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 waterborne contaminants off-site. 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 stream-aquifer relations near the SRS. 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 trans-river flow. To provide a more accurate and up-to-date evaluation of trans-river flow near the SRS, the earlier model was updated to incorporate new data and simulate 2002 conditions.

Objectives

- Update the previously developed ground-water-flow model to better define present-day (2002) ground-water flowpaths near SRS.
- Use 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, 2004–2005

- The previous model (Clarke and West, 1998) was updated to simulate ground-water flow under 2002 hydrologic conditions and for four hypothetical pumping scenarios based on ground-water-use trends from 1980 to 2000 (Fanning, 2003).
- Four steady-state pumping scenarios were developed to simulate a range of pumping and climatic conditions affecting potential contaminant migration from the SRS:
  - 2002 observed pumping and boundary conditions for an average year.
  - 2002 observed pumping and boundary conditions for an average year with SRS pumping discontinued.
- The USGS particle-tracking code MODPATH (Pollock, 1994) was used to generate advective water-particle path lines and time-of-travel based on MODFLOW simulations of the four scenarios. Results of model simulations and particle tracking were summarized in USGS Scientific Investigations Report 2006-5195 (Cherry, 2006). Major findings include:
  - Simulated ground-water flowpaths for each of the four pumping scenarios indicate that time-of-travel from recharge areas originating near central SRS (D and K Areas) westward into Georgia range from 110 years to 800 years (facing page).
  - Particle-tracking analysis indicates travel times and flowpaths are similar for the various pumping scenarios; however, the shutdown of the SRS production wells allows fewer particles to penetrate into deeper units (layers A3–A5), and median travel times are decreased by about 90 years.

References Cited


(A) Map and (B) cross section showing simulated ground-water flowpaths near the Savannah River Site (SRS) for scenario B, representing average climatic conditions and the elimination of pumping at the SRS. Longer flowpaths originate in upland areas where head in the uppermost unit provides a driving force to allow flow to greater depths of penetration through aquifers and intervening confining units (see 810-year flowpath). Shorter flowpaths originate in lowland areas where head in the uppermost unit is low and there is less driving force for penetration into deeper units (see 110-year flowpath). Modified from Cherry (2006). (NAVD 88, North American Vertical Datum of 1988)