FINDING GROUNDWATER FOR THE ROANOKE VALLEY, VIRGINIA

Bill Henika, Virginia Department of Mines, Minerals and Energy
Brent B. Waters, Golder Associates
Ted Dean and Bill Seaton, ATS International

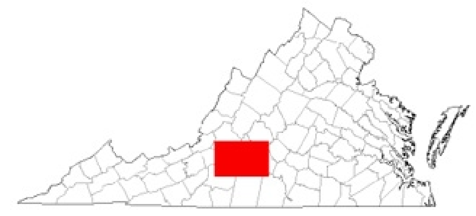

Figure 1: Research site location

Introduction: Over the last few years dropping water levels in local reservoirs have threatened economic growth in the Roanoke Valley. A deep monitoring well at the Virginia Tech Hydrogeology Research Site southwest of Roanoke (Figures 1 and 2) showed a declining trend in static water levels beginning in 1997.

City and County resource managers were able to work through the severe drought in 2000-2002 to deliver several million additional gallons per day to area treatment plants. This was accomplished by drilling a series of new science-based, high-yield wells each of which was capable of producing from 250 gallons per minute (gpm) to over 1000 gpm. Most wells previously located in this area (80 percent) produce less than 50 gpm. Only 4 percent of the wells in the EPA data base for Roanoke County produced greater than 250 gpm. This is because the rocks in the Roanoke Valley and Blue Ridge region have very little original permeability and porosity preserved. This is the result of extensive recrystallization during the continental plate collision event known as the Alleghanian Orogeny that occurred some 300 million years ago.

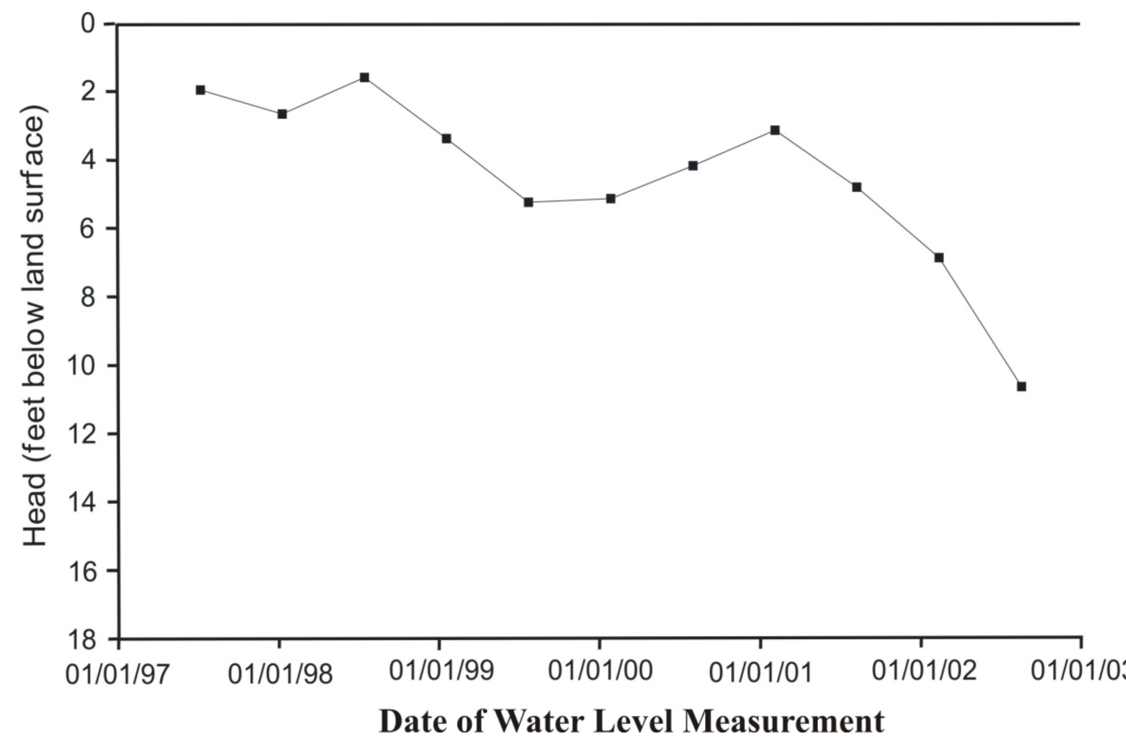

Figure 2: Static water level measurements in a deep observation well at the Virginia Tech Hydrogeology Research site in the Blue Ridge above Roanoke, Virginia.

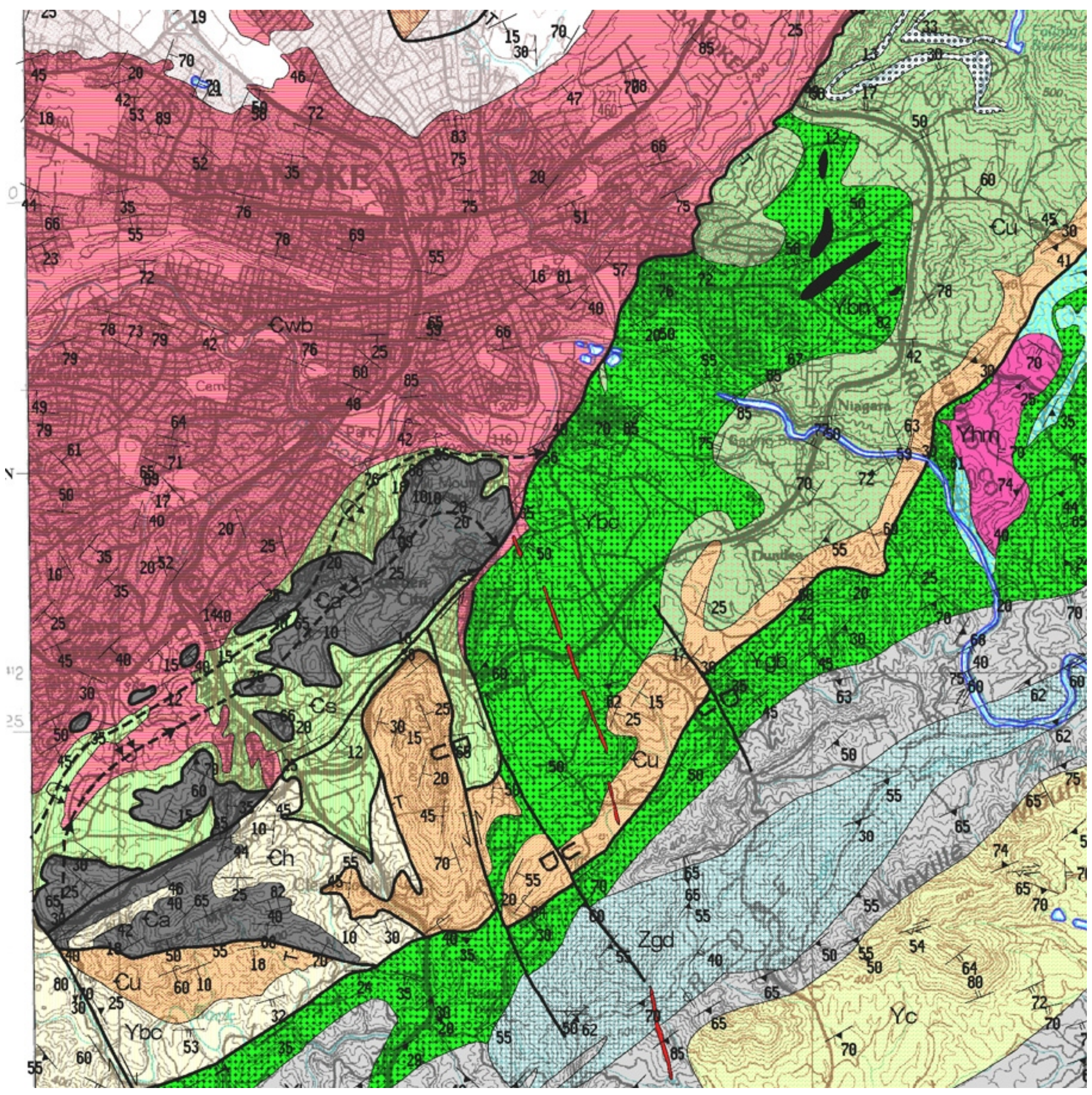

Figure 3: Geologic map of area.

The new high-yield wells were located because of major breakthroughs in the understanding of the rock structure, underground reservoir characterization, and the natural groundwater distribution systems in the Roanoke Region. This advance in the understanding of natural resource distribution was the direct result of new geologic mapping and digital compilation funded through a cooperative program between the Virginia Department of Mines, Minerals and Energy and the U.S. Geological Survey.

The Geologic Map: The new *State Map Program* geologic maps (Figure 3) show that Roanoke was developed within a large structural basin along the southeastern boundary of the Valley and Ridge Province. The Roanoke Valley is inset along a major fault-bound reentrant in the Paleozoic Blue Ridge thrust sheet. Water gaps that allowed the major streams to excavate the Valley and Ridge topography developed along transverse faults, ramps, and extensional fractures that were locally intruded by Mesozoic igneous dikes associated with the rifting of the Atlantic Ocean Basin that began about 200 million years ago. Mesozoic igneous rocks had not previouslybeen recognized to cross the Blue Ridge and to intrude the rocks in the Roanoke Valley. The dikes, that are easily traced because of their distinctive black basaltic boulders, red residual soils, and highly magnetic composition were a key in understanding the geometry of the transverse major fracture systems (i. e. the Crystal Spring and Niagara Fracture systems delineated in Figure 3).

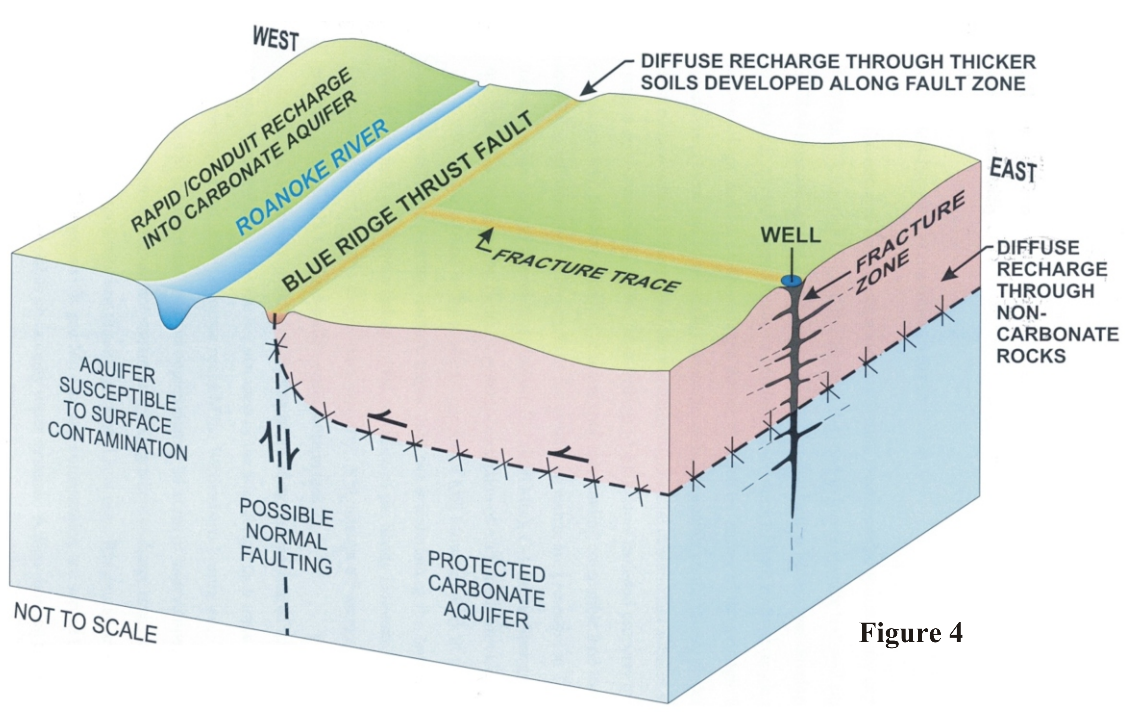

Figure 4

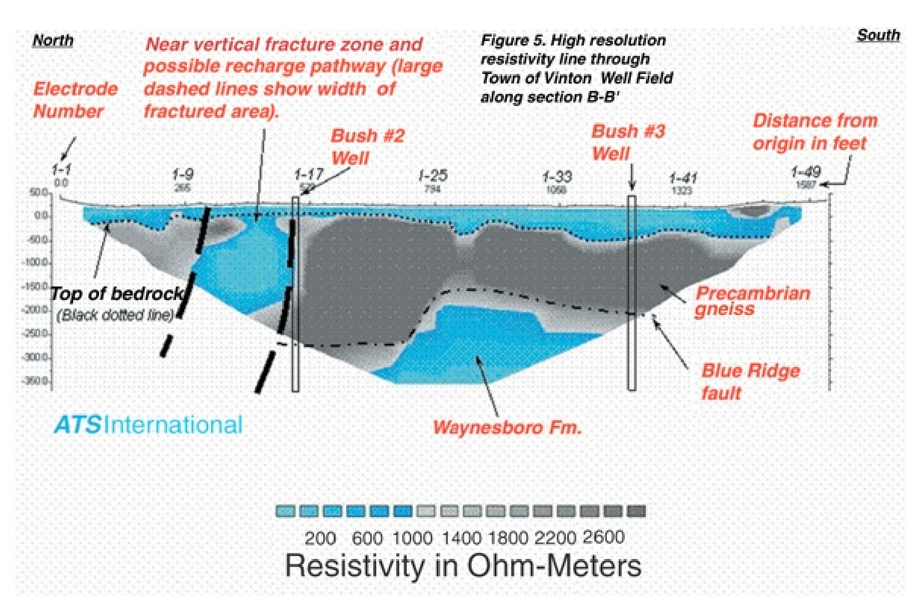

Figure 5

Using the Map: The 27 t h Virginia Field Conference, led by Henika in 1997 to provide a public review of the newly published Roanoke *State Map* geology, had severalstops focused on the detailed subsurface structure and history of the natural fracture system behind Roanoke's Crystal Spring, which has been the historic water supply for downtown Roanoke for more than 100 years. This spring flows northeastwards from a natural limestone cavern in the Shady Formation beneath the Blue Ridge thrust sheet on Mill Mountain. During the conference it was emphasized that similar natural systems might deliver millions of gallons of clean water from the Blue Ridge Mountains to the Roanoke Valley every day.

Conclusion: Publication of the new geologic mapping created a synergy in the geologic community that stimulated science partnerships between Geologic Surveys, Virginia Tech researchers, and Local Government ground water contractors that helped “Big Lick” (Roanoke) beat the drought of the century. Henika has been working closely with Virginia Tech's new Hydrogeology Program and several consulting firms during the drought emergency to provide maps, fracture trace studies and on-site drilling assistance. Figures 4 and 5 are structural models that profile several high yield wells that are shown on Figure 3. These models, developed more or less concurrently by two different companies using the new geologic maps, will provide a guide to the newly consolidated City and County water departments for resource development well into the twenty-first century.