ANNUAL REPORT

July 1, 2011 – June 30, 2012

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 109 graduate student and 41 undergraduate student participants in 12 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:** Daya Muralidharan, 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 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 2011-12 by CWS.

3.1.1 World Water Day Poster Competition – March 22, 2012

CWS celebrated World Water Day 2012 by hosting a social to view the World Water Day Student Poster entries, and to meet the World Water speaker, Lana Pollack from the International Joint Commission.

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/2012CWS_Posters.html

The awards for the Poster competitions are as follows.

Original Research Posters

1st Place Award ($250)
Marcel Dijkstra
"*Predicting Ecosystem Changes in Lake Superior Insights Regarding Thermal Structure and the Spring Algal Bloom*"

2nd Place Award ($150)
Aparupa Sengupta
"*Degradation of antibiotics in wastewater using tetracycline resistant microbes recovered from an invitro hydroponic phytoremediation system* "

3rd Place Award ($100 - tie)
Jonathan Ebel
"*Biofilm Response to Nutrient Mitigation Using Salmon Carcass Analog in Central Idaho Streams*"

3rd Place Award ($100 - tie)
Ashley Coble
"*Nutrient spiraling and export responses to seasonal changes in a 1st-order tributary of Lake Superior*"

Coursework/Informational Posters

1st Place Award ($250)
Class Poster from BL4465 – Spokesperson, Bethany Blease
"Human Noise Pollution and its Impact on Marine Life"

2nd Place Award ($150)
Paula Giryn
"Land-use change effects on the Mississippi River Basin"

3rd Place Award ($100)
Stephanie Tulk
"Management of Hydrological Systems near Alpine Glaciers"

3.1.2 CWS Seminars and Lectures

Christine Manninen, September 16, 2011
Communications / GLIN Director, Great Lakes Commission, Ann Arbor, MI
"State of the Great Lakes 2011: Successes and Continued Challenges"

Dr. Bob Shuchman, September 19, 2011
Michigan Tech Research Institute
"The Role of Satellite Derived Information in the Restoration of the Great Lakes"

Dave Dempsey, October 25, 2011
Policy Advisor, International Joint Commission
"New Directions on Great Lakes Water Resources Policy"

Dr J. Val Klump, November 10, 2011
Director, Great Lakes WATER Institute and Professor, School of Freshwater Sciences, University of Wisconsin, Milwaukee
"Green Bay Hypoxia: Biogeochemical Dynamics, Watershed Inputs and Climate Change" -- NOAA Coastal Hypoxia Research Program

John R. (Jack) Kelly, December 6, 2011
Chief, Ecosystem Assessment Research Branch
US EPA Office of Research and Development
National Health and Environmental Effects Laboratory
Mid-Continent Ecology Division
Duluth MN 55804
"Across Hydrological Interfaces from Coastal Watersheds to the Open Lake: Finding Landscape Signals in the Great Lakes Coastal Zone"

Dr. Guy Meadows, February 8, 2012
University of Michigan and Adjunct Professor in GMES at Michigan Tech
"Full Scale Coastal Experiments… from Flying Buoys to Caribou Hunters"

Michelle Banonis, March 19, 2012
U.S. Bureau of Reclamation (MTU alumna), San Joaquin River Restoration Program
"San Joaquin River Restoration Program: Federal Politics and National Resources Defense Council (NRDC) comments on SJRR"

Steve Sebestyen, March 21, 2012
Research Hydrologist, USDA Forest Service, Northern Research Station, Grand Rapids, MN
"Identifying When, Where, and Why Nitrate is directly Transported from Atmospheric Deposition to Streams in Forests"

Dr. Lana Pollack, World Water Day Lecture, March 22, 2012
U.S. Delegate of the International Joint Commission
"Can Science Save the Great Lakes?"

Alan Weidemann, April 2, 2012
Office of Naval Research
"*Remote optical studies of the Great Lakes****"***

W. Charles Kerfoot, April 12, 2012
Lake Superior Ecosystem Research Center & Department of Biological Sciences, Michigan Technological University
"LiDAR and MSS Applications for Coastal Ecosystem Research & Restoration Projects"

Daniel Boatwright, April 20, 2012
Senior Associate Dean and Presidential Professor of Occupational and Environmental Health College of Public Health, University of Oklahoma Health Sciences Center
"Public Health Aspects of Disaster Response"

3.2 Degree and Education Subcommittee Activities

(**Members:** John Gierke, 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 listed as 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 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

Since fall 2009 CWS has offered a graduate certificate in Sustainable Water Resource Systems. This Certificate is awarded to students who have obtained a set of core competencies in understanding current water resource issues and developed 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. The certificate signifies that students understand water resource management from an interdisciplinary perspective that includes policy, natural sciences, and applied sciences. 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 2011-12

Valoree Gagnon, March 28-31, 2012
American Society for Environmental History (ASEH) Conference 2012
Madison, Wisconsin
"Fish Contaminants through the Tribal Perspective: An Ethnography of the Keweenaw Bay Indian Community's Tribal Fish Harvest"

Martin Hobmeier, April 17-18, 2012
Western Great Lakes Resource Management Conference
Ashland, Wisconsin
"Inland Dispersal and Ecological Impacts of an Invasive Zooplankter, the Spiny Water Flea (Bythotreples longimanus)"

Rabi Gyawali, May 20-24, 2012
EWRI – World Environmental and Water Resources Congress, ASCE
Albuquerque, New Mexico
(1) "*Show modeling of Himalyan catchment using HEC-HMS*"
(2) "*Climate downscaling using regional sequestion and physically based watershed model*"
(3) "*Determination of water stress indices as a function of ecological flows*"

Rasika Gawde, 2-week study
SUNY, Buffalo, New York
Study hydrodynamics and mathematical models with Dr. J. Atkinson

Approved in FY 2011-12, but travel and/or funds will be 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 Graduate research grants

Ashley Coble (Fall - $747)
"Nutrient spiraling and export responses to seasonal changes in a 1st order tributary of Lake Superior"

Alex Collins (Fall - $750)
"Investigating the Effects of Experimental Warming and irrigation on Source Water of Sugar Maple Trees"

Matt Van Grinsven (Fall - $750)
"The fate of snowmelt in black ash wetlands following an emerald ash borer disturbance"

Anthony Matthys (Spring - $752)
"Assessing the ability of an in-stream sediment removal restoration to create preferred native fish habitat"

Meral Jackson - (Spring - $750)
"Wetland and Stream Restoration Effects on Hydrology, Vegetation, and Gas Flux within Seney National Wildlife Refuge"

Joshua Davis - (Spring - $750)
"Changes in Dissolved Nitrogen Concentrations in Ground and Surface Water Following Simulated Emerald Ash Borer Mortality in Black Ash-Dominated Swamps"

Aparupa Sengupta - (Spring - $750)
"Degradation of Tetracycline in Wastewater Systems Using Vetiver grass (Chrysopogon zizanoides L. Nash) and its Root-Associated Microorganisms"

Andrew Kozich - (Spring - $750)
"Relationships between Values, Beliefs, and Residential Water Use in the Great Lakes Watershed"

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. Preliminary discussions were held in 2012, but no recommendations were developed.

3.4 Outreach Activities

Sponsor of Green Film Series, January – June, 2012
Jan. 19: *The Economics of Happiness*
Feb. 16: *Addicted to Plastic*
Mar. 15: *Blue Gold: World Water Wars*
Apr. 19: *Carbon Nation*
May 17: *Food*
Jun 21: *Inter Eternity*

Great Lakes Watershed Investigations Teacher Institute, June 2012

Strawberry Festival, July 2011
Support the use of the Agassiz Research Vessel for community lake ecology tours during the Strawberry Festival activities.

Great Lakes Research Center Education/Outreach Brainstorm Session, May 23, 2012
CWS provided salary for Joan Chadde and Lloyd Wescoat to plan for education/outreach activities in the Great Lakes Research Center. Valorie Troesch was hired to facilitate the 3-hr workshop for 25 invited participants. Participants included representatives from MTU, the regional K-12 educators, and local community groups. The workshop focused on two questions: 1) What can be done to enhance the visibility and recognition of the GLRC as a nationally-recognized and state-of-the-art center focused on the upper Great Lakes; and 2) How can the GLRC be used to enhance Awareness-Appreciation-Understanding-Action about the Great Lakes in order to inspire and prepare current and future stewards and to promote and develop sustainability and stewardship of the Great Lakes? Participants were first grouped into expert panels and subsequently mixed into smaller groups to address both questions. A large list of recommendations was elicited and subsequently prioritized. Some high priority recommendations for the second question included:

- Host workshops/short courses for city managers, agency personnel on new scientific development and implementable technologies that positively impact Great Lakes;
- Hire an AmeriCorps or other person whose job is to develop K-12 curriculum and bring classrooms here to do it as well as reach out to classrooms;
- Partner with community organizations on community based research projects.

The large list of suggestions will be used over the next several years to enhance the visibility of the GLRC and to develop its outreach program.

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 4 GLRI proposals submitted in May 2012.

C2E2 Equipment grant
PI: Nancy Auer
CWS provided $1,000 of cost share towards the purchase of a modular aquaponic system

REF Equipment grant
PI: Noel Urban
CWS provided $2500 of cost share towards the purchase of sediment traps to be used on the Agassiz Research Vessel. These funds are currently encumbered on the CWS account, but will be used in FY 2012-13.

CWS REF equipment grant
PI: Noel Urban
CWS requested $50,000 but was granted $20,000.
The grant will purchase a carbon analyzer for water samples and 2 analytical balances. CWS has approved cost share of $6,955 to help cover this equipment purchase, which will be beneficial to Forestry, Chemistry and Environmental Engineering students and faculty, and will be installed in the Great Lakes Research Center. This purchase was approved in FY 2011-12, and will be funded in FY 2012-13.

3.6 Awards and Recognition for CWS Participants

Auer, Nancy A.
1st Place Coursework/Informational Poster (Class BL4465, *"Human Noise Pollution and its Impact on Marine Life"*) - World Water Day, Center for Water and Society, March 22, 2012.

Green, Sarah A.
Candler-Misener Award, International Association of Great Lakes Research, June 1, 2011.

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

Kerfoot, W. Charles
Recognition, Wikipedia The Free Encyclopedia 2006-20012, 2012.
The Chandler-Misener Award for Outstanding Article, International Association for Great Lakes Research, May 2011.

Waddell, R C.
Top 10% Teaching Evaluations, May 17, 2011.

Watkins, David W.
Outstanding Faculty Mentor, Michigan Tech Graduate Student Government, February 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.

- October 26-27, 2011: CWS director, Noel Urban, attended the *"2012 State of the Lakes Ecosystem Conference (SOLEC),"*Erie, Pennsylvania, sponsored by EPA and Environment Canada. SOLEC meetings are held every two years and represent a binational effort to protect the nearshore regions of the Great Lakes from human-induced stressors. It would be appropriate for CWS to send a representative regularly and to have factsheets/mini-posters on coastal sustainability work performed through the Center.

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 2011-12. New SFHI hires were Colleen Mouw (GMES), Jason Gulley (GMES), Nancy Langston (SS), and Emma Norman (SS).

4 CWS Budget

CWS Institute O/H Inventive Account

Beginning Balance July 1, 2011 ..... **$22,326.73**

Research Incentive Transfer In **$34,032.15**

Expenditures **$30,087.66**

- CWS Sponsored Seminars $1,098.42
- Student Research & Travel Grants $7,750.95
- Student Research Poster & Art Competition Awards $1,100.00
- Center Supplies $1,420.00
- Administrative Assistant $8,998.35
- Travel $679.80
- Outreach $6,374.05
- Center Functions $416.67
- Project Support $2,249.42

Balance as of June 30, 2012 ..... **$26,271.22**

5 Research

5.1 New Awards 2011-12

New Research Funding 2010-12: $ 540,823 ($567,777)

1. 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 (9/1/2011-8/31/2013)

2. SustR: Sustainable Development for Rural Communities: Social, Health, Economic, and Environmental Advances
   PI: Mayer, Alex (CEE)
   US Dept of Education
   080423P4: $50,000 (9/1/2011-8/31/2013)

3. 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)

4. Lake Superior Stewardship Initiative
   PI: Joan Chadde (CEE)
   Copper Country Intermediate School District (CCISD)
   1107038P1: $68,000 (8/1/2011-3/31/2013)

5. CI-TEAM Demo: Environmental CyberCitizens: Engaging Citizen Scientists in Global Environmental Change through Crowdsensing and Visualization
   PI: Mayer, Alex (CEE)
   National Science Foundation
   1103036P4: $20,000 (4/15/2012-8/31/2013)

6. Inventory of Mining Impacted Streams in the Coastal Zone of the Keweenaw
   PI: Urban, Noel (CEE)
   Michigan Dept of Environmental Quality
   1105024P1: $55,560 (1/1/2012-3/31/2013)

7. Integrated Assessment of Torch Lake AOC
   PI: Urban, Noel (CEE)
   UNIVERSITY OF MICHIGAN-MICH SEA GRANT
   1104023P1: $59,790 (2/1/2012-1/31/2014)

8. 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)
   National Science Foundation
   091213P3: $2,000 (9/15/2010-8/31/2013)

9. REF-IE: Building Infrastructure for Great Lakes Research
   PI: Noel Urban (CEE)
   Michigan Technological University
   1205011P1: $26,955 (7/1/2012–8/31/2013)

5.2 Active Research Projects Affiliated with CWS, 2011-12

Total Research Expenditures 2011-12: $1,969,711

1. **Collaborative Research: The carbon balance of Lake Superior: modeling lake processes and understanding impacts on the regional carbon budget**
   PI: Noel Urban
   Sponsor: NSF
   060332P1: $242,199 (8/1/2006-9/30/2011)

   The purpose of the North American Carbon Program (NACP) is to (1) to develop quantitative scientific knowledge, robust observations, and models to determine emissions and uptake of CO2, CH4, and CO1 changes in carbon stocks, and factors regulating these processes for North America and adjacent ocean basins; and (2) to develop the scientific basis for full carbon accounting on regional and continental scales. The Laurentian Great Lakes over 25% of the land area of the 8 Great Lakes states, and CO2 emission and seasonal cycling from them may be comparable to local terrestrial ecosystems. Although their contributions to the regional carbon balance may be significant, these fluxes are currently poorly understood. CO2 fluxes from Lake Superior are of particular interest because they may directly impact observations at nearby AmeriFlux towers.

   Motivated by the need for improved knowledge of Great Lake CO2 fluxes, we will couple an exosystem-carbon module to an existing hydrodynamic model of Lake Superior to estimate these fluxes and their spatial and temporal variability. We will also obtain new wintertime observations of carbon parameters in the lake to constrain this model. Using model output, we will evaluate the impact of Lake Superior CO2 fluxes on observations at AmeriFlux towers and on the regional carbon budget.

   Sampling of water intakes has clearly shown the annual cycle in pCO2, chlorophyll, and other analytes. Comparison of municipal water intakes with ship-based sampling has revealed that while comparable results were obtained at one intake location, a second location has yielded large differences. All biological parameters (bacterial counts, bacterial growth rates, carbon fixation rates) are markedly lower in the samples from the Ontonagon municipal water intake than in samples collected from a boat at the same location.

   Measurements of CO2 concentrations in air above the lake have been collected with an open-path IRGA mounted on the ferry to Isle Royale over the 100-km route across the open lake from the Keweenaw Peninsula to Isle Royale. While concentrations above the lake are higher than above land at the corresponding time, we do not yet know if this is just the result of the time lag as an air mass is advected across the lake. We anticipate being able to make eddy covariance measurements of CO2 fluxes on at least three occasions this year.

   Development of the lower-food web model is being conducted by Cory McDonald, the doctoral student on the program. Cory is using information theory to derive an optimized food web model with a minimum number of components. This modeling shows that while model fit to experimental data generally improves with increasing number of calibration or fitting parameters, the Akaike Index reaches a minimum in models with an intermediate number of fitting parameters. The ratio of number of measurements to number of fitting parameters determines the optimal complexity of the model. Results from this work have been presented at four international conferences, and the first manuscript will be submitted in August 2008 to Ecological Modeling.

2. **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 (9/1/2007-8/31/2012)

   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.

3. **Evaluating Riparian Timber Harvesting Guidelines: Phase 3, Result 2 Evaluate Aquatic Habitat Impacts**
PI: Casey Huckins
Sponsor: USDA Forest Service, Northern Research Station
070542P2: $71,193 (5/24/2007-?)

Our primary objective is to assess long-term effects of riparian harvest techniques on stream ecosystem function at the LCMR sites and Pokegema Creek sites. The following objectives are included into the study plan:

- Quantify available food resources for stream food webs (periphyton and detrital standing crops), and macroinvertebrate response (biomass of functional feeding groups and diets) in stream reaches subjected to various riparian harvest treatments.
- Evaluate breakdown rates of leaf litter and wood in streams under the different riparian treatments.

Results from this research will be used to validate or revise the State of Minnesota's riparian forest management guidelines and demonstrate the use of functional measures of ecological integrity for assessment of stream health.

4. **Graduate student scholarships to advance a global outlook of economic and social prosperity that protects the environment**
PI: Judith Perlinger
co-PIs: Veronica Griffis, James Mihelcic, Kurt Paterson, Qiong Zhang
Sponsor: NSF
071119P1: $599,979 (5/15/2008-5/31/2012)

Judith Perlinger, Veronica Griffis, James Mihelcic, Kurt Paterson, Jane Zhang of the Civil and Environmental Engineering's Michigan Tech Center for Water and Society have received an award in the amount of $599,978 from the National Science Foundation for a project titled Graduate Student Scholarships to Advance a Global Outlook of Economic and Social Prosperity that Protects the Environment. The project provides up to eighteen need-based scholarships annually to an integrated community of MS and PhD graduate students who are not only educated in the economic, social, and environmental pillars of sustainability but will also transfer research techniques and knowledge from their different graduate perspectives. This program partners with the U.S. Peace Corps incorporating 2+ years of overseas engineering service.

5. **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.

6. 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 series, 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.

7. 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.

8. **Monitoring Zebra Mussel Phosphorus Excretion**
PI: Marty Auer (CEE)
Michigan Dept of Environmental Quality
090254P1: $61,103 (9/1/2009 - 8/31/2011)

A) Statement of Water Quality Concern
Cladophora is a native, filamentous, green alga that grows attached to solid substrate in all of the Laurentian Great Lakes. Nuisance growth of Cladophora in the nearshore regions of Lakes Erie, Huron (Saginaw Bay) and Michigan have drawn the attention of those involved in public recreation, operation of utilities and water quality management. Public awareness of the problem has been heightened by reports in the popular press of beach fouling and the shutdown of nuclear power plants, concerns that incidences of avian botulism are linked to Cladophora and scientific studies linking Cladophora and human pathogens. This issue has recently been the focus of a bi-national working group supporting renewal of the Great Lakes Water Quality Agreement (GLWQA) and a eutrophication workshop sponsored by the International Joint Commission. Beyond its contribution to lost beneficial use, the issue is of particular significance to state regulatory authorities because the negative effects of the phenomenon are manifested in a manner and at locations that influence public perception of water quality.

It is well accepted that phosphorus, the growth-limiting nutrient, is the appropriate target for management of nuisance growth of Cladophora. Efforts to manage phosphorus loadings initiated in the J970s were effective in reducing nuisance growth. Colonization of the Great Lakes by dreissenids (zebra and quagga mussels) has markedly altered ecosystem dynamics with respect to Cladophora by increasing light penetration (yielding more substrate for colonization) and enhancing phosphorus cycling (making larger amounts of nutrients available). The resultant resurgence of Cladophora in the Great Lakes has become a top priority for environmental managers at levels ranging from the local communities impacted to bi-national policymakers. Reduction or elimination of nuisance growths will require further control of the amounts of phosphorus entering the nearshore waters of the Great Lakes.

The critical step in establishing target loads for phosphorus is to relate the magnitude of those loads to the amount of phosphorus ultimately available to Cladophora in its benthic habitat. It is here that the emerging role of dreissenids becomes significant as mussels process significant amounts of previously unavailable particulate (algal and soil) phosphorus, making that nutrient resource available to support Cladophora growth. The scientific basis for understanding this phenomenon is well established with respect to (J) the ability of dreissenids to generate a phosphorus flux to the water column and (2) the impact of water column phosphorus on Cladophora growth. It is the linkage between those scientific strengths that merits additional study, i.e. *taking into account the effects of turbulent mixing in the nearshore, what levels of phosphorus can be maintained in the water column?* We propose to provide that linkage by monitoring phosphorus concentrations in the water column above dreissenid beds in Saginaw Bay (Lake Huron), quantifying the ability of mussels to increase nutrient levels at locations colonized by Cladophora.

9. **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 - 8/31/2012)

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 ill 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.

10. **Bioavailability and Phosphorus Management for Onondaga Lake**
PI: Auer, Martin (CEE)
Upstate Freshwater Institute Inc
091243P1: $85,555 (1/1/2010 - 8/31/2011)

Background
Section 303 of the Clean Water Act Amendments of 1977 requires identification of waters remaining polluted after the application of technology-based effluent limitations and subsequent determination of the Total Maximum Daily Loads (TMDLs) necessary to meet receiving water quality standards. As the nutrient most generally limiting algal growth in freshwater systems, phosphorus is the appropriate target for development of TMDLs in lakes where water quality is impacted by trophic state conditions. In evaluating the phosphorus TMDL for Onondaga Lake (NY), Effler et al. (2002) described a total effective phosphorus loading rate, i.e. one which quantifies the fraction of the phosphorus load that is actually available to support algal growth. The calculation takes into account several factors ameliorating the loading impact on Onondaga Lake including plunging inflows, deposition of particulate phosphorus and the bioavailability of the dissolved and particulate phosphorus fractions. The authors concluded that the total effective phosphorus loading rate formed the appropriate basis for comparison of loading sources, especially with respect to their selection as targets for remediation activities.

The conclusions of Effler et al. (2002) are supported by the results of studies conducted on tributaries to the New York City drinking water supply system (Needham 2000) where the bioavailability of particulate phosphorus ranged from 14% (Schoharie Creek) to nearly 50% (West Branch of the Delaware River). Similarly dramatic results were obtained for tributary and point source discharges to Onondaga Lake. Not only was there evidence of enrichment in phosphorus bioavailability among inputs (Figure 1; Tomasoski 1997), but significant temporal variation in tributary phosphorus bioavailability was noted as well (Figure 2; Nover 2004). More recently, Effler et al. (2008) have demonstrated that accounting for bioavailability effects can change the ratio of the METRO: Tributary phosphorus load from 31%:69% to 57%:43%, a near doubling in the relative METRO contribution. For this reason, it is prudent to more carefully establish the total effective phosphorus loads for METRO and other sources as a prelude to consideration of further phosphorus management options.

Proposed Research
Here we propose to conduct -50 phosphorus bioavailability assays on selected tributaries and point source inputs to Onondaga Lake in support of the calculation of total effective phosphorus loads. Inputs to be assayed and the proposed frequency of sampling are identified in Table 1. Samples will be collected by Upstate Freshwater Institute and processed to yield a bioassay concentrate using tangential flow filtration. Samples will be shipped to Michigan Technological University where the assays will be performed using the Dual Culture Diffusion Apparatus (DCDA) method developed by DePinto (1982). This approach has been applied to municipal wastewater treatment effluents by Young et al. (1982), to tributaries to Great lakes waters by DePinto et al. (1981) and Young et al. (1985) and as described above to selected waters in New York. The DCDA (Figure 3) consists of a dark chamber containing the bioassay concentrate and a light chamber containing a population of phosphorus starved algae. The chambers are separated by an opaque 0.45 µm filter. Bioavailable particulate phosphorus from the concentrate held in the dark chamber is solubilized and diffuses into the light chamber where it is taken up by the algae. The algae are periodically removed from the light chamber, assayed for their phosphorus content and replaced by fresh, phosphorus-starved algae. The quantity of bioavailable phosphorus produced is reflected in the change in the phosphorus content of the algae. The cumulative production of phosphorus over the course of the incubation represents the bioavailable phosphorus content of the sample and is expressed as a percentage of the initial total phosphorus (Figure 4).
(References and Figures available upon request to mtcws@mtu.edu)

11. **WSC-Category 1: Humans, Hydrology, Climate Change, and Ecosystems-An Integrated Analysis of Water Resources and Ecosytem 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 ofthe 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 planed 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.

12. **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 (9/15/2010-8/31/2013)

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.

13. **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 - 4/30/2013)

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.

14. **Erosion Reduction by Air Entrainment, Phase IV**
PI: Brian Barkdoll
Sponsor: S. Florida Water Management District
080217P5: $27,999 (10/1/2010-9/30/2011)

Excessive scour of sediment can be a problem at hydraulic structures if the scour depth is such that it undermines the structure's foundation, which can lead to sliding, tilting, and potentially to the collapse of the structure. Scour is induced by flowing water in the various modes of sediment rolling, saltation, or entrainment into the flow as suspended load. Moreover, drought conditions followed by a large storm may result in excessive scour due to the low-flow depth protecting the sediment from scour downstream of hydraulic structures. Under such conditions the flow sediment carrying capacity can be exacerbated by the type and length of the hydraulic jump at the terminal structure, which will, in turn, scour large holes in the channel bed downstream of the terminal structure.

The SFWMD has numerous gated control structures in which there is not only flowing water but plunging water as well. The primary objective of Phase 2 of this project is identify the relationship between hydraulic flow and downstream erosion scour, with the goal of reducing scour at actual District structures. The investigation is to be performed on a reduced-scale model flume of a District gate that has been previously constructed in order to evaluate opportunities to reduce the formation of down-stream scour holes. The use of an air-curtain to disrupt the hydraulic flow has been shown to mitigate the effect of scour erosion. This effort is intended to learn more about the effect of placement of the air curtain, the effect of the air flow volume on scour, and the impact on conveyance capacity when an air curtain is activated. Based on the insight gained from these laboratory investigations, an investigation intended to identify a suitable filed structure for performing future investigations will be performed. Actual field testing is not covered under this SOW.

15. **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.

16. 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, (2/3/2011-8/1/2013)

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.

17. **Acoustic Measurement of Pipe Discharge Downstream of 90-degree Bend**
PI: Barkdoll, Brian (CEE)
South Florida Water Management District
1103051P1: $49,203 (3/24/2011-9/30/2011)

The Hydro Data Management (HDM) Division of the South Florida Water Management District (SFWMD) is responsible for developing equations and computing flows within the District's approximately 1,800 miles of canals and levees, 135 gated spillways, 400 culverts, and 60 pump stations. These data sets are used for many District activities including water quality analyses, flood control analyses, assessment of ecological restoration efforts, water supply analyses, regulation and permitting, and design of new water control structures.

Flows through these structures are obtained with equations that establish the relationship between the flow through the structure, the structure's geometry and operating conditions, and the water stages upstream and downstream of the structure. The development of these equations involves the use of known hydraulic and fluid mechanics principles, manufacturer's pump rating curves, and curve-fitting using in-situ flow measurements.

To improve the accuracy of the flow estimates at a specific structure, the equations are revised through a rating calibration, for which direct flow measurements from stream-gauging are required. A variety of instruments are used for stream-gauging, which are based on different operating principles that stem from various physical, optical, acoustical, and mechanical characteristics. Typical instruments used at the District for stream-gauging include current meters and acoustic Doppler current profilers (ADCPs).

Difficulties exist in measuring discharge at pumping stations since pump performance curves are not always available or may not be accurate. To improve upon the accuracy of vendor-provided pump performance curves, a method of measuring discharge in the pump discharge pipe is desirable. Commercially-available discharge meters assume a velocity profile in the pipe corresponding to that in a straight section of pipe in which the flow is

fully developed. This requires a location along the pipe a long distance downstream from any change in flow direction (i.e., pipe bend). In the District pump stations, however, pipe bends are located closely together and, therefore, do not allow for the application of such meters in full compliance with vendor specifications.

Professor Roger Turpening (Michigan Technological University), has successfully captured profiles with circular cross sections using acoustic-based measurement methods. While Professor Turpening's work has focused primarily in the field of the Geophysical Engineering, it is expected that the methods and algorithms are closely related to the needs of the District to measure turbulent water flow in a circular pipe downstream of a 90^{o} bend. For the purpose of this investigation, Professor Turpening will work closely with Professor Brian Barkdoll (MTU) to demonstrate the ability to accurately capture the velocity field in a pipe downstream of a 90^{o} bend using an existing flume in Professor Barkdoll's laboratory.

The objective of this project is to refine existing acoustic technology to generate fluid -flow profiles with circular, turbulent cross-sections downstream of a 90-degree bend.

18. **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.

19. **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.

20. **Great Lakes Maritime Education for K-12 Teachers**
PI: Chadde, Joan (CEE)
University of Wisconsin - Superior
100611P2: $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).

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21. **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.

22. **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 (9/1/2011-8/31/2013)

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.

23. **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.

24. **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) Placed-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.

25. **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

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, co=unity 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.

26. **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

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).

27. **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.

5.3 Proposals Submitted under CWS, 2011-12

1. REU Supplement: 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: Mayer, Alex (CEE)
   co-PIs: MacLennan, Carol (SS), Orr, Blair (SFRES)
   National Science Foundation
   070215P2: $8,000, Awarded

2. Erosion Reduction by Air Entrainment, Phase V
   PI: Barkdoll, Brian (CEE)
   South Florida Water Management District
   080217P6: $48,000

3. SustR: Sustainable Development for Rural Communities: Social, Health, Economic, and Environmental Advances
   PI: Mayer, Alex (CEE)
   US Dept of Education
   080423P4: $50,000, Awarded

4. 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-PI: Halvorsen, Kathleen (SFRES\SS)
   National Science Foundation
   091213P3: $2,000, Awarded

5. CI-TEAM Demo: Environmental CyberCitizens: Engaging Citizen Scientists in Global Environmental Change through Crowdsensing and Visualization
   PI: Mayer, Alex (CEE)
   National Science Foundation
   1103036P3: $74,728

6. CI-TEAM Demo: Environmental CyberCitizens: Engaging Citizen Scientists in Global Environmental Change through Crowdsensing and Visualization
   PI: Mayer, Alex (CEE)
   National Science Foundation
   1103036P4: $20,000, Awarded

7. Acoustic Measurement of Pipe Discharge Downstream of 90 Degree Bend, Phase 2
   PI: Barkdoll, Brian (CEE)
   South Florida Water Management District
   1103051P2: $50,001

8. Changes in Ecosystem Function Associated with Sand Accumulation in a Lake Superior Tributary
   PI: Marcarelli, Amy (BIO)
   co-PI: Huckins, Casey (BIO)
   US Dept of Agriculture
   1106039P2: $35,633, Awarded

9. Lake Superior Stewardship Initiative
   PI: Chadde, Joan (CEE)
   Copper Country Intermediate School District (CCISD)
   1107038P1: $68,000, Awarded

10. Integrated Seasonal Drought Forecast-Decision Support System for the Highland Lakes System in Central Texas
    PI: Watkins, David (CEE)
    co-PI: Brooks, Colin (MTRI)
    National Aeronautics Space Administration

1109082P1: $197,693

11. Value of Great Lakes Water Phase ll: Testing an Integrated Water Resource Management Approach to Urban Water Management
    PI: Watkins, David (CEE)
    co-PI: Mayer, Alex (CEE)
    Great Lakes Commission
    1109084PP: $209,324

12. Collaborative Research WSC Category 2: Mulitdisciplanary Analysis of Drought Effects on California: Water Sustainability and Climate (MADE-Cal WSC)
    PI: Muralidharan, Daya (SBE)
    co-PIs: Breffle, William (SBE), Halvorsen, Kathleen (SFRES\SS), Urban, Noel (CEE)
    National Science Foundation
    1110066P1: $241,806

13. WSC Category 2 Collaborative: People, Water, and Climate: Predicting Change, Response, and Adaptation in Socio-Ecological Systems
    PI: Mayer, Alex (CEE)
    National Science Foundation
    1110088P1: $1,951,375

14. 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: $459,571

15. CNH: Managing Impacts of Global Transport of Atmosphere-surface Exchangeable Pollutants in the Context of Global Change
    PI: Perlinger, Judith (CEE)
    National Science Foundation
    1111028P1: $1,499,741

16. The Wall of Green and End Game Management in the Great Lakes Region
    PI: Auer, Martin (CEE)
    co-PIs: Brooks, Colin (MTRI), Shuchman, Robert (MTRI), Urban, Noel (CEE), Watkins, David (CEE)
    National Science Foundation
    1204032P1: $187,978

17. REF-IE: Building Infrastructure for Great Lakes Research
    PI: Urban, Noel (CEE)
    co-PIs: Auer, Martin (CEE), Green, Sarah (CH), Kerfoot, W Charles (BIO)
    Michigan Technological University
    1205011P1: 26,955, Awarded

18. Phytoplankton Size Structure from Airbourne and Satellite Remote Sensing in the Gulf of Mexico Before, During and After the 2010 Deepwater Horizon Oil Spill
    PI: Mouw, Colleen (GMES)
    Columbia University
    1205044P1: $188,138

19. Interpreting Ecological Variability using Remotely Observed Optical Properties and Ocean Models
    PI: Mouw, Colleen (GMES)
    Massachusetts Institute of Technology
    1205053P1: $213,364

20. Establishing Phosphorus Standards for Cladophora Management
    PI: Auer, Martin (CEE)
    University at Buffalo
    1205060P1: $275,888

21. Bioavailability-Based Management of Nonpoint Phosphorus Loads
    PI: Auer, Martin (CEE)
    co-PI: Watkins, David (CEE)
    US Environmental Protection Agency
    1205061P1: $374,515

22. Long-term Monitoring of the Sand Point Brownfield Site
    PI: Datta, Rupali (BIO)
    co-PI: Mayer, Alex (CEE)
    US Environmental Protection Agency
    1205073P1: $285,258

23. Implementation of Green BMP's in Maumee River Watershed
    PI: Datta, Rupali (BIO)
    co-PIs: Auer, Martin (CEE), Urban, Noel (CEE)
    US Environmental Protection Agency
    1205074P1: $609,994

24. 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)
    National Science Foundation
    1206001P1: $275,172

25. Regional Frequency Analysis of Hydrologic Extremes Informed by Climate and Land Surface Data
    PI: Griffis, Veronica (CEE)
    co-PIs: Brooks, Colin (MTRI), Watkins, David (CEE)
    National Science Foundation
    1206004P1: $360,858

6 Publications by CWS Participants, 2011-12

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.

6.1 Publications (Published or Accepted)

6.1.1 Book

1. 2012, "*The Great Lake Sturgeon*", editors: **Auer, N**., Dempsey, D., MSU press, Lansing, MI, *Accepted.*

2. 2011, "*Sediment Dynamics upon Dam Removal*", Edited by Athanasios (Thanos) N. Papanicolaou, Ph.D.; **Brian D. Barkdoll, Ph.D., P.E.**, Manuals of Practice (MOP) 122, American society of Civil Engineers (ASCE), Reston, VA, 192 pp. *Published.*

3. 2011, NRC-NAS Committee on Economic and Environmental Impacts of Increasing Biofuels Production: (Lave, L.B. (chair), I.C. Burke (co-chair), W.E. Tyner (co-chair), V.H. Dale, **K.E. Halvorsen**, J.D. Hill, S.R. Kaffka, K.C. Klasing, S.J. McGovern, J.A. Miranowski, A. Patrinos, J.L. Schnoor, D.R. Schweikhardt, T.L. Selfa, B.L. Sohngen, and J.A. Soria). "*Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy*". Washington, DC: The National Academies Press. *Published.*

4. **MacLennan, Carol A.**, 2011, "Sovereign Sugar: Industry and Environment in Hawai'i", University of Hawai`i Press, Honolulu, Hawai`i, *Accepted.*

6.1.2 Book, Chapter in

5. **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.*

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.*

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.*

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.*

9. **Chimner, Rodney A.,** Cooper, D J., 2011, "Fens of the San Juan Mountains", editors: Blair, R. and Bracksieck, G., *Eastern San Juan Mountains, Colorado: Geology, Ecology and Human History*, University Press of Colorado, Boulder, CO. *Published.*

10. Cooper, D J**., Chimner, Rodney A.,** Merritt, D M., 2011, "Mountain Wetlands of North America", editors**:** Batzer, D. and Baldwin, A., *Wetland Habitats of North America: Ecology and Conservation Concerns*, University of California Press, Berkeley, CA. *Published.*

11. **Gorman, Hugh S.,** 2011, "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.*

12. **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.*

13. **Pypker, 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.*

14. Scott, J. T**., Marcarelli, Amy M.,** 2012, "Cyanobacteria in freshwater benthic environments", editors: Whitton, B., *The Ecology of Cyanobacteria*, 2nd edition, Springer, Dordrecht, *Published.*

6.1.3 Journal Article

15. Andra, Syam, Saminathan, Sumathi, Sarkar, Dibyendu, **Datta, Rupali**, 2011, "Exchangeable lead from prediction models relates to vetiver lead in different soil types", J Env. Monit. Assess., Springer, Vol. 175, 661-667, *Published.*

16. 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, *Accepted.*

17. **Breffle, William S.**, Morey, E. R., Thacher, J., 2011, "A joint latent-class model: combining Likert-scale preference statements with choice data to harvest preference heterogeneity", Environmental and Resource Economics, Vol. 50, 83-110, *Published.*

18. **Bruning, Jill, Gierke, John S., Maclean, Ann L.**, 2011, "An Approach to Lineament Analysis for Groundwater Exploration in Nicaragua", Photogrammetric Engineering & Remote Sensing, American Society for Photogammetry and Remote Sensing, Bethesda, MD, Vol. 77, No. No 5, pp. 509-519, ISBN/ISSN 0099-1112/11/7705-0509, *Published.*

19. 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, *Published.*

20. Chou, Chiung-Wen, **Seagren, Eric A.**, Aydilek, Ahmet H., Lai, Michael, 2011, "Biocalcification of sand through ureolysis", Journal of Geotechnical and Geoenvironmental Engineering (ASCE), American Society of Civil Engineers, Reston, VA, *Published.*

21. Cooke, Colin A., Balcom, Prentiss H., **Kerfoot, W. Charles**, Abbott, Mark B., Wolfe, Alexander P., 2011, "Pre-Columbian Mercury Pollution with the Smelting of Argentiferous Ores in the Bolivian Andes", AMBIO, Vol. 40, 18-25, *Published.*

22. **Datta, Rupali**, Das, Padmini, Smith, Stephanie, Punamiya, Pravin, Ramanathan, Dil, Reddy, Ramana, Sarkar, Dibyendu, 2012, "PHYTOREMEDIATION POTENTIAL OF VETIVER GRASS [CHRYSOPOGON ZIZANIOIDES (L.)] FOR TETRACYCLINE", International J. Phytoremediation, Elsevier, *Accepted.*

23. 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, *Accepted.*

24. Donofrio, Robert, Saha, Ratul, Besterveldt, Lori, **Bagley, Susan T.**, 2012, "Molecular cloning of Brevundimonas diminuta for efficacy asessment of reverse osmosis devices", Journal of Water and Health, Vol. 10, No. 2, 278-287, *Published.*

25. 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, *Accepted.*

26. **Gyawali, Rabi, Watkins, David W.**, 2012, "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, *Accepted.*

27. Hallack-Alegria, Michelle, Ramirez, Jorge, **Watkins, David W.,** 2011, "ENSO-Conditioned Rainfall Drought Frequency Analysis in Northwest Baja California, Mexico", International Journal of Climatology, Volume 32, Issue 6, Pages: 831–842. *Published.*

28. **Harless, M L., Huckins, Casey J.**, Grant, J B., **Pypker, Thomas G.**, 2011, "Effects of six chemical deicers on larval wood frogs", Environmental Toxicity and Chemistry, *Published.*

29. 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.*

30. 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.*

31. **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.*

32. **Kerfoot, W. Charles, Yousef, Foad, Hobmeier, Martin M.**, Maki, Ryan P., Jarnagin, S T., Churchill, James H., 2011, "Temperature, Recreational Fishing and Diapause Egg Connections: Dispersal of Spiny Water Fleas (Bythotrephes longimanus)", Biological Invasions, Biological Invasions, No. 13, 2513-2531 doi 10.1007/s10530-011-0078-8, *Published.*

33. **Marcarelli, Amy M.**, Baxter, Colden V., Mineau, Madeleine M., Hall, Robert O., 2011, "Quantity and quality: unifying food web and ecosystem perspectives on the role of resource subsidies in freshwaters", Ecology, Vol. 92, No. 6, 1215-1225, *Published.*

34. **McDonald, Cory P.**, Bennington, Val, **Urban, Noel R.**, McKinley, Galen A., 2012, "1-D test-bed calibration of a 3-D Lake Superior biogeochemical model", Ecological Modeling, Elsevier, Vol. 225, No. 1, 115-126, *Published.*

35. Mellor, Jonathon, **Watkins, David W.**, Mihelcic, James, 2012, "Rural Water Usage in East Africa: Does Collection Effort Really Impact Basic Access", Waterlines, *Accepted.*

36. Mineau, Madeleine M., Baxter, Colden V., **Marcarelli, Amy M.**, Minshall, G W., 2012, "An invasive riparian tree reduces stream ecosystem efficiency via a recalcitrant organic matter subsidy", Ecology, Vol. Online early, *Published.*

37. **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, *Accepted.*

38. 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, *Accepted.*

39. Packalen, Maara, **Bagley, Susan T**., McLaughliln, James, 2011, "Peatland stream lipid biogeochemistry features in an intermediate fen peatland, Ontario, Canada", Wetlands, Canada, Vol. 31, No. 2, 353-365, *Published.*

40. Quazi, Shahida, Sarkar, Dibyendu, **Datta, Rupali**, 2011, "Changes in arsenic fractionation, bioaccessibility and speciation in organo-arsenical pesticide amended soils as a function of soil aging", Chemosphere, Elsevier, Vol. 84, No. 11, 1563-1571, *Published.*

41. Ray, Patrick A., Kirshen, Paul K**., Watkins, David W.**, 2011, "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, *Accepted.*

42. **Robles Morua, Agustin, Halvorsen, Kathleen E., Mayer, Alex S.,** 2011, "Waterborne disease-related risk perceptions in the Sonora River Basin, Mexico", Risk Analysis, Vol. 31, Issue 5, Pages: 866–878. *Published.*

43. **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, *Accepted.*

44. Saha, Ratul, Donofrio, Robert, **Bagley, Susan T**., 2011, "Quantitative real-time PCR detection of P. oleovorans subsp. lubricantis using TaqMan-MGB assay in contaminated metalworking fluids", International Biodeterioration and Biodegradation, Great Britain, Vol. 65, No. 3, 460-464, *Published.*

45. **Seagren, Eric A.**, Davis, Allen P., 2011, "Integrating fundamental science and engineering concepts into a civil engineering sustainability course", Journal of Professional Issues in Engineering Education and Practice (ASCE), American Society of Civil Engineers, Reston, VA, Vol. 137, No. 4, 183-188, *Published.*

46. **Seely, Bruce E.**, 2012, ""Pan American Highway: Roads and Politics"", Routes-Roads, France, *Accepted.*

47. **Seely, Bruce E.**, 2011, ""Der Pan American Highway – eine Straße zwischen zwei Kontinenten,"", Zeitschrift für Weltgeschichte, Germany, Vol. 12.2, 141-73, *Published.*

48. **Seely, Bruce E.**, 2011, "Expertise, Politics and Highways in the U.S., 1960-2000", Routes-Roads, Paris, France, *Published.*

49. **Wei, Wenge, Watkins, David W.**, 2011, "Probabilistic Streamflow Forecasts Based on Hydrologic Persistence and", Journal of Hydroinformatics, IWA Publishing, Vol. 13, No. 4, *Published.*

50. **Wei, Wenge, Watkins, David W.,** 2011, "Data Mining Methods for Hydroclimatic Forecasting", Advances in Water Resources, Vol. 34, 1390-1400, *Published.*

51. 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, *Accepted.*

52. Zhang, Lan, **Seagren, Eric A.**, Davis, Allen P., Karns, Jeffrey S., 2011, "Long-term sustainability of Escherichia coli removal in conventional bioretention Media", Journal of Environmental Engineering (ASCE), American Society of Civil Engineers, Reston, VA, Vol. 137, No. 8, pp. 669-677. *Published.*

6.1.4 Review

53. **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

54. **Barkdoll, Brian**, 2012, "Scour-inducing stilling basin flow patterns", World Environmental and Water Resources Congress 2011: Bearing Knowledge for Sustainability, American Society of Civil Engineers, p 2545-2551, *Published.*

55. **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, ASCE, Reston, Virginia, *Accepted.*

6.2 Published Papers Not Listed Above

1. Attinti, Ramesh, Sarkar, Dibyendu, **Datta, Rupali**, 2012, "Ethylenediaminedisuccinic Acid (EDDS) Enhances Phytoextraction of Lead by Veviver Grass From Paint Contaminated Residential Soils: A Field Study", Am. Soc. Agronomy/soil Sci. Soc. Am abstracts, *Accepted.*

2. Attinti, Ramesh, Sarkar, Dibyendu, Roychowdhary, Abhishek, **Datta, Rupali**, 2012, "Increase in plant-available lead in paint contaminated residential soils using a biodegradable chelating agent", Hudon-Delaware SETAC Annual Meeting Abstracts with Program, *Published.*

3. **Auer, Nancy A., Auer, Martin T**., 2012, "Semi-Annual report EPA - GLRI", Predicting Ecosystem Change Lake Superior, *Accepted.*

4. **Auer, Nancy A., Auer, Martin T.**, 2011, "Semi-annual progress report, USEPA", Predicting Ecosystem change in Lake Superior, *Published.*

5. Das, Padmini, Sarkar, Dibyendu, **Datta, Rupali**, 2012, "A Chemically-Catalyzed Phytoremediation Model for TNT-contaminated Soils", Hudson-Delaware Soc. of Toxicol. & Chem. Abstracts with Program, *Published.*

6. 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.*

7. **Datta, Rupali**, Sarkar, Dibyendu, 2012, "The Legacy of War: Using Plants to remove Lead, TNT and RDX from Soil", Hudson-Delaware SETAC Annual Meeting Abstracts with Program, *Published.*

8. **Fritsch, Casey E., Griffis, Veronica W.**, 2011, "Climate informed flood risk projections", American Geophysical Union (AGU) Fall Meeting, American Geophysical Union, *Published.*

9. **Fritsch, Casey E., Griffis, Veronica W**., 2011, "Evaluation of flood risk under climate variability using continuous hydrologic modeling", Proceedings World Water & Environmental Resources Congress 2011, ASCE, Reston, Virginia, *Published.*

10. **Green, Sarah A.**, 2012, "We've been through climate changes before", editors: Romm, J., Climate Progress, repost from skeptical science.com, *Published.*

11. **Green, Sarah A.**, 2012, "We've been through climate changes before", editors: Cook, J., skepticalscience.com, Skeptical Science, *Published.*

12. **Green, Sarah A.**, 2011, "CO2 is just a trace gas", editors: Romm, J., Climate Progress, repost from skepticalscience.com, *Published.*

13. **Green, Sarah A.**, 2011, "CO2 is just a trace gas", editors: Cook, J., http://skepticalscience.com/, *Published.*

14. **Green, Sarah A.**, 2011, "Christy Crock #7: Expensive and inaccessible (Part 2)", editors: Cook, J., http://skepticalscience.com/, *Published.*

15. **Green, Sarah A.**, 2011, "Christy Crock #7: People Need Fossil Fuel Energy (Part 1)", editors: Cook, J., http://skepticalscience.com/, *Published.*

16. 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.*

17. Punamiya, Pravin, Sarkar, Dibyendu, **Datta, Rupali**, 2012, "Drinking water treatment residuals as a "green" sorbent for veterinary antibiotics:", Hudson-Delaware SETAC Annual Meeting Abstracts with Program, *Published.*

18. 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.*

19. Rakshit, Sudipta, Sarkar, Dibyendu, **Datta, Rupali**, 2012, "Antibiotics removal by iron oxide nanoparticles", Hudson-Delaware SETAC Annual Abstracts with Program, *Published.*

20. 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.*

21. 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, *Accepted.*

22. **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.*

23. **Watkins, David W., Griffis, Veronica W.**, Faber, Beth, 2011, "Systems approaches to flood risk management modeling: barriers and directions for research", Proceedings World Water & Environmental Resources Congress 2011, ASCE, Reston, Virginia, *Published.*

6.3 Presentations

1. **Auer, Nancy A**., **Holtgren, John Marty**, 2011, “Collaborative Fisheries Management opportunities between tribal and state agencies.”, 141st American Fisheries Society, American Fisheries Society, Seattle, WA, September 4, 2011 - September 8, 2011.

2. **Ballard, Meredith**, Dale, Robertson, **Mayer, Alex S.**, 2011, Forecasting Future Phosphorus Loading in the Great Lakes Region from Changing Land-Derived Nutrient Inputs, International Assocation of Great Lakes Research, International Assocation of Great Lakes Research, Duluth, MN, May 29, 2011 - June 2, 2011.

3. Bourgeau-Chavez, L., K. Scarbrough, M.E. Miller, Z. Laubach, S. Endres, E. Banda, M. Battaglia, A. Landon, **L. Jenkins**, R. Powell, **C. Brooks**. (2012). Mapping Coastal Great Lakes Wetlands and Adjacent Land use Through Hybrid Optical-Infrared and Radar Image Classification Techniques. Presented at Intecol 9th International Wetlands Conference, Orlando, FL.

4. **Brooks, C.**, Sayers, M., **Kerfoot, W.C., Shuchman, R., Green, S.** Sabol, B., **Jessee, N., Yousef, F.**, Endsley, K.A. (2011). "Assessing impacts from historical copper mining stamp sands in the Keweenaw Peninsula through analysis of LiDAR and multispectral imagery from the US Army Corps of Engineers." Presented at the 54th International Conference on Great Lakes Research, IAGLR, Duluth, WI.

5. **Brooks, C., Kerfoot, W.C.**, Sabol, B., **Shuchman, R., Yousef, F.**, Sayers, M., **Jessee, N.**, Endsley, K.A., **Green, S.** (2011). "An update on applications of CHARTS data to characterizing the impacts of mining stamp sands in Michigan's Keweenaw Peninsula." Presented to the 12th JALBTCX Airborne Coastal Mapping and Charting Technical Workshop, June 22nd, 2011, Baltimore, MD.

6. **Brooks, C.**, Sayers, M., **Kerfoot, W.C., Shuchman, R., Green, S.**, Sabol, B., **Jessee, N., Yousef, F.**, Endsley, K.A. (2011). "Applications of the US Army Corps of Engineers CHARTS LiDAR and Multispectral Coastal Mapping System to Analyze the Impacts and Trends of Historical Copper Mining Stamp Sand in Michigan's Keweenaw Peninsula." Presentation to the NOAA Coastal Zone 2011 Conference, Chicago, IL.

7. **Brooks, C., Shuchman, R.**, Sayers, M., **Auer, M.**, Meadows, G., Dayton, A. (2011). "Mapping and Monitoring the Extent of Cladophora Algae in the Great Lakes using Multi-Resolution, Multi-temporal Satellite Imagery." Presented at the ASPRS 2011 Annual Conference, Milwaukee, WI.

8. **Brooks, C., Shuchman, R.**,Sabol, B., **Kerfoot, W.C., Green, S.**, Sayers, M., **Yousef, F.**, Endsley, K.A., **Jessee, N.**, Andersen, J. (2011). "Analyzing the impacts and trends of historical copper mining stamp sands in Michigan’s Keweenaw Peninsula using the US Army Corps of Engineer’s CHARTS

LiDAR and multispectral coastal mapping system." Presented at the ASPRS 2011 Annual Conference, Milwaukee, WI.

9. **Coble, Ashley A., Marcarelli, Amy M., Kane, Evan S.**, 2012, Nutrient spiraling and export responses to seasonal changes in a 1st-order tributary of Lake Superior, ESC/BRC Student Research Forum, Ecosystem Science Center/Biotechnology Research Center, Houghton, MI.

10. **Coble, Ashley A., Marcarelli, Amy M., Kane, Evan S.**, 2012, Nutrient spiraling and export responses to seasonal changes in a 1st-order tributary of Lake Superior, World Water Day Poster Competition, Center for Water and Society, Houghton, MI.

11. Collins, Scott F., Baxter, Colden V., **Marcarelli, Amy M.**, 2012, A critical assessment of the ecological assumptions underpinning compensatory mitigation of salmon derived nutrients, Annual meeting, Idaho Chapter of the American Fisheries Society, Coeur d'Alene, Idaho, March 7, 2012 - March 9, 2012.

12. Collins, Scott F., Baxter, Colden V., **Marcarelli, Amy M.**, Wipfli, Mark S., 2011, Effects of Salmon Carcass and Analog Additions on Resident Trout in Idaho, Annual Meeting, American Fisheries Society, Seattle, WA.

13. Collins, Scott F., Baxter, Colden V., **Marcarelli, Amy M.**, Wipfli, Mark S., 2011, Effects of salmon carcass and analog additions on resident trout in Idaho, Annual meeting, North American Benthological Society, Providence, RI, May 2011.

14. **Datta, Rupali**, Attinti, Ramesh, Roychowdhary, Abhishek, Sarkar, Dibyendu, 2012, Increase in plant-available lead in paint contaminated residential soils using a biodegradable chelating agent, Hudson-Delaware SETAC Annual Meeting, SETAC, Montclair, NJ, April 26, 2012 - April 27, 2012.

15. **Datta, Rupali**, Das, Padmini, Sarkar, Dibyendu, 2012, A Chemically-Catalyzed Phytoremediation Model for TNT-contaminated Soils, Hudson-Delaware SETAC Annual Meeting, SETAC, Montclair, NJ, April 26, 2012 - April 27, 2012.

16. **Datta, Rupali**, Punamiya, Pravin, Sarkar, Dibyendu, 2011, 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, 2011 - October 12, 2011.

17. **Datta, Rupali**, Punamiya, Pravin, Sarkar, Dibyendu, 2012, Drinking water treatment residuals as a "green" sorbent for veterinary antibiotics:, Hudson-Delaware SETAC Annual Meeting, SETAC, Montclair, NJ, April 26, 2012 - April 27, 2012.

18. **Datta, Rupali**, Rakshit, Sudipta, Sarkar, Dibyendu, 2012, Antibiotics removal by iron oxide nanoparticles, Hudson-SETAC Annual Meeting, SETAC, Montclair, NJ, April 26, 2012 - April 27, 2012.

19. **Datta, Rupali**, Rakshit, Sudipta, Sarkar, Dibyendu, Elzinga, Evert, Punamiya, Pravin, 2011, CIPROFLOXACIN ADSORPTION ON MAGNETITE-WATER INTERFACE, Geological Society of America Annual Meeting, Geological Society of America, Minneapolis, MN, October 9, 2011 - October 12, 2011.

20. **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.

21. **Datta, Rupali**, Sarkar, Dibyendu, Das, Padmini, Punamiya, Pravin, 2011, PHYTOREMEDIATION POTENTIAL OF VETIVER GRASS (CHRYSOPOGON ZIZANIOIDES L.) FOR 2,4,6-TRINITROTOLUENE (TNT) FROM SOIL: UREA-CATALYZED UPTAKE AND NITROREDUCTASE

ENZYME MEDIATED TRANSFORMATION, Geological Society of America Annual Meeting, Geological Society of America, Minneapolis, MN, October 9, 2011 - October 12, 2011.

22. **Ebel, Jonathan D., Marcarelli, Amy M.**, Kohler, Andre, 2012, Biofilm response to nutrient mitigation using salmon carcass analog in Central Idaho Streams, ESC/BRC Student Research Forum, Ecosystem Science Center/Biotechnology Research Center, Houghton, MI.

23. **Ebel, Jonathan D., Marcarelli, Amy M.**, Kohler, Andre, 2012, Biofilm response to nutrient mitigation using salmon carcass analog in Central Idaho Streams, World Water Day Poster Competition, Center for Water and Society, Houghton, MI.

24. **Ebel, Jonathan D., Marcarelli, Amy M.**, Kohler, Andre, 2012, Biofilm response to nutrient mitigation using salmon carcass analog in Central Idaho Streams, Graduate Research Colloquium, Graduate Student Government of Michigan Technological University, Houghton, MI.

25. Eggert, Sue L., **Marcarelli, Amy M., Huckins, Casey J.**, King, Nicole, **Ebel, Jonathan D., Matthys, Anthony D.**, Kolka, Randy K., 2012, Effects of sand accumulation on food webs of a coaster brook trout tributary to Lake Superior, Forestry, Wildlife and Natural Resource Research Review, Cloquet, MN.

26. Eggert, Sue, **Huckins, Casey J., Marcarelli, Amy M.**, 2011, Effects of sand accumulation on invertebrate communities of the Salmon Trout River, Michigan, Annual meeting, North American Benthological Society, Providence, RI.

27. Endsley, K.A., Erickson, T. **Brooks, C., Shuchman, R.**, Wienert, M. (2011). "The Lake Superior Water Monitoring and Information System: A Web Service with Real-Time Wave Dynamics, Water Quality and Meteorology Data for Climate and Ecosystem Studies." Presented at the 54th International Conference on Great Lakes Research, IAGLR, Duluth, WI.

28. **Flores-Rangel, R, Doskey, Paul V., Perlinger, Judith A.**, 2011, Description of organic aerosol diagenesis with a GC x 2GC retention diagram, American Geophysical Union Meeting, San Fransisco, CA, 2011.

29. **Fritsch, Casey E., Griffis, Veronica W.**, 2011, Climate Informed Flood Risk Projections, AGU Fall Meeting 2011, AGU, San Francisco, CA, December 6, 2011.

30. **Fritsch, Casey E., Griffis, Veronica W.**, 2011, Evaluation of Flood Risk Under Climate Variability Using Continuous Hydrologic Modeling, World Water & Environmental Resources Congress 2011, ASCE, Palm Springs, CA, May 2011.

31. **Gorman, Hugh S.**, 2011, Policy choices affecting the dissemination of photovoltaics in Panama, Teatime Talk, Programa de las Naciones Unidas para el Medio Ambiente Oficina Regional para America Latina y el Caribe.

32. Groves, Stephanie, Liu, Jifei, Roll, Alex, Jill, Jensen, Shonnard, David R., **Bagley, Susan T.**, 2011, Comparative Proteomic Analysis of Pichia stipitis CBS6054 Adapted to a Dilute Acid Pretreated Waste Stream for Improved Ethanol Yield., 2011 Annual Meeting and Exposition of the Society for Industrial Microbiology, Society for Industrial Microbiology, New Orleans, LA, July 23, 2011 - July 24, 2011.

33. **Harless, Meagan, Huckins, Casey J., Pypker, Thomas G**., Grant, Jacqualine B., 2011, Comparative Toxicity of Six Chemical Road Deicers to Wood Frog (Rana sylvatica) Larvae, Joint Meeting of the Society for the Study of Amphibians and Reptiles and the American Society of Ichthyologists and Herpetologists, American Society of Ichthyologists and Herpetologists, Minneapolis MN.

34. **Hobmeier, Martin M., Yousef, Foad, Leduc, Jaime F., Kerfoot, W. Charles**, 2011, Inland spiny water flea (Bythotrephes longimanus) dispersal and impacts on zooplankton communities., IAGLR's

54th Annual Conference on Great Lakes Research, International Association for Great Lakes Research, Duluth, MN, May 30, 2011 - June 3, 2011.

35. **Huckins, Casey J.**, 2011, Aquatic Ecology and Monitoring, E. B. Holman School System, E. B. Holman Elementary School.

36. **Huckins, Casey J.**, 2012, Fish and Macroinvertebrate Survey of the Pilgrim River Watershed, The Pilgrim River Watershed Advisory Council, Houghton Keweenaw County Conservation District, MTU Lakeshore Center, March 19, 2012.

37. **Huckins, Casey J.**, 2012, Panel Discussion, Brook Trout Symposium -" The Future of Brook Trout in the UP- Issues, Strengths and Threats", The Escanaba River Association and the Fred Wasra and Copper Country Chapters of Trout Unlimited, Marquette, MI.

38. **Huckins, Casey J., Auer, Nancy A., Holtgren, Marty, Ogren, Stephanie A.**, 2011, Suitability of the Michigan Manistee River watershed 1836 Treaty Area for reintroduction of Arctic Grayling, Artic Grayling Symposium and Workshop, American Fisheries Society, Trout Unlimited-Canada, others, Grand Prairie, Alberta, Canada, June 2011.

39. **Huckins, Casey J.**, Baker, Edward A., **Matthys, Tony, Marcarelli, Amy**, , 2012, Habitat degredation from sedimentation may limit coaster brook trout Salvelinus fontinalis in the Salmon Trout River, Marquette County, Upper Peninsula Brook Trout Symposium, The Escanaba River Association and the Fred Waara and Copper Country Chapters of Trout Unlimited, Marquette, MI.

40. **Huckins, Casey J., Marcarelli, Amy M.**, Eggert, Sue, **Matthys, Tony**, 2011, Multi-scale variation in salmonid abundance in the Salmon Trout River, Michigan and associations with sand accumulation, Annual meeting, North American Benthological Society, Providence, RI, May 2011.

41. **Huckins, Casey J., Matthys, Anthony**, 2012, Influence of introduced species and excess sand on habitat use by stream salmonids in the Salmon Trout River, Marquette County, MI, 8th Annual Student Research Forum, The Ecosysem Science Center, Michigan Tech University, March 2012.

42. **Huckins, Casey J., Ogren, Stephanie A**., 2012, Comparative Assessment of Bioassessment Indices, Tribal Environmental Program Management Conference, Environmental Protection Agency, Chicago, IL, 2012.

43. **Huckins, Casey J., Ogren, Stephanie A**., 2011, Integrating tribal stream monitoring data into regional assessment frameworks, National American Fisheries Society Conference, American Fisheries Society, Seattle, WA, 2011.

44. **Kerfoot, W. Charles**, 2012, Western Great Lakes Resource Mgmt Conference, Great Lakes-Northern Forest Cooperative Ecosystem Studies Unit, Ashland, WI, April 17, 2012 - April 18, 2012.

45. **Kerfoot, W. Charles**, Budd, Judith W., **Yousef, Foad, Hobmeier, Martin M.**, Churchill, James H., Chen, Changsheng, 2011, Climate And Food Web Interactions In Time And Space (Bythotrephes Dispersal), 2010 Summer Meeting, AQUATIC SCIENCES: GLOBAL CHANGES FROM THE CENTER TO THE EDGE, ASLO, Advancing the Science of Limnology and Oceanography, Sante Fe, New Mexico, June 6, 2011 - June 11, 2011.

46. **Kerfoot, W. Charles, Yousef, Foad, Green, Sarah A.**, Schwab, David, Vanderploeg, Henry, Sabol, Bruce, Graves, Mark, 2012, Approaching Storm: Update On Disappearing Chl a in Lake Michigan And Food Web Responses, GLRC Special Seminar Series 2011-2012, EPSSI and CWS, Michigan Tech, April 12, 2012.

47. **Kerfoot, W. Charles, Yousef, Foad, Green, Sarah A.**, Schwab, David, Vanderploeg, Henry, 2011, Approaching Storm: Update On Disappearing Chl a in Lake Michigan And Food Web Responses, IAGLR's 54th Annual Conference on Great Lakes Research, International Association for Great Lakes Research, Duluth, MN, May 30, 2011 - June 3, 2011.

48. Lai, YenJung, **Becker, Jennifer G.,** 2011, Experimental and mathematical evaluation of the interactions between two hydrogenotrophic dehalorespirers (Dehalococcoides ethenogenes and Dehalobacter restrictus), International Symposium on Bioremediation and Sustainable Environmental Technologies, Battelle Memorial Institute, Reno, NV, June 27, 2011 - June 30, 2011.

49. Lai, YenJung, **Becker, Jennifer G.**, 2011, Mathematical simulation of the interactions between Geobacter lovleyi and Dehalococcoides strains and the implications for detoxification of tetrachloroethene (PCE) in situ, International Symposium on Bioremediation and Sustainable Environmental Technologies, Battelle Memorial Institute, Reno, NV, June 27, 2011 - June 30, 2011.

50. **Marcarelli, Amy M.**, Baxter, Colden V., Wipfli, Mark S., Kohler, Andre E., Collins, Scott F., **Ebel, Jonathan D**., Servheen, Gregg, 2011, Salmon nutrient mitigation effects on bottom-up processes in streams: lessons from large-scale experiments in central Idaho, Annual Meeting, American Fisheries Society, Seattle, WA.

51. **Marcarelli, Amy M.**, Eggert, Sue, **Huckins, Casey J.**, 2011, Variation in organic matter production, storage and processing associated with sand accumulation in the Salmon Trout River, Michigan, Annual meeting, North American Benthological Society, Providence, RI, May 2011.

52. **Marcarelli, Amy M.**, Eggert, Sue, **Huckins, Casey J.**, 2011, Variation in organic matter production, storage and processing associated with sand accumulation in the Salmon Trout River, Michigan, Annual meeting, North American Benthological Society, Providence, RI, May 2011.

53. **Martin, Susan R.**, 2011, Landscape and Meaning among the first inhabitants of the Lake Superior Basin, Field Geology for Michigan Earth Science Teachers, Michigan Teaching Excellence Program, Michigan Technological University/National Science Foundation, Copper Harbor Michigan, June 20, 2011.

54. **Martin, Susan R.**, 2011, The Lake Superior Basin and its prehistory, Copper Country History; Social Sciences Department, Michigan Technological University, Houghton MI, May 23, 2011.

55. **Martin, Susan R.**, 2011, The Uses of the Cliff Mine and Keweenaw Landscape by Indigenous Peoples, IRKPA Annual Meeting, Isle Royale Keweenaw Parks Association, Keweenaw County, Michigan, July 24, 2011.

56. **Matthias, Nicole, Marcarelli, Amy M**., 2012, Nutrient Limitation of Biofilm Biomass in Streams of the Keweenaw Peninsula, Michigan., ESC/BRC Student Research Forum, Ecosystem Science Center/Biotechnology Research Center, Houghton, MI.

57. **Matthias, Nicole, Marcarelli, Amy M.**, 2012, Nutrient Limitation of Biofilm Biomass in Streams of the Keweenaw Peninsula, Michigan., World Water Day Poster Competition, Center for Water and Society, Houghton, MI.

58. **Pennington, Wayne D.**, 2011, Scientific and Humanitarian Aspects of the 2010 Haiti Earthquake, IRIS/SSA Distinguished Lecture, IRIS and SSA (Incorporated Research Institutions for Seismology, and the Seismological Society of America), Rochester, NY, 2011.

59. **Pennington, Wayne D.**, 2011, Scientific and Humanitarian Aspects of the 2010 Haiti Earthquake, IRIS/SSA Distinguished Lecture, IRIS and SSA (Incorporated Research Institutions for Seismology, and the Seismological Society of America), Storrs, CT, 2011.

60. **Pennington, Wayne D.**, 2011, Scientific and Humanitarian Aspects of the 2010 Haiti Earthquake, IRIS/SSA Distinguished Lecture, IRIS and SSA (Incorporated Research Institutions for Seismology, and the Seismological Society of America), Atlanta, GA, 2011.

61. **Pennington, Wayne D.**, 2011, Scientific and Humanitarian Aspects of the 2010 Haiti Earthquake, IRIS/SSA Distinguished Lecture, IRIS and SSA (Incorporated Research Institutions for Seismology,

and the Seismological Society of America), New York City, NY (American Museum of Natural History), 2011.

62. **Pennington, Wayne D.**, 2011, Scientific and Humanitarian Aspects of the 2010 Haiti Earthquake, IRIS/SSA Distinguished Lecture, IRIS and SSA (Incorporated Research Institutions for Seismology, and the Seismological Society of America), Los Alamos, NM, 2011.

63. **Pennington, Wayne D.**, 2011, Scientific and Humanitarian Aspects of the 2010 Haiti Earthquake, IRIS/SSA Distinguished Lecture, IRIS and SSA (Incorporated Research Institutions for Seismology, and the Seismological Society of America), Hackettstown, NJ, 2011.

64. **Perlinger, Judith A., Doskey, Paul V., Flores-Rangel, R, Zhang, B**, Murray, K, 2011, Estimates of total molecular polarity to evaluate atmospheric evolution of organic aerosol, European Geosciences Union, Vienna, Austria, 2011.

65. Richardson, David P., Kohler, Andre E., **Marcarelli, Amy M., Ebel, Jonathan**, Campbell, Steven, Keeley, Ernest R., 2012, How do stream food webs respond to the addition of salmon carcass analogs in Idaho streams?, Annual meeting, Idaho Chapter of the American Fisheries Society, Coeur d'Alene, Idaho, March 7, 2012 - March 9, 2012.

66. **Scarlett, Timothy J.**, 2011, Mining, Smelting, and Mills, Oh MY!" Industrial Heritage Research at Michigan Tech, MTU Alumni Assocation, Michigan Technological University, Houghton, MI, August 4, 2011.

67. **Scarlett, Timothy J.**, Gohman, Sean, 2011, Community Based Archaeology in the Keweenaw, Global City, Global City, Houghton, MI, September 20, 2011.

68. Schwabe, Kurt, Howell, Colleen**, Muralidharan, Daya**, 2011, Non-timber Forest Product Collection among Indigenous Forest-fringe Households in Peninsular Malaysia, Brown Bag Lunch Series, Michigan Technological University, Houghton, Michigan, USA.

69. **Seagren, Eric A.**, 2011, Biomediated geomechanical processes: A collaborative research approach, 2nd International Workshop on Bio-Soil Interactions & Engineering, National Science Foundation, University of Cambridge, United Kingdom, September 18, 2011 - September 20, 2011.

70. **Seagren, Eric A.,** Mayer, Audrey L., 2011, Using 'Collapse' to teach sustainability, Association of Environmental Engineering and Science Professors (AEESP) Annual Meeting, AEESP, Tampa FL, July 2011.

71. **Seely, Bruce E.**, 2012, Political and Social Responses to Climate Change in the United States: Seen through a Historians Lens, Indo-US Bilateral Workshop: Global Challenges: Climate Change, Water, Environment and Society, ITM University, Guragon, India.

72. Servheen, Gregg, Wipfli, Mark S., Baxter, Colden V., Felicetti, Laura, **Marcarelli, Amy M.**, Kavanagh, Katy, 2011, Managing and Mitigating Salmon-Derived Nutrients: Are Analogs Salmon Avatars?, Annual Meeting, American Fisheries Society, Seattle, WA.

73. **Shuchman, R.**, Leshkevich, G., **Brooks, C.**, Sayers, M., Hatt, C. (2011). "A Satellite Algorithm for the Retrieval of Chlorophyll, Dissolved Organic Carbon, and Suspended Minerals for All the Great Lakes." Presented at the 54th International Conference on Great Lakes Research, IAGLR, Duluth, WI.

74. **Shuchman, R.**, Leshkevich, G**., Brooks, C.N.,** Sayers, M., Hatt C. (2011). "Satellite Based Retrievals of Chlorophyll, Dissolved Organic Carbon and Suspended Minerals for Lake Michigan." September 27, 2011 presentation to the State of Lake Michigan Conference, Michigan City, IN.

75. **Shuchman, R.**, Roussi, C., **Kerfoot, W.C., Green, S.,** Meadows, G., Erickson, T., **Brooks, C.**, Endsley, K.A., Wienert, M., Sayers, M. (2011) The Lake Superior Water Monitoring and Information System. Presented to the NOAA Coastal Zone 2011 Conference, Chicago, IL.

76. **Shuchman, R.**, Sayers, M., **Brooks, C., Jenkins, L., Auer, M.,** Meadows, G. (2011). "Mapping Cladophora Extent in Lake Michigan Using Multi-scale Satellite Imagery." September 27, 2011 presentation to the State of Lake Michigan Conference, Michigan City, IN.

77. **Shuchman, R.**, Sayers, M., **Jenkins, L., Brooks, C., Auer, M.**, Meadows, G. (2011). "Mapping and Monitoring the Extent of Cladophora Algae in the Great Lakes using Multi-Resolution, Multi-temporal Satellite Imagery". Presented at the 54th International Conference on Great Lakes Research, IAGLR, Duluth, WI.

78. **Shuchman, R.A.,** Roussi, C., **Kerfoot, W.C., Green, S.**, Meadows, G., Erickson, T., **Brooks, C.**, Endsley, A., Wienert, M., Sayers, M., **Jessee, N.**, Anderson, J., Abbot, M. (2012). "The Lake Superior Water Monitoring and Information System," Limnotech Webinar Presentation, January 28, 2012.

79. **Watkins, David W., Griffis, Veronica W.**, Faber, Beth, 2011, Systems Approaches to Flood Risk Management Modeling: Barriers and Directions for Research, World Water & Environmental Resources Congress 2011, ASCE, Palm Springs, CA, May 2011.

80. **Wesseldyke, Eric S., Seagren, Eric A., Becker, Jennifer G., Mayer, Alex S.**, 2011, 2-D modeling of bioenhanced DNAPL dissolution, AGU Fall Meeting, 2011, American Geophysical Union (AGU), San Francisco, CA, December 5, 2011 - December 9, 2011.

81. **Yousef, Foad, Kerfoot, W. Charles, Shuchman, Robert, Green, Sarah A.**, Sabol, Bruce, 2011, LiDAR (Light Detection and Ranging) And MSS (Multi-spectral Scanner) Studies Of Lake Superior Coastal Environments., IAGLR's 54th Annual Conference on Great Lakes Research, International Association for Great Lakes Research, Duluth, MN, May 30, 2011 - June 3, 2011.

6.4 Editorial Activities

Bagley, Susan T.

Associate Editor, SIM News, Society for Industrial Microbiology, Appointed. January 1, 2008 - December 31, 2013.

Editorial Board Member, Journal of Industrial Microbiology and Biotechnology, Society for Industrial Microbiology, Appointed. July 1, 2003 - June 30, 2013.

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.

Associate Editor, A CASE STUDY IN APPLYING RISK-BENEFIT ANALYSIS TO SELECT AN APPROPRIATE STREAMBANK STABILIZATION MEASURE, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, A semi-empirical equation for determining longitudinal dispersion coefficient in rivers, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, Effective Manning's n as a Means to Model Cross Vanes with One-dimensional Modeling Techniques, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

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. 2011.

Associate Editor, Estimating boundary shear stress along vegetated streambanks with turbulent kinetic energy, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, Evaluation of Flow-altering Countermeasures against Bridge Pier Scour, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, Flow Resistance Caused by Large-Scale Bank Roughness in a Channel, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, Genetic programming for critical submergence of intakes in open channel flows, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, Investigations on the Trajectory of Large Sandbags in Open Channel Flow, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, NEW SHAPES OF BAFFLE PIERS USED IN STILLING BASIN AS ENERGY DISSIPATORS, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, On the Effectiveness of Levees for Flood Control: An Application of the Hydraulic Performance Graph Method, ASCE J. of Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, Piano Key Weir Submergence in Channel Applications, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Associate Editor, Propagation of discharge uncertainty in 1D hydraulic models, ASCE J. Hydraulic Engineering, Papers, Appointed. 2011.

Campbell, Gary A.

Associate Editor, Resources Policy, Papers, Appointed. January 2011 - Present.

Editorial Board Member, African Journal of Business Management. 2007 - Present.

Associate Editor, Resources Policy, Papers, Appointed. January 2011 - December 2011.

Datta, Rupali

Associate Editor, Comparison of Perchlorate and Iodide Concentrations in Edible Seaweeds in South Korea, Int. J Env. Sci. Technol., Papers, Appointed. April 10, 2012 - Present.

Associate Editor, EVALUATION OF NATURAL RADIOACTIVITY IN ROCKS OF DODDABETTA PEAK, NILGIRI HILLS AND THEIR RADIATION HAZARD TO MANKIND, Internatl. J Env. Sci Technol., Papers, Appointed. January 30, 2012 - Present.

Associate Editor, THE RELEVANCE OF BISPHENOL A ADSORPTION DURING FENTON´S OXIDATION, Internatl J. Env. Sci. Technol., Papers, Appointed. January 25, 2012 - Present.

Associate Editor, Isolation and identification of an anti-algal compound from Artemisia annua and mechanisms of inhibitory effect on algae, Interntal. J Env. Sci. Technol., Papers, Appointed. January 1, 2012 - Present.

Associate Editor, A comparison of metallic contents in lichen Pyxine subcinerea, its substratum and soil, Interntl J Env. Sci. Technol., Papers, Appointed. November 29, 2011 - Present.

Associate Editor, Impacts of Tropical Rainforest Conversion on Soil Properties: An Example from Akure Forest Reserve, Ondo State, Nigeria, Internatl. J. Env. Sci. Technol., Papers, Appointed. November 28, 2011 - Present.

Doskey, Paul V.

Editor, Journal of Great Lakes Research.

Gierke, John S.

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

Halvorsen, Kathleen E.

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, The Royal Residences of Kapalama: Locating the Homes of Princess Ruth Keʻelikolani and Queen Liliʻuokalani, Hawaiian Journal of History, Papers. January 2012 - March 1, 2012.

Editorial Board Member, To Raise a Voice in Praise: The Revivalist Mission of John Henry Wise, 1889 – 1896, Hawaiian Journal of History, Papers, Appointed. January 2012 - March 1, 2012.

Editorial Board Member, Up In Arms. Hawaii National Park at the Forefront of the Home Front During WWII, Hawaiian Journal of History, Papers, Appointed. January 2012 - March 1, 2012.

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.

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. 2004 - Present.

7 Appendix 1: CWS Faculty/Staff Participants

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Thomas G. Pypker
James M. Schmierer
Amy J. Schrank
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Patrick E. Martin
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Timothy Scarlett
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8 Appendix 2: CWS Student Participants

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Meagan Harless
Martin Hobmeier
John "Marty" Holtgren
Mike Kraft, undergrad
Jaime LeDuc
Melanie Lemerande, undergrad
Taylor Luginbill, undergrad
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Darcy Mundahl
Michael Nagel, undergrad
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Stephanie Ogren
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Abby Raguse, undergrad
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Tim Wilson
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Jade Woiderski, undergrad
Foad Yousef

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Mark Maguire, undergrad
Cory McDonald
Ali Mirchi
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Khila Dahal
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Seminars and Symposia: Carol MacLennan, Joan Chadde, Daya Muralidharan, Noel Urban