

A Systems Approach for the Understanding of Agricultural Contaminant Sources and Transport within a Karst Groundwater Drainage Basin

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Abstract

The sources and transport of pesticides, nitrates, and bacterial contaminants in an Iowa karst groundwater basin will be determined using isotopic analysis, antibiotic resistance analysis, and general water quality testing, coupled with a detailed evaluation of the extent and land use of the recharge area and surface and groundwater movement in the basin. The basin under study is a shallow karst aquifer in an agricultural area of northeastern Iowa and southern Minnesota. Previous analyses of water quality results have shown that both surface streams and groundwater within the basin contain anomalously high concentrations of nitrates, waste-related bacteria, and pesticides. The high nitrates imply that sources other than soil organic matter have contributed nitrates to the shallow karst aquifer. High fecal coliform levels suggest an influx of waste products from humans and/or livestock and/or wildlife. Pesticide levels in the study area fluctuate seasonally and are a reflection of seasonal application on row crops. Water quality testing conducted during normal and high-flow conditions indicates that contaminant movement through the basin is rapid and temporary degradation of water quality is significant after storm events. In order to address these problems of contamination of karst aquifers, a systems approach is required in which the function of the aquifer and its relationship to the recharge area, and the sources of contamination, are considered separately and as integrated parts of a karst groundwater study. The development of effective management practices to preserve water quality, and remediation plans for areas that are already polluted, requires identification of the actual sources of contaminants and understanding of the processes affecting local contaminant concentrations. In particular, a better understanding of hydrologic flow paths and solute sources is required to determine the impact of contaminants on karst groundwater basins.