

## *Long Term Hydrologic Change: Disturbance Legacies in Material Fluxes*

*Rationale:* The Northeast Consortium for Hydrologic Synthesis organized their first Summer Institute around the question, how was hydrology changing in the Northeast United States (i.e., Chesapeake Bay to the St. Johns River) during the colonial period? Focusing on a series of “drivers” (e.g., governance, land use, engineering, and climate), early career graduate students have been challenged with synthesizing our best estimate of how hydrology and these drivers interacted during this period. Interesting, fundamental questions have emerged. For example:

- During deforestation, does tree removal or soil erosion have a larger impact on the storm hydrograph?
- What’s larger, the water volume stored in trees removed during land use change (deforestation and urbanization) or the water stored by human engineering structures?

The rigorous pursuit of these sorts of questions requires well-characterized, data-rich environments. Reconstructing spatial and temporal distributions of hydrologic drivers, let alone hydrology, across the colonial Northeast is simply not possible. However, careful examination of process in specific locations, used to inform larger regional and global inquiries presents a powerful coupling of approaches that will transform our ability to understand how past hydrologic and ecologic changes reverberate in contemporary watersheds. Further, this understanding improves our ability to predict future hydrologic and associated ecologic change. The LTER network, specifically LTER’s in the Eastern Seaboard (BES, CWT, HBR, HFR, and PIE), are ideal candidates for such efforts. When compared across sites, they comprise sets allowing the examination of urbanization (e.g., BES/PIE vs CWT/HBR/HFR) and landscape controls on the systems (e.g., glaciated PIE/HBR/HFR vs. unglaciated BES/CWT). A synthesis of the Northeast Consortium’s hydrologic perspective and the LTER network’s ecologic perspective will enrich and further both efforts.

### *Hypotheses/Research Questions:*

1. Are the degradations we currently attribute to hydrologic response to urbanization (e.g., stream incision, etc.) actually a response to urbanization or more dependent on the accumulation of landscape change occurring before urbanization begins?
2. How do urbanization and glaciation independently and synergistically impact nutrient efflux from eastern US hydrologic systems?

*Mechanism:* We are proposing a workshop bringing together researchers from five Eastern Seaboard LTER sites (BES, PIE, HBR, HFR, CWT) and from the Northeast Consortium for Hydrologic Synthesis to synthesize current knowledge in answering the research questions above. In addition, workshop attendees will plan future activities for answering cross-site research questions. This workshop will cross-fertilize efforts of the LTER network and the CUAHSI-affiliated Northeast Consortium for Hydrologic Synthesis.

### *Workshop Tasks:*

1. Synthesize the sequences of land use change and hydrologic changes from each of the LTER sites to provide a conceptual model of coupled landscape/fluvial processes, extending the period

of interest back to at least the colonial period. This process will identify holes in each LTER's conceptual model and suggest future research questions.

2. Synthesize existing nutrient biogeochemistry data from each site to examine fundamental questions including: what is the efflux/loading ratio for each basin? What are the relationships between flux and discharge in each basin? How do these fundamental measures relate to land use and historical land use impacts?

*Larger Goals:*

1. Improve incorporation of emerging synthetic information on historical hydrological change into the LTER Core Area Research on the movement of organic and inorganic materials through LTER site ecosystems.
2. Encourage extension of relevant hydrologic time scales in the LTER research agenda, extending the hydrologic period of interest from the instrumented record to at least the beginning of European settlement.
3. Encourage the collection of additional hydrologic, biogeochemical (e.g., major cations), and geomorphic (e.g., return cross-sections) data at LTER network sites.

*Participants:*

The following individuals have expressed interest in participating in the workshop:

Dan Bain (U. Pitt) – BES & Hydro-Synthesis

Larry Band (U. of North Carolina) – BES, CWT, & Hydro-Synthesis

Grace Brush (Johns Hopkins) – BES

Jon Duncan (U. of North Carolina) – BES, CWT, & Hydro-Synthesis

Mark Green (U. of NH/City College of NY) – Hydro-Synthesis

Peter Groffman (Cary Institute of Ecosystem Studies) – BES & HBR

William McDowell (U. of New Hampshire) – HFR

Kevin McGuire (Plymouth State U.) – HBR

Charles Vörösmarty (U. of NH/City College of NY) – PIE & Hydro-Synthesis

Wil Wollheim (U. of New Hampshire) – PIE

The workshop will be heavily advertised in targeted forums (e.g., site and consortium list-servs, LTER network outlets) to maintain an essential balance between workshop size and attendee variety and diversity. The funding requested will pay for a core 15-20 participants' travel and the workshop facility costs. The workshop will be open to additional participants who can provide travel funds. Graduate students, post-docs, and early career scientists will be recruited and encouraged to participate in the workshop.

*Timing:* January 2009

*Expected products:*

1. Synthesis paper (prepared for *Frontiers in Ecology and Environment*) documenting common data, data gaps, and synthesizing our understanding of historic and hydrologic process in these LTER sites
2. Proposal seeking funding to fill cross-site holes in the hydrologic record (e.g., testing of archived water samples for major cations, etc.)

***Long Term Hydrologic Change:  
Disturbance Legacies in Material Fluxes Workshop Budget***

<b>Description</b>	<b>Number</b>	<b>Cost</b>	<b>Subtotal</b>
New England Center “Total Conference” Package per Person (3 days)	15	\$777	\$11,655
Travel to Durham, NH	15	\$750	\$11,250
Local Participants Meal Costs (3 days)	4	\$132	\$528
Meeting Materials	19	\$10	\$190
<b>Subtotal:</b>			\$23,623
Charles Vörösmarty Cost Share			-\$6,148
<b>Total from LTER Network:</b>			\$17,475

***Budget Justification***

We are requesting a total of \$17,475 from the LTER network office to fund this workshop.

The workshop will be hosted at the New England Center (NEC) on the University of New Hampshire campus.

Conferences costs reflect the NEC “Total Conference” package for 15 people, which includes meeting space, meals, coffee, and hotel accommodations.

Travel is the other major expense, with an estimated average cost of \$750 per person. This amount is large enough to ensure coverage for the flight, travel to and from either the Manchester, NH or Boston, MA airports and additional *per diem* on travel before/after the conference.

The meal costs for local residents who may attend are assumed at the Durham, NH governmental *per diem* rate.

Finally, we are assuming \$10 per attendee to provide miscellaneous meeting materials (pens, binder, printing, phone costs, etc.).



## UNIVERSITY of NEW HAMPSHIRE

July 15, 2008

Dear Mark:

I enthusiastically support the workshop being proposed by Dan Bain and yourself titled “Long Term Hydrologic Change: Disturbance Legacies in Material Fluxes”. It represents a wonderful synergy and extension of our CUAHSI pilot project on the *500-year Challenge* in hydrologic synthesis. Furthermore, I am excited to be invited to participate in the workshop and will support the travel of additional participants from our synthesis project to join the workshop beyond the number that you have proposed (see [http://www.htwc.unh.edu/hs\\_contact.html](http://www.htwc.unh.edu/hs_contact.html)).

I find it compelling to use a hydrologic perspective to synthesize the patterns of material fluxes, particularly those with legacies arising from human disturbance and across such a large spatial domain. While our project has begun to understand the long-term history of material fluxes across the Northeast, the proposed workshop findings will provide a powerfully complementary synthesis of human legacies in current material fluxes at a much finer scale. The collaboration between the LTER network and the CUAHSI synthesis project would enhance each effort – and demonstrate to the broader community the value of integrating across disciplines and project boundaries.

Finally, I am encouraged by the list of workshop participants because it spans not just the five LTER sites and hydrologic synthesis effort, but also spans the continuum of career levels. Inclusion of graduate students, post docs, and early career faculty in the synthesis process has improved our project’s results and helps prepare the next generation that will be leading the LTER and other national scientific efforts.

I strongly support the proposal, as it would provide a valuable forum for our hydrologic synthesis effort to engage the LTER network more formally.

Sincerely,

Charles J. Vörösmarty  
Director, Water Systems Analysis Group

July 11, 2008

Dr. Daniel J. Bain  
Assistant Professor  
University of Pittsburgh  
Department of Geology and Planetary Science  
200 SRCC Building  
4107 O'Hara Street  
Pittsburgh, PA 15260-3332

Dear Dan,

I am pleased to write this letter of support for your proposal, "Long Term Hydrologic Change: Disturbance Legacies in Material Fluxes."

As Project Director for the Baltimore Ecosystem Study (BES), I am happy to state that this proposal will contribute to the overall mission of BES. The workshop, as proposed, will serve to reinforce and encourage evaluation of important lessons learned through work in the BES.

Basins draining the Eastern US Piedmont are challenging areas for nutrient management, largely because the long history of clearance, erosion, and sedimentation has degraded nutrient retention capacities. How would Baltimore's hydrology and riparian ecology be different if it were situated north of the last glacial extent? If we consider this question, can we better understand how to reconfigure systems in Baltimore to improve ecosystem health and resilience?

Moreover, the questions the workshop is organized around are exactly the types of questions that we have identified as central to the latest LTER decadal plan. For example, we will certainly examine water and land use dynamics as they continue to evolve. The reconstruction of historical conditions, particularly irreversible changes in hydrologic systems, informs and expands our ability to understand these dynamics. Further, these interactions and the legacy of associated and accumulated impacts dictate system response to extreme pulses, particularly system responses in nutrient dynamics.

Finally, this workshop represents unique and innovative potential to enhance cross-disciplinary and cross-site research. The opportunity to cooperate and integrate with the Northeast Consortium for Hydrologic Synthesis represents a remarkable opportunity for the LTER network. Encouraging and inviting hydrologists onto our sites would improve our understandings of flux. Further, if transformative hydrology occurs across LTER sites, this positions the network as even more vital to long term systems science.

I am happy to endorse this proposal on behalf of the Baltimore Ecosystem Study LTER.

Sincerely,



Steward T.A. Pickett