RESULTS OF PUMPING TESTS PERFORMED AT THE BARNESVILLE SITE, LAMAR COUNTY, GEORGIA

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INTRODUCTION

The Georgia Geologic Survey Branch of the Environmental Protection Division, Georgia Department of Natural Resources, established the North Georgia Hydrogeology Program to study the occurrence and movement of ground water in the Piedmont and Blue Ridge Physiographic Provinces. Many previous investigations on the ground-water resources of these areas have been descriptive in nature and lacking comprehensive data. To date, three research sites have been selected in the Piedmont Physiographic Province. The major purpose of these sites is to perform pumping tests to measure the area of influence and to determine the source of water that supplies the production wells. If the source of the water is known then steps can be taken to protect this vital resource from contamination. One research site is located in Lamar County, about 50 miles south of Atlanta and two miles northwest of Barnesville (Figure 1). Ground-water investigations conducted at the site will provide data on the response of observation wells to pumping. This information will be used by hydrogeologists, engineers and other professionals for future ground-water protection activities.

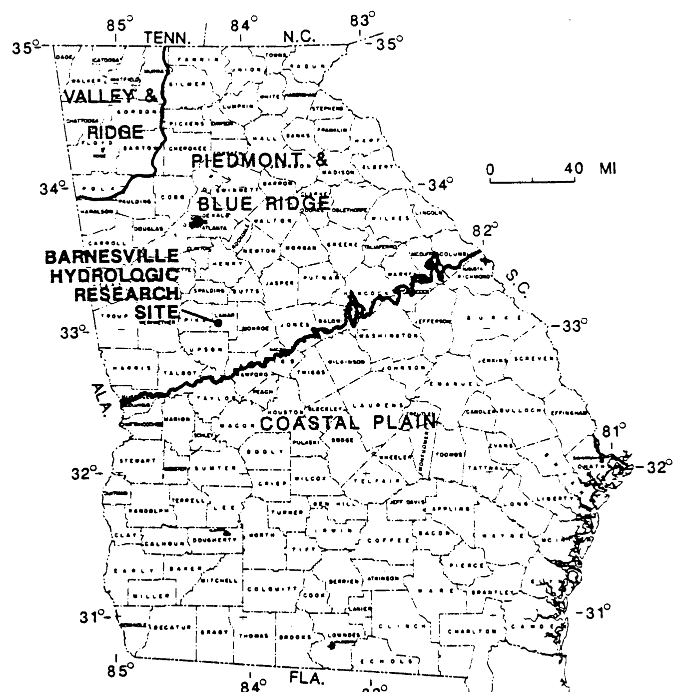

Figure 1: Location map of study site.

HYDROGEOLOGY

The Barnesville study site is constructed in the Towaliga fault zone. Rocks in the fault zone consist of mylonites, blastomylonites, augen gneisses and flinty crushed rocks (Gorday, 1989). These rocks generally strike northeast to east-west and dip to the northwest and north in the immediate study area.

The study site consists of one municipal production well and eight observation wells. Figure 2 shows the location of these wells.The production well (PW) is 400 feet in depth and is cased to 50 feet with 8 inch steel casing. The major water-bearing interval is between 50 and 60 feet of depth according to the geologist's records. A caliper log of this well shows that the borehole diameter increases significantly between 50 and 60 feet

(Figure 3). This interval is most likely in the transition zone where saprolite (weathered rock) gradually changes to relatively unweathered rock.

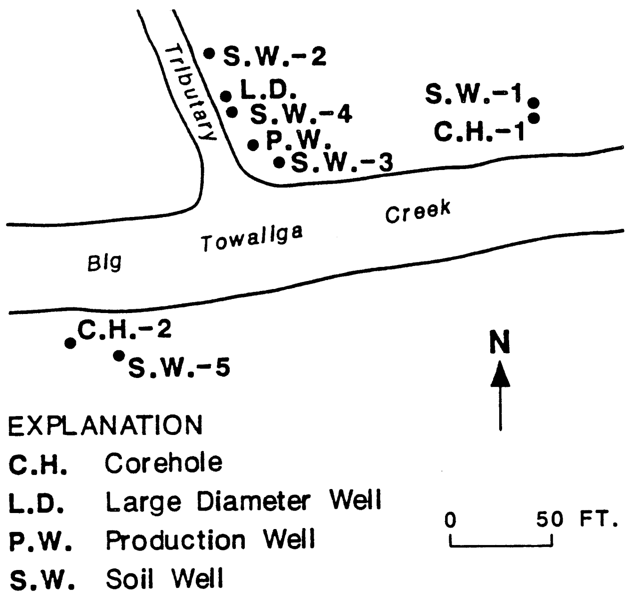

Figure 2: Well location map of the study site.

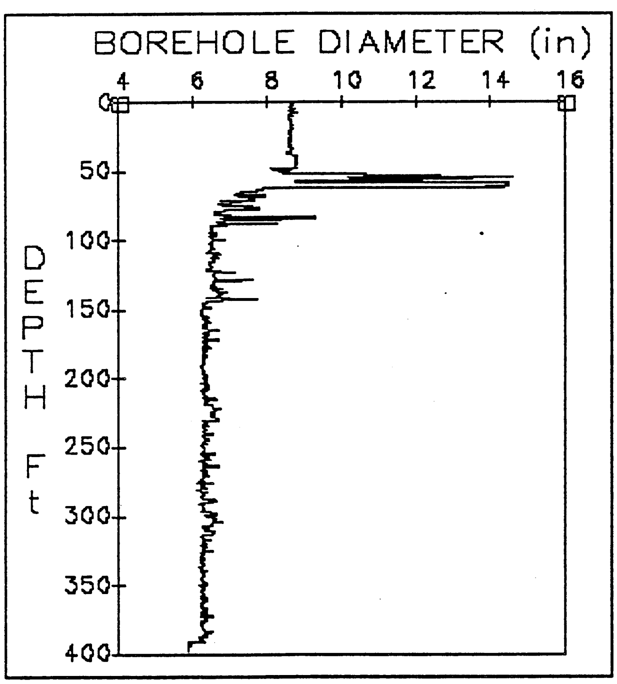

Figure 3: Caliper log of the Production Well.

METHODS

The Georgia Geologic Survey drilled a total of eight observation wells near the PW. Six of these observation wells are shallow, 26 to 60 feet in depth, penetrating only the regolith (soil, alluvium and saprolite). The purpose of these wells is to monitor water-level changes in the regolith. Well depth is generally based on the depth to unweathered rock. The regolith wells are all screened in the lower five feet with a filter pack extending from the base of the screen to a foot to several feet above the top of the screen. Bentonite was poured on top of the filter pack to isolate the screened interval.

The other two observation wells are coreholes drilled to gather lithologic, structural and water-level data in the unweathered rock. Corehole 1 (CH-1) was drilled to a depth of 328.5 feet and encountered a massive augen gneiss with water-bearing fractures concentrated between 50 and 65 feet. CH-1 is located parallel to the general strike of rocks in the immediate area. Corehole 2 (CH-2) was drilled to 227 feet and quartzite and minor mylonite were the predominant rock types encountered. Water-bearing fractures are concentrated between 70 and 120 feet in this well. CH-2 is located nearly perpendicular to the strike of rocks in the area. In general, rocks encountered in CH-2 are less massive, more weathered and have a greater number of water-bearing fractures than rocks penetrated by CH-1. Regolith was cased off and sealed in each of the coreholes.

PUMPING TESTS

Two pumping tests of 24-hours and 72-hours duration were performed at the research site in the spring and summer of 1990. The constant head pumping test methodology (Brackett and others, 1989) was used for both these tests. Depth-to-water measurements were made in all wells, prior to, during and after the tests, to record the effects of pumping on water levels in the bedrock and regolith.

24-hour Test

During the 24-hour test, conducted in April, 1990, the pumping rate ranged from 65 to 70 gallons per minute resulting in a maximum drawdown in the PW of 90 feet (Figure 4). CH-1, located 142 feet east of the PW (Figure 2), drew down almost 18 feet whereas CH-2, located 133 feet southwest of the PW and across Big Towaliga Creek drew down about 1.5 feet (Figure 5). Both of these wells responded within the first 30 minutes of pumping. All shallow or soil wells (SW) were also affected within the first 30 minutes of pumping, with drawdowns ranging from just under 2.5 feet to over 22 feet (Figures 6a and 6b). Soil Wells 3 and 4, and the Large Diameter Well are located relatively close to the PW (Figure 2). These wells drew down about 22, 8.75 and 9 feet, respectively, as shown on Figure 6a. Soil Wells 1, 2 and 5 are more distant from the PW. Soil Well 5 is also located across Big Towaliga Creek from the PW (Figure 2). These three wells drew down 2.5, 4.5 and 3.2 feet, respectively, as shown on Figure 6b. These data show that the amount of drawdown in the shallow wells was, in general, greater in wells closer to the PW and less in wells more distant from the PW.

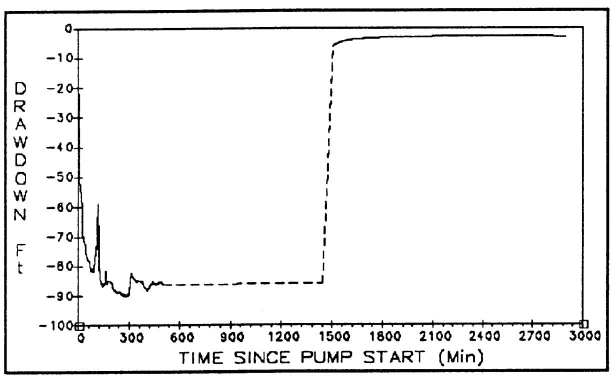

Figure 4: Drawdown-recovery curve of the Production Well, April 4-6, 1990.

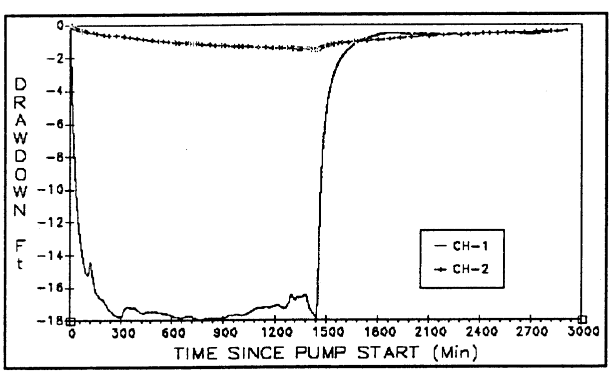

Figure 5: Drawdown-recovery curves of Coreholes 1 and 2, April 4-6, 1990.

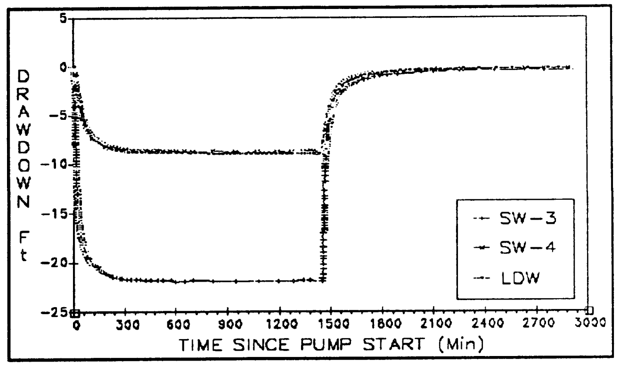

Figure 6a: Drawdown-recovery curves of Soil Wells located near the Production Well, April 4-6, 1990.

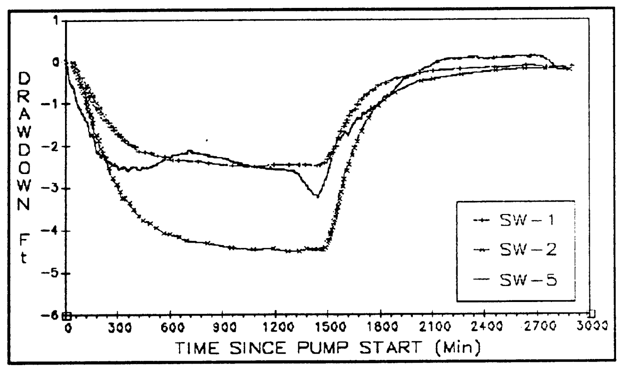

Figure 6b: Drawdown-recovery curves of Soil Wells located distant from the Production Well, April 4-6, 1990.

72-hour Test

A higher-capacity pump was installed and a 72-hour test was performed in July, 1990, during which the same observation wells were used. A rate of 80-85 gallons per minute was sustained resulting in a 260 foot maximum drawdown in the PW (Figure 7). Drawdown in CH-1 and CH-2 was 4 feet and 3.5 feet greater, respectively, than in the April, 1990 test however; the overall shape of the curves are comparable (Figure 8). Again, both of these wells responded to pumping within the first 30 minutes of the test. Drawdown-recovery curves in the three shallow wells closest to the PW (Figure 2) were almost identical to curves for the April 1990 test (Figure 9a). Drawdown in SW-1, SW-2 and SW-5 was about 3, 5.5 and 4.8 feet, respectively, for the 72-hour test (Figure 9b). These data show that, the 72-hour pumping test produced more drawdown in the shallow wells located farthest from the PW than did the 24-hour test. The data also show that all shallow wells responded to pumping within the first 30 minutes of the test. For both tests, the amount of drawdown in the shallow wells is greater in wells near the PW and less in wells farther from the PW.

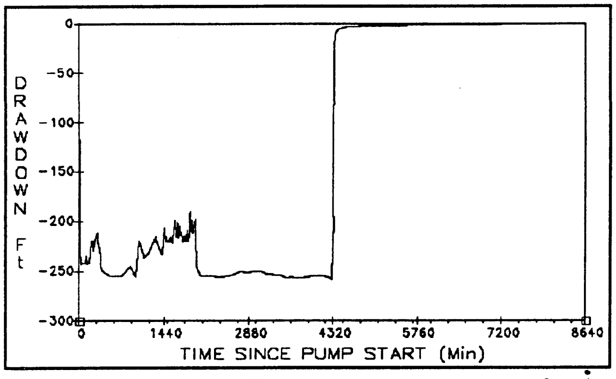

Figure 7: Drawdown-recovery curve of the Production Well, July 9-15, 1990.

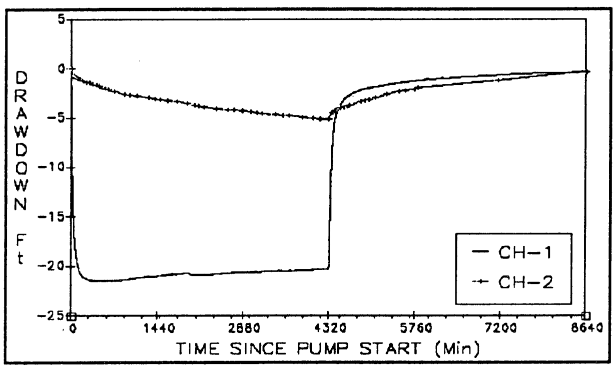

Figure 8: Drawdown-recovery curves of Coreholes 1 and 2, July 9-15, 1990.

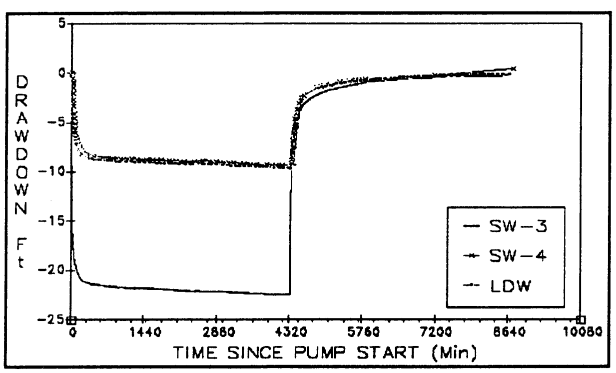

Figure 9a: Drawdown-recovery curves of Soil Wells located near the Production Well, July 9-15, 1990.

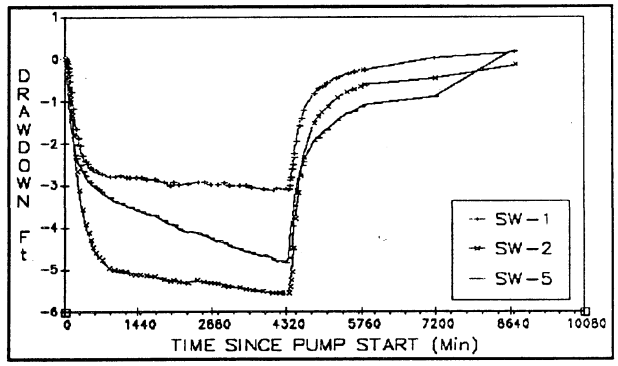

Figure 9b: Drawdown-recovery curves of Soil Wells located distant from the Production Well, July 9-15, 1990.

SUMMARY

There were three major observations made from the 24-hour and 72-hour tests:

1. Both tests produced drawdown in all observation wells, including those located across Big Towaliga Creek.
2. Wells closest to the PW produced greater drawdown than those farther away.
3. All observation wells (both soil and core) responded within the first 30 minutes of pumping.

INTERPRETATIONS AND RECOMMENDATIONS

The rapid response of the shallow wells to pumping indicates that the regolith is the source, or storage area, for the water that recharges the well. During pumping, the water in the regolith is rapidly transmitted to the PW via the transition zone. The area of influence of the PW was not completely defined by this study as shown by the fact that all the observation wells showed a response to pumping within a relatively short time. Additional observation wells, drilled farther away, and more pumping tests would be necessary to better define the limits of the area of influence over a relatively short pumping period. The rapid response of the shallow observation wells to pumping demonstrates the need for protecting ground-water recharge areas near municipal supply wells from contamination.

Since all of the observation wells responded to pumping in a consistent manner, a hydrologic connection (at least at this site) between the PW and the observation wells is indicated. This suggests that ground-water monitoring at this fractured rock site is feasible and that the area of influence (e.g. capture zone) can be defined.

LITERATURE CITED

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