Vermont Water Resources and Lake Studies Center

Program Evaluation Report

Fiscal Years FY 2003 through FY 2007

Submitted By

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To:

Office of External Research

Water Resources Discipline

U.S. Geological Survey

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Preface

The Vermont Water Resources and Lake Studies Center receives an annual Federal matching grant as authorized by section 104 of the Water Resources Research Act of 1984 (Public Law 98-242) as amended by Public Laws 101-397, 104-147, 106-374, and 109-471. Section 104 of the Act requires that the Secretary of the Interior "conduct a careful and detailed evaluation of each institute at least once every 3 years to determine that the quality and relevance of its water resources research and its effectiveness at producing measured results and applied water supply research as an institution for planning, conducting, and arranging for research warrants its continued support under this section." The U.S. Geological Survey (USGS), Department of the Interior, administers the provisions of the Act. This evaluation report describes, in the format prescribed by the USGS, the research, training, and information transfer activities supported by the section 104 grants and required matching funds during fiscal years FY 2003 through FY 2007.

Program Evaluation Report

Introduction

Water resources issues in Vermont have traditionally focused primarily on water quality and less so on water quantity. Most of the concerns about water quality stem from long-standing concerns about agricultural activities augmented by newer concerns about urban and suburban development. However, there is a growing awareness that water quantity may be an issue for Vermont as well. Because Vermont is in the humid northeast, the public perception that water quantity might be an issue has been low. However, recent changes in climate patterns, including minor droughts in some areas and lower snowfall especially in recreational ski areas, are raising awareness that water quantity may become a more important issue for Vermont than has been the case in the past. Key issues include the following:

The Water Resource Problems of Vermont

A. Surface Water Quality:

A.1. Storm water runoff: While early attention in Vermont focused on runoff from agricultural lands, much of the current interest centers on the impacts of runoff from urban and suburban development on the state's streams and rivers. While a variety of Best Management Practices have been implemented to control stormwater runoff in Vermont, many of the state's streams remain degraded and debate about the best approaches for dealing with storm water has been intense. At the heart of the issue are difficulties encountered in trying to link storm water controls to specific improvements in stream ecosystem health or to improvements in nutrient loading to Lake Champlain, specifically lower phosphorus concentrations. The Director of the Vermont Water Resources and Lakes Studies Center (hereafter referred to as the Vermont Water Center) was instrumental in leading a critical discussion initiated by the Vermont Water Resources Board in 2003 to establish the scientific basis for stormwater management in Vermont. This discussion involved key stakeholders from across the state and lead to important new directions in stormwater management in Vermont that are receiving attention in other states as well. Research on the consequences of stormwater runoff and the effectiveness of stormwater management make up an important portion of the research portfolio for the Vermont Water Center.

A.2. Lake Champlain: Lake Champlain is viewed as vital resource and cultural treasure for the state. There are, however, a number of critical concerns about Lake Champlain’s future including continued high levels of phosphorus loading and the threats of associated lake eutrophication, increasing prevalence of blue-green algal (cyanobacterial) blooms some of which have been toxic, the introduction of new invasive species including most recently alewife, and increased awareness that there are worrisome concentrations of exotic chemicals in the lake including estrogen mimics, flame retardants, and other pharmaceuticals. While research and education about the lake have increased over the past 15 years, key issues still demand attention from the regulatory and research communities.

A.3. Protection of pristine mountain streams: Development pressures, particularly from Vermont's ski industries, continue to be a concern for some of Vermont's high elevation streams. Possible threats include expansion of ski area development, water withdrawals, and wastewater disposal. The Vermont Water Center

has supported projects to compare water quality in developed vs undeveloped high elevation watersheds in northern Vermont.

A.4. Watershed protection: Vermont is currently updating its river basin plans throughout the state. The use of TMDLs to reduce inputs of such pollutants as phosphorus to Vermont's rivers and lakes continues to be a challenge for the state from both a scientific and a regulatory perspective.

A.5. Mercury contamination: Fish advisories based on elevated mercury levels continue in Lake Champlain and other Vermont lakes. While our knowledge about how mercury moves through Vermont's forested watersheds has increased over the past few years, we need to learn much more about how to better manage this continuing contamination problem. Unfortunately, with at least half of the mercury in Vermont lakes coming from sources outside the state, regulatory fixes are not entirely within our control.

B. Ground Water Quality: While Vermont has closed its unlined landfills, incidents of groundwater contamination continue at various sites in the state. Some of these cases represent ongoing contamination from industrial sites, while others result from leaking underground storage tanks, inputs of nitrates from fertilizers and contamination by bacteria from leaking septic systems. Additional concerns in recent years have focused on elevated radon levels in some northern Vermont wells. However, groundwater continues to be one of the least understood and least studied water resources in Vermont. This is a growing concern because of the large number of rural communities, farms and households in Vermont that rely on groundwater as their primary source of water.

C. Water Supply Issues: Ground and surface are both important sources of potable water in Vermont. As noted above the state of knowledge concerning Vermont's aquifers is not well developed in terms of aquifer capacity, flow rate or rates of recharge. So far very little attention has been given the security of Vermont’s water supplies. However, this is a growing concern.

D. Water Use Demands: Competing demands for Vermont's water resources are still a challenge. While past controversies have pitted ski area managers versus trout anglers and canoeists versus motor craft users, more recent examples include the relicensing of Vermont's hydropower facilities. With the restoration of cold−water fisheries a possibility in several dammed Vermont rivers, discussions between angling interests and water supply purveyors have increased in recent years.

E. Biological Diversity: Vermont's many surface waters, wetlands and marshes are home to a number of rare and endangered species. In addition, a recent state−wide tally identified 91 species of fish in state waters and numerous species of plants, invertebrates, amphibians and other aquatic life. Invasive species like purple loosestrife, zebra mussels, alewife, and the spiny water flea threaten the existence of many indigenous aquatic species, including a number of mussel species on the state's list of rare and endangered species. Evidence of malformations among Vermont's frog population has been well documented. While the exact cause of the problem remains unknown, these abnormalities have raised concerns about the overall condition of Vermont's wetlands and possible links to exotic toxins noted above.

Vermont Water Resources and Lake Studies Center: An Overview

The goal of the Vermont Water Resources and Lake Studies Center during the review period has been to encourage, fund, execute, and communicate objective and competent research to assist in the solution of high priority water resources problems in Vermont.

Much of the research funded in the last few years of this review period was done with direct input, support, and collaboration from the Vermont Agency of Natural Resources (VTANR), especially the River Management and the Clean and Clear Programs. This collaborative and coordinated research has focused on better understanding how to quantify the influences of stormwater runoff on the geomorphic structure of urban-impacted streams. This research is essential to help support VTANR's mission to manage the natural resources of Vermont, including its streams and rivers. Quantifying the sources of sediment to Lake Champlain is a critical first step to managing these sources and mitigating their impacts.

The Vermont Water Resources and Lake Studies Center must address a number of challenges to maintain its position as a viable resource for the state. Vermont is a small and rural state, but is also developed and productive. As a consequence we face most of the same water resource management problems that other larger states must address but have fewer people and fewer resources to address these issues. For example, there are comparatively few scientists in Vermont available to do high–level, water–related research. At the same time, the human and financial resources within the state government that can be focused on water-related issues is also limited. Thus, it has always been the case that there are far more issues demanding attention than there are academic scientists available to address them.

More seriously, however, there are fewer and fewer non-Federal funding resources available to help meet the 2:1 match required in the state water resources grants program. We have been fortunate over the period of this review to have more than met our match requirements. However, it has been a struggle and in the current economic climate of 2009-2010 and looking to the future, we foresee that it will be even more difficult to meet this match in the future. The 2:1 match requirement has become an important impediment to many faculty who would otherwise participate in this program. Despite our small size and these challenges, the Vermont Water Center has been able to make strategic contributions to help manage the state's valuable water resources, primarily by leveraging our resources and working direcly with stakeholders.

In addition to the Section 104b grants program, additional efforts that the Vermont Water Resources and Lake Studies Center has undertaken have included:

1. Research and monitoring: Throughout this review period, the Vermont Water Center was actively associated with an EPA-funded project called *Redesigning the American Neighborhood*, which was focused on community uptake of low-impact design best management practices (BMPs) to reduce sediment and nutrient loading to Lake Champlain, primarily by phosphorus. Involvement in this program led to independent contracts with the VTANR Stormwater Section to help them develop a radically new approach to stormwater management in Vermont and to generate monitoring data that could be used to support these management efforts. Additional stormwater related efforts include ongoing monitoring of campus streams and stormwater treatment facilities led by the Director of the Water Center. Featuring both routine sampling of water quality of campus streams and storm-related sampling at five campus storm water detention ponds, the storm water monitoring initiative has become an important component of UVM's environmental efforts.

2. Involvement and Advice: The Director of the Vermont Water Center as well as many of the supported principle investigators and their students have been actively involved in work groups, task forces, committees, and other organizations that have authority to manage water resources in Vermont. The Director's involvement in the Vermont Water Resources Board hearings on the scientific basis for stormwater management in Vermont has already been noted. The Director has also been a long-standing member of the Lake Champlain Basin Program's Technical Advisory Committee and will take over as Chair of this Committee in September 2010. This important group of Vermont, New York, and Canadian (Quebecois) science, management and regulatory stakeholders identifies research goals and sets research priorities relevant to the Lake Champlain basin.

3. Outreach and education: the Vermont Water Resources and Lake Studies Center continues to play an active role in educating local officials and the public about stormwater resource management issues in the state. In addition to our normal web and newsletter offerings, the Center co-sponsored a region-wide conference on the state of the Lake Champlain environment in 2007. Results from several projects directly supported by or related to the Vermont Water Center were presented at this important meeting.

Section 104 Objectives

1. To encourage and support basic and applied research directed at Vermont's critical water quality and quantity issues.

2. To transmit, through workshops, annual meetings and printed literature, information on water resources statewide.

3. To promote education in water resources.

Allocation of Federal Grant and Matching Funds Among Program Activities: FY 2003 through FY 2007	
Activity	**Percent**
Research	35
Information Transfer	15
Education	35
Administration	15
Other (please specify)	0
Total	100

Institutional Support and Effectiveness

Instiutional support for the Vermont Water Resources and Lake Studies Center comes primarily in the form of space allocated to the Director and the Director's Assistant and in cost-share through matching intitutional funds. One of the primary forms of costshare is the waiver on indirect costs associated with the Federal funds awarded from USGS. However, UVM has also agreed to waive indirect costs on supplementary funds made available by the state via VTANR. This is a substantial benefit to the program.

Discretionary Base Funding

No discretionary funding was provided by the state or university. However, the state VTANR did provide extremely valuable collaborative funding which is documented below.

Appropriated or Other Discretionary Funds Available to the Institute: FY 2003 through FY 2007					
Source of Discretionary Funds	**2003**	**2004**	**2005**	**2006**	**2007**
None	$0	$0	$0	$0	$0

Other Water Resources Research Funding

Total and Average Value of Water Resources Grants, Contracts, and Cooperative Agreements in Which the Institute Had a Major Role During the Evaluation Period: FY 2003 through FY 2007	
Total Value of Awards, in dollars	$1,927,065
Number of Awards	9
Average Value of Awards	$214,118.33

Please list in the table below the 10 largest grants (other than section 104 grants), contracts, and cooperative agreements for which the Director or staff of the institute played a major role in assembling the proposal or otherwise obtaining the grant or contract. Include the dollar amount of the contract, grant, or cooperative agreement, the year that it was initiated, and the source of the funds. USGS-Water Resources Research Institute Internships and funds from other federal agencies passed through to your institute by the USGS should be included here.

The Ten Largest Water Resources Grants, Contracts, and Cooperative Agreements in Which the Institute Had a Major Role during the Period of the Evaluation: FY 2003 through FY 2007			
Title/Topic	**Source of Fundings**	**Year Initiated**	**Amount**
Redesigning the American Neighborhood	US/EPA	2003	$1,312,201
Integrated Stormwater Planning Tools	VTANR Stormwater	2005	$1,590,22
Flow Monitoring Project	VTANR Stormwater	2006	$2,828,42
Water Center/VTANR Joiint Program	VTANR Clean/Clear	2006	$1,730,00
University of Vermont Stormwater Monitoring Program	UVM	2003	$100,000

The Redesigning the American Neighborhood project consisted of 3 sequential awards spanning a period from 2003 to 2006.

The Integrated Stormwater Planning Tools project consisted of an original award in 2005 with 2 additional supplements in the period up to 2007.

The Flow Monitoring Project consisted of an original award in 2006 that was supplemented in 2007.

The Water Center/VTANR Joint Program consisted of an original award in 2006 that was supplemented in 2007.

The University of Vermont Water Stormwater Monitoring Program consists of an annual alllocation of $20,000 from UVM to the Center to collect stormwater data to satisfy the University's interest in the development of an MS4 stormwater discharge permit.

Research Program

During the 2003-2007 reporting period the focus of the Vermont Water Center shifted from a series of projects that were focused on processes and issues directly relevant to Lake Champlain (e.g. paleolimnology and cyanobacterial blooms) to processes and issues relevant to riverine and watershed processes that had become the focus of heated debate in the state. This shift in focus was accompanied by an important new form of collaboration with the VTANR in which the agency provided funding that could be used directly as match for Vermont Water Center (USGS) funds. The Vermont Water Center and VTANR jointly decided on research projects that would best address the most pressing issues. UVM contributed substantially to this partnership by agreeing to forego indirect costs on the VTANR Non-Federal supplementary funding in the same way that they agreed to forego the indirect costs on the USGS Federal funding. This was an important cost savings that allowed each dollar supplied by VTANR to be used more effectively for research support and to be matched more effectively with dollars supplied by USGS. This partnership is a win-win-win for the missions of the participating organizations. Descriptions of the individual projects supported by the Vermont Water Center during the period 2003-2007 are summarized in the following section.

Research Projects

Summary of Research Projects

Note: The percentages below do not sum to 100 because, contrary to instructions, not all research projects were assigned a research category.

Number of Research Projects and Percentage of Research Funds, by Research Category: FY 2003 through FY 2007

Research Category	Number	Percent of Funds
Biological Sciences	0	0
Climate and Hydrologic Processes	0	0
Engineering	1	11
Ground-water Flow and Transport	0	0
Social Sciences	0	0
Water Quality	4	61

Research Projects Receiving Follow-on Funding

The number of projects receiving follow-on funding from another source after completion as a section 104-funded project was: 0.

The project managed by A. Lini and S. Levine ultimately resulted in additional funding from NOAA for follow-on research (Emerging Threats to the Lake Champlain Ecosystem, August 1, 2006 – July 31, 2008, $456,510).

Summary of Research Publications

Number of Research Publications, by Category of Publication: FY 2003 through FY 2007	
Publication Category	Number
Articles in Refereed Journals	4
Book Chapters	0
Theses and Dissertations	2
Water Resources Institute Reports	0
Articles in Conference Proceedings	5
Other Publications	53

Most Significant Research

- Drs. Suzanne Levine and Leslie Morrissey (both from the Rubenstein School) focused on detection of cyanobacterial (blue-green algal) blooms that have recently become a major nuisance and potential health threat in Lake Champlain. For the last several years cyanobacterial cell numbers sampled and analyzed manually to inform a health alert management program. However, the efficiency of sampling these blooms and developing timely management plans is hampered by their extremely patchy distributions in time and space. The results of the project showed clearly that remote sensing can be successfully employed to identify cyanobacterial blooms to help inform health alerts.

- Prof. William B. Bowden (Rubenstein School and Director of the Vermont Water Center) and several undergraduate and graduate students from the University of Vermont (UVM) worked with staff from the Vermont ANR River Management Program to employ and improve a ‘Stream Geomorphic Assessment (SGA)' protocol developed by staff from the River Management Program for use in all of Vermont streams. The UVM collaborators examined ways to strengthen the SGA protocol for the small streams that are typical of the Chittenden County area and often heavily impacted by urban and suburban development. These improved protocols were subsequently used to provide baseline data for monitoring future changes in streams draining urban areas in Vermont and to help inform permitting and policy decisions regarding stormwater management.

- Erosion of stream banks may constitute an important and underappreciated nonpoint source of pollution to the streams and lakes in Vermont. Past land use, including extensive deforestation and

agriculture has stripped riparian vegetation and loaded riparian soils with high levels of nutrients such as nitrogen and phosphorous. With over 7000 miles of waterways in Vermont these sediment and nutrient deposits are important potential source of water pollution. Drs. Mandar Dewoolkar (Engineering) and Paul Bierman (Geology) examined what makes some banks stable and other banks fail over both time and changing river and groundwater conditions with the goal to develop a reliable quantitative model of stream bank slope stability. This project was developed in conjunction with the state River Management program and is being used to inform the VTANR Stream Geomorphic Assessment initiative.

- Phosphorus is the key element that controls primary production in Lake Champlain and other water bodies in the northeast. Dr. Don Ross (Plant and Soil Science) and his students examined the transport of phosphorus from agricultural areas and how it is influenced by the presence or absence of best management practices in riparian zones. Site-specific factors such as phosphorus levels, hydrology, chemical processes, and erosion within riparian zone soils control the actual amount of phosphorus mobilized from these areas. Dr. Ross' team examined how phosphorus levels in riparian soils differ in time and space to improve phosphorus mitigation efforts in different soil and landscape conditions. Results of this research are of direct interest to local resource managers and the state River Management Program and have lead to additional collaborations with the Vermont Office of the US Natural Resources Conservation Service.

- Drs. Donna Rizzo (Engineering) and Leslie Morrissey (Rubenstein School) used artificial intelligence (AI) methods to integrate geomorphic and ecological information for environmental assessments of rivers. The goal of the assessment program was to develop a scientific basis for fluvial erosion hazards and sediment and nutrient load reduction as well as aquatic habitat protection and restoration. They used data from the VTANR SGA database (described above) from ~1000 miles of stream and river reaches throughout the state to develop test an AI method to help water resource managers integrate stream and ecological information. These methods are now being used by the state to perform quality assurance and quality control on the geomorphic data they collect.

Distinquished Grant Recipients

- Dr. George Pinder, Professor, School of Engineering, Groundwater Modeling

- Dr. Alan McIntosh, Professor, Rubenstein School of Environment and Natural Resources, Environmental Toxicology

- Dr. Paul Bierman, Professor, Department of Geology, Landform processes

- Dr. William Bowden, Professor and Director of the Water Center, Rubenstein School of Environment and Natural Resources, Watershed Science and Planning

- Dr. Donna Rizzo, Associate Professor, School of Engineering, Artificial Intelligence and Advanced Geospatial Techniques

- Dr. Leslie Morrissey, Associate Professor, Rubenstein School of Environment and Natural Resources, Remote sensing and GIS

Summary of Awards

None

Information Transfer Program

Our Information Transfer program includes distributing a newsletter (cooperatively produced with the Lake Champlain Seagrant Program. and sponsoring/co−sponsoring a variety of water−related meetings.

Information Transfer Projects

Information Transfer Publications

IT Publication Type	IT Publication Citation

Audio-Visual Productions

None

Newsletter

Reflections on Water Newsletter:

2003 mailed to 622 once/year and published on the Vermont Water Resources and Lake Studies Center website

2004-2005 produced once/year and published on the Vermont Water Resources and Lake Studies Center website. Announcement was via e-mail notification.

2006 newsletter was not produced this year.

2007 produced twice/year and published on the Vermont Water Resources and Lake Studies Center website. Announcement was via e-mail notification.

Reference documents for **Newsletter** appear in Appendix C.

Conferences

The Vermont Water Center supported serveral outreach and education initatives during the 2003-2007 reporting period, as noted below.

Lead Sponsor

- In 2004 The Vermont Water Center sponsored a graduate/staff seminar in River Corridor Management with the Vermont Agency of Natural Resources, River Management Program. This seminar brought together graduate students from the University of Vermont and key staff members from the VTANR in a series of regular seminars to discuss recent scientific literature on the relationship between the geomorphic condition of streams and other measures of stream health. Unlike typical seminars in which a different, individual agency staff member might meet with students on different weeks, the entire River Management Staff met with students associated with the Aquatic Ecology and Watershed Science graduate concentration. Much of literature review was led by the students with practical insight about on-the-ground management issues provided by the VTANR staff. Agency staff gained an appreciation of emerging literature in their area of interest and graduate students gained an appreciation for some of the challenges in translating science into practical management. See: http://www.uvm.edu/~wbowden/Teaching/NR385_River_Corridors/RC_frameset.html

Cosponsor or Supporter

- In 2004 The Vermont Water Center cosponsored the continuing efforts of the Stormwater Study Group, a resident/stakeholder working group that was organized to address local stormwater management issues and responses. This group met periodically between 2004 and 2007. See: http://www.uvm.edu/~ran/?Page=homeowners.html.

- The Vermont Water Center regularly promotes activities of the Lake Champlain Research Consortium including annual Student Research Symposia. The Center helped sponsor a basin-wide research conference called "Lake Champlain - Our Lake, Our Future" that was held early in 2008. However, planning activities for this conference took place towards the end of the period covered by this report. A more in depth description of this conference will be included in the next 5-year evaluation report. See: http://academics.smcvt.edu/lcrc/archives.htm.

Internet Services

The Vermont Water Resources and Lake Studies Center website provides information to current and potential PIs related to current RFPs; current news and events; a list of Water Center funded projects; water-related publications; copies of Reflections on Water newsletters; as well as a list of Water Center accomplishments.

http://www.uvm.edu/envnr/vtwater/index.html

Awards

None

Most Significant Achievements

- Regular dialogue with staff from the VTANR - faciliated especially by the Advanced Seminar in River Corridor Management sponsored by the Vermont Water Center - led ulimately to closer working relationship between UVM and VTANR and ulitimately led to substantial financial support in the form of matching funds for the Center in 2006 and 2007.
- Regular meetings with residents and stakeholders in the Stormwater Working Group that was co-sponsored by the Vermont Water Center led to more direct communications between residents and staff members from the city of South Burlington and VTANR.

Education

The primary form of student support made avaiable by the 104b and matching funds managed by the Vermont Water Center are for graduate student stipends on research projects. However, the Center also supports a large number of undergraduate students who serve as temporary field and lab assistants on projects funded by the Center. Finally, the Center also provides support for students - graudate and undergraduate - to attend relevant conferences to present the results of their Center-funded projects and learn about emerging trends in the fields of their particlar interest.

Number of Students Supported

Number of Students Supported, by Degree and Grant Type: FY 2003 through FY 2007		
Degree	**Base Grants**	**National Competitive Grants**
Undergraduate	14	
Masters	14	
Ph.D.	3	
Post Doc	2	

Theses and Dissertations

Number of Theses and Dissertations

Resulting from Student Support: FY 2003 through FY 2007	
Master's Theses	16
Ph.D. Dissertations	1

Student Grants and Fellowships

Administration, Coordination, and Cooperation

Vermont Water Resources and Lake Studies Center is managed by a Director who is supported by an Assistant. The Director and Assistant are housed in the Rubenstein School of Environment and Natural Resources although the Director and the Center are independent of the Rubenstein School. However, the Rubenstein School provides other substantial support including business services and project financial managment services. The Vermont Water Center coordinates with other relevant research initiatives, especially within UVM. Vermont is a small state and UVM is the largest public instution of higher education in the state and the only one with a substantial research portfolio. Thus, it is not unusual that most of the research supported by the Center occurs through UVM. However, the Center interacts regularly with other private institutions of higher education in the state (e.g. Middlebury College and St. Michael's College) and has funded faculty from these institutions in the past. Finally, the Vermont Water Center works collaboratively with a number of other water resource related organizations and agencies, including the Vermont Agency of Natural Resouces, the Lake Champlain Seagrant Program, the Lake Champlain Research Consortium, the Lake Champlain Basin Program, and the USGS New Hampshire/Vermont Water Science Center.

National Competitive Grant Program

Cooperation

Expenditure of Section 104 and Matching Funds, by University or Other Organization, State, and Year: FY 2003 through FY 2007						
		Section 104 Federal Grant and Matching Fund Expenditures				
University or Organization	State	2003	2004	2005	2006	2007
University of Vermont	Vermont	258692	278280	278064	413955	347730

Institute Directors over Evaluation Period

Name	Academic Discipline	Term
Alan McIntosh	Environmental Science	2003-2004
William (Breck) Bowden	Watershed Science & Planning	2005-2007

Advisory Committees

Philip Benedict, Vermont Department of Agriculture, 2003-2004

Doug Burnham, Vermont Agency of Natural Resouces, 2003-2007

Barry Cahoon, Vermont Department of Environmental Conservation, 2005

Craig Heindel, Heindel & Noyes, 2003-2007

James Hoffmann, University of Vermont, 2003-2004

Linda Howe, University of Vermont, 2003-2004

Cully Hession, University of Vermont, 2003, 2005-2006

Chris Killian, Conservation Law Foundation, 2003-2004

Mike Kline, Vermont Department of Environmental Conservation, 2005

Winslow Ladue, Vermont Department of Environmental Conservation, 2003-2004, 2007

Crea Lintilhac, Lintilhac Foundation, 2003-2007

Mary Watzin, University of Vermont, 2003-2007

Mike Winslow, Lake Champlain Committee, 2005-2006

Research Proposal Review and Selection Process

Each proposal submitted to the Water Center for consideration is sent out for external technical review. Typically proposals are reviewed by staff in the Vermont Agency of Natural Resources (VTANR) who review each proposal for technical merit and relevance to state needs. Where necessary proposals may be sent to

other technical reviewers in areas if the proposal falls outside the expertise within VTANR. All proopsal and technical reviews are sent to Advisory Committee members who meet annually to discuss the proposals and the technical reviews. The Advisory Committee decides which proposals will be funded. The Director may ask for modifications to proposed objectives and budgets based on input from Advisory Committee and the Director's percpetions of the strategic needs of the Center.

Peer Review of Institute Publications

The Vermont Water Center encourages its principal investigators to publish their Section 104 research results in technical journals that receive peer review, primarily becuase these journals are typically trusted sources that have wide distribution. Though we require a final report for each project, we do so primarily to ensure that there is full documentation of the activities and results from each project funded by Center. These final project reports are retained and posted on our Center website. In many cases final reports are required by collaborating agencies, e.g., VTANR. In these cases the reports are reviewed by agency staff before they are accepted and posted.

Number of Principal Investigators Supported, by Rank and Year

Principal Investigators on Research Projects Supported by Section 104 Grants and Matching Funds, by Academic Rank and Year: FY 2003 through FY 2007					
Academic Rank	**2003**	**2004**	**2005**	**2006**	**2007**
Assistant Professor and below	0	3	0	7	8
Associate Professor	3	2	3	4	2
Professor	1	2	3	3	2
Total	4	7	6	14	12

Additional Information for the Evaluation Panel

None

Appendix A: Individual Project Attachments

'Detection of cyanobacter...': 2002VT5B Research Project Description

Title Detection of cyanobacterial blooms using remote sensing
Project Number 2002VT5B
Start Date 3/1/2003
End Date 2/28/2005
Research Category Not Applicable
Focus Categories Water Quality, Methods, Toxic Substances

Principal Investigators		
Name	**Rank During Project Period**	**Affiliation**
Suzanne Levine	Associate Professor	University of Vermont
Leslie Morrissey	Associate Professor	University of Vermont

Funding				
Funding Period	**Federal 104 Funds**	**Required 104 Matching Funds**	**Other Funding**	
			Source	**Funds**
FY2004	$32,000	$59,167		

This project received follow-on funding after completion as a section 104-funded project (Yes ___ No _X_). *If yes, please describe the funding period, source and amount in the funding table*.

Student Support		
Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	0	0
Masters	2	2
Ph.D.	0	0
PostDoctoral	0	0

Publications	
Publication Type	**Publication Citation**
Other Publications	Wheeler, S., L. Morrissey, S. Levine, and W. Vincent, 2005, Mapping Cyanobacteria Blooms in Lake Champlain at Multiple Scales: A Comparison of Three Satellites, Ecological Society of American 90th Annual Meeting, August 7-12, Montreal, Canada.
Other Publications	Wheeler, S., S. Levine, L. Morrissey, and W. Vincent, 2005, A Comparison of Satellite Sensors for Mapping Cyanobacteria in Lake Champlain, USA/CAN, American Society of Limnology and Oceanography Annual Summer Meeting, June 19-24, Santiago de

	Compostela, Spain.
Other Publications	Wheeler, S.M, S.N. Levine, L.A. Morrissey, and W.F. Vincent. 2005. A COMPARISON OF SATELLITE SENSORS FOR MAPPING CYANOBACTERIA IN LAKE CHAMPLAIN. ASLO Meeting, June 19-24, Santiago de Compostela, Spain.
Other Publications	Wheeler, S.M, L.A. Morrissey, S.N. Levine and W.F. Vincent. 2005. Mapping cyanobacteria blooms in Lake Champlain at multiple scales: A comparision of three satellites. Abstracts. ESA INTECOL Joint Meeting, August 7-12, Montreal, Canada.
Dissertations	Wheeler, S. M. An evaluation of the utility of remote sensing for monitoring cyanobacteria in Lake Champlain, thesis completed in fulfillment of Master of Science degree, University of Vermont, October 2006, 89 pages.
Conference Proceedings	L. Morrissey, S. Wheeler, S. Levine, W. Vincent, and G. Livingston. Mapping Cyanobacteria Blooms in Lake Champlain at Multiple Scales: QuickBird and MERIS Satellite Data, NEARC 2007 Conference, Nov 4-7, Burlington, VT.
Other Publications	Wheeler, S. L. Morrissey, S. Levine and W. Vincent, Mapping Cyanobacteria Blooms in Lake Champlain at Multiple Scales: QuickBird and MERIS Satellite Data, New England Association of Environmental Biologists 31st Annual Conference, West Dover, Vermont, March 14-16, 2007.
Other Publications	Shambaugh, A., S. Wheeler, S. Levine. Seeking Local Insight to a Local Problem: Toxic Cyanobacteria in Lake Champlain. Faultline. Spring 2004.
Articles in Refereed Scientific Journals	Dybas, C. Harmful Algal Blooms: Biosensors Provide New Ways of Detecting and Monitoring Growing Threat in Coastal Waters. BioScience 53(10): 918-923. 2003.
Other Publications	Dorscher, C. Research in Bloom. The View. UVM Communications. Sept. 1, 2004.

Awards and Achievements

[None]

'Water quantity and quali...': 2002VT1B Research Project Description

Title	Water quantity and quality dynamics in high-elevation watersheds: Developing a scientific approach to understanding ski area impacts in Vermont
Project Number	2002VT1B
Start Date	3/1/2002
End Date	2/28/2004
Research Category	Not Applicable
Focus Categories	Hydrology, Water Quality, Models

Principal Investigators		
Name	**Rank During Project Period**	**Affiliation**
Beverley Wemple	Assistant Professor	Univ. of Vermont
Donald Ross	Research Assistant Professor	University of Vermont
James Shanley	Research Hydrologist	NH/VT District, USGS

Funding				
Funding Period	**Federal 104 Funds**	**Required 104 Matching Funds**	**Other Funding**	
			Source	**Funds**
FY2003	$29,880	$61,996		

This project received follow-on funding after completion as a section 104-funded project (Yes ___ No _X_). *If yes, please describe the funding period, source and amount in the funding table*.

Student Support		
Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	3	0
Masters	1	1
Ph.D.	0	0
PostDoctoral	0	0

Publications	
Publication Type	**Publication Citation**
Other Publications	Wemple, B. C. 2003. Water quality and quantity in high-elevation watersheds: developing a scientific approach to understanding ski area impacts in Vermont. Vermont Water Resources and Lake Studies Center, Annual Meeting, October, Burlington, VT.

Other Publications	Wemple, B. C., J. B. Shanley, and S. Waichler, 2003. Forest disturbance through alpine ski area development: results of a paired watershed study in the Northeastern U.S. American Geophysical Union, Fall Meeting, December, San Francisco, CA.
Other Publications	Wemple, B., J. Shanley, and J. Denner. 2004. Effects of an alpine ski resort on hydrology and water quality in the Northeastern U.S.: preliminary findings from a field study (poster). Vermont EPSCoR Program, Annual Meeting, March, Burlington, VT.
Other Publications	Mills, K. 2004. Understanding the spatial variability of snow water equivalent on Mt. Mansfield,Stowe, VT. Vermont Geological Society Spring Meeting, April, Middlebury, VT.
Other Publications	Zinni, B., B. Wemple, J. Shanley, and A. Lini. 2004. Using streamwater chemistry in flow pathanalysis of large-scale forested watersheds near Stowe, VT. American Geophysical Union, Spring Meeting, May, Montreal, Quebec, Canada.
Other Publications	Mills, K. 2004. Understanding the spatial variability of snow water equivalent on Mount Mansfield, Stowe, Vermont. Unpublished senior research project, Dept. of Geography, University of Vermont.
Other Publications	Ambers, R. K. R., and B. C. Wemple, 2008. Reservoir Sedimentation Dynamics: Interplay and Implications of Human and Geologic Processes. Northeastern Geology and Environmental Science, 30(1):49-60.
Other Publications	Wemple, B. C., J. Shanley, J. Denner, D. Ross, and K. Mills. 2007. Hydrology and water quality in two mountain basins of the northeastern US: assessing baseline conditions and effects of ski area development. Hydrological Processes, DOI: 10.1002/hyp.6700.
Other Publications	Shanley, J. B. and B. C. Wemple, 2002. Water Quantity and Quality in the Mountain Environment, in J. Milne and E. Miller (eds.) Mountain Resorts: Ecology and the Law special issue of the Vermont Law Review, 26(3): 717-751.
Other Publications	Shanley, J. B. and B. Wemple, 2009. Water Quality and Quantity in the Mountain Environment, in J. E. Milne, J. LeMense, and R. A. Virginia (eds.), Mountain Resorts: Ecology and the Law, Surrey, U.K., Ashgate Publishing Ltd.
Other Publications	Vermont Monitoring Cooperative, 2009. Vermonts Changing Forests: Key Findings on the Health of Forested Ecosystems from the Vermont Monitoring Cooperative. Burlington, Vermont. Available at http://www.uvm.edu/vmc.
Other Publications	Wemple, B., J. Shanley, and J. Denner, 2002. Effects of an Alpine Ski Resort on Hydrology and Water Quality in the Northeastern U.S.: Preliminary Findings from a Field Study, American Geophysical Union Fall Meeting, San Francisco, CA. December 2002.

Awards and Achievements

[None]

'A Comparison of Bacteria...': 2004VT16B Research Project Description

Title	A Comparison of Bacterial Concentrations in Streams: a Paired Watershed Study
Project Number	2004VT16B
Start Date	3/1/2004
End Date	2/28/2006
Research Category	Water Quality
Focus Categories	Non Point Pollution, Surface Water, Hydrology

Principal Investigators		
Name	**Rank During Project Period**	**Affiliation**
Leslie Morrissey	Associate Professor	University of Vermont
Alan Mcintosh	Professor	University of Vermont

Funding				
Funding Period	**Federal 104 Funds**	**Required 104 Matching Funds**	**Other Funding**	
			Source	**Funds**
FY2005	$28,886	$45,371		

This project received follow-on funding after completion as a section 104-funded project (Yes ___ No _X_). *If yes, please describe the funding period, source and amount in the funding table*.

Student Support		
Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	0	0
Masters	2	2
Ph.D.	0	0
PostDoctoral	0	0

Publications	
Publication Type	**Publication Citation**
Other Publications	Bruhns,Matthew, Analysis of Fecal Contamination in a High Elevation Paired Watershed, M.S., Rubenstein School of Environment and Natural Resources, in progress.
Other Publications	American Water Resources Association 2006 Spring Specialty Conference, GIS and Water Resources IV, May 8-10, 2006, Houston, TX.
Other Publications	Northeast ARC Users Conference, Burlington, VT, November, 2007.
Dissertations	

	Sargent, Deborah H. 2001, Spatial and Temporal Distribution of Escherichia coli in the Mad River Watershed, Vermont, M.S. Thesis, School of Natural Resources, University of Vermont, 68 pp. Advisor: Morrissey.

Awards and Achievements

This research led to the submission of several (funded) grants: 1) L. A. Morrissey, Mapping Impervious Surface Areas in Vermont's Impaired Watersheds, Vermont Agency of Natural Resources, Department of Environmental Conservation, 2005-2008. 2) L. Morrissey, Monitoring Development using High Resolution Satellite and Aircraft Data, City of South Burlington, VT, 2007-2008. 3) D. Rizzo and L. Morrissey, co-PIs, An Adaptive Management System using Hierarchical Artificial Neural Networks and Remote Sensing for Fluvial Hazard Mitigation, VT ANR in collaboration with Vermont Water Resources and Lake Studies Center, U.S. Geological Survey, 2006-2008. 4) L. Morrissey, D. Rizzo, and B. Wemple, Linking roads in forested watersheds to stream stability and stream health: tools for assessing road impacts and restoration options, USDA Northeaster States Research Cooperative, 2009-2012.

'Trophic status of Lake C...': 2005VT22B Research Project Description

Title	Trophic status of Lake Champlain over 400 years of changing land use: A paleolomnological study
Project Number	2005VT22B
Start Date	3/1/2005
End Date	2/28/2007
Research Category	Water Quality
Focus Categories	Water Quality, Nutrients, Sediments

Principal Investigators		
Name	**Rank During Project Period**	**Affiliation**
Andrea Lini	Associate Professor	University of Vermont
Suzanne Levine	Associate Professor	University of Vermont

Funding				
Funding Period	**Federal 104 Funds**	**Required 104 Matching Funds**	**Other Funding**	
			Source	**Funds**
FY2006	$29,962	$61,493		

This project received follow-on funding after completion as a section 104-funded project (Yes ___ No _X_). *If yes, please describe the funding period, source and amount in the funding table*.

Student Support		
Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	0	0
Masters	5	5
Ph.D.	0	0
PostDoctoral	0	0

Publications	
Publication Type	**Publication Citation**
Other Publications	Burgess, Heather D. 2007. Geochemical Indicators of Productivity Change in Lake Champlain, USA-Canada. MS Thesis, The University of Vermont, Burlington, VT. 191 pages.
Other Publications	Burgess, H., Lini, A., Levine, S., Ostrofsky, M., and Kamman, N., 2006, Trophic status of Lake Champlain over 400 years of changing land use: a paleolimnological study. 30th Annual

	Meeting of the New England Association of Environmental Biologists, Bethel, Maine, USA.
Other Publications	Burgess, H., Lini, A., Levine, S., Ostrofsky, M., and Kamman, N., 2006, Trophic status of Lake Champlain over 400 years of changing land-use: I. Elemental and isotopic records. 10th International Paleolimnology Symposium, Duluth, MN, USA.
Other Publications	Ostrofsky, M., Lini, A., Levine, S., Burgess, H., and Kamman, N., 2006, Trophic status of Lake Champlain over 400 years of changing land-use: II. Sediment chemistry. 10th International Paleolimnology Symposium, Duluth, MN, USA.
Other Publications	Levine, S., Lini, A., Leavitt, P., Dahlen, D.M., Burgess, H., and Ostrofsky, M., 2006, Trophic status of Lake Champlain over 400 years of changing land-use: III. Biological indicators. 10th International Paleolimnology Symposium, Duluth, MN, USA.
Other Publications	Levine, S., Lini, A., Burgess, H., and Ostrofsky, M., Leavitt, P., Bunting, L., Dahlen, D.M., and Kamman, N., 2006, A Trophic History of Lake Champlain since European Settlement. Lake Champlain Research Consortium Water Quality Conference, St. Michael's College, Colchester, VT, USA.
Other Publications	Lini, A., Levine, S., Burgess, H., Ostrofsky, M., Kamman, N., and Collyer, E., 2007, Trophic History of Lake Champlain since European Settlement: A paleolimnological study. New England Association of Environmental Biologists, 31st Annual Meeting, Mt. Snow, VT.
Other Publications	Lini A., Levine, S., Burgess, H., Ostrofsky, M., Dahlen, D., Leavitt, P., Bunting L., and Kamman, N., 2007, A multiproxy paleolimnological study of Lake Champlain, USA- Canada. Geological Society of America Abstracts with Programs, Vol. 39, No. 6, p. 383.
Other Publications	Levine, S.N., Lini, A. Ostrofsky, M.L. , Bunting, L. , Burgess, H.D., Dahlen, D. and Leavitt, P. 2008. Impacts of land use and climate on two shallow embayments of Lake Champlain (USA-Canada). Structure and function of world shallow lakes. 23-28 Nov. 2008. Punta del Este, Uruguay. Book of Abstracts. p. 70.
Other Publications	Levine, S. 2008. The Limnology and Paleolimnology of Lake Champlain, New England's Lago Maggiore. CNR Institute of Ecosystem Study. Verbania Pallanza, Italy.
Other Publications	Lini, A., Levine, S., Ostrofsky, M, Bunting, L., Burgess, H., Dahlen, D., and Leavitt, P. 2009, Impacts of Land Use and Climate on Lake Champlain (USA-Canada), GSA Abstracts with Programs Vol. 41, No. 3
Other Publications	Lini, A., Levine, S., Ostrofsky, M, and Dahlen, D. 2009. Lake Champlain before and after European settlement: What we can learn from its sediments. Vermont Lake Champlain Quadricentennial Indigenous Conference, St. Michaelâ s College, Colchester, VT
Other Publications	Levine, S. Spring 2007. Lake Detectives: Reconstructing Lake Champlain's History from Sediment Characteristics. Faultline.
Other Publications	Levine, S., and Lini, Spring 2008. A. Reading Lake Champlain's Mud Encyclopedia. Faultline.

Awards and Achievements

[None]

'An Adaptive Management S...': 2006VT26B Research Project Description

Title	An Adaptive Management System using Hierarchical Artificial Neural Networks and Remote Sensing for Fluvial Hazard Mitigation
Project Number	2006VT26B
Start Date	3/1/2006
End Date	2/29/2008
Research Category	Water Quality
Focus Categories	Geomorphological Processes, Hydrology, Models

Principal Investigators		
Name	**Rank During Project Period**	**Affiliation**
Donna Rizzo	Assistant Professor	University of Vermont
Leslie Morrissey	Associate Professor	University of Vermont

Funding				
Funding Period	**Federal 104 Funds**	**Required 104 Matching Funds**	**Other Funding**	
			Source	**Funds**
FY2007	$57,696	$41,423		

This project received follow-on funding after completion as a section 104-funded project (Yes ___ No _X_). *If yes, please describe the funding period, source and amount in the funding table.*

Student Support		
Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	0	0
Masters	1	1
Ph.D.	1	1
PostDoctoral	0	0

Publications	
Publication Type	**Publication Citation**
Articles in Refereed Scientific Journals	Hackett W., P.R. Bierman, L.E. Besaw and D.M. Rizzo, In Review, Increasing and Cyclical Trends in Precipitation and Runoff in the Winooski River Basin, Northern Vermont, Journal of Hydrology.

Articles in Refereed Scientific Journals	Besaw, LE., D.M. Rizzo, P.R. Bierman, and W. Hackett, In Revision, 2009, Advances in Ungauged Streamflow Prediction using Neural Networks, Journal of Hydrology. doi: 10.1016/j.jhydrol.2010.02.037.2010.
Articles in Refereed Scientific Journals	Besaw, LE., D.M. Rizzo, M. Kline, K.L. Underwood, J.J. Doris, L.A. Morrissey and K. Pelletier, 2009, Stream Classification using Hierarchical Artificial Neural Networks: A Fluvial Hazard Management Tool, Journal of Hydrology, Accepted April 6, 2009, DOI: 10.1016/j.jhydrol.2009.04.007, 2009.
Conference Proceedings	Besaw, L.E., K. Pelletier, D.M. Rizzo, L.A. Morrissey and M. Kline, 2008, Advances in Watershed Management and Fluvial Hazard Mitigation using Artificial Neural Networks and Remote Sensing, R. W. Babcock Jr. and R. Walton (Eds.), ASCE 2008 World Water & Environmental Resources Congress, Environmental and Water Resources Institute, Honolulu, HI, May.
Conference Proceedings	Besaw, L.E. and D.M. Rizzo, 2008, Stochastic Conditional Simulation of Berea Sandstone Geophysical Properties with a Counterpropagation Neural Network, R. W. Babcock Jr. and R. Walton (Eds.), ASCE 2008 World Water & Environmental Resources Congress, Environmental and Water Resources Institute, Honolulu, HI, May 2008.
Conference Proceedings	Besaw, L.E., and D.M. Rizzo, 2007, Counterpropagation Neural Network for Stochastic Conditional Simulation: An Application with Berea Sandstone, Seventh IEEE International Conference on Data Mining, N. Ramakrishnam, O. Zaiane, Y. Shi, C. Clifton and X. Wu (Eds.), Omaha, NE, October.
Conference Proceedings	Besaw, L.E., D.M. Rizzo and M. Kline, 2007, Artificial Neural Networks for the Prediction of Channel Geomorphic Condition and Stream Sensitivity, ASCE World Environmental & Water Resources Congress, C. Kabblas (Ed.), Tampa FL, May.
Other Publications	Hackett, W.R., P.R. Bierman and D.M. Rizzo, 2009, Increasing Precipitation, Runoff, Forests, and Pavement over the Last 70 Years, The Winooski River Basin, Geological Society of America Abstracts with Programs, Session No. 8: Climate Signals in Rivers and Streams, (Presentation), Paper No. 8-3., Portland OR, October.
Other Publications	Hackett, W.R., P.R. Bierman, D.M. Rizzo and L.E. Besaw, 2009, Increasing precipitation and runoff interact with land use change over the last 70 years in the Winooski River basin, northern Vermont, WRCC annual meeting, Amherst, Massachusetts, 2009.
Other Publications	Besaw, L.E., D.M. Rizzo, P.R. Bierman, and W.R. Hackett, 2008, Daily stream flow forecasting with Artificial Neural Networks: Application in the Winooski River Basin, Vermont, EOS Transactions, American Geophysical Union, 89 (53), Abstract H31C-0888, Fall Meeting, December.
Other Publications	Hackett, W.R., P.R. Bierman, D.M. Rizzo, and L.E. Besaw, 2008, Increasing Precipitation and Runoff Over the Last 70 Years, the Winooski River Basin, Vermont. Paper Number 301-1. Geological Society of America, Vol. 40, No. 6, p. 468. (POSTER and Invited Presentation), October.
Other Publications	Besaw, L.E., K. Pelletier, N.J. Hayden, L.A. Morrisey and D.M. Rizzo, 2007, Investigating Spatial Interpolation of Light Detection and Ranging Data for Analyzing Fluvial Geomorphic Properties of Streams, EOS Transactions, American Geophysical Union, Fall Meeting, December.
Other Publications	Morrissey, L.A. K. Pelletier, D. M. Rizzo, L.E. Besaw, M. Kline and B. Cahoon, 2007, High Resolution Remote Sensing to Characterize Geomorphic Stability of River Reaches, NEARC Northeast Arc Users Group 22nd Annual Conference, Burlington, VT, November 4-7.

Other Publications	Pelletier, K, L. Morrissey, D. Rizzo, L. Besaw, and M. Kline, 2008, High Resolution Remote Sensing to Characterize Geomorphic Stability of Stream Reaches, NSF Water Dynamics Workshop, November 9-12, 2008, Burlington, VT.
Other Publications	Pelletier, K., L. A. Morrissey, D. M. Rizzo, L. Besaw, M. Kline, and B. Cahoon, 2007, High Resolution Remote Sensing to Characterize Geomorphic Stability of Stream Reaches, Northeast ARC Users Conference, Burlington, VT, November.
Other Publications	Besaw, Lance, 2009, Advances in Artificial Neural Networks with Applications in Surface and Subsurface Hydrology. Ph.D. Dissertation, Environmental Engineering, University of Vermont, Burlington, VT.

Awards and Achievements

[None]

'Evaluating Quantitative ...': 2006VT25B Research Project Description

Title	Evaluating Quantitative Models of Riverbank Stability
Project Number	2006VT25B
Start Date	3/1/2006
End Date	2/29/2008
Research Category	Engineering
Focus Categories	Sediments, Models, Geomorphological Processes

Principal Investigators		
Name	**Rank During Project Period**	**Affiliation**
Mandar Dewoolkar	Assistant Professor	University of Vermont
Paul Bierman	Professor	University of Vermont

Funding				
Funding Period	**Federal 104 Funds**	**Required 104 Matching Funds**	**Other Funding**	
			Source	**Funds**
FY2007	$14,679	$56,276		

This project received follow-on funding after completion as a section 104-funded project (Yes ___ No _X_). *If yes, please describe the funding period, source and amount in the funding table*.

Student Support		
Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	10	0
Masters	5	5
Ph.D.	2	0
PostDoctoral	0	0

Publications	
Publication Type	**Publication Citation**
Other Publications	Borg, Jaron. 2007. Northeast Geotechnical Symposium at University of Massachusetts at Amherst, and Lake Research Conference - !Lake Champlain: Our Lake, Our Future.! Burlington, VT.
Other Publications	Borg, J. and M. Dewoolkar, 2007, Lake Research Conference, Lake Champlain: Our Lake, Our Future, Burlington, VT.

Awards and Achievements

The equipment purchased through this grant (borehole shear tester) has been used by many students in their undergraduate and graduate courses (e.g. capstone senior design, Geotechnical Design) Richard Barrett Foundation scholarships for two undergraduate student researchers related to the Water Center project.
Understanding mechanisms involved in streambank stability - Richard Barrett Foundation - $8,000
Experimental investigation of erosion potential of soils - Richard Barrett Foundation - $8,000

'Phosphorus availability ...': 2006VT27B Research Project Description

Title	Phosphorus availability from the soils along two streams of the Lake Champlain Basin: mapping, characterization and seasonal mobility
Project Number	2006VT27B
Start Date	3/1/2006
End Date	2/29/2008
Research Category	Water Quality
Focus Categories	Nutrients, Non Point Pollution, Water Quality

Principal Investigators		
Name	**Rank During Project Period**	**Affiliation**
Donald Ross	Research Assistant Professor	University of Vermont
Joel Tilley	Laboratory Director	University of Vermont

Funding				
Funding Period	**Federal 104 Funds**	**Required 104 Matching Funds**	**Other Funding**	
			Source	**Funds**
FY2007	$8,000	$132,641		

This project received follow-on funding after completion as a section 104-funded project (Yes ___ No _X_). *If yes, please describe the funding period, source and amount in the funding table*.

Student Support		
Degree Level	**Number of Students**	**Number of Dissertations/Theses**
Undergraduate	5	0
Masters	0	0
Ph.D.	0	0
PostDoctoral	2	0

Publications	
Publication Type	**Publication Citation**
Other Publications	Young, E.O., D.S. Ross, J.P. Tilley, K. Underwood, C. Alves, and T. Villars. 2006. Phosphorus availability along two small streams in Vermont: Mapping, characterization and potential mobility. ASA-CSA-SSSA Annual Meeting. Indianapolis, IN. In Agronomy Abstracts.
Other Publications	Alves, C., E.O. Young, and D.S. Ross. 2007. Phosphorus availability in some Vermont floodplain soils. ASA-CSA-SSSA Annual Meeting. New Orleans, LA. In Agronomy Abstracts.

Other Publications	Young, E.O., D.S. Ross, C. Alves and T. Villars. In Revision, Influence of soil series and texture on riparian soil phosphorus concentrations in two Lake Champlain Basin stream corridors. being submitted to The Journal of Soil and Water Conservation.
Other Publications	Young, E.O. and D.S. Ross. 2008. Using laboratory microcosms to study reactive phosphorus release in floodplain soils. Plants & Soils (joint meeting of Northeastern ASA, Canadian Society of Agronomy and Canadian Society of Hort. Sci.), Montreal, July.
Other Publications	Young, E.O., D.S. Ross, C.Alves, T. Villars. 2008. Linking soil-landscape factors to phosphorus levels in Vermont floodplains. Lake Champlain: Our Lake, Our Future, Burlington, January.
Other Publications	Alves, C., E.O. Young, and D.S. Ross. 2007. Evaluating phosphorus availability in Vermont floodplain soils. Annual meeting of the Soil Science Society of America, New Orleans, November.

Awards and Achievements

[None]

Reflections on Water

Vermont Water Resources & Lake Studies Center

University of Vermont Extension

VOL. 25

May 2003

NO. 1

MESSAGE FROM THE DIRECTOR

RESEARCH UPDATE:

The Vermont Water Center recently submitted two research proposals to USGS for funding. One is the second year of an exciting project led by Dr. Beverley Wemple of UVM's Geography Department. Dr. Wemple and several colleagues from UVM and the USGS are investigating the impacts of ski area development on high-elevation water quality. Using a paired watershed approach on the eastern slopes of Mt. Mansfield, scientists have already detected a distinct difference in runoff volume and water quality between developed and undeveloped watersheds. Analyses to date show elevated levels of suspended solids likely coming from ski trails and parking lots and some contamination of streams by deicing salts. Work during the upcoming year will include development of a hydrological model designed to assess the effects of current development and future scenarios on stream flow and water quality.

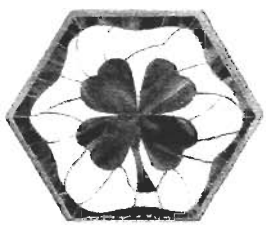
The second project, initiated last year with seed funding, will be substantially expanded this upcoming field season. A team of School of Natural Resources scientists led by Dr. Suzanne Levine has been experimenting with the use of satellite imagery to detect the presence and extent of blooms of blue-green algae in Lake Champlain and other Vermont lakes. Analysis this past summer using Landsat imagery clearly demonstrated its potential to detect and characterize algal blooms from space. While spatial and spectral limitations of Landsat imagery are a concern, ENVISAT, a recently launched Earth observation satellite, carries a MERES sensor specifically designed to analyze color. The research team this field season will evaluate the MERES imagery of Lake Champlain in the hope that this technology might revolutionize our ability to monitor noxious algal blooms in Vermont lakes. One potential outcome might be an early warning system alerting state lake managers when blooms are beginning to form.

ODDS AND ENDS:

Fall meeting in the works: we'll be hosting our annual meeting this fall on the UVM campus. In addition to updates from on-going and recently completed research projects, we're planning to organize a workshop on the storm water issue. Building on the January 2002 workshop which looked broadly at the scientific, engineering, policy and legal aspects of the issue, next fall's session will take a more intensive look at local storm water issues. We may also have some exciting news about support for a storm water project by that time. *More details to follow.*

Table of Contents

Federal budgeting problems again: once again the federal budget for '04 has neglected to include funding for the national Water Center program. While we hope that Congress will once again restore our funding, letters of support to our delegation on behalf of the Water Center program would be most welcome. Contact Murphy MacLean (802-656-4057) if you'd be willing to write such a letter. Thanks.



4-H / Youth Gardening Program Teaches Water Quality

Monika Baege, Extension 4-H Youth Specialist, received funding from the U.S. Department of Agriculture to develop and implement a water quality curriculum module for the 4-H Summer Gardening Program. This program is free and open to all youth ages 6-18 in Washington County. Sarika Tandon, Extension Program Assistant, developed the water quality module in conjunction with Michelle Monagas, Extension Youth Gardening Program Coordinator, who was responsible for the workshops and other events. In 2002, 108 youth and 56 adult volunteers actively participated in this program. The gardening program has four major components: 1) a May workshop at which youth attend three mini workshops about gardening where they receive free plants, seeds, and information packets; 2) midsummer events at which youth exhibit their produce and participate in educational activities; 3) garden visits by adult Master Gardeners who give advice; and 4) youth are recognized and honored for their efforts at local Rotary banquets.

The purpose of the water quality curriculum module is to help youth understand the connection between gardening and water quality. This curriculum, together with the overall 4H gardening program covers the following themes: groundwater, pollution, soil preparation, irrigation, pest management, fertilizers, composting, erosion, and drought.

Evaluation of the new water quality module indicated that all who responded to the survey implemented one or more strategies to conserve and protect water resources. Most notably, 90% of youth and parents responding to the survey stated that they use little or no chemical fertilizers or pesticides in their garden as part of their commitment to protecting water resources. These results show that participants gained skills and knowledge that supports an environmental ethic and stewardship of natural resources. For more information, contact Monika Baege or Michelle Monagas in the Berlin Extension office at (866) 860-1382.

Dr. William (Breck) Bowden

Patrick Professor for Watershed Science and Planning - School of Natural Resources–University of Vermont

In 2002, Breck was invited to occupy the newly created Patrick Chair in Watershed Science and Planning. This position was made possible by a generous, $1 million gift from the Robert and Genevieve Patrick Trust to the School of Natural Resources at The University of Vermont. The purpose of this endowed Chair is to promote research, teaching, and outreach on sustainable management of natural resources through an integrated watershed management perspective. This integrated perspective includes multiple disciplines, diverse stakeholders, participatory processes, and a focus on the links between environmental, social, and economics processes.

Breck received his B.Sc. with majors in both Zoology and Chemistry from the University of Georgia in 1973. He earned his M.Sc. from North Carolina State University for a project in which he developed a novel method to enumerate bacteria in estuarine water samples, with a scanning electron microscope. Breck continued his academic affiliation with North Carolina State University, but moved to the newly formed Ecosystems Center of the Marine Biological Laboratory in Woods Hole, Massachusetts (USA) to co-lead an interdisciplinary research project focused on the structure and function of tidal, freshwater wetlands, a little-studied but important wetland type on the east coast of the United States. Breck earned his Ph.D. in 1982, for his work on nitrogen cycling in this wetland type.

In 1982, Breck moved to Yale University where he worked with Dr. Herbert Bormann, co-founder of the Hubbard Brook Ecosystem Study, as a Post-Doctoral Fellow. Breck lead a project that focused on the impacts of whole-tree harvesting – at the time a relatively new form of forest management in the northeastern US – on emissions of nitrous oxide from soils to the atmosphere. Nitrous oxide in an important contributor to climate change through "greenhouse" warming and has been implicated as a potentially important sink in the terrestrial nitrogen cycle. While at Yale, Breck began his teaching career, in water resources management.

In 1987 Breck moved to the University of New Hampshire as an Assistant Professor, to establish a new undergraduate program in Water Resources Management, in what is now the Department of Natural Resources. This new program complemented existing programs in Forestry, Soils, Wildlife, and Environmental Conservation. After establishing the undergraduate program in Water Resources Management, Breck assisted with an important restructuring of the M.Sc. programs with the Department of Natural Resources and lead initial efforts to develop what has become a very successful interdisciplinary Ph.D. program in Natural Resources. While at UNH, students in the department twice selected Breck for their annual Distinguished Professor award. In 1991 the University honored him by naming him as Outstanding Assistant Professor. He was promoted to Associate Professor of Water Resources Management, with tenure, in 1992.

In 1997 Breck accepted a new position as Team Leader for Catchment and Biospheric Processes at Manaaki Whenua Landcare Research New Zealand, Ltd. in Lincoln, New Zealand. Shortly thereafter, he was also appointed as Programme Leader for the Integrated Catchment Management Programme. The goal of this program is to improve the ability to manage land and water resources in New Zealand to achieve ecological sustainability and maintain biodiversity. This program is ongoing and has served as a model for collaboration among research organizations and among researchers and stakeholder groups, including indigenous Maori communities. While in New Zealand, Breck helped develop opportunities for U.S. undergraduate students to study sustainable management of natural resources through his involvement as an Advisory Board Member for EcoQuest International, a novel study-abroad program located in Kaiaua, near Auckland.

In addition to his formal appointments, Breck has been a member of the Arctic Long-Term Ecological Research (ArcLTER) program since 1987. The ArcLTER is a multi-institutional and multi-disciplinary program managed by the Ecosystem Center in Woods Hole, Massachusetts. This research program focuses on the influences of direct and indirect human impacts on the basic ecology of terrestrial, lake, and stream ecosystems in the Arctic. Breck continues to collaborate with a team of scientists who have focussed on stream ecosystems and their functions in the Arctic landscape.

Breck speaks frequently at public and professional meetings and is the author of over 60 scientific papers and reports. He lives in Burlington, Vermont with his wife Linda. His oldest son, Jared, is a Psychology student at the University of Otago. His younger son, Seth, is an Economics student at the University of Vermont.

PUBLICATIONS

Dairy Manure Systems: Equipment and Technology (NRAES-143), is the proceedings from a conference held March 20-23, 2001 in Rochester, NY. Included are 34 papers authored by manure-systems experts from the U.S. land-grant university system; dairy producers; and both U.S. and Canadian government officials and private-sector equipment representatives. Available for $30 plus shipping and handling of $5.50 from NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, NY 148535701. Contact NRAES by phone at (607) 255-7654 or by e-mail at nraes@cornell.edu.

Guide to Hydric Soils in New England (TR016 Guide) helps field personnel identify and document hydric soils and their boundaries. Updated pages are provided as needed. Available for $5.00 from the New England Interstate Water Pollution Control Commission, Boott Mills South, 100 Foot of John Street, Lowell, MA 01852-1124 or call (978) 323-7929 or e-mail at mail@neiwpcc.org.

Onsite Wastewater Treatment Systems Manual published by the U.S. Environmental Protection Agency is available from the National Service Center for Environmental Publications (NSCEP). Besides covering system siting, design, installation, maintenance, and replacement, the manual discusses significant advances that can help onsite systems become more cost effective and environmentally protective. Specify EPA document number 625/R-00/008 when ordering. Available by phone at (800) 490-9198 or e-mail at www.epa.gov/ncepihom/ordering.htm.

Visit the Vermont Water Resources and Lake Studies Center website at: www.uvm.edu/snr/vtwater for information about the Water Center and the School of Natural Resources at The University of Vermont.

The American Water Works Association Research Foundation has launched a new web site designed to help water utility personnel, state drinking water administrators, and source water coordinators address requirements for Source Water Assessment Programs. Available at www.drinkingH2O.com/swap, the site features databases that contain information for each U.S. state on source water quality, chemical occurrence, data resources, and helpful contacts. The U.S. Environmental Protection Agency offers a good source of information for public water supply systems. View this site at www.epa.gov/safewater/.

The U.S. Environmental Protection Agency offers private well owners that might be facing a contaminated well from a flood or other event an educational web site at www.epa.gov/safewater/consumer/whatdo.htm.

Homeowners who rely on septic systems to treat their household wastewater can click onto www.bae.ncsu.edu/programs/extension/publicat/wqwm/septic.html. The following publications are available at this site: Septic Systems and Their Maintenance, Management of Single Family and Small Community Wastewater Treatment and Disposal Systems, Investigate Before You Invest, and About Septic Systems: What You Need to Know.

MEETINGS/WORKSHOPS

June 2-5, 2003 In Situ and On-Site Bioremediation: The Seventh International Symposium, Disney's Coronado Springs Resort, Orlando, FL. Will consist of 53 sessions and 40 exhibits. Will facilitate technology transfer and will integrate the latest developments in fundamental research with innovative engineering applications. Sponsored by Battelle who charges a separate fee for each day's courses. For more information contact by e-mail at battelle.org/biosymp.

July 28 - 31, 2003, The North American Surface Water Quality Conference & Exposition, will be held at the Marriott Rivercenter, San Antonio, Texas. For more information go to www.StormCon.com.

June 29-July 2, 2003 Watershed Management for Water Supply Systems, New York, NY. Sponsored by the American Water Resources Association (AWRA), the congress is organized around three major tracks: Science and Technology, Education and Outreach, and Management and Policy. The congress will address the management of water supply watersheds where public and private forestry, agriculture, and other relevant land uses are practiced in all or part of the supply catchments and ground water recharge zones. For more information refer to the AWRA web site at awra.org.

July 29 - August 1, 2003, "Protecting Public Health: Water and Wastewater Solutions for a New Era", will be presented by the National Environmental Training Center for Small Communities at the Mountainlair Conference Center, Morgantown, West Virginia. For more information go to www.netc.wvu.edu or call 1-800-624-8301 extension 5536.

November 3 - 6, 2003, American Water Resources Association Annual Conference, Hilton San Diego Resort Hotel, San Diego, CA. This conference is a forum for all participants of the water resources community. The focus of this year's conference is providing reliable water supplies in the face of many challenges. Questions on registering can be submitted to Harriette Bayse, at harriette@awra.org or by calling 1-540-687-8390.

AQUACULTURE CORNER

Controlling Algae in Ponds: A Tale Of Bales Of Barley Straw & Algae (Mark Leslie in Wisconsin Aquaculture Association, March 2003).

While science and technology are striving to remove algae from ponds, some superintendents are accomplishing the task with a simple bale of barley straw.

"Generally speaking, I'd say it works," said Gordon Witteveen, director of golf maintenance for the board of Trade's five golf courses here. Witteveen, who has two or three bales of barley straw in each of his half-dozen ponds, said, "We've implemented it and had pretty darn good success."

Two bales per acre of pond is sufficient, he said. He also suggested wrapping the bale with chicken wire or fishing net to prevent its falling apart when it decomposes. The bale floats, anchored by a string tied to a cement block.

"In Canada we can't use any dye or chemicals for aquatic weed control in non-self-contained ponds. If the pond is self-contained, you can use chemicals, but you must get a permit for every application," Witteveen said. "Mechanical harvesters, or long rakes can take algae out. Fountains work well too. This (barley straw) is another tool."

But why would barley straw rid a pond of algae? "This is my theory," said Dr. Eric Nelson of Cornell University, who has seen this method work. "It ties up nitrogen during decomposition of the barley straw. And since it's the nitrogen in the water that promotes algal blooms, they stop. "I have not seen any research to prove this, but it makes sense. When you mulch plants with wood chips sometimes those chips pull nitrogen right out of the plant."

WEBSITES

The Aquaculture Network Information Center http://aquanic.org is a gateway to the world's electronic aquaculture resources. The goals of AquaNIC are to:

1.Provide access to all electronic aquaculture information at the national and international level.
2.Increase the quantity and quality of electronic information available to the aquaculture industry.
3.Provide self-paced aquaculture instruction to the aquaculture industry.
4.Obtain user input in directing AquaNIC services.

The mission of the Regional Aquaculture Centers is to support aquaculture research, development, demonstration, and extension education to enhance viable and profitable U.S. aquaculture that will benefit consumers, producers, service industries, and the American economy. Two centers are important to those interested in aquaculture in Vermont and northern New York. The Northeastern Regional Aquaculture Center (NRAC) http://www.umassd.edu/specialprograms/nrac/ is a principal public forum for the advancement and dissemination of science and technology needed by Northeastern aquacultural producers and support industries. The North Central Regional Aquaculture Center http://ag.ansc.purdue.edu/aquanic/ncrac/index.htm supports more than 1,000 producers of food fish, baitfish, and fish for stocking into recreational water bodies.

These websites support a highly diverse range of producers, ranging from well established producers who have made a significant capital investment and are interested in ways of reducing production costs while increasing output to those who could be classified as newcomers, who need training, capital, and an awareness of the potentially high risk, high investment, and low returns that most producers encounter.

This newsletter is prepared by Linda Marek Howe, Extension Water Resources Specialist, University of Vermont Extension, 617 Comstock Road, Suite 5, Berlin, VT 05602-9194, (802) 223-2389; Dr. Alan McIntosh, Director, Vermont Water Resources and Lake Studies Center, School of Natural Resources, University of Vermont, George D. Aiken Center, Burlington, Vermont 05405-0088, (802) 656-4057; and Dr. Jurij Homziak, Lake Champlain Sea Grant Program, School of Natural Resources, George D. Aiken Center, University of Vermont, Burlington, VT 05405-0088, (802) 656-0682. This newsletter is published with funds provided in part by the U.S. Geological Survey, Department of the Interior, as authorized by the Water Resources Research Act of 1984 and by the University of Vermont Extension System and U.S. Department of Agriculture.

Linda M. Howe
Extension Water Resources Specialist

Reflections on Water

Vermont Water Resources and Lake Studies Center at The Universityof Vermont

May 2004

Al McIntosh, Director

Jurij Homziak
Lake Champlain Sea Grant

Director's Message

As the Vermont winter has turned into spring, another field season approaches. The Vermont Water Center's research program for the upcoming year has just been approved by the U.S. Geological Survey. We'll be continuing to support a project by Rubenstein School of Environment and Natural Resources (RSENR) faculty Suzanne Levine, Leslie Morrissey and Gerry Livingston focused on the detection of blue-green algal blooms using remote sensing. The research team is correlating satellite imagery of Lake Champlain and several smaller Vermont lakes with field data to assess the usefulness of remotely sensed data to detect and describe blooms of noxious lake algae. Last summer saw major blue-green blooms in portions of the lake, and we hope that the results from this project will provide lake managers a tool for getting a jump on developing blue-green blooms.

A new project addressing the contributions of high-elevation forested watersheds on stream bacteria levels will be initiated by Professor Leslie Morrissey. There has been a recent debate about whether or not "pristine" watersheds contribute significant amounts of bacteria to streams. While one previous study in Vermont documented the contributions of two small streams to fecal bacteria levels in an undeveloped watershed, there are few data regarding this issue in high-elevation watersheds in the Northeast. Dr. Morrissey will compare stream water quality in two high-elevation forested watersheds, one developed and one undeveloped, in northern Vermont to quantify the contribution of the undeveloped watershed to bacteria levels in adjacent streams. The study will provide valuable baseline data as additional development in Vermont's forested watersheds is considered.

Another Water Center project is well underway. With funding from the US EPA, a group of scientists from RSENR and the Gund Institute is working in a suburban development, Butler Farms/Oak Creek in South Burlington, VT, to develop an approach for most effectively managing storm water runoff in the development. The research team is working with community members to evaluate storm water mitigation steps ranging from rain gardens and barrels at the individual home owner level to neighborhood modifications like enhanced wetlands in a natural area below the development. By factoring in environmental, social and economic concerns, the research team hopes to work with the residents of Butler Farm/Oak Creek to develop a model that can be used in other developing areas to pinpoint the best approaches for dealing with the highly controversial problem of storm water management. Butler Farm/Oak Creek homeowners have been surveyed about the issue, and a recent initial meeting with some of the residents to discuss storm water is the first step in an on-going effort to tackle this issue.

From the Desk of Jurij Homziak

AQUAPONICS: BASIL AND TILAPIA

There are opportunities in aquaculture in Vermont. Growth in recognition and demand for tilapia has also opened opportunities for indoors, closed system production, especially combining fish and hydroponics produce, known as aquaponics.

Aquaponic production methods were pioneered at the University of the Virgin Islands (UVI). High value produce, such as herbs, lettuce and tomato, are the principal crops, with tilapia producing additional revenue. Sweet basil is one of the easiest plants to grow in an aquaponic system. Basil can tolerate a wide range of nutrient levels. The largest commercial aquaponic facility in the U.S., Bioshelters in Amherst, Massachusetts, has been growing basil commercially for nearly 15 years in a tilapia production system. They are believed to produce approximately 600 cases of basil leaves weekly. Demonstration systems at UVI have produced commercial quantities of lettuce and basil for many years under a variety of conditions.

Design of aquaponic sytems varies greatly. References to such systems are available at http://www.aquaponics.com. The fish and plants you select for your aquaponic system should have similar needs as far as temperature and pH. There will always be some compromise to the needs of both but, the closer they match, the more success you will have. As a general rule, warm water fish and leafy crops such as lettuce and herbs will do the best. In a system heavily stocked with fish, you may have luck with fruiting plants such as tomatoes and peppers. Species that do well in aquaponics include:

- tilapia
- largemouth bass
- sunfish
- bream
- crappie
- koi
- carp
- crayfish
- almost any ornamental fish such as angelfish, guppies, tetras, gouramis, swordfish, mollies

The general guideline from UVI is to feed the fish at a ratio of 57 g per square meter of plant growing area per day. This ratio provides the good nutrient levels for fish and basil. Equal amounts calcium hydroxide and potassium hydroxide are added as needed to maintain pH near 7.0. Chelated iron (2 mg/L) is added every 3 weeks. Maintaining adequate nutrient concentrations is essential for lettuce and sweet basil production. Recommended ranges are given in http://www.aquaponics.com/aj_qa.htm.

Bioshelters' ratio of feeding to plant growing area is much higher than the UVI system, approximately 1400 g per square meter per day. This reflects some of the important differences between the two systems. UVI removes sludge (organic solids) from the system very slowly (up to 1 week) so that it mineralizes, releasing in dissolved form many of the nutrients tied up in organic compounds. Bioshelters removes particulate organic waste very rapidly (in just a matter of minutes) from their system. UVI uses soft rainwater, while Bioshelters uses hard well water. Bioshelters has sufficient potassium in their well water but needs to supplement with calcium in the form of a base. Bioshelters also applies iron as a foliar spray and has to correct for phosphorus deficiency, evident as leaf elongation.

Tom Speraneo of West Plains, MO, has developed an integrated system based on tilapia and basil culture. Speraneo modeled his system after a model at North Carolina State University, then modified it extensively to get where he is today. He has also raised tomatoes and cucumbers but finds herbaceous plants are better adapted than heavy-feeders

like fruiting plants. Effluent from the bottom of the fish tanks is trickle irrigated "directly" onto gravel-cultured hydroponic vegetable beds. There is no intermediary stage like a biofilter or nitrifier. The plant roots and bacteria living in the gravel serve as the biofilter. They remove the nitrates and other nutrients as food. The purified water is then recirculated back to the fish tanks after going through an aerator.

The fertility input to hydroponic production is the fish food. Adjustment of protein level in the fish food helps regulate pH, etc. Fish metabolites (i.e., manure), decomposing fish food, and algae are the source of nutrients. The bacteria in the gravel run the whole show. To inoculate the system, you collect a liter of tank water from a plain home aquarium and dump it into the fish tanks.

The product, tilapia, is secondary. The largest biomass and most salable product is the vegetable/herb produce. Peak production is an estimated 70 lbs produce for every 1 lb. tilapia.

The Freshwater Institute in West Virginia focuses on cutting edge recirculating trout aquaculture. Using oxygenation and ozonation, plus demand feeders and injected aerated stream water, they are able to get impressive trout yields in tanks. Recirculated water is treated with an expensive clarifier, sand biofilter, and aerator. Prior to returning the water back to the natural stream, they remove the several hundred parts per million of excess nutrients by running it through aquaponic greenhouses. Aquaponic plants raised include strawberries and lettuce. Plant production is solely based on nutrients in used fish tank water except for iron injection.

Contrasting these systems illustrates the wide range in growing conditions under which fish and produce will thrive. Produce, from strawberries to basil to lettuce, would do well with any type of standard hydroponic nutrient formula but aquaponics provides most of the necessary nutrients for free using aquaculture effluent.

Additional details on all of these systems can be found at the Appropriate Technology Transfer for Rural Areas (ATTRA) website: http://attra.ncat.org/attra-pub/aquaponic.html.

An excellent example of small scale commercial aquaponic production suitable for Vermont is the Energy Xchange/Project Branch Out in Burnsville, NC. This aquaponic greenhouse produces tilapia, along with basil, cilantro, and other produce. Fish are sold directly to the public. Contact them at:

66 EnergyXchange Dr.,
Burnsville, NC 28714
828-675-5541
energy@yancey.main.nc.us
www.energyxchange.org

Jurij Homziak
Executive Director and Watershed Specialist
Lake Champlain Sea Grant

Helping to address the storm water problem:

Professors Breck Bowden and Alan McIntosh recently organized a storm water field trip for the members of the Vermont House of Representatives Fish and Wildlife Committee. Also accompanied by Linda Seavey, Director of UVM's Campus Planning Services, Bob Penniman of CATMA, and Bill Nedde, a consulting engineer from Krebs and Lansing, the group looked at several degraded local streams and a variety of Best Management Practices for storm water control. The tour included a stop at the Water Center's RAN project in the nearby Butler Farms/Oak Creek subdivision (see related story Director's message).

Meetings/Conferences of Interest

May 22–26 - **Missouri River Natural Resources Conference**, Columbia, Missouri. See www.infolink.cr.usgs.gov.

May 23–26 - **Measure for Measure: How Do We Gauge Coastal Stewardship? The Coastal Society 19th International Conference,** Newport, RI. See www.thecoastalsociety.org/conference/tcs19/. Contact Judy Tucker, coastalsoc@aol.com, 703/768-1599.

May 23–27—**28th - Annual Larval Fish Conference,** Clemson, SC. See www.lfc2004.org/. Contact Howard Browman, howard.browman@imr.no, 47 56 18 22 64.

May 24, 2004 - May 29, 2004 - 6th Symposium on Fish Immunology, Turku, Finland: organized by the Nordic Society for Fish Immunology (NOFFI). Scientists from all over the world, working on basic or applied aspects of fish immunology are invited to participate and present their work. The meeting is divided into two parts: a two day workshop on May 24 - 25 on Luminescence Applications for Fish Immunology and a three day scientific symposium on May 26 – 29 with lectures and poster sessions. For additional information: http://www.noffi.org/finland2004/

May 30 - June 3, 2004 - The Sixth International Conference on Hydro-science and Engineering
Brisbane, Australia

The conference will provide a forum to exchange new research findings, engineering approaches, practice experiences, ideas and opinions of professionals in all branches of water resources and environmental science, engineering, planning, management, etc. For additional information:
http://www.ncche.olemiss.edu/iche2004/index.php

Jun 3–Jul 1 - **The University of Rhode Island Coastal Resources Center's Summer Institute in Coastal Management**, Narragansett, RI. See www.crc.uri.edu. Contact Kim Kaine, kkaine@gso.uri.edu.

Jun 2–6—**International Symposium on Society and Resource Management: Human-Wildlife Conflict Session,** Keystone, CO. Contact Ketil Skogen, Human Dimensions in Natural Resources Unit, Colorado State University.

June 13–18—**American Society of Limnology and Oceanography 2004 Summer Meeting: The Changing Landscapes of Oceans and Freshwater,** Savannah, GA. See www.aslo.org/meetings/savannah2004/. Contact Helen Schneider, helens@sgmeet.com, 254/77i6-3550.

Jun 25–27—**International Marine Aquarium Conference**, Chicago, IL. See www.theimac.org. Dennis Gallagher, dennis2103@comcast.net.

June 28-30, 2004 - **AWRA's 2004 Summer Specialty Conference**
Riparian Ecosystems and Buffers:
Multi-scale Structure, Function, and Management
The Resort at Squaw Creek
Olympic Valley, CA
For additional information: http://www.awra.org/meetings/Olympic2004/

Jun 28–30—**Riparian ecosystems and buffers: multi-scale structure, function, and management**, Olympic Valley, CA. See www.awra.org.

Jul 11-14—**Watershed 2004**, Dearborn, MI. See. www.wef.org/pdffiles/Watershed04Call.pdf.

Jul 11–16—**Third International Symposium on Fish Otolith Research and Application**, Queensland, Australia. See www.Otolith2004.com. **Contact** Otolith2004@ozaccom.com.au, +61 (0)7 3854 1611.

Jul 19–23—**Fisheries Society of the British Isles International Symposium: Comparative Biology and Interactions of Wild and Farmed Fish**, London, UK. See http://fp.paceprojects.f9.co.uk/FSBI2004home.htm. **Tricia Ellis-Evans,** tricia@paceprojects.co.uk.

Jul 21–23—**Climate Change and Aquatic Systems: Past, Present, and Future**, Plymouth, UK. See www.biology.plymouth.ac.uk/climate/climate.htm. Contact Martin Attrill, matrill@plymouth.ac.uk.

Aug 1–5—**AFS International Congress on the Biology of Fishes**, Manaus, Brazil. Contact Chris Kennedy, ckennedy@sfu.ca, 604/291-5640.

Aug 3–6—**Hydric Soils Workshop,** Norfolk, VA. Contact Ralph Spagnolo, spagnolo.ralph@epa.gov.

Aug 15–22—**Second International Symposium on Riverine Landscapes,** Bredsel, Alvsbyn, Sweden. See www.riverine-landscapes.ch. Contact Roland Jansson, roland.jansson@eg.umu.se, +46-90-786 95 73.

Aug 21–26—**AFS 134th Annual Meeting: The Gathering: Leopold's Legacy for Fisheries**, Madison, WI. Contact Betsy Fritz, bfritz@fisheries.org, 301/897-8616, ext. 212

Sep 12–15—**Restore America's Estuaries' 2nd National Conference on Coastal and Estuarine Habitat Restoration,** Seattle, WA. See www.estuaries.org/2ndnationalconference.php. Contact Nicole Maylett, nmaylett@estuaries.org.

Sep 12–17—**Fifth International Symposium on Ecohydraulics: Aquatic Habitats: Analysis and Restoration,** Madrid, Spain. See www.tilesa.es/ecohydraulics. Contact ecohydraulics@tilesa.es, +3491-361 2600.

Sep 18–22—**The Wildlife Society 11th Annual Conference: Excellence in Wildlife Stewardship through Science and Education,** Calgary, Alberta, Canada. See www.wildlife.org. Contact tws@wildlife.org, 301/897-9770.

Sep 20–22—**Wild Trout VIII Symposium: Working Together to Ensure the Future of Wild Trout,** Yellowstone National Park, WY. See www.wildtrout8.org. Contact Robert Carline, rcarline@psu.edu, 814/865-4511.

Sep 30–Oct 3—**22nd Wakefield Fisheries Symposium: Sea Lions of the World: Conservation and Research in the 21st Century,** Anchorage, AK. See www.uaf.edu/seagrant/Conferences/sealions. Contact 907/474-6701.

Oct 20–23—**Aquaculture Europe 2004: Biotechnologies for Quality**, Barcelona, Spain. See www.easonline.org/agenda/en/AquaEuro20004/default.asp. Contact ae2004@aquaculture.cc.

Nov 9–11—**Fifth Florida State University Fisheries Symposium: The Good, the Bad, and the Ugly: Integrating Marine and Human Ecology in Fisheries Management**, Sarasota, FL. See www.bio.fsu.edu/mote/current.html. Contact Felicia Coleman, coleman@bio.fsu.edu.

Dec 3–4—**Fourth Biennial Northeast Aquaculture Conference and Exposition: From the Mountains to the Sea,** Manchester, NH. See www.northeastaquaculture.com. Contact JJ Newman-Rode, jj.newman@unh.edu, 603/749-1565.

25 - 29 October 2004 - **International Conference on Isotopes in Environmental Studies - Aquatic Forum 2004**
Monte-Carlo, Monaco

Organized by the International Atomic Energy Agency
Co-sponsored by the Intergovernmental Oceanographic Commission (IOC) of UNESCO Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée (CIESM) *Hosted by the* Government of the Principality of Monaco
http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=118

Publications

The "Guide to Federal Aquaculture Programs and Services" was prepared by the Joint Subcommittee on Aquaculture (JSA) as a directional resource to aquaculture programs and services within the Federal government. This document provides program and service descriptions and World Wide Web links to the homepages of many Federal government agencies or organizations with respect to its aquaculture activities. Sources of contact for further information include addresses, phone numbers, and/or email addresses are included or are located on specific WWW web pages. For additional information:
http://ag.ansc.purdue.edu/aquanic/jsa/federal_guide/index.htm

Guide to Drug, Vaccine, and Pesticide Use in Aquaculture: available in printed form from the Aquaculture Information Center, National Agricultural Library, U.S. Department of Agriculture, 10301 Baltimore Blvd., Rm. 304, Beltsville, MD 20705; 301/504-5558 (telephone) or aic@nalusda.gov (Internet-mail). The guide is also available from state Cooperative Extension Services, state Sea Grant Marine Advisory Services, and national aquaculture associations. For additional information:
http://aquanic.org/publicat/govagen/usda/gdvp.htm

Pond Dynamics/Aquaculture: The Pond Dynamics/Aquaculture Collaborative Research Support Program (PD/A CRSP) represents an international, multi-disciplinary effort to improve human nutrition through pond aquaculture research. The work of the PD/A CRSP benefits both domestic and international aquaculture. For additional Information: http://pdacrsp.oregonstate.edu/

The NFI Species Guide provides detailed information about the various types of fish and shellfish supplied by the seafood industry. Information can be viewed at:
http://www.aboutseafood.com/dictionary/index.html

Aquaculture Magazine Online - Information on Fish Farming, Processing, Breeding and Raising aquatic species including tilapia, trout, salmon, shrimp, catfish, crayfish, oysters, Redclaw, hybrid striped bass and shellfish. Topics include pond management, diseases, market trends, farm stocking, recirculating systems, statistics, selling, nutrition, feed and more. U.S. and international aquaculture industry focus. This Online Magazine can be viewed at: http://www.aquaculturemag.com/

Aquaculture Outlook - Examines the U.S. aquaculture industry: production, inventory, sales, prices, inputs, and trade of catfish, trout, tilapia, salmon, mollusks, crawfish, shrimp, ornamental fish and new species. For additional information: http://usda.mannlib.cornell.edu/reports/erssor/livestock/ldp-aqs/

World Aquaculture Society publishes the "Journal of the World Aquaculture" (http://www.was.org/main/ArticlesMenu.asp?Type=Journal), "World Aquaculture" magazine and many books on aquaculture. For additional information: http://www.was.org/main/FrameMain.asp

The quarterly *Fishery Bulletin* (FB) is the oldest and one of the finest fisheries journals in the world. It has been an official publication of the U.S. Government since 1881, under various titles, and is the U.S. counterpart to other highly regarded governmental fisheries science publications. It publishes original research or interpretative articles in all scientific fields that bear on marine fisheries and marine mammal science. For additional information: http://fishbull.noaa.gov/

NRAC Publications for the Northeastern Region
United States Department of Agriculture
Cooperative State Research Education and Extension Service
Regional Aquaculture Center Program
For additional information http://aquanic.org/publicat/usda_rac/nrac.htm

Alternative Farming Systems Information Center. Aquaculture-Related Internet Sites and Documents. Visit: http://www.nal.usda.gov/afsic/aqua/aquasite.htm

Websites:

Center for Marine Biovidersity & Conservation. http://cmbc.ucsd.edu/
Center for Marine Biodiversity and Conservation (CMBC) programs help us understand, communicate, and work to remedy the impact that humans have on marine ecosystems and, in turn, help the oceans continue to feed, employ, and nourish humans and all life on Earth.

ASLO
As the leading professional organization for researchers and educators in the field of aquatic science, ASLO works to provide for their needs at all phases of professional development. ASLO is best known for its highly rated research journals, its interdisciplinary meetings and its special symposia. The society supports increasingly important programs in public education and outreach and public policy. It strives to encourage student participation and to increase opportunities for minorities in the aquatic sciences.
http://www.aslo.org/

Top Ten Seafoods
.S. Per-Capita Consumption By Species in Pounds
Raw data from National Marine Fisheries Service. 2001 Top Ten calculated by Howard Johnson, H.M. Johnson & Associates for NFI.

Note: *Catfish consumption has been re-calculated to reflect the change in U.S. law that prohibits imported "catfish"— basa, tra, etc. - from being called catfish. The entire listing from 1990 – 2002 can be viewed at: http://www.nfi.org/?a=news&b=Top%20Ten%20Seafoods&PHPSESSID=064155f6a5937fbbe6564f045abff40a

Reflections on Water

Vermont Water Resources and Lake Studies Center at The University of Vermont

June 2005

Breck Bowden,
Director

Jurij Homziak
Lake Champlain
Sea Grant

Director's Message

The Vermont Water Resources and Lake Studies Center supported two major research projects during FY2004. One a project, lead by Drs. Suzanne N. Levine and Leslie A. Morrissey, addresses Cyanobacterial (blue-green algal) blooms that have recently become a major nuisance and potential health threat in Lake Champlain. Some species of cyanobacteria produce neurotoxins that may cause serious illness and even death in humans. So far there have been no incidents of human health problems associated with cyanobacterial blooms, but several years ago two pet dogs died from drinking water heavily infested with cyanobacterial. Since that time cyanobacterial cell numbers have been monitored seasonally and a plan has been developed to monitor the toxin levels in the water. However, the efficiency of sampling these blooms and developing timely management plans is hampered by their extremely patchy distributions in time and space. The primary goal of this project was to investigate whether remote sensing tools could be used to reliably identify cyanobacterial blooms in the lake. The project participants assessed a variety of potential remote sensing platforms and products, acquired several test images, developed and tested algorithms to predict cyanobacterial abundance from the imagery and verified the remote sensing predictions through a groundtruthing protocol. The results of the project suggest that remote sensing can be successfully employed to identify cyanobacterial blooms. Some continued refinement of the algorithms is on-going.

The Center also supported a project led by Dr. Leslie A. Morrissey. This project is a complement to an ongoing paired watershed that is focused on the effects of ski development on water quality. The ski industry is important in Vermont. There are numerous ski developments in the state that exert pressures through associated developments. These developments are expanding in Vermont and there is concern that continued development might impair these healthy streams. Fieldwork completed in the first year of this project shows that fecal bacteria are not abundant in streams during baseflow. However, during storm events levels of fecal coliform bacteria in excess of the state standards were detected in stream water draining both the developed and undeveloped watershed. The sources of this contamination are currently not known. Work will continue this coming year on land use/land cover classification using remotely sensed data to help identify and assess the risks of fecal contamination from various sources.

In addition to oversight of these two projects the Water Center continues to play a leadership role in evolving strategies of land and water management in Vermont. In particular, the Water Center has been instrumental in obtaining funds from EPA and the Agency of Natural Resources for research that is urgently needed to support management decisions about urban stormwater management in rapidly developing areas in Vermont. These projects include efforts to identify impairments to ecosystem functions in stormwater impacted streams, a project to identify key indicators of geomorphic change in urban streams, a project to find ways to better involve citizen stakeholders in decisions about local stormwater management, a project to develop new hydrological and GIS based tools to prioritize stormwater permitting activities, and a project to identify whether and how neighborhood 'types' influence stream health. All of these projects are relevant to key policy and management needs identified by local stakeholders. The Vermont Water Resources and Lake Studies Center continues to be a visible and trusted source of data and knowledge about these issues.

From the Desk of Jurij Homziak

Lake Champlain Sea Grant http://www.uvm.edu/~seagrant/, one of 32 Sea Grant programs nationwide, is the first bi-state, basin-based program. LCSG outreach, education and research support science based watershed and aquatic resources stewardship, water quality protection and sustainable development of the Lake Champlain basin.

Based at the University of Vermont (UVM), and Plattsburgh State University (PSU), Sea Grant is led by Dr. Larry Forcier. UVM-based staff include: Jurij Homziak, Executive Director, Caitrin Noel, Watershed Alliance Coordinator, and Emma-Lynn Melvin, Water Quality Specialist. Plattsburgh State staff are Mark Malchoff, Aquatic Resources Specialist and Doug Furman, Watershed Educator.

Mark Malchoff works with living aquatic resources, such as fisheries and aquatic nuisance species http://research.plattsburgh.edu/LakeChamplainSeaGrantAquatics/. Jurij Homziak focuses on watersheds, water quality, water quality education. Emma-Lynn Melvin supports local offcials in protecting local water quality. Caitrin Noel leads watershed based education, monitoring and service programs for middle and high school youth in the bi-state basin http://www.uvm.edu/%7Ewatershd/

Our mission is to address critical aquatic issues through high quality research, outreach and education so that individual, community, business, academic and other northern New York and Vermont stakeholders may contribute to decisions that better conserve, utilize and rehabilitate Lake Champlain Resources.

Sea Grant Extension educational methods include:

- fact sheets
- workshops
- meeting presentations
- newspaper articles
- radio and TV interviews, web pages

K-12 teacher training

Sea Grant Topical Areas include:

- water quality
- watershed stewardship
- fisheries
- nuisance aquatic species

K-12 watershed education

For additional information, please visit our websites
Lake Champlain Sea Grant http://www.uvm.edu/~seagrant
Lake Champlain Sea Grant at Plattsburgh State http://research.plattsburgh.edu/ LakeChamplainSeaGrantAquatics
Watersehd Allaince http://www.uvm.edu/~watershd/

Jurij Homziak
Executive Director and Watershed Specialist
Lake Champlain Sea Grant

Alan McIntosh | **Redesigning The American Neighborhood**

The RAN project is well into its second year of funding, thanks to the good efforts of Senator James Jeffords and his staff. We are working with the residents of Butler Farm/Oak Creek Village (BF/OCV), a development in South Burlington, to try to come up with a storm water management approach in the neighborhood that considers environmental, social and economic factors. There is a great deal of interest in the issue in BF/OCV as a storm water utility has formed in South Burlington, and residents have become aware that they will need to address the problem. We hope to put into place this summer several projects, perhaps including rain gardens on individual lots, designed to demonstrate some of the low-impact approaches to managing storm water runoff in suburban developments. Our overall goal is to help the neighborhood design an approach that is both effective and widely acceptable to BF/OCV residents.

Meetings/Conferences of Interest

On-Going Workshop – Hazard Analysis Critical Control Point (HACCP). Alaska. http://www.uaf.edu/map/haccp/index.html

August 5-9 – European Aquaculture Society. Aquaculture Europe 2005 "Optimising the Future." Trondheim, Norway. http://www.easonline.org/agenda/en/AquaEuro2005/default.asp

September 6 -7 – International Conference: Chernobyl - Looking Back to Go Forward. Towards a United Nations Consensus on the Effects of the Accident and the Future. Vienna, Austria. http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=141

September 13–15 – American Fisheries Society 135th Annual Meeting. Biology, Assessment, and Management of North Pacific Rockfishes. Anchorage, Alaska. http://www.uaf.edu/seagrant/Conferences/symposia.html

September 27–28 – IAEA SCIENTIFIC FORUM 2005. Nuclear Science: Physics Helping the World. Vienna, Austria. http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=138

October 3–7 – International Conference on the Safety of Radioactive Waste Disposal. *Organized by the* International Atomic Energy Agency. Tokyo, Japan. http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=135

October 10-13 – FAO/IAEA Technical Meeting. Combating Soil Degradation to Enhance Food Security in Africa: The Role of Nuclear Techniques in Developing Improved Soil, Water and Nutrient Management Practices. ICRAF Headquarters. Nairobi, Kenya. http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=82

November 7-10 - American Water Resources Association 2005 Annual Conference. http://www.awra.org/meetings/Seattle2005/index.html

November 14–18 – International Symposium on Trends in Radiopharmaceuticals. Vienna, Austria. http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=130

November 15–18 – Sustainability of the Arctic-Yukon-Kuskokwim Salmon Fisheries. Anchorage, Alaska. http://www.uaf.edu/seagrant/Conferences/symposia.html#copper

November 30 – December 2 – International Conference on Operational Safety Performance in Nuclear Installations. Vienna, Austria. http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=133

2006

14-16 November – Sixth Mote International Symposium in Fisheries Ecology. Sarasota, Florida. Announcement and Call for Papers. http://www.bio.fsu.edu/mote/current.html

Publications

U.S. Federal Government. Publications and documents from many of the federal agencies involved in the aquaculture industry. http://aquanic.org/publicat/govagen/govag.htm

US Regional Aquaculture Centers. One of the leading producers of aquaculture publications based on research discovery. These publications range from very technical findings from research projects to specific technical documents written in easily understandable terms. http://aquanic.org/publicat/usda_rac/racpubs.htm

National Sea Grant Library. The NSGL, (formerly known as the National Sea Grant Depository) was established in 1970 as an archive and lending library for Sea Grant funded documents. These documents cover a wide variety of subjects, including oceanography, marine education, aquaculture, fisheries, limnology, coastal zone management, marine recreation and law. http://nsgl.gso.uri.edu/searchguide.html

State. USDA and Sea Grant Extension documents written by extension professionals, university scientists or a combination of the two groups. http://aquanic.org/publicat/state/statepub.htm

International. A listing of international groups who have developed aquaculture documents addressing a broad range of topics. http://aquanic.org/publicat/intlpubs.htm

Recipes. If you like to consume fish, then many excellent seafood recipes have been provided for your enjoyment. http://aquanic.org/publicat/recipes.htm

Other. The catch all for all other publications which do not fit into one of the above categories. http://aquanic.org/publicat/otherpubs.htm

Pond Dynamics/Aquaculture: The Pond Dynamics/Aquaculture Collaborative Research Support Program (PD/A CRSP) represents an international, multi-disciplinary effort to improve human nutrition through pond aquaculture research. The work of the PD/A CRSP benefits both domestic and international aquaculture. For additional Information: http://pdacrsp.oregonstate.edu/

The NFI Species Guide provides detailed information about the various types of fish and shellfish supplied by the seafood industry. Information can be viewed at: http://www.aboutseafood.com/dictionary/index.html

Aquaculture Magazine Online - Information on Fish Farming, Processing, Breeding and Raising aquatic species including tilapia, trout, salmon, shrimp, catfish, crayfish, oysters, Redclaw, hybrid striped bass and shellfish. Topics include pond management, diseases, market trends, farm stocking, recirculating systems, statistics, selling, nutrition, feed and more. U.S. and international aquaculture industry focus. This Online Magazine can be viewed at: http://www.aquaculturemag.com/

Aquaculture Outlook - Examines the U.S. aquaculture industry: production, inventory, sales, prices, inputs, and trade of catfish, trout, tilapia, salmon, mollusks, crawfish, shrimp, ornamental fish and new species. For additional information: http://usda.mannlib.cornell.edu/reports/erssor/livestock/ldp-aqs/

World Aquaculture Society publishes the "Journal of the World Aquaculture" (http://www.was.org/main/ArticlesMenu.asp?Type=Journal), "World Aquaculture" magazine and many books on aquaculture. For additional information: http://www.was.org/main/FrameMain.asp

The quarterly *Fishery Bulletin* (FB) is the oldest and one of the finest fisheries journals in the world. It has been an official publication of the U.S. Government since 1881, under various titles, and is the U.S. counterpart to other highly regarded governmental fisheries science publications. It publishes original research or interpretative articles in all scientific fields that bear on marine fisheries and marine mammal science. For additional information: http://fishbull.noaa.gov/

NRAC Publications for the Northeastern Region
United States Department of Agriculture
Cooperative State Research Education and Extension Service
Regional Aquaculture Center Program
For additional information http://aquanic.org/publicat/usda_rac/nrac.htm

NRAC Publications for the Northeastern Region
United States Department of Agriculture
Cooperative State Research Education and Extension Service
Regional Aquaculture Center Program
For additional information http://www.nal.usda.gov/afsic/afsaqua.htm

Websites:

Center for Marine Biovidersity & Conservation. http://cmbc.ucsd.edu/
Center for Marine Biodiversity and Conservation (CMBC) programs help us understand, communicate, and work to remedy the impact that humans have on marine ecosystems and, in turn, help the oceans continue to feed, employ, and nourish humans and all life on Earth.

ASLO
As the leading professional organization for researchers and educators in the field of aquatic science, ASLO works to provide for their needs at all phases of professional development. ASLO is best known for its highly rated research journals, its interdisciplinary meetings and its special symposia. The society supports increasingly important programs in public education and outreach and public policy. It strives to encourage student participation and to increase opportunities for minorities in the aquatic sciences. http://www.aslo.org/

Top Ten Seafoods
U.S. Per-Capita Consumption By Species in Pounds
Raw data from National Marine Fisheries Service. 2001 Top Ten calculated by Howard Johnson, H.M. Johnson & Associates for NFI.

Note: *Catfish consumption has been re-calculated to reflect the change in U.S. law that prohibits imported "catfish"— basa, tra, etc. - from being called catfish. The entire listing from 1990 – 2002 can be viewed at: http://www.nfi.org/?a=news&b=Top%20Ten%20Seafoods&PHPSESSID=064155f6a5937fbbe6564f045abff40a

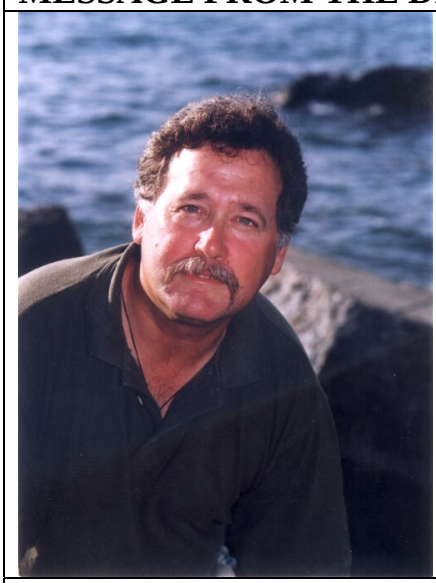
Reflections on Water

Vermont Water Resources & Lake Studies Center

University of Vermont Extension

April 2007

MESSAGE FROM THE DIRECTOR



RESEARCH UPDATE:

The Vermont Water Center entered into an exciting new collaboration during 2006-2007 with the River Management Program in the Department of Environmental Conservation (Vermont Agency of Natural Resources). In recognition of substantial state matching support provided by the River Management Program, the Vermont Water Center RFP for 2006 was designed to specifically address several broad aspects of river management that are of direct interest to the Department of Environmental Conservation. While proposals on any topic relevant to the mission of the Water Center were considered, proposals that addressed some aspect of the research needs expressed by the River Management Program were given priority for funding.

The general objectives of the Joint ANR/Water Center RFP included: to advance scientific understanding that helps describe and quantify the contribution of sediment and nutrients derived from fluvial processes in Vermont's rivers; to establish the socio-economic justifications, costs, and benefits associated with or represented by river corridor protection in Vermont; and to contribute to Vermont's river corridor management, restoration, and protection infrastructure.

Several areas of particular interest were identified. We sought proposals that would strengthen and help validate Vermont's draft fluvial geomorphic-based model for describing sediment regime departures from reference or equilibrium conditions, which may influence the magnitude of sediment and nutrient production, transport, and attenuation or storage on a watershed scale. Three new projects were recommended for 2-year funding.

Donald Ross (UVM – Plant and Soil Science), Joel Tilley (UVM – Plant and Soil Science), Eric Young (UVM – Plant and Soil Science), Kristen Underwood (South Mountain Research and Consulting). Phosphorus Availability from the Soils along Two Streams of the Lake Champlain Basin: Mapping, Characterization and Seasonal Mobility.

Donna Rizzo (UVM – Civil and Environmental Engineering), Leslie Morrissey (UVM – The Rubenstein School). An Adaptive Management System Using Hierarchical Artificial Neural Networks and Remote Sensing for Fluvial Hazard Mitigation.

Mandar Dewoolkar (UVM – Civil and Environmental Engineering) and Paul Bierman (UVM – Geology). Evaluating Quantitative Models of Riverbank Stability.

STUDENT RESEARCH:

Evan P. Fitzgerald

Measuring erosion from a stormwater outfall in Centennial Brook watershed.

The Vermont Agency of Natural Resources (ANR) has developed a state-of-the-art methodology for Stream Geomorphic Assessments (SGA), and has been collecting data on the physical condition of streams and rivers throughout the state since 2001. The protocols have been used widely in

different watersheds throughout Vermont, but prior to 2005 their use in highly urbanized areas (e.g., Chittenden County) had been limited. As part of an effort to develop Total Maximum Daily Load (TMDL) analyses in stormwater impaired watersheds in the state, ANR sought baseline geomorphic assessment data for these watersheds and partnered with UVM in 2005 to obtain this information.

My thesis research project developed out of the collaborative effort between ANR and UVM's Rubenstein School to complete the SGA Phase I (GIS-based analysis) and Phase II (field-based rapid stream assessment) level surveys for the stormwater impaired streams in Chittenden County, as well as a select group of nearby attainment streams. Data collection was completed in summer 2005 in 9 impaired watersheds and 5 attainment watersheds, including a total of 145 reaches. The reach-level assessment data includes multiple metrics of geomorphic stability, channel evolution and morphology, and physical habitat condition, and are summarized in two composite metrics: RGA (Rapid Geomorphic Assessment); and RHA (Rapid Habitat Assessment) scores. The geomorphic assessment data, when combined with other land use and aquatic biota data collected by ANR, provided the basis for the following research topics: 1) the effect of urban land use on stream geomorphic stability and physical habitat conditions; 2) the comparison of hydraulic geometry between urban and rural watersheds; 3) linkages between geomorphic stability and aquatic biota in the urban environment.

Results of our research suggest that the physical and biotic conditions of streams in the cold climate of Vermont are perhaps more sensitive to urbanization than streams found in other regions. While much data from across the country has shown that stream health typically declines when watershed imperviousness exceeds 10%, our data indicate that significant decline is observed at ~5% watershed imperviousness. In addition, small headwaters reaches in urban watersheds of Chittenden County appear to be much more sensitive to channel adjustments (e.g., widening) than larger, downstream reaches. Results also indicate that some recovery of biotic communities may be possible following natural channel restabilization. UVM and ANR are working together to incorporate these findings into the long-term management of stormwater impaired watersheds in the state.

The State of Vermont, Agency of Natural Resources Flow Monitoring Project

Meredith Curling

Introduction:

This report presents the results of streamflow gauging and precipitation measurement from June 2006 through January 2007 in sixteen impaired and ten attainment watersheds in the state of Vermont. The State of Vermont has listed the sixteen impaired watersheds as Impaired due to the effects of stormwater runoff. The state has also listed the other 10 streams with the classification of attainment, indicating that these streams are currently meeting state biological monitoring protocol, and are not currently stormwater impaired. The purpose of the streamflow gauging and precipitation measurement was to develop a substantial precipitation and stream flow record for

stormwater-impaired and attainment watersheds in, and around Chittenden County. This record may be used in current and future management, permitting, and research efforts throughout the state. Previous efforts have been made to gauge streamflow in impaired watersheds only. These efforts were a great start, but highlighted the need for multi-season gauged precipitation and streamflow data for both the impaired, and attainment watersheds, in order to produce the appropriate validation for hydrologic models that will aid in future adaptive management efforts. Data collected previously by the private consulting firm Heindel and Noyes (H&N) may serve as a baseline for the sixteen impaired watersheds included in this study. Their data may be used to illuminate possible changes in the hydrology and for the purpose of comparison with future monitoring efforts. Similarly, the attainment data presented in this report represents baseline conditions in the attainment watersheds, and may be used to aid future monitoring efforts. Collectively, these data will establish a basis for historical data records for each of the focus watersheds.

Work Performed

UVM established streamflow gauging stations at twenty-five of the twenty-six watersheds included in this study. Streamflow gauging at the Englesby Brook watershed was performed separately by the United States Geological Survey (USGS). Precipitation measurements for all of the twenty-six watersheds included in this report were performed by the University of Vermont using HOBO® recording tipping bucket precipitation gauges and were recorded in number of tips per five minute interval. Stage data was collected in five minute intervals using Trutrack® capacitance stage sensors and dataloggers. Discharge profiling was also completed at each site in order to develop discharge rating curves to accompany the recorded stage data. This section of the report describes general data collection and analysis procedures.

CALL FOR ABSTRACTS:

2007 Summer Specialty Conference Call for Abstracts

Emerging Contaminants of Concern in the Environment: Issues, Investigations, and Solutions
Vail Cascade Resort,
Vail Colorado
June 25-27, 2007

Abstract Submission Deadline Extension: February 12, 2007

On-Line Registration: http://www.awra.org/cgi-bin/sc_2007_summer_conference.cgi?html

March 21, 2007: Maine Water Conference

*** Poster Abstract Deadline February 23rd ***

Posters invited for display will address one or more aspects of water quality or quantity issues. These may include chemical, biological, hydrological, and geochemical aspects of surface and ground waters, and their policy and economic implications Poster abstracts will be accepted for juried high school, undergraduate and graduate competitions. Non-student poster presentations based on appropriate research findings are also accepted for display.

Undergraduate and graduate students should go to: http://www.umaine.edu/waterresearch/mwc/poster_07.htm for complete abstract and poster guidelines.

*** Registration Information ***

Registration before March 3, 2007 is only $38 and includes all conference sessions, breaks, and lunch. Registration is limited to 350 attendees. Discounts are available for students giving oral or poster presentations. A limited number of scholarships for undergraduate student admission are also available.

Registration forms are available online at http://www.umaine.edu/waterresearch/mwc/Registration_07.htm. If you would prefer to have a registration form faxed or mailed to you, please call 207/581-3244.

WASHINGTON, D.C. - VERMONT HOUSE AND SENATE:

Senator Bernard Sanders: http://www.congress.org/congressorg/bio/?id=594

Senator Patrick Leahy: http://leahy.senate.gov/

Representative Peter Welch: http://www.congressmerge.com/onlinedb/cgi-bin/newmemberbio.cgi?member=VT00&site=congressmerge

WEB PAGES

Visit the Vermont Water Resources and Lake Studies Center website at: **www.uvm.edu/envnr/vtwater** for information about the Water Center, **The Rubenstein School of Environment and Natural Resources** and the **Lake Champlain Sea Grant Program** at The University of Vermont.

MEETINGS/CONFERENCES/SEMINARS/WORKSHOPS

February 20-23, 2007: International Conference on Stormwater & Urban Water Systems Modeling. Toronto, Ontario, Canada. Conference website: http://www.computationalhydraulics.com/Training/Conferences/confsem.html.

February 20-21, 2007: PCSWMM & SWMM Workshop, Toronto, Ontario, Canada. Workshop website: http://www.computationalhydraulics.com/Training/Workshops/torontoworkshop.html.

February 28-March 1, 2007: River Terrace & Flood Plain Hydrology Symposium. Las Cruces, NM. Symposium website: http://spectre.nmsu.edu:16080/water/.
March 5-10, 2007: International Smoked Seafood Conference, Anchorage, Alaska. Conference website: http://seagrant.uaf.edu/conferences/2007/smokedseafood/index.html.
March 8-10, 2007: International Smoked Seafood Conference: Indian Valley Meats • Indian, Alaska. Conference website: http://seagrant.uaf.edu/conferences/2007/smokedseafood/index.html.
March 10-14, 2007: The 2007 NOWRA Water for All Life Conference. Marriott Waterfront Hotel, Baltimore, Maryland. Conference will involve participants in practical applications for sustainability. Conference website: http://www.nowra.org/?p=832.
March 19-21, 2007: AGU Hydrology Days 2007. Colorado State University, Fort Collins, Colorado. Celebration of multi-disciplinary hydrological science and closely related disciplines. Information: http://www.hydrologydays.colostate.edu
March 21-23, 2007: Paying for Sustainable Water Infrastructure: Innovations for the 21st Century. Conference website: http://www.payingforwater.com/.
April 1-4, 2007: The 10th International Symposium on Wetland Biogeochemistry. Annapolis, Maryland. Information: http://www.serc.si.edu/conference.
April 3-5, 2007: 2007 Alaska AWRA Water and Restoration Conference**,** Fairbanks, Alaska. Conference website: http://www.awra.org/state/alaska/ameetings/2007am/2007am.html.
April 2-4, 2007: Marine Habitat Mapping Technology Workshops for Alaska. Anchorage Alaska. Workshop website: http://seagrant.uaf.edu/conferences/2007/benthic/index.html.
April 9-12, 2007: Emerging Issues: Along Urban/Rural Interfaces II. Sheraton Hotel, Atlanta, Georgia. The conference links human aspects of land-use change with ecological implications that follow. Information: http://www.sfws.auburn.edu/urbanruralinterfaces/focus.
April 16-19, 2007: International Conference on Non-Electric Applications of Nuclear Power: Seawater Desalination, Hydrogen Production and other Industrial Applications. Oarai, Japan. Conference ID: IAEA-CN-152. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=152.
April 22-27, 2007: 2nd National Conference on Ecosystem Restoration (NCER). Kansas City, Missouri. Information: http://conference.ifas.ufl.edu/NCER2007.
April 23-27, 2007: International Conference on the Challenges faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety. Aix-en-Provence, France. Conference ID: IAEA-CN-142. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=142.
April 23-27, 2007: International Conference on Environmental Radioactivity: From Measurements and Assessments to Regulation. Vienna, Austria. Conference ID: IAEA-CN-145. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=145.
May 6-8, 2007: Fourth International Symposium on Flood Defence. Toronto, Ontario, Canada. Symposium website: http://www.flood2008.org/flood/.
May 21-23, 2007: 18th Annual Nonpoint Source Pollution Conference: Seeding New Solutions to Old Probems: The Nonpoint Source Program at 20 Years. Newport, Rhode Island. Information: http://www.neiwpcc.org/npsconference.

May 21-25, 2007: International Symposium on Advances in Isotope Hydrology and its Role in Sustainable Water Resources Management. Vienna, Austria. Conference ID: IAEA-CN-151. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=151.
June 11-22, 2007: Marine/Aquatic Science Education Workshop for Teachers: A Workshoip to Update the Alaska Sea/River Week Curricula. Kasitsna Bay Laboratory, Alaska. Workshop website: http://seagrant.uaf.edu/marine-ed/workshops/sea-river-week07/index.html.
June 17-20, 2007: ASABE Annual International Meeting. Minneapolis, Minnesota. Information: http://www.asabe.org/meetings/aim2007.
June 18-21, 2007: International Conference on Knowledge Management in Nuclear Facilities. Vienna, Austria. Conference ID: IAEA-CN-153Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=153.
July 24-26, 2007: NIWR 2007 Annual Conference: Hazards in Water Resources. Boise, Idaho. Conference website: http://www.ucowr.siu.edu/.
July 31, 2007: Midwest Strip-Tillage Expo 2007. Hawkeye Community College, Waterloo, Iowa. Demonstration of equipment for strip-tillage and associated operations as well as information on strip-tillage related topics. Information: http://wrc.umn.edu/outreach/striptillageexpo/midwest.
August 14, 2007: Minn-Dak Strip-Tillage Expo. Fergus Falls, Minnesota. Information: http://wrc.umn.edu/outreach/striptillageexpo/minndak.
August 20-23, 2007: StormCon '07. Phoenix, Arizona. Information: http://www.stormcon.com.
September 3-6, 2007: 10th International River Symposium & International Environmental Flows Conference. Brisbane, Australia. Symposium website: http://www.riversymposium.com/index.php?page=Home.
September 16-19, 2007: Ninth International Symposium: Fluid Control Measurement & Visualization. Tallahassee, Florida. Symposium website: http://www.eng.fsu.edu/flucome9/.
September 17-23, 2007: 2nd International Conference of GIS/RS in Hydrology, Water Resources and Environment (ICGRHWE'07) and 2nd International Symposium on Flood Forecasting and Management with GIS and Remote Sensing (FM2S'07). Conference website: http://www.hydroinfor.sysu.edu.cn/.
September 24-26, 2007: Science and Education of Land Use: A Transatlantic Multidisciplinary and Comparative Approach. Washington, DC. Information: http://www.nercrd.psu.edu/TALUC/TALUC.html.
November 5-9, 2007: International Conference on Research Reactors: Safe and Effective Utilization. Sydney, Australia. Conference ID: IAEA-CN-156. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=156.
November 10-14, 2007: International Conference on Clinical PET and Molecular Medicine. Bangkok, Thailand. Conference ID: IAEA-CN-157. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=157.
November 12-15, 2007: AWRA 2007 Annual Conference. Albuquerque, New Mexico.
AQUACULTURE CORNER

European Aquaculture Society.
http://www.easonline.org/home/en/default.asp

Fishery Bulletin.
http://fishbull.noaa.gov/fcontent.htm

Fish Farmer Magazine.
http://www.fishfarmer-magazine.com/news/categoryfront.php/id/20/Fish_Farmer_News.html

The Aquaculture Network Information Center aquanic.org is a gateway to the world's electronic aquaculture resources. The goals of AquaNIC are to:

1.Provide access to all electronic aquaculture information at the national and international level.
2.Increase the quantity and quality of electronic information available to the aquaculture industry.
3.Provide self-paced aquaculture instruction to the aquaculture industry.
4.Obtain user input in directing AquaNIC services.

The mission of the Regional Aquaculture Centers is to support aquaculture research, development, demonstration, and extension education to enhance viable and profitable U.S. aquaculture that will benefit consumers, producers, service industries, and the American economy. Two centers are important to those interested in aquaculture in Vermont and northern New York. The Northeastern Regional Aquaculture Center (NRAC) **www.umassd.edu/specialprograms/nrac/** is a principal public forum for the advancement and dissemination of science and technology needed by Northeastern aquacultural producers and support industries. The North Central Regional Aquaculture Center **ag.ansc.purdue.edu/aquanic/ncrac/index.htm** supports more than 1,000 producers of food fish, baitfish, and fish for stocking into recreational water bodies.

These websites support a highly diverse range of producers, ranging from well established producers who have made a significant capital investment and are interested in ways of reducing production costs while increasing output to those who could be classified as newcomers, who need training, capital, and an awareness of the potentially high risk, high investment, and low returns that most producers encounter.

MEETINGS/CONFERENCES

February 26 – March 2, 2007: Aquaculture 2007: Sustainable Aquaculture. San Antonio, Texas. Conference website: http://www.was.org/meetings/ConferenceInfo.asp?MeetingCode=AQ2007**.**

August 5-8, 2007: Asian – Pacific Aquaculture 2007. Hanoi, Viet Nam. Conference website: http://www.was.org/meetings/ConferenceInfo.asp?MeetingCode=AP2007.

November 6-9, 2007: Caribbean & Latin American Aquaculture 2007. San Juan, Puerto Rico. Conference website: http://www.was.org/meetings/ConferenceInfo.asp?MeetingCode=LAA2007.

February 11-14, 2007: Arabian Seas Int. Conference on Science & Technology of Aquaculture, Fisheries and Oceanography. Kuwait. Conference website: http://www.kisr.edu.kw/stafo/.

March 11, 2007: The 8th International Marine Biotechnology Conference 2007 - IMBC 2007. Eilat, Israel. Conference website: http://imbc2007.ocean.org.il/.

March 26-27, 2007: Barrel Aquaponics - Construction and Operation. Camp Living Water, Bryson City, NC. Conference website: http://www.aquacultureinternational.org/.

April 15-19, 2007: Fish Immunology Workshop. Wageningen, The Netherlands. Workshop contact: Geert Wiegertjes +31317482732 (fish.workshop@wur.nl).

May 9-10, 2007: Aquafeed Horizons. Jaarbeurs Halls, Utrecht, Netherlands. Conference website: http://www.victam.com/international.php#brochure.

May 28-31, 2007: Global Trade Conference on Aquaculture. Qingdao, China. **Contact:** INFOFISH and GLOBEFISH 603-26914466 infish@po.jaring.my or globefish@fao.org.

August 6, 2007: AquaPartners 2007. 6th International Exhibition & Conference on Fisheries & Aquaculture. Athens, Greece. Conference website: http://www.europartners.gr/page/default.asp?id=16&la=2.

October 15-17, 2007: 3rd International Sustainable Marine Fish Culture Conference. Fort Pierce, Florida. Conference website: http://www.hboi.edu/aqua/sustainable_conf.html.

This newsletter is prepared by Dr. Breck Bowden, Director, Vermont Water Resources and Lake Studies Center, The Rubenstein School of Environment and Natural Resources, The University of Vermont, George D. Aiken Center, Burlington, Vermont 05405-0088, (802) 656-4057; and Dr. Jurij Homziak, Lake Champlain Sea Grant Program, The Rubenstein School of Environment and Natural Resources, George D. Aiken Center, The University of Vermont, Burlington, VT 05405-0088, (802) 656-0682. This newsletter is published with funds provided in part by the U.S. Geological Survey, Department of the Interior, as authorized by the Water Resources Research Act of 1984 and by the University of Vermont Extension System and U.S. Department of Agriculture.

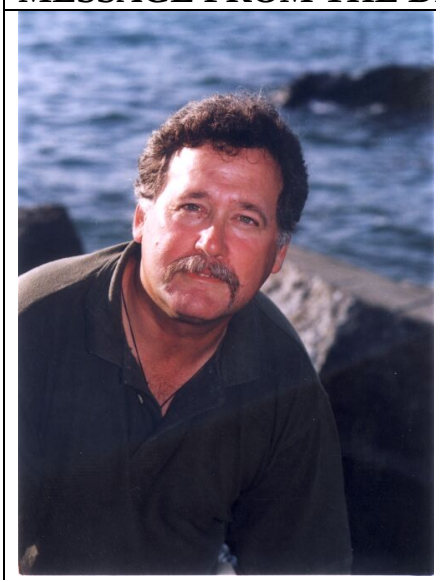
Reflections on Water

Vermont Water Resources & Lake Studies Center

University of Vermont Extension

MESSAGE FROM THE DIRECTOR

April 2007



Breck Bowden
Water Center Director

Jurij Homziak
Lake Champlain Sea Grant

RESEARCH UPDATE:

The Vermont Water Center entered into an exciting new collaboration during 2006-2007 with the River Management Program in the Department of Environmental Conservation (Vermont Agency of Natural Resources). In recognition of substantial state matching support provided by the River Management Program, the Vermont Water Center RFP for 2006 was designed to specifically address several broad aspects of river management that are of direct interest to the Department of Environmental Conservation. While proposals on any topic relevant to the mission of the Water Center were considered, proposals that addressed some aspect of the research needs expressed by the River Management Program were given priority for funding.

The general objectives of the Joint ANR/Water Center RFP included: to advance scientific understanding that helps describe and quantify the contribution of sediment and nutrients derived from fluvial processes in Vermont's rivers; to establish the socio-economic justifications, costs, and benefits associated with or represented by river corridor protection in Vermont; and to contribute to Vermont's river corridor management, restoration, and protection infrastructure.

Several areas of particular interest were identified. We sought proposals that would strengthen and help validate Vermont's draft fluvial geomorphic-based model for describing sediment regime departures from reference or equilibrium conditions, which may influence the magnitude of sediment and nutrient production, transport, and attenuation or storage on a watershed scale. Three new projects were recommended for 2-year funding.

Donald Ross (UVM – Plant and Soil Science), Joel Tilley (UVM – Plant and Soil Science), Eric Young (UVM – Plant and Soil Science), Kristen Underwood (South Mountain Research and Consulting). Phosphorus Availability from the Soils along Two Streams of the Lake Champlain Basin: Mapping, Characterization and Seasonal Mobility.

Donna Rizzo (UVM – Civil and Environmental Engineering), Leslie Morrissey (UVM – The Rubenstein School). An Adaptive Management System Using Hierarchical Artificial Neural Networks and Remote Sensing for Fluvial Hazard Mitigation.

Mandar Dewoolkar (UVM – Civil and Environmental Engineering) and Paul Bierman (UVM – Geology). Evaluating Quantitative Models of Riverbank Stability.

Student Research:
Evan P. Fitzgerald

Measuring erosion from a stormwater outfall in Centennial Brook watershed.

The Vermont Agency of Natural Resources (ANR) has developed a state-of-the-art methodology for Stream Geomorphic Assessments (SGA), and has been collecting data on the physical condition of streams and rivers throughout the state since 2001. The protocols have been used widely in different watersheds throughout Vermont, but prior to 2005 their use in highly urbanized areas (e.g., Chittenden County) had been limited. As part of an effort to develop Total Maximum Daily Load (TMDL) analyses in stormwater impaired watersheds in the state, ANR sought baseline geomorphic assessment data for these watersheds and partnered with UVM in 2005 to obtain this information.

My thesis research project developed out of the collaborative effort between ANR and UVM's Rubenstein School to complete the SGA Phase I (GIS-based analysis) and Phase II (field-based rapid stream assessment) level surveys for the stormwater impaired streams in Chittenden County, as well as a select group of nearby attainment streams. Data collection was completed in summer 2005 in 9 impaired watersheds and 5 attainment watersheds, including a total of 145 reaches. The reach-level assessment data includes multiple metrics of geomorphic stability, channel evolution and morphology, and physical habitat condition, and are summarized in two composite metrics: RGA (Rapid Geomorphic Assessment); and RHA (Rapid Habitat Assessment) scores. The geomorphic assessment data, when combined with other land use and aquatic biota data collected by ANR, provided the basis for the following research topics: 1) the effect of urban land use on stream geomorphic stability and physical habitat conditions; 2) the comparison of hydraulic geometry between urban and rural watersheds; 3) linkages between geomorphic stability and aquatic biota in the urban environment.

Results of our research suggest that the physical and biotic conditions of streams in the cold climate of Vermont are perhaps more sensitive to urbanization than streams found in other regions. While much data from across the country has shown that stream health typically declines when watershed imperviousness exceeds 10%, our data indicate that significant decline is observed at ~5% watershed imperviousness. In addition, small headwaters reaches in urban watersheds of Chittenden County appear to be much more sensitive to channel adjustments (e.g., widening) than larger, downstream reaches. Results also indicate that some recovery of biotic communities may be possible following natural channel restabilization. UVM and ANR are working together to incorporate these findings into the long-term management of stormwater impaired watersheds in the state.

The State of Vermont, Agency of Natural Resources Flow Monitoring Project

Meredith Curling

Introduction:

This report presents the results of streamflow gauging and precipitation measurement from June 2006 through January 2007 in sixteen impaired and ten attainment watersheds in the state of Vermont. The State of Vermont has listed the sixteen impaired watersheds as Impaired due to the effects of stormwater runoff. The state has also listed the other 10 streams with the classification of attainment, indicating that these streams are currently meeting state biological monitoring protocol, and are not currently stormwater impaired. The purpose of the streamflow gauging and precipitation measurement was to develop a substantial precipitation and stream flow record for stormwater-impaired and attainment watersheds in, and around Chittenden County. This record may be used in current and future management, permitting, and research efforts throughout the state. Previous efforts have been made to gauge streamflow in impaired watersheds only. These efforts were a great start, but highlighted the need for multi-season gauged precipitation and streamflow data for both the impaired, and attainment watersheds, in order to produce the appropriate validation for hydrologic models that will aid in future adaptive management efforts. Data collected previously by the private consulting firm Heindel and Noyes (H&N) may serve as a baseline for the sixteen impaired watersheds included in this study. Their data may be used to illuminate possible changes in the hydrology and for the purpose of comparison with future monitoring efforts. Similarly, the attainment data presented in this report represents baseline conditions in the attainment watersheds, and may be used to aid future monitoring efforts. Collectively, these data will establish a basis for historical data records for each of the focus watersheds.

Work Performed

UVM established streamflow gauging stations at twenty-five of the twenty-six watersheds included in this study. Streamflow gauging at the Englesby Brook watershed was performed separately by the United States Geological Survey (USGS). Precipitation measurements for all of the twenty-six watersheds included in this report were performed by the University of Vermont using HOBO® recording tipping bucket precipitation

gauges and were recorded in number of tips per five minute interval. Stage data was collected in five minute intervals using Trutrack® capacitance stage sensors and dataloggers. Discharge profiling was also completed at each site in order to develop discharge rating curves to accompany the recorded stage data. This section of the report describes general data collection and analysis procedures.

WASHINGTON, D.C. - VERMONT HOUSE AND SENATE:
Senator Bernard Sanders: http://www.congress.org/congressorg/bio/?id=594
Senator Patrick Leahy: http://leahy.senate.gov/
Representative Peter Welch: http://www.congressmerge.com/onlinedb/cgi-bin/newmemberbio.cgi?member=VT00&site=congressmerge

WEBSITES

Visit the Vermont Water Resources and Lake Studies Center website at: **www.uvm.edu/envnr/vtwater** for information about the Water Center, **The Rubenstein School of Environment and Natural Resources** and the **Lake Champlain Sea Grant Program** at The University of Vermont.

MEETINGS/CONFERENCES/SEMINARS/WORKSHOPS
April 16-19, 2007: International Conference on Non-Electric Applications of Nuclear Power: Seawater Desalination, Hydrogen Production and other Industrial Applications. Oarai, Japan. Conference ID: IAEA-CN-152. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=152.
April 22-27, 2007: 2nd National Conference on Ecosystem Restoration (NCER). Kansas City, Missouri. Information: http://conference.ifas.ufl.edu/NCER2007.
April 23-27, 2007: International Conference on the Challenges faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety. Aix-en-Provence, France. Conference ID: IAEA-CN-142. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=142.
April 23-27, 2007: International Conference on Environmental Radioactivity: From Measurements and Assessments to Regulation. Vienna, Austria. Conference ID: IAEA-CN-145. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=145.
April 29-May 3, 2007: The 2007 Groundwater Summer. The summit is designed to facilitate the exchange and dissemination of technical information and new science developments. Albuquerque, New Mexico. Information: http://www.ngwa.org/e/conf/0704295095.cfm
May 6-8, 2007: Fourth International Symposium on Flood Defence. Toronto, Ontario, Canada. Symposium website: http://www.flood2008.org/flood/.
May 20-23, 2007: The 10th National Watershed Conference. "Total Watershed Awareness-Extending the Legacy.**"** La Crosse, Wisconsin. Registration Information: http://watershedcoalition.org
May 21-23, 2007: 18th Annual Nonpoint Source Pollution Conference: Seeding New Solutions to Old Probems: The Nonpoint Source Program at 20 Years. Newport, Rhode Island. Information: http://www.neiwpcc.org/npsconference.

May 21-25, 2007: International Symposium on Advances in Isotope Hydrology and its Role in Sustainable Water Resources Management. Vienna, Austria. Conference ID: IAEA-CN-151. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=151.
June 2-7, 2007: American Industrial Hygiene Conference & Expo. Philadelphia, Pennsylvania. Conference website: http://www.aihce2007.org.
June 11-22, 2007: Marine/Aquatic Science Education Workshop for Teachers: A Workshoip to Update the Alaska Sea/River Week Curricula. Kasitsna Bay Laboratory, Alaska. Workshop website: http://seagrant.uaf.edu/marine-ed/workshops/sea-river-week07/index.html.
June 17-20, 2007: ASABE Annual International Meeting. Minneapolis, Minnesota. Information: http://www.asabe.org/meetings/aim2007.
June 18-21, 2007: International Conference on Knowledge Management in Nuclear Facilities. Vienna, Austria. Conference ID: IAEA-CN-153Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=153.
July 23-26, 2007: UCOWR/NIWR 2007 Annual Conference: Hazards in Water Resources. Boise, Idaho. Conference website: http://www.ucowr.siu.edu/.
July 31, 2007: Midwest Strip-Tillage Expo 2007. Hawkeye Community College, Waterloo, Iowa. Demonstration of equipment for strip-tillage and associated operations as well as information on strip-tillage related topics. Information: http://wrc.umn.edu/outreach/striptillageexpo/midwest.
August 14, 2007: Minn-Dak Strip-Tillage Expo. Fergus Falls, Minnesota. Information: http://wrc.umn.edu/outreach/striptillageexpo/minndak.
August 20-23, 2007: StormCon '07. Phoenix, Arizona. Information: http://www.stormcon.com.
September 3-6, 2007: 10th International River Symposium & International Environmental Flows Conference. Brisbane, Australia. Symposium website: http://www.riversymposium.com/index.php?page=Home.
September 16-19, 2007: Ninth International Symposium: Fluid Control Measurement & Visualization. Tallahassee, Florida. Symposium website: http://www.eng.fsu.edu/flucome9/.
September 17-23, 2007: 2nd International Conference of GIS/RS in Hydrology, Water Resources and Environment (ICGRHWE'07) and 2nd International Symposium on Flood Forecasting and Management with GIS and Remote Sensing (FM2S'07). Conference website: http://www.hydroinfor.sysu.edu.cn/.
September 24-26, 2007: Science and Education of Land Use: A Transatlantic Multidisciplinary and Comparative Approach. Washington, DC. Information: http://www.nercrd.psu.edu/TALUC/TALUC.html.
November 5-9, 2007: International Conference on Research Reactors: Safe and Effective Utilization. Sydney, Australia. Conference ID: IAEA-CN-156. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=156.
November 10-14, 2007: International Conference on Clinical PET and Molecular Medicine. Bangkok, Thailand. Conference ID: IAEA-CN-157. Conference website: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=157.
November 12-15, 2007: AWRA 2007 Annual Conference. Albuquerque, New Mexico.

AQUACULTURE CORNER

European Aquaculture Society. http://www.easonline.org/home/en/default.asp

Fishery Bulletin.
http://fishbull.noaa.gov/fcontent.htm

Fish Farmer Magazine.
http://www.fishfarmer-magazine.com/news/categoryfront.php/id/20/Fish_Farmer_News.html

The Aquaculture Network Information Center aquanic.org is a gateway to the world's electronic aquaculture resources. The goals of AquaNIC are to:

1.Provide access to all electronic aquaculture information at the national and international level.
2.Increase the quantity and quality of electronic information available to the aquaculture industry.
3.Provide self-paced aquaculture instruction to the aquaculture industry.
4.Obtain user input in directing AquaNIC services.

The mission of the Regional Aquaculture Centers is to support aquaculture research, development, demonstration, and extension education to enhance viable and profitable U.S. aquaculture that will benefit consumers, producers, service industries, and the American economy. Two centers are important to those interested in aquaculture in Vermont and northern New York. The Northeastern Regional Aquaculture Center (NRAC)
www.umassd.edu/specialprograms/nrac/ is a principal public forum for the advancement and dissemination of science and technology needed by Northeastern aquacultural producers and support industries. The North Central Regional Aquaculture Center **ag.ansc.purdue.edu/aquanic/ncrac/index.htm** supports more than 1,000 producers of food fish, baitfish, and fish for stocking into recreational water bodies.

These websites support a highly diverse range of producers, ranging from well established producers who have made a significant capital investment and are interested in ways of reducing production costs while increasing output to those who could be classified as newcomers, who need training, capital, and an awareness of the potentially high risk, high investment, and low returns that most producers encounter.

FAO GLOSSARY OF AQUACULTURE. The Food and Agriculture Organization of the United Nations (FAO) Fisheries Department has published a multilingual Glossary of Aquaculture containing, at the time of publication, 2,958 terms with definitions, synonyms, related terms, information sources and images, when available. The primary objectives of the glossary are to: (i) serve as a reference to fish farmers, consultants, administrators, policy makers, developers, engineers, agriculturists, economists, environmentalists and all those interested in aquaculture, and (ii) facilitate communication among experts and scientists involved in aquaculture research and development. Website: http://www.fao.org/fi/glossary/aquaculture/

MEETINGS/CONFERENCES

August 5-8, 2007: Asian – Pacific Aquaculture 2007. Hanoi, Viet Nam. Conference website: http://www.was.org/meetings/ConferenceInfo.asp?MeetingCode=AP2007.
November 6-9, 2007: Caribbean & Latin American Aquaculture 2007. San Juan, Puerto Rico. Conference website: http://www.was.org/meetings/ConferenceInfo.asp?MeetingCode=LAA2007.
May 9-10, 2007: Aquafeed Horizons. Jaarbeurs Halls, latest advances in aquaculture feed formulation and production technology. Utrecht, Netherlands. Conference website: http://www.victam.com/international.php#brochure.
May 11-18, 2007: The 16th International Pectinid Workshop. Dedicated to the dissemination of knowledge concerning the scallop species of the world. Halifax, Nova Scotia, Canada. Contact: Dr. G. Jay Parsons 613-990-0278. Conference website: http://www.aquacultureassociation.ca/ipw/IPW.htm
May 16-18, 2007: The 31st Fish Feed and Nutrition Workshop. Designed to allow interaction and sharing of information with people interested in aquatic animal nutrition. Auburn, Alabama. Contact**:** D. Allen Davis 334-844-9312 http://cf.acesag.auburn.edu/fisheries/feed-conference
May 19-23, 2007: World Aquaculture 2008. Annual International Conference & Exposition of World Aquaculture Society and Korean Aquaculture Society. Busan Korea. Conference website: https://www.was.org/meetings/ConferenceInfo.asp?MeetingCode=WA2008.

May 28-31, 2007: Global Trade Conference on Aquaculture. Qingdao, China. Contact**:** INFOFISH and GLOBEFISH 603-26914466 infish@po.jaring.my or globefish@fao.org.
June 18-22, 2007: The NOFFI Society presents: International Symposium on Fish Immunology. Contact: NOFFI Symposium Organisers 44 1786 467912. Stirling, Scotland. Conference website: http://www.abdn.ac.uk/noffi
July 31–August 1, 2007: 13th Annual FWS Aquaculture Drug Approval Coordination Workshop. Workshop includes presentations/discussions on the status of all ongoing aquaculture drug approval activities. Bozeman, Montana. Contact: 406-994-9913. Conference website: http://www.abdn.ac.uk/noffi
August 6–October 6, 2007: AquaPartners 2007. 6th International Exhibition & Conference on Fisheries & Aquaculture. Athens, Greece. Contact: Mrs. Maria Karka 30 210 9221254. Conference website: http://www.fws.gov/fisheries/aadap/
August 29–31, 2007: The 1st International Workshop on Biology of Fish Sperm. Workshop will include biological aspects of fish sperm. Vodnany, Czech Republic. Contact: Otomar Linhart 420 383 382 402.
September 11-15, 2007: Fish Stock Assessment Methods for Lakes and Reservoirs: Towards the true picture of fish stock. Ceske Budejovice, Czech Republic. Contact: 420 385 310 248. Conference website: http://fsamlr2007.czweb.org/
September 23-26, 2007: Aquaculture Canada 2007. 24th annual meeting will include invited speakers, organized and contributed session and the 2nd Canadian Freshwater Aquaculture Symposium. Edmonton Alberta Canada. Contact: Linda Hiemstra 250-751-4862. Conference website: http://www.aquacultureassociation.ca/AC06/welcome.html
October 15-17, 2007: 3rd International Sustainable Marine Fish Culture Conference. Fort Pierce, Florida. Conference website: http://www.hboi.edu/aqua/sustainable_conf.html.
October 24-27, 2007: Aquaculture Europe 2007. Events will combine a scientific conference with an exhibition. Contact: Mario Stael 32-9-23 34 912. Conference website: http://www.easonline.org/
November 27-30, 2007: Iran's 5th International Fisheries, Aquaculture & Seafood Exhibition. Goal of the Exhibition is to create a dynamic environment for presenting, transferring, exchanging, expanding and developing the know-how and marketing of fisheries and aquaculture industry through active participation of Iranian and foreign companies. Contact: The Secretariate 91 484 2394798.

This newsletter is prepared by Dr. Breck Bowden, Director, Vermont Water Resources and Lake Studies Center, The Rubenstein School of Environment and Natural Resources, The University of Vermont, George D. Aiken Center, Burlington, Vermont 05405-0088, (802) 656-4057; and Dr. Jurij Homziak, Lake Champlain Sea Grant Program, The Rubenstein School of Environment and Natural Resources, George D. Aiken Center, The University of Vermont, Burlington, VT 05405-0088, (802) 656-0682. This newsletter is published with funds provided in part by the U.S. Geological Survey, Department of the Interior, as authorized by the Water Resources Research Act of 1984 and by the University of Vermont Extension System and U.S. Department of Agriculture.