




Progress in Water-Supply Planning

Illinois State Water Survey
Annual Report 2006-2007

ILLINOIS STATE WATER SURVEY
ANNUAL REPORT
JULY 1, 2006-JUNE 30, 2007

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Front Cover: Many factors must be considered in water-supply planning: climate conditions, urban and industrial areas, groundwater and surface water, residential and rural areas, and availability and supplies for drinking water and other uses.

All uncredited photographs provided by Water Survey staff

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Illinois State WATER Survey (1895)

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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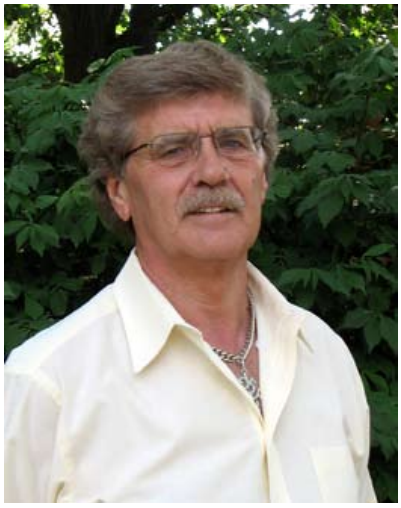
FROM THE CHIEF'S DESK



I am pleased to report that for the first time in the state's history, a regional water-supply planning and management process for Illinois is underway.

Compared with states out West that receive perhaps 10 inches of precipitation over 12 months, Illinois is a water-rich state with average annual precipitation of about 38 inches. That does not mean that water problems and conflicts do not arise. They do. And with an increasing population and a growing economy that demand increasing amounts of water for industries, agriculture, domestic consumption, commerce, and energy production, problems and conflicts can and will increase.

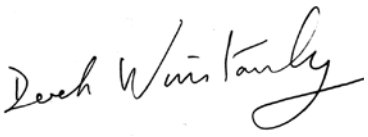
In most counties and municipalities in Illinois, decisions on water-supply planning and management currently are made on a case-by-case basis with little consideration of cumulative regional impacts of all water withdrawals. The purpose of regional water-supply planning and management, however, is to provide all users with adequate supplies of clean water at reasonable cost. The main strategy of this effort is to enhance communication and coordination among all those who tap into and share groundwater and surface water from aquifers, lakes, streams, and reservoirs.

Large aquifers, streams, lakes, and reservoirs cross political boundaries, supply water for everyone who lives within and sometimes outside those boundaries, and also experience and reflect cumulative impacts of all those water withdrawals. Regional planning and management brings together representatives of all groups who withdraw water from shared resources and requires them to plan ahead a few decades for future generations. It is hoped that in so doing, problems and conflicts will be minimized; aquifers, streams, lakes, wetlands, and aquatic ecosystems will be protected; and Illinois will become increasingly attractive for economic growth and investment. Regional planning and management is a way to ensure that decision-making entities have the best available data and information available to make those decisions, not to usurp that authority or responsibility from entities that currently have it.

In this report you will find information on the considerable progress that has been made in implementing Executive Order 2006-01 issued by Governor Blagojevich in January 2006. The Executive Order requires the Illinois Department of Natural Resources (IDNR) to take the lead in establishing a process and framework for regional water-supply planning and management in two priority areas: an 11-county region in northeastern Illinois and a 25-county region in east-central Illinois have been selected.

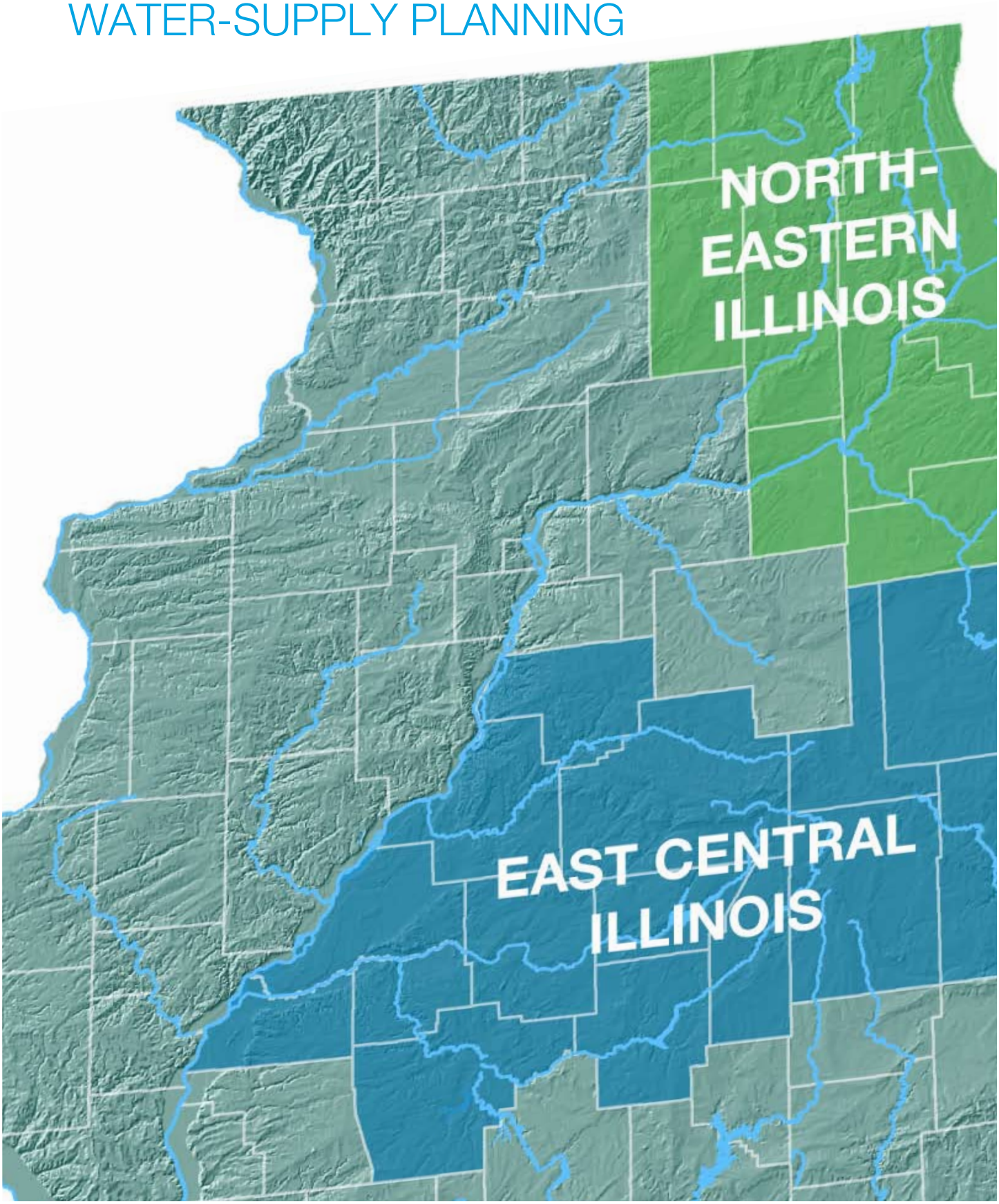
The Illinois State Water Survey (ISWS) and the Illinois State Geological Survey are working closely to establish a scientific basis for this regional planning and management of water supplies in Illinois. They also are providing technical services to the IDNR Office of Water Resources in establishing a grass-roots regional water-supply planning committee in each priority region and eventually throughout Illinois as part of a statewide strategic plan. Much has been achieved on both fronts and is detailed herein along with highlights of ISWS research, programs, and services over the past year.

A key facet of building a scientific basis for water-supply planning and management is to ensure that technical data and reports are readily accessible. I am pleased to report that the ISWS is close to finishing electronic scanning of all ISWS reports published since the agency was established in 1895. There are more than 1500 reports, and most are now available in full text and are searchable (http://www.sws.uiuc.edu/pubs/isearch.asp). This brings instant access to the wealth of scientific and engineering data and information accumulated over more than a century.



Derek Winstanley, D. Phil.
Chief

WATER-SUPPLY PLANNING



Water-Supply Planning for Illinois

Statewide

Governor Blagojevich's Executive Order 2006-01, issued in January 2006, called for the Illinois Department of Natural Resources Office of Water Resources (IDNR/OWR), in coordination with the Illinois State Water Survey (ISWS), to define a comprehensive program of state and regional water-supply planning (WSP) and management with a scientific basis, one that uses locally based regional WSP committees in two priority water-quantity planning areas.

As the 2006–2007 year began, the IDNR had committed funding year one of a three-year WSP initiative. Two priority areas were selected for the development of regional plans by the ISWS, the Illinois Interagency Coordinating Committee on Groundwater, and the Illinois State Water Plan Task Force. One planning area is the deep bedrock aquifer underlying 11 counties in northeastern Illinois and shallow aquifers and surface waters of the Fox River basin in that area. The other designated 15-county area in east-central Illinois includes the Mahomet aquifer and the Sangamon River basin.

While the Scientific Surveys' knowledge of the geology and water availability in Illinois is considerable, there is much yet to be learned. To enhance the scientific basis of the initiative, the ISWS and Illinois State Geological Survey (ISGS) are conducting additional research. Deliverables and related costs of this joint research program were defined in a September 2006 proposal that became a $2,637,000 three-year contract between the State (IDNR) and the University of Illinois. This work builds on ongoing research at both Surveys and other project work funded, for example, by the Illinois American Water Company.

As a part of the Surveys' public education/outreach efforts, staff developed a Web site (www.sws.uiuc.edu/wsp) dedicated to the initiative to make the Surveys' considerable knowledge about water available to members of regional WSP committees and the public. Survey staff helped IDNR draft a charge document outlining roles and responsibilities of groups and organizations involved.

The Illinois Water Inventory Program at the ISWS also was reactivated as part of the initiative. This voluntary reporting program collects and processes water-use data throughout Illinois from numerous user groups prior to making it available for research and planning efforts.

Northeastern Illinois

The northeastern Illinois priority planning area includes the deep bedrock aquifer under Boone, Cook, DeKalb, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, McHenry, and Will Counties, and shallow aquifers and surface waters of the Fox River basin. The IDNR selected the Chicago Metropolitan Area for Planning (CMAP) to form and provide administrative, financial, and technical support to a locally based Regional Water Supply Planning Group (RWSPG) in northeastern Illinois. Both IDNR and CMAP approved a $1,140,000 three-year grant agreement for this work.

Nine CMAP-defined water-user interest groups are represented on the 35-member RWSPG. Two persons represent each of seven user groups: agriculture; business, industry, and power; conservation and resource management; environmental advocacy; academia and the public interested in regional planning; real estate and development; and wastewater treatment and nonmunicipal water suppliers. Ten persons represent municipalities and municipal water suppliers, ten others represent county interests. One additional person was selected to chair the group the first year.

At an open forum held in Oak Brook last November, CMAP began a process for each user group, not including municipalities and counties, to select two representatives for the planning group. Issues and concerns began to be defined at the forum, which was promoted to individuals and organizations with potential interest in the process and also the general public. Interest group representatives were selected at a series of CMAP-facilitated meetings in December as councils

Vern Knapp speaks to the Northeastern Illinois Regional Planning Group.

The ISWS and the ISGS are developing surface-water accounting tools for the Fox and Sangamon River basins.

of government and county boards in the region were selecting municipal and county representatives.

The Northeastern Illinois RWSPG met for the first time in January 2007, and monthly since then. With the assistance of subcommittees, and ISWS review and comment, it established interim working goals and adopted operating guidelines. The RWSPG has seen numerous ISWS presentations related to water planning and the hydrologic cycle to help all members understand the science and issues involved. Information about the Northeastern Illinois RWSPG membership and meetings, and copies of their working goals and operating guidelines are available on the Web (www.chicagoareaplanning.org/watersupply).

A primary RWSPG responsibility is to develop water-demand scenarios of water use to the year 2050. This CMAP-initiated process began with developing a request for qualifications (RFQ), with ISWS technical assistance. Subsequently, CMAP negotiated a contract with Dr. Benjamin Dziegielewski, Southern Illinois University (SIU), to conduct this work. He has decades of experience with planning for future water use nationwide and worldwide. Together, ISWS staff, CMAP, and Dr. Dziegielewski produced a detailed methodology statement for water-demand scenarios. This work also includes coordinating with the IDNR Lake Michigan Management Section as it reviews and reissues Lake Michigan diversion allocation permits to the year 2030.

East-Central Illinois

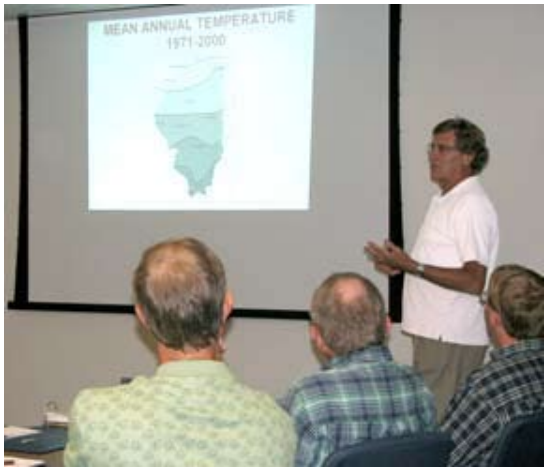
The east-central Illinois priority planning area includes the Mahomet aquifer and the Sangamon River basin in Cass, Champaign, DeWitt, Ford, Iroquois, Logan, Macon, Mason, McLean, Menard, Piatt, Sangamon, Tazewell, Vermilion, and Woodford Counties. The IDNR selected the Mahomet Aquifer Consortium (MAC) to form and provide administrative, financial, and technical support to a locally based Regional Water Supply Planning Committee (RWSPC) in east-central Illinois. Both IDNR and the MAC approved a $400,000 three-year grant agreement for this work.

The MAC defined 12 interest groups to be represented on the RWSPC: agriculture, counties, electric-generating utilities, environmental groups, industries, municipalities, the public, rural water districts, small businesses, soil and water conservation districts, water authorities, and water utilities. The MAC determined that one person would represent each interest group, resulting in a 12-member planning committee.

In February, the MAC held a forum in Urbana, widely promoted to individuals and organizations with a potential interest in the process, and the general public. Interested persons were asked to complete applications to represent the various RWSPC interest groups. At the forum, with moderator assistance from ISWS and ISGS staff, each interest group identified two persons who might represent each interest group. Interest group issues and concerns also began to be defined through breakout groups at the meeting. After the forum, the MAC Board selected one RWSPC member from each interest group based on interest group recommendations and an interest in a geographically balanced membership.

The East-Central Illinois RWSPC began meeting in March 2007, and monthly since then. With the assistance of a subcommittee, and with ISWS review and comment, it adopted operating guidelines that already proved effective when the MAC Board found it necessary to replace a member who also served as chair due to his

The East Central Illinois Regional Planning Committee meets monthly.



Chief Derek Winstanley speaks to the East Central Illinois Regional Planning Committee.

move to Florida. The RWSPC has seen numerous ISWS presentations related to issues and concerns expressed by its members. Information about East Central RWSPC membership and meetings, and a copy of its operating guidelines are available on the Web (www.rwspc.org/).

Beginning with its first meeting, the RWSPC initiated steps to select a consultant to produce water-demand scenarios to the year 2050. With assistance from CMAP, ISWS, and the MAC Board, an RFQ was prepared and distributed. The ISWS also helped the RWSPC and MAC Board evaluate credentials of the consulting team that responded. Wittman Hydro Planning Associates (WHPA) and Dr. Ben Dziegielewski, SIU, were designated as preferred consultants. Together, ISWS staff, MAC Board members, WHPA staff, and Dr. Dziegielewski developed a detailed methodology statement for the water-demand scenarios. The IDNR approved and attached that statement to the contract between the MAC and WHPA.

Local Regional Planning Committees

The ISWS provided technical assistance to both regional planning committees, CMAP and the MAC, in developing methodology statements for water-demand scenarios for northeastern and east-central Illinois. Mutual development of these statements helps ensure compatibility between scenarios in both regions. It also will provide a consistent basis for development of scenarios in regional WSP areas throughout Illinois that allow meaningful consolidation of information in a statewide plan.

There are significant differences between both regional planning committees in composition, operating procedures, and approaches to plan development. These differences are expected to prove instructive when expanding the locally based regional planning process throughout Illinois, however.

Deliverables

The ISWS and ISGS are conducting technical and scientific research in northeastern and east-central Illinois as part of this initiative and as part of other research initiatives. This research has multiple objectives:

- Improve knowledge about aquifer recharge and groundwater/surface-water interactions.
- Provide improved regional climate simulations for 2050 and 2100.
- Provide sensitivity analyses of Lake Michigan water levels and Cook County stormwater runoff to climate change.
- Provide improved information about groundwater quality.
- Provide improved geologic information for groundwater flow models, including those for the deep bedrock aquifer, shallow aquifers in the Fox River basin, and the Mahomet aquifer.
- Create future water-demand scenarios with impacts to 2050 on shallow and deep aquifers using groundwater modeling.
- Provide a continuous simulation watershed model for the Fox and Sangamon River basins.
- Provide surface-water accounting tools for the Fox and Sangamon River basins.
- Provide an evaluation of drought and flood impacts on surface-water supplies.

The ADM plant in Decatur uses water in processing agricultural products.

- Provide additional and improved well location, elevation, and water-level data.
- Provide updated potentiometric maps of aquifers.
- Provide improved public access to WSP information.
- Provide an improved scientific basis for comprehensive, strategic WSP and management plans for northeastern Illinois, east-central Illinois, and statewide.

In the long run, success of locally based regional WSP depends on familiarity of elected and appointed public officials with WSP issues. To help develop that awareness, a conference on WSP issues is designed for Illinois public officials. As a part of education and outreach responsibilities, the ISWS is helping plan this conference with the Paul Simon Institute for Public Policy at SIU, the Metropolitan Planning Council, IDNR, and CMAP.

The WSP Web site, developed by the ISWS to make the Surveys' knowledge about geology and water accessible to regional planning committees and the public, also continues to evolve. In addition to playing a continuing role in educating public officials and the general public about water issues, the site will evolve into a decision-support system for State officials and locally based regional WSP committees throughout Illinois.

In May 2007, the ISWS and ISGS submitted a supplemental research proposal for additional geologic and hydrologic studies in northeastern and east-central Illinois in 2008 and 2009. The work involves shallow aquifer mapping and improving knowledge of surface-water/groundwater interactions in the Fox River basin, preparing surface-water accounting tools for the Kankakee and Vermilion/Wabash River watersheds, and improving knowledge of recharge. The $598,300 proposal, an amendment to the contract between IDNR and the University of Illinois, has been approved by the University and is awaiting IDNR approval.

The Chicago skyline serves as a backdrop for Lake Michigan.

The first year of the initiative has seen successful formation of two grassroots regional WSP committees representing all water-user groups. These committees' monthly meetings have been very well attended by their members. The committees have organized to conduct business, are working with consultants to develop future water-demand scenarios, and are learning about WSP issues from the Scientific Surveys and CMAP staff.

Both Surveys have hired new staff in accordance with the research proposal. Some deliverables have been completed, and work is progressing toward on-schedule completion of others. Quarterly reports, including progress on scientific and technical deliverables, are posted on the WSP Web site under Background/Planning History.

In June 2009, the two regional planning committees will submit recommendations for regional water-supply management to CMAP and the MAC. In turn, the recommendations will be forwarded to IDNR and the Governor. The governor also will receive from IDNR a comprehensive plan for water-supply planning and management across the entire state.

Ed Glatfelter speaks with the press about water-supply planning.

OFFICE OF THE CHIEF

Education and Outreach

Illinois State Water Survey (ISWS) education and outreach efforts promote stewardship of Illinois' natural resources, foster public understanding and support of environmental programs, and nurture interest in the sciences. Primary goals are to educate the public about water and atmospheric resources, develop a new generation of good stewards who respect natural resources, and encourage students to become scientists. Staff Surveywide achieve these goals through issues-based presentations at meetings, conferences, and for the general public; press releases and media interviews; presentations and demonstrations for students; responses to information requests; ISWS information booths at various events; and other public service.

Illinois Science Olympiad

The Public Service Laboratory manager was invited to write the environmental chemistry exam for a new Illinois Science Olympiad trial event. The long-term ISWS employee has volunteered at Olympiad regional, state, and national levels for years. Funds from a $1000 grant from the East-Central Illinois Section of the American Chemical Society were used to purchase data collection software, a sensor interface, a carbon dioxide gas sensor, a conductivity probe, and a nitrate ion-selective electrode. Students use actual samples and conduct multiple environmental tests with these portable instruments that also can be used for other outreach events.

Students conduct experiments for the Science Olympiad.

Environmental Horizons Conference

The 9th Environmental Horizons Conference was held on the University of Illinois campus at Urbana-Champaign in April 2007. This carbon-neutral conference attempted to eliminate or offset all carbon produced by its activities. Strategies included using Energy Star-compliant printers and recycled paper and ink for all materials; encouraging poster presenters to do likewise; reducing plastic, paper, and other waste of food vendors; and encouraging participants to walk or ride the bus to the event. Staff at the ISWS booth fielded questions about water-supply issues, research interests, water testing, and mercury concerns.

Teen Camp Visits ISWS

Urbana Park District students in the Teen Camp program came to the ISWS as part of their two-week study of water and water resources. The 19 students toured the Public Service Laboratory, visited the weather station, and learned about weather instruments, groundwater, the hydrologic cycle, and wells. Students found that science can be fun and challenging at three impressive demonstrations that emphasized supersaturation, exothermic reactions, and dissolved gases. In all, 12 ISWS staff helped make the visit a success.

Illinois Envirothon

The 13th annual Illinois Envirothon was held in early May at Allerton Park in Monticello. One ISWS staffer was an invited judge for oral presentations at this state competition. Local Soil and Water Conservation Districts sponsor this natural resource education program for high-school students. The Envirothon covers a different environmental issue each year and emphasizes hands-on, team-oriented, problem-solving skills. Sixteen teams advanced through regionals to the state competition. Triad High School (Madison County), winner of the Illinois competition, will advance to the North American competition in Geneva, New York.

Eighth-Grade Career Conference

Early January found ISWS staff volunteering at the 16th annual career conference for eighth graders held in Champaign. Three ISWS scientists discussed science and technical careers at six sessions for students from seven area schools. They spoke to 300 students about chemistry and engineering careers; discussed salary ranges, educational requirements, and science careers

Laura Keefer works with students at Boneyard Creek stream station.

available at the ISWS; and conducted a hands-on activity with students on measuring pH of rain samples. About 2600 students learned about career opportunities during the week-long conference.

Gulf Hypoxia

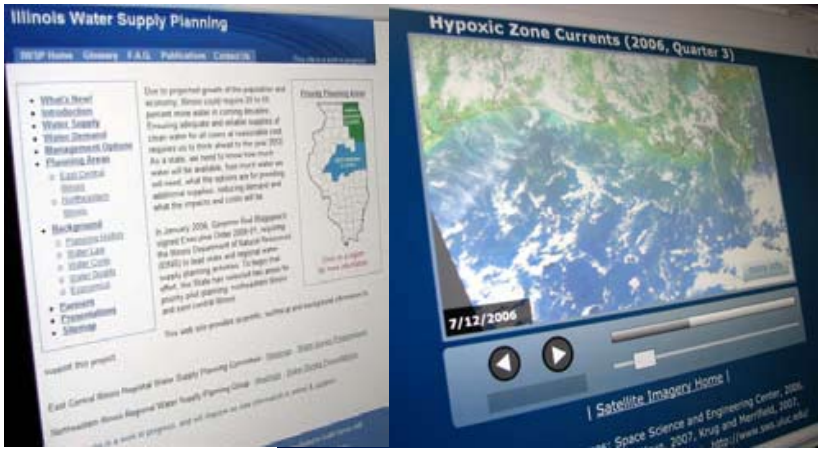
A special issue of *Hydrology and Earth System Sciences*, "A View from the Watershed Revisited," includes two invited ISWS articles on hypoxia in the Gulf of Mexico. Nutrient flux induced by human activities in the Mississippi/Atchafalaya River basin (MARB), which includes Illinois, is said to stimulate algal blooms that decompose and produce hypoxia in the northern Gulf by reducing dissolved oxygen to 2 milligrams per liter or less. "Coastal Change and Hypoxia in the Northern Gulf of Mexico: Part I," however, shows that the hypoxic zone is undergoing massive changes associated with the Atchafalaya's partial capture of the Mississippi River. This is the same type of immense river-switching, delta-building event that created hypoxia prior to European settlement of the Americas. Thus, MARB effects on Gulf hypoxia are superimposed on effects of coastal change occurring in and around the hypoxic zone.

"Marine Modification of Terrestrial Influences on Gulf Hypoxia: Part II" builds on that study and examines oceanographic conditions that give events associated with the Atchafalaya River a disproportionately large influence on Gulf hypoxia. Both articles and supporting analyses of thousands of updated satellite images and animations are available on the ISWS Web site, "Hypoxia in the Gulf of Mexico and Nutrients in the Midwest" (http://www.sws.uiuc.edu/docs/hypoxia/hypoxia.asp).

Web Site Happenings

As a state, Illinois needs to know how much water will be available, projected water use, options for providing additional supplies and reducing demand, and impacts and costs. To begin that effort, the ISWS created a Web site to assist the decision-making process. The Illinois Water-Supply Planning Web site (www.sws.uiuc.edu/wsp/) will help ensure adequate, reliable supplies of clean water for all Illinoisans at reasonable cost to the year 2050. Two areas were selected for the initial priority pilot planning effort: northeastern Illinois and east-central Illinois. The Web site provides scientific, technical, and background information that support this project, including climate, watershed, and aquifer information for each planning area and also statewide.

More than 1000 scanned publications, brochures, maps, and other ISWS documents were released in full-text electronic format this year (www.sws.uiuc.edu/pubs/isearch.asp). This significantly increases the number of full-text documents on the ISWS Web site from a few hundred to well over a thousand. A few documents remain to be scanned. Upon completion, the effort will provide on-line access to all ISWS reports dating back to the late 1800s, more than a century of ISWS research, data, and other work previously available only in paper format. Many different scanning technologies helped achieve this goal, including in-house scanning and outside vendors. Scanning technologies have evolved greatly, but high standards were set from the start to ensure fast downloads and searchability. Almost all documents download easily over a modem connection and print with crisp graphics and text.



New Web additions include the Illinois Water-Supply Planning site and Gulf hypoxia animations.

Ken Hlinka explains the water cycle to students in the Urbana Park District teen camp.

Two new Web sites with precipitation data for viewing or download were added. The Cook County Precipitation Network Data site (www.sws.uiuc.edu/data/ccprecipnet/dataStation.asp?p=CCPN) offers 1989–2006 data for 25 stations in Cook County. The Imperial Valley Precipitation Network Data site (www.sws.uiuc.edu/data/ccprecipnet/dataStation.asp?p=IVPN) offers 1992–2006 data for 20 stations in an ISWS-operated network for the Imperial Valley Water Authority. Daily data for both networks are measured from midnight to midnight.

Updated satellite image animations of hypoxia in the Gulf of Mexico were added (www.sws.uiuc.edu/docs/hypoxia/satimg.asp). These new images cover the fourth quarter of 2005, and the first three quarters of 2006.

The ISWS also completed its metadata entry form project. This new Web site collects information about ISWS data for use by internal staff. Eventually information collected will be available from a point-and-click interface that will give the public access to various information about ISWS data.

Annual Web operations exceeded 26,000,000 hits and more than 2,734,595 user sessions, another ISWS plateau (www.sws.uiuc.edu). This continues the decade-long streak of continuous annual increases in Web performance and valuable new content.

Geographic Information Systems

The Geographic Information Systems (GIS) group promotes and facilitates use of GIS technology in water and atmospheric resources research; provides accurate, timely, and accessible geographic information to researchers, decision-makers, and Illinois citizens; and develops innovative applications that expand the field of GIS-assisted research.

The enterprise GIS system was improved to increase storage capacity. Now all ISWS researchers can archive and share GIS data for future use in a searchable repository. The system also streamlines data retrieval and centralizes data locations for regular backup.

Educating users is an important component. A small training laboratory gives ISWS staff hands-on instruction using the latest GIS software. Internal training helps meet user needs by demonstrating specific GIS resources.

A monthly lunch meeting affords an opportunity for information exchange with other GIS users. These lunches provide the venue for discussing industry trends and sharing GIS tips, experiences, and questions with many GIS professionals at once.

Water and Atmospheric Resources Monitoring (WARM) Program

The Water and Atmospheric Resources Monitoring (WARM) Program collects, analyzes, and reports on water and atmospheric resources in Illinois, data crucial for water-supply planning and modeling. Quantitative observations of weather and climate, soil moisture, shallow groundwater, flows and suspended sediments in rivers and streams, and reservoir levels are the primary focus. Not only are these data important in developing a climatology of normal or average conditions of these resources in Illinois, but also in providing real-time tracking data essential during periods of natural water stresses, such as droughts and floods, and used to formulate the State's aid and assistance response.

A broad spectrum of WARM observations is updated daily on the Web (http://www.sws.uiuc.edu/warm/). This includes basic weather information, crop and pest degree day totals, and current shallow groundwater (water table) depths. Data on other resources are updated soon after collection, typically bi-weekly or monthly. These data provided quality information for approximately 175,000 users in various fields during the past year and opportunities for unique studies using those data.

For example, the WARM Program has installed equipment that enhances spatial and temporal observations of soil moisture under sod across its moni-

toring location at the Bondville Environmental and Atmospheric Research site, a highly instrumented rural research field made available to numerous research programs by the State of Illinois and the University of Illinois at Urbana-Champaign Department of Electrical and Computer Engineering. The WARM project is designed to quantify soil moisture in layers near the soil surface and to document selected soil characteristics that affect soil moisture in extracted soil cores. Better understanding variability of soil moisture across Illinois, and in particular, data representativeness under sod and in adjacent corn and soybean fields, will provide high-quality, timely soil moisture information for the agricultural community in Illinois.

Quality Assurance Program

The ISWS Quality Assurance Program is a management system that promotes planning, documentation, and assessment for environmental programs involving research, service, and data collection. The ISWS Quality Management Plan (QMP) guides this system with documentation in the form of quality assurance plans and standard operating procedures (SOPs). The Quality Assurance/Quality Control Committee serves as a staff resource and aids in assessment through document review.

The committee maintains a Web page for staff that links guidance documents from the U.S. Environmental Protection Agency, the U.S. Geological Survey, and the National Environmental Laboratory Accreditation Conference. Inventories of QMPs, Quality Assurance Project Plans, and SOPs serve as a resource for proposals and new documents. A new endeavor this year was creation of a Web template for new SOPs.

A second project that began this year was use of the Archive Record Room for long-term document storage. The instruction sheet and relevant forms (flowchart, packing checklist, and transmittal forms) are available to ISWS staff on an internal Web site.

Classes from local schools often visit the ISWS.

Program Planning and Management

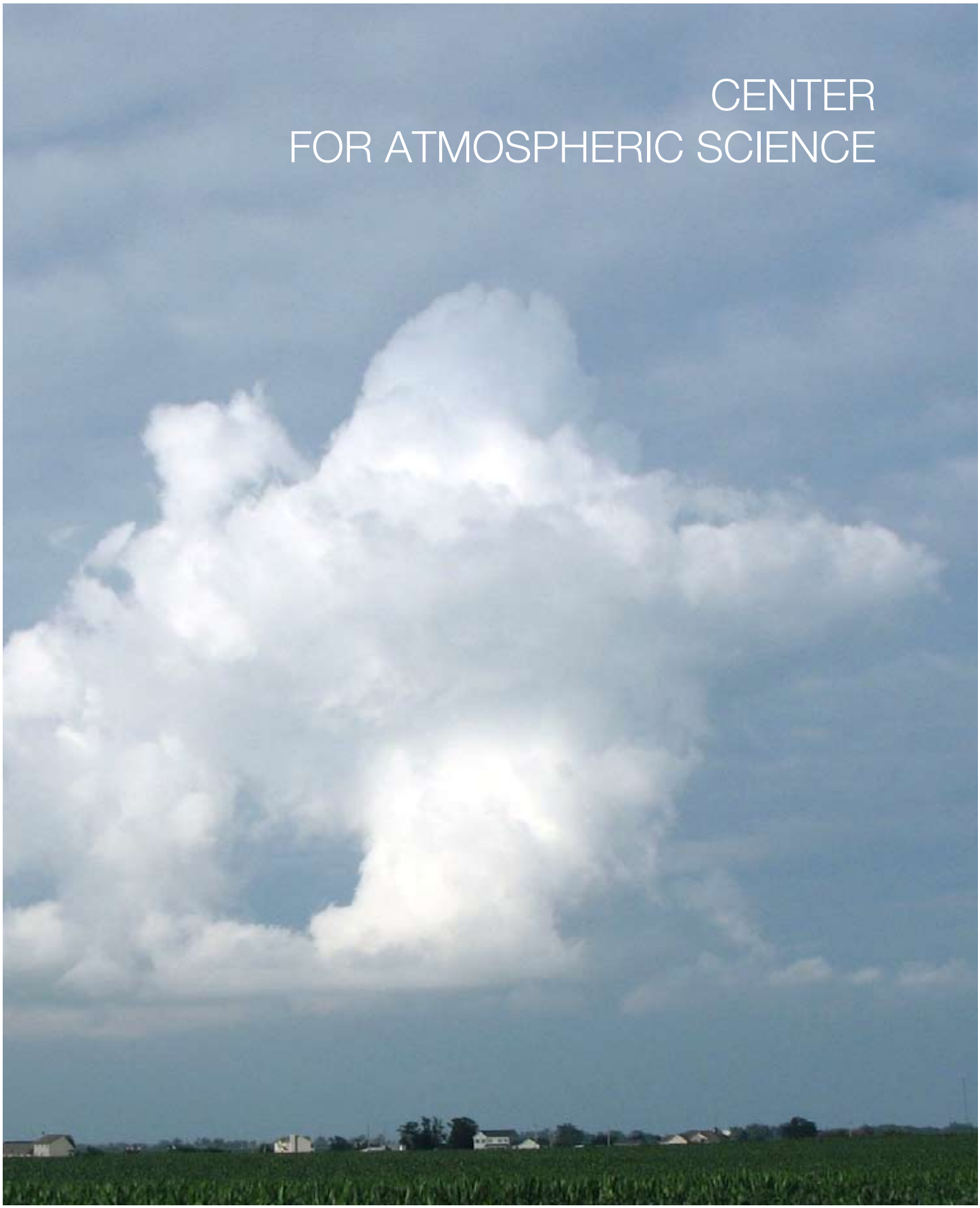
The ISWS Strategic Plan is the framework for program planning within the Water Survey. The strategic plan focuses on future direction and changes needed to achieve specific goals. Each year, the ISWS updates the plan and determines action items to be achieved during the current fiscal year. All planning documents are developed in the context of current conditions and emerging trends; therefore, the program planning process remains fluid and allows for unforeseen changes. This plan is coordinated with the IDNR and UIUC Strategic Plans.

Capital Project Update

The ISWS and University of Illinois Facilities and Service personnel continue monitoring Building 11, which became operational during the last fiscal year. Addition of that building and major upgrades to Water Survey Research Center infrastructure have enhanced ISWS facilities. Various aspects of building and infrastructure upgrades are still under a one-year warranty, and any facility problems are handled through the prescribed warranty process.

The chiller system at the ISWS facility in Peoria failed in July 2006. Replacing the chiller unit was determined to be the most cost-effective solution. The IDNR sent a request for an Emergency Affidavit to the Capital Development Board (CDB) last March. The CDB agreed to issue the affidavit and to fund the approximately $50,000 project. Bid opening for chiller replacement will occur in July 2007.

CENTER FOR ATMOSPHERIC SCIENCE



Understanding Weather and Climate and Their Role in Significant Issues

Weather and climate of Illinois represent a valuable natural resource, particularly the generally abundant precipitation and relatively moderate temperatures. Natural variations (see sidebar), extreme conditions, and possible future anthropogenically forced changes in weather and climate, however, have many economic and environmental impacts with continuing challenges for government, businesses, and the general public. Continuing research on a variety of topics helps scientists better understand basic atmospheric processes, investigate effects of possible future climate change, and detect ongoing changes.

Climate Change and Air Quality

One area of study is air quality, with specific emphasis on ozone (O_3). The objective is to quantify and understand uncertainties of individual and combined impacts of global climate and emission changes on air quality from the present to 2020, 2050, and 2100. This project, funded by a four-year grant from the U.S. Environmental Protection Agency (USEPA) beginning in 2003, has investigated air-quality processes over a range of spatial and temporal scales from (1) chemical processes and emissions on local to regional scales, (2) long-range transport and precursors of global pollutants, and (3) global and regional climate changes and variability. The original contribution of this research is a unique, state-of-the-art, integrated modeling system. It produces good qualitative simulations of several important features of current air quality and climate with a carbon dioxide (CO_2) concentration of 378 ppm, including the diurnal cycle and multiday periods of high O_3 concentrations resulting from transient weather regimes.

To characterize the range of possible future conditions, this integrated modeling system was used to simulate all combinations from two regional climate models, two global climate models (the regional modeling system requires lateral boundary conditions from global model simulations), and four future CO_2 atmospheric concentration scenarios by the year 2100 (conservative, ~550 parts per million or ppm by the year 2100; moderate, ~620 ppm; high, ~860 ppm; and very high, ~970 ppm). Regional simulations indicate substantial degradation of Midwest air quality in the future if warming exceeds 6°F. If CO_2 concentrations can be kept below ~600 ppm through limits on emissions and warming reduced to less than 3°F, however, air quality may change little, or even improve.

There are counterintuitive subtleties in the results. Under the very high emissions scenario, summer average daily mean and maximum 8-hour O_3 concentrations show upward trends in many rural areas, the reverse of what occurs in those areas under the low emissions scenario. In major cities and metropolitan areas, however, large reductions in O_3-destroying nitrous oxide emissions tend to increase surface O_3 concentrations. Projected emissions changes (directly affecting pollutant concentrations) and projected climate changes (directly affecting reaction rates and transport) both make significant direct contributions to the estimated O_3 changes. Biogenic emissions changes induced by the projected climate also make substantial contributions.

Results have been and are being used in national and regional assessments on climate change, including the USEPA Assessment of Climate Change Impacts on Air Quality, the U.S. Climate Change Science Program Assessments, the Northeast Climate Impacts Assessment, and the upcoming Chicago Regional Climate Change Assessment.

Monitoring Air Quality: Atmospheric Ammonia

While there are many abundant acidic species in the atmosphere, ammonia is the only commonly occurring alkaline gas. Agricultural sources produce approximately 80 percent of U.S. ammonia emissions, with the remainder from vehicular, industrial, domestic, and natural sources. Ammonia reacts rapidly with sulfuric, nitric, and other acids in the atmosphere to form water-soluble salts, making it a critical factor for air quality. Aerosol particles that contain hygroscopic ammonium salts can act as nuclei for water vapor condensation, thereby strongly influencing regional haze formation. In order to develop strategies for improving and maintaining visibility in compliance with USEPA's 2004 Clean Air Rules, however, scientists developing and applying computerized atmospheric chemistry models need a comprehensive dataset of accurate ammonia concentration measurements.

With support from the Lake Michigan Air Directors Consortium, the Central Region Air Planning Association, and the U.S. Department of Agriculture, Illinois State Water Survey (ISWS) staff are improving, validating, and using advanced methods to monitor atmospheric ammonia. Ideally, researchers want hourly data from an extensive nationwide network, but tight

This commercial instrument system combines actively pumped sampling with automated ion chromatography to measure ambient ammonia and related atmospheric chemical species at concentrations in the parts-per-billion range twice each hour.

A much simpler ISWS shop-built sampling system extracts ammonia and related acidic gases from air drawn at controlled flow rates through specially designed gas denuders. After each 24-hour sampling period, field site operators manually remove, pack, and ship exposed denuders for laboratory analyses.

budgets limit monitor quantities and types that can be maintained. For example, a commercial instrument (see photo, top left) capable of twice-hourly ammonia measurements with a minimum quantitative limit (MQL) of one part per billion by volume (ppbv) costs more than $75,000 and also requires an air-conditioned instrument shelter and frequent attention from skilled technical personnel.

An intermediate level, ISWS shop-built ammonia monitor (see photo, top right) works by pumping air to be sampled through annular glass denuder tubes that are acid-coated to capture ammonia. These cost $3,500 and require 120-volt electricity and routine operator attention. Denuder sampler MQLs for 24-hour-average measurements made once every six days are also in the low ppbv range.

Much simpler passive diffusion air samplers (see photo, right) developed recently require no pumps, electricity, or fragile components, thus making monitoring feasible at remote locations. Costs for passive sampling equipment total less than $120 per site. Repeatedly using, retrieving, and shipping passive devices also is much simpler than with annular denuders. The MQLs for passive samplers are comparable to those for the other methods, but require 1- to 3-week exposure times to achieve acceptable signal-to-noise ratios. Efforts are continuing on minimizing site costs and maximizing performance of the monitoring network in support of improved air quality in Illinois and nationwide.

Impacts of Climate Extremes

Extreme weather conditions and resulting societal, environmental, and economic impacts were assessed for a variety of climate anomalies in the continental United

Triplicate sets of passive diffusion sampling tubes mounted in a simple shelter measure ammonia gas concentrations at remote monitoring sites. These comparatively inexpensive devices require no electricity and are not subject to breakage during handling and shipping. Exposure times of two weeks or less are sufficient for part-per-billion ammonia quantitation.

States during 1985–2005. Climate anomalies, periods of high or low temperatures and dry or wet conditions lasting a season or longer, create a myriad of impacts (see photo, right) and occur in all areas of the nation. Most produce sizable losses, but some also benefit Society and the environment.

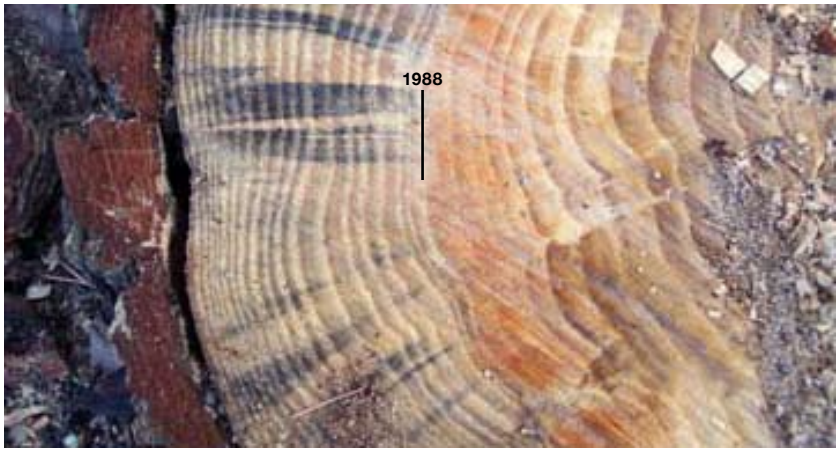
Among the ten major climate anomalies during the study period were the 1988 drought, 1993 floods, the 1995 heat wave, and the unusually good 2004 growing season. Impacts in the Midwest from these anomalies included $265.5 billion in losses and $125.0 billion in gains (2006 dollars). The 1988 drought had the largest loss, $86.5 billion, and the 2004 growing season had the greatest gain, $26.6 billion. Together, the anomalies caused 7,955 deaths nationally, primarily from heat waves in 1988, 1995, 1999, and 2000.

While economic impacts of the mild 2001–2002 winter helped bring the nation's economy out of an ongoing recession, economic impacts from the other anomalies were most significant at regional and state scales where losses were concentrated. For example, $6 billion in flood-related losses in Illinois in 1993 rated as 12 percent of the Gross State Product that year.

Losses and gains in the United States also were assessed for major sectors of effects during the study period. Agriculture, the primary sector, experienced $62.8 billion in losses but also $42.4 billion in gains from the ten anomalies. Property losses ranked as the second highest area of losses, but lower energy costs for consumers ranked second among the gains. Power costs for utilities were third-ranked losses. Other heavily affected sectors included retail businesses and the transportation and construction industries. Government losses and costs were also excessive, totaling $33.9 billion. These economic measures are useful for estimating impacts of possible future climate changes due to global warming.

Agriculture and Climate

Rising CO_2 and ground-level O_3 concentrations influence plant growth, physiology, and yields. The Soybean Free Air Concentration Enrichment (SoyFACE) experiment was established to address soybean and corn responses when grown under future atmospheric conditions of increased CO_2 and O_3. The SoyFACE soybeans (see top left photo, page 16) and corn are grown under field conditions, but the soybeans are exposed to atmospheric concentrations of CO_2 and O_3 predicted for 2050, and the corn is exposed to future predicted CO_2 concentrations.



Tree rings of a pine on ISWS grounds reflect impacts of the 1988 drought.

The interdisciplinary SoyFACE experiment includes biological and agronomic sciences researchers. The ISWS is measuring water use associated with soybeans and corn grown in experimental plots. Recently published research demonstrates that soybeans grown under elevated CO_2 conditions use substantially less water than those grown under current conditions. This is consistent at the leaf and whole-field scale, suggesting that future plants may use water more efficiently. Results also demonstrate that plants grown under elevated CO_2 conditions are more resistant to drought: less water use by plants improves soil moisture. In addition to lower water requirements for the elevated CO_2-grown soybeans, yields were higher. Similar changes in water use for soybeans grown under elevated O_3 were observed, but yields were lower than those of the control group.

Research implications include many direct impacts on agriculture in Illinois and the Midwest; namely, soybeans with lower water requirements and drought resistance. Indirect impacts include vegetation-induced data on climate, particularly related to humidity.

Related SoyFACE studies include measuring water use from corn changes when grown under elevated CO_2 conditions. After year one of that multiyear study, a more substantial decrease in water use was observed for corn than for soybeans. Another ongoing experiment is studying interactions between drought and future predicted CO_2 concentrations, again focusing on water use associated with soybeans grown under those conditions.

Scientists Carl Bernacchi, ISWS, and Bruce Kimball, U.S. Arid-Land Agricultural Research Center, Maricopa, Arizona, measure photosynthesis and water use of soybeans grown in elevated CO_2 at the SoyFACE research facility in Champaign.

Zhining Tao and Kent McClure evaluate a potential road salt sampling site along the Chicago I&M Canal. In the background are bridge supports for the 12.5-mile I-355 south extension project. The project is part of the Illinois Toll Highway Authority's $5.3 billion Congestion-Relief Program to reduce travel times.

Challenges of Measuring Snowfall Trends

There is ongoing interest in long-term trends in measures of snow climatology, due in part to its likely sensitivity to temperature variability and possible future climate change. Examination of 1900–2004 U.S. daily snowfall records revealed numerous apparent inconsistencies. For example, long-term snowfall trends among neighboring climate stations sometimes differ greatly, likely a result of problems due to the methods used to obtain measurements. Internal inconsistencies in snow records, such as lack of upward trends in maximum seasonal snow depth at stations with large upward snowfall trends, also point to inhomogeneities. Nationwide, frequency of daily observations with a 10:1 snowfall-to-liquid-equivalent ratio declined from 30 percent in the 1930s to the current value of 10 percent, a change clearly due to observation practices, which could bias cold-season, liquid-equivalent precipitation, or snowfall measurements, or both. An empirical adjustment of snow-event, liquid-equivalent precipitation indicates those potential biases can be statistically significant.

This study showed that analyzed trends in snow variables are not necessarily a physical reality, but may be an artifact of measurement problems. Thus, great care should be taken when interpreting time series of snow-related variables from the observation network.

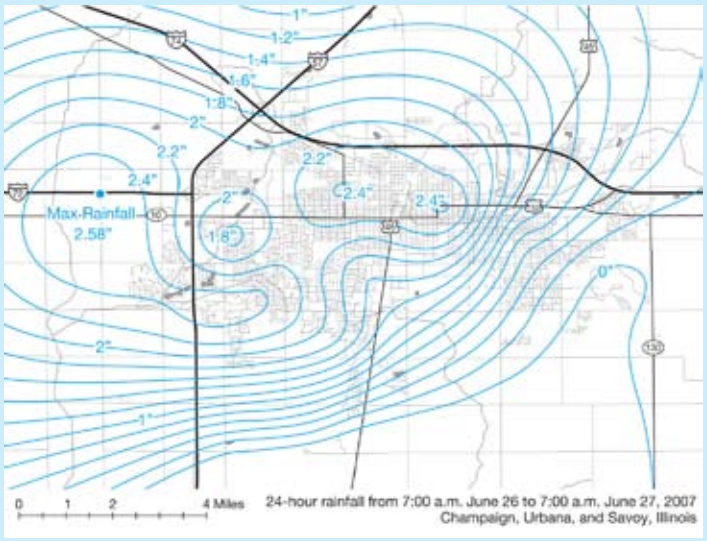
Inconsistencies in snowfall trends may be due to problems in observation practices.

Local Storm Demonstrates Value of High-density Network

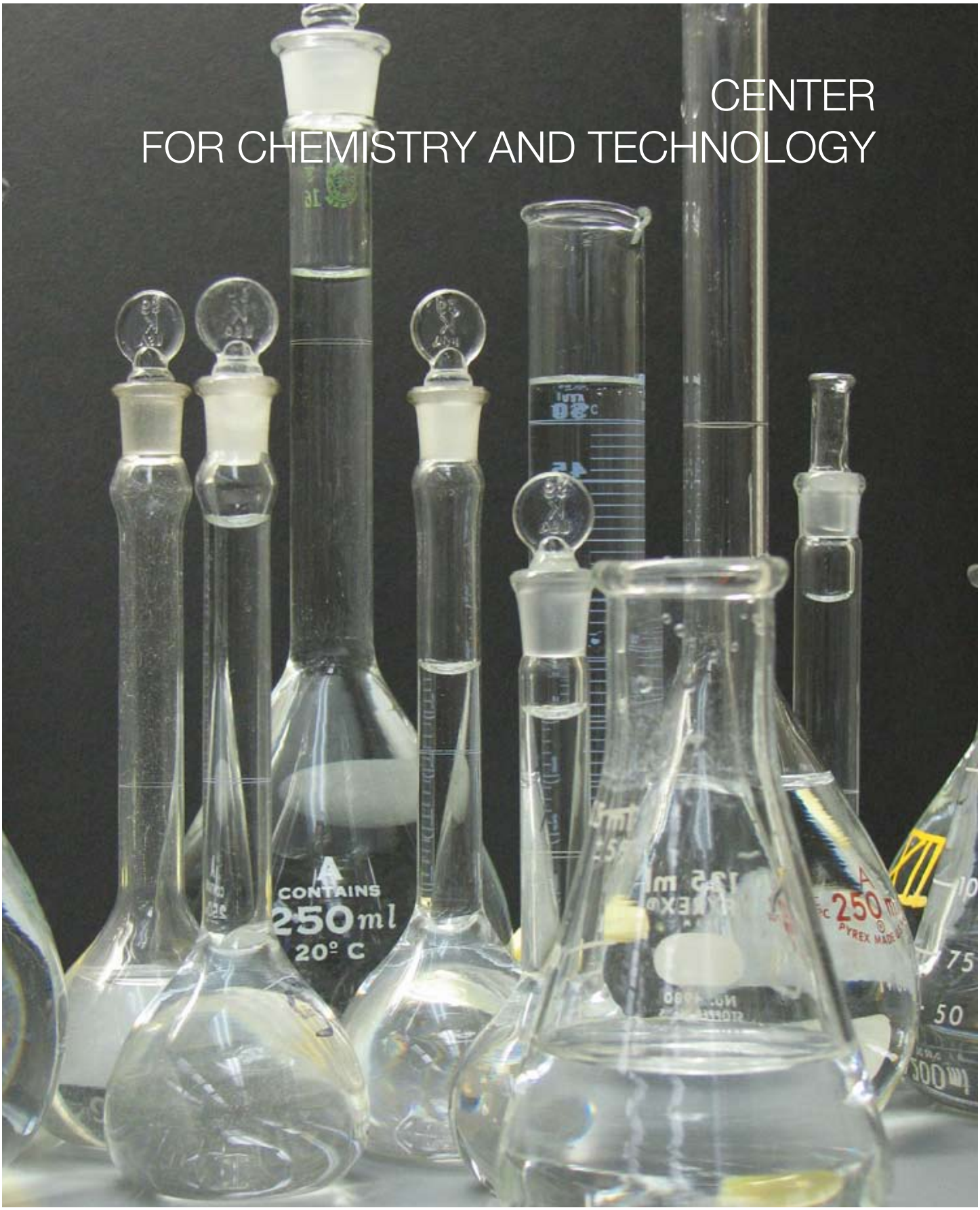
Summer rainfall is highly variable as individual thunderstorms produce significant rainfall over small areas. Because raingages often are far apart, available measurements do not provide a complete picture of rainfall variability over an area. The value of a high-density network in identifying large differences in rainfall amounts was demonstrated in measurements for a storm in Champaign-Urbana on June 26–27, 2007.

Twenty-four rainfall observations from volunteer networks for the 24-hour period ending at 7:00 a.m. on June 27, 2007, provide rainfall details that otherwise would not have been available (see map). The two National Weather Service (NWS) cooperative observers in the area reported 1.34 inches and 2.36 inches, respectively. Additional data from the volunteer networks, however, showed that the maximum rainfall area was further west and more extensive than with just data from the two NWS stations. Storm amounts ranged from 2.58 inches just west of the I-57/I-72 interchange (west of Champaign) to less than 0.20 inch (southeast Urbana).

The ISWS, one of the two NWS stations, maintains the official records for Champaign-Urbana, dating back to 1888. The Boneyard Network (http://www.sws.uiuc.edu/atmos/boneyard/) has operated in this area for more than 50 years, mainly with data from ISWS employees. That network is merging with the much larger Community Collaborative Rain, Hail, and Snow network or CoCoRaHS (www.cocorahs.org) that covers Champaign County, the rest of Illinois, and is part of a rapidly expanding national volunteer network. Map data are mainly from CoCoRaHS participants. Data from the volunteer networks should not be regarded as official quality-assured ISWS records.



CENTER FOR CHEMISTRY AND TECHNOLOGY



Chemistry and Technology Address Water Issues

The Center for Chemistry and Technology (CCT) programs provide analyses for research projects and help private citizens, state facilities and departments, and small public drinking-water systems solve water-related problems in Illinois and the Midwest. Support and assistance include direct interactions, outreach, and funded research addressing critical needs. Center programs also sponsor related research, including some conducted by ISWS staff.

Midwest Technology Assistance Center

The Midwest Technology Assistance Center (MTAC) for Small Public Water Systems (http://mtac.sws.uiuc.edu) cooperates with other similar Centers around the country to build capacity of these small systems to provide safe drinking water at reasonable cost. This program, funded by the U.S. Environmental Protection Agency (USEPA), is a joint effort between the ISWS and the University of Illinois, and the MTAC uses the unique capabilities and resources of both institutions to provide an invaluable service for small water systems in Illinois and the Midwest.

Maintaining and, if necessary, expanding the existing water supply is the one of the most critical issues facing small systems. Several MTAC-sponsored products in recent years, including current projects, address water-supply planning.

For example, the MTAC is helping small water systems that use groundwater plan now to secure their future water supply. The first step in this study identified 60 small water systems in Illinois likely to face supply shortages. Groundwater resources in each of those facilities will be assessed within a 5- and 10-mile radius, and each community will receive a detailed report advising them on adequacy of their supply and potential sources for enhancing it. Another MTAC project will produce background information and guidelines to help small systems that use surface water evaluate yield impacts during a protracted drought and also help them to prepare a response plan.

Public Service Laboratory

The Public Service Laboratory (PSL) offers water testing for private well owners, public water-supply customers and officials, engineers, contractors, agencies, researchers, industry, and others in Illinois. Testing results are used to improve water quality by treatment or by altering current treatment methods. This service dates back more than 100 years, and all this water-quality information is in a database used by scientists to study water problems in Illinois.

Over the past year, the PSL analyzed about 400 water samples from people wanting to know if their water was appropriate for the intended use. About 100 of those water samples were submitted by well owners after a newspaper article in the Kankakee County area mentioned the natural occurrence of arsenic in the groundwater there. Samples were tested, and well owners received information on reducing arsenic content in their water if necessary. Laboratory staff also consult with water users over the phone about water problems or concerns, more than 450 phone calls annually.

Anyone interested in submitting water samples for testing should contact the PSL first to obtain a kit for collecting and transporting samples to the laboratory. There is no fee, but it is important to follow sampling instructions carefully.

Staff members also participate in various outreach activities. This year PSL staff hosted a new Illinois Science Olympiad trial event on environmental chemistry. Other activities include on-site water/science demonstrations for student groups, discussing science careers with students at career conferences or other events, Illinois State Fair activities, and working with teachers and providing ISWS educational resources.

Analytical Services

The Analytical Services group provides analyses in support of ISWS and University research projects,

Sofia Lazovsky analyzes samples.

Kaye Surratt analyzes samples for metals on the ICP spectrometer.

including many that focus on monitoring or improving water-supply quality. There continues to be great interest in nutrients such as nitrogen (nitrate, ammonia, total Kjeldahl nitrogen, total nitrogen, and nitrite) and phosphorus (orthophosphate, total phosphorus, and total dissolved phosphorus), metals, and nonvolatile organic carbon. Other parameters measured include anions, pH, alkalinity, and total dissolved solids. Laboratory staff also provide guidance on sample collection and preservation, results interpretation, and quality assurance protocols.

Inductively coupled plasma optical emission spectrometry was used for analyses of water quality at U.S. Army bases (Construction Engineering Research Laboratory) and metals (Illinois State Geological Survey). Sample analyses are also an important component of many other projects: sediment and nutrient monitoring (Illinois River Conservation Reserve Enhancement Program), watershed monitoring (Lake Decatur), impacts of market-based nutrient management on water quality in tributaries of the Sangamon River (Agricultural Watershed Institute), bioavailability of phosphorus in Illinois streams, metals analysis (Institutional Water Treatment Program), development of a process for removing arsenic in water supplies (MTAC), dewatering well assessment for the East St. Louis highway drainage system (Illinois Department of Transportation), water quality in Illinois Nature Preserves, and subsurface water quality in fields receiving various soil amendments.

Institutional Water Treatment Program

The Institutional Water Treatment Program (IWTP) has helped state facilities with water problems in their drinking water and heating/cooling systems since 1949. The program was such a success that other state departments and facilities soon began using IWTP services. More than 100 state facilities receive unbiased, professional water-treatment expertise by paying a nominal fee that supports some costs associated with administering the program.

Participating facilities realize annual cost savings in treatment chemicals, fuel, water, and also prolong equipment life. As a part of this service, IWTP staff present on-site training and seminars for facility engineers. They also write specifications for water treatment chemicals and testing supplies for the annual state chemical bid administered by the Illinois Department of Central Management Services to ensure products supplied meet specifications. Staff responded to more than 1,000 phone calls for information and assistance, made nearly 420 site visits, and analyzed more than 4,150 samples in the field.

State facilities produce their own drinking water by chemically treating water from nearby wells before distributing it throughout the facility. By working with these facilities, IWTP staff ensure the water is safe to drink, noncorrosive, and free of scale.

Dwight Correctional Center

The Dwight Correctional Center blends two distinct water sources to produce finished water, a mixture of city-supplied water from three wells and water from

Ion exchange softeners remove hardness salts to prevent deposits from fouling equipment and hot water systems at Dwight Correctional Center.

its own two wells. A further complication is that city-supplied water with hardness of 244–556 milligrams per liter (mg/L) also may be used separately or blended. Hardness levels in Center wells also varies from 315 mg/L (primarily source) to 414 mg/L (emergency use only). These different water qualities result in corrosive, scale-forming water.

City water and Center water are blended about 50/50, softened with three softeners, and then blended with 15–20 percent unsoftened water to maintain water hardness of 60–90 mg/L. This action stabilizes scaling potential of the water. Addition of silica forms a protective coating on pipes that reduces corrosion. Raising the pH with caustic soda makes the silica coating more effective. Addition of chlorine disinfects the water.

With IWT staff advice on proper treatment, this accelerator at W. Howe Development Center water plant operates past its expected life span.

W. Howe Developmental Center

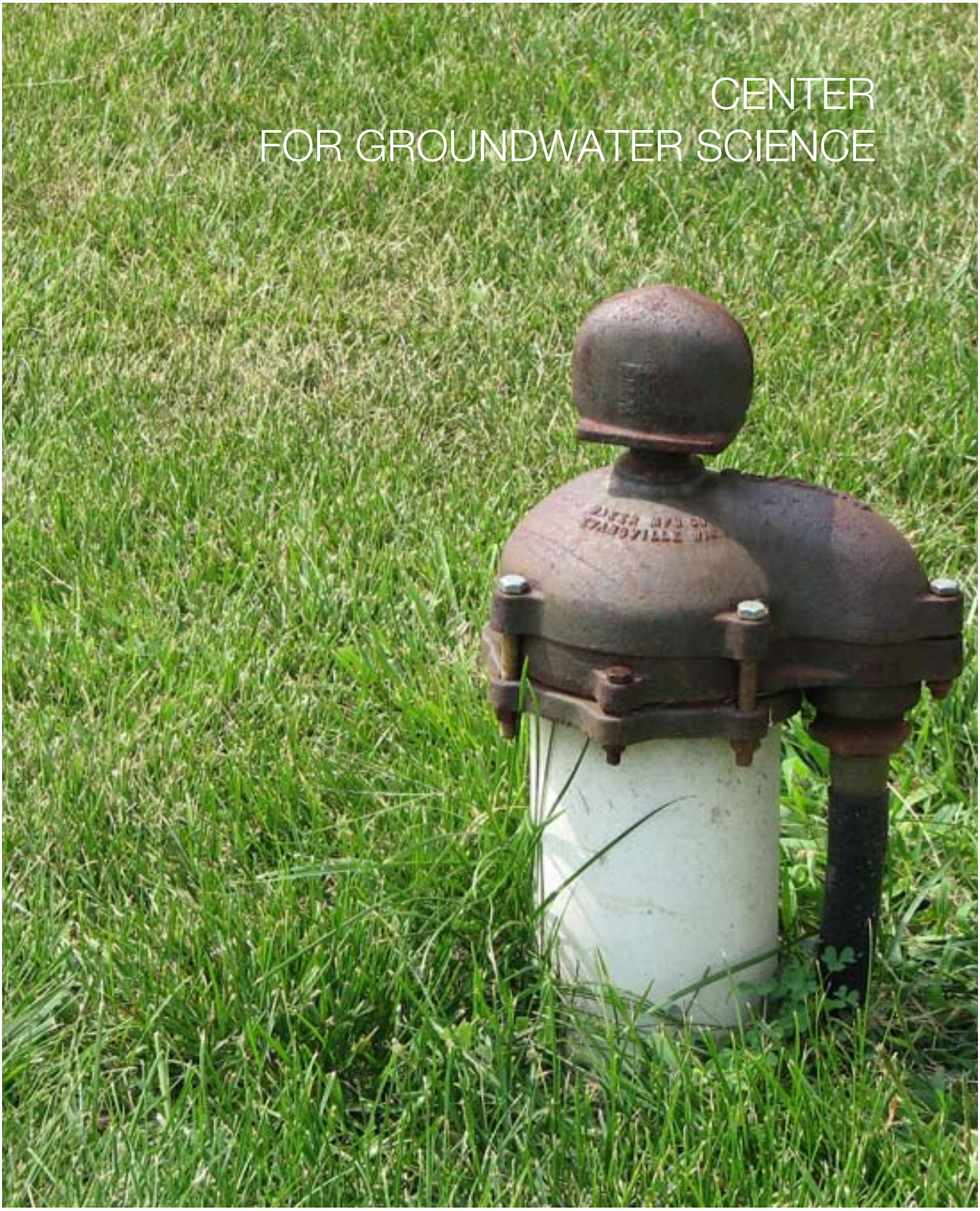
Water from wells at the W. Howe Development Center is very hard, but addition of quick lime maintains a hardness level of 80–120 mg/L. Addition of soda ash helps reduce noncarbonate hardness. Injection of carbon dioxide reduces pH and stabilizes water before it enters filter beds at pH level between 8.0 and 8.2.

Dan Webb prepares samples for ion chromatography analysis.

Pere Marquette State Park

Raw water from wells supplied by the nearby Illinois River is very hard and averages about 430 mg/L at Pere Marquette State Park. Addition of lime reduces that level to 130–170 mg/L. Alkalinity and dissolved solids also are reduced. Lime raises the pH above 10.0, but addition of sulfuric acid maintains the pH at 8.3–8.7. This results in stable water with reduced scaling and corrosion potential.

CENTER FOR GROUNDWATER SCIENCE



Ensuring Groundwater Supplies for Illinois

The Center for Groundwater Science (CGS) has core responsibilities in water-supply planning, and activities of all Center staff touch on ensuring adequate and clean groundwater for Illinois users. Two major CGS program areas highlight recent and continuing efforts for long-term water-resource planning: data access/archival and water-use documentation.

GWINFO, an Integrated Groundwater Data/ Project Archival System for Illinois

The CGS is the official repository for more than 300,000 well records for the State of Illinois. The CGS also maintains a groundwater-quality database of about 1.3 million analyses from more than 60,000 water samples since testing began in the 1890s. In addition to well records and water-quality data, the CGS houses data on groundwater levels, aquifer pump tests, and water withdrawals. Water-level data are from a long-term network of shallow observation wells, including many wells monitored for more than 50 years, and mass (synoptic) measurements collected to map aquifer potentiometric surfaces. The CGS also maintains data from thousands of pump tests collected to help Illinois communities and planners determine well and aquifer yields. These data are used daily in CGS basic and applied groundwater research, and public service activities.

Data were integrated into a relational database and software program, Groundwater Information Database (GWINFO), developed in house, that allows desktop computer entry, reporting, and electronic document archival, storage, and retrieval of groundwater data and documents. It provides complete access to all datasets (well records, water quality, water levels, water use, and aquifer hydraulic properties) and is searchable by location, depth, date, or aquifer. All data include spatial coordinates, allowing easy import into any geographical information system, and GWINFO automatically integrates laboratory analyses from the ISWS Public Service Laboratory with the water-quality database. The GWINFO system also acts as a server for electronic documents (data spreadsheets, word processing and PDF memos, letters, draft reports, etc.) archived under project headings containing simple searchable metadata fields, either keywords or project abstracts.

The GWINFO system has proven extremely useful for CGS staff, enhancing their abilities to respond quickly to information requests, using all data available in ISWS groundwater archives. It also streamlines data entry, provides easy desktop access to data and documents, and lets scientists store and share research data or create datasets in minutes rather than hours or days as in the past. Due to data security issues, GWINFO is available only to ISWS staff. Public access to selected datasets is under consideration, however.

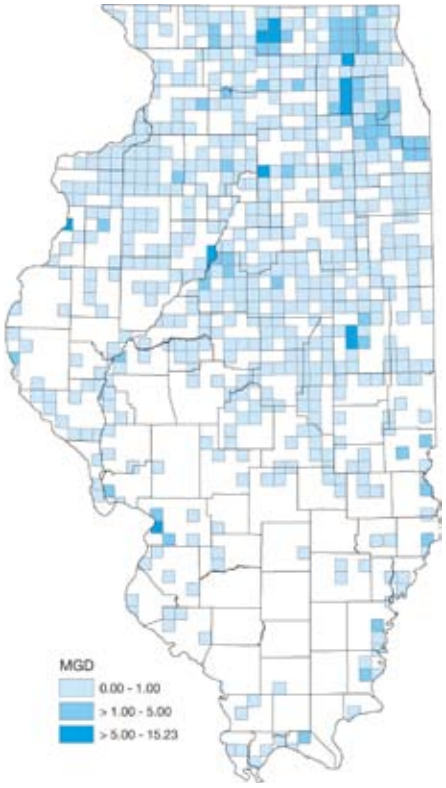
The Midwest Technology Assistance Center is funding a project to sample small public water supplies to evaluate how well existing treatments remove arsenic under varying chemical conditions.

Illinois Water Inventory Program (IWIP)

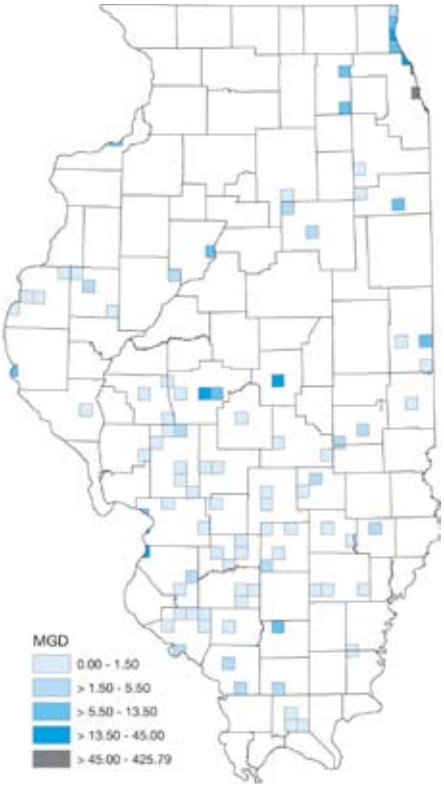
Good resource planning and accurate scenarios of future water demand both require a firm understanding of current water withdrawals and trends. The ISWS has been collecting water-withdrawal data for Illinois since at least the early 1940s, originally in regions where water resources were being extensively developed, such as northeastern Illinois, Peoria-Pekin, and East St. Louis. For such areas, it was extremely important to know water withdrawals in relation to water availability, an axiom still true for data now collected statewide.

Illinoisans use about 2 billion gallons of water per day (bgd) for domestic purposes and nearly another 1 bgd is used for industry and commerce, but those amounts pale in comparison to the 17,000 bgd used for thermoelectric power generation. Ever wonder how these amounts are determined?

Water withdrawal is the amount of water taken from its source, groundwater or surface water. The principal requisite for a withdrawal is that water from



Community groundwater withdrawals by township, 2005 (million gallons per day). ***Note:*** *Map shows locations of withdrawals by township, not area served.*



Community surface-water withdrawals by township, 2005 (million gallons per day). ***Note:*** *Map shows locations of withdrawals by township, not area served.*

the source is conveyed to the place of use. If the water is withdrawn more than once by recycling, each subsequent withdrawal also is counted; that is, all successive withdrawals are tallied and counted if withdrawn water is returned to a stream, lake, aquifer, or other source, and then withdrawn anew. Return flows are not subtracted from the withdrawal to determine water use. Therefore, water used for cooling, such as vast quantities of river water for thermoelectric power generation, is considered a water withdrawal, even though much of the water is returned to the original source. Nonwithdrawal uses of surface water for recreation or ecological habitats are not considered, however.

Documentation of annual water withdrawals for *all* of Illinois began in 1978. The Illinois Water Inventory Program (IWIP) tracks withdrawals from voluntary completion and remission of forms sent annually to major water users in the state. Although housed within the CGS, surface-water withdrawals also are included. The IWIP database of water-using facilities originally was created by compiling responses to letters sent to Illinois industries listed in the *Illinois Manufacturers' Directory*, through review of public water-supply records of the Illinois Environmental Protection Agency (IEPA), and historical ISWS files and reports. The list of facilities is updated continually through reviews of IEPA records and drillers' reports of high-capacity wells submitted to the ISWS by county health departments. The IWIP database contains site-specific information for about 11,500 active and inactive withdrawal points for 4,450 facilities throughout Illinois.

Survey forms are tailored to each facility and contain a list of wells/intakes the facility owns. Facility officials supply total annual gallons pumped for each well/intake. The CGS maintains data on each well/intake, such as location and water source (e.g., name of aquifer or surface water). Matching water withdrawals with specific well/intakes facilitates further examination of withdrawal data by region, aquifer, or water body.

Information on the quantity of water withdrawn (both surface water and groundwater) are generally categorized as community water supply, self-supplied industry and commerce (thermoelectric or hydroelectric power generation, manufacturing, and mineral extraction), and other (withdrawals for fish and wildlife management areas and irrigation). The IWIP has not attempted to survey agricultural uses of water for row-crop irrigation or rural domestic and livestock uses, however. Data can be examined by geographic regions, such as county, hydrologic unit, major aquifer system, and standard metropolitan statistical area, or by political township.

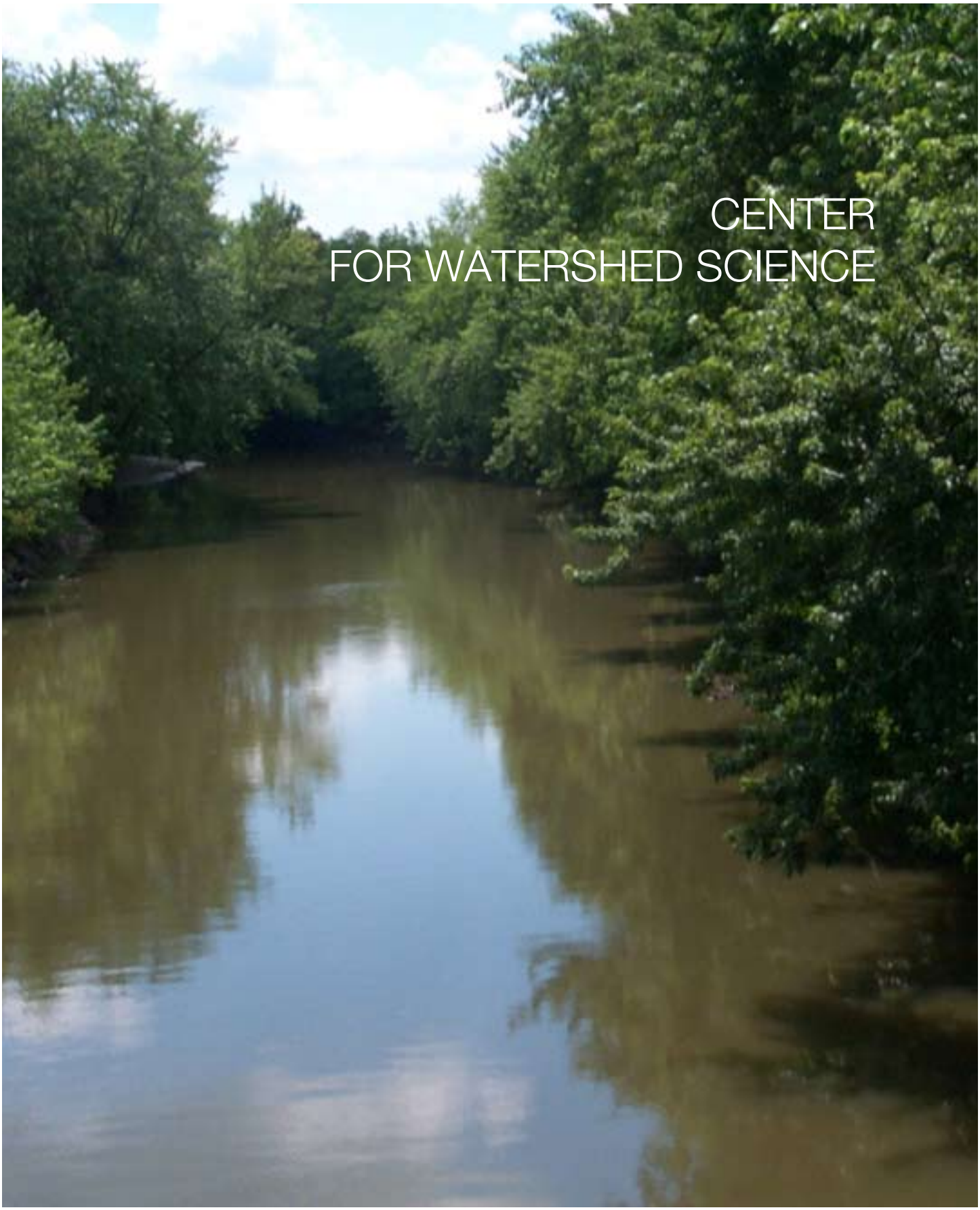
If a community supply is either not available or not used, water used is self-supplied. Individual families and small communities not served by a central water supply are not tracked, and their water withdrawal is estimated. Industries and commercial establishments using their own water source facilities are categorized as self-supplied industry and commerce. These commercial establishments include businesses (motels, lake access areas, campgrounds, golf courses, sod farms, nurseries, etc.). Other irrigation withdrawals are largely unreported to the IWIP, primarily because most irrigation pumps lack water meters. Water withdrawn for row-crop irrigation is estimated from county-irrigated acreages and precipitation deficits.

For the year 2005, the IWIP received an 89 percent return on inquiries sent to 2,781 active facilities, including 93 percent of 1769 community supplies. Those data are supplemented with previous data for nonrespondents to compile a complete picture for a given year.

The maps illustrate locations of withdrawals for community supplies in Illinois during 2005, not service areas. Abundant aquifers occur in the northern half of Illinois. Surface waters generally are used in the southern half of Illinois and in northeastern Illinois (Lake Michigan).

Groundwater from more than 1000 community facilities supplies consumers with approximately 400 million gallons per day (mgd). Only about 100 self-supplied community facilities use surface water, approximately 1300 mgd. Lake Michigan alone provides more than 900 mgd to Chicago and 140 satellite community systems in Cook, DuPage, and Will Counties. In addition, Hammond, Indiana provides ~19 mgd of Lake Michigan water to ten Illinois communities.

Kevin Rennels samples and records well water levels.



CENTER FOR WATERSHED SCIENCE

Addressing Surface Water Issues in Illinois

Numerous projects throughout Illinois, including many long-term projects, attest to Center for Watershed Science (CWS) contributions to resolving water issues. For example, modeling and analyses determine strategies for preserving, protecting, and restoring nationally and internationally recognized natural habitats, such as the Cache River watershed. Efforts on behalf of this watershed, which contains diverse plant and animal communities in valuable and still pristine natural areas, date back to the 1980s, with ISWS-designed erosion control measures around Heron Pond. Monitoring stations established later provide data used extensively by local, state, and federal agencies.

Erosion and sedimentation are major problems recognized by the State of Illinois, U.S. Army Corps of Engineers (USACE), nongovernment organizations, and local citizens. A focus of assessments begin made for the Illinois River basin are recommendations for high-priority areas for restoration, such as Peoria Pool. The ISWS provides leadership and also facilitates and coordinates the important efforts by the Scientific Surveys, the IDNR, and the USACE. Assessment procedures adopted by the ISWS use existing and new information and rapid data collection to characterize high-priority watersheds and their stream channels for potential restoration.

Sediment in streams also increases phosphorus load, a pollutant known to increase algal biomass and contribute to large dissolved oxygen swings during summer low flows. The resulting stagnant water reduces water quality for plants and animals that live there and also for water supplies from those streams. Ongoing sampling and monitoring in the Spoon River, a major tributary to the Illinois River, will increase available information about those processes, a significant necessary step in improving water quality.

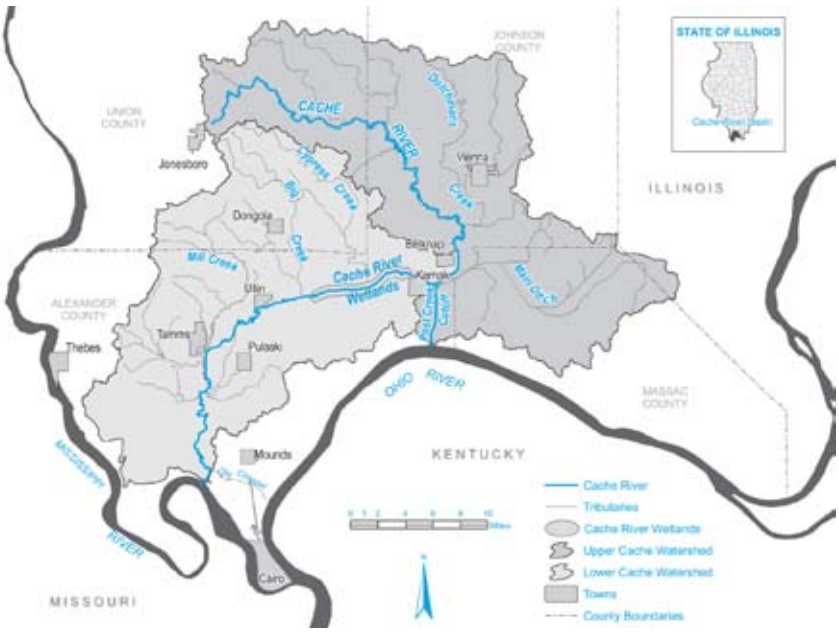
Arsenic in water supplies is also a concern. That is why CWS scientists are working on an inexpensive treatment option that reduces this naturally occurring element in supplies of drinking water.

Floodplain maps for Illinois counties are being modernized. The program is part of a nationwide, multiyear effort to provide high-quality maps that meet new digital standards (see sidebar).

Modeling and Analyses Guide Cache River Watershed Restoration

Just north of the confluence of the Ohio and Mississippi Rivers, the Cache River basin in far southern Illinois covers parts of Union, Johnson, Alexander, Pulaski, Massac, and Pope Counties. The watershed's total drainage area is 737 square miles. Since construction of the Post Creek Cutoff in 1915, the Cache River basin has been divided into two subwatersheds (see map). The Upper Cache River watershed, eastern part of the basin, has a drainage area of 368 square miles directly to the Ohio River through the Post Creek Cutoff. The Lower Cache River watershed, western part of the basin, has a drainage area of 358 square miles to the Mississippi River through a diversion channel downstream. Eleven square miles of the Lower Cache River watershed continue to drain into the Ohio River through the original channel.

Because of its unique location at the junction of major rivers and at the confluence of different topographic and physiographic regions, the Cache River basin's physical, chemical, and biological features produce diverse natural communities, including many on the edge of their species range. Many other natural communities here, however, are relatively undisturbed and still support the full range of species and natural character they displayed prior to human disturbance. Changed land-use practices and hydrologic modifications over the last century significantly have threatened ecological integrity of these nationally and internationally recognized natural habitats.



The Cache River basin is located in southern Illinois.

Concerned citizens, nongovernment organizations, and state and federal agencies have been working together over the last 30 years to protect and restore these valuable natural resources. The most prominent conservation organizations in Illinois joined forces to address the massive scale and complexity associated with successful restoration, preservation, and management of natural resources in the Cache River basin. The IDNR, The Nature Conservancy, U.S. Fish and Wildlife Service, and Ducks Unlimited form the nucleus of the Cache River Joint Venture Partnership (JVP).

The JVP is committed to preserving, restoring, and managing natural resources in the Cache River basin, with emphasis on bottomland hardwood forests, wetlands, migratory waterfowl and neotropical songbirds, and shorebirds. Together, the JVP partners own and manage nearly 35,000 acres in the Cache River watershed, including the Cache River State Natural Area, Cypress Creek National Wildlife Refuge, and Grassy Slough Preserve, within a planned purchase boundary of more than 60,000 acres.

The long history of ISWS involvement in the Cache River started with design of erosion control measures around Heron Pond in the early 1980s. Since then, the ISWS has established monitoring stations at strategic watershed locations and collected significant hydrologic and sediment data extensively used by local, state, and federal agencies. Models developed at the ISWS also have been used to simulate hydrologic conditions in the river under different natural and management scenarios.

Josh Stevens collects dissolved oxygen data in Court Creek, Knox County, Illinois.

The CWS is working with the JVP to update these earlier models and to evaluate management alternatives for the Lower Cache River, particularly effects of sediment control structures on the west and east ends of the Cache River wetlands and possibilities for partially reconnecting both portions of the Cache River. Model results will be the basis for science-based decisions toward sustainable restoration of the Cache River basin.

Watershed Assessment in Support of Illinois River Restoration

Historically, many fish and wildlife species thrived in the rich ecosystem of the Illinois River and its floodplain. Efforts to maintain and enhance habitat, recreational, and economic value of this riverine system have alleviated some abasement, but the IDNR and the USACE have shown that the river and its tributaries continue to lose ecosystem value. Reversing that trend requires systematic assessment to help resource managers develop management recommendations quickly to stave off further degradation.

Erosion of tributary stream channels and near channel environments is a major problem in the Illinois River basin, one recognized by IDNR, USACE, nongovernment organizations, and local stakeholders. Concerns about erosion of tributary streams rank equally high with concerns about sedimentation of the Illinois River mainstem, backwater lakes, and side channels; floodplain alterations; and water-level fluctuations. Destabilization of tributary streams increases channel bed and bank erosion, buries productive substrates, undermines effectiveness and value of existing capitol infrastructure.

The Scientific Surveys are assessing the Illinois River basin with IDNR and USACE funding. The ISWS provides leadership and also facilitates and coordinates this effort.

Watersheds in the Illinois River basin were prioritized for assessment and restoration based on consensus criteria developed by the IDNR, USACE, and other stakeholders. Revised watershed and tributary stream assessment procedures adopted by the ISWS to better characterize these priority watersheds and their stream channels are based on existing and new information. Analyses of existing GIS data are presented for the entire watershed, but this is the only effort in Illinois that also systematically integrates data on stream channel geomorphology (channel stability), habitat, and biology of several high-priority watersheds in the Illinois River basin. Rapid examination of that information improves characterizations. Not only does this improve subsequent prioritizing of target areas for restoration projects along stream and riparian areas in the watershed, but this process also provides justification for those recommendations.

For example, Senachwine Creek watershed drains directly into Peoria Pool, a high-priority area for restoration. Senachwine Creek watershed was assessed using watershedwide GIS data and rapid data collection techniques that better characterize channel stability, habitat, and biology. Five potential restoration sites were delineated for the Senachwine Creek mainstem. Eleven other channel and near channel sites were considered

Bill White conducts field reconnaissance of Hickory Creek within the city limits of Joliet, Illinois.

high-priority candidates for restoration along assessed watershed tributaries.

The assessment document contains numerous recommendations. These include traditional upland farm treatment such as additional terraces, water and sediment control basins, grassed waterways, and no-till practices. Naturalization methods in streams and near channels include multipurpose riffle-and-pool structures, other structures to improve fish habitat, and bioengineering techniques for streambank stabilization. Also recommended are priority upland and floodplain wetland restoration and enhancement of hydric soils; forested slope and riparian management, including timber stand improvements and techniques that improve forest structure and habitat; stabilization of select mass wasting sites; and integration of these and other watershed restoration practices with existing blueprints for urban stormwater management and riverfront conservation and development plans.

Sediment Impacts on Potential Bioavailability of Phosphorus in Streams

Impacts of suspended and bed sediments on the potential bioavailability of phosphorus, a known pollutant, are being clarified for the Spoon River watershed in west-central Illinois. Bioavailable phosphorus is the portion of total phosphorus present that is available to be taken up by algae and other aquatic biota. The Spoon River, a major tributary to the Illinois River, is the focus of a study funded by the Illinois Council of Food and Agricultural Research. Intensive monitoring in this watershed includes Court and North Creeks, two lesser tributaries, and the Spoon River mainstem at Seville.

Phosphorus forms and bioavailability are determined using intensive low-flow and storm sampling of suspended and bed sediments. While data are being collected, important water-quality parameters, such as pH, temperature, dissolved oxygen (DO), and chlorophyll *a* (both suspended and benthic), also are being monitored through *in-situ* sampling and continuous monitoring instrumentation. Already there are several principal findings.

Summer rainfall/runoff events have the beneficial effect of removing stagnant water, accumulated fine sediment, and algal biomass, in effect, "resetting" streams to a less eutrophic state, typified by reduced diurnal DO fluctuations. Severe drought conditions during summer 2005 resulted in uninterrupted low flows characterized by unusually high concentrations of suspended algae, low concentrations of bioavailable dissolved reactive phosphorus (DRP), and persistently large diurnal swings in DO concentrations.

Estimated bioavailable phosphorus concentrations, using an iron-oxide filter strip method, are about 10–30 percent of total phosphorus concentrations. This agrees with findings from other studies of agriculturally dominated watersheds.

A thick silt-clay sediment layer quickly forms in 1–2 weeks at the sediment-water interface at study sites during low flows and reaches quasi- or pseudoequilibrium with overlying DRP concentrations in the water column. Consequently, over a longer period, these fine-grained sediments are neither a source or sink for water-column DRP concentrations.

This sediment layer also supports an algal biomass population (as measured by chlorophyll a) that exceeds suspended algae in the overlying water column under summer low flows. This bottom-dwelling or benthic algal population is probably the greatest contributor to the large diurnal DO swings observed in streams under summer low flows.

Diurnal DO swings were minimal for the Spoon River at Seville until stage dropped below about 7 feet at the end of May, and subsequent runoff events decreased diurnal DO swings for periods up to about 14 days.

Removing Arsenic from Drinking Water

Arsenic occurs naturally in groundwater in parts of Illinois. Communities that use wells for their municipal supply usually remove iron before distributing water to consumers, and iron removal also typically removes about a third of the arsenic present. After the U.S.

Environmental Protection Agency's lowered maximum contaminant level (MCL) for arsenic in drinking water (10 micrograms/liter), many drinking waters were now out of compliance. Treating water can be expensive, particularly for small communities. Scientists at the CWS and the Center for Groundwater Science are collaborating to develop and test a low-cost water treatment method using existing equipment already on site in these communities and substances present in groundwater.

Water Survey researchers Tom Holm and Gary Peyton operate the Fenton filtration arsenic removal unit during pilot tests at the water treatment plant at Monticello, Illinois. The pilot unit is stored on site between experiments for ready availability during optimum treatment conditions. The glass column (bottom of unit) is the flocculation basin and contains a sand filter. Plastic containers (middle level) are the aeration basin and chemical reservoirs, and pumps (top level) supply treatment chemicals.

Iron dissolved in groundwater and present in a reduced form (ferrous iron) oxidizes to insoluble ferric iron during treatment and is removed by filtration. Ferrous iron also reacts with hydrogen peroxide to produce ferric iron and a very reactive chemical species that can oxidize arsenic to a form that adsorbs more completely to the insoluble iron, which is removed more completely during filtration. This chemistry, called the Fenton reaction, provided the basis for treatment method development.

The concentration of hydrogen peroxide required is about 1,000 times more dilute than drugstore hydrogen peroxide and is therefore an inexpensive addition to treatment. After laboratory determination of optimal amounts, groundwater sources used as drinking water were treated at Danvers, Monticello, and Dwight, Illinois.

In addition to hydrogen peroxide, it was necessary to add a little more iron to provide sufficient iron oxide to adsorb all arsenic. Arsenic concentrations at all three facilities could be reduced below the MCL. Using relatively inexpensive doses of iron and peroxide, 3–6.4 milligrams per liter (mg/L) of ferrous iron and 0.7–1.5 mg/L of hydrogen peroxide was adequate to reduce total arsenic to the maximum allowable contaminant level in treatment site waters. The estimated chemical cost was $0.04–$0.07 per thousand gallons in the most favorable cases. The treatment mechanism is being evaluated for use in modeling treatability of other waters, and to select a site for full-scale trial of the method. Prior reports on this and other arsenic research are available on the Web (http://mtac.sws.uiuc.edu/).

Floodplain Mapping

When the IDNR signed a Cooperating Technical Partnership Agreement with the Federal Emergency Management Agency (FEMA) to fully participate in a 5-year Floodplain Map Modernization Program, the ISWS Floodplain Mapping Program was launched. The ISWS program has grown from its initial 7-member staff in 2004 to its current team of 25 staffers and 3 student interns. The ISWS and the Office of Water Resources (OWR) are working jointly to prepare floodplain maps for most of Illinois following new digital standards.

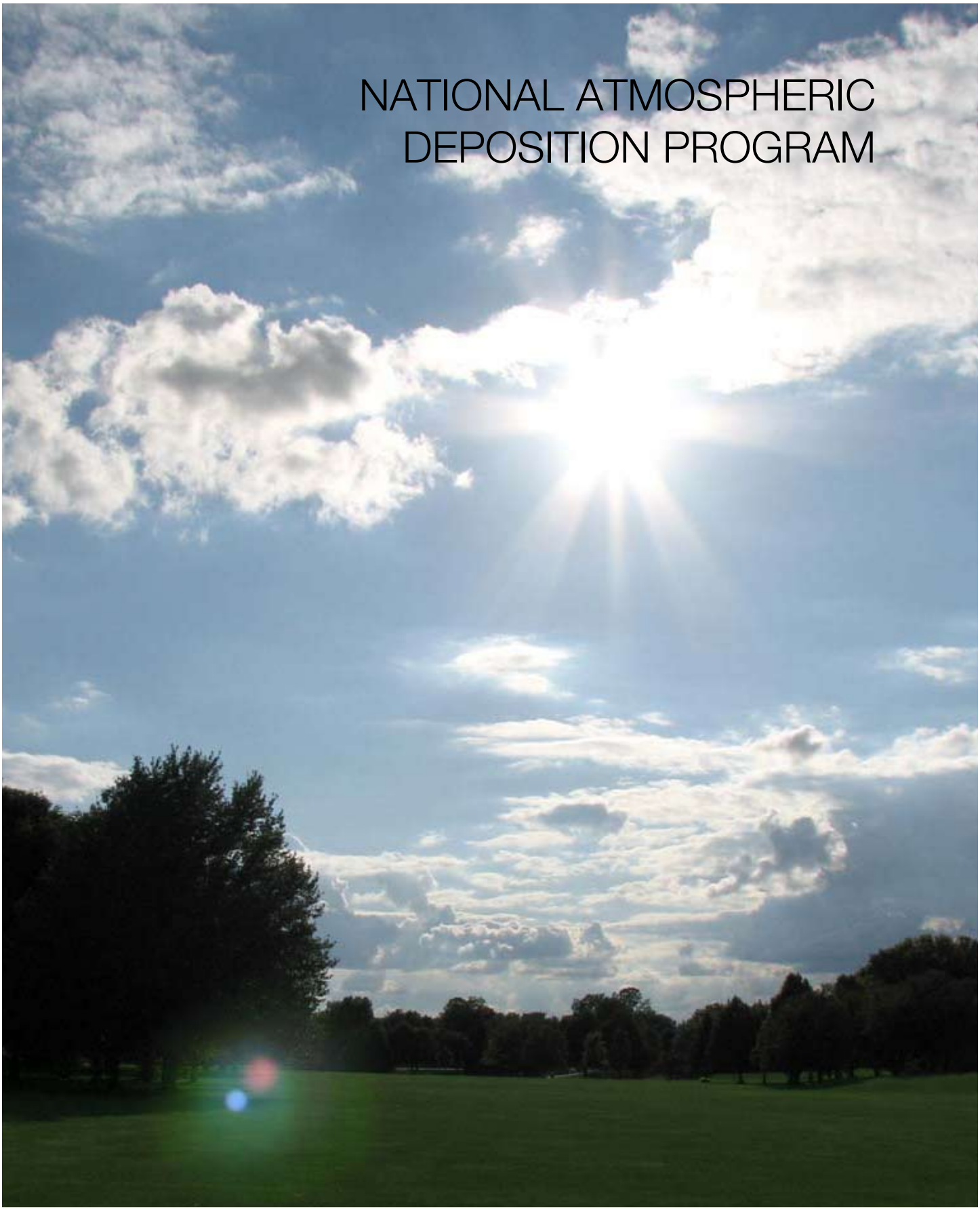
These new digital floodplain maps use GIS technology. Local involvement is stressed to ensure that maps contain up-to-date and accurate data. The ISWS is providing technical expertise to prepare digital maps for Illinois and to conduct new hydrologic and hydraulic flood studies in critical areas. The 18- to 24-month process typically begins with a meeting of program staff and local officials before the technical phase of map preparation. Local officials and the public have an opportunity to review and comment on preliminary maps before they are finalized. After extensive quality assurance checks and resolution of public comments, a target date is set for final maps. Work began on digital maps for 5 Illinois counties in 2004, followed by a contract for 15 counties in 2005, and one for 19 counties in 2006. Currently, 4 counties have final maps, 5 counties are reviewing preliminary maps, and 10 other counties have their completed digital maps. Preliminary maps for Illinois can be viewed on the Web (http://www.illinoisfloodmaps.org).

A major milestone occurred in 2007, with release of the preliminary digital flood insurance rate maps (DFIRMs) for Cook County. These 252 panels and 3-index DFIRMs represent a significant step in the national program and received high praise from FEMA for production quality and expedience. Information is being collected to start the process for another 20 counties scheduled for funding later in 2007.

This first phase of the FEMA Map Modernization Program will end in 2010. Congress already is evaluating the next phase, modernizing and maintaining high-quality, accurate flood hazard maps, however. The ISWS/OWR team fully expects to continue to serve Illinois citizens with timely and accurate information that can save lives and property.

Engineers and GIS Team lead a planning meeting.

NATIONAL ATMOSPHERIC DEPOSITION PROGRAM



Mercury in Illinois' Rain

The Mercury Problem

Illinois is one of 48 states with fish consumption advisories due to high mercury levels in fish from its lakes and streams. Only Alaska and Wyoming do not have advisories. Studies have shown that mercury adversely affects nervous system development in fetuses and children, so advisories address women of childbearing age and children under 15 years old. Prior to 2002, advisories recommended limited consumption of certain fish species from listed water bodies. Like many other states in 2002, Illinois issued a statewide advisory due to methyl mercury in fish (http://www.idph.state.il.us/envhealth/fishadv/fishadvisory02.htm) cautioning above populations to eat no more than one meal a week of Illinois' predator fish (bass, walleye, sauger, saugeye, catfish, muskellunge, and northern pike).

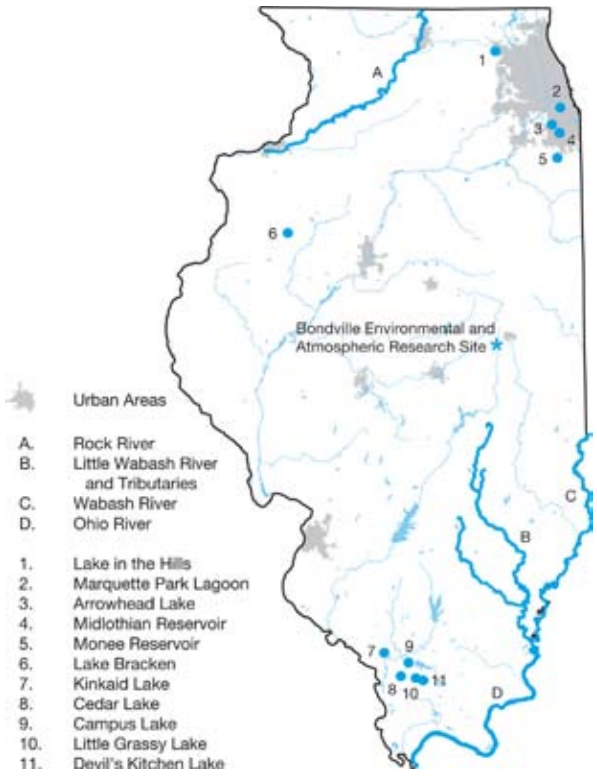
The Illinois Fish Contaminant Monitoring Program (IFCMP) annually screens fish from surface water in Illinois (lakes, streams, and reservoirs) for 13 chemicals, including mercury, with adverse effects on human health. This is a joint effort of the Illinois Environmental Protection Agency and Illinois Departments of Agriculture, Natural Resources, Public Health, and Nuclear Safety. Based on test results, the Illinois Department of Public Health issues fish consumption advisories.

Mercury, a persistent toxic inorganic element, is slow to degrade. Certain bacteria transform inorganic mercury into an even more toxic organic form, methyl mercury. Scientists are investigating physical, chemical, and biological conditions under which this occurs in surface water and sediments. Larger fish eat smaller fish, and methyl mercury bioaccumulates in fish tissue at each step up the food chain, substantially increasing mercury concentrations. Methyl mercury has been found at part-per-million levels in some of Illinois' predator fish.

The latest Illinois Department of Public Health special advisory on fish consumption (http://www.idph.state.il.us/public/press07/2.2.07fishadv.htm) includes the 15 water bodies shown (see map above).

Natural processes transport and disperse mercury. For example, streams carry sediment containing mercury downstream over months, years, and decades. Geysers carry mercury from geological formations deep in the earth to the surface over the span of an eruption.

Human activities also redistribute mercury. Municipal and medical waste contain trace amounts of mercury released into the atmosphere during waste incineration. Similarly, most coal contains mercury, so coal combustion is another source. Soils, geological formations, industrial waste, and atmospheric deposition all contribute mercury, but there has been no comprehensive evaluation of their relative importance as sources of mercury in Illinois' surface waters.



Locations of Bondville MDN site and Illinois Department of Public Health fish consumption advisories for Illinois' surface waters.

Measuring Mercury

The National Atmospheric Deposition Program (NADP) operates a monitoring network that measures total concentration of mercury in precipitation and the amount of mercury it deposits at regionally representative sites. As of June 2007, the Mercury Deposition Network (MDN) had more than 100 sites, including eight sites in Canada. The MDN Bondville site (see map above) in east-central Illinois has been active since 1999.

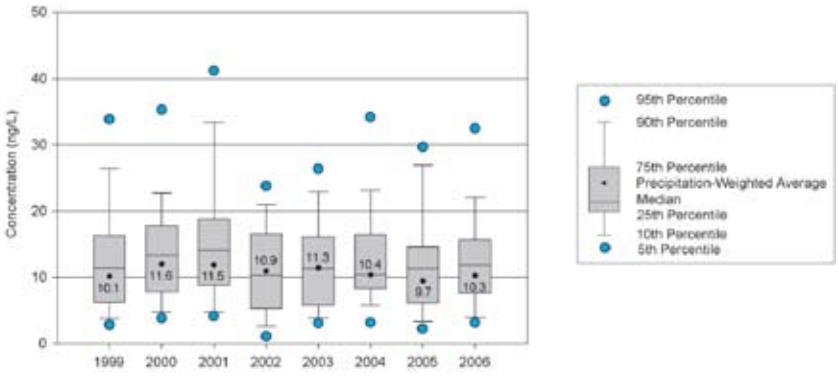
Atmospheric mercury is deposited either by wet deposition (precipitation) or dry deposition (gas or particulate form). Mercury is present in the atmosphere as gaseous elemental mercury (GEM), reactive gaseous mercury (RGM), and particulate mercury (PM). Each form has a different atmospheric life cycle. The RGM

readily dissolves in water within hours or days, is absorbed in dew, is captured efficiently in clouds, fog, and precipitation, and rapidly dry deposits. The GEM is relatively insoluble and unreactive for nearly a year, and is not captured efficiently in precipitation or rapidly dry deposited. The PM is generally unreactive for about a week, is captured in clouds and precipitation, and may travel hundreds or even thousands of kilometers before removed from the atmosphere as wet or dry deposition.

All MDN samples are collected at the end of a seven-day period from a sampler that opens only during precipitation to exclude dry deposition. Sample bottles contain a 10-percent hydrochloric-acid solution to preserve mercury in solution. The NADP mercury analytical laboratory in Seattle, Washington, measures and reports total concentration of all forms of mercury without differentiating species. All MDN data are available on the NADP Web site (http://nadp.sws.uiuc.edu/mdn/).

The graph below displays annual 1999–2006 mercury concentration data from the Bondville site. Box plots display distributions of weekly mercury concentrations, median concentrations, and annual precipitation-weighted means. Over the 8-year period, annual means were between 9.7 nanograms per liter (ng/L) and 11.6 ng/L. Statistical tests comparing each year of data with the other seven years show neither an increase nor a decrease in mercury concentrations at the Bondville site over time. Instead, results reflect year-to-year fluctuations expected from variations in sources, storm tracks, and related weather conditions. Weekly concentrations in a typical year range from a low of 1–3 ng/L to a high of 30–65 ng/L.

The 10.3 ng/L for Bondville on the latest map of weighted-average mercury concentrations at U.S. MDN sites (see map, top left) is at the 70th percentile. Highest average concentrations occurred at arid sites in New Mexico and Colorado. The wet deposition map (see map, top right) shows 2006 mercury deposition amounts at active MDN sites, and the 8.8 micrograms per square meter value at Bondville is below the median at all MDN sites. Highest annual deposition occurred in southern Florida at the Everglades National Park site. Unlike sulfate and nitrate deposition, which are highest in the Northeast from Illinois to western Pennsylvania, mercury deposition tends to be highest in Gulf Coast states. There also are no statistically significant correlations between mercury and any acids, nutrients, or other chemicals measured in precipitation at the Bondville site.

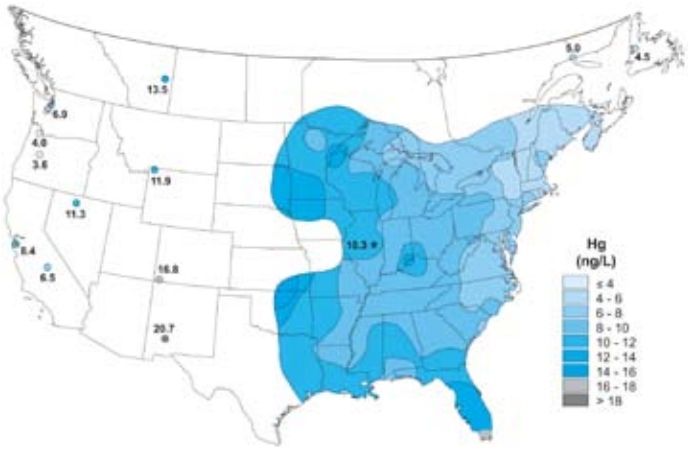


Distributions of weekly total mercury concentrations in precipitation samples, Bondville MDN site, 1999–2006.

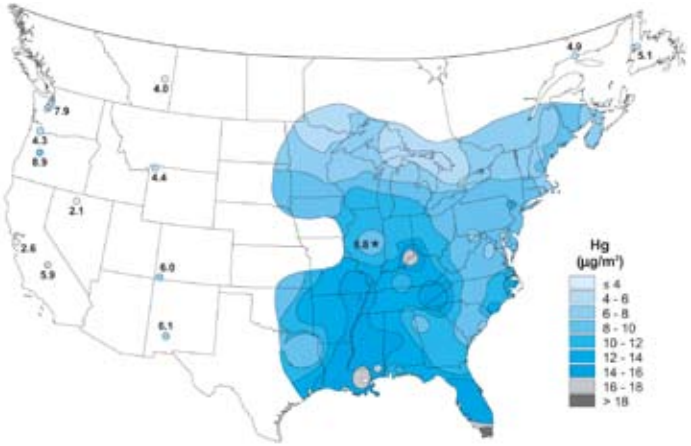
Summary

Every year, the IFCMP tests fish samples for mercury and other chemicals. Where these tests find high levels of mercury in fish tissue, the Illinois Department of Public Health issues an advisory recommending limited consumption of affected species by women of child-bearing age and children. Tests have shown that mercury interferes with nervous system development in that population, and large amounts of toxic methyl mercury accumulate in fish tissue. Mercury enters surface water from runoff, geological formations, atmospheric deposition, etc., and a small fraction is transformed into methyl mercury under special conditions. This is an area of active research in the scientific community because there has not been a comprehensive evaluation of mercury sources that lead to high levels of methyl mercury in Illinois' fish.

Mercury has important natural sources and also comes from human activities, such as waste incineration and coal combustion. All these sources contribute to airborne mercury, which is returned to earth in precipitation (wet deposition) or as dry deposition. Based on the 1999–2006 data record at the Bondville site, annual average mercury concentrations are in the 9.7–11.6 ng/L range, typically slightly above the median concentration observed at MDN sites. Annual deposition amounts at the site are in the 8.5–10.1 micrograms/square meter range, typically below the median deposition at MDN sites. No trends are evident, and there are no statistically significant relationships between mercury and acids, nutrients, or other chemicals measured in precipitation at this site. Mercury generally tends to be highest in Gulf Coast states, northern



Precipitation-weighted average mercury concentrations, MDN sites, 2006.



Wet deposition of mercury, MDN sites, 2006.

Minnesota, Wisconsin, and western sites. Maximum mercury concentrations and deposition amounts do not coincide with sulfate maxima in and downwind of the Ohio River valley, an area of high sulfur dioxide emissions from coal combustion.

For a regionally representative site, such as the one at Bondville, the relationship between mercury in precipitation and combustion sources is not evident in MDN data. Further research will be necessary to identify sources of mercury in precipitation over Illinois and in game fish populations.

Bondville site operator Mike Snider regularly collects samples from equipment that measures mercury.

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Center for Chemistry & Technology

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Center for Groundwater Science

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National Atmospheric Deposition Program

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HONORS & AWARDS

Kingsley Allan
Recipient, Honorable Mention, Digital Earth 3D Visualization Grand Challenge, Fifth International Symposium on Digital Earth

Elias Bekele
Recipient, Honorable Mention, Best Dissertation Award, Universities Council on Water Resources, 2007

Van Bowersox
Invited Reviewer, National Research Initiative Air Quality Program Panel, U.S. Department of Agriculture, Cooperative Research Education and Extension Service

Mark Brooks
Conference Co-Chair, 59th Annual Illinois Institutional Chief Engineers Workshop, October 2006

Stanley Changnon
Recipient, 2006 Choice Award, Atmospheric Sciences Librarians International, for *Railroads and Weather*

Charles Curtiss
Conference Co-Chair, 59th Annual Illinois Institutional Chief Engineers Workshop, October 2006. Member, Planning Committee for Electric Utility Chemistry Workshop, 2007

Misganaw Demissie
Elected Diplomate, Water Resources Engineer (D.WRE), American Academy of Water Resources Engineers, American Society of Civil Engineers

David Kristovich
Session Chair, Symposium on Boundary Layers and Turbulence, American Meteorological Society; and Session Co-Chair, 50th Anniversary Conference, International Association for Great Lakes Research

Kenneth Kunkel
Lead Author, U.S. Climate Change Science Program Synthesis and Assessment Product 3.1, *Climate Models and Their Uses and Limitations: Climate Sensitivity, Feedbacks, and Uncertainties*; and Member, Climate Change Science Program Product Development Advisory Committee, U.S. Department of Energy

Christopher Lehmann
Session Chair, "Data Analysis and Trends" and "Data Management and Quality Assurance," 100th Annual Air and Waste Management Association Conference, Pittsburgh, PA, June 2007; and Secretary, Data Management Analysis and Quality Assurance Committee

Xin-Zhong Liang
Member, Editorial Advisory Board *Open Atmospheric Science*

Sally McConkey
Recipient, Outstanding Service Award, Illinois Association for Floodplain and Stormwater Management, for "guidance, commitment, and extraordinary efforts as Chairwoman of IAFSM"

Gary Peyton
Invited Member, Organizing Committee, 13th International Conference on Advanced Oxidation Technologies for Treatment of Water, Air, and Soil; and Charter Member, International Editorial Advisory Board, *Journal of Advanced Oxidation Technologies*

Doug Walker
Member, Groundwater Executive Committee, *American Geophysical Union*, 2006; and Associate Editor, *Ground Water*, 2002–present

Daniel Webb and *Mary LeFaivre*
Recipients, Certificate of Appreciation for conducting Water Chemistry event, Illinois Science Olympiad, April 2007

Allen Wehrmann
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Surface Water Information: Bill Saylor, (217) 333-0447
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Assistant Coordinator & Central Analytical Laboratory Director: Chris Lehmann, (217) 265-8512
Assistant Coordinator for Toxics: David Gay, (217) 244-0462
Database and NADP Web Site Manager: Bob Larson, (217) 333-9008

ADJUNCTS & EMERITUS APPOINTMENTS

Adjuncts to University of Illinois at Urbana-Champaign

Office of the Chief
Derek Winstanley, Department of Geography
and Department of Atmospheric Sciences

Center for Atmospheric Science
James Angel, Department of Geography
Stanley Changnon, Department of Geography
David Kristovich, Department of Atmospheric Sciences
Kenneth Kunkel, Department of Atmospheric Sciences
Xin-Zhong Liang, Department of Atmospheric Sciences

Center for Groundwater Science
Walton Kelly, Department of Geology

Adjuncts to Other Universities

Center for Groundwater Science
Walton Kelly, Department of Geology,
Fort Hare University, Alice, South Africa

Adjuncts to Illinois State Water Survey

Dr. Geoffrey Hewings
Regional Economics Applications Lab
Department of Geography
University of Illinois at Urbana-Champaign
Urbana, IL

Dr. Scott Isard
Department of Plant Pathology
The Pennsylvania State University
University Park, PA

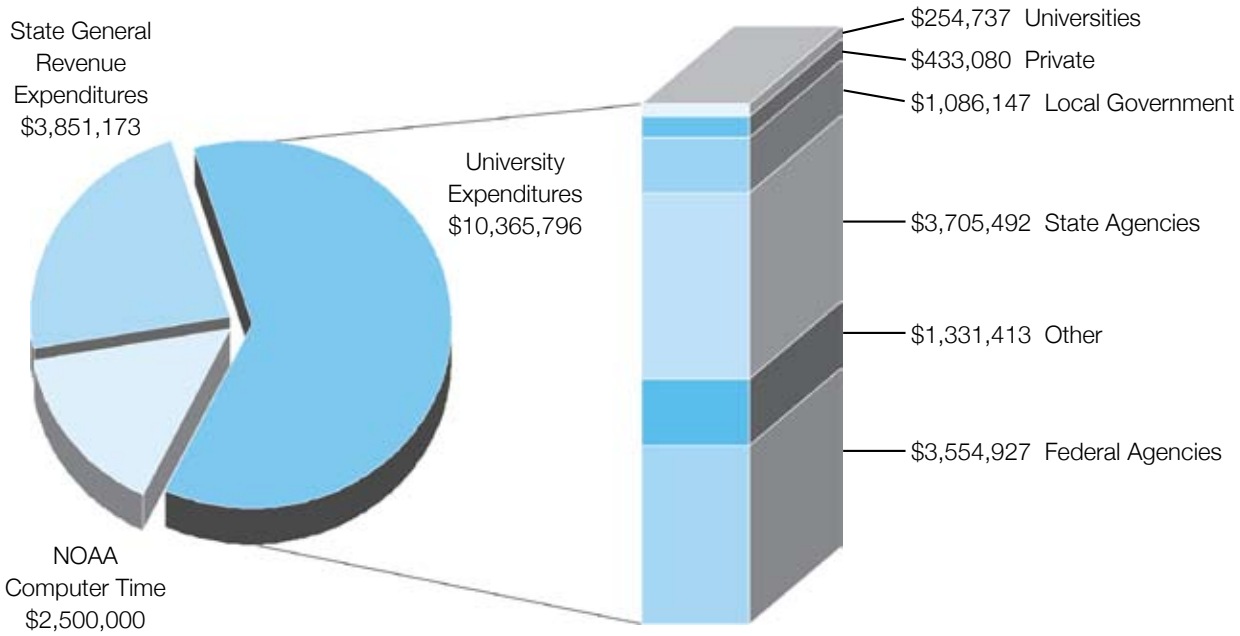
Dr. Roger A. Pielke, Jr.
Center for Enivronmental Sciences
University of Colorado, Boulder
Boulder, CO

Thomas A. Prickett
Thomas A. Prickett & Associates
Urbana, IL

Emeritus Appointments

Russell Lane, Principal Scientist Emeritus, 1981
Ralph Evans, Principal Scientist Emeritus, 1984
Stanley Changnon, Chief Emeritus, 1985
Robert Sasman, Professional Scientist Emeritus, 1987
Richard Schicht, Principal Scientist Emeritus, 1989
Eugene Mueller, Principal Scientist Emeritus, 1990
Donald Staggs, Professional Scientist Emeritus, 1990
Richard Semonin, Chief Emeritus, 1991
Chester Neff, Principal Scientist Emeritus, 1992
Michael Terstriep, Principal Scientist Emeritus, 1993
Wayne Wendland, Principal Scientist Emeritus, 1996
Thomas Butts, Senior Professional Scientist Emeritus, 1998
Raman Raman, Principal Scientist Emeritus, 1998
Donald Gatz, Principal Scientist Emeritus, 1999
Nani Bhowmik, Principal Scientist Emeritus, 2001
Shundar Lin, Senior Professional Scientist Emeritus, 2001
Harry Ochs, Principal Scientist Emeritus, 2002
Mark Peden, Senior Professional Scientist Emeritus, 2002
Kenneth Beard, Principal Scientist Emeritus, 2003
Steven Hollinger, Principal Scientist Emeritus, 2005

FINANCIAL STATEMENT, FY07



TOTAL EXPENDITURES $16,716,969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