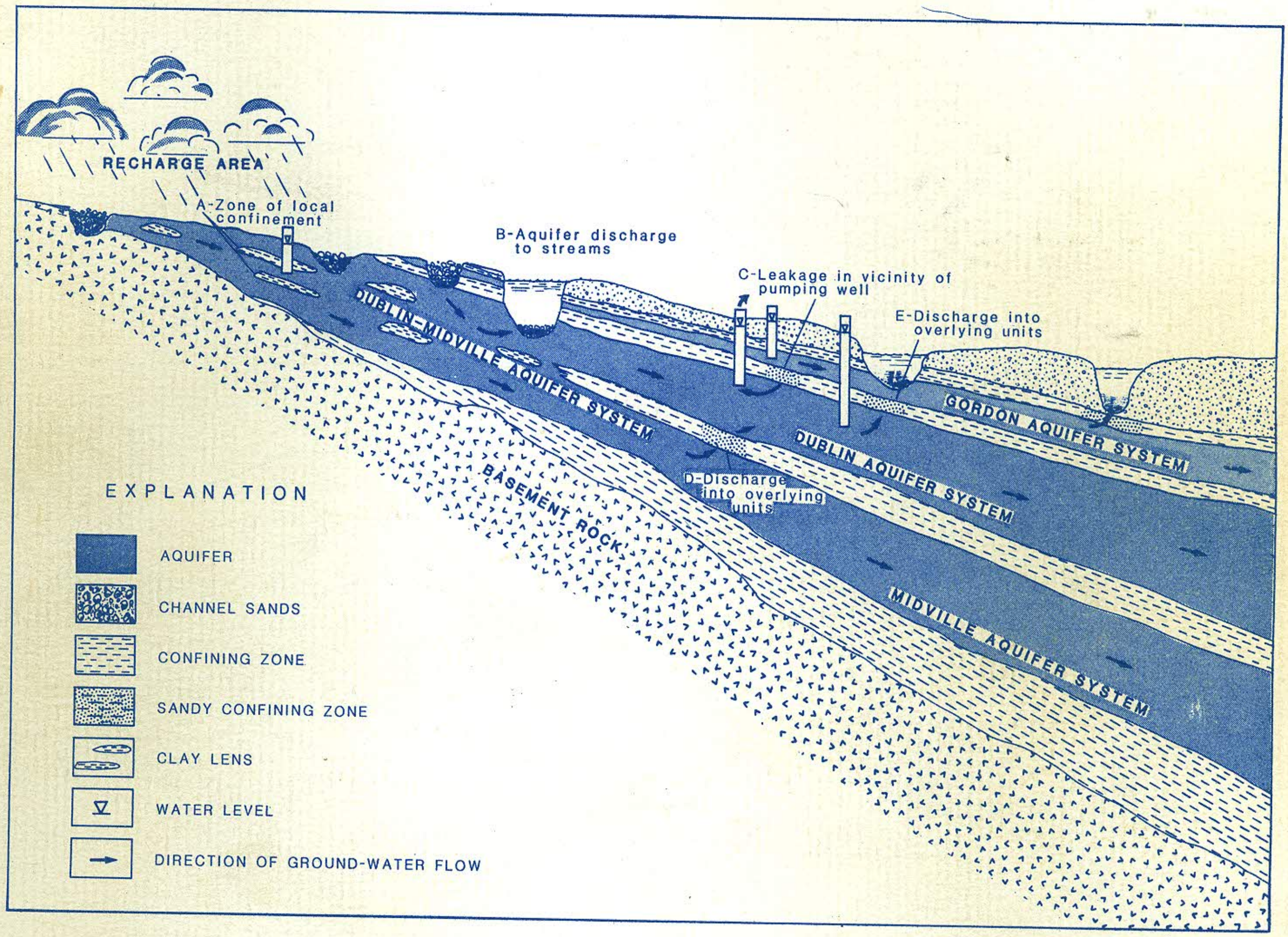
HYDROGEOLOGY OF THE DUBLIN AND MIDVILLE AQUIFER SYSTEMS OF EAST-CENTRAL GEORGIA

John S. Clarke, Rebekah Brooks, and Robert E. Faye



Prepared as part of the
Accelerated Ground-Water Program
in cooperation with the
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
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INFORMATION CIRCULAR 74

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Geologic Units

In this report, for the purpose of simplicity, formations of Late Cretaceous and Paleocene age that are present in the study area and have similar lithologies and(or) equivalent stratigraphic positions, are grouped into informal geologic units. Some informal geologic units were assigned names taken from geologic formations of equivalent age from adjacent areas. For example the Peedee-Providence unit consists of age equivalents of the Peedee Formation in western South Carolina, and the Providence Sand in western Georgia. Although the informal geologic units are age equivalents of the formations, they are not necessarily lithostratigraphic equivalents.

COVER PHOTO: Schematic diagram of recharge and discharge, and the direction of ground-water flow in the Gordon, Dublin, Midville, and Dublin-Midville aquifer systems.

John S. Clarke

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Department of Natural Resources
J. Leonard Ledbetter, Commissioner

Environmental Protection Division
Harold F. Reheis, Assistant Director

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William H. McLemore, State Geologist

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CONVERSION FACTORS

For use of readers who prefer to use SI (metric) units, conversion factors for terms used in this report are listed below:

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
inch (in.)	25.4	millimeter (mm)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow	
gallon per minute (gal/min)	0.06309	liter per second (L/s)
million gallons per day (Mgal/d)	0.04381	cubic meters per second (m^3/s)
	43.81	liter per second (L/s)
	Concentration	
part per million	1	milligrams per liter (mg/L)
	1000	micrograms per liter (μg/L)
	Transmissivity	
foot squared per day (ft^2/d)	0.0929	meter squared per day (m^2/d)
	Specific capacity	
gallon per minute per foot [(gal/min)/ft]	0.207	liter per second per meter [(L/s)/m]
	Specific conductance	
micromho per centimeter at 25° Celsius (μmhos/cm at 25°C)	1	microsiemens per centimeter at 25° Celsius (μS/cm at 25°C)
	Temperatures	
degrees Fahrenheit (°F)	°C = 5/9(°F-32)	degrees Celsius (°C)
degrees Celsius (°C)	°F = 9/5(°C+32)	degrees Fahrenheit (°F)

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ABSTRACT

During 1980, an estimated 121 million gallons of water per day was pumped in a 26-county area in east-central Georgia from sand aquifers of Paleocene and Late Cretaceous age. Maximum withdrawals were at the kaolin mining and processing centers in Twiggs, Wilkinson, and Washington Counties, where water levels have declined as much as 50 feet since 1944-50. In the southern two-thirds of the study area, water levels have shown little, if any, change. Declining water levels and increasing competition for ground water have caused concern over the adequacy of ground-water supplies. This report defines the areal extent and describes the hydrogeology of the Paleocene-Upper Cretaceous aquifers of east-central Georgia, and evaluates the effects of man on the ground-water flow system.

Hydrogeologic data from four test wells indicate that the aquifers consist of alternating layers of sand and clay that are largely of deltaic origin. The aquifers contain discontinuous confining units of clay and silt that are believed to extend for only short distances and are not significant in a regional evaluation. For this reason, the aquifers were grouped into two regional aquifer systems that are bounded by three regional confining units. The Dublin and Midville aquifer systems were each named for a geographic feature near a test well that penetrates sediments which are representative of the geologic and hydrologic characteristics of the aquifer system.

In the northern third of the study area, the confining unit between the Dublin and Midville aquifer systems is absent and the aquifer systems combine to form the Dublin-Midville aquifer system. The aquifer systems range in thickness from 80 to 645 feet and their transmissivities range from 800 to 39,000 feet squared per day. The hydraulic conductivity ranges from 15 to 530 feet per day. Wells yield as much as 3,400 gallons per minute. Chemical analyses of water from 49 wells indicate that water from both aquifer systems is of good quality except in the central part of the study area, where iron concentrations are as high as 6,700 micrograms per liter and exceed the 300 micrograms per liter recommended limit for drinking water.

The principal recharge to the aquifer systems is from precipitation that occurs within and adjacent to the outcrop areas. The principal discharge is to streams in the outcrop area, although in the southern part of the study area, discharge occurs by leakage into overlying units.

INTRODUCTION

In east-central Georgia, sand aquifers of Paleocene and Late Cretaceous age yielded an estimated 121 Mgal/d during 1980. About 60 percent of this withdrawal was at the kaolin mining and processing centers in Twiggs, Wilkinson, and Washington Counties. At these centers, water levels have declined as much as 50 ft since 1944-50. Concern over declining water levels, together with increasing competition for ground-water resources between municipal, industrial, and agricultural users, spurred interest in evaluating available supplies of ground water. An understanding of the hydrogeologic properties of the aquifer systems is important for effective management of the ground-water resources.

This study was conducted by the U.S. Geological Survey in cooperation with the Georgia Department of Natural Resources, Environmental Protection Division, Geologic Survey Branch. This report is one in a series presenting the results of studies being conducted on the lower Tertiary-Upper Cretaceous aquifers in the Georgia Coastal Plain as part of the Georgia Accelerated Ground-Water Program. Two previous reports described aquifers in southwestern Georgia, whereas this report is one of three that describe aquifers in east-central Georgia (fig. 1).

Purpose and Scope

The purpose of this report is to define the areal extent and describe the hydrology and geology of the Paleocene-Upper Cretaceous aquifers of east-central Georgia. The effects of man on the ground-water-flow system were also evaluated. The 26-county study area covers 9,200 mi^2 and is generally bounded to the east by the Savannah River, to the west by the Ocmulgee River, and to the north by the Fall Line (fig. 1).

Methods of Study

With the exception of the southern part of the study area, data resources for the study were comprehensive. Data were obtained from published reports, consultant's reports, from files of the U.S. Geological Survey and the Georgia Geologic Survey, water-use and water-quality files of the Georgia Environmental Protection Division, and local industries and municipalities.

Borehole geophysical logs, and lithologic and paleontologic data were obtained from Herrick (1961) and from files of the U.S. Geological Survey, the Georgia Geologic Survey, and the Georgia Environmental Protection Division. These data, supplemented by data from four test wells, were used to construct hydrogeologic sections and maps showing the areal extent and the approximate top, base, and thickness of the two aquifer systems that were delineated.

Water levels measured in more than 80 wells during October 20-24, 1980, were used to construct a map showing the configuration of the potentiometric surface. Water-level data from reports by LaMoreaux (1946), LeGrand and Furcron (1956), and LeGrand (1962) were used to prepare a map showing the configuration of the potentiometric surface for the period 1944-50. Until recently, topographic maps were not available to accurately locate and determine the latitude and longitude of the wells listed in these reports. Because this information was crucial for the construction of accurate potentiometric maps, plots of well locations were transferred from original field maps onto more accurate U.S. Geological Survey 7.5-minute topographic quadrangle maps and were field checked, where possible. The data were used to construct a map showing the configuration of the potentiometric surface during 1944-50. Water-level declines were then estimated by comparing the 1944-50 and October 1980 potentiometric surfaces. Continuous water-level recorders were installed on seven wells to monitor water-level fluctuations and long-term water-level trends.

During the investigation, water samples for chemical analysis were obtained from four test wells and from two other wells. Data from these analyses together with historical data from 43 additional wells were used to map areal trends in pH, and in dissolved-solids and iron concentrations.

Aquifer transmissivity was computed from time-drawdown and time-recovery data collected from the four test wells, and from published and unpublished aquifer-

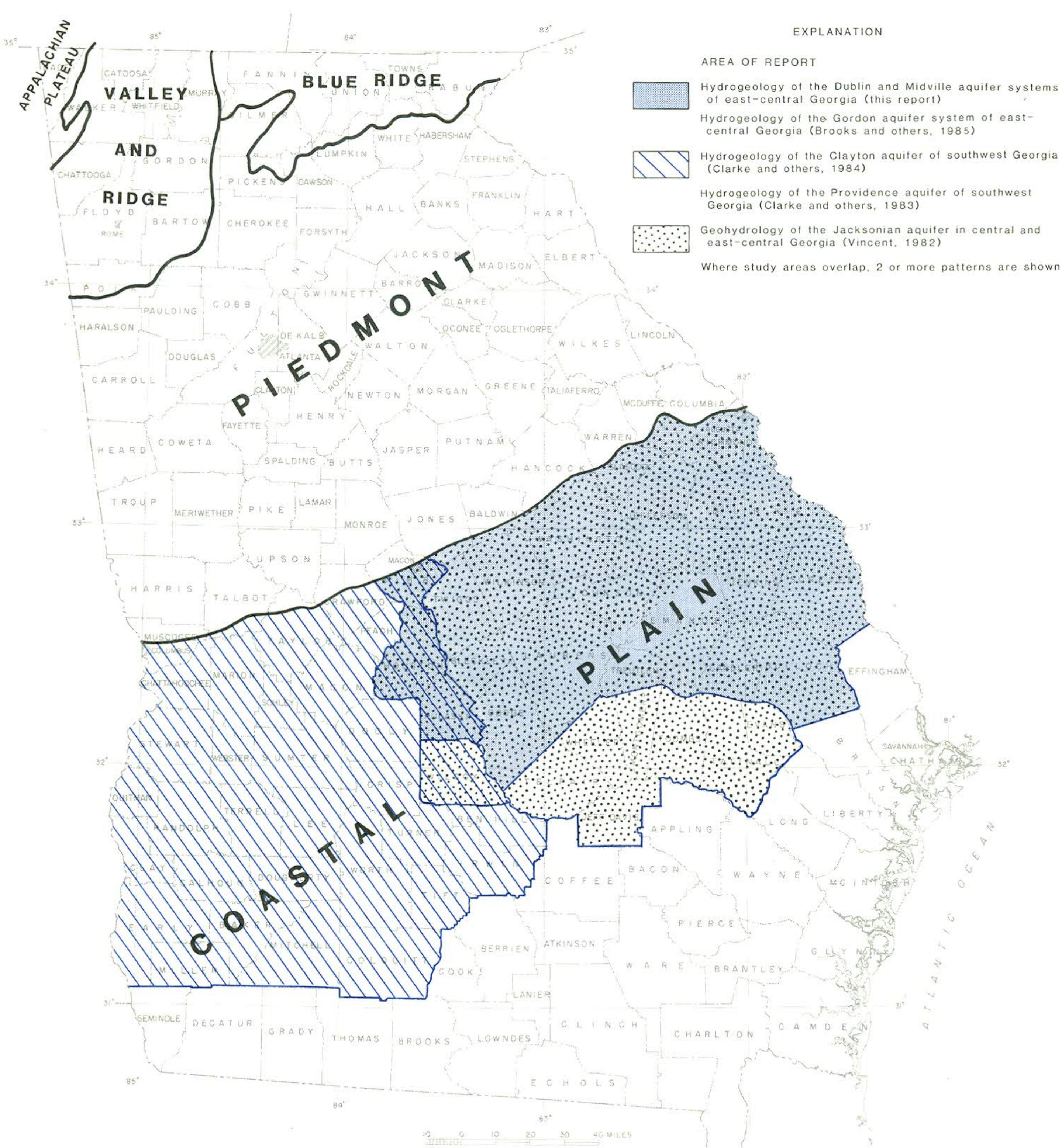


Figure 1.—Location of study area, physiographic provinces, and areas covered by investigations as part of the Upper Cretaceous-lower Tertiary aquifer study.

test and specific-capacity data. Transmissivity values were mapped to show areal trends. Permeameter analyses of core samples collected at well 24V1 were used to estimate the vertical and horizontal hydraulic conductivity of confining units. Aquifer hydraulic conductivity was estimated from aquifer-test data.

Ground-water-use data for municipalities and industries were obtained from water-use reports submitted quarterly to the Georgia Environmental Protection Division. Agricultural water-use data were obtained from water-use surveys sponsored by the U.S. Geological Survey and conducted by the U.S. Soil Conservation Service during 1979-80.

Test-Well Drilling Program

Because of insufficient geologic, hydrologic, and water-quality data in the southern half of the study area, four test wells were drilled during 1980 and 1981 as part of this study (fig. 3). The wells are near Midville, in Burke County (28X1); near Wrightsville, in Johnson County (24V1); near Dublin, in Laurens County (21U4); and in northern Pulaski County (18T1), along a line that approximately parallels the strike of the strata. Each of the wells completely penetrated Tertiary strata and all except well 18T1 completely penetrated Upper Cretaceous strata. Drill cuttings, cores, paleontologic samples, and geophysical logs were obtained from each well and were used to correlate geologic units, aquifers, and confining units.

Each of the four test wells was screened in Upper Cretaceous strata (pls. 1 and 2). After completion of each well, water samples were collected for chemical analysis and water-level recorders were installed. These wells are now part of statewide ground-water-level and ground-water-quality monitoring networks.

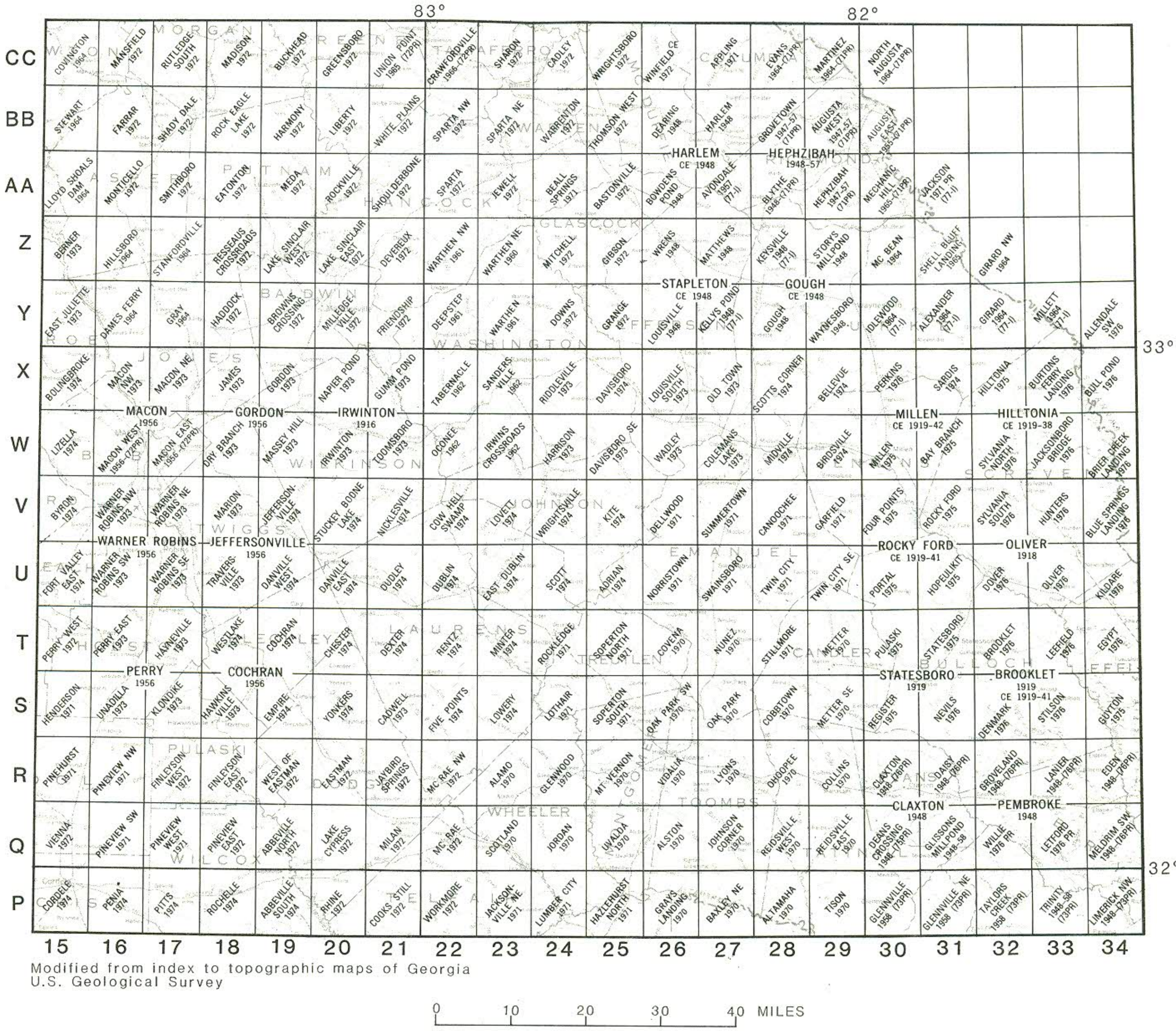
Well-Numbering System

With the exception of wells in South Carolina, wells in this report are numbered according to a system based on the U.S. Geological Survey Index to Topographic Maps of Georgia (fig. 2). Each 7.5-minute topographic quadrangle in the State has been given a number and letter designation beginning at the southwest corner of the State. Numbers increase eastward and letters increase alphabetically northward. The letters "I" and "O" are omitted. Quadrangles in the northern part of the State are designated by double letters. Wells inventoried in each quadrangle are numbered consecutively beginning with 1. Thus, the fourth well scheduled in the Sandersville quadrangle in Washington County is designated 22X4.

In areas where modern water-level data were unavailable, wells were used from Georgia Geological Survey reports (LaMoreaux, 1946; LeGrand and Furcron, 1956; and LeGrand, 1962). Because these wells are not included in the modern data base and thus were not assigned grid numbers, the sequential well numbers from the reports were retained. In South Carolina, wells are designated by letters prefixing sequential well numbers as follows: SRP, Savannah River Plant; AK, Aiken County; AL, Allendale County; and VSC, Plant Vogtle, SC. Additional information regarding wells used in this report may be obtained by referring to the well identification number in any correspondence to the District Chief, U.S. Geological Survey, 6481-B Peachtree Industrial Boulevard, Doraville, Ga. 30360.

Previous Studies

Previous reports about the study area include descriptions of the geology and ground-water resources of Baldwin, Hancock, Jones, Twiggs, Washington, and Wilkinson Counties (LaMoreaux, 1946); Burke,



Modified from index to topographic maps of Georgia
U.S. Geological Survey

Figure 2.—Number and letter designations for 7.5-minute topographic quadrangles covering east-central Georgia.

Columbia, Glascock, Jefferson, McDuffie, Richmond, and Warren Counties (LeGrand and Furcron, 1956); and Bibb, Crawford, Houston, Macon, Peach, Schley, and Taylor Counties (LeGrand, 1962). The three reports include descriptions of drill cuttings and outcropping sediments, and tables listing well-construction, water-level, well-yield, and water-quality data.

Pollard and Vorhis (1980) described the geohydrology of the Cretaceous aquifer system in southern Georgia. That report includes hydrogeologic sections and maps showing the altitude of the tops of the aquifers and their approximate thicknesses. Siple (1967), in a comprehensive study, described the geology and ground-water resources of the Savannah River Plant, S.C., near the Georgia-South Carolina border. The effects of suspected Late Cretaceous and Cenozoic faulting on ground-water flow near the Savannah River in Georgia and South Carolina were evaluated by Faye and Prowell (1982). As part of a series of reports on the lower Tertiary-Upper Cretaceous aquifers in Georgia, Vincent (1982) described the geohydrology of the Jacksonian aquifer in the study area and Clarke and others (1983; 1984) described the hydrogeology of the Providence aquifer and the Clayton aquifer in southwest Georgia, including Houston and Pulaski Counties (fig. 1).

Geologic reports describing the study area include maps showing the geology and mineral resources of the Macon-Gordon kaolin district in Twiggs and western Wilkinson Counties (Buie and others, 1979), and the geology of the central Georgia kaolin district in Wilkinson, Washington, Baldwin, and Hancock Counties (Hetrick and Fridell, 1983, part I). Prowell and others (1985) correlated geologic units along a line extending across the central part of the study area, providing stratigraphic correlations between western and eastern Georgia and western South Carolina based on new data from the test wells drilled as part of the present study. Herrick (1961) presented lithologic logs and paleontologic data from wells throughout the Coastal Plain of Georgia. Guidebooks describing outcropping sediments in the study area include: Herrick and Counts (1968), Pickering (1971), and Huddlestun and others (1974). Other hydrologic and geologic reports are listed in Selected References.

Acknowledgments

The authors extend their appreciation to the many well owners, drillers, and managers of municipal and industrial waterworks who readily furnished information about wells. In particular, the writers wish to thank Douglas M. Dangerfield of M. R. Chasman and Associates, Athens, Ga.; Gerald S. Grainger of the Southern Company, Birmingham, Ala; Robert Massey of Layne-Atlantic Company, Savannah, Ga.; Sam M. Pickering of Yara Engineering, Deepstep, Ga.; and Dan Zeigler of Southeast Exploration and Production Company, Dallas, Tex, for providing hydrologic and geologic data. Conway Mizelle of Insurance Services of Georgia provided historical records of municipal water use in the study area.

Lin D. Pollard, U.S. Geological Survey, organized and monitored the test-well-drilling program. Laurel M. Bybell, Raymond A. Cristopher, Lucy E. Edwards, and Norman O. Frederiksen, U.S. Geological Survey, identified fossils in core samples from the test wells. The writers extend particular appreciation and acknowledgment to David C. Prowell, U.S. Geological Survey, for his invaluable advice and assistance regarding the correlation of lithologic and stratigraphic units within the study area. Special appreciation is extended to Willis G. Hester and Ellie R. Black for preparing the illustrations in this report.

GEOLOGY

General Setting

Coastal Plain sedimentary rocks within the study area (fig. 1) consist of alternating layers of sand, clay, and limestone that range in age from Late Cretaceous through Holocene. These strata dip and progressively thicken to the southeast, reaching a maximum thickness of at least 3,000 ft in the southern part of the study area. The approximate northern limit of the strata and the contact between the Coastal Plain and Piedmont physiographic provinces is marked by the Fall Line (fig. 1). The strata crop out in discontinuous belts that are generally parallel to the Fall Line (fig. 3). The sedimentary sequence unconformably overlies igneous and metamorphic rocks of Paleozoic age, and consolidated red beds of early Mesozoic age (Chowns and Williams, 1983).

The age and stratigraphic correlations of geologic units in east-central Georgia long have been controversial because fossil evidence is sparse, lithologies of adjacent units are commonly similar, and some units can only be observed in drill cuttings. For example, certain strata in the study area that were assigned by early workers to the Upper Cretaceous Tuscaloosa Formation have recently been shown by palynologic and stratigraphic studies to be of younger Cretaceous and Tertiary age (Tschudy and Patterson, 1975, p. 434, 437). According to David C. Prowell (U.S. Geological Survey, written commun., 1982), the Tuscaloosa Formation and unnamed rocks of equivalent age are absent in most of the study area, except possibly in southern Pulaski and Treutlen Counties.

Sediments of Late Cretaceous and Tertiary age in east-central Georgia commonly contain thick lenses of kaolin. These lenses grade from deposits of relatively pure kaolin having economic importance into clayey sand. The origin of the kaolin is controversial, but it is generally agreed that the kaolin was derived from the weathering of crystalline rocks of the Piedmont physiographic province (fig. 1) and probably was deposited in a deltaic environment (Kesler, 1963, p. 10). Kaolin is useful in distinguising sediments of Late Cretaceous age from sediments of Tertiary age. According to Hetrick and Friddell (1983, part II), kaolin of Tertiary age may be distinguished by physical hardness; a very faint, greenish-gray cast; irregular fractures; and the presence of Panolites (a type of burrow). Kaolin of Late Cretaceous age is soft, white to pale tan, and has a conchoidal fracture and a high mica content.

Depositional Environments

The depositional environments of sediments in the study area controlled the distibution and types of lithologies that accumulated and thus effected the hydrologic properties of the sediments. In the study area, sediments of Late Cretaceous age were deposited mainly in deltaic environments where sediment-laden rivers and streams entered larger bodies of water. Deltaic depositional environments are characterized by three principal subenvironments, in seaward order: the delta plain, the delta front, and the prodelta (fig. 4).

The delta plain is the level or nearly level surface composing the most landward part of a large delta (fig. 4). The lower delta plain shows some tidal marine influence, whereas the upper delta plain shows little, if any, tidal influence. On the delta plain, sediment-laden rivers and streams deposit coarse permeable sand and clayey sand mostly within distributary channels. Interdistributary bays and marshes accumulate discontinuous deposits of clay and fine sand that are relatively impermeable.

The delta front is a narrow zone seaward of the delta plain and within the effective depth of wave erosion. Deposition is most active in this subenvironment and sediments are chiefly interlayered silty sand, silt, and clay that generally become finer in texture in a seaward direction.

The prodelta lies below the effective depth of wave erosion and marks the most seaward part of a delta. Sediments deposited in this fully marine subenvironment consist mostly of laminated clay and

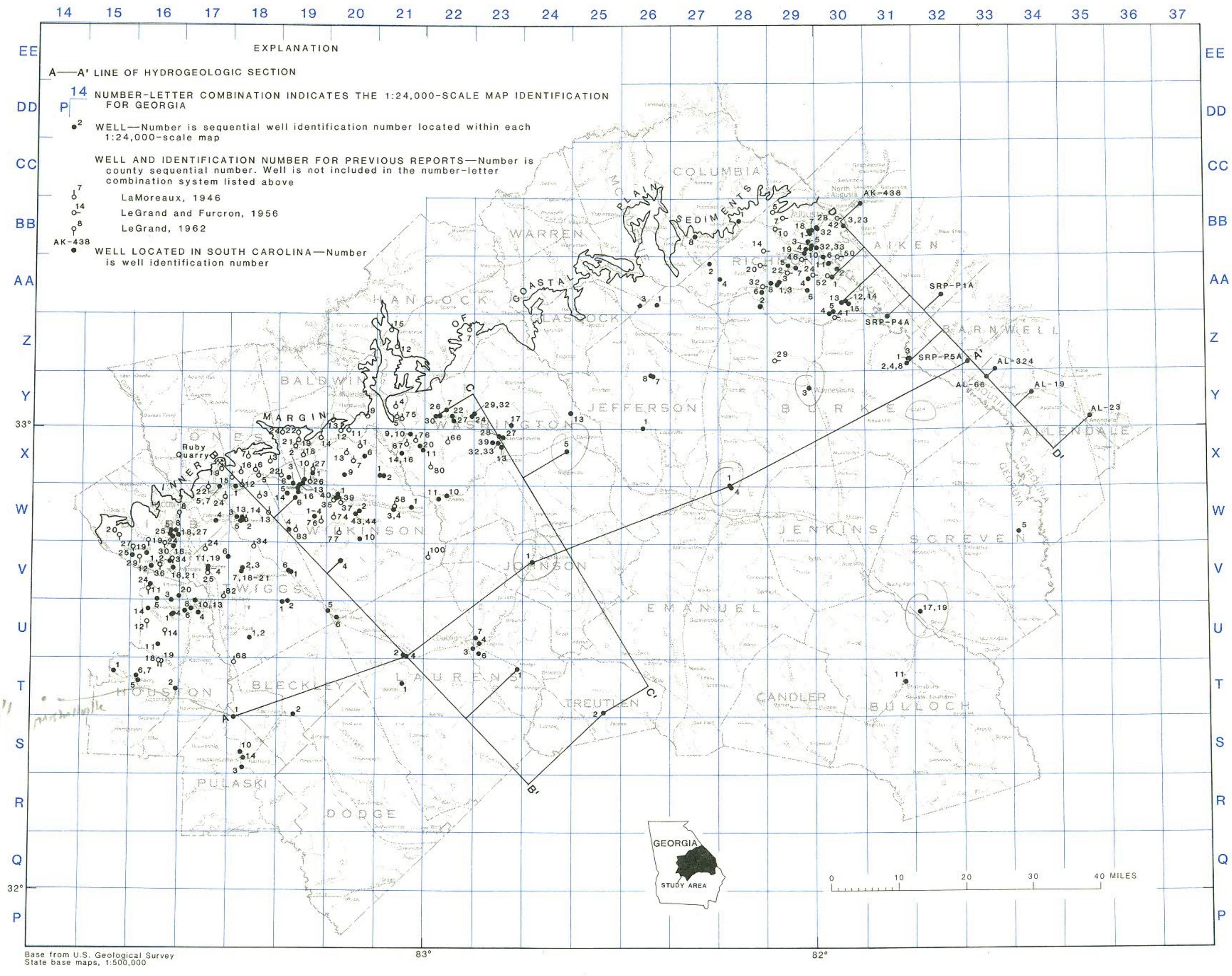


Figure 3.—Locations of selected wells and hydrogeologic sections in east-central Georgia.

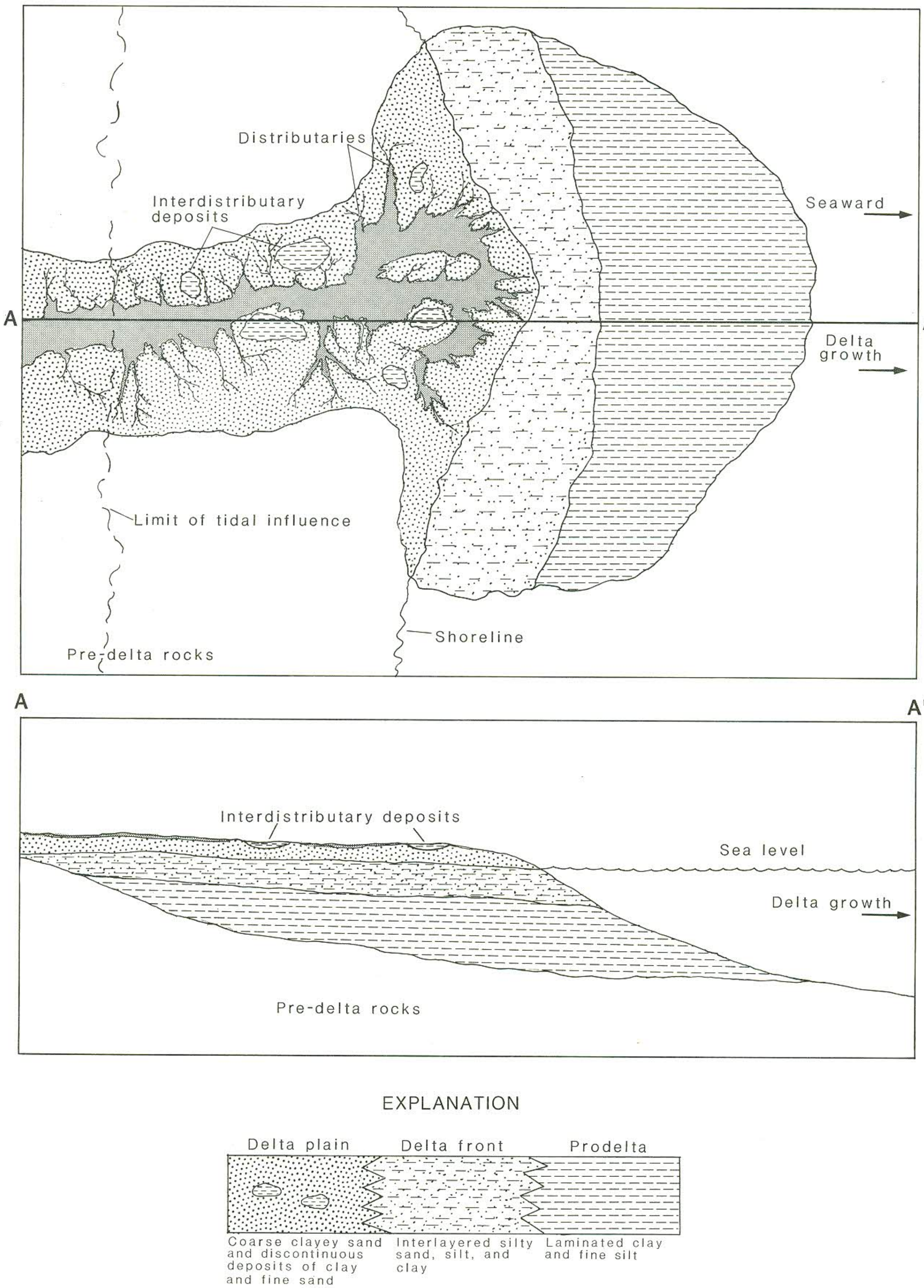


Figure 4.—Schematic diagram showing deltaic depositional environments.

fine silt that are more laterally continuous than sediments deposited in delta front and delta plain environments.

Geologic Units

In this report, for the purpose of simplicity, formations of Late Cretaceous and Paleocene age that are present in the study area and have similar lithologies and(or) equivalent stratigraphic positions, are grouped into informal geologic units (table 1). Some informal geologic units were assigned names taken from geologic formations of equivalent age from adjacent areas. For example, the Peedee-Providence unit consists of age equivalents of the Peedee Formation in western South Carolina, and the Providence Sand in western Georgia (table 1). Although the informal geologic units are age equivalents of the formations, they are not necessarily lithostratigraphic equivalents. Geologic units in the study area include, in ascending order: the Cape Fear unit, the Middendorf-Blufftown unit, the Black Creek-Cusseta unit, the Peedee-Providence unit, the lower Huber-Ellenton unit, the Baker Hill-Nanafalia unit, and post-Paleocene units. The following lithostratigraphic descriptions are based on Prowell and others (1985).

Upper Cretaceous

Cape Fear unit

The Cape Fear unit has a maximum known thickness of about 700 ft in the study area (well 25T2, pls. 1 and 2) and has been recognized in boreholes from western South Carolina to central Georgia (Prowell and others, 1985). In most of the study area, the unit unconformably overlies pre-Cretaceous "basement" rock, although it is thought to locally overlie unnamed rocks equivalent to the Tuscaloosa Formation (table 1) in the extreme southern part of the study area in Pulaski and Treutlen Counties. The Cape Fear unit does not crop out in the study area and its northern limit is just north of well 19W6 on section B-B' (pl. 1), well 22Y30 on section C-C', and well SRP-P4A on section D-D' (pl. 2). The approximate northern limit of the Cape Fear unit is outlined on figure 8.

The Cape Fear unit corresponds to the UK1 lithologic unit of Prowell and others (1985) which has been assigned an early Austinian age on the basis of fossil evidence in wells 18T1 and 21U4 (pl. 1). Sediments described in the present report as the Cape Fear unit at wells 23T1 and 25T2 (section B-B', pl. 1) were assigned by Mayer and Applin (1971, pl. 13) to the Tuscaloosa Formation of Eaglefordian age (table 1). The strata that Mayer and Applin identified as the Tuscaloosa Formation in this area were considered to be updip facies equivalents of the upper part of the Atkinson Formation, also considered by earlier workers to be of Eaglefordian age (Applin, 1955; Applin and Applin, 1967). Studies by Hazel (1969), Valentine (1982), and Owens and Gohn (1985) have redefined the age of the upper part of the Atkinson Formation as Austinian (table 1), which corresponds to the age assigned to the Cape Fear unit by Prowell and others (1985). Consequently, sediments assigned to the Cape Fear unit at wells 23T1 and 25T2 are thought to be Austinian in age and correlative with both the upper part of the Atkinson Formation of Mayer and Applin (1971) and the UK1 lithologic unit of Prowell and others (1985).

Throughout most of the study area, the Cape Fear unit consists of poorly sorted, angular, fine to coarse sand admixed with kaolin that has a buff to pale-green cast and is commonly iron stained (pl. 1). In the northern part of its extent, the unit is semi-indurated owing to a large percentage of crystobalite cement. The Cape Fear unit is generally expressed on geophysical logs as a zone of low electrical resistivity (pls. 1 and 2). The lithology of the unit, together with a sparsity of marine organisms in core samples (Prowell and others, 1985), suggests that the Cape Fear unit was deposited in an upper delta plain environment (fig. 4).

Table 1.—Generalized correlation of geologic and hydrologic units of Late Cretaceous and Tertiary age in Georgia. (Modified from Prowell and others, 1985)

SERIES	EUROPEAN STAGE	PROVINCIAL STAGE	ALABAMA (W–E)	WESTERN GEORGIA	LITHOLOGIC UNIT	EASTERN GEORGIA	SOUTH CAROLINA (W–E)	THIS REPORT: GEOLOGIC UNIT	THIS REPORT: THICKNESS (FEET)	THIS REPORT: HYDROLOGIC UNIT
MIOCENE	Undifferentiated	Undifferentiated			M_1	Hawthorn Formation	Hawthorn Formation; Edisto Formation; Chandler Bridge Fm.	Channel sands[1]	0-1000	
OLIGOCENE	Chattian	Chickasawhayan	Paynes Hammock Sand; Chickasawhay Formation		O_1	Suwanee Limestone	Cooper Formation (Ashley Member)			
OLIGOCENE	? — ? Rupelian	Vicksburgian	Byram Formation; Marianna Limestone; Red Bluff Clay/ Bumpnose Formation							
EOCENE	Priabonian	Jacksonian	Yazoo Clay; Ocala Limestone	Ocala Limestone	E_8; E_7	Barnwell Formation	Barnwell Formation; Cooper Formation (Parkers Ferry and Harleyville Members) ?	Post-Paleocene units		Jacksonian aquifer[2]
EOCENE	Bartonian		Moodys Branch Fm.; Gosport Sand	Moodys Branch Fm.	E_6					
EOCENE	Lutetian	Claibornian	Lisbon Formation	Lisbon Formation	E_5; E_4	? Lisbon/McBean Formations ?	? McBean Formation; Santee Limestone			Confining unit
EOCENE	Ypresian		Tallahatta Formation	Tallahatta Formation	E_3; ? — E_2 — ?	Huber Formation	Congaree Formation			Gordon aquifer system[3]
		Sabinian	Hatchetigbee/Bashi Fms.	Hatchetigbee/Bashi Fms.	E_1		Fishburne Formation			
PALEOCENE	Thanetian		Tuscahoma Formation; Nanafalia/Baker Hill Fms.	Tuscahoma Formation; Nanafalia/Baker Hill Fms.	P_2		Black Mingo Formation; Black Mingo Group	Baker Hill-Nanafalia unit	0-130	Confining unit
PALEOCENE	Danian	Midwayan	Naheola Fm.; Porters Creek Formation; Clayton Formation	Porters Creek Formation; Clayton Formation	P_1		Ellenton Formation; of Van Nieuwenhuise and Colquhoun	Lower Huber-Ellenton unit	0-200	Dublin aquifer system
UPPER CRETACEOUS	Maestrichtian	Navarroan	Prairie Bluff Chalk; Ripley Formation	Providence Sand; Ripley Formation	UK_6	Unnamed rocks	Peedee Formation	Peedee-Providence unit	0-380	
UPPER CRETACEOUS	Campanian	Tayloran	Demopolis Chalk	Cusseta Sand	UK_5; UK_4		Black Creek Formation	Black Creek-Cusseta unit	0-240	Confining unit
UPPER CRETACEOUS		Austinian	Mooreville Chalk	Blufftown Formation	UK_3		Unnamed rocks (Coastal areas)	Middendorf-Blufftown unit	0-520	Midville aquifer system
UPPER CRETACEOUS	Santonian		Eutaw Formation	Eutaw Formation	UK_2	Middendorf Formation	Middendorf Formation			
UPPER CRETACEOUS	Coniacian				UK_1	Cape Fear Formation	Cape Fear Formation	Cape Fear unit	0-700	Confining unit
UPPER CRETACEOUS	Turonian ? — ?	Eaglefordian								
UPPER CRETACEOUS	Cenomanian	Woodbinian	Tuscaloosa Formation	Tuscaloosa Formation		Unnamed rocks (Coastal areas)	Unnamed rocks (Coastal areas)			

1 LaMoreaux (1946); Kesler (1963).
2 Vincent (1982).
3 Brooks and others (1985).

In the southern part of the study area, the unit becomes less indurated and more sandy, and is expressed on geophysical logs by increased electrical resistivity at wells 23T1 and 25T2 (pl. 1). Changes in the lithologic character of the unit are also recognizable by changes in the drilling rate, and by sonic and lithologic logs at two oil-test wells (GGS 789 and GGS 964, Swanson and Gernazian, 1979) drilled near well 25T2. The transition from semi-indurated clayey sand in the north to poorly consolidated, cleaner sand in the south may be the result of lithologic changes during deposition or may reflect the southern limit of the crystobalite cementation process (D. C. Prowell, U.S. Geological Survey, oral commun., 1983). This transition begins between wells 24U1 and 23T1 on section B-B' (pl. 1) and between wells 24V1 and 25T2 on section C-C' (pl. 2).

Middendorf-Blufftown unit

The Middendorf-Blufftown unit has a maximum known thickness of about 520 ft in the study area (well 25T2, pl. 1) and includes strata that belong to the Middendorf Formation of eastern Georgia and western South Carolina and that are age equivalents of the Eutaw and Blufftown Formations of western Georgia, and the UK1, UK2, and UK3 lithologic units of Prowell and others (1985) (table 1). The unit overlies the Cape Fear unit and is distinguished by its lack of induration, better sorted sands, and carbonaceous character.

The lower part of the Middendorf-Blufftown unit consists of poorly consolidated, angular to subangular, fine to very coarse sand containing silt and white to buff kaolin (section A-A', pl. 1). The upper part of the unit consists of alternating beds of silty clay and subangular, medium to coarse sand. These lithologies, and marine microfauna found in core samples (Prowell and others, 1985), suggest that the Middendorf-Blufftown unit was deposited in a delta plain environment under some marine influence (fig. 4).

Black Creek-Cusseta unit

The Black Creek-Cusseta unit has a maximum known thickness of about 240 ft in the study area (well 25T2, pl. 1), and includes strata that are age equivalents of the Black Creek Formation of western South Carolina, the Cusseta Sand of western Georgia, and the UK4 lithologic unit of Prowell and others (1985) (table 1). The unit unconformably overlies the Middendorf-Blufftown unit and is distinguished by its better sorted sands, fine-grained character, and a relatively high clay content.

In the southern two-thirds of the study area, the Black Creek-Cusseta unit consists of gray-green clayey silt and fine sand that is well sorted, very micaceous, carbonaceous, and locally glauconitic (section A-A', pl. 1). In this area, the top of the unit can be distinguished on borehole geophysical logs as a zone of low electrical resistivity and high natural gamma radiation (pls. 1 and 2). These geophysical characteristics are typified by the wells shown on section A-A' (pl. 1). The Black Creek-Cusseta unit in the southern part of the study area was probably deposited in a delta front or prodelta environment, as indicated by its lithology and an abundance of marine macrofauna and microfauna (Prowell and others, 1985). The approximate northern limit of the prodelta or delta front deposits generally corresponds to the northern limit of the Black Creek-Cusseta confining unit (table 1) shown in figure 7. (See section on Aquifer Systems.)

In the northern third of the study area, the Black Creek-Cusseta unit grades into clayey, fine to medium, subangular to subrounded quartz sand and silty clay that is moderately well sorted and contains thick, discontinuous, locally carbonaceous, kaolinitic clay beds. These lithologies are indicative of more landward deposition on the delta front and lower delta plain (fig. 4). Marine microfossils recognized in samples from northern areas, however, suggest a strong marine influence (Prowell and others, 1985).

The transition from fine-grained, prodelta or delta front deposits in the southern part of the area, to coarser grained, more landward deltaic deposits in the northern part of the area, is reflected by changing patterns on borehole geophysical logs (pls. 1 and 2). For example, along section B-B' (pl. 1), an increased percentage of sand in the unit is indicated by a general increase in electrical resistivity on log patterns in wells to the north.

Peedee-Providence unit

The Peedee-Providence unit is the youngest unit of Late Cretaceous age in the study area and has a maximum known thickness of about 380 ft (well 23T1, pl. 1). The unit includes strata that are age equivalents of the Peedee Formation in western South Carolina, the Ripley Formation and Providence Sand in western Georgia, and the UK5 and UK6 lithologic units of Prowell and others (1985) (table 1). The unit overlies the Black Creek-Cusseta unit and is distinguished from it by a higher percentage of sand, a lower percentage of glauconite, and on geophysical logs by higher electrical resistivity and lower natural gamma radiation (pls. 1 and 2).

The lower part of the Peedee-Providence unit consists of well-sorted, well-rounded, fine to medium quartz sand, silt, and off-white to buff kaolin that contains thin beds of micaceous and highly carbonaceous clay (section A-A', pl. 1). The upper part of the unit consists of silty kaolin and fine to medium sand that is subangular, moderately sorted, kaolinitic, and contains thin beds of coarse sand and gravel. The upper 20 to 40 ft of the unit commonly is an orange-red weathered zone. These lithologies, and an abundance of marine microfauna (Prowell and others, 1985), suggest that the lower part of the Peedee-Providence unit was deposited in a marginal marine barrier complex. The upper part of the unit was deposited in a delta plain or marsh under some marine influence, as indicated by a sparsity of marine fossils.

Paleocene

Lower Huber-Ellenton unit

The lower Huber-Ellenton unit unconformably overlies the Peedee-Providence unit and has a maximum known thickness of about 200 ft (well 25T2, pl. 1). The unit includes strata that are age equivalents of the Ellenton Formation in western South Carolina (Siple, 1967), the lower part of the Huber Formation in eastern Georgia (Buie and others, 1979), the Clayton and Porters Creek Formations in western Georgia (table 1), and the P1 lithologic unit of Prowell and others (1985).

The lower Huber-Ellenton unit consists of a basal layer of poorly sorted, silty, fine to coarse, angular, noncalcareous quartz sand containing varying percentages of kaolin, lignite, and mica (section A-A', pl. 1). The remainder of the unit consists of locally carbonaceous, kaolinitic clay. The diversity of marine microfauna and these lithologies are indicative of deposition in a deltaic environment under marine influence.

In the southern third of the study area, the unit is more calcareous and grades into relatively porous, medium-gray, glauconitic and highly fossiliferous limestone interlayered with fine to coarse sand and beds of calcareous clay. This lithofacies was identified in drill cuttings from well 25T2 (pl. 1) and is indicative of deposition in an open marine shelf environment that periodically received an influx of clastic sediment.

Baker Hill-Nanafalia unit

The Baker Hill-Nanafalia unit has a maximum known thickness of about 130 ft in the study area and includes strata that are age equivalents of the Black Mingo Formation in western South Carolina and the Tuscahoma, Nanafalia, and Baker Hill Formations (Gibson, 1982) in western Georgia (table 1). The unit overlies the lower Huber-Ellenton unit and is unconformably overlain by post-Paleocene units. North of wells 20V4 (section B-B', pl. 1) and 24V1 (section C-C', pl. 2), the Baker Hill-Nanafalia unit is truncated by post-Paleocene units. The Baker Hill-Nanafalia unit is distinguished by a high percentage of clay and is characterized on borehole geophysical logs as a zone of high natural gamma radiation when compared to the overlying post-Paleocene units (pl. 1).

In the northern two-thirds of the study area, the Baker Hill-Nanafalia unit consists of thin-bedded, medium to dark-gray, silty, carbonaceous and kaolinitic clay (section A-A', pl. 1). An abundance of marine fauna suggest that the unit was deposited in a marginal marine (lagoonal to shallow shelf) environment.

In the southern one-third of the study area, the Baker Hill-Nanafalia unit consists of gray-green, fine to medium, well-rounded, calcareous, quartz sand and interbedded limestone that is highly fossiliferous and glauconitic. These lithologies were observed in cuttings from wells AL-66 and AL-19 (section D-D', pl. 2), and suggest that here the unit was deposited in an open marine shallow shelf environment.

Post-Paleocene

Post-Paleocene units in the study area range from Eocene to Miocene in age and include strata that are the age equivalents of: (1) the Fishburne, Congaree, and Cooper Formations in western South Carolina; (2) the upper part of the Huber Formation, the Barnwell Formation, and the Suwannee Limestone in eastern Georgia; (3) the McBean and Hawthorn Formations in western South Carolina and eastern Georgia; (4) the Tallahatta Formation, Moodys Branch Formation, and Ocala Limestone of western Georgia; and (5) the Lisbon Formation that is recognizable throughout most of the Georgia Coastal Plain (table 1). The post-Paleocene units unconformably overlie the Baker Hill-Nanafalia unit and have a maximum thickness of about 1,000 ft (well 25T2, pl. 1). Over most of the study area, post-Paleocene units are more marine in character than the underlying Cretaceous and Paleocene units and consist of alternating layers of sand, limestone, marl, and clay. For a more detailed discussion of post-Paleocene units, see Brooks and others (1985).

Channel sands

The channel sands (LaMoreaux, 1946) consist of discontinuous deposits of cross-bedded coarse sand, gravel, and kaolin fragments derived from underlying sediments and basement rock. These deposits fill ancient stream channels and range in thickness from a few inches to about 25 ft. The channel sands are present in northern Twiggs, Wilkinson, and Washington Counties, and in southern Jones, Baldwin, and Hancock Counties. The age of the channel sands is unknown, but LaMoreaux (1946) suggested that they might be of late Eocene age (table 1) as indicated by: (1) a gradational transition into sediments of Jacksonian age at some localities, and (2) their close association with onlapping Eocene strata. Kesler (1963), on the other hand, suggested that the Channel Sands might be a mixture of reworked sediments of Late Cretaceous to Miocene age that were redeposited during the Pliocene Epoch.

Structure

Units of Late Cretaceous and Paleocene age in the study area generally dip to the southeast and strike to the northeast. Major structural features (fig. 5) reported in the study area include: the Belair fault (Prowell and O'Connor, 1978) and the Gulf Trough (Herrick and Vorhis, 1963).

The northeast-trending Belair fault crosses the study area in Jefferson, Burke, Richmond, and Columbia Counties (fig. 5). The fault is a high-angle reverse fault, upthrown on the southeast side and has a maximum vertical displacement of 100 ft at the base of Coastal Plain strata (Prowell and O'Connor, 1978).

A projection of the northeast-trending Gulf Trough may cross the southeastern part of the study area into Bulloch and Screven Counties (Miller, 1982). The Gulf Trough has an adverse effect on the ground-water flow system, as evidenced by low well yields, low transmissivity, high dissolved-solids concentrations, and steepened potentiometric gradients in the Floridan aquifer system (formerly principal artesian aquifer) in southwestern Georgia (Zimmerman, 1977). It is likely that similar effects occur in the vicinity of the Gulf Trough in eastern Georgia. On the basis of what they considered to be anomolous potentiometric data, Faye and Prowell (1982) inferred that the Gulf Trough may extend into Bulloch and Screven Counties, which is farther northeastward than previously interpreted. A significant reduction in well yields and transmissivity (fig. 12) in the Dublin aquifer system between Dover, in Screven County, and Statesboro, in Bulloch County (wells 32U19 and 31T11, Appendix A) may support the presence of the trough. (See section on Aquifer Properties.) Several different opinions as to the nature and origin of the Gulf Trough have been expressed by previous investigators. Patterson and Herrick (1971, p. 11-12) presented a summary of these differing views: (1) that the feature represents a buried submarine valley or strait, (2) that it is a grabben, (3) that it is a syncline, or (4) that it is a buried solution valley. The authors prefer the second hypothesis. Further study will be required to assess the nature and origin of the Gulf Trough and its effect on the ground-water flow system.

HYDROLOGY

Aquifer Systems

Definition

An aquifer system is herein defined as a body of material of varying permeability that acts as a water-yielding hydrologic unit of regional extent. The concept of an aquifer system is desirable because it provides a framework for grouping local aquifers and confining units into a regional hydrologic unit. This study defines the Dublin aquifer system of Paleocene and Late Cretaceous age and the Midville aquifer system of Late Cretaceous age. Each aquifer system was named for a geographic feature near a test well that penetrates strata representative of the geologic and hydrologic properties of the aquifer system. This method of naming allows aquifer systems to cross time and geologic formation lines and is therefore independent of changing stratigraphic nomenclature.

Although the aquifer systems defined herein are regional in extent, they contain discontinuous confining layers that locally separate them into two or more aquifers. Such local confining units are not significant in a regional evaluation, but they increase the complexity of the hydrologic framework. The number and thickness of confining units penetrated by wells in the study area were measured from borehole geophysical logs, and descriptions of drill cuttings and core samples. Confining units 20 ft or more thick were considered to be most significant and are shown on cross sections A-A', B-B', C-C', and D-D' (pls. 1 and 2). Three confining units were judged sufficiently thick and widespread to have regional significance, and together with the Coastal Plain floor, define the upper and lower limits of the Dublin and Midville aquifer systems.

In the study area, several aquifers and aquifer systems are used for water supply. They are, in descending order: (1) the Jacksonian aquifer (Vincent, 1982), comprised largely of calcareous sand and limestone of the Barnwell Formation (2) the Gordon aquifer system (Brooks and others, 1984), comprised largely of sands of early and middle Eocene age; and (3) the Dublin and Midville aquifer systems of this report. The general correlations of the aquifer units are shown in table 1.

Dublin aquifer system

The Dublin aquifer system was named for sediments penetrated by well 21U4 (pls. 1 and 2; Appendix A) drilled near Dublin, Laurens County. At this well, the upper part of the Dublin aquifer system consists of fine to coarse sand and limestone of the lower Huber-Ellenton unit, whereas the lower part consists of alternating layers of kaolinitic sand and clay of the Peedee-Providence unit (table 1). The Dublin aquifer system is confined above by clayey beds of the Baker Hill-Nanafalia unit and below by clay and fine silt of the upper part of the Black Creek-Cusseta unit.

Throughout most of the study area, the Dublin aquifer system is a single hydrologic unit, because clay layers within the system seem to have limited areal extent (pls. 1 and 2). For example, on section A-A', several clay layers are present within the aquifer system at well 21U4, that are absent at wells 18T1 and 24V1. These layers may be local confining units, but do not extend laterally over a large enough area to be considered regionally significant confining units. Exceptions occur in the western and eastern parts of the study area, where widespread clay layers divide the Dublin aquifer system into several discrete aquifer units.

In the western part of the study area, the upper part of the Dublin aquifer system grades laterally into the Paleocene Clayton aquifer of Clarke and others (1984); and the lower part grades laterally into the Upper Cretaceous Providence-Cusseta aquifer of Clarke and others (1983). This division is shown at well 18T1 on section A-A' (pl. 1) where the upper part of the Peedee-Providence unit grades into silty clay and very clayey sand that forms a confining unit which continues westward and separates the Clayton and Providence-Cusetta aquifers. To the east, near the Savannah River, clays within the upper part of the lower Huber-Ellenton unit form a confining unit that separates an upper aquifer of Paleocene age from a lower aquifer of Late Cretaceous age (wells AL-19 and AL-23, pl. 2).

In the eastern part of the area, the confining unit that overlies the Dublin aquifer system is less than 20 ft thick and is not an effective confining unit. In this area, the Dublin aquifer system is hydraulically connected with the overlying Gordon aquifer system (table 1). This hydraulic connection occurs near the Savannah River and is characterized by wells 31Z2 and AL-324 (section D-D', pl. 2). In southern Laurens County and in Treutlen County, the Dublin and Gordon aquifer systems may be connected between wells 23T1 and 25T2 (section B-B', pl. 1).

Midville aquifer system

The Midville aquifer system was named for sediments penetrated by well 28X1 (pl. 1; Appendix A) near Midville, Burke County. At this well, the upper part of the Midville aquifer system consists of fine to medium sand of the lower part of the Black Creek-Cusseta unit and the lower part of the aquifer system consists of alternating layers of medium to coarse sand, silt, and kaolin of the Middendorf-Blufftown unit (table 1). In the eastern part of the study area, the Midville aquifer system locally includes as much as 35 ft of sand from the upper part of the Cape Fear unit (wells SRP-P5A and AL-324, pl. 2). The Midville aquifer system is confined above by the upper part of the Black Creek-Cusseta unit and its base is marked by semi-indurated to unconsolidated kaolinitic sand of the Cape Fear unit.

At wells 20V4, 23T1, and 25T2 (section B-B', pl. 1), the Cape Fear unit which forms the base of the Midville aquifer system contains several layers of poorly consolidated, permeable sand, ranging in thickness from about 20 to 210 ft. In the southern part of the study area, these permeable sand layers make up over 50 percent of the Cape Fear unit (wells 23T1, 25T2, pl. 1) and are probably hydraulically connected with the overlying Midville aquifer system. This hydraulic connection occurs between wells 24U1 and 23T1 on section B-B' (pl. 1) and between wells 24V1 and 25T2 on section C-C' (pl. 2).

Dublin-Midville aquifer system

In the northern one-third of the study area, the Black Creek-Cusseta confining unit that separates the Dublin aquifer system from the Midville aquifer system becomes sandier and is, therefore, not an effective confining unit. In this area, the Dublin and Midville aquifer systems combine to form a single aquifer system, herein called the Dublin-Midville aquifer system. Changes in the lithology and confining character of the intervening Black Creek-Cusseta confining unit are illustrated on sections B-B', C-C', and D-D' (pls. 1 and 2). For example, along section B-B' the confining unit progressively thins to the north, decreasing to a thickness of about 35 ft at well 20V4. North of well 20V4 the confining unit is absent and the two aquifer systems combine to form the Dublin-Midville aquifer system. The approximate northern limit of the Black Creek-Cusseta confining unit is outlined in figure 7.

The Dublin-Midville aquifer system is generally confined above by clayey beds of the Baker Hill-Nanafalia unit and below by semi-indurated, kaolinitic sand of the Cape Fear unit (table 1). In the northern part of the study area, the Baker Hill-Nanafalia confining unit is absent and the Dublin-Midville aquifer system is hydraulically connected with the overlying Gordon aquifer system (well 24X5, pl. 1). In the extreme northern part of the study area, the Cape Fear confining unit is absent and the Dublin-Midville aquifer system overlies low permeability rocks that are part of the Coastal Plain floor (fig. 8).

Altitude of Tops of Aquifer Systems and Confining Units

Borehole geophysical and lithologic logs of wells in the study area were used to estimate the altitudes of the tops of: (1) the Dublin and Dublin-Midville aquifer systems (fig. 5); (2) the Midville aquifer system (fig. 6); (3) the Black Creek-Cusseta confining unit (fig. 7); and (4) the base of the Midville and Dublin-Midville aquifer systems (fig. 8). In Bulloch and Screven Counties, it was not possible to measure accurately the altitudes of the top and base of the aquifer systems because of sparse geologic control. In this part of the area, the contours shown in figures 5-8 represent an approximation of the top of a unit. Depths below land surface to the top of a unit may be calculated by subtracting the altitude of the top of the unit (figs. 5-8) from the altitude of land surface shown on U.S. Geological Survey 7.5-minute topographic quadrangle maps.

Thickness and Sand Content

Maps showing the approximate thickness, sand content, and number of sand layers having a thickness of 20 ft or more in the Dublin, Midville, and Dublin-Midville aquifer systems were constructed using data from geophysical and lithologic logs (figs. 9, 10). The number of sand layers 20 ft or more thick is an indication of the number of separate water-bearing intervals available to be screened in a well. The aquifer systems have the greatest potential for development in areas where the thickness, percentage of sand (figs. 9, 10), and the transmissivity (fig. 12) are greatest. Aquifer system thicknesses were computed by comparing maps showing the altitude of the top of each aquifer system with the altitude of the top of the underlying regional confining unit or base of the aquifer system. For example, the thickness of

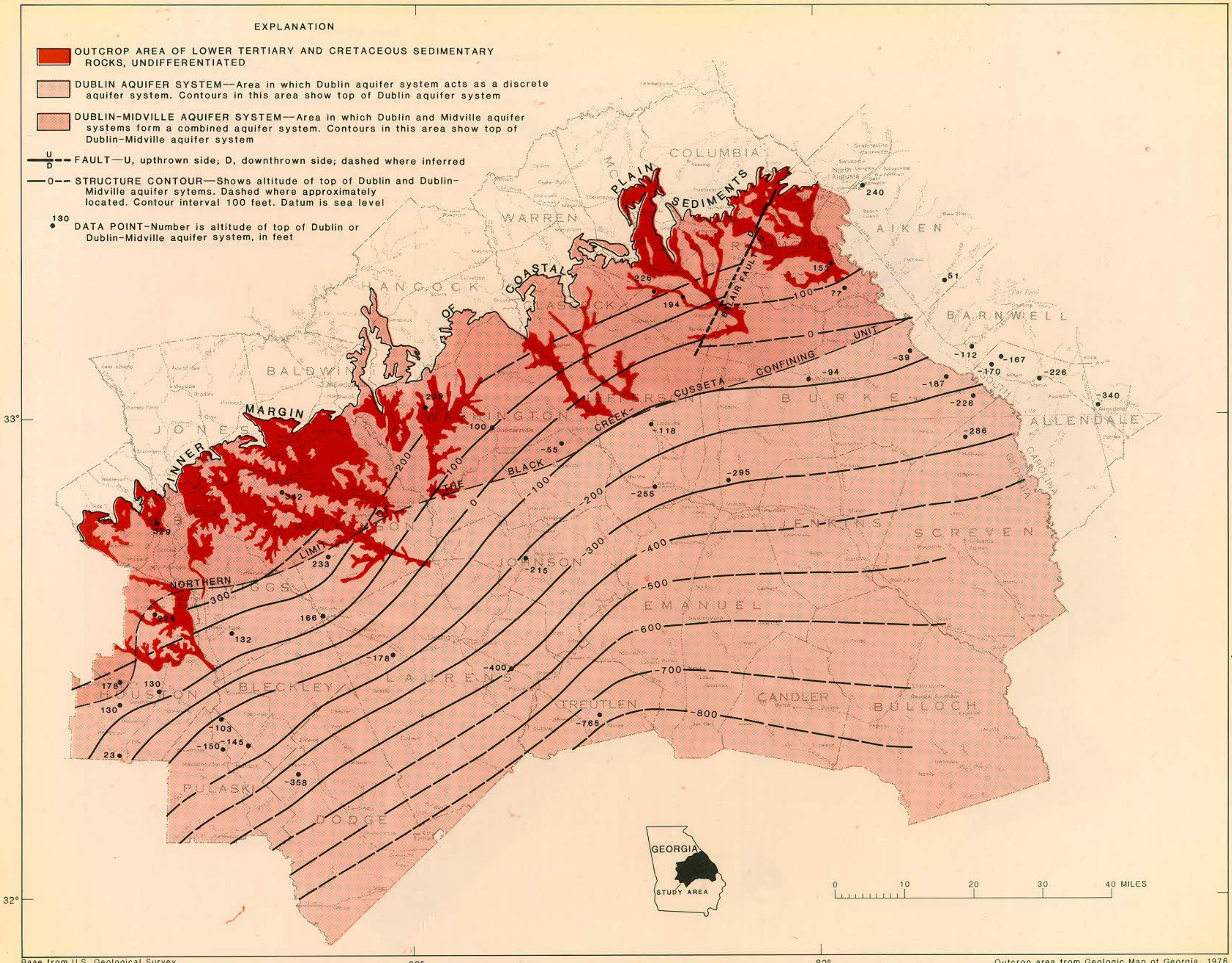


Figure 5.—Structural features, outcrop area, and altitude of the top of the Dublin and Dublin-Midville aquifer systems.

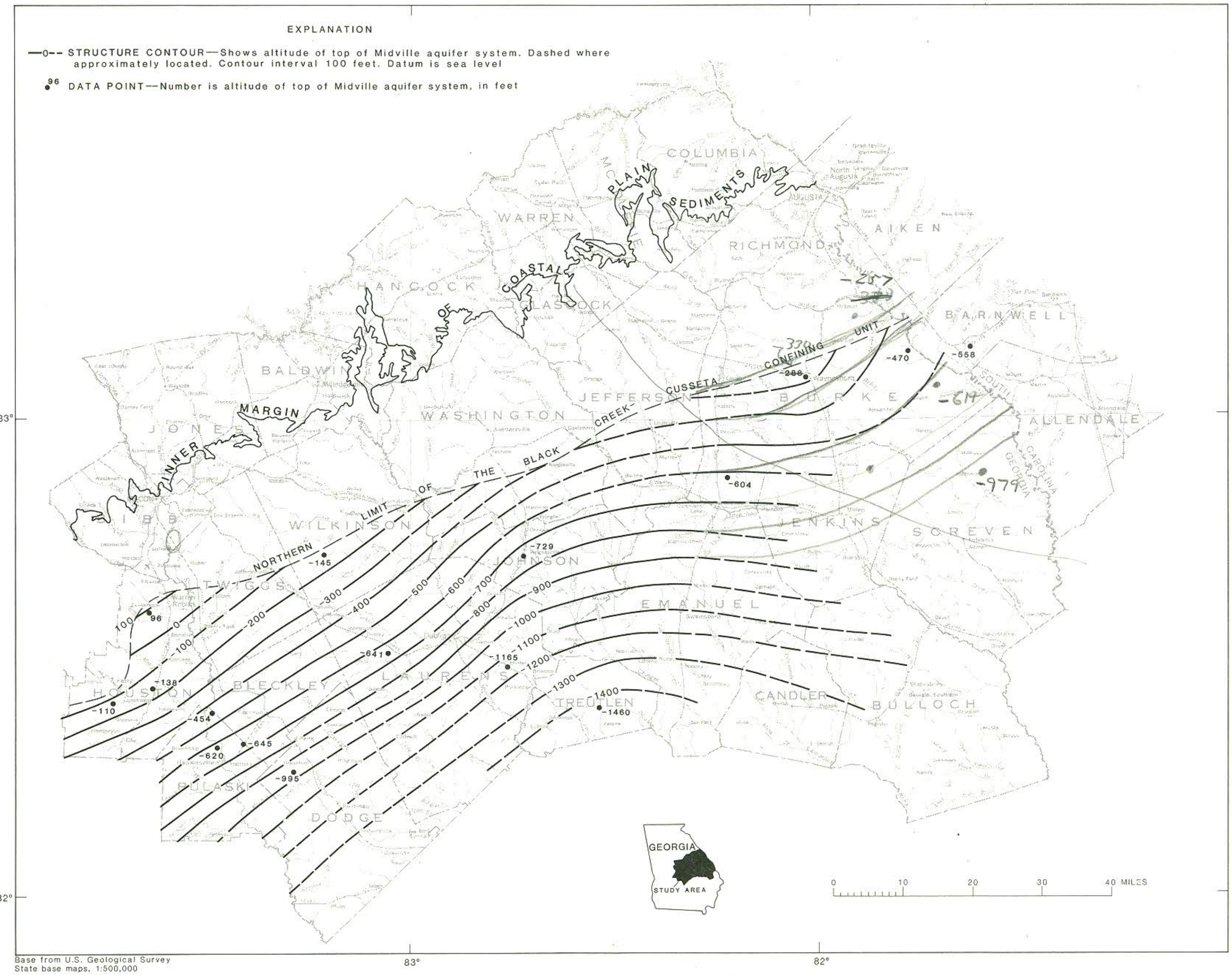


Figure 6.—Altitude of the top of the Midville aquifer system.

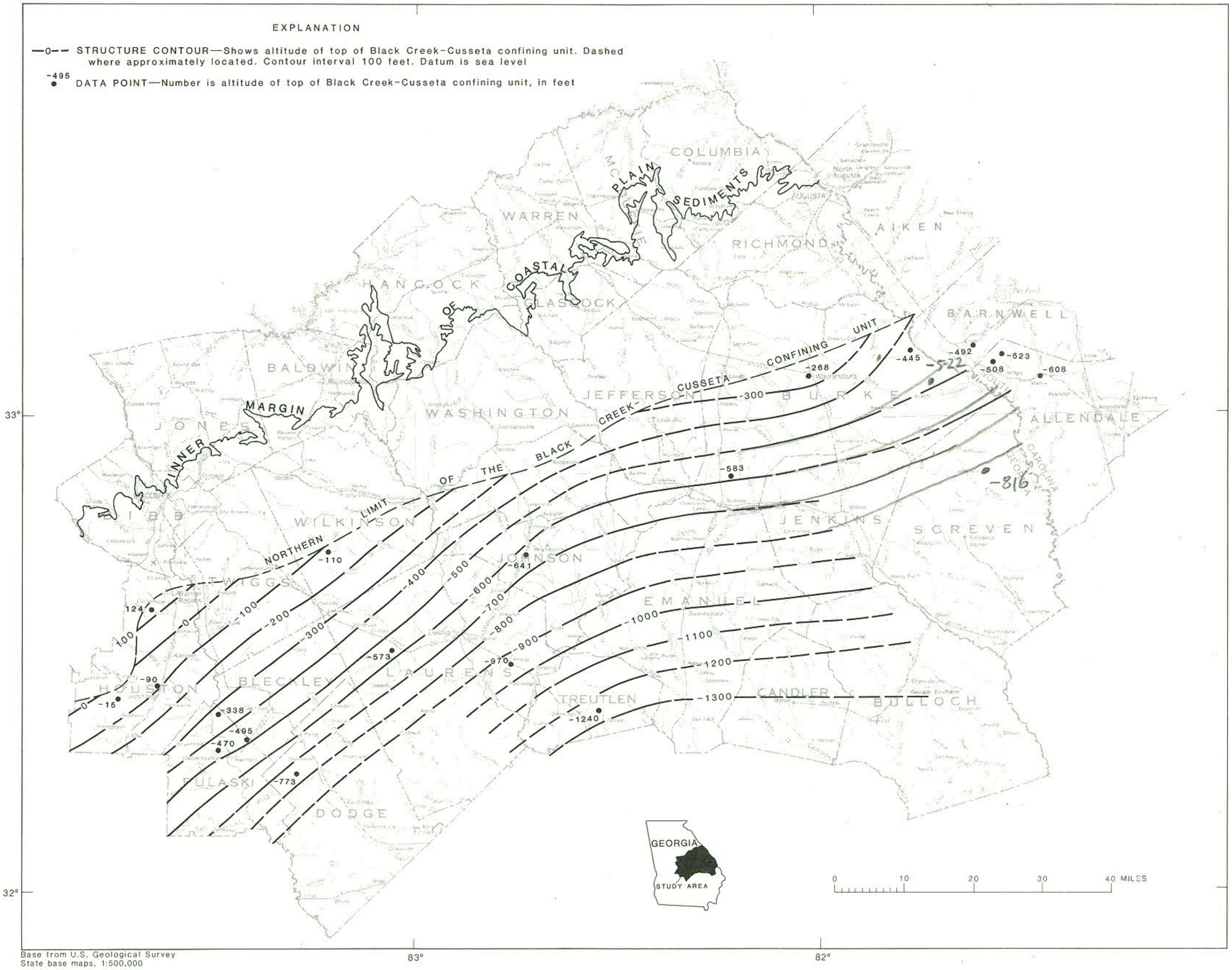


Figure 7.— Altitude of the top of the Black Creek-Cusseta confining unit.

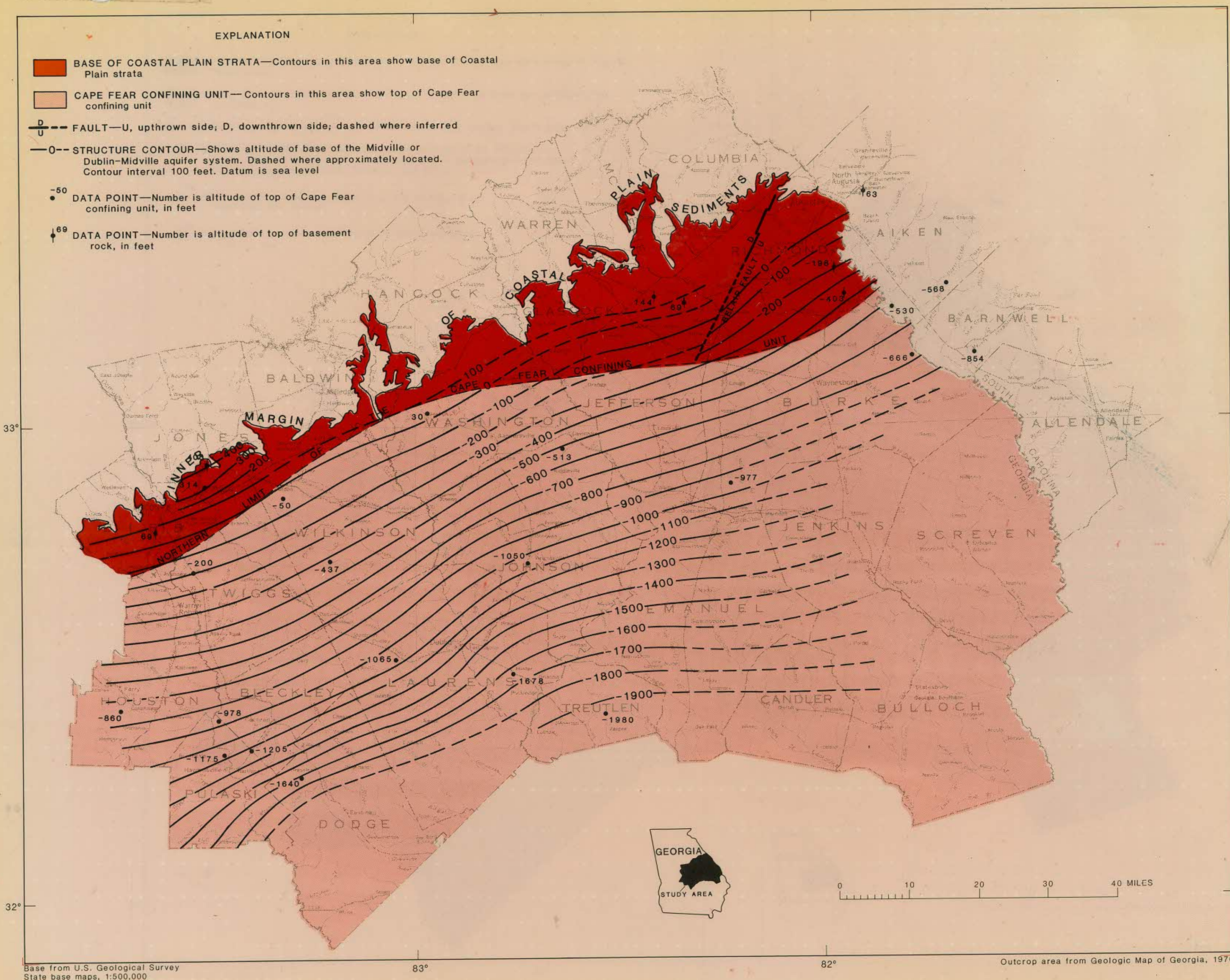


Figure 8.—Structural features and altitude of the base of the Midville and Dublin-Midville aquifer systems.

the Midville aquifer system was computed by subtracting the altitude of the Cape Fear confining unit, or base (fig. 8), from the altitude of its top (fig. 6).

The Dublin aquifer system ranges in thickness from about 145 ft in western Houston County to about 570 ft in eastern Laurens County (fig. 9). The Midville aquifer system ranges in thickness from about 195 ft in eastern Burke County, to about 645 ft in Dodge County (fig. 10). The Dublin-Midville aquifer system ranges in thickness from about 80 ft in northern Jefferson County, to about 620 ft in western Aiken County, S.C. (figs. 9, 10).

Aquifer and Well Properties

Specific capacity

The specific capacity of a well is defined as yield per unit of drawdown, generally expressed in gallons per minute per foot [(gal/min)/ft]. Values range from 0.7 (gal/min)/ft at well 27AA2 tapping the Dublin-Midville aquifer system in Richmond County, to 69.3 (gal/min)/ft at multiaquifer well 16U20 tapping both the Dublin and Midville aquifer systems in Houston County (Appendix A). Specific-capacity data are used to estimate aquifer transmissivity.

Transmissivity

The transmissivity of an aquifer is a measure of the aquifer's ability to transmit water, and generally is expressed in feet squared per day (ft^2/d). Transmissivity values listed in table 2 and Appendix A, and shown in figure 12, are probably somewhat lower than the total aquifer system transmissivity because they have been measured only from the interval of the aquifer system that was screened in a given well.

Transmissivities were calculated by analysis of time-drawdown or time-recovery data, and by application of a linear regression model to specific-capacity data (table 2; fig. 12; Appendix A). The linear regression model was based on paired specific-capacity and transmissivity data from 16 wells (table 2) distributed throughout the study area and was used to estimate an approximate relation of transmissivity to specific capacity. The resulting equation is listed below:

$$T = 420 + 554 \times SC, \qquad (1)$$

where

T is the estimated transmissivity in feet squared per day,

and

SC is the specific capacity in gallons per minute per foot.

The correlation coefficient is 0.9. Considering that a correlation coefficient of 1.0 indicates a perfect correspondence between two variables, a value of 0.9 indicates that specific capacity is a reasonable approximation of transmissivity. A comparison of observed transmissivity computed from time-drawdown or time-recovery data with estimated transmissivity computed from equation (1) is shown in figure 11. Transmissivity estimated using equation (1) differed from the transmissivity computed using time-drawdown or time-recovery data by an average of 30 percent, and ranged from 73 percent lower to 78 percent higher.

The transmissivity of the Dublin, Midville, and Dublin-Midville aquifer systems is shown in figure 12. In the northern third of the study area, the Dublin and Midville aquifer systems are combined and the contours on figure 12 are representative of the Dublin-Midville aquifer system. In the southern two-thirds of the study area, the Dublin and Midville aquifer systems are separate hydrologic units, and transmissivity data from wells tapping the Dublin and Midville aquifer systems, and from multiaquifer wells tapping both aquifer systems, are plotted on figure 12.

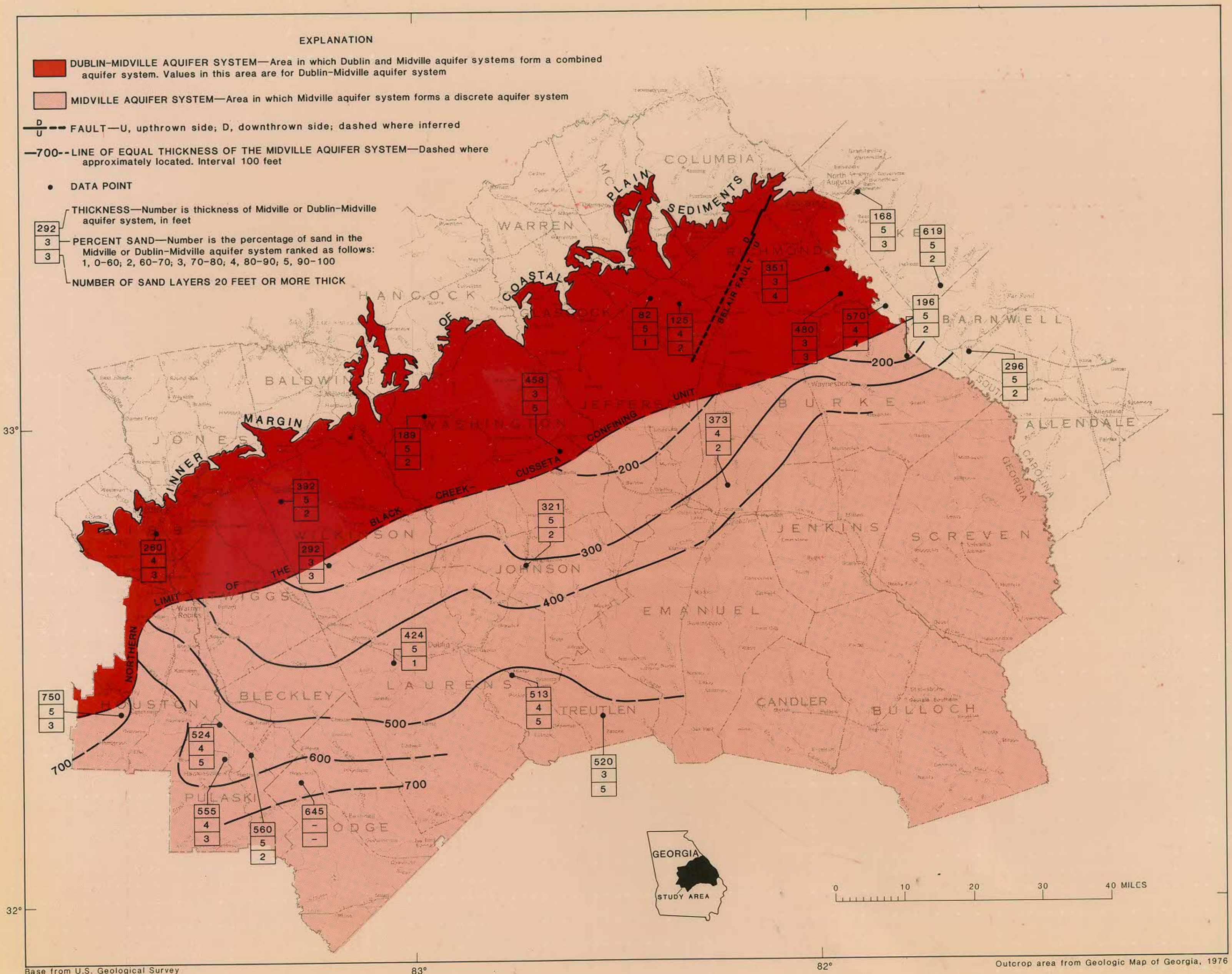


Figure 10.—Thickness and percentage of sand in the Midville and Dublin-Midville aquifer systems.

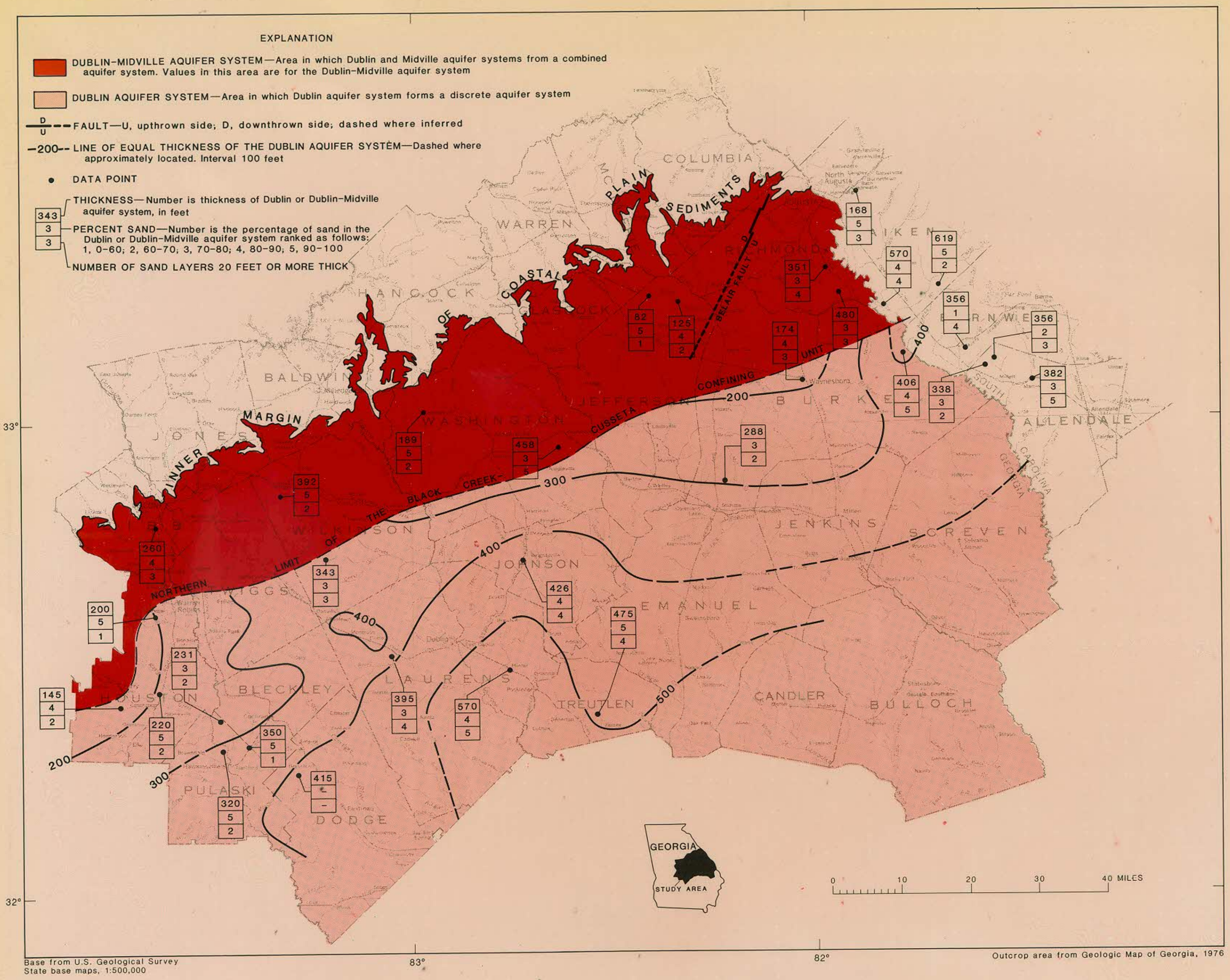


Figure 9.—Thickness and percentage of sand in the Dublin and Dublin-Midville aquifer systems.

Table 2.--Aquifer properties at wells in which aquifer tests were conducted

County	Well number	Aquifer	Open interval (feet)	Yield (gal/min)	Specific capacity [(gal/min)/ft]	Observed transmissivity (ft^2/d)	Hydraulic conductivity (ft/d)
Bibb	16V20	Dublin-Midville	50	565	9.8	4,100	80
Burke	31Z8	Dublin, Midville	83	--	--	31,000	370
	31Z4	do.	85	--	--	26,000	310
	28X1	Midville	40	110	2.1	7,100	180
	31Z2	Dublin, Midville	125	1,200	56.4	21,000	170
Houston	16U11	Midville	70	1,300	44.9	29,000	410
	17U13	do.	--	1,000	33.0	20,000	--
	16T2	Dublin, Midville	60	1,560	44.5	32,000	530
	17U8	do.	40	755	23.6	7,800	200
Richmond	29BB19	Dublin-Midville	20	--	--	6,900	340
	30AA14	do.	60	--	--	7,600	130
	30AA15	do.	20	--	--	6,600	330
	30BB33	do.	25	400	8.1	7,900	320
	30AA12	do.	137	505	4.0	3,400	25
	29BB3	do.	30	400	8.5	3,200	110
Twiggs	18V7	Dublin-Midville	100	2,060	52.8	37,000	370
	17V4	do.	90	1,175	12.1	8,700	100
	18V18	do.	--	(1)	--	32,000	--
	18V19	do.	--	(1)	--	34,000	--
	18V20	do.	--	(1)	--	34,000	--
	18V21	do.	--	(1)	--	32,000	--
Washington	22Y29	Dublin-Midville	68	1,040	22.1	7,300	110
	22Y32	do.	70	835	19.0	7,200	100
	22Y7	do.	30	220	4.0	2,700	90
Wilkinson	19W1	Dublin-Midville	210	(1)	--	6,800	30
	19W4	do.	50	705	7.3	3,300	65
	19W2	do.	210	(1)	--	5,100	25
	19W3	do.	210	(1)	--	3,600	15

[1] No yield recorded, observation well for aquifer test.

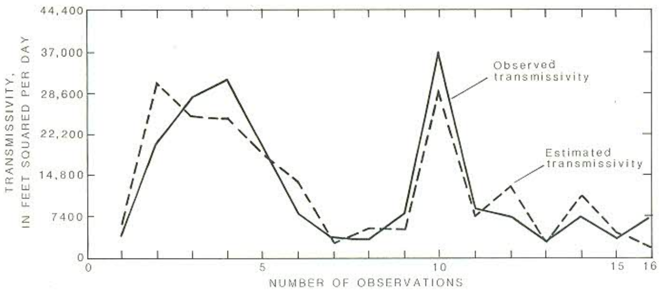


Figure 11.—Comparison of observed transmissivity computed from time-drawdown or time-recovery data with estimated transmissivity computed from equation(1).

The transmissivity of the Dublin-Midville aquifer system ranges from about 800 ft^2/d at well 27AA2 in northern Richmond County, to about 39,000 ft^2/d at well 16U20 in Houston County, and exceeds 20,000 ft^2/d in Twiggs, Houston, Wilkinson, Washington, Laurens, and Burke Counties (fig. 12; Appendix A). The transmissivity of the Dublin aquifer system ranges from 2,200 ft^2/d at well 19U1 in Twiggs County to about 35,000 ft^2/d at well 20U6 in Wilkinson County. A reduction in transmissivity in the Dublin aquifer system between wells 32U19 in Screven County and well 31T11 in Bulloch County (fig. 12; Appendix A) may be due to the effects of the Gulf Trough. (See section on Structure.) The transmissivity of the Midville aquifer system ranges from about 5,000 ft^2/d at well 21U4 in Laurens County to about 29,000 ft^2/d at wells 16U4 and 16U11 in Houston County (fig. 12; Appendix A).

Hydraulic conductivity

Hydraulic conductivity, like transmissivity, is a measure of an aquifer's ability to transmit water, under a hydraulic gradient, and is commonly expressed in feet per day (ft/d). Horizontal hydraulic conductivity is estimated by dividing the transmissivity at a well by the footage of the well bore open to the aquifer.

At the Wrightsville test well (well 24V1; Appendix A; pl. 1), core samples were collected for laboratory measurement of vertical and horizontal hydraulic conductivity of the confining units within and separating the aquifer systems. The samples were collected from: (1) a clay in the upper part of the Dublin aquifer system (607.8-608.7 ft), (2) the clayey lower confining unit (1,100.9-1,101.5 ft), and (3) a clay within the upper part of the Midville aquifer system (1,200.8-1,200.7 ft). The samples were sealed in wax and sent to Core Laboratories, Dallas, Tex., for permeameter analysis. Results of the analysis are summarized on table 3. Of the three samples, vertical and horizontal conductivity values were largest in the clay from the upper part of the Dublin aquifer system, and were smallest in the clay within the upper part of the Midville aquifer system. Horizontal hydraulic conductivity values ranged from 1.4×10^{-4} ft/d to 8.4×10^{-1} ft/d. Corresponding vertical hydraulic conductivity values ranged from 8.2×10^{-5} ft/d to 2.4×10^{-1} ft/d (table 3).

Horizontal hydraulic conductivities in the aquifer systems were estimated at 24 wells by dividing the observed transmissivity by the total open interval in the well. Values ranged from 15 ft/d to 530 ft/d (table 2).

Horizontal hydraulic conductivity is useful in estimating the transmissivity of the entire saturated thickness of an aquifer. For example, at well 28X1 in Burke County (Appendix A), the transmissivity estimated from aquifer-test data was 7,100 ft^2/d and is relative only to the open interval in the well (40 ft). On the other hand, the transmissivity

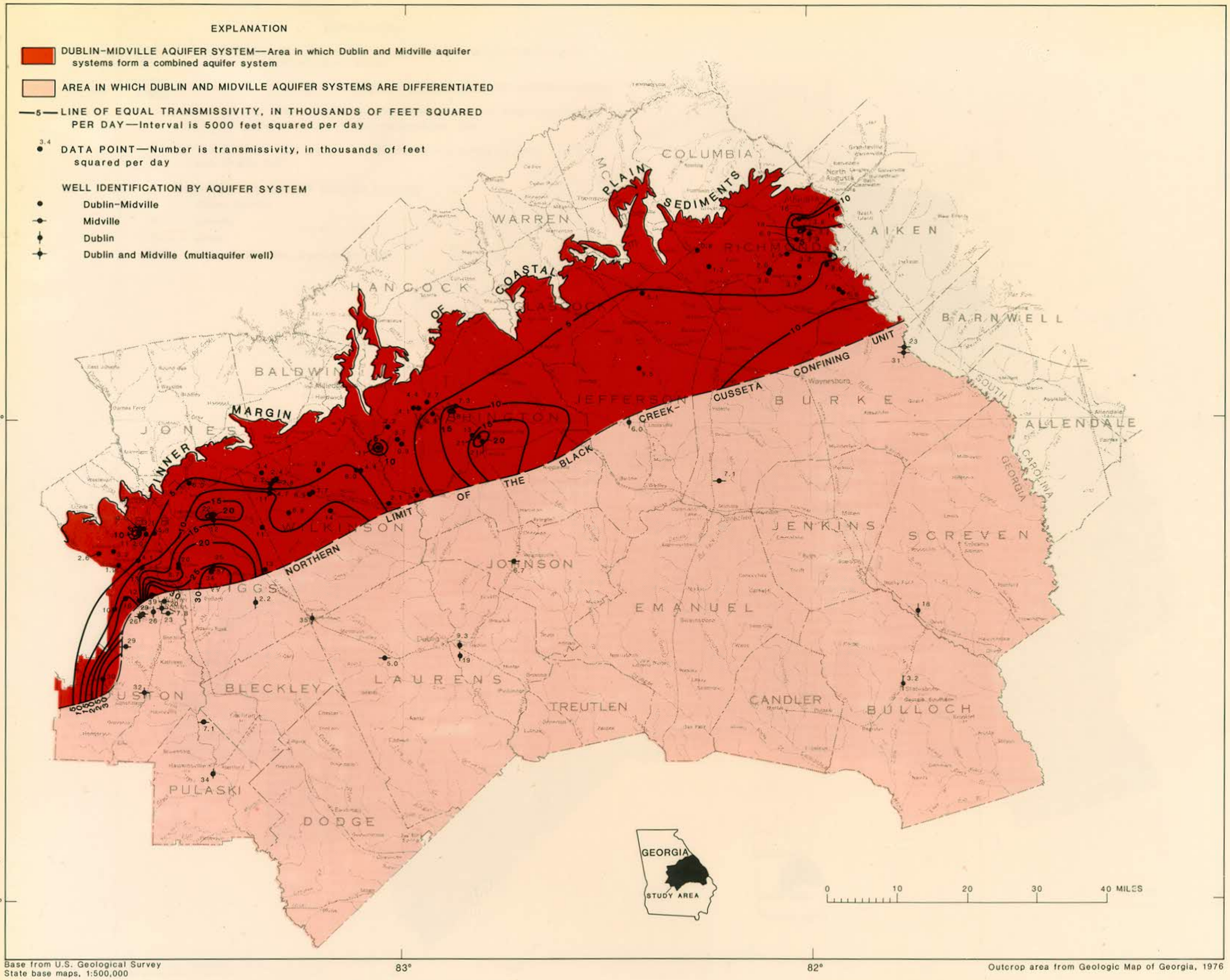


Figure 12.—Estimated transmissivity of the Dublin, Midville, and Dublin-Midville aquifer systems.

Table 3.--Hydraulic conductivity of sediments cored at well 24V1, near Wrightsville, Johnson County

Interval (ft)	Hydrologic unit	Lithologic description	Hydraulic conductivity[1] (ft/d) Horizontal	Vertical
607.8-608.7	Clay within Dublin aquifer system	Micaceous, carbonaceous, silt and clay	8.4×10^{-1}	2.4×10^{-1}
1,100.9-1,101.5	Black Creek-Cusseta confining unit	Micaceous, carbonaceous, clayey silt and very fine sand	2.2×10^{-2}	1.1×10^{-4}
1,200.0-1,200.7	Clay within Midville aquifer system	Micaceous clay and silt	1.4×10^{-4}	8.2×10^{-5}

[1]Values measured by permeameter analysis of core samples.

relative to the total saturated thickness of the aquifer system was about 40,000 ft^2/d and was estimated by multiplying the horizontal hydraulic conductivity (180 ft/d) by the total saturated thickness (about 220 ft). This value is probably somewhat larger than the actual transmissivity of the aquifer system because: (1) the estimated value does not account for variation in transmissivity within the aquifer system, and (2) it is likely that the screens were put in the most productive zones of the aquifer.

Yield

Yields exceeding 1,000 gal/min are obtained from wells tapping the Dublin aquifer system in Laurens and Screven Counties; the Midville aquifer system in Houston County; and the Dublin-Midville aquifer system in Twiggs, Washington, Wilkinson, and Jefferson Counties (Appendix A). Multiaquifer wells tapping both the Dublin and the Midville aquifer systems in Houston and Burke Counties also have been reported to yield more than 1,000 gal/min.

Ground-Water Levels

Seasonal and Long-Term Fluctuations

Water-level fluctuations in the Dublin, Midville, and Dublin-Midville aquifer systems are related to seasonal changes in precipitation, evapotranspiration, and pumping rates. A network of seven water-level monitoring wells was established during 1975-83 to monitor seasonal fluctuations and long-term trends (fig. 22; Appendix A). The wells are near Midville in Burke County (well 28X1), near Wrightsville in Johnson County (well 24V1), near Dublin in Laurens County (well 21U4), near McBean in Richmond County (well 30AA4), near Adams Park in Twiggs County (well 18U1), near Gordon in Wilkinson County (well 19W4), and in northern Pulaski County (well 18T1).

Although there are no exact data to indicate the extent of water-level fluctuations where the Dublin-Midville aquifer system is unconfined in its outcrop area, annual water-level fluctuations probably range from 1 to 15 ft, depending on the location and the amount of precipitation. For example, the water level in well 30AA4, tapping the Dublin-Midville aquifer system where it is semiconfined, about 4 mi south of the outcrop area at McBean, Richmond County, fluctuated about 1.3 ft in 1980 and 0.8 ft in 1981 (fig. 13). A comparison of the water level in this well with the cumulative departure of precipitation at National Weather Service station 090495 (Augusta WSO AP (R) GA) near Augusta, Richmond County (fig. 13), indicates that the water level is influenced primarily by seasonal changes in precipitation. From June 1979 to April 1981, mean monthly water levels in the well declined 0.5 ft, corresponding to a period of lower-than-normal precipitation. Small rises in the water level during this period probably reflected changes in local pumping. Water-level fluctuations in the nearby outcrop area of the Jacksonian aquifer (Vincent, 1982) probably reflect water-table conditions and correspond to those that would be expected in wells located in the outcrop area of the Dublin-Midville aquifer system. For example, the average annual water-level fluctuations at well 21T1 north of Dexter, Laurens County (location shown in fig. 3), ranged from about 6 to 13 ft during 1973-82 (fig. 14).

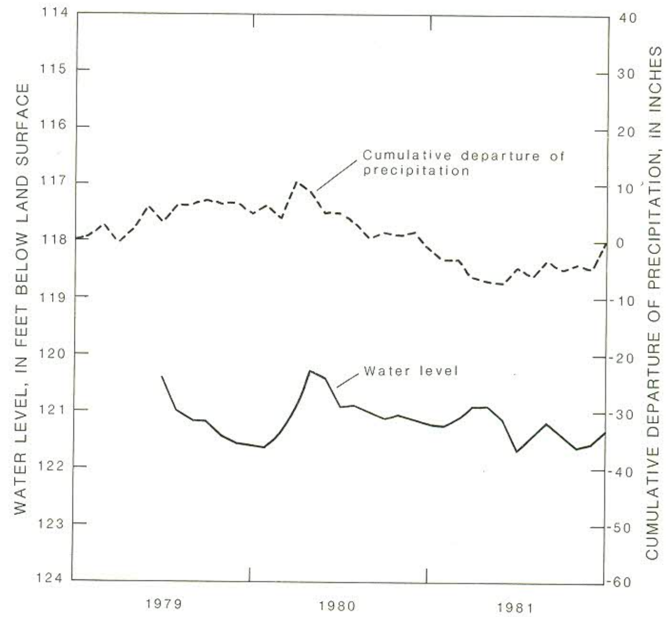


Figure 13.—Mean monthly water levels in the Dublin-Midville aquifer system at well 30AA4, and the cumulative departure of precipitation at National Weather Service station 090495, Richmond County, 1979-81.

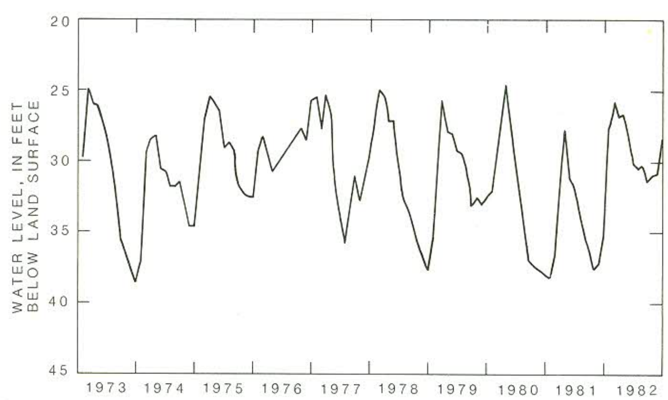


Figure 14.—Mean monthly water levels in the Jacksonian aquifer at well 21T1, Laurens County, 1973-82. Modified from Stiles and Mathews (1983).

Mean monthly water levels in the Dublin aquifer system at well 18U1 near Adams Park in Twiggs County showed annual fluctuations ranging from about 0.9 to 1.8 ft during 1975-82 (fig. 15). Although the well is about 3 miles from the outcrop area, water levels in the well are probably affected both by seasonal changes in precipitation and by changes in pumping rates in the Huber-Warner Robins area, about 9 mi north of the well, where pumpage exceeded 30 Mgal/d during 1980. A comparison of mean monthly water levels in well 18U1 with the cumulative departure of precipitation at National Weather Service station 095443 (Macon WSO AP (R) GA) near Avondale in southern Bibb County (fig. 15) shows that prior to March 1977, water levels in the well seemed to show a greater response to precipitation. This is suggested by a water-level rise of 1.8 ft from March 1976 to March 1977 that generally corresponded to a period of greater-than-normal precipitation (fig. 15). After March 1977, the water level in the well was probably influenced more by changes in pumping rates than by precipitation. This is suggested by a water-level decline of about 1.7 ft from March 1977 to March

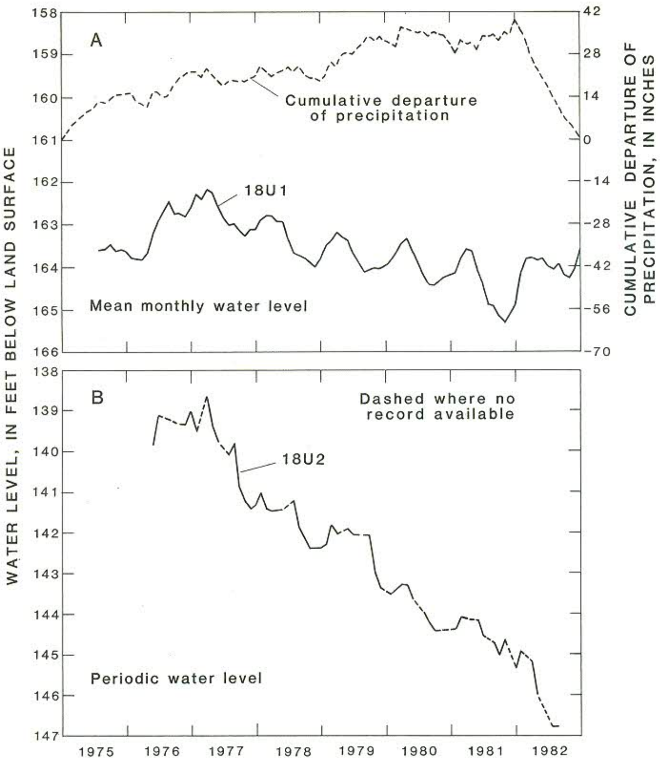


Figure 15.— Water-level fluctuations in wells 18U1 and 18U2, Twiggs County, and the cumulative departure of precipitation at National Weather Service station 095443, Bibb County, 1975-82.

1982, a period of generally greater-than-normal precipitation and increased pumping in the Huber-Warner Robins area; and by a water-level rise of about 1.4 ft from November 1981 to December 1982, a period of lower-than-normal precipitation and reduced pumping in the Huber-Warner Robins area.

Well 18U2 is about 1,000 ft northeast of well 18U1 and taps the Midville aquifer system (see location, fig. 3). Periodic water-level measurements in well 18U2 from June 1976 to October 1982 indicate a decline in water level of about 7 ft and a seasonal response to pumping similar to that in well 18U1 (fig. 15). The larger decline in well 18U2 is probably due to greater pumping from the Midville aquifer system than from the Dublin aquifer system in the Huber-Warner Robins area (table 4).

Mean monthly water levels in the Midville aquifer system at wells 28X1 (fig. 16) near Midville, Burke County, and well 24V1 (fig. 17) near Wrightsville, Johnson County, show fluctuations primarily in response to changes in regional pumping.

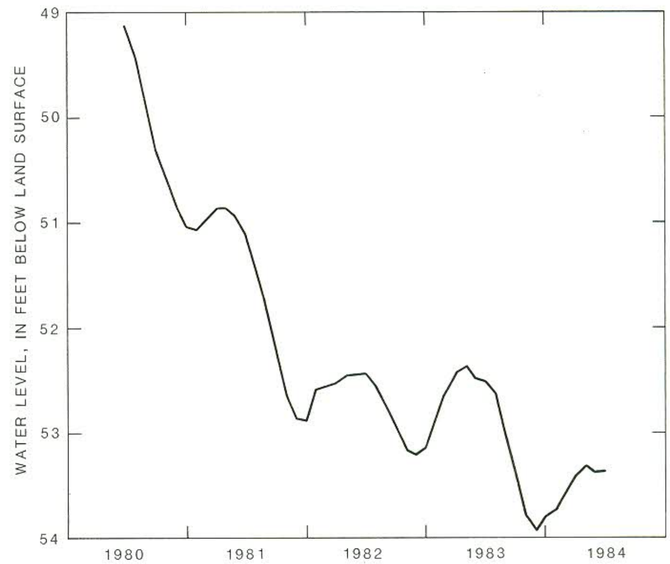


Figure 16.—Mean monthly water levels in the Midville aquifer system at well 28X1, Burke County, 1980-84.

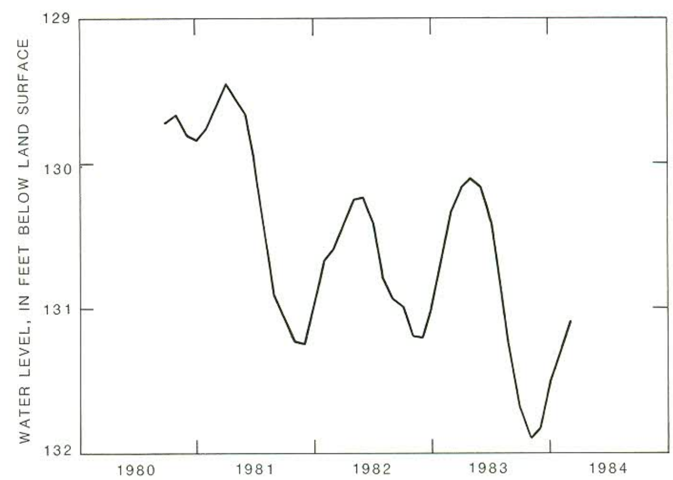


Figure 17.—Mean monthly water levels in the Midville aquifer system at well 24V1, Johnson County, 1980-84.

This is because the aquifer system is deeply buried and is not affected by local precipitation, and the outcrop area is too far away for varying rates of recharge to have a pronounced effect on the water level. Well 24V1 is about 13 mi south of the outcrop area and well 28X1 is about 18 mi south (fig. 3). In addition, there is little, if any, local pumping from the Midville aquifer system in these areas. (See section on Water Use.) Most of the pumping is to the north where the Dublin and Midville aquifer systems combine to form the Dublin-Midville aquifer system. Mean monthly water levels in well 28X1 declined 4.6 ft from June 1980 to January 1984 (fig. 16). Similarly, mean monthly water levels in well 24V1 declined 2.1 ft from November 1980 to November 1983 (fig. 17). These declines probably reflect increased regional pumping.

Potentiometric Surface

The potentiometric surface of an aquifer is an imaginary surface representing the altitude to which water would rise in tightly cased wells that penetrate the aquifer (Lohman, 1972). The potentiometric surfaces of Dublin, Midville, and Dublin-Midville aquifer systems were contoured primarily from well data. Within and near the outcrop area, potentiometric contours cross rivers and streams where the altitude of the stream surface was considered to be nearly coincident with the altitude of the potentiometric surface. Although there are few data to indicate the extent of water-level fluctuations in the outcrop area, annual water-level fluctuations probably range from 1 to 15 ft, depending on the location and the amount of precipitation. (See section on Seasonal and Long-Term Fluctuations.) Consequently, natural water-level fluctuations in the outcrop area of the Dublin-Midville aquifer system are probably too small to alter the configuration of the potentiometric surface at the contour interval used in figures 18 and 19.

The potentiometric maps on figures 18 and 19 show the principal direction of ground-water flow and areas of recharge and discharge. Four major discharge areas--the Ocmulgee River to the west, the Savannah River to the east, and the Oconee and Ogeechee Rivers in between--are drains to the regional ground-water-flow system. Ground-water discharge to these rivers is indicated by potentiometric contours that bend upstream in an inverted "V" pattern showing that the hydraulic gradient is toward the stream. The potentiometric contours also show two major ground-water divides--one to the southwest between the Ocmulgee and Oconee Rivers, and the other to the southeast between the Oconee and Savannah Rivers. There also are a large number of small ground-water divides in the outcrop area that generally correspond to interstream drainage divides. Significant quantities of precipitation recharge the aquifer near divides in the outcrop area.

In the southern two-thirds of the study area, the Dublin and Midville aquifer systems are separate hydrologic units. However, owing to a scarcity of data in this part of the area, figures 18 and 19 show data from both the Dublin and Midville aquifer systems. In a few parts of the study area, there are sufficient water-level data to define potentiometric differentials between several aquifer systems (fig. 20). Water-level measurements indicate that: (1) the potentiometric surface of the Midville aquifer system was about 20 ft higher than the potentiometric surface of the Dublin aquifer system in central Twiggs County in September 1981, and about 2 ft higher near Dublin, Laurens County, in January 1982; and (2) the potentiometric surface of the Midville aquifer system was about 12 ft higher than the potentiometric surface of the Gordon aquifer system (table 1) near Midville, Burke County, during May-June 1980.

In a multiaquifer well, the water level is a composite of the head of each of the aquifers tapped by the well. For example, near Dublin in Laurens County, well 21U2 (Appendix A) taps the Jacksonian aquifer, the Gordon aquifer system,

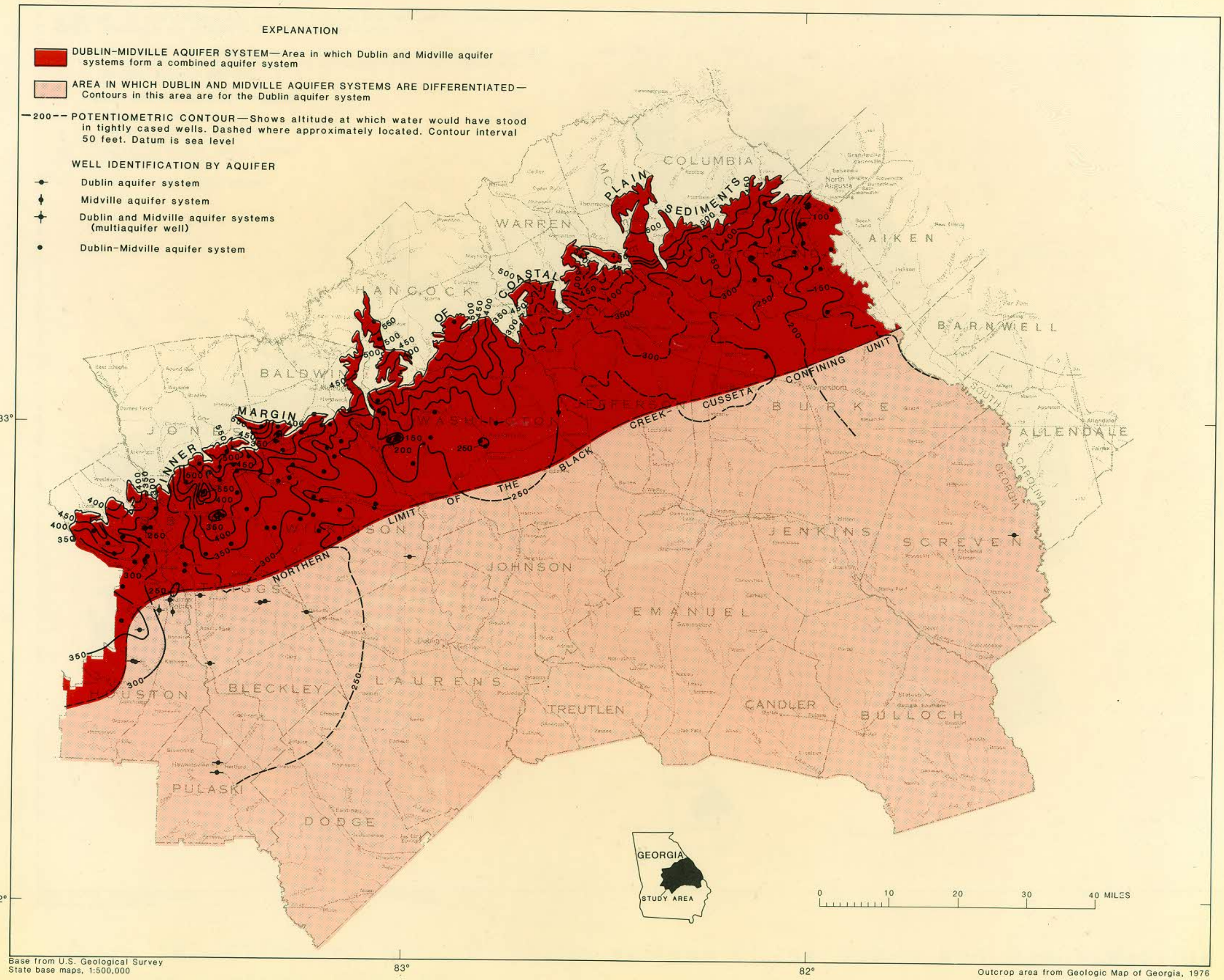


Figure 18.—Estimated potentiometric surface of the Dublin and Dublin-Midville aquifer systems, 1944-50.

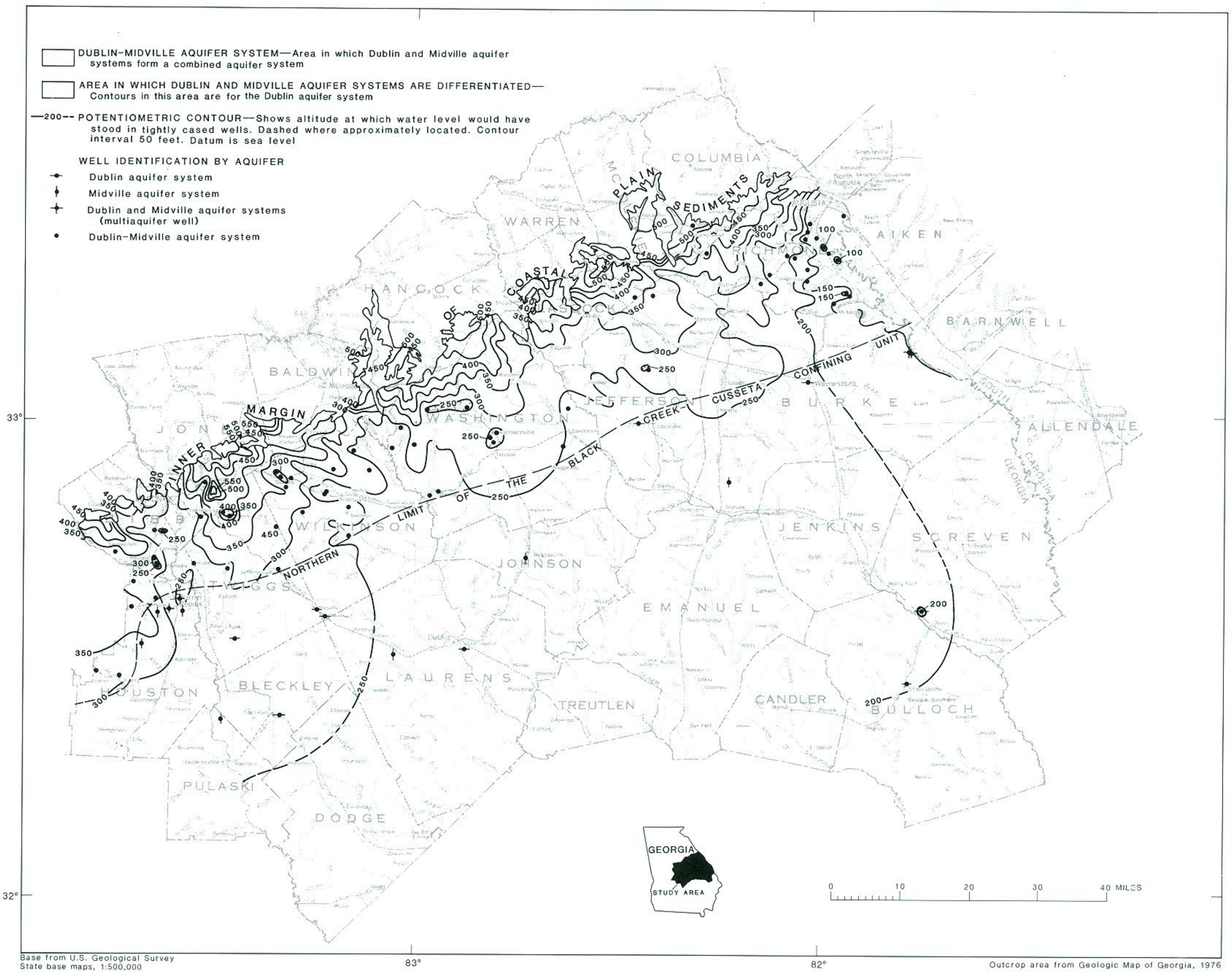


Figure 19.—Potentiometric surface of the Dublin and Dublin-Midville aquifer systems, October 1980.

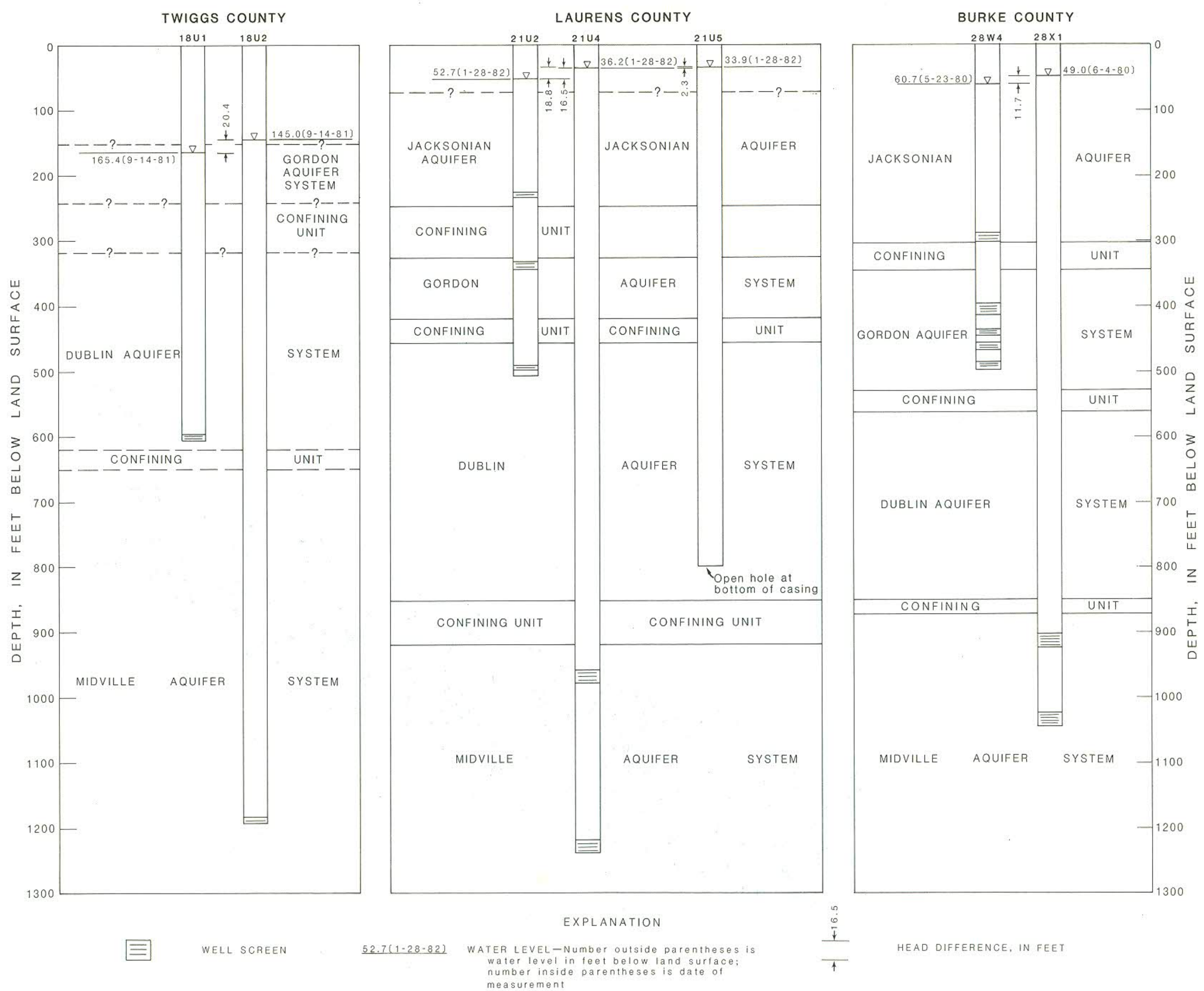


Figure 20.—Head difference between the Dublin and Midville aquifer systems in Twiggs and Laurens Counties and between the Gordon and Midville aquifer systems in Burke County.

and the Dublin aquifer system. A comparison of its water level with that of nearby well 21U5, which taps only the Dublin aquifer system, shows that the water level in well 21U5 was about 18 ft higher than that in well 21U2 (fig. 20). This large difference probably means that the water level in well 21U2 is more representative of the Gordon aquifer system and the Jacksonian aquifer. The water level in well 21U4 tapping only the Midville aquifer system was 16.5 ft higher than in multiaquifer well 21U2 (fig. 20).

In the northern one-third of the study area, the maps shown on figures 18 and 19 are representative of the potentiometric surface of the Dublin-Midville aquifer system. In this area, discontinuous confining units within the Dublin-Midville aquifer system (pls. 1 and 2) may result in local confinement (Area A, fig. 23). Evidence for local zones of confinement within Upper Cretaceous sediments near Gordon, Wilkinson County, were outlined in a report by the Georgia Geologic Survey (1980).

Estimated 1944-1950 potentiometric surface

The map of the 1944-50 potentiometric surface was constructed mainly from data collected during 1944-50. Some data from 1938-44 and 1950-71 were used in areas where there was no significant water-level change.

The predevelopment potentiometric surface of an aquifer represents natural conditions before man-induced stresses such as pumping were applied. Over most of the study area, the 1944-50 potentiometric surface (fig. 18) of the Dublin, Midville, and Dublin-Midville aquifer systems is probably a close approximation of the predevelopment surface, because ground-water withdrawals were small and were limited to widely distributed pumping centers. Exceptions occurred in the vicinity of pumping centers such as: (1) Sandersville and an area southwest of Deepstep, in Washington County; (2) Augusta, in Richmond County; (3) Steven's Pottery, in Baldwin County; and (4) the Huber-Warner Robins area, in Twiggs and Houston Counties (fig. 18). In these areas, the potentiometric surface was sufficiently lowered to form small cones of depression and the principal direction of ground-water flow was toward the pumping centers. Over most of the rest of the study area, the principal direction of ground-water flow was toward major rivers and streams.

October 1980 potentiometric surface

The configuration of the October 1980 potentiometric surface is similar to the 1944-50 surface except near areas of large-scale pumping, where water levels have declined (fig. 19). Pumping has produced major cones of depression in southern Bibb County, at Deepstep, in Washington County, and at Gordon, in Wilkinson County (fig. 19). Continued pumping also caused expansion of existing cones at Sandersville in Washington County, and in the Huber-Warner Robins area in Twiggs and Houston Counties. Small cones of depression also developed near Augusta, Richmond County, south of Macon, Bibb County, north of Louisville, Jefferson County, and north of Dover, Screven County.

Ground-water withdrawals from the Dublin-Midville aquifer system southwest of Deepstep, Washington County, have caused water levels to decline over a large area (fig. 22). As a result, potentiometric contours have shifted northward and the ground-water divide between Bluff Creek and Gumm Creek has become less pronounced since 1944-50 (compare figs. 18 and 19).

Mine dewatering operations

Commercial kaolin and other clay deposits in the study area are mined by the open-pit method and the clays are hauled by truck or transported by pipeline as a slurry to a central processing plant. A typical mining operation involves exploratory core drilling to measure the depth, thickness, areal extent, and quality of the deposit, followed by removal of the overburden and mining of the clay.

Flooding of the mines by water from the Dublin-Midville aquifer system and overlying aquifers is possible, and this is prevented at several mine pits by a system of dewatering wells constructed in, and upgradient from, the pits. The dewatering wells are pumped continuously to maintain the water level below the working level of the mine.

A typical mine dewatering operation is that of the Huber Corporation mine (Oxford, 1968) near Jeffersonville, Twiggs County (fig. 21). Eight dewatering wells were designed and located to maximize drawdown and maintain the water level below the lowest planned altitude of mining (about 250 ft). Each well is pumped continuously at rates ranging from 2,000 to 3,400 gal/min. Prior to pumping, water in the Dublin-Midville aquifer system at the site generally flowed westward toward Buck Branch (A, fig. 21). The amount of drawdown produced by the dewatering operation (B, fig. 21) was sufficient to reverse the direction of ground-water flow in the vicinity of the mine (C, fig. 21). Due to the intersection of adjacent cones of depression (well interference), actual drawdown at the site was probably greater than that shown in figure 21.

Long-Term Water-Level Declines

During the predevelopment or prepumping period, water levels in the Dublin, Midville, and Dublin-Midville aquifer systems remained relatively steady because aquifer recharge and discharge were in natural equilibrium. After pumping commenced, ground-water withdrawals in some areas caused a reduction in compressive aquifer storage and a corresponding decline in water levels (Lohman, 1972, p. 8). During 1944-50, cones of depression formed at pumping centers in Washington, Richmond, Baldwin, Twiggs, and Houston Counties (fig. 19). Although data for the predevelopment period are lacking, it is likely that water levels declined slightly prior to 1944-50 in the vicinity of these pumping centers.

The few data available indicate that from 1950 to 1980, water levels in the southern two-thirds of the study area declined little, if any. Water levels in the northern one-third of the study area, however, declined as much as 50 ft in the vicinity of the kaolin mining and processing centers in Twiggs, Wilkinson, and Washington Counties; and at industrial and municipal pumping centers near Augusta in Richmond County and south of Macon in Bibb County (fig. 22). Areas having declines of 25 ft or less were widely scattered throughout the northern third of the study area.

Recharge

Because much of the study area is covered by sandy soil, it is likely that a large percentage of the 45 inches of average annual rainfall enters the ground and is available to recharge the underlying aquifers. The Dublin-Midville aquifer system is recharged by precipitation in the vicinity of drainage divides, and also along a narrow and discontinuous outcrop belt that generally parallels the Fall Line (fig. 5). In northern Twiggs, Wilkinson, and Washington Counties, and southern Jones, Baldwin, and Hancock Counties, confining units have been cut through by ancient streams whose channels are filled with permeable sand and gravel (channel sands of LaMoreaux, 1946). The channel sands provide conduits through which precipitation can recharge the aquifer system (fig. 23).

Recharge also occurs where the Baker Hill-Nanafalia confining unit is absent, or is too sandy or thin to provide effective confinement, and potentiometric gradients are vertically downward (Area C, fig. 23). The Baker Hill-Nanafalia confining unit is apparently absent north of well 24X5 in Washington County, south of well 24V1 in Johnson County, and south of well 23T1 in Laurens County (pl. 1). The Baker Hill-Nanafalia confining unit is less than 20 ft thick in the eastern part of the study area between wells 28X1 and SRP-P5A (section A-A', pl. 1) and wells P4A and A1-324 (section D-D', pl. 2). In these areas, the overlying Gordon aquifer system (table 1) is probably hydraulically connected with the Dublin or Dublin-

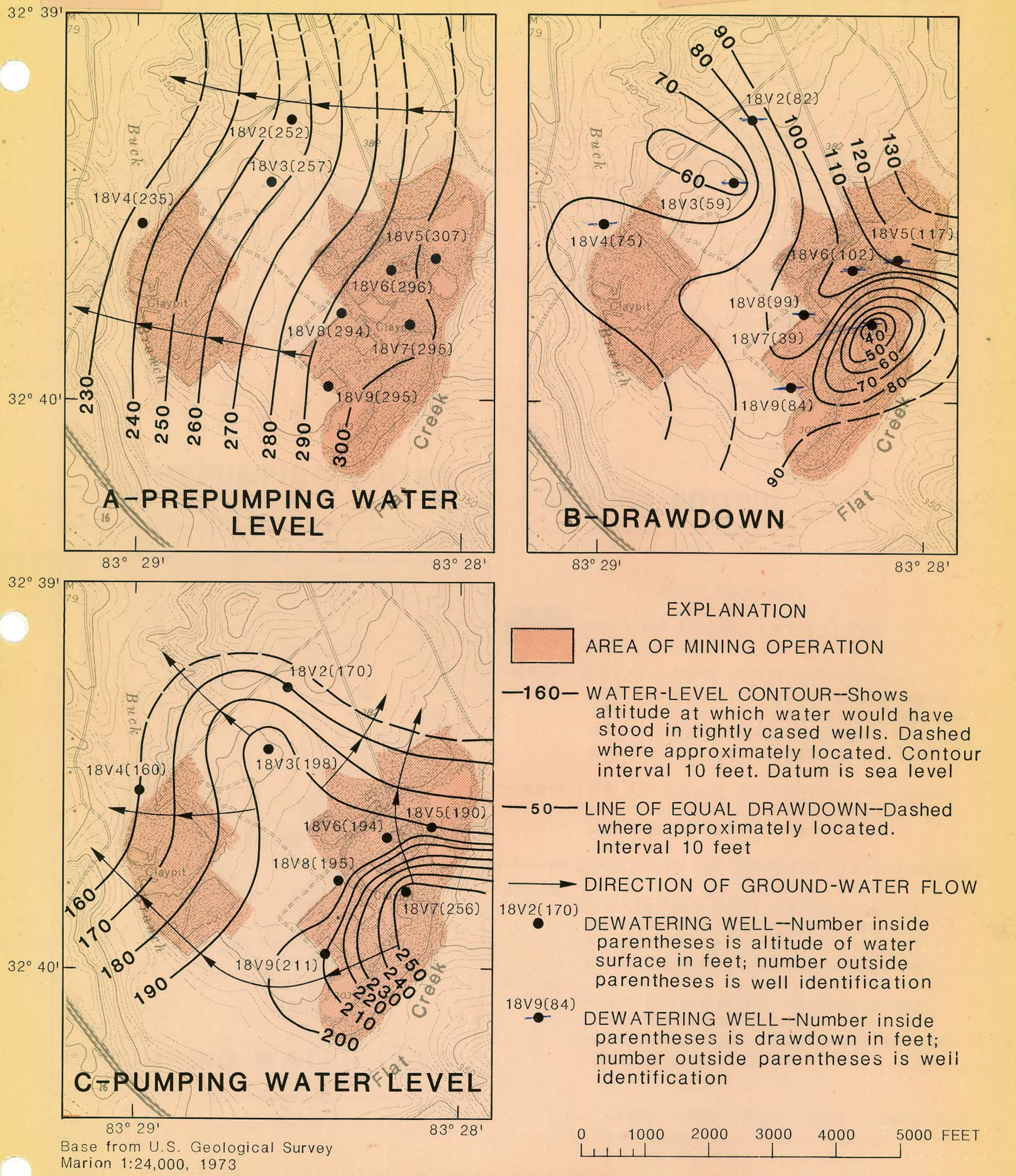


Figure 21.--Huber Corporation mine dewatering operation and its effect on ground-water flow, central Twiggs County, 1968-72.

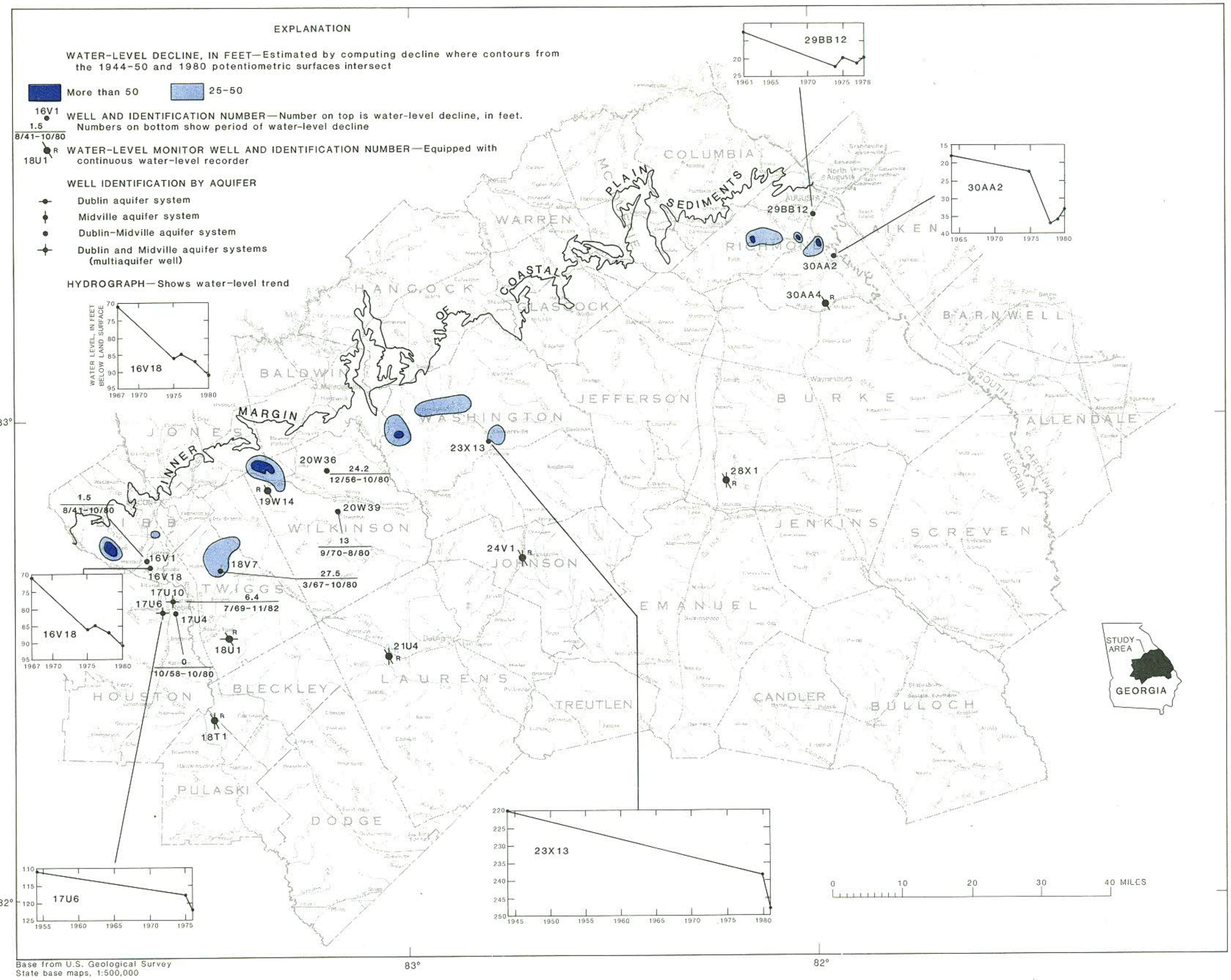


Figure 22.—Location of water-level monitoring wells and water-level declines in the Midville and Dublin-Midville aquifer systems, 1950-80.

Midville aquifer systems. If potentiometric gradients in these areas are vertically downward, this interconnection would provide a conduit for recharge to enter the aquifer systems.

Discharge

South of the outcrop area where potentiometric gradients are upward, water from the Dublin and Midville aquifer systems is discharged into overlying aquifer systems (Areas D and E, fig. 23). Vertical potentiometric gradients favoring upward flow were observed between the Dublin and Midville aquifer systems in central Twiggs County and near Dublin, Laurens County; and between the Gordon (table 1) and Midville aquifer systems near Midville, Burke County (fig. 20). The water level in multiaquifer well 21U2 near Dublin, Laurens County (Appendix A) indicates that there is a potential for vertical flow from the Dublin and Midville aquifer systems into the overlying Jacksonian aquifer and Gordon aquifer system (fig. 20).

In the outcrop area, the Dublin-Midville aquifer system discharges water largely into streams (Area B, fig. 23). Ground-water discharges as indicated by streamflow measurements during the drought period of October-November 1954 (Thomson and Carter, 1955) are plotted on figure 24. These data represent the measured stream discharge divided by the drainage area of the stream, and were generally greatest in the eastern part of the study area. The high discharge in this area may be the result of: (1) the high storage properties of the aquifer, which result in delayed drainage to streams, or (2) a greater interconnection between aquifers and streams in that area.

WATER USE

An estimated 121 Mgal/d was pumped from the Dublin, Midville, and Dublin-Midville aquifer systems during 1980 (table 4). Of this amount, about 75 percent was used by industry, 23 percent by municipalities, and 2 percent by agriculture.

The Dublin aquifer system supplied an estimated 9.3 Mgal/d during 1980, of which about 56 percent was used by municipalities, 32 percent by industries, and 12 percent by agriculture. Major users of the Dublin aquifer system include the cities of Warner Robins and Dublin, and industries in Houston, Pulaski, and Screven Counties.

The Midville aquifer system is not used in most of the study area because water can be obtained from shallower aquifers at lower cost. During 1980, the only major users of the Midville aquifer system were the city of Warner Robins and industrial and agricultural users in Houston County, which withdrew an estimated 11.1 Mgal/d.

During 1980, an estimated 100.7 Mgal/d was withdrawn from the Dublin-Midville aquifer system (table 4). Maximum withdrawals were at the kaolin mining and processing centers in Twiggs, Wilkinson, and Washington Counties where pumpage exceeded 72.8 Mgal/d. Pumping by kaolin companies accounted for about 60 percent of the total water withdrawn from the Dublin, Midville, and Dublin-Midville aquifer systems. About 54 percent of the water pumped by the kaolin industry is used for processing and pipeline slurry operations, and 46 percent is for mine dewatering operations (LaMoreaux and Associates, 1980). The amount of kaolin mined in Georgia increased from about 9 million tons during 1941-50 to about 46 million tons during 1971-80 (fig. 25). It is likely that the amount of water pumped from the Dublin-Midville aquifer system by the kaolin industry has increased proportionately during 1941-80.

WELL CONSTRUCTION

Wells tapping the Dublin, Midville, and Dublin-Midville aquifer systems typically have screenline construction. This

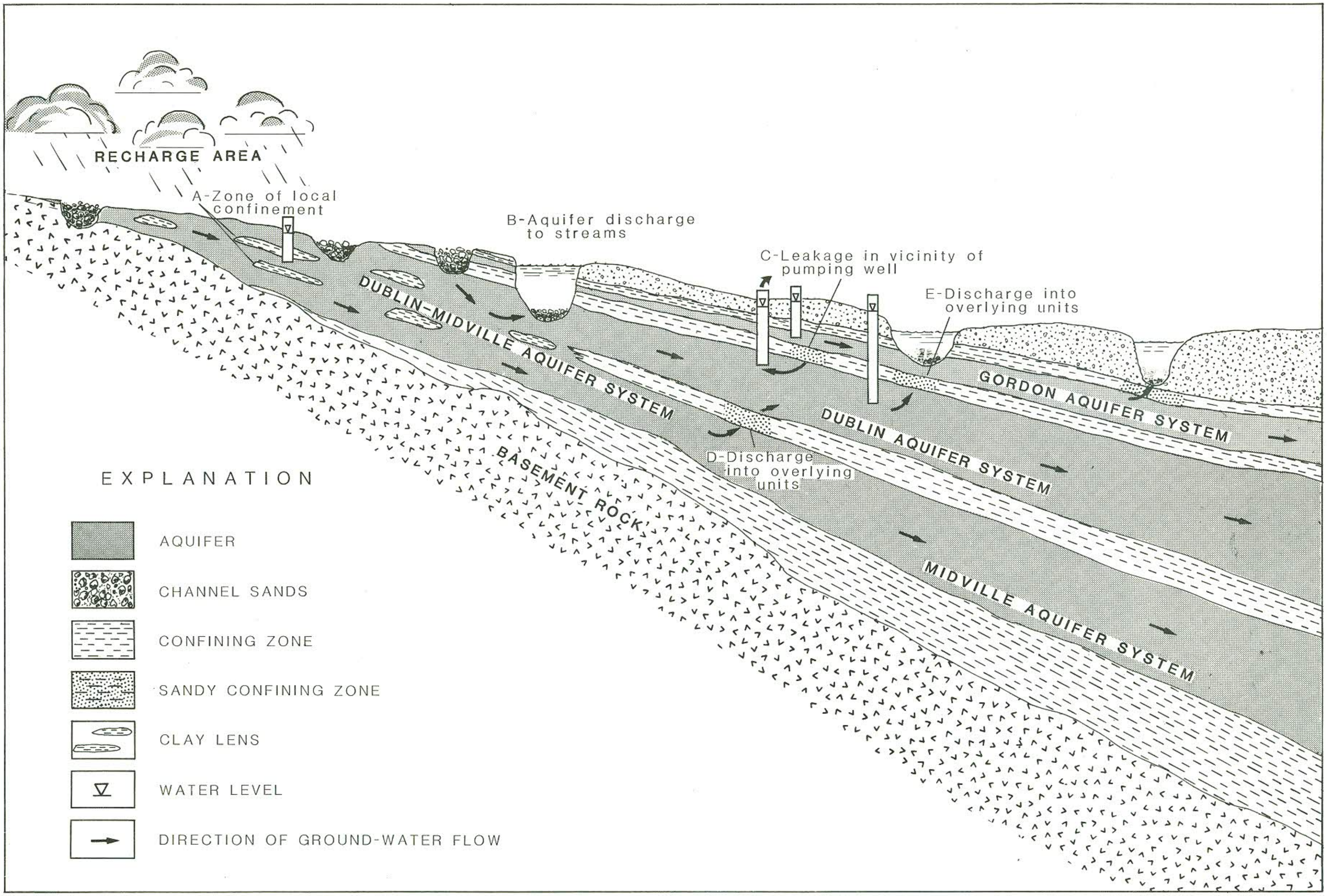


Figure 23.—Schematic diagram of recharge and discharge, and the direction of ground-water flow in the Gordon, Dublin, Midville, and Dublin-Midville aquifer systems.

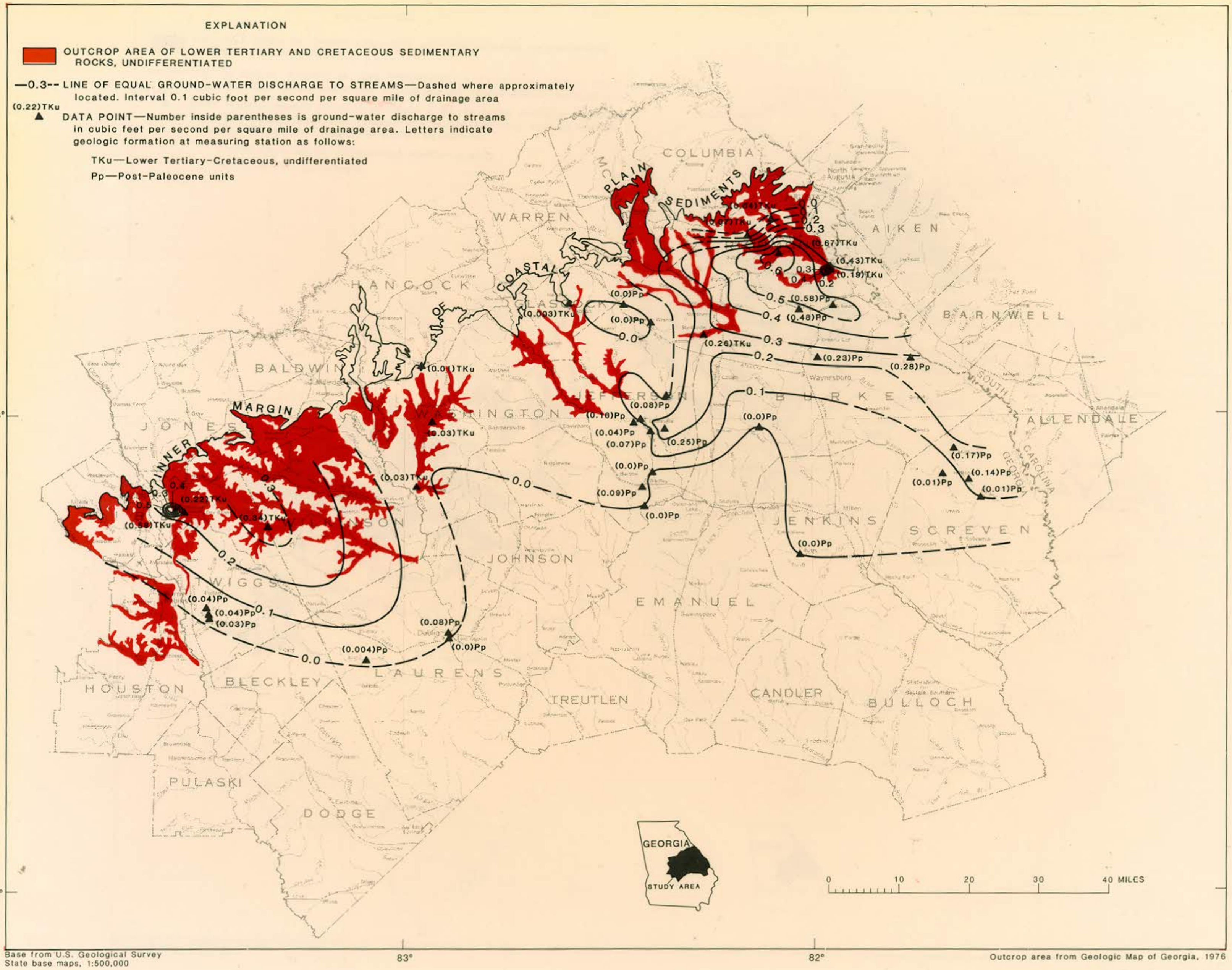


Figure 24.—Estimated ground-water discharge to streams from aquifers in east-central Georgia, October-November 1954.

Table 4.--Estimated water use from the Dublin, Midville, and Dublin-Midville aquifer systems, 1980

[<, less than]

County	Ground-water use (Mgal/d)												
	Dublin aquifer system				Midville aquifer system				Dublin-Midville aquifer system				
	Agricultural 1/	Municipal	Industrial	County total 2/	Agricultural 1/	Municipal	Industrial	County total 2/	Agricultural 1/	Municipal	Industrial	County total 2/	Grand total 2/
Bibb	--	--	--	--	--	--	--	--	--	--	3.1	3.1	3.1
Burke	0.1	0.3	0.1	0.5	--	--	0.1	0.1	--	--	--	--	.6
Emanuel	--	--	--	--	--	--	--	--	--	--	--	--	--
Houston	.4	3.4	1.4	5.2	0.3	8.4	2.3	11.0	--	1.6	--	1.6	17.8
Jefferson	--	--	--	--	--	--	--	--	0.3	<.1	.7	1.0	1.0
Johnson	.1	.1	--	.2	--	--	--	--	--	--	--	--	.2
Jones	--	--	--	--	--	--	--	--	--	.3	--	.3	.3
Laurens	.3	.7	.5	1.5	--	--	--	--	--	--	--	--	1.5
Pulaski	--	.3	.7	1.0	--	--	--	--	--	--	--	--	1.0
Richmond	--	--	--	--	--	--	--	--	--	10.7	9.2	19.9	19.9
Screven	--	--	.6	.6	--	--	--	--	--	--	--	--	.6
Twiggs	.2	.1	--	.3	--	--	--	--	--	.1	38.2	38.3	38.6
Washington	--	--	--	--	--	--	--	--	.2	.2	10.7	11.1	11.1
Wilkinson	--	<.1	<.1	<.1	--	--	--	--	--	1.5	23.9	25.4	25.4
Totals 2/	1.1	4.9	3.3	9.3	0.3	8.4	2.4	11.1	0.5	14.4	85.8	100.7	121.1

1/ Values are estimated growing-season withdrawals averaged over a 365-day period.
2/ Totals do not include domestic use.

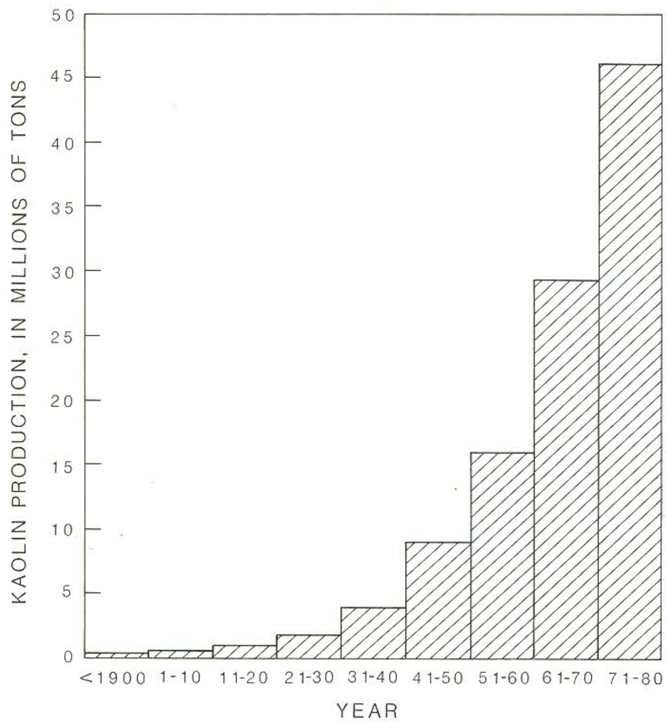


Figure 25.—Georgia kaolin production, 1900-1980. Modified from Stockman and Pickering (1977).

type of construction and the lithologic and geophysical properties of aquifer sediments are typified by well 16U1 at Warner Robins, Houston County (fig. 26; Appendix A).

In some areas, the individual aquifer systems supply insufficient quantities of water and are used together or in combination with other aquifers. Multiaquifer wells in Warner Robins, Houston County (well 16U1, fig. 26; Appendix A), and in Burke County (wells 31Z1, 31Z3, 31Z4, and 31Z8, Appendix A) tap both the Dublin and Midville aquifer systems. In Jefferson County, multiaquifer wells (wells 26AA1, 26Y7, and 26Y8, Appendix A) tap both the Dublin-Midville aquifer system and the overlying Gordon aquifer system (table 1).

WATER QUALITY

Water from the Dublin, Midville, and Dublin-Midville aquifer systems is generally of good chemical quality. With the exception of high concentrations of iron in the central part of the study area, constituent concentrations are within Georgia Environmental Protection Division (1977) standards and recommended limits for drinking water (Appendix B).

Water-quality analyses indicate that concentrations of dissolved solids and most other constituents generally increase from the outcrop area southward (fig. 27; Appendix B). Values of pH are generally lower near the outcrop area and range from a low of 3.7 at well 20W44 in Wilkinson County to a high of 8.6 at well 13T11 in Bulloch County (fig. 28; Appendix B). The low values of pH in the northern part of the study area are probably the result of reactions involving the oxidation of a sulfur species or ferrous iron (Hem, 1970, p. 93-95).

The presence of iron in drinking water is objectionable because of its taste, staining capacity, and encrusting property. The Georgia Environmental Protection Division (1977) recommends a concentration limit of 300 μg/L of iron in drinking water. Concentrations of dissolved iron range from less than 300 μg/L near the outcrop area and in the southern part of the study area, to more than 6,700 μg/L at well 23U3 in Laurens County in the central part of the study area (fig. 28).

Iron in ground water may be derived from decaying organic debris or from iron-bearing minerals, such as pyrite, in the aquifer sediments. The iron in these materials is dissolved as it comes in contact with oxygenated ground water, producing soluble ferrous iron and sulfate (Hem, 1970, p. 124). Near the outcrop area where concentrations of dissolved oxygen are high, iron concentrations generally are less than 300 μg/L. This comparatively low concentration is

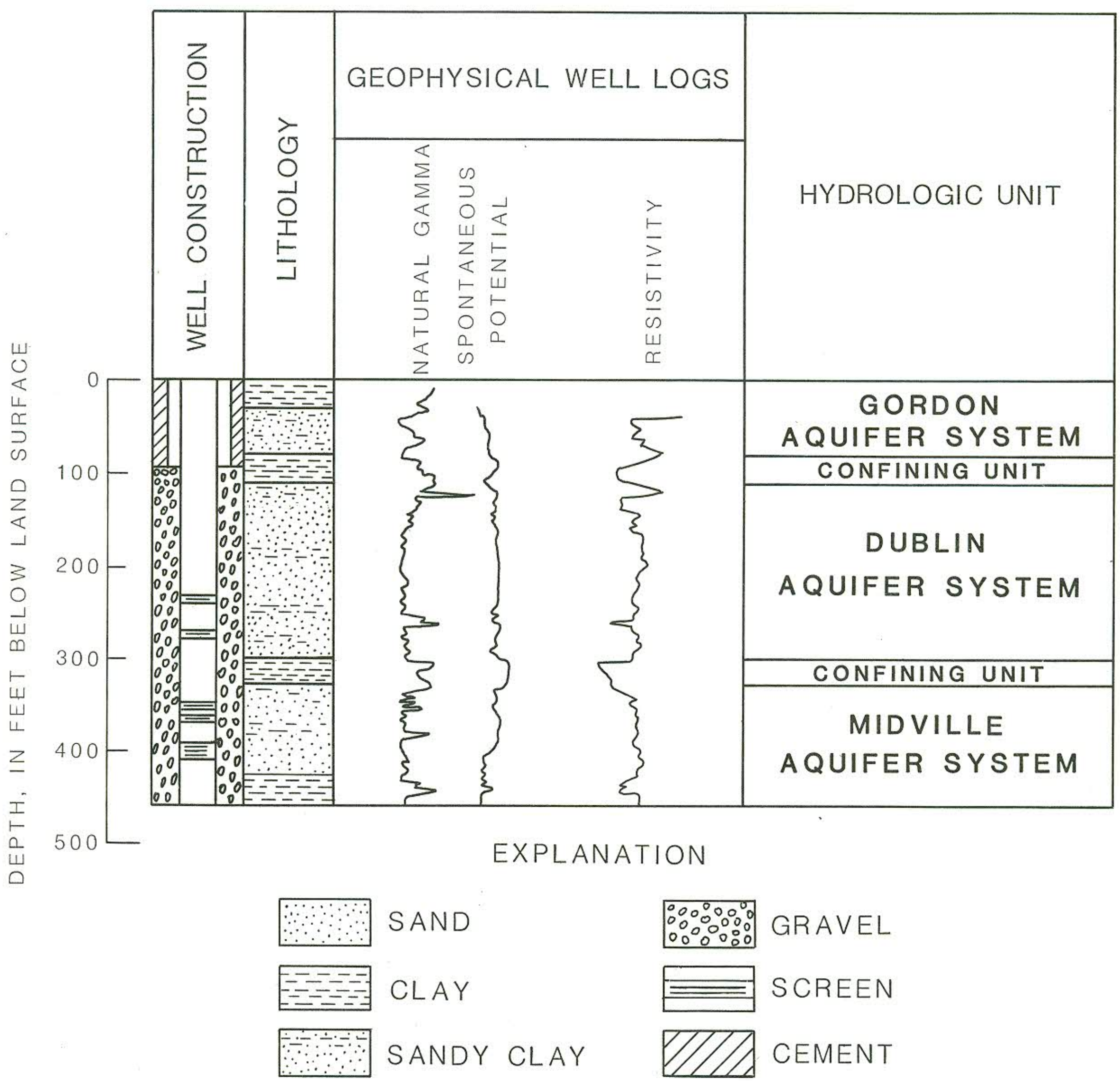


Figure 26.—Well construction and lithologic and geophysical properties of aquifer sediments at well 16U1, near Warner Robins, Houston County.

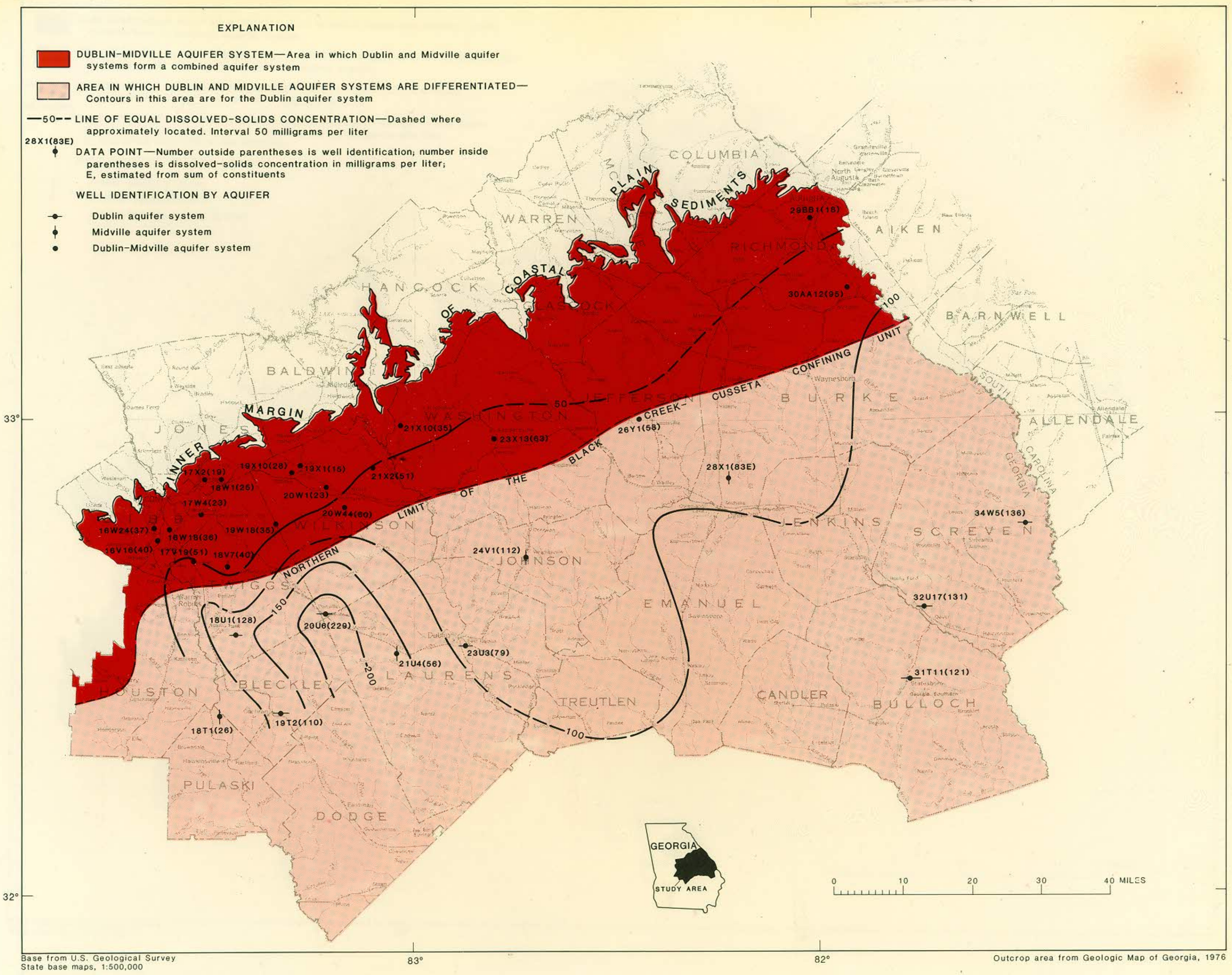


Figure 27.—Dissolved-solids concentration of water from the Dublin, Midville, and Dublin-Midville aquifer systems, 1940-82.

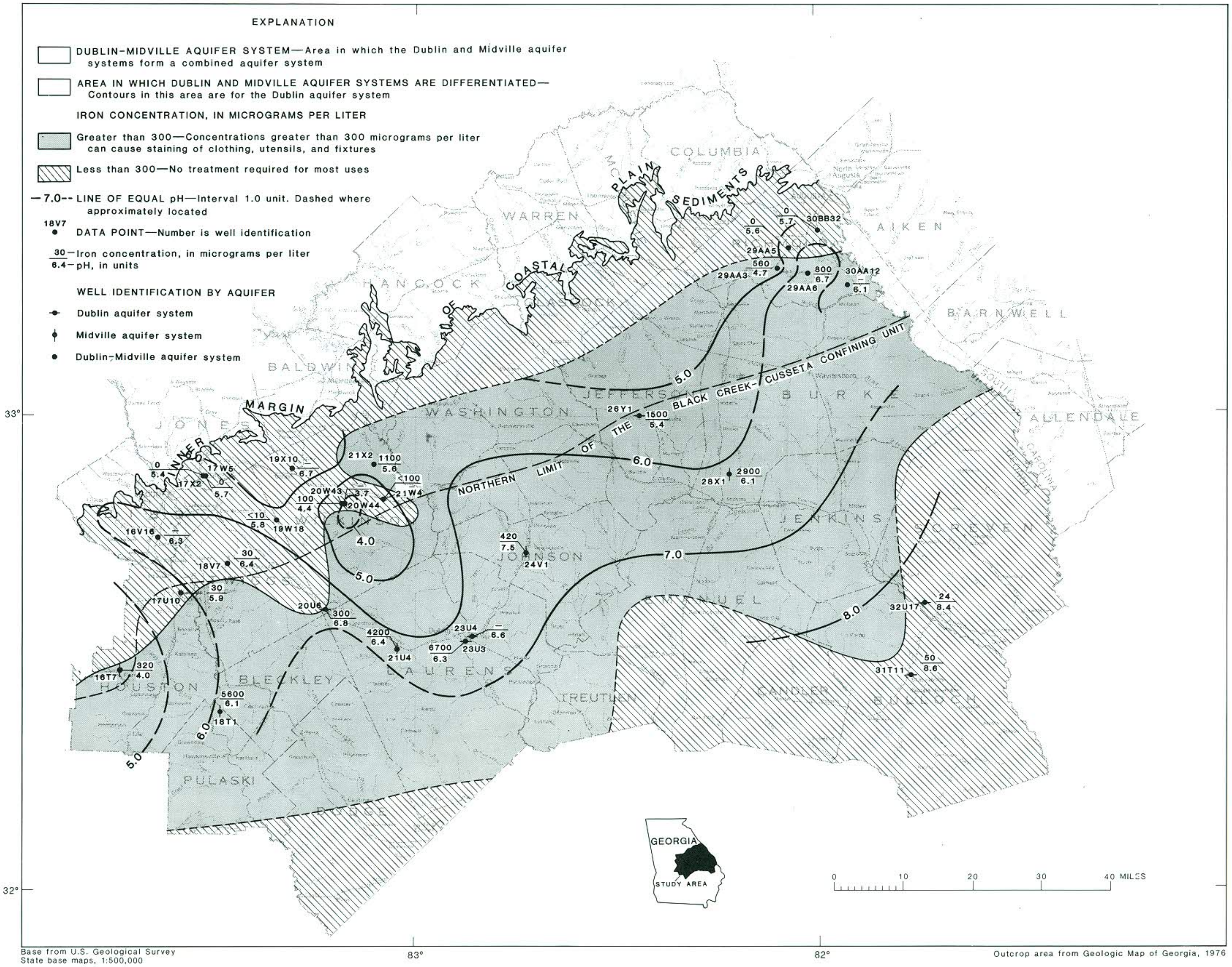


Figure 28.—Iron concentration and pH of water from the Dublin, Midville, and Dublin-Midville aquifer systems, 1 2-82.

due to a short period of contact between the oxygenated ground water and the source material. As the ground water moves downdip, more iron goes into solution as the dissolved-oxygen supply is gradually depleted. As a result, iron concentrations in the central part of the study area exceed the 300 µg/L recommended limit for drinking water. Farther downdip ferrous iron may combine with a reduced sulfur species and precipitate to form a ferrous sulfate, such as pyrite (Jackson and Patterson, 1982), or ferrous iron may combine with colloidal ferric hydroxide and coprecipitate (Langmuir, 1969). These reactions, together with cation exchange, decrease the concentration of iron to less than 300 µg/L in the southern part of the study area (fig. 28).

Sulfide

SUMMARY

In east-central Georgia, interlayered sand and clay of Paleocene and Late Cretaceous age form the Dublin and Midville aquifer systems. In the northern third of the study area, the systems combine to form the Dublin-Midville aquifer system. The aquifer systems have thicknesses that range from 80 to 645 ft and include discontinuous clay layers that result in local zones of confinement. Estimated hydraulic conductivities of aquifer sediments range from 15 to 530 ft/d. The aquifer systems have transmissivities that range from about 800 to 39,000 ft^2/d, and wells yield as much as 3,400 gal/min. Water from the aquifer systems is of good quality except in the central part of the study area, where iron concentrations are as high as 6,700 µg/L and exceed the recommended limit of 300 µg/L for drinking water.

During 1980, the aquifer systems supplied an estimated 121 Mgal/d, about 60 percent of which was withdrawn for kaolin mining and processing. Water levels in the aquifer systems have shown little change since 1950 in the southern two-thirds of the study area, but localized declines of as much as 50 ft have occurred due to pumping near industrial, municipal, and kaolin mining and processing centers in the northern third of the study area.

Recharge of the aquifer systems by precipitation occurs within and adjacent to the outcrop areas of aquifer sediments, and where ancient stream channels eroded through the overlying confining zone and were filled with permeable sand. Ground-water discharge occurs largely to streams in the outcrop area. Within the southern half of the study area, aquifer discharge occurs through leakage into overlying units.

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APPENDICES

Appendix A.--Record of selected wells

[Use: A, agricultural; D, domestic; I, industrial; P, public supply; O, observation, Water Level: Reported levels are given in feet, measured levels are given in feet and tenths; L, airline measurement; F, flowing. Yield: <, less than. Transmissivity: †, determined from aquifer test; *, estimated from regression equation]

County	Well numbers	Georgia Geologic Survey No.	Latitude-longitude	Name or owner	Date drilled or modified	Depth of well (ft)	Depth of casing (ft)	Diameter of well (in.)	Altitude of land surface	Aquifer(s)	Water level: Above (+) or below (-) land surface (ft)	Water level: Date of measurement	Yield (gal/min)	Specific capacity (gal/min/ft)	Use	Remarks
Bibb	16V25	—	324252- 0834437	B & G Hooper Hill #2, well 2	—	210	205	4	400	Dublin-Midville	-60 -70.2	1965 10-24-80	80	4	I	Screen 205-210 ft. Transmissivity = 2,600 ft^2/d.*
	17W4	—	324812- 0833232	Tom's Foods, 1	—	245	100	10	335	do.	-30 -24.4	06-30-57 01-03-79	1,140	—	I	Screen 100-110, 178-188, 200-220, 232-242 ft. Water-quality analysis, 06-09-75. Well 6 in GGS Bull. 72.
	16V2	7	324230- 0833911	Bibb Co. Water Authority, well 2	1941	220	106	10	335	do.	-63.9 -57.6	05-12-41 10-24-80	565	9.8	P	Screen 106-121, 126-146, 174-179, 210-220 ft. Transmissivity = 4,100 ft^2/d.† Well 39 in GGS Bulletin 72.
	16V18	1853	324220- 0833857	Packaging Corp. of America, 2	03-07-67	240	160	10	335	do.	-71 -91.1	03-13-67 10-24-80	350	10.3	I	Screen 160-180, 192-207, 215-230 ft. Transmissivity = 6,100 ft^2/d.*
	16W18	2117	324619- 0833743	Georgia Kraft, 1	03-27-46	244	60	8	310	do.	-34 -54.2	04-20-46 01-29-79	410	8.9	I	Screen 60-70, 160-170, 212-217 ft. Water-quality analysis, 06-19-68. Transmissivity = 5,300 ft^2/d.*
	16V1	8	324229- 0833908	Cochran Field, 1	—	368	132	10	385	do.	-94 -95.5	08- -41 10-24-80	620	10.3	I	Screen 132-147, 224-234, 314-319, 353-368 ft. Transmissivity = 6,100 ft^2/d.*
	16W8	357	324656- 0833826	Streitman Biscuit Co.	—	190	110	—	370	do.	-104	10-02-53	450	4.8	I	Screen 110-115, 125-130, 155-160, 175-190 ft. Transmissivity = 3,100 ft^2/d.*
	16W5	—	324615- 0833903	Armstrong Cork, 4	1948	285	120	8	251	do.	-42	06-15-48	630	7.6	I	Screen 120-130, 150-165, 225-235, 255-260 ft. Transmissivity = 4,600 ft^2/d.* Well 23 in GGS Bulletin 72.
	16W27	—	324616- 0833743	Georgia Kraft, 3	09-10-79	290	150	—	305	do.	-60 -71.0	10-02-79 10-24-80	250	2.8	I	Screen 150-190, 200-210, 270-280 ft. Transmissivity = 2,000 ft^2/d.*
	16V19	—	324340- 0834228	B & G Goodall, 2	—	165	155	4	410	do.	-50	05-21-76	100	5	D	Screen 155-165 ft. Transmissivity = 3,200 ft^2/d.*
	16W25	2158	324611- 0833903	Armstrong Cork, 4A	—	245	125	—	290	do.	-60	12-18-69	525	18.7	I	Screen 120-155, 225-240 ft. Transmissivity = 11,000 ft^2/d.*
	16V12	—	324154- 0834200	B & G Thornhill, 1	—	133	127	4	315	do.	-70	1968	30	2.7	D	Screen 127-133 ft. Transmissivity = 1,900 ft^2/d.*
	16V21	—	324220- 0833908	Packaging Corp. of America, 1	—	240	150	10	370	do.	-71 -84	03-03-67 12-29-77	350	21.9	I	Transmissivity = 13,000 ft^2/d.*
	16W24	—	324622- 0833925	Armstrong Cork, 5	1964	243	100	—	320	do.	-87 -54	12-18-64 11-11-82	465	—	I	Screen 100-105, 133-153, 168-173, 228-243 ft. Water-quality analysis, 06-09-75.
	16V16	—	324424- 0833837	Standard Oil Co.	—	191	142	—	340	do.	-70	04-01-59	40	—	I	Screen 142-147, 157-162 ft. Well 33 in GGS Bulletin 72.
Bleckley	19T2	—	322243- 0832038	Middle Georgia College, 1A	1970	680	620	—	370	Dublin	-100 -92	05- -70 10-24-80	—	—	P	Screen 620-680 ft. Water-quality analysis, 06-10-75.
Bulloch	31T11	1044	322723- 0814624	Statesboro, 5	1969	1,526	1,390	—	202	do.	0	09-08-66	80	5.0	P	Packer test 1390-1411 ft. Water-quality analysis, 01-14-66. Transmissivity = 3,200 ft^2/d.*
Burke	31Z3	—	330847- 0814537	Ga. Power Plant Vogtle, Makeup 5	08-26-77	851	437	10	197	Dublin, Midville	-25.1 -29.2	08-24-77 10-22-80	3,335	26.9	I	Screen 437-462, 468-483, 498-512, 536-546, 550-572, 676-696, 720-732, 788-820 ft. Transmissivity = 15,000 ft^2/d.*
	31Z1	—	330846- 0814552	Ga. Power Plant Vogtle, Makeup 6	12-22-77	850	450	10	214	do.	-42.1 -43.3	12-18-77 10-22-80	3,320	40.5	I	Screen 450-462, 470-482, 490-505, 515-530, 540-552, 557-567, 620-635, 674-694, 711-728, 780-792, 810-820 ft. Transmissivity = 23,000 ft^2/d.*
	31Z8	—	330828- 0814548	Vogtle observation well, 5	1972	850	513	2	211	do.	-38	07-08-72	—	—	O	Screen 513-533, 555-576, 702-723, 829-850 ft. Transmissivity = 31,000 ft^2/d.†
	28X1	3444	325232 0821315	USGS SEX TW-1 Midville	05- -80	1,045	903	4	269	Midville	-49.0 -53.0	06-04-80 11-15-82	110	2.1	O	Screen 903-923, 1025-1045 ft. Water-quality analysis, 05-23-80. Transmissivity = 7,100 ft^2/d.†
	31Z4	—	330830- 0814542	Vogtle observation well, 1	—	883	502	2	208	Dublin, Midville	-37.9	07-08-72	—	—	O	Screen 502-524, 545-566, 735-756, 862-883 ft. Transmissivity = 26,000 ft^2/d.†
	29Y3	—	330516- 0820115	Waynesboro, 3	1981	557	447	20,8	310	Dublin	-106	02-14-81	1,200- 1,250	—	P	Screen 447-557 ft.

Appendix A.--Record of selected wells--Continued

[Use: A, agricultural; D, domestic; I, industrial; P, public supply; O, observation, Water Level: Reported levels are given in feet, measured levels are given in feet and tenths; L, airline measurement; F, flowing. Yield: <, less than. Transmissivity: †, determined from aquifer test; *, estimated from regression equation]

County	Well numbers	Georgia Geologic Survey No.	Latitude-longitude	Name or owner	Date drilled or modified	Depth of well (ft)	Depth of casing (ft)	Diameter of well (in.)	Altitude of land surface	Aquifer(s)	Water level: Above (+) or below (-) land surface (ft)	Water level: Date of measurement	Yield (gal/min)	Specific capacity (gal/min/ft)	Use	Remarks
Burke	28W4	—	325227-0821301	Midville Expmt. Sta., 2 (Va. Well & Supply, 2)	—	500	292	—	269	Gordon, Jacksonian	-60.7	05-23-80	—	—	A	Screen 292-302, 395-415, 434-444, 455-465, 484-494 ft.
	31Z2	—	330827-0814543	Ga. Power Plant Vogtle, TW-1 (Stndby mkup #1)	1972	928	505	10	214	Dublin, Midville	-40 -33.0	07-09-72 11-13-82	1,200	56.4	I	Screen 505-535, 555-585, 695-705, 730-750, 815-850 ft. Transmissivity = 21,000 ft^2/d.†
Columbia	28BB1	254	332701-0820853	Grovetown, 1	1951(?)	320	120	—	545	Dublin-Midville, Basement	-105	03- -51	160	—	P	Open hole, 120-320 ft.
	27BB8	—	332458-0821938	Harlem, 8	—	35	30	72	536	Dublin-Midville	-25 -24.1	1946 10-24-80	5	—	P	Open hole, 30-35 ft. Well 26 in GGS Bulletin 64.
Glascock	26AA3	—	331548-0822711	Thiele Kaolin, W1	05-01-71	153	145	6	440	Dublin-Midville, Gordon	-66 -68.3	06-10-71 10-20-80	90	6.2	I	Screen 145-150 ft. Transmissivity = 3,900 ft^2/d.*
Houston	17U6	370	323628-0833702	Warner Robins, 1	02- -54	375	185	12	397	Dublin, Midville	-111 -122.1	02-10-54 11-01-76	800	47.1	P	Screen 185-195, 285-295, 345-365 ft. Transmissivity = 26,000 ft^2/d.* Well 7 in GGS Bulletin 72.
	16U4	—	323556-0833840	Warner Robins, 9	10- -71	490	330	12	400	Midville	-101 -88.7	10-05-71 10-22-80	1,615	52	P	Screen 330-340, 360-380, 405-415, 460-480 ft. Transmissivity = 29,000 ft^2/d.*
	16U13	—	323522-0834245	Gleaton's MHP 1	1969(?)	95	90	—	450	Dublin-Midville	-45	06-26-69	25	17.3	D	Screen 90-95 ft. Transmissivity = 10,000 ft^2/d.*
	16T6	—	322809-0834456	Perry, 2	07-21-72	650	320	10	380	do.	-60 -78.0	07-13-72 10-22-80	1,060	30.3	P	Screen 320-330, 340-350, 410-420, 510-520, 590-600, 630-640 ft. Water-quality analysis, 04-19, 22-79. Transmissivity = 17,000 ft^2/d.*
	16V3	—	323755-0833945	Centerville, 2	1965	678	320	10	430	do.	-80 -120.2	1965 10-22-80	1,340	21.6	P	Screen 320-330, 648-678 ft. Transmissivity = 12,000 ft^2/d.*
	16U11	—	323150-0834100	Houston Co. Brd. of Comm., Sanderfur Rd., 2	08-22-77	625	515	10	380	Midville	-68 -68.2	08-11-77 10-22-80	1,300	44.9	P	Screen 515-575, 605-615 ft. Transmissivity = 29,000 ft^2/d.†
	17U4	—	323604-0833445	Robins AFB, 7	—	440	266	10	292	do.	-38 -38.2 L	10-17-58 10-22-80	990	41.3	P	Screen 266-286, 315-325 ft. Transmissivity = 23,000 ft^2/d.*
	17U10	1818	323726-0833507	Robins AFB, 3A	1969(?)	305	190	12	275	Dublin, Midville	-21.6 -30.0 L	07-24-69 10-22-80	—	—	P	Screen 190-210, 285-305 ft.
	17U13	—	323726-0833507	Robins AFB, 3	1942(?)	375	—	12	275	Midville	-24.1	10- -42	1,000	33.0	P	Transmissivity = 20,000 ft^2/d.† Well 3 in GGS Bulletin 72.
	16U1	910	323552-0833848	Warner Robins, 5	1962(?)	422	235	12	424	Dublin, Midville	-132 -129.4	11-27-62 11-01-76	1,100	45.8	P	Screen 235-245, 270-280, 349-354, 366-371, 392-412 ft. Transmissivity = 26,000 ft^2/d.*
	16V20	2119	323807-0833743	Warner Robins, 6	1968(?)	435	250	12	394	Dublin-Midville	-116 -117.0 L	07-16-68 10-28-80	1,040	69.3	P	Screen 250-260, 290-310, 390-400, 415-425 ft. Transmissivity = 39,000 ft^2/d.*
	16T2	1094	322619-0833812	Pabst Brewery, 4	1967(?)	640	295	12	300	Dublin, Midville	-5 -12.4	12-18-67 10-22-80	1,560	44.5	I	Screen 295-300, 310-330, 340-360, 438-443, 510-520, 560-565, 580-585, 600-630 ft. Transmissivity = 32,000 ft^2/d.†
	16V24	—	323927-0834212	Georgia Forestry Commission	09- -57	285	285	4	470	Dublin-Midville	-150 -144.9	1962 10-22-80	75	—	P	Well 10 in GGS Bulletin 72.
	15T1	—	322818-0834729	James Simmerson, Peach Co., farm and ranch	—	186	170	4	397	do.	-65	02-20-71	70	—	A	Screen 170-175 ft.
	16V5	—	323837-0834118	Centerville, 3	—	510	370	10	455	Midville	-148	11-08-76	1,000	27.8	P	Screen 370-390, 430-440, 480-500 ft. Transmissivity = 16,000 ft^2/d.*
	16T7	2159	322758-0834452	Perry, 3	—	630	320	10	380	Dublin-Midville	-60	11-18-69	1,060- 1,560	53.7 51.9	P	Screen 320-330, 390-400, 410-420, 430-440, 570-580, 610-620 ft. Transmissivity = 30,000 ft^2/d.*
	16T5	—	327722-0834419	Perry, 1	—	465	314	10	293	do.	0 -35	06-25-64 11-04-76	1,080	23.0	P	Screen 314-324, 362-367, 376-381, 405-415, 426-436, 445-465 ft. Transmissivity = 13,000 ft^2/d.*
	17U8	—	323645-0833518	Robins AFB, Old 5	1943(?)	370	200	12	296	Dublin, Midville	-32 44.7	07-02-43 07-24-69	755	23.6	P	Screen 200-210, 260-270, 290-300, 360-370 ft. Transmissivity = 7,800 ft^2/d.† Well 4 in GGS Bulletin 72. Well destroyed, 1971.

Appendix A.--Record of selected wells--Continued

[Use: A, agricultural; D, domestic; I, industrial; P, public supply; O, observation, Water Level: Reported levels are given in feet, measured levels are given in feet and tenths; L, airline measurement; F, flowing. Yield: <, less than. Transmissivity: †, determined from aquifer test; *, estimated from regression equation]

County	Well numbers	Georgia Geologic Survey No.	Latitude-longitude	Name or owner	Date drilled or modified	Depth of well (ft)	Depth of casing (ft)	Diameter of well (in.)	Altitude of land surface	Aquifer(s)	Water level: Above (+) or below (-) land surface (ft)	Water level: Date of measurement	Yield (gal/min)	Specific capacity (gal/min/ft)	Use	Remarks
Jefferson	26AA1	--	331627-0822433	J. M. Huber, 1	05- -65	352	192	10	478	Dublin-Midville, Gordon	-162 -165.8	05- -65 10-20-80	305	8.5	I	Screen 192-202, 215-220, 232-242, 305-310, 334-349 ft. Transmissivity = 5,100 ft^2/d.*
	26Y8	--	330640-0822523	F. Gresbrecht	--	435	435	14.5	385	do.	-118.2 -145.8	11-13-78 10-20-80	1,000	--	D	Slotted casing 235-435 ft.
	26Y7	--	330629-0822501	Richard Johnson, 1	08-27-78	425	225	13.5	382	do.	-108 -126.9	08- -78 10-20-80	1,250	16.4	I	Screen 225-392, 392-425 ft. Transmissivity = 9,500 ft^2/d.*
	26Y1	--	330024-0822729	J. P. Stevens, A1	--	540	450	10	310	Dublin	-68	1977	1,000	10	I	Screen 450-530 ft. Water-quality analysis, 08-20-81. Transmissivity = 6,000 ft^2/d.*
Johnson	24V1	3453	324209-0824302	USGS, Wrightsville Firetower TW-1	08- -80	1,780	1,120	4	355	Midville	-128.8 -132.1	08-29-80 10-23-80	--	--	P	Screen 1120-1140, 1260-1280, 1320-1340 ft. Water-quality analysis, 08-29-80. Transmissivity = 6,700 ft^2/d.*
Jones	17X2	2141	325234-0833154	Jones Co., 1	11- -68	75	35	8	430	Dublin-Midville	-10 -60 L	11-27-68 10-21-80	150	10.1	P	Screen 35-65 ft. Water-quality analysis, 06-09-75. Transmissivity = 6,000 ft^2/d.*
	17W5	--	325225-0833148	Jones Co., 3	--	103	63	8	410	do.	-3 -15	04-10-78 02-20-79	195	--	P	Screen 63-103 ft.
	18W1	--	325223-0832923	Griswold Elementary School	1958	40	40	24	475	do.	-28.7	10-18-60	--	--	P	Water-quality analysis, 10-18-60. Well 14 in GGS Bulletin 52.
Laurens	23U3	--	323121-0825128	American Home Products Co., 1	--	690	--	--	208	Dublin	-2.5 -2.0	1975 11-16-76	905	--	I	
	23U7	--	323249-0825219	East Dublin, 1	12- -56	580	455	8	248	Dublin, Midville	-38 -51.0	05-01-75 11-10-78	600	--	P	
	23U4	1037	323211-0825204	East Dublin, 2	1965	662	580	8	230	Dublin	-29	04-29-65	645	16.1	P	Screen 580-590, 604-614, 624-629, 642-652 ft. Transmissivity = 9,300 ft^2/d.*
	23U6	--	323100-0825124	Laurens Park, 3 Mohasco	--	604	455	12	210	do.	F -8	04-01-76 10-27-80	1,700	32.7	I	Screen 455-516, 573-594 ft. Transmissivity = 19,000 ft^2/d.*
	21U4	3524	323030-0830243	USGS, Laurens Co., TW-3	01- -82	1,685	1,060	4	282	Midville	-35.8	01-28-82	--	--	O	Screen 1060-1080, 1220-1240 ft. Water-quality analysis, 01-28-82.
	21U2	--	323030-0830246	Ga. D.O.T. 87A2, Rest stop well	09- -68	509	229	--	282	Dublin, Gordon, Jacksonian	48 -52.7	09-03-68 01-28-82	160	--	P	Screen 229-234, 335-346, 495-500 ft.
	21U5	--	323030-0830240	USGS, Laurens Co., TW-1	11-05-80	800	800	6,4	282	Dublin	-33.9	01-28-82	--	--	O	Broken drill stem in well.
Pulaski	18S3	--	321615-0832800	Hawkinsville, 1	1959	473	458	--	225	do.	F F	1959 10-30-80	250 F 1,200	60	P	Screen 458-470 ft. Transmissivity = 34,000 ft^2/d.*
	18S14	--	321656-0832750	Hawkinsville	--	450	--	8	228	do.	F F	03-16-43 10-30-80	250	--	P	
	18T1	3511	322245-0832901	USGS, Arrowhead test well, 1	09- -81	1,560	970	4	334	Midville	-56.7	05-12-81	60	--	O	Screen 970-980, 1110-1130, 1270-1280 ft. Water-quality analysis, 05-12-81. Transmissivity = 7,100 ft^2/d.*
	18S10	--	322245-0832800	Portals Co.	03- -81	520	325	36,24, 12	238	Dublin, Gordon	+1.15	04-22-81	1,080	22.4	I	Screen 325-335, 345-355, 360-370, 440-445, 475-480, 502-510 ft. Transmissivity = 13,000 ft^2/d.
Richmond	29BB7	--	332529-0820039	Richmond Co., 9	12- -58	110	90	8	140	Dublin-Midville	-13 -16	12-08-58 11-22-76	275	6.1	P	Screen 90-110. Transmissivity = 3,800 ft^2/d.*
	29BB1	--	332505-0820055	Richmond Co., 10	09- -66	85	55	12	148	do.	-14.3 -39.7	09-20-66 10-22-80	810	27.9	P	Screen 55-85 ft. Transmissivity = 16,000 ft^2/d.*
	29AA1	526	331838-0820557	Hephzibah, 1	02-03-55	295	285	8	432	do.	-178 -198.3	02-03-55 11-16-78	125	5.7	P	Screen 285-295 ft. Transmissivity = 3,600 ft^2/d.*
	30AA4	--	331525-0815747	McBean, 2	1967	496	174	8	293	Dublin-Midville, Gordon	-121 -121.2	06- -79 10-22-80	--	--	P	Screen 174-192, 299-319, 341-372, 393-434 ft.
	27AA2	--	332120-0821630	Ft. Gordon, 1	--	200	190	6	434	Dublin-Midville	-62.7 -62.6	11-24-76 10-24-80	40	0.7	P	Screen 190-200 ft. Transmissivity = 800 ft^2/d.*
	29AA3	--	331909-0820540	Hephzibah, 3	04-22-74	484	319	6	410	do.	-173 -177.4	04-23-74 10-21-80	255	3.9	P	Screen 319-325, 346-367, 381-402, 438-444, 465-475 ft. Transmissivity = 2,600 ft^2/d.*

Appendix A.--Record of selected wells--Continued

[Use: A, agricultural; D, domestic; I, industrial; P, public supply; O, observation, Water Level: Reported levels are given in feet, measured levels are given in feet and tenths; L, airline measurement; F, flowing. Yield: <, less than. Transmissivity: †, determined from aquifer test; *, estimated from regression equation]

County	Well numbers	Georgia Geologic Survey No.	Latitude-longitude	Name or owner	Date drilled or modified	Depth of well (ft)	Depth of casing (ft)	Diameter of well (in.)	Altitude of land surface	Aquifer(s)	Water level: Above (+) or below (-) land surface (ft)	Water level: Date of measurement	Yield (gal/min)	Specific capacity (gal/min/ft)	Use	Remarks
Richmond	29AA7	--	332045-0820310	Pine Hill, 1	10- -72	256	114	8	194	Dublin-Midville	-6 -9.4	10- -72 10-22-80	255	2.0	P	Screen 114-125, 139-155, 168-178, 223-239 ft. Water-quality analysis, 10-22-72, 01-26-76. Transmissivity = 1,500 ft^2/d.*
	29AA5	--	332107-0820409	Pine Hill, 2	--	195	96	8	217	do.	0 -6.9	04-04-74 10-22-80	510	--	P	Screen 96-107, 130-146, 161-188 ft. Water-quality analysis, 04-17-74, 01-26-76.
	29AA6	--	331805-0820109	Pine Hill, 3	09- -77	258	159	14	180	do.	0 -36.2	09-28-77 10-22-80	870	5.9	P	Screen 159-180, 199-249 ft. Transmissivity = 3,700 ft^2/d.* Water-quality analysis, 03-27-79.
	30AA6	--	332106-0815946	Richmond Co., 1	--	274	161	--	147	do.	28 -53.2	05-27-77 10-22-80	890	--	P	Screen 161-222 ft.
	30AA11	--	332137-0815812	Richmond Co., 6	--	255	170	--	130	do.	-19	03-15-80	800	--	P	Screen 170-200, 208-218, 226-246 ft.
	30AA12	--	331630-0815554	Kimberly-Clark PW-4	1980	674	387	8	290	do.	-145	09-08-80	505	4.0	I	Screen 387-390, 394-409, 436-446, 458-482, 520-552, 596-635, 650-664 ft. Transmissivity = 3,400 ft^2/d.† Water-quality analysis, 06-30-80.
	30AA15	--	331607-0815532	Kimberly-Clark OW-3	1980	618	360	4	221	do.	-69.6	09-08-80	--	--	O	Screen 360-365, 378-383, 404-409, 437-442, 465-470, 485-490, 532-537, 558-563, 571-576, 608-613 ft. Transmissivity = 6,600 ft^2/d.† Water-quality analysis, 05-04-80.
	29AA10	129	322322-0820320	Gracewood, 1 (Ga. Trng. School)	--	329	176	6	164	do.	23 -15	1940 08-06-46	--	--	P	Screen 176-196 ft.
	28AA04	--	331926-0821439	Fort Gordon, 4	--	95	85	6	310	do.	F	08-01-45	45	1.4	P	Screen 85-95 ft. Transmissivity = 1,200 ft^2/d.*
	30AA5	--	331544-0815718	Pine Hill, 5 (McBean, 3)	--	527	--	--	165	do.	-25 -22.03	07-26-72 10-22-80	310	--	P	Screen 215-225, 265-275, 335-345, 410-420, 507-517 ft.
	29AA4	--	332006-0820005	Pine Hill, 4 (Goshen well)	11-17-69	162	108	12	210	do.	-41 -41.6	01-07-70 10-22-80	350	5	P	Screen 108-160 ft. Transmissivity = 3,200 ft^2/d.*
	29AA8	--	331854-0820708	Babcock-Wilcox plant mine	--	482	442	--	385	do.	-150 -153.2	08-24-67 10-23-80	210	--	I	Screen 442-482 ft.
	29BB4	--	332309-0820113	Gracewood, 3	06-05-74	130	90	12	165	do.	-20 -34.4	06-25-74 10-23-80	400	--	P	Screen 90-130 ft.
	29BB5	--	332409-0820107	Richmond Co., 16	10- -70	122	92	12	165	do.	-24.3 -38.2	11-12-70 10-22-80	1,050	30.9	P	Screen 92-122 ft. Transmissivity = 18,000 ft^2/d.*
	30BB33	--	332325-0815920	Monsanto, 2	07-18-74	171	146	12	143	do.	-12 -29.4	07-13-74 10-21-80	400	8.1	I	Screen 146-171 ft. Transmissivity = 7,900 ft^2/d.†
	28AA6	--	331726-0820823	Oak Ridge, 1	--	340	300	--	412	do.	-131 -136.3	11-21-67 10-21-80	120	--	P	Screen 300-340 ft.
	30AA2	--	332040-0815655	Olin, 1	08- -64	315	270	10	125	do.	-18 -33	08- -64 10-21-80	600	7.7	I	Screen 270-315 ft. Transmissivity = 4,700 ft^2/d.*
	29BB18	371	332511-0820213	Silvercrest & Fleming Hgts. School	--	262	152	11	185	do.	-132	02-23-54	150	--	P	Screen 152-162 ft.
	30BB3	--	332615-0815608	Nipro, 8	06- -65	103	83	10	127	do.	9 -9.1	06- -65 10-21-80	380	6.5	I	Screen 83-103 ft. Transmissivity = 4,000 ft^2/d.*
	30AA14	--	311618-0815608	Kimberly-Clark OW-2	1980	637	380	4	267	do.	-112	09-08-80	--	--	O	Screen 380-385, 410-415, 445-450, 480-485, 500-505, 520-525, 555-560, 575-580, 595-600, 627-632 ft. Transmissivity = 7,600 ft^2/d.[2]† Water-quality analysis, 05-03-80.
	30AA1	585	331941-0815712	Continental Can Co.	--	317	116	8	153	do.	-52	03- -59	185	13.7	I	Screen 116-126, 301-311 ft. Transmissivity = 8,000 ft^2/d.*
	30BB23	--	332649-0815552	Columbia Nitro, 10	--	105	85	10	125	do.	-17.4 -29	07-20-66 01-05-79	405	25.4	I	Screen 85-105 ft. Water-quality analysis, 07-10-78. Transmissivity = 14,000 ft^2/d.*
	29BB19	--	332237-0820129	Gracewood School, 1	--	150	120	--	215	do.	-37	1979	150	--	P	Screen 120-140 ft. Transmissivity = 6,900 ft^2/d.[3]†

Appendix A.--Record of selected wells--Continued

[Use: A, agricultural; D, domestic; I, industrial; P, public supply; O, observation, Water Level: Reported levels are given in feet, measured levels are given in feet and tenths; L, airline measurement; F, flowing. Yield: <, less than. Transmissivity: †, determined from aquifer test; *, estimated from regression equation]

County	Well numbers	Georgia Geologic Survey No.	Latitude-longitude	Name or owner	Date drilled or modified	Depth of well (ft)	Depth of casing (ft)	Diameter of well (in.)	Altitude of land surface	Aquifer(s)	Water level: Above (+) or below (-) land surface (ft)	Water level: Date of measurement	Yield (gal/min)	Specific capacity (gal/min/ft)	Use	Remarks
Richmond	30BB28	--	332601- 0815951	Babcock-Wilcox, 7	--	63	43	10	135	Dublin- Midville	-10 -16.8	04- -66 01-17-79	525	18.0	I	Screen 43-63 ft.
	29BB12	--	332610- 0820003	Babcock-Wilcox, 6	1961(?)	57	37	--	140	do.	-12.5 -19.3	06- -61 03-28-78	170	--	I	Screen 37-57 ft.
	30BB32	--	332322- 0815933	Monsanto, 1	1968(?)	178	148	--	143	do.	-15 -26	09-10-68 06-30-77	400	--	I	Screen 148-178 ft. Water-quality analysis, 03-17-76.
	29BB3	--	332328- 0820014	Proctor & Gamble Co., 1	1968	170	140	10	162	do.	-26.5 -42	11-05-68 01-14-79	400	8.5	I	Screen 140-170 ft. Transmissivity = 3,200 ft^2/d.†
Screven	32U19	--	323604- 0814411	King Finishing Co., 3	11- -71	1,331	1,007	12	158	Dublin	F +12.6	11-02-71 10-22-80	1,750 968 F	32.6	I	Screen 1007-1022, 1032-1047, 1150-1220 ft. Transmissivity = 18,000 ft^2/d.*
	34W5	--	324624- 0812900	C. B. Pfeiffer	1933	804	800	2	119	do.	+62	06-08-39	40 F	--	P	
	32U17	979	323608- 0814423	King Finishing Co., 1	1965(?)	1,326	1,115	--	155	do.	+26.5	06- -65	870 F 1,500 P	--	I	Screen 1115-1130, 1153-1168, 1214-1224, 1266-1326 ft. Water-quality analysis, 06-18-75, 08-19-81.
Twiggs	17V19	--	324218- 0833333	J. M. Huber Co. HP-4	1972	230	70	12	270	Dublin- Midville	-16 L -19 L	11-22-72 10-20-80	1,040	34.7	I	Screen 70-90, 110-120, 170-180, 210-220 ft. Transmissivity = 20,000 ft^2/d.*
	17V6	360	324314- 0833002	J. M. Huber Co. mine well 4	10- -53	310	285	6	470	do.	-118	10- -53	111	5.3	I	Screen 285-305 ft. Transmissivity = 2,300 ft^2/d.*
	18U1	--	323259- 0832649	Georgia Kraft, USGS 3	--	616	596	--	442	Dublin	-164.5	10-21-80	--	--	I	Screen 596-606 ft. Water-quality analysis, 06-10-75.
	18V7	--	324113- 0832809	J. M. Huber Co. DW-1	02- -67	225	85	18	326	Dublin- Midville	-31 -58.5	03- -67 10-20-80	2,060	52.8	I	Screen 85-135, 150-185, 195-210 ft. Water-quality analysis, 04-23-71. Transmissivity = 37,000 ft^2/d.†
	18V3	--	324134- 0832835	J. M. Huber Co. DW-6	04- -72	330	170	18	405	do.	-148 -160	03-15-72 04-17-79	2,565	43.5	I	Screen 170-180, 240-280, 305-325 ft. Water-quality analysis, 12-16-44. Transmissivity = 25,000 ft^2/d.*
	18V2	--	324144- 0832832	J. M. Huber Co. DW-7	07- -72	340	200	18	390	do.	-138 -157	08-02-72 04-17-79	2,830	34.5	I	Screen 200-210, 240-275, 285-320 ft. Transmissivity = 20,000 ft^2/d.*
	18W13	--	324731- 0832814	Georgia Kaolin Co., 5	1937	306	306	10	420	do.	-79 --	12-31-44 10-20-80	300	--	I	Well 18 in GGS Bulletin 52.
	18W5	415	324721- 0832835	Georgia Kaolin Co., 10	03-07-55	372	150	10	455	do.	-60	03-24-55	584	14.2	I	Screen 150-160, 240-250, 280-290 ft.
	19W18	416	324708- 0832053	Georgia Kaolin Co., 11	11-28-55	433	160	10	425	do.	-103 -101.9	02-28-55 10-20-80	560	19.3	I	Screen 160-165, 210-220, 240-250, 280-285 ft. Water-quality analysis, 06-14-74, 12-13-74, 06-09-75. Transmissivity = 11,000 ft^2/d.*
	18W2	1104	324751- 0832814	Georgia Kaolin Co., 12	02-04-65	552	210	10	465	do.	-134 -144	03-18-65 12-26-78	608	21	I	Screen 210-220, 285-295, 315-325, 375-385 ft. Water-quality analysis, 09-28-76. Transmissivity = 12,000 ft^2/d.*
	18W3	--	324743- 0832637	Georgia Kaolin Co. Twisco well	04- -41	238	228	10	512	do.	-170 -175.1	01-04-45 10-20-80	30	--	I	Screen 228-238 ft. Water-quality analysis, 12-23-44. Well 20 in GGS Bulletin 52.
	19U2	604	323747- 0832109	Twiggs Co. Board of Educ.	--	440	395	--	510	Dublin	-252 -240.4	02-14-59 11-05-82	125	--	P	Screen 395-405, 425-435 ft.
	19U1	602	323729- 0832149	Twiggs Co. Board of Educ.	--	440	395	6	508	Dublin- Midville	-250 -236.4	11-30-59 11-07-78	125	3.3	P	Screen 395-410, 430-435 ft. Transmissivity = 2,200 ft^2/d.*
	19V1	--	324114- 0832037	Jeffersonville, 3	03-10-78	685	625	8	522	do.	-244.9 -247	10-21-80 03-10-78	495	23.6	P	Screen 625-675 ft. Transmissivity = 13,000 ft^2/d.*
	20U5	--	323611- 0831512	E. T. Smith	--	420	401	4	450	do.	-205 -182.6	05-30-58 11-10-78	--	--	D	Screen 400-420 ft.
	17V11	--	324214- 0833333	J. M. Huber Co., HP-2	1951	278	--	8	270	do.	-7	02-09-51	388	32.3	I	Pump removed in 1979. Transmissivity = 18,000 ft^2/d.*
	18W14	--	324800- 0832823	Georgia Kaolin Co., 4	--	291	--	10	440	do.	-65	03-25-37	500	38.5	I	Water-quality analysis, 06-15-71, 09-28-76. Transmissivity = 22,000 ft^2/d.* Well 17 in GGS Bulletin 52.

Appendix A.--Record of selected wells--Continued

[Use: A, agricultural; D, domestic; I, industrial; P, public supply; O, observation. Water Level: Reported levels are given in feet, measured levels are given in feet and tenths; L, airline measurement; F, flowing. Yield: <, less than. Transmissivity: †, determined from aquifer test; *, estimated from regression equation]

County	Well numbers	Georgia Geologic Survey No.	Latitude-longitude	Name or owner	Date drilled or modified	Depth of well (ft)	Depth of casing (ft)	Diameter of well (in.)	Altitude of land surface	Aquifer(s)	Water level: Above (+) or below (-) land surface (ft)	Water level: Date of measurement	Yield (gal/min)	Specific capacity (gal/min/ft)	Use	Remarks
Twiggs	17V4	--	324150-0833321	J. M. Huber Co., HP-5	--	440	60	12	265	Dublin-Midville	+8	02-08-72	150F 1,175	12.1	I	Screen 60-90, 250-270, 374-394, 410-430 ft. Transmissivity = 8,700 ft²/d.†
	18V18	--	324122-0832815	J. M. Huber Co., B-2	1967	225	--	4	338	do.	-50	03-06-67	--	--	O	Transmissivity = 32,000 ft²/d. 4/†
	18V19	--	324103-0832827	J. M. Huber Co., C-2	1967	225	--	4	370	do.	-72	03-06-67	--	--	O	Transmissivity = 34,000 ft²/d. 4/†
	18V20	--	324100-0832823	J. M. Huber Co., D-2	1967	225	--	4	325	do.	-46	03-06-67	--	--	O	Transmissivity = 34,000 ft²/d. 4/†
	18V21	--	324112-0832808	J. M. Huber Co., E-2	1967	225	--	4	310	do.	-24	03-06-67	--	--	O	Transmissivity = 32,000 ft²/d. 4/†
	19V6	--	324119-0832049	Jeffersonville, 2	1957(?)	580	--	--	520	do.	-245 -247	1977 04-11-78	--	--	P	
	18U2	--	323301-0832639	Ga. Kraft, USGS TW-2	--	1,227	1,175	--	442	Midville	--	--	--	--	O	Screen 1175-1185 ft. Water-quality analysis, 09-28-76.
Washington	22Y29	--	330154-0825241	American Ind. Clay Co., P-5	01-30-75	410	278	10	420	Dublin-Midville	-182 -194	01-27-75 10-22-80	1,040	22.1	I	Screen 278-306, 310-340, 390-400 ft. Transmissivity = 7,300 ft²/d.†
	21X11	--	325715-0830024	Freeport Kaolin, 2	06-28-75	315	195	10	368	do.	-81 -91.4	06-26-75 10-23-80	500	.8	I	Screen 195-200, 210-230, 259-274, 295-305 ft. Transmissivity = 860 ft²/d.*
	22W11	--	325101-0835750	Englehard Min. & Chem., Gard-1	01- -66	180	160	6	215	do.	0 +2.5	01- -66 10-22-80	185	4.6	I	Screen 160-180 ft. Transmissivity = 3,000 ft²/d.*
	21X9	--	325912-0830212	Englehard, WC-2	07-31-59	365	180	10	295	do.	-70	07-31-59	335	2.3	I	Screen 180-190, 225-230, 275-280, 314-324, 355-360 ft. Transmissivity = 1,700 ft²/d.*
	22Y22	--	330131-0825611	Thiele Kaolin, H-2	--	251	191	--	320	do.	-43	03-26-54	285	--	I	Screen 191-197, 213-219, 236-248 ft.
	23X27	--	325848-0824809	Sandersville, 8	--	750	480	--	450	do.	-216.5 -220.6	02-04-74 10-23-80	500	--	P	Screen 480-485, 605-610, 650-655, 695-705, 740-745 ft.
	21X14	--	325702-0830340	Thiele Kaolin Co., A-2	09- -72	360	140	16	265	do.	-48 -51.6	10-02-72 10-22-80	1,230	16.6	I	Screen 140-150, 170-190, 210-230, 250-270, 290-310, 360-380 ft. Transmissivity = 9,600 ft²/d.*
	22W10	--	325124-0825704	Oconee, 1	--	311	281	--	218	do.	-3 -9.2	10- -60 10-22-80	455	--	P	Screen 281-311 ft.
	22Y27	--	330057-0825603	American Ind. Clay Co., M-5 (Chambers Mine)	1963	286	110	8	260	do.	-7.0	07-11-63	670	10.6	I	Screen 110-120, 160-170, 200-210, 276-286 ft. Transmissivity = 6,300 ft²/d.*
	23X33	--	325804-0824911	Thiele Kaolin Co., P-4	01- -71	700	455	10	455	do.	-222 -231.9	01-15-71 11-09-78	610	38	I	Screen 455-460, 495-500, 555-560, 605-615 650-660, 675-690 ft. Transmissivity = 21,000 ft²/d.*
	23X32	--	325811-0824917	Thiele Kaolin Co., P-1	06- -50	518	407	6	452	do.	-205 -222.8	06-10-50 10-22-80	400	7.5	I	Screen 407-417, 484-504 ft. Transmissivity = 4,600 ft²/d.*
	23Y17	1506	330030-0824711	Dr. Gilmore, 2	--	433	--	--	470	do.	-170	10-15-65	--	--	D	
	23X13	94	325739-0824826	Sandersville, 4	--	760	535	10	470	do.	-220 -248.3	07-03-44 11-06-81	400	36.4	P	Screen 535-540, 560-565, 660-670, 694-699, 704-709, 755-760 ft. Transmissivity = 21,000 ft²/d.* Well 37 in GGS Bulletin 52.
	23X39	--	325806-0824932	Anglo-American Clay Co., 2	1973	795	--	12	440	do.	-211	06-21-73	1,250	23.6	I	Water level deeper than -300 ft on 10-23-80. Transmissivity = 13,000 ft²/d.*
	24Y13	152	330139-0823732	Georgia Forestry Commission	--	526	320	--	385	Dublin-Midville, Gordon	-135 -159.3	03-17-48 10-22-80	--	--	P	Screen 320-330, 350-355, 375-380, 440-445, 465-470, 490-500 ft.
	24X5	--	335718-0823820	Sepco SX 79 (Geisbricht)	1980	2,541	1,136	--	375	Dublin-Midville, Basement	-127.8 -124.8	04-30-80 10-23-80	--	--	I	Open hole, 1136-2541 ft.
	22Y30	--	330142-0825804	American Ind. Clay Co., M-7	11-12-79	341	175	10	330	Dublin-Midville	-76.9	10-22-80	525	6.6	I	Screen 175-185, 210-240, 260-270 ft. Transmissivity = 4,100 ft²/d.*
	22Y24	--	330135-0825254	American Ind. Clay Co., P-2A	--	380	310	10	434	do.	-211	04-28-72	1,015	29.0	I	Screen 310-330, 340-350, 370-380 ft. Transmissivity = 16,000 ft²/d.*

Appendix A.--Record of selected wells--Continued

[Use: A, agricultural; D, domestic; I, industrial; P, public supply; O, observation, Water Level: Reported levels are given in feet, measured levels are given in feet and tenths; L, airline measurement; F, flowing. Yield: <, less than. Transmissivity: †, determined from aquifer test; *, estimated from regression equation]

County	Well numbers	Georgia Geologic Survey No.	Latitude-longitude	Name or owner	Date drilled or modified	Depth of well (ft)	Depth of casing (ft)	Diameter of well (in.)	Altitude of land surface	Aquifer(s)	Water level: Above (+) or below (-) land surface (ft)	Water level: Date of measurement	Yield (gal/min)	Specific capacity (gal/min/ft)	Use	Remarks
Washington	22Y26	—	330143-0825807	American Ind. Clay Co., M-4B	—	262	155	10	330	Dublin-Midville	-63 -55	06-21-67 07-03-76	570	7.2	I	Screen 155-170, 185-200, 220-230, 240-250 ft. Transmissivity = 4,400 ft^2/d.*
	21X16	—	325722-0830330	Thiele Kaolin Co., A-4	—	152	140	6	260	do.	-39	04-26-76	20	20.0	I	Screen 140-150 ft. Transmissivity = 11,000 ft^2/d.*
	21X20	1817	335749-0830045	American Ind. Clay Co. (Buffalo China Clay Mine)	—	370	135	12	320	do.	-112.2 -104.8	06-16-75 11-18-76	510	5.9	I	Screen 135-145, 180-220, 235-250, 285-290, 355-365 ft. Transmissivity = 3,700 ft^2/d.*
	21X10	—	325906-0830233	Englehard, WC-1	—	302	118	10	300	do.	-70 -56	07-31-59 02-26-79	470	3.2	I	Screen 118-128, 194-204, 286-296 ft. Transmissivity = 2,200 ft^2/d.*
	22Y32	—	330151-0825234	American Ind. Clay Co., P-6	1982	372	280	12,10	400	do.	-189 -184.2	11-08-82 11-15-82	840	19.0	I	Screen 280-310, 312-342, 352-362 ft. Transmissivity = 7,200 ft^2/d.†
	22Y7	—	330236-0825649	Julian Veal, Test hole 2	1942(?)	114	36	—	248	do.	-17	08-30-42	220	4.0	O	Screen 36-41, 54-69, 104-114 ft. Well 18 in GGS Bulletin 52. Transmissivity = 2,700 ft^2/d.†
Wilkinson	19W6	1524	325104-0831958	Georgia Kaolin Co., 13	12- -65	490	130	10	400	do.	-48 -48 L	12-21-65 10-20-80	805	18.3	I	Screen 130-140, 200-210, 235-245, 310-320, 365-375 ft. Transmissivity = 11,000 ft^2/d.* Water-quality analysis, 06-09-75.
	19X13	—	325253-0832952	Town of Gordon, 1	1938	146	40	6	345	do.	-18	09-19-44	65	4.3	P	Screen 40-146. Transmissivity = 2,800 ft^2/d.* Well 24 in GGS Bulletin 52.
	19X3	—	325245-0832024	Freeport Kaolin Plant, 2	1963	351	80	8	350	do.	-20 -126.9	10- -63 10-20-80	—	—	I	Screen 80-90, 123-128, 137-142, 168-173, 243-248, 258-268, 284-294, 312-322, 336-341 ft.
	19X6	—	325327-0832050	Freeport Kaolin Research well	1960	305	262	8	390	do.	-60 -100.9	1960 10-20-80	430	5.4	I	Screen 262-272 ft. Transmissivity = 3,400 ft^2/d.*
	20W1	—	325135 0831322	Englehard Plant, 10	1966	245	135	12	290	do.	-18	04-08-66	1,370	13.2	I	Screen 135-215 ft. Water-quality analysis, 06-18-68. Transmissivity = 7,700 ft^2/d.*
	20W39	2257	325107-0831329	Englehard Plant, 13	07- -70	265	150	12	280	do.	-55 -68 L	09-23-70 08-26-80	1,210	13	I	Screen 150-210, 245-265 ft. Transmissivity = 7,600 ft^2/d.*
	20W40	—	325103-0831351	Englehard Plant, 14	11- -73	360	160	12	296	do.	-58.6 -88	10-03-73 02-26-79	1,040	11.7	I	Screen 160-220, 270-280, 300-330 ft. Transmissivity = 6,900 ft^2/d.*
	19W2	—	324844-0831658	J. M. Huber	—	300	90	4	320	do.	-33.9 -29.5	04-17-69 12-26-78	—	—	O	Perforated casing, 90-300 ft. Transmissivity = 5,100 ft^2/d. 5/†
	19W4	—	324846-0831655	J. M. Huber	—	215	115	18	320	do.	-49.2	04-17-69	705	7.3	I	Screen 115-125, 140-150, 180-210 ft. Transmissivity = 3,300 ft^2/d. 5/†
	19W1	—	324837-0831657	J. M. Huber	—	280	280	4	301	do.	-15.6 -11.5	04-17-69 12-26-78	—	—	O	Perforated casing, 70-280 ft. Transmissivity = 6,800 ft^2/d. 5/†
	21W3	—	324933-0830447	Town of Toomsboro, 1	1950	372	—	—	235	do.	+1.6	1951	375	—	P	
	20W2	—	324844-0831105	Town of Irwinton, old 1	1956	280	260	6	380	do.	-100 -103.2	1958 10-21-80	500	—	P	Screen 260-280 ft.
	19W16	—	325153-0831948	Freeport Kaolin, P-8	—	410	280	10	390	do.	-85 -87.2	06- -80 10-20-80	900	7.8	I	Screen 280-320, 360-400 ft. Transmissivity = 4,700 ft^2/d.*
	19W3	—	324851-0831704	J. M. Huber	—	300	300	4	319	do.	-31 -28.8	04-18-69 12-26-78	—	—	I	Slotted casing, 90-300 ft. Transmissivity = 3,600 ft^2/d. 5/†
	20U6	—	323747-0831235	Town of Allentown	1981	440	320	8	430	Dublin	-171	08- -81	315	63.2	P	Screen 320-340, 352-362, 375-385, 420-440 ft. Water-quality analysis, 08-19-81. Transmissivity = 35,000 ft^2/d.*
	19W5	—	325224-0831954	Freeport Kaolin, P-7	—	491	210	10	375	Dublin-Midville	-40	03-21-75	430	3.3	I	Screen 210-230, 276-286, 353-373, 406-416 ft. Transmissivity = 2,200 ft^2/d.*
	21X2	—	325351-0830628	Englehard Gib-1	—	365	328	6	360	do.	-126	02-03-71	100	7.1	I	Screen 328-348 ft. Water-quality analysis, 06-10-75, 04-17-79. Transmissivity = 4,400 ft^2/d.*
	20X9	—	325400-0831248	Englehard KL-3	—	352	207	10	370	do.	-75 -99.2	12-11-56 10-21-80	505	4.4	I	Screen 207-212, 244-249, 271-276, 306-316, 340-345 ft. Transmissivity = 2,900 ft^2/d.*
	21X1	—	325350-0830711	Englehard Gib-2	—	585	280	12	420	do.	-130 -145	05-03-71 10-21-80	865	13.7	I	Screen 280-290, 330-340, 352-372, 400-420, 445-475, 485-495 ft. Transmissivity = 8,000 ft^2/d.*

Appendix A.--Record of selected wells--Continued

[Use: A, agricultural; D, domestic; I, industrial; P, public supply; O, observation, Water Level: Reported levels are given in feet, measured levels are given in feet and tenths; L, airline measurement; F, flowing. Yield: <, less than. Transmissivity: †, determined from aquifer test; *, estimated from regression equation]

County	Well numbers	Georgia Geologic Survey No.	Latitude-longitude	Name or owner	Date drilled or modified	Depth of well (ft)	Depth of casing (ft)	Diameter of well (in.)	Altitude of land surface	Aquifer(s)	Water level: Above (+) or below (-) land surface (ft)	Water level: Date of measurement	Yield (gal/min)	Specific capacity (gal/min/ft)	Use	Remarks
Wilkinson	20W10	—	324551-0831005	Nat Toller	—	87	—	2	232	Dublin-Midville	+9.8 +2	09-23-44 10-21-80	3 <0.5	—	D	Well 65 in GGS Bulletin 52.
	20X6	—	325628-0830925	Blacklake Plantation	—	28	—	36	248	do.	-11.7 -10.1	09-24-44 10-21-80	—	—	D	Dug well. Well 4 in GGS Bulletin 52.
	21W4	—	324532-0830447	Toomsboro	1982	310	225	8	235	do.	-6 -5.8	09-30-82 11-11-82	300	26.7	P	Screen 225-240, 252-257, 268-278, 292-302 ft. Water-quality analysis, 09-01-82.
	20W43	—	324844-0831105	Irwinton, 2 (Hwy. 57 well)	1982	228	120	8	290	do.	-36 -34.2	05-11-82 11-11-82	315	24.4	P	Screen 120-140, 200-220 ft. Water-quality analysis, 05-12-82. Transmissivity = 14,000 ft²/d.*
	21W1	—	324939-0830233	Englehard Min. & Chem., Dixie Mine, 1	—	631	350	12	358	do.	-140 -135.8	11-30-78 11-11-82	1,230	3.0	I	Screen 350-370, 390-400, 416-436, 510-520, 540-560, 580-600 ft. Transmissivity = 2,100 ft²/d.*
	19X9	—	325259-0831925	Gordon (1966 well)	1966	267	65	8	355	do.	-16 -18.2	07- -66 10-20-80	500	3.6	P	Screen 65-75, 105-110, 135-140, 155-160, 254-264 ft. Transmissivity = 2,400 ft²/d.*
	19X1	—	325429-0831735	Ivey, 1	1965(?)	223	205	—	360	do.	-70	1965	—	—	P	Screen 205-223 ft. Water-quality analysis, 06-18-68.
	20W44	—	324844-0831105	Irwinton, Ga. (U.S. 441 well)	1982	283	225	8	385	do.	-127 -124.6	06-02-82 11-11-82	315	—	P	Screen 225-245, 255-275 ft. Water-quality analysis, 06-03-82.
	19X10	—	325326-0831836	Gordon, 3 (1974 well)	1974	340	185	—	395	do.	-64	05-13-74	450	—	P	Screen 185-195, 204-215, 268-273, 290-311, 320-325 ft. Water-quality analysis, 05-16-74.
	19W14	—	325116-0832112	Gordon Svc. Co. EPD TW-8	1980	204	124	4	480	Dublin-Midville, Gordon	-137.0	05- -80	—	—	O	Screen 124-204 ft. Water-level recorder installed, 05-25-83.

1 Bechtel Corp., 1973.
2 J. E. Sirrine Co., 1980.
3 W. G. Keck and Associates, Inc., 1965.
4 E. F. Oxford, 1968.
5 P. E. LaMoreaux Associates, 1969.

Appendix B.--Water-quality analyses for the Dublin, Midville, and Dublin-Midville aquifer systems

(Analyses by U.S. Geological Survey, except as noted. <, less than)

Well number	Owner or name	Aquifer(s)	Date sampled	Milligrams per liter: Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Nitrite (NO_2)	Dissolved solids: Residue at 180°C	Dissolved solids: Sum of constituents	Hardness[1]: Calcium, Magnesium	Hardness[1]: Noncarbonate
Georgia Environmental Protection Division recommended limits (R) and standards (S) for safe drinking water, 1977											250 (R)	250 (R)	3/			500 (S)	500 (R)		
Bibb County																			
16W24	Armstrong Cork, 5	Dublin-Midville	06-09-75	10	2.5	0.2	2.4	0.7	0	0	1.1	2.4	0.0	4.9	0.00	37	24	7	7
16W18	Georgia Kraft, 1	do.	06-19-68	9.0	1.6	.5	4.2	.7	1	1	6.4	3.2	.1	2.0	--	36	28	6	5
16V16	Standard Oil Co.	do.	11-19-59	5.6	1.2	.5	4.0	.2	17	14	.2	4.0	.0	10	--	40	--	5	--
17W4	Toms Food, 1	do.	06-09-75	12	1.8	.1	2.2	.2	11	9	.6	1.8	.1	1.1	.03	23	--	5	--
Blackley County																			
19T2	Middle Georgia College, 2	Dublin	06-10-75	10	29	1.0	1.9	2.7	83	68	15	3.5	.1	.04	.03	110	110	77	8
Bulloch County																			
31T11	Statesboro, 5	Dublin	[5]01-14-66	--	7.2	.00	--	--	85	8	--	4.00	--	--	--	121	--	18	--
Burke County																			
28X1	USGS, SEX TW-1, Midville	Midville	05-23-80	13	8.1	1.6	10	4.5	--	[4]44	13	1.8	.1	--	--	--	83	27	0
Houston County																			
16T7	Perry, Ga., 3	Dublin-Midville	06-11-74	10	3.4	.3	1.0	.2	0	0	8.4	1.8	.1	.00	.00	31	26	10	10
17U10	Robins AFB, 3	do.	09-22-52	8.5	3.0	.9	2.1	--	11	9	1.6	1.8	.0	.60	--	--	--	9	0
Jefferson County																			
26Y1	J. P. Stevens, 1A	Dublin	08-20-81	31	5.1	.69	2.3	4.8	12	--	--	--	--	--	--	58	--	16	--
Johnson County																			
24U1	USGS, Wrightsville Fire Tower, TW-1	Midville	08-29-80	13	12	1.0	23	3.2	--	[4]73	9.3	1.9	0.2	--	--	112	109	34	0
Jones County																			
18W1	Griswold Elem. School	Dublin-Midville	10-18-60	9.5	2.6	.1	.5	.3	9	7	.8	3.0	.2	2.2	--	25	24	7	0
17W5	Jones County, 3	do.	[5]05-01-78	8.0	2.0	.5	3.2	--	12	10	.0	.3	.0	--	--	--	--	7	0
17X2	Jones County, 1	do.	06-09-75	8.1	1.1	.2	1.3	.1	4	3	.1	2.2	.0	.31	.03	19	16	4	0
17W8	Jones County, 2	do.	[6]03-13-78	--	--	--	--	--	--	14	--	--	.1	--	--	--	--	13	--

Well number	Specific conductance, in micromhos at 25°C	pH	Temperature (°C)	Color, in platinum-cobalt units	Carbon dioxide[2] (mg/L as CO_2)	Micrograms per liter: Aluminum (Al)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Selenium (Se)	Strontium (Sr)	Zinc (Zn)
Georgia Environmental Protection Division recommended limits (R) and standards (S) for safe drinking water, 1977				15 (R)			50 (S)	10 (S)	50 (S)	1,000 (R)	300 (R)	50 (S)	50 (R)	2.0 (S)	10 (S)		5,000 (R)
Bibb County																	
16W24	[4]36	[4]5.3	[4]19.0	0	0	10	0	0	0	3	80	0	60	--	0	--	0
16W18	[4]39	[4]5.5	[4]20.0	0	5.1	--	--	--	--	--	--	--	--	--	--	0	--
16V16	[4]53	[4]6.3	[4]14.5	0	14	--	--	--	--	--	--	--	--	--	--	--	--
17W4	[4]31	[4]5.3	[4]20.0	0	88	10	0	0	0	7	--	0	60	--	0	--	10
Blackley County																	
19T2	[4]168	[4]6.5	[4]23	2	42	<100	<1	--	--	--	5,200	--	90	<0.5	<1	--	--
Bulloch County																	
31T11	--	8.6	--	5	--	--	--	--	--	--	50	--	--	--	--	--	--
Burke County																	
28X1	[4]126	[4]6.1	[4]20.9	--	--	100	1	3	<10	1	2,900	0	130	<.1	0	130	160
Houston County																	
16T7	[4]35	[4]4.0	[4]18.9	0	.0	430	1	9	0	16	320	34	29	0	3	--	20
17U10	[4]63	[4]5.9	--	11	22	--	--	--	--	--	30	--	--	--	--	--	--
Jefferson County																	
26Y1	[4]60	[4]6.9	[4]21.2	--	76	200	--	1	--	10	1,500	10	25	<.1	<1	23	5
Johnson County																	
24U1	[4]145	[4]7.5	[4]26.0	--	--,	10	1	0	2	2	420	0	40	<.1	0	110	10
Jones County																	
18W1	[4]23	[4]5.9	[4]21.0	4	18	--	--	--	--	--	--	--	--	--	--	--	--
17W5	30	5.7	--	0	30	0	--	--	--	0	0	--	--	--	--	--	--
17X2	[4]22	[4]5.4	--	3	25	9	0	0	0	0	0	0	70	.0	0	--	0
17W8	--	--	--	--	18	--	--	--	--	--	--	--	120	--	--	--	--

Appendix B.--Water-quality analyses for the Dublin, Midville, and Dublin-Midville aquifer systems--Continued

(Analyses by U.S. Geological Survey, except as noted. <, less than)

Well number	Owner or name	Aquifer(s)	Date sampled	Milligrams per liter: Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Nitrite (NO_2)	Dissolved solids: Residue at 180°C	Dissolved solids: Sum of constituents	Hardness [1]: Calcium, Magnesium	Hardness [1]: Noncarbonate	Specific conductance, in micromhos at 25°C	pH	Temperature in degrees Celsius	Color, in platinum-cobalt units	Carbon dioxide[2], mg/L as CO_2	Micrograms per liter: Aluminum (Al)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Selenium (Se)	Strontium (Sr)	Zinc (Zn)
Georgia Environmental Protection Division recommended limits (R) and standards (S) for safe drinking water, 1977											250 (R)	250 (R)	3/			500 (S)	500 (R)						15 (R)			50 (S)	10 (S)	50 (S)	1,000 (R)	300 (R)	50 (S)	50 (R)	2.0 (S)	10 (S)		5,000 (R)
Laurens County																																				
21U4	USGS, Laurens, TW-3	Midville	01-28-82	13	7.8	0.8	4.2	7.0	46	[4]38	8.9	1.0	2.3	--	--	56	75	23	0	[4]115	[4]6.4	[4]24.9	--	33	<100	--	<1	--	<10	4,200	<10	83	<0.1	<1	72	680
23U3	American Home Prod. Co.	Dublin	06-10-75	11	15	.8	1.6	3.7	51	42	9.8	2.1	.1	0.00	.03	79	76	41	0	[4]123	[4]6.3	[4]23	16	41	0	0	0	2	0	6,700	0	100	.0	0	--	0
23U4	East Dublin, Ga., 2	do.	11-09-76	--	--	--	--	--	--	44	--	--	--	--	--	--	--	33	--	124	6.6	--	--	24	--	--	--	--	--	--	--	--	--	--	--	--
23U6	Laurens Park Mill, 3	do.	10-30-75	16	--	1.9	--	--	--	--	--	5.2	.2	--	--	--	--	93	--	--	6.8	--	--	26	<100	--	--	--	--	2	--	<10	--	--	--	--
			01-16-76	--	--	--	--	--	--	69	--	--	--	--	--	--	--	58	--	--	6.9	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--
			04-21-76	--	--	--	--	--	--	92	--	--	--	--	--	--	--	92	--	--	7.3	--	--	9.0	--	--	--	--	--	--	--	--	--	--	--	--
Pulaski County																																				
18T1	USGS Arrowhead TW-1	Midville	05-12-81	16	3.1	.6	3.0	6.1	29	<4	10	2.3	.0	8.5	--	26	71	10	0	[4]79	[4]6.1	[4]24.5	--	38	--	--	<1	--	<10	5,600	<10	79	--	--	27	1,000
Richmond County																																				
29BB1	Richmond Co., 10	Dublin-Midville	06-17-78	7.5	.4	.4	.1	.5	1	--	0	1.8	.1	3.4	--	18	16	2	2	[4]18	[4]5.7	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--
30AA1	Continental Can Co.	do.	10-17-60	11	--	1.0	.4	.2	95	--	2.4	3.0	.1	--	--	--	--	4	0	--	[4]7.1	[4]21.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
29AA1	Hephzibah, 1	do.	04-11-55	--	--	--	--	--	--	--	--	3.0	--	--	--	--	--	0	--	--	[4]5.6	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--
29AA3	Hephzibah, 3	do.	06-17-75	16	--	.3	.2	.3	3	--	2.0	1.4	.1	--	--	--	--	2	0	--	[4]4.7	[4]21.0	--	--	--	<1	--	--	6	560	20	<10	--	--	--	80
30AA12	Kimberly Clark, PW-4	do.	[7]06-30-80	--	--	--	--	--	--	--	--	--	--	<.05	--	95	--	--	--	105	6.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
30BB32	Monsanto, 1	do.	[8]03-17-76	.8	--	--	5.4	--	14	0	--	.2	5.0	--	--	--	--	0	0	--	5.7	--	12	--	--	--	--	--	--	0	--	0	--	--	--	--
29AA7	Pine Hill, 1	do.	[9]10-27-72	4.6	--	.8	--	--	--	--	--	7.4	--	--	--	--	--	6	--	--	5.7	--	28	--	0	--	--	--	--	0	--	0	--	--	--	--
			[6]01-26-76	--	--	--	--	--	--	6	--	--	--	--	--	--	--	5	--	9	4.9	--	.1	--	--	--	--	--	--	--	--	--	--	--	--	--
29AA6	Pine Hill, 3	do.	[6]03-27-79	--	--	--	--	--	--	--	78	--	--	--	--	--	--	52	--	--	6.7	--	--	32	--	--	--	--	--	800	--	--	--	--	--	--
29AA5	Pine Hill, 2 (Goshen well)	do	[9]04-17-74	4.2	--	.4	--	--	--	--	--	2.1	.0	--	--	--	--	3	--	--	5.6	--	--	10	0	--	--	--	--	0	--	--	0	--	--	--
			[6]01-26-76	--	--	--	--	--	--	4	--	--	--	--	--	--	--	4	--	7	4.9	--	--	.1	--	--	--	--	--	--	--	--	--	--	--	--
Screven County																																				
32U17	King Finishing Co., 1	Dublin	06-18-75	15	10	1.8	28	4.1	113	93	8.0	2.5	.3	.04	.0	124	126	32	0	[4]210	[4]7.8	[4]28.0	1	2.9	<100	<1	--	--	--	50	--	<10	<.5	1	--	--
			08-19-81	15	7.5	1.2	27	3.3	111	93	--	--	--	--	--	131	--	23	0	[4]215	[4]8.4	[4]27.2	--	.7	<10	--	2	--	10	24	10	9	<.1	<1	160	4
34W5	C. Pfeiffer	do.	09-09-63	12	6.4	2.9	41	2.4	118	97	7.6	10	.4	0	--	136	141	28	0	[4]200	[4]7.1	[4]24.0	2	15	10	--	--	--	--	--	--	--	--	--	--	--
Twiggs County																																				
18W3	Ga. Kaolin Co., Twisco	Dublin-Midville	12-23-44	--	--	--	--	--	22	18	2.0	2.0	.0	.80	--	--	--	24	6	--	--	18.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix B.--Water-quality analyses for the Dublin, Midville, and Dublin-Midville aquifer systems--Continued

(Analyses by U.S. Geological Survey, except as noted. <, less than)

Well number	Owner or name	Aquifer(s)	Date sampled	Milligrams per liter: Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Alkalinity as $CaCO_3$	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Nitrite (NO_2)
Georgia Environmental Protection Division recommended limits (R) and standards (S) for safe drinking water, 1977											250 (R)	250 (R)	3/		
Twiggs County															
19W18	Ga. Kaolin Co., 11	Dublin-Midville	06-09-75	11	4.1	0.1	1.3	0.1	14	11	0.1	1.7	0.1	1.2	0.03
18W2	Ga. Kaolin Co., 12	do.	[6]09-28-76	--	--	--	--	--	--	66	--	--	--	--	--
18W14	Ga. Kaolin Co., 4	do.	[10]06-15-71 [6]09-28-76	-- --	-- --	-- --	-- --	-- --	-- --	54 50	-- --	-- --	-- --	- --	-- --
18V7	J. M. Huber Co., DW-1	do.	04-23-71	11	6.5	.7	1.5	.3	18	15	.0	3.0	.1	1.4	.01
18U1	Ga. Kraft, USGS 3	Dublin	06-10-75	15	17	1.3	18	2.7	83	68	22	3.4	.3	.27	.00
18U2	Ga. Kraft, USGS 2	Midville	05-21-75 04-26-76	17 17	4.7 4.8	.5 .4	8.2 7.2	8.0 3.5	35 30	29 25	8.6 9.3	2.1 2.1	<.1 .3	.18 .04	.23 .00
17V19	J. M. Huber Corp.	Dublin-Midville	06-09-75	13	11	.3	1.8	.2	35	29	.6	2.5	<.1	2.3	.03
Washington County															
23X13	Sandersville, 3	Dublin-Midville	11-28-40	14	12	.9	3.0	.6	30	25	2.1	5.5	.5	--	--
21X10	Englehard Corp., WC 1	do.	06-10-75	11	.7	.6	1.7	.2	1	1	.9	1.8	.1	1.1	.03
Wilkinson County															
21X2	Englehard Corp., Gib-1	Dublin-Midville	06-10-75	16	2.3	.3	3.5	3.7	9	7	7.1	3.2	.1	.04	.00
19X1	Ivey, Ga.	do.	06-18-68	9.8	.6	.3	1.2	.3	3	2	.0	1.8	.1	.10	15
19X10	Gordon, 3 (1974 well)	do.	05-16-74	12	--	.6	2.4	--	--	[4]2	2.8	3.1	.1	--	28
21W4	Toomsboro (1982 well)	do.	[8]09-01-82	--	--	--	2.17	--	--	80	11	9.0	.01	.01	--
20W44	Irwinton, 1 (1982 well)	do.	[8]06-03-82	--	--	--	--	--	--	--	--	--	--	--	60
20W43	Irwinton, 2 (1982 well)	do	[8]05-12-82	--	.1	12	.4	--	<1.0	<1.0	19	8.5	<.01	<.1	--
20U6	Allentown (1981 well)	Dublin	[5]08-19-81	12	53.6	0	--	--	149	122	15	6	0	<.0	229
20W1	Englehard Corp., 10	Dublin-Midville	06-18-68	8.5	1.1	.2	1.6	6.0	0	0	1.2	1.8	.1	1.1	23

Well number	Dissolved solids: Residue at 180°C	Dissolved solids: Sum of constituents	Hardness[1]: Calcium, magnesium	Hardness[1]: Noncarbonate	Specific conductance, in micromhos at 25°C	pH	Temperature, in degrees Celsius	Color, in platinum-cobalt units	Carbon dioxide[2] (mg/L as CO_2)	Micrograms per liter: Aluminum (Al)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Selenium (Se)	Strontium (Sr)	Zinc (Zn)
Georgia Environmental Protection Division recommended limits (R) and standards (S) for safe drinking water, 1977	500 (S)	500 (R)						15 (R)			50 (S)	10 (S)	50 (S)	1,000 (R)	300 (R)	50 (S)	50 (R)	2.0 (S)	10 (S)		5,000 (R)
Twiggs County																					
19W18	35	27	11	0	[4]33	[4]5.8	[4]19.0	0	36	9	<1	ND	ND	11	<10	<2	60	<0.5	<1	--	--
18W2	--	--	64	--	--	7.8	--	--	2.2	--	--	--	--	--	--	--	--	--	--	--	--
18W14	-- --	-- --	68 63	-- --	-- --	6.3 7.2	-- --	-- --	65 6.0	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
18V7	40	33	19	4	[4]40	[4]6.4	--	0	11	20	0	0	0	0	30	0	10	--	--	30	30
18U1	128	121	48	0	[4]160	[4]6.4	[4]21.0	2	59	50	<1	ND	ND	ND	<10	<2	50	<.5	<1	--	30
18U2	84 60	68 63	14 14	0 0	[4]92 [4]84	[4]6.7 [4]6.2	[4]24 [4]24	33 0	12 30	8 <100	2 <1	-- --	-- --	-- --	630 3,700	-- --	40 50	<.5 <.5	<1 <1	-- 100	<20 20
17V19	51	49	29	0	[4]58	[4]6.7	[4]19.5	0	11	<100	<1	--	<2	<2	<10	--	60	<.5	<1	--	--
Washington County																					
23X13	63	58	34	9	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
21X10	35	19	4	3	[4]25	[4]5.1	[4]19	1	13	<100	<1	--	--	5	30	--	50	<.5	<1	--	--
Wilkinson County																					
21X2	51	42	7	0	[4]54	[4]5.6	[4]21	2	36	5	0	0	0	1	1.100	0	70	--	0	--	20
19X1	16	2	0	[4]15	[4]5.9	[4]21	0	6.0	--	--	--	--	--	--	--	--	--	--	--	--	--
19X10	--	5	--	--	[4]6.7	--	--	--	<100	--	--	--	--	--	<10	<10	--	--	--	--	--
21W4	--	96	--	--	--	--	5	5	--	<10	<10	<10	<10	<100	<10	<10	<10	<10	<10	--	<10
20W44	--	--	--	70	3.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
20W43	--	12	--	--	4.4	--	<5	4.0	--	<10	<10	--	<10	<100	<10	<10	<10	<10	<10	--	<10
20U6	--	134	--	280	6.8	--	5	4	0	<10	<5	<5	0	300	<10	0	<1	<1	<1	--	<10
20W1	16	4	4	[4]27	[4]5.1	[4]19.0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--

1/ Water having a $CaCO_3$ hardness of 0 to 60 mg/L is classified "soft"; 61 to 120 mg/L, "moderately hard"; 121 to 180 mg/L, "hard"; and more than 181 mg/L, "very hard."
2/ Carbon dioxide concentration calculated from measured values of pH and bicarbonate ion.
3/ State and Federal standards for fluoride are set according to temperature.
4/ Field value.
5/ Analysis by Parker Laboratory, Charleston, S.C.
6/ Analysis by Georgia Environmental Protection Div.
7/ Analysis by J. E. Sirrine Co., Greenville, S.C.
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