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GEORGIA

STATE DIVISION OF CONSERVATION

DEPARTMENT OF MINES, MINING AND GEOLOGY
GARLAND PEYTON, Director

THE GEOLOGICAL SURVEY
Information Circular 28

GEOLOGY AND GROUND-WATER RESOURCES OF CATOOSA COUNTY, GEORGIA

By

Charles W. Cressler
U. S. Geological Survey

Prepared in cooperation with the U. S. Geological Survey

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GEOLOGY AND GROUND-WATER RESOURCES OF CATOOSA COUNTY, GEORGIA

by Charles W. Cressler

ABSTRACT

Catoosa County, in the Valley and Ridge province of Georgia, is underlain by rocks ranging in age from Early Cambrian to Pennsylvanian. Inventory of more than 500 wells indicates that all of the geologic formations except the Chattanooga Shale and the Lookout Sandstone yield sufficient water to wells for domestic and farm use. Most wells are between 50 and 150 feet deep, but some are deeper than 200 feet, particularly in the Knox Group.

The largest sustained pumpage, 50 gpm (gallons per minute), was from a 265-foot well in the Chickamauga Limestone, but many wells in the Knox Group, the Conasauga Formation, and the Floyd Shale probably could supply 50 gpm or more.

Ground water in the county ranges in total hardness from about 50 to 800 ppm (parts per million) and the mineral constituents in the water vary considerably within each formation. The iron content generally is less than 0.02 ppm.

Eight unused springs that discharge more than 11 million gallons per day from the Knox Group form the best source for industrial water supply in the county. The spring water ranges in total hardness from about 80 to 150 ppm. The iron content in most of the spring water is less than 0.02 ppm.

INTRODUCTION

Location, Purpose, and Scope

Catoosa County occupies an area of 167 square miles in northwest Georgia (Fig. 1). It is bounded on the east, south, and west by Whitfield and Walker Counties, Ga., and on the north by Hamilton County, Tenn. Ringgold, the county seat, is on U.S. Highway 41 about 17 miles southeast of Chattanooga, Tenn.

The ground-water resources of Catoosa County were investigated by the U.S. Geological Survey in cooperation with the Georgia Department of Mines, Mining, and Geology as part of a statewide program designed to appraise Georgia's water resources. The amount of ground water being used, and the quantity, quality, and availability of ground water in the county were studied. The investigation was made under the general supervision of P. E. LaMoreaux, former chief, Ground Water Branch, and under the direct supervision of J. T. Callahan, district geologist.

Methods of Investigation

During the investigation more than 500 drilled and dug wells were inventoried to obtain information about the range in depth of wells and depth to water and to determine the quantity and the quality of the ground water.

Springs of significant size were inventoried and their rate of flow measured or estimated. Water temperature was measured and the reliability, fluctuation, and water quality were learned where possible. The larger springs were measured during wet and dry seasons for the period of the investigation to determine the range of flow.

Water samples from 13 wells and 7 springs were analyzed in the Quality of Water Branch Laboratory, Ocala, Fla. Partial analyses for chloride and total hardness were made by the writer of water from additional wells and springs.

Recording gages were installed on two wells to obtain a continuous water-level record. A network of 18 wells was established in which water-level measurements were made about once a month.

Geology was mapped on the Tennessee Valley Authority 7½-minute quadrangle series and the thickness of the Knox Group was measured using a Brunton compass and a 500-foot steel tape.

Acknowledgments

The writer wishes to express his appreciation to the well owners of Catoosa County for their cooperation and to the well drillers and operators who furnished information and collected well cuttings, especially Mr. Pete Kittle.

Dr. A. T. Allen and Mr. R. J. Martin of the Geology Department of Emory University were helpful on problems concerning geology. The unpublished geologic map of Catoosa County by Dr. Allen and others of Emory University was of great assistance. Mr. Mack G. Croft helped measure the thickness of the Knox Group.

The U.S. Park Service permitted the installation of recording gages on wells in Chickamauga and Chattanooga National Military Park.

Previous Investigations

The earliest detailed geologic investigations in the area were made by C. W. Hayes (1891) of the U.S. Geological Survey. Butts (1948), also of the U.S. Geological Survey, made the most recent general study of the area. Other works on the Paleozoic rocks in the area were published by several authors as Georgia Geological Survey Bulletins and are listed in detail by Butts (1948). Allen and Lester (1957) reported on the Middle and Upper Ordovician Limestone.

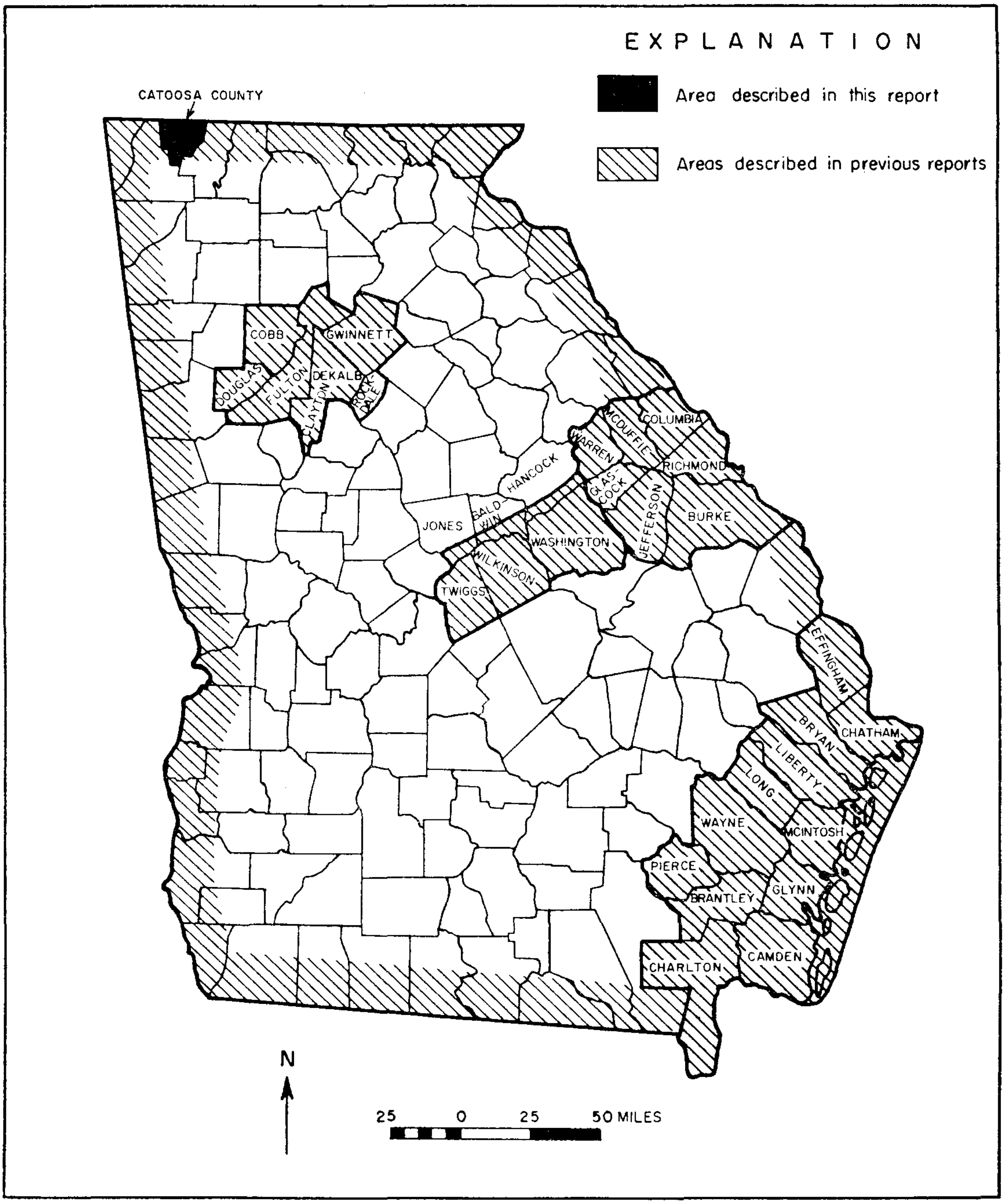


Figure 1.—Map of Georgia showing Catoosa County and areas described in previous reports.

Industry and Agriculture

Industrial development in Catoosa County is limited primarily to carpet and furniture manuturing, milk processing, and lumbering.

Agriculture in the county is characterized by part time and residential farming. More than half of the agricultural income of the county is from poultry products, and facilities are available for growing more than 4 million broilers per year. Dairying ranked second as a source of cash income for Catoosa County farmers in 1954, accounting for nearly 21 percent of the total (Catoosa County Agricultural Development Board, 1958).

Soils of the county are derived mostly from limestone and are only moderately productive. The county is divided by undulating valleys and ridges, which extend its entire length. The valleys are adapted to cotton, corn, small grains, and pastures. The lower ridges are used to grow truck, hog, and pasture crops, and the rougher terrane is used mostly for growing timber.

Transportation

Catoosa County is served by a good network of all-weather roads. U.S. Highway 41 crosses in a southeast-northwest direction, giving Ringgold, the county seat, direct access to Chattanooga, Tenn. U.S. Highway 27 passes along the west side of the county and Georgia Highway 2 serves as an east-west connecting link between the two main arteries. Georgia Highway 151 traverses the county in a north-south direction, passing through Ringgold. Many miles of paved roads and good quality secondary roads make all but the remotest areas easily accessible. The Louisville and Nashville Railroad serves the county through its facilities at Ringgold and Graysville.

Well and Spring Numbering System

Wells in Catoosa County are numbered consecutively in each 7½-minute quadrangle. A well number is preceded by the first letter, or letters, of the name of the quadrangle in which it is located—ER, East Ridge; R, Ringgold; NG, Nickajack Gap; TH, Tunnel Hill; K, Kensington; and FO, Fort Oglethorpe. Springs are listed in the same manner as wells except that spring numbers are preceded by "S" — for example ER-S8.

PHYSICAL GEOGRAPHY

Physiography

Catoosa County is in the Valley and Ridge province of Georgia, a part of the Appalachian Valley (Butts, 1948, p. 3), which is a comparatively narrow belt of generally low-lying country extending from Canada to northern Alabama.

The terrane of the Valley and Ridge province is composed of valleys, separated by steep or by well rounded ridges. The part of the county east of Whiteoak Mountain and Taylor Ridge is characterized by long, discontinuous, steep-sided ridges separated by narrow valleys. West of Whiteoak Mountain and Taylor Ridge the valleys ridges are wide and the ridges are rounded.

Lowland areas are 700 to 800 feet above sea level. Ridges rise 100 to 300 feet above the valley floors. The most prominent topographic features in the county are Whiteoak Mountain and Taylor Ridge which rise more than 1,300 feet above sea level.

Drainage

Catoosa County lies in the Tennessee River basin and is drained by South Chickamauga Creek, which flows northward and joins the Tennessee River about 4 miles above Chattanooga, Tenn.

The county has four main drainage areas: (1) the valleys and ridges east of Whiteoak Mountain and Taylor Ridge which are drained by Tiger and East Chickamauga Creeks; (2) Rabbit and Wood Station Valleys together with Peavine Ridge, which are drained by the Little Chickamauga Creek system; (3) Peavine Valley, drained by Peavine Creek and; (4) Chickamauga Valley, drained by West Chickamauga Creek and Black Branch.

Rivers of the Valley and Ridge province have an average annual runoff of 20 to 25 inches depending upon the location. In valleys, the streams meander along flood plains but where they have cut through ridges the stream channels are shallow and contain many rapids.

Climate

Catoosa County has a mild climate with an average January temperature of 41°F and an average July temperature of 78°F. The frost free season averages 212 days. The average annual precipitation is about 52 inches.

Precipitation in the county has two well marked peaks — one in winter and the other in midsummer — separated by periods of lighter rain in the spring and autumn. Autumn is the driest season of the year.

The amount of rainfall varies from year to year and the amounts for the wettest years are nearly double those of the driest years. Almost half of the rainfall amounts to one inch or more within 24 hours. Severe droughts seldom occur oftener than once every 10 to 15 years (U.S. Department of Agriculture, 1941, p. 828).

GEOLOGY AND GROUND WATER

Geologic History

The Paleozoic rocks of the Valley and Ridge province comprise more than 20,000 feet of strata laid down between Early Cambrian and Pennsylvanian time.

The sediments of Lower Cambrian through Lower Ordovician were washed off land areas to the northwest and deposited on the floor of a shallow sea (Rodgers, 1953, p. 60). Sediments of Middle Ordovician through Pennsylvanian were derived from land areas to the southeast or east (Rodgers, 1953, p. 92). Younger sediments buried older sediments and the resulting pressure compacted the sediments into rock.

Marine fossils are fairly abundant in the rocks of Lower Ordovician through Mississippian age but nonmarine fossils are found in the Pennsylvanian strata.

Structural Setting

The geologic formations underlying Catoosa County were flat until compressional forces from the southeast deformed them into giant folds.

As shown in the geologic section (Fig. 2), the rocks of the county west of Sand Mountain are included in a large wave-like fold (the top of which has been eroded) that brought the rocks up across an axis in Peavine Valley and down beneath Chickamauga Valley, and up again to form Missionary Ridge. Faulting broke and distorted the fold somewhat at Boynton Ridge and western Peavine Valley.

East of Sand Mountain older rocks were thrust over and now overlie younger rocks. The stratigraphic displacement along this fault contact is about 9,000 feet. Two other faults of considerable displacement brought younger rocks down into contact with older rocks. The formations east of Sand Mountain generally are distorted, but the more competent layers have a general east dip.

Hydrologic Cycle

The earth's moisture is involved in a continuous circulation, from the oceans to the land and back to the oceans. Water from the oceans evaporates into the atmosphere and is carried by winds to land areas. The moisture condenses and falls to earth as precipitation.

Precipitation feeds lakes and rivers and is the source of water in the underground reservoirs. Rivers carry some of the water back to the oceans. Evaporation from the rivers, land, and oceans, puts water back into the atmosphere, from which it again falls to earth as precipitation. The exchange goes on continuously. Water travels endlessly from earth to atmosphere and back to earth in what is called the hydrologic cycle.

In one phase of the hydrologic cycle water travels beneath the earth's surface giving us one of our most valuable natural resources — ground water.

Source and Occurrence of Ground Water

Underground reservoirs of water store the largest amount of fresh water in the nation — far more than all surface reservoirs and lakes, including the Great Lakes. Public interest in ground water is growing along with the interest in stream regulation and development, in weather modification, and in conversion of salt water to fresh water. Such interest arises from the nationwide trend which indicates that our water needs for industry, irrigation, and municipal use will more than double our present usage in 25 years (U.S. Department of Agriculture, 1955, p. 63).

The selection of ground water as a source of supply instead of surface water is often made for one or more of the following reasons (U.S. Department of Agriculture, 1955, p. 63):

1. Ground water can be obtained on or near the property where it is to be used, whereas surface water may require long pipelines.
2. Yields from wells and springs fluctuate less than stream flow.
3. Ground water may be obtained in areas where stream and lake waters have been appropriated by other users.
4. Ground water is more uniform in temperature and mineral content than surface water, and is generally free of turbidity and bacterial pollution.

The subsurface water of Catoosa County is derived from precipitation. Water falling on the ground either runs off the surface to a stream, evaporates back into the atmosphere, or soaks into the ground. Of the water that soaks into the ground, some remains near the surface clinging to soil particles, to be evaporated or used by plants, but much of it passes downward into the zone of saturation. The zone of saturation is that part of the earth below land surface in which all the pore spaces and openings are filled with water. This water is called ground water. The upper surface of the zone of saturation is called the water table except where that surface is formed by an impermeable body of rock.

The water table is seldom flat but is generally a subdued replica of the topography of the land. The depth of the water table below land surface in Catoosa County varies with the amount of precipitation. During wet periods the water table is nearer the surface than during dry periods.

The size and number of rock openings in the zone of saturation determine the amount of water that can be stored there. Rocks such as cemented sandstone, shale, and compact limestone initially contain little open space in which to store ground water. Weathering and the forces of deformation produce secondary openings in the form of fractures, joints, and solution cavities that enable the rocks to store vast quantities of ground water. Limestone and dolomite are the most important ground-water reservoirs in Catoosa County.

In some areas of the county water occurs under artesian conditions. Ground water under natural pressure is called artesian water. For a well to be artesian, its water must rise above the water-bearing layer, but not all artesian wells flow at the land surface. Figure 3 shows a sandstone unit cropping out on a hill. Covering the sandstone on its downslope side is an impervious layer that confines the water in the sandstone. Being confined, the water is under pressure. If a well is drilled into the sandstone as shown, water will rise in the well and may flow at the land surface.

Practically all wells in Catoosa County derive water from ground water that exists under water-table conditions.

Ground water moves in response to gravity just as surface water does, though more slowly because it loses energy by friction while passing through the small openings in the rock. The direction of movement is down the hydraulic gra-

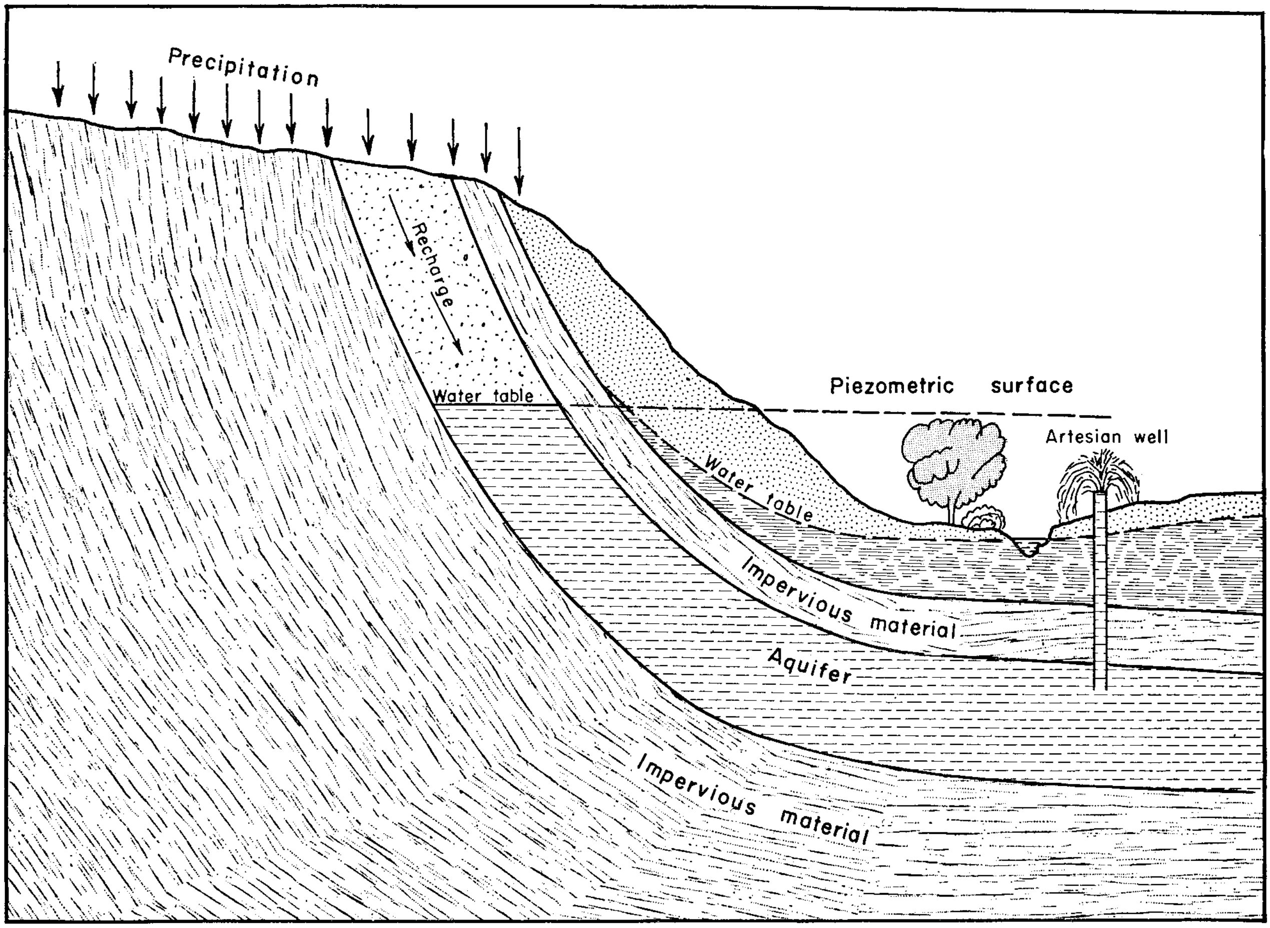


Figure 3.—Artesian conditions in sandstone aquifer, Catoosa County, Ga.

dient (downhill) toward the point of lowest level in any given area.

A geologic formation, group of formations, or part of a formation that is water bearing is called an aquifer (Meinzer, 1923, p. 30). The geologic formations and their water-bearing properties are summarized in table 1.

Descriptions and Water-Bearing Character of Geologic Formations

Cambrian

Rome Formation

The Rome Formation of Early Cambrian age is the oldest formation exposed in Catoosa County. The Rome underlies two parallel northeast-trending belts in the eastern part of the county. One belt includes Sugartown, Keith, and Salem. The other belt lies close to the eastern boundary of the county (Fig. 2).

The Rome Formation consists almost entirely of sandstone, siltstone, and claystone. A few beds of limestone and calcareous siltstone also occur. The lower part of the Rome is dominantly red claystone and siltstone. This distinctive part was named the Apison Shale by Hayes (1894), who considered it a separate formation. Above the lower red strata are 1,500 to 2,000 feet of alternating layers of varicolored sandstone, siltstone, and claystone. Passing upward, the proportion of sandstone gradually decreases so that toward the top it is almost absent. The claystone and siltstone beds are green, yellow, brown, or red. For the most part they are fissile and are correctly termed shale. The sandstone is fine grained and green, red, brown, dark gray, or nearly white. Ripple marks on the sandstone may indicate that it is a shallow water deposit.

Folding, particularly in the more clayey and silty parts, is a striking feature of the formation. In nearly all exposures, the strata are steeply tilted or vertical. Even the thick sandstone beds have been severely folded. Where the sandstone is steeply inclined it forms low knobby ridges. The shale underlies valleys.

The thickness of the Rome Formation, including the Apison Shale Member, was estimated by Hayes (1894) to be between 4,000 and 5,000 feet. The thickness in Catoosa County is uncertain because repetition caused by folding and faulting makes accurate measurement virtually impossible and the base of the formation is not exposed.

The Rome Formation furnishes as much as 20 gpm (gallons per minute) to wells for domestic and farm purposes. The water-bearing properties

Table 1. Geologic formations and their water-bearing properties, Catoosa County, Ga.

System	*Formation*	*Thickness (feet)*	*Lithology*	*Water-bearing characteristics*
Pennsylvanian	Lookout Sandstone	?	Massive-bedded, conglomeratic sandstone; shale.	Not an aquifer
Mississippian	Floyd Shale	1,400	Shale; includes thick units of limestone, siltstone, and sandstone.	Yields from limestone are greater than needed for farm and home use. Yields from shale and sandstone are smaller, though usually adequate.
	Fort Payne Chert	400	Bedded chert, shale, and limestone.	More than adequate for rural needs.
Mississippian and Devonian	Chattanooga Shale	15	Shale, black, hard	Not an aquifer.
Silurian	Red Mountain Formation	1,000	Sandstone and shale	Moderate amounts of water; much has high iron content; aquifer little used because of rough terrain.
Ordovician	Chickamauga Limestone	1,400-2,300	Limestone, clayey and silty, and siltstone.	Wells yield as much as 50 gpm; sulfur water common; wells reliable and shallow.
	Knox Group: Longview Dolomite	350	Thick-bedded limestone and dolomite	Wells yield as much as 50 gpm or more; water of good chemical quality; best aquifer for large supplies of water. Springs discharge several million gallons per day.
	Knox Group: Chepultepec Dolomite	800+	Thick-bedded dolomite; little limestone.	
Cambrian	Knox Group: Copper Ridge Dolomite	2,500	Thick to massive-bedded dolomite; some thin-bedded dolomite at base.	
	Conasauga Formation	1,500-4,000	Impure limestone, calcareous siltstone, and claystone.	Yields 5 to 20 gpm or more from limestone cavities; shale areas yield less; dug wells supply farms and homes.
	Rome Formation	4,000-5,000	Shale and sandstone.	Fair to poor aquifer; locally yields small to moderate quantities of water to wells; a few wells yield as much as 20 gpm.

of the Rome vary from place to place, depending on the predominance of sandstone or shale. The largest supplies are obtained from wells drilled along the edges of sandstone ridges. Areas underlain by shale generally yield small supplies, although some wells 200 feet deep or more yield as much as 20 gpm for short periods of pumpage (Table 1).

Nearly all wells in the Rome Formation are less than 100 feet deep and many are less than 50 feet deep. The majority of the deeper wells furnish more water than is needed for domestic or farm use and never go dry. Many dug wells and shallow drilled wells pump dry after heavy use but usually refill in a few hours or overnight. One 80-foot well, R-136, in a predominantly shale area, was bailed at 15 gpm for one hour and had no measurable drawdown of the water level. A 205-foot well, R-144, drilled in shale was bailed at 17 gpm for one hour with a drawdown of 100 feet.

Many wells were reported to have been completely dry during drilling until they struck water-filled cavities. Water is also obtained in what local drillers call "rotten rock" in which drilling is quite easy. The "rotten rock" is described as being very porous and it occurs at depths greater than 200 feet.

Rock from a 200-foot well drilled in a shale area of the Rome was a dark greenish gray shale which effervesced in weak hydrochloric acid; pale pink and white calcite filled small fractures in the shale. Many people reported a "lot of lime" in their water. Therefore, it appears that shale of the Rome Formation contains more calcium carbonate than surface exposures indicate.

Analysis data of water from wells in the Rome showed a range in hardness of 108 to 203 ppm (parts per million). Water containing iron in solution is common in the formation. Several people reported that their wells had to be abandoned because of excessive amounts of iron in the

Table 2. Chemical analyses, in parts per million, of ground water, Catoosa County, Ga.
(Analyses by U.S. Geological Survey)

Water-bearing formations: Mfp, Fort Payne Chert; Srm, Red Mountain Formation; Oc, Chickamauga Limestone; O€k, Knox Group; €c, Conasauga Formation; €r, Rome Formation.

Well No.	Owner	Date of collection	Water-bearing formation	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids Residue at 180°C	Hardness as $CaCO_3$: Total hardness	Hardness as $CaCO_3$: Non-carbonate hardness	Specific conductance (micromhos 25°C)	pH	Color	Temperature (°F)
TH-1	K. R. Bandy	8-26-58	Mfp	11	0.49	46	6.1	2.0	0.8	149	18	2.0	0.2	0.3	160	140	18	275	7.4	4	—
R-112	J. E. Bowman	8-25-58	Srm	24	.01	53	7.3	5.7	1.2	171	24	6.5	.2	.8	219	162	22	342	7.2	5	—
R-55	M. A. Wells	5- 1-58	Oc	12	.03	45	13	36	6.3	328	42	34	.2	2.8	393	166	0	682	7.7	0	66
ER-68	Maggie Williams	5- 5-58	Oc	15	.01	18	9.5	162	6.5	450	76	5.0	1.5	3.2	525	84	0	832	8.1	0	61
NG-34	Mt. Pisgah Baptist	9- 2-58	O€k	9.2	.02	39	18	.7	.4	205	.8	1.5	.1	.4	169	172	4	313	7.5	2	—
FO-1	Post Ice & Coal	5- 5-58	O€k	8.7	.01	55	12	2.9	1.0	217	11	4.5	.1	2.9	209	186	8	362	7.4	1	61
ER-31	W. M. Hill, Jr.	9- 2-58	O€k	10	.00	40	18	.6	.4	186	8.8	4.0	.1	18	202	174	22	335	7.7	3	—
NG-31	Ira Warren	9- 2-58	O€k	8.6	.02	29	13	1.7	.3	147	.2	2.5	.0	7.4	125	124	4	245	7.4	6	—
NG-68	H. A. Wells	9- 2-58	O€k	9.3	.05	31	18	1.0	1.0	177	.0	.0	.1	.6	152	148	3	281	7.9	0	—
ER-83	S. H. Bonds	5- 7-58	€c	18	.01	79	3.6	6.4	1.4	280	9.2	3.0	.1	.2	265	212	0	432	7.9	2	57
TH-5	Sam Greeson	8-25-58	€r	9.4	.02	68	5.0	1.5	.2	216	6.2	4.5	.1	6.5	213	190	13	365	7.6	6	—
R-114	Handy White	5- 1-58	€r	30	.01	28	6.8	6.4	1.4	108	20	5.0	.3	.5	146	98	10	226	7.2	0	62
ER-29	Wes Tudor	6-29-59	Oc	10	.07	32	12	195	4.3	498	84	32	1.0	1.6	630	130	0	999	8.0	5	—
Spring No.																					
NG-S8	H. R. Andrews (Leitz Spring)	5- 5-58	€c[1]	7.3	.01	29	12	.6	.4	155	.2	1.5	.1	.1	129	122	0	232	7.8	1	60
ER-S1	J. R. Graham	9-25-58	€c[1]	7.4	.01	43	5.5	.8	.6	161	.8	2.5	.1	.0	138	130	0	248	7.9	3	60
ER-S2	Graysville Springs	8-25-58	O€k	9.1	.02	27	12	.6	.6	136	.8	.5	.1	.3	112	117	6	213	7.2	6	60
ER-S13	Dr. F. Johnson (Blue Spring)	8-28-58	Oc[1]	6.5	.00	37	12	.8	.2	167	2.7	1.5	.3	.5	136	142	5	260	7.7	2	61
ER-S6	Ellis Spring	5- 7-58	O€k	7.6	.15	20	9.0	1.2	.7	110	1.2	2.0	.1	1.6	92	87	0	170	7.6	2	58
NG-S12	Yates Spring	5- 2-58	Oc[1]	9.5	.01	26	10	.5	.5	129	1.2	1.5	.0	1.3	110	106	0	209	7.5	0	59
ER-S16	Poplar Spring	8-20-58	O€k	6.9	.00	26	13	1.0	.1	141	.4	1.5	.1	.7	116	118	4	220	7.6	3	59

[1]Springs discharge from indicated formation, but water is from the Knox Group.

water. Water from well TH-5 had an iron content of 0.02 ppm (Table 2).

Springs in the Rome are small and are not important sources of water, although a few near sandstone ridges furnish water to houses. Water from several of these springs is highly mineralized as illustrated by the analyses of water from Catoosa Springs listed in Table 3.

Conasauga Formation

The Conasauga Formation of Middle and Late Cambrian age underlies Peavine Valley and a narrow valley just east of Smith Chapel on the east side of the county. Exposures of the formation are numerous in Peavine Valley.

The Conasauga in Catoosa County consists of clayey and silty limestone, calcareous siltstone, and claystone. The bulk of the formation is a mixture of siltstone, claystone, and limestone interbedded in varying proportions. The upper 300 feet or so of the formation is a limestone unit consisting of massive bedded gray limestone. The Conasauga contains enough silt and clay so that it weathers to a shale.

In many outcrops the siltstone contains enough calcium carbonate to give it the appearance of limestone. However, after dissolving a piece of the rock in acid it becomes apparent that lime is a minor constituent, and this accounts for the small reduction in volume that the rock undergoes upon weathering.

Tight folding and poor exposure make accurate measurement of the Conasauga impossible. The thickness was estimated by Hayes (1894) at 1,500 to 4,000 feet.

Table 3. Chemical analyses, in parts per million, of water from Catoosa Springs, Catoosa County, Ga.[1]

(from McCallie, 1908, p. 272)

Constituents determined	Epsom Springs	Coffee Springs	Buffalo Lithia Springs	Cosmetic Springs
Silica (SiO_2)	18	31	70	17
Sulfate (SO_4)	760	730	915	840
Carbon dioxide (CO_2)	123	138	181	126
Phosphorus (P)	trace	trace	—	—
Chloride (Cl)	7	6	5	5
Iron (Fe)	2	2.1	2.4	.4
Aluminum (Al)	.1	.5	.5	.3
Calcium (Ca)	290	304	345	292
Magnesium (Mg)	38	48	55	36
Sodium (Na)	4.4	8.3	5.6	2.2
Potassium (K)	3.3	13.2	14.1	6.6
Probable Combinations				
Potassium chloride	9.3	12	10	4.8
Potassium sulphate	—	7.1	2	—
Sodium chloride	3.5	—	—	4.3
Sodium sulphate	4.3	36	42	13
Sodium phosphate	trace	trace	—	—
Magnesium sulphate	190	241	281	180
Calcium sulphate	848	711	924	971
Calcium carbonate	112	213	182	15
Aluminum sulphate	3.8	3.3	3.3	2
Ferrous carbonate	4.2	4.3	6.5	1.1
Silica	18	31	70	17
Dissolved solids	1,193	1,259	1,521	1,208
Free carbon dioxide	73	45	101	59

[1]Catoosa Springs includes four separate springs within an area of about two acres.

The Conasauga in Peavine Valley forms a folded asymmetric anticline, steeper on the west side. Faulting on the west side of Peavine Valley may have removed part of the formation because the upper limestone unit is not exposed, whereas it is well exposed on the opposite side of the valley.

The Conasauga exposed in the belt on the east side of the county is highly folded but the beds appear to have a general east dip.

The Conasauga Formation is a fairly productive aquifer. Most wells penetrating the Conasauga are less than 100 feet deep and furnish ample water for domestic and farm purposes. Many wells show practically no drawdown when bailed at 20 gpm for several hours.

Solution openings are common in the formation, especially in the upper limestone unit. The openings store ground water and yield large quantities to wells. One well just across the line in Walker County penetrated a 9-foot cavity at a depth of 65 feet. The well was bailed at 20 gpm for an hour and the drawdown of the water level was only 3 feet.

Wells penetrating large solution cavities or several large joints may appear to be exceptionally good wells capable of supplying an abundance of water. However, experience has shown that some wells are not as good as they first appear. A 235-foot well at Emory University Geology Field Camp, in the southern part of Peavine Valley, gave a large yield when first drilled. The water was obtained from joints at less than 100 feet, but drilling was continued to provide room for storage. At first, the well was pumped freely and yielded many gallons per minute, but after several hours it was pumped dry. Despite attempts to further develop the well, it would yield only about 2 gpm.

A well tapping joint or solution openings may at first yield large quantities of stored water, but once the openings are emptied, they may be slow to refill.

The majority of drilled wells in the Conasauga are less than 100 feet deep, but some wells as deep as 250 feet yield excellent supplies. As a general rule, it is probably better to drill no deeper than 150 feet in the Conasauga when attempting to find water because the number of interconnected rock openings are fewer at greater depths and the chances of finding water are reduced. The selection of a new well site, particularly in an east-west direction (across the strike of the layers) and preferably downhill would improve the chances of reaching water at a shallow depth, but when economically feasible, drilling to 250 feet may result in a good yield.

Analysis of water from a 94-foot well in the Conasauga gave a hardness of 212 ppm. Iron and sulfur are uncommon in water from the formation.

Dug wells in the residuum of the Conasauga Formation yield water throughout the year provided they are deep enough. Most of the dug wells are from 20 to 40 feet deep. Their yield is usually adequate for household and farm needs.

The thick limestone unit at the top of the Conasauga Formation is quite soluble, and solution openings are common on the rock surfaces. Numerous sinkholes along the outcrop indicate the presence of many hidden solution openings in the limestone. Several large caves occur in the limestone on the west slope of Peavine Ridge and in one cave deep water is visible all year. The limestone probably would yield abundant water to wells. Unfortunately it underlies steep slopes that restrict its use as an aquifer.

In some areas the Conasauga is covered by a thick mantle of overburden; in other areas the bare bedrock is exposed. Wells in both covered and uncovered areas seem to be equally productive and reliable. The presence or absence of overburden apparently has no affect on the development of solution openings in the rock.

Cambrian and Ordovician

Knox Group

In Georgia the Knox Group of Late Cambrian and Early Ordovician age includes rocks that in Alabama, Tennessee, and Virginia have been separated into the following formations named in ascending order: Copper Ridge Dolomite, Chepultepec Dolomite or Limestone, and Longview Limestone. In Tennessee the Newala Limestone is included in the Knox Group (Butts, 1948, p. 16). In this report, however, the Newala Limestone is not included in the Knox but is included in the overlying Chickamauga Limestone because the Newala and Chickamauga are lithologically similar.

The largest exposures of the Knox Group in Catoosa County are Peavine Ridge, which is more than 2 miles wide, and Boynton Ridge, about half a mile wide. The Knox also is exposed just north of Salem and forms a ridge at Lees Chapel and at the eastern boundary of the county. A small strip of Knox extends into Wood Station Valley from Walker County; it forms the eastern slope of Missionary Ridge, which cuts across the northwest corner of the county above Fort Oglethorpe.

Copper Ridge Dolomite. — The Copper Ridge Dolomite in Catoosa County forms the lower half or so of the Knox Group. The lower 200 feet of the formation is mainly light-gray, thin-bedded (less than 1 foot) dolomite but the lower half of the formation is dominantly thick-bedded (up to 3 feet) brownish-gray dolomite which has an asphaltic odor on fresh breaks. Many light and dark layers of thinly laminated chert and chert interbedded with dolomite are common. The upper half of the Copper Ridge is mostly light-gray dolomite and some light-brownish-gray dolomite. Bedded chert is common in the upper half. The Copper Ridge is about 2,500 feet thick.

Upon weathering the Copper Ridge yields a very distinctive chert. It is dense, tough, porcelaneous, and usually white or light gray. The chert generally has rough, uneven surfaces in contrast to the smooth straight surfaces of chert from the Longview Dolomite.

Chepultepec Dolomite. — The Chepultepec Dolomite is about 800 feet thick and consists of dolomite and a few beds of limestone. Most of the dolomite is light gray, but some is brownish gray, light olive gray, or light red. Bedding ranges in thickness from less than 1 inch to more than 10 feet. Several layers of chert as much as 10 feet thick are present but chert in thin beds and nodules is very common all through the section. One or more thin sandstone beds that have a matrix of chert occur at or near the base of the formation.

Chert weathered from the Chepultepec is different from the chert of the formations above and below. The Chepultepec has chert which is largely porous, rather than compact, and much of it has the appearance of "worm eaten wood." The light weight chert contains many cavities which preserve the rhombic outlines of individual dolomite crystals. Chert on the surface usually is soft and yellowish or yellowish white. Both blocky and nodular forms are common but the abundance of cavernous pieces is outstanding. Most of the chert is dull rather than porcelaneous.

Thin-bedded chert which crushes easily under the blow of a hammer is common to the Chepultepec. In contrast, chert from the Copper Ridge and Longview formations is relatively hard and when struck flies apart in sharp, jagged pieces.

Fossils are fairly common in the Chepultepec, particularly in cavernous chert. Oolitic chert with small white oolites is characteristic of the Chepultepec.

Longview Limestone. — The Longview Limestone in Catoosa County is composed of about 350 feet of cherty dolomite and limestone. The middle and upper sections of the formation are made up of limestone and some dolomite. The lower part is dominantly limestone.

The limestone and dolomite of the Longview is light gray and light olive gray and contains many layers and nodules of chert. Reddish-colored chert layers and nodules are very distinctive.

Chert weathered from the Longview is hard and brittle and is cut by numerous joints that cause it to weather into small pieces with smooth straight surfaces. Chert nodules are abundant in the residuum. Quartzite pebbles with white interior are common in the residuum overlying the upper part of the Longview.

The Knox Group is one of the better aquifers in Catoosa County. Potentially it probably is the best aquifer. Not only does it supply large quantities of water to wells, but it yields water to the largest springs in the county. Some wells in the Knox are reported to yield more than 150,000 gpd (gallons per day) and it is probable that greater yields could be obtained by installing larger pumps on the wells. Eight of the largest springs in the county, which have their catchment areas in the Knox, flowed at a combined rate of more than 11 mgd (million gallons per day) during October 1958, which was a period of relatively low flow.

The thick blanket of chert and clay that overlies the Knox Group serves to absorb and hold precipitation, allowing it to filter downward slowly into the rock openings below. In ridge areas the overburden is as much as 200 feet thick. Many shallow wells drilled into the overburden furnish enough water for rural domestic needs. Because water moves slowly through the chert and clay, the wells do not refill fast enough to sustain large withdrawals. During periods of drought a few of the wells in the overburden go dry.

Dug wells are also common in the overburden of the Knox, mainly as a carryover from the past. The wells range in depth from 20 to more than 50 feet, and most of them yield a few gallons of water per day. Many dug wells are being replaced by drilled wells.

In order to obtain a large yield from a well in the Knox it is necessary to drill through the overburden into the bedrock. Wells that penetrate bedrock generally are very dependable, and many can be pumped at a rate of more than 20 gpm for long periods without failing. On the basis of small drawdowns that occurred in many deep wells that were bailed or pumped at 12 to 20 gpm, it seems probable that sustained yields of 30 to 50 gpm could be obtained, although no pumps of such capacity were found on any well.

Although the dolomite of the Knox Group is somewhat less soluble than limestone, the Knox has extensive solution openings. Numerous small caves have openings at the surface and are commonly associated with springs. Large caves also exist at depth. Well ER-146 penetrated a dry cave at a depth of 180 feet. Air would suck or blow through the well with considerable force for hours at a time, indicating that the cave was quite large. Solution openings are important because they act as storage resorvoirs in rock that otherwise is almost nonporous. Water collects in the openings and can move freely into wells.

Bedding plane openings in the dolomite of the Knox Group commonly are enlarged by solution to the extent that considerable quantities of water flow along them. In wet weather, water flows out of bedding planes on dolomite surfaces exposed in quarries and road cuts. Water in bedding planes is an important source for wells that do not strike joints or large solution openings in the rock.

Analyses of water from wells in the Knox showed a hardness ranging from 128 to 194 ppm and generally little iron. Only in the small valley south of Ellis Spring was iron reported to be a problem; two wells were abandoned because of the high iron content of the water.

The principal springs discharging water from the Knox Group are in valley bottoms adjacent

Table 4. Chemical determinations of ground water, Catoosa County, Ga.

(Analyses by author)

Well No.	Owner or name	Date of collection	Water-bearing formation	Parts per million	
				Total hardness	Chloride (Cl)
ER-68	Maggie Williams	September 29, 1958	Chickamauga Limestone	52	5
NG-11	Maude Owens	September 29, 1958	do.	764	90
NG-10	Tom Napier	September 29, 1958	do.	287	—
ER-70	G. R. Gaskin	September 29, 1958	do.	340	22
ER-31	W. M. Hill, Jr.	October 15, 1958	Knox Group	174	4
Spring No.					
ER-S10	W. M. Hill, Jr.	October 15, 1958	Chickamauga Limestone[1]	140	1.4
NG-S6	W. E. Waters	October 15, 1958	Conasauga Formation[1]	120	.4
ER-S1	J. R. Graham	October 15, 1958	do.	130	.8
ER-S16	Poplar spring	October 3, 1959	Knox Group	129	1.4
ER-S6	Ellis spring south opening	October 3, 1959	do.	116	.8
ER-S6	Ellis spring east opening	October 3, 1959	do.	116	.8
ER-S6	Ellis spring west opening	October 3, 1959	do.	115	.8
ER-S10	W. M. Hill, Jr.	October 3, 1959	Chickamauga Limestone[1]	132	1.6
ER-S13	Blue Spring	September 29, 1959	do.	137	.4

[1]Springs discharge from indicated formations but water is from the Knox Group.

to Knox ridges. Yates Spring (NG-S12) and Leitz Spring (NG-S8) are on opposite sides of Peavine Ridge. Blue Spring (ER-S13) and Hills Spring (ER-S10) are in the valley west of Boynton Ridge. The four springs have their openings in the formation overlying or underlying the Knox. Water issues from solution channels in limestone or dolomite level with the valley floor.

Topography seems to have been the dominant influence on the location of the spring outlets, which are located at the junction of the water table with the land surface, rather than at faults or formational contacts. Hills Spring may issue water under artesian pressure.

Most small springs in the Knox discharge in valleys or along stream courses within the Knox ridges.

Analyses of spring water from the Knox Group showed a range in hardness from 87 to 129 ppm (Tables 3 and 4). The iron content ranged from 0.0 to 0.15 ppm.

Springs discharging water from the Knox Group are the largest and most important source of ground water in the county. Eight springs with catchment areas in the Knox discharged about 11 mgd during October 1958 (Table 5). This total is based on measurements made October 8 and 9, which is in the annual low-flow period. The discharge of several unmeasured springs in the Knox probably would increase the total to at least 12 mgd during the low-flow period.

The low-flow period of spring discharge corresponds to the annual period of lowest precipitation and lowest ground-water levels. During the wet months of each year spring discharge increases somewhat, with small springs nearly doubling in amount of discharge. Unusually wet periods and periods of drought probably affect the rate of spring discharge, but records are not available to indicate how great the affect might be.

Table 5. Measurements of spring flow in Catoosa County, Georgia.

(1950-51 measurements by S. M. Herrick; 1958 measurements by author)

Name of spring and number	Date of measurement	Discharge (gallons per day)
Yates (NG-S12)	November 30, 1950	7,700,000
	June 11, 1958	8,200,000
	October 8, 1958	7,500,000
Leitz (Beaumont) (NG-S8)	November 30, 1950	300,000
	June 10, 1958	440,000
	October 9, 1958	250,000
Blue (ER-S13)	November 30, 1950	1,200,000
	October 9, 1958	1,000,000
Ellis	January 17, 1951	560,000
	August 8, 1958	990,000
	October 9, 1958	800,000
Graysville	December 1, 1950	540,000
	October 9, 1958	440,000
Poplar (ER-S16)	October 9, 1958	90,000
Waters (NG-S6)	October 9, 1958	230,000
Hills (ER-S10)	October 9, 1958	720,000

Ordovician

Chickamauga Limestone

In Catoosa County the Chickamauga Limestone of Lower, Middle, and Upper Ordovician age represents two distinct lithologic types and two different depositional environments (Allen and Lester, 1957, p. 5). The strata cropping out east of Whiteoak Mountain and Taylor Ridge are near-shore sediments; those to the west are offshore sediments.

The near-shore sediments consist of about 2,300 feet of sandy siltstone, claystone, and a little limestone. Exposures in Catoosa County are limited to a narrow belt east of Dick Ridge in the southern part of the county.

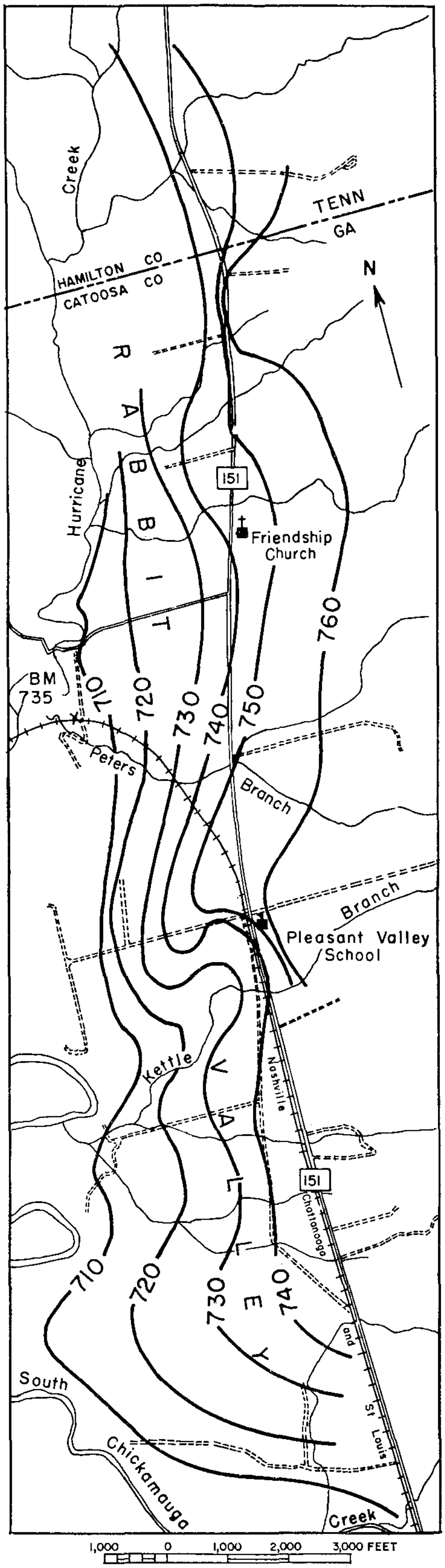
The offshore sediments consist of 1,400 to 2,100 feet of limestone much of which contains silt and clay. Calcareous siltstone and claystone are interbedded with the limestone, particularly in the lower and upper parts. Bedding ranges from very thin to massive. Chert in layers and nodules is present in some parts of the formation. The offshore sediments underlie Rabbit Valley, Wood Station Valley, and Chickamauga Valley.

The Chickamauga Limestone contains numerous joints and solution cavities that store large quantities of ground water. Because it underlies densely populated Rabbit Valley, Wood Station Valley, and Chickamauga Valley, the formation is an important aquifer in Catoosa County.

The Chickamauga Limestone yields water to drilled wells in all areas of the county except parts of Rabbit Valley. At some places on the east side of Rabbit Valley, north of Ringgold, water is difficult to obtain by drilling. Wells as deep as 500 feet are reported to have been completely dry. On one man's property, 4 out of 6 holes were dry and 2 yielded "sulfur water"; the dry holes were 90, 150, 170 and 500 feet deep and the "sulfur water" yielding wells were 60 to 150 feet deep.

Well drillers reported difficulty in getting a good well after drilling through a layer of what they called "red shale" apparently a reddish siltstone common to the lower part of the Chickamauga. A well that is dry when it reaches the siltstone probably will continue to be dry or will yield only a small amount of sulfur water at greater depths. Difficulty in finding water is experienced only in areas where the siltstone is near the surface.

Drillers report that limestone near the top of the Chickamauga Formation also has a high incidence of dry holes. The limestone is located along the steep slopes of Whiteoak Mountain and Taylor Ridge where surface runoff is great. The limestone is overlain by shale which retards the downward movement of ground water. The high rate of runoff and the lack of percolation from above probably has resulted in the development of relatively few solution openings that can supply water to wells.



Datum is mean sea level
Contour interval 10 feet

Figure 4.—Map of Rabbit Valley showing water-table contours, January 17—27, 1958

Except in the above mentioned areas, practically all wells in the Chickamauga yield ample water for farm and home needs. Figures are not available to indicate the maximum rate at which wells in the Chickamauga can be pumped over long periods, but many wells equipped with pumps of 10 gpm capacity have never failed.

The only record of pumpage from a well in the Chickamauga Limestone was obtained from Nance and Son Dairy, Ringgold. An 8-inch well, drilled in 1956 to a depth of 256 feet, was tested at 65 gpm. In actual use the well was pumped continuously 10 hours a day at a rate of 50 gpm until the summer of 1957, when it pumped dry. Since that time the well has been used only 6 hours a day and to date (1959) it has not failed.

In water analyzed from the Chickamauga Limestone, hardness ranged from 52 to 764 ppm and chloride ranged from 5 to 90 ppm. Water containing hydrogen sulfide is fairly common in the formation, though wells yielding "sulfur water" generally are concentrated in small scattered areas.

Springs in the Chickamauga are small and unimportant except for a few that are used for domestic supplies. The largest springs discharge only a few gallons per minute. Many of the springs go dry during the summer months.

In Rabbit Valley the beds of Chickamauga Limestone dip about 15° E. The valley floor slopes gently westward toward South Chickamauga Creek and surface drainage is in the same general direction. A water-table map of Rabbit Valley based on measurements taken in open wells indicates that the water table slopes westward toward South Chickamauga Creek (Fig. 4). Also, ground water reportedly enters freshly drilled wells from the east side. Water in two wells (R-72 and R-73) became muddy during the drilling of a well more than 1,000 feet to the east. Thus, it appears that at depths domestic wells normally reach, ground water moves through rock openings from east to west across the strike of the bedding, and the amount of water moving downdip along bedding planes seem to be minor.

In Chickamauga Valley where the beds of limestone form a syncline, water from several wells was known to have a salty taste or to have a laxative effect making the water unfit for human or animal consumption. Analysis of water collected from one of the wells in 1909 is listed below (McCallie, 1913, p. 32). The well was known as the Bagwell Well and is now owned by J. L. Ivey.

Bagwell Well

(J. M. McCandless, analyst)

Constituents	Parts per million
Silica (SiO_2)	45
Chloride (Cl)	40,000
Sulfate (SO_4)	1,520
Carbon dioxide (CO_2)	84
Sodium (Na)	21,400
Potassium (K)	176
Calcium (Ca)	2,380
Magnesium (Mg)	1,460

Bagwell Well — continued

Constituents	Parts per million
Bromine (Br)	379
Iodine (I)	19
Lithium (Li)	29
Iron (Fe)	23
Aluminum (Al)	11
Probable combinations	
Potassium chloride	335
Sodium chloride	54,800
Lithium sulphate	225
Magnesium chloride	5,260
Magnesium bromide	494
Calcium chloride	4,830
Calcium sulphate	1,880
Calcium carbonate	192
Sodium iodide	23
Ferric oxide and alumina	53
Silica	45
Dissolved solids	68,137

In 1931 additional water samples were collected in Chickamauga Valley from four wells known to yield salt water. Analyses of this water, from unpublished records of the Georgia Department of Mines, Mining, and Geology, are shown in Table 6.

From the results of the analyses it was believed that brine of commercial quality might be obtained from the syncline underlying Chickamauga Valley. Two test holes, one 2,200 feet deep (ER-51) and the other 550 feet deep (ER-52) were drilled on the property of J. L. Ivey in search of brine. According to Garland Peyton, Director, Georgia Department of Mines, Mining, and Geology, the results of the tests were disappointing. No other exploratory work has been done in the area.

The 2,200-foot brine test hole was reported by Mr. Ivey to have yielded combustible gas for about 3 weeks. Well ER-47, about 0.5 mile northeast of the test well reportedly issued large quantities of gas for several days. The volume of gas was so large that when it ignited, a nearby building was threatened. Several other wells drilled in the Chickamauga Limestone throughout the county are claimed to have given off gas or to have a gasoline odor.

On June 29, 1959 a water sample was taken from well ER-29 that appears to be the J. P. Clark well of table 6. Analysis data showed a chlorine content of 32 ppm and a dissolved solids content of 630 ppm. The owner reports that during the dry summer months water from this well becomes too salty to drink.

Silurian

Red Mountain Formation

The Red Mountain Formation of Silurian age makes up Whiteoak Mountain, Taylor Ridge, Dick Ridge, and two small ridges northeast of Ringgold. The formation is composed mainly of interbedded sandstone and shale. A few beds of limestone and fossil iron ore occur.

The sandstone of the Red Mountain ranges in grain size from very fine to coarse and is in beds ranging from less than 1-inch to more than 10 feet thick. On fresh exposures the sandstone is commonly calcareous and gray to nearly white; upon weathering it turns brown or maroon.

Table 6. Chemical analyses of ground water from wells in Chickamauga Valley, Catoosa County, Ga.

Well owner	Well depth (feet)	Parts per million[1]											
		Sodium Nitrate	Sodium Chloride	Sodium Sulphate	Sodium Carbonate	Magnesium Chloride	Magnesium Carbonate	Calcium Chloride	Calcium Sulphate	Calcium Carbonate	Silica	Total Salts	Chloride (Cl)
Harden	250	0.9	2,590	821	247	0	78.0	0	0	114	10.0	3,910	1,575
J. P. Clark	135	—	—	—	—	—	—	—	—	—	—	7,510	3,630
Robinson (before pumping)	239	—	—	—	—	—	—	—	—	—	—	95,100	34,200
Robinson (after pumping)	239	4	76,500	0	0	7,280	0	7,530	2,250	42	—	94,100	56,600
McKenny	161	—	—	—	—	—	—	—	—	—	—		10,800

[1]F. E. Clark, analyst

Shale of the Red Mountain is in layers ranging from 0.1-inch to more than 4 inches thick. Unbroken shale units more than 10 feet thick are common. Where freshly exposed most of the shale is gray, but it is ferruginous and weathers quickly to different shades of brown.

Sandstone dominates the lower part of the formation. Passing upward, shale is present in increasing amounts and constitutes the bulk of the middle section. Sandstone is abundant in the upper part of the formation.

No measurement of the Red Mountain was made in Catoosa County, but a section was measured along Georgia Highway 143, where it crosses Taylor Ridge in Walker County, about 6 miles south of the Catoosa County line. The thickness there is about 1,050 feet.

The Red Mountain Formation makes up such steep and rugged terrane that it is poorly developed as an aquifer. Nearly all the homes on the formation use city water or water from small springs.

A few wells on the east slope of Dick Ridge derive water from the Red Mountain. Yields are adequate for farm and home needs, but heavy use causes some of the wells to pump dry temporarily.

Analysis of water from one well shows a hardness of 184 ppm, an iron content of 0.01 ppm, and a chloride content of 6.5 ppm.

A 1,625-foot oil-test well (R-77) that penetrated part of the Red Mountain Formation yielded water under artesian pressure. Sulfur water flowed from the well for a time, but the flow decreased and finally stopped. The owner of the well reported that gas was struck eight times during drilling and that "oil" appeared on the bit several times.

Artesian conditions may exist generally beneath the east side of Whiteoak Mountain and Taylor Ridge. The depth required to obtain a flowing well, however, probably would be fairly great because it is necessary to drill beneath the jointed upper rock strata to reach water under hydrostatic pressure.

The cost of drilling a flowing well for domestic or farm purposes probably would be too great. Also, a deep well might yield highly mineralized water.

Devonian and Mississippian

Chattanooga Shale

In Catoosa County the Chattanooga Shale, of Devonian and Mississippian age, is a highly fissile black shale that has a thickness of about 15 feet. In weathered exposures the shale is brown. The Chattanooga is a reliable datum from which to identify and measure the formations above and below (Butts, 1948, p. 40).

In the upper part of the Chattanooga Shale is a layer of greenish clay about 1-foot to 2.5 feet thick, containing phosphatic nodules which range from 0.5-inch to 2 inches in diameter. According to Butts (1948, p. 40) the clay is the same as the Maury Formation of Tennessee.

The Chattanooga is an incompetent formation. In nearly all exposures it is highly contorted, whereas the Red Mountain Formation below and the Fort Payne Chert above were little affected by deforming forces. Slickensides indicate that movement generally was parallel to the dip of the strata.

The Chattanooga Shale is not an aquifer in Catoosa County. The formation is nearly impermeable except along joints. One well just across the county line in Walker County penetrated the Chattanooga and yields water having a very high iron content. An "oily scum" reportedly collects when the water is heated.

In some areas the Chattanooga may act as a confining layer to produce artesian conditions, although this could not be verified from inventoried wells.

Mississippian

The Mississippian System in Catoosa County includes two principal formations: the Fort Payne Chert below, and the Floyd Shale above (Butts, 1948, p. 41).

Fort Payne Chert

The Fort Payne Chert crops out along the east slope of Whiteoak Mountain and Taylor Ridge and around the edges of Houston Valley.

In Catoosa County the Fort Payne Chert consists of about 400 feet of bedded chert, calcareous shale, and cherty limestone. The bedded chert usually occurs at the base of the formation and overlies the Chattanooga Shale, but due east of Ringgold, the chert is absent and a dark-colored shale, known as the Lavender Shale (Butts, 1948, p. 43), overlies the Chattanooga. The bedded chert is dense, brittle, gray to black and evenly bedded. The beds range in thickness from less than 2 inches to more than 1 foot and are irregularly furrowed along the bedding surface, causing an uneven contact. The uneven contacts appear to have resulted from solution by ground water. Small quartz geodes, 0.25 inch to 2.5 inches in diameter are common in the chert, particularly in the lower part. Abundant fossils in the Fort Payne Chert make it easily distinguishable from the chert of other formations.

Drilled wells in the Fort Payne Chert are less than 100 feet deep and yield ample water for farm and home use and large broiler houses. The wells are very dependable.

Analysis of water from one well showed a hardness of 158 ppm and an iron content of 0.49 ppm.

Dug wells in the residuum overlying the Fort Payne yield water low in calcium and magnesium content and in quantities large enough to meet most rural needs. The dug wells seldom fail during droughts.

Numerous small springs issue from the Fort Payne and a few are used for domestic supply.

In Alabama the Fort Payne is an excellent aquifer, yielding as much as 1,000 gpm to shallow drilled wells. The formation may prove to be an equally productive aquifer in Catoosa County.

Floyd Shale

The Floyd Shale is exposed in a broad belt east of Whiteoak Mountain and Taylor Ridge, and in Houston Valley.

In Houston Valley the Floyd Shale consists of light-gray to black fossiliferous shale. The black shale of the Floyd is similar in appearance to the Chattanooga Shale except that the Floyd locally contains abundant fossils.

East of Whiteoak Mountain and Taylor Ridge the Floyd Shale is partly shale, but it also includes thick units of limestone, sandstone, and siltstone. According to Allen and Lester (1953, p. 193) about 600 feet of limestone are included in the Floyd shale, along with a 350-foot unit of sandstone and siltstone.

The limestone is thick-bedded, bluish gray to dark gray, and fine to coarse crystalline. The lower limestone is chert-bearing.

The sandstone in the Floyd is fine to medium grained and light gray. The sandstone is interbedded with light gray siltstone, and the two form a resistant unit that makes up Cherokee Ridge.

The thickness of the Floyd Shale is about 1,400 feet.

The Floyd Shale in Houston Valley probably would supply a few gallons of water per minute to wells. Only two wells were inventoried, one dug well and one drilled well without a pump. Both wells yielded a satisfactory supply for home use.

The Floyd Shale east of Whiteoak Mountain and Taylor Ridge contains thick limestone units which supply large quantities of water to wells from solution openings. Most wells are less than 100 feet deep and supply more than enough water for broiler production and household needs. The wells are very dependable and well owners reported that their pumps could be left running over night without pumping the wells dry. The pumps have a capacity of 5 to 10 gpm.

No wells were inventoried in the sandstone and shale of the Floyd.

Water from the Floyd Shale was not analyzed for mineral content. However, water from the limestone units probably is hard and of a quality similar to water from the Chickamauga Limestone. Water from the sandstone and siltstone may be similar to water from the Rome or Red Mountain formations.

Pennsylvanian

Lookout Sandstone

The Lookout Sandstone of Pennsylvania Age forms the caprock on Sand Mountain, about 3 miles northeast of Ringgold. The Lookout Sandstone includes two members, the Gizzard Member below consisting of gray shales and fine-grained sandstone, and the Sewanee Member above above consisting of massive conglomeratic cliff-forming sandstone. The thickness of the formation in Catoosa County was not determined.

Because of its limited extent and topographic position, the Lookout Sandstone is not used as an aquifer in Catoosa County.

ARTESIAN WATER

In many reports concerning the Paleozoic area, mention is made of the possibility of obtaining flowing artesian wells. However, flowing wells are rare in Catoosa County; only 4 such wells are reported. Well R-77, just east of Whiteoak Mountain, is 1,625 feet deep and flowed for a time. Well R-60, more than 1,200 feet deep in Rabbit Valley is said to have flowed. Well FO-1, drilled 310 feet deep just east of Missionary Ridge in Fort Oglethorpe, struck a cavity and issued water at a rate of 150,000 gpd. A 2,200-foot well near the center of Chickamauga Valley, ER-51, flowed for about three weeks after being drilled. The four wells are located so that they tap water from deeply buried rock strata which extend to the surface in nearby ridges and have their interconnected openings filled with water to a height above the tops of the wells.

WATER-LEVEL FLUCTUATIONS

Continuous water-level records were obtained from two wells to determine the amount of fluctuation in the ground-water level that occurs during the seasonal variations in rainfall. The maximum fluctuation during the period of record was about 14 feet (Fig. 5).

The water table was highest during April and May, and lowest in November, December, and January when precipitation was light.

Monthly water-level measurements in several wells throughout the county showed seasonal fluctuations in most wells to be about 10 feet, though one well varied nearly 25 feet (Fig. 6).

Long-term variations in ground-water levels result from cyclic variations in the amount of rainfall extending over several years. Water levels are higher than usual during abnormally wet periods, but are lower than usual during extended droughts. A gradual rise in the water level may occur for several years to be followed by a gradual lowering for several years.

The present investigation did not show evidence that a permanent lowering of the water table has occurred in Catoosa County. Dug wells throughout the county were reported to have about the same depth of water as when first dug many years ago.

UTILIZATION

Present use of ground water in Catoosa County is limited mainly to supplying farm and rural household needs, broiler houses, and dairies. More than 9,000 rural residents use 20 million gallons per month. Stock usage accounts for an additional 10 or so million gallons, making the total ground water used in the county about 30 million gallons per month. Practically all of this water comes from wells, but the amount is minor in comparison to what can be developed. During 1959 about 20 million gallons of water per month

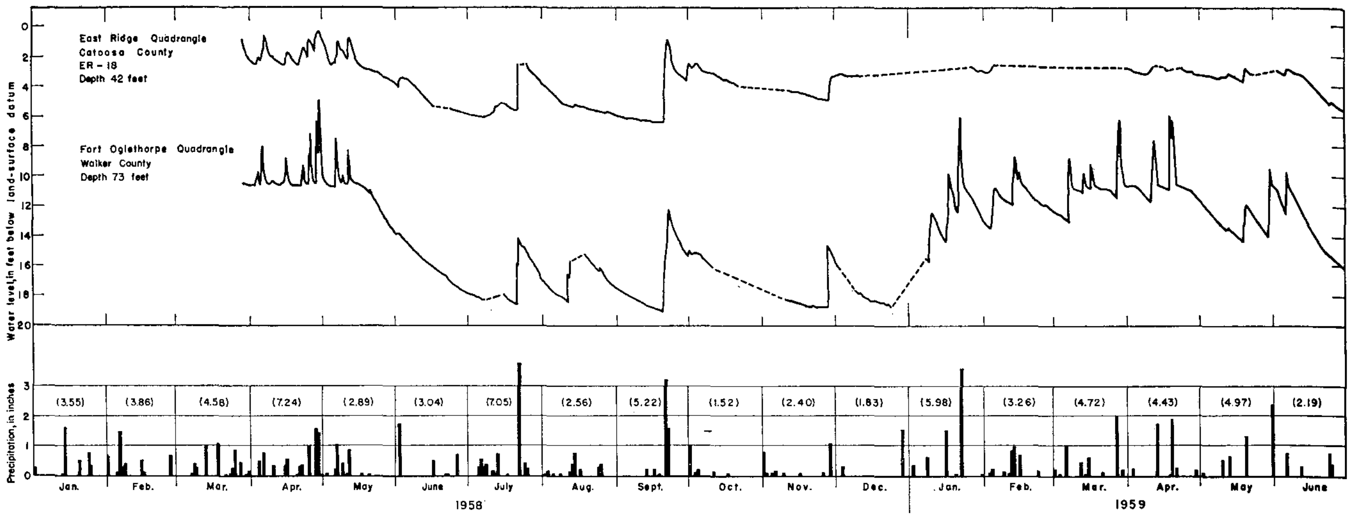


Figure 5.—Comparison of precipitation and water-level fluctuations in wells in Catoosa and Walker Counties. (precipitation records from U.S. Weather Station at Chickamauga and Chattanooga National Military Park)

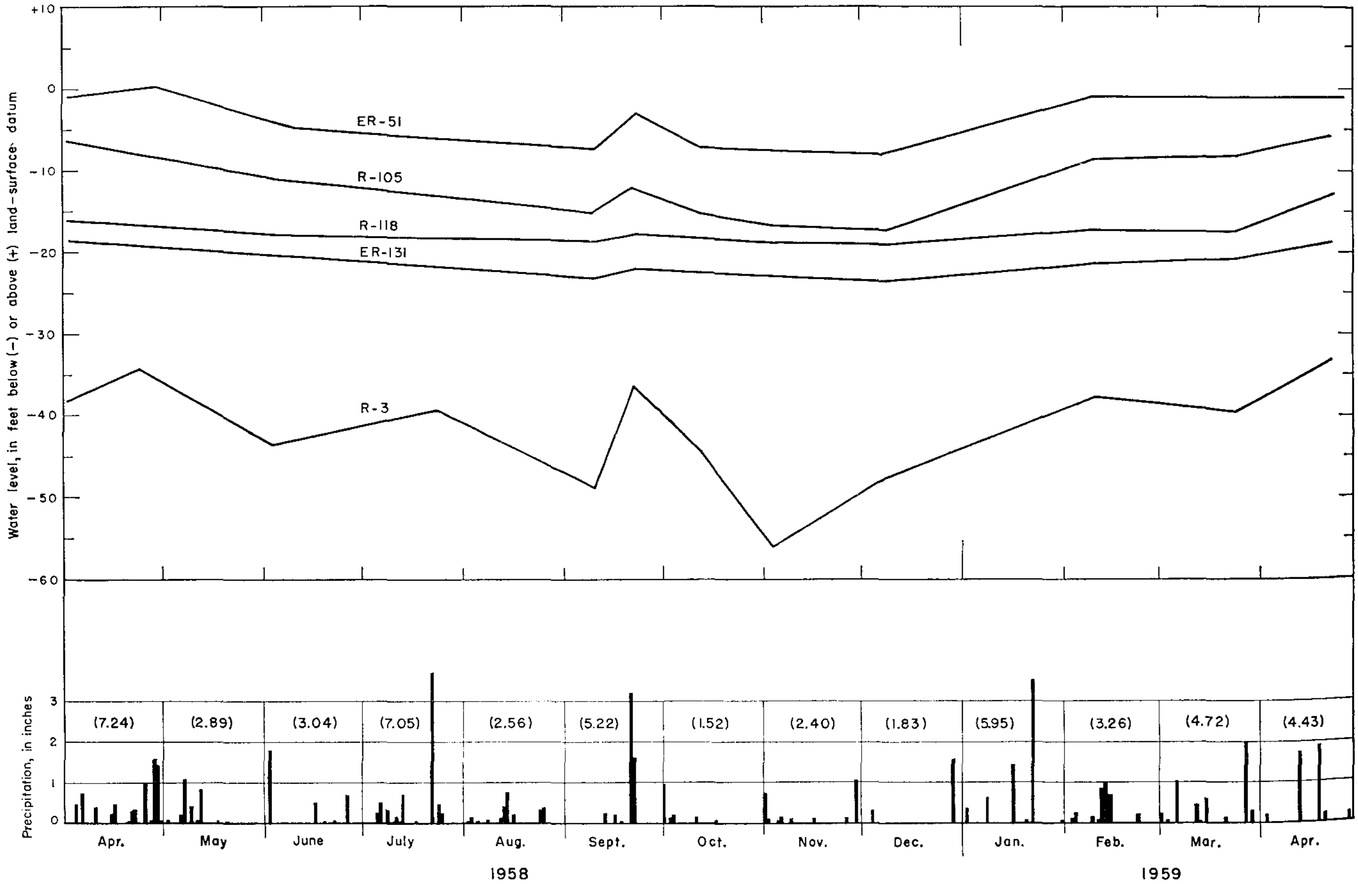


Figure 6—Comparison of precipitation and water-level fluctuations in wells in Catoosa County (precipitation records from U.S. Weather Station at Chickamauga and Chattanooga National Military Park).

was distributed by commercial pipeline to the residents of Ringgold, Fort Oglethorpe, and other areas of the county[1]. The commercial water is surface water from the Tennessee River and South Chickamauga Creek.

[1]This figure does not include the county's population adjacent to and in Rossville because water is supplied directly from Chattanooga, Tenn.

About 50 million gallons of surface water and ground water were used in Catoosa County during 1959.

Springs in the Knox Group discharged at the rate of more than 300 million gallons per month during their annual low-flow period in 1958, and nearly all the water went unused except to maintain stream flow. Drilled wells in most parts of the county are widely scattered and vast areas have no wells, indicating that a considerable increase in ground-water withdrawals above present levels is possible without depleting the ground-water reservoirs.

Water from springs together with water from increased well development should be capable of meeting the county's total water requirements for years to come.

SUMMARY OF GROUND WATER

In nearly all of Catoosa County except the high ridges, dug and drilled wells supply water for farm and home use. In some locations dug wells yield enough water for a house with bathroom and washing machine and for farms with several thousand chickens. In general, however, a drilled well is needed to supply a fully equipped modern home or farm. A few drilled wells in the Knox Group, the Chickamauga Limestone, and the Floyd Shale will yield 50 gpm or more, though the maximum yield of these wells is unknown because they are equipped with small pumps.

Most drilled wells in the county are less than 100 feet deep, although in some areas the depth averages nearly 150 feet. In ridges of the Knox Group, many wells are drilled through 200 feet of chert and clay in order to reach bedrock. Wells in the chert and clay yield less water than wells in bedrock, but the water is soft and is preferred by many people in the county.

The hardness of well water in the county ranges from about 50 to 800 ppm, but generally is less than 250 ppm. Water from the residual material overlying a formation generally is softer than water from the bedrock of the formation. Water from the residuum of the Red Mountain and Rome formations is likely to contain objectionable quantities of iron. Water containing hydrogen sulfide is common in areas underlain by the Chickamauga Limestone, and the high chloride content of the water has been a problem in central Chickamauga Valley.

The largest ground-water supplies in Catoosa County are the springs that discharge water from the Knox Group. The springs range in size from less than 100,000 gpd to more than 8 mgd. Eight of these springs discharged more than 11 mgd during October 1958 and most of the water was unused. Spring water is the best source of industrial supply in the county.

The hardness of the spring water collected from 12 locations ranged from 87 to 147 ppm. The iron content of most of this water was less than 0.02 ppm.

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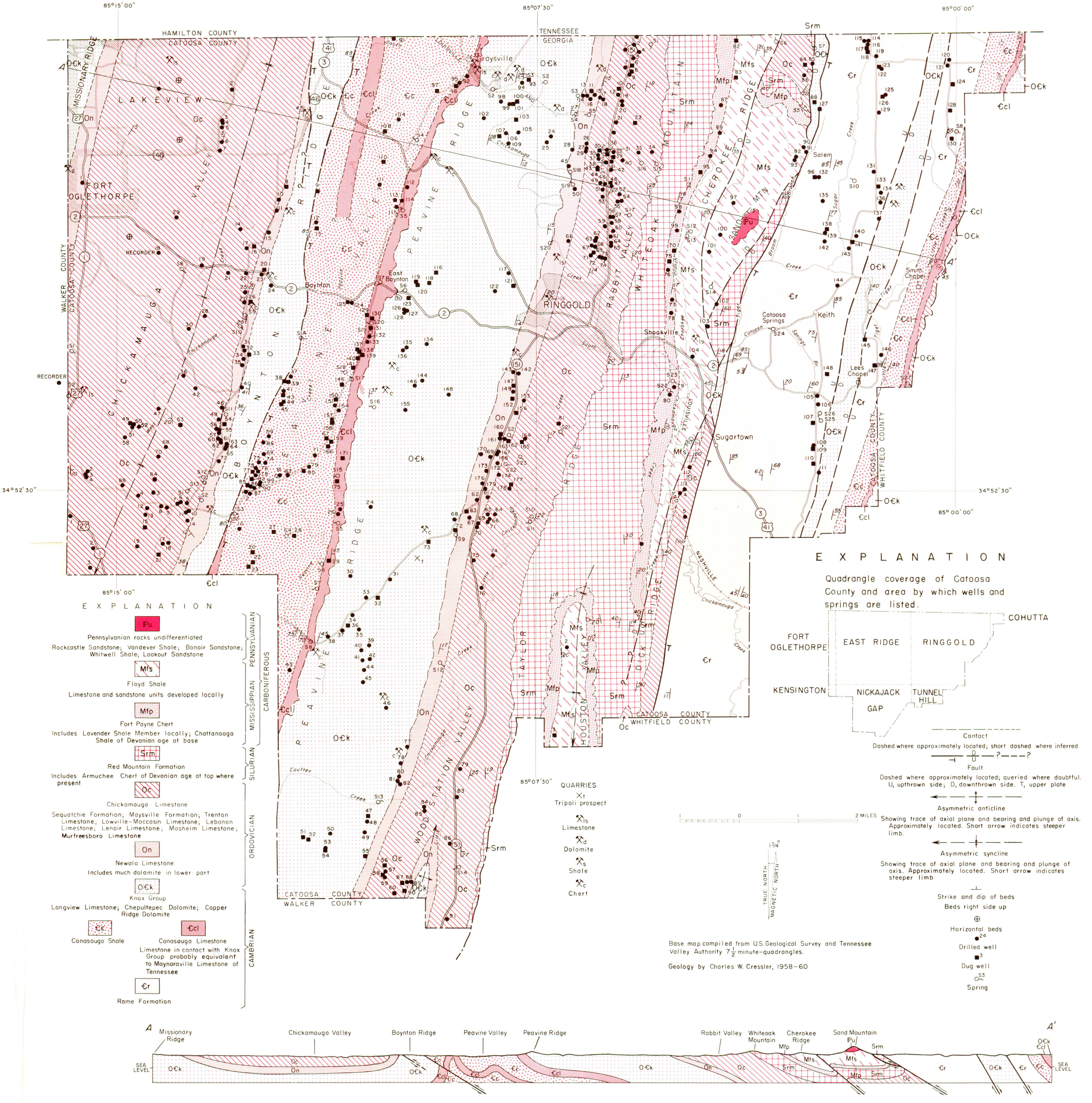

Figure 2.—Map showing geology and well and spring locations, Catoosa County, Georgia.