Summer 2007

ASC
Aquatic Sciences Chronicle
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UNIVERSITY OF WISCONSIN SEA GRANT INSTITUTE UNIVERSITY OF WISCONSIN WATER RESOURCES INSTITUTE

INSIDE:

UW WATER RESOURCES RESEARCH AND OUTREACH

Gathering Groundwater Resources

Groundwater research verified how quickly nearby contaminants washed pollution through a sinkhole into groundwater and seeped out to a discharge area. Pollution spreads wide, deep, and quickly where the rock is fractured near the surface.

One of Wisconsin's greatest treasures is perhaps its least visible — groundwater. The state is blessed with over one quadrillion gallons of groundwater (enough to cover the state to a depth of 100 feet!) and is highly dependent on this resource, using more than one billion gallons every day. More than 70 percent of the state's residents rely upon groundwater as a source of drinking water, including 97 percent of all inland communities.

In Wisconsin, like many states, responsibility for groundwater management and research falls in the purview of several agencies, including the Departments of Agriculture, Trade & Consumer Protection; Commerce; Health and Family Services; Natural Resources; and Transportation, as well as the University of Wisconsin System. To avoid a cacophony of overlapping decisions and redundant research, however, Wisconsin has developed a nationally unique institution — the Wisconsin Groundwater Coordinating Council (GCC), established by a 1984 state law.

The GCC helps state agencies streamline groundwater policymaking decisions and ensures that agencies' research efforts are complementary. Moreover, the GCC efficiently directs funding towards Wisconsin's most pressing groundwater issues and leverages funding from the federal government and other sources.

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Aquatic Sciences Chronicle

University of Wisconsin Aquatic Sciences Center
1975 Willow Drive
Madison, WI 53706-1177

Telephone: (608) 263-3259
Email: *chronicle@aqua.wisc.edu*

The Aquatic Sciences Center is the administrative home of the **University of Wisconsin Sea Grant Institute** & **University of Wisconsin Water Resources Institute.**

University of Wisconsin Sea Grant Institute is part of a national network of 30 university-based programs funded through the National Sea Grant College Program, National Oceanic & Atmospheric Administration, U.S. Department of Commerce, and through matching contributions from participating states and the private sector. *www.seagrant.wisc.edu*

University of Wisconsin Water Resources Institute is one of 54 Water Resources Research Institutes nationwide authorized by the federal Water Resources Research Act and administered through the U.S. Geological Survey. *www.wri.wisc.edu*

Sea Grant University of Wisconsin WRI University of Wisconsin

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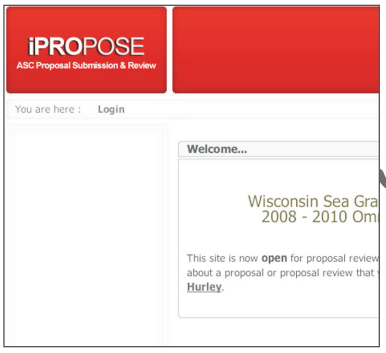


FEATURED WEB SITE
iPROPOSE

aqua.wisc.edu/ipropose

Last fall, the iPRO family got a little bigger. For the past six years, the Interactive Project Reporting Online (iPRO) system has provided an easy, efficient way for Wisconsin Sea Grant and Water Resources principal investigators (PIs) to manage their projects online.

iPROPOSE, its new companion site, is an online proposal submission and review Web site aimed at streamlining the process of applying for Sea Grant funds. Prospective PIs submit a proposal by filling out a series of forms and uploading their full proposal and budget. Assigned reviewers can then complete their reviews online through iPROPOSE by answering a series of questions. Once all of the reviews are completed, a panel is given access to the reviews and original proposals to help decide which proposals are funded.

According to Rich Dellinger, Aquatic Sciences Center web developer, iPROPOSE provides a framework for consistently capturing the same information from all of the prospective investigators, helping to ensure that each proposal is treated equally and fairly. And since iPROPOSE is part of the iPRO family, PIs can easily begin their online project reporting if their proposal is funded.

programpeoplenews

Mr. Hurley Goes to Washington

James Hurley, ASC assistant director for research and outreach, has accepted a temporary year-long position at the National Sea Grant Office in Silver Spring, Md.

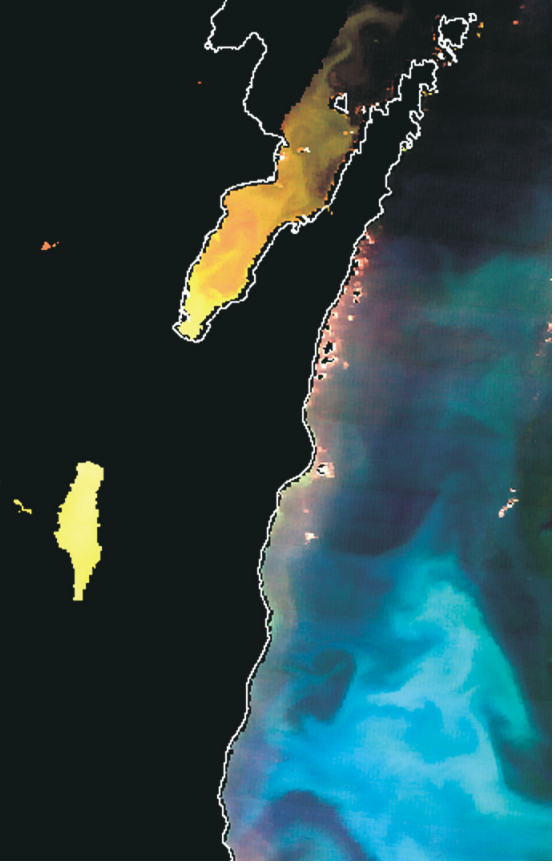
As an associate program officer, Hurley will be working directly with a few Sea Grant programs. He is excited about the opportunity to better understand the administrative structure and policies of the national office, and he is also interested in learning new ideas from other programs.

"That's always how Sea Grant has grown in the past," he said.

Hurley will also help with research competitions and work on a few national initiatives, to be determined when he arrives in Silver Spring in August.

The entire Hurley clan will make the move. His wife, **Nancy**, and children, **Thomas** and **Julia**, are looking forward to exploring the D.C. area and living in the heart of history. And, of course, there is the added benefit of being a mere 7½-hour drive from Fenway Park.

Phil Moy, UW Sea Grant fisheries and aquatic nuisance species specialist, has agreed to be acting assistant director of research and outreach in Hurley's absence.



Nature Enhanced. *To produce this image, Jonathan Chipman amplified visible blue, green and red wavelengths of reflected light to visually emphasize differences in reflectance properties of Green Bay and Lake Michigan. With this manipulation, high algae concentrations in Green Bay and Lake Winnebago produce deep yellow colors. In Lake Michigan, precipitated calcium carbonate produces swirling shades of blue. Land areas have been masked in black. Original image captured by Terra MODIS on Aug. 14, 2001.*

The sensors on the Aqua and Terra satellites are known as MODIS (moderate resolution imaging spectroradiometer) instruments. They sample 36 spectral bands with a ground resolution ranging from 250 to 1000 meters. Images are received and processed daily by several locations around the world, including the UW Space Science and Engineering Center, where they are processed for many applications at the Environmental Remote Sensing Center (ERSC). True-color images of Wisconsin are made available to the public at the ERSC MODIS Imageserver at *www.ersc.wisc.edu/research/sloi/modisserver*. More information on the MODIS instruments and the satellites that carry them is available at

http://modis.gsfc.nasa.gov/.

UW SEA GRANT RESEARCH

Sampling Water from Space

SCIENTIST USES SATELLITES, SUNLIGHT, AND LOTS OF MATH TO MEASURE WATER QUALITY

The warm days of summer regularly trigger explosions of algae in Green Bay and other Great Lakes waters. The water turns green as pea soup, and the algae can be toxic to fish, pets, and people. Zillions of zebra mussels may be making things worse.

Using two satellites soaring 700 kilometers (435 miles) above Earth, remote sensing scientist Jonathan Chipman is seeking new perspectives on the unpleasant phenomenon. His work, funded by UW Sea Grant and other agencies, will soon help water quality managers and municipal, industrial, and agricultural officials better understand what causes excessive algal blooms and what can be done to control them.

Remote sensing cannot replace traditional, in-the-water measurements of water clarity or suspended solids, but it can tremendously multiply the value of those efforts, according to Chipman, a scientist at the Environmental Remote Sensing Center (ERSC) at the University of Wisconsin-Madison.

For example, logistical and economic considerations might limit sampling from a boat to a dozen locations on Green Bay every week. However, using those data to "ground truth" indirect measurements from satellites, remote sensing technology can make similar measurements from thousands of locations every day, covering the entirety of Green Bay, Lake Michigan or other large water bodies any day the skies are clear.

The technology essentially uses light to probe the water. The full spectrum of sunlight, or electromagnetic radiation, includes wavelengths both longer and shorter than visible light. When this radiation reaches the surface of Earth, the chemical composition of the surfaces it strikes — whether they're lakes, forests, parking lots, or rooftops — determines how much of each wavelength is reflected back to space. Thus, anything in the water that absorbs some wavelengths of light and reflects others can be measured by analyzing the reflected light.

Limnologists refer to these light-absorbing and reflecting substances as "color-producing agents," because they affect the apparent color of water bodies. In Green Bay, two of the most important color-producing agents are chlorophyll-related pigments, produced by algae, and particles of sediment that are suspended in the water. High concentrations of chlorophyll-*a* and total suspended solids (TSS) cause an increase in water turbidity and a decrease in water clarity (or Secchi depth).

The two satellites Chipman works with are part of NASA's Earth Observing System. Named Aqua and Terra, they each orbit Earth 14 times every day, one passing over the upper Midwest in the morning; the other, in the afternoon. They carry sophisticated instruments that are like digital cameras sensitive to many wavelengths of light. The instruments divide the scene below them into millions of tiny regions, or pixels, and they record the radiation reflected from each pixel. The data for each pixel, tagged with its precise geographical location, is then transmitted to special receiving equipment on the roof of the UW-Madison Space Science and Engineering Center, home of ERSC.

That's when Chipman's challenges begin. He wants to analyze the energy reflected at the water's surface, but dust, pollution, and water vapor in the atmosphere interfere with that radiation before it reaches the satellites' sensors. So Chipman must, in a sense, mathematically decode the at-sensor radiation data to recover what that radiation looked like the moment it left the water's surface.

Such mathematical filters have been developed by other scientists for other water bodies, but they do not work well for Green Bay. The chemistry of the bay's water, and thus its optical properties, is substantially different from that of, say, the North Atlantic Ocean. It's even quite different from the open waters of Lake Michigan.

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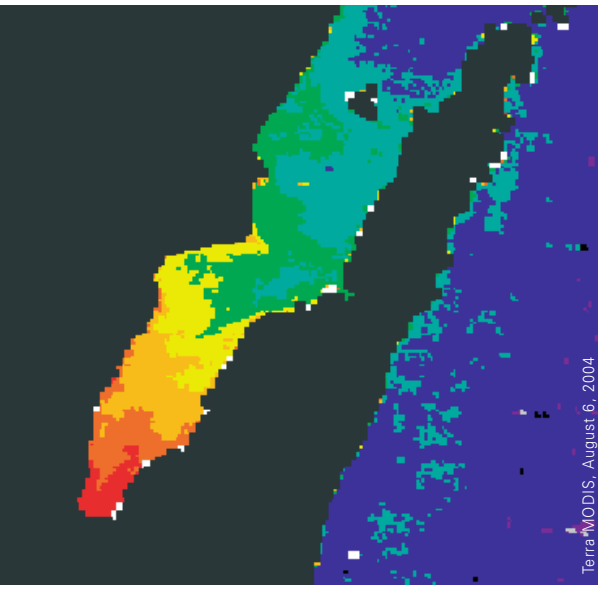


Typical Gradient. *Light reflected from Green Bay, recorded by satellite and analyzed at the UW Environmental Remote Sensing Center, indicates a gradient of water clarity. Inferred Secchi depth measurements were less than 0.5m in the southern bay (red) and 4.0 to 8.0m in the north (dark blue). MODIS image, Aug. 6, 2004.*

Sampling Water from Space

continued from page 3

"I've spent a lot of time producing algorithms that are reliable enough," Chipman said.

A key part of the process involves using field measurements of water quality parameters — such as Secchi depths and chlorophyll concentrations — to "calibrate" a set of numerical models. These models take specific patterns of light measured by the satellites and correlate them with *in situ* measurements (made "in place," from a boat or bouy) on the same date. To give a simplistic example, if a particular *in situ* sampling location (corresponding to a particular pixel in the image) shows a Secchi depth of 2.3 feet, then other pixels in the image with the same surface reflectance values must also have a Secchi depth of 2.3 feet.

Chipman describes this process as "training" the computer to interpret water quality parameters from the satellite imagery. Once the algorithm has been developed and tested, it can be used to estimate water quality at times and places where no field sampling occurred.

Several agencies and scientists provide the vital *in situ* data to Chipman, including the Green Bay Metropolitan Sewerage District and the Wisconsin Department of Natural Resources.

Chipman has so far produced a series of maps of Green Bay, from 2000 to 2006, that are color coded for Secchi depth, chlorophyll-*a* concentrations, suspended solids, and turbidity. He is working on ways to automate the production of such maps and to improve the accuracy of satellite estimates for times when no field data are available for comparison. His ultimate goal is to deliver near-real-time data and maps via the Web whenever the satellites can get a clear view of Green Bay or Lake Michigan.

From such data, maps of monthly and yearly averages can be produced, showing recurring trouble spots and, hopefully, improvements over time, according to Vicky Harris, UW Sea Grant water quality and habitat restoration specialist.

Harris chairs an outreach committee charged with informing people about new daily limits being developed for the amount of phosphorous and suspended solids allowed to enter the Fox River in runoff from farm fields, urban storm water, and sewage and industrial wastewater discharges. The Fox is by far the largest source of such pollution to Green Bay, and that pollution is a main cause of the bay's excessive algae blooms, according to Harris.

Maps of those blooms will demonstrate the problem much more effectively than mere numbers on a chart, Harris said.

"People will be able to see in a highly accessible way what phosphorous and other runoff pollution does to the bay and how extensive the problem is," Harris said. "Hopefully, then they'll be supportive of a solution."

When it comes to water quality measurements, a satellite picture is indeed worth a thousand words – or numbers. —JK

Wisconsin's Water Library

Staff members at the Aquatic Sciences Center send best wishes to JoAnn Savoy for an enjoyable retirement. For the past 16 years, Savoy has been the librarian at the UW Water Resources Library, a UW-Madison special-purpose library housed in Goodnight Hall.

In addition to overseeing 30,000 volumes of water-related information and providing reference and research assistance, Savoy recently expanded her duties to include library outreach. She has been a vital part of many significant efforts to bring the resources of the library to people in the community, including activity-filled reading hours in Madison's Allied Drive neighborhood and, most recently, an exhibit of historic Great Lakes maps at the Memorial Library.

Plans are underway to combine the UW Water Resources Library Web site with two projects Savoy worked extensively on over the last four years, Wisconsin's Water Library and Wisconsin's Water Library for Kids. The new Web site, as well as the library itself, will be renamed Wisconsin's Water Library.

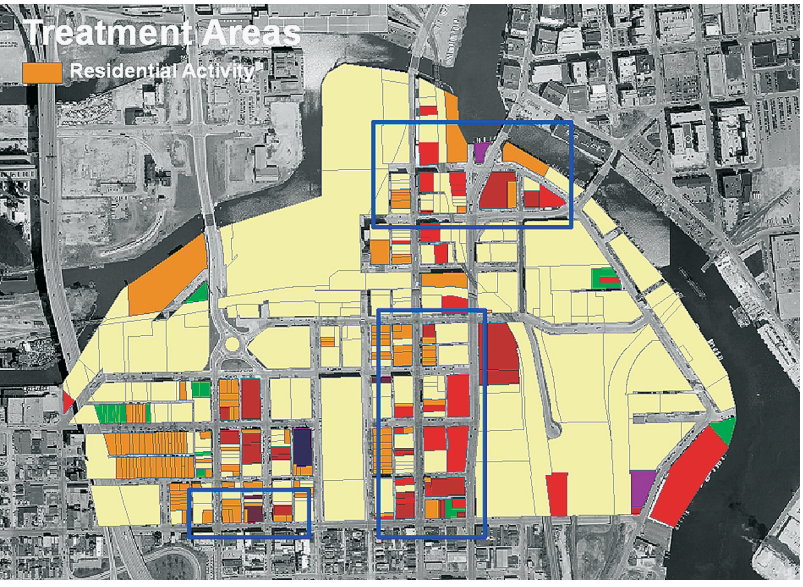
The library will remain open during the summer, and a new librarian will be hired in the fall.

Librarian JoAnn Savoy reads to children at Madison's Allied Drive Learning Center as part of a water-themed reading hour.

Class Evaluates New Tools for Land Use Analysis

Last semester, in a special topics class in urban and regional planning, David Hart and 10 students explored ways geospatial technologies and a sophisticated new land use classification system can work together to analyze land use in a complex urban neighborhood. Hart is the geographic information systems (GIS) specialist at UW Sea Grant and adjunct faculty in the UW-Madison Urban and Regional Planning department.

The class used the Land-Based Classification Standards (LBCS), a "multi-dimensional" classification scheme developed by the American Planning Association in 2001. The system is the first comprehensive update of land use coding and classification since the 1960s. It characterizes land according to activity, function, structure, site, and ownership. While some planning departments have adopted LBCS, many view it as too complicated and time-consuming, according to Hart.



Elements of Vital Districts

- Shopping
- Restaurants
- Civic/Cultural Activity
- Social/Religious Activity
- Art Spaces/Museums
- Other Amusement, Recreation
- Parks
- Outdoor Recreation
- Other Parcels

Fostering a Sense of Place: *Using GIS to explore data in the Land Based Classification System, Student Michelle Scott identified parts of Milwaukee's historic Fifth Ward where beautification projects could improve the area's "sense of place." Scott first created a map showing shopping, restaurants, and other elements of "vital districts." These activities were found to be concentrated in three areas (blue boxes).*

Scott suggested that these areas would most benefit from design improvements, signage, beautification, and other elements of "Main Street Programs." Mapping residential parcels showed where the presence of residents could help keep these areas active well into the evening.

"We wanted to document just how much time and effort an LBCS survey takes," Hart said. "Also, we wanted to showcase the types of maps and reports we could create by using geospatial technology with LBCS. We hope our work helps planners decide whether they should invest in the new system."

The class selected Milwaukee's historic Fifth Ward/Walker's Point neighborhood as its study area. The complex, rapidly-changing neighborhood lies just south of downtown, bounded by the Inner Harbor, the Milwaukee River, I-94, and National Avenue. It includes residences, retail outlets, and industrial sites. It boasts one of the highest concentrations of jobs in the city, and it has a strong Hispanic presence. The city of Milwaukee has just started a development plan for the area, hoping to expand its job base while following smart growth principles.

"The complexity of the neighborhood and the fact that a plan is just getting started made the historic Fifth Ward a perfect place to test out LBCS," said Hart.

On a sunny Saturday morning in March, Hart and his ten students piled into a van and headed to Milwaukee to conduct their survey. Students tackled the challenge of documenting properties ranging from restaurants with apartments above them to loft buildings and vacant industrial sites. Walking the sidewalks and meeting people who live and work there gave the students a taste of life in the neighborhood — literally, in one case when one team was offered a product sample at a local brewery.

After boiling down the real-world complexity of the neighborhood into a database of LBCS codes, students set to work exploring and presenting the data in a variety of ways with GIS maps. The results showed everything from parcels with mixed uses to the owners of multiple parcels. Other maps identified coastal dependent uses and sites for "catalytic projects" — those that would spur desired development in the area. The students also mapped the smart growth principles of creating walkable neighborhoods, fostering a "sense of place," and preserving or expanding open space.

Students presented the results of their work twice at the end of the class — once on campus and again to planners in Milwaukee through a WisLineWeb session originating from the Pyle Center. WisLineWeb is UW Extension's Web collaboration software.

The final products of the course will include a report on the best methods for conducting an LBCS survey and a tutorial that demonstrates exactly how to use GIS and LBCS to conduct land use analyses. Course products will be available on the class Web site: *coastal.lic.wisc.edu/urpl969-spring07/*.

Hart says he and his students learned a lot — and he hopes others can benefit from their experience.

"I think the students really demonstrated the flexibility of the LBCS system and the power of GIS to display that data in helpful, insightful ways," Hart said. —JK

Robert Queen

Gathering Groundwater Resources *continued from page 1*

Through the joint solicitation process for funding research, the GCC's members have provided more than $13 million to over 330 projects characterizing threats to Wisconsin's groundwater supplies and developing new methods for testing, protecting, and remediating groundwater.

This year, the UW Water Resources Institute (WRI) is helping the GCC celebrate more than 20 years of groundwater research with the publication of a pamphlet recounting many significant projects funded through the council over the past two decades.

As part of the GCC, the WRI coordinates the UW System's funding of GCC groundwater projects. Among the many significant projects that the WRI has supported through the GCC are a 2001 study that created a method to estimate more accurately groundwater recharge from rainfall; a 2002 study finding that rain gardens are highly effective at reducing stormwater runoff and increasing urban aquifer recharge; and a 2005 study that compiled exemplar case studies of Wisconsin municipalities incorporating groundwater into comprehensive land use planning.

ASC Assistant Director for Research and Outreach, James Hurley, helps to review research proposals submitted to WRI through the GCC process, notes that the benefits of the GCC's coordinated research efforts are hard to overstate.

"Without a doubt, this program has enabled Wisconsin to be a leader in groundwater research in the nation," said Hurley. "The quality of proposals submitted each year rivals those funded by the NSF and U.S. EPA. It is so important to make these research results available for scientists around the world."

The new WRI pamphlet also recounts various ways in which GCC-supported research has translated directly into policy changes that have protected Wisconsin groundwater from threats by arsenic, nitrates from fertilizer applications, pesticides, and excessive drawdowns of aquifers due to overdevelopment.

Publication of the pamphlet will be followed later this year by a more in-depth series of fact sheets that highlight connections between the GCC's research on individual groundwater threats and more robust groundwater protection.

— Peter Boger

Great Lakes Make the Classroom Greater

COSEE GREAT LAKES
CENTERS FOR OCEAN SCIENCES EDUCATION EXCELLENCE
Dive in and enjoy COSEE's Greatest of the Great Lakes!

Teachers gearing up for another school year have a new resource for working Great Lakes themes into their lesson plans. The *Greatest of the Great Lakes* is a CD-ROM of 41 multidisciplinary activities for grades 4-10 that bridge science with math, geography, environmental studies, and language arts. Funded through COSEE Great Lakes (Centers for Ocean Sciences Education Excellence), this collection offers insight into current Great Lakes concerns, as well as potential solutions.

"These Great Lakes activities have been in existence for some time but haven't been discovered by many educators," said Rosanne Fortner, COSEE project leader and professor emeritus at the Ohio State University. "We chose activities that have been used in classrooms successfully over the years and that address COSEE science goals."

The collection is designed to enhance a number of learning skills, including inquiry, data interpretation, hypothesis development, and decision making. Activities chosen for this collection have been aligned by classroom teachers to state and national science and Earth system standards.

Seven of the activities are available for download through the Illinois-Indiana Sea Grant program at *www.iisgcp.org/edk-12/gogl/gogl.htm*. If you would like to order the *Greatest of the Great Lakes*, send your request and a $15 check payable to the University of Illinois to Susan White, 388 NSRC, 1101 W. Peabody Dr., Urbana, IL 61801.

ASC DROPLETS

Bob Rashid

Look out for the largest fish in the Great Lakes making a splash on the big screen. An IMAX film crew traveled along Wisconsin's Wolf River in April on the lookout for spawning lake sturgeon. The footage will appear in *Wonders of the Great Lakes*, scheduled to be released in May 2008.

The new Great Lakes Research and Outreach Consortium (GLROC) is designed to foster communication, cooperation, coordination, and collaboration on research, education, and outreach projects that address regional problems and opportunities. This consortium of the seven Great Lakes Sea Grant programs will provide the means for any one of the programs to coordinate and develop projects for the entire region as well as accept and distribute funds to the other six programs.

Lake Michigan has been chosen as one of three pilot study sites for use in the development of the National Water Quality Monitoring Network for U.S. Coastal Waters and their Tributaries, a response to a U.S. Commission on Ocean Policy recommendation for a national monitoring network that can provide the information necessary for effective stewardship of ocean and coastal resources. San Francisco Bay and the Delaware River Basin are the other two pilot sites.

Digital Vision

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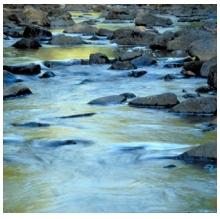
a joint newsletter from UW Sea Grant and UW Water Resources



CALENDAR OF EVENTS

SEPTEMBER 6-8, 2007

3rd Annual Great Lakes Restoration Conference
Chicago, Ill.
www.greatlakes.org/calendar/restoration_conference.asp

SEPTEMBER 16-19, 2007

Great Lakes Sea Grant Network Meeting
Chicago, Ill.
www.environ.uiuc.edu/network

SEPTEMBER 29-OCTOBER 3, 2007

Sea Grant 2007: Uniting for Action
San Diego, Calif.
www.sgmeet.com/seagrant/seagrant2007

OCTOBER 18-20, 2007

Midwest Environmental Education Conference
Stevens Point, Wis.
www.uwsp.edu/cnr/waee/Events/fall07.htm

OCTOBER 29-31, 2007

Making a Great Lake Superior 2007
Duluth, Minn.
www.seagrant.umn.edu/superior2007

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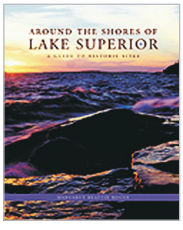

Around the Shores of Lake Superior: A Guide to Historic Sites
Second Edition

by Margaret Beattie Bogue

Cloth $60.00
Paper $29.95

Much has changed in the deep, cold waters of Lake Superior and along its rugged shoreline since 1979, when this book was first released. This completely revised second edition incorporates current research and updated records of human activities to create a "twenty-first-century image of the lakeshore." The University of Wisconsin Press published both editions with support from the UW Sea Grant Institute.

Around the Shores of Lake Superior is an ideal trip planner and a unique guide to the region. Hundreds of landmarks and points of interest are highlighted with short descriptive histories, directions, contact information, and color photographs. In addition, each site is keyed to a beautiful color foldout map of Lake Superior created by the University of Wisconsin Cartographic Laboratory.

For more information, visit *aqua.wisc.edu/publications/*