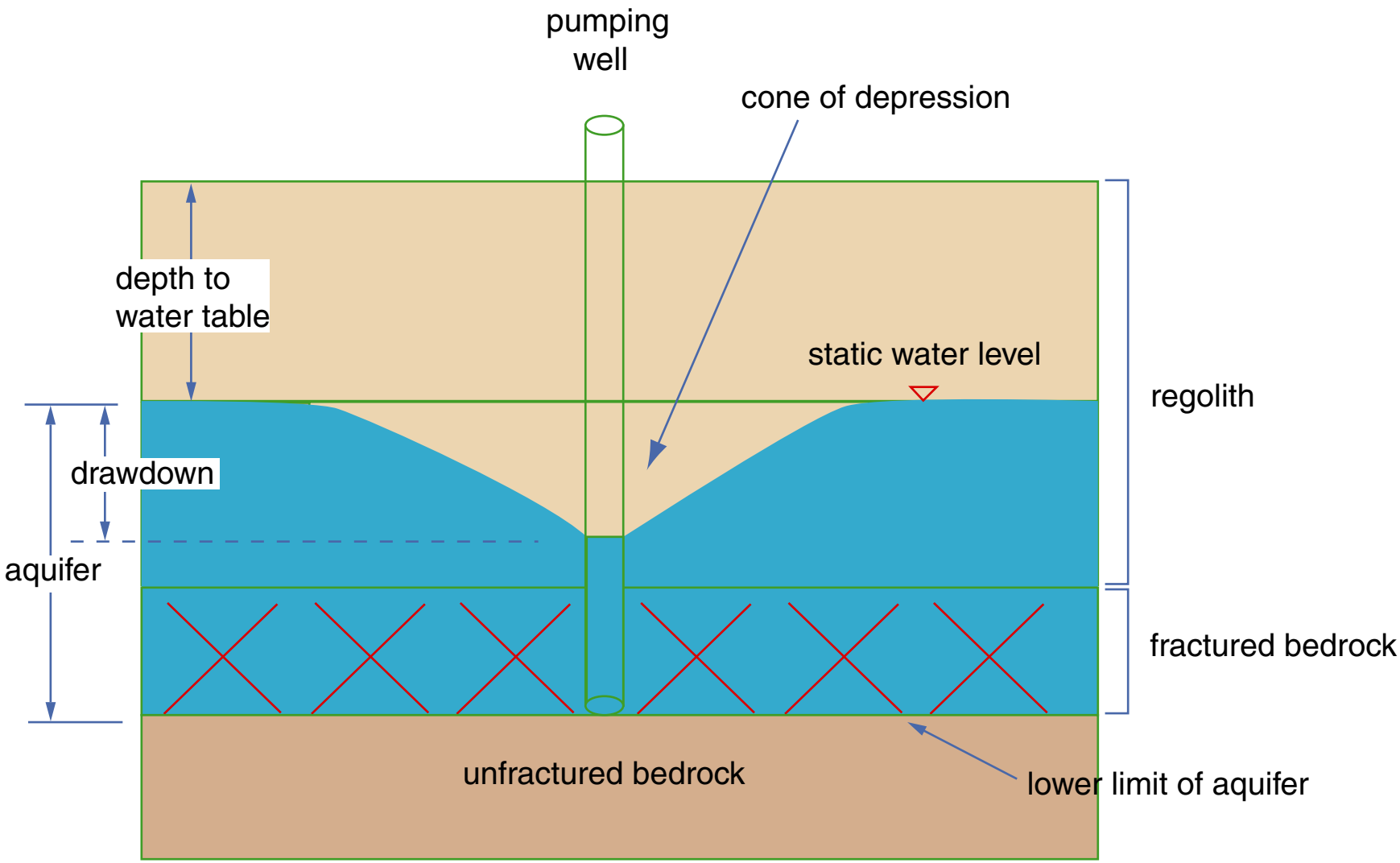


Figure 9.–Cone of depression in a Piedmont aquifer consisting of regolith and underlying fractured bedrock (modified from Driscoll, 1986). Not to scale.

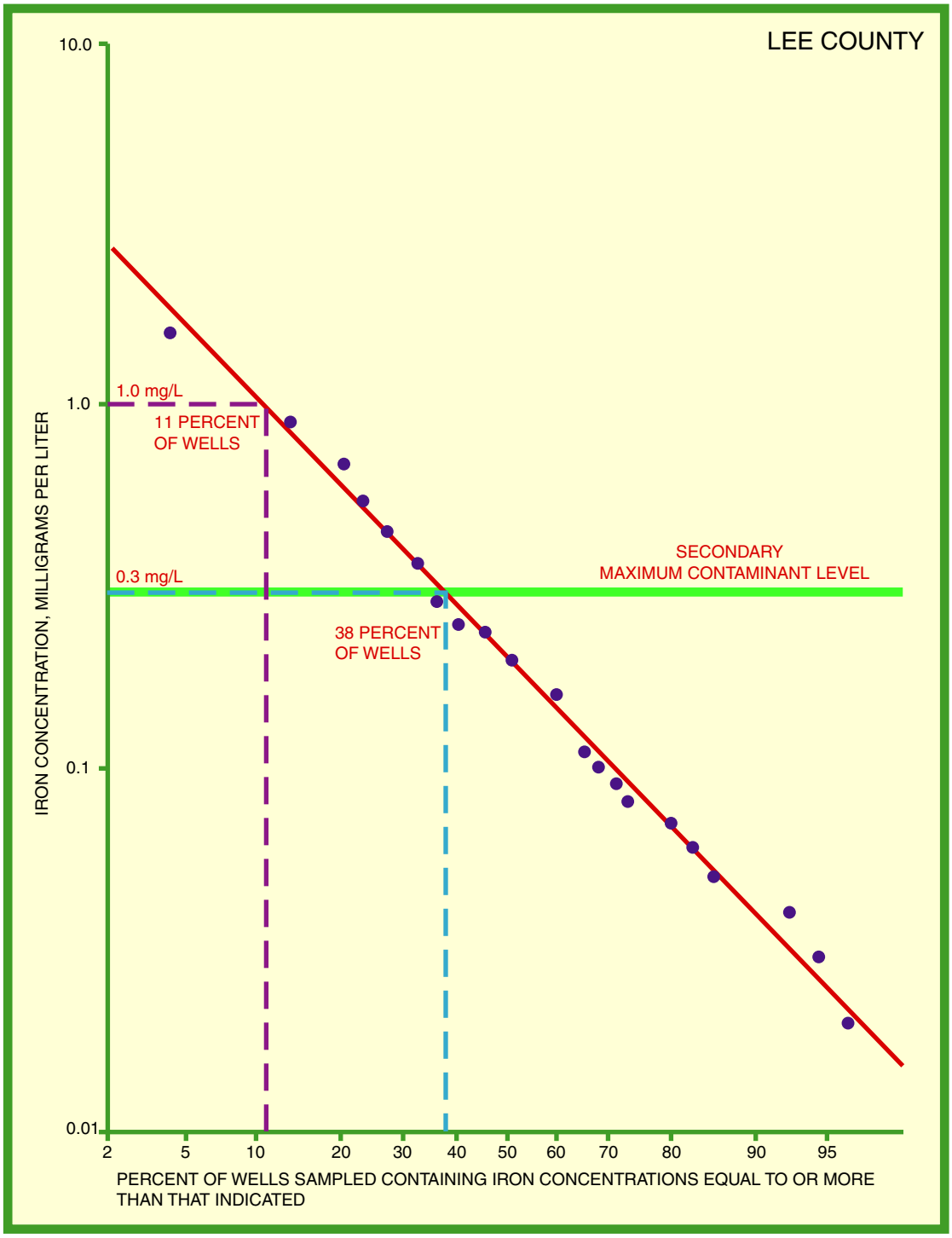


Figure 10.–Iron concentration in ground water versus percent of wells containing an equal or greater iron concentration in Lee County, Alabama (modified from Scott and Lines, 1972). For instance, 11 percent ofwells contain at least 1.0 mg/L of dissolved iron, and 38 percent equal or exceed the EPA secondary maximum contaminant level of 0.3 mg/L.

VULNERABILITY OF AQUIFERS TO CONTAMINATION

Aquifer vulnerability is a difficult concept to evaluate in Area 5 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 can 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 can become contaminated depends on the nature of the contaminant and on the hydrogeologic characteristics of the aquifer. These hydrogeologic characteristics are highly variable from aquifer to aquifer and even within individual aquifers and are largely controlled by the permeability of the units comprising an 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 towards 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. Aquifers least vulnerable to contamination are typically overlain by thick (50 feet or more) relatively impermeable units such as clay or chalk. These impermeable units are either aquicludes or aquitards. Neither of these extreme cases is represented in Area 5.

Vulnerability may also vary within aquifers. Aquifers are most vulnerable in their outcrops where water table conditions exist. Where aquifers are buried beneath other units and become confined their vulnerability to surface contamination decreases. This is because 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. In Area 5, all aquifers are unconfined. Some slight protection from contamination from the surface is provided by soils and unsaturated regolith, but no aquifer in Area 5 is overlain by a thick impermeable layer that might provide substantial protection. 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.

General guidelines (shown below) have been established to assist in identifying aquifers that have either a high vulnerability, moderate vulnerability, or low vulnerability to contamination. 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
- 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 impermeable 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
- Aquifer is well confined by aquicludes that 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.

Piedmont aquifers in Area 5 are moderately vulnerable to contamination from the surface in their outcrop areas (plate 2). The Valley and Ridge aquifer system and Coker, Gordo, and Watercourse aquifers are highly vulnerable to contamination from the surface in their outcrop areas.

Piedmont aquifers in Area 5 (plate 2) are unconfined, which means that they are readily accessible to contaminants introduced at or near the land surface, even where the aquifers are buried by soil or unsaturated regolith. Saturated regolith is the most productive common aquifer type in Area 5 and is characterized by localized porosity values of up to 50 percent (Chandler, 1976). Further, regolith and fractured bedrock tend to be moderately to highly permeable (Lines and Scott, 1972; Scott and Lines, 1972), permitting rapid recharge and discharge of stored ground water. However, the thickness and permeability of regolith and the permeability of fractured bedrock are highly variable in Area 5. Piedmont aquifers in Area 5 are highly permeable locally but not regionally.

Because aquifers in Area 5 are essentially water-table aquifers, topographic divides approximately define watersheds for ground water as well as surface water (fig. 4) (Kidd, 1989). Hence, individual potential sources of ground water contamination threaten ground water basins that tend to correspond to topographic basins on the land surface. Adjacent basins tend to be hydraulically separate; therefore, basin boundaries tend to impede transmission of contaminants. Thus hydrogeologic complexity resulting both from aquifer variability and topography tends to reduce the likelihood of long-distance lateral ground water movement. In addition, data are not currently available to map the distribution of regolith thickness, regolith or bedrock permeability, or ground water movement in Area 5.

Because of ready accessibility from the surface and locally high porosity and permeability values, Piedmont aquifers in some parts of Area 5 could be considered highly vulnerable to contamination. However, such a determination would not be reasonable for most of Area 5. Piedmont aquifers of Area 5 are substantially less permeable than high vulnerability aquifers in other areas, such as unconsolidated sand or karstic limestone. Also, long-distance ground water movement in Area 5 is impeded by complex structure and highly variable permeability. Consequently, any ground water contamination would likely be restricted to small areas around the point(s) of contaminant introduction. Finally, although some small parts of Area 5 are underlain by regolith and/or fractured bedrock that are uncharacteristically permeable, these areas cannot be delineated using available data.

A few places in Area 5 are underlain by low-quality confining units, or aquicludes (plate 2). These areas also are considered moderately vulnerable to contamination from the surface because confining units in these areas are thin, heterogeneous, and contain permeable strata.

Vulnerability is least in areas where thick soils and regolith serve as natural filters that prevent or retard the entrance of contaminants into the water-bearing rocks, and where porosity and permeability values are relatively low. However, no aquifers in Area 5 are strongly protected from potential surficial contamination by overlying soil or unsaturated regolith and therefore none of Area 5 is considered of low vulnerability.

Certain topographic settings are more susceptible to contamination from the surface than others. More vulnerable settings in Area 5 include valleys and lowlands where the water table is at or near land surface. These areas are more susceptible to contamination because of the small vertical distance between the land surface and the aquifer.

Highly faulted regions also are potentially more vulnerable to contamination from the surface than regions cut by few faults. Fault zones or faults may be extremely transmissive and, where they crop out, may be sites of increased recharge. Most of the major faults in the study area have been mapped and are shown on plate 1. However, Area 5 likely contains many minor faults, not mapped on plate 1, that could locally increase aquifer vulnerability.

The small parts of Area 5 underlain by the Valley and Ridge aquifer system, and by the Coker, Gordo, and Watercourse aquifers, are highly vulnerable to contamination from the surface because these aquifers are substantially more permeable than Piedmont aquifers.

Aquifers tend to be less vulnerable to contamination from the surface where they are buried beneath thick successions of relatively impermeable strata. However, there

are few deeply buried ground water supplies in Area 5; most aquifers in this area are found at or close to the land surface. Consequently, aquifer vulnerability throughout Area 5 is controlled chiefly by characteristics of aquifers and not of aquitards.

PUBLIC SUPPLY WELLS

In Area 5, nine public ground water supply wells provide water for five water systems (table 2; plate 2). Most of these wells derive water from the metasedimentary and metavolcanic aquifers, but Wedowee's well (93 feet deep) is completed in the metagranite aquifers. Currently, active public water supply wells completed in the metasedimentary and metavolcanic aquifers range from 140 to 352 feet in depth. Public water supply wells are scarce in Area 5 because the aquifers there yield only enough water to meet quite modest needs (median yield is about 10 gpm).

WELLHEAD PROTECTION AREAS

Public water supply systems that use ground water provide water to nearly half the population of Alabama (Baker and Mooty, 1993; Mooty and Richardson, 1998). Programs that protect ground water sources from potential contamination are known as Wellhead Protection Programs (WHPP's) or Source Water Assessment Programs (SWAP's). 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 and springs. The 1996 amendments established Source Water Assessment requirements for public water supply systems using either ground water or surface water sources. Under ADEM's existing WHPP, local wellhead protection plans (LWHPP) are not required. However, the SWAP requires a Source Water Assessment Area (SWAA) delineation (under previous regulations, a Wellhead Protection Area [WHPA] 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 susceptibility to contamination. The SWAA's 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. As the terms SWAA and WHPA can be used to identify the same area around a public water supply well or spring, they are used synonymously in this report.

Some public water supply systems in the study area that have in the past used ground water supplies now use surface water supply sources. Only one Wellhead Protection Program has been completed in Area 5. In Randolph County, the Wadley Wellhead Protection Area delineation was included in a demonstration project for

wellhead protection areas in Alabama (Baker and Raymond, 1990). However, Wadley now uses surface water rather than ground water for public supply, and therefore, their Wellhead Protection Area has been removed from the official list.

SUMMARY AND CONCLUSIONS

Metamorphic and igneous rocks crop out in over 90 percent of the study area. Sedimentary rocks of the Valley and Ridge physiographic province crop out in northern Cleburne and northwestern Coosa Counties. Unconsolidated sediments of the Eutaw Formation and the Tuscaloosa Group crop out in southern Lee and Tallapoosa Counties. Quaternary age deposits occur along major streams throughout the study area.

Ground water is currently used very little for municipal public water supplies in Area 5. None of the sedimentary rocks or unconsolidated deposits are tapped by public supply wells. None of the igneous and metamorphic rocks are considered major aquifers because of low yields and hydraulic independence. Igneous and metamorphic aquifers in Area 5 are unconfined. Surface-drainage divides of the igneous and metamorphic rocks generally correspond to boundaries between separate ground water reservoirs.

Ground water in Area 5 is naturally rich in dissolved iron, and iron concentrations in ground water exceed the secondary drinking-water maximum contaminant level of 0.3 mg/L in much of the region. Other natural sources of ground water contamination in Area 5 are only locally significant.

Piedmont aquifers in Area 5 are moderately vulnerable to contamination from the surface throughout their entire outcrop areas. Small regions in the western and northern parts of Area 5 that are underlain by low-quality confining units also are moderately vulnerable to contamination from the surface. Small parts of Area 5 underlain by the Valley and Ridge aquifer system and by the Coker, Gordo, or Watercourse aquifers are highly vulnerable to contamination from the surface. Faulted areas are potentially more vulnerable; major faults are mapped on plate 1. Also, valleys where water levels are at or near land surface are more susceptible to contamination from the surface. However, detailed mapping of these small potentially highly susceptible areas is not possible with existing data.

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Table 3.– Records of selected wells in Area 5 (modified from Kidd, 1989)

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
U.S. Forest Service	1		235	1966	Graves	1,180	t	55	1966	Coleman Lake well. Casing 6 in., 0 to 45 ft.
U.S. Dept. of Agriculture	2		104	1962	C.D. Pace	950	t	--	--	Pine Glenn well. Casing 6 in., 0 to 40 ft.
U.S. Dept. of Agriculture	3		100	1962	C.D. Pace	949	t	--	--	Pine Glenn well. Casing 6 in., 0 to 45 ft.
Town of Fruithurst	4		350	1968	Adams-Massey	1,075	t	22	1968	25 gpm. Casing 6 in., 0 to 63 ft.
Town of Fruithurst	5		352	1968	Adams-Massey	1,042	t	4	1968	20 gpm. Casing 6 in., 0 to 48 ft.
Town of Heflin	6		400	1968	All Purpose Boring	926	t	22	1968	Well no. 8. 81 gpm. Casing 6 in., 0 to 64 ft.
Town of Heflin	7		355	1934	H.W. Deerman	984	t	60	1954	Well no. 1. 22 gpm. Casing 6 in., 0 to 60 ft.
Town of Heflin	8		230	1939	C.D. Pace	891	t	20	1969	Well no. 2. 60 gpm. Casing 6 in., 0 to 60 ft.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Numbe r	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Town of Heflin	9		223	1958	Adams-Massey	941	t	2.8	9-26-58	Well no. 6. 75 gpm. Casing 6 in., 0 to 22 ft.
Cleburne County School	10		180	1959	All Purpose Drilling	1,015	t	45	1959	
Town of Heflin	11		228	1958	Adams-Massey	906	t	22	1958	Well no. 5. 100 gpm. Casing 6 in., 0 to 26 ft.
Town of Heflin	12		194	1935	C.D. Pace	965	t	50	1945	Well no. 3. 77 gpm. Casing 6 in., 0 to 66 ft.
Town of Heflin	13		162	1955	C.D. Pace	900	t	30	1955	Well no. 4. 65 gpm. Casing 6 in., 0 to 70 ft.
Town of Heflin	14		328	1958	Adams-Massey	863	t	6.21	1-27-87	Well no. 7. 30 gpm. Casing 6 in., 0 to 50 ft.
Huddle House Restaurant	15		--	--	--	905	t	--	--	

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Alabama Highway Dept.	16		115	1978	Alabama Highway Dept.	1,010	we	34.16	1-28-87	Supply well for Welcome Center, I-20. Casing 6 in., 0 to 60 ft; 4 in: 0 to 65 ft.
Cleburne County Vocational School	17		--	--	Cleburne County Vocation al School	1,040	t	55.67	1-27-87	
Tyson Foods	18		300	--	--	830	hf, pbm, mi, & hc undiff.	--	--	River well.
Tyson Foods	19		308	1956	C.D. Pace	820	hf, pbm, mi, & hc undiff.	--	--	Well no. 1. Casing 10 in., 0 to 55 ft.
Tyson Foods	20		215	1969	Adams-Massey	825	hf, pbm, mi, & hc undiff.	5	1-05-70	Thrower's Bottom well. Casing 10 in., 0 to 21 ft.
Boy Scouts of America	21		--	--	--	920	hf, pbm, mi, & hc undiff.	--	--	Camp Sequoah.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Pleasant Grove School	22		200	1957	Mack Otwell	901	hf, pbm, mi, & hc undiff.	43.47	1-27-87	
Town of Ranburne	23		200	1966	Adams-Massey	936	we	21.6	6-02-70	Well no. 1. 34 gpm. Casing 6 ft., 0 to 20 ft.
Town of Ranburne	24		120		Adams-Massey	934	we	7	1966	Well no. 6. 9 gpm. Casing 6 in., 0 to 12 ft.
Alabama Dept. of Conservation	25		345	1970	H.W. Peerson	2,275	t	62.0	1-19-71	Well no. 2. State Park. Casing 9 in., 0 to 40 ft.
Alabama Dept. of Conservation	26		269	1970	H.W. Peerson	2,150	t	39.4	10-20-70	Well no. 1. State Park. Casing 9 in., 0 to 40 ft.
Alabama Dept. of Conservation	27		520	1984	Graves Well Drilling Co.	2,400	t	--	--	Well no. 7. State Park.
Alabama Dept. of Conservation	28		540	1984	Graves Well Drilling Co.	2,350	t	--	--	Well no. 8 State Park.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Alabama Dept. of Conservation	29		--	--	--	1,290	t	9.72	1-26-87	Cheaha Lake well.
Alabama Dept. of Conservation	30		383	1970	H.W. Peerson	2,030	t	13.7	1-26-71	Well no. 3. State Park.. Casing 9 in., 0 to 21 ft.
Alabama Dept. of Conservation	31		--	--	--	1,390	t	--	--	Well no. 6. State Parl.
Alabama Dept. of Conservation	32		n.a.	n.a.	n.a.	1,390	t	--	--	Spring – State Park.
Folsom School	33		190	1949	J.W. Woods	1,244	hf, pbm, mi, & hc undiff.	54.8	4-03-70	School now leased by sewing factory.
Barfield School	34		140	1947	Graves Well Drilling Co.	1,010	hf, pbm, mi, & hc undiff.	36.4	2-18-68	Casing 6 in., 0 to 82 ft.
Lakeside Service	35		110		Ballard	810	we	--	--	

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Woodland	36	RANG-3	101	1966	Ballard and Son	1,012	we	6	1966	Casing 6 in., 0 to 24 ft. Drawdown 19.5 ft. when pumped 24 hrs. at 62 gpm in 1966.
Aaron Meadows	37		--	--	Ballard	800	we	--	--	Piney Wood Lake Service
Town of Lineville	38	CLAH-3	150	1951	Carl Pace	1,025	hf, pbm, mi, & hc undiff.	43.8	12-13-68	Casing 6 in., 0 to 70 ft. Drawdown 12 ft. when pumped 10 hrs. at 150 gpm in 1951.
Town of Lineville	39	CLAH-2	109	1945	Carl Pace	1,025	hf, pbm, mi, & hc undiff.	47.8	12-13-68	Casing 8 in., 0 to 50 ft. Yield 350 gpm in 1945.
Town of Lineville	40	CLAI-1	200	1961	Adams-Massey	1,026	hf, pbm, mi, & hc undiff.	4.04	1-30-87	Casing 6 in., 0 to 61 ft. Drawdown 86.91 ft. when pumped 20 hrs. at 123 gpm in 1968.
Wedowee	41	RANK-2	116	1956	Carlisle and Ballard	862	we	50	1956	Well no. 4. 25 gpm in 1956. Casing 6 in.: 0 to 116 ft.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Wedowee	42	RANK-3	109	1956	Carlisle and Ballard	852	we	1.0	3-31-70	Well no. 5. 45 gpm in 1956. Casing 6 in., 0 to 21 ft.
Wedowee	43		340	1945	C.D. Pace	880	we	30.60	1-29-87	Well no. 2. 40 gpm. Casing: 8 in., 0 to 60 ft.
Wedowee	44	RANK-4	325	1936	H.W. Peerson	906	we	143.5	3-31-70	Well no. 1. 30 gpm in 1936. Casing 6 in., 0 to 150 ft.
Wedowee	45	RANK-6	93	1966	Ballard and Son	810	we	19.4	3-31-70	Well no. 3. Casing 6 in., 0 to 35 ft. Drawdown 4.6 ft. when pumped 2.5 hrs. at 65 gpm in 1970.
Woodland	46		250	1972	Ballard and Son	943	we	+1.22	1-08-72	Well no. 2. Casing 6 in., 0 to 20 ft.
Town of Ashland	47	CLAI-II	206	1954	Carl Pace	1,063		hf, pbm, mi, & hc undiff.	--	Casing 6 in., 0 to 55 ft. Drawdown 37 ft. when pumped 8 hrs. at 175 gpm in 1954. Swimming pool well.
Town of Ashland	48		--	--	--	1,060		hf, pbm, mi, & hc undiff.	--	Swimming pool well.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Town of Ashland	49	CLAI-10	200	1965	Graves Well Drilling Co.	1,064	hf, pbm, mi, & hc undiff.	40.3	12-13-68	Gaither well. Casing 8 in., 0 to 52 ft. Drawdown 68 ft. when pumped 8 hrs. at 50 gpm in 1965.
Town of Ashland	50		220	1970	Graves Well Drilling Co.	1,060	hf, pbm, mi, & hc undiff.	16	7-13-70	Gaither well. Casing 8 in., 0 to 90 ft.
Town of Ashland	51	CLAI-9	215	1947	Carl Pace	1,049	hf, pbm, mi, & hc undiff.	15	1968	Tate well or Iron well. Casing 8 in., 0 to 71 ft. Drawdown 15 ft. when pumped 12 hrs. at 135 gpm in 1947.
Town of Ashland	52	CLAI-14	303	1960	Carl Pace	1,068	hf, pbm, mi, & hc undiff.	19.0	10-06-69	Casing 8 in., 0 to 92 ft. Drawdown 75 ft. when pumped 8 hrs. at 300 gpm in 1960; 72 ft. when pumped 12 hrs. at 157 gpm in 1969. Housing well.
Town of Ashland	53	CLAI-17	255	1959	Carl Pace	1,030	hf, pbm, mi, & hc undiff.	2.64	1-29-87	Curlee Well. Casing 8 in., 0 to 39 ft. Drawdown 107 ft. when pumped 6 hrs. at 150 gpm in 1959.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Town of Ashland	54		--	--	--	1,110	hf, pbm, mi, & hc undiff.	--	--	Noland well.
Mellow Valley High School	55		--	--	--	935	we	6.48	1-29-87	
Wadley	56	RANU-6	160	1968	Graves Well Drilling Co.	654	hf, pbm, mi, & hc undiff.	3.5	3-31-70	Well no. 3. Casing 6 in., 0 to 48 ft. Drawdown 50 ft. when pumped 24 hrs. at 51 gpm in 1970.
Wadley	57	RANU-10	100	1955	Ballard and Son	635	hf, pbm, mi, & hc undiff.	25.5	3-31-70	Well no. 2. Casing 6 in., 0 to 62 ft. Drawdown 19.2 ft. when pumped 1.5 hrs. at 35 gpm in 1968.
Hackneyville High School	58		100	1954	Carlisle and Ballard	702	egn	30	1954	Casing 6 in., 0 to 95 ft.
Hackneyville High School	59		155	1954	Carlisle and Ballard	698	egn	25.4	12-04-69	Casing 6 in., 0 to 120 ft.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Weogufka High School	60		120	1947	Graves Well Drilling Co.	668	t	26	11-12-47	
Weogufka High School	61		219	1966	Coleman Supply	668	t	--	--	
Coosa County Vocational Center	62		215	--	Graves Well Drilling Co.	770	hf, pbm, mi, & hc undiff.	--	--	Well no. 1.
Newsite	63		206	1967	Ballard and Son	727	we	7.2	3-12-68	24 gpm.
Newsite	64		100	1967	Ballard and Son	723	we	8.3	1-30-87	20 gpm. Casing 6 in., 0 to 30 ft.
Chambers County High School	65		--	1951	Virginia Well and Supply	667	d	21.1	6-27-69	
U.S. Dept. of the Interior	66		110	1962	Adams-Massey	540	hf, pbm, mi, & hc undiff.	17.93	1-30-87	Horseshoe Band National Park.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Five Points Elementary School	67		241	1955	Carlisle and Ballard	878	d	38.14	2-03-87	
Five Points Elementary School	67		241	1955	Carlisle and Ballard	878	d	38.14	2-03-87	
Five Points Elementary School	68		350	1951	Adams-Massey	860	d	75.70	2-03-87	
Avondale Mills	69		371	1965	Graves Well Drilling Co.	779	hf, pbm, mi, & hc undiff.	7.20	1-26-87	Well no. 1. Casing 6 in., 0 to 76 ft.
Avondale Mills	70		250	1965	Graves Well Drilling Co.	805	hf, pbm, mi, & hc undiff.	62.3	7-03-68	Well no. 2. Casing 6 in., 0 to 61 ft.
Avondale Mills	71	COOL-7	340	1965	Graves Well Drilling Co.	776	hf, pbm, mi, & hc undiff.	32	7-03-68	Well no. 3. Casing 6 in., 0 to 68 ft. Yield 37.5 gpm in 1966.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Avondale Mills	72	COOL-5	160	1966	Graves Well Drilling Co.	753	hf, pbm, mi, & hc undiff.	23.5	7-03-68	Well no. 4. Casing 8 in., 0 to 46 ft. Yield 110 gpm in1966.
Avondale Mills	73		310	1966	Graves Well Drilling Co.	746	hf, pbm, mi, & hc undiff.	34.9	7-03-68	Well no. 5. Casing 6 in.: 0 to 29 ft.
Avondale Mills	74		340	1972	Graves Well Drilling Co.	780	hf, pbm, mi, & hc undiff.	--	--	Well no. 6.
Avondale Mills	75		--	1972	Graves Well Drilling Co.	760	hf, pbm, mi, & hc undiff.	--	--	Well no. 7.
Avondale Mills	76		--	1972	Graves Well Drilling Co.	740	hf, pbm, mi, & hc undiff.	--	--	Well no. 8.
Town of Rockford	77		--	--	Graves Well Drilling Co.	780	hf, pbm, mi, & hc undiff.	9.3	1-26-87	Well no. 3.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year Drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Town of Rockford	78	COOM-2	300	1960	Graves Well Drilling Co.	728	egn	24.5	4-25-85	Well no. 1. 33 gpm. Casing 6 in., 0 to 34 ft. Drawdown 280 ft. when pumped 3 hrs. at 33 gpm in 1960.
Town of Rockford	79	COOM-3	237	1941	C.D. Pace	718	egn	35.6	7-27-66	Well no. 2. 15 gpm. Casing 8 in., 0 to 30 ft. Drawdown 29 ft. when pumped 1 hr. at 15 gpm in 1968.
AASCA Camp	80		200	1976	Ballard	500	hf, pbm, mi, & hc undiff.	9.50	1-30-87	Casing 6 in., 0 to 75 ft.
U.S. Corps of Engineers	81		--	1972-73	Dixie Well Drilling	700	d	44.8	7-19-73	
U.S. Corps of Engineers	82		--	1972-73	Dixie Well Drilling	680	d	16.0	6-18-73	
U.S. Corps of Engineers	83		--	1972-73	Dixie Well Drilling	660	d	43.1	7-19-73	
U.S. Corps of Engineers	84		--	1972-73	Dixie Well Drilling	645	d	--	--	Veasey Creek.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
U.S. Corps of Engineers	85		--	1972-73	Dixie Well Drilling	650	d	--	--	Veasey Creek.
U.S. Corps of Engineers	86		--	1972-73	Dixie Well Drilling	670	d	--	--	Veasey Creek.
Mrs. Harold Knight	87		120	--	--	665	d	30.26	2-04-87	Rocky Point Camp Ground.
U.S. Corps of Engineers	88		--	1972-73	Dixie Well Drilling	650	d	15.2	7-13-73	Amity Park.
U.S. Corps of Engineers	89		--	1972-73	Dixie Well Drilling	645	d	6.6	6-28-73	Amity Park.
U.S. Corps of Engineers	90		--	1972-73	Dixie Well Drilling	680	d	43.5	7-11-73	Amity Park.
U.S. Corps of Engineers	91		--	1972-73	Dixie Well Drilling	665	d	33.9	6-27-73	Amity Park.
U.S. Corps of Engineers	92		--	1972-73	Dixie Well Drilling	665	d	73.8	6-26-73	Amity Park.
U.S. Corps of Engineers	93		--	--	--	680	d	--	--	Burnt Village Camp Ground well.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
U.S. Corps of Engineers	94		--	1972-73	Dixie Well Drilling	650	d	14.7	8-27-73	Rocky Point.
U.S. Corps of Engineers	95		--	--	--	630	d	12.78	2-03-87	Burnt Village Marina well.
U.S. Corps of Engineers	96		--	1972-73	Dixie Well Drilling	655	d	25.5	7-13-73	West Over-look well.
Lake o' the Hill Trailer Park	97		--	--	--	600	hf, pbm, mi, & hc undiff.	--	--	
Piney Woods Marina Restaurant	98		--	--	--	500	hf, pbm, mi, & hc undiff.	--	--	
Piney Woods Marina Restaurant	99		--	--	--	500	hf, pbm, mi, & hc undiff.	--	--	

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Wind Creek State Park	100	TAPL-5	150	1960	Ballard and Son	506	hf, pbm, mi, & hc undiff.	41	1968	Casing 6 in., 0 to 120 ft. Yield 80 gpm in 1960.
Wind Creek State Park	101	TAPL-6	130	1960	Ballard and Son	506	hf, pbm, mi, & hc undiff.	11.79	2-02-87	Casing 6 in.,0 to 76 ft.
Town of Lafayette	102	CHAL-3	275	1911	--	815	d	20.85	2-03-87	Casing 7 in. to unknown depth. Yield 15 gpm in 1911.
Pleasure Point Park	103	TAPN-2	200	1966	Graves Well Drilling Co.	521	egn	30	1966	Casing 6 in., 0 to 36 ft.
Pleasure Point Park	104	TAPN-3	75	1967	Ballard and Son	490	egn	12	1967	
Town of Dadeville	105	TAPO-1	350	1943	H.W. Peerson	724	d	33.04	11-01-82	Casing 6 in., 0 to 78 ft. Yield 94 gpm in 1943.
Town of Dadeville	106	TAPO-6	225	1949	H.W. Peerson	553	d	15	1949	Casing 8 in., 0 to 40 ft. Yield 65 gpm in 1949.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Town of Dadeville	106	TAPO-6	225	1949	H.W. Peerson	553	d	15	1949	Casing 8 in., 0 to 40 ft. Yield 65 gpm in 1949.
Plainview Headstart School	107		77	1955	Carlisle and Ballard	749	d	19.77	2-03-87	
Camp Alamisco	108	TAPN-01	539	1984	Champion Well Drilling	550	egn	79.50	2-02-87	Geological Survey of Alabama semi-annual well. Casing 6 in., 0 to 80 ft.
Maxwell Air Force Base	109		98	1968	Ballard and Son	500	d	31.37	2-02-87	Base recreational area. 40 gpm. Casing 6 in., 0 to 82 ft.
Camp Hill	110		202	1957	Virginia Well and Supply	628	d	20	1957	42 gpm. Casing 6 in., 0 to 73 ft.
Camp Hill	111		500	1952	Virginia Well and Supply	632	d	+1	2-05-70	6 gpm. Casing 8 in., 0 to 50 ft.
Cusseta Headstart School	112		123	1957	Ballard and Son	664	d	56.26	2-03-87	
Bama Park	113		35	1960	Ballard and Son	503	d	12.4	11-07-69	

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Bama Park	114		203	1968	Graves Well Drilling Co.	525	d	--	--	
Sheriffs Assoc of Ala.	115		123	1973	Graves Well Drilling Co.	740	d	--	--	Girls Ranch.
Town of Auburn	116	LEER-2	140	1920	--	610	w	165	1965	Casing 10 in. to unknown depth. Pumped at 65 gpm in 1968. Well flows when not pumped. Not used for drinking.
Town of Opelika	117	LEEJ-6	na	na	na	590	w	700 2,630 730	1968 10-31-1984 10-31-1985	Spring Villa Spring, back up source.
Beauregard Water Works	118	LEEQ-02	165	1981	Graves Well Drilling Co.	585	w	16	1981	Well no. 3. Casing 12 in., 0 to 82 ft; 8 in., 0 to 124 ft., screen 124 to 164 ft. Drawdown 26 ft. when pumped 24 hrs. at 300 gpm in 1980.
Beauregard Water Works	119		173	--	--	--	w	16.75	1975	Well no. 1. Casing 8 in., 0 to 30 ft.

Table 3.– Records of selected wells in Area 5–Continued

Well Owner	Well Number	GSA ID	Depth (feet)	Year drilled	Drilling contractor	Altitude	Aquifer	Water level	Date measured	Well construction, yield, remarks
Beauregard Water Works	120	LEER-01	148	1980	Graves Well Drilling Co.	550	w	25.25	1980	Well no. 2. Casing 12 in., 0 to 108 ft. Screen 108 to 148 ft. Drawdown 17 ft. when pumped 48 hrs. at 300 gpm in 1980.
Smiths Water Authority	121	LEEY-01	252	1974	Ballard and Son	245	w	--	--	Ennis well. Casing 8 in. to 60 ft.
Smiths Water Authority	122		350	--	Robinson	360	w	--	--	Ross well. Smiths Water Authority is a Lee County Water Authority, but this well is in Russell County.
Smiths Water Authority	123		350	--	Robinson	361	w	265.4	2-04-86	Observation well near Ross well.
Auburn Exp. Station	124		157	1966	Bozeman and Son	480	w	57.83	5-00-85	

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.

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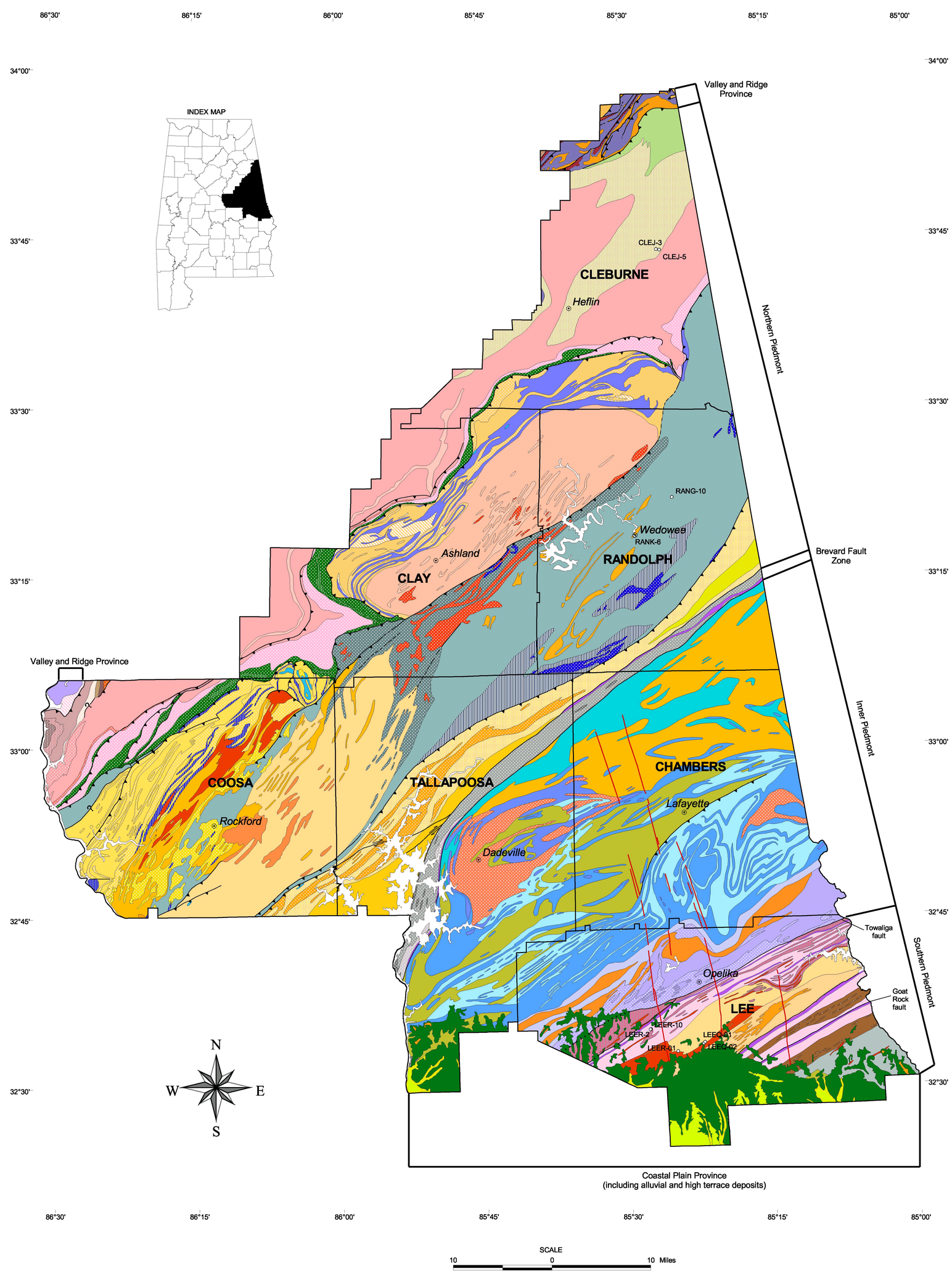


EXPLANATION

RANG-10 Public water supply well and number

Geologic contact

Thrust or reverse fault, sawteeth on upper plate, dashed where inferred, dotted where concealed

Fault, arrows show relative horizontal movement

Nature of contact uncertain

Fault for which sense of movement is unknown

County Seat

	SYSTEM	SERIES	GROUP	GEOLOGIC UNIT
Cenozoic	Quaternary	Holocene		Alluvial and low terrace deposits
		Pleistocene		High terrace deposits

COASTAL PLAIN PROVINCE

Mesozoic	Cretaceous	Upper		Eutaw Formation
			Tuscaloosa	Tuscaloosa Group undifferentiated

VALLEY AND RIDGE PROVINCE

Paleozoic	Mississippian	Parkwood Formation and Floyd Shale undifferentiated
	Ordovician	Newala Limestone
	Cambrian-Ordovician	Knox Group undifferentiated
	Cambrian	Conasauga Formation
		Rome Formation
		Shady Dolomite
		Chilhowee Group undifferentiated
		Weisner and Wilson Ridge Formations undifferentiated
		Nichols Formation
		Cochran Formation

NORTHERN PIEDMONT
PIEDMONT PROVINCE
LOW-GRADE METAMORPHIC ROCKS

	GROUP OR COMPLEX	
Precambrian to Paleozoic		Hillabee Greenstone
		Unnamed unit of quartz dacite in Hillabee Greenstone
	Talladega Group	Jemison Chert and Chulafinnee Schist undifferentiated
		Butting Ram Sandstone
		Lay Dam Formation
		Unnamed diamictite facies of Lay Dam Formation
		Cheaha Quartzite Member of Lay Dam Formation
		Heflin Phyllite
	Sylacauga Marble Group	Gooch Branch Chert
		Shelvin Rock Church Formation
		Fayetteville Phyllite
		Jumbo Dolomite
	Kahatchee Mountain Group	Wash Creek Slate
		Kalona Quartzite Member of Wash Creek Slate
		Stumps Creek Formation
		Waxahatchee Slate
	HIGH-GRADE METAMORPHIC AND IGNEOUS ROCKS	
	Higgins Ferry Group	Unnamed unit of biotite gneiss
		Unnamed unit of graphitic quartzite
		Unnamed unit of garnet quartzite
	Poe Bridge Mountain Group	Unnamed unit of graphite schist
		Unnamed unit of roscoelite-graphite schist
		Unnamed unit of garnet quartzite
	Hatchet Creek Group	Pinchoulee Gneiss
		Hanover Schist
	Mad Indian Group	Unnamed unit of biotite gneiss
		Unnamed unit of graphite schist
	Wedowee Group	Wedowee Group undifferentiated
		Hackneyville Schist
		Cornhouse Schist
	Emuckfaw Group	Emuckfaw Group undifferentiated
		Glenloch Schist
	MAFIC AND ULTRAMAFIC ROCKS	
		Mitchell Dam Amphibolite
		Ketchepedrakee Amphibolite
		Beaverdam Amphibolite
		Ultramafic rock
	INTRUSIVE ROCKS	
		Elkahatchee Quartz Diorite Gneiss
		Rockford Granite
		Hissop Granite
		Almond Trondhjemite
		Zana Granite
		Kowaliga Gneiss
		Bluff Springs Granite
	BREVARD FAULT ZONE	
	Jacksons Gap Group	Jacksons Gap Group undifferentiated
		Unnamed unit of phyllite
		Tallassee Metaquartzite
	INNER PIEDMONT HIGH-GRADE METAMORPHIC AND IGNEOUS ROCKS	
	Dadeville Complex	Agricola Schist
		Ropes Creek Amphibolite
		Waresville Schist
		Waverly Gneiss
		Mafic and ultramafic rock
		Camp Hill Granite Gneiss
		Rock Mills Granite Gneiss
	Opelika Complex	Loachapoka Schist
		Auburn Gneiss
		Unnamed unit of muscovite-biotite schist in Auburn Gneiss
		Bottle Granite
	SOUTHERN PIEDMONT HIGH-GRADE METAMORPHIC AND IGNEOUS ROCKS	
	Pine Mountain Group	Manchester Schist
		Chewacla Marble
		Hollis Quartzite
	Wacoochee Complex	Halawaka Schist
		Whatley Mill Gneiss
		Phelps Creek Gneiss
		Motts Gneiss
		Unnamed unit of mylonitic gneiss and amphibolite in Motts Gneiss
		Moffits Mill Schist
	Uchee Complex	Phenix City Gneiss
		Hospilika Granite
	MYLONITIC AND CATACLASTIC ROCKS IN THE BREVARD ZONE, TOWALIGA AND GOAT ROCK FAULT ZONES	
		Mylonite and blastomylonite
		Blastomylonite
		Crushed schistose rock
	INTRUSIVE ROCKS	
Mesozoic Erathem		Diabase dikes

STATE OF ALABAMA
GEOLOGICAL SURVEY

DONALD F. OLTZ
State Geologist

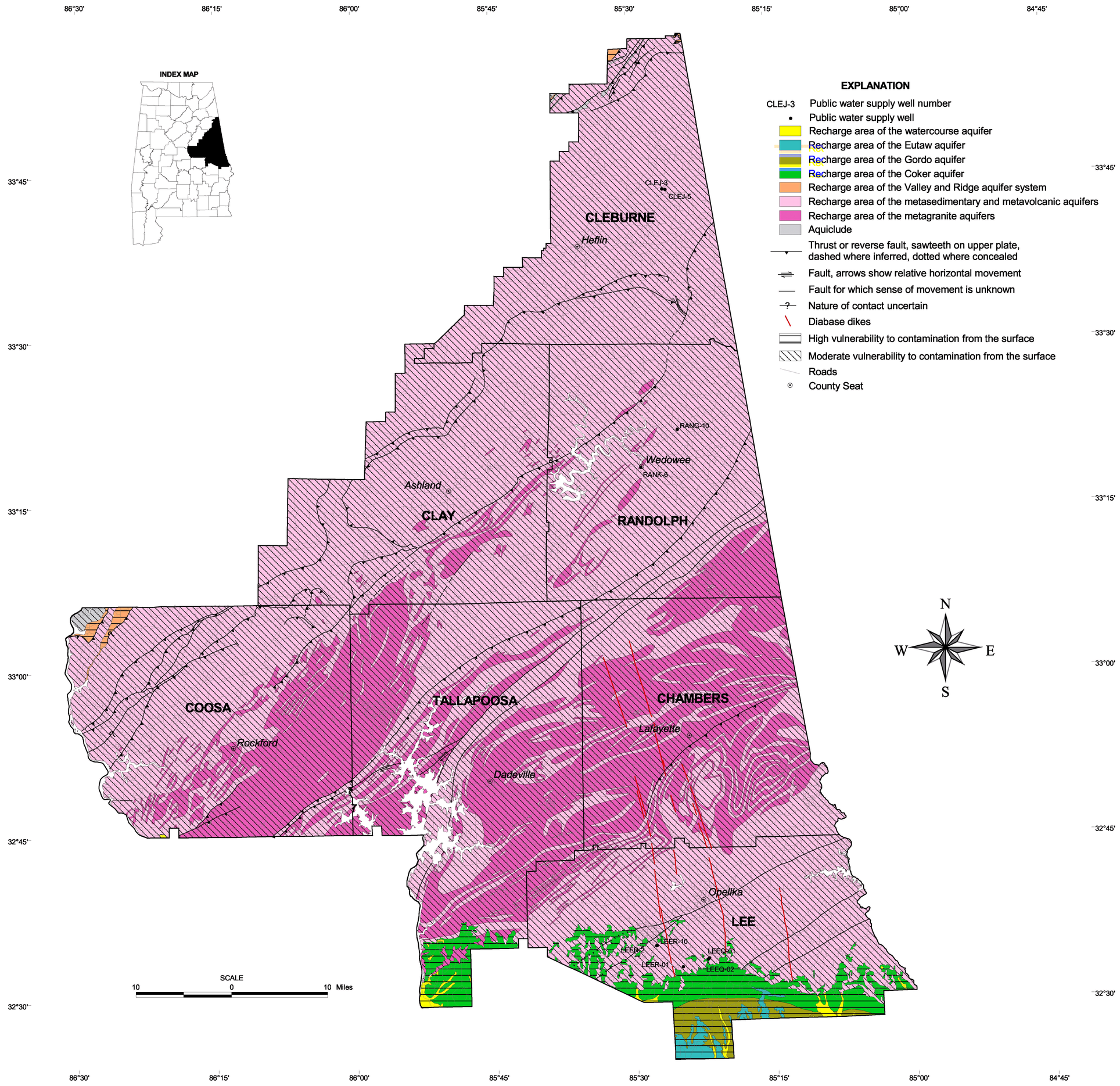
GEOLOGY AND LOCATIONS OF PUBLIC WATER SUPPLY WELLS IN AREA 5

Compiled by Lewis S. Dean

Geology modified from Osborne and others (1988)

2000

GIS by Ruth T. Collier and Douglas R. Taylor



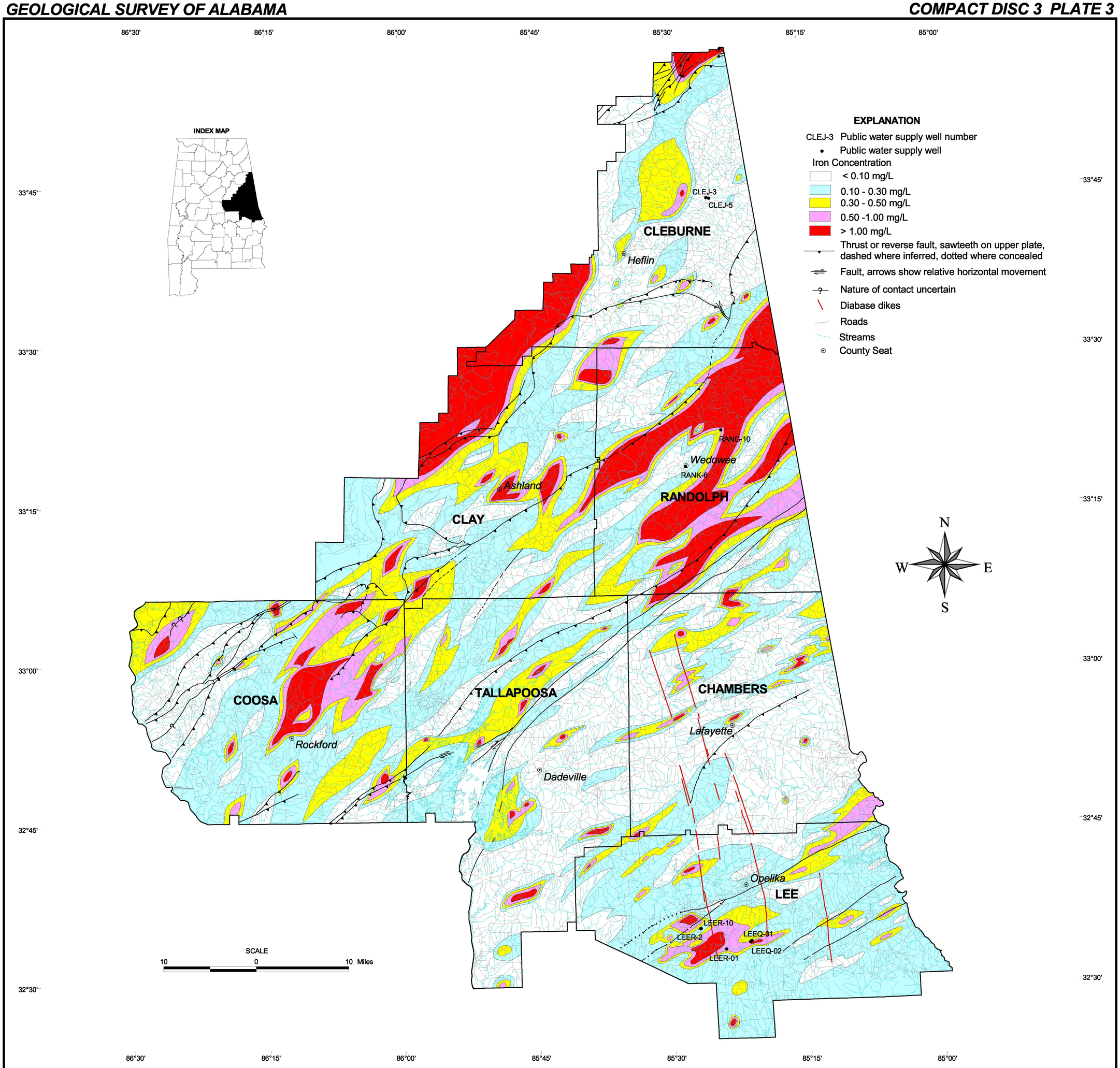
AQUIFER RECHARGE AREAS, AREAS VULNERABLE TO CONTAMINATION FROM THE SURFACE, AND LOCATIONS OF PUBLIC WATER SUPPLY WELLS IN AREA 5

By David C. Kopaska-Merkel
(modified in part from Moore, 1998)

2000

STATE OF ALABAMA
GEOLOGICAL SURVEY
DONALD F. OLTZ
State Geologist

GIS by Ruth T. Collier and Douglas R. Taylor



CONCENTRATION OF IRON IN SHALLOW GROUND WATER IN AREA 5

By David C. Kopaska-Merkel

2000

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DONALD F. OLTZ
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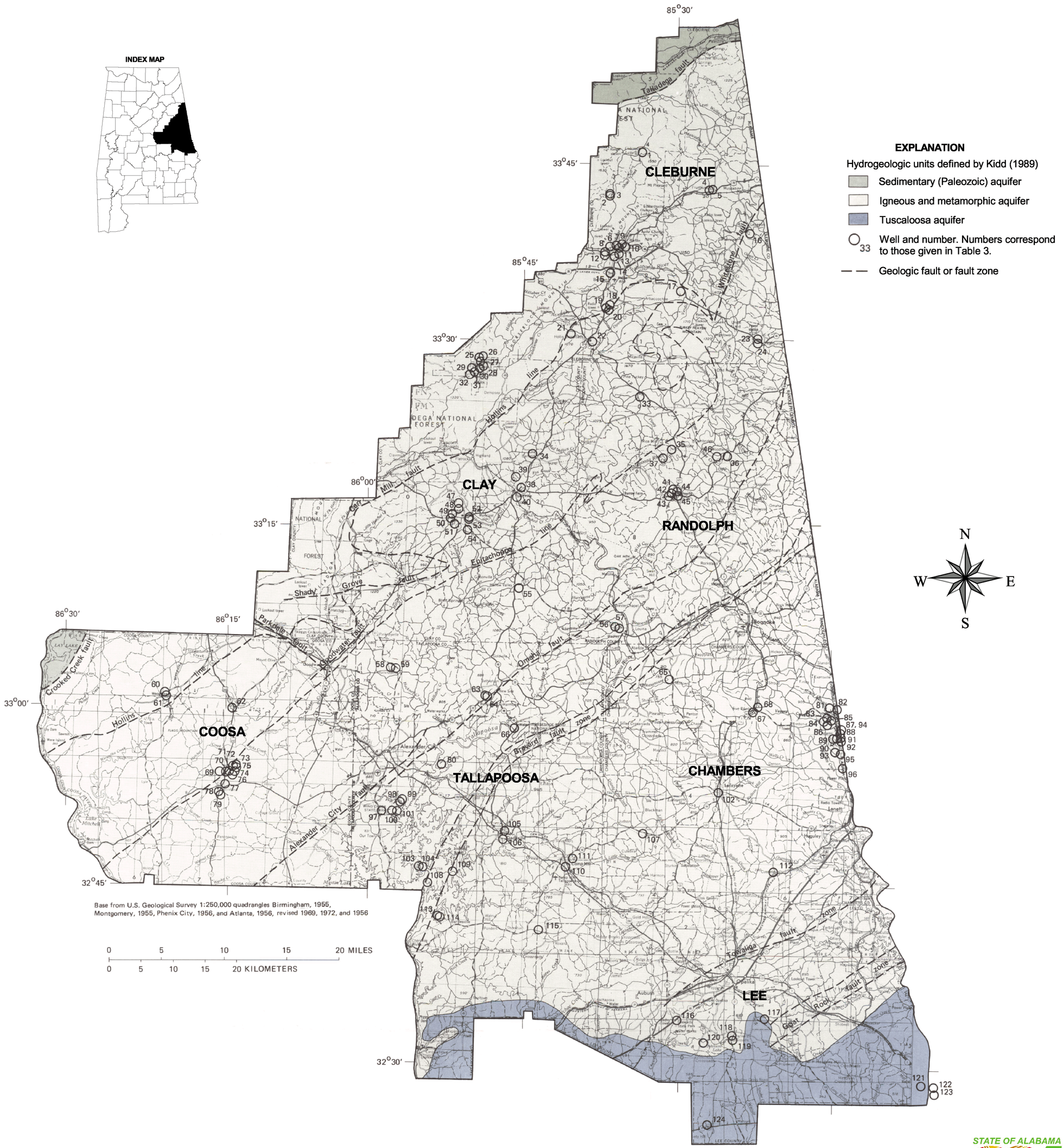

LOCATIONS OF SELECTED WELLS IN AREA 5

From Kidd, 1989

2000

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