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Water Resources Year in Review - Winter 2003

Annis Water Resource Institute

2003 YEAR IN Review

ROBERT B. ANNIS WATER RESOURCES INSTITUTE

GRAND VALLEY STATE UNIVERSITY

Dr. Alan Steinman, Director of the Robert B. Annis Water Resources Institute

The Institute has undergone a number of significant changes over the past three years, including a new location, a new director, four new staff scientists, the addition of several new research associates and assistants, and a new mission statement.

Changes like these can be challenging, often causing an organization to take time to readjust and adapt to the new surroundings and stimuli.

But the amount of work we've accomplished over these past few years, and the progress that we've made, is truly amazing.

The team that we've established, from our student interns to our principal investigators, are responsible for our success. Every person at the Annis Water Resources Institute plays a critical part in our ability to fulfill our mission of integrating education, outreach, and research to enhance and preserve our freshwater resources.

The environmental issues that this region and this planet face are so complex that interdisciplinary teams, using multidisciplinary approaches, are now needed to solve them. What makes the Institute unique is our desire and ability to comprehensively attack and solve problems that range from microbial to landscape scales within our one facility. Combining ecology, microbiology, chem-

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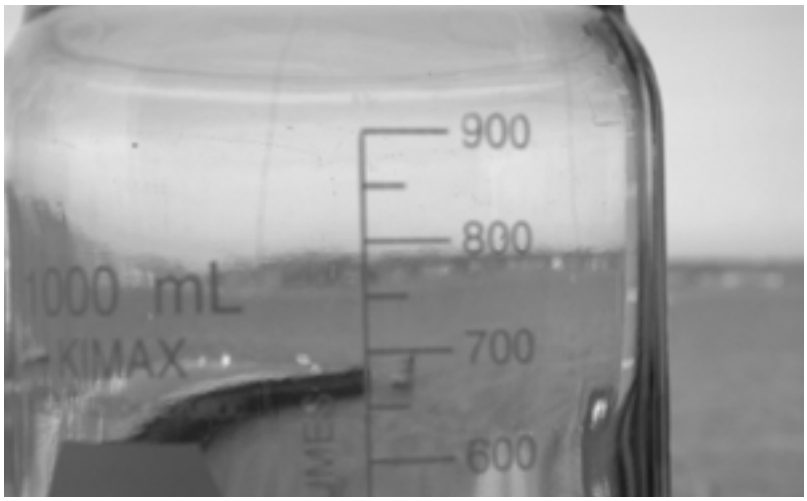
Collecting, analyzing, and disseminating scientific research as well as educating others about environmental issues are necessary steps toward restoring and preserving our natural resources.



Integrating research, education, and outreach to enhance and preserve freshwater resources

The Annis Water Resources Institute:

- **conducts research and collects data on the natural resources in our region**
- **shares information about our environment with the community**
- **collaborates with other organizations to discuss ideas and find solutions to problems**
- **offers hands-on learning experiences aboard research vessels and in the classroom**
- **helps business, industry, and communities implement environmentally-safe practices**
- **confronts issues that will affect our community in the future**
- **provides GVSU students with the opportunity to apply their classroom learning and be part of a research team**
- **collaborates with GVSU professors and others on research projects**

Institute Highlights in 2003

• This past fall, Grand Valley State University began offering a Master of Science degree in Biology with an emphasis in aquatic sciences. Members of AWRI helped develop this program and are teaching courses specializing in aquatic sciences.

• AWRI offered graduate assistantships to three new graduate students working at the Lake Michigan Center. Their projects focus on yellow perch, round goby, and contaminated sediments. We look forward to continued growth of our graduate program.

• Both the *W.G. Jackson* and the *D.J. Angus* have switched from a petroleum-based diesel fuel to a biofuel, made from soy oil. Although slightly more expensive, the new fuel will result in better water and air quality, and hopefully provide another market for soybean producers in west Michigan.

• The Lake Michigan Center hosted over 75 events in 2003, including the rollout of the Great Lakes Legacy Act in Michigan, a poster session for the Lake Michigan: State of the Lake '03 Conference, and the kick-off meeting for the Muskegon Lake Research Endowment Fund.

• AWRI initiated a long-term monitoring program in Muskegon Lake, one of the Areas of Concern (AOC) in the Great Lakes. This monitoring activity will define the current ecological conditions in the lake and provide information to help get Muskegon Lake de-listed as an AOC.

• Renovations to the Lake Michigan Center, home of AWRI, continued in 2003. This past year saw the completion of five new office suites, new laboratories for microbial ecology and radioisotope ecology, and renovations to the classrooms. In addition, our mesocosm facility was officially inaugurated, with experiments examining 1) the influence of light on Muskegon Lake algae and 2) interactions between sculpin and round goby.

• AWRI's Science Advisory Board (SAB) met in 2003. The Board noted that AWRI continues to make "significant and outstanding advances in their research and educational capabilities." The SAB meets every one to two years and provides AWRI with advice and counsel.

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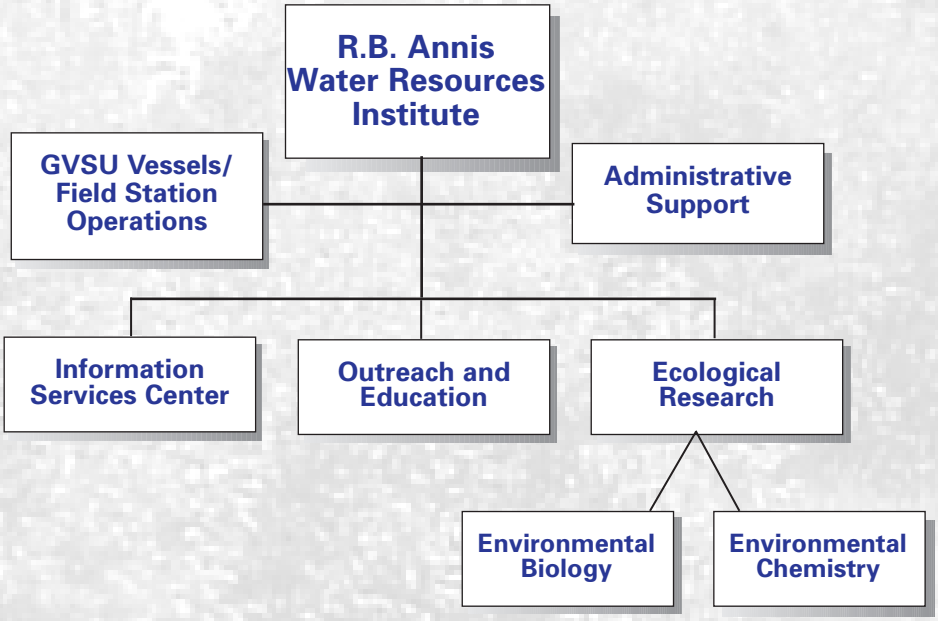
istry, hydrology, geography, education, and outreach under one roof allows synergies to develop and new pathways to emerge when tackling problems as diverse as contaminated sediments, wetland destruction, invasive species, changes in water quality and quantity, and impacts of land use change. Our respected outreach and education programs bring these important issues into the curriculum of our schools, as well as to the community at large. By focusing on collaboration (both internal and external), we are able to build our expertise and our capacity.

In this issue of *Year in Review*, we'd like to show how working together can result in a broader and more thorough understanding of the problems and potential solutions facing our water resources. Specifically, we will highlight work that AWRI has done in west Michigan's drowned river mouth systems. These unique systems are comprised of a broad spectrum of complex, ecological habitats, each of which are threatened by a suite of environmental impacts. As a consequence, they offer rich opportunities for collaborative research.

The results of our work in these drowned river mouth systems can significantly contribute to improving the condition of west Michigan's natural resources and aquatic habitats. But that's not where it ends. The processes we define and the data we collect can be applied to other ecosystems in the United States and in the world. Although the work is done here, the implications and outcomes of that work can contribute to research and decisions far from this location.

If there is one lesson that we should learn from the work that AWRI has done since its formation, it's this—our water resources are intricately connected. What happens to one small piece of the watershed can and often does impact another part of the watershed. This connectivity involves not only the water and its aquatic resources, but also the social, economic, and political sectors that influence and co-exist within each watershed.

From a global perspective, the same truth applies. The collaborative work that we do at the Institute can help the west Michigan community preserve and restore its natural resources and thereby improve our quality of life. But it also has far-reaching applications. By expanding our vision to include national and even global concerns, we are acknowledging that the only way any of us can truly make a difference is by working together.



Information Services Center

The Information Services Center (ISC) collects and analyzes data from environmental research projects, condenses these data into useful information, and then offers the information to those who make decisions about managing our natural resources. For more information about the ISC's projects, contact John Koches at (616) 331-3792 or kochesj@gvsu.edu.

Outreach and Education Initiatives

AWRI outreach initiatives offer unique learning opportunities on the GVSU vessels and in the classroom that create awareness of, and appreciation for, our natural resources. Emphasis is on programs for pre-college students, teachers, and the general public. For more information about programs and learning opportunities, contact Janet Vail at (616) 331-3048 or vailj@gvsu.edu.

Ecological Research Group

AWRI plays an important role in assessing the condition of our natural environment. Scientists and research technicians gather specimens and conduct sophisticated analyses in our research laboratories. This information provides the foundation that helps us make decisions about living responsibly within our environment. For more information about the Institute's research projects, contact Al Steinman at (616) 331-3749 or steinmaa@gvsu.edu.

AWRI Collaborations with Other Groups and Researchers

Dennis Albert, Michigan Natural Features Inventory
Jeff Auch, Muskegon County Conservation District
Judy Beck, U.S. EPA Great Lakes National Program Office
Patrick Bohlen, Archbold Biological Station, Lake Placid, FL
Andy Bowman, Grand Valley Metro Council
Thomas Burton, Michigan State University
John Bush, Ionia County Drain Commissioner
James Cotner, University of Minnesota
Phil Dakin, Timberland R, C, & D
Mary-Lynn Dickson, University of Rhode Island
Thomas C. Doyle, Barry County Drain Commissioner
Mary Emerson, Ice Mountain
Keith Etheridge, Michigan Environmental Council
Gary Fahnenstiel, NOAA, Muskegon, MI
Pat Fowler, USDA Forest Service
Nicole Frost, County of Ionia, Bertha Brock Park
John Gabrosek, Grand Valley State University
Paul Geerlings, Ottawa County Drain Commissioner
Tony Groves, Progressive AE
Indiana Dunes National Lakeshore
Joel Ingram, Environment Canada
Thomas Johengen, Cooperative Institute of Limnology and Ecosystem Research, Ann Arbor, MI
Dave Jude, University of Michigan
Joseph Kaltz, Newaygo County Road Commission
Dave Kraker, Kent County Health Department
Gary Lamberti, University of Notre Dame
Roger Laninga, Kent County Drain Commissioner
Cheri Leach, Raven Hill Discovery Center
Patricia Machemer, Michigan State University
Charle Madenjian, USGS
Miguel Marino, University of California
Karen Meyers, GVSU Regional Math & Science Center
Muskegon Chronicle
Muskegon County Environmental Coordinating Council
Muskegon Lake Public Advisory Council
Sharrie Parke, Mecosta Osceola Intermediate School District
Graham Peaslee, Hope College
Jay Peters, West Michigan Strategic Alliance
John Phillips, Ford Motor Company
Bryan Pijanowski, Purdue University
Chuck Pistis, Michigan Sea Grant
Ramesh Reddy, University of Florida
Roosevelt University
Steve Ruberg, NOAA, Ann Arbor, MI
Susie Schreiber, Waukegan Area of Concern
Ron Schumacher, District 10 Health Department
Jan Stevenson, Michigan State University
Robert Stuber, U. S. Forest Service
Don Stypula, Grand Valley Metro Council
Cindy Sullivan, Newaygo County Drain Commissioner
Jim Szejda, Ottawa County Health Department
Paul Thorsnes, Grand Valley State University
Steve Timmermans, Bird Studies Canada
Robert Walker, Michigan State University
Mike Wiley, University of Michigan

Spotlight on Research

What are drowned river mouths?

More than 11,500 years ago, about three-quarters of Lake Michigan and the surrounding land was covered by a glacial field. Receding ice gouged a large channel across Canada, draining water out of Lake Michigan. This dramatic drop in water elevation forced rivers and streams to cut deeply into the landscape. Around 4,000 years later, water levels in Lake Michigan rose, flowing back toward the land, and thus "drowning" the original mouth of the river.

At the same time, shifting dunes along the Lake Michigan shore began to restrict the river mouth to a narrow channel. With a restricted water flow, the water backed up, transforming rivers into lakes and creating wetland areas. The drowned river mouths on the west coast of Michigan are unique because of the action of these shifting dunes. Given their inherent diversity and proximity to AWRI, these systems provide the Institute with ample opportunities for research.

What do they look like today?

When you look at a map or an aerial photograph of the west Michigan shoreline, you can spot these drowned river mouth areas immediately. The lakes are long and narrow with the mouth of the lake constricting to a channel at Lake Michigan. Pentwater Lake, White Lake, Muskegon Lake, Mona Lake, and Lake Macatawa are all examples of bodies of water that were formed years ago from the action of the receding glaciers and shifting dunes.

Why are they important to study?

The transitions from a large lake to small lakes to wetland estuaries to rivers and headwaters in drowned river mouth systems create a variety of different habitats that support a rich diversity of life. AWRI scientists gather and analyze information about these different life forms and study how land use, contaminants, nonpoint source pollution, and other influences can affect the health of the entire watershed system.

Although the Institute has been researching many of these ecosystems for years, there is still much we don't know about these unique and complicated environments. In order to preserve and protect drowned river mouth systems and the life they support, more research needs to be done.

Satellite photo of Lake Michigan shoreline. The three large lakes from top to bottom are White Lake, Muskegon Lake, and Mona Lake—all drowned river mouth systems.

In the next few pages, we'll take a look at a few of the projects the Institute has undertaken on drowned river mouth systems. We'll see how the collaborative work of AWRI researchers and technicians can give us a more comprehensive understanding of what is happening to these vital natural resources.

White Lake

White Lake has been an important part of the area's economic vitality for decades. But much of the industrial activity over the years has contaminated the lake, which is now listed as an Area of Concern (AOC) by the U.S. Environmental Protection Agency (EPA).

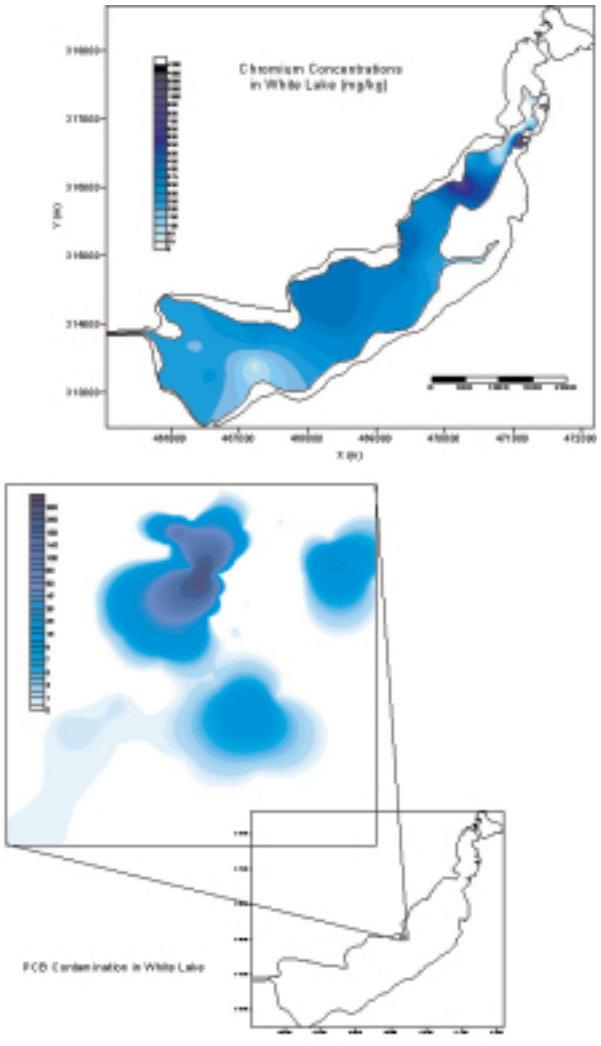
In 1996, the Institute initiated a study on Tannery Bay, located on the northeast side of White Lake, and discovered high levels of chromium, a metal used in the tanning process. Although the practice of dumping contaminants into the lake was banned years ago, the heavy metal has remained within the lake since the 1940s.

Studies conducted by Dr. Rick Rediske of AWRI

have indicated that the chromium contamination has not remained in one location. Rediske's work has uncovered chromium throughout the lake at levels higher than allowed by the U.S. EPA. Although not considered toxic to people, chromium has altered the natural environment. Research by Dr. Don Uzarski's lab has confirmed that the number of nematodes and midges, aquatic animals important in the lake's food chain, were lowest in areas where chromium levels were highest.

AWRI analyses also indicate that White Lake contains PCBs and chromium in a deep area of the lake off Dowie's Point, the former site of Hooker Chemical Co. The chemicals were dumped into the lake in the 1950s, but unlike the chromium, tests show that the contamination has not spread throughout the lake.

White Lake continued next page



These maps indicate how chromium and PCB (higher concentrations shown in darker blue) have dispersed throughout White Lake.

Ecological Research Group Highlights

Research projects supervised by Dr. Bopaiah Biddanda:

- **Fate of land carbon in streams and lakes of west Michigan. Funded by MI Space Grant.**
- **Role of submerged sinkhole ecosystems in Lake Huron. Funded by NOAA.**
- **Nutrient bioassay studies in Mona Lake.**
- **Long-term hydrobiological studies in Muskegon Lake.**
- **Planktonic processes in Lake Michigan.**

Research projects supervised by Dr. Michael Chu:

- **Development of physically-based hydrologic model for continuously simulating surface runoff, infiltration, and unsaturated water flow along a layered soil profile.**
- **Nutrient loading analysis in Mona Lake watershed.**
- **Mapping the distribution of chromium and PCB contamination in White Lake.**

Research projects supervised by Dr. Mark Luttenton:

- **Biological monitoring and assessment of the Henry's Fork River, Idaho. Funded by Henry's Fork Foundation.**
- **Preliminary evaluation of the impact of zebra mussels on primary production in Croton Pond.**
- **Survival of two hatchery strains of brown trout in the Rogue River (collaboration with Dr. Alex Nikitin, GVSU).**

Research projects supervised by Dr. Rick Rediske:

- **Sediment analysis and spatial distribution of chromium and PCBs in White Lake. Funded by U.S. EPA.**
- **Concentration of PCB congeners in Lake Michigan whitefish and development of a bioenergetics model (collaboration with NOAA and USGS).**
- **Sediment contamination projects on White Lake and Mona Lake. Funded by U.S. EPA and Mott Foundation.**
- **Monitoring program for *E. coli* concentrations at Lake Michigan beaches with the Muskegon County Health Department and MDEQ. Funded by Muskegon Co. Health Dept.**

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• Nutrient loading in the Muskegon River watershed (collaboration with Dr. Mike Wiley, Univ. of MI). Funded by Great Lakes Fishery Trust.

Research projects supervised by Dr. Carl Ruetz:

• Long-term monitoring of fish populations in Muskegon Lake.

• Assess the role of fish predation in streams.

• Fish population dynamics in the Florida everglades.

Research projects supervised by Dr. Alan Steinman:

• Ecological assessment of the Mona Lake watershed. Funded by Mott Foundation.

• Internal phosphorus loading study in Spring Lake. Funded by Spring Lake – lake board.

• Muskegon Lake long-term monitoring program. Funded by Muskegon Lake Research Endowment Fund.

• Role of internal vs. external phosphorus loading in Mona Lake. Funded by MDEQ.

• Influence of light level on phytoplankton growth in Muskegon Lake using mesocosms.

Research projects supervised by Dr. Don Uzarski:

• Monitoring and evaluating coastal habitats for potential restoration activities. Funded by MDEQ.

• Bioassessment procedures and guidance for field staff for evaluation of depressional wetlands in Michigan. Funded by MDEQ.

• Testing variability and usefulness of SOLEC indicators in wetlands of Lakes Huron and Michigan. Funded by U.S. EPA.

• Investigate the effects of beach grooming on wetland biota. Funded by MDEQ.

Upcoming projects:

• Drs. Rick Rediske, Don Uzarski, Michael Chu, and Tom Burton (MSU) obtained a grant from the EPA to investigate the extent and ecological effects of sediment contamination in the Little Black Creek watershed and to develop a hydrological model for cadmium transport.

• Drs. Steinman and Uzarski will be assessing the lower Muskegon River for fish habitat (collaboration with Drs. Jan Stevenson and Tom Burton, MSU). Funded by Great Lakes Fishery Trust.

Dr. Michael Chu mapped chromium and PCBs distributions in White Lake. The flow of water from the upper area of the lake to the channel has been shifting the sediment and carrying chromium away from Tannery Bay for decades, depositing it in the western part of the lake. However, because the PCBs were deposited in deeper water—the lake's "dead zone"—the shallower lake currents did not disturb it.

Collaboration among the Institute's scientists was critical in developing an accurate picture of the lake's condition. Although more tests still need to be conducted, the study offers decision-makers concrete data that will allow them to choose the best possible option for cleaning up the lake. They will also be able to take advantage of comprehensive tools developed by the Information Services Center (ISC), such as maps and a detailed resource atlas. These tools provide current and future decision-makers the information they will need to make accurate and thorough assessments.

Mona Lake

Mona Lake and its surrounding watershed is another example of a drowned river mouth system that is being adversely impacted. Work completed by Drs. Steinman, Biddanda, Uzarski, Rediske, and Chu at AWRI has demonstrated that the lake contains contaminated sediments from past industrial activity, has higher than normal levels of nutrients, and carries too much sediment.

Even though it's easy to understand how dumping raw sewage or chemical waste directly into a lake or river—called point source pollution—can contaminate a body of water, it's not so apparent how nonpoint source pollution can also cause problems. Nonpoint source pollution is the collective material that ends up in the lake even though the source may be miles away. Nutrients such as nitrogen and phosphorus from farms and fertilized lawns; runoff that contains grease and oil from parking lots and roads; excess sediment eroded from watersheds and stream channels—all these factors take their toll on our water resources.

Unnatural shoreline of Mona Lake. Nonpoint source runoff from lawns and storm drains impairs lake water quality.

Dr. Alan Steinman assessed external and internal loads of nutrients by conducting a series of field investigations and laboratory experiments. To better understand the sources of nutrients and their spatial and temporal variations, Dr. Chu simulated nitrogen and phosphorus loads into Mona Lake based on the monitoring data and watershed hydrologic modeling.

Excess nutrients in the water trigger the growth of vegetation, especially algae. These algal blooms cause problems in the ecosystem by depleting the supply of oxygen, altering the lake's chemical composition, and, in some species, releasing deadly toxins. Cyanobacteria (or blue-green algae) are especially a problem. Because of their buoyancy, they can cover a wide area.

Many drowned river mouth lakes, including Mona Lake, suffer from algal blooms throughout the warm weather season. The collective studies that the Institute undertakes on how algae affect the environment, why algal blooms develop, and what methods are most effective in eliminating this problem are critical in determining the most effective remedial action.

Dr. Janet Vail was pivotal in the selection of Mona Lake for a pilot stewardship assessment by the U.S. EPA Lake Michigan Forum. AWRI staff provided critical information as part of the assessment development process, which ultimately resulted in a 66-page document that will assist the Mona Lake stakeholders with their watershed management plan. Rod Denning, and support staff at the

Mona Lake continued next page

Information Services Center Highlights

• Continued to collect and manage the database developed as a component of the "Mega Model" Project. Funding provided by Great Lakes Fishery Trust.

• Continued work on numerous projects in the Rogue River watershed. Over the past year, information and education activities have included a Rogue River Celebration, Stream Search events, and workshops for local decision-makers, homeowners, and farmers on a host of topics including stormwater management, land-use planning, Stream Search training, and more. The ISC has improved three road/stream crossings, as well as stabilized the streambank and reestablished vegetative buffers in critical areas. Funding provided by US EPA/MDEQ, Section 319 Implementation Grant.

• Established the Rogue River Watershed Council, a group dedicated to the long-term protection and enhancement of the Rogue River and its tributaries.

• Continued a three-year project to update, examine, and forecast land use and cover conditions within the Muskegon River watershed. The ISC has completed the inventory for all twelve counties in the watershed and is in the process of analyzing the data to determine changes in the last 20 years. The ISC is also developing an extensive atlas for each of the 113 townships. The atlas will look at surface geology, topography, presettlement landscape, and 1978/1998 land use and cover conditions. ISC has already conducted a series of planning workshops in the watershed and will continue this dissemination process throughout the remaining year. Funding provided by the Wege Foundation and the Fremont Area Community Foundation.

• Continued work on the Lower Grand River Watershed Management Plan, which will result in a nonpoint source management plan for the ten counties within the watershed. Four pilot project areas have been selected for more detailed analysis. ISC is working with partners in the Sand Creek watershed, which has been identified as the rural pilot area. The goal will be to identify nonpoint source pollutants and recommend best management practices to reduce, prevent, and control these pollutants. Funding provided by US EPA/MDEQ, Section 319 Planning Grant.

• Continued work on the Coldwater River Watershed Management Project to develop an approvable 319 nonpoint source management plan. When completed, the plan will include hydrology studies, maps, macro-

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invertebrate studies, and water chemistry studies. Funding provided by the Coldwater River Watershed Council.

• Continued work on the Road/Stream Crossing Inventory of Newaygo County, which includes information on 1,230 crossing sites within the entire 860 square miles of the county. The project team worked with the Newaygo County Road Commission, U.S. Forest Service, and Timberland RC&D to gather over 7,400 digital photos. Collected data will be integrated into a geographic information decision support system as a management tool. The ISC will also provide training. Funding provided by Michigan Department of Transportation.

• Completed final year of the Source Water Assessment Program (SWAP). Funding provided by MDEQ.

• Continued work on the Mecosta County Groundwater Project. Field crews visited 50 groundwater sites in the county to collect water samples for analysis. Funding provided by the Fremont Area Community Foundation and Ice Mountain, Environmental Stewardship Fund.

• Completed the Muskegon River Watershed Transition Project, which resulted in water quality assessments and inventories of critical areas in subwatersheds, such as the West Branch and Lower Clam River. The ISC held several training workshops for homeowners and agricultural producers, as well as interactive water quality workshops with school groups. A project brochure, display, slide show, and give-away materials were produced. Project partners included the Muskegon River Watershed Assembly, the Michigan State University Extension office, and conservation districts throughout the watershed. Funding provided by US EPA/MDEQ, Section 319 Implementation Grant.

• Completed analysis for the the Green Infrastructure Task Force, West Michigan Strategic Alliance. This information characterized what was unique and special about the west Michigan landscape, helping to establish priorities for future preservation. Funding provided by the West Michigan Strategic Alliance.

Mona Lake continued

ISC, have provided a detailed resource atlas, which provides critical information that will help natural resource managers, zoning and planning staff, and elected officials to make informed choices about restoration activities and land use decisions in the watershed.

Muskegon Lake

Part of the second largest watershed system in Michigan, Muskegon Lake has significant economic and environmental importance. For years, the lake has played a vital role in Muskegon's lumber and foundry industries and has become a magnet for the recreation and tourism markets. Muskegon Lake offers excellent walleye and perch fishing, and is a popular location for recreational and competitive sailing.

In many ways Muskegon Lake is the heart of the community. Yet it is listed as another Area of Concern (AOC) by the state, and the health of the lake, as well as the entire watershed, is in jeopardy.

The Institute, along with the Community Foundation *for* Muskegon County, initiated a campaign to create an endowment fund that would support a long-term monitoring program in Muskegon Lake. The research will generate a quantitative database to be used to assess the health of the lake, and compare it to past data. Thanks to generous lead

Researchers sample water quality and collect fish in Muskegon Lake.

gifts from Dr. William Jackson and the Muskegon Sports Fishing Association, the campaign is well on its way of reaching its $250,000 goal.

This past year, several AWRI scientists, including Drs. Steinman, Ruetz, Rediske, and Biddanda have been working on collecting important data on vegetation, nutrients, plankton, invertebrates, and fish in three main areas of the lake—the eastern end of the lake, the middle, and the western end near Snug Harbor and the state park. By looking at a broad spectrum of elements in the lake, the Institute will be able to provide a more detailed picture of Muskegon Lake's ecological conditions, which will help the community understand how this lake is being affected.

But it's not just what happens in the lake that can affect its health. If something happens further up in the watershed, the lake can be compromised. For example, an invasion of exotic species, such as zebra mussels, lampreys, curly pond weed, and spiny water flea, has found its way into upstream tributaries. These exotics prey on eggs of native species, compete for food and spawning beds, and alter natural habitats.

Dr. Mark Luttenton has chronicled the migration of exotic species in the Muskegon River. He has identified several exotic species located near Croton Dam that have now altered the natural habitat and threatened native species. How exactly these species will impact the watershed, including Muskegon Lake, still needs to be determined.

Getting an accurate, comprehensive picture of all the factors that may be contributing to the problems associated with Muskegon Lake—and all bodies of water in a drowned river mouth system—is essential in developing policies and determining action steps. The tools and information provided by the ISC, directed by John Koches, is part of the holistic approach that the Institute takes. The Geographic Information Systems (GIS) and area maps provide critical data about a given watershed. For example, the group can describe how the land is being used—the mix of agricultural, urbanized, and natural environments. ISC staff examine storm drains and road crossings, which often force water to move faster, eroding stream banks and picking up

Muskegon Lake continued next page

Outreach and Education Initiatives Highlights

• The *D.J. Angus* and the *W.G. Jackson* research vessels provided educational opportunities for over 6,500 people. The *Angus* was again the recipient of auction proceeds from the Trawler Fest. Both vessels are now running on a biodiesel blend and students are informed about this through our education program.

• The Making Lake Michigan Great Tour 2003, funded by the U.S. EPA Great Lakes National Program Office, brought the *W.G. Jackson* vessel to Chicago, Port of Indiana, Milwaukee, Sheboygan, and White Lake. We used the *R/V Neeskay* from the University of Wisconsin-Milwaukee for three days of outreach and education for Waukegan, Illinois students.

• Our Global Learning and Observations to Benefit the Environment (GLOBE) program was selected as an outstanding U.S. partner, and we were honored at the GLOBE Student Learning Expedition in Croatia.

• Fifteen teachers were added to the GLOBE network through training at the Lake Michigan Center. Training partners were the Michigan Environmental Council and the Regional Math and Science Center, with funding by the Dart Foundation. GLOBE is supported by NASA.

• Funding from the Michigan Space Consortium made it possible for the AWRI science instructors to conduct classroom activities and support for GLOBE teachers at the LMC's R.B. Annis Educational Foundation classroom. About 1,325 students were reached by classroom activities and AWRI staff visits to schools.

• AWRI received funding from Nestle Waters to facilitate Michigan Project WET water festivals. Four festivals were held reaching almost 900 students with hands-on water education activities.

• An invasive species workshop for teachers and an essay contest were held in partnership with the Muskegon Chronicle and Michigan Sea Grant.

• AWRI was selected to write the air quality curriculum for the Clean Michigan Initiative Environmental Education Curriculum Project. AWRI is also assisting with drafting the water quality curriculum for that project.

State of the Lake 2003

The Lake Michigan: State of the Lake ’03 conference drew over 250 people from throughout the Lake Michigan basin for two days of updates on Lake Michigan policy and research. The conference was an Institute-wide effort, involving both our principal investigators and support staff. The Great Lakes National Program funded this event in partnership with the U.S. EPA Lake Michigan Forum.

“This conference is a great way for scientific researchers, government agencies, policy makers, and interested individuals to discuss and become aware of current issues affecting Lake Michigan,” says Dr. Janet Vail, who chaired the event. “Our theme was connecting watersheds to Lake Michigan. Because the lake connects watersheds in so many different communities, it’s important that we all work together to preserve and protect this great natural resource.”

Topics covered at the two-day event included lakes and wetland biology, web-based decision tools, contaminants, hydrology and geology, invasive species, local initiative, and data about the Lake Michigan basin and its watersheds. Many of the AWRI researchers made presentations at the conference.

Keynote speaker Dave Ullrich of the Great Lakes Cities Initiative challenged local communities to get involved in Lake Michigan protection. U.S. EPA team manager Judy Beck commented on the new challenges and opportunities for the lake. U.S Representative Peter Hoekstra discussed the Great Lakes Recovery legislation and stressed the important role local communities can play. Lake Michigan Forum Co-chair Ron Baba presented information on the Forum’s Mona Lake Stewardship project.

State of the Lake attendees learn how invasive species are affecting Lake Michigan.

Satellite imagery and aerial photography are used to help identify the land use and land cover types within a watershed.

Muskegon Lake continued

excess sediments. The information the ISC provides can help decision-makers and local groups understand the problems and come up with viable solutions.

In the Muskegon River watershed, the ISC is wrapping up a three-year project, called the Sustainable Futures Project, that will update, examine, and forecast land use and cover conditions within the watershed. The ISC is also developing a 15-page township atlas for each of the 113 townships within the watershed’s boundaries, including important information such as surface geology, topography, presettlement landscape, and land use and cover conditions. Examining how the land has and will change will greatly impact the condition of the entire watershed.

ISC has also created an information depository as part of the Mega Model Project. It is a centralized location where researchers and decision-makers can share critical information, such as scientific reports, recent aerial photography, and up-to-date land use and cover data.

Another critical part of preservation and restoration is education. The Institute’s Outreach and Education Initiatives group, directed by Dr. Vail, strives to help community members and decision-makers understand and become aware of complex environmental issues.

Many of its programs are aimed at involving elementary through high school students in research projects, creating unique learning experiences. In Muskegon Lake, for example, students from area schools contribute to knowledge about the lake through sampling cruises on the *W.G. Jackson*. They compare and contrast Muskegon Lake with Lake Michigan as they study a variety of water quality parameters.

The Institute is also involved in helping the local community deal with concerns that the Muskegon Lake watershed faces. The Muskegon Area of Concern Public Advisory Council, chaired by Dr. Rediske, has been working on several projects, including remediating sediment and restoring Ruddiman Creek, assessing sediment quality of Ryerson Creek, and developing numerical targets for delisting Muskegon Lake.

The Institute's collaborative work on drowned river mouth systems—collecting specimens and analyzing data, creating computer models, generating tools to help assess conditions, and bringing important issues to the forefront of the public's attention—is a great example of how the Institute fulfills its mission. By working together, AWRI researchers and technicians can provide a much clearer and more comprehensive picture of these systems' state of health and offer possible options to protect and preserve this vital natural resource.

Students collect data onboard the *Jackson*.

AWRI Peer-reviewed Publications

Biddanda, B. and J. B. Cotner. 2003. Enhancement of dissolved organic matter bioavailability by sunlight and its role in the carbon cycle of Lakes Superior and Michigan. Journal of Great Lakes Research 29: 228-241.

Anesio, A., P. Abreu, and **B. Biddanda**. 2003. The role of free and attached microorganisms in the decomposition of estuarine macrophyte detritus. Estuarine, Coastal and Shelf Science 56: 197-201.

Abreu, A., L. Rorig, V. Garcia, C. Odebrecht, and **B. Biddanda**. 2003. Decoupling between bacteria and the surf-zone diatom *Asterionellopsis glacialis* at Cassino Beach, Brazil. Aquatic Microbial Ecology 32: 219-228.

Chu, X. and M.A. Marino. Semidiscrete pesticide transport modeling and application. Journal of Hydrology 285(1-4):19-40.

Ruetz III, C.R., A.L. Hurford, and B. Vondracek. 2003. Interactions between brown trout and slimy sculpin in stream enclosures. Transactions of the American Fisheries Society 132(3):611-618.

Ruetz, III, C.R., and D.W. Stephens. 2003. Site selection under differential predation risks by drifting prey in streams. Oikos 102:85-94.

Steinman, A.D., J. Conklin, P. Bohlen, and **D.G. Uzarski.** 2003. Influence of cattle grazing and pasture land use on macroinvertebrate communities in freshwater wetlands. Wetlands 23:877-889.

Baron, J.S., N.L. Poff, P.L. Angermeier, C.N. Dahm, P.H. Gleick, N.G. Hairston, Jr, R.B. Jackson, C.A. Johnston, B.D. Richter, and **A.D. Steinman**. 2003. Sustaining healthy freshwater ecosystems. Issues in Ecology Volume 10. Ecological Society of America.

Uzarski, D.G., T.M. Burton, and J.A. Genet. Validation and performance of an invertebrate index of biotic integrity for Lakes Huron and Michigan fringing wetlands during a period of lake level decline. Aquatic Ecosystem Health & Management (In Press).

Uzarski, D.G., C.A. Stricker, T.M. Burton, D.K. King, and **A.D. Steinman**. 2003. The importance of hyporheic sediment respiration in several mid-order Michigan rivers: comparison between methods in estimates of lotic metabolism. Hydrobiologia (In Press).

Burton, T.M., **D.G. Uzarski,** and J.A. Genet. Invertebrate habitat use in relation to fetch and plant zonation in northern Lake Huron coastal wetlands. Aquatic Ecosystem Health & Management (In Press).

Vail, J.H., R. Morgan, C. R. Merino, F. Gonzales, R. Miller, and J. L. Ram. 2003. Enumeration of waterborne *Escherichia coli* with petrifilm plates: Comparison to standard methods. Journal of Environmental Quality 32: 368-373.

Vail, J.H. 2003. Volunteer monitoring: *E. coli* and fecal coliform bacteria. LakeLine 23(2):33-35.

The R. B. Annis Water Resources Institute works closely with GVSU professors researching our environment. The following professors received AWRI Faculty Research Awards in 2003:

Stephen Burton
Project Title: Extinction Proneness in Amphibians and Aquatic Macroinvertebrates: an Examination of Disturbance Effects

Neil MacDonald
Project Title: Monitoring Soil Solution, Soil Chemistry, and Vegetation Responses to Municipal Solid Waste Leachate Applications at the Fenske Landfill

Alexey Nikitin
Project Title: Biological Remediation of Oil-contaminated Water Using Continuous-flow Aerobic System

Eric Snyder
Project Title: Ecology of Plankton and Periphyton in Western Michigan Streams

AWRI research vessel support was provided to:

United States Coast Guard, Search & Rescue Training

AWRI provides opportunities for students to pursue their interests in our environment. The following students received AWRI internships during 2003.

D. J. Angus-Scientech Educational Foundation Interns:
Elizabeth Haak
Marjory Hool
Shelly Kennedy
Andrew Stille

Ford Motor Company Intern:
Michael Russ

Herbert VanderMey Intern:
Daniel Kroll

2003 AWRI Staff

Director:
Alan Steinman, Professor

2003 Staff/Administrative:
Tonya Cnossen, AWRI Assistant
Heidi Feldpausch, Secretary
Roxana Taylor, Secretary

Information Services Center:
John Koches, Associate Research Scientist
Jean Conzelmann, Research Assistant
Rod Denning, Research Associate
Brian Hanson, Technical Call-in
Abigail Matzke, Adjunct Research Assistant
Laurie Beth Nederveld, Adjunct Research Assistant
Eric Nemeth, Technical Call-in
Kate Rieger, Adjunct Research Assistant
Donna Stevens, Technical Call-in
Nichol Stout, Research Assistant
Kurt Thompson, Research Associate

Outreach & Education:
Janet Vail, Associate Professor
Thomas Baar, Science Instructor
Paula Capizzi, Science Instructor
Bonnie Cowles, Science Instructor
Leslie De Vries, Science Instructor
Candi Goldman, Science Instructor
James Muller, Science Instructor
Roger Tharp, Science Instructor
Gus Unseld III, Science Instructor
Chuck Vanderlaan, Science Instructor

GVSU Vessels/Field Station Operations:
Anthony Fiore, Jr., Fleet Captain
Ronald Brown, Captain
Robert Burns, Captain
Christopher Drake, Deckhand
John Gort, Deckhand
Roger Hillstead, Deckhand
Douglas Maas, Mechanical Engineer
Robert Pennell, Deckhand
Robert Udell, Biofuel Analyst

Ecological Research, Environmental Chemistry:
Richard Rediske, Senior Research Scientist
Augie Kotlewski, Technical Call-in
Jim O'Keefe, Research Associate
Gail Smythe, Technical Call-in

Environmental Research, Environmental Biology:
Bopaiah Biddanda, Assistant Professor
Adam Bosch, Technical Call-in
Beau Braymer, Technical Call-in
Xuefeng (Michael) Chu, Assistant Professor
Matt Cooper, Adjunct Research Assistant
Nick Fiore, Technical Call-in
Mark Luttenton, Associate Professor of Biology
Lori Nemeth, Research Assistant
Carl Ruetz III, Assistant Professor
Don Uzarski, Assistant Professor

Graduate Assistants:
Kenneth Royce Hughes
Aaron Parker
Dana VanHaitsma

Student Assistants:
Eric Andrews
Katie Ballard
Michael Buth
Jennifer DeLoge
Stephanie Gamble
Jonathan Ginka
Mary Horan
Daniel Kroll
Jeffrey Schrag
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Greg Simon
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If you would like more information about AWRI's programs, please call us at (616) 331-3749 or (231) 728-3601, fax us at (616) 331-3864, contact us through the internet at http://www.gvsu.edu/wri/, or write us at Annis Water Resources Institute, Lake Michigan Center, 740 W. Shoreline Dr., Muskegon MI 49441.