# Illinois State Water Survey

# Annual Report 1998-1999

## What a Difference We Make . . .

# Illinois State Water Survey

# Annual Report

## 1998-1999

**2204 GRIFFITH DRIVE**
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**1999**

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All photographs provided by Water Survey staff

**Front cover**: A Geographic Information Systems shaded relief map of Illinois based on a 1:250,000 scale U.S. Geological Survey Digital Elevation Model (clockwise from top right): Dana Shackleford installs a water quality monitor on the Cal-Sag Channel; Bank erosion on the Kankakee River at Six-Mile Pool; State Representatives Tim Osmond (center) and Ron Lawfer (far right) confer with Survey staff at the Legislative Sportsmen's Caucus Tour at the Waste Management and Research Center; Cypress trees grow in Horseshoe Lake of the Cache River watershed; Jet Hall drills an observation well in Tazewell County; and Erin Hessler surveys elevations near Peoria Lake.

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ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

# Introduction


In preparing the final annual report of the millennium, it is natural to reflect on the evolution of water issues in Illinois since the founding of the Illinois State Water Survey in 1895. With a hazy crystal ball and with some trepidation, I also gaze into the new millennium.

A century ago, safe drinking water was the major concern for the rapidly growing number of Illinoisans. Even before the application of inorganic fertilizers and the establishment of drinking water standards, shallow wells in much of the state had high concentrations of nitrate—probably a combination of naturally nitrogen-rich soils and animal wastes. As the population of Chicago soared past a million, the discharge of human and industrial wastes into Lake Michigan and the Illinois River posed increasing health problems. These wastes fouled rivers and streams in every county, and the Illinois River was described as an open septic system. Typhoid and cholera were a direct result of contaminated water supplies.

A reported 40-year average of 7,700 cubic feet of Lake Michigan water per second (cfs) was diverted into the Illinois River when the Chicago Sanitary and Ship Canal opened in 1900. Prior to the opening of the canal, the average flow of water in the Illinois River at Averyville, near Peoria, approximated 10,000 cfs. This diversion of lake water diluted the waste, helped transform organic material into inorganic material, and dispersed the resulting material further downstream. Construction of waste treatment plants later reduced the pollution load in the river. The overall benefit of the improvements was that the incidence of disease decreased.

However, total pollution loading in the Illinois River was high and increased. After construction of the Illinois lock and dam system in the 1930s, siltation increased and further compounded water-quality problems. Throughout the first 60 years of this century, the Illinois River was hypoxic (depleted of the oxygen needed to sustain life), and ecological conditions deteriorated.

With implementation of regulations and better waste management practices, water quality has improved dramatically over the last 30 years. Aquatic ecological conditions also have improved significantly, and the numbers of fish, birds, and other animals and plants have increased.

Of particular importance to me is that the Water Survey, together with the other Scientific Surveys, has played a major part in the collection and reporting of high-quality data that have allowed scientists to document both the earlier deterioration and the subsequent partial recovery of ecological conditions in the state. We would not be able to document these changes without these data, which allow Survey scientists to make valuable contributions to important policy debates 100 years after the data were collected and reported.

These data sets are unique in the state and nation. For example, historical water-quality data allow us to refute the hypothesis of scientists preparing assessments of hypoxia in the Gulf of Mexico: that the flux of nitrogen from Midwest states has doubled or tripled over the last 50 years and increased 2- to 7-fold over the last 100 years.

The historical data show that nitrogen concentrations in the Illinois and Mississippi Rivers were already high in the "pre-disturbed" Illinois River in the 1890s, that nitrogen concentrations reached a peak in the 1920-1970 period, and that nitrogen concentrations have declined in recent decades. Nitrogen concentrations have not increased many fold

over the past 100 years. Contrary to the conclusion of the federal hypoxia assessment, historical data also demonstrate that the spring peak in nitrogen concentration was characteristic of Illinois rivers and streams 100 years ago and is not a recent phenomenon caused by fertilizer use.

The roles of fertilizer use, human waste, manure, atmospheric deposition, soil cultivation, and other sources on the flux of nutrients in rivers must be evaluated in light of these historical water-quality trends. Unless all sources and all forms of nitrogen are considered, reasonable scientific understanding of these complex issues cannot be attained. Changes in nitrogen amounts and forms in Illinois rivers and streams can be understood only when changes in other chemical elements, such as oxygen and carbon, are also considered.

Without historical data, scientists, laypersons, and policymakers alike can reach erroneous conclusions about the causes and consequences of human activities on the environment and can develop inappropriate and ineffective response strategies. Science and scientists at the Water Survey provide objective, comprehensive scientific data about the natural environment and human activities for use as a basis for making wise and effective decisions. And this leads to the theme of this report, "What a difference we make!"

As usual, this report provides information about ongoing projects, development of new projects, and lists of publications, honors, contacts, and sources of additional information. This year there are also examples of the benefits of using data and information provided by Water Survey scientists and engineers. The various benefits extend beyond Illinois to other states in the Midwest and to the nation and include economic savings, protection of human health, and restoration and protection of the environment. For every state dollar directly appropriated, the Water Survey leverages an additional $1.63 from other state, local, and federal sources. Beyond this benefit, the cost-benefit ratio increases many fold as Water Survey products are used in decisionmaking and in education.

Within my hazy crystal ball, I see the need for water and atmospheric data increasing rapidly in the new millennium. Water in rivers, streams, and ground-water aquifers will become an increasingly scarce and valuable resource as continued economic and population growth undoubtedly place increasing demands on surface and ground water.

Regulations, policies, and laws related to the allocation and quality of water resources will tighten. Improved capabilities of scientists to forecast future states of the atmosphere and of decisionmakers to use these forecasts will result in improved risk management and loss reductions. Scientists will be called upon to provide more data and improved analytical tools to project the consequences of proposed actions and to understand trade-offs between competing forces and interests. Spatial and temporal perspectives will broaden as the public and decisionmakers further consider the cumulative consequences of their actions on their neighbors and on future generations.

The value of Water Survey data and services will increase. One test will be whether Water Survey data are used at the end of the 21st century to shape public policy debate and decisions, just as data collected in the 19th century are being used today.

Derek Winstanley, Chief

## Extension And Education Activities

### *William C. Ackermann Scholarship Recipient*

University of Illinois student Scott W. Tieman of Urbana was the recipient of the 1999 W.C. Ackermann Scholarship. The presentation was made on April 16, 1999, by Chief Derek Winstanley and Nicholas Schneider, Executive Director of the Nature of Illinois Foundation. The $1,000 scholarship is awarded annually by the Nature of Illinois Foundation and the Illinois State Water Survey. Mr. Tieman is a May graduate with a B.S. in Civil Engineering.

His senior thesis work focused on the use of reverse osmosis technology for the removal of organic matter, pesticides, and nitrates in Lake Decatur, the drinking water supply for the city of Decatur. He will begin graduate work in Civil and Environmental Engineering this fall at the University of Illinois at Urbana-Champaign (UIUC). The W.C. Ackermann Scholarship was established in honor of Dr. William C. Ackermann, Chief of the Illinois State Water Survey and Professor of Engineering at UIUC from 1956-1979. Mr. Tieman is the sixth scholarship award recipient.

*Scott W. Tieman (center) accepts the 1999 W.C. Ackermann Scholarship from Chief Winstanley (right) and Dr. Nicholas Schneider, Executive Director, Nature of Illinois Foundation (left).*

### *Enhancing Relationships with the University of Illinois*

For more than a century, the Department of Natural Resources' Scientific Surveys have enjoyed a close working relationship with the faculty and students of the University of Illinois at Urbana-Champaign (UIUC). The Surveys' primary facilities are located on the UIUC campus in buildings owned and maintained by the University. This physical proximity provides many opportunities for collaboration between UIUC students and faculty and Survey research scientists.

Under the terms of a new agreement established between the University and the Scientific Surveys, this relationship will be enhanced by promoting undergraduate internships, graduate assistantships in a new Earth Systems Sciences Program, shared sabbaticals, and joint faculty/Survey appointments. The intent of this new partnership agreement is to formalize some of the relationships that currently exist and to enhance the educational experience for undergraduate and graduate students by providing exposure to natural resources issues studied by the Surveys.

The Earth Systems Sciences Program, a graduate-level certificate program, will bring together many campus departments and the four Scientific Surveys working together to serve as student advisors. Students enrolled in the program will select a research or thesis topic that will involve at least one faculty member paired with a Scientific Survey staff member. Students will be encouraged to conduct their research at the Scientific Surveys but may also elect a University department as their primary research location. Initiation of this new program is scheduled for the fall 1999 semester.

### *Second Annual Allerton Park Chautauqua*

The second annual Allerton Park Chautauqua was held on Sunday, June 6, 1999, at the University of Illinois' Robert Allerton Park in Monticello to highlight University units in cooperation with local communities using a

*Jerry Soesbe, Director of Robert Allerton Park (left), participates in the "Taste Test" at the Allerton Park Chautauqua as Water Survey staffer Susie Dodd watches.*

format developed in the late 1800s in Chautauqua Lake, New York. Chautauquas were popular family and community events during the late 19th century and early 20th century and evolved into a type of "summer camp" of educational programs and cultural arts. More than 900 participants visited this year's outdoor one-day event.

The Water Survey was one of the campus units represented with a "taste test" exhibit that asked participants to determine if they could taste the difference between distilled water and local ground water. This was coupled with an informational display about the importance of ground water as a source for much of the state's drinking water supplies. More than 400 participants defied 90-degree heat to "take the test" and learn more about the state's valuable ground-water resources.

## Scientific Surveys Sponsor First Annual Science Showcase

The Scientific Surveys hosted their first annual Science Showcase on October 16, 1998, at the Illini Union on the University of Illinois at Urbana-Champaign (UIUC) campus. "Why on Earth?" provided a forum for the Surveys to present results from some of their studies to the public. The day-long event was held to coincide with National Earth Science Week and included a panel discussion by the four Survey Chiefs, technical presentations by staff on current environmental issues, poster presentations, demonstrations, and a science quiz bowl that teamed middle and high school science students in an exciting, educational competition. The 1999 Science Showcase has been scheduled for October 4 at the Illini Union and will be called the "Natural Resources Expo." This year's event will include an expanded science quiz bowl, a tabletop sand model describing the geological history of Illinois, and more hands-on demonstrations that describe the work of the Surveys.

*Water Survey engineer Sally McConkey (right) demonstrates a flood-plain model at the October 16 Science Showcase.*

## Scientific Surveys Host Legislative Tours

The Scientific Surveys hosted visits from Lt. Governor Corrine Wood and the Legislative Sportsmen's Caucus during January 1999. On January 25, Lt. Governor Wood met in Champaign with the Survey Chiefs and Department of Natural Resources Director Brent Manning for a brief facilities tour, followed by summaries by the Chiefs of key natural resources issues being addressed by the Surveys.

In her role as Lt. Governor, Ms. Wood leads the Illinois River Coordinating Council, a governmental body charged with developing and implementing a comprehensive plan for the river's future. Several Survey staff members, including Chief Derek Winstanley, serve on the Science Advisory Committee to the Council. In addition to Lt. Governor Wood, State Representative Rick Winkel and State Senator Stanley Weaver also participated in the facilities tour and discussions. University of Illinois President James Stuckel was also present to meet the Lt. Governor and welcome her to the Urbana-Champaign campus.

On January 29, the Surveys hosted members of the Illinois Legislative Sportsmen's Caucus at an event held at the Waste Management and Research Center in Champaign. This event was organized by Representative Winkel and Senator Weaver and was attended by 10 Caucus members, 5 representatives from state conservation groups, and representatives from the University administration. Each Survey presented posters and demonstrations describing how Survey work helps protect and enhance the state's natural resources. This was the third tour in recent years for Illinois General Assembly representatives, and the event's growing success will likely result in similar gatherings on a biennial basis.

## *Surveys Participate in Farm Bureau Leadership Conference*

On March 1, 1999, the Water Survey and representatives from the other Scientific Surveys presented overviews of their research and service programs to Illinois Farm Bureau members attending their annual Governmental Affairs Leadership Conference in Springfield. The focus of Survey presentations was how research conducted by the Surveys assists the Illinois agricultural community.

The Water Survey display provided information on weather and climate services and water quality and quantity research efforts that have a direct impact on issues of concern to the Farm Bureau and its statewide constituency. Approximately 45 Farm Bureau members attended the presentations. Department of Natural Resources Deputy Director John Comerio delivered welcoming remarks and encouraged attendee feedback on making this forum available on a regular basis for each annual Leadership Conference.

*DNR Director Brent Manning (center) discusses the Department's role in stream bank erosion control with Senator Stanley Weaver (right) and members of the Legislative Sportsmen's Caucus.*

*Geographic Information System specialist Kingsley Allan (center) describes county and statewide databases.*

*Displays for the Legislative Sportsmen's Caucus tour were arranged throughout the Waste Management and Research Center.*

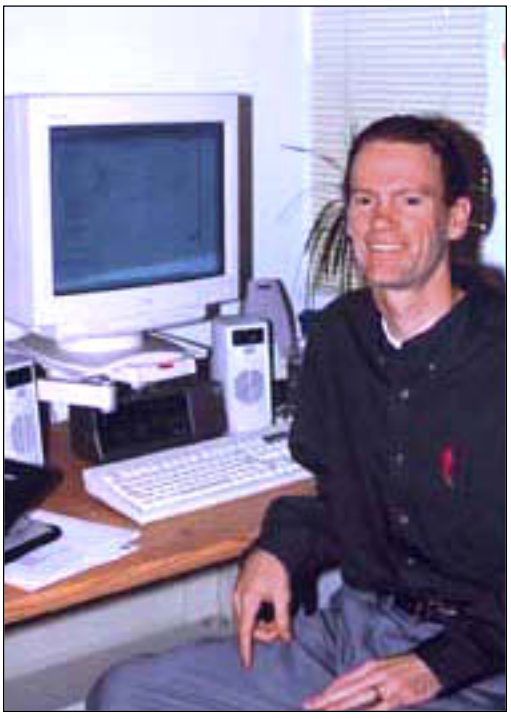
*Water Survey Chief Derek Winstanley (left) briefs State Representative Suzanne Bassi on floodplain information available from the Survey.*

## Web Site: Internet and Intranet

Overall use of the Water Survey Web site (http://www.sws.uiuc.edu/) on the Internet is rising. Between May 1998 and May 1999, usage has jumped more than 300 percent due to the posting of more quality data and improved links with search engines and other Web pages. Unique long-term databases and lists of Water Survey publications are being added. Promotional plans are being developed to attract even more users and establish the Water Survey as a resource for water information on the Web.

The primary goal of the Survey's Web site is to disseminate a wide variety of information in an array of usable formats. The site includes new Survey documents; descriptions of recent events, opportunities, and milestones; Web areas being showcased; and downloadable data. Each scientific Section has a home page listing current activities and information about programs and projects. Contact information for Survey staff and employment opportunities are also posted.

An expanded internal Intranet site just for Survey employees allows ready access to the most recent copy of forms that change frequently, phone lists, and other documents. Office policy, weather information, and an employee "Profile of the Month" are also accessible from the Web site.



*Kevin Merrifield is revamping the Water Survey Web site.*

*Kathy Brown begins work on a GIS project.*

## Geographic Information Systems (GIS)

Researchers within the Water Survey use GIS support on many of the projects explained elsewhere in this *Annual Report*. The GIS group is also a resource for other university, private sector, state, federal, and local government groups, and the public in accomplishing work related to environmental monitoring, management, and research. The GIS databases are available through CD-ROMs, the GIS Database Clearinghouse on the World Wide Web (http://www.isgs.uiuc.edu/nsdihome/ISGSindex.html), and maps.

Some of the most important databases created recently include a digital set of U.S. Geological Survey (USGS) topographic maps that were revised for Illinois; a statewide greenways inventory compiled from regional planning association maps; digital maps of property ownership for select counties; a digital elevation model for portions of the Illinois River as it existed 100 years ago; and a gas pipelines and electric lines coverage.

As part of the Targeted Watershed Approach, the GIS group set up the Illinois Environmental Protection Agency (IEPA) GIS Laboratory and helped them to determine priority one watersheds. These watersheds are assigned top priority by meeting certain IEPA criteria, including the presence of highly sensitive or threatened streams, streams providing full drinking water use, or State-protected streams. Resource features were mapped for use by IEPA in planning and

management activities. The IEPA uses GIS data to focus programs and resources on those areas with the greatest need for remediation, protection, or restoration while continuing statewide program activities.

University students employed learn practical, marketable GIS skills. Students also become more proficient in applying GIS to environmental areas.

The GIS group is also working on the National Atmospheric Deposition Program (NADP) site characterizations by revising nationwide GIS databases of land cover and USGS topographic maps. Site location maps and isopleth maps have been created for the NADP Web site.

## Water and Atmospheric Resources Monitoring Program

The Water and Atmospheric Resources Monitoring (WARM) program provides the State of Illinois with a variety of hydrologic and climate data archiving the long-term quality and quantity of Illinois water resources. Multiple program networks of observing platforms collect and compile nearly continuous observations on water data below ground, on the surface, and within the atmosphere. These program data are rather unique in the United States due to the number and variety of variables being monitored and the completeness of observations within the hydrologic cycle in Illinois.

To enhance the program and lay a foundation for its national consideration, the WARM program undertook a process of assessment that led to a scientific review in September 1998. A team of state and national professionals in hydrology, climate, and network operations was invited to discussions and was asked to judge the quality of the program data being collected and its suitability for the various scientific fields the data may support. The team applauded the Illinois State Water Survey, in general, and the WARM program, in particular, as one of the nation's finest in the monitoring of hydrologic and climate data.

In partial response to this assessment, the program has begun restructuring the dissemination of its data for Web access by scientists from across the country, the large agricultural community of Illinois, state government officials, and the general public. Historic climate data are available in both hourly and daily formats on the WARM Web page (http//: www.sws.uiuc.edu/warm/).

These data provide information on air temperature, relative humidity, precipitation, wind speed and direction, barometric pressure, solar radiation, and soil temperatures at 19 Illinois Climate Network stations across the state. Data are enhanced by computations of dewpoint temperatures and potential evapotranspiration. All data are in electronic, comma-delimited format for ease of downloading into various spreadsheet softwares. Data will be added on other WARM information networks, including soil moisture, shallow well water depths, streamflows, and reservoir elevations.

In its effort to further improve observations related to Illinois water resources, the program experimented with expansion of its data collection into the area of water quality. Scientists initiated a pilot study in September 1998 by installing a monitoring device in the Sangamon River near Monticello to take continuous readings of water quality variables within the river flow. Data are stored on a data logger within a submerged instrumentation package, retrieved on a 4- to 6-week schedule.

The test study provides information on dissolved oxygen, temperature, conductivity, specific conductance, total dissolved solids, salinity, pH, turbidity, and nitrates. These new data will document the frequency and extent of trends that exist in water quality from high temporal resolution, and thereby permit a determination of the need and magnitude for similar enhanced and extensive water quality observations in other areas around the state. Assessments related to the continuation of the program are in progress.

# ANALYTICAL CHEMISTRY & TECHNOLOGY UNIT

## Providing Analytical Chemistry and Technology Services

Kent Smothers heads the reorganized Analytical Chemistry and Technology Unit. Programs include an Illinois Environmental Protection Agency-certified Public Service Laboratory, internal analytical laboratory services, the Institutional Water Treatment Program, and the Midwest Technology Assistance Center.

### *Public Service Laboratory Program*

The Public Service Laboratory Program staff has been assisting Illinois water users with their water quality questions and concerns for more than 100 years, dating back to 1895 when Dr. Arthur Palmer, the first Chief of the Water Survey, performed testing for typhoid-infected water in the state. This service activity fulfills two functions: 1) it increases the database of the state's ground water that is used by scientists who study water quality, and 2) it provides information about the water supply to water consumers, allowing them to make decisions about treatment and usage.

Private well owners, public water supply operators, well contractors, engineers, state and county agencies, industry, health professionals, researchers, and others have used the laboratory in the past year. Questions posed included whether water quality was appropriate for the intended use, whether treatment could improve water quality, or whether the current water treatment was obtaining the desired results. Last year, the program received more than 500 water samples for testing. The laboratory also received approximately 600 requests for information regarding water quality and treatment.

Persons interested in using services should contact the laboratory to obtain a sampling kit. There is no fee for the service, but the samples must be collected according to the instructions provided with the bottles. The Illinois Environmental Protection Agency (IEPA) has certified the laboratory for its tests, a "seal of approval" that they can successfully obtain accurate results.

*Sofia Lazovsky preserves a sample for metals analysis with nitric acid.*

### *Analytical Services*

The laboratory staff provided chemical analyses in support of research activities. Although the largest user group consists of Water Survey investigators, work has also been done with researchers from the other Scientific Surveys and for University of Illinois at Urbana-Champaign (UIUC) staff and students. The analytical tests measured both inorganic (metals, anions, and physical parameters) and organic (pesticides and nonvolatile organic carbon) parameters. More than 2,500 samples were analyzed for more than 40,000 individual test results.

Water samples comprised the majority of samples; however, there was also a significant volume of sediment and tissue samples. There were a variety of applications in which chemical analysis was an integral part of an interdisciplinary approach to projects. Research projects involved:

- Analysis of waters, sediments, plants, and animals as part of the site characterization of the DePue Wildlife Management Area,

working with other Scientific Surveys and the UIUC College of Veterinary Medicine.

- Formulation of synthetic rain samples for use as audit samples for metals analyses for the World Meteorological Organization.
- Analysis of nitrates in private wells in cooperation with school districts and the Future Farmers of America as an educational and community service project.
- Analysis of waters, sediments, plants, and slag from the Lake Calumet region for site characterization.
- Analysis of nutrients and pesticides in samples collected for watershed monitoring and watershed modeling verification.
- Analysis of hot spring waters for UIUC Geology Department researchers who are trying to establish an aqueous-solid process model for hot spring travertine deposits with which to explore fossil microbial life on the early Earth and Mars.
- Analysis for metals concentrations in water samples for the Institutional Water Treatment Program.

## Institutional Water Treatment Program

The Institutional Water Treatment Program (IWTP) provides unbiased, professional water treatment advice at more than 100 state facilities throughout Illinois. The program results in substantial annual savings in costs of chemicals, fuel, water, and maintenance in industrial and potable water systems for participating facilities and for the State of Illinois. Since 1949, IWTP services have ranged from presenting on-site training and seminars to providing chemical specifications and making recommendations concerning a comprehensive water treatment program for control of corrosion, mineral scale formation, and biological growths. Facilities receive detailed written recommendations and specifications for recommended treatment equipment, chemicals, and corrosion-resistant materials for use in construction.

Program staff are also actively involved in an annual workshop for Illinois Institutional Chief Engineers cosponsored by the Department of Natural Resources, the University of Illinois, and other state agencies. Now in its 52nd year, the workshop also provides information on pending regulations and water treatment developments of relevance for

*Ion exchange resin removed from a water softener shows signs of iron fouling (dark color) and osmotic cracking.*

supervisory and administrative staff at individual institutions. State facilities pay a fee to recover some of the IWTP costs associated with routine visits (3-6 per year, depending on facility size and complexity), recommendations, consultations, and sample analyses to help them comply with state and federal guidelines for water quality of drinking water and wastewater discharge. As a public service, there is no charge to public utilities or private individuals.

During FY99, IWTP staff responded to more than 1,100 phone requests and provided more than 1,500 written copies of detailed laboratory water analyses, recommendations for action based on analytical results, and other materials. Each year, program staff also make approximately 440 site visits to state facilities to evaluate the chemical treatment program, answer questions, solve emerging problems, and analyze samples. Last year, approximately 2,800 water samples were analyzed in the field, and an additional 725 samples received a complete laboratory analysis. Typical inquiries from state facilities about treatment concern their steam, heating, cooling, and drinking water systems while public utilities or the general public generally have questions about scale or corrosion problems in wells and other potable water systems. Among the state facilities participating in the IWTP are the Department of Corrections, Human Services, Secretary of State, Central Management Services, Department of Transportation, Department of Veterans Affairs, Department of Natural Resources State Lodges, and several state universities.

## Midwest Technology Assistance Center for Small Public Water Systems

The Midwest Technology Assistance Center (MTAC) for Small Public Water Systems is one of five competitively selected Centers established in 1998 by the U.S. Environmental Protection Agency under section 1420(f) of the

1996 Safe Drinking Water Act Amendments to address needs of small public water systems and Native American water systems. The Midwest contains more than 20 percent of the small community water systems in the United States. More than 90 percent of the violations of the drinking water regulations occur in small systems, often due to a lack of technically trained staff. Some current MTAC programs are highlighted:

*Small potable water treatment plants use an up-flow clarifer to remove dissolved solids.*

### *Services and Activities*

- *Benchmark Economic Analysis* will enable small community water systems to formulate rate structures and plan for future financial needs.
- *Corrosion Control Analysis and Recommendations* will help communities protect infrastructure, reduce maintenance and repair costs, and prepare for regulatory compliance with federal statutes such as the Lead and Copper Rule.
- *Technical Workshops* for Native American water-supply systems are being developed with the cooperation and participation of the Native American community to ensure the workshops are tailored to their needs.
- *Information Dissemination* occurs throughout Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, and Wisconsin and, through partners, to other regions. The MTAC also uses its Web site (http://mtac.sws.uiuc.edu/) to disseminate information to the public quickly and efficiently.
- *Small System Needs Assessment* of small communities to identify their most pressing technical problems and to help to better focus MTAC efforts in addressing their needs.

## What a Difference We Make...
## Analytical Chemistry & Technology Unit

When the Illinois Department of Corrections (IDOC) was considering the siting and construction of a prison at Pickneyville, one of the first things they did was contact the Institutional Water Treatment Program (IWTP) at the Water Survey, which has advised state facilities on water treatment and corrosion control issues since 1949.

Program staff gathered historical water quality data from Water Survey records and collected and analyzed new water samples to determine if any significant changes had occurred. Mineral scale and corrosion indices were used to evaluate sample analysis data and identify any potential maintenance problems resulting from water quality. Staff then recommended appropriate construction materials for the water-supply system and also alerted IDOC to equipment needs. Calcium hardness concentrations in the water indicated the need for partial softening of the hot distribution water to prevent mineral scale formation. Other water quality information indicated copper piping for distribution of the prison's potable water supply.

After construction had begun, IWTP staff surveyed equipment to identify heating and cooling systems that would require chemical treatment. Recommendations specified appropriate water treatment equipment and chemicals, reagents, and testing supplies for steam boilers, hot water heating systems, and cooling systems.

Once IDOC maintenance engineers were available to coordinate the chemical treatment program, IWTP staff conducted informative training seminars. Topics covered included how and why to apply

*The IWTP also keeps existing state facilities up to date with current technology. This reverse osmosis equipment is used to pretreat boiler makeup at the Dixon Correctional Center.*

chemicals, how to perform the necessary monitoring tests, and how to interpret and respond to test results. Engineers conduct daily control tests to monitor chemical treatment and and measure equipment performance on site and record chemical usage on log sheets submitted weekly to the IWTP. Program staff provide supplemental training during regular site visits and collect water samples from various systems for complete laboratory analysis.

On-going implementation of appropriate water treatment practices, comprehensive training of staff, and careful monitoring and oversight by the IWTP help ensure reduced maintenance costs and greater reliability of water-supply systems in the future. Careful selection and application of suitable chemical treatment during facility construction and startup pays dividends for the state in long-term operating costs and reliability.

# ATMOSPHERIC ENVIRONMENT SECTION

## Atmospheric Scientists Address Environmental and Societal Issues

Under the leadership of Dr. Ken Kunkel, the Atmospheric Environment Section is pursuing a diverse program of basic and applied research and services to address atmospheric issues of critical environmental and societal importance. Key issues are climate variability and change, atmospheric air quality, and severe weather phenomena. State funding for these activities was markedly enhanced by the acquisition of grants and contracts from federal and state agencies.

Requests for data and services from the Midwestern Climate Center (MCC) and the Office of State Climatologist (OSC) continue to increase. Annual accesses to the Midwestern Climate Information System (MICIS) exceed 46,000, with annual "hits" on the MCC home page now exceeding 1.2 million. The MCC and OSC are also handling more than 9,000 annual requests by phone, fax, mail, and e-mail.

Two studies of the effect of El Niño on Midwestern climate conditions were completed. One study provides the basis for future advance forecasts of winter snowfall and found that strong El Niños consistently result in significantly below average snowfall over Illinois and much of the eastern Midwest. A second study found that generally above average corn and soybean yields occur in El Niño summers.

Impact studies of two major events were also completed. The unusually warm, dry, and snow-free winter produced by the 1997-1998 El Niño resulted in a significant decrease in weather-related deaths. Financial benefits of the milder winter in the Midwest amounted to $8.85 billion. Snow-related industries incurred losses of $750 million, approximately 10 percent of the total benefits. A second study was on the region's second worst blizzard of the 20th century, which struck the Midwest on January 1-3, 1999, producing 22 inches of snow in Chicago. The Governor of Illinois declared the entire state a disaster area. Major impacts

*Climatologist Wayne Wendland removes a core sample of snow to determine how patterns of snow melt vary with land use.*

included 73 deaths and staggering effects on commercial aviation. For example, United Airlines canceled 60 percent of its O'Hare flights during the 2-day storm. Approximately 300,000 travelers were stranded for periods of hours up to 4 days at O'Hare Airport.

Wet and dry transport of nitrogen nutrients from the atmosphere to the surface can affect water quality of rivers and lakes. A national dry deposition network, operated by the U.S. Environmental Protection Agency (USEPA) and including three sites in Illinois, has been used to estimate the dry deposition of nitrogen. Water Survey research has shown that routine data underestimate nitrogen fluxes by a factor of 2, which has implications for assessment of impacts.

Movement of carbon dioxide between the surface and the atmosphere is being continuously measured over a no-till agricultural field in a corn and soybean rotation. These unique measurements represent the only long-term continuous monitoring in a corn and soybean ecosystem. This research shows that no-till agriculture may be considered a sink of carbon dioxide, rather than a source, an important finding for Illinois agriculture if carbon emission regulations are imposed.

In 1998, the Illinois State Water Survey took a leadership role in collecting an extensive data set on processes involved in the formation of lake-effect snowstorms, which can have major impacts on northeastern Illinois. Analysis of these data and data on the evolution of heavy lake-effect snow from a new, 3-year research project funded by the National Science Foundation could lead to better forecasting techniques for these often severe local snowstorms. Another project on snow entailed field measurements of the reflectivity of snow and found it to be highly dependent on land use and the meteorological conditions during snowfall, information of great value for weather forecasting models.

Cloud physics research is contributing to our understanding of how precipitation forms. Analysis of field data suggests that large aerosol particles play a significant role in the onset of precipitation. Laboratory experiments showed that evaporation of ice nuclei may play a role at cloud temperatures of -15 to -20°C, a result that may have implications for cloud seeding.

Several new programs were initiated. The most significant, a modeling program, will provide a framework to comprehensively address critical issues. A completed plan outlines the development of an integrated climate, air quality, and impacts assessments

*Air-quality sampling equipment at a site near Lemont detects salt particles in the air.*

modeling system. Critical issues for investigation include the impacts of climate change and contemporary societal trends on extreme weather events and air quality, with special focus on the Chicago metropolitan area and the Illinois River basin.

Scientists have also begun to use modeling and experiments to investigate certain aspects of hog odor. This information will be used to identify ways to reduce these odors.

Another new program will address air quality standards by determining the sources of small aerosol particles (PM-2.5) in Illinois and estimating the contribution of regional PM-2.5 to the total PM-2.5 in urban areas. Information from this project funded by the Illinois Environmental Protection Agency will be incorporated into the Illinois action plan for meeting air quality standards for PM-2.5.

## What a Difference We Make... Atmospheric Environment Section

The Midwestern Climate Center (MCC) provided support for an innovative course at Northern Illinois University (NIU) pairing teams of students and weather-sensitive organizations. Each team defined a weather-sensitive problem and then developed climate relationship models to address it. This practical course has provided many students with hands-on experience using climate data. Students are exposed to the wealth of enhanced climate data available, and the industry partners become aware of the value of applied climatology.

Without resources available at the MCC, access to such data would be difficult. Program partners have included Illinois Power Company, Wisconsin Public Service Corporation, Del Monte Foods, Salomon Smith Barney, United Airlines, DeKalb County Road Commission, and NIU. One problem addressed required extensive MCC climate data and advice on long-range climate outlooks. The NIU staff member took forecast information to the head of the university's heating plant, who consequently decided to ride the spot market to acquire natural gas supplies rather than contracting for the university's entire winter supply in advance. This action saved NIU more than $0.5 million in heating costs, and further led to the decision to employ a full-time meteorologist to help with all forms of weather issues.

Radar meteorology, a research focus at the Water Survey for more than 40 years, has included the development and use of state-of-the-art weather radars. One Water Survey radar became the prototype for the National Weather Service WSR88D radars that have become a primary tool for improved warnings of severe storms and tornadoes in Illinois. There are two such radars in Illinois at Lincoln and Romeoville. This national network of radars was recently credited with saving more than 1,000 lives during the tornado outbreak in Oklahoma.

# GROUND-WATER SECTION

## Seeking Alternatives for Future Growth

The Ground-Water Section has embarked on several exciting, new challenges, highlighted by the employment of a new Section Head, Dr. Manoutchehr Heidari. Under his vision, the Section is moving on several fronts to enhance research and service capabilities.

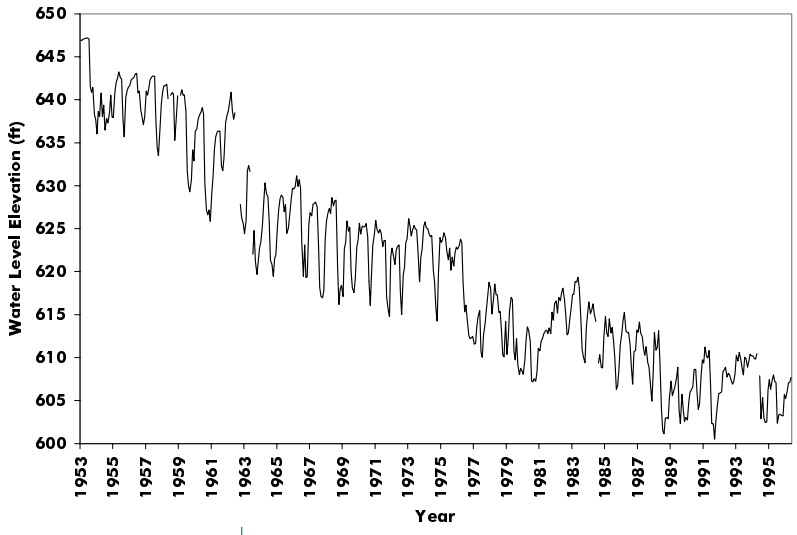
Foremost among these is Section involvement, along with the Groundwater Geology Section of the Illinois State Geological Survey, as technical advisors to the Mahomet Aquifer Consortium (MAC), which was formed to "...further study the Mahomet aquifer on a regional basis and to develop a plan for the management of this valuable resource." Members include representatives from water authorities; water companies; local, county, and state agencies; and the general public—all with an interest in maintaining an adequate and good quality water supply from the Mahomet aquifer.

The Mahomet aquifer, the most viable resource for expanding water demands in east-central Illinois, underlies approximately 4,000 acres beneath 15 counties in east-central Illinois. It already supplies the communities of Champaign-Urbana, Normal, Rantoul, Mahomet, Paxton, and Clinton, and several hundred irrigation wells primarily in the sandy soils of Mason and Tazewell Counties. Average pumpage from the aquifer exceeds 80 million gallons per day (mgd) and exceeds 180 mgd during summer irrigation months. Groundwater levels in portions of the aquifer have dropped in response to increasing withdrawals, and it is important to seek alternative plans to meet the growing water demand.

The 1988-1989 drought in central Illinois focused attention on the Mahomet aquifer as a reliable, long-term water supply for many communities currently dependent on surface reservoirs. The city of Decatur has already constructed a wellfield capable of 8-10 mgd to pump water down the Sangamon River to Lake Decatur when lake levels are low. Other communities, such as Springfield, Bloomington, and Danville, may also turn to the Mahomet aquifer to supplement reservoir capacity or water quality.

A preliminary plan has been developed for a regional study of the Mahomet aquifer from the Indiana state line to the Illinois River. The plan calls for a $10 million, 9-year investigation that includes field investigations and computer modeling that will help decision-makers make informed decisions about meeting future demands for good quality water. Through efforts of MAC members, Governor Ryan has come out in support of the project, and efforts are now focusing on obtaining federal funding.

The Section has also initiated a program to address ground-water issues in northeastern Illinois. Nearly 67 percent of Illinois residents live in this region, and the population is expected to increase by nearly 25 percent by 2020. Populations of the outer collar counties (McHenry, Kane and Will) are projected to grow by 70 to more than 100 percent during this period. Such rapid population growth, together with the requirements of commercial concerns such as proliferating electric power generation facilities, will place significant demands on the region's water resources. Moreover, existing water sources, including the deep bedrock aquifer system and Lake Michigan, may not be available to accommodate these demands.



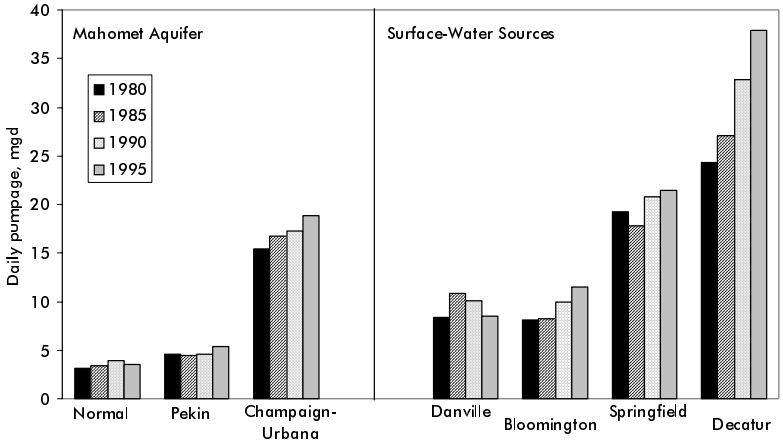

*Water levels in the Mahomet aquifer near Champaign declined as a result of increased pumpage since 1953. Such historical information will be important in modeling development alternatives for the entire aquifer.*

As of 1995, withdrawals from the deep bedrock aquifer system in northeastern Illinois totaled 67 mgd, a significant decline in withdrawals from the deep bedrock of about 180 mgd 20 years ago but still slightly in excess of the 65 mgd sustained yield of the northeastern Illinois system estimated by Suter et al. in 1959 (ISWS/ISGS Cooperative Ground-Water Report 1, *Preliminary Report on Ground-Water Resources of the Chicago Region, Illinois*). Illinois' Lake Michigan allocation, which is limited by a U.S. Supreme Court decree and is unlikely to change, is, according to available data, already entirely consumed.

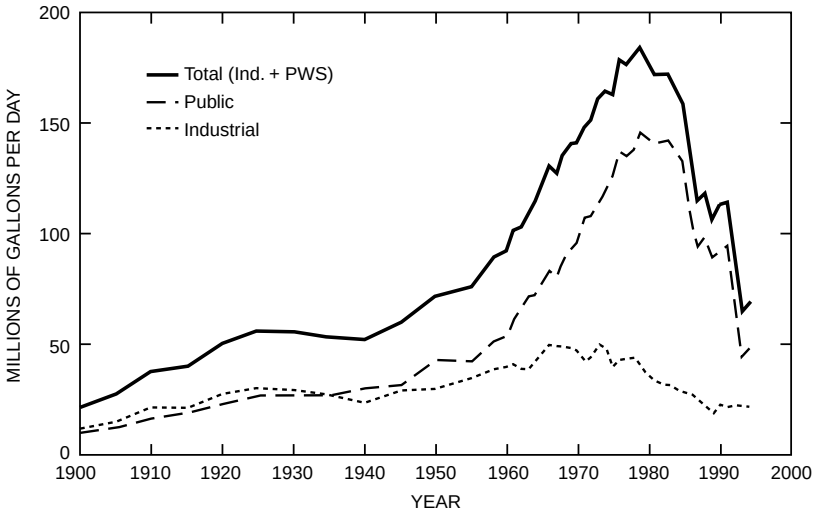
Population increases and economic development also have the potential to degrade ground-water quality in northeastern Illinois. Such manifestations of urban and suburban development as septic systems, road deicing operations, storage of hazardous materials, and waste management/disposal processes can and do affect shallow ground-water quality. Discharge of degraded ground water may reduce surface water quality, disrupting natural communities in the region's streams, rivers, lakes, and wetlands, and limiting use of the region's surface water for human needs.

Section staff have consulted available resources in northeastern Illinois to identify problematic geographic areas and regional issues, and to identify directions for new research addressing the region's ground-water concerns. Data suggest that shallow bedrock and glacial drift aquifers may be capable of meeting the region's water demands through 2020 and beyond, but significant data and analysis are necessary to fill in knowledge gaps about these resources. Staff have also been working with the Northeastern Illinois Planning Commission, numerous local government authorities, and university faculty and staff to incorporate sound science into water resource decisionmaking for the region. In addition, an investigation of water levels in the deep bedrock aquifer system scheduled for fall 2000 will provide information on aquifer system recovery from excessive withdrawals, peaking in 1979, and on system capability to satisfy future water demands.

Finally, Section staff are developing a prototype ground-water database that incorporates graphic access and statistical analysis capabilities using historical data available for the Mahomet aquifer system within Water Survey records. However, the prototype will be designed for expansion to include ground-water data for all of Illinois, allowing any interested party to access data for a particular region. In so doing, the Section is striving to maintain its standing at the forefront of ground-water services and information for Illinois citizens.




*Approximate water use for communities near the Mahomet aquifer. Communities currently using surface water may look to the Mahomet to improve their supplies of water.*




*Even with recent shifts to Lake Michigan water for public supplies, withdrawals from the Chicago region's deep bedrock aquifers exceed the practical sustained yield, and pressures mount to resume pumping to meet area needs.*

## What a Difference We Make...
## Ground-Water Section

Thousands of individuals and communities rely on Water Survey technical expertise and historical data for the development of safe, reliable ground-water supplies, from the smallest domestic wells to large municipal and industrial supplies. Some recent examples follow.

### Developing a New Ground-Water Supply for Homer

The village of Homer in Champaign County sought assistance from the Water Survey to locate a new water source. After reviewing historical records, Water Survey engineers recommended exploration of an area approximately 6 miles north and west of Homer, and the State Geological Survey conducted a reconnaissance electrical earth resistivity survey.

A potentially suitable aquifer was located, and the village drilled a test hole that revealed a deposit of water-bearing sand and gravel 100 feet thick. Results from subsequent aquifer tests indicated a new 100 gallon per minute supply was feasible, and two permanent wells and a pipeline to the village are being constructed at the site—all as a result of a review of information available from Water Survey records.

### Protecting Municipal Wells at Loves Park

Using data collected from observation wells constructed by the Water Survey, a ground-water flow model was developed for the sand-and-gravel aquifer beneath the city of Loves Park in Winnebago County. Ground-water capture zones were identified for the city's two wells using the model. The city subsequently formed a partnership between Rock Valley College students, Winnebago Retired and Senior Volunteers, and staff at the Illinois Environmental Protection Agency and Department of Public Health to inventory potential sources of ground-water contamination within 10-year capture zones defined by the model.

Workshops prior to the inventory included seminars by Water Survey scientists to describe basic ground-water concepts and the techniques used to develop the capture zone maps serving as the basis for the contaminant source inventory. Partnership members are developing additional recommendations for ground-water protection measures.

### Ecological Restoration and a Nature Center at Indian Ridge Marsh

Water Survey efforts to understand the ground water and wetlands in the Lake Calumet region of Chicago contributed substantially to both the ecological restoration and the economic development of one of the state's most environmentally degraded areas. A key contribution has been to show some simple techniques to remediate contaminated ground water discharging into the region's wetlands and lakes. Water Survey water quality and modeling studies of Indian Ridge Marsh have shown that restoration of this large wetland complex is possible even though it has been severely affected by surrounding waste disposal activities.

These ideas have greatly influenced the city of Chicago's recent decision to build a multimillion-dollar nature center and research station at the site. The Nature Center at Indian Ridge Marsh, a high-visibility project that is expected to attract thousands of visitors each year, will highlight water-quality and wetland issues. This project represents a significant turning point in the ecological restoration of the region and is expected to be the "anchor" for more restoration activities throughout the region.

# NATIONAL ATMOSPHERIC DEPOSITION PROGRAM

## 20th Anniversary as Nation's Precipitation Chemistry Network

Van Bowersox heads the National Atmospheric Deposition Program (NADP). Last October 100 scientists, sponsors, and members of the NADP Technical Committee gathered in St. Petersburg, Florida, to recognize 20 years of NADP precipitation chemistry network operations. This noteworthy annual meeting featured 6 technical sessions with 53 papers, of which 7 papers were submitted for publication in a special section of the international journal *Atmospheric Environment*.

Among the presenters were Russian, Japanese, and Canadian scientists, who addressed historical and global perspectives on atmospheric deposition. Other presentations covered long-term precipitation chemistry trends, forest and stream responses to deposition changes, dry deposition, perspectives on nutrient deposition and nitrogen in the Gulf of Mexico and other watersheds, mercury and other air toxics in precipitation, and results from various data analysis projects using NADP data.

During his keynote address, "NADP, Twenty Years Down and a Century to Go," Professor Ellis Cowling, the first NADP chair, challenged NADP participants to be diligent about maintaining the only nationwide database of precipitation chemistry in the United States. Cowling and other past Technical Committee chairs received special recognition at the meeting. Four site operators were also honored for 20 years of continuous service since the network began collecting samples at 22 stations in 1978.

Headquarters for the NADP are at the Illinois State Water Survey in Champaign, and the program operates three precipitation chemistry networks: the National Trends Network (NTN), the Atmospheric Integrated Research Monitoring Network (AIRMoN), and the Mercury Deposition Network (MDN). These networks provide regional and national data and information on the amounts, geographic distribution, and temporal changes of chemical deposition by precipitation.

*Other past Technical Committee chairs watch as keynote speaker Ellis Cowling (left) prepares to cut the cake.*

The NTN conducts weekly measurements of major inorganic acids, inorganic nutrients (nitrogen and phosphorus), alkaline cations, and salt (sodium chloride) in U.S. precipitation. Seventeen sites joined the NTN in 1998-1999, bringing the total number of sites to 217. Among these new sites were 15 sites that formerly comprised the U.S. Environmental Protection Agency's Clean Air Status and Trends Network.

Complementing the NTN are the 10-site AIRMoN and the 38-site MDN. The AIRMoN sites collect daily samples used for measuring the same chemical constituents as at NTN sites. The MDN offers the only regional measurements of mercury deposition in the country. More than 40 states have advisories warning people not to consume certain freshwater fish because of high mercury concentrations in fish tissues. Atmospheric deposition has been implicated as an important source of the mercury that accumulates in the food chain of these fish.

Twenty NADP sites now offer a 20-year record of atmospheric chemical deposition to the nation's agricultural crops, forests, rangelands, streams and lakes, and other natural and cultural resources. Data from these

and other NADP sites support research on new and recurring environmental issues such as:

- Assessing acidic deposition and its impacts on aquatic and terrestrial ecosystems and material and cultural resources.
- Quantifying and supporting atmospheric modeling of inorganic nitrogen deposition to estuarine waters, such as the Chesapeake Bay, in which nutrient enrichment degrades water quality.
- Examining the relationship between pollutant sources, air quality, and precipitation quality.
- Evaluating intra-annual and long-term trends in precipitation chemistry and deposition, and how these trends relate to pollutant sources and deposition effects.
- Determining the mercury deposition rate to lakes and streams and the relative importance of atmospheric deposition and other sources in causing high mercury levels in fish in those lakes and streams.

Making the 20-year NADP data record available on-line (http://nadp.sws.uiuc.edu) has proven an enormous success. Records compiled demonstrate a 20-fold increase in Web site visits (more than 400,000 per year) since 1997. Moreover, 13,910 visitors actually downloaded NADP data. Requests for data numbered in the hundreds per year prior to the Web site. Most frequently accessed data (24,284 times) are the color concentration and deposition maps.

Records show that universities are the largest user group and also that just over 67 percent of the electronic data requests served the needs of researchers, with the remainder serving educators from elementary schools, secondary schools, and colleges. Having a Web page that links the world to quality-assured data and information on the chemicals in precipitation has proven to be efficient and effective in serving NADP's role as a national research support project. In the past year alone, NADP data have been cited in more than 130 publications and journal articles written by scientists at NADP and at other organizations.

Currently, the federal Committee on Environment and Natural Resources is conducting a scientific assessment of causes and consequences of a large zone of hypoxic waters in the Gulf of Mexico. Hypoxia in the Gulf, a seasonal phenomenon, begins in spring, ends in fall, and reaches a maximum area of 16,000-18,000 square kilometers June-August. State, federal, and university scientists are conducting the assessment of the 31-state Mississippi River watershed. Sediment cores from the river delta suggest that increased nutrient fluxes from the river have accompanied the increase in eutrophication and hypoxia. Some scientists have targeted fertilizer in runoff and sewage and industrial effluents as the source of increased nutrient fluxes. Scientists are using NADP data in their assessment to quantify the flux of inorganic nitrogen entering the Mississippi drainage from the atmosphere.

To enhance the future usefulness of NADP data, a multi-year effort to add Geographic Information System (GIS) coverages has begun. Recognizing that a principal contemporary use of NADP data is to estimate the atmospheric deposition of nutrients in watersheds, GIS applications that allow Web retrievals of deposition rates (fluxes) and loadings (masses) for watersheds by seasons and years are being developed. Once this watershed framework for data retrievals is established, land use/cover overlays will be added so that fluxes to forests, fields, and water bodies within watersheds can be provided. Other coverages being considered are ecoregions, sulfur and nitrogen emissions sources, roads and highways, and population distributions.

Maintaining a long-term precipitation chemistry monitoring program requires the steadfast efforts and cooperation of NADP scientists, staff, and sponsors. It also requires a program that responds to and meets changing needs of scientists and educators who use NADP data. The NADP will remain committed to its vision of being an organization of scientists serving science and education and supporting informed decisions on air-quality issues related to precipitation chemistry.

*Two recipients (left) of 20-year service awards are shown with their supervisor.*

## What a Difference We Make...
## National Atmospheric Deposition Program

In 1990, the U.S. Congress amended the Clean Air Act, requiring reductions in airborne sulfur dioxide emissions in two steps, Phase I in 1995 and Phase II in 2000. The purpose of the reductions is to reduce the adverse impact of acidic deposition. Burning sulfur-bearing fossil fuels releases sulfur dioxide to the atmosphere. The largest U.S. emissions of sulfur dioxide occur when utilities burn coal at electric-generating plants. Phase I of the Clean Air Act set lower sulfur dioxide emission limits at 110 coal-fired electric-generating plants, all but one in states bordering or east of the Mississippi River. In the atmosphere, sulfur dioxide is transformed into sulfate compounds that, unneutralized, acidify precipitation. By lowering sulfur dioxide emissions, the Act seeks to reduce the deposition of acids to the environment.

Data from the National Atmospheric Deposition Program (NADP) National Trends Network (NTN) demonstrate benefits of the Act: 1995-1997 sulfate concentrations and acidity of precipitation in the Ohio River valley and northeastern United States were significantly lower than in the previous 12 years. Stepwise decreases in acidic deposition occurred in these areas in 1995, accompanying large sulfur dioxide emissions reductions.

Scientists at the University of California at Davis are using NADP data with computer models that simulate the evolution and deposition of air contaminants to agricultural crops. These scientists are investigating the composition of tiny airborne particles, fog and cloud water, and precipitation to learn about the total exposure of plants to atmospheric pollutants. Metering plant growth and crop yield and how these are affected by environmental conditions, including air pollution, are helping scientists better understand how agricultural systems respond to changes in our environment.

Many estuaries along the Atlantic and Gulf Coasts report that water quality has been affected by excessive concentrations of nitrogen, a nutrient that stimulates algal growth. Decaying algae remove dissolved oxygen from the water, sometimes below levels that will support fish and other animals. Nitrogen in estuarine waters has many sources, but one oft neglected source, atmospheric deposition, is receiving increased attention. Two nitrogen-containing compounds in precipitation are nitrates and ammonium. Nitrates are derived largely from nitrogen oxides released as a combustion by-product, such as automobile exhaust or smoke from an industrial boiler. Ammonium comes largely from animal waste. Precipitation efficiently removes both compounds from the atmosphere.

Scientists in the Tampa Bay National Estuarine Program operate a site in the Atmospheric Integrated Research Monitoring Network (AIRMoN), one of three NADP networks. The AIRMoN measurements are being combined with dry deposition estimates to evaluate the total atmospheric deposition of nitrogen to Tampa Bay, Florida. Scientists are reporting wide swings (changes of 100 to 1,000) in the wet to dry nitrogen deposition ratios, and they are finding the atmosphere is an important contributor of nitrogen to the Tampa Bay estuary. As a result, atmospheric deposition is being considered alongside nitrogen from sewage and runoff from agricultural fields when looking for ways to reduce nitrogen inputs to coastal waters.

Scientists at the U.S. Geological Survey report that the calcium levels of some eastern U.S. forest soils have decreased, reducing soil fertility and acid-neutralizing capacity. Indeed, the reduced resistance of sugar maple and red spruce to stresses from insect defoliation and low winter temperatures has been related to lower calcium availability. Precipitation contains calcium and other “base cations” such as magnesium and potassium. Based on downward trends in base cation concentrations shown by NADP data, scientists are examining how lower soil calcium concentrations may be related to decreasing calcium deposition and to the long-term effect of acidic precipitation.

# WATERSHED SCIENCE SECTION

## Applying Science for Better Management of Watersheds

Watershed-based management of our resources has become a centerpiece of resource management. Presently, state, federal, local, public, and private entities are looking into "total resource management concepts" in which all things and activities are interdependent. The Water Survey has taken positive steps in synthesizing existing scientific data and information, monitoring present and anticipated future activities, and providing scientifically applicable methods and techniques to resource managers for the management of our water resources based on the watershed concept.

Present activities incorporate applied research and public service at a watershed level. Geographic areas include the Illinois River, Kankakee River, Cache River, several small to large lakes, watersheds, streams, and rivers. Activities can be broadly subdivided into data collection and monitoring; research related to management of ecosystems and water resources; decision support systems; stream restoration and rehabilitation; and outreach, education, and information dissemination.

*Jim Slowikowski uses an ISCO 6700 pump sampler at North Creek of the Spoon River watershed.*

### *Data Collection and Long-Term Monitoring*

Numerous conservation practices applied at a watershed level should improve the watershed and the quality of the receiving bodies of water. However, the impacts of management practices could not be determined without proper monitoring and data collection. Thus, appropriate monitoring and evaluation can and will assist the manager "to make a difference" in resource management. Sediment and nutrients from Court Creek, a sub-basin of the Spoon River, and Site M, near Springfield, are being monitored as part of the federal and state initiative on the Conservation Reserve Enhancement Program (CREP).

Four other watersheds—Hurricane Creek on the Embarras River, Big Creek on the Cache River, Sugar Creek on the Kaskaskia River, and the Vermilion and Little Vermilion on the Wabash River—also are being monitored as part of the pilot watershed project and to assist local partnership councils in their decision-making process on the best management of their resources. Long-term monitoring of sediments in selected rivers is continuing to determine trends in sediment loadings.

### *Research Related to Management of Ecosystems and Water Resources*

The city of Villa Grove on the Embarras River frequently floods during heavy rainfall. Increasing the density of trees on the floodplain could slow down the water, store water for a longer time, and decrease flood peaks. As part of the Conservation 2000 Program of the Illinois Department of Natural Resources (IDNR), scientists are conducting research to determine the effectiveness of increased vegetation on floodplains and how more vegetation could reduce flooding potential. Management of the Cache River basin, Heron Pond, and Buttonland Swamp is extremely important for the state and the IDNR.

Buttonland Swamp has been designated as a wetland of international significance. Previous and current research will continue to

assist the IDNR, the U.S. Army Corps of Engineers, and the Nature Conservancy in managing the Cache River and Buttonland Swamp without excessive sediment deposition, which will enhance the viability of these vital and extremely scenic resources.

The Kankakee River contains one of the last remnants of the original wetlands, formerly "Kankakee Marsh" and now called "Momence Wetland". In recent times, sand movement from Indiana may be hurting this wetland. Our research has shown how much sand is transported when the sands move with water. This research is being used to design sand-removal techniques at the state line before sand covers riverbed habitats. This activity should prolong the life of an important habitat of a high-quality river.

Several communities along Illinois rivers obtain their drinking water supply from ground-water wells close to the river. Filtration of the natural ground between the river and the wells, which essentially is force pumped through the wells, reduces water quality problems of river water. This research should alleviate some concerns of the river communities about their water supply.

Maintenance of a healthy ecological habitat of streams and rivers requires the availability of a certain amount of water during dry periods. Statistical analyses conducted for approximately the last decade define the quantities of water expected at different frequencies within various river basins. This year an analysis was completed for the Little Wabash River basin, which will assist water resources and ecosystem managers to manage such rivers with confidence. The IDNR owns Stratton Dam on the Fox River near McHenry where a hydrologic investigation was conducted to provide managers with appropriate tools to manage this dam without increasing flood potential of the Fox Chain of Lakes.

There are about 30 Ecosystem Partnership Councils in Illinois. Six reports, a continuation of similar reports started 2 years ago, were prepared on water resources, air quality, and water qualities, one each for the Vermilion River, Heart of the Sangamon River, Thorn Creek, Prairie Parklands, Upper DuPage River, and the Kaskaskia River. This work has assisted and will continue to assist local partnership councils to manage their ecosystems based on science and actual data.

Collecting enough field data from a variety of river basins and/or watersheds is not always possible. To determine and/or predict future conditions based on present conditions, we have been using a variety of mathematical models for streams, rivers, and watersheds. A dynamic watershed model is being applied to the Big Ditch watershed, a tributary to the Lake Decatur watershed. We also plan to test the model on the Court Creek watershed. Our hydraulic modeling effort includes Peoria Lake, LaGrange Pool, and the impacts of levees on flood stages.

*Nani Bhowmik examines a sandbar deposit on the Kankakee River at the Stateline Bridge.*

Chemical reactions driven by sunlight can be an important mechanism by which rivers and lakes rid themselves of contaminants. This mechanism is being investigated within the Lake Calumet watershed to determine how sunlight could be a driving force in destroying natural contaminants and to determine various remediation processes. Research is also being conducted to determine how toxic ordinance compounds such as RDX, an explosive and propellant that frequently occurs as a ground- and surface water pollutant at munitions manufacturing and handling facilities, degrade in bodies of water and how newly discovered reductive processes could destroy some contaminants in water and wastewater treatment facilities.

The State of Illinois has one of the highest numbers of nuclear power plants in the nation. Corrosion in steam and nuclear power plants is a multibillion-dollar national problem. Research is being conducted to determine how analyzing metal oxides in these high-temperature settings could reduce corrosion.

## The Illinois River Decision Support System

The Illinois River has become a focus of state and federal agencies interested in integrated management of watersheds. Issues

*Stream restoration techniques were used at Cox Creek near Site M, a fish and wildlife area northwest of Springfield.*

related to habitat restoration, floodplain management, navigation, erosion and sedimentation, water quality, and point and nonpoint source pollution are all being discussed at the watershed level. These discussions have resulted in the Integrated Management Plan for the Illinois River watershed, which includes 34 recommendations being implemented by different agencies at different paces and levels of intensity.

The Water Survey has played a major role in the development of the plan and is actively participating in its implementation. The implementation phase involves questions and answers on a watershedwide basis and is not limited to local or regional issues. Currently, there is no integrated tool to evaluate and predict hydrological and water quality responses to changes in the physical environment of the Illinois River basin. To fill this gap, the Water Survey has initiated the development of the Illinois River Decision Support System (ILRDSS) to assess and evaluate the effectiveness of different projects undertaken under the plan and the consequences of other natural or human-induced changes in the watershed. The ILRDSS will be developed in cooperation with other agencies.

The ILRDSS will integrate and expand existing databases and models for segments of the river and portions of the watershed into an integrated decision support system for the entire watershed. The ILRDSS will enable decisionmakers to answer "what-if" questions during the implementation phase of the plan or other policies and programs within the Illinois River system. A report outlining basic concepts and results based on the first year's research has been prepared.

## Stream Restoration and Rehabilitation

Work is continuing on a ten-year National Watershed Monitoring Program to develop biotechnical methods of urban stream restoration in the Waukegan River. After eight years, the success of test restoration techniques led to publication of an urban stream restoration field manual by the Conservation Technology Information Center.

Since 1997, our expertise and manuals have been used to train more than 200 consultants and contractors. Many similar projects were funded by Lake, DuPage, Cook, and Kane Counties, which created a large demand for such training. For example, the Four Seasons Sun Retirement Center in Huntley used the stream restoration manual to develop naturalized streams in former drainage ditches.

The IDNR has used these naturalized stream restoration techniques in pilot watershed projects on Site M near Springfield and Court Creek near Galesburg. The pioneering watershed study on Court Creek led to recognition of stream channel erosion as a major sediment source in Illinois River tributaries.

Since 1988, multiple stream restoration techniques have been developed to stabilize channels, increase in-stream habitats and water quality, and improve gamefish populations. The Site M stream projects illustrated many of these techniques and served as field training sites.

## Outreach, Education, and Information Dissemination

Core outreach, education, and information dissemination activities consist of providing surface water and floodplain information services to individual homeowners, community staff and administrators, agency staff, engineering consultants, researchers, and other members of the public. The Floodplain Information Repository includes a collection of regulatory floodplain maps, studies, and engineering data related primarily to the National Flood Insurance Program (NFIP). Technical services provided facilitate community and property owner compliance with state and local floodplain management practices, and with NFIP provisions. Awareness of floodplain management concerns and Water Survey services is also promoted through displays at public forums and participation in professional organizations.

During this reporting year, 772 requests were handled: 174 flood zone determinations for individual properties, 51 calculations of 100-year flood elevations, 32 requests for specific engineering and technical data, 370 general requests related to flooding and floodplain management, and 145 requests for surface water information and data. Staff also provided advice by phone or correspondence on numerous occasions and assist in the compilation of surface water data for the monthly *Illinois Water and Climate Summary* published by the Water Survey. Month-end water surface levels are compiled from local operators at more than 40 Illinois reservoirs, each continuing a period of record typically between 10 and 15 years. Provisional peak and average streamflows, and the average Lake Michigan level, also are compiled from various gaging sources throughout the state. Other information provided to the general public relates to low flows in streams and rivers.

## What a Difference We Make... Watershed Science Section

### Metropolitan Water Reclamation District of Greater Chicago

The Metropolitan Water Reclamation District of Greater Chicago (MWRDC) has significantly improved the water quality of sewage discharge as a result of Water Survey research on the Sidestream Elevated Pool Aeration (SEPA) System. This system in which treated water is aerated by flowing over a cascade of waterfalls has received national recognition, and the MWRDC has constructed five SEPA stations on the Calumet River, Little Calumet River, and Cal-Sag channels.

Recently, the Water Survey completed two reports for the MWRDC on SEPA effectiveness. These studies demonstrated that SEPA stations were operating at or above design specifications, especially increasing the dissolved oxygen concentrations. Thus, our work has improved the aesthetics of these reaches of the river, decreased treatment costs, and contributed to the ecological vitality of these streams and rivers. This innovative concept could be used at other sites.

### Lakes and Reservoirs

More than 2,900 Illinois lakes, reservoirs, and ponds provide water for drinking, recreation, and storage of sediments, nutrients, etc. Over approximately the last 70 years, Water Survey engineers have helped many local communities by evaluating the overall health of lakes and lake capacity loss due to sediment deposition. Water Survey data provide these communities with needed information to anticipate and plan for future lake capacity losses due to sediment deposition.

Communities have used Water Survey studies to implement lake management alternatives such as dredging, watershed erosion control programs, shoreline stabilization programs, raising dam levels to increase capacity, or securing supplemental water resources. During the last year, several studies were completed as part of the U.S. Environmental Protection

*As part of a sedimentation survey for Peoria Lake, Bill Bogner surveys one of five deltas.*

Agency Clean Lakes Program, as a service to local communities, or to provide essential information for the Illinois Department of Natural Resources (IDNR) to manage water resources.

Many communities choose different options to solve the loss of storage capacity in their lakes. As a result of a recent study of Otter Lake, a shoreline stabilization program is being initiated and the water intake is being relocated to improve water quality. Based on a 1977 survey of Lake Vermilion, the city of Danville raised the lake's water level in the early 1990s, and data from a 1998 survey will be used to assess current sedimentation rates for use in future planning.

Using information from several lake surveys dating back to 1934, the city of Springfield has dredged the upper arms of Lake Springfield to increase sediment trap efficiency and is currently conducting feasibility studies to build a second lake to supplement the water supply. A survey of Lake DePue, a backwater lake on the Illinois River, is assisting IDNR in making this lake suitable for recreation and ecological enhancement. This 70- to 80-year history of Water Survey involvement in lake studies has made, and will continue to make, a difference in the lives of Illinois citizens.

### Peoria Lake

Peoria Lake along the Illinois River has the highest sedimentation rates of any Illinois lake and has lost more than 80 percent of its original capacity. Water Survey scientists initiated the first scientific analyses of this lake in 1984. Restoration of the lake ecosystem will require in-lake and off-lake sediment management. A mathematical analysis now being done has shown that the creation of artificial islands with dredged materials is a viable option both for increasing aquatic and terrestrial habitats and for finding a workable solution for sediments already within the system.

# PUBLICATIONS BY WATER SURVEY STAFF

## Water Survey Series

Anliker, M.A. 1999. *Long-Term Ground-Water Level Monitoring Network and Aquifer Hydraulic Properties Database for DeWitt, Piatt, and Northern Macon Counties.* Illinois State Water Survey Contract Report 642.

Borah, D.K. 1998. *Investigation of the STEWARD Expert System for the Lake Pittsfield Watershed.* Illinois State Water Survey Contract Report 639.

Borah, D.K., and K.M. Allan. 1998. *Modeling the Lake Pittsfield Watershed Using the AGNPS-ARC/INFO Model.* Illinois State Water Survey Contract Report 640.

Burch, S.L., R.D. Olson, and A.P. Visocky. 1999. *Ground-Water Investigation for the University of Illinois*. Illinois State Water Survey Contract Report 636.

Changnon, S.A., and D. Winstanley. 1999. *Temporal Fluctuations in Seasonal Weather Conditions Critical to Water Resources and Crop Production in Illinois.* Illinois State Water Survey Research Report 127.

Hlinka, K.J., A.G. Buck, and G.R. Clark. 1999. *Ground-Water/Surface Water Interactions at Sand Lake, Mason County, Illinois*. Illinois State Water Survey Miscellaneous Publication 187.

Hollinger, S.E., and C.S.T. Daughtry. 1999. *Southern Great Plains 1997 Hydrological Experiment: Vegetation Sampling and Data Documentation.* Illinois State Water Survey Contract Report 644.

Keefer, L., and M. Demissie. 1999. *Watershed Monitoring for the Lake Decatur Watershed 1997-1998.* Illinois State Water Survey Contract Report 637.

Knapp, H.V. 1999. *Influence of Streamflow Forecasts and Hydrometeorological Conditions on Stratton Dam Operations.* Illinois State Water Survey Contract Report 635.

Rothert, J. 1999. *Quality Assurance Report, National Atmospheric Deposition Program, 1996 and 1997.* Illinois State Water Survey Miscellaneous Publication 188.

Sanderson, E.W. 1998. *Ground-Water Investigation in the Embarras River Valley, Jasper County, Illinois.* Illinois State Water Survey Contract Report 634.

Sanderson, E.W., and R.D. Olson. 1999. *Dewatering Well Assessment for the Highway Drainage System at Five Sites in the East St. Louis Area, Illinois (FY94 - Phase 11).* Illinois State Water Survey Contract Report 641.

Sanderson, E.W., and A.P. Visocky. 1998. *Ground-Water Investigation for the Village of Homer, Ogden Township, Champaign County, Illinois*. Illinois State Water Survey Contract Report 633.

*Tom Holm (left) and Joe Karny sample ground water at DePue State Fish and Wildlife Area in Bureau County.*

Wilson, S.D., G.S. Roadcap, B.L. Herzog, D.R. Larson, and D. Winstanley. 1998. *Hydrogeology and Ground-Water Availability in Southwest McLean and Southeast Tazewell Counties. Part 2: Aquifer Modeling and Final Report*. Illinois State Water Survey/Illinois State Geological Survey Cooperative Ground-Water Report 19.

## External Publications

### *Analytical Chemistry & Technology Unit*

Sanderson, G.C., W.L. Anderson, G.L. Foley, S.P. Havera, L.M. Skowron, J.W. Brawn, G.D. Taylor, and J.W. Seets. 1998. Effects of Lead, Iron, and Bismuth Alloy Shot Embedded in the Breast Muscles of Game-Farm Mallards. *Journal of Wildlife Diseases* **34**(4):688-697.

Selby, K.A., and K.W. Smothers**.** 1999. *Boiler Safety, Environmental and Indoor Air Quality Issues*, Proceedings, National Association of Corrosion Engineers Annual Conference, San Antonio, TX, Paper #99340.

Smothers, K.W., and M.D. Brooks. 1999. *Corrosion Control Analysis and Recommendations for Boilers at Ft. Drum, New York*. Technical Report DACA88-98-M-0239, U.S. Army Construction Engineering Research Laboratories, Champaign, IL.

### *Atmospheric Environment Section*

Angel, J R., and F.A. Huff. 1999. Hydrometeorological Characteristics of the Northern Illinois Heavy Rains of 17-18 July 1996. *Journal of Applied Meteorology* **38:**266-272.

Angel, J.R., S.A. Isard, and G. Van Dyke. 1999. *The Effects of ENSO on Great Lakes Cyclones*. Preprints, 11th Conference on Applied Climatology, American Meterological Society, Dallas, TX, pp. 305-308.

Beard, K.V., H.T. Ochs, and S. Liu. 1998. *A Physically Based Scaling for the Effect of Pressure on the Coalescence Efficiency of Small Precipitation Drops.* Preprints, Conference on Cloud Physics, American Meteorological Society, Everett, WA, p. 438.

Bonner, W., S.A. Changnon, K. Crawford, N. Doesken, T. Horst, R. Jenne, V. Nieva, and D. Robinson. 1998. *Future of the National Weather Service Cooperative Observer Network.* National Research Council, National Academy Press, Washington, DC.

Changnon, S.A. 1998. Comments on "Secular Trends of Precipitation Amount, Frequency, Intensity in the U.S." *Bulletin of the American Meteorological Society* **79**:2550-2552.

Changnon, S. 1998. Review of the "Rising Tide: The 1927 Flood." *Rivers* **6**:220-221.

Changnon, S.A. 1998. *Trends in Flood Losses: A Hazard Out of Control?* Proceedings, Shake, Rattle, and Flow. Employers Reinsurance, Overland Park, KS, pp. 1-13.

Changnon, S.A. 1999. Factors Affecting Temporal Fluctuations in Damaging Storm Activity in the U.S. Based on Insurance Loss Data. *Meteorological Applications* **6**:1-11.

Changnon, S.A. 1999. The Historical Struggle with Floods on the Mississippi River Basin: Impacts of Recent Floods and Lessons for Future Flood Management and Policy. *Water International* **23**:263-271.

Changnon, S. 1999. Impacts and Responses to the July 1996 Rainstorm at Chicago. *Journal of Applied Meteorology* **38**:273-280.

Changnon, S.A. 1999. Record High Losses for Weather Disasters in the United States during the 1990s: How Excessive and Why? *Natural Hazards* **18**:287-300.

Changnon, S.A., and K.E. Kunkel. 1999. Improved Use of Climate Information in Agriculture and Water Resources. *Bulletin of the American Meteorological Society* **80**:43-56.

Changnon, S.A., and K.E. Kunkel. 1999. Rapidly Expanding Uses of Climate Data and Information in Agriculture and Water Resources: Causes and Characteristics of New Applications. *Bulletin of the American Meteorological Society* **80**:821-830.

Changnon, S., and K. Kunkel. 1999. The Record 1996 Rainstorm at Chicago. *Journal of Applied Meteorology* **38**:257-265.

Changnon, S.A., E. Lecomte, and E. Fosse. 1999. Interactions between the Insurance Industry and Atmospheric Sciences. *Climatic Change* **35**:456-471.

Cooper, K.A., M.R. Hjelmfelt, D.A.R. Kristovich, R.G. Derickson, and N.F. Laird. 1998. *Numerical Simulations of an Observed Lake Effect Snow Storm with Transitions between Linear and Cellular Convective Structures.* Preprints, Conference on Cloud Physics. American Meteorological Society, Everett, WA, pp. 379-380.

Heim, R.R., Jr., and J.R. Angel. 1999. *Urbana, Illinois: A Case Study of 20th Century Snowfall.* Preprints, 11th Conference on Applied Climatology, American Meteorological Society, Dallas, TX, pp. 275-282.

Hollinger, S.E. 1999. Agricultural Climatology. In *Illinois Agronomy Handbook.* College of Agricultural Consumer and Environmental Sciences, University of Illinois, Urbana, pp. 1-16.

Isard, S.A., D.A.R. Kristovich, S.H. Gage, C.J. Jones, and N.F. Laird. 1998. Atmospheric Motion Systems that Influence the Redistribution and Accumulation of Insects on the Beaches of the Great Lakes in North America. *Physical Aerobiology*, Vol. 1 (An International Online Journal), http://www.fisbat.bo.cnr.it/AERO/PA/PAIJ.html.

Kristovich, D.A.R., and R.R. Braham, Jr. 1998. Profiles of Moisture Fluxes in Snow-Filled Boundary Layers. *Boundary-Layer Meteorology* **87**:195-215.

Kristovich, D.A.R., and N.F. Laird. 1998. Observations of Widespread Lake-Effect Cloudiness: Influences of Lake Surface Temperature and Upwind Conditions. *Weather Forecasting* **13**:811-821.

Kristovich, D.A.R., N.F. Laird, and M.R. Hjelmfelt. 1999. *Initial Investigations of Coherent Structures Observed during the Lake-Induced Convection Experiment (Lake-ICE).* Preprints, 13th Symposium on Boundary Layers and Turbulence, American Meteorological Society, Dallas, TX, pp. 666-669.

Kristovich, D.A.R., N.F. Laird, M.R. Hjelmfelt, and P.H. Hildebrand. 1998. *Airborne Doppler Radar Observations of Boundary Layer Rolls in Lake-Effect Snow Storms.* Preprints, Conference on Cloud Physics, American Meteorological Society, Everett, WA, pp. 377-378.

*Jim Slowikowski installs a gaging station for the Spoon River watershed.*

Kunkel, K.E., K. Andsager, G. Conner, W.L. Decker, H.J. Hilaker, Jr., P. Naber Knox, F.V. Nurnberger, J.C. Rogers, K. Scheeringa, W.M. Wendland, J. Zandlo, and J.R. Angel. 1998. An Expanded Digital Daily Database for Climatic Resources Applications in the Midwestern United States. *Bulletin of the American Meteorological Society* **79**:1357-1366.

Kunkel, K.E., K. Andsager, and D.R. Easterling. 1999. *Circulation Patterns Associated with Flood-Producing Precipitation Events.* Preprints, 10th Symposium on Global Change Studies, American Meteorological Society, Boston, MA, pp. 319-322.

Kunkel, K.E., N.E. Westcott, and S.E. Hollinger. 1998. *Operational Modeling of Soil Moisture at High Spatial Resolution in the Central U.S.* Preprints, 23rd Conference on Agricultural and Forest Meteorology, American Meteorological Society, Boston, MA, pp. 88-89.

Laird, N.F. 1999. Observation of Coexisting Mesoscale Lake-Effect Vortices over the Western Great Lakes. *Monthly Weather Review* **127**:1137-1141.

Laird, N.F., L.J. Miller, and D.A.R. Kristovich. 1999. *Mesoanalysis and NEXRAD Synthetic Dual-Doppler Retrieval of a Winter Mesoscale Vortex.* Preprints, 8th Conference on Mesoscale Processes, American Meteorological Society, Boulder, CO, pp. 268-270.

*One study is examining ways to reduce flooding along the Embarras River.*


Laird, N.F., H.T. Ochs, R.M. Rauber, and L.J. Miller. 1998. *Microphysical Properties of Florida Small Cumulus Clouds. Part I: Observations.* Preprints, Conference on Cloud Physics, American Meteorological Society, Everett, WA, pp. 486-489.

Litan, R., R. Andrews, S.A. Changnon, L. Cluff, R. Eguchi, J.F. Kimpel, A. Kiremidjian, R.J. Roth, Jr., T. Schelling, R. Sylves, and C. West. 1999. *The Costs of Natural Disasters: A Framework for Assessment.* National Research Council, National Academy Press, Washington, DC.

Mearns, L.O., I. Bogardi, F. Giorgi, I. Matyasovsky, and M. Palecki. 1999. Comparison of Climate Change Scenarios Generated from Regional Climate Model Experiments and Statistical Downscaling. *Journal of Geophysical Research* **104**:6603-6621.

Ochs, H.T., III, N.F. Laird, and R.M. Rauber. 1998. *A Numerical Model of Developing Precipitation in Tropical Cumulus Clouds.* Abstracts, 6th International Conference on Precipitation, Kona, HI, p. 3-10.

Ochs, H.T., III, N.F. Laird, R.M. Rauber, and L.J. Miller. 1999. *Precipitation Processes in Tropical Cumulus Clouds.* Preprints, 23rd Conference on Hurricanes and Tropical Meteorology, American Meterological Society, Dallas, TX, pp. 634-635.

Ochs, H.T., R.M. Rauber, and N.F. Laird. 1998. *Microphysical Properties of Florida Small Cumulus Clouds, Part II: Modeling Studies.* Preprints, Conference on Cloud Physics, American Meteorological Society, Everett, WA, pp. 490-491.

Ochs, H.T., C. Twohy, K.V. Beard, and M. Belding. 1998. *Measurements of Drop and Aerosol Charges in and around Wintertime Continental Clouds.* Conference on Cloud Physics, American Meteorological Society, Everett, WA, pp. 134-135.

Palecki, M.A. 1999. *Examining the Climate Response to El Niño and La Niña Using High Temporal Resolution Approaches.* Proceedings, 11th Conference on Applied Climatology, American Meteorological Society, Boston, MA, pp. 97-100.

Rauber, R.M., J.J. Wang, H.T. Ochs, III, and R. Carbone. 1999. *Precipitation Enhancement of Trade Wind Rainbands.* Abstracts, 6th International Conference on Precipitation, Kona, HI, p. 2-17.

Rose, B.L., D.A.R. Kristovich, and J.E. Walsh. 1998. *A Numerical Investigation of the Role of Lake Michigan in Determining Severity of Lake-Effect Snowstorms over Lake Erie.* Preprints, Conference on Cloud Physics, American Meterological Society, Everett, WA, pp. 383-386.

Stensland, G.J. 1998. Acid Rain. In *Encyclopedia of Environmental Science and Engineering* (J.R. Pfafflin and E.N. Ziegler, eds.), Volume 1, Fourth Edition. Gordon and Breach Science Publishers, New York, NY, pp. 1-13.

Stensland, G.J. 1999. *Comparison of Dry Deposition Data from a Rural Monitoring Site in Illinois.* Proceedings, 92nd Annual Meeting, Air and Waste Management Association, Pittsburgh, PA, Paper 99.328.

Szumowski, M.J., R.M. Rauber, and H.T. Ochs. 1998. *A Test of the Ultragiant Nuclei Theory Using a Lagrangian Raindrop Trajectory Model in Four-Dimensional Dual-Doppler Fields.* Preprints, Conference on Cloud Physics, American Meteorological Society, Everett, WA, pp. 498-501.

Szumowski, M.J., R.M. Rauber, H.T. Ochs, III, and K.V. Beard. 1998. *Formation of Precipitation in Shallow Tropical Convection.* Abstracts, 6th International Conference on Precipitation, Kona, HI, p. 2-20.

Vinnikov, K.Y., A. Robock, S. Qui, J.K. Entin, M. Owe, B.J. Choudhury, S.E. Hollinger, and E. Njoku. 1999. Satellite Remote Sensing of Soil Moisture in Illinois, USA. *Journal of Geophysical Research* **104**(D4):4145-4168.

Wang, J.-J., R.M. Rauber, H.T. Ochs, and R. Carbone. 1998. *The Effects of the Island of Hawaii on Trade-wind Rainband Evolution.* Preprints, Conference on Cloud Physics, American Meteorological Society, Everett, WA, pp. 366-369.

Westcott, N.E., D.A.R. Kristovich, and K.E. Kunkel. 1999. *Climatology of Heavy Lake Effect Snows for Lake Erie.* Preprints, Conference on Applied Climatology, 11th American Meterological Society, Boston, MA, pp. 248-253.

Williams, A., and G.J. Stensland. 1999. *Atmospheric Dispersion of Deicing Salt Applied to Roads.* Proceedings, 92nd Annual Meeting, Air and Waste Management Association, Pittsburgh, PA, Paper 99.441.

## Ground-Water Section

Dey, W.S., E. Mehnert, D.A. Keefer, H.A. Wehrmann, and S.D. Wilson. 1999. *Installation of a State Wide Monitoring Network To Evaluate Pesticide Contamination in Groundwater in Illinois.* Program with Abstracts, Geological Society of America 33rd Annual Meeting, North-Central Section, Champaign, IL, p. 13.

Frankie, W.T., J.A. Devera, R.J. Jacobson, C.A. Phillips, R.A. Locke, II, and M.J. Wagner. 1998. *Guide to the Geology of the LaRue-Pine Hills Area, Jackson and Union Counties, Illinois.* Illinois State Geological Survey Field Trip Guidebook 1998-D/1999-A, Champaign, IL.

Frankie, W.T., A.C. Phillips, R.J. Jacobson, M.M. Killey, D.H. Wahl, J.H. Hoxmeier, and G.S. Roadcap. 1998. *Guide to the Geology of the Lake Shelbyville Area, Shelby and Moultrie Counties, Illinois*. Illinois State Geological Survey Field Trip Guidebook 1998-C, Champaign, IL.

Heidari, M., K. Ghiassi, and E. Mehnert. 1999. Analysis of Pumping Tests: Significance of Well Diameter, Partial Penetration, and Noise. *Journal of the American Water Resources Association* **35**(2):333-347.

Heidari, M., D. Keefer, W.R. Roy, I.G. Krapac, A. Valocchi, and K. Ghiassi. 1998. Movement of Contaminants in Alluvial Aquifers during Light and Heavy (Flood) Rainfall Conditions: Field Data Collection and Model Simulation. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions VIII.* Proceedings, Eighth Annual Conference, Illinois Groundwater Consortium, Makanda, IL, pp. 1-21.

Holm, T.R., W.R. Kelly, H.A.Wehrmann, D.J. Adomaitis, K.W. Carr, and A.L. Erdmann. 1999. *An Assessment of Metals Distribution and Transport in Ground Water beneath a Diked Sediment Disposal Area.* Abstract, Environmental Horizons 99 Conference Proceedings, University of Illinois at Urbana-Champaign, p. 24.

Kelly, W.R., T.R. Holm, and H.A. Wehrmann. 1999. *The Effects of Periodic Flooding on a Soil Contaminated with Heavy Metals, Preliminary Results*. Abstract H42C-17, Proceedings, American Geophysical Union Annual Meeting, Boston, MA, p. S141.

Kelly, W.R., and S.D. Wilson. 1998. The Effect of Periodic Flooding on the Movement of Pesticides in the Subsurface. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions VIII.* Proceedings, Eighth Annual Conference, Illinois Groundwater Consortium, Makanda, IL, pp. 31-46.

Kelly, W.R., and S.D. Wilson. 1998. *The Movement of Surface-Applied Atrazine, Nitrate, and Bromide in the Subsurface in a Flooded Field.* Abstract, Illinois Water '98 Conference, Urbana, IL, p. 27.

Locke, R.A., II. 1999. *Potential for Groundwater Contamination at Illinois Nature Preserves and Class III Groundwater.* Proceedings, Policy Forum on Regional Groundwater

*Water gushes at the rate of 900 gallons per minute during a 30-day aquifer test to determine aquifer properties for a cooperative project with the city of Mackinaw.*

Protection Programs, Abstract, Illinois Environmental Protection Agency, IEPA/BOW/99-03, Springfield, Illinois, p. 18.

Panno, S.V., K.C. Hackley, W.R. Kelly, and H.H. Hwang. 1999. Sources of Nitrate Contamination in Karst Springs Using Isotopic Chemical and Bacterial Indicators: Preliminary Results. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions IX.* Proceedings, Ninth Annual Conference, Illinois Groundwater Consortium, Carbondale, IL, pp. 91-103.

Panno, S.V., W.R. Kelly, C.P. Weibel, I.G. Krapac, and S.L. Sargent. 1998. The Effects of Land Use on Water Quality and Agrichemical Loading in the Fogelpole Cave Groundwater Basin, Southwestern Illinois. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions VIII.* Proceedings, Eighth Annual Conference, Illinois Groundwater Consortium, Makanda, IL, pp. 215-233.

Ray, C., T.W. Soong, G. Roadcap, and D. Borah. 1998. *A Study of the Dynamics of Contaminant Transport at Bank Filtration Sites*. American Water Works Association Proceedings, Dallas, TX, pp. 90-100.

Roy, W.R., M. Heidari, I.G. Krapac, D.A. Keefer, S.F.J. Chou, and J.S. Lee. 1999. Pesticide Storage and Release in Soil: Results of a Field Experiment. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions IX.* Proceedings, Ninth Annual Conference, Illinois Groundwater Consortium, Carbondale, IL, pp. 77-90.

Roy, W.R., I.G. Krapac, M. Heidari, and K. Ghiassi. 1998. Pesticide Storage and Release in Unsaturated Soils: Field Experiments. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions VIII.* Proceedings, Eighth Annual Conference, Illinois Groundwater Consortium, Makanda, IL, pp. 202-214.

Wehrmann, H.A., M.E. Caughey, J.R. Karny, T.R. Holm, E. Mehnert, D.A. Keefer, and W.S. Dey. 1998. *An Examination of Pesticide Occurrence in Large-Diameter Wells: Are High Detection Rates Related to On-Field Applications?* Abstract, 43rd Annual Midwest Ground Water Conference, Lawrence, KS, p. 18.

Wehrmann, H.A., M.E. Caughey, J.R. Karny, T.R. Holm, E. Mehnert, D.A. Keefer, and W.S. Dey. 1999. *An Examination of Pesticide Occurrence in Large-Diameter Wells: Are High Detection Rates Related to On-Field Applications?* Abstract, Environmental Horizons 99 Conference Proceedings, University of Illinois at Urbana-Champaign, p. 21.

Wilson, S.D., and J.R. Karny. 1998. A Community-Based Sampling Program for Evaluating Long-Term Flood Impacts on Rural Well-Water Quality. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions VIII.* Proceedings, Eighth Annual Conference, Illinois Groundwater Consortium, Makanda, IL, pp. 234-246.

Wilson, S.D., and J.R. Karny. 1999. A Community-Based Sampling Program for Evaluating Long-Term Flood Impacts on Rural Well-Water Quality. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions IX.* Proceedings, Ninth Annual Conference, Illinois Groundwater Consortium, Carbondale, IL, pp. 104-112.

Wilson, S.D., G.S. Roadcap, B.L. Herzog, D.R. Larson, and D. Winstanley. 1998. *Site Characterization—Evolution of a Conceptual Model*. National Ground Water Association Annual Convention and Expo, AGWS&E Technical Education Session 1998 Abstract Book, Las Vegas, NV, pp. 89-90.

*Al Wehrmann (left) and Bryan Coulson drill an observation well.*

## National Atmospheric Deposition Program


Bachman S.R., and T. Bergerhouse. 1998. *Procedures for Stabilizing $NH_4$ and $PO_4$ Concentrations in Rainwater Samples.* Proceedings, NADP Technical Committee Meeting, St. Petersburg, FL, p. 51.

Demir, B., J. Rothert, L. Henry, and V.C. Bowersox. 1998. *Thymol Preservation in Daily Precipitation Samples or More Mols with Thymol.* Proceedings, NADP Technical Committee Meeting, St. Petersburg, FL, p. 54.

Gatz, D.F., and C.W. Sweet. 1998. *Air Toxics in the Great Lakes Area: Regional Source Locations.* Proceedings, NADP Technical Committee Meeting, St. Petersburg, FL, p. 40.

Larson, R.S., D.R. Claybrooke, G.J. Stensland, and V.C. Bowersox. 1998. *The Changing Precipitation Chemistry Picture and Hypoxia in the Gulf of Mexico - Contemporary Applications of NADP Data.* Proceedings, NADP Technical Committee Meeting, St. Petersburg, FL, p. 58.

Lawrence, G.B., D.A. Goolsby, W.A. Battaglin, and G.J. Stensland. 1998. *Atmospheric Deposition of Nitrogen in the Mississippi River Basin.* Proceedings, NADP Technical Committee Meeting, St. Petersburg, FL, p. 27.

Lynch, J.A., V.C. Bowersox, and J.W. Grimm. 1998. *Changes in Atmospheric Deposition in Eastern USA Following Enactment of Title IV of Clean Air Act Amendments of 1990.* Proceedings, NADP Technical Committee Meeting, St. Petersburg, FL, p. 22.

NADP. 1998. *NADP Technical Committee Meeting Abstracts of Papers, Celebrating Twenty Years of Network Operations.* NADP Program Office, Champaign, IL.

NADP. 1998. *National Atmospheric Deposition Program 1998-99 CALendar.* NADP Program Office, Champaign, IL.

NADP. 1999. *National Atmospheric Deposition Program 1997 Wet Deposition.* NADP Program Office, Champaign, IL.

Stensland, G.J., and S.C. Milton. 1998. *Some Historical Aspects of the National Atmospheric Deposition Program.* Proceedings, NADP Technical Committee Meeting, St. Petersburg, FL, p. 63.


*The sun sets on the Quincy Bridge on the Mississippi River.*


Sweet, C.W., E.M. Prestbo, and R. Brunnette. 1998. *Wet Deposition of Total Mercury at Mercury Deposition Network (MDN) Sites in 1996 and 1997.* Proceedings, NADP Technical Committee Meeting, St. Petersburg, FL, p. 64.


## Watershed Science Section


ASCE Task Committee on Hydraulics, Bank Mechanics, and Modeling of River Width Adjustment (C.R. Thorne, C. Alonso, R. Bettess, D. Borah, S. Darby, P. Diplas, P. Julien, D. Knight, L. Li, J. Pizzuto, M. Quick, A. Simon, M. Stevens, S. Wang, and C. Watson). 1998. River Width Adjustment. I: Processes and Mechanisms. *Journal of Hydraulic Engineering* **124**(9):881-902.

ASCE Task Committee on Hydraulics, Bank Mechanics, and Modeling of River Width Adjustment (C.R. Thorne, C. Alonso, R. Bettess, D. Borah, S. Darby, P. Diplas, P. Julien, D. Knight, L. Li, J. Pizzuto, M. Quick, A. Simon, M. Stevens, S. Wang, and C. Watson). 1998. River Width Adjustment. II: Modeling. *Journal of Hydraulic Engineering* **124**(9):903-917.

Bhowmik, N.G. 1998. Hydraulic and Hydrologic Aspects of the 1993 Flood on the Upper Mississippi and Missouri Rivers in the USA. In *Bangladesh Floods Views from Home and Abroad* (M.M. Ali, M.M. Hogue, R. Rahman, and S. Rashid, eds.). The University Press Limited, Dhaka, Bangladesh, pp. 137-160.

Bhowmik, N.G. 1998. River Basin Development: An Integrated Approach. *Water International* **23**(2):84-90.

Bhowmik, N.G. 1998. *The Mississippi River: A National Resource of the United States.* Proceedings, Third Princess Chulabhorn Science Congress, Water and Development: Water Is Life, Vol. II, December 11-15, 1995, Bangkok, Thailand, pp. 115-139.

Bhowmik, N.G., J.A. MacDonald, and A. Dasgupta. 1998. *Guidelines for Integrated River Basin Management, Summary Report*. Proceedings, Third Princess Chulabhorn Science Congress, Water and Development: Water Is Life, Vol. II, December 11-15, 1995, Bangkok, Thailand, pp. 547-548.

Borah, D.K., M. Bera, S. Shaw, L. Keefer, and M. Demissie. 1999. *Dynamic Modeling of Sediment, Nutrient, and Pesticide Transport in Agricultural Watersheds during Severe Storm Events.* Proceedings, Ninth Annual Conference, Illinois Groundwater Consortium, Carbondale, IL, pp. 24-38.

Borah, D., M. Demissie, and L. Keefer. 1996. *Modeling the Lake Decatur Watershed in Illinois To Evaluate Effects of Best Management Practices on Nitrate Loading.* Proceedings, North America Water and Environment Congress '96, Anaheim, CA, ASCE: CD-ROM.

Borah, D., M. Demissie, and L. Keefer. 1998. *Modeling the Lake Decatur Watershed in Illinois To Evaluate Effects of Best Management Practices on Nitrate Loading.* Abstracts, Illinois Renewable Natural Resources Conference, Springfield, IL, p. 80.

Borah, D.K., M. Demissie, L. Keefer, M. Bera, and S. Shaw. 1998. *Dynamic Modeling of Sediment, Nutrient, and Pesticide Transport in Agricultural Watersheds during Severe Storm Events.* Proceedings, Eighth Annual Conference, Illinois Groundwater Consortium, Makanda, IL, pp. 128-150.

Borah, D.K., H.V. Knapp, R.K. Raman, S.D. Lin, and T.W.D. Soong. 1998. *Evaluating Impacts of Droughts and Drawdowns on a Lake System in Illinois Using a Mathematical Model.* Program and Abstracts, Illinois Lake Management Association 13th Annual Conference, Rockford, IL, pp. 11-12.

Borah, D., R. Raman, S. Lin, V. Knapp, and D. Soong. 1997. *Water Quality Evaluations for a Lake System in Illinois Using a Simulation Model.* Paper No. 2-C-408-C-TP3.2-2, IXth World Water Congress of the International Water Resources Association, Montreal, Canada. Collection Environment de Universite de Montreal: Extended Abstracts (A.M. Shady, A. Kassem, C.E. Delisle, and M.A. Bouchard, eds.), pp. 259-262.

Demissie, M., and L. Keefer. 1998. Watershed Approach for the Protection of Drinking Water Supplies in Central Illinois (U.S.A.). *Water International* **23**(4):272-277.

Guo, Y., and B.J. Adams. 1998. Hydrologic Analysis of Urban Catchments with Probabilistic Models, 1. Runoff Volume. *Water Resources Research* **34**(12):3421-3431.

Guo, Y., and B.J. Adams. 1998. Hydrologic Analysis of Urban Catchments with Probabilistic Models, 2. Peak Discharge Rate. *Water Resources Research* **34**(12):3433-3443.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1998. H.V. Knapp (pp. 1-7, 25-35, 43-46); M. Miller, L. Suloway (pp. 8-13); L. Keefer (pp. 8-14); J. Angel, W. Armstrong (pp. 15-24); G. Ramamurthy, K. Nichols (pp. 25-35); M. Demissie, R. Xia, B. Bogner (p. 37); K. Hlinka, J. Blomberg (pp. 39-43, 47-57); K. Charles (pp. 39-43); and T. Holm (pp. 47-57). In *Sinkhole Plain Area Assessment, Vol. 2, Water Resources*. Illinois Department of Natural Resources, Springfield, IL.

*Randy Locke uses Global Positioning System equipment on the Illinois River at DePue.*

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1998. D. Gatz (pp. 2-1 to 2-8). In *Sinkhole Plain Area Assessment, Vol. 4, Socio-Economic Profile, Environmental Quality, Archaeological, Part II*. Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1998. H.V. Knapp (pp. 1-4, 25-34, 41-43); M. Miller, L. Suloway (pp. 5-9); L. Keefer (pp. 5-11); J. Angel, W. Armstrong (pp. 13-23); G. Ramamurthy, K. Nichols (pp. 25-34); M. Demissie, R. Xia, B. Bogner (p. 35); K. Hlinka, J. Blomberg (pp. 37-41, 45-55); K. Charles (pp. 37-41); and T. Holm (pp. 45-55). In *Sugar-Pecatonica Area Assessment, Vol. 2, Water Resources*. Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1998. D. Gatz (pp. 2-1 to 2-10). In *Sugar-Pecatonica Area Assessment, Vol. 4, Socio-Economic Profile, Environmental Quality, Archaeological, Part II*. Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. H.V. Knapp (pp. 1-5, 23-34, 42-44); M. Miller, L. Suloway (pp. 6-10 ); L. Keefer (pp. 6-12 ); J. Angel (pp. 13-22); M. Myers (pp. 23-34 ); M. Demissie, R. Xia, W. Bogner (pp. 35-36 ); K. Hlinka (pp. 37-41, 45-53); S. Sinclair (pp. 37-41, 45-53); and T. Holm (pp. 45-53). In *DuPage River Assessment Area, Vol. 2, Water Resources.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. D. Gatz (pp. 2-1 to 2-8); and S. Lin (pp. 2-9 to 2-23). In *DuPage River Area Assessment, Vol. 4, Socio-Economic Profile, Environmental Quality, Archaeological Resources, Part II.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. H.V. Knapp (pp. 1-7, 25-37, 52-55); M. Miller, L. Suloway (pp. 7-12); L. Keefer (pp. 7-13); J. Angel (pp. 15-23); M. Myers (pp. 25-37); M. Demissie, R. Xia, W. Bogner (pp. 39-45); K. Hlinka (pp. 47-51); S. Sinclair (pp. 47-51, 57-67); and T. Holm (pp. 57-67). In *Prairie Parklands Assessment Area, Vol. 2, Water Resources.* Illinois Department of Natural Resources, Springfield, IL.

*A wellhead with a turbine pump was used for an aquifer test near Emden.*

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. D. Gatz (pp. 2-1 to 2-8); and S. Lin (pp. 2-9 to 2-20). In *Prairie Parklands Area Assessment, Vol. 4, Socio-Economic Profile, Environmental Quality, Archaeological Resources, Part II.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. H.V. Knapp (pp. 1-3, 23-33, 45-48); M. Miller, L. Suloway (pp. 3-7); L. Keefer (pp. 3-7, 10-11); J. Angel (pp. 13-22); M. Myers (pp. 23-33); M. Demissie, R. Xia, W. Bogner (pp. 35-39); K. Hlinka (pp. 41-45, 49-57); S. Sinclair (pp. 41-45, 49-57); and T. Holm (pp. 49-57). In *Sangamon River Area Assessment, Vol. 2, Water Resources.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. D. Gatz (pp. 2-1 to 2-7); and S. Lin (pp. 2-9 to 2-19). In *Sangamon River Area Assessment, Vol. 4, Socio-Economic Profile, Environmental Quality, Archaeological Resources, Part II.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. S. Lin (pp. 1-11). In *Sugar-Pecatonica Area Assessment, Vol. 4. Socio-Economic Profile, Environmental Quality, Archaeological Resources, Part II.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. H.V. Knapp (pp. 1-3, 7-10, 21-31, 39-40); M. Miller, L. Suloway (pp. 4-8); L. Keefer (pp. 4-9); J. Angel (pp. 11-19); M. Myers (pp. 21-31); M. Demissie, R. Xia, W. Bogner (p. 33); K. Hlinka (pp. 35-39, 41-48); S. Sinclair (pp. 35-39, 41-48); and T. Holm (pp. 41-48). In *Thorn Creek Area Assessment, Vol. 2, Water Resources.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. D. Gatz (pp. 2-1 to 2-6); and S. Lin (pp. 2-7 to 2-14). In *Thorn Creek Area Assessment, Vol. 4, Socio-Economic Profile, Environmental Quality, Archaeological Resources, Part II.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. H.V. Knapp (pp. 1-5, 23-34, 45-48); M. Miller, L. Suloway (pp. 5-9); L. Keefer (pp. 5-11); J. Angel (pp. 13-22); M. Myers (pp. 23-34); M. Demissie, R. Xia, W. Bogner (pp. 35-40); K. Hlinka (pp. 41-45, 49-59); S. Sinclair (pp. 41-45, 49-59); and T. Holm (pp. 49-59). In *Vermilion River Area Assessment, Vol. 2, Water Resources.* Illinois Department of Natural Resources, Springfield, IL.

Illinois State Water Survey Division, N. Bhowmik, Project Coordinator. 1999. D. Gatz (pp. 2-1 to 2-8); and S. Lin (pp. 2-9 to 2-23). In *Vermilion River Area Assessment, Vol. 4, Socio-Economic Profile, Environmental Quality, Archaeological Resources, Part II.* Illinois Department of Natural Resources, Springfield, IL.

Ray, C., T.W.D. Soong, D.K. Borah, and G.S. Roadcap. 1997. *Flood Induced Loading of Agricultural Chemicals to Public Water Supply Wells in Selected Reaches of the Illinois River.* Proceedings, Seventh Annual Conference on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions, Illinois Groundwater Consortium, Makanda, IL, pp. 11-24.

Ray, C., T.W.D. Soong, G.S. Roadcap, and D.K. Borah. 1998. Agricultural Chemicals: Effects on Wells during Floods. *Journal of the American Water Works Association* **90**(7):90-100.

Soong, T.W. 1999. Fine Sediment of the Upper Mississippi River and Its Disastrous Consequences. *International Journal of Sediment Research* **14**(2):171-178.

Soong, T.W., N.G. Bhowmik, and M. Bera. 1998. *A 1995 Bank Survey along the Illinois Waterway*. Proceedings, International Water Resources Engineering Conference, Water Resources Engineering 98 (S.R. Abt, J. Young-Pezeshk, and C.C. Watson, eds.). American Society of Civil Engineers, Memphis, TN, pp. 364-369.

Soong, D., G. Roadcap, Y. Lian, and C. Ray. 1999. Management Strategies for Riparian Water Supply Wells. In *Research on Agricultural Chemicals in Illinois Groundwater: Status and Future Directions IX.* Proceedings, Ninth Annual Conference, Illinois Groundwater Consortium, Carbondale, IL, pp. 113-125.

Wang, Z.Y., T.W. Soong, and B.C. Yen (eds.). 1999. Special Issue on Sediment Transport and Disasters. In *International Journal of Sediment Research*. Proceedings, Sino-U.S. Workshop on Sediment Transport and Disasters, March 15-17, 1999, Beijing, China.

*David Soong maps bank conditions along the Kankakee River.*

# HONORS

*Nani Bhowmik*
Invited keynote speaker, "The First Sino-U.S. Workshop on Sediment Transport and Sediment Induced Disasters," March 15-22, 1999, Beijing, China, sponsored by the National Science Foundation (U.S.) and the Natural Science Foundation (China)

*Van Bowersox*
Member, Precipitation Chemistry Science Advisory Group, World Meteorological Organization

*Mark Brooks*
Symposium Vice-Chairman, National Association of Corrosion Engineers 1999 Annual Conference, San Antonio, TX

*Stanley Changnon*
Member, National Climate Change Data and Detection Panel

*Mike Demissie*
Member, Organization Committee, "The First Sino-U.S. Workshop on Sediment Transport and Sediment Induced Disasters," March 15-22, 1999, Beijing, China, sponsored by the National Science Foundation (U.S.) and the Natural Science Foundation (China)

*Scott Dossett*
Chair, National Atmospheric Deposition Program Network Operations Subcommittee

*Manoutchehr Heidari*
Member, Steering Committee, Mahomet Aquifer Consortium

*Steven Hollinger*
Member, National Assessment Team-Agricultural Sector, which is studying effects of climate change and variability on agriculture for Intergovernmental Panel on Climate Change

*Brian Kaiser*
Member, Education Committee, Illinois Section of American Water Works Association

*Kenneth Kunkel*
Member, National Assessment Team - Great Lakes Region, which is studying effects of climate change and variability of the Great Lakes region for Intergovernmental Panel on Climate Change

*Sally McConkey*
Recipient, Illinois Association for Floodplain and Stormwater Management Outstanding Service Award "for her outstanding and tireless efforts to the Association for initiating the Downstate Annual Conferences"

*Harry Ochs*
Program Chairman and Organizer, 1999 Annual Meeting, Midwest Cloud and Aerosol Physics Association

*Michael Palecki*
Member, National Climatic Data Center Climate Reference Network Implementation Group: Station Siting Standards/Station Selection Criteria team and Data QC/Data Management team

*George Roadcap*
Member, Lake Calumet Working Group

*Jane Rothert*
Recipient, American Society for Testing Materials (ASTM) Award for leadership in ASTM Subcommittees on Atmospheric Deposition and Quality Control

*Kent Smothers*
Chairman, Technical Committee T-7G (Corrosion and Its Control in Water-Supply Systems and Water-Using Systems in Buildings), National Association of Corrosion Engineers

*David Soong*
Co-coordinator, "The First Sino-U.S. Workshop on Sediment Transport and Sediment Induced Disasters," March 15-22, 1999, Beijing, China, sponsored by the National Science Foundation (U.S.) and the Natural Science Foundation (China)

*Gary Stensland*
Member, Hypoxia Assessment Team, one of six national teams appointed by the White House Committee on Environment and Natural Resources Hypoxia Work Group

*Derek Winstanley*
Chair, Illinois Global Climate Change Task Force, and Member, National Science Working Group on Hypoxia in the Gulf of Mexico

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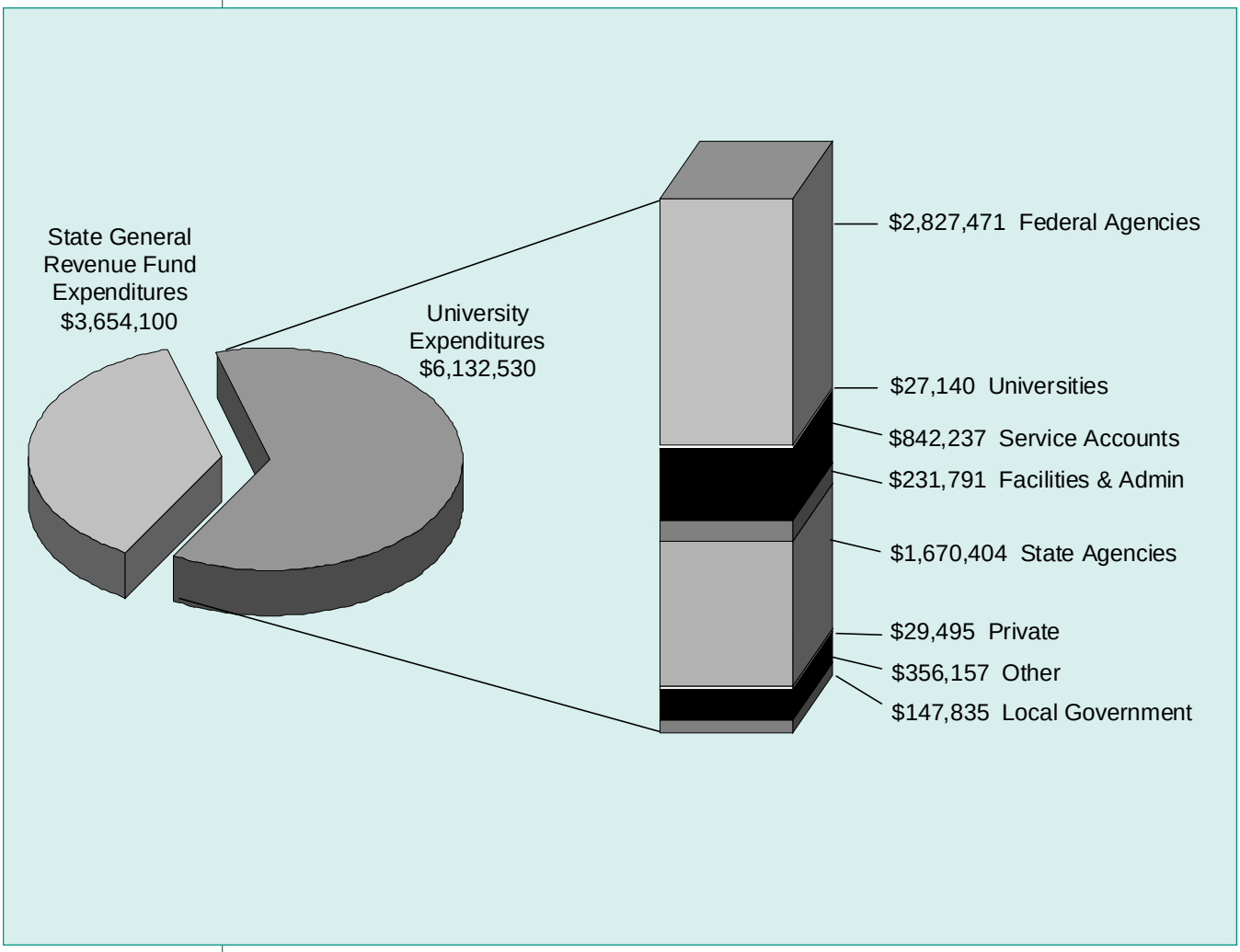


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