

Professional Inventory  
**William (Breck)enridge Bowden, Professor**  
*Robert & Genevieve Patrick Chair of Watershed Science and Planning Emeritus*  
*Rubenstein School of Environment and Natural Resources*  
*University of Vermont*

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## Education

- Ph.D. 1982 North Carolina State University, Raleigh, NC  
Conducted at Marine Biological Laboratory: 1976-1982  
*Research Area:* biogeochemistry of nitrogen in coastal ecosystems
- M.S. 1976 North Carolina State University, Raleigh, NC  
*Research Area:* microbial numbers and biomass in aquatic ecosystems
- B.S. 1973 University of Georgia, Athens, GA.  
*Majors:* Zoology and Chemistry

## Experience

2022 to present, *Robert & Genevieve Patrick Professor of Watershed Science & Planning Emeritus*

2002-2022, *Robert & Genevieve Patrick Professor of Watershed Science & Planning*, Rubenstein School of Environment and Natural Resources, Burlington, Vermont. Provide leadership in teaching, research and community service, focused on management of natural resources through an approach to watershed management that integrates environmental, social, and economic considerations and approaches.

2020 to 2022, *Interim Associate Dean for Research and Faculty Development*, Rubenstein School of Environment and Natural Resources, Burlington, Vermont. Provide strategic support for research and faculty development, including annual review of faculty; reappointment, promotion, and tenure; and administration of the graduate programs in the school.

2008-2023, *Director and Principal Investigator*, Theme 1, Northeastern States Research Collaborative, Rubenstein School of Environment and Natural Resources, Burlington, Vermont. Manage an interdisciplinary research program on the integration of resource management and socio-economic concerns in the northern forests of the New England region.

2012 to 2022, *Director*, Lake Champlain Sea Grant program. Manage and develop resources for research, education and outreach relevant to the mission of the National Sea Grant Organization. The Director of the Lake Champlain Sea Grant program is a de facto member of the Lake Champlain Basin Program Steering Committee.

2004-2022, *Director*, Vermont Water Resources and Lake Study Center, Rubenstein School of Environment and Natural Resources, Burlington, Vermont. Manage and develop resources relevant to water resources of the state of Vermont and the Lake Champlain region.

2004-12/2015-2020, *Member* and 2010-12, *Chair*, Technical Advisory Committee for the Lake Champlain Basin Program. Manage a committee of technical experts from two state and one province (Quebec) and provide advice about technical issues and needs relevant to management of the resources in the Lake Champlain basin. The Chair of the Technical Advisory Committee is a de facto member of the Lake Champlain Executive and Steering Committees.

1997-2002, *Programme Leader*, Integrated Catchment Management Programme, Landcare Research, Lincoln, New Zealand. Provide overall science leadership for a national research program involving approximately 40 research scientists and collaborators focused on integrated management of land and water resources in regional-scale catchments. Manage collaborative subcontracts with four other national

laboratories. Maintain communication and collaboration with key government and industry stakeholders. Report to key managers within the company and to the New Zealand Foundation for Research, Science & Technology.

1997-2002, *Team Leader*, Catchment and Biospheric Processes, Landcare Research, Lincoln, New Zealand. Provide direct human resources support and guidance for a team of 15 science staff. Identify and develop consulting opportunities to minimize the un-funded time of team members. Identify career training and development opportunities. Conduct annual performance appraisals and recommend merit increases and bonuses.

1992-1997, *Associate Professor (Tenured) and Curriculum Coordinator*, Water Resources Management, Department of Natural Resources, UNH, Durham, NH. Taught a General Education course in freshwater resources and upper class courses in Wetland Resources Management and Field Wetland Ecology. Lead Senior Research Projects on alternate years. Team taught an introductory course for Natural Resources department majors. Supervised, on demand, independent study and senior thesis projects. Developed independent research programs focused on various aspects of land and water management.

1993-1994, *Visiting Scientist*, Landcare Research, Lincoln, New Zealand. Sabbatical leave. Conducted a study of hillslope flow processes in a native tussock grassland, wetland, and stream system on the South Island (Glendhu Forest).

1987-1997, *Assistant Professor and Curriculum Coordinator*, Water Resources Management, Department of Natural Resources, University of New Hampshire, Durham, NH.

1987-1989, *Director and Advisor*, Hubbard Brook Research Experiences for Undergraduates Program. Directed a summer program for 10 undergraduate students who worked on research projects at the Hubbard Brook Experimental Forest.

1984-1986, *Lecturer in Water Resources*, School of Forestry and Environmental Studies, Yale University, New Haven, CT. Taught a graduate student course in hydrology and water resources management.

1982-1984, *Associate in Research (Post-Doctoral Fellow)*, School of Forestry and Environmental Studies, Yale University, New Haven, CT. Effect of whole-tree harvesting on gaseous nitrogen emissions from soils. With Dr. Herbert Bormann.

1979-1982, *Graduate Research Associate*, The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA. Nitrogen cycling in a freshwater tidal wetland. With Dr. John E. Hobbie.

1973-1978, *Project Consultant or Research Assistant*:

Boston University Marine Program, Woods Hole, MA

The Ecosystems Center, MBL, Woods Hole, MA

Water Resources Research Institute, Raleigh, NC

Sea Grant Program, NCSU, Raleigh, NC

S.E. Fish and Game Statistics Project, NCSU, Raleigh, NC

## Synergistic Activities

2011 to 2022, *Member*, Toolik Field Station Advisory Board and Toolik Environmental Data Center Advisory Committee, University of Alaska - Fairbanks

2017 to 2020, *Member*, Aquatics Technical Working Group, National Environmental Observatory Network, Boulder.

2012 to 2016, *Senior Science Advisor* and *co-PI*, Northeastern Water Resources Network project. Vermont ESPCoR. Provided overall science advising and leadership for a proposed multi-state project (Vermont, Rhode Island, and Delaware) to integrate an advanced optical sensor network with research on end user uptake of new forms of environmental monitoring data.

2013 to 2018, *Member*, Advisory Board, Polar Geospatial Center, University of Minnesota, St. Paul

2011 to 2017, *Member*, NSF Search for Arctic Change (SEARCH) Science Steering Committee.

2011 to 2016, *Senior Science Advisor*, Regional Adaptation to Climate Change. Vermont ESPCoR. Provided overall science advising and leadership to integrate research on lake, watershed, and social research focused on climate change in the Lake Champlain basin.

2008 to 2011, *Senior Science Advisor*, Complex Systems initiative. Vermont ESPCoR. Provided overall science advising and leadership to integrate research on lake, watershed, and social research focused on climate change in the Lake Champlain basin.

2010 to 2011, *co-Guest Editor*, Special issue of the New Zealand Journal of Marine and Freshwater Science dedicated to a collection of research articles on integrated catchment management.

2009 to 2012, *Chair*, Domain Science, Education, and Communication Committee, Arctic Domain (D-18), National Environmental Observatory Network.

2009 to 2010, *Member*, Understanding the Arctic, National Science Foundation Task Force.

2008-2010, *Science co-Leader*, Watershed Science and Hydrology, Vermont ESPCoR Complex Systems research project. Led one of three science areas focused on integrating research on ecosystem processes with research on innovative complex systems modeling techniques.

2008 to 2011, *Lead-PI*, NSF Changing Seasonality in Arctic Stream Networks project. This collaborative and integrated research project included approximately 7 researchers at 3 independent institutions. Served in 2010 as the co-organizer and host for a national workshop of ~25 collaborating scientists working in NSF's Changing Seasonality in the Arctic research program.

2008 to 2014, *Lead-PI*, Arctic Systems Science Thermokarst Project. This collaborative and integrated research project included 25 researchers and 12 independent institutions across the US and including Canada.

2008 to 2023, *Co-PI and Coordinator*, Arctic Long-Term Ecological Research Program, Streams Component. This collaborative and integrated research project included approximately a dozen researchers at 5 independent institutions across the US.

2008 to 2015, *Contributor*, Stream Environmental Observatory Network (STREON) experiment development team.

2007-2008, *Contributor*, National Environmental Observatory Network, Aquatic Sensor Array Team.

2006 to 2009, *Co-PI*, Consortium of University Scientist for the Advancement of Hydrologic Sciences, Hydrologic Measurement Facility working group.

2004-2012 *Member and Chair* (2010-2012), Technical Advisory Committee, Lake Champlain Basin Program. *Chair* automatic membership in the Lake Champlain Basin Program Steering Committee and Executive Committee.

2004, *Co-Developer* of UNESCO Hydrology for Environment Life and Policy (HELP) Basin Program for the Lake Champlain Basin, USA.

2001-2002, *Charter Member and Developer* of UNESCO Hydrology for Environment Life and Policy (HELP) Basin Program for the Motueka River and Tasman Bay, New Zealand.

2000-2002, *Founding Member and Organizer*, the Cooperative Research Group for Integrated Catchment Management. An ad-hoc, national coordinating group for interdisciplinary research on integrated environmental management in New Zealand.

1989, *Coordinator*, Department of Natural Resources, University of New Hampshire, Durham, NH. Led an initiative to establish the Ph.D. program in Natural Resources Management.

1987-1997, *Curriculum Coordinator*, Department of Natural Resources, University of New Hampshire, Durham, NH. Established a new undergraduate major and later M.S. in Water Resources Management.

1987-1989, *Director and Advisor*, Hubbard Brook Research Experiences for Undergraduates Program.

### **Honors and Awards**

Kroepsch-Maurice Teaching Award. Nominated but not selected. 2016.

Vermont Transportation Research Center annual meeting, Best Poster presentation (with J. Bartlett and M. Watzin), 2009 and 2010.

Kroepsch-Maurice Teaching Award. Nominated but could not accept due to time conflicts to prepare required materials. 2008.

North American Benthological Society annual meeting. Best Poster presentation (with N. Morse), 2004.

Royal Society of New Zealand. ISAT collaborative initiative funding. 2001.

New Zealand Hydrological Society. Best presentation on a management issue. 2000.

New Zealand Ministry for Research, Science & Technology. Travel award. 2000.

Marion and Jasper Whiting Foundation. Sabbatical travel award. 1993.

Distinguished Teaching Award, Department of Natural Resources. 1993.

Outstanding Assistant Professor Award, University of New Hampshire. 1991.

Teacher of the Year Award, Department of Forest Resources. 1989.

NSF Doctoral Dissertation Grant. 1978-1980.

Awards while at the Ecosystems Center, MBL, Woods Hole, MA.  
Year-in-Science Student Program. 1976-1982

Robert Sterling Clark Foundation Fellowship. 1976-1977.

Jessie Smith Noyes Foundation Fellowship. 1976-1982.

Phi Kappa Phi, University of Georgia. 1973.

Graduated cum laude, University of Georgia. 1973.

Phi Eta Sigma, freshman honor society, University of Georgia. 1969.

### **Other Appointments**

Adjunct Professor, Department of Natural Resources, University of New Hampshire (2001 - 2003)  
Water Steward, in the Water Stewards Network (2002)

### **Professional society memberships**

Member, American Association for the Advancement of Science

Member, American Geophysical Union

Member, Society for Freshwater Science (formerly North American Benthological Society)

Member, Phi Kappa Phi, Honor Society

Member, Xi Sigma Pi, Alpha Epsilon Chapter, Forestry Honor Society

### **Teaching interests and experience**

#### Courses taught

*Critical Thinking in Natural Resources* (NR095, UVM, 2019) and *Race and Culture in Natural Resources* (NR006, UVM, 2018 to 2019). A two-semester sequence specifically designed for first-year undergraduates in the Rubenstein School, to introduce good habits in critical thinking and applications to considerations of power, privilege, and equity in society. Students in the class are also academic advisees for their first year at UVM.

*Stream Ecology*, (NR280, UVM, Fall 2011-2020): An advanced undergraduate and graduate course in basic stream ecology including hydrology, biogeochemistry, and biology in the context of resource management.

*Ecological Risk (Watershed) Assessment* (ENSC 202, UVM, Spring 2003-2017): A senior capstone course in the UVM Environmental Sciences major focusing on the science underpinning resource management at the watershed scale.

*Aquatic Ecology and Watershed Science Seminar*, (NR385, UVM, Fall and Spring, 2010-2011): A graduate seminar course for students in the AEWS graduate concentration.

*Ecological Stoichiometry* (ENSC 285, UVM, Fall 2004, 2006, 2008, 2010): A senior-to-graduate level seminar focused on recent research on interactions between biogeochemical dynamics and food webs in

an ecosystem context.

*Fate and Transport of Pollutants* (ENSC 160, UVM, Fall 2010). A junior-level course required in the UVM Environmental Sciences major, focusing on quantitative methods to estimate dynamics of pollutants in the environment. Section of lectures on water.

*Environmental Hydrology* (NR285, with Beverley Wemple, Geography): A senior-to-graduate level, project-based, quantitative course designed to provide students with an interest in natural resources management with the essential theory and technical knowledge they need to communicate effectively with hydrologic engineers and consultants.

*Geomorphic Assessment of Stormwater Impacted Urban Streams* (ESNC 285B, Spring 2005): A senior-to-graduate level, project based, service learning course supported by the Vermont Agency of Natural Resources, Department of Environmental Conservation, River Management Section. The seminar was focused on development of a benchmark database of stream geomorphic metrics for stormwater impacted streams in Chittenden County Vermont and improvement of the protocols developed by ANR/DEC to better assess and monitor these streams. The seminar was a precursor to a field campaign conducted in the summer of 2005 to quantify the stream geomorphic metrics.

*Stream Ecosystem Modeling* (ENSC 285, UVM, Fall 2003): A senior-to-graduate level seminar focused on the biogeochemistry of whole-stream ecosystems at the reach scale.

*Urban Stormwater Management* (ENSC 285, UVM, Fall 2003): A senior-to-graduate level seminar focused on modeling stormwater dynamics in traditional and green-engineered urban and sub-urban systems.

*Urban Watershed Management* (NR 285, UVM, Fall 2002): A senior-to-graduate level seminar focused on urban sprawl and its impacts on water resources.

*Independent studies* (UNH, as required): Individual senior research projects.

*Critical Analysis in Water Resources Management* (UNH, 1996-1997): A senior and graduate level seminar focused on readings and analysis of topical water resource management issues.

*Land use seminar* (UNH, 1988-1989, 1992): A senior 'cap-stone' course focused on a real and current resource management problem approached as a group research project.

*Wetlands Resources Management and Wetland Field Ecology* (UNH, annually from 1989 to 1997): Two linked courses for seniors, graduate students, and continuing education professionals. Focusing on wetland types, identification, ecology, and management. The field course focused on practical skills needed to assess the ecology of different wetland types.

*Water Resources Management* (UNH annually from 1987-1997): The water cycle, nutrient cycles, water policy and regulation, and water management issues for both majors in natural resources and non-majors.

*Catchment Hydrology* (Yale University 1985-1986): Water cycle and water processes for graduate students in the Yale University School of Forestry and Environmental Studies graduate program.

Teaching record at UVM (2003-2022)

<u>Year</u>	<u>Course</u>	<u>Content</u>	<u>Credits</u>	<u>Students</u>
2020	Spring	Race and Culture in Natural Resources	3	16
2019	Fall	Stream Ecology (field intensive)	4	17
2019	Fall	Critical Thinking in Natural Resources	1	16
2018	Fall	Stream Ecology (field intensive)	4	14
2018	Fall	Race and Culture in Natural Resources	2	17
2018	Spring	Sabbatical Leave	NA	NA
2017	Fall	Sabbatical Leave	NA	NA
2017	ENSC 202	Ecological Risk Assessment	4	46
2016	NR 280	Stream Ecology (field intensive)	4	18
2016	ENSC 202	Ecological Risk Assessment	3+1	40
2015	NR 280	Stream Ecology (field intensive)	4	16
2015	ENSC 202	Ecological Risk Assessment	3	42
2014	NR 280	Stream Ecology (field intensive)	4	14
2014	ENSC 202	Ecological Risk Assessment	3	41
2013	NR 280	Stream Ecology (field intensive)	4	28
2012	NR 280	Stream Ecology (field intensive)	4	20
2012	ENSC 202	Ecological Risk Assessment	3	44
2011	NR 280	Stream Ecology	4	30
2011	ENSC 202	Ecological Risk Assessment	3	48
2010	ENSC 106	Fate and Transport (Co-taught)	4	75
2010	NR 285	Ecological Stoichiometry	2	8
2010	Spring	Sabbatical semester	NA	NA
2009	Fall	Sabbatical semester	NA	NA
2008	NR385	AEWS Seminar	1	Var
2008	ENSC 202	Ecological Risk Assessment	3	27
2007	NR385	AEWS Seminar	1	Var
2007	NR285	Environmental Hydrology (Co-taught)	4	16
2007	ENSC 202	Ecological Risk Assessment	3	28
2006	ENSC 285	Ecological Stoichiometry	2	10
2005	ENSC 285	Urban Stream Geomorphic Assessment	2	8
2005	ENSC 202	Ecological Risk Assessment	3	22
2004	ENSC 285	Ecological Stoichiometry	2	8
2004	ENSC 202	Ecological Risk Assessment	3	36
2003	ENSC 285	Stream Ecosystem Modeling	2	3
2003	ENSC 285	Urban Stormwater Modeling	2	4
2003	NR 285	Urban Watershed Management	2	15

*Teaching record at UNH (1985-1997)*

1997	WaRM 700	Critical Analysis of WaRM Literature	2	14
1997	WaRM 504	Freshwater Resources	4	74
1996	NR 993	“Hot Topics” Graduate Seminar	1	7
1996	WaRM 713/813	Field Wetland Ecology	3	9
1996	WaRM 711/811	Wetland Resources Management	3	23
1996	WaRM 700	Critical Analysis of WaRM Literature	2	9
1996	WaRM 504	Freshwater Resources	4	123
1995	WaRM 711/811	Wetland Resources Management	3	31
1993	WaRM 504	Freshwater Resources	4	159
1992	NR 775	Senior Team Project	Var	5
1992	NR 401	Natural resources perspectives	4	75
1992	WaRM 713/813	Field wetland ecology	2	17
1992	WaRM 711/811	Wetland resources management	3	29
1992	WaRM 504	Freshwater Resources	4	163
1991	NR 401	Natural resources perspectives	4	67
1991	WaRM 713/813	Field wetland ecology	2	13
1991	WaRM 711/811	Wetland resources management	3	27
1991	WaRM 504	Freshwater Resources	4	155
1990	NR 401	Natural resources perspectives	4	60
1990	WaRM 713/813	Field wetland ecology	2	13
1990	WaRM 711/811	Wetland resources management	3	24
1990	WaRM 716/816	Wetland delineation (Co-taught)	4	35
1990	WaRM 610	Independent study	Var	2
1990	WaRM 594	Freshwater resources	4	160
1989	WaRM 611	Wetland resources management	4	25
1989	WaRM 610	Independent study	Var	2
1989	WaRM 775	Land use seminar	2	6
1989	WaRM 504	Freshwater resources	4	120
1988	WaRM 775	Land use seminar	2	6
1988	WaRM 603	Watershed management	4	12
1988	FORS 504	Freshwater resources	4	145
1988	FORS 755	Regional silviculture (Co-taught)	2	9
1987	FORS 603	Watershed management	4	11
1987	FORS 504	Freshwater resources	4	125
1986	FES 543b	Water resource management	4	24
1985	FES 543b	Water resource management	4	12

*Undergraduate advisees by year*

2020	-	19
2019	-	17
2018	-	0
		Sabbatical leave

2017	-	43	
2016	-	42	
2015	-	30	
2014	-	29	
2013	-	28	
2012	-	28	
2011	-	22	
2010	-	7	Sabbatical year, graduate students only
2009	-	7	Sabbatical year, graduate students only
2008	-	30	
2007	-	23	
2006	-	23	
2005	-	16	
2004	-	14	
2003	-	33	Including A. McIntosh advisees, during his sabbatical leave
1997-2002	-	Na	Overseas, New Zealand, non-academic appointment
1997	-	27	
1996	-	27	
1995	-	50	Including W. McDowell advisees, during his sabbatical leave
1994	-	Na	Sabbatical year
1993	-	25	
1992	-	27	
1991	-	20	
1990	-	19	
1989	-	10	
1988	-	6	
1987	-	3	

## Research interests and experience

### General

Interactions between hydrological and biogeochemical processes, especially as these processes are influenced by land use practices and land cover characteristics at catchment scales. Uptake and use of science knowledge by resource managers, policy makers, and community stakeholders.

### Active and Recent Research Areas

*Linkages between benthic primary production and nutrient cycling in Arctic tundra streams, North Slope, Alaska:* Since 1987 I have collaborated on the Arctic Long-Term Ecological Research project, a large, inter-disciplinary program to better understand the basic ecosystem ecology of Arctic tundra landscapes, through an investigation of “bottom-up and top-down” controls on ecosystem processing. Between 2008 and 2023 I led and coordinated the streams research on this long-term project. My research has contributed to a better understanding of Arctic streams ecosystems. The key findings of this on-going research are that benthic primary production is fundamental controller of N and P cycling in these streams and that the balance of N and P inputs has profound influences on the structure and function of the benthic autotrophic community structure and function. More recently, this work has begun to focus on interactions among iron, carbon, and other nutrients cycles and the way these interactions control nutrient processing and transport at the landscape scale. More information on this research program can be found at <https://arc-lter.ecosystems.mbl.edu/>. The Arctic LTER project has provided an important base for other components of my research portfolio, as summarized below.

*Changing Seasonality in the Arctic System:* This suite of 3 large, collaborative projects was funded by the Office of Polar Programs at the National Science Foundation and build on my 20+ years of experience in Arctic research. In 2008 I initiated a collaborative project with colleagues across the United States and in Canada to take a systems approach to quantify the environmental consequences of thawing permafrost on the structure and function of the arctic landscape. This project focused on the formation of thermokarst failure features (a physical disturbance to the soil that can occur when frozen ground thaws) on hydrological, biogeochemical, microbial, soil, vegetation, geomorphological, and social processes in the arctic. I was the lead Principal Investigator on this project, which included 14 other collaborating PIs and 12 graduate students, technicians and post-doctoral researchers. Also beginning in 2008 I worked with a group of 10 other collaborators to investigate the ecological consequences of a highly unusual tundra wild fire. Until recently wildfires were virtually unheard of in the tundra biome. The Anaktuvuk Burn that occurred in late 2007 burned over 1000 square kilometers near the Toolik Field Station, our research base, and is the largest arctic tundra fire on record. We hypothesized that fire may become a more important component of the arctic landscape in a future, warmer arctic landscape and use the Anaktuvuk Burn as a natural laboratory to understand how fire affects the tundra environment. We continue to monitor this unusual event. Finally, in 2009 I initiated a project with 2 other colleagues to examine the effects of changing seasonality on stream nutrient and material processing. Warming in the arctic is extending the snow- and frost-free seasons in the spring and autumn. However, plants continue to bloom and senesce on the basis of sunlight (day length) cues. Thus, there is growing asynchrony in demand for nutrients and plants and production of nutrients by soil microbes that has important consequences for the way that nutrients and carbon are processed in arctic streams. Additional information on this and related projects can be found at <https://arc-lter.ecosystems.mbl.edu/content/collaborating-projects>

*Scaling ecosystem processes in river networks:* The initial impetus for this effort was a collaborative research project funded by the NSF Macrosystems Biology program. The project was designed to explore how small-scale ecological experiments can be applied to understand structure and function of large, regional ecological systems. Our goal was to develop new insights regarding how best to extrapolate

small-scale experimental measurements used by field researchers to large-scale river networks. Specifically, we addressed whether patch-scale measurements (at 10s of cm) of ecosystem rates over- or under-estimate reach-scale (100 – 1000 m) rates in streams. We examined abiotic variables that drive scaling of reach- to network-scale measures of ecosystem function and exploring how ecosystem rates and the effects of consumers vary among a suite of biomes across the United States. This project was designed to provide information to the National Ecological Observatory Network (NEON) initiative. I was one of five co-PIs on this project and Leader of the Arctic group. More recently this work has led to a larger-scale consideration of fine-scale biogeochemical patterns in watersheds and how they are influenced by local landscape factors and regional climate factors. This has led to a new, NSF-funded project called the Arctic River Integrated Observations via Synoptic Sampling (Arctic RIOS) project. This project is a collaboration with Brigham Young University, Michigan State University, and the National Park Service. The first field season will be conducted in 2020.

*Next-generation sensors to characterize biogeochemical dynamics in rivers:* Over the past decade, there have been important advances in the technologies used to monitor important biogeochemical properties of water. In particular, in situ optical water quality sensors are providing new insights into our understanding of the behavior of aquatic systems at temporal and spatial scales that were unachievable previously. The primary advantages of advanced optical sensors for watershed studies is that they can frequently, consistently and comparably measure a suite of biogeochemical parameters (e.g.; DOC, nitrate, particle loads) unattended, over long deployments. We explored the capabilities of these instruments in an NSF EPSCoR-funded project called the New England Water Resources network (NEWRnet) in which we deployed an identical array of sensors across three states (Vermont, Rhode Island, and Delaware) to explore water quality and ecosystem dynamics in three distinct land use class (forested, agriculture, and urban). This research led to new insights regarding the dynamics of nitrate and DOC during storm events and highlighted some of the capabilities and challenges in using this powerful new instruments. Information about this project can be found at <https://epscor.w3.uvm.edu/2/node/2185>. We have begun to use similar sensors in our Arctic research, described previously.

*The role of iron as a controlling element in Arctic biogeochemical cycling:* It has long been recognized that iron plays a crucial role in regulating the mobility and availability of phosphorus – an essential nutrient and frequent pollutant – in aquatic systems. Recently, we have begun to realize that iron may influence the behavior of other essential elements as well, like carbon and nitrogen. This influences of iron on key biogeochemical elements may be particularly important in Arctic, where iron is particularly abundant in the tundra soil and permafrost – frozen soil – is thawing rapidly as the Arctic climate warms. The interaction of warming climate, thawing permafrost, and the interactions among iron and the essential elemental nutrients carbon, nitrogen, and phosphorus, is currently poorly understood. A new, collaborative effort funded by the NSF called the “Iron-Methane in Tundra Ecosystems” project is focused on better understanding these relationships. The primary partner in this effort is the Bigelow Laboratory for Ocean Sciences, with a secondary collaboration with the Oak Ridge National Laboratory.

### Previous Research Experience

*Influences of hyporheic dynamics on nutrient processing in Arctic tundra streams:* The key findings from this research are that hyporheic processes are of fundamental importance to clear understanding of C, N, and P turnover in arctic tundra stream; a finding that was unexpected. In August 2003 I received a new, multi-year award from NSF, with co-PIs from Utah State University (Dr. Michael Gooseff) and Boise State University (Drs. Jim McNamara and John Bradford) to study the potential impacts of climate change in the Arctic on stream hyporheic dynamics. Additional information on this and related projects can be found at <https://arc-lter.ecosystems.mbl.edu/content/collaborating-projects>

*Vermont Flow Monitoring Project:* In 2004 the Water Resources Board created a stakeholder-driven process to develop a scientific rationale for the management of stormwater in Vermont. The group concluded that stream flow data alone could be used to target actions to reduce stormwater pollution. Based on this decision, the Vermont Agency of Natural Resources (VTANR) developed Total Maximum Daily Load (TMDL) analyses for some stormwater impaired streams in Vermont, which have subsequently been accepted by the USEPA. The original TMDL analyses were based on synthetic stream flow values produced by Tetrtech using the P8 model. Although the model was partially validated using stream flow data from selected streams in the Vermont and New York area, the lack of historic data for the specific streams that VTANR has identified as impaired by stormwater presents a serious challenge to validate any hydrologic model or to select hydrologic targets. In addition, VTANR realized that without “benchmark” data providing a basis for comparison, future monitoring efforts to assess the effectiveness of mitigation efforts would be difficult. Thus, beginning in 2005 VTANR sought to address this lack of data and has contracted with my lab to monitor precipitation and stream flow in stormwater-impaired and attainment streams through the state. This management objective is leading to interesting new research on simple indicators of hydrologic alteration to small urban streams in Vermont.

*Impacts of Transportation Infrastructure on Stream Ecosystem:* Transportation infrastructure is a major source of stormwater runoff that can alter hydrology and contribute significant loading of nutrients, sediment, and other pollutants to surface waters. These increased loads frequently lead to impaired receiving waters, as is the case for streams throughout the Lake Champlain basin, as well as the Lake itself. We have selected six watersheds that represent the range of road types (gravel and paved) and road densities (rural, suburban, and urban) present in Chittenden County, Vermont and have characterized the road networks for each watershed using GIS (geographic information systems) analysis. Monitoring stations in each watershed were constructed and instrumented to measure discharge and water quality parameters continuously from spring through early winter. Storm event composite samples and monthly water chemistry grab samples have been collected and analyzed for total nutrients, chloride, and total suspended sediments. Preliminary results from two field seasons of monitoring suggest that road type and road density may be closely linked with the level of impairment in each watershed.

*Water quality monitoring in the National Park Service Northeastern Temperate Network:* The Northeast Temperate Network (NETN) was established by the National Park Service to monitor ecological conditions in eleven parks located throughout seven northeastern states. The vital signs include physical, chemical, and biogeochemical indicators intended to represent overall health or condition of park resources. My has been monitoring water quality within the network since 2006. The majority of that work has consisted of implementing the network's stream and pond monitoring protocol. More recently we have included a wetland monitoring component. These monitoring efforts have lead to a research interest in the importance mercury accumulation and methylation in vernal pools, a critical habitat for amphibian species. The data collected for NETN is used in a multitude of ways to inform park planning decisions, evaluate the effectiveness of management decisions or restoration efforts, provide early warning of potential threats, and promote public understanding of park resources.

*Stormwater management utilizing low-impact designs in urbanizing landscapes:* In 2003 I initiated a research program with several colleagues from the Rubenstein School of Environment and Natural Resource and the Gund Institute for Ecological Economics that is focused on stormwater management issues that are currently a critical challenge to resource management and economic development in Vermont. The “Redesigning the American Neighborhood” (RAN) is a collaboration of several different projects that are designed to assess public attitudes and understanding of stormwater processes and issues, monitor effects of stormwater on suburban streams, and demonstrate the utility of alternative low-impact stormwater management options. This program has already drawn considerable local attention and provides information that is essential to address these pressing issues. The project has developed strong collaborations with the City of South Burlington, Vermont and with the Vermont Agency of Natural

Resources, Department of Environmental Conservation.

*Integrated management of land and water resources in complex catchments:* Until 2002 I was the Program Leader this suite of projects focused on research relevant to adaptive management of land and water resources in urban and intensively-utilized rural catchments. The core research focuses on surface-water/groundwater interactions, land use impacts on river water quality, characterization of riparian structure and function, catchment scale hydrological modeling, marine biogeochemical processes, and development of publicly-accessible knowledge bases linked to GIS databases and Web interfaces.

*Flow path dynamics at hillslope to catchment scales:* Hydrodynamics of runoff processes in landscapes under different land use. Recent research has focused on storm event hydrodynamics in tussock grasslands with native cover compared with those afforested with *Radiata* pine and on runoff processes in pasture land that may be subject to municipal development or modified farm management.

*Environmental impacts of applying municipal biosolids in forest lands (New England and New Zealand):* Land application of biosolids (solid wastes from municipal and industrial waste water treatment) has the potential to be an inexpensive alternative to traditional engineered waste treatment options and can substantially improve soil moisture and nutrient qualities with economic benefits in farming and forestry applications. However, inappropriate applications can lead to environmental degradation and potential health risks. I have conducted research on the effects of biosolid loading rates on nutrient uptake by vegetation uptake and loss through soil leaching, in both the Northeast, USA and in New Zealand. The key finding from this research was that mechanisms that limit  $\text{NO}_3$  leaching losses will typically tend to limit the losses of other solutes that might be of concern in surface and ground water. With careful attention to the nature of the material being applied and the characteristics of the target environment, land application of biosolids can be a safe and economical alternative.

*The Lotic Intersite Nitrogen Experiment (LINX): comparative nitrogen cycling in North American headwater streams:* A collaborative project to compare N cycling in selected North American headwater streams and to test a number of key hypotheses about the influences of stream metabolism and hydrologic function on N cycling in streams. A key finding was that biogeochemical cycling of nitrogen was strongly linked to discharge rates and that nitrification was a surprisingly responsive component of the nitrogen cycle in these headwater streams.

*Impacts of differing riparian zone geomorphology on nitrogen fluxes from a tropical rain forest to headwater streams:* An investigation of N flux through the riparian zones of two tropical streams with distinctly different riparian flow paths. The key finding was that the rate, mode, and location of N processing was highly dependent on the geomorphology of the riparian zone, which in turn controlled hydrological flow paths.

*Impacts of whole-tree harvesting on  $\text{N}_2\text{O}$  losses from a northern hardwood forest:* Impacts of new forest harvesting method on losses of volatile forms of N from a forest ecosystem type that was known to be especially prone to soluble N loss (primarily as  $\text{NO}_3$ ) in response to disturbance. The project identified a key link between hydrological transport and volatilization of  $\text{N}_2\text{O}$  to the atmosphere.

*Nitrogen cycling in tidal freshwater wetland:* Influence of a unique and poorly understood coastal wetland type on water quality (N level) in a river draining an urbanizing watershed. The investigation focused on N turnover in wetland sediments, using  $^{15}\text{N}$  isotope dilution techniques. Major fluxes and stores of N in the wetland ecosystem were examined and quantified. Key interactions with the riverine system were identified.

## Research funding

*Research funding overview:* Since coming to the University of Vermont I have personally generated or managed just over \$19,000,000 of direct research funding. This does not include the value of matching funding or of collaborative awards that I initiated but that were managed by others. In my career I have generated or managed just under \$35,000,000 in research funding.

### Research funding – current

3. *NSF/NNA: Collaborative Research - Constraining fate and function of permafrost nutrients with direct multi-scale observations: Stream networks as indicators of watershed processes* NSF/ARCSS. Award 19-16576. \$393,560 (Vermont portion only). October 2019 - September 2022. Bowden Co-PI. Lead PI: Ben Abbot, Brigham Young University.
2. *NSF/DEB/LTERLTER: The Role of Biogeochemical and Community Openness in Governing Arctic Ecosystem Response to Climate Change and Disturbance.* Award: 1637459, \$1,004,000 (Vermont portion only) March 2017 – Feb 2023. Bowden Co-PI and Streams Research Coordinator. Lead organization: The Ecosystems Center, Marine Biological Laboratory.
1. *NSF, Department of Environmental Biology – Collaborative Research: Interactions of the microbial iron and methane cycles in the tundra ecosystem.* Award 1754379, \$260,431, October 1, 2018 – September 30, 2021. Bowden Co-PI. Lead PI: Dr. David Emerson, Bigelow Lab, Maine.

### Research funding – managed

3. *Lake Champlain Sea Grant Program.* In mid-2018 the National Sea Grant College Program within the National Oceanic and Atmospheric Administration designated the LCSG as a Sea Grant Institute and provided a substantial increase in annual base funding to \$1,000,000/year, which is to be matched 1:2 (Non-Federal:Federal). The annual value of this program is now \$1,500,000/year. The LSCG program combines research, outreach and education about Lake Champlain and its coastal environment. The program is a collaboration between Vermont and New York. Bowden, Director.
2. *Vermont Water Resources and Lake Studies Center.* Approximately \$125,000 annually from the U.S. Geological Survey, which has to be matched 2:1 (Non-Federal:Federal). The annual value of this program is about \$375,000. The Vermont Water Center is a competitive grants program that – with partners throughout the state – supports research on water resources in Vermont. Bowden, Director.
1. *Northeastern States Research Cooperative.* The NSRC is a competitive grants program that supports cross-disciplinary, collaborative research in the Northern Forest — a 26-million acre working landscape that is home to over a million residents and stretches from eastern Maine through New Hampshire and Vermont and into northern New York. A central component of the program has been the importance of the Northern Forest to society and the need for research activities to have relevance and benefit to the people who live within its boundaries, work with its resources, use its products, visit it, and care about it. In 2020 this program received a significant new infusion of funding - \$5 million - and is expecting similar funding levels in future years. UVM is the primary recipient of funds and co-administers the program with representatives from the University of New

Hampshire, the University of Maine, SUNY/ESF, and the Hubbard Brook Research Foundation. Bowden, Director.

Research funding – pending or planned

1. Currently none.

*Research funding – received and successfully completed at UVM*

61. *Lake Champlain Basin Program* - Quantifying phosphorus retention in restored riparian wetlands of the Lake Champlain Basin. 2018-2020. Bowden Co-PI. Lead PI: Eric Roy, UVM.
60. *NSF/DEB/LTER*: Supplement to purchase a river profiling ADCP. Award: 1637459 Amendment 03, \$25,000. Awarded to Marine Biological Laboratory and passed through to UVM subcontract. 22 May 2019.
59. NSF EPSCoR Track 2 Award IIA-1330446. Collaborative Research: North East Water Resources Network. \$2,000,000. 2013 – 2016. Co-PI.
58. NSF Macrosystems Biology EF-1065682, Collaborative Research: Macrosystems - Scaling of Basic Ecosystem Processing Rates and Consumer Influences in Streams from Centimeters to a Continent. \$251,822 UVM portion, \$3.5 million overall. 2012-2017. Co-PI and Leader of Arctic group.
57. NSF-OPP-ARC-0806394, How will increased thermokarst activity affect aquatic resources on the foothills of the North Slope, Alaska, 2008-2014, \$467,193. Part of a \$5 million collaborative project for which I was the overall Principal Investigator.
56. NSF/DEB/LTER-1026843, Arctic LTER: Climate Change and Changing Disturbance Regimes In Arctic Landscapes, \$943,740 UVM only, \$5,640,000 overall, National Science Foundation, 2011-2017. Co-PI and Streams Theme Leader.
55. 2012VT69B, Development of monitoring buoy system for lake studies, \$74,463 with cost-share. US Geological Survey (Vermont Water Resources and Lake Studies Center). 2012-2013
54. 2011VT58B, Use of Acoustic Doppler Current Profiler data to estimate sediment and total phosphorus loads to Lake Champlain from the Rock River, \$60,000 with cost-share from US Geological Survey (Vermont Water Resources and Lake Studies Center, 2011-2012) plus \$21,360 from the Vermont Agency of Natural Resources ( 2011-2013). Co-PI with Jamie Shanley, USGS.
53. NSF-ARC-0902106, How does changing seasonality affect the capacity of arctic stream networks to influence nutrient fluxes from the landscape to the ocean?, \$549,581. Part of a \$1,263,769 collaborative project. 2009-2013. Principal Investigator.
52. Vermont ANR, Stream Flow Monitoring Project, \$224,194, 2006-2013, PI.
51. University of Vermont Transportation Center, Effects of transportation networks on water quality and freshwater ecosystem integrity, 2008-2011, \$250,000. Co-Principle Investigator.

50. NPS/NETN/I&M, Evaluation and Implementation of the Northeast Temperate Network Water Quality and Quantity Monitoring Protocol, May 2007 – Dec 2011, \$273,368, PI.
49. NSF-DEB-0423385; “The Arctic LTER Project: Regional Variation in Ecosystem Processes and Landscape Linkages”; 1/15/2005-11/30/2010; \$4,920,000 (Marine Biological Laboratory; J Hobbie PI, Bowden one of 4 co-PIs). A no-cost extension to 11/30/2011 is expected. This project has been recommended for renewal from 2011-2017.
48. NPS/ARCN/I&M, Thermokarst distribution and characterization in the National Park Service Arctic Network (Phase 1), May 2007 – Dec 2009, \$145,084, PI.
47. NPS/ARCN/I&M, Thermokarst distribution and characterization in the National Park Service Arctic Network (Phase 1), May 2006 – Dec 2009, \$54,729 + \$12,000 supplement, PI.
46. NPS/ARCN/I&M, Aquatic Biodiversity, Community Composition and Ecosystem Processes in Gates of the Arctic Park and Preserve and the Noatak National Preserve (Phase 3), May 2007 – Dec 2009, \$141,644, PI.
45. NPS/ARCN/I&M, Aquatic Biodiversity, Community Composition and Ecosystem Processes in Gates of the Arctic Park and Preserve and the Noatak National Preserve (Phase 2), May 2006 – Dec 2009, \$260,713, PI.
44. NPS/ARCN/I&M, Aquatic Biodiversity, Community Composition and Ecosystem Processes in Gates of the Arctic Park and Preserve and the Noatak National Preserve (Phase 1), Co-op agreement J9840050100, May 2005 – Dec 2008, \$224,339, PI.
43. NSF/OPP, Aquatic Ecosystem Responses to Changes in the Environment of an Arctic Drainage Basin, Award #9911278, July 05 – July 07, \$ 4,563,868 (\$53,000/year PI subcontract component only)
42. NSF/DEP, LTER: The Arctic LTER Project: The Future Characteristics of Arctic Communities, Ecosystems, and Landscapes, DEB-9810222, 2005-2010, \$ 4,920,000 (unsupported co-PI)
41. EPA, Impacts of acid rain on form and transport of pollutants in urban stormwater runoff, 2004-2007, \$75,000 (graduate student support only), PI.
40. EPA, Redesigning the America neighborhood: cost-effectiveness of innovative interventions to manage stormwater at different watershed scales, Award X97137901-0, 2006-2008 (Phase 4), \$443,400, Co-PI.
39. EPA, Redesigning the America neighborhood: cost-effectiveness of innovative interventions to manage stormwater at different watershed scales, Award X97137901-0, 2005-2007 (Phase 3), \$396,800, Lead-PI.
38. NSF/OPP, Will climate change affect hyporheic processes in arctic streams? An assessment of interactions among geomorphology, hydrology, and biogeochemistry in Arctic tundra streams, Award OPP-0327440, Sep 03-Jun 07, \$608,709, Lead-PI.

37. EPA, Redesigning the America neighborhood: cost-effectiveness of innovative interventions to manage stormwater at different watershed scales (Phases 1 and 2), Award X98187601-0, \$915,000, 2004-2005, Co-PI.
36. Vermont ANR, River Management Seminar Series and Regional Workshop, 2004-2006, \$35,000, PI.
35. Vermont ANR, Geomorphic Assessment of Storm Water-Impacted Streams in Chittenden County and Developing Seminars to Define Geomorphic-Based River Management as a Component Of Integrated Storm-water Management, 2004-2006, \$93,267, PI.
34. Vermont ANR, Development of an integrated, watershed-scale, planning tool for stormwater management in Vermont, 2004-2006, \$30,755, PI.
33. Vermont ESPCoR, Equipment grant for whole-stream metabolism research. March 2004, \$8,760. Principal Investigator.
32. NSF-Office of Polar Programs, Aquatic Ecosystem Responses to Changes in the Environment of an Arctic Drainage Basin. July 1, 2000 to May 31, 2005. \$3,999,991. Co-Principal investigator. Sub-contract for 1 month

*Research funding received and completed at Landcare Research in New Zealand*

31. The Royal Society of New Zealand, International Science & Technology Technical Participation Programme, “US-New Zealand collaboration on research relevant to nitrogen cycling in streams”, \$4,000NZ, 2001. Travel support for Dr. Bruce Peterson to visit New Zealand, to develop a collaborative research effort.
30. Landcare Research, Internal Re-investment Funding Programme, “Predicting coastal productivity from remotely-sensed land condition data: a feasibility assessment”, \$30,000NZ, 2001-2002.
29. University of Otago, “Ecosystem consequences of an invader: brown trout in New Zealand streams”, subcontract, \$10,000NZ, Associate Investigator. Part of a project (\$218,000NZ total award) from the Royal Society of New Zealand, Marsden Fund.
28. Forest Research, “Land treatment of municipal wastes” (Christchurch City Council and Selwyn Plantation Board project subcontract), \$50,000NZ, 1998-2002. Project Leader. Part of a program funded by the NZ Foundation for Research Science & Technology.
27. National Institute for Water & Atmosphere, “Water quantity and quality in river basins” (Whatawhata project subcontract), \$202,000NZ, 2000-2002. Project Leader. Part of a program funded by the NZ Foundation for Research Science & Technology.
26. New Zealand Foundation for Research Science and Technology, “Integrated management of land and water resources in complex catchments”, C09X0014, \$1,629,000NZ, 2000-2002 with contract renewals through 2006. Programme Leader.

25. National Institute for Water & Atmosphere, “Water fluxes and pathways in river basins” (Mahurangi project subcontract), \$202,000NZ, 1998-2000. Project Leader. Part of a program funded by the NZ Foundation for Research Science & Technology.
24. New Zealand Foundation for Research Science and Technology, “Ecosystem processes for catchment management”, C09807, \$2,147,000NZ, 1998-2000. Programme Leader. Funding for this program was reorganised in 2000 and renewed for a six year period (to 2006), in two-year contracts.
23. Tasman District Council, “Analysis of stakeholder priorities for research on water resources in the Motueka River catchment”, \$2000NZ, 2000. Project director and co-author.
22. Christchurch City Council, “Soils and Geology of the Styx River basin”, \$15,700NZ, 2000. Commercial contract delegated to Les Basher (Landcare Research staff and team member).
21. New Zealand Ministry for Research Science & Technology, International Science & Technology Technical Participation Programme, “US-Japanese Joint Seminar on the Hydrology and Biogeochemistry of Forested Catchments”, \$5,000NZ, 2000. Invited participant and speaker.

*Research funding received and completed at UNH*

20. NSF-Office of Polar Programs, “Key connections in arctic aquatic landscapes”, NSF-OPP-9615949, \$158,303, 1997-2000. Co-Principal investigator.
19. NSF-Ecosystems, “Nitrogen uptake, retention and cycling in stream ecosystems: An intersite N-15 tracer experiment.”, \$141,649 (UNH portion only), 1996-1999 (primary activity in one month in 1997). Co-principal investigator on a multi-site group project.
18. NH Agricultural Experiment Station/Cooperative State Research, "Riparian nitrogen cycling: denitrification versus plant uptake", \$30,000, July 1996 - June 1999. Principal investigator. Withdrew from project after resigning position at UNH to take up position at Landcare Research.
17. NSF-Office of Polar Programs, “Controls of structure and function of aquatic ecosystems in the arctic”, NSF OPP-9400722, \$124,500, 1994-1997. Co-Principal investigator.
16. Cooperative State Research Service/National Research Initiatives/Competitive Grants Program, "Riparian influences on water quality from natural and afforested grasslands", \$78,841, October 1993 - September 1995. Principal Investigator.
15. NH Agricultural Experiment Station (Hatch or McIntire/Stennis), "Riparian denitrification as a control on nitrate export before forest harvesting", \$10,000, July 1993 - June 1995. Principal investigator.
14. Marion and Jasper Whiting Foundation, travel supplement award, used during sabbatical leave in 1993-1994 to do research in New Zealand, \$6,500, July 1993-August 1994.
13. Scott Paper Co, Inc., "Assessing potential water quality impacts of creating topsoil with pulp and paper mill residuals", \$80,000, Feb 1990-June 1992. Co-principal investigator. Cooperative agreement with NE-158/H-317.

12. Maine DEP/Sludge Research Advisory Committee, "Mobility of chlorinated organic compounds in forest soil microcosms", \$144,136, April 89 - June 1992. Co-principal investigator. Cooperative agreement with NE-158/H-317.
11. Department of Interior/U.S. Geological Survey, "Land application of municipal sludge in New Hampshire forests: minimizing the risks to groundwater quality". July 1990 to June 1991. (Renewal) Co-principal investigator.
10. Department of Interior/U.S. Geological Survey, "Land application of municipal sludge in New Hampshire forests: minimizing the risks to groundwater quality", \$30,983, 1 July 1989-30 June 1990. Co-principal investigator.
9. Resource Conservation Services Inc., "Forest utilization of wood ash: soil chemical changes and effects on forest vegetation", \$30,000, July 1988-June 1990. Cooperative agreement with NE-158/H-317. Co-principal investigator.
8. Scott Paper Co. Inc., "Mobility of nutrients and heavy metals in forest soil microcosms treated with pulp and paper mill sludge", \$37,300 September 1988-March 1990. Cooperative agreement with NE-158/H-317. Co-principal investigator.
7. NE-158/Hatch-317 Regional CSRS project, "Utilization of sludge on forest and non-agricultural land", Oct 1986 - Sept 1991 (extended to Oct 1992). Co-principal investigator.
6. NSF, "Catastrophic disturbance in a tropical rain forest - impact of the riparian zone on nutrient export", \$150,000, July 1990 to December 1991. Co-principal investigator.
5. NSF, "Experimental studies of nitrogen cycling in tropical stream ecosystems" (BSR 8718395), \$25,674, July 1987-June 1989. Co-principal investigator.
4. NSF, "Research experiences for undergraduates at the Hubbard Brook Experimental Forest", \$39,900, November 1987-August 1989. Project leader.
3. NSF, "Long-term ecological research at the Hubbard Brook Experimental Forest", \$244,359, April 1987 - March 1994. Co-principal investigator
2. NSF, "Ecosystem reactions to disturbance: arctic streams and lakes." \$125,000, March 1991-Feb 1994. Co-principal investigator.
1. NSF, "Ecosystem reactions to disturbance: arctic streams and lakes." \$102,667, March 1988-Feb 1991. Co-principal investigator.

### **Undergraduate research theses and projects supervised**

<u>Name</u>	<u>Year</u>	<u>Program</u>	<u>Project</u>
Calvin McClellan	2020	(Honors)	Area specific discharge in Arctic watersheds
Abigail Rec	2019	(REU)	Assessment of nutrient limitation in Arctic streams

Allie Pankoff	2018	(REU)	Assessment of hyporheic depths in Arctic streams
Meghan Christie	2016	(REU)	Diel cycling of nutrients in an arctic river
Geoffrey Gray-Loeb	2015	(REU)	Synoptic sampling of an agricultural watershed in Vermont
Ryan Sleeper	2013	(Research)	Whole-stream metabolism in arctic streams
Genna Waldvogel	2011	(REU)	Changing seasonality in nutrient delivery to streams
Trevor Gearhart	2010	(REU)	Characteristics of riparian vegetation in arctic watersheds
Samuel Parker	2007	(URECA!)	Invertebrate responses to stream channel evolution
Satish Serchan	2007	(McNair)	Methods in stream ecohydrology
Andrew Duling	2004	(REU)	Geomorphic controls on stream suspended sediment loads
Nathaniel Morse	2003	(REU)	Estimating re-aeration rate from sound pressure level
Erin Steiner	2001	(REU)	Estimates of oxygen re-aeration rates in Arctic streams
Sarah Beck	2000	(REU)	Extinction coefficient for total chlorophyll in aquatic mosses
Aimee Genung	1999	(REU)	Total chlorophyll-nutrient relationships in aquatic mosses
William Schofield	1998	(REU)	Bryophyte health in arctic stream reaches
Michael Vester	1997	(UROP)	Distributions of bryophytes in New Hampshire streams
Dena Pappathanasi	1996	(REU)	Decomposition of bryophyte litter in an arctic stream
Ken Edwardson	1995	(REU)	Hyporheic dynamics in arctic streams
Karen Missel	1995	(project)	Modeling soil water infiltration with the SWIM model
John Terninko	1993	(REU)	Bryophyte and microalgal distributions in arctic streams
Patricia Maloney	1991	(REU)	Bryophyte and microalgal abundances in arctic streams
Don Schad	1989	(thesis)	Modeling soil infiltration with PRZM model
Jacques Finlay	1989	(REU)	Stream nutrient concentrations in pristine arctic streams
Jacques Finlay	1987	(REU)	Denitrification in forest soil catenas at Hubbard Brook
Neil Bettez	1987	(REU)	Whole soil denitrification at Hubbard Brook
Abednego Barnes	1987	(REU)	Soil infiltration rates in sand

### Graduate student theses supervised

#### *Master's*

<u>Student</u>	<u>Function</u>	<u>Dept</u>	<u>Completed</u>	<u>Status</u>
Frederick Sutor	Chair	AEWS	2023	Successfully defended
Ryan Sleeper	Co-Chair	AEWS	2018	Withdrew (job)
Eric Davis	Chair	AEWS	2013	Successfully defended
Lisle Snyder	Chair	AEWS	2013	Successfully defended
Joseph Bartlett	Co-chair	AEWS	2015	Successfully defended
Julie Larouche	Chair	AEWS	2008	Successfully defended
Amanda Holland	Chair	AEWS	2007	Successfully defended
Julie Foley	Chair	AEWS	2006	Successfully defended
Morgan Johnson	Chair	AEWS	2006	Successfully defended
Evan Fitzgerald	Chair	AEWS	2006	Successfully defended
Carl Cappelletti	Chair	AEWS	2005	Successfully defended
Alexander Hackman	Chair	AEWS	2005	Successfully defended
Amy Pervanas	Chair	WARM	1999	Withdrew (job)

Dave Arscott	Chair	WARM	1997	Successfully defended
Ken Edwardson	Chair	WARM	1997	Successfully defended
Jennifer Ashby	Chair	WARM	1996	Successfully defended
Sara Radasci	Member	EC	1996	Successfully defended
Willard Dyche	Member	SOIL	1993	Successfully defended
Neal Sullivan	Chair	FORS	1992	Successfully defended
Amy Suffet	Member	MICRO	1992	Successfully defended
Georgia Murray	Member	EOS	1992	Successfully defended
Chris Nash	Member	ESCI	1992	Successfully defended
Chris Catricala	Co-lead*	ESCI	1992	Successfully defended
Dave Cedarholm	Sponsor@	CIVE	1992	Successfully defended
Mike Cuomo	Chair	SOIL	1992	Successfully defended
Mark Anderson	Member	BOT	1991	Successfully defended
Rich Hallet	Co-lead*	FORS	1991	Successfully defended
Ken Kennedy	Member	ESCI	1991	Successfully defended
Patricia Shattuck	Sponsor@	ESCI	1991	Successfully defended
Steve Stresky	Sponsor@	ESCI	1991	Successfully defended
David Devoe	Co-lead*	ESCI	1990	Successfully defended
Laura Medalie	Co-lead*	ESCI	1990	Successfully defended
Robert Farrel	Member	ESCI	1989	Successfully defended
Chris Pyott	Member	EOS#	1989	Successfully defended

*Ph.D*

<u>Student</u>	<u>Function</u>	<u>Dept</u>	<u>Completed</u>	<u>Status</u>
Lindsey Carlson	Chair	NR	2025	Successfully defended
Abigail Rec	Chair	NR	2025	Successfully defended
Courtney Hammond	Co-Chair	NR	2019	Successfully defended
Matthew Vaughan	Co-Chair	NR	2018	Successfully defended
Samuel Parker	Chair	NR	2018	Successfully defended
Peter Isles	Member	NR	2016	Successfully defended
Julia Larouche	Chair	NR	2015	Successfully defended
Pooja Kanwar	Chair	NR	2014	Successfully defended
Joel Nipper	Chair	NR	2014	Successfully defended
Karim Chichakly	Co-chair	CS	2012	Successfully defended
Paul Lilly	Member	NR	2010	Successfully defended
Erica Gaddis	Member	NR	2006	Successfully defended
Ryan Davis	Member	WARM	1999	Successfully defended
Louis Barton	Reader	U. Waikato	1999	Successfully defended
Pam Morgan	Member	WARM	1998	Successfully defended
Dean Moosavi	Member	EOS#	1997	Successfully defended
John Portnoy (NPS)	Member	MBL	1995	Successfully defended
Steve McNulty	Member	EOS#	1991	Successfully defended
Charlie Vorosmarty	Member	EOS#	1991	Successfully defended

\* Primary technical research advisor with C.T. Smith, chair may be in other department  
@Primary technical research advisor, providing support, chair in other department

*Post Doctoral Fellows*

Andrea Pearce	RSENR	2011-13	Lecturer, Engineering, University of Vermont
Michael Flinn	RSERN	2009-11	Associate Professor, Murray State University
Wenzhi Cao	LCR	2001-02	Full Professor, Xaimen University, China

*Notes on graduate mentoring*

Due to the nature of my own research and the lack of a graduate program in Water Resources Management within the Department of Natural Resources prior to 1993, I have found it necessary to establish close working relationships with other academic programs to attract and support graduate students on my research projects. While logistically awkward, this situation fostered interdisciplinary research among my department and other departments with complementary academic and research interests. Thus, in many cases (noted above), I was not the official chair of record for the graduate committee but *was* the primary technical advisor.

In some cases (noted) this primary technical advisor function was shared with Dr. C.T. Smith, with whom I maintained a very close research relationship on joint Agricultural Experiment Station projects from 1987 to 1992.

Between 1997 and 2002 I was employed by Landcare Research in New Zealand, a Crown Research Institute which is not a degree-granting institution. Thus, I did not have graduate students during this period.

## Publications

### *Publications currently in review*

4. Grose, A. L., J. P. Zarnetske, A. Grewal, A. J. Shogren, A. F. Rec, J. A. O'Donnell, B. W. Abbott, and W. B. Bowden. 2026. Tracing seasonal ground thaw with stream chemistry in Alaskan Arctic permafrost catchments. *Hydrological Processes* (In review).
3. Rec, A. F., W. B. Bowden, A. J. Shogren, J. P. Zarnetske, A. L. Grose, B. W. Abbott, and J. O'Donnell. 2026. Landscape characteristics inform DOC and Nitrate mobility and export magnitude in two Arctic catchments. *Journal of Geophysical Research - Biogeosciences* (In review).
2. Rec, A. F., A. J. Shogren, J. P. Zarnetske, A. L. Grose, J. A. O'Donnell, B. W. Abbott, and W. B. Bowden. 2026. Coupling Concentration- and Process-Discharge Analysis Informs Arctic Stream Metabolic Response to River Discharge. *Limnology and Oceanography - Methods* (In review).
1. Sahlmann, L, M.B. Edlund, and W.B. Bowden. Assessing the response of benthic diatom communities to environmental change in an Arctic river: A 25-year longitudinal study of the Upper Kuparuk River, Alaska, USA. 2026. *Freshwater Science* (In revision after positive review).

### *Manuscripts in development*

6. Bowden, W.B., R.E. Sleeper, J.P. Beneš, and F.M. Iannucci. Long-term measurements of whole-stream metabolism in an Arctic tundra river experimentally enriched with phosphorus [In revision after initial review in *Freshwater Science*]
5. Bowden, W.B., M. Gooseff, W. Wolheim, A. Wloskowski, K. Whitinghill, and C. Treat. Influences of geomorphology on stream metabolism in permafrost-dominated, Arctic tundra streams. [Manuscript has been outlined, data are complete.]
4. Bowden, W.B., C. Song, S.P. Parker, and SCALER PI Team. Scaling measurements of metabolism in stream ecosystems: challenges and approaches to estimates of reaeration. [Manuscript has been outlined, data are complete.]
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#### *Editorials and Commentary*

2. Lajtha, K. and Biogeochemistry Editorial Board (including Bowden). 2017. Brave New World. A commentary of the need for good science. Biogeochemistry DOI 10.1007/s10533-017-0316-y
1. Bowden, W.B. 2016. Seeking Certainty About an Uncertain Future for Lake Champlain. Burlington Free Press and Vermont Digger.

#### *Web design and development and commentary*

9. Development of personal website for teaching and research dissemination (created personally) <http://www.uvm.edu/~wbowden>

8. Development of Bowden Watershed Research Lab website (code by S. Halik)  
<http://www.uvm.edu/bwrl>
7. Development of Vermont Water Resources and Lakes Students Center website (coded by M. MacLean), including regular commentary. <http://www.uvm.edu/envnr/vtwater/>
6. Development of the Northeastern States Research Cooperative website (designed by K. Baldwin and coded by S. Halik). <http://www.uvm.edu/envnr/nsrc/index.php>
5. Development of the Redesigning the American Neighborhood Project website (Created originally by A. Voinov, redesigned personally, coded by S. Halik)
4. Database contributions to US Arctic LTER programme archive.  
[http://ecosystems.mbl.edu/arc/data\\_doc/streams/streamsdefault.htm](http://ecosystems.mbl.edu/arc/data_doc/streams/streamsdefault.htm)
3. Integrated land and water resource management in complex catchments programme. [Abstract]  
<http://www.landcareresearch.co.nz/research/rurallanduse/integratedlandprog.asp>
2. Motueka Integrated Catchment Management Programme web site. [Co-developer of site.]  
<http://icm.landcareresearch.co.nz>
1. Commentary on Integrated Catchment Management:  
(Current: [http://icm.landcareresearch.co.nz/programme\\_leader/programme\\_leader\\_update.htm](http://icm.landcareresearch.co.nz/programme_leader/programme_leader_update.htm))  
(Archive: [http://icm.landcareresearch.co.nz/programme\\_leader/archive\\_hot\\_topics.htm](http://icm.landcareresearch.co.nz/programme_leader/archive_hot_topics.htm))

What is 'broken' in the Motueka catchment that needs fixing?

Recent research provides essential information to help protect valuable recreational fisheries in New Zealand.

Commentary on the "Muddied waters: estimating the national cost of soil erosion and sedimentation in New Zealand"

Motueka ICM partner wins Environmental Reporting award

Motueka ICM earns prestigious UNESCO designation

Introduction to the Motueka ICM web site

## Professional activities

### *Presentations and published abstracts*

*(Not fully up to date for 2011-present, typically 3-5 presentations per year)*

204. Zarnetske, J. P., A. Grose, P. Allsup, A. J. Shogren, B. W. Abbott, W. B. Bowden, J. A. O'Donnell, A. Rec, J. Nipko, and R. J. Frei. 2024. Arctic Alaska River Chemistry Controlled by Topography, Vegetation, and Seasonality across Headwater Catchments. Pages H42B-07 AGU Fall Meeting Abstracts, Washington, D.C.
203. Bowden, W. B., F. Sutor, E. D. Roy, A. W. Schroth, A. Michaud, D. Emerson, E. Herndon, L. E. Kinsman-Costello, and S. Hurley. 2024. Geochemical phosphorus sequestration in tundra soils impedes delivery of bioavailable phosphorus to an Arctic headwater river - regional and pan-Arctic implications. Pages C51D-0451 AGU Fall Meeting Abstracts, Washington, D.C.
202. Shogren, A., J. P. Zarnetske, A. Rec, A. Grose, J. Nipko, J. A. O'Donnell, W. B. Bowden, and B. W. Abbott. 2023. Exploring the importance of capturing shoulder seasons dynamics in Arctic headwaters: Are we giving the Arctic the cold shoulder? Pages B11F-1857 AGU Fall Meeting Abstracts, San Francisco, CA.

201. Rec, A., W. B. Bowden, A. J. Shogren, A. Grose, J. Nipko, J. P. Zarnetske, J. A. O'Donnell, and B. W. Abbott. 2023. Using Coupled Concentration- and Process-Discharge Analysis to Inform Arctic Stream Metabolic Response to River Discharge. Pages B41G-2539 AGU Fall Meeting Abstracts, San Francisco, CA.
200. Nipko, J., B. W. Abbott, Z. Aanderud, W. B. Bowden, J. P. Zarnetske, A. J. Shogren, J. A. O'Donnell, R. Lee, A. Rec, A. Grose, and J. VerSteeg. 2023. Seasonal Drivers of Carbon Processing in Arctic Rivers: Biodegradation and Photodegradation in North Slope, Alaska. Pages B52D-03 AGU Fall Meeting Abstracts, San Francisco, CA.
199. Grose, A., J. P. Zarnetske, A. J. Shogren, B. W. Abbott, W. B. Bowden, J. A. O'Donnell, and J. D. Gomez-Velez. 2023. Assessing the Transferability of Runoff Generation Paradigms to Permafrost Catchments in the Arctic. Pages H23G-06 AGU Fall Meeting Abstracts, San Francisco, CA.
198. Shogren, A., B. W. Abbott, W. B. Bowden, H. A. Dugan, A. Eichert, J. D. Gomez-Velez, A. Grose, C. Jones, E. I. Larson, A. Medvedeff, J. Nipko, J. A. O'Donnell, A. Rec, G. Shoell, W. Sutor, J. VerSteeg, T. L. Williamson, J. P. Zarnetske, and Q. Zhang. 2022. Stable Instability: Exploring the role of Arctic stream-lake chains on watershed-scale carbon and nutrients. Pages B22F-1509 AGU Fall Meeting Abstracts, Chicago, IL.
197. Rec, A., A. Grose, A. J. Shogren, J. Nipko, W. B. Bowden, J. P. Zarnetske, and B. W. Abbott. 2022. Arctic Stream Networks are Sensitive Sentinels of Environmental Change in the Permafrost Zone. Pages H32S-1154 AGU Fall Meeting Abstracts, Chicago, IL.
196. Nipko, J., Z. Aanderud, B. W. Abbott, W. B. Bowden, A. Eichert, A. Grose, C. Jones, R. Lee, A. Rec, J. A. O'Donnell, G. Shoell, A. J. Shogren, J. VerSteeg, J. P. Zarnetske, and Q. Zhang. 2022. Blinded by the Light: Seasonal Sensitivity of Arctic River Carbon to Photo- and Biodegradation. Pages B12K-1172 AGU Fall Meeting Abstracts, Chicago, IL.
195. Evans, S. G., S. Godsey, C. Chew, B. Yokeley, K. Hatch, E. Ferm, R. H. Harris, B. T. Crosby, M. N. Gooseff, A. A. Mohammed, and W. B. Bowden. 2022. Saturation Dynamics Along Thawing Continuous Permafrost Hillslopes. Pages EP36B-03 AGU Fall Meeting Abstracts, Chicago, IL.
194. Shogren, A., J. Zarnetske, B. Abbott, J. O'Donnell, T. Williamson, A. Rec, A. Grose, Q. Zhang, J. Nipko, R. Fulweber, H. Greaves, A. Medvedeff, and W. Bowden. 2021. Arctic River Integrated Observations through Synoptic Sampling (RIOS): Aquatic Networks Reveal Ecosystem Export of Carbon and Nutrients in Permafrost Watersheds. Pages B45J-1745 AGU Fall Meeting Abstracts, New Orleans, LA.
193. Wiegman, A., I. C. Augustin, M. L. Kubow, M. Fein-Cole, G. H. Myers, D. S. Ross, B. C. Wemple, R. M. Diehl, D. M. Rizzo, K. Underwood, W. B. Bowden, and E. D. Roy. 2020. Predicting Post-Restoration Risk of Soil Legacy Phosphorus Release in Historically Drained and Farmed Riparian Wetlands. Pages H092-007 AGU Fall Meeting Abstracts. Virtual/Online.
192. Shogren, A., J. P. Zarnetske, B. W. Abbott, F. Iannucci, W. B. Bowden, and A. Medvedeff. 2020. Shining light on Arctic river biogeochemical dynamics: Using in-situ high-frequency optical sensors to constrain carbon and nitrogen exports and stoichiometry in two headwaters. Pages H055-005 AGU Fall Meeting Abstracts. Virtual/Online.
191. Wiegman, A., M. L. Kubow, I. C. Augustin, G. H. Meyers, K. Underwood, W. B. Bowden, and E. D. Roy. 2019. Parameterizing Functions of Soil-Water Soluble Reactive Phosphorus Flux for an Ecohydrological Model of Formerly Drained Riparian Wetlands in the Lake Champlain Basin. Pages H53L-1948 AGU Fall Meeting Abstracts. San Francisco, CA.
190. Shogren, A., J. P. Zarnetske, B. W. Abbott, S. T. Cairns, F. Iannucci, M. J. Duda, and W. B. Bowden. 2019. Seasonal and event-based concentration discharge relationships from contrasting Arctic headwater catchments. Pages H43G-2078 AGU Fall Meeting Abstracts. San Francisco, CA.

189. Kincaid, D. W., E. C. Seybold, C. Adair, W. B. Bowden, J. N. Perdrial, M. Vaughan, and A. W. Schroth. 2019. Event-scale riverine loading of nitrogen and phosphorus: Impacts of land use, seasonality, and antecedent conditions on N:P export ratios. Pages H43G-2074 AGU Fall Meeting Abstracts. San Francisco, CA.
188. Bowden, W. B., E. B. Rastetter, K. L. Griffin, P. Budy, B. C. Crump, A. E. Giblin, L. Gough, and G. W. Kling. 2019. Catchment Research in the Arctic Long-Term Ecological Research program: North Slope, Alaska, USA. Pages PA13B-0995 AGU Fall Meeting Abstracts. San Francisco, CA.
187. Bowden, W. B., R. M. Cory, D. Emerson, A. E. Giblin, E. Herndon, G. W. Kling, A. B. Michaud, and N. Record. 2019. The Fundamental Roles of Iron as a Mediator of Land-Water Interactions in Arctic Catchments. Pages H42A-04 AGU Fall Meeting Abstracts. San Francisco, CA.
186. Abbott, B. W., A. V. Rocha, A. Shogren, J. P. Zarnetske, F. Iannucci, W. B. Bowden, S. Bratsman, R. Watts, R. A. Fulweber, R. J. Frei, A. Huebner, S. Ludwig, and G. T. Carling. 2019. Tundra wildfire triggers long-term lateral nitrogen loss. Pages C13E-1355 AGU Fall Meeting Abstracts. San Francisco, CA.
185. Zarnetske, J. P., B. Abbott, G. Pinay, G. Gruau, W. B. Bowden, A. Shogren, and F. Iannucci. 2018. On the value of collecting long-term, periodic, synoptic water chemistry data in stream networks: Revealing structure and stability of headwater conditions. Pages H11C-08 AGU Fall Meeting Abstracts. Washington, D.C.
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183. Vaughan, M. C. H., W. B. Bowden, J. B. Shanley, V. Andrew, and A. Schroth. 2018. Land use influences storm hysteresis of dissolved organic matter character and concentration. Pages EP32B-07 AGU Fall Meeting Abstracts. Washington, D.C.
182. Bowden, W. B. 2018. The Co-Evolution of Monitoring, Science, and Management in the Intensively-Utilized Watershed of Lake Champlain: History, Successes, and Challenges. Pages H11C-02 AGU Fall Meeting Abstracts. Washington, D.C.
181. Abbott, B. W., J. P. Zarnetske, W. B. Bowden, F. Iannucci, A. Shogren, N. Griffin, S. Bratsman, and R. Watts. 2018. Carbon and nutrient dynamics in Arctic stream networks determined with catchment-scale estimates of redox reactions. Pages B31G-2573 AGU Fall Meeting Abstracts. Washington, D.C.
180. Zarnetske, J. P., B. W. Abbott, W. B. Bowden, F. Iannucci, N. Griffin, S. Parker, G. Pinay, and Z. Aanderud. 2017. Repeat synoptic sampling reveals drivers of change in carbon and nutrient chemistry of Arctic catchments. Pages B33D-2106 AGU Fall Meeting Abstracts. New Orleans, LA.
179. Seybold, E. C., A. Gold, S. P. Inamdar, S. M. Pradhanang, W. B. Bowden, M. Vaughan, K. Addy, J. B. Shanley, V. Andrew, R. Sleeper, D. F. Levia, Jr., C. Adair, B. C. Wemple, and A. W. Schroth. 2017. Effects of land use on the timing and magnitude of dissolved organic carbon and nitrate fluxes: a regional analysis of high-frequency sensor measurements from forested, agricultural, and urban watersheds. Pages H53G-1561 AGU Fall Meeting Abstracts. New Orleans, LA.
178. Gold, A., J. Loffredo, K. Addy, E. S. Bernhardt, A. B. Berdanier, A. W. Schroth, S. P. Inamdar, and W. B. Bowden. 2017. Stream Response to an Extreme Defoliation Event. Pages H43L-1795 AGU Fall Meeting Abstracts. New Orleans, LA.
177. Bowden, W. B., S. Parker, and C. Song. 2016. Scaling measurements of metabolism in stream ecosystems: challenges and approaches to estimating reaeration. Pages B24C-04 AGU Fall Meeting Abstracts. San Francisco, CA.

176. Vaughan, M., A. W. Schroth, W. B. Bowden, J. B. Shanley, A. Vermilyea, R. Sleeper, A. Gold, S. M. Pradhanang, K. Addy, S. P. Inamdar, D. F. Levia, Jr., R. D. Rowland, and C. G. Winters. 2015. Regional in-situ optical water quality sensor network quantifies influence of land use and seasonality on storm event nitrate and dissolved organic carbon loading. Pages B11F-0497 AGU Fall Meeting Abstracts. San Francisco, CA.
175. Song, C., A. Argerich, C. Baker, W. B. Bowden, W. K. Dodds, M. Douglas, K. Farrell, M. B. Flinn, E. Garcia, K. B. Gido, T. Harms, J. Jones, L. Koenig, J. S. Kominoski, K. S. McDonald, W. H. McDowell, D. McMaster, S. Parker, A. Rosemond, J. Rüegg, K. Sheehan, M. T. Trentman, W. M. Wollheim, and F. Ballantyne. 2015. Temperature sensitivity of stream gross primary production and respiration from the tropics to the arctic. Pages B51F-0488 AGU Fall Meeting Abstracts. San Francisco, CA.
174. Inamdar, S. P., M. Vaughan, R. D. Rowland, C. G. Winters, K. Addy, A. W. Schroth, A. Gold, W. B. Bowden, A. Vermilyea, T. B. Parr, S. Andres, and D. F. Levia, Jr. 2015. "Hot moments" of carbon and nitrogen in streams: Key insights from in-situ, high-frequency optical sensors from the North East Water Resources Network (NEWRnet). Pages B14D-04 AGU Fall Meeting Abstracts. San Francisco, CA.
173. Dodds, W. K., J. Rüegg, K. Sheehan, C. Song, F. Ballantyne, C. Baker, W. B. Bowden, K. Farrell, M. B. Flinn, E. Garcia, T. Harms, J. Jones, L. Koenig, J. S. Kominoski, W. H. McDowell, D. McMaster, S. Parker, M. T. Trentman, M. Whiles, W. M. Wollheim, A. Argerich, and B. Penaluna. 2015. Biome Context and Lotic Ecosystem Rates. Pages B21D-0503 AGU Fall Meeting Abstracts. San Francisco, CA.
172. Vaughan, M., A. W. Schroth, W. B. Bowden, A. Jerram, J. B. Shanley, and A. Vermilyea. 2014. Observing Nutrient Dynamics in Streams Draining Varied Land Uses Using In Situ Optical Sensors. Pages H11B-0867 AGU Fall Meeting Abstracts. San Francisco, CA.
171. Gold, A., A. W. Schroth, S. P. Inamdar, K. Addy, W. B. Bowden, S. Andres, D. F. Levia, Jr., V. Andrew, D. J. Leathers, M. Garfield, J. Chace, A. Jerram, M. Vaughan, and J. B. Shanley. 2014. North East Water Resources Network (NEWRnet): A real-time water quality sensor network to study impacts of climate variability for Delaware, Rhode Island and Vermont. Pages H11B-0865 AGU Fall Meeting Abstracts. San Francisco, CA.
170. Bowden, W. B., M. N. Gooseff, J. J. Stuckey, R. A. Fulweber, and J. R. Larouche. 2014. Rapid Recovery of a Gully Thermokarst: 10 Years of Observation of the Toolik River Thermokarst, North Slope, Alaska. Pages GC13C-0659 AGU Fall Meeting Abstracts. San Francisco, CA.
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82. Cao, W., W.B. Bowden, T. Davie, and A. Fenemor. 2003. Modeling impacts of land cover change on critical water resources in the Motueka River Catchment, New Zealand. American Geophysical Union Chapman Conference on Ecosystem Responses to Land Use Change. Santa Fe, New Mexico, 13-18 June 2003.
81. Dodds, W.K., E. Martí, J.L. Tank, J. Pontius, S.K. Hamilton, P.J. Mulholland, N.B. Grimm, W.B. Bowden, W.H. McDowell, B.J. Peterson, H.M. Valett, J.R. Webster, J.L. Meyer, and S.V. Gregory. 2003. Nitrogen cycling rates and carbon and nitrogen stoichiometry in streams. Annual meeting of the North American Benthological Society, Athens, 27-31 May 2003.
80. Green, A.C., B.J. Peterson, L.A. Deegan, J.P. Benstead, W.B. Bowden, A.D. Huryn, S.M. Parker, J.A. Vacca, C.P. Crockett, and J.L. Mosher. 2003. Effects of nutrient fertilization on a small, beaded tundra stream on the North Slope of Alaska. Annual meeting of the North American Benthological Society, Athens, 27-31 May 2003.

79. Lawford, R., W.B. Bowden, and F.N. Scatena. Hydrology for Environment, Life, and Policy (*HELP*): A new UNESCO program of interest to stream ecologists. 2003. Annual meeting of the North American Benthological Society, Athens, 27-31 May 2003. (Poster)
78. Sanzone, D.M., B.J. Peterson, K.H. Barnes, J.P. Benstead, L.A. Deegan, C.P. Crockett, W.B. Bowden, S.M. Parker, A.D. Huryn, and A.C. Green. 2003. Nitrogen uptake and transformation in arctic spring and mountain streams. Annual meeting of the North American Benthological Society, Athens, 27-31 May 2003.
77. Sanzone, D.M., J.L. Meyer, J.L. Tank, E.P. Gardiner, B.J. Peterson, P.J. Mulholland, S.V. Gregory, N.B. Grimm, W.H. McDowell, W.B. Bowden, W.K. Dodds, and J.R. Webster. 2002. Stable isotopes provide evidence that stream subsidies influence the spatial distribution of terrestrial predators in eight biomes. 2002 Annual meeting of the North American Benthological Society, Pittsburg, 28 May – June 2002.
76. Bowden, W.B. An introduction to integrated catchment management. 2001. An invited presentation for the New Zealand Ministry for the Environment workshop supported by the Sustainable Management Fund on 'Bringing integrated catchment management to the community level'. October 2001, Wellington.
75. Bowden, W.B. Integrated catchment management in the Motueka Catchment. 2001. Tasman District Council 'Ecofest 2001'. November 2001, Motueka.
74. Bowden, W.B., J. Payne, A. Watson, R. Jackson and R. McLaren. 2001. Mobility of constituents from municipal biosolids applied to plantation forest land on the Canterbury Plains. Joint meetings of the New Zealand Hydrological and Limnological Societies. Palmerston North, 20-23 November 2001.
73. Dymond, J, R. Andrew, and Bowden, W.B. Raster-based hydrological modeling of the Motueka catchment. 2001. Joint meetings of the New Zealand Hydrological and Limnological Societies. Palmerston North, 20-23 November 2001.
72. Bidwell, V., W.B. Bowden, B. Fahey, L. Basher, M. Stewart, R. Woods, V. 2000. Subsurface flow dynamics in a pasture hillslope: an alternative hypothesis. Fresh Perspectives Conference. First joint meeting of the New Zealand Hydrological, Meteorological, and Limnological Societies, Christchurch, New Zealand, 20-24 November 2000.
71. Bowden, W.B., A. Pearce, J. Harding, P. Gillespie, A. Fenemor, T. Dunne, and G. Likens. 2000. Integrating biophysical, ecological, and social research for catchment-scale management: The Motueka River Initiative. Fresh Perspectives Conference. First joint meeting of the New Zealand Hydrological, Meteorological, and Limnological Societies. Christchurch, New Zealand, 20-24 November 2000.
70. Bowden, W.B., B. Fahey, L. Basher, M. Stewart, R. Woods, and V. Bidwell. 2000. Subsurface flow dynamics in a pasture hillslope, North Island, New Zealand. Annual meetings of the American Geophysical Union, San Francisco, 14-19 December 2000.

69. Bowden, W.B., B. Fahey, L. Basher, M. Stewart, R. Woods, and V. Bidwell. 2000. Subsurface flow dynamics in a pasture hillslope, North Island, New Zealand. Fresh Perspectives Conference, Christchurch, New Zealand, 20-24 November 2000.
68. Bowden, W.B., B. Fahey, L. Basher, M. Stewart, R. Woods, V. Bidwell. 2000. Subsurface flow dynamics in a pasture hillslope, Mahurangi River. Fresh Perspectives Conference. First joint meeting of the New Zealand Hydrological, Meteorological, and Limnological Societies, Christchurch, New Zealand, 20-24 November 2000.
67. Bowden, W.B., K. J. Edwardson, C. Pruden, G. Kling, and K. J. Riseng. 2000. Controls on nutrient processing in hyporheic substrates from an arctic tundra stream. Poster presented at the annual meetings of the North American Benthological Society, Keystone Colorado, 28 May - 1 June, 2000.
66. D'Angelo, D. J., S. C. Christman, B. J. Peterson, P. J. Mulholland, C. S. Fellows, J. L. Tank, S. K. Hamilton, E. Marti, L. R. Ashkenas, W. B. Bowden, W. K. Dodds, W. B. McDowell, J. L. Meyer, and J. R. Webster. 2000. A comparison of nitrogen processing in the P&G experimental stream facility with natural streams in the LINX study using stable isotopes. Paper presented at the annual meetings of the North American Benthological Society, Keystone Colorado, 28 May - 1 June, 2000.
65. Fox, M.K., B. J. Peterson, W. B. Bowden, A. E. Hershey, K. Slavik, and C. Pruden. 2000. Nitrogen cycle of a first order peaty tundra stream. Paper presented at the annual meetings of the North American Benthological Society, Keystone Colorado, 28 May - 1 June, 2000.
64. McGlynn, B.L., J.J. McDonnell, and W.B. Bowden. 2000. Dissolved organic carbon dynamics at multiple catchment scales: the role of hydrogeomorphic units. Annual meetings of the American Geophysical Union, San Francisco, 14-19 December 2000.
63. Mulholland, P.J., C. S. Fellows, J. L. Tank, S. K. Hamilton, E. Marti, L. R. Ashkenas, W. B. Bowden, W. K. Dodds, W. H. McDowell, J. L. Meyer, B. J. Peterson, and J. R. Webster. 2000. Controls on stream metabolism determined by an interbiome comparison study. Paper presented at the annual meetings of the North American Benthological Society, Keystone Colorado, 28 May - 1 June, 2000.
62. Peterson, B.J., W. M. Wollheim, P. J. Mulholland, J. R., Webster, J. L. Tank, J. L. Meyer, N. B. Grimm, E. Marti, W. B. Bowden, J. Merriam, H. M. Valett, A. E. Hershey, W. H. McDowell, W. K. Dodds, S. K. Hamilton, S. L. Johnson, L. R. Ashkenas, and D. J. D'Angelo. 2000. Control of din export from small watersheds by headwater stream nitrogen processing. Paper presented at the annual meetings of the North American Benthological Society, Keystone Colorado, 28 May - 1 June, 2000.
61. Peterson, B.J., W. Wollheim, P.J. Mulholland, J.R Webster, J. L. Tank, J.L. Meyer, N. B. Grimm, E. Marti, W.B. Bowden, J. Merriam, H.M. Vallet, A.E. Hershey, K. Rezenka, W.M. McDowell, W.K. Dodds, S.K. Hamilton, S.L. Johnson, L. Askenans, and D.J. D'Angelo. An intersite comparison of nitrification in streams. Annual meeting of the North American Benthological Society Meetings. Duluth, Minnesota. June 1999.

60. Wollheim, W., B.J. Peterson, P.J. Mulholland, J.R Webster, J. L. Tank, J.L. Meyer, N. B. Grimm, E. Marti, W.B. Bowden, J. Merriam, H.M. Valett, A.E. Hershey, K. Rezenka, W.M. McDowell, W.K. Dodds, S.K. Hamilton, S.L. Johnson, L. Askenans, and D.J. D'Angelo. An intersite comparison of nitrogen regeneration in streams. Annual meeting of the North American Benthological Society Meetings. Duluth, Minnesota. June 1999.
59. Wollheim, W.M., B. J. Peterson, P. J. Mulholland, J. R. Webster, J. L. Tank, J. L. Meyer, N. B. Grimm, E. Marti, W. B. Bowden, J. Merriam, H. M. Valett, A. E. Hershey, W. H. McDowell, W. K. Dodds, S. K. Hamilton, S. L. Johnson, L. R. Ashkenas, and D. J. D'Angelo. 2000. Estimates of nitrogen loading to streams using in-stream processing rates. Paper presented at the annual meetings of the North American Benthological Society, Keystone Colorado, 28 May - 1 June, 2000.
58. Bowden, W.B. and K.J. Edwards. 1999. Controls on nutrient processing in hyporheic substrates from an arctic tundra stream. Annual meeting of the North American Benthological Society Meetings. Duluth, Minnesota. June 1999.
57. Slavik, K., B.J. Peterson, L.A. Deegan, A.E. Hershey, W.B. Bowden, and M.C. Miller. Biological responses to long-term fertilization of the Kuparuk River, Alaska. Annual meeting of the North American Benthological Society Meetings. Duluth, Minnesota. June 1999.
56. Bowden, W.B., J. Merriam, J. Tank, R. Hall, K. MacNeale, E. Bernhardt, P. Mulholland, J. Webster, and B. Sichel. 1998. The Hubbard Brook LINX Project: Nitrogen transformations in a northern hard forest stream. Annual meeting of the North American Benthological Society Meetings. Prince Edward Island, Canada. June 1998.
55. Edwardson, K.J, W.B. Bowden, K. Slavik, D.B. Arscott, B.J. Peterson, and W. Schofield. 1998. Biogeochemistry of spring streams in the tundra foothills, North Slope, Alaska. Annual meeting of the North American Benthological Society Meetings. Prince Edward Island, Canada. June 1998.
54. Mulholland, P.J, N.B. Grimm, E. Marti, W.B. Bowden, M. Valett. Terrestrial biomes and stream hydrology. 1998. Annual meeting of the North American Benthological Society Meetings. Prince Edward Island, Canada. June 1998.
53. Peterson, B.J., Wollheim W.M, W.B. Bowden, N.B. Grimm, J.L. Meyer, D. Sanzone, P.J. Mulholland, J.L. Tank, and J.R. Webster. 1998. Transformations and export of ammonium nitrogen during  $^{15}\text{NH}_4$  tracer additions to streams. Annual meeting of the North American Benthological Society Meetings. Prince Edward Island, Canada. June 1998.
52. Slavik, K., Peterson, B.J., D.B. Arscott, W.B. Bowden, R.L. Lowe. 1998. Comparison of primary production in spring, mountain and tundra streams on the North Slope of Alaska. Annual meeting of the North American Benthological Society Meetings. Prince Edward Island, Canada. June 1998.
51. Tank, J.L., P.J. Mulholland, J.L. Meyer, W.B. Bowden, J.R. Webster, B.J. Peterson, and D. Sanzone. 1998. Nitrogen cycling in grazing versus detrital pathways in 3 temperate forested streams. Annual meeting of the North American Benthological Society Meetings. Prince Edward Island, Canada. June 1998.

50. Wollheim, W.M., B.J. Peterson, W.B. Bowden, N.B. Grimm, J.L. Meyer, D. Sanzone, P.J. Mulholland, J. L. Tank, and J.R. Webster. 1998. Estimating ammonium Sw using <sup>15</sup>N-biota and water column <sup>15</sup>NH<sub>4</sub> during tracer additions to streams. Annual meeting of the North American Benthological Society Meetings. Prince Edward Island, Canada. June 1998.
49. Arscott, D.B., W.B. Bowden, and J.C. Finlay. 1997. Stress effects on physiologically contrasting bryophytes in an arctic stream. Annual meeting of the North American Benthological Society Meetings. San Marcos, Texas. June 1997.
48. Bowden, W.B. and K.J. Edwardson. 1997. Hyporheic processing at various scales in an arctic landscape. Annual meeting of the North American Benthological Society Meetings. San Marcos, Texas. June 1997.
47. Edwardson, K.J. and W.B. Bowden. 1997. Hyporheic processing in contrasting arctic stream reaches. Annual meeting of the North American Benthological Society Meetings. San Marcos, Texas. June 1997.
46. Arscott, D.B., W. B. Bowden and J.C. Finlay. 1996. A comparison of primary production by epilithic algae and bryophytes in control and fertilized reaches of a tundra stream, Alaska. Special Session on the "Roles of Bryophytes in Stream Ecosystems". Annual meeting of the North American Benthological Society Meetings. Kalispell, Montana. June 1996.
45. Bowden, W.B. and D. Pappathanasi. 1996. Decomposition of aquatic bryophytes. Special Session on the "Roles of Bryophytes in Stream Ecosystems". Annual meeting of the North American Benthological Society Meetings. Kalispell, Montana. June 1996.
44. Bowden, W.B. 1996. Introduction. Special Session on the "Roles of Bryophytes in Stream Ecosystems". Annual meeting of the North American Benthological Society Meetings. Kalispell, Montana. June 1996.
43. Finlay, J.C., W.B. Bowden, and D.B. Arscott. 1996. Production by bryophytes in aquatic ecosystems. Special Session on the "Roles of Bryophytes in Stream Ecosystems". Annual meeting of the North American Benthological Society Meetings. Kalispell, Montana. June 1996.
42. Wollheim, W.M., J. C. Finlay, B. J. Peterson, W. B. Bowden, D. Arscott. 1996. Nitrogen uptake by bryophytes in reference and fertilized reaches of an arctic tundra river. Special Session on the "Roles of Bryophytes in Stream Ecosystems".
41. Edwardson, K.E., W.B. Bowden, J.C. Finlay, and B.J. Peterson. 1995. Synoptic study of metabolism, nutrient transport, discharge, and transient storage in a lake-dominated, arctic tundra stream. Poster presentation at the annual meetings of the North American Benthological Society. Keystone, Colorado.
40. Kling, G.W., G.W. Kipphut, W.B. Bowden, and C. Dahm. 1995. Using SF<sub>6</sub> to estimate the flux of CO<sub>2</sub> and CH<sub>4</sub> from Arctic streams. Presentation at the annual meetings of the American Society of Limnology and Oceanography.

39. Smith, C.T. and W.B. Bowden. 1995. Forest Utilization of wood ash: soil chemical changes and effects on forest vegetation. Presented at the Symposium on land application of wood-fired and combination boiler ashes. NCASI. 2-3 August, 1995. Ashville, North Carolina.
38. W.B. Bowden, J.C. Finlay, and J. Terninko. 1995. Distribution and production of bryophytes in two fertilized, arctic, tundra streams. Presentation at the annual meetings of the North American Benthological Society. Keystone, Colorado.
37. Peterson, B.J., J.E. Hobbie, L.A. Deegan, W.J. O'Brien, M.E. McDonald, A.E. Hershey, and W.B. Bowden. 1994. Global change effects on arctic freshwater: predictions from whole-system experiments. Global Change Workshop. Woods Hole.
36. Finlay, J.C. and W.B. Bowden. 1993. Controls on production of bryophytes in an arctic tundra stream. Poster presentation at the 1993 annual meetings of the North American Benthological Society. Calgary, Alberta, Canada. May 1993.
35. Bowden, W.B., J.C. Finlay, and P.E. Maloney. 1993. Long-term effects of  $po_4$  fertilization on the distribution of bryophytes in an arctic stream. Presentation at the 1993 annual meetings of the North American Benthological Society. Calgary, Alberta, Canada. May 1993.
34. Pardo, L.H, C-Y. Li, B.T. Bormann, R.H. Bormann, W.B. Bowden, R.S. Pierce, M.C. Snyder, and D.Wang. 1992. Associative nitrogen fixation in two expermienta Pinus ecosystems. Poster presentation at the annual meeting of the Ecological Society of America. Hawaii. August 1992.
33. Bowden, W.B. and W.H. McDowell. 1991. Interactions among plants, microbes, and water and their influences on N dynamics in the riparian zones of two geomorphologically distinct forested tropical watersheds. Poster presented at the 1991 Gordon Conference on Hydrological-Geochemical-Biological Interactions in Forested Catchments.
32. McDowell, W.H. and W.B. Bowden. 1991. Impact of Hurricane Hugo on stream and groundwater chemistry in a tropical rain forest. North American Benthological Society. Santa Fe, NM.
31. Bowden, W.B. 1990. Hillslope hydrology research within the LTER network: three case examples. Poster presented at the triennial All-Scientists LTER Workshop. Estes Park, Colorado. September 1990.
30. Bowden, W.B., McDowell, W.H., C.E. Asbury, and A.M. Finley. 1990. Nitrous oxide emissions from the riparian zone of a tropical stream. Annual meeting of the Ecological Society of America. Snowbird, UT.
29. Hallet, R., C.T. Smith, W.B. Bowden. 1990. Nitrogen mineralization in forest soils after municipal sludge additions. Presented at the annual meeting of the Soil Science Society of America, San Antonio, Texas, October 1990.
28. Hallet, R., Medalie, L., C.T. Smith, and W.B. Bowden. 1990. Two posters presented at the 1990 Earth Day celebrations, University of New Hampshire.

27. Hallett, R., C.T. Smith, and W.B. Bowden. 1990. Forest response after municipal sludge additions. In: Smith, C.T. (ed.), Forestry abstracts: proceedings of the technical poster session of the New England Society of American Foresters 70th Annual Winter Meeting, p. 10. Manchester, NH.
26. McDowell, W.H., W.B. Bowden, C.E. Asbury, and A.M. Finley. 1990. Impact of hurricane Hugo on groundwater and stream water chemistry in a tropical watershed. Annual meeting of the North American Benthological Society.
25. Medalie, L., C.T. Smith, and W.B. Bowden. 1990. Forest land application of municipal sludge: the biotic barrier to nutrient leaching. Presented at the annual meeting of the Soil Science Society of America, San Antonio, Texas, October 1990.
24. Medalie, L., C.T. Smith, and W.B. Bowden. 1990. Forest land utilization of municipal sludge: the biotic barrier to nutrient leaching. In: Smith, C.T. (ed.), Forestry abstracts: proceedings of the technical poster session of the New England Society of American Foresters 70th Annual Winter Meeting, p. 11. Manchester, NH.
23. Smith, C.T., W.B. Bowden, L. Medalie, and R. Hallett. 1990. Forest ecosystem responses to municipal sludge application. Invited presentation. Northeastern Branch of the American Society of Agronomy and the Eastern Section of the Canadian Society of Agronomy. Durham, NH.
22. Bowden, W.B., A. Federer, S. Shepard, and S. Russell. 1989. Hillslope hydrology at the Hubbard Brook Experimental Forest. American Geophysical Union, Chapman Conference. September, 1989. Bar Harbor, ME.
21. Devoe, D.R., C.T. Smith, and W.B. Bowden. 1989. Sludge C/N ratio controls forest soil microcosm elemental fluxes. Annual Meeting of the Soil Science Society of America. 15-20 October 1989. Las Vegas, NV.
20. McDowell, W.H., W.B. Bowden, A. Finley, C.E. Asbury, and F. Scatena. 1989. Influence of groundwater hydrology on nitrogen transformation at the stream-groundwater interface of a tropical stream. Annual Meeting of the Ecological Society of America. 6-10 August 1989. Toronto, Ontario.
19. Bowden, W.B., C.P. McSwiney, and F.H. Bormann. 1988. Potential losses of N<sub>2</sub>O and N<sub>2</sub> by nitrification and denitrification in northern hardwood forest soils at the Hubbard Brook Experimental Forest. Annual Meeting, Ecological Society of America. August 1988. Davis, CA.
18. Smith, C.T., and W.B. Bowden. 1988. Quantifying the mobility of sludge-derived nutrients and metals with forest soil microcosms. NCASI Northeast Regional Meeting. October 1988. Boston.
17. Bowden, R.D., G.T. Geballe, and W.B. Bowden. 1987. Foliar uptake of <sup>15</sup>N- labelled cloud/fogwater by red spruce (*Picea rubens*) seedlings. Presentation at the annual meeting of the Ecological Society of America. Columbus, Ohio. 9-14 August, 1987.

16. Bowden, W.B., C.P. McSwiney, and F.H. Bormann. 1987. Gaseous, ionic, and organic nitrogen balance of soils from the Hubbard Brook Experimental Forest. Presentation at the annual meeting of the Ecological Society of America. Columbus, Ohio. 9-14 August, 1987.
15. Bowden, W.B. 1986. Nitrous oxide evolution from northern hardwood forests. Invited lecture delivered at NASA/Ames Research Laboratory, Moffett Field, California. 10 April, 1986.
14. Bowden, W.B. 1986. The biogeochemistry of nitrogen in freshwater wetlands. Keynote presentation at the International Symposium on the Ecology and Management of Wetlands. Charleston, SC. 16-20 June, 1986.
13. Bowden, W.B. and F.H. Bormann. 1986. Flux of nitrous oxide from a northern hardwood forest spodosol before and after whole-tree harvesting. Poster presentation at the Fourth International Congress of Ecology. Syracuse, NY. August, 1986.
12. Vorosmarty, C.V., W.B. Bowden, J.M. Morris, B. Moore, J.E. Hobbie, and B.J. Peterson. 1986. The nitrogen budget for a tidal, freshwater marsh. Symposium on Wetland Ecosystems. Charleston, SC. 26-30 March, 1986.
11. Bowden, W.B. 1985. Are nitrogen gas emissions important in natural ecosystems: a critical review. Delivered at the Annual Meetings of the Ecological Society of America. Minneapolis, MN. Organizer and Chairman for invited symposium on "The Nitrogen Cycle: Central Issues for Research and Management". See Ecological Bulletin Spring 1985.
10. Bowden, W.B. and F.H. Bormann. 1985. Spatial and temporal variability of nitrous oxide emissions from northern hardwood spodosols. Delivered at the International Union of Forestry Research Organizations symposium on Spatial and Temporal Variability of Water and Nutrient Movement in Soils. Hampton Beach, NH. Sept 1985. Moderator of session on Water Movement in Soils.
9. Bowden, W.B. 1983. A nitrogen budget for ammonium in a tidal freshwater marsh. Delivered at the Biennial Estuarine Research Federation Meeting. Virginia Beach, VA. Organizer and Chairman for invited symposium on "Tidal Freshwater Marshes". See Estuaries 6: 277-279.
8. Bowden, W.B. 1983. Is assimilatory nitrate reduction important in marsh sediments? Delivered at the New England Estuarine Research Society Meeting 22-23 April 1983. Portland, Maine.
7. Bowden, W.B. 1982. Conservative recycling of ammonium in a freshwater, tidal marsh sediment: Massachusetts, USA. Delivered at the Annual Meeting of the American Society of Limnology and Oceanography, Raleigh, NC.
6. Hobbie, J.E., C.V. Vorosmarty, B. Moore, B.J. Peterson, and W.B. Bowden. 1982. A hydrobiological model of nutrient cycling in a freshwater, tidal marsh: the North River, Mass., U.S.A. Delivered at the Annual Meeting of the American Society of Limnology and Oceanography, Raleigh, NC.
5. Bowden, W.B. 1981. Nitrogen remineralization in the sediments of a freshwater, tidal marsh. Delivered at the Biennial meeting of the Estuarine Research Federation, Gleneden Beach, OR. See Estuaries 4(3):295.

4. Bowden, W.B. 1981. Methods and preliminary estimates of nitrogen mineralization and immobilization in a freshwater, marsh sediment. Delivered at the Annual Meeting of the American Society of Limnology and Oceanography, Milwaukee, WI.
3. Daukas, P., B.J. Peterson, and W.B. Bowden. 1981. The potential influence of a mussel population on the phytoplankton community of a freshwater tidal marsh. Delivered at the Annual Meeting of the Marine Biological Laboratory. See Biol. Bull., October 1981.
2. Bowden, W.B. and J. Waterbury. 1980. Nitrifier populations in salt marsh sediments treated with sewage sludge. Delivered at the Annual Meeting of the American Society of Limnology and Oceanography, Knoxville, TN.
1. Bowden, W.B. 1976. A comparison of two direct-count techniques for quantitatively enumerating aquatic bacteria. Delivered at the Annual Meeting of the American Society of Limnology and Oceanography, Savannah, GA.

*Invited lectures, seminars, and testimony*

Not updated since 2017. Typically, 3-5 invited presentations annually.

49. Invited Speaker. An Introduction to the Environment, Ecology, and Water Resources Issues of the Lake Champlain Basin, Vermont. Chinese Delegation of Environmental Judges. Vermont Law School & University of Vermont. 10 January 2017. Burlington, VT.
48. Invited Participant. National Science Foundation Arctic Program, Committee of Visitors. A blue-ribbon panel convened to evaluate the Arctic Program. 17-19 May 2016.
47. Invited Seminar Speaker. Interactions among biogeochemistry, hydrology, and stream ecology in permafrost-dominated arctic watersheds...and why this matters to the non-arctic world. Intersections Seminar Series. Department of Geography. University of Toronto. Toronto. 29 March 2014.
46. Invited Keynote Speaker. Interactions among biogeochemistry, hydrology, and stream ecology in permafrost-dominated arctic watersheds. THAW 2014 Thermokarst Impacts on Aquatic and Wetland Systems. Climate and Cryosphere (CLiC) Workshop. Laval University, Quebec City. 13 March 2014.
45. Invited Speaker. Climate change in the arctic: Permafrost, thermokarst, and why they matter to the non-arctic world. Biological and Environmental Science Colloquium. University of Rhode Island. Kingston. 18 October 2014
44. Invited testimony. Shoreland protection act. Vermont Senate Committee on Energy and Natural Resources. Montpelier, Vermont. 10 April 2013.
43. Invited Speaker. 2<sup>nd</sup> International Conference on Hydrology and Ground Water Expo" (Hydrology-2013), August 26-27, 2013, Raleigh North Carolina, USA, hosted by OMICS Group Conferences. Declined due to schedule conflict with classes.

42. Invited Keynote Speaker. Watershed process discoveries made possible by emerging sensor technologies. 22<sup>nd</sup> National NSF EPSCoR Conference. Couer d'Alene, Idaho. 25 October 2011.
41. Invited participant and speaker, NSF National Science Board workshop on the Role of Mid-Scale Research in NSF's Investment Portfolio. Arlington, VA. 5 June 2011.
40. Invited Speaker. Ecohydrological perspective of climate change aspects of northern catchments. North-Watch workshop on Simple models for complex problems - using empirical data and models in a learning framework for prediction in northern catchments. McGuire, K., J. Shanley, and D. Tetzlaff, organizers. Hubbard Brook, New Hampshire, US, 14-17 April, 2011
39. Invited Seminar. Hyporheic processes in Arctic streams: How will climate warming affect biogeochemical dynamics in high-latitude stream ecosystems? Department of Biology, University of Maine – Orono. 22 February 2008.
38. Invited speaker. Physical, chemical, and biological characteristics of streams in the central Noatak National Preserve: an assessment of current status for future trends. Arctic Parks Science Symposium. National Park Service. Fairbanks. October 2008.
37. Invited speaker. Opportunities for Research on the Environment: Stormwater. Annual meeting of the Vermont ESPCoR Program. March 2004.
36. Invited speaker. Defining stormwater water management in Vermont. Symposium on Stormwater Management in Vermont. September 2003.
35. Invited speaker. Integrated catchment management for community stakeholders. Ministry for the Environment, Sustainable Management Fund. 29-30 October 2001.
34. Invited participant and speaker. Engaging the public in complex science. Royal Society of New Zealand. 18-19 October 2001
33. Invited speaker, “The Motueka Integrated Catchment Management Programme”. Tasman District Council EcoFest. 5 November 2001.
32. Lecture. Integrated Catchment management. Lecture to students and faculty from EcoQuest International. April 2000 and 2001.
31. Seminar. Hillslope hydrology of tussock grassland, South Island, New Zealand. Seminar at the Department of Natural Resources, Durham, New Hampshire, USA. March, 2000.
30. Invited speaker. Hillslope and wetland hydrodynamics on a tussock grassland, South Island, New Zealand. Invited presentation at the Joint US-Japan Seminar on Hydrology and Biogeochemistry in Forested Catchments. For the New Zealand Ministry for the Environment, International Science and Technology/Technical Participation Programme. Report on a workshop convened by Drs. J. McDonnell and T. Tanaka, at the East-West Center, Honolulu, Hawai'i, 1-4 February, 2000.

29. Invited speaker. National Landcare Research conference, “Cherishing the Land”, Te Papa, Wellington, New Zealand, 21-23 April 1999. Presentation on integrated catchment management rediscovered: an essential tool for a new millennium.
28. Invited speaker. The Lotic Intersite Nitrogen Experiment. Seminar presented to the Zoology Department, University of Otago. 1998.
27. Invited speaker. Landcare Research Board of Directors. New directions in integrated catchment management. 1998.
26. Invited participant. NSF/LTER workshop on hydrological processes in forested catchments. H.J. Andrews Forest. 1997.
25. Participant. Gordon Conference on Forest Hydrology, Geochemistry, and Biology. New London, NH. 1997.
24. Invited participant. Workshop on future directions in hillslope hydrology research in New Zealand. Manaaki Whenua Landcare Research. 1997.
23. Invited speaker. Biosolids management in the northeast. Workshop of sludge and septage managers. New England Interstate Water Pollution Control Commission. 1996.
22. Invited speaker. Best management practices for sustainable forestry: the functioning wetland interface. Special technical session on sustainable forestry practices. Annual meeting of the Society of American Foresters. 1996.
21. Participant. Gordon Conference on Forest Hydrology, Geochemistry, and Biology. New London, NH. 1995.
20. Invited participant. Transport and cycling of biologically important solutes in streams: a cross-biome comparison. NSF/LTER funded workshop. July 1995. Coweeta Experimental Forest, North Carolina.
19. Panel member. NSF/EPA special joint program for research on Water and Watersheds. June 1995.
18. Invited participant. Workshop on the environment of the Antarctic Dry Valleys, McMurdo Sound. 14-17 March, 1995. Santa Fe, New Mexico.
17. Wetlands as landscape ecotones: effects on hydrology and nutrient biogeochemistry. 1995. Keynote address presented at the annual meeting of the New Hampshire Association of Wetlands Scientists. 11 February, 1995. Durham, New Hampshire.
16. Wetlands as components in landscapes and landscape-scale models. 1994. Modelling the delivery of terrestrial materials to freshwater and coastal ecosystems. International Global Biosphere Program. Inter-Core Project Workshop. 5-7 December 1994. Durham, New Hampshire.

15. Does the terrestrial nitrogen cycle really matter? A perspective on the role of riparian ecosystems. 1994. Seminar on nitrogen cycling. Institute for the Study of Earth, Oceans, and Space. Durham, New Hampshire.
14. Participant. Gordon Conference on Forest Hydrology, Geochemistry, and Biology. Holderness, NH. 1993.
13. Effects of phosphorus and nitrogen fertilization in a pristine arctic stream. 1991. University of Maine, Orono.
12. The influences of riparian wetlands on water quality: nitrogen in the North River, Massachusetts. 1991. Seminar Series on Estuarine Studies. Jackson Estuarine Laboratory, University of New Hampshire.
11. Participant. Gordon Conference on Forest Hydrology, Geochemistry, and Biology. Holderness, NH. 1991.
10. Workshop on global trace gas emissions. EPA/LINETI. Lisbon. 1990. (Declined due to other commitments.)
9. Workshop on global trace gas emissions. Dahlem Conference. Berlin. 1989. (Declined due to other commitments.)
8. Invited speaker, Acid rain panel discussion sponsored by University of New Hampshire Outing Club and GAIA for Earth Week (1989)
7. Participant. Hillslope hydrology and biogeochemical cycling in forested watersheds. American Geophysical Union. Chapman Conference. Bar Harbor, Maine. (September 1989)
6. N<sub>2</sub>O emissions for clearcut northern hardwood forests, Boston University. April, 1989.
5. Effects of acid rain on watershed chemistry, Society of American Foresters national convention, Technical Workshop C-3 (1988)
4. Invited speaker, "Wetlands as a resource", Speaker's Bureau presentation to Salmon Falls River Watershed Association (1988)
3. Emissions of nitrous oxide from temperate forests. Informal invited presentation at an EPA sponsored workshop on "Biogenic and combustion sources of nitrous oxide." Boulder, CO. 15-16 September 1987.
2. The biogeochemistry of nitrogen in freshwater wetlands. Delivered at the International Symposium on the Ecology and Management of Wetlands. Charleston, SC. 16-20 June, 1986.
1. Nitrous oxide evolution from northern hardwood forests. Delivered at NASA/Ames Research Laboratory, Moffett Field, California. 10 April, 1986.

## *Interviews*

Numerous interviews given to newspapers, magazines, radio and TV between 1980 and the present. Examples include:

- The Economist, NPR, and BBC on permafrost thaw in the arctic. (2009)
- Quoted regularly on stormwater and other environmental issues in the Burlington Free Press and Vermont Digger (2004 - 2023)
- The Scientist, September 13, 2004, *What lies beneath*, by Eugene Russo. On effects of Arctic climate warming on permafrost thaw.
- Solon.com on-line magazine, September 10, 2004, *Baked Alaska*, by Rebecca Clarren. On climate warming in the Arctic.
- Rutland Herald, New directions for integrated teaching and research in the Rubenstein School of Environment and Natural Resources. (April 2004)
- National Public Radio, New directions for stormwater management in Vermont. (Oct 2003)
- Vermont Quarterly, Shedding light on watersheds. (Spring 2003)

## **Service Activities and Other Experience**

### *Institutional Activities*

- Member, Rubenstein School Curriculum Committee (2019)
- Member, Dean's 5-year review committee (2019)
- Member and Chair, Faculty Standards Committee, Rubenstein School of Environment and Natural Resources (2004-2009 [Chair 2006-2008], 2017-2019 [Chair 2019])
- Chair, UVM Grievance Committee (2017)
- Member, Limnologist Search Committee (2016)
- Member, Institute of the Environment Visioning Committee (2014-15)
- Member, Incentive-Based Budget Steering Committee, University of Vermont (2013 to 2019)
- Chair, Incentive-Based Budget Subcommittee for Fees and Other Revenue, University of Vermont (2013)
- Member, Search Committee and Faculty Panel, Provost, University of Vermont (2013)
- Member, Envisioning Environment Working Group, University of Vermont (2012-13)
- Member, Professional Standards Committee, University of Vermont (2010-13)
- Chair, Search Committee, Director of the Rubenstein Ecosystems Science Lab and Associate Professor of Aquatic Ecology, Rubenstein School of Environment and Natural Resources (2010-2011).
- Member, Business Services Advisory Committee (2010-2011)
- Member, Aquatic Ecology and Watershed Science Graduate Concentration (2005-2023). Chair, 2009-2011.
- Member, Environmental Sciences Faculty (2002-2023)
- Participant, Admitted Students Visitation days (Regularly participate)
- Participant, Alumni and other VIP research outreach days (Regularly participate)
- Chair, Search Committee, Managing Director of the Gund Institute of Ecological Economics, Rubenstein School of Environment and Natural Resources (2009).
- Member, Business Manager Search Committee, School of Natural Resources (2005)

- Chair, Faculty Standards Committee, Rubenstein School of Environment and Natural Resources (member 2004-08, Chair 2006-08). Led successful redraft of the Rubenstein School's By-Laws and protocols for Review, Promotion, and Tenure.
- Active in the development and leadership of the Applied Ecology and Watershed Sciences graduate concentration (2004 - 2023)
- Member, Associate Dean's Search Committee, School of Natural Resources, University of Vermont (2003)
- Member, Panel, Jumpstart for Juniors, University of Vermont (2003)
- Member, Faculty Senate, Rubenstein School of Environment and Natural Resources, University of Vermont (2003 - 2023)
- Member, Wildlife Faculty Search Committee, Department of Natural Resources (1996)
- Member, Earth Oceans and Space Institute Review Committee (1993)
- Member, College of Life Sciences and Agriculture Planning Commission (1993-1996)
- Chair, College of Life Sciences and Agriculture Planning Commission (1993)
- Member, Policy Faculty Search Committee, Department of Natural Resources (1992)
- Charter member, University of New Hampshire Research Advisory Board (1991-1995)
- Member, Remote Sensing faculty search committee, Department of Natural Resources (1991)
- Member, review group, Biology Program option in Marine and Freshwater Biology (1991)
- Advisor, Eric Schwab and Lauren Guillet, high school environmental research projects (1990)
- Member, College of Life Sciences and Agriculture Distinguished Ecologist Seminar planning committee (1990)
- Member, Biology Building and Department Resources committee (1990)
- Participant, University System of New Hampshire Environment Symposium, Manchester, New Hampshire (1989)
- Participant, College of Life Sciences and Agriculture Super-Science Saturday (1989)
- Participant, Department of Forest Resources Natural Resources Seminar for high school students interested in environmental issues (1989)
- Participant, Natural Resources Ph.D. External Review Visit (1989)
- Chair, Water Resources Management faculty search committee (1989)
- Member, Natural Resources Management Ph.D. Executive Committee (1989 - 2023)
- Member, Department of Forest Resources ad hoc Biology Committee (1988-1990)
- Participant, Faculty-Undergraduate mixer sponsored by University of New Hampshire Mini-dorms (1988)
- Member, Department Graduate Committee (1988-1991)
- Member, ROTC Scholarship Interview Panel (1988)
- Member, *ad hoc* Natural Resources Ph.D. Committee (1987-1988)
- Member, College of Life Sciences and Agriculture Dean Search Committee (1988)
- Member, College of Life Sciences and Agriculture Strategic Planning Committee - Natural Resources (1988)
- Member, College of Life Sciences and Agriculture Strategic Planning Committee - Biology (1988)
- Member, University of New Hampshire Undergraduate Research Opportunities Program (1987-1990)
- Member, University of New Hampshire Honors Program (1987-1990)
- Curriculum Coordinator, Water Resources Management Program, Department of Forest Resources, University of New Hampshire (1987-1997)

### *State and Regional Activities*

- Member, Technical Advisory Committee, Lake Champlain Basin Program (2004 to 2012, 2015 to 2020), Chair (2010-2012).
- Member, Steering Committee, Lake Champlain Basin Program (2013 to 2022).
- Member, Federal Partners Working Group (2013 to 2022, Chair 2020 to 2022)
- Invited Member, Curriculum Review Committee, Curriculum in Environment and Ecology, University of North Carolina – Chapel Hill, North Carolina. 25-27 March 2013.
- Inaugural Member, Water Quality Advisory Committee, Vermont Department of Conservation, 2012-2014)
- Director, Lake Champlain Sea Grant Program (2012-2022)
- Director, Theme 1, Northeastern States Research Cooperative (2008-2023)
- Director, Vermont Water Resources and Lake Studies Center (2004-2022)
- Member, Vermont EPSCoR Advisory Committee (2004 to 2020)
- Co-Chair, Working Group on Assessment Approaches, Water Resources Board Investigative Docket (2003-2004)
- Member, Water Resources Board Investigative Docket on Stormwater (2003-2004)
- Co-Organizer and Chair, "Panel discussion on urban sprawl issues in Vermont". University of Vermont (2003)
- Advisor, wetland resource management, various agencies.
- Advisor, sludge application in forest lands, various agencies.
- Participant, Workshop to produce a video on sludge and septage management in New Hampshire (1992)
- Advisor, New Hampshire Timber Owners Association exhibit for Farm and Forest Exposition (1989)
- Director, Administrator, and Advisor for NSF sponsored Research Experiences for Undergraduates program at Hubbard Brook (1987-1988)
- Advisor, Coos County Extension - Effects of municipal watershed forest thinning on water quality and flooding potential (1988)
- Committee member, NH State Non-Point Source Pollution Advisory Committee (1988)
- Co-Organizer and Co-Chairman for workshop on "Sludge and ash application in forest lands: research needs". New England Center. Durham, New Hampshire (1987)
- Advisor, NH Department of Resource Economics and Development, Division of Forests and Lands - Forest Water Resources Trends Analysis (1987)
- Co-organizer, Workshop on Sludge and Ash Application in Forest Lands (1987)

### *National and International Activities*

- Associate Editor, Biogeochemistry (peer-reviewed journal, impact factor 3.488) (2015 to 2019).
- Reviewer for proposals and manuscripts for numerous professional journals and federal funding agencies.
- Member, Toolik Field Station Science Steering Committee (2004 to 2022).
- Member, SEARCH (Search for Arctic Change) Science Steering Committee (2011-2018).
- Invited participant, NSF National Science Board workshop on the Role of Mid-Scale Research in NSF's Investment Portfolio, June 2011.
- Invited Associated Editor, Special Issue of New Zealand Journal of Marine and Freshwater Science. (2010-2011).
- Chair, Domain Science, Education, and Communication Committee, Arctic Domain (D-18), National Environmental Observatory Network. (2009 to ~2014).

- Member, Understanding the Arctic, National Science Foundation Task Force. 2009 to 2010.
- Member, Pre-Proposal and Full-Proposal Panels, NSF Frontiers in Biological Research Panel (2005)
- Panel Member. NSF/FIBR Panel (pre-proposals). November (2004)
- Member, Consortium of Universities for the Advancement of Hydrological Sciences, Hydrologic Measurement Facility development team (2004-2022)
- Founding Member and co-Director, Lake Champlain Basin UNESCO/HELP Initiative (2004)
- Founding Advisory Board Member, EcoQuest International. A study abroad program based in New Zealand (1999 to 2002)
- Founding Member and Chair. Cooperative Research Group for Integrated Catchment Management. New Zealand (1999 to 2002)
- Organizer and Chairman for invited symposium on “The Role of Bryophytes in Stream Ecosystems”. North American Benthological Society (1996)
- Invited panelist, NSF/EPA proposal evaluation panel for Water and Watersheds Program (1995)
- Invited Workshop Participant, EPA Workshop on N<sub>2</sub>O emissions from non-agricultural lands (1987)
- Organizer and Chairman for invited symposium on "The Nitrogen Cycle: Central Issues for Research and Management". June 1985. Ecological Society of America. See Ecological Bulletin Spring (1985)
- Organizer and Chairman for invited symposium on "Tidal Freshwater Marshes". Estuarine Research Society. See Estuaries 6: 277-279. (October 1983)

#### *Volunteer Activities*

- Member, Subcommittee on Science and Data Subcommittee of the Vermont Climate Council (2024-ongoing)
- Member, Vermont Citizens Advisory Committee for the Future of Lake Champlain (2024-ongoing)
- Volunteer, AARP Vermont, Advocacy Volunteer Coordinator (2023-ongoing)
- Member, Durham Conservation Commission. Drafted text for pamphlets on Wetland Resources and Shoreline Protection and text to update current town Wetland Ordinance. (1990 to 1997)
- Member, Durham Congregational Church, Nominating Committee (1997)
- Volunteer, Oyster River Youth Hockey rink work crew (1996)
- Member, Durham Congregational Church, Christian Education Cabinet (1995-1996)
- Coach and Referee, Oyster River Youth Association soccer (1990-1991)
- Member, Moharimet School playground construction crew (1990)

#### *Consulting projects not identified earlier*

- Advisor, Styx River (Christchurch) Integrated Catchment Management. Christchurch City Council. 2000.
- Participant, EPA workshop on Combined Sewer Overflows during Wet-Weather Events. Washington, D.C. 2 July 1992.
- Comments on EPA technical assessment of nitrogen cycling in wetlands ecosystems. April 1990.
- Discussion of likely problems with a storm sewer design in New Haven harbor for proposed Long Wharf Condominium development. September 1986.
- Comments on effects of the Sunbeach condominium development on groundwater quality and quantity in East Hampton, Long Island, New York. Fall 1986.
- Comments on connections between development of the Laurel Hills Golf Course, Hamden Connecticut, and flooding in the Hill Street area. Fall 1986.
- Comments on effects of the Monument Stables development on the Bethany Bogs, Bethany, Connecticut. February 1986.

- Comments on effects of the proposed North Haven Mall on flooding and marsh vegetation along the Quinnipiac River. Fall 1985.

*Professional self-improvement activities*

- Sabbatical leave (2017-18)
- Optical sensors in stream ecology workshop. Consortium for the Advancement of Hydrological Sciences, Ins., Gainesville, Florida. 14-16 February 2013.
- Sabbatical leave (2009-10)
- Executive Improvement workshops. Landcare Research. 2001 and 2002.
- 7-Habits of Highly Effective People workshop. Franklin Institute and Landcare Research. 2000.
- Executive staff management course. New Zealand Institute of Management. 1999.
- Riparian influences on water quality from natural and afforested grasslands. USDA-funded sabbatical leave. 1993-1994.
- Wetland restoration and creation workshop. National Wildlife Federation. Washington, D.C. 5-7 (October 1987)
- Stable isotope workshop. The Ecosystems Center. Marine Biological Laboratory. Woods Hole, MA. (17-22 May 1987)
- Teaching workshop. Department of Forest Resources, University of New Hampshire. (1987)
- Post-doctoral fellow. Yale University (1982-1984)
- Ph.D. dissertation. North Carolina State University (1979-1982)
- Writing workshop. Marine Biological Laboratory. Woods Hole, MA. (1983)
- M.S. thesis, North Carolina State University. (1974-1976)
- Research cruise: R/V Knorr - Nutrient studies in Humbolt Current, Peru. (January-February 1978)