UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Water-Supply Paper 912

# INDUSTRIAL QUALITY OF PUBLIC WATER SUPPLIES IN GEORGIA 1940


BY

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Prepared in cooperation with the
DIVISION OF MINES, MINING, AND GEOLOGY OF THE
GEORGIA DEPARTMENT OF NATURAL RESOURCES




UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1942

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - - - - - Price 15 cents

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# ILLUSTRATION

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## ABSTRACT

Information relating to the chemical characteristics of public water supplies is essential to the location of many industries and to a better and more economical use of the water by industries and domestic consumers. The 66 public water supplies described in this report serve places with a total population of 1,098,819, which is 35.2 percent of the population of the State. All or nearly all the water for half of these supplies is obtained from surface sources and that for the other half is obtained from underground sources. Practically all the surface supplies included in this report are in the Appalachian Highlands and nearly all the supplies from wells are in the Coastal Plain. The surface supplies serve 759,784 consumers and the ground supplies serve 339,035 consumers. By far the larger number of people in the State, however, use ground water as most of the smaller public supplies and nearly all the individual supplies are obtained from underground sources.

For each of the public supplies data are given on the ownership, source, treatment, storage, and distribution of the water. A total of 157 complete mineral analyses are given showing the chemical character of the water at each place. At places where the water receives chemical treatment other than chlorination, analyses are given for both the raw and the finished water.

There is some variation in the composition of the surface waters during the year, but for most of them the mineral content is low at all times. For only a few of the surface supplies will the maximum concentration of dissolved solids exceed 100 parts per million. The total mineral content exceeds 100 parts per million for all but a few of the ground waters, being in general between 100 and 200 parts per million. For some supplies it exceeds 200 parts per million. The extremes in total dissolved solids for the ground waters as furnished to consumers were 24 and 1,030 parts per million.

Silica and bicarbonate account for more than half of the mineral content of the raw surface waters. The use of alum in the coagulation of the surface waters increases the sulphate at the expense of the bicarbonate, but usually the bicarbonate is brought back or even increased by the final adjustment of pH. For many of the ground waters calcium and magnesium bicarbonates and silica make up nearly all of the mineral matter. Some of the well waters, particularly those in the southern and southeastern parts of the Coastal Plain, also contain appreciable quantities of sulphate.

The analyses of the surface waters show that the raw waters contain very little iron and that most of the small amount present has been removed in the process

of treatment. However, as the coagulated surface waters are generally corrosive, the treated waters would dissolve iron from mains and service pipes but for the fact that most of them receive final adjustment of pH (hydrogen-ion concentration) to inhibit corrosion. The analyses of the ground waters show that generally in those in which the iron or manganese content was sufficient to cause trouble it has been removed by the treatment. Only a few of the ground waters as furnished to consumers are corrosive enough to dissolve troublesome quantities of iron.

Most of the streams used as sources for the larger public water supplies in Georgia furnish soft water at all times. The analyses given in this report show that for only two places did the hardness of the finished surface waters exceed 60 parts per million. The ground waters are generally appreciably harder than the surface waters, the hardness of all but a few of the ground-water supplies being in the range of 60 to 200 parts per million. The extremes in hardness for the ground waters as furnished to consumers were 12 and 621 parts per million. The hardest ground waters contain in addition to carbonate hardness some noncarbonate hardness due to calcium sulphate.

The hardness of the water furnished by each of the public supplies is given in table 2 and is also shown graphically on plate 1, on which the cities are shown by symbols corresponding to four groups of hardness. Table 3 shows the number of consumers using water of different degrees of hardness and indicates that by far the largest number receive water in the range of hardness of 1 to 60 parts per million.

The average hardness of the water furnished consumers by the 66 public water supplies is 29 parts per million for the 33 surface supplies, 123 parts per million for the 33 ground supplies, and 77 parts per million for all supplies. For these averages each city is considered a unit, regardless of its size. The weighted average hardness of all supplies considered is 53 parts per million.

## INTRODUCTION

Information relating to the chemical characteristics of public water supplies is essential to the location of many industries and to a better and more economical use of the water by both industries and domestic consumers. Knowledge of the chemical quality of public water supplies is of particular aid in the satisfactory distribution of many commodities. In order to make available needed data on the chemical quality of water furnished to consumers by the larger public supplies in the State of Georgia, a study was made by the Geological Survey of the United States Department of the Interior in cooperation with the Georgia Division of Mines, Mining, and Geology. This report gives data for 66 of the larger public water supplies in Georgia, which furnish a total population of 1,098,819, or 35.2 percent of the population of the State, according to the census of 1940. The report includes all cities which were shown in the 1930 census to have as many as 2,500 inhabitants.

The sources of the larger public water supplies in Georgia largely fall into one or the other of two classifications, corresponding to the two major physiographic regions. Practically all the surface supplies considered in this report are in the Appalachian Highlands, which lie to the north of an irregular line passing through the cities of Augusta, Macon, and Columbus. Nearly all the supplies from wells are in the Coastal Plain, which is south of the line bounding the Appalachian Highlands.

The public water supplies were visited by the writer, who obtained information directly from the waterworks officials, and samples were collected and sent to the water-resources laboratory of the Geological Survey, at Washington, for analysis. The waterworks officials in Georgia cooperated to the fullest extent and were very helpful in furnishing the descriptive data that were needed. Getting accurate information on wells, such as depth, diameter, and date drilled, presented about the most difficult problem. In some places records were either not kept or were not available, and the data were given from memory. An attempt was made to check and correct, whenever possible, any of the descriptive material that appeared to be questionable. For many of the wells the figures given for depth, diameter, and date drilled are undoubtedly correct, but for others they are probably only approximate.

The text of this report follows in a general way the plan of a report by the Geological Survey on the industrial quality of the larger public water supplies in the United States.[1] The material given under the heading "Descriptions and analyses" was prepared according to one or the other of two general plans. For the surface-water supplies the following information was usually obtained:

1. Ownership.
2. Places and population supplied.
3. Source or sources.
4. Proportion of supply from each source.
5. Complete description of treatment process.
6. Rated capacity of filtration plant.
7. Capacity of raw-water reservoirs.
8. Capacity of finished-water reservoirs, elevated tanks, and standpipes.
9. Location of filtration plant and intake.
10. Brief description of distribution system.

For the well supplies the following information was usually obtained:

1. Ownership.
2. Places and population supplied.
3. Wells.
    (*a*) Well number.
    (*b*) Location.
    (*c*) Depth and diameter.
    (*d*) Date drilled.
    (*e*) Yield.
    (*f*) Proportion of supply from each well.
    (*g*) Temperature of water.

[1] Collins, W. D., Lamar, W. L., and Lohr, E. W., The industrial utility of public water supplies in the United States, 1932: U. S. Geol. Survey Water-Supply Paper 658, 1934.

4. Complete description of treatment process.
5. Capacity of storage reservoirs, elevated tanks, and standpipes.
6. Brief description of distribution system.

The 66 public water supplies included in this report are arranged alphabetically by the names of the cities. For each place data are given on the ownership, source of supply, treatment, storage, and distribution of the water. Complete mineral analyses are given for each supply. For the surface supplies analyses are given of both the raw and the finished waters. In surface supplies the mineral content of the water will vary during the year; however, with only a few exceptions the mineral content and hardness of these waters are low at all times. At several places the chemical treatment applied to the water was not regulated quite so well as it might be, with resulting variation in the composition of the finished water.

For underground waters receiving no chemical treatment other than sterilization, analyses are given for the individual wells and springs; where chemical treatment other than sterilization was applied, analyses of both the raw and the finished waters are given. For an artesian well a single analysis is usually representative of the composition of its water throughout the year. The composition of mixed water from several wells will depend upon the mineral content of the individual wells and upon the extent to which each well is used.

## ACKNOWLEDGMENTS

This investigation was made possible through the cooperation of Capt. Garland Peyton, director of the Georgia Division of Mines, Mining, and Geology, and Mr. W. H. Weir, associate director of public health engineering of the Georgia Department of Public Health. Mr. N. M. de Jarnette and other public health officials in Georgia furnished information and assistance. The waterworks officials in Georgia contributed much of the descriptive material that is given for each public supply.

## SURFACE WATER

Half of the 66 public supplies discussed are obtained from surface sources. Included in these 33 supplies, however, are a supply that obtains a small part of its water from a well and another that obtains a small part from a spring. The surface supplies are used by a population of 759,784, which is 69.1 percent of the total population served by the supplies included in this report. All the surface waters are coagulated, filtered, and chlorinated, and to most of them some final treatment is applied to adjust the pH to prevent corrosion. The surface waters are usually lower in mineral content and softer than the ground waters, and they are also generally more corrosive unless sufficient final adjustment of pH has been maintained to prevent it.

A report published in 1909 [2] gives series of analyses of composites of daily samples collected over a period of a year for six rivers in Georgia. A report is now being prepared by the Geological Survey of the United States Department of the Interior in cooperation with the Georgia Division of Mines, Mining, and Geology on the chemical character of surface waters of Georgia.

## GROUND WATER

The ground-water supplies include those of 25 places that obtain all or most of their supply from artesian wells in the Coastal Plain; 6 places that obtain from about 12 percent to all of their supply from wells in the Appalachian Highlands; and 6 places that obtain from 20 percent to all of their supply from springs. These supplies are used by a population of 339,035, which is 30.9 percent of the total population served by all the supplies included in this report. By far the largest number of people in the State, however, use ground water, as most of the smaller water departments get their supplies from ground-water sources, and nearly all the people not furnished by a public supply use ground water.

Most of the larger ground-water supplies are chlorinated; two are softened and a few receive treatment to prevent corrosion or to remove iron or iron and manganese.

The ground waters in Georgia are generally higher in mineral content and harder than the surface waters. The artesian-well water in the Coastal Plain is generally considered less corrosive than the surface water that has not received sufficient final adjustment of pH. Many of the artesian waters in the Coastal Plain contain some hydrogen sulphide, which may contribute to a small amount of corrosion. There are some soft well waters in the Coastal Plain just below the fall line, and some well waters from rock fractures in the Appalachian Highlands that are naturally corrosive. A few of the well waters carry objectionable quantities of iron or iron and manganese in solution.

Previous publications by the Geological Survey of Georgia [3] give information on the underground waters of Georgia. A report published in 1915 [4] gives analyses of and information on the public water supplies using underground waters in the Coastal Plain of Georgia.

[2] Dole, R. B., The quality of surface waters in the United States: U. S. Geol. Survey Water-Supply Paper 236, 1909.

[3] McCallie, S. W., Artesian-well system of Georgia: Georgia Geol. Survey Bull. 7, 1898; Underground waters of Georgia: Georgia Geol. Survey Bull. 15, 1908; Mineral springs of Georgia; Georgia Geol. Survey Bull. 20, 1913.

[4] Stephenson, L. W. and Veatch, J. O., Underground waters of the Coastal Plain of Georgia: U. S. Geol. Survey Water-Supply Paper 341, 1915.

## COLLECTION AND EXAMINATION OF SAMPLES

Most of the samples were collected in gallon pyrex bottles by the writer. For most of the underground supplies a separate small sample was collected for the iron determination, and for a few another sample was collected for the manganese determination. Considerable care was taken to collect representative samples.

The complete mineral analyses were made by the methods in general use.[5] Table 1 shows that 150 of the 157 complete analyses were made in the water-resources laboratory of the Geological Survey, United States Department of the Interior. Seven of the older analyses were taken from the report published in 1934 [6] on the larger public water supplies in the United States. Of the analyses given in the present report 96 were made by Arthur T. Ness, 17 by Wesley M. Noble, and 29 by the writer. The analyses include 7 average analyses which are based on averages from 226 single analyses.

TABLE 1.—*Sources of analyses used in this report*

| Laboratory | Analyses | | | |
|---|---|---|---|---|
| | Surface | Well | Spring | Total |
| Geological Survey: | | | | |
| Made for this report | [1] 62 | 70 | 6 | 138 |
| Made for other reports | 8 | 4 | 0 | 12 |
| Other laboratories | 2 | 5 | 0 | 7 |
| | 72 | 79 | 6 | 157 |

[1] Includes one analysis of mixed surface and spring water.

## REGULAR DETERMINATIONS AT THE FILTRATION PLANT

In connection with the purification of waters many of the waterworks laboratories in Georgia make daily determinations of alkalinity, pH, turbidity, temperature, carbon dioxide, and residual free chlorine and also daily bacteriological tests. A regular monthly report of the results is furnished to the Georgia Department of Public Health. Average, maximum, and minimum results for alkalinity, pH, turbidity, and temperature were compiled for this report by N. M. de Jarnette of the Georgia Department of Public Health. Raw-water results represent the water as delivered to the filtration plant, and finished-water results represent the water as delivered to the mains by the filtration plant. Usually the water was supplied to the filtration plant from raw-water storage or settling reservoirs. This storage decreased the turbidity and particularly the heavier suspended matter

[5] Collins, W. D., Notes on practical water analysis: U. S. Geol. Survey Water-Supply Paper 596, pp. 235–261, 1928. Am. Public Health Assoc. and Am. Water Works Assoc., Standard methods for the examination of water and sewage, 8th ed., 1936.

[6] Collins, W. D., Lamar, W. L., and Lohr, E. W., The industrial utility of public water supplies in the United States, 1932: U. S. Geol. Survey Water-Supply Paper 658, pp. 54–55, 1934.

carried by the stream. Storage in rather shallow reservoirs would affect the temperature of the water to some extent.

The results for alkalinity, pH, turbidity, and temperature show the variation in some of the characteristics of the surface waters during the year. The results for alkalinity are generally a good index to the variation in total mineral content of the raw surface waters. No results are given for the turbidity of the finished water, as practically all water served to consumers by filtration plants is free of noticeable turbidity. Temperature determinations were made only on the raw water as delivered to the filtration plant.

## EXPRESSION OF RESULTS

The analyses are reported in parts per million and for manganese, calcium, magnesium, sodium, potassium, bicarbonate, sulphate, chloride, fluoride, and nitrate the equivalents per million are also given. Under "Regular determinations at the filtration plant" alkalinity is expressed in parts per million in terms of calcium carbonate, pH and turbidity are expressed in units (see "pH" p. 16 and "Turbidity" p. 20), and temperature is reported in degrees Fahrenheit.

## MINERAL CONSTITUENTS IN SOLUTION

The complete analyses given for each public supply include results for silica, iron, calcium, magnesium, sodium (or sodium and potassium as sodium), potassium, bicarbonate, sulphate, chloride, fluoride, nitrate, and total dissolved solids. In several analyses results for manganese are also given. Each of these constituents is discussed in the text that follows.

### SILICA

Silica ($SiO_2$) is dissolved from practically all rock materials. Its state in natural waters is not definitely known, but in reports of analyses it is assumed to be in the colloidal state, taking no part in the equilibrium between acids and bases. The extent to which silica is dissolved in water depends upon the condition of the silica in the rock material, time of contact, and the composition of the water. The more alkaline waters have a tendency to take more silica in solution than the less alkaline waters. Water stored in a poor-grade soft-glass bottle will dissolve silica from the bottle.[7]

With the increasing use of modern high-pressure boiler plants silica is probably now considered the most troublesome constituent in a boiler-feed water. The hard silica scale prevents the rapid transfer of heat, causing local overheating and the resulting boiler-tube failure. With low-pressure boilers the main objection to silica is its tendency

[7] Collins, W. D., and Riffenburg, H. B., Contamination of water samples with material dissolved from glass containers: Ind. and Eng. Chemistry, vol. 15, pp. 48–49, 1923.

to form scale and to cement other materials into a hard, troublesome scale, causing loss in heat transfer. Hard scale is formed from some waters that have been completely softened by the use of zeolites. Silica is not removed by the treatment and a small amount of silica may be added to the water by solution of a siliceous zeolite. However, outside of its effect on high-pressure boiler plants silica is of comparatively little importance.

The analyses show that the silica content of the surface waters ranged from about 5 to 30 parts per million, with an average of about 12 parts per million. In general, the silica content of the well waters is appreciably higher than that of the surface waters. The analyses show that the silica content of the well waters ranged from about 5 to 60 parts per million and that the silica content of the spring waters was less than 10 parts per million.

## IRON

Iron (Fe) is dissolved from practically all soils and rocks and frequently from iron pipes. Soft waters low in mineral content and other waters of low pH will dissolve iron from iron pipes and particularly from hot-water lines and boilers. Most natural surface waters and many ground waters previous to their contact with iron pipes do not contain objectionable quantities of iron, though some natural ground waters do contain troublesome quanties of iron.

Water furnished to consumers should not contain more than about 0.2 part per million of iron. Water that contains much more than this amount of iron is not suitable on account of the appearance of "red water," or reddish-brown sediment caused by the oxidation of the iron. The iron will make stains on white porcelain or enameled ware and fixtures and on clothing or other fabrics. Many industrial plants, including those manufacturing and preparing foods, carbonated beverages, beer, textiles, dyed fabrics, high-grade paper, and ice, must have a water practically free from iron.

Iron is almost completely removed by the coagulation and filtration practiced at water-purification plants, but coagulation with alum leaves the water in such condition that it can and does dissolve iron from pipes unless some final treatment is applied to prevent corrosion. For most of the filtered waters for which analyses are given in this report the pH of the water is adjusted to prevent corrosion by the addition of lime, and at several places soda ash is used.

The analyses of the surface waters show that the raw water contained very little iron and that most of any small amount originally present was removed by the treatment process. Because the analyses of the finished water show the composition of water as delivered by the filtration plants, the analyses do not indicate the possible iron content of the water received by the consumer for the surface water supplies that received no pH adjustment or insufficient pH adjustment to prevent corrosion.

The analyses show that most of the ground waters are not corrosive and do not contain troublesome quantities of iron. At College Park, Dublin, East Point, and Thomasville iron is removed by treating the water, and at Fort Valley the soft well water is aerated and treated with lime to prevent corrosion.

## MANGANESE

Manganese (Mn) is dissolved from soils and rock materials. Surface-water supplies in large reservoirs may contain manganese that has been dissolved from the mud on the bottom of the reservoir by the action of carbon dioxide produced by anaerobic fermentation of organic matter. Sudden and periodic appearance of manganese is typical of its occurrence in surface waters from large reservoirs. When a ground-water supply contains objectionable quantities of manganese it usually contains, also, troublesome quantities of iron. The occurrence of manganese in waters used for public supply is not nearly as general as the occurrence of iron. Results for manganese are given in the tables of analyses for only a few supplies.

Manganese has about the same objectionable qualities as iron but causes a dark-brown to black stain instead of the reddish-brown stain due to iron. Manganese may be more troublesome than iron in that it is less readily oxidized and removed by ordinary methods of water treatment unless special attention is given to the treatment for the removal of manganese.[8] Manganese precipitated on filter beds is at times again taken in solution in the finished water.

## CALCIUM AND MAGNESIUM

Calcium (Ca) and magnesium (Mg) are dissolved from many rocks. Calcium may be dissolved in large quantities from limestone, which is essentially calcium carbonate. Although calcium carbonate is only very slightly soluble in pure water, many waters flowing through calcareous deposits dissolve large quantities of calcium carbonate because they contain an excess of carbon dioxide, which produces a soluble calcium bicarbonate. Gypsum—calcium sulphate—is also an important source of calcium in some waters. Magnesium may be dissolved from dolomite and dolomitic limestones. Sea water contains large quantities of magnesium, and therefore water contaminated with sea water or flowing through deposits of sea salts may contain considerable quantities of magnesium.

[8] Hopkins, E. S., Water purification control, 2d ed., pp. 30–32, Williams & Wilkins Co., 1936.

Calcium and magnesium cause hardness in water (see "Hardness" p. 22 and "Distribution of hardness" p. 23) which is most universally recognized as a cause of trouble in water in both domestic and industrial uses. The general industrial value of waters used for public supplies is more affected by calcium and magnesium than by any other constituents.

In all supplies examined, with the exception of several in the northwestern part of the State, the calcium content of the raw surface waters was below 10 parts per million—generally below 5 parts per million—and the magnesium content was lower than the calcium. Lime used to aid coagulation, and particularly when used in the final adjustment of pH, increases the calcium content of the finished waters.

On the whole, the ground waters contain considerably more calcium, and some of them considerably more magnesium, than the surface waters. A few of the well waters that contain considerable calcium contain only very small amounts of magnesium. The analyses of the ground waters show a minimum calcium content of 1.1 parts per million. For the ground waters as delivered to consumers the extremes in calcium were about 4 and 132 parts per million.

## SODIUM AND POTASSIUM

Sodium (Na) and potassium (K) are dissolved from practically all rocks and soils, but they make up only a small part of the dissolved mineral matter of the public water supplies given in this report. As sea water is largely a solution of common salt (sodium chloride), considerable quantities of sodium may be found in water contaminated with sea water or in water that flows through deposits of sea salts. In semiarid regions sodium may be dissolved in large quantities from soils and alkali deposits. Ground waters obtained from the deeper formations are likely to contain more sodium than those obtained from the upper water-bearing strata. The quantity of potassium present in a natural water is generally comparatively small. As moderate quantities of sodium and potassium have no effect on the suitability of water for domestic and practically all industrial uses, the amounts of these constituents in the larger public supplies of Georgia are of no particular significance.

The analyses show that the sodium and potassium together were generally below 10 parts per million. The maximum sodium content found in the most highly mineralized water was 69 parts per million and the maximum potassium content was 5.6 parts per million. Soda ash (sodium carbonate), used in the treatment of a few of the waters, increases the sodium content of the finished water.

## BICARBONATE

Bicarbonate ($HCO_3$) in natural waters results from the action that the carbon dioxide dissolved in the water has on carbonate rocks. A few natural waters contain carbonate ($CO_3$), but generally its presence in samples is the result of the action of the water on the sample bottles or of previous treatment of the water. In the tables of analyses the figure for bicarbonate includes the equivalent carbonate if any carbonate was present in the water. If the carbonate content of a water was over 5 parts per million, the quantity is indicated in a footnote unless it was reasonably certain that the carbonate was due to a change in composition of the water after collection of the sample.

It is standard practice for filtration-plant laboratories to report bicarbonate and carbonate in terms of alkalinity expressed as calcium carbonate ($CaCO_3$). For a number of the surface-water supplies for which alkalinity determinations were made regularly at the waterworks laboratories the range and average of these results are given for a period of a year for both the raw and the finished water under the heading "Regular determinations at the filtration plant." One part of alkalinity as $CaCO_3$ corresponds to 1.22 parts of bicarbonate.

Bicarbonate is the principal acid radicle in nearly all the waters used by the public supplies in this report.

## SULPHATE

Sulphate ($SO_4$) is dissolved from rocks and soils and especially from material containing gypsum ($CaSO_4$). Some sulphate in the Georgia waters is derived from the oxidation of sulphides. In semiarid regions sulphate may be dissolved from alkali deposits of sodium sulphate. Sulphate in hard water will form a hard, adhering boiler scale and may influence the choice of the method of treatment for boiler feed water. Calcium and magnesium sulphates in hard water may also influence the choice of the method of softening, and they will add to the cost of softening if the more troublesome noncarbonate hardness is removed by the lime-soda process.

The sulphate content of the raw surface waters was below 10 parts per million, and generally it was below 5 parts per million. The sulphate content of the raw surface waters will vary throughout the year and at Rossville it is likely to reach a maximum above 10 parts per million. The use of alum (aluminum sulphate) as a coagulant increases the sulphate content of the finished waters. The sulphate content of the finished surface waters ranged from 5.2 to 34 parts per million. The variation in sulphate content of the finished water is more likely to be caused by the treatment than by the variation of sulphate in the raw water.

Analyses of the ground waters show that generally the sulphate content was below 20 parts per million. For a small proportion of the wells the sulphate ranged from 20 to 100 parts per million. At East Point the sulphate content of well 5 was 239 parts per million, and at Cairo the sulphate content of the public-supply well was 522 parts per million. In the Coastal Plain the sulphate content of the artesian well waters was below 20 parts per million, except in the southern and southeastern parts where the higher sulphates were found. Analyses of other artesian supplies in southeastern part of the Coastal Plain, not given in this report, also show higher sulphates.

### CHLORIDE

Chloride (Cl) is dissolved in small quantities from rock materials, and in semiarid regions it may be dissolved in large quantities from the soil. Sewage and industrial wastes may increase the chloride content of surface waters. Waters that have become contaminated with sea water or that come in contact with sea salts laid down with sedimentary rocks are likely to contain considerable chloride, as sodium chloride (common salt) is the abundant constituent of sea water.

Appreciable quantities of chloride in equilibrium with calcium or magnesium may increase the corrosiveness of a water. However, the chloride in the water of the public supplies discussed in this report has little significance in the domestic and industrial use of the water.

The analyses show the chloride content of the surface waters to be very low, being below 5 parts per million, except in two of the waters, in which it was between 10 and 12 parts per million. The chloride content of the surface waters varies during the year, and at Rossville it may reach a maximum of more than 30 parts per million. In general, the chloride content of the ground waters was below 5 parts per million. In only one supply, that of Cairo, did the chloride content of the underground water exceed 20 parts per million; there it was 75 parts per million.

### FLUORIDE

Fluoride (F) has been reported as present in rocks [9] to about the same extent as chloride. However, the quantity present in natural waters is very much less than that of chloride. The analyses of the surface waters do not show more than 0.2 part per million of fluoride, and it seems unlikely that any of the surface waters in Georgia naturally contain much more. None of the underground waters were found to contain more than 0.5 part per million of fluoride. In the United States there are regional concentrations of fluoride, and well waters in some areas are likely to contain as much as 10 or 15 parts per million

[9] Shepherd, E. S., Note on the fluoride content of rocks and ocean-bottom samples: Am. Jour. Sci., vol. 238, pp. 117-128, 1940.

of fluoride. Deep-well waters and sodium waters are more likely to contain harmful quantities of fluoride than calcium bicarbonate waters.

Fluoride in water is known to be associated with the dental defect known as mottled enamel if the water is used for drinking and cooking during calcification or formation of the teeth. Dr. H. T. Dean,[10] of the United States Public Health Service, has reported as follows:

In surveys made of cities having the requisities for quantitative evaluation and even where these requisites are closely approximate, there is a definite quantitative relation between the fluoride concentration and the clinical effect. Although a prognosis with respect to any one individual is obviously unwarranted, it is felt that a prognosis relative to the group response to waters of varying fluoride concentration may be tentatively made at this time. From the continuous use of water containing about 1 part per million, it is probable that the very mildest forms of mottled enamel may develop in about 10 percent of the group. In waters containing 1.7 or 1.8 parts per million, the incidence may be expected to rise to 40 or 50 percent, although the percentage distribution of severity would be largely of the "very mild" and "mild" types. At 2.5 parts per million an incidence of about 75 to 80 percent might be expected, with possibly 20 to 25 percent of all cases falling into the "moderate" or a severer type. A scattering few may show the "moderately severe" type.

At 4 parts per million the incidence is, in general, in the neighborhood of 90 percent, and as a rule 35 percent or more of the children are generally classified as "moderate" or worse. In concentrations of 6 parts per million or higher an incidence of 100 percent is not unusual.

The teeth of children, only, are endangered, as normally formed teeth have not been known to become mottled later, regardless of the fluoride content of the drinking water. Teeth having mottled enamel erupt showing a dull chalky white, which in many cases later takes on a characteristic dark-brown stain.

A report published in 1941 [11] by the United States Public Health Service points to fluoride in water as a factor in partially inhibiting dental caries. From the data now available it appears that the dental caries inhibitory factor, presumably present in water and probably fluoride, is operative when the fluroide content of the water is not sufficient to cause permanent disfigurement from mottled enamel.

## NITRATE

Nitrate ($NO_3$) is a relatively unimportant constituent of the waters used for the public supplies discussed in this report. Nitrate may indicate previous contamination by sewage or other organic matter, as it represents the final stage of oxidation in the nitrogen cycle.

For most of the supplies examined the nitrate was less than 1 part per million. Several of the surface waters show a nitrate content

[10] Dean, H. T., Chronic endemic dental fluorosis: Am. Medical Assoc. Jour., vol. 107, pp. 1269–1272, 1936.

[11] Dean, H. T., Jay, Philip, Arnold, F. A. Jr., and Elvove, Elias, Domestic water and dental caries: Public Health Reports, vol. 56, pp. 761–792, 1941.

between 1 and 2 parts per million, and for a few of the surface supplies the nitrate at times will be above 2 parts per million. Only three of the artesian well waters in the Coastal Plain show more than 2 parts per million of nitrate. Some of the wells in the Appalachian Highlands show a higher nitrate content, the highest being 28 parts per million for well 18 at Marietta. The nitrate content of the spring waters ranged from 2.2 to 10 parts per million.

## TOTAL DISSOLVED SOLIDS

Total dissolved solids, the residue on evaporation, consists mainly of the dissolved mineral constituents in the water. A little organic matter and water of crystallization are sometimes included. The quantity of total solids is determined by evaporating a given quantity of water and weighing the residue after it has been dried at 180° C. In drying, the bicarbonate is changed to carbonate, as carbon dioxide is given off. In calculating the quantity of dissolved solids (sum of mineral constituents), the figure for bicarbonate is divided by 2.03 to account for the conversion of bicarbonate to carbonate, and the quantities of carbonate and all other mineral constituents are added. The sum of the mineral constituents as compared with the total dissolved solids [12] obtained by evaporation may often be either low or high, depending upon the type of water. For calcium sulphate waters the dissolved solids may contain water of crystallization; waters containing appreciable chloride may lose weight on drying. For magnesium bicarbonate waters the sum of the mineral constituents is likely to be higher than the figure for total dissolved solids. Some of the soft surface waters that originate in the eastern and southern parts of the Coastal Plain of Georgia are highly colored and, due to quantities of organic matter, show very little agreement between total dissolved solids by evaporation and the sum of the mineral constituents. However, none of these colored surface waters are used by the larger public supplies. For the analyses in this report the figure for total dissolved solids may be taken as representative of the total of the dissolved mineral constituents in the water.

Waters with less than 500 parts per million of dissolved solids are satisfactory for domestic and most industrial uses, except for difficulties resulting from hardness and from objectionable minor constituents, such as iron, manganese, and fluoride. Waters with more than 1,000 parts per million of dissolved solids are likely to contain enough of certain constituents to make them unsuitable for many domestic and industrial uses.

The total dissolved solids of the surface waters will vary throughout the year, and at a few places at times of maximum concentration the

[12] Howard, C. S., Determination of total dissolved solids in water analysis: Ind. and Eng. Chemistry, Anal. Ed., vol. 5, pp. 4-6, 1933.

quantity of dissolved solids will exceed 100 parts per million. The analyses of the raw surface waters show that the concentration of total dissolved solids was below 100 parts per million in all but one public supply, that of Dalton, in which it was 131 parts per million. Softening of the water at Dalton, however, reduced the total dissolved solids in the finished water to 61 parts per million. The total dissolved solids of the finished surface waters will vary throughout the year, due to variations in the constituents naturally present and to variations in the treatment of the water. At several places the treatment of the water may, at times, raise the total dissolved solids above 100 parts per million.

The total dissolved solids was above 100 parts per million for all but a few of the ground waters, being in general between 100 and 200 parts per million. In some waters it was above 200 parts per million. The extremes of total dissolved solids in the ground waters were raw water 19 and finished water 24 parts per million at Fort Valley and 1,030 parts per million at Cairo.

### CONSTITUENTS NOT REPORTED

*Free acid.*—The waters used by the public supplies given in this report do not contain any free acid. In certain coal mining and industrial areas, however, some waters do contain free acid. Pyrites occur in most veins of bituminous coal, and by their oxidation free sulphuric acid is formed. The effect of acid mine water discharging into streams may range from merely a decrease in alkalinity of the water to an appreciably acid water.

*Aluminum, copper, and zinc.*—Small quantities of aluminum, copper, and zinc may be found in some public water supplies, but the quantities are normally too small to have any effect on the domestic and industrial use of the water. At a few small filtration plants where the treatment is not regulated sufficiently well at all times there may, on some occasions, be small amounts of residual aluminum in the filtered water. In recent years there has been a great increase in the use of red brass and copper pipe. Aggressively corrosive waters will dissolve copper and cause a troublesome green stain. A large part of the zinc found in tap waters results from the solution by the water of the zinc coating on galvanized pipes and water tanks and by the action of corrosive water on brass pipe. (See "Corrosiveness," p. 16.) However, some natural waters, in areas where they come in contact with zinc ores, as in zinc mining regions, are likely to contain more zinc [13] than is commonly realized.

[13] Bartow, Edward, and Weigle, O. M., Zinc in water supplies: Ind. and Eng. Chemistry, vol. 24, pp. 463-465, 1932.

## PROPERTIES AND CHARACTERISTICS OF WATER

### HYDROGEN-ION CONCENTRATION (pH)

The degree of acidity or alkalinity of a water as indicated by the hydrogen-ion concentration [14] is of importance with reference to corrosiveness and the proper treatment for coagulation. The hydrogen-ion concentration is commonly reported as pH.

Technically pH is the logarithm of the reciprocal of the hydrogen-ion concentration in gram atoms per liter, but simply it is merely a number denoting the degree of acidity or alkalinity. A pH value of 7.0 represents neutrality, which means that the water is neither acid nor alkaline. Values higher than 7.0 denote increasing alkalinity; values lower than 7.0 denote increasing acidity.

It has been general practice to determine pH almost as soon as the samples are collected. Values for pH are not given in the tables of analyses because the samples were shipped to Washington and the analyses were not made as promptly as is required for satisfactory pH results. For a number of the surface water supplies for which pH determinations were made regularly at the waterworks laboratories the range and average of these results are given for a period of a year for both raw and finished water under the heading "Regular determinations at the filtration plant."

For all but a small proportion of the surface supplies and for several of the well supplies the pH of the finished water is adjusted to inhibit corrosion. At nearly all of the filtration plants not practicing final pH adjustment, lime or soda ash is generally added with the alum in the coagulation of the water, and the pH is not lowered as much as it would be if alum alone were used for coagulation.

### CORROSIVENESS

Water furnished by a public supply to domestic and industrial users should be noncorrosive to the extent that it will not aggressively attack and destroy metal surfaces and cause trouble by the appearance of "red water." The disadvantages of iron in a water supply have previously been discussed. (See p. 8.) However, besides the trouble caused by iron in water, corrosion causes the deterioration of water pipes, steam boilers, and water-heating equipment. Many waters that do not appreciably corrode cold-water lines will aggressively attack hot-water lines, as raising the temperature of the water greatly increases its corrosive activity. Corrosion of pipe lines resulting in tuberculation [15] causes economic losses, due to increased friction and loss of flow. Speller,[16] in his book on corrosion, makes

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[14] Clark, W. M., The determination of hydrogen ions, 3d ed., Williams & Wilkins Co., 1928.

[15] Alexander, L. J., Economic evaluation of tuberculation in pipe lines: Am. Water Works Assoc. Jour., vol. 32, pp. 371-385, 1940.

[16] Speller, F. N., Corrosion, causes and prevention, 2d ed., McGraw-Hill Book Co., 1935.

readily available a comprehensive inventory of available information on the general principles, causes, and prevention of corrosion. Oxygen, carbon dioxide, free acid, and acid-generating salts are the principal constituents in water causing corrosion. The alkalinity of water is a factor in decreasing corrosion.

Waters such as the soft surface waters in Georgia are likely to be corrosive unless final treatment is given to prevent this. The coagulation of water with alum increases the carbon dioxide content and produces a more corrosive water. Although a few of the soft surface waters delivered to consumers are corrosive, by far the majority of the surface-water supplies described in this report receive final adjustment of pH to inhibit corrosion by the addition of lime and a few by the addition of soda ash.

Only a few of the ground waters as served to consumers are corrosive. Most of the ground-water supplies described are obtained from artesian wells in the Coastal Plain, and these hard artesian well waters are generally not noticeably corrosive. The hydrogen sulphide in many of the artesian waters of the Coastal Plain may cause a slight amount of corrosion. There are some soft well waters in the Coastal Plain just below the fall line and some well waters from rock fractures in the Appalachian Highlands that are naturally corrosive.

Corrosion may be inhibited by protective coatings. A protective coating control can be maintained in water-purification plants by the proper adjustment of pH by the addition of lime. The lime produces a protective coating consisting largely of calcium carbonate. For water mains such protective coatings as cement and bituminous materials are used. Pitting of the metal may develop if the coatings are irregular or poorly adherent, so that spots of the metal are exposed. This localizing of the corroding activity may accelerate the deterioration of the metal.

In some household installations sodium silicate is added to the water to favor the formation of a protective film, especially in hot-water lines. The use of small amounts of sodium hexametaphosphate[17] in the control of corrosion and deposits is now receiving favorable attention at a number of water plants.

Resistant iron alloys are often used as casings for corrosive well waters. Red brass and copper pipe are being used more and more to inhibit corrosion in household pipe lines. A few waters very high in carbon dioxide seem to have a solvent action on copper pipe and dissolve a small amount of copper, which is objectionable. Brass pipe that contains a fairly high percentage of zinc may be attacked severely by water that would corrode iron pipes. The water may come through the brass pipes without any color, because the zinc does not

[17] Gidley, H. T. and Weston, R. S., Corrosion control by sodium hexametaphosphate: Am. Water Works Assoc. Jour., vol. 32, pp. 1484–1494, 1940.

have the staining action of iron, manganese, and copper, but in time the zinc may be dissolved at many places, leaving a skeleton of copper, which is porous, so that the pipes develop many leaks. Red brass, which is low in zinc, appears to withstand the corrosive action of water much better than ordinary yellow brass, which is comparatively high in zinc. In some installations tin-coated copper pipe is used where the water is corrosive enough to attack red brass or copper pipe.

## COLOR

In water analysis the term "color" refers to the appearance of water that is free from suspended matter. Water for domestic use and some industrial uses should be free from perceptible color. Many of the raw surface waters in Georgia appear to have a yellow or reddish-yellow color due to the presence of finely suspended clay. Usually these waters will be practically colorless after the suspended matter is removed. Many of the surface waters originating in the eastern and southern parts of the Coastal Plain of Georgia are highly colored, but none of the public supplies discussed use these highly colored Coastal Plain waters.

Natural color in surface waters is caused almost entirely by organic matter extracted from leaves, roots, and other substances in the ground. The platinum-cobalt standard proposed by Hazen[18] in 1892 is the commonly adopted standard for measuring color in water in the United States, the unit of color being that produced by 1 milligram of platinum per liter, dissolved as platinic chloride, with the addition of enough cobalt chloride to give a color matching the shade of the natural water. The figures for color given in the table of analyses represent units of this platinum-cobalt scale.

Color determinations were made on practically all samples of the raw and finished water from surface-water supplies. If the raw water had color, the coagulation and filtration reduced the color to a negligible amount. Generally, color was not reported for the ground waters, because, as a rule, they were practically free from color.

## TASTE AND ODOR

The increasing demand by the public for more palatable drinking water is being met steadily by the elimination of taste and odor from water delivered to consumers by public water supplies. Trouble from taste and odor is usually confined to surface waters. A number of the artesian well waters in the Coastal Plain of Georgia contain hydrogen sulphide, which gives a characteristic odor to water, but this odor can be eliminated readily by aeration.

[18] Hazen, Allen, A new color standard for natural waters: Am. Chem. Jour., vol. 14, pp. 300–310, 1892. Am. Public Health Assoc. and Am. Water Works Assoc., Standard methods for the examination of water and sewage, 8th ed., pp. 12–14, 1936.

Many of the tastes and odors in surface waters are of natural origin, and are produced largely by microscopic organisms. Unless preventive treatment is applied, water standing in the sunlight in large reservoirs is almost certain to develop taste and odor due to microscopic growths. Certain industrial wastes and pollution from sewage also cause taste and odor in water. Taste in water that results from the treatment of the water is generally produced by chlorine. Often the taste is not due to the chlorine itself but results from its combination with certain other substances, particularly phenolic compounds.

Activated carbon is being extensively used to remove tastes and odors.[19] It is used at many of the water-purification plants in Georgia when taste and odor are present in the raw water. A number of the treatment plants use ammonia in some form to control taste and odor, particularly to prevent taste caused by the chlorination of the water.

## TEMPERATURE

Information on temperature of water is of value to those industries in which the efficiency of the process is dependent to some degree upon the temperature of the water, particularly the use of water for cooling purposes. The rapidly expanding air-conditioning business has greatly increased the demand for data on water temperature. The maximum water temperatures and the extent of their duration are of primary importance in connection with the use of water for cooling. The general subject of the temperature of surface and ground water is discussed in a report by Collins.[20] Records of monthly temperatures of the water at the main outlet for public water supplies of cities having a population of 20,000 or more are given in a report by Holleran.[21]

Temperatures for the underground waters are given in the tables of analyses. Nearly all the temperature measurements of the underground waters were made by the writer with thermometers calibrated by the National Bureau of Standards, and the figures given represent the temperature of the water as it comes from the ground. In the few cases where the ground water received chemical treatment the temperature of the finished water is also given. Near the surface the temperature of ground water follows changes in air temperature. For water from depths below about 30 feet there will be little variation in temperature throughout the year. For water from depths below 30 to 60 feet there will be an increase in temperature with increasing depth corresponding to the increase in earth temperature. For the

[19] Baylis, J. R., Elimination of taste and odor in water: McGraw-Hill Book Co., 1935.

[20] Collins, W. D., Temperature of water available for industrial use in the United States: U. S. Geol. Survey Water-Supply Paper 520, pp. 97–104, 1925.

[21] Holleran, O. C., Effect of city water and sewerage facilities on industrial markets: Bur. Foreign and Domestic Commerce Market Research Series No. 17, 1938.

well waters given in this report there is no appreciable change throughout the year in the temperature of the water as it comes from the ground, and there is probably very little change in the temperature of the spring waters.

Temperatures for the surface waters are not given in the tables of analyses as the range and variation throughout the year are so great that single-spot temperatures would have little significance. At a number of the filtration plants, however, daily measurements of the temperature of the raw water were made, and the range and average of these results are given under the heading "Regular determinations at the filtration plant." When the water is warming up in the spring and early summer the temperature of the surface water will lag behind, whereas in August and September it may exceed the mean temperature of the air. At any place, however, the mean monthly temperature of a surface water is generally within a few degrees of the mean monthly air temperature when the air temperature is above freezing. Waters from large lakes or reservoirs are particularly slow to warm up to summer air temperatures, except that the surface and shallow parts of these waters will warm up at a much greater rate.

The temperatures given may be said to represent the water at its source; for the underground waters they represent the water as it comes from the ground, and for the surface waters they represent the raw water delivered to the filtration plant. In many public supplies the temperature of the water at the source will give a good indication of the temperature of the water received by consumers. For well supplies that are pumped directly into the mains there is generally little change in temperature. Supplies that stand in shallow reservoirs, elevated tanks, and standpipes show a greater tendency to follow air temperature.

## SUSPENDED MATTER AND TURBIDITY

Suspended matter as reported in water analyses is the weight in parts per million of the suspended or insoluble material carried by the water. The turbidity of water is a measure of the obstruction to the passage of light by suspended material. The most widely used unit for the measurement of turbidity is based on a standard adopted by the Geological Survey and published in 1902 [22] as follows:

> The standard of turbidity shall be a water which contains 100 parts of silica per million in such a state of fineness that a bright platinum wire 1 millimeter in diameter can just be seen when the center of the wire is 100 millimeters below the surface of the water and the eye of the observer is 1.2 meters above the wire, the observation being made in the middle of the day, in the open air, but not in sunlight, and in a vessel so large that the sides do not shut out the light so as to influence the results. The turbidity of such water shall be 100.

[22] U. S. Geol. Survey, Div. Hydrography Circ. 8, 1902.

The suspended matter carried by a stream is an item of considerable importance in connection with the utilization of the water. Any plan for a filtration plant and reservoir must take into account the amount and nature of the suspended matter carried by the streams. The development of plans for the utilization of surface water without filtration should include adequate information on the suspended matter that may be carried by the stream at any time.

The quantity of suspended matter varies widely and changes suddenly at most places, in accordance with the rainfall and the condition of the ground on which the rain falls. Many of the large streams in Georgia and the streams originating in the Appalachian Highlands and the northern part of the Coastal Plain carry suspended matter that consists mainly of red and yellow clay, which produces a relatively high turbidity for the amount of suspended matter that is actually present. Some of the suspended matter is so fine that it cannot be removed with filter paper without coagulation and some of it may persist almost indefinitely in undisturbed sample bottles. The colored surface waters originating in the eastern and southern parts of the Coastal Plain generally carry very little suspended matter. Except for some small mountain streams, the surface waters in the Appalachian Highlands and in the northern part of the Coastal Plain frequently carry considerably more suspended material than dissolved material, but for the colored surface waters originating in the eastern and southern parts of the Coastal Plain the opposite of this is true.

Because the suspended matter carried by the streams used for the public supplies discussed in this report generally varies during the year and from one year to another considerably more than the dissolved constituents, results for suspended matter based on single analyses are not given, as they may be decidedly misleading. For those waters, however, for which the average of a series of analyses covering a period of a year is used, the average suspended matter carried by the stream is given in the tables of analyses.

At a number of the waterworks laboratories the turbidity was determined regularly, and the range and average of these results are given for the raw water for a period of a year under the heading "Regular determinations at the filtration plant." These turbidity tests were made on the raw water delivered to the filtration plant, which in many public supplies represents the water after it has been settled in reservoirs. No results are given for the turbidity of the finished water, as generally the water served to consumers is free of noticeable suspended matter or turbidity. At times some water used by consumers may contain a little sediment due to iron.

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## HARDNESS

Hardness is the characteristic of water that receives the most attention with reference to domestic and industrial use. Hardness is caused almost entirely by calcium and magnesium. Other constituents, such as iron, aluminum, barium, strontium, zinc, and free acid also cause hardness, but in the water of public supplies as delivered to the mains they are not usually present in quantities large enough to have any appreciable effect.

Hardness is commonly reported as calcium carbonate ($CaCO_3$) equivalent to the calcium and magnesium. The hardness of water in terms of calcium carbonate may be calculated by multiplying the parts per million of calcium by 2.5 and of magnesium by 4.1; the sum of these represents the total hardness of the water in parts per million. All hardness results given in this report are calculated. The hardness of water can be determined also by means of a standard soap solution, but the soap method is generally considered less reliable than the method of calculating hardness from the quantities of calcium and magnesium as determined by analysis.

The hardness caused by calcium and magnesium equivalent to the bicarbonate or carbonate in a water is called carbonate hardness; the hardness caused by other compounds of calcium and magnesium is called noncarbonate hardness.

Hard water is objectionable in the home on account of its soap-consuming capacity. The calcium and magnesium react with the soluble soap to form an insoluble curd or grease, which not only wastes the soap but is also objectionable in all washing processes. The consumption of soap by water of a given hardness is normally the same whether the hardness is caused by calcium or magnesium and is the same for carbonate and noncarbonate hardness. The character of scale formed in steam boilers is affected by the relation of carbonate to noncarbonate hardness; the addition of chemicals for softening is governed by the ratio of carbonate to noncarbonate hardness and of magnesium to calcium.

For economical and satisfactory operation commercial laundries require water that is practically of zero hardness. Many laundries use the exchange-silicate process in completely softening the water. The processing water for textile mills is required to be very soft. Hard water is objectionable also in the bleaching, dyeing, soap, and tanning industries. In the manufacture of high-grade papers hardness may interfere with the proper sizing. In the canning of peas the adsorption of calcium has a tendency to toughen the peas. A protective coating produced by the formation of scale may inhibit corrosion of pipe lines and other equipment, but scale if uncontrolled may cause loss in heat transfer, loss of flow, and boiler failure.

## DISTRIBUTION OF HARDNESS

Carbonate hardness caused by calcium and magnesium bicarbonates represents much of the mineral content of the waters discussed in this report. This is particularly true for the ground waters. A number of the artesian well waters in the southern and southeastern parts of the Coastal Plain also have noncarbonate hardness due to calcium sulphate, and the hardness of these waters is increased accordingly.

In the coagulation of the surface waters the sulphate is increased at the expense of the bicarbonate, but generally the bicarbonate is brought back or even increased by the final adjustment of pH by the addition of lime or, occasionally, soda ash. If lime is used, the hardness of the water is increased.

The data on the hardness of water of the larger public water supplies in Georgia as given by the analyses have been summarized in different ways in tables 2 and 3 and in figure 1. To avoid drawing erroneous conclusions from these summaries the nature of the base data must be kept in mind. These data relate only to the 66 public water supplies described in this report. According to the 1940 census the population served by the 66 supplies is 1,098,819, or 35.2 percent of the population of the State. The hardness of surface waters varies during the year, and at places where lime is used the variation may be increased in accordance with the extent of the treatment. For all but a few of the surface supplies, however, the hardness of the water is low at all times. For an artesian well a single analysis is usually representative of the composition of the water from that well throughout the year. The hardness of the mixed water from several wells depends on the hardness of the individual wells and upon the extent to which each well is used. Generally at any one place the water from the different wells was reasonably similar in composition, so that changes in percent of supply did not alter greatly the hardness of the mixed water. For several water departments, however, there was a considerable difference in hardness of the water from the individual sources. At East Point analyses of the water from 3 wells show extremes in hardness of 49 and 260 parts per million for the raw water and 69 and 251 parts per million for the finished water.

Table 2 lists the 66 public supplies, the population served by each, and the hardness of the water. The hardness of the water supplies reported here was determined from the data given in the tables of analyses, which generally cover all or nearly all regular sources of supply.

The average hardness of the finished water as furnished consumers by the 66 larger Georgia public water supplies is 29 parts per million for the surface supplies, 123 parts per million for the ground supplies, and 77 parts per million for all supplies. These results are straight averages in which each city is considered equally, regardless of its size.

TABLE 2.—*Hardness of the larger public water supplies in Georgia*

| Place | Population served | Hardness as $CaCO_3$ (parts per million) | | | |
|---|---|---|---|---|---|
| | | Surface supplies | | Ground supplies | |
| | | Raw water | Finished water | Raw water | Finished water |
| Albany | 19,055 | | | 81 | 81 |
| Americus | 9,281 | | | 95 | 95 |
| Athens | 20,650 | 15 | 32 | | |
| Atlanta | 342,300 | 11 | 22 | | |
| Augusta | 65,919 | 16 | 18 | | |
| Bainbridge | 6,352 | | | 121 | 121 |
| Barnesville | 3,535 | 9.8 | 26 | | |
| Brunswick | 15,035 | | | 205 | 205 |
| Buford | 4,191 | 15 | 42 | | |
| Cairo | 4,653 | | | 621 | 621 |
| Canton | 3,000 | 12 | 23 | | |
| Carrollton | 6,214 | 13 | 34 | | |
| Cartersville [1] | 6,141 | 15 | 41 | 117 | 41 |
| Cedartown | 9,025 | | | 132 | 132 |
| College Park | 8,213 | | | 44 | 55 |
| Columbus | 56,000 | 12 | 23 | | |
| Commerce | 3,294 | 8.3 | 9.8 | | |
| Cordele | 7,929 | | | 123 | 123 |
| Covington | 4,800 | 9.4 | 11 | | |
| Cuthbert | 3,447 | | | 138 | 138 |
| Dalton | 10,448 | 131 | 60 | | |
| Dawson | 3,681 | | | 118 | 118 |
| Decatur | 17,100 | 16 | 30 | | |
| Douglas | 5,175 | | | 198 | 198 |
| Dublin | 7,814 | | | 178 | 45 |
| Eastman | 3,311 | | | 136 | 136 |
| East Point | 12,403 | | | 110 | 120 |
| East Thomaston | 3,590 | 12 | 12 | | |
| Elberton | 6,600 | 9.6 | 32 | | |
| Fitzgerald | 7,388 | | | 94 | 94 |
| Fort Valley | 4,953 | | | 5.2 | 12 |
| Gainesville | 11,200 | 6.9 | 16 | | |
| Griffin | 13,222 | 20 | 32 | | |
| Hapeville [2] | 5,059 | | | 58 | 58 |
| Lafayette | 3,700 | | | 86 | 86 |
| La Grange [3] | 21,983 | 20 | 32 | 93 | 93 |
| Lindale | 3,361 | | | 146 | 146 |
| Macon | 67,900 | 16 | 28 | | |
| Manchester | 3,462 | 2.6 | 24 | | |
| Marietta | 8,667 | | | 60 | 60 |
| Milledgeville: | | | | | |
| Municipal | 8,700 | 33 | 44 | | |
| State Hospital | 8,000 | 18 | 20 | | |
| Millen | 2,820 | | | 113 | 113 |
| Monroe | 4,168 | 8.9 | 17 | | |
| Moultrie | 10,147 | | | 113 | 113 |
| Newnan | 7,182 | 9.2 | 21 | | |
| Pelham | 2,579 | | | 166 | 166 |
| Porterdale | 3,116 | 13 | 15 | | |
| Quitman | 4,450 | | | 141 | 141 |
| Rockmart | 3,764 | 66 | 63 | | |
| Rome | 26,282 | 39 | 50 | | |
| Rossville | 3,538 | 64 | 72 | | |
| Sandersville | 3,566 | | | 49 | 49 |
| Savannah | 100,000 | | | 106 | 106 |
| Silvertown | 3,930 | 12 | 12 | | |
| Statesboro | 5,028 | | | 106 | 106 |
| Thomaston | 6,396 | 12 | 11 | | |
| Thomasville | 12,683 | | | 202 | 60 |
| Tifton | 5,228 | | | 144 | 144 |
| Toccoa | 5,494 | 8.0 | 16 | | |
| Trion | 3,800 | | | 103 | 103 |
| Valdosta | 15,595 | | | 98 | 98 |
| Vidalia | 4,109 | | | 102 | 102 |
| Washington | 3,537 | 31 | 33 | | |
| Waycross | 16,763 | | | 148 | 148 |
| Waynesboro | 3,793 | 16 | 32 | | |
| Winder | 4,100 | 6.2 | 37 | | |
| Average | | 21 | 29 | 131 | 123 |
| Weighted average | | 16 | 25 | 122 | 115 |
| Total population | 1,098,819 | | | | |

[1] The finished water is a mixture of about 80 percent river water and about 20 percent spring water.
[2] A small amount of finished surface water is purchased from Atlanta.
[3] A small proportion of the consumers receive well water or a mixture of well and river water.

It should be understood that the average figure for all supplies may be appreciably affected by the proportional number of surface and ground supplies. The weighted average hardness of the finished water, in the calculation of which each city is considered in proportion to the popu-

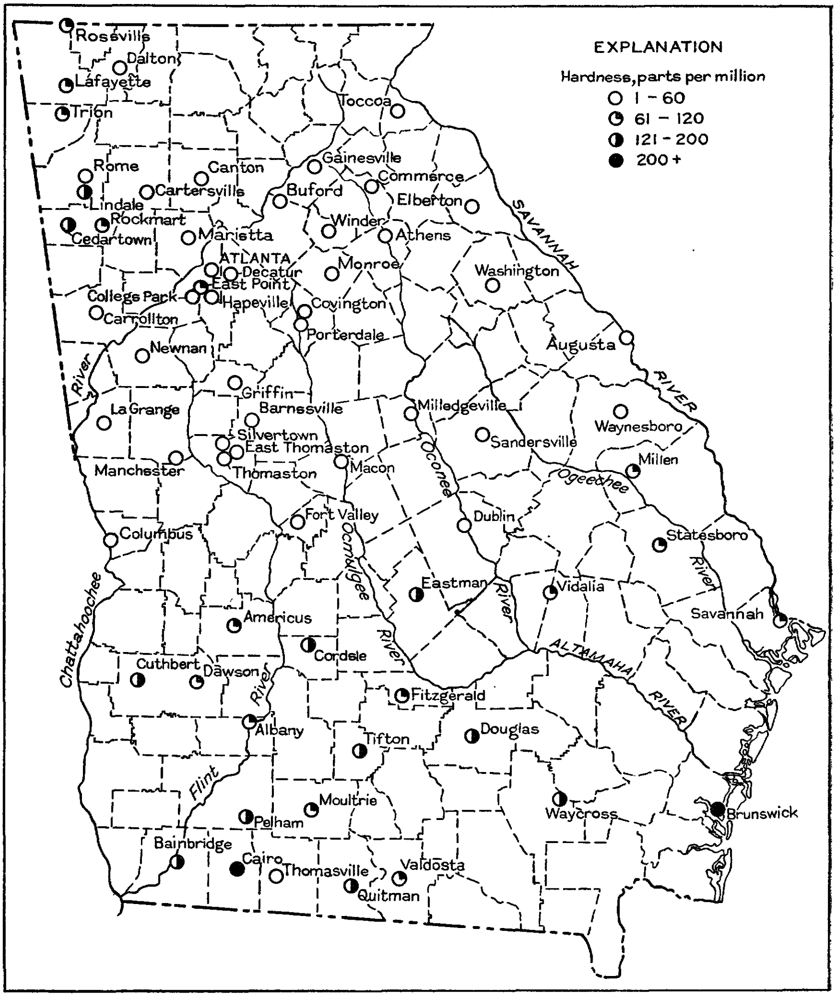


FIGURE 1.—Hardness of public water supplies in Georgia.

lation it serves, was determined to be 53 parts per million for all supplies.

The data on hardness of the finished water in table 2 are shown graphically on figure 1, on which the cities are marked to correspond to four groups of hardness.

The first group is made up of cities having water of hardness in the range of 1 to 60 parts per million. Water of this degree of hardness is considered soft. It is entirely satisfactory for all domestic uses. For supplies with a hardness near 60 softening is profitable for many steam-boiler plants and for some other industrial uses.

The second group is made up of cities having water of hardness in the range of 61 to 120 parts per million. The waters of this group may be considered moderately hard. People who are accustomed to really soft water will notice the hardness of the supplies in this range, especially in the upper part, but to those who have regularly used water with a hardness of several hundred parts per million the waters of this group will seem soft. Municipal softening is not usually practiced for waters in this group, although where municipal softening is practiced for harder waters the hardness is often reduced to about the lower limit of this group. Household water softeners have been installed by some users of supplies with a hardness near the upper limit for this group. Softening of any supply in this group is likely to be profitable for a laundry, and softening or treatment within the boiler is necessary for a steam-boiler plant. The hardness of the waters of this group, particularly near the upper limit, is objectionable also for some other industrial uses.

The third group includes cities having water of hardness in the range of 121 to 200 parts per million. Waters in the upper range of this group may be considered hard. The hardness of waters of this group is noticed by nearly everyone, but the waters near the lower limit cause little complaint when used without softening. Household softening, however, is commonly found desirable by people using supplies that fall within this range of hardness. Any indistrial plant employing processes in which hard water is detrimental will soften waters whose hardness falls within the range of this group. Municipal softening, particularly for those supplies in the upper part of the range, may be profitable.

The fourth group includes waters having a hardness of 201 parts per million and above. Only two of the supplies, Brunswick (hardness 205) and Cairo (hardness 621), fall in this group. Waters of this group may be considered hard to very hard, and they are objectionable for many domestic and industrial uses. It is desirable to soften such waters, but the cost of softening a public supply of very hard water may be prohibitive. For satisfactory domestic use some of the water may be softened in the home, or else rainwater may be collected and used for purposes for which hard water is objectionable. Softer water from shallow wells is available at some places and may be used to supplement the public supply for certain household uses.

Table 3 gives the number of consumers (census of 1940) using water of different degrees of hardness from the 66 larger public supplies in Georgia. The table indicates that by far the largest number of consumers use water with hardness of from 1 to 60 parts per million. All the finished surface waters as given in this report fall within this group except those for two places, Rockmart (hardness 63) and Rossville (hardness 72). At times the raw water at Dalton is considerably harder, but at those times it is generally softened to a hardness of about 60 parts per million.

More than half of the people using ground water from the larger public supplies in Georgia receive water of hardness between 61 and 120 parts per million. The number of consumers using ground water of hardness between 121 and 200 parts per million is somewhat larger than the number using ground water of hardness between 1 and 60 parts per million.

TABLE 3.—*Number of persons using water of different degrees of hardness from the larger public water supplies in Georgia*

| Range of hardness (parts per million) | Population | | |
|---|---|---|---|
| | Surface | Ground | Total |
| 1–10 | 0 | 0 | 0 |
| 11–20 | 119, 907 | 4, 953 | 124, 860 |
| 21–30 | 500, 580 | 0 | 500, 580 |
| 31–40 | 77, 461 | 0 | 77, 461 |
| 41–50 | 44, 086 | 12, 608 | 56, 694 |
| 51–60 | 10, 448 | 34, 521 | 44, 969 |
| 1–60 | 752, 482 | 52, 082 | 804, 564 |
| 61–80 | 7, 302 | 0 | 7, 302 |
| 81–100 | 0 | 57, 657 | 57, 657 |
| 101–120 | 0 | 141, 988 | 141, 988 |
| 61–120 | 7, 302 | 199, 645 | 206, 947 |
| 121–140 | 0 | 30, 064 | 30, 064 |
| 141–160 | 0 | 29, 802 | 29, 802 |
| 161–180 | 0 | 2, 579 | 2, 579 |

| Range of hardness (parts per million) | Population | | |
|---|---|---|---|
| | Surface | Ground | Total |
| 181–200 | 0 | 5, 175 | 5, 175 |
| 121–200 | 0 | 67, 620 | 67, 620 |
| 201–250 | 0 | 15, 035 | 15, 035 |
| 251–300 | 0 | 0 | 0 |
| 301–350 | 0 | 0 | 0 |
| 351–400 | 0 | 0 | 0 |
| 401–450 | 0 | 0 | 0 |
| 451–500 | 0 | 0 | 0 |
| 501–550 | 0 | 0 | 0 |
| 551–600 | 0 | 0 | 0 |
| 601–650 | 0 | 4, 653 | 4, 653 |
| 201–650 | 0 | 19, 688 | 19, 688 |
| | 759, 784 | 339, 035 | 1, 098, 819 |

## WATER PURIFICATION

The general subject of water purification is discussed comprehensively in several publications,[23] and others deal with special features, such as the chemistry of water treatment,[24] the microscopy of drinking water,[25] and the control and operation of filtration plants.[26] The control of processes employed in the treatment of water for public supplies has been discussed with special reference to conditions in Georgia.[27] Articles on changes and improvements in treatment processes are published currently in journals of the American Water

[23] Manual of water quality and treatment: Am. Water Works Assoc., 1940. Ellms, J. W., Water purification, 2d ed., McGraw-Hill Book Co., 1928. Flinn, A. D., Weston, R. S., and Bogert, C. L., Waterworks handbook of design, construction, and operation, 3d ed., McGraw-Hill Book Co., 1927.

[24] Buswell, A. M., The chemistry of water and sewage treatment: Am. Chem. Soc. Mon. 38, Chemical Catalog Co., 1928.

[25] Whipple, G. C., The microscopy of drinking water, 4th ed., revised by G. M. Fair and M. C. Whipple, John Wiley & Sons, 1927.

[26] Hopkins, E. S., Water purification control, 2d ed., Williams & Wilkins Co., 1936.

[27] Practical procedures for the water works operator, Georgia Dept. Public Health, 1939.

Works Association and the New England Water Works Association and in other journals dealing with water, sewerage, sanitation, and engineering. A published census of municipal water-purification plants [28] includes a chart giving data on the design and actual operation, in January 1932, of 45 large rapid sand filtration plants in the United States and 3 in Canada and also lists by States several thousand water-purification plants (including those using simple chlorination), for which it gives information on type of source of supply, rated capacity and average output of plant, and treatment process.

It is understood that the water furnished by a public supply should be safe to drink at all times. All surface supplies and most ground supplies discussed in this report are treated with chlorine. Usually water from deep wells with sealed casings is much less subject to pollution than water from surface supplies. Some of the unchlorinated water from wells in rock fractures in the Appalachian Highlands and in certain formations in the Coastal Plain might be regarded as a potential source of danger. For some of the surface supplies and several of the well supplies ammonia, or ammonia in the form of ammonium sulphate, is used to prevent a chlorinous taste and also to prevent other tastes being made more pronounced by chlorine. The ammonia-chlorine treatment provides prolonged sterilization and permits higher residual chlorine without its being detected by the consumer.

In the descriptive material under each public supply (pp. 31–83) the treatment process is given, and the operations and chemicals involved are listed in the order in which they are used. Table 4 also gives data on the treatment of the larger public supplies. Several places using mixed surface and ground waters and several places using different treatment for waters from different sources are classified in this table in accordance with the main part of the supply. The population served, however, was determined strictly on the basis of the number of people receiving each kind of water.

The surface waters are coagulated with alum (aluminum sulphate), except that at Dalton ferric sulphate is used when the water is softened. A number of the treatment plants use lime or soda ash in conjunction with the alum to produce the alkalinity necessary for satisfactory floc formation. Activated carbon is used, when needed, to remove tastes and odors from many of the surface waters. Lime is used for the final adjustment of pH for most of the surface waters and for several of the ground waters. At some of the filtration plants soda ash is used instead of lime to adjust the pH of the finished water. A few of the well waters are treated to remove iron or iron and manganese.

[28] Census of municipal water-purification plants in the United States, 1930–31, Am. Water Works Assoc., 1933.

TABLE 4.—*Treatment of the larger public water supplies in Georgia*

| Source of treatment | Number of places | Population served | Percentage of population served |
|---|---|---|---|
| Surface water | 33 | 759,784 | 69.1 |
| Coagulation and rapid sand filtration | 33 | 759,784 | 69.1 |
| Final adjustment of pH | 27 | 728,777 | 66.3 |
| Softening [1] | 1 | 10,448 | 1.0 |
| Chlorination | 33 | 759,784 | 69.1 |
| Ground water | 33 | 339,035 | 30.9 |
| Aeration | 7 | 62,526 | 5.7 |
| Iron and manganese removal by chemical treatment | 4 | 34,476 | 3.1 |
| Final adjustment of pH | 2 | 10,291 | .9 |
| Softening | 2 | 20,497 | 1.9 |
| Chlorination | 26 | 297,831 | 27.1 |
| No treatment | 7 | 41,204 | 3.8 |

[1] For part of the time only.

## SOFTENING

There is an increasing demand for soft water for both domestic and industrial uses, and where soft water is not naturally available more and more places are softening the water. Once a public supply of hard water has been softened, the consumers demand softened water. Studies on the consumption of soap by hard water have shown that softening would save sufficient soap in the average home to offset the expense of the treatment. A paper published in 1939 [29] evaluates the savings from softened water and gives a comprehensive bibliography on water softening. The degree to which municipalities soften water is being lowered, and many softening plants reduce the hardness of the finished water to about 60 parts per million.

Hard water is softened by treatment that changes soluble calcium and magnesium compounds to insoluble substances and then removes them from the water. The lime or lime-soda softening process [30] is generally used where the water requires filtration and where the installation is large enough to warrant technical supervision. Softening with lime is the more economical and it reduces the total mineral content of the water, but it removes only the carbonate hardness. Soda ash may be used with the lime to reduce the more troublesome noncarbonate hardness. This use of soda ash makes little change in the total mineral content. Lime or lime-soda softening is used in conjunction with coagulation, and it is effective in removing iron and some silica. It is especially adapted to the treatment of badly polluted waters, as it aids in the removal of bacteria, organic matter, color, and objectionable gases. Water softened by the lime or lime-soda process is generally recarbonated, by the addition of carbon

[29] Olson, H. M., Benefits and savings from softened water for municipal supply: Am. Water Works Assoc. Jour., vol. 31, pp. 607–639, 1939.

[30] Hoover, C. P., Use of lime in water softening and water purification: Ind. and Eng. Chemistry, vol. 19, pp. 567–570, 1927; Review of lime-soda water softening: Am. Water Works Assoc. Jour., vol. 29, pp. 1687–1696, 1937; Water supply and treatment, National Lime Assoc., 1941.

dioxide, to prevent deposits of calcium carbonate in the filters and in pipe lines, particularly hot-water lines. For the past few years sodium hexametaphosphate [31] has also been used for the stabilization of water softened by the lime or lime-soda process, and reports show certain advantages in the use of this chemical for the prevention of after-precipitation of calcium carbonate.

Zeolites [32] are used extensively in water softening, particularly for supplies that do not need to be filtered. For such waters the zeolite process has the advantage of requiring less careful control and supervision than the lime-soda process. By the zeolite process the water can be softened to about zero hardness, but this is not generally economically practical for public water supplies. Good results have been obtained by municipalities by softening part of the water to about zero hardness by zeolites and then mixing the softened water with some of the unsoftened water to obtain an effluent of the desired hardness. Many laundries and industrial plants that require softer water than that furnished by the public supplies use zeolites to soften the water. Softening with sodium zeolites is not satisfactory with certain industrial waters where the amount of sodium salts will be objectionable.

The siliceous sodium zeolites soften the water by base exchange, in which the calcium and magnesium of the water are exchanged for the sodium of the zeolite and the total mineral content of the water is altered very little. Carbonaceous zeolites [33] have been developed that will remove hardness and alkalinity and thereby reduce the total mineral content of the water. Boiler-feed waters low in silica can be softened by carbonaceous zeolites without the danger of silica pick-up, which might result if siliceous zeolites were used.

Of the 66 public supplies only one surface supply, that at Dalton, and 2 ground-water sugplies, those at Dublin and Thomasville, are softened. At Dalton the water is softened with lime, but softening is necessary only during dry weather, when the hardness of the water becomes objectionable. Except for this supply at Dalton during dry weather the hardness of surface supplies is generally below the limit where municipal softening is now practiced.

At Dublin the water is softened with lime, but the water at Thomasville contains some noncarbonate hardness and therefore is softened

[31] Rice, Owen, and Hatch, G. B., Threshold treatment of municipal water supplies: Am. Water Works Assoc. Jour., vol. 31, pp. 1171-1185, 1939. Hoover, C. P., and Rice, Owen, Threshold treatment—a new method of stabilizing water in softening or corrosion control through water conditioning: Water Works and Sewerage, vol. 86, pp. 10-12, 1939.

[32] Powell, S. T., Trends in zeolite softening: Am. Water Works Assoc. Jour., vol. 29, pp. 1722-1738, 1937. Behrman, A. S., Progress in municipal zeolite water softening: Am. Water Works Assoc. Jour., vol. 26 pp. 618-628, 1934.

[33] Applebaum, S. B., Recent experiences with carbonaceous zeolites: Am. Water Works Assoc. Jour., vol. 32, pp. 583-592, 1940.

with lime and soda ash. The softening process at Dublin and Thomasville also serves to remove iron from the raw water. Many of the hard ground-water supplies given in this report could profitably be softened. As softening can usually be handled more economically in a large municipal plant than in a number of small individual installations in the homes and in different business establishments, it is worth while for any public supply furnishing hard water to consider the advantages of softening the water from the standpoint of industrial development and more satisfactory use of the water.

## GEORGIA PUBLIC WATER SUPPLIES

### DESCRIPTIONS AND ANALYSES

In the following section, arranged alphabetically by the names of the cities, are given the data on the 66 public water supplies of Georgia upon which this report is based. The population of each city according to the 1940 census is shown. For a waterworks system serving other communities and consumers outside the city limits, the names of the communities and the total population supplied are also given. For each public supply the description includes, in the following order, the ownership, source of supply, treatment, storage, and distribution of the water. Rated capacities of the filtration plants are given, as well as other data pertinent to individual waterworks systems. Under treatment, the operations and chemicals are listed in the order in which they are employed. At some of the places where water is obtained from several sources, the percent of supply from each source may vary from time to time, but the data on percent of supply indicate in general the extent to which each source is used.

The analyses show the mineral content of the water. For the waters receiving chemical treatment other than chlorination, analyses are given for both the raw and the finished water. For most of the underground waters receiving no treatment other than chlorination, analyses are given for the individual wells and springs. For a number of filtration plants average, maximum, and minimum results are given for alkalinity, pH, turbidity, and temperature in order to show the variation of these characteristics during the year.

#### ALBANY

[Population 19,055]

Ownership: Municipal.

Source: 3 wells (Nos. 5 to 7), 813, 850, and 1,027 feet deep (the yield of well 7 is reported to be 1,200 gallons per minute); emergency supply from 4 wells (Nos. 1 to 4), 750, 750, 1,000, and 234 feet deep.

Treatment: Chlorination.

Storage: 3 reservoirs (Nos. 1 to 3), 310,000, 244,000, and 998,000 gallons; elevated tank, 500,000 gallons.

Wells 1 to 4 are at the waterworks pumping plant; well 5 on Flint Alley between Madison and Monroe Streets; well 6 at Wilson and Dewey Streets; well 7 at Flint Avenue and Front Street. Well 2 was drilled to 1,200 feet, and a 2-inch pipe goes to this depth. This 2-inch pipe is used to furnish drinking water at the well. This well is cased to 750 feet with a 10-inch casing, and the water when used for the public supply is obtained from this part of the well. The water from wells 1 to 5 is pumped to the reservoirs and from the reservoirs to the distribution system and elevated tank. The water from well 6 is pumped directly to the distribution system.

Wells 1 to 5, now reported to be 750, 750, 1,000, 234, and 813 feet deep, were reported in 1930 and in Geological Survey Water-Supply Paper 658 as 800, 800, 900, 460, and 800 feet deep.

*Analyses*

[Well 5, analyzed by McCandless Laboratory, Atlanta, Ga.; well 6, analyzed by L. B. Lockhart, Law & Co., Inc., Atlanta, Ga.; well 7, analyzed by William L. Lamar]

| | Well 5 | | Well 6 | | Well 7 | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 18 | | 11 | | 24 | |
| Iron (Fe) | [1].70 | | .07 | | .01 | |
| Calcium (Ca) | 24 | 1.198 | 26 | 1.298 | 21 | 1.048 |
| Magnesium (Mg) | 4.6 | .378 | 5.7 | .469 | 5.2 | .428 |
| Sodium (Na) | 30 | 1.304 | 35 | 1.522 | 43 | 1.870 |
| Potassium (K) | 1.8 | .046 | | | 2.3 | .059 |
| Bicarbonate ($HCO_3$) | 156 | 2.557 | 178 | 2.918 | 194 | 3.180 |
| Sulphate ($SO_4$) | 11 | .229 | 7.8 | .162 | 8.3 | .173 |
| Chloride (Cl) | 5.2 | .147 | 4.5 | .127 | 2.9 | .082 |
| Fluoride (F) | | | | | .2 | .010 |
| Nitrate ($NO_3$) | | | | | .09 | .002 |
| Total dissolved solids | [2]173 | | 192 | | 202 | |
| Total hardness as $CaCO_3$ | 79 | | 88 | | 74 | |
| Temperature (°F.) | | | | | 76 | |
| Date of collection | May 2, 1928 | | April 1937 | | Sept. 15, 1939 | |
| Depth (feet) | 813 | | 850 | | 1,027 | |
| Diameter (inches) | 18 | | 18 | | 30 | |
| Date drilled | | | 1937 | | 1939 | |
| Percent of supply | 30 | | 40 | | 30 | |

[1] Iron and aluminum oxides.
[2] Calculated.

## AMERICUS

[Population 9,281]

Ownership: Municipal.

Source: 4 wells, 259, 168, 337, and 400 feet deep, and 182 developed springs. The yield of the wells is reported to be about 520, 415, 300, and 300 gallons per minute; the yield of the 182 springs is reported to be about 225 gallons per minute.

Treatment: Chlorination.

Storage: 4 reservoirs, total capacity 422,000 gallons; elevated tank, 350,000 gallons.

The wells are located at the waterworks pumping plant and the springs about half a mile northeast of the wells. The water is pumped from the wells and flows from the springs to the reservoirs. It is pumped from the reservoirs to the distribution system and the elevated tank.

*Analyses of water from 4 wells (74 percent of supply)*

[Collected Jan. 21, 1938. Analyzed by Arthur T. Ness. Well numbers assigned by Geological Survey]

| | Well 1 | | Well 2 | | Well 3 | | Well 4 | |
|---|---|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 28 | | 50 | | 22 | | 56 | |
| Iron (Fe) | .18 | | .36 | | .56 | | .36 | |
| Calcium (Ca) | 46 | 2.296 | 30 | 1.497 | 46 | 2.296 | 24 | 1.198 |
| Magnesium (Mg) | 4.5 | .370 | 3.1 | .255 | 3.8 | .312 | 2.2 | .181 |
| Sodium (Na) | 3.4 | .148 | 3.3 | .144 | 3.2 | .139 | 3.5 | .152 |
| Potassium (K) | 3.4 | .087 | 3.0 | .077 | 2.9 | .074 | 2.9 | .074 |
| Bicarbonate ($HCO_3$) | 152 | 2.492 | 96 | 1.574 | 149 | 2.442 | 78 | 1.278 |
| Sulphate ($SO_4$) | 16 | .333 | 14 | .292 | 15 | .312 | 12 | .250 |
| Chloride (Cl) | 2.0 | .056 | 2.0 | .056 | 2.2 | .062 | 2.0 | .056 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .08 | .001 | .06 | .001 | .0 | .000 | .05 | .001 |
| Total dissolved solids | 177 | | 155 | | 168 | | 146 | |
| Total hardness as $CaCO_3$ | 133 | | 88 | | 131 | | 69 | |
| Temperature (°F.) | 67 | | | | 67 | | | |
| Depth (feet) | 259 | | 168 | | 337 | | 400 | |
| Diameter (inches) | 12 | | 10 | | 6 | | 6 | |
| Date drilled | 1927 | | 1914 | | 1896 | | 1896 | |
| Percent of supply | 60 | | 6 | | 4 | | 4 | |

*Analysis of water from 182 springs (26 percent of supply)*

[Collected Jan. 21, 1938. Analyzed by Arthur T. Ness]

| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
|---|---|---|---|---|---|
| Silica ($SiO_2$) | 5.5 | | Chloride (Cl) | 4.0 | 0.113 |
| Iron (Fe) | .09 | | Fluoride (F) | .0 | .000 |
| Calcium (Ca) | 1.1 | 0.055 | Nitrate ($NO_3$) | 10 | .161 |
| Magnesium (Mg) | 1.0 | .082 | Total dissolved solids | 29 | |
| Sodium (Na) | 4.0 | .174 | | | |
| Potassium (K) | .8 | .020 | Total hardness as $CaCO_3$ | 6.8 | |
| Bicarbonate ($HCO_3$) | 2.0 | .033 | Temperature (°F.) | 65 | |
| Sulphate ($SO_4$) | .7 | .015 | | | |

## ATHENS

[Population, 20,650]

Ownership: Municipal.

Source: Oconee River and Sandy Creek.

Treatment: Ammonia, chlorine, coagulation with alum and lime, rapid sand filtration, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 3,000,000 gallons per day.

Raw-water storage: Reservoir (supplied by Sandy Creek), 100,000,000 gallons.

Finished water storage: Clear water well, 500,000 gallons; elevated standpipe, 176,000 gallons; elevated tank, 250,000 gallons.

The filtration plant is located on the west side of the Oconee River about 1½ miles north of the center of Athens. Either the Oconee River or Sandy Creek is used as the source of supply, in accordance with conditions that give the most economical operation. The intake on the Oconee River is near the filtration plant; the intake on Sandy Creek is about half a mile north of the filtration plant. When Oconee River is used the water is pumped directly from the river to the filtration plant; flows through the filtration plant to the clear water well; is pumped from the clear water well to the distribution system, standpipe, and elevated tank. When Sandy Creek is used the water is pumped from the creek to the reservoir; flows from this reservoir to the filtration plant and is then distributed in the same manner as the water from the Oconee River.

*Analyses*

[Analyzed by William L. Lamar and Arthur T. Ness]

| | Oconee River (raw water) | | Oconee River (finished water) | | Sandy Creek (raw water) | | Sandy Creek (finished water) | |
|---|---|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 15 | | 13 | | 12 | | 11 | |
| Iron (Fe) | .05 | | .01 | | .12 | | .01 | |
| Calcium (Ca) | 3.9 | 0.195 | 12 | 0.599 | 2.9 | 0.145 | 7.5 | 0.374 |
| Magnesium (Mg) | 1.8 | .148 | 1.7 | .140 | 1.5 | .123 | 1.6 | .132 |
| Sodium (Na) | 3.8 | .165 | 4.4 | .191 | 3.0 | .130 | 2.7 | .117 |
| Potassium (K) | 1.2 | .031 | 1.6 | .041 | 1.5 | .038 | 1.5 | .038 |
| Bicarbonate ($HCO_3$) | 25 | .410 | 29 | .475 | 20 | .328 | 24 | .393 |
| Sulphate ($SO_4$) | 2.9 | .060 | 17 | .354 | 2.3 | .048 | 9.3 | .194 |
| Chloride (Cl) | 2.1 | .059 | 3.0 | .085 | 2.0 | .056 | 2.4 | .068 |
| Fluoride (F) | .1 | .005 | .1 | .005 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .31 | .005 | .21 | .003 | .60 | .010 | .52 | .008 |
| Total dissolved solids | 43 | | 66 | | 37 | | 48 | |
| Total hardness as $CaCO_3$ | 17 | | 37 | | 13 | | 25 | |
| Color | 6 | | 2 | | 12 | | 3 | |
| Date of collection | Nov. 15, 1940 | | Nov. 15, 1940 | | May 10, 1938 | | May 10, 1938 | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 18 | 22 | 15 | 6.8 | 7.0 | 6.5 | 30 | 110 | 20 | 60 | 80 | 42 |
| Finished water | 24 | 26 | 17 | 7.1 | 7.6 | 6.7 | | | | | | |

**ATLANTA**

[Population, 302,288]

Ownership: Municipal; supplies also the unincorporated communities of Bolton, Buckhead, Hills Park, Morningside, Riverside, Whittier Mill Village, and other suburban districts. Total population supplied, about 342,300.

Source: Chattahoochee River.

Treatment: Coagulation with alum, at times bleaching clay and copper sulphate, ammonia, chlorine, activated carbon, rapid sand filtration, final adjustment of pH to about 8.5 by addition of lime. Copper sulphate is also applied periodically to the raw-water reservoirs.

Rated capacity: Gravity filter plants, 21,000,000 and 33,000,000 gallons per day; pressure filter plant, 18,000,000 gallons per day.

Raw-water storage: 2 reservoirs, 240,000,000 and 350,000,000 gallons.

Finished-water storage: Clear-water well, 10,000,000 gallons.

The filtration plants are located in Atlanta about 4 miles northwest of Five Points. The intake is located about 4 miles northwest of the filtration plants. The water is pumped from the river to the raw-water reservoirs; flows from these reservoirs through the filtration plants to the clear-water well; is pumped from the clear-water well to the distribution system.

The system is connected with the Hapeville supply and furnishes an average of several thousand gallons per day of the finished water to Hapeville.

Daily samples of the raw water were collected from the Chattahoochee River near Vinings for the year ending April 30, 1938. This sampling point is fairly close to the waterworks intake. There is some variation in composition of the water throughout the year, but the mineral content of the river water is low at all times.

*Analyses*

[Raw water, average of analyses of 10-day composites of daily samples from Chattahoochee River near Vinings, Ga., 1937–38; analyzed by Arthur T. Ness. Finished water, average of analyses of monthly composites of daily samples, 1937; analyzed by Paul Weir, Atlanta Water Works]

| | Raw water (average) | | Finished water (average) | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 11 | | 4.5 | |
| Iron (Fe) | .04 | | .09 | |
| Manganese (Mn) | | | .02 | 0.001 |
| Calcium (Ca) | 2.4 | 0.120 | 6.0 | .300 |
| Magnesium (Mg) | 1.1 | .090 | 1.6 | .132 |
| Sodium (Na) | 3.3 | .144 | } 3.0 | } .130 |
| Potassium (K) | 1.1 | .028 | | |
| Bicarbonate ($HCO_3$) | 16 | .262 | 16 | .262 |
| Sulphate ($SO_4$) | 2.7 | .056 | 6.1 | .127 |
| Chloride (Cl) | 1.9 | .054 | 1.9 | .054 |
| Fluoride (F) | .0 | .000 | | |
| Nitrate ($NO_3$) | .40 | .006 | .39 | .006 |
| Total dissolved solids | 33 | | 40 | |
| Total hardness as $CaCO_4$ | 11 | | 22 | |
| Color | 9 | | | |
| Suspended matter | 207 | | | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 12 | 15 | 9 | 6.8 | 7.1 | 6.5 | 290 | 2,000 | 15 | 64 | 85 | 39 |
| Finished water | 15 | 25 | 13 | 8.5 | 8.6 | 8.3 | | | | | | |

## AUGUSTA

[Population, 65,919]

Ownership: Municipal.

Source: Savannah River (intake on Augusta Canal).

Treatment: Coagulation with alum or alum and lime, ammonia, chlorine, rapid sand filtration, final chlorine at times, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 15,000,000 gallons per day.

Raw-water storage: 2 reservoirs, 60,000,000 gallons each.

Finished water storage: 2 clear-water wells, 1,250,000 and 3,000,000 gallons.

The filtration plant is in northwest Augusta. The intake on the Augusta Canal is north of Augusta. The water is pumped from the canal to the raw-water reservoirs, flows from these reservoirs through the filtration plant to the clear-water wells, and from the clear-water wells to most of the distribution system. A small proportion of the water is pumped from the clear-water wells to the high service.

Daily samples of the raw water were collected from the Savannah River near Clyo for the year ending April 30, 1939. This sampling point is about 150 river miles southeast of Augusta. There is some variation in the composition of the water throughout the year, but the mineral content is low at all times, and the average of the analyses of the water from the Savannah River near Clyo may be taken to represent reasonably well the composition of the river water at Augusta.

*Analyses*

[A, Average of analyses of 10-day composites of daily samples of raw water from Savannah River near Clyo, Ga., 1938-39; B, raw water from Augusta Canal at waterworks intake, Jan. 18, 1938; C, finished water at filtration plant, Jan. 18, 1938. Analyzed by William L. Lamar and Arthur T. Ness]

| | A (raw water) average | | B (raw water) | | C (finished water) | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 11 | | 12 | | 12 | |
| Iron (Fe) | .05 | | .09 | | .03 | |
| Calcium (Ca) | 4.3 | 0.215 | 2.8 | 0.140 | 4.5 | 0.225 |
| Magnesium (Mg) | 1.3 | .107 | 1.4 | .115 | 1.7 | .140 |
| Sodium (Na) | 3.4 | .148 | 3.4 | .148 | 3.8 | .165 |
| Potassium (K) | 1.2 | .031 | 1.1 | .028 | 1.1 | .028 |
| Bicarbonate ($HCO_3$) | 22 | .361 | 20 | .328 | 20 | .328 |
| Sulphate ($SO_4$) | 3.0 | .062 | 2.0 | .042 | 6.3 | .131 |
| Chloride (Cl) | 2.4 | .068 | 2.2 | .062 | 2.9 | .082 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .34 | .005 | .36 | .006 | .25 | .004 |
| Total dissolved solids | 41 | | 38 | | 43 | |
| Total hardness as $CaCO_3$ | 16 | | 13 | | 18 | |
| Color | 13 | | 8 | | | |
| Suspended matter | 82 | | | | | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 18 | 22 | 11 | 7.0 | 7.2 | 6.8 | 220 | 1,700 | 12 | 66 | 87 | 41 |

## BAINBRIDGE

[Population, 6,352]

Ownership: Municipal.

Source: Well (No. 3), 464 feet deep (yield reported to be 1,000 gallons per minute); emergency supply from 2 wells (Nos. 1 and 2), 950 and 450 feet deep.

Treatment: None.

Storage: Two reservoirs (Nos. 1 and 2), 114,000 and 90,000 gallons; standpipe, 94,000 gallons.

The wells are located at the waterworks pumping plant. Well 3 regularly furnishes the supply. Wells 1 and 2 are connected with the system and are pumped a little each month to keep them in service. The water is pumped to the reservoirs and from the reservoirs to the distribution system and the standpipe.

*Analysis*

[Collected Feb. 5, 1938. Analyzed by Wliliam L. Lamar]

| | Well 3 | | | Well 3 | |
|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 5.0 | | Total dissolved solids | 134 | |
| Iron (Fe) | .21 | | | | |
| Calcium (Ca) | 36 | 1.797 | Total hardness as $CaCO_3$ | 121 | |
| Magnesium (Mg) | 7.5 | .617 | Temperature (°F.) | 70 | |
| Sodium (Na) | 5.7 | .248 | | | |
| Potassium (K) | .6 | .015 | | | |
| Bicarbonate ($HCO_3$) | 138 | 2.262 | Depth (feet) | 464 | |
| Sulphate ($SO_4$) | 3.3 | .069 | Diameter (inches) | 12 | |
| Chloride (Cl) | 7.8 | .220 | Date drilled | 1931 | |
| Fluoride (F) | .0 | .000 | Percent of supply | 100 | |
| Nitrate ($NO_3$) | 2.9 | .047 | | | |

## BARNESVILLE

[Population 3,535]

Ownership: Municipal.

Source: Little Towaliga River.

Treatment: Coagulation with alum, rapid sand filtration, chlorination, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 500,000 gallons per day.

Raw-water storage: None.

Finished-water storage: Clear-water well, 95,000 gallons; reservoir, 265,000 gallons.

The filtration plant is located on Jackson Highway 1 mile north of the center of Barnesville. The intake is near the Atlanta Highway and about 1½ miles northwest of the center of Barnesville. The water is pumped from the river to the filtration plant; flows through the filtration plant to the clear-water well; is pumped from the clear-water well to the distribution system and the reservoir.

*Analyses*

[Collected May 3, 1938. Analyzed by William L. Lamar]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 18 | | 16 | |
| Iron (Fe) | .03 | | .01 | |
| Calcium (Ca) | 2.3 | 0.115 | 8.9 | 0.444 |
| Magnesium (Mg) | 1.0 | .082 | 1.0 | .082 |
| Sodium (Na) | 3.8 | .165 | 3.7 | .161 |
| Potassium (K) | 1.6 | .041 | 1.8 | .046 |
| Bicarbonate ($HCO_3$) | 18 | .295 | 32 | .524 |
| Sulphate ($SO_4$) | 2.7 | .056 | 5.2 | .108 |
| Chloride (Cl) | 2.4 | .068 | 3.1 | .087 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .52 | .008 | .27 | .004 |
| Total dissolved solids | 43 | | 58 | |
| Total hardness as $CaCO_3$ | 9.8 | | 26 | |
| Color | 6 | | 2 | |

*Regular determinations at the filtration plant*

| Year 1938 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 18 | 19 | 17 | 6.8 | 6.9 | 6.7 | 150 | 5,000 | 10 | 62 | 81 | 38 |
| Finished water | 28 | 33 | 25 | 7.7 | 8.3 | 7.1 | | | | | | |

## BRUNSWICK

[Population, 15,035]

Owner: Peoples Water Service Co. of Georgia (controlled by Peoples Water Service Co. of Maryland, Baltimore, Md.).

Source: 4 wells, 1,027, 600, 456, and 456 feet deep.

Treatment: Chlorination.

Storage: Reservoir, 140,000 gallons.

The two deeper wells are located at the waterworks pumping plant. One of the 456-foot wells is located at Norwich and F Streets; the other at the foot of F Street. The total flow of the wells is reported to be 650 gallons per minute. A pump on the 1,027-foot well may be used to increase the discharge of this well to 1,500 gallons per minute. When this well is pumped the other wells stop flowing. The water from the four wells flows to the reservoir and is pumped from the reservoir to the distribution system.

The three wells now reported to be 600, 456, and 456 feet deep were reported in 1931 and in Geological Survey Water-Supply Paper 658 as 750 feet deep.

*Analysis*

[Analyzed by L. A. Shinn and N. A. Talvitie]

| | Well at Grant and F Streets | | Well at Grant and F Streets | | Well at Norwich and F Streets | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 37 | | 37 | | 25 | |
| Iron (Fe) | .02 | | .19 | | .02 | |
| Calcium (Ca) | 56 | 2.795 | 42 | 2.096 | 33 | 1.697 |
| Magnesium (Mg) | 17 | 1.398 | 26 | 2.138 | 22 | 1.809 |
| Sodium (Na) | 15 | .652 | 17 | .739 | 19 | .826 |
| Potassium (K) | 2.2 | .056 | 2.0 | .051 | 2.1 | .054 |
| Bicarbonate ($HCO_3$) | 146 | 2.393 | 143 | 2.344 | 138 | 2.262 |
| Sulphate ($SO_4$) | 96 | 1.999 | 103 | 2.144 | 80 | 1.666 |
| Chloride (Cl) | 16 | .451 | 18 | .508 | 16 | .451 |
| Fluoride (F) | | | .5 | .026 | | |
| Nitrate ($NO_3$) | .05 | .001 | .0 | .000 | .0 | .000 |
| Total dissolved solids | 312 | | 321 | | 270 | |
| Total hardness as $CaCO_3$ | 210 | | 212 | | 175 | |
| Temperature (°F.) | | | 75 | | | |
| Date of collection | Feb. 13, 1931 | | Jan. 23, 1941 | | Feb. 13, 1931 | |
| Depth (feet) | 1,027 | | 600 | | 456 | |
| Diameter (inches) | 12 | | 8 | | 6 | |
| Date drilled | | | 1918 | | | |
| Percent of supply | 60 | | 25 | | 8 | |

## BUFORD

[Population, 4,191]

Ownership: Municipal.

Source: Big Creek.

Treatment: Coagulation with alum and lime, activated carbon, rapid sand filtration, chlorination, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 500,000 gallons per day.

Raw-water storage: Reservoir, 1,500,000 gallons.

Finished-water storage: Clear-water well, 250,000 gallons; elevated tank, 40,000 gallons.

The filtration plant is located 4.2 miles north of the center of Buford. The intake is about a quarter of a mile north of the filtration plant. The water is pumped from the creek to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the elevated tank.

Bona Allen, Inc., in Buford, obtains its industrial water from Suwanee Creek. This water is filtered, and the system is connected for emergency use with the Buford supply.

*Analyses*

[Collected Sept. 8, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 9.4 | | 7.5 | |
| Iron (Fe) | .02 | | .06 | |
| Calcium (Ca) | 4.5 | 0.225 | 15 | 0.749 |
| Magnesium (Mg) | 1.0 | .082 | 1.1 | .090 |
| Sodium (Na) | 1.9 | .083 | 1.8 | .078 |
| Potassium (K) | 1.8 | .046 | 2.1 | .054 |
| Bicarbonate ($HCO_3$) | 20 | .328 | 25 | .410 |
| Sulphate ($SO_4$) | 2.5 | .052 | 24 | .500 |
| Chloride (Cl) | 1.6 | .045 | 1.5 | .042 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .20 | .003 | .25 | .004 |
| Total dissolved solids | 33 | | 69 | |
| Total hardness as $CaCO_3$ | 15 | | 42 | |
| Color | 6 | | 6 | |

*Regular determinations at the filtration plan*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 20 | 24 | 13 | 7.3 | 7.4 | 6.9 | 115 | 500 | 25 |
| Finished water | 22 | 27 | 12 | 8.2 | 8.4 | 8.0 | | | |

## CAIRO

[Population, 4,653]

Ownership: Municipal.

Source: Well (No. 2) 870 feet deep (yield reported to be 400 gallons per minute); emergency supply from a well (No. 1) 750 feet deep.

Treatment: Chlorination.

Storage: 2 reservoirs, 72,000 and 100,000 gallons; elevated tank, 60,000 gallons.

The wells are located at the waterworks pumping plant. The water is pumped to the reservoirs and from the reservoirs to the distribution system and the elevated tank.

*Analysis*

[Collected Feb. 4, 1938. Analyzed by Arthur T. Ness]

| | Well 2 | | | Well 2 | |
|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 16 | | Total dissolved solids | 1,030 | |
| Iron (Fe) | .03 | | | | |
| Calcium (Ca) | 132 | 6.588 | Total hardness as $CaCO_3$ | 621 | |
| Magnesium (Mg) | 71 | 5.839 | Temperature (°F.) | 76 | |
| Sodium (Na) | 69 | 3.000 | | | |
| Potassium (K) | 5.6 | .143 | | | |
| Bicarbonate ($HCO_3$) | 150 | 2.459 | Depth (feet) | 870 | |
| Sulphate ($SO_4$) | 522 | 10.868 | Diameter (inches) | 12 | |
| Chloride (Cl) | 75 | 2.115 | Date drilled | 1928 | |
| Fluoride (F) | .4 | .021 | Percent of supply | 100 | |
| Nitrate ($NO_3$) | .28 | .004 | | | |

## CANTON

[Population, 2,651]

Ownership: Municipal; supplies also North Canton. Total population supplied, about 3,000.

Source: Etowah River.

Treatment: Coagulation with alum and lime, chlorination, rapid sand filtration, final adjustment of pH by addition of lime.

Rated capacity of filtration: 500,000 gallons per day.

Raw-water storage: Reservoir, 800,000 gallons (available 400,000 gallons).

Finished-water storage: Clear-water well, 200,000 gallons; standpipe, 200,000 gallons; elevated tank, 60,000 gallons.

The filtration plant and intake are located on the river in Canton. The water is pumped from the river to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the standpipe. Water is pumped from the distribution system to the elevated tank, which is located in the eastern section of the city and, in general, supplies the high service in that section.

The temperature of the raw water as determined at the filtration plant for the year 1937 ranged from 34° to 79° F., with an average of 58°.

*Analyses*

[Collected May 20, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 8.9 | | 7.7 | |
| Iron (Fe) | .03 | | .02 | |
| Calcium (Ca) | 3.2 | 0.160 | 7.6 | 0.379 |
| Magnesium (Mg) | .9 | .074 | .9 | .074 |
| Sodium (Na) / Potassium (K) | 2.8 | .122 | 2.8 | .122 |
| Bicarbonate ($HCO_3$) | 18 | .295 | 22 | .361 |
| Sulphate ($SO_4$) | 1.2 | .025 | 8.2 | .171 |
| Chloride (Cl) | 1.1 | .031 | 1.5 | .042 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .30 | .005 | .08 | .001 |
| Total dissolved solids | 27 | | 41 | |
| Total hardness as $CaCO_3$ | 12 | | 23 | |
| Color | 5 | | 2 | |

## CARROLLTON

[Population, 6,214]

Ownership: Municipal.

Source: Little Tallapoosa River.

Treatment: Coagulation with alum and lime, ammonium sulphate, chlorine, rapid sand filtration, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 1,000,000 gallons per day.

Raw-water storage: None.

Finished-water storage: Clear-water well, 150,000 gallons; standpipe, 125,000 gallons.

The filtration plant and intake are located on the river 1.2 miles north of the center of Carrollton. The water is pumped from the river to the filtration plant, flows through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the standpipe.

*Analyses*

[Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 13 | | 11 | |
| Iron (Fe) | .31 | | .01 | |
| Calcium (Ca) | 3.1 | 0.155 | 11 | 0.549 |
| Magnesium (Mg) | 1.2 | .099 | 1.7 | .140 |
| Sodium (Na) | 3.0 | .130 | 3.0 | .130 |
| Potassium (K) | 1.2 | .031 | | |
| Bicarbonate ($HCO_3$) | 19 | .311 | 29 | .475 |
| Sulphate ($SO_4$) | 3.0 | .062 | 13 | .271 |
| Chloride (Cl) | 1.8 | .051 | 2.4 | .068 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .25 | .004 | .39 | .006 |
| Total dissolved solids | 38 | | 60 | |
| Total hardness as $CaCO_3$ | 13 | | 34 | |
| Color | 20 | | 2 | |
| Date of collection | Mar. 24, 1937 | | May 6, 1938 | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature ° F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 18 | 22 | 15 | 6.8 | 7.0 | 6.5 | 500 | 3,800 | 40 | 61 | 80 | 36 |
| Finished water | 32 | 45 | 25 | 8.2 | 9.2 | 8.0 | | | | | | |

## CARTERSVILLE

[Population, 6,141]

Ownership: Municipal.

Source: Etowah River (80 percent of supply) and a spring located at the filtration plant (20 percent of supply).

Treatment: Coagulation with alum, chlorination, rapid sand filtration, chlorination, at times final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 1,000,000 gallons per day.

Raw-water storage: None.

Finished-water storage: Clear-water well, 50,000 gallons; reservoir, 1,100,000 gallons.

The filtration plant and intake are located on the Etowah River about 1½ miles southeast of the center of Cartersville. The water is pumped from the Etowah River and the spring to the filtration plant, flows through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the reservoir.

Daily samples of the raw water were collected from the Etowah River about half a mile above the waterworks intake for the year ending September 30, 1939. There is some variation in the composition of the water throughout the year, but the mineral content of the river water is low at all times. Mining operations on the river above the intake increase the amount of suspended matter. The turbidity of the mixed raw water as determined at the filtration plant for the year 1938 ranged from 25 to 1,800, with an average of 135.

*Analyses*

[A, Average of analyses of 10-day composites of daily samples from Etowah River near Cartersville, 1938–39; B, Etowah River at waterworks intake, May 3, 1938; C, spring at filtration plant, May 3, 1938; D, mixed finished water as furnished consumers, May 3, 1938. Analyzed by William L. Lamar and Arthur T. Ness]

| | A (raw water) average | | B (raw water) | | C (raw water) | | D (finished water) | |
|---|---|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 11 | | 10 | | 9.1 | | 9.7 | |
| Iron (Fe) | .03 | | .05 | | .01 | | .01 | |
| Calcium (Ca) | 4.0 | 0.200 | 5.2 | 0.260 | 24 | 1.198 | 10 | 0.499 |
| Magnesium (Mg) | 1.3 | .107 | 2.1 | .173 | 14 | 1.151 | 3.8 | .312 |
| Sodium (Na) | 2.8 | .122 | 2.8 | .122 | 1.7 | .074 | 2.9 | .126 |
| Potassium (K) | 1.0 | .026 | | | 1.7 | .044 | | |
| Bicarbonate ($HCO_3$) | 22 | .361 | 28 | .459 | 136 | 2.229 | 45 | .738 |
| Sulphate ($SO_4$) | 3.2 | .067 | 2.1 | .044 | 2.5 | .052 | 6.1 | .127 |
| Chloride (Cl) | 1.5 | .042 | 1.5 | .042 | 2.6 | .073 | 2.0 | .056 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .21 | .003 | .52 | .008 | 6.0 | .097 | 1.0 | .016 |
| Total dissolved solids | 36 | | 39 | | 126 | | 58 | |
| Total hardness as $CaCO_3$ | 15 | | 22 | | 117 | | 41 | |
| Color | 6 | | 8 | | 2 | | 2 | |
| Suspended matter | 180 | | | | | | | |
| Temperature (° F.) | | | | | 62 | | | |

## CEDARTOWN

[Population, 9,025]

Ownership: Municipal.
Source: Cedartown Spring.
Treatment: Chlorination.
Storage: 2 standpipes, 185,000 and 1,575,000 gallons.

The spring is located at the waterworks pumping plant in Cedartown. The water is pumped from the spring to the distribution system and the standpipes.

*Analysis*

[Collected Apr. 19, 1938. Analyzed by William L. Lamar]

| | Cedartown Spring | | | Cedartown Spring | |
|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 8.3 | | Chloride (Cl) | 2.6 | .073 |
| Iron (Fe) | .01 | | Fluoride (F) | .0 | .000 |
| Calcium (Ca) | 30 | 1.497 | Nitrate ($NO_3$) | 4.2 | .068 |
| Magnesium (Mg) | 14 | 1.151 | Total dissolved solids | 135 | |
| Sodium (Na) | 1.7 | .074 | | | |
| Potassium (K) | .5 | .013 | Total hardness as $CaCO_3$ | 132 | |
| Bicarbonate ($HCO_3$) | 151 | 2.475 | Temperature (° F.) | 62 | |
| Sulphate ($SO_4$) | 3.4 | .071 | | | |

## COLLEGE PARK

[Population, 8,213]

Ownership: Municipal.

Source and treatment: (*a*) 2 wells, Cambridge Avenue and Francis Street, 500 and 485 feet deep; chlorination. (*b*) 3 wells, Wiley, Jackson Street, and Harvard Avenue, 300, 407, and 490 feet deep, auxiliary supply from 2 spring branches impounded in a 15,000,000-gallon reservoir; aeration over coke, coagulation with alum and lime, activated carbon at times, ammonia, chlorine, rapid sand filtration, final adjustment of pH by addition of lime; rated capacity of filtration plant, 800,000 gallons per day.

Finished-water storage: 2 reservoirs, 100,000 and 300,000 gallons; elevated tank, 100,000 gallons.

The wells are located at separate points in the city. The water is pumped directly to the distribution system from the Cambridge Avenue and Francis Street wells. The water from the Wiley, Jackson Street, and Harvard Avenue wells and from the auxiliary supply, when that is used, is pumped to the filtration plant; flows through the filtration plant to the reservoirs; and is pumped from the reservoirs to the distribution system and the elevated tank.

*Analyses of water from Cambridge Avenue and Francis Street wells (34 percent of supply)*

[Collected Sept. 12, 1938. Analyzed by Arthur T. Ness]

| | Cambridge Avenue well | | Francis Street well | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 22 | | 30 | |
| Iron (Fe) | .02 | | .05 | |
| Calcium (Ca) | 15. | 0.749 | 13 | 0.649 |
| Magnesium (Mg) | 2.2 | .181 | 2.9 | .238 |
| Sodium (Na) | 7.7 | .335 | 8.2 | .356 |
| Potassium (K) | 2.3 | .059 | 2.3 | .057 |
| Bicarbonate ($HCO_3$) | 56 | .918 | 56 | .918 |
| Sulphate ($SO_4$) | 14 | .292 | 14 | .292 |
| Chloride (Cl) | 2.9 | .082 | 2.5 | .070 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | 1.2 | .019 | .0 | .000 |
| Total dissolved solids | 98 | | 104 | |
| Total hardness as $CaCO_3$ | 47 | | 44 | |
| Temperature (°F.) | 64 | | 65 | |
| Depth (feet) | 500 | | 485 | |
| Diameter (inches) | 8 | | 8 | |
| Date drilled | 1924 | | 1923 | |
| Percent of supply | 21 | | 13 | |

*Analyses of mixed water from Wiley, Jackson Street, and Harvard Avenue wells (65 percent of supply)*

[Collected Dec. 9, 1940. Analyzed by William L. Lamar]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 27 | | 24 | |
| Iron (Fe) | 1.3 | | .49 | |
| Calcium (Ca) | 13 | 0.649 | 20 | 0.998 |
| Magnesium (Mg) | 2.6 | .214 | 2.6 | .214 |
| Sodium (Na) | 6.1 | .265 | 6.1 | .265 |
| Potassium (K) | 2.0 | .051 | 2.0 | .051 |
| Bicarbonate ($HCO_3$) | 47 | .770 | 61 | 1.000 |
| Sulphate ($SO_4$) | 15 | .312 | 22 | .458 |
| Chloride (Cl) | 2.2 | .062 | 2.8 | .079 |
| Fluoride (F) | .1 | .005 | .1 | .005 |
| Nitrate ($NO_3$) | .19 | .003 | .13 | .002 |
| Total dissolved solids | 91 | | 117 | |
| Total hardness as $CaCO_3$ | 43 | | 61 | |
| Color | 2 | | 7 | |

## COLUMBUS

[Population, 53,280]

Ownership: Municipal; supplies also Bibb City and part of Bealwood. Total population supplied, about 56,000.

Source: Chattahoochee River.

Treatment: Aeration at times, coagulation with alum, rapid sand filtration, chlorination, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 10,000,000 gallons per day.

Raw-water storage: Reservoir, 45,000,000 gallons (also a series of dams on the Chattahoochee River above the intake).

Finished-water storage: 3 clear-water wells, 200,000, 2,500,000, and 3,000,000 gallons; 2 standpipes, 300,000 gallons each.

The filtration plant and intake are located on the river about 4 miles north of the center of Columbus. The water is pumped from the river to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water wells, and from the clear-water wells to the distribution system and the standpipes.

*Analyses*

[Collected May 11, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 9.9 | | 11 | |
| Iron (Fe) | .01 | | .02 | |
| Calcium (Ca) | 2.8 | 0.140 | 6.9 | 0.344 |
| Magnesium (Mg) | 1.1 | .090 | 1.3 | .107 |
| Sodium (Na) } Potassium (K) } | 3.8 | .165 | 3.9 | .170 |
| Bicarbonate ($HCO_3$) | 17 | .279 | 22 | .360 |
| Sulphate ($SO_4$) | 2.0 | .042 | 8.6 | .179 |
| Chloride (Cl) | 2.1 | .059 | 2.6 | .073 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .96 | .016 | .62 | .010 |
| Total dissolved solids | 34 | | 47 | |
| Total hardness as $CaCO_3$ | 12 | | 23 | |
| Color | 6 | | 2 | |

*Regular determinations at the filtration plant*

| Year 1938 | Alkalinity | | | pH | | | Turbidity | | | Temperature ° F.[1] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 15 | 19 | 11 | 6.8 | 7.1 | 6.1 | 90 | 280 | 15 | 67 | 83 | 47 |
| Finished water | 18 | 22 | 12 | 8.4 | 8.8 | 7.0 | | | | | | |

[1] Results for the year 1937.

## COMMERCE

[Population, 3,294]

Ownership: Municipal.

Source: Turkey Creek.

Treatment: Coagulation with alum and lime, rapid sand filtration, chlorination, final adjustment of pH.

Rated capacity of filtration plant: 750,000 gallons per day.

Raw-water storage: Reservoir, 780,000 gallons.

Finished-water storage: Clear-water well, 200,000 gallons; elevated tank, 75,000 gallons.

The filtration plant is located on the creek 1.7 miles southwest of the center of Commerce. The finished water is pumped from the clear-water well to the distribution system and the elevated tank.

*Analyses*

[Collected Sept. 21, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 18 | | 16 | |
| Iron (Fe) | .02 | | .02 | |
| Calcium (Ca) | 2.0 | 0.100 | 2.6 | 0.130 |
| Magnesium (Mg) | .8 | .066 | .8 | .066 |
| Sodium (Na) }<br>Potassium (K) } | 3.9 | .170 | 4.3 | .187 |
| Bicarbonate ($HCO_3$) | 15 | .246 | 10 | .164 |
| Sulphate ($SO_4$) | 1.3 | .027 | 7.0 | .146 |
| Chloride (Cl) | 1.8 | .051 | 2.2 | .062 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .74 | .012 | .55 | .009 |
| Total dissolved solids | 39 | | 42 | |
| Total hardness as $CaCO_3$ | 8.3 | | 9.8 | |
| Color | 5 | | 4 | |

## CORDELE

[Population, 7,929]

Ownership: Municipal.

Source: 2 wells, 400 and 735 feet deep.

Treatment: Chlorination.

Storage: Reservoir, 250,000 gallons; standpipe, 250,000 gallons.

Both wells are located at the waterworks pumping plant. The water is pumped from the wells to a sand trap; then flows to the reservoir; and is pumped from the reservoir to the distribution system and the standpipe.

*Analyses*

[Collected Jan. 21, 1938. Analyzed by Wesley M. Noble. Well numbers assigned by Geological Survey]

| | Well 1 | | Well 2 | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 13 | | 36 | |
| Iron (Fe) | .01 | | .03 | |
| Calcium (Ca) | 44 | 2.196 | 48 | 2.396 |
| Magnesium (Mg) | 1.5 | .123 | 5.0 | .411 |
| Sodium (Na) | 3.4 | .148 | 2.8 | .122 |
| Potassium (K) | .5 | .013 | 1.6 | .041 |
| Bicarbonate ($HCO_3$) | 135 | 2.213 | 162 | 2.655 |
| Sulphate ($SO_4$) | 1.4 | .029 | 7.5 | .156 |
| Chloride (Cl) | 4.8 | .135 | 2.6 | .073 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | 3.2 | .052 | .05 | .001 |
| Total dissolved solids | 142 | | 181 | |
| Total hardness as $CaCO_3$ | 116 | | 140 | |
| Depth (feet) | 400 | | 735 | |
| Diameter (inches) | 8 | | 6 | |
| Date drilled | 1900 | | 1905 | |
| Percent of supply | 70 | | 30 | |

## COVINGTON

[Population, 3,900]

Ownership: Municipal; supplies also Oxford and about 270 other consumers outside Covington. Total population supplied, about 4,800.

Source: Dried Indian Creek.

Treatment: Coagulation with alum and soda ash, rapid sand filtration, chlorination.

Rated capacity of filtration plant: 1,000,000 gallons per day.

Raw-water storage: Reservoir, 5,000,000 gallons.

Finished-water storage: Clear-water well, 75,000 gallons; standpipe, 125,000 gallons.

The filtration plant is located in Covington. The intake is about a mile north of the center of Covington. The water is pumped from the creek to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the standpipe.

*Analyses*

[Collected Sept. 13, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 15 | | 12 | |
| Iron (Fe) | .10 | | .02 | |
| Calcium (Ca) | 2.3 | 0.115 | 2.6 | 0.130 |
| Magnesium (Mg) | .9 | .074 | 1.0 | .082 |
| Sodium (Na), Potassium (K) | 4.5 | .196 | 26 | 1.131 |
| Bicarbonate ($HCO_3$) | 18 | .295 | 34 | .557 |
| Sulphate ($SO_4$) | .9 | .019 | 34 | .708 |
| Chloride (Cl) | 2.1 | .059 | 2.8 | .079 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .78 | .013 | .66 | .011 |
| Total dissolved solids | 38 | | 94 | |
| Total hardness as $CaCO_3$ | 9.4 | | 11 | |
| Color | 10 | | 2 | |

## CUTHBERT

[Population, 3,447]

Ownership: Municipal.

Source: 2 wells (Nos. 1 and 2), 500 and 480 feet deep. The yield of the wells is reported to be 300 and 266 gallons per minute.

Treatment: Chlorination.

Storage: Reservoir, 120,000 gallons; elevated tank, 110,000 gallons.

Both wells are located at the waterworks pumping plant. They are used alternately. The water is pumped to the reservoir and from the reservoir to the distribution system and the elevated tank.

*Analyses*

[Collected Feb. 2, 1938. Analyzed by William L. Lamar]

| | Well 1 | | Well 2 | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 16 | | 17 | |
| Iron (Fe) | .19 | | .10 | |
| Calcium (Ca) | 48 | 2.396 | 50 | 2.496 |
| Magnesium (Mg) | 3.7 | .304 | 3.7 | .304 |
| Sodium (Na) | 2.2 | .096 | 1.6 | .070 |
| Potassium (K) | 1.1 | .028 | 1.0 | .026 |
| Bicarbonate ($HCO_3$) | 147 | 2.410 | 152 | 2.492 |
| Sulphate ($SO_4$) | 15 | .312 | 14 | .292 |
| Chloride (Cl) | 2.1 | .059 | 2.1 | .059 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .0 | .000 | .0 | .000 |
| Total dissolved solids | 160 | | 165 | |
| Total hardness as $CaCO_3$ | 135 | | 140 | |
| Temperature (°F.) | 68 | | 68 | |
| Depth (feet) | 500 | | 480 | |
| Diameter (inches) | 6 | | 6 | |
| Date drilled | 1913 | | 1925 | |
| Percent of supply | 50 | | 50 | |

## DALTON

[Population, 10,448]

Ownership: Municipal.

Source: Mill Creek.

Treatment: Ammonia and chlorine at all times; during dry weather coagulation with ferric sulphate, softening with lime, recarbonation, rapid sand filtration, chlorine; during wet weather coagulation with alum, rapid sand filtration, chlorine, final adjustment of pH by addition of lime. The turbidity of the raw water is used as a guide for softening, because the water is usually harder when the turbidity is low. Softening is practiced when the turbidity is below about 1,000. The softening is carried out to produce an effluent having a hardness of about 60 parts per million.

Rated capacity of filtration plant: 1,500,000 gallons per day.

Raw-water storage: None.

Finished-water storage: 2 clear-water wells, 50,000 and 70,000 gallons; reservoir, 750,000 gallons.

The filtration plant and intake are located on Mill Creek 1.4 miles northwest of the center of Dalton. The water is pumped from the creek to the filtration plant, flows through the filtration plant to the clear-water wells, and is pumped from the clear-water wells to the distribution system and the reservoir.

There is considerable variation in the hardness of the raw water throughout the year. It is reported that the hardness of the raw water varies from 20 to 150 parts per million.

Crown Cotton Mill obtains water from a spring supply and furnishes 500 to 1,000 people in a mill village that is partly within the city limits of Dalton. The water is chlorinated and the system is connected for emergency use with the Dalton supply.

*Analyses*

[Collected Jan. 5, 1940. Analyzed by Wesley M. Noble]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 7.5 | | 7.1 | |
| Iron (Fe) | .01 | | .01 | |
| Calcium (Ca) | 36 | 1.797 | 9.1 | 0.454 |
| Magnesium (Mg) | 10 | .822 | 9.0 | .740 |
| Sodium (Na), Potassium (K) | 1.2 | .052 | 2.3 | .100 |
| Bicarbonate ($HCO_3$) | [1] 156 | 2.557 | [2] 65 | 1.065 |
| Sulphate ($SO_4$) | 3.1 | .064 | 8.3 | .173 |
| Chloride (Cl) | 1.5 | .042 | 1.8 | .051 |
| Fluoride (F) | .1 | .005 | .1 | .005 |
| Nitrate ($NO_3$) | .25 | .004 | .25 | .004 |
| Total dissolved solids | 131 | | 61 | |
| Total hardness as $CaCO_3$ | 131 | | 60 | |
| Color | 2 | | 1 | |

[1] Includes equivalent of 5.9 parts of carbonate ($CO_3$).
[2] Includes equivalent of 21 parts of carbonate ($CO_3$).

## DAWSON

[Population, 3,681]

Ownership: Municipal.

Source: Well 475 feet deep (yield reported to be 500 gallons per minute); emergency supply from a well reported to be about 400 feet deep.

Treatment: None.

Storage: 2 reservoirs, total capacity 482,000 gallons; elevated tank, 75,000 gallons.

Both wells are located at the waterworks pumping plant. The water is pumped from the wells to a sand trap at each well; then flows to the reservoirs; and is pumped from the reservoirs to the distribution system and the elevated tank.

*Analysis of water from well 475 feet deep*

[Collected Feb. 2, 1938. Analyzed by William L. Lamar]

| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
|---|---|---|---|---|---|
| Silica ($SiO_2$) | 24 | | Total dissolved solids | 164 | |
| Iron (Fe) | .03 | | | | |
| Calcium (Ca) | 39 | 1.947 | Total hardness as $CaCO_3$ | 118 | |
| Magnesium (Mg) | 4.9 | .403 | Temperature (°F.) | 70 | |
| Sodium (Na) | 7.5 | .326 | | | |
| Potassium (K) | 2.0 | .051 | | | |
| Bicarbonate ($HCO_3$) | 142 | 2.328 | Depth (feet) | 475 | |
| Sulphate ($SO_4$) | 14 | .292 | Diameter (inches) | 12 | |
| Chloride (Cl) | 2.1 | .059 | Date drilled | 1924 | |
| Fluoride (F) | .0 | .000 | Percent of supply | 100 | |
| Nitrate ($NO_3$) | .05 | .001 | | | |

## DECATUR

[Population, 16,561]

Ownership: Municipal; supplies also Avondale Estates. Total population supplied, about 17,100.

Source: Burnt Fork impounded in 16,000,000-gallon reservoir (95 percent of supply), South Fork Peachtree Creek impounded in 10,000,000-gallon reservoir (5 percent of supply).

Treatment: Activated carbon, coagulation with alum, ammonia, chlorine, activated carbon, lime for pH adjustment, rapid sand filtration, final chlorine when necessary.

Rated capacity of filtration plant: 2,000,000 gallons per day.

Finished-water storage: 2 clear-water wells, 100,000 and 300,000 gallons; 2 elevated tanks, 80,000 and 500,000 gallons.

The filtration plant and intake are located on Burnt Fork 3 miles north of the center of Decatur. The South Fork Peachtree Creek supply is used in summer when necessary; when this water is used it is chlorinated and pumped into the Burnt Fork Reservoir. The water flows from the Burnt Fork Reservoir through the filtration plant to the clear-water wells and is pumped from the clear-water wells to the distribution system and the elevated tanks.

*Analyses of water from Burnt Fork supply*

[Collected May 7, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 13 | | 12 | |
| Iron (Fe) | .03 | | .02 | |
| Calcium (Ca) | 3.9 | 0.195 | 9.4 | 0.469 |
| Magnesium (Mg) | 1.6 | .132 | 1.7 | .140 |
| Sodium (Na), Potassium (K) | 4.1 | .178 | 4.8 | .209 |
| Bicarbonate ($HCO_3$) | 25 | .410 | 36 | .590 |
| Sulphate ($SO_4$) | 1.4 | .029 | 7.5 | .156 |
| Chloride (Cl) | 2.0 | .056 | 2.5 | .070 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .67 | .011 | .14 | .002 |
| Total dissolved solids | 42 | | 57 | |
| Total hardness as $CaCO_3$ | 16 | | 30 | |
| Color | 6 | | 5 | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 22 | 27 | 12 | 6.6 | 7.1 | 6.4 | 140 | 1,500 | 20 | 61 | 86 | 39 |
| Finished water | 30 | 42 | 20 | 8.5 | 8.7 | 8.0 | | | | | | |

## DOUGLAS

[Population, 5,175]

Ownership: Municipal.

Source: Well 600 feet deep (yield reported to be 900 gallons per minute); auxiliary supply from another well 600 feet deep (yield reported to be 600 gallons per minute); emergency supply from an air-lift well.

Treatment: Chlorination.

Storage: 2 reservoirs, 150,000 and 225,000 gallons; elevated tank, 60,000 gallons.

The wells are located at the waterworks pumping plant. The water is pumped to the reservoirs and from the reservoirs to the distribution system and the elevated tank.

The analysis of the water from the well furnishing the regular supply most of the time is given below.

*Analysis of water from well 600 feet deep*

[Collected Jan. 31, 1938. Analyzed by Wesley M. Noble]

| | Parts per million | equivalents per million | | Parts per million | Equivalents per million |
|---|---|---|---|---|---|
| Silica ($SiO_2$) | 46 | | Total dissolved solids | 284 | |
| Iron (Fe) | .01 | | | | |
| Calcium (Ca) | 48 | 2.396 | Total hardness as $CaCO_3$ | 198 | |
| Magnesium (Mg) | 19 | 1.562 | Temperature (°F.) | 73 | |
| Sodium (Na) | 7.9 | .344 | | | |
| Potassium (K) | 1.5 | .038 | | | |
| Bicarbonate ($HCO_3$) | 146 | 2.393 | Depth (feet) | 600 | |
| Sulphate ($SO_4$) | 79 | 1.645 | Diameter (inches) | 10 | |
| Chloride (Cl) | 6.8 | .192 | Date drilled | 1928 | |
| Fluoride (F) | .3 | .016 | Percent of supply | 95 | |
| Nitrate ($NO_3$) | .0 | .000 | | | |

## DUBLIN

[Population, 7,814]

Ownership: Municipal.

Source: 3 wells (Nos. 1 to 3), 490, 290, and 290 feet deep. The yield for well 1 is reported to be 500 gallons per minute; for the other 2 wells the total yield is reported to be 150 gallons per minute.

Treatment: Aeration, ammonia, softening with lime, chlorine, recarbonation, rapid sand filtration. The softening is carried out to produce an effluent having a hardness of about 45 parts per million.

Finished-water storage: Reservoir, 500,000 gallons; 2 elevated tanks, 63,000 and 250,000 gallons.

The wells are located at the waterworks. The water flows from the wells to a settling basin, is pumped from the settling basin to the treatment plant, flows through the treatment plant to the reservoir, and is pumped from the reservoir to the distribution system and the elevated tanks.

*Analyses of water from well 1 and of mixed water from wells 2 and 3*

[Collected Jan. 28, 1938. Analyzed by Arthur T. Ness]

| | Well 1 | | Wells 2 and 3 | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 23 | | 22 | |
| Iron (Fe) | .83 | | .52 | |
| Calcium (Ca) | 64 | 3.194 | 70 | 3.494 |
| Magnesium (Mg) | 3.6 | .296 | 4.2 | .345 |
| Sodium (Na) | 4.1 | .178 | 4.1 | .178 |
| Potassium (K) | 2.6 | .066 | 2.0 | .051 |
| Bicarbonate ($HCO_3$) | 204 | 3.344 | 224 | 3.672 |
| Sulphate ($SO_4$) | 16 | .333 | 16 | .333 |
| Chloride (Cl) | 2.8 | .079 | 2.8 | .079 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .07 | .001 | .05 | .001 |
| Total dissolved solids | 213 | | 226 | |
| Total hardness as $CaCO_3$ | 175 | | 192 | |
| Temperature (°F.) | 69 | | 69 | |
| Depth (feet) | 490 | | 290 | |
| Diameter (inches) | 10 | | 4 | |
| Date drilled | 1917 | | 1890 | |
| Percent of supply | 77 | | 23 | |

*Analyses of mixed raw water and of finished water*

[Collected Jan. 28, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 26 | | 20 | |
| Iron (Fe) | .56 | | .01 | |
| Calcium (Ca) | 66 | 3.294 | 12 | 0.599 |
| Magnesium (Mg) | 3.2 | .263 | 2.7 | .222 |
| Sodium (Na) | 3.8 | .165 | 3.4 | .148 |
| Potassium (K) | 2.0 | .051 | 2.1 | .054 |
| Bicarbonate ($HCO_3$) | 204 | 3.344 | [1] 36 | .590 |
| Sulphate ($SO_4$) | 16 | .333 | 16 | .333 |
| Chloride (Cl) | 2.8 | .079 | 3.0 | .085 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .08 | .001 | .0 | .000 |
| Total dissolved solids | 220 | | 78 | |
| Total hardness as $CaCO_3$ | 178 | | 41 | |
| Temperature (°F.) | 64 | | 59 | |

[1] Includes equivalent of 13 parts of carbonate ($CO_3$).

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | |
|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 160 | 182 | 159 | 7.1 | 7.3 | 7.1 |
| Finished water | 30 | 37 | 28 | 8.9 | 9.7 | 8.7 |

## EASTMAN

[Population, 3, 311]

Ownership: Municipal.
Source: 2 wells 705 and 405 feet deep.
Treatment: Chlorination.
Storage: Reservoir, 135,000 gallons; elevated tank, 100,000 gallons.

The wells are located at the waterworks pumping plant. The water is pumped from the wells to the reservoir and from the reservoir to the distribution system and the elevated tank.

*Analyses*

Collected Jan. 22, 1938. Analyzed by Wesley M. Noble. Well numbers assigned by Geological Survey]

| | Well 1 | | Well 2 | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 30 | | 29 | |
| Iron (Fe) | .07 | | .23 | |
| Calcium (Ca) | 53 | 2.645 | 43 | 2.146 |
| Magnesium (Mg) | 2.2 | .181 | 2.2 | .181 |
| Sodium (Na) | 2.3 | .100 | 2.2 | .096 |
| Potassium (K) | 1.7 | .044 | 1.2 | .031 |
| Bicarbonate ($HCO_3$) | 167 | 2.737 | 140 | 2.295 |
| Sulphate ($SO_4$) | 6.7 | .140 | 1.2 | .025 |
| Chloride (Cl) | 2.2 | .062 | 2.1 | .059 |
| Fluoride (F) | .1 | .005 | .0 | .000 |
| Nitrate ($NO_3$) | .33 | .005 | .15 | .002 |
| Total dissolved solids | 185 | | 153 | |
| Total hardness as $CaCO_3$ | 142 | | 117 | |
| Temperature (°F.) | 70 | | 68 | |
| Depth (feet) | 705 | | 405 | |
| Diameter (inches) | 12½ | | 8 | |
| Date drilled | 1927 | | 1908 | |
| Percent of supply | 75 | | 25 | |

## EAST POINT

[Population, 12,403]

Ownership: Municipal.

Source and treatment: Well (No. 1) 500 feet deep (aeration, lime, ammonium sulphate, chlorine); 4 wells (Nos. 2, 3, 4, and 13), 500, 530, 684, and 250 feet deep (lime, ammonium sulphate, chlorine); 3 wells (Nos. 5, 8, and 12), 638, 400, and 552 feet deep (aeration, lime, ammonium sulphate, chlorine, rapid sand filtration); well (No. 6) 490 feet deep (aeration, hypochlorite); well (No. 7) 500 feet deep (hypochlorite); well (No. 9) 510 feet deep (aeration); well (No. 10) 600 feet deep (no treatment); and well (drilled in March 1940) 400 feet deep (aeration, ammonium sulphate, chlorine). Auxiliary supply from 2 wells (Nos. 15 and 16), 377 and 563 feet deep (lime, ammonium sulphate, chlorine) and from a spring (ammonium sulphate, chlorine). The yield of the wells (Nos. 1 to 10, 12, 13, 15, and 16) is reported to be 180, 35, 60, 40, 50, 35, 40, 100, 50, 40, 50, 18, 25, and 55 gallons per minute. The yield of the well drilled in 1940 and that of the spring are reported to be 110 and 25 gallons per minute, respectively.

Finished-water storage: Reservoir, 300,000 gallons; elevated tank, 500,000 gallons.

Wells 1 to 4 and 13 are located at or near the waterworks pumping plant. The other wells are located in different sections of the city. The water from wells 1 to 4 and 13 is treated, then pumped to the reservoir and from the reservoir to the distribution system and the elevated tank. For the other wells and the spring the treatment used is applied at the source and the water is pumped to the distribution system. Auxiliary wells 15 and 16 are owned by Swift & Co. and are used at their Oil Mill Harper Plant. The city supplements its regular supply with water from these wells when necessary.

*Analyses*

[Collected Sept. 12, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | | | | |
|---|---|---|---|---|---|---|
| | Well 1 | | Well 5 | | Well 8 | |
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 11 | | 29 | | 27 | |
| Iron (Fe) | .16 | | 2.0 | | .41 | |
| Manganese (Mn) | | | 1.7 | 0.062 | | |
| Calcium (Ca) | 29 | 1.448 | 71 | 3.544 | 14 | 0.699 |
| Magnesium (Mg) | 7.3 | .600 | 20 | 1.645 | 3.4 | .280 |
| Sodium (Na) | 7.2 | .313 | 20 | .870 | 7.4 | .322 |
| Potassium (K) | 2.6 | .066 | 5.4 | .138 | 3.0 | .077 |
| Bicarbonate ($HCO_3$) | 9.0 | .148 | 66 | 1.082 | 40 | .656 |
| Sulphate ($SO_4$) | 84 | 1.749 | 239 | 4.976 | 23 | .479 |
| Chloride (Cl) | 12 | .338 | 4.0 | .113 | 8.8 | .248 |
| Fluoride (F) | .0 | .000 | .1 | .005 | .0 | .000 |
| Nitrate ($NO_3$) | 9.0 | .145 | .0 | .000 | .0 | .000 |
| Total dissolved solids | 191 | | 449 | | 107 | |
| Total hardness as $CaCO_3$ | 102 | | 260 | | 49 | |
| Temperature (°F.) | 64 | | 66 | | 63 | |
| | Finished water | | | | | |
| Silica ($SiO_2$) | 9.6 | | 23 | | 26 | |
| Iron (Fe) | .06 | | .05 | | .18 | |
| Manganese (Mn) | | | .0 | 0.000 | | |
| Calcium (Ca) | 34 | 1.697 | 71 | 3.544 | 22 | 1.098 |
| Magnesium (Mg) | 6.8 | .559 | 18 | 1.480 | 3.4 | .280 |
| Sodium (Na), Potassium (K) | 8.5 | .370 | 22 | .957 | 7.5 | .326 |
| Bicarbonate ($HCO_3$) | 20 | .328 | 53 | .869 | 59 | .967 |
| Sulphate ($SO_4$) | 85 | 1.770 | 239 | 4.976 | 23 | .479 |
| Chloride (Cl) | 13 | .367 | 4.0 | .113 | 8.5 | .240 |
| Fluoride (F) | .0 | .000 | .1 | .005 | .0 | .000 |
| Nitrate ($NO_3$) | 10 | .161 | .0 | .000 | 1.2 | .019 |
| Total dissolved solids | 200 | | 430 | | 130 | |
| Total hardness as $CaCO_3$ | 113 | | 251 | | 69 | |
| Temperature (°F.) | 65 | | 68 | | 65 | |
| Depth (feet) | 500 | | 638 | | 400 | |
| Diameter (inches) | 8 | | 10 | | 10 | |
| Date drilled | 1911 | | 1926 | | 1926 | |
| Percent of supply | 42 | | 9 | | 17 | |

## EAST THOMASTON

[Population, 3,590]

Owner: Thomaston Cotton Mill.

Source: Potato Creek. East Thomaston also purchases 720,000 gallons of finished water daily for 5 days a week from Silvertown. The raw water for the Silvertown supply is also taken from Potato Creek, and the composition of the finished water is about the same as that furnished by East Thomaston. (See also Silvertown.)

Treatment: Ammonium sulphate, coagulation with alum or alum and soda ash, chlorine, activated carbon, rapid sand filtration, final adjustment of pH to 7.2–7.3 by addition of soda ash.

Rated capacity of filtration plant: 1,500,000 gallons per day.

Raw-water storage: Reservoir 10,000,000 gallons.

Finished-water storage: Clear-water well, 15,000 gallons; 2 reservoirs, 200,000 gallons each; reservoir used to supply processing water at the mill, 3,000,000 gallons; 2 elevated tanks, 100,000 gallons each.

The filtration plant is located in East Thomaston. The intake is at the bridge on U. S. Highway 19 just above the Thomaston intake and about 100 yards below the Silvertown intake.

The system is connected with the Thomaston supply for emergency use. It is also connected with the Silvertown supply and at present is receiving water from Silvertown as indicated above.

*Analyses*

[Collected May 3, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 9.4 | | 9.3 | |
| Iron (Fe) | .12 | | .01 | |
| Calicum (Ca) | 2.8 | 0.140 | 2.8 | 0.140 |
| Magnesium (Mg) | 1.2 | .099 | 1.2 | .099 |
| Sodium (Na), Potassium (K) | 4.2 | .183 | 13 | .565 |
| Bicarbonate ($HCO_3$) | 19 | .311 | 32 | .524 |
| Sulphate ($SO_4$) | 1.7 | .035 | 9.6 | .200 |
| Chloride (Cl) | 2.2 | .062 | 2.9 | .082 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .64 | .010 | .86 | .014 |
| Total dissolved solids | 35 | | 54 | |
| Total hardness as $CaCO_3$ | 12 | | 12 | |
| Color | 8 | | 2 | |

## ELBERTON

[Population, 6,188]

Ownership: Municipal; supplies also about 400 people outside the city limits. Total population supplied, about 6,600.

Source: Beaverdam Creek (tributary to Savannah River).

Treatment: Coagulation with alum and lime, rapid sand filtration, chlorination, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 1,000,000 gallons per day.

Raw-water storage: Reservoir, approximately 2,000,000 gallons.

Finished-water storage: Clear-water well, 200,000 gallons; elevated tank, 100,000 gallons.

The filtration plant and intake are located on the creek about 3 miles north of the center of Elberton. The water is pumped from the creek to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the elevated tank.

At the time the samples were collected the pH of the finished water was being maintained at about 9.1 to prevent corrosion.

*Analyses*

[Collected Sept. 22, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 12 | | 11 | |
| Iron (Fe) | .02 | | .01 | |
| Calcium (Ca) | 2.2 | 0.110 | 11 | 0.549 |
| Magnesium (Mg) | 1.0 | .082 | 1.2 | .099 |
| Sodium (Na) / Potassium (K) | 3.9 | .170 | 4.1 | .178 |
| Bicarbonate ($HCO_3$) | 16 | .262 | [1] 31 | .508 |
| Sulphate ($SO_4$) | 1.9 | .040 | 12 | .250 |
| Chloride (Cl) | 1.9 | .054 | 2.1 | .059 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .42 | .007 | .52 | .008 |
| Total dissolved solids | 33 | | 59 | |
| Total hardness as $CaCO_3$ | 9.6 | | 32 | |
| Color | 4 | | 2 | |

[1] Includes equivalent of 6.9 parts of carbonate ($CO_3$).

*Regular determinations at the filtration plant*

| Year 1937-38 | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 6.8 | 7.2 | 6.4 | 120 | 750 | [1] 25 | 61 | 82 | 39 |
| Finished water | 8.7 | 9.1 | 8.4 | | | | | | |

[1] Less than.

## FITZGERALD

[Population, 7,388]

Ownership: Municipal.

Source: 2 wells, 576 and 825 feet deep. The yield of each well is reported to be 500 gallons per minute.

Treatment: Chlorination.

Storage: 3 reservoirs, 34,000, 120,000, and 750,000 gallons; standpipe, 98,000 gallons.

The wells are located at the waterworks pumping plant. The water is pumped from the wells to the reservoirs and from the reservoirs to the distribution system and the standpipe.

*Analyses*

[Collected Feb. 1, 1938. Analyzed by William L. Lamar. Well numbers assigned by Geological Survey]

| | Well 1 | | Well 2 | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 22 | | 23 | |
| Iron (Fe) | .02 | | .01 | |
| Calcium (Ca) | 24 | 1.198 | 22 | 1.098 |
| Magnesium (Mg) | 8.4 | .691 | 9.6 | .790 |
| Sodium (Na) | 3.0 | .130 | 3.4 | .148 |
| Potassium (K) | .6 | .015 | 1.0 | .026 |
| Bicarbonate ($HCO_3$) | 120 | 1.967 | 118 | 1.934 |
| Sulphate ($SO_4$) | 1.6 | .033 | 2.4 | .050 |
| Chloride (Cl) | 2.5 | .070 | 2.6 | .073 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .06 | .001 | .10 | .002 |
| Total dissolved solids | 122 | | 116 | |
| Total hardness as $CaCO_3$ | 94 | | 94 | |
| Temperature (°F.) | 71 | | 71 | |
| Depth (feet) | 576 | | 825 | |
| Diameter (inches) | 10 | | 10 | |
| Date drilled | 1921 | | 1898 | |
| Percent of supply | 50 | | 50 | |

## FORT VALLEY

[Population, 4,953]

Ownership: Municipal.

Source: Well 500 feet deep (yield reported to be 450 to 500 gallons per minute); auxiliary supply from another well 500 feet deep; emergency supply from 4 wells 325 to 475 feet deep.

Treatment: Aeration, chlorination, final adjustment of pH by addition of lime.

Finished-water storage: 2 reservoirs, 187,000 and 200,000 gallons; elevated tank, 200,000 gallons.

The wells are located either at or near the waterworks treatment and pumping plant. The water is pumped to the treatment plant, flows through the treatment plant to the reservoirs, and is pumped from the reservoirs to the distribution system and the elevated tank.

*Analyses*

[Collected Jan. 20, 1938. Analyzed by William L. Lamar]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 6.8 | | 7.5 | |
| Iron (Fe) | .01 | | .01 | |
| Calcium (Ca) | 1.1 | 0.055 | 3.7 | 0.185 |
| Magnesium (Mg | .6 | .049 | .6 | .049 |
| Sodium (Na) | 1.4 | .061 | 1.3 | .056 |
| Potassium (K) | .4 | .010 | .3 | .008 |
| Bicarbonate ($HCO_3$) | 3.0 | .049 | 11 | .180 |
| Sulphate ($SO_4$) | 2.4 | .050 | 2.5 | .052 |
| Chloride (Cl) | 1.9 | .054 | 1.9 | .054 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | 1.5 | .024 | .97 | .016 |
| Total dissolved solids | 19 | | 24 | |
| Total hardness as $CaCO_3$ | 5.2 | | 12 | |
| Temperature (°F.) | 65 | | 63 | |
| Depth (feet) | 500 | | | |
| Diameter (inches) | 18 | | | |
| Date drilled | 1936 | | | |
| Percent of supply | 99 | | | |

## GAINESVILLE

[Population, 10,243]

Ownership: Municipal; supplies also about 1,000 people outside the city limits. Total population supplied, about 11,200.

Source: Crier Creek (45 percent of supply), Peeler Branch (15 percent of supply), and Chattahoochee River (40 percent of supply).

Treatment: Coagulation with alum and lime, rapid sand filtration, chlorination.

Rated capacity of filtration plant: 2,000,000 gallons per day.

Finished-water storage: Clear-water well, 480,000 gallons; 2 elevated tanks, 210,000 and 300,000 gallons.

The filtration plant is located on Peeler Branch 3.4 miles northeast of the center of Gainesville. A reservoir impounding about 3,000,000 gallons is on Peeler Branch at the filtration plant. The water from Crier Creek and that from the Chattahoochee River are also fed to this reservoir, and the mixed water flows from this reservoir through the filtration plant to the clear-water well. It is pumped from the clear-water well to the distribution system and the elevated tanks.

The system is connected for emergency use with the water supply at the Gainesville Cotton Mills and with the water supply at the New Holland Mills.

*Analyses*

[Analyzed by Arthur T. Ness]

| | Crier Creek (raw water) | | Peeler Branch (raw water) | | Chattahoochee River (raw water) | | Finished water | |
|---|---|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 12 | | 7.9 | | 9.4 | | 9.3 | |
| Iron (Fe) | .03 | | .01 | | .01 | | .02 | |
| Calcium (Ca) | 1.5 | 0.075 | .8 | 0.040 | 2.0 | 0.100 | 5.6 | 0.280 |
| Magnesium (Mg) | .6 | .049 | .5 | .041 | .9 | .074 | .6 | .049 |
| Sodium (Na) | 3.2 | .139 | 2.4 | .104 | 2.5 | .109 | 3.1 | .135 |
| Potassium (K) | | | | | .7 | .018 | | |
| Bicarbonate ($HCO_3$) | 12 | .197 | 7.0 | .115 | 10 | .164 | 13 | .213 |
| Sulphate ($SO_4$) | 1.6 | .033 | .9 | .019 | 3.5 | .073 | 10 | .208 |
| Chloride (Cl) | 1.1 | .031 | 1.6 | .045 | 1.6 | .045 | 1.5 | .042 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .08 | .001 | .30 | .005 | .83 | .013 | .05 | .001 |
| Total disolved solids | 26 | | 18 | | 27 | | 37 | |
| Total hardness as $CaCO_3$ | 6.2 | | 4.0 | | 8.7 | | 16 | |
| Color | 5 | | 4 | | 5 | | 2 | |
| Date of collection | Sept. 8, 1938 | | Sept. 8, 1938 | | June 3, 1937 | | Sept. 8, 1938 | |

*Regular determinations at the filtration plant*

| April to December 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 8 | 11 | 7 | 6.8 | 7.0 | 6.4 | 40 | 500 | 10 | 68 | 77 | 48 |
| Finished water | 9 | 11 | 6 | 6.9 | 7.0 | 6.7 | | | | | | |

## GRIFFIN

[Population 13,222]

Ownership: Municipal.

Source: Flint River.

Treatment: Coagulation with alum, activated carbon, rapid sand filtration, chlorination, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 4,000,000 gallons per day.

Raw-water storage: None.

Finished-water storage: Clear-water well, 1,500,000 gallons; 2 elevated tanks, 275,000 and 300,000 gallons.

The filtration plant is about 1½ miles west of the center of Griffin. The intake is about 9 miles west of the center of Girffin. The water is pumped from the river to the filtration plant, flows through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the elevated tanks.

*Analyses*

[Collected May 2, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 15 | | 16 | |
| Iron (Fe) | .06 | | .01 | |
| Calcium (Ca) | 4.8 | 0.240 | 9.5 | 0.474 |
| Magnesium (Mg) | 1.9 | .156 | 1.9 | .156 |
| Sodium (Na) | 4.3 | .187 | 4.2 | .183 |
| Potassium (K) | 1.5 | .038 | 1.4 | .036 |
| Bicarbonate ($HCO_3$) | 30 | .492 | 36 | .590 |
| Sulphate ($SO_4$) | 1.6 | .033 | 7.1 | .148 |
| Chloride (Cl) | 2.0 | .056 | 2.6 | .073 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .66 | .011 | .57 | .009 |
| Total dissolved solids | 51 | | 62 | |
| Total hardness as $CaCO_3$ | 20 | | 32 | |
| Color | 8 | | 1 | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 20 | 26 | 10 | 6.8 | 7.1 | 6.3 | 125 | 1,500 | 20 | 64 | 80 | 42 |
| Finished water | 24 | 30 | 15 | 8.2 | 8.6 | 7.7 | | | | | | |

## HAPEVILLE

[Population, 5,059]

Ownership: Municipal.

Source: 5 wells (Atlanta Avenue, Jonesboro Road, Clay Place, Sims Street, and Oakdale Road), 800, 600, 825, 600, and 616 feet deep (98 percent of supply). The yield of these wells is reported to be 100, 75, 72, 70, and 35 gallons per minute. Auxiliary supply from Fulton Avenue well, 600 feet deep.

Treatment: None.

Storage: Elevated tank, 100,000 gallons.

The wells are located in different sections of the city. The water is pumped from the wells to the distribution system and the elevated tank.

The system is connected with the Atlanta supply and receives an average of several thousand gallons per day of the finished surface water from Atlanta. (See also Atlanta.)

*Analyses*

[Collected May 2, 1938. Analyzed by Arthur T. Ness]

| | Atlanta Avenue well | | Jonesboro Road well | | Sims Street well | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 34 | | 34 | | 33 | |
| Iron (Fe) | .05 | | .04 | | .27 | |
| Calcium (Ca) | 20 | 0.998 | 13 | 0.649 | 11 | 0.549 |
| Magnesium (Mg) | 3.2 | .263 | 5.8 | .477 | 4.5 | .370 |
| Sodium (Na) | 11 | .478 | 7.6 | .330 | 6.6 | .287 |
| Potassium (K) | 2.2 | .056 | 5.3 | .136 | 3.0 | .077 |
| Bicarbonate ($HCO_3$) | 93 | 1.524 | 80 | 1.311 | 64 | 1.049 |
| Sulphate ($SO_4$) | 10 | .208 | 9.3 | .194 | 7.0 | .146 |
| Chloride (Cl) | 1.8 | .051 | 2.5 | .070 | 2.5 | .070 |
| Fluoride (F) | .1 | .005 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .0 | .000 | .08 | .001 | .22 | .004 |
| Total dissolved solids | 128 | | 115 | | 97 | |
| Total hardness as $CaCO_3$ | 63 | | 56 | | 46 | |
| Temperature (°F.) | 66 | | 64 | | 63 | |
| Depth (feet) | 800 | | 600 | | 600 | |
| Diameter (inches) | 10 | | 10 | | 10 | |
| Date drilled | 1931 | | 1930 | | 1925 | |
| Percent of supply | 34 | | 30 | | 2 | |

## LAFAYETTE

[Population, 3,509]

Ownership: Municipal; supplies also about 200 people in Linwood. Total population supplied, about 3,700.

Source: Spring at waterworks pumping plant.

Treatment: Chlorination.

Storage: Reservoir, 225,000 gallons.

The spring and water works pumping plant are located about 1 mile from the center of Lafayette. The spring is surrounded by a large collecting basin. The water is pumped from the collecting basin to the distribution system and the reservoir.

*Analysis*

[Collected Apr. 20, 1938. Analyzed by William L. Lamar]

| | Spring | | | Spring | |
|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 6.9 | | Chloride (Cl) | 1.6 | 0.045 |
| Iron (Fe) | .18 | | Fluoride (F) | .0 | .000 |
| Calcium (Ca) | 22 | 1.098 | Nitrate ($NO_3$) | 3.1 | .050 |
| Magnesium (Mg) | 7.5 | .617 | Total dissolved solids | 94 | |
| Sodium (Na) | 1.1 | .048 | | | |
| Potassium (K) | .5 | .013 | Total hardness as $CaCO_3$ | 86 | |
| Bicarbonate ($HCO_3$) | 99 | 1.623 | Color | 5 | |
| Sulphate ($SO_4$) | 2.4 | .050 | Temperature (°F.) | 62 | |

## LA GRANGE

[Population, 21,983]

Ownership: Municipal.

Source and treatment: Long Cane Creek (88 percent of supply); coagulation with alum, activated carbon, rapid sand filtration, chlorination, final adjustment of pH by addition of lime. Well 370 feet deep (12 percent of supply); chlorination.

Rated capacity of filtration plant: 2,000,000 gallons per day.

Raw-water storage: Reservoir, 6,000,000 gallons.

Finished-water storage: Clear-water well, 225,000 gallons; standpipe, 330,000 gallons.

The filtration plant is located about 2 miles southeast of the center of La Grange, and the intake about 2 miles southeast of the filtration plant. The water is pumped from the creek to the raw water reservoir, flows from this reservoir through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the standpipe.

The well is located on Springdale Drive. The water from the well is pumped directly to the distribution system and in general supplies the west end of the city.

*Analyses of water from Long Cane Creek*

[Collected May 16, 1938. Analyzed by William L. Lamar]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 21 | | 19 | |
| Iron (Fe) | .05 | | .01 | |
| Manganese (Mn) | .01 | 0.000 | .09 | 0.003 |
| Calcium (Ca) | 4.7 | .235 | 9.8 | .489 |
| Magnesium (Mg) | 2.0 | .164 | 1.9 | .156 |
| Sodium (Na) | 4.4 | .191 | 4.3 | .187 |
| Potassium (K) | 1.1 | .028 | 1.0 | .026 |
| Bicarbonate ($HCO_3$) | 31 | .508 | 40 | .656 |
| Sulphate ($SO_4$) | 2.5 | .052 | 5.8 | .121 |
| Chloride (Cl) | 1.9 | .054 | 2.1 | .059 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .32 | .005 | .14 | .002 |
| Total dissolved solids | 54 | | 68 | |
| Total hardness as $CaCO_3$ | 20 | | 32 | |
| Color | 6 | | 1 | |

*Regular determinations at the filtration plant*

| Year 1938 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 29 | 34 | 18 | 6.9 | 7.2 | 6.6 | 50 | 800 | 30 | 62 | 82 | 34 |
| Finished water | 38 | 48 | 28 | 8.8 | 9.0 | 8.4 | | | | | | |

*Analysis of water from well 370 feet deep*

[Collected June 23, 1932. Analyzed by E. W. Lohr]

| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
|---|---|---|---|---|---|
| Silica ($SiO_2$) | 43 | | Total dissolved solids | 137 | |
| Iron (Fe) | .01 | | | | |
| Calcium (Ca) | 19 | 0.948 | Total hardness as $CaCO_3$ | 93 | |
| Magnesium (Mg) | 11 | .905 | | | |
| Sodium (Na) | 3.9 | .170 | | | |
| Potassium (K) | 1.0 | .026 | Depth (feet) | 370 | |
| Bicarbonate ($HCO_3$) | 109 | 1.787 | Diameter (inches) | 10 | |
| Sulphate ($SO_4$) | 3.3 | .069 | Date drilled | 1923 | |
| Chloride (Cl) | 2.8 | .079 | Percent of supply | 12 | |
| Nitrate ($NO_3$) | 2.0 | .032 | | | |

## LINDALE

[Population, 3,361]

Owner: Pepperell Manufacturing Co.

Source: Main Spring station, supplied by Lindale Spring and Silver Creek Spring; Meadow station, supplied by 5 wells (Nos. 1 to 5), 275, 153, 126, 125, and 75 feet deep, and Van Tassel Spring. The yield of the wells is reported to be 44, 50, 50, 50, and 50 gallons per minute.

Treatment: Chlorination.

Storage: 2 reservoirs (Nos. 1 and 2), 960,000 and 1,450,000 gallons.

The springs and wells are located in Lindale. The water from Silver Creek Spring flows to the collecting basin surrounding the Lindale Spring at the Main Spring pumping station. The water from this collecting basin is pumped to the distribution system and the reservoirs. The water is pumped from the wells and flows from the Van Tassel Spring to the collecting basin at the Meadow pumping station. The mixed water is pumped to the distribution system and the reservoirs.

*Analyses*

[Collected Sept. 19, 1938. Analyzed by Arthur T. Ness]

| | Lindale Spring and Silver Creek Spring | | Wells 1 to 5 | | Well 2 | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 7.0 | | 7.7 | | 7.5 | |
| Iron (Fe) | .02 | | .05 | | .04 | |
| Calcium (Ca) | 40 | 1.996 | 41 | 2.046 | 33 | 1.647 |
| Magnesium (Mg) | 9.3 | .765 | 14 | 1.151 | 18 | 1.480 |
| Sodium (Na) | 1.3 | .056 | 1.5 | .065 | 1.5 | .065 |
| Potassium (K) | .6 | .015 | .9 | .023 | 1.0 | .026 |
| Bicarbonate ($HCO_3$) | 158 | 2.590 | 190 | 3.114 | 185 | 3.032 |
| Sulphate ($SO_4$) | 2.6 | .054 | 2.1 | .044 | 2.2 | .046 |
| Chloride (Cl) | 3.4 | .096 | 1.6 | .045 | 1.6 | .045 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | 2.2 | .036 | 2.2 | .036 | 3.2 | .052 |
| Total dissolved solids | 147 | | 162 | | 158 | |
| Total hardness as $CaCO_3$ | 138 | | 160 | | 156 | |
| Temperature (° F.) | 64 | | 62 | | 63 | |
| Depth (feet) | | | 75 to 275 | | 153 | |
| Diameter (inches) | | | 6 | | 6 | |
| Date drilled | | | 1929 | | 1929 | |
| Percent of supply | 57 | | 35 | | | |

## MACON

[Population, 57,865]

Ownership: Municipal; supplies also about 10,000 people outside the city limits. Total population, about 67,900.

Source: Ocmulgee River.

Treatment: Coagulation with alum, ammonia, chlorine, activated carbon at times, rapid sand filtration, final chlorine at times, final adjustment of pH to about 8.2 by addition of lime.

Rated capacity of filtration plant: 12,000,000 gallons per day.

Raw-water storage: None.

Finished-water storage: Clear-water well, 275,000 gallons; 2 reservoirs, 1,500,000 and 3,000,000 gallons; 2 standpipes, 200,000 and 1,000,000 gallons.

The filtration plant and intake are located on the river about 3 miles north of the center of Macon. The water is pumped from the river to the filtration plant, flows through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system, reservoirs, and standpipes.

Daily samples of the raw water were collected from the Ocmulgee River at the filtration plant for the year ending April 30, 1938. There is some variation in the composition of the water throughout the year, but the mineral content of the river water is low at all times.

*Analyses*

[Raw water, average of analyses of 10-day composites of daily samples from Ocmulgee River at filtration plant, 1937–38; finished water, sample collected at filtration plant, May 4, 1938. Analyzed by Arthur T. Ness]

| | Raw water (average) | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 12 | | 11 | |
| Iron (Fe) | .06 | | .01 | |
| Calcium (Ca) | 3.6 | 0.180 | 8.8 | 0.439 |
| Magnesium (Mg) | 1.6 | .132 | 1.4 | .115 |
| Sodium (Na) | 4.6 | .200 | 4.5 | .196 |
| Potassium (K) | 1.6 | .041 | | |
| Bicarbonate ($HCO_3$) | 22 | .361 | 25 | .410 |
| Sulphate ($SO_4$) | 3.9 | .081 | 12 | .250 |
| Chloride (Cl) | 2.9 | .082 | 2.9 | .082 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .97 | .016 | .63 | .003 |
| Total dissolved solids | 44 | | 56 | |
| Total hardness as $CaCO_3$ | 16 | | 28 | |
| Color | 9 | | 2 | |
| Suspended matter | 95 | | | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 17 | 19 | 10 | 7.0 | 7.2 | 6.9 | 160 | 1,900 | 18 | 65 | 86 | 33 |
| Finished water | 20 | 23 | 15 | 8.2 | 8.3 | 8.1 | | | | | | |

## MANCHESTER

[Population, 3,462]

Ownership: Municipal.

Source: "New" reservoir on a tributary at head of Pigeon Creek (50 percent of supply), and "old" reservoir on another tributary at head of Pigeon Creek (50 percent of supply). The reservoirs impound about 1,500,000 gallons each. Emergency supply from a well 538 feet deep.

Treatment: Coagulation with alum and lime, chlorination, rapid sand filtration, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 500,000 gallons per day.

Finished-water storage: Clear-water well 260,000 gallons.

The filtration plant is located on Pine Mountain about half a mile south of Manchester. The reservoirs are located on Pine Mountain about 5 miles west of the center of Manchester. The water flows from the reservoirs through the filtration plant to the clear-water well and from the clear-water well to the distribution system.

The well is located in Manchester, at the high school, on State Highway 41. When the well water is used it is pumped to the raw water line supplying the filtration plant.

*Analyses*

[Analyzed by William L. Lamar and Arthur T. Ness]

| | "New" reservoir (raw water) | | "Old" reservoir (raw water) | | Finished water | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 3.9 | | 5.0 | | 5.1 | |
| Iron (Fe) | .01 | | .06 | | .04 | |
| Calcium (Ca) | .8 | 0.040 | .3 | 0.015 | 8.9 | 0.444 |
| Magnesium (Mg) | .3 | .025 | .3 | .025 | .4 | .033 |
| Sodium (Na) | 1.5 | .065 | 1.9 | .083 | 2.4 | .104 |
| Potassium (K) | .5 | .013 | .2 | .005 | | |
| Bicarbonate ($HCO_3$) | 3.6 | .059 | 2.0 | .033 | [1] 24 | .393 |
| Sulphate ($SO_4$) | .9 | .019 | 1.6 | .033 | 5.3 | .110 |
| Chloride (Cl) | 1.8 | .051 | 2.1 | .059 | 2.6 | .073 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .05 | .001 | .15 | .002 | .20 | .003 |
| Total dissolved solids | 15 | | 15 | | 39 | |
| Total hardness as $CaCO_3$ | 3.2 | | 2.0 | | 24 | |
| Color | 7 | | | | 3 | |
| Date of collection | May 11, 1938 | | Dec. 9, 1933 | | Aug. 1, 1938 | |

[1] Includes equivalent of 6.9 parts of carbonate ($CO_3$)

## MARIETTA

[Population, 8,667]

Ownership: Municipal.

Source: 21 wells (Nos. 1 to 5, 7, 8, 10 to 12, 14 to 18, 20 to 25), 259, 293, 286, 294, 392, 413, 272, 320, 301, 506, 506, 435, 500, 325, 910, 449, 382, 349, 330, 365, and 297 feet deep.

Treatment: None.

Storage: 2 reservoirs, 243,000 and 1,000,000 gallons; 2 standpipes, 500,000 gallons each.

The wells are located in different sections of the city. For most of the wells the water is pumped directly into the distribution system; for wells 1 to 4 it is pumped to the reservoirs, and for wells 5 and 8 it may be pumped to the reservoirs or directly to the distribution system. The water from the reservoirs is pumped to the distribution system.

*Analyses*

[Collected Apr. 22, 1938. Analyzed by Arthur T. Ness]

| | Well 7 | | Well 8 | | Well 16 | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 38 | | 19 | | 27 | |
| Iron (Fe) | .08 | | .10 | | .08 | |
| Calcium (Ca) | 14 | 0.699 | 6.0 | 0.300 | 7.3 | 0.364 |
| Magnesium (Mg) | 6.4 | .526 | 3.6 | .296 | 5.4 | .444 |
| Sodium (Na) | 6.9 | .300 | 3.1 | .135 | 4.0 | .174 |
| Potassium (K) | 2.0 | .051 | 1.5 | .038 | 1.4 | .036 |
| Bicarbonate ($HCO_3$) | 56 | .918 | 31 | .508 | 58 | .951 |
| Sulphate ($SO_4$) | 1.9 | .040 | 3.0 | .062 | 2.3 | .048 |
| Chloride (Cl) | 9.2 | .260 | 4.0 | .113 | 1.5 | .042 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | 19 | .306 | 2.5 | .040 | .10 | .002 |
| Total dissolved solids | 144 | | 59 | | 74 | |
| Total hardness as $CaCO_3$ | 61 | | 30 | | 40 | |
| Temperature (°F.) | 62 | | 63 | | 62 | |
| Depth (feet) | 413 | | 272 | | 500 | |
| Diameter (inches) | 10 | | 10 | | 10 | |
| Date drilled | | | | | 1926 | |
| Percent of supply | 2 | | 6 | | 3 | |

| | Well 18 | | Well 21 | | Well 25 | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 34 | | 27 | | 22 | |
| Iron (Fe) | .09 | | .50 | | .43 | |
| Calcium (Ca) | 32 | 1.597 | 10 | 0.499 | 9.8 | 0.489 |
| Magnesium (Mg) | 10 | .822 | 3.3 | .271 | 3.9 | .321 |
| Sodium (Na) | 15 | .652 | 5.4 | .235 | 12 | .522 |
| Potassium (K) | 3.1 | .079 | 2.2 | .056 | 1.8 | .046 |
| Bicarbonate ($HCO_3$) | 103 | 1.688 | 40 | .656 | 33 | .541 |
| Sulphate ($SO_4$) | 25 | .520 | 16 | .333 | 3.4 | .071 |
| Chloride (Cl) | 16 | .451 | 1.8 | .051 | 15 | .423 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | 28 | .452 | .20 | .003 | 20 | .322 |
| Total dissolved solids | 226 | | 88 | | 119 | |
| Total hardness as $CaCO_3$ | 121 | | 39 | | 40 | |
| Temperature (°F.) | 62 | | 62 | | 62 | |
| Depth (feet) | 910 | | 382 | | 297 | |
| Diameter (inches) | 10 | | 10 | | 10 | |
| Date drilled | 1927 | | 1928 | | 1937 | |
| Percent of supply | 7 | | 4 | | 6 | |

## MILLEDGEVILLE

[Population, 6,778]

(*a*) Ownership: Municipal; supplies also Georgia State College for Women, Georgia Military College, and State Training School for Boys. Total population supplied, about 8,700.

Source: Fishing Creek.

Treatment: Coagulation with alum, activated carbon, ammonia, chlorine, rapid sand filtration, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 1,000,000 gallons per day.

Raw-water storage: Reservoir, 2,100,000 gallons.

Finished-water storage: 2 clear-water wells, 35,000 and 165,000 gallons; standpipe, 150,000 gallons.

The filtration plant and intake are located on the creek about 2¼ miles west of the center of Milledgeville. The water is pumped from the creek to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water wells and, is pumped from the clear-water wells to the distribution system and the standpipe.

*Analyses*

[Collected Jan. 19, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 20 | | 19 | |
| Iron (Fe) | .03 | | .01 | |
| Calcium (Ca) | 7.1 | 0.354 | 11 | 0.549 |
| Magnesium (Mg) | 3.8 | .312 | 4.0 | .329 |
| Sodium (Na) | 9.1 | .396 | 8.8 | .383 |
| Potassium (K) | 1.9 | .049 | 1.7 | .044 |
| Bicarbonate ($HCO_3$) | 43 | .705 | 40 | .656 |
| Sulphate ($SO_4$) | 5.6 | .117 | 16 | .333 |
| Chloride (Cl) | 10 | .282 | 11 | .310 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .20 | .003 | .14 | .002 |
| Total dissolved solids | 80 | | 92 | |
| Total hardness as $CaCO_3$ | 33 | | 44 | |
| Color | 12 | | | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | Turbidity | | | Temperature ° F. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 47 | 48 | 30 | 7.4 | 95 | 400 | 5 | 67 | 84 | 42 |
| Finished water | 48 | 52 | 14 | 7.6 | | | | | | |

(*b*) Owner: Milledgeville State Hospital; supplies about 8,000 people at the hospital.

Source: Oconee River.

Treatment: Coagulation with alum and at times with alum and lime, rapid sand filtration, chlorination, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 1,500,000 gallons per day.

Raw-water storage: None.

Finished-water storage: Clear-water well, 40,000 gallons; reservoir, 1,000,000 gallons; elevated tank, 150,000 gallons.

The filtration plant and intake are located on the river between the highway bridge and the Georgia Railroad bridge. The water is pumped from the river to the filtration plant and then flows through the filtration plant to the clear-water well. It is pumped from the clear-water well to the reservoir and from the reservoir to the distribution system and the elevated tank.

Daily samples of the raw water were collected from the Oconee River at Milledgeville for the year ending April 30, 1938. This sampling point is about 1½ miles below the filtration plant. There is some variation in the composition of the water throughout the year, but the mineral content of the river water is low at all times.

Regular determinations on the raw water at the filtration plant for the year 1937: Turbidity, 20 to 2,400; pH, 6.3 to 7.3.

*Analyses*

[Raw water, average of analyses of 10-day composites of daily samples from Oconee River at Milledgeville, Ga., 1937–38; finished water, sample collected at filtration plant, Jan. 19, 1938. Analyzed by Arthur T. Ness]

| | Raw water (average) | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 16 | | 16 | |
| Iron (Fe) | .05 | | .01 | |
| Calcium (Ca) | 4.1 | 0.205 | 4.5 | 0.225 |
| Magnesium (Mg) | 1.8 | .148 | 2.1 | .173 |
| Sodium (Na) | 5.1 | .222 | 4.5 | .196 |
| Potassium (K) | 1.7 | .044 | 1.2 | .031 |
| Bicarbonate ($HCO_3$) | 27 | .443 | 24 | .393 |
| Sulphate ($SO_4$) | 2.9 | .060 | 6.5 | .135 |
| Chloride (Cl) | 3.2 | .090 | 3.1 | .087 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | 1.2 | .019 | .55 | .009 |
| Total dissolved solids | 51 | | 50 | |
| Total hardness as $CaCO_3$ | 18 | | 20 | |
| Color | 8 | | | |
| Suspended matter | 173 | | | |

## MILLEN

[Population, 2,820]

Ownership: Municipal.

Source: 2 wells, 500 and 310 feet deep. The yield obtained from these wells is reported to be 75 gallons per minute for the 500-foot well and 170 gallons per minute when pumped for the 310-foot well.

Treatment: None.

Storage: Reservoir, 200,000 gallons; elevated tank, 60,000 gallons.

Both wells are located at the waterworks pumping plant. The water flows from the 500-foot well and is pumped from the 310-foot well to the reservoir. The flow from the 310-foot well does not produce sufficient head to supply the reservoir. The water is pumped from the reservoir to the distribution system and the elevated tank.

*Analyses*

[Collected Jan. 18, 1938. Analyzed by William L. Lamar. Well numbers assigned by Geological Survey]

| | Well 1 | | Well 2 | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 37 | | 38 | |
| Iron (Fe) | .05 | | .14 | |
| Calcium (Ca) | 40 | 1.996 | 42 | 2.096 |
| Magnesium (Mg) | 3.2 | .263 | 3.6 | .296 |
| Sodium (Na) | 3.1 | .135 | 3.7 | .161 |
| Potassium (K) | 2.2 | .056 | 2.1 | .054 |
| Bicarbonate ($HCO_3$) | 130 | 2.131 | 139 | 2.278 |
| Sulphate ($SO_4$) | 11 | .229 | 10 | .208 |
| Chloride (Cl) | 1.8 | .051 | 2.5 | .070 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .05 | .001 | .05 | .001 |
| Total dissolved solids | 165 | | 172 | |
| Total hardness as $CaCO_3$ | 113 | | 120 | |
| Temperature (°F.) | 70 | | | |
| Depth (feet) | 500 | | 310 | |
| Diameter (inches) | 6 | | 4½ | |
| Date drilled | 1906 | | 1927 | |
| Percent of supply | 94 | | 6 | |

### MONROE

[Population, 4,168]

Ownership: Municipal.

Source: Jacks Creek.

Treatment: Coagulation with alum and lime, activated carbon, rapid sand filtration, chlorination.

Rated capacity of filtration plant: 500,000 gallons per day.

Raw-water storage: Reservoir, about 1,250,000 gallons.

Finished-water storage: 2 clear-water wells, 77,000 and 78,000 gallons; standpipe, 159,000 gallons.

The filtration plant is located in Monroe. The intake is about 1½ miles north of the center of Monroe. Water is pumped from the creek to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water wells, and is pumped from the clear-water wells to the distribution system and the standpipe.

*Analyses*

[Collected Sept. 21, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 10 | | 8.8 | |
| Iron (Fe) | .02 | | .01 | |
| Calcium (Ca) | 2.1 | 0.105 | 5.0 | 0.250 |
| Magnesium (Mg) | .9 | .074 | 1.0 | .082 |
| Sodium (Na) }<br>Potassium (K) } | 2.8 | .122 | 3.1 | .135 |
| Bicarbonate ($HCO_3$) | 13 | .213 | 14 | .230 |
| Sulphate ($SO_4$) | 1.4 | .029 | 8.1 | .169 |
| Chloride (Cl) | 1.8 | .051 | 2.0 | .056 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .57 | .009 | .67 | .011 |
| Total dissolved solids | 27 | | 36 | |
| Total hardness as $CaCO_3$ | 8.9 | | 17 | |
| Color | 3 | | 2 | |

*Regular determinations at the filtration plant*

| Year 1938 | Alkalinity | | | pH | | | Turbidity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 12 | 15 | 11 | 6.8 | 6.9 | 6.0 | 18 | 35 | 15 |
| Finished water | 15 | 17 | 12 | 6.9 | 7.0 | 6.8 | | | |

### MOULTRIE

[Population, 10,147]

Ownership: Municipal.

Source: Well 750 feet deep (yield reported to be 1,000 gallons per minute). Emergency supply from 2 wells, 598 and 690 feet deep.

Treatment: Chlorination.

Storage: 2 reservoirs, 45,000 and 80,000 gallons; elevated tank, 150,000 gallons.

The wells are located at the waterworks pumping plant. The water is pumped from the wells to the reservoirs and from the reservoirs to the distribution system and the elevated tank.

*Analysis of water from well 750 feet deep*

[Collected Feb. 4, 1938. Analyzed by Wesley M. Noble]

| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
|---|---|---|---|---|---|
| Silica ($SiO_2$) | 23 | | Total dissolved solids | 200 | |
| Iron (Fe) | .0 | | | | |
| Calcium (Ca) | 24 | 1.198 | Total hardness as $CaCO_3$ | 113 | |
| Magnesium (Mg) | 13 | 1.069 | Temperature (° F.) | 73 | |
| Sodium (Na) | 25 | 1.087 | | | |
| Potassium (K) | 3.4 | .087 | | | |
| Bicarbonate ($HCO_3$) | 135 | 2.213 | Depth (feet) | 750 | |
| Sulphate ($SO_4$) | 47 | .978 | Diameter (inches) | 12 | |
| Chloride (Cl) | 5.9 | .166 | Date drilled | 1936 | |
| Fluoride (F) | .5 | .026 | Percent of supply | 100 | |
| Nitrate ($NO_3$) | .0 | .000 | | | |

## NEWNAN

[Population, 7,182]

Ownership: Municipal.

Source: Bolton Mill Reservoir, impounding 125,000,000 gallons.

Treatment: Coagulation with alum and at times with alum and lime, ammonium sulphate, chlorine, rapid sand filtration, final adjustment of pH by addition of lime. During the summer copper sulphate and activated carbon, also, are used when necessary.

Rated capacity of filtration plant: 1,500,000 gallons per day.

Finished-water storage: 2 clear-water wells, 250,000 and 1,250,000 gallons; elevated tank, 500,000 gallons; standpipe, 300,000 gallons.

The filtration plant and intake are located at the impounding reservoir about 2 miles south of the center of Newnan. The water flows from the reservoir through the filtration plant to the clear-water wells and is pumped from the clear-water wells to the distribution system, elevated tank, and standpipe.

*Analyses*

[Collected May 6, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 8.5 | | 7.9 | |
| Iron (Fe) | .04 | | .02 | |
| Calcium (Ca) | 2.2 | 0.110 | 6.7 | 0.334 |
| Magnesium (Mg) | .9 | .074 | 1.0 | .082 |
| Sodium (Na), Potassium (K) | 3.7 | .161 | 2.8 | .122 |
| Bicarbonate ($HCO_3$) | 15 | .246 | 16 | .262 |
| Sulphate ($SO_4$) | 2.3 | .048 | 9.8 | .204 |
| Chloride (Cl) | 1.6 | .045 | 2.2 | .062 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .30 | .005 | .64 | .010 |
| Total dissolved solids | 28 | | 41 | |
| Total hardness as $CaCO_3$ | 9.2 | | 21 | |
| Color | 8 | | 1 | |

## PELHAM

[Population, 2,579]

Ownership: Municipal. Leased to and operated by Pelham Public Utilities.

Source: Well 680 feet deep (yield reported to be about 500 gallons per minute). Emergency supply from a well 710 feet deep.

Treatment: Chlorination.

Storage: 2 reservoirs, combined capacity, 180,000 gallons; elevated tank, 60,000 gallons.

The wells are located at the waterworks pumping plant. The water is pumped from the wells to the reservoirs and from the reservoirs to the distribution system and the elevated tank.

*Analysis of water from well 680 feet deep*

[Collected Feb. 4, 1938. Analyzed by Arthur T. Ness]

| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
|---|---|---|---|---|---|
| Silica ($SiO_2$) | 28 | | Nitrate ($NO_3$) | 0.05 | 0.001 |
| Iron (Fe) | .02 | | Total dissolved solids | 186 | |
| Calcium (Ca) | 37 | 1.847 | | | |
| Magnesium (Mg) | 18 | 1.480 | Total hardness as $CaCO_3$ | 166 | |
| Sodium (Na) | 4.1 | .178 | | | |
| Potassium (K) | 2.0 | .051 | | | |
| Bicarbonate ($HCO_3$) | 204 | 3.344 | Depth (feet) | 680 | |
| Sulphate ($SO_4$) | 4.7 | .098 | Diameter (inches) | 10 | |
| Chloride (Cl) | 3.6 | .102 | Date drilled | 1931 | |
| Fluoride (F) | .0 | .000 | Percent of supply | 100 | |

## PORTERDALE

[Population, 3,116]

Owner: Bibb Manufacturing Co.

Source: Yellow River impounded.

Treatment: Coagulation with alum and soda ash, chlorination, rapid sand filtration, final adjustment of pH by addition of soda ash.

Rates capacity of filtration plant: 1,000,000 gallons per day.

Finished-water storage: Clear-water well, 49,000 gallons; reservoir, 866,000 gallons; 5 elevated tanks, 50,000 gallons each, and another elevated tank, 30,000 gallons, the latter is suspended under one of the 50,000-gallon tanks.

The filtration plant and intake are located on the river in Porterdale. The water flows from the river through the filtration plant to the clear-water well; it is pumped from the clear-water well to the reservoir and from the reservoir to the distribution system and the elevated tanks.

*Analyses*

[Collected Sept. 13, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 14 | | 15 | |
| Iron (Fe) | .02 | | .01 | |
| Calcium (Ca) | 3.3 | 0.165 | 3.6 | 0.180 |
| Magnesium (Mg) | 1.2 | .099 | 1.4 | .115 |
| Sodium (Na) } Potassium (K) | 5.4 | .235 | 11 | .478 |
| Bicarbonate ($HCO_3$) | 24 | .393 | 32 | .524 |
| Sulphate ($SO_4$) | 1.6 | .033 | 8.6 | .179 |
| Chloride (Cl) | 2.1 | .059 | 2.8 | .079 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .82 | .013 | .66 | .011 |
| Total dissolved solids | 42 | | 58 | |
| Total hardness as $CaCO_3$ | 13 | | 15 | |
| Color | 5 | | 2 | |

## QUITMAN

[Population, 4,450]

Ownership: Municipal.

Source: Well 312 feet deep (yield reported to be 1,000 gallons per minute); emergency supply from a well 642 feet deep (yield reported to be 750 gallons per minute).

Treatment: None.

Storage: Elevated tank, 150,000 gallons.

Both wells are located in the waterworks-well field in Quitman. The water is pumped directly to the distribution system and the elevated tank. The emergency well is pumped several hours each week to keep it in service.

*Analysis of water from well 312 feet deep*

[Collected Feb. 7, 1938. Analyzed by Arthur T. Ness]

| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
|---|---|---|---|---|---|
| Silica ($SiO_2$) | 16 | | Total dissolved solids | 154 | |
| Iron (Fe) | .01 | | Total hardness as $CaCO_3$ | 141 | |
| Calcium (Ca) | 40 | 1.996 | Temperature (°F.) | 69 | |
| Magnesium (Mg) | 10 | .822 | | | |
| Sodium (Na) | 2.4 | .104 | | | |
| Potassium (K) | .8 | .020 | | | |
| Bicarbonate ($HCO_3$) | 168 | 2.754 | Depth (feet) | 312 | |
| Sulfate ($SO_4$) | 1.9 | .040 | Diameter (inches) | 12 | |
| Chloride (Cl) | 4.1 | .116 | Date drilled | 1936 | |
| Fluoride (F) | .0 | .000 | Percent of supply | 100 | |
| Nitrate ($NO_3$) | .40 | .006 | | | |

## ROCKMART

[Population, 3,764]

Ownership: Municipal.

Source: Euharlee Creek.

Treatment: Coagulation with alum and at times with alum and soda ash, rapid sand filtration, chlorination.

Rated capacity of filtration plant: 1,000,000 gallons per day.

Raw-water storage: None.

Finished-water storage: Clear-water well, 180,000 gallons; two elevated reservoirs, 180,000 and 250,000 gallons.

The filtration plant is located on the creek in Rockmart. The intake is about half a mile above the filtration plant. The water is pumped from the creek to the filtration plant, flows through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the elevated reservoirs.

*Analyses*

[Collected Apr. 19, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 6.7 | | 6.4 | |
| Iron (Fe) | .02 | | .02 | |
| Calcium (Ca) | 18 | 0.898 | 17 | 0.848 |
| Magnesium (Mg) | 5.2 | .428 | 4.9 | .403 |
| Sodium (Na) / Potassium (K) | 2.3 | .100 | 3.1 | .135 |
| Bicarbonate ($HCO_3$) | 80 | 1.311 | 72 | 1.180 |
| Sulphate ($SO_4$) | 3.0 | .062 | 7.2 | .150 |
| Chloride (Cl) | 1.4 | .040 | 1.6 | .045 |
| Flnoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .74 | .012 | .70 | .011 |
| Total dissolved solids | 75 | | 75 | |
| Total hardness as $CaCO_3$ | 66 | | 63 | |
| Color | 6 | | 4 | |

**ROME**

[Population, 26,282]

Ownership: Municipal.

Source: Oostanaula River.

Treatment: Coagulation with alum or alum and lime, ammonia, chlorine, rapid sand filtration, chlorine, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 6,000,000 gallons.

Raw-water storage: None.

Finished-water storage: Clear-water well, 1,000,000 gallons; reservoir, 3,000,000 gallons.

The filtration plant is located about 2 miles north of the center of Rome. The intake is about half a mile south of the filtration plant. The water is pumped from the river to the filtration plant, flows through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the reservoir.

*Analyses*

[Collected Apr. 19, 1938. Analyzed by William L. Lamar]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 6.2 | | 6.2 | |
| Iron (Fe) | .02 | | .01 | |
| Calcium (Ca) | 11 | 0.549 | 15 | 0.749 |
| Magnesium (Mg) | 2.9 | .238 | 3.1 | .255 |
| Sodium (Na) | 2.0 | .087 | 1.8 | .078 |
| Potassium (K) | .8 | .020 | .6 | .015 |
| Bicarbonate ($HCO_3$) | 46 | .754 | 28 | .459 |
| Sulphate ($SO_4$) | 4.8 | .100 | 26 | .541 |
| Chloride (Cl) | 1.4 | .040 | 1.5 | .042 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | 1.1 | .018 | .83 | .013 |
| Total dissolved solids | 52 | | 73 | |
| Total hardness as $CaCO_3$ | 39 | | 50 | |
| Color | 6 | | 1 | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature° F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 43 | 62 | 14 | 7.1 | 7.6 | 6.6 | 225 | 1,600 | 20 | 62 | 82 | 37 |

## ROSSVILLE

[Population, 3,538]

Water furnished by the public supply at Chattanooga, Tenn.

Owner: City Water Co. of Chattanooga, Tenn. (controlled by American Water Works & Electric Co., Inc., 50 Broad St., New York, N. Y.)

Source: Tennessee River.

Treatment: Coagulation with alum and lime, chlorination, rapid sand filtration, chlorination.

The Georgia-Tennessee State line separates Rossville, Ga., from Chattanooga Tenn. The City Water Co. of Chattanooga furnishes water to Chattanooga, Tenn., and Rossville, Ga. The filtration plant and intake are located on the river in Chattanooga. The intake is about 5½ river miles below the Chickamauga Dam. The filtration plant has a rated capacity of 27,500,000 gallons per day. There is no finished-water storage in Rossville, but the system in Chattanooga has the following finished-water storage: Clear-water well, 1,250,000 gallons; reservoir, 3,500,000 gallons; 11 standpipes, total capacity 2,500,000 gallons.

Samples of the raw water were generally collected at about weekly intervals from the Tennessee River near Chattanooga by the Tennessee Valley Authority for the year ending April 1937. This sampling point is about 13 river miles below the waterworks intake. These analyses show an appreciable range in the composition of the river water throughout the year.

*Analyses*

Raw water, average of analyses of weekly samples from Tennessee River near Chattanooga, Tenn., 1936–37; analyzed by Tennessee Valley Authority. Finished water, sample collected at Chattanooga filtration plant Jan. 24, 1939; analyzed by William L. Lamar]

| | Raw water (average) | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 7.2 | | 4.4 | |
| Iron (Fe) | .06 | | .01 | |
| Calcium (Ca) | 19 | 0.948 | 22 | 1.098 |
| Magnesium (Mg) | 4.0 | .329 | 4.2 | .345 |
| Sodium (Na) | 6.4 | .278 | 3.5 | .152 |
| Potassium (K) | | | 1.2 | .031 |
| Bicarbonate ($HCO_3$) | 64 | 1.049 | 62 | 1.016 |
| Sulphate ($SO_4$) | 7.2 | .150 | 18 | .375 |
| Chloride (Cl) | 12 | .338 | 6.6 | .186 |
| Fluoride (F) | | | .0 | .000 |
| Nitrate ($NO_3$) | .41 | .007 | 1.2 | .019 |
| Total dissolved solids | 95 | | 94 | |
| Total hardness as $CaCO_3$ | 64 | | 72 | |
| Color | | | 2 | |
| Suspended matter | 90 | | | |

*Regular determinations at the filtration plant*

| Year 1939 | Alkalinity | | | Hardness | | | Turbidity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 69 | 95 | 34 | | | | 135 | 700 | 25 |
| Finished water | 61 | 93 | 29 | 83 | 143 | 63 | | | |

## SANDERSVILLE

[Population, 3,566]

Ownership: Municipal.

Source: 3 wells (Nos. 1 to 3), 250, 280, and 250 feet deep. The yield of the wells is reported to be 100, 100, and 150 gallons per minute.

Treatment: Chlorination.

Storage: 2 reservoirs, 120,000 and 87,000 gallons; elevated tank, 110,000 gallons.

Well 1 is at the old waterworks pumping plant; well 2 is about a quarter of a mile to the east. Well 3 is at the new waterworks pumping plant, 1¼ miles south of the old pumping plant. The water is pumped from wells 1 and 2 to the 120,000-gallon reservoir and from this reservoir to the distribution system and the elevated tank. The water is pumped from well 3 to the 87,000-gallon reservoir and from this reservoir to the distribution system and the elevated tank.

*Analyses*

[Analyzed by William L. Lamar and Wesley M. Noble]

| | Well 1 | | Well 2 | | Well 3 | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 26 | | 33 | | 14 | |
| Iron (Fe) | .01 | | .01 | | .01 | |
| Calcium (Ca) | 73 | 3.644 | 67 | 3.344 | 12 | 0.599 |
| Magnesium (Mg) | 1.7 | .140 | 1.6 | .132 | .9 | .074 |
| Sodium (Na) | 5.2 | .226 | 2.2 | .096 | 3.0 | .130 |
| Potassium (K) | .5 | .013 | .3 | .008 | .6 | .015 |
| Bicarbonate $HCO_3$ | 214 | 3.508 | 206 | 3.377 | 30 | .492 |
| Sulphate ($SO_4$) | 9.5 | .198 | 2.8 | .058 | 2.1 | .044 |
| Chloride (Cl) | 10 | .282 | 2.6 | .073 | 5.5 | .155 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .5 | .026 |
| Nitrate ($NO_3$) | .51 | .008 | .20 | .003 | 4.8 | .077 |
| Total dissolved solids | 241 | | 213 | | 63 | |
| Total hardness as $CaCO_3$ | 189 | | 174 | | 34 | |
| Temperature (°F.) | 66 | | | | | |
| Date of collection | Jan. 19, 1938 | | Jan. 19, 1938 | | Nov. 28, 1940 | |
| Depth (feet) | 250 | | 280 | | 250 | |
| Diameter (inches) | 6 | | 8 | | 8 | |
| Date drilled | | | 1928 | | 1939 | |
| Percent of supply | 5 | | 5 | | 90 | |

## SAVANNAH

[Population, 95,996]

Ownership: Municipal; supplies also about 4,000 people outside the city limits. Total population supplied, about 100,000.

Source: 8 wells (Nos. 14, 15, 17 to 20, 22, and 23), 500, 500, 500, 700, 603, 525, 595, and 696 feet deep; emergency supply from a well (No. 21) 550 feet deep.

The yield of wells 14, 15, and 17 to 23 is reported to be 1,400, 1,000, 1,700, 3,000, 3,000, 2,800, 2,800, 3,100, and 4,640 gallons per minute.

Treatment: Chlorination except for wells 17 and 21. The water from wells 17 and 21 does not receive any treatment.

The wells are located in different sections of the city, and the water is pumped directly from them into the distribution system.

*Analyses of water from wells 15, 17, 18, and 19*

[Collected Feb. 9, 1938. Analyzed by Arthur T. Ness]

| | Well 15 | | Well 17 | | Well 18 | | Well 19 | |
|---|---|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 53 | -- | 53 | -- | 52 | -- | 53 | -- |
| Iron (Fe) | .01 | -- | .0 | -- | .01 | -- | .01 | -- |
| Calcium (Ca) | 26 | 1.298 | 27 | 1.348 | 27 | 1.348 | 26 | 1.298 |
| Magnesium (Mg) | 9.7 | .798 | 10 | .822 | 9.1 | .748 | 10 | .822 |
| Sodium (Na) | 9.5 | .413 | 11 | .478 | 10 | .435 | 10 | .435 |
| Potassium (K) | 1.4 | .036 | 1.4 | .036 | 1.1 | .028 | 1.4 | .036 |
| Bicarbonate ($HCO_3$) | 137 | 2.246 | 145 | 2.377 | 137 | 2.246 | 138 | 2.262 |
| Sulphate ($SO_4$) | 6.9 | .144 | 6.3 | .131 | 7.1 | .148 | 6.8 | .142 |
| Chloride (Cl) | 5.0 | .141 | 5.2 | .147 | 5.5 | .155 | 5.8 | .164 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .0 | .000 | .06 | .001 | .0 | .000 | .0 | .000 |
| Total dissolved solids | 173 | -- | 181 | -- | 174 | -- | 176 | -- |
| Total hardness as $CaCO_3$ | 105 | -- | 108 | -- | 105 | -- | 106 | -- |
| Temperature (°F.) | 73 | -- | 73 | -- | 71 | -- | 73 | -- |
| Depth (feet) | 500 | | 500 | | [1]512½ | | 603 | |
| Diameter (inches) | 10 | | 15 | | 18 | | 20 | |
| Date drilled | 1916 | | 1920 | | 1927 | | 1937 | |
| Percent of supply | 5 | | 5 | | 12 | | 22 | |

[1] Deepened to 700 feet in 1940. A partial analysis of a sample collected Jan. 29, 1941, is similar to the analysis given.

*Analyses of water from wells 20, 21, 22, and 23*

[Analyzed by Arthur T. Ness, Charles G. Seegmiller, and L. A. Shinn]

| | Well 20 | | Well 21 | | Well 22 | | Well 23 | |
|---|---|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 54 | -- | 56 | -- | 55 | -- | 50 | -- |
| Iron (Fe) | .01 | -- | .04 | -- | .01 | -- | .01 | -- |
| Calcium (Ca) | 27 | 1.348 | 30 | 1.497 | 27 | 1.348 | 25 | 1.248 |
| Magnesium (Mg) | 11 | .905 | 11 | .905 | 11 | .905 | 9.2 | .757 |
| Sodium (Na) | 10 | .435 | 4.3 | .187 | 9.4 | .409 | 13 | .565 |
| Potassium (K) | 1.2 | .031 | 2.0 | .051 | 1.4 | .036 | 2.0 | .051 |
| Bicarbonate ($HCO_3$) | 145 | 2.377 | 139 | 2.278 | 146 | 2.393 | 135 | 2.213 |
| Sulphate ($SO_4$) | 6.4 | .133 | 7.2 | .150 | 6.7 | .140 | 10 | .208 |
| Chloride (Cl) | 6.0 | .169 | 6.0 | .169 | 5.5 | .155 | 8.5 | .240 |
| Fluoride (F) | .0 | .000 | -- | -- | .0 | .000 | .4 | .021 |
| Nitrate ($NO_3$) | .0 | .000 | .10 | .002 | .0 | .000 | .0 | .000 |
| Total dissolved solids | 182 | -- | 180 | -- | 183 | -- | 179 | -- |
| Total hardness as $CaCO_3$ | 113 | -- | 120 | -- | 113 | -- | 100 | -- |
| Temperature (°F.) | 67 | -- | -- | -- | 72 | -- | 73 | -- |
| Date of collection | Feb. 9, 1938 | -- | Mar. 9, 1931 | -- | Feb. 9, 1938 | -- | Jan. 29, 1941 | -- |
| Depth (feet) | 525 | | 550 | | 595 | | 696 | |
| Diameter (inches) | 15 | | 12 | | 20 | | 20 | |
| Date drilled | 1920 | | 1923 | | 1935 | | 1940 | |
| Percent of supply | 4 | | Emergency | | 22 | | 28 | |

## SILVERTOWN

[Population, 3,930]

Owner: Martha Mills (B. F. Goodrich Co.).
Source: Potato Creek.
Treatment: Ammonium sulphate, coagulation with alum, chlorine, rapid sand filtration, final adjustment of pH by addition of soda ash.
Rated capacity of filtration plant: 1,000,000 gallons per day.
Raw-water storage: Reservoir, 10,000,000 gallons.
Finished-water storage: Clear-water well, 250,000 gallons; 2 elevated tanks, 100,000 gallons each.

The filtration plant is located in Silvertown. The intake is near U. S. Highway 19 and about 100 yards above the Thomaston and East Thomaston intakes. The water is pumped from the creek to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the elevated tanks.

The system is connected with the Thomaston supply for emergency use. It is also connected with the East Thomaston supply and at present is furnishing East Thomaston with 720,000 gallons of finished water per day for five days a week.

The chemical composition of the water is practically the same as at East Thomaston. (For analyses, see East Thomaston.)

*Regular determinations at the filtration plant*

| Year 1938 | Alkalinity | | | pH | | | Turbidity | | | Temperature ° F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 19 | 22 | 17 | 7.0 | 7.1 | 6.8 | 55 | 280 | 17 | 63 | 81 | 42 |
| Finished water | 29 | 32 | 24 | 7.7 | 8.0 | 7.5 | | | | | | |

## STATESBORO

[Population, 5,028]

Ownership: Municipal.
Source: 3 wells, 561, 540, and 555 feet deep. The yield of the wells is reported to be 450, 300, and 350 gallons per minute.
Treatment: None.
Storage: 2 reservoirs, 40,000 and 185,000 gallons; 2 elevated tanks, 65,000 and 150,000 gallons.

The 561-foot well is located in the City Park; the other two wells are located at the pumping plant at Hill and Mulberry Streets. The water is pumped from the wells to the reservoirs and from the reservoirs to the distribution system and elevated tanks.

*Analyses*

[1, Analyzed by Wesley M. Noble; 2, analyzed by Arthur T. Ness; 3, analyzed by Pittsburgh Testing Laboratory, Pittsburgh, Pa. Well numbers assigned by Geological Survey.]

| | Well 1 | | Well 2 | | Well 3 | |
|---|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 62 | | 57 | | 49 | |
| Iron (Fe) | .06 | | .04 | | .1 | |
| Calcium (Ca) | 32 | 1.597 | 35 | 1.747 | 36 | 1.797 |
| Magnesium (Mg) | 5.2 | .428 | 5.9 | .485 | 6.6 | .543 |
| Sodium (Na) | 7.0 | .304 | 7.0 | .304 | 7.3 | .317 |
| Potassium (K) | 1.3 | .033 | 1.9 | .049 | | |
| Bicarbonate ($HCO_3$) | 128 | 2.098 | 144 | 2.360 | 146 | 2.393 |
| Sulphate ($SO_4$) | 6.7 | .140 | 6.3 | .131 | 1.5 | .031 |
| Chloride (Cl) | 3.5 | .099 | 3.4 | .096 | 8.0 | .226 |
| Fluoride (F) | .0 | .000 | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .0 | .000 | .0 | .000 | 1.8 | .029 |
| Total dissolved solids | 180 | | 188 | | [1] 183 | |
| Total hardness as $CaCO_3$ | 101 | | 112 | | 117 | |
| Temperature (°F.) | | | 71 | | | |
| Date of collection | Jan. 17, 1938 | | Jan. 17, 1938 | | Apr. 24, 1939 | |
| Depth (feet) | 561 | | 540 | | 555 | |
| Diameter (inches) | 15 | | 10 | | 8 | |
| Date drilled | 1927 | | 1916 | | 1912 | |
| Percent of supply | 70 | | 3 | | 27 | |

[1] Calculated.

## THOMASTON

[Population, 6,396]

Ownership: Municipal.

Source: Potato Creek.

Treatment: Coagulation with alum and soda ash, activated carbon, chlorination, rapid sand filtration, chlorination, final adjustment of pH by addition of soda ash.

Rated capacity of filtration plant: 1,500,000 gallons per day.

Raw-water storage: Reservoir, 2,500,000 gallons.

Finished-water storage: 2 clear-water wells, 100,000 and 225,000 gallons; elevated tank, 75,000 gallons.

The filtration plant is located in Thomaston. The intake is at the bridge on U. S. Highway 19 about 2 miles north of the center of Thomaston. The water is pumped from the creek to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water wells, and is pumped from the clear-water wells to the distribution system and the elevated tank.

The system is connected with the East Thomaston and Silvertown supplies for emergency use.

*Analyses*

[Collected May 3, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 9.4 | | 8.7 | |
| Iron (Fe) | .12 | | .02 | |
| Calcium (Ca) | 2.8 | 0.140 | 2.6 | 0.130 |
| Magnesium (Mg) | 1.2 | .099 | 1.2 | .099 |
| Sodium (Na) / Potassium (K) | 4.2 | .183 | 35 | 1.522 |
| Bicarbonate ($HCO_3$) | 19 | .311 | 66 | 1.082 |
| Sulphate ($SO_4$) | 1.7 | .035 | 27 | .562 |
| Chloride (Cl) | 2.2 | .062 | 2.9 | .082 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .64 | .010 | .54 | .009 |
| Total dissolved solids | 35 | | 110 | |
| Total hardness as $CaCO_3$ | 12 | | 11 | |
| Color | 8 | | 3 | |

## THOMASVILLE

[Population, 12,683]

Ownership: Municipal.

Source: 3 wells (Nos. 2, 3, and 4), 300, 550, and 305 feet deep, The yield of the wells is reported to be 500, 1,000, and 1,000 gallons per minute.

Treatment: Aeration, softening with lime and soda ash, bleaching clay, ammonium sulphate, chlorine, recarbonated to produce a final pH of about 8.7, rapid sand filtration. The softening is carried out to produce an effluent having a hardness of about 60 parts per million.

Finished-water storage: Reservoir, 500,000 gallons; elevated tank, 300,000 gallons.

The wells are located at the waterworks. Only one well is pumped at a time. Well 2 is pumped very little; well 3 is pumped on Sunday; well 4 is pumped during the rest of the week. The water is pumped from the wells to the treatment plant, flows through the treatment plant to the reservoir, and is pumped from the reservoir to the distribution system and the elevated tank.

*Analyses*

[Samples from well 3 collected Mar. 13, 1932; analyzed by L. B. Lockhart, Law & Co., Inc., Atlanta, Ga. Samples from well 4 collected Feb. 5, 1938; analyzed by Wesley M. Noble]

| | Well 3 | | | | Well 4 | | | |
|---|---|---|---|---|---|---|---|---|
| | Raw water | | Finished water | | Raw water | | Finished water | |
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 22 | | 11 | | 24 | | 15 | |
| Iron (Fe) | .07 | | .07 | | .64 | | .02 | |
| Calcium (Ca) | 44 | 2.916 | 16 | 0.799 | 45 | 2.246 | 13 | 0.649 |
| Magnesium (Mg) | 21 | 1.727 | 6.6 | .543 | 22 | 1.809 | 6.4 | .526 |
| Sodium (Na) | } 11 | .478 | 28 | 1.218 | 7.9 | .344 | 29 | 1.261 |
| Potassium (K) | | | | | 1.0 | .026 | 1.1 | .208 |
| Bicarbonate ($HCO_3$) | 158 | 2.590 | 39 | .639 | 153 | 2.508 | [1] 39 | .639 |
| Sulphate ($SO_4$) | 70 | 1.457 | 78 | 1.624 | 77 | 1.603 | 77 | 1.603 |
| Chloride (Cl) | 12 | .338 | 10 | .282 | 7.8 | .220 | 8.4 | .237 |
| Fluoride (F) | | | | | .3 | .016 | .2 | .010 |
| Nitrate ($NO_3$) | | | | | .10 | .002 | .10 | .002 |
| Total dissolved solids | 276 | | 173 | | 265 | | 170 | |
| Total hardness as $CaCO_3$ | 196 | | 67 | | 203 | | 59 | |
| Temperature (°F.) | | | | | 71 | | 71 | |
| Depth (feet) | 550 | | | | 305 | | | |
| Diameter (inches) | 16 | | | | 16 | | | |
| Date drilled | 1924 | | | | 1936 | | | |
| Percent of supply | 14 | | | | 85 | | | |

[1] Includes equivalent of 6.9 parts of carbonate ($CO_3$).

## TIFTON

[Population, 5,228]

Ownership: Municipal.

Source: Two wells, 511 and 501 feet deep. The yield of the wells is reported to be 1,500 and 1,000 gallons per minute.

Treatment: Aeration, chlorination.

Storage: Reservoir, 200,000 gallons; elevated tank, 100,000 gallons.

Both wells are located at the waterworks pumping plant. The water is pumped from the wells to the reservoir and from the reservoir to the distribution system and the elevated tank.

*Analyses*

[Collected June 5, 1940. Analyzed by Wesley M. Noble. Well numbers assigned by Geological Survey]

| | Well 1 | | Well 2 | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 19 | | 19 | |
| Iron (Fe) | .06 | | .09 | |
| Manganese (Mn) | .06 | 0.002 | .02 | 0.001 |
| Calcium (Ca) | 45 | 2.246 | 44 | 2.196 |
| Magnesium (Mg) | 7.8 | .641 | 8.0 | .658 |
| Sodium (Na) | 3.1 | .135 | 3.5 | .152 |
| Potassium (K) | .8 | .020 | .7 | .018 |
| Bicarbonate ($HCO_3$) | 174 | 2.852 | 173 | 2.836 |
| Sulphate ($SO_4$) | 1.0 | .021 | 1.1 | .023 |
| Chloride (Cl) | 2.6 | .073 | 2.6 | .073 |
| Fluoride (F) | .1 | .005 | .0 | .000 |
| Nitrate ($NO_3$) | .05 | .001 | .05 | .001 |
| Total dissolved solids | 158 | | 159 | |
| Total hardness as $CaCO_3$ | 144 | | 143 | |
| Depth (feet) | 511 | | 501 | |
| Diameter (inches) | 15 | | 12 | |
| Date drilled | 1939 | | 1940 | |
| Percent of supply | 60 | | 40 | |

## TOCCOA

[Population, 5,494]

Ownership: Municipal.

Source: Little Toccoa Creek impounded in the Toccoa Waterworks Lake (capacity about 31,000,000 gallons).

Treatment: Coagulation with alum and lime, activated carbon, rapid sand filtration, chlorination, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 1,500,000 gallons per day.

Finished-water storage: Clear-water well, 300,000 gallons; elevated tank, 200,000 gallons.

The filtration plant and intake are located at the Toccoa Waterworks Lake, 2½ miles northwest of the center of Toccoa. The water flows from the lake through the filtration plant to the clear-water well and from the clear-water well to the distribution system and the elevated tank.

*Analyses*

[Collected Sept. 7, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 7.9 | | 8.6 | |
| Iron (Fe) | .03 | | .01 | |
| Calcium (Ca) | 1.9 | 0.095 | 5.1 | 0.255 |
| Magnesium (Mg) | .8 | .066 | .7 | .058 |
| Sodium (Na) | 1.6 | .070 | 1.7 | .074 |
| Potassium (K) | 1.4 | .036 | 1.6 | .041 |
| Bicarbonate ($HCO_3$) | 14 | .230 | 18 | .295 |
| Sulphate ($SO_4$) | 1.0 | .021 | 5.4 | .112 |
| Chloride (Cl) | 1.1 | .031 | 1.2 | .034 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .0 | .000 | .0 | .000 |
| Total dissolved solids | 23 | | 34 | |
| Total hardness as $CaCO_3$ | 8.0 | | 16 | |
| Color | 6 | | 5 | |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 12 | 15 | 9 | 6.9 | 7.0 | 6.0 | 35 | 200 | 5 |
| Finished water | 15 | 16 | 10 | | | | | | |

## TRION

[Population, 3,800]

Owner: The Trion Co.
Source: Developed spring.
Treatment: Chlorination.
Storage: Reservoir, 635,000 gallons.

The developed spring is located at the Trion pumping station, on the west bank of the Chattooga River about 1 mile north of Trion. The water is pumped from the spring to the reservoir and flows from the reservoir to the distribution system.

*Analysis*

[Collected Apr. 20, 1938. Analyzed by William L. Lamar]

| | Developed spring | | | Developed spring | |
|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 7.0 | | Chloride (Cl) | 1.5 | .042 |
| Iron (Fe) | .01 | | Fluoride (F) | .0 | .000 |
| Calcium (Ca) | 23 | 1.148 | Nitrate ($NO_3$) | 2.4 | .039 |
| Magnesium (Mg) | 11 | .905 | Total dissolved solids | 103 | |
| Sodium (Na) | 1.1 | .048 | | | |
| Potassium (K) | .6 | .015 | Total hardness as $CaCO_3$ | 103 | |
| Bicarbonate ($HCO_3$) | 118 | 1.934 | Temperature (°F.) | 61 | |
| Sulphate ($SO_4$) | 1.4 | .029 | | | |

## VALDOSTA

[Population, 15,595]

Ownership: Municipal.

Source: Well (No. 3) 409 feet deep; emergency supply from a well (No. 2) 500 feet deep. The yield of well 3 is reported to be 1,000 to 1,200 gallons per minute.

Treatment: Aeration, chlorination.

Storage: 2 reservoirs, 250,000 and 1,000,000 gallons.

The wells are located at the waterworks pumping plant. The water is pumped from the wells to the reservoirs and from the reservoirs to the distribution system. Well 2 is connected with the system and is pumped for about five days during the year to keep it in service for emergency use.

Well 3, now reported to be 409 feet deep, was reported in 1932 and in Geological Survey Water-Supply Paper 658 as 408 feet deep.

*Analysis*

[Collected Sept. 30, 1941. Analyzed by Charles G. Seegmiller]

| | Well 3 | | | Well 3 | |
|---|---|---|---|---|---|
| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 15 | | Total hardness as $CaCO_3$ | 98 | |
| Iron (Fe) | .01 | | Temperature (°F.) | 72 | |
| Calcium (Ca) | 32 | 1.597 | | | |
| Magnesium (Mg) | 4.4 | .362 | | | |
| Sodium (Na) | 2.3 | .100 | | | |
| Potassium (K) | 1.0 | .026 | | | |
| Bicarbonate ($HCO_3$) | 78 | 1.278 | | | |
| Sulphate ($SO_4$) | 30 | .625 | Depth (feet) | 409 | |
| Chloride (Cl) | 3.8 | .107 | Diameter (inches) | 15 | |
| Fluoride (F) | .2 | .010 | Date drilled | 1923 | |
| Nitrate ($NO_3$) | .30 | .005 | Percent of supply | 100 | |
| Total dissolved solids | 136 | | | | |

## VIDALIA

[Population, 4,109]

Ownership: Municipal.

Source: Well 1,100 feet deep (yield reported to be 650 gallons per minute); emergency supply from a well 500 feet deep.

Treatment: Chlorination.

Storage: 2 reservoirs, 150,000 and 250,000 gallons; elevated tank, 65,000 gallons.

The wells are located at the waterworks pumping plant. The water is pumped from the wells to the reservoirs and from the reservoirs to the distribution system and the elevated tank.

*Analysis of water from well 1,100 feet deep*

[Collected Jan. 28, 1938. Analyzed by Wesley M. Noble]

| | Parts per million | Equivalents per million | | Parts per million | Equivalents per million |
|---|---|---|---|---|---|
| Silica ($SiO_2$) | 45 | | Total dissolved solids | 169 | |
| Iron (Fe) | .04 | | | | |
| Calcium (Ca) | 31 | 1.547 | Total hardness as $CaCO_3$ | 102 | |
| Magnesium (Mg) | 5.9 | .485 | Temperature (°F.) | 74 | |
| Sodium (Na) | 9.4 | .409 | | | |
| Potassium (K) | 2.8 | .072 | | | |
| Bicarbonate ($HCO_3$) | 138 | 2.262 | Depth (feet) | 1,100 | |
| Sulphate ($SO_4$) | 4.5 | .094 | Diameter (inches) | 10 | |
| Chloride (Cl) | 4.6 | .130 | Date drilled | 1930 | |
| Fluoride (F) | .0 | .000 | Percent of supply | 100 | |
| Nitrate ($NO_3$) | .0 | .000 | | | |

## WASHINGTON

[Population, 3,537]

Ownership: Municipal.

Source: Beaverdam Creek (tributary to Little River).

Treatment: Coagulation with alum, chlorination, rapid sand filtration.

Rated capacity of filtration plant: 1,000,000 gallons per day.

Raw-water storage: Reservoir, 1,000,000 gallons.

Finished-water storage: Clear-water well, 47,000 gallons; standpipe, 282,000 gallons; 2 elevated tanks, 30,000 gallons each, for emergency use.

The filtration plant and intake are located on the creek 3½ miles southwest of the center of Washington. The water is pumped from the creek to the raw-water reservoir and from this reservoir to the filtration plant; flows through the filtration plant to the clear-water well; and is pumped from the clear-water well to the distribution system and the standpipe. The elevated tanks are kept full for emergency use.

*Analyses*

[Collected Sept. 22, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 32 | | 27 | |
| Iron (Fe) | .22 | | .01 | |
| Calcium (Ca) | 7.8 | 0.389 | 8.1 | 0.404 |
| Magnesium (Mg) | 2.9 | .238 | 3.2 | .263 |
| Sodium (Na) }<br>Potassium (K) } | 8.8 | .383 | 8.4 | .365 |
| Bicarbonate ($HCO_3$) | 54 | .885 | 32 | .524 |
| Sulphate ($SO_4$) | 1.3 | .027 | 19 | .396 |
| Chloride (Cl) | 3.4 | .096 | 4.0 | .113 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .06 | .001 | .0 | .000 |
| Total dissolved solids | 86 | | 90 | |
| Total hardness as $CaCO_3$ | 31 | | 33 | |
| Color | 12 | | 3 | |

## WAYCROSS

[Population, 16,763]

Ownership: Municipal.

Source: 2 wells, 658 and 686 feet deep. The yield of the wells is reported to be 1,210 and 2,080 gallons per minute.

Treatment: Chlorination.

Storage: 2 reservoirs, 39,700 and 48,800 gallons; standpipe, 287,000 gallons.

The 658-foot well is located in Legion Park; the 686-foot well is at the water-works pumping plant. The water is pumped from the wells to the reservoirs and from the reservoirs to the distribution system and the standpipe.

*Analyses*

[Analyzed by Wesley M. Noble and Charles G. Seegmiller. Well numbers assigned by Geological Survey]

| | Well 1 | | Well 2 | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 46 | | 42 | |
| Iron (Fe) | .21 | | .14 | |
| Calcium (Ca) | 34 | 1.697 | 40 | 1.996 |
| Magnesium (Mg) | 14 | 1.151 | 18 | 1.480 |
| Sodium (Na) | 16 | .696 | 19 | .826 |
| Potassium (K) | 2.4 | .061 | 1.9 | .049 |
| Bicarbonate ($HCO_3$) | 159 | 2.606 | 162 | 2.655 |
| Sulphate ($SO_4$) | 29 | .604 | 50 | 1.041 |
| Chloride (Cl) | 14 | .395 | 20 | .564 |
| Fluoride (F) | .4 | .021 | .2 | .010 |
| Nitrate ($NO_3$) | .15 | .002 | .0 | .000 |
| Total dissolved solids | 224 | | 268 | |
| Total hardness as $CaCO_3$ | 142 | | 174 | |
| Temperature (°F.) | 74 | | 76 | |
| Date of collection | May 28, 1941 | | Jan. 31, 1938 | |
| Depth (feet) | 658 | | 686 | |
| Diameter (inches) | 12 | | 12 | |
| Date drilled | 1893 | | | |
| Percent of supply | 80 | | 20 | |

## WAYNESBORO

[Population, 3,793]

Ownership: Municipal.

Source: Brier Creek.

Treatment: Coagulation with alum, activated carbon, rapid sand filtration, chlorination, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 1,000,000 gallons per day.

Raw-water storage: None.

Finished-water storage: Clear-water well, 200,000 gallons: elevated tank, 100,000 gallons.

The filtration plant is located on the old Augusta road about 2 miles east of Waynesboro. The intake is about half a mile east of the filtration plant. The water is pumped from the creek to the filtration plant, flows through the filtration plant to the clear-water well, and is pumped from the clear-water well to the distribution system and the elevated tank.

### *Analyses*

[Collected Jan. 17, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 9.3 | | 9.4 | |
| Iron (Fe) | .12 | | .04 | |
| Calcium (Ca) | 4.8 | 0.240 | 11 | 0.549 |
| Magnesium (Mg) | .9 | .074 | 1.0 | .082 |
| Sodium (Na) | 2.6 | .113 | 2.4 | .104 |
| Potassium (K) | .8 | .020 | .8 | .020 |
| Bicarbonate ($HCO_3$) | 20 | .328 | 30 | .492 |
| Sulphate ($SO_4$) | 1.7 | .035 | 7.9 | .164 |
| Chloride (Cl) | 3.2 | .090 | 3.5 | .099 |
| Fluoride (F) | .1 | .005 | .0 | .000 |
| Nitrate ($NO_3$) | .26 | .004 | .08 | .001 |
| Total dissolved solids | 37 | | 53 | |
| Total hardness as $CaCO_3$ | 16 | | 32 | |
| Color | 15 | | | |

## WINDER

[Population, 3,974]

Ownership: Municipal; supplies also about 150 people outside the city limits. Total population supplied, about 4,100.

Source: Cedar Creek.

Treatment: Coagulation with alum and lime, activated carbon, rapid sand filtration, ammonium sulphate, chlorine, final adjustment of pH by addition of lime.

Rated capacity of filtration plant: 500,000 gallons per day.

Raw-water storage: Reservoir, capacity estimated at 1,000,000 gallons.

Finished-water storage: 2 clear-water wells, 70,000 and 130,000 gallons; standpipe, 160,000 gallons.

The filtration plant is located in Winder. The intake is about 2 miles north of the center of Winder. The water is pumped from the creek to the raw-water reservoir, flows from this reservoir through the filtration plant to the clear-water wells, and is pumped from the clear-water wells to the distribution system and the standpipe.

*Analyses*

[Collected Sept. 21, 1938. Analyzed by Arthur T. Ness]

| | Raw water | | Finished water | |
|---|---|---|---|---|
| | Parts per million | Equivalents per million | Parts per million | Equivalents per million |
| Silica ($SiO_2$) | 13 | ------------ | 9.9 | ------------ |
| Iron (Fe) | .02 | ------------ | .01 | ------------ |
| Calcium (Ca) | 1.5 | 0.075 | 14 | 0.699 |
| Magnesium (Mg) | .6 | .049 | .6 | .049 |
| Sodium (Na), Potassium (K) | 3.9 | .170 | 4.9 | .213 |
| Bicarbonate ($HCO_3$) | 12 | .197 | 21 | .344 |
| Sulphate ($SO_4$) | 1.6 | .033 | 26 | .541 |
| Chloride (Cl) | 1.9 | .054 | 2.1 | .059 |
| Fluoride (F) | .0 | .000 | .0 | .000 |
| Nitrate ($NO_3$) | .74 | .012 | .82 | .013 |
| Total dissolved solids | 30 | ------------ | 72 | ------------ |
| Total hardness as $CaCO_3$ | 6.2 | ------------ | 37 | ------------ |
| Color | 4 | ------------ | 1 | ------------ |

*Regular determinations at the filtration plant*

| Year 1937 | Alkalinity | | | pH | | | Turbidity | | | Temperature °F. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. | Av. | Max. | Min. |
| Raw water | 13 | 19 | 10 | 7.2 | ------ | ------ | 45 | 150 | 20 | 65 | 86 | 41 |
| Finished water | 24 | 31 | 10 | 8.1 | 9.2 | 6.8 | ------ | ------ | ------ | ------ | ------ | ------ |