UNIVERSITY OF MINNESOTA

Final Program and Book of Abstracts

Minnesota Water 2005
and
Annual Water Resources
Joint Conference

Bringing water scientists and professionals together

October 25-26, 2005

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

Sponsored by:

Water Resources Center, University of Minnesota

College of Continuing Education, University of Minnesota

Co-sponsored by:

Department of Civil Engineering, University of Minnesota

Minnesota Section, American Society of Civil Engineers

Minnesota Sea Grant College Program, University of Minnesota

Natural Resources Research Institute, University of Minnesota

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

Minnesota Water 2005 and Annual Water Resources Joint Conference

October 25-26, 2005

The annual ***Water Resources Conference,*** now in its 38th year, presents emerging and implemented water resource management techniques for water resource professionals, including consultants, city, county, and state practicing engineers.

For the past 14 years, the University of Minnesota's Water Resources Center has held the ***Minnesota Water*** conference on a biennial basis. It serves to highlight the current issues and research regarding Minnesota's wealth of water resources, and facilitate interactions among resource managers, researchers, and other water professionals.

The time is right to offer these conferences under a joint sponsorship to allow for the natural synergy and interactions between the audiences. 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 2005 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

2005 Water Resources Planning Committee

Tina Carstens	Ramsey-Washington Metro Watershed District
Dennis J. Fuchs	Stearns County Soil and Water Conservation 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
** Ron Leaf*	Short Elliott Hendrickson, Inc.
Barbara Liukkonen	Water Resources Center, University of Minnesota
Greg Mitton	U.S. Geological Survey
Jennifer L. Olson	Emmons and Olivier Resources, Inc.
Nels P. Nelson	Barr Engineering Company
Wayne Sicora	Ryan Companies US, 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.
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Martin J. Weber	Stanley Consultants, Inc.
Paul Wotzka	Minnesota Department of Agriculture
Keith R. Yapp	Bonestroo Williamson Kotsmith

**Water Resources Planning Committee Chair*

2005 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
David Hokanson	Minnesota Department of Health
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
Faye Sleeper	Minnesota Pollution Control Agency
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 Biosystems and Agricultural Engineering, University of Minnesota
C. Bruce Wilson	Minnesota Pollution Control Agency

**Minnesota Water Planning Committee Chair*

Tuesday, October 25, 2005

7:00 a.m. **Registration and Continental Breakfast,** *Carriage Hall Foyer*

8:00–8:10 **Welcome,** *Carriage Hall A*
Ron Leaf, Short Elliott Hendrickson, Inc.

8:10–8:20 **Dave Ford Water Resources Award,** *Carriage Hall A*

8:20–9:30 **Plenary Session,** *Carriage Hall A*
Moderator: Deborah Swackhamer, Water Resources Center and School of Public Health, University of Minnesota

"Changing Strategies in a Changing Climate"
John J. Magnuson, Professor Emeritus, Limnological Research Center, University of Wisconsin-Madison

9:30–10:00 **Poster Session and Refreshment Break,** *Carriage Hall foyer*

10:00–11:30 CONCURRENT SESSIONS I

A Carriage Hall B	B Tack Room	C Garden City Ballroom	
New Urban BMPs: Implementation Case Studies	Pollutant Loads and Trends for Large River Systems	Surface Water Analysis	

11:30–1:00 p.m. **Luncheon,** *Carriage Hall A*

1:15–2:45 CONCURRENT SESSIONS II

A Carriage Hall B	B Tack Room	C Garden City Ballroom	D Captain's Room
Hydraulic Improvements in Developed Environments	Remote Sensing and GIS for Watersheds and Streams	Lake Water Quality Improvement	Streams and Rivers

2:45–3:15 **Poster Session and Refreshment Break,** *Carriage Hall Foyer*

3:15–4:45 CONCURRENT SESSIONS III

A Carriage Hall B	B Tack Room	C Garden City Ballroom	
Surface and Ground Water Interactions	Remote Sensing and GIS for Lakes and Wetlands	Understanding and Managing Nutrient Loads to Aquatic Ecosystems	

4:45–5:45 **Reception and Poster Session,** *Carriage Hall Foyer*

Join Us for the

Water Conference
Reception and Poster Session

4:45–5:45 p.m.
Carriage Hall Foyer

Wednesday, October 26, 2005

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Moderator: Faye Sleeper, Minnesota Pollution Control Agency

"TMDLs: Impaired Waters, Impaired Process? Three Perspectives on Improving the Process"
Walt Poole, TMDL Project Circuit Rider, Association of State and Interstate Water Pollution Control Administrators; Michael Robertson, Environmental Policy, Minnesota Chamber of Commerce; and Dennis Ozment, Representative, Minnesota House of Representatives

9:30–10:00 **Poster Session and Refreshment Break,** *Carriage Hall foyer*

10:00–11:30 CONCURRENT SESSIONS IV

A Tack Room	B Garden City Ballroom	C Carriage Hall B	
Pesticides, Nitrates, and Drinking Water	Surface Water Management	Fate and Effects of Emerging Aquatic Contaminants	

11:30–12:45 p.m. **Luncheon Presentation,** *Carriage Hall A*

"Everglades Restoration: A Remarkable Convergence of Science, Policy, Advocacy, and Law"
Thomas Fontaine, Director, Western Ecology Division, National Health and Environmental Effects Laboratory, Office of Research and Development, U.S. Environmental Protection Agency

1:00–2:30 CONCURRENT SESSIONS V

A Tack Room	B Garden City Ballroom	C Carriage Hall B	D Captain's Room
Agricultural Issues	Water Quality Standards and Modeling	TMDL Assessments	Sustainable Watersheds, Competing Goals, and the Tool Box

2:30–2:45 **Refreshment Break**

2:45–4:15 CONCURRENT SESSIONS VI

A Tack Room	B Garden City Ballroom	C Carriage Hall B	D
Nitrogen Management and Modeling	When the TMDL Rubber Hits the Road	River and Lake Management	

4:15 **Adjourn**

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10:00–11:30 CONCURRENT SESSIONS I

Track A *Carriage Hall B*

New Urban BMPs: Implementation Case Studies
Moderator: Nels Nelson
Co-moderator: Ron Leaf

Burnsville Rainwater Garden Retrofit Project
Leslie Yetka, City of Burnsville; and Fred Rozumalski, Barr Engineering Company

Storm Water Management with Porous or Dense Hot-Mix Asphalt Pavement
Jill Thomas, Minnesota Asphalt Pavement Association

Planning, Design, and Construction of "Enhanced" BMPs in the Maplewood Mall (MMATI) Project Area
Chris Cavett, City of Maplewood; Dwayne Sikich, Landform; and Ron Leaf, Short Elliot Hendrickson, Inc.

Track B *Tack Room*

Pollutant Loads and Trends for Large River Systems
Moderator: Larry Baker
Co-moderator: Steve Kloiber

Long-Term Water Quality Trends in the Minnesota River: Assessing Statistical Methodologies and Total Maximum Daily Load Implications
Heather Offerman Johnson and Satish Gupta, University of Minnesota

Nutrient and Sediment Loads and Yields from Major Tributaries to the Upper Mississippi River – Headwaters to Twin Cities
Jim MacArthur, Minnesota Pollution Control Agency

Estimating the Nonpoint Source Pollution Contribution of the Twin Cities Metropolitan Area
Steve Kloiber, Metropolitan Council

Track C *Garden City Ballroom*

Surface Water Analysis
Moderator: Suzanne Jiwani
Co-moderator: Jon Hendrickson

Evaluation of Hydrologic Trends, Sources of Runoff, and Implications for Streambank Erosion in Minnesota Basins
Greg Wilson, Tim Anderson, and Henry Runke, Barr Engineering Company; and Mark Tomasek, Minnesota Pollution Control Agency

Travel-Time Estimates for Seven Tributaries of the Mississippi River, St. Cloud to Minneapolis, Minnesota, 2003
James Stark, Alan Arntson, and James Fallon, U.S. Geological Survey; and David Brostrom, D. L. Brostrom Consulting

The Twin Cities 'Old Faithful'—Finding Solutions to the 35W Tunnel
David Filipiak and Walter Eshenaur, SRF Consulting Group, Inc.; Rick Voigt, Polaris Group, Inc.; and Brent Nelson, CNA Engineers

11:30–1:00 p.m. **Luncheon,** *Carriage Hall A*

1:15–2:45 CONCURRENT SESSIONS II

Track A *Carriage Hall B*

Hydraulic Improvements in Developed Environments
Moderator: Keith Yapp
Co-moderator: Tina Carstens

Balancing Flows, Water Quality, and Aesthetics around Brookview Park in Golden Valley, Minnesota
Dan Cazanacli, Veronica Anderson, and Sue Mason, Short Elliot Hendrickson, Inc.; Jeannine Clancy and Jeff Oliver, City of Golden Valley

TH55/Boone Avenue Floodplain and Wetland Mitigation Project
Andrea Moffatt and Pete Willenbring, WSB & Associates; and Jeannine Clancy, City of Golden Valley

Practical Application of a Hood Drop Inlet Structure
Stephan Becker, U.S. Department of Agriculture-NRCS

Track B *Tack Room*

Remote Sensing and GIS for Watersheds and Streams
Moderator: C. Bruce Wilson|
Co-moderator: Steve Kloiber

Land Cover Assessment Using High-Resolution, Multi-Spectral Digital Aerial Imagery: A Tool for Monitoring Impervious Surfaces
Steve Kloiber, Metropolitan Council; and Marvin Bauer, University of Minnesota

GIS Delineation of Variable-Width Riparian Zones: A Topographical Approach
Timothy Aunan, Minnesota Department of Natural Resources

Uncertainty in Stream Gradient Estimation in TMDL
Matthew Kocian, Udai Singh, and Bruce Wilson, University of Minnesota; and Bruce Vondracek, U.S. Geological Survey and University of Minnesota

Track C *Garden City Ballrm*

Lake Water Quality Improvement
Moderator: Heinz Stefan
Co-moderator: Barb Liukkonen

The Use of Barley Straw to Increase Water Clarity in Lakes and Ponds
Steve McComas, Blue Water Science; and Randy Ahorn, Metropolitan Council

A Dynamic Modeling Tool for Determining Internal Loadings of Phosphorus in Water Bodies
Hong Wang, Metropolitan Council

Restoration of Degraded Lake Minnetonka Bays
Lorin Hatch, Minnehaha Creek Watershed District

Track D *Captain's Room*

Streams and Rivers
Moderator: Jeff Stoner
Co-moderator: Greg Mitton

Ecological Restoration of Streams to Improve Water Quality
Diane Spector and Ed Matthiesen, Wenck Associates, Inc.; Peter MacDonagh, The Kestrel Design Group, Inc.; and Kevin Larson, City of Brooklyn Park

Assessing Agroforestry Options for Water Quality Using Regional Hydraulic Geometry Curves
Joe Magner, Minnesota Pollution Control Agency; and Ken Brooks, University of Minnesota

Mississippi National River and Recreation Area & St. Croix National Scenic Riverway: Special Cases in River Resource Management
Brenda Lafrancois, National Park Service; Randy Ferrin, St. Croix National Scenic Riverway; and Steve Johnson, Mississippi National River and Recreation Area

2:45–3:15 **Poster Session and Refreshment Break,** *Carriage Hall Foyer*

3:15–4:45 CONCURRENT SESSIONS III

Track A *Carriage Hall B*

Surface and Ground Water Interactions
Moderator: Petra DeWall
Co-moderator: Jennifer Olson

Geology, Stream Piracy and the TMDL at Walker Brook
Robert Melchior and John Gleason, Bemidji State University; and Molly MacGregor, Minnesota Pollution Control Agency

Assessing the Interactions Between Ground Waters and Surface Waters at Three Lakes on the Grand Portage Reservation, Minnesota, 2003-2004
Perry Jones, U.S. Geological Survey; and Margaret Watkins, Grand Portage Reservation

Distribution of Deicing Chemicals in Ground Water and Surface Water in Glaciated Parts of the United States
John Mullaney and James Stark, U.S. Geological Survey

Track B *Tack Room*

Remote Sensing and GIS for Lakes and Wetlands
Moderator: Steve Kloiber
Co-moderator: C. Bruce Wilson

National Wetlands Inventory Delineation and Classification Using eCognition Remote Sensing Software
Jeff Knopf and Andy Robertson, St. Mary's University

Remote Sensing of Minnesota's Land and Water Resources
Leif Olmanson, Brian Loeffelholz, Marvin Bauer and Patrick Brezonik, University of Minnesota

Spatial Analyses for Reference Area Identification and Indicator Development for Coastal Ecosystems of the Great Lakes
George Host, Lucinda Johnson, Thomas Hollenhorst, Valerie Brady, NicholasDanz, and Gerald Niemi, University of Minnesota-Duluth; and Jan Ciborowski, University of Windsor, Ontario, Canada

Track C *Garden City Ballroom*

Understanding and Managing Nutrient Loads to Aquatic Ecosystems
Moderator: Euan Reavie
Co-moderator: Larry Baker

Nutrient Criteria Development for Lakes: Minnesota's Approach
Steven Heiskary, Minnesota Pollution Control Agency

Whole Watershed Phosphorus Mass Balances for Lake Management
Johanna Schussler, Ramsey-Washington Metro Watershed District

Is Watershed P Retention Sustainable?
Lawrence Baker, University of Minnesota

4:45–5:45 **Reception and Poster Session,** *Carriage Hall Foyer*

Wednesday, October 26, 2005

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Walt Poole, TMDL Project Circuit Rider, Association of State and Interstate Water Pollution Control Administrators; Michael Robertson, Environmental Policy, Minnesota Chamber of Commerce; and Dennis Ozment, Representative, Minnesota House of Representatives

9:30–10:00 **Poster Session and Refreshment Break,** *Carriage Hall foyer*

10:00–11:30 CONCURRENT SESSIONS IV

Track A *Tack Room*

Pesticides, Nitrates, and Drinking Water
Moderator: Paul Wotzka
Co-moderator: Bruce Wilson

Contaminants Above Drinking Water Standards in the Dakota County Ambient Groundwater Quality Study
Jill Trescott and Vanessa Demuth, Dakota County

Integrated Solutions for Protecting Public Water Supplies in Agricultural Communities
Bruce Montgomery, Don Sirucek, and Brian Williams, Minnesota Department of Agriculture; Michael Russelle, U.S. Department of Agriculture; Bruce Olsen, Minnesota Department of Health; and Carl Rosen, University of Minnesota

Town & Country: Comparisons on Fertilizer and Pesticide Use
Jerry Spetzman, Minnesota Department of Agriculture

Track B *Garden City Ballroom*

Surface Water Management
Moderator: Tina Carstens
Co-moderator: Andrea Hendrickson

Urban Development Effects on Stream Temperatures
William Herb, Omid Mohseni, Ben Janke, John Nieber, and Heinz Stefan, University of Minnesota

Impacts of Perennial Vegetation on the Hydrologic Stability and the Economic Viability in Watersheds of the Minnesota River Basin
Driss Ennaanay, Yoshifumi Konishi, Kenneth Brooks, and William Easter, University of Minnesota

DuluthStreams to LakeSuperiorStreams: Making Storm Water and Stream Data Come Alive for Citizens, Students, Resource Agencies, and Decision-Makers
Richard Axler, George Host, Jane Reed, Elaine Ruzycki, Cynthia Hagley, and Jesse Schomberg, University of Minnesota – Duluth; and Marnie Lonsdale, City of Duluth

Track C *Carriage Hall B*

Fate and Effects of Emerging Aquatic Contaminants
Moderator: Bill Arnold
Co-moderator: Heiko Schoenfuss

Concentration-Dependent Effects of 4-Nonylphenol on Male Fathead Minnows in a Competitive Reproductive Assay
Heiko Schoenfuss and Travis Bistodeau, St. Cloud State University

Environmental Photochemistry of the Antibiotic Compound Tetracycline: Dependence on Acid-Base and Meta Binding Speciation
Jeffrey Werner, William Arnold, and Kristopher McNeill, University of Minnesota

Antibiotics Losses from Agricultural Land in the Karst Region
Holly Dolliver and Satish Gupta, University of Minnesota

11:30–12:45 p.m. **Luncheon Presentation,** *Carriage Hall A*
"Everglades Restoration: A Remarkable Convergence of Science, Policy, Advocacy, and Law"
Thomas Fontaine, Director, Western Ecology Division, National Health and Environmental Effects Laboratory, Office of Research and Development, U.S. Environmental Protection Agency

1:00–2:30 CONCURRENT SESSIONS V

Track A *Tack Room*

Agricultural Issues
Moderator: James Anderson
Co-moderator: Dennis Busch

Small-Group Nutrient Management Planning in Minnesota
Kevin Blanchet, Jodi DeJong-Hughes, and Les Everett, University of Minnesota

Demonstrating the Use of a Living Mulch System in Grain Crop Production
Palle Pedersen, Iowa State University

2003 Pesticide Use on Minnesota's Four Major Crops
Denton Bruening, Minnesota Department of Agriculture

Track B *Garden City Ballrm*

Water Quality Standards and Modeling
Moderator: Wayne Sicora
Co-moderator: Lisa Goddard

An Innovative Approach Integrating Rural Storm Water Management and Bridge Replacements – Cascade Watershed
Ivo López, Bonestroo, Rosene, Anderlik, and Associates

Land Use Evaluation – Developing Hydrologic and Water Quality Modeling Standards for Minneapolis
Walter Eshenaur, SRF Consulting Group, Inc.

Modeling Water Quality for the I-35W and Highway 62 Crosstown Commons Reconstruction Project
Keith Pilgrim and Whitney Erickson, Barr Engineering Company

Track C *Carriage Hall B*

TMDL Assessments
Moderator: Barb Liukkonen
Co-moderator: John Borovsky

The Role of Paleolimnology in the Southeast Lake of the Woods TMDL
Euan Reavie, University of Minnesota-Duluth; Mark Edlund, St. Croix Watershed Research Station; Mike Hirst, Lake of the Woods Soil and Water Conservation District; and Nolan Baratono, Minnesota Pollution Control Agency

Turbidity and Fecal Material in Streams Associated with Conventional Grazing and Managed Intensive Grazing in Southeastern Minnesota
Jason Ewert and Joe Magner, Minnesota Pollution Control Agency; and Naomi Magner, University of Wisconsin-River Falls

Analysis of Stream Data for TMDL Assessment
Udai Singh, Jason Ulrich, Bruce Wilson, and Matthew Kocian, University of Minnesota; Bruce Vondracek, U.S. Geological Survey and University of Minnesota; and Joe Magner and Greg Johnson, Minnesota Pollution Control Agency

Track D *Captain's Room*

Sustainable Watersheds, Competing Goals, and the Tool Box
Moderator: Gene Soderbeck
Co-moderator: Tina Carstens

Measuring the Sustainability of Water Management in the U.S.
John Wells, Minnesota Environmental Quality Board

A Holistic Approach to the Clean Water Act
Dennis Larson, AMEC

Minnesota's New Storm Water Manual
Gary Oberts and Jay Michels, Emmons and Olivier Resources, Inc.; and Brian Livingston, Minnesota Pollution Control Agency

2:30–2:45 **Refreshment Break**

2:45–4:15 CONCURRENT SESSIONS VI

Track A *Tack Room*

Nitrogen Management and Modeling
Moderator: Paul Wotzka
Co-moderator: James Anderson

Developing Nitrogen BMPs from Field Research
Gyles Randall, University of Minnesota

Nitrate Removal in Vertical-Flow Wetland Microcosms
Dennis Busch and James Anderson, University of Minnesota

Modeling Long-Term Nitrate Losses in Response to Changes in Fertilizer Application Rate and Timing
Vinay Nangia, David Mulla, and Gary Sands, University of Minnesota; and Prasanna Gowda, U.S. Department of Agriculture

Track B *Garden City Ballroom*

When the TMDL Rubber Hits the Road
Moderator: John Thene
Co-moderator: Bruce Vondracek

The Economics of TMDL Implementation: Champagne Taste on a Beer Budget
Joe Bischoff and Diane Spector, Wenck Associates, Inc.

How Low Should You Go? The TMDL/Water Quality Standards Limbo
Hans Holmberg, Limno – Tech, Inc.

Lake Pepin Watershed TMDL
Norman Senjem, Minnesota Pollution Control Agency

Track C *Carriage Hall B*

River and Lake Management
Moderator: Marty Weber
Co-moderator: Rick Voigt

Water on the Web: Lake and Stream Data-Rich Teaching Resources
Cynthia Hagley, Carl Richards, Bruce Munson, Richard Axler, George Host, Elaine Ruzycki, Jane Reed, and Norm Will, University of Minnesota-Duluth; and Glenn Merrick, Lake Superior College

Mississippi River Headwaters Reservoir Operations Plan Evaluation Study
Terry Zien, Jodell Kormanik, Jonathan Peterson, and Marilyn Katuria, U.S. Army Corps of Engineers

Driven by Water: The Master Plan for Cascade Lake Park, Rochester, Minnesota
Rich Brasch, Bonestroo and Associates; and Denny Stotz, City of Rochester

4:15 **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 Carriage Hall Foyer.

Evaluating the Effects of Riparian Forest Harvest on Macroinvertebrate Communities and Water Quality in Northern Minnesota
Dickson Atuke and Raymond Newman, University of Minnesota; and Bruce Vondracek, U.S. Geological Survey and University of Minnesota

Impervious Surface Mapping by Satellite Remote Sensing
Marvin Bauer and Brian Loeffelholz, University of Minnesota

Strategy to Reduce Thermal Impacts on the Kinnickinnic River, River Falls, Wisconsin
Rich Brasch, Bonestroo and Associates; and Reid Wronski, City of River Falls

Mercury Bioaccumulation in Streams Receiving Predominantly Atmospheric Mercury Inputs
Mark Brigham, Dennis Wentz, Lia Chasar, Barbara Scudder, and Mark Marvin-DiPasquale, U.S. Geological Survey

Farm Nutrient Management Assessment of a Karst Watershed
Denton Bruening, Minnesota Department of Agriculture

Fate of 14C-cis-1,2 Dichloroethylene in Wetland Microcosms Containing Cattail and Giant Bur-Reed
Todd DeJournett, University of Minnesota

Using GPS and GIS to Complete Wetland Inventories and Functions and Values Assessments
Deric Deuschle and Allyz Kramer, Short Elliot Hendrickson, Inc; and Lori Haak, City of Chanhassen

Technical Standards Evaluation for Urban Stormwater Management
Mark Doneux and Bob Fossum, Capitol Region Watershed District

Aquatic Photochemistry of Nitrofuran Antibiotics
Betsy Edhlund, William Arnold, and Kristopher McNeill, University of Minnesota

Methods and Results from the First Two Years of the Manure Analysis Proficiency Program
Jerry Floren, Minnesota Department of Agriculture

How Natural Resource Professionals Can Prevent the Spread of Aquatic Invasive Species Using the HACCP Approach
Jeffrey Gunderson and Douglas Jensen, University of Minnesota-Duluth

Lamplighter Pond: A Case Study in Consensus Building
Steve Gurney, WSB & Associates

Our Community and the USEPA Watershed Initiative-A Unique Partnership on a Watershed Basis
Lauren Klement and Amy Stratton, Three Rivers Resource Conservation and Development Council

Affecting Small Watershed Hydrology with an ECS (Evaporative Control System) and Other New Construction Materials
William McCully, Glenn Rehbein Companies

Human Choice and Household Landscape Management Decisions
Kristen Nelson, Victoria Kalkirtz, Larry Baker, Paul Hartzeim, Sarah Hobbie, Jennifer King, and Michelle Payton, University of Minnesota

Northern Washington County, Minnesota, Bog and Fen Wetlands
Elizabeth Nixon and Melissa Arikian, Emmons and Olivier Resources

Techniques in Stormwater Management and Design for Development and Re-Development Projects
Adam Parker, McCombs Frank Roos Associates, Inc.

Mosquitoes in Underground BMP Structures
Nancy Read and Kirk Johnson, Metro Mosquito Control District

DuluthStreams: Community Partnerships for Understanding Urban Stormwater and Water Quality Issues at the Head of the Great Lakes
Elaine Ruzycki, Jane Reed, Richard Axler, George Host, Norm Will, Jerry Henneck, Cynthia Hagley, Jesse Schomberg, Carl Richards, and Bruce Munson, University of Minnesota-Duluth; and Marnie Lonsdale, City of Duluth

Human Dimensions of Water Resource Management: The Case Leech Lake Area Visitors
Raintry Salk, University of Minnesota

Simulation of Storm Runoff Using the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) Model for Comparison of Best Management Practices (BMPs)
Brennon Schaefer and John Nieber, University of Minnesota; Greg Eggers, U.S. Army Corps of Engineers; and Greg Johnson, Minnesota Pollution Control Agency

Tree Leaf Fall Contribution to Storm Water Runoff Phosphorus – An Estimation
Ron Struss, University of Minnesota

The Effects of Long-Term Low-Level Antibiotic Exposure on the Development of Antibiotic Resistance
Kristine Wammer, Timothy LaPara, and Leslie Onan, University of Minnesota

Street Sweeping - State of the Practice, Survey Results, and Policy Improvements for this BMP in Minnesota
Louise Watson, Ramsey-Washington Metro Watershed District; and Joel Schilling, Schilling Consultant Services

The Cost and Effectiveness of Stormwater Management Practices
Peter T. Weiss, Valparaiso University; John Gulliver, University of Minnesota; and

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Book of Abstracts

Arranged by session in order of presentation
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Plenary Session 8:20–9:30

Changing Strategies in a Changing Climate

John J. Magnuson, Professor Emeritus, Center for Limnology, University of Wisconsin-Madison

The climate is changing, not only the physical climate, but also our attitudes and beliefs about climate and what to do about it. I have come to the following realizations:

1. Climate is changing globally and here in the Great lakes Region,
2. Impacts have already occurred and will get worse,
3. Greenhouse gas emissions, especially carbon dioxide, contribute to this change, and
4. Actions, including adaptations, taken now can reduce some future impacts.

Many other scientists and increasingly, the general public, share these general views.

Every region, state, or municipality can document local changes. These changes have become increasingly rapid over the last 30 years so that even the casual observer can and has noticed them. The certainties of impacts and causation have become more evident, and the uncertainties are moving more towards issues of how to deal with present and future impacts and how to decrease release of greenhouse gases to the atmosphere. We continue to ponder and worry about abrupt climate change. I will briefly review some changes in our region and the relation between greenhouse gases and climate change, but it is time to plan, act, and do something about managing our world in a changing climate while working to reduce greenhouse gas releases.

Climate change is a better term than global warming because other concerns than warming, per se, exist and need to be considered. In particular for this audience, climatic change includes profound changes in the hydrologic system such as in patterns and amount of rainfall, and the seasonality of ice cover, snow cover, and frozen soils. Expect changes in runoff, stream flow, flooding, lake and wetland water levels, drought, and groundwater supplies. Freshwater ecosystems will respond to these hydrologic changes as well as to the increasing temperatures.

It is time to include climatic change in our planning for management of water resources and freshwater ecosystems. It is time to implement those plans and consider alternatives. So what kind of adaptations should we plan and implement in water and aquatic resource management? I will present a few possibilities.

It is time to plan reductions in the release of greenhouse gases. It is time to implement those plans. So what can we do? Much is known about what is possible. Consider actions that you can take as individuals and families, as organizations, and as municipal and state governments, as individuals involved in agriculture, power production and industry. I will present a few possibilities.

It is time for us to develop and implement strategies that respond to and anticipate the impacts of our changing climate and that restore the chemistry of the atmosphere.

Tuesday, October 25

Concurrent Sessions I 10:00–11:30

Track A: New Urban BMPs: Implementation Case Studies

Burnsville Rainwater Garden Retrofit Project

Leslie Yetka, City of Burnsville, leslie.yetka@ci.burnsville.mn.us; Fred Rozumalski, Barr Engineering Co.

The Burnsville Rainwater Garden Retrofit Project examines the effectiveness of rainwater gardens in reducing runoff from a typical urban residential neighborhood with curb and gutter. In 2003, seventeen rainwater gardens were designed and installed within a 25-lot, 7.5-acre residential neighborhood adjacent to Crystal Lake in Burnsville, Minnesota. Fourteen were constructed in front yards adjacent to the street, and four were constructed in a backyard swale that drains to the street. The gardens were primarily designed to capture street runoff through the installation of curb cuts at each garden. Stormwater runoff was monitored both prior to and after installation of the gardens. For comparative purposes, runoff was also monitored in an adjacent 36-lot, 7.5-acre control neighborhood with no rainwater gardens. Preliminary monitoring results indicate an 82% reduction in runoff from the study watershed when compared to the control watershed. Monitoring will continue through 2005.

Storm Water Management with Porous or Dense Hot-Mix Asphalt Pavement

Jill Thomas, Minnesota Asphalt Pavement Association, jthomas@mnapa.org

Porous hot-mix asphalt (HMA) pavements are attracting attention because of the role they can play in sustainable site design and storm water management. This technology is of interest to public works officials, consulting engineers, land developers, contractors, environmental engineers, and others with an interest in minimizing the impact of development on the environment.

The concept of managing storm water with porous or dense graded hot mix asphalt (HMA) pavements is fairly new in Minnesota, however this design has been used successfully since the 1970's to provide a solution to storm water runoff as well as groundwater table recharge. This pavement structure has been used in various climate conditions with the benefits of providing runoff control, aquifer recharge, reduction of drainage structures needed to comply with storm water regulations, and increased skid resistance and safety. The most common locations for usage include parking lots and low volume roads, and in high activity recreational areas like basketball and tennis courts or playground lots.

The proper design and application of storm water HMA pavement design is important for successful use of the concept. Soil characteristics, local topography, and climate conditions are physical factors that will be used in the planning and design processes. Other considerations include traffic loading, use of the facility, and agency regulations (i.e. storm water regulations). Special consideration is needed in the design relative to soil type, topography, and climate conditions. It is recommended that sites with a relatively deep water table be used. Areas with gentle sloping topography are ideal to allow the water to percolate through the system, although terracing the parking lot and using dense-graded HMA in steeper areas has worked successfully in hilly terrain. Several climate factors should be considered in the design including precipitation rate, depth of frost penetration, and excessive dust in the area. The design should be free of frost susceptible materials to at least the expected frost depth for the area.

Planning, Design and Construction of "Enhanced" BMPs: in the Maplewood Mall (MMATI) Project Area

Chris Cavett, City of Maplewood, chris.cavett@ci.maplewood.mn.us; Dwayne Sikich, Landform; Ron Leaf, SEH Inc.

The Maplewood Mall Area Transportation Improvements Project (MMATI) area encompasses approximately 400 acres within the City of Maplewood and the Ramsey-Washington-Metro Watershed District (RWMWD). The MMATI project was initiated, in part, to relieve traffic congestion around the Mall and to provide the public infrastructure necessary to support a planned development within the area. The project involved coordination of public input, multiple agencies, developers, individual land owners and consultants. One critical requirement for the project to move forward was completion of a comprehensive Storm Water and Wetlands Plan that was acceptable to the stakeholders. This presentation will summarize the upfront coordination efforts, the overall storm water management and wetland mitigation plan and discuss basic and "enhanced" (infiltration) standards placed on development projects. The presentation will focus on and show photographs (construction and current conditions) of several regional ponds, a range of infiltration BMPs and a 3.7-acre wetland mitigation area that have been constructed starting in 2003. Brief discussions of what went well and not so well, and of RWMWD plans to monitor runoff from portions of the project area will be presented.

Concurrent Sessions I 10:00–11:30

Track B: Pollutant Loads and Trends for Large River Systems

Long-Term Water Quality Trends in the Minnesota River: Assessing Statistical Methodologies and Total Maximum Daily Load Implications

Heather J. Offerman Johnson, University of Minnesota, offe0004@umn.edu; Satish C. Gupta, Department of Soil, Water, and Climate, University of Minnesota

The poor water quality of the Minnesota River, due to excess sediment and nutrient loading, is one of the major water quality issues facing the state of Minnesota. Data collected from 1969 through 2003 at Fort Snelling and Jordan on the Minnesota River, and at Mankato on the Blue Earth River were analyzed for long-term trends using the nonparametric Seasonal Kendall trend test and the parametric QWTrend test. Parameters analyzed are Total Suspended Solids, Nitrate-Nitrogen, Total Phosphorus and Ortho-Phosphorus. The goal of this study is to identify statistical procedures that can quantify trends in water quality of the Minnesota River and some of its tributaries. In this presentation, we report the results of the trend analysis and the implications for current best management practices in light of Total Daily Maximum Load goals.

Nutrient and Sediment Loads and Yields from Major Tributaries to the Upper Mississippi River – Headwaters to Twin Cities

Jim MacArthur, Minnesota Pollution Control Agency, james.macarthur@pca.state.mn.us

A two-year study was conducted of nutrients in the Upper Mississippi River and its major tributaries north of the Twin Cities. Flow data from the USGS, COE and DNR were used where available and flow monitoring stations were established where necessary. Chemistry samples were collected on an approximately bi-weekly schedule during the ice free months. Existing chemistry data, primarily from the Milestone monitoring program, were also used. Chemistry, flow and load calculations from Met Council sites were also incorporated into this analysis. Loads and flow weighted means were calculated using the Flux program for the major tributaries and for the Mississippi mainstem at several locations. Chemistry data collected in this study were also used in assessing these streams for impaired status.

Nutrient concentrations in tributaries generally increase predictably from north to south as land use changes from forest and wetland to agriculture and suburban. Nutrient concentrations for most tributaries are consistent with Ecoregion expectations. Streams in the southwestern part of the basin show the highest concentrations of nutrients. The Crow River Watershed is the primary contributor of phosphorus and nitrogen to the Upper Mississippi.

The study is scheduled to continue with a current emphasis on tracking high nutrient concentrations to their sources by monitoring more smaller tributaries.

Estimating the Nonpoint Source Pollution Contribution of the Twin Cities Metropolitan Area

Steve Kloiber, Metropolitan Council, steve.kloiber@metc.state.mn.us

The Twin Cities Metropolitan Area (TCMA) has made major advances in the past 25 years in controlling pollution discharges to rivers and lakes that come from point sources. Unfortunately, efforts to control pollution from diffuse, nonpoint sources (NPS) have not been nearly as effective. To begin to address pollution more effectively, we must first estimate how much NPS pollution reaches a waterbody and where this pollution originates. Part of an effective solution to this problem is to measure pollution at the outlet of a watershed, thus integrating all the pollution sources within a watershed. To this end, the Metropolitan Council established a monitoring program designed to measure pollutant loads coming from TCMA watersheds. Nineteen streams that are tributary to the Mississippi, the Minnesota, and the St. Croix Rivers within the TCMA are monitored through this program; however, cost and logistical issues make it infeasible to measure all NPS contributions. The purpose of this presentation is to provide a summary of annual NPS pollutant loads of nutrients and suspended solids for the monitored watersheds and to present a simple regression model with which to extrapolate annual pollutant loads for the unmonitored watersheds.

Tuesday, October 25

Concurrent Sessions I 10:00–11:30

Track C: Surface Water Analysis

Evaluation of Hydrologic Trends, Sources of Runoff, and Implications for Streambank Erosion in Minnesota Basins

Greg Wilson, Barr Engineering Company, gwilson@barr.com; Tim Anderson, Barr Engineering Company; Henry Runke, Barr Engineering Company; Mark Tomasek, Minnesota Pollution Control Agency

As part of work on the MPCA's Statewide Assessment of Phosphorus, Barr Engineering Company evaluated flow gage data from several watersheds to identify rainfall and runoff volumes that were indicative of the expected flow conditions in each of the Minnesota basins. Annual watershed yield was plotted for the period of record for the Mississippi River near Anoka and the Minnesota River at Jordan gages. Both plots showed an increasing trend in the watershed yield over time, with the Minnesota River exhibiting a trend line slope that was twice as high as the Upper Mississippi River basin. Another task was completed to identify if these hydrologic trends exist in other basins of the State, evaluate these trends in more detail, estimate how much additional sources of runoff may be contributing to the observed trends, and determine how the additional runoff volume from non-climate related factors influence the rates of streambank erosion in the corresponding basins. Results indicate that one-third to one-half of the additional runoff producing increasing trends in watershed yield is associated with non-climatic factors (such as land cover conversion, drainage and urbanization) in each of the watersheds.

Travel-Time Estimates for Seven Tributaries of the Mississippi River, St. Cloud to Minneapolis, Minnesota, 2003

James Stark, U. S. Geological Survey, stark@usgs.gov; Alan Arntson, U. S. Geological Survey; James Fallon, U. S. Geological Survey; David Brostrom, D L Brostrom Consulting

Travel times were estimated for low-, median-, and high-flow conditions for seven streams tributary to the Mississippi River from St. Cloud to Minneapolis, Minnesota, The tributaries included the Sauk, Elk, Crow, and Rum Rivers, and Elm, Coon, and Rice Creeks. Regression equations, based on watershed characteristics of drainage area, river slope, mean annual discharge, and instantaneous discharge at the time of measurement from more than 900 streams across the nation, were used to estimate travel times. To test the validity of these equations, a time of travel study, using a luminescent dye, was conducted on the Sauk River, from Rockville, to the confluence with the Mississippi River on June 16, 2003, at a discharge of 457 cubic feet per second at Rockville. Dye was injected in the Sauk River at Rockville, and time and concentrations were measured at three sampling sections downstream. Travel times were estimated for the leading edge, peak concentration, and trailing edge of tracer-response curves. The estimated travel times for the leading edge, peak concentration, and trailing edge at County Road 1 were 10.6 hrs, 11.9 hrs, and 14.6 hrs, respectively. The measured travel times for the leading edge, peak concentration, and trailing edge were 13.4 hrs, 15.5 hrs, and 20.5 hrs, respectively for the 15.7 mile reach.

The Twin Cities 'Old Faithful' – Finding Solutions to the 35W Tunnel

David Filipiak, SRF Consulting Group, Inc., dfilipiak@srfconsulting.com; Walter Eshenaur, SRF Consulting Group, Inc.; Rick Voigt, Polaris Group, Inc.; Brent Nelson, CNA Engineers

The Twin Cities landscape contains a plethora of features, all woven together by natural resources that have been preserved in a variety of fashions. Below this landscape lies a geological regime that provides a perfect setting for a variety of underground uses, as a thick sandstone layer underlies the limestone bedrock. Construction of tunnels in the sandstone layer to carry storm water from the surface to the Mississippi River proved to be both efficient and cost effective.

Much of the storm water in the south Minneapolis area drains to the Mississippi River via storm tunnels. The I-35W storm tunnel, also referred to as the Minneapolis storm drain tunnel, runs south to north, draining approximately 4.6 square miles of urban landscape prior to discharging to the river under the I-35W bridge. A number of physical changes have occurred since the original design that creates capacity problems in the tunnel system, including an increase in drainage area, increased intensity due to development and redevelopment, and changes to the highway system resulting in greater impervious surface and storage losses.

Mn/DOT and the City of Minneapolis commissioned a study to evaluate the hydrology and hydraulics of the storm sewer system draining to the I-35W tunnel as well as the tunnel hydraulics. The system has exhibited conveyance issues for years including localized flooding and 'geysers' at two of the tunnel dropshafts at 35th Street and 39th Street.

The study involved the following elements:

- Construction of an existing conditions XP-SWMM model, incorporating over 1,500 nodes and 3,100 links.
- Calibration of the model using available rainfall and flow data.
- Evaluating various solutions for their ability to meet design objectives for both Minneapolis and Mn/DOT, as well as to meet short term (construction/funding/etc) and long term (maintainability/meet future needs/etc) objectives.
- Working with a technical advisory committee and a public task force to discuss observations and potential solutions.

Tuesday, October 25

Concurrent Sessions II 1:15–2:45

Track A: Hydraulic Improvements in Developed Environments

Balancing Flows, Water Quality, and Aesthetics Around Brookview Park in Golden Valley, Minnesota

Dan Cazanacli, Short Elliott Hendrickson, dcazanacli@sehinc.com; Veronica Anderson, Short Elliott Hendrickson; Sue Mason, Short Elliott Hendrickson; Jeannine Clancy, City of Golden Valley; Jeff Oliver, City of Golden Valley

The Brookview Park portion of the 2003 Street Reconstruction Project in Golden Valley included several unique surface water components. A new stormwater pond was designed to control the anticipated runoff and provide adequate quality treatment in accordance to local regulations. Other ponds within Brookview Park were subject to functional modifications and aesthetic enhancements. A native grasses and forbs buffer zone was designed around the perimeter to provide a filter between the ponds and the mowed lawn turf areas. The buffers provided a higher degree of plant diversity to support urban wildlife habitat. This network of ponds is located within the Bassett Creek floodplain. Variable tailwater conditions added complexity to the hydrologic and hydraulic analysis. Additionally, a nearby DNR protected wetland had to be connected to the network of ponds in a way that would ensure adequate permanent wet conditions without the risk of a large increase in the water level.

Th55/Boone Avenue Floodplain and Wetland Mitigation Project

Andrea Moffatt, WSB & Associates, amoffatt@wsbeng.com; Pete Willenbring, WSB & Associates; Jeannine Clancy, City of Golden Valley

In 2004/2005, the City of Golden Valley reconstructed the TH55 and Boone Avenue intersection. This intersection was in the Bassett Creek 100-year floodplain and thus the intersection flooded routinely for many hours during rain events, shutting down TH55 and causing significant traffic and safety problems.

The project removed the intersection from the 100-year floodplain, resulting in the loss of 26 acre-feet of floodplain storage and 1 acre of wetland. To compensate for this floodplain and wetland loss, the City and WSB worked with General Mills to construct a large wetland complex that provided 36 acre-feet of floodplain storage and 7 acres of wetland mitigation on the General Mills property. General Mills donated the land to be used by the City; the City constructed the wetland/floodplain mitigation area including trails; and the area will be preserved in perpetuity by the Minnesota Land Trust. This partnership between public and private entities provided a creative and cost-effective solution to constructing a public improvement project.

Practical Application of a Hood Drop Inlet Structure

Stephan Becker, USDA-NRCS, steve.becker@mn.usda.gov

A grade stabilization problem was addressed with an earthen dam, auxiliary spillway, 48" Hood Drop Inlet (Blaisdell and Donnelly, SAFHL, TP 20, 1958), 600 LF of 24" dual wall polyethylene pipe, and a rock outlet basin. The dam is located about 150 feet upstream of a rural residence. Provisions were made to minimize dam breach potential.

A Hood Drop Inlet was used to improve the intake efficiency of a 24" dual wall polyethylene pipe, while keeping the dam height under 5 feet. The pipe was installed on a 4.4% grade for 500 feet, then a 17% grade for 100 feet. Both grades are hydraulically steep. A vent will be installed 150 feet downstream of the inlet to introduce open channel flow and reduce negative pressures in the pipe.

Concurrent Sessions II 1:15–2:45

Track B: Remote Sensing and GIS for Watersheds and Streams

Land Cover Assessment Using High-resolution, Multi-spectral Digital Aerial Imagery: A Tool for Monitoring Impervious Surface Cover

Steve Kloiber, Metropolitan Council; steve.kloiber@metc.state.mn.us; Marvin Bauer, Department of Forest Resources, University of Minnesota; Fei Yuan, Department of Geography

Many management and policy decisions of local, county, and regional agencies require timely, accurate land information. The decreasing costs and increasing availability of digital imagery can help lead to more effective land monitoring programs. One important new application of this technology is the use of digital imagery to map changes in urban development and imperviousness. In this application, we evaluate the potential to use automated image processing techniques, including a new object-based classifier, to map the extent of urban land and imperviousness using high-resolution (0.6 meter), multi-spectral digital aerial photographs acquired for the Twin Cities Metropolitan Area in late-Spring 2004. The spectral bands from a color-infrared image and a standard color image were combined to create a 4-band multi-spectral image that was used for a comparison of two automated classification procedures. Training areas were developed from the image objects delineated using the object-based classifier so that the same training areas could be applied in both methods. The automated classification procedures were applied to the imagery to stratify the data into generalized land cover classes, which were then reclassified into impervious/pervious cover data sets. The r-squared values between the automated and manually delineated imperviousness were essentially equal for the two methods (r-squared ~ 0.9) and the slopes were comparable. The pixel-based classification showed some considerable speckling of impervious areas throughout the study area. Whereas, the object-based classification map showed less noise, but processing time was longer for this method.

GIS Delineation of Variable-width Riparian Zones: A Topographical Approach

Timothy Aunan, Minnesota Department of Natural Resources, timothy.aunan@state.mn.us

Delineation of riparian management zones along streams is often accomplished by applying a buffer of fixed width. This approach is unsatisfactory in many respects. A new GIS procedure, which explores digital elevation models outward from successive stream segments to approximate 50-year flood heights, was developed and tested in two topographically diverse Minnesota subwatersheds. Riparian zones delineated by this method show different proportions of land uses and land ownerships than those delineated by simple fixed-width buffers. The process has the advantage of incorporating stream order information.

Uncertainty in Stream Gradient Estimation in TMDL

Matthew Kocian, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, kocia001@umn.edu; Udai Singh, Department of Biosystems and Agricultural Engineering, University of Minnesota; Bruce Vondracek, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota; Bruce Wilson, Department of Biosystems and Agricultural Engineering, University of Minnesota

Stream gradient is utilized for TMDL research and implementation at several different levels, including the calculation of stream power and estimation of flood flow frequency. While methods for measuring stream gradient in the field have been standardized, methods for estimating stream gradient using Geographic Information Systems (GIS) vary. The main differences in methods usually lay in the measurement of elevation. At a broad level, a GIS can estimate elevation change using either a topographic map, or a digital elevation model (DEM). We compared localized stream gradient estimates generated from two different methods in four hydrologic units in Minnesota. One of the methods utilized topographic maps to measure elevation change, while the other used a DEM. The values generated from the two different methods produces significantly different results ($\alpha = 0.05$, $p = 0.034$, $n = 62$). We will supplement these data with field measurements of stream gradient and attempt to validate a single, effective method.

Tuesday, October 25

Concurrent Sessions II 1:15–2:45

Track C: Lake Water Quality Improvement

The Use of Barley Straw to Increase Water Clarity in Lakes and Ponds

Steve McComas, Blue Water Science, mccomas@pclink.com; Randy Anhorn, Metropolitan Council

Since the early 1990s, research has shown that barley straw added to a lake can reduce nuisance open water algal growth. Algal inhibition has been attributed to decomposing barley straw byproducts and polyphenolic compounds have been suspected as the inhibitory agents. Our study on Valley Lake, an 8-acre lake and an adjoining 3-acre pond in Lakeville, Minnesota, tested the chemical inhibition mechanism as well as another possible mechanism, namely, that barley straw serves as an organic carbon source for increased heterotrophic production which results in lowering the water column phosphorus and thus reduces algal growth. Based on results of our 4-year study, heterotrophic production enhanced by barley straw is the most likely mechanism. Barley straw, installed at about 250 pounds per surface acre, can reduce excessive phytoplankton production and improve water clarity in ponds and small lakes.

A Dynamic Modeling Tool for Determining Internal Loadings of Phosphorus in Water Bodies

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

Internal loadings of phosphorus are those released from aquatic sediments to the water column under certain conditions in a water body. The released phosphorus can sustains eutrophication processes in water quality impaired lakes and rivers and therefore prevent or delay the effectiveness of restoration measures or the Best Management Practices (BMPs) in watersheds. Information with respect to how, how much and how long the phosphorus is released from sediments to the overlying water has become of wide interest and crucial in water resources management, particularly in implementation of Total Maximum Daily Load (TMDL).

The presentation will discuss a dynamic model developed to study phosphorus release processes, to predict short-term and long-term loadings and to evaluate effectiveness of the loading control measures. The method has been successfully applied to a tropical reservoir in Singapore, Chesapeake Bay and Jessie Lake in USA.

Restoration of Degraded Lake Minnetonka Bays

Lorin Hatch, Minnehaha Creek Watershed District, lhatch@minnehahacreek.org

Water quality in Lake Minnetonka has improved significantly since the 1970s and 1980s due to the diversion of municipal wastewater from local treatment facilities to a centralized facility: treated wastewaters have ceased being discharged into Lake Minnetonka tributaries. However, there are a number of bays that continue to maintain poor water quality. These bays are located in the northern and western parts of the lake, and are typically at the mouths of creek systems. The Minnehaha Creek Watershed District is implementing a number of watershed-based and lake-based restoration measures to address poor water quality in these bays. The focus of this presentation will be our activities in Stubbs Bay, Jennings Bay, and Halsteads Bay.

Concurrent Sessions II 1:15–2:45

Track D: Streams and Rivers

Ecological Restoration of Streams to Improve Water Quality

Diane Spector, Wenck Associates, Inc., dspector@wenck.com; Ed Matthiesen, Wenck Associates, Inc.; Peter MacDonagh, The Kestrel Design Group, Inc.; Kevin Larson, City of Brooklyn Park, Minnesota

Landscape and hydrologic change strongly influence stream water quality and biologic integrity. Many urban streams are impaired by low dissolved oxygen, excess sediment and nutrients, and low biological integrity, often the result of channel and hydrology alterations and poor streambank and riparian vegetation management. Ecological restoration is the process of returning an ecosystem as closely as possible to predisturbance conditions and functions. In an urban setting, watershed change may be so profound that it is impossible to return a stream to predisturbance conditions. However, ecological restoration principles can be used to reestablish the general structure, function, and dynamic of a healthier stream ecosystem, addressing known and presumed impairments and improving water quality and ecological integrity. These concepts are applied to projects on two highly disturbed urban streams in the Shingle Creek watershed: a completed project on Pike Creek in Maple Grove and an upcoming project on Shingle Creek in Brooklyn Park.

Assessing Agroforestry Options for Water Quality Using Regional Hydraulic Geometry Curves

Joe Magner, Department of Forest Resources, University of Minnesota, magne027@umn.edu; Ken Brooks, Department of Forest Resources, University of Minnesota

Agroforestry practices can buffer peak streamflows and attenuate non-point source pollutants. However, given climatic, geologic, and landscape complexity it can be challenging to determine where and how agroforestry practices are applied within a watershed to enhance water quality. Excessive stream sediment, and associated turbidity and phosphorus, may be locally derived or transported long distances downstream because of systemic watershed and stream channel degradation. This paper presents the use of regional hydraulic geometry curves (drainage area vs cross-sectional area) as an assessment tool for evaluating sediment contributions from channel erosion caused by increased peak streamflows resulting from land use changes in the watershed. To illustrate the use of geomorphic tools in evaluating agroforestry options, five different hydrogeomorphic settings across Minnesota were selected for the development of regional hydraulic geometry curves.

Mississippi National River and Recreation Area & St. Croix National Scenic Riverway: Special Cases in River Resource Management

Brenda Lafrancois, National Park Service, brenda_moraska_lafrancois@nps.gov ; Randy Ferrin, St. Croix National Scenic Riverway; Steve Johnson, Mississippi National River and Recreation Area

Large rivers are prominent features in Minnesota's history and landscape. Two of the State's large rivers have received national recognition for their scenic, cultural, and ecological attributes, and have been incorporated into the National Park System as Mississippi National River and Recreation Area (MISS) and St. Croix National Scenic Riverway (SACN). Because of the preservation and protection mission of the National Park Service, these two rivers represent special cases in river resource management. In this presentation, we will highlight specific ways in which these parks and their partners have approached water resource management, including basin-wide efforts to establish more protective nutrient goals for the St. Croix and recent water resources scoping efforts to prioritize management issues for the Mississippi River within MISS. Current research and monitoring needs at each park will be identified, and opportunities for dual-park investigations will be noted.

Tuesday, October 25

Concurrent Sessions III 3:15–4:45

Track A: Surface and Ground Water Interactions

Geology, Stream Piracy and the TMDL at Walker Brook

Robert C. Melchior, melch@paulbunyan.net; John Gleason, Bemdji State University; Molly MacGregor, Minnesota Pollution Control Agency

Sampling at Walker Brook, a small stream in north-central Minnesota, showed that reach to be impaired for dissolved oxygen under the Clean Water Act and required development of a water restoration study. Sampling data from that study suggest that the usual variables associated with DO may not be wholly responsible for the deficit. Proxies for organic matter (TKN, Ammonia, etc.) that commonly bear a specific relationship to DO, support this contention. Walker Brook is in a deeply incised glacial marginal stream valley of Itasca age associated with a recessional moraine of the Itasca Phase ice near Bagley MN. In the modern hydrological setting, high heads in the over-thrust moraine material on the southern flank valley drives groundwater through the fens bordering the stream to the north. This information will be used to reclassify Walker Brook in Minnesota's water quality standards scheme, thereby removing it from the impaired waters list.

Assessing the Interactions Between Ground Waters and Surface Waters at Three Lakes on the Grand Portage Reservation, Minnesota, 2003-2004

Perry M. Jones, U.S. Geological Survey, pmjones@usgs.gov, Margaret Watkins, Grand Portage Reservation Environmental Department

The U.S. Geological Survey (USGS) and Grand Portage Reservation Environmental Department applied several techniques for identifying shoreline areas of ground-water inflow to three lakes on the Reservation. Aerial photography analyses, shoreline sediment temperatures, and seasonal isotope data of pore-water and surface-water samples were the most valuable data for identifying locations of ground-water inflow. Collected pore-water and surface-water samples were analyzed for major constituents, nutrients, and isotopes of oxygen and hydrogen. Rain-water samples were analyzed for oxygen and hydrogen isotopes to determine the local meteoric water line. Specific conductance values for surface waters ranged from 47 to 129 µS/cm, while values for pore waters where ground-water inflow occurred ranged from 123 to 504 µS/cm. Cation exchanges in the acidic bogs surrounding the lakes confounded the use of major constituent chemistry to identify locations of ground-water inflow at several locations.

Distribution of Deicing Chemicals in Ground Water and Surface Water in Glaciated Parts of the United States

John Mullaney, U. S. Geological Survey Connecticut Water Science Center, jmullane@USGS.gov; James R. Stark, U. S. Geological Survey Minnesota Water Science Center

The use of sodium chloride as a deicing chemical on paved areas has increased dramatically in the northern United States since the 1950's. Sales of sodium chloride for highway deicing have increased from 591,000 tons in 1950 to more than 19 million tons in 2003. Concern has been growing about the effects of road salt on public ground-water and surface-water supplies and aquatic habitats.

A study of the effects of sodium chloride input on ground-water and surface-water quality was initiated in 2004 by the U.S. Geological Survey through the National Water Quality Assessment (NAWQA) program. Data collected from 1993-2003 from shallow ground-water networks and surface-water basins in urban and forested settings in glaciated parts of the northern United States were studied to determine ancillary factors related to chloride concentrations, changes to water quality caused by sodium input, and whether export from selected basins was dominated by overland runoff or ground-water discharge.

Based on preliminary results, and analysis of ancillary data, factors that are significant for predicting chloride concentrations in shallow ground water include recharge rates, soil type, population density, age of housing stock, and the presence of septic systems. Factors that were significant in predicting maximum chloride concentrations in surface water include road density, average April precipitation, potential evapotranspiration, and the percentage of total runoff from overland flow.

Typical chloride concentrations in ground water and surface water in selected forested areas in the study area are typically less than 10 mg/L. The maximum concentration of chloride in shallow ground water underlying urban areas was 800 mg/L and the median was 46 mg/L. Chloride concentrations were as large as 4,300 mg/L in surface water from 20 urbanized basins averaging 27 square miles. The median of the maximum concentrations at 20 basins was 145 mg/L.

Yields of chloride from the selected surface-water basins were typically less than 10 tons per square mile per year in forested basins, and were typically greater than 50 tons per square mile per year from urban basins.

Concurrent Sessions III 3:15–4:45

Track B: Remote Sensing and GIS for Lakes and Wetlands

National Wetlands Inventory Delineation and Classification Using eCognition Remote Sensing Software

Jeff Knopf, GeoSpatial Services of St. Mary's University, jcknop01@smumn.edu; Andy Robertson, GeoSpatial Services of St. Mary's University

The National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service has produced large scale wetlands maps for approximately 35 percent of Alaska. Mapping by NWI is conducted under the mandates of The Clean Water Act of 1977 and the Emergency Wetlands Resources Act of 1986. To date, these wetlands maps have been produced by traditional manual photo interpretation and mapping processes.

The eCognition software package from Definiens A.G. of Germany has been used to successfully automate the classification of a variety of landscape and land use features from digital aerial photo and satellite images. The purpose of this project was to apply eCognition software to the task of delineating and classifying NWI polygons within the National Petroleum Reserve Area of Alaska. This presentation will report on the procedures, processes and results of this joint project between the U.S. Fish and Wildlife Service and Saint Mary's University of Minnesota. Preliminary results indicate that eCognition can be used to significantly reduce the amount of manual photo interpretation time required to complete NWI mapping in Alaska.

Remote Sensing of Minnesota's Land and Water Resources

Leif Olmanson, Remote Sensing and Geospatial Analysis Laboratory, University of Minnesota, olman002@umn.edu; Brian Loeffelholz, Remote Sensing and Geospatial Analysis Laboratory, University of Minnesota; Marvin Bauer, Department of Forest Resources, University of Minnesota; and Patrick Brezonik, Department of Civil Engineering, University of Minnesota

The University of Minnesota is working to develop aerial and satellite remote sensing applications to map and monitor Minnesota's land and water resources to assist state and local agencies and citizen groups gather information needed for environmental planning and management. An overview of our research using remote sensing for local to statewide land and water resource assessments will be presented. The water resources applications include: 1) water clarity assessments using high (IKONOS and QuickBird), moderate (Landsat) and low (MODIS) resolution imagery. This will include a brief overview and statistical comparison of our Landsat derived Minnesota statewide historical water clarity database. 2) Water quality assessment of rivers using airborne hyperspectral imagery. 3) Aquatic plant classification and wetland health assessment using high resolution satellite and airborne hyper-spectral imagery. 4) Assessment of shoreland impacts using high resolution satellite imagery.

Multitemporal satellite remote sensing is also being used to classify land cover and impervious surface area in Minnesota. Statewide Landsat classifications of land cover and impervious surface area have recently been completed. The results demonstrate the potential of multitemporal Landsat data to provide an accurate, economical means to map and analyze land cover and impervious surface area and changes over time that can be used as inputs to land management and policy decisions.

Spatial Analyses for Reference Area Identification and Indicator Development for Coastal Ecosystems of the Great Lakes

G.E. Host, UMD Natural Resources Research Institute, ghost@umn.edu; L.B. Johnson, UMD Natural Resources Research Institute; T. Hollenhorst, UMD Natural Resources Research Institute; V. Brady, UMD Natural Resources Research Institute; N. Danz, UMD Natural Resources Research Institute; G. Niemi, UMD Natural Resources Research Institute, and J. Ciborowski, UMD Natural Resources Research Institute

Identification of reference conditions and ecological indicators is challenging in highly modified landscapes. We developed spatial metrics for characterizing anthropogenic stress using readily-available GIS data. Wetlands and shoreline reaches were classified by hydrogeomorphic type along the US Great Lakes coast. Degree of anthropogenic disturbance was assessed with a sliding-window approach for high-energy shorelines and a 'watershed' approach for wetlands. Anthropogenic stressor data included population and road density, proportions of agricultural or residential landuse, and distance from point sources. Several metrics were derived to ordinate sites along a stress gradient, including ordering sites with stressors scaled to the most intense disturbance, summed cumulative distributions across stress axes, and rank-transformed distributions. Sites along the gradient were sampled for fish, macroinvertebrates and other indicator variables. This research provides a means to evaluate indicators under reference and disturbed conditions, assess scale issues, and, ultimately develop mechanisms to assess the overall health of coastal ecosystems.

Concurrent Session III 3:15–4:45

Track C: Understanding and Managing Nutrient Loads to Aquatic Ecosystems

Nutrient Criteria Development for Lakes: Minnesota's Approach

Steven Heiskary, Environmental Analysis and Outcomes Division, Minnesota Pollution Control Agency, steven.heiskary@pca.state.mn.us

The Minnesota Pollution Control Agency developed ecoregion–based phosphorus "criteria" for lakes in the late 1980s. These criteria have been used for goal setting in projects and have most recently been used to define thresholds for 303(d) "TMDL" listing of nutrient-impaired lakes. We are now promulgating nutrient (eutrophication) standards for lakes. As a part of that effort we consider lake uses ranging from preservation of coldwater fisheries in northern Minnesota to improving the biological integrity of shallow lakes in central and southern Minnesota. This presentation provides an overview of research conducted in support of nutrient criteria development including: collaborative study of shallow lakes that considers relationships among rooted plants relative to water quality and other factors and assessment of pre-European trophic status of select lakes in Minnesota based on sediment diatom reconstruction.

A summary of our overall approach for developing and applying eutrophication criteria will also be provided. The draft criteria, as of September 2005, follow:

Ecoregion	TP ppb	Chl-a ppb	Secchi meters
NLF – Lake trout (Class 2A)	< 12	< 3	> 4.8
NLF – Stream trout (Class 2A)	< 20	< 6	> 2.5
NLF – Aquatic Rec. Use (Class 2B)	< 30	< 9	> 2.0
CHF – Stream trout (Class 2a)	< 20	< 6	> 2.5
CHF – Aquatic Rec. Use (Class 2b)	< 40	< 14	> 1.4
CHF – Aquatic Rec. Use (Class 2b) Shallow lakes	< 60	< 20	> 1.0
WCP & NGP – Aquatic Rec. Use (Class 2B)	< 65	< 22	> 0.9
WCP & NGP – Aquatic Rec. Use (Class 2b) Shallow lakes	< 90	< 30	> 0.7

For further information on research related to development of Minnesota's nutrient criteria and overall standards process please refer to MPCA's lake water quality page at:

http://www.pca.state.mn.us/water/lakequality.html#reports, and standards revision page at: http://www.pca.state.mn.us/water/standards/rulechange.html#changes.

Whole Watershed Phosphorus Mass Balances for Lake Management

Johanna Schussler, Ramsey-Washington Metro Watershed District, schu0389@umn.edu

P In this study, we developed whole-watershed phosphorus (P) mass balances as a diagnostic tool for lake management. The P mass balance equation was: Inputs = deliberate exports + stream output (to lakes) + retention. Calculated P inputs included human food, livestock food, fertilizers, industrial waste, atmospheric deposition and, for some lakes, sewage from other watersheds. Deliberate P exports included crops, animal products (meat and milk), and sewage. Data used to compute these terms was derived from digital databases (locations of animal operations and point sources of wastewater, human populations, landuse, harvested cropland) and published literature (human diet, animal transfer efficiencies, crop fertilizer application rates). Stream P inputs were reverse modeled using the MNLEAP lake eutrophication model, and retention was computed by difference. P balances for the watersheds of eleven recreational lakes in north-central Minnesota showed that watershed retention was most often the major fate of P accounting for 17% to 89% of P inputs. Deliberate exportation was important for watersheds having major agricultural operations and for watersheds that exported sewage. Stream P to lakes was generally < 10% of gross input, with the exception of small, primarily residential watersheds. The P mass balance approach used in this study uses readily available, public, digital information and presents a relatively simple, affordable option for water quality planners to evaluate sources and sinks of P and to identify potential improvements in P management.

Tuesday, October 25

Concurrent Session III 3:15–4:45

Track C: Understanding and Managing Nutrient Loads to Aquatic Ecosystems, continued

Is Watershed P Retention Sustainable?

Lawrence Baker, Water Resources Center, University of Minnesota, baker127@umn.edu

With increasingly stringent regulation of urban and agricultural water quality we are rapidly implementing "best management practices" (BMPs) for pollution reduction. Many BMPs rely upon retention of pollutants in the watershed, with little question regarding the sustainability of these practices. In this presentation we focus on retention of phosphorus (P) and ask: is P retention sustainable? In a recent analysis of P balances for 11 watersheds of major recreational lakes we reported that watershed retention accounted for 17% to 89% of gross P input to the watershed. Stream export (to lakes) ranged from 1% to 39%. Given the importance of watershed P retention, it is apparent that any decline in retention would have a deleterious impact on downstream lakes. In fact, P retention may not be sustainable in many situations where high P loads saturate soils. These situations include septic tank leach fields, heavily manured fields and lawns – all common features of Minnesota's lake watersheds. We review literature for these situations, augmented by literature on analog systems (irrigation with wastewater; wastewater infiltration ponds; sludge disposal) and groundwater P contamination to gain insights regarding sustainability of P retention practices. We conclude that P retention is not sustainable in many situations. BMPs based on reduced P inputs or increased P exports are proposed as viable alternatives to BMPs based on P retention.

Reception and Poster Session 4:45–5:45

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

Evaluating the Effects of Riparian Forest Harvest on Macroinvertebrate Communities and Water Quality in Northern Minnesota

Dickson Atuke, Department of Fisheries, Wildlife and Conservation, atuk0001@umn.edu; Raymond Newman, Department of Fisheries, Wildlife and Conservation; Bruce Vondracek, USGS, Minnesota Cooperative Fish and Wildlife Research Unit, University of Minnesota

Timber harvest activities have the potential to degrade water quality and aquatic resources. We evaluated effects of riparian forest harvest along eight northern Minnesota streams in 2003 (preharvest) and 2004 (postharvest) on macroinvertebrates and water quality. The study is part of a larger project to assess fish, habitat, vegetation and birds. At each stream, a treatment and two control forest plots were established: upland clearcut with either high or low residual basal area riparian forest harvest (4 streams each), no riparian harvest and no upland or riparian harvest. Stream reaches were sampled downstream, within and upstream of all plots. Water quality was assessed each spring and fall and benthic macroinvertebrates were assessed following the US EPA family-level composited, multi-habitat rapid bioassessment protocol. Initial results indicate substantial variability in flow among sites, and differences within and among sites in macroinvertebrate species composition and abundance. Monitoring will continue in 2005-2007 to further assess the effects of riparian harvest.

Land Cover Classification, Land Change Monitoring, and Impervious Surface Mapping by Satellite Remote Sensing

Marvin E. Bauer, Remote Sensing and Geospatial Analysis Laboratory, College of Natural Resources, University of Minnesota, mbauer@umn.edu; Brian Loeffelholz, Remote Sensing and Geospatial Analysis Laboratory, College of Natural Resources, University of Minnesota

This presentation will describe how multitemporal satellite remote sensing is being used to classify and map land cover and impervious surface area in Minnesota. Most of our research has been with Landsat imagery at a spatial resolution of 30 meters for classification of county to multi-county areas, but we have also investigated the potential of high resolution (1- 4 meters) data from the IKONOS and QuickBird satellites for classification and mapping at local scales.

Landsat TM data of the Twin Cities Metropolitan Area have been used to map land cover at five different dates from 1986 to 2002 and analyze changes in land cover. The classifications have shown that between 1986 and 2002 the amount of urban or developed land increased from 23.7 to 32.8% of the seven-county area, while rural cover types of agriculture, forest and wetland decreased from 69.6% to 60.5%. A statewide classification of a combination of spring, summer and fall dates of Landsat imagery for 2000 has recently been completed. The classifications of the metro area and the state have formed the basis for estimation and mapping of percent impervious surface area, with very positive results. The correlation between Landsat-derived estimates and measurements made from DOQ's is approximately 0.9 with a standard error of 8 – 10%. The classifications of the TCMA show that the percent impervious area has increased from 9% in 1986 to 13% in 2002. The maps are readily compatible with GIS and results can be tabulated and displayed for any area of interest, including counties, cities, and watersheds, and are being used by the Minnesota Pollution Control Agency for modeling runoff and water quality effects. Analyses of the high resolution IKONOS and QuickBird imagery show excellent potential for local mapping applications, but the high resolution while showing more spatial detail, also results in more variation within classes that must be addressed in the methods.

The results demonstrate the potential of multitemporal Landsat data to provide an accurate, economical means to map and analyze land cover and impervious surface area and changes over time that can be used as inputs to land management and policy decisions.

Tuesday, October 25

Reception and Poster Session 4:45–5:45

Posters by first author, continued

Strategy to Reduce Thermal Impacts on the Kinnickinnic River, River Falls, Wisconsin

Rich Brasch, Bonestroo and Associates, rbrasch@bonestroo.com; Reid Wronski, City of River Falls

The Kinnickinnic River is one of the upper Midwest's premier trout streams. This project centered on an evaluation of a portion of the River that includes a small on-line reservoir (Lake George) as well as tributary drainage areas that encompass downtown River Falls and adjacent residential areas. With the help of CE-QUAL-W2 to analyze the impact of various alternatives to reduce thermal impacts on the River, an overall management strategy was developed as a joint effort between the City and representatives of the Wisconsin Department of Natural Resources, Trout Unlimited, the University of Wisconsin-River Falls, and others. That effort includes a combination of watershed management retrofits designed to increase infiltration of runoff and re-configuration of Lake George in a manner that improves the River and is compatible with the City's vision of the downtown area. This presentation will focus on a review the technical rationale behind the proposed management strategy.

Mercury Bioaccumulation in Streams Receiving Predominantly Atmospheric Mercury Inputs

Mark E. Brigham, U.S. Geological Survey, Mounds View, Minnesota, mbrigham@usgs.gov; Dennis A. Wentz, U.S. Geological Survey, Portland, Oregon; Lia C. Chasar, U.S. Geological Survey, Tallahassee, Florida; Barbara C. Scudder, U.S. Geological Survey, Middleton, Wisconsin; Mark C. Marvin-DiPasquale, U.S. Geological Survey, Menlo Park, California

The U.S. Geological Survey studied mercury cycling in eight streams, located in Oregon, Wisconsin, and Florida, during 2002-2004. All eight streams receive mercury predominantly from atmospheric deposition to the watershed, with subsequent transport to the streams through various runoff processes. Aqueous concentrations of total mercury, methylmercury, and dissolved organic carbon (DOC) positively correlated with streamflow in most streams, suggesting that runoff of mercury-DOC complexes controls both total mercury and methylmercury concentrations in streams. Benthic mercury methylation was active in organic-rich sediments, whereas demethylation of methylmercury dominated in sandy, inorganic sediments. Given the observed relations among streamflow, DOC, and aqueous methylmercury, watershed inputs of methylmercury are likely more important than in-channel methylation for subsequent bioaccumulation in fish. Mean aqueous methylmercury concentrations strongly correlated with mercury concentrations in forage fish and game fish, suggesting that processes that convert inorganic mercury to methylmercury are an important control on mercury bioaccumulation.

Farm Nutrient Management Assessment of a KARST Watershed

Denton Bruening, Minnesota Department of Agriculture, denton.bruening@state.mn.us

The Minnesota Department of Agriculture in cooperation with the Minnesota Extension Service is assessing the Root River farmers through assessment of nutrient and pesticide use within these areas. The Department of Agriculture has developed a systematic approach, called the Farm Nutrient Management Assessment Program (FANMAP), to collect baseline information on farm nutrient use, specifically nitrogen, phosphorous, potash and pesticides within the South Branch of the Root River where farming is prevalent. Analyzing responses provides information such as comparison of the nutrient inputs from fertilizer, legumes, and manure, to the nutrient needs of the specific crop. Results will provide information to determine where education should be focused and changes need to be made. Through FANMAP analysis, we will discuss the differences between livestock farming and crop farming and the differences between different crop rotations and where reductions in fertilizer applications can be made.

Fate of 14C-cis-1,2 Dichloroethylene in Wetland Microcosms Containing Cattail and Giant Bur-Reed

Todd DeJournett, Department of Civil Engineering, University of Minnesota, dejo0036@umn.edu

While wetland treatment systems may be a cost-effective means for protecting surface water from risks posed by chlorinated solvent plumes such as dichloroethylne (DCE), the mechanisms for contaminant removal are poorly understood. Laboratory microcosm studies were performed using narrow-leaf cattail and giant bur-reed. A mixture of 14C-labeled DCE and cold (unlabeled) DCE was added to the microcosms and its fate was tracked. The polymerase chain reaction (PCR) was used to evaluate the effect of wetland vegetation on the population of methanotrophic bacteria. Results indicated that uptake and volatization through plant tissues are the dominant fate mechanisms in the microcosms, accounting for 70-80% of the added label. While vegetation was observed to increase the number of methanotrophic bacteria in the soil, no 14C-CO2 was detected in the root zone or in off-gas from the leaf zone. Wetland vegetation was also observed to reduce the concentration of vinyl chloride, which accumulated in soil controls.

Using GPS and GIS to Complete Wetland Inventories and Functions and Values Assessments

Deric Deuschle, SEH, Inc., ddeuschle@sehinc.com ; Lori Haak, City of Chanhassen; Allyz Kramer, SEH, Inc.

SEH Inc., is in the process of completing a wetland inventory and functions and values assessment for the City of Chanhassen as a component of their updated Surface Water Management Plan. The wetland inventory is an update of past inventories, but is being created in an all-electronic format using Global Positioning Systems (GPS), Geographic Information Systems (GIS), and portable computers. Each of the approximately 400 wetlands within the city limits are being mapped and simultaneously field-verified using GPS with high-resolution aerial photograph backgrounds and on-site editing capabilities. Each basin is also being assessed for wetland functions and values using the Minnesota Routine Assessment Method Version 3.0 (MnRAM 3.0). The use of technology to complete this inventory provides highly efficient use of field time, on-site QA/QC, and nearly instantaneous end-products compatible with the city's GIS database.

Technical Standards Evaluation for Urban Stormwater Management

Mark Doneux, Capitol Region Watershed District, mark@capitolregionwd.org; Bob Fossum, Capitol Region Watershed District

The Capitol Region Watershed District initiated a rulemaking process in 2004. The key component was developing and evaluating technical standards for the rules. To achieve this objective the Watershed District selected 3 sites that did not fully meet the existing Criteria. The 3 sites were evaluated to determine the following: A) Is it possible to achieve current criteria, what would the stormwater BMP's be and how much would they cost; OR B) If it is determined that it is not possible to meet our criteria, then alternative criteria should be developed, BMP's identified and costs should be detailed. For this evaluation the focus was on rate control, volume control, and water quality criteria only. This project accomplished the following:

Reevaluation of the current Criteria
Exploring alternative Criteria
Provided examples of alternative compliance
Provided costs for different practices
Demonstrated the feasibility of implementing new rules

Aquatic Photochemistry of Nitrofuran Antibiotics

Betsy L. Edhlund, University of Minnesota; edhlund@chem.umn.edu; William A. Arnold, University of Minnesota; Kristopher McNeill, University of Minnesota

Pharmaceuticals and personal care products, now well-established natural water contaminants, may degrade through photochemical reactions. Antibiotics are of particular concern because of the potential for the formation of bacterial resistance. Thus, the aquatic photochemical behavior of a class of pharmaceuticals known as the nitrofuran antibiotics has been investigated. Direct photolysis has been found to be the major photochemical degradation pathway, with the formation of a photostationary state between the syn and anti isomers occurring in the first several minutes of light exposure. The photoequilibrium constant, as well as both the wavelength and pH dependence of this photoequilibrium, has been determined for the nitrofurans. In addition, direct photolysis quantum yields have been measured and the degradation products investigated.

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Reception and Poster Session 4:45–5:45

Posters by first author, continued

Methods and Results from the First Two Years of the Manure Analysis Proficiency Program

Jerry Floren, Minnesota Department of Agriculture; jerry.floren@state.mn.us

Over application of nutrients from manure can lead to water quality problems. Farmers may apply excess manure because they are not aware of the nutrient content in the manure. For this reason, livestock farmers are encouraged to have manure tested by laboratories for nutrient content and to properly credit the nutrients applied in manure to their crops. However, little is gained if the laboratories do not provide an accurate analysis of the manure.

In 2003 the Minnesota Department of Agriculture received a grant from the Environmental Protection Agency to develop a proficiency testing program to help laboratories become more consistent in their methods and results for manure analysis. This poster describes the methods used to prepare the proficiency samples and the results from the laboratories during the first two years of the program. Partners in the program are the North American Proficiency Testing Program and the Soil Science Society of America.

How Natural Resource Professionals Can Prevent the Spread of Aquatic Invasive Species Using the HACCP Approach

Jeffrey Gunderson, Minnesota Sea Grant College Program; jgunder1@umn.edu; Douglas Jensen, Minnesota Sea Grant College Program

Managers, researchers, consultants and enforcement officers frequently move boats, nets, monitoring and sampling equipment, fish and other organisms during field operations. Without adequate controls, such operations pose significant risks for the accidental spread of aquatic invasive species (AIS). AIS fish, invertebrates, plants, and pathogens can permanently damage the aquatic natural resources we as professionals seek to manage and conserve. Recreational water users, businesses and industries must be assured that natural resource professionals are also doing their part to prevent the spread of AIS. AIS-HACCP (Hazard Analysis and Critical Control Point) planning is a practical approach that focuses attention on critical points where the spread of AIS can be prevented. AIS-HACCP provides managers with a risk assessment tool for the consistent application of methods, reporting, and verification to assure compliance.

Lamplighter Pond: A Case Study in Consensus Building

Steve Gurney, WSB & Associates, sgurney@wsbeng.com

The City of St. Louis Park and its residents experienced road and structure damage due to routine flooding of the Lamplighter Pond area during significant rainfall events. To address this flooding problem, Lamplighter Pond was enlarged from 6.9 acres to 9.4 acres and dredged to enhance flood protection, water quality, habitat and aesthetics. The project elements included removing 90,000 cubic yards of material of silt and organic matter from the existing pond bottom plus peat, sand, and gravel from adjacent upland areas. To provide additional flood protection, the City replaced the 1950-era storm water lift station, constructed a new berm, flood proofed low buildings, and constructed dry ponds.

The public involvement process proved a challenging part of the project that shaped the final design. While residents who experienced flooding were in favor of the project, a few vocal residents expressed concerns throughout the project. These concerns included aesthetics, tree removal, and potential damage to adjacent pile-supported homes due to lowering of the pond's water level. The resulting project balanced many of these concerns while still providing flood protection for the neighborhood.

Our Community and the USEPA Watershed Initiative-A Unique Partnership on a Watershed Basis

Lauren Klement, Three Rivers RC&D, lauren.klement@rcdnet.net; Amy Stratton, USDA NRCS/Three Rivers RC&D

The Watershed Initiative was conceived to encourage successful community-based approaches to restore, preserve and protect watersheds of the nation. The Greater Blue Earth River Watershed (GBERW) is one of the original twenty watersheds that were selected nationwide for the Environmental Protection Agency's (EPA) Targeted Watershed Grants Program. This opportunity for GBERW has brought many partners together, which include local, state and federal partners from both Iowa and Minnesota. The Watershed lies within fourteen counties and is approximately 2.26 million acres in size. GBERW is an agricultural based watershed. The project incorporates urban and agricultural Best Management Practices (BMPs) into the work plan. Highlights of the workplan include nutrient trials, monitoring, rain garden demonstrations, conservation cost share, riparian buffer incentive, wetland restoration, and education. The unique partnership between the EPA and local partners spells success as the future prediction for the project.

Affecting Small Watershed Hydrology with an ECS (evaporative control system) and Other New Construction Materials

William McCully, Glenn Rehbein Companies, wmccully@rehbein.com

The Evaporative Control System (ECS) is a new stormwater management system that serves as a drainage system as well as an irrigation system. This new system will be explained and the audience will see how it operates. The hydrological benefits will be identified and examples of applications will be shown. This system solves rate control and water quality problems associated with urbanization and development. Other construction materials that affect small watershed hydrology will also be introduced and examples shown.

The interesting part of my practice is incorporating innovative products in site development which reduces the amount of runoff from the site. By addressing the construction materials and the source of the stormwater runoff, without losing functionality of the land, we are directly affecting the hydrology modeling of the site development. By changing curve numbers of traditional surfaces we are affecting the hydrology of sites. We refer to it as source control and the systems we could introduce to you and your group are the following.

For additional information on the system see www.ecsgreen.com

Human Choice and Household Landscape Management Decisions

Kristen Nelson, University of Minnesota, College of Natural Resources, nelso468@umn.edu; Victoria Kalkirtz, University of Minnesota, College of Natural Resources; Larry Baker, University of Minnesota;Paul Hartzeim, University of Minnesota; Sarah Hobbie, University of Minnesota; Jennifer King, University of Minnesota; Michelle Payton, University of Minnesota

Human choice may be the single most important contributing factor to household landscape management in urban areas. The fertilizers, pesticides and compost applied to household landscapes contain nutrients that are cycled through ecosystems. The way people manage their property affects the urban nutrient cycles and can create pollution problems. This study provides further insights into the factors that influence how people manage their household landscapes. The two main research questions were: 1) how do urban households manage their landscapes and 2) what factors influence their management choices. Homeowners were visited on-site and researchers collected social (i.e. knowledge, beliefs, perceived norms) and biological (i.e. yard area, number of trees) data. Respondents overwhelmingly believed they were in control of their landscape choices. Despite this perception, different factors limited homeowner choices, such as bans on phosphorus fertilizers and pressures from neighbors to keep lawns green and aesthetically pleasing.

Northern Washington County, Minnesota, Bog and Fen Wetlands

Elizabeth Nixon, Emmons and Olivier Resources, bnixon@eorinc.com; Melissa Arikian, Emmons and Olivier Resources

A characteristic group of bogs and fens is located in a prominent groundwater discharge and recharge area northeast of St. Paul, MN. These wetlands have in common a similar plant community structure and hydrologic setting, and include the largest most southerly tamarack stand in Minnesota. The region, approximately 115,000 acres, is characterized by what is known geologically as the St. Croix Moraine and the headwaters reaches of three surface watershed drainages. Previously, groundwater and surface water models were developed to explain the water chemistry and morphological characteristics of area lakes. No data were collected or analyses were performed on groundwater-dependent wetlands. Presented here are characteristics of these bog and fen wetlands and a generalized model to explain the community characteristics of this bog and fen group.

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Reception and Poster Session 4:45–5:45

Posters by first author, continued

Techniques in Stormwater Management and Design for Development and Re-development Projects

Adam Parker, McCombs Frank Roos Associates, Inc. (MFRA), aparker@mfra.com

This presentation discusses some of the common stormwater management standards used for development and re-development projects, how and why some standards and policies may not be beneficial for either flood prevention or stormwater treatment, and how those standards can cause undue hardship for the developer and the community. This presentation also provides stormwater management standards and policies that allow greater flexibility of site layout, that will properly evaluate existing site constraints and ground conditions, and which rely less on stormwater models provided by the developer. The end result will be stormwater management standards that are more consistent, provide adequate flood protection, erosion control, and stormwater treatment.

Mosquitoes in Underground BMP Structures

Nancy Read, Metro Mosquito Control District, nancread@mmcd.org; Kirk Johnson, Metro Mosquito Control District

Larvae of mosquito species that can carry West Nile Virus have been found in underground stormwater structures and BMPs in many parts of the U.S. In the Minneapolis-St. Paul area, the Metropolitan Mosquito Control District conducted surveys to locate underground structures and check if they are serving as larval mosquito habitat. Initial results show that of 63 structure inspections, 32 contained mosquito larvae. Structures with tightly-sealed lids and controlled access to inlets and outlets are not likely to contain mosquitoes. Open structures that hold water, such as vortex centers, can sometimes have high numbers of mosquito larvae.

DuluthStreams: Community Partnerships for Understanding Urban Stormwater and Water Quality Issues at the Head of the Great Lakes

Elaine Ruzycki, Natural Resources Research Institute, University of Minnesota –Duluth, eruzycki@nrri.umn.edu; Jane Reed, Natural Resources Research Institute, University of Minnesota; Rich Axler, Natural Resources Research Institute, University of Minnesota; George Host, Natural Resources Research Institute, University of Minnesota; Norm Will, Natural Resources Research Institute, University of Minnesota; Jerry Henneck, Natural Resources Research Institute, University of Minnesota; Cindy Hagley, Minnesota Sea Grant College, University of Minnesota –Duluth; Jesse Schomberg, Minnesota Sea Grant College, University of Minnesota –Duluth; Carl Richards, Minnesota Sea Grant College, University of Minnesota –Duluth; Marnie Lonsdale, City of Duluth Stormwater Utility; Bruce Munson, Department of Education, University of Minnesota -Duluth

The DuluthStreams project began in 2002 as a partnership between the University of Minnesota-Duluth's Natural Resources Research Institute and Sea Grant Programs and the City of Duluth Stormwater Utility. It has now grown to include 22 local and regional organizations called the RSPT (Regional Stormwater Protection Team). Their goal is to increase public understanding of aquatic ecosystems and their connections to land use and human behaviors. Their primary education tool is www.duluthstreams.org (now www.lakesuperiorstreams.org) which averages ~200,000 "hits/month". Sensors in 4 streams measure EC25 (salt), turbidity (TSS), temperature and flow every 5 minutes, and transmit the data to the website daily. You can interactively compare and animate the data to watch values respond to thunderstorms, Spring runoff, and daily changes during base flow. The website also includes extensive interpretive and other information to educate residents, contractors, students, teachers, agencies and decision makers to improve stewardship of Northland water resources.

Human Dimensions of Water Resource Management: The Case Leech Lake Area Visitors

Raintry Salk, University of Minnesota, salk0006@umn.edu

Minnesota lakes are primary destination areas for recreation and nature-based tourism. Effective water resource management and planning includes the dynamic and growing social dimensions of natural resources. This project reports on preferences, expenditures, and information sources of Leech Lake area visitors, summer 2004. More than 500 visitors completed an onsite questionnaire across 30 days of data collection. Results indicate Leech Lake area visitor respondents are mature, Anglo and possess high educational and income status. A long visitation history coupled with frequent visitation to the area was common, as was the importance of the natural environment. Lodging, shopping, and casino expenditures were the highest among visitors who primarily consulted the Internet, previous experience, and friends/family for trip information. Comparable to other lake visitors, Leech Lake area visitors represent an important social element for water resource professionals, particularly the importance they ascribe to nature and solitude as well as their economic impact.

Simulation of Storm Runoff using the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) Model for Comparison of Best Management Practices (BMPs)

Brennon Schaefer, University of Minnesota; scha0896@umn.edu; John Nieber, University of Minnesota; Greg Eggers, U.S. Army Corps of Engineers; Greg Johnson, Minnesota Pollution Control Agency

The Whitewater River Watershed Monitoring Project is a U.S. Environmental Protection Agency (EPA) National Monitoring Program (NMP) project. Located in southeastern Minnesota, the watershed area is found in a region of karst limestone geology. Land use in the area is dominated by agricultural cropland and pastureland, which has posed problems to the aquatic life in the coldwater streams of the watershed. The project was established in 1997 to evaluate the effectiveness of various best management practices (BMPs) using a paired watershed monitoring design. Two paired catchments are currently monitored in this project. A corn/soybean rotation was used from 1997-2001 and then converted to pasture/alfalfa in 2002-2004. Automated sampling equipment is set up at the sites to record precipitation, streamflow, and water quality.

An additional goal of this project is to model the hydrology of each of the paired catchments. To attain this goal, a beta test version of the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model, developed by the U.S. Army Corps of Engineers Environmental lab (ERDC), is being employed. The model is a physically-based, process driven distributive parameter model. Data available from the sites, including surface topography, soils type, vegetative cover, and precipitation, were processed for input to the model for performing simulations of runoff events. Model calibration and validation was performed so that the hydrologic effects of BMP conversion could be studied.

This presentation will describe the catchment sites, give a brief overview of the GSSHA model, and present comparisons of observed flow data and model simulated rainfall-runoff events for the different BMP scenarios.

Tree Leaf Fall Contribution to Stormwater Runoff Phosphorus—An Estimation

Ron Struss, University of Minnesota Extension Service, rstruss@umn.edu

Many urban stormwater pollution prevention educational messages – rake up leaves, sweep up grass clippings, pick up pet waste – are intuitive, logical, but currently stand on limited scientific research.

This poster will summarize the research basis of popular stormwater education messages. It will outline needed areas of research and what research is currently under way to provide needed answers.

I will build on a literature review I have done on the phosphorus contributions of autumn tree leaf fall, and add research on the contribution of phosphorus from grass clippings and turfgrass, and bacteria from pet waste.

IF there are papers on on-going field work (e.g., UM's Brian Horgan on his turf runoff plots, or UW's John Stier on turfgrass vs. prairie planting runoff plots) then my talk will hold less currency. Reports on actual research should trump a report based on literature reviews.

Posters by first author, continued

The Effects of Long-term Low-Level Antibiotic Exposure on the Development of Antibiotic Resistance

Kristine H. Wammer, Department of Chemistry, University of Minnesota, wammer@umn.edu; Timothy LaPara, Department of Civil Engineering, University of Minnesota; Leslie J. Onan, Department of Civil Engineering, University of Minnesota

Antibacterial compounds have been detected in the environment at low, subtherapeutic levels. Here, we examined whether the presence of antibiotics at these levels would lead to an increase in antibacterial resistance among exposed bacteria. Two parallel chemostats were operated with an identical enrichment culture from Mississippi River water (Minneapolis, MN). One chemostat contained no antibiotics; the other contained four antibiotics (sulfamethoxazole, norfloxacin, trimethoprim, and tylosin) as a mixture at very low concentrations (< 1 nM each). Enumeration of the proportion of bacteria from each chemostat exhibiting antibiotic resistance was performed every 2-4 weeks using heterotrophic plate counts on nutrient media supplemented with elevated levels of each antibiotic. Polymerase chain reaction followed by denaturing gradient gel electophoresis (PCR-DGGE) was used to track changes in the community structure over time. Preliminary results suggest that very low antibiotic concentrations do not select for antibiotic resistant bacteria in the environment.

Street Sweeping – State of the Practice, Survey Results and Policy Improvements for this BMP in Minnesota

Louise Watson, Ramsey-Washington Metro Watershed District, louise@rwmwd.org; Joel Schilling, Schilling Consultant Services

In early 2005, the Ramsey-Washington Metro Watershed District completed a three-part project addressing the current state of the practice for street sweeping by reviewing literature and current research, surveying 120 governments across the United States (57 in Minnesota) and Canada, and addressing practice and policy issues with the Ramsey-Washington Public Works Forum. Research is showing that street sweeping has promise as a water quality BMP. The survey revealed that other states use street sweeping as a BMP more than Minnesota. The Public Works Forum views the three-part study results as supportive of street sweeping BMP use and needed policy change. The goal of this study effort by the District and its local government units is to determine street sweeping BMP effectiveness and implementation efficiencies for water quality improvement.

The Cost and Effectiveness of Storm Water Management Practices

Peter T. Weiss, Valparaiso University, Peter.Weiss@valpo.edu; John S. Gulliver, University of Minnesota; Andrew J. Erickson, University of Minnesota

The cost and effectiveness of seven stormwater management practices (SMPs) for treating urban rainwater runoff was evaluated. The SMPs analyzed were dry extended detention basins, wet basins, sand filters, constructed wetlands, bioretention filters, infiltration trenches, and grassed/vegetative swales. Using publications that reported on existing SMP sites across the country, construction and annual operating and maintenance (O&M) cost data for the various SMPs was collected and analyzed. After additional statistical analysis on historical values of inflation and bond yields, the annual O&M costs were converted to a total present worth based on a 20-year life and added to the construction cost. The total present worth of each SMP was reported as a function of the water quality design volume or, in the case of swales, the swale top width. Finally, after statistical analysis on relevant variables, the amount of total suspended solids and total phosphorus removed over the 20-year life was estimated as a function of the water quality volume. All costs are reported in 2005 dollars and all results are given with a 67% confidence interval. The results can be used by planners and designers to estimate both the total cost of installing a SMP at a given site and the corresponding total suspended solids and phosphorus removal effectiveness.

Concurrent Sessions IV 10:00–11:30

Track A: Pesticides, Nitrates, and Drinking Water

Contaminants Above Drinking Water Standards in the Dakota County Ambient Groundwater Quality Study

Jill Trescott, Dakota County, jill.trescott@co.dakota.mn.us; Vanessa Demuth, Dakota County

Dakota County began its long-term Ambient Groundwater Quality Study in 1999 to establish a baseline of groundwater quality data and track changes over time. The Study concept is to sample the same set of private drinking water wells (in the Prairie du Chien, Jordan, and Quaternary sand and gravel aquifers) throughout the County once each year. The results of the Study to date raise concerns about agricultural pesticides and nitrate in private drinking water wells.

Elevated nitrate is, historically, the most common form of groundwater contamination in Minnesota, including Dakota County. On a County-wide basis, nitrate has not changed significantly from year to year in the study wells; in 2005, nitrate was detected in 53% of the wells and exceeded the drinking water standard in 18% of the wells.

In the bedrock wells tested for pesticides in 2002-2003 (using the United States Geological Survey's Organic Geochemistry Research Lab), 61% of the Prairie du Chien and Jordan wells had detectable levels of pesticides or their breakdown products. None of these wells exceeded drinking water standards, but half the wells contained multiple pesticides or their breakdown products. In 2004, the sand and gravel wells were analyzed by the USGS using a relatively new analytical method; 24% of the wells exceeded the Health Based Value for Cyanazine (which was removed from the market in 2002). 76% of the sand and gravel wells had detectable pesticides or breakdown products; 64% contained multiple pesticides.

Next Steps: The number of wells that exceed the drinking water standard for cyanazine, have multiple pesticide contaminants, or have both pesticides and high nitrate warrant additional investigations. With the assistance of the Minnesota Department of Agriculture and the Minnesota Department of Health, Dakota County is developing Water Treatment Recommendations for private well owners in the County. In May 2005, Dakota County resampled all its Ambient Study wells for analysis using the USGS's new analytical method. Based on this re-sampling, the County will develop guidelines to help well owners to determine whether they should use alternatives such as reverse-osmosis (R/O) systems or other water supplies for their drinking water.

Integrated Solutions for Protecting Public Water Supplies in Agricultural Communities

Bruce Montgomery, Minnesota Department of Agriculture, bruce.montgomery@state.mn.us; Brian Williams, Minnesota Department of Agriculture; Don Sirucek; Minnesota Department of Agriculture; Bruce Olsen, Minnesota Department of Health Michael Russelle, USDA ARS; Carl Rosen, Department of Soil, Water and Climate, University of Minnesota

Many rural communities are facing the challenge of elevated nitrate concentrations in their public water supplies. In Minnesota, there are 10 to 15 communities that have significant nitrate problems and as a response strategy, suppliers will frequently install deeper wells, drill additional wells for blending purposes, install nitrate removal systems, or take other actions to avoid exceeding the 10 mg/L NO3-N Health Standard. While local communities are effective at developing short-term solutions, considerable planning, implementation, and science-based decisions need to be conducted to insure high quality water for future generations.

The MN Department of Agriculture, with support from many different cooperators, has actively assisted a number of agricultural communities by working with area farmers and agribusiness. This presentation will feature the alliances and examples of "win-win" solutions developed with a variety of public water suppliers found in different agroecoregions. Solutions are unique to each location but commonly include a blend of the following strategies: federal cost sharing on nutrient management planning and set aside acres through CRP; introducing modified cropping rotations in vulnerable locations; promotion of BMPs and university fertilizer recommendations; new technology; and alternative land use decisions.

Wednesday, October 26

Concurrent Sessions IV 10:00–11:30

Track A: Pesticides, Nitrates, and Drinking Water, continued

Town & Country: Comparisons on Fertilizer and Pesticide Use

Jerry Spetzman, Minnesota Department of Agriculture, jerome.spetzman@state.mn.us

How will rapid urbanization affect the water quality of the Lower Saint Croix River? What are our perceptions of the effects of land use on water quality and how do our perceptions compare to what we are finding? In a recent radio broadcast, Paul Harvey said "Recent reports show that homeowners in cities apply 10 times as much chemicals to their lawns as do farmers". Is this true? What do we know?

The Minnesota Department of Agriculture has regulatory authority over agricultural fertilizers and pesticides. This includes fertilizers and pesticides used on urban lawns and landscapes. As a result, the MDA has done a significant amount of work studying the amounts of fertilizers and pesticides being applied and monitoring the levels being found in ground and surface waters.

This presentation will provide an overview of topics such as:

- How do the levels of fertilizers being applied to farmland compare to the levels beings applied to lawns?
- Are the pesticides which are applied to farmland the same or different from those applied to lawns?
- As a result, what are we finding in ground and surface water in agricultural and urban areas?

Most of the information in this presentation was compiled from reports found at the MDA web site – www.mda.state.mn.us. Please refer to the web site for more complete information.

Concurrent Sessions IV 10:00–11:30

Track B: Surface Water Management

Urban Development Effects on Stream Temperatures

William Herb, University of Minnesota, stefa001@umn.edu; Omid Mohseni, University of Minnesota; Ben Janke, University of Minnesota; John Nieber, University of Minnesota; Heinz Stefan, University of Minnesota

Stream temperatures respond to a variety of heat transfer processes in a watershed. The imprints of radiation, evaporation, conduction and convection are compounded in observed stream temperatures. Hydrologic and thermal parameters of a watershed that affect water temperatures include topography, surface cover, soil type, weather and hydrogeology. When urban development encroaches on a watershed, the drainage system is often dramatically altered by landscaping, changes in surface cover (pavements and buildings), and addition of a new drainage (storm sewer) system.

There are short-term (single storm runoff) effects on stream temperatures, and long term (base flow) effects through infiltration and ground water.

Impacts of Perennial Vegetation on the Hydrologic Stability and the Economic Viability in Watersheds of the Minnesota River Basin

Driss Ennaanay, University of Minnesota, enna0001@umn.edu; Yoshifumi Konishi, University of Minnesota; Kenneth Brooks, University of Minnesota; William Easter, University of Minnesota

Intensive agricultural drainage and cropping practices have altered the hydrologic response of the Minnesota River Basin. Extensive areas of wetlands have been drained and converted to annual croplands, resulting in hydrologically unstable streams and polluted water bodies. Opportunity to convert portions of the basin from drained corn and soybean systems to perennial crops can potentially reduce flood peaks associated with frequent return periods (2 yr – 50 yr or so) and bring about environmental benefits. Effects on low flows seem to be less obvious. The objective of this paper is to examine the potential impacts of hypothetically constructed land-use changes on watersheds in the Minnesota River Basin. The Hydrologic Simulation Program Fortran (HSPF) model is applied to simulate different scenarios of land use within two watersheds. These scenarios include different percentages of perennial vegetation, such as woody species, and different levels of wetland restoration within the two watersheds. Enhanced hydrologic stability and improved water quality can result in ecological and economic benefits. The simulated hydrologic results are being input into economic models to assess economic benefits. We focus on two economic impacts: (1) reduced flood damages; and (2) enhanced recreational values. The Computerized Agricultural Crop Flood Damage Assessment System (CACFDAS) is used to simulate changes in agricultural damages for different hydrologic conditions. Recreational values are estimated for improvement up to a "swimmable" water quality condition, using Mitchell and Carson's benefit function approach. Lastly, given their financial viability, proposed perennial vegetation systems may provide for significant cost-saving opportunities for point-source polluters through the process of nutrient trading.

DULUTHSTREAMS to LAKESUPERIORSTREAMS: Making Storm Water and Stream Data Come Alive for Citizens, Students, Resource Agencies and Decision-makers

Richard Axler, NRRI-University of Minnesota-Duluth, raxler@nrri.umn.edu; Marnie Lonsdale, City of Duluth, Stormwater Utility; Cindy Hagley, Sea Grant, University of Minnesota-Duluth; George Host, NRRI, University of Minnesota-Duluth; Jane Reed, NRRI, University of Minnesota-Duluth; Jesse Schomberg, Sea Grant, University of Minnesota-Duluth; Elaine Ruzycki, NRRI, University of Minnesota-Duluth

Urbanization and rural development are placing pressure on western Lake Superior streams and nearshore zones. Stormwater runoff and discharge of partially treated domestic wastewater threaten public health via pathogens and fish-Hg; increased flows, temperature, sediments, nutrients and organic matter represent ecological health risks. Stream and coastal zone degradation represents a significant social and economic impact to a region whose economy and character are tied to its pristine natural state. This project uses web-based delivery and unique animated visualizations of real-time stream monitoring data to address issues of sustainability in critical Minnesota watersheds. The website incorporates interpretive information, curricula, case studies and a site design toolkit to educate contractors, consultants, developers, realtors, students, teachers, homeowners, agencies and decision-makers. DuluthStreams led to a Partnership (Regional Stormwater Protection Team) of >20 organizations to deliver common educational messages, collaborate on projects and provide tools, approaches, and lessons via a variety of formats.

Wednesday, October 26

Concurrent Sessions IV 10:00–11:30

Track C: Fate and Effects of Emerging Aquatic Contaminants

Concentration-dependent Effects of 4-nonylphenol on Male Fathead Minnows in a Competitive Reproductive Assay

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

In two experiments, we examined the concentration-dependent effects of a 28 day exposure to 4-nonylphenol (NP) on the reproductive potential of male fathead minnows. Minnows were exposed in a flow-through system to the following measured NP concentrations: 0.2, 0.3, 0.63, 3.2 µg/L (experiment one) and 0.29, 5, 11, 15 µg/L (experiment 2). After exposure, treated males were individually paired with control males and allowed to compete for reproductive opportunities. After seven days, fish were analyzed for morphometric data, histopathology, secondary sexual characters, and vitellogenin. Survival was excellent (>95%) and most nest sites (>85%) were occupied. In the first, but not second, experiment, males exposed to the highest NP concentration exhibited reduced secondary sexual characters and reduced testis size. However, no abnormal histopathology was noted. In both experiments, males from the lowest NP treatment out-competed control males for nest sites, but males from the highest NP treatment were consistently defeated. Results indicate a subtle and reproducible effect of NP at concentrations approximating those reported in some wastewater effluents.

Environmental Photochemistry of the Antibiotic Compound Tetracycline: Dependence on Acid-base and Metal-binding Speciation

Jeffrey J. Werner, Department of Civil Engineering, University of Minnesota, wern0122@umn.edu; William A. Arnold, Civil Engineering, University of Minnesota; Kristopher McNeill, Department of Chemistry, University of Minnesota

Anthropogenic input of antibiotic compounds to the aquatic environment poses a currently unknown risk of eco-toxicity, as well as the potential to increase the development and spread of antibiotic-resistant genes in bacteria. Many antibiotics, including tetracycline, are known to be unstable upon exposure to ambient light, indicating that sunlight may provide a significant loss process. The goal of this study was to investigate the kinetic parameters necessary to predict the photodegradation of the antibiotic tetracycline in sunlit natural waters. Aqueous association constants necessary to calculate speciation were elucidated from UV-vis data taken concurrently with titration experiments, and kinetic parameters for photolysis were measured for various conditions under simulated sunlight. The relevant equilibria include acid-base speciation and binding to calcium and magnesium ions, resulting in the aqueous forms, and consequently the photolysis rate, of tetracycline having a strong dependence on both pH and water hardness.

Antibiotics Losses from Agricultural Land in the Karst Region

Holly Dolliver, University of Minnesota, hswanson@umn.edu; Satish C. Gupta, University of Minnesota

Antibiotics are commonly used in animal agriculture to prevent disease and help increase animal's ability to absorb feed. However, a substantial amount of the antibiotics added to animal feed may be excreted in urine and manure. These antibiotics can potentially appear in surface and ground waters from manure-applied lands. This could be problematic in the karst region of the upper midwest, where soils are relatively shallow and underlain with fractured bedrock, and landscapes are steep and prone to surface sealing. A study is being conducted at the University of Wisconsin Agricultural Experiment Station at Lancaster, WI to determine antibiotic losses in both surface runoff and through subsurface leaching from solid beef manure and liquid hog manure applications in chisel plow and no-till tillage systems. Antibiotics monitored are chlortetracycline, tylosin, and monensin.

Luncheon Presentation 11:30-12:45

Everglades Restoration: A Remarkable Convergence of Science, Policy, Advocacy, and Law

Thomas D. Fontaine, Director, Western Ecology Division, NHEERL, ORD, USEPA

The South Florida environment has changed dramatically as a result of human activities. Major hydrological modifications to the landscape have made possible widespread development of agricultural and urban areas. With the advent of air conditioning and the attractiveness of the South Florida's sub tropical climate to many, the area's population and economy have grown substantially with far-reaching consequences for both human and ecological systems. The historic Everglades has been reduced to about 50 percent of its original extent and its water supply has been significantly modified in both quantity and quality. These factors, loss of extent, altered water quantity, and altered water quality, have had marked effects on native fish and wildlife populations, the potential for successful establishment of invasive species, and the overall ecological structure and function of the natural Everglades. The need to preserve the remaining Everglades, while at the same time providing adequate water supplies for future urban and agricultural uses, has prompted a massive restoration effort (CERP, Comprehensive Everglades Restoration Plan) accompanied by a full range of policy, regulatory, and legal issues, proponents and opponents, and a need for innovative science and engineering projects to held guide decision making and achieve desired results. CERP implementation will take place over an estimated 30 year period, and will include projects to restore the quantity, timing, and distribution of water to the Everglades, as well as provide for water supply and flood protection needs.

Concurrent Sessions V 1:00–2:30

Track A: Agricultural Issues

Small-group Nutrient Management Planning in Minnesota

Kevin Blanchet, University of Minnesota Extension Service, blanc013@umn.edu; Jodi DeJong Hughes, University of Minnesota Extension Service; Les Everett, Water Resources Center, University of Minnesota

In 2002, UM Extension began leading groups of 10-15 producers through writing a nutrient management plan for 2 fields of each of their own farms. Participants bring soil and manure test results, field maps, and expected yields, to the 3-hour session. An Extension specialist provides background information and coaches participants through plan preparation. Surveys are carried out both in the sessions and after the subsequent crop growing season. 68 workshops have been delivered to 700 participants. In-session calculations indicated that 86% of participants would save $6 or more per acre in fertilizer costs by following their plans. 56% intended to complete the plan for the whole farm themselves, 17% would hire a professional, and 3% would not complete it. (24% did not respond.) The increase in post-workshop intended over pre-workshop actual implementation was 33% for testing manure, 21% for calibration of spreaders, 42% for crediting nutrients in manure, and 14% for keeping records of manure applications.

Demonstrating the Use of a Living Mulch System in Grain Crop Production

Palle Pedersen, Iowa State University, palle@iastate.edu

Kura clover (Trifolium ambiguum M. Bieb.) is a forage legume that is expected to become a key forage crop in the future. Kura clover (also called Caucasian clover) is native to part of the former USSR and it is adapted to mountain slopes, valleys, and to drier grassy areas, where white clover often fails.

Kura clover is known for its persistence, disease resistance, high forage quality, and its ability to survive in many different soils and climate regions. It may be a better alternative to the most commonly used legumes in the upper Midwest, such as white clover, red clover, and alfalfa, because of its ability to survive frost, drought, and heat. Kura clover is adapted to many soils and tends to perform better in cooler regions. It grows best on well-drained, fertile soil and benefits from neutral pH, and phosphorus fertility.

There are many benefits of using a kura clover-living mulch system. Living mulches are plants that are intercropped in combination with cash crops. The mulch can decrease erosion, suppress weeds, reduce insect pests, and supply nitrogen to the cash crop. We believe that a kura clover-living mulch system could be largely nitrogen self-sufficient and result in year-round groundcover. When compared to conventional systems, it leaves less opportunity for weed invasion, requires less tillage, and reduces soil erosion. The kura clover living mulch system would be attractive to producers with a mixed enterprise (livestock and grain crops).

2003 Pesticide Use on Minnesota's Four Major Crops

Denton Bruening, Minnesota Department of Agriculture, denton.bruening@state.mn.us

The Minnesota Department of Agriculture and the Minnesota Agricultural Statistic Service surveyed approximately 2,500 farmers for herbicide, insecticide and fungicide use information for the 2003 crop year. Excellent participation and good record keeping by Minnesota farmers and agricultural chemical dealerships played a vital part in providing complete and detailed pesticide information. The survey targeted the four major crops grown in Minnesota which are corn, soybeans, wheat, and hay. Collectively, these crops account for over 90% of Minnesota's farmland. This survey collected pesticide information from over one million acres of cropland in seventy-six of the state's most intensively agricultural counties. The survey covered 5-6% of the state's corn, soybean, and hay acres and 8% of the wheat acres. This survey represents one of the largest ever conducted on pesticide use in Minnesota. Pesticide use data provides the Minnesota Department of Agriculture's monitoring division useful information as to pesticide use differences across Minnesota and corresponding needs for monitoring based on pesticide use survey data. Discussion will include pesticide use across Minnesota.

Concurrent Sessions V 1:00–2:30

Track B: Water Quality Standards and Modeling

An Innovative Approach Integrating Rural Storm Water Management and Bridge Replacements—Cascade Watershed

Ivo López, Bonestroo, Rosene, Anderlik and Associates, ilopez@bonestroo.com

Can stream corridor improvements generate cost savings to pay for the bridge replacement program? That is the approach being tested in southeastern Minnesota's Cascade Creek.

Land use changes, roadways, and bridges have altered the natural hydrology, accelerating runoff and sediment delivery that degrade stream corridors. The cascading effect of designing individual bridges—required to meet higher flood protection—further accelerates degradation, down-cutting and loss of floodplain functionality.

A proactive watershed approach that integrates storm water management with bridge replacements yields hydrologic, environmental and economic benefits. Seven high-priority locations were identified within the stream corridor for ecologically-sensitive flow control structures. Wetland restoration or other improvements are added based on landowner's willingness. These improvements enhance floodplain functionality—attenuating peak flows, stabilizing base flows, and reducing pollutant loading—for the frequent runoff events. Hence, less expensive bridges can be constructed and higher flood protection standards be met, while also enhancing water quality and our free-flowing stream corridors.

Land Use Evaluation – Developing Hydrologic and Water Quality Modeling Standards for Minneapolis

Walter Eshenaur, SRF Consulting Group, Inc., weshenaur@srfconulting.com

SRF and Minneapolis Public Works staff worked together to assemble a set of standards for future georeferenced hydrologic, hydraulic and water quality models created for the City using the Storm Water Management Model (SWMM). The techniques, standards and recommended model parameters will be used to evaluate stormwater BMPs, water quantity and quality impacts from proposed and existing development projects and to assure consistent modeling by staff as well as a variety of professionals. The City will also use the Project Report and Guidance Manual for conducting future modeling studies related to its NPDES MS4 permit and for water body impairment and TMDL studies that may occur within city limits.

Five sites that represented five different land uses were identified, with stormwater runoff flow data collection and water quality sampling conducted for all five sites during the latter half of 2004. GIS-based XP-SWMM models were developed for each site, and hydrologic calibration was completed using rainfall and in-pipe flow data. Water quality information was also collected to begin to assemble data for a similar calibration for water quality modeling.

The presentation will include a discussion of the process used to identify sites, collect data and calibrate the models, and the findings of the calibration.

Modeling Water Quality for the I-35W and Highway 62 Crosstown Commons Reconstruction Project

Keith Pilgrim, Barr Engineering Co., kpilgrim@barr.com

To guide the development of appropriate storm water mitigation approaches with the redevelopment of the I-35W and Highway 62 interchange, the Minnesota Department of Transportation has initiated the collection of five years of storm water flow and water quality monitoring data in this interchange and in the Diamond Lake watershed. This presentation will demonstrate the importance of high quality storm water flow and water quality monitoring data for making meaningful model predictions of the effect of development projects on water quality of receiving water bodies (in this case Diamond Lake). The presentation will provide a general overview of the I-35W and Highway 62 interchange water quality project, provide detail on how flow and water quality monitoring data was used to calibrate the P8 model for different land uses and make predictions of expected changes in water quality, and how the model was used to provide accurate estimates of storm water inputs to Diamond Lake such that in-lake processes could be modeled.

Wednesday, October 26

Concurrent Sessions V 1:00–2:30

Track C: TMDL Assessments

The Role of Paleolimnology in the Southeast Lake of the Woods TMDL

Euan Reavie, NRRI, University of Minnesota Duluth, ereavie@nrri.umn.edu; Mark Edlund, St. Croix Watershed Research Station; Mike Hirst, Lake of the Woods SWCD; Nolan Baratono, Minnesota Pollution Control Agency

Williams Creek, from its headwaters to Zippel Bay, was put on the TMDL list for low oxygen affecting aquatic life. Erosion, sediment deposition and elevated nutrient loading have been identified as common issues throughout the watershed, likely resulting from anthropogenic stressors including agriculture and hydrologic modifications. Paleolimnology was employed in Zippel Bay and its tributaries to characterize long-term nutrient loading and sedimentation rates since European settlement of the region. Isotope analyses of three sediment cores indicated notable shifts in sedimentation rates in response to human activities, and the application of a new diatom-based nutrient model to fossil diatom assemblages indicated that phosphorus levels have approximately doubled over the last 150 years. These results suggest that there may be a higher than natural frequency of low oxygen events resulting from algal blooms. This study has important implications on the Southeast Lake of the Woods TMDL, as it quantifies the extent of limnological impacts and validates the need for remediation.

Turbidity and Fecal Material in Streams Associated with Conventional Grazing and Managed Intensive Grazing in Southeastern Minnesota

J Jason Ewert, Minnesota Pollution Control Agency, jason.ewert@pca.state.mn.us; Naomi Magner, University of Wisconsin-River Falls; Joe Magner, Minnesota Pollution Control Agency

Streams in southeastern Minnesota were listed on the federal Clean Water Act, Section 303(d) list for Fecal Coliform bacteria. The Minnesota Pollution Control Agency (MPCA) developed a regional total maximum daily load (TMDL) for Fecal Coliform bacteria for the southeastern Minnesota streams listed on the 303(d) list. In an effort to monitor the effectiveness of managed intensive grazing (MIG), as a best management practice to limit pollutant loads to southeastern Minnesota streams, water samples were collected at over 25 sites representing conventionally grazed (CG), MIG, and non-grazed (NG) riparian land use. Sampling occurred in clear and turbid flow conditions. Prior to sample collection field parameters of temperature, specific conductance, pH, DO, and turbidity were collected using a YSI 6820 multi-parameter sonde.

Results showed relatively high fecal material numbers (>3000 MPN) for all grazed sites when bed sediment (silt and clay fractions) was suspended to the point of exceeding the MPCA numeric criteria for turbidity (25 NTU). Ground water from two control wells and clear baseflow contained no fecal material, whereas turbid water from NG sites showed a mix range of values (10-800 MPN) with several samples exceeding the MPCA numeric criteria of 200 MPN. Data suggest that fecal material are present in stream bed sediments and streamflows that entrain fine sediments will likely yield fecal numbers in excess of 200 MPN, especially adjacent to grazed riparian areas.

Analysis of Stream Data for TMDL Assessment

Udai B. Singh, Department of Biosystems and Agricultural Engineering, University of Minnesota, singh015@umn.edu; Jason Ulrich Department of Biosystems and Agricultural Engineering, University of Minnesota; Matthew Kocian, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota; Bruce Wilson, Department of Biosystems and Agricultural Engineering, University of Minnesota; Bruce Vondracek, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota; Joe Magner, Minnesota Pollution Control Agency and Greg Johnson, Minnesota Pollution Control Agency

Variability in indicators of stream health and their predictor variables contribute to the uncertainty of TMDL assessment. Obtaining a better understanding of this variability is critically important to achieving better TMDL assessments. Stream data obtained from existing databases, as well as field data collected during the summer 2005, will be analyzed to characterize the variability of dependent (indicators of stream health) and independent (predictors variables) variables for three study areas in Minnesota River, Upper Mississippi River, and St. Croix River basins. Uni-variate and multi-variate statistical techniques will be utilized to identify site specific relationships between indicators of stream health and localized stream characteristics. Analyzing and understanding these relationships will be vital in the development of a stream classification system for TMDL assessments.

Concurrent Sessions V 1:00–2:30

Track D: Sustainable Watersheds, Competing Goals, and the Tool Box

Measuring the Sustainability of Water Management in the U.S.

John Wells, Minnesota Environmental Quality Board, john.wells@state.mn.us

In December 2002, the national Sustainable Water Resources Roundtable embarked on a process to identify key indicators of water sustainability. The goal was to help people understand the degree to which water management in the U.S. maintains the capacity to meet the needs of future generations while addressing current needs. The Roundtable suggests that sustainability is achieved by maintaining the capacities of human and environmental systems to meet the needs of people and other living things over the long run. If people maintain these capacities in a watershed and if they allocate them in a way that meets human needs and supports healthy ecosystems, then the Roundtable would conclude they are managing the watershed in a sustainable manner. The author, a member of the Roundtable steering committee, will present the first edition of the Roundtable's work, which will be published in early October 2005.

A Holistic Approach to the Clean Water Act

Dennis Larson, AMEC, dennis.larson@dot.state.mn.us

Both clean water and a safe and efficient transportation system are essential elements in the state infrastructure. Water quality is federally mandated by the Clean Water Act (CWA), aimed at restoring the quality of the nation's waters so they can be used both as water supplies and for recreational activities. In practice, however, satisfying the requirements of the CWA can conflict with the delivery of a safe and effective transportation system.

This presentation uses examples of current CWA issues as they affect program delivery and operations at the Minnesota Department of Transportation. Then an infrastructure management approach that can be used to mediate conflicts between the CWA and delivery of transportation projects in Minnesota is presented. This approach uses a methodology developed in Europe that includes valuation of the natural environment in infrastructure investment decisions.

In closing it is argued that adoption of a systems approach as presented by the Infrastructure Systems Engineering Program at the University of Minnesota combined with the approach used in Europe would lead to a significant improvement in management of the state infrastructure.

Minnesota's New Storm Water Manual

Gary Oberts, Emmons and Olivier Resources, Inc., goberts@eorinc.com; Jay Michels, Emmons and Olivier Resources, Inc.; Brian Livingston, Minnesota Pollution Control Agency

The State of Minnesota Stormwater Steering Committee hired EOR and the Center for Watershed Protection (CWP) to prepare a state stormwater manual. The manual is newly completed and ready for use. This session will introduce the manual before a statewide training program begins. Attendees will be introduced to the features of the manual, including the vision of the Steering Committee in initiating a manual, the purpose and use of the manual, how stormwater can be integrated into site design up-front, Minnesota's regulatory framework, identification and selection of BMPs, possible use of stormwater "credits", and technical/engineering guidance for proper stormwater management and BMP use.

Wednesday, October 26

Concurrent Sessions VI 2:45–4:15

Track A: Nitrogen Management and Modeling

Developing Nitrogen BMPs from Field Research

Gyles W. Randall, University of Minnesota, grandall@umn.edu

Field research by University of Minnesota soil scientists has produced an integrated set of data on corn production, economic return to N, and nitrate losses to drainage water since the late 80's. This data set and its interpretation will assist in updating the original BMPs developed in 1991 for southern Minnesota. A four-year corn-soybean rotation study completed in 2004 showed significantly greater nitrate losses in tile drainage accompanied by no increase in profitability when applied N rates exceed the University's recommended rate. A 15-year study completed in 2000 indicated that spring application of ammonia for corn after soybean produces greatest yield and profit while minimizing nitrate loss to drainage compared with fall-applied ammonia without N-Serve, and thus is a preferred BMP. Fall application of ammonia with N-Serve also significantly reduced nitrate losses but is considered a BMP with RISK because yields and economic return were lower in years when May and/or June were very wet. Results from these studies clearly show application rates in excess of University recommendations and fall application of ammonia without N-Serve are not BMPs for south-central Minnesota.

Nitrate Removal in Vertical-flow Wetland microcosms

Dennis Busch, Water Resources Center and University of Minnesota Extension Service, University of Minnesota, buschd@uwplatt.edu; James L. Anderson, Water Resources Center and Department of Soil, Water, & Climate, University of Minnesota

Experiments on disturbed and undisturbed wetland microcosms were conducted to determine the effect that wetland hydrology and hydraulic loading rate have on nitrate removal rates. Two hydrologic flow regimes were used: vertical-flow, where drainage water flowed vertically through the sediment in the microcosm, and surface-flow, where drainage water flow was horizontal over the surface of wetland sediment. Hydraulic loading rates were 8, 25, and 75 cm day-1.

Results indicated that nitrate removal rates vertical-flow wetland microcosms were significantly greater than rates observed in surface-flow wetland microcosms. Increasing hydraulic loading rate resulted in significant increases in nitrate removal rates and effluent nitrate concentration. Influent nitrate concentration (15 mg NO3-N l-1) was reduced to a level below the drinking water standard at the 8 cm day-1 hydraulic loading rate in both the disturbed and undisturbed vertical-flow wetland microcosms but not in the surface-flow wetland microcosms.

Modeling Long-term Nitrate Losses in Response to Changes in Fertilizer Application Rate and Timing

Vinay Nangia, Department of Soil, Water, & Climate, University of Minnesota, nang0004@umn.edu; Prasanna Gowda, CPRL-USDA-ARS; David Mulla, Department of Soil, Water, & Climate, University of Minnesota; Gary Sands, Biosystems and Agricultural Engineering, University of Minnesota

This paper evaluates N losses in tile drainage as a function of N fertilizer management. A drainage model was calibrated and validated for using 4 years of monthly flow and nitrate loss data from two tile drained fields (11 and 9.3 ha) in Nicollet County. Half the monitoring data from the 11 ha field were used for calibration and half for validation of the model. The model was also validated using independent monitoring data from the 9.3 ha field. The model performed well during both calibration and validation. Switching the N application timing from fall to spring at an N rate of 180 kg/ha gave an 8% reduction in nitrate losses. A further twelve percent reduction in nitrate losses was observed when application rates were reduced from 180 kg/ha to 135 kg/ha. These results are relevant to water quality goals associated with reducing nitrate transport to the Gulf of Mexico.

Concurrent Sessions VI 2:45–4:15

Track B: When the TMDL Rubber Hits the Road

The Economics of TMDL Implementation: Champagne Taste on a Beer Budget

Joe Bischoff, Wenck Associates, Inc.; jbischoff@wenck.com; Diane Spector, Wenck Associates, Inc.

The primary focus of the TMDL program has been on the technical aspects of source identification and allocation. What is often missing is an up-front discussion of the cost of implementation, which can be high in developed areas where retrofitting is the only option. Typically the burden of implementation falls to local governments who must balance those costs with the need to fund basic services. We will illustrate potential implementation costs in the fully developed Shingle Creek watershed, where 13 lakes are impaired by excess nutrients, a tributary has impaired biota, and the main stem has impairments for excess chloride and low dissolved oxygen, with a pathogen listing expected in 2006. Understanding the economics of water quality helps stakeholder buy-in and manages expectations for timelines and cost shares. Ultimately, we must balance the cost of implementation with ecological benefits to develop a reasonable plan and time frame for improving our water resources.

How Low Should You Go? The TMDL/Water Quality Standards Limbo

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

Many TMDLs are being developed for waterbodies where existing water quality standards (WQS) are inconsistent with existing uses or are not reasonably attainable for one reason or another, such as natural flow, habitat, or water quality conditions. The cost of attainment may be another important consideration if required controls would result in economic hardship. Therefore, the review of existing WQS and consideration for a Use Attainability Analysis (UAA) or development of site-specific criteria should be a fundamental component in the TMDL process so that attainable goals are targeted. This paper will draw on past and on-going projects to examine the implications of developing TMDLs where existing WQS are not appropriate. It will also discuss the WQS review process and present the options available for revising WQS. Experiences that will be highlighted include TMDL and UAA research projects funded by the Water Environment Research Foundation (WERF), the most recent efforts by EPA's Office of Water, and TMDL development for state agencies and private interests across the nation.

Lake Pepin Watershed TMDL

Norman Senjem, Minnesota Pollution Control Agency, norman.senjem@pca.state.mn.us

The Lake Pepin Watershed TMDL includes two hypereutrophic lakes – Lake Pepin and Spring Lake – and a chronically turbid segment of the Mississippi River from the confluence with the Minnesota River to upper Lake Pepin. The TMDL project will eutrophication and turbidity as inter-related impairments in a single study, guided by a Stakeholder Advisory Committee and Science Advisory Panel, both of which have been established. Encompassing more than half of the land area of Minnesota and part of western Wisconsin, the Lake Pepin watershed which comprises the study area is large and complex, including five different ecoregions. The presentation will describe how this large and complex project is organized, how it relates to TMDL projects in upstream tributary basins and watersheds, how numerical TMDL targets are being developed for water quality standards for eutrophication and turbidity, and how the Waste Load Allocation and Load Allocation for phosphorus and sediment will be developed.

Wednesday, October 26

Concurrent Sessions VI 2:45–4:15

Track C: River and Lake Management

Water on the Web: Lake and Stream Data-rich Teaching Resources

Cynthia Hagley, Minnesota Sea Grant College, University of Minnesota-Duluth, chagley@d.umn.edu; Bruce Munson, Department of Education, University of Minnesota-Duluth; Richard Axler, NRRI, University of Minnesota-Duluth; George Host, NRRI, University of Minnesota-Duluth; Elaine Ruzycki, NRRI, University of Minnesota-Duluth; Carl Richards, Minnesota Sea Grant College, University of Minnesota-Duluth; Glenn Merrick, Department of Biology, Lake Superior College; Jane Reed, NRRI, University of Minnesota-Duluth; Norm Will, NRRI, University of Minnesota-Duluth

Water on the Web (WOW: www.waterontheweb.org) is a nationally-acclaimed program to educate two and four-year college students, high school and college teachers, and future water science technicians in basic and water science. The data, curriculum materials, lake and stream data visualization tools, and an extensive set of explanatory materials and graphics are provided through a deep and multifaceted web site. A two-semester water resource management course (27 modules) includes PowerPoint lectures and labs ranging from basic watershed and aquatic ecology to field survey techniques to GIS and statistical analysis to presentation and communication skills. Curriculum and real-world case studies (labs) use real-time data from 15 lakes and 7 streams nationwide. Independent evaluations have graded WOW highly for its ability to inspire critical thinking and to facilitate inquiry-based learning by students and teachers. WOW materials and data are also closely coupled with two community education websites, www.lakesuperiorstream.org and www.lakeaccess.org.

Mississippi River Headwaters Reservoir Operations Plan Evaluation Study

Terry Zien, Army Corps of Engineers, terry.r.zien@mvp02.usace.army.mil; Jodell Kormanik, U.S. Army Corps of Engineers; Jonathan W. Petersen, U.S. Army Corps of Engineers; Marilyn Katuria, U.S. Army Corps of Engineers

The Mississippi River Headwaters Reservoir Operations Plan Evaluation (ROPE) study will analyze the water control operating plans for the Mississippi River Headwaters system and will identify other operations-related issues. The analysis will consider and attempt to balance the many functions and objectives of the river and reservoir system as a whole. The various functions include navigation, preserving tribal resources, flood damage reduction, enhancing fish and wildlife habitat quality, recreation, water quality, erosion control, hydropower production, and sustaining hydrologic function on lakes and rivers system-wide. The study reach is from Bemidji to St. Paul, Minnesota.

This ROPE study is intended to better regulate the reservoirs as a system, fully considering all their public and tribal purposes. The Prescriptive Reservoir Model (PRM) program from the Hydrologic Engineering Center (HEC) is being used to do tradeoff and optimization evaluations and to formulate potential reservoir operation alternatives. In addition, a simulation model using Structural Thinking Experimental Learning Laboratory with Animation (STELLA) modeling software (High Performance Systems, 2003) is being used extensively to assist in plan evaluation and impact assessment and in the communication and education of the public and the project's stakeholders.

The reservoir operating plans will be examined using a procedure called Shared Vision Planning (SVP). SVP, also referred to as systems thinking, is composed of thinking, communicating and learning. This translates to planning, collaborating, and technical analyses. SVP combines the best of traditional water resources analyses, rigorous and effective public involvement techniques, and the use of easy to understand computer models to formulate and evaluate new ways of managing water. The name "Shared Vision Model" captures their most important advantage, which is that experts and stakeholders can build these models together.

The Mississippi River Headwaters ROPE Study web site can be found at: http://www.mvp.usace.army.mil/rope/

Driven by Water: The Master Plan for Cascade Lake Park, Rochester, Minnesota

Rich Brasch, Bonestroo and Associates, rbrasch@bonestroo.com, Denny Stotz, City of Rochester

The City of Rochester has developed a Master Plan that outlines a detailed strategy through which gravel mining areas along Cascade Creek on the western edge of the City will be transformed into a premier multi-use park. The center piece of the 230-acre Park will be a 90-100 acre lake fed largely by groundwater. This presentation will review how technical water quality considerations drove the development of the master plan for the Park, including the decision to disconnect the future lake from the Cascade Lake watershed by re-routing a portion of the heavily impacted Creek around the lake in a re-aligned low-flow channel and floodplain.

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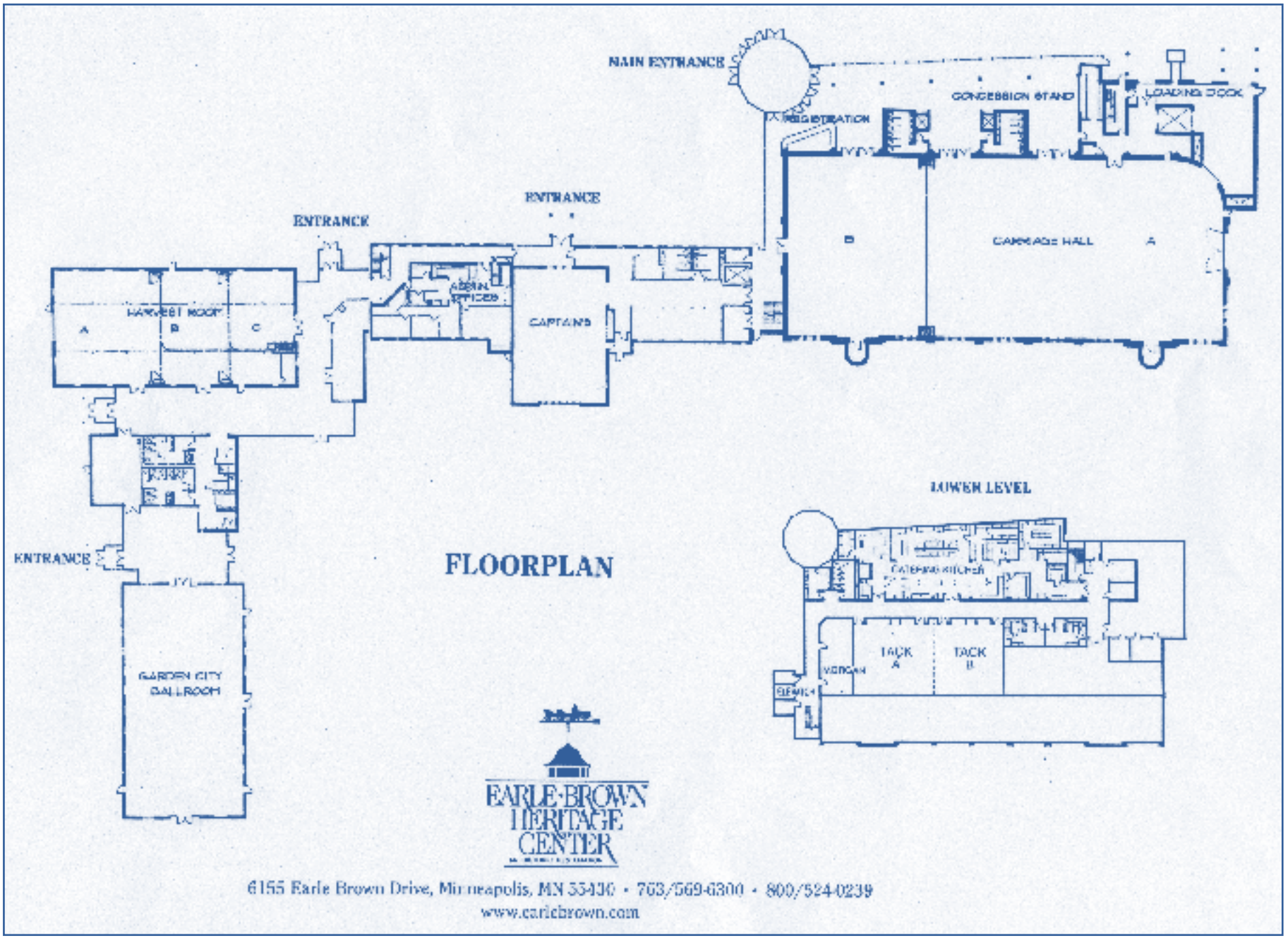
Notes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