Hydrogeology and Ground-Water Quality of Coastal Plain Sediments in the Central Fort Gordon Area, near Augusta, Georgia, 2001

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INTRODUCTION

Fort Gordon, near Augusta, Georgia, is experiencing increased demand for ground-water supplies. To meet the demand, the U.S. Geological Survey (USGS) in cooperation with the Environmental and Natural Resources Management Office of the U.S. Army Signal Center and Fort Gordon is conducting an investigation of the hydrogeology and water quality of water-bearing units in the vicinity of Training Area 25. The investigation includes: drilling a test well to determine ground-water quality in the study area; compiling a well inventory and performing geophysical logging of new and existing wells; determining the hydrogeologic framework; monitoring water levels; and collecting water-quality samples.

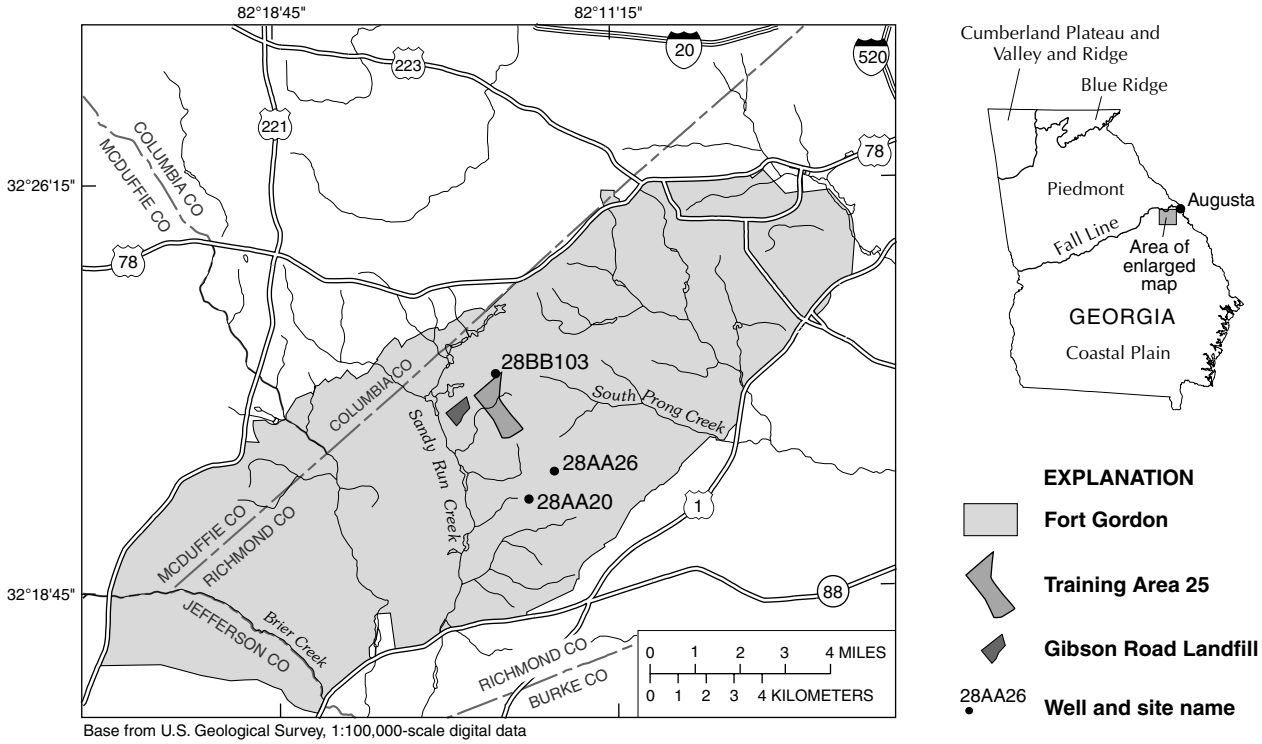
Description of Study Area

Fort Gordon is located southwest of Augusta, Georgia, in western Richmond County and in adjacent parts of Columbia, Jefferson, and McDuffie Counties (map, below). Fort Gordon is located in the Coastal Plain physiographic province near the Fall Line (Clark and Zisa, 1976)—a transition zone between the Coastal Plain and Piedmont physiographic provinces. The general topography along the Fall Line is typified by rolling hills with local rock outcroppings in stream valleys. Topographic relief across Fort Gordon is moderate; land-surface altitudes range from about 225 feet (ft) above National Vertical Datum of 1988 (NAVD 88) in the east to about 500 ft in the northwest.

Training Area 25 and Gibson Road Landfill are located in the central part of Fort Gordon. The area is densely wooded and is drained by an unnamed tributary of Sandy Run Creek. Local topography slopes primarily to the west. Runoff is to the southwest to Sandy Run Creek.

Method of Study

The study included test-well drilling and geophysical logging well 28AA26 and geophysical logging existing



Study site and selected wells at Fort Gordon, Georgia.

well 28BB103. These data were used to identify water-bearing zones and to correlate the local hydrogeology to the regional hydrogeologic framework.

Geophysical logs made from measurement of the natural-gamma radiation of sediments underlying the study area were used to aid in correlating stratigraphic units and water-bearing zones. At well 28AA26, a continuous core was collected from land surface to a depth of about 75 ft; lithologic and geophysical data from this borehole and from well 28BB103 were used to evaluate local and regional hydrogeology.

A continuous water-level recorder was installed in well 28AA26 in August 2001, and was used with previously installed continuous water-level recorders in wells 28AA20 and 28BB103 to assess water-level fluctuations and trends. To describe the general ground-water quality, a water sample was taken from well 28AA26 and analyzed for dissolved constituents and organic compounds.

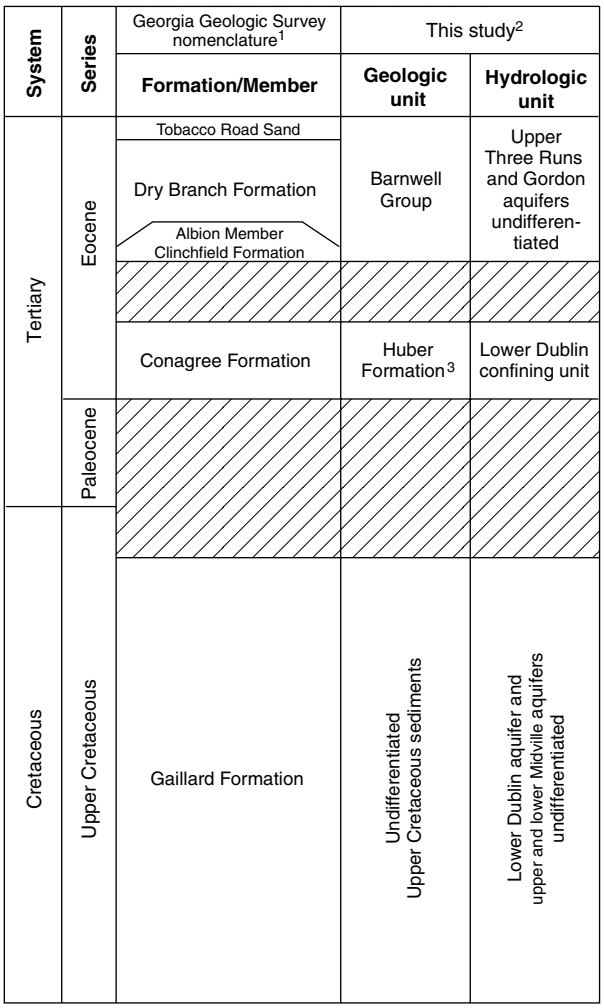
HYDROGEOLOGY

Fort Gordon is underlain by Upper Cretaceous and middle Tertiary sediments (correlation chart, to the right). These sediments unconformably overlie Paleozoic igneous and metamorphic rocks (Chowns and Williams, 1983). In this study, sediments of the Eocene Barnwell Group through the undifferentiated Upper Cretaceous were penetrated during drilling. The stratigraphic descriptions in this report are derived from Hetrick (1992) and Falls and others (1997).

Geologic Units

The undifferentiated Upper Cretaceous sediments are the basal Coastal Plain unit in the area and consist of unconsolidated, moderately to poorly sorted, fine to very coarse sand with interbedded sandy clay. The Cretaceous sediments can be micaceous and have granules and pebbles within the sand or as layers (William F. Falls, U.S. Geological Survey, written commun., 2002). In Richmond County, the Upper Cretaceous sediments range from 100 to 150 ft thick.

The Huber Formation unconformably overlies the Upper Cretaceous sediments in Fort Gordon. The Huber Formation is composed of kaolinitic sand, sand, sandy kaolin, and kaolin (Hetrick, 1992). The sands are coarse and poorly sorted. Mica and heavy minerals are present in the upper portions of the Huber Formation and the upper sandy kaolin are cemented by silica (Hetrick, 1992). In Richmond County, the Huber Formation is less than 50 ft thick.



[1] Huddlestun and Summerour, 1996
[2] Falls and others, 1997
[3] Hetrick, 1992

Generalized correlation of Coastal Plain hydrologic and geologic units in east-central Georgia (modified from Hetrick, 1992; Huddlestun and Summerour, 1996; Falls and others, 1997).

The Barnwell Group unconformably overlies the Huber Formation and consists of poorly sorted to moderately well sorted medium to very coarse quartz sand with minor interstitial clay. Maximum thickness of the Barnwell Group is about 200 ft in parts of southern Burke County, but averages 100 ft thick or less at most localities (Falls and others, 1997). The Barnwell Group thins from Burke County updip toward the Fall Line. Huddlestun and Summerour (1996) defined the Barnwell Group as three formations in Georgia: Clinchfield Formation (including the Albion member), Dry Branch Formation, and Tobacco Road Sand. In Richmond County, the Barnwell Group is about 100 ft thick.

Hydrogeologic Units

Principal water-bearing units in the central Fort Gordon area are, in order of increasing depth, the Upper Three Runs and Gordon aquifers, undifferentiated, and the lower Dublin and the upper and lower Midville aquifers, undifferentiated (correlation chart, previous page). These units are separated by a low permeability clayey confining unit. Several hydrogeologic units identified by Falls and others (1997) are absent in the central Fort Gordon area due to nondeposition or erosional unconformities. These include the Gordon confining unit, the Millers Pond aquifer and confining unit, the upper Dublin aquifer and confining unit, and the basal confining unit. The updip limit of most of these units is to the east of Fort Gordon.

Hydrogeologic units were characterized at wells 28BB103 and 28AA26 on the basis of lithologic and borehole geophysical logs (well diagrams, facing and following pages). Data from these wells were interpolated to other sites to determine water-bearing units tapped by other wells in the area. Water-bearing units tapped by selected wells in central Fort Gordon are listed in the table below.

In Richmond County, the Upper Three Runs aquifer coalesces with the underlying Gordon aquifer because several intervening units are absent in the area (Falls and others, 1997). These aquifers are present between land surface and a depth of 75 ft at well 28AA26 and between land surface and a depth of approximately 120 ft in well 28BB103. The undifferentiated Upper Three Runs and Gordon aquifers consist of quartz, calcareous sand, and limestone of the Barnwell Group. The sands are highly permeable; however, low permeability clay beds and lenses occur within the Tobacco Road Sand at the top of the Barnwell Group (Huddlestun and Summerour, 1996).

The lower Dublin confining unit underlies the undifferentiated Upper Three Runs and Gordon aquifers and is present between depths of approximately 124 and 164 ft in well 28BB103. The confining unit consists of very poorly to poorly sorted, fine to very coarse sand, sandy kaolin, and kaolin of the Huber Formation.

In the central Fort Gordon area, the lower Dublin aquifer and the upper and lower Midville aquifers coalesce because several intervening units are absent. These aquifers underlie the lower Dublin confining unit and are present between depths of approximately 164 and 260 ft in well 28BB103. The aquifers consist of poorly to moderately sorted fine to very coarse sand with interbedded clay of the undifferentiated Upper Cretaceous sediments. The base of these aquifers overlies the bedrock in the central Fort Gordon area (Wait and Davis, 1986).

Ground-Water Levels

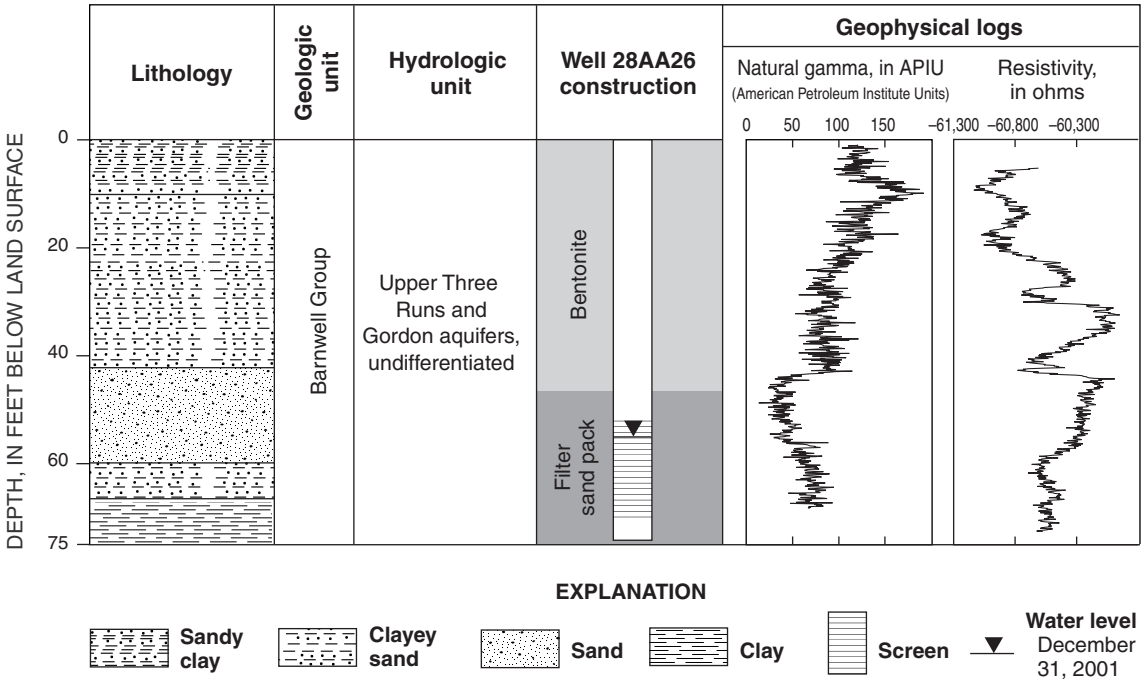
Ground-water levels are affected by changes in recharge and discharge, which are mainly affected by precipitation, evapotranspiration, and pumping. Daily mean water-level fluctuations in the central Fort Gordon area are shown in hydrographs of wells completed in the undifferentiated Upper Three Runs and Gordon aquifers and the undifferentiated lower Dublin and upper and lower Midville aquifers (hydrographs, following pages). The updip limit of these aquifers is present in Richmond County causing the aquifers to be affected by seasonal climatic variations.

The water level in well 28AA26 has declined about 0.75 ft from the time the well was installed until the end

Location and construction data for wells used in this study [—, no data; NAVD 88, National Vertical Datum of 1988]

Site name	Other identifier	Latitude	Longitude	Altitude (feet above NAVD 88)	Depth, feet below land surface		Water-bearing units
					Top of screen or open interval	Bottom of screen or open interval	
28AA20	Fish and Wildlife	33°20'29"	82°12'59"	463	—	[1/]89	Lower Dublin and upper and lower Midville aquifers, undifferentiated
28AA26	Washrack–Forestry Road	33°20'53"	82°12'42"	468	51	71	Upper Three Runs and Gordon aquifers, undifferentiated
28BB103	Range Control	33°22'41"	82°14'01"	500	223	243	Lower Dublin and upper and lower Midville aquifers, undifferentiated

[1/] Initial depth of well was 200 feet. Geophysical logging indicates obstruction in well.



Lithologic and hydrologic units, construction, and geophysical logs of well 28AA26, Fort Gordon, Georgia.

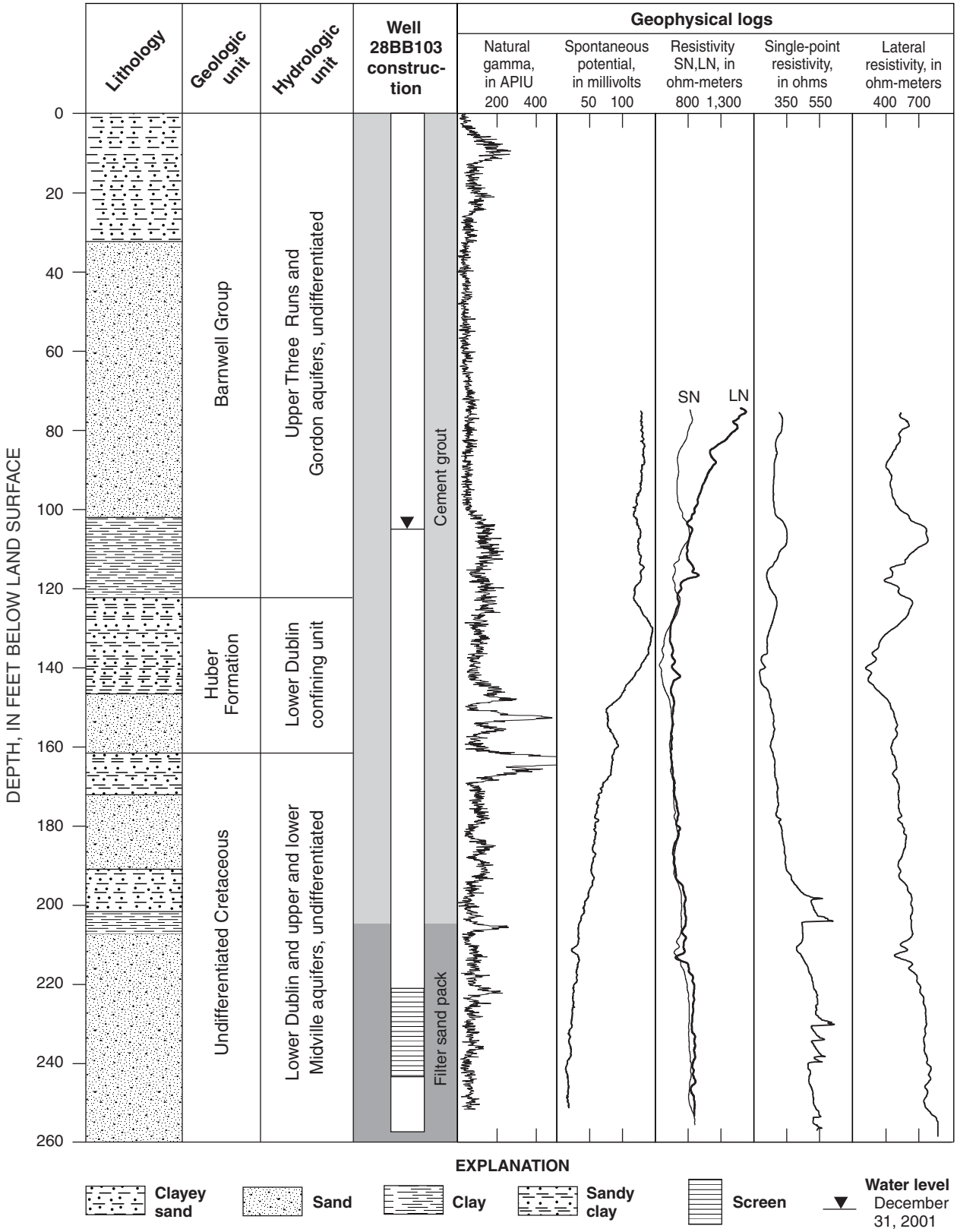
of the year (2001) corresponding to a period of low precipitation and increased evapotranspiration. The water level in well 28AA20 declined about 1 ft from January to March, remained stable until September, then declined about 1 ft from September to December. The fluctuation is due to seasonal precipitation, evapotranspiration, and pumping. The water level in well 28AA20 declined about 2 ft during 2001.

The water level in well 28BB103 was stable from January to June, then declined from June to October due to pumping and decreased precipitation. In November, the water level began to rise as the aquifer was recharged from precipitation. Overall, the water level in well 28BB103 declined about 0.5 ft during 2001.

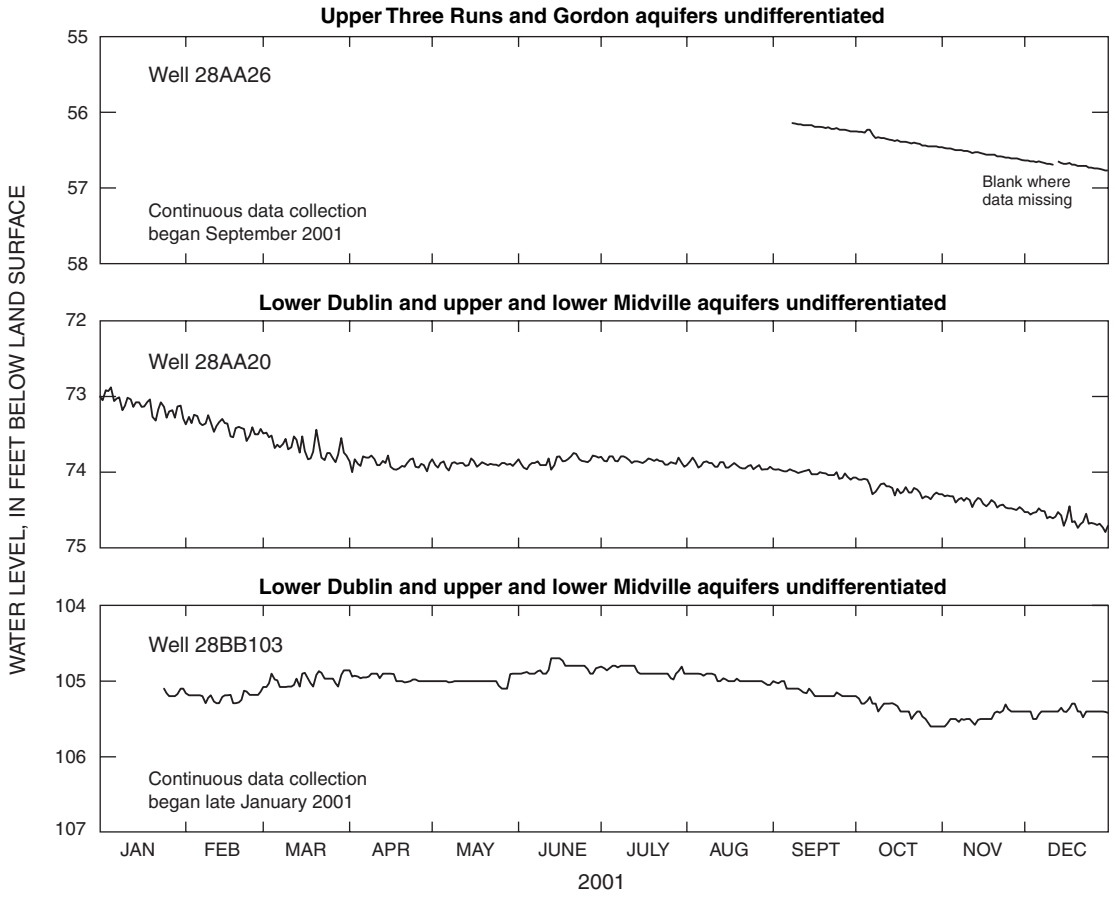
Ground-Water Quality

Information on ground-water quality in the central Fort Gordon area is limited to data collected at the Gibson Road Landfill (Priest and McSwain, 2002) and to a sample collected in well 28AA26. At the Gibson Road Landfill, Priest and McSwain (2002) reported that selected trace elements and organic compounds exceeded the maximum contaminant levels (MCL, formerly known as the primary maximum contaminant level) of the U.S. Environmental Protection Agency (2000), National Primary Drinking Water Standards in several wells surrounding the landfill. The selected trace elements reported are: arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, sulfide, thallium, vanadium, and zinc. Water in 6 of the 10 wells from the study had selected trace elements exceeding the MCL. The selected trace element and organic compound detections showed that a ground-water contaminant plume was present in the vicinity of the landfill (Priest and McSwain, 2002).

Additionally, specific conductance measured in 10 wells ranged from 22 to 755 microsiemens per centimeter and pH ranged from 4.78 to 7.32. In well 28AA26, a sample collected in December 2001 was analyzed for benzene, toluene, ethyl benzene, xylene (BTEX), and ethylene glycol. The analyses indicated that BTEX was not detected above its reporting limit of 0.50 micrograms per liter and ethylene glycol was not detected above its reporting limit of 25 milligrams per liter.



Lithologic and hydrologic units, construction, and geophysical logs of well 28BB103, Fort Gordon, Georgia. [APIU, American Petroleum Institute Units; SN, 16-inch (short) normal; LN, 64-inch (long) normal]



Daily ground-water levels in wells 28AA26, 28AA20, and 28BB103 during 2001.

REFERENCES CITED

Chowns, T.M., and Williams, C.T., 1983, Pre-Cretaceous rocks beneath the Georgia Coastal Plain-Regional implications, *in* Gohn, G.S., ed., Studies related to the Charleston, South Carolina earthquake of 1886—Tectonics and seismicity: U.S. Geological Survey Professional Paper 1313-L, p. L1–L42.

Clark, W.Z., Jr., and Zisa, A.C., 1976, Physiographic map of Georgia: Georgia Geologic Survey, scale 1:2,000,000.

Falls, W.F., Baum, J.S., Harrelson, L.G., Brown, L.H., and Jerden, J.L., Jr., 1997, Geology and hydrogeology of Cretaceous and Tertiary strata, and confinement in the vicinity of the U.S. Department of Energy Savannah River Site, South Carolina and Georgia: U.S. Geological Survey Water-Resources Investigations Report 97-4245, 125 p.

Hetrick, J.H., 1992, A geologic atlas of the Wrens-Augusta area: Georgia Geologic Survey Atlas 8, 3 sheets.

Huddlestun, P.F., and Summerour, J.H., 1996, The lithostratigraphic framework of the uppermost Cretaceous and the lower Tertiary of eastern Burke County, Georgia: Georgia Geologic Survey Bulletin 127, 196 p.

Priest, Sherlyn, and McSwain, K.B., 2002, Hydrogeology and water quality of the Upper Three Runs aquifer in the vicinity of the Gibson Road Landfill, Fort Gordon, Georgia, June–November 1999: U.S. Geological Survey Water-Resources Investigations Report 02-4153, 22 p.

U.S. Environmental Protection Agency, 2000, Maximum contaminant levels (Subpart B of Part 141, National Primary Drinking Water Regulations): U.S. Code of Federal Regulations, Title 40, Parts 100–149, revised as of July 1, 2000, p. 334–560.

Wait, R. L. and Davis, M. E., 1986, Configuration and hydrology of the pre-Cretaceous rocks underlying the southeastern Coastal Plain aquifer system: U.S. Geological Survey Water-Resources Investigations Report 86-4010, 1 plate.