

Serious Problems with Ground Water Monitoring Wells: The Confounding Effect of Vertical Ambient Flows

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Abstract: Commonly, there is a downward component of ground water flow in recharge areas and an upward component in discharge areas. This flow is due to head differences in the vertical direction within a given aquifer. When an observation well is drilled in such an aquifer, the well serves as a "short circuit" between the vertical head differences. This sets up a small but continuous vertical flow in the wellbore, that one may call ambient, or natural-gradient-induced, flow [Elçi et al., 2001, Ground Water 39(6)]. Data collected mainly during the past decade have shown that detectable ambient flows occur in about 70% of long-screened monitoring wells. An early study by Reilly, Franke and Bennett [ASCE J. Hyd. Eng. 115, 1989] warned that such flows might pose a problem by biasing the results of chemical measurements in some way. Using numerical simulations of the detailed flow and transport process in the near vicinity of an observation well at the Savannah River Site, the authors show that such flows could make a reasonable assessment of chemical measurements an impossible, and potentially misleading, task. Simulations demonstrate the dislocation and dilution of a contaminant plume, and how contaminants may by-pass the observation well under certain ambient flow conditions. Because the effect of ambient flow can be reduced significantly by using short-screened monitoring wells, the sensitivity of ambient flow magnitude to well screen length is studied also.