GROUND-WATER QUALITY IN GEORGIA FOR 1988

by

Kenneth R. Davis

GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
GEORGIA GEOLOGIC SURVEY

CIRCULAR 12E

GROUND-WATER QUALITY IN GEORGIA FOR 1988

KENNETH R. DAVIS, PROJECT COORDINATOR
GROUND-WATER MANAGEMENT PROGRAM

The preparation of this report was financed in part through a grant from the U.S. Environmental Protection Agency under the provisions of Section 106 of the Federal Water Pollution Control Act of 1972, as amended.

GEORGIA DEPARTMENT OF NATURAL RESOURCES
LONICE C. BARRETT, COMMISSIONER

ENVIRONMENTAL PROTECTION DIVISION
HAROLD F. REHEIS, ASSISTANT DIRECTOR

GEORGIA GEOLOGIC SURVEY
WILLIAM H. McLEMORE, STATE GEOLOGIST

ATLANTA
1990

CIRCULAR 12E

TABLE OF CONTENTS

Section	Page
Introduction	1-1
Purpose and scope	1-1
Ground-water quality controls	1-1
Hydrogeologic provinces of Georgia	1-2
Regional ground-water quality problems	1-4
Georgia Ground-Water Monitoring Network	2-1
Monitoring stations	2-1
Uses and limitations	2-3
Analyses	2-4
Ground-water quality in Georgia - 1988	3-1
Overview	3-1
Cretaceous aquifer system	3-3
Providence aquifer system	3-7
Clayton aquifer system	3-11
Claiborne aquifer system	3-15
Jacksonian aquifer system	3-19
Floridan aquifer system	3-22
Miocene aquifer system	3-26
Piedmont/Blue Ridge unconfined aquifers	3-30
Valley and Ridge unconfined aquifers	3-35
Summary and conclusions	4-1
References cited	4-7
Appendix	
Analyses of samples collected during 1988 for the Georgia Ground Water Monitoring Network	A-1
Table A-1. - Standard water quality analysis: indicator parameters, Organic Screens #2 and #4, and ICP metal screen	A-2
Table A-2. - Additional water quality analyses: cyanide, mercury and Organic Screens #1,#3,#5 and #7	A-3
Table A-3. - Additional water quality analyses: Organic Screens #8 and #9	A-4
Table A-4. - Additional water quality analyses: Organic Screen #10	A-5

Section
Appendix (Continued)

	Page
Water quality analyses of the Cretaceous aquifer system	A-6
Water quality analyses of the Providence aquifer system	A-11
Water quality analyses of the Clayton aquifer system	A-12
Water quality analyses of the Claiborne aquifer system	A-14
Water quality analyses of the Jacksonian aquifer system	A-16
Water quality analyses of the Floridan aquifer system	A-18
Water quality analyses of the Miocene aquifer system	A-30
Water quality analyses of the Piedmont unconfined aquifers	A-32
Water quality analyses of the Blue Ridge unconfined aquifers	A-37
Water quality analyses of the Valley and Ridge unconfined aquifers	A-38

LIST OF ILLUSTRATIONS

Figure	3-1. - The seven major aquifer systems of the Coastal Plain Province	3-2
	3-2. - Water quality of the Cretacous aquifer system	3-5
	3-3. - Water quality of the Providence aquifer system	3-9
	3-4. - Water quality of the Clayton aquifer system	3-13
	3-5. - Water quality of the Claiborne aquifer system	3-17
	3-6. - Water quality of the Jacksonian aquifer system	3-20
	3-7. - Water quality of the Floridan aquifer system	3-24
	3-8. - Water quality of the Miocene aquifer system	3-28
	3-9. - Water quality of the Piedmont/Blue Ridge unconfined aquifers	3-32
	3-10.- Water quality of the Valley and Ridge unconfined aquifers	3-36

TABLES

Table	2-1. - Georgia Ground-Water Monitoring Network, 1988	2-2
	2-2. - Standard water quality analysis of the Ground-Water Monitoring Network - drinking-water limits from the Georgia Rules for Safe Drinking Water	2-6
	2-3A.- The significance of parameters of a basic water quality analysis, cations	2-7
	2-3B.- The significance of parameters of a basic water quality analysis, anions	2-8
	3-1. - Summary of ground-water quality analyses, Cretaceous aquifer system	3-6
	3-2. - Summary of ground-water quality analyses, Providence aquifer system	3-10

TABLES (Continued)

		Page
Table 3-3. -	Summary of ground-water quality analyses, Clayton aquifer system	3-14
3-4. -	Summary of ground-water quality analyses, Claiborne aquifer system	3-18
3-5. -	Summary of ground-water quality analyses, Jacksonian aquifer system	3-21
3-6. -	Summary of ground-water quality analyses, Floridan aquifer system	3-25
3-7. -	Summary of ground-water quality analyses, Miocene aquifer system	3-29
3-8. -	Summary of ground-water quality analyses, Piedmont unconfined aquifers	3-33
3-9. -	Summary of ground-water quality analyses, Blue Ridge unconfined aquifers	3-34
3-10.-	Summary of ground-water quality analyses, Valley and Ridge unconfined aquifers	3-37
4-1. -	Nitrite/nitrate concentrations measured in samples from select monitoring stations	4-3
4-2. -	Average value of indicator parameters, 1984-1988	4-4
4-3A.-	Contaminants and pollutants detected by the Ground Water Monitoring Network for south-central and southeastern Georgia	4-5
4-3B.-	Contaminants and pollutants detected by the Ground Water Monitoring Network for southwestern Georgia	4-5
4-3C.-	Contaminants and pollutants detected by the Ground Water Monitoring Network for northern Georgia	4-6

INTRODUCTION

PURPOSE AND SCOPE

This report is the fifth annual summary of ground-water quality in Georgia. These evaluations are one of the tools used by the Georgia Environmental Protection Division (EPD) to assess trends in the State's ground-water resources. EPD is the State organization with regulatory responsibility for maintaining and, where possible, improving ground-water quality and availability.

Analyses of water samples collected for the Georgia Ground-Water Monitoring Network during calendar year 1988 and from previous years are the data base for this summary. Representative water samples were collected from 115 wells and springs in 1988. A review of the 1988 data, and comparison of these data with analyses of samples collected as early as 1984, indicates that ground-water quality at these 115 sampling sites generally has changed little and remains excellent.

GROUND-WATER QUALITY CONTROLS

The quality of water from a well is the end result of complex physical and bio-chemical processes. Some of the more significant controls are the nature of the water entering the ground-water flow system, the reactions of infiltrating water with the soils and rocks that are encountered, and the effects of the well/pump system.

Most water enters the ground-water system in upland recharge areas. Water seeps through interconnected pores and joints in the soils and rocks until it is discharged to a surface-water body (e.g., stream, river, lake or ocean). The chemistry and amount of recharging water and

the attenuation capacity of soils have a strong influence on the nature of ground water in recharge areas. Chemical interaction of water with the aquifer host rocks has an increasing significance with longer underground residence times. Ground water from discharge areas tends to be more highly mineralized than ground water in recharge areas as a result.

The well/pump system can have a strong imprint on the quality of the well water. Well casings can contribute metals (e.g., iron) and organic compounds (e.g., tetrahydrofuran) to the water. Pumps often aerate the water being discharged. Improperly constructed wells, on the other hand, can present a conduit for local pollution to enter the ground-water flow system.

HYDROGEOLOGIC PROVINCES OF GEORGIA

General geologic properties define three hydrogeologic provinces in Georgia. They are the Coastal Plain Province of southern Georgia; the Piedmont/Blue Ridge Province, occupying most of northern Georgia; and the Valley and Ridge/Cumberland Plateau Province of northwestern Georgia. Ground water in the Coastal Plain Province flows through interconnected granular pore space in the host rocks and through solution-enlarged voids. Fractures and geologic discontinuities provide the permeability for ground-water flow in the Piedmont/Blue Ridge Province. The permeable features of the Valley and Ridge/Cumberland Plateau Province are principally fractures and solution voids; intergranular porosity also is important in some places.

Georgia's Coastal Plain Province is composed of a wedge of loosely consolidated sediments that gently dip and thicken to the south and

southeast. The oldest outcropping sedimentary formations (Cretaceous) are exposed along the Fall Line, which is the northern limit of the Coastal Plain Province. Successively younger formations occur at the surface to the south and southeast.

The Coastal Plain contains the State's major confined (artesian) aquifers. Confined aquifers are those which are overlain by a layer of impermeable material (e.g., clay or shale) and contain water at greater-than-atmospheric pressures. Water enters the aquifers in their updip outcrop areas where the permeable rocks of the aquifer are exposed. Ground-water flow through these aquifers is generally to the south and southeast, in the direction of dip of the rocks.

Rocks forming the seven major confined aquifers in the Coastal Plain range in age from Cretaceous to Miocene. Horizontal and vertical changes in the permeability of the rock units that form these aquifers and the quality of ground water they contain determine the thickness and extent of the aquifers. Several aquifers may be present in a single geographic area, forming a vertical 'stack.'

The Cretaceous and Jacksonian aquifer systems (primarily sands) are a common source of drinking water within a 35-mile wide band that lies adjacent to and south of the Fall Line. Southwestern Georgia relies on four vertically stacked aquifers (sands and carbonates) for drinking-water supplies: the Providence, Clayton, Claiborne and Floridan aquifer systems. A large area of south-central and southeastern Georgia is served by the Floridan aquifer system (primarily carbonates). The Miocene aquifer system (sands and carbonates) is the principal 'shallow' unconfined aquifer system occurring in the broad area underlain by the Floridan aquifer system. It becomes confined in the coastal counties

and locally in the Grady-Thomas-Brooks-Lowndes Counties area.

Crystalline rocks of metamorphic and igneous origin (primarily Paleozoic) underlie the Piedmont/Blue Ridge Province. The principal water-bearing features are fractures and other geologic discontinuities in the rock as well as the overlying soil/saprolite horizons. Thick soils and saprolites are often important as the 'reservoir' to the water-bearing fracture/joint systems. Ground-water typically flows from local highlands towards discharge areas along streams. However, during prolonged dry periods or in the vicinity of heavy pumpage, ground water may flow from the streams into the fracture/joint systems.

The Valley and Ridge/Cumberland Plateau Province is underlain by consolidated Paleozoic sedimentary formations. Ground-water and surface-water systems are locally closely interconnected. Dolostones and limestones of the Knox Group are the principal aquifers where they occur in the axes of broad valleys. The greater permeabilities of the thick carbonate sections in this Province, in part due to solution-enlarged joints, permit development of more extensive aquifer systems than in the Piedmont/Blue Ridge Province.

REGIONAL GROUND-WATER QUALITY PROBLEMS

Data from ground-water investigations in Georgia, including the Ground-Water Monitoring Network, indicate that virtually all of Georgia has shallow ground water suitable for domestic supply. Iron and manganese are the only constituents that occur routinely in concentrations exceeding drinking-water standards. These two naturally occurring metals can cause staining of objects but do not pose a health risk.

Only a few occurrences of polluted or contaminated ground waters are known from north Georgia. Aquifers in the outcrop areas of Cretaceous sediments south of the Fall Line typically yield acidic water that may require treatment. The acidity is naturally occurring and results from the inability of the sandy aquifer sediments to buffer acidic rainwater and acid-producing reactions between infiltrating water and soils and sediments. Nitrite/nitrate concentrations in ground water from the karstic areas of both southwestern and northwestern Georgia are within drinking-water standards but are somewhat higher than levels found in other areas of the State.

The Floridan aquifer system includes two areas of naturally occurring reduced ground-water quality in addition to its karstic plain in southwestern Georgia. The Gulf Trough, a narrow, linear geologic feature extending from southwestern Decatur County through central Bulloch County, typically yields water with high total dissolved solids concentrations. Elevated levels of barium, sulfate and radionuclides are common in ground water from the Gulf Trough. High levels of total dissolved solids also are common to the lower section of the Floridan aquifer system along the Georgia coast. Ground-water withdrawals have allowed upconing of brine from deeper parts of the aquifer in the Brunswick area.

GEORGIA GROUND-WATER MONITORING NETWORK

MONITORING STATIONS

Stations of the Ground-Water Monitoring Network include all seven major aquifer systems of the Coastal Plain Province and unconfined ground-water systems of the Piedmont and Blue Ridge Provinces and the Valley and Ridge Province (Table 2-1). Monitoring stations are located in three critical settings:

(a) areas of surface recharge,

(b) other areas of potential pollution related to regional activities (agricultural and industrial areas) and

(c) areas of significant ground-water use.

The majority of monitoring stations are municipal and industrial wells that have reliable well-construction data. The Monitoring Network also includes monitoring wells in specific areas where the State's aquifers are recognized to be susceptible to contamination or pollution (e.g., the Dougherty Plain of southwestern Georgia and the State's coastal area). These monitoring wells are maintained jointly by the Georgia Geologic Survey and the U.S. Geological Survey.

During 1988 and 1989, 22 shallow wells located in agricultural areas of the Coastal Plain Province were added to the Monitoring Network to better assess the threat of pesticides to ground-water quality. Most of the wells are the source of domestic drinking-water supplies. The program of pesticides analysis also was expanded for two previous monitoring wells.

Table 2-1. - Georgia Ground-Water Monitoring Network, 1988

AQUIFER SYSTEM	NUMBER OF MONITORING STATIONS	PRIMARY STRATIGRAPHIC EQUIVALENTS	AGE OF AQUIFER FORMATIONS
Miocene	4	Altamaha Formation and Hawthorne Group	Miocene
Floridan	41	Suwannee Limestone, Ocala Group, Bridgeboro Limestone and Claibornian Carbonates	Oligocene to Middle Eocene
Jacksonian	6	Barnwell Group	Late Eocene
Claiborne	7	Tallahatta Formation	Middle Eocene
Clayton	7	Clayton Formation	Paleocene
Providence	3	Providence Sand	Late Cretaceous
Cretaceous	18	Ripley Formation, Cusseta Sand, Blufftown Formation, Eutaw Formation, and Tuscaloosa Formation	Late Cretaceous
Piedmont	16	New Georgia Group, Sandy Springs Group, Laura Lake Mafic Complex, Austell Gneiss, Sand Hill Gneiss, Mulberry Rock Gneiss, Atlanta Group and Lithonia Gneiss	Predominately Paleozoic
Blue Ridge	4	Corbin Gneiss Complex, Snowbird Group, Walden Creek Group, Great Smoky Group and Murphy Marble Belt Group	Predominately Paleozoic
Valley and Ridge	9	Rome Formation, Conasauga Group, Knox Group, Chickamauga Group and Floyd Shale	Predominately Paleozoic

USES AND LIMITATIONS

Regular sampling of wells and springs of the Ground-Water Monitoring Network permits analysis of ground-water quality with respect to location (spatial trends) and with respect to the time of sample collection (temporal trends). Spatial trends are useful for assessing the effects of the geologic framework of the aquifer on ground-water quality. Temporal trends permit an assessment of the effects of rainfall and drought periods on ground-water quantity and quality. Both trends are useful for the detection of nonpoint source pollution. Examples of nonpoint source pollution include acid rain and regional land-use activities (e.g., urban, agricultural or forest lands).

However, it should be noted that the data of the Ground-Water Monitoring Network are representative of water quality in only limited areas of the State. Monitoring water quality at 115 sites located throughout the State provides an indication of ground-water quality at those depths and in those areas sampled. Caution should be exercised in drawing broad conclusions and applying any results reported in this study to ground waters that are not being monitored.

Stations of the Ground-Water Monitoring Network are purposely located distant from known point sources of pollution. The stations provide baseline data on ambient water quality in Georgia. EPD requires other forms of ground-water monitoring for activities that may result in point source pollution (e.g., landfills, hazardous waste facilities and land application sites) through its environmental facilities permit programs.

Ground-water quality often changes gradually and predictably in the areally extensive aquifers of the Coastal Plain Province. The

Monitoring Network allows for some definition of the chemical processes occurring in large confined aquifers. Unconfined aquifers in northern Georgia and the surface recharge areas of southern Georgia are comparatively small and more open to interactions with land-use activities. The coarse spacing of monitoring stations does not permit equal characterization of water-quality processes in all of these settings. Water quality of monitoring stations in unconfined aquifers represents only the general nature of ground water. The ground water of the surface recharge areas of southern Georgia aquifers, on the other hand, is the future drinking-water resource for down-flow areas. Monitoring stations in these recharge areas, in effect, constitute an early warning system.

ANALYSES

Analyses are available for 151 water samples collected during 1988 from 112 wells and three springs. Annual analyses of water samples from 29 wells span five years with the addition of the 1988 data. For 1984, the first year of the Ground-Water Monitoring Network, hydrogeologists sampled water from 39 wells located in the Piedmont, Blue Ridge, and Coastal Plain Provinces. Water samples were collected state-wide from 84 wells and three springs in 1985; 125 wells and three springs in 1986; and 123 wells and three springs in 1987.

EPD's concern over pesticides in ground water warranted the addition of 22 shallow wells as monitoring stations and an expanded pesticides analysis program for samples from two other Monitoring Network wells during 1988 and 1989. The increased number of monitoring stations necessitated a reduction in the frequency of sample collection from some of the other

Monitoring Network wells, especially those located in confined aquifers of south-central and coastal Georgia. Three of the recently added wells were sampled during 1988.

Ground water from all monitoring stations is tested for the basic quality parameters included in the Monitoring Network's standard analysis: pH, specific conductivity, chloride, sulfate, nitrite/nitrate, twelve common pesticide and industrial organic compounds and thirty metals (Table 2-2). Where regional land-use activities have the potential to affect ground-water quality in the vicinity of a monitoring station, additional parameters are tested. These additional chemical screens are listed in the appendix. Tables 2-3A and 2-3B summarize the significance of the common major constituents of a water quality analysis.

In-place pumps are used whenever possible to purge wells and collect water samples. Using these pumps minimizes the potential for cross-contamination of wells. Some wells that are included in the Ground-Water Monitoring Network are continuous water-level monitoring stations and do not have dedicated pumps. A two horse-power electric submersible pump and a PVC hand pump are the principal portable purge-and-sampling devices used.

Sampling procedures are adapted from techniques used by the U.S. Geological Survey and the U.S. Environmental Protection Agency. Hydrogeologists purge the wells prior to the collection of a sample to minimize the influence of the well and the pump/distribution system on water quality. Municipal, industrial and domestic wells typically require 45 minutes of purging prior to sample collection. Wells without dedicated pumps often require much longer periods of purging.

Table 2-2. - Standard water quality analysis of the Ground-Water Monitoring Network - drinking-water limits from the Georgia Rules for Safe Drinking Water

Parameter*		Drinking-Water Standard (Where Applicable)
pH	S.U.	--
Spec. Cond.	umho/cm	--
Chloride	mg/L	250
Sulfate	mg SO4/L	250
Nitrite/nitrate	mg N/L	10
ORGANIC SCREEN #2		
Dicofol	ug/L	--
Endrin	ug/L	0.2
Lindane	ug/L	4
Methoxychlor	ug/L	100
PCB's	ug/L	--
Permethrin	ug/L	--
Toxaphene	ug/L	5
ORGANIC SCREEN #4		
2,4-D	ug/L	100
Acifluorfen	ug/L	--
Chloramben	ug/L	--
Silvex	ug/L	10
Trichlorfon	ug/L	--
ICP SCREEN		
Calcium	mg/L	--
Magnesium	mg/L	--
Potassium	mg/L	--
Sodium	mg/L	--

Parameter*		Drinking-Water Standard (Where Applicable)
ICP SCREEN, Cont.		
Aluminum	ug/L	--
Antimony	ug/L	--
Arsenic	ug/L	50
Barium	ug/L	1,000
Beryllium	ug/L	--
Bismuth	ug/L	--
Cadmium	ug/L	10
Chromium	ug/L	50
Cobalt	ug/L	--
Copper	ug/L	1,000
Gold	ug/L	--
Iron	ug/L	300
Lead	ug/L	50
Manganese	ug/L	50
Molybdenum	ug/L	--
Nickel	ug/L	--
Selenium	ug/L	10
Silver	ug/L	50
Strontium	ug/L	--
Thallium	ug/L	--
Tin	ug/L	--
Titanium	ug/L	--
Vanadium	ug/L	--
Yttrium	ug/L	--
Zinc	ug/L	5,000
Zirconium	ug/L	--

*S.U. = standard units,
umho/cm = micromhos/centimeter,
mg/L = milligrams/liter (parts per million),
ug/L = micrograms/liter (parts per billion)

Table 2-3A. - The significance of parameters of a basic water quality analysis, cations (Wait, 1960)

PARAMETER(S)	SIGNIFICANCE
pH (Hydrogen ion concentration)	pH is a measure of the concentration of the hydrogen ion. Values of pH less than 7.0 denote acidity and values greater than 7.0 indicate alkalinity. Corrosiveness of water generally increases with decreasing pH. However, excessively alkaline waters may also attack metals. A pH range between 6.0 and 8.5 is considered acceptable.
Calcium and magnesium*	Calcium and magnesium cause most of the hardness of water. Hard water consumes soap before a lather will form and deposits scale in boilers, water heaters and pipes. Hardness is reported in terms of equivalent calcium carbonate. The hardness of a water can be estimated by multiplying the parts per million of calcium by 2.5 and that of magnesium by 4.1.

Water Class	Hardness (parts per million)
Soft	Less than 60
Moderately Hard	60 to 120
Hard	121 to 180
Very Hard	More than 180

Sodium and potassium*	Sodium and potassium have little effect on the use of water for most domestic purposes. Large amounts give a salty taste when combined with chloride. A high sodium ratio may limit the use of water for irrigation.
Iron and manganese	More than 300 parts per billion of iron stains objects red or reddish brown and more than 50 parts per billion of manganese stains objects black. Larger quantities cause unpleasant taste and favor growth of iron bacteria but do not endanger health.

*Major alkali metals present in most ground waters.

Table 2-3B. - The significance of parameters of a basic water quality analysis, anions (Wait, 1960)

PARAMETER(S)	SIGNIFICANCE
Sulfate	Sulfate in hard water increases the formation of scale in boilers. In large amounts, sulfate in combination with other ions imparts a bitter taste to water. Concentrations above 250 parts per million have a laxative effect, but 500 parts per million is considered safe.
Chloride	Chloride salts in excess of 100 parts per million give a salty taste to water. Large quantities make the water corrosive. Water that contains excessive amounts of chloride is not suitable for irrigation. It is recommended that chloride content should not exceed 250 parts per million.
Nitrite/nitrate	Concentrations much greater than the local average may suggest pollution. Excessive amounts of nitrogen in drinking or formula water of infants may cause a type of methemoglobinemia ("blue babies"). Nitrite/nitrate nitrogen in concentrations greater than 10 parts per million is considered to be a health hazard.

Hydrogeologists monitor water quality parameters prior to sample collection. Measurements of pH, dissolved oxygen content, specific conductivity, temperature and ionic potential are observed using field instruments. The instruments are mounted in a manifold that captures flow at the pump system discharge point before the water is exposed to atmospheric conditions. Typical trends include a lowering of pH, dissolved oxygen content, specific conductivity, and a transition towards the mean annual air temperature with increasing time of purging. The hydraulic flow characteristics of unconfined aquifers and pump effects often alter these trends.

Samples are collected once the parameters being monitored in the field stabilize or otherwise indicate that the effects of the well have been minimized. Files at the Georgia Geologic Survey contain records of the field measurements. The sample bottles are immediately placed in an ice water bath after they are filled to preserve the water quality. After one to two hours, the bottles are transferred to a dry cooler, refrigerated with an ice tray. The hydrogeologists transport the samples to the laboratories for analysis on or before the Friday of the week in which they are collected. EPD laboratories in Atlanta perform all analyses except for some organic chemical screens. The Agricultural Services Laboratory of the Cooperative Extension Service at the University of Georgia in Athens performs these organic screens.

GROUND-WATER QUALITY IN GEORGIA - 1988

OVERVIEW

Georgia's aquifers are grouped into nine major aquifer systems for the purpose of this report. Seven of the major aquifer systems lie in the Coastal Plain Province and are specific to both region and depth because of their three-dimensional geologic framework (Figure 3-1). These major aquifer systems in many cases incorporate smaller aquifers that are locally confined. The two major aquifer systems of northern Georgia are defined by hydrogeologic province. Small-scale local ground-water flow systems that are constrained by land topography predominate in northern Georgia. Deeper regional flow systems are less well developed in northern Georgia than in the Coastal Plain Province because of the discontinuous nature of their permeable features.

The following sections outline spatial and temporal trends that are apparent from the data of the Ground-Water Monitoring Network. An increase of nitrite/nitrate concentrations in many areas of the State is the only temporal trend that is apparent from the analyses. Nitrite/nitrate levels, however, have never exceeded drinking-water limits in any of the samples collected for the Ground-Water Monitoring Network through 1988. Because state-wide monitoring has been ongoing only for a few years, the increase in nitrite/nitrate concentrations can not be attributed to any specific origin or cause. That is, while concentrations have been increasing over the time period of sampling, the long-term effect or significance of these increases is unknown.

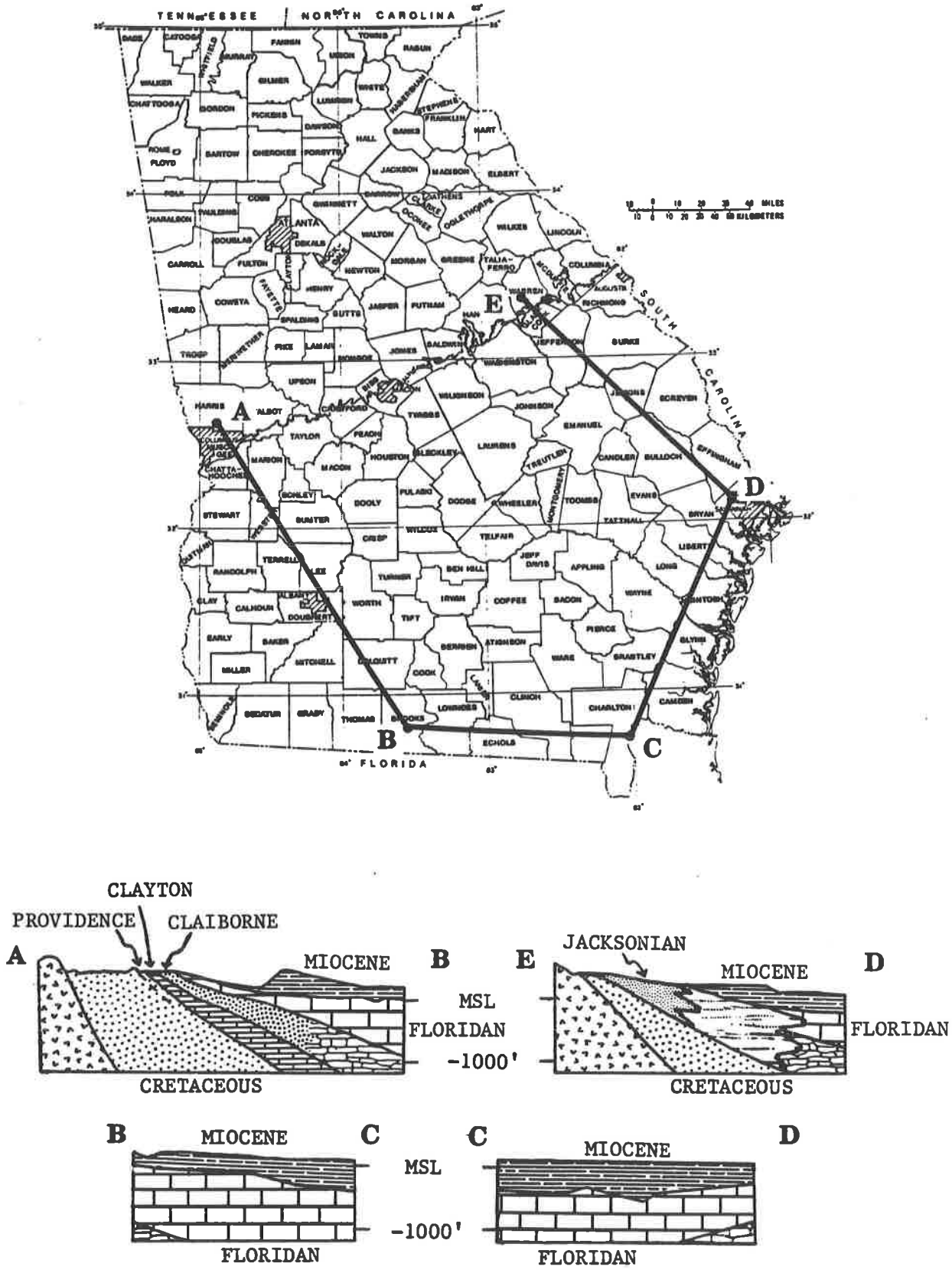


Figure 3-1. - The seven major aquifer systems of the Coastal Plain Province

CRETACEOUS AQUIFER SYSTEM

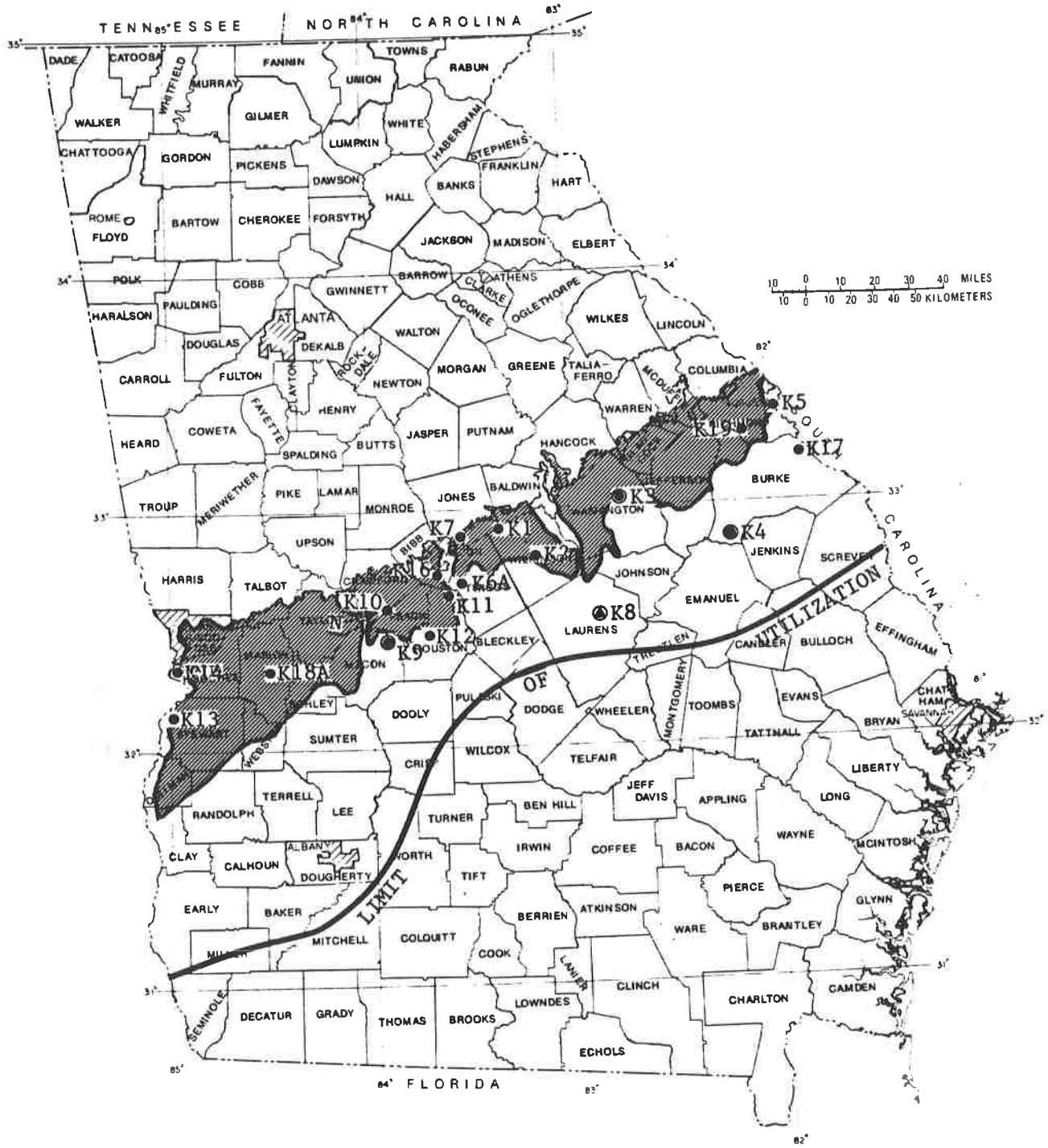
The Cretaceous aquifer system is a complexly interconnected group of aquifer subsystems consisting of the Late Cretaceous sands of the Coastal Plain Province. These sands form an extensive outcrop/recharge area immediately south of the Fall Line in west and central Georgia (Figure 3-2). Overlying sediments restrict Cretaceous outcrops to valley bottoms in parts of the northeastern Coastal Plain. Five distinct subsystems of the Cretaceous aquifer system, including the Providence aquifer system, are recognized west of the Ocmulgee River (Pollard and Vorhis, 1980). These merge into three subsystems to the east (Clarke, et al., 1985). Aquifer sands thicken southward from the Fall Line, where they pinch out against crystalline Piedmont rocks, to a sequence of sand and clay approximately 2,000 feet thick at the southern limits of the main aquifer-use area. Leakage from adjacent members of the aquifer system provides significant recharge in downdip areas.

Water quality of the Cretaceous aquifer system, other than the Providence aquifer system which is discussed separately in this report, was monitored in 18 wells (Table 3-1). These included fifteen updip-area wells located in or adjacent to outcrop and surface recharge areas across the State and three downdip-area wells located in Burke and Laurens Counties.

Water from the updip-area wells was typically acidic, to the point of being corrosive, and soft. The two outcrop-area wells adjacent to the Chattahoochee River yielded basic water. Iron and manganese concentrations were commonly below detection limits. Water from the downdip-area wells ranged from slightly acidic to basic and from soft

to moderately hard. High iron and manganese levels were present in water samples from two of the three wells. The major alkali metals (calcium, magnesium, potassium and sodium) and the trace metals (aluminum, barium, copper, strontium and zinc) were the other cations common to the Cretaceous aquifer system water samples.

Chloride and sulfate levels were low, less than 15 parts per million, in all samples. Sulfate concentrations were generally higher in samples from the two wells in the Chattahoochee River area and wells located in confined areas of the aquifer system. Water samples from twelve of the updip-area wells and two of the downdip-area wells contained detectable levels of nitrite/nitrate. This marks the first observation of trace levels of nitrite/nitrate in the downdip-area wells. Highest values, 0.23 to 1.2 parts per million were measured in samples from five updip-area wells in middle Georgia and in a Richmond County well. Nitrite/nitrate levels were generally greater than concentrations measured in 1987 in water samples from these same wells. Trihalomethane compounds were present in one of two samples collected from a Perry, Houston County, well. These compounds typically originate as degradation products of chlorine-treated water which is getting into the well through the pumping system.



○ Iron and/or manganese concentrations exceed Drinking-Water Limits
N Nitrite/nitrate concentrations exceed 0.45 parts per million
● Soft water
▲ Moderately hard water
▨ General recharge area (from Davis, et al., 1988)

Figure 3-2. - Water quality of the Cretaceous aquifer system

Table 3-1. - Summary of ground-water quality analyses, Cretaceous aquifer system

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988			1984 - 1987		
	24 ANALYSES			78 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	4.1	5.7	8.2	3.9	5.8	9.2
CALCIUM Ca (ppm)	0.4	4	26	0.3	4	37
MAGNESIUM Mg (ppm)	0.2	0.4	1.7	0.0	0.4	2.1
SODIUM Na (ppm)	1.0	7	55	0.9	11	85
POTASSIUM K (ppm)	<0.5	0.6	4.5	<0.5	1	5.7
IRON Fe (ppb)	<10	442	4100	<10	375	4580
MANGANESE Mn (ppb)	<10	11	160	<10	<10	220
CHLORIDE Cl (ppm)	1.2	4	14	1.0	4	14
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<0.02	0.2	1.2	<0.02	0.2	1.1
SULFATE SO_4 (ppm)	<2	5	12	<2	3	15

*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

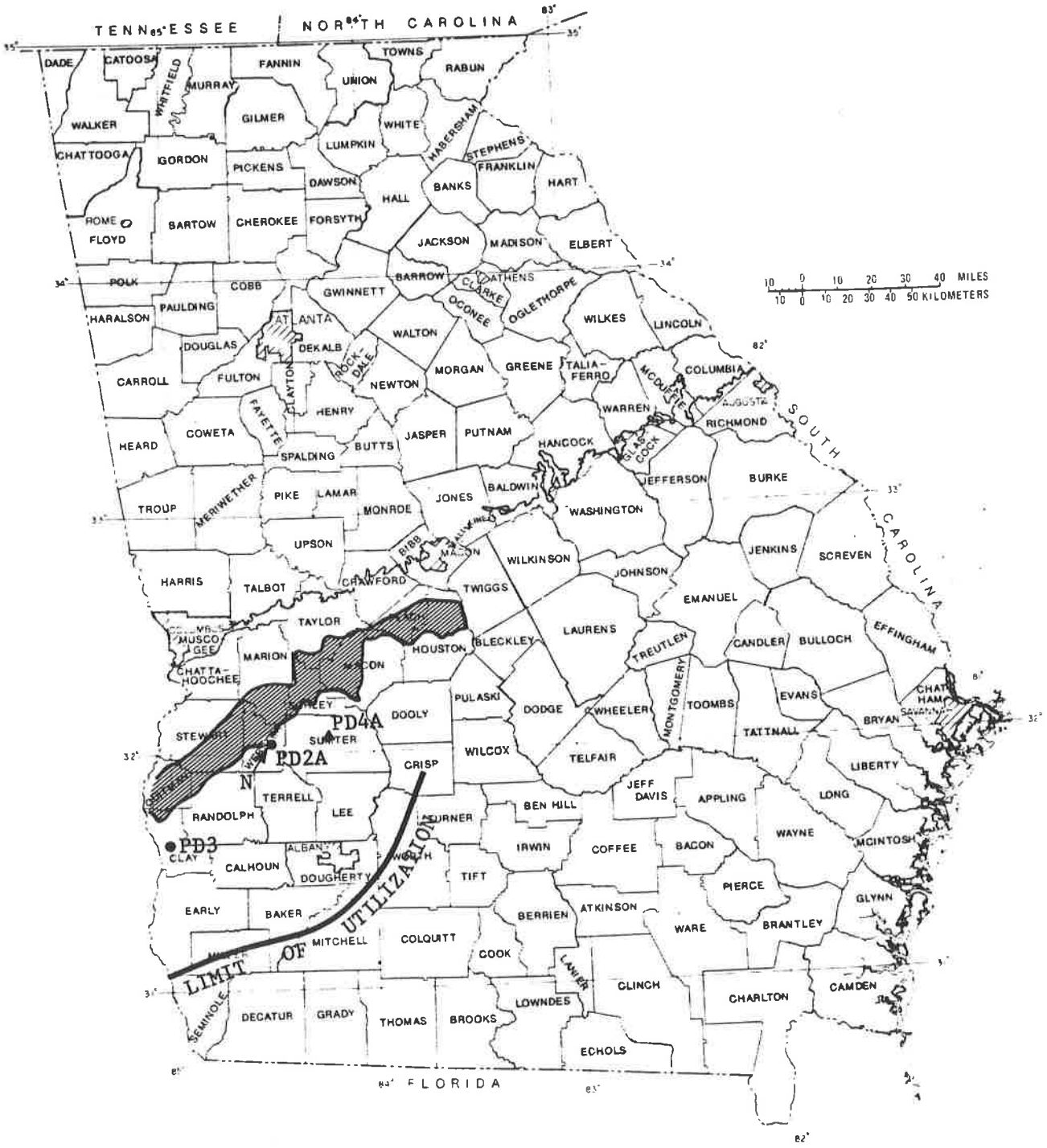
PROVIDENCE AQUIFER SYSTEM

Sand and coquinoid limestone of the Late Cretaceous Providence Formation comprise the Providence aquifer system of southwestern Georgia. Outcrops of the aquifer system extend from northern Clay and Quitman Counties through eastern Houston County (Figure 3-3). In its updip extent, the aquifer system thickens both to the east and to the west of a broad area adjacent to the Flint River. Areas of greater-than-300-feet thickness are known in Pulaski County and projected in the Baker-Calhoun-Early Counties area (Clarke, et al., 1983).

The permeable Providence Formation-Clayton Formation interval forms a single aquifer east of the Flint River (Clarke, et al., 1983). This same interval is recognized as the Dublin aquifer system to the east of the Ocmulgee River (Clarke, et al., 1985). Outcrop areas and adjacent covered areas to the east of the Flint River, where the aquifer is overlain by permeable sand units, are surface recharge areas. The Chattahoochee River forms the western discharge boundary for this flow system in Georgia.

Water quality in the Providence aquifer system was monitored in one outcrop-area well and in two updip-area wells where the system is confined (Table 3-2). Water from the outcrop-area well was slightly acidic and soft. The wells of the updip confined areas yielded water that was basic and soft to moderately hard. Iron and manganese levels were below drinking-water maximums in the water samples from all three wells. Calcium, magnesium, potassium, sodium and strontium were the only other cations that were commonly detected.

Chloride and sulfate concentrations were low, less than 16 parts per million, in all samples. Minor nitrite/nitrate levels were present in the water samples from two wells.



N Nitrite/nitrate concentrations exceed 0.45 parts per million
• Soft water
▲ Moderately hard water
▨ General recharge area (from Davis, et al., 1988)

Figure 3-3. - Water quality of the Providence aquifer system

Table 3-2. - Summary of ground-water quality analyses, Providence aquifer system

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988 3 ANALYSES			1985 - 1987 13 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	6.2	7.1	7.6	5.7	7.7	9.1
CALCIUM Ca (ppm)	6.1	16	36	5.5	14	38
MAGNESIUM Mg (ppm)	0.5	1.3	2.2	0.5	1.1	2.2
SODIUM Na (ppm)	1.6	34	97	1.3	44	85
POTASSIUM K (ppm)	0.95	1.6	2.4	0.8	1.6	2.9
IRON Fe (ppb)	<10	44	105	12	280	1870
MANGANESE Mn (ppb)	<10	8	23	<10	<10	26
CHLORIDE Cl (ppm)	3.0	7	11	1.5	6	12
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<0.1	0.3	0.85	<0.02	<0.16	0.76
SULFATE SO_4 (ppm)	2.8	10	16	<2	7	15

*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

CLAYTON AQUIFER SYSTEM

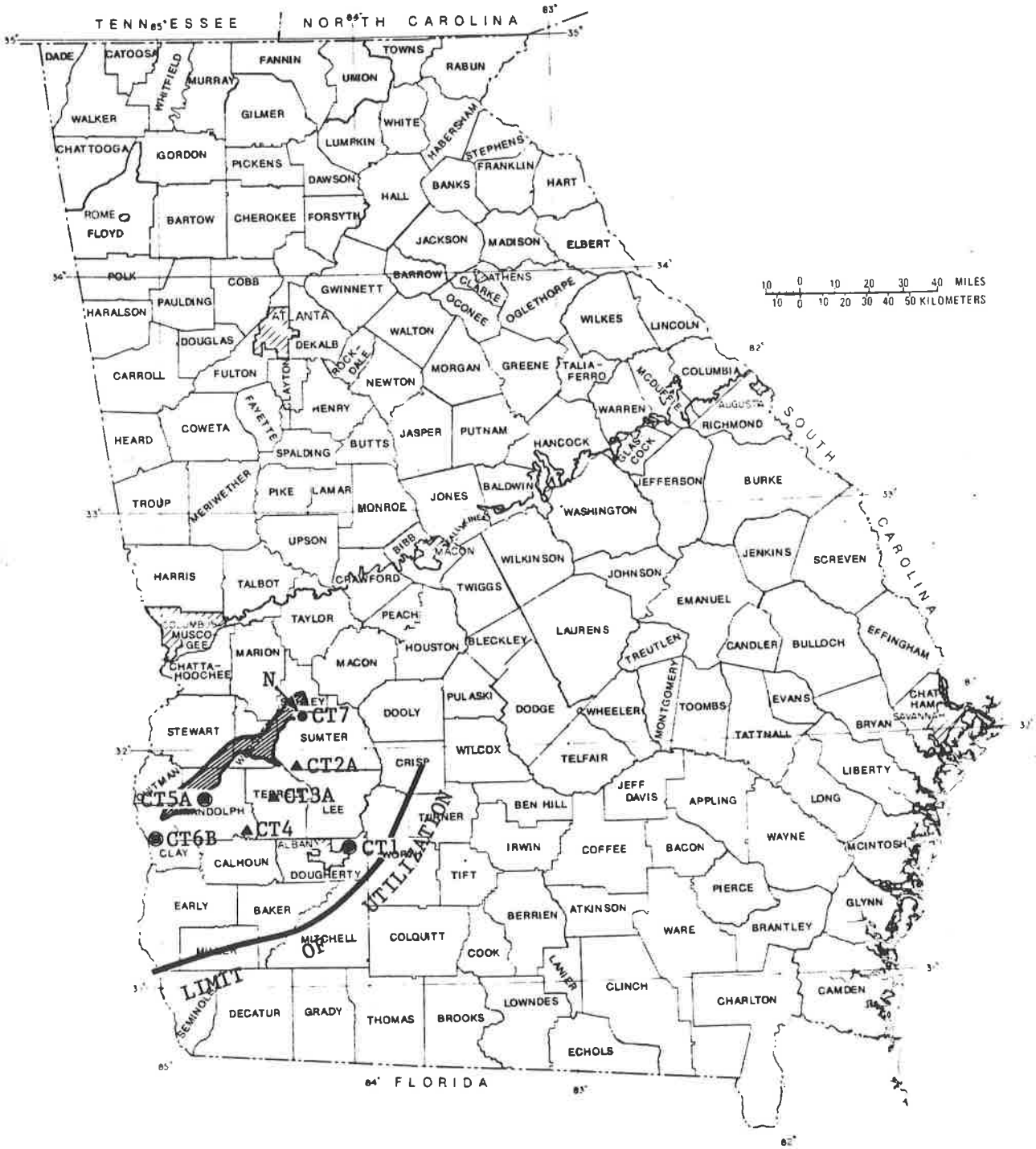
The Clayton aquifer system of southwestern Georgia is developed in the middle limestone unit of the Paleocene Clayton Formation. Limestones and calcareous sands of the Clayton aquifer system crop out in a narrow belt extending from northeastern Clay County to southwestern Schley County (Figure 3-4). Aquifer thickness varies irregularly, ranging from 50 feet near outcrop areas to 265 feet in southeastern Mitchell County (Clarke, et al., 1984). Both the Flint River, to the east, and the Chattahoochee River, to the west, are areas of discharge for the aquifer system in its updip extent. Leakage from the underlying Providence aquifer system and the overlying Wilcox confining zone is significant in downdip areas (Clarke, et al., 1984). The Clayton Formation and Providence Formation merge to form the Dublin aquifer system east of the Ocmulgee River (Clarke, et al., 1985).

Seven wells were used to monitor water quality of the Clayton aquifer system (Table 3-3). These sample stations included one outcrop-area well that was sampled for the Monitoring Network for the first time in 1988, five confined updip-area wells, and one confined downdip-area well. Water from the outcrop-area well was acidic, to the point of being corrosive, and soft with iron and manganese concentrations within drinking-water limits. Aluminum, barium, copper, strontium and zinc were the other trace metal constituents.

All water samples from the confined-area wells were basic and non-corrosive. The water samples from the updip-area wells were moderately hard to very hard. Iron and manganese concentrations exceeded drinking-water limits in samples from the two western-most wells. Barium, bismuth and strontium and the major alkali metals were the other common

cations. The water sample from the one downdip-area well was soft with iron and manganese levels that were too high for untreated public drinking-water uses.

Chloride content was uniformly low, less than 10 parts per million, in all samples. Sulfate levels were less than 17 parts per million in the water from all sample stations, except for a well adjacent to the Chattahoochee River. Nitrite/nitrate concentrations were below detection limits in all samples from confined-area wells. The nitrite/nitrate concentration of the water sample from the single outcrop-area well was 6.8 parts per million. This value is typical of nitrite/nitrate concentrations in water from wells in outcrop areas of the Coastal Plain aquifers. A temporal analysis can not be made as ground-water quality has not previously been monitored in the outcrop areas of the Clayton aquifer system.



- ○ Iron and/or manganese concentrations exceed Drinking-Water Limits
- N Nitrite/nitrate concentrations exceed 0.45 parts per million
- ● Soft water
- ▲ Moderately hard water
- ■ Hard water
- ▨ General recharge area (from Davis, et al., 1988)

Figure 3-4. - Water quality of the Clayton aquifer system

Table 3-3. - Summary of ground-water quality analyses, Clayton aquifer system

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988 7 ANALYSES			1985 - 1987 18 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	4.6	7.3	7.9	7.3	7.7	8.2
CALCIUM Ca (ppm)	3.1	46	140	10	41	126
MAGNESIUM Mg (ppm)	3.4	4.6	5.8	1.1	3.5	5.1
SODIUM Na (ppm)	1.7	10	43	1.5	11	39
POTASSIUM K (ppm)	<1	2	3.5	0.7	1.8	3.1
IRON Fe (ppb)	22	1186	6900	21	1105	14400
MANGANESE Mn (ppb)	<10	28	160	<10	28	460
CHLORIDE Cl (ppm)	1.2	3.8	9.2	1.5	3.0	8.8
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<2	1	6.8	<0.02	<0.02	<0.02
SULFATE SO_4 (ppm)	<2	19	73	8	15	70

*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

CLAIBORNE AQUIFER SYSTEM

Sands of the Middle Eocene Claiborne Group are the primary members of the Claiborne aquifer system of southwestern Georgia. Claiborne Group sands crop out in a belt extending from northern Early County through western Dooly County (Figure 3-5). Limited recharge may be derived downdip in the vicinity of Albany in Dougherty County by leakage from the overlying Floridan aquifer system (Hicks, et al., 1981). Discharge boundaries of the aquifer system are the Ocmulgee River, to the east, and the Chattahoochee River, to the west.

The aquifer generally thickens from the outcrop area towards the southeast, attaining a thickness of almost 300 feet in eastern Dougherty County. In downdip areas where the Claiborne Group can be divided into an overlying Lisbon Formation and an underlying Tallahatta Formation, the Claiborne aquifer system is generally restricted to the Tallahatta Formation (McFadden and Perriello, 1983). The permeable Tallahatta unit is included in the Gordon aquifer system east of the Ocmulgee River (Brooks, et al., 1985).

Ground-water samples of the Claiborne aquifer system were collected from four outcrop-area wells and from three downdip-area wells where the aquifer is confined (Table 3-4). Water from wells in the outcrop areas was acidic, to the point of being corrosive, and soft. Iron and manganese concentrations exceeded drinking-water limits. Wells in the downdip areas yielded water that was basic and moderately hard to very hard, with acceptable iron and manganese levels. Aluminum, barium, strontium, yttrium and zinc were commonly detected trace metals.

Chloride and sulfate concentrations in the water samples were uniformly low. Further downdip, in Thomas County, water in the Claiborne aquifer system is highly mineralized (Sever, 1966). Nitrite/nitrate levels ranged between 3.4 and 7.3 parts per million in water samples from three of the four outcrop-area wells. Concentrations have increased from 5.86 to 7.3 parts per million in the water samples collected from a Shellman, Randolph County, well since sampling began in 1986. Water samples from the confined-area wells contained nitrite/nitrate concentrations near or below detection limits.

- ○ Iron and/or manganese concentrations exceed Drinking-Water Limits
- N Nitrite/nitrate concentrations exceed 0.45 parts per million
- ● Soft water
- ▲ Moderately hard water
- ■ Hard water
- ▨ General recharge area (from Davis, et al., 1988)

Figure 3-5. - Water quality of the Claiborne aquifer system

Table 3-4. - Summary of ground-water quality analyses, Claiborne aquifer system

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988			1985 - 1987		
	7 ANALYSES			23 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	4.2	6.1	7.9	4.2	6.5	8.0
CALCIUM Ca (ppm)	1.2	23	57	1.3	28	55
MAGNESIUM Mg (ppm)	<1	3	9.5	0.3	3.7	8.6
SODIUM Na (ppm)	1.3	3.6	9.4	1.2	6	19
POTASSIUM K (ppm)	<1	1	3.5	<0.5	1.7	3.6
IRON Fe (ppb)	18	274	1000	<10	299	875
MANGANESE Mn (ppb)	<10	92	470	<10	66	460
CHLORIDE Cl (ppm)	1.7	4	11	1.8	6	16
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<0.02	2	7.3	<0.02	1.3	6.8
SULFATE SO_4 (ppm)	<2	<2	7.4	<2	4	21

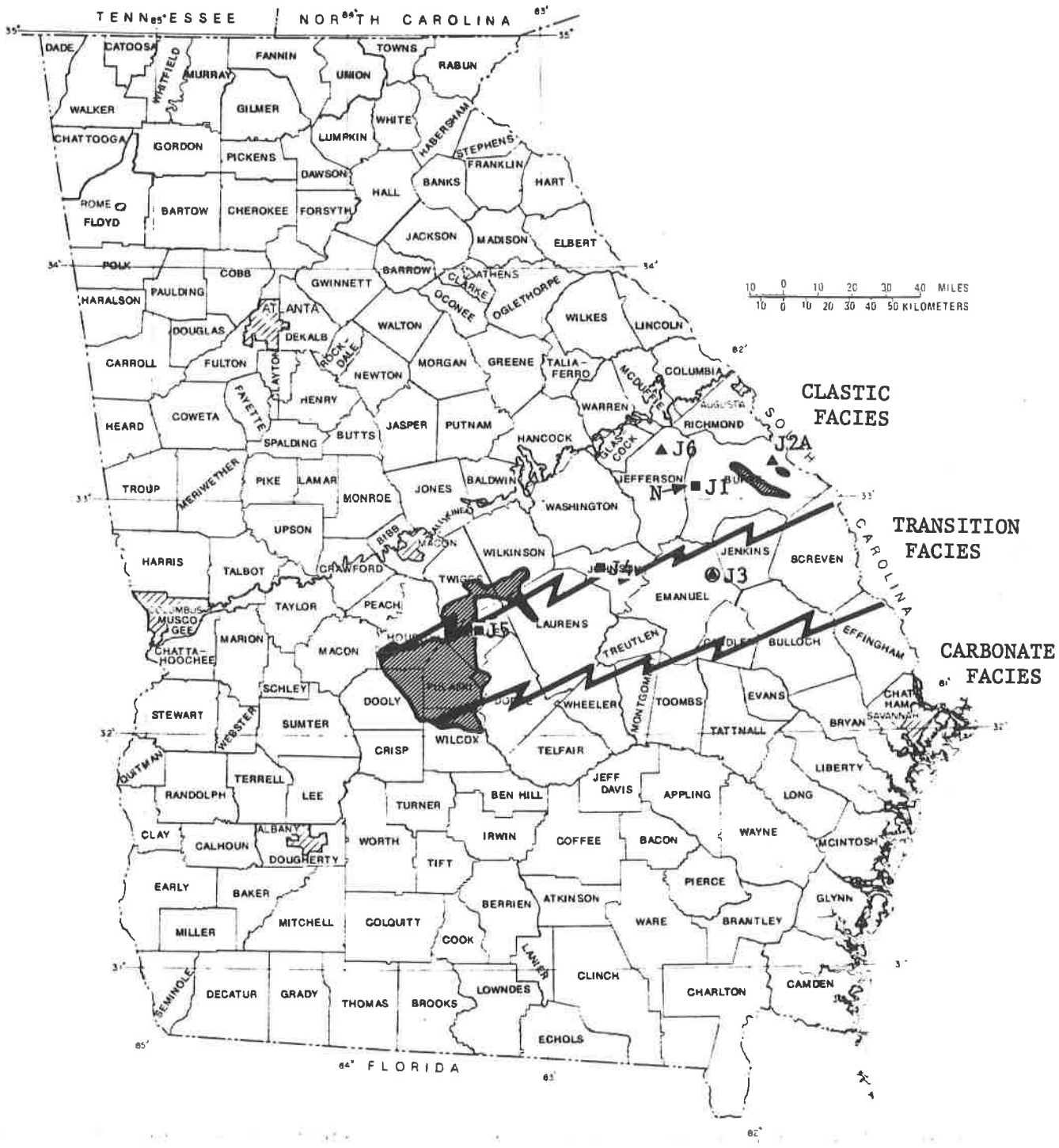
*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

JACKSONIAN AQUIFER SYSTEM

The Jacksonian aquifer system of central and east-central Georgia is developed in sands of the Eocene Barnwell Group. Outcrops of sand and clay of the Barnwell Group extend from Macon and Peach Counties eastward to Burke and Richmond Counties (Figure 3-6). Aquifer sands form a northern clastic facies of the Barnwell Group and grade southward into less permeable silts and clays of a transition facies (Vincent, 1982). The water-bearing sands are relatively thin, generally ranging from ten to fifty feet in thickness. Limestones equivalent to the Barnwell Group form a southern carbonate facies and are included in the Floridan aquifer system. The Savannah River and Ocmulgee River are eastern and western discharge boundaries, respectively, for the updip flow system of the Jacksonian aquifer system.

Water quality in the Jacksonian aquifer system was monitored in four wells in the clastic facies and two wells in the transition facies (Table 3-5). Water from the aquifer system was generally basic and moderately hard to hard. Iron levels in all samples were below the maximum limits for drinking water. Manganese exceeded the limit in the water sample from one transition-facies well. The major alkali metals and barium, strontium and zinc were the other common cations.

Chloride and sulfate levels were 15 parts per million or less in all samples. Nitrite/nitrate concentrations ranged from below detection limits up to 0.35 parts per million in the water samples from five of the wells. Levels of nitrite/nitrate in the samples from a Vidette, Burke County, well were 2.40 and 2.9 parts per million. These concentrations are within the range of previous measurements in water from the well.



- O Manganese concentrations exceed Drinking-Water Limits
- N Nitrite/nitrate concentrations exceed 0.45 parts per million
- ▲ Moderately hard water
- ■ Hard water
- General recharge area (from Davis, et al., 1988)
- Facies boundary (from Vincent, 1982)

Figure 3-6. - Water quality of the Jacksonian aquifer system

Table 3-5. - Summary of ground-water quality analyses, Jacksonian aquifer system

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988 10 ANALYSES			1984 - 1987 28 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	6.7	7.4	7.9	6.5	7.4	7.9
CALCIUM Ca (ppm)	24	43	66	24	45	67
MAGNESIUM Mg (ppm)	<1	2	6.1	0.9	1.9	6.1
SODIUM Na (ppm)	1.5	3.4	9.8	1.5	3.4	9.7
POTASSIUM K (ppm)	<0.5	1	2.2	<0.5	1	2.1
IRON Fe (ppb)	<10	82	226	<10	100	285
MANGANESE Mn (ppb)	<10	24	124	<10	18	125
CHLORIDE Cl (ppm)	1.9	5	11	1.5	5	10
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<0.02	0.6	2.9	<0.02	0.7	3.7
SULFATE SO_4 (ppm)	<2	5	11	<2	4	17

*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

FLORIDAN AQUIFER SYSTEM

The Floridan aquifer system, formerly known as the Principal Artesian aquifer system, consists of Eocene and Oligocene limestones and dolostones that underlie most of the Coastal Plain Province (Figure 3-7). Other units are included locally in the aquifer. The aquifer is a major source of ground water for much of its outcrop area and throughout its downdip extent to the south and east.

Floridan aquifer system carbonates form a single permeable zone in updip areas. There are two permeable zones in downdip areas (Miller, 1986). The upper water-bearing units of the Floridan are the Ocala Group and the Suwannee Limestone (Crews and Huddlestun, 1984). These limestones crop out in a karstic area in southwestern Georgia including the Dougherty Plain and adjacent areas along strike to the northeast. From its updip limit, defined in the east by clays of the Barnwell Group, the aquifer thickens to well over 700' in coastal Georgia. A dense limestone facies along the trend of the Gulf Trough locally limits ground-water quality and availability (Kellam and Gorday, in press). The Gulf Trough is a linear depositional feature that extends from southwestern Decatur County through central Bulloch County.

A ground-water divide isolates the Dougherty Plain's southwestward flow system from the Floridan aquifer system's major southeastward flow system in Georgia. Rainfall infiltration in outcrop areas and leakage from extensive surficial aquifers provide recharge to the Dougherty Plain flow system (Hayes, et al., 1983). The main body of the Floridan aquifer system, to the east, is recharged by leakage from the Jacksonian aquifer system and by rainfall infiltration in outcrop and shallowly-covered areas. Significant recharge also occurs in the

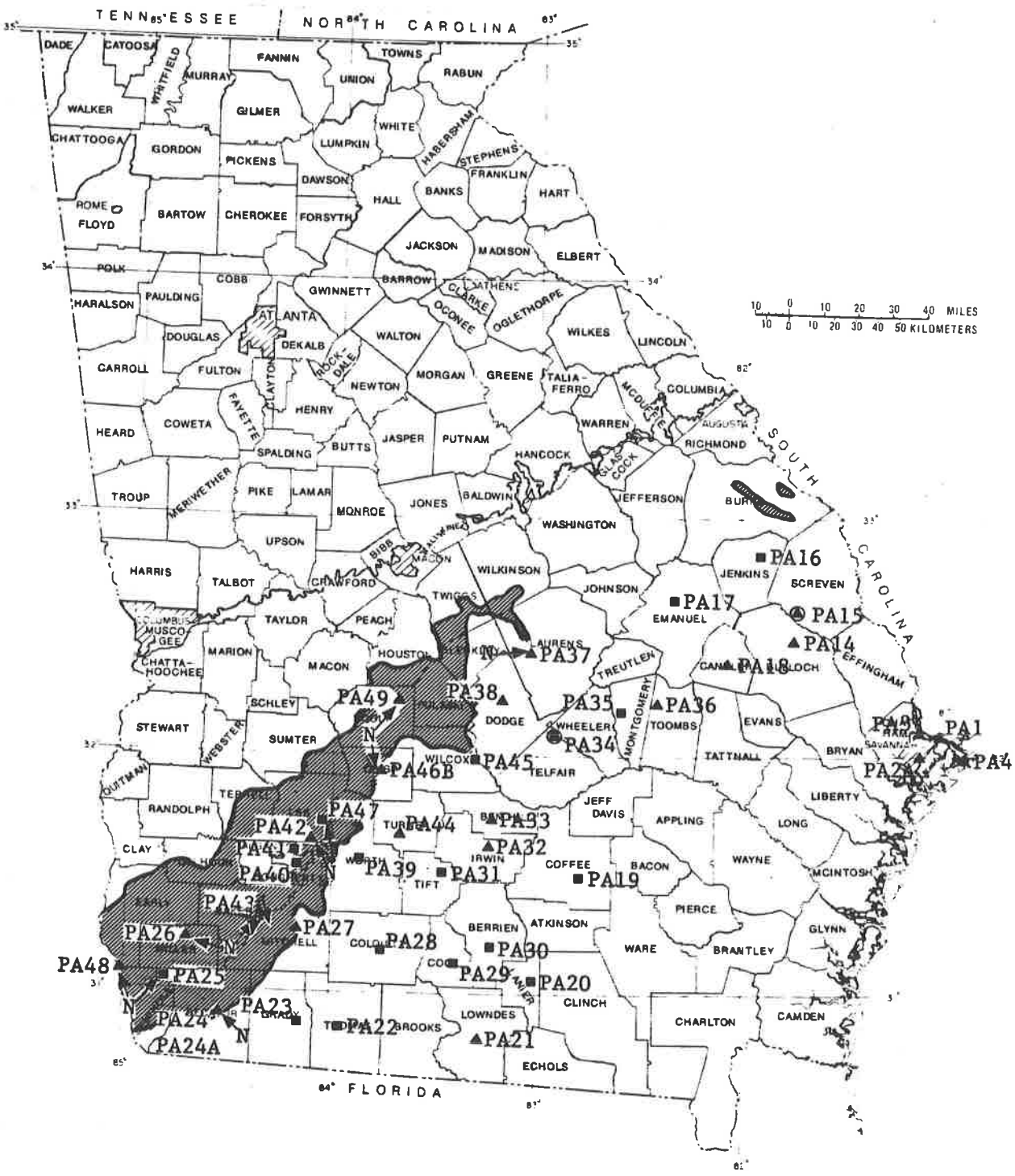
Brooks-Echols-Lowndes Counties area where the Withlacoochee River and numerous sinkholes breach upper confining beds (Krause, 1979).

Ground-water samples were collected from 41 wells completed in the Floridan aquifer system (Table 3-6). All of the water samples were basic and moderately hard to very hard. Iron and manganese exceeded drinking-water limits in water from only three wells. Barium, strontium, tin and zinc were other common trace metals. Barium levels in water samples from a Fitzgerald well, Ben Hill County, exceeded the drinking-water maximum.

Chloride and sulfate concentrations in the water samples commonly were below 10 parts per million. Chloride levels were highest, 46 parts per million, in water from a Tybee Island, Chatham County, well. Concentrations of sulfate were highest, 43 to 151 parts per million, in water samples from the Tybee Island well and in eight wells located within and south of the Gulf Trough.

Most water samples from wells in the Floridan aquifer system in south central and southeastern Georgia contained trace concentrations of nitrite/nitrate. Many of the first detections of nitrite/nitrate in the water samples from these wells occurred in 1987 and 1988. Nitrite/nitrate levels remained highest (0.37 to 7.5 parts per million) in water samples from wells located in the Dougherty Plain. The concentrations in the samples from the Dougherty Plain wells remained within previously established ranges in most cases.

Water from a shallow monitoring well in Albany, Dougherty County, continued to contain traces of volatile organic compounds. The pesticide chlordane was also detected at trace levels in one of two water samples collected from this same well during 1988.



O Iron and/or manganese concentrations exceed Drinking-Water Limits
N Nitrite/nitrate concentrations exceed 0.45 parts per million
▲ Moderately hard water
■ Hard water
▨ General recharge area (from Davis, et al., 1988)

Figure 3-7. - Water quality of the Floridan aquifer system

Table 3-6. - Summary of ground-water quality analyses, Floridan aquifer system

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988 57 ANALYSES			1984 - 1987 203 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	7.2	7.7	8.3	7.0	7.7	8.1
CALCIUM Ca (ppm)	23	43	102	22	45	136
MAGNESIUM Mg (ppm)	0.48	6	23	0.4	12	95
SODIUM Na (ppm)	1.6	6	49	1.6	18	575
POTASSIUM K (ppm)	<0.5	1.0	4.5	<0.5	1.5	11.1
IRON Fe (ppb)	<10	29	340	<10	78	3600
MANGANESE Mn (ppb)	<10	6	99	<10	<10	130
CHLORIDE Cl (ppm)	2.0	7	46	1.5	29	1092
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<0.02	1	7.5	<0.02	0.6	7.3
SULFATE SO_4 (ppm)	<2	26	172	<2	46	425

*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

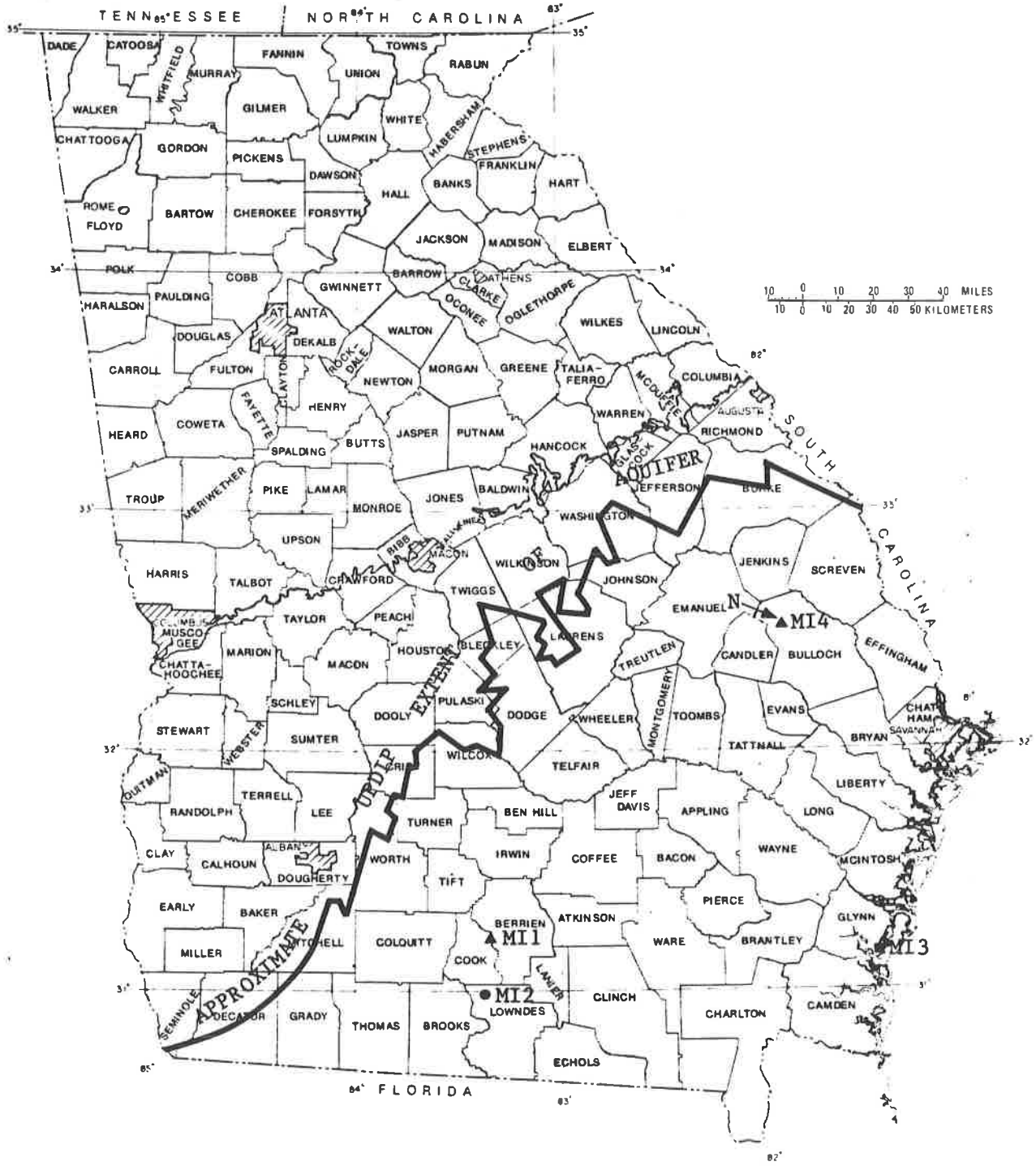
MIOCENE AQUIFER SYSTEM

Much of south-central and southeastern Georgia lies within outcrop areas of the Miocene Altamaha Formation and Hawthorne Group (Figure 3-8). Discontinuous lens-shaped bodies of sand, 50 to 80 feet thick, are the main permeable units. Miocene clays and sandy clays are thickest, more than 500 feet, in Wayne County (Watson, 1982).

Areas of confinement exist along the coast and locally in Grady, Thomas, Brooks and Lowndes Counties. Leakage from overlying surface aquifers into the Miocene aquifer system and, in some areas, from the underlying Floridan aquifer system is significant in the coastal counties (Watson, 1982). Two principal aquifer units are present in the coastal area (Joiner, et al., 1988).

Water quality of the Miocene aquifer system was monitored in two rural domestic wells and two monitoring wells (Table 3-7). A Lowndes County domestic well yielded water that was acidic, to the point of being corrosive, and soft with iron and manganese levels that were below detection limits. Water from a Cook County domestic well and a monitoring well near Hopeulikit, Bulloch County, was basic and moderately hard to hard. Iron and manganese concentrations in the water samples from the Cook County well were low. However, iron and manganese levels in water of the Hopeulikit monitoring well were above drinking-water standards. The water from a monitoring well at Coffin Park, Brunswick, in Glynn County was basic and very hard with iron and manganese concentrations that were below drinking-water maximums. Aluminum, barium and strontium and the major alkali metals were other commonly detected cations in the Miocene aquifer system water samples.

Chloride and sulfate levels were highest (up to 28 parts per million chloride and 64 parts per million sulfate) in the water samples from the Coffin Park monitoring well. Nitrite/nitrate levels in the samples were 0.13 parts per million or less with the exception of one sample collected from the Hopeulikit monitoring well, where the concentration was 4.9 parts per million. The low levels of nitrite/nitrate measured in the water from the Lowndes County domestic well were significantly less than previously monitored levels.



N Nitrite/nitrate concentrations exceed 0.45 parts per million
• Soft water
▲ Moderately hard water
■ Hard water

Figure 3-8. - Water quality of the Miocene aquifer system

Table 3-7. - Summary of ground-water quality analyses, Miocene aquifer system

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988 8 ANALYSES			1985 - 1987 19 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	5.7	7.1	7.9	4.7	7.0	8.2
CALCIUM Ca (ppm)	2.9	28	76	1.1	27	68
MAGNESIUM Mg (ppm)	1.0	7	15	0.6	8	14
SODIUM Na (ppm)	2.3	9	22	2.9	10	21
POTASSIUM K (ppm)	<0.5	1	3.7	<0.5	2	4.4
IRON Fe (ppb)	<10	273	1100	<10	284	2010
MANGANESE Mn (ppb)	<10	34	110	<10	30	110
CHLORIDE Cl (ppm)	3.9	10	28	2.0	9	26
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<0.02	0.7	4.9	<0.02	0.5	3.1
SULFATE SO_4 (ppm)	<2.0	16	64	<2	14	46

*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

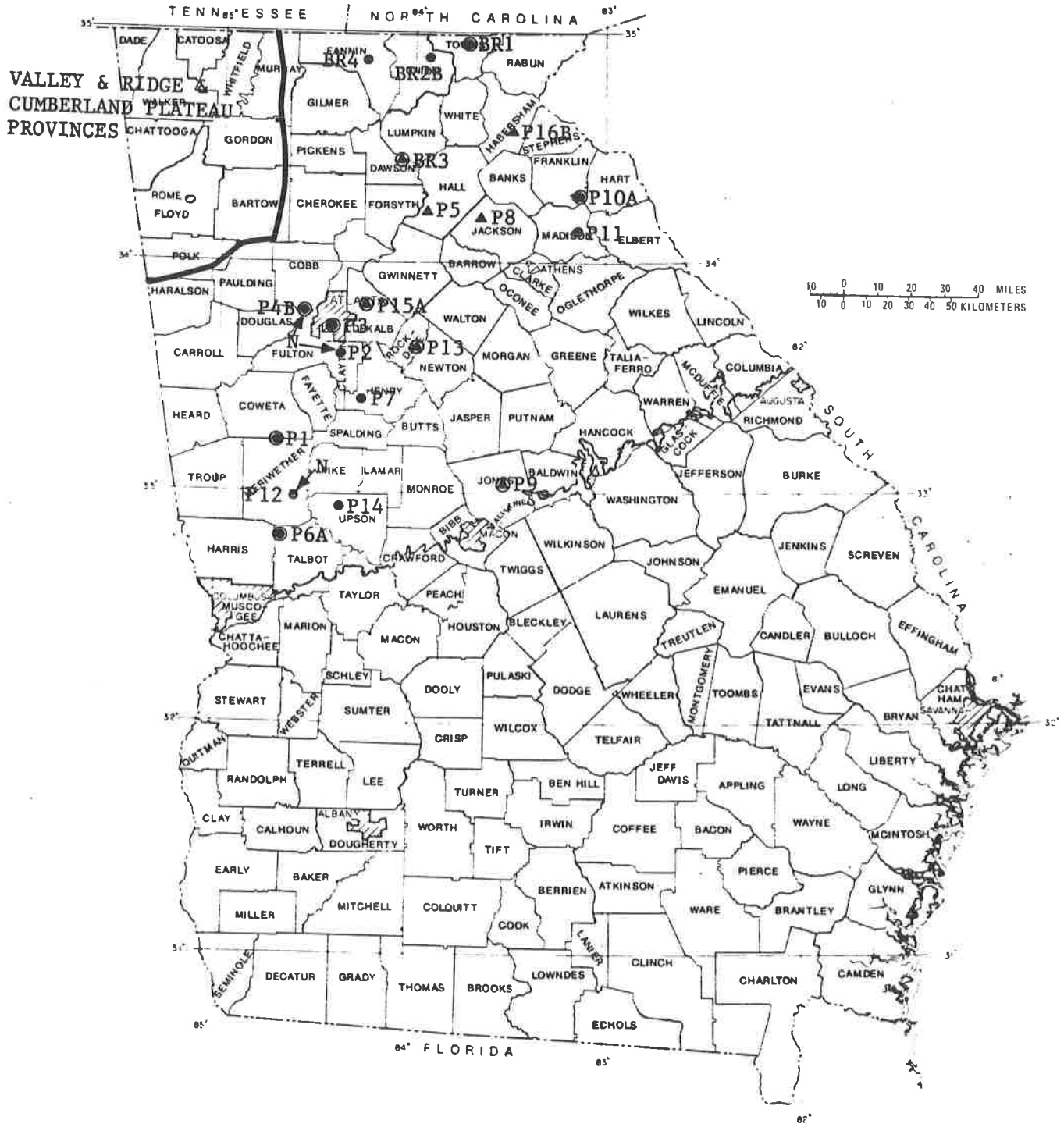
PIEDMONT/BLUE RIDGE UNCONFINED AQUIFERS

Georgia's Piedmont and Blue Ridge Physiographic Provinces are developed on metamorphic and igneous rocks that are predominately Paleozoic. Soil and saprolite horizons and openings along fractures and joints in the rocks are the major water-bearing features. Fracture density and interconnection provide the primary controls on the rate of flow of water into wells completed in crystalline rocks. The permeability and thickness of soils and shallow saprolite horizons determine the amount of discharge that can be sustained.

Ground-water samples were collected from sixteen wells in the Piedmont Province and four wells in the Blue Ridge Province (Figure 3-9) and (Tables 3-8 and 3-9). Water from the wells in the crystalline rock aquifers was generally non-corrosive and soft to moderately hard. Iron and manganese levels exceeded drinking-water limits in water samples from ten of the wells. Aluminum, barium, strontium and zinc were common trace metal constituents.

Chloride and sulfate concentrations in the water samples were typically below 15 parts per million. Nitrite/nitrate was present in water from nine of the wells. Only three of these wells yielded water with nitrite/nitrate levels greater than 0.45 parts per million. The maximum concentration was 3.3 parts per million. Nitrite/nitrate concentrations monitored in 1988 were generally lower than the levels in samples collected during 1987 from the same wells.

Traces of volatile organic compounds continued to be detected in samples from wells in Fulton and Rockdale Counties. Both water samples collected from a monitoring well at Fort McPherson, Fulton County, contained 1,2-dichloropropane at a level of one part per billion. An unused well in Conyers, Rockdale County, yielded water containing tetrachloroethylene at a concentration of eight parts per billion. Current drinking-water supplies are not compromised in either area.



O Iron and/or manganese concentrations exceed Drinking-Water Limits
N Nitrite/nitrate concentrations exceed 0.45 parts per million
• Soft water
▲ Moderately hard water

Figure 3-9. - Water quality of the Piedmont/Blue Ridge unconfined aquifers

Table 3-8. - Summary of ground-water quality analyses, Piedmont unconfined aquifers

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS 1988 21 ANALYSES			1984 - 1987 61 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	5.2	6.7	7.8	4.8	6.7	8.2
CALCIUM Ca (ppm)	<1	14	29	0.2	15	64
MAGNESIUM Mg (ppm)	<1	4	10	0.2	3	12
SODIUM Na (ppm)	1.6	10	28	0.9	11	59
POTASSIUM K (ppm)	0.9	2.5	4.9	1.1	2.4	4.9
IRON Fe (ppb)	<10	1348	11360	<10	1052	10900
MANGANESE Mn (ppb)	<10	100	966	<10	84	1310
CHLORIDE Cl (ppm)	1.3	7	26	<0.1	7	50
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<0.02	0.4	3.3	<0.02	0.5	3.6
SULFATE SO_4 (ppm)	0.5	13	84	<2	16	280

*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

Table 3-9. – Summary of ground-water quality analyses, Blue Ridge unconfined aquifers

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988 4 ANALYSES			1984 - 1987 11 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	6.3	6.8	7.7	5.9	6.7	7.8
CALCIUM Ca (ppm)	2.9	15	24	2.9	11	24
MAGNESIUM Mg (ppm)	1.2	2.1	2.5	1.3	2.0	2.5
SODIUM Na (ppm)	3.4	8	12	2.1	7	13
POTASSIUM K (ppm)	1.4	1.8	2.5	1.5	2.1	2.8
IRON Fe (ppb)	21	221	528	<10	589	4950
MANGANESE Mn (ppb)	<10	113	314	<10	36	120
CHLORIDE Cl (ppm)	3	4	6	1.0	3.6	9.3
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	<0.02	0.04	0.13	<0.02	0.7	1.9
SULFATE SO_4 (ppm)	<2	8	29	<1	7	19

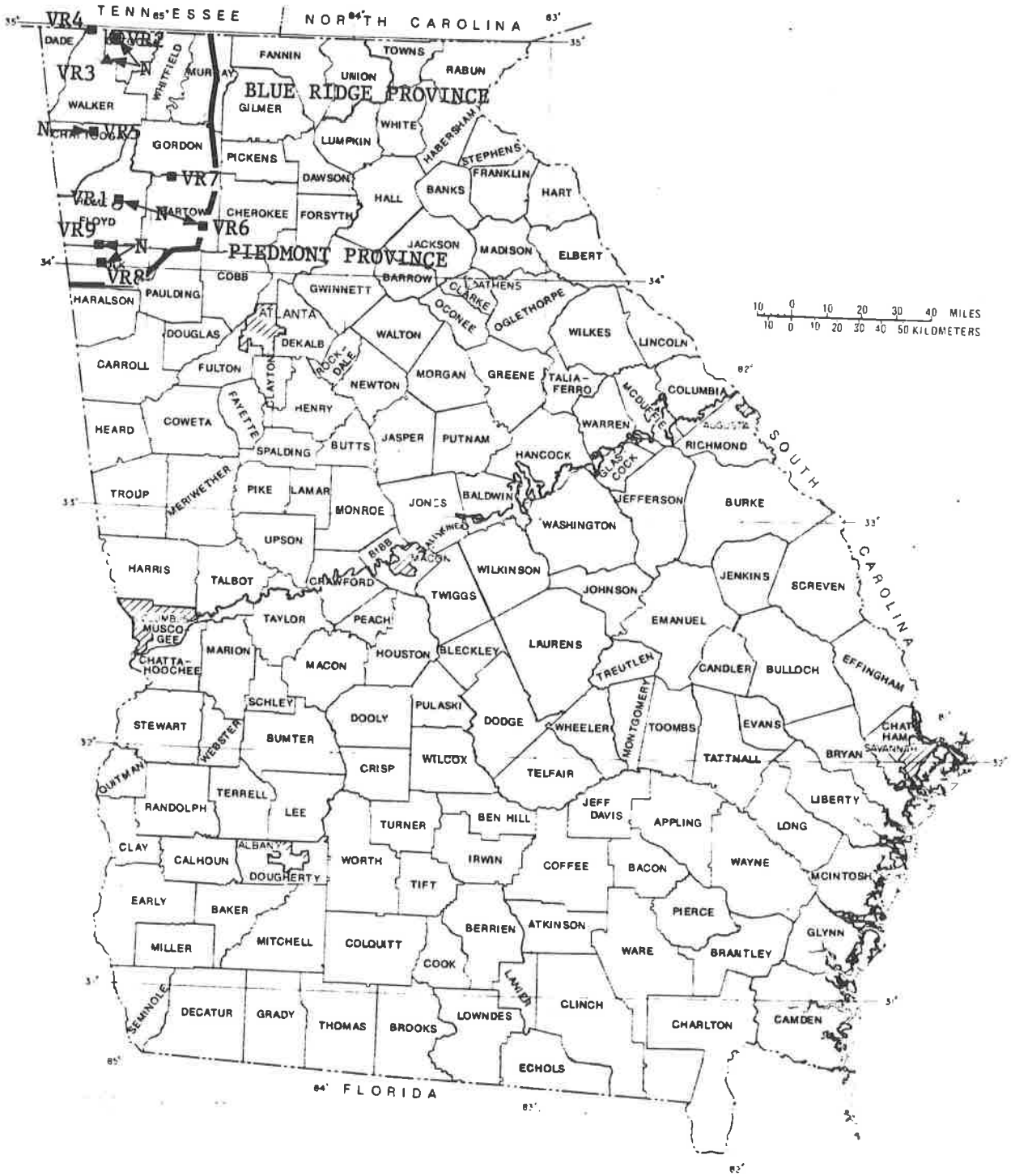
*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

VALLEY AND RIDGE UNCONFINED AQUIFERS

Soil and residuum forms low-yield unconfined aquifers across most of the Valley and Ridge Province of northwestern Georgia. Valley bottom outcrops of dolostones and limestones of the Cambro-Ordovician Knox Group are the locations of most higher-yielding wells and springs that are suitable for municipal supplies.

Water quality in the Valley and Ridge unconfined aquifers was monitored in six wells and three springs located across the Province (Figure 3-10) and (Table 3-10). Four of these wells and all three springs produced water from Knox Group carbonates. The other wells represent water quality in the Ordovician Chickamauga Group of Walker County and the Cambrian Shady Dolomite of Bartow County. Water from the Valley and Ridge monitoring stations was typically basic and hard. Iron and manganese concentrations were below drinking-water limits in all but two water samples. Barium and strontium were the only common trace metal constituents.

Chloride and sulfate concentrations were typically less than five parts per million. Nitrite/nitrate was present in all of the water samples. Concentrations ranged from 0.36 to 3.36 parts per million in water from eight of the wells and springs. The nitrite/nitrate levels measured in 1988 were generally within previously established ranges for water from these monitoring stations.



- ○ Manganese concentrations exceed Drinking-Water Limits
- N Nitrite/nitrate concentrations exceed 0.45 parts per million
- ▲ Moderately hard water
- ■ Hard water

Figure 3-10. - Water quality of the Valley and Ridge unconfined aquifers

Table 3-10. - Summary of ground-water quality analyses, Valley and Ridge unconfined aquifers

CONSTITUENT OR PHYSICAL PROPERTY*	ANALYTICAL RESULTS					
	1988 10 ANALYSES			1985 - 1987 33 ANALYSES		
	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN	MAXIMUM
LABORATORY pH (standard units)	7.4	7.6	8.2	6.7	7.6	8.0
CALCIUM Ca (ppm)	23	42	87	22	43	78
MAGNESIUM Mg (ppm)	3.8	15	26	3.2	15	30
SODIUM Na (ppm)	<1	5	24	0.7	10	50
POTASSIUM K (ppm)	<0.5	0.5	2.8	<0.5	0.8	3.7
IRON Fe (ppb)	<10	77	590	<10	30	415
MANGANESE Mn (ppb)	<10	18	140	<10	10	66
CHLORIDE Cl (ppm)	1.1	7	25	1.0	19	125
NITRITE & NITRATE NO_2 & NO_3 (ppmN)	0.02	1.0	3.4	<0.02	1	6.5
SULFATE SO_4 (ppm)	1.0	10	69	<2	12	83

*ppm = parts per million,
ppmN = parts per million as nitrogen,
ppb = parts per billion
< = below detection limits

SUMMARY AND CONCLUSIONS

Hydrogeologists collected 151 water samples for analysis from 112 wells and three springs for the Ground-Water Monitoring Network in 1988. These wells and springs represent the nine major aquifer systems/ground-water provinces of the State:

Cretaceous aquifer system,
Providence aquifer system,
Clayton aquifer system,
Claiborne aquifer system,
Jacksonian aquifer system,
Floridan aquifer system,
Miocene aquifer system,
Piedmont/Blue Ridge unconfined aquifers and
Valley and Ridge unconfined aquifers.

Analyses of water samples collected in 1988 were compared with analyses for the Ground-Water Monitoring Network dating back to 1984, permitting the recognition of temporal trends.

An increasing occurrence of detectable levels of nitrite/nitrate is the only apparent adverse trend in ground-water quality in Georgia. While few wells or springs yielded water samples in 1988 with nitrite/nitrate concentrations that exceeded previously established ranges, the first appearance of nitrite/nitrate in some downdip areas of the Cretaceous and Floridan aquifer systems was noted. Samples from Coastal Plain aquifers with the highest nitrite/nitrate levels were, in most cases, from wells in outcrop areas. No occurrences of nitrite/nitrate concentrations greater than the drinking-water standard of 10 parts per million have been documented by the Ground-Water Monitoring Network through 1988.

Spatial and temporal limitations of the Ground-Water Monitoring Network preclude the determination of the most important sources of the increasing levels of nitrogen compounds in Georgia's ground water.

Nitrite/nitrate originates in ground water from direct sources and through oxidation of other forms of dissolved nitrogen. The most common sources of dissolved nitrogen are septic systems, agricultural wastes and fertilizers (Freeze and Cherry, 1979). Dissolved nitrogen is also present in rainwater, derived from terrestrial vegetation and volatilization of fertilizers (Drever, 1988). The conversion of other nitrogen species to nitrate occurs in aerobic environments (i.e. recharge areas). Anaerobic conditions, as are commonly developed along the flow path of ground water, foster the denitrification process. However, this process is inhibited by the lack of denitrifying bacteria in ground water (Freeze and Cherry, 1979).

The Georgia Geologic Survey will be conducting a survey of nitrite/nitrate concentrations in shallow aquifers of the Georgia farm belt during 1990 and 1991, using a grant from the U.S. Environmental Protection Agency. Water from between 2,500 and 3,500 shallow wells will be analyzed to define the extent and magnitude of nitrite/nitrate levels in the ground water. The spatial relationships may be adequate to define the most important sources of the dissolved nitrogen compounds.

Table 4-1. - Nitrite/nitrate concentrations (parts per million) measured in samples from select monitoring stations

Well ID	1984	1985	1986	1987	1988
BR4	1.32	----	1.86	1.92	U
CL4	----	1.15	3.42	3.10	3.4
CL5	----	----	5.86/6.80	6.75	7.3
J1	2.02	2.46	2.50/1.92	3.70/2.50	2.9/2.40
J4	----	0.51	0.20/0.59	0.51/0.62	0.08/0.29
K5	0.25	0.29/0.29	0.22/0.12	0.53/U	0.35/0.37
K6	----	0.45	0.54	0.06	----
K10	0.94	0.92	1.10	1.07/1.10	0.25/1.2
MI2	----	U/0.42	2.20	2.95/3.10	0.13/0.13
PA24	----	U/1.19	1.08	1.43/1.30	1.35
PA25	----	0.99/1.31/1.24	1.38	1.41/1.37	1.35/1.41
PA26	----	1.08/1.41/1.26	1.46	1.53/1.66	0.86
PA27	----	1.09/0.40	0.30/0.30	0.33/0.32	0.37/0.33
PA37	----	----	1.53	5.25	2.35
PA40	----	U/1.06	1.32/1.05	1.31/1.24	1.28/1.3
PA41	----	2.08	1.62/3.40/3.83	2.20/6.86	2.17/2.4
PA42	----	2.60	3.15/3.08	2.90/3.50	3.3/3.2
PA43	----	1.12/1.29	1.20/1.47	1.51/1.66	1.68/1.54
PA46B	----	----	1.20	1.07	1.38
PA47A	----	----	3.75	1.95/7.32	2.31/7.5
PA48	----	1.68	1.12	2.20/1.84	1.89/1.8
P2	1.04	1.20/1.25	1.23/1.08	1.77/1.19	1.3/0.92/0.8
P4B	----	----	0.39	0.75/0.39	0.6/0.56
P12	----	1.05	3.65	3.20	3.3
P14	----	0.42	0.52	0.44	0.32
PD2A	----	0.76	0.64	----	0.85
VR1	----	0.50	0.52	0.73	0.54
VR2	----	0.49/0.77	0.39/0.81	0.56/1.07	0.48/0.88
VR3	----	0.67/0.75	0.61/0.65	0.94/0.73	1.04/0.67
VR5	----	3.30	3.35	6.50	3.36
VR6	----	0.65	0.68	0.94	0.64
VR9	----	1.04	0.82	1.19	0.87

U = less than (below detection limit)

Table 4-2. - Average value of indicator parameters (parts per million) 1984-1988

Parameter / Aquifer	1984 #	1984 Value	1985 #	1985 Value	1986 #	1986 Value	1987 #	1987 Value	1988 #	1988 Value
Nitrite/nitrate										
Cretaceous	12	0.3	14	0.2	27	0.2	25	0.2	24	0.2
Providence	*	---	4	0.2	5	0.1	4	0.1	3	0.3
Clayton	*	---	1	<0.02	11	<0.02	6	<0.02	7	1.0
Claiborne	*	---	2	0.6	14	1.2	7	1.6	7	2.0
Jacksonian	3	0.7	6	0.5	9	0.6	10	0.8	10	0.6
Floridan	11	0.0	61	0.4	64	0.7	69	0.8	57	0.8
Miocene	*	---	5	0.1	6	0.4	8	0.8	8	0.7
Piedmont	11	0.4	10	0.4	20	0.4	20	0.5	21	0.4
Blue Ridge	3	0.5	*	---	4	0.6	4	0.9	4	0.0
Val. & Ridge	*	---	11	0.8	11	0.8	11	1.3	10	1.0
Chloride										
Cretaceous	12	2	14	3	27	5	25	3	24	4
Providence	*	--	4	5	5	7	4	5	3	7
Clayton	*	--	1	2	11	2	6	4	7	4
Claiborne	*	--	2	7	14	5	7	7	7	4
Jacksonian	3	5	6	5	9	6	10	5	10	5
Floridan	11	10	61	19	64	39	69	30	57	7
Miocene	*	--	5	8	6	9	8	9	8	10
Piedmont	11	4	10	12	20	6	20	8	21	7
Blue Ridge	3	2	*	--	4	3	4	5	4	4
Val. & Ridge	*	--	11	26	11	16	11	15	10	7
Sulfate										
Cretaceous	12	1	14	2	27	3	25	4	24	5
Providence	*	--	4	7	5	7	4	6	3	10
Clayton	*	--	1	13	11	12	6	22	7	19
Claiborne	*	--	2	2	14	4	7	3	7	<2
Jacksonian	3	2	6	3	9	5	10	4	10	5
Floridan	11	29	61	48	64	44	69	47	57	26
Miocene	*	--	5	10	6	16	8	15	8	16
Piedmont	11	55	10	8	20	8	20	9	21	13
Blue Ridge	3	6	*	--	4	8	4	6	4	8
Val. & Ridge	*	--	11	9	11	11	11	15	10	10

*Samples not collected during this year.

Table 4-3A. - Contaminants and pollutants detected by the Ground-Water Monitoring Network for south-central and southeastern Georgia

Well ID (Date)	Contaminants Above Drinking Water Limits			Organic Pollutants		
J3	Manganese =	124	ug/L			
J4	Manganese =	69	ug/L			
K3	Iron =	542	ug/L			
K4	Iron =	3500	ug/L			
	Manganese =	160	ug/L			
K8	Iron =	4100	ug/L			
K9	Iron =	1820	ug/L			
K12				Chloroform =	2.2	ug/L
(6/21/88)				Dichlorobromomethane =	1.5	ug/L
MI4	Iron =	760	ug/L			
(1/12/88)	Manganese =	110	ug/L			
MI4	Iron =	1100	ug/L			
(5/24/88)	Manganese =	110	ug/L			
PA15	Iron =	340	ug/L			
PA18	Manganese =	53	ug/L			
PA33	Barium =	2190	ug/L			
PA34	Manganese =	99	ug/L			

Table 4-3B. - Contaminants and pollutants detected by the Ground-Water Monitoring Network for southwestern Georgia

Well ID (Date)	Contaminants Above Drinking Water Limits			Organic Pollutants		
CL3	Iron =	1000	ug/L			
CL4	Manganese =	58	ug/L			
CL5	Manganese =	470	ug/L			
CL8	Iron =	500	ug/L			
	Manganese =	100	ug/L			
CT1	Iron =	510	ug/L			
CT5A	Iron =	390	ug/L			
CT6B	Iron =	6900	ug/L			
	Manganese =	160	ug/L			
PA41				Chloroform =	1	ug/L
(3/22/88)				Tetrachloroethylene =	7	ug/L
				Cis 1,2 Dichloroethene =	5	ug/L
PA41	Selenium =	120	ug/L			
(10/13/88)				Chlordane =	0.31	ug/L
				Tetrachloroethylene =	1.6	ug/L

Table 4-3C. - Contaminants and pollutants detected by the Ground-Water Monitoring Network for northern Georgia

Well ID (Date)	Contaminants Above Drinking Water Limits			Organic Pollutants		
BR1	Iron =	528	ug/L			
	Manganese =	314	ug/L			
BR3	Iron =	309	ug/L			
	Manganese =	137	ug/L			
P1	Iron =	2400	ug/L			
	Manganese =	58	ug/L			
P2 (4/27/88)	Manganese =	55	ug/L			
P3 (4/25/88)	Iron =	7360	ug/L			
	Manganese =	58	ug/L			
P3 (10/6/88)	Iron =	1100	ug/L	1,2-Dichloropropane =	1	ug/L
	Manganese =	75	ug/L			
P4B (4/27/88)	Manganese =	966	ug/L	1,2-Dichloropropane =	1.0	ug/L
P4B (9/13/88)	Iron =	1200	ug/L			
P6A	Manganese =	85	ug/L			
P9	Iron =	1970	ug/L			
	Manganese =	266	ug/L			
P10A	Iron =	11360	ug/L			
	Manganese =	170	ug/L			
P13	Iron =	1000	ug/L			
	Manganese =	78	ug/L			
P15A (4/27/88)	Iron =	574	ug/L			
	Manganese =	100	ug/L			
P15A (9/13/88)	Iron =	640	ug/L			
	Manganese =	88	ug/L			
VR2 (7/13/88)	Manganese =	140	ug/L			
VR3 (1/20/88)	Iron =	590	ug/L	Tetrachloroethylene =	1.5	ug/L

REFERENCES CITED

Brooks, Rebekah, Clarke, J.S., and Faye, R.E., 1985, Hydrogeology of the Gordon Aquifer System of East-Central Georgia: Georgia Geologic Survey Information Circular 75, 41 p.

Clarke, J.S., Brooks, Rebekah, and Faye, R.E., 1985, Hydrogeology of the Dublin and Midville Aquifer Systems of East-Central Georgia: Georgia Geologic Survey Information Circular 74, 62 p.

Clarke, J.S., Faye, R. E., and Brooks, Rebekah, 1983, Hydrogeology of the Providence Aquifer of Southwest Georgia: Georgia Geologic Survey Hydrologic Atlas 11, 5 pl.

Clarke, J.S., Faye, R.E., and Brooks, Rebekah, 1984, Hydrogeology of the Clayton Aquifer of Southwest Georgia: Georgia Geologic Survey Hydrologic Atlas 13, 6 pl.

Crews, P.A., and Huddlestun, P.F., 1984, Geologic Sections of the Principal Artesian Aquifer System, in Arora, Ram, editor, Hydrogeologic Evaluation for Underground Injection Control in the Coastal Plain of Georgia: Georgia Geologic Survey Hydrologic Atlas 10, 41 pl.

Davis, K.R., Donahue, J.C., Hutcheson, R.H., and Waldrop, D.L., 1988, Most Significant Ground-Water Recharge Areas of Georgia: Georgia Geologic Survey Hydrologic Atlas 18, 1 pl.

Drever, J.I., 1988, The Geochemistry of Natural Waters: Prentice-Hall, Englewood Cliffs, N.J., 437 p.

Environmental Protection Division, 1989, Rules for Safe Drinking Water, Chapter 391-3-5, Revised June 1989, Georgia Department of Natural Resources 63 p.

Freeze, R.A., and Cherry, J.A., 1979, Groundwater: Prentice-Hall, Englewood Cliffs, N.J., 604 p.

Hayes, L.R., Maslia, M.L., and Meeks, W.C., 1983, Hydrology and Model Evaluation of the Principal Artesian Aquifer, Dougherty Plain, Southwest Georgia: Georgia Geologic Survey Bulletin 97, 93 p.

Hicks, D.W., Krause, R.E., and Clarke, J.S., 1981, Geohydrology of the Albany Area, Georgia: Georgia Geologic Survey Information Circular 57, 31 p.

Joiner, C.N., Reynolds, M.S., Stayton, W.L., and Boucher, F.G., 1988, Ground-Water Data for Georgia, 1987: United States Geological Survey Open-File Report 88-323, 172 p.

Kellam, M.F., and Gorday, L.L., Hydrogeology of the Gulf Trough Apalachicola Embayment Area, Georgia: Georgia Geologic Survey Bulletin, in press.

Krause, R.E., 1979, Geohydrology of Brooks, Lowndes, and Western Echols Counties, Georgia: United States Geological Survey Water-Resources Investigations 78-117, 48 p.

McFadden, S.S., and Perriello, P.D., 1983, Hydrogeology of the Clayton and Claiborne Aquifers in Southwestern Georgia: Georgia Geologic Survey Information Circular 55, 59 p.

Miller, J.A., 1986, Hydrogeologic Framework of the Floridan Aquifer System in Florida and Parts of Georgia, Alabama, and South Carolina: United States Geological Survey Professional Paper 1403-B, 91 p.

Pollard, L.D., and Vorhis, R.C., 1980, The Geohydrology of the Cretaceous Aquifer System in Georgia: Georgia Geologic Survey Hydrologic Atlas 3, 5 pl.

Sever, C.W., 1966, Reconnaissance of the Ground Water and Geology of Thomas County, Georgia: Georgia Geologic Survey Information Circular 34, 14 p.

Vincent, R.H., 1982, Geohydrology of the Jacksonian Aquifer in Central and East Central Georgia: Georgia Geologic Survey Hydrologic Atlas 8, 3 pl.

Wait, R.L., 1960, Source and Quality of Ground Water in Southwestern Georgia: Georgia Geologic Survey Information Circular 18, 74 p.

Watson, W., 1982, Aquifer Potential of the Shallow Sediments of the Coastal Area of Georgia, in Arden, D.D., Beck, B.F., and Morrow, E., Editors, Second Symposium on the Geology of the Southeastern Coastal Plain (March, 1979): Georgia Geologic Survey Information Circular 53, pp. 183-194.

APPENDIX

APPENDIX: ANALYSES OF SAMPLES COLLECTED DURING 1988 FOR THE GEORGIA GROUND-WATER MONITORING NETWORK

All water quality samples that are collected for the Georgia Ground-Water Monitoring Network are subjected to a Standard Analysis which includes tests for five 'indicator' parameters, twelve common pesticides and industrial chemicals, and thirty metals. Analyses for additional parameters may be included for samples that are collected from an area where a possibility of ground-water pollution exists due to regional activities. These optional screens include tests for agricultural chemicals, coal-tar creosote, phenols and anilines and volatile organic compounds (refer to Tables A-1 through A-4). Because parameters other than the five 'indicators' and eight of the metals of the Standard Analysis were detected very rarely, other parameters are listed in the appendix only when they were detected.

For this appendix, the following abbreviations are used:

SU = standard units,

mg/L = milligrams per liter (parts per million),

ug/L = micrograms per liter (parts per billion) and

umho/cm = micromhos per centimeter.

U = less than (below detection limit)

Table A-1. - Standard water quality analysis: indicator parameters, Organic Screens #2 and #4 and ICP metal screen

Parameter	Typical Detection Limit	
pH	---	SU
Spec. Cond.	1.0	umho/cm
Chloride	0.1	mg/L
Sulfate	2	mg/L
Nitrite/nitrate	0.02	mg/L
ORGANIC SCREEN #2		
Dicofol	0.10	ug/L
Endrin	0.03	ug/L
Lindane	0.008	ug/L
Methoxychlor	0.30	ug/L
PCB's	0.60	ug/L
Permethrin	0.30	ug/L
Toxaphene	1.20	ug/L
ORGANIC SCREEN #4		
2,4-D	5.2	ug/L
Acifluorfen	1.0	ug/L
Chloramben	0.2	ug/L
Silvex	0.1	ug/L
Trichlorfon	2.0	ug/L
ICP METAL SCREEN		
Calcium	1	mg/L
Magnesium	1	mg/L
Sodium	1	mg/L
Potassium	0.5	mg/L

Parameter	Typical Detection Limit	
ICP SCREEN, Cont.		
Silver	30	ug/L
Aluminum	50	ug/L
Arsenic	50	ug/L
Gold	10	ug/L
Barium	10	ug/L
Beryllium	10	ug/L
Bismuth	30	ug/L
Cadmium	5	ug/L
Cobalt	10	ug/L
Chromium	10	ug/L
Copper	20	ug/L
Iron	10	ug/L
Manganese	10	ug/L
Molybdenum	10	ug/L
Nickel	20	ug/L
Lead	25	ug/L
Antimony	40	ug/L
Selenium	5	ug/L
Tin	20	ug/L
Strontium	10	ug/L
Titanium	10	ug/L
Thallium	40	ug/L
Vanadium	10	ug/L
Yttrium	10	ug/L
Zinc	20	ug/L
Zirconium	10	ug/L

Table A-2. - Additional water quality analyses: cyanide, mercury and Organic Screens #1, #3, #5 and #7

Parameter	Typical Detection Limit		Parameter	Typical Detection Limit	
Cyanide	0.05	ug/L	Mercury	0.2	ug/L
ORGANIC SCREEN #1					
Alachlor	3.00	ug/L	Malathion	1.40	ug/L
Atrazine	0.44	ug/L	Metolachlor	2.40	ug/L
Azodrin	1.00	ug/L	Metribuzin	1.25	ug/L
Chloropyrifos	0.80	ug/L	Mevinphos	1.40	ug/L
Cynazine	1.00	ug/L	Napropamide	0.81	ug/L
Dasanit	0.60	ug/L	Parathion (E)	0.08	ug/L
DCPA	0.01	ug/L	Parathion (M)	0.10	ug/L
Demeton	1.00	ug/L	Pebulate	1.81	ug/L
Diazinon	1.00	ug/L	Pendimethalin	1.80	ug/L
Dimethoate	0.50	ug/L	Phorate	1.00	ug/L
Disyton	1.00	ug/L	Profluralin	2.00	ug/L
Eptam	1.70	ug/L	Simazine	1.25	ug/L
Ethoprop	0.50	ug/L	Sutan	1.25	ug/L
Fluchloralin	15.0	ug/L	Terbufos	3.00	ug/L
Fonophos	0.50	ug/L	Trifluralin	2.00	ug/L
Guthion	2.00	ug/L	Vernam	0.56	ug/L
Isopropalin	2.00	ug/L			
ORGANIC SCREEN #3					
Dinoseb	0.10	ug/L			
ORGANIC SCREEN #5					
Carbaryl	10.0	ug/L	Linuron	1.0	ug/L
Carbofuran	2.0	ug/L	Methomyl	3.0	ug/L
Diuron	1.0	ug/L	Monuron	1.0	ug/L
Fluometuron	1.0	ug/L			
ORGANIC SCREEN #7					
EDB	1.0	ug/L			

Table A-3. - Additional water quality analyses:
Organic Screens #8 and #9

ORGANIC SCREEN #8

Parameter	Typical Detection Limit
Naphthalene	10 ug/L
2-Chloronaphthalene	10 ug/L
Acenaphthylene	10 ug/L
Acenaphthene	10 ug/L
Fluorene	10 ug/L
Phenanthrene	10 ug/L
Anthracene	10 ug/L
Fluoranthene	10 ug/L
Pyrene	10 ug/L
Benzo(a)anthracene	10 ug/L
Benzo(b)fluoranthene	10 ug/L
Benzo(k)fluoranthene	10 ug/L
Benzo(a)pyrene	10 ug/L
Indeno(1,2,3-cd)pyrene	10 ug/L
Benzo(ghi)perylene	10 ug/L

ORGANIC SCREEN #9

Parameter	Typical Detection Limit
Anilene	10 ug/L
2-Chlorophenol	10 ug/L
2-Nitrophenol	10 ug/L
Phenol	10 ug/L
2,4-Dimethylphenol	10 ug/L
2,3-Dichlorophenol	10 ug/L
2,4,6-Trichlorophenol	10 ug/L
Parachlorometa cresol	10 ug/L
2,4-Dinitrophenol	50 ug/L
4,6-Dinitro-o-cresol	50 ug/L
Pentachlorophenol	20 ug/L
4-Nitrophenol	50 ug/L

Table A-4. - Additional water quality analyses: Organic Screen #10

ORGANIC SCREEN #10

Parameter	Typical Detection Limit
Methyl chloride	5 ug/L
Trichlorofluoromethane	1 ug/L
1,1-Dichloroethylene	1 ug/L
1,1-Dichloroethane	1 ug/L
1,2-Trans-dichloroethylene	1 ug/L
Chloroform	1 ug/L
1,2-Dichloroethane	1 ug/L
1,1,1-Trichloroethane	1 ug/L
Carbon tetrachloride	1 ug/L
Dichlorobromomethane	1 ug/L
1,2-Dichloropropane	1 ug/L
Trans-1,3-dichloropropene	1 ug/L
Trichloroethylene	1 ug/L
Benzene	1 ug/L
Chlorodibromomethane	1 ug/L
1,1,2-Trichloroethane	1 ug/L
Cis-1,3-dichloropropene	1 ug/L
Bromoform	1 ug/L
1,1,2,2-Tetrachloroethane	1 ug/L
Tetrachloroethylene	1 ug/L
Toluene	1 ug/L
Chlorobenzene	1 ug/L
Ethylbenzene	1 ug/L
Acetone	10 ug/L
Methyl ethyl ketone	10 ug/L
Carbon disulfide	1 ug/L
Vinyl chloride	10 ug/L
Isopropyl acetate	1 ug/L
2-Hexanone	1 ug/L
Methyl isobutyl ketone	1 ug/L
Styrene	1 ug/L
Xylene	1 ug/L

WATER QUALITY ANALYSES OF THE CRETACEOUS AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-K1 Englehard Kaolin Company #2, Gordon Wilkinson County 06/22/88	4.9	0.89	0.28	1.9	0.67	10U	10U	2.5	3.0	0.23	10U	10U	24	Al = 20	
GWN-K2 Irwinton #2 Wilkinson County 06/22/88	4.8	1.2	0.34	1.7	0.50U	27	10U	3.9	4.0	0.27	10U	10U	28	Al = 56 Cu = 16	10
GWN-K3 Sandersville #7B Washington County 04/28/88	6.5	15.4	1.4	2.1	0.5	542	32	4	8.6	0.03	21	60	106		1,5,10
GWN-K4 Midville Experiment Station TW 1 Burke County 01/13/88	6.8	7.7	1.7	10.4	4.5	3,500	160	2.0	9.6	0.04	450	150	113		1,3,5
GWN-K5 Richmond County #101, Augusta Richmond County 04/27/88	5.4	0.42	0.23	1.1	0.5U	10U	10U	3	2U	0.35	10U	10U	13		Hg,8,9

WATER QUALITY ANALYSES OF THE CRETACEOUS AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-K5 Richmond County #101, Augusta Richmond County 09/13/88	5.0	1U	1U	1.2	1U	20U	10U	1.2	2U	0.37	10U	80U	31	Au = 11	Hg,8,9
GWN-K6A Huber Corp. #6 Twiggs County 06/21/88	5.9	4.2	0.5	3.6	1.1	15	10U	4.4	5.6	0.07	17	57	46	Zn = 30	CN
GWN-K7 Jones County #4, Macon Jones County 06/23/88	5.7	1.7	0.4	1.7	0.5U	10U	10U	3.9	2.0	0.15	13	11	21		
GWN-K8 Laurens Park Mill #3, Mohasco Corp., East Dublin Laurens County 01/14/88	6.6	26.0	1.2	1.9	3.3	4,100	47	3.9	11.3	0.03	82	125	154	Cu = 22	1,5,10
GWN-K9 Marshallville #1 Macon County 06/21/88	4.1	2.0	0.3	1.4	0.5U	1,820	13	3.0	12	0.04	10U	10U	44	Al = 300	1,5,10

WATER QUALITY ANALYSES OF THE CRETACEOUS AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L ---------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-K10 Fort Valley #1 Peach County 01/14/88	6.2	1.1	0.5	2.6	0.5U	10U	10U	3.9	2U	0.25	10U	10U	57		10
GWN-K10 Fort Valley #1 Peach County 06/21/88	5.3	1.2	0.5	2.8	0.5U	10U	10U	4.9	2.1	1.2	10U	10U	30		
GWN-K11 Warner Robins #1A Houston County 01/14/88	5.2	0.6	0.2	1.0	0.5U	48	10U	2.0	2U	0.35	10U	10U	13	Cu = 15	10
GWN-K11 Warner Robins #1A Houston County 06/21/88	5.5	0.5	0.24	1.1	0.5U	10U	10U	3.9	2.2	--	10U	10U	14	Cu = 14	10
GWN-K12 Perry, Holiday Inn Well Houston County 01/14/88	4.1	0.5	0.25	1.0	0.5U	180	10U	2.9	8.7	0.03	10U	10U	45	Al = 360 Zn = 52	10

WATER QUALITY ANALYSES OF THE CRETACEOUS AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-K12 Perry, Holiday Inn Well Houston County 06/21/88	4.1	1.0	0.27	1.1	0.5U	164	10	8.4	9.2	--	10U	10U	44	Al = 350 Zn = 43 Chloroform = 2.2 Dichlorobromomethane = 1.5	1,5,10
GWN-K13 Omaha #1 Stewart County 11/17/88	8.2	3.2	1U	55	1U	20U	10U	13.7	10.6	0.1U	20U	59	227	Bi = 27	1,3,5
GWN-K14 Fort Benning Test Well Chattahoochee County 12/20/88	7.9	15	1.0U	27	2.2	76	10U	8.1	5.8	0.02U	20	240	208		
GWN-K16 Packaging Corporation of America, North Well Bibb County 01/14/88	5.3	0.6	0.2	4.2	0.5U	12	10U	3.9	2.3	0.05	10U	10U	26		10
GWN-K16 Packaging Corporation of America, North Well Bibb County 06/21/88	5.7	0.61	0.23	4.8	0.50U	10U	10U	3.0	2.9	0.37	10U	10U	28	Zn = 33	10

WATER QUALITY ANALYSES OF THE CRETACEOUS AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-K17A Well #2 (East) Burke County 04/28/88	7.8	2.6	0.54	37.1	1.8	61	10U	3	5	0.02U	18	44	180		Hg,1,3, 5,8,9,10
GWN-K18A Buena Vista #6 Marion County 03/24/88	5.9	1.4	0.36	1.3	0.5U	39	10U	3.0	3.6	0.16	10U	10U	25	Al = 46	10
GWN-K19 Hephzibah, Murphy Street Well (#3) Richmond County 04/27/88	5.4	0.49	0.35	1.2	0.5U	11	10U	2	3	0.08	10U	10U	15	Cu = 15	10
GWN-K19 Hephzibah, Murphy Street Well (#3) Richmond County 09/13/88	5.2	1U	1U	1.5	1U	22	10U	1.6	2U	0.02U	10U	10U	32		7,10

WATER QUALITY ANALYSES OF THE PROVIDENCE AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	---------- mg/L -------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PD2A Preston #1 Webster County 03/24/88	6.2	6.1	0.52	1.6	0.95	10U	10U	3.0	2.8	0.85	20	13	50		1,3,5
GWN-PD3 Fort Gaines #2 Clay County 11/18/88	7.6	6.5	1.3	97	1.3	26	10U	11.4	10.4	0.1U	20U	110	372	Al = 26 Bi = 23	
GWN-PD4A Americus #3 Sumter County 03/23/88	7.4	36.3	2.2	2.5	2.4	105	23	6.0	15.6	0.06	10U	208	219	Zn = 34	1,3,5,10

WATER QUALITY ANALYSES OF THE CLAYTON AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-CT1 Turner City Well Dougherty County 10/26/88	7.9	11	5.8	43	2.7	510	12	1.7	10.6	0.02U	20U	290	262		
GWN-CT2A Burton Thomas Well Sumter County 10/12/88	7.8	36	3.4	5.8	1.4	70	10U	1.2	16.4	0.02U	10U	290	251		1,3,5
GWN-CT3 Dawson, Crawford St. Well Terrell County 10/12/88	7.8	35	4.9	6.6	1.8	22	10U	1.7	12.0	0.02U	10U	430	250		1,3,5,7,10
GWN-CT4 C.T. Martin TW 2 Randolph County 10/12/88	7.8	38	3.7	4.6	1.5	240	10U	1.6	9.0	0.02U	14	300	248		1,3,5
GWN-CT5A Cuthbert #3 Randolph County 10/12/88	7.6	57	4.3	1.7	1.2	390	27	2.1	12.1	0.02U	18	160	299	Bi = 41	1,3,5,7,10

WATER QUALITY ANALYSES OF THE CLAYTON AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-CT6B Fort Gaines Test Well Clay County 11/17/88	7.4	140	4.6	9.8	3.5	6,900	160	9.2	73	0.1U	56	230	590	Bi = 31 Sn = 67 Zn = 78	1,3,5
GWN-CT7 Moore Residence Well Sumter County	4.6	3.1	5.8	1.8	1U	170	10U	9.0	2U	6.8	23	58	93	Al = 210 Cu = 39 Zn = 42	1,5

WATER QUALITY ANALYSES OF THE CLAIBORNE AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L ---------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-CL1 TW 5 - Albany Dougherty County 10/25/88	7.7	57	9.5	9.4	2.9	220	10U	3.3	2U	0.02U	20U	390	337		
GWN-CL2 Unadilla #3 Dooly County 10/11/88	7.9	38	1U	1.5	1U	22	10U	1.7	7.4	0.1	13	110	214		1,3,5
GWN-CL3 Pete Long TW 2 Lee County 10/11/88	5.3	1.2	1U	1.3	1U	1,000	18	1.9	2U	0.02U	10U	12	22		1,3,5
GWN-CL4 Plains #3 Sumter County 03/23/88	4.9	2.0	1.4	4.4	1.2	18	58	3.0	2U	3.4	19	16	62	Al = 44 Cu = 43 Y = 12 Zn = 27	1,3,5,10
GWN-CL5 Shellman #2 Randolph County 10/12/88	4.2	4.6	3.1	3.0	3.5	20U	470	11.3	2U	7.3	57	38	115	Al = 240 Au = 13 Co = 23 Y = 64	

WATER QUALITY ANALYSES OF THE CLAIBORNE AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-CL7B Vet. Memorial State Park TW 2 Crisp County 03/21/88	7.8	55.5	2.10	2.8	1.39	158	10U	4.0	6.0	0.03	10U	198	305		10
GWN-CL8 Flint River Nursery Dooly County 10/13/88	5.1	2.9	2.2	2.7	1U	500	100	4.9	2U	3.4	79	29	58	Al = 36 Au = 12 Zn = 230	1,5

WATER QUALITY ANALYSES OF THE JACKSONIAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-J1 Vidette #1 Burke County 04/28/88	7.6	57.8	1.0	4.0	0.5U	10U	10U	11	2U	2.9	47	34	320		1,3,5
GWN-J1 Vidette #1 Burke County 09/12/88	7.6	56	1.1	4.1	1U	20U	10U	9.9	2U	2.40	54	33	318		1,3,5
GWN-J2A Oakwood Village MHP #2 Burke County 04/28/88	7.4	45.8	0.97	1.5	0.7	18	10U	3	2U	0.27	56	63	250	Zn = 50	1,3,5,10
GWN-J2A Oakwood Village MHP #2 Burke County 09/12/88	7.0	35	1U	1.7	1U	60	10U	1.9	2U	0.35	51	48	207	Zn = 130	1,3,5,7,10
GWN-J3 J. W. Black Well, Canoochee Emanuel County 01/13/88	7.7	33.7	6.1	9.8	1.6	110	124	7.8	2.0	0.03	770	310	244		1,5,10

WATER QUALITY ANALYSES OF THE JACKSONIAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-J4 Wrightsville #4, North Myrtle Street Well Johnson County 01/13/88	7.6	44.8	2.2	3.1	1.4	27	10U	3.9	6.7	0.08	12	189	237		1,5
GWN-J4 Wrightsville #4, North Myrtle Street Well Johnson County 06/22/88	7.9	44	2.2	3.2	1.2	10U	69	3.0	7.1	0.29	16	176	242		1,5
GWN-J5 Cochran #3 Bleckley County 06/22/88	7.8	66	2.6	3.4	2.2	226	25	3.0	15	--	11	240	328	Sn = 49	1,3,5,10
GWN-J6 Wrens #4 Jefferson County 04/27/88	7.0	24.9	1.0	1.6	0.5U	213	12	4	11	0.02	24	98	150		1,5,10
GWN-J6 Wrens #4 Jefferson County 09/12/88	6.7	24	1.2	1.6	1U	170	13	1.7	7.6	0.02U	14	94	158		1,5,7,10

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA1 Thunderbolt #1 Chatham County 05/25/88	7.8	24	8.6	15	2.1	10U	10U	18	7.6	0.02	12	370	266		
GWN-PA2A Savannah #6 Chatham County 05/25/88	7.7	23	7.8	11	1.7	10U	10U	7.0	7.8	0.05	14	290	222		8,9
GWN-PA3 Layne Atlantic Well, Savannah Chatham County 05/25/88	7.2	29	7.5	9.1	1.7	18	10U	9.0	8.6	0.02U	22	300	232		8,9
GWN-PA4 Tybee Island #1 Chatham County 05/25/88	7.7	31	23	49	4.1	13	10U	46	172	0.02U	10U	1,200	594		
GWN-PA14 Statesboro #7 Bulloch County 01/12/88	8.0	32.4	5.2	6.5	1.3	76	35	3.9	6.2	0.03	38	206	213	Zn = 20	

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA15	7.9	26.0	8.7	7.8	4.0	340	10U	2.9	7.9	0.03	10U	440	224		
King Finishing Company, Fire Pump Well, Dover Screven County 01/12/88															
GWN-PA16	7.6	44.7	3.1	4.6	2.3	35	33	5.8	8.2	0.03	10U	210	251	Zn = 11	
Millen #1 Jenkins County 01/13/88															
GWN-PA16	7.8	44	3.2	5.1	2.4	27	34	7.0	7.7	0.04	10U	206	259	Sn = 34	1,5
Millen #1 Jenkins County 06/22/88															
GWN-PA17	7.6	45.4	2.1	2.9	0.8	10U	10U	2.9	2U	1.18	170	190	237		
Swainsboro #7 Emanuel County 01/13/88															
GWN-PA17	7.8	44	2.1	3.0	0.80	10U	10U	4.9	2.0	0.08	167	184	242	Sn = 35	
Swainsboro #7 Emanuel County 06/22/88															

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA18 Metter #2 Candler County 01/13/88	7.8	29.5	3.4	10.0	0.5U	10U	53	4.9	3.2	0.02	27	264	203		
GWN-PA19 Douglas #4 Coffee County 02/09/88	7.7	42.6	18.3	10.3	1.5	26	10U	8.8	107	0.03	57	496	386		
GWN-PA20 Lakeland #2 Lanier County 02/09/88	7.6	42.8	16.6	4.8	0.9	15	10U	5.9	83	0.02	28	209	342		10
GWN-PA20 Lakeland #2 Lanier County 07/27/88	7.6	--	18	5.1	0.51	25	10U	7.0	87.0	0.02U	27	210	343		10
GWN-PA21 Valdosta #1 Lowndes County 02/10/88	7.4	34.5	4.0	3.1	0.5U	10U	10U	6.9	52	0.02U	48	60	225		1,5,8,9,10

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA21 Valdosta #1 Lowndes County 07/27/88	7.4	39	4.6	3.6	0.5U	10U	10U	9.0	59.8	0.02U	49	59	231		1,5,7, 8,9,10
GWN-PA22 Thomasville #6 Thomas County 02/17/88	8.2	41.3	19.6	7.6	0.9	10U	10U	7.8	98	0.10	25	364	385		
GWN-PA23 Cairo #8 Grady County 02/17/88	8.2	33.0	16.3	12.2	2.1	40	10U	7.8	43	0.02U	139	370	319		10
GWN-PA24 Bainbridge #1 Decatur County 02/17/88	--	35.9	3.3	2.0	0.5U	10U	10U	4.9	2U	1.35	10U	38	203		1,3,5,7,10
GWN-PA24A Bainbridge #3 Decatur County 07/27/88	7.9	39	3.4	1.9	0.5U	10U	10U	4.0	2.4	1.48	10U	38	206		1,3,5,7,10

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA25 Donalsonville East 7th St. Well Seminole Co. 02/17/88	8.1	50.9	0.6	3.7	0.5U	10U	10U	5.8	2U	1.35	10U	26	260	Sn = 36	CN,3,5,10
GWN-PA25 Donalsonville East 7th St. Well Seminole Co. 07/27/88	7.6	57	0.63	3.6	0.5U	10U	10U	7.0	2.4	1.41	10U	25	265	Sn = 41	1,3,5,10
GWN-PA26 Colquitt #3 Miller Co. 02/18/88	8.2	42.5	0.57	2.2	0.5U	10U	10U	4.9	2U	0.86	10U	22	216	Al = 23 Zn = 13	1,3,5,10
GWN-PA26 Colquitt #3 Miller Co. 07/27/88	--	46	0.56	2.0	0.5U	10U	10U	--	--	--	10U	21	--		1,3,5,7,10
GWN-PA27 Camilla New Well (#4) Mitchell Co. 02/16/88	7.8	39.5	1.2	1.7	0.5U	10U	10U	4.9	2U	0.37	10	40	220		1,3,5, 7,8,9,10

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA27 Camilla New Well (#4) Mitchell Co. 07/26/88	7.8	47	1.3	2.0	0.5U	10U	10U	4.0	2.4	0.33	10U	39	215		1,3,5, 7,8,9,10
GWN-PA28 Moultrie #1 Colquitt County 02/16/88	8.3	32.4	19.0	26.6	4.2	10U	10U	10.7	151	0.02U	95	2,160	446		
GWN-PA29 Adel #6 Cook County 02/10/88	7.7	46.1	17.2	3.8	0.7	60	10U	5.9	107	0.03	15	364	369		CN,1,5,10
GWN-PA29 Adel #6 Cook County 07/26/88	7.2	46	16	3.9	0.59	67	32	6.0	84.0	0.02	13	310	332		CN,1,5,10
GWN-PA30 Nashville Mills #2, Amoco Fabrics Company Berrien County 02/09/88	7.9	39.0	16.0	4.8	1.2	10U	10U	5.9	90	0.03	54	250	336		

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA30 Nashville Mills #2, Amoco Fabrics Company Berrien County 07/26/88	7.6	49	20	5.0	1.0	22	10U	6.0	87.0	0.02	56	240	335		
GWN-PA31 Tifton #6 Tift County 02/09/88	7.7	40.0	8.4	2.6	0.5	10U	10U	2.9	2U	0.04	63	285	262		
GWN-PA32 Ocilla #3 Irwin County 02/08/88	7.8	31.1	4.8	2.3	0.5	130	10U	5.9	2U	0.03	77	160	193		
GWN-PA33 Fitzgerald Well C Ben Hill County 02/08/88	7.9	23.5	8.3	3.0	0.7	200	17	3.9	2U	0.03	2,190	281	178	Zn = 14	10
GWN-PA34 McRae #1 Telfair County 06/22/88	--	50	11	5.5	1.8	183	99	--	--	--	302	784	--		

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA35 Mount Vernon New Well Montgomery County 06/22/88	--	29	13.7	6.5	4.5	61	30	--	--	--	107	523	--		
GWN-PA36 Vidalia #1 (Sixth Street Well) Toombs County 06/22/88	--	29	5.6	12	3.1	21	36	--	--	--	165	383	--	Sn = 34	CN
GWN-PA37 Hogan Monitoring Well Laurens County 01/14/88	7.5	43.5	0.6	1.9	0.5U	27	10U	5.8	2U	2.35	13	26	219		
GWN-PA38 Eastman #4 Dodge County 06/22/88	7.9	43	1.4	2.4	1.2	10U	10U	4.9	2.3	--	118	95	221		1,3,5,10
GWN-PA39 Sylvester #1 Worth County 02/16/88	7.9	44.3	6.7	3.3	1.1	10U	10U	5.8	2U	0.04	207	380	271	Sn = 38	1,3,5,10

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA39 Sylvester #1 Worth County 07/26/88	7.6	49	7.1	3.7	0.98	10U	10U	6.0	2.4	0.06	210	370	278	Sn = 39	1,3,5,10
GWN-PA40 Merck and Company #8 Dougherty County 03/22/88	7.8	52.0	1.14	2.33	0.6	10U	10U	6.9	2U	1.28	15	54	276		CN
GWN-PA40 Merck and Company #8 Dougherty County 10/26/88	7.7	61	1.2	2.7	1U	20	10U	3.5	2U	1.3	20	55	285	Bi = 21	CN
GWN-PA41 TW 13 - Albany Dougherty County 03/22/88	7.2	102	2.9	18.3	0.5U	18	10U	4.0	27.8	2.17	28	10U	589	Chloroform = 1 Tetrachloroethylene = 7 Cis 1,2 Dichloroethene = 5	CN,1,3,5,10
GWN-PA41 TW 13 - Albany Dougherty County 10/13/88	7.2	100	3.4	21	3.0	24	10U	15.1	31	2.4	44	85	606	Se = 120 Sn = 89 Chlordane = 0.31 Tetrachloroethylene = 1.6	CN,1,3, 5,7,10

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA42 Garrett OW 4 Lee County 03/23/88	7.2	27.9	0.48	2.5	0.5U	15	10U	2.0	2U	3.3	10U	14	166		CN
GWN-PA42 Garrett OW 4 Lee County 10/27/88	7.3	36	1U	3.0	1U	45	10U	6.7	2U	3.2	20U	18	197		CN,1,5
GWN-PA43 Newton #1 Baker County 02/18/88	8.1	42.4	0.93	2.6	0.5U	10U	10U	3.9	2U	1.68	10U	42	218		1,3,5,10
GWN-PA43 Newton #1 Baker County 07/26/88	7.9	46	1.0	2.7	0.5U	10U	10U	7.0	2.4	1.54	10U	44	218		1,3,5,10

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA44 Sycamore #2 Turner County 02/09/88	8.0	28.4	4.1	2.3	0.5U	10U	10U	2.9	2.0	0.15	137	296	182		1,3,5,10
GWN-PA45 Abbeville #2 Wilcox County 02/08/88	7.8	48.1	3.7	2.0	1.6	21	10U	3.9	4.5	0.10	15	229	260		1,10
GWN-PA46B C. Tyson Well Crisp County 03/21/88	7.7	43.8	0.77	2.3	0.5U	21	10U	4.0	2U	1.38	28	38	242	Zn = 80	1,3,5,10
GWN-PA47 Haley Farms TW 19 Lee County 03/22/88	7.6	51.1	0.93	1.8	0.5U	45	10U	5.0	2U	2.31	12	60	265		3,5,10

WATER QUALITY ANALYSES OF THE FLORIDAN AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-PA47 Haley Farms TW 19 Lee County 10/27/88	7.7	73	1.2	3.0	1U	20U	10U	10.1	2U	7.5	20U	58	345	Bi = 31	1,3,5,7,10
GWN-PA48 Doug Harvey TW 1 - Jakin Early County 03/23/88	7.6	45.7	0.63	2.24	0.5U	36	10U	5.0	2U	1.89	10U	24	240	Al = 42	CN,1,3,10
GWN-PA48 Doug Harvey TW 1 - Jakin Early County 11/16/88	7.6	55	1U	2.4	1U	25	10U	3.7	2U	1.8	20U	26	239	Bi = 22	CN,1,3, 5,7,10
GWN-PA49 Harmony Baptist Church Dooly County 10/13/88	7.8	38	1U	1.6	1U	20U	10U	2.6	2U	1.2	18	23	210	Au = 10	1,5

WATER QUALITY ANALYSES OF THE MIOCENE AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-MI1 W. J. McMillan Well Cook County 02/09/88	7.8	21.7	4.1	2.3	0.5U	10U	10U	3.9	9.6	0.03	22	129	228		CN,5,10
GWN-MI1 W. J. McMillan Well Cook County 07/26/88	7.9	24	15	7.0	1.2	62	23	5.0	4.8	0.03	19	130	229	Zn = 22	1,5,10
GWN-MI2 Boutwell Well Lowndes County 02/10/88	5.8	2.9	1.0	2.5	0.5	10U	10U	3.9	2U	0.13	10U	10U	36		CN,1,5, 8,9,10
GWN-MI2 Boutwell Well Lowndes County 07/27/88	5.7	2.9	1.0	2.7	0.5U	10U	10U	5.0	2.0U	0.13	10U	10U	37	Al = 24	1,5,7,8,9,10

WATER QUALITY ANALYSES OF THE MIOCENE AQUIFER SYSTEM

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-MI3 Coffin Park TW 3 Glynn County 05/25/88 GWN-MI3	7.5	64	10.0	20.0	3.6	130	14	28	64	0.02U	10	420	496		10
GWN-MI3 Coffin Park TW 3 Glynn County 12/06/88	7.4	76	12	22	3.7	130	12	20.1	38.9	0.12	20U	470	501	Bi = 31	7,10
GWN-MI4 Hopeulikit TW 2 Bulloch County 01/12/88	7.2	15.3	5.1	5.8	1.0	760	110	4.9	4.9	4.9	81	94	135	Al = 54	
GWN-MI4 Hopeulikit TW 2 Bulloch County 05/24/88	7.2	15	5.0	6.0	0.9	1100	110	7.0	7.0	0.02U	78	87	143	Al = 90 Zn = 14	

WATER QUALITY ANALYSES OF THE PIEDMONT UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-P1 Luthersville New Well Meriwether County 08/16/88	6.5	6.9	2.8	9.2	2.6	2,400	58	5.1	15.4	0.02U	10U	94	109	Au = 14	
GWN-P2 Riverdale, Delta Drive Well Clayton County 04/27/88	6.4	6.2	1.4	7.8	1.7	32	55	7.9	3	1.3	48	82	84		10
GWN-P2 Riverdale, Delta Drive Well Clayton County 09/13/88	6.3	9.5	1.6	10	1.5	20U	27	3.6	2U	0.92	32	78	119		7,10
GWN-P2 Riverdale, Delta Drive Well Clayton County 11/02/88	6.5	12	1.5	12	2.1	150	29	4.3	2	0.8	42	81	112	Al = 66	
GWN-P3 Fort McPherson Well Fulton County 04/25/88	6.9	7.9	2.6	8.1	3.2	7,360	58	4	8	0.04	17	70	106	Al = 830 Ti = 94 1,2-Dichloropropane = 1	8,10

WATER QUALITY ANALYSES OF THE PIEDMONT UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-P3 Fort McPherson Well Fulton County 10/06/88	6.7	12	3.3	9.1	3.9	1,100	75	1.3	6.5	0.02U	25	72	106	Al = 1,600 Au = 15 Bi = 23 Ti = 160 Zn = 53 1,2-Dichloropropane = 1.0	7,8,9,10
GWN-P4B Barton Brands, Inc. #2 Fulton County 04/27/88	6.5	17.8	3.6	27.2	2.7	135	966	26	16	0.6	75	288	256		8,9,10
GWN-P4B Barton Brands, Inc. #2 Fulton County 09/13/88	6.4	17	4.1	28	2.7	1,200	10U	19.7	13.7	0.56	73	280	257	Au = 15 Zn = 85	7,8,9,10
GWN-P5 Flowery Branch #1 Hall County 05/11/88	7.2	23	4.2	1.8	1.5	10U	10U	2	4	0.02U	31	88	160	Zn = 21	10

WATER QUALITY ANALYSES OF THE PIEDMONT UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-P6A Shiloh #1 Harris County 11/16/88	7.5	17	2.9	8.7	2.6	180	85	2.1	4.9	0.1U	20U	49	144	Al = 71 Bi = 38	
GWN-P7 Hampton #6 Henry County 08/16/88	6.7	10	5.1	7.7	1.4	20U	10U	2.0	3.0	0.25	50	71	117		10
GWN-P8 Wayne Poultry Company #4, Pendergrass Jackson County 05/11/88	7.2	25	8.6	9.0	1.3	10U	10U	4.0	8.6	0.02U	10U	71	230	Sb = 15	
GWN-P9 Gray #4 Jones County 06/21/88	5.6	19	10	14	3.9	1,970	266	9.9	84	0.04	48	155	250		10

WATER QUALITY ANALYSES OF THE PIEDMONT UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	------- mg/L -------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-P10A Franklin Springs Well #4 Franklin Springs 05/11/88	5.9	6.5	4.7	6.6	3.0	11,360	170	4	46	0.02U	19	78	130	Al = 32 Tl = 120 Zn = 29	
GWN-P11 Danielsville #1 Madison County 05/13/88	7.0	11	5.1	7.0	2.0	78	20	3	5	0.02U	10U	30	130	Sb = 40 Zn = 36	
GWN-P12 Nabisco Plant Well #1, Woodbury Meriwether County 08/16/88	6.4	10	2.9	13	3.2	30	10U	12.7	4.9	3.3	45	79	148	Cu = 22	
GWN-P13 Conyers, Rosser Street Well Rockdale County 08/16/88	7.5	29	1.7	11	1.4	1,000	78	5.2	10.1	0.02U	10U	82	203	Al = 110 Mo = 28 Ti = 25 Zn = 20 Tetrachloroethylene = 8	10

WATER QUALITY ANALYSES OF THE PIEDMONT UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Test
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-P14 Upson County, Sunset Village #1 Upson County 08/16/88	5.2	1U	1U	1.6	1.3	96	10U	2.2	0.5	0.32	28	10U	20	Zn = 130	
GWN-P15A P. Bolton Well Dekalb County 04/27/88	7.3	18.3	4.8	7.9	4.9	574	100	11	11	0.02U	58	103	180		10
GWN-P15A P. Bolton Well Dekalb County 09/13/88	7.2	17	5.3	7.8	4.5	640	88	7.3	7.3	0.02U	63	96	186		7,10
GWN-P16B Demorest Mize Road Well Habersham County 05/12/88	7.8	20	3.3	8.6	0.9	10U	17	7	10	0.02U	10U	141	160		10

WATER QUALITY ANALYSES OF THE BLUE RIDGE UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-BR1 Hiawassee #6 Towns County 05/12/88	7.0	24	2.2	7.5	1.8	528	314	3	4	0.13	20	217	180		10
GWN-BR2B Notla Water Authority #6 Union County 05/12/88	6.3	2.9	1.2	3.4	1.4	21	10U	4	2U	0.02U	36	32	48		
GWN-BR3 Dawsonville, Shoal Hole Park Well Dawson County 05/11/88	7.7	24	2.5	12	2.5	309	137	3	29	0.02	14	210	200	Tl = 26 Zn = 12	
GWN-BR4 Morganton Old Well Fannin County 05/12/88	6.3	9.9	2.4	7.5	1.7	25	10U	6	2U	0.02U	10U	98	110	Zn = 12	10,CN

WATER QUALITY ANALYSES OF THE VALLEY AND RIDGE UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-VR1 Kingston Road Well, Rome Floyd County 07/14/88	7.7	24	15	1.3	1U	20U	10U	1.6	1.0	0.54	10U	16	219		10
GWN-VR2 Tri-County Hospital Well - Ft. Oglethorpe Catoosa County 01/20/88	7.9	27.7	13.1	0.8	0.5U	10U	10U	4.9	2U	0.48	70	23	224		10
GWN-VR2 Tri-County Hospital Well - Ft. Oglethorpe Catoosa County 07/13/88	7.4	72	26	24	1U	84	140	25	19	0.88	34	88	608	Bi = 28 Sn = 51 Tetrachloroethylene = 1.5	10
GWN-VR3 Chickamauga, Crawfish Springs Walker County 01/20/88	7.4	22.7	9.2	1.1	1.1	590	15	4.9	3.6	1.04	57	25	194	Al = 690	10

WATER QUALITY ANLYSES OF THE VALLEY AND RIDGE UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-VR3	7.5	29	14	1.3	1U	20U	10U	1.5	2.0	0.67	81	26	234		
Chickamauga, Crawfish Springs Walker County 07/13/88															
GWN-VR4	7.5	87	22	15	2.8	100	20	15.8	69	0.02	150	680	601		
American Thread Co. (formerly Standard Cossa-Thatcher Co.) #4 Walker County 07/13/88															
GWN-VR5	7.4	68	3.8	5.4	1.1	20U	10U	8.4	2.9	3.36	110	180	364		10
Chattooga County #4 Chattooga County 07/13/88															
GWN-VR6	7.4	--	--	--	--	--	--	3.5	3.2	0.64	--	--	244		
Chemical Products Corporation, East Well Bartow County 07/14/88															

WATER QUALITY ANALYSES OF THE VALLEY AND RIDGE UNCONFINED AQUIFERS

PARAMETERS	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO_4	NO_2 &NO_3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	-------- mg/L --------				ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
Well ID#															
GWN-VR7 Adairsville, Lewis Spring Bartow County 07/14/88	8.2	27	15	1U	1U	20U	10U	1.1	1.3	0.36	38	27	--		10
GWN-VR8 Cedartown Spring Polk County 07/14/88	7.6	31	16	1.6	1U	20U	10U	1.9	1.6	0.62	13	21	251		10
GWN-VR9 Polk County #2 Polk County 07/14/88	7.9	32	13	1.4	1U	20U	10U	2.6	1.4	0.87	10U	10U	246		

For convenience in selecting our reports from your bookshelves, they are color-keyed across the spine by subject as follows:

Red	Valley and Ridge mapping and structural geology
Dk. Purple	Piedmont and Blue Ridge mapping and structural geology
Maroon	Coastal Plain mapping and stratigraphy
Lt. Green	Paleontology
Lt. Blue	Coastal Zone studies
Dk. Green	Geochemical and geophysical studies
Dk. Blue	Hydrology
Olive	Economic geology
	Mining directory
Yellow	Environmental studies
	Engineering studies
Dk. Orange	Bibliographies and lists of publications
Brown	Petroleum and natural gas
Black	Field trip guidebooks
Dk. Brown	Collections of papers

Colors have been selected at random, and will be augmented as new subjects are published.

Editor: Patricia Allgood

$720/100