HYDROGEOLOGIC EVALUATION FOR UNDERGROUND INJECTION CONTROL IN THE COASTAL PLAIN OF GEORGIA

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Atlanta

1984

Hydrologic Atlas 10

HYDROGEOLOGIC EVALUATION FOR UNDERGROUND INJECTION CONTROL IN THE COASTAL PLAIN OF GEORGIA

INTRODUCTION

RAM ARORA

The Coastal Plain of Georgia covers 35,416 square miles or about 60 percent of the area of the State. The Coastal Plain is a wedge of sediments ranging in thickness from 0 ft at the Fall Line to about 7,000 ft along the Georgia-Florida border, and rests on a basement of Mesozoic and Paleozoic sediments, igneous and metamorphic rocks. This wedge of clastic and carbonate sediments contains the State's major aquifers. Coastal Plain formations generally strike northeast-southwest and dip southeast. The block diagram shows the Coastal Plain of Georgia and illustrates, in simplified form, the thicknesses, general outcrop area, and stratigraphic relationship of aquifers.

Cretaceous Aquifers

Cretaceous sediments in the Coastal Plain are dominantly clastic in origin and contain several aquifers. Generally, the sediments of these aquifers are coarsest updip adjacent to the outcrop area immediately south of the Fall Line. In this area, confining units may be absent and some Cretaceous aquifers, which are confined downdip, may be hydraulically continuous with other Cretaceous aquifers or with contiguous lower Tertiary units. Cretaceous deposits thicken downdip and are overlain by as much as 3000 ft of Tertiary sediments in extreme south Georgia.

Clayton Aquifer

The Clayton Aquifer consists mostly of the middle limestone member of the Paleocene Clayton Formation. In southwestern Georgia, the limestone varies greatly in thickness and is generally not present southeast of the Flint River. The limestone also terminates at an apparent fault in southern Early County, restricting the aquifer to a relatively small portion of the State. Farther to the southeast, the limestone member of the Clayton Aquifer is present, but its great depth and poor water quality preclude its use as an aquifer. The outcrop area of the Clayton Formation is extremely small and occurs along a narrow band of stream valleys in southwestern Georgia.

Claiborne Aquifer

The Claiborne Aquifer consists mostly of sand in the Eocene Lisbon, Tallahatta, and Hatchetigbee Formations. These sands crop out along a broad band in stream valleys in southwest Georgia north and northwest of Albany. Downdip, southeast of Albany, the Claiborne Group thickens and the lithofacies becomes more calcareous. Beneath Brunswick, in extreme southeastern Georgia, the Claiborne Group consists mostly of limestones which are hydraulically connected to the overlying Principal Artesian Aquifer.

Principal Artesian Aquifer

The Principal Artesian Aquifer is a complex series of hydraulically interconnected limestones mostly of Eocene-Oligocene age that extends over most of the Georgia Coastal Plain and into Florida, Alabama, and South Carolina. The aquifer crops out in southwestern Georgia along the Flint River where it consists almost entirely of the upper Eocene Ocala limestone and includes limestones of Oligocene and middle Eocene age. In extreme southeastern Georgia, limestone units as old as Upper Cretaceous may be hydraulically connected as part of the Principal Artesian Aquifer. Thickness may be as much as 3,000 ft in the Southeast Georgia Embayment.

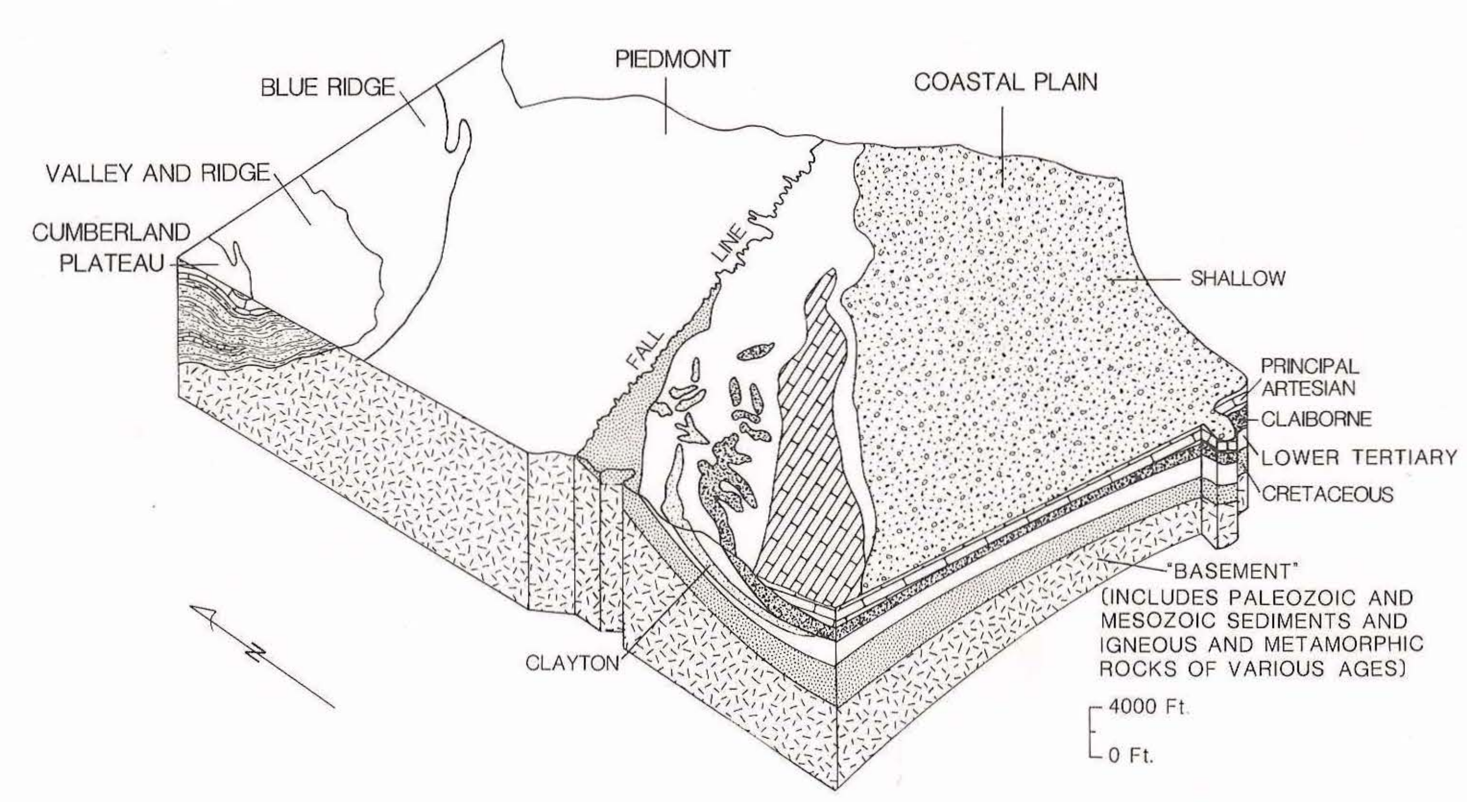
Shallow Aquifer System

The shallow aquifer system includes Miocene and Pliocene-to-Recent aquifers. These aquifers are composed mostly of clastic materials, and, although widely used for low-yielding wells, they are not heavily developed. No major areas of significant potentiometric declines have been reported.

Hydrogeology

Prior to development, Georgia's Coastal Plain aquifers probably were hydrologically in equilibrium. Recharge equaled discharge, and there was no net change in storage except for minor seasonal fluctuations. Development of the aquifers for municipal, industrial, agricultural, and domestic supply has altered this balance. Total ground-water use for 1980 in the Georgia Coastal Plain exceeded 1,000 Mgal/d. Water-level fluctuations in aquifers are determined by the interrelated factors of recharge, discharge, and hydraulic properties (transmissivity, storage coefficient, and specific yield) of the aquifer. Recharge and discharge are themselves dependent on the complex interaction of climatic conditions (precipitation, evapotranspiration, and runoff), infiltration rate (which depends on outcrop area, slope, and permeability), relationship to other aquifers and surface water bodies (head potential and effectiveness of confining units), and withdrawals by man. These factors vary considerably in the aquifers of Georgia's Coastal Plain.

The aquifers of the Coastal Plain represent a system of hydrostratigraphic units with varying degrees of interconnection. When confining boundaries are locally well developed, measured aquifer characteristics such as transmissivity and storativity are representative of the specific aquifer being tested. For localities or regions where confining beds are poorly developed or absent, the measured aquifer parameters are representative of the interconnected system. For example, the Principal Artesian Aquifer is unconfined in areas where it crops out and is directly recharged via precipitation. Elsewhere, this aquifer generally exhibits confined flow conditions. However, in the vicinity of Brunswick, Georgia, it is hydraulically connected with Miocene and Cretaceous strata.



BLOCK DIAGRAM OF GEORGIA SHOWING COASTAL PLAIN AQUIFERS AND MAJOR PHYSIOGRAPHIC PROVINCES

Although Georgia receives abundant rainfall (average annual precipitation in the Coastal Plain varies from 44 to 56 in.), most of this precipitation does not recharge the aquifers. About 30 to 35 in. annually are lost to evapotranspiration while 12 to 16 in. flow out of the State in surface streams, leaving only about 6 to 8 in. infiltrating into the aquifers annually. Although winter and summer are the seasons of highest precipitation in Georgia, winter rainfall is especially critical to the recharge of Georgia's aquifers. Winter rainfall generally occurs at a slower rate than summer rainfall, allowing greater infiltration and less runoff. Evapotranspiration rates are lowest in winter. Therefore, seasonal water-level highs tend to occur in early spring, just after the winter season, whereas water-level lows occur in late fall, coincident with the seasons of relatively low rainfall and high evapotranspiration. Superimposed on these natural fluctuations are the effects of man's withdrawals.

Plates

A total of 41 plates have been produced for the underground injection control project for the Pliocene-to-Recent, Miocene, Principal Artesian, Claiborne, Clayton and Cretaceous Aquifers of Georgia's Coastal Plain. Seven categories of plates have been prepared. Not all categories of plates could be prepared for each of the above aquifers.

(1) Structure-contour maps indicating the elevations of aquifer tops.

(2) Isopach maps illustrating aquifer thickness trends.

(3) Structure-contour maps indicating the elevations of aquifer bases.

(4) Water-quality maps showing concentrations of total dissolved solids (TDS) or sodium chloride.

(5) Geologic cross-sections to illustrate general aquifer structure and changes in lithology accross the State.

(6) Potentiometric maps showing current ground-water flow conditions.

(7) Hydrographs of selected observation wells illustrating changes in water levels.

Text and descriptive material accompanying maps and diagrams are brief and, wherever possible, limited to the space available on the map sheets. Narratives cover such topics as aquifer lithology and general structure, ground-water quality, and general hydrology.

In addition, an aquifer summary plate and stratigraphic column of Georgia's Coastal Plain are included. The aquifer summary plate includes definition of aquifer boundaries, references, and possible sources of error. A recent stratigraphic chart developed by Paul Huddlestun of the Georgia Geologic Survey for the Commission of Stratigraphic of North America (COSUNA) project has been added.

Data

Principally, the data for the preparation of these maps were obtained from published and unpublished material available at the U.S. Geological Survey, the Georgia Geologic Survey, and other Environmental Protection Division agencies of the State of Georgia. Also, persons involved in current aquifer studies were consulted. To expand on available stratigraphic and hydrogeologic information, some drilling was performed as a part of the project.

Map Scale

Map scale for all maps in this atlas is 1:1,000,000. Horizontal and vertical scales for cross-sections are such that the vertical exaggeration is not greater than 100:1; e.g., a vertical scale of 1" = 100' and a horizontal scale of 1" = 10,000' gives a vertical exaggeration of 100:1. Contour intervals are dependent on the number of data points and the range of variability of the data. Locations of contour lines between data points are approximate, with extrapolation based on an assumed continuous trend between points. Original maps at the scale of 1:500,000 are catalogued in the technical files of the Georgia Geologic Survey.

Funding

Funding for this project has been provided by the Environmental Protection Agency (EPA) and the State of Georgia Environmental Protection Division, Department of Natural Resources.

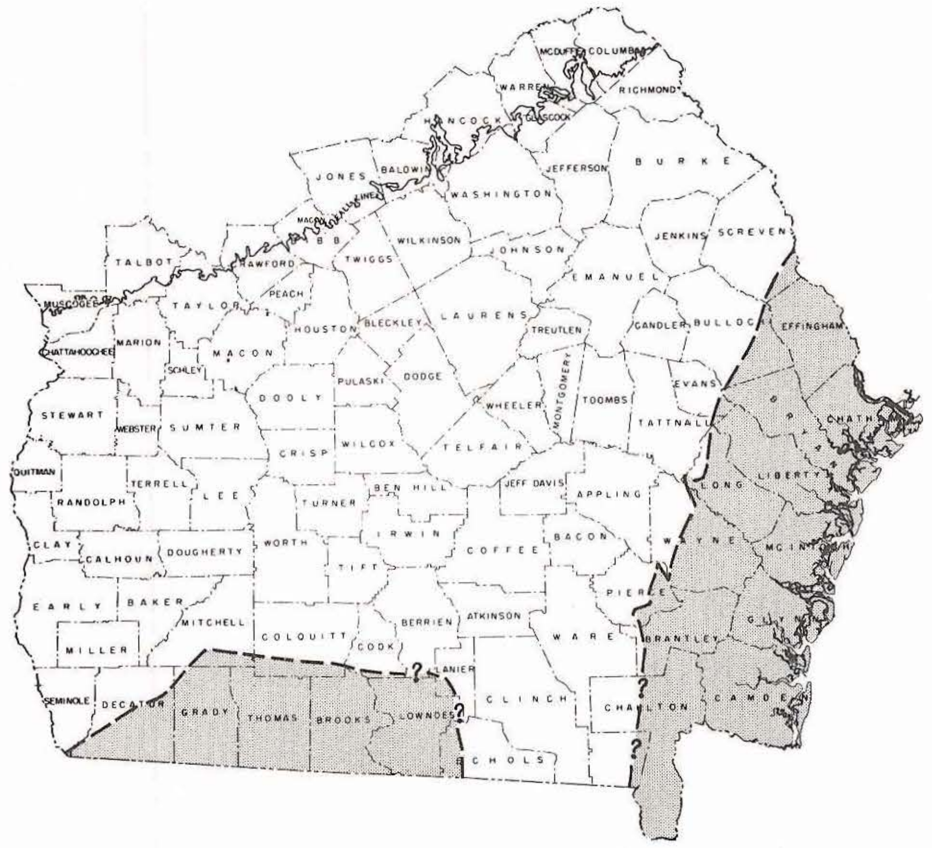
Underground Injection Control, North Georgia

The Georgia Geologic Survey has prepared a series of maps and cross-sections of the Piedmont, Blue Ridge, Valley and Ridge, and Cumberland Plateau Provinces of Georgia, entitled: Hydrogeologic evaluation for underground injection control in North Georgia: Georgia Geologic Survey Hydrologic Atlas 12.

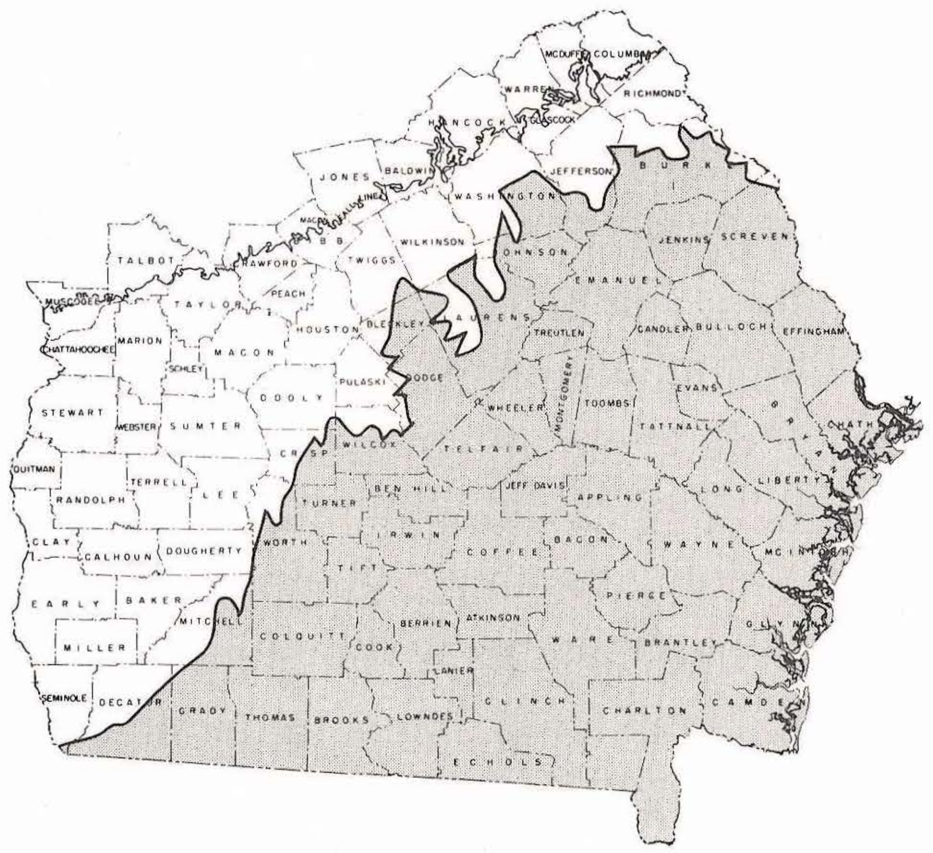
To obtain a copy, direct requests to:

Georgia Geologic Survey
Room 400
19 Martin Luther King, Jr. Dr., S.W.
Atlanta, Georgia, 30334

AREAL EXTENT OF THE AQUIFERS OF THE COASTAL PLAIN

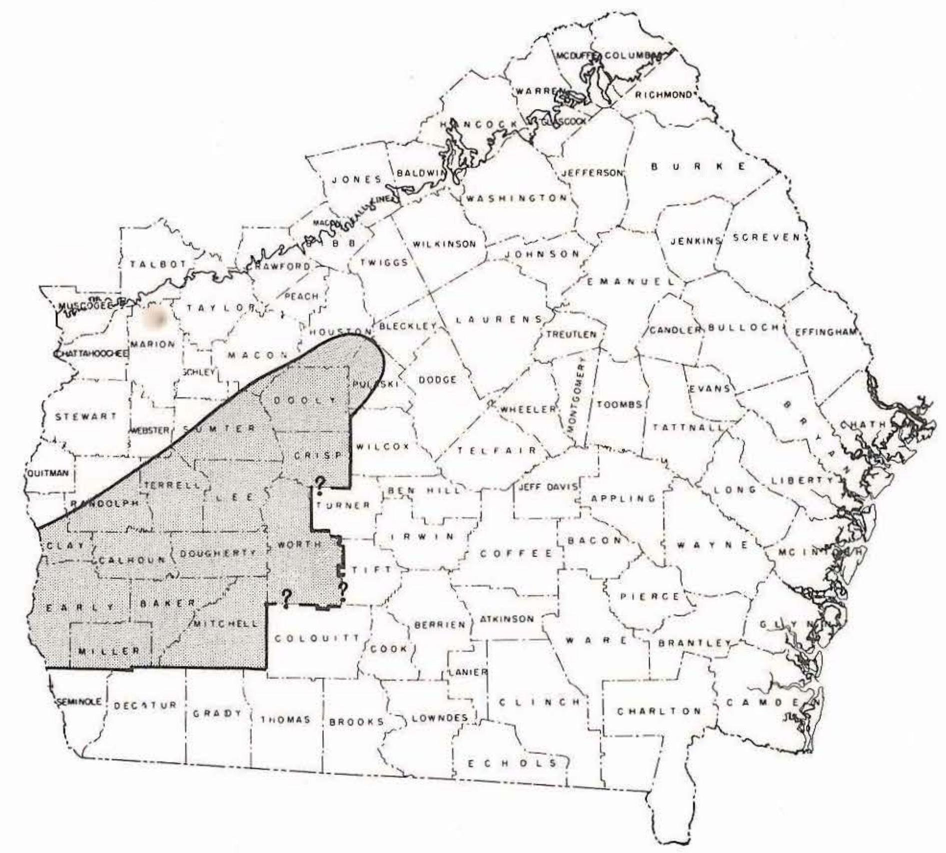


PLIOCENE–TO–RECENT AQUIFER SYSTEM

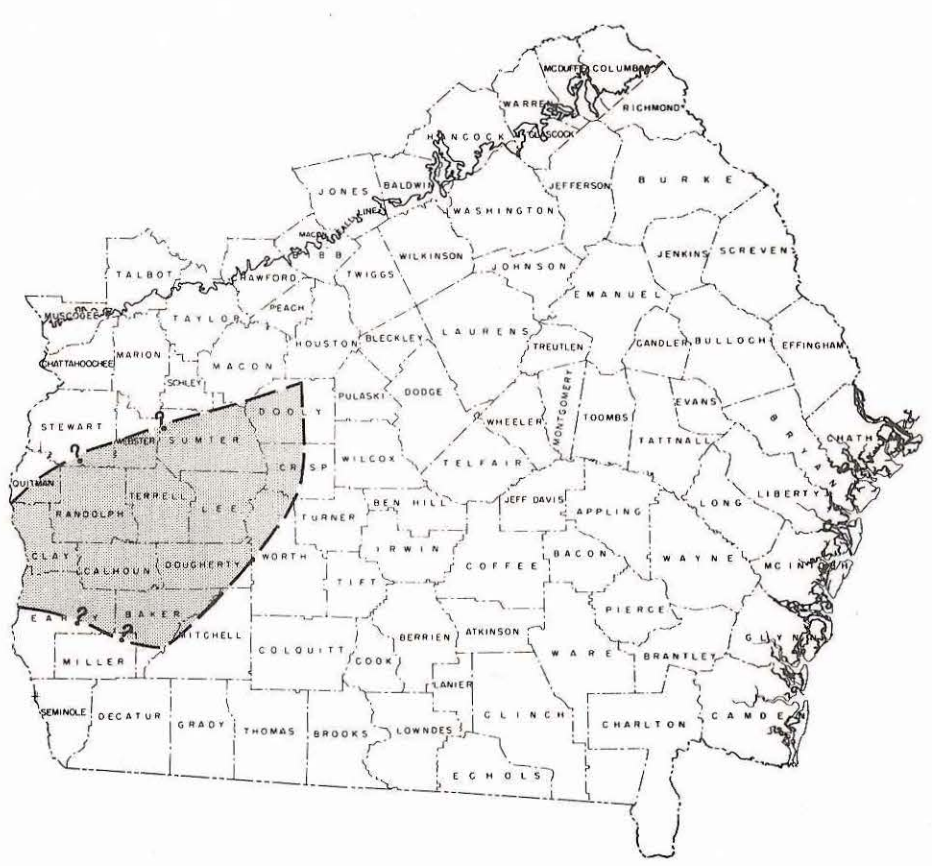


MIOCENE AQUIFER SYSTEM

PRINCIPAL ARTESIAN AQUIFER SYSTEM



CLAIBORNE AQUIFER



CLAYTON AQUIFER

CRETACEOUS AQUIFER SYSTEM

LOWER CRETACEOUS AQUIFER

LOCATION MAP

0 20 40 MILES

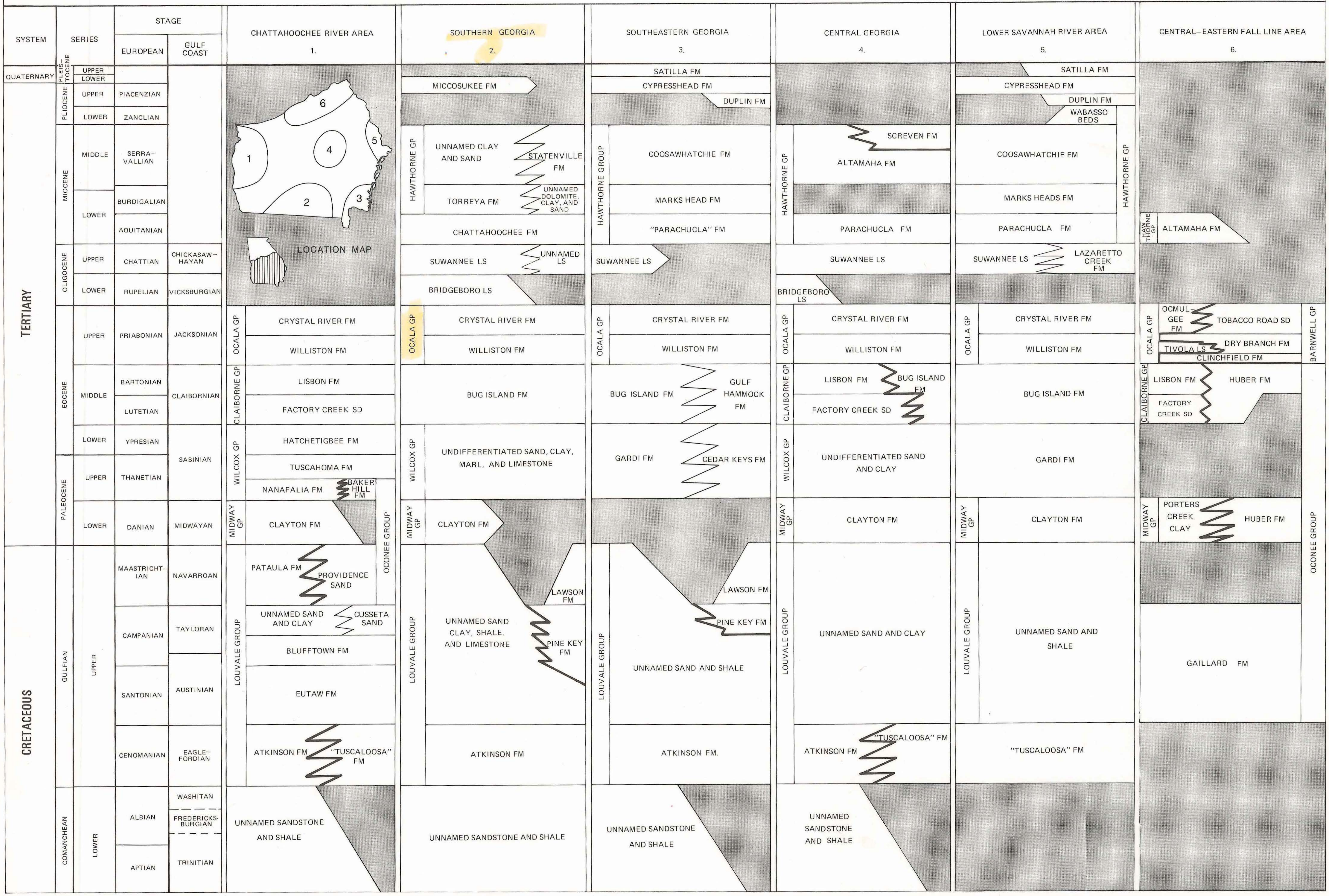
CORRELATION CHART OF THE COASTAL PLAIN OF GEORGIA

P. F. HUDDLESTUN

Only those series and stages represented by deposits are included on this chart. Some are excluded due to requirements of space. Pre-Comanchean deposits are not included because they are not aquifers. Areas which have no record of deposition are shaded.

EXPLANATION

HEAVY LINES DELIMIT LATERAL BOUNDARIES OF GROUPS WHERE INTERFINGERING OCCURS.



SUMMARY OF PLATES

AQUIFER	PLATE NO.	PLATE TYPE	DEFINITION OF AQUIFER	SOURCES	POSSIBLE SOURCE OF ERROR
PLIOCENE-TO-RECENT AQUIFER SYSTEM	1	AREAL MAP	Upper boundary — Land surface. Lower boundary — Contact between Pliocene sands and Miocene phosphatic sandy clay.	Herrick, S.M., 1961 Georgia Geologic Survey, 1976 Huddlestun, P.F., 1981	Because of cut-and-fill channel deposits, elevations may change drastically within a short distance. Sufficient data were not available to illustrate these localized features. Dashed limit of the Pliocene-to Recent strata is based on the preliminary field work of Huddlestun.
	2	STRUCTURE CONTOUR OF THE BASE			
	3	ISOPACH			
	4	DISSOLVED-SOLIDS CONCENTRATION		U.S. Geological Survey, 1976	
MIOCENE AQUIFER SYSTEM	5	STRUCTURE CONTOUR OF THE TOP	Upper boundary — Elevation of the top of the Screven Formation, or where the Screven Formation is not present, the top of the underlying Hawthorne Group. Lower boundary — Contact between the sand and clay of the Hawthorne Group and underlying limestone.	Herrick, S.M., 1961 Unpublished well logs on file at the Georgia Geologic Survey	In Jenkins and Screven Counties, sand and clay of the Barnwell Group underlie the Hawthorne Group. In this area, the lower boundary of the Miocene Aquifer is difficult to distinguish. Hawthorne Group may cause confusion since the name "Hawthorne Formation" is entrenched in the literature. However, Hawthorne Group refers to a multi-formation unit consisting of five distinct lithostratigraphic units. (See correlation chart.)
	6	STRUCTURE CONTOUR OF THE BASE			
	7	ISOPACH			
	8	GEOLOGIC SECTIONS OF THE MIOCENE AND PLIOCENE-TO-RECENT AQUIFER SYSTEMS			
	9	DISSOLVED-SOLIDS CONCENTRATION		U.S. Geological Survey, 1976	
PRINCIPAL ARTESIAN AQUIFER SYSTEM	10	STRUCTURE CONTOUR OF THE TOP	Upper boundary — Uppermost Tertiary limestone (usually the top of the Suwannee Formation or Ocala Group). Lower boundary — Contact between permeable Tertiary and Upper Cretaceous limestone and the relatively permeable underlying recrystallized limestone, fine-grained sandstone and shale.	Miller, J.A., 1982	In the northeast Coastal Plain (Jenkins and Screven Counties) the Ocala Limestone grades laterally into the sand and clay of the Barnwell Group. In this area, the aquifer boundaries are not well defined.
	11	STRUCTURE CONTOUR OF THE BASE			
	12	ISOPACH			
	13	ISOPACH OF OVERLYING STRATA		Herrick, S.M., 1961	
	14	GEOLOGIC SECTIONS		Miller, J.A., 1982	
	15	POTENTIOMETRIC SURFACE		Krause, R.E., and Hayes, L.R., 1981	Possible inaccurate water-level data may reflect faulty well construction.
	16	WATER-LEVEL TRENDS, 1981		Unpublished data on file at the U.S. Geological Survey, Water Resources Div. Unpublished data on file at the Georgia Geologic Survey	Possible inaccurate water-level data may reflect faulty well construction.
	17	SPECIFIC CAPACITY			Available data is poorly distributed.
	18	DISSOLVED-SOLIDS CONCENTRATION		U.S. Geological Survey, 1976	Concentrations of dissolved solids may have changed since measurements were made.
CLAIBORNE AQUIFER	19	STRUCTURE CONTOUR OF THE TOP	Upper boundary — Contact between relatively permeable Claiborne-age sediments with overlying impermeable marl, clay, and sandy limestone within the Lisbon Formation. Lower boundary — Top of the impermeable Hatchetigbee Formation or, where the Hatchetigbee Formation is not impermeable, top of the clay-rich Tuscahoma Sand.	Herrick, S.M., 1961 Unpublished data on file at the Georgia Geologic Survey	Very little data is available in Mitchell, Worth and Miller counties. In this area, the elevation of the outcrop of the Hatchetigbee Formation varies considerably. Hatchetigbee Formation porosities vary considerably within a short distance. For this reason, in some areas it makes up the lower part of the aquifer; in other areas it is the lower confining unit.
	20	STRUCTURE CONTOUR OF THE BASE			
	21	ISOPACH			
	22	ISOPACH OF OVERLYING STRATA			
	23	GEOLOGIC SECTIONS			
	24	DISSOLVED-SOLIDS CONCENTRATION		U.S. Geological Survey, 1976	Concentrations of dissolved solids may have changed since measurements were made.
	25	WATER-LEVEL TRENDS AND POTENTIOMETRIC SURFACE		McFadden, S.S., and Perriello, P.D., 1983 Unpublished data on file at the Georgia Geologic Survey	Possible inaccurate water-level data may reflect faulty well construction.
CLAYTON AQUIFER	26	STRUCTURE CONTOUR OF THE TOP	Upper boundary — Contact between the fossiliferous limestone of the Clayton Formation and the overlying clay, marl, and sand within the Clayton Formation or Wilcox Group. Lower boundary — Contact between the fossiliferous limestone of the Clayton Formation and the underlying Cretaceous sand, marl, and chalk.	Herrick, S.M., 1961 Unpublished data on file at the Georgia Geologic Survey	Due to limited data, the southern boundary of the Clayton Formation is not well defined; south of the mapped area, the Clayton Formation is absent. Updip, the contact between the Clayton Aquifer and the lower confining unit is irregular and difficult to contour meaningfully. In Terrell County, the Clayton Aquifer includes some sand of the overlying Oconee Group. In this area, the upper boundary of the aquifer is not well defined.
	27	STRUCTURE CONTOUR OF THE BASE			
	28	ISOPACH			
	29	ISOPACH OF OVERLYING STRATA			
	30	GEOLOGIC SECTIONS			
	31	DISSOLVED-SOLIDS CONCENTRATION		Unpublished data on file at the Georgia Geologic Survey	Concentrations of dissolved solids may have changed since measurements were made.
	32	WATER-LEVEL TRENDS AND POTENTIOMETRIC SURFACE		McFadden, S.S., and Perriello, P.D., 1983 Unpublished data on file at the Georgia Geologic Survey	Possible inaccurate water-level data may reflect faulty well construction.
CRETACEOUS AQUIFER SYSTEM	33	STRUCTURE CONTOUR OF THE TOP	Upper boundary — Top of the first rock of Cretaceous age with less than a 50% clay content. Lower boundary — Contact between strata deposited before the Fredericksburgian Provincial Stage (Lower Cretaceous Series) and the overlying strata.	Herrick, S.M., 1961 Pollard, L.D., and Vorhis, R.C., 1980 Unpublished data on file at the Georgia Geologic Survey	In southeast Georgia, the boundary of the top of the Cretaceous limestone is not well defined. This limestone is included in both the Principal Artesian Aquifer System (Miller, 1982) and the Cretaceous Aquifer System (Pollard and Vorhis, 1980). In southwest Georgia, lower Cretaceous sand of questionable age is not included in the Cretaceous Aquifer. This sand is also not represented on the structure-contour map of the pre-Cretaceous unconformity.
	34	STRUCTURE CONTOUR OF THE BASE			
	35	ISOPACH			
	36	ISOPACH OF OVERLYING STRATA			
	37	GEOLOGIC SECTIONS			
LOWER CRETACEOUS AQUIFER SYSTEM	38	STRUCTURE CONTOUR OF THE TOP	Lower Cretaceous pre-Tuscaloosa-aged strata. Boundary — Base of the Cretaceous-aged strata.	Brown, P.M., and others, 1979 Herrick. S.M., 1961 Milton, C., and Hurst, V.J., 1965 Unpublished data on file at the Georgia Geologic Survey	Geophysical methods were used for boundary and salinity determinations. In southwest Georgia, lower Cretaceous sand of questionable age is not included in the Cretaceous Aquifer. This sand is also not represented on the structure-contour map of the pre-Cretaceous unconformity.
	39	ISOPACH			
	40	CHLORIDE CONCENTRATIONS			
	41	STRUCTURE CONTOUR OF THE PRE-CRETACEOUS UNCONFORMITY			

PLATE 1

AREAL MAP OF THE PLIOCENE-TO-RECENT AQUIFER SYSTEM

M. C. TURLINGTON

The areal map of the Pliocene-to-Recent Aquifer System shows the outcrop area of the Pliocene-to-Recent strata; this area approximates the extent of the aquifer. Since no sediments overlie this aquifer, the entire surface is outcrop. The Pliocene-to-Recent Aquifer consists of sand, gravel, and clay extending from the surface to an average depth of approximately 60 feet. The major part of the outcrop is composed of barrier island, lagoon, and marsh deposits. Quaternary alluvium in floodplains is shown on the map for the major rivers. The strata cropping out in the Grady-Thomas-Brooks-Lowndes County area are the Pliocene-aged Miccosukee Formation. In some areas along stream beds, the Miccosukee has been removed, locally exposing the Miocene-aged Hawthorne Formation; such areas are isolated and are not differentiated on this map.

SOURCES

Cooke, C.W., 1943, Geology of the Coastal Plain of Georgia: U.S. Geol. Survey Bull. 941, 117 p.

Cramer, H.R., 1974, Isopach and lithofacies analysis of the Cretaceous and Cenozoic rocks of the Coastal Plain of Georgia, in Symposium on the petroleum geology of the Georgia Coastal Plain: Georgia Geol. Survey Bull. 87, p. 21-43.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Henry, V.J., Giles, R.T., and Woolsey, J.R., 1973, Geology of the Chatham County area, in The Neogene of the Georgia Coast: Georgia Geol. Soc. 8th ann. fieldtrip guidebook, p. 67-80.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

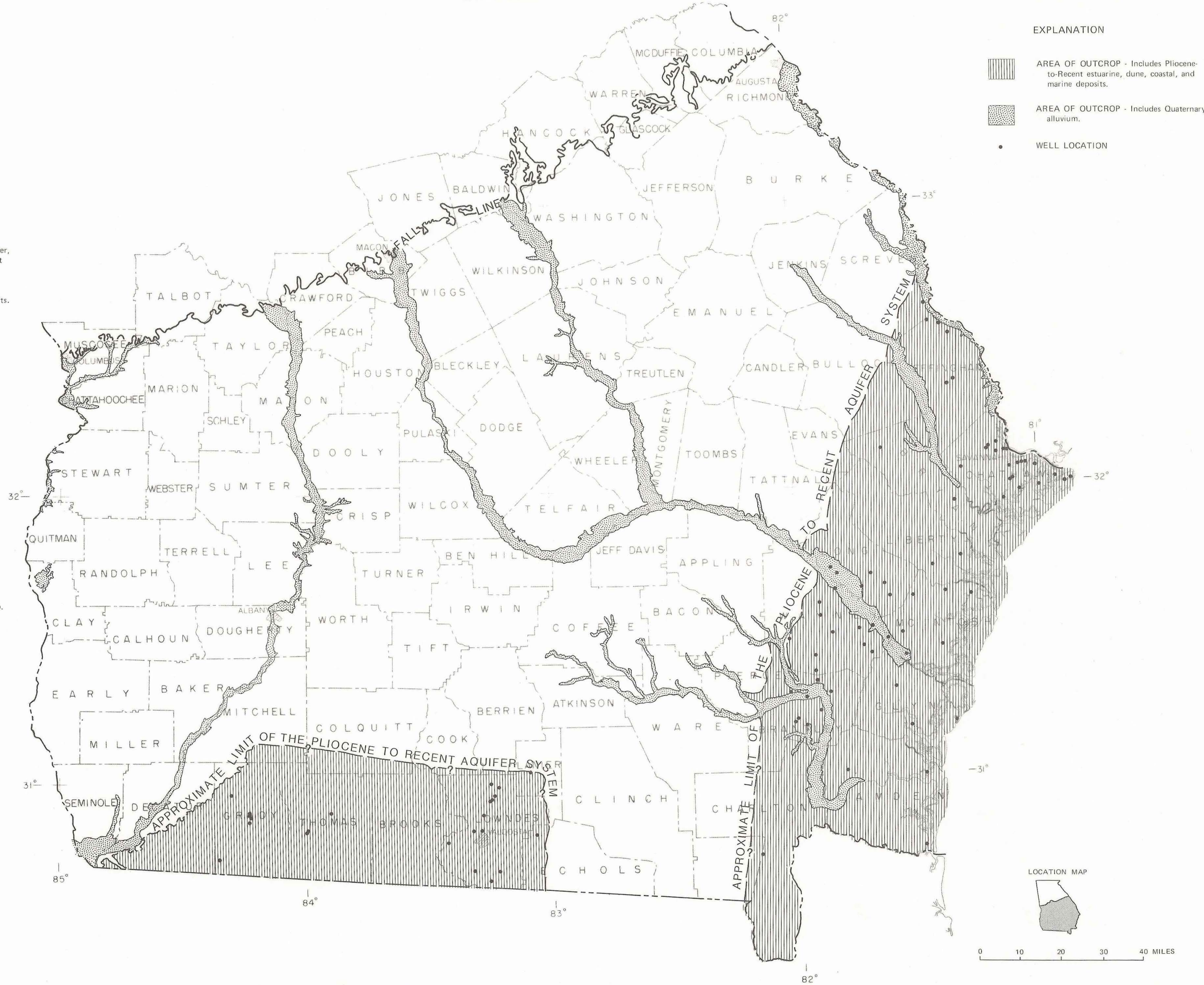


PLATE 2

STRUCTURE-CONTOUR MAP OF THE BASE OF THE PLIOCENE-TO-RECENT AQUIFER SYSTEM

M. C. TURLINGTON

The structure-contour map of the base of the Pliocene-to-Recent Aquifer System shows the elevation of the base of the aquifer. Generally, Pliocene sands, which are often coarser at the base, are underlain by Miocene green, phosphatic, sandy clays. In Charlton and Camden Counties, however, the Pliocene or Pleistocene strata directly overlie Miocene limestone and dolostone. The base of the Pliocene-to-Recent Aquifer System generally dips southeast. Localized low areas may be channels cut into the Miocene; larger depressions may reflect structural lows in the underlying surface. Quaternary alluvium is not differentiated from the Pliocene-to-Recent marine and estuarine deposits on this map.

SOURCES

Cooke, C.W., 1943, Geology of the Coastal Plain of Georgia: U.S. Geol. Survey Bull. 941, 117 p.

Cramer, H.R., 1974, Isopach and lithofacies analysis of the Cretaceous and Cenozoic rocks of the Coastal Plain of Georgia, in Symposium on the petroleum geology of the Georgia Coastal Plain: Georgia Geol. Survey Bull. 87, p. 21-43.

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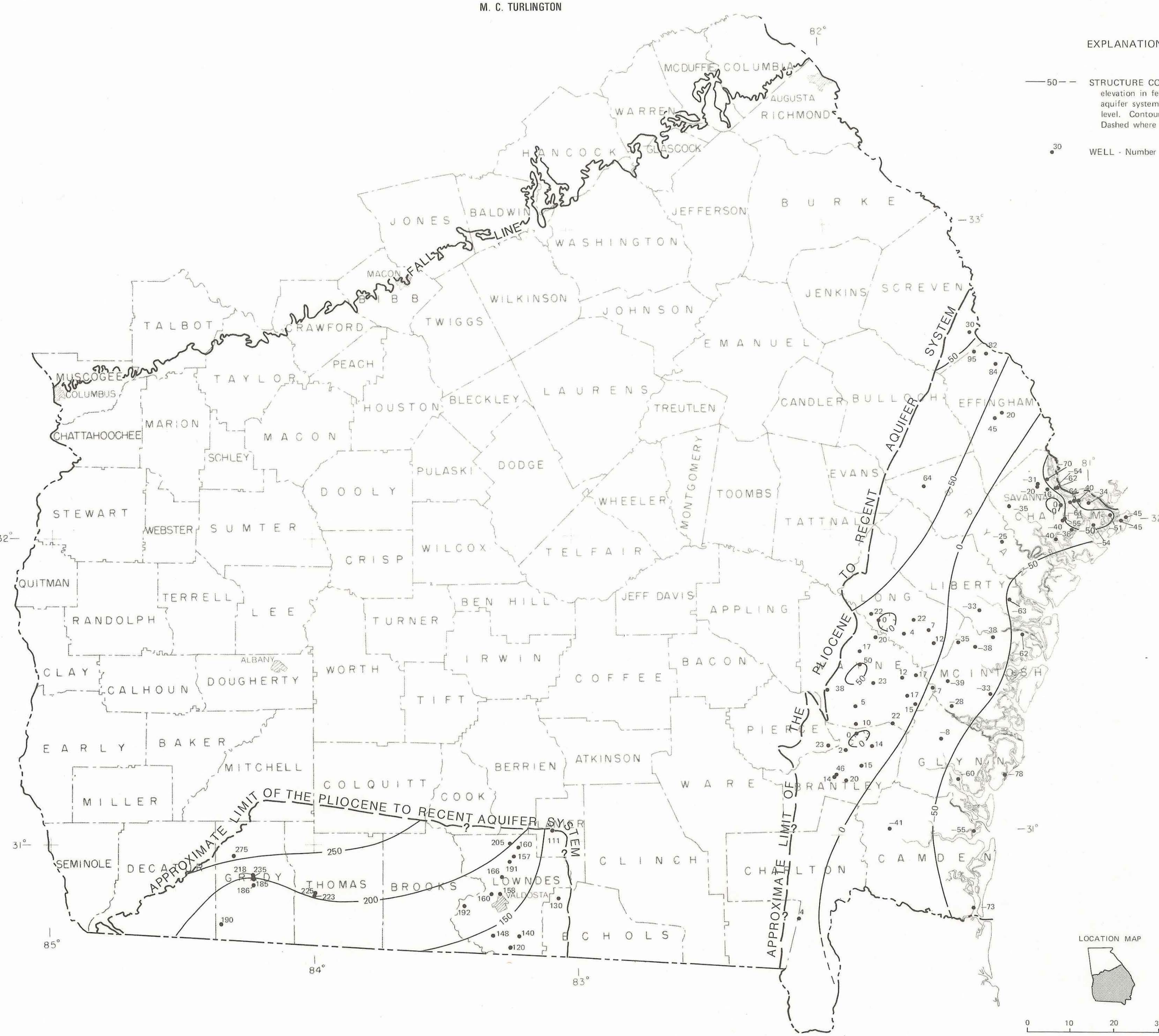


EXPLANATION

—50— — STRUCTURE CONTOUR - Shows elevation in feet of the base of the aquifer system. Datum is mean sea level. Contour interval is 50 feet. Dashed where approximately located.

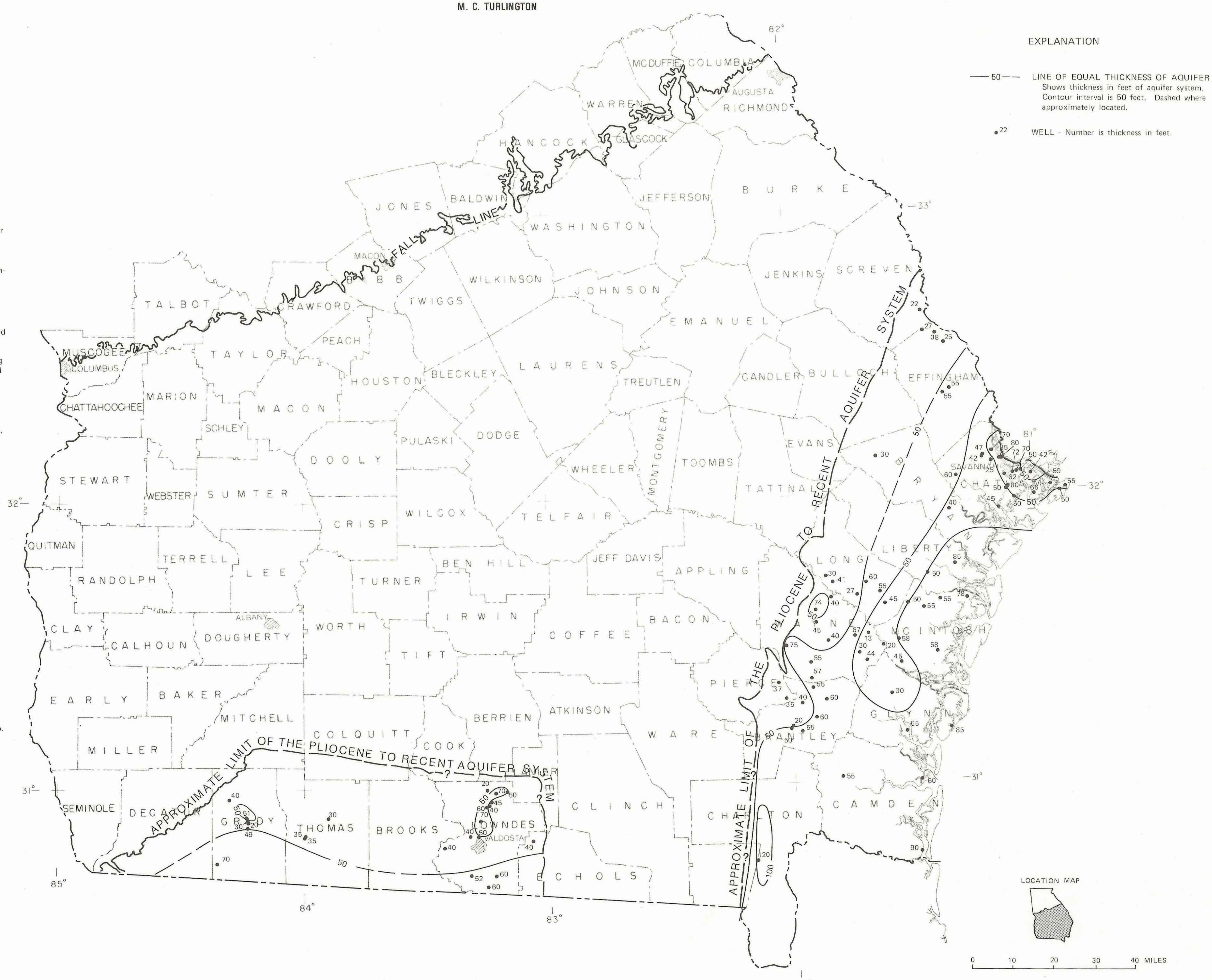
•30 WELL - Number is elevation in feet.

ISOPACH MAP OF THE PLIOCENE-TO-RECENT AQUIFER SYSTEM

M. C. TURLINGTON

The isopach map of the Pliocene-to-Recent Aquifer System shows the thickness of the strata from the base of the aquifer to land surface. The aquifer's thickness averages about 60 feet and rarely exceeds 100 feet. In general, the system thickens from northwest to southeast. Localized thickened sediments may be infilled channels cut into the Miocene, or they might reflect differences in topography, such as the high dunes which form Trail Ridge (in Charlton and Brantley Counties).

The Pliocene-to-Recent Aquifer System is composed predominantly of sand mixed or interbedded with clay, silt, gravel, or shells. The Pleistocene and Holocene sediments, present in the counties bordering the coast, were deposited in a series of barrier island chains and lagoons aligned roughly parallel to the present coastline. These sediments include well-sorted, usually fine sand of the barrier island facies, and clay, silt, and sand deposited in lagoons and salt marshes. The Pliocene strata, underlying the Pleistocene sediments and cropping out west of them, are predominantly composed of sand, gravel, and clay deposited in estuaries, lagoons, and beaches. These deposits include the Cypresshead Formation in the eastern outcrop area and the Miccosukee Formation in the western outcrop area. Quaternary alluvium is not differentiated from the Pliocene-to-Recent marine and estuarine deposits on this map.



SOURCES

Cooke, C.W., 1943, Geology of the Coastal Plain of Georgia: U.S. Geol. Survey Bull. 941, 117 p.

Cramer, H.R., 1974, Isopach and lithofacies analysis of the Cretaceous and Cenozoic rocks of the Coastal Plain of Georgia, in Symposium on the petroleum geology of the Georgia Coastal Plain: Georgia Geol. Survey Bull. 87, p. 21-43.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Henry, V.J., Giles, R.T., and Woolsey, J.R., 1973, Geology of the Chatham County area, in The Neogene of the Georgia Coast: Georgia Geol. Soc. 8th ann. fieldtrip guidebook, p. 67-80.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

CONCENTRATION OF DISSOLVED SOLIDS IN THE PLIOCENE-TO-RECENT AQUIFER SYSTEM

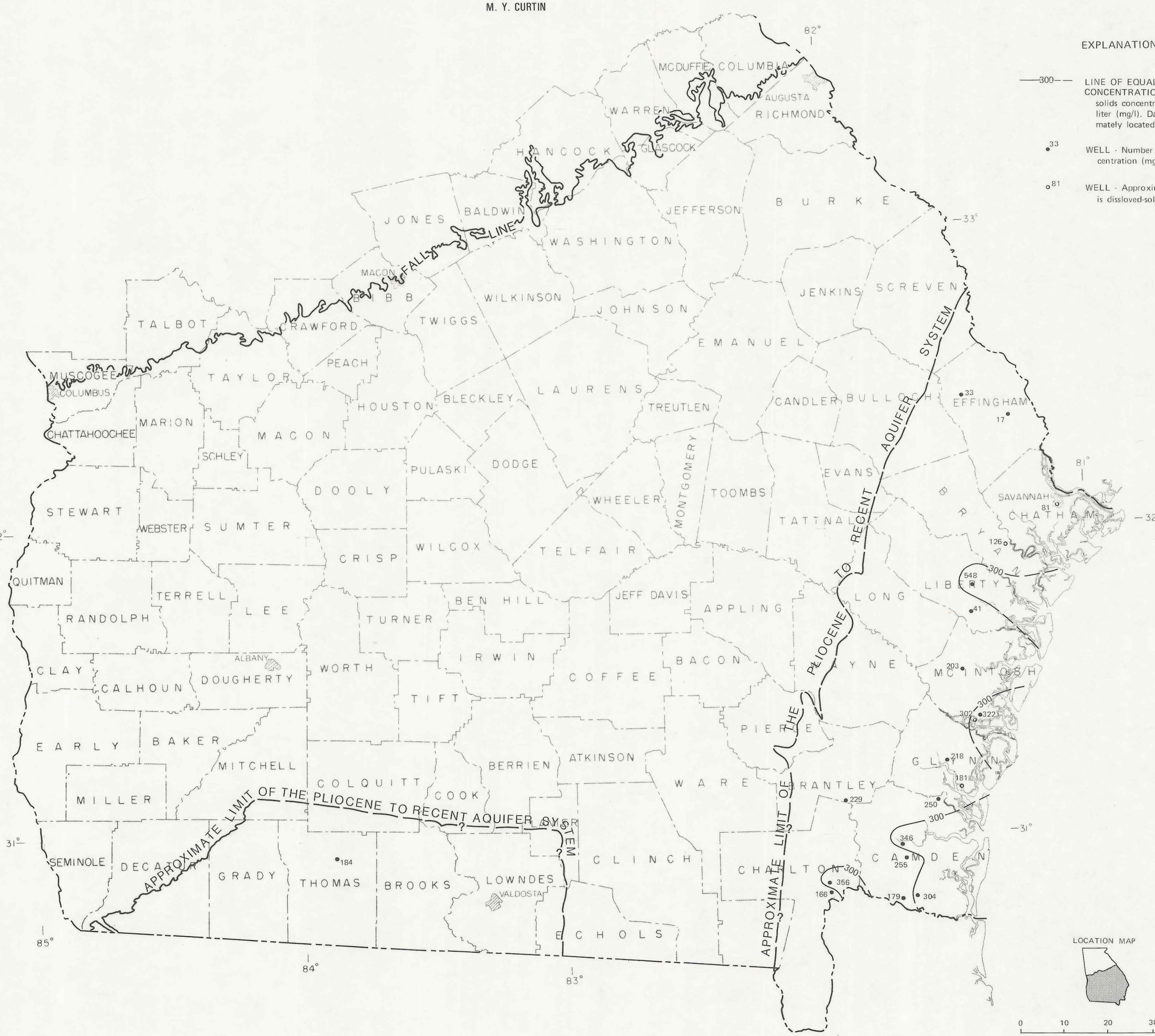
M. Y. CURTIN

This map shows the concentration of dissolved solids in water from the Pliocene-to-Recent Aquifer System. The concentration of dissolved solids is everywhere below the National Drinking Water Standard of 500 milligrams per liter (mg/l), except in Liberty County where one well has a dissolved-solids concentration of 548 mg/l. The origin of the high concentration is unknown, but might result from contamination from: a) downward infiltration from tidal creeks and channels, b) miscellaneous downward infiltration from the surface, or c) a combination of the above.

SOURCES

U.S. Geological Survey, 1976, Ground-water quality data for Georgia: Doraville, Ga., Water Res. Div., 216 p.

Watson, T., 1979, Aquifer potential of shallow sediments of the coastal area of Georgia, in Investigations of alternative sources of ground water in the coastal area of Georgia: Georgia Geol. Survey Open-file Report 80-3, p. A1-A30.



EXPLANATION

—300— LINE OF EQUAL DISSOLVED-SOLIDS CONCENTRATION - Shows dissolved solids concentration in milligrams per liter (mg/l). Dashed where approximately located.

•33 WELL - Number is dissolved-solids concentration (mg/l).

∘81 WELL - Approximate location. Number is dissloved-solids concentration (mg/l).

STRUCTURE-CONTOUR MAP OF THE TOP OF THE MIOCENE AQUIFER SYSTEM

D. M. MACK AND H. C. KARP, JR.

The structure-contour map of the top of the Miocene Aquifer System shows the elevation of the top of the Screven Formation or, where the Screven is not present, the top of the Hawthorne Group. The outcrop area of the Miocene sediments also is shown. The Screven Formation, a poorly sorted pebbly sand with clay balls, is a prograding fluvial deposit. The Hawthorne Group, a multiformation unit, is predominantly sand and clay, and has a shallow-water, marine origin.

Much of the Miocene Aquifer System is exposed. Where it is overlain by younger sediments, the top of the Miocene Aquifer System dips gently to the east and southeast. In southwest Georgia, the overlying Pliocene-to-Recent sediments have been eroded along the streams, exposing the Miocene sediments. This produces an outcrop terrane with the dissected appearance.

SOURCES

Applin, E.R., and Applin, P.L., 1964, Logs of selected wells in the Coastal Plains of Georgia: Georgia Geol. Survey Bull. 74, 229 p.

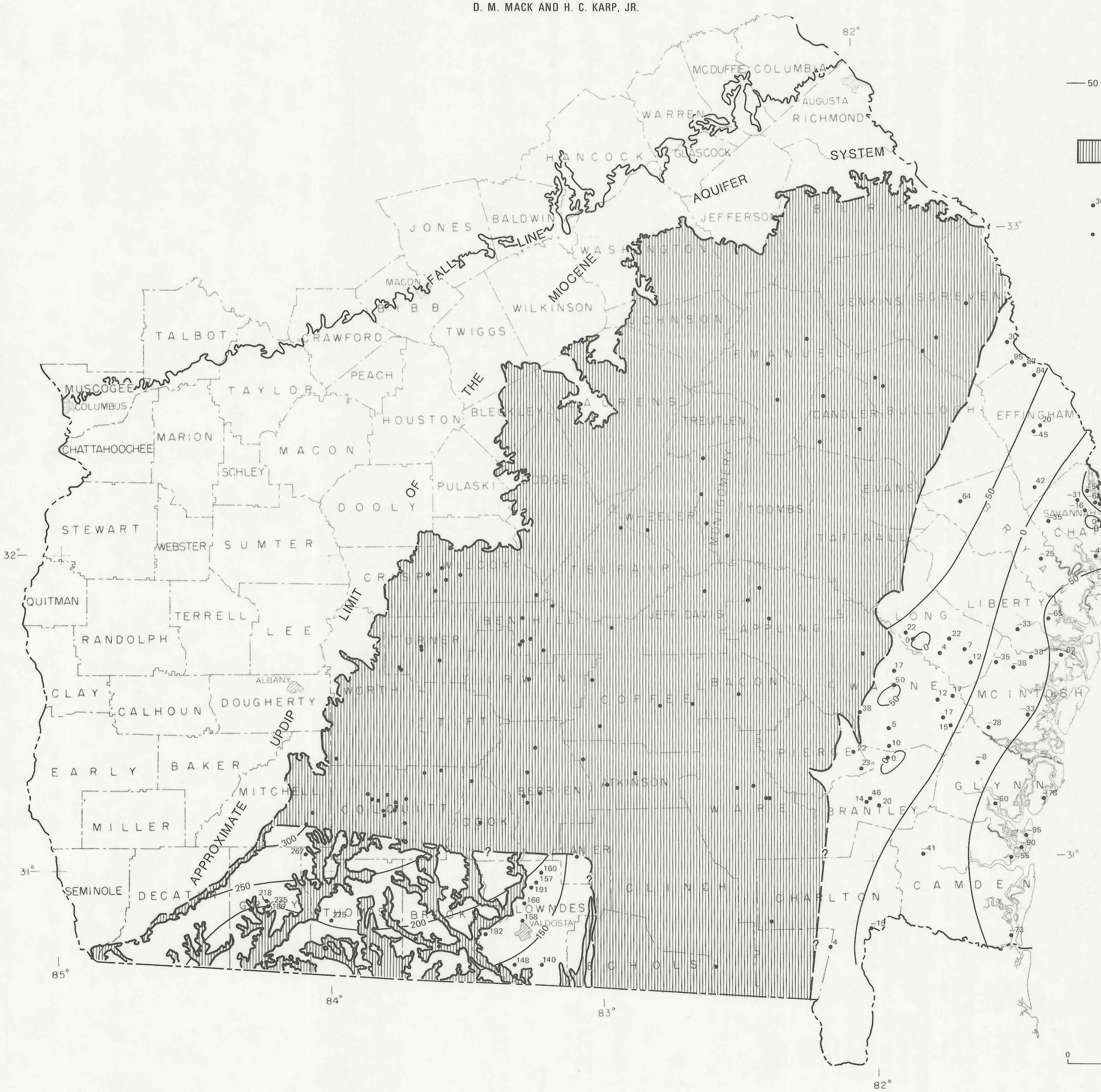
Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Sever, C.W., 1966, Miocene structural movements in Thomas County, Georgia: U.S. Geol. Survey Prof. Paper 550-C, p. 12-16.

Weaver, C.E., and Beck, K.C., 1977, Miocene of the S.E. United States, a model for chemical sedimentation in a peri-marine environment: Sedimentary Geology, v. 17, 234 p.



EXPLANATION

—50— STRUCTURE CONTOUR - Shows elevation in feet of the top of the aquifer system. Datum is mean sea level. Contour interval is 50 feet.

AREA OF OUTCROP - Includes Miocene and discontinuous Recent sediments. Boundary dashed where approximately located.

•30 WELL - Number is elevation in feet.

• WELL - Located in outcrop area. Top of aquifer removed by erosion.

LOCATION MAP

0 10 20 30 40 MILES

STRUCTURE-CONTOUR MAP OF THE BASE OF THE MIOCENE AQUIFER SYSTEM

H. C. KARP, JR. AND D. M. MACK

The structure-contour map of the base of the Miocene Aquifer System shows the elevation of the base of the Hawthorne Group. In general, the aquifer dips toward the Atlantic coast. A structural feature, the Gulf Trough, trends northeast-southwest across the Georgia Coastal Plain, and affects the elevation of the aquifer base.

Several structural depressions are present throughout the Miocene Aquifer System. Three large depressions occur along the Gulf Trough in Grady, Colquitt, and Tattnall Counties. Other large depressions are present in Camden, Wayne, Glynn, and McIntosh Counties.

SOURCES

Applin, E.R., and Applin, P.L., 1964, Logs of selected wells in the Coastal Plains of Georgia: Georgia Geol. Survey Bull. 74, 229 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

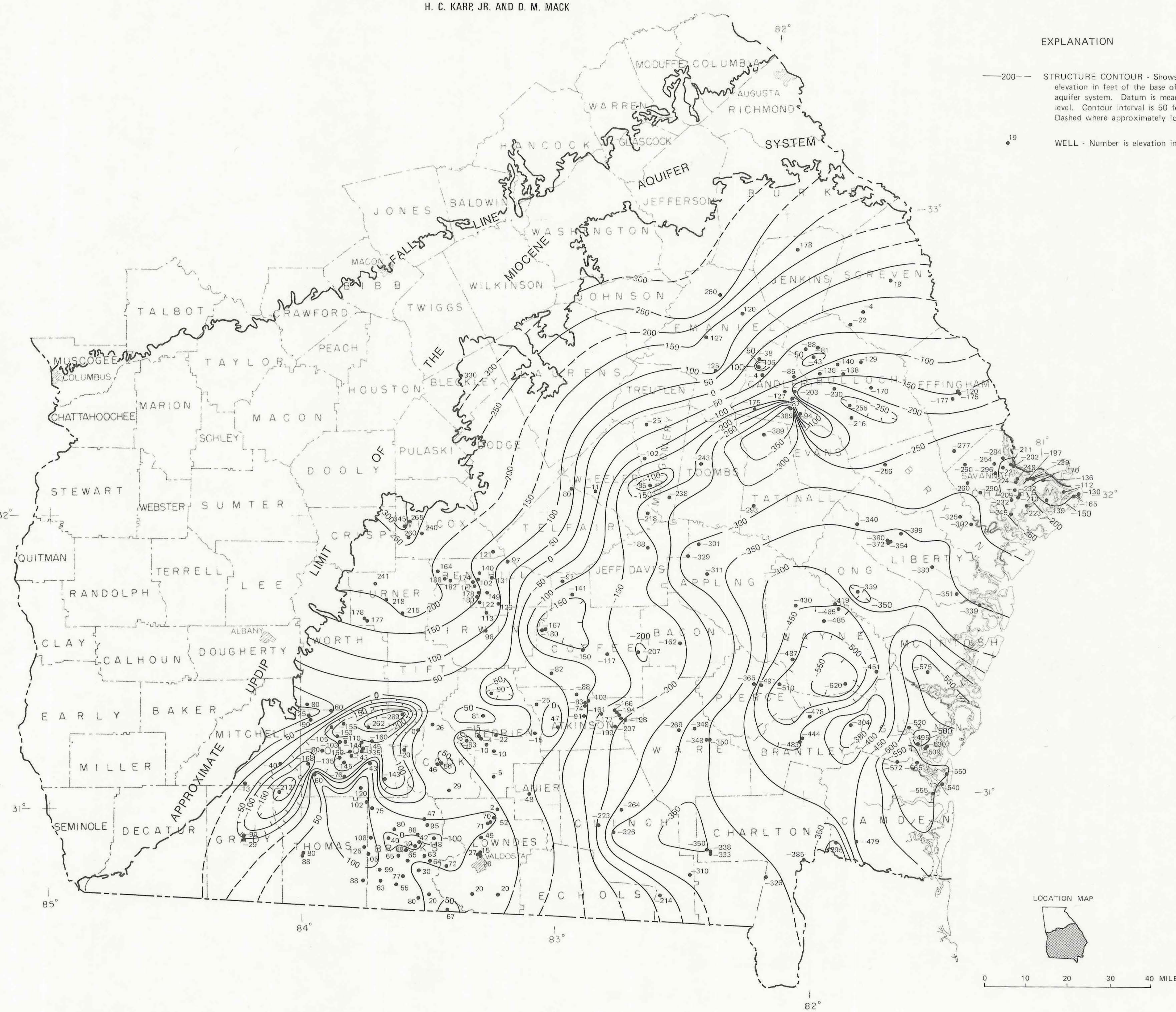
Sever, C.W., 1966, Miocene structural movements in Thomas County, Georgia: U.S. Geol. Survey Prof. Paper 550-C, p. 12-16.

Weaver, C.E., and Beck, K.C., 1977, Miocene of the S.E. United States, a model for chemical sedimentation in a peri-marine environment: Sedimentary Geology, v. 17, 234 p.

EXPLANATION

—200— — STRUCTURE CONTOUR - Shows elevation in feet of the base of the aquifer system. Datum is mean sea level. Contour interval is 50 feet. Dashed where approximately located.

•19 WELL - Number is elevation in feet.



ISOPACH MAP OF THE MIOCENE AQUIFER SYSTEM

D. M. MACK AND H. C. KARP, JR.

The isopach map of the Miocene Aquifer System shows the thickness of the Hawthorne Group and the overlying Screven Formation. The formations included in the Hawthorne Group are the Altamaha, Parachucla, Marks Head, Torreya, and the Coosawhatchie.

There is a general thickening of Miocene strata toward the Atlantic Coast. Three areas of thickened strata within this trend, centered in Tattnall, Colquitt and Wayne Counties, are probably basin-filling sediments in structural lows. Those in Tattnall and Colquitt Counties occur along the northeast-southwest trending axis of the Gulf Trough. South of the axis, in Brooks and Lowndes Counties, relatively thin strata occur.

SOURCES

Applin, E.R., and Applin, P.L., 1964, Logs of selected wells in the Coastal Plains of Georgia: Georgia Geol. Survey Bull. 74, 229 p.

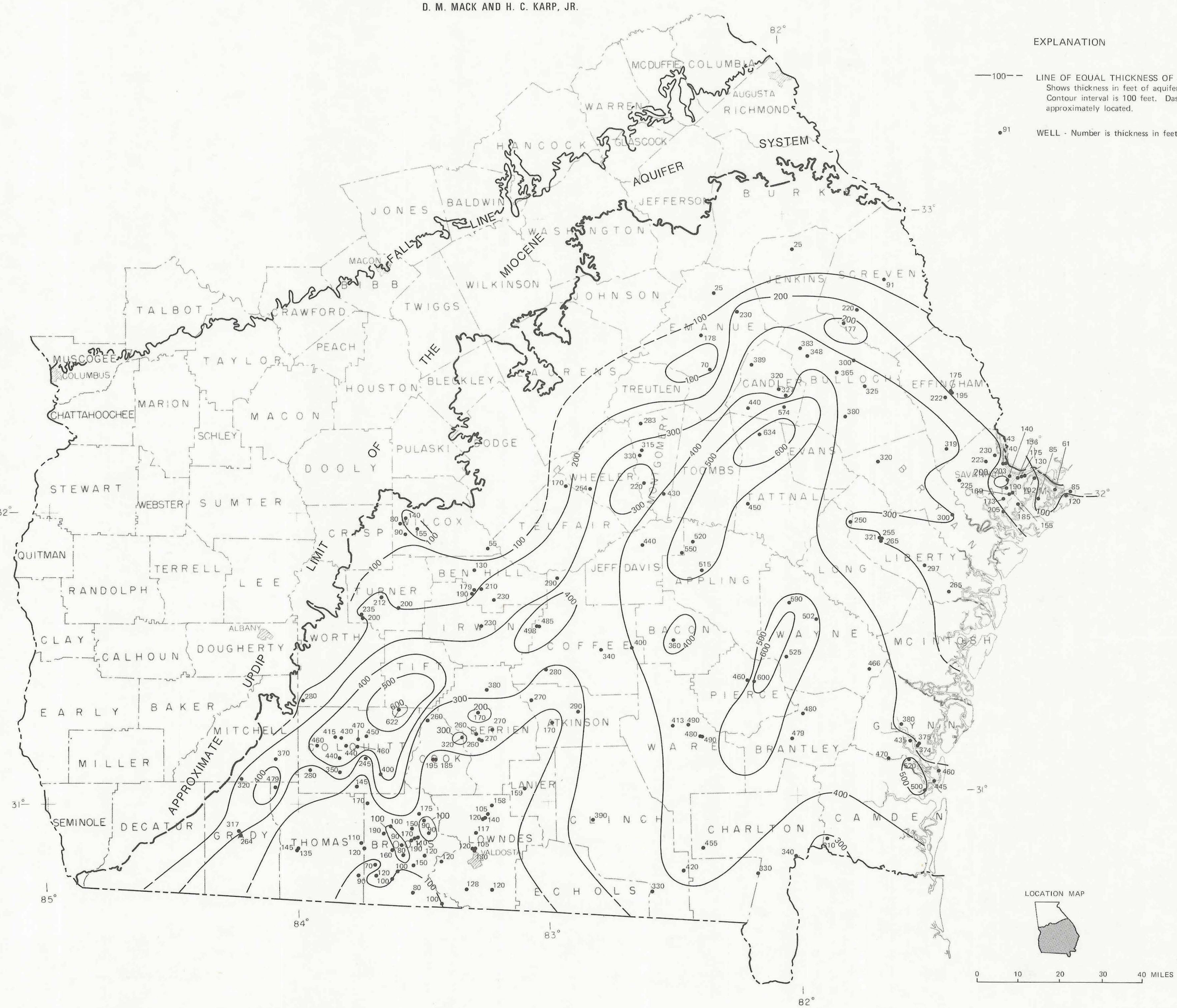
Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Sever, C.W., 1966, Miocene structural movements in Thomas County, Georgia: U.S. Geol. Survey Prof. Paper 550-C, p. 12-16.

Weaver, C.E., and Beck, K.C., 1977, Miocene of the S.E. United States, a model for chemical sedimentation in a peri-marine environment: Sedimentary Geology, v. 17, 234 p.



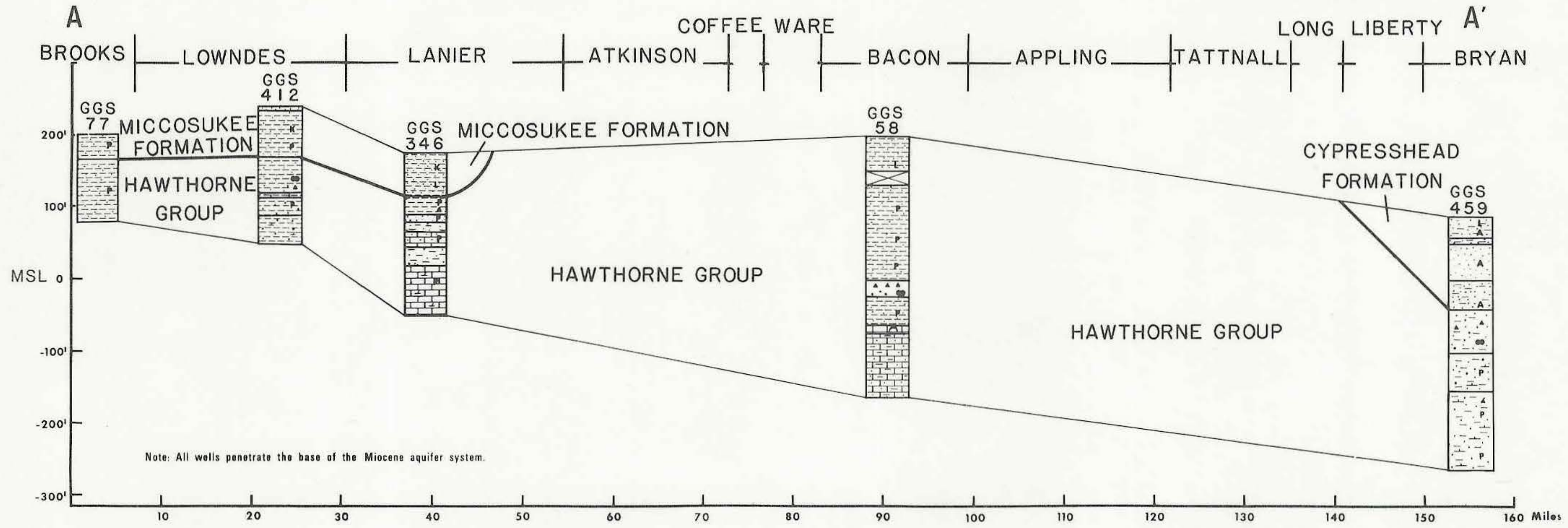
EXPLANATION

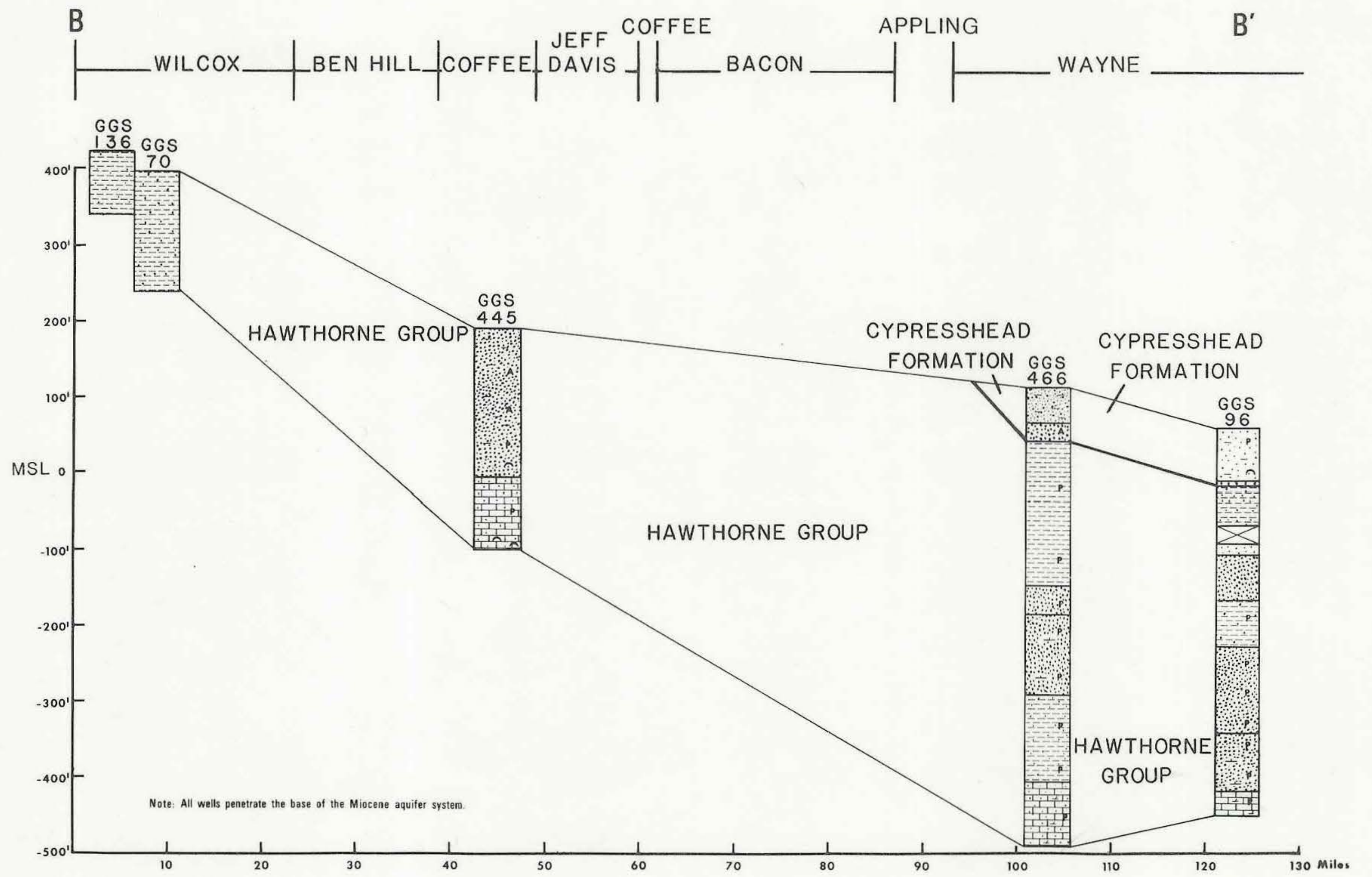
—100— — LINE OF EQUAL THICKNESS OF AQUIFER - Shows thickness in feet of aquifer system. Contour interval is 100 feet. Dashed where approximately located.

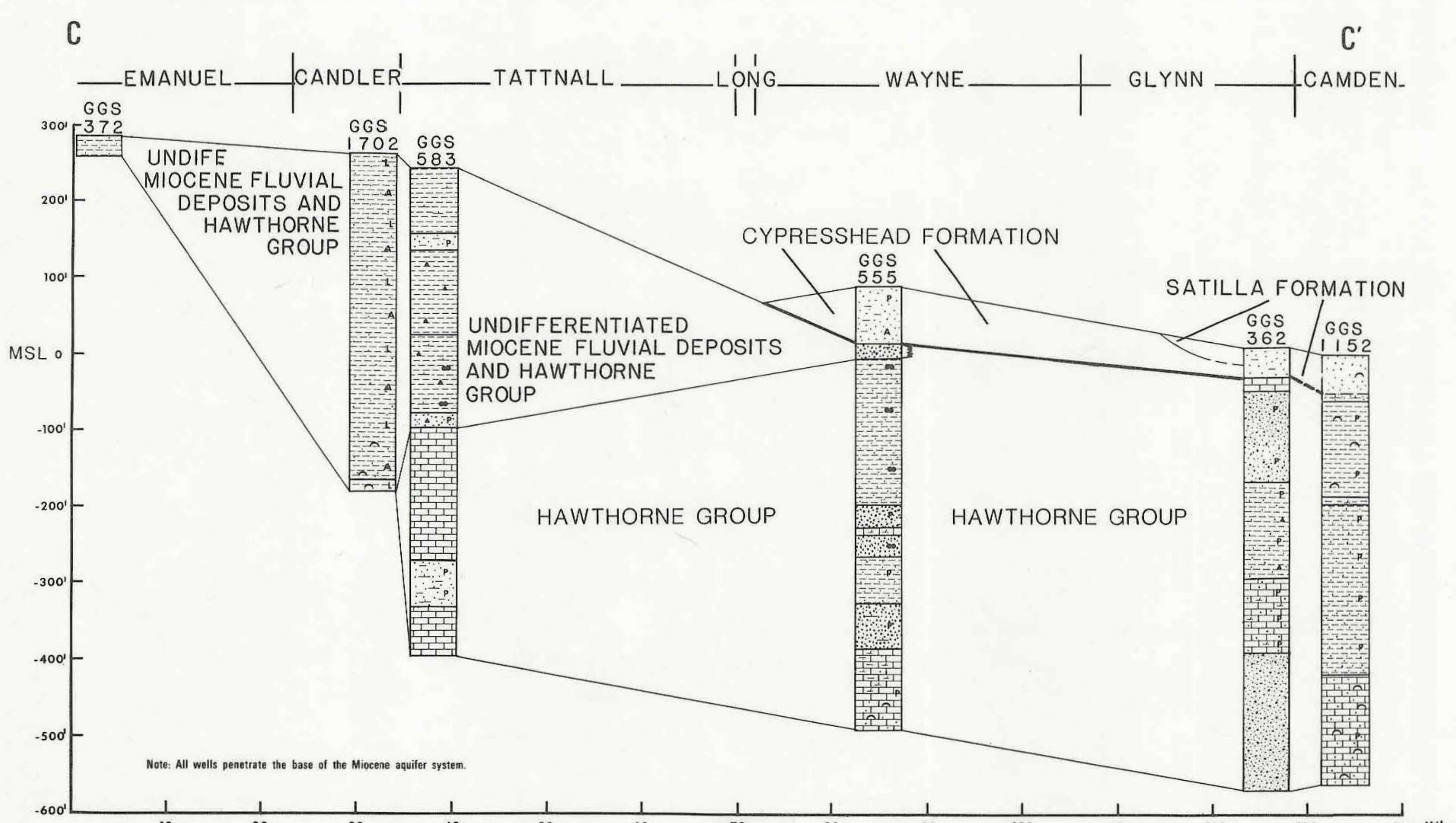
•91 WELL - Number is thickness in feet.

GEOLOGIC SECTIONS OF THE MIOCENE AND PLIOCENE-TO-RECENT AQUIFER SYSTEMS

P. A. CREWS







The stratigraphic cross sections of the Miocene and Pliocene-to-Recent Aquifer Systems illustrate the lithology of 16 wells along three lines in Georgia's Coastal Plain. These aquifer systems encompass all strata above the base of the Hawthorne Group. The Pliocene-to-Recent strata are generally restricted to the coastal counties and a five-county area along the Florida-Georgia border. In contrast, the Miocene-aged Hawthorne Group is laterally persistent throughout the Coastal Plain.

The Pliocene-to-Recent Aquifer System consists of estuarine, dune, beach, lagoon, and shallow marine deposits of the Satilla, Cypresshead and Miccosukee Formations.

Strata in the Miocene Aquifer System include undifferentiated Miocene fluvial deposits and the underlying Hawthorne Group. These are prograding fluvial deposits consisting of poorly sorted pebbly, clayey sand. The underlying Hawthorne Group is a multiformation unit composed predominantly of sand and clay. It is characterized by palygorskite and sepiolite clay, dolomite and phosphorite.

SOURCES

Applin, E.R., and Applin, P.L., 1964, Logs of selected wells in the Coastal Plains of Georgia: Georgia Geol. Survey Bull. 74, 229 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale, 1:500,000.

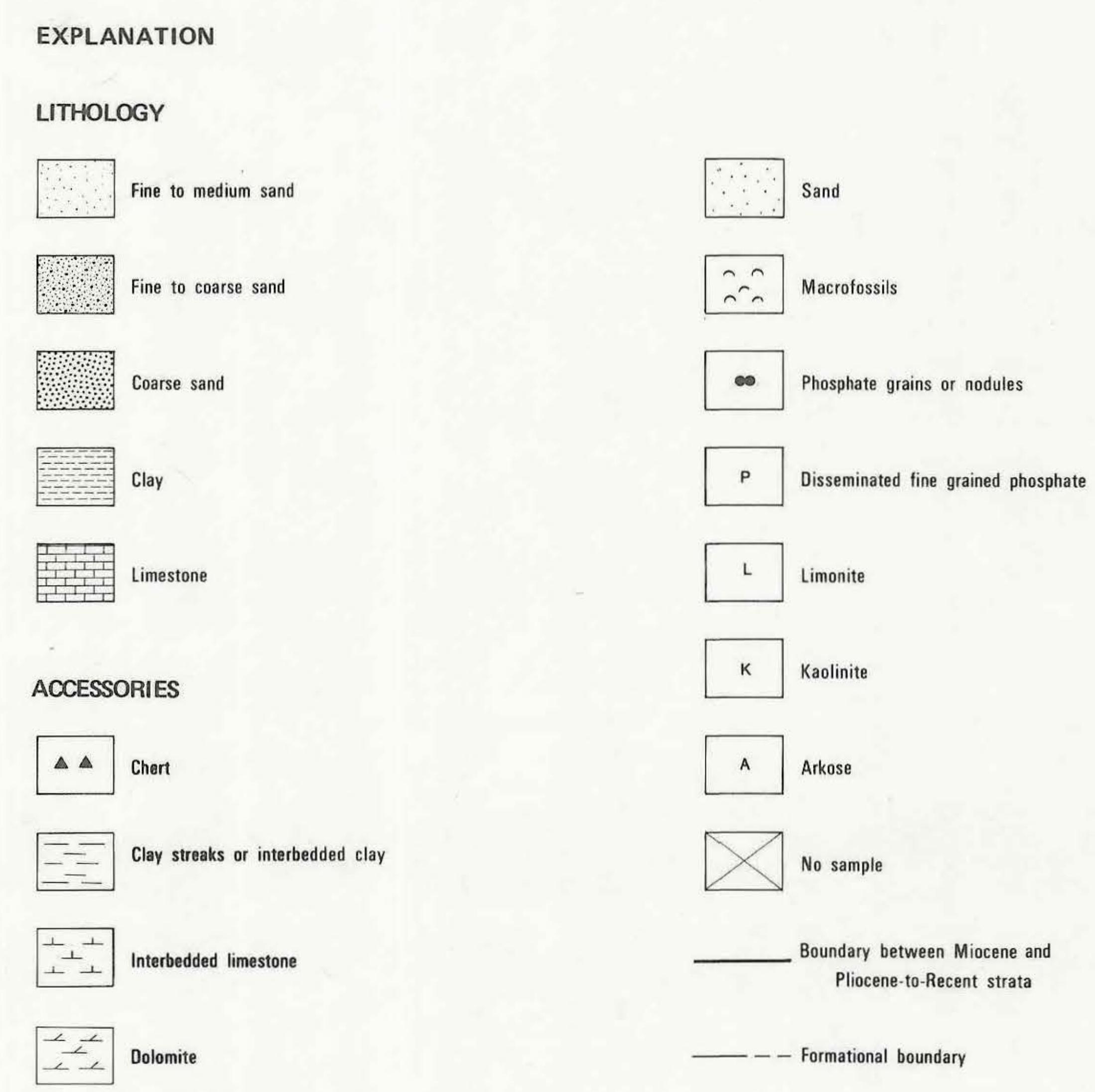
Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia, scale, 1:500,000.

Huddlestun, P.F., 1982, Correlation chart—Georgia Coastal Plain: Georgia Geol. Survey Open-file Report 82-1.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Sever, C.W., 1966, Miocene structural movements in Thomas County, Georgia: U.S. Geol. Survey Prof. Paper 550-C, p. 12-16.

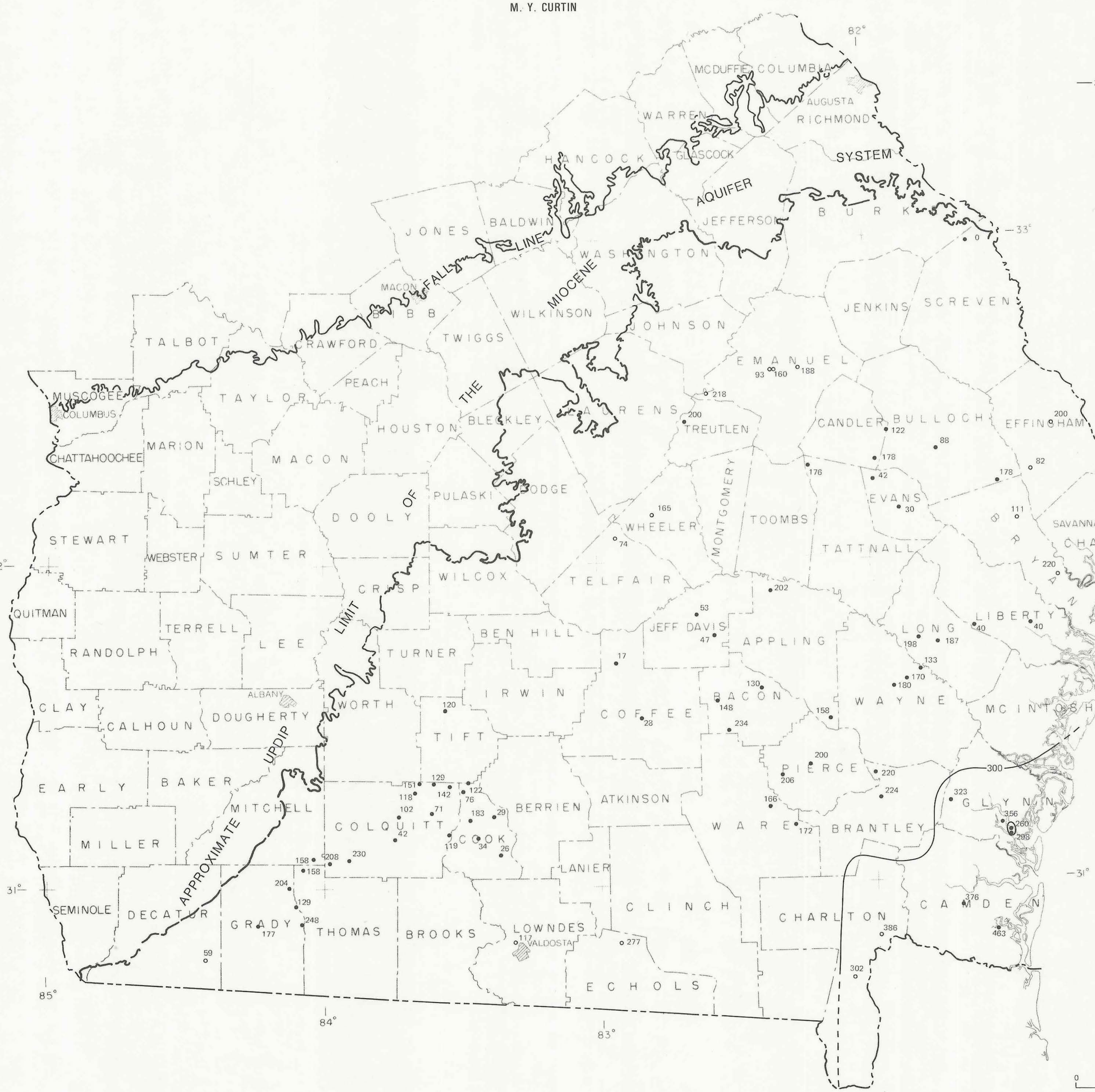
Weaver, C.E., and Beck, K.C., 1977, Miocene of the S.E. United States, a model for chemical sedimentation in a peri-marine environment: Reprinted from Sedimentary Geology, v. 17.



CONCENTRATION OF DISSOLVED SOLIDS IN THE MIOCENE AQUIFER SYSTEM

M. Y. CURTIN

The quality of the water from the Miocene Aquifer System is generally very good, with an average dissolved-solids content between 100 and 200 milligrams per liter (mg/l). This is well below the National Drinking Water Standard of 500 mg/l. The dissolved-solids concentration increases toward the downdip area, Camden, Charlton, and Glynn Counties. Because it is close to the surface, this aquifer is also somewhat susceptible to contamination from the surface.



EXPLANATION

—300— — LINE OF EQUAL DISSOLVED-SOLIDS CONCENTRATION - Shows dissolved solids concentration in milligrams per liter (mg/l). Dashed where approximately located.

•80 WELL - Number is dissolved-solids concentration in mg/l.

o200 WELL - Approximate location. Number is dissolved-solids concentration (mg/l).

SOURCES

Sever, C.W., 1965, Ground-water resources and geology of Seminole, Decatur, and Grady counties, Georgia: U.S. Geol. Survey Water-Supply Paper 1809-Q, 30 p.

__________, 1972, Ground-water resources and geology of Cook County, Georgia: U.S. Geol. Survey Open-file Report, 40 p.

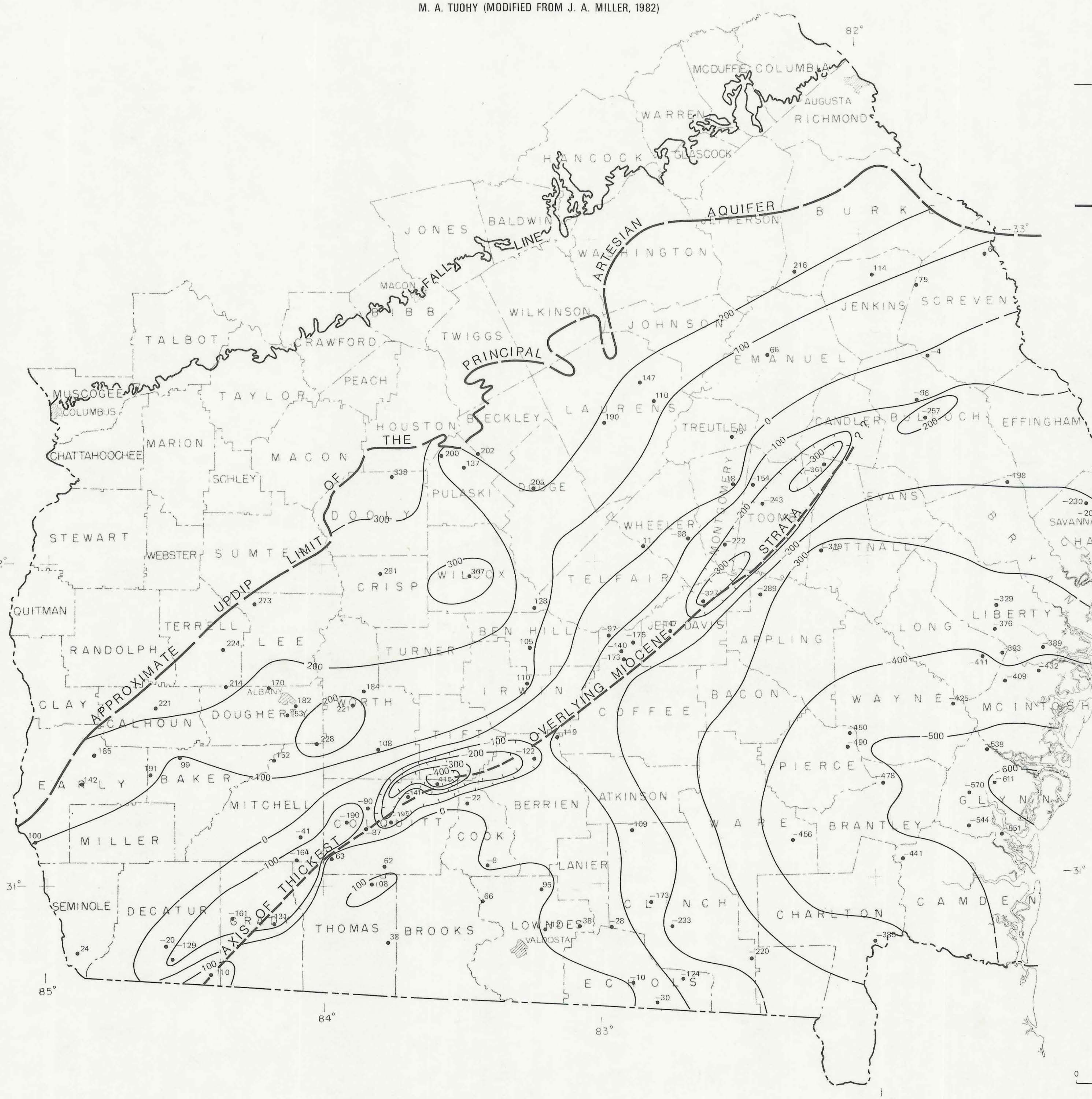
U.S. Geological Survey, 1976, Ground-water quality data for Georgia: Doraville, Ga., Water Res. Div., 216 p.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

Watson, T., 1979, Aquifer potential of shallow sediments of the coastal area of Georgia, in Investigations of alternative sources of ground-water in the coastal area of Georgia: Georgia Geol. Survey Open-file Report 80-3, p. A1-A30.

STRUCTURE-CONTOUR MAP OF THE TOP OF THE PRINCIPAL ARTESIAN AQUIFER SYSTEM

M. A. TUOHY (MODIFIED FROM J. A. MILLER, 1982)



EXPLANATION

—100— STRUCTURE CONTOUR - Shows elevation in feet of the top of the aquifer system. Datum is mean sea level. Contour interval is 100 feet. Dashed where approximately located.

•61 WELL - Number is elevation of top of aquifer as determined by J. A. Miller (1982).

— — ? AXIS OF THICKEST OVERLYING MIOCENE STRATA. Line is from Isopach Map of the Miocene Aquifer System (Mack and Karp, this atlas).

This map shows the elevation, in feet above or below sea level, of the top of the Principal Artesian Aquifer System. In the Georgia Coastal Plain, the top is mostly coincident with the top of the Suwannee Limestone of Oligocene age. Where the Suwannee is absent, the Ocala Limestone of late Eocene age forms the top of the aquifer system. In area Ia of Figure 1, the Ocala Limestone is exposed at the surface and the aquifer is unconfined except for a thin, clayey residuum that overlies it. In area Ib, the Ocala Limestone thins updip and grades into sand and clay of the Barnwell Group. In area II, the Suwannee Limestone is present and forms the top of the aquifer system. Here, the aquifer system is directly overlain by Miocene dolomitic limestone. In area Ic, the Ocala Limestone forms the top of the Principal Artesian Aquifer System; the Suwannee Limestone is not present.

The Gulf Trough, a linear feature overlain by a thick sequence of Miocene strata, is approximated by a heavy dashed line on the large map. In this region, recharge to the aquifer system is effectively lowered by the thick Miocene confining unit. North and west of the Gulf Trough, the upper surface of the aquifer system slopes generally southeastward. South of the trough the aquifer system slopes toward the Southeast Georgia Embayment.

SOURCE

Miller, J.A., 1982, Geology and configuration of the top of the Tertiary limestone aquifer system, southeastern United States: U.S. Geol. Survey Water-Resources Invs. Open-file Report 81-1178, 1 sheet.

UPPERMOST UNITS OF THE PRINCIPAL ARTESIAN AQUIFER SYSTEM

Ia-c OCALA LIMESTONE OR EQUIVALENT
II SUWANNEE LIMESTONE OR EQUIVALENT

AFTER MILLER, 1982

Figure 1.

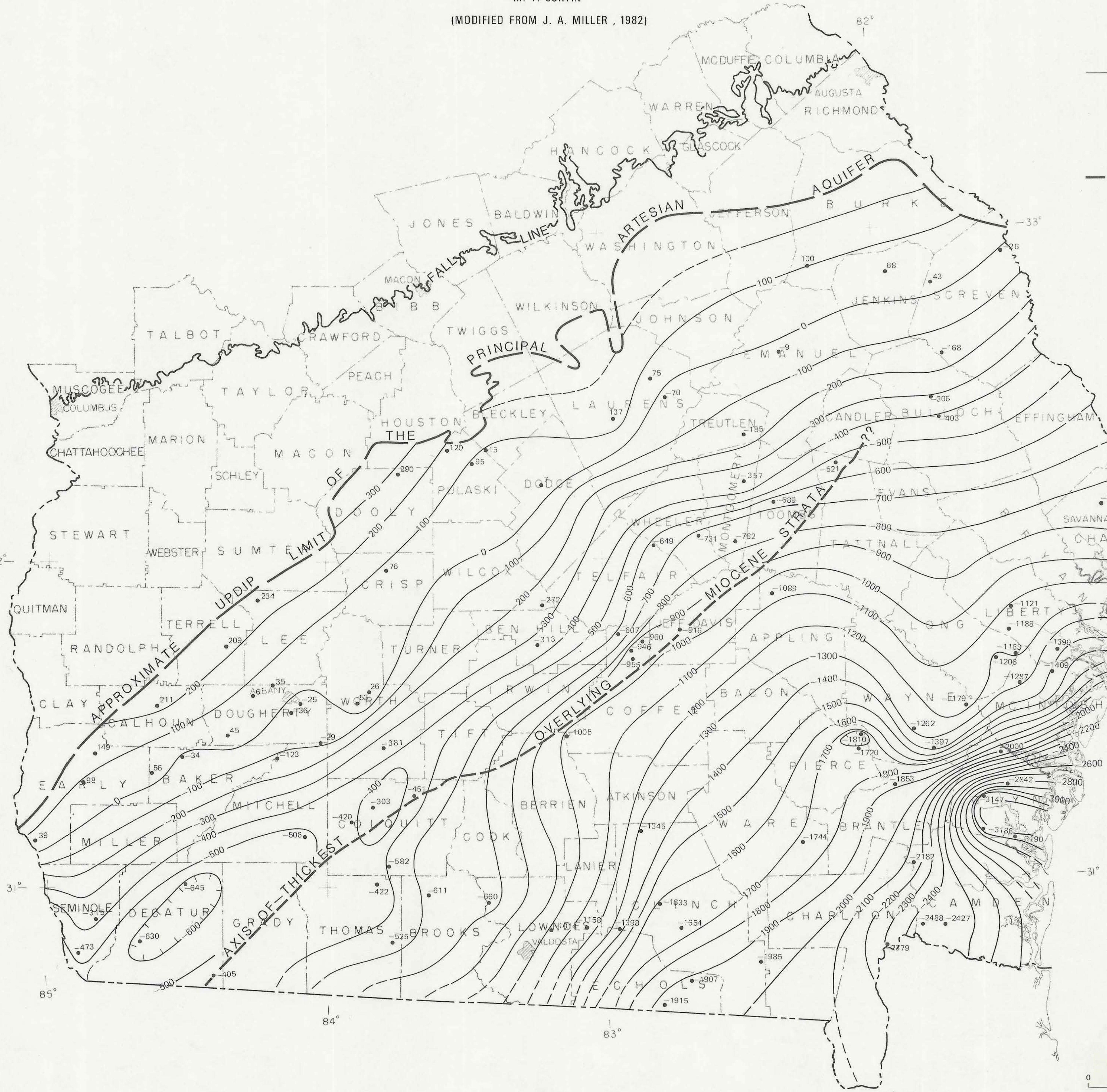
LOCATION MAP

0 10 20 30 40 MILES

STRUCTURE-CONTOUR MAP OF THE BASE OF THE PRINCIPAL ARTESIAN AQUIFER SYSTEM

M. Y. CURTIN

(MODIFIED FROM J. A. MILLER, 1982)



EXPLANATION

—100— — STRUCTURE CONTOUR - Shows elevation in feet of the base of the aquifer system. Datum is mean sea level. Contour interval is 100 feet. Dashed where approximately located.

•-26 WELL - Number is elevation in feet.

— — ? AXIS OF THICKEST OVERLYING MIOCENE STRATA - Line is from Isopach Map of Miocene Aquifer System (Mack and Karp, this atlas).

This map shows the elevation, in feet, of the base of the Principal Artesian Aquifer System. Plotted values represent the top of the clay, argillaceous fine-grained sand, recrystallized limestone, and chalk that underlie the aquifer system. The base of the aquifer system generally increases in both age and depth toward the southeast. Area I in Figure 1 is underlain by upper Eocene calcareous clay. Throughout Area II, the aquifer system is underlain by sand and clay of the middle Eocene Claiborne Group. In Area III, pore space in the lower part of the upper Eocene Ocala Limestone is infilled with secondary gypsum. Here, the top of the recrystallized gypsiferous limestone forms the base of the aquifer system. In Area IV, the top of the fine-grained sand and lignitic clay of the Wilcox Group and equivalent fine-grained limestone form the base of the aquifer. In Areas V and VI, Paleocene fine-grained limestone, gypsiferous dolostone, and Upper Cretaceous chalk, respectively, underlie the Principal Artesian Aquifer System.

Two structural features interrupt the southeast-dipping trend of the base of the aquifer and affect the quality and quantity of the ground water. These features are: 1) the Gulf Trough, and 2) the Southeast Georgia Embayment. The Gulf Trough is approximated by a dashed line through the thickest overlying Miocene strata (see Plate 7). This feature reduces the recharge to the Principal Artesian Aquifer System southeast of the Trough and thereby reduces the quantity of available ground water. The lithologic change due to the structure of the Southeast Georgia Embayment causes the base of the Principal Artesian Aquifer System to increase in depth. The base of the aquifer in this area extends down to Cretaceous sediments. These sediments contain brines which decrease the quality of ground water.

SOURCES

Gelbaum, C., 1978, The geology and ground water of the Gulf Trough, in Short contributions to the geology of Georgia: Georgia Geol. Survey Bull. 93, p. 38-48.

Huddlestun, P.F., 1982, personal commun., Georgia Geologic Survey, Atlanta.

Miller, J.A., 1982, Geology and configuration of the top of the Tertiary limestone aquifer system, southeastern United States: U.S. Geol. Survey Water-Resources Invs. Open-file Report 81-1178, 1 sheet.

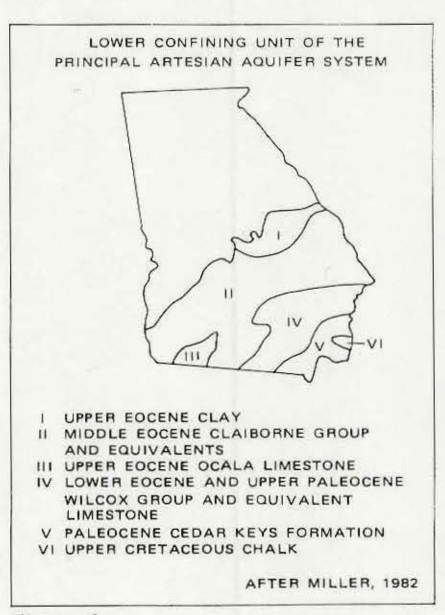


Figure 1.

LOCATION MAP

ISOPACH MAP OF THE PRINCIPAL ARTESIAN AQUIFER SYSTEM

M. Y. CURTIN

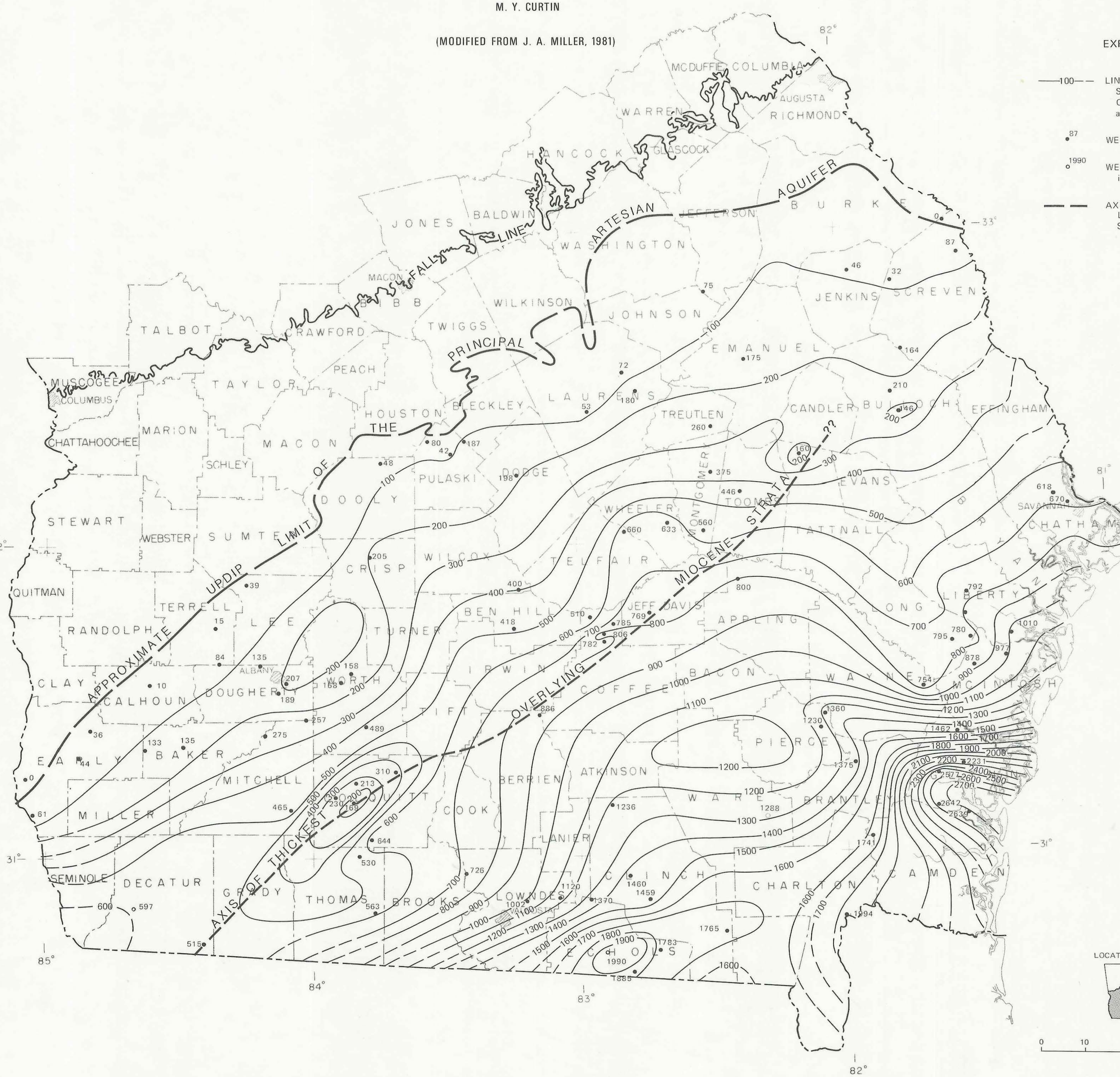
(MODIFIED FROM J. A. MILLER, 1981)

This map shows the thickness, in feet, of the Principal Artesian Aquifer System. The thickness is measured from the top of the first occurrence of Tertiary limestone to the base of the lowest layer of permeable limestone that is hydrologically connected with the overlying limestone. Less permeable zones within the aquifer are included in the thickness measurement.

The thickness of the aquifer system increases toward southeast Georgia. The thickening trend is a consequence of infilling of the Southeast Georgia Embayment and hydrologic interconnection of strata downdip resulting from facies differences from updip to downdip. That is, strata that act as lower confining units near the Fall Line (updip) grade into permeable limestones that are included in the aquifer system toward the southeast (downdip). In extreme southeast Georgia, Upper Cretaceous limestone makes up the lower part of the aquifer system. Toward southwest Georgia, in Decatur, Grady and Thomas Counties, the aquifer system thins because the lower part of the upper Eocene Ocala Limestone has become infilled with gypsum and acts as a confining unit. The axis of thickest overlying Miocene strata approximates the position of the Gulf Trough.

SOURCE

Miller, J.A., 1981, Thickness of the Tertiary limestone aquifer, southeastern United States: U.S. Geol. Survey Water-Resources Invs. Open-file Report 81-1124, 1 sheet.



EXPLANATION

—100— LINE OF EQUAL THICKNESS OF AQUIFER - Shows thickness in feet of aquifer system. Contour interval is 100 feet. Dashed where approximately located.

•87 WELL - Number is thickness in feet.

o1990 WELL - Approximate location. Number is thickness in feet.

— — AXIS OF THICKEST OVERLYING STRATA - Line from Isopach Map of Miocene Aquifer System (Mack and Karp, this atlas).

LOCATION MAP

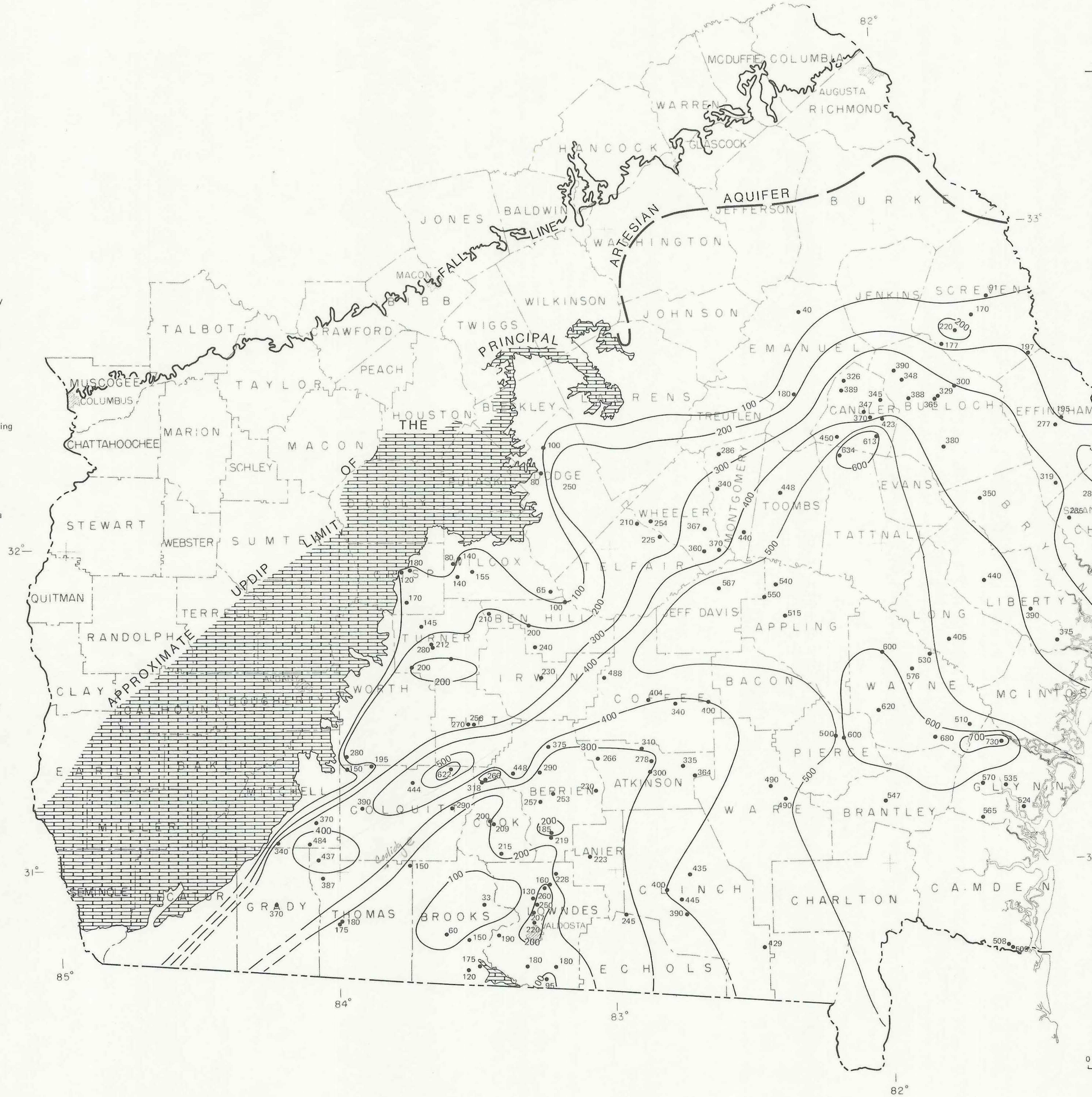
0 10 20 30 40 MILES

ISOPACH MAP OF STRATA OVERLYING THE PRINCIPAL ARTESIAN AQUIFER SYSTEM

H. C. KARP, JR.

This map shows the depth, in feet, from land surface to the top of the Principal Artesian Aquifer System. The overlying material shows two general thickening trends: 1) from the outcrop area toward the Atlantic Coast, and 2) around a northeast-southwest trending axis extending from Grady County through Tattnall County. There are three areas of thickened sediments. Two of these areas, in Colquitt County and Tattnall County, occur along the aforementioned axis. The third area occurs in Glynn County, and may be related to faulting in this area. All three areas of greater thickness appear to be the result of basin-filling of structural lows, thus resulting in a thickened Miocene and younger sequence.

South of the axis of thickening, in southwest Georgia, the overlying strata are thinner in Brooks and Lowndes Counties as a result of deposition during uplift of the Peninsular Arch and Ocala Uplift.



EXPLANATION

—100— — LINE OF EQUAL THICKNESS OF OVERLYING STRATA - Shows thickness in feet of strata between land surface and top of aquifer. Contour interval is 100 feet. Dashed where approximately located.

AREA OF OUTCROP - Includes Suwannee Limestone, Ocala Limestone, and Oligocene and Eocene residuum undifferentiated.

91 WELL - Number is thickness in feet.

LOCATION MAP

0 10 20 30 40 MILES

SOURCES

Applin, E.R., and Applin, P.L., 1964, Logs of selected wells in the Coastal Plains of Georgia: Georgia Geol. Survey Bull. 74, 229 p.

Cooke, C.W., 1943, Geology of the Coastal Plain of Georgia: U.S. Geol. Survey Bull. 941, 117 p.

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Gelbaum, C., 1978, The geology and ground water of the Gulf Trough, in Short contributions to the geology of Georgia: Georgia Geol. Survey Bull. 93, p. 38-48.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

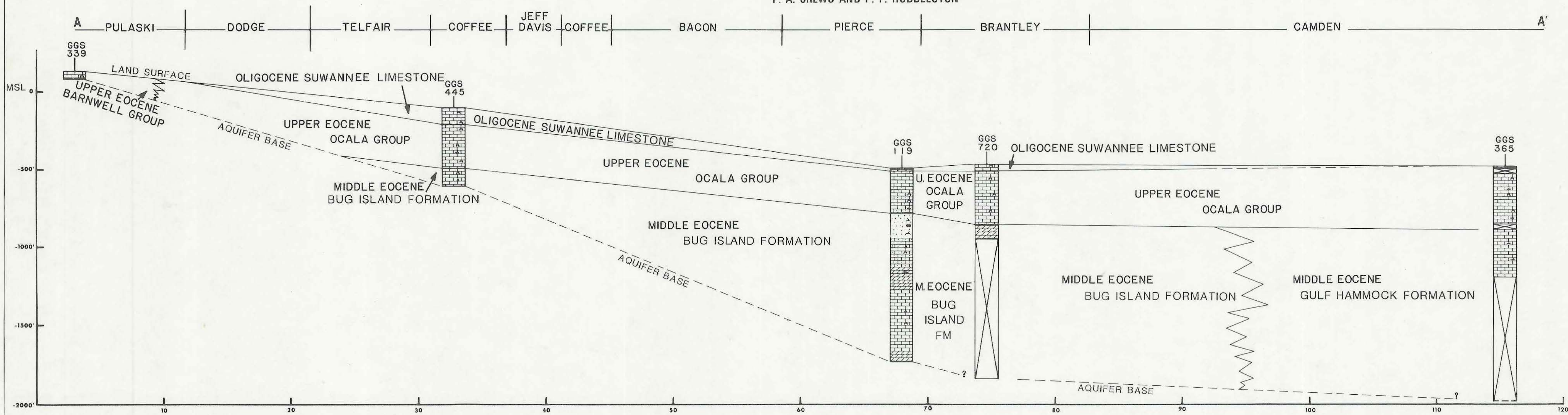
Herrick, S.M., and Vorhis, R.C., 1963, Subsurface geology of the Georgia Coastal Plain: Georgia Geol. Survey Info. Circ. 25, 80 p.

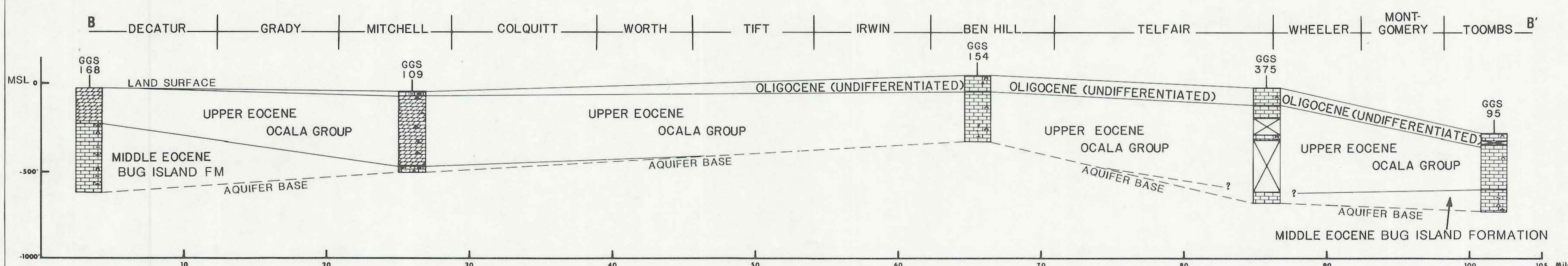
Krause, R.E., and Gregg, D.O., 1972, Water from the Principal Artesian Aquifer in Coastal Georgia: Georgia Geol. Survey Hydrol. Atlas 1.

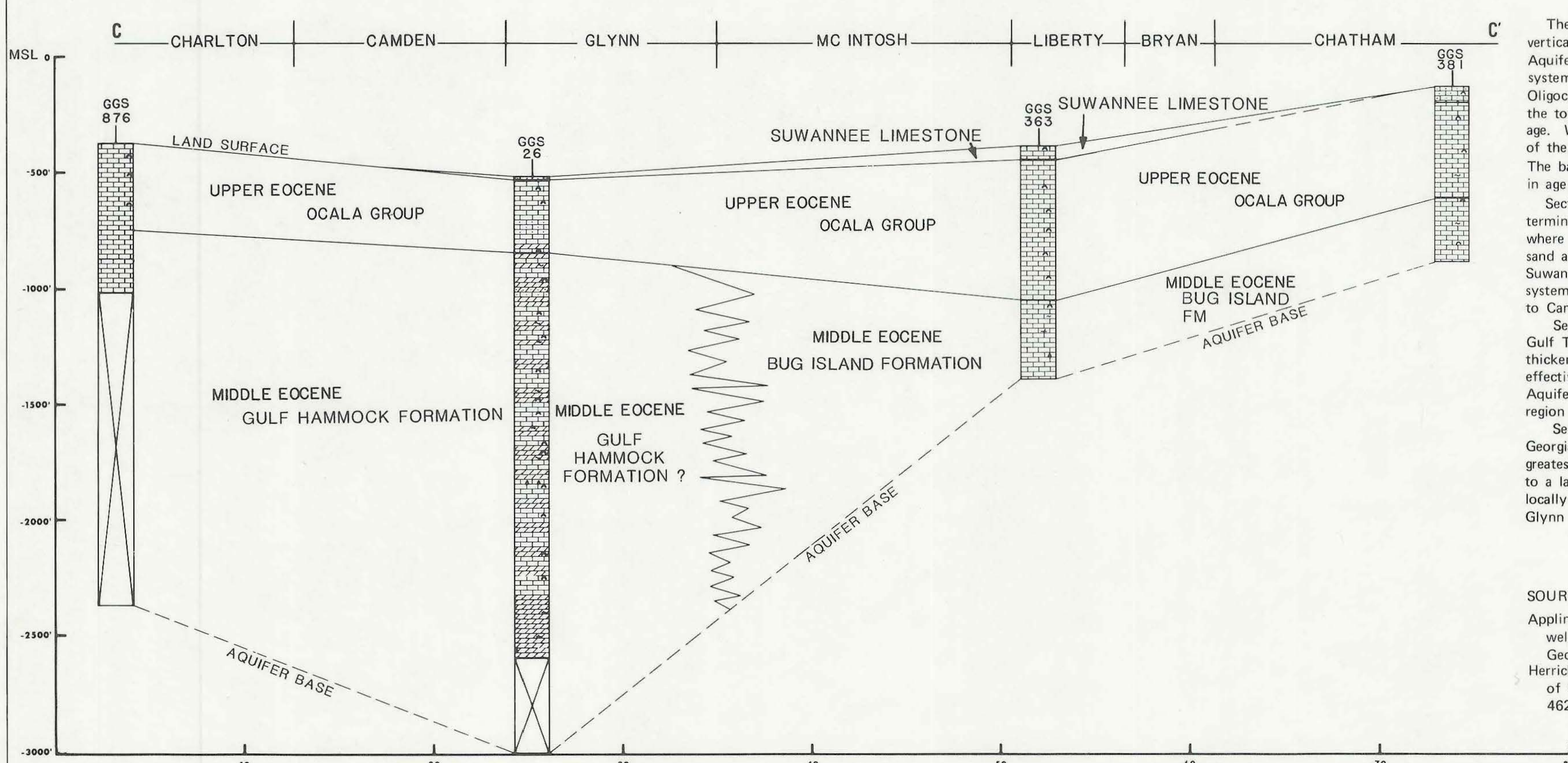
Unpublished material on file at the Georgia Geologic Survey, Atlanta.

GEOLOGIC SECTIONS OF THE PRINCIPAL ARTESIAN AQUIFER SYSTEM

P. A. CREWS AND P. F. HUDDLESTUN





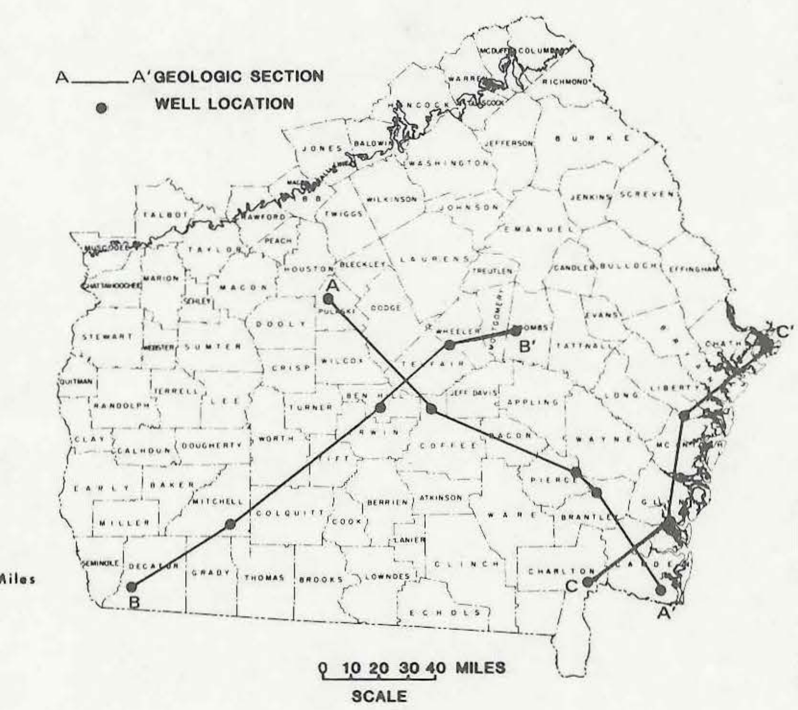


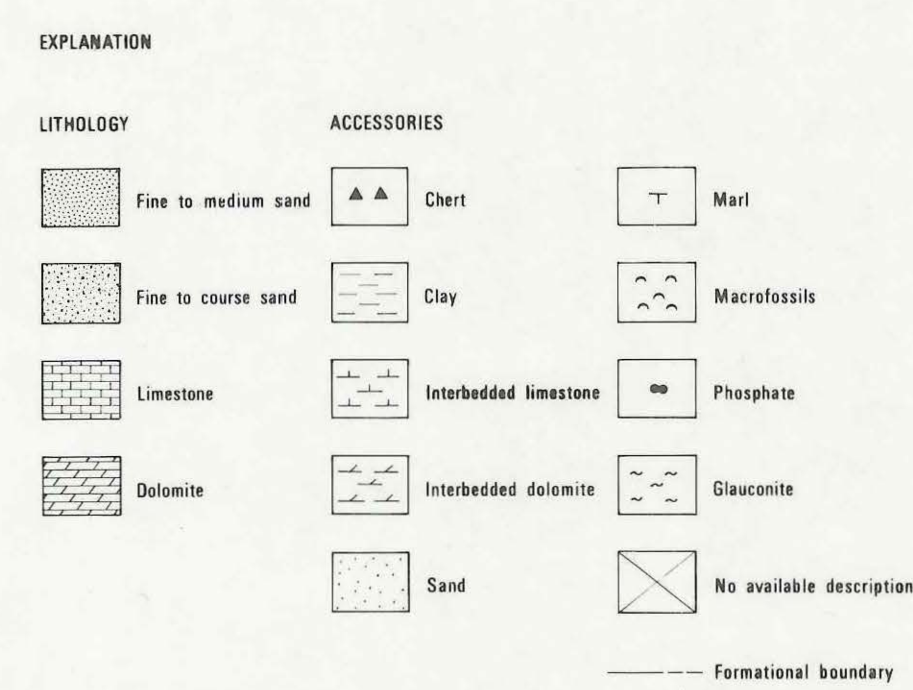
These geologic sections show the lateral and vertical lithologic trends of the Principal Artesian Aquifer System. In the Georgia Coastal Plain, this system includes units from Late Cretaceous to late Oligocene age. The top is mostly coincident with the top of the Suwannee Limestone of Oligocene age. Where the Suwannee is absent, the limestone of the Ocala Group forms the top of the system. The base of the aquifer system generally increases in age and depth toward the southeast.

Section A-A' illustrates the updip thinning and termination of the Principal Artesian Aquifer System where the limestone of the Ocala Group grades into sand and clay of the Barnwell Group. The Oligocene Suwannee Limestone forms the top of the aquifer system in Dodge County and continues downdip to Camden County, where the Suwannee is absent.

Section B–B' is approximately parallel to the Gulf Trough. Within the trough itself, an abrupt thickening of relatively impermeable Miocene strata effectively lowers the top of the Principal Artesian Aquifer System. GGS well 95 (B') is within this region and illustrates this lowering.

Section C-C' is roughly parallel and close to the Georgia coast. This is the region of the system's greatest thickness. Although not shown here, due to a lack of appropriate data, the aquifer system locally includes Upper Cretaceous limestone in Glynn County.





SOURCES

Applin, E.R., and Applin, P.L., 1964, Logs of selected wells in the Coastal Plains of Georgia: Georgia Geol. Survey Bull. 74, 229 p.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, Correlation chart—Georgia Coastal Plain: Georgia Geol. Survey Open-file Report 82-1, 2 p.

Miller, J.A., 1982, Unpublished data from study of Tertiary Limestone Aquifer System, Southeastern United States, on file at U.S. Geol. Survey, Water Resources Div., Doraville, Ga.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

POTENTIOMETRIC SURFACE OF THE PRINCIPAL ARTESIAN AQUIFER SYSTEM, MAY 1980

(AFTER R. E. KRAUSE AND L.R. HAYES, 1981)

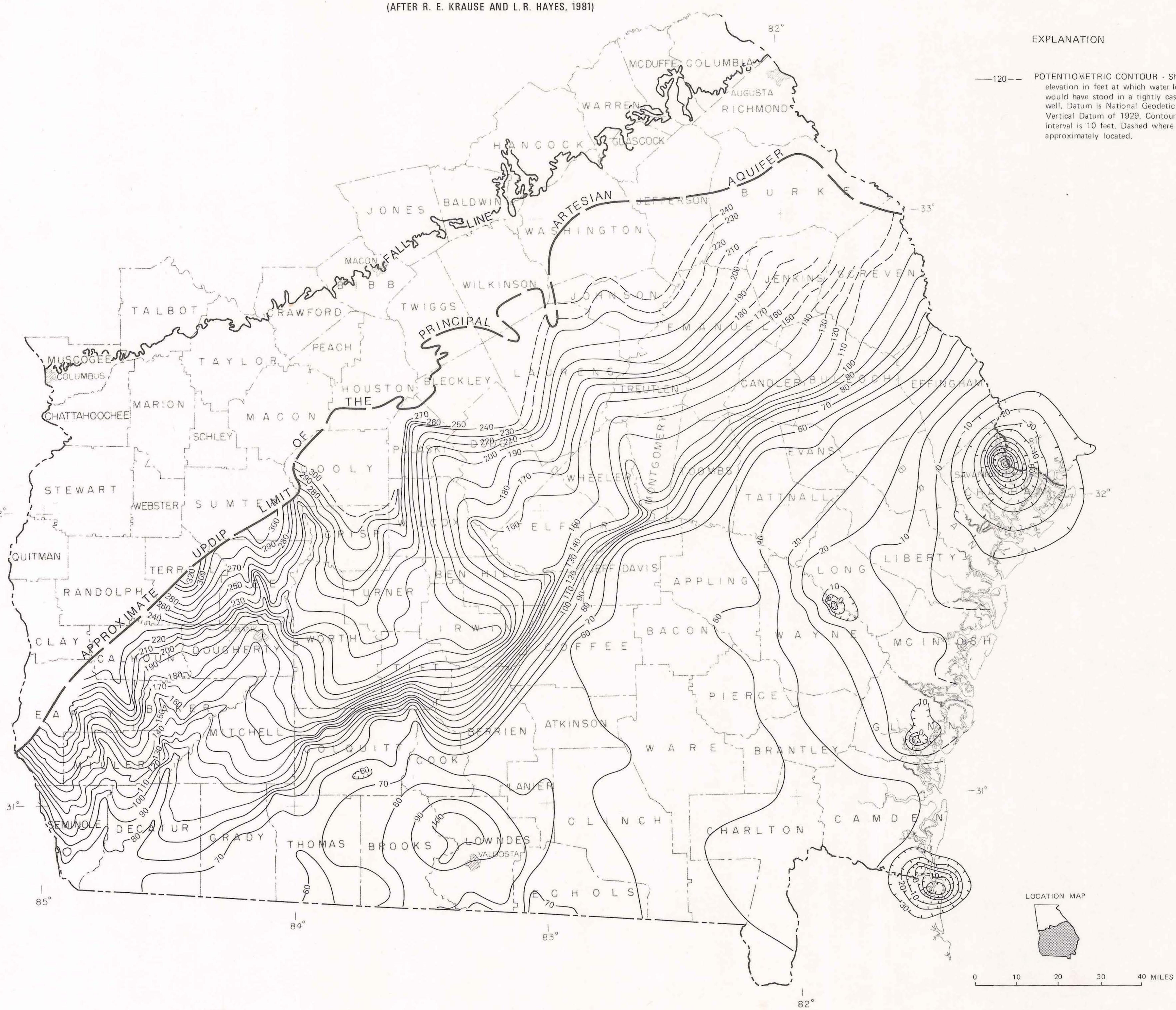
Water in the Principal Artesian Aquifer System is under artesian pressure except in those areas where the aquifer crops out at the surface. This artesian pressure causes the water level in a tightly cased well to rise above the surface of the water-bearing limestone unit. The potentiometric map shows the elevation of water in wells in the aquifer.

The potentiometric surface also indicates the direction of ground-water flow in the aquifer. Ground water moves downgradient, perpendicular to potentiometric contours.

In areas of heavy ground-water withdrawals such as Jesup, Savannah, and Brunswick, a feature of the potentiometric surface, known as a cone of depression, has developed. In such areas, the natural potentiometric surface is lowered and the direction of ground-water flow is disrupted and may be reversed.

SOURCE

Krause, R.E., and Hayes, L.R., 1981, Potentiometric surface of the Principal Artesian Aquifer in Georgia, May 1980: Georgia Geol. Survey Hydrol. Atlas 6, plate 1.



EXPLANATION

—120— — POTENTIOMETRIC CONTOUR - Shows elevation in feet at which water level would have stood in a tightly cased well. Datum is National Geodetic Vertical Datum of 1929. Contour interval is 10 feet. Dashed where approximately located.

WATER-LEVEL TRENDS OF THE PRINCIPAL ARTESIAN AQUIFER SYSTEM, 1970 – 1979

C. L. GARDINIER

Water-level hydrographs for selected observation wells in the Principal Artesian Aquifer System, and their locations, are presented on this map. These hydrographs show water-level trends and fluctuations from January 1970 through December 1979. Short-term fluctuations over a single year are produced by seasonal variations in recharge and discharge. Long-term trends are caused by a general imbalance between recharge and discharge.

Seasonal fluctuations are greatest in areas of recharge, where precipitation and evapotranspiration directly affect the amount of water in the aquifer system. Recharge to the aquifer system occurs in updip areas near the northwestern limits of the system such as Laurens County and in local recharge areas such as Lowndes County. In downdip areas, seasonal recharge has less effect on water levels. In the southeast where major population and industrial centers are located, short-term fluctuations are related to changes in pumping.

Long-term water-level trends vary with the location of observation wells, with respect to population and industrial centers and with distance from recharge areas. In updip low-population areas, there is little change in average water levels over the 10-year period. In downdip high-population areas, a steady decline in water levels is evident. In areas of decline, ground-water withdrawals exceed recharge. Wells around major pumping centers such as Savannah and Brunswick have the greatest decline. Wells at intermediate locations between updip recharge areas and downdip pumping centers have smaller long-term declines.

SOURCES

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Krause, R.E., 1979, Geohydrology of Brooks, Lowndes, and western Echols counties, Georgia: U.S. Geol. Survey Water Resources Invs. Open-file Report 78-117, 48 p.

Matthews, S.E., Hester, W.G., and O'Byrne, M.P., 1980, Ground-water data for Georgia, 1979: U.S. Geol. Survey Open-file Report 80-501, 94 p.

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Unpublished data on file at the U.S. Geological Survey, Water Resources Div., Doraville, Ga.

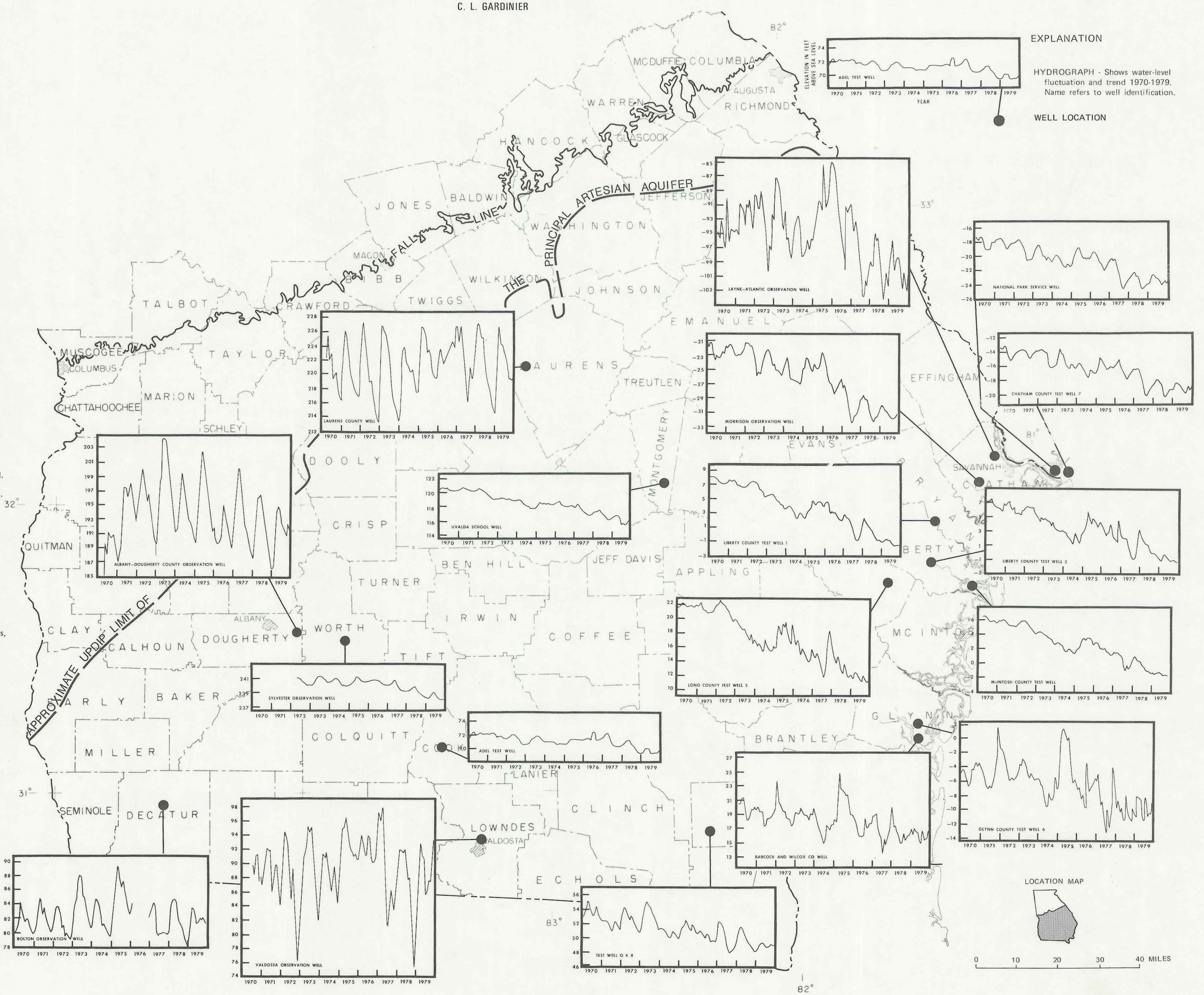

PLATE 17

SPECIFIC CAPACITIES OF SELECTED WELLS IN THE PRINCIPAL ARTESIAN AQUIFER SYSTEM

M. A. TUOHY AND J. A. KELLAM

This map shows well yields in terms of specific capacity (gallons/minute/foot drawdown) for wells that penetrate the Principal Artesian Aquifer System. Specific capacity is a useful term because it describes the productivity of both aquifer and well in a single parameter. All wells used to prepare this map meet the following criteria: 1) the diameter of the casing is at least eight inches, 2) the bottom of the casing is within 15 feet of the top of the aquifer, and 3) the bottom of the well is within the Principal Artesian Aquifer System. Whenever possible, wells with pump tests known to be greater than 12 hours in duration were used for calculating specific capacity. Some closely spaced wells are enclosed by a small circle labeled with an average specific capacity.

Specific capacities range from 1250 gal/min/ft drawdown in Grady County to 1 gal/min/ft drawdown in Burke County. The average specific capacity is about 75 gal/min/ft drawdown. Low values occur in the updip area of the aquifer. Data points are poorly distributed with large concentrations in some areas, such as Chatham County, and a complete lack of data in other areas, such as a 10-county area surrounding Waycross in the southeast. Abrupt differences in the specific capacity in the area are commonly a reflection of lithologic changes in the Principal Artesian Aquifer System.

SOURCES

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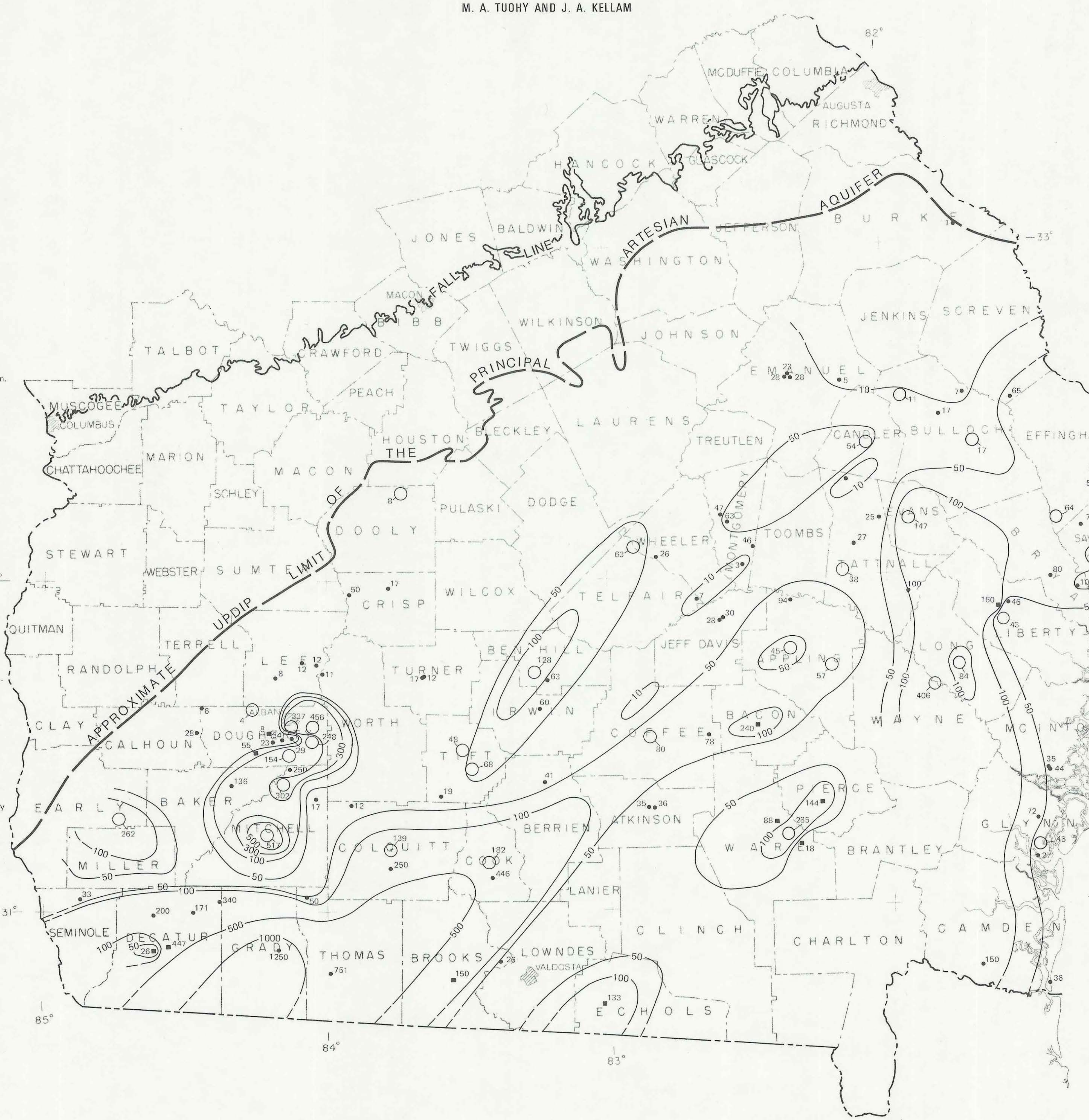

EXPLANATION

—10— — LINE OF EQUAL SPECIFIC CAPACITY- Shows well yield in gallons/minute/foot drawdown. Contour interval varies. Dashed where approximate.

•1 WELL - Number is specific capacity.

○17 COMPOSITE WELL LOCATIONS - Number is average of specific capacities for several closely spaced wells.

▪160 APPROXIMATE WELL LOCATION - Number is specific capacity.

LOCATION MAP

0 10 20 30 40 MILES

PLATE 18

CONCENTRATION OF DISSOLVED SOLIDS IN THE PRINCIPAL ARTESIAN AQUIFER SYSTEM

C. L. GARDINIER

Ground-water quality in the Principal Artesian Aquifer System is good in terms of dissolved-solids concentration with average concentrations between 100 and 200 milligrams per liter (mg/l). This is well below the National Drinking Water Standard, which sets a maximum dissolved-solids concentration of 500 mg/l. Within the Principal Artesian Aquifer System, dissolved-solids concentrations vary with depth and distance from recharge areas. Dissolved-solids concentrations are generally higher near the base of the aquifer and increase with greater distance from updip recharge areas.

Exceptions to the generally high-quality water occur in the Brunswick area, Glynn County, in a northeast-southwest trending area extending from Grady County through Coffee County, and in the extreme southeast along the Georgia-Florida border. The first two areas contain major population centers with high rates of ground-water withdrawals. In these areas, the potentiometric surface of the aquifer has been lowered and allowed infiltration of brackish water from zones underlying the aquifer. The third area may have higher dissolved-solids concentrations due to its greater distance downdip and away from fresh-water recharge areas.

In the Brunswick area, contamination may be due to wells and faults penetrating the brackish zone creating an ineffective lower confining unit, and providing conduits for infiltration of mineralized, brackish water. Chloride and dissolved-solids concentrations have been continuously increasing for the past twenty years. The inset map on this sheet shows chloride concentration in Brunswick, Georgia.

In the Savannah area, where chloride concentration and general water quality have remained nearly constant for the past two decades, a future source of contamination may exist. In South Carolina, to the northeast of Savannah, decreased artesian head and breaching of the top of the aquifer below sea level have allowed recharge of the aquifer by sea water. The contaminated water may be moving toward Savannah.

SOURCES

Counts, H.B., and Donsky, E., 1963, Salt-water encroachment, geology, and ground-water resources of the Savannah area, Georgia and South Carolina: U.S. Geol. Survey Water-Supply Paper 1611, 100 p.

Gregg, D.O., and Zimmerman, E.A., 1974, Geologic and hydrologic control of chloride contamination in aquifers at Brunswick, Glynn County, Georgia: U.S. Geol. Survey Water-Supply Paper 2029–D, 44 p.

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Wait, R.L., 1960, Source and quality of ground water in southwestern Georgia: Georgia Geol. Survey Inf. Circ. 18, 74 p.

Wait, R.L., and Gregg, D.O., 1973, Hydrology and chloride contamination of the Principal Artesian Aquifer in Glynn County, Georgia: Georgia Geologic Survey Survey Hydrol. Report 1, 93 p.

Warren, M.A., 1944, Artesian water in southeastern Georgia, with special reference to the coastal area: Georgia Geol. Survey Bull. 49, 140 p.

Zimmerman, E.A., 1977, Ground-water resources of Colquitt County, Georgia: U.S. Geol. Survey Open-file Report 77-56, 70 p.

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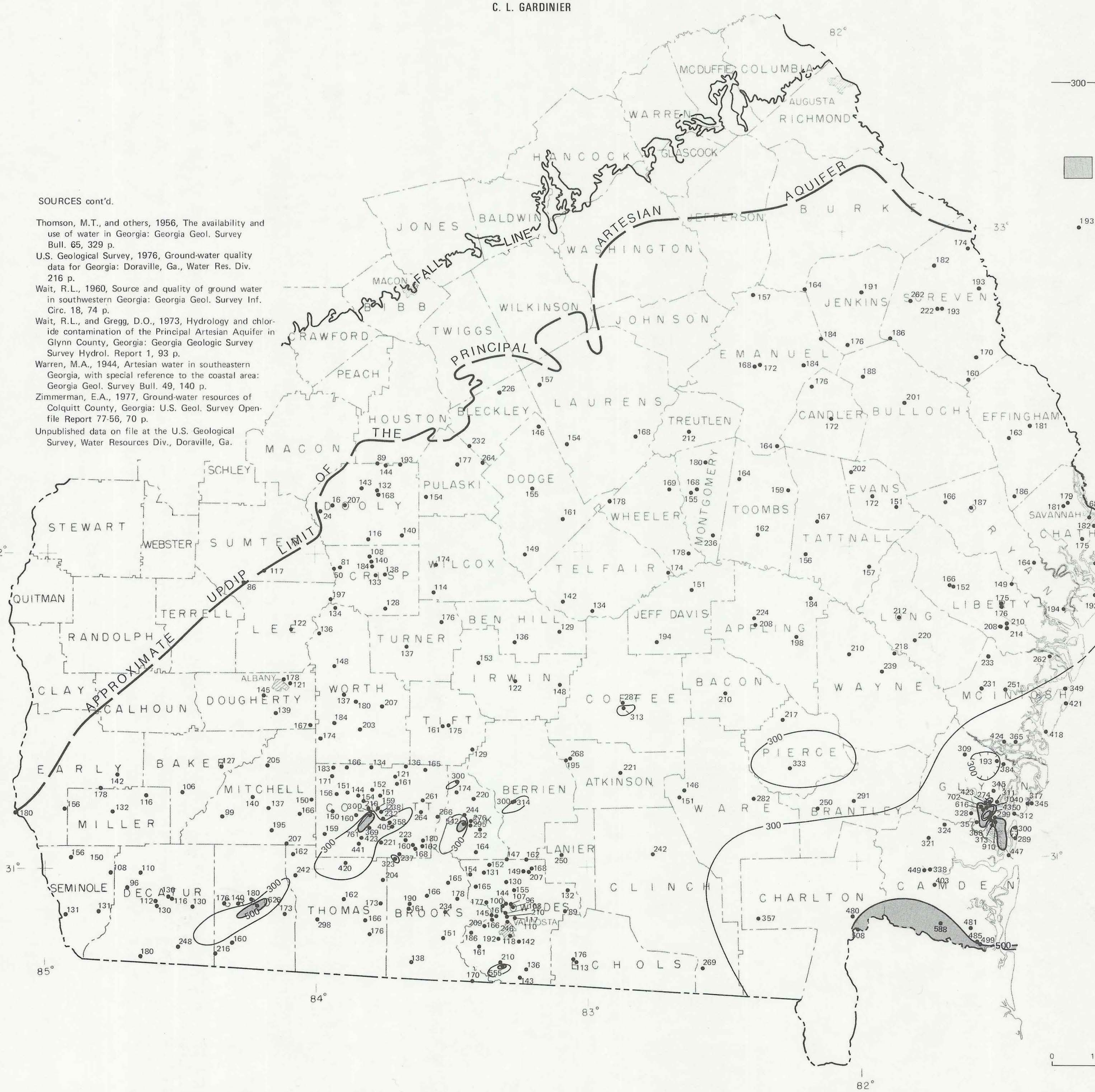


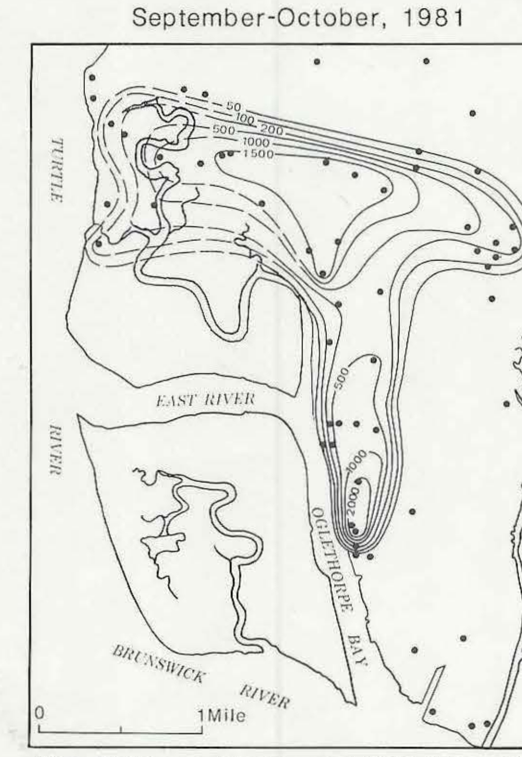
EXPLANATION

—300— LINE OF EQUAL DISSOLVED-SOLIDS CONCENTRATION - Shows dissolved solids concentration in milligrams per liter (mg/l). Dashed where approximately located. Contour interval varies.

AREA WHERE DISSOLVED-SOLIDS CONCENTRATION EXCEEDS 500 MG/L (RECOMMENDED LIMIT FOR DRINKING WATER).

•193 WELL - Number is dissolved-solids concentration in mg/l.

Chloride concentrations, Brunswick area, September-October, 1981



After Matthews, Hester, and McFadden, 1981

LOCATION MAP

0 10 20 30 40 MILES

STRUCTURE-CONTOUR MAP OF THE TOP OF THE CLAIBORNE AQUIFER

M. L. McKOY AND D. M. MACK

This structure-contour map shows the altitude, in feet, of the top of the middle Eocene Claiborne Aquifer. Because of limited data availability, plotted values are limited to the outlined 19-county area in southwest Georgia. The Claiborne Aquifer consists predominantly of sands of the Tallahatta and Hatchetigbee Formations. Downdip, permeable sandy limestones within the overlying Lisbon Formation also are included in the aquifer.

The upper confining unit of the Claiborne Aquifer is comprised of impervious marls, clays and sandy limestones within the Lisbon Formation.

The top of the Claiborne Aquifer has a southeastward dip of approximately 16 ft/mi. The dip becomes more southerly adjacent to the Chattahoochee River.

SOURCES

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

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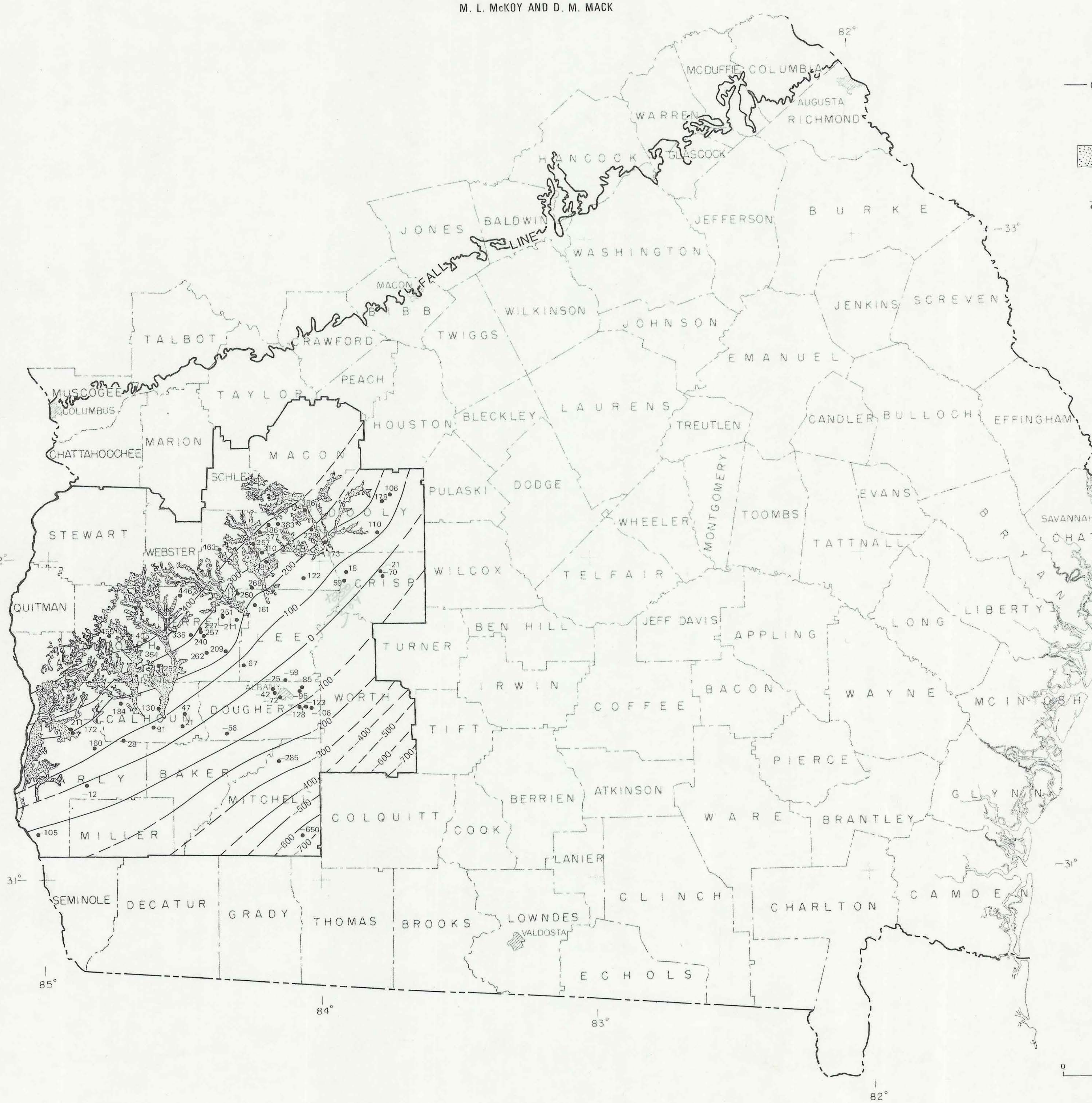
Unpublished data on file at the Georgia Geologic Survey, Atlanta.



EXPLANATION

—0— — STRUCTURE CONTOUR - Shows elevation in feet of the top of the aquifer system. Datum is mean sea level. Contour interval is 100 feet. Dashed where approximately located.

AREA OF OUTCROP - Includes undifferentiated Claiborne Group, Lisbon and Tallahatta Formations.

•21 WELL - Number is elevation in feet.

LOCATION MAP

0 10 20 30 40 MILES

STRUCTURE-CONTOUR MAP OF THE BASE OF THE CLAIBORNE AQUIFER

M. L. McKOY AND D. M. MACK

This structure-contour map shows the elevation, in feet, of the base of the Claiborne Aquifer. Because of limited data availability, plotted values are limited to the outlined 19-county area in southwestern Georgia. The Claiborne Aquifer consists predominantly of sands of the Tallahatta and Hatchetigbee Formations. Sandy, glauconitic limestones within the clay-rich Tuscahoma Sand make up the lower confining unit.

Structurally, the base of the Claiborne Aquifer dips southeast at approximately 21 ft/mi. The lowest elevation in the mapped area occurs in southeastern Mitchell County where the base of the aquifer is more than 800 feet below sea level.

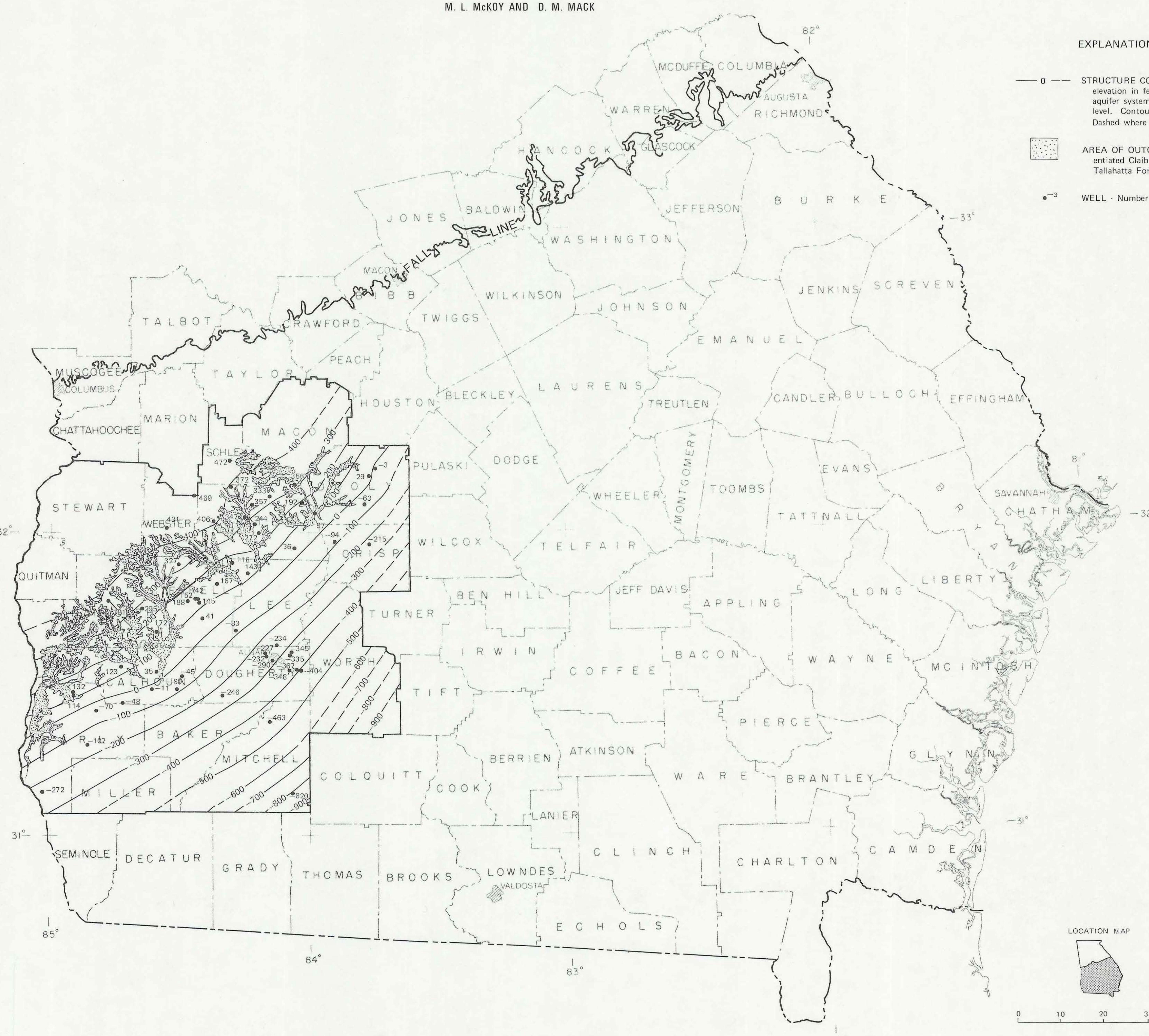
SOURCES

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.



EXPLANATION

—— 0 —— STRUCTURE CONTOUR - Shows elevation in feet of the base of the aquifer system. Datum is mean sea level. Contour interval is 100 feet. Dashed where approximately located.

AREA OF OUTCROP - Includes undifferentiated Claiborne Group, Lisbon and Tallahatta Formations.

•-3 WELL - Number is elevation in feet.

LOCATION MAP

0 10 20 30 40 MILES

ISOPACH MAP OF THE CLAIBORNE AQUIFER

M. L. McKOY AND D. M. MACK

This isopach map shows the thickness, in feet, of the middle Eocene Claiborne Aquifer. Plotted values represent all strata between the top of the clay-rich Tuscahoma Sand and the base of the impermeable clays within the Lisbon Formation. Data availability is limited to the outlined 19-county area in southwest Georgia.

The Claiborne Aquifer consists of 1) fossiliferous, calcareous sand of the Hatchetigbee Formation, 2) massive, phosphatic, quartz sand of the Tallahatta Formation, and 3) sandy, glauconitic, fossiliferous limestones of the lower Lisbon Formation.

The thickness of the Claiborne Aquifer appears to increase toward the east where it reaches a maximum of 298 feet in eastern Dougherty County. Toward the northwest, recent stream erosion has caused local variations in thickness.

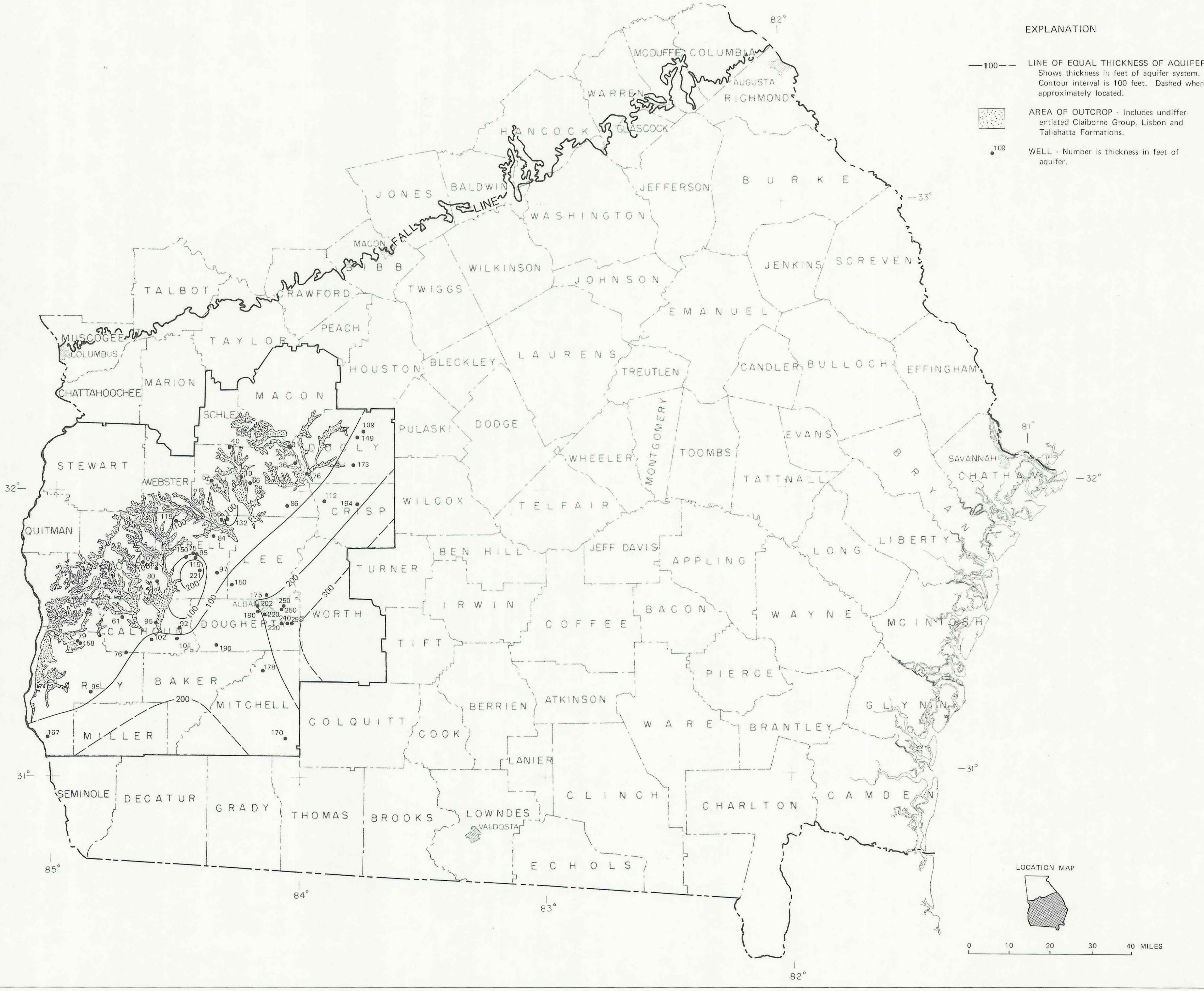
SOURCES

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.



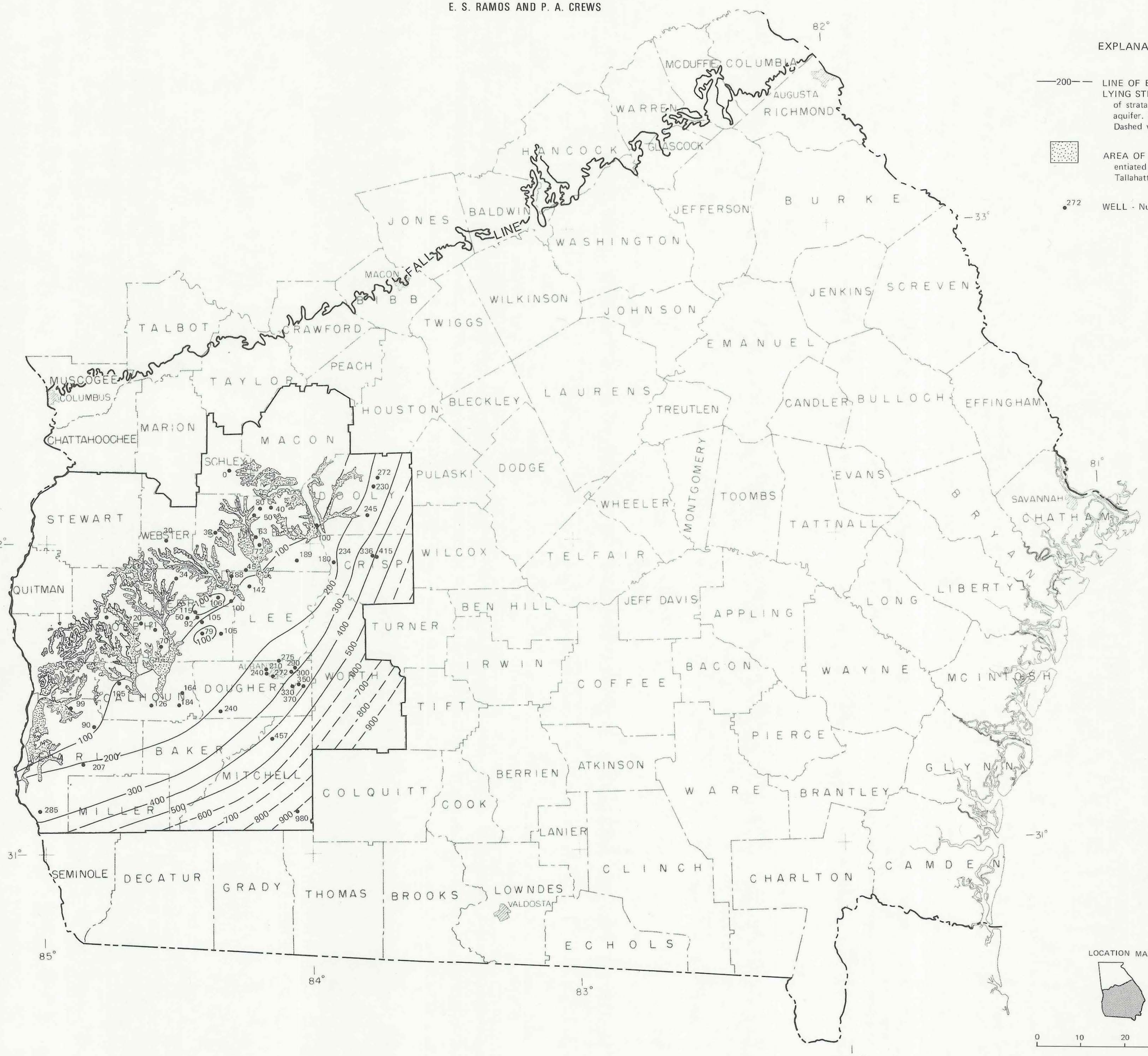
ISOPACH MAP OF STRATA OVERLYING THE CLAIBORNE AQUIFER

E. S. RAMOS AND P. A. CREWS

This isopach map shows the thickness, in feet, of strata overlying the Claiborne Aquifer. Plotted values represent all strata above the base of the impermeable clay layers within the Lisbon Formation. Available data are limited to the outlined 19-county area in southwest Georgia.

Strata overlying the Claiborne Aquifer, from oldest to youngest, include 1) clay and dense marl of the Lisbon Formation, 2) the Clinchfield Sand, 3) the Ocala Limestone, 4) the Suwannee Limestone, and 5) residuum. The Suwannee Limestone is restricted in the subsurface to Mitchell and Worth Counties. The Ocala Limestone does not extend northwest of Miller, Baker, Calhoun, Dougherty, Lee and Crisp Counties. The Clinchfield Sand is present only in the extreme northeast corner of the outlined area.

The thickness of overlying strata and depth to the aquifer increases to the southeast, and reaches a maximum of 980 feet in Mitchell County. To the west and north, the Claiborne Aquifer crops out along streams, and the depth to the top of the aquifer varies considerably.



EXPLANATION

—200— LINE OF EQUAL THICKNESS OF OVERLYING STRATA - Shows thickness in feet of strata between land surface and top of aquifer. Contour interval is 100 feet. Dashed where approximately located.

AREA OF OUTCROP - Includes undifferentiated Claiborne Group, Lisbon and Tallahatta Formations.

•272 WELL - Number is thickness in feet.

SOURCES

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

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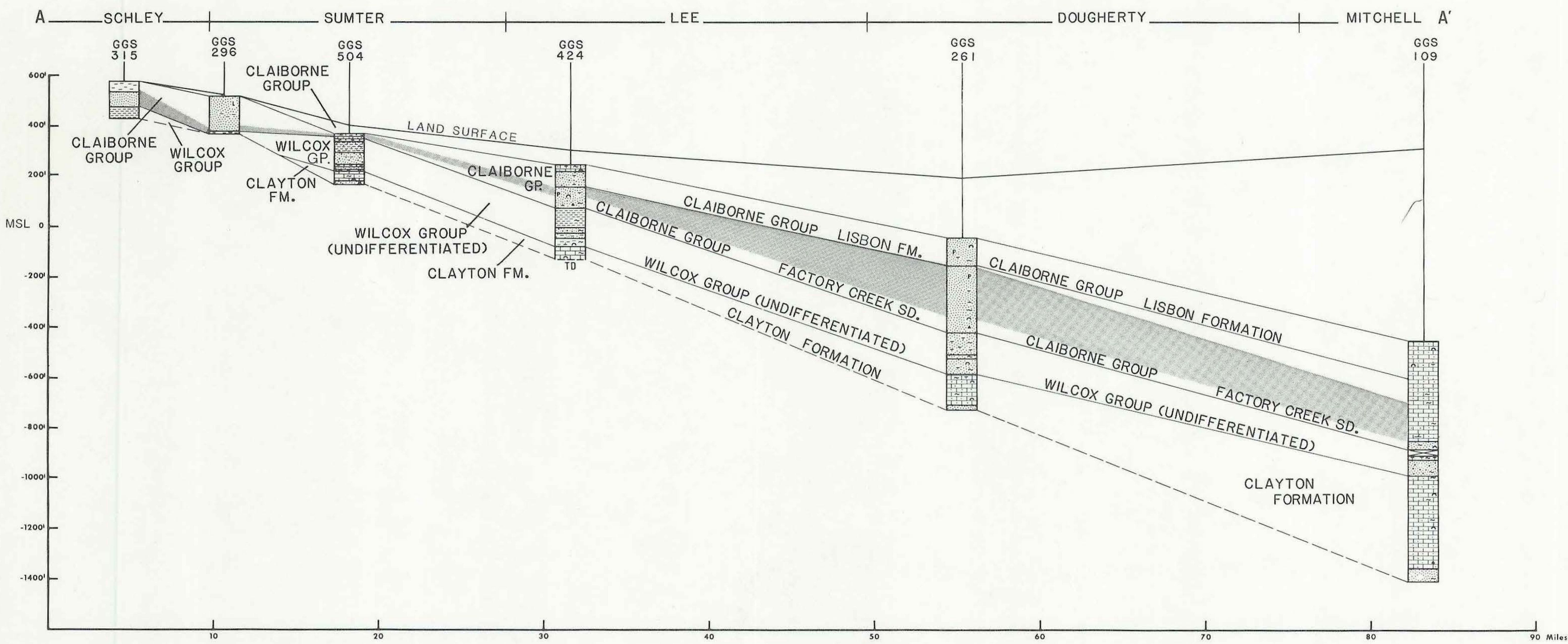
Hicks, D.W., Krause, R.E., and Clarke, J.S., 1981, Geohydrology of the Albany area, Georgia: Georgia Geol. Survey Info. Circ. 57, 31 p.

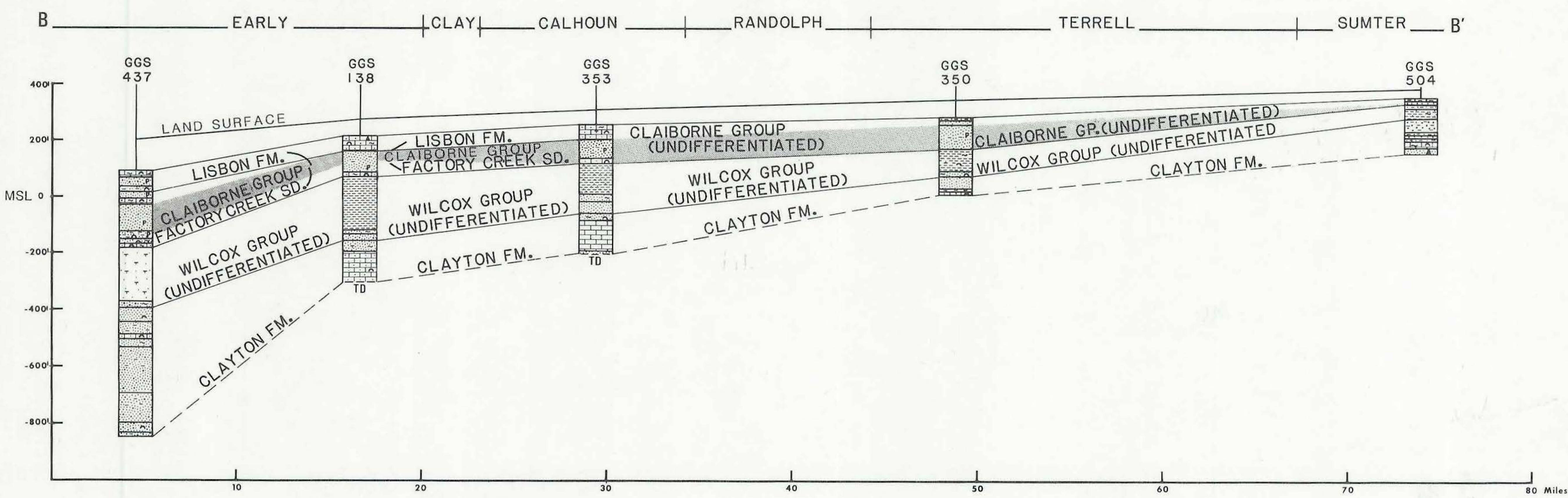
Ripy, B.J., McFadden, S.S., Perriello, P.D., and Gernazian, A.M., 1981, An interim report on the hydrology of the Clayton and Claiborne Aquifers in southwestern Georgia: Georgia Geol. Survey Open-file Report 82-2, 41 p.

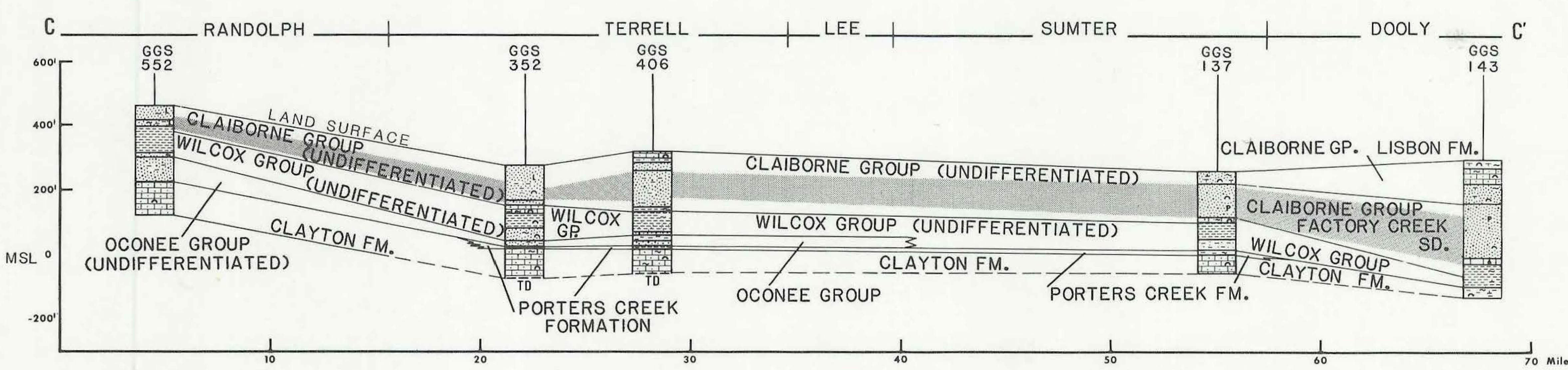
Unpublished data on file at the Georgia Geologic Survey, Atlanta.

GEOLOGIC SECTIONS OF THE CLAIBORNE AQUIFER

P. A. CREWS







These geologic sections show the lateral lithologic trends of the middle Eocene Claiborne Aquifer. Strata of the Wilcox and Oconee Groups, and Porters Creek and Clayton Formations are shown to illustrate the relative stratigraphic positions. Available data are limited to the outlined 19-county area shown on the index map.

The shaded area indicates the general position of the Claiborne Aquifer. All strata between the top of the clay-rich Tuscahoma Sand and the base of the impermeable clay layers within the Lisbon Formation are included in the aquifer. Some interlayered, impervious sediments may also be included.

The Claiborne Aquifer consists of the Hatchetigbee Formation, Factory Creek Sand, and lower Lisbon Formation. The Hatchetigbee Formation is composed of glauconitic, calcareous sand with varying amounts of clay. The Factory Creek Sand consists of massive, phosphatic quartz sand with increasing amounts of clay and shell fragments toward the top. Sandy glauconitic limestones make up the saturated strata of the lower Lisbon Formation.

The Claiborne Aquifer generally dips and thickens to the southeast, away from the outcrop area. Section A to A' shows an increase in thickness and slight increase in dip from north to south. Section B to B', which trends from southwest to northeast, shows a general thinning of the aquifer toward the north. Section C to C', which trends from east to west, generally thickens and dips eastward.

SOURCES

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

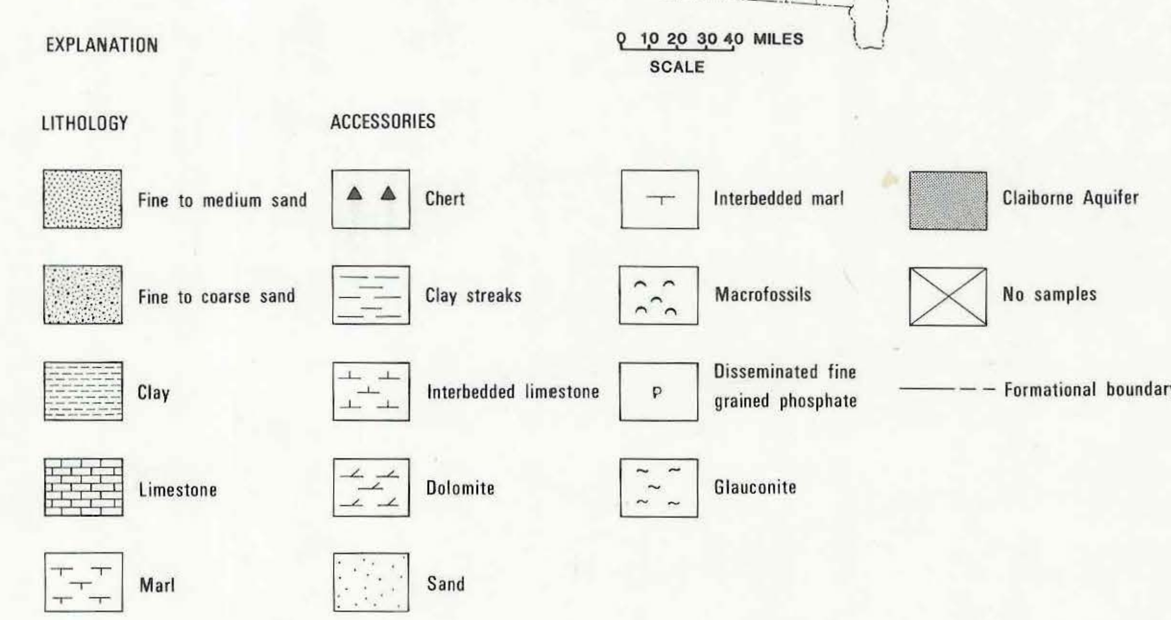
Herrick, S.M., 1961, Well Logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, Correlation chart–Georgia Coastal Plain: Georgia Geol. Survey Open-file Report 82-1, 2 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Ripy, B.J., McFadden, S.S., Perriello, P.D., and Gernazian, A.M., 1981, An interim report on the hydrology of the Clayton and Claiborne aquifers in southwestern Georgia, Open-file Report 82-2, 37 p., 25 figs.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.



CONCENTRATION OF DISSOLVED SOLIDS IN THE CLAIBORNE AQUIFER

P. A. CREWS

EXPLANATION

—200— LINE OF EQUAL DISSOLVED-SOLIDS CONCENTRATION - Shows dissolved solids concentration in milligrams per liter (mg/l). Dashed where approximately located.

AREA OF OUTCROP - Includes undifferentiated Claiborne Group, Lisbon and Tallahatta Formations.

• 205(116) WELL - Number is dissolved-solids concentration (mg/l). Subscript is carbonate hardness value.

LOCATION MAP

The water-quality map for the Claiborne Aquifer System presents the concentration of total dissolved solids (TDS) and hardness value (as a subscript) for wells in a 19-county area. Plotted values are limited to these counties on the basis of data availability.

SOURCES

Ripy, B.J., McFadden, S.S., Perriello, P.D., and Gernazian, A.M., 1981, An interim report on the hydrogeology of the Clayton and Claiborne aquifers in southwestern Georgia: Georgia Geol. Survey Open-file Report 82-2, 37 p.

U.S. Geological Survey, 1976, Ground-water quality data for Georgia: Doraville, Ga., Water Res. Div., 216 p.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

Unpublished data on file at the U.S. Geological Survey, Water Resources Div., Doraville, Ga.

PLATE 25

WATER-LEVEL TRENDS AND POTENTIOMETRIC SURFACE OF THE CLAIBORNE AQUIFER, MARCH, 1982

M. Y. CURTIN, S. S. MCFADDEN, AND P. D. PERRIELLO

This map shows the potentiometric surface of the Claiborne Aquifer based on March, 1982, water-level measurements, along with continuous hydrographs of five observation wells in the aquifer. The Claiborne Aquifer has been developed extensively in the outlined counties for industrial, municipal and, since the late 1970's, agricultural uses. Observation wells equipped with continuous recorders have been in operation only since the late 1970's. Therefore, long-term hydrograph data over the entire area of use are not available.

The continuous hydrograph data, which are clustered around Albany, show the seasonal effects of the heavy pumping in the area, as well as some overall trends. Hydrographs from Test Wells 2, 5, and 8 (which are closest to the center of the cone of depression) show the greatest changes in water level during a one-year period. The Test Well 4 hydrograph shows less seasonal effect, but does show the same noticeable downward trend over a three-year period. The Test Well 11 hydrograph is located in an area southwest of the cone of depression where most wells use the overlying Principal Artesian Aquifer. It shows almost no seasonal variation and only a few feet downward trend over two and a half years.

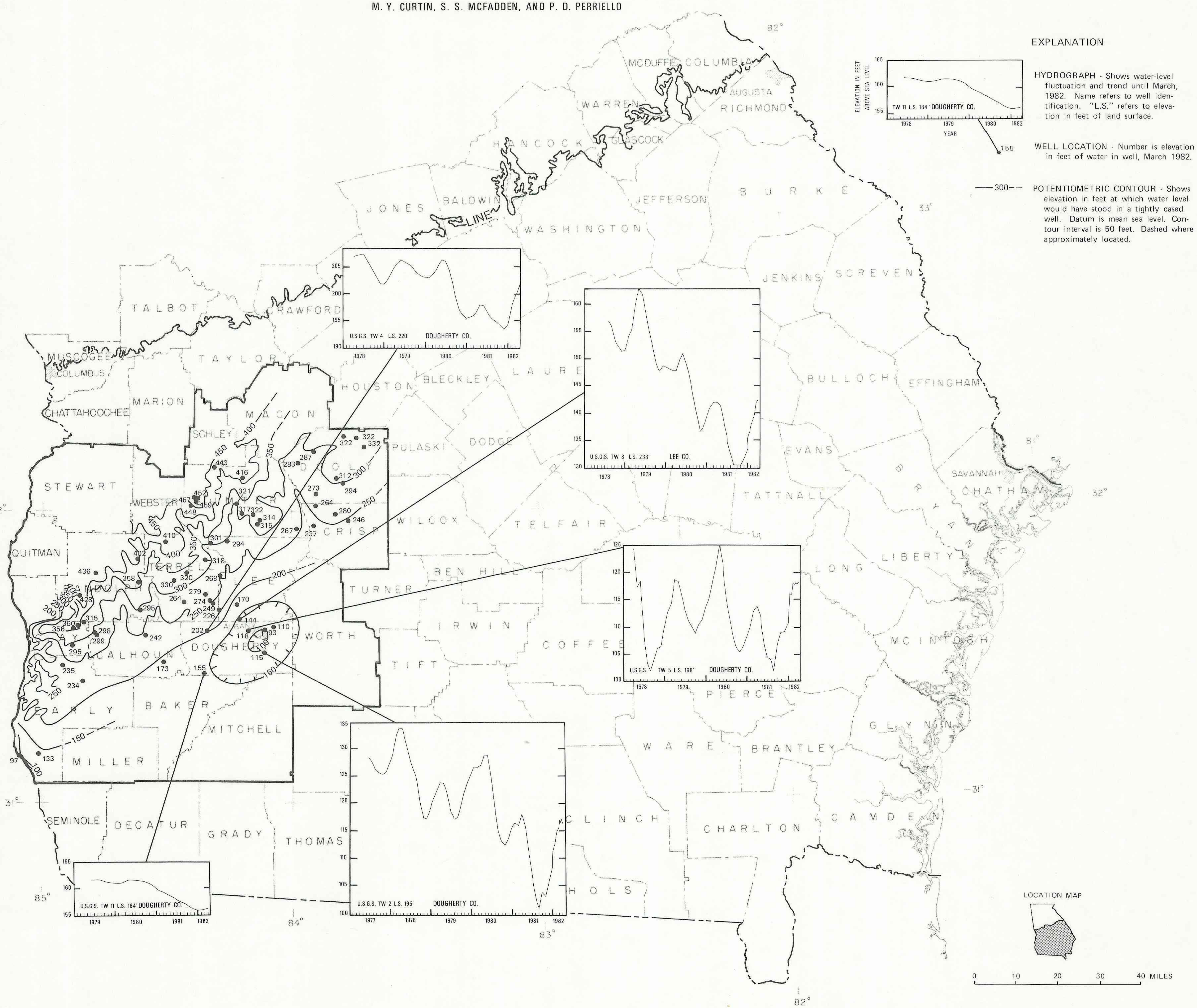
Water-level trends for the rest of the outlined area are more stable. In Crisp and Dooly Counties the Claiborne Aquifer is used almost exclusively for all water needs. Here the water levels have declined, but not to the same extent as in the Albany area. Elsewhere in the outlined area, the Claiborne Aquifer is not heavily used and water levels are relatively constant.

From the measurements made in March, 1982, a map of the potentiometric surface (the surface to which the water in a properly constructed well would rise due to artesian pressure) was constructed. In general, the potentiometric surface dips to the southeast away from the major recharge area, the outcrop of the Claiborne Group. Average slope is 10.4 feet per mile; this slope decreases downdip. The surface appears highly dissected where it shows the effects of discharge to surface streams and rivers (surface water is not shown). A cone of depression is centered around Albany, an area of very high pumpage for municipal and industrial use.

SOURCES

McFadden, S.S., and Perriello, P.D., 1983, Hydrogeology of the Clayton and Claiborne aquifers in southwestern Georgia: Georgia Geol. Survey Inf. Circ. 55.

Unpublished data on file at the U.S. Geological Survey, Water Resources Div., Doraville, Ga.



STRUCTURE-CONTOUR MAP OF THE TOP OF THE CLAYTON AQUIFER

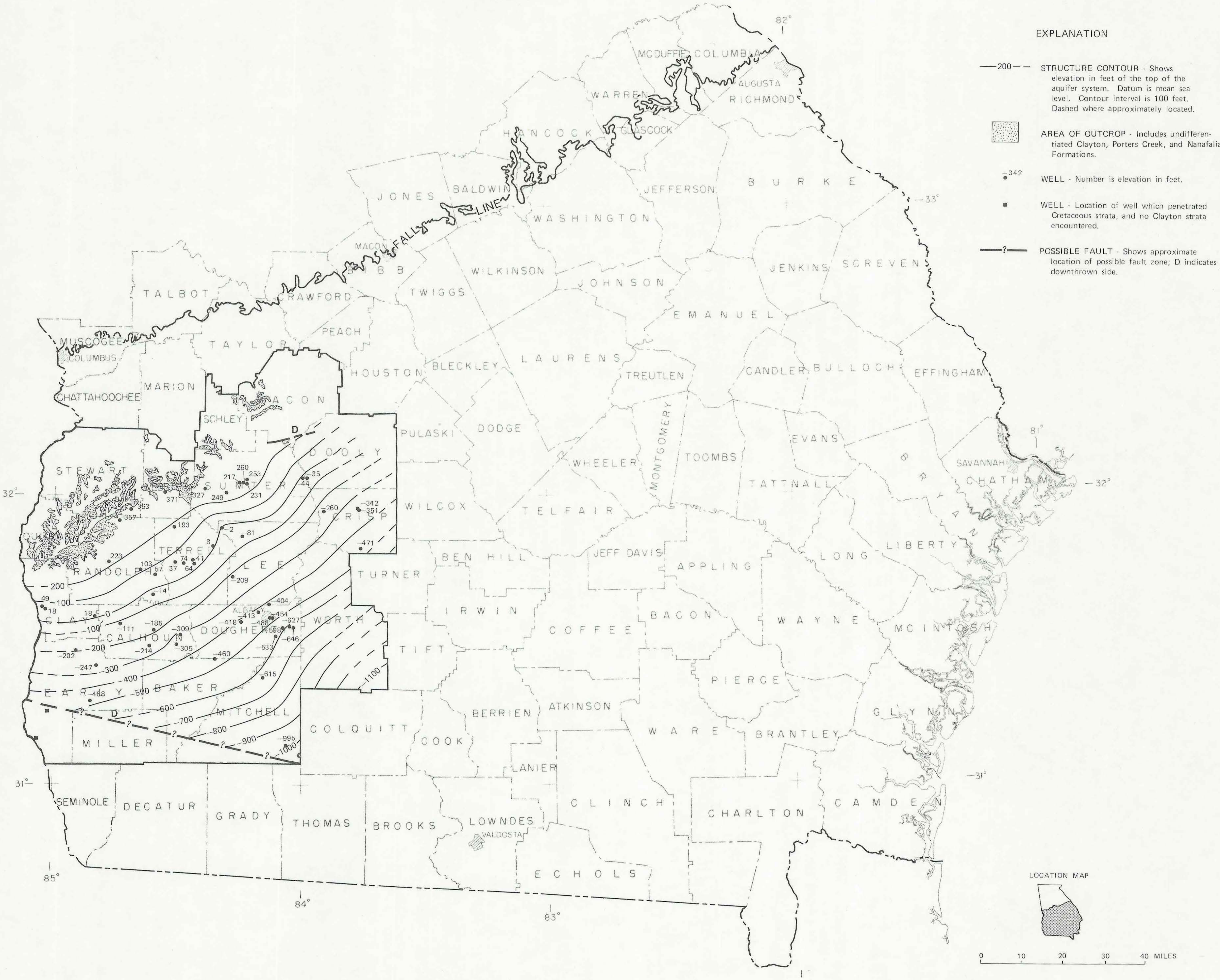
M. A. TUOHY

This structure-contour map shows the elevation of the top of the Paleocene Clayton Aquifer. Although present in other areas of the Coastal Plain, the usefulness of the Clayton Formation as a fresh-water aquifer is limited to the outlined 19-county area in southwest Georgia.

The Clayton Formation is overlain by sand, clay, and marl of the Sabinian Wilcox Group. The upper boundary of the Clayton Formation is marked by an erosional unconformity and exhibits an irregular surface updip.

The Clayton Aquifer is composed predominantly of a fossiliferous limestone within the Clayton Formation. Some surrounding and interlayered sand and sandy limestone are also included. It is generally confined above by clay, marl and well-cemented sand contained either within the Clayton Formation or the overlying Wilcox Group.

Areally, the Clayton Aquifer is limited to the north by erosion. To the east the limestone pinches out and clay predominates. In the southern part of the outlined area, the Clayton Formation is absent and younger Wilcox Group (Sabinian) strata directly overlie Cretaceous strata. Limited data for this area preclude detailed structural interpretation. A possible fault or fault zone is indicated.



SOURCES

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

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Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey.

Rice, T.E., Jr., 1980, The Sabine Stage in the Georgia Coastal Plain: MS thesis, Emory University, 122 p.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

PLATE 27

STRUCTURE-CONTOUR MAP OF THE BASE OF THE CLAYTON AQUIFER

M. A. TUOHY

This structure-contour map shows the elevation of the base of the Paleocene Clayton Aquifer. Although present in other areas of the Coastal Plain, the usefulness of the Clayton Formation as a fresh-water aquifer is limited to the outlined 19-county area in southwest Georgia.

The Clayton Formation unconformably overlies the Upper Cretaceous Providence Sand and Prairie Bluff Chalk. The contact is somewhat irregular, especially updip. Some basal Clayton sand probably represents reworked Cretaceous strata.

The Clayton Aquifer is composed predominantly of a fossiliferous limestone within the Clayton Formation. Some surrounding and interlayered sand and sandy limestone are also included. Below, it is confined by Cretaceous sand and marl and some Paleocene clay, sand and sandy marl.

To the northeast, in the vicinity of Macon, Dooly and Crisp Counties, the limestone pinches out and the Clayton Formation is predominantly clay. Along strike eastward from Clay through Sumter and Lee Counties, basal sand, limestone and sandy limestone of the Clayton Aquifer directly overlie the Providence Sand. South of this area, the uppermost Cretaceous sediments become increasingly calcareous and grade into the Prairie Bluff Chalk. Where overlying the Prairie Bluff Chalk, the basal unit of the Clayton Formation is a thin sand or sandy marl overlain by limestone. South and west of southern Mitchell County, the Clayton Formation abruptly ends and younger (Sabinian) sediments directly overlie Cretaceous sediments. Limited data for this area precludes detailed structural interpretation. A possible fault or fault zone is indicated.

EXPLANATION

—100— — STRUCTURE CONTOUR - Shows elevation in feet of the base of the aquifer system. Datum is mean sea level. Contour interval is 100 feet. Dashed where approximately located.

AREA OF OUTCROP - Includes undifferentiated Clayton, Porters Creek, and Nanafalia Formations.

-347 WELL - Number is elevation in feet.

-762 WELL - Number is elevation in feet of bottom of well which did not penetrate the base of the Clayton Aquifer.

WELL - Location of well which penetrated Cretaceous strata, and no Clayton strata encountered.

—?— POSSIBLE FAULT - Shows approximate location of possible fault zone; D indicates downthrown side.

LOCATION MAP

0 10 20 30 40 MILES

SOURCES

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

Rice, T.E., Jr., 1980, The Sabine Stage in the Georgia Coastal Plain: MS thesis, Emory University, 122 p.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

PLATE 28

ISOPACH MAP OF THE CLAYTON AQUIFER

M. A. TUOHY

This isopach map shows the thickness, in feet, of the Clayton Aquifer. Although the Clayton Formation is present in other areas of the Coastal Plain, its usefulness as a fresh-water aquifer is limited to the outlined 19-county area in southwest Georgia.

The Clayton Formation is bounded above and below by erosional unconformities. This produces local variations in thickness. It overlies the Cretaceous Providence Sand and Prairie Bluff Chalk and underlies the Sabinian Wilcox Group.

The Clayton Aquifer is composed predominantly of fossiliferous limestone within the Clayton Formation. Some surrounding and interlayered sand and sandy limestone are also included. The aquifer is generally confined above by clay, marl, and indurated sand of the Clayton Formation. Below, it is confined by Cretaceous sand and marl and some Paleocene clay, sand, and sandy marl.

Areally, the Clayton Aquifer is limited to the north by erosion. To the east, the limestone pinches out and clays predominate. In the southern part of the outlined area the Clayton Formation is absent and younger Wilcox Group (Sabinian) strata directly overlie Cretaceous Strata. Limited data for this area preclude detailed structural interpretation. A possible fault is indicated.

SOURCES

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, Personal commun.: Georgia Geologic Survey, Atlanta.

Rice, T.E., Jr., 1980, The Sabine Stage in the Georgia Coastal Plain: MS thesis, Emory University, 122 p.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

EXPLANATION

— 50 — — LINE OF EQUAL THICKNESS OF AQUIFER Shows thickness in feet of aquifer system. Dashed where approximately located. Contour interval is 50 feet.

AREA OF OUTCROP - Includes undifferentiated Clayton, Porters Creek, and Nanafalia Formations.

• WELL - Number is thickness in feet.

°140 WELL - Number is minimum thickness in feet of aquifer for well which did not penetrate base of Clayton Aquifer.

▪ WELL - Location of well which penetrated Cretaceous strata, and no Clayton strata encountered.

—?— POSSIBLE FAULT - Shows approximate location of possible fault zone; D indicates downthrown side.

LOCATION MAP

0 10 20 30 40 MILES

ISOPACH MAP OF STRATA OVERLYING THE CLAYTON AQUIFER

M. A. TUOHY

This isopach map shows the thickness, in feet, of strata overlying the Paleocene Clayton Aquifer. Although the Clayton Formation is present in other areas of the Coastal Plain, its usefulness as a fresh-water aquifer is limited to the outlined 19-county area in southwest Georgia.

The Clayton Aquifer is composed predominantly of fossiliferous limestone within the Clayton Formation. Some surrounding and interlayered sand and sandy limestone are also included. It is generally confined above by clay, marl, and well-cemented sand contained within the Clayton Formation or the overlying Wilcox Group. Uppermost confining units within the Clayton Formation are included in the overlying strata.

Updip, in the Fall Line Hills area, stream dissection and pronounced relief on the upper boundary of the Clayton Formation produce large local variations in the thickness of overlying strata. In parts of this area, the outcrop of the Clayton Formation is difficult to distinguish from residuum of the overlying Nanafalia Formation and is mapped as Nanafalia, Porters Creek and Clayton Formations undifferentiated. Farther downdip, the Wilcox Group is overlain by the middle Eocene Claiborne Group and late Eocene to Oligocene residuum.

In the southern part of the outlined area, the Clayton Formation is absent and younger Wilcox Group (Sabinian) strata directly overlie Cretaceous strata. Limited data for this area preclude detailed structural interpretation. A possible fault or fault zone is indicated.

EXPLANATION

—200— — LINE OF EQUAL THICKNESS OF OVERLYING STRATA - Shows thickness in feet of strata between land surface and top of aquifer. Contour interval is 100 feet. Dashed where approximately located.

AREA OF OUTCROP - Includes undifferentiated Clayton, Porters Creek, and Nanafalia Formations.

•305 WELL - Number is thickness in feet.

▪ WELL - Location of well which penetrated Cretaceous strata, and no Clayton strata encountered.

—?— POSSIBLE FAULT - Shows approximate location of possible fault zone; D indicates downthrown side.

LOCATION MAP

0 10 20 30 40 MILES

SOURCES

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

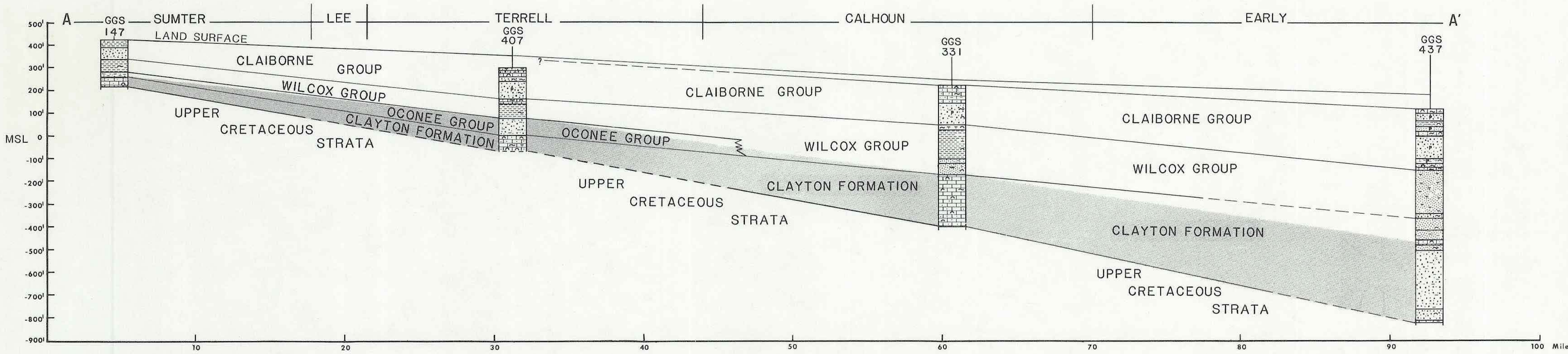
Huddlestun, P.F., 1981, personal commun.: Georgia Geologic Survey, Atlanta.

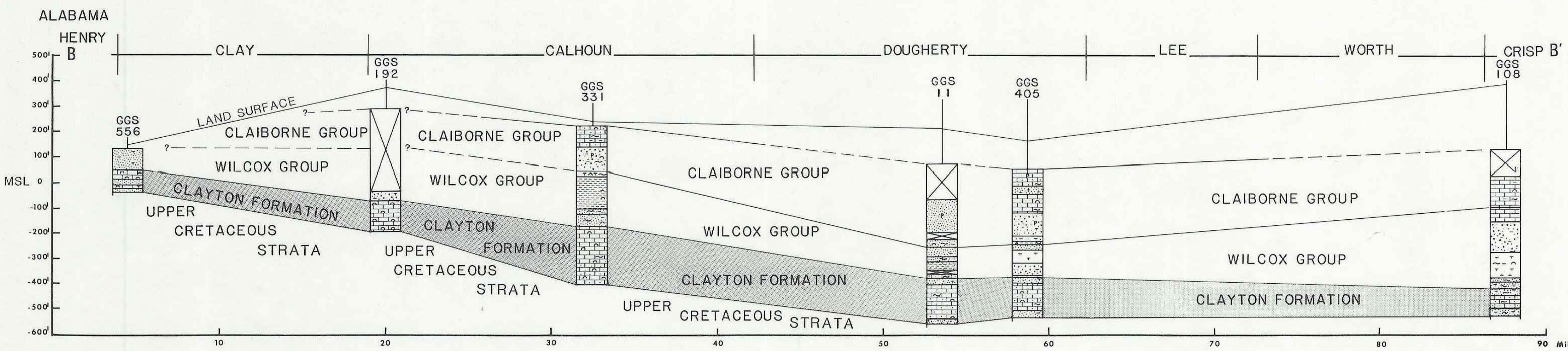
Rice, T.E., Jr., 1980, The Sabine Stage in the Georgia Coastal Plain: MS thesis, Emory University, 122 p.

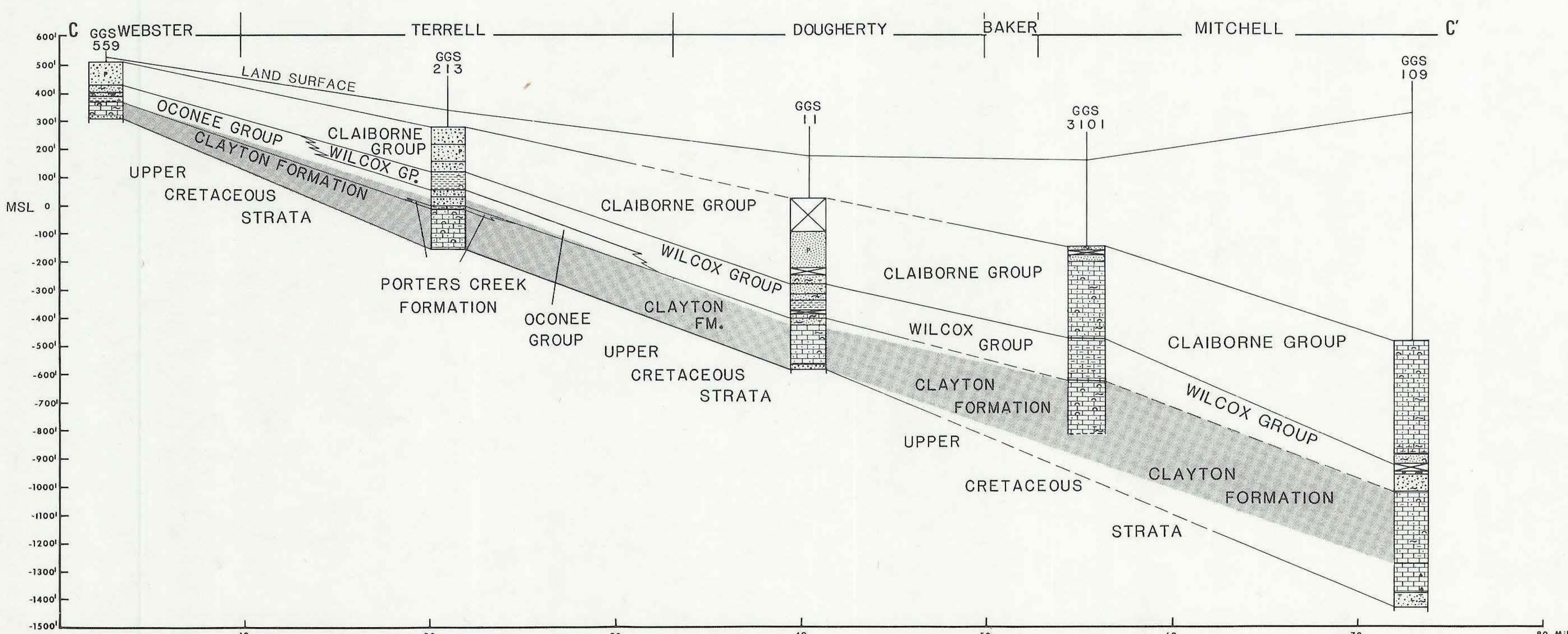
Unpublished data on file at the Georgia Geologic Survey, Atlanta.

GEOLOGIC SECTIONS OF THE CLAYTON AQUIFER

M. A. TUOHY







These geologic sections show the lateral lithologic trends of the lower Paleocene Clayton Formation and Aquifer. Where present, strata of the middle Eocene Claiborne Group are also shown to illustrate the relative stratigraphic position. Although these units are present in other areas of the Coastal Plain, their usefulness as fresh-water aquifers is limited to the 19-county area outlined on the index map.

The Clayton Aquifer is composed predominantly of fossiliferous limestone within the Clayton Formation. Some surrounding and interlayered sandstone and sandy limestone are also included. The aquifer is generally confined above by impervious sandstone, clay, and marl of the Clayton Formation and lower Wilcox and Oconee Groups. It is confined below by impervious sandstone and marl of the Upper Cretaceous and some impervious clay, sandstone, marl and siliceous limestone within the Clayton Formation.

Section A to A' is oblique to both strike and dip and shows a trend of increased depth and thickness to the southwest. Section B to B' is approximately along strike. It illustrates the general thinning of the main limestone aquifer at the eastern and western margins of the outlined area. Section C to C', which approximates dip, shows a gradual increase in thickness and depth of the aquifer to the southwest.

South of a line through A' and C', the Clayton Formation is absent and younger Wilcox Group (Sabinian) strata directly overlie Cretaceous strata. A possible fault or fault zone approximately paralleling this line has been postulated.

SOURCES

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Huddlestun, P.F., 1981, Correlation chart—Georgia Coastal Plain: Georgia Geol. Survey Open-file Report 82-1, 2 p.

Huddlestun, P.F., 1981, personal commun., Georgia Geologic Survey, Atlanta.

Rice, T.E., Jr., 1980, The Sabine Stage in the Georgia Coastal Plain: MS thesis, Emory University, 122 p.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

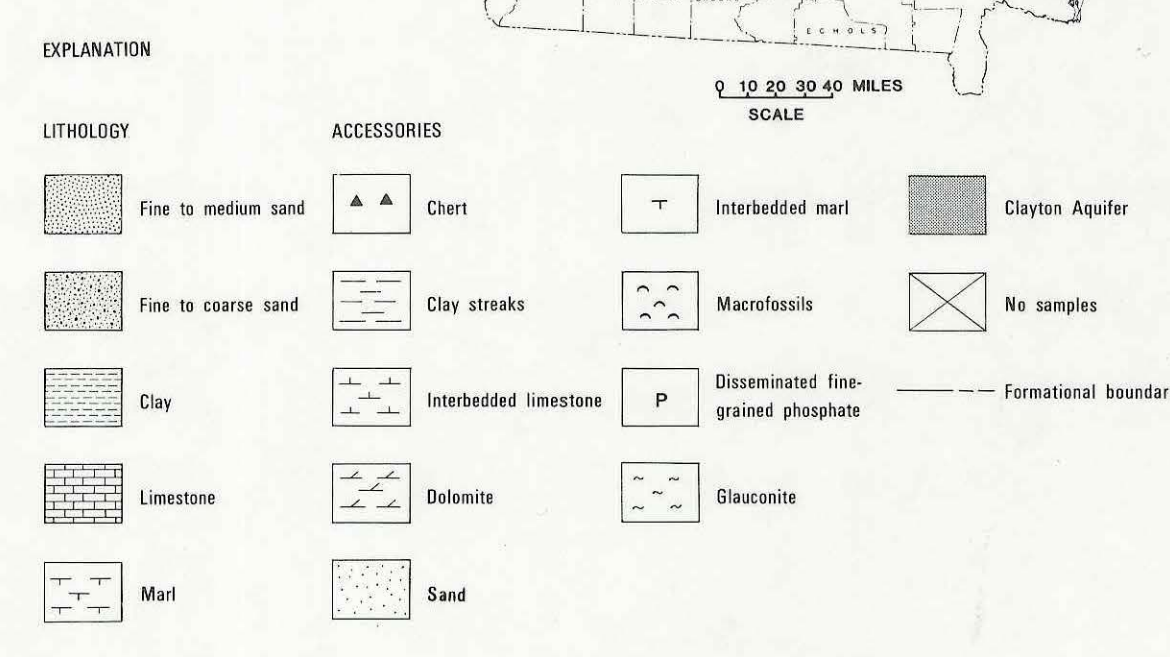


PLATE 31

CONCENTRATION OF DISSOLVED SOLIDS IN THE CLAYTON AQUIFER

P. A. CREWS

The water-quality map for the Clayton Aquifer System presents the concentration of total dissolved solids (TDS) and hardness value (as a subscript) for wells in a 19-county area. Plotted values are limited to these counties on the basis of data availability.

SOURCES

Ripy, B.J., McFadden, S.S., Perriello, P.D., and Gernazian, A.M., 1981, An interim report on the hydrogeology of the Clayton and Claiborne aquifers in southwestern Georgia: Georgia Geol. Survey Open-file Report 82-2, 37 p.

U.S. Geological Survey, 1976, Ground-water quality data for Georgia: Doraville, Ga., Water Res. Div. 216 p.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

Unpublished data on file at the U.S. Geological Survey, Water Resources Div., Doraville, Ga.

EXPLANATION

—200— LINE OF EQUAL DISSOLVED-SOLIDS CONCENTRATION - Shows dissolved solids concentration in milligrams per liter (mg/l). Hardness values are not contoured.

AREA OF OUTCROP - Includes undifferentiated Clayton, Porters Creek, and Nanafalia Formations.

•148(126) WELL - Number is dissolved-solids concentration (mg/l). Subscript is carbonate hardness value.

WATER-LEVEL TRENDS AND POTENTIOMETRIC SURFACE OF THE CLAYTON AQUIFER, MARCH, 1982

E. S. RAMOS, S. S. MCFADDEN, AND P. D. PERRIELLO

This diagram shows water-level trends and potentiometric surface of the Clayton Aquifer. Water-level trends are shown by hydrographs from observation wells equipped with continuous water-level recorders. The potentiometric surface of the Clayton Aquifer is based on water-level measurements of March, 1982.

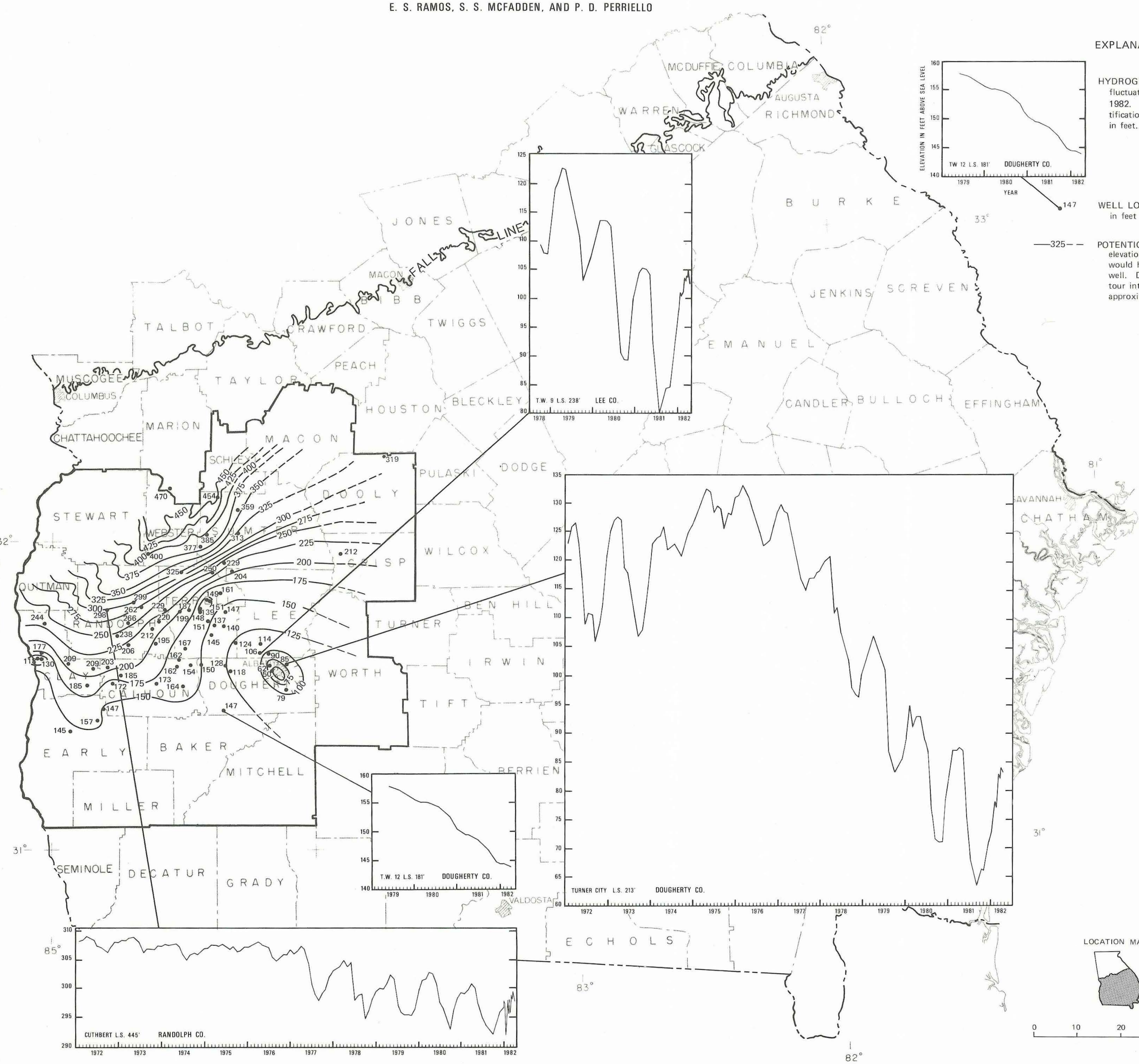
Hydrographs from observation wells show that since 1979, 1) water levels have generally declined, and 2) seasonal fluctuations have increased. In the Albany area, the Turner City hydrograph shows a decline of 33' from May to September, 1980, while the Test Well 9 hydrograph shows a decline of 28' in the same time period. Test Well 12 shows the same downward trend, but not the seasonal fluctuations of the hydrographs. The trends shown in the hydrographs are caused by large municipal, industrial, and agricultural ground-water withdrawals coupled with below average rainfall in the late 1970's through 1981. The city of Albany currently withdraws approximately 12.0 million gallons per day. Irrigation use of the Clayton Aquifer in the outlined area is estimated at 15.0 million gallons per day (1980).

SOURCES

Mitchell, G.D., 1981, Hydrologic data of the Dougherty Plain and adjacent areas, southwest Georgia: Georgia Geol. Survey, Info. Circ. 58, 124 p.

McFadden, S.S., and Perriello, P.D., Hydrology of the Clayton and Claiborne aquifers in southwestern Georgia: Georgia Geol. Survey, Info. Circ. 55.

Unpublished data on file at the U.S. Geological Survey, Water Resources Div., Doraville, Ga.



EXPLANATION

HYDROGRAPH - Shows water-level fluctuation and trend until March, 1982. Name refers to well identification. "L.S." refers to elevation in feet.

WELL LOCATION - Number is elevation in feet of water in well in March, 1982.

POTENTIOMETRIC CONTOUR - Shows elevation in feet at which water level would have stood in a tightly cased well. Datum is mean sea level. Contour interval is 25 feet. Dashed where approximately located.

LOCATION MAP

0 10 20 30 40 MILES

STRUCTURE-CONTOUR MAP OF THE TOP OF THE CRETACEOUS AQUIFER SYSTEM

M. Y. CURTIN

This structure-contour map shows the elevation of the top of the Cretaceous Aquifer System. However, the top of this system is not a single stratigraphic unit across the Coastal Plain, because the lithology of individual units and the stratigraphy of the Cretaceous rocks are complex.

In the northeastern Coastal Plain, the entire Cretaceous Aquifer System is designated as A_1, because the entire thickness acts as one hydrologic unit. A_1 includes the sand and interbedded clay which are mapped on the Geologic Map of Georgia (Georgia Geologic Survey, 1976) as Lower Tertiary-Cretaceous undifferentiated, Twiggs Clay, and Irwinton Sand, and their subsurface equivalents. In this area the structure contour map represents the top of A_1.

To the south and west (downdip and along strike, respectively) individual aquifer units become distinct. In these areas, the individual aquifers are designated A_2 through A_6 in descending stratigraphic order. They include the following lithostratigraphic units: Providence Sand, Ripley Formation, Cusseta Sand, Blufftown Formation, Eutaw Formation, and Tuscaloosa Formation; and their subsurface equivalents (see cross sections, plate 37, Geologic Sections of the Cretaceous Aquifer System)

Aquifers A_2 through A_6 are not lithologically consistent. They grade from sand into sandy clay. This gradation has two important effects from a hydrologic standpoint. In some places, the confining units disappear and two aquifers act as a single hydrologic unit; and, in other places, the uppermost aquifer grades into a predominantly clay lithology. Where the latter occurs, a cutaway is necessary in order to view the stratigraphically lower aquifer. These cutaway views are outlined on the map; labels indicate which aquifer unit the contour lines represent.

Overall, the structure-contour map shows that the top of the system dips gently from the Fall Line to the southeast. There are structural lows centered in Wheeler County, southern Wayne County, and western Camden County.

SOURCES

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

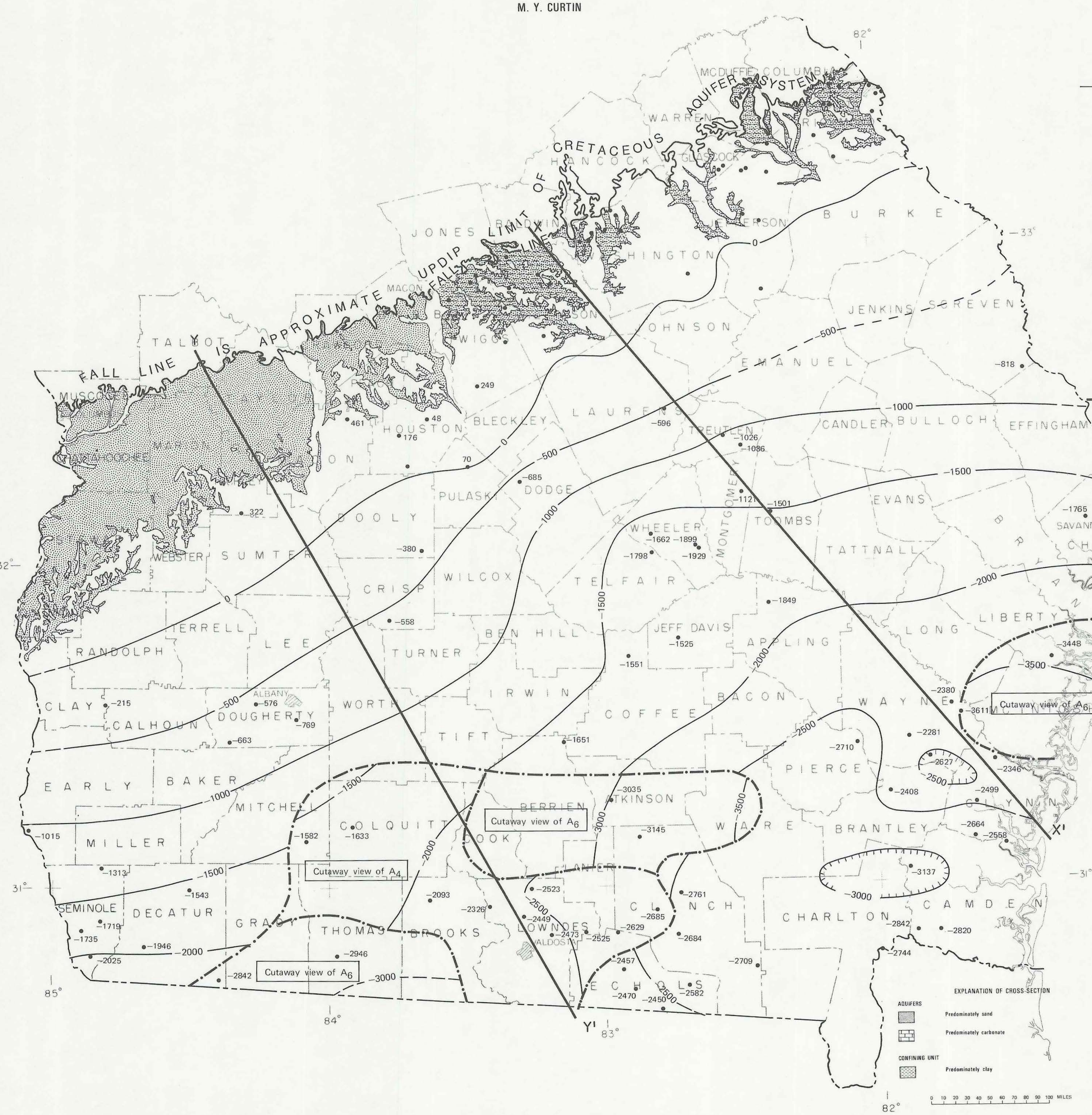
Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Pollard, L.D., 1980, Unpublished data from study of geohydrology of Cretaceous Aquifer System in Georgia on file at the Georgia Geologic Survey, Atlanta.

Pollard, L.D., and Vorhis, R.C., 1980, The geohydrology of the Cretaceous Aquifer System in Georgia: Georgia Geol. Survey Hydrol. Atlas 3.

LOCATION MAP

0 10 20 30 40 MILES



EXPLANATION

—— 0 — — STRUCTURE CONTOUR - Shows elevation in feet of the top of the Cretaceous Aquifer. Datum is mean sea level. Contour interval is 500 feet. Dashed where approximately located. Note that the top of the highest aquifer is not necessarily the top of the Cretaceous strata.

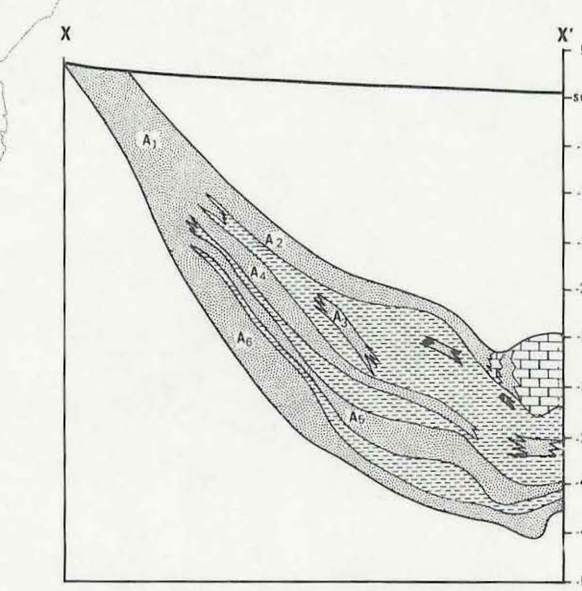
AREA OF OUTCROP - Includes Providence Sand, Ripley Formation, Cusseta Sand, Blufftown Formation, Eutaw Formation and Tuscaloosa Formation. (From Georgia Geologic Survey, 1976.)

AREA OF OUTCROP - Includes Lower Tertiary-Cretaceous undifferentiated. (From Georgia Geologic Survey, 1976.)

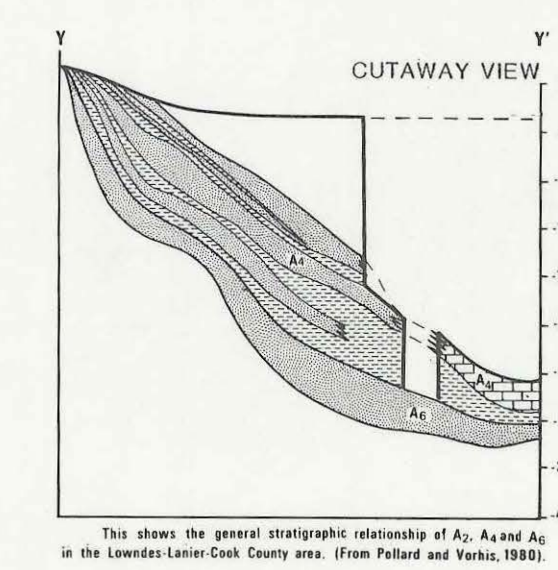
-818 WELL - Number is elevation in feet of the top of the Cretaceous Aquifer. Locations without data are taken from the map of Distribution and Thickness of Aquifer A_1 in Pollard and Vorhis, 1980, Sheet 2.

CUTAWAY VIEW - Delineates area where Cretaceous strata yield relatively low amounts of water. In these areas, greater yields may be obtained by drilling to elevations indicated by structure contours in cutaway views. (See section Y-Y' for cross sectional view).

GENERALIZED CROSS SECTIONS



This shows the downdip relationship of A_1 which outcrops on the northeast edge of the Coastal Plain, to the other aquifer units. (From Pollard and Vorhis, 1980).



This shows the general stratigraphic relationship of A_2, A_4 and A_6 in the Lowndes-Lanier-Cook County area. (From Pollard and Vorhis, 1980).

STRUCTURE-CONTOUR MAP OF THE BASE OF THE CRETACEOUS AQUIFER SYSTEM

H. C. KARP, JR.

This structure-contour map shows the elevation of the base of the Cretaceous Aquifer System of the Fredericksburgian-age sands. This surface represents sediments deposited before the Fredericksburgian Stage (Lower Cretaceous Series) in the southwestern Coastal Plain and pre-Cretaceous metamorphic, sedimentary, and volcanic rocks elsewhere. In general, the lower and downdip portions of the aquifer contain salt water.

In the northern portion of the Georgia Coastal Plain, the altitude at the base steadily decreases southward away from the Fall Line. In the central and southern areas, the pre-Upper Cretaceous surface is affected by several structural features. The low areas in the southwest and southeast corners of the State represent the Apalachicola Embayment and the Southeast Georgia Embayment, respectively. The relatively high central portion, in the Echols-Clinch-Ware to Jeff Davis County area, probably reflects the Peninsular Arch.

SOURCES

Applin, E.R., and Applin, P.L., 1964, Logs of selected wells in the Coastal Plains of Georgia: Georgia Geol. Survey Bull. 74, 229 p.

Brown, P.M., Brown, D.L., Reid, M.S., and Lloyd, O.B., Jr., 1979, Evaluation of the geologic and hydrologic factors related to the waste-storage potential of Mesozoic aquifers in the southern part of the Atlantic Coastal Plain, South Carolina and Georgia: U.S. Geol. Survey Prof. Paper 1088, 37 p.

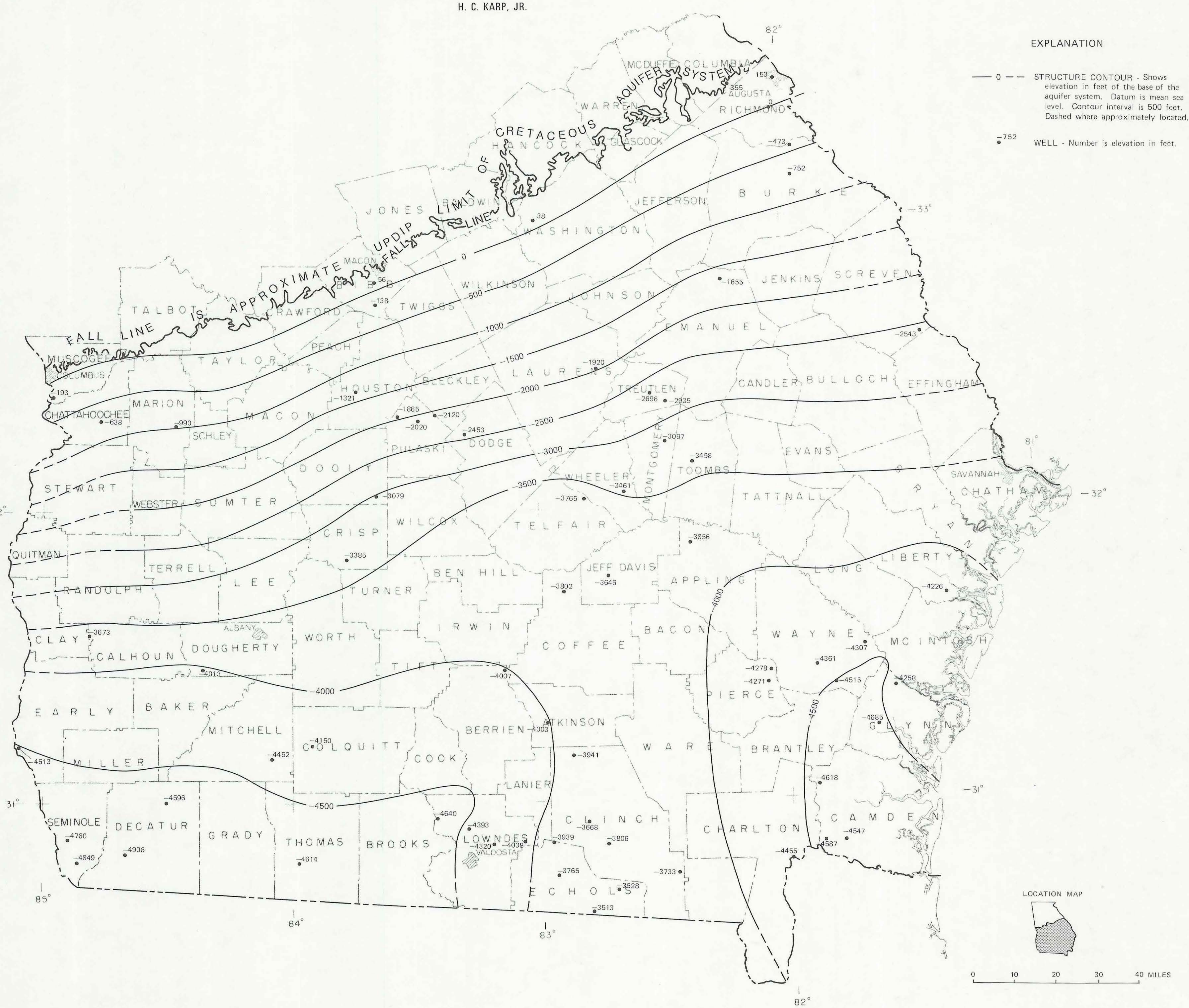
Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Herrick, S.M., and Vorhis, R.C., 1963, Subsurface geology of the Georgia Coastal Plain: Georgia Geol. Survey Info. Circ. 25, 80 p.

Swanson, D.E., and Gernazian, A., 1979, Petroleum exploration wells in Georgia: Georgia Geol. Survey Info. Circ. 51, 67 p

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

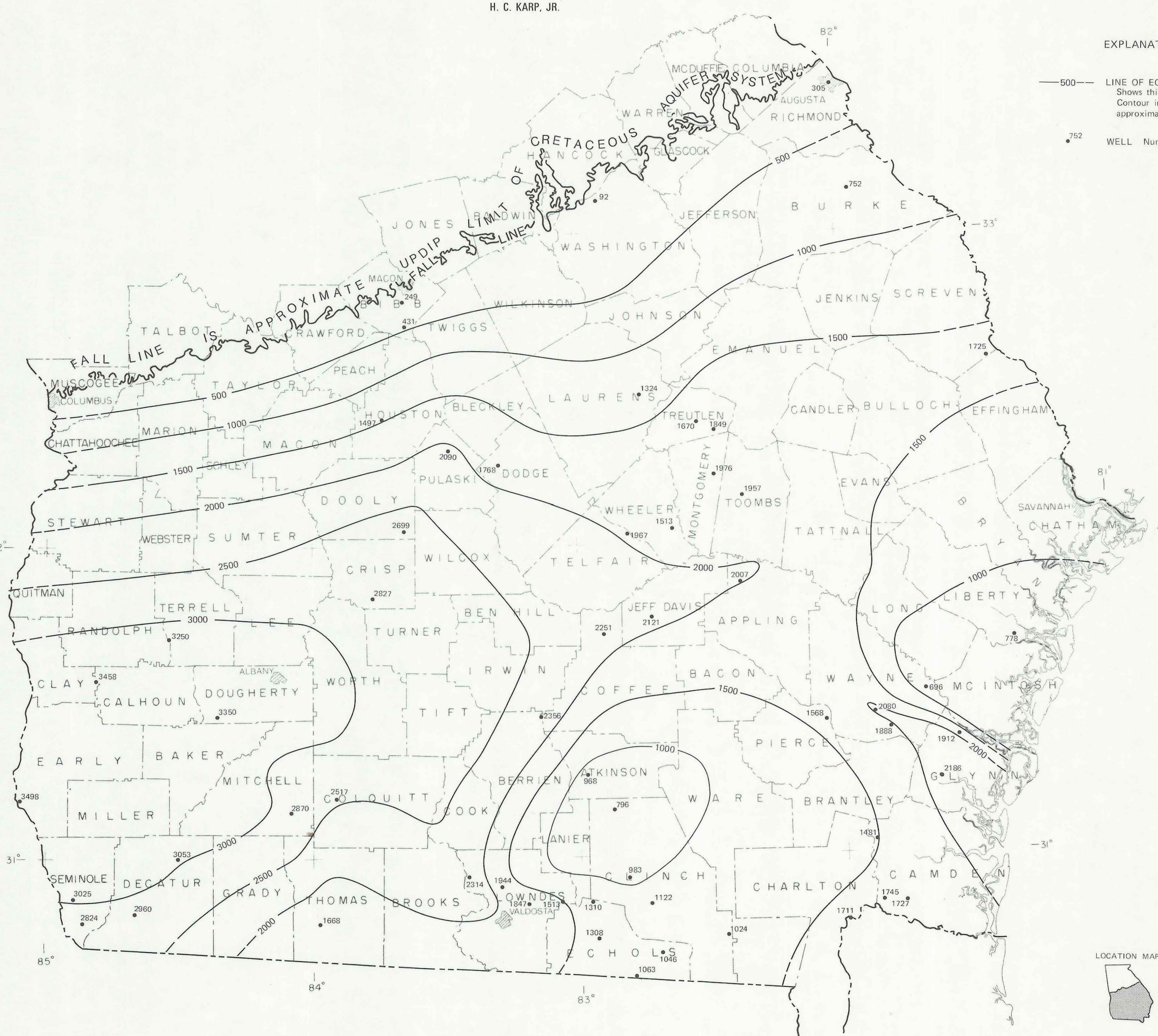


ISOPACH MAP OF THE CRETACEOUS AQUIFER SYSTEM

H. C. KARP, JR.

The isopach map of the Cretaceous Aquifer System shows the thickness of the system from the base of the Fredericksburgian-age sand to the top of the Providence Sand. Strata included in this system range from the Lower Cretaceous Series (Fredericksburgian Stage) through the Upper Cretaceous Series (Navarroan Stage). Some Lower Tertiary strata from the northeast section of the Coastal Plain also are included as they are hydraulically interconnected with Cretaceous strata, (i.e., they form a single aquifer system).

Several structural features have affected the distribution and thickness of the Cretaceous sediments. The central area of thinner strata was probably caused by the pre-existing Peninsular Arch, where less deposition has occurred. The thin sequence near the McIntosh and Glynn County area (Southeast Georgia Embayment) can be seen on the pre-Cretaceous structure-contour map (plate 41). Apparently, the basin did not become an active sediment trap until after the Cretaceous (Cramer, 1974). The Apalachicola (Southwest Georgia) Embayment is represented by a thick sequence located near the southwestern corner of the State. The embayment probably was filled by Lower Cretaceous strata before Upper Cretaceous sediments were deposited (Maher, 1965).



EXPLANATION

—500— LINE OF EQUAL THICKNESS OF AQUIFER - Shows thickness in feet of aquifer system. Contour interval is 500 feet. Dashed where approximately located.

•752 WELL Number is thickness in feet.

LOCATION MAP

0 10 20 30 40 MILES

SOURCES

Applin, E.R., and Applin, P.L., 1964, Logs of selected wells in the Coastal Plains of Georgia: Georgia Geol. Survey Bull. 74, 229 p.

Brown, P.M., Brown, D.L., Reid, M.S., and Lloyd, O.B., Jr., 1979, Evaluation of the geologic and hydrologic factors related to the waste-storage potential of Mesozoic aquifers in the southern part of the Atlantic Coastal Plain, South Carolina and Georgia: U.S. Geol. Survey Prof. Paper 1088, 37 p.

Cramer, H.R., 1974, Isopach and lithofacies analysis of the Cretaceous and Cenozoic rocks of the Coastal Plain of Georgia, in Symposium on the petroleum geology of the Georgia Coastal Plain: Georgia Geol. Survey Bull. 87., p. 45-60.

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Herrick, S.M., and Vorhis, R.C., 1963, Subsurface geology of the Georgia Coastal Plain: Georgia Geol. Survey Info. Circ. 25, 80 p.

Maher, J.C., 1965, Correlations of subsurface Mesozoic and Cenozoic rocks along the Atlantic Coast: Am. Assoc. Petroleum Geol., 18 p.

Pollard, L.D., 1980, Unpublished data from study of geohydrology of Cretaceous Aquifer System in Georgia on file at the Georgia Geologic Survey, Atlanta.

Pollard, L.D., and Vorhis, R.C., 1980, The geohydrology of the Cretaceous aquifer system in Georgia: Georgia Geol. Survey Hydrol. Atlas 3.

Swanson, D.E., and Gernazian, A., 1979, Petroleum exploration wells in Georgia: Georgia Geol. Survey Info. Circ. 57, 67 p.

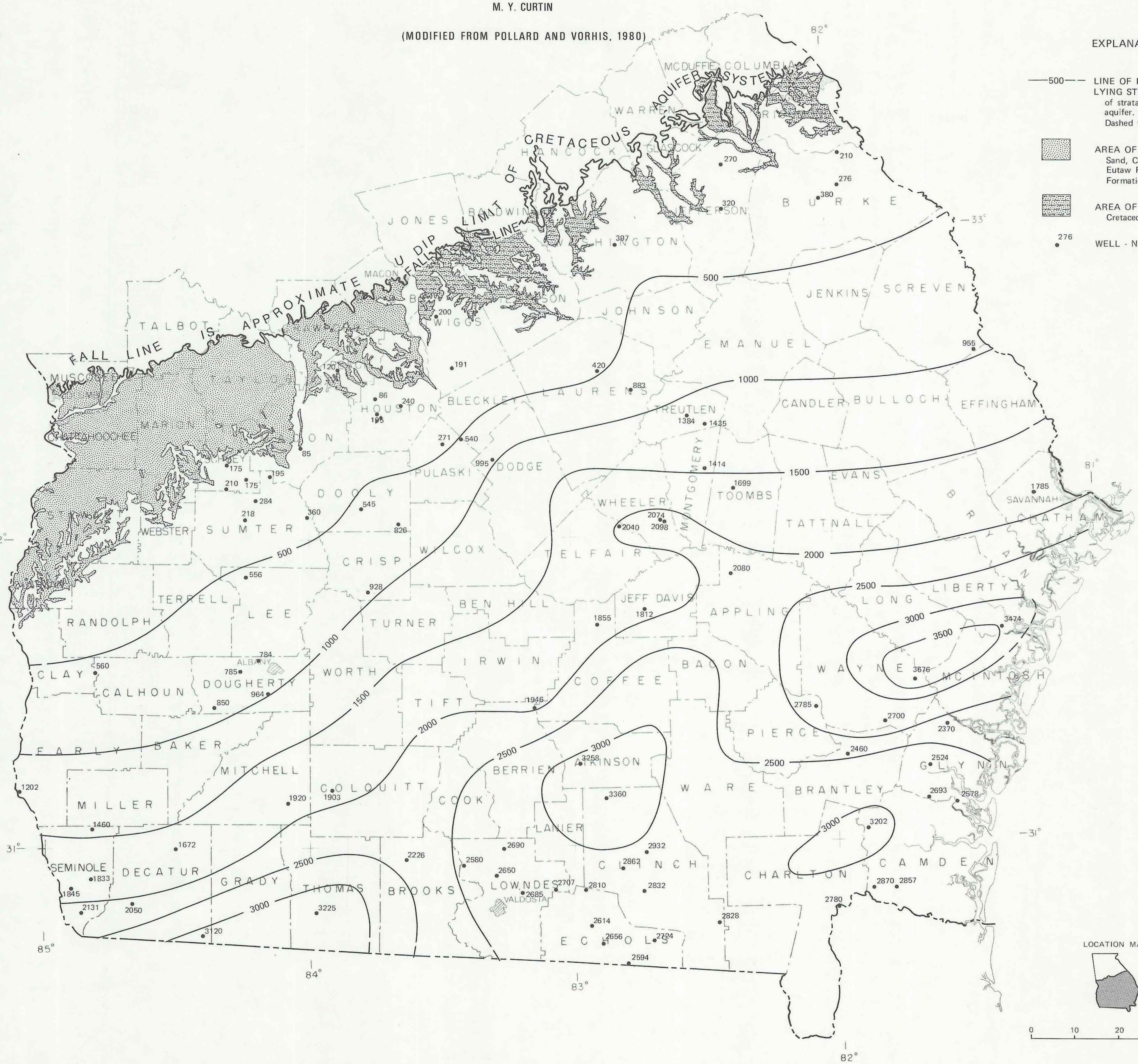
Unpublished data on file at the Georgia Geologic Survey, Atlanta.

ISOPACH MAP OF STRATA OVERLYING THE CRETACEOUS AQUIFER SYSTEM

M. Y. CURTIN

(MODIFIED FROM POLLARD AND VORHIS, 1980)

The isopach map of strata overlying the Cretaceous Aquifer System shows the depth, in feet, from land surface to the top of the uppermost significant water-transmitting unit. These overlying strata generally thicken southward from the Fall Line toward the Atlantic Coast. There are three areas of greatly thickened strata. In two of these areas (Atkinson-Clinch Counties and McIntosh-Long Counties), the uppermost Cretaceous strata have a high clay content and act as confining units; therefore they are considered to be part of the overlying aquiclude rather than as part of the aquifer system (i.e., they are not significant water-transmitting units). In the third area (Camden-Charlton-Brantley Counties), the increased thickness appears to be the result of basin-filling of a structural low, thus resulting in a thickened Tertiary and younger sequence. A more detailed explanation of the geologic framework of the Cretaceous Aquifer System and the distinction between water-transmitting and confining units is given on the map entitled "Structure-Contour of the Top of the Cretaceous Aquifer System" (plate 33) and the cross sections entitled "Geologic Cross Sections of the Cretaceous Aquifer System" (plate 37).



EXPLANATION

—500— — LINE OF EQUAL THICKNESS OF OVERLYING STRATA - Shows thickness in feet of strata between land surface and top of aquifer. Contour interval is 500 feet. Dashed where approximately located.

AREA OF OUTCROP - Includes Providence Sand, Cusseta Sand, Blufftown Formation, Eutaw Formation, and Tuscaloosa Formation.

AREA OF OUTCROP - Includes lower Tertiary-Cretaceous undifferentiated.

276 • WELL - Number is thickness in feet.

LOCATION MAP

0 10 20 30 40 MILES

SOURCES

Applin, P.L., and Applin, E.R., 1967, The Gulf Series in the subsurface in northern Florida and southern Georgia: U.S. Geol. Survey Prof. Paper 524-G, 35 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.

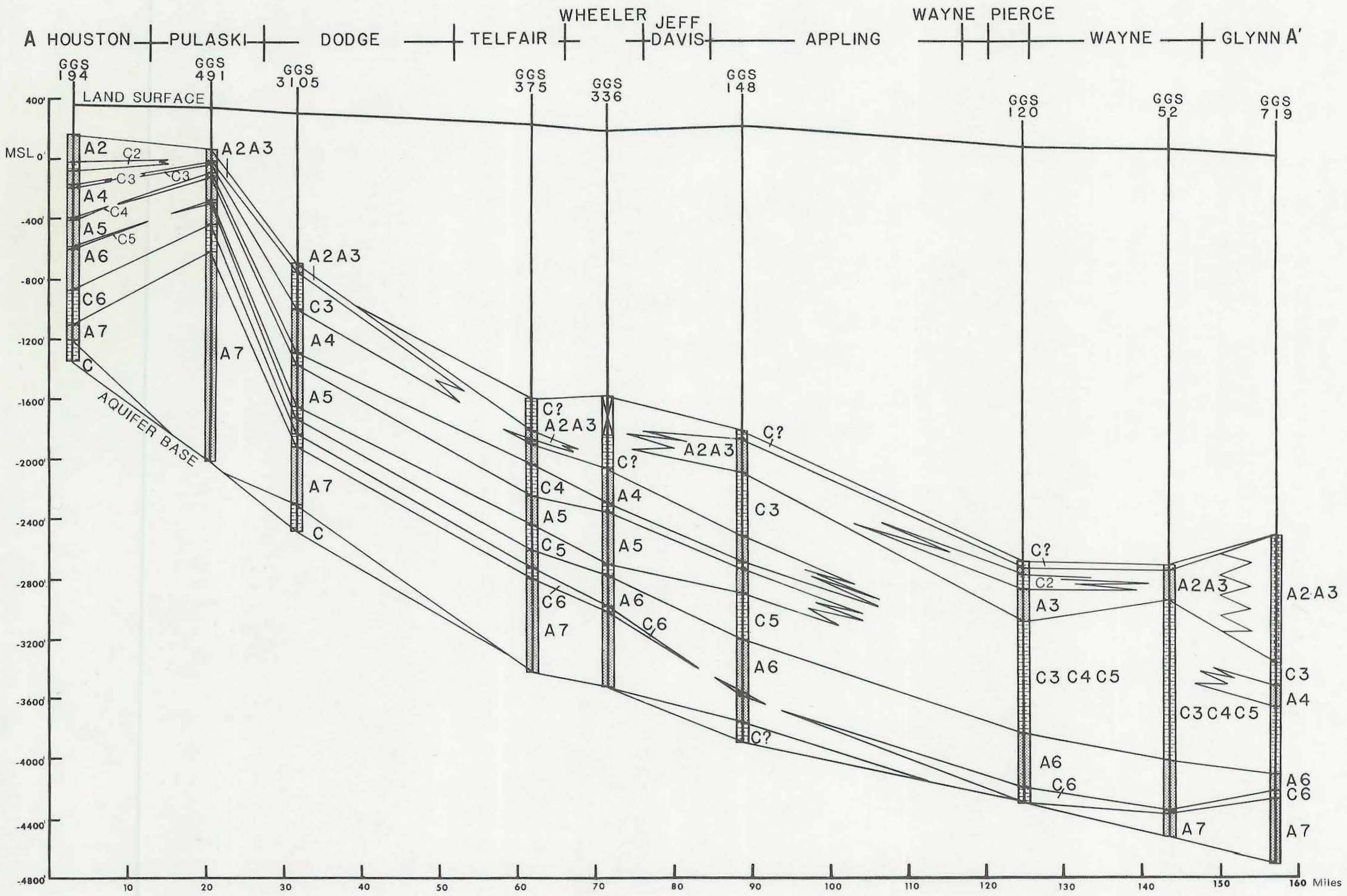
Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 461 p.

Pollard, L.D., and Vorhis, R.C., 1980, The geohydrology of the Cretaceous Aquifer System in Georgia: Georgia Geol. Survey Hydrol. Atlas 3.

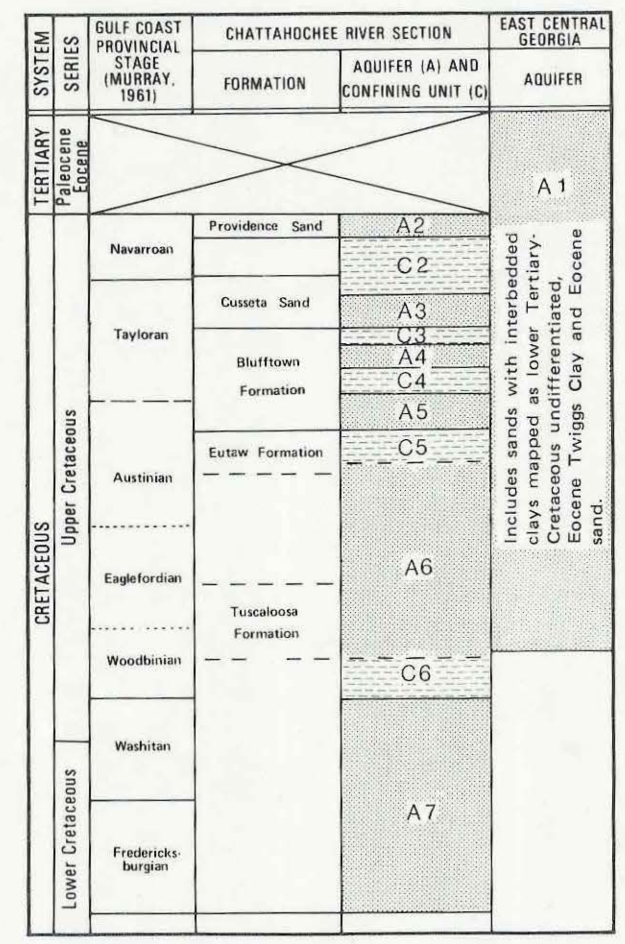
Pollard, L.D., 1980, Unpublished data from study of geohydrology of Cretaceous Aquifer System in Georgia on file at the Georgia Geologic Survey, Atlanta.

GEOLOGIC SECTIONS OF THE CRETACEOUS AQUIFER SYSTEM

M. Y. CURTIN AND W. M. STEELE (MODIFIED FROM POLLARD AND VORHIS, 1980)



Stratigraphic Correlation Chart of the Cretaceous Aquifer System

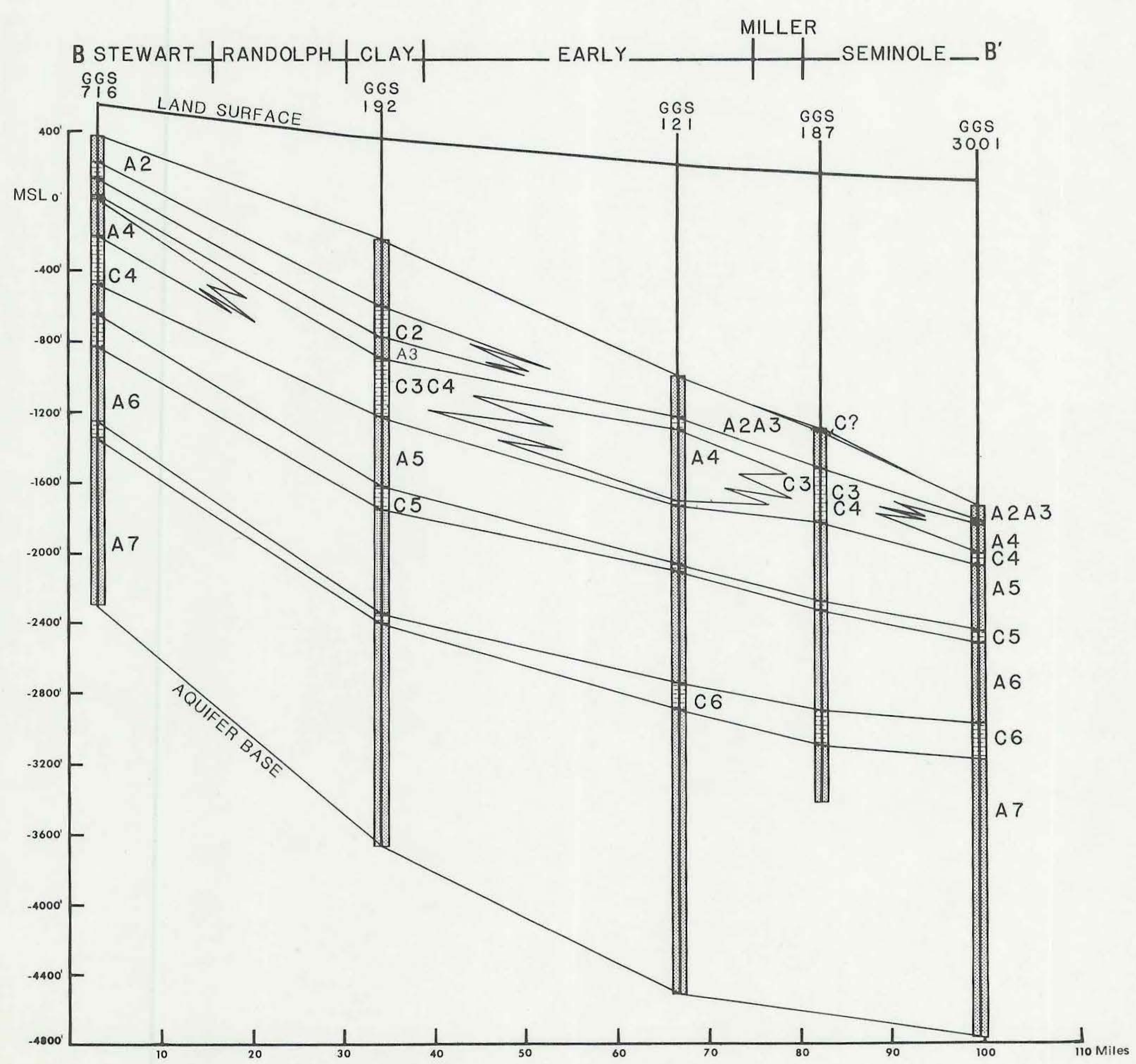


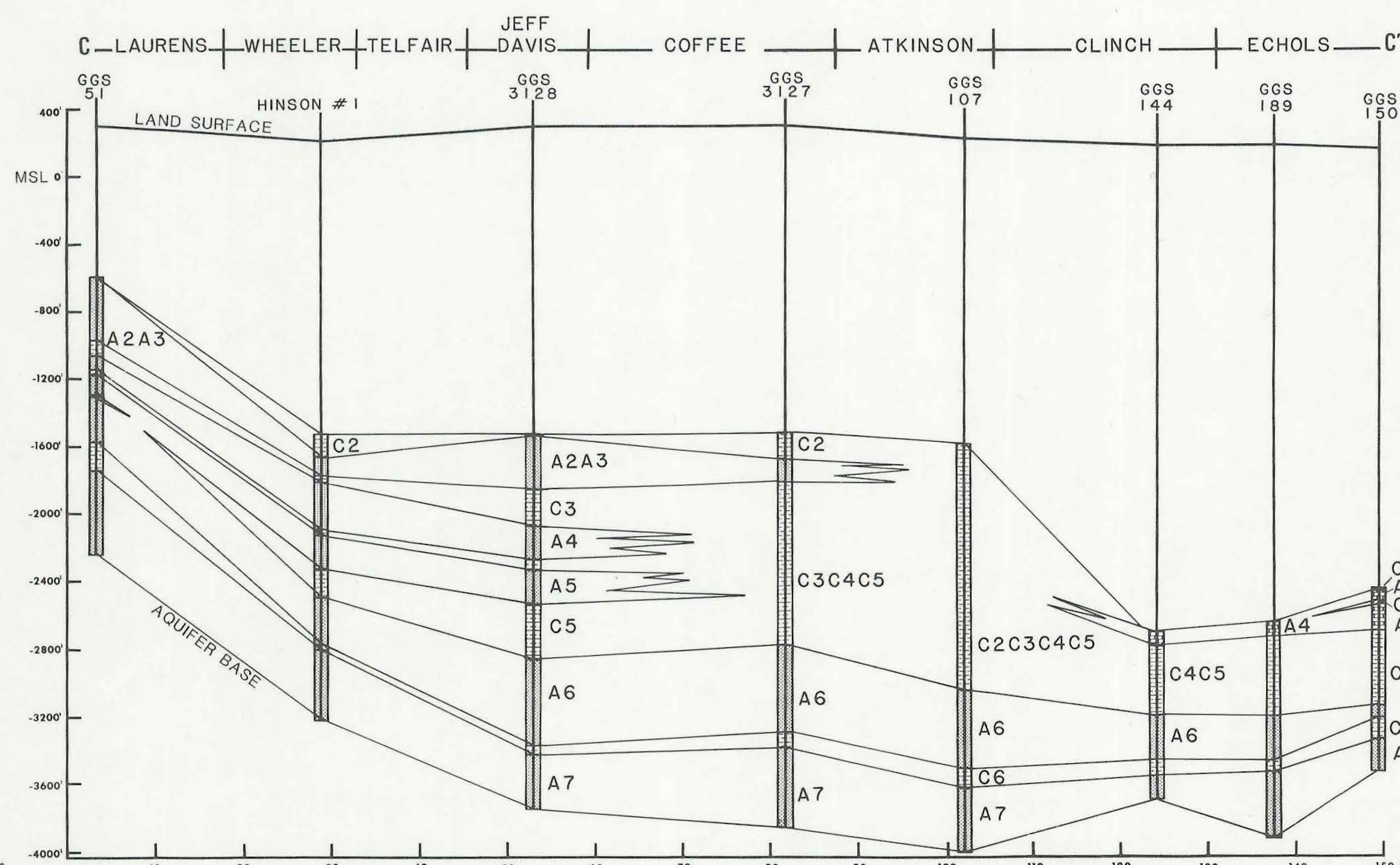
The Cretaceous Aquifer System in Georgia consists primarily of interbedded sand and clay, with some predominantly carbonate units in extreme southern Georgia.

For the purposes of this study, an aquifer is considered to have less than a 50 percent clay content. The geologic section shows that, in places, the water-transmitting units grade laterally into confining units due to an increased clay content. In other places, the confining units are thin or locally discontinuous so as to allow two aquifers to act as a single hydrologic unit. An example of this is found in section A-A' between GGS 194 and GGS 491. The confining units between A_3, A_4 and A_5 are shown as discontinuous to indicate that these aquifers may act as a single aquifer.

SOURCES

Georgia Geologic Survey, 1976, Geologic map of Georgia, scale 1:500,000.
Pollard, L.D., and Vorhis, R.C., 1980, The geohydrology of the Cretaceous aquifer system in Georgia: Georgia Geol. Survey Hydrol. Atlas 3.





EXPLANATION

AQUIFER

Predominantly terrigenous clastics

Predominantly carbonates

CONFINING UNIT

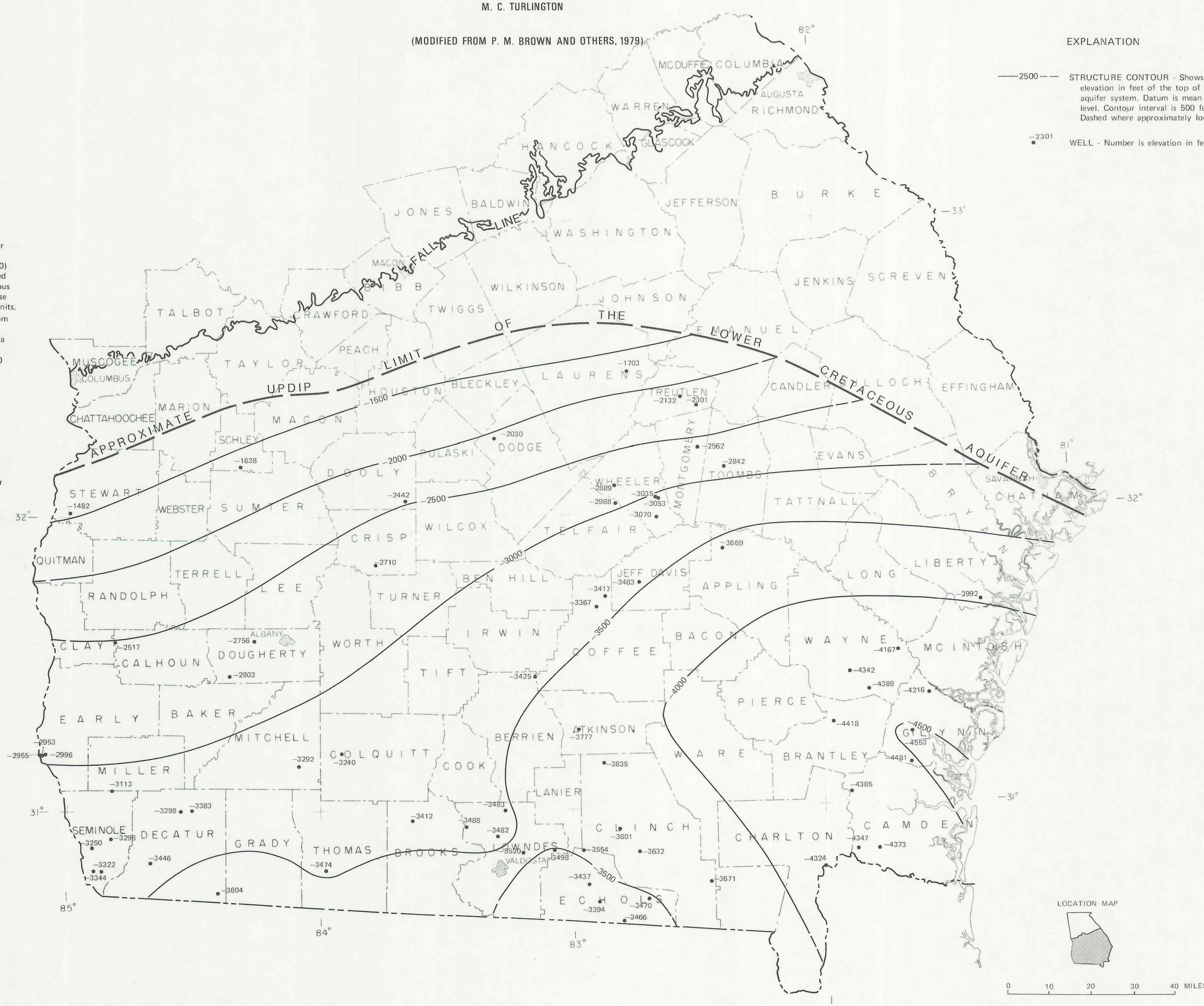
Predominantly clay

Formational boundary

STRUCTURE-CONTOUR MAP OF THE TOP OF THE LOWER CRETACEOUS AQUIFER SYSTEM

M. C. TURLINGTON

(MODIFIED FROM P. M. BROWN AND OTHERS, 1979)



EXPLANATION

——2500—— STRUCTURE CONTOUR - Shows elevation in feet of the top of the aquifer system. Datum is mean sea level. Contour interval is 500 feet. Dashed where approximately located.

•-2301 WELL - Number is elevation in feet.

This map shows the elevation, in feet, of the top of the pre-Gulfian sand and shale of the Lower Cretaceous Aquifer. These units are equivalent to the Comanchean Series of Cramer and Arden (1980) and, in part, equivalent to units F and G as defined by Brown and others (1979). The Lower Cretaceous Aquifer consists of the permeable sands within these units, which may be separated by less permeable units.

The aquifer top generally dips southeastward from the Fall Line. In the southeast corner of Georgia, it slopes toward the center of the southeast Georgia Embayment. In Camden and Glynn Counties, the aquifer top attains a maximum depth of over 4500 feet below sea level.

SOURCES

Brown, P.M., Brown, D.L., Reid, M.S., and Lloyd, O.B., Jr., 1979, Evaluation of the geologic and hydrologic factors related to the waste-storage potential of Mesozoic aquifers in the southern part of the Atlantic Coastal Plain, South Carolina and Georgia: U.S. Geol. Survey Prof. Paper 1088, 37p.

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Herrick, S.M., and Vorhis, R.C., 1963, Subsurface geology of the Georgia Coastal Plain: Georgia Geol. Survey Info. Circ. 25, 78 p.

ISOPACH MAP OF THE LOWER CRETACEOUS AQUIFER

M. C. TURLINGTON

(MODIFIED FROM P. M. BROWN AND OTHERS, 1979)

This map shows the thickness, in feet, of the pre-Gulfian sands and shales of the Lower Cretaceous Aquifer. These units are equivalent to the Comanchean Series of Cramer and Arden (1980) and, in part, equivalent to units F and G as defined by Brown and others (1979). The Lower Cretaceous Aquifer consists of the permeable sands which may be separated by less permeable units. Therefore, the thickness mapped here may be greater than the total thickness of permeable sands.

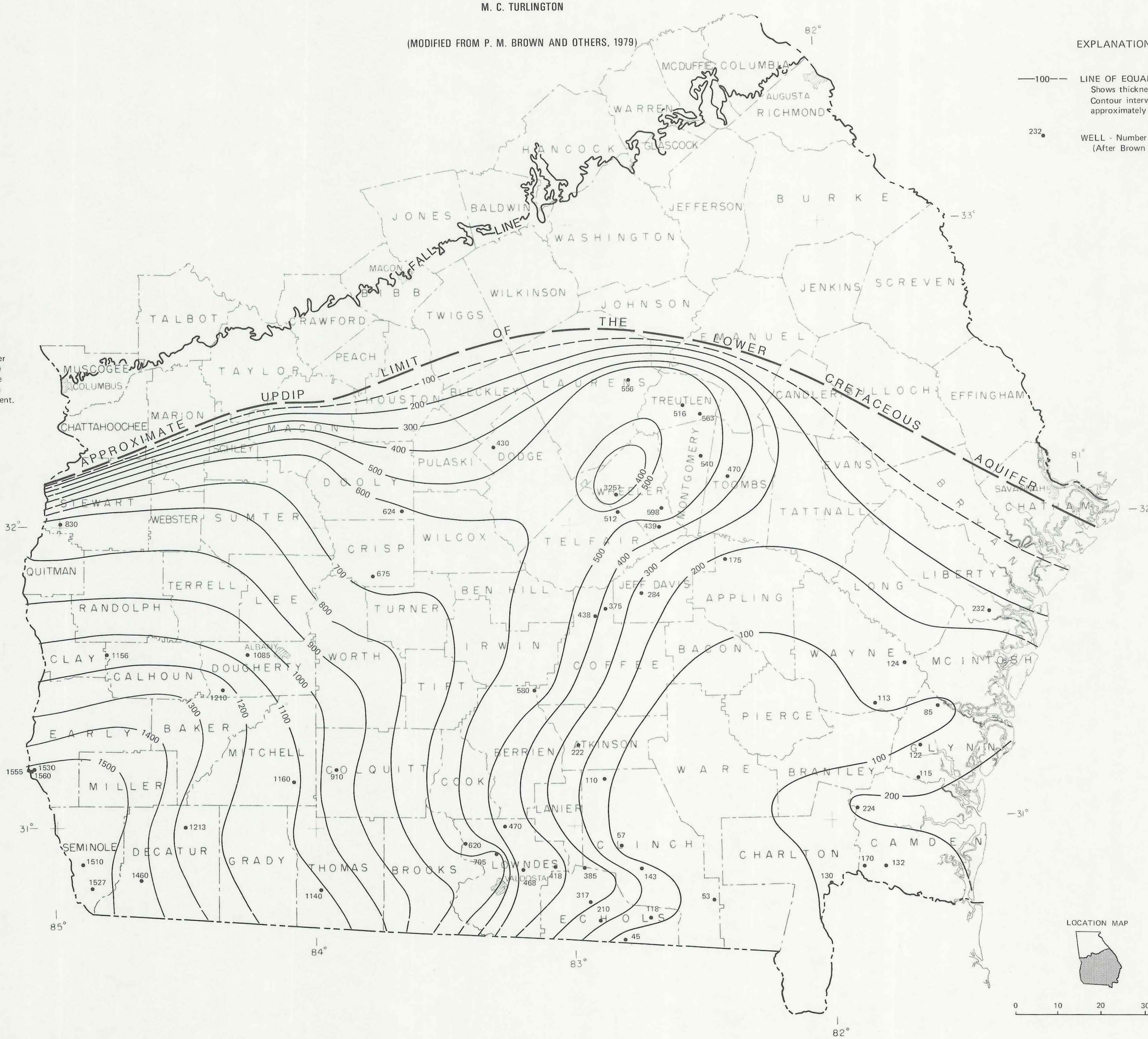
The Lower Cretaceous Aquifer generally thickens toward the southwest and attains a thickness of greater than 1500 feet in the Apalachicola (Southwest Georgia) Embayment. In the southeast portion of the State, the permeable strata thin to less than 100 feet, although they thicken slightly in the Southeast Georgia Embayment.

SOURCES

Brown, P.M., Brown, D.L., Reid, M.S., and Lloyd, O.B., Jr., 1979, Evaluation of the geologic and hydrologic factors related to the waste-storage potential of Mesozoic aquifers in the southern part of the Atlantic Coastal Plain, South Carolina and Georgia: U.S. Geol. Survey Prof. Paper 1088, 37 p.

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Herrick, S.M., and Vorhis, R.C., 1963, Subsurface geology of the Georgia Coastal Plain: Georgia Geol. Survey Info. Circ. 25, 78 p.



EXPLANATION

—100— LINE OF EQUAL THICKNESS OF AQUIFER - Shows thickness in feet of aquifer system. Contour interval is 100 feet. Dashed where approximately located.

232• WELL - Number is thickness in feet. (After Brown and others, 1979).

LOCATION MAP

0 10 20 30 40 MILES

CONCENTRATION OF SODIUM CHLORIDE IN THE LOWER CRETACEOUS AQUIFER

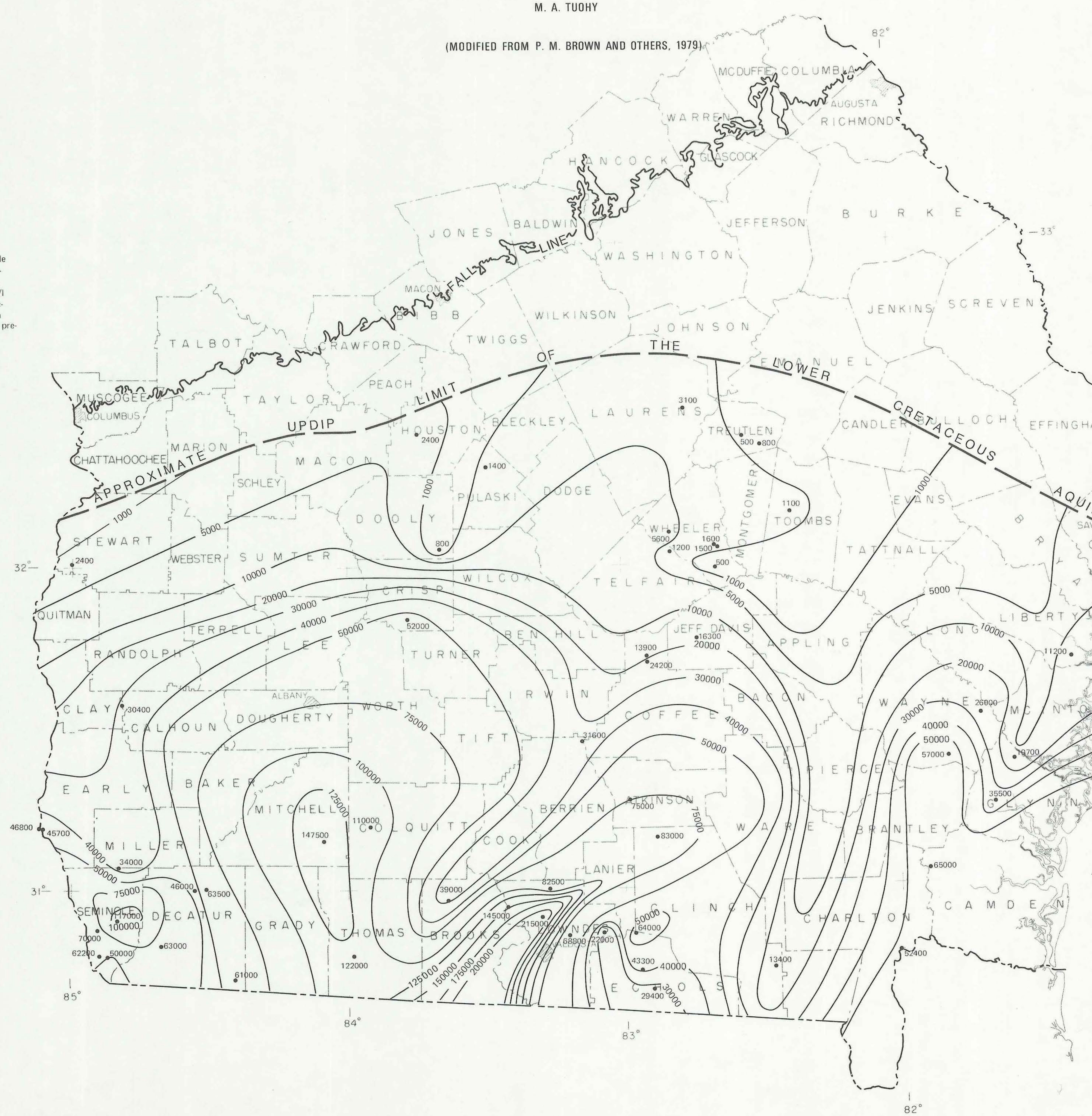
M. A. TUOHY

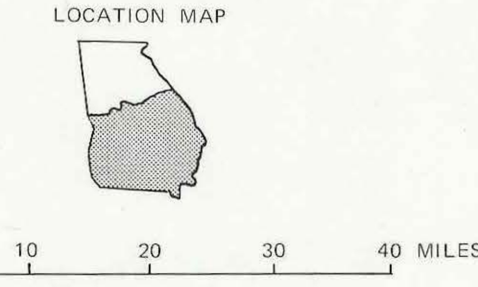
(MODIFIED FROM P. M. BROWN AND OTHERS, 1979)

This map shows concentrations of sodium chloride (NaCl) within pre-Gulfian strata of the Lower Cretaceous Aquifer. Soduim chloride values increase with depth and to the south. Values range from 500 mg/l to 215,000 mg/l. Approximately half of the area occupied by this unit contains water with greater than 10,000 mg/l NaCl. Values greater than 50,000 mg/l prevail in a large area of south-central Georgia.

SOURCE

Brown, P.M., Brown, D.L., Reid. M.S., and Lloyd. O.B., Jr., 1979, Evaluation of the geologic and hydrologic factors related to the waste-storage potential of Mesozoic aquifers in the southern part of the Atlantic Coastal Plain, South Carolina and Georgia: U.S. Geol. Survey Prof. Paper 1088, 37 p.





EXPLANATION

—1000— LINE OF EQUAL SODIUM CHLORIDE CONCENTRATION - Shows NaCl concentration in milligrams per liter (mg/l). Contour interval is variable.

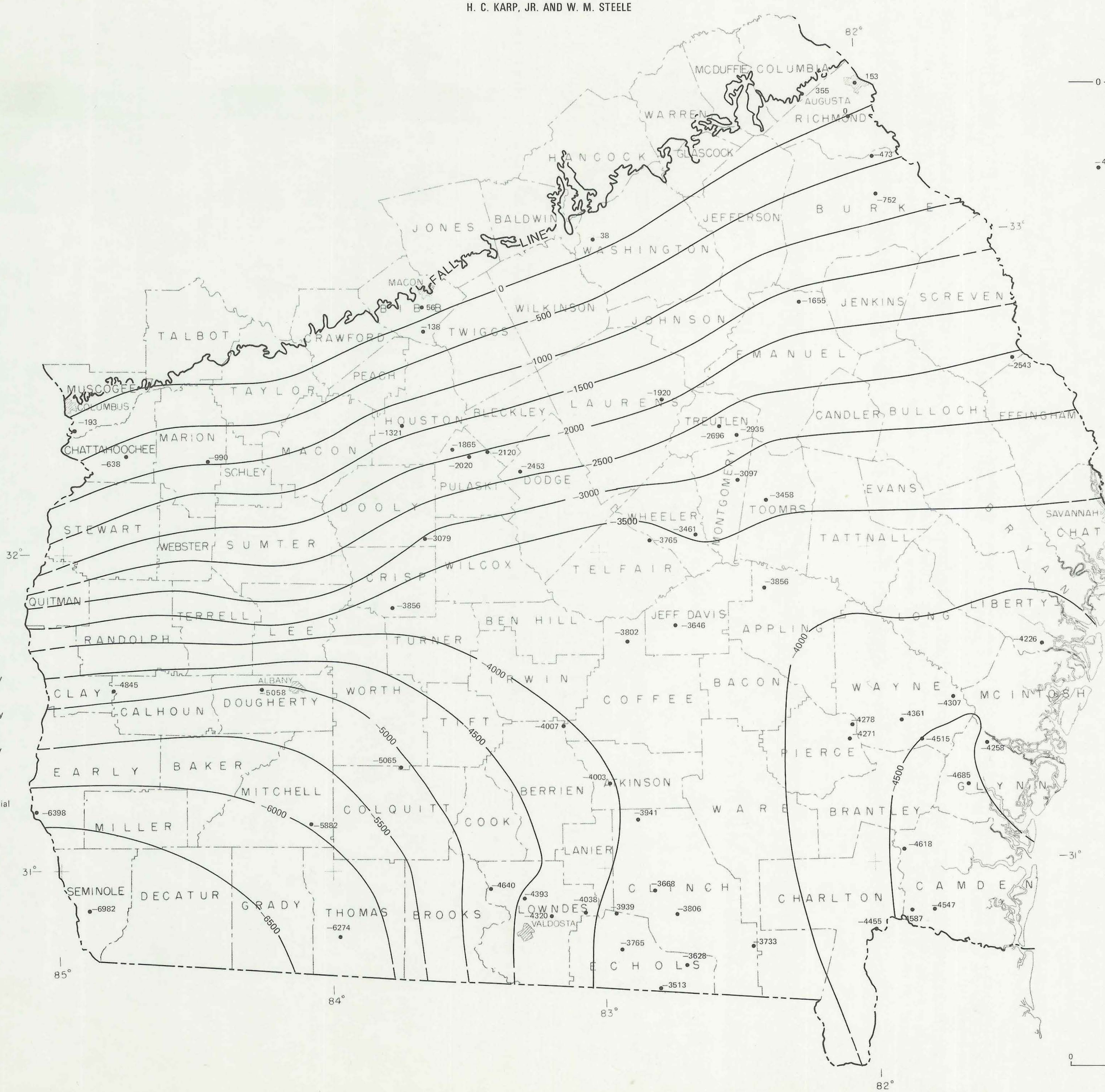
•600 WELL - Number is NaCl concentration in mg/l.

STRUCTURE-CONTOUR MAP OF THE PRE-CRETACEOUS UNCONFORMITY

H. C. KARP, JR. AND W. M. STEELE

The pre-Cretaceous "basement", which consists of crystalline and sedimentary rocks that range in age from Precambrian and early Paleozoic to Triassic, underlies a seaward-thickening wedge of Cretaceous to Quaternary strata. The "basement" is present below the coastal basin and crops out north of the Fall Line and forms the Piedmont Province.

The pre-Cretaceous unconformity descends rather evenly toward the south into two major depocenters called the Southeast Georgia Embayment and the Apalachicola (Southwest Georgia) Embayment, which are structurally low areas. The Southeast Georgia Basin and the Apalachicola Embayment are separated by a structural saddle known as the Central Georgia Uplift.

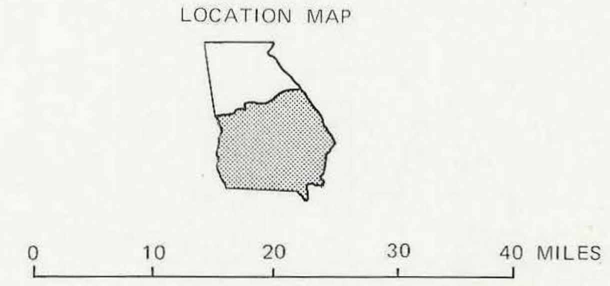


EXPLANATION

—0— — STRUCTURE CONTOUR - Shows elevation in feet of the pre-Cretaceous unconformity. Datum is mean sea level. Contour interval is 500 feet. Dashed where approximately located.

•-473 WELL - Number is elevation in feet.

LOCATION MAP



SOURCES

Applin, P.L., 1951, Preliminary report on buried pre-Mesozoic rocks in Florida and adjacent states: U.S. Geol. Survey Circ. 91, 28 p.

Brown, P.M., Brown, D.L., Reid, M.S., and Lloyd, O.B., Jr., 1979, Evaluation of the geologic and hydrologic factors related to the waste-storage potential of Mesozoic aquifers in the southern part of the Atlantic Coastal Plain, South Carolina and Georgia: U.S. Geol. Survey Prof. Paper 1088, 37 p.

Cramer, H.R., and Arden, D.D., 1980, Subsurface Cretaceous and Paleogene geology of the Coastal Plain of Georgia: Georgia Geol. Survey Open-file Report 80-8, 184 p.

Herrick, S.M., 1961, Well logs of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 70, 462 p.

Herrick, S.M., and Vorhis, R.C., 1963, Subsurface geology of the Coastal Plain: Georgia Geol. Survey Info. Circ. 25, 80 p.

Milton, C., and Hurst, V.J., 1965, Subsurface "basement" rocks of Georgia: Georgia Geol. Survey Bull. 76, 56 p.

Swanson, D.E., and Gernazian, A., 1979, Petroleum exploration wells in Georgia: Georgia Geol. Survey Info. Circ. 51, 67 p.

Unpublished data on file at the Georgia Geologic Survey, Atlanta.

Note: Some recent oil and gas wells were confidential at the time of publication and therefore were not used.