U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with
Augusta Utilities

SCIENTIFIC INVESTIGATIONS MAP 2982
Hydrogeology and Potentiometric Surface of the Dublin and Midville Aquifer Systems—SHEET 1 OF 1
Williams, L.J., 2007, Hydrogeology and Potentiometric Surface of the Dublin and Midville Aquifer Systems in Richmond County, Georgia, January 2007

Introduction

The Dublin and Midville aquifer systems are part of the Cretaceous aquifer system that underlies most of Richmond County, Georgia (Gorday, 1985; Falls and others, 1997). The Cretaceous aquifer system is the second most productive aquifer in Georgia and is a major source of water in the region. About 220 million gallons per day (Mgal/d) of water was withdrawn from the Cretaceous aquifer system during 2000 in Georgia (Fanning, 2003). The Augusta–Richmond County Water System is the largest public water supplier in the county and withdrew 13 Mgal/d of ground water during 2000; withdrawals decreased from 2001 to 2005 (see bar chart for ground-water withdrawals). The towns of Hephzibah and Blythe withdrew 0.4 and 0.03 Mgal/d, respectively. Industrial ground-water withdrawals are concentrated along the Savannah River and totaled 2.89 Mgal/d. To monitor seasonal and long-term water-level fluctuations and trends in the aquifers, the U.S. Geological Survey (USGS)—in cooperation with Augusta Utilities—maintains a countywide network of about 100 water-level monitoring wells in various aquifers, including a new continuous monitoring site (well 30AA33) and two existing USGS–Georgia Environmental Protection Division network sites (wells 29AA09 and 30AA04). Data compiled during this study were used to better define the hydrogeologic units and to construct an updated potentiometric-surface map for the area, which is used to better understand ground-water movement in the Cretaceous aquifer system. In addition, the potentiometric surface and related water-level data can be used for water-resource planning and to update ground-water flow models for the region (Clarke and West, 1997; Cherry, 2006).

Numerous private well owners, industries, well drillers, and local municipalities supplied information used in this report and permitted access to their wells for water-level measurements. In particular, the author would like to thank Wes Byne, Max Hicks, Bobby Robinson, and George Bales of the Augusta–Richmond County Water System; Roger James with the town of Hephzibah; Tim Miles with Graves Water Services Inc.; John Wellborn and Brian Foloey with Fort Gordon; Ian Kief with Prayton Corporation; Kelly Brown and Amanda McRoy with Olin Chlor Alkali Products; and Eric Yarborough with Proctor and Gamble Corporation.

General Hydrogeology

The Richmond County, Georgia, area, from the Fall Line south, is underlain by a southward thickening wedge of sand, clay, and minor limestone that range in age from Late Cretaceous through post-Eocene (correlation chart, right). The principal aquifer systems in descending order are the Floridan aquifer system, which is subdivided into the Upper Three Runs and Gordon aquifers (Falls and others, 1997); the Dublin aquifer system (Clarke and others, 1985), which is subdivided into the Millers Pond aquifer and the upper and lower Dublin aquifers; and the Midville aquifer system (Clarke and others, 1985), which is subdivided into the upper and lower Midville aquifers. The "upper" and "basal" Cretaceous aquifers defined by Gorday (1985) are equivalent to the upper and lower Midville aquifers, respectively. All of the principal aquifers and confining units are represented in the Kimberly Clarke observation well 30AA13, located in the lower right quadrant of this map. In this report, hydrogeologic units above the Dublin aquifer are not discussed because these do not form significant water-bearing units in Richmond County.

HYDROGEOLOGIC UNITS		GEOLOGIC UNITS		SERIES	SYSTEM
This study	Georgia	This study			
Upper Three Runs aquifer	Upper Floridan aquifer/ Jacksonian aquifer	Post-Eocene		Post-Eocene	Tertiary
Gordon confining unit	Gordon aquifer system	Barnwell unit		Eocene	
Gordon aquifer		Tinker/ Santee unit	Fourmile Branch/ Warley Hill unit		
Millers Pond c.u.		Snapp Formation		Paleocene	
Millers Pond aquifer					
Upper Dublin confining unit		Ellenton Formation			
Upper Dublin aquifer	Dublin aquifer system	Steel Creek Formation		Upper Cretaceous	Cretaceous
Lower Dublin confining unit		Black Creek Group (undivided)			
Lower Dublin aquifer					
Upper Midville confining unit	Midville aquifer system				
Upper Midville aquifer		Middendorf Formation			
Lower Midville confining unit					
Lower Midville aquifer		Cape Fear Formation			
Basal confining unit	Confining unit				

Modified from Falls and others, 1997; c.u., confining unit

Dublin Aquifer System

The Dublin aquifer system is composed largely of clayey sand, soft clay with brown sand layers, and in some places thin sand and gravel layers. The uppermost screens in many of the municipal wells are open to this aquifer system. Many of the shallow domestic and rural wells in southern Richmond County also tap the Dublin aquifer system. South of Tobacco Road near county well field #2 (see logs for well 30AA11), the Dublin aquifer system is composed of about 140 feet (ft) of sand and clay, but is not a large producing unit at this location. Further south near county well field #3 (see log for well 29AA30), the Dublin aquifer system is about 130 ft thick and is composed mostly of clay with some medium-to-coarse sand and clayey sand. A red clay layer (lower Dublin confining unit), separates the upper and lower Dublin aquifers. The Dublin aquifer system is thickest in the extreme southern part of Richmond County—at well 30AA13, the Dublin aquifer system is about 250 ft thick and is composed of pinkish-gray to gray sand, clayey sand, and sandy clay.

A hard red clay layer, defined as the upper Midville confining unit (Falls and others, 1997), separates the Dublin aquifer system from the Midville aquifer system. At the northern part of its extent, near county well field #1, the upper Midville confining unit is 27 ft thick; near county well field #2, it is 19 ft thick; and near county well field #3, it is 20 ft thick.

Midville Aquifer System

The Midville aquifer system is composed of an interlayered sequence of medium-to-coarse sand and gravel, clayey sand, sand with clay layers, and massive hard clay. This aquifer system is confined between a red clay layer (upper Midville confining unit) and the basal confining unit. The lowermost screens in the municipal wells are open to permeable sand and gravel layers in this aquifer system (see logs of various wells). In the updip section near county well field #1 (see logs for well 29BB95), the upper and lower Midville aquifers are composed of about 50 ft of loose, medium-to-coarse sand and gravel overlying clay or basement rock. South of Tobacco Road near county well field #2 (see logs for well 30AA11), the Midville aquifer system is composed of about 90 ft of sand with a few clay layers that separate the upper and lower aquifers. Further south near county well field #3 (see logs for 29AA30), the upper and lower Midville aquifers are about 170 ft thick and composed mostly of sand and gravel with some clay layers. The Midville aquifer system is thickest in the extreme southern part of Richmond County—at well 30AA13, the upper Midville aquifer is about 135 ft thick and the lower Midville aquifer is about 180 ft thick.

Potentiometric Surface of the Dublin and Midville Aquifer Systems, January 2007

The potentiometric surface of the Dublin and Midville aquifer systems—which represents the altitude at which water would have stood in tightly cased wells open to the aquifers—was constructed using water levels collected from 75 wells during January 2007. In the Richmond County area, wells commonly have multiple screens and many are open to both the Dublin and Midville aquifer systems, producing "multi-aquifer" wells. Water levels in these multi-aquifer wells are a composite of both aquifer systems. Because most of wells used in constructing the map are screened in the Midville aquifer system, the map is considered more representative of the Midville than the Dublin aquifer system.

The configuration of a potentiometric surface (see map) indicates general directions of ground-water flow. In general, ground water flows through the aquifer from areas of high ground-water level to areas of low ground-water level. At Fort Gordon, along the western side of Richmond County, ground-water altitudes were about 400 ft above NGVD 29, decreasing to about 200 ft in the center of the county and to about 100 ft in eastern Richmond County along the Savannah River. This configuration generally produces a west-to-east flow gradient across most of county, with some local variations around the major pumping centers and streams. Most notable features in the potentiometric surface are:

- At county well field #1, the hydraulic gradient is relatively steep in the northern portion of the well field and locally flattens around the individual pumping wells where the drawdown is greatest. Water-level altitudes range from about 128 to 170 ft above NGVD 29 and generally show a west-to-east gradient toward the Savannah River, which is the major discharge area for the aquifer systems.
- At county well field #2, the hydraulic gradient is somewhat steep on the western side of the well field and then flattens around the main centers of pumping where drawdown is greatest. Water-level altitudes range from about 131 ft above NGVD 29 with the lowest levels along the eastern side of the well field at altitudes near that of river stage.
- At county well field #3, the hydraulic gradient is relatively steep along the western side of the well field and then flattens around the pumping wells along Old Waynesboro Road. Water-level altitudes range from about 160 to 175 ft above NGVD 29 with the lowest levels in the central part of the well field.
- A trough north of the town of Hephzibah roughly coincides with a tributary of Spirit Creek and forms a broad low area in the potentiometric surface in that area. East of Hephzibah, ground water flows to the east toward county well field #3.

Long-term water-level records indicate decreases in ground-water levels in Richmond County (see hydrographs for wells 29AA09 and 30AA04). Water levels for well 30AA04, completed in the Gordon and Dublin aquifers near McBean Creek in southern Richmond County, were about 3 ft lower during January 2007 compared to the mid- to early 1990s and were about 8 ft lower compared to the early 1980s (Clarke and West, 1997). More recently, water levels in the wells increased between November 2006 and January 2007. The potentiometric-surface map for January 2007 depicts the period roughly midway between the seasonal high (normally late spring) and the seasonal low (normally late fall), shown on the hydrograph for well 30AA04. Long-term water-level trends are similar in the Gracewood observation well (29AA09). A new continuous monitoring site, installed during February 2007 in an unused observation well near county well field #2, is being used to evaluate water-level trends in response to pumping in this area (see well 30AA33 on map).

Summary

A network of about 100 water-level monitoring wells, including 2 existing and 1 new well equipped with continuous water-level recorders, monitors seasonal and long-term water-level fluctuations in the Cretaceous aquifer systems in Richmond County, Georgia. Data compiled during this study were used to better define the hydrogeologic units underlying the area and to update the potentiometric-surface map for the Dublin and Midville aquifer systems. During January 2007, water levels were measured in about 100 wells throughout the county, of which about 75 measurements were used to produce the updated map. Water-level altitudes decreased from about 400 ft above NGVD 29 along the western border of Richmond County at Fort Gordon to about 100 ft above NGVD 29 along the eastern border of the county and near the Savannah River. Ground-water flow generally is from west to east across the county, with some local variations in flow direction. Long-term water-level trends indicate slow decadal-scale decreases in water levels in the Dublin and Midville aquifer systems. The water level in one well was about 3 ft lower during January 2007 compared to the mid- to early 1990s and was about 8 ft lower compared to the early 1980s. Short-term water-level fluctuations, however, indicate an increase in water levels between November 2006 and January 2007. A continuous monitoring station was added near county well field #2 to further evaluate water-level trends in response to pumping.

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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., also available online at *http://pubs.er.usgs.gov/usgspubs/wri/wri974245*

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Gorday, L.L., 1985, The hydrogeology of the Coastal Plain strata of Richmond and northern Burke Counties, Georgia: Georgia Geologic Survey Information Circular 61, 43 p.

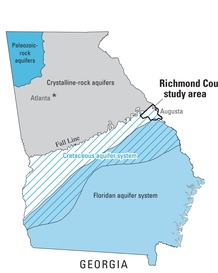
Datums

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to the North American Datum of 1983.

U.S. DEPARTMENT OF THE INTERIOR
DIRK KEMPTHORNE, Secretary

U.S. GEOLOGICAL SURVEY
Mark D. Myers, Director

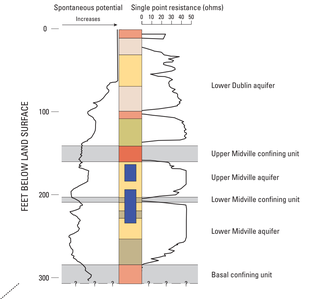


Richmond County—study area

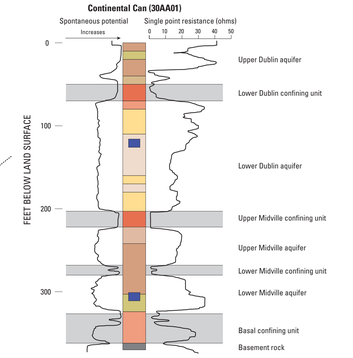
Base from U.S. Geological Survey 1:100,000-scale digital data

Near County Well Field #1 Proctor & Gamble (29BB95)

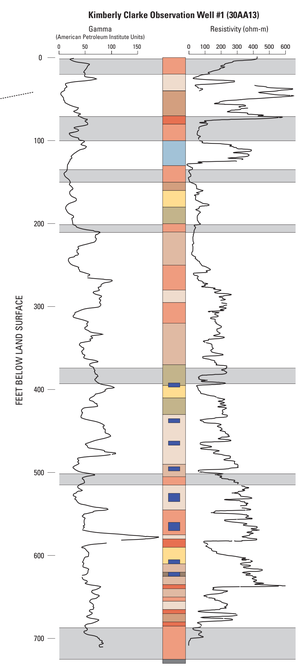
County Well Field #2 Well 106 (30AA11)



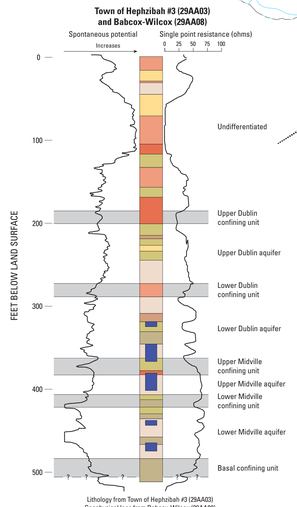
Continental Can (30AA01)



Kimberly Clarke Observation Well #1 (30AA13)

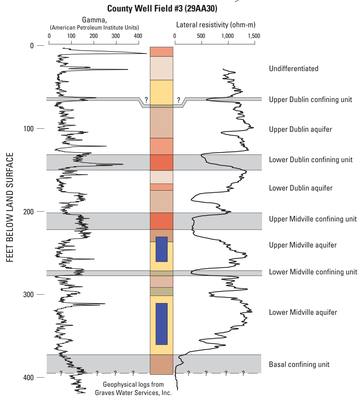


Town of Hephzibah #3 (29AA03) and Babcox-Wilcox (29AA08)



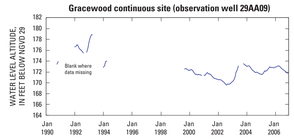
Lithology from Town of Hephzibah #3 (29AA03)
Geophysical logs from Babcox-Wilcox (29AA08)

County Well Field #3 (29AA30)

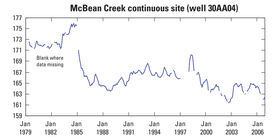


Geophysical logs from Graves Water Services, Inc.

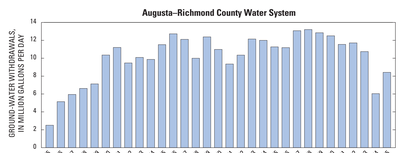
Gracewood continuous site (observation well 29AA09)



McBean Creek continuous site (well 30AA04)



Augusta–Richmond County Water System



EXPLANATION

MAP

Well field

410 — **Potentiometric contour**—Shows approximate altitude at which water level would have stood in tightly cased wells, January 2007. Dashed where inferred. Contour interval 10 feet. Datum is NGVD 29

30AA04 ◆ 163.1 **Well and identification number**—Number in smaller font size is water-level altitude. Datum is NGVD 29

COLUMN

Lithology—Taken from drillers' logs

- Massive clay
- Sand and/or gravel
- Clayey sand
- Sandy clay
- Sandy limestone
- Clay with sand layers
- Sand with clay layers
- Red clay
- Mostly clay
- Rock layers
- Basement rock

Screen

Hydrogeology and Potentiometric Surface of the Dublin and Midville Aquifer Systems in Richmond County, Georgia, January 2007

By
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2007