



ANNUAL REPORT

July 1, 2012 – June 30, 2013

Submitted by:

The Center for Water and Society Advisory Committee

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2 CWS Mission Statement

Statement of Purpose. The purpose of the Michigan Technological University Center for Water and Society (CWS) is to enhance the ability and the visibility of MTU personnel to solve water-related problems of local, regional, and international interest.

Mission Statement. The mission of the CWS is to promote research, education, and outreach in all disciplines at Michigan Tech related to water issues. The objectives of the CWS are

- to serve as a focal point for instructional and research activities in water-related fields and water-related outreach activities across the Michigan Tech campus;
- to provide an organizational structure that supports continuing growth in water-related fields and outreach activities and encourages interdisciplinary projects;
- to support interdisciplinary graduate and undergraduate education and research in water related fields;
- to pursue external funding opportunities to support these objectives and to facilitate CWS participating faculty to obtain external support; and
- to enhance the visibility of MTU and CWS as centers of expertise and cutting-edge research in water-related fields.

CWS has 59 faculty/staff participants and 56 current graduate student and 16 undergraduate student participants in 11 units across the Michigan Tech campus (see Appendices 1 and 2). CWS is governed by a director and advisory committee (see Appendix 3).

The most recent renewal proposal (renewed through December 31, 2015) which includes a five year plan can be viewed at:

http://www.mtcws.mtu.edu/pdf/CWS_Renewal_through_Dec2015.pdf

3 CWS Year in Review

3.1 Seminars & Symposia Subcommittee Activities

(Members: Amy Marcarelli, Carol MacLennan, Joan Chadde, Noel Urban)

The primary activity of the Seminars & Symposia Subcommittee was the planning and organization of CWS seminars. The largest CWS event takes place on or near World Water Day, March 22 of each year. The World Water Day events include a student poster competition, a guest lecturer, and a CWS social. The following events were sponsored or co-sponsored in 2012-13 by CWS.

3.1.1 World Water Day Poster Competition – March 21, 2013

CWS celebrated World Water Day 2013 by hosting a social to view the World Water Day Student Poster entries, and to participate in a faculty research showcase.

The Student posters were judged during the day, and were set up on display during the social. The World Water Day Poster competition included Original Research and Coursework/Informational award categories. The posters are presented in PDF format on the CWS web page at:

http://www.mtcws.mtu.edu/2013CWS_Posters.html

The awards for the Poster competitions are as follows.

Original Research Posters

1st Place Award (\$250)

Miles Corcoran

[“Respiration and Consumption Rates of Lake Superior *Diporeia*”](#)

2nd Place Award (\$150)

Julie Padilla

[“An Evaluation of the Proposed MDEQ Water Quality Standard for Copper in the Upper Peninsula Using Two Multimetric Approaches “](#)

3rd Place Award (\$100 - tie)

Jade Ortiz

[“Sand Accumulation in the Salmon Trout River Changes Gross Primary Production and Respiration Rates by Biofilms ”](#)

3rd Place Award (\$100 - tie)

Martin Hobmeier

[“Spiny Water Flea \(*Bythotrephes longimanus*\) Impacts on Zooplankton Communities of Voyageurs National Park ”](#)

Coursework/Informational Posters

1st Place Award (\$250)

Class Poster from BL4465 – Spokesperson, Barbara Michel

[“Plastic and Pharmaceutical Accumulation in the Great Lakes: A Local Problem with Global Impacts”](#)

3.1.2 CWS Seminars and Lectures

Mary Power, September 27, 2011

Department of Integrative Biology

University of California Berkeley

“Food webs in river networks: towards predictive mapping”

Sally Fairfax, November 5, 2011

University of California Berkeley Department of Environmental Science, Policy and Management

“Obamacare and Public Lands Management: A Nervous Making Connection”

Desmond Lawler, October 22, 2012

Department of Civil, Architectural and Environmental Engineering

University of Texas

“Particles, Particles, and More Particles”

Ann Baughman & Gary Street, October 8, 2012

Freshwater Future

“Safe Drinking Water— A Privilege or a Right? Finding Solutions to Address One of the World’s Largest Plumes of TCE (trichloroethylene)”

Wendy Eisner, February 5, 2013

Department of Geography, University of Cincinnati

“Advancing Landscape Change Research in the Arctic through the Incorporation of Iñupiaq (Eskimo) Knowledge”

3.2 Degree and Education Subcommittee Activities

(Members: Sarah Green, Tom Pypker, Noel Urban)

The primary activities of the Degree Subcommittee included the development of the CWS graduate level colloquium course, the development of the CWS Graduate Certificate in Sustainable Water Resources Systems, and the review of the Graduate Student Research and Travel grants awarded by CWS.

3.2.1 Colloquium Course

A new colloquium course was established in Spring 2009. The purpose of the colloquium is to review and discuss current interdisciplinary advances in a water topic of interest to CWS participants. The one-credit course is temporarily listed under UN5100 – Center for Water & Society.

Each week, participants read a journal paper or scientific report in preparation of discussion sessions on Fridays. Students not registered for the course and faculty are encouraged to participate. Discussion sessions are led by a group of students and faculty. This group prepares questions or comments the week preceding the discussion and sends these to the class. The group begins the discussion session with a 10-minute summary of the major issues covered the preceding week's reading and repeat the discussion questions. After the "formal" one-hour discussion session, course participants are invited to stay and continue the discussion. Students are expected to (a) produce and present a poster on a relevant topic for the Center for Water & Society's World Water Day poster session and/or (b) write and submit a 5-page reflection paper due at the end of the term.

Colloquium Topics:

Spring 2013: *"Interactions between water and people"*

Spring 2012: *"Humans and Aquatic Ecosystems: A Fluid Situation"*

Spring 2011: *"The Value of Water"*

Spring 2010: *"Impacts of Climate Change on the Great Lakes Ecosystem"*

Spring 2009: *"Climate Change and the Sustainability of Water Resources"*

3.2.2 Graduate Certificate in Sustainable Water Resources Systems

The Graduate Certificate in Sustainable Water Resources Systems formally recognizes students who have a set of core competencies in understanding current water resource issues and develop an advanced understanding of the problems and new technology development in their field of expertise. This certificate is useful to students in such fields as natural resource management, business and policy, environmental and civil engineering, geology and geological engineering, and environmental policy. Students holding this certificate understand water resource management from an interdisciplinary perspective that includes policy, natural and applied sciences. Seven certificates have been earned since Fall 2009.

<http://www.mtu.edu/gradschool/administration/academics/forms-deadlines/pdfs/Certificates-ICSW.pdf> .

3.2.3 Graduate travel awards

Approved and funds were processed in FY 2012-13

Aparupa Sengupta, October 21-24, 2012

American Society of Agronomy, Crop Science Society of America, Soil Science Society of America

Cincinnati, Ohio

“Uptake and Transformation of Tetracycline by Vetiver Grass (Chrysopogon zizanioides L. Nash) from Contaminated Water”

Mollie Ruth & Julie Padilla, September, 2012

Great Lakes Commons Summit

Notre Dame University, South Bend, Indiana

Qili Hu, August 19-23, 2012

244th American Chemical Society National Meeting & Exposition

Philadelphia, Pennsylvania

“pH response of fluorescent dyes immobilized in hydrogel films”

Valoree Gagnon, November 11-18, 2012

American Anthropological Association Annual Conference

San Francisco, California

“Conflicting perspectives of risk: Evaluating prescription fish consumption advisories’ policy within the Ojibwa tribal fish harvest”

Ashley Coble, December 3-7, 2012

American Geophysical Union

San Francisco, California

“Seasonal variation in nutrient uptake in a 1st-order tributary of Lake Superior and implications for climate change”

Matt Van Grinsven, December 3-7, 2012

American Geophysical Union

San Francisco, California

“Use of isotopic and hydrometric monitoring methods to partition hydrologic contributions to forested wetlands in the Upper Peninsula of Michigan”

Lindsey Watch, March 4-6, 2013

The RemTEC Summit

Westminster, Colorado

“Estimation of mass transfer and transport parameters for a microfluidic groundwater model containing a PCE DNAPL pool source zone”

Martin Hobmeier, March 13-14, 2013

2013 lake of the Woods and rainy Basin Water Quality Forum

International Falls, Minnesota

“Spiny Water Flea (Bythotrephes longimanus) impacts on zooplankton communities of Voyageurs National Park”

Emma Schwaiger, May 30-June 2, 2013

Society for Industrial Archaeology 2013 Annual Conference

Saint Paul, Minnesota

“The Environmental Impact of the Torch Lake Industrial Waterfront”

Rabi Gyawali, May 19-23, 2013

World Environmental and Water Resources Institute

Cincinnati, Ohio

“Energy Budget Considerations for Hydro-Climate Impact Assessment”

Mariah Maggio, June 4-8, 2013

19th International Symposium on Society and Research Management (ISSRM)

Estes Park, Colorado

“Investigation of the utility of Rapid Assessment Process for Peace Corps Master’s International students engaged in environmental development projects”

Andrew Kozich, June 2013

19th International Symposium on Society and Research Management (ISSRM)

Estes Park, Colorado

“Water Resources and Residents of the Great Lakes Basin: Concerns, Conservation, and the Way of Life”

Approved in FY 2011-12, but travel and/or funds were processed in FY 2012-13

Ali Mirchi, May 20-24, 2012

EWRI – World Environmental and Water Resources Congress, ASCE

Albuquerque, New Mexico

“A Systems Approach to TMDL Policy Assessment: The Case of Lake Allegan, Michigan”

Alex Collins, August 5-10, 2012

97th Annual Ecological Society of America Meeting

Portland, Oregon

“The effects of experimental warming and irrigation on the water use of sugar maples (Acer saccharum) in a northern hardwood forest”

Adam Coble, August 5-10, 2012

97th Annual Ecological Society of America Meeting

Portland, Oregon

“Investigating vertical gradients of leaf morphology and anatomy in a sugar maple (Acer saccharum) forest”

Aparupa Sengupta, August 12-16, 2012

Society for Industrial Microbiology & Biotechnology
Washington, DC

“Microbial Degradation of Antibiotics in Wastewater Systems”

3.2.4 Research grants

Brenda Bergman (Fall - \$750)

“Biotic and abiotic effects on aquatic mercury consumption by terrestrial herbivores”

Christa Meingast (Fall - \$750, undergraduate)

“Effects of Biosolids Moisture Content on Indicator Organism Reduction via Freezing and Thawing”

Julie Padilla (Fall - \$715)

“Ecological effects of mining residues on coastal stream mouths in the Keweenaw Peninsula”

Cameron Goble - (Fall - \$589)

“Net energy intake as a predictor of fish biomass and carrying capacity in small Michigan streams”

Kaitlin Hannum - (Spring - \$750, undergraduate)

“Great Lakes Basin Inland Lakes Simulation Modeling”

James Olson - (Spring - \$706)

“Small-scale Impacts of Velocity and Substrate Variability on Biofilms in Streams”

Matt Van Grinsven (Fall - \$750)

“Water and dissolved organic carbon fluxes exiting black ash wetlands in ephemeral streams”

Alex Collins - (Spring - \$750)

*“Investigating the potential wounding response of sugar maple (*Acer saccharum*) to long term use of sap flux heat dissipation sensors”*

3.3 Ad Hoc Committee: Interdisciplinary Proposals

(Members: John Gierke, Carol MacLennan, Noel Urban, Amy Marcarelli)

This subcommittee was formed to explore ways that CWS could foster interdisciplinary proposals, and match proposal RFPs to specific CWS members or research areas. Suggestions from the committee included: 1) create social events that allow CWS members to know each other and develop networks; 2) sponsor one large proposal each year and assemble an appropriate team for it; 3) personally notify appropriate faculty of proposal opportunities in their

field; 4) publicize to faculty both large grant opportunities and intra-university opportunities for assistance with large proposal preparation.

3.4 Outreach Activities

June 24- 28, 2013 Great Lakes Watershed Investigations Teacher Institute at Michigan Tech University

Explore the physical, chemical, and biological components of the Great Lakes ecosystem, using the Lake Superior watershed as the classroom: Agassiz research vessel, day at Gratiot Lake, visit streams, wetlands, stewardship projects. 2 credits. (22 Participants)

July 7, 2012 Scientific Excursions Aboard MTU's Research Vessel: How Do Scientists Assess Great Lakes Health?

162 participants went out on eight 30-minute scientific excursions led by Marcel Dykstra, a PhD student in CWS. Participants learned how scientists assess the health of the Great Lakes, how they collect data, what equipment they use, and what they think are the major threats to Great Lakes health.

2013 Green Film Series (January-May 2013)

Monthly showing of films on environmental topic to audiences of ~100 composed of MTU students and faculty and local community members. The Series is co-sponsored by CWS, the Keweenaw Land Trust, and the Keweenaw Universalist Unitarian Fellowship. Five films were shown in 2013 (listed below); each was followed by a discussion moderated by MTU faculty or community members.

January – River Planet
February – Last Call at the Oasis
March – The Strange Disappearance of the Bees
April – Switch
May – Chasing Ice

K-12 Students ~ 1st Annual Water Festival for Gr.4-8 Students

The first ever Lake Superior Water Festival enthralled **1,019 students** in grades 4-8 classes from Houghton (Grades. 6-8), Hancock (Gr. 8), Calumet (Grades 4, 5, 8), Lake Linden-Hubbell (Grades 4, 8), Dollar Bay (Grades 4-6, 8), Jeffers (Gr. 7), Stanton Twp. (Gr. 4-8), and Ewen-Trout Creek (Gr. 4-6) schools, in addition to triggering excitement amongst their teachers and the parent chaperones who accompanied them, and the 101 presenters and guides.

There were a total of 67 presenters and volunteers who contributed their time throughout the day, in addition to 34 Michigan Tech students who served as guides leading the classes to their various sessions in and around the Great Lakes Research Center. A total of 30 different sessions on a wide range of topics related to Lake Superior and water resources were presented. 75% of the sessions were presented by MTU scientists, graduate and undergraduate students, and 25% were presented by a diverse array of specialists from the National Park Service, U.S. Forest

Service, U.S. Fish & Wildlife Service, Copper Country Arts Center, Friends of the Land of Keweenaw, Keweenaw Land Trust, U.S. Coast Guard, Copper Country Trout Unlimited, LakeDance in Chicago, SOAR from Dollar Bay High School, and the Michigan Nature Association.

The Water Festival was a monumental task and you and your staff did a great job. Nearly 1100 kids in a first year event in a new building and it went very well. Thank You for all of your efforts.

Clay Cotey, Earth Science Teacher, Washington Middle School (Calumet)

Thank you for putting on a wonderful event today! Everything was topnotch and very much appreciated!

Jean Dunstan, Gr. 6-8 science & social studies teacher, Stanton Twp. School

Great job! Thanks for a wonderful learning experience.

Janet Larson, Gr. 4 teacher, Stanton Twp. School

Water Festival publicity:

TV 6: <http://www.uppermichiganssource.com/news/story.aspx?id=809687#.UHB6Hq6rTTo>

TV 10: <http://abc10up.com/2012/10/michigan-tech-water-festival/>

Six videos from the Festival posted on YouTube:

<http://www.youtube.com/watch?v=lsA6bTi37v8>

An article in Michigan Tech Lode (Oct. 9, 2012).

Photos of Festival posted on the Water Festival website:

http://www.wupcenter.mtu.edu/education/water_festival/water_festival/index.html

The Water Festival was supported by---Michigan Space Grant Consortium, Lake Superior Stewardship Initiative, MTU Center for Water & Society, and Upper Peninsula Environmental Coalition. The Water Festival was coordinated by the Western UP Center for Science, Math & Environmental Education at Michigan Tech.

3.5 Project Support

One of the goals of CWS is to provide equipment cost share funding for proposals that will benefit multiple faculty and students with their water-related research.

GLRI Proposal support

Carol Asiala assisted in the preparation of 2 (MDEQ & NOAA) proposals submitted in May 2012.

REF Equipment grant

PI: Noel Urban

CWS provided \$2,748.77 of cost share towards the refurbishing of sediment traps to be used on the Agassiz Research Vessel. . A sediment box corer also was purchased on this grant.

CWS REF equipment grant

PI: Noel Urban

CWS requested \$50,000 but was granted \$20,000.

The grant has purchased a carbon analyzer for water samples and 2 analytical balances. CWS has provided cost share of \$6,760.73 towards the purchases, which will be beneficial to Forestry, Chemistry and Environmental Engineering students and faculty. Instrumentation is installed in the Great Lakes Research Center.

Century II Campaign Endowed Equipment Fund

Colleen Mouw - \$2500 Fluorometer cost share for C2E2 grant.

3.6 Awards and Recognition for CWS Participants

Auer, Nancy A.

AFS subcommittee for the Award of Excellence, 2013, American Fisheries Society, April 28, 2013.

Acknowledged in Fisheries Magazine, American Fisheries Society, March 2013.

1st Place Coursework World Water Day Poster, Center for Water and Society, March 21, 2013, Poster Title: *Plastic and Pharmaceutical Accumulation in the Great Lakes: A Local Problem with Global Impacts*

Included in "Lake Superior Profiles: People on the Big Lake", John Gagnon (interview 5/24/2010), May 25, 2012.

Gierke, John S.

Diploma de Reconocimiento, La Universidad de El Salvador Facultad Multidisciplinaria Paracentral, March 15, 2013.

Green, Sarah A.

Named Jefferson Science Fellow by the US Department of State, March 30, 2013

Griffis, Veronica W.

2011 Outstanding Reviewer, Journal of Hydrologic Engineering, February 27, 2012.

Kerfoot, W. Charles

Recognition, Wikipedia The Free Encyclopedia 2006-2012, 2013.

Faculty Distinguished Research Award, Michigan Tech, April 10, 2013

Marcarelli, Amy M.

Top 10% of teachers, Michigan Technological University, October 2012.

Orr, Blair D.

Silver Medal, Michigan Tech Board of Control, December 2012.

Perliger, Judith A.

Manuscript Reviewer, SAR and QSAR in Environmental Research, August 2012.

3.7 Participation of CWS Director and Advisory Committee in Initiatives, Conferences and Workshops in support of CWS

The CWS director, advisory committee members and participants participated in the following Michigan Tech initiatives or efforts as representatives of CWS.

- May 8-10, 2013: CWS member, Alex Mayer, attended the Global Water Workshop held by Ford Motor Company on behalf of CWS.

The workshop focused on developing alternative scenarios for the next 15 years for global water use and water quality trends. The scenario development is driven by Ford's interest in the global water "setting" in general and, more specifically, in relation to water availability for their vehicle assembly facilities around the world. The scenarios were keyed to global economic scenarios that Ford has developed over the last year. The scenario development was led by a Ford's "Futurist," Sheryl Connelly. The attendees consisted of academics, NGO representatives, and Ford employees ranging from corporate executives to environmental engineers who manage water efficiency engineering at individual facilities. One of the takeaway messages is that, given that the economic and water futures are so uncertain, it makes sense for industries, in general, and Ford, in particular, to increase water use efficiency and, correspondingly, decrease wastewater discharges, in preparation for the worst case scenarios. An interesting sidelight is that Ford hired a graphic artist to take "illustrated notes" to document the workshop (see figure below as an example).

We should consider pursuing connections with Ford around water use, since our expertise could be of value to them and since Ford seems to be on the progressive end of industries in terms of sustainability. We may be able to help them with water footprinting/water life-cycle analysis, water use optimization, and other areas. We have a good connection with Ford through a former MTU environmental engineering BS/MS student, Heidi McKenzie. I strongly recommend that we invite Heidi to MTU to give a seminar in the 2013-2014 academic year as part of the environmental engineering seminar series. Since she is in charge of Ford's global water strategy, she can give an in-depth perspective on how an industry inserts water resources management into their current and future operations.



3.8 Other CWS activities

- With the assistance of the Geological & Mining Engineering & Sciences and Civil & Environmental Engineering departments, CWS purchased a membership for Michigan Tech to CUAHSI, the Consortium of Universities for the Advancement of Hydrologic Science, Inc.
- CWS members were active in the search committee and review of the Strategic Faculty Hiring Initiative for Water in 2012-13. New SFHI hires were Pengfei Xue (CEE) and Daisuke Minakata (CEE)

4 CWS Budget

CWS Institute O/H Incentive Account

Beginning Balance July 1, 2012	\$26,271.22
Research Incentive Transfer In	\$28,338.13
Expenditures	\$39,993.65
CWS Sponsored Seminars.....	\$1,221.55
Student Research & Travel Grants.....	\$13,280.19
Student Research Poster Competition Awards.....	\$850.00
Center Supplies.....	\$600.00
Administrative Assistant	\$7,398.62
Travel	\$466.60
Outreach	\$1,814.00
Center Functions.....	\$701.23
Project Support	\$13,661.46
Balance as of June 30, 2013.....	\$14,615.70

5 Research

5.1 *New Awards 2012-13*

New Research Funding 2012-13:

\$ 1,926,272

1. CI-TEAM Demo: Environmental CyberCitizens: Engaging Citizen Scientists in Global Environmental Change through Crowdsensing and Visualization
PI: Mayer, Alex (CEE)
National Science Foundation
1103036P5: \$16,000 (9/1/2011-8/31/2014); incremental funding
2. Integrated Assessment of Torch Lake AOC
PI: Urban, Noel (CEE)
UNIVERSITY OF MICHIGAN-MICH SEA GRANT
1104023P2: \$29,775 (2/1/2012-1/31/2014); incremental funding
3. WSC-Category 2 Collaborative: Robust Decision-making for South Florida Water Resources by Ecosystem Service Valuation, Hydro-economic Optimization and Conflict Resolution Modeling
PI: Watkins, David (CEE)
National Science Foundation
1110089P1: \$430,497 (1/1/2013-12/31/2017)
4. CNH: Managing Impacts of Global Transport of Atmosphere-Surface Exchangeable Pollutants in the Context of Global Change
PI: Perlinger, Judith (CEE)
National Science Foundation
1211086P1: \$1,450,000 (9/1/2013-8/31/2016); Award date: 7/31/2013

5.2 Active Research Projects Affiliated with CWS, 2012-13

1. Collaborative Research: Modeling and Analyzing the Use, Efficiency, Value and Governance of Water as a Material in the Great Lakes Region Through an Integrated Approach

PI: Alex Mayer

co-PIs: James Mihelcic, David Watkins, Qiong (Jane) Zhang

Sponsor: NSF

070215P1: \$1,078,322 (9/1/2007-8/31/2013)

This multidisciplinary 5-year research project (funded by the National Science Foundation MUSES program) will determine, through integrated physical and economic models and under various scenarios of population growth, climate change, land use, and emissions, the impact of direct and indirect drivers on water quality, quantity, and availability in the Great Lakes region.

Though it is well known that nearly every product in global commerce is dependent on water, water has not traditionally been considered a material characterized by integrated analyses to quantify flows and stocks, opportunity costs, and full valuation (i.e., social, environmental, and service costs) through its myriad of uses. This has led to an undervaluing of water as a finite resource.

The Great Lakes region is chosen due to its large volume of available freshwater (but low rate of replacement), high economic impact, complex governance issues including an international border, and increasing competition for water allocation among industrial, agricultural, municipal, recreational, and ecosystem needs, as well as existing and future threats of water quality deterioration.

2. SustR: Sustainable Development for Rural Communities: Social, Health, Economic, and Environmental Advances

Investigator: Alex Mayer (GMES), Carol MacLennan (SS), and Blair Orr (SFRES)

Sponsor: U.S. Dept of Education, Fund for the Improvement of Post-Secondary Education

080423P1-P4: \$180,000 (9/1/2008-8/31/2013)

A consortium of six research-based universities and colleges in Mexico, Canada and U.S. has been formed to tackle the most critical issues in rural sustainability by educating a new generation of students and creating collaborative ties among researchers at these institutions. The consortium universities will exchange students and faculty in several engineering and science disciplines (anthropology, sociology, political science, biology, health sciences, environmental engineering and sciences, forestry) involved in finding social, political, economic and technical solutions to the problems of rural communities.

These universities offer a broad range of expertise in the area of rural sustainability, from social sciences, including an understanding of the social dynamics and economics in rural communities; public and community health, including an understanding of determinants of community and individuals' health in rural and remote communities; natural sciences, including an understanding of the capacity of the natural environment to sustain development in rural communities; and engineering, including knowledge of how to design, build and manage technical solutions.

Faculty activities will focus on the development of a general web-based course in water resources and intensive courses in urban water issues, and on the compilation of a collection of web-based case studies in water resources systems in North America. Faculty at the institutions will benefit immensely from exchange and discussion with each other as they compare the differences and similarities in their home territories. This exchange will enable students to learn in an "integrated" manner that not only combines diverse disciplines, but also the histories and experiences of the different regions. In effect this will be a laboratory for student learning and preparation for resolving a central problem that faces rural communities: linking reduction in poverty and increasing sustainability.

3. Enhancing the Capacity for Sustainable Forest Management in Chiapas and Oaxaca

PI: Alex Mayer (GMES)

co-PI: Kathleen Halvorsen (SFRES/SS)

Sponsor: Higher Education in Development/USAID

080645P1: \$249,999 (2/16/2009-8/31/2012)

The forests of Chiapas and Oaxaca provide an excellent opportunity for the pursuit of integrated sustainability-related projects that protect local communities, economies, and ecosystems. Oaxaca and Chiapas are two of the most ecologically and culturally diverse states in Mexico. However, these states simultaneously confront

problems of high levels of poverty, poor education and public services, and rapid rates of environmental destruction. The formation of human resources having the broad range of skills and experience needed to address these problems is crucial to promoting the wise use of the state's natural resources to meet the productive needs of human populations while ensuring the maintenance of the unique flora, fauna, and ecological processes supported by the diverse ecosystems in the region.

We suggest that there is a need for forest managers in Chiapas and Oaxaca who are prepared to apply the concepts of integrated sustainability to resolve the critical forest resources issues facing these states. Thus, the goal of our project is to train a new generation of interdisciplinary experts in managing forest for the sustainable provision of diverse ecosystem services, and in applying emerging policy and financial instruments such for achieving greater balance between forest conservation with local economic development in Chiapas and Oaxaca. This project will be a partnership between Michigan Technological University (MTU) and the Colegio de la Frontera Sur (ECOSUR) in Chiapas and the Instituto Tecnológico del Valle de Oaxaca (ITVO).

The proposed training will be conducted via curricula tailored to fit within existing Master's degree programs at MTU. We will offer a unique combination of biophysical and social sciences, so that graduates will have a broad array of skills, from key disciplinary knowledge for sustainable forest management to integrative thinking and multi-disciplinary, collaborative problem-solving skills. The training will include coursework and field experiences in the U.S. and Mexico, through partnerships with government agencies and non-governmental organizations (NGOs) in the two countries. In addition, we will develop Diplomado programs in sustainable forest management at the Mexican partner institutions.

4. **New GK12 Global Watershed: Integrating Rural and Global Perspectives with Research and Technological Advances**

PI: Alex Mayer (GMES)

Co-PIs: Nancy Auer (BIO), Linda Nagel (SFRES)

Sponsor: NSF

080701P1: \$2,499,352 (9/1/2009-8/31/2014)

Project Description/Intellectual Merit. In project **GlobalWatershed**, graduate Fellows will conduct research in watershed science topics, at a range of scales and cultural contexts, while working with middle/high school teachers to create lesson plans that transfer this knowledge to their students. The goals of **GlobalWatershed** are to (a) expand traditional STEM graduate student training to allow graduate students to acquire improved teaching and communication skills and to gain a greater appreciation of the scientific context of their research, and make this expanded training a permanent fixture at MTU and to enrich STEM learning and instruction in local K12 schools serving low-income and high Native American populations and a Sonora, Mexico K12 school system, specifically by translating state-of-the-art watershed research to the K12 level, and make this enrichment sustainable at these schools. Fellows will receive training in effective teaching techniques, learning styles, lesson planning, classroom management, ways of assessing science proficiency, inquiry-based approaches for teaching science, teaching concepts of scientific research, and indigenous perspectives and awareness and sensitivity to other ways of learning. Teachers will attend professional development workshops to learn about watershed science research and methodologies. Lesson plans and units will be developed by Fellows and teachers on a range of watershed topics, to be incorporated into secondary school curricula, including science, mathematics, and social studies. These materials will be aligned with appropriate Michigan and Sonora educational standards.

Broader Impacts. **GlobalWatershed** will integrate and strengthen global perspectives and technological advances in University research and rural secondary education. Fellows will gain research experience while also learning effective educational techniques and pedagogies from secondary school teachers. Together, the Fellow/teacher teams will impart knowledge of the many components of watersheds to secondary students. Teachers will become proficient in the use of new technologies in their classrooms, increase their research experience, and learn to address watershed research questions into their lessons. Our focus on Native American students will help us develop appropriate educational materials for a group that is traditionally under-represented in science and engineering. The collaboration with schools in Sonora will allow for exchanges in teaching strategies and will enrich the outlooks of all participants by exposure to a region where water scarcity is a day-to-day reality. Dissemination will occur via the **GlobalWatershed** web site and presentations at professional conferences and publications in peer-reviewed journals.

5. **IDR: Collaborative Research: Sustainable Water Resources for Communities Under Climate Change: Can State-of-the-Art Forecasting Inform Decision-Making in Data Sparse Regions?**

PI: Mayer, Alex (CEE)

co-PIs: Halvorsen, Kathleen (SS/SFRES)

National Science Foundation
091213P2: \$317,389 (9/15/2010-8/31/2014)

Intellectual Merit: Arid and semiarid regions may shoulder disproportional impacts of climate change due to the low resiliency and robustness inherent in both the natural and human infrastructure systems. One of the critical engineering systems threatened by climate change in these areas is water supply and its associated infrastructure. Imposing a warmer climate in a region of water scarcity may lead to unsustainable alternative future scenarios and further increase the complexity of water resources management. In this proposal, we intend to study decision-making for water resources management in anticipation of climate change in northern Mexico as a case study for the broader arid and semiarid southwestern North America. The goal of the proposed project is to determine whether water resources systems modeling, developed within a participatory framework, can contribute to the building of management strategies in a context of water scarcity, conflicting water uses and highly variable and changing climate conditions. Local stakeholders will be involved in guiding the design of supply- and demand-side management strategies and selection of climate change scenarios using state-of-the-art engineering tools. These tools include a water resources systems framework, a spatially-explicit hydrologic model, the use of forecasted climate scenarios under 21st century climate change, and observations obtained from field and satellite sensors. The participatory modeling approach will be conducted through a series of interactive workshops, carefully designed to encourage substantive participation from a broad range of stakeholders, including representatives from federal and local government agencies, water use sectors, non-governmental organizations, and academics. We will utilize the theory of planned behavior, which explains planned decisions, such as those made by water resource decision makers, as grounded in a suite of factors, including beliefs regarding risks, problems, and solutions. Through the theory of planned behavior, the participatory modeling process will be evaluated to understand if, and to what extent, the engineering tools are useful in the uncertain and politically-complex setting. Furthermore, the work will evaluate the sustainable outcomes emerging from the climate change scenarios and the potential adaptations that can be implemented in the decision-making process.

Broader Impacts: The proposed work combines engineering research with social and behavioral sciences for the purpose of evaluating sustainable water management outcomes in a semiarid region in a developing country. This approach undoubtedly challenges participants to carry out transformative, interdisciplinary research. We will engage three doctoral level students at MTU and ASU as well as undergraduate students for short-term research experiences. A focus on recruiting Hispanic students (with language skills) will facilitate interactions with local decision makers, regional stakeholders and the general public. Our team will build on prior work at ASU and MTU in water research within Mexico and other developing countries. In particular, we will bring the expertise and experience of the ASU School of Sustainable Engineering and the Built Environment and the MTU Center for Water and Society to bear on the problems of water supply under climate change threats. We will also work with several local universities in Sonora to develop an effective participatory modeling program. We expect that the results of this project will have an impact on water decision-making under climate change in the study area and provide a case study for replication in other data-sparse, semiarid regions.

6. **Predicting Ecosystem Changes in Lake Superior**

PI: Auer, Nancy (BIO)
co-PI: Auer, Martin (CEE)
US Environmental Protection Agency
100181P1: \$306,014 (9/1/2010 - 4/30/2014)

A linked hydrodynamic - nutrient food chain model will be expanded to include a bioenergetics submodel and applied to predict ecosystem changes in associated with climate change, variations in nutrient dynamics and alteration of food web structure (invasive species). A capacity to simulate the interplay of changes in energy resources (e.g. primary production) and energy sinks (e.g. predation and competition for food resources) will be developed and tested for benthic (*Diporeia* - lake whitefish) and pelagic (*Mysis*-rainbow smelt) food web components characteristic of Lake Superior.

7. **Integrated Modeling and Experimental Evaluation of Hydrodynamic and Microbial Controls on DNAPL Dissolution and Detoxification**

PI: Becker, Jennifer
co-PI: Seagren, Eric
National Science Foundation
100318P1: \$376,192 (12/28/2009 - 8/31/2014)

Background. In situ bioremediation based on biological reductive dehalogenation is now an established remediation approach for sites contaminated with aqueous-phase chlorinated ethenes. However, the EPA

estimates that chlorinated ethenes are present as dense non-aqueous phase liquids (DNAPLs) at 46,000 contaminated sites in the U.S. The presence of DNAPL forms of these contaminants, which are known or suspected carcinogens, is a major obstacle to remediation efforts that has widespread implications for human and ecological health. Importantly, abiotic dissolution of DNAPLs into groundwater is a slow process and may require several hundred years to deplete the DNAPL source of contamination. Several *in situ* DNAPL treatment methods use physicochemical processes to mobilize and subsequently capture and/or destroy contaminants and thus accelerate the clean-up process. These methods can be difficult and costly to implement and may preclude bioremediation of dissolved contaminants by making conditions inhospitable to microorganisms. Recently, interest has grown in the use dehalorespiring bacteria to treat DNAPLs through bioenhanced dissolution, i.e., enhanced mass removal from chlorinated ethene DNAPLs through reductive dechlorination of dissolved contaminants near the DNAPL-water interface. This approach is appealing because it does not rely on DNAPL mobilization and is compatible with the clean-up of dissolved contaminants using bioremediation. Although bioenhanced dissolution appears promising, the design of biological DNAPL source treatment measures using a "black box" approach may not promote and sustain the growth of the populations with the greatest potential to bioenhance dissolution rates. The proposed project focuses on understanding the interrelated roles that hydrodynamics and competition among different dehalorespiring populations, as well as other community members, play in determining the distribution of dehalorespiring populations in the DNAPL source zone and dissolved contaminant plume and the resulting impact on the magnitude of bioenhanced dissolution and the extent of detoxification.

Project Approach and Objectives. Evaluation of the hydrodynamic and microbial controls on bioenhanced dissolution and detoxification of chlorinated ethenes will be accomplished using an integrated modeling and experimental approach that includes the following key objectives: (1) Mathematical modeling will be used to theoretically predict the relationships between microbial competition, hydrodynamic conditions, and bioenhancement for three model scenarios and design a micromodel system for studying DNAPL dissolution and source-zone microbial ecology at the porescale. (2) The micromodels will be used to independently estimate key system parameters and test model predictions for the three scenarios by experimentally evaluating the effects of microbial competition and hydrodynamics on population distribution, dissolution bioenhancement and plume detoxification. An innovative fluorescent *in situ* hybridization approach will be used to directly visualize and quantify population distribution in the micromodel. (4) An intermediate-scale flow cell will be used to test whether the micromodel experiments and mathematical modeling can predict bioenhancement effects in a scaled up system. (5) Mathematical modeling will be refined based on the experimental results and used to predict the effects of microbial competition and hydrodynamics on DNAPL source zone longevities for four DNAPL configurations.

8. **WSC-Category 1: Humans, Hydrology, Climate Change, and Ecosystems-An Integrated Analysis of Water Resources and Ecosystem Services in the Great Lakes Basin**

PI: Mayer, Alex (CEE)

co-PIs: Breffle, William; Halvorsen, Kathleen; Pypker, Thomas; Urban, Noel

National Science Foundation

100422P1: \$150,000 (9/1/2010 - 8/31/2012)

Water shortages will likely be exacerbated by climate change in water-scarce regions, but water-rich regions may get wetter. The Great Lakes region of North America is undeniably water-rich, but apprehension exists that water resources may be over-used. Policies for regulating water withdrawals and exports are evolving through the recently-passed binational Great Lakes Water Compact, including prescriptions for water conservation. The economic future of the region is uncertain and may be linked to expansion of potentially water-intensive sectors such as biofuel feedstock growth and processing. Shifts in water usage may bring about corresponding stresses on ecosystems. Climate change will bring about shifts in the hydrologic cycle that will also produce stress on aquatic ecosystems. If pressures on water resources intensify in the Great Lakes, will individuals and organization within this water-rich region modify their behavior to conserve water? **We propose to address this question by (a) developing integrated biophysical models for predicting ecosystem impacts due to future scenarios of land and climate change and (b) developing an understanding of how the region's groups and individuals view the regions' aquatic resources and what they believe are appropriate norms shaping human behavior vis a vis these water resources, especially as they relate to ecosystem services, and linking these assessments to interventions designed to shift their planned behavior with regard to regional water resources.**

The **long-range objectives** of this work are (1) to predict environmental impacts and associated losses of ecosystem values and services resulting from water quantity and quality alterations caused by future land development and climate changes; (2) to develop data collection protocols for evaluating community perceptions

of the social impacts of climate induced biophysical impacts (participatory self-assessment); (3) to investigate possible social responses to predicted biophysical impacts and evaluate mechanisms for changing those responses; and (4) to develop policy scenarios for mitigating negative impacts that can in turn be evaluated by a diverse set of criteria. The immediate **objectives of the 1-year planning grant** are: (1) to refine research objectives and formulate key hypotheses, utilizing available databases and literature to inform in-depth analyses and dialogue by a team of researchers from the economic, social, and biophysical sciences; (2) to assess existing datasets for model inputs and calibration and verification efforts; (3) to test existing and hybrid biophysical and ecosystem impact modeling strategies on a few key watersheds; (4) to develop quantitative and qualitative social data collection tools for regionwide use; and (5) to develop a proposal for a full project. The **corresponding planning grant** activities will include (1) convening workshops with invited scientific experts and members of NGOs and state, federal and binational agencies; (2) hiring a post-doc to pull together existing models and databases to develop a predictive hydrologic-ecosystem model; and (3) developing and testing the social data collection tools. The data collection and modeling activities will be leveraged by ongoing work by the co-PIs on Great Lakes biogeochemical processes and human-ecological interactions.

Intellectual merit: This project builds upon our ability to understand and predict behavior of individual ecosystems and develops tools needed to predict responses of the regional landscape to future scenarios of altered climate and socioeconomic conditions. The models we develop will require innovations in integrating climate change and human activity drivers into coupled hydrologic-ecosystem services models. Our analysis of attitudes and beliefs surrounding human perception of the Great Lakes water resources will yield important insights into the norms that shape human activities with regard to these resources and how those norms can be shaped to solve water-related problems.

Broader impacts: This project will begin the training of one M.S. student, mentor one post-doctoral fellow, and develop an educational web-based module for use by the public and schools. The module will be disseminated through the co-PIs' ongoing, broad range of local, regional, and international K-12 water resource activities. Through MTU's graduate Water Resources Management Certificate, we will feature a series of team presentations in the graduate symposium on the climate change-related implications for Great Lakes management, policy, and human values. The project will develop new interdisciplinary connections between MTU departments and among multiple institutions. It will bring together academic researchers and policy makers to structure the research to produce outcomes useful for resource managers and public policy decision makers.

9. **Great Lakes Maritime Education for K-12 Teachers**

PI: Chadde, Joan (CEE)
University of Wisconsin - Superior
100611P2: \$15,000 (10/1/2010 - 9/15/2012)

The Center for Science & Environmental Education Outreach at Michigan Technological University (MTU) requests support from GLMRI to continue and expand several of the successful Great Lakes Maritime Transportation education/outreach programs that have been implemented 2006-2010. The Center will partner with the National Center for Freight & Infrastructure Research and Education (CFIRE) at the University of Wisconsin-Madison (<http://cfire.wistrans.org>).

The Center proposes to conduct two summer teacher institutes-Mathematics & Navigation to be held at Michigan Tech using the research vessel Agassiz, and a Great Lakes Maritime Transportation institute in Door County, Wisconsin. In addition, the Center proposes to conduct two 1-day elementary teacher workshops during the school year in Michigan, Wisconsin, Minnesota, or Ohio. The workshops will result in the development of a lesson & activity guide on Great Lakes maritime transportation. Eight more Great Lakes maritime transportation education teaching chests will be assembled and distributed to education/outreach schools, museum, and institutions in the Great Lakes region.

10. **Virtual Water Accounting: A New Paradigm for the Adaptive Management of Great Lakes Water**

PI: Mayer, Alex (CEE)
Co-PI: Huckins, Casey (BIO)
Great Lakes Protection Fund
100679P3: \$916,736, (2/3/2011-12/31/2013)

This is a synthetic project to achieve the outcomes of (1) developing and proving a new scientific methodology relating economic production, watershed flow depletion, and ecosystem services, (2) pilot the new methodology to quantify these relationships in select HUC-12 scale watersheds and downstream watersheds in the Great Lakes Basin, (3) work with an advisory board of policymakers, watershed advocates, and leaders of business and finance to determine the implications of these relationships for water and economic development policy, and

(4) determine how this pilot project's findings could be further developed and implemented to inform Great Lakes Basin water policy, including future revisions to the Great Lakes Compact. Towards this end will implement a comprehensive communication plan, with the goal of gathering input from water policy stakeholder communities. The deliverable of this research will be a proof of concept and plan of implementation for a new approach to an integrated adaptive management of water resources in the Great Lakes Basin that accounts for the economic and environmental impacts of water uses. The project investigators include the primary personnel and an advisory committee consisting of technical and policy domain experts who will collaborate with the primary personnel.

11. Evaluation of Larval Lake Sturgeon Production on Fighting Island Reef in the Detroit River

PI: Auer, Nancy (BIO)

US Dept of the Interior

100684P1: \$ 60,611 (2/18/2011 - 5/31/2013)

This research project capitalizes on an opportunity to discover important new information regarding lake sturgeon (*Acipenser fulvescens*) ecology and the response of native fish populations to habitat restoration efforts. These types of information are critical for the design, implementation, and assessment of future fisheries management strategies directed toward restoration of native fish habitat within and beyond the Great Lakes basin. Efforts to rehabilitate fisheries habitat rely on knowledge of habitat availability and function to use as a benchmark for restoration goals. In addition, scientists require an understanding of how the habitat functions in its current state in order to set restoration goals and assess the effectiveness of restoration strategies. In 2010, 2011, and 2012 we will employ passive drift samplers and active bongo samplers below Fighting Island reef during the period one week prior to and for one month after expected emergence occurs to assess 1) density and abundance of larval lake sturgeon, 2) phenology and chronology of larval lake sturgeon drift, 3) size and growth of lake sturgeon larvae, and 4) histological assessment of head and brain morphology. Field sampling durations will be adjusted to minimize larval mortality so that most lake sturgeon larvae can be returned to the system after biological measurements are made.

12. Evaluation of Suitability from Native Species Restoration in the 1836 Treaty Area with Prescriptions Developed for Arctic Grayling

PI: Auer, Nancy (BIO)

co-PI: Huckins, Casey (BIO)

Little River Band of Ottawa Indians

1010065P1: \$149,999 (1/1/2011-5/31/2013)

This project will develop a comprehensive native species restoration plan for the Little River Band of Ottawa Indians (LRBOI) Reservation and Big Manistee River watershed, running from 2010-2012. Specifically, we will evaluate historic and current conditions of local ecosystems for development of plans for the reintroduction of Arctic grayling (*Thymallus arcticus*) and elk (*Cervus elaphus*). The objectives of this project are to: 1) determine historic conditions in the Big Manistee River watershed when grayling and elk existed naturally, 2) summarize research on grayling and elk habitat parameters for all life stages, 3) determine present habitat conditions and abundance of species that may potentially interact with reintroduced species, and 4) develop prescriptions for re-establishing grayling and elk populations (a component of a native species management plan).

The grayling and elk both maintain historic cultural importance to the LRBOI and are considered cultural indicator species. In the 1800's both of these species were used for subsistence, and Tribal knowledge has been preserved and passed on regarding the value and handling of these species. This project will be an important component of capacity building of the LRBOI to restore cultural indicators to their rightful place in Tribal society and allow for the transfer of traditional values from generation to generation. The LRBOI has successfully managed the restoration of other cultural indicators, as evidenced by the Nme (Lake Sturgeon) Stewardship Plan for the Big Manistee River and 1836 Reservation. This dual-species restoration project is consistent with and supports numerous efforts throughout the Great Lakes (Great Lakes Restoration Initiative) and Michigan focused on restoring native species, such as, sturgeon (*Nme*), coaster brook trout (*Meegwas*), wild rice (*Manoomin*) and kiyi (*Atikameg*). This project will further enhance partnerships with management agencies and academic institutions, including the US Fish and Wildlife Service, US Forest Service, Environmental Protection Agency, and Michigan Technological University. These partnerships ultimately promote comprehensive management of natural resources and build Tribal capacity to manage for the needs of its members.

13. Great Lakes Maritime Education for K-12 Teachers

PI: Chadde, Joan (CEE)

University of Wisconsin - Madison
1012026P1: \$15,000 (10/1/2010 - 9/30/2012)

The Center for Science & Environmental Education Outreach at Michigan Technological University (MTU) requests support from GLMRI to continue and expand several of the successful Great Lakes Maritime Transportation education/outreach programs that have been implemented 2006-2010. The Center will partner with the National Center for Freight & Infrastructure Research and Education (CFIRE) at the University of Wisconsin-Madison (<http://cfire.wistrans.org>).

The Center proposes to conduct two summer teacher institutes-Mathematics & Navigation to be held at Michigan Tech using the research vessel Agassiz, and a Great Lakes Maritime Transportation institute in Door County, Wisconsin. In addition, the Center proposes to conduct two 1-day elementary teacher workshops during the school year in Michigan, Wisconsin, Minnesota, or Ohio. The workshops will result in the development of a lesson & activity guide on Great Lakes maritime transportation. Eight more Great Lakes maritime transportation education teaching chests will be assembled and distributed to education/outreach schools, museum, and institutions in the Great Lakes region.

14. CI-TEAM Demo: Environmental CyberCitizens: Engaging Citizen Scientists in Global Environmental Change through Crowdsensing and Visualization

PI: Mayer, Alex (CEE)
National Science Foundation
1103036P1: \$249,840 (9/1/2011-8/31/2014)

This demonstration project will create and evaluate a set of activities aimed at preparing a diverse science and engineering workforce with cyberinfrastructure knowledge and skills. A multidisciplinary team of faculty and undergraduate students will collaborate with citizen scientist end users to develop and deploy data collection and visualization tools, to monitor the critical ecosystems of Lightfoot Bay in the Upper Peninsula of Michigan. The proposed program will build upon existing educational programs at Michigan Technological University, Keweenaw Bay Ojibwa Community College, several local high schools, and a local land conservancy. Research scientists at International Business Machines who are actively engaged in the development of crowdsensing applications will collaborate with the co-PIs and students.

15. Integrated Assessment of Torch Lake AOC

PI: Urban, Noel (CEE)
co-PIs: MacLennan, Carol (SS), Perlinger, Judith (CEE)
UNIVERSITY OF MICHIGAN-MICH SEA GRANT
1104023P1: \$ 119,339 (2/1/2012-1/31/2014)

Torch Lake was impacted by copper mining and listed as an Area of Concern (AOC) in 1987. Beneficial Use Impairments (BUis) included fish tumors, degraded benthos, and fishconsumption advisories. The U.S.EPA conducted remediation and removed the site from the National Priority List. The Public Advisory Council petitioned the state to delist the site as an AOC. The state determined that two BUis still exist, and the site is not ready for delisting as an AOC. This site was not included in the 2010 Great Lakes Restoration Initiative projects because EPA deemed that inadequate information was available to accomplish rapid remediation. This site provides a contrast to many AOCs that are being successfully delisted. We propose a two-phase Integrated Assessment: Phase I will consist of gathering available data, and in Phase II the information will be presented to stakeholders. We will gather data not previously reviewed by state or federal agencies. Data will be summarized in multiple forms (fact sheets, presentations, maps, etc.) and presented to a variety of stakeholder groups that will be solicited for input on potential remedies. Results from both phases will be reported to the Michigan Dept. of Environmental Quality (MDEQ).

16. Inventory of Mining Impacted Streams in the Coastal Zone of the Keweenaw

PI: Urban, Noel (CEE)
co-PI: Kerfoot, W Charles (BIO)
Michigan Dept of Environmental Quality
1105024P1: \$55,560 (1/1/2012-8/31/2013)

The mouths of all perennial streams tributary to Lake Superior and located on the Keweenaw Peninsula will be surveyed for physical habitat quality and biological health in order to identify degraded habitat, particularly habitats impacted by historical mining activities. Benthic macroinvertebrate surveys will be conducted in spring and fall, and copper concentrations in water and sediments will be measured. This study will identify the most

impacted sites and will help local non-profit organizations and government agencies to plan subsequent remediation. In addition, community outreach and public education efforts will inform the public of results of this study and of the health and threats to the coastal wildlife habitat and water quality.

17. Changes in Ecosystem Function Associated with Sand Accumulation in a Lake Superior Tributary

PI: Marcarelli, Amy (BIO)
US Dept of Agriculture
1106039P2: \$35,633 (8/29/2011-8/31/2013)

Watershed land-use such as the construction and maintenance of roads (e.g., grading and plowing unpaved roads) can enhance erosion of fine sediments, which can be deposited into river channels. These inputs can shift the equilibrium between erosion and sedimentation within the stream, favoring deposition of fine sediments. This is especially problematic in relative low gradient channels such as those in the lower reaches of the Salmon Trout River in Marquette County, Michigan. The accumulation of sand in stream channels can embed larger substrates such as cobble and gravel, and resultant loss of substrate heterogeneity in streams can have wide-ranging impacts on stream ecosystem structure and function, as well as reduce quality and quantity of fish habitat. Long-term surveys of juvenile salmonid abundances reveal notably low densities in the Salmon Trout River relative to those detected in neighboring tributaries of Lake Superior. We predict this variation may in part be the result of variation in productivities across the systems, which may relate to the fine sediment dynamics and accumulation in the Salmon Trout River. We are conducting a comparative survey of functional attributes (i.e. nutrient retention, microbial, algal, and animal biomass and production, and organic matter decomposition) and structural attributes (i.e., stream habitat and the biological communities it hosts) of river reaches that are more or less impacted by accumulation of fine sediments. This research will lead to increased understanding of the Salmon Trout River ecosystem, its ecosystem properties, and the ecosystem effects of sand accumulation. This will enhance prediction of the effects of sand on stream ecosystem and in the long-term this knowledge should enhance preservation and restoration of the Salmon Trout River watershed, and the native fish, including the population of coaster brook trout it hosts.

18. REF-IE: Upgrade to MTU Sediment Collection Capabilities

PI: Alex Mayer
REF-IE program
1106069P1: \$20,000 (7/1/2011-8/31/2012)

Funding is sought for the acquisition of a sediment multi-corer (\$23,500), upgrading of existing sediment traps (\$20,470), and enhancement of the davit (\$5,000) on the R/V Agassiz. The multi-corer is the instrument of choice for oceanographic and large lake sediment collection. To deploy this unit from the MTU research vessel (R/V Agassiz) the existing davit must be modified. The primary modification required is greater height. MTU currently owns two high quality sediment traps, but these units are now 11 years old, and are in need of upgrading and servicing to render them operable. These units also cannot be deployed from the R/V Agassiz without modification of the davit. By modifying the davit, we will be able to use MTU's own research vessel rather than paying for other ships; not only will this keep research funds at MTU but it will make proposals more competitive because it costs less to use the R/V Agassiz than the larger Great Lakes research vessels.

This equipment is essential to making MTU competitive in grants for Great Lakes research. These competitive abilities will also enhance the stature of the Great Lakes Research Center now under construction. Considerable funding is currently available for Great Lakes work through the Great Lakes Restoration Initiative (GLRI) and Great Lakes Legacy Act; this funding is being funnelled to groups with demonstrated capability to perform work quickly. MTU has not been competitive in this program to date because of a lack of equipment needed to perform restoration and research in support of remediation.

19. Lake Superior Stewardship Initiative

PI: Joan Chadde (CEE)
Copper Country Intermediate School District (CCISD)
1107038P1: \$68,000 (8/1/2011-3/31/2013)

The Lake Superior Stewardship Initiative (LSSI) is part of a statewide Great Lakes Stewardship Initiative (GLSI) launched by the Great Lakes Fishery Trust with financial support from the Wege Foundation and several community foundations. The goal of the GLSI is to increase understanding and active stewardship of the Great Lakes by K-12 teachers and students working in partnership with local units of government and community organizations. The LSSI seeks to prepare K-12 students to become knowledgeable citizens engaged in activities that enhance their school, community, and the Lake Superior watershed. The Initiative incorporates three

strategies:

- (1) Implementing 'place-based curricula' in the classroom that engages students in learning about their community, cultural heritage, local watershed, and the Great Lakes;
- (2) Providing teacher-training and student programs that increase content knowledge about the Great Lakes and opportunities for students to visit and learn about Lake Superior, tributary streams, wetlands, forests, and other outdoor environments near their schools;
- (3) Developing school-community partnerships with local units of government and community organizations to address local needs by working together on local stewardship projects.

Desired Outcomes:

- (1) Students will have the knowledge to make informed decisions and become actively involved in their communities.
- (2) Teachers will integrate local Great Lakes topics into their curriculum.
- (3) School-community partnerships will engage students in stewardship projects that are responsive to the needs of local communities.
- (4) Place-based education will become an integral and permanent part of the work of partner schools.
- (5) Communities in the Lake Superior watershed will be improved through collaborative efforts of schools and their community partners.
- (6) Students and teachers will be recognized as valued, contributing citizens and will act in that capacity, building stronger schools and communities.

20. **WSC-Category 2 Collaborative: Robust Decision-making for South Florida Water Resources by Ecosystem Service Valuation, Hydro-economic Optimization and Conflict Resolution Modeling**

PI: David Watkins (CEE)

National Science Foundation

1110089P1: \$430,497 (1/1/2013-12/31/2017)

Intellectual Merit

We propose a cross-disciplinary approach utilizing the expertise of multiple institutions to investigate the behavioral dimensions of decision-making for water management and land use plans under various climate change, economic, population, and sea level rise (SLR) scenarios. Our study site is south Florida, a region with many competing water allocation targets, which is subject to extreme climate variability and threatened by SLR. We employ new optimization modeling approaches based on robust-decision making to develop management strategies that enhance the resilience and sustainability of water supplies for the built and natural systems, while also accounting for the broad-sector value of water use. Optimization criteria in the model will incorporate the results of new research linking water management, ecological functioning, and the economic value of ecosystem services in collaboration with the NSF-funded Florida Coastal Everglades Long-Term Ecological Research (FCE-LTER) program. New experimental approaches will be implemented to better understand the impacts of information type and uncertainty in the processes of both selecting decision criteria and evaluating model outcomes among individuals and groups of local stakeholders. These experiments are designed to improve our understanding of the roles of cognitive and perceptual biases in risk assessment and decision-making when hydro-economic optimizations are coupled with scenario forecasts. Finally, with agency and stakeholder involvement we will collaboratively develop recommendations for adaptive water management plans that foster long-term support.

Broader Impacts

Low-lying coastal regions, such as south Florida, which are subject to SLR, climate change, and growing populations will benefit from the development of this innovative, pragmatic approach to optimizing the social-ecological benefits of water resources allocated between the built and natural environments. Our work will include novel approaches for dynamically incorporating economic assessments into stakeholder evaluations of adaptive land use and water management strategies. Participating local, state, and federal agencies responsible for managing the region's water resources will benefit from these broad-sector analyses of adaptive schemes that explicitly incorporate uncertainty estimates of potential outcomes. Comparative behavioral analysis of stakeholder evaluations and institutional decision-making will provide unique insights into how information type, information content and cognitive biases combine to influence risk perception under different hydro-economic scenarios, and how the perceived risks to specific indicators of individual and collective well-being influence scenario selection. Societies such as those in south Florida, whose options for managing public water resources are limited by climatic, physical or legal constraints, require this type of integrated assessment to promote cooperative decision-making while preparing for uncertain hydro-climatic conditions and socioeconomic future.

Under-represented minorities and women will be recruited for all graduate and post-doctoral positions. We will

train a total of 4 undergraduate and 11 graduate students in economics (2), behavioral sciences (2), ecosystem sciences (3), environmental policy (2), climatology (1), and hydrologic modeling (1), as well as 4 post-doctoral level researchers. Junior investigators will be expected to present findings at the annual meetings planned as part of this project. Outcomes from the project will be broadly disseminated through publication in peer-reviewed journals and presentations to be made at various venues, including scientific meetings, civic and environmental organizations, and government agencies. The project will engage a diverse array of people via surveys and via stakeholder meetings, specifically incorporating the lower income and Hispanic American communities in south Florida.

21. REF-IE: Building Infrastructure for Great Lakes Research

PI: Noel Urban (CEE)

co-PIs: Auer, Martin (CEE), Green, Sarah (CH), Kerfoot, W. Charles (BIO)

Michigan Technological University

1205011P1: \$26,955 (7/1/2012–8/31/2013)

Equipment grant to purchase a Carbon Analyzer for use in the labs of the Great Lakes Research Center.

22. CNH: Managing Impacts of Global Transport of Atmosphere-Surface Exchangeable Pollutants in the Context of Global Change

PI: Judith Perlinger (CEE)

co-PI: Emma Norman

National Science Foundation

1211086P1: \$1,450,000 (9/1/2013-8/31/2016)

Toxic pollutants that pass readily in both directions between the atmosphere and environmental surfaces exhibit three characteristic tendencies when they are emitted to the environment: resistance to rapid degradation, accumulation in organic-rich surface reservoirs, and semivolatility causing re-emission to the atmosphere. These pollutants, which we term "Atmosphere-Surface Exchangeable Pollutants" or ASEPs, are emitted to the environment through human activities, are transported and "processed" in the environment, and are then deposited where they may harm humans and wildlife, often in locations distant from their original use or release. Incomplete understanding of the dynamic behavior of these pollutants in the environment has resulted in efforts to regulate them that do not fully protect human and ecosystem health from risks. The human system, including sociopolitical activities, cultural perspectives, and socioeconomic activity resulting in emission of the pollutants into the environment and other environmental stressors, the biogeochemical cycling of the pollutants in the global environment, and the impairment of ecosystem services that result from this cycling comprise the coupled human-natural system of study. Our objective is to probe the complex dynamics and feedbacks within the system and to identify critical social adaptations and governance advancements required to address the challenges to sustainability posed by these chemicals. Because emissions of these pollutants occur throughout the world and they tend to move northward in cycles of re-volatilization and deposition, resource managers face a particularly difficult challenge in addressing concerns related to this form of contamination. To identify ways in which the regulation of these chemicals can be improved we will simulate their global transport under differing future climate and land cover/land use scenarios to estimate amounts sequestered in and re-emitted from ecosystems. We will quantify the economic costs in the United States caused by exposure to these chemicals. We will analyze efforts to adaptively manage these chemicals at scales ranging from local to global. The Laurentian Great Lakes will provide the geographical focus for nested analysis of social adaptation and governance.

The project focuses on pollutants that travel long distances in the atmosphere and cause harm to humans and ecosystems far from the locations where they were emitted. The characteristics of atmosphere-surface exchangeable pollutants lead to a separation in space and time of use and harmful impacts. These pollutants are released into the environment through human activities that yield economic benefits, but the economic costs of damage to human health and environmental impacts are often borne by other segments of society. Because the chemicals cross political boundaries, efforts to address any concerns are complex. The project will examine details about the environmental cycling of these pollutants (how, where and when they cycle between the air and the Earth surface) that currently impede our ability to model their global transport and fate and thus inform policy decision-making. The project will also assess the economic damages caused by these pollutants in the United States. By studying the coupled human-natural system involving these chemicals, this project will improve our understanding of sustainable means of production, use and governance of a class of pollutants. Public outreach and distributed K-college education activities, and partnering between researchers, educators, stakeholders, and decision makers, will promote incorporation of research results into learning, education, and governance. This project brings together a diverse group of natural and social scientists from four academic institutions to study the problem of these pollutants in a more holistic fashion than has ever been attempted to date, and may serve as a model for studying other classes of substances in the future.

5.3 Proposals Submitted under CWS, 2012-13

1. CI-TEAM Demo: Environmental CyberCitizens: Engaging Citizen Scientists in Global Environmental Change through Crowdsensing and Visualization
PI: Mayer, Alex (CEE)
National Science Foundation
1103036P5: \$16,000
2. Global Freshwater Security for Urban Watersheds
PI: Mayer, Alex (CEE)
Co-PIs: Muralidharan, Daya (SBE), Norman, Emma (SS), Urban, Noel (CEE)
Belmont Forum & G8 Research Councils Initiative on Multilateral Research Funding
1207047P1: \$599,993; submitted pre-proposal and proposal
3. Connecting Phytoplankton Cell Size to Variability in the Ocean Carbon Sink
PI: Mouw, Colleen (GMES)
University of Wisconsin - Madison
1207068P1: \$105,999; Awarded – moved to Great Lakes Research Center
4. Ocean Basin Impact of Ambient Noise on Marine Mammal Detectability, Distribution, and Acoustic Communication
PI: Mouw, Colleen (GMES)
Pennsylvania State University
1207069P1: \$29,963; Awarded – moved to Great Lakes Research Center
5. A Proposal to Establish the Indo-US Joint Networked Center for Impacts of Climate Change on Urban Water Systems
PI: Mayer, Alex
co-PIs: Urban, Noel (CEE), Watkins, David (CEE)
Indo-US Science and Technology Forum (IUSSTF)
1208020P1: \$69,200
6. Parameterizing Spectral Characteristics of Optically Active Constituents in Inland Water for Improved Satellite Retrievals
PI: Mouw, Colleen (GMES)
National Aeronautics Space Administration
1208033P1: \$667,440; moved to Great Lakes Research Center
7. Collaborative Research: Understanding How Changes in the Supraglacial and Subglacial Drainage System Affect the Dynamics of the Greenland Ice Sheet over Multiple Timescales
PI: Gulley, Jason (GMES)
National Science Foundation
1210075P1: \$572,668

8. Reducing Copper Loads from Stamp Sand Deposits in the Keweenaw Peninsula with Permeable Reactive Barriers - Phase 1
 PI: Mayer, Alex (CEE)
 co-PIs: Chimner, Rodney (SFRES), Datta, Rupali (BIO)
 Michigan Dept of Environmental Quality
 1210079P1: \$193,650

9. Experimental Frameworks for Evaluating the Net Effects of Hydrological Service Payments on Coupled Social-ecological Systems in Mexico
 PI: Mayer, Alex (CEE)
 co-PI: Halvorsen, Kathleen (SS/SFRES)
 University of New Hampshire
 1211077P1: \$359,468

10. Integrated Seasonal Drought Forecast-Adaptive Management System for the Lower Colorado River Basin in Texas
 PI: Watkins, David (CEE)
 co-PI: Brooks, Colin (MTRI)
 US Dept of Commerce
 1211078P1: \$189,781

11. CNH: Managing Impacts of Global Transport of Atmosphere-Surface Exchangeable Pollutants in the Context of Global Change
 PI: Perlinger, Judith (CEE)
 co-PI: Norman, Emma (SS)
 National Science Foundation
 1211086P1: \$1,499,975; Awarded

12. Collaborative Research: Ocean Acidification: Great Lakes Ocean Acidification
 PI: Urban, Noel (CEE)
 National Science Foundation
 1212002P1: \$484,903

13. Coastal SEES (Track 2), Collaborative: The Third Coast: Keys to the Sustainability of the Great Lakes Coastal Socio-Ecological System
 PI: Mayer, Alex (CEE)
 co-PIs: Halvorsen, Kathleen (SS/SFRES), Norman, Emma (SS), Urban, Noel (CEE)
 National Science Foundation
 1301021P1: \$1,394,808

14. The Sante Fe River Basin Critical Zone Observatory: Exploring Linkages among Geology, Hydrology, Ecology, and Humans in a Carbonate Terrain
 PI: Gulley, Jason (GMES)
 University of Florida
 1301044P1: \$355,430

15. Reassessment of the Role of Fresh and Saltwater Mixing in Post Depositional Porosity Generation in Carbonate Platforms: Questioning Karstification Paradigms in the Yucatan Peninsula, Mexico
PI: Gulley, Jason (GMES)
American Chemical Society
1303022P1: \$100,000

16. Collaborative Research: Impact of Interior Lake Formation Due to Sea Level Rise on the Water Resources of Low-lying Carbonate Islands
PI: Gulley, Jason (GMES)
co-PI: Mayer, Alex (CEE)
National Science Foundation
1305078P1: \$370,470

6 Publications by CWS Participants, 2012-13

This listing includes publications by CWS members that are relevant to water-related issues. Publications are ordered by first author and include journal articles, books, and chapters in books that are published, in press, or accepted. Items which are in press or accepted will be counted as published with complete references in the next CWS Annual Report.

Published/Accepted journal articles, books, chapters, proceedings, reviews	97
Accepted journal articles, books, chapters, proceedings, reviews	36
Other Publications	17
Proceedings	4
Reviews	8
Presentations	78
FY 2011-12 references which completed publication in 2012-13	25

6.1 Publications (Published or Accepted)

6.1.1 Book

1. 2012, "Water without Borders? Canada, the United States, and Shared Waters", editors: **Norman, E.**, Cohen, A., Bakker, K., University of Toronto Press, Toronto, *Accepted*.
2. **Gorman, Hugh S.**, 2013, "The Story of N: A Social History of Nitrogen Cycle and the Challenge of Sustainability", Rutgers University Press, *Published*.

6.1.2 Book, Chapter in

3. **Auer, Martin T., Auer, Nancy A., Barkdoll, Brian D.**, Bornhorst, Theodore J., **Brooks, Collin**, Dempsey, David, **Doskey, Paul V., Green, Sarah A.**, Hyslop, Michael D., **Kerfoot, W. Charles, Mayer, Alex S., Perlinger, Judith A., Shuchman, Robert A., Urban, Noel R., Watkins, David W.**, 2012, "*Physical process in the Great Lakes*", editors: Schnoor, J., The Great Lakes: Foundations and Perspectives for a Sustainable Future, Elsevier e-book, Maryland Heights, MO, *Accepted in FY2012*.
4. **Auer, Martin T., Auer, Nancy A., Barkdoll, Brian D.**, Bornhorst, Theodore J., Brooks, T. J., Dempsey, David, **Doskey, Paul V., Green, Sarah A.**, Hyslop, Michael D., **Kerfoot, W. Charles, Mayer, Alex S., Perlinger, Judith A., Shuchman, Robert A., Urban, Noel R., Watkins, David W.**, 2013, "The Great Lakes: Foundations of Physics, Hydrology, Water Chemistry, and Biodiversity.", editors: Schnoor, J., Water Quality and Sustainability, Elsevier Publishers, London, *Published*.
5. **Auer, Martin T., Auer, Nancy A., Barkdoll, Brian D.**, Bornhorst, Theodore J., Brooks, T. J., Dempsey, David, **Doskey, Paul V., Green, Sarah A.**, Hyslop, Michael D., **Kerfoot, W. Charles, Mayer, Alex S., Perlinger, Judith A., Shuchman, Robert A., Urban, Noel R., Watkins, David W.**, 2013, "The Great Lakes: Nutrients, Sediments, Persistent Pollutants, and Policy Perspectives for a Sustainable Future.", editors: Schnoor, J., Water Quality and Sustainability, Elsevier Publishers, London, *Published*.

6. **Auer, Nancy A.**, 2012, "Form and Function in Lake Sturgeon", editors: **Auer, N.**, Dempsey, D., *The Great Lake Sturgeon*, MSU Press, Lansing, MI, *Accepted-Published*
7. **Auer, Nancy A.**, 2012, "Future Management and Stewardship of Lake Sturgeon", editors: **Auer, N.**, Dempsey, D., *The Great Lake Sturgeon*, MSU Press, Lansing, MI, *Accepted-Published*.
8. **Auer, Nancy A.**, Baker, Edward A., 2012, "Sturgeon Habitat, Foods and Feeding", editors: **Auer, N.**, Dempsey, D., *The Great Lake Sturgeon*, MSU Press, Lansing, MI, *Accepted-Published*.
9. Cohen, Alice, **Norman, Emma**, Bakker, Karen, 2012, "Conclusion to Water without Borders?", editors: Norman, E., Cohen, A., Bakker, K., *Water without Borders: Canada, the U.S., and Shared Waters*, University of Toronto Press, Toronto, *Accepted*.
10. **Gorman, Hugh S.**, 2012, "Thinking in Cycles: Flows of Nitrogen and Sustainable Uses of the Environment", editors: Luebken, U., Uekotter, F., *Managing the Unknown: Natural Reserves in Historical Perspective*, German Historical Institute, Washington, DC. *Accepted*.
11. **Gulley, Jason D.**, Fountain, Andrew, 2012, "Glacier Caves", editors: Culver, D., William, W., *Encyclopedia of Caves*, Elsevier, New York, New York, *Published*.
12. **Martin, Patrick E.**, 2012, "Industrial Archaeology", editors: Douet, J., Carnegie Publishing Ltd, in association with The International Committee for the Conservation of the Industrial Heritage, Lancaster, 40-47, ISBN/ISSN ISBN 978-1-85936-218-1, *Published*.
13. **Mirchi, Ali**, Madani, Kaveh, Roos, Maury, **Watkins, David W.**, 2011, "Climate Change Impacts on California's Water Resources", editors: Schwabe, K., *Drought in Arid and Semi-arid Regions: A Multi-disciplinary and Cross-Country Perspective*, Springer Publishing, Dordrecht, *Accepted-Published*.
14. **Norman, Emma**, Cohen, Alice, 2013, "Lines, Treaties, Wars, and Watersheds: How Constructed Borders Impact Water Governance", *Border Flows: A Century of Canadian-American Water Relations*. University of Calgary Press, *Accepted*.
15. **Norman, Emma**, 2013, "Water", *Annotated Bibliographies for Geography*, Oxford University Press, New York, *Published*.
16. **Norman, Emma**, Bakker, Karen, 2012, "Delegation and Devolution in Transboundary Water Governance", editors: Norman, E., Cohen, A., Bakker, K., *Water without Borders: Canada, the U.S., and Shared Waters*, University of Toronto Press, Toronto, *Accepted*.
17. **Norman, Emma**, Cohen, Alice, Bakker, Karen, 2012, "Introduction to Water without Borders?", *Water without Borders: Canada, the U.S., and Shared Waters*, University of Toronto Press, Toronto, *Accepted*.
18. **Pyper, Thomas G.**, Levia, D F., Staelens, J, Van Stan, J T., 2011, "Chapter XVII. Canopy structure in relation to hydrological and biogeochemical fluxes", editors: Levia, D., co-editors: Carlyle-Moses, D. and Tanaka, T., *Forest Hydrology and Biogeochemistry: Synthesis of Past Research and Future Directions*. Ecological Studies Series, Springer-Verlag, Heidelberg, Vol. 216, *Accepted-Published*.
19. Scott, J. T., **Marcarelli, Amy M.**, 2012, "Cyanobacteria in freshwater benthic environments", editors: Whitton, B., *Ecology of Cyanobacteria II: Their Diversity in Space and Time*, Springer, Dordrecht, 271-289, *Published*.

6.1.3 Journal Article

20. **Auer, Martin T., Auer, Nancy A., Urban, Noel R.,** Auer, M. Thomas A., 2013, "Distribution of the amphipod *Diporeia* in Lake Superior: The Ring of Fire", *Journal of Great Lakes Research*, Elsevier, Vol. 39, No. 2013, 33-46, *Published*.
21. **Barkdoll, Brian D.**, 2012, "Battle of the Water Calibration Networks", *J. Water Resources Planning and Management*, American Society of Civil Engineers, Reston, VA, Vol. 138, No. 5, 523-532, *Published*.
22. **Barkdoll, Brian D.**, 2012, "Discussion of "Bank-Attached Vanes for Bank Erosion Control and Restoration of River Meanders"", *J. Hydraulic Engineering*, American Society of Civil Engineers, Reston, VA, No. 138:6, 579-580, *Published*.
23. Bechtold, Heather A., **Marcarelli, Amy M.**, Baxter, Colden V., Inouye, Richard S., 2012, "Effects of N, P, and organic carbon on stream biofilm nutrient limitation and uptake in a semi-arid watershed", *Limnology and Oceanography*, 57(5), 1544-1554. DOI: [10.4319/lo.2012.57.5.1544](https://doi.org/10.4319/lo.2012.57.5.1544) *Accepted-Published*.
24. Benn, D I., Bolch, T, Dennis, K, **Gulley, Jason**, Luckman, A, Nicholson, K L., Quincey, D, Thompson, S, Tourni, R, Wiseman, S, 2012, "Response of debris-covered glaciers in the Mount Everest region to recent warming and implications for outburst flood hazards", *Earth Science Reviews*, Vol. 114, 156-174, *Published*.
25. Bork, S, **Pypker, Thomas G.**, Corace III, R A., **Chimner, Rodney A.**, Maclean, Ann L., 2013, "A case study in large-scale hydrologic restoration at Seney National Wildlife Refuge, Upper Michigan, USA", *American Midland Naturalist*, American Midland Naturalist, Vol. 169, No. 2, 286-302, *Published*.
26. **Breffle, William S., Muralidharan, Daya,** Donovan, Richard P., Liu, Fangming, Mukherjee, Amlan, Jin, Yongliang, 2012, "Socioeconomic Evaluation of the Impact of Natural Resource Stressors on Human-Use Services in the Great Lakes Environment: A Lake Michigan Case Study", *Resources Policy*, *Resources Policy*, Vol. 10.1016/j.resourpol.2012.10.004, *Accepted*.
27. Chen, Ning, Xiang, Xu, Saha, Ratul, **Bagley, Susan T.**, Heiden, Patricia A., 2012, "Copolymerization of bacterial cell wall materials to enhance stability of polyhydroxyalkanoate", *Macromolecular Chemistry & Physics*, Vol. 213, 2647 - 2652, *Published*.
28. Chestnut, Lauraine G., Rowe, Robert D., **Breffle, William S.**, 2012, "Economic valuation of mortality risk reduction: stated preference estimates from the U.S. and Canada", *Contemporary Economic Policy*, Vol. Forthcoming, 399-416, *Published*.
29. Covington, M D., Banwell, A F., **Gulley, Jason**, Saar, M O., Wicks, C M., Willis, I, Arnold, N, 2012, "Quantifying the effects of recharge and system geometry on proglacial hydrograph form", *Journal of Hydrology*, No. 414, 59-71, *Published*.
30. **Datta, Rupali,** Das, Padmini, Smith, Stephanie, Punamiya, Pravin, Ramanathan, Dil, Reddy, Ramana, Sarkar, Dibyendu, 2013, "PHYTOREMEDIATION POTENTIAL OF VETIVER GRASS [*CHRYSOPOGON ZIZANIODES* (L.)] FOR TETRACYCLINE", *International J. Phytoremediation*, Elsevier, 15(4), 343-351. DOI: 10.1080/15226514.2012.702803 *Accepted-Published*.
31. Dawdy, David R., **Griffis, Veronica W.**, Gupta, Vijay K., 2012, "Regional flood frequency analysis: how we got here and where we are going", *Journal of Hydrologic Engineering*, 17(9), 953-959. DOI: [10.1061/\(ASCE\)HE.1943-5584.0000584](https://doi.org/10.1061/(ASCE)HE.1943-5584.0000584) *Accepted-Published*.

32. **Fry, Lauren M., Watkins, David W., Rowe, Mark D.**, Reents, Nathan, Mihelcic, James R., 2012, "Climate Change and Development Impacts on the Sustainability of Spring-fed Water Supply Systems in the Alto Beni Region of Bolivia", *Journal of Hydrology*, Vol. 468-469, 120-129, *Published*.
33. **Fuchs, Valerie J., Gierke, John S.**, Mihelcic, James R., 2012, "Laboratory investigation of ammonium and nitrate removal in vertical flow regimes in planted and unplanted wetland columns", editors: Joel Burken, Assoc. Editor, *Journal of Environmental Engineering*, American Society of Civil Engineers, Vol. 138, No. 12, 1227-1230, *Published*.
34. Ghimire, Santosh, **Watkins, David W.**, Li, Ke, 2011, "Life Cycle Cost Assessment of a Rain Water Harvesting System for Toilet Flushing", *Water Science and Technology: Water Supply*, 12(3), 309-320. DOI:10.2166/ws.2011.135. *Accepted-Published*.
35. Gregoire, Kyla, **Becker, Jennifer G.**, 2012, "Design and characterization of a microbial fuel cell for the conversion of a lignocellulosic crop residue to electricity", *Bioresource Technology*, Elsevier, Vol. 119, 208-215, *Published*.
36. Groves, Stephanie, Liu, Jifei, Shonnard, David R., **Bagley, Susan T.**, 2013, "Evaluation of hardboard manufacturing process wastewater as a feedstream for ethanol production.", *Journal of Industrial Microbiology and Biotechnology*, Springer Verlag, Vol. 40, *Published*.
37. **Gulley, Jason**, Martin, J, Moore, P, Murphy, J, 2013, "Formation of phreatic caves in an eogenetic karst aquifer by CO2 enrichment at lower water tables and subsequent flooding by sea level rise", *Earth Surface Processes and Landforms*, Vol. Early View, *Published*.
38. **Gulley, Jason**, Martin, J, Spellman, P, Moore, P, Sreaton, E, 2013, "Influence of partial confinement and holocene river formation on groundwater flow and dissolution in the Florida carbonate platform", *Hydrological Processes*, Vol. Early View, *Published*.
39. **Gulley, Jason**, Walthard, P, Martin, J, Banwell, A, Benn, D, Catania, G, 2012, "Conduit roughness and dye trace breakthrough curves: why slow velocity and high dispersivity may not reflect flow in distributed systems", *Journal of Glaciology*, Vol. 58 (211), 915-925, *Published*.
40. **Gulley, Jason**, Grabiec, M, Martin, J B., Jania, J, Catania, G, Glowacki, P, 2012, "The effect of discrete recharge by moulins and heterogeneity in flow path efficiency at glacier beds on subglacial hydrology", *Journal of Glaciology*, Vol. 58(211), 926-940, *Published*.
41. **Gulley, Jason D.**, Martin, Jonathan B., Spellman, Patricia D., Paul, Moore J., 2013, "Dissolution in a variably-confined carbonate platform: Effects of allogenic runoff, hydraulic damming of groundwater inputs, and surface-groundwater exchange at the basin scale", *Earth Surface Processes and Landforms*, Vol. Early View, *Published*.
42. **Gulley, Jason D.**, Spellman, Patricia D., Covington, Matt, Martin, Jonathan B., Benn, Doug I., Ginny, Catania, 2013, "Large values of hydraulic roughness in subglacial conduits during conduit enlargement: implications for modeling", *Earth Surface Processes and Landforms*, *Published*.
43. **Gyawali, Rabi, Watkins, David W.**, 2013, "Continuous Hydrologic Modeling of Snow-Affected Watersheds in the Great Lakes Basin Using HEC-HMS", *Journal of Hydrologic Engineering*, American Society of Civil Engineers, Reston, VA, 18(1), 29-39. DOI: [10.1061/\(ASCE\)HE.1943-5584.0000591](https://doi.org/10.1061/(ASCE)HE.1943-5584.0000591) *Accepted-Published*.
44. Haskell, Dan, **Flaspohler, David J.**, Meyer, Michael, Webster, Christopher R., 2012, "Variation in plant survival in shoreline restoration plots as a function of woody additions", *Restoration Ecology*, USA, Vol. 20, 113-121, *Published*.

45. Hurley, Peter, Webster, Christopher R., **Flaspohler, David J.**, Parker, George, 2012, "Untangling the landscape of deer overabundance: Reserve size vs. landscape context in the agricultural Midwest", *Biological Conservation*, UK, Vol. 146, 62-71, *Published*.
46. **Ilorme, Fredline, Griffis, Veronica W.**, 2013, "A Novel Procedure for Delineation of Hydrologically Homogeneous Regions and the Classification of Ungauged Sites for Design Flood Estimation", *Journal of Hydrology*, *Accepted*.
47. **Ilorme, Fredline, Griffis, Veronica W., Watkins, David W.**, 2012, "Regional Rainfall Frequency and Ungauged Basin Analysis for Flood Risk Assessment in Haiti", *Journal of Hydrologic Engineering*, *Accepted*.
48. Johnson, C P., **Pypker, Thomas G., Hribljan, J A., Chimner, Rodney A.**, 2013, "Open top chambers and infrared lamps: A comparison of heating efficacy and CO₂/CH₄ dynamics in a northern Michigan peatland", *Ecosystems*, *Accepted*.
49. **Kane, Evan S.**, 2013, "Response of anaerobic carbon cycling to water table manipulation in an Alaskan rich fen", *Soil Biology and Biochemistry*, Vol. 58, 50-60, *Published*.
50. **Kane, Evan S.**, 2012, "Squeezing the Arctic carbon balloon", *Nature Climate Change*, Vol. 2, 841-842, *Published*.
51. **Kane, Evan S.**, 2012, "Contributions of algae to GPP and DOC production in an Alaskan fen: effects of historical water table manipulations on ecosystem responses to a natural flood", *Oecologia*, *Oecologia*, Vol. 169, 821-832, *Published*.
52. **Kane, Evan S.**, 2012, "Effects of trees on the burning of organic layers on permafrost terrain", *Forest Ecology and Management*, Vol. 267, 127-133, *Published*.
53. **Kane, Evan S.**, 2012, "The response of soil organic carbon of a rich fen peatland in interior Alaska to projected climate change", *Global Change Biology*, No. doi: 10.1111/gcb.12041, *Published*.
54. **Kerfoot, W. Charles, Yousef, Foad, Green, Sarah A.**, Regis, Robert S., Shuchman, Robert, **Brooks, Colin N.**, Sayers, Mike, Sabol, Bruce, Graves, Mark, 2012, "Light detection and ranging (LiDAR) and multispectral studies of disturbed Lake Superior coastal environments", *Limnology and Oceanography*, doi:10.4319/lo.2012.57.3.0749, Vol. 57, No. 3, 749-71, *Published*.
55. **Kozich, A.T., K.E. Halvorsen.** 2012. Compliance with Wetland Mitigation Standards in the Upper Peninsula of Michigan, USA. *Environmental Management* 50:97-105." *Published*.
56. Lai, YenJung, **Becker, Jennifer G.**, 2013, "Compounded effects of chlorinated ethene inhibition on ecological interactions and population abundance in a Dehalococcoides-Dehalobacter coculture", *Environmental Science & Technology*, ACS, Vol. 47, 1518-1525, *Published*.
57. Martin, J, **Gulley, Jason**, Spellman, P, 2012, "Tidal pumping of water between Bahamas blue holes, the aquifer and the ocean", *Journal of Hydrology*, 28-38, *Published*.
58. Mellor, Jonathon, **Watkins, David W.**, Mihelcic, James, 2012, "Rural Water Usage in East Africa: Does Collection Effort Really Impact Basic Access", *Waterlines*, 31(3), 215-225. DOI: 10.3362/1756-3488.2012.022 *Accepted-Published*.

59. **Mirchi, Ali**, Madani, Kaveh, **Watkins, David W.**, Ahmed, Sajjad, 2012, "Synthesis of System Dynamics Tools for Holistic Conceptualization of Water Resources Problems", *Water Resources Management*, 26(9), 2421-2441. DOI 10.1007/s11269-012-0024-2. *Accepted-Published*.
60. **Mirchi, Ali, Watkins, David W.**, 2012, "A systems approach to holistic TMDL policy: The case of Lake Allegan, Michigan", *Journal of Water Resources Planning and Management*, American Society of Civil Engineers, Reston, VA, *Accepted*.
61. Morar, Doina L., Aydilek, Ahmet H., **Seagren, Eric A.**, Demirkan, M. M., 2011, "Leaching of metals from fly ash-amended permeable reactive barriers", *Journal of Environmental Engineering (ASCE)*, American Society of Civil Engineers, Reston, VA, 138:815-825. DOI: 10.1061/(ASCE)EE.1943-7870.0000531 *Accepted-Published*.
62. **Mouw, Colleen**, Chen, H, McKinley, G A., Effler, S, O'Donnell, D, Perkins, M G., Strait, C, 2013, "Evaluation and optimization of bio-optical inversion algorithms for remote sensing of Lake Superior's optical properties", *Journal of Geophysical Research*, American Geophysical Union, USA, Vol. 118, 1696-1714, ISBN/ISSN doi:10.1002/jgrc.20139, *Published*.
63. Nagar, Rachana, Makris, Konstantinos, Sarkar, Dibyendu, **Datta, Rupali**, 2013, "BIOACCESSIBILITY AND SPECIATION OF AN ORGANOARSENICAL IN DRINKING-WATER", *J Hydrology*, Elsevier, *Published*.
64. Nagar, Rachana, Sarkar, Dibyendu, Makris, Konstantinos, **Datta, Rupali**, 2013, "Inorganic Arsenic Sorption by Drinking-Water Treatment Residual-Amended Sandy Soil: Effect of Soil Solution Chemistry", *Intl. J Env. Sci. Technol.*, Springer, Vol. 10, 1-10, *Published*.
65. Naik, P, D'Sa, E J., Gomes, H, Goés, J I., **Mouw, Colleen**, 2013, "Light absorption properties in southeastern Bering Sea during July 2008: analysis, parameterization and absorption budget", *Remote Sensing of Environment*, Elsevier, USA, Vol. 134, 120-134, *Published*.
66. Nizzetto, L, **Perlinger, Judith A.**, 2012, "Climatic, biological and land cover controls on the exchange of gas-phase semivolatile chemical pollutants between air and forest canopies", *Environ. Sci. Technol.*, Vol. 46, 2699-2707, *Published*.
67. **Norman, Emma**, Dunn, Gemma, Bakker, Karen, Allen, Diana K., Cavalcanti de Albuquerque, Rafael, 2013, "Water Security Assessment: Integrating Governance and Freshwater Indicators. *Water Resources Management*", *Water Resources Management*, Vol. 27, No. 2, 535-551, *Published*.
68. **Norman, Emma**, 2013, "Who's counting? Spatial politics, ecocolonisation, and the politics of calculation in Boundary Bay", *AREA (Royal Geographical Society with the Institute of British Geographers)*, Wiley-Blackwell, Edinburgh, *Published*.
69. Pavlot, Laura, **Gorman, Hugh S.**, 2012, "Public Participation and Smart Growth in Silver Spring, Maryland", *Environmental Practice*, *Accepted*.
70. Quazi, Shahida, Sarkar, Dibyendu, **Datta, Rupali**, 2013, "Human Health Risk from Arsenical Pesticide Contaminated Soils: A Long-Term Greenhouse Study", *J. Hazardous Materials*, Elsevier, *Published*.
71. Rakshit, Sudipta, Elzinga, Evert, **Datta, Rupali**, Sarkar, Dibyendu, 2013, "In Situ Attenuated Total Reflectance Fourier-Transform Infrared Study of Oxytetracycline Sorption on Magnetite", *Journal of Environmental Quality*, Agronomy/Crop Science/Soil Science Society of America, USA, Vol. 42, No. 3, 822-827, *Published*.

72. Rakshit, Sudipta, Sarkar, Dibyendu, Elzinga, Evert, Punamiya, Pravin, **Datta, Rupali**, 2013, "Mechanisms of Ciprofloxacin removal by nano-sized magnetite", *Journal of Hazardous Materials*, Elsevier, Vol. 246-247, 221-226, *Published*.
73. Ray, Patrick A., Kirshen, Paul K., **Watkins, David W.**, 2012, "Stochastic Programming for Staged Climate Change Adaptation Planning for Amman, Jordan", *Journal of Water Resources Planning and Management*, American Society of Civil Engineers, Reston, VA, Vol. 138, No. 5, 403–411.. DOI: 10.1061/(ASCE)WR.1943-5452.0000172, *Accepted-Published*.
74. Reed, Sasha C., Wood, Tana E., **Cavaleri, Molly A.**, 2012, "Tropical forests in a warming world", *New Phytologist*, Vol. 193, 27-29, *Published*.
75. Rivera, Julio L., **Seely, Bruce E., John, Sutherland W.**, 2012, "Societal implications of nanotechnology: occupational perspectives", *Environment, Development and Sustainability*, Springer, 14(5), 807-825. DOI: 10.1007/s10668-012-9355-7. *Accepted-Published*.
76. **Robles-Morua, A., Mayer, Alex S., Auer, Martin T.**, Vivoni, E., 2012, "Modeling riverine pathogen fate and transport in Mexican rural communities and its public health implications", *Journal of Environmental Management*, 113: 61-70. DOI: [10.1016/j.jenvman.2012.08.035](https://doi.org/10.1016/j.jenvman.2012.08.035). *Accepted-Published*.
77. **Robles, Agustin**, Enrique, Vivoni, **Mayer, Alex S.**, 2012, "Distributed Hydrologic Modeling in Northwest Mexico Reveals the Links between Runoff Mechanisms and Evapotranspiration", *Journal of Hydrometeorology*, Vol. 13, No. 3, 785-807, *Published*.
78. **Rowe, M D., Perlinger, Judith A.**, 2012, "Micrometeorological measurements of hexachlorobenzene and polychlorinated biphenyl compound air-water gas exchange in Lake Superior", *Atmos. Chem. Phys.*, *Atmos. Chem. Phys.*, Vol. 12, 4607-4617, *Published*.
79. **Seely, Bruce E.**, 2012, ""Pan American Highway: Roads and Politics"", *Routes-Roads*, France, 88-93 *Accepted*.
80. Veverica, Timothy, **Kane, Evan S.**, 2012, "Tamarack and black spruce adventitious root patterns are similar in their ability to estimate organic layer depths in northern temperate forests ", *Canadian Journal of Soil Science*, Vol. 92(5), 799-802, *Published*.
81. Wang, J, Hu, H, Miksis-Olds, J, **Mouw, Colleen**, D'Sa, E, Gomes, H, Wang, D R., Mizobata, K, Saitoh, S, Lou, L, 2013, "A modeling study of seasonal variations of sea ice and plankton in the Bering and Chukchi Seas during 2007-2008", *Journal of Geophysical Research*, American Geophysical Union, USA, Vol. 118, 1-14, ISBN/ISSN doi:10.1029/2012JC008322, *Published*.
82. Wood, Tana E., **Cavaleri, Molly A.**, Reed, Sasha C., 2012, "Tropical forest carbon balance in a warmer world: a critical review spanning microbial- to ecosystem-scale processes", *Biological Reviews*, Vol. 87, 912-927, *Published*.
83. **Yousef, Foad, Kerfoot, W. Charles, Brooks, Colin N.**, Shuchman, Robert A., Sabol, Bruce, Graves, Mark, 2013, "Using LiDAR to reconstruct the history of a coastal environment influenced by legacy mining", *Journal of Great Lakes Research*, Elsevier, Germany, *Published*.
84. Yu, K, **Pypker, Thomas G.**, Keim, R, Chen, N, Yang, Y, Guo, Q, Wang, G, 2012, "Canopy rainfall storage capacity as affected by sub-alpine grassland degradation in the Qinghai-Tibetan Plateau, China", *Hydrological Processes*, Vol. 26, 3114-3123, *Published*.
85. Zhang, Lan, **Seagren, Eric A.**, Davis, Allen P., Karns, Jeffrey S., 2011, "Effects of temperature on bacterial transport and destruction in bioretention media: Field and laboratory evaluations", *Water*

Environment Research, Water Environment Federation, Reston, VA, 84(6):485-96. *Accepted-Published.*

6.1.4 Review

86. **Gorman, Hugh S.**, 2013, "Review of Hybrid Nature: Sewage Treatment and the Contradictions of the Industrial Ecosystem", *History and Philosophy of the Life Sciences*, *Accepted.*
87. **Gorman, Hugh S.**, 2013, "Review of Politics of Urban Runoff: Nature, Technology, and the Sustainable City", *Technology & Culture*, Vol. 53, 945-947, *Published.*
88. **Gorman, Hugh S.**, 2013, "Review of Dangerous Trade: Histories of Industrial Hazard Across a Globalizing World", *Business History Review*, Vol. 87, 173-175, *Published.*
89. **Gorman, Hugh S.**, 2012, "Review of Crude Reality: Petroleum in World History", *Business History Review*, *Accepted.*
90. **Gorman, Hugh S.**, 2012, "Review of The Wired Northwest: The History of Electric Power, 1870s-1970s", *Choice*, *Accepted.*
91. **Gorman, Hugh S.**, 2012, "Review of Politics of Urban Runoff: Nature, Technology, and the Sustainable City", *Choice*, Vol. 49, 1283, *Published.*
92. **Norman, Emma**, 2013, "Review for "A ditch in time: the city, the West, and water" by Patricia Nelson Limerick with Jason L. Hanson et al", *Published.*
93. **MacLennan, Carol A.**, 2012, "Review of "Engineering Nature: Water, Development and the Global Spread of American Expertise", editors: John Clark, *Hawaiian Journal of History*, University of Hawai'i Press, Honolulu, Hawai'i, Vol. 45, to be published in December 2012, *Accepted.*

6.1.5 Proceedings

94. **Barkdoll, Brian D.**, 2012, "Effects of Climate Change on Bridge Scour", *Proc. World Environmental and Water Resources Congress 2012*, American Society of Civil Engineers, Reston, VA, 2532-253, *Published.*
95. **Gyawali, Rabi, Watkins, David W., Griffis, Veronica W.**, 2012, "Climate downscaling using regression and physically based watershed models", *Proceedings World Water & Environmental Resources Congress 2012: Crossing Boundaries*, ASCE, Reston, Virginia, pp1806-1815. DOI: 10.1061/9780784412312.180). *Accepted-Published.*
96. **Rios-Sanchez, Miriam, Gierke, John S., T. Muñoz, O. Larrea**, 2012, "Impacto de la tectónica y la topografía en la hidrogeología del sistema acuífero de Quito", *Memorias XI Congreso Latinoamericano de Hidrogeología*, Cartagena de Indias, Colombia, Agosto 20 al 24 de 2012. *Published.*
97. **Rios-Sanchez, Miriam, Gierke, John S., Munoz-Martinez, Teresa**, 2012, "Hydrogeological characterization of the plateaus region of the Quito aquifer system using remote sensing, digital geomorphology and geophysics", editors: E.D. Loucks, *Proceedings of the 2012 World Environmental & Water Resources Congress: Crossing Boundaries*, American Society of Civil Engineers, *Published.*

6.2 *Published Papers Not Listed Above*

1. Attinti, Ramesh, Sarkar, Dibyendu, **Datta, Rupali**, 2012, "Ethylenediaminedisuccinic Acid (EDDS) Enhances Phytoextraction of Lead by Vetiver Grass From Paint Contaminated Residential Soils: A Field Study", Am. Soc. Agronomy/soil Sci. Soc. Am abstracts, *Accepted-Published*.
2. **Auer, Nancy A., Auer, Martin T.**, 2012, "Semi-Annual report EPA - GLRI", Predicting Ecosystem Change Lake Superior, *Accepted-Published*.
3. **Auer, Nancy A., Auer, Martin T.**, 2013, "Semi-Annual report EPA - GLRI", Predicting Ecosystem Change Lake Superior, *Accepted*.
4. **Campbell, Gary A.**, 2012, "A History of Silver and Gold", Global Commodities: Trade, Exploration and Cultural Exchange, Adam Matthew Digital, Marlborough, Wiltshire, *Published*.
5. Das, Padmini, **Datta, Rupali**, Sarkar, Dibyendu, 2012, "Nitroreductase Enzyme Mediated Phytodegradation of 2,4,6 Trinitrotoluene by Vetiver Grass", Am. soc. Agronomy/Soil Sci. Soc. Am. Abstract, *Accepted-Published*.
- 6.
7. **Gorman, Hugh S.**, 2013, "An Environmental Event of Truly Global Significance: Industrial Fixation", Global Environment, *Accepted*.
8. **Griffis, Veronica W., Gyawali, Rabi, Watkins, David W.**, 2012, "Climate Change Projections Using Regional Regression Models", American Geophysical Union 2012 Fall Meeting, *Published*.
9. **Mouw, Colleen**, Gerb, S, 2012, "Workshop for Remote Sensing of Coastal and Inland Water", EOS, Madison, Wisconsin, Vol. EOS 93(39), 375, *Published*.
10. Padmini, Dibyendu, **Datta, Rupali**, 2013, "Optimization of Kinetic Factors Influencing the Nitroreductase Enzyme Mediated Phyto-transformation of 2,4,6-Trinitrotoluene (TNT) by Vetiver Grass.", Hudson-Delaware SETAC Conference Abstracts, *Published*.
11. Pidatala, Venkataramana, Sarkar, Dibyendu, **Datta, Rupali**, 2012, "Metabolite profiling of Vetiver Grass (*Chrysopogon Zizanioides*) under lead stress", Am. Soc. Agronomy/Soil Sci. Soc Am Abstracts, *Accepted-Published*.
12. Punamiya, Pravin, Sarkar, Dibyendu, **Datta, Rupali**, 2012, "Using Drinking Water Treatment Residuals to Immobilize Tetracyclines in Manures and Manure-Amended Soils: Greenhouse Study.", Am. Soc. Agronomy/Soil Sci. Soc. Am. Abstracts, *Accepted-Published*.
13. Punamiya, Pravin, Sarkar, Dibyendu, **Datta, Rupali**, 2013, "Al-based Drinking Water Treatments Residuals as a Novel Green Sorbent for Tetracycline and Oxytetracycline: Results from Greenhouse Study.", Hudson-Delaware SETAC, *Published*.
14. Rakshit, Sudipta, Sarkar, Dibyendu, Elzinga, Evert, **Datta, Rupali**, 2012, "Molecular Mechanisms of Oxytetracycline and Ciprofloxacin Sorption On Nano-Magnetite", Am Soc Agronomy/Soil Sci soc Am Abstracts, *Accepted-Published*.

15. Saha, Ratul, Donofrio, Robert, Goeres, Carla, **Bagley, Susan T.**, 2011, "Rapid detection of rRNA group I Pseudomonads in contaminated metalworking fluids and biofilm formation by fluorescent in situ hybridization", *Applied Microbiology and Biotechnology*, Springer-Verlag, Berlin, Vol. 94, No. 3, 799-808. DOI: 10.1007/s00253-011-3647-y. *Accepted-Published*.
16. **Sengupta, Aparupa, Bagley, Susan T.**, Sarkar, Dibyendu, Ramanathan, Dil, **Datta, Rupali**, 2012, "Uptake and Transformation of Tetracycline by Vetiver Grass (*Chrysopogon zizanioides* L. Nash)", *American Soc. Agronomy/Soil Sci. Soc. America Abstracts*, *Accepted-Published*.
17. Wurtsbaugh, Wayne A., **Marcarelli, Amy M.**, Boyer, Greg L., 2012, "Eutrophication and Metal Concentrations in Three Bays of the Great Salt Lake (USA)", Final Report to the Utah Division of Water Quality, Salt Lake City, UT, 66, *Published*.

6.3 Presentations

1. **Auer, Martin T., Brooks, C. N.**, Sayers, M. J., Shuchman, R. A., Meadows, G. A., **Jessee, N. L.**, 2012, Mapping Cladophora and Other Submerged Aquatic Vegetation in the Great lakes Using Satellite Imagery., 55th Annual Conference, International Association for Great Lakes Research, Cornwall, Ontario, May 16, 2012.
2. **Auer, Martin T., Dayton, A. I.**, 2012, Feeding the Beast: Temporal Scale, Cladophora and the Nearshore Phosphorus Shunt, 55th Annual Conference, International Association for Great Lakes Research, Cornwall, Ontario, May 16, 2012.
3. **Auer, Martin T., Dayton, A. I.**, 2012, Phosphorus Accumulation over Dreissenid Beds: Impact on Cladophora., 55th Annual Conference, International Association for Great Lakes Research, Cornwall, Ontario, May 16, 2012.
4. Barton, Tyler, **Rios-Sanchez, Miriam, MacLennan, Carol A., Gierke, John S.**, 2012, Is It Still a Disaster if It is Routine? A Case Study in El Salvador, 2012 Fall Meeting, American Geophysical Union, San Francisco, December 3, 2012 - December 7, 2012.
5. Baxter, Colden V., Benjamin, Joseph, Mineau, Madeleine M., Fausch, Kurt, Lepori, Fabio, **Marcarelli, Amy M.**, Minshall, G W., 2012, Emerging lessons: invasive species effects that cross habitat boundaries, Annual meeting, Ecological Society of America, Portland, OR, August 2012.
6. Baxter, Colden V., Benjamin, Joseph, Mineau, Madeleine M., Fausch, Kurt, Lepori, Fabio, **Marcarelli, Amy M.**, Minshall, G W., 2012, Emerging lessons: invasive species effects that cross habitat boundaries, Annual meeting, Society for Freshwater Science, Louisville, KY, May 2012.
7. Bowman, Luke J., Cruz, J F., Henquinet, Kari B., **Gierke, John S.**, 2012, Rainfall-Induced Landslides and Disaster Risk Reduction at San Vicente Volcano, El Salvador, Peace Corps Connect, U.S. Peace Corps, Minneapolis, MN, June 29, 2012 - July 1, 2012.
8. Bowman, Luke J., Henquinet, Kari B., **Gierke, John S., Rose, William I.**, 2012, Social Vulnerability as a Contributing Factor to Disasters in Central America: A Case Study at San Vicente Volcano, El Salvador, 2012 Fall Meeting, American Geophysical Union, San Francisco, December 3, 2012 - December 7, 2012.
9. **Breffle, William S., Muralidharan, Daya**, Donovan, Richard P., Liu, Fangming, Mukherjee, Amlan, Yongliang, Jin, 2012, Socioeconomic Evaluation of the Impact of Natural Resource Stressors on Human-Use Services in the Great Lakes Environment: A Lake Michigan Case Study, Pathways to

Success: Integrating Human Dimensions into Fisheries and Wildlife Management Conference, Colorado State University, Breckenridge, Colorado.

10. **Breffle, William S., Muralidharan, Daya,** Eiswerth, Mark, Thornton, Jeffrey, 2012, Economic values for lake improvement using a method to better reflect the preferences of less wealthy residents, North American Lake Management Symposium, NALMS, Madison, WI, November 7, 2012 - November 9, 2012.
11. **Cavaleri, Molly A.,** 2012, GO BIG or go home: Adventures in the development of a large-scale climate manipulation experiment in the tropics, Biological Sciences Departmental Seminar Series, Michigan Tech, Houghton, MI, November 2012.
12. **Cavaleri, Molly A.,** 2012, Tropical forest carbon balance in a warmer world: A critical review spanning microbial- to ecosystem-scale processes, U.S.D.A. Forest Service Northern Research Station Seminar Series, U.S.D.A. Forest Service, Rhinelander, WI, October 2012.
13. **Cavaleri, Molly A.,** 2012, Tropical forest carbon balance in a warmer world: A critical review spanning microbial- to ecosystem-scale processes, Critical Research Needs for Tropical Ecosystems Workshop, U.S. Department of Energy, Bethesda, MD, June 2012.
14. Chen, H, **Mouw, Colleen,** McKinley, G A., 2012, Mesoscale and sub-mesoscale signatures of chlorophyll and phytoplankton size structure along multi-satellite identified eddy footprint, AGU, San Francisco, CA, December 2012.
15. Chen, H, **Mouw, Colleen,** McKinley, G A., 2012, Tracking eddies using multiple satellite products and the observed mesoscale signatures in SST and Chlorophyll, Workshop for Remote Sensing of Inland and Coastal Waters, University of Wisconsin - Madison, Madison, WI, June 2012.
16. **Chimner, Rodney A.,** 2012, Mountain Fen Restoration in Colorado: An Overview, The 14th International Peat Conference, International Peat Society, Stockholm, Sweden, 2012.
17. **Chimner, Rodney A., Hribljan, J A., Pypker, Thomas G., Kane, Evan S.,** 2012, Effects of short term warming and long-term water table alterations on vegetation and carbon cycling in a great lakes peatland, The 14th International Peat Conference, International Peat Society, Stockholm, Sweden, 2012.
18. **Coble, Adam P., Cavaleri, Molly A.,** 2012, Investigating vertical gradients of leaf morphology and anatomy in a sugar maple forest, 97th Annual Meeting of the Ecological Society of America, ESA, Portland, OR, August 2012.
19. **Coble, Ashley A., Marcarelli, Amy M.,** 2012, Seasonal variation in nutrient uptake in a 1st-order tributary of Lake Superior and implications for climate change, Fall Meeting, American Geophysical Union, San Francisco, CA, December 2012.
20. **Coble, Ashley A., Marcarelli, Amy M., Huckins, Casey J.,** 2013, Nitrogen and phosphorus, but not carbon, are quickly taken up in streams: assessing variability in nutrient uptake across six Lake Superior tributaries, ESC/BRC Student Research Forum, Ecosystem Science Center/Biotechnology Research Center, Houghton, MI.
21. **Coble, Ashley A., Marcarelli, Amy M., Huckins, Casey J.,** 2013, Nitrogen and phosphorus, but not carbon, are quickly taken up in streams: assessing variability in nutrient uptake across six Lake Superior tributaries, World Water Day Poster Competition, Center for Water and Society, Houghton, MI.
22. **Collins, Alex R., Cavaleri, Molly A.,** 2012, The effects of experimental warming and irrigation on the water use of sugar maples (*Acer saccharum*) in a northern hardwood forest, 97th Annual Meeting of the Ecological Society of America, ESA, Portland, OR, August 2012.

23. Collins, Scott F., Baxter, Colden V., **Marcarelli, Amy M.**, Wipfli, Mark S., 2013, Spatiotemporal complexity in stream food web responses to salmon subsidies, Annual meeting, Western Division of the American Fisheries Society, Boise, ID, April 15, 2013 - April 18, 2013.
24. **Datta, Rupali**, Attinti, Ramesh, Sarkar, Dibyendu, 2012, ADSORPTION OF ARSENIC (V) FROM AQUEOUS SOLUTIONS BY GOETHITE-COATED SILICA NANOPARTICLES, Geological Soc. America Annual Meeting, Geological Soc. Am., Minneapolis, MN, October 9, 2012 - October 12, 2012.
25. **Datta, Rupali**, Doskey, Claire, Sarkar, Dibyendu, 2012, PHYTOREMEDIATION OF HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE (RDX) USING CHRYSOPOGON ZIZANIODES, Geological Society of America Annual Meeting, Geological Society of America, Minneapolis, MN, October 9, 2012 - October 12, 2012.
26. **Datta, Rupali**, Punamiya, Pravin, Sarkar, Dibyendu, 2012, ALUMINUM-BASED DRINKING-WATER TREATMENT RESIDUALS A "GREEN" SORBENT FOR TETRACYCLINES, Geological Society of America Annual Meeting, Geological Society of America, Minneapolis, MN, October 9, 2012 - October 12, 2012.
27. **Datta, Rupali**, Sarkar, Dibyendu, 2012, The Legacy of War: Using Plants to remove Lead, TNT and RDX from Soil, Hudson-Delaware SETAC Annual Meeting, SETAC, Montclair, NJ, April 26, 2012 - April 27, 2013.
28. D'Sa, Eurico, Goes, Joaquim, Naik, Puneeta, **Mouw, Colleen**, Gomes, Helga, 2013, Summer CDOM characteristics in the southeastern Bering Sea using excitation-emission matrix fluorescence and PARAFAC analysis, ASLO Aquatic Sciences Meeting, Association for the Science of Limnology and Oceanography, New Orleans, LA, February 2013.
29. **Ebel, Jonathan D.**, **Marcarelli, Amy M.**, Kohler, Andre E., 2012, Biofilm responses to nutrient enrichment using salmon carcass analog in central Idaho streams, Annual meeting, Ecological Society of America, Portland, OR, August 2012.
30. Eggert, Sue, Timm, Anne, King, Nicole, **Marcarelli, Amy M.**, Kolka, Randy, Higgins, Dale, Reinecke, Sue, 2012, Food Web Responses to Stream Simulation Design of Road-Stream Crossings: Moving Beyond Aquatic Organism Passage, Annual meeting, American Fisheries Society, Minneapolis-St. Paul, MN, August 2012.
31. **Gorman, Hugh S.**, 2012, Hydro, Fossil, and Solar: Environmental Change and the Political Economy of Energy in Panama, American Society for Environmental History, American Society for the History of Technology, Madison, Wisconsin, 2012.
32. **Gorman, Hugh S.**, 2012, Learning to Govern Human Interactions with the Nitrogen Cycle, Hazardous Chemicals: Agents of Risk and Change, Maastricht University, Rachel Carson Center, Munich, Germany, 2012.
33. Groves, Stephanie, Liu, Jifei, Cary, Adam, Roll, Alex, Shonnard, David R., **Bagley, Susan T.**, 2012, Comparative proteomic analysis of *Pichia stipitis* CBS 6054 adapted to an industrial waste stream, 111th General Meeting of the American Society for Microbiology, American Society for Microbiology, San Francisco, CA, June 16, 2012 - June 19, 2012.
34. Groves, Stephanie, Liu, Jifei, Shonnard, David R., **Bagley, Susan T.**, 2012, Comparative metabolomics and physiology of xylose-fermenting yeast adapted to a dilute acid pretreated lignocellulose-containing waste stream, 2012 Annual Meeting and Exposition of the Society for Industrial Microbiology, Society for Industrial Microbiology and Biotechnology, Washington, DC, August 12, 2012 - August 15, 2012.

35. **Halvorsen, Kathleen E.**, 2012, 2013 Panel Author: "Socioecological Impacts from Bioenergy Development across the Americas" at International Symposium on Society and Resource Management Conference. Estes Park, CO. June 5, 2012 - June 6, 2012.
36. **Halvorsen, Kathleen E.**, 2012, Invited Keynote Speaker in INTA Bioenergy Workshop: "NSF PIRE Project on Socioecological Impacts from Bioenergy Development across the Americas" in Buenos Aires, Argentina. May 28, 2012.
37. **Halvorsen, Kathleen E.**, 2012, Invited Panel Participation: "Experiences with Interdisciplinary Water-related Research Science Teams" at Rural Sociological Society Meeting, Chicago IL, July 22, 2012 - July 25, 2012.
38. **Halvorsen, Kathleen E.**, 2013, Invited Keynote Speaker in Bioeconomy Series: "Forty more years of five years away from cellulosic ethanol commercialization?" at Iowa State University, April 26, 2013.
39. Hirata, T, Hardman-Mountford, N, Brewin, R.J. W., Bracher, A, **Mouw, Colleen**, Kostadinov, T S., Clementson, L, Barlow, R, Hirawake, T, Alvain, S, Uitz, J, 2012, Satellite PFT Algorithm Intercomparison, Ocean Optics, Glasgow, Scotland, October 2012.
40. **Hobmeier, Martin M.**, Hirsch, Jodie K., **Kerfoot, W. Charles**, **Yousef, Foad**, **LeDuc, Jaime F.**, Maki, Ryan P., 2013, Spiny Water Flea (*Bythotrephes longimanus*) Impacts on Zooplankton Communities of Voyageurs National Park, 2013 Lake of the Woods and Rainy Basin Water Quality Forum, Lake of the Woods Water Sustainability Foundation, International Falls, MN, March 13, 2013 - March 14, 2013.
41. **Huckins, Casey J.**, **Ogren, Stacey A.**, 2012, Comparative Assessment of Bioassessment Indices, Tribal Environmental Program Management Conference, Environmental Protection Agency, Chicago, IL, 2012.
42. **Kerfoot, W. Charles**, **Urban, Noel R.**, **Green, Sarah A.**, Rossmann, Ronald, Wusirika, Ramakrishna, 2012, A Rare Glimse into the Past: Lake Sediments Reveal Long-term Methylmercury Records from Mining, Nonferrous Mining in the Lake Superior Basin: Overview and Updates, Lake Superior Binational Forum, Marquette, MI, September 28, 2012.
43. King, Nicole R., Eggert, Sue L., **Marcarelli, Amy M.**, **Huckins, Casey J.**, **Ebel, Jonathan D.**, **Matthys, Anthony D.**, Kolka, Randy K., 2012, Detrital breakdown and macroinvertebrate communities affected by sedimentation in a low-gradient tributary to Lake Superior, Annual meeting, Society for Freshwater Science, Louisville, KY, May 2012.
44. Kohler, Andre E., Richardson, David P., **Marcarelli, Amy M.**, **Ebel, Jonathan D.**, Keeley, Ernest R., 2013, Three years of experimental carbon and nutrient additions in upper Salmon River Basin streams using salmon carcass analogs: what have we learned so far?, Annual meeting, Western Division of the American Fisheries Society, Boise, ID, April 15, 2013 - April 18, 2013.
45. **MacLennan, Carol A.**, 2012, The Long Shadow of Pearl Harbor, Long Shadows: An Environmental History of the Second World War, Helsinki, Finland, August 8, 2012 - August 10, 2012.
46. **Marcarelli, Amy M.**, Cross, Wyatt, Brandt, Darren, Servheen, Gregg, Ireland, Kathy, Baxter, Colden V., Ross, TJ, 2013, Silver Bullet or so much fertilizer? Synthesis and dialogue regarding the science and management of nutrient amendments as mitigation tools, Annual meeting, Western Division of the American Fisheries Society, Boise, ID, April 15, 2013 - April 18, 2013.
47. **Marcarelli, Amy M.**, **Ebel, Jonathan D.**, Baxter, Colden V., Kohler, Andre, Collins, Scott F., Wipfli, Mark S., 2013, Integrating ecosystem science into fisheries-targeted nutrient enhancement programs aimed to mitigate for the loss of Pacific salmon, Annual meeting, Western Division of the American Fisheries Society, Boise, ID, April 15, 2013 - April 18, 2013.

48. **Mayer, Alex S.**, 2012, Nonaqueous Phase Liquid Migration and Distribution, LNAPL Work Shop, American Institute of Professional Geologists, American Institute of Professional Geologists, Roscommon, MI, June 2012.
49. **Mayer, Alex S., Watkins, David W., Mirchi, Ali, Gyawali, Rabi, Katelyn, Watson**, 2012, Determination of Water Stress Indices as a Function of Ecological Flows, American Society of Civil Engineers Environmental and Water Resources Institute, American Society of Civil Engineers, Albuquerque, NM, May 2012.
50. McKinley, Galen A., Bennington, Val, **Urban, Noel R.**, 2012, Physical drivers of carbon and biogeochemical cycling in Lake Superior, International Association for Great Lakes Research, International Association for Great Lakes Research, Cornwall, Ontario, May 14, 2012 - May 17, 2012.
51. **Mouw, Colleen**, 2012, Aquatic Optics and Remote Sensing, Presidential Council of Alumnae, Michigan Technological University, Houghton, MI, September 2012.
52. **Mouw, Colleen**, 2012, Aquatic Optics and Remote Sensing, Undergraduate Research Scholars, Michigan Technological University, Houghton, MI, December 2012.
53. **Mouw, Colleen**, 2012, Aquatic Remote Sensing: from Cell to Ecosystem, Environmental Engineering Seminar Series, Michigan Technological University, Houghton, MI, December 2012.
54. **Mouw, Colleen**, 2012, Oceanography: A View from Above, Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI, November 2012.
55. **Mouw, Colleen**, 2012, Phytoplankton Groups in the Global Ocean: Where, When and Why, Biological Sciences Seminar Series, Michigan Technological University, Houghton, MI, November 2012.
56. **Mouw, Colleen**, 2013, Algorithm Development in Optical Complex Systems, Biogeochemistry of the Great Lakes Workshop, Wayne State University, NSF, Detroit, MI, March 2013.
57. **Olson, James C., Marcarelli, Amy M.**, Timm, Anne, Eggert, Sue, Kolka, Randy, 2013, Evaluating the impact of culvert designs on hydrologic connectivity and nutrient uptake in northern Wisconsin streams, ESC/BRC Student Research Forum, Ecosystem Science Center/Biotechnology Research Center, Houghton, MI.
58. **Olson, James C., Marcarelli, Amy M.**, Timm, Anne, Eggert, Sue, Kolka, Randy, 2013, Evaluating the impact of culvert designs on hydrologic connectivity and nutrient uptake in northern Wisconsin streams, World Water Day Poster Competition, Center for Water and Society, Houghton, MI.
59. **Ortiz, Jade E., Marcarelli, Amy M., Huckins, Casey J.**, Eggert, Sue, 2013, Sand accumulation in the Salmon Trout River changes gross primary production and respiration rates by biofilms, ESC/BRC Student Research Forum, Ecosystem Science Center/Biotechnology Research Center, Houghton, MI.
60. **Ortiz, Jade E., Marcarelli, Amy M., Huckins, Casey J.**, Eggert, Sue, 2013, Sand accumulation in the Salmon Trout River changes gross primary production and respiration rates by biofilms, World Water Day Poster Competition, Center for Water and Society, Houghton, MI.
61. **Papacek, Josh R., Marcarelli, Amy M.**, 2013, Nutrient limitation of phytoplankton in Portage Lake, Michigan, ESC/BRC Student Research Forum, Ecosystem Science Center/Biotechnology Research Center, Houghton, MI.
62. **Papacek, Josh R., Marcarelli, Amy M.**, 2013, Nutrient limitation of phytoplankton in Portage Lake, Michigan, World Water Day Poster Competition, Center for Water and Society, Houghton, MI.

63. **Perlinger, Judith A.**, 2012, The frosting on Lake Superior, President's Council of Alumnae Meeting, PCA, Michigan Tech, September 15, 2012.
64. **Rios-Sanchez, Miriam, Gierke, John S.**, Muñoz-Martínez, Teresa, 2012, Hydrogeological characterization of the plateaus region of the Quito aquifer system using remote sensing, digital geomorphology and geophysics, 2012 World Environmental & Water Resources Congress: Crossing Boundaries, American Society of Civil Engineers, Albuquerque, NM, May 22, 2012 - May 25, 2012.
65. **Rios-Sanchez, Miriam, Gierke, John S.**, Muñoz-Martínez, Teresa, Larrea, Oscar, 2012, Impacto de la tectónica y la topografía en la hidrogeología del sistema acuífero de Quito, Memorias XI Congreso Latinoamericano de Hidrogeología, International Association of Hydrogeologists (IAH) and Asociación Latinoamericana de Hidrología Subterránea para el Desarrollo (ALHSUD), Cartagena de Indias, Colombia, August 20, 2012 - August 24, 2012.
66. **Scarlett, Timothy J.**, 2012, Industrial Archaeology and Mining in the Keweenaw, Teachers workshop, Michigan Technological University/Bill Rose, Hancock and Quincy, MI, June 27, 2012.
67. **Seagren, Eric A.**, 2012, Biomediated Geomechanical Processes: A Collaborative Research Approach, Grain Processing Seminar, Department of Chemical Engineering, Michigan Technological University.
68. Seely, Bruce E., 2012, Integrating Advanced Science and Society: The Societal Implications of Nano-scale Science and Engineering, International Conference for the Integration of Science and Technology into Society—, Korean Advanced Institute for Science and Technology (KAIST), Daejeon, South Korea, August 9, 2012.
69. **Seely, Bruce E.**, 2013, The Societal Implications of Nano-scale Science and Engineering, IIT Jodhpur, Jodhpur, India, March 13, 2013.
70. **Seely, Bruce E.**, 2013, The Societal Implications of Nano-scale Science and Engineering, NIIT University, Neemrana, India, March 6, 2013.
71. Smith, Daniel M., Oommen, Thomas, Bowman, Luke J., **Gierke, John S.**, 2012, Stability and Rainfall Susceptibility of Volcanic Slopes on the Chichontepec Volcano in Central El Salvador, 2012 AEG Annual Meeting, Association of Engineering Geologists, Salt Lake City, UT, September 15, 2012 - September 23, 2012.
72. **Urban, Noel R.**, McKinley, Galen A., 2012, CO₂-driven acidification of the Great Lakes: Equilibrium and Kinetic Bounds on the Magnitude, International Association for Great Lakes Research, International Association for Great Lakes Research, Cornwall, Ontario, May 14, 2012 - May 17, 2012.
73. Veverica, Timothy, **Kane, Evan S., Marcarelli, Amy M.**, Fisk, Brian P., 2013, Lifting the humic veil: a novel approach to quantitating occluded iron in peat porewater, ESC/BRC Student Research Forum, Ecosystem Science Center/Biotechnology Research Center, Houghton, MI.
74. **Watch, Lindsey M., Wesseldyke, Eric S., Seagren, Eric A., Becker, Jennifer G.**, 2013, Estimation of mass transfer and transport parameters for a microfluidic groundwater model containing a PCE DNAPL pool source zone., RemTEC Summit, Westminster, CO, March 4, 2013 - March 6, 2013.
75. Webster, Christopher R., **Flaspohler, David J.**, Roth, Amber M., 2012, Legacy tree retention balances commodity and conservation objectives in intensively-managed North American aspen forests, 2nd International Conference on Biodiversity in Forest Ecosystems and Landscapes, IUFRO, Cork, Ireland, August 29, 2012.
76. Wurtsbaugh, Wayne A., **Marcarelli, Amy M.**, Boyer, Greg L., 2013, Harmful algal blooms in the Great Salt Lake (Utah): Salinity, Nutrient and Top-Down Controls, Aquatic Sciences Meeting, Association for the Sciences of Limnology and Oceanography, New Orleans, LA, February 2013.

77. Wurtsbaugh, Wayne A., **Marcarelli, Amy M.**, Boyer, Greg, 2012, Eutrophication in the Great Salt Lake, Utah, Great Salt Lake Issues Forum, Friends of Great Salt Lake, Salt Lake City, UT, May 2012.
78. Zhang, B, Owen, Robert C., **Perlinger, Judith A.**, Kumar, A, Wu, Shiliang, Val Martin, M, Kramer, Louisa J., Helmig, D, Honrath, Richard E., 2013, A Lagrangian view of ozone production tendency in North American outflow in summers 2009 and 2010, European Geosciences Union Meeting, European Geosciences Union, Vienna, Austria, April 7, 2013 - April 12, 2013.

6.4 Editorial Activities

Bagley, Susan T.

Editor, MicrobeLibrary, American Society for microbiology, Papers, Appointed. July 1, 2012 - Present.
 Editorial Board Member, Journal of Industrial Microbiology and Biotechnology, Society for Industrial Microbiology, Appointed. July 1, 2003 - June 30, 2013.
 Associate Editor, SIM News, Society for Industrial Microbiology, Appointed. January 1, 2008 - December 21, 2012.
 Editor, Visual Resource Collection, MicrobeLibrary, ASM, Papers, Appointed. July 1, 2006 - June 30, 2012.

Barkdoll, Brian D.

Associate Editor, Hydraulic models of the flow distribution in a four branch open channel junction with supercritical flow, Journal of Hydraulic Engineering, ASCE.
 Associate Editor, 3D turbulent intensity in a compound channel, ASCE J. Hydraulic Engineering, Papers, Appointed. 2012.
 Associate Editor, 3D turbulent intensity in a compound channel, ASCE J. Hydraulic Engineering, Papers, Appointed. 2012.
 Associate Editor, Effects of vegetation canopy density and bank angle on near-bank patterns of turbulence and Reynolds stresses, ASCE J. Hydraulic Engineering, Papers, Appointed. 2012.
 Associate Editor, Hydraulic principles of the 2,268-year-old Dujiangyan Project in China, ASCE J. Hydraulic Engineering, Papers, Appointed. 2012.
 Associate Editor, Investigation of the velocity field in a stilling basin induced by flow from an ogee spillway, ASCE J. Hydraulic Engineering, Papers, Appointed. 2012.

Campbell, Gary A.

Associate Editor, Resources Policy, Papers, Appointed. January 2011 - Present.
 Editorial Board Member, African Journal of Business Management. 2007 - Present.

Datta, Rupali

Editor, Textbook, An Integrated Approach to Environmental Management, Wiley, Papers, Appointed. March 2013 - Present.
 Associate Editor, International Journal of Environmental Science and Technology, Papers, Appointed. 2013 - Present.

Doskey, Paul V.

Associate Editor, Journal of Great Lakes Research.

Gierke, John S.

Associate Editor, Journal of Contaminant Hydrology, Appointed. 2009 - Present.

Griffis, Veronica W.

Editor, Book, Applications of Statistical Distributions in Hydrologic Sciences and Engineering, American Society of Civil Engineers.
 Associate Editor, ASCE Journal of Hydrologic Engineering, American Society of Civil Engineers, Papers. October 2012 - Present.

Halvorsen, Kathleen E.

Associate Editor, Society and Natural Resources, Appointed. May 1, 2012 - April 30, 2013.

Associate Editor, Environmental Management. May 1, 2012 - January 1, 2013.

Editorial Board Member, Environmental Management, Editorial Board. 2006 - 2012.

Associate Editor, Society and Natural Resources, Associate Editor. 2006 - 2012.

MacLennan, Carol A.

Editorial Board Member, He Kā Waiho Ho‘ohemahema, Hawaiian Journal of History, Papers, Appointed.
January 2013 - Present.

Editorial Board Member, Justice on Kaua‘i, Hawaiian Journal of History, Papers. January 2013 - Present.

Editorial Board Member, The Royal Residences, Hawaiian Journal of History. January 2013 - Present.

Marcarelli, Amy M.

Associate Editor, Freshwater Science, Society for Freshwater Science, Papers, Appointed. March 1, 2013 - Present.

Rose, William I.

Editor, Journal Editor, Journal of Volcanology and Geothermal Research.

Scarlett, Timothy J.

Editor, Guides to American Artifacts Series, Left Coast Press.

Seagren, Eric A.

Editorial Board Member, Korean Society for Civil Engineering (KSCE) Journal of Civil Engineering, Papers,
Appointed. July 2011 - Present.

Editorial Board Member, Visual Media Briefs, American Society for Microbiology, Papers, Appointed. July 1,
2012 - June 30, 2015.

Waddell, Craig

Editorial Board Member, Environmental Communication Yearbook, Papers, Appointed. January 2002 - Present.

Watkins, David W.

Editorial Board Member, Journal of Water Resources Planning & Mgmt. (ASCE), Papers, Appointed.

December 2004 - Present.

Associate Editor, Journal of Water Resources Planning and Management, Appointed. December 2004 - Present.

Associate Editor, ASCE Journal of Water Resources Planning and Management Papers. 2004 - Present.

7 Appendix 1: CWS Faculty/Staff Participants

Biological Sciences

Nancy A. Auer
Susan T. Bagley
Rupali Datta
Casey J. Huckins
Charles W. Kerfoot
Amy M. Marcarelli

Chemistry

Sarah A. Green

Civil & Environmental Engineering

Martin T. Auer
Brian D. Barkdoll
Jennifer G. Becker
Paul Doskey
Veronica Griffis
David W. Hand
Neil J. Hutzler
Alex S. Mayer
Kurtis G. Paterson
Judith A. Perlinger
Eric A. Seagren
Noel R. Urban
David W. Watkins

Educational Opportunity

Christine S. Anderson

Geological & Mining Eng. & Science

John S. Gierke
Jason D. Gulley
Alex S. Mayer
Colleen B. Mouw
Essa L. Paterson
Wayne D. Pennington
William I. Rose

Humanities

R. Craig Waddell

Michigan Tech Research Institute (MTRI)

Colin Brooks
Liza Jenkins
Nathaniel Jessee

School of Business & Economics

William S. Breffle
Gary Campbell
Daya Muralidharan

School of Forest Resources & Environmental Science

Molly A. Cavaleri
Rodney A. Chimner
David J. Flaspohler
Margaret R. Gale
Kathleen E. Halvorsen
Martin F. Jurgensen
Evan S. Kane
Linda M. Nagel
Blair D. Orr
Thomas G. Pypker
James M. Schmierer
Amy J. Schrank
Kenneth J. Vrana

Social Sciences

Mary Durfee
Hugh Gorman
Kathleen E. Halvorsen
Carol A. MacLennan
Patrick E. Martin
Susan R. Martin
Timothy Scarlett
Bruce E. Seely

Western UP Center for Science, Mathematics & Environmental Education

Joan F. Schumaker Chadde

Adjunct Faculty

John Sutherland
Qiong Zhang

8 Appendix 2: CWS Student Participants

Biological Sciences

Emily Bouckaert
Bethany Blease, undergrad
Ashley Coble
Miles Corcoran
Brian Danhoff
Alicia Doyle, undergrad
Cameron Goble
Martin Hobmeier
John "Marty" Holtgren
Taylor Luginbill, undergrad
Anthony Matthys
Barbara Michel
Stephanie Ogren
Jade Ortiz, undergrad
Josh Papacek, undergrad
Aparupa Sengupta
Alexandria Winters, undergrad
Jade Woiderski, undergrad
Foad Yousef, post-doc

Chemistry

Qili Hu

Civil & Environmental Engineering

Nate Arnold
Rachael Barlock
Jorge Campos
Marcel Dijkstra
Ben Downer
Meng Gao
Rasika Gawde
Andrew Grow
Rabi Gywali
Kaitlin Hannum, undergrad
Coleen Huling, undergrad
Meral Jackson
Erica Jones
Katie Kalman, undergrad
Tanvir Khan
Kaye LaFond
Taile Leswif
MAnkita Mandelia
Christa Meingast
Ali Mirchi

Renee Oats
Julie Padilla
Erin Satchell
Helen (Grace) Schmitz, undergrad
Alicia Sherrin
Lindsey Watch

Geological & Mining Engineering & Sciences

Paula Giryn
Emily Gochis
Will McSorley, undergrad
Josh Richardson
Miriam Rios-Sanchez
Dan Smith

School of Forest Resources & Environmental Science (SFRES)

Brenda Bergman
Adam Coble
Alex Collins
Erin Collins, undergrad
Aleta Daniels
Joshua Davis
Eric Dipping, undergrad
Erin Grupido, undergrad
John Hribljan, post-doc
Rita Koch
Cassandra Ott
Melissa Patterson, undergrad
Matt Van Grinsven

Social Sciences

Aparajita Banerjee
Valorie Gagnon
Andrew Kozich
Mariah Maggio
Brian Pattullo
Emma Schwaiger
Melanie Yang

9 Appendix 3: CWS Advisory Committee

Director

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Western Upper Peninsula Center for Science, Mathematics &
Environmental Education

CWS Subcommittees

Research and Education: Tom Pypker, John Gierke, Noel Urban

Seminars and Symposia: Carol MacLennan, Joan Chadde, Amy Marcarelli, Noel Urban