Simulating Interbasin Transfer in Abandoned Coal Mines

M.D. Kozar, USGS Washington Water Science Center, Tacoma WA
K.J. McCoy, USGS Virginia Water Science Center, Richmond VA

Abstract: Simulation of groundwater flow in abandoned mines can be difficult, especially where flux to and from mines is unknown or poorly quantified, and interbasin transfer of groundwater occurs. A 3-year study was conducted in McDowell County, West Virginia to define the mined area contributing to groundwater outflow from above-grade abandoned coal mines. The study area was specifically selected, as all the mines are located above the elevation of tributary streams, which allowed accurate measurements of discharge from mine portals and tributaries to provide data for groundwater model calibration.

Abandoned mine workings were initially simulated as a layer of high hydraulic conductivity bounded by lower permeability bedrock in adjacent strata. A second approach used rows of higher hydraulic conductivity mine tunnels embedded within a lower hydraulic conductivity unmined coal matrix. Regardless of the hydraulic conductivity assigned to mine workings, neither indirect approach to simulate mine workings could accurately simulate interbasin transfer of groundwater from adjacent watersheds.

To resolve the problem, a third approach was developed. The MODFLOW DRAIN package was used to simulate seepage to mine workings and tunnels discharging water to Elkhorn Creek, North Fork, and tributaries of the Bluestone River. Drain nodes were embedded in a matrix of uniform hydraulic conductivity cells that represented unmined coal aquifer. Drain heads were empirically defined from well observations and elevations were based on structure contours for the Pocahontas No. 3 mine workings. Use of the DRAIN package to simulate workings as an internal boundary condition resolved the interbasin transfer problem. Model simulations prior to use of the DRAIN package for simulating mine workings produced estimated flows of 0.31 m^3/s in each of the similar sized Elkhorn Creek and North Fork Watersheds, but failed to estimate interbasin transfer of groundwater from the adjacent Bluestone River Watershed. The simulation of mine entries and discharge using the DRAIN package produced estimated flows of 0.46 and 0.27 m^3/s for the Elkhorn Creek and North Fork watersheds, which matched well with measured flows for the respective watersheds of 0.47 and 0.26 m^3/s.