GROUND-WATER AVAILABILITY IN THE SOUTH METROPOLITAN ATLANTA REGION, GEORGIA

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INTRODUCTION

An investigation examining the availability of ground-water resources in south metropolitan Atlanta region (south metro region) was conducted because of an increasing demand for additional water supplies, and concern that surface-water supplies may not satisfy future requirements. In response to this concern, the U.S. Geological Survey, in cooperation with the U.S. Army Corps of Engineers, Savannah District, and the Georgia Department of Natural Resources, Environmental Protection Division, Geologic Survey Branch, conducted a study to provide a general evaluation of the ground-water resources of the south metro region and their development potential. This involved estimating ground-water recharge in the upper Flint River Basin and providing a description of existing ground-water supplies in the region, including wells and springs; their yield, hydrogeologic and topographic setting, and construction specifications.

Much of the 2,808 square mile study area lies in the upper Flint River basin in the Piedmont physiographic province (Figure 1). The extreme southern part of the study area is in the Coastal Plain physiographic province.

Geologic Setting

Previous investigators have divided the various igneous and metamorphic rock units of the south metro region into more than 40 named formations and unnamed mappable units that range in thickness from less than 10 feet (ft) to possibly more than 10,000 ft). Regional tectonic stresses have warped these rocks into a complex series of folds and refolded folds, that have been injected by younger igneous plutons and dikes and broken by faults (Cressler and others, 1983, p. 7). The rocks are characterized by several distinct regions that are separated from each other by thrust faults (Higgins and others, 1988).

Hydrologic Setting

Average annual precipitation in the south metro region for the period 1941-70 ranged from less than 48 inches (in.) in eastern Lamar County to more than 52 in. in Talbot, and parts of Meriwether, Coweta, and Fayette Counties. Maximum rainfall

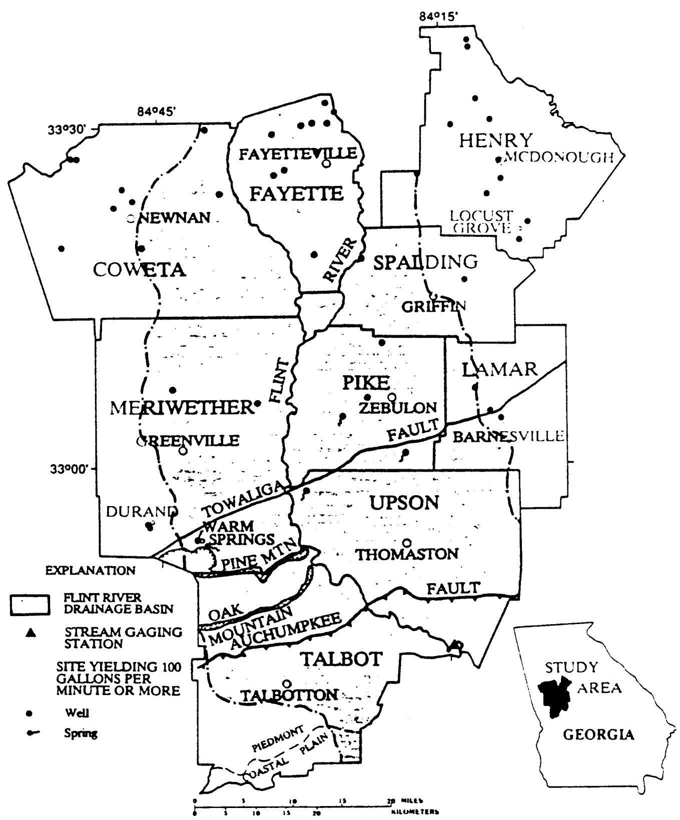

Figure 1.–Location of study area, physiographic provinces, Flint River basin, significant geologic features, and high-yielding wells and springs.

generally occurs during the winter and midsummer. Average annual runoff for the same period ranged from less than 16 in. in Spalding and eastern Lamar and Fayette Counties, to more than 24 in. in southeastern Talbot County, which lies within the Coastal Plain physiographic province (Carter and Stiles, 1983).

Water Use

In the study area, approximately 43.3 million gallons per day (Mgal/d) was withdrawn from surface- and ground-water sources during 1985 (Turlington and others, 1987) (Figure 2). Of this total, about 63 percent (27 Mgal/d) was from surface-water sources and 37 percent (16 Mgal/d) from ground-water sources. Of the 16 Mgal/d withdrawn from ground-water sources, 54 percent was for domestic and commercial use, 29 percent was for livestock, 11 percent was for public supply, 3.5 percent was for irrigation, and 2.5 percent was for industrial and mining uses.

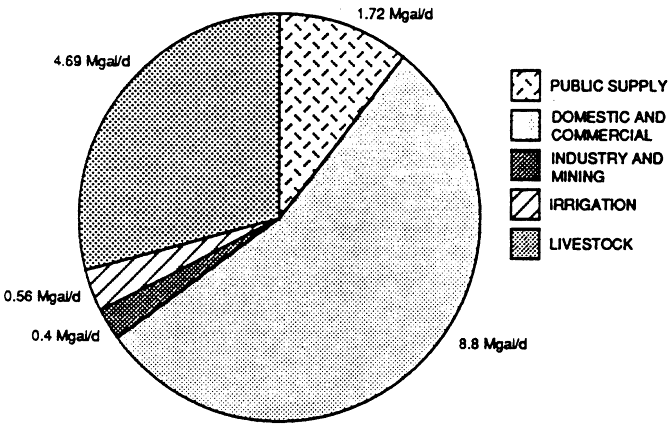

Figure 2.--Ground-water use in the south metropolitan Atlanta region, 1985.

GROUND-WATER AVAILABILITY

The availability of ground water in the Georgia Piedmont is largely limited to the regolith and where secondary permeability has developed along geologic discontinuities in the otherwise impermeable bedrock. Regolith is the semi-consolidated to unconsolidated material that overlies the bedrock. The regolith is composed of soil, saprolite (weathered rock), stream alluvium, colluvium, and other surficial deposits. The availability of ground water in the Coastal Plain (extreme southern Talbot County) is similar to the Piedmont, because the Coastal Plain strata are comparatively thin and overlie crystalline rocks.

Certain structural and stratigraphic features associated with increased permeability of crystalline rock were noted as factors influencing well yield throughout the Piedmont part of the south metro region. These factors are: (1) there are more than 4,000 miles (mi) of contact zones between rocks of contrasting lithologies in the south metro region that could favor increased permeability of the rock; (2) the Towaliga and Auchumpkee faults are major fault zones that cut across the southern part of the area; (3) in parts of the area, there are shear zones and microbreccia zones that commonly are associated with increased permeability of the rock. Some of the most significant structural and stratigraphic features in the Warm Springs-Barnesville area are shown in Figure 3.

Hydrogeologic Units

Many of the rock units underlying the south metro region exhibit similar physical properties and yield water of comparable quantity and chemical quality. On the basis of these similarities, Cressler and others (1983) grouped rock units of the greater Atlanta region into nine hydrogeologic units designated units A-H and J. See Figure 3 for descriptions of significant units in the Warm Springs-Barnesville area. Clarke and Peck (1991) extended each of the nine units southward throughout the south metro region.

Ground-Water Recharge

Ground-water recharge rates in the upper Flint River basin were estimated by Faye and Mayer (1990) using a hydrograph separation technique for the Flint River near Culloden stream gaging station (Figure 1). The upper Flint River basin lies in the Piedmont, and covers an area of about 1,850 square miles, or about 66 percent of the study area. Although ground-water contribution from outside the river's drainage basin through faults, fracture systems, or contact zones transecting the basin boundary is possible, it is likely that the largest percentage of recharge is derived from precipitation within the basin. The estimated mean annual ground-water recharge rate in the Flint River basin averages about 6.5 inches per year (in/yr), or 575 Mgal/d, but is higher during wet years and lower during dry years (Faye and Mayer, 1990).

Recharge rates during average wet and dry years were estimated by examining streamflow records for 1911-87. During an average dry year (1941), the recharge rate was about 4.7 in/yr (415 Mgal/d), whereas during an average wet year (1949), the recharge rate was about 8.8 in/yr (770 Mgal/d). The recharge rate is well below the average during extreme droughts. For example, ground-water recharge during the severe drought of 1954 was estimated to be only about 0.8 in/yr (70 Mgal/d).

Although the amount of recharge greatly exceeds current ground-water withdrawals in the basin (16 Mgal/d), only a small percentage of the estimated annual recharge can be economically recovered by wells. The actual amount that can be recovered will depend on utilization of scientific water-prospecting techniques to locate sites favorable for the development of high-yielding wells.

Well Yields

The reported yield for 406 wells ranged from 0.5 to 700 gallons per minute (gal/min), and averaged 43 gal/min. A graphical summary of selected well yield and construction characteristics is shown in Figure 4. The average diameter of well casing was largest for wells located on hills and ridges, possibly indicating a preference for such topographic locations by municipal and industrial users who typically develop larger diameter wells than domestic users. For a given depth range or well diameter, the highest well yields were obtained in draws and valleys, with lesser yields obtained from wells located on hills and ridges and slopes and flats.

Many of the well sites in the south metro region were located for convenience, that is, near towns, manufacturing plants, and homes without regard to well-site selection criteria. It is likely that greater well yields could be obtained by applying systematic well-siting techniques. For a complete discussion of well-siting

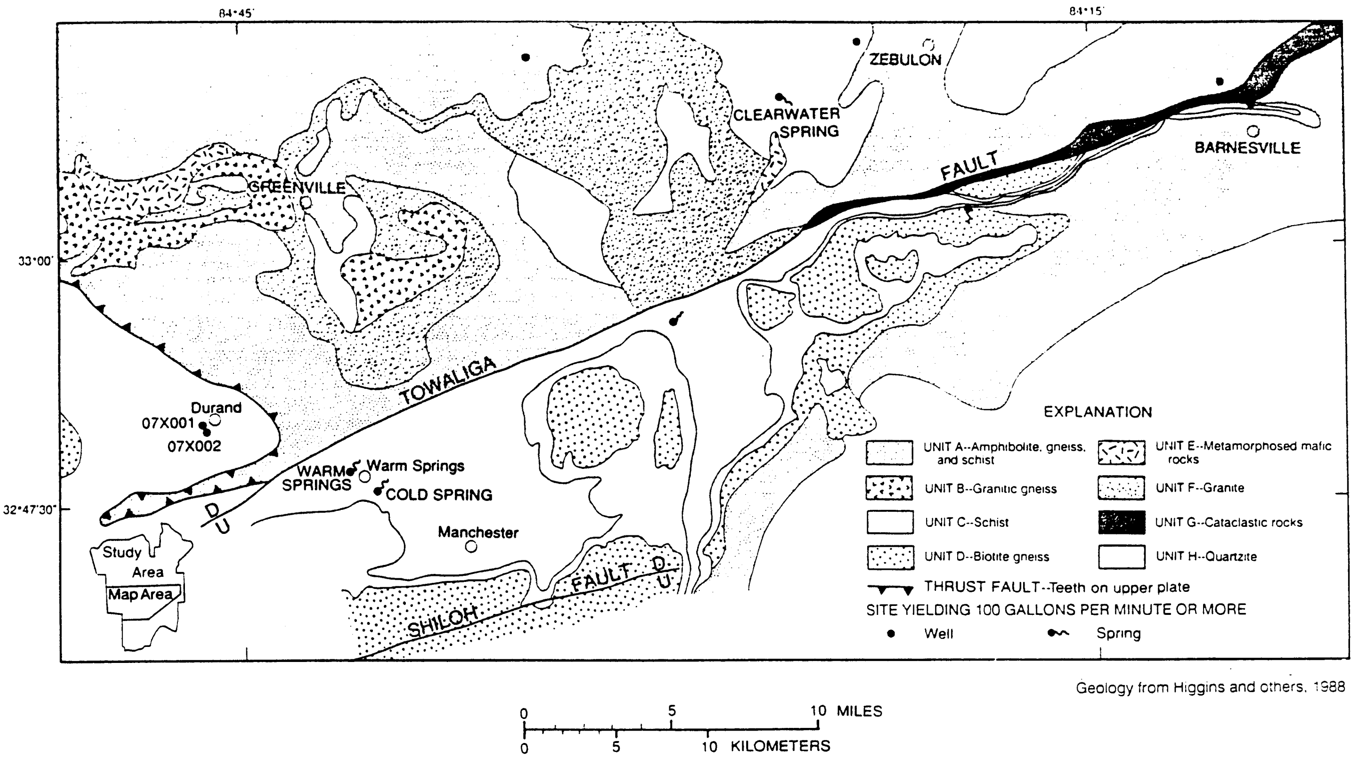

Figure 3.--Generalized geology and the locations of high-yielding wells and springs in the Warm Springs-Barnesville area.

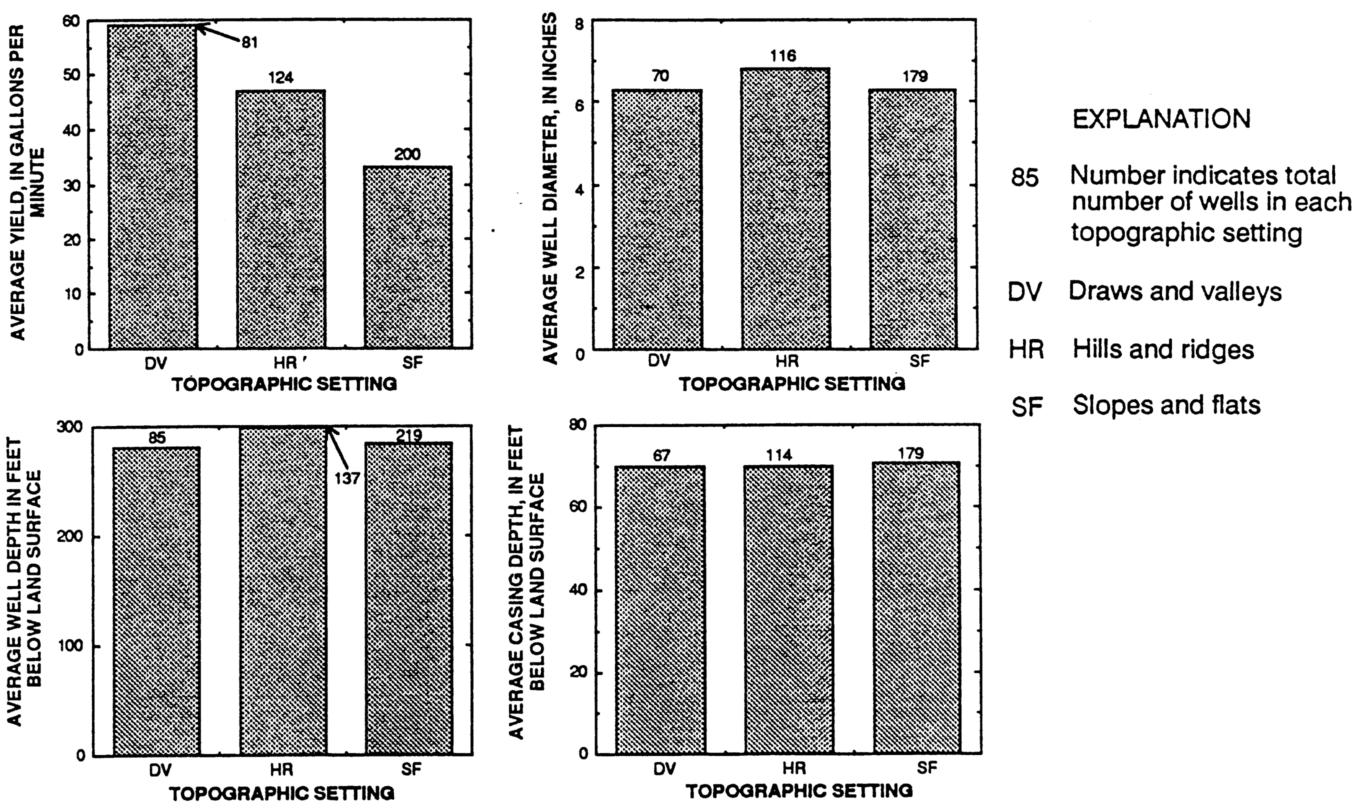

Figure 4.--Relations among well yield, well construction and topographic setting.

criteria as related to topography, the reader is referred to LeGrand (1967) and Cressler and others (1983).

Occurrence of High-Yielding Wells and Springs

High-yielding wells and springs are herein defined as those that yield 100 gal/min or more. Forty-three high-yielding wells and five high-yieldingc springs were inventoried in the south metro region (Figure 1). The high-yielding wells had reported yields from 100 to 700 gal/min, ranged in depth from 85 to 550 ft, and were cased to depths of 14 to 300 ft. Most of the wells were drilled near contact zones between rocks of contrasting lithologic and weathering properties (24 wells), and in areas underlain by hydrogeologic unit A (14 wells). The other 5 wells were located in areas underlain by unit B (2 wells) and unit C (3 wells). The high-yielding wells were located in a variety of topographic settings; hillsides (15 wells), upland draws (12 wells), and hilltops (11 wells) were the most prevalent. With the exception of two wells in Lamar County, all the high-yielding wells were located north of the Towaliga fault. This study (1990) found no high-yielding wells in Talbot or Upson Counties.

The five high-yielding springs had discharges ranging from 125 to 679 gal/min during the period 1933-35. With the exception of Cold Spring and Clearwater Spring, water temperatures of the high-yielding springs exceeded 18.8 degrees celsius (°C) and the springs were classified as warm springs. One of the high-yielding springs was located near the contact between units A and H, three near the contact between units C and H, and one within unit C (Figure 3). The springs were located in valleys (two springs), hillsides (two springs), and upland draws (one spring). With the exception of Clearwater Spring, the high-yielding springs were south of the Towaliga fault.

SUMMARY AND CONCLUSIONS

Wells and springs supplied about 16 Mgal/d or 37 percent of the total water withdrawals in the south metro region in 1985. Of the total ground-water withdrawals, 54 percent was for domestic and commercial uses, 29 percent was for livestock, 11 percent was for public supply, 3.5 percent was for irrigation, and 2.5 percent was for industrial and mining uses.

Ground-water recharge to the upper Flint River basin, which covers about 68 percent of the study area, estimated using a hydrograph separation technique, averaged 6.5 in/yr (575 Mgal/d). Although the amount of recharge exceeds current ground-water withdrawals in the basin, only a small percentage of the estimated annual recharge can be economically recovered by wells. The actual amount that can be recovered will depend on utilization of modern water prospecting techniques to locate sites favorable for the development of high-yielding wells.

Nearly all of the south metro region is within the Piedmont physiographic province, with the southernmost part of Talbot County in the Coastal Plain province. Rocks of the Piedmont consist of igneous and metamorphic rocks of low permeability. Certain structural, stratigraphic, and topographic features that are associated with increased permeability of the rock were noted as factors influencing well yield throughout the Piedmont part of the south metro area (1) there are more than 4,000 miles of contact zones between rocks of contrasting lithologies in the south metro area that could favor increased permeability of the rock; (2) the Towalaga and Auchumpkee faults are major fault zones that cut across the southern part of the south metro area; (3) in parts of the south metro region, there are shear and microbrecia zones that are often associated with increased permeability of the rock. It is likely that further, more detailed geologic mapping could uncover more of these features in the area.

Data from more than 480 wells and 13 springs were compiled during the current study (1990). The reported yield for more than 480 wells drilled into crystalline rock units ranged from 0.5 to 700 gal/min, and averaged 43 gal/min. The reported flow from 13 springs ranged from 0.54 to 678.6 gal/min. The yield of 43 wells and flow from 5 springs was reported to exceed 100 gal/min. Most of the high-yielding wells and springs were near contact zones between rocks of contrasting lithologic and weathering properties. The high-yielding wells and springs were located in a variety of topographic settings, with hillsides, upland draws, and hilltops being most prevalent. Many of the well sites in the south metro region were located for convenience and without regard to well-site selection criteria. It is probable that more high-yielding wells could be obtained using proper well-siting techniques.

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