Holistic Approach to Improved Nutrient Management: Experience, Challenges, and Success in Agriculture and Urban Partnerships

Thursday, September 17, 2020 2:00 – 4:00 pm ET





Today's Moderators





Harry Zhang, PhD, PE Research Program Manager – Integrated Water & Stormwater, WRF

Dave Clark, PE Principal Investigator, Senior Vice President, HDR





Today's Agenda

- WRF Welcome and Introduction: Peter Grevatt, CEO
- Project Overview and Research Plan: Dave Clark, Principal Investigator, HDR
- Agricultural Nonpoint Source Strategies & Innovation: Roger Wolf, Iowa Soybean Association
- Utility Perspectives on Nonpoint Source Partnerships: Steve Hershner, City of Cedar Rapids
- Panel on Partnerships Understanding Perspectives for Creating Ground Level Partnerships: Steve Hershner, City of Cedar Rapids
- Panel on Practices Current Knowledge of Nutrient Reduction Effectiveness, Scaling, and Receiving Waters: Peter Vanrolleghem, Université Laval
- Panel on Policies Working Together to Achieve Multiple Benefits and Watershed Optimization: Trent Stober, Co-Principal Investigator, HDR
- Live Audience Polling
- Questions and Answers





Welcome



Peter Grevatt Chief Executive Officer The Water Research Foundation





Holistic Approach to Improved Nutrient Management: Experience, Challenges, and Success in Agriculture and Urban Partnerships

WRF goal: Develop a research roadmap to identify innovative approaches and best practices for holistic nutrient management on a national scale





Trends in total water withdrawals by water-use category, 1950-2015







Nitrogen and phosphorous cause poor water quality in more than 100,000 miles of rivers and streams, close to 2.5 million acres of lakes, reservoirs and ponds, and more than 800 square miles of bays and estuaries in the **United States**









Agriculture-urban partnerships are essential for successful nutrient management at a watershed scale

- Primary sources of nitrogen and phosphorous include agriculture, stormwater and wastewater
- A holistic approach and integrated planning framework can facilitate the development of effective solutions for both agricultural and municipal sectors
- Collaboration between federal, regional, state and local programs provide important opportunities for controlling nonpoint source pollution





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Agricultural Best Management Practice Database



- Starting 2011, WRF, the National Corn Growers Association (NCGA), and the United Soybean Board (USB) began a collaborative effort to develop an Agricultural Best Management Practice (BMP) database
- This is a companion effort to the International Stormwater BMP Database, which is the largest of its kind in the water sector
- WRF Partners: NCGA and USB



Agricultural Use of Recycled Water: Impediments and Incentives



- Agricultural irrigation comprises by far the highest end use of conventional water sources in arid and semi-arid regions of the world.
- This project identified the drivers, incentives, and impediments for increasing the use of recycled water in agriculture.
- WRF Partners: California State Water Board and Pentair Foundation



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Holistic Approach and Integrated Planning Framework



Toolbox for Completing an Alternatives Analysis as Part of an Integrated Planning Approach to Water Quality Compliance



User's Guide for Integrated Wastewater and Stormwater Planning







Dave Clark, PE Principal Investigator, Senior Vice President, HDR





Project Overview and Research Plan

Dave Clark, HDR, Inc.





Holistic Approach to Improved Nutrient Management: Phase 1

- Phase 1 Goals
 - Engagement
 - Point and Nonpoint Sources
 - Regulatory Agencies
 - Stakeholders
 - Research Plan Development
 - Prepare Phase 2 Roadmap
 - Foster Innovation and New Opportunities
 - Improve Nutrient Management



Nater Research



Holistic Approach to Improved Nutrient Management: Phase 1 (WRF RFP#4974)

Figure 1. US Watersheds and Strategic Locations of Partner Utilities and Workshop Locations









Project Overview and Research Plan

- Task 1: Literature Review
- Task 2: Stakeholder Workshops/Webinars
 - Workshop No. 1 BACWA and San Francisco Bay
 - Workshop No. 2 Philadelphia Water Department and Delaware River
 - Workshop No. 3 Iowa Soybean Association and City of Cedar Rapids
- Task 3: Development a Phase 2 Research Roadmap Based on Findings from Tasks 1 and 2

https://www.waterrf.org/research/projects/holistic-approach-improved-nutrient-management-phase-1





Task 1: Literature Review

- WRF Research
 - Nutrient Removal Challenge (NUTR5R14g/4827g)
 - Modeling Guidance for Nutrient Target Setting (LINK1T110)
 - Innovation-Stimulating Regulations (NTRY-17-06 #04826)
 - Etc.
- Other Nutrient Management Approaches and Incentives
 - Colorado Nutrient Incentive Program
 - Iowa Nutrient Reduction Exchange
 - European Nutrient Regulations
 - Gray Literature





Water

Research

Task 2: Stakeholder Workshops/Webinars

- Workshop No. 1 BACWA and San Francisco Bay
- Workshop No. 2 Philadelphia Water Department and Delaware River
- Workshop No. 3 Iowa Soybean Association and City of Cedar Rapids with Point and Nonpoint Sources







Workshop No. 1 BACWA and San Francisco Bay – March 19, 2020 Webcast

- 2014 Watershed Permit
 - Unique Collaboration of 37 WRRFs, Regulators, & Scientists
 - Innovative and Cooperatively Developed
 - Evaluate the Potential Nutrient Discharge Reduction by Treatment Optimization and Side-Stream Treatment
 - Evaluate the Potential Nutrient Discharge Reduction by Treatment Upgrades or Other Means
 - Support Monitoring, Modeling, and Embayment Studies
- 2019 Watershed Permit Renewal
 - Targets
 - Incentives







Workshop No. 1 BACWA and San Francisco Bay – March 19, 2020 Webcast

- Puget Sound Collaboration Workshop December 18, 2019
 - Developing an Approach for Protection of Puget Sound









Workshop No. 2 Philadelphia Water Department and Delaware River – June 4, 2020 Webcast

- Delaware River and Estuary
 - 12 WRRF Dischargers
 - Dissolved Oxygen Sags
 - Toxics
 - Endangered Species
 - Atlantic Sturgeon
- Potential Collaboration



Nater Research



Workshop No. 2 Philadelphia Water Department and Delaware River - June 4, 2020 Webcast

- Philadelphia Water Department:
 - Bay Area Clean Water Agencies (BACWA) Nutrient Reduction Study, November 9, 2018



Water Research





Workshop No. 2 Philadelphia Water Department and Delaware River - June 4, 2020 Webcast

Philadelphia Water Department

Delaware River Basin Commission







Workshop No. 3 Iowa Soybean Association and City of Cedar Rapids with Point and Nonpoint Sources

- Iowa Soybean Association (ISA)
 - Largest State-based Row-crop Commodity Association
 - ISA Supports >40,000 Soybean Farmers
- City of Cedar Rapids
 - Middle Cedar Partnership Project Collaboration with Growers
 - USDA-NRCS Regional Conservation Partnership Program (RCPP)



Water Research



Workshop No. 3 Iowa Soybean Association and City of Cedar Rapids

- Both Nitrogen and Phosphorus
- Agricultural BMPs
- Nutrient Management from WRRF Agencies:
 - Treatment
 - Urban Stormwater
 - CSO/SSOs
- Drinking Water Impairment
 - Harmful Algal Blooms
- Regulatory and Implementation Strategies to Facilitate Nonpoint Source Partnerships









Task 3: Development of a Research Roadmap Based on Findings from Tasks 1 and 2

• Policy

- Holistic Watershed Perspective
 - Watershed-based Permitting
 - Trading and Offset Programs
- Guidance
 - Permit Writer Guidance
 - Compendium of BMP Approaches and Tools
- Regulations & Regulatory Tools
 - Integrated Planning
 - Adaptive Management Strategies





Topics and Discussion

- Agricultural Nonpoint Source Strategies & Innovation
- Utility Perspectives on Nonpoint Source Partnerships
- Panel 1: Partnerships
 - Understanding Perspectives for Creating Ground Level Partnerships
- Panel 2: Practices
 - Current Knowledge of Nutrient Reduction Effectiveness, Scaling, and Receiving Waters
- Live Audience Polling
- Panel 3: Policies
 - Working Together to Achieve Multiple Benefits and Watershed Optimization





Nutrient Issues and Opportunities

Roger Wolf, Director of Innovation & Integrated Solutions, Iowa Soybean Association

• Agricultural Nonpoint Source Strategies & Innovation



Steve Hershner, Utilities Director, City of Cedar Rapids

• Utility Perspectives on Nonpoint Source Partnerships









Agriculture Nonpoint Source Strategies & Innovation

Roger Wolf rwolf@iasoybeans.com

September 2020

Midwest Water Challenges



Des Moines Source Water - Nitrate Removal System



Cedar Rapids June 13, 2008



Research Center for Farming Innovation





DRIVEN TO DELIVER

Water Challenges – State/Federal Response

TO:

Gulf Hypoxia – Mississippi **River**



Iowa Nutrient Reduction Strategy







DRIVEN TO DELIVER



Key Ingredients: Driving Innovations Intentionally

- Invest in human resources to add capacity
- Entrepreneurial
- Quest for inquiry and discovery
- Build culture of collaboration
- Bridging disciplines via an integrated framework
- Seek impactful outcomes with value





Iowa Soybean Association

- Created 1964
- Headquarters in Ankeny, Iowa
- Elected volunteer board of 22 farmers
- 38,000 soybean farmers
- Production 500 million bu. on 10M acres annually
- Manage and administer programs





Watershed planning: Incorporates input from local farmers and stakeholders

Watershed planners convene a watershed advisory group to help develop local goals, determine acceptable practices, timelines and other watershed plan components.





Advisory group members help to identify and prioritize practices.

	Difficult		Effort	→	
Low High		No-Till	N Rate		
Ē	Buffer Strips	Bioreactors			
Impact		Cover Crops			
\uparrow	Wetlands				

Watershed planners use a ranking system to score practices based on willingness 33 to implement and the impact those practices have on the resources.



Grassroots Planning & Advocacy

Goal: Scaling up and advocacy

IOWA SOYBEAN Association 6

Objective: Build grassroots support for soil and water conservation action and funding

Status 2020:

- Developed conservation roadmaps for 4 cropping districts in Northwest Iowa covering 40 counties
- Roadmaps demonstrate opportunity for improving cropping systems
- Integrating agronomy programming with conservation to deliver outcomes that have value and will endure
- Facilitating action forums to build farmer support for local project development and informing advocacy



Research Center for Farming Innovation

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Technical Infrastructure Support



Partner with Ag Retail

- In 2020 ISA has network of 6 Conservation Agronomist's
- Technical outreach to farmers to assist with practice adoption
- Leveraging retail sales agronomists
- ISA provides back-office support for tools, training and coordination with agencies

DRIVEN TO DELIVER
Multi scale water sampling = ability to target & measure impact



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Fields with cover crop had 29% lower nitrate-N concentrations than fields without



Innovation to address Scale and Sustainability Cashflow Continuum - Incentives to Finance Trajectory



Complexity

Innovating Conservation Finance - Soil and Water Outcomes Fund



Independent, 3rd party partner using bestin-class models and in-field data collection



Thank You



Cedar Rapids, Iowa











Cedar Rapids, Iowa

RED STAR ORIGINAL General Mills Ingredion QUAKER PEPSICO Cargill















Economic Development — Wastewater









Economic Development — Water







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Regulatory Environment — Nutrient Reduction at City Wastewater Treatment Facility

Feasibility Study (2019) – plan to reduce nutrients in effluent to the Cedar River

2018 Baseline year N & P 20,866 lbs/day N 3,862 lb/day P

Current reduction: N 28% P 32%

IOWA Nutrient Reduction Strategy Reduce N 66% Reduce P 75%









Watershed Strategy





















2016









What We're Doing

Watershed-scale Thinking & Action









Beyond Borders: Investing Upstream for Downstream Benefits











Regional Watershed Management Authorities







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Middle Cedar Partnership Project (MCPP)



Middle Cedar Partnership Project (MCPP)

Nutrient Management	Bioreactors
Cover Crops	Wetlands/easements
Saturated Buffers	













MCPP Implementation Achievements



Nutrient Management: 7,813 acres	Bioreactor: 1 planned
Cover Crops: 17,629 acres	Oxbow Wetland: 1 completed
Saturated Buffers: 2,350 feet	Conservation Tillage: 11,646 acres













Within Cedar Rapids











Wastewater Treatment

Opportunity

Aging Facilities

Condition

Approaching 40 years in age Corrosive environment Flooded in 2008









Wastewater Treatment

Opportunity

Nutrient Reduction

- Address water quality issues in local watersheds and in Gulf of Mexico
- Iowa Nutrient Reduction Strategy targets 45% nutrient reduction









Wastewater Treatment

Opportunity

Sustainability & Energy Efficiency

- Wastewater as a resource
- Increased energy efficiency
- Biogas as an energy source
- Biosolids as a soil amendment
- Recovery of phosphorous as a fertilizer
- Watershed stewardship









Implementation











Watershed Partnerships Nutrient Reduction Exchange (NRE)

- A framework for registering nutrient reductions achieved in the watershed and using the 'credits' to offset future NPDES permit requirements for nutrient reduction
- MOU with Iowa Department of Natural Resources









Nutrient Reduction Exchange: Additional Strategies to Acquire Credits

- Partnership with The Soil & Water Outcomes Fund to purchase nutrient credits achieved from on-farm conservation activities
- Ag conservation on Cityowned farmland





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Multiple Benefits

- Flood resiliency
- Water quality
- Economic vibrancy
- Collaboration
- Contributions from non-profits & foundations
- Sustainable future









Panel on Partnerships:

Understanding Perspectives for Creating Ground Level Partnerships



Steve Hershner City of Cedar Rapids



Linda Prokopy, Ph.D. Purdue University



Charles Stevens Kansas City Water Services







Linda Prokopy, Ph.D. Purdue University





Understanding Adoption of Agricultural Conservation Practices

> Dr. Linda Prokopy Department of Forestry and Natural Resources Purdue University Twitter: @lprokopy













Reimer et al., 2012 Arbuckle and Roesch-McNally, 2015 Rogers 2003 Fishbein and Ajzen, 2010



Statistical Significance of Independent Variables All Models, 5417 rows of data, 92 Studies, 1982-2017



Prokopy et al., 2019, Journal of Soil and Water Conservation

Farmer Identity

Steward Innovator <u>Not</u> Financially Motivated





Systems Thinker

Are we messaging the right way to late adopters?




Seeking/Using Information

Field Days Consistent Messages Broadening Networks





Networks: Who Do Farmers Talk To?

Other Farmers Private Sector





Land Tenure





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Research reports available at: https://www.purdue.edu/fnr/prokopy/research/ Feel free to contact me for non-open access publications: lprokopy@purdue.edu







Charles Stevens Kansas City Water Services





Building Effective Partnerships – Federal Background

- The 2018 Farm Bill brought source water protection, the protection of sources of potable water, to the forefront of agriculture and environment conservation programs for the first time
- The 2018 Farm Bill directed that a minimum of 10 percent of the total spending on Conservation Title programs (Natural Resource Conservation Service Programs) be on source water protection
- Though the NRCS is long experienced and accomplished in the areas of soil health and water quality conservation programs, they have more limited experience in explicit source water protection for drinking water supplies
- ➤ The drinking water industry, facing numerous challenges such as emerging contaminants, aging infrastructure repair and expansion needs, funding shortfalls, needed to embrace the partnership opportunity that was born from the 2018 Farm Bill for protection and resiliency of their source water supplies





Building Effective Partnerships – Statewide Strategy

- > The hard work to enact it through conservation practices takes place at the State level
- The State Of Missouri is unique in the fact that it past tax legislation for 1/10th statewide Parks, Soils and Water sales tax represents an annual income of \$40M - 45M
- The Missouri Section of the American Water Works Association ("MO AWWA"), volunteers whom are drinking water industry professionals rapidly built a coalition and collaboration with Missouri Rural Water Association (MRWA), paid staff for developing source water protection plans throughout the State, to identify source water protection needs and priorities in Missouri
- These partners requested permission from the Missouri NRCS State Conservationist to sit on the MONRCS State Technical Committee, and were swiftly welcomed to contribute
- ➢ MO AWWA and MRWA and other partners have successfully provided input into prioritizing source water protection areas to protect existing and future source water supplies within the State of Missouri within the first two (2) years of building this working relationship with the NRCS State Technical Committee member's





Building Effective Statewide Strategy & Partnerships – Continued

- The partners in the first year wanted to develop long-term strategies for source water protection & make measurable success stories, i.e., existing source water supplies and future source water supplies
- An early success of the collaboration is the award of a NRCS Regional Conservation Partnership Program (RCPP) to the North Central Missouri Regional Water Commission ("NCMRWC") to mitigate non-point source runoff from contaminating the future East Locust Creek Reservoir
- This future source water supply for NCMRWC is expected to fill a critical need for a sustainability water supply in a 10 county region of rural Missouri for approximately 70,000 people
- Harve Rhodes, Chairman of the NCMRWC stated, "We are elated that our friends at NRCS have, once again, lent their support for our efforts to create and preserve this desperately needed water supply. NRCS officials have provided us great leadership and support throughout the lake project and now with the RCPP, which will aid us significantly in keeping our water clean. We are also grateful for the collaboration with MRWA and the AWWA"





Building Effective Statewide Communications Tools – FY 20



The Agricultural Improvement Act of 2018, otherwise known as the 2018 Farm Bill, was passed in December 2018. This new farm bill reauthorized existing conservation programs utilized in the previous farm bill, incorporating some changes within the programs offered. One of the key changes is the inclusion of a source water focus across the programs and throughout the United States Department of Agriculture (USDA).

The 2018 Farm Bill Program is

This process provides the public

currently in the rule-making process.

the opportunity to comment on the

NRCS SOURCE WATER PROTECTION AREAS

The farm bill charged the Natural **Resources Conservation Service** INRESI in each state with identifying local priority areas for drinking water These priorities areas will provide a focus where community water systems need resources to address water quality and quantity concerns across the landscape. NRCS worked In partnership with State Technical Committees and other source water stakeholders to make these a priority (watersheds or areas) for Missouri. As we move forward with implementing the farm bill, NRCS will be able to provide increased incentives to farmers and landowners in these watersheds selected. These incentives will be utilized to install practices that. relate to water quality and protect drinking water sources. Our overall goal is to dedicate at least 10% of the conservation program funds toward source water protection efforts.

Over the past year, the Missouri (MO) Section NRCS worked closely with members of the MO Section of American Water Works Association (AWWA) to Identify ways to make implementation of this new farm bill a success. The communication and dialogue from AWWA to NRCS has helped us ensure that the watershed, we deemed as a priority, was also a priority for the local municipalities. This partnership has been a model to other states as they begin this process.

14 . Show-Me Magazine + Spring 2020



If a of this farm bill. The best way to find out what opportunities are available in your area is to stop in your local USDA Service Center and

INRCS Watershed Am

Current ONR WMPs

IN NRCS Priority

DNR Priority

Karen Brinkman servics Assistant State Conservationitit for Partmetships and Special Initiatives USDA Natural Resources Conservation Sovieto (NRCS) in Columbia, Missource in this copacity, Karen is Joased on strengthening existing and developing new conservation partmetships to further efforts to address Issues, facing agriculture in Missourt. Koren may be reached of karen brinkmeningbucda.gov and 573-475-69364.

proposed changes made to the

USDA conservation programs. The

Program (EQIP) rule is currently out

meet with NRCS staff. The following

website will assist you in locating your local NRCS field office:

www.farmers.gow/service-center.

Environmental Quality Incentives







Building Effective Statewide Communications Tools – FY 21

NRCS SOURCE WATER PROTECTION AREAS E. Locust Creek Watershed Area FY 21 MOAWWA/MRWA Priority - Clark County Watershed Area FY 21 MOAWWA MRWA Priority - City of Marysville MOAWWA/MRWA MO. Source Priority - Sugar Creek Water Lake ake Watershed Area Watershed Area FY 21 (Being Jointh Funded By OAWWA/MRWA Local riority - Lower Sources Meramec (from Currently & confluence of the Big River to MS. Statewide liver) Watershed RCPP Match) rea FY 21 MOAWWA/MRWA riority - James River & Little Sac Watershed's Area FY 21 0

INRCS Watershed Assessments Current DNR WMPs

NRCS Priority
 Partner Priority
 DNR Priority

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Source Water Protection Projects Synopsis

Clark County Public Water Supply: 3 wells averaging 100 foot depth. One out of compliance with Nitrates. At this time blending to meet regulations. Operator Dan Dover has been testing numerous wells within the area, both private wells for personal use and irrigation wells. Dan is compiling a spreadsheet at this time but the average has been close to 30 ppm on these tests. Clark County Public Water Supply provides drinking water to approximately 9,500 people in Clark County. We have had 2 stakeholder meetings with farmers, businesses and others to discuss options. COVID-19 put a stop to our progress.

There is also concern with some by products from a local corn processing facility that is being stored and applied near the well head.

At this point we are looking at recommendations to change land use practices on acres around the well heads. Farmer involvement is going to be challenging and collecting more information for "ammunition" is the goal for now. We believe the nitrates are coming from the top down (Sandy alluvium with a very shallow static water level) Irrigation in the area has skyrocketed in the last 10 years. There is a fear that the nitrate issues are going to start trending up on the other two wells.

Recommended Practice(s); Cover crops. Application timing changes of nitrogen, by-product application changes (analysis and timing)

City of Maryville: January of 2020 Maryville source water lake experienced algal blooms. They have had issues for a few years due to algae and the fact their water treatment plant has no current ability to feed powdered activated carbon. Taste and odor issues are very bad. Maryville provides drinking water to approximately 30,000 people in Nodaway County. There is no drinking water interconnect with another water system to supplement the current supply provided by the City of Maryville. The algae bloom prompted the MODNR to issue a no body contact order for the lake which is a huge economic driver for the City (approximately \$15 million per year). With the help of American Water Works Association (AWWA), we were able to receive \$200k short notice funding from NRCS, and then \$200k more from SWCD. This money has already been allocated. Many partners have agreed to help put this project in motion. Producer meetings were being planned when COVID-19 put a stop to in person meetings. At this point we are still moving forward with the project. Eric Fuchs, Missouri Rural Water Source Water Protection Specialist, NRCS and SWCD representatives conducted two (2) site surveys. We have also compiled a list of landowners and BMP cost for the entire watershed. The local university will be monitoring to track baseline and future progress on sediments, Nitrogen and Phosphorus. More money will be utilized from a statewide RCPP from DNR.

Recommended Practice(s); Cover crops, no till, riparian buffers, grazing systems, saturated buffers, row crop conversion

East Locust Creek: RCPP approved and first landowner meeting took place for practice interest and participation. Sign up should be this fall. First of its kind RCPP to protect a watershed BEFORE it's built. This reservoir will eventually provide a source water supply for drinking water treatment to approximately 70,000 people in the surrounding area.

Recommended Practice(s); improved grazing systems and change in winter feeding habits

Little Sugar Creek: City of Moberly MO., Long term water quality issues from producer runoff and sediment. Lots of monitoring taking place from the City and U of MO. City interested in a joint RCPP application with AWWA/Missouri Rural Water Association (MRWA). City is also working on stormwater/septic issues in some subdivisions. Long term source water program within the City. The City of Moberly Public Utilities Department supplies drinking water to approximately 12,200 people in the City of Moberly and surrounding area.

Recommended Practice(s); primarily filter strips, improved grazing systems and no-till cover crop regiments

James River: Eric Fuchs, MRWA will be meeting Mike Kromrey to discuss how The Committee of The Ozarks can bring more partners to the table including producer groups. The RCCP application was denied last year but The Watershed Committee of the Ozarks will be applying again for RCPP funding. The plan is to bring on the Cattleman, MDC, Farm Bureau, MFA and other farmer groups as partners. This project has buy in from many local water utilities. The Watershed Committee of The Ozarks source water protection program will protect source water supplies for approximately 200,000 people served by City Utilities in Springfield, MO.

Recommended Practice(s); riparian fencing, providing alternative livestock watering facilities

Lower Meramec River Watershed: The lower Meramec River watershed runs from Sullivan, Missouri through the southern part of the St. Louis Metropolitan area and enters the Mississippi River near the City of Arnold. The lower Meramec is utilized for many uses, including serving as drinking water source of much of south St. Louis County. An EPA approved lower Meramec Watershed Plan, was prepared by East-West Gateway Council of Governments in September of 2017 and provides a framework for maintaining and improving water quality within the Lower Meramec. While point sources, especially constructed sanitary sewer overflows (SSOs), have been a problem in the past, the efforts of the MSD should successfully address this problem within the next decade. Therefore, the 2017 Plan focuses on non-point source runoff, including stormwater, which will be an on-going area wide source of pollution. The MWP identifies key partners and projects for achieving the water quality related goals in the MWP. Missouri American Water Company's source water protection program will protect source water supplies for approximately 230,000 people in St. Louis County. Tim Ganz will meet with key partners involved with the MWP to identify projects that may be candidates for funding under the Source Water Protection umbrella.

Recommended Practice(s); Repair and restore riparian corridors' along streams.



Partnership Panel Discussion





Panel on Practices:

Current Knowledge of Nutrient Reduction Effectiveness, Scaling, & Receiving Waters



Peter Vanrolleghem Universite Laval



Matt Helmers, Ph.D. Iowa State University



Jane Clary Wright Water Engineers







Peter Vanrolleghem Universite Laval





Holistic Approach to Improved Nutrient Management: Experience, Challenges, and Success in Agriculture and Urban Partnerships

Practices – Current Knowledge of Nutrient Reduction Effectiveness, Scaling, and Receiving Waters

Peter Vanrolleghem, Jane Clary & Matt Helmers





Tension over the fence...



De Dommel WWTP, Eindhoven, The Netherlands





Tension over the fence...







My personal motivation

• The low countries ... Livestock density (more pigs than people...)







Tension over the fence

- Environmental policy and agriculture...:
 - Acid rain







Tension over the fence

- Environmental policy and agriculture...:
 - Acid rain reduced
 - Fertilizer loss minimized as well!





No subsidies needed !



Best management practices

• SWAT model run for N-load to streams







Best management practices

Contour farming

Strip cropping







Best management practices

Buffer strips (5 – 10 – 20 m)











Matt Helmers, Ph.D. Iowa State University





Reducing Nutrient Export for Agricultural Lands: Practices and Scale

Matt Helmers Iowa Nutrient Research Center Iowa State University





Nitrate-N Practice Performance – Iowa Science Assessment



*MRTN - Maximum Return to Nitrogen Application Rate from Corn Nitrogen Rate Calculator (http://cnrc.agron.iastate.edu/) ** Load reduction Error bars show standard deviation of practice performance





Phosphorus Practice Performance (Field to Stream Reduction) – Iowa Science Assessment



Error bars show standard deviation of practice performance





Level of Implementation Needed for one Nitrate-N Reduction Scenario – Iowa Science Assessment







Take Home Points

- Have a range of practices to reduce downstream nutrient export
 - Active technology development for new practices (e.g. drainage water recycling)
- Scale of implementation is large
 - Barriers to adoption are economics, cultural/social, etc.
- Some practices provide greater benefits than the land area they occupy disproportionate benefits (e.g., wetlands, buffers, saturated buffers, bioreactors)
- Needs for the future
 - Targeted practice placement
 - Diversity of land use living cover
 - Small watershed monitoring studies with practice implementation to confirm benefits
 - Look for win-win solutions (e.g., manure management, unprofitable areas)







Jane Clary Wright Water Engineers







International Stormwater BMP Database: Agricultural BMP Database Development









engineers | scientists | innovators

Panelist: Jane Clary, Wright Water Engineers, Denver, CO





Overview of BMP Database www.bmpdatabase.org





- Goal: Future Analysis Similar to Urban Stormwater BMP Database
- Urban BMP Database widely used by municipal stormwater managers to support design, set realistic performance goals, support modeling efforts, etc.
- Pollutant trading/crediting documentation



BMP	Study & Sample Count (% ND)		Interquartile Range (25 th – 75 th %tiles)		Median (95% Conf. Interval)*		In vs
Category	In	Out	In	Out	In	Out	Out**
Detention	43; 542	44; 577	0.138 -	0.107 -	0.250	0.186	• • •
Basin	(1.5%)	(1.7%)	0.428	0.320	(0.216; 0.262)	(0.170; 0.200)	
Retention	71; 1161	75; 1138	0.0996 -	0.0500 -	0.246	0.120	
Pond	(0.9%)	(2.0%)	0.542	0.263	(0.220; 0.268)	(0.104; 0.129)	•••
Wetland	27; 690	27; 647	0.106 -	0.0660 -	0.170	0.122	
Basin	(0.3%)	(1.4%)	0.319	0.222	(0.151; 0.177)	(0.108; 0.133)	•••
Wetland	15; 256	13; 214	0.129 -	0.120 -	0.201	0.184	♦♦▼
Channel	(0.4%)	(0.0%)	0.372	0.338	(0.179; 0.230)	(0.160; 0.207)	
Grass Swale	34; 574	39; 671	0.0700 -	0.104 -	0.129	0.180	
	(0.3%)	(0.3%)	0.270	0.300	(0.118; 0.140)	(0.165; 0.190)	
Grass Strip	50; 893	50; 666	0.0800 -	0.120 -	0.185	0.230	
	(8.2%)	(3.2%)	0.300	0.460	(0.160; 0.190)	(0.206; 0.240)	
Bioretention	47; 850	44; 667	0.0800 -	0.0900 -	0.190	0.240	♦\
	(4.8%)	(3.1%)	0.460	0.553	(0.170; 0.210)	(0.190; 0.270)	
Media Filter	32; 494	35; 525	0.0900 -	0.0490 -	0.165	0.0900	• • •
	(1.4%)	(5.1%)	0.285	0.147	(0.150; 0.180)	(0.0800; 0.0973)	
HRBF	6; 100	6; 100	0.0640 -	0.0377 -	0.0990	0.0500	• • •
	(0.0%)	(8.0%)	0.157	0.0848	(0.0854; 0.112)	(0.0409; 0.0600)	
HRMF	19; 349	19; 351	0.0680 -	0.0496 -	0.120	0.0800	• • •
	(1.7%)	(3.1%)	0.500	0.277	(0.100; 0.130)	(0.0703; 0.0900)	
HDS	23; 338	23; 303	0.117 -	0.102 -	0.230	0.176	♦▼▼
	(0.3%)	(1.7%)	0.474	0.370	(0.198; 0.268)	(0.150; 0.197)	
OGS	10; 170	10; 138	0.0815 -	0.0367 -	0.316	0.115	♦▼▼
	(4.7%)	(10.9%)	0.691	0.530	(0.206; 0.428)	(0.0700; 0.213)	
PFC		6; 124	NLA	0.0380 -	NIA	0.0625	NA
	NA	(0.0%)	NA	0.100	NA	(0.0500; 0.0745)	
Porous	13; 447	21; 365	0.110 -	0.0700 -	0.170	0.100	• • •
Pavement	(0.9%)	(1.4%)	0.360	0.194	(0.150; 0.180)	(0.0980; 0.112)	

*Confidence interval about the median computed using the BCa bootstrap method described by Efron and Tibishirani (1993). ** Each symbol represents an influent/effluent comparison test. Left position compares overlap of 95% confidence intervals around influent/effluent medians. Middle position compares Mann-Whitney rank-sum hypothesis test P-value to a significance value of 0.05. Right position compares Wilcoxon signed-rank hypothesis test P-value to a significance value of 0.05. % ND

percentage of non-detects

not available or less than 3 studies for BMP/constituent NA

- \diamond influent/effluent comparison test indicates no significant difference in concentrations
- ▼ influent/effluent comparison test indicates significant reduction in concentrations
- influent/effluent comparison test indicates significant increase in concentrations Δ



AgBMPDB Project Components

- User's Guide with Reporting Protocols
- Data entry spreadsheets in Excel
- Microsoft Access Database
- Biennial data summary updates
- Future: on-line analysis tools
- Publicly Accessible Project website: <u>http://www.bmpdatabase.org/agBMP.html</u>



2020 12-page Summary Here: https://www.waterrf.org/research/projects/2020update-agricultural-best-management-practicesdatabase

Water

Research



Conservation Practice Categories

• Many practice types accepted, representative examples in AgBMPDB include:

	In-Field	In-Field	Edge-of-Field	
	Management Practice	Constructed Practices	Treatment Practices	
Example practices	Nutrient management	 Grassed waterways 	 Buffer strips 	
within category	Tillage	 Tile drains/controlled 	Constructed wetlands	
	Cover crops	drainage	Wood-chip bioreactors	
	 Crop rotations 	Terraces		
Functional	These practices promote	These practices alter the	These practices create a	
description	soil health and reduce	transport of water and can	zone for pollutant removal	
	loss of nutrients and soil.	reduce erosional forces.	before water exits the	
			agroecosystem.	





2019 AgBMPDB (V. 3)

- ~100 studies with ~400 fields/plots
- Mostly corn & soybean crops
- 24 states and >12 in Canada
- Performance results for a variety of in-field and edge-of-field practices are encouraging in terms of reducing nutrient and sediment concentrations and loads from row crops.







AgBMPDB Structure: Importance of Metadata

Lessons Learned:

 Ag studies are complicated!

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- Cost data often not reported in literature with performance studies
- Yields more likely to be reported (but not always)
- Producers want to know return on investment




Challenges of Evaluating Ag BMP Performance

- Site-specific conditions
- Complex temporal and spatial variables (e.g., nutrient management consists of many variables such as nutrient source, application rate, timing and method of application, and cropping history)
- Combinations of multiple practices that often have overlapping or related effects
- Synergies and tradeoffs related to how practices affect various nutrients (e.g., decreased nitrogen losses, but increased phosphorus losses)*
- Lag-phase in effectiveness of some practices*
- Geographically varied water quality challenges (e.g., West: irrigation management is key; Midwest: drainage water management is key)
- Weather's "random noise" in observed data about changes in nutrients losses from BMPs*

*Source: Sharpley, A., Helmers, M., Kleinman, P., King, K., Leytem, A., and Nelson, N. 2019. Managing crop nutrients to achieve water quality goals, *Journal of Soil and Water Conservation*, 79(5): 91-101.







Emmanuel Deleon, Colorado State University

Example Findings from Statistical Analysis of AgBMPDB

AgBMPDB demonstrates alignment between real-world BMP performance and expectations presented in the literature such as:

- No-till and conservation tillage: reductions in surface runoff sediment loads and subsurface nitrate concentrations compared to conventional tillage.
- Nutrient management practices: reductions in surface runoff phosphorus and subsurface nitrate loads.
- Buffer strips: high reductions TSS concentrations and loads.
- Cover crops: reductions in subsurface nitrate loads.

Statistic	Sediment Concentration (mg/L)			Sediment Load (kg/ha)		
	Convential Tillage (CN)	Conservation Tillage (CT)	No-Till (NT)	Convential Tillage (CN)	Conservation Tillage (CT)	No-Till (NT)
Nbr. of observations	1	6	9	7	8	14
Minimum	683	149	169	311	190	111
Maximum	683	1435	395	6598	2600	1162
Median	683	261	248	1350	310	341
Mean	683	465	270	1990	767	445

Note: only one study reported sediment concentrations for conventional tillage in this data set.







Next Steps

- 1. Continue to populate the database with traditional and innovative practices.
- 2. Online data retrieval tools (similar to Urban BMP Database tools)
- 3. Outreach (moving beyond "proof of concept" stage)
- 4. Promote robust reporting of site metadata, crop yield, and cost data.
- 5. Secure additional project sponsors and partners.







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Practices Panel Discussion





Live Audience Polling Questions (Facilitator: Dave Clark)

- Q1: What's the biggest impediment to progress in reducing nutrients in watersheds?
- Q2: How do Wastewater/Stormwater Utilities and Agriculture Sector better organize and coordinate for nutrient management? Select all that apply.
- Q3: What research can help address needs and knowledge gaps related to advancing holistic nutrient management? Select all that apply.





Panel on Policies:

Working Together to Achieve Multiple Benefits and Watershed Optimization



Trent Stober HDR



Paul Kent Stafford Rosenbaum LLP



Errin Kemper

City of Springfield, MO



Adam Schnieders Iowa Department of Natural Resources







Trent Stober, PE HDR





Innovative Policies to Overcome Impediments to Nutrient Reduction Progress



Integrated Planning





Water Quality Trading



TMDL & Listing Alternatives



Innovative State Approaches





Paul Kent Stafford Rosenbaum LLP





Panel: Policies – Working Together to Achieve Multiple Benefits and Watershed Optimization: Wisconsin Adaptive Management

Paul G. Kent, Partner at Stafford Rosenbaum LLP





Wisconsin Numeric Water Quality Criteria for Phosphorus in Lakes and Streams

0.075 mg/l	Most streams
0.10 mg/l	Large streams
0.015 – 0.040 mg/l	Lakes and impoundments











Yahara WINS (Watershed Improvement Network)

- The Yahara River Watershed approximately 536 square miles
- Madison Metropolitan Sewerage District
 - 50 mgd facility
 - Treatment Cost \$120 million to meet TP of 0.075 mg/l
- TMDL for the Rock River Basin -- Yahara River Watershed reduce 100,000 pounds of phosphorus per year.





Adaptive Management

- Authorized by administrative code NR 217.18, as an alternative to meeting WQBELs
- 15-20 years with end goal of meeting in-stream (not end of pipe) phosphorus TMDL targets or WQBELs.
- Provides compliance mechanism for point sources which is cheaper than advanced filtration





Yahara WINS Partnership:

Urban and Agricultural Partners

- Urban
 - 23 MS4s; 3 POTWs operate under an intergovernmental Agreement
 - The IGA provides for raising funds and disbursing them for reductions
- Agricultural
 - 3 counties and agricultural producers such as Yahara Pride Farms.
 - Service agreements





Coordination with County Projects

Dane County Multi-year "suck the muck project."







Progress to Date







WPDES Permit Compliance

- MMSD Permit Compliance Schedule for 2035:
 - "Compliance may be demonstrated using effluent data and watershed modeling that uses similar assumptions as the TMDL to demonstrate that the sum total of the allocations have been achieved for each reach."
 - "If the allocations in the TMDL have been achieved but the applicable phosphorus water quality criterion ...has not been achieved in the reach for MMSD's outfall to Badfish Creek, ... further evaluation and additional actions will be necessary in the next reissued permit as necessary to achieve phosphorus water quality criterion."







Errin Kemper City of Springfield, MO





Springfield - Greene County, Missouri Integrated Plan for the Environment













Invest in what matters most to our community...

while addressing the most significant problems...

using the most effective solutions...

in a way that is affordable to our citizens.







Lessons learned:





CAPTURE OUR COMMUNITY'S PRIORITIES



Tier 2

- · Reduction in health related air quality issues
- · Protected fish and other aquatic life
- Streams or lakes that are clean enough to swim in
- Attainment of air quality standards to attract and retain businesses

Tier 4

- · Fish are safe to eat
- Streams and lakes clean enough to boat and wade in
- Aesthetic beauty of our lakes and streams

Community's #1 Priority: Drinking Water Protection

Tier 1

· Clean and healthy drinking water supply

Tier 3

- Reduction in greenhouse gas emissions
- Reduction of air quality impacts on food supply

Clean water from streams and lakes for crop irrigation, livestock and wildlife watering





IDENTIFY & PRIORITIZE THE MOST SIGNIFICANT PROBLEMS

Pollution Sources















Partnership Opportunities:

- City of Springfield
- City Utilities
- Greene County
- USDA
- Watershed Committee of the Ozarks
- James River Basin Partnership
- Mo Dept of Natural Resources
- Mo Dept of Conservation

Water Environment

he water quality people'

Federation



Putting the Puzzle Together:

- Nutrient Trading Framework
- Partner Communication
- Data Gaps





Adam Schnieders Iowa Department of Natural Resources





Holistic Approach to Improved Nutrient Management: Experience, Challenges, and Success in Agriculture and Urban Partnerships

Adam Schnieders, Water Quality Resource Coordinator at Iowa DNR





Panel: Policies – Working Together to Achieve Multiple Benefits and Watershed Optimization











Begin with the end in mind...

















Different Playbooks Available







IOWA NUTRIENT REDUCTION EXCHANGE

• Utilize Motivations

• Environmental benefits, flood mitigation, source water protection, economic development, habitat development, nutrient reduction, increased production

Track Multi-Benefit Investments

• RIBITS

Provide Incentives for Investment

• Exploring improved ratios, environmental excellence, longer term schedules, etc.

• Data Points

• Watershed, permit number, project name, funding source, practice type, install data, term of practice (years), type of credits generated (N, P, sediment, etc.), credit calculation method, verifying entity, monitoring, pollutant reductions, ancillary benefits













MOU – Memorandum of Understanding

Outline of MoU – what does it do?

- Lays out foundation for agreement
- Sets the goal regulatory certainty
- Enables the mechanism to engage in watershed work as part of NPDES permit compliance
- Allows credit for past voluntary work





Progress and Barriers

Progress

- More Ag/Urban Partnerships Cedar Rapids, Dubuque, and more
- Regulatory certainty coupled with a voluntary approach resulting proactive actions by utilities

Barriers (or next areas to tackle)

- Staffing and expertise both City and State
- Accommodating innovations in
 - Process
 - Incentives
 - Database
 - Regulatory placement
 - Models
 - Financing





Policies Panel Discussion





Questions and Answers

Holistic Approach to Improved Nutrient Management: Experience, Challenges, and Success in Agriculture and Urban Partnerships





Thank You



