Improving the MN River: The BMP CHALLENGE™ & Water Quality Credit Trading

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THE MINNESOTA RIVER WATERSHED

- All or portions of 38 MN counties
- 13 major watershed management units
- ~92% in agriculture
- >15,000 miles$^2$ in MN, IA, ND, & SD
- 335 miles of flow
- Increases MS River flow by 50%
- Nutrient Issues?
  - Impairments!
THE MINNESOTA RIVER WATERSHED

Nutrient Impairments – Phosphorous Flow-weighted Mean Concentrations (mg/L)

EPA Desired Goal = 0.1 mg/L
Algal Reduction = 0.26 mg/l
THE MINNESOTA RIVER WATERSHED

Nutrient Impairments – Nitrates
Flow-weighted Mean Concentrations (mg/L)

Drinking Water Standard = 10 mg/L
Proposed EPA Limits Much Lower
THE MINNESOTA RIVER WATERSHED
Who do we impact?

- **Impacts – Phosphorous**
  - Drinking water quality – health/economics
  - Freshwater eutrophication
  - Toxic algae blooms
  - Loss of recreational value
  - Impairments – e.g., lower MN River DO
  - Tied to sediment issues (e.g., Lake Pepin)

- **Impacts – Nitrogen**
  - Drinking water quality – health/economics
  - Blue Baby Syndrome
  - Potential link to some cancers/birth defects
  - Weight gain suppression in livestock
  - Saltwater eutrophication
  - Impairments – e.g., Gulf of Mexico hypoxia
THE MINNESOTA RIVER WATERSHED
Who do we impact?

- ~1% of the Mississippi River Watershed
- IATP estimated
  Upper MS basin
  ~50% NO₃
- USGS estimated
  MN ~6-9% NO₃
- Up to 8,000 miles²
THE MINNESOTA RIVER WATERSHED
What Needs to be Done?

- EPA – 40% reduction in nitrate-nitrogen
- Voluntary measures FIRST
  - Program Support (nutrient trading, BMPs)
- Mandated measures IF NECESSARY
  - Farm Bill requirements
  - Clean Water Act enforcement
  - TMDL
THE MINNESOTA RIVER WATERSHED
Progress is being made.....

- State Funded BMPs include
  - Residue Management - 52,768 Acres
  - Nutrient Management - 26,977 Acres
  - Conservation Crop Rotation - 15,527 Acres
  - Critical or Sensitive Area Protection - 2,717 Acres
  - Wetland Restoration - 1,134 Acres
  - >227 miles - drainage, buffer, & windbreak improvements
THE MINNESOTA RIVER WATERSHED
Opportunities for improvement…..

- Alternative Crops – cellulosic ethanol production
- Certified Crop Consultants – expertise
  - Field-specific applications
  - Soil Testing
  - Prudent manure mgmt
  - Crop rotations
  - Application timing
- Nutrient Trading
  - Credit Trading (Point-Point trading)
  - Future for Non-Point – Point Trades?
- Nutrient application reduction demonstrations
  - BMP Challenge
  - Minnesota Nutrient Management Initiative
Water Quality Credit Trading 101

Improving Conservation & Agricultural Economics with Water Quality Credit Trading

Prepared by:
James Klang, P.E., Senior Project Engineer
and Laurence Picq, Project Scientist
Learning Objectives

- How Does It Work?
- What is the Value?
- How does it Pay?
Water Quality Credit Trading

- Uses a **Watershed Approach**

- Wastewater treatment plants achieve a minimum level of performance before being allowed to trade

- Allows flexibility and cost savings

- Provides greater WQ protection than conventional wastewater treatment alone
Watershed Approach

- Most effective & comprehensive water quality method
  - Builds a broad-based community understanding
  - Community-developed goals
  - Applies many tools to solve water quality concerns

- **Nutrients and sediments** are two significant concerns affecting water bodies:
  - Loading from many sources (cumulative WQ impacts)
  - Persistent in the environment: transported throughout the watershed with little or no chemical/physical losses
  - Diminished aesthetics, recreation and fisheries
<table>
<thead>
<tr>
<th>Benefits with Trading</th>
<th>Treatment Plant Upgrades</th>
<th>Agricultural Management Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollutant of concern reduced</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Other pollutants reduced</td>
<td>Maybe</td>
<td>Yes</td>
</tr>
<tr>
<td>Habitat improved</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Canopy enhanced</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Streambanks stabilized</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Flow velocity decreased</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Wetlands created</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Floodplains preserved</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Assimilative capacity increased</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Water Quality Trading
How does it work?

Case Example:
- Municipal wastewater treatment plant
- Minimum treatment levels:
  - 25 mg/l Carbonaceous Biochemical Oxygen (CBOD) Demand
  - 30 mg/l Total Suspended Solids (TSS)
  - 1 mg/l Total Phosphorus (TP) (all new or upgrading plants)
Wastewater Minimum Requirements

Carbonaceous Biochemical Oxygen Demand (mg/l)

CBOD 5 (mg/l)

0 25 50 75 100 125 150 175 200

Raw Secondary TMDL

Must Treat

Tradable
Minimum Wastewater Requirements (existing discharges)

Total Phosphorus (mg/l)

- Raw
- Secondary
- TMDL

<table>
<thead>
<tr>
<th>TP (mg/l)</th>
<th>Raw</th>
<th>Secondary</th>
<th>TMDL</th>
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<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
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<td></td>
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<tr>
<td>3</td>
<td></td>
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<td>4</td>
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<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Must Treat**

**Tradable**
Minimum Wastewater Treatment Requirements

Total Phosphorus (mg/l)

- **Raw**
- **Past Standard**
- **TMDL**

**Must Treat**

**Tradable = 0**
Water Quality Credit Trading is:

1. One of the tools used in the watershed management approach to achieve water quality goals efficiently.

2. Not available for every watershed. The type of impairment, pollutants of concern and presence of potential buyers and sellers all must fit for WQT.

From EPA 2004 Water Quality Trading Assessment Handbook
Potentially Tradable Pollutants

Pollutants that:
- come from both point and nonpoint sources
- tend to be transported through stream network without assimilation
- have a water-quality based effluent limit

For agriculture, most commonly traded pollutants: Phosphorus, Sediment, Nitrogen

In some watersheds, physical variables are also being traded: flows, temperature

*Lethal toxins and bioaccumulation pollutants (such as mercury) are typically NOT traded*
What is a Credit?

The Trading Currency
Surplus Pollutant Reductions = “Credits”
(Unit of mass over a period of time; for example Pounds/year)

1) **Real:** Actual non-point source reduction is made to generate a credit that can be traded

2) **Surplus:** Load reduction is greater than required by permit and/or TMDL allocation goals

3) **Quantifiable:** Load reduction can be measured or calculated by a standard method/equation

4) **Watershed-based:** Credits can only be produced and traded within the same, pre-defined watershed

5) **Net improvement (trading ratio):** Trading ratio must be greater than 1:1 (accounts for uncertainty, provides net water quality benefit)
How do you generate credits?

Farmer achieves baseline performance *prior* to generating a credit

- Must meet TMDL allocation goals first
- Watersheds without TMDL goals:
  - Policy formation for minimum baseline
  - Rule may require minimum baseline
  - History may set minimum baseline
  - Local program authority should set the baseline
What is the credit value?

- Market-driven
- Price can reflect actual cost to generate credit
- “Credits” exchanged with a Trading Ratio (e.g., Buyer purchases 20 pounds of TP to offset 10 pounds of permitted discharge)
- Demand driven (TMDL or other obligation)
- What the buyer (WWTP) is willing to pay
### WWTP Treatment Costs

<table>
<thead>
<tr>
<th>Wastewater Treatment</th>
<th>Size (Million Gallons/Day)</th>
<th>Type of Treatment Typically Applied</th>
<th>Treatment Costs ($/lb P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Lake</td>
<td>55</td>
<td>Continuous</td>
<td>$0.20</td>
</tr>
<tr>
<td>Mankato</td>
<td>10</td>
<td>Continuous</td>
<td>$2.00</td>
</tr>
<tr>
<td>Industrial</td>
<td>1.5</td>
<td>Continuous</td>
<td>$14-$18</td>
</tr>
<tr>
<td>Mid Size Rural</td>
<td>0.2</td>
<td>Continuous</td>
<td>$5-$18</td>
</tr>
<tr>
<td>Small Rural</td>
<td>0.05</td>
<td>Ponds</td>
<td>$60</td>
</tr>
<tr>
<td>Trading Program Location</td>
<td>Buyer Treatment Costs ($/lb TP)</td>
<td>Ag Credit Price Range ($/lb TP)</td>
<td>Average Credit Price ($/lb TP)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------------</td>
<td>--------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Michigan</td>
<td>292</td>
<td>3 – 652</td>
<td>--</td>
</tr>
<tr>
<td>Ohio</td>
<td>23.37</td>
<td>1 – 12</td>
<td>1.50</td>
</tr>
<tr>
<td>PA</td>
<td>30 - 3,000</td>
<td>6 – 113</td>
<td>9.27</td>
</tr>
<tr>
<td>Ontario</td>
<td>775</td>
<td>156</td>
<td>--</td>
</tr>
<tr>
<td>Minnesota</td>
<td>0.2-60</td>
<td>3-24</td>
<td>--</td>
</tr>
</tbody>
</table>
What are the contractual terms?

- Farmer signs a legally binding contract with WWTP
  - Description of BMP
  - Life of contract
  - Payment schedule
  - BMP Operation & Maintenance requirements
- Contract is NOT a permit
- Civil contract
Trading Program Participation
(assuming baselines are met)

- **Step 1** – Farmer selects an approved trading BMP(s) from their conservation plan or a crop consultant and estimates pollutant load reduction using standard calculation method such as RUSLE2 (a NRCS soil erosion model).

- **Step 2** - Farmer installs new BMP(s) and calculates credits using approved crediting methods.

- **Step 3** – Farmer connects with a credit buyer via an aggregator, broker or individual contact, and signs private contract to provide credits.

- **Step 4** – Buyer applies “Trading Ratio” to his reduction needs to determine volume of credits needed from farmer.

- **Step 5** – Buyer or seller registers credits with the state regulatory agency (MPCA, or third party).
MZ Point Source-Nonpoint Source Trading

SMBSC Facility

Dissolved Oxygen Impaired Reach

Rahr Malting Facility
Goal: Malt producer wanted to expand by operating its own wastewater treatment plant.

Issues:
- Minnesota River waste load allocation for CBOD fully allocated to other dischargers.
- Previously high sanitary sewer fees forced Rahr towards other options.

Solution: Point source/non-point source permit trade. Trades with agriculture offset Rahr’s CBOD loading by reducing several parameters causing WQ problems in river upstream of facility.
Rahr Malting: 8 Mile Creek

Rahr installed four erosion control sites:

8 Mile Creek – Channel stabilization, livestock exclusion
Results:
- Discharge of up to 150 lbs CBOD/day
- 212 lbs of CBOD reductions/ year from erosion control sites
Southern MN Beet Sugar Co-op

- **Goal:** Cooperative wanted to expand but faced air & water quality compliance issues

- **Issues:**
  - Expanded wastewater discharge difficult to obtain because of Minnesota River D.O. problems
  - Prohibitive costs for expanding spray irrigation treatment process

- **Solution:** Point Source/Non-point Source trade:
  - Allows continuous discharge of treated wastewater
  - Requires 2.6 times TP offset reductions from upstream NPS
Spring Cover Crops

58,832 acres planted in 2005
West Fork Beaver Creek

Results:
- Trading requirements exceeded
- West Fork Beaver Creek: channel stabilization, livestock exclusion
- Spring cover crop contracts with shareholders over 50,000 acres.
Common Questions

Can conservation practices I’ve implemented in the past be used to generate credits?
Will Depend on MPCA Rules and Guidance.

What is the life of my credits and what are they worth?
Annually renewable/saleable for the life of the practice with a value that is market driven.

If I sell credits, will I eventually be regulated?
No. But credits are used by someone who is regulated.

What happens if I default on implementing my practices?
You may have liability within your contract and MN rules.

Who could buy my credits?
Any regulated facility within your watershed.
The BMP Challenge - Goals

- The “Input Paradox”

- BMP Challenge
  - Eligibility and Requirements
  - Application
  - Check Strips
  - Yield Assessment
  - Net Returns Analysis and Examples

- Past Results
Input paradox?

EPA, National Academy of Sciences and more than 20 other studies identify ECONOMIC RISK as a major barrier to BMP adoption.

“We’ve used a crop consultant in the past...

...if he’s wrong, the cost of him being wrong is much more than the cost of that additional insecticide or herbicide.”
“EXTRA” is a Rational Defense Against Economic Uncertainty!

- Nutrient mgmt is an uncertain science - 1.2# N/bu no longer

- Nutrients may be lost if heavy spring rains occur

- Bumper crop conditions may call for more nutrients

- Minn. corn farmers apply an avg. of 43# extra N after legume; 69# after legume and manure
2005 corn farmer survey

- 700 farmers, each planting 850 acres/year on average
- Progress in some areas
  - 54% have reduced fertilizer over past five years, 18% by 15% or more
- Enormous potential for practice adoption
  - 16% do not credit N from soybeans
  - 25% do not credit nutrients in manure
  - 67% do not use variable rate
  - 88% do not use in-season testing/application
2005 corn farmer survey

- 46% want to see proof before changing practices
- 80% would be interested in reducing fertilizer rates if income were guaranteed
BMP CHALLENGE

- How will BMPs perform in my field?
- Risk-free opportunity to find out.
Who can participate?

- Owner/operators must be NRCS EQIP-eligible
  - not exceeding the $450,000 Payment Limitation (during term of Farm Bill)
  - not exceeding the Adjusted Gross Income provision (2.5 million per year)
  - complying with the Highly Erodible Land (HEL) and Wetlands Conservation provisions.
- Grow corn for grain or silage
  - sweet corn, popcorn, wildlife plots ineligible
- Certified crop advisor must certify BMP, set out check strip and oversee yield assessment
A simple application is required

Information required prior to planting:

- Farmer contact information
- Certified advisor contact info, certification, certification number
- Field information: location, yield history, soil test results (if covering P and K), yield goal, BMP information (including recommended rate and amount applied), or reduced tillage practice
- Check strip information: N, P and K rates or conventional tillage practice, location, how marked, aerial photo
Setting out check strips

- **When:** Prior to fertilizer application or tillage.
- **Who:** Certified crop advisor (CCA, NAICC or Agflex approval) must set out check strip.
- **Where:** Representative location within one or more fields in the management unit.
- **What:** 40’ to 80’ wide (depending on equipment width) and running the length of the field.
Assessing yield at harvest

- **When:** After crop maturity (black layer)
- **Who:** Certified Crop Advisor
- **Where:** Check strips and adjacent BMP strips
- **How:** Weigh wagon, portable scale, stationary scale, yield monitor
Net returns: The bottom line

- Calculate gross returns for check strip and BMP strips using RMA-APH corn price ($3.50 in 2007, $? in 2008)
- Subtract fertilizer or tillage costs from gross returns to calculate net returns
- If net returns to BMP are negative, farmer receives guarantee payment equal to the difference
- If net returns to BMP are positive, farmer contributes 1/3 of savings back to BMP Challenge program, up to a maximum of $6 per acre
### Example from 2006: N only

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>BMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nutrients</td>
<td>140# N</td>
<td>92# N</td>
</tr>
<tr>
<td>Fertilizer Cost</td>
<td>$51.80</td>
<td>$34.04</td>
</tr>
<tr>
<td>Planning Cost</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Savings</td>
<td></td>
<td>$17.76/acre, 48# N</td>
</tr>
<tr>
<td>Yield</td>
<td>164 bu/acre</td>
<td>169 bu/acre</td>
</tr>
<tr>
<td>Value ($2.20/bu)</td>
<td>$360.80</td>
<td>$371.80</td>
</tr>
<tr>
<td>Yield Gain (loss)</td>
<td></td>
<td>$11.00/acre</td>
</tr>
<tr>
<td>Guarantee payment</td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>Farmer contribution</td>
<td>$5.88 per acre (1/3 of $17.76)</td>
<td></td>
</tr>
<tr>
<td>FARMER NET</td>
<td>$22.88 per acre (17.76+11-5.88)</td>
<td></td>
</tr>
<tr>
<td>27 acre field</td>
<td></td>
<td>$617.76</td>
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</table>
## Example from 2006: N only

<table>
<thead>
<tr>
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<th>Conventional</th>
<th>BMP</th>
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</thead>
<tbody>
<tr>
<td>Total Nutrients</td>
<td>189# N</td>
<td>133# N</td>
</tr>
<tr>
<td>Fertilizer Cost</td>
<td>$66.22</td>
<td>$50.17</td>
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<tr>
<td>Planning Cost</td>
<td>$0</td>
<td>$0</td>
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<tr>
<td>Savings</td>
<td>$16.05/acre, 56# N</td>
<td></td>
</tr>
<tr>
<td>Yield</td>
<td>156.5 bu/acre</td>
<td>146.4 bu/acre</td>
</tr>
<tr>
<td>Value ($2.20/bu)</td>
<td>$344.30</td>
<td>$322.08</td>
</tr>
<tr>
<td>Yield Gain (loss)</td>
<td>($22.22 per acre)</td>
<td></td>
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<tr>
<td>Guarantee payment</td>
<td></td>
<td>$6.17 per acre</td>
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<tr>
<td>Total payment</td>
<td></td>
<td>$215.95 (35 acres)</td>
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<tr>
<td>Farmer contribution</td>
<td></td>
<td>$0.00</td>
</tr>
<tr>
<td>FARMER NET</td>
<td></td>
<td>$344.30 per acre</td>
</tr>
</tbody>
</table>
Results 2002 - 2006

- Avg. farmer benefit from BMP: ($0.05) per acre
  - 74 replicates, 3227 acres in seven states
  - BMP rate averaged 6 bu per acre less than traditional rate, offset by over $12 per acre in fertilizer savings

- Average fertilizer savings
  - 23% or 41# N/acre
  - Over $12 per acre
BIG THANKS to:

Funders, Partners, Collaborators

Agflex ♦ Altria Group ♦ City of Decatur (IL)
Great Lakes Protection Fund
Illinois Council on Best Management Practices
Illinois Department of Agriculture
Iowa Farm Bureau Financial Services
Iowa Department of Economic Development
IPM Institute of North America ♦ Joyce Foundation
LeSueur County (MN) ♦ McKnight Foundation
Minnesota Department of Agriculture
National Fish and Wildlife Foundation
Alex C. Walker Foundation
National Foundation for IPM Education ♦ Ohio State Extension
PA Dept of Agriculture ♦ Seven Mile Creek Watershed Project
US EPA ♦ University of Wisconsin ♦ USDA CSREES
USDA Small Business Innovative Research Program
USDA Natural Resources Conservation Service
USDA Risk Management Agency
Wisconsin Department of Natural Resources

Partners Wanted!

Photos courtesy USDA ARS Image Library
www.ars.usda.gov/is/graphics/photos/

www.bmpchallenge.org