UNIVERSITY OF MINNESOTA

Water Resources Center

COLLEGE OF CONTINUING EDUCATION

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Water Resources Center, University of Minnesota

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Final Program and Book of Abstracts

Minnesota Water 2006

and

Annual Water Resources

joint Conference

Bringing water scientists and professionals together

October 24–25, 2006

Earle Brown Heritage Center
6155 Earle Brown Drive
Brooklyn Center, Minnesota

Who Should Attend?

Water resource professionals
Researchers
Engineers
Educators
Students
Resource managers
Local governments
Consultants
Lake and river organizations

http://wrc.umn.edu/waterconf/

Minnesota Water 2006 and Annual Water Resources Joint Conference

October 24–25, 2006

The ***Minnesota Water and Annual Water Resources Joint Conference*** presents innovative and practical water resource management techniques and highlights research about Minnesota's water resources. The conference provides an opportunity to address emerging issues and present on lessons learned and best practices discovered. The conference facilitates interactions among resource managers, researchers, state and local agency staff, and other water resources professionals, including consultants and practicing engineers.

For nearly 40 years, the annual Water Resources Conference presented emerging and implemented water resource management techniques for water resource professionals, including consultants, and city, county, and state practicing engineers. For almost 15 years, the University of Minnesota's Water Resources Center held the biennial Minnesota Water conference to highlight issues and research regarding Minnesota's wealth of water resources, and to facilitate interactions among resource managers, researchers, and other water professionals.

Successfully presented jointly in 2005, this water resources conference once again allows for the natural synergy and interactions between the audiences that each audience has historically attracted. The objectives of the two conferences are complementary, and the joint conference brings together these unique events to create a program with a broader and more inclusive appeal.

Continuing Education Units (CEUs); Professional Development Hours (PDHs)

Conference attendees will receive .675 CEUs/PDHs for each day of the Minnesota Water 2006 and Annual Water Resources Joint Conference. Participants who wish to receive full CEU credit must attend all scheduled hours of the event. Forms will be available.

Minnehaha Falls photo by Grace Wilson

Mark Your Calendars

Minnesota Water 2007 and Annual Water Resources Joint Conference

October 23–24, 2007

Earle Brown Heritage Center, Brooklyn Center, Minnesota

2006 Water Resources Planning Committee

** Tina Carstens*	Ramsey-Washington Metro Watershed District
Lisa Goddard	SRF Consulting Group
Lori Graven	College of Continuing Education, University of Minnesota
Julie Grazier	College of Continuing Education, University of Minnesota
Andrea Hendrickson	Minnesota Department of Transportation
Jon Hendrickson	U.S. Army Corps of Engineers
Suzanne A. Jiwani	Minnesota Department of Natural Resources
Steve Kloiber	Environmental Services, Metropolitan Council
Ron Leaf	Short Elliott Hendrickson, Inc.
Barbara Liukkonen	Water Resources Center and Minnesota Sea Grant College Program, University of Minnesota
Jennifer L. Olson	Emmons and Olivier Resources, Inc.
Nels P. Nelson	Barr Engineering Company
Wayne Sicora	Ryan Companies U.S., Inc.
Gene Soderbeck	Minnesota Pollution Control Agency
Heinz Stefan	Department of Civil Engineering, University of Minnesota
Deborah Swackhamer	Water Resources Center and School of Public Health, University of Minnesota
John Thene	Wenck Associates, Inc.
Rick Voigt	Polaris Group, Inc.
Martin J. Weber	Stanley Consultants, Inc.
Thomas Winterstein	U.S. Geological Survey
Steve Woods	Board of Water and Soil Resources

**Water Resources Planning Committee Chair*

2006 Minnesota Water Planning Committee

James Anderson	Water Resources Center and Department of Soil, Water, & Climate, University of Minnesota
John Baker	Department of Soil, Water, & Climate, University of Minnesota
Larry Baker	Water Resources Center, University of Minnesota
John Borovsky	Barr Engineering Company
Wayne Edgerton	Minnesota Department of Natural Resources
Miki Hondzo	Department of Civil Engineering, University of Minnesota
Emi Ito	Department of Geology and Geophysics, and Limnological Research Laboratory, University of Minnesota
Maria Juergens	Water Resources Center, University of Minnesota
Steve Kloiber	Environmental Services, Metropolitan Council
Barbara Liukkonen	Water Resources Center and Minnesota Sea Grant College Program, University of Minnesota
Euan Reavie	Center for Water and the Environment, NRRI, University of Minnesota
Jeff Stoner	U.S. Geological Survey
**Deborah Swackhamer*	Water Resources Center and School of Public Health, University of Minnesota
Doug Thomas	Board of Water and Soil Resources
Tracy Thomas Wilson	Water Resources Center, University of Minnesota
Stew Thornley	Minnesota Department of Health
Bruce Wilson	Department of Bioproducts and Biosystems Engineering, University of Minnesota
C. Bruce Wilson	Minnesota Pollution Control Agency

**Minnesota Water Planning Committee Chair*

Tuesday, October 24, 2006

7:00 a.m. **Registration and Continental Breakfast**

8:00 **Welcome,** *Carriage Hall A*
Deborah Swackhamer, Water Resources Center and School of Public Health, University of Minnesota

8:10 **Dave Ford Water Resources Award**
Award Recipient: *Ron Harnack,* Board of Water and Soil Resources

8:20 **Plenary Session: Effects Impaired Waters Have on Us**
Moderator: *Tina Carstens,* Ramsey-Washington Metro Watershed District

"Maple Lake/Annandale Court Decision on TMDLs and Development"
Louis Smith, Water Resources Attorney, Smith Partners PLLP

"Policy Framework for Water Quality Trading"
Virginia Kibler, Environmental Protection Agency, Washington D.C.

"Impaired Waters: Effects of Maple Lake/Annandale Decision on Minnesota"
Brad Moore, Acting Commissioner, Minnesota Pollution Control Agency

9:30 **Poster Session and Refreshment Break**

10:00–11:30 CONCURRENT SESSIONS I

A Carriage Hall B	B Garden City Ballroom	C Harvest Room	D Tack Room
Bank Erosion	Finding Urban Stormwater Pollutants	Innovations in How Row Crops are Grown and Potential Environmental Benefits	Ground and Surface Water Interactions

11:30–12:15 p.m. Lunch, *Carriage Hall A*

12:15–1:00 p.m. **Luncheon Presentation**
"Water Quality Trading as a Tool for Water Resources Management: Hype, Hysteria, or Helpful? "
Mark Kieser, Senior Scientist, Kieser & Associates and Acting Chair, Environmental Trading Network

1:15–2:45 CONCURRENT SESSIONS II

A Carriage Hall B	B Garden City Ballroom	C Harvest Room	D Tack Room
Stream and River Restoration	New Applications in Stormwater Modeling	Assessing Agricultural Impacts	Lakes

2:45–3:15 **Poster Session and Refreshment Break**

3:15–4:45 CONCURRENT SESSIONS III

A Carriage Hall B	B Garden City Ballroom	C Harvest Room	
Thermal Impacts	Stormwater BMP Assessment	Beyond the Land of Sky-Blue Waters—National and International Issues	

4:45–5:45 **Poster Session and Reception,** *Captain's Room*

Join us for the
Water Conference Reception and Poster Session
4:45–5:45 p.m. in the Captain's Room

Wednesday, October 25, 2006

7:00 a.m. **Registration and Continental Breakfast**

8:00 **Welcome,** *Carriage Hall A*
Tina Carstens, Ramsey-Washington Metro Watershed District

8:10 **Plenary Session**
Moderator: *Deborah Swackhamer,* Water Resources Center and School of Public Health, University of Minnesota

"Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters"
Robert Glennon, Morris K. Udall Professor of Law and Public Policy, Rogers College of Law, University of Arizona

Book-signing with Dr. Glennon immediately following his presentation.

9:30 **Poster Session and Refreshment Break**

10:00–11:30 CONCURRENT SESSIONS IV

A Carriage Hall B	B Garden City Ballroom	C Harvest Room	D Tack Room
Lake Pepin TMDLs	Effects of Climate Change on Surface Water Flow	Endocrine Disruption	Flood Protection and Control

11:30–12:15 p.m. Lunch, *Carriage Hall A*

12:00–1:15 p.m. **Luncheon Presentation**
"Impacts of Corn Ethanol and Other Biofuels on Water Quality and Carbon Gas Emissions"
David Tilman, Regents Professor, Department of Ecology, Evolution and Behavior, College of Biological Science, University of Minnesota

1:15–2:45 CONCURRENT SESSIONS V

A Carriage Hall B	B Tack Room	C Harvest Room	D Garden City Ballroom
Wetlands as a Resource to Meet TMDLs	Water Supply: Planning for Future Droughts	Contaminants of Concern	Planning and Implementing Low Impact Development (LID)

2:45–3:00 **Refreshment Break**

3:00–4:30 CONCURRENT SESSIONS VI

A Carriage Hall B	B Garden City Ballroom	C Harvest Room	
Wetland Indicators and Monitoring	Planning, Policy, and Implementation	Catastrophe and Recovery	

4:30 **Adjourn**

Tuesday, October 24, 2006

8:00 **Welcome,** *Carriage Hall A*
Deborah Swackhamer, Water Resources Center and School of Public Health, University of Minnesota

8:10 **Dave Ford Water Resources Award**
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"Impaired Waters: Effects of Maple Lake/Annandale Decision on Minnesota"
Brad Moore, Acting Commissioner, Minnesota Pollution Control Agency

9:30 **Poster Session and Refreshment Break**

10:00–11:30 CONCURRENT SESSIONS I

Track A *Carriage Hall B*

Bank Erosion
Moderator: *Gene Soderbeck*
Co-Moderator: *Ron Leaf*

Assessing the Physical Integrity of Streams
Brenda Asmus, University of Minnesota (UM); *Joseph Magner,* UM; *Bruce Vondracek,* USGS; and *Jim Perry,* UM

Predicting Channel Erosion in a Lacustrine Basin Using Stream Geomorphology Metrics
Joe Magner, MPCA and *Ken Brooks,* UM

The Answer is in the Lakes: A New Use of Pb-210 to Fingerprint Sediment Sources
Shawn Schottler and *Daniel R. Engstrom,* St. Croix Soil and Water Conservation District

Track B *Garden City Bllrm*

Finding Urban Stormwater Pollutants
Moderator: *Steve Kloiber*
Co-Moderator: *Steve Woods*

Methods of Urban Storm Water Monitoring
John Mason and *Sarah S. Roley,* Capitol Region Watershed District

Detailed Assessment of Phosphorus Sources for Ramsey-Washington Metro Watershed District
Greg Wilson, Barr Engineering Company

Sources of Urban Stormwater Pollutants
Larry Baker, UM

Track C *Harvest Room*

Innovations in How Row Crops are Grown and Potential Environmental Benefits
Moderator: *Paul Wotzka*
Co-Moderator: *Kevin Blanchet*

Exploring the Potential Benefits of Polymer-Coated Urea on the Irrigated Outwash
Carl Rosen, UM; *John Moncrief,* UM; *Norm Krause,* MNSCU; *Don Sirucek,* MDA; and *Bruce Montgomery,* MDA

Conservation Drainage: Improving Water Quality Through Subsurface Drainage Design
Gary Sands, UM; *Inhong Song,* UM; *Lowell M. Busman*, MDA; and *Bradley Hansen,* UM

On-Farm Comparisons of Conservation Tillage Systems
Jodi DeJong-Hughes, UM Extension Service and *Jeffrey Vetsch,* UM Southern Research and Outreach Center

Track D *Tack Room*

Ground and Surface Water Interactions
Moderator: *Barbara Liukkonen*
Co-Moderator: *Lisa Goddard*

Groundwater Interaction in the Vermillion River Headwaters
Jennifer Olson, Emmons and Olivier Resources, Inc., and *Laura Jester,* Dakota Soil and Water Conservation District

A Chloride Budget for Olmsted County, Minnesota
Robert Wilson and *Kimm Crawford,* Minnesota State University

An Evaluation of Methods for the Delineation of Source Water Protection Areas in Karst Aquifers
E. Calvin Alexander, Jr. , UM; *Geary M. Schindel,* Edwards Aquifer Authority; and *Steven B. Johnston,* Edwards Aquifer Authority

11:30–12:15 p.m. Lunch, *Carriage Hall A*

12:15–1:00 p.m. **Luncheon Presentation**
"Water Quality Trading as a Tool for Water Resources Management: Hype, Hysteria, or Helpful?"
Mark Kieser, Senior Scientist, Kieser & Associates and Acting Chair, Environmental Trading Network

1:15–2:45 CONCURRENT SESSIONS II

Track A *Carriage Hall B*

Stream and River Restoration
Moderator: *Jennifer Olson*
Co-Moderator: *Jon Hendrickson*

Rush River Streambank Restoration
Matthew Wildman and *Scott D. Wallace,* North American Wetland Engineering, LLC

Rice Creek Regains Its Curves
Kevin Biehn, Emmons & Olivier Resources, Inc., and *Chuck Johnson,* Rice Creek Watershed District

Spring Lake Islands Habitat Rehabilitation and Enhancement Project
Kari Layman and *Thomas Novak,* U.S. Army Corps of Engineers, St. Paul District

Track B *Garden City Bllrm*

New Applications in Stormwater Modeling
Moderator: *Nels Nelson*
Co-Moderator: *Steve Kloiber*

Muddy Waters: Assessment and Modeling of Turbidity Impaired Streams
Steve Kloiber, Ron Jacobson, Karen Jensen, Joe Mulcahy, Judy Sventek, and *Hong Wang,* Metropolitan Council

Integrating Radar Rainfall Data, GIS, and XPSWMM to Model Storm Events
Jeff Christopherson, HDR Engineering, Inc., and *Matt Moore,* South Washington Watershed District

Implementation of BMPs in Bluff Creek, MN — A Scenario Study using SWAT
Hong Wang, Metropolitan Council

Track C *Harvest Room*

Assessing Agricultural Impacts
Moderator: *Jim Anderson*
Co-Moderator: *Jodi Dejong-Hughes*

Fecal Coliform Source Tracking in the Beauford Minor Watershed
Scott Matteson and *Shannon Fisher,* Minnesota State University

Agricultural Nutrient Mass-Balances in the Huelskamp Creek Watershed in Nicollet County, Minnesota
Luke Stuewe, MDA; *D. J. Mulla,* UM., and *A. S. Birr,* MDA

On-Farm Nitrogen and Phosphorous Nutrient Management Demonstrations
Brian Williams, MDA; *Linda Meschke,* Rural Advantage; and *Jeff St. Ores.* USDA-NRCS

Track D *Tack Room*

Lakes
Moderator: *Gene Soderbeck*
Co-Moderator: *Thomas Winterstein*

Establishing Hydrologic and Hydraulic Design Criteria for Shallow Lake Restoration
Mark Deutschman, and *Nancy Stowe,* Houston Engineering, Inc.

Seasonal Salinity Cycles in Northern Urban Lakes
Dan Murphy, Bonestroo, rosene, Anderlik, and Associates, Inc., and *Heinz Stefan,* UM

Modeling Framework to Assess Big Sauk Lake Restoration Alternatives: A Step toward Developing the TMDL
Amal Djerrari, Hydrogeological and Modeling Services, Inc.; *Julie Klocker,* Crow River Watershed District; and *Lynn Nelson,* Sauk River Watershed District

2:45–3:15 Poster Session and Refreshment Break

3:15–4:45 CONCURRENT SESSIONS III

Track A *Carriage Hall B*

Thermal Impacts
Moderator: *Heinz Stefan*
Co-Moderator: *Barbara Liukkonen*

Case Study—Infiltration Basin Performance of the Trout Habitat Preservation Project
Christa Bren, Emmons and Olivier Resources, Inc.

TMDL for Trout Streams: Winter Dynamics Matter
Leonard Ferrington, Jr., and *R. Will Bouchard,* UM

Characterization of Storm Events with Maximum Thermal Impact on Surface Water Runoff from Developed Lands
William Herb, Ben Janke, Omid Mohseni, and *Heinz Stefan,* UM

Track B *Garden City Ballroom*

Stormwater BMP Assessment
Moderator: *Lisa Goddard*
Co-Moderator: *Andrea Hendrickson*

Testing Versus Monitoring in the Assessment of Stormwater BMPs
Andrew Erickson, John Gulliver, and *James Anderson,* UM

Techniques for Evaluating the Effectiveness of Rain Gardens as a Stormwater BMP
Brooke Asleson, Rebecca S. Nestingen, John Gulliver, Raymond M. Hozalski, and *John Nieber,* UM

Assessing the Effectiveness of Proprietary Stormwater Treatment Devices
Matt Wilson, John Gulliver, and *Omid Mohseni,* UM

Track C *Harvest Room*

Beyond the Land of Sky-Blue Waters —National and International Issues
Moderator: *Martin Weber*
Co-Moderator: *Larry Baker*

Assessing Human Vulnerability in Major River Systems
Karlyn Eckman, UM

Beyond Privatization: Restructuring Water Systems to Improve Performance
Ian Hart, Pacific Institute

Urban Landscape Scenarios and Cycling of Carbon, Nitrogen and Phosphorus
Paul Hartzheim and *Larry Baker,* UM

4:45–5:45 Reception and Poster Session, *Captain's Room*

Wednesday, October 25, 2006

8:00 **Welcome,** *Carriage Hall A*
Tina Carstens, Ramsey-Washington Metro Watershed District

8:10 **Plenary Session**
Moderator: *Deborah Swackhamer,* Water Resources Center and School of Public Health, University of Minnesota

"Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters"
Robert Glennon, Morris K. Udall Professor of Law and Public Policy, Rogers College of Law, University of Arizona

Book-signing with Dr. Glennon immediately following his presentation.

9:30 **Poster Session and Refreshment Break**

10:00–11:30 CONCURRENT SESSIONS IV

Track A *Carriage Hall B*

Lake Pepin TMDLs
Moderator: *Norm Senjem*
Co-Moderator: *Les Everett*

Prospects at Midpoint: A Minnesota River/Lake Pepin TMDL Progress Report (A series of three papers)

1. Lake Pepin Game Plan for Completion
Norman Senjem, MPCA and *Hans Holmberg,* Limno-Tech, Inc. (LTI)

2. Providing Clarity: An Overview of the Minnesota River Turbidity TMDL
Larry Gunderson, MPCA

3. Minnesota River and Lake Pepin TMDLs: The Agricultural Perspective
Paul Torkelson, Minnesota Farm Bureau Federation

Track B *Garden City Bllrm*

Effects of Climate Change on Surface Water Flow
Moderator: *Jeff Stoner*
Co-Moderator: *Ron Struss*

Stream Flow in Minnesota: Indicator of Climate Change?
Eric Novotny and *Heinz G. Stefan,* UM

Probabilistic River Forecasts at the North Central River Forecast Center: Case Studies for the Minnesota River and the Red River of the North
Heather Offerman Johnson and *Michael DeWeese,* National Weather Service

A Fresh Look at Low-Flow Statistics in Minnesota
Thomas Winterstein, U.S. Geological Survey

Track C *Harvest Room*

Endocrine Disruption
Moderator: *Heiko Schoenfuss*
Co-Moderator: *Daniel Carlson*

Effects of Alkylphenol Polyethoxylates (AP) Alone and in Mixture on Two Life Stages of the Fathead Minnow *(Pimephales promelas)*
Heiko Schoenfuss and *Travis J. Bistodeau,* St. Cloud State University

Partitioning of Estrogenic Compounds in Wastewater Treatment
Matthew Wogen, Megan Ogdahl, Brendan Moore, Paige Novak, Michael Semmens, and *Deborah Swackhamer,* UM

Estrogens in Swine Manure
Kuldip Kumar, Satish C. Gupta, Ashok K. Singh, Shveta Gupta, and *Yogesh Chander,* UM

Track D *Tack Room*

Flood Protection and Control
Moderator: *Ron Leaf*
Co-Moderator: *Wayne Sicora*

Red River of the North at East Grand Forks, MN/Grand Forks, ND—Local Flood Damage Reduction Project
Michael Lesher, U. S. Army Corps of Engineers

Overcoming Design Challenges for a Drop Structure for the Heartsville Coulee Diversion Channel: East Grand Forks Flood Protection Project
Rocky Keehn and *Brad Woznak,* Short Elliott Hendrickson, Inc. (SEH)

Lazarus Creek Floodwater Control Project
Brent Johnson, Houston Engineering, Inc., and *James Rudd,* American Engineering Testing, Inc.

11:30–12:15 **Lunch,** *Carriage Hall A*

12:00–1:15 **Luncheon Presentation**
"Impacts of Corn Ethanol and Other Biofuels on Water Quality and Carbon Gas Emissions"
David Tilman, Regents Professor, Department of Ecology, Evolution and Behavior, College of Biological Science, University of Minnesota

1:15–2:45 CONCURRENT SESSIONS V

Track A *Carriage Hall B*

Wetlands as a Resource to Meet TMDLs
Moderator: *Suzanne Jiwani*
Co-Moderator: *Les Everett*

Using a Comprehensive Wetland Management Approach to Meet TMDL Goals for Watersheds Rapidly Converting from Agrarian to Urban Land Uses
Part 1: Technical Components
Jason Naber and *Marcey Westrick,* Emmons and Olivier Resources, Inc.

Part 2: Policy Components
Louis Smith, Smith Partners PLLP, and *Steve Hobbs,* Rice Creek Watershed District

Impact of Restored Wetlands on Stormflow, Sediment and Nutrient Loading from Small Watersheds in Southern Minnesota
Ken Brooks, UM; *Christian Lenhart,* UM; and *Joe Magner,* MPCA

Track B *Tack Room*

Water Supply: Planning for Future Droughts
Moderator: *Thomas Winterstein*
Co-Moderator: *Martin Weber*

Planning for the Twin Cities Region's Water Supply
Chris Elvrum, Metropolitan Council

Estimating Stream Quality and Managing for Drought in the Red River Valley
Wesley Saunders-Pearce, Houston Engineering, Inc.

The Flathead Lake Drought Management Plan Based on the Hydro-Climate Indicators
Foad Hussain and *Scott Reed,* HDR Engineering, Inc.

Track C *Harvest Room*

Contaminants of Concern
Moderator: *Tim LaPara*
Co-Moderator: *Matt Simcik*

Source Tracking of Escherichia coli at the Duluth Boat Club Beach
Satoshi Ishii, UM; *Winfried Ksoll,* UMD; *Dennis Hansen,* UMD; *Randall Hicks,* UMD; and *Michael Sadowsky,* UMD

Partitioning and Bioaccumulation Dynamics of PBDEs in the Upper Great Lakes
Summer Streets, Scott A. Henderson, Amber D. Stoner, Matt F. Simcik, and *Deborah L. Swackhamer,* UM

Fate and Transport of Perfluorinated Chemicals
Matt Simcik, University of Minnesota

Track D *Garden City Bllrm*

Planning and Implementing Low Impact Development (LID)
Moderator: *Tina Carstens*
Co-Moderator: *Andrea Hendrickson*

Land Use and Stormwater—Making the Connection in a Landlocked Setting
Brett Emmons, Emmons & Olivier Resources, Inc.; *Mark Koegler,* Hoisington Koegler Group; and *Tom Link,* City of Inver Grove Heights

Low Impact Development—Having Your Cake & Eating it, Too!
Kevin Biehn and *Christa Bren* Emmons & Olivier Resources, Inc.

The RWMWD Experience—Building for Zero Off-Site Runoff
Clifton Aichinger, Ramsey-Washington Metro Watershed District; and *Kurt Luethold,* Barr Engineering

2:45–3:00 Refreshment Break

3:00–4:30 CONCURRENT SESSIONS VI

Track A *Carriage Hall B*

Wetland Indicators and Monitoring
Moderator: *Cindy Hagley*
Co-Moderator: *Valerie Brady*

A Comprehensive Monitoring Strategy for Assessing Status and Trends in Minnesota Wetland Quantity and Quality
Mark Gernes, MPCA and *Doug Norris,* MN DNR

Assessing the Quantity and Quality of Depressional Wetlands in the Redwood River Watershed Utilizing a Probabilistic Survey Design
John Genet, MPCA and *Anthony Olsen,* EPA

Environmental Indicators for the Coastal Region of the U.S. Great Lakes
Gerald Niemi, Lucinda B. Johnson, and *Valerie Brady,* UM

Track B *Garden City Ballroom*

Planning, Policy, and Implementation
Moderator: *Jennifer Olson*
Co-Moderator: *Tina Carstens*

Engaging Community Planners in Surface Water Management Issues
Paul Nelson, HDR Engineering, Inc., and *Michael Sobota,* Scott County

When the Water Hits the Road: Local Stormwater Rules and Case Studies in Roadway Reconstruction
Carl Almer, Emmons & Olivier Resources, Inc.; *Tina Carstens,* Ramsey-Washington Metro Watershed District; and *Bob Fossum,* Capitol Region Watershed District

Operation & Maintenance of Best Management Practices—Wet & Dry Detention Ponds
Foad Hussain and *Mike Johnson,* HDR Engineering, Inc.

Track C *Harvest Room*

Catastrophe and Recovery
Moderator: *John Thene*
Co-Moderator: *Rick Voigt*

After the Wave—Sri Lanka Rebuilds after the Tsunami
Suresh Hettiarachchi, HDR Engineering, Inc.

Restoring New Orleans' Hurricane Protection System
Craig Johnson, Stanley Consultants, Inc.

Sinkhole Collapse of Storm Water Retention Pond CD-P27, Woodbury, Minnesota
E. Calvin Alexander, Jr., UM; *Keith S. Rosvold,* Braun Intertec Corporation; *Douglas J. Bergstrom,* Braun Intertec Corporation; *Kelton Barr,* Kelton Barr Consulting, Inc.; *Paul Heuer,* Laurent Development Company LLC; *Jacob Fick,* Laurent Development Company LLC; *Steve Kernik,* City of Woodbury

4:30 Adjourn

Poster Session

The following posters, listed in alphabetical order by first author, will be displayed during the breaks and at the poster session and reception on Tuesday at 4:45 p.m. in the Captain's Room.

Exposure and Risk Assessment of Selected Pesticides to Threatened and Endangered Species in North Dakota
Jenilynn Bohm and *Steven Spigarelli,* Bemidji State University

Minnesota's Efforts to Establish an Agricultural Fertilizer Research Fund
Greg Buzicky, MDA

Effects of Agricultural Land Retirement Practices on Small Streams of the Minnesota River Basin
Victoria Christensen, U.S. Geological Survey

Certification of Laboratories for Manure Analysis
Jerry Floren, MDA, and *Robert Miller,* Colorado State University

The Effects of Fluoxetine Exposure on Locomotion and Reproductive Competence in Male Fathead Minnows *(Pimephales Promelas)*
Kent Grove and *Heiko L. Schoenfuss,* St. Cloud State University

Development of Goose-Specific DNA Markers to Determine Sources of *Escherichia coli* in Waterways
Matthew Hamilton, Tao Yan, and *Michael J. Sadowsky,* UM

Identifying the Sources of *Escherichia coli* at Three Public Beaches in the Duluth-Superior Harbor
Dennis Hansen, UMD; *Michael J. Sadowsky,* UM; *Satoshi Ishii,* UM; *Randall E. Hicks,* UMD

Stream Water Quality Monitoring Using Wireless Embedded Sensor Networks
Jeremiah Jazdzewski, Miki Hondzo, and William Arnold, UM

A Web-Enabled Environmental Data Warehouse for the Twin Cities
Steve Kloiber, Terrie O'Dea, Charles Chiang, Scott Sherman, Metropolitan Council, and *Marianne Kollar,* consultant

Costs of Groundwater Nitrate Contamination to Municipal and Private Well Owners
Ann Lewandowski, UM; *Bruce Montgomery,* MDA; *Carl Rosen,* UM; *John Moncrief,* UM

Mosquito Control in Underground BMPs—What Works?
Nancy Read and *Kirk Johnson,* Metropolitan Mosquito Control District

Green-Ampt vs. SCS Hydrology: Calibrated Basin Study
Eli Rupnow and Carl Almer, Emmons & Olivier Resources, Inc.

Turning the Irrigation and Stormwater Management World Upside-Down
Aileen Nygaard, RLA; *Gary Glandon,* RLA; *Chris Dufour,* RLA; *Scott Stokes,*RRM Design Group (*Jonas Sipaila,* Evaporative Control Systems, Inc. and *William McCully,* Glenn Rehbein Companies, presenters)

The Effectiveness of Wetland Buffers in Maintaining Water Quality During Construction on Residential Sites
Sarah Stai and Kate Livingood, Westwood Professional Services

Preliminary Assessments on Public Drainage Systems and Watersheds in South Central Minnesota
Bill Thompson, Minnesota Pollution Control Agency

Rain Garden Water Quality
Lan Tornes, U.S. Geological Survey

Upcoming Programs

Professional Engineer Refresher Courses
Fundamentals of Engineering Review (EIT Refresher) – Fall/Spring Semester
Refresher Course for Electrical Engineers – Fall/Spring Semester
Refresher Course for Mechanical Engineers – Fall Semester
Refresher Course for Civil Engineers – Spring Semester
Contact: 612-624-3708; www.cce.umn.edu/engrrefresher

Design, Construction, and Maintenance of Storm Water Treatment Basins and Erosion Control Measures
November 16, 2006 – Medina, MN
Contact: 612-624-4754; www. mnltap.umn.edu/workshops

Culvert Installation and Maintenance
May 1, 2007 – Rochester, MN
May 2, 2007 – Medina, MN
May 3, 2007 – Brainerd, MN
Contact: 612-624-4754; www. mnltap.umn.edu/workshops

Project Management Certificate Program
Contact: 612-624-4000; www.cce.umn.edu/certificateprograms/pmt

Onsite Sewage Treatment Program
Professional training workshops for septic system installers, designers, inspectors, and maintainers, and a continuing education course for realtors. Offered periodically, September through March. Information and registration at http://septic.umn.edu; 800-322-8642 or 612-625-9797.

Minnesota Water 2006
and
Annual Water Resources
Joint Conference

Bringing water scientists and professionals together

October 24–25, 2006
Earle Brown Heritage Center

6155 Earle Brown Drive
Brooklyn Center, Minnesota

Book of Abstracts

Arranged by session in order of presentation
Index of first authors on page 51

Contents

Concurrent Sessions I 10:00–11:30

Track A: Bank Erosion

Assessing the Physcial Integrity of Streams

Brenda Asmus, University of Minnesota, asmus024@umn.edu; Joseph Magner, University of Minnesota; Bruce Vondracek, United States Geological Survey; and Jim Perry, University of Minnesota

Monitoring programs related to the Clean Water Act often assess the chemical and biological integrity of streams; physical integrity is often assessed in terms of aquatic habitat. Unstable banks can deliver excess sediment to streams and contribute to habitat loss and chemical and biological impairments; clearly there is a need for channel stability assessments. We examined the relationship between channel stability (Pfankuch Stream Reach Inventory and Channel Stability Evaluation), a modified Qualitative Habitat Evaluation Index (QHEI) and fish Index of Biotic Integrity (IBI) for 28 streams in two river basins in Minnesota. We found a significant correlation between channel stability and IBI in the Snake River Basin but not in the Redwood River Basin. Habitat quality strongly predicted IBI in the Redwood River basin but not in the Snake River Basin. We recommend that habitat and channel stability assessments be used in conjunction for monitoring physical integrity.

Predicting Channel Erosion in a Lacustrine Basin Using Stream Geomorphology Metrics

Joe Magner, Minnesota Pollution Control Agency, joseph.magner@pca.state.mn.us, and Ken Brooks, University of Minnesota

Turbidity is a numeric criterion used to assess the water quality condition of Minnesota streams. Turbid stream water can be driven by channel erosion in basins with lacustrine geology because channels are formed in fine-grained silts and clays. When Minnesota's numeric water quality criteria for turbidity is exceeded, then the Clean Water Act requires the development of a total maximum daily load (TMDL). Mass wasting of cohesive sediment into stream channels has been a historic process driving exceedance of turbidity water quality standards in the Nemadji River. Geomorphic relationships between hydraulic and geotechnical channel stability can be used to predict future bluff and stream bank erosion. A matrix of channel evolution potential (CEP) is presented using geomorphic data collected at 15 sites in the upper Nemadji River basin, northeastern Minnesota. A principal components analysis (PCA) found that 86 % of the variance between sites could be explained by watershed scale, D84/mean bankfull channel depth, channel shear ratio and stable channel width ratio. Most small headwater (scale <2 km2) channels were stable whereas, larger scale cohesive-sediment channels will need to erode 6-to-10 times their current bankfull channel width to acquire an active functional floodplain. This prediction assumes land use, and climate will remain stable over the next decade; minimizing future changes to the channel base elevation and associated knickpoint migration. A lack of aggradable sediment within the lacustrine core of the basin will increase the time needed for channels to evolve to a stable form.

The Answer is in the Lakes: A New Use of Pb-210 to Fingerprint Sediment Sources

Shawn Schottler, St. Croix Soil and Water Conservation District, schottler@smm.org, and Daniel R. Engstrom, St. Croix Soil and Water Conservation District

Atmospherically deposited radioisotopes have been used to discriminate between upland field erosion versus streambank erosion as contributors to riverine suspended sediment. These traditional fingerprinting methods are limited by the spatial variability and correction factors necessary to accurately characterize the upland (or agricultural field) source fingerprint. To get around these obstacles, this study utilized excess ^{210}Pb in the sediment of seepage lakes, with no channelized inputs, as reference systems to ascertain a temporally and spatially integrated upland field fingerprint, encompassing sheet, rill and gully erosion. The relationship between ^{210}Pb flux and modern sedimentation rate was plotted for 15 such reference lakes in the Minnesota River watershed. The slope of this relationship, 4.8 pCi/g, ($p<0.001$, $r^2=0.58$) predicts the average activity of ^{210}Pb on sediments eroded from upland fields. The relationship of ^{210}Pb flux to sedimentation rate was also applied to 20 cores collected from Lake Pepin (Mississippi River, MN and WI). Lake Pepin receives greater than 85% of its sediment burden from the Minnesota River and acts as a basin wide integrator of bank and upland erosion sources. A plot of ^{210}Pb flux to sedimentation rate at two core intervals, pre-1965 and 1965 to 1996, yielded slopes of 3.16 and 1.87 pCi/g respectively ($r^2 > 0.94$, $p<0.001$). The ratio of these slopes to the slope determined in the reference lakes predicts the proportion of sediment derived from upland sources. This comparison estimates that the relative contribution from upland sources to Lake Pepin has decreased from approximately 65% to 38% in the past 30 years. During this period, the overall sediment accumulation rate remained 8 to 10 times greater than historic rates, thus highlighting the significant contribution (>60%) from non-upland sources to the current sediment loading.

Tuesday, October 24

Concurrent Sessions I 10:00–11:30

Track B: Finding Urban Stormwater Pollutants

Methods of Urban Storm Water Monitoring

John Mason, Capitol Region Watershed District, john@capitolregionwd.org, and Sarah S. Roley, Capitol Region Watershed District

Capitol Region Watershed District (CRWD), in the Twin Cities metropolitan area, is entirely urbanized, with a drainage system comprised almost entirely of storm sewers. Monitoring storm water in an urban setting has unique challenges: systems respond extraordinarily fast to rain events, base flows are low or non-existent, high velocities can damage equipment, sites are subject to vandalism, and it often requires physically entering storm sewers. Traditional monitoring techniques must be modified, but little information is available on how to monitor in an urban setting. To monitor flow and water quality, we installed automatic samplers and area-velocity sensors. These samplers collected samples during rain events and low flows, in addition to collecting stage, velocity, and discharge readings. Water samples were analyzed for nutrients, sediments, fecal coliform, and metals. The results have allowed CRWD to determine water quality conditions, identify problem areas in the District, and determine the effectiveness of storm water BMPs.

Detailed Assessment of Phosphorus Sources for Ramsey-Washington Metro Watershed District

Greg Wilson, Barr Engineering Company, gwilson@barr.com

This study was intended to identify specific sources of phosphorus within the Ramsey-Washington Metro Watershed District (District), estimate their relative contributions to surface waters, and evaluate potential management implications. Together, lawns/open space, freeways, water, commercial parking lots, and residential streets and roofs comprise more than 87 percent of the entire District. During an average year, it is estimated that lawn and open space contribute approximately 5 percent of the source area phosphorus loadings throughout the District even though this source area comprises more than 40 percent of the watershed areas. Residential streets, driveways/sidewalks and freeway/railroad rights-of-way, parking lots and commercial and industrial streets combine to contribute approximately 70 percent of the total phosphorus loading within the District, which provides further support for the District's proposed infiltration requirements.

Sources of Urban Stormwater Pollutants

Larry Baker, University of Minnesota, baker127@umn.edu

Streets and highways are often deemed the "source" of pollutants. This characterization is misleading. Road surfaces are conduits for pollutants, but not the major source of pollutants. Penultimate sources include lawn runoff (which has concentrations of N and P similar to treated sewage), leaves from boulevard trees, erosion from construction sites, road sand and salt, and particles eroded from tires and brakes, among others. The relative importance of these sources will be examined for key pollutants (suspended solids, phosphorus, nitrogen and copper). Source reduction is an important but underplayed approach for addressing stormwater pollution, the "poor cousin" to end-of-pipe BMPs. Effective source reduction may more effective for reducing concentrations of soluble pollutants, which are not easily treated in many structural BMPs. Source reduction can also reduce O&M costs for sediment-trapping BMPs, and improve the overall reliability of stormwater pollution reduction efforts.

Concurrent Sessions I 10:00–11:30

Track C: Innovations in How Row Crops are Grown and Potential Environmental Benefits

Exploring the Potential Benefits of Polymer-Coated Urea on the Irrigated Outwash

Carl Rosen, University of Minnesota, crosen@umn.edu; John Moncrief, University of Minnesota; Norm Krause, Minnesota State Colleges and Universities; Don Sirucek, Minnesota Department of Agriculture; and Bruce Montgomery, Minnesota Department of Agriculture

Controlling nitrogen leaching losses in groundwater-sensitive agricultural regions has always been difficult. When adding in other complicating factors such as irrigation and growing specialty crops with shallow root systems (i.e. potatoes and edible beans), protecting water quality and farm profitability are significant challenges. Currently most nitrogen management strategies on the irrigated outwash rely on multiple incremental applications during the growing season. While highly effective compared to single pre-plant applications, the application costs associated with the additional labor, energy, and higher costing UAN (28-32% liquid nitrogen) are considerable. In addition, unpredictable rainfall following fertigation may exacerbate nitrate leaching problems.

During the last decade, there have been some significant technology advancements for coating urea with a relatively low cost polymer. This coating slows the dissolution of urea and subsequent conversion to nitrate. To the producer, this technology could provide the opportunity of reducing the number of split applications or even possibly applying all of the nitrogen in a single application.

One of the commercially available polymer coated products is called ESN (Environmentally Smart Nitrogen, Agrium Corp). Over the past three years, field experiments were conducted on outwash soils to evaluate the effects of ESN on nitrate leaching and the production of edible beans and potato. The goal of these studies was to match the release rate of ESN with crop nitrogen uptake. Timing and rate of both ESN and urea were found to affect yield and nitrate leaching. ESN applied early in the season and at appropriate rates tended to minimize nitrate leaching and produced yields equal to conventional urea applied in multiple applications. In contrast, ESN applied too late in the season resulted in elevated residual soil nitrate levels at harvest which are highly vulnerable to leaching losses during the non-cropping season. Results from these studies suggest that both ESN and urea, when managed properly, had similar yield and leaching potentials. The advantage of ESN is that fewer applications are required to achieve similar yields and leaching.

Conservation Drainage: Improving Water Quality Through Subsurface Drainage Design

Gary Sands, University of Minnesota, grsands@umn.edu; Inhong Song, University of Minnesota; Lowell M. Busman, Minnesota Department of Agriculture; and Bradley Hansen, University of Minnesota

A field experiment was conducted from 2001 to 2005 to investigate the effects of shallow drainage and drainage intensity on hydrology and water quality in south central Minnesota (Waseca). Subsurface drainage systems were established on nine field-sized watersheds, 0.8 to 2.5 ha in size, at 90 and 120 cm depths and at 1.3 and 5.1 cm/day drainage coefficients. Surface and subsurface drainage runoff and nitrate-nitrogen (NO_3-N) were monitored with automated equipment for 2001 through 2005. Results from the five years show that for the conventional drain spacing, annual drainage runoff and NO_3-N were reduced for the shallow drains by up to 30%. The more intensely drained watersheds (narrow drain spacing) exhibited comparable increases in drainage runoff and NO_3-N loss. No significant changes were observed in mean flow-weighted NO_3-N concentrations among any of the treatments. Thus, reductions in NO_3-N loss were attributed primarily to reductions in annual drainage runoff volume. Reductions in annual drainage runoff were not accompanied by commensurate increases in surface runoff, which overall, represented a very small portion of the water balance. We theorize that the reduced annual drainage volume in the shallow and less intensive drainage systems was accompanied by an increase in deep or lateral seepage from the watersheds.

Tuesday, October 24

Concurrent Sessions I 10:00–11:30

Track C: Innovations in How Row Crops are Grown and Potential Environmental Benefits, *continued*

On-Farm Comparisons of Conservation Tillage Systems

Jodi DeJong-Hughes, UM Extension Service, dejon003@umn.edu, and Jeffrey Vetsch, UM Southern Research and Outreach Center

Use of some conservation tillage systems in Minnesota is constrained by cold, wet soils in the spring, which may delay planting and reduce corn crop yields. The objective of this project was to measure yield response to four tillage systems on commercial farm fields. Corn yield following soybean was compared in no-till, fall strip-till, spring one-pass, and fall chisel plow treatments applied in field-length replicated strips on six farms per year across southern and central Minnesota in 2004 and 2005. Average between-row residue coverage after planting was 60, 47, 29, and 21% respectively for the four systems. Yields averaged over site-years were 181, 186, 183, and 186 bu./acre respectively, indicating that full-width aggressive tillage (chisel) and in-row only tillage (strip-till) provide similar yields, while strip-till maintains more residue cover for soil protection. Previous on-station research also indicated similar yields among the three active tillage treatments, with a significantly lower yield for no-till.

Concurrent Sessions I 10:00–11:30

Track D: Ground and Surface Water Interactions

Groundwater Interaction in the Vermillion River Headwaters

Jennifer Olson, Emmons & Olivier Resources, Inc (EOR), jolson@eorinc.com, and Laura Jester, Dakota Soil and Water Conservation District

The Vermillion River is one of five high priority trout streams in the Twin Cities Metropolitan Area located in a portion of Dakota County that is rapidly developing. Anticipated development within the watershed and along the banks of the River have the potential to impact the River significantly. This project was initiated by the Dakota County SWCD to determine the current interaction of groundwater in the River, identify key recharge areas, and develop management policies for protecting the River and cold water fisheries.

A comprehensive monitoring program was established to evaluate groundwater interactions within the River. Monitoring components included surface water levels; water levels at private residential wells and within shallow hand driven piezometers within the River; chemistry in the River, it's tributaries, and nearby lakes; temperature in the River and River bed; and baseflow measurements. Data were then used to develop maps of ground water influence on the River, ground water contours, key recharge areas and infiltration potential.

A total of 23 stream reaches were monitored as part of a long-term program which evaluated over 55 miles of River channel. The data were analyzed to determine the significance of groundwater interaction at each reach. Two reaches were identified that significantly contribute to the base flow in the River and one reach was identified as a losing reach. While there were varying degrees of interaction among the remaining reaches, the majority of them showed a slight gain in groundwater.

An overlay district has been developed to guide policy and includes three management categories. A model ordinance has been developed to protect ground water recharge quality and quantity, and dependent natural resources based on the data collected as part of this study.

A Chloride Budget for Olmsted County, Minnesota

Robert Wilson and Kimm Crawford, Minnesota State University, lee.terry@co.olmsted.mn.us

Chloride has been used in numerous hydrologic studies as a tracer under the assumption that it flows freely with water and is relatively inexpensive to track. We undertook a county-wide budget with the hypothesis that the chloride loading found in streams and groundwater could be accounted for by inventoried sources. In Olmsted County three major sources of chloride, road salt, softener salt, and potassium fertilizer account for over 90-percent of the inventoried load. All of the inventoried load could be accounted for in the stream flow leaving the county within the uncertainty of the data. Testing shows however that chloride is also accumulating in Olmsted County groundwater and therefore some unaccounted for fraction of the inventoried load is being lost to groundwater. While the relative magnitude of chloride sources will differ by county, the chloride budget method should be applicable in many other situations.

An Evaluation of Methods for the Delineation of Source Water Protection Areas in Karst Aquifers

E. Calvin Alexander, Jr., University of Minnesota, alexa001@umn.edu; Geary M. Schindel, Edwards Aquifer Authority; and Steven B. Johnston, Edwards Aquifer Authority

Methods proposed for the delineation of source water protection areas (SWPA) for municipal groundwater sources include simplified variable shapes, arbitrary fixed radius, time-of-travel, hydrologic mapping, numerical modeling and analytical methods. The selection of a delineation method is commonly based on economics and with little consideration given to aquifer characteristics. Many of the methods assume that the aquifer being evaluated is an equivalent porous media, which limits the usefulness of SWPA for soluble rock aquifers such as limestones, dolostones and some sandstone. A true SWPA for a karst aquifer must be based on an accurate conceptual model of karst groundwater flow. Secondary porosity in soluble rocks form via positive feedback loops and is highly self-organized. These aquifers are noted for having large recharge areas, little if any filtration, very high groundwater velocities (> 1 kilometer/day), convergent flow paths, turbulent flow and a limited capacity for assimilation of contaminants. We will present methods to identify self-organized (karst) aquifers and discuss the application and misapplication of various delineation methods and tools including well hydrodynamics and tracer testing.

Tuesday, October 24

Luncheon Presentation 12:15–1:00 (Lunch served at 11:30)

Water Quality Trading as a Tool for Water Resources Management: Hype, Hysteria, or Helpful?

Mark Kieser, Kieser & Associates and Environmental Trading Network

Concurrent Sessions II 1:15–2:45

Track A: Stream and River Restoration

Rush River Streambank Restoration

Matthew Wildman, North American Wetland Engineering, LLC, mwildman@nawe-pa.com, and Scott D. Wallace, North American Wetland Engineering, LLC

The Rush River near Le Sueur, Minnesota, has been reshaped to reduce erosion by an innovative bank stabilization method called J-hooks. The design used boulders placed in a J configuration combined with bioengineered stream bank stabilization vegetative plantings to eliminate the severe erosion of the river's edge.

In the fall of 1999 the river channel was moved about 15-feet and a bench constructed at the toe of the stream bank. The bank was severely eroded and unstable with over a 100-foot cut bank. In 2003, the J-hooks had deteriorated and the bench terrace had been damaged. Although the original design had been successful in limiting the cut bank erosion, changes had to be made to prevent future erosion. Lessons learned from the original design and construction were implemented in a repair plan that was successfully designed and constructed in the fall of 2003.

Rice Creek Regains Its Curves

Kevin Biehn, Emmons & Olivier Resources, Inc (EOR), kbiehn@eorinc.com, and Chuck Johnson, Rice Creek Watershed District

The Rice Creek Watershed District (RCWD) has recently completed one of the largest stream restoration projects undertaken in Minnesota. Over three-quarters of a mile of Rice Creek, presumably straightened in the early 1900's for agricultural drainage purposes, was reconnected to its natural meandering flow path. No longer an agricultural landscape, the project reach is located entirely within Rice Creek North Regional Trail Corridor, a Ramsey County park, located in Shoreview, MN.

This substantial project was divided into two construction phases. During the first phase (completed spring 2005), meanders were re-excavated and stabilized with a variety of soil bioengineering and stream restoration techniques. These meanders were constructed "offline," or disconnected from Rice Creek, to allow the planted native vegetation to establish along the reclaimed stream banks. Upon satisfactory maturity of the essential bank-holding plant roots, the meanders were brought online during the second construction phase. Additionally lateral surface drainages, still present from a past agricultural era, were decommissioned in an effort to restore local wetland hydrology. Final site restoration was completed in the spring of 2006.

The objectives of this project were to improve water quality, increase habitat diversity and educate park users about the science and geometry of streams. There is a good chance that when the project matures, park users might not realize that this project took place. Bird-watchers might not be aware that the vegetation was replanted. Canoe enthusiasts might not know that the depths and widths determining the creek's velocity and sinuosity were carefully calculated and that the rocks were strategically placed. Recreating natural areas, as complex as it is, should be transparent.

Topics Covered by Proposed Presentation:

- Avoiding pitfalls
- Cost of Design and Construction
- Design and construction nuisances
- Design, installation and function of techniques utilized (construction documents, photographs and audio/video)
- Minimizing construction disturbance and cost
- Required Environmental Review & Permitting

Tuesday, October 24

Concurrent Sessions II 1:15–2:45

Track A: Stream and River Restoration, *continued*

Spring Lake Islands Habitat Rehabilitation and Enhancement Project

Kari Layman, U.S. Army Corps of Engineers, kari.l.layman@usace.army.mil, and Thomas Novak, R.A., U.S. Army Corps of Engineers, St. Paul District

The Spring Lake Islands Habitat Rehabilitation and Enhancement Project (HREP) is a five island complex designed to improve shallow water fish and wildlife habitat in Spring Lake. Located on the Wisconsin side of the Mississippi River in Pool 5, this backwater lake provides overwintering habitat for fish and its dense aquatic plant beds provide food and protection for migrating waterfowl. Since the creation of Pool 5, river currents, ice action, and wind driven wave action have eroded the island complex protecting this backwater habitat. Incorporating lessons learned from past projects and new innovative design features, this project will restore structure and habitat diversity in Spring Lake.

The layout and shape of the complex mimics the original island complex that existed in the 1930s just after lock and dam 5 was constructed. Built to the bankfull flood elevation or lower, the new islands protect the 500 acre backwater from wave action while allowing frequent recharge to maintain adequate water quality. Mudflats, wildlife loafing structures, and turtle mounds add structure and diversity to this island complex, enhancing the productivity for both fish and wildlife.

Concurrent Sessions II 1:15–2:45

Track B: New Applications in Stormwater Modeling

Muddy Waters: Assessment and Modeling of Turbidity Impaired Streams

Steve Kloiber, Metropolitan Council, steve.kloiber@metc.state.mn.us; Ron Jacobson, Metropolitan Council; Karen Jensen, Metropolitan Council; Joe Mulcahy, Metropolitan Council; Judy Sventek, Metropolitan Council; and Hong Wang, Metropolitan Council

Excessive turbidity is the second leading cause of water quality impairment for streams in Minnesota. Thirty percent of impaired stream reaches are listed for exceeding the turbidity standard. In the Twin Cities, the Metropolitan Council and local units of government are working to address this problem through a variety of efforts in support of TMDLs. There are three main components to the Council's efforts: 1) to translate the turbidity standards into total suspended solids (TSS) goals, and 2) to develop watershed models that can be used to help create the TMDL allocation, and 3) to use the models to assess the potential effectiveness of various management scenarios.

TSS goals have been developed using site-specific regression models. Proposed TSS goals typically range from 38 to 82 mg/L. The SWAT model has been applied to several watersheds. Some initial calibrations have been completed for Bevens Creek, Bluff Creek, Carver Creek, and Credit River. Results to date indicate that the model predicts flow and suspended solids quite well. Index of agreement values range from 0.79 to 0.97 for monthly flows. The index of agreement for Bluff Creek TSS is 0.92.

Integrating Radar Rainfall Data, GIS, and XPSWMM to Model Storm Events

Jeff Christopherson, HDR Engineering Inc, shettiar@hdrinc.com, and Matt Moore, South Washington Watershed District

On October 4th and 5th, 2005, average rainfalls of 6-inches deluged the South Washington Watershed District (SWWD), causing extensive flooding. The subsequent impacts of this flooding resulted in the SWWD and the City of Woodbury wanting to use the watershed model developed by HDR to analyze the watershed's response to the storm, define the causes of flooding, and evaluate mitigation measures. HDR described and modeled the rainfall within the SWWD using the storm's radar trace data to develop half mile by half mile gridded cumulative rainfall totals and their corresponding hyetographs in GIS. The gridded rainfall layers were added to the current XP-SWMM model through a directly linked, comprehensive GIS geodatabase. Lake levels were set to pre-storm elevations and adjustments made to the antecedent soil moisture, resulting in a model reflecting the high water marks at key locations, surveyed after the storm event. Managed and evaluated in GIS, mitigation options included additional storage, outlet improvements, and an emergency overflow.

Implementation of BMPs in Bluff Creek, MN—A Scenario Study using SWAT

Hong Wang, Metropolitan Council, hong.wang@metc.state.mn.us

This presentation will discuss SWAT application to Bluff Creek, a rapidly urbanizing watershed in Minnesota, to analyze its sources, loading and spatial distribution of surface runoff, TSS and nutrients in the watershed. BMP implementation scenarios of buffers, conservation tillage, fertilization, and wetlands/ponds were analyzed using calibrated SWAT model.

The modeled results indicated that buffer strips would be efficient in TSS and TP reductions but relatively less efficient in removing dissolved pollutants from runoff. A minimum 3 m wide strip was recommended for the watershed. By using conservation tillage practices, the watershed TSS and TP loads discharged to Minnesota River would be reduced by 13% and 15%. Increases in fertilizer application would directly increase the nutrient exports from the watershed. The model suggests that fertilization rates should be less than 45 kg/ha P and 180 kg/ha N for corn, 18 kg/ha P for soybean and 45 kg P/ha for alfalfa in order to benefit both water quality and crop yields. Wetlands and ponds implemented within the watershed were found to be highly efficient for improving stream water quality, but implementation should follow the planning and regulations of local watershed management authorities. Further studies may be needed to determine overall impacts of wetlands and ponds on watershed ecosystems.

Tuesday, October 24

Concurrent Sessions II 1:15–2:45

Track C: Assessing Agricultural Impacts

Fecal Coliform Source Tracking in the Beauford Minor Watershed

Scott Matteson, Minnesota State University, scott.matteson@mnsu.edu, and Shannon Fisher, Minnesota State University

The 5,500-acre Beauford Creek minor watershed is located in Blue Earth County, Minnesota. In the early 1990s, the watershed was part of a large scale septic improvement program. Today, 83% of the septic systems in the watershed are legally permitted; however, fecal coliform levels remain high during high and low flow periods. This presentation will focus on water quality data collected from the stream between 1993 and 2005. Intensive field sampling and GIS analysis have tentatively identified sources of fecal contamination during both low and high flow periods. Results suggest the presence of a streambed sediment source during low flow periods and agricultural fields or tile as primary sources during high flow periods.

Agricultural Nutrient Mass-Balances in the Huelskamp Creek Watershed in Nicollet County, Minnesota

Luke Stuewe, Minnesota Department of Agriculture, Luke.Stuewe@state.mn.us; D. J. Mulla, University of Minnesota; and A. S. Birr, Minnesota Department of Agriculture

An annual agricultural nitrogen (N) and phosphorus (P) mass-balance was estimated in a 2,290 ha watershed in Nicollet County. This balance was based on detailed farm survey information and water quality, soils and manure data. All major inputs and outputs of N and P within the system were considered, giving a net removal of organic soil N (104 kg/ha) and accumulation of P (15 kg/ha) within the watershed. N lost to surface water (20 kg/ha) and groundwater (9 kg/ha) account for 10% of all N outputs, while atmospheric N losses (91 kg/ha) were 32% of N outputs. P lost to surface water (1.0 kg/ha) accounted for 3% of all P outputs. Changes in nitrogen management (such as conversion from fall to spring applications and reduction in rates consistent with the UM recommendations) are needed to minimize the loss of N to the environment. Reductions in supplemental P added to livestock feed appears to offer the most practical potential for reducing the excess P applied to croplands.

On-Farm Nitrogen and Phosphorous Nutrient Management Demonstrations

Brian Williams, Minnesota Department of Agriculture, brian.c.williams@state.mn.us; Linda Meschke, Rural Advantage; and Jeff St. Ores, USDA-NRCS

Historic efforts to improve N and P management have often focused on "telling" and "showing" farmers prescriptions of best management practices (BMPs) and then convincing them to adopt "BMPs." Growers doing evaluations on their own farms can further refine their management so the room for local improvement is real. The purpose of the Minnesota Nutrient Management Initiative is to conduct field-size replicated nutrient management demonstrations that: (1) compare farmers' nutrient management techniques to nutrient management techniques recommended by the USDA Natural Resources Conservation Service (NRCS) nutrient management guidelines; (2) provide educational information to assist farmers tailoring nutrient management to their crop's needs; (3) to assist NRCS in adjusting its nutrient management guidance and (4) provide a platform for nutrient educational efforts.

Numerous on farm nutrient demonstration sites in southern Minnesota have been established in 2006. These demonstration sites are replicated three times evaluating farmers' normally applied application rates versus NRCS nutrient management guidelines. Farmers are required to work with certified crop consultants with demonstration site layout, rate determination, and data collection. Results from these sites will help farmers evaluate management practices considering economics, yield response, application timing, and long term soil nutrient levels. Certified Crop Advisers working with these farmers will be compensated for participation with these on-farm demonstrations.

Concurrent Sessions II 1:15–2:45

Track D: Lakes

Establishing Hydrologic and Hydraulic Design Criteria for Shallow Lake Restoration

Mark Deutschman, Houston Engineering, Inc., mdeutschman@houstonengineeringinc.com, and Nancy Stowe, Houston Engineering, Inc.

Hydrologic and hydraulic design criteria are generally well established for traditional public improvement projects. Hydrologic and hydraulic design is guided by numerous design manuals and guidance documents developed by the U.S. Army Corps of Engineers, the National Resources Conservation Service, the Federal Highway Administration, State transportation authorities and others. However, little guidance exists for restoring ecological processes to natural systems, including those within shallow lakes, which depend on specific hydrologic or hydraulic conditions.

This presentation is focused on the challenges of establishing hydrologic and hydraulic design criteria, necessary to establish water regimes to restore the ecological function to two important Minnesota shallow lake systems; i.e., Lake Christina and Lake Ogechie. Lake Christina, located in Grant County, Minnesota, is an important local, State and National waterfowl resource. Intensive management to maintain its prominence as a premier waterfowl resource dates back nearly 20 years. Lake Ogechie, located immediately downstream from Lake Mille Lacs in Mille Lacs County, Minnesota, is an important wild rice and fishery resource. The loss of a viable wild rice population from Lake Ogechie is believed related to artificially high water levels for a long duration.

Seasonal Salinity Cycles in Northern Urban Lakes

Dan Murphy, Bonestroo, Rosene, Anderlik & Associates, Inc., dmurphy@bonestroo.com, and Heinz Stefan, University of Minnesota

Road salt application is considered an economic necessity to keep roads free of ice for safe winter travel in northern climate zones. The most commonly used road salts to deice roads are calcium chloride (CaCl2) and sodium chloride (NaCl). Because of a large difference in cost NaCl is applied much more frequently. Surface runoff from snowmelt containing dissolved road salt feeds many Twin Cities Metro Area lakes. Little is known about the fate of NaCl entering the lakes.

Salinity in eight urban lakes in the Minnepolis/St.Paul metropolitan area was measured 9 times in 14 months including two winters and a summer. Variations of specific conductance were found with season and with depth in each of the lakes. Specific conductance values varied from 400 to 1800 μS/cm in seven of the lakes and reached a maximum of 3500 μS/cm in the eighth lake which was meromictic. The largest specific conductance values were in late winter and at the bottom of the lakes, and the lowest in late summer near the surface of the lakes.

Chloride concentration was linearly related to specific conductance. Chloride concentration profiles were calculated from specific conductance, and integrated with depth to give total chloride and total NaCl content. The largest salt content in any of the eight lakes was about 1000 metric tons in Lake Johanna and in Cedar Lake, and the lowest was about 70 metric tons in Ryan Lake. There was clearly a seasonal pattern in salt storage in all eight lakes, i.e. an accumulation of NaCl during the winter months and a decrease in total salt content during the summer. The difference between the highest and the lowest salt content measured was about 300 metric tons in Cedar Lake.

Chloride concentrations near the lake bottom in Brownie Lake and Ryan Lake exceeded the chronic chloride standard of 230 mg/L during the entire 14 months of the field study. The chronic standard was also exceeded near the lake bottom in McCarrons Lake and in a bay of Medicine Lake during late spring 2004 and 2005, respectively.

Density increases due to salinity were mostly less than 0.0001kg/m3 and made only a weak contribution to the density stratification of the lakes. The largest density increase due to salinity was calculated for the bottom of Brownie Lake ($\Delta\rho$=0.00135kg/m3). The effect of vertical density gradients on the vertical dispersion coefficient was calculated with and without the effect of salinity. In all lakes the vertical diffusivity changed by less than a factor of 1.8 due to the salt content, i.e., the vertical mixing coefficients are more strongly affected by temperature than by salinity.

The overall conclusion is that lakes are in the hydrologic pathway of roadway deicing salts. They act as a sink and provide temporary storage of dissolved salt in the winter months when road salts are applied, and they act as a source of salinity in the summer months. One of the eight lakes studied has provided permanent storage for salt (It is a meromictic lake with a permanent salt water layer), but it is still unknown under what conditions the other lakes would act likewise.

Tuesday, October 24

Concurrent Sessions II 1:15–2:45

Track D: Lakes, *continued*

Modeling Framework to Assess Big Sauk Lake Restoration Alternatives: A Step Toward Developing the TMDL

Amal Djerrari, Hydrogeological and Modeling Services, Inc., amaldjerrari@comcast.net; Julie Klocker, Crow River Watershed District; and Lynn Nelson, Sauk River Watershed District

Big Sauk Lake in Todd County (within the Sauk River Watershed) is listed among the MPCA TMDL projects that are planned or underway. Big Sauk is impaired by excessive nutrients. A bathtub model of the lake was developed back in 1993 as part of the Lake Diagnostic Study. The model, steady-state in nature, failed to provide an understanding as to how lake restoration could be attained once the TMDL are defined.

In this work, we developed a dynamic water-sediment total phosphorus lake model that takes into account the specific dynamics of Big Sauk Lake (which consist of two bays, with the North Bay that has a residence time of 4.5 years, whereas the SW Bay has a 21-day residence time). The model, constructed in four compartments, links TP stream loadings to in-lake total phosphorus concentration and take into account internal TP loading during anoxic conditions in the hypolimnion. The model was calibrated on a daily basis for data gathered from Sept 1988 to August 1991. Validation of the model was carried for the 2001-2004 data. The in-lake concentration within the North Bay of the lake was found to be very influenced by internal phosphorous loading

To assess how land-use and farm management practices influence TP stream loadings to the lake, a SWAT watershed management model was developed for one of the major creeks that feeds the SW Bay of the lake, Ashley Creek. The SWAT model was calibrated for hydrology, sediments and phosphorus for Data gathered by SRWD for 2001 thru 2004. Data validation will be carried out using future data gathered by the SRWD.

The linkage between the two models provides a modeling framework for assessing BMPs and their impact on Sauk Lake TP concentrations. Preliminary modeling suggests that restoration of the North Bay may be a long-term endeavor due to the internal phosphorus loading.

Concurrent Sessions III 3:15–4:45

Track A: Thermal Impacts

Case Study—Infiltration Basin Performance of the Trout Habitat Preservation Project

Christa Bren, Emmons & Olivier Resources, Inc (EOR), cbren@eorinc.com

The Trout Habitat Preservation Project (THPP), of the Brown's Creek Watershed District (BCWD), was a project designed to alleviate flooding surrounding a large land-locked basin while protecting the temperature sensitive resources of Brown's Creek.

The THPP design, by District Engineers Emmons & Olivier Resources, Inc., was an innovative approach which tackled the challenges of the project by including infiltration as a key component. The design provided a lake outlet from the flooding basin, created wetland habitat, and used infiltration basins to minimize discharge and thermal impacts to Brown's Creek.

The THPP project was selected for evaluation by a University of Minnesota graduate student, Christa Bren, with guidance from advisor Prof. John Gulliver. Monitoring data collected from construction completion in 2000 through 2005 was used to assess the performance of the THPP infiltration basins.

The monitoring data revealed successful basin performance, as well as, a few areas for improvement.

TMDL for Trout Streams: Winter Dynamics Matter

Leonard Ferrington, Jr., University of Minnesota, ferri016@umn.edu, and R. Will Bouchard, University of Minnesota

Field studies to determine target levels for TMDL routinely are conducted during warm water months. Metro-area trout streams are thermally buffered by groundwater, and are generally considered as cold-water habitats. However, these streams are warmer in winter than surface-water dominated streams and our studies have shown very contrasting life cycle dynamics of winter-growing macroinvertebrates compared to surface-water dominated streams that ice-over. More that 15 species of aquatic insects mature and emerge from trout streams during winter and serve as over-wintering food resources for trout. Several are active as adults on the water surface or adjacent snow covered banks at sub-zero temperatures and can supercool to -21 C. However, as larvae these aquatic insects are among the most intolerant to reductions in dissolved oxygen. Consequently, we recommend that TMDL targets for TSS, DO, N and P be set at levels that ensure viable populations of winter-active macroinvertebrates in trout streams.

Characterization of Storm Events with Maximum Thermal Impact on Surface Water Runoff from Developed Lands

William Herb, University of Minnesota, herb0003@umn.edu; Ben Janke, University of Minnesota; Omid Mohseni, University of Minnesota; and Heinz Stefan, University of Minnesota

Urban development dramatically alters a drainage system by landscaping, changes in surface cover (pavements and buildings), and addition of new storm sewers and detention ponds. Surface runoff from developed land can impact the temperature of nearby cold water streams and degrade trout habitat. Although the thermal impact of development on cold water streams has been measured in a few specific streams, there is a need for prediction of these impacts for proposed developments that can be used in the permitting process. In the process of developing a simulation tool to predict thermal impacts, we have performed extensive analyses of climate and surface temperature data to better understand the processes that produce thermal impact. There has been a general belief that the precipitation events that produce the largest thermal impacts on streams would consist of a mid-day storm of moderate size, with the surface runoff heated by warm pavement. Extensive analyses of climate and surface temperature data have shown the situation to be more complex, with rapid cooling of pervious surfaces prior to rainfall events and widely varying rainfall temperatures. Mid-summer evening or early morning storms with high dew point temperatures may produce a high thermal impact on streams, even without additional heating from pavement. We have also used detailed process models to study the heat transfer from paved surfaces to surface runoff to simulate the temperature and flow rate of surface runoff for different storm events. In this presentation, we will summarize data on storm events and surface temperatures, the results of computer simulations of runoff temperature and flow rate, and potential thermal impact of these events on stream temperature.

Tuesday, October 24

Concurrent Sessions III 3:15–4:45

Track B: Stormwater BMP Assessment

Testing versus Monitoring in the Assessment of Stormwater BMPs

Andrew Erickson, University of Minnesota, eric0706@umn.edu; John Gulliver, University of Minnesota; and James Anderson, University of Minnesota

Historically, assessment of stormwater BMPs has been accomplished with monitoring. Monitoring programs are often expensive to maintain due to the effort and time required to gather quality data. We have established three additional levels of alternative methods for assessment that can determine the effectiveness of stormwater BMPs in a cost effective manner, depending on the objectives of the assessment effort. In increasing order of effort and cost, the four levels are: 1)Visual Inspection (is it working at all?), 2) Capacity Testing (is it working properly?), and 3) Simulated Runoff Testing (is it improving runoff quantity, quality, or both?), and 4) Monitoring. Some advantages for testing (versus monitoring) include: constant discharge, known contaminant concentration, and repeatable measurements (with improved precision). Some disadvantages include: constant discharge, size or discharge limitations, required computational simulation of storm events, and limited experience in testing. Testing for the assessment of stormwater BMPs provides a cost effective alternative to monitoring, and is one area being developed for the MPCA Assessment Protocol.

Funding: Minnesota Pollution Control Agency
Metropolitan Council
Minnesota Local Road Research Board

Techniques for Evaluating the Effectiveness of Rain Gardens as a Stormwater BMP

Brooke Asleson, University of Minnesota, crow0077@umn.edu; Rebecca S. Nestingen, University of Minnesota; John S. Gulliver, University of Minnesota; Raymond M. Hozalski, University of Minnesota; and John Nieber, University of Minnesota

Rain gardens are a low impact development (LID) technique that is commonly used to treat stormwater runoff. Monitoring rain gardens and other stormwater Best Management Practices (BMPs) can be difficult and time consuming due to the unpredictability of storm events. Alternatives to monitoring are needed to assess rain gardens as an effective long-term stormwater BMP. For assessment of the rain gardens ability to control runoff, proposed methods include a four level process. The use of infiltrometers and permeameters for point infiltration measurements, and whole rain garden infiltration measurements using synthetic simulated storm events are being researched extensively. Research has been conducted over the past two years, and will continue during the next year to evaluate the various techniques for measuring infiltration and will be used to further examine their accuracy in the field. These field "testing" methods provide input parameters to infiltration models to facilitate investigation of rain garden performance over a wide variety of conditions. This research is part of an overall project to create a stormwater BMP assessment protocol. Results of field measurements performed during the past two years will be summarized in this presentation. Partners on this project include: the University of Minnesota, Metropolitan Council Environmental Services (MCES), MN Pollution Control Agency (MPCA), and the Dakota County Soil and Water Conservation District (SWCD). The rain garden infiltration measurements made during the growing season will be combined with winter infiltration measurements made by the Dakota County SWCD as part of a Water Environment Research Federation (WERF)-funded project that is evaluating the performance of rain gardens in cold climates. The final product of this and related efforts will be an assessment protocol that will explain both monitoring and cost-effective testing procedures for stormwater BMPs. In addition, understanding the infiltration performance of rain gardens will facilitate improvements in their design, use, and maintenance.

Track B: Stormwater BMP Assessment, *continued*

Assessing the Effectiveness of Proprietary Stormwater Treatment Devices

Matt Wilson, University of Minnesota, wilso888@umn.edu; John Gulliver, University of Minnesota; and Omid Mohseni, University of Minnesota

This research investigates the feasibility of controlled field tests of proprietary underground devices under a variety of treatment flow rates and influent sediment concentrations in order to gain a better understanding of each device's performance. This approach contrasts with field monitoring studies which must overcome the challenge of obtaining representative samples upstream and downstream of the device. Under field testing, each device is carefully cleaned prior to the testing, a given flow rate and sediment/pollutant concentration are supplied during testing, and then a bulk solids analysis is performed on sediment captured by the device. This will eliminate errors due to sampling of both influent and effluent water. After data analysis is complete, a revised sizing criterion is proposed which will improve overall performance and sizing of such devices. The resulting approach refined through field experiments will be incorporated into an assessment (monitoring and field testing) protocol that will be used by consultants, local governments, and state agencies to assist in selecting, designing, and evaluating stormwater treatment technologies for public infrastructure improvement projects.

Tuesday, October 24

Concurrent Session III 3:15–4:45

Track C: Beyond the Land of Sky-Blue Waters—National and International Issues

Assessing Human Vulnerability in Major River Systems

Karlyn Eckman, University of Minnesota, eckma001@umn.edu

Through the Mekong-Mississippi Partnership (MMP), the presenter is working with an international team of experts on a study of human vulnerability and dependence of people on aquatic resources in the Lower Mekong Basin (Cambodia, Thailand, Lao PDR and Vietnam). This effort includes a major literature review on vulnerability and dependence in each LMB country, as well as a general review of available methods to assess the human dimensions of vulnerability, food insecurity and dependence on aquatic resources. In the coming months, the team will review secondary data, design a study methodology, prepare training curricula in vulnerability assessment (VA), and carry out training of trainers from the four countries in VA. Field work at the community level in all four countries will then be done. The presentation will include the findings of the MRC literature review, and an update on current work on the Mekong VA, along with a comparison of the major factors that lead to the vulnerability of people living in the Mississippi and Mekong river basins; a comparison of the methods and techniques used to assess vulnerability in each context; and a summary of the major gaps in decision-making tools based upon the lessons learned in the Mississippi and Mekong contexts.

Beyond Privatization: Restructuring Water Systems To Improve Performance

Ian Hart, Pacific Insitute, ihart@pacinst.org

Water managers throughout the United States face significant challenges meeting the needs of the communities they serve. Numerous documents have been written about these challenges and how to overcome them. The most controversial types of solution options involve increased reliance on the private sector.

In the U.S., interest in the privatization of water and wastewater utilities, and to a much lesser extent in stormwater management, increased significantly during the 1990s. Private companies saw an opportunity for profit in owning or operating water systems, and they entered or expanded their presence in many markets. In some cases they have been strongly opposed by those who feel that water is too essential and fundamental a public good to allow private ownership or even operation of publicly owned facilities. For similar reasons, some communities have purchased or attempted to purchase water system assets from investor owned utilities. This action of "municipalization" is the opposite of selling public assets to an investor owned company. By "restructuring" we mean the full range of options including and between these two extremes.

This document is unique in that it discusses the role of the private sector in water systems in the upper Midwest while arguing that "public versus private" is not the "bright line" that separates success from failure. We believe that the ideological debate over privatization has overshadowed more important determinants of success. Our essential message is that the issue of public versus private is an important "value issue" that has, unfortunately, become a distraction from other, more important determinants of success. These determinants include effective staffing, adequate and innovative funding, better asset management systems, performance measurements and rewards, and better stakeholder involvement and transparency.

This report (http://www.pacinst.org/reports/beyond_privatization/) provides a framework for assessing problems, identifying possible solutions, and choosing among them. It provides practical information and examples to help urban and rural municipal-level decision-makers who need to improve the effectiveness of the water, wastewater, and storm water utilities that serve them, whether public or private.

Urban Landscape Scenarios and Cycling of Carbon, Nitrogen and Phosphorus

Paul Hartzheim, University of Minnesota, hart0406@umn.edu, and Larry Baker, University of Minnesota

While traditional approaches to pollution control have centered on "end of pipe" management, current research suggests that focusing on the impacts of individual households on their local and regional environments may prove more effective. Through the development and application of a "household nutrient flux calculator," which estimates the quantities, forms and pathways of household carbon (C), nitrogen (N), and phosphorus (P)—we have found substantial variability among structurally similar households due to differences in human choice. Preliminary analysis of two household survey groups (Falcon Heights, MN and Tirana, Albania) indicates that C, N and P flux may vary by a factor of five (or more) from one household to another. Beyond human choice, several urban landscape characteristics (house sizes, population density, green spaces) may have an equally large impact on household C, N, and P cycling. Understanding nutrient cycling under different urban development scenarios may provide useful tools for both public policy and urban design.

Reception and Poster Session 4:45–5:45

Posters are listed, and displayed, in alphabetical order by first author

Exposure and Risk Assessment of Selected Pesticides to Threatened and Endangered Species in North Dakota

Jenilynn Bohm, Bemidji State University, jbohm@bemidjistate.edu, and Steven Spigarelli, Bemidji State

The U.S. EPA's Endangered Species Protection Plan, requires states to have county bulletins that provide information about the risks of pesticides to endangered species. North Dakota Department of Agriculture chose Bemidji State University to perform risk assessments on 66 pesticides for five of its threatened and endangered species: Bald Eagle, Piping Plover, Interior Least Tern, Whooping Crane, and Pallid Sturgeon. Species exposure will be estimated by using Quantitative Structure Activity Relationships (QSAR) and the Trophic Trace model. The results will be compared and used in risk assessments according to EPA guidelines. The results of this study will: 1). Estimate species body burdens of pesticides according to Kow (octanol-water partition coefficient), Koc (organic carbon in soil-water partition coefficient), and water solubility; 2). Expand Kow and water solubility QSARs to avian species; and 3). Provide a quantitative basis for the preservation and protection of the threatened and endangered species in North Dakota.

Minnesota's Efforts to Establish a Agricultural Fertilizer Research Fund

Greg Buzicky, Minnesota Department of Agriculture, Greg.Buzicky@state.mn.us; Perry Aasness, Minnesota Department of Agriculture; Bruce Montgomery, Minnesota Department of Agriculture, and Gregg Regimbal, Minnesota Department of Agriculture

The 2005 Legislature directed the Commissioner of Agriculture to assemble an Agricultural Nutrient Task Force to study fours topics related to agricultural nutrient issues. The primary focus of the task force was the need for research, education and training in the selection and application of agricultural fertilizer and soil nutrients. A mechanism was also needed to fund the research. This legislation was a compromise solution to a bill that had been introduced during the previous legislative session that called for the establishment of a fertilizer check off fund dedicated to agricultural fertilizer research.

The Agricultural Nutrient Task Force was a diverse group of twenty members representing major farm and commodity organizations, fertilizer retailers, crop consultants, legislators and the Minnesota Department of Agriculture. After meeting throughout the fall and winter, a report as required by statute, became the basis of legislation that was introduced in both the Minnesota House of Representatives and the Senate. The legislation, as the Agriculture Nutrient Task force had unanimously recommended, called for a dedicated research fund to be raised by the imposition of a fee of forty cents per ton of agricultural fertilizer which would raise approximately $850,000 per year. In addition, the legislation included all the components that the Task Force had recommended including an independent Ag Fertilizer Research and Education Council to oversee the fund.

This paper will review the Task Force's efforts, the process the Task Force followed, key information they considered and their final recommendations. The status of the legislation will be presented along with future implications of these efforts.

Effects of Agricultural Land Retirement Practices on Small Streams of the Minnesota River Basin

Victoria Christensen, U.S. Geological Survey, vglenn@usgs.gov

The Legislative Commission on Minnesota Resources and the Minnesota Board of Water and Soil Resources are cooperating with the U.S. Geological Survey to study the effects of agricultural retirement programs, such as Conservation Reserve Enhancement Program (CREP), Conservation Reserve Program (CRP), and large-scale best management practices (BMPs), on streams. Monitoring of water quality and aquatic biology at Chetomba Creek, West Fork Beaver Creek, and South Branch Rush River began in October 2005 and will continue through September 2007. The basins (from 82 to 153 square miles) have similar geologic and hydrologic settings, but differ with respect to the amount, type, and location of fallow land. Each is monitored for streamflow, suspended sediment, nutrients, fish diversity, physical habitat characterization, and other biological and physical measurements. Results from this study can be used by resource managers to evaluate the success of agricultural BMPs and land-retirement programs for improving stream quality.

Tuesday, October 24

Reception and Poster Session 4:45–5:45

Posters by first author, *continued*

Certification of Laboratories for Manure Analysis

Jerry Floren, Minnesota Department of Agriculture, jerry.floren@state.mn.us, and Robert Miller, Colorado State University

Laboratory testing of manure is an important component of a sound nutrient management plan. Despite the recent environmental concerns regarding the land application of manure, less than 10% of Minnesota's livestock operations test manure on a regular basis. One chronic obstacle is the producer concerns that the lab results were highly variable and consequently of little value. Until recently, there was no technical guidance for the analytical methodology available to the laboratories offering these services. Additionally there were no certification or proficiency-type programs available to ensure accurate and credible manure testing results.

The Effects of Fluoxetine Exposure on Locomotion and Reproductive Competence in Male Fathead Minnows (*Pimephales promelas*)

Kent Grove, St. Cloud State University, grke9802@stcloudstate.edu, and Heiko L. Schoenfuss, St. Cloud State University

The pharmaceutical compound fluoxetine has been detected in water samples from several North American surface waters including the outfalls of major wastewater treatment plants. In a series of experiments we exposed mature male fathead minnows to fluoxetine in order to determine the compound's effect on reproductive competence and locomotion in exposed male organisms. In one experiment, we exposed male fish for ten days, in the other experiment for 28 days to fluoxetine at 100 µg/L. At the end of both experiments, we allowed males to compete for reproductive opportunities with unexposed fish from the same batch. In the ten-day exposure, 74% of the nest sites were held by unexposed fish, and 26% were held by fish exposed to fluoxetine. The 28 day exposures yielded 45% of the nest sites were held by unexposed fish, and 55% were held by exposed fish. After the six day competitive spawning assay, all male fish were sacrificed and their livers and gonads were extracted for histological analysis. The relative liver size (HSI) was 0.0209 for untreated and 0.0876 for fluoxetine treated males, indicating an increased liver size within the exposed fish. The relative gonad size (GSI) for the unexposed fish was 0.0049 and 0.0074 for the exposed fish indicating a decrease in gonadal size after only ten days. Fish were also analyzed for secondary sexual characters and histopathology. In addition, fish from the ten-day exposure were evaluated for their reaction time and speed in escaping a threatening stimulus. Detailed methodology and results will be presented at the conference.

Development of Goose-Specific DNA Markers to Determine Sources of *Escherichia coli* in Waterways

Matthew Hamilton, University of Minnesota, hami0192@umn.edu; Tao Yan, University of Minnesota; and Michael J. Sadowsky, University of Minnesota

Fecal contamination of waterways remains a persistent threat to public health. Identification of fecal contamination sources is a vital component for abatement and in determination of total maximum daily loads. Most methods to determine sources of fecal bacteria require large known-source libraries, and often fail to adequately differentiate isolates from different sources. In this study, we used subtractive hybridizations to enrich for source-specific DNA markers for *E. coli* from geese. When used in colony hybridization studies, the combined markers identified 76% of the goose and 73% of duck isolates tested, and cross-hybridized, on average, with 5% of the human E. coli strains, and less than 10% with strains from other hosts. However, the probes mainly reacted with isolates from geese in the upper Midwest, indicating regional specificity. Coupled with high-throughput, automated screening, these markers may provide a quantitative, cost-effective, and accurate library-independent method to determine sources of *E. coli*.

Posters by first author, *continued*

Identifying the Sources of *Escherichia coli* at Three Public Beaches in the Duluth-Superior Harbor

Dennis Hansen, University of MN Duluth, hanse799@d.umn.edu; Michael J. Sadowsky, University of Minnesota; Satoshi Ishii, University of Minnesota; and Randall E. Hicks, University of Minnesota, Duluth

Contact with recreational waters containing fecal contamination may result n gastroenteritis, ear infections, and sore throats, and symptoms can be more sever in young children and the elderly. To monitor fecal contamination in public waters, the MPCA currently enumerates fecal coliform bacteria and *Escherichia coli* at 18 St. Louis county beaches. However, they do not determine the source of fecal coliforms, which would be imperative to the management of public beaches. Using rep-PCR DNA fingerprinting methods, sources of environmental *E. coli* strains from three beaches were determined by comparing *E. coli* rep-PCR fingerprints to a library of similar *E. coli* fingerprints from potential source animals. Our preliminary results indicate that Canadian geese, sewage effluent, and ring-billed gulls are important sources of fecal contamination in water and sediment atbeaches often closed to recreational use in the Duluth-Superior Harbor.

Stream Water Quality Monitoring Using Wireless Embedded Sensor Networks

Jeremiah Jazdzewski, University of Minnesota, jazdz007@umn.edu; Miki Hondzo, University of Minnesota; and William Arnold, University of Minnesota

The increased human impact on aquatic environments has generated a need for frequent water quality measurements in streams, rivers, and lakes. The development of wireless sensor technologies has led to data collection at more discrete spatial and temporal scales and eased the transfer of data. By applying this emerging technology to river systems, the monitoring of the dynamics of these spatial and temporal heterogeneities of interest is improved. Of particular interest is the loading of biological and chemical contaminants, which will be more accurately resolved with the use of a wireless real-time monitoring network. The system allows links between the environment and the laboratory, reducing the amount of field sampling. Ultimately, the data collected will lead to more precise modeling techniques and the development of better management practices. The proposed setup will enable the monitoring of parameters such as temperature, water level, turbidity and nitrate concentration in Minnehaha Creek.

A Web-Enabled Environmental Data Warehouse for the Twin Cities

Steve Kloiber, Metropolitan Council, steve.kloiber@metc.state.mn.us; Terrie O'Dea, Metropolitan Council; Charles Chiang, Metropolitan Council; Scott Sherman, Metropolitan Council; and Marianne Kollar, Consultant

The Twin Cities Metropolitan Area (TCMA) has many agencies and organizations involved in collecting and using environmental monitoring data. The Metropolitan Council and its partners collect water quality information from hundreds of lakes, rivers and streams throughout the TCMA as well as from industrial and municipal wastewater dischargers. Some of these databases cover decades and collectively include millions of individual observations. To make better use of this data and to support environmental planning, the Metropolitan Council has developed a coordinated Environmental Information Management System (EIMS) to provide timely and reliable environmental information. EIMS aims to enhance data sharing and facilitate data distribution within the Council, with other agencies and the public. Data are enter the system from many sources, including automated uploads and manual entry through secure web forms. Once reviewed and approved, the data from the EIMS are delivered through a flexible, user-friendly, Internet interface that includes menu-driven searching, keyword searching and interactive mapping.

Tuesday, October 24

Reception and Poster Session 4:45–5:45

Posters by first author, *continued*

Costs of Groundwater Nitrate Contamination to Municipal and Private Well Owners

Ann Lewandowski, University of Minnesota, alewand@umn.edu; Bruce Montgomery, Minnesota Department of Agriculture; Carl Rosen, University of Minnesota; and John Moncrief, University of Minnesota

More than 70% of Minnesotans get their drinking water from groundwater. Many of them pay costs associated with nitrate contamination. Across the state, over 10% of community water systems have elevated nitrate levels (>3 mg/L), and 10-15% of private wells exceed the 10 mg/L health standard. Little is know about the costs of nitrate contamination. An MDA study of 5 of the 6 municipalities with nitrate removal systems showed that installation and operation of the systems increased water supply costs by 10 to 100 fold. However, the study did not consider costs of other responses to groundwater contamination such as installing deeper wells or blending water from low and high nitrate wells. Private well owners also face costs of new wells, treatment systems, bottled water, and property devaluation. Understanding the costs of nitrate contamination can help planners justify and allocate the costs of wellhead protection to prevent nitrate leaching and aquifer contamination. The objective of this study was to learn how municipalities and private well owners respond to elevated nitrate and to quantify the costs of their choices. The information was gathered through interviews of municipal water supply managers, and a random mail survey of private well owners. Preliminary results of the two surveys will be presented.

Turning The Irrigation and Stormwater Management World Upside-Down

Aileen Nygaard, RLA; Gary Glandon, RLA; Chris Dufour, RLA; Scott Stokes,RRM Design Group (Jonas Sipaila, Evaporative Control Systems, Inc., jonas@ecsgreen.com and William McCully, Glenn Rehbein Companies, presenters)

A community with limited water resources. Sound familiar? The challenge was to provide 130,000 sq. ft. of an all season, durable, multi use play fields and still save mounting water costs. The unique solution provides a water conservation system that utilizes the harvest and storage of rainwater runoff, and efficient non-pressurized sub-surface irrigation.

The main player in this conservation game was a unique subsurface irrigation system developed by Evaporative Control Systems, Inc. This irrigation system is a versatile player as it acts as a collector, water distributor, and filtration system all in one. In the Cambria School, all of the stormwater runoff from the campus' hardscape is collected and stored in a subsurface detention basin beneath the main playfield. Sufficient water is collected during seasonal rains to supply all of the campus's irrigation needs for the rest of the year.

The best part of this design solution is the functional simplicity, low-tech/ low maintenance components, reduced water usage, stormwater management and saving the community's potable water supply for drinking – not landscaping.

Mosquito Control in Underground BMPs—What Works?

Nancy Read, Metropolitan Mosquito Control District, nanread@mmcd.org, and Kirk Johnson, Metropolitan Mosquito Control District

Many underground BMPs (such as sumps, grit chambers, and vortex units) are serving as larval habitat for mosquitoes that potentially can transmit West Nile Virus. In 2006, dry weather reduced flushing action in these structures and led to very high levels of larvae. At the same time the number of birds and mosquitoes testing positive for virus was higher earlier in the year than has been seen since the introduction of the virus in this area in 2002. Human cases were also found earlier in the year, and included a fatality in the metro area.

MMCD has been treating sumped catch basins in the metro area with materials including pellets and briquets that release methoprene, an insect growth regulator that prevents adult emergence. Additional tests were done on briquets that release the naturally-occuring soil bacterium Bti. Results show that it is possible to make significant reductions in mosquito emergence from these BMP habitats.

Given the specialized equipment needed to access many of these structures, MMCD has started working with some cities to provide public works staff the materials to treat them and prevent mosquito problems, and would like to make similar arrangements with more cities. Cities or Watersheds are also asked to let MMCD know if underground structures that allow any mosquito access (including pick holes and loose-fitting lids) are being installed.

Posters by first author, *continued*

Green-Ampt vs. SCS Hydrology: Calibrated Basin Study

Eli Rupnow, Emmons & Olivier Resources, Inc (EOR), erupnow@eorinc.com, and Carl Almer, Emmons and Olivier Resources, Inc.

The northwest quadrant of Inver Grove Heights is comprised of large, landlocked depressions, which were monitored during 2005. An XP-SWMM hydrologic and hydraulic model was calibrated using Green-Ampt parameters to a 6.4" rainfall event that occurred over 27 hours on October 4-5, 2005. The Green-Ampt parameters, once calibrated, needed to be converted to equivalent SCS curve numbers for use by development engineers for the permitting process for Inver Grove Heights. This process indicated that neither the standard Green-Ampt parameters, nor the standard SCS curve numbers were appropriate for this area of Inver Grove Heights and should be used with discretion in other areas.

The Effectiveness of Wetland Buffers in Maintaining Water Quality During Construction on Residential Sites

Sarah Stai, Westwood Professional Services, sarah.stai@westwoodps.com, and Kate D. Livingood, Westwood Professional Services

Protected upland areas adjacent to water resources, or buffers, protect water quality by filtering nutrients and sediment as stormwater flows overland toward wetlands. Water quality concerns in the Twin Cities Metropolitan Area (TCMA) have prompted more frequent incorporation of buffers in developing areas. The quantitative factors that characterize an effective buffer are not thoroughly understood, however, given that multiple variables affect a buffer's pollutant removal capabilities. We studied the effect of buffer width on pollutant removal in residential subdivisions under development. Four sites around the TCMA were outfitted with in-ground collectors in staggered 80-foot transects to capture runoff at increasing intervals down the buffer slope. Sites were monitored between 2004 and 2005 for rainfall intensity and magnitude, and runoff samples were analyzed for phosphorus and sediment content. The effect of down-slope distance on pollutant removal will be presented and discussed in the context of site-specific and storm event characteristics.

Preliminary Assessments on Public Drainage Systems and Watersheds in South Central Minnesota

Bill Thompson, Minnesota Pollution Control Agency, bill.thompson@pca.state.mn.us

The Greater Blue Earth River Basin (GBERB) of south central Minnesota and northern Iowa comprises 3,500 square miles of drainage area in productive agricultural lands. There are three major watersheds in the GBERB—the LeSueur River, Blue Earth River, and Watonwan River watersheds. Due to precipitation patterns and landuse/management, in-stream pollution loads are often higher in these streams, and numerous water quality impairments have been identified. Public drainage systems, under the management of public drainage authorities, are a critical infrastructure within these watersheds for agricultural production. There are approximately 2,600 miles of county tile mains and 720 miles of open ditches within these public drainage systems in the GBERB of Minnesota. The size of these systems varies from several hundred acres, to well over 10,000 acres. Management authorities also vary, from a single county, to joint multi-county boards. Preliminary data on system type, location by watershed, and system status will be presented. An overview of selected case studies of systems where more comprehensive planning and management has occurred, which has led to water storage opportunities, will also be addressed.

Tuesday, October 24

Reception and Poster Session 4:45–5:45

Posters by first author, *continued*

Rain Garden Water Quality

Lan Tornes, U.S. Geological Survey, tornes@usgs.gov

Five rain-garden sites in the suburban Minneapolis – Saint Paul area were sampled for dissolved and particulate residue and nutrients by the U.S. Geological Survey in cooperation with the Metropolitan Council. The project evaluates the effects of water-management systems on water quality. Rain gardens can enhance infiltration of stormwater and can reduce concentrations of many constituents.

The rain gardens captured most stormwater runoff. When overflow occurred, concentrations of particulates were reduced compared to inflow. Median specific conductance and chloride concentrations in the ground water beneath the rain gardens were generally greater than in inflow. The long-term effectiveness on water quality from the rain gardens was difficult to estimate because these rain gardens were new and in disequilibrium. Continued monitoring could provide information to better understand the effectiveness of rain gardens for protecting water quality.

Wednesday, October 25

Plenary Session and Book-Signing 8:10–9:30

Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters

Robert Glennon, Morris K. Udall Professor of Law and Public Policy, Rogers College of Law, University of Arizona

The excessive pumping of our aquifers has created an environmental catastrophe known to only a few scientists, a handful of water management experts, and those unfortunate enough to have suffered the direct consequences. As our groundwater use has increased, pumping has caused rivers, springs, lakes, and wetlands to dry up, ground beneath us to collapse, and fish, birds, wildlife, trees, and shrubs to die. This talk will illustrate the scope of the problem with stories from around the country. These water follies are tales of human foibles including greed, stubbornness, and, especially, the unlimited human capacity to ignore reality.

Wednesday, October 25

Concurrent Sessions IV 10:00–11:30

Track A: Lake Pepin TMDLs

Prospects at Midpoint: A Minnesota River/Lake Pepin TMDL Progress Report

Hans Holmberg, Limno-Tech, Inc., hholmberg@limno.com

Lake Pepin Game Plan for Completion

Norman Senjem, Minnesota Pollution Control Agency, and Hans Holmberg, Limno-Tech, Inc. (LTI)

The Lake Pepin TMDL has been underway since May 2004. If all goes as planned, a draft TMDL should be ready by mid-2009. The TMDL report will specify point and nonpoint source allocations for turbidity impairments on the Mississippi River from the mouth of the Minnesota through Lake Pepin, and for excess nutrient impairments on Spring Lake and Lake Pepin. Advisory committees are providing input from stakeholders and scientists; water quality modeling of the impaired waters is well underway; and modeling of runoff from upstream watersheds is getting started.

Questions remain: What degree of consensus will be achieved regarding scientific and technical issues that arise in the course of the TMDL study? How is the water quality modeling effort addressing these issues? Can a TMDL project of this size allow for adequate engagement of citizens and stakeholders? Will the TMDL lead to effective, balanced implementation of needed reductions from point and nonpoint sources? How the Lake Pepin TMDL "game plan" addresses such questions will be reviewed in this presentation.

Providing Clarity: An Overview of the Minnesota River Turbidity TMDL

Larry Gunderson, Minnesota Pollution Control Agency

Excess sediment and turbidity have long been considered problems in the state's namesake river. The Minnesota River Turbidity TMDL focuses on this murky issue by targeting 18 reaches on the Minnesota River and its tributaries, including the Chippewa, Redwood, Cottonwood, Blue Earth, Hawk Creek, Yellow Medicine, Watonwan, and Le Sueur Rivers. A Stakeholder Advisory Committee is progressively discussing potential sources and modeling will begin next year. This presentation will provide an overview of the project and the approach to identify the major turbidity sources and complete the TMDL.

Questions to be answered include: How are people representing agriculture, the environment, cities, the University of Minnesota and Minnesota State University, watershed projects, local government, and business involved? How is this project linked to the Lower Minnesota River Dissolved Oxygen TMDL, completed in 2004? Will this project provide the information needed for Lake Pepin?

Minnesota River and Lake Pepin TMDLs: The Agricultural Perspective

Paul Torkelson, Minnesota Farm Bureau Federation

Addressing turbidity and nutrient enrichment impairments in the Minnesota and Mississippi Rivers will undoubtedly impact agricultural practices in the watersheds. The agricultural community is committed to being good stewards of the land and contributing to the protection and restoration of Minnesota's waters.

Questions to be answered include: What have Minnesota's farmers been doing to understand the potentials impacts of agricultural practices? What are some of the activities farmers are undertaking to improve watershed health? How much improvement is really needed and practicable? What obstacles are in the way of further improvements? What can be done to address these obstacles?

Concurrent Sessions IV 10:00–11:30

Track B: Effects of Climate Change on Surface Water Flow

Stream Flow in Minnesota: Indicator of Climate Change?

Eric Novotny, University of Minnesota, nov00002@umn.edu, and Heinz G. Stefan, University of Minnesota

Indications are present that mean annual precipitation is increasing in Minnesota in the form of more intense rainfall invents and more days with precipitation. A study was conducted to examine if stream flows throughout the state of Minnesota reflect these changes. Stream flow records from 36 USGS gauging stations in five major river basins of Minnesota were studied. Seven annual stream flow parameters were extracted (up to the year 2002) and analyzed: mean annual flow, 7-day low flow in winter, 7-day low flow in summer, peak flow due to snow melt runoff, peak flow due to rainfall as well as flood duration and large flood duration (number of days with flow rates greater than the mean plus one or two standard deviations, respectively). The Mann-Kendal non-parametric test was used to detect significant trends over time windows from 90 to 10 years. Trends differed significantly from one basin to another, and became more accentuated for shorter time windows. For example, stations with significant trends in the Red River of the North for mean annual flow increased 2 % per year over the past 50 years (1953 – 2002), but have increased at a rate of 14 % per year over the last 15 years (1988-2002). Periodic trends were detected in the Red River of the North, the Mississippi River, and the Minnesota River basins, in 5-year running averages and significant trends in 10-year running windows, for six of the parameters studied. The period was on the order of 13 to 15 years, and the amplitude was particularly strong after 1980. Peak flow due to snowmelt, typically the highest flow in each year, appears to be the only parameter that has not changed at a significant rate. On the other hand, peak flows due to rainfall events in the summer are increasing, as well as the number of days with higher flows (flood durations). Increases in low flow (base flow) in summer and in winter have been significant. For water resources management these results suggest that the threat of spring flooding has not increased, larger floods due to rainfall are likely, and recreational use of streams as well as water quality during summer low flow may benefit from higher stream flows.

Probabilistic River Forecasts at the North Central River Forecast Center: Case Studies for the Minnesota River and the Red River of the North

Heather Offerman Johnson, National Weather Service, and Michael DeWeese, National Weather Service, 951-361-6650

Once a month, probabilistic river forecasts are issued by the National Weather Service (NWS) North Central River Forecast Center (NCRFC) for locations in the Upper Midwest. These forecasts provide the chance of possible flood or drought conditions that might occur in the next three months. Forecasts are issued through the Ensemble Streamflow Prediction (ESP) model, a component of the National Weather Service River Forecast System (NWSRFS). This model combines current basin conditions with past historical climate data to create future potential outcomes. Probabilistic river forecasts issued from December 2005 through March 2006 will be discussed in reference to high water conditions on the Minnesota River and the flood conditions that occurred on the Red River of the North. There will be results on how well these forecasts performed, how users can interpret the data and how these forecasts can be used by the water resources community for rivers and streams in their own area.

A Fresh Look at Low-Flow Statistics in Minnesota

Thomas Winterstein, U.S. Geological Survey, twinters@usgs.gov

The U.S. Geological Survey, in cooperation with the Minnesota Pollution Control Agency, has computed the 1-, 7-, and 30-day low-flow statistics for streams with continuous-record streamflow gaging stations in Minnesota for the first time since 1986. Statistics were computed for 120 gaging stations with at least 20 years of record through 2004. Seventy-nine of the 120 gaging stations had an additional 21 years of record, 1984-2004. At nine of these gaging stations the low-flow statistics did not change, the discharge remained 0 ft3/s for all three low-flow statistics. At 54 gaging stations all three low-flow statistics increased; at 6 gaging stations all three low-flow statistics decreased; and at the remaining 10 gaging stations some of the low-flow statistics either increased or decreased. The statistics, supporting data, and graphs will be available through the USGS Minnesota Water Science Center web site: mn.usgs.gov. The statistics will be plotted on graphs with the traditional log-normal axis and on graphs with a log-Pearson type III axis. In addition, the discharge measurements made at more than 600 partial-record and low-flow sites in Minnesota will be available from the same web site.

Wednesday, October 25

Concurrent Sessions IV 10:00–11:30

Track C: Endocrine Disruption

Effects of Alkylphenol Polyethoxylates (AP) Alone and in Mixture on Two Life Stages of the Fathead Minnow (*Pimephales promelas*)

Heiko Schoenfuss, St. Cloud State University, hschoenfuss@stcloudstate.edu, and Travis J. Bistodeau, St. Cloud State University

In a series of experiments we tested the effects of APs on anatomical, physiological, and reproductive endpoints in the fathead minnow. In one series of experiments, fathead minnow larvae, less than 24 hrs old, were exposed for 64 days to a complex mixture of APs that models the alkylphenol component of a major metropolitan sewage treatment plant effluent. Fish were reared to adulthood and allowed to compete for reproductive opportunities with unexposed fish from the same batch. In another series of experiment, we exposed mature male fathead minnows for 28 days to a graded series of nonylphenol, the most estrogenic AP before allowing fish to compete with control males for reproductive opportunities. All male fish were then sacrificed and analyzed for vitellogenin induction, differences in the development of secondary sexual characters, developmental changes as measured by histology, and morphometric changes. Results indicate a greater sensitivity of early life stages to APs as manifested by higher mortality and reduced reproductive potential. Exposures to AP mixtures were more detrimental to survival and reproductive competence than single compound exposure. No larval exposure resulted in measurable induction of vitellogenin in mature male fish. Mature male fathead minnows were more resilient to exposure, however, at higher, yet environmentally realistic concentrations, exhibited signs of reduced reproductive competence. Results of this study suggest that mixtures of biologically active compounds have at least additive effects on exposed organisms.

Partitioning of Estrogenic Compounds in Wastewater Treatment

Matthew Wogen, University of Minnesota, woge0003@umn.edu; Megan Ogdahl, University of Minnesota; Brendan Moore, University of Minnesota; Paige Novak, University of Minnesota; Michael Semmens, University of Minnesota; and Deborah Swackhamer, University of Minnesota

Estrogenic compounds have been detected in the effluent of wastewater treatment plants and can have serious environmental effects. These compounds have been shown to cause developmental defects and reproductive disorders in biota. If estrogenic compounds are to be removed in the treatment processes, we must better understand the fate of these compounds during treatment. This research is using a yeast estrogen screen (YES) assay to assess the estrogenicity at various locations along the treatment train of the Metropolitan Wastewater Treatment Plant in St. Paul, MN. Field samples are being taken to formulate a mass balance to determine how estrogenic compounds behave during wastewater treatment. The ultimate goal of this project is to be able to suggest treatment alternatives to best remove estrogenic compounds from our wastewater to prevent their discharge.

Estrogens in Swine Manure

Kuldip Kumar, University of Minnesota; Satish C. Gupta, University of Minnesota; Ashok K. Singh, University of Minnesota; Shveta Gupta, University of Minnesota; and Yogesh Chander, University of Minnesota

Naturally occurring estrogens in animal waste can cause negative environmental impact through disruption of endocrine system in wild life, domesticated animal, and humans. Very little information is available on the type and the extent of estrogenic activities in swine manure. This is partially due to lack of analytical ability for estrogen analysis in manures. The goal of this study was to develop procedures for analyzing different estrogens in different types of swine wastes. The wastes included samples of urine and feces from pregnant female pig, non-pregnant pig of similar age, and a boar. The ELISA and HPLC-UV based methods were developed to quantify estrone (E1), 17β estradiol (E2), and estriol (E3) and their conjugates. HPLC analysis showed many organic compounds in manure which had properties similar to that of conjugates of the parent estrogen compounds. Therefore, we concentrated on analyzing only the parent compounds E1, E2, and E3 in this study. In general, ELISA gave higher concentrations of these compounds compared to HPLC-UV analysis. The total concentration of estrogens was more in feces than in urine and followed the trend: pregnant female > non-pregnant female > boar. The concentration of various estrogens in swine waste was variable with concentrations as low as traces to 84 µg/L of E1 in manure from nursery pigs and 1398 µg/L of E2 in pits from finishing pigs. The concentrations of E2 in manure increased by as much as 50–100% on treatment with glucuronidase and sulfatases enzymes indicating that significant concentrations of conjugates were present in manure. Although these conjugates do not have much estrogenic activity, they can convert to free estrogens in manure lagoons thus leading to higher estrogenic activities.

Concurrent Sessions IV 10:00–11:30

Track D: Flood Protection and Control

Red River of the North at East Grand Forks, MN/Grand Forks, ND—Local Flood Damage Reduction Project

Michael Lesher, USACE, michael.d.lesher@usace.army.mil

East Grand Forks, Minnesota and Grand Forks, North Dakota, located on the Red River of the North about 100 miles south of the U.S./Canada border, have a long history of significant flooding. The most damaging flood occurred in April 1997 when the temporary levee system and flood fighting efforts were not successful resulting in estimated total damages exceeding $1 billion. A local flood damage reduction project for the two cities was formulated, optimized and designed and construction is nearly complete.

This presentation will cover the following aspects and lessons learned regarding the project design and construction.

- Top-of-levee design was an iterative process based on hydraulic analysis and geotechnical slope stability analysis.
- Superiority profile for overtopping at the least critical location was complicated by overbuilds for levee settlement.
- Interior Flood Control Analysis for each City included limited optimization analyzes.
- Standard pump sizes were selected, then pumps, pump controls and generators were purchased under supply contract.
- For 15 construction contracts, four were prepared in-house and the other 11 were prepared by A-E firms.
- East Grand Forks constructed a 1,000 ft long "removable" floodwall for their downtown area.
- A stepped dam was converted to a rock rapids to improve safety, dam integrity and fish passage.
- Three railroad closure structure sills were installed in a single 24-hour track outage.
- Some levee construction was performed using GPS guided bulldozers.
- An ice bridge over the Red Lake River was used to haul borrow material.
- Construction Office and Design Team issues.
- Project performance during the 2006 spring flood event.

Overcoming Design Challenges for a Drop Structure for the Heartsville Coulee Diversion Channel: East Grand Forks Flood Protection Project

Rocky Keehn, Short Elliott Hendrickson, Inc. (SEH), rkeehn@sehinc.com, and Brad Woznak, Short Elliott Hendrickson, Inc. (SEH)

As part of the US Army Corps of Engineers flood control project in East Grand Forks, Minnesota, a diversion channel was required to divert the flow from a major drainage system or Coulee around the interior of the City of East Grand Forks during times when the flood gates are closed to protect the interior of the City. One key component of the diversion project was to determine how to convey the flows in the diversion channel from a high flat plain area to the river valley which over 30 feet lower.

The drop structures were designed such that 2,100 cfs would pass through the structure with minimal tailwater impacts from the river and the higher 12,000 cfs maximum flow rates would be allowed to pass over the structure with the entire structure submerged due to high tailwater from the river. The flow profile at each drop structure largely depends on the tailwater level, which is the existing river water surface elevation downstream of the structure.

The focus of the presentation will be on the initial design relationship between the hydraulic designs and geotechnical considerations. The hydraulic analysis of the baffled chute drop structure, diversion channel sizing, the impacts of river tailwater on the design and the challenge of hydraulic design of a structure that must operate under several potential scenarios and flow rates and several tailwater impacts of the downstream river. Construction of the project was completed in early 2006 with final cost of this portion of the project over $10 million. Photographs of the construction stages and completed project will be presented.

Wednesday, October 25

Concurrent Sessions IV 10:00–11:30

Track D: Flood Protection and Control, *continued*

Lazarus Creek Floodwater Control Project

Brent Johnson, Houston Engineering, Inc., brent.johnson@houstonengineeringinc.com, and James Rudd, American Engineering Testing, Inc.

Building dams is challenging. Construction of the Lazarus Creek dam began in 2004, once challenging political, technical and environmental issues were resolved. Although project funding was approved twice by the Legislature, then Governor Ventura vetoed the funding both times. Finally, on the Watershed District's third try, with the signature of Governor Pawlenty, project funding was passed. Alluvial soils and groundwater at the site presented technical design challenges regarding seepage control. The dam was built with three lines of defense against seepage: an impervious clay core and cutoff trench, a chimney drain and a toe drain. Wetland and prairie mitigation were included as part of the Section 404 permit.

Due to the persistence of the Lac Qui Parle-Yellow Bank Watershed District, the Project was completed 34 years after the concept was envisioned. Construction of the $1.7 Million earthen dam began in 2004 and was completed in 2005. The dam on Lazarus Creek is 67 feet high and 700 feet long and controls the runoff from a 21 square mile area. The presentation will provide an overview of the project development and its design, construction and operation.

Luncheon Presentation 12:00–1:15 (Lunch served at 11:30)

Impacts of Corn Ethanol and Other Biofuels on Water Quality and Carbon Gas Emissions

David Tilman, Regents Professor, Department of Ecology, Evolution and Behavior, College of Biological Science, University of Minnesota

Negative environmental consequences of fossil fuels and concerns about petroleum supplies have spurred the search for renewable transportation biofuels. To be a viable alternative, a biofuel should provide a net energy gain, have environmental benefits, be economically competitive, and be producible in large quantities without reducing food supplies. We use these criteria to evaluate, through life-cycle accounting, ethanol from corn grain and biodiesel from soybeans. Ethanol yields 25% more energy than the energy invested in its production, whereas biodiesel yields 93% more. Neither food-based biofuel can replace much petroleum even if all corn and soybeans produced in the USA were dedicated to biofuel production. Corn ethanol imposes much greater environmental harm than biodiesel. Compared with ethanol, biodiesel releases just 1.0%, 8.3%, and 13% of the agricultural nitrogen, phosphorus, and pesticide pollutants, respectively, per net energy gain. Relative to the fossil fuels they displace, greenhouse gas emissions are reduced 12% by the production and combustion of ethanol and 41% by biodiesel.

In contrast, biofuels based on high diversity mixtures of native grassland perennials can provide more energy, greater greenhouse gas reductions, and markedly less agrichemical pollution per hectare than food-based biofuels. Moreover, high diversity grassland biofuels can be produced on agriculturally-abandoned lands, need not displace food production and can lead to ecosystem restoration rather than habitat destruction.

Wednesday, October 25

Concurrent Sessions V 1:15–2:45

Track A: Wetlands as a Resource to Meet TMDLs

Using A Comprehensive Wetland Management Approach to Meet TMDL Goals for Watersheds Rapidly Converting from Agrarian to Urban Land Uses

The aged agricultural drainage systems of the Rice Creek Watershed District (RCWD) continue to be relied upon more heavily to deliver stormwater from a rapidly urbanizing watershed. Development of the historically agrarian landscape to an urban landscape has led to more runoff resulting in channel and stream bank erosion and subsequent degradation of natural resources. The RCWD has a statutory obligation to administer the State Drainage Law as well as the State Wetland Conservation Act. In addition, RCWD is also an MS4 obligated to meet Total Maximum Daily Load (TMDL) requirements for impaired waters. These complex obligations have created the need for a comprehensive approach to watershed management. The RCWD is using a Comprehensive Wetland Management Plan (CWMP) as a planning and implementation device that fulfills the obligation for repair of a drainage system while meeting the requirements established by a TMDL for the improvement of downstream water quality and improving the functions of the area's wetlands by connecting them in a contiguous, protected greenway. The RCWD will implement the CWMP via a specific ordinance that mandates wetland mitigation, infiltration requirements, buffers, volume control and phosphorus banking. Collaborating with State and Federal regulatory agencies on this comprehensive planning approach has been a valuable effort leading to a commitment to conduct more efficient coordinated project reviews.

Part 1: Technical Components

Jason Naber, Emmons & Olivier Resources, Inc (EOR), jnaber@eorinc.com, and Marcey Westrick, Emmons & Oliver Resources, Inc (EOR)

The Technical Components discussion will focus on methodologies used to compare ditch repair alternatives and address natural resource goals. Specific topics will include, cost-benefit analysis, lateral effect estimates, use of landscape level wetland functional assessment, wetland restoration/enhancement strategies, water quality BMPs and lake water quality treatment options.

Part 2: Policy Components

Louis Smith, Smith Partners, smith@smithpartners.com, and Steve Hobbs, Rice Creek Watershed District

The Policy Components portion of the presentation will focus on the issues in balancing Minnesota and federal laws regarding drainage and environmental protection, including the establishment of Total Maximum Daily Load (TMDL) allocations for impaired waters that are also impacted by drainage. This section will also deal with how comprehensive water resource management can be integrated into overall land use planning and open space preservation in a community.

Impact of Restored Wetlands on Stormflow, Sediment and Nutrient Loading from Small Watersheds in Southern Minnesota

Ken Brooks, University of Minnesota; Christian Lenhart, University of Minnesota, lenh0010@umn.edu; and Joe Magner, Minnesota Pollution Control Agency

The quantity and quality of surface runoff and tileflow were monitored from small agricultural watersheds with combinations of perennial and annual row-crop land-use and restored wetlands. The study was conducted on two subwatersheds of Elm Creek, in south central Minnesota. Data was collected in 2005-2006 both upstream and downstream of two restored wetlands at watershed scales ranging from 400 to 3500 acres. Total P, TSS, total N, and orthophosphorous were collected with discharge. The wetlands substantially reduced TSS, TP, TN, and orthophosphorous and dampened inflowing flood peaks in 2005. Surface water flood peaks greater than 150 cfs were reduced to 10 cfs. TN concentrations were reduced from a mean of 21.4 and 17.4 mg/l from two tile main outlets to a mean of 0.41 mg/l (min 0.2/max 1.25) at the Ditch 73-2 wetland outlet. The results of this study will be useful for assessing the benefits of wetlands in improving the hydrologic stability of stream channels and in achieving sediment reductions for TMDLs.

Concurrent Sessions V 1:15–2:45

Track B: Water Supply: Planning for Future Droughts

Planning for the Twin City Region's Water Supply

Chris Elvrum, Metropolitan Council, christopher.elvrum@metc.state.mn.us

There are currently 2.5 million users in 121 communities served by 106 separate municipal water systems using approximately 384 mgd day groundwater and surface water in the Twin Cities area. This is expected to grow to 517 mgd by 2040.

The region's relative abundance of good quality water was very important to the original development of Minneapolis and St. Paul. At times, however, droughts have caused concerns for suppliers. There are also more frequent issues relating to water supply that result from well interferences, negative impacts on natural resources, poor water quality, or aquifer limitations.

The Minnesota State Legislature passed a measure in 2005 which directs the Metropolitan Council to carry out planning activities addressing the water supply needs of the metropolitan area (Minnesota Statue 473.1565). The Council is undertaking various studies to evaluate the region's resources and ensure a sustainable long-term supply.

Estimating Stream Quality and Managing for Drought In The Red River Valley

Wesley Saunders-Pearce, Houston Engineering, Inc., wsaunders-pearce@houstonengineeringinc.com

As if preparing for a drought isn't bad enough, try estimating water quality during a drought year. Research suggests there is a strong possibility that a drought could hit the Red River Valley at some point in the next five decades. This drought could be of the same magnitude as the 1930s drought, or even worse.

In 2000, the Department of the Interior was charged with assessing long term water quantity and quality needs in the Red River Valley. The goal was to determine potential options to ensure adequate water supply during a drought with estimated future population growth and water demand. Federal groups leading the Environmental Impact Statement for the water supply alternatives needed a way to derive inputs in order to perform their unsteady simulations.

This discussion will present how and why Monte Carlo modeling was used to establish water quality inputs (boundary conditions) for unsteady simulations. This presentation will highlight a unique interactive database which facilitated the stochastic water quality modeling. Anyone interested in stream quality modeling, as well as water supply, will benefit from this overview of drought management and characterization of in-stream phosphorus, dissolved solids, chloride, sulfate and sodium concentrations.

The Flathead Lake Drought Management Plan Based on the Hydro-Climate Indicators

Foad Hussain, HDR Engineering Inc, chussain@hdrinc.com, and Scott Reed, HDR Engineering, Inc.

A Drought Management Plan (DMP) based was developed for the operation of Kerr Dam Hydroelectric Project, located on the Flathead Lake. The Muti-Variant ENSO Index (MEI) and Flathead Lake Precipitation Index (FPRI) were selected as hydro-climate indicators. The historic MEI time series from 1951 to 2003 was analyzed to generate early October, November and December MEI average values. The use of the MEI results in a 68 percent correct DMP activation decision in early October that improves to 74 percent correct in December for water years 1951-2003. The historic precipitation data (1951-2003) collected at different stations in the Flathead Lake basin was analyzed to calculate the FPRI value for January, February, March and April. It was found that the application of FPRI, in concert with the Multi-Variant ENSO Index, results in an 87 percent correct DMP activation decision in January that improves to 96 percent correct in April for Water Years 1951-2003.

Wednesday, October 25

Concurrent Sessions V 1:15–2:45

Track C: Contaminants of Concern

Source Tracking of *Escherichia coli* at the Duluth Boat Club Beach

Satoshi Ishii, University of Minnesota, ishi0040@umn.edu; Winfried Ksoll, University of Minnesota, Duluth; Dennis Hansen, University of Minnesota, Duluth; Randall Hicks, University of Minnesota, Duluth; and Michael Sadowsky, University of Minnesota

Boat Club Beach (Duluth, MN) is often closed in summer due to high counts of *Escherichia coli,* an indicator of recent fecal contamination. In this study, potential sources of E. coli impacting this beach were investigated using a DNA fingerprinting method. Water and sand samples were taken in five transects at the beach from May to October in 2004 and 2005. *E. coli* were isolated and enumerated, and their DNA fingerprints were compared to those of E. coli isolates from local wild animals and a wastewater treatment plant (WTP). *E. coli* counts in all samples increased in summer (June-September), with the highest counts in nearshore sand. Potential sources of *E. coli* isolates were mainly from geese, gulls, and WTP, but their relative contribution changed seasonally. The high concentration of *E. coli* in nearshore sand suggests that this sand serves as temporal sink and source of this indicator organism.

Partitioning and Bioaccumulation Dynamics of PBDEs in the Upper Great Lakes

Summer Streets, University of Minnesota, stree072@umn.edu; Scott A. Henderson, University of Minnesota; Amber D. Stoner, University of Minnesota; Matt F. Simcik, University of Minnesota; and Deborah L. Swackhamer, University of Minnesota

Water from Lake Michigan and fish from all five Great Lakes have been sampled and analyzed for a suite of six polybrominated diphenyl ether (PBDE) congeners and 110 polychlorinated biphenyl (PCB) congeners. Lake Michigan dissolved phase PBDE congener concentrations (0.2 to 10 pg/L) are of the same order as dissolved phase PCB congener concentrations (nd to ~10 pg/L). PBDE congener distribution in the dissolved phase most closely resembles the distribution reported for air near Lake Michigan. In contrast, the fish are depleted in BDE-99 and elevated in BDE-66, BDE-153, and BDE-154 relative to the dissolved phase. Bioaccumulation factors (BAFs) were calculated for four PBDE congeners for Lake Michigan (6.8 to 7.5) using water and lake trout data. Using the PBDE BAFs for Lake Michigan and the PBDE lake trout concentrations from the other Great Lakes (except for Lake Erie), it is expected that the dissolved phase concentrations in the other lakes would range from 0.02 to ~8 pg/L. Additional data from Lake Superior water will be presented.

Fate and Transport of Perfluorinated Chemicals

Matt Simcik, University of Minnesota, msimcik@umn.edu

Perfluorochemicals (PFCs) are a class of compounds that have drawn considerable attention from the environmental chemistry community over the past ten years. In part, this interest stems from the ubiquity of contamination, from pole to pole in biota and abiotic matrices. This has been somewhat surprising given the physical-chemical properties of these compounds. The compounds found in biota and water in remote areas have high water solubilities and low vapor pressures, making them unlikely to undergo long-range transport through the atmosphere. These properties, however, do ma ke these compounds more susceptible to hydrologic processes resulting in contamination of surface and ground waters near areas of use and disposal. Theories on fate and transport of PFCs resulting in global distribution will be presented along with evidence from field studies supporting these theories.

Concurrent Sessions V 1:15–2:45

Track D: Planning and Implementing Low Impact Development (LID)

Land Use and Stormwater—Making the Connection in a Landlocked Setting

Brett Emmons, Emmons & Olivier Resources, Inc (EOR), bemmons@eorinc.com; Mark Koegler, Hoisington Koegler Group; and Tom Link, City of Inver Grove Heights

Everyone acknowledges the impacts that land use decisions and subsequent land conversions have on water resources. This has been a topic of much discussion, but it seems that little progress has been made. In growing numbers, studies are also indicating the benefits that good quality water resources have on the value of land and sustainability of neighborhoods. How do we achieve good, sustainable land use planning and also protect and enhance our water resources?

In the community of Inver Grove Heights' planning for their northwest area, which includes nearly 3,000 acres, one key issue arose which was stormwater. The first plan put forward called for an extensive and costly pipe and pump system to link many landlocked depressions and build a long outlet pipe to the Mississippi River, creating a new discharge to the River. A group of residents of the area, dismayed by the proposed high stormwater assessments, worked with the City to explore alternative development patterns and stormwater management methods. From that effort grew a robust plan that combines sustainable land use planning with new stormwater methods to establish a first-of-its-kind plan for flexible and innovative land uses and managing stormwater on-site, without a pipe to the Mississippi River. The planning, analysis, and ordinance work has been extensive. Now the community is poised to establish a new benchmark for prudent and innovative land use planning and water and natural resources management.

Low Impact Development—Having Your Cake & Eating it Too!

Kevin Biehn, Emmons & Olivier Resources, Inc (EOR), kbiehn@eorinc.com, and Christa Bren, Emmons and Olivier Resources, Inc.

Low Impact Development (LID) is often touted as a solution which permits growth, while maintaining or improving environmental quality—having your cake and eating it too. While there are many proponents of this advancement in stormwater management, many have questioned the validity and viability of LID.

To address some of the doubts, fears and unanswered questions surrounding LID, this project undertook an apple-to-apples comparison of three development approaches to stormwater management for the same parcel. The built example, which is more progressive than the conventional development was compared and contrasted to a traditional "pipe and pond" development and a Low Impact Development. To get at comparable numbers, numerous quantitative (development cost, 30-year maintenance cost, stormwater quality and quantity performance) and qualitative measures (additional quality of life benefits) were evaluated and compared across the three development scenarios.

The Low Impact Design performed better on all of the evaluated parameters. In short the LID scenario was cheaper to build, cheaper to maintain, more profitable, had superior water quality and quantity and afforded a higher quality of life.

This project provides state and local decision makers, city staff, developers and other stakeholders with an example of how a traditional development proposal can be modified to meet water quality goals, including non-degradation requirements, and community goals, including economic growth and development, through the incorporation of Low Impact Development.

Not only does this project quantitatively and qualitatively show the benefits of Low Impact Development, it shows that LID works with a variety of land uses, soil types and densities. Most importantly, this project shows how we as a state can grow, while we protect our beloved water resources and maintain economic viability.

Wednesday, October 25

Concurrent Sessions V 1:15–2:45

Track D: Planning and Implementing Low Impact Development (LID), *continued*

The RWMWD Experience—Building for Zero Off-Site Runoff

Clifton Aichinger, Ramsey-Washington Metro Watershed District, cliff@rwmwd.org, and Kurt Luethold, Barr Engineering

The Ramsey-Washington Metro Watershed District completed construction of its own office building in December 2005. The planning of this building and site serves as a demonstration of green building techniques and commercial site stormwater runoff best management practices (BMPs). One of the original goals of the project was to build a project that results in zero runoff. What we achieved is predicted on-site infiltration in excess of a 2 inch rainfall event. The site also includes rain gardens that take runoff from the adjacent public street. This is achieved through the use of several stormwater BMPs including rain gardens, a pervious asphalt parking lot, a green roof on the garage, rain barrels, and native vegetation planting. The building green features include daylighting, energy efficient heating and air conditioning, efficient lighting, recycled and recyclable materials and office furniture. The presentation will include discussion and photos of the planning and construction process for the building and landscape, stormwater modeling and design, discussion of construction issues and lessons learned, and preliminary BMP monitoring results.

Concurrent Sessions VI 3:00–4:30

Track A: Wetland Indicators and Monitoring

A Comprehensive Monitoring Strategy for Assessing Status and Trends in Minnesota Wetland Quantity and Quality

Mark Gernes, Minnesota Pollution Control Agency, mark.gernes@pca.state.mn.us, and Doug Norris, Minnesota Department of Natural Resources

The Wetland Conservation Act of 1991 established a goal of achieving no-net-loss in the quantity, quality and biological diversity of the state's wetlands. Objective comprehensive methods for assessing progress toward that goal have previously not been applied or available. An interagency team from the Pollution Control Agency, Department of Natural Resources, Board of Water and Soil Resources, Department of Agriculture, the Army Corps of Engineers and the U.S. Fish and Wildlife Service developed and are beginning to implement a comprehensive strategy to objectively assess the status and trends in Minnesota's wetland resource—quantity and quality. This strategy includes three approaches: 1) updating the National Wetlands Inventory; 2) a random sample survey, of 5,000 randomly selected one square mile sample plots located throughout the state; 3) developing an online, integrated wetland permitting and accounting system. Regional assessments of wetland quality status and trends are planned in randomly selected wetlands located in the random one square mile sample plots.

Assessing the Quantity and Quality of Depressional Wetlands in the Redwood River Watershed Utilizing a Probabilistic Survey Design

John Genet, Minnesota Pollution Control Agency, john.genet@pca.state.mn.us, and Anthony Olsen, Environmental Protection Agency

The condition of emergent depressional wetlands in the Redwood River watershed was assessed using aquatic plant and macroinvertebrate indices of biological integrity (IBIs). Sites were randomly selected from a modified National Wetland Inventory (NWI) coverage. Approximately 150 sites were evaluated to determine if the wetland still existed and was the correct wetland class, 40 of which were assessed with IBIs. This evaluation allowed estimation of wetland losses in the watershed since the NWI (1980-2003) and condition assessments of those that remained. Cumulative distribution functions of IBI results estimated that 69% of the wetland basins in the watershed, representing 91% of the depressional wetland area, were biologically impaired. The number of wetland basins in the watershed decreased by 56%, representing a 21% decrease in depressional wetland area, since the early 1980s. This assessment indicates that depressional wetlands in this watershed have experienced various impacts that have either resulted in their elimination or degradation.

Environmental Indicators for the Coastal Region of the U.S. Great Lakes

Gerald Niemi, University of Minnesota, gniemi@d.umn.edu; Lucinda B. Johnson, University of Minnesota; and Valerie Brady, University of Minnesota

The goal of our research program was to develop indicators that both estimate ecological condition and suggest plausible causes of ecosystem degradation in the coastal region of the US Great Lakes. Our project consisted of seven components to investigate different types of biological responses each with different sampling methodologies and sample size requirements. These indicators included amphibian, bird, diatom, fish, macroinvertebrate, and wetland plant communities as well as landscape characterization. We employed a random stratified sampling design which incorporated over 200 stressor variables (e.g., agriculture, atmospheric deposition, land cover, human populations, point source pollution, and shoreline modification) affecting the coastal region. The coastal region was subdivided into two major ecological provinces and further subdivided into 762 "segment sheds." We developed a suite of over 20 environmental indicators based on these biological communities and landscapes. The primary influences on these indicators resulted from activities associated with agriculture and urbanization and at the watershed scale. A series of summary documents were prepared to describe the primary indicators for potential application in the Great Lakes coastal region, but each has potentially broad application to other types of coastal ecosystems (see http://glei.nrri.umn.edu).

Wednesday, October 25

Concurrent Sessions VI 3:00–4:30

Track B: Planning, Policy, and Implementation

Engaging Community Planners in Stormwater Management Issues

Paul Nelson, HDR Engineering Inc, paul.nelson@hdrinc.com, and Michael Sobota, Scott County

Stormwater management has historically been thought of as an engineering and infrastructure management exercise. More recently, however, Water Resources Professionals have realized that this view is not sufficient given the cumulative nature of stormwater impacts and their costs. There is an emerging recognition that solutions also need to incorporate Land Use Planning, and there is a perception that land use decisions are rarely affected. Given these perceptions, why are most groups working on this issue still dominated by Engineering and Public Works representatives? This presentation explores this question from the perspective of two planners: a Water Resources Planner/Scientist, and a Community Development Director. The presentation uses experience from Scott County, the Prior Lake-Spring Lake Watershed District, and the City of Lakeville to describe the multitude of issues facing Community Planners, how stormwater management fits into this mix, and how to better engage Planners while still maintaining engineering and infrastructure functions.

When the Water Hits the Road: Local Stormwater Rules and Case Studies in Roadway Reconstruction

Carl Almer, Emmons & Olivier Resources, Inc (EOR), calmer@eorinc.com; Tina Carstens, Ramsey-Washington Metro Watershed District; and Bob Fossum, Capitol Region Watershed District

Historically there has been a wide range in the level of stormwater management incorporated into roadway improvement and reconstruction projects. On separate but parallel tracks, the Rice Creek Watershed District and jointly the Ramsey-Washington Metro and the Capitol Region Watershed Districts unveiled draft stormwater management standards for roadway improvement projects.

The intent of these standards is to set reasonable management criteria while providing significant water quality improvement on an average annual basis. The main benefit to road authorities is the recognition of the constraints typically associated with linear projects. This allows for provisions for increased flexibility in the means to attain the standards, while at the same time leveling the playing field. Recognizing and giving credit for the fact that infiltration (volume control) practices are also very efficient water quality practices is paramount the proposed standards. Panel discussion will highlight unique stormwater management techniques utilized to address these standards.

Operation & Maintenance of Best Management Practices—Wet & Dry Detention Ponds

Foad Hussain, HDR Engineering Inc, chussain@hdrinc.com, and Mike Johnson, HDR Engineering, Inc.

Storm water runoff is a major source of water pollution in urban areas. Different Best Management Practices are usually adopted to remove the pollutants and improve the storm water quality. This paper presents the case studies of the existing pond conditions, inspection procedures and recommendations for long term and short term maintenance of thirteen (13) wet and dry detention ponds. A site visit has been conducted for each pond to inspect its existing condition, assess its current performance, and perform level surveying to determine the approximate depth of the sediments deposited at the pond bottom. A review of the National Wetland Inventory (NWI) has also been performed to investigate the jurisdictional status of each pond. Based on the inspection and assessment of the pond conditions, numerous recommendations are proposed to improve or sustain the performance of these BMP's. A periodic maintenance and inspection schedule is also compiled to keep the pond in operating and optimum condition. Additionally, guidelines for maintenance frequencies and inspection programs are also discussed.

Concurrent Sessions VI 3:00–4:30

Track C: Catastrophe and Recovery

After the Wave—Sri Lanka Rebuilds after the Tsunami

Suresh Hettiarachchi, HDR Engineering Inc, shettiar@hdrinc.com

On December 26th 2004, a 9.4 scale earthquake rocked the sea bed off the coast of Sumatra which caused a tsunami that spread disaster along the coasts of South East Asia. Sri Lanka was one of the worst hit with 30 ft high waves hitting the eastern coast of the island. The total devastation caused is impossible to measure but 36,000 people, including 12,000 children lost their lives. More than a Million were significantly affected. The relief effort following this catastrophe was amazing with the people of the country and the rest of the world responding immediately. The continuing efforts recover and rebuild from this disaster include building homes and re-establishing livelihoods, resurrecting the towns and cities that were washed away, infrastructure improvements, and environmental restoration and mitigation. One year since the disaster happened, the people of Sri Lanka have made significant progress, with much more left to do.

Restoring New Orleans' Hurricane Protection System

Craig Johnson, Stanley Consultants, Inc., johnsoncraig@stanleygroup.com

Since shortly after Hurricane Katrina devastated greater New Orleans, the mission to restore the hurricane protection system has been first and foremost on the residents' minds. Restoring the system to pre-Katrina elevations by 1 June 2006, the beginning of the 2006 hurricane season, was accomplished the Corps of Engineers' Task Force Guardian. The restoration task required assessing the damage, understanding the cause of failure, restoring damage sections to make them "better and stronger", and to do this while the world is looking over your shoulder giving you lots of advice. The hurricane overwhelmed some features while other features failed unexpectantly. The breath of the damage (over 100 miles of levee and floodwall), the complexity of the topography (the second lowest place in the United States but 1,000,000 people used to live there), and the need to deal with a 100 percent pumped storm water system (with the largest pumping station in the world) made the mission especially daunting.

Sinkhole Collapse of Storm Water Retention Pond CD-P27, Woodbury, Minnesota

E. Calvin Alexander, Jr., University of Minnesota, alexa001@umn.edu; Keith S. Rosvold, Braun Intertec Corporation; Douglas J. Bergstrom, Braun Intertec Corporation; Kelton Barr, Kelton Barr Consulting, Inc.; Paul Heuer, Laurent Development Company LLC; Jacob Fick, Laurent Development Company LLC; and Steve Kernik, City of Woodbury

A new storm water infiltration pond (Regional Pond CD-P27, in Woodbury, Minnesota) excavated into the St. Peter Sandstone was first filled to capacity by a large precipitation event on 4-5 October 2005. Three days later on Saturday, 8 October 2005, a series of about a dozen sinkholes opened under the eastern end of the pond and drained 60 acre-feet of storm water in a few hours. The largest sinkhole was 100 feet long, 60 feet wide and 20 feet deep. This presentation describes the hydrogeologic investigation of the karst collapses, their hydrogeologic setting, and the remediation of the sinkholes and the pond. These karst collapses illustrate a poorly recognized risk in the design of water retention structures in a common Minnesota hydrogeologic setting.

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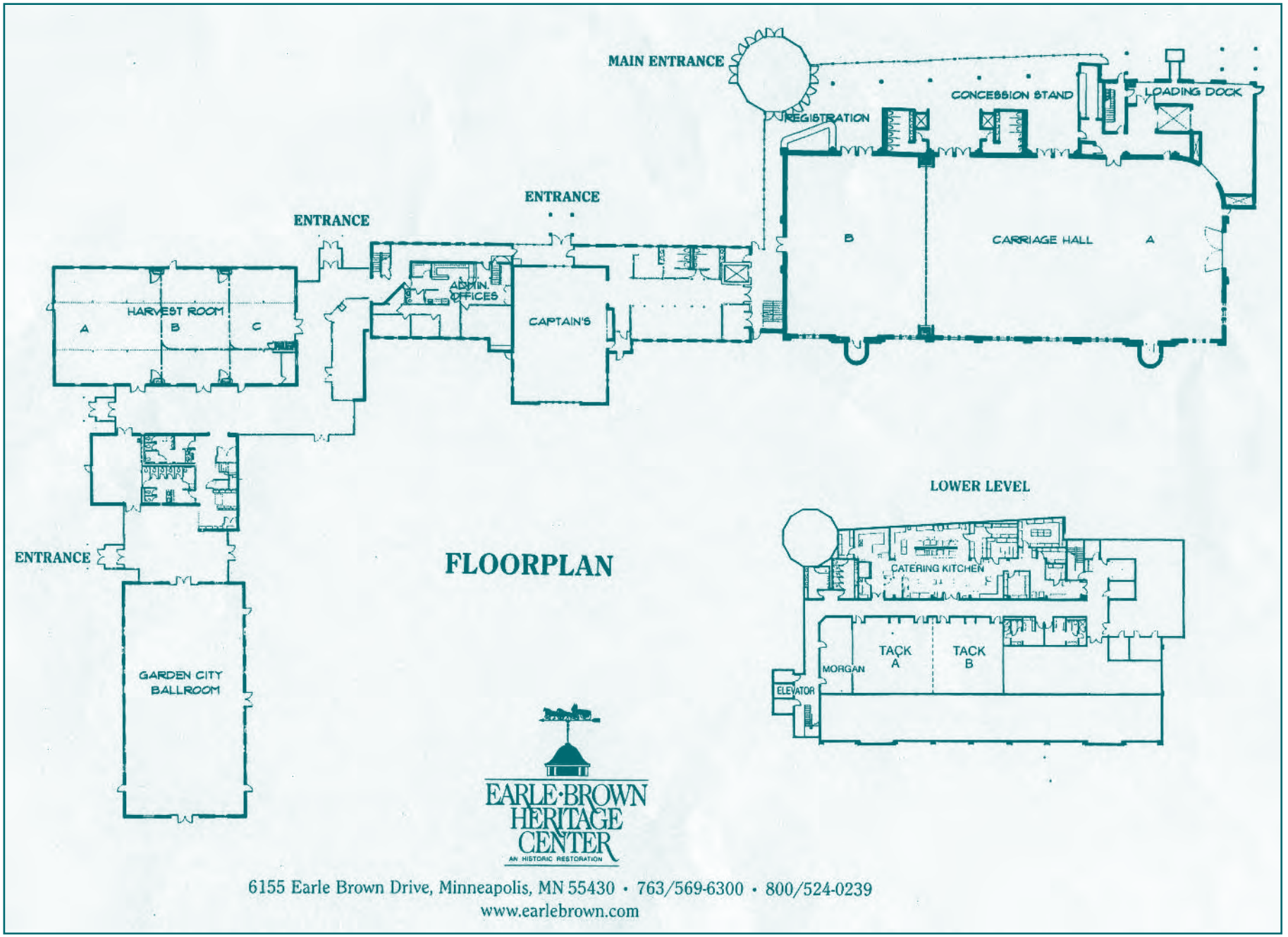
Notes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