Illinois Water Conference 2008

October 8 - 9, 2008
Champaign, Illinois

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Agenda

Illinois Water Conference 2008

Wednesday, October 8, 2008

8:00 am - 9:00 am — Registration/Check-in (Conference Center Foyer)

9:00 am - 9:10 am — Welcome and Opening Comments (Boilermaker Room)
Richard Warner, Director, Illinois Water Resources Center

9:10 am - 10:10 am — Featured Speaker (Boilermaker Room)
Richard Sparks, Research Director, National Great Rivers Research and Education Center
Where We Have Been and Where We Are Going: A Personal Retrospective and Outlook on Water Resources in Illinois

10:10 am - 10:25 am — Break/Exhibits (Illini Ballroom)

10:25 am - 12:15 pm — Plenary Session (Boilermaker Room)

Water Resources Development Act of 2007 - Recent Experiences in Illinois

Moderator: Timothy Feather, CDM Federal Programs

Gary Clark, Illinois Department of Natural Resources, Office of Water Resources
Federal Water Resources Development Act: Illinois' Interest and Influence

John Zimmerman, U.S. Army Corps of Engineers
WRDA: What It Is and What It Can Do For You

Claudia Emken, The Nature Conservancy
WRDA 2007—A 7 Year Quest for The Nature Conservancy

12:15 pm - 1:30 pm — Lunch (Illini Ballroom)

1:30 pm - 3:00 pm — Themed Session I (concurrent sessions)

Water Supply (Fighting Illini Room)

Moderator: Gary Clark, Illinois Department of Natural Resources

Allen Wehrmann, Illinois State Water Survey
Water Supply Planning in Illinois – A Progress Report from the State Surveys

Tim Loftus, Chicago Metropolitan Agency for Planning
21st Century Water Conservation in Northeastern Illinois

Gary Clark, Illinois Department of Natural Resources
Uncertainties and Challenges in Regional and Statewide Water Supply Planning and Management

Nutrients (Golden Gopher Room)
Moderator: Gregg Good, Illinois Environmental Protection Agency

Mark David, University of Illinois at Urbana-Champaign
Overview of Nutrients in Illinois Waters from Sources to Downstream Contributions

Paul Terrio, U.S. Geological Survey
Nutrient Standards for Illinois Surface Waters - A Progress Update

Nick Menninga, Illinois Association of Wastewater Agencies
Costs of POTW Nutrient Removal in Illinois

Dennis McKenna, Illinois Department of Agriculture
Agricultural Nutrient-Reduction Alternatives and Costs

3:00 pm - 3:30 pm Break/Exhibits (Illini Ballroom)

3:30 pm - 5:00 pm Technical Session I (concurrent sessions)

Environmental Measures (Fighting Illini Room)
Moderator: David Larson, Illinois State Geological Survey

Teresa Chow, Illinois Sustainable Technology Center
Evaluation of Analytical Methods for Pharmaceuticals and Personal Care Products

Michael Plewa, University of Illinois at Urbana-Champaign
Induction of Mammalian Cell Chronic Cytotoxicity and Acute Genomic DNA Damage by Drinking Water Disinfection Byproducts

Charles Pederson, Eastern Illinois University
Use of Photopigments as a Descriptor of Phytoplankton Assemblages

Lewis Parish, University of Illinois at Springfield/Illinois Department of Public Health
GIS Mapping of Surface Discharge Septic Systems

Groundwater Research (Golden Gopher Room)
Moderator: Stacy James, Prairie Rivers Network

Edward Mehnert, Illinois State Geological Survey
Refining Estimate of Shallow Groundwater Recharge Using Hydrologic and Geologic Information

Thomas Holm, Illinois State Water Survey
Spatial Variability of Arsenic in Glacial Aquifers

William Dey, Illinois State Geological Survey
Mapping The Mahomet Aquifer Beneath Champaign County, Illinois

Agenda

5:15 pm - 7:30 pm Reception (Illini Ballroom)
Poster Session 5:15 pm - 6:15 pm

6:30 pm - 7:30 pm Student Career Panel (Fighting Illini Room)

Thursday, October 9, 2008

8:00 am - 8:30 am Registration (Conference Center Foyer)

8:30 am - 10:30 am Themed Session II (concurrent sessions)

Water and Energy/Biofuels (Fighting Illini Room)
Moderator: Steve John, Agricultural Watershed Institute

Vijay Singh, University of Illinois at Urbana-Champaign
Water Use in Bioethanol Production

Allen Wehrmann, Illinois State Water Survey
Water and Ethanol Production in Illinois

Gregory McIsaac, University of Illinois
Perennial Grass, Corn and Soybean Effects on Soil Moisture and Inorganic Nitrogen Leaching in Central Illinois

David Riber, Avenine Renewable Energy, Inc.
Ethanol Production and Water Usage

Climate Change (Golden Gopher Room)
Moderator: Jim Angel, Illinois State Water Survey

Ximing Cai, University of Illinois at Urbana-Champaign
Impact of Climate Change on Crop Yield? A Case Study of Rainfed Corn in Central Illinois

Joseph Kozak, Metropolitan Water Reclamation District of Greater Chicago
The Energy and Carbon Footprint of Wastewater Treatment and Waterway Management in Greater Chicago

Jim Angel, Illinois State Water Survey
Future Climate Change Scenarios for Lake Michigan Levels

10:30 am - 10:45 am Break and Exhibits (Illini Ballroom)

10:45 am - 12:15 pm Technical Session II (concurrent sessions)

Hydrology/Hydraulics (Fighting Illini Room)
Moderator: Phil Mankin, Illinois-Indiana Sea Grant

David Soong, U.S. Geological Survey
Illinois StreamStats — A Basin Characteristics and Flood-peak Frequencies Determination Tool

Jorge Abad, University of Illinois at Urbana-Champaign
Linking the Detailed Physical Understanding of Meandering Channels into the River Restoration Rramework

Diego Oviedo-Salcedo, University of Illinois at Urbana-Champaign
Balancing Irrigation and Instream Water Requirements under Drought Conditions: A Study of Kankakee River Watershed

Andrea Zimmer, University of Illinois at Urbana-Champaign
Critical Rainfall and Infrastructure Dependencies as CSO Triggering Thresholds

Watershed Planning (Golden Gopher Room)
Moderator: Glynnis Collins, Prairie Rivers Network

Patrick Mills and Tim Bryant, U.S. Geological Survey
Estimating Water Use in Illinois — Present Realities, Future Visions

Barbara Minsker, University of Illinois Urbana-Champaign
Harnessing the Power of Sensors and Cyberinfrastructure Towards Environmental Sustainability: The WATERS Network Vision and Testbedding Research in Illinois

Luiz Freitas, University of Illinois at Urbana-Champaign
Adoption of Green Technologies: The Case of Chicago Rain Barrels

Christopher Slemp, Southern Illinois University Carbondale (SIUC)
Stakeholder Visions of Community and Environmental Health in the Lower Kaskaskia River Watershed

Water Quality (Spartan Room)
Moderator: Thomas Holm, Illinois State Water Survey

Charnsmorn Hwang, Southern Illinois University Carbondale
Effects of Urbanization on Water Quality in the Lower Kaskaskia Watershed in Southern Illinois

Timothy Straub, U.S. Geological Survey
Sediment Issues in Illinois

David Kovacic, University of Illinois at Urbana-Champaign
Constructed Wetland Size Requirements for Effective Nutrient Removal in Agricultural Watersheds

Agenda

12:15 pm - 1:30 pm — Lunch (Illini Ballroom)

1:30 pm - 3:00 pm — Technical Session III (concurrent sessions)

Technology Updates (Fighting Illini Room)
Moderator: Phil Mankin, Illinois-Indiana Sea Grant

Yovanni Catao, University of Illinois at Urbana-Champaign
Laboratory Testing of a Vortex Flow Restrictor

Paul Horvatin, U.S. EPA Great Lakes National Program Office
Monitoring — U.S. EPA Great Lakes National Program Office Nearshore Monitoring Using the Triaxus Towed Instrument Platform

Robert Hudson, University of Illinois at Urbana-Champaign
Methylmercury Dynamics in Streams and Wetlands in Illinois and Indiana: Geochemical Survey and Method Comparison Results Obtained Using a Novel Analytical Method

Mostafa Noureldin, Illinois Institute of Technology
Biosolids Dewatering Using Super Absorbent Polymers

Watershed Scale Science (Golden Gopher Room)
Moderator: Bill White, Illinois State Water Survey

Walton Kelly, Illinois State Water Survey
Nitrate and Chloride in the Illinois River Basin

Ryan Jackson, US Geological Survey, Illinois Water Science Center
Density Currents in the Chicago River: Characterization, Effects on Water Quality, and Potential Sources

Erin Bauer, Illinois State Water Survey
15 Years of Hydrologic and Nutrient Monitoring of the Lake Decatur Watershed: Floods, Droughts and In Between

Julia Friedmann, Southern Illinois University Carbondale
Effects of Agricultural Land Cover on Water Quality at the Watershed Scale

3:00 - 3:15 pm — Closing Comments (Fighting Illini Room)
Richard Warner, Director, Illinois Water Resoureces Center

Richard Sparks

Where We Have Been and Where We Are Going: A Personal Retrospective and Outlook on Water Resources in Illinois

The six proceedings of the biennial Water Illinois conferences (including this year's) provide a 10-year history of major issues that have engaged the water community throughout Illinois. The very first conference (1998) now seems eerily prescient of our current concerns about terrorism, because the title of the featured presentation (by Dr. Yacov Haimes) was "The Risk of Willful Hazard to Water Infrastructure." Dr. Haimes urged advance planning to reduce vulnerabilities to either willful or natural hazards (storms, floods and droughts). The latter have been the subject of many presentations during the last 10 years. The 1998 conference had one paper on the after-effects on water and sediment quality of the Great Midwest Flood of 1993 and the second conference (2000) followed the drought of 1998-1999. The featured speaker in 2000 (Dr. Don Wilhite, Director of the National Drought Mitigation Center) argued persuasively for drought assessment, planning and management, something the Illinois State Water Plan Task Force, the Interagency Coordinating Committee on Groundwater, and the Water Survey took to heart. A second drought in 2005 stimulated many papers in the 2006 Conference and impelled the Governor to issue an executive order that speeded the development of plans for areas that were most at risk for water shortages and conflicts. The potential effects of climate change on water availability, irrigation use, and streams were addressed in just one paper in 1998, but are the subject of a Plenary Panel in this year's program, indicating growing concern about longer term trends.

On a par with water availability, water quality has been a persistent theme. The process of identifying surface waters in Illinois that are not attaining their designated beneficial uses, and then correcting the problem by developing total maximum daily loadings of contaminants that will be allowed in those streams has been going on for at least 10 years. This regulatory process has spurred research on sources and fate of contaminants and nutrients in watersheds, development of predictive models, and experimentation with treatment systems, including constructed wetlands. In the water realm below ground, concerns about natural and human-induced contamination, as well as concerns about depletion, have also spurred innovations in analytical techniques and predictive modeling.

Where are we going? It is likely that the effects of climate change on water resources will be increasingly discernable above the "noise" of annual variation. Evidence from Illinois includes: (1) increases in precipitation and river flows during the spring in the Illinois River basin when the past four decades are compared to the previous seven; (2) increasing abundances of some typically "southern" species of fishes, turtles, and amphibians; (3) some explanatory simulation models that predict wetter winter seasons, but the same or drier growing seasons. Implications are that we might see more frequent large floods, especially if we do not change the trend toward more impervious surfaces in rapidly-developing areas around our cities. Water will be the nexus among policies regarding climate change, energy, food, and land use. For example, some biofuels may reduce carbon emissions and our dependence on fossil fuels (effectiveness depends on whether corn or cellulosic feedstocks are used), but the water and land requirements may present problems (see the Plenary Panel II at this conference). We contribute to the downstream flows of nutrients and contaminants to the Gulf of Mexico and we are subject to continuing invasions of harmful species and fallout of toxicants from distant coal-burning plants. Our abilities to assess, validate, and enhance carbon uptake, contaminant reduction, and nutrient retention or conversion will continue to improve, and we'll see markets develop for these and many other ecosystem services. Although the Illinois water conferences will continue to focus on issues in our state, we will find ourselves increasingly connected with, and responsive to, the larger world.

Richard Sparks *(cont.)*

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In 1998, the outgoing Director of Illinois Water Resources Center, Dr. John Braden, and the incoming Director, Dr. Richard Sparks, formed a planning committee that organized the very first of the biennial Illinois Water Conferences. From 1998 to 2002, Dr. Sparks was Director of the Illinois Water Resources Center, Research Coordinator for the Illinois-Indiana Sea Grant College Program, and a faculty member in the Department of Natural Resources and Environmental Sciences at the University of Illinois in Urbana-Champaign. For 26 years prior to that, he directed the Illinois Natural History Survey's Large River Research Program on the Illinois and Upper Mississippi Rivers from the field station on the Illinois River at Havana. Dr. Sparks is currently the Director of Research, National Great Rivers Research and Education Center, Alton, Illinois, which is a partnership of the University of Illinois at Urbana-Champaign, Lewis and Clark Community College, the Illinois State Natural History Survey, and several other institutions and agencies concerned with river management and with education and research on rivers and watersheds. He co-authored "The Flood Pulse Concept in River-Floodplain Systems", a much-cited paper which described the role of seasonal flood cycles in maintaining the ecological structure and function of large floodplain-river ecosystems. He has served on several U.S. National Research Council committees, including the Committee on Restoration of Aquatic Ecosystems and the Committee to Assess U.S. Army Corps of Engineers Water Resources Project Planning Procedures. In Argentina, Brazil, India, and China he provided advice on management of floodplain ecosystems and large rivers.

Moderator: Timothy Feather

Dr. Feather is CDM's national water resources strategy leader. He focuses on development of interdisciplinary solutions to environmental challenges and has been involved in projects nationwide servicing federal and state water resource agencies with special planning and policy studies. Dr. Feather has supervised development of a range of projects including resource valuation, consensus-based watershed planning, environmental law review/assessment, outdoor recreation analysis, and water demand and conservation analysis. He is the current Illinois Section President of the American Water Resources Association and Chairman of the Environmental and Water Resources Planning Committee of the American Society of Civil Engineers.

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Claudia Emken

WRDA 2007—A 7 Year Quest for The Nature Conservancy

The Nature Conservancy is the single largest cost-share partner of the Corps of Engineers for its environmental restoration programs in regard to the number projects across the country. Two Conservancy projects along the Illinois River, Emiquon and Spunky Bottoms, are good examples of the rewards and challenges in working through complex federal processes. The Illinois River has been a priority for The Nature Conservancy since the early 1990s and since 1999, the Conservancy has partnered with the Corps of Engineers on these two floodplain restoration projects in Brown and Fulton counties. When the Conservancy entered into these partnerships with the Corps, we identified legal authorities under which to proceed and collaboratively began investigations and planning. In 2000, we identified the need for legislative changes in order to proceed with our Spunky Bottoms project, so we began working with our Congressional delegation to secure the correct language in WRDA. Thus began our seven year journey to get critical authorizations to proceed at Spunky Bottoms. In 2000, the Conservancy purchased nearly 7,000 acres in Fulton County, now called Emiquon Preserve, and a second partnership with the Corps was begun. And again we needed to seek legislative changes to proceed. Working on federal re-authorizations is not for the short-winded. After years of lobbying, the proper authorizations passed in WRDA 2007 and now we focus on appropriations to pay for the work authorized.

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Claudia Emken has been with The Nature Conservancy in Illinois since March 1997. She was first hired as Director of Government Relations and in 2007, was promoted to Associate Director of Conservation. In that capacity she supervises land acquisition, land conservation, and policy work for the chapter. She works directly on federal policy.

Emken's degree in political studies is from Sangamon State University (now University of Illinois, Springfield), class of 1993. She served as Constituency Liaison for the Illinois Department of Conservation/Department of Natural Resources from 1990 to 1997.

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Mr. Clark started his career as a civil engineer with the State of Illinois Department of Natural Resources, Office of Water Resources in 1974. On July 1, 2003, Mr. Clark was appointed as the Director of the Office of Water Resources. During his career with the Office of Water Resources, Mr. Clark has served as the Chief of the Planning and Research Section and as manager of the Division of Program Development. During his career, his areas of professional responsibilities included the administration and conduct of research and planning in the areas of instream flow protection, statewide water supply management, groundwater modeling, drought management, groundwater and surface water law and state water planning. Mr. Clark is a graduate of the University of Wisconsin, with a B.S. Civil Engineering in 1972, and a M.S. in Civil and Environmental Engineering in 1974. He is a licensed Professional Engineer in the State of Illinois and Wisconsin. In June of 2005 Mr. Clark was credentialed as a Diplomate, Water Resources Engineer by the American Academy of Water Resources Engineers.

Federal Water Resources Development Act: Illinois' Interest and Influence

The Water Resources Development Act (WRDA) is periodic federal legislation that authorizes the Corps of Engineers' programs and projects. WRDA is a very significant federal action that is closely monitored by all State Natural Resources Agencies under the leadership of DNR's Office of Water Resources. DNR's Office of Water Resources has actively worked on all WRDA's since the mid 1970's. This program for covering Illinois' interests and significant provision of WRDA's over the last three decades will be highlighted.

John Zimmerman

WRDA: What it is and what it can do for you.

An overview of how the Water Resources Development Act (WRDA) is formulated and approved will be provided, with particular commentary on what it is and what it is not. Highlights of WRDA 2007 will be provided as will discussion of what is being considered in WRDA 2009. Comments on WRDA and impacts in Illinois will be offered.

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A registered Professional Engineer and Surveyor in Kentucky and Tennessee, Mr. Zimmerman has been with the U.S. Army Corps of Engineers for the last 28-plus years, mostly with the Louisville District, Lakes and River Division and at Headquarters, Washington, D.C. on several long term assignments. At Louisville, he has served in a variety of positions as both a Military and Civil Project and Construction Manager. During this time he has managed and constructed more than $800 million dollars in improvement projects spanning Navigation, Flood Control, Ecosystem Restoration, Recreation and numerous Military programs.

Moderator and Speaker: Gary Clark

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Mr. Clark started his career as a civil engineer with the State of Illinois Department of Natural Resources, Office of Water Resources in 1974. On July 1, 2003, Mr. Clark was appointed as the Director of the Office of Water Resources. During his career with the Office of Water Resources, Mr. Clark has served as the Chief of the Planning and Research Section and as manager of the Division of Program Development. During his career, his areas of professional responsibilities included the administration and conduct of research and planning in the areas of instream flow protection, statewide water supply management, groundwater modeling, drought management, groundwater and surface water law and state water planning. Mr. Clark is a graduate of the University of Wisconsin, with a B.S. Civil Engineering in 1972, and a M.S. in Civil and Environmental Engineering in 1974. He is a licensed Professional Engineer in the State of Illinois and Wisconsin. In June of 2005 Mr. Clark was credentialed as a Diplomate, Water Resources Engineer by the American Academy of Water Resources Engineers.

Uncertainties and Challenges in Regional and Statewide Water Supply Planning and Management

There is great uncertainty in the future. Planning for water supplies to 2050 requires consideration of uncertainties in climate, geology, hydrology and a host of social and economic factors. The presentation identifies major uncertainties and associated challenges for regional and state water supply planning and management. The topics include climate change and drought, water demand, water availability, and the impacts of water withdrawals - all in the context of sustainability.

Allen Wehrmann

Water Supply Planning in Illinois – A Progress Report from the State Surveys

In January 2006, Governor Blagojevich signed Executive Order 2006-01, initiating a 3-year water-supply planning process for Illinois. Two regions were selected as pilot planning areas, an 11-county area in northeastern Illinois and a 15-county area in east-central Illinois. Other presentations in this session will discuss the activities of each region and their recently published water demand reports looking to 2050.

This presentation will focus on the results of the State Water and Geological Surveys' assignment to assess the impact of the published 2050 water demand scenarios on available water resources. The regional planning committees are awaiting the final piece to this planning puzzle before making their recommendations. Can the available water resources meet possible 2050 demands? An overview of the impacts of those water withdrawals on regional aquifers and surface water sources, such as the deep bedrock aquifers and Fox River in northern Illinois and the Mahomet aquifer and Sangamon River in east-central Illinois, will be provided.

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Allen Wehrmann began his career at the Illinois State Water Survey in 1977. As Head of the Water Survey's Center for Groundwater Science, Mr. Wehrmann oversees the research, data collection, and public service activities of approximately 20 scientists, engineers, and technical support staff. Allen earned a B.S. in Civil Engineering from Iowa State University, is a registered Professional Engineer, is a certified Professional Groundwater Hydrologist by the American Institute of Hydrology and is a Diplomate, Water Resources Engineer by the American Academy of Water Resources Engineers.

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Tim Loftus earned his doctorate degree in geography with an emphasis on water resources from Southern Illinois University Carbondale. As an environmental geographer, Dr. Loftus has served on the faculty at Eastern Kentucky University and as Director of the Water Quality Laboratory at Heidelberg College in Tiffin, Ohio. More recently, Tim joined the Northeastern Illinois Planning Commission in 2005. Now the Chicago Metropolitan Agency for Planning, he is involved in watershed planning efforts and is currently the project director for an 11-county regional water supply planning project and is crafting the region's first water supply plan expected in July 2009.

21st Century Water Conservation in Northeastern Illinois

Regional water supply planning, an outcome of Governor Blagojevich's Executive Order 2006-1, has been underway in northeastern Illinois for two years. One accomplishment to date has been completion of a regional-scale water demand study. The study indicates that water demand could increase as much as 64% by 2050 absent any new policy and program intervention.

The eleven-county planning region, home to 8.4 million people in 2000, is predominantly dependent on Lake Michigan; a source of water that is institutionally constrained. Nearly 20% of the region's population also relies on groundwater. However, the deep-bedrock aquifer is currently being dewatered and the shallow aquifer system is threatened by increasing contamination and other aspects of land-use change. Thus, it is apparent that a new vision for water supply/demand management is necessary.

The regional plan is due next summer, but will include fourteen water-use conservation measures that promise to be significant if implemented. A conceptual model is presented for ranking the measures and a scheme is offered for evaluating the efficacy of the measures that have been adopted. Measures include: 1) water survey program for residential customers, 2) residential plumbing retrofit, 3) system water audits, leak detection, and repair, 4) metering with commodity rates, 5) large landscape program and incentives, 6) high-efficiency washing machine rebate, 7) public information, 8) school education, 9) program for commercial, industrial, and institutional, 10) wholesale agency assistance, 11) conservation pricing, 12) conservation coordinator, 13) water waste prohibition, and 14) residential ultra-low flush toilet replacement.

Acknowledgment of regional heterogeneity with respect to legal doctrines governing water use, sources of water, housing density, and housing-stock age, will vary the mix of measures that are most appropriate for a given community. Demand scenarios for groundwater-dependent communities should lead them to an overall more robust response to regional water plan recommendations.

Moderator: Gregg Good

Gregg Good is Manager of IEPA Bureau of Water's Surface Water Section, overseeing development and implementation of inland lake, river/stream, Lake Michigan, and wetland-related Clean Water Act Section 305(b) monitoring and assessment activities.

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Dennis McKenna

Agricultural Nutrient-Reduction Alternatives and Costs

The USEPA Science Advisory Board Advisory Panel on Gulf Hypoxia concluded that a 45% reduction in both nitrogen and phosphorus loads to the Gulf of Mexico was needed to reduce the hypoxic zone to less than 5,000 square kilometers. In Illinois, TMDLs to address phosphorus impairments of reservoirs have called for reductions of nearly 90%. The costs to achieve these levels of reduction in nutrient loadings from agricultural non-point sources are likely to be billions of dollars.

The costs, whether in incentive payments for changes to management practices or for constructed management practices, are relatively constant for an acre of land treated. However, loadings of sediment and nutrients vary greatly across Illinois, within counties or small watersheds, and even from differing areas of fields. The most cost-effective strategies to achieve pollutant reduction will require targeting of the delivery and implementation of improved management practices.

Educational and incentive programs to encourage changes in nitrogen management practices will be most fruitful if they are targeted to tile-drained areas and erosion control practices are likely to be most efficient if they are targeted to fields contributing high sediment loads. Variable payment rates in financial incentive programs may also play a part in an effective strategy for nutrient reduction.

Because phosphorus is typically the limiting nutrient in freshwater systems and nitrogen is the primary limit on algal growth in the Gulf, state and local agencies face a difficult choice in designing programs to meet multiple, if not conflicting, goals. There are about 22 million acres of cultivated cropland in Illinois and with limited state and federal resources for technical assistance and cost-sharing, accurate targeting will be critical to achieving water quality improvements.

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Mr. McKenna provides scientific analysis and policy recommendations to the Director of the Illinois Department of Agriculture and the Manager of the Division of Natural Resources on complex water quality and quantity issues of national and statewide significance, including development of TMDLs, hypoxia in the Gulf of Mexico, pesticides and nutrients in surface water and groundwater, and groundwater withdrawals. He represents the State of Illinois as a member of the Coordinating Committee of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, the Upper Mississippi River Sub-Basin Hypoxia Nutrient Committee, and the Steering Committee of the Ohio River Sub-Basin Committee.

Mr. McKenna has a B.A. from Purdue University and a Masters degree in Soil Geomorphology from Northern Illinois University. He is a member of the American Society of Agronomy and the Soil Science Society of America.

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- B.S. Degree in Hydrology from the University of Arizona
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- USGS in Illinois since 1985.

I have participated on large regional and national scope projects (such as the National Water Quality Assessment program) as well as numerous small water-quality focused projects including:

- Evaluating nitrate transport in agricultural tile drainage
- Sedimentation of the Kankakee River
- Evaluating effectiveness of best management practices (BMPs) for water quality
- Continuous monitoring of dissolved oxygen and other physical parameters
- Monitoring agricultural and urban compounds in surface waters

Through an inter-agency agreement, I am acting as the Coordinator for the development of nutrient standards by the Illinois Environmental Protection Agency.

Nutrient Standards for Illinois Surface Waters - A Progress Update

The 1998 Clean Water Action Plan called for expanded efforts to address problematic levels of nitrogen and phosphorus in the Nation's surface waters. In response, the U.S. Environmental Protection Agency (USEPA) published recommended criteria for nutrients in 2000. The criteria were based upon reference stream conditions developed for USEPA's level III ecoregions. In preference to adopting the USEPA recommended criteria, the State of Illinois and most other states opted to develop state-specific standards for nutrients based upon environmental cause and effect relations among nitrogen and phosphorus concentrations, aquatic plant and algal growth, dissolved-oxygen characteristics, and biological community health. Consequently, the Illinois Environmental Protection Agency has been working to determine environmentally-relevant, scientifically-based criteria for nutrients. This work has included targeted research projects, expert workgroups, focused data-collection activities, and analyses of available data.

As of August 2008, consistent and predictable relationships between nutrient concentrations and environmental responses have not been able to be determined due, primarily, to confounding influences of habitat conditions, inorganic turbidity levels, and relatively high nutrient concentrations prevalent in Illinois streams and rivers. Consequently, correlative relations among nitrogen and phosphorus concentrations and biological-community measures that have been found to be useful in some other states are being evaluated for Illinois streams. Other alternatives to strictly numeric nutrient criteria are also being assessed. Development of nutrient criteria and subsequent adoption of nutrient standards for Illinois surface waters has taken longer than anticipated due to confounding environmental observations, however, it is anticipated that criteria will be finalized in 2009 and a petition for rulemaking on nutrient standards will be delivered to the Illinois Pollution Control Board by the end of 2009.

Nick Menninga

Costs of POTW Nutrient Removal in Illinois

In 2003, the Illinois Assocation of Wastewater Agencies retained Consoer Townsend Envirodyne Engineers to evaluate the costs associated with nutrient removal at Publicly Owned Treatment Works (POTWs) in Illinois. This presentation is a summary of the findings of that study.

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Nick Menninga is the General Manager of the Downers Grove Sanitary District in Downers Grove, Illinois. He has over 20 years of varied experience in the Water Environment Industry, including experience at the Illinois EPA, as a consulting engineer, and in POTW management. He is a Certified Wastewater Treatment Operator and a registered Professional Engineer in Illinois, and a Diplomate of the American Academy of Environmental Engineers.

Mark David

Overview of Nutrients in Illinois Waters from Sources to Downstream Contributions

Illinois is a major contributor of nutrients (nitrogen and phosphorus) to the Mississippi River, where they are transported to the Gulf of Mexico, causing seasonal hypoxia. Most of the nutrients in surface waters of the state are from agricultural production and wastewater treatment plants; greatly reducing either of these sources will be difficult. However, the USEPA Science Advisory Panel of Gulf Hypoxia recently concluded that 45% reductions in both N and P loads to the Gulf were needed to reduce the hypoxic zone to an acceptable size. This presentation will summarize nutrient sources, nutrient balances, the seasonality of loads, and the contribution Illinois makes to Mississippi River loads and the Gulf of Mexico. Two major points that will be the focus of the presentation are: 1) that the critical spring nitrate is primarily from agricultural fields, specifically tile-drained corn and soybeans, and 2) P sources are split between point sources (sewage effluent) and agriculture, requiring reductions from both. An overall conclusion is that in a state like Illinois with a large population (nearly 13 million) and extensively modified and utilized landscape (agriculture with tile drainage), major changes would be needed to greatly reduce stream loads of N and P.

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Moderator: David Larson

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Dr. Michael J. Plewa, University Scholar and Professor of Genetics, is Assoc. Head of the Dept. of Crop Sciences. He is a researcher at the NSF WaterCAMPWS Center in the College of Engineering, UIUC. Dr. Plewa has conducted research on water quality for over 20 years; he has 180 peer reviewed publications and has presented his work at the first Gordon Conference on drinking water DBPs. He has had appointments at Oak Ridge National Lab, NIH, Kyoto University (Japan), University of Bradford (UK) and was a Fulbright Senior Fellow at the Academy of Sciences of the Czech Republic.

Induction of Mammalian Cell Chronic Cytotoxicity and Acute Genomic DNA Damage by Drinking Water Disinfection Byproducts

Co-Authors: Elizabeth D. Wagner

In order to generate a quantitative, direct comparison amongst classes of drinking water disinfection by-products (DBPs), we developed and calibrated in vitro mammalian cell cytotoxicity and genomic DNA damage assays to integrate the analytical biology with the analytical chemistry of these important environmental contaminants. We quantita-tively analyzed individual DBPs from the major DBP classes and their rank order for cel-lular cytotoxicity and genotoxicity is haloacetamides; haloacetonitriles > halonitro-methanes > haloacetic acids > other haloacids > halomethanes. The generated data-base of over 65 DBPs demonstrates the universality of the comparative toxicity of iodo- > bromo- >> chloro-DBPs across different structural DBP classes and the substantially greater toxicity of nitrogen-containing DBPs (N-DBPs) compared to carbonaceous DBPs (C-DBPs). These results are important in light of the increasing occurrence of io-dinated-DBPs and N-DBPs resulting from the use of alternative disinfectants.

Teresa Chow

Evaluation of Analytical Methods for Pharmaceuticals and Personal Care Products

Co-Authors: Monte Wilcoxon

The United States Geological Survey began surveying 139 streams across 30 states (include Illinois, near Chicago area) in 1999-2000 and found 80 percent of water samples contained residues of pharmaceuticals and personal care products (PPCPs) which included prescription and over-the counter drugs; veterinary drugs, antibacteria soaps/detergents and cosmetics. The sources of PPCPs were mainly from human activity; residues from hospitals and nursing homes; veterinary drug use and livestock wastes. Conventional sweage treatment processes does not remove PPCPs completely and subsequent discharge of wastewater passes into surface water or ground water.

There is a great need for more laboratories to be able to analyze PPCPs at sub-ppb levels in surface waters and wastewater by solid-phase extraction (SPE) followed by high performance liquid chromatography with tandem mass spectrometry (HPLC/MS/MS). WMRC is developing methods to analyze 18 PPCPs that were selected based on the findings in Central Illinois surface waters near Bloomington (Caughey et al. 2007). They represent different types of antibiotics, antiepileptic, antimicrobial, analgesic, antiinfalmmatory and antacids.

The analyses of the PPCP compounds by SPE and HPLC/MS-MS will be developed based on the new EPA method (USEPA Method 1694, 2007) and other published papers (Hua et al. 2007, Ye et al. 2007). The goal is to develop one to two LC/MS-MS method (using both positive and negative ion modes) for the target analytes. Extraction efficiencies will be determined from both tapwater and surface water matrix. Quantitation using external, internal standard and isotopic dilution methods will be evaluated for accuracy and reproducibility.

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Since 1989, I have been a member of the Biological Sciences faculty at Eastern Illinois University, where I teach advanced courses in Freshwater Ecology, Advanced Limnology, Stream Ecology, and Phycology. I and my students have conducted research in first order and perennial streams, strip mine lakes, cooling water lakes, reservoirs and natural lakes. We have investigated abiotic factors affecting phytoplankton, zooplankton and benthic algal ecology, with a focus on utility of organisms for bioassessment of environmental perturbation. My lab has been supported by grants from federal agencies, state agencies, and municipalities.

Use of Photopigments as a Descriptor of Phytoplankton Assemblages

Co-Authors: Robert J. Krenz III

Biocriteria may be useful for monitoring the ecological health of Illinois reservoirs, and while similar efforts have been undertaken in other states, these focused primarily on lakes of glacial origin. Phytoplankton assemblages may prove to be the best candidate for this purpose because they are not stocked, they are readily sampled, and they are sensitive to environmental change. Whereas identification and enumeration of phytoplankton is time consuming and potentially biased by the relative skills of the analyst, photopigment signatures as determined by HPLC provide a more rapid and objective evaluation of taxa present in a given sample. Analysis of historical data available through Illinois Environmental Protection Agency (IEPA) by way of the Ambient Lakes Monitoring Program (ALMP) has enabled us to determine that Illinois lakes and reservoirs are best divided into three geographical regions. We have confirmed that specific genera of phytoplankton appear to respond to environmental gradients within each of the three regions. In addition, we have identified which lakes can be considered as “minimal impact reference” sites (relatively unimpaired) and which are stressed reference sites (highly impaired) in the context of relevant environmental data. We collected samples from 50 lakes and reservoirs throughout Illinois in summer, 2007 for determination of relevant environmental variables and photopigment concentrations. For all sites within a given region, we identify the photopigment metrics which offer the best discrimination between unimpaired and impaired reference sites. These preliminary efforts will be augmented with additional sampling during the 2008 index period.

Lewis Parish

GIS Mapping of Surface Discharge Septic Systems

This project will develop septic surface discharge pollution monitoring and evaluation in order to create a non-point source (NPS) septic system management program in Illinois. The project has two primary objectives: 1) help track, reduce, and prevent surface discharge septic system NPS pollution and 2) coordinate the efforts of the Illinois Department of Public Health (IDPH) and Illinois Environmental Protection Agency (IEPA). The project addresses a recent change of scope in the Clean Water Act (CWA) to classify septic systems as NPS polluters. The project will use innovative GIS techniques to mark the surface discharging units in Sangamon County. The IDPH would add this data to existing GIS layers mapping water wells, watersheds, and at risk areas. This combination of data would increase the ability of IDPH and the EPA to monitor NPS pollution and demonstrate NPS pollution needs in Illinois. The Department will work closely with IEPA and USEPA officials, Sangamon County Health officials, and other organizations with an interest in the project such as the University of Illinois school system, the Illinois Environmental Health Association, and local government officials. The project utilizes modern technology to improve the efficiency and capability of the agencies. This project requires GIS hardware, software and expertise; purchase of technology and training are necessary. Funding for the project may come from Clean Water State Revolving Funds (EPA) or the National Environmental Public Health Tracking Program (CDC)

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Moderator: Stacy James

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Stacy James joined Prairie Rivers Network in 2006. Her policy and outreach work focuses on nonpoint source pollution from urban and agricultural stormwater runoff, and she also coordinates Prairie Rivers' involvement in the Mississippi River Water Quality Collaborative. Previously, Stacy was a post-doc for the U.S.Geological Survey Columbia Environmental Research Center in Missouri, where she conducted research on the effects of contamination on aquatic organisms. Her dissertation at the University of Missouri assessed how amphibians respond to cadmium contamination in the aquatic and terrestrial environment. Before enrolling in graduate school, she worked all over the U.S. as a seasonal technician for bird, mammal, amphibian, reptile, and plant projects.

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Spatial Variability of Arsenic in Glacial Aquifers

Co-Authors: Steven Wilson

Recent research by the Illinois State Water Survey and others found that arsenic levels in private wells can be difficult to predict, even in areas where elevated arsenic levels are known to occur. Sampling to date has generally been over large areas, with sample points a kilometer or more apart, evaluated at a county or township scale. However, there was one cluster in which a well with 190g/L As was located 200-400m from wells with 2 and <0.5g/L As (the detection limit). In another cluster, two wells with <0.5 and 44.0g/L were on adjoining properties ~100m apart. In the present work, two sets of private wells were selected, in glacial aquifers where previous sampling has shown elevated arsenic in close proximity. In each area, the wells are all within a 1 kilometer square. The distance between wells is on the order of 10s to 100s of meters. Between 20 and 50 wells in each area are being sampled. Even on this smaller scale, arsenic concentrations ranged from undetectable to ~100g/L. The sampling results and their implications will be discussed.

Edward Mehnert

Refining Estimates of Shallow Groundwater Recharge Using Hydrologic and Geologic Information

Recharge is an important parameter for defining the quantity of water that is available from an aquifer, but it is a difficult parameter to estimate. Analytic element (AE) modeling offers a technique to estimate recharge for a watershed, based on steady-state, shallow groundwater flow and streamflow. Unique estimates of recharge and hydraulic conductivity (r/K) are possible if streamflow data are available. An AE model requires limited input data. Input data include hydraulic conductivity, aquifer thickness, recharge and heads within and around the watershed.

The Blackberry Creek watershed covers more than 70 square miles in southern Kane County and northern Kendall County, has more than 400 feet of relief and is similar to other watersheds in Illinois. It was selected for study because of its location in Kane County, low stream order, availability of streamflow data (USGS stream gages at Montgomery and Yorkville). The watershed is underlain by <25 to more than 200 feet of Wisconsin and Illinois Episode materials over Paleozoic bedrock. The watershed is mostly agricultural but has some urban areas.

An increasingly complex, AE model was developed to refine the estimate of shallow groundwater recharge based on the available hydrologic and geologic data. A solution including uniform groundwater recharge across the watershed was developed first. Other conceptual models of shallow groundwater recharge and groundwater flow were tested using AE flow modeling which incorporated three significant sources of data. These data sources included detailed geologic mapping, detailed streamflow data (data collected at 10 locations in June 2007), and potentiometric data for the underlying bedrock aquifer. Both estimates of recharge will be compared and discussed. The ramifications on land use planning for both estimates also will be discussed.

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Dr. Mehnert's current research focuses on the use of analytic element modeling to estimate recharge and refine geologic modeling. Also, he is involved with a project to demonstrate the feasibility of geologic carbon sequestration which includes the injection of 1 million tonnes of CO2 in a saline aquifer.

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William S. Dey graduated from the University of Illinois with a BS in Agricultural Engineering in 1984 and an M.S. in Civil Engineering in 1999. Since 1985, he has have worked at the Illinois State Geological Survey. His present position is geohydrologist in the Hydrogeology Section. His research interests include 3-dimensional mapping of groundwater resources, groundwater surface water interactions, and groundwater recharge.

Mapping The Mahomet Aquifer Beneath Champaign County, Illinois

Co-Author: Andrew Stumpf

The Mahomet aquifer and overlying Banner and Glasford aquifers are vital sources of water to municipalities, industries, and rural landowners of east-central Illinois. The demand for water in Champaign County is projected to increase two-fold over the next few decades. To assist in mitigating increased withdrawals and determine total water availability, the Illinois State Geological Survey has undertaken detailed 3-dimensional geologic mapping in northern Champaign County and adjacent areas to better understand the distribution of aquifers that contain important water supplies. Through this mapping, a more precise visualization of the subsurface geology will be possible that may identify interconnections between permeable units. These interconnections may affect recharge rates to the Mahomet aquifer. Reliable estimates of recharge are essential in determining sustainable groundwater withdrawals.

This mapping will utilize legacy geologic data collected when drilling private water wells and public water supplies. New stratigraphic borings will be made during the study where existing data is limited or does not provide enough detail about the subsurface geology. A nest of a least two observation wells will be installed where stratigraphic borings are drilled. Surface seismic surveys utilizing both P-wave and SH-wave techniques will be conducted to collect subsurface geologic data between stratigraphic borings. The P-wave method often provides more detail about the deeper geologic materials and the bedrock surface that is necessary to determine the bottom of the Mahomet aquifer. The SH-wave method better images the lower contrasting, near-surface sediments and complements the data collected from the P-wave method. Vertical seismic and natural gamma data will be collected in the observation wells to assist with calibrating the surface seismic data. Electrical earth resistivity surveys will be conducted at sites where shallow-lying sand and gravel are present and could constitute hydraulic connections with deeper aquifers. The 3-dimensional mapping should be completed in 2010.

Moderator: Steve John

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Steve John is the executive director of the Agricultural Watershed Institute, a nonprofit organization based in Decatur, Illinois. AWI's mission is to conduct research and educational programs on practices and policies to improve water quality, maintain or restore ecosystem health, and conserve and manage land and water resources in agricultural watersheds. Prior to AWI's formation in 2003, Mr. John was an environmental planning consultant specializing in watershed management, decentralized wastewater systems, and the links between land use and water quality. He has a BA in sociology from the University of Notre Dame.

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Water Use in Bioethanol Production

Dry grind ethanol production has grown at an exponentional pace in the US in last few years. It is expected that ethanol production in the US will reach 15 billion gallons by 2010. Several new dry grind ethanol plants are being sited at places where there is scarcity of water, causing water availability concerns for the local community. Reducing water requirements would help dry grind ethanol industry become more sustainable. To produce a gallon of ethanol, 3 to 4 gallons of water are required. Water in an ethanol plant is classified as either noncontact water or contact water. Noncontact water does not get mixed with corn and is used primarily in cooling fermentors and providing steam for the process. Contact water (also known as process water) gets mixed with corn and is used primarily for yeast propagation and scrubbing CO2 coming off the fermentors. Amount of contact water used in an ethanol plant is 20 to 22% of the total water used. Research is being conducted to reduce the amount of contact water by increasing the amount of slurry solids or by reusing water in the process. Engineering and consulting firm personal have proposed new designs that claim to reduce noncontact water use. Water balance in an ethanol plant, research conducted and new engineering designs to reduce water use will be presented.

Dr. Vijay Singh is an Associate Professor in the Department of Agricultural and Biological Engineering at the University of Illinois at Urbana-Champaign. His research is on development of novel fractionation technologies for corn dry grind ethanol and corn wet milling processes. Dr. Singh has authored 130 professional publications and holds five patents related to corn processing and ethanol production. He received his M.S. and Ph.D. in Food and Bioprocess Engineering from the University of Illinois at Urbana-Champaign. Dr. Singh is recipient of several research and teaching awards from professional societies, trade organizations and academic institutions.

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Allen Wehrmann began his career at the Illinois State Water Survey in 1977. As Head of the Water Survey's Center for Groundwater Science, Mr. Wehrmann oversees the research, data collection, and public service activities of approximately 20 scientists, engineers, and technical support staff. Allen earned a B.S. in Civil Engineering from Iowa State University, is a registered Professional Engineer, is a certified Professional Groundwater Hydrologist by the American Institute of Hydrology and is a Diplomate, Water Resources Engineer by the American Academy of Water Resources Engineers.

Water and Ethanol Production in Illinois

Over the last several years, there has been an explosion in the number of proposals for constructing ethanol production facilities across Illinois. A recent review of the Illinois EPA web-site (updated 7/23/08) lists applications for 49 air permits for 4.8 billion gallons/year of new ethanol production. How many, if any, of these plants actually gets constructed is highly speculative under current economic conditions.

However, of particular interest to the State Water Survey has been the impact these facilities may have on the state's water resources. Assuming 3-5 gallons of water are needed to make 1 gallon of ethanol, this will add 39-65 million gallons of water PER DAY to the state's water demands.

A review of the statewide demand for all water uses and how ethanol production may fit into this picture, Illinois water law, as well as a layman's explanation of how water withdrawals affect our aquifers will be provided.

Gregory McIsaac

Perennial Grass, Corn and Soybean Effects on Soil Moisture and Inorganic Nitrogen Leaching in Central Illinois

Corn and soybean production on tile drained lands contributes large quantities of nitrate to surface waters, which is a contaminant of concern for drinking water supplies and coastal eutrophication. Perennial grasses are likely to have lower leaching losses but may also alter stream hydrology due to their evapotranspiration characteristics. As part of an effort to evaluate bioenergy production potential and environmental impacts of Miscanthus and switchgrass, we measured soil moisture and inorganic N leaching from corn, soybeans, Miscanthus and switchgrass during 2005-07 at the University of Illinois South Farms. Soil water content was measured two to three times per week to a depth of one meter. Inorganic N fluxes (nitrate and ammonium) were assessed using ion exchange resin lysimeters buried at a depth of 50 cm. Nitrate and ammonium leaching from corn-soybean was 35 to 50 kg N/ha/yr compared to less than 10 kg/ha/yr for the perennial grasses. Thus, widespread conversion of tile drained land from corn-soybean production to switchgrass or Miscanthus would decrease inorganic N leaching losses to surface waters. Soil water content in the perennial grass plots was less than in corn or soybeans early in the growing seasons. This could result in reduced spring flood flows if switchgrass or Miscanthus were planted on large areas. At the end of the growing season, soil moisture under Miscanthus was less than all other crops. Differences were relatively small in 2005 (a relatively dry year) but were considerably larger in 2006 and 2007. The increased water use by Miscanthus late in the growing season is more likely to extend the duration and severity of stream low flow periods in the late summer and fall, which could have negative consequences for surface water supplies and aquatic communities.

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Gregory McIsaac earned a PhD in agricultural engineering at the University of Illinois and taught courses in soil and water conservation in the Departments of Natural Resources and Environmental Sciences and Agricultural Engineering. The research in this presentation was conducted in collaboration with Professor Mark David and Mr. Corey Mitchell who are both affiliated with the Department of Natural Resources and Environmental Sciences. Funding for the research was provided by the Illinois Council on Food and Agriculture Research.

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Mr. Riber has worked in financing and accounting roles for several firms and industries in the Central Illinois area for more than 25 years. Currently, Mr. Riber is the Director of Finance for Aventine Renewable Energy, Inc. in Pekin, Illinois with ethanol production facilities located in Pekin, Illinois and Aurora, Nebraska.

Ethanol Production & Water Usage

How much water is used in ethanol production and how is the water processed?

Moderator: Jim Angel

Jim Angel has been with the Illinois State Water Survey since 1984 and has studied droughts, floods, rainfall patterns, extreme rainfall events, storms, El Niño, La Niña, and climate change across Illinois and the Midwest. He has been the Illinois State Climatologist since 1997. Besides being involved in a wide range of applied research, he spends time providing climate information and data to a wide variety of users across Illinois.

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Joseph Kozak

The Energy and Carbon Footprint of Wastewater Treatment and Waterway Management in Greater Chicago

Co-Authors: Kuldip Kumar, Catherine O'Connor, Thomas Granato

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) treats roughly 1.2 billion gallons per day of wastewater during dry weather at seven treatment plants throughout Cook County, Illinois. Treatment is conventional secondary treatment at the largest plants, which discharge to secondary contact waters, and tertiary treatment at plants that dis-charge to general use waters. This presentation will detail the energy and resulting carbon foot-print associated with treating water at these different plants. Included in the presentation will be the energy used to manage the Chicago Area Waterways, an outline of the water consumed by facilities that produce electricity in the MWRD service basin, and the results of efforts to quantify fugitive emissions of methane and nitrous oxide.

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Impact of Climate Change on Crop Yield — A Case Study of Rainfed Corn in Central Illinois

Co-Authors: Dingbao Wang

Today the changes in weather risk factors for agriculture at the local level still remain highly speculative. Among the various reasons, the following two are notable: 1) regional and local climate change remains uncertain; 2) the intra-season weather variability at the local scale is not clear. This paper presents a systematic downscaling approach to assess uncertainties in climate change projections and intra-season weather variability and incorporate the assessment into the generation of probability distribution of crop yield, by which we estimate the risk of crop yield loss due to climate change. The approach is applied to Central Illinois, the heartland of the Corn Belt to exploit the impact of possible climate changes on crop yield around year 2055, from a soil water balance perspective. The results show that significant intra-seasonal variance may occur with the change of temperature, precipitation, and solar radiation in the region. A drier and hotter summer during the corn growth season and wetter and warmer pre- and post-crop seasons will likely occur, which can cause soil water deficit levels to increase significantly in the flowering and yield formation stages, resulting in more variable and vulnerable rainfed crop yield in 2055 than at present. We find that the mean rainfed corn yield in Central Illinois in 2055 is likely to decline by 13 - 21% and the yield may come out below 50% of the potential yield at a probability of 32 - 70%, if not taking any adaptation measures. This indicates a high risk.

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Future Climate Change Scenarios for Lake Michigan Levels

The climate scenarios for the Great Lakes region from multiple Global Climate Models (GCM) using three emission scenarios were employed to estimate possible future levels of Lake Michigan using the lake-level model developed by the Great Lakes Environmental Research Laboratory (GLERL). The first step was to use the changes in relevant climate variables such as temperature, precipitation, humidity, wind speed, and solar radiation from the GCM model runs to adjust the present-day climatology (1970-1999) of the Great Lakes basin. Next, these adjusted climate 'states' were introduced into the GLERL model to compute the expected water levels for each of three 30-year periods (2005-2034, 2035-2064, and 2065-2094). Between 18 and 23 GCM's were used in this project - the number varied depending on their availability for each particular scenario. In many cases, multiple runs were made for each model with slight adjustments in their initial conditions. A total of 160 model runs were used for the A2 scenario, 211 for the A1B scenario, and 194 for the B1 scenario. The model scenarios should be considered as having an equal, but unknown, probability of occurring across the range of the distribution. While the median values from all three emission scenarios showed a decrease in Lake Michigan water levels, there was a considerable range in the results – including cases of increasing water levels in some model runs.

Moderator: Phil Mankin

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Balancing Irrigation and Instream Water Requirements under Drought Conditions: A Study of Kankakee River Watershed

Recently, ISWS has listed the Kankakee watershed as one of the priority areas to be studied for long-term water supply planning. There, the Silurian dolomite aquifer is a major source for irrigation in Northern Iroquois and Kankakee River areas. During drought conditions farming activities have induced peaks in the pumping requirements. As a consequence, lowering of the water levels in the overlying sand and gravel aquifer occurred during the 1987-1988 droughts, adversely affecting several domestic wells in the area. During this same period, it was also observed that irrigation pumping adversely impacted baseflow in the Kankakee River, which has a spatially variable direct hydraulic connection with the Silurian dolomite due to the varying thickness of the overlying formations. Evaluation of this spatial variability is needed to explore the tradeoffs between irrigated agriculture and instream low flow demands in this particular human-nature interaction system.

A numerical groundwater model is being developed in order to gain a better understanding of the coupled river-aquifer system. Modeling efforts to date have incorporated many of the complexities seen in the real system. The geology database at the Center for Groundwater Science, ISWS, has been utilized for model construction at the regional scale. USGS gauge stations provide the time series of the streamflow in the Kankakee River. Pumping records for irrigation during the drought periods in 1987-1988 account for human impact on the dolomite aquifer. These datasets have been integrated using Geographic Information System (GIS), ArcGIS 9.2 software to organize and improve the conceptual model components. MODFLOW 2000 has served as the main tool during the 3D numerical modeling analysis. River and stream packages accounted for surface-groundwater interaction. In our future work this model will be used to evaluate management strategies to minimize the impacts of irrigation during drought conditions.

Jorge Abad

Linking the Detailed Physical Understanding of Meandering Channels into the River Restoration Framework

Co-Author: Marcelo H. Garcia

A sound understanding of river planform evolution and bank erosion control, together with the integration of expertise from several disciplines (engineering, geomorphology, ecology, among others), is required for the development of predictive models for river naturalization. Both basic research and applications are needed to cover the wide range of spatial- and time-scales found in rivers.
Meandering rivers migrate along the floodplain describing amazing morphodynamics features such as double heading, scroll bars, and upstream- and downstream-valley bend orientations. The prediction of these features is still unresolved, therefore not allowing their direct integration into the river restoration framework. Among the so-called “detailed understanding”, this study concerns to the hydrodynamics and morphodynamics of high-amplitude meandering rivers, where emphasis is put into the effect of bend orientation on the hydrodynamics and morphodynamics of transitional meandering channels. Meander bends oriented downstream valley tend to produce fully developed secondary flows, more developed bedforms along the bend, higher shear stresses along the bed and banks, thus higher erosional power and higher bend migration rates as their counterparts at upstream valley orientation cases. Overall this research explains the details of the hydrodynamics and morphodynamics at transitional channels, which is of great importance for geological studies and river restoration (e.g. projects involving instream structures for bank erosion control).

Finally, some examples of potential combination of basic research coupled with engineering applications are discussed in order to improve the prediction of morphodynamic features and planform migration of meandering rivers, the design criteria of in-stream structures taking into consideration not only hydraulic and morphologic parameters but also the impact of such structures on stream ecosystem.

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Jorge D. Abad obtained both the MS and PhD at the University of Illinois at Urbana-Champaign under the guidance of Prof. Marcelo H. Garcia. His work at the Hydrosystems Lab was mostly dedicated to understand the hydrodynamics and morphodynamics of high-amplitude meandering channels were both experimental and numerical simulations were used. The key component of his research was to describe the effects of having bends oriented upstream or downstream valley into the evolution of meandering channels. It was concluded that bends oriented downstream valley may produce higher migration rates than bends oriented upstream-valley, which may infer that the former ones could migrate more rapidly along the floodplain. Among his current research interests are not only the study of reach-scale processes but also the details of flow (mean and turbulence) structure around bedforms and their influence on the overall hydrodynamics and most importantly the combination of basic research and engineering applications for river naturalization purposes.

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Illinois StreamStats — A Basin Characteristics and Flood-peak Frequencies Determination Tool

Co-Authors: Audrey L. Ishii, Jennifer B. Sharpe

The presentation will report on the results of the analyses and procedures used in the development and evaluation of the Illinois StreamStats, a GIS tool for determining drainage basin characteristics and flood-peak frequencies.

Streamflow statistics such as flood-peak discharge frequencies have broad engineering and scientific applications, including flood-hazard mitigation planning, hydraulic-structure design, and the management of water resources. Streamflow records are essential for deriving reliable flow statistics, but the records represent site-specific information, whereas the need for such information is region-wide. In order to transfer streamflow statistics information regionally, the U.S. Geological Survey (USGS) has developed regional regression analysis techniques that result in regional flood-frequency equations for estimating streamflow statistics at rural drainage basins. The regional equations relate basin characteristics determined for gaged watersheds to flood-peak frequency characteristics at the gage. In order to apply the equations at ungaged sites, the basin characteristics must be determined for ungaged sites, a process that has historically been time-consuming, difficult, and potentially inconsistent. The StreamStats application was developed by the USGS in cooperation with Environmental System Research Institute (ESRI) to address the need for quick and reliable basin characteristic and peak flood-discharge frequencies at ungaged sites. The application includes an Internet Map Server user interface, processed geospatial data including a hydrocorrected 30-meter Digital Elevation Model and base-map data, a streamflow statistics database, automated processes for computing drainage basin characteristics at any stream network location, and an integrated program for computing the peak flood-frequencies utilizing the regression equations and the computed basin characteristics. The Illinois StreamStats can be accessed through URL: http://streamstats.usgs.gov and selecting State Applications.

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Andrea is a second-year PhD student at the University of Illinois at Urbana-Champaign working with Professor Barbara Minsker. She graduated with a Bachelors in Civil Engineering and a Masters of Science in Civil Engineering, with a focus on urban flood control, from Rice University in Houston, Texas. Her work at UIUC involves analyzing the spatio-temporal and management dependencies of combined sewer overflows in Chicago in order to better inform operational strategies to prevent overflows.

Critical Rainfall and Infrastructure Dependencies as CSO Triggering Thresholds

Co-Authors: David Hill, Barbara Minsker, Arthur Schmidt, Avi Ostfeld, Murugesu Sivapalan

Severe rainfall events in Chicago that exceed downstream sewer capacity lead to basement flooding and combined sewer overflows (CSOs). Events caused by excess precipitation can be modeled as threshold processes triggered when rainfall exceeds a certain intensity or volume. Over 300 combined sewer outfall points exist within the service area of the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC). This research models CSO events as threshold processes activated after excess rainfall has exceeded overland depression storage, soil infiltration, and sewer capacity. CSOs are considered as an alternative hydraulic pathway to basement flooding.

The Tunnel and Reservoir Plan (TARP) was designed to prevent CSOs by directing potential overflows into the deep tunnel system. Many connections to the tunnels include sluice gates that allow control of TARP inflows. Operator decisions to open or close gates at certain outfalls are correlated to predefined threshold tunnel levels and have the potential to introduce management triggered CSOs.

Spatio-temporal analysis of reported CSO events from November 2004 to December 2007 identified time periods and locations that exhibited high CSO event frequency. Critical storm characteristics and excess rainfall pathways within each sewershed can be more explicitly identified with a cell model. The cell model assumes a linear conversion of excess rainfall to runoff and a linear transformation of channel flow. A reservoir constant, a channel time delay, and a routing coefficient are used to calibrate the model to flows at monitored drop shafts. The sensitivity of these parameters to sewershed characteristics is used to identify critical state points. The cell model has been chosen for threshold modeling over a more physically descriptive model because it enables identification of critical hydraulic pathways invoked by threshold processes for more complex future modeling.

Future work will evaluate storm statistical properties and decisions that instigate CSOs in an effort to distinguish the subset of CSO-triggering events from typical storms and operational strategies.

Moderator: Glynnis Collins

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Glynnis took over the leadership role as Prairie Rivers Network's Executive Director in July. Previously one of PRN's Water Resources Scientists, she is well versed in the Clean Water Act and permitting issues having worked for many years at the San Francisco Bay Regional Water Quality Control Board, dealing with 404, 401, and NPDES permits and TMDLs. She also has experience in watershed-based ambient water quality monitoring and has done research into the fate and transport of nitrogen in water. She has worked with permit applicants, advocacy groups, municipalities, and local citizens; all of whom we communicate with in our clean water work on a regular basis. Glynnis has a B.S. in Environmental and Forest Biology and M.S. in Biology.

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Stakeholder Visions of Community and Environmental Health in the Lower Kaskaskia River Watershed

Co-Authors: Mae A. Davenport, Erin L. Seekamp, Joan M. Brehm

Community planners and managers are facing increased pressures to address the impacts of growth and development patterns on water resources. Urban and suburban sprawl have been linked to problems such as increased flooding and high concentrations of water pollutants in watersheds (Tu, Xia, Clarke, & Frei, 2006). Sustaining a healthy community depends on both a shared vision for the future of the community among residents and leaders, as well as a capacity to realize that vision, or to respond to threats. This study uses an interpretive research approach to better understand the perspectives of stakeholders in four southeastern Illinois communities within the lower Kaskaskia River watershed. Driving research questions are (1) How do diverse stakeholders define a healthy community and natural environment, (2) To what extent do stakeholders perceive their communities to be healthy, and (3) What is the capacity of the communities to address threats. In-depth interviews were conducted with diverse stakeholders including community planners and managers, natural resource professionals, business owners, and environmental advocates. Growth and stormwater management were identified as major concerns of stakeholders. Preserving quality of life and the rural character of the communities were also significant themes. Understanding the visions of community health of diverse stakeholders, as well as their perceptions of capacity needs, will provide natural resource managers and community leaders with valuable insight for integrated community and watershed planning.

Barbara Minsker

Harnessing the Power of Sensors and Cyberinfrastructure Towards Environmental Sustainability: The WATERS Network Vision and Testbedding Research in Illinois

Co-Authors: Praveen Kumar, Jim Myers, Don Wuebbles, and the WATERS Network Design Team

The WATERS Network (http://watersnet.org) is a National Science Foundation environmental observatory initiative whose goal is to understand and predict the multi-scale processes coupling water with Earth and human systems. Research enabled by the WATERS Network will provide the basic knowledge needed to understand, engineer, manage, and set policy for water resources systems and infrastructure that are critical for life and society. This talk will provide an overview of the national WATERS Network vision; science, education, and outreach agenda; and current status and plans.To assist with identifying needs and potential research outcomes from WATERS Network observatories, testbedding activities are underway in various locations around the U.S. This talk will highlight ongoing research and infrastructure activities to scope a WATERS Network observatory in Chicago under the Adaptive Environmental Sensing and Information Systems (AESIS) Initiative. Activities range from creating a prototype digital watershed and stormwater management information system, quantifying the value of new sensors and streamgauges, using storm drain sensors to study the hydrologic causes of West Nile Virus, creating hydrologic models that include the effects of human influences, and studying water demand and the causes of combined sewer overflows.

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Amy Ando is Associate Professor in the Department of Agricultural and Consumer Economics, UIUC. She works primarily on problems of species and land conservation, with publications in outlets such as Science, the Journal of Jaw and Economics, and the Journal of Environmental Economics and Management. She has also studied topics related to environmental policy and political economy such as enforcement of natural resource damage liability statutes and the determinants of household recycling behavior.

Adoption of Green Technologies: The Case of Chicago Rain Barrels

Co-Author: Amy Ando

The hydrological disruption caused by urban areas can be greatly reduced if households choose to adopt and maintain a wide range of green technologies such as decentralized stormwater control technologies and water-saving plumbing fixtures. Government agencies can use education and incentive programs to encourage households to make those choices, but little is currently understood about how households will respond to such programs. We study the City of Chicago's heavily subsidized rain barrel program to explore what factors influence household purchases of rain barrels, what spatial pattern of rain barrel adoption is likely to result from program expansion, and what steps the City could take to increase the impact of the program.

We combine census and voting data for the Chicago area with spatial data on rain barrel adoption for years 2004, 2006, and 2007. We explore the spatial characteristics of rain barrel adoption, and apply techniques of multivariate regression analysis to evaluate the importance of economic and ideological factors in rain barrel adoption. Further, we analyze variables developed with GIS analysis to determine if geographical phenomena play important roles; for example, whether one is more likely to adopt a rain barrel if a neighbor owns one, whether distance from a distribution center affects adoption tendency, or whether the presence of other City projects, such as Green Alleys, affect one's decision.

Two different strains of economic research inform our analysis of rain barrel adoption patterns. The first is the technology diffusion literature, which studies the factors that underlie the deployment and spread of new technologies. The second is the spatial sorting literature, which describes how people settle in areas with other individuals who share their own preferences over goods and services. Each of these may play a powerful role in shaping our observed data; econometric techniques help differentiate between them.

Patrick Mills

Estimating Water Use in Illinois — Present Realities, Future Visions

Co-Authors: Tim Bryant, Illinois State Water Survey

Estimating annual water use in Illinois has been undertaken periodically as part of various local, State, Federal, and international efforts. Ongoing efforts include those by the East-Central and Northeastern Illinois Water Supply Planning Committees for the development of future (to 2050) demand scenarios and by the U.S. Geological Survey (USGS) to compile nationwide estimates of use in 5-year intervals (2005 in review). As part of these efforts, the USGS, Illinois Water Science Center has worked closely with the Illinois State Water Survey (ISWS) through their Illinois Water Inventory Program to provide county level withdrawal estimates for various sectors of use.

Water withdrawals are reported voluntarily to the ISWS for public-supply and self-supplied industrial/commercial use. These reportings form the basis of withdrawal estimates by the USGS for these sectors of use. Coefficient-based methods are used by the USGS to estimate self-served domestic-supply, irrigation, livestock, mining, and aquaculture use. Estimates of thermoelectric-power withdrawals are derived from water-use data reported to other Federal agencies and the USGS. Coefficient-based estimates often are supplemented with appropriate data available from the ISWS. Information exchange between the USGS and ISWS, including consensus-based discussions regarding methodology, are an integral part of improving estimates to the extent possible.

In Illinois, the accuracy of these estimates is hampered by dependence on voluntary reporting and the use of coefficient-based methods that may of necessity be based on older data. This presentation will address current methods employed for estimating water use; limitations and relative uncertainties associated with the estimation methods and quantifications of use; and visions for improving future estimations. The good news is present water-withdrawal estimates for most large-use sectors are considered reasonably accounted for and useful as the basis for regional water-supply studies. There remains, however, a recognizable need for improved accuracy in estimating water use for all sectors of use.

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Moderator: Thomas Holm

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Sediment Issues in Illinois

Co-Authors: Gary Johnson

Reservoir and stream sedimentation, stream erosion and rehabilitation, and dam removal are but a few of the sediment issues facing Illinois water-resource managers. Streamflow and sediment load data are needed to establish baseline information for water-resource managers to evaluate historical and current conditions, and plan management alternatives. The U.S. Geological Survey Illinois Water Science Center (USGS), in cooperation with several agencies, monitors sediment concentrations at 17 of the 180 USGS streamgages in the State. Some sites have as many as 28 years of continuous streamflow and sediment data. However, systematic data collection has been declining in recent years because of budgetary constraints of several agencies. The amount of water and sediment delivered in streams is affected by many natural and human factors that are constantly changing. Long-term streamflow- and sediment-monitoring stations are crucial for providing the requisite data to evaluate the effects of these factors. Hence, thoughtful and effective management of water and sediments is predicated on the continuous operation of a well-designed streamgaging network with a subset of sediment-monitoring sites in Illinois. This presentation will highlight the utility and limitations of the USGS sediment-monitoring sites in helping water-resource managers address sediment issues in Illinois.

Charnsmorn Hwang

Effects of Urbanization on Water Quality in the Lower Kaskaskia Watershed in Southern Illinois

Co-Authors: Julia D. Friedmann, Karl W.J. Williard, Jon E. Schoonover

Increased watershed urbanization can drive significant changes in stream hydrology, water quality, and biotic integrity. This study focuses on the effects of land use, including urbanization, on water quality (total suspended solids, nitrate, ammonium, orthophosphate, and fecal coliform populations) and hydrology in the Lower Kaskaskia watershed. Based on delineation of the Lower Kaskaskia watershed and two of its major contributing tributaries, Richland Creek and Silver Creek, forty-five catchments ranging from 12 km2 to 50 km2 were identified as study watersheds. Stream grab samples from the catchments are being collected every two weeks from January 2008 until October 2009 for water quality analysis. Stream gauging stations with automatic water samplers are being installed on four of the catchments to measure discharge and estimate loads of the water analytes. Preliminary findings suggest that catchments in Silver and Richland Creeks have elevated levels of orthophosphate and fecal coliform levels in baseflow (3.185-0.806 and 1.904 - 0.311 mg L-1; and 1359 - 540 and 1451 - 315 FCU, respectively). These fecal coliform levels exceed Illinois EPA fecal criteria of 400 FCU for full body contact. Baseflow ammonium levels in Silver and Richland catchments were 0.668 - 0.186 and 0.833 - 0.223 mg L-1, and total suspended solid concentrations at baseflow were relatively low, as expected. Different watershed and landscape metrics, such as land use percentage, impervious surface area, and riparian vegetation continuity, will be examined through stepwise regression procedures to determine which variables are the best predictors of the individual water quality parameters. Also, the developed water quality database will aid the targeting of current and future watershed planning and restoration efforts in Silver and Richland Creek watersheds.

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Dr. Kovacic is an associate professor in the Department of Landscape Architecture at the University of Illinois (UIUC). His work has involved a holistic approach to the study of habitat disturbances (e.g., fire, insect outbreaks, forestry, and agriculture) and their effects on biogeochemical cycling. His current research focuses on the use of riparian ecosystems, including buffer strips and constructed wetlands, to reduce pollution entering Illinois surface waters. He is interested in applying these methodologies as a solution to Gulf Hypoxia and in the development of sustainable agro-ecosystems.

Constructed Wetland Size Requirements for Effective Nutrient Removal in Agricultural Watersheds

Co-Authors: Maria Lemke, Michael Wallace, Krista Kirkham, Tim Lindenbaum

Rapid transport of subterranean tile drainage from Illinois agricultural fields results in high nutrient loading to surface waters. Nitrogen (N) and phosphorus (P) laden water increases eutrophication, lowers habitat quality, contaminates drinking water reservoirs, and ultimately increases hypoxia in the Gulf of Mexico. Nearly 25% of the N entering the Gulf of Mexico originates from Illinois agricultural fields. Our current research is designed to determine the area of farmland that should be converted to wetlands to effectively reduce agricultural nutrient loading to surface waters. We have worked with landowners to develop a 250-acre demonstration farm with 3 tile-drained wetland units, each consisting of a series of three wetland subunits that cover 3-9% of the surrounding farmland. Automatic sampling units at inlets and outlets of the 9 wetland subunits quantify flows and collect water samples. Samples are used to determine nutrient budgets for each wetland unit. From January to December 2007 the constructed wetlands received a total 357 kg of NO_3-N and removed 211 kg or 59% of the N load. Preliminary results from individual units show that wetlands covering 3% of the contributing watershed removed 32-67% of the tile drainage NO_3-N. Wetlands covering 6% and 9% of the contributing watershed removed 38-82% and 47-90% of the tile drainage NO_3-N, respectively.

Moderator: Phil Mankin

Dr. Mankin is the Research Coordinator for the Illinois-Indiana Sea Grant College Program, located at the University of Illinois, Urbana. As a researcher for many years with the University of Illinois, Dr. Mankin has studied the interaction of human activity and wildlife from many perspetives. In urban and agricultural settings, he explores relationships between ecosystems and land use management. In his role as Reasearch Coordinator, Mankin developes research partnerships and collaborative funding opportunities, as well as optimize impacts from research projects.

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Biosolids Dewatering Using Super Absorbent Polymers

Co-Authors: Paul Anderson, Fouad Teymour

Super absorbent polymers “SAP” have the ability to absorb water and to form gel particulate chunks. It can absorb from several tens to several hundreds from its own weight. It is already been used in various applications such like diapers. A study has been carried on these polymers to evaluate rate of absorption and water storage ratio. Most importantly another study to release water from gel formed from polymers took place through electrical current passing through gel body. Results of water capture from gel were significant. Furthermore SAP recycling is possible and was reused for up to 20 times. Believing this procedure is promising to other several applications; in this paper we are presenting the ability of SAP to dewater biosolids considering parameters such as solid content, particle size, and particle charge. Other factors are included in the study such like membrane pouches that contain the SAP so to allow the gel to form in the membrane thus to increase solid content in the wastewater. Sustainability occurs when SAP is regenerated after water has been released and recycled polymer is used several times in the process. Consequently improve the biosolids dewatering process.

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Monitoring — U.S. EPA Great Lakes National Program Office Nearshore Monitoring using the Triaxus Towed Instrument Platform

Co-Authors: Jacqueline Adams

Nearshore monitoring is an important factor in assessing the ecosystem health of the Great Lakes, but it often presents a challenge due to the limited availability of research vessels and difficulty in surveying the extensive (>10,000 miles) shoreline. The U.S. EPA Great Lakes National Program Office (GLNPO) recently acquired a Triaxus 3D towed undulating vehicle that will be deployed from the R/V Lake Guardian in all five Great Lakes in waters as shallow as 20m to gain more insight into nearshore water quality and habitat characteristics. This state of the art towed instrument platform will provide real-time multiparameter profile data of the nearshore water column over a large shoreline distance as well as supplement the GLNPO open water surveys. Details of the Triaxus specifications, the various sensors it will house, preliminary sampling locations, and opportunities for Lake Michigan nearshore work will be presented.

Yovanni Catano

Laboratory Testing of a Vortex Flow Restrictor

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Flow restrictors are devices installed at inlets of storm drain catch basins to limit the peak flow entering a Combined Sewer System (CSS). Excess runoff is temporarily stored on the street surface and enters the system at either the inlet location at a controlled rate or through a more downstream structure. The volume of on-street storage is governed by the capacity of the static flow device used for restriction as well as surface drainage patterns. The vortex restrictor limits flow by forcing flow through a helicoidal chamber followed by sudden expansions and contractions that creates high internal turbulence. The high turbulence produced in a vortex restrictor limits flow rates much more than a simple orifice, while maintaining a relatively large flow opening that can reduce the chance of clogging. The vortex restrictor is elevated off the bottom to allow room for debris accumulation. Hydraulic tests were conducted with a vortex flow restrictor (Type I) as well as a modified version in which the vortex chamber has been removed (Type II). Discharge coefficients are calculated for the tested flow restrictor configurations and are compared to the case in which no flow restrictor is used.

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Methylmercury Dynamics in Streams and Wetlands in Illinois and Indiana: Geochemical Survey and Method Comparison Results Obtained Using a Novel Analytical Method

Co-Authors: Brian Vermillion

A novel method for analyzing methylmercury (MeHg) has been developed at the University of Illinois and tested in geochemical studies conducted in the Grand Calumet watershed (at the southern tip of Lake Michigan in northwestern Indiana) and in the Piasa Creek watershed (near Alton, Illinois). The analytical system, which was developed with the intent of reducing the analytical costs for Hg studies, performed well and these field studies demonstrate that the method is viable for large scale studies. Together, the results from an intercomparison of dissolved MeHg measurements from a lab using speciated isotope dilution with distillation/ethylation method, a variant of the standard USEPA Method 1630, and the coherent geochemical patterns observed in our studies strongly support the validity of the new analytical system and sample processing methods.

The Grand Calumet watershed has been designated a Great Lakes Area of Concern, in part due to the legacy Hg contamination in its streams and lacustrine wetlands. In order to characterize Hg pollution within the watershed, a survey of MeHg in water, sediments and fish was conducted in ~30 lacustrine wetlands during the summer of 2006. In addition, a seasonal study of MeHg in water and sediments of 9 wetlands, one of which is a restored system, in INDU and the Grand Calumet was conducted in 2007.

Piasa Creek watershed is impacted by Hg emissions from industries in the St. Louis area in addition to the regional background deposition. Observed MeHg levels in water samples collected monthly at 12 sites within the watershed were well correlated with DOC. The levels of MeHg in water and biota were surprisingly high compared to the bulk of the reported values for Illinois.

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Nitrate and Chloride in the Illinois River Basin

Co-Authors: Samuel Panno, Keith Hackley, Hue-Hwa Hwang

A two-year investigation was conducted to investigate the sources and fate of nitrate (NO_3-) and chloride (Cl-) in the Illinois River Basin. Water samples were collected on 13 occasions from 14 locations, 9 in the Illinois River, 2 in the Des Plaines River, and one each in the Sanitary & Ship Canal, Fox River, and Sangamon River. Samples of potential sources, including treated wastewater (TWW), road salt runoff, precipitation, and tile drain water, were also collected.

The Des Plaines River and the Sanitary & Ship Canal in Chicago had relatively high concentrations of nitrogen species and NO_3- isotopic data indicative of TWW. Downstream of Chicago, the isotopic signature shifted as increasing amounts of agriculturally derived nitrogen entered the river. The TWW signature was evident downstream at least as far as Pekin during most of the year and to the Mississippi River during low flow. There is isotopic evidence that denitrification is occurring in Peoria Lake during periods of low flow.

Discharge of TWW and road salt runoff in the Chicago area have led to increased levels of Cl- in the river. Chloride concentrations in river water spiked during the late winter and early spring as a result of road salt runoff, primarily in the Chicago region. A large component of Cl- in the Illinois River throughout the year was attributed to TWW from the Chicago area. Agricultural activities which dominate land use in the watershed downstream from Chicago appear to be primarily causing dilution of road salt and TWW. Chloride concentrations in the Illinois River at Peoria have been increasing with time; the annual median increased from about 20 mg/L in 1946 to near 100 mg/L in 2005. Periodic spikes in Cl- concentrations (maximum measured in 2003 was 904 mg/L) may be harmful to freshwater biota.

Ryan Jackson

Density Currents in the Chicago River: Characterization, Effects on Water Quality, and Potential Sources

Co-Authors: Carlos Garcia, Kevin Oberg, Kevin Johnson, Marcelo Garcia

Bidirectional flows in a river system can occur under stratified flow conditions and in addition to creating significant errors in discharge estimates, the upstream propagating currents are capable of transporting contaminants and affecting water quality. Detailed field observations of bidirectional flows were made in the Chicago River in Chicago, Illinois in the winter of 2005-06. Using multiple acoustic Doppler current profilers simultaneously with a water-quality profiler, the formation of upstream propagating density currents within the Chicago River both as an underflow and an overflow was observed on three occasions. Density differences driving the flow primarily arise from salinity differences between intersecting branches of the Chicago River, whereas water temperature is secondary in the creation of these currents. Deicing salts appear to be the primary source of salinity in the North Branch of the Chicago River, entering the waterway through direct runoff and effluent from a wastewater-treatment plant in a large metropolitan area primarily served by combined sewers. Water-quality assessments of the Chicago River may underestimate (or overestimate) the impairment of the river because standard water-quality monitoring practices do not account for density-driven underflows (or overflows). Chloride concentrations near the riverbed can significantly exceed concentrations at the river surface during underflows indicating that full-depth parameter profiles are necessary for accurate water-quality assessments in urban environments where application of deicing salt is common.

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15 Years of Hydrologic and Nutrient Monitoring of the Lake Decatur Watershed: Floods, Droughts and In Between

Co-Authors: Laura Keefer

The Upper Sangamon River watershed, 925 mi2, in east-central Illinois drains into Lake Decatur, which is the drinking-water supply source for the City of Decatur. Since the early 1980s nitrate-N concentrations in Lake Decatur have exceeded the Safe Drinking Water Act (SDWA) maximum contamination level (MCL) of 10 mg/L almost every year to present. In 1993 the Illinois State Water Survey established eight stations throughout the watershed to monitor the hydrology and nitrate-N concentrations to determine any sources and trends. At various times since 2000, additional studies have enhanced the monitoring to include nitrogen, phosphorus and suspended sediment at existing stations. Recently four new stations have been established in two tributary watersheds. Over the course of the 15-year study period, and at different times, discharge and nutrient samples have been collected at 12 stations across the watershed. The monitoring periods of the initial 8 stations vary from 7-15 years. During the last 3 years (2005-2008) there are 7 active stations where all monitor discharge and nitrate-N, four monitor nitrogen, and two monitor phosphorus. The drainage areas of all the stations vary from 1 to 543 mi2. Nitrate-N concentrations in the Sangamon River and tributaries vary seasonally with high nitrate-N occurring from spring through mid-summer and in late winter. During the study period, mean annual discharge of the tributaries and Sangamon River were significantly above average in 1993-1994 and 2004-2005, significantly below average in 1999-2000, 2005-2006, and 2007-2008, and below or near normal for the remaining years. The hydrologic and water quality data from the entire project period will be presented.

Julia Friedmann

Effects of Agricultural Land Cover on Water Quality at the Watershed Scale

Co-Authors: Charnsmorn R. Hwang, Jon E. Schoonover, Karl W.J. Williard

Agricultural runoff is a major non-point source pollutant and is the leading impairment of streams and rivers in the United States. The majority of water quality studies in agricultural areas have been conducted at the field scale, which does not account for multiple land covers within a watershed. Thus, this study examines the effects of agricultural land cover and riparian buffers on water quality at the watershed level. Forty five catchments ranging from 12 to 50 km2 were selected based on a land cover gradient within Richland and Silver Creeks, which are all tributaries of the Lower Kaskaskia River Watershed in Illinois. Grab samples will be collected biweekly over a two year period and be analyzed for nutrients (ammonium, nitrate, and orthophosphate), bacteria (total coliform, fecal coliform, and E. coli), and total suspended solids (TSS). Preliminary findings suggest that catchments in both Silver Creek (1359 - 540 CFU) and Richland Creek (1451 - 315 CFU) exceed the IL EPA fecal coliform criteria of 400 CFU. Catchments in Silver and Richland Creeks had similar levels of ammonium, (NH_4-N), (0.668-0.186 and 0.833 - 0.223 mg L-1, respectively). Orthophosphate levels are elevated in both Silver (3.185 - 0.806 mg L-1) and Richland Creeks (1.904 - 0.311 mg L-1). Regression models will be developed to examine the relationships between agricultural land cover and riparian vegetation continuity on water quality parameters at a watershed scale. Additionally, automated water samplers will be installed during the first year of the study to monitor water quality during storm flow. Project results will provide insight to land use planners for the design and implementation of BMPs in agricultural watersheds.

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Alternative Futures for Headwater Stream and Wetland Landscapes in the Upper Delaware Basin, New York, USA

Co-Authors: Mary Anne Thiesing, Robert Simpson, Claire Jantz, David Kovacic

Headwater streams and wetlands contribute to hydrologic and ecologic functions of the Upper Delaware Basin, northwest of New York City. These systems deliver services important to humans and other species. From September 2004 to June 2006, flood events of national significance occurred within the watershed. In particular, Sullivan and Delaware counties experienced property damage, loss of life, streamside erosion, and degraded water quality, which affected downstream river and estuary areas.

Urban growth management needs to consider ecosystem services of the watershed, specifically to identify and evaluate flood storage and water quality maintenance, and to both preserve and enhance these functions. Headwater streams and wetlands are especially important as providers of these services.

Complementary to a larger study on future watershed impacts, a landscape analysis of flood storage capacity and water quality maintenance contributions of wetlands and streams was completed. Analyses included: 1) watershed-based preliminary assessment of wetland functions (W-PAWF), 2) reference wetland derived wetland storage capacity model, 3) identification of aggregated headwater stream networks, and 4) stream corridor condition assessment, using the Cornell Streamside Health Model.

Ecological and hydrologic analyses facilitated identification of conservation designs for best management practices (BMPs), including buffered and restored wetlands and riparian corridors, natural stream channel design, bioswales, resized culverts, and compact development. I conclude conservation design can be an important part of possible flood management strategies for an urbanizing Upper Delaware Basin.

Frank Engel

Stream Naturalization Design: HEC-RAS Modeling of Pool-Riffle Structure Designs, Copper Slough Ditch, Champaign County, IL

Co-Author: Bruce Rhoads

Stream naturalization has become increasingly popular as river managers realize the need to improve aquatic habitats in highly impacted systems. A common technique is to construct riffle structures in a reach of river in the form of rock weirs. However in low-gradient systems with large amounts of fine bedload, the pools upstream from these structures can infill over time and fail to function according to design. A successful channel design should function at all expected flows in the system and be self-maintaining through time. This study considers three conceptual designs for the implementation of a self-maintaining pool-riffle sequence for a short reach of the Copper Slough Ditch, Champaign, Illinois. The designs were modeled using 1-D steady flow in HEC-RAS to determine whether or not they would function and be self-maintaining for a range of flows. Two of the three designs exhibited hydraulic conditions that should lead to self-maintenance, suggesting that they would likely be able to maintain the pool-riffle sequence without infilling through a range of expected flows in the ditch. The other design did not exhibit intended hydraulic conditions, and thus would likely infill over the expected range of flows for the ditch.

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An Assessment of the Feasibility of Treated Wastewater Source Heat Pumps for NE Illinois

Co-Author: Paul Anderson

Energy-efficient heat pumps have been used to heat and cool homes in the United States and other regions of the world for decades. Air-to-air heat pumps, although common in the southern U.S., are limited in NE Illinois due to the relatively cold winter air temperatures. Geothermal heat pumps have been used, but their adoption is hindered due to the high cost of drilling and installing a ground loop. An alternative choice is treated-wastewater-source heat pumps because treated wastewater effluent is readily available and its relatively high and narrow temperature range suggests it could be a useful heat transfer fluid. For example, Baek et al. (2001) completed a study of wastewater source heat pumps and air-source heat pumps, and concluded that wastewater source heat pumps could reduce energy consumption by 34% and lower emissions of carbon dioxide by 68%.

In this project we assess the technical and economic feasibility of a heat pump system for home heating and cooling in NE Illinois. Important technical issues related to water quality include management of potential corrosion, scaling, and biofilm problems. Our life-cycle economic analysis includes capital costs and operating costs including a comparison of greenhouse gas emission between the heat pump system and conventional gas furnace and air-conditioning. We considered a 300 m2 residential space in the City of Chicago and compared heating and cooling costs for conventional heating and cooling systems relative to a treated-wastewater-source heat pump. Projected savings for the heat pump system were about $11,000 over the life cycle of the system. Furthermore, the heat pump system should result in a decrease in CO_2 emissions of around 1 ton per year.

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How to Estimate Groundwater Recharge and Discharge Maps in One Day: A Framework for Evaluation of Alternative Conceptual Models Using Interdisciplinary Information

Co-Authors: Albert J. Valocchi, Peter Bajcsy, Jihua Wang, Alex Yahja, Chulyun Kim

Groundwater recharge/discharge processes are known to relate to multiple information sources such as soil type, river and lake location, irrigation patterns and land use. Although scientists have been trying to understand and model the interaction between each of these information sources and recharge/discharge processes, it is extremely difficult to quantify their correlations using a universal approach due to the complexity of the processes, the spatiotemporal distribution and uncertainty. Chamberlin (1890) recommended use of 'multiple working hypotheses' (alternative conceptual models) for rapid advancement in understanding of applied and theoretical problems. Therefore, cross analyzing recharge/discharge rates and patterns from various estimation methods and related field information will likely be a feasible and efficient approach.

We have developed two software packages for accurate estimation of geospatial models from sparse field measurements using image processing and machine learning. A GIS plug-in package, PRO-GRADE, has been applied to help hydrogeologists establish alternative recharge/discharge conceptual models in a more efficient way than conventional methods. The PRO-GRADE uses numerical methods and image processing algorithms to estimate and visualize shallow recharge/discharge patterns and rates. Furthermore, a JAVA based package, SP2Learn, was developed to cross analyze results from (but not limited to) the PRO-GRADE with ancillary field information, such as land coverage, soil type, topographic maps and previous estimates. The learning process of SP2Learn cross examines each initially recognized recharge/discharge pattern with the ancillary spatial dataset, and then calculates a quantifiable reliability index for each recharge/discharge map using machine learning techniques. The SP2Learn is capable of generating alternative recharge/discharge maps if the user decides to apply certain conditions recognized by the learning process. The results from the PRO-GRADE and SP2Learn can also provide a fast initial estimate prior to planning labor intensive and time consuming field recharge/discharge measurements. The packages are free to download at: http://www.sws.uiuc.edu/gws/sware/.

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With an average annual precipitation of 38 inches, Illinois has relatively abundant water resources (Winstanley, 2002). However with population growth, water demand is going up high in the near future. According to a forecast by Dziegielewski et al. (2005), by 2025 the population in Illinois will increase 12% relative to 2000. Consequently, water withdrawals and use could increase as much as 28% (about 4406 mgd) from 2000 to 2025.

The increased demand for water could exceed current resources, and one way to address potential water shortages is to promote water reuse. Present water use is not very efficient; in many cases high quality (potable) water is used in applications such as irrigation, commerce, and industrial cooling water that could be satisfied with lower quality water. Although water reuse is common in other parts of the United States (according to the USEPA (2002) water reuse in Florida and California amounted to 584 mgd and 525 mgd, respectively, in 2002) it remains an uncommon practice in Illinois.

Our study focuses on the potential for water reuse in the City of Aurora, the second largest city in Illinois. We compare water quality among existing sources and the potential source of treated wastewater; identify potential users; and assess economic, technological, regulatory, and risk barriers to reuse. We conclude that wastewater reuse in the Chicago suburban region can be economical, especially where it is possible to identify clusters of commercial, industrial, and irrigation users. Furthermore, it will take a cooperative effort among multiple stakeholders to promote water reuse.

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Residential Water Demand Analysis in Chicago Metropolitan Area

Co-Author: John Braden

Recently, Illinois was given a quota for the amount of water that it is allowed to pump from Lake Michigan. The quota came at a time when water use in the Salt Creek watershed, which depends on water pumped from Lake Michigan, was expanding due to population and economic growth. Separately, ground water level has consistently fallen due to excessive pumping. Among supply side solutions, Illinois may consider two popular alternatives to meet its growing demand: it may pump water from remote sources, or it may increase water extraction from nearby aquifers. The former will require huge investments in infrastructure, while the latter will merely postpone those investments. In light of these facts, curbing water demand through the adjustment of water prices, rather than expanding water supply, seems like a promising option.

The objective of this study is to examine the effects of water prices, weather conditions and socio-demographic data on water demand in the Salt Creek watershed. It is generally acknowledged that water prices are set too low, and consequently efficient usage of water is discouraged. For example, in the City of Chicago, where about 60% of water pumped from Lake Michigan was consumed in 2006, water prices were $1.33 per one thousand gallons. This is outstandingly low compared to other cities in the Salt Creek watershed. In this study, we will focus on the effect of price controls on water demand as a potential solution. Economic theory tells us that regulators should be able to curb water demand and encourage more efficient use of water by raising water prices. For legislators, consumer responsiveness to water price changes will be invaluable information when setting a new water prices. Factors like income and weather conditions, which are thought to significantly affect water demand, are also included in our model.

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Metal Speciation by Liquid Chromatography Inductively Coupled Plasma Mass Spectrometry (LC/ICP-MS)

Co-Authors: John W Scott, Kishore Rajagopalan

The Illinois Sustainable Technology Center has developed the unique capability to separate and detect metal species by coupling a liquid chromatography (LC) system with an inductively coupled plasma mass spectrometer (ICP-MS). Increasing demands for lower detection limits for metal species makes this a very desirable technique as it allows determination of the analytes into the parts-per-billion and lower ranges. Over the past five years the Illinois Sustainable Technology Center laboratory program has used LC/ICP-MS to successfully perform arsenic and selenium speciation determinations on hundreds of samples, with many of the results ending up as vital components of published research projects. Another variation on LC/ICP-MS instrumentation developed by Illinois Sustainable Technology Center allows the real time analysis of sample streams. This setup has been used for things such as the determination of the metal adsorption capacities of anion exchange resins and other experimental adsorbent materials. These resins and experimental adsorbents were being examined for potential use in purifying drinking water. In addition, LC/ICP-MS instrumentation could also be used for isotope analysis of metal species or complexes. The Illinois Sustainable Technology Center laboratory program is seeking to provide this “cutting edge” metal speciation services for research support. This poster will provide an overview of the system and its capabilities by highlighting results of current and past speciation projects performed at the Illinois Sustainable Technology Center.

John Scott

Release of Mercury from Dental Amalgam to Disinfectant Solutions

Co-Authors: Mark Stone, Marvin Piwoni, Gary Bordson, Brent Panno

Dental amalgam is a filling material that is widely used by dentists to restore carious tooth structure. It contains approximately 50% mercury by weight. Waste material from dental offices can contain large amounts of dental amalgam and there is concern that this waste may release mercury to the environment. The occasional observation of highly elevated levels of mercury in the wastewater may be related to the addition of disinfectant solutions. To simulate waste amalgam found in the dental operatory, fresh dental amalgam and used dental amalgam were exposed to 1 mg/L and 10 mg/L hypochlorite and chloramine disinfectant solutions. Exposure to disinfectant solutions was conducted over 24 hours with sampling intervals of 0 hours, 2 hours, 4 hours, and 8 hours. Parameters measured at each sampling interval were; pH, free chlorine, monochloramine, chloride, and mercury. Results obtained in this experiment indicate that 1 mg/L hypochlorite, 1 mg/L monochloramine, and 10 mg/L monochloramine solution did not leach substantial concentrations of mercury from dental materials. Exposure of dental materials to10 mg/L hypochlorite to simulate "superchlorination" did leach significantly higher concentrations of mercury up to 3.3 mg/L. In addition, fresh amalgam leached the greater amounts in "superchlorination" simulations.

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Evaluation of a Polyacrylamide (PAM) Assisted Solid/liquid Separation System, Consisting of a Gravity Screen and Gravity Belt Thickener, Coupled with Separated Solids Composting for the Treatment of Swine Waste.

Co-Authors: Paul Walker, Tim Kelley

Current methods for managing swine manure consist of holding tanks, settling lagoons and direct injection application on crop producing fields, but these methods create problems for the environment, the public and the pork producer. The 500 million tons of livestock manure generated annually in the US has consistently been identified as a major contributor to water quality impairment in surface waters. Failure of storage systems and mishaps during application can result in discharges leading to environmental degradation in both local waterways and those farther downstream. With the shift to high intensity confined animal feeding operations, the amount of waste generated may exceed the capacity of proximal and available agricultural lands for land application, resulting in "land-limited conditions". The high water content of the slurry makes it difficult to transport and handle, further limiting disposal options. The nutrient characteristics of untreated swine slurry, with a N:P (nitrogen to phosphorus) ratio of approximately 5:1, results in an over application of phosphorus when land applying based on N application rates and creates odor and hygienic concerns during storage and application. Pork producers need to implement low cost, efficient manure management systems that will address environmental and health concerns while creating economically viable products from the waste. By applying treatment technologies similar to those used in treating municipal wastewater, a low odor, more nutrient balanced effluent results (N:P ratio of 11:1) while biosolids are concentrated and can easily be composted to create a valuable fertilizer alternative. Our evaluation of a gravity screen in tandem with a polyacrylamide assisted gravity belt thickener for the treatment of swine waste showed a 80.9% reduction of Total Suspended Solids, 62.8% reduction of Chemical Oxygen Demand, 37.0% of total Nitrogen and a 70.9% reduction in total Phosphorus in the treated effluent. The total cost of separation and application is only 1¢ per gallon of raw slurry.

Yaning Yang

Particulate Carbonaceous Materials: On the Trail of Polycyclic Aromatic Hydrocarbons in a Small Urban Watershed

Co-Authors: Charles Werth, Bertrand Ligouis, Muhit Razzaque

Concentrations of polycyclic aromatic hydrocarbons (PAHs) have been increasing in recent decades in many urban lakes and streams, particularly in areas with rapid urbanization. PAHs are primarily associated with carbonaceous material (CM) particles and enter receiving water bodies with storm runoff, as well as by atmospheric deposition. CMs differ in type and amount, and are hypothesized to affect the fate of PAHs in urban watersheds. The objectives of this research are to determine the types and amounts of CMs in urban soils, dust, and sediments, to identify the sources of CM particles that may concentrate, transport, and redistribute PAHs in urban watersheds, and to elucidate the relationships between CM properties and PAH loadings. Samples were collected from Lake Como and Fosdic Lake watersheds in Fort Worth, TX. They include soils from residential and commercial area, dust from residential street, and coal-tar-sealed and unsealed parking lots, stream sediments, and lake sediments as a function of depth. All samples were subject to CM characterization by quantitative petrographic analysis, density separation followed by sequential chemical treatment, and chemothermal oxidation at 375C. PAH concentrations in bulk samples and in density separated fractions were analyzed. Sorption isotherms for 14C-phenanthrene were obtained to estimate the PAHs uptake capacities of CMs. Results indicate that the majority of CMs are associated with heavy particles which control the sorption of phenanthrene. Soot, coal tar pitch, and asphalt are the most recalcitrant types of CMs in urban soils, dust, and sediments. Relatively little to no coal tar pitch was observed in sediments by petrographic analysis; however, due to their high levels of intrinsic PAHs, coal tar pitch in sealed parking lots may be a potential contaminant source of PAHs in lake sediments.

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Bev Herzog - Illinois State Geological Survey
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