CSREES National Water Quality Program

Title: Site Factors Affecting Riparian Groundwater Nitrate Removal

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Theme: Watershed Management

Situation: This NRI research project focuses on the role of riparian zones as removal zones for watershed nitrate. Riparian areas can serve as a significant nitrate sink through the microbial process of denitrification. However, there is enormous variability in physical and chemical conditions, as well as in groundwater flow paths through riparian areas. This potentially significant sink for nitrate is a poorly characterized, hindering modeling and management of catchment nitrogen sources.

Objectives: We hypothesized that groundwater denitrification in riparian areas would vary with geomorphic setting, following the expected distribution of carbon in the subsurface. We suspected that riparian zones in glacial outwash would have limited potential for groundwater nitrate removal due to an abrupt decline of C with depth. In contrast, we assumed that buried carbon-rich layers in alluvial settings would induce nitrate removal throughout the riparian aquifer.

Methods: We studied riparian groundwater denitrification and flow paths to a depth of 3 meters in hydric soils at both glacial outwash and alluvial settings. We quantified denitrification by tracking the fate of 15N-enriched nitrate and subsequent analysis of 15N enriched denitrification gases.

Partnerships: This work is done in conjunction with the Institute of Ecosystems Studies.

Research: Our work has been the focus for three graduate students (2 Ph.D and one M.S.). We have begun to incorporate the results into GIS analyses directed at watershed assessment for local communities.

Resources: This work has spawned a number of related research projects with funding from NSF, SeaGrant and Hatch.

Results: We rejected our hypothesis, finding no significant differences when sites were grouped by setting. Substantial denitrification rates were observed throughout the riparian aquifer at all depths. However, we did find significant correlation of groundwater denitrification rates and subsurface carbon deposits with distance from the stream -- suggesting that fluvial processes that enhance nitrate transformations routinely influence the subsurface groundwater environment near the stream.