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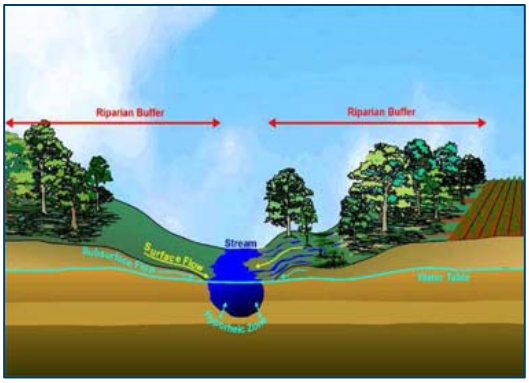
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION RESEARCH

Effectiveness of Riparian Buffers for Managing Nitrogen

Background

Bioreactive nitrogen (nitrite and nitrate) is a non-point source pollutant that impacts ecosystem function and threatens human health. Riparian zones, the vegetated region adjacent to streams and wetlands, are effective at intercepting and controlling nitrogen and sediments entering water bodies. EPA investigated the biogeochemical, hydrological, and biological factors that govern the structure and function of riparian zone ecosystems. Improved understanding of riparian ecosystems is necessary to identify effective restoration approaches that best sustain ecosystem services, such as nutrient processing and sediment capture.

Objectives



- Quantify biotic and abiotic mechanisms control nitrogen removal in riparian soils and stream bed sediments
- Identify optimal widths of riparian buffers for nitrogen and sediment control
- Assess biotic responses to riparian restoration and identify the best ecological indicators to assess ecosystem recovery

Approach

EPA evaluated the importance of riparian buffer width on nitrogen control and surveyed the effectiveness of current state and federal regulations. EPA surveyed the scientific literature containing data on riparian buffers and nitrogen concentration in streams and ground water to identify trends between nitrogen removal effectiveness and buffer width, hydrological flow path, and vegetative cover.

Major Findings

The research shows that riparian buffers can significantly reduce nitrogen loads entering streams and, thus, represent important nutrient best management practices (BMPs) for land managers. Though riparian buffer efficiency varied widely among individual studies, EPA meta-analysis found important trends. While some narrow buffers (up to 25 meters) proved effective, buffers wider than 50 meters more consistently removed significant amounts of nitrogen. Buffers of various vegetation types were equally at removing nitrogen, but buffers with grassy vegetation were more effective when wider. Another strong trend in the data showed that subsurface removal of nitrogen was far more efficient than removal at or near the soil surface. Other important patterns observed among the studies reviewed indicated that nitrogen control peaks when:

- Buffers extend along both stream banks, allowing greater opportunity for plant uptake
- Buffers are maintained at stream headwaters

- Water flow (overland and subsurface) is evenly distributed and soil infiltration rates are high
- Anaerobic conditions persist in the subsurface
- Sufficient organic carbon is present

Publications

Mayer, P.M., S.K. Reynolds, M.D. McCutchen, and T.J. Canfield. (2007). "Meta-Analysis of Nitrogen Removal in Riparian Buffers." *Journal of Environmental Quality*, 36: 1172–1180.

Research Shows Importance of Riparian Buffers for Aquatic Health – Science in Action (PDF) (1 pp, 178 KB) (EPA/600/F-07/004) June 2007

Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations (PDF) (40 pp, 1.15 MB) (EPA/600/R-05/118) October 2005

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