Report for 2001NY1142B: An investigation into the mechanisms controlling storm water quality improvement by a large, stream-outflow wetland draining into Irondequoit Bay, Lake Ontario, New York

- Other Publications:
  - Plan to have a publication in September after a full year of data has been collected.

Report Follows:

Problem and Research Objectives:

Wetlands are now acknowledged, and utilized, as a natural, powerful mechanism for reducing NPS because of their ability to filter out sediments, trace metals, and nutrients from storm water runoff before these contaminants can enter streams and lakes. New York is unusual in having five or more large, 100+ acre, wetlands strategically located along the mouths of rivers and lakes and cumulatively draining more than one thousand square kilometers of watersheds of the Finger Lakes and Lake Ontario. Relatively little is actually known about how any large wetlands, greater than 30 ha, interact with stream surface waters to reduce contaminants. It is uncertain whether sedimentation, groundwater dilution, wetland transformation, or some other process is responsible for the improvements in water quality. Do these processes change seasonally, among years, or as regional hydrologic conditions become more extreme? Can their wetland functions be impaired with chronic or pulse loading of contaminants?

Our previous efforts looked at seasonal patterns in wetland-stream interactions by monitoring a network of two stream gauges and seven stations, each consisting of a water table well, three nested piezometers, and floating boardwalks, all established in June, 1999. This work suggests that the stream-wetland interactions are not constant through time. The proposed work will concentrate on a shorter time scale, to examine how daily factors identified in the first study, including precipitation events, cattail plant evapo-transpiration, and over-bank flood events, are affecting wetland filtering processes. The broader goal is to investigate these short-term processes and then place them in the context of the documented seasonal and interannual patterns for an overall understanding of how the Irondequoit Creek wetland functions in surface water quality improvement.

Methodology:

Intensive sampling will be made of the water table fluctuations and porewater redox conditions at hourly intervals in association with the daily pattern of evapotranspiration from the cattail stands. The evapotranspiration monitoring will be done at biweekly intervals throughout the growing season and into early fall to capture changes associated with growth and senescence of the cattails. At each sampling time, measurements will be made hourly, from pre-dawn through early nightfall to capture the diurnal cycle. Water table levels will be monitored within the existing wells and piezometers. Evapotranspiration rates will be monitored using a Li-Cor photosynthesis meter. Plant biomass and heights over the course of the study will be monitored in replicate quadrats associated with each station.

All water samples collected from the surface water, wells and porewater samplers will be analyzed for pH and conductivity in the field. Samples will be collected, filtered, and stored on ice for later analysis of total dissolved nitrogen and phosphorus, nitrate and nitrite, orthophosphate, selected cations and trace metals.

Principal Finding and Significance:

Large natural wetlands are increasingly being relied upon to improve the quality and quantity of stormwater runoff coming from upstream developments. We have been investigating the mechanisms by which a 200 acre cattail marsh is removing contaminants from Irondequoit Creek after it drains 300 sq. miles of the watershed of Rochester, New York and before it discharges into Lake Ontario. Specifically, we are examining how surface waters and groundwaters change their interactions with changes in stream inflows, precipitation, and levels of Lake Ontario. From

1999 and 2000, we determined the groundwater flow paths and hydrologic interactions in the wetland by installing and monitoring a set of seven stations, including surface water gages, water table wells and nested piezometers. This initial work indicated that there are four distinctly different phases in the wetland that differ in the direction and magnitude of surface water and groundwater interactions. These phases range from drought conditions when the stream waters move horizontally into the wetland as plant evapotranspiration draws down the wetland water table, to wet periods, when the groundwater flow reverses direction and discharges into the stream.

Over the past 12 months, we have begun to investigate how associated contaminant filtering, and specifically the wetland's removal of phosphorus, differs among these four phases. This work is being conducted at two complementary spatial scales; including microscale processes controlling phosphorus flow within the plant root zone and larger scale sequestration of phosphorus among the different parts of the wetland. Last summer, we developed and piloted an insitu lysimeter that allows us to quantify transpiration (ET) rates from whole, intact cattail plants within the marsh. These lysimeters were monitored in late summer 2001 and will continue to be monitored through the remainder of this year's growing season. In association with the lysimeter measurements, we are monitoring how the flux of groundwater due to ET is influencing soil redox chemistry and the mass flow of phosphorus to the plants. At the larger spatial scale of the entire 10 ha study site, an M.S. graduate student is developing a phosphorus budget for the wetland by monitoring groundwater chemistry and periodic sampling of the aboveground and belowground biomass, litter, and sediment phosphorus pools under the four different hydrologic phases. Later this year, we plan to link the findings from the two scales to understand how wetland phosphorus removal occurs and changes through time.