GEOHYDROLOGY OF THE PRINCIPAL AQUIFERS IN BUTLER COUNTY, ALABAMA

By John C. Scott and Riley H. Cobb

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Table 1. Records of selected wells in Butler County, Alabama

CONVERSION FACTORS, ABBREVIATED WATER-QUALITY UNITS, AND VERTICAL DATUM

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
	Area	
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
acre	4,047	square meter
	Flow	
gallon per minute (gal/min)	0.06308	liter per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second
	Temperature	
degree Fahrenheit (°F)	°C = 5/9 x (°F-32)	degree Celsius
	Transmissivity	
square foot per day [$(ft^3/d)/ft^2$]ft	0.09290	square meter per day

Additional abbreviations

foot per mile (ft/mi)
inches per year (in/yr)
million gallons per year (Mgal/yr)
billion gallons per year (Ggal/yr)
milligrams per liter (mg/L)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

Butler County, in south-central Alabama, depends entirely on ground water for public and domestic water supplies. The county includes an area of about 780 square miles, and has a population of about 21,680. The county is primarily rural, but public water supplies are available in most areas. The cities of Georgiana, Greenville, and McKenzie have municipal water systems, and most rural areas have access to water from the Butler County Water Authority system.

The major aquifers underlying Butler County are the Nanafalia-Clayton aquifer in sediments of Tertiary age and the Providence-Ripley aquifer sediments of Cretaceous age. These aquifers dip south-southwest about 25 to 40 feet per mile. The Nanafalia-Clayton aquifer crops out across the central part of Butler County, and is a major aquifer in the southern part of the county. The Providence-Ripley aquifer crops out across the southern part of Lowndes County, which borders Butler County on the north, and the northeastern corner of Butler County. The Nanafalia-Clayton aquifer is used for public water supply by the town of McKenzie and is used extensively in central and southern parts of the county for domestic water supplies. The Providence-Ripley aquifer is used for public water supply by the cities of Georgiana and Greenville and the Butler County Water Authority, which supplies water to most rural parts of the county.

Best estimates, based on available data, indicate that annual recharge to the Nanafalia-Clayton aquifer greatly exceeds current annual withdrawals. A potentiometric map of the Nanafalia-Clayton aquifer indicates that the aquifer is only minimally stressed, and that water levels in wells completed in this aquifer have not changed substantially during the past 45 years.

Estimated annual recharge to the Providence-Ripley aquifer approximately equals current annual withdrawals. Comparison of a potentiometric map for the Providence-Ripley aquifer based on measurements made in the 1960's with a potentiometric map based on measurements made in 1989 indicates that the potentiometric surface in the vicinity of Greenville has declined more than 80 feet during the past 25 years. Published water-level data indicate that water levels in some wells at Greenville have declined about 140 feet since the mid-1940's.

Ground-water withdrawals from the Providence-Ripley aquifer in Butler County have increased from less than 1 million gallons per day in the 1940's to about 6 million gallons per day in 1990. Increased withdrawals from the aquifer and limited recharge may result in the necessity to develop an alternative source of water supply in the vicinity of Greenville in the near future.

INTRODUCTION

Butler County, Alabama, depends on ground water for public and domestic water supplies and obtains most of its water from two major aquifers. Withdrawals from one of these aquifers have increased substantially since the 1940's, and have resulted in a decline in the potentiometric surface of as much as 140 ft in the vicinity of Greenville. Local water managers, concerned about the ability of these aquifers to meet the growing demand for water, identified the need for additional information of the geohydrology of the area. To meet this need, the U.S. Geological Survey, in cooperation with the Butler County Water Authority and the Greenville Waterworks Board, conducted an investigation of the ground-water resources of Butler County during 1989-90. This report presents the results of that investigation and describes the geohydrology of the prinicpal aquifers in the county.

Description of the Area

Butler County (fig. 1), in south-central Alabama, has a land area of about 780 mi^2, and had a population of 21,680 in 1980 (Alabama Department of Economic and Community Affairs, 1988). The county is mainly rural but public water supplies are available to most residents. The cities of Georgiana, Greenville, and McKenzie have municipal water systems. Most other parts of the county are supplied water by the Butler County Water Authority system.

Butler County is in the East Gulf Coastal Plain section of the Coastal Plains physiographic province. Most of the county is in the Southern Red Hills district of the East Gulf Coastal Plain (fig. 2). The northeastern corner of the county is in the Chunnennuggee Hills district, and the southernmost part is in the Lime Hills district. The Southern Red Hills district is a southward-sloping upland of moderate relief. The Chunnennuggee Hills district is a series of sand hills and cuestas developed on more-resistant sandstone, siltstone, and sand (fig. 2). The Lime Hills district consists of a rugged topography developed on more-resistant limestone and siltstone (Sapp and Emplaincourt, 1975).

Surface drainage for most of the county is southward through Pigeon, Persimmon, Panther, and Long Creeks and their tributaries (fig. 2). Drainage in the northwestern part of the county is northwestward through Cedar, Pine Barren, and Wolf Creeks and their tributaries (fig. 2). Average annual rainfall at Greenville is about 57 in. Average monthly rainfall ranges from 2.34 in. in October to 6.66 in. in March (National Oceanic and Atmospheric Administration, 1989). Average monthly temperatures range from about 46 °F in January to about 81 °F in July and August. The lowest temperature at Greenville in 1988 was 12 °F on February 7; the highest temperature was 100 °F on June 27.

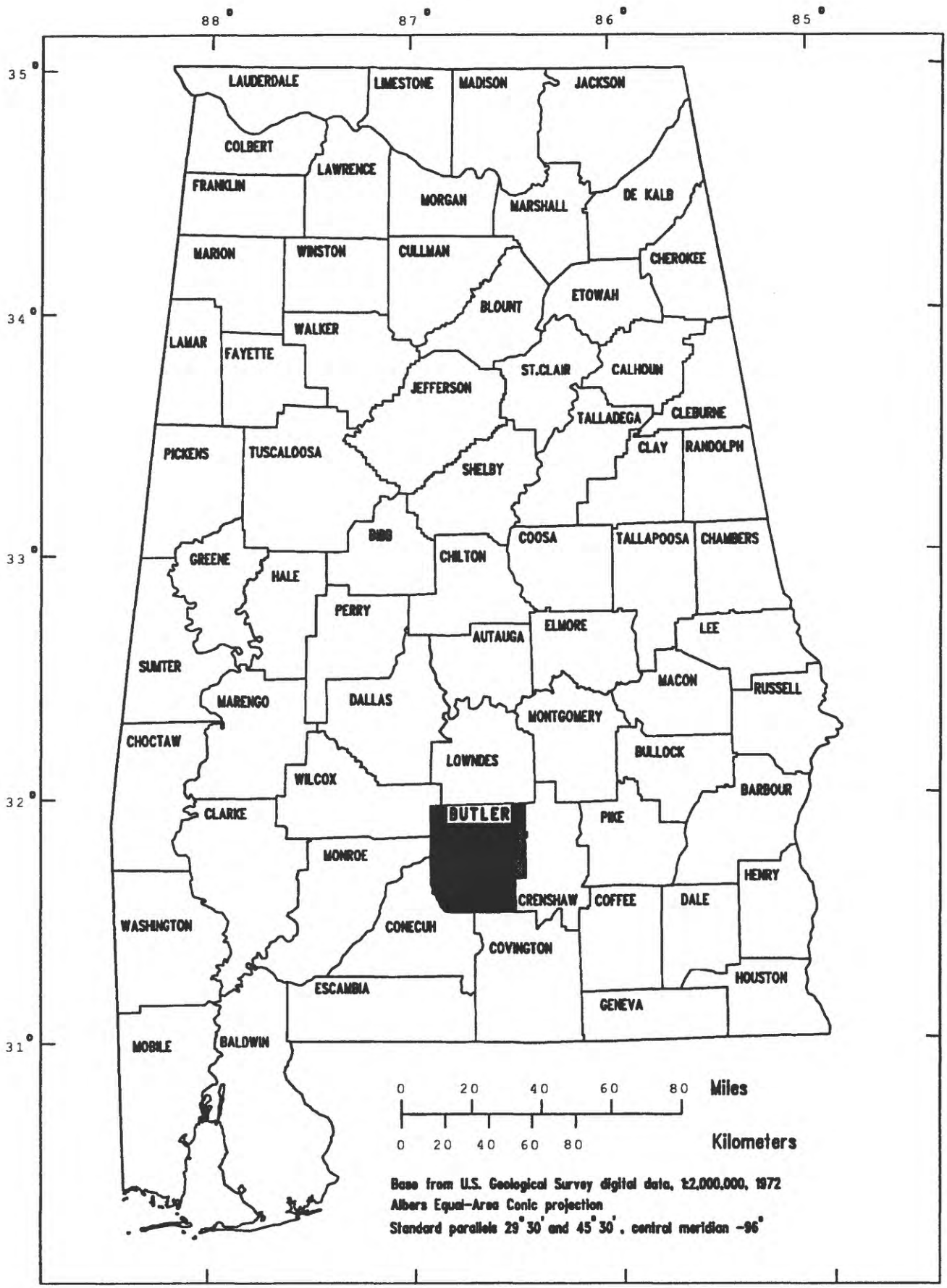


Figure 1.-- Location of Butler County.

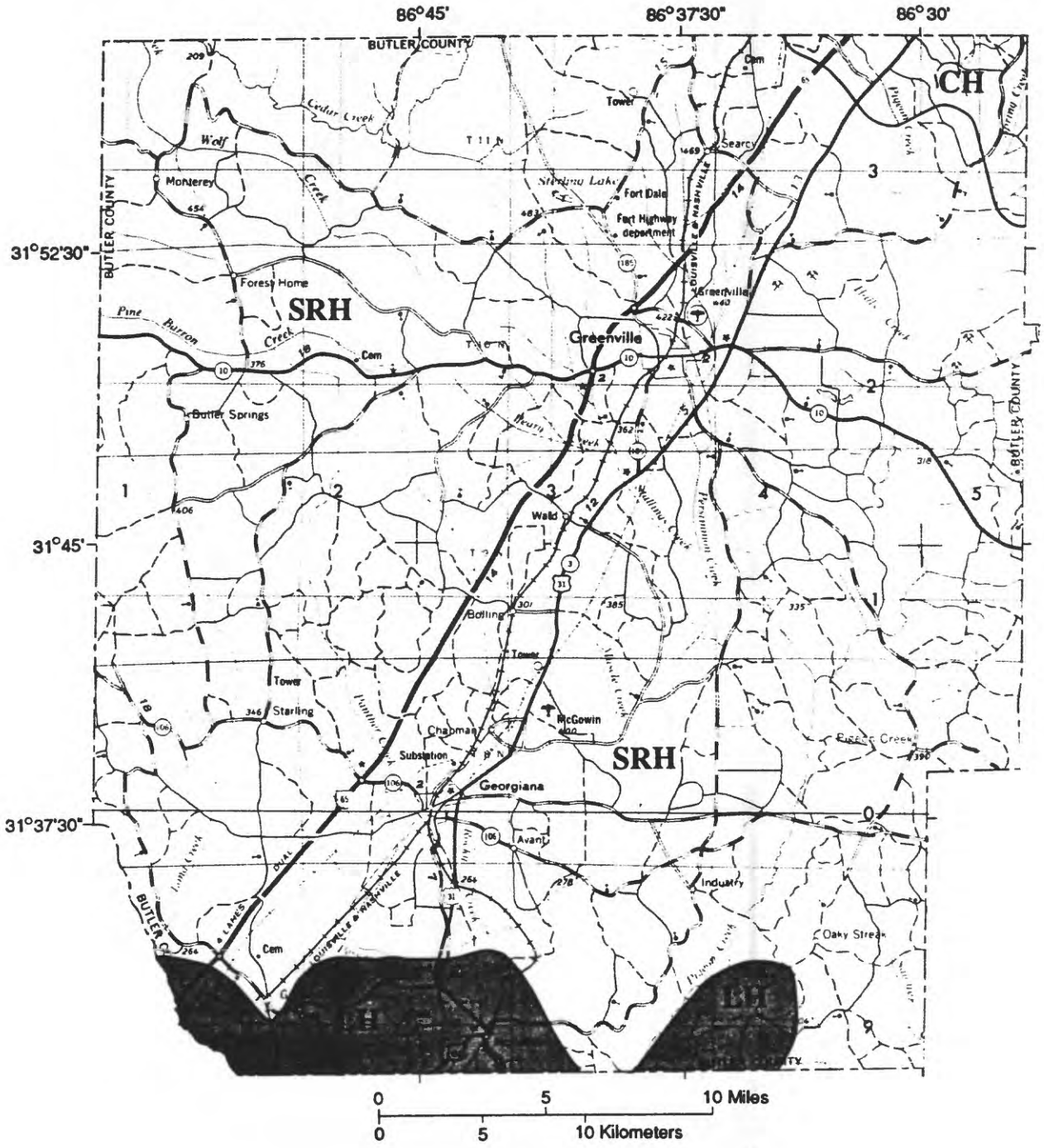


Figure 2.--Physiographic districts in Butler County.
(from Sapp and Emplaincourt, 1975)

Previous Investigations

Some of the earliest information on ground water in Butler County was collected as part of statewide ground-water investigations in the early 1900's (Smith, 1907). Other investigations that collected information on the geology and ground-water resources of the county include those documented reports and maps by Adams and others (1926), LaMoreaux (1948), Carter and others (1949), Newton and Toulmin (1966), Reed and others (1967), Reed and Newton (1967), Shamburger and Moore (1985), and Castleberry and others (1989).

Acknowledgments

The authors extend their appreciation to the people in Butler County who contributed information on wells and allowed access to wells for water-level measurements. Special appreciation is extended to Mr. Wilbur Nichols, former Manager of the Butler County water system; Mr. Grady Norrell, Chairman, and Ms. Velma Briggs, Secretary and Treasurer of the Greenville Waterworks and Sewer Board; Mr. Tim Waddle of Southern Engineering Company, consultants for the Butler County Water Authority; and Mr. Don Mills of Goodwyn, Mills, and Cawood, Inc., consultants for the Greenville Waterworks for their assistance and support during the investigation. Lastly, the authors wish to thank Mr. Charles Copeland, Geological Survey of Alabama, for examining drill cuttings from test wells in the county and identifying formation boundaries from the cuttings.

GEOHYDROLOGY

Butler County is underlain by geologic formations of Cretaceous, Tertiary, and Quaternary ages (fig.3). The Cretaceous and Tertiary formations strike generally east-southeastward across the county and dip south-southwestward 25 to 40 ft/mi. The Quaternary deposits consist of alluvium that underlies flood plains of larger streams in the county. These deposits generally dip toward the streams.

Cretaceous Formations

Cretaceous formations that underlie Butler County include, from oldest to youngest, the Coker and Gordo Formations of the Tuscaloosa Group, and the Eutaw Formation, the Mooreville and Demopolis Chalks, the Ripley Formation, the Prairie Bluff Chalk, and the Providence Sand of the Selma Group (fig. 3). The Coker, Gordo, and Eutaw Formations are major aquifers updip in Montgomery and northern Lowndes Counties (fig. 4), but available data indicate that the water in these aquifers is highly mineralized in Butler County and not suitable for human consumption.

The Mooreville and Demopolis Chalks overlie the Eutaw Formation and consist of 800 to 1,000 ft of chalk and calcareous clay (fig. 4). These formations are relatively impermeable, and are not sources of water supply. They confine the underlying Eutaw Formation and separate it from the overlying Ripley Formation.

The Ripley Formation overlies the Demopolis Chalk, and crops out across southern Lowndes and Montgomery Counties. The Ripley consists of fossiliferous, sparsely glauconitic and micaceous sand, calcareous clay, and calcareous sandstone. The unit ranges in thickness from less than 150 ft at outcrops in Lowndes County to more than 200 ft in central and southern Butler County. The Ripley Formation from south-central Montgomery County eastward consists of the lower Cusseta Sand Member and an upper unnamed member. The Cusseta Sand Member merges with the Demopolis Chalk in Montgomery County, and is not a recognizable unit at outcrops north of Butler County. However, the lower part of the Ripley in the subsurface in central and southern Butler County may be equivalent to the Cusseta Member, and may account for the additional thickness of the unit in those areas.

The Ripley is a major aquifer from southeastern Alabama to western Wilcox County. Yields generally decrease to the west and, from Wilcox County westward, the unit is not a major aquifer. Wells developed in the Ripley produce 200 to 300 gal/min in the northern part of the county, and 500 gal/min or more in central and southern parts (see fig. 5 and table 1). In Butler County, the Ripley is the sole source of water supply for the cities of Greenville and Georgiana, and the Butler County water system.

The Prairie Bluff Chalk overlies the Ripley Formation and crops out across southern Lowndes and Montgomery Counties. The Prairie Bluff consists of 75 to 100 ft of calcareous sandy chalk and calcareous fossiliferous sandstone. The unit is relatively impermeable, and is not a source of water supply in Butler County.

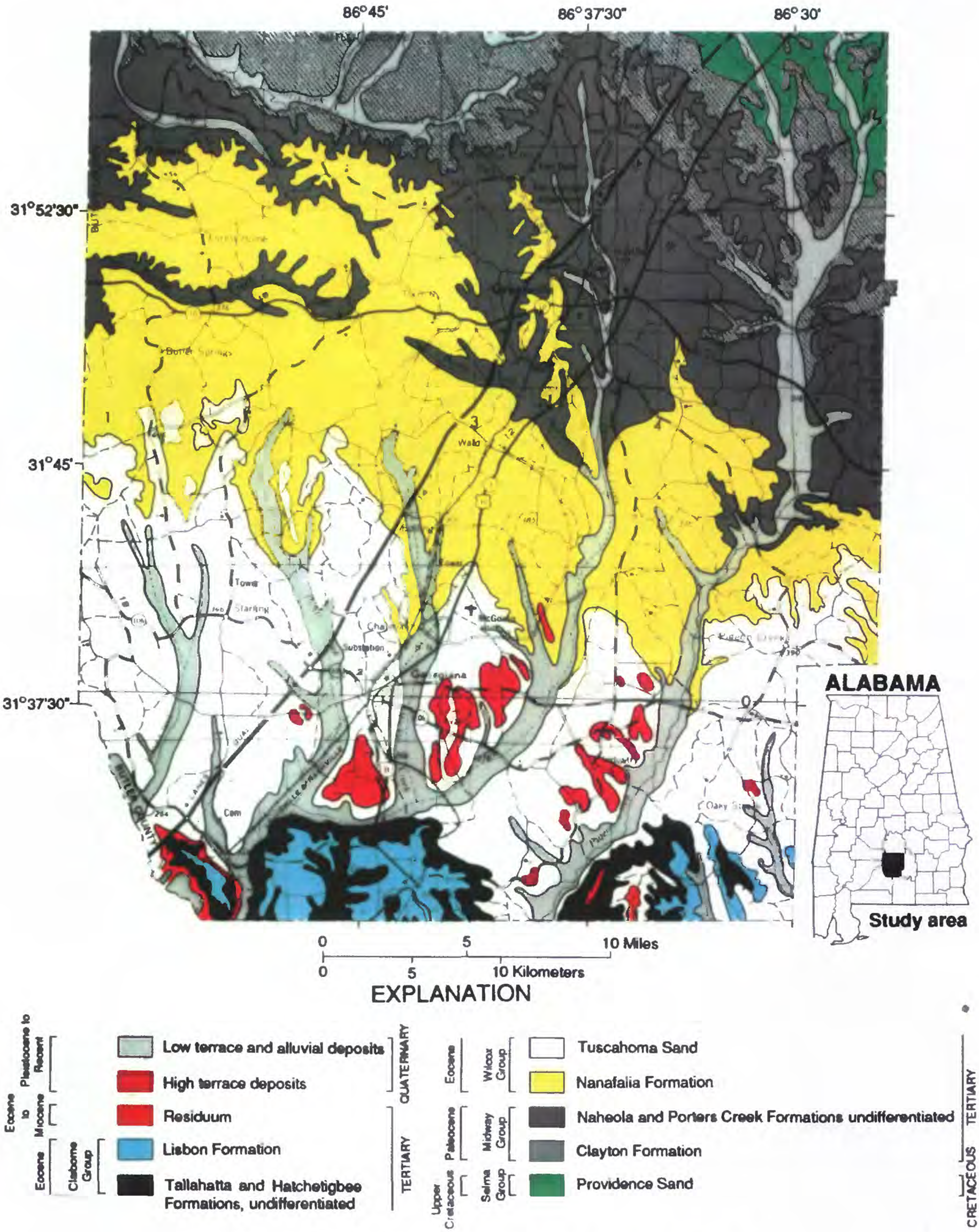


Figure 3.--Geologic map of Butler County, Alabama.

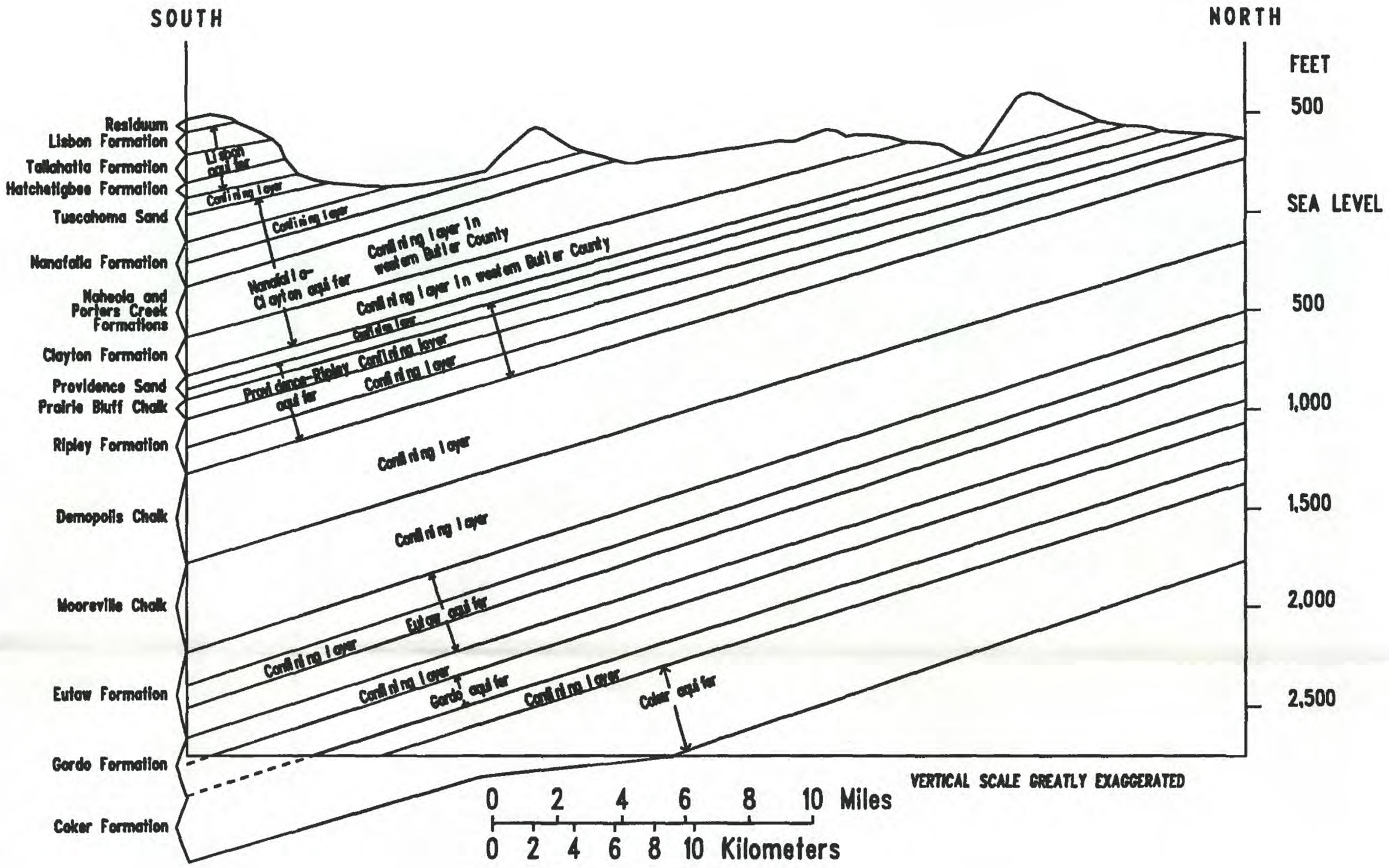
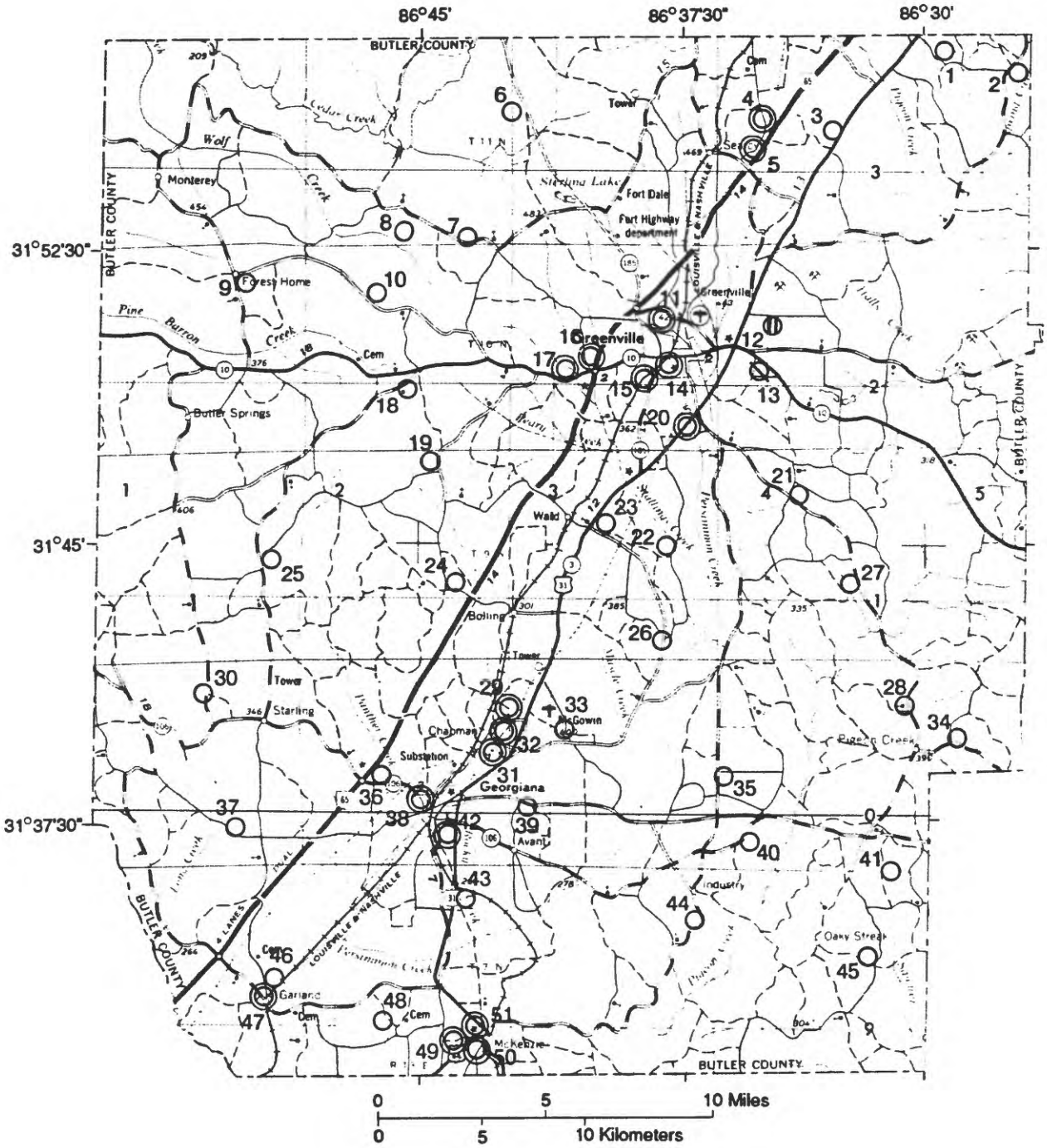


Figure 4.--Generalized north-south geohydrologic section through eastern Butler County.



EXPLANATION

- PUBLIC WATER SUPPLY OR INDUSTRIAL WELL
- DOMESTIC WELL
- TEST WELL
- OBSERVATION WELL

NOTE: Numbers correspond to well numbers in table 1.

Figure 5.--Locations of selected wells in Butler County.

The Providence Sand overlies the Prairie Bluff Chalk and crops out in the northeastern corner of Butler County, and in southern Lowndes and Montgomery Counties. The unit consists of the lower Perote Member and an upper unnamed member in eastern Alabama. The unit thins to the west, and is absent from south-central Lowndes County westward. The Perote Member consists of thin-bedded to laminated fine-grained sand, silt, and clay interbedded with calcareous sandstone and siltstone. The Perote is about 60 ft thick in southwestern Montgomery County (Knowles and others, 1963), and merges with the Prairie Bluff Chalk in southwestern Lowndes County. The upper unnamed member consists of fine- to coarse-grained sand interbedded with mottled reddish-purple and brown clay. The upper member is not mapped west of southern Montgomery County and northwestern Crenshaw County. The unit is about 85 ft thick in southern Montgomery County.

The Providence Sand is a major aquifer in southeastern Alabama, but is not a source of large water supplies in Butler County. Municipal wells at Greenville reported by Smith (1907) may have been developed in the Providence Sand. These wells, now abandoned, were about 200 ft deep and, reportedly, produced 75 to 100 gal/min. The Providence-Ripley aquifer in Alabama consists of sand zones in the Providence Sand and the underlying Ripley Formation.

Tertiary Formations

Tertiary formations that underlie Butler County include, from oldest to youngest, the Clayton Formation, the Naheola and Porters Creek Formations undifferentiated, the Nanafalia Formation, the Tuscahoma Sand, the Hatchetigbee Formation, the Tallahatta Formation, and the Lisbon Formation.

The Clayton Formation overlies the Providence Sand in the eastern part of Butler County and the Prairie Bluff Chalk in the western part. In western Butler County, the Clayton consists of relatively impermeable silty limestone and calcareous sandy clay. In the eastern part of the county, the unit consists of relatively pure limestone and a basal sand. The wells at the town of McKenzie may tap the Clayton in conjunction with the overlying Porters Creek and Nanafalia Formations (Castleberry and others, 1989). No other large-capacity wells are known to tap the Clayton in Butler County, but the Clayton is a potential source of large water supplies in the southeastern part of the county.

The Naheola and Porters Creek Formations undifferentiated overlie the Clayton Formation and crop out across northern and east-central parts of Butler County. The unit consists of carbonaceous sandy clay, micaceous clay and silt, clayey sand, and glauconitic sand. The unit contains sporadic lenses of limonitic iron ore, some of which have been strip-mined in Butler County. The upper part of the unit in Crenshaw County consists of relatively pure limestone. These beds extend westward in the subsurface and underlie the southeastern part of Butler County.

The Naheola-Porters Creek unit is a potential source of large water supplies in the southeastern part of Butler County. A well at the town of Dozier in southwestern Crenshaw County reportedly produces 600 gal/min from the Naheola-Porters Creek in conjunction with the underlying Clayton Formation (Castleberry and others, 1989).

The Nanafalia Formation overlies the Naheola-Porters Creek unit and crops out across the central part of Butler County. The Nanafalia consists of a basal gravelly sand (the Gravel Creek Sand Member) overlain by glauconitic sand beds (the Ostrea thirsae beds), which are overlain by calcareous clay, claystone, and calcareous sandstone (the Grampian Hills Member). The maximum thickness of the Nanafalia in Butler County is about 220 ft.

The gravelly sand and the glauconitic sand in the Nanafalia Formation comprise a major aquifer across south Alabama. The gravelly sand is absent in eastern Butler County, but is as much as 80 ft thick in the western part of the county (Reed and others, 1967). The glauconitic sand is 30 to 40 ft thick in Butler County (Reed and others, 1967). Wells at the town of McKenzie are screened in the Nanafalia aquifer. The city of Georgiana produced water from the Nanafalia aquifer until about 1965, but presently (1990) pumps exclusively from the Providence-Ripley aquifer.

The Nanafalia Formation and the underlying Porters Creek, Naheola, and Clayton Formations comprise the Nanafalia-Clayton aquifer in southern Butler County. Water-quality data indicate that water in the aquifer has excessive concentrations of iron at some places but, otherwise, the water is suitable for public water supplies. Test drilling, pumping, and water-quality analyses will be needed to evaluate the aquifer as a source of water supply.

The Tuscahoma Sand overlies the Nanafalia Formation, and crops out across central and southern parts of Butler County. The Tuscahoma consists of thin-bedded to laminated sandy, silty carbonaceous clay and fine- to coarse-grained fossiliferous sand. A basal sand bed 10 to 50 ft thick occurs sporadically across the county at the base of the formation. The total thickness of the unit in Butler County ranges from 220 to 350 ft.

The Tuscahoma Sand is not a major aquifer in Butler County. The unit is a source of domestic supplies in the southern part of the county. In areas where the basal sand is more than 25 ft thick, the unit may yield 100 gal/min or more. Water in the Tuscahoma is chemically suitable for most uses, but has iron concentrations exceeding 0.3 mg/L in some areas.

The Hatchetigbee Formation overlies the Tuscahoma Sand, and crops out across southernmost parts of Butler County. The Hatchetigbee consists of a basal glauconitic sand containing fossiliferous sandstone concretions and thin-bedded to massive clay. The unit ranges in thickness from 5 to 55 ft in Butler County. The Hatchetigbee is not a major aquifer in Butler County. The basal sand in the unit is a potential source of domestic supplies in southernmost parts of the county, but the water probably has excessive concentrations of iron.

The Tallahatta Formation overlies the Hatchetigbee Formation, and crops out across the southernmost part of Butler County. Outcrops of the Tallahatta and the overlying Lisbon Formation form a prominent cuesta from the town of Garland in southwestern Butler County through the town of McKenzie to the southeastern part of the county. The Tallahatta consists of clay and claystone and glauconitic sand and sandstone. The unit ranges in thickness from 80 to 100 ft in Butler County. The Tallahatta Formation is not a major aquifer in Butler County, but is a source of public and domestic water supplies downdip in Covington and Conecuh Counties.

The Lisbon Formation overlies the Tallahatta Formation, and crops out across the southernmost parts of Butler County. The Lisbon consists of fine- to coarse-grained sand and lenses of clay. The maximum thickness of the Lisbon in Butler County is about 80 ft; however, downdip in the subsurface the unit is as much as 250 ft thick. The Lisbon Formation is not a major aquifer in Butler County; however, downdip in Covington and Conecuh Counties the unit is a source of public water supplies.

Quaternary Terrace and Alluvial Deposits

Terrace and alluvial deposits of Quaternary age overlie older formations in, and adjacent to, flood plains of larger streams in Butler County. These deposits, which generally range in thickness from 1 to 30 ft, consist of gravel, sand, silt, and clay. The terrace and alluvial deposits are not a source of large water supplies in the county, but are a potential source of water for domestic and stock supplies.

HYDROLOGY OF THE NANAFALIA-CLAYTON AND PROVIDENCE-RIPLEY AQUIFERS

The major aquifers in Butler County are the Nanafalia-Clayton and Providence-Ripley aquifers. Most public water supplies in Butler County are pumped from the Providence-Ripley aquifer. The Nanafalia-Clayton aquifer is a potential source of public water supplies in the southern part of the county; however, excessive concentrations of iron in the water in some areas has apparently discouraged its use.

Source of Ground Water

All ground water in Butler County is derived from precipitation that falls within or directly north of the county. The average annual rainfall at Greenville is about 57 in.; the average at Montgomery, about 40 mi north of Greenville, is about 50 in. Most of the rainfall leaves the area as runoff through streams or as evapotranspiration. A small part of the rainfall infiltrates downward to recharge the aquifers.

Recharge and Discharge

The estimated annual recharge to the aquifers underlying Butler County is 3 to 4 in. (Castleberry and others, 1989). Expressed another way, the estimated annual recharge is about 81,500 to 108,500 gal/yr/acre of recharge area.

The recharge area for the Nanafalia-Clayton aquifer extends from the vicinity of Forest Home in northwestern Butler County southeastward through the central part of the county (fig. 6). The Nanafalia-Clayton recharge area generally ranges in width from 4 to 12 mi and averages about 7 mi; the length of outcrop across the county is about 30 mi. Therefore, the recharge area consists of about 134,400 acres. Using the estimates of recharge of 3 to 4 in/yr, the average annual recharge to the aquifer is 11 to 14 Ggal/yr or 30 to 40 Mgal/d. Estimated average withdrawals from the aquifer total about 2 Mgal/d or about 0.7 Ggal/yr.

Most of the recharge to the Nanafalia-Clayton aquifer is discharged as base flow to streams or through evapotranspiration. Based on estimates of recharge and withdrawals given above, only about 5 to 6.5 percent of the estimated recharge to the aquifer is being pumped from the aquifer. Based on low-flow (dry-weather flow) data for Persimmon and Pigeon Creeks, which flow southward across the recharge area of the aquifer, discharge from the aquifer to streams is about 2.6 Ggal/yr. Streamflow data also show that the low flow of streams is significantly higher in southeastern Butler County where the recharge area is widest (Hayes, 1978).

The recharge area for the Providence-Ripley aquifer, which is primarily in southern Lowndes County (fig. 6), is mainly on the northern slope of a northward-facing cuesta (escarpment). The recharge area is only about 1 mi wide and is on a relatively hilly terrain. Assuming a recharge area 1 mi wide and 30 mi long, the total recharge area for Butler County is about 19,200 acres. Using the estimated recharge rate of 3 to 4 in/yr, the average annual recharge to the aquifer is about 1.6 to 2.1 Ggal/yr. Estimated average withdrawals from the aquifer in Butler County total about 6 Mgal/d or about 2.2 Ggal/yr.

Surface drainage across most of the recharge area for the Providence-Ripley aquifer is northward to the Alabama River. Streamflow data for this area indicate that discharge from the aquifer to streams is only about 7 Mgal/yr.

Withdrawals

Withdrawals from the Nanafalia-Clayton aquifer in Butler County have remained relatively constant during the past 45 years. Wells developed in the aquifer at Georgiana are no longer used, and pumpage from the aquifer at McKenzie is less than 1 Mgal/d. Domestic withdrawals from the aquifer probably are less than they were 45 years ago, mainly because a large part of rural southern Butler County has access to public water supplies.

Withdrawals from the Providence-Ripley aquifer have increased significantly during the past 45 years. Average daily withdrawals for public water supplies totaled about 0.9 Mgal/d in the mid-1940's (Carter and others, 1949). Present (1990) average withdrawals are estimated to be about 6 Mgal/d.

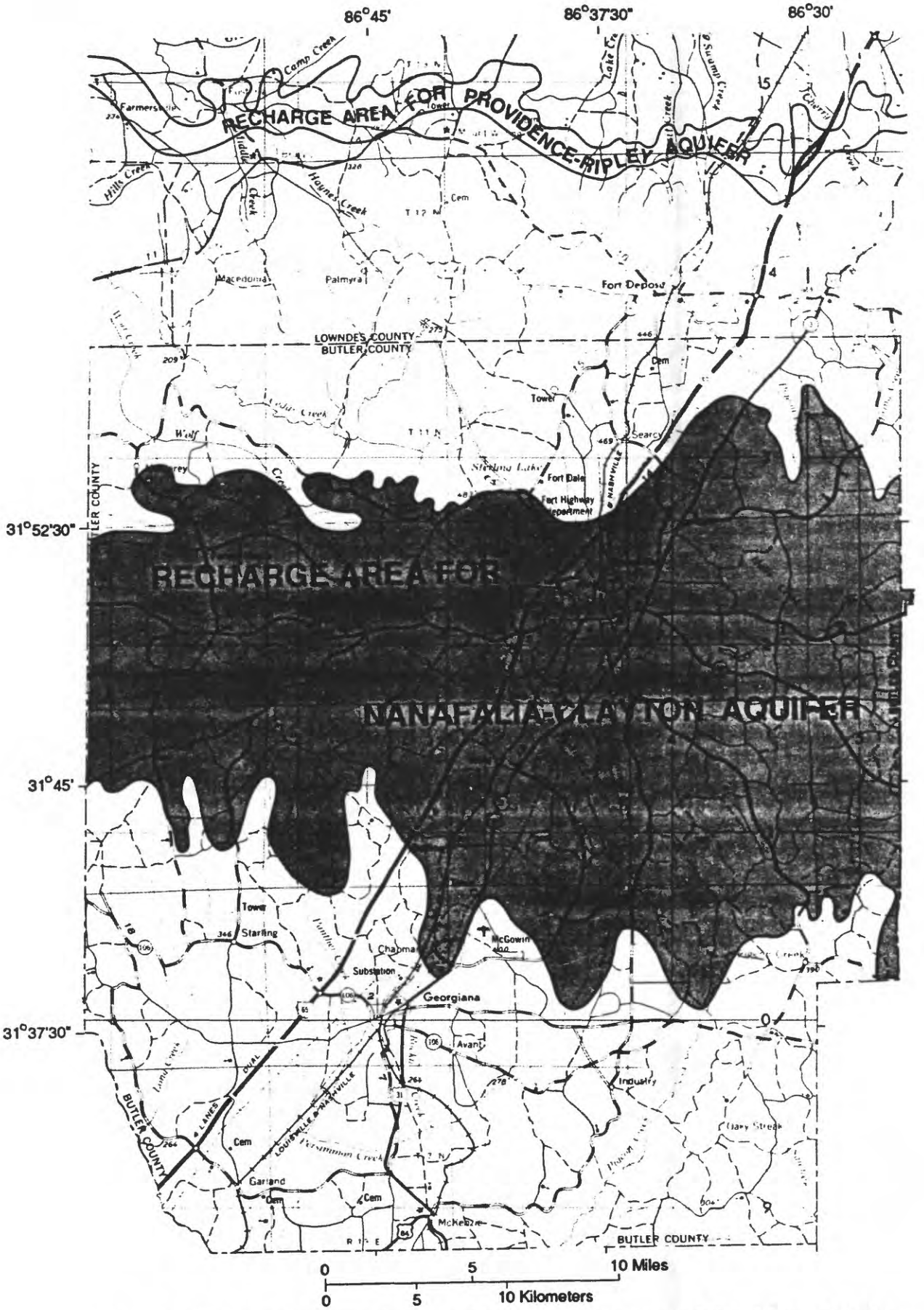


Figure 6.--Recharge areas for the Nanafalia-Clayton and Providence-Ripley aquifers in Butler County.

Aquifer Tests

A capacity test in Butler County test well 3 (well 20,table 1), screened in the Providence-Ripley aquifer was made on January 2 and 3, 1990. The well was pumped at 805 gal/min for 1,800 minutes; drawdown in the water surface in the well during the pumping period was 123.7 ft. The transmissivity of the aquifer, based on the test and using the Jacob time-drawdown equation, was 2,100 $[(ft^3/d)/ft^2]ft$. A 14-day capacity test was made in Butler County test well 3 from May 23 to June 6, 1990. Total drawdown in the water surface was 107.1 ft while pumping 650 gal/min. Using data from the pumping well, the transmissivity of the aquifer was 1,990 $[(ft^3/d)/ft^2]ft$.

Fluctuations of the Potentiometric Surface

The potentiometric surfaces (water levels) of aquifers in Butler County fluctuate in response to seasonal and long-term variations in recharge from rainfall, and to withdrawals from the aquifers. The potentiometric surface in an unstressed aquifer (no large withdrawals) generally is highest in April and lowest in October or November. Extended droughts may affect when the annual high or low water surface occurs. The potentiometric surface in a stressed aquifer responds to the amount and duration of withdrawals in addition to annual recharge. In areas where large, systematic withdrawals are made, the effect of the withdrawals on the potentiometric surface may be so dominant that the effects from variations in recharge can not be detected.

The potentiometric surface of the Nanafalia-Clayton aquifer in Butler County fluctuates mainly in response to recharge (fig. 7). Comparison of water-level measurements made in the 1960's with measurements made in 1989-90 indicate that the configuration of the potentiometric surface has not changed substantially during the period. A decline of about 50 ft in the water surface has occurred in the vicinity of McKenzie. This decline has primarily resulted from increased pumpage at McKenzie and, possibly, from pumpage in northern Covington and southwestern Crenshaw Counties.

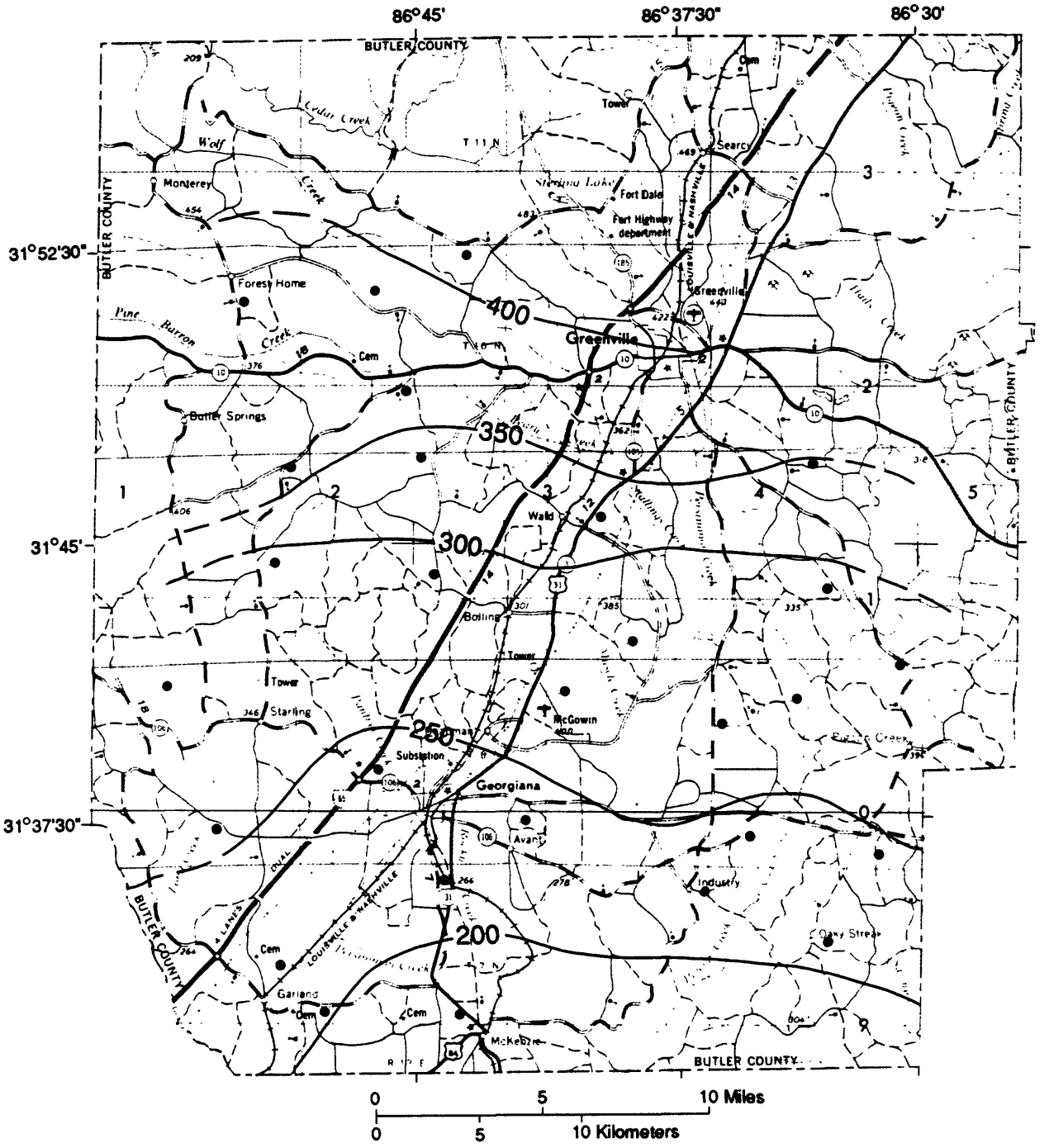
The potentiometric surface of the Providence-Ripley aquifer has been substantially affected by withdrawals during the past 50 years. According to LaMoreaux (Carter and others, 1949), the potentiometric surface of the aquifer at Greenville was more than 200 ft above sea level in 1946. The potentiometric surface had declined to about 140 ft above sea level in 1964 (fig. 8), and was about 60 ft above sea level in the vicinity of Greenville in 1989 (fig. 9). The potentiometric surface has declined more than 100 ft in the vicinity of Georgiana since 1964.

Effects of Withdrawals on the Aquifer Systems

Total average withdrawals from the Nanafalia-Clayton aquifer in Butler County are estimated to be less than 1 Mgal/d. These withdrawals have had little effect on the aquifer, except in the vicinity of McKenzie where a decline in the potentiometric surface of about 50 ft has occurred since 1965.

Withdrawals from the Providence-Ripley aquifer in Butler County have increased from less than 1 Mgal/d in the mid-1940's to about 6 Mgal/d in 1990. These withdrawals have resulted in an extensive depression in the potentiometric surface that is centered in the vicinity of Greenville. The potentiometric surface in the aquifer at Greenville has declined at an average rate of about 10 ft/yr during the past 10 years (see well 17, table 1). If this decline continues at a similar rate during the next 10 years, withdrawals from public water-supply wells in the vicinity of Greenville will have to be significantly reduced, or an alternate source of water supply developed.

Alternate sources of water are the Nanafalia-Clayton aquifer in central and southern parts of the county and Pigeon Creek south of Alabama Highway 10. Wells developed in the Nanafalia-Clayton aquifer will probably produce 700 gal/min or more in the southeastern part of the county, and 300 gal/min or more in the south-central and southwestern parts of the county. The 10-year 7-day low flow for Pigeon Creek at Alabama Highway 106 is about 10 Mgal/d; the 2-year (median) 7-day low flow is about 20 Mgal/d (Hayes, 1978).

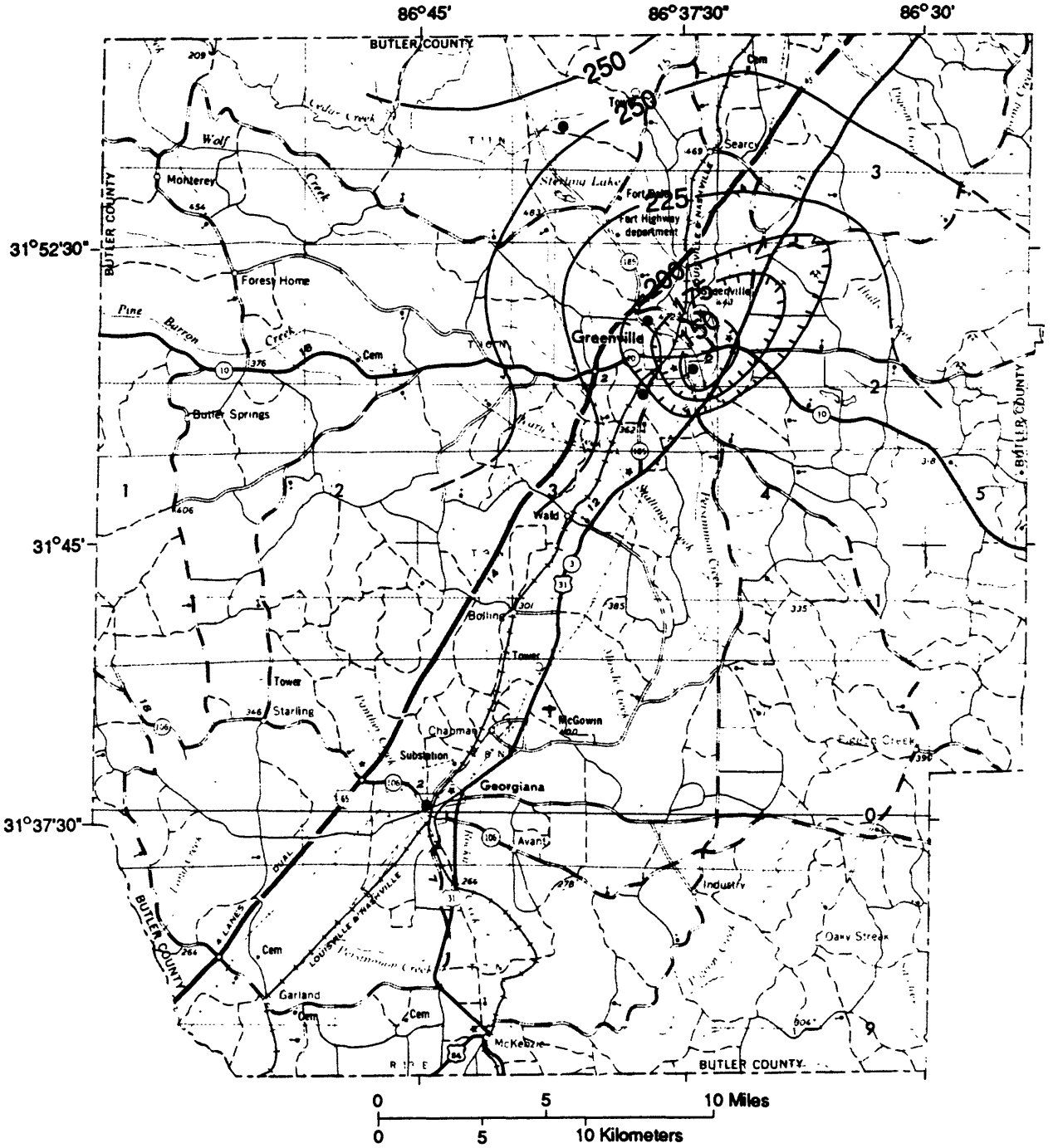


EXPLANATION

— POTENTIOMETRIC CONTOUR--Shows the potentiometric surface for the Nanafalia-Clayton aquifer in Butler County. Dashed where approximately located. Contour interval 50 feet. Datum is sea level.

• Well in which water level was measured in 1989.

Figure 7.--Potentiometric surface of the Nanafalia-Clayton aquifer in Butler County, 1989.



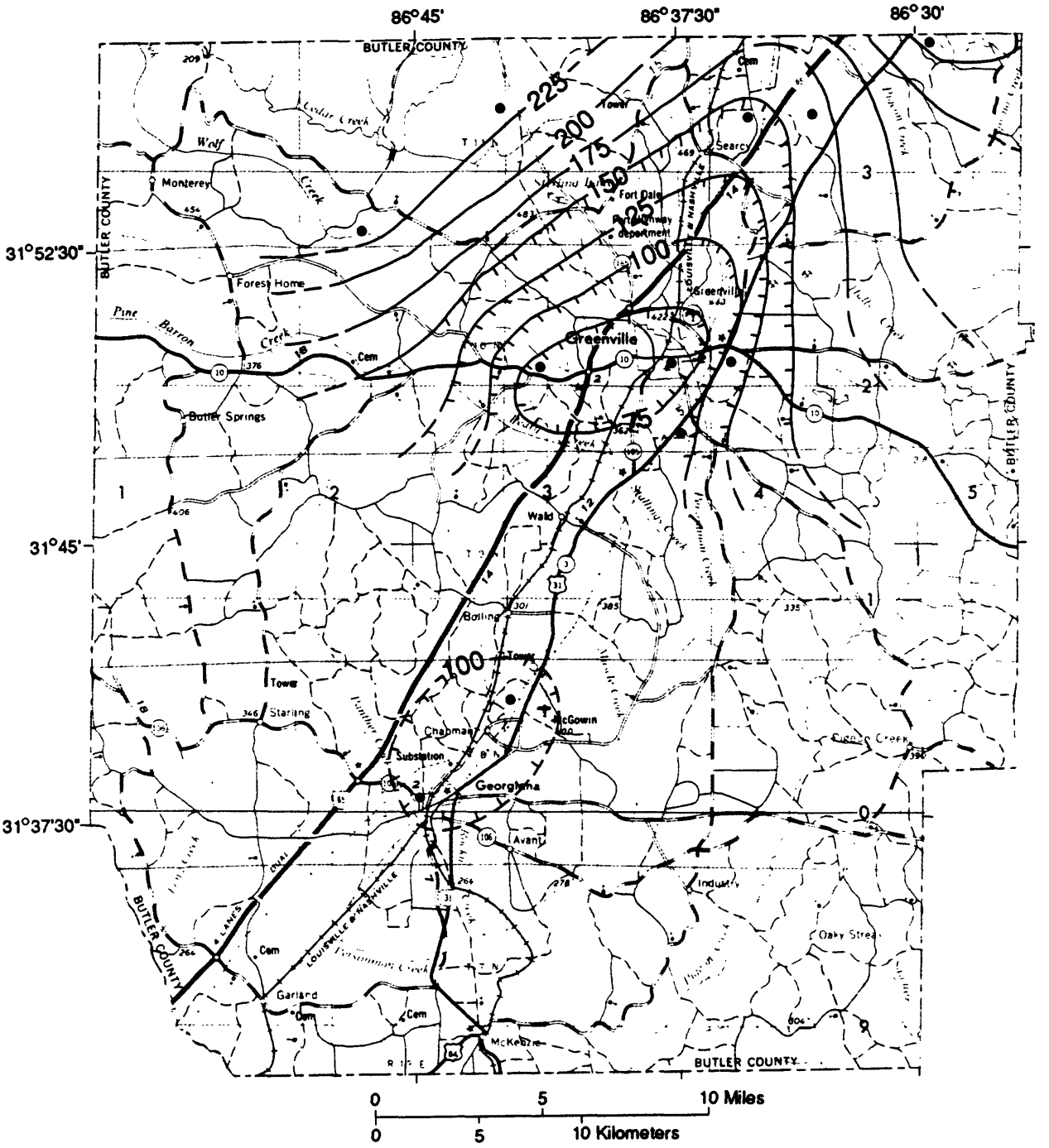
EXPLANATION

— POTENTIOMETRIC CONTOUR--Shows the potentiometric surface for the Providence-Ripley aquifer in Butler County. Dashed where approximately located. Contour interval 25 feet. Datum is sea level.

—ᵀᵀ— Hachures indicate depressions.

• Well in which water level was measured in 1964-65.

Figure 8.--Potentiometric surface of the Providence-Ripley aquifer in Butler County, 1964-65.



EXPLANATION

— POTENTIOMETRIC CONTOUR--Shows the potentiometric surface for the Providence-Ripley aquifer in Butler County. Dashed where approximately located. Contour interval 25 feet. Datum is sea level.

— Hachures indicate depressions.

• Well in which water level was measured in 1989.

Figure 9.--Potentiometric surface of the Providence-Ripley aquifer in Butler County, 1989.

SUMMARY

Butler County depends entirely on ground water for public and domestic supplies. Major aquifers underlying the county consist of the Nanafalia-Clayton aquifer in sediments of Tertiary age and the Providence-Ripley aquifer in sediments of Cretaceous age.

The Nanafalia-Clayton aquifer is a major aquifer in the southern part of the county, but is used for public water supply only by the town of McKenzie. The aquifer is used extensively in central and southern parts of the county for domestic water supplies.

The Providence-Ripley aquifer is a major aquifer in all but the northernmost part of Butler County. The cities of Greenville and Georgiana and the Butler County Water Authority, which supplies water to most rural parts of the county, use the Providence-Ripley aquifer exclusively for sources of water supply.

The major aquifers in Butler County are recharged by precipitation. The recharge area for the Nanafalia-Clayton aquifer extends from the vicinity of Forest Home in northwestern Butler County southeastward through the central part of the county. The recharge area extends for about 30 mi across the county, and has an average width of about 7 mi. The average recharge to the aquifer is estimated to be about 11 to 14 Ggal/yr. Estimated average withdrawals are about 0.7 Ggal/yr.

The recharge area for the Providence-Ripley aquifer extends across southern Lowndes County and the northeastern corner of Butler County. The effective recharge area of the aquifer for Butler County is about 30 mi long and about 1 mi wide. The average recharge to the aquifer is estimated to be about 1.6 to 2.1 Ggal/yr. Estimated withdrawals in 1990 are estimated to be about 2.2 Ggal/yr.

Withdrawals from the Nanafalia-Clayton aquifer have remained fairly constant during the past 45 years. The potentiometric surface of the aquifer has declined slightly in the vicinity of McKenzie, where the only public water supply tapping the aquifer in Butler County is located. Access to the rural public water supply in the county has probably resulted in a decrease in pumpage from the aquifer for domestic supplies.

Withdrawals from the Providence-Ripley aquifer have increased from less than 1 Mgal/d in the 1940's to about 6 Mgal/d in 1990. This increase in withdrawals has resulted in a decline in the potentiometric surface in the aquifer of more than 140 ft at Greenville. If withdrawals increase over the next 10 years at the same rate they have increased during the last 10 years, it may be necessary to develop an alternative source of water supply in the vicinity of Greenville.

SELECTED REFERENCES

Adams, G.I., Butts, Charles, Stephenson, L.W., and Cooke, C.W., 1926, Geology of Alabama: Geological Survey of Alabama Special Report 14, 312 p, 97 pls.

Alabama Department of Economic and Community Affairs, 1988, Alabama County data book 1987, 12th edition, 84 p.

Carter, R.W., Williams, M.R., LaMoreaux, P.E., and Hastings, W.W., 1949, Water resources and hydrology of southeastern Alabama: Geological Survey of Alabama Special Report 20, 265 p.

Castleberry, R.D., Moreland, R.S., and Scott, J.C., 1989, Geohydrology and susceptibility of major aquifers to surface contamination in Alabama; area 11: U.S. Geological Survey Water-Resources Investigations Report 88-4107, 47 p.

Hayes, E.C., 1978, 7-day low flows and flow duration of Alabama streams through 1973: Geological Survey of Alabama Bulletin 113, 163 p.

Knowles, D.B., Reade, H.L., and Scott, J.C., 1963, Geology and ground-water resources of Montgomery County, Alabama: U.S. Geological Survey Water-Supply Paper 1606, 76 p.

LaMoreaux, P.E., 1948, Fluoride in ground water of the Tertiary area of Alabama: Geological Survey of Alabama Bulletin 59, 77 p.

Newton, J.G., and Toulmin, L.D., 1966, Profile showing geology along U.S. Highway 31 from Logan, Lowndes County, to McKenzie, Butler County, Alabama: Geological Survey of Alabama Special Map 41.

National Oceanic and Atmospheric Administration, 1989, Climatological data annual summary, Alabama, 1988, v. 94, no. 13, 31 p.

Reed, P.C., and Newton, J.G., 1967, Geologic map of Butler County, Alabama: Geological Survey of Alabama Special Map 56.

Reed, P.C., Scott, J.C., Golden, H.G., and Avrett, J.R., 1967, Water availability map of Butler County, Alabama: Geological Survey of Alabama Special Map 57.

Sapp, C.D., and Emplaincourt, Jacques, 1975, Physiographic regions of Alabama: Geological Survey of Alabama Special Map 168.

Shamburger, V.M., and Moore, J.D., 1985, Selected wells and springs in southeastern Alabama: Geological Survey of Alabama Special Map 201A, 108 p.

Smith, E.A., 1907, The underground water resources of Alabama: Geological Survey of Alabama Monograph 6, 388 p.

Szabo, M.W., Osborne, W.E., Copeland, C.W., and Neathery, T.L., 1988, Geologic map of Alabama: Geological Survey of Alabama Special Map 220.

Table 1.--Records of selected wells in Butler County, Alabama

Well numbers: Numbers correspond to those shown in figure 5; letter and number (A-1) denotes well number in Geological Survey of Alabama Special Map 57.

Geographic coordinate number: Latitude (ddmmss) longitude (ddmmss) sequential number (xx).

Depth of well and water level: Depth of well given in feet; reported water levels are in feet above (-) or below land surface; measured water levels are in feet and tenths.

Well diameter: Casing and screen diameter in inches.

Water-bearing unit: Kr, Ripley Formation; Kp, Providence Sand; Tc, Clayton Formation; Tnf, Nanafalia; Ttu, Tuscahoma Sand; Th, Hatchetigbee Formation; Tt, Tallahatta Formation; Tth, Tallahatta and Hatchetigbee Formations undifferentiated; Tl, Lisbon Formation; (?), denotes uncertainty of water bearing unit.

Altitude of land surface: Altitudes given in feet from topographic map, or determined by aneroid barometer; altitudes given in feet and tenths determined by instrumental leveling.

Method of lift: B, bucket; C, cylinder; F, flows; J, jet; N, none; S, submersible, T, turbine; I, Industrial.

Use of well: D, domestic well; O, observation well; P, public water supply well; T, Test well; U, Unused well.

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
1	315734086290301	Connie Heartsill	Unknown -----	----	6	Kr (?)	415	156.4 156.9 155.1 160.9	11/29/88 10/30/89 04/25/90 10/23/90	S	U	Unused well. Well supplied chicken houses. Casing: Unknown. Screen: Unknown.
2	315702086272401	Mary Cheatham	Alton Powell Well and Supply Co. 1964	352	4	Kr	519	240 269.9 269.2 269.7 273.4	1964 11/29/88 10/30/89 04/25/90 10-23-90	N	U	Unused well. Casing: 4 in. from surface to 321 ft. Open hole below. A-1.
3	315546086321601	McMillan-Bloedel Corp.	English Well and Supply Co. 1985	340	4	Kr	430	265.0 265.9 266.7 265.3 268.5	01/23/89 10/30/89 01/30/89 04/25/90 10-23-90	S	D	Casing: 4 in. from surface to 260 ft. Screen: 260 to 340 ft.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
4	315530086343801	Town of Fort Deposit	Acme Drilling Co. Inc. 1970	521	12 8 6	Kr	520	306 369 370 372 372 373 372 371 372 374 372 371 373	--/--/70 01/--/86 12/--/87 12/--/88 03/--/89 04/--/89 05/--/89 06/--/89 07/--/89 08/--/89 10/--/89 04/--/90 10/01/90	T	P	Fort Deposit Well no. 2 Casing: 12 in. from surface to 411 ft; 8 in. from 411 to 461 ft. Screen: 6 in. from 461 to 521 ft. Reported drawdown 34 ft when pumped at 302 gal/min in 1970. Water levels are from airline measurements.
5	315504086345401	Town of Fort Deposit	Acme Drilling Co. Inc 1970	444	12 8 6	Kr	420	240 276 279 295 315 319 318 318 316 317 315 317 318 316 318	--/--/70 12/11/79 05/05/82 01/22/86 12/--/87 12/--/88 03/--/89 04/--/89 05/--/89 06/--/89 07/--/89 08/--/89 10/--/89 04/--/90 10/01/90	T	P	Fort Deposit Well no. 1 Casing: 12 in. from surface to 300 ft; 8 in. from 280 to 390 ft; 6 in. from 403 to 408 ft. Screen: 6 in. from 390 to 403 ft and from 408 to 444 ft. Reported drawdown 37 ft when pumped at 302 gal/min in 1970. Water levels are from airline measurements.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
6	315528086414901	Estate of Mrs. E.T. Hill	Unknown -----		4	Kr (?)	360	117 136.0 131.4 98.8 --	--/--/64 03/20/89 10/30/89 04/25/90 10/24/90	S	D	Casing: 4 in. to unknown depth. Screen: Unknown. Pump set 168 ft below surface. C-4.
7	315243086435001	Estate of F. Womack	F. Womack -----	105	37	Tnf	500	77.5 94.2 75.0 73.7 74.9	06/25/64 01/13/89 10/30/89 04/25/90 10/24/90	B	D	Dug well. Casing: 37 in. concrete well curb to 105 ft. D-3.
8	315314086460301	Richard Crenshaw Jr.	English Well and Supply Co. 1986	620	4	Kr	435	202.8 197.3 195.6 199.4	02/15/89 10/30/89 04/25/90 10/24/90	S	D	Casing: 4 in. from surface to 244 ft, open hole below.
9	315144086501801	Sam Wall	Unknown -----	110	4	Tnf (?)	450	76.1 78.1 78.0 77.9 78.0 78.4 73.8 77.9 73.7 73.6	05/02/85 04/23/86 10/23/86 10/14/87 04/01/88 11/02/88 01/13/89 10/31/89 04/10/90 10/08/90	S	D	Casing: Unknown. Screen: Unknown. F-8.
10	315115086463501	J.C. Gardner	J.C. Gardner -----	50	28	Tnf	420	47 44.2 44.0 42.4 44.4	00/00/63 01/13/89 10/30/89 04/25/90 10/24/90	J	D	Dug well. Casing: 28 in. concrete curb. G-2.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
11	315045086373801	City of Greenville Water Works	Layne Central Co. Inc. 1961	623	16 12 8	Kr	465	277	03-10-61	T	P	Well no. 3 Casing: 16 in. from surface to 518 ft; 8 in. from 458 to 522 ft, and 542 to 563 ft. Screen: 8 in. from 522 to 542 ft and 563 to 623 ft. Reported drawdown 88 ft when pumped 8 hours at 500 gal/min in 1961. H-4
12	315046086345401	Butler County Water Authority	Weldon Drilling Co. 1989	682	6	Kp Kr	450	-----	--------			Test well. Filled and abandoned 1989. Drillers log available in files of the U.S. Geological Survey. Site considered unacceptable for development of a production well.
13	314934086344601	Butler County Water Authority	Weldon Drilling Co. 1988	638	6 4	Kr	430	312.8 302.4 309.3 309.4 309.4 311.9 314.5 316.1 316.5 317.0 317.5	12/22/88 10/30/89 01/30/90 02/13/90 03/13/90 05/24/90 06/19/90 07/31/90 07/31/90 08/17/90 10/01/90	N	O	But-5 obs. well. Casing: 6 in. from surface to 480 ft, and 4 in. from 480 to 508 ft. Screen: 4 in. from 508 to 638 ft. Reported drawdown 113 ft when pumped at 100 gal/min in 1988.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below lsnd surface (feet)	Water level: Date of measure-ment	Method of lift	Use of well	Remarks
14	314947086364201	City of Greenville Water Works	Layne Central Co. Inc. 1942	577 12 8		Kr	360	236.5 304.8	05/29/64 07/14/86	T	P	Well no.1 Casing: 12 in. from surface to 460 ft; 8 in. from 460 to 473 ft, 493 to 525 ft, and 545 to 557 ft. Screen: 8 in. from 473 to 493 ft, 525 to 545 ft, and 557 to 577 ft. Reported draw-down 156 ft when pumped 24 hours at 575 gal/ min in 1942. H-12.
15	314914086380601	City of Greenville Water Works	Layne Central Co. Inc. 1956	661 12 8		Kr	375	189	00/00/56	T	P	Well no. 2. Casing: 12 in. from surface to 503 ft; 8 in. from 443 to 508 ft, and 568 to 601 ft. Screen: 8 in. from 508 to 568 ft, and 601 to 661 ft. Reported draw-down 60 ft when pumped 8 hours at 530 gal/min in 1956. H-7.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
16	314952086400401	City of Greenville Water Works	Layne Central Co. Inc. 1972	680	16 8	Kpu(?) Kr	410	256	02-00-72	T	P	Well no. 4. Casing: 16 in. from surface to 580 ft. Screen: 8 in. from 580 to 680 ft. Reported drawdown 36 ft when pumped 8 hours at 503 gal/min in 1972.
17	314908086403301	Butler County Water Authority	Layne Central Co. Inc. 1979	708	16 8	Kr	395	255 240 318.2 335.6 344.8 361.3	02/00/79 06/04/79 01/31/89 11/01/89 04/26/90 10/25/90	N	O	Well no. 1 Casing: 16 in. from surface to 560 ft; 8 in. from 490 to 565 ft, 580 to 615 ft, and 675 to 683 ft. Screen: 8 in. from 565 580 ft, 615 to 675 ft, and 683 to 708 ft. Reported drawdown 55 ft when pumped 24 hours at 530 gal/min in 1979.
18	314914086450501	Stalling Estate	W.J. Bozeman -----	101	4	Tnf (?)	420	28.0 25.7 23.7 28.0	02/02/89 10/30/89 04/25/90 10/24/90	J	U	Unused well. Casing: Unknown. Screen: Unknown. G-3.
19	314657086442601	Gary Brittingham	W.J. Bozeman -----	80	4	Tnf	360	34.9 38.6 36.6 35.7	02/08/89 10/30/89 04/26/90 10/24/90	J	D	Casing: 4 in. from surface to 40 ft, open hole below.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
20	314748086363401	Butler County Water Authority	Weldon Drilling Co. 1989	701	16 8	Kr	380	287.4 287.5 287.2 --	02/20/89 03/13/90 04/25/90 10/23/90	T (pumping)	P	Well no. 3. Casing: 16 in. from surface to 530 ft; 8 in. from 485 to 535 ft, and 701 to 730 ft. Screen: 8 in. from 535 to 701 ft. Reported drawdown 123 ft when pumped at 805 gal/min in 1990.
21	314618086335801	Butler County Bridle and Saddle Club	Unknown -----	---	3	Tnf (?)	390	45.4 43.7 37.3 45.8	03/20/89 10/31/89 04/25/90 10/23/90	C	U	Unused well. Casing: 3 in. to unknown depth.
22	314443086373501	W.G. Gaston	Unknown -----	400	4	Tc	370	70.7 70.7 70.8 69.6	02/08/89 10/31/89 04/26/90 10/24/90	J	D	Casing: 4 in. from surface to 19 ft, open hole below.
23	314522086394601	Wald Baptist Church	Unknown -----	---	3	Tnf (?)	395	69.2 69.4 68.1 67.9	02/08/89 10/30/89 04/25/90 10/24/90	S	D	Casing: 3 in. depth unknown.
24	314355086440501	Union Camp Corp.	E.L. Graves Drilling Co. 1969	213	6	Tnf	370	73.8 74.2 73.5 73.8 73.2 74.2 73.2 75.8 75.6 75.6 74.4 75.5	04/10/70 10/10/70 04/10/71 10/10/71 04/10/72 10/15/72 04/10/73 11/08/88 02/02/89 10/30/89 04/25/90 10/24/90	N	O	But-3 obs. well. Casing: 6 in. from surface to 203 ft. Screen: 203 to 213 ft. Still operated as a continuous record atation by the Geological Survey of Alabama in 1990.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
25	314423086493801	W.O. Black	Unknown -----	196	4	Tnf	375	97.3 96.8 95.6 96.8	02/02/89 10/30/89 04/26/90 10/24/90	N	U	Unused well. Casing: 4 in. from surface to 60 ft, open hole below. O-6.
26	314243086374901	R.L. Hitson	Unknown -----	200	4	Tc	340	62.7 61.9 61.1 62.4	02/09/89 10/31/89 04/26/90 10/24/90	N	U	Unused well. Casing: 4 in. from surface to 53 ft, open hole below. M-7.
27	314338086314501	Carl Miller	L.A. Killough -----	170	4	Tc	325	47.5 49.3 48.7 45.8 50.6	05/30/64 03/20/89 10/31/89 04/26/90 10/23/90	N	U	Unused well. Casing: 4 in. from surface to 65 ft, open hole below. L-7.
28	314049086302601	Sardis Baptist Church	Unknown -----	---	4	Tnf (?)	430	158.6 156.7 155.0 155.7	02/15/89 10/31/89 04/26/90 10/23/90	S	D	Well supplies church. Casing: 4 in. to unknown depth.
29	314036086415201	Butler County Water Authority	Layne Central Co. Inc. 1968	838	12 6	Kr	335	175 242.1 241.3 258.8 239.5 239.7 248.7 257.0 258.5 250.0	00/00/68 11/10/83 05/01/84 11/07/84 10/31/85 04/23/86 04/05/88 11/07088 01/31/89 10/24/90	T	P	Well no. 2. "Chapman" well. Casing: 12 in. from surface to 793 ft; and 6 in. from 718 to 798 ft. Screen: 6 in. from 798 to 838 ft. Reported drawdown 52 ft when pumped 3 hours at 302 gal/min in 1986. R-9.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinste number	Well owner	Driller and year drilled	Well depth (feet)	Well dismeter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Dste of measure-ment	Method of lift	Use of well	Remarks
30	314115086511001	G.D. Vickery	Richard Killough -----	320	4	Tnf	350	49.5 87.8 89.1 89.8 90.0 89.7 90.4 90.3 90.4 89.6 90.8	06/23/64 05/02/85 04/23/86 10/23/86 10/14/87 04/01/88 11/02/88 02/02/89 10/31/89 04/25/90 10/08/90	J	D	Casing: 4 in. from surface to 120 ft, open hole below. P-1.
31	314022086424901	Union Camp Corp.	Layne Central Co. Inc. 1944	861	16 8	Kr	265	24	00/00/44	T	I	Well no. 1 Casing: 16 in. from surface to 740 ft; 8 in. from 656 to 761 ft. Screen: 8 in. from 761 to 861 ft. Reported drawdown 51 ft when pumped at 570 gal/min in 1944. Reported to produce 585 gal/min in 1964. Q-4.
32	314028086422801	Union Camp Corp.	Layne Central Co. Inc. 1968	827	20 10	Kr	270	99	02/00/68	T	I	Well no. 2 Casing: 20 in. from surface to 722 ft; 10 in. from 642 to 727 ft. Screen: 10 in. from 727 to 827 ft.
33	314004086401301	Brushy Creek Baptist Church	Unknown -----	---	4	Tscm (?)	360	53.9 92.8 92.4 94.8	02/09/89 10/31/89 04/25/90 10/23/90	N	U	Unused well. Casing: 4 in. from surface to depth unknown.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
34	314003086294201	Z.K. Andress	L.A. Killough Jr. -----	350	4	Tnf	415	80 144.5 149.8 147.9 147.0 145.9 148.9 146.1 144.0 143.6	00/00/59 05/08/85 04/23/86 10/23/86 10/14/87 04/01/88 11/01/88 10/31/89 04/11/90 10/08/90	S	D	Casing: 4 in. from surface to 63 ft, open hole below. T-3.
35	313917086360001	Friendship Holiness Church	Unknown -----	---	4	Tnf (?)	340	83.7 83.8 83.4 83.9	02/15/89 10/31/89 04/25/90 10/23/90	S	D	Casing: 4 in. from surface to unknown depth.
36	313859086461901	Daryl Stinson	Unknown -----	---	4	Tnf (?)	255	12.2 13.0 12.7 14.4	02/07/89 10/31/89 04/25/90 10/23/90	N	U	Unused well. Casing: 4 in. to unknown depth.
37	313741086501401	M. Goodwin	Richard Killough -----	380	4	Tnf	300	49.3 45.9 44.9 41.2 46.9	-------- 02/02/89 10/31/89 04/25/90 10/23/90	S	D	Used well. Casing: 4 in. from surface to 60 ft, open hole below. P-4.
38	313814086443502	Georgiana Water Works and Sewer Board	Powell Drilling Co., Inc. 1982	1,021	12 6	Kr	290	179 194.5 193.4 183.6 183.7 186.0 187.6 198.6 -- --	02/00/82 09/03/82 05/01/84 05/02/85 04/22/86 10/23/86 04/01/88 11/02/88 04/00/89 10/31/90	T	P	Well no. 2. Casing: 12 in. from surface to 917 ft. Screen: 6 in. from 916 1,021 ft. Reported drawdown 56 ft when pumped 24 hours at 615 gal/min in 1982. Q-14.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
39	31381108641100	Mrs. T. Skipper	L.A. Killough Jr. -----	300	4	Tnf	295	47.7 60.9 60.4 60.0 63.6	07/06/64 02/09/89 10/31/89 04/25/90 10/23/90	N	U	Unused well. Casing: 4 in. from surface to 84 ft, open hole below. R-8.
40	313730086352301	L.S. Jones	L.A. Killough Jr. -----	400	4	Tnf Tscm	285	36.5 37.2 37.8 35.7 36.8 38.2 37.3 36.5 38.2	05/08/85 04/23/86 10/23/86 10/14/87 04/01/88 02/09/89 10/31/89 04/11/90 10/08/90	S	U	Unused well. Casing: 4 in. from surface to 47 ft, open hole below. S-6.
41	313640086310701	H. Shine	English Well and Supply Co. 1974	270	4	Tnf	335	94.8 95.5 95.4 96.3	02/16/89 10/31/89 04/25/90 10/23/90	S	D	Casing: 4 in. from surface to 168 ft, open hole below. Reported to produce 6 gal/min in 1974.
42	313754086442301	Georgiana Water Works and Sewer Board	Acme Drilling Co., Inc. 1971	1,076	18 12 6	Kr	330	178	07/00/71	T	P	Well No. 1 Casing: 18 in. from surface to 40 ft; 12 in. from surface to 976 ft. Screen: 6 in. from 976 to 1,076 ft. Reported drawdown 36 ft when pumped 8 hours at 360 gal/min in 1971.
43	313612086433701	William H. Bush	English Well and Supply Co. 1967	346	4	Tnf Tscm	370	61.0 62.8 61.7 68.8	02/07/89 10/31/89 04/25/90 10/23/90	S	D	Casing: 4 in. from surface to 100 ft, open hole below.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
44	313524086363101	Mrs. H.F. Wood	Unknown -----	200	4	Tnf (?)	270	50.9 50.0 49.5 54.0	02/09/89 10/31/89 04/25/90 10/23/90	J	U	Unused well. Casing: 4 in. from surface to unknown depth. Screen: unknown.
45	313427086314001	Mrs. V. Lester Nix	English Well and Supply Co. 1980	380	4	Tnf	295	77.0 77.5 74.3 75.5	03/20/89 10/31/89 04/25/90 10/23/90	S	D	Casing: 4 in. from surface to 204 ft, open hole below.
46	313339086491801	Garland Baptist Church	English Well and Supply Co. 1976	260	4	Tscm	240	24.9 25.0 24.0 25.4	02/03/89 10/31/89 04/25/90 10/23/90	S	D	Casing: 4 in. from surface to 44 ft, open hole below.
47	313324086492101	Town of Garland	Unknown 1911	280	4	Tscm	211	-4.5 -2.8	07/29/46 05/26/64	F,S	U	Unused well. Casing: Depth unknown.
48	313248086453301	Jesse Wright	English Well and Supply Co. -----	300	4	Tscm	330	128.2 128.2 126.3 129.3	02/07/89 10/31/89 04/25/90 10/23/90	S	D	Casing: 4 in. from surface to 220 ft, open hole below.
49	313223086425801	McKenzie Water Board	W.J Bozeman 1945	751	8 6 4	Tnf Tc	450	220 240	00/00/45 01/28/53	T	U	Unused or abandoned well. Casing: 8 in. from surface to 94 ft; 6 in. from 84 to 650 ft, and 660 to 741 ft. Screen: 6 in. from 650 to 660 ft; 4 in. from 741 to 751 ft. Reported drawdown 22 ft when pumped 3 hours at 30 gal/min in 1945. W-5.

Table 1.--Records of selected wells in Butler County, Alabama--Continued

Well number	Geographic coordinate number	Well owner	Driller and year drilled	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface (feet)	Water level: Distance above(-)or below land surface (feet)	Water level: Date of measurement	Method of lift	Use of well	Remarks
50	313228086432101	McKenzie Water Board	Acme Drilling Co. Inc. 1978	758	12 6	Tnf Tc	450	256.0	10/17/78	T	P	Well no. 2. Casing: 12 in. from surface to 728 ft; 6 in. from 670 to 728 ft. Screen: 6 in. from 728 to 758 ft. Reported drawdown 37 ft when pumped 8 hours at 305 gal/min on 10/17/78. W-01.
51	313225086425401	McKenzie Water Board	Acme Drilling Co. Inc. 1965	763	12 6	Tnf Tc	450	240 277.7 284.4 294.2 275.9 291.8 302 279.2 281.0 295 -- --	07/03/65 11/10/83 11/07/84 05/02/85 04/23/86 10/23/86 10/13/87 04/01/88 11/01/88 10/31/89 04/00/90 (pumping) 10/00/90 (pumping)	T	P	Well no.1. Casing: 12 in. from surface to 738 ft; 6 in. from 691 to 738 ft. Screen: 6 in. from 738 763 ft. Reported drawdown 38 ft when pumped 21 hours at 354 gal/min in 1965. W-11.