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GEORGIA

STATE DIVISION OF CONSERVATION

DEPARTMENT OF MINES, MINING AND GEOLOGY
A. S. FURCRON, Acting Director

THE GEOLOGICAL SURVEY
Information Circular 32

GROUND-WATER RESOURCES OF BAINBRIDGE, GEORGIA

By

Charles W. Sever
U.S. Geological Survey

1776

Prepared in cooperation with the U.S. Geological Survey

ATLANTA
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GROUND-WATER RESOURCES OF BAINBRIDGE, GEORGIA

C. W. Sever

ABSTRACT

Baindbridge is underlain by a substantial limestone aquifer capable of yielding more than 50 million gallons per day of water suitable for municipal and most industrial needs. Data obtained from aquifer-performance tests show the coefficient of transmissibility to be about 0.6 mgd/ft (million gallons per day per foot) at the Clay Street well field and about 10 mgd/ft at the Alice Street well field. Coefficients of storage are about 0.002 to 0.003 respectively.

Bainbridge obtains its water from 4 wells that range in depth from 350 to 465 feet, but most of the water comes from depths of less than 150 feet.

Chemical analyses show the water is moderately hard and of good quality. Nearby however, these limestones yield water containing as much as 5 parts per million dissolved iron that someday may start contaminating the Alice Street well field.

INTRODUCTION

Purpose of the Investigation

A ground-water investigation at Bainbridge, Ga. was made for the purpose of evaluating the quantity and quality of ground water available for industrial and municipal use and to provide information for the orderly development of this resource. This investigation was made by the U.S. Geological Survey in cooperation with the Georgia Department of Mines, Mining and Geology, and is part of a project to evaluate the ground-water resources of Seminole, Decatur, and Grady Counties, Ga.

Location of Area

Bainbridge, Ga. is located in Decatur County in extreme southwestern Georgia about 38 miles north-northwest of Tallahassee, Fla. (Figure 1). It is situated on the banks of the Flint River along a northern extension of Lake Seminole.

Bainbridge, known as "Georgia's Inland Port", has small craft and barge docks and a 9-foot channel to the Gulf of Mexico.

Previous Investigations

General information about the area is included in Cooke (1943), Stephenson and Veatch (1915), and Wait (1961).

Herrick (1961, p. 155) has published a detailed lithologic and paleontological log of well 6 (GGS 228) on Alice Street, in Bainbridge.

Related studies were made at the Bainbridge Air Base by Sever (1963), and in Mitchell County by Owen (1961).

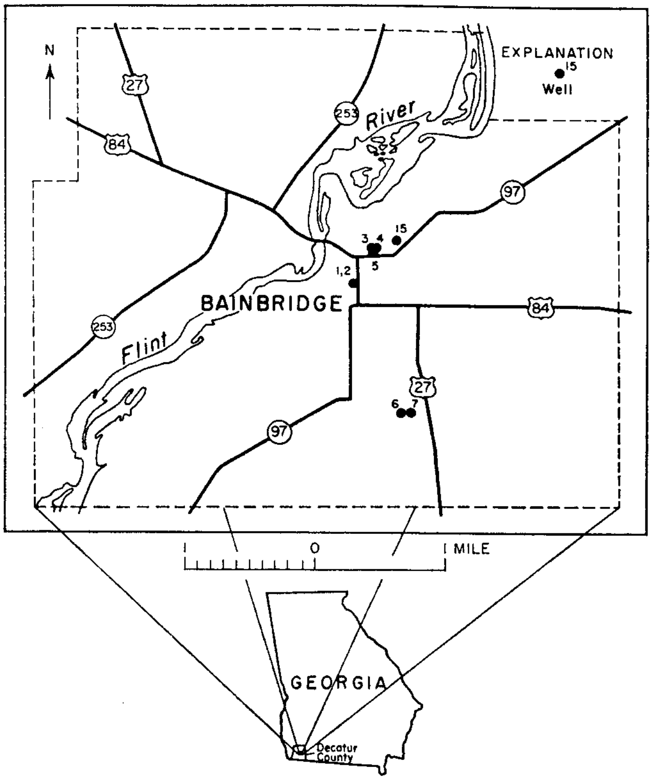

Figure 1.—Map of Bainbridge, Decatur County, Ga.

Acknowledgments

Acknowledgment is due Mr. Roger W. Bell, Superintendent of the City of Bainbridge Water and Gas Department, for his cooperation during the aquifer performance tests.

The author acknowledges the interest and assistance of the staff of the Georgia Department of Mines, Mining, and Geology, Garland Peyton, former Director.

Physiography and Topography

The City of Bainbridge lies on the Dougherty Plain (LaForge and others, 1925, p. 40) which, in the vicinity of Bainbridge, is a flat surface whose monotony is broken by the channel and flood plains of the Flint River and by numerous shallow sinks caused by solution and collapse of the underlying limestone. Two such sinks—Douglas and Twin Lakes—occur within the city limits.

The Flint River flows southwesterly through the city and has an average daily flow of 8,669 cfs (cubic feet per second) or about 5,603 mgd (million gallons per day) at Bainbridge (U. S. Geological Survey, 1963). The minimum recorded daily flow at Bainbridge was 1,770 cfs on November 7, 1962. The flow of the Flint River is regulated by upstream power plants but normal operations do not affect daily discharge.

The highest altitude of the land surface is about 140 feet above mean sea level and the average altitude of the water level in Seminole, Douglas and Twin Lakes is about 78 feet.

GROUND-WATER RESOURCES

Aquifers

Rocks at Bainbridge contain potable water to a depth of about 1,200 feet. A summary description of these rocks is given in table 1 and detailed descriptions are given by Herrick (1961, p. 149-156).

Data about aquifers of Cretaceous to early Eocene age which lie at depths greater than about 1,200 feet are not available, but they probably contain highly mineralized waters.

The Tallahatta Formation of middle Eocene age is believed to be the lowermost aquifer at Bainbridge that contains potable water. It is a fine to medium grained glauconitic sand and occurs from about 700 to 1,200 feet below land surface. Because it will cost appreciably more to develop wells in these sands than in the shallower aquifer, water in the Tallahatta Formation probably will not be extensively utilized in the near future unless water in the shallower aquifer becomes polluted. If pollution were to occur, careful drilling plus the aid of electric logging could be used to find water-bearing sands that probably would supply the city adequately with water.

The Lisbon Formation of middle Eocene age overlies the Tallahatta Formation at Bainbridge and occurs at from about 350 to 700 feet below land surface. It is a light gray to cream colored limestone that contains pyrite and glauconite. Most of the existing city wells tap the upper part of this formation, but it contributes only 5 to 10 percent of the water pumped.

The Ocala Limestone of late Eocene age overlies the Lisbon Formation and occurs at from about 70 to 350 feet below land surface. It is a cream to brown, rather pure limestone and supplies 90 to 95 percent of the water pumped from the city wells.

Alluvium and residuum deposits of Eocene to Recent age overlie the Ocala Limestone from land surface to about 70 feet. Wells drilled in these deposits would require screens and should be gravel packed. This type of construction is more costly than that required for wells in the Ocala. For this reason these deposits are cased off and open-hole wells are drilled into the underlying limestones.

History of Well Construction at Bainbridge

The northeast corner of the town square was selected as the site for Bainbridge's first well (well 1 of this report, see figure 1). It was drilled prior to 1891 to a depth of 900 feet and is believed to have tapped the Lisbon and Tallahatta Forma-

Table 1.—*Partial stratigraphic section at Bainbridge, Ga.*

Formation	Brief geologic description	Thickness	Depth to top of formation (feet)	Altitude of top of formation (feet)	Remarks
Alluvium	River terrace sand and gravel	20±	At land surface near river	80 to 110	Not utilized as an aquifer.
Residuum	Residual sands, clays, and limestone boulders derived from Eocene to Recent formations	0 to 100	0 to 20	60 to 140	Contains abundant water. Water probably slightly corrosive. Not utilized as an aquifer.
Ocala Limestone	Fossiliferous limestone	250 to 280	20 to 100	40 to 70	Principal aquifer — water of good quality
Lisbon Formation	Glauconitic limestone containing thick beds of pyritic limestone; may contain beds of dolomitic limestone, sand, and marl in lower part	350±	300 to 360	−220	Good aquifer—water may be slightly mineralized.
Tallahatta Formation	Glauconitic sand	400 to 600	650 to 710	−570±	Good aquifer but screens would be required. Water may be slightly mineralized.

tions. Dr. J. W. Spencer, former Georgia State Geologist, made the following notes on the well (in McCallie, 1898, p. 160):

"1. Sand and clayey sand	75 feet
2. Limestone (the upper 200 feet the softer): no clay	700 feet
3. Soft limestone	50 feet
4. Quicksand (to the bottom of the well)	75 feet"

This well is believed to have been destroyed.

The second site selected was within three feet of the first, and the well (well 2, figure 1), was drilled prior to 1891 to a depth of 1,250 to 1,325 feet. This well penetrated about the same sequence of rocks as the first well but reportedly went 425 feet into the quicksand (McCallie, 1898, p. 160-162). It has been abandoned and is located within a small building on the northeast part of the square. Electric and gamma-ray logs were made of the well, but the instruments could not be lowered below a depth of 248 feet. Electric logging showed that the well casing extended below this depth, and either the casing is reduced in size or the well has filled with sand. Interpretation of the gamma-ray log by the author indicates:

1. Residuum, sand and clay	0 to 58 feet
2. Weathered limestone(?)	58 to 83 feet
3. Limestone	83 to 248 feet

The water level in the well was 46 feet below land surface on October 12, 1962.

Bainbridge's third well (well 3, figure 1) was drilled about 1900 on the west side of the old reservoir on Clay Street to a depth of 452 feet. It is still in use by the city and yields about 600 gpm (gallons per minute) by an airlift pump. Following is a driller's log of this well taken from Stephenson and Veatch (1915, p. 220):

"1. Surface sands and clays	0 to 70
2. Limestone	70 to 235
3. Light-colored sandstone	235 to 265
4. Limestone with shells (?)	265 to 451
5. Sand	451 to 452"

The site selected for well number four (well 4, figure 1) was about 90 feet east of well 3. Well 4 was drilled about 1920 to a depth of 500 feet. It yielded 600 gpm by an airlift pump.

Apparently the city officials like the taste of the water from wells 3 and 4 because they decided in 1931 to drill well 5 between these two already closely spaced wells. Well 5 is located 56 feet east-southeast of well 3 and 39 feet southwest of well 4. It is 464 feet deep and cased to 144 feet with 12-inch casing. Upon completion a turbine pump driven by a 40 hp (horsepower) electric motor pumped 1,260 gpm from the well.

In 1962 electric and gamma-ray logs and a current-meter traverse were made of this well. Interpretation of the logs by the author indicates that this well penetrated sand and clay between land surface and about 100 feet and limestone between 100 and 465 feet.

Well 5 proved to be too near wells 3 and 4 and small amounts of clay soon began to appear in the water from well 5 when wells 3, 4, and 5 were pumped simultaneously. The clay was temporarily stopped from entering well 5 by placing a 20-foot concrete plug below the casing, drilling a hole through the plug and placing 10 feet of screen below the plug.

In 1951, the city drilled its sixth well selecting as a site the corner of Alice and Monroe Streets. Well 6 is 20 inches in diameter and was drilled to a depth of 485 feet. A turbine pump, driven by a 100 hp electric motor, pumps 1,550 gpm from the well with only 0.3 feet measured drawdown. The well penetrated sandy clay between land surface and 75 feet and limestone between 75 and 445 feet (Herrick, 1961, p. 155).

Prior to 1960, water demand made it necessary to replace the old airlift pump on well 4 with a turbine pump which pumped 726 gpm.

In 1960 the 40 hp motor and the turbine pump on well 5 were replaced with a 125 hp motor and a new turbine pump. This combination yielded 1,500 gpm.

To meet the water demand during the summer of 1962, wells 3, 4, and 5 had to be pumped simultaneously in addition to well 6. Soon sand began to stop water meters, clog washing machines and become a general nuisance. The sand was traced to well 5, the center well in the old well field which had previously pumped small amounts of clay.

Use of well 5 was discontinued and a new well, well 7, was drilled in 1962 on the corner of Alice and Scott Streets, 487 feet east of well 6. Well 7 is only 351 feet deep, and is cased to 122 feet with 12-inch casing. It penetrated sandy clay between land surface and 50 feet and limestone between 50 and 351 feet.

Well 7 is the only well which obtains all of its water from the Ocala Limestone. Wells 3, 4, 5, and 6 tap the Ocala Limestone and the Lisbon Formation, and wells 1 and 2 probably tapped the Lisbon and Tallahatta Formations.

Chemical Quality of Water

The quality of natural ground water generally is controlled by the mineralogy of the rocks through which it flows. Thus, the water obtained from limestone aquifers would be expected to contain much calcium and bicarbonate because the mineral calcium carbonate composes the bulk of most limestones. If the aquifer is a sand, then the water would contain appreciable silica. Additional minerals known to affect the quality of water in the aquifers at Bainbridge are pyrite, an iron sulfide; and glauconite, a potassium iron silicate. No chemical analyses are available of water from the aquifers beneath the Tallahatta Formation, but the water probably contains appreciable dissolved chloride (salt).

Chemical analyses of water exclusively from the sands of the Tallahatta Formation are not available, but the water probably is soft to moderately hard with some iron dissolved from glauconite in the formation. The partial chemical analysis of water from well 2 given in table 2 is thought to represent water mostly from the Tallahatta Formation but possibly mixed with water from overlying aquifers.

Table 2.—*Chemical analyses of water at Bainbridge, Ga.*

Well number		1[a]	2[a]	6[b]
Depth (feet)		900	1,325	485
Date collected		Prior to 1908	Prior to 1908	8/9/61
Temperature (°F)		—	—	70
Silica (SiO_2)	Parts per million (PPM)	3.9	4.0	7.7
Iron (Fe)		9.8	.1	.39
Calcium (Ca)		62	29	36
Magnesium (Mg)		4.6	.1	2.9
Sodium (Na) and Potassium (K)		26	57	1.7
Bicarbonate (HCO_3)		85	82	124
Sulfate (SO_4)		58	32	.4
Chloride (Cl)		21	17	2.0
Floride (F)		—	—	.1
Nitrate (NO_3)		—	—	.7
Dissolved Solids (Residue at 180°C)		293	221	112
Hardness as $CaCO_3$ (Calcium and Magnesium)		—	—	102
pH		—	—	7.6
Aquifer		Lisbon Formation(?)	Tallahatta Formation(?)	Ocala Limestone and Lisbon Formation

[a] Stephenson and Veatch, 1915, p. 223.

[b] USGS = United States Geological Survey.

Chemical analyses of water exclusively from the Lisbon Formation at Bainbridge are not available, but the water probably contains appreciable iron dissolved from pyrite and glauconite in the formation. The chemical analysis of water from well 1 (table 2) is believed to represent water dominantly from the Lisbon Formation but possibly represents water from the Lisbon Formation mixed with water from other aquifers. The analysis of water from well 6 (table 2) represents a mixture of water from the Lisbon Formation and the Ocala Limestone. Most of the iron content of this water is believed to come from the Lisbon Formation.

Chemical analyses of water exclusively from the Ocala Limestone at Bainbridge are not available but the water is moderately hard to hard and of excellent quality for municipal and most industrial uses.

For additional information about the quality of water in aquifers in southwestern Georgia, see Wait (1961).

Dissolved Iron

Iron is present in small amounts in most water but the recommended limit for domestic use is 0.3 ppm (Public Health Service 1962, p. 42-43). Water containing more than 0.3 ppm will stain fabrics, utensils, and fixtures, and 0.5 ppm is detectable by taste. Also, water having a high iron content favors growth of the organism *Crenothrix* which forms reddish brown (rust) colored deposits in water pipes and fixtures, partly or completely clogging them. Dissolved iron may be removed by aeration of the water, followed by settling or filtration.

Water from the Lisbon Formation contributes most of the iron dissolved in the city's water. It is suggested that future wells be constructed so that they do not penetrate the Lisbon Formation. Water from such wells should be low in dissolved iron content.

Water from wells in the Ocala Limestone near Douglas and Twin Lakes in the southeastern part of Bainbridge contains as much as 5 ppm dissolved iron. As water utilization and pumpage increase in Bainbridge this water might start moving toward the city well fields. Semiannual or annual analyses of water from the southeasternmost city wells (wells 6 and 7) will detect the movement of the high iron water to these wells.

Recharge

Essentially all recharge to the limestone aquifers at Bainbridge is from precipitation that enters the limestones by direct inflow through sinkholes or by percolation through sands and clays of the residuum. In the Bainbridge area the recharge rate to the limestones exceeds the rate at which water can flow laterally through the aquifer and much of the available recharge is either rejected or discharged locally through springs.

Recharge to the underlying aquifers is mostly by infiltration of precipitation where these formations crop out south and east of Fort Gaines, Ga. The amount of recharge is unknown.

HYDRAULIC PROPERTIES OF THE PRINCIPAL ARTESIAN AQUIFER

An extensive aquifer system known as the principal artesian aquifer underlies about two-thirds of the Coastal Plain of Georgia and is the most extensively used aquifer system in the state. It is predominantly limestone and is made up of Ocala Limestone and limestones in the Lisbon Formation at Bainbridge, Ga.

Wells that tap limestones in the Bainbridge area obtain most of their water from a few thin cavernous zones capable of transmitting large volumes of water, rather than from the entire thickness of limestone. Knowing the stratigraphic position and thickness of the water-bearing zones, as well as the hydraulic properties of the aquifer, allows the proper construction and spacing of wells.

The principal hydraulic properties influencing the development of an artesian aquifer are the coefficients of transmissibility (T) and storage (S). The capacity of a formation to transmit ground water is expressed by the coefficient of transmissibility, which is defined as the rate of flow of water in gallons per day, through a vertical strip of the aquifer 1 foot wide and extending the full saturated thickness under a hydraulic gradient of 100 percent (1 foot per foot). The storage properties of an aquifer are expressed by the coefficient of storage, which is defined as the volume of water released from storage per unit surface area of the aquifer per unit decline in head or water level. The coefficients of transmissibility and storage of an aquifer may be determined by means of aquifer-performance tests wherein the effect of pumping a well at a known constant rate is measured in the pumped well and at nearby observation wells penetrating the aquifer. Graphs of drawdown versus time after pumping started, or recovery versus time after pumping stopped, are used to solve equations which express the relation between the coefficients of transmissibility and storage of an aquifer and the lowering of water levels in the vicinity of a pumped well (Theis, 1935 and Cooper and Jacob, 1946).

Current-Meter Tests

On October 9, 1962 and April 9, 1963, current-meter tests were made in wells 5 and 7 respectively to determine the stratigraphic position and thickness of water-yielding zones in the limestone at each well field. A current meter consists of a helical vane mounted on a pivot and placed in an open-end tube through which the water moves. The revolutions per minute of the vane indicate the velocity of the water. If the well diameter and the rate of pumpage are known, the volume of flow at various depths can be estimated and the depth, thickness, stratigraphic position and volume of water supplied by each water-yielding zone can be determined.

To test well 5, the turbine pump first was taken out of the well and a current meter, attached to the end of a small steel cable, was lowered into the well. Then the pump was replaced and the well pumped at about 1,500 gpm as the meter traversed the well. Well 7 was tested before a pump was installed by allowing about 800 gpm to flow into the well through two fire hoses as the meter traversed the well. Table 3 summarizes the data obtained by these tests. More than 80 percent of the total yield of both well fields comes from the Ocala Limestone immediately below the well casings at depths of less than 150 feet below land surface.

Table 3.—*Location and yield of water-bearing zones in the principal artesian aquifer at Bainbridge, Ga.*

Well number	Amount of Casing (feet)	Depth to top of water-yielding zone (feet)	Altitude of top of zone	Thickness of zone (feet)	Estimated percent of total well yield supplied by each zone
5	141 (?)	141	-16	3	80
		285	-160	2	17
7	122	375	-250	23	3
		122	-5	6	86
		310	-194	2	14

Aquifer Performance Test at the Clay Street Well Field

During the period December 4-8, 1961 an aquifer performance test was made at Bainbridge to determine the hydraulic properties of the limestone aquifer at the Clay Street well field.

The city of Bainbridge well 4 was pumped for 48 hours at 726 gpm and then pumping was stopped for 24 hours. The water-level decline and recovery were measured in city wells 2, 3, 4, and 5 and in well 15 (fig. 1), on the corner of Independent Street and Cemetery Street, owned by the Atlantic Ice and Coal Co.

Based upon data obtained during this test the coefficient of transmissibility of the principal artesian aquifer at the Clay Street well field was determined to be about 600,000 gpd/ft. The coefficient of storage was determined to be about 0.003.

Aquifer Performance Tests at the Alice Street Well Field

The drawdown of the water level in well 6 caused by pumping the well at 1,550 gpm was measured on June 2, 1960 to be 0.03 feet. Periodic measurements were made of the water level and they show the specific capacity (rate of yield per unit of drawdown) of well 6 to be about 5,000 gallons per minute per foot of drawdown.

A water-level recorder was placed on well 7 from April 5 to 9, 1963 to record the drawdown and recovery of water level in this well caused by intermittent pumping of 1,550 gpm from well 6, located 487 feet to the west. Each time the pump in well 6 started or stopped the water level in well 7 almost instantaneously oscillated with an amplitude of 0.08 feet followed by a respective decline or rise in the water level of about 0.02 feet. Figure 2 shows the recorded graph.

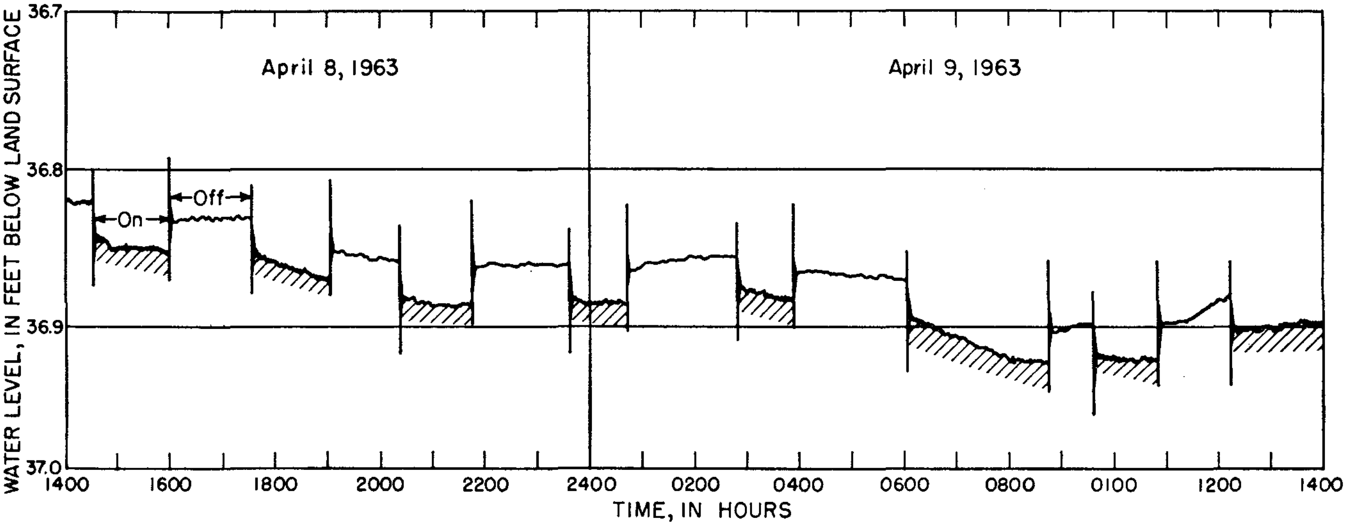

Figure 2.—Graph showing rise and fall of water level in well 7 on April 8 and 9, 1963 caused by intermittent pumping of 1,550 gpm from well 6, Alice Street well field, Bainbridge, Ga.

Recovery of the water level in well 7 was measured on April 17, 1963 after pumping it for 22 hours at 1,700 gallons per minute. Figure 3 is a graph showing water levels in well 7 before and after pumping stopped. The specific capacity of well 7 was found to be about 3,400 gallons per minute per foot of drawdown.

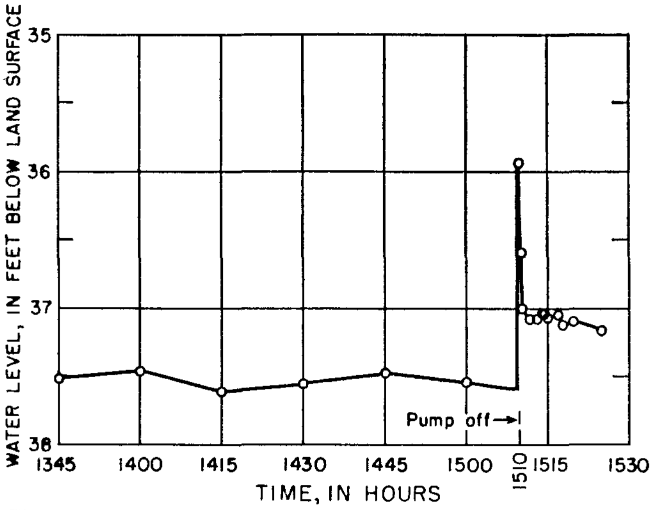

Figure 3.—Graph showing recovery of water level in well 7 after pumping 1,700 gpm for 22 hours, April 17, 1963, Bainbridge, Ga.

Based upon data obtained from these tests the coefficient of transmissibility of the principal artesian aquifer at the Alice Street well field is estimated to be about 10 million gpd per ft and the coefficient of storage to be about 0.002.

Effects of Pumping

When a well is pumped, water levels decline in a funnel shape, called a cone of depression, with the greatest drawdown at the pumped well. With continuous pumping, water is taken from storage at greater distances from the pumped well and the cone of depression grows in size and depth until a state of equilibrium is reached. Water-level decline is directly proportional to the pumping rate and diminishes in a logarithmic manner outward from the pumped well.

In a multiple well system a cone of depression is formed around each pumped well. When the cones overlap the wells are said to interfere and water levels decline in a manner directly proportional to the pumping rates and inversely proportional to the logarithm of the distance between wells.

Pumping from wells in artesian aquifers has a widespread effect on water levels. Hydraulic properties determined for the well fields at Bainbridge were used to evaluate the magnitude of interference between theoretical wells and well fields and to compute the theoretical decline of water levels at various distances from a pumped well and for different periods of time after pumping started. The amount of interference by a pumping well with nearby wells can be estimated using the graphs in figures 4 and 5.

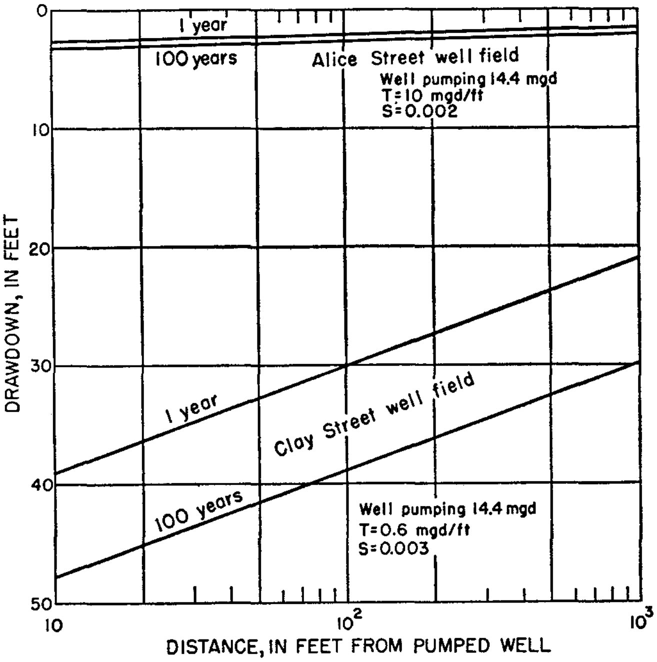

Figure 4.—Theoretical drawdown with respect to distance from pumped well and time after start of pump, Clay Street and Alice Street well fields, Bainbridge, Ga.

Figure 4 shows the theoretical amount of interference that will occur at distances of 10 feet to 1,000 feet from a well pumping continuously at 10,000 gpm (14.4 million gallons per day) for periods of 1 year and 100 years at Clay Street and Alice Street well fields. The drawdowns given theoretically would occur at equal distances from the pumped well in all directions. Even widely spaced wells in the limestone will interfere with one another but the amount of interference decreases where the coefficient of transmissibility is large. For example, for a pumping period of 1 year at 10,000 gpm the drawdown at a distance of 1,000 feet at the Clay Street well field (T=0.6 mgd per ft) is 21 feet but at the Alice Street well field (T=10 mgd per ft) the drawdown is only 1.5 feet.

Figure 5 shows the drawdown caused by interference for wells spaced at distances of 10 feet to 1,000 feet apart at the Clay Street and Alice Street well fields for a continuous pumping period of 10 years at 1,000 gpm, 10,000 gpm, 20,000 gpm, and 100,000 gpm. Note the tremendous difference in drawdown versus pumpage for the two well fields. For example, if 10,000 gpm were pumped from a well in the Clay Street well field (continuously for 10 years) the drawdown at 100 feet distance would be 32.5 feet. To cause a similar drawdown at the Alice Street well field a well would have to be pumped at about 150,000 gpm.

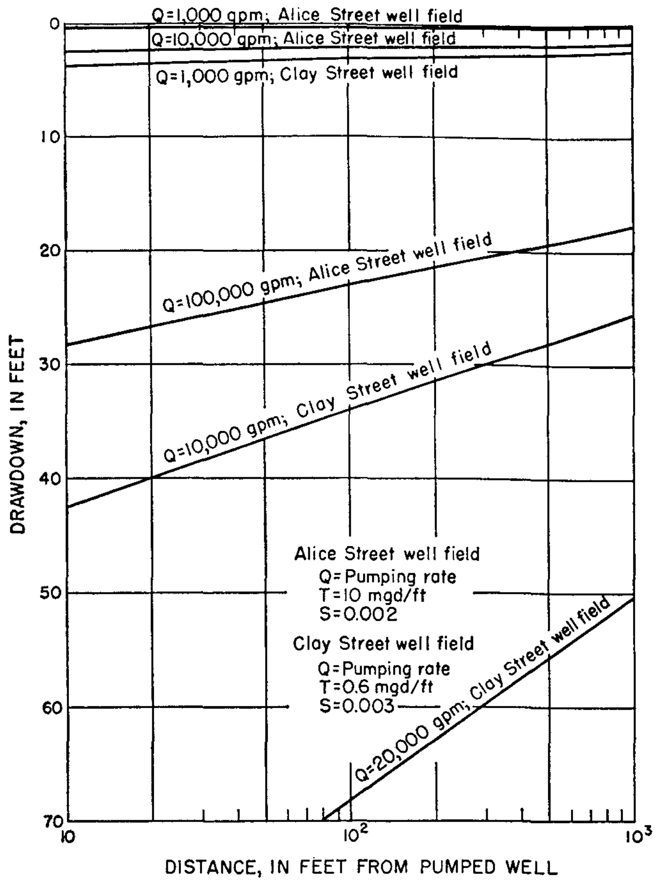

Figure 5.—Theoretical drawdown with respect to distance from pumped well after 10 years continuous pumping, Clay Street and Alice Street well fields, Bainbridge, Ga.

Spacing of Wells

The problem of spacing wells is generally one of economics - the farther apart they are the less their interference but the greater the cost of the connecting pipeline and electrical installation. The optimum economic spacing of wells varies directly with the square of the proposed pumping rate and inversely with the aquifer transmissibility (Theis, 1963, p. 113-116). In an aquifer with high transmissibility, like the aquifer at the Alice Street well field, the governing principal for spacing wells generally is convenience of operation and not hydrologic conditions. This, of course, does not mean that wells should be located too close together — at opposite corners of the water tank for example.

Wells 3, 4, and 5 at the Clay Street well field are a good example of wells located too close to one another. Well 5, the middle well, finally had to be abandoned.

Practical Sustained Yield

The practical sustained yield of an aquifer is largely dependent on the rate of recharge and its hydraulic properties. Because the rate of recharge is unknown, an exact determination of the sustained yield cannot be made. However, based upon data obtained from the aquifer tests, the limestone aquifer at Bainbridge is capable of furnishing from storage alone (no recharge) more than 50 mgd and possibly as much as 100 mgd continuously for a period of 100 or more years. Natural recharge through numerous lime sinks and recharge induced from the Flint River during pumpage could be enough to sustain a larger yield.

SUMMARY

Aquifer performance tests indicate that the City of Bainbridge is underlain by a limestone aquifer capable of yielding 50 to 100 mgd of water. Natural recharge from rainfall, along with recharge induced from the Flint River during pumpage could be enough to sustain a larger yield. The presence of such a large quantity of moderately hard, good quality water should be of considerable interest to industries considering the location of a plant at Bainbridge.

The aquifer at the Alice Street well field is capable of yielding about 16 times as much water per foot of drawdown as the aquifer at the Clay Street well field. Several wells can be added within the Alice Street well field without danger of overpumping the aquifer.

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