

NSF Initiative: Enhancing environmental science for the 21st century

by Marcey Westrick

The amount of money given to environmental researchers may triple if Congress approves a new National Science Foundation (NSF) Initiative aimed at increasing environmental research, education, and scientific assessment by an additional \$1 billion over the next five years. Developed by the Task Force for the Environment (TFE), the proposed initiative was released and approved by the National Science Board (NSB), the governing body of the NSF, as an interim report in July. The report, "Environmental Science and Engineering for the 21st Century: The Role of the National Science Foundation," is an effort to improve our nation's scientific basis for environmental decision making.

When it comes to environmental issues, the process of sorting out fact from fiction is often problematic. While credible information is available for some important environmental phenomena, a growing frustration over the lack of adequate scientific information has been evolving. The nation's need for fundamental environmental knowledge and understanding led the NSB to establish the TFE, whose primary goal is to provide guidance to NSF in defining the scope of its role in environmental research and in determining the best means of fulfilling that role.

The report speaks of the "overwhelming importance and exciting opportunities" for progress in the environmental arena and discusses recommendations

"Ecological services are essential to humanity, but their dimensions and values are inadequately understood."

—NSB Interim Report

ranging from research funding to building laboratories. In addition to substantially increasing funding for environmental research, one of the recommendations calls for increasing opportunities and support for interdisciplinary research. Ecosystems must be studied on large spatial and temporal scales to adequately understand environmental phenomena, making it necessary to draw upon and integrate numerous fields of science. NSF funding for multi-disciplinary research and education will lead to significant advances in our environmental knowledge base.

Another recommendation is to create an organizational approach within NSF that is highly visible and has budgetary authority to support multi-discipline environmental research guided by environmental problems rather than by

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Proposal aims for cleaner water

For a quarter of a century, the Clean Water Act has been behind a remarkable effort to reduce pollutants entering our nation's waterways. Tremendous progress in reducing point-source pollution has been made. Non-point source pollution is the reason that 40 percent of America's surveyed waterways remain too polluted for fishing and swimming.

In August, the Clinton administration unveiled a new strategy proposed by the U.S. Environmental Protection Agency (EPA) to achieve clean waters across America. The new proposal would strengthen current Total Maximum Daily Load (TMDL) provisions by requiring states to identify the amount of pollution that a body of water can absorb without surpassing clean water levels. Under this proposal, states must identify waterbodies where state water quality standards are not being met and establish TMDLs for these waters.

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2000



Around the state

WATER RESOURCES UPDATES

Governor signs water management initiative

In an effort to unify the numerous agencies and programs in Minnesota involved in water resources, Governor Ventura signed the Executive Order for the Water Management Unification Initiative in June. Declaring that the sustainability of Minnesota's water resources is of primary importance to Minnesota's economic, environmental, and community health, Ventura expressed hope that the new initiative will allow Minnesota agencies to create specific goals and objectives that deal

comprehensively with water resources and to evaluate regulations and programs for success. Under this new initiative, the Environmental Quality Board will oversee the Water Unification Initiative and develop a statewide framework consisting of water-related goals, objectives, and measurable outcomes for the year 2010 that will be adapted to each major river basin and will serve as the basis for Minnesota Water Plan 2000. In addition, basin-specific goals, objectives and outcomes may be developed, tailored to each major river basin. The Minnesota Water Plan will be used to determine water priorities, policies and budgets for the Ventura administration.

which is under increasing development pressure.

Calthorpe will work with Washington County, Minnesota, and St. Croix County, Wisconsin, to identify opportunities for new types of development and suggest options for the corridor that will better accommodate current and future growth.

The St. Croix Valley Development Design Study is being done in conjunction with planning for the new St. Croix River Bridge. The study will not re-examine the need for a bridge or its location.

Local governments and residents on both sides of the river will be encouraged to participate in workshops to discuss future growth in their communities and their hopes and expectations for the years to come. The study is expected to be completed in the fall, and the results will be available to local governments throughout the metro area.

Phosphorus reduction plan

The MPCA has developed a draft report on a phosphorus reduction plan for the Minnesota River that explains the basis for phosphorus reduction goals for the basin. The report specifies how various programs for point and non-point sources of phosphorus can be used to achieve significant reductions. Phosphorus reduction estimates were developed for municipal wastewater treatment facility permitting, the Conservation Reserve Enhancement Program (CREP), and residue management. Other programs such as feedlots, manure management, and nutrient management also are discussed in the draft plan. To review a copy of the draft plan, or to offer comments and suggestions, contact the MPCA at (507) 280-3592.

WaterShed Partners wins two awards

Governor Jesse Ventura awarded the WaterShed Partners one of five 1999 Minnesota GREAT (Government Reaching Environmental Achievements Together) Awards recognizing outstanding work to prevent non-point source pollution. The Partners also received the 1999 Environmental Initiative Award for Environmental Education from the Minnesota Environmental Initiative earlier this year.

WaterShed Partners is a collaborative of over 35 public and private organizations (including the Water Resources Center) working together in the metro area to promote public understanding of watersheds and educate citizens to play an active role in protecting water quality.

Encouraging smarter community growth

The Metropolitan Council has hired Calthorpe Associates of Berkeley, California, a nationally recognized urban design firm, to develop growth and design alternatives for the St. Croix Valley,

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Aquatic ecologist named director of Minnesota Sea Grant

Carl Richards, an aquatic ecologist, accepted the position of director of the Minnesota Sea Grant College Program in August.

Concurrently, Richards was appointed a professor in the UMD Biology Department.

He is also a faculty member of the Water Resources Science Graduate Program.



Richards was a senior research associate with the University of Minnesota Duluth's Natural Resources Research Institute, where he led Sea Grant studies on Eurasian ruffe ecology and identified potential sites for reintroducing coaster brook trout into Lake Superior streams.

As director and professor, Richards will guide the statewide, national, and international research, outreach, and communications of Minnesota Sea Grant.

Invasive crayfish found in Duluth Harbor

Rusty crayfish (*Orconectes rusticus*) were found for the first time on June 25 in the Duluth-Superior harbor at Minnesota Power's M. L. Hibbard Steam Electric Station near the Bong Bridge. While inspecting for zebra mussels, Doug Jensen, exotic species expert for the University of Minnesota Sea Grant Program, and Eric Skadsberg, Plant Manager, collected four of these invasive crayfish from the screens that guard the plant's water intake pipes. "Rusty crayfish are aggressive, displace native crayfish, and can clear-cut aquatic plant

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"We're taking new action to ensure that every river, lake and bay in America is clean and safe," said President Clinton. The EPA will work in partnership with states to assess the quality of all our waterways—to identify the most polluted waters, and to develop strong, enforceable plans to restore them to health. "These steps will chart a course to clean up 20,000 waterways and ensure that they remain safe for generations to come."

In addition, states would have to allocate further reductions among classes of polluters—a certain amount of pollution would be allowed to come from agriculture, a certain amount from urban areas, and a certain amount from factories and municipalities already regulated. Among much else, the proposal also envisions a market in pollution reduction, in which those able to reduce pollution below required levels could sell or trade their excess ability to others struggling to comply.

While the proposal provides a framework to accomplish a goal objective, enforcement by the states will be the key to success. It will thus be sent to Congress for debate.

beds," said Jensen. "They can grow quickly, avoid fish predation, and are known to chase fish from nests and then eat the eggs."

Jensen believes we can prevent or slow the spread of rusty crayfish through education. He urges everyone not to transport or release crayfish. Boaters should avoid transporting aquatic plants, drain water from boats and motors, and discard unwanted bait on land. "Once rusty crayfish gain a foothold there is no environmentally friendly way to eradicate them," said Jensen. "Preventing the spread of rusty crayfish and all the other aquatic invaders from the harbor is an essential part of protecting our inland waters."

Rusty crayfish are native to the Ohio River Basin. The pest may have spread to Minnesota through live-bait use by non-resident anglers, and releases by students or teachers after studying crayfish purchased from a biological supply house. Rusty crayfish have also spread to other midwestern states such as Michigan, Wisconsin, and Iowa.

Sea Grant Press Release



Council on invasive species established

Representatives from the Departments of Agriculture, Interior, and Commerce gathered for the first meeting of the President's Council on Invasive Species. The council was formed as an executive order from President Clinton in February with the goal of developing a comprehensive plan to minimize economic, ecological, and human health impacts of invasive species. Currently, the economic impact of invasive species is estimated at approximately \$123 billion annually.

The executive order charges all federal agencies with responsibility to take aggressive steps to prevent the introduction and spread of invasive species in our nation's ecosystems.

Workshop focuses on cumulative impacts of development

In August, representatives of federal, state and local government agencies, the University of Minnesota, and private organizations attended "Cumulative Impacts of Development on Lakes," a workshop sponsored by the Water Resources Center. Participants came together to share their expertise and exchange ideas about how to better monitor the impact that development is having on Minnesota's lakes.

The workshop addressed impacts of urban/suburban development in four focused discussions. The principal goal of the workshop was to solicit ideas from researchers and resource managers about the increasing pressure on lakes and how to monitor their stressors. The workshop included brief presentations of preliminary results from a Water Resources Center study funded by the Department of Natural Resources to assess the cumulative impacts of development on lake water quality. The study makes extensive use of satellite imagery (see adjacent box). Several presentations at the workshop featured the use of this technology to estimate impervious areas in watersheds and to monitor trophic conditions in lakes.

Interestingly, most participants emphasized the need to monitor socio-logical issues of lakes and to increase public education about unintentional impacts on lakes. "Water quality is not an issue until some trigger level is finally reached that the public will no longer tolerate," said Minnesota Sea Grant Educator, Cindy Hagley. "We need to link social issues to biological repercussions so the public can better understand how they are influencing Minnesota's water resources."

For more information, contact the Water Resources Center at the University of Minnesota at (612) 624-9282.

GIS and Satellite Imagery: Tools for water quality assessment

by Erin Day

A group of University researchers is examining the use of GIS and satellite-based remote sensing for regional water quality assessments in Minnesota. Professors Pat Brezonik, Jim Perry, and Marvin Bauer, and their students are using these techniques to study cumulative impacts of development on lakes. The study aims to identify relationships between lake water quality and related land use/cover factors and to develop metrics to assess the effects of changing land use and development on lakes. To demonstrate the usefulness of remote sensing for assessing impacts of development, researchers are comparing lakes in the rapidly growing area of Alexandria, Minnesota, with similar but more developed lakes in the Twin Cities Metropolitan Area (TCMA). Landsat (satellite) images for late-summer conditions were processed by WRS graduate student Erin Day and WRC scientist Leif Olmanson to develop estimates of trophic state conditions in all lakes of the two areas. The estimates are based on strong correlations that have been found between satellite-measured reflectance of the lakes in certain wavelength bands and ground-based measurements of Secchi disk transparency and chlorophyll levels for a subset of the lakes.

Adjacent riparian land use is also being evaluated using GIS techniques to determine which land uses may be reducing water quality in the two areas. A 150-meter buffer around lakes was identified as having the greatest impact on the water. Land-use variables such as percent-imperviousness, number of farm animal units, population density, and land cover type were considered along with such lake characteristics as depth, area, and bathymetry.

In addition, satellite imagery was used by WRS student Jean Doyle to estimate the amount of impervious area within each of the contrasting regions of interest. The researchers expect to be able to express probabilistic relationships between lakes and their watersheds and to identify the most sensitive variables for future impact assessments.

U of M acquires new water chemistry faculty

Faculty expertise in the area of environmental water chemistry has increased significantly at the University of Minnesota with the addition of three new assistant professors: Matt Simcik (Ph.D., Rutgers University), who joins the Environmental and Occupational Health Division in the School of Public Health; Bill Arnold (Ph.D., Johns Hopkins University), who joins Environmental Engineering Program in the Department of Civil Engineering, and Kris McNeill (Ph.D., UC-Berkeley), who joins the

Department of Chemistry. Simcik's specialty is atmospheric transport of organic contaminants and their fate in large lakes. He recently completed a post-doctoral position at Indiana University. Arnold specializes in chemical degradation pathways of organic contaminants in groundwater. McNeill, who specializes in photochemical degradation processes, will arrive full-time in January after completing a post-doctoral appointment at MIT. He already has been active in promoting cooperation among the U's environmental chemistry programs by developing a web site that links these programs and their faculty (see <http://www.chem.umn.edu/groups/mcneill/envchem.html>).

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disciplines. This concept is similar to the proposal from the Committee for the National Institute for the Environment (CNIE) for a non-regulatory agency that would support interdisciplinary research and education efforts. The NSF report recommends the implementation of nearly all of the activities proposed for a National Institute for the Environment, and is praised by the CNIE for its bold vision. The CNIE proposal for a new agency was endorsed by over 440 universities, and private, public, and non-profit agencies. "The concrete recommendations in the report address the central concern of the CNIE and its constituencies: namely, to improve the scientific basis for environmental decision-making. If the NSF will now fully implement the recommendations of its Board, this would help focus science on important environmental problems that people care about, and the CNIE will enthusiastically support the NSF efforts," stated CNIE president, Richard Benedick.

The NSB report was released as an interim document to provide opportunity for discussion and consultation with the National Science and Technology Council, the scientific community, the public and private sectors, and other interested parties. The NSB welcomes comments at its website, <http://www.nsf.gov/nsb/tfe/nsb99133/start.htm>, until November 1, 1999, when the report will be sent to Congress.

NSF report recommendations

- ◆ **Resources and Funding:** Make environmental research, education and scientific assessment one of the highest priorities.
- ◆ **Organizational Approach:** Ensure a well-integrated, high priority, high visibility, cohesive, and sustained environmental portfolio within the NSF.
- ◆ **Interdisciplinary Research:** Greater investment, more effective support mechanisms, and strengthened capabilities for identifying research needs, prioritizing across disciplines, and providing for their long-term support.
- ◆ **Disciplinary Research:** Enhance environmental research within all relevant disciplines and make significant new investments in research critical to understanding biocomplexity, including biological/ecological and social sciences and environmental technology.
- ◆ **Long-Term Research:** Significantly increase investments in existing long-term programs and establish new support mechanisms for long-term research.
- ◆ **Environmental Education:** Enhance formal educational efforts by encouraging proposal submissions that capitalize on inherent student interest in environmental areas while supporting significantly more environmental educational efforts through informal vehicles.
- ◆ **Scientific Assessments:** Significantly increase research on methods and models that support the scientific assessment process.
- ◆ **Enabling Infrastructure:** Give high priority to enhancing infrastructure for environmental observations and collections, and new information networking capacity.
- ◆ **Environmental Technology:** Vigorously support research on environmental technologies, including those that can help both public and private sectors, avoid environmental harm, and permit wise utilization of natural resources.
- ◆ **Enabling Technologies:** Enable and encourage the use of new and appropriate technologies in environmental research and education.
- ◆ **Environmental Information:** Take the lead in enabling a coordinated, digital, environmental information network.
- ◆ **Implementation of Partnerships:** Actively seek and provide stable support for research, education, and assessment partnerships that correspond to the location, scale, and nature of environmental issues.

Announcing



Minnesota Water 2000 Conference

Theme: Status of Minnesota's ground and surface waters as we begin the millenium

Date: April 23 and 24, 2000

Location: Minneapolis Convention Center

Contact: Tracy Thomas, Water Resources Center,
thoma032@tc.umn.edu, (612) 625-2282

A formal call for papers will be issued in November



Minnesota Water Community News

Kerry Kelts (Dept. of Geology and Geophysics) received a \$1.4 million grant from the National Science Foundation's Earth Systems History and International Continental Drilling Program to develop a mobile drilling rig to take long undisturbed cores from lakes throughout the world. **Kelts** traveled to Brest, France, in June to attend the 2nd Congress of Limnogeology. In addition to giving the opening keynote speech, "Frontiers of Limnology," he presented joint results on seismic evidence of neotectonic movements along earthquake faults below the Great Salt Lake. He was also elected as the new president and received the Bradley Silver Medal of the International Association of Limnogeology.

Emi Ito (Dept. of Geology and Geophysics) was appointed acting director of the Limnological Research Center while Kerry Kelts is on leave.

Elise Ralph (Dept. of Physics and Large Lakes Observatory, UMD) was featured in the July 5 issue of *Newsweek* for her research on warming trends in Lake Superior.

Bruce Wilson (Dept. of Biosystems and Agricultural Engineering) presented "Evaluation of Surface Inlet Designs Using a Prototype," at the 1999 ASAE Annual International Meeting in Toronto, Canada, in July. **Gary Sands** (Dept. of Biosystems and Agricultural Engineering) gave a presentation at the same meeting on drainage research and outreach priorities and projects in Minnesota.

Deborah Swackhamer (Dept. of Environmental and Occupation Health) presented "Atmospheric Deposition of Persistent Organic Pollutants and Potential for Human Exposure" at the joint annual meeting of the International Society for Exposure Analysis and the International Society of Environmental

Epidemiology in Athens, Greece, in August.

Jim Perry (Dept. of Forest Resources) and **Pam Davis** (Water Resources Science) joined staff of the Science Museum of Minnesota in leading a workshop on faculty development. The workshop is part of the NSF Faculty Institutes for Reforming Science Teaching. The workshop involved faculty from the University of Minnesota, the University of Wisconsin, and Hamline University. **Perry** also received a grant from the Forest Resources Council to study the impacts of riparian zone management in conjunction with the MNDNR and USFS. In addition, **Perry** assumed responsibility as the Director of Graduate Studies for Water Resources Science. He succeeds **Patrick Brezonik** who stepped down after guiding the program for four years, providing leadership during times of significant growth.

Patrick Brezonik (Civil Engineering, WRC) has been appointed to a new National Research Council (NRC) Committee on Restoration of the Greater Everglades Ecosystem.

Congratulations to **Bob Sterner** (Dept. of Ecology, Evolution, and Behavior) who was promoted to Professor.

Jay Hatch (Dept. of Fisheries and Wildlife) received a grant from the Minnesota Department of Natural Resources for his project, "Topeka shiner surveys and life history and habitat characterization in Minnesota—Phase I."

Keith Anderson, Cindy Hagley, Doug Jensen, and Glenn Kreag (Minnesota Sea Grant) received a research award from the University of Minnesota Association of Extension Educators Community and Natural Resources Association for their

work on the 1998 Minnesota lakes survey. The survey was a cooperative project with the Minnesota Department of Natural Resources and was cited as an example of quality applied research.

John Gulliver (Dept. of Civil Engineering) was appointed the first holder of the Joseph T. and Rose S. Ling Professorship in Civil Engineering. One of Gulliver's students, **Alicia Urban**, received a \$10,000 scholarship from the U.S. Committee on Large Dams, and presented an invited paper entitled "Modeling Total Dissolved Gas Levels and Associated Environmental Impacts Due to Dams" at the annual conference in Atlanta, Georgia.

Janell Miersch (Water Resources Science) was hired by Minnesota Sea Grant to organize shoreland and lake-related materials into a shoreland guidebook. The project is funded by the Minnesota Legislature through the Board of Water and Soil Resources.

Barb Liukkonen (University of Minnesota Extension Service and Minnesota Sea Grant Program) has returned to the Water Resources Center after a year's sabbatical as program director for the Rivers Council of Minnesota. She will focus primarily on shoreland education, including the Shoreland Volunteer Program, Water on the Web, and helping citizens understand water quality data and shoreline restoration.

Midhat (Miki) Hondzo has joined the Department of Civil Engineering and St. Anthony Falls Laboratory as an assistant professor of water resources engineering. He received his Ph.D. from the University of Minnesota in 1994 and was on the faculty of Purdue University for the past four years.



Upcoming Events

October 10–15. **Dam Safety '99.** St. Louis, MO. Hosted by the Association of State Dam Safety Officials, this conference will be an opportunity for national dam safety professionals to share the latest technologies and research. For more information, contact ASDSO at (606) 257-5146.

October 13–15. **The Midwest Groundwater Conference.** St. Paul, MN. Hosted by the Minnesota Department of Natural Resources and the Minnesota Pollution Control Agency, this conference will provide an opportunity for groundwater scientists from different states to meet and discuss mutual problems in the Midwest and summarize results of field data. For further information, contact James Lundy at (800) 657-3864 or E-mail: jim.lundy@pca.state.mn.us.

October 23. **Great Plains Limnology Meeting.** Columbia, MO. For more information, please contact Jack Jones at (573) 882-3543 or Lorna Gilliland at (573) 882-3436.

October 25. **32nd Annual Water Resources Conference.** St. Paul Campus, University of Minnesota. The theme of the morning general session is "Sustainability—Sustainable Storm Water Management, Sustainable Agriculture and Biodiversity, Sustainability and Minnesota Water Resources." The afternoon will consist of three concurrent sessions: Sustainability, Wetlands, and Drainage Issues. For more information, contact Bev Ringsak at (612) 625-6689 or E-mail: bringsak@tc.umn.edu.

October 28. **The Next Generation of Sewage Treatment: Flushing in the New Millennium.** St. Paul, MN. A live satellite conference from the University of Minnesota Extension Service Onsite

Sewage Program. Explore on-site sewage treatment alternatives for individual residences and small groups of homes where standard trench and mound treatment systems are not a good choice because of high groundwater, shallow bedrock, small lot size, or poor soil conditions. For more information, call the U of M On-Site Sewage Treatment Program at (800) 719-2825 or visit <http://www.extension.umn.edu/water/>.

October 29–30. **Sharing the Heartland: Practical Tools for Conserving Farmland and Natural Resources.** Recognizing the importance of protecting farmland and natural resources in Minnesota, a number of organizations and agencies have joined together to sponsor this statewide conference. For more information, visit <http://www.mn.nrcs.usda.gov/conference/heartland.htm>.

November 4. **Colloquium on Ecological Risk Assessment of Exotic Species.** Sponsored by The Midwest Ecological Risk Assessment Center, this colloquium will begin with theory, discuss applications to current research, and end with a discussion of how a state agency uses ecological risk assessment in the regulation of exotic species. For more information, contact Barb Murdoch at (612) 626-0149.

November 8–9. **The Practice of Restoring Native Ecosystems.** Nebraska City, NE. Sponsored by the National Arbor Day Foundation, this conference will examine the principles behind the concept of restoration as well as important issues, approaches, and techniques. For more information, call (888) 448-7337 or E-mail: conferences@arborday.org.

November 8–9. **Lake Michigan: State of the Lake '99.** Muskegon, MI. The U.S. Environmental Protection Agency Lake Michigan Forum and the Robert B. Annis Water Resources Institute of Grand Valley State University will host this conference on Lake Michigan. Policymakers, scientists, agencies, and the general public will have an opportunity to be updated on Lake Michigan issues and research as well as to assist in providing input for the Lakewide Management Plan. Highlights include the Lake Michigan Mass Balance Study, habitat and fisheries, and fluctuating lake levels. For further information, contact Dr. Janet Vail at (616) 895-3048 or E-mail: vailj@gvsu.edu.

We've Moved!!

The Water Resources Center can now be found in Suite 146 of the Classroom Office Building, 1994 Buford Avenue, on the St. Paul campus. Our telephone and fax numbers will remain the same.





New Publications

Hennepin County Indicators of Community Sustainability. 1999.

The fourth annual assessment of conditions throughout the county, providing data on 39 indicators, relating to three broad areas of community sustainability: economic, social and environmental health. Available from Hennepin County; call (612) 345-8795.

Urbanization of Rural Landscapes 1999: Syllabus and Teaching Materials from a University Course. This report provides useful ideas to instructors who want to design a course on this topic or modify an existing course. Available from the Center for Sustainable Agricultural Systems; call (402) 472-2056.

Status and Trends of the Nation's Biological Resources. 1999. This 2-volume report from the USGS synthesizes current information within a historical perspective to document how the nation's biological resources are changing. For more details on the report,

please visit <http://www.usgs.gov>, or call (703) 648-4073.

The quality of our nation's waters: nutrients and pesticides. 1999.

This report is the first in a series of non-technical publications designed to describe major findings of the National Water-Quality Assessment Program regarding water quality issues of regional and national concern. Available from the USDA; call (651) 872-0967.

New Publications from the US Geological Survey: Publications issued January–March 1999. USGS Permanent catalog, list 1086-1088. Available from the USGS; call (612) 783-3100.

Protecting Lake Superior: Lakewide Management Plan, Stage 2, Load Reduction Targets for Critical Pollutants. 1999. This report outlines targets for reducing discharges of nine critical pollutants into Lake Superior. The targeted pollutants include dioxin,

mercury, hexachlorobenzene (HCB), octachlorostyrene (OCS), polychlorinated biphenyls (PCBs); and the pesticides chlordane, DDT, dieldrin, and toxaphene. Available from the U.S. EPA; call (312) 886-0132.

Concentrated Animal Feeding Operations Draft Permitting Guidance. 1999. In an effort to facilitate and improve NPDES permitting program for concentrated animal feeding operations, EPA has published a draft guidance manual and example NPDES permit for permitting authorities. EPA is requesting public comment; for a copy of the draft guidance manual and example permit, visit <http://www.epa.gov/owm/afoguide.htm>.

Draft Cooperative Management Plan Environmental Impact Statement. 1999. This plan presents and analyzes six alternatives for a cooperative management plan for the Lower St. Croix National Scenic River. Available from the USNPS; call Randy Thoreson at (651) 439-7122.

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