"Effects of Ecosystem Restoration on Water Quality in an Urban Stream: Minebank Run Stream Restoration Project as a Case Study"

Before:

After:

Investigators: Paul Mayer and Elise Striz, USEPA/ORD/NRMRL, Ada, OK 74820. (mayer.paul@epa.gov, phone: 580-436-8647; striz.elise@epa.gov, phone: 580-436-8594)

Collaborators: US Geological Survey, Institute of Ecosystem Studies, Baltimore County of Environmental Protection and Resource Management, University of Maryland

Background: Bioreactive nitrogen (nitrite and nitrate) is a pollutant that threatens ecosystem and human health. Restoring ecological condition of streams may be a cost-effective, sustainable means to reduce nitrogen pollution in watersheds. Minebank Run, an urban stream in Towson, MD, Baltimore Co., will be restored in 2004 to improve geomorphic stability. Restoration will include reshaping stream banks to reconnect stream channel to flood plain, stream bank reinforcement, reconstructing stream meander features and riffle zones, and re-establishing riparian plant communities.

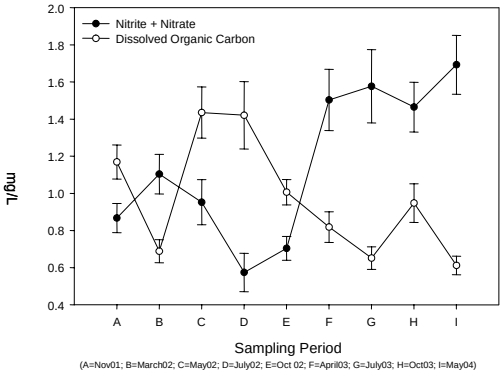
Objectives: 1) Assess ecosystem benefits of restoration, 2) Identify stream restoration methods that enhance nitrogen control, 3) Develop predictive models of stream hydrology and sediment movement, 4) Develop ecologically-based guidelines for stream restoration

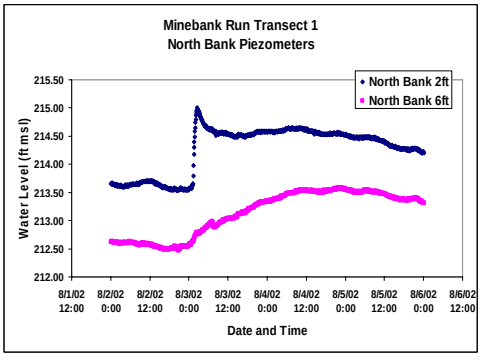
Approach: Examine an urban stream before and after restoration to measure and identify limits to microbial denitrification, a natural process occurring in soils and groundwater that removes significant amounts of bioreactive nitrogen by transformation to a biologically inactive gas form. Stream restoration may enhance the conditions necessary for denitrification by reestablishing flood plain hydrology and/or increasing carbon availability to microbes. Identifying stream features and restoration techniques where high denitrification activity occurs may provide important water quality management tools and help direct future restoration efforts.

Major Findings as of 5 Nov 2004: Geomorphic stability of the stream appears to be greatly improved after restoration; far less sediment is being transported and lateral migration of the stream has halted. Denitrification is occurring in the stream channel and groundwater (i.e. hyporheic zone). Removal of bioreactive nitrogen appears to be limited by the supply of carbon necessary for microbial activity (bottom left). Hydrology of the stream and groundwater are closely linked, allowing carbon to reach the groundwater (bottom center). Bioreactive nitrogen is lower in the restored stream reach than in the degraded reach (bottom right) likely due to enhanced carbon supply and reconnection of the stream and floodplain after restoration. **Restoration appears to be a potentially sustainable means of improving water quality by reducing bioreactive nitrogen concentration in the surface water and groundwater of urban streams.**

Near future tasks: Continued post-restoration assessment. Develop stable isotope approach for identifying carbon and nitrogen origin. Construct mass balance model of nitrogen removal by stream feature and length. Synthesize findings of the research team. Convey results to clients and to the scientific community.

Bioreactive N and DOC in the hyporheic zone over time





Bioreactive Nitrogen in Unrestored and Restored Stream Reaches