# Assessment of Ground-Water Flow near the Savannah River Site, Georgia and South Carolina

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#### Problem

The U.S. Department of Energy (DOE) Savannah River Site (SRS) has manufactured nuclear materials for national defense since the early 1950s. A variety of hazardous materials including radionuclides, volatile organic compounds, and trace metals—are either disposed of or stored at several locations at the SRS. As a result, contamination of ground water has been detected at several locations within the site and concern has been raised about the possible migration of water-borne contaminants offsite. Two issues have been raised: (1) is ground water flowing from the SRS and beneath the Savannah River into Georgia?; and (2) under what pumping scenarios could such ground-water movement occur? To address these concerns, the U.S. Geological Survey (USGS), in cooperation with the DOE, conducted a comprehensive study during 1991-97 that simulated ground-water flow and streamaquifer relations in the vicinity of the SRS. These groundwater simulations are limited by simplification of the conceptual model, which was based on available data through 1992. Large increases in ground-water pumping in Burke and Screven Counties, Georgia, since 1992 and a pronounced drought during 1998-2002 may have changed hydraulic gradients near the river and affected the potential for transriver flow. To provide a more accurate and up-to-date evaluation of transriver flow near the SRS, the earlier model is being updated to incorporate new data and simulate 2002 conditions. The revised model will be used to simulate a variety of water-management scenarios that could impact transriver flow in the SRS area.

### **Objectives**

- Update the previously developed ground-water flow model to better define present-day (2002) ground-water flowpaths near SRS.
- Utilize the 2002 calibrated model to identify ground-water flowpaths and quantitatively describe current ground-water flowpaths near SRS under a variety of hypothetical pumping scenarios.

## Progress and Significant Results, 2002-03

• Collected water-level measurements from 282 wells in Georgia and South Carolina during September 9–13, 2002, and constructed potentiometric-surface maps for four major aquifers. The potentiometric-surface maps were integrated into a Geographic Information System to determine the horizontal and vertical hydraulic gradients for the aquifers along with any interaction with streams and rivers. The water-level measurements were used to adjust boundary conditions and determine if any additional calibration is required to the model under 2002 hydrologic conditions.



- Updated ground-water use estimates within the eight-county study area to reflect the changes that have occurred since the previous study (Clarke and West, 1998). The major increase in ground-water use between 1995 and 2000 is evident for Burke, Jefferson, and Screven Counties, Ga.; and Allendale and Barnwell Counties, S.C. In these counties, ground-water use for irrigation increased from 16.7 million gallons per day (Mgal/d) during 1995 to 53.1 Mgal/d during 2000 and irrigated acreage increased from 61,690 acres during 1995 to 97,690 acres during 2000 (Fanning, 2003).
- Converted existing regional ground-water model to Graphical User Interface (GUI) environment to generate current model input for MODFLOW-2000 simulations. The new MODFLOW GUI incorporates the hydrogeologic framework (Falls and others, 1997) into the various model layers and is essential when performing three-dimensional particle-tracking analysis.
- Adjusted specified heads in the source-sink layer (A1) of the model to conform with the 2002 potentiometric-surface map of the Upper Three Runs aquifer, and lowered the specified heads along the lateral boundaries of the model in layers A2–A7 based on observation points in each aquifer. The specified heads in the source-sink layer were lowered to reflect the decline in water levels that resulted from the drought that occurred from 1998 to 2002.
- Evaluated ground-water model under steady-state conditions for 2002 to determine if additional calibration is necessary. The model simulations conducted using updated pumping estimates, observed aquifer heads, and recharge rates from the source-sink layer (A1), indicated that no additional calibration was required.

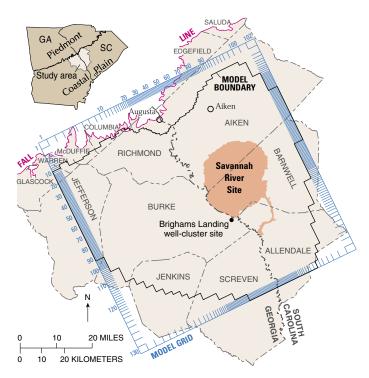
### References Cited

Clarke, J.S., and West, C.T., 1998, Simulation of ground-water flow and stream-aquifer relations in the vicinity of the Savannah River Site, Georgia and South Carolina: U.S. Geological Survey Water-Resources Investigations Report 98-4062, 134 p.

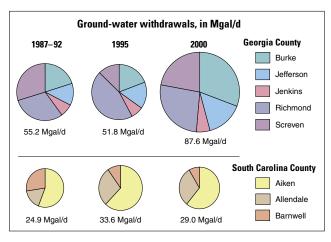
Falls, W.F., Baum, J.S., Harrelson, L.G., Brown, L.H., and Jerden, J.L., 1997, Geology and hydrogeology of Cretaceous and Tertiary strata, and confinement in the vicinity of the U.S. Department of Energy Savannah River Site, South Carolina and Georgia: U.S. Geological Survey Water-Resources Investigations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

Fanning, J.L., 1997, Water use in Georgia by county for 1995: Georgia Geologic Survey Information Circular 101, 95 p.

Fanning, J.L., 2003, Water use in Georgia by county for 2000 and water use trends for 1980–2000: Georgia Geologic Survey Information Circular 106, 176 p.



The 5,147-square-mile study area is in the Coastal Plain physiographic province, and is the same area investigated during the earlier 1991–97 study, including the SRS and adjacent parts of Georgia and South Carolina. Coastal Plain sediments consist of layers of silt, clay, sand, and minor amounts of limestone ranging in age from Cretaceous to Tertiary. Sediments dip to the southeast away from the Fall Line and reach a maximum thickness of about 2,700 feet near the southern boundary of the study area.



Data on ground-water use in the eight-county study area show a substantial increase since the earlier USGS study. Clarke and West (1998) reported that during 1987–92 total ground-water use was about 80 Mgal/d. By 1995, the total ground-water use was about 85.4 Mgal/d (Fanning, 1997). Available data for 2000 (Fanning, 2003; W.J. Stringfield, U.S. Geological Survey, written commun., 2002) show that total ground-water use was about 117 Mgal/d.

The major increase in ground-water use between 1995 and 2000 is evident for Burke, Jefferson, and Screven Counties, Ga. In these counties, ground-water use for irrigation increased from 12.6 Mgal/d during 1995 to 43.8 Mgal/d during 2000, and irrigated acreage increased from 53,520 acres during 1995 to 76,380 acres during 2000 (Fanning, 2003). In the Georgia part of the study area, the majority of ground water used for irrigation is withdrawn from the Upper Three Runs aquifer in Jenkins and southern Screven Counties, and from the Upper Three Runs and Gordon

