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Direct Measurement of Ground Water Contaminant Discharge to Surface Water

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Biographical Sketches of Authors

James Lundy is a hydrogeologist at the Minnesota Pollution Control Agency in St. Paul, Minnesota. He has performed ground water studies at leaking underground storage tank sites and superfund sites, and contributed to remediation policy development efforts. He currently works on issues related to ground water contaminant discharge to surface waters.

Mark Ferrey is an environmental scientist at the Minnesota Pollution Control Agency. Before working at the MPCA, he researched the attenuation and biological degradation of the herbicide alachlor in soil. He is currently studying the role of abiotic natural attenuation in the remediation of solvents in ground water at Superfund sites.

Abstract

Defining zones of strongly discharging ground water is one way to characterize threats posed to surface water quality by contaminated ground water in both point source and non-point source settings. The three techniques most useful techniques for mapping areas of upward-discharging ground water and downward-discharging surface water are: temperature contrast, vertical gradient, and seepage flux. Pore water samples collected in zones of strong upward discharge show whether ground water contaminants affect surface water quality. Estimates of contaminant loading to surface water via the ground water pathway are made by combining pore water quality data with seepage flux rates.

At one site, the actual locations of contaminant discharge to surface water were not consistent with the conceptual model developed from up-gradient monitoring well data. Differences in streambed hydraulic conductivity are one factor in the departure. Hydrogeologic heterogeneity along or between flow paths, variations in recharge or natural attenuation capacity along flow paths, and other factors may play a role as well.

Although reductive dehalogenation of chlorinated ethenes does occur in the upgradient ground water, natural biodegradation processes do not appear to be enhanced in the hyporheic zone as ground water enters the surface water environment. This is consistent with the iron-reducing ground water geochemistry that predominates in the last 100 cm of ground water flow. Phospholipid and fatty acid analyses revealed variation in microbial community structure with depth, but this did not correlate to apparent attenuation of contaminants.