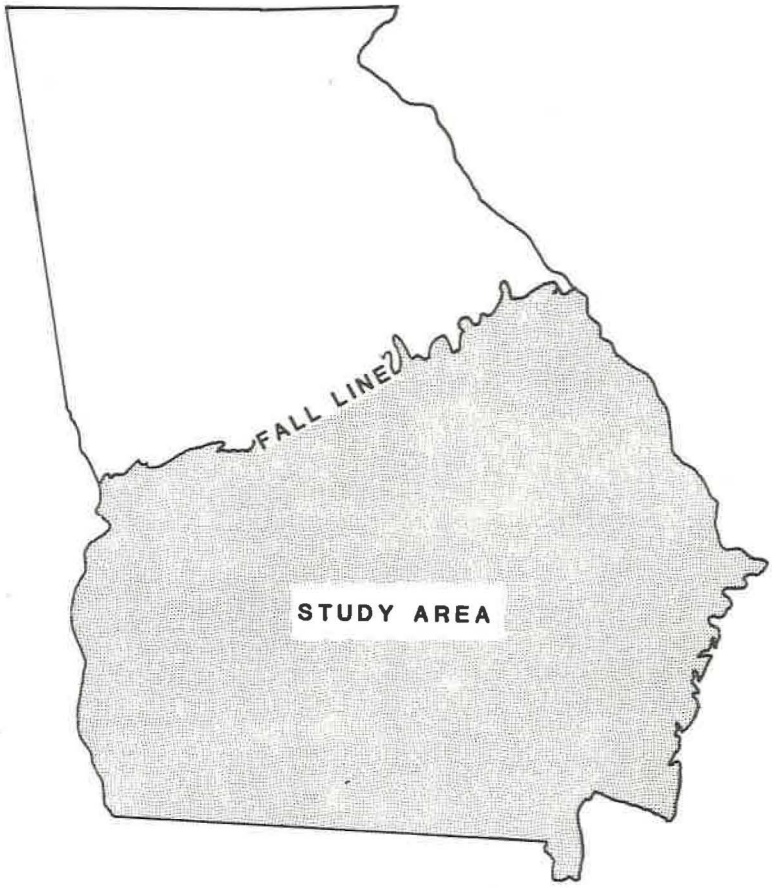
HYDROLOGIC ATLAS 14

# INTERPRETATION OF THE FRESHWATER/SALTWATER INTERFACE ZONE OF THE COASTAL PLAIN OF GEORGIA

J.A. Kellam

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# CONTOUR MAP OF THE 1000 PARTS PER MILLION CHLORIDE CONCENTRATION "INTERFACE" FOR THE COASTAL PLAIN OF GEORGIA

The contours on this map depict the surface of the conceptual fresh water/salt water interface in the Coastal Plain aquifers of Georgia. Data is plotted in feet below mean sea level. For the purpose of this study, "interface" is defined as the depth at which groundwater in the aquifer has a chloride concentration of approximately 1000 parts per million (ppm). The contouring of the interface represents the shallowest strata in which the chloride concentration exceeds 1000 ppm. The limit of 1000 ppm for fresh water comes from the definition of fresh water, in Davis and DeWiest (1966), as being less than or equal to 1000 ppm total dissolved solids. It is generally recognized that in most cases in the Coastal Plain of Georgia, when the total dissolved solids exceed 1000 ppm, the majority of solids are chlorides.

A total of 106 wells (data points) were used; 84 are geophysical log interpretations or calculations; 22 are water quality calculations. The data points were assessed by one or more of the following methods:

(1) Calculations involving the use of resistivity and sonic logs, as described by Brown (1971), and Schlumberger (1972, 1974);
(2) Interpretations by correlation with nearby wells, with either water quality information or reliable geophysical log suites;
(3) Actual chloride concentrations from a previous study by Brown et al. (1979);
(4) Empirical water quality data used to define the interface in a specific well (Grantham and Stokes, 1976; Gill and Mitchell, 1979; Clarke et al., 1985 and data on file at the Georgia Geologic Survey).

For each well, log calculations were performed three times. The numbers derived were averaged to obtain a mean. When the concentrations derived fell within 500± ppm of the mean, the mean was regarded as "reliable". For well logs from which reliable concentrations could not be calculated, the interface was estimated by correlation with the nearest well or wells.

There are relatively few wells in the Coastal Plain for which logs exist that could be used for this study, so a great deal of interpolation was necessary. Also log interpretations are estimations and therefore approximate rather than precise.

The contours presented on this map are not a continuous surface, but instead represent several Coastal Plain aquifers, each of which can vary in lithology, depth, thickness, hydraulic conductivity, and/or ground water chemistry across the study area. Overlying, less permeable, and potentially confining beds, which separate the interface zone from less saline strata, vary in thickness from a few feet in some wells to hundreds of feet in others.

Shallow expression of the interface occurs in the coastal area, around Savannah and Brunswick. Salt water is present in this area in the Floridan Aquifer System strata ranging from Oligocene to upper Cretaceous in age.

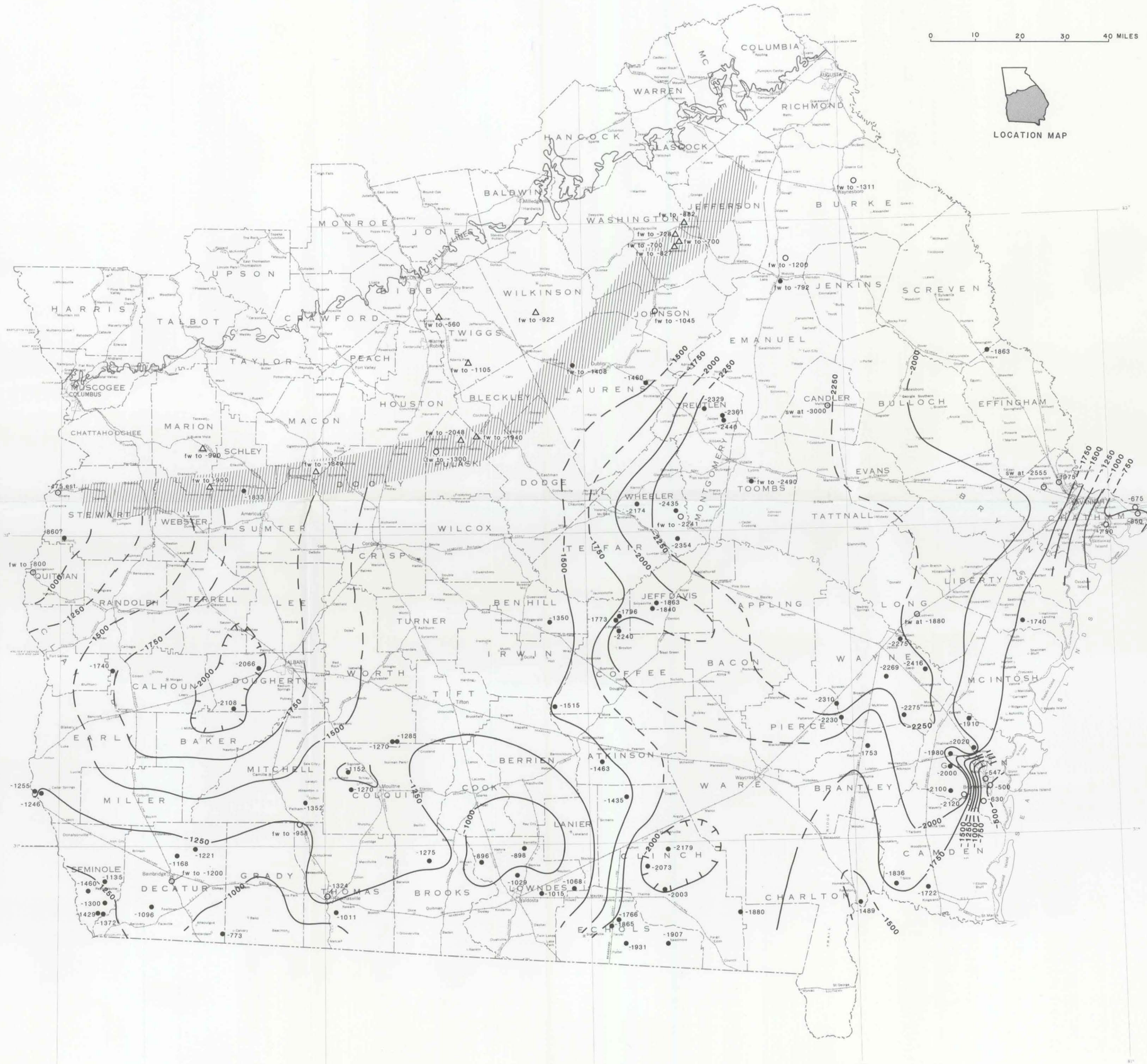
For the remainder of the Coastal Plain, with the exception of southwestern Georgia, the interface occurs in the Cretaceous Aquifer System. In the east-central portion of the Coastal Plain the interface is, in some counties, deeper than 2250 feet below sea level. The interface follows the general structural trend of the Cretaceous sediments, shallowing "up dip", to the northwest, but somewhat modified by a "low" centering on the Albany area.

In the southwestern portion of Georgia, chloride concentrations calculated to exceed 1000 ppm are found in aquifers of the Wilcox Group, Clayton Group, and Claiborne Formation in some locations at less than 1000 feet below sea level. These strata range in age from middle Eocene to Paleocene. The deepest calculated interface zone in this portion of the Coastal Plain is in the low area around Albany, at greater than 2000 feet below sea level.

In the northeastern Coastal Plain area, geophysical logs from wells as deep as 1300 feet below sea level are interpreted to show fresh water to total depth. The northeast-to-southwest trending zone (shown in hatches), south of the Fall Line, indicates the approximate boundary of the part of the Coastal Plain in which wells have penetrated crystalline units and/or Triassic "red beds". Interpretation of the geophysical logs from these wells show no salt water to be present throughout the Cretaceous and younger sedimentary formations overlying these Triassic and/or crystalline units. Saline water, however, does occur within Triassic sediments.

Although highly interpretative by its nature, this map can be used in conjunction with the map depicting the maximum known depth of fresh water, to estimate the approximate location of the intermediate zone in which ground-water quality varies from fresh to chloride contaminated.

Areas in which there is an overlap of contours on this plate and plate 2 can be explained by the approximate nature of the calculated picks and by the lack of definitive data in some of these areas.




## EXPLANATION

- -1863 — Location of well used as data source. Number is depth in feet below mean sea level. Based on chloride concentration estimate from log calculations, log pick or correlation to nearby well(s).
- -1975 — Location of well used as data source. Number is depth in feet below mean sea level. Based on water quality data.
- -860? — Question mark indicates limited confidence.
- —-2250-— Contour of fresh water/salt water interface (1000 ppm, approximately). Contour interval is 250 feet. Number is feet below mean sea level. Dashed where less certain.
- Hatchured zone is approximate southern boundary of that portion of the Coastal Plain where wells penetrating entire sequence of Coastal Plain sediments do not encounter interface.
- fw to -1105 — Location of well used as data source, in which entire sequence of Coastal Plain sediments is penetrated and in which no interface was identified.
- fw to -1045 — Fresh water found in well to depth shown. Interface not identified to total depth of well. Number is depth in feet below mean sea level.
- sw at -3000 — Salt water found in well at depth shown. Number is depth in feet below mean sea level. No information is available regarding chloride concentration up-hole.

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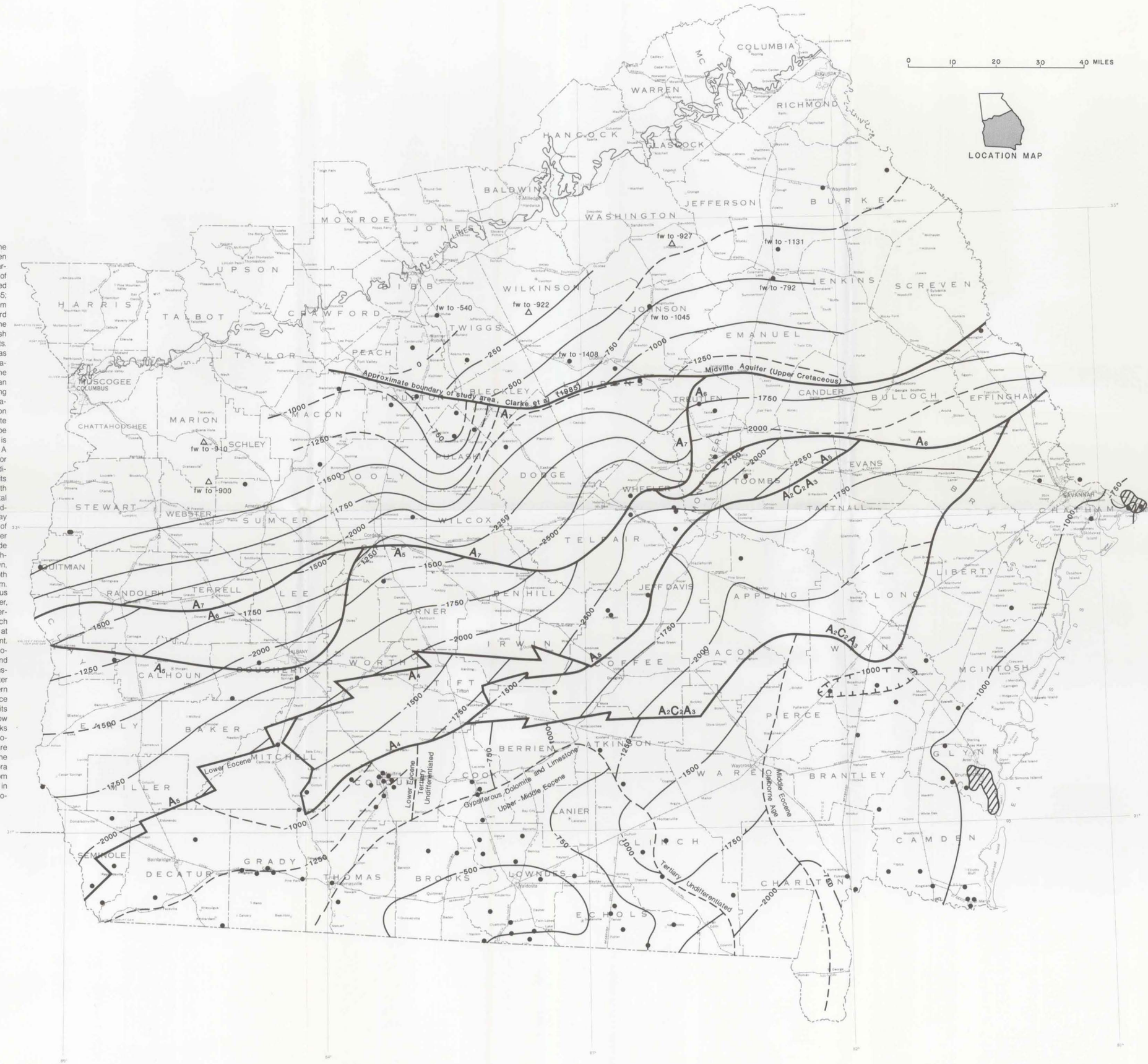
# CONTOUR MAP OF THE TOP OF THE DEEPEST FRESH WATER AQUIFERS UNDER THE COASTAL PLAIN OF GEORGIA

This map shows the known depth to the top of the deepest aquifer in which fresh water (fw) has been interpreted to occur in the Floridan Aquifer and various Cretaceous aquifers of the Coastal Plain of Georgia. These structure-contours were developed from existing data (Arora, 1984; Clarke et al. 1985; Miller, 1982; and Pollard and Vorhis, 1980; and from data filed at the Georgia Geologic Survey). Pollard and Vorhis (1980) have assessed that under the central and northern parts of the Coastal Plain, fresh water is present in Cretaceous-age sediments. Fresh water in the Cretaceous aquifers is defined as that formation water having a chloride concentration of 250 parts per million (ppm) or less. The contours on the map show the depth below mean sea level to the top of the deepest aquifer containing water that has an approximate chloride concentration of 250 ppm or less. Some of the data points on the map are labelled "Fw to -". These points indicate the maximum depth to which fresh water can be shown to exist. Below these depths, water quality is unknown. Two types of wells are represented. A number are relatively deep holes, usually oil and/or gas tests, which penetrated Coastal Plain sediments and were completed in either crystalline units or Triassic "red beds". For these wells the depth shown indicates the depth to the base of Coastal Plain sediments. In all of these wells the groundwater is fresh to this depth. Salt water, however, may occur in the Triassic sediments. The second type of wells are shallower water wells in which fresh water is found to the bottom of the well, with chloride concentrations of less than 250 ppm. For the northern portion of the map where these wells are shown, no information exists which could indicate the depth to chloride concentrations of greater than 250 ppm.

The paucity of wells penetrating the Cretaceous units, particularly for the deepest Cretaceous aquifer, $A_7$ (Pollard and Vorhis, 1980), prohibits the inference that fresh water extends to the base of each aquifer. What is shown is the maximum depth at which fresh water can be interpreted to be present.

For the southern portion of the Coastal Plain, chloride concentrations exceeding 250 ppm are found in Tertiary formations. In the Savannah and Brunswick areas, the Floridan Aquifer contains salt water at or near its top. For the balance of the southern portion of the Coastal Plain, fresh water occurrence extends down into Eocene-age formations, at its shallowest in the upper to middle Eocene-age low permeability formations in Lowndes and Brooks Counties, and at its deepest (lower Eocene/Paleocene?) in the formations of Charlton and Ware Counties. Information for the southern portion of the Coastal Plain was obtained from studies by Arora (1984) and Miller (1982) and, in some cases, from water quality data from deeper water wells in southwest Georgia (data filed at the Georgia Geologic Survey).




## EXPLANATION

- —1750— Contour of the top of the aquifer with the deepest documented occurrence of fresh water (less than or equal to 250 ppm). Number is depth below mean sea level. Dashed where uncertain.
- Approximate boundary, within each aquifer, separating fresh water from saline. Interface is 250 ppm chloride concentration. Serrated lines represent facies change within each unit from aquifer to non-aquifer lithology.
- fw to -922 △ Location of oil test well or water well used as data source in one or more of the studies referenced in compiling this map. Subscript notation indicates depth at which fresh water is found in that well. Number is total depth of well in feet below sea level.
- ● Location of oil test well used as data source in compiling this map, in which entire sequence of Coastal Plain sediments is penetrated, with chloride concentrations less than 250 ppm throughout sequence.
- Indicates area in which chloride concentration exceeds 250 ppm at or near the top of the Floridan Aquifer.
- "$A_7$" or "Claiborne Age." $A_2C_2A_3$, $A_4A_6$, $A_7$ are from Pollard and Vorhis (1980). Tertiary undifferentiated, lower Eocene, middle Eocene Claiborne, gypsiferous dolomite and limestone upper-middle Eocene, are from Miller (1982). Midville Aquifer is from Clarke et al. (1985).

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