The organizers wish to thank the following organizations for helping to make this conference possible with their generous donations.

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November 2000

Dear Illinois Water 2000 Participant:

When the Planning Committee for Illinois Water 2000 began meeting in the spring of this year, Illinois seemed to be heading into a severe drought. Reservoirs in central Illinois were low, Springfield had instituted water use restrictions (restaurants only served water when patrons asked for it and lawn watering was restricted), and some towns had requested emergency assistance for water supply. Soil moisture levels were well below average and severe reductions in crop yields were predicted. In response to the developing water shortages, the Committee decided to hold a plenary session on drought preparedness and water conservation and to invite Dr. Don Wilhite, Director of the National Drought Mitigation Center in Lincoln, Nebraska, as our keynote speaker.

Shortly thereafter, the rains began to fall. Soil moisture was replenished, streams returned to normal flows, and reservoirs began to fill. Although the impending crisis passed us by this year, the pictures on the cover of this program book, taken at Lake Bloomington during the 1988-1989 drought, remind us that droughts are periodic. We need to listen to our keynote speaker and our own state water professionals and prepare now for vagaries in annual rainfall and for longer term changes associated with projected shifts in regional climate. By coming together at Illinois Water 2000, local and state officials, researchers and practitioners in many disciplines, and educators and students can learn how water availability affects not only municipal and industrial water supply and agriculture, but also water quality, fish and wildlife habitat, and human amenities. Collectively we can generate more momentum for preparedness than we can by working independently.

The Planning Committee is especially pleased that Lt. Governor Corinne Wood will speak about the efforts of the Illinois River Coordinating Council, which she chairs, to protect and enhance the Illinois River Basin, where over 90 percent of the state's population lives. There are many other current activities and issues that will be presented at plenary sessions and technical sessions in Illinois Water 2000, including stormwater and flooding in urban and suburban areas (the inverse of the drought problem!), the new regulatory and analytical approach to water quality embodied in the Total Maximum Daily Load (TMDL) determinations, non-point source pollution, lake management issues, and water education for both schools and watershed management partnerships.

The Planning Committee, the Sponsors, and the Illinois Water Resources Center welcome you to Urbana and hope you will enjoy your visit. You will find a short conference evaluation questionnaire in your folder of conference materials. Please complete the questionnaire and leave it in the box at the registration desk. You can also contact us at any time at the Illinois Water Resources Center by mail at 1101 W. Peabody Dr., Room 350, Urbana, IL 61801-4723, phone (217-333-0536), fax (217-333-8046), or email (iwrc@uiuc.edu). For information about the Center and for links to other web sites about water resources visit our revamped web site: http://www.environ.uiuc.edu/iwrc/

Sincerely,

Richard E. Sparks
Director
Illinois Water Resources Center
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ILLINOIS

WATER

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illinois water resources center  university of illinois at urbana-champaign
Monday, November 13, 2000

7:30 Continental Breakfast (Ballroom Lobby)

8:00 Registration (Ballroom Lobby)

9:00 Opening Remarks (Salon F)

9:10 Plenary Session I - Drought Response and Water Conservation (Salon F)

Moderator
Tim Feather, Planning & Management Consultants, Inc.

Presenters
Vernon Knapp, Illinois State Water Survey
Don Vonnahme, Director, Office of Water Resources, Illinois Department of Natural Resources,
Tom Skelly, Springfield City Water Light & Power
Jack C. Kiefer, Planning & Management Consultants, Ltd.

10:40 Break (Salon D/E)

11:00 Plenary Session II - Non-Point Source Pollution (Salon F)

Moderator
Nancy Erickson, Director, Natural Resources, Illinois Farm Bureau

Speaker
Gary Rolfe, Head, Department of Natural Resources & Environmental Sciences,
University of Illinois

Panel
Debbie Bruce, Head, Watershed Management & Wetlands Unit, Office of Resource Conservation,
Illinois Department of Natural Resources
Jim Park, Chief, Bureau of Water, Illinois Environmental Protection Agency
Warren Goetsch, Administrator, Division of Natural Resources, Illinois Department of Agriculture

12:30 Lunch and Keynote Address (Salon A)

Dr. Don Wilhite, Director, National Drought Mitigation Center, University of Nebraska - Lincoln

2:00 Plenary Session III - Present and Future Lake Management Issues (Salon F)

Moderator
Keith Alexander, Illinois Lake Management Association

Speakers
Gregg Good, Manager, Surface Water Section, Illinois Environmental Protection Agency
Peter Berrini, Manager, Lake Restoration Services, Cochran & Wilken, Inc.
**Modeling Hydrology I (Salon B)**
Moderator: Gary Clark, Illinois Department of Natural Resources

*Mechanistic, 3-Dimensional Modeling of Nutrient Transport and Reaction in Tile-Drained Fields*
Bob Hudson, Department of Natural Resources & Environmental Sciences, University of Illinois (Albert Valocchi, Gregory McIsaac, Manoj Shukla and David Hill, co-authors)............................................... P. 23

*Dynamic Watershed Simulation Model for Studying Nonpoint Source Pollution in Illinois*
Deva Borah, Illinois State Water Survey (Renjie Xia and Maitreyee Bera, co-authors)....................... P. 24

*Statewide Mass Balance Model for Estimating Allowable N Application Rates*
Steve Wente, Department of Natural Resources & Environmental Sciences, University of Illinois (Bob Hudson and George Gertner, co-authors)................................................................. P. 25

*TMDL: A Multistakeholder Modeling Challenge*
James Westervelt, Department of Agricultural & Consumer Economics, University of Illinois.... P. 26

*Nitrogen Fate and Transport under Variable Cropping Systems and Soil Types at a Watershed Scale: Evaluation of the ADAPT Model*
Jean Sogbdeji, Department of Natural Resources & Environmental Science, University of Illinois (Gregory McIsaac, co-author).................................................................................. P. 27

**Stakeholders and Education (Salon C)**
Moderator: Cari Swiatak, Illinois Section, American Water Works Association

*Watershed Park*

*The Ten-Day Water Environment Curriculum*
Gregory D. Cargill, Illinois Water Environment Association.............................................................. P. 29

*The Kankakee River Basin Partnership - Conserving the Kankakee River for the Future*
R.A. Shultz, Kankakee River Basin Partnership.................................................................................. P. 30

*Using the Fox River as an Educational Resource*
Gary Swick, Friends of the Fox River Watershed Monitoring Network.......................................... P. 31

*Water Education*
Mark Werth, Illinois Department of Agriculture, Bureau of Land & Water Resources............... P. 32
3:45 - 5:30 Hydrosystems Laboratory Tour
(concurrent with Technical Session I)

The Hydrosystems Laboratory is a unit of the Department of Civil and Environmental Engineering at the University of Illinois. It covers a surface area of about 11,000 square feet, has its own water supply system, and contains experimental flumes, stratified flow tanks, sediment resuspension tunnel, and model basins. The Hydrosystems Laboratory is pleased to offer a tour of its facility and demonstrations of current research to interested participants of the Illinois Water 2000 conference. Hydraulic models on display will include:

- A scale model of the Fox River at Batavia, Illinois.
- A scale model of the Boneyard Creek at Wright Street, Urbana-Champaign.
- A scale model of the Boneyard Creek at Lincoln Avenue, Urbana.
- A model of a canoe chute to facilitate recreational boating at low-head dams in Illinois.

The Hydrosystems Laboratory is located at the corner of Main Street and Mathews Avenue in Urbana. Visitors may enter the east door (at the corner of Main and Mathews) and follow the signs to direct them inside. Free parking is available in lot B22 at the corner of Clark Street and Goodwin Avenue, approximately two blocks from the Lab. Metered parking is available in front of the Lab. From the Holiday Inn, drive south on Lincoln Avenue, past University Avenue, and turn right on Clark Street or Main Street, depending upon your parking preference. Clark is the first street after University, and Main is the second. The tour will last approximately two hours and will be given by Professor Marcelo Garcia, Director of the Hydrosystems Laboratory.

- There will be a van available to shuttle participants to and from the Hydrosystems Laboratory. To sign up, participants should visit the conference registration table. Maps will also be available.
6:30 Reception, Poster Presentations and Flood Luck [8 p.m.]
(Hotel Atrium)

Posters

Monitoring Big Ditch and the Upper Sangamon River during Storm Events for Nonpoint Source Pollution
Deva Borah, Illinois State Water Survey (Susan Shaw and Maitreyee Bera, co-authors)............. P. 54

Dynamic Watershed Simulation Model Helping Citizen Group Restoring the Court Creek Pilot Watershed
Deva Borah, Illinois State Water Survey (Maitreyee Bera and Renjie Xia, co-authors)............... P. 55

Reducing Water Quality Impacts on the Waukegan River
Scott Tomkins, Illinois Environmental Protection Agency................................................................. P. 56

Peoria Lake Sediment Quality
Michael L. Machesky, Illinois State Water Survey
(Thomas R. Holm and Richard A. Cahill, co-authors)................................................................. P. 57

Shallow Groundwater Flow and Mass Flux of Nitrogen and Phosphorus in the Big Ditch Watershed
Thomas R. Holm, Illinois State Water Survey
(Walton R. Kelly, Joseph R. Karny, Edward Mehnert, Donald A. Keefer and William S. Dey, co-authors). P. 58

The Mahomet Aquifer Consortium: Progress in Water-Resources Management through Knowledge and Cooperation
Edward Mehnert, Illinois State Geological Survey
(David R. Larson and Manoutch Heidari, co-authors)................................................................. P. 59

Native Riparian Vegetation Impacts on Agricultural Surface and Subsurface Water Quality in the Cache River Watershed
Jon Schoonover, Department of Forestry, Southern Illinois University at Carbondale
(Karl Williard, co-author).................................................................................................................. P. 60

Best Management Practices to Protect Surface Water Quality
Robert W. Frazee, University of Illinois Extension........................................................................ P. 61

Combining Surface and Borehole Geophysical Techniques to Locate and Define a Buried Outwash Aquifer in Central Illinois
Timothy C. Young, Illinois State Geological Survey........................................................................ P. 62

Mechanisms Responsible for the Loss of Specific Capacity By High Capacity Wells Screened in the Mahomet Aquifer, Champaign, IL
Samuel V. Panno, Illinois State Geological Survey
(Keith C. Hackley, Edward Mehnert, David Larson, Dylan Canavan and Timothy Young, co-authors)..... P. 63
Exhibits
Exhibits from the following organizations will be on display in Salon D/E throughout the conference

- American Water Resources Association, Illinois Section
- Army Corps of Engineers, Rock Island District
- Floran Technologies
- Hydrolab Corporation
- Hydrosystems Lab, Environmental Hydrology & Hydraulic Engineering Program, Department of Civil & Environmental Engineering, University of Illinois
- Illinois Department of Agriculture, Bureau of Land and Water Resources
- Illinois Department of Natural Resources, Office of Water Resources
- Illinois Environmental Protection Agency, Bureau of Water
- Illinois Farm Bureau
- Illinois Lake Management Association
- Illinois-Indiana Sea Grant College Program
- Illinois State Geological Survey
- Illinois Environmental Protection Agency, Bureau of Water
- Illinois Water Resources Center
- Illinois Watershed Academy
- Illinois Water Well Sealing Coalition
- Natural Resources Conservation Service
- The Environmental Council at the University of Illinois
- TestAmerica, Inc.
- Woolpert LLP

Tuesday, November 14, 2000

7:00 Illinois Section of the American Water Resources Association [AWRA] Business Meeting (Salon B)

7:00 Continental Breakfast (Ballroom Lobby)

8:00 Registration (Ballroom Lobby)

8:30 Plenary Session IV - Urban Stormwater (Salon F)
Moderator
Ken Alderson, Illinois Municipal League

Panel
Tom McSwiggin, Head, Permits Section, Illinois Environmental Protection Agency
Ward Miller, Executive Director, Lake County Stormwater Management Commission
Daniel Lau, Vice President, Camp Dresser & McKee, Inc. - Abstract, P. 52
Richard Worthen, Metro East Stormwater Office - Abstract, P. 53

10:00 Break (Salon D/E)
10:15 Technical Session II

**Water Resources Issues (Salon B)**
Moderator: Mark Peden, Illinois State Water Survey

*Quantifying the Status of Flood Prone Structures in Illinois*
Paul A. Osman, Illinois Department of Natural Resources, Office of Water Resources................. P. 33

*The Necessity for a Real-Time Streamflow Data Network: The Multitude of Uses and a Look at the Cost Issue*

*Kane County, Illinois: Stormwater Management Programs*
Karen Kosky, Kane County Department of Environmental Management................................. P. 35

*Water Withdrawals and Water Use in Illinois and Nearby States; Results and Trends, 1950-1995*

*Tradeoffs Among Candidate Water Withdrawal Regulations: An Illinois Example*
J. Wayland Eheart, Department of Civil & Environmental Engineering, University of Illinois...... P. 37

**Watershed Management Practices (Salon C)**
Moderator: Albert Valocchi, Department of Civil & Environmental Engineering, University of Illinois

*Drainage Management to Improve Water Quality and to Enhance Agriculture Production*
Don Pitts, Natural Resources Conservation Service, U.S. Department of Agriculture............... P. 38

*Can Carbon Enhanced Conservation Buffer Strips Better Protect Water Quality?*
Jennifer Gleespen......................................................................................................................... P. 39

*Livestock Waste Management Requirements and Solutions*
Lawrence E. Ziemba, Illinois Environmental Protection Agency.............................................. P. 40

*The Effects of Sediment Characteristics on Denitrification in Big Creek*
Jon O’Brien, Department of Forestry, Southern Illinois University at Carbondale
(Karl Williard, co-author)............................................................................................................. P. 41

*“Urban Stormwater Management and Ecological Restoration” is not an oxymoron*
Deborah L. Roush, Corps of Engineers, St. Louis District
(Timothy George, Kelly Burkes, Mary L. White, Patrick A. Malone, Ellen Starr and Brian Wiebler, co-authors)......................................................................................................................... P. 42
AGENDA

12:00 Lunch and Speaker: Lt. Governor Corinne Wood (Salon A)

1:30 Technical Session III

Water Quality Models and Strategies (Salon B)

Urban Waterway Water Quality Strategy for Chicago
Richard Lanyon, Metropolitan Water Reclamation District of Greater Chicago........................................... P. 43

Sources of Nitrate in Spring Water from the Shallow Karst Aquifer of Illinois' Sinkhole Plain: Isotopic and Chemical Indicators
Samuel V. Panno, Illinois State Geological Survey
(Keith C. Hackley, Hue H. Hwang and Walton R. Kelly, co-authors)............................................................ P. 44

The Age and Chemical Composition of Groundwater from the Mahomet Valley Aquifer: Implications for Recharge Zones, Groundwater Movement and its Geochemical Evolution
Keith C. Hackley, Illinois State Geological Survey (Samuel V. Panno and C-L. Liu, co-authors)....................... P. 45

Groundwater Wellfield Management Computer Model for Simultaneous Source Water Protection, Raw Water Quality and Treatment Costs for a Water Treatment Plant
Eduardo Gasca, Tetra Tech EM Inc. (Tom Rust, co-author).................................................. P. 46

George Groschen, U.S. Geological Survey
(Paul Terrio, Mitchell A. Harris, Kelly Warner, Robin King and William Morrow, co-authors).................. P. 47

Modeling Hydrology II (Salon C)
Moderator: Bob Frazee, University of Illinois Extension

Water Quality Models for Addressing TMDLs in Agricultural Watersheds
Gregory McLsaac, Department of Natural Resources & Environmental Sciences, University of Illinois (Richard Cooke and Jean Sogbedji, co-authors)................................................................. P. 48

Developments in Subsurface Drainage in Illinois: Mapping Tiles and Modeling Flow
Ana Maria Garcia, Department of Agricultural Engineering, University of Illinois
(Richarde Cooke, co-author).................................................. P. 49
Solute Transport Variability in Tile-drained Field Plots
Chris Harbout, Department of Natural Resources & Environmental Sciences, University of Illinois
(Tim Ellsworth, Charles Boast and Mike Hirschi, co-authors)............................................................................. P.50

 Conjunctive Overland, Soil and Tile Transport Model for Farmland Drains
Ben Chie Yen, Department of Civil & Environmental Engineering, University of Illinois
(Yanqing Lian, co-author).................................................................................................................................... P.51

3:15 Wrap-up (Salon F)
3:30 Adjourn (Salon F)
Dr. Wilhite is Professor of Agricultural Climatology in the School of Natural Resource Sciences at the University of Nebraska-Lincoln. He is director of the National Drought Mitigation Center, an organization that helps people and institutions develop and implement measures to reduce societal vulnerability to drought by stressing preparation and risk management, rather than crisis management. He is also director of the International Drought Information Center. Dr. Wilhite's research and outreach activities focus on issues of drought monitoring, planning, and mitigation. In that capacity, he works with U.S. and foreign governments and international organizations such as the World Meteorological Organization, World Bank, and the U.N. Development Program. Dr. Wilhite and his staff have recently organized and conducted a series of training workshops on drought contingency planning in the United States, Mexico, South Africa, and Brazil.


After earning his B.S. in geography from Central Missouri State University - Warrensburg, Dr. Wilhite earned his M.A. in geography, specializing in physical geography with an emphasis in climatology from Arizona State University - Tempe and his Ph.D. in Geography, specializing in agricultural climatology, climate change and water resources from the University of Nebraska - Lincoln. He has authored or co-authored more than 90 journal articles, monographs, book chapters, and technical reports in the past 10 years.
In 1998, Corinne Wood made history by becoming Illinois’ first female Lieutenant Governor. She pledged to be active in her role as the state’s second highest-ranking official, and has fulfilled that promise by providing strong leadership in health care, environmental protection, senior advocacy, rural affairs and streamlining state government. Wood brings extensive experience in the public and private sectors to the Office of Lieutenant Governor, a post previously held by Governor George Ryan and former U.S. Senator Paul Simon.

Lt. Governor Wood began her career in public service over 20 years ago. Known as an effective advocate for women and children, Wood’s experience includes service as a state representative, attorney, and community activist, as well as wife and mother. Among her achievements, she earned distinction as one of “100 Women Making a Difference” in Illinois by Today’s Chicago Woman magazine, and was chosen to chair the Midwestern Region of the National Conference of Lieutenant Governors.

Lt. Governor Wood acts as the state’s advocate for rural areas as Chair of the Governor’s Rural Affairs Council and the Illinois Rural Bond Bank, an agency that assists smaller communities in obtaining financing for local infrastructure. As chair of the Illinois River Coordinating Council, Wood also directs the state’s strategy in protecting the Illinois River Watershed and its tributaries. She worked to double funding for a voluntary incentive program to remove eroding lands from farm production and now is leading Illinois Rivers 2020, a bold, long-range initiative to restore Illinois waterways. She also serves as Chair of the Illinois Main Street Council, which provides assistance to communities in restoring their downtown and historic areas.
Kenneth A. Alderson is Executive Director of the Illinois Municipal League, the official statewide municipal association representing 1,090 cities, villages and towns in Illinois. A 27-year veteran of the Springfield based organization, he has also served in the capacities of Manager of Membership Services, Director of Administration and Assistant Executive Director. Prior to joining the Municipal League, Mr. Alderson was Manager of the Legislative Liaison Section of the Illinois EPA and previously was with Caterpillar Tractor Company in Decatur, IL.

A 1971 graduate of Southern Illinois University in Carbondale with a major in political science and a minor in Southeast Asian studies, Mr. Alderson also attended Milliken University, the University of Maryland, Far East Division, Japan, and was an exchange student at National Taiwan Normal University Mandarin Training Center in Taipei, Taiwan.

He is presently a member of the National League of Cities Board of Directors and Chairman of the Illinois Community Water Supply Testing Council. In his 27 years at the Illinois Municipal League he has served on numerous state and national boards, committees, commissions and task forces.

Keith Alexander has been the Manager of Lake Decatur for the past 10 years for the City of Decatur, IL. He administers the Lake Management Division, which is responsible for Lake Decatur, Decatur sponsored watershed improvement activities and Decatur owned farm land. Keith is a graduate of Michigan State University (B.S.) and Arizona State University (M.S.). Pleading temporary insanity, he is completing work on an M.A. in Public Administration from the University of Illinois at Springfield.
Peter Berrini
Manager, Lake Restoration Services, Cochran & Wilken Inc.

Speaker, Plenary Session III:
Present and Future Lake Management Issues

As the manager of Lake Restoration Services at Cochran & Wilken Inc. in Springfield, IL, Peter Berrini has been directly responsible for numerous sediment removal and lake enhancement projects throughout the Midwest over the past 14 years. He received a B.S. in Geology from Salem State College in Massachusetts and an M.A. in Environmental Studies from the University of Illinois. He is also a Licensed Professional Geologist and a Certified Lake Manager.

Debbie Bruce
Chief of Special Projects, Office of Resource Conservation, Illinois Department of Natural Resources

Panelist, Plenary Session II:
Non-Point Source Pollution

Debbie is the Chief of Special Projects in the Office of Resource Conservation in the Illinois Department of Natural Resources. Her primary responsibility is administering programs that address watershed restoration and management issues. She currently administers the state side of the Illinois Conservation Reserve Enhancement Program. Debbie has been with the Department of Natural Resources for six years, serving as a section head in the Division of Fisheries before assuming her current position. Prior to working for the DNR, Debbie worked for the electric utility industry for 17 years in a variety of Resource Management and Environmental Assessment positions.

Debbie holds a Bachelor of Science Degree in Biology from the University of Illinois and a Master of Arts Degree in Environmental Science with an Aquatic Ecosystems emphasis from the University of Illinois - Springfield.
NANCY ERICKSON
Director, Natural & Environmental Resources, Governmental Affairs and Commodities Division, Illinois Farm Bureau

Moderator, Plenary Session II:
Non-Point Source Pollution

Nancy Erickson serves as Director of Natural & Environmental Resources for the Governmental Affairs and Commodities Division of the Illinois Farm Bureau. In that capacity, she is responsible for programs and activities involving environmental issues. Erickson works with county Farm Bureaus in the area of soil conservation, water quality-related issues, agricultural chemicals, recycling and other agricultural-related issues. Erickson also maintains liaison with various state agencies including the Department of Agriculture, Department of Natural Resources, Environmental Protection Agency, University of Illinois and various local organizations involved with natural resource issues.

Erickson received a bachelor’s degree in education, with a science minor, from the University of Illinois.

Before joining the Illinois Farm Bureau in 1984, Erickson was a school instructor for ten years. Erickson, a native of Elgin, IL, resides in Bloomington.

TIMOTHY D. FEATHER
Planning & Management Consultants, Inc.

Moderator, Plenary Session I:
Drought Response and Water Conservation

Timothy Feather’s professional focus is on supporting water resources decision-making through interdisciplinary solutions. His educational training spans engineering and economic geography, having earned a Ph.D. from the University of Florida in Geography and Environmental Engineering. Presently, he manages the strategic development program at Planning and Management Consultants, Ltd. in Carbondale, where he has been employed for 12 years.

Dr. Feather is involved in projects nationwide servicing federal and state water resource agencies with special planning and policy studies. He has supported water resources planning and conservation analysis in highly contentious settings such as Las Vegas and south Florida. In 1996, Dr. Feather managed an assessment of Illinois water law for the DNR under the Conservation 2000 program.

Presently, Dr. Feather serves as Vice-President of the Illinois Section of the Illinois Water Resources Association and is also very active in the American Society of Civil Engineers, Environment and Water Resources Institute.
WARREN D. GOETSCH, P.E.
Division Administrator of Natural Resources, Illinois Department of Agriculture

Panelist, Plenary Session II:
Non-Point Source Pollution

Mr. Goetsch currently serves as the Division Administrator for Natural Resources for the Illinois Department of Agriculture. In this position, he is responsible for providing administrative oversight to the Bureaus of Land and Water Resources and Environmental Programs, including: pesticide licensing and product registration; nursery quarantine and inspection; agrichemical and lawncare facility permitting; livestock facility regulation and siting; mineland reclamation and farmland preservation programs; coordination of the Department of Agriculture's support of soil and water conservation districts; and the apiary inspection program.

He was raised on a small grain and livestock farm in Montgomery County, IL, and received both his Bachelor of Science and Masters of Science Degrees in Agricultural Engineering from the University of Illinois.

Previous to joining the Department of Agriculture, he served for over 9 years as an Area Extension Engineer with the University of Illinois Cooperative Extension Service, working in 19 central Illinois counties with producers regarding alternate energy systems, livestock confinement facilities, waste handling facilities, agrichemical facilities and other engineering related topics.

Warren joined the Department of Agriculture in 1989 and has served as the Bureau Chief of Laboratories and the Bureau Chief of Environmental Programs prior to assuming his present duties.

Warren is a registered Professional Engineer, is married with 3 children and resides in rural Williamsville, IL.

GREGG GOOD
Manager, Surface Water Section, Illinois Environmental Protection Agency, Bureau of Water

Speaker, Plenary Session III:
Present and Future Inland Lake Management Issues

Gregg Good received his Soil Science degree from the University of Wisconsin – Stevens Point in 1982. Shortly thereafter, he became employed and worked for several central Illinois Soil and Water Conservation Districts. In 1985, he began his career with the Illinois Environmental Protection Agency, working first in their Nonpoint Source Management Section, where he authored the Agency’s first NPS Assessment and Management Program Reports required by Section 319 of the Clean Water Act (CWA). In 1989 he became Manager of the Lakes Unit within the Surface Water Section. There he oversaw implementation of ambient and volunteer lake monitoring programs, and detailed lake study and implementation grant programs authorized by Section 314 of the CWA, better known as the Federal Clean Lakes Program. He authored the Agency’s first comprehensive inland lake management plan that was ultimately funded, and is currently being implemented, with funding provided by Conservation 2000. In April 2000 he became Manager of the Surface Water Section, and now oversees development and implementation of all inland lake and river/stream monitoring and assessment activities on behalf of the Agency.
SPEAKERS

JACK C. KIEFER
Water Resources Program Manager,
Planning & Management Consultants, Ltd.
Presenter, Plenary Session I:
Drought Response and Water Conservation

Mr. Jack C. Kiefer is the Manager of the Water Resources Research Branch at Planning and Management Consultants, Ltd. in Carbondale, Illinois. In his 10 years at PMCL, Mr. Kiefer has focused on the planning and management of urban water supplies. He has served as principal investigator for several long-range water demand forecasts for major water providers in the United States. In all of these engagements, he has studied the costs and benefits of water conservation as an alternative to water supply augmentation. More recently, Mr. Kiefer has modeled both urban and non-urban water withdrawals within a risk-based supply reliability framework, considering the impacts of short-term and more protracted water shortages. Finally, Mr. Kiefer is currently developing a multicriteria decision-support model for establishing water pricing alternatives, which he hopes will help balance financial objectives with societal concerns over equity and sustainability. Mr. Kiefer holds Bachelor’s and Master’s degrees in Economics and is a doctoral candidate in Geography.

H. VERNON KNAPP
Illinois State Water Survey
Presenter, Plenary Session I:
Drought Response and Water Conservation

Vernon Knapp is a Senior Hydrologist with the Illinois State Water Survey in Champaign, IL, where he has worked for the past 21 years. Mr. Knapp has conducted applied research to solve practical problems on a variety of water resource issues for the State of Illinois, with areas of concentration including the regional, trend, and frequency analyses of streamflows in Illinois for use in drought and water resource management, and hydrologic simulation of streamflows for application in water supply and flood control operations and planning.

Among his accomplishments are the developments of the Illinois Streamflow Assessment Model, which aids planners in assessing impacts of water resource projects on streamflows, and the procedures for the water supply assessment of side-channel reservoirs in Illinois. Mr. Knapp is currently the president of the Illinois Section of the American Water Resources Association, and has a Master's degree in Water Resources Science from the University of Kansas.
DANIEL LAU  
Vice President, Camp Dresser & McKee Inc.  
Panelist, Plenary Session IV: Urban Stormwater

Mr. Lau is a vice president with Camp Dresser & McKee Inc., responsible for water resources initiatives in the midwest. He has a Bachelor of Science in civil engineering from Michigan State University and a Master of Science in hydrology and water resources from Colorado State University. He has over 25 years of experience in stormwater and flood control management projects throughout the midwest. His experience includes the St. Louis MSD Stormwater System Master Improvement Plan, the Milwaukee Metropolitan Sewerage District Watercourse System Management Plan and the Boneyard Creek Improvement Plan. He has been involved in stormwater utility or user fee programs in Missouri, Iowa, Minnesota, and Wisconsin and is currently assisting Lake County Stormwater Management Commission in updating its Comprehensive Stormwater Management Plan.

THOMAS G. McSWIGGIN  
Manager, Permit Section, Division of Water Pollution Control, Illinois Environmental Protection Agency  
Panelist, Plenary Session IV: Urban Stormwater

Thomas G. McSwiggin is a graduate of the University of Iowa, holding a Bachelor of Science in Civil Engineering and a Master of Science in Sanitary Engineering. He is a registered professional engineer in the states of Iowa and Illinois. He has been employed by the State of Illinois since 1962 in the water pollution control field, first with the Illinois Department of Public Health and then with the Illinois Environmental Protection Agency since its founding in 1970. Mr. McSwiggin has held his position as Manager, Permit Section, Division of Water Pollution Control, since August 1977. This Section is responsible for administering both the NPDES permit system and the State construction / operating permit system.
WARD S. MILLER  
Executive Director, Lake County Stormwater Management Commission  
Panelist, Plenary Session IV: Urban Stormwater

Ward S. Miller received a Masters degree in Regional and City Planning and a B.A. in Urban Studies from the University of Oklahoma.

Mr. Miller has 20 years of professional city and county planning experience in the areas of development regulations, capital improvements, environmental, neighborhood revitalization, stormwater program design, watershed agency development, intergovernmental coordination, grants project management and supervision. Based on his experience in regional planning and stormwater management, Mr. Miller believes in a comprehensive, watershed-based approach to managing Lake County’s drainage system.

As Executive Director of the Lake County Stormwater Management Commission, he developed a new, county-wide watershed planning and regulatory agency from the ground up. The Commission is an equal partnership between the county government and municipalities. This $1.6 million per year, 14 person agency is currently managing more than 60 intergovernmental cooperation projects ($9.5 million) related to flood control, water quality, and natural resources, and a county-wide regulatory program.

JAMES B. PARK  
Chief, Bureau of Water, Illinois Environmental Protection Agency  
Panelist, Plenary Session II: Non-Point Source Pollution

Jim Park earned a Bachelor of Science Degree in Engineering from Southern Illinois University at Carbondale in June 1970 and a Master of Science Degree in Engineering from Southern Illinois University at Carbondale in June 1971. He has been employed by the Illinois Environmental Protection Agency since July 1971 and has held the position of Chief of the Bureau of Water since February 1992. His responsibilities include administration of several programs including all water pollution control programs in the State of Illinois, statewide water quality monitoring, all community drinking water protection programs in the State of Illinois, financial assistance programs for municipal wastewater, and drinking water infrastructure projects averaging $100 million/year in grants and loans.

Mr. Park is on the Board of Directors for both the Great Lakes Protection Fund, and the Association of State and Interstate Water Pollution Control Administrators. He is also the Illinois Representative to the Water Quality Board for the International Joint Commission for the Protection of the Great Lakes, is part of the Technical Committee and has held a chairman position in the past for the Ohio River Valley Water Sanitation Commission. In addition, he is part of the Judging Committee for the American Consulting Engineer Council National Engineering Excellence Awards and is a Registered Professional Engineer in Illinois.
GARY L. ROLFE
Head, Department of Natural Resources & Environmental Sciences, University of Illinois at Urbana-Champaign.

Speaker, Plenary Session II: Non-Point Source Pollution

Dr. Rolfe received his B.S. and M.S. from the Department of Forestry, University of Illinois in Forest Science/Forest Ecology and his Ph.D. from the Department of Botany, University of Illinois majoring in Ecology. He has been a professor and head of the University of Illinois at Urbana-Champaign Department of Natural Resources and Environmental Sciences since 1995, and has worked as Interim Associate Director for the Illinois Ag Experiment Station as well as in the University of Illinois Department of Forestry.

His current research interests include the ecological characteristics of old growth forests in the Great Smoky Mountains, bottomland and wetland ecology and ecosystem-based management integrating the ecological, social and political dimensions for agricultural and natural lands.

Dr. Rolfe currently teaches NRES 199/401-"Ecology of the Mixed Mesophytic Forest" during the Spring Semester.

He is part of several committees including the Executive Committee for the Conservation Congress, the Executive Committee for the Illinois Groundwater Consortium, as well as the Illinois River Coordinating Council and the Illinois Stewardship Alliance. In addition, he is a Chairman of the Illinois Forestry Development Council.

TOM SKELLY
Manager, Water Division, City Water, Light & Power

Presenter, Plenary Session I: Drought Response and Water Conservation

Tom Skelly is the Water Division Manager for City Water, Light and Power, the municipal utility for the City of Springfield, IL. Tom has been with the city for 16 years and has held his current position for nine years. Tom has purview over the operations of the drinking water utility including Source of Supply, Water Treatment, and Engineering and Distribution. He holds Bachelor and Master of Science degrees from the University of Illinois at Urbana-Champaign and was an Assistant Supportive Scientist in Aquatic Biology at the Illinois Natural History Survey prior to taking his first appointment as Supervisor of Water Resources in Springfield.
DONALD R. VONNAHME
Director, Illinois Department of Natural Resources, Office of Water Resources

Presenter, Plenary Session I:
Drought Response and Water Conservation

As the Director of IDNR/OWR, Don is responsible for the regulation of all construction in the floodways of the rivers, lakes and streams of Illinois; the administration of structural and nonstructural flood control programs; statewide water supply planning; the management of Illinois' Lake Michigan diversion; and, he is the trustee of the public waters of the state and their submerged beds.

He chairs or is a member of numerous Task Forces and Commissions such as the Illinois State Water Plan Task Force, the Illinois Drought Task Force, the Great Lakes Commission, the Upper Mississippi River Basin Association and the Ohio River Basin Commission. Don is a member of the Board of Directors of the Interstate Council on Water Policy, and he also serves on the Board of Directors of the National Association of Flood and Stormwater Management Agencies.

Previously, he was employed as a Hydraulic Engineer and Deputy Director of the Illinois Division of Water Resources in the Department of Transportation. He has been recognized with numerous professional development and management awards, given by both the National and Illinois Societies of Professional Engineers, as well as the Excellence in Flood Hazard Management Award, given by the Association of State Floodplain Managers.

Don holds a Bachelor of Science in Civil Engineering from the University of Illinois with specialties in Hydraulics, Hydrology and Economics.

RICHARD H. WORTHEN
Coordinator, Metro East Regional Stormwater Committee

Panelist, Plenary Session IV:
Urban Stormwater

Dick Worthen received a B.A. from Illinois State University in 1964 in Social Science Comprehensive and an M.A. from Illinois State University in 1971 in American History.

He has been employed as coordinator for Metro East Regional Stormwater Committee since December, 1997. The Committee is a three county ad hoc steering committee addressing local problems of interior flooding.

Previously, he was employed with Sears Roebuck Company for twenty-one years in home improvement, installation, and rehabilitation. He has also worked as an educational and training consultant with Burlington Industries, Lees Carpet Division and as a teacher of history and government at the secondary and community college level.

From 1976 to 1998, he was a county board member in Madison County and served as Chairman of the Environment Committee for many years. As Chairman, he provided leadership on issues of county transit district, solid waste planning/implementation, the public health department, and stormwater issues. He was actively involved in writing and lobbying the local siting act for pollution control facilities in Illinois in the early 80's and in implementing the same law on the County level at a later date.
Mechanistic, 3-Dimensional Modeling of Nutrient Transport and Reaction in Tile-Drained Fields

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A variety of field-scale models have been developed to simulate nutrient and agrochemical transport from tile-drained fields, but to date none incorporate a 3-dimensional representation of water flow with solute movement and reaction. Such a model will likely enhance our understanding of the roles of soil properties, preferential flow (hydrologic short-circuiting in the vadose zone), denitrification, nutrient cycling in soils, management practices, field topography, and weather variability in determining nutrient concentrations in tile drainage water in central Illinois.

As a part of the CFAR-funded Water Quality Strategic Research Initiative, we have begun developing such a model. This paper will report on progress in two areas. The first is assessing the current state of the art in field-scale models, in particular the Root Zone Water-Quality Model (RZWQM). We are also reviewing the literature in order to critique RZWQM and estimate parameter values needed to apply it to Illinois farms. But because of the high demands for computational power of 3-dimensional modeling, our objective is to identify the essential biogeochemical and transport processes and the appropriate process equations required for the new model to accurately simulate nitrate transport to tile drainage under commonly used crop management practices and changing environmental conditions.

The second area of work has been in formulating a mathematical approach for handling complex biogeochemical reactions that can be coupled with a 3-D hydrologic model. An established mathematical approach known as "operator splitting" is being applied for this purpose.
Dynamic Watershed Simulation Model
for Studying Nonpoint Source Pollution in Illinois

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A dynamic watershed simulation model (DWSM) is being developed at the Illinois State Water Survey (ISWS) using physically based governing equations to simulate rainfall-runoff, propagation of flood waves, soil erosion, entrainment and transport of sediment, and commonly used agricultural chemicals for agricultural and rural watersheds. These processes are simulated by subdividing the watershed into sub-watersheds, specifically, into one-dimensional overland, channel, and reservoir flow segments. The overlands contribute storm water runoff and its constituents laterally to the channels through the surface and subsurface soil and tile drains, which are carried downstream through the channel-reservoir network as cascading process. Model formulations are based on efficient routing schemes using established approximate analytical solutions of the physically based governing equations, which preserve the dynamic behaviors of the water, sediment, and the accompanying chemicals. The model has three major components: (1) hydrology, (2) soil erosion and sediment transport, and (3) nutrient and pesticide transport. The hydrology and sediment components were tested on the 38-square-mile Big Ditch and the 925-square-mile Lake Decatur watersheds in Illinois using monitored data. Lake Decatur, a public water supply reservoir for the City of Decatur, has high nitrate-N concentration periodically exceeding 10 mg/L and violating the USEPA and IEPA's drinking water standards. Monitoring during 1998-1999 and the monitored data will be presented in this conference as a poster. The model has been also used in studies of the Court Creek watershed, a 97-square-mile watershed in Knox County, Illinois, one of the pilot watersheds in the Illinois Pilot Watershed Program (PWP) and part of the Illinois Conservation Reserve Enhancement Program (CREP). Application of the DWSM to the Court Creek watershed will be also presented in this conference as a poster.

In this presentation, an overview of the ISWS-DWSM and its concepts and formulations, its applications to the Big Ditch and Lake Decatur watersheds verifying validity and usefulness of the ISWS-DWSM on Illinois watersheds will be presented and discussed.
Statewide Mass Balance Model for Estimating Allowable N Application Rates

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USEPA is requiring states to develop numeric water quality criteria for N by 2003. Lakes, rivers and streams not meeting these criteria will have total maximum daily loads (TMDLs) imposed that will restrict the amount of N discharged to a waterbody. Since agriculture is a major source of N, such restrictions would likely result in farmers having to reduce their application rates of N fertilizers. Finding optimal N standards that meet water quality goals and negatively impact agriculture the least would be greatly facilitated by having the capability to quickly evaluate and compare agricultural N impacts across the entire state for many alternative nutrient standard scenarios. This project will produce a model capable of predicting daily lotic nitrate (NO₃⁻) concentrations for all stream segments in the state of Illinois between 1979 and the present with known levels of confidence using a watershed-scale N balance model with spatial interpolation of model parameters. Existing statewide IEPA NO₃⁻ water quality data from approximately 200 sites will be used to calibrate and validate the model. The resulting analysis will generate: 1) estimates of spatial and temporal variation in NO₃⁻ concentrations and loads; 2) estimates of the fraction of NO₃⁻ loads attributable to agriculture; and 3) a model capable of relating NO₃⁻ export from watersheds to fertilizer application rates that can be used to rapidly evaluate multiple regulatory scenarios.
Section 303(d) of the Federal Clean Water Act requires that states list water bodies targeted for TMDL development. In Illinois, 536 stream segments and 201 lake segments are listed. This involved 336 watersheds.

Watershed management plans are to be developed over a total of 15 years that establish total maximum daily loads of problem pollutants in each of these areas. Total loads are likely to be established for small segments of the watershed and may affect landowners on a field basis. Establishing loads that landowners respect will require balancing ecological, economic, agronomic, hydrologic, and social objectives. Current discipline-centric simulation models developed by scientists in these fields are unable to capture the interactions between these different parts of the system. This talk reviews local and federal agency efforts to develop integrated multidisciplinary dynamic landscape simulation modeling approaches that will be better able to advise watershed planners.
Nitrogen Fate and Transport under Variable Cropping Systems and Soil Types at a Watershed Scale: Evaluation of the ADAPT Model

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There is a variety of simulation models available for estimating water and solute movement in tile drained fields. One possible approach to simulating nitrate transport from tile drained fields to streams would be to simulate each field in a GIS environment. However, in many central Illinois watersheds where high nitrate concentrations are a problem, soils and crop rotations are highly uniform, and spatially explicit information about the tile drain locations and N fertilizer management practices are difficult and/or costly to acquire. Thus, investment in GIS may not be cost effective. In an ongoing study, we are testing how well field scale simulation models estimate nitrate concentrations and loads at the watershed scale. This presentation will focus on results from the ADAPT model which is a combination of GLEAMS and DRAINMOD models. Model simulations will be compared with USGS stream flow measurements and IEPA nitrate concentrations for five watersheds in central Illinois. Inputs will include readily available soils data and N fertilizer application rates reported in recent surveys and in county level fertilizer sales data.
Watershed Park

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Watershed Park is an outdoor, interactive educational exhibit developed by the Illinois Department of Agriculture, funded in part by a Section 319 grant from the Illinois Environmental Protection Agency. The goal of this project is to give the public a hands-on opportunity to gain awareness of the importance of water quality and to experience good watershed management practices. Watershed Park is geared toward a 5th grade education level. However, it can be enjoyed as a fun educational environment for the entire family.

The park will be located on the Illinois State Fairgrounds and includes various stations throughout the exhibit which address best management practices (BMPs) in a watershed. Some topics addressed in Watershed Park include abandoned well sealing, soil erosion and conservation, urban storm water management and stream bank stabilization. Also included in the park are handicap accessible trails, a stream, a pond, bridges, shelters, benches, water fountains, and an outdoor amphitheater for interactive presentations.

Watershed Park is a permanent exhibit that will be operational at the 2001 State Fair. The park will be open during State Fairs, special occasions such as Earth Stewardship Day, and on an appointment basis during the months of April-October, weather permitting.
The Ten-Day Water Environment Curriculum

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To help support the academic efforts in the educational systems of Illinois, Wisconsin, and Minnesota, the Illinois Water Environment Association (IWEA), partnering with the Central States WEA, has created a comprehensive science curriculum for Grades 5-9. Both IWEA and Central States are member associations of the Water Environment Federation. To date this curriculum has been used in 85 schools since its inception in 1993.

The units of the Ten Day Water Environment Curriculum (TDWEC), comprise a detailed road map for leading the student through the issues related to the water environment including preparation of drinking water, collection and treatment of wastewater, proper solids processing and utilization/disposal, plus non-point source pollution abatement and control as it relates to both surface waters and groundwater. There is also a unit on water conservation and recycling. The Teacher’s Guide and Reference Manual provides hands-on experiments and student activities for each of the nine classroom units. Many of these offerings can easily be done in the classroom; more importantly, they allow the students to become involved and participate in the classroom. The compiled video contains eight separate videos that help explain the various aspects of the water environment. The last day is reserved for a field trip to the local water filtration plant, wastewater treatment facility, or to a local community water body in their watershed.

The Curriculum, last revised in 1997, will be again revised in 2002 and include additional reference materials and instruction guides on watersheds, non-point source pollution and urban stormwater problems. Information will be added on, for example, how the class can adopt their watershed, test surface water quality, assess the extent of shoreline erosion and learn stabilization measures that can help control any erosion observed. Also, the Guide will provide information on how the class can determine if there is an active watershed partnership in their watershed, and if not, how they can help encourage one to be developed, and register it with the National Watershed Network.
The presentation will provide a brief history of the Kankakee River Basin and a discussion of its current problems. Information will be provided regarding the outstanding diversity of the area in terms of its flora and fauna and its natural habitats. The entire Kankakee / Iroquois River watershed received a rating of "good" in the Illinois EPA's 1998 watershed assessment. Relatively free from the degrading impacts of industrial wastes and poorly treated wastewater discharges, it is sedimentation from various sources both within Illinois and Indiana which are the most serious threat to the aquatic health of the region.

The Kankakee River Basin Partnership was formed and developed a "Stewardship Plan" with goals and objectives intended to address the causes of the sedimentation problem within the watershed. Using its stewardship plan as a guide, the Partnership has formulated various proposals for projects and studies directed at understanding and controlling the sedimentation in the basin. The Partnership has been quite successful in obtaining funding in excess of $1.3 million for these proposals from IDNR's Conservation 2000 program over the past several years.

Highlights of some of these successful projects will be discussed. Specific attention will be given to the "Stateline Project" which is being developed in cooperation with the IDNR, U.S. Army Corps of Engineers, and Basin Partnership. Once approved and authorized, this project is expected to involve sand bed removal, wetland restoration, and reestablishment of mussel beds in an area of the Kankakee River adjacent to the Indiana-Illinois state line in a remnant of the once huge "Grand Kankakee Marsh." This project will test new technology for sediment removal and other restoration techniques.

The presentation will include slides of various features of the Kankakee basin.
Using the Fox River as an Educational Resource

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Goal: Develop an integrated, multi-grade level program to build a watershed of caretakers.

The Fox River was identified as the 7th most endangered River in America in 1999. Through a Monitoring Network, students are taking environmental action to protect and restore this valuable natural resource. This initiative was created to serve as a model of a sustainable effort. In its first year, it has gained national attention, gathered substantial support, and been effective in involving over 1500 participants. It involves students in peer mentoring, training, communications, and community involvement. Find out about the Monitoring Network's development, involvement, laboratory (Find out Dragon-fly Wagon), how 200 music students got into the river for a musical tribute, Monitor with your Mother, web site use, and other components of this project.
The Illinois Department of Agriculture Bureau of Land & Water Resources has developed and maintained a self-help, voluntary water resource education program, Illinois FarmAsyst, since 1996. Along with demonstrating program features and mechanics through PC multi-media, updates and program impacts will be discussed in this presentation. New components to the original program will be featured; they include: an instate toll-free water quality HelpLine, an interactive web site, new publication efforts, and an open-lands water risk assessment software.

The Illinois FarmAsyst program has also worked well with source water protection programs, to extend risk assessment efforts beyond required municipal boundaries into agricultural land-use areas, where ground and surface water influences can be related in unconfined aquifer venues. The pilot program called, Targeted Aquifer Protection, or "TAP", has demonstrated the usefulness of providing communities with program-related feedback from Illinois FarmAsyst results. The greatest incidence of risk factors can be prioritized with local and state cost share funds made available through trial funding mechanisms, and hence, a community's water supply can be made safer without costly remediation. Pertinent case study information will be reviewed.

Illinois FarmAsyst is administered to the local level through 98 county soil and water conservation districts across the state. Significant funding and support for the program is supplied by the Illinois EPA and staffed by the IDOA's Bureau of Land and Water Resources. This is perhaps the only state administered voluntary water education program that has been designed for, and that can reach, virtually every Illinois county's rural area. Local attitudes towards water stewardship largely determine program use and outcome.
Quantifying the Status of Flood Prone Structures in Illinois

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Because of its large population and prevalence of waterways, Illinois has consistently ranked within the top 10 states in the nation for both flood insurance claims and repetitive loss properties. However, since the 1993 flood, strong floodplain management programs in Illinois have produced many positive results. Thousands of local officials and property owners have been educated on the importance of properly regulating construction in identified flood prone areas. In addition, millions of federal and state dollars have been used in Illinois for the expansion of floodplain buyout and relocation programs. The results have been a noticeable decrease in the number of properties in the state where repetitive flood insurance claims occur.

In an effort to further reduce these repetitively flooded structures, the State has recently completed a detailed analysis and established a repetitive loss data base. In addition to this database, a Plan of Action for Repetitive Loss Properties was developed as a written summary of the findings and to serve as an addendum to the Illinois Hazard Mitigation Plan. The Plan of Action addresses the methodology and data collection findings, as well as suggests mitigation options and provides a resource to prioritize all future mitigation projects in the state.

Based on study findings, Illinois far outranks other states in the nation for keeping new development out of flood prone areas. Illinois also ranks as one of the top two states in the nation for reducing the number of repetitively flooded structures. While the effort is just beginning to show results, future floods in Illinois will not damage as many properties as in the past. This will result in fewer flood insurance claims and reduced long-term cost to the taxpayers of the State for emergency response and flood recovery efforts.
The Necessity for a Real-Time Streamflow Data Network:
The Multitude of Uses and a look at the Cost Issue

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The State of Illinois and the Midwest face many water issues, including floods, droughts and water pollution. The U.S. Geological Survey (USGS) operates and maintains a real-time network of over 170 streamflow-gaging stations in Illinois. The data from this network are used for many of the water issues that the State is facing now. Every day the data are used to operate river control structures for barge traffic, drinking-water intake pumps, and hydroelectric and nuclear power plants. The availability of real-time streamflow data for these purposes is important and critical during times of floods and droughts. During floods, the data are used to make decisions such as: operation of control structures, where and what type of flood-fighting efforts such as sandbagging, evacuation, or road closures, and adjustment of computer models to forecast flood crests. During floods, water-management agencies make decisions that can result in saving or spending multi-millions of dollars; thus they need accurate and up-to-date data to make these decisions. During drought conditions, these data are used to monitor and manage drinking-water supplies, water-quality conditions, and operation of hydroelectric and nuclear power plants. The effect of shutting down a nuclear power plant because not enough water is available for cooling can cost the power industry up to a million dollars per day and result in power outages.

The data collected from the USGS real-time network are archived and used in numerous ways. For example, streamflow data are used to determine the low flow characteristics of streams to facilitate determination of waste-load allocation and water-supply capacity, to determine the flood characteristics of streams for bridge design and flood inundation mapping, and to understand the hydrology of streams to assist in biological and climatological studies.

Presently, the annual operating cost of a streamflow-gaging station in Illinois by the USGS is approximately $10,000. The benefits of having quality and timely data collected must be considered carefully. During a single hydrologic extreme event, making the correct water management decision may well pay for the cost of the station for many years.

Kane County, Illinois: Stormwater Management Programs

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Kane County, Illinois is in the midst of tremendous change as its landscape faces increasing urbanization pressures. Since 1996 the Kane County Department of Environmental Management (DEM) has developed and adopted a Comprehensive Stormwater Management Plan and initiated several programs to improve countywide stormwater management and improve water quality.

The DEM addresses and mitigates present stormwater issues and prevents future problems. To address current concerns, the department operates a countywide stream maintenance program. Under the stream maintenance program, staff respond to requests for assistance in addressing regional residential flooding matters. Since its inception in 1997, over 50 miles of streams throughout the county have been surveyed or maintained and logged in a digital database for ongoing stream tracking. In addition, the department sponsors modeling and engineering studies as necessary to develop solutions to regional hydrologic and hydraulic stormwater issues.

To prevent future problems, the DEM has drafted a Countywide Stormwater Ordinance made possible through 1989 Illinois State legislation enabling five Chicagoland "collar" counties to develop stormwater regulations. The ordinance establishes guidelines for detention and retention, BMPs for construction and agriculture, floodway and floodplain management, and buffers necessary for protecting wetlands and other water bodies. The Stormwater Ordinance is scheduled to be adopted by the Kane County Board in November, 2000. Modeling efforts on several of the county's watersheds, including a comprehensive hydrologic/hydraulic/water quality modeling effort currently underway in Blackberry Creek watershed, will give staff new tools to effectively address issues such as development in the floodplain and modifying structures in existing floodways.

The DEM is also working cooperatively with the Kane County Forest Preserve District to purchase lands to be used as both open space and stormwater management. In a similar effort, the county is participating in an Advanced Identification of Wetlands (ADID) project to identify and delineate high-quality wetlands to supplement traditional wetland maps.

Staff have initiated several water quality improvement programs as well. Federal Total Maximum Daily Load (TMDL) and National Pollutant Discharge Elimination System (NPDES) program requirements are being addressed through countywide educational and organizational activities. At the local level, staff assist with administration of funding for streambank stabilization programs to address downstream water quality issues. The county works cooperatively with local governments and nonprofit groups such as watershed planning committees.
Water Withdrawals and Water Use in Illinois and Nearby States; Results and Trends, 1950-1995.

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From 1950 through 1995, the U.S. Geological Survey tabulated offstream water withdrawals in the north-central States of Illinois, Indiana, Iowa, Kentucky, Missouri, Michigan, and Wisconsin to examine regional trends in water use. During this period total water withdrawals increased in each of the north-central States by at least a factor of two. Illinois led the north-central States in total withdrawals and withdrawals from surface water and, typically, withdrawals from ground water. Per capita withdrawals were highest in Indiana or Illinois, however, the disparity in per capita withdrawals in the north-central States decreased from 1950 through 1995. Surface water was the source of 75 to 95 percent of all water withdrawals in these States and consistently accounted for over 90 percent of total withdrawals in Illinois. From 1950 to 1995, the magnitude of increase in withdrawals from surface water was lower in Illinois than in most of the other north-central States, even though surface water withdrawals in Illinois increased from about 9,000 to 19,000 million gallons per day. Total water withdrawals from ground water in Illinois have decreased by about 150 million gallons per day since 1975. From 1950 to 1995, 68 to 86 percent of the total water withdrawals in Illinois were for generation of thermoelectric power; the percentage is somewhat higher than for the other north-central States and has increased since 1970. Approximately 12 percent of water withdrawals in Illinois are for municipal water supply, which was consistent with the other north-central states.
Tradeoffs Among Candidate Water Withdrawal Regulations: An Illinois Example

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As Illinois proceeds to formulate the large number of 303(d) programs it is obligated to undertake under the clean water act, it would be ill-advised not to take account of water quantity and the potential for future stream withdrawals to impact water quality.

As a follow-up to a paper presented at Illinois Water '98, this paper reports on further findings of a project to estimate the hydrologic and economic outcomes of alternative potential regulations to control the withdrawal of water, for commercial use, from Midwestern streams. The research estimates the frequency of low flow events and farm profits, both characterized as cumulative distribution functions (CDFs). These estimates are generated for an example river basin in Illinois, the Sangamon River at Monticello, using the SWAT model developed by the ARS in Temple, TX.

Five candidate water withdrawal regulation scenarios are modeled, which represent a spectrum of severity of possible regulatory options. These are: 1) no regulation, 2) constant withdrawal limitation, 3) withdrawal limitation proportional to streamflow, 4) no withdrawal, and 5) a regulation that imposes no limitation on withdrawals until a trigger low streamflow is breached, and then stops all withdrawals abruptly. Scenario 1) represents the current status quo in Illinois, as there is no effective regulation of surface withdrawals. Scenarios 2) and 3) represent practicable candidates for regulation of streamflows. Scenario 4) represents the most restrictive regulation possible, and is simulated only to establish a benchmark of severity against which to evaluate the other alternatives. Within Scenarios 2) and 3), several quantitative levels of allocation were modeled, as was market trading of withdrawal permits. Several climate change scenarios were modeled, representing various combinations of changes in the mean and variance of precipitation, including no change from historical patterns.

The results show that, regardless of the climate scenario, the following trends hold. The no-regulation scenario, as expected, is best at maintaining farm profits but has the highest frequency of low-streamflow events. And, of course, the no-withdrawal scenario has the lowest profits (and highest profit variability) and the lowest frequency of low-flow events. The practicable regulations represented by Scenarios 2) and 3), as expected, fall somewhere in the middle on both scores. However, the proportional-withdrawal regulation (Scenario 3) achieves a far better tradeoff between profit and streamflow preservation than the fixed-withdrawal regulation, Scenario 2). Scenario 5) achieves a very poor tradeoff between these two objectives. For both the fixed- and proportional-withdrawal Scenarios 2) and 3), withdrawal permit trading substantially improves both profit and streamflow preservation performance. The effect of climate change on both low-flow frequency and profit is generally diminished under a withdrawal permit trading program.
Drainage Management to Improve Water Quality and to Enhance Agricultural Production

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Illinois is one of the most productive agricultural areas of the world, and in many parts of the state, this productivity relies heavily on the practice of drainage. Within the state there are approximately 10 million acres of drained farmland. Most of this land is drained with subsurface tile. Due to naturally high water tables, these soils need drainage for economical crop production. Drainage is practiced to insure trafficable conditions for seedbed preparation, planting, harvesting and other field operations. It is also practiced to reduce crop stress from excess water within the root zone, following periods of high rainfall. These are necessary and important functions of drainage systems.

Although in many areas drainage is essential for economic crop production, the nutrient rich tile flow has produced significant environmental impact. High nitrate levels have endangered public water supplies in some areas. Also studies have suggested that nitrogen enrichment is the main cause of the hypoxic zone in the Gulf of Mexico. Tile flow data have shown that a large portion of the total nitrogen load to the Mississippi River is being delivered to surface water from tile drainage systems in the Midwest. Though tile drains contribute significant amounts of nitrate to receiving streams, the economic importance of tile drainage to the agricultural and the Illinois farm economy precludes the removal of tile-drain systems in order to improve water quality.

The tile-drain systems are typically constructed without any control mechanisms and allow the soil to drain whenever the water table is above the elevation of the tile outlet. If water level control devices were retrofitted to tile systems, drainage management could be practiced. Drainage management, a form of water table control, would allow for drainage outlets to be artificially set at levels between the ground surface and the drain outlet. The water table could be allowed to rise during the fallow season, which would result in significant water quality benefits. Also, raising the water table after planting can keep water and nutrients available for plant use during the growing season, which could produce a significant production benefit.

The objective of this presentation would be to describe how drainage management could provide water quality and agriculture production benefits. Results of computer simulations will be used to show how drainage management can decrease nitrate loading to streams, decrease stress or damage to crops during dry periods, and potentially provide seasonal habitat for wildlife and waterfowl. This has significance for Illinois, the Midwest region, and the nation. National benefit includes reduced nitrate loading to the nation’s largest river system and to the Gulf of Mexico, where high nitrate levels are thought to be contributing to excess algal growth and subsequent oxygen depletion (hypoxia).
Can Carbon Enhanced Conservation Buffer Strips Better Protect Water Quality?

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The Clean Water Act has focused on conventional pollutants generally associated with point source discharges. Now the Clean Water Act has a sequel. Part two is headed to the countryside and fields if a water body is failing to meet federal or state water quality standards. This is requiring Total Maximum Daily Load studies which may put a significant burden on farmers who are contributing pollutants to effected water bodies. In response to this burden, the USDA has launched the National Conservation Buffer Initiative to help encourage controls to reduce the loading of farm chemicals on our nation’s waters.

The paper will summarize my three years of research at Pana High School in using Illinois coal along with vegetation in buffer strips to remove pesticides before they reach surface and ground waters. This resulted in my presenting a paper and project on this research at the Illinois Junior Academy of Science Regional competition and State Expositions. My project this year was rated as outstanding by the Academy. Also, this year I received the Grand Prize in the Illinois Water Environment Association’s Clean Water Awards program at the State Exposition.

I decided to use coal as my source of carbon since it has a ninety to ninety-five percent carbon content and is available through local mines near our farming community. I also decided to use coal since if I could prove my hypothesis correct, it could help the economy, the farmers, and the local coal mines. I will present the variables in my experiment and field trials including whether coal was used in the buffer strip, the types of coal used in a buffer strip, the application rates of coal that were used, and the amount of organic residue in the fields. I will discuss how they affected the concentrations of pesticide found in the soil and water.
The Illinois EPA, in their Illinois Water Quality Report - 1998 Update, reports that, of the waters assessed for overall and individual use support, 44% of our streams and 75% of our inland lakes have some level of use impairment, most of which is due to nonpoint sources. Also the report indicates that 44% of the State's streams and 75% of the inland lakes assessed need additional actions to correct nonpoint source problems. Agriculture is the primary cause of use impairment. Livestock waste, pesticides, fertilizers and soil erosion are the categories of agricultural pollutants that have adverse effects on water quality. This paper will be directed at the livestock waste aspect of this pervasive problem.

To date, the Illinois EPA has addressed this problem primarily by investigating complaints concerning pollutional discharges from livestock (animal) feeding operations (AFOs) and, as necessary, enforces the requirements of the Environmental Protection Act and the regulations of the Pollution Control Board on owners and operators of these operations. Recently a new player, the US EPA, has taken an active interest in controlling and preventing pollution from confined animal feeding operations (CAFOs). In March of 1999, the US EPA and the United States Department of Agriculture (USDA) published a Unified National Strategy for Animal Feeding Operations. The Strategy provides a comprehensive framework for using voluntary and regulatory methods to protect public health and water quality from CAFOs. Included within this Strategy are priorities for regulating these CAFOs in the existing National Pollutant Discharge Elimination System (NPDES) permit program.

To help implement this strategy, the US EPA Region 5 has asked the states to prepare a compliance assurance plan for CAFOs that identifies State priority areas and includes the scheduling of inspections for operations with 1000 or more animal units in these priority areas. Also, they want states to develop a strategic approach for identifying and inspecting those CAFOs with more than 300, but less than 1000 animal units. In response, the Illinois EPA has identified their priority areas as those waterbodies that the current 305 (b) report identifies as being impacted by livestock waste. This report identifies 52 waterbodies so impacted and an inspection strategy to identify and inspect these CAFOs is currently being developed by the Illinois EPA.

This paper will discuss this strategy and its potential impact on the Illinois farmer. Furthermore, case histories will present current pollution problems encountered by the Illinois EPA and corrective actions taken to abate and prevent pollution from these operations. It also will present costs incurred by farmers in constructing these improvements and sources of financial assistance available to the farmer to comply with these state and federal regulations on animal waste management. Slides will be used to illustrate problems encountered and solutions implemented.
The Effects of Sediment Characteristics on Denitrification in Big Creek

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Extensive non-point source inputs of nutrients, such as nitrate, into streams can greatly contribute to the eutrophication of downstream water bodies. The process of denitrification within stream sediments is critical for the removal of nitrate from overlying stream water. This study investigates the effects of differing sediment compositions on denitrification rate in Big Creek, an agricultural and forested watershed in Southern Illinois. Comparisons were made between sediment characteristics and denitrification rate in a "natural" gravel dominated substrate and a channelized sand-silt dominated substrate. Denitrification rates were estimated using both the acetylene block technique and the sediment core incubation technique. Addition of acetylene to sediment slurry incubations was performed to determine potential denitrification rates of sediments under optimized conditions. The acetylene block incubations were performed as part of a cooperative effort with members of the University of Illinois, Department of Natural Resources and Environmental Sciences. Laboratory incubations of sediment cores at stream temperature were used to determine actual nitrate loss from overlying stream water. Characterization of sediments were made on the basis of particle size, pH, organic matter content, and nitrogen content. Preliminary data indicates a higher rate of denitrification with in the channelized stream segment. The potential difference in denitrification rate is likely to be due to a prevalence of organic matter in the sediments of the downstream channelized site.
“Urban Stormwater Management and Ecological Restoration” is not an oxymoron

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A working coalition of state and federal agencies is in the planning and modeling stages of a novel stormwater management and ecological restoration plan for the American Bottoms of Illinois. The focus includes a multiple watershed planning effort designed to create and enhance the area’s ecosystem while controlling storm water events which cause serious flooding for the urban residences. Challenges include a project footprint which lies within an urban area, natural wetlands which have been severed from the hydrologic pulse that created them, stream bank stabilization and sedimentation concerns, and nationally significant agricultural lands.

When complete, this plan will attempt to mimic the presettlement hydrology in the project area by management of up to the 100 year flood event. Increased biodiversity can be expected through the reestablishment of wet prairies, forested wetlands, marshes and meandering streams totaling up to 5000 acres. The project is expected to directly improve water quality by reducing sediment loads throughout the system and improved flood protection while developing and protecting significant environmental resources.

In this presentation we will introduce the project area and restoration plans. Results of the Habitat Evaluation Procedure (HEP) will be presented for selected areas as well as a discussion of the tradeoffs of social, economic and ecological considerations that necessarily take place in the planning of a project of this size.
Urban Waterway Water Quality Strategy for Chicago

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The history and physical description of the Chicago Waterway System provides backdrop for a strategy to allow the Chicago Waterway System to achieve the goals of the Clean Water Act. Complicating factors in this strategy are the diminished flow of dilution water from Lake Michigan, dominance of flow in the system by effluents from sewage treatment plants, inflow of nonpoint source pollutants from two major watersheds plus numerous small tributary areas, occasional combined sewer overflows and the prevalence of legacy pollutants in sediments. The impact of combined sewer overflows is greatly diminished with the completion of the Tunnel and Reservoir Plan (TARP) Phase I tunnels and will be further reduced with the completion of the TARP Phase II reservoirs.

Water quality conditions have shown dramatic improvement since the 1970s with the completion of major improvements at sewage treatment plants and supplemental aeration stations and the near completion of the TARP tunnels. It is yet to be determined if further improvements in infrastructure are needed to achieve water quality goals.

Of current concern is the methods and procedures used to analyze and determine the causes and sources of impairment in the Chicago Waterway System. Additional monitoring is necessary to provide the data required to make scientifically defensible conclusions regarding impairment issues. Causes and sources require more detailed definition. Ongoing issues regarding sediment quality, biological conditions and fish contaminant advisories require additional monitoring.

Although the Chicago Waterway System was listed as impaired in 1998 by the Illinois Environmental Protection Agency, continued listing in the future is uncertain as monitoring is increased and the methods for impairment assessment are improved. If impairment of the Chicago Waterway System continues to be an ongoing problem, total maximum daily loads (TMDLs) will be established. Equity demands that there be a reasonable allocation of TMDLs to point sources, nonpoint sources, and the legacy pollutants. A dramatically different strategy for resolution of the impact of legacy pollutants must be developed. Significant limitations on habitat will remain as long as the waterways are primarily used for urban drainage and commercial navigation. Innovative ways to compensate for habitat limitations must be sought.
Sources of nitrate (NO$_3^-$) in groundwater of the shallow karst aquifer in southwestern Illinois' sinkhole plain were investigated using chemical and isotopic techniques. The groundwater in this aquifer is an important source of potable water for about half of the residents of the sinkhole plain area, and it discharges from springs that feed surface streams. Previous work showed that groundwater from 18% of bedrock wells in the sinkhole plain have NO$_3^-$ concentrations in excess of the USEPA's drinking water standard of 10 mg-N/L. Relative to background levels (approximately 1.4 mg-N/L NO$_3^-$), NO$_3^-$ concentrations in groundwater from 52% of the wells, and all of the springs sampled in the study area are anomalously high, indicating that sources other than naturally-occurring soil organic matter have contributed NO$_3^-$ to the groundwater. This information, and the dominance of agriculture in the study area, suggested that agrichemical contributions to groundwater may be significant. To test this hypothesis, water samples from 10 relatively large karst springs were collected during four consecutive seasons and analyzed for inorganic constituents, atrazine, and $d^{15}$N and $d^{18}$O of the NO$_3^-$ ions.

Groundwater samples from the springs were Ca$^{2+}$-HCO$_3^-$ type waters that were oversaturated to slightly undersaturated with respect to calcite, aragonite and dolomite, and oversaturated with respect to quartz. The pH values ranged from 6.8 to 8.2, with most samples having values greater than 7.5, which reflects the buffering effects of the carbonate bedrock. The temperature of spring water can be indicative of the seasons and the openness of the flow system. Specific conductance ranged from 450 to over 800 μS/cm and can be used as a direct measure of alkalinity. Chloride concentrations ranged from 7.8 to 24.7 mg/L. Water samples collected during the spring for all the sites contained the highest Cl$^-$ concentrations. Chloride values tended to drop systematically throughout the year with winter showing the lowest concentrations. This drop may be due to spring-time recharge bringing in anthropogenic sources of Cl$^-$, possibly related to livestock, agrichemicals, septic effluent and/or road salt. Nitrate concentrations ranged from 2.28 to 7.48 mg-N/L, which are below the USEPA's standard for drinking water of 10 mg-N/L, but above background. That is, all springs had been contaminated with NO$_3^-$ by one or more sources. Atrazine concentrations in groundwater were highest in the spring-time and correlated with NO$_3^-$ concentrations, suggesting agrichemical runoff into sinkholes and associated macropores.

The isotopic data were most definitive and suggested that sources of NO$_3^-$ in spring water were dominated by N-fertilizer with some influence of atmospheric NO$_3^-$, and human and/or animal waste. Differences in the isotopic composition of NO$_3^-$ and some of the chemical characteristics were observed during all four seasons in which spring-water samples were collected. Isotopic values for $d^{15}$N and $d^{18}$O of the NO$_3^-$ ranged from 3.2 to 19.1‰ and 7.2 to 18.7‰, respectively. The trend of $d^{15}$N and $d^{18}$O data for NO$_3^-$ also indicated that a significant degree of denitrification is occurring in the shallow karst hydrologic system (within the soil zone, the epikarst and the shallow karst aquifer) prior to discharging to springs.
The Age and Chemical Composition of Groundwater from the Mahomet Valley Aquifer: Implications for Recharge Zones, Groundwater Movement and its Geochemical Evolution

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The Mahomet Valley Aquifer (MVA) is a major source of drinking water for about 800,000 people in central Illinois, and for industrial and agricultural interests. Because of its importance, an understanding of groundwater movement within and recharge to the aquifer system is necessary for proper management. This investigation involved the determination of the chemical composition and isotope geochemistry of 40 groundwater samples from wells that pump from the MVA and overlying aquifers. New techniques were used to date the groundwater samples.

Preliminary $^{14}$C data on groundwater from Champaign Co. indicate an age between 3000 and 5000 years BP. A post-glacial age is supported by dD and d$^{18}$O data. Absolute ages of the groundwater are problematic because of methane in parts of the aquifer. Methanogenesis alters the concentration and isotopic composition of the dissolved inorganic carbon, making the interpretation of $^{14}$C ages difficult. To help resolve this problem, we took a new approach to dating the groundwater by using the $^{14}$C age of fulvic acid extracted from groundwater and evaluating the geochemical evolution of the groundwater. Fulvic acid is derived from the decomposition of vegetation and should yield a more representative age.

The radiocarbon data indicate that groundwater is probably being recharged from the surface most rapidly in the northern two thirds of Champaign Co. Groundwater farther from Champaign Co. (toward the west, east and northeast) has lower $^{14}$C activity and is older. The data support the hypothesis that groundwater in the Onarga Valley (the northeastern branch of the MVA) is recharged from an underlying carbonate bedrock aquifer that has a strong upward hydraulic gradient. The variable geochemistry at the boundary between the Onarga Valley and the main channel of the MVA indicates a zone of mixing. The western portion of the MVA has significantly slower rates of recharge than the central portion in Champaign Co. The western end of the MVA discharges into the confluence area of the Mackinaw Valley Aquifer (MCVA). Differences in Cl$^{-}$ concentrations between the MVA and the MCVA allowed us to calculate the volume of groundwater discharging from the MVA into the MCVA. These data showed that discharge from the MVA at the confluence is only about three million gallons per day.

Relatively low recharge rates in the western part of the MVA are reflected in the redox conditions of the groundwater. Somewhere near the Champaign-Piatt Co. line, groundwater of the MVA contains significantly more dissolved methane and no detectable sulfate. These lower redox conditions may be exacerbated by discharge of saline groundwater from depth along a bedrock structure in the same area. Lower redox conditions appear to have a profound effect on the concentration of arsenic in groundwater of the MVA. Previous work by the authors found that arsenic concentrations increase from below detection limits east of the Champaign-Piatt Co. line to 20-70 micrograms per liter west of the line. These concentrations greatly exceed the new five µg/L limit for arsenic now being promulgated by the U.S. Environmental Protection Agency.
The wellfield management computer model uses a production well status database, measured well flows data, analytical results of water samples collected at each well, their associated treatment cost (comprised of the sum of electrical, water treatment and sludge disposal costs for each well), concentration of parameters of concern at each well, and other database fields necessary for the computer model. Parameters of concern could be trace concentrations of a specific regulated parameter such as radon, a heavy metal, or a nutrient such as nitrogen or phosphorus, or a pesticide. Shallow groundwater aquifers are known to be impacted by nutrients, pesticides, herbicides and insecticides in agricultural areas (USGS, 1999).

The wellfield management computer model determines the well operation priority that will maintain an influent to the WTP within a specified parameter concentration range. To accomplish this, the model (1) tracks flows and parameter-specific concentrations for all production wells that contribute to the influent to the WTP; (2) tracks data on flows and target parameters concentrations for the WTP influent, including changes in concentrations in the influent to the WTP from one day to the next; (3) calculates the total flow and parameter-specific concentrations of the WTP influent based on changes associated with operation scenarios or individual well operation status; and (4) calculates the daily water treatment costs based on the actual wells operation. The model was calibrated against actual daily flow and one target parameter.

The purpose of this paper is to present an overview of the wellfield management computer model, including a description of wellfields, water treatment process, model data inputs and outputs, and programming algorithms used.

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The U. S. Geological Survey, National Water-Quality Assessment (NAWQA) program is designed to provide the status and trends of the Nation's water resources. The lower Illinois River Basin (LIRB) is one of more than 50 NAWQA study units throughout the country. The lower Illinois River Basin encompasses 18,000 square miles of western and central Illinois. About 1.3 million people live within the study-unit area. The source of public-water supply is about 50 percent ground water. During 1995-98, samples were collected from 117 wells, 8 surface-water sites, 8 habitat and biology sites, and 20 bed-sediment and fish-tissue sites.

Agrichemicals in surface and ground water is a major issue in the LIRB. Concentrations of nutrients generally were low in sampled ground water; however, nitrate exceeded the drinking-water standard of 10 mg/L in less than 10% of ground-water samples. Pesticides and pesticide transformation products were detected in 21% of water samples from the shallow glacial drift aquifer. Metolachlor ethanesulfonic acid was the most frequently detected pesticide-related compound. Only six volatile organic compounds (VOCs) from five wells were detected in ground-water samples. Methyl tert-butyl ether (MTBE) was detected (0.59 micrograms per liter, ug/L) in one sample from a shallow glacial drift aquifer. Radon concentrations in ground water ranged from less than 80 to 1,300 picocuries per liter (pCi/L). In the shallow aquifer samples 44 percent of the radon concentrations exceeded the drinking-water standard of 300 pCi/L. 30 water samples from the deep glacial drift aquifer in the Mahomet buried valley were analyzed for arsenic. The 10 wells with the highest concentrations of arsenic were resampled to determine arsenic speciation. In the deep glacial aquifer, 60 percent of the samples exceeded 5 ug/L of arsenic, and one-half, or more, of the arsenic is in the more toxic arsenite form.

Agrichemicals in surface water is a greater concern than ground water in the LIRB. Nitrate concentrations are higher—18 percent of the samples exceeded 10 mg/L. Nitrate concentrations in the Illinois River at Ottawa (inflow to the basin) and Valley City (outflow from the basin) were similar (7.6 and 5.6 mg/L, respectively), but the nitrate load at Valley City (122,000 tons per year) was almost double the nitrate load at Ottawa (65,000 tons per year). Nitrogen concentrations typically were higher and more variable in the smaller drainage basins, whereas organic nitrogen and phosphorus concentrations were higher in larger drainage basins.

More pesticides were detected in surface water (31) than in ground water, and priority pollutant metals were frequently detected in stream sediments. Atrazine and metolachlor were detected in every surface-water sample from the reporting level up to 120 ug/L. Cyanazine and prometon were detected in more than 90 percent of samples from the reporting level to 2 ug/L. Acetochlor, simazine, and alachlor were detected in three-quarters, or more, of samples. In May–June periods during 1996–98, atrazine concentrations exceeded the drinking-water standard of 3 ug/L in 60 percent of the surface-water samples. Cyanazine also occasionally exceeded the drinking-water standard. The highest pesticide concentrations were detected in stream samples collected following spring chemical applications. Dieldrin and a transformation product of the pesticide dichloro-diphenyl-trichloroethane (DDT) were the most frequently detected organochlorine compounds in fish tissue.
This presentation will provide a brief overview of some of the simulation models that have been developed to estimate transport of water, sediment, nutrients and pesticides from agricultural fields and how these models could be used or modified to address TMDLs in agricultural watersheds. Models such as CREAMS, GLEAMS, RZWQM, LEACHM, DRAINMOD were developed to simulate processes at the scale of fields or smaller and do not address watershed scale processes such as base flow or in-stream chemical transformations. Recently, models such as SWAT and AGNPS have been linked to GIS to simulate upland processes and in-stream processes. However, data are needed to verify some of in-stream model parameter values for Midwestern conditions. Moreover, the AGNPS model does not simulate the effects of tile drainage, and therefore will not be suitable for many Illinois watersheds that produce high loads of nitrate N through tile drainage. Lack of information about the location, density and other characteristics of existing tile drainage networks may hamper representing tile drainage in watershed scale models.
Developments in Subsurface Drainage in Illinois: Mapping Tiles and Modeling Flow

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A distributed, physically-based flow model has been developed to specifically address the influence of irregular tile networks on Midwestern watershed hydrology. This model utilizes vector coverages of tile networks that were obtained from aerial infrared images taken in spring, a few days after a soaking rain. The model relies on topographic analysis to determine flow paths for all surface processes. The subsurface flow subroutines account for the spatial conditions encountered at the field level, particularly the presence of single or multiple tile lines which drain the soil profile and affect the subsurface water balance. The tile system is modeled as a network of links and nodes that are connected to the streams in the watershed. Water that is drained by individual tile lines is routed through the network using the kinematic wave approximation to yield transient responses to precipitation. The paper discusses issues encountered in modeling the tile drainage system and presents the application of the model to the Upper Little Vermilion River watershed in East Central Illinois.
A chemical fate and transport experiment is in progress on a tile drained field near Champaign IL. The experiment is designed to quantify chemical residence times in a tile-drained watershed as a function of application distance from the drain. The experiment is performed within four plots (30 m x 30 m each) which are hydrologically isolated by a system of tile drains and border drains. Each plot is instrumented with a nest of piezometers (15) and tensiometers (12), as well as 4 thermocouples. These instruments are fully automated, by employing pressure transducers and data loggers to record water table fluctuations, soil water pressure variations, and soil temperature at 15 and 30 cm depths on a 10 minute time interval. Other instrumentation at the field site includes a nest of 6 automated rain gauges, soil lysimeters for soil evaporation measurement, a weather station recording wind velocity and run, air temperature, humidity, pan evaporation. Each plot has a research drain and a border drain. Each drain is connected separately to a sump pump within a sump pit. The research drain, which drains the plot area, is also connected to an automated solution sampler which samples tile effluent on a 10 minute time interval. A suite of 7 water tracers were applied in narrow bands that ran parallel to the drain, and which were situated at various distances from the drain. These tracers include bromide, chloride, and several benzoic acid derivatives, and are used to quantify the water flow path distributions during transient flow events. Nitrate was applied uniformly to the plot surface. Preliminary results will be presented.
Conjunctive Overland, Soil and Tile Transport Model for Farmland Drains

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Agricultural pollutant transport comes mainly from major rainstorms and heavy irrigation applications. Rainfall intensity always varies with time and space. Consequently, major runoff from a farmland varies with time and space, on the overland as two-dimensional (2-D) unsteady non-uniform open channel flow, in the soil as time varying unsaturated and saturated porous media three-dimensional (3-D) flow, and in the tile it is unsteady spatially varying open channel or surcharged flow. It is during the high flow that most of the constituent transport occurs. The flows on the land surface, in the soil and in the tiles are inter-related. Despite the importance of farm plots as the source of pollutants, no model exists to simulate or predict the agricultural runoff process reliably and scientifically. Particularly, no model exists for accurate simulation of simultaneous overland, soil and tile flows in farmland scale. There exist many 1- or 2-D flow models for overland runoff. There are many 1- or 2- or 3-D subsurface models for saturated as well as unsaturated porous media flows. There are also a number of models for 1-D open-channel and surcharged flows in pipe networks, especially those for sewers, which are similar to tile networks. But no model links the tile network, soil and overland components together to provide reliably the basic information on farmland runoff which is the source of this type of non-point source pollution.

Under the sponsorship of C-FAR SRI-WQ a one-dimensional non-inertia sewer network model of Paliagad and Yen (1996) has been modified and linked into the two-dimensional surface three-dimensional subsurface model to simulate conjunctive flows in the overland, porous media and tile drains. The vertical drains and pumping wells can also be simulated as sources and sinks within the model. Tests based on small size plots will be conducted for accuracy and stability of the model. Coordination with Dr. Hudson and Dr. Valocchi has been planned to use this model as part of their study on the transport of nitrate and other chemicals in the farm field.
One of the most critical components of a successful comprehensive stormwater management program is an adequate and reliable revenue stream to carry out the required stormwater activities and responsibilities. A user fee has evolved as a fair and equitable means of financing stormwater management. However, implementation of a user fee has proven to be a major roadblock to many programs that lacked certain critical success factors. This presentation examines a number of stormwater user fee programs in the midwest and across the country to identify the critical components that enabled their successful implementation as well as the roadblocks that have prevented or delayed others from implementation.

The minimum requirements for successful implementation of a stormwater user fee include:

- Problems and need
- Legal authority
- Technical data
- Administrative resources
- Political support
- Public involvement
- Champion or visionary

Several of these requirements, such as technical data, administrative resources, public involvement, and even a champion or visionary can be acquired, developed or enhanced given enough time and the appropriate resources. However, the others may be more difficult to put in place, may be impossible to control, and are often “roadblocks” to the successful implementation of the user fee.

Problems and need may be defined through analysis of the stormwater system, but are really only validated by a major flood event and its associated damages and inconveniences. Political support may be developed over time, but is often achieved most easily by actual flooding problems and the public’s response to these problems. Legal authority, although related to political support, may often be the biggest roadblock that requires the most effort and the right timing to succeed. Nonetheless, each of these minimum requirements has been met successfully by those programs with user fees in place. The experiences of those communities with successful stormwater user fee programs provide valuable lessons in implementing a stormwater user fee.
Stormwater User Fee – The Mechanism of Choice*

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The presentation will provide a basic discussion of the stormwater user fee as the financing mechanism of choice in the management of stormwater on a local level. The introduction will summarize a short history from the first user fee in the 1980's and explain the explosion of user fee programs to exceed 400 at the present time. This information will explain the development of the user fee as the mechanism of choice.

Discussion will be presented to differentiate between taxes and fees. Proper understanding of these differences will be important to any advocates for the user fee since citizens and politicians often do not understand the difference. A short discussion of the principles to use in choosing a financial mechanism will be emphasized: fairness, yield, collectability, and acceptability. This information will indicate a preference for users fees.

Definitions important to the concept of stormwater user fee will be presented, and a full discussion will be conducted to explain how a stormwater user fee program works. This will include a calculation of the costs to property owners, explanation of higher costs to large users of the storm sewer system, billing, implementation, coordination for a unified program, operation and maintenance, public education and participation, and other aspects of a successful program. Examples of existing programs will be shared and mixed into the presentation as useful. This information will explain the everyday functions of a user fee program.

At the conclusion, a summary of pluses and minuses will be offered. Included in the minus category will be observations on the legal situation in Illinois, and a recommendation to work toward an enabling statute to allow this alternative to be created.

* Speaker moved to Plenary Session IV
Monitoring Big Ditch and the Upper Sangamon River during Storm Events for Nonpoint Source Pollution

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The Illinois State Water Survey (ISWS) has established an extensive monitoring network in the 925-square-mile Upper Sangamon River basin draining into Lake Decatur in central Illinois and has been monitoring stream flow and nitrate-N concentrations for over six years. Lake Decatur, a public water supply reservoir for the City of Decatur, has a history of high nitrate-N concentration, periodically exceeding 10 mg/L, and violating the USEPA and IEPA's drinking water standards. Under an Illinois Groundwater Consortium funded research project, one tributary station and two mainstem stations were intensely monitored for water discharge, nitrate-N, phosphate-P, atrazine, and metolachlor during the 1998 and 1999 spring and early summer storm events. The stations monitored were Big Ditch, a tributary station draining a 38-square-mile subwatershed, and Fisher and Mahomet, mainstem stations draining respectively 240- and 360-square mile basins of the Upper Sangamon River. Six raingages, one in 1998 and five in 1999 were established evenly throughout the watershed above the Mahomet station and were used to continuously record rainfall depths during the monitoring period.

In this poster, the monitoring procedure, the monitored data, and results of some data analyses will be presented. The major goals of the monitoring program were to develop a database of observed conditions during storm events, to understand the nonpoint source pollution processes in a watershed, and to use the data to field-verify the Dynamic Watershed Simulation Model (DWSM) being developed at the ISWS. The DWSM and its verification will be presented in a concurrent session of this conference.
Dynamic Watershed Simulation Model Helping Citizen Group Restoring the Court Creek Pilot Watershed

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The Illinois State Water Survey (ISWS) has been developing a Dynamic Watershed Simulation Model (DWSM) using physically based governing equations to simulate rainfall-runoff, propagation of flood waves, soil and streambank erosion, and entrainment and transport of sediment and chemicals in agricultural and rural watersheds. The ISWS collected flow, sediment, nutrient, and pesticide/herbicide data during storm events from the upper Sangamon River basin in Illinois draining a 2,400-square kilometer (925-square-mile) watershed into Lake Decatur and used these data to test different components of the DWSM. In this study, the hydrologic component of the DWSM was applied to a 251-square-kilometer (97-square-mile) watershed of Court Creek in Illinois. The Court Creek watershed is part of Illinois’ multi-agency Pilot Watershed and Conservation Reserve Enhancement Programs (PWP and CREP). The Court Creek Pilot Watershed Planning Committee (CCPWPC), a local citizen based group, is responsible for making the watershed restoration and management decisions and utilizing appropriated resources under the above government programs. The DWSM-hydrology was calibrated and verified using data monitored earlier. The model was then used to identify high, moderate, and low runoff potential areas of the watershed to guide the watershed restoration programs. The model will be used to evaluate BMPs, such as wetlands, detention basins, and dry dams, in reducing downstream flooding, erosion, and sedimentation in sensitive areas. This study is being conducted in partnerships with the ISWS, Illinois Department of Natural Resources-Watershed Management Section, CCPWPC, Illinois Council on Food and Agricultural Research, and the University of Illinois at Urbana-Champaign.

In this poster, application of the DWSM to the Court Creek Pilot Watershed and its results while helping the CCPWPC in restoring the watershed under the PWP and government-incentive CREP will be presented.
Reducing Water Quality Impacts on the Waukegan River

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The Waukegan River watershed is highly urbanized and is located thirty-five miles northwest of Chicago. Water quality has been degraded as a result of streambank erosion, increased urban runoff, and increased channelization. Biotechnical stream stabilization techniques have been implemented on the Waukegan River since 1992. Funding for these activities was supplied in part by the United States Environmental Protection Agency under Section 319 of the Clean Water Act.

Unknown water quality impacts have resulted in periodic fish kills that have occurred on the Waukegan River since 1994. Standard nutrient analyses conducted by the Illinois State Water Survey Laboratory were performed from samples collected when the fish kills were detected. The results of the analyses showed that no high levels of toxic nutrients were present in the samples collected.

To investigate the possible source(s) of toxicity, a separate sediment sampling event was conducted in a sediment basin on the South Branch of the Waukegan River at Roosevelt Park in the City of Waukegan on September 10, 1998. The result of the acute screen biomonitoring illustrated significant toxicity to the test organisms utilized (Ceriodaphina, fathead minnows). Elevated levels of parameters of certain metal plating by-products were detected in the inorganic analyses conducted along with elevated levels of organic parameters on this set of sediment samples.

The Illinois EPA has proposed a method to contain the toxicity detected in the Roosevelt Park sediment basin. The proposed method involves the installation of stream and wetland restoration techniques on the South Branch of the Waukegan River including the retrofit of the existing Roosevelt Park sediment basin. Such efforts will help to retain the contaminated sediment in the basin, improve water quality, create wildlife habitats and provide for environmental educational opportunities. This restoration project will also be funded in part by the Illinois EPA and United States Environmental Protection Agency under Section 319 of the Clean Water Act. Implementation of the proposed method to reduce water quality impacts will further help support the measured improvements of fisheries in the Waukegan River.
Peoria Lake Sediment Quality

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Peoria Lake is an impoundment on the Illinois River near Peoria. Sedimentation in the lake has been severe; the lake had lost 68% of its 1903 capacity by 1985. The feasibility of extensive dredging in the lake is under investigation. In this project Peoria Lake sediments are being characterized with respect to ammonia and the toxic metals Cu, Pb, Cd, Zn, and Ni. Ammonia is of concern because of its toxicity to aquatic organisms. Dredging may release ammonia to the overlying river and cause fish kills. Metals in the sediments may limit sediment disposal options if the concentrations are above regulatory standards. Moreover, dredging will expose the overlying water to older sediments which, due to higher pollutant loadings in the past, may actually contain higher total concentrations of many metals than the dredged sediments.

Sediment cores are being collected at ten stations from Peoria to Chillicothe (river mile 164-179). The cores are divided into sections immediately after collection. The sediment pore waters are separated from the sediments and analyzed for ammonia and metals. The sediment solid phase is analyzed for metals and acid-volatile sulfide (AVS). AVS is of concern for two reasons. First, it may limit the bioavailability of metals in the sediments. Second, the AVS may impose an oxygen demand if the sediments are dredged and exposed to overlying water. Fish kills may result if dissolved oxygen concentrations get too low. Natural organic matter may also help limit the bioavailability of metals, so both pore waters and sediment solids are being analyzed for organic carbon.
Shallow Groundwater Flow and Mass Flux of Nitrogen and Phosphorus in the Big Ditch Watershed


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Illinois and other corn belt states have been identified as principal sources of nitrates to the Mississippi River, which lead to hypoxia (dissolved oxygen at <2 mg/L) in the Gulf of Mexico. To address the volatile issue of hypoxia in the Gulf of Mexico, a comprehensive, watershed-scale, mass balance of nitrogen is needed to provide data and develop recommendations. The mass balances of nitrogen (N) and phosphorus (P) are being estimated for a small agricultural watershed (38 square miles) in northern Champaign County. The Illinois State Water Survey (ISWS) and Illinois State Geological Survey are determining components of the mass balance for the shallow groundwater. Researchers from the ISWS and UI College of Agriculture, Consumer and Environmental Sciences are determining the other components. The goal of the overall project is to comprehensively determine the mass balance of nutrients (N and P) in the Big Ditch watershed. The project was started in December 1999 and will, hopefully, extend through June 2002.

The surficial geology of the watershed is being characterized and generally consists of more than 50 feet of loamy till interbedded with thin layers of sorted sediments. These sorted sediments are sand and gravel away from the moraines and silt near the moraines. Twenty monitoring wells have been installed at eleven sites across the watershed, allowing water levels to be measured and water quality samples to be collected. Eleven shallow monitoring wells were installed to monitor the water table, while 9 wells were installed to monitor the groundwater of deeper, sand and gravel layers. Water levels will be measured at regular intervals, at least every 2 weeks. In 8 wells, continuous water-level recorders will be installed. Slug tests will be conducted to determine aquifer properties. Ground-water/surface water interactions of the Big Ditch may be obtained by baseflow separation calculations and by field experiments such as determining hydraulic gradients with a potentiometer. A ground-water flow model also will be developed.

Water samples are being collected from the wells and analyzed for nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus, and nonvolatile organic carbon. The analytical results will be combined with the ground-water flow model to estimate the fluxes of N and P within the groundwater of the Big Ditch watershed, a tributary of the Sangamon River.
The Mahomet Aquifer Consortium:
Progress in Water-Resources Management through Knowledge and Cooperation

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Stakeholders along the Mahomet aquifer recently organized into the Mahomet Aquifer Consortium (MAC) to serve as a forum for discussing diverse concerns about the aquifer and developing possible solutions for those concerns. The Consortium expressed its concerns in the following list of reasons to study the aquifer: 1) informed decisions could be made about managing the Mahomet aquifer to meet future water demands, 2) water quality issues could be identified and resolved, 3) water supply for the future could be ensured, 4) water supply costs could be optimized, and 5) economic development could be planned and promoted. Membership in the MAC is open to all and members currently represent the private sector; county, state, and federal agencies; agriculture; water authorities; municipalities; and professional organizations.

The Mahomet aquifer occurs in a broad arc that sweeps east-west across 15 counties in east-central Illinois from the Illinois/Indiana state line to the Illinois River. This confined aquifer consists of sand and gravel from the pre-Illinois Episode glaciation (Banner Formation) that fills the lower third to half of the Mahomet Bedrock Valley, the western-most reach of the Teays-Mahomet Bedrock Valley that was a major feature of the preglacial landscape of Illinois and the Midwest. Aquifer width ranges between 4 and 14 miles. Aquifer thickness averages 100 feet, but ranges from less than 50 feet to about 200 feet locally. Deposits of the Glasford Formation (Illinois Episode) and Wedron and Mason Groups (Wisconsin Episode) overlie the Banner Formation. Sand and gravel within these deposits also form aquifers, although they are not as widespread or prolific as the Mahomet aquifer.

The demand for water in the counties overlying the Mahomet aquifer is currently 84 million gallons per day. Demand for water from the Mahomet aquifer will grow as a result of factors such as increasing municipal needs, new industrial uses such as ethanol fuel production, new large-scale livestock facilities, and additional irrigated acreage. At one time, only land over the western end of the Mahomet aquifer was irrigated. Irrigation wells can now be found in locations scattered over the aquifer. Several large communities located near the edges of the Mahomet aquifer are supplied from surface water sources. For these communities, the Mahomet aquifer represents a source of supplemental water to improve drinking water quality, or to meet future water demand.

In the past, competition for groundwater sometimes resulted in political conflicts over real or perceived adverse effects. The MAC has developed a plan to study the entire aquifer and is seeking long-term funding for this proposed study. The knowledge that is developed during this study will be used to educate a wide variety of audiences that rely on the Mahomet aquifer and serve as the basis to develop a management plan by a consensus of the stakeholders. This water-resource management plan should be successful because it will be developed by stakeholders who have invested time and built trust through a long-term process of openly, actively, and cooperatively studying their water resource.
Riparian areas can play a critical role in the attenuation of nutrient and sediment loads to streams in agricultural watersheds. Overland flow, subsurface flow, and deep groundwater were monitored in a riparian zone of a small watershed along Cypress Creek in southern Illinois. Two native vegetation communities are being tested to compare their abilities to take up nutrients and filter sediments. One plot is a mixed deciduous forest and the other is composed of giant cane (*Arundinaria gigantea*). The study area is located along Cypress Creek in southern Illinois. The soils of the two communities are classified as a Wakeland silt loam. Overland flow, interflow through the rooting zone, and shallow groundwater are being monitored at the two sites. The study is designed to allow comparisons of sediment filtration and nutrient uptake at different buffer widths. Water samples will be collected at the field edge and at 10, 20, and 30 feet from the field edge. At the four sampling points, overland flow "dust-pan" collectors, lysimeters, and piezometers were installed to collect water samples. The overland flow collectors were designed to collect sheet flow over an 18 inch width and are coupled with a 10X splitter to reduce the sample size. Lysimeters were installed to the bottom of the rooting zone at each site, which was 12 in. in the cane and 20 in. in the forest site. Installation of the piezometers was based on the depth of the water table, which was 2 ft. during wet periods and approximately 17 ft. during dry periods. The samples collected from the piezometers will allow testing of shallow groundwater quality. Preliminary results will be available by the Illinois Water 2000 conference in mid-November.
The State of Illinois is blessed with abundant water resources. Throughout our state, there are approximately 900 creeks and streams and more than 87,600 inland lakes and ponds. Our water resources serve a multitude of purposes, which include: drinking water; recreational, agricultural, industrial, and navigational purposes; and fish and wildlife habitat.

According to the 1999 Water Quality Survey conducted by the Illinois Environmental Protection Agency, the major contaminants in rivers and streams are now nutrients and siltation. Unfortunately, the major source of pollution today is now agriculture.

What this means for farmers, is that society is now looking towards agriculture to minimize the runoff of sediment, nutrients, pesticides, and other contaminants. Surface water quality will soon be receiving increased national attention as the new Federal Clean Water Action Plan (CWAP) begins emphasizing nonpoint pollution control.

Although many farmers have taken initial steps to improve water quality, even greater adoption of Best Management Practices (BMP’s) will be required in the future to protect water quality. In this poster presentation, I will highlight BMP’s that have been identified by leading conservationists from throughout the Midwest, that are included in a new book, published by University of Illinois Extension, entitled 60 Ways Farmers Can Protect Surface Water.

Farmers are being encouraged to increase their adoption of BMP’s for the following three reasons: 1. It is the right and socially responsible thing to do! 2. Many practices make better economic sense and can increase profitability. 3. Farmers can begin voluntary implementation now or be faced with mandatory government programs in the future.
Combining Surface and Borehole Geophysical Techniques to Locate and Define a Buried Outwash Aquifer in Central Illinois

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Sand and gravel deposits (glacial outwash) comprise most aquifers supplying water to many small communities in central Illinois. In eastern Champaign County, much of the outwash was deposited in thin, narrow bands trailing away from the receding glacial front. Typically, these deposits are less than a few hundred feet wide and less than a few feet thick, but at a few locations, they may be as much as \( \frac{3}{4} \) mile wide and up to 100 feet thick. It is costly and impractical to use test drilling as the only method of exploration in regions that are known to be marginal or limited in groundwater resources. Because the outwash deposits are encased within clayey glacial till and overlie shale, and both clay and shale are better conductors of electrical current than sand and gravel, outwash deposits make excellent targets for Electrical Earth Resistivity (EER) surveys. In addition to surface geophysical methods, borehole geophysical methods are very sensitive to the minor variations of clay content in the outwash, which affect permeability. When used together, surface and borehole geophysical techniques provide a powerful means for locating and characterizing sand and gravel aquifers in regions considered marginal for groundwater development.

Following 20 years of unsuccessful test drilling, an EER survey was conducted for the Village of Homer to help locate and delineate a sand and gravel aquifer. A total of 144 EER soundings were recorded within a 7.5 square-mile area that was determined to have the best potential for a reliable groundwater supply. To detect the presence of an outwash deposit capable of providing the community with more than 100,000 gallons per day (g.p.d.), EER stations were placed every 500 feet with a maximum a-spacing of 200 feet. This allowed the outermost (current) electrodes of the Wenner array to overlap, providing uniform, end-to-end coverage. Using a prominent resistivity anomaly as a guide, test drilling confirmed the presence of a 100-foot thick sand and gravel deposit buried by 40 to 50 feet of glacial till. Borehole geophysical logs of 3 test holes indicated a major change in the thickness of the sand and gravel outwash from south to north, which was influenced by the elevation of the bedrock surface. Local outwash sand and gravel deposits that are typically thin and separated by clay layers, may have coalesced into one thick deposit within a pre-glacial bedrock channel that is the aquifer in which the new village wells were completed.
Mechanisms Responsible for the Loss of Specific Capacity By High-Capacity Wells Screened in the Mahomet Aquifer, Champaign, IL

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The progressive loss of specific capacity by production wells screened in the Mahomet aquifer in Champaign, IL has been observed for over three decades. Geochemical modeling strongly suggested that calcite was precipitating within the Mahomet aquifer near the production wells. These wells are pumped at rates that range from about 60 to 200 L/s. Precipitation of calcite adjacent to the wells was attributed to a lowered piezometric surface and concomitant outgassing of CO₂ and appeared to be contributing to the loss of specific capacity of the production wells.

To test this hypothesis, two boreholes were drilled 4.6 meters and 18.3 meters from a production well that has been in operation since 1964. The boreholes were drilled using rotasonic techniques that did not require drilling fluids; core recovery was near 100%. Drill core samples were examined using a variety of microscopic, X-ray diffraction and microbiological techniques. In addition, 500 liters of groundwater from each of three production wells was passed through 0.50 μm filters and the suspended solids were examined using scanning electron microscopy.

The results provided evidence that a number of factors were responsible for the loss of specific capacity by the production wells. Analysis of core samples showed that clay minerals were enriched in the < 45 micron fraction of the aquifer's sand and gravel in the borehole drilled closest to the production well. Suspended solids in the production wells yielded a more definitive set of data on the loss of specific capacity. Materials collected on filters revealed the presence of iron-depositing bacteria and fragments of their biofilms within three production wells. The bacteria consisted of iron-enriched tubercles and twisted stalks of iron-depositing bacteria that often were entwined around and encased minerals fragments. This hypothesis is supported by a report of a downhole camera footage taken by IAWC during the renovation of a production well stated that the wells screen was "heavily incrusted" with a dark-colored scale. The well scale was reportedly removed from the well screen with small explosive charges and scrubbers.

Pumping rates of the production wells examined ranged from 70 to 145 L/s correlated with the size and volume of mineral matter, and the amount of bacterial materials collected on the filters. Specifically, the filtered material from the well pumped at a rate of 70 L/s contained only small, sparsely-distributed euhedral crystals of calcite and small fragments of twisted stalks of iron-depositing bacteria. Conversely, the filter from the well pumped at a rate of 145 L/s contained relatively large and abundant mineral fragments and bacterial debris. Based on these findings, we concluded that iron-depositing bacteria deposited biofilms on the well screens of the wells (and possibly within the gravel pack) that entrapped entrained mineral fragments and clay minerals, and newly precipitated calcite crystals. The combination of these three factors probably is responsible for the loss of specific capacity of production wells in the Mahomet aquifer. In addition, the enrichment of clay minerals in the aquifer adjacent to the production well may have reduced the hydraulic conductivity of the sand and gravel surrounding the production wells.