

Effects of Development on Nutrient Loading: Septic System Influence Status Report: March 1 2009 through February 28 2010

Statement of Regional or State Water Problem-

The waters of New Hampshire represent a valuable water resource contributing to the state's economic base through recreation, tourism, and real estate revenues. Some lakes and rivers serve as current or potential water supplies. For most residents (as indicated by boating and fishing registrations, shoreline re-development) our waters help to insure a high quality of life. As documented in the 2000 Census, New Hampshire currently leads all of the New England states in the rate of new development and redevelopment. The long-term consequences of the resulting pressure and demands on the state's precious water resources remain unknown. Of particular concern is the response of our waters to increasing non-point source pollutant loadings due to watershed development and land use activities.

Of all the in-depth watershed nutrient budget measurements and modeling efforts that have been attempted in NH none have included an in depth analysis of septic system influences from newly built and legacy septic systems. The current project expanded on an existing study of septic system hydrology to evaluate the use of emerging contaminant markers such as caffeine and triclosan to assess septic influence on water quality. In addition project work continued to support our long-term monitoring program conducted through differing weather years at both shallow and deep lake sites that offer the potential to cost effectively estimate the lake response to the loadings due to development over time.

Objectives:

- 1- To initiate analysis of water samples collected at septic tanks, test wells and near shore for a range of septic systems of various ages in a range of suitable and unsuitable soils/slopes.
- 2- The continued collection and analysis of long-term water quality data in selected watersheds.
- 3- The dissemination of the results of the analysis to cooperating agencies, water managers, educators and the public on a local, statewide and regional basis.
- 4- To offer undergraduate and graduate students the opportunity to gain hands-on experience in water quality sampling, laboratory analysis, data management and interpretation.
- 5- To further document the changing water quality in a variety of watersheds throughout the state in the face of land use changes and best management efforts.
- 6- To determine next steps for further analysis of long-term data sets and GIS spatial data on land cover.
- 7- To assist state agencies and communities in setting Total Phosphorous concentration targets as part of their lake watershed management plans.

Methods:

The septic study was primarily based at the Squam Lakes where we have already conducted an extensive water and nutrient budget study and have compiled a complete GIS analysis system that includes septic system locations and specifications. The Squam

Lakes (Squam and Little Squam Lake) benefit from the absence of point sources of pollution like wastewater treatment facilities, industrial facilities or large agricultural operations in close proximity to the shore; however, the role of non-point sources of pollution continues to be an issue. In 2001, Schloss et al. conducted a preliminary survey of septic systems around the Squam Lakes. They found that certain basins were at elevated risk of pollution by septic systems where age of system/design, soil characteristics and slopes were unfavorable to septic waste treatment. This study collected environmental samples from five of the basins found to be at high risk for pollution, one basin at moderate risk, and one basin found to be at low risk of pollution by shore side property septic systems (Figure 1). Shallow water samples were collected using a Van Dorn sampler at 0.5 meters or less. Samples were analyzed for Total Phosphorous in the UNH Center for Freshwater Biology Analytical Laboratory. The emerging contaminants caffeine and triclosan were analyzed through ELISA procedures using very high sensitivity test kits from Abraxis Analytical. Samples from some of these same sites as well as additional river sites bracketing sewage treatment facilities were also analyzed for specific anions/cations, boron, boron isotopes, and, using a modified HPLC/MS procedure: acetaminophen (a common analgesic), caffeine, carbamazepine (an antiepileptic, mood stabilizer) and trimethoprim (an antibiotic) as part of a companion study funded through the NH WRRC and will be reported upon elsewhere.

Emphasis on Lakes Lay Monitoring Program efforts was on expanding shallow water monitoring sampling to try to detect septic leachate influences. Lake and stream monitoring through the LLMP generally involved a minimum of monthly sampling starting at spring runoff through to lake stratification and weekly to bi-weekly sampling through to fall mixis. Water clarity, chlorophyll a, acid neutralizing capacity, dissolved organic color, dissolved oxygen and nutrients (total N, total P and nitrate) were the default suite of parameters measured for lakes while nutrients, turbidity, dissolved organic color and flow were the parameters of choice for the lake tributary work. On occasion, student field teams traveled to join the volunteer monitors to perform quality assurance checks and do more in-depth analysis and lake profiling.

Major Findings and Significance:

As of February 28, 2010 samples were still being processed and analyzed. In addition we will be doing additional sampling this summer to confirm positive results and expand our sampling base. We expect to have the full project completed before February 2011. Preliminary results received March 2010 indicate significant differences between control and targeted samples.

Publications, Presentations, Awards:

Reports:

Craycraft, R. and J.A.Schloss 2009. New Hampshire Lakes Lay Monitoring Program Yearly Report 2008. 28 individual lake reports 18 to 160 pages each. UNH Center for Freshwater Biology. University of NH. Durham, NH.(see appendix for report names and pages).

Craycraft, R. and J.A.Schloss 2009. Newfound Watershed Assessment Project 2007 and 2008. Special report in fulfillment for the NH DES 319 Watershed Assistance Grant. UNH Center for Freshwater Biology. University of NH. Durham, NH. 170pages (report 83pp, appendices 87pp)

Peer Reviewed Reports:

Craycraft, R. and J.A.Schloss 2009. Newfound Lake Watershed Assessment Project Quality Assurance Project Plan Ammendment for 2010 Sampling Program. UNH Center for Freshwater Biology. University of NH. Durham, NH. 28pp.

Presentations:

March 24, 2009- “Summary of the Mendums Pond Watershed Study”. J.A. Schloss, S Wilderman, R. Craycraft (invited) to the Barrington Selectmen, Planning Board, Conservation Commission and general public. Barrington NH.

April 13, 2009 Landscaping at the Water’s Edge: An Ecological Approach. J.A. Schloss Full day workshop (invited) in Portage IN for US EPA Region 5.

April 14, 2009. “On the Edge: Enhancing Ecological Integrity of Shorelines” JA Schloss, M. Bickendorfer, P. Goggin. (invited) full day pre-conference workshop for Enhancing State Lake Management Programs Conference. Chicago IL.

June 26, 2009. “New High-Tech Tools for Lake Management” J.A. Schloss (invited). NH Lakes 17th Lakes Congress, NH Lakes Association. Colby Sawyer College, New London, NH.

October 31, 2009 “Landscaping at the Waters Edge: An Ecological Approach” J. Schloss (invited) half day workshop for the North American Lake Management Society International Symposium, Hartford CT.

November 24, 2009- “Nutrient Budgets for NH Lakes-implications for TMDL models” J.A.Schloss, NH Water Resources Research Center, UNH Natural Resources Dept., NH USGS –Water Resources Brown bag seminar series. Durham NH.

Publications from WRRRC supported work completed in previous years and not reported previously:

Wilderman, Susan E. 2009. Contributions of Groundwater Seepage to the Water and Nutrient Budget of Mendums Pond Barrington, New Hampshire. Masters Thesis. University of New Hampshire. Durham, NH. May 2009.

Outreach Activities:

May 19, 2009. J.Schloss. Landscaping at the Waters Edge: Reigning in Runoff for the Town of Dover and Dover open lands committee (televised).

July 10, 2009. J. Schloss, R. Craycraft, J Haney, A. Baker. NH LLMP 30 Year Anniversary Meeting/Symposium. Durham, NH.

September 23, 2009. J. Schloss. "Farm Field Forest Buffers for River Water Quality Protection". Walpole NH. In conjunction with UNH Cooperative Extension and US Fish and Wildlife Service.

September 25, 2009. J.Schloss. Invited presentation and field tour for the NH Lakes Management Advisory Committee: "Over 30 years of Research on Squam: Lessons learned". Squam Lakes Association, Holderness NH.

On going monthly meetings with Lake Winnepesaukee Watershed Project Steering Committee concerning P modeling for local decision-makers to set target lake P concentrations (Center Harbor, Guilford and Laconia).

Number of students supported:

Directly: (partial wage/salary funding)

Graduate:

Jeff Schloss PhD Natural Resources and Earth Systems Science

Undergraduate:

Lejla Kadic BS Biology (Premed)

Gabrielle Hodgman BS Biology (General)

Indirectly (supply support, LLMP project)

Undergraduate:

Taylor Salas BS Marine Biology University of Vermont

Emma Leslie BS Zoology

Jesica Waller BS Marine Biology

Jessy Klotzer BS Zoology (PreVet)/Biochemistry