Monitoring Methods Used to Improve Agricultural Conservation Practice Evaluations at the Edge-of-Field Scale

US Geological Survey
Wisconsin Water Science Center
Matt Komiskey

USDA Natural Resources Conservation Service
Acting Great Lakes Restoration Initiative Coordinator
Lisa Duriancik

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Executive Summary

• Phosphorus reduction in the Great Lakes is the current focus to reduce nearshore lake eutrophication and harmful algal blooms

• Multi-agency partnerships formed during GLRI to evaluate successes of voluntary, producer-based efforts

• Tiered monitoring and modeling is necessary to address complex processes at various scales

• Incorporation of monitoring efforts into the conservation programs and producer discussion are essential for the adaptive management of the conservation systems
Priority Watersheds

Lower Fox River
Saginaw River
Genesee River
Maumee River
Priority Watersheds
Monitoring Scale – Streams to Field Edge


Scientific Investigations Report
U.S. Department of the Interior
U.S. Geological Survey

Evaluation of Barnyard Best Management Practices in Wisconsin using Upstream-Downstream Monitoring
by Todd D. Sturdevant

Introduction

The Designated Nutrient Water Pollution Abatement Program was enacted in 1975 by the Wisconsin Legislature. The goal of the program is to identify and address the water quality of lakes, streams, wetlands, and ground water within selected priority areas, remediated by controlling sources of point pollution. For each selected watershed, the Wisconsin Department of Natural Resources develops a management plan that addresses the implementation of pollution control strategies known as Best Management Practices (BMP). BMPs use water resource and land-use interventions, describes the results of pollution control modeling, and considerations of land use, water quality, and other related factors. The U.S. Geological Survey, through a cooperative effort with the Wisconsin Department of Natural Resources, is evaluating water quality improvements resulting from the implementation of BMPs. The data collected are then compared to the watershed plans to assess progress and determine whether goals are being met.

Data Collection

The sampling stations were established at each stream (Fig. 1). One station is upstream from a barnyard management site and the other station is downstream from that same barnyard. The barnyard management site was identified by each watershed plan as a critical watershed area based on land use, proximity to the stream, and knowledge of actual flow characteristics.

Upstream Creek is within the Elkhorn River Priority Watershed. It drains into Lake Michigan, a waterbodies of Wisconsin (Fig. 1). The downstream site of Ulver Creek is in a U.S. area with the same characteristics, and both are in the watershed of Lake Michigan. The upstream and downstream sampling stations are not adjacent to Ulver Creek. The upstream and downstream water samples were collected at Ulver Creek in March 1994. Water samples are collected with a refrigerated water-quality sampler that is activated by the rise and fall of water levels.

Scanning Prairie Creek is within the Black Earth Creek Priority Watershed, 20 miles southwest of Madison, in a rural area (Fig. 1). The sampling site along Scanning Prairie Creek is in a U.S. area with the same characteristics, and few are in the watershed of 15 percent agricultural (Fig. 2). Upstream and downstream sampling stations are not adjacent to Scanning Prairie Creek. Scanning Prairie Creek is a tributary of Black Earth Creek. The upstream and downstream sampling stations were established at Scanning Prairie Creek in April 1992. The upstream sampling station continuously monitors stream discharge and water quality. The downstream station is run by the water samples only.

Upstream-downstream sampling stations have the inherent potential for upstream smoking events to mask the effects of the streamwater. Agricultural and individual runoff are often week compared to the cumulative impact of up

Great Lakes RESTORATION
What is EOF Monitoring?

- Small Ag basins
- Concentrated flow
- Year-round - natural rainfall/snowmelt
- Surface and/or Tile
Why do EOF Monitoring?

- Better understanding of sources
- Effects of practices, field activities
- Improved models
- Shorter study duration
- Producer involvement
USGS EOF Monitoring History

• Projects since 2001:
  – Pioneer Farm (2001 – 2011) 13 Sites
  – Discovery Farms (2003 – ongoing) 36 Sites
    • Currently 11 EOF
  – Mississippi River Basin Initiative (2012 – 2014) 3 Sites
    • 2 EOF, 1 Tile
  – W. Branch Milwaukee River (2012 – 2015) 3 Sites
  – GLRI (2012 – ongoing) 22 Sites
    • Currently 14 EOF, 8 Tile

• 60+ EOF Surface Water Sites
  – > 250 site-years of record

• 16 Subsurface Tile Sites
  – > 50 site-years of record
Not Your “Traditional” Sites

- Each site is custom to fit location and study objectives
- Need to minimize disturbance to agricultural activities
- Need Flexibility
- Depending on site conditions, limited number of events
- Directly impacted by field treatments
- Variable concentrations during events
Equipment

Measure the quantity and quality of water leaving agricultural sites (edges-of-fields, streams and tiles)
Typical Monitoring Station

- Datalogger
- Stage sensor
- Refrigerated Autosampler
- Power Source(s)
- Communication
- Time-lapse camera

- ~$20-$25K per station depending on power needs
Challenges
Turning Data into Information

• Collecting the data is only one step
Turning Data into Information

- Evaluation of a BMP
- Defining the impact of agricultural practices
- Calibration/validation data for models
Beyond Change Detection

- Education
- Producer Involvement
- Partnership building
- Model calibration
Advancing Science and Improving Conservation

Producer Meetings + Conservation Tours

Public Policy Research
“People here in the United States – and in many other countries – are learning that we must have soil conservation if we are to have continuous, abundant agricultural production. We are fast learning, too, that it must be effective conservation…”

Who Needs Data and Why?

Producers, farm managers, advisors
• Feedback on particular practices, concerns
• Support adaptive management, conservation planning

Conservationists, watershed planners, managers
• Identify constituents of concern and sources
• Track implementation of watershed plan or conservation needs/plan
• GIS approaches
• Watershed monitoring for outcomes

Program Managers
• Is current design achieving or addressing expectations? Yes or why?
• Adjust program design or implementation
• Enhance projects and evaluation criteria

Agencies, scientists
Research – understanding
Official reporting
Accountability
Different scales of reporting expectations
• National/large regional
• Small watershed with implementation
• Value of benchmarks

Map from Phil Heilman, USDA ARS
Water Quality Monitoring Is a Tool

CANNOT

• Conduct watershed planning
• Determine appropriate conservation practices
• Determine critical source areas
• Identify watershed farmers’ attitudes toward conservation practices
• Maintain conservation practice
• Provide economic and technical assistance

CAN

• Help Identifying pollutant(s) of concern, sources, and hydrologic transport
• Help identify conservation practice effectiveness
• Inform future management decisions
• Provide information for outreach and adaptive management

Photo by Deanna Osmond, Rock Creek CEAP, 20
How Can NRCS Use EOF Data?

- Conservation Planning
  - Practice effectiveness (need under a range of conditions)
  - Practice interactions and systems, where we can test that, at field scale
- Practice Standards
- Modeling
  - algorithm development
  - need a range of weather, soils, hydrologic conditions
  - calibration, validation

Photo by Lisa Duriancik. EOF monitoring in Indiana.
How Can NRCS Use Watershed Data?

- Primary constituents, sources and flow paths for planning
- Outcome reporting
  - Align with conservation implementation
  - Feedback into watershed conservation plan
- Explanatory variables
  - Why or why not?
  - Be explicit about conclusions
    - Articulate the nuances
    - EOF within helps
- Modeling to help understand and attribute effects
  - Combined approach often necessary

Upper Big Walnut Creek ARS CEAP Watershed, OH

King, Kevin W., et al. 2014. JEQ.
Considerations for Greater Utility of Water Quality Monitoring Data

<table>
<thead>
<tr>
<th>Comprehensive scales and watershed designs more useful</th>
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<tr>
<td>• EOF, within watershed and at watershed outlet</td>
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<tr>
<td>• Combine locations regionally</td>
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<td>• Model to evaluate broader effects</td>
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<th>Synthesize lessons learned</th>
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<tr>
<td>• Implications of water quality changes and impacts</td>
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<td>• Share learning with stakeholders</td>
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<td>• Guide future decisions and strategies beyond actions</td>
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<td>• Inform outcome assessment strategies, approaches</td>
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The 3 Cs: COORDINATE, COLLABORATE, COMMUNICATE

- Coordinated monitoring
- Collaborative planning and implementation
- Communicating results and impacts