Modeling & Analysis Tools for Nonpoint Source Implementation

Theresa M. Possley Nelson, PE
Wisconsin Department of Natural Resources
Special Thanks

- **Challenge.gov Award**
  - Funded by a partnership of US Federal Agencies and other stakeholders including the White House Office of Science and Technology Policy, USEPA, USDA, NOAA, USGS, Tulane University, and the Everglades Foundation.

- Local County, UW–Extension, and WDNR
Acknowledgements

- Aaron Ruesch
- Dave Evans
- Corinne Billings
- Andrew Craig
- Amanda Minks
- Adam Freihofer
- Ann Hirekatur
Overview

- Impaired Waters & TMDLs
- Nonpoint Source Implementation & the 9 Key Elements
- Model Comparison (*break in middle*)
- DNR Web Maps & Online Data
- Healthy Watersheds Assessment
- LUNCH
- EVAAL
- *break*
- STEPL
- Discussion/Questions
Impaired Waters & TMDLs
Water quality standards are the foundation
  ◦ Designated uses & criteria

Impaired waters don’t meet water quality standards
  ◦ Assess against standards

States are required to develop list of impaired waters

Total Maximum Daily Loads (TMDLs), or cleanup plans, are developed for impaired waters

Restored waterbodies are removed from the list
Statewide Phosphorus Criteria

<table>
<thead>
<tr>
<th>Environment</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers</td>
<td>100 μg/L</td>
</tr>
<tr>
<td>Streams 1</td>
<td>75 μg/L</td>
</tr>
<tr>
<td>Reservoirs</td>
<td></td>
</tr>
<tr>
<td>• Not Stratified</td>
<td>40 μg/L</td>
</tr>
<tr>
<td>• Stratified</td>
<td>30 μg/L</td>
</tr>
<tr>
<td>Inland Lakes 2</td>
<td></td>
</tr>
<tr>
<td>Ranges from</td>
<td></td>
</tr>
<tr>
<td>15-30 μg/L</td>
<td></td>
</tr>
<tr>
<td>Great Lakes</td>
<td></td>
</tr>
<tr>
<td>• Lake Michigan</td>
<td>7 μg/L</td>
</tr>
<tr>
<td>• Lake Superior</td>
<td>5 μg/L</td>
</tr>
</tbody>
</table>

1All unidirectional flowing waters not in NR 102.06(3)(a). Excludes Ephemeral Streams.
2Excludes wetlands and lakes less than 5 acres
Listing Process

1. Preparation of listing methodology
2. Compilation of readily available data
3. Assessment of available data
4. Public notice of draft list
5. Send finalized list to EPA for approval
Impaired Waters

Legend
- 303d Listed
- 303d Proposed
- 303d Proposed

Wisconsin Department of Natural Resources
TMDLs in Wisconsin

- TMDL = Total Maximum Daily Load
- Established under the Clean Water Act
- The maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards
Current Pollutant Load

Does not meet water quality standards

Meets water quality standards

TMDL Purpose
TMDL

Each subwatershed is assessed for:

**Load Allocation**
- Runoff from the landscape
- Background

**Waste Load Allocation**
- Municipal Wastewater
- Industrial Wastewater
- Stormwater (MS4s)

**Background Load**
- Naturally occurring from wetlands, forests

**TMDL**

Load Allocation + Waste Load Allocation + Margin of Safety
TMDLs Statewide

Status of Wisconsin’s TMDLs

TMDL Status
- TMDL Development
- TMDL Approved
- County Boundary
- DNR Regional Boundary
- River Network

Notes:
1. Map reflects TMDLs for all pollutants (TSS, TP, PCBs, Hg, etc) reported in the WCINR WATERS database as of April 2013.
2. Sub-HUC12 watersheds were delineated using PRESTO.
Alternatives to TMDLs

- Environmental Accountability Projects
  - Simple and well-understood impairments
  - Flexibility
  - Goal is to remove impairment

- Examples:
  - Watershed plan developed
    - Must include EPAs 9 key elements
  - State or local regulations will address impairment
  - Superfund projects
  - Dam removals
TMDL Implementation

- **Point Sources**
  - Municipal & Industrial Wastewater
  - Municipal Stormwater
  - CAFO Production Areas

- **Nonpoint Sources**
  - Agricultural Lands

**Permit Partnership**
- County Land Conservation
- Watershed Groups
- Producers
- Point Source Dischargers
Nonpoint Source Implementation
NPS Implementation

- Overview of implementation
- 9 key element plans
- Adaptive management & water quality trading
NPS Implementation – State

- Develop & enforce rules
  - DNR, DATCP
- Develop implementation tools & strategies
- Award funding through competitive grant processes
- Work with partners
NPS Implementation – County

- Boots on the ground
  - NR151
  - Ordinances
  - Grants
  - Farmland Preservation

- Land & Water Resource Management Plans
  - Address soil erosion and water quality concerns
  - Strategies for addressing problems
  - Benchmarks
  - Update at least every 10 years
NPS Implementation – TMDL Areas

- TMDL Report
  - Includes section on implementation
  - Tends to be general

- TMDL Implementation plan
  - Include specific details on planned activities
  - Goal is to delist waters
  - Must include 9 key elements to be eligible for funding
What are 9 Key Element Plans?

- Watershed based

- Restore impaired waters by reducing nonpoint runoff sources (agriculture and urban)

- Can also be used to protect non-impaired waters

- Mimic TMDL’s – reduce nonpoint pollutant loads to levels a receiving water can assimilate and meet uses (fishable, swimmable, drinkable)

- Incorporate existing activities/plans
  - LW plans, FPP, NR 151 implementation, ordinances, grants, AWQMP
9 Key Elements

- **Identify the causes and sources** that need to be controlled to achieve pollutant load reductions
  - Maps
  - Accounting of significant sources and background levels

- **Describe management measures** that need to be implemented to achieve load reductions

- **Estimate** the load reductions expected from selected management measures
  - SNAP+, STEPL, BARNY
  - Map priority areas and practices
9 Key Elements

- Estimate amounts of technical and financial assistance, costs and authorities relied upon to implement the plan
  - Long Term Operation and maintenance of BMPs
  - Monitoring and Evaluation

- Information/education component to encourage participation and plan implementation

- **Schedule** for implementing the management measure
  - 5, 10, 15 or 20 years?
  - Include plan milestones
9 Key Elements

- **Interim, measurable milestones** to assess if plan is being implemented

- Set of criteria to determine whether load reductions are or are not being achieved over time

  If little progress, how and when will plan be revised?

- **Monitoring component** to evaluate the effectiveness of the implementation efforts over time using criteria from above
  - Integrate with schedule and milestones
Importance of 9 Element Plans

- EPA 2015 grant requirements – October 2014
- DNR Nonpoint activities funded with EPA 319 grant funds should be linked to water quality outcomes
- Focus on restoration of impaired waters via watershed based plans
- At least 50% of 319 funds must be used in 319 eligible areas
- 319 eligible area = has a plan consistent with EPA’s 9 Key Elements – DNR/EPA review
Cross-hatch = 319 eligible
Expire in 2016-2019

Pink = approved TMDLs

Pink areas will become ineligible in 2015 if they do not have a 9 element plan
Nine key element watershed plans
Implementing plans on a watershed basis to restore and protect Wisconsin's waters

Overview
Watershed plans consistent with EPA's nine key elements provide a framework for improving water quality in a holistic manner within a geographic watershed. The nine elements help assess the contributing causes and sources of nonpoint source pollution, involve key stakeholders and prioritize restoration and protection strategies to address water quality problems.

Understanding the Nine Key Elements
Development of watershed-based plans funded with Section 319 funds must be consistent with EPA's nine elements [PDF]. The elements can be used in watersheds with impaired waters or used to protect watersheds not yet impaired.

The first three elements characterize and set goals to address pollution sources. The remaining six elements determine specific resources and criteria to implement and evaluate the plan.

The nine elements can provide a structure to develop:
- land and water resource management plans [pdf]
- TMDL implementation plans
- lake management and protection plans
- river protection plans
- other watershed-based plans

Summary of the Nine Minimum Elements
A. Identify the causes and sources
B. Estimate pollutant loading into the watershed and the expected load reductions
C. Describe management measures that will achieve load reductions and targeted critical areas
D. Estimate the amounts of technical and financial assistance and the relevant authorities needed to implement the plan
E. Develop an information/education component
F. Develop a project schedule
G. Develop the interim, measurable milestones
H. Identify indicators to measure progress and make adjustments
I. Develop a monitoring component
2.6 Nine Minimum Elements to Be Included in a Watershed Plan for Impaired Waters Funded Using Incremental Section 319 Funds

Although many different components may be included in a watershed plan, EPA has identified nine key elements that are critical for achieving improvements in water quality. Go to [www.epa.gov/owow/nps/ewact.html](http://water.epa.gov/polwaste/nps/handbook_index.cfm) for a copy of the FY 2004 Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories.

EPA requires that these nine elements be addressed in watershed plans funded with incremental Clean Water Act section 319 funds and strongly recommends that they be included in all other watershed plans intended to address water quality impairments. In general, state water quality or natural resource agencies and EPA will review watershed plans that provide the basis for section 319-funded projects. Although there is no formal requirement for EPA to approve watershed plans, the plans must address the nine elements discussed below if they are developed in support of a section 319-funded project.

In many cases, state and local groups have already developed watershed plans for their rivers, lakes, streams, wetlands, estuaries, and coastal waters. If these existing plans contain the nine key elements listed below, they can be used to support section 319 work plans that contain projects extracted from the plan. If the existing plans do not address the nine elements, they can still provide a valuable framework for producing updated plans. For example, some watershed management plans contain information on hydrology, topography, soils, climate, land uses, water quality problems, and management practices needed to address water quality problems but have no quantitative analysis of current pollutant loads or load reductions that could be achieved by implementing targeted management practices. In this case, the plan could be amended by adding this information and other key elements not contained in the original plan. If separate documents support the plan and the nine elements listed below but
Welcome! Thank you for visiting our website where you’ll find resources and additional information to supplement the Watershed Planning Guide.

The guide and this website were developed for YOU. While our state (DNR) or federal (EPA) agencies are often looked to to “fix” our water quality problems, we recognize that grassroots efforts, involving local citizens with a passion for their local waterbodies, are the key to making improvements and being stewards of their water resources. This guide to watershed planning is written with the grassroots approach in mind. It offers processes, tips, lists, resources and other information to assist you in writing and implementing a watershed plan that will provide the framework for protecting or restoring local water resources.

Take some time to explore this site and the resources we’ve collected.

On this website, you’ll find links to resources to help you on your plan writing path. We’ve collected example plans that we think are well written and can serve as guides as you write your own plan. Additionally, we’ve added links to other plan writing guidance and a host of information and data sources you might tap into for information specific to your watershed.
Measuring & Tracking Progress

- National performance measures for NPS Program
  - **WQ–9** – Estimate annual load reductions of nitrogen, phosphorus, and sediment achieved by § 319 funded projects
  - **WQ–10** – Number of waterbodies primarily NPS–impaired that are partially or fully restored
  - **WQ–SP12** – Improve water quality conditions in impaired watersheds using the watershed approach
NPS Web Site

- dnr.wi.gov – keyword: nonpoint
Andrew Craig – DNR Nonpoint Source Planning Coordinator

Andrew.craig@wisconsin.gov
(608)267-7695

dnr.wi.gov – keyword: 9 key

http://dnr.wi.gov/topic/nonpoint/9keyelementplans.html
“Without a plan, there's no attack. Without attack, no victory.”

–Curtis Armstrong, *One Crazy Summer*
NPS & Point Source Partnerships

- NPS plans identify source areas opportunities for BMPs
- Point sources must reduce phosphorus to comply with permit
- Compliance options allow for partnerships
Minor operational changes to the treatment system
Construct significant new or upgraded treatment
Change industrial processes (industrial facilities)
Water quality standards variance

Water quality trading
Adaptive management
What is Trading and Adaptive Management?

- Allows point sources to take credit for phosphorus reductions made within their watershed to comply with permit requirements

- Create partnerships to achieve water quality goals in the most economically feasible manner possible

- Voluntary permit compliance option
Compliance option focusing on water quality improvements

Allows point sources to work with other sources of phosphorus in the watershed

Goal: To reduce overall phosphorus loads so that water quality criteria can be attained
Facility J has a phosphorus WQBEL equal to 0.075 mg/L.
Facility J has a phosphorus WQBEL equal to 0.075 mg/L.

The receiving water is exceeding the phosphorus criteria.
Facility J has a phosphorus WQBEL equal to 0.075 mg/L.

The receiving water is exceeding the phosphorus criteria.

A watershed plan is developed to improve water quality and reduce sources of P from:
- Barnyards
- Urban areas
- Cropland
- Natural features
- Other
Adaptive management has a 10–15 year project life

Less restrictive interim limits are included in permit instead of the restrictive WQBEL

In-stream monitoring required

Adaptive management can be rolled over into water quality trading if insufficient water quality improvements are demonstrated
A Closer Look at Water Quality Trading

- End of pipe pollutant offset
- Water quality trading is an exchange of pollutant reduction credits
- A buyer with a high pollutant control cost can purchase pollutant reduction or treatment from a willing seller
- Buyer applies credits towards compliance with a permit limit
Example:

- Facility A has a phosphorus WQBEL equal to 0.075 mg/L. They need offset 250 lbs of P/mo to comply.
Example:

- Facility A has a phosphorus WQBEL equal to 0.075 mg/L. They need offset 250 lbs of P/mo to comply.

- Facility B adds treatment to comply with their own permit limits and is able to sell 100 lbs of P/mo to Facility A.
Example:

- Facility A has a phosphorus WQBEL equal to 0.075 mg/L. They need offset 250 lbs of P/mo to comply.

- Facility B adds treatment to comply with their own permit limits and is able to sell 100 lbs of P credit/mo to Facility A.

- Facility A also works with a non-permitted urban area to implement a series of practices in the watershed to buy 150 lbs of P credit/mo.
Keys to Trading

- Trade ratio is required to quantify credits to ensure trades result in water quality improvement
  - Minimum trade ratio is 1.2 : 1 for point to nonpoint source trades
  - Minimum trade ratio is 1.1 : 1 for point to point source trades

- Geographic extent
  - Trades should occur upstream of credit user
  - If downstream trades occur, they should occur within same HUC-12
    - Additional trade ratio factor apply

- Timing
  - Practices must be established and effective before they generate credit
  - Typically cannot take credit for past practices
Benefits of Adaptive Management

- **Time**
  - Don’t have to generate credits as they can be used
  - More restrictive WQBELs will be included in third permit term if water quality improvements not demonstrated

- **Flexibility**
  - Can adjust plans as you gain more experience
  - Flexibility in quantifying offset requirements and interim success
  - Can always switch to a different option if AM doesn’t work, including trading

- Ancillary environmental benefits such as wellhead protection, flood retention, riparian improvement and habitat.
Benefits of Trading

- Certainty
  - A “1, 2, 3” process– calculate the offset, do the offset, and meet your limit
  - Compliance not dependent on criteria attainment

- Potential pollutants
  - Can look at both TSS and P trades

- Experience
  - Trading has already been done in Wisconsin and in other states

- Ancillary environmental benefits such as wellhead protection, flood retention, riparian improvement and habitat.
Map of AM/WQT Projects

[Map image with project locations marked]

This map depicts WPDES permit holders that have formally selected adaptive management or water quality trading as their preferred phosphorus compliance option. Select a pin on the map to view more information about the permit holder, including the Notice of Intent submitted to the DNR. Permittees identify themselves by submitting either a Notice of Intent to Trade or an Adaptive Management Request form to DNR. If you would like to be identified on this map in advance of form submittal, contact Amanda Minka.

http://dnr.wi.gov/topic/SurfaceWater/AmWqtMap.html
Available Guidance

Adaptive Management Technical Handbook
Released: 01/07/2013

http://dnr.wi.gov/topic/SurfaceWater/AdaptiveManagement.html
(topic keyword: “adaptive management”)

Implementing Water Quality Trading in WPDES Permits
Released: 08/21/2013

Water Quality Trading How-To Manual
Released: 09/09/2013

(topic keyword: “water quality trading”)
AM/WQT DNR Webinar Series

Watershed-Based Phosphorus Compliance Strategies Webinar Series

This four-part webinar series builds on previous years’ offerings to feature case studies, water quality trading and adaptive management examples, and support tools designed to aid in decision making.

Part 1: The Great Phosphorus Compliance Adventure
Wednesday, January 21 • 11am-12pm
WEBINAR COMPLETE - View archived recording and presentation slides

Part 2: Case studies: Opportunities for Adaptive Management and Water Quality Trading to be Successful
Wednesday, February 18 • 11am-12pm

Part 3: EVAAL Model Overview
Wednesday, March 18 • 11am-12pm

Part 4: Using the P Trade Report in SNAP+
Wednesday, April 22 • 11am-12pm

http://fyi.uwex.edu/nrwebinars/

Archived Webinars:
http://fyi.uwex.edu/nrwebinars/category/previous-webinars/previous-water/
### AM & WQT DNR Contacts

<table>
<thead>
<tr>
<th>Location</th>
<th>Contact Information</th>
<th>DNR Office/Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statewide coordinators</td>
<td>Amanda Minks</td>
<td><a href="mailto:Amanda.Minks@Wisconsin.gov">Amanda.Minks@Wisconsin.gov</a></td>
</tr>
<tr>
<td></td>
<td>Kevin Kirsch</td>
<td><a href="mailto:Kevin.Kirsch@Wisconsin.gov">Kevin.Kirsch@Wisconsin.gov</a></td>
</tr>
<tr>
<td></td>
<td>Andrew Craig</td>
<td><a href="mailto:Andrew.Craig@Wisconsin.gov">Andrew.Craig@Wisconsin.gov</a></td>
</tr>
<tr>
<td>Northern District</td>
<td>Lonn Franson</td>
<td><a href="mailto:Lonn.Franson@Wisconsin.gov">Lonn.Franson@Wisconsin.gov</a></td>
</tr>
<tr>
<td>Southern District-West</td>
<td>Amy Schmidt</td>
<td><a href="mailto:Amy.Schmidt@Wisconsin.gov">Amy.Schmidt@Wisconsin.gov</a></td>
</tr>
<tr>
<td>Southern District-East</td>
<td>Mark Riedel</td>
<td><a href="mailto:Mark.Riedel@Wisconsin.gov">Mark.Riedel@Wisconsin.gov</a></td>
</tr>
<tr>
<td></td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Eastern District</td>
<td>Keith Marquardt</td>
<td><a href="mailto:KeithA.Marquardt@Wisconsin.gov">KeithA.Marquardt@Wisconsin.gov</a></td>
</tr>
<tr>
<td>Western District</td>
<td>Mike Vollrath</td>
<td><a href="mailto:Michael.Vollrath@Wisconsin.gov">Michael.Vollrath@Wisconsin.gov</a></td>
</tr>
</tbody>
</table>

[http://dnr.wi.gov](http://dnr.wi.gov)

keywords: “adaptive management”, “water quality trading”
Start Implementation Plan

1. Identify the causes and sources
2. Describe management measures that need to be implemented
3. Estimate the load reductions expected from selected management measures
Model Comparison
Model Comparison Overview

- What is a model?
- Why use a model?
- Types/characteristics
- Approach
- Overviews
What is a model?

A model is a simplified, yet translatable definition of the landscape and its processes.

Average Annual Soil Loss = R \times K \times L \times S \times C \times P
What is a model?

- Simplified assumptions of environmental processes
- Idealized formulation that represents the response of a physical system to an external stimuli
- Inputs, parameters, boundary conditions, equations
Why use a model?

- Explain scientific phenomena
  - What happened?

- Predict outcomes & behavior
  - Why did it happen?

- Inform decision making process

http://plumcreek.tamu.edu/our-watershed/
Model Categories

- Type
- Scale
- Land use setting
- Complexity
Landscape models
  ◦ Runoff of water and pollutants on and through the land surface

Receiving water models
  ◦ Flow of water through streams and into lakes
  ◦ Transport, deposition, and transformation in receiving waters

Watershed models
  ◦ Combination of landscape and receiving water models
Scale

- Regional
- Basin
- Field
Land use setting

- Agricultural
- Urban
- Mixed land use
Low
  ◦ Screening
  ◦ Risk potential
  ◦ Long-term averages
  ◦ Large geographic scope
  ◦ Little to no variation in space and time
  ◦ Little data required

Medium
  ◦ More process-based
  ◦ Monthly or annual averages
  ◦ May vary in time and space
  ◦ Some data required

High
  ◦ Process-based
  ◦ Daily (or less) representation of system
  ◦ Variation in time and space (more than one dimension)
  ◦ A lot of data required
Complexity

Data Requirements
Level of Effort

Basins

Fields
General Modeling Approach

- **Selection**
  - Question to answer, data availability, watershed characteristics, experience, time/money

- **Development**
  - Conceptualization, input data, scenarios

- **Evaluation**
  - Check results, calibration, validation

- **Application**
  - Answer specific question
  - Try scenarios
“All models are wrong; some models are useful”

–George E.P. Box
Start Implementation Plan

1. Identify the causes and sources
2. Describe management measures that need to be implemented
3. Estimate the load reductions expected from selected management measures
Models Overview

Identify Sources (Regional)
- SPARROW
- PRESTO

Evaluate Loads & BMPs
- TMDL
- SWAT
- HSPF

Identify Sources (Field)
- STEPL
- L-THIA
- EVAAL
- HIT

Estimate Load Reductions
- BARNY
- SnapPlus

Scale
- Large
- Small

Detail
- General
- Specific
Identify Sources
(Regional)

SPARROW
PRESTO

TMDL

SWAT
HSPF

Evaluate
Loads & BMPs

STEPL
L-THIA

Identify Sources
(Field)

EVAAL
HIT

Estimate Load
Reductions

BARNY
SnapPlus
<table>
<thead>
<tr>
<th>Name:</th>
<th>Spatially-referenced Regression on Watershed Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer:</td>
<td>USGS</td>
</tr>
<tr>
<td>Website:</td>
<td><a href="http://water.usgs.gov/nawqa/sparrow/">http://water.usgs.gov/nawqa/sparrow/</a></td>
</tr>
<tr>
<td>Overview:</td>
<td>The SPARROW model relates in-stream water-quality measurements to spatially referenced characteristics of watersheds, including contaminant sources and factors influencing terrestrial and aquatic transport. It empirically estimates the origin and fate of contaminants in river networks and quantifies uncertainties in model predictions.</td>
</tr>
<tr>
<td>Type:</td>
<td>Watershed</td>
</tr>
<tr>
<td>Scale:</td>
<td>Regional – Watershed (HUC10–HUC12)</td>
</tr>
<tr>
<td>Land use:</td>
<td>Mixed</td>
</tr>
<tr>
<td>Complexity:</td>
<td>Low</td>
</tr>
<tr>
<td>Format:</td>
<td>Online viewers; download tabular data</td>
</tr>
</tbody>
</table>
SPARROW – DSS

http://cida.usgs.gov/sparrow/
SPARROW

Main Uses
- Predicting long-term average values of water characteristics, such as concentrations and amounts of selected constituents that are delivered to downstream receiving waters
- Decision Support System based on existing or hypothetical source contributions
- Screening tool

Limitations/Cautions
- Limited long-term monitoring data
- Coarse data inputs
- Base year 2002
**Name:** Pollutant–Load Ratio Estimate Tool  
**Developer:** WDNR  
**Website:** [http://dnr.wi.gov/topic/SurfaceWater/presto.html](http://dnr.wi.gov/topic/SurfaceWater/presto.html)  

**Overview:** PRESTO is a GIS–based tool that compares the average annual phosphorus loads originating from point and nonpoint sources within a watershed. The comparison provides a screening tool for industrial and municipal dischargers to determine one of the conditions of eligibility for adaptive management as part of s. NR 217.18, Wisconsin Administrative Code.

<table>
<thead>
<tr>
<th><strong>Type:</strong></th>
<th>Watershed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scale:</strong></td>
<td>Basin</td>
</tr>
<tr>
<td><strong>Land Use:</strong></td>
<td>Mixed (Ag)</td>
</tr>
<tr>
<td><strong>Complexity:</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Format:</strong></td>
<td>ArcGIS Toolbox; results for statewide outfalls on web; web–based version under development</td>
</tr>
</tbody>
</table>
Village of Almena WWTP

Upstream Watershed: 32.9 mi²

Nonpoint Load

Village of Almena WWTP
Upstream Point Sources

6%  16%  78%

Point to Nonpoint Phosphorus Load Ratio

22% : 78%

Red Cedar River Watershed (HUC 08, 1,890 mi²)
20 Outfalls

Village of Almena WWTP
Upstream Watershed: 32.9 mi²

22% : 78%

Point to Nonpoint Phosphorus Load Ratio
PRESTO-Lite
A Watershed Delineation and Characterization Tool for Integration into Geocortex Applications

1. Click button located in toolbar of Geocortex viewer to activate tool
2. Select location for watershed delineation
   Follow steps to select delineation point
Watershed Name: Wild River
HUC08 Drainage: Chippewa River
Watershed Area: 100 mi²
Stream Type: Cool-Warm Mainstem

**PRESTO Phosphorus Load Estimate**

<table>
<thead>
<tr>
<th>Nonpoint-source Phosphorus</th>
<th>Average Annual Load (80% Confidence Interval)</th>
<th>1,000 (860 - 1250) lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point-source Phosphorus</td>
<td>Number of Facilities <em>(Individual Facility Information on Page 2)</em></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Average Annual Load (2010 – 2012 total of all facilities)</td>
<td>500 lbs.</td>
</tr>
<tr>
<td>Point to Nonpoint Phosphorus Ratio</td>
<td>Most Likely</td>
<td>33% : 66%</td>
</tr>
<tr>
<td></td>
<td>Low Estimate (Use for Adaptive Management)</td>
<td>29% : 71%</td>
</tr>
</tbody>
</table>

**Landcover**

- Developed Land: 6 mi²
- Forest: 63 mi²
- Agriculture: 20 mi²
- Wetland: 11 mi²

**Tributary Stream Types**

- Cool-Warm Mainstem: 8%
- Cool-Warm Headwater: 15%
- Cool-Cold Mainstem: 14%
- Cool-Cold Headwater: 24%
- Coldwater: 20%
- Macroinvertebrate: 19%

**Stream Flow**

- Discharge (cfs)
- Percent of time exceeded

WDNR Watershed Report (May 30, 2014)
Based on user-defined point, upstream watershed report is produced

**Adaptive Management Results – Facilities Discharging to the Wild River Watershed**

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Permit #</th>
<th>Outfall #</th>
<th>Waste Type</th>
<th>Receiving Water</th>
<th>2010-2012 Avg. Phosphorus Load (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater Plant ABC</td>
<td>001000</td>
<td>001</td>
<td>Municipal</td>
<td>Unnamed Tributary</td>
<td>167</td>
</tr>
<tr>
<td>Paper Mill XYZ</td>
<td>002000</td>
<td>001</td>
<td>Industrial</td>
<td>Clear Creek</td>
<td>166</td>
</tr>
<tr>
<td>Cheese Plant 123</td>
<td>003000</td>
<td>003</td>
<td>Industrial</td>
<td>Wild River</td>
<td>167</td>
</tr>
</tbody>
</table>

**Watershed Analysis Limitations**

1. This analysis relies on pre-defined catchments and may not delineate from the exact location required. When assessing phosphorus loads for specific facility in support of efforts such as adaptive management, care should be taken to ensure that additional downstream point sources do not exist. For adaptive management information related to specific facilities please reference the PRESTO website [http://dnr.wi.gov/topic/surfacewater/presto.html](http://dnr.wi.gov/topic/surfacewater/presto.html)

2. If a watershed requires delineation from an exact location the user may use the desktop version of PRESTO that requires ESRI ArcGIS. The PRESTO tool and default datasets can be downloaded at [http://dnr.wi.gov/topic/surfacewater/presto.html](http://dnr.wi.gov/topic/surfacewater/presto.html)
Main Uses
- Delineating watersheds
- Defining a watershed's land cover composition
- Defining the average annual nonpoint phosphorus loading
- Defining annual municipal and industrial phosphorus effluent loading
- Determining eligibility for adaptive management
- Screening tool

Limitations/Cautions
- Only for Wisconsin
- Not accurate for small subbasins, urban areas
SPARROW vs. PRESTO

- More robust regression equations
- Results for entire US
- Nitrogen
- Allows for basin-wide management scenarios

- Specific to Wisconsin
- Results run for all WI outfalls
- Custom watershed delineation
- Easy to run for new location
- AM eligibility
Identify Sources (Regional) ➔ SPARROW

Evaluate Loads & BMPs

Identify Sources (Field) ➔ TMDL ➔ SWAT

STEPL

L-THIA

EVAAL

HIT

BARNY SnapPlus

Estimate Load Reductions
### Soil Water Assessment Tool (SWAT)

**Name:** Soil Water Assessment Tool  
**Developer:** USDA ARS & Texas A&M  
**Website:** [http://swat.tamu.edu/](http://swat.tamu.edu/)

**Overview:** SWAT is a physically based continuous simulation model useful for predicting the impact of land management practices on water, sediment, and different agricultural chemical yields from watersheds of various scales and complexities.

**Type:** Watershed  
**Scale:** Basin  
**Land use:** Mixed (Ag)  
**Complexity:** High  
**Format:** Executable program; ArcSWAT ArcGIS extension; included in BASINS
• Simulates conditions on landscape each day based on climate data

• Input data intensive

• Output information is provided for each subwatershed defined

• Outputs include crop yields, discharge, sediment, & water chemistry
SWAT Results

Average Subwatershed Phosphorus Export (1999 - 2004)

- 304 - 500 lbs per year
- 501 - 1,000 lbs per year
- 1,001 - 1,500 lbs per year
- 1,501 - 2,000 lbs per year
- 2,001 - 2,600 lbs per year

0 1 2 4 Miles

North
ArcSWAT
SWAT

- **Main Uses**
  - Predicting the impact of land management decisions on water, sediment, nutrient and pesticide yields
  - Evaluating BMPs
  - Developing TMDLs
  - Evaluating scenarios such as climate change or urbanization

- **Limitations/Cautions**
  - Best for agricultural lands, but fields are not explicit
  - Does not spatially locate loadings within subbasin
  - Does require calibration
# HSPF

<table>
<thead>
<tr>
<th>Name:</th>
<th>Hydrological Simulation Program – FORTRAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer:</td>
<td>EPA &amp; USGS</td>
</tr>
<tr>
<td>Website:</td>
<td><a href="http://www2.epa.gov/exposure-assessment-models/hspf">http://www2.epa.gov/exposure-assessment-models/hspf</a></td>
</tr>
<tr>
<td>Overview:</td>
<td>HSPF is a watershed model that simulates nonpoint source runoff and pollutant loadings for a watershed, combines these with point source contributions, and performs flow and water quality routing in reaches.</td>
</tr>
<tr>
<td>Type:</td>
<td>Watershed</td>
</tr>
<tr>
<td>Scale:</td>
<td>Basin</td>
</tr>
<tr>
<td>Land use:</td>
<td>Mixed</td>
</tr>
<tr>
<td>Complexity:</td>
<td>High</td>
</tr>
<tr>
<td>Format:</td>
<td>Executable; included in BASINS, WMS</td>
</tr>
</tbody>
</table>
HSPF Results

Analysis Plot for FLOW

Y = 0.633 X + 19.729
Corr Coef = 0.631

Scatter Plot (OBSERVED UPMARLER vs HYD_MAN RCH5) for FLOW
HSPF

Main Uses
- Simulate watershed hydrology and water quality for both conventional and toxic organic pollutants
- Simulate in-stream processes
- Develop TMDLs

Limitations/Cautions
- Does not spatially locate loadings within subbasin
- Extensive setup
- Not as good for agriculture management practices
- Requires calibration
SWAT vs. HSPF

- Better representation of ag land practices
- Explicit plant growth
- Irrigation
- Better user interface

- Toxics
- Better river & lake processes
Models

Identify Sources (Regional) → SPARROW PRESTO

Evaluate Loads & BMPs
- TMDL
- SWAT HSPF
- STEPL L-THIA
- Identify Sources (Field)
- EVAAL HIT

Estimate Load Reductions
- BARNY SnapPlus
<table>
<thead>
<tr>
<th>Name:</th>
<th>Spreadsheet Tool for Estimating Pollutant Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer:</td>
<td>EPA/Tetra Tech</td>
</tr>
<tr>
<td>Website:</td>
<td><a href="http://it.tetratech-ffx.com/steplweb/default.htm">http://it.tetratech-ffx.com/steplweb/default.htm</a></td>
</tr>
<tr>
<td>Overview:</td>
<td>STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various BMPs. It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices.</td>
</tr>
<tr>
<td>Type:</td>
<td>Landscape</td>
</tr>
<tr>
<td>Scale:</td>
<td>Basin</td>
</tr>
<tr>
<td>Land use:</td>
<td>Mixed</td>
</tr>
<tr>
<td>Complexity:</td>
<td>Low</td>
</tr>
<tr>
<td>Format:</td>
<td>Software interface for MS Excel</td>
</tr>
</tbody>
</table>
STEPL Methods

- Hydrology – curve number approach
- Erosion – USLE, urban runoff concentration
- Pollutant load – runoff concentration

NRCS Photo/Tim McCabe
CPRblog/Dave Owen
## STEPL Results

### 1. Total load by subwatersheds

<table>
<thead>
<tr>
<th>Watershed</th>
<th>N Load (no BMP)</th>
<th>P Load (no BMP)</th>
<th>BOD Load (no BMP)</th>
<th>Sediment Load (no BMP)</th>
<th>N Reduction</th>
<th>P Reduction</th>
<th>BOD Reduction</th>
<th>Sediment Reduction</th>
<th>N Load (with BMP)</th>
<th>P Load (with BMP)</th>
<th>BOD (with BMP)</th>
<th>Sediment Load (with BMP)</th>
<th>%N Reduction</th>
<th>%P Reduction</th>
<th>%BOD Reduction</th>
<th>%Sed Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention</td>
<td>1267.4</td>
<td>495.7</td>
<td>2574.3</td>
<td>604.7</td>
<td>1223.1</td>
<td>470.3</td>
<td>2446.1</td>
<td>764.4</td>
<td>64.4</td>
<td>24.8</td>
<td>23.7</td>
<td>40.2</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
</tr>
<tr>
<td>Total</td>
<td>1267.4</td>
<td>495.7</td>
<td>2574.3</td>
<td>604.7</td>
<td>1223.1</td>
<td>470.3</td>
<td>2446.1</td>
<td>764.4</td>
<td>64.4</td>
<td>24.8</td>
<td>23.7</td>
<td>40.2</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
</tr>
</tbody>
</table>

### 2. Total load by land uses (with BMP)

<table>
<thead>
<tr>
<th>Sources</th>
<th>N Load (Lb/yr)</th>
<th>P Load (Lb/yr)</th>
<th>BOD Load (Lb/yr)</th>
<th>Sediment Load (Lb/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Cropland</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Pastureland</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Forest</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Feedlot</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Uses Defined</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Septic</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Cully</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Streambank</td>
<td>64.37</td>
<td>24.78</td>
<td>128.74</td>
<td>40.23</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>64.37</td>
<td>24.78</td>
<td>128.74</td>
<td>40.23</td>
</tr>
</tbody>
</table>
Main Uses
- Evaluating pollutant load reductions due to BMPs
- Reporting BMP load reductions for DNR/EPA funded grant requirements
- General what if scenarios

Limitations/Cautions
- Simple, planning tool
- Based on coarse data, gives rough estimates
- Pollutant loads by land use type
- Annual average values
<table>
<thead>
<tr>
<th><strong>Name:</strong></th>
<th>Long Term Hydrologic Impact Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Developer:</strong></td>
<td>Purdue University</td>
</tr>
<tr>
<td><strong>Website:</strong></td>
<td><a href="https://engineering.purdue.edu/~lthia/">https://engineering.purdue.edu/~lthia/</a></td>
</tr>
<tr>
<td><strong>Overview:</strong></td>
<td>L–THIA estimates changes in recharge, runoff, and nonpoint source pollution resulting from past or proposed development. It estimates long-term average annual runoff for land use and soil combinations, based on actual long-term climate data for that area</td>
</tr>
<tr>
<td><strong>Type:</strong></td>
<td>Landscape</td>
</tr>
<tr>
<td><strong>Scale:</strong></td>
<td>Basin</td>
</tr>
<tr>
<td><strong>Land use:</strong></td>
<td>Mixed</td>
</tr>
<tr>
<td><strong>Complexity:</strong></td>
<td>Medium–Low</td>
</tr>
<tr>
<td><strong>Format:</strong></td>
<td>Online viewer/model; ArcGIS extension</td>
</tr>
</tbody>
</table>
This Online Watershed Delineation (OWL) tool will delineate the area that flows to your point and allow you to send that outline, and the soil and landuse data within the outline to our online models.

Check the checkbox to display streaming WMS layer

- Streaming Layer
- HIT Sediment
- HIT Erosion
- HUC 8, 10, and 12 layer
- NHD water layer

To enter a specific latitude-longitude, select "Lat-Lon" button below, longitude with minus sign must be within 92.70000 to 87.00000 and
ArcL-THIA

Create CN Map¹: Combined map of landuse and soil
Create Allocated CN Map²: Combined map of landuse, soil, and precipitation gauges
Main Uses
- Easy online model for load estimating
- Evaluating pollutant load reductions due to BMPs
- General what if scenarios

Limitations/Cautions
- Simple, planning tool
- Based on coarse data, give rough estimates
- Pollutant loads by land use type
- Annual average values
STEPL vs. L–THIA

- Easy-to-use spreadsheet
- Numerous BMPs
- EPA supported

- Online interface
- Automatically determines land use and soils
- GIS interface
Identify Sources (Regional)

Evaluate Loads & BMPs

Identify Sources (Field)

Estimate Load Reductions

SPARROW
PRESTO

TMDL

SWAT
HSPF

STEPL
L-THIA

EVAAL
HIT

BARNY
SnapPlus
## EVAAL

<table>
<thead>
<tr>
<th>Name:</th>
<th>Erosion Vulnerability Assessment for Agricultural Lands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer:</td>
<td>WDNR</td>
</tr>
<tr>
<td>Website:</td>
<td><a href="http://dnr.wi.gov/topic/nonpoint/evaal.html">http://dnr.wi.gov/topic/nonpoint/evaal.html</a></td>
</tr>
<tr>
<td>Overview:</td>
<td>EVAAL evaluates locations of relative vulnerability to</td>
</tr>
<tr>
<td></td>
<td>sheet, rill and gully erosion using information about</td>
</tr>
<tr>
<td></td>
<td>topography, soils, rainfall and land cover. This tool</td>
</tr>
<tr>
<td></td>
<td>enables watershed managers to prioritize and focus</td>
</tr>
<tr>
<td></td>
<td>field-scale data collection efforts, thus saving time</td>
</tr>
<tr>
<td></td>
<td>and money while increasing the probability of locating</td>
</tr>
<tr>
<td></td>
<td>fields with high sediment and nutrient export for</td>
</tr>
<tr>
<td></td>
<td>implementation of best management practices.</td>
</tr>
<tr>
<td>Type:</td>
<td>Landscape</td>
</tr>
<tr>
<td>Scale:</td>
<td>Basin/Field</td>
</tr>
<tr>
<td>Land use:</td>
<td>Agricultural</td>
</tr>
<tr>
<td>Complexity:</td>
<td>Medium</td>
</tr>
<tr>
<td>Format:</td>
<td>ArcGIS Toolbox</td>
</tr>
</tbody>
</table>
LiDAR

Crop Data

Soils
EVAAL

Erosion Vulnerability

- Low
- Medium
- High
Main Uses
- Prioritize areas of highest erosion vulnerability
- Visualize general crop rotations
- Identify internally draining areas

Limitations/Cautions
- Wisconsin only
- LiDAR not available for all counties
- Does not account for tillage, manure, delivery, etc.
- Erosion must be driving factor of P problems
### HIT

<table>
<thead>
<tr>
<th>Name:</th>
<th>High Impact Targeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer:</td>
<td>Michigan State University</td>
</tr>
<tr>
<td>Website:</td>
<td><a href="http://www.iwr.msu.edu/hit2/">http://www.iwr.msu.edu/hit2/</a></td>
</tr>
</tbody>
</table>

**Overview:** HIT is an on-line tool that allows users to prioritize erosion and sedimentation reduction conservation efforts in the Great Lakes Basin. Users can compare watersheds by total erosion or sediment load, rates of erosion or sediment loading, and the cost benefit of best management practices (BMPs). Users can also view field-level maps, in 2D and 3D, showing areas at high risk for erosion and sediment loading.

<table>
<thead>
<tr>
<th>Type:</th>
<th>Landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale:</td>
<td>Regional – Basin</td>
</tr>
<tr>
<td>Land use:</td>
<td>Agricultural</td>
</tr>
<tr>
<td>Complexity:</td>
<td>Low</td>
</tr>
<tr>
<td>Format:</td>
<td>Online viewer; download model results</td>
</tr>
</tbody>
</table>
Main Uses
- Identify areas at risk for erosion and sediment loading
- Assess impacts of BMPs (select watersheds only)

Limitations/Cautions
- Great Lakes basin only
- Agricultural lands – not urban
- No gully, streambank, or wind erosion
- Results not precise, best used in relative manner
EVAAL vs. HIT

- Specific to Wisconsin
- Uses LiDAR
- Can run analysis on your own data
- Crop rotation info

- Easy to view online
- Gives estimate of sediment delivery
- Apply BMPs (only in Fox/Wolf Basin)
EVAAL vs. HIT
Models

Identify Sources (Regional) ➔ SPARROW

Evaluate Loads & BMPs

TMDL ➔ SWAT

Identify Sources (Field)

STEPL ➔ HSPF

EVAAL

Estimate Load Reductions ➔ BARNY

SnapPlus
<table>
<thead>
<tr>
<th><strong>Name:</strong></th>
<th>Barnyard Runoff Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Developer:</strong></td>
<td>WDNR</td>
</tr>
<tr>
<td><strong>Website:</strong></td>
<td><a href="http://datcp.wi.gov/uploads/Environment/xls/BARNY.xls">http://datcp.wi.gov/uploads/Environment/xls/BARNY.xls</a></td>
</tr>
<tr>
<td><strong>Overview:</strong></td>
<td>BARNY is used to estimate loads of phosphorus and chemical oxygen demand in stormwater runoff from individual barnyards. It can also evaluate the impacts of buffers.</td>
</tr>
<tr>
<td><strong>Type:</strong></td>
<td>Landscape</td>
</tr>
<tr>
<td><strong>Scale:</strong></td>
<td>Field (barnyard)</td>
</tr>
<tr>
<td><strong>Land use:</strong></td>
<td>Agricultural</td>
</tr>
<tr>
<td><strong>Complexity:</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Format:</strong></td>
<td>MS Excel Spreadsheet</td>
</tr>
</tbody>
</table>
Main Uses
- Evaluating phosphorus export from barnyards
- Evaluating phosphorus load reductions due to barnyard management activities

Limitations/Cautions
- Buffer effectiveness pretty good, other calcs questionable
- Streams flowing across yard are usually over-rated
- Roof gutter are usually under-rated
- Good comparison as long as upstream drainages are no larger than the lot itself
**SnapPlus**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Soil Nutrient Application Planner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer:</td>
<td>University of Wisconsin</td>
</tr>
<tr>
<td>Website:</td>
<td><a href="http://snapplus.wisc.edu/">http://snapplus.wisc.edu/</a></td>
</tr>
<tr>
<td>Overview:</td>
<td>SnapPlus is Wisconsin’s nutrient management planning software. By calculating potential soil and phosphorus runoff losses on a field–by–field basis while assisting in the economic planning of manure and fertilizer applications, it provides Wisconsin farmers with a tool for protecting soil and water quality.</td>
</tr>
<tr>
<td>Type:</td>
<td>Landscape</td>
</tr>
<tr>
<td>Scale:</td>
<td>Field</td>
</tr>
<tr>
<td>Land Use:</td>
<td>Rural (ag)</td>
</tr>
<tr>
<td>Complexity:</td>
<td>Medium – High</td>
</tr>
<tr>
<td>Format:</td>
<td>Software</td>
</tr>
</tbody>
</table>
P Index: Nutrient Management Planning Information Is Used to Estimate Annual P Delivery to Surface Water

- County
- Soil Type
- Soil Test P and Organic Matter
- Field Slope
- Field Slope Length
- Tillage
- Rotation crops and yields
- Manure Applications
- P Fertilizer Applications
- Downfield Slope to Surface Water
- Distance to Surface Water

Annual (Crop Year):
- Total P Index
- Soluble P Index
- Particulate P Index

Rotation:
- Average Total P Index
SnapPlus

- **Main Uses**
  - Determining Phosphorus Index for individual fields
  - Testing impacts of management practices on P-Index and soil loss
  - Estimating P and sediment load reductions due to management changes for trading

- **Limitations/Cautions**
  - Assumes gulley erosion is addressed
  - Assumes field is uniform
  - Uses simplified delivery to stream
Some Additional Models

- Lake Response
  - WiLMS
- Urban
  - WinSLAMM
  - P8
# WiLMS

<table>
<thead>
<tr>
<th>Name:</th>
<th>Wisconsin Lake Modeling Suite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer:</td>
<td>WDNR</td>
</tr>
<tr>
<td>Website:</td>
<td><a href="http://dnr.wi.gov/lakes/model/">http://dnr.wi.gov/lakes/model/</a></td>
</tr>
<tr>
<td>Overview:</td>
<td>WiLMS model is a lake water quality–planning tool. Non-point source phosphorus loading is predicted using export coefficients; point–sources can be included as well. The model uses an annual time step and predicts spring overturn (SPO), growing season mean (GSM) or annual average (ANN) total phosphorus concentration in lakes. Trophic response parameters (e.g., chlorophyll) are estimated.</td>
</tr>
<tr>
<td>Type:</td>
<td>Watershed</td>
</tr>
<tr>
<td>Scale:</td>
<td>Basin</td>
</tr>
<tr>
<td>Land use:</td>
<td>Mixed</td>
</tr>
<tr>
<td>Complexity:</td>
<td>Low–Medium</td>
</tr>
<tr>
<td>Format:</td>
<td>Software</td>
</tr>
</tbody>
</table>
**WinSLAMM**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Source Loading and Management Model for Windows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer:</td>
<td>PV &amp; Associates</td>
</tr>
<tr>
<td>Website:</td>
<td><a href="http://winslamm.com/">http://winslamm.com/</a></td>
</tr>
<tr>
<td>Overview:</td>
<td>WinSLAMM was developed to evaluate nonpoint source pollutant loadings in urban areas using small storm hydrology. The model determines the runoff from a series of normal rainfall events and calculates the pollutant loading created by these rainfall events. The user is also able to apply a series of control devices to determine how effectively these devices remove pollutants.</td>
</tr>
<tr>
<td>Type:</td>
<td>Landscape</td>
</tr>
<tr>
<td>Scale:</td>
<td>Basin</td>
</tr>
<tr>
<td>Land use:</td>
<td>Urban</td>
</tr>
<tr>
<td>Complexity:</td>
<td>Medium</td>
</tr>
<tr>
<td>Format:</td>
<td>Proprietary software (fee)</td>
</tr>
</tbody>
</table>
### Program for Predicting Polluting Particle Passage thru Pits, Puddles, & Ponds

**Developer:** William W. Walker, Jr., Ph.D.

**Website:** [http://wwwalker.net/p8/](http://wwwalker.net/p8/)

**Overview:**

P-8 is a model for predicting the generation and transport of storm water runoff pollutants in urban watersheds. The model has been developed for use by engineers and planners in designing and evaluating runoff treatment schemes for existing or proposed urban developments. The model is used to examine the water quality implications of alternative treatment objectives.

**Type:** Landscape

**Scale:** Basin

**Land use:** Urban

**Complexity:** Medium–Low

**Format:** Software
WinSLAMM vs. P8

- Stormwater control practices
- Ongoing updates
- Developed in WI

- Free
- Allows % impervious as input
DNR Web Maps & Online Data
DNR Web Maps & Online Data

- Interactive Web Mapping Applications
- Online information and data
- GIS Data
Interactive Web Maps

- List can be found here:
  - [http://dnr.wi.gov/maps/gis/applist.html](http://dnr.wi.gov/maps/gis/applist.html)

- Surface Water Data Viewer
- Lakes & AIS Viewer
- Watershed Restoration Viewer
Surface Water Data Viewer (SWDV)

Welcome to the Surface Water Data Viewer (SWDV), a Wisconsin DNR data delivery system that provides interactive webmapping tools for a wide variety of datasets including chemistry (water, sediment), physical, and biological (macroinvertebrate, aquatic invasive) data.

The new interactive web mapping application for surface water resources has nearly all the capabilities as the old version as well as a number of new features. One major difference between the old and new versions is that the new interface has tabs which group similar sets of tools (similar to MS Word or Excel). Turning on layers, panning and zooming are more seamless; with much shorter page loading times. Other new features include more drawing tools, the ability to add a CSV or Shapefile, and the ability to change coordinate systems.

NOTE: This site is best viewed with Internet Explorer 6 or higher. For best performance, a high speed internet connection is recommended. Dialup connection to this site is not recommended. This site uses the Microsoft Silverlight plug-in for your web browser. If you do not have the SilverLight plug-in installed, you will be prompted to install it.

Overview

Welcome to the Surface Water Data Viewer (SWDV), an interactive mapping tool providing primarily statewide water-related data. The SWDV has five different "themes" or versions, all of which are available through links below. The first is the general theme in which you manually select the data layers you would like to view. The other themes are wetlands, dam safety, floodplain and designated waters.

Launch application: Surface Water Data Viewer Web Mapping Application

Handy Links

- SWDV Updates & Help Documents
- Data Layer Inventory
- SWDV Feedback Survey Results

Contact information

For information on this page, contact:
Hilari MacDonald
608-266-5242
SWDV File Manager
Water Division

Last revised: Tuesday December 17 2013

http://dnr.wi.gov/topic/surfacewater/swdv/
### Onion River - Downstream of CTHY I (Station 10031961)

#### Details

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWIMS Station ID</td>
<td>10031961</td>
</tr>
<tr>
<td>Primary Station ID</td>
<td>Onion River - Downstream of CTHY I</td>
</tr>
<tr>
<td>WBIC</td>
<td>51200</td>
</tr>
</tbody>
</table>

#### Monitoring Station

- **Station ID**: 10031961
- **Station Name**: Onion River - Downstream of CTHY I

#### Show specific parameter: `<Show All>`

#### Sample Results

<table>
<thead>
<tr>
<th>Project</th>
<th>Date/Time</th>
<th>DNR Parameter</th>
<th>Species</th>
<th>Result</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>TEMPERATURE FIELD</td>
<td>12.0</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>AMBIENT AIR TEMPERATURE - FIELD</td>
<td>14.5</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>CLOUD COVER</td>
<td>100</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>CONDUCTIVITY FIELD</td>
<td>68.1</td>
<td>UMHOS/CM</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>TEMPERATURE AT LAB</td>
<td>1CED</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>DISSOLVED OXYGEN FIELD</td>
<td>9.95</td>
<td>MGL</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>OXYGEN, DISSOLVED, PERCENT OF SATURATION %</td>
<td>91.5</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>PH FIELD</td>
<td>8.42</td>
<td></td>
<td>SU</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>PHOSPHORUS TOTAL</td>
<td>0.981</td>
<td>MGL</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>TRANSPARENCY TUBE</td>
<td>52.6</td>
<td>CM</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>10/23/2012 02:20 PM</td>
<td>TEMPERATURE FIELD</td>
<td>11.2</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>AMBIENT AIR TEMPERATURE - FIELD</td>
<td>12.8</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>CLOUD COVER</td>
<td>10</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>CLOUD COVER</td>
<td>10</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>STREAM FLOW - CFS</td>
<td>6.4</td>
<td>CFS</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>TEMPERATURE FIELD</td>
<td>10.2</td>
<td>MGL</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>DISSOLVED OXYGEN FIELD</td>
<td>93.3</td>
<td>MGL</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>OXYGEN, DISSOLVED, PERCENT OF SATURATION %</td>
<td>93.3</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>PH FIELD</td>
<td>8.1</td>
<td></td>
<td>SU</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>PHOSPHORUS TOTAL</td>
<td>0.103</td>
<td>MGL</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>TRANSPARENCY TUBE</td>
<td>35.0</td>
<td>CM</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>TEMPERATURE FIELD</td>
<td>21.83</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>AMBIENT AIR TEMPERATURE - FIELD</td>
<td>15.30</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>CLOUD COVER</td>
<td>100</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>WWTP Background TP monitoring 2012 - WCR_13_CMP13</td>
<td>09/24/2012 10:45 AM</td>
<td>STREAM FLOW - CFS</td>
<td>5.73</td>
<td>CFS</td>
<td></td>
</tr>
</tbody>
</table>
Add Data

The screen shows the Surface Water Data Viewer interface with a focus on the Add Layer tool. The Add Layer window is open, allowing the user to discover a Map Service by entering a URL or searching by keywords. The available map services include:

- WT_Healthy_Watershed_Assessment_Ext
- WT_Inland_Water_Resources_WTM_Ext
- WT_Monitoring_Sites_and_Data_WTM_Ext
- WT_Natural_Community_Modeling_WTM_Ext

Each map service has a URL associated with it for further access.
Lakes & AIS Viewer

Welcome to the Lakes and AIS Mapping Tool, a Wisconsin DNR interactive web mapping tool for Lakes and Aquatic Invasive Species (AIS). This tool allows users to search and map AIS and Lakes monitoring locations, Watercraft Inspection sites, and Grants projects across the state as well as view the geographical distribution of invasive plants, fish, and invertebrates and so much more.

**NOTE:** This site is best viewed with Internet Explorer 8 or higher. For best performance, a high speed Internet connection is recommended. Dialup connection to this site is not recommended.

If you have multiple toolbars open at the top of your internet browser or are using a widescreen monitor, you may need to adjust the browser’s zoom setting (under the View menu) to access all tools and functions.

*This site uses the Microsoft Silverlight plug-in for your web browser. If you do not have the Silverlight plug-in installed, you will be prompted to install it.*

Click the "Proceed" button to go to the site.

[Proceed] [Exit]

http://dnr.wi.gov/lakes/viewer/
### Volunteer Water Quality Monitoring Station

**Details**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBJECTID</td>
<td>3678</td>
</tr>
<tr>
<td>Station ID</td>
<td>643173</td>
</tr>
<tr>
<td>Station Type</td>
<td>LAKE</td>
</tr>
<tr>
<td>Secondary Station Type</td>
<td>DEEPEST SPOT</td>
</tr>
</tbody>
</table>

---

### Wisconsin Department of Natural Resources

**Lake Water Quality 2014 Annual Report**

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Storet #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fence Lake - Deep Hole-North</td>
<td>643173</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>SD (ft)</th>
<th>SD (m)</th>
<th>Hit Bottom</th>
<th>CHL</th>
<th>TP</th>
<th>TSI (SD)</th>
<th>TSI (CHL)</th>
<th>TSI (TP)</th>
<th>Lake Level</th>
<th>Clarity</th>
<th>Color</th>
<th>Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>06/17/2014</td>
<td>1.41</td>
<td>0.44</td>
<td>6.17</td>
<td>37</td>
<td>42</td>
<td>27</td>
<td>42</td>
<td>27</td>
<td>42</td>
<td>27</td>
<td>42</td>
<td>27</td>
</tr>
</tbody>
</table>

**Data Collectors**

<table>
<thead>
<tr>
<th>Date</th>
<th>Data Collectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>06/17/2014</td>
<td>DANIELA GURLIN</td>
</tr>
</tbody>
</table>

**SD** = Secchi depth measured in feet converted to meters; **CHL** = Chlorophyll a in micrograms per liter (ug/l); **TP** = Total phosphorus in ug/l, surface sample only; **TSI(SD)**, **TSI (CHL)**, **TSI(TP)** = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

**Wisconsin Department of Natural Resources**

**Report Generated:** 01/15/2015
Watershed Restoration Viewer

About the Viewer
Welcome to the Watershed Restoration Viewer, a Wisconsin DNR interactive web mapping tool for exploring water quality improvement projects across Wisconsin. The Bureau of Water Quality is continuously working to improve the condition of streams and lakes to provide exceptional aquatic environments for Wisconsinites and beyond. When waters are listed as impaired, we work to improve them through various types of federally supported frameworks such as Total Maximum Daily Loads (TMDLs). When the waters are already exceptional, we protect them for future generations to enjoy. This tool allows users to search and map DNR information regarding water quality with a focus on the places in Wisconsin where the DNR is working with partners to provide exceptional water quality. Within these areas, viewers can explore water quality standards, the current condition of rivers and lakes, and the results of models that the DNR uses to allocate the least amount of resources for the greatest overall improvement in water quality. The map viewer is organized by “themes”—click here for more information about each theme.

NOTE: This site is best viewed with Internet Explorer 8 or higher. For best performance, a high speed Internet connection is recommended. Dialup connection to this site is not recommended. This site uses the Microsoft Silverlight plug-in for your web browser. If you do not have the Silverlight plug-in installed, you will be prompted to install it.

Themes
The Restoration Viewer currently has two primary themes. Please select a theme below to view information about the layers within each.

- Launch the Wisconsin River TMDL Restoration Theme
  - Wisconsin River TMDL Datasets
  - Related Sites: Wisconsin River TMDL

- Launch the Rock River TMDL Restoration Viewer Theme
  - Related Sites: Rock River TMDL

- Launch the Healthy Watersheds Assessment Theme
  - Related Sites: Healthy Watersheds

- Launch the Statewide TMDL Status Restoration Theme
  - Statewide TMDL Status Theme

Contact information
For information on this page, contact:
Theresa Nelson
Restoration Viewer Manager
Water Division

http://dnr.wi.gov/topic/surfacewater/restorationviewer/
Online Info & Data

http://dnr.wi.gov/topic/water.html
Wisconsin surface waters

Wisconsin’s abundant waters

Wisconsin’s newly updated Water Quality Report to Congress 2014 summarizes surface water and groundwater conditions.

Wisconsin is water rich, with thousands of streams stretching over 84,000 miles, inland lakes that span more than 1 million acres, 1,000 miles of Great Lakes shoreline and more than five million wetland acres. Beneath this surface water bounty lies an equally rich supply of groundwater. Explore Wisconsin’s Waters.


Wisconsin residents are fortunate to live in a state bountiful with natural resources, including our many and varied lakes, streams, wetlands, aquifers, and springs.

Search tools

- Surface water data viewer
- Search waters
- Search watersheds
- Search projects
- Search impaired waters
- Search lakes
- Search basins
Search Waters

Onion River, Mullet River, Onion River, Sheboygan River Watershed (SH03, SH04, SH06)
Onion River (51200)

Size: 31.80 Miles
Segment: 0 - 31.80
Natural Community: Not Determined
Year Last Monitored: 2014
General Condition: Poor
Impairments include: Degraded Biological Community
Pollutants include: Total Phosphorus

Overview

T15N R22E Sec. 36 NESE Stream Length = 44.0 miles

The Onion River discussion is segmented into two sections to represent the different stream classifications and biological characteristics of the stream from its headwaters downstream. The Onion River is classified as a Cold Water Fish Community stream, Class II trout stream from the headwaters downstream to the top of the Waldo Dam impoundment. A Warm Water Sport Fish Community classification exists from the Waldo Impoundment downstream to the confluence with the Sheboygan River.

ONION RIVER WARM WATER SEGMENT (RM 0.0-31.9)
The lower Onion River extends from the Waldo Dam downstream to its confluence with the Sheboygan River at Rochester Park. It does not completely achieve its potential to support a warm water sport fish community because of water quality and habitat limitations. The reach flows through vast acreage of farmland, where intensive pasturing contributes to erosion and sedimentation. Even light rains, or during periods when the carp are active, the stream becomes turbid, resulting in heavy siltation, and increased nutrient levels due principally to agricultural pollutants (pers. comm. Galarneau). The lower Onion River supports a tolerant warm water fishery with carp, bullhead, northern pike, and green sunfish present.

Overall the Onion River water quality has changed little from the information presented in the Onion River Priority Watershed Plan (WDNR 1981) as compared to our monitoring in 1994. Water quality is still good to excellent in the rivers upstream reaches (above Waldo) and poor in the river's lower reaches. The rivers tributary streams, specifically Belgium Creek and Lima tributary, are severely degraded due to both point and nonpoint sources and ultimately effect the water quality in the Onion River.

The Onion River Priority Watershed Plan (WDNR 1981) reported that both the biotic index samples and the water chemistry samples above the Hingham impoundment were indicative of good to excellent water quality. While samples collected at the downstream end of the watershed (Ourtown Road) rated the river's water quality as poor. Similar results were observed from our 1994 Onion River water quality monitoring (WDNR 1999).

WDNR personnel surveyed the Onion River approximately 1.6 miles downstream of Ourtown Road in July 2000 (River mile 2.8). The stream reach that was surveyed was within the boundaries of the Pinehurst ("The Bull") Golf Course. The fish community rated good with a total of 30 fish samples, of which 21 were trout species and 9 were warm water species. The water chemistry rating was excellent.

Counties
Sheboygan

Trout Water
No

Outstanding or Exceptional
No

Impaired Water
Yes

Fish and Aquatic Life

Current Use
FAL

Attainable Use
FAL

Designated Use
Default FAL
<table>
<thead>
<tr>
<th>Project</th>
<th>Date/Time</th>
<th>DRR Parameter</th>
<th>Species</th>
<th>Result</th>
<th>Units</th>
<th>Present/Absent</th>
<th>Lab Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/15/2011 12:00 AM</td>
<td>Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery</td>
<td>N</td>
<td>1.293863000359387</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/15/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>1.40764912895166</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/17/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>0.0032525360590</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>0.47135433948733</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>3.09653297706342</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>1.59941983598941</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>1.0087334878528</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>0.568748427229305</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>4.643051</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>1.605779</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>1.28</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>1.36</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 2011</td>
<td>09/07/2011 12:00 AM</td>
<td>Satellite derived water clarity greater than max depth of lake</td>
<td>N</td>
<td>1.79</td>
<td>FEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Lake Clarity Monitoring 1999-2001</td>
<td>07/28/2001 12:00 PM</td>
<td>Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery</td>
<td>N</td>
<td>0.40</td>
<td>M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GIS Data

- FTP site:
  - ftp://dnrftp01.wi.gov/geodata

- ArcGIS REST Services Directory
  - http://dnrmaps.wi.gov/arcgis/rest/services/
FTP directory /geodata at dnrftp01.wi.gov

To view this FTP site in File Explorer: press Alt, click View, and then click Open FTP Site in File Explorer.

Up to higher level directory

- Directory 02/13/2012 12:00AM county_bnds
- 3,946 dnralegal.txt
- 01/18/2007 12:00AM DNR_geog_mgmt_units
- 01/20/2011 12:00AM DNR_regions
- 10/31/2014 12:00AM drg_100k
- 01/20/2011 12:00AM drg_250k
- 01/04/2013 12:00AM ecological_landscapes
- 01/20/2011 12:00AM elevation
- 08/13/2014 12:00AM EVAAL_V1_0
- 04/11/2014 12:00AM forestry
- 01/20/2011 12:00AM gcsm
- 12/11/2014 12:00AM hydro_24k
- 03/21/2014 12:00AM hydro_va_24k
- 05/15/2014 12:00AM Impaired_Waters
- 01/20/2011 12:00AM landcover
- 01/20/2011 12:00AM landnet
- 01/20/2011 12:00AM Landsat_RTMPplus_mosaic
- 01/20/2011 12:00AM LTAs
- 11/08/2012 12:00AM managed_lands
- 11/14/2014 12:00AM metadata
- 11/06/2009 12:00AM NAD_1983_HARN_Transverse_Mercator.prj
- 01/20/2011 12:00AM orig_veg_cover
- 01/16/2015 03:31PM outgoing
- 05/15/2014 12:00AM Outstanding_and_Exceptional_Res_Waters
- 05/01/2013 12:00AM PRSTO_V1_1
- 01/20/2011 12:00AM projection_file
- 01/20/2011 12:00AM quad_indexes
- 11/08/2011 12:00AM reed_canary_grass
- 01/13/2007 12:00AM schema.ini
- 37 US_Census_2010_Roads
- 01/20/2011 12:00AM watersheds
- 07/28/2014 12:00AM water_division
- 03/19/2014 12:00AM wildlife_mgmt
- 03/20/2014 12:00AM WI_DNR_2014_Metadata
- 01/20/2011 12:00AM WI_state_outline
- 01/20/2011 12:00AM WI_WBD_HUCs
Folder: /
Current Version: 10.11
View Footprints In: ArcGIS.com Map

Folders:

- DW_Map_Cached
- DW_Map_Dynamic
- ER_Biotics
- FR_OPFL
- FR_WIS_BURN
- LF_DML
- PR_TRAILS
- RR_Sites_Map
- Utilities
- WM_CWD
- WM_DMAP
- WM_LMS
- WM_LMS_EDIT
- WT_SWDV
- WT_TMDL
- WY_Lakes_AIS
- WY_PRESTO
162,651 total features
Including boundary waters
Watershed Delineation

- One watershed per REACH ID
- Flow direction based on 10m NED
- Conforms to HUC12 boundaries
- Similar to NHD-Plus, but 1:24K
What's this stream like?
- Width
- Gradient
- Discharge
- Temperature
- Connectivity
- Watershed land cover, topography, geology, soils
- Fish community
- ...

Spatial unit:
REACH ID = HYDRO ID
(Section of stream bounded by confluence or change in HYDRO TYPE)

Attributes
- HYDRO ID: 200030082
- WBIC: 1248400
- ROW NAME: Blue Mounds Creek
- HYDRO TYPE:
  Stream/River, single-line
- A few more…
Attribute Dimensions

- **Riparian**: 60 m on both sides of feature
- **Watershed**: Average 0.9 km²
- **Channel**: Average 0.8 km
- **Riparian Trace**: 
- **Watershed Trace**: 

---

[Diagram showing the dimensions and traces for riparian, watershed, channel, and riparian trace.]
Attributes

Hydrology/temperature
- Groundwater potential
- High capacity wells
- Stream discharge*
- Stream temperature*
- Stream Natural Community*
- Water residence time (lakes)*

Stream network
- Connectivity to Great Lakes, inland lakes, large rivers
- Stream gradient and sinuosity

Climate
- Annual precipitation
- Annual, growing season, and July temperature

Land Cover
- 1992 WiscLAND
- 2001 and 2006 NLCD
- Projected 2020–50
- Pre–settlement

Geology/soils/topography
- Soil permeability
- Surficial geology type
- Bedrock depth and type
- Internally drained areas
- Land slope
- Artificial drainage*
- Runoff curve number

*Modeled attribute
Healthy Watersheds Assessment
Healthy Watersheds Assessments

National EPA effort to help states:

- Rank watersheds based on their level of “health” and “vulnerability”
- Use it comparatively, not Good/Bad
- Based on a range of metrics & datasets
- Geospatial data & modeled predictions
- Broad-level screening tool
- Make strategic decisions for protection
- Wisconsin is one of the early states to do this

Kristi Minahan
DNR
Project Partners

- WI DNR
- EPA Headquarters
- EPA Region 5
- The Nature Conservancy
- USGS
- Cadmus consulting
WHDPlus scale (similar to HUC 16 or NHD+)

- 0.5 km$^2$ (ave)
- Can also be ‘rolled up’ to HUC 12, etc.
Aquatic Ecosystem Health

**Hydrologic Condition**
- Change in flow regime

**Habitat Condition/Geomorphology**
- Dams
- Road crossings
- Stream Habitat Rating*
- % Reed canary grass
- Canals/ditches

**Water Quality**
- Nitrogen*
- Phosph.*
- Susp. Sediment*
- Lake Clarity

**Biological Condition**
- Aquatic Insects IBI*
Aquatic Ecosystem Health

Hydrology

Water Quality

Habitat/Geomorphology

Biology

SUBINDICES

Aquatic Ecosystem Health Index

Low  High

Miles

0  25  50  75  100
Watershed Vulnerability

**Climate Change**
Projected change in:
- Runoff*
- Phosphorus*
- Nitrogen*
- Sediment*

**Land Use Change**
Projected change in Land cover*

**Water Use**
- High capacity wells
- Groundwater dependent ecosystems
Aquatic Ecosystem Health

Vulnerability

Aquatic Ecosystem Health Index

- Low
- High

Miles

Watershed Vulnerability Index

- Low
- High

Miles
Combine Health & Vulnerability Scores...

- Eastern District
- Protection priority
- Restoration priority
Combine Health & Vulnerability Scores...
Applications

- County/Regional Planning
- Watershed/Lake Planning
- Grant criteria
- Wetland assessment and mitigation
- Protecting lands
Healthy Watersheds Website

- Download:
  - Final Report
  - PDF maps
  - Shapefiles
  - Raw data

- Online Mapping Tool
  - Zoom to your watershed
  - Select map layers
  - See ranking scores

http://dnr.wi.gov/topic/Watersheds/HWA.html
EVAAL

Overview
TMDLs Statewide

Status of Wisconsin’s TMDLs

TMDL Status
- TMDL Development
- TMDL Approved
- County Boundary
- DNR Regional Boundary
- River Network

Notes:
1. Map reflects TMDLs for all pollutants (TSS, TP, PCBs, Hg, etc) reported in the WDNR WATERS database as of April 2013.
2. Sub-HUC12 watersheds were delineated using PRESTO.
TMDL Results

Total Phosphorus (lbs/acre/year)

- Green Bay

0.0-0.3
0.3-0.6
0.6-0.8
0.8-1.1
1.1-1.6
Watershed

- 23 square miles
- 187 farms
- 1,129 fields
Erosion Vulnerability Assessment for Agricultural Lands

- GIS-based model
- Vulnerability to erosion and nutrient export
- Deprioritizes internally draining areas
EVAAL System Requirements

- Windows operating system
- ArcGIS Desktop 10.1 or 10.2
- ArcGIS Spatial Analyst 10.1 or 10.2
- 1.5 GB RAM minimum

- Does not require any installation, but does need write access to file folder
Available Datasets

LiDAR

Crop Data

Soils
Digital Dams
Crop Rotations

＝ Cash Grain Rotation
Time series of crop types by CDL code

- corn: [1]
- soy/grain: [4, 5, 21, 22, 23, 24, 25, 27, 28, 29, 30, 39, 205]
- potato: [43]
- vegetables: [12, 42, 47, 49, 50, 53, 206, 216]
- alfalfa: [28, 36, 37, 58]
- pasture: [62, 181, 176]

- corn >= 3/5 AND (soy/grain + potato + vegetables + alfalfa + pasture) == 0 → continuous corn
- no

- corn + soy/grain >= 2/5 AND (potato + vegetables + alfalfa + pasture) == 0 → cash grain
- no

- alfalfa >= 1 AND (corn + soy/grain) >= 1/5 → dairy
- no

- potato >= 1/5 AND alfalfa >= 1/5 AND vegetable == 0 → potato/vegetable
- no

- (potato + vegetables) >= 1/5 → pasture/hay/grass
- no

- (pasture + alfalfa) >= 2/5 AND (corn + soy/grain + potato + vegetables) == 0 → no agriculture
- no
Soils – gSSURGO

http://datagateway.nrcs.usda.gov/
Erosion Vulnerability Analysis

**USLE + SPI − IDA**

**EVAAL**

Erosion Vulnerability Assessment for Agricultural Lands
Universal Soil Loss Equation

Sheet and rill erosion

\[ A = RK( LS ) CP \]

- Rainfall erosivity
- Soil erodibility
- Slope/Slope-Length
- Cover factor
- Practice Factor
Sheet and rill erosion

\[ A = R K (L S) C P \]

Constant \hspace{2em} Constant
Universal Soil Loss Equation

- Sheet and rill erosion

\[ A = RK(LOS)CP \]

\[ A = K(LOS)C \]
Universal Soil Loss Equation

- Sheet and rill erosion

\[ A = K(LS)C \]

- SSURGO soils
- DEM
- Cropland data layer
Universal Soil Loss Equation
Stream Power Index

- Potential for gully erosion

\[ \text{SPI} = f(\text{slope, catchment area}) \]
Internally Draining Areas

- Areas that do not contribute to surface waters

\[ \begin{align*}
V_s & \geq V_r, \text{ Internally drained} \\
V_s & < V_r, \text{ Not internally drained}
\end{align*} \]
Internally Draining Areas

- Areas that do not contribute to surface waters
Results

USLE

SPI

NC Areas

Legend:
- Low
- Medium
- High
Results

Erosion Vulnerability

Low
Medium
High
Results

Erosion Vulnerability

- Low
- Medium
- High
Results

Prioritization

Legend:
- Low
- Medium
- High
We can’t model what we don’t know
  ◦ Tillage
  ◦ Manure application
  ◦ BMPs
Erosion must be driving factor
Does not account for delivery factors or tile drainage
Cannot “target”, rather “prioritize”
EVAAL Website

- Documents
- Tutorial Data
- ArcToolbox

![EVAAL Website Screenshot](http://dnr.wi.gov/topic/nonpoint/evaal.html)
EVAAL Applications

- Outagamie County LWCD
  - NPS Implementation Plan
    - Rotation analysis
    - Stream Power Index
    - Erosion Vulnerability
- The Nature Conservancy
  - Mullet Creek Watershed
    - Erosion vulnerability to prioritize field inventories
- Engineering Consultants
  - Watershed assessments
EVAAL

LiDAR & DEM processing
What is LiDAR?

- **Light Detection And Ranging**

- A pulsed laser is used to measure distance to earth

- Most often collected by helicopter or airplane

- Results in a continuous grid of elevation points
Continuous grid = raster data

File formats:
- GeoTIFF (.tif)
- ERDAS Imagine (.img)
- ESRI raster geodatabase (no extension)
- LiDAR specifically:
  - Any of above or
  - Point clouds
    - .LAS or .LAZ
    - Requires additional processing
3 meter LiDAR

- Often described by the resolution of one grid cell or pixel (e.g., 3 meter, etc.)
- Large effect on fine scale detail of landscape

1000m (~1/2 mile)
Resolution

- Often described by the resolution of one grid cell or pixel (e.g., 3 meter, etc.)
- Large effect on fine scale detail of landscape

10 meter
Resolution

- Often described by the resolution of one grid cell or pixel (e.g., 3 meter, etc.)
- Large effect on fine scale detail of landscape

30 meter

1000m (~1/2 mile)
Elevation data is available for the entire state at the 10 meter (30 foot) resolution from the USGS National Elevation Dataset (NED).

LiDAR in Wisconsin is collected on county by county basis
- Only certain counties currently have LiDAR coverage, that is 3m (5 ft) resolution

http://www.wisconsinview.org/
Can I run EVAAL without LiDAR?

- EVAAL is intended to be used with high-resolution elevation data, LiDAR data

- This provides highly detailed maps of where potential areas of erosion exist

- However, **Yes**, EVAAL can still be used with lower resolution elevation data

- **Note**: The lower resolution will affect the results!
Difference in IDAs

- Internally drained areas
  - Modeled hydrology is different
  - For example: 80 times more internally drained area with the LiDAR data
Erosion vulnerability is a relative metric, changes based on which areas are included in the analysis.

- Less area included (because more internally drained) means different range of values.
- Compared to LiDAR data, erosion vulnerability is more variable, and a slightly higher mean.

**NOTE:** this relationship may not always hold true.
Erosion Vulnerability Difference

- Beware the relative nature, only looking within the watershed
- Assess only as relative values
What to do if you are interested in two watersheds next to one another, breaking across county lines, one with LiDAR, one without?

- Mosaic together:
  - 1st: resample the non-LiDAR to the resolution of the LiDAR (resample tool)
  - 2nd: use mosaic tool to fuse together
EVAAL Outputs

- EVAAL outputs a relative erosion score, take care in assessing output from different model runs!
  - Normalizes values across watershed
  - Cannot compare values from different watersheds
  - Look at relative values for one run

- How to compare across watersheds?
  - Merge USLE, SPI, IDA layers prior to running erosion vulnerability
EVAAL

Culvert processing
Digital Dams & Culverts

- Locate depressions
- Create culverts
- Run EVAAL step 1, DEM processing, and check internally draining areas
- Repeat if necessary
Locate Depressions

- Create filled DEM
  - Spatial Analyst Toolbox – Hydrology – Fill

![Raw vs Filled DEM Comparison](image-url)
Locate Depressions

- Subtract rawDEM from filledDEM to get depressions (a.k.a. sinks)
  - Some are real
    - Lakes, quarries, etc.
  - Some are product of LiDAR DEM
How to differentiate between real and “fake” depressions
- Overlay lakes
- View only very deep depressions
- Look for tell-tale flat sided depression (road berm)

Classic case
Locate Depressions

- Ditches
- Notice the flat side
Locate Depressions

- Small streams
- Flat side again
• Completely round…

• Don’t bother trying to cut these
• Completely round...

• Don’t bother trying to cut these
• Another

• Again, don’t bother
• Another
• Again, don’t bother
• Quarries
• Lakes
• Can’t cut
• Quarries
• Lakes
• Can’t cut
Create culverts

- Different approaches:
  - Geolocate culverts in your area of interest in the field, prior to digitizing
  - View aerial photos and base maps while creating the culvert layer
  - After creating a culverts layer, field verify questionable areas
Create Culvert Layer

- Shapefile or Feature Class
  - Must be Polyline
- Projection
  - NAD_1983_HARN_Transverse_Mercator
- Edit in ArcMap
Create Culverts

- **Main idea**: input culverts to areas that are drained by culverts, bridges, etc.
  - Find sinks that are likely drained by culverts
  - Create a line that represents a culvert
  - Repeat

- **NOTE**: this can be a difficult and iterative process. It will take some time to get right and will involve a number of judgment calls.
Input Culverts

- Classic case of a ‘digital dam’.
  - Large puddle shape
  - Flat on one side where there is a road
  - Most likely a culvert spanning this area
  - Actually see where the culvert is
Input Culverts

- Classic case of a ‘digital dam’.
  - Large puddle shape
  - Flat on one side where there is a road
  - Most likely a culvert spanning this area
  - Actually see where the culvert is
Once you’ve selected the line tool in the create features box:

- Click once on the upstream side and once on the downstream side (in that order)
- We’ve found it useful to first use the identify tool to make sure the first point is higher in elevation than the second
- After the two points have been selected, push F2 or right-click and click ‘Finish sketch’ to finish that culvert.

- Only two points per line
- First point must be higher elevation than second
And repeat

- Find the next digital dam and repeat until done
- Skip ponds
- Skip quarries
- Skip wetland-like areas
- Run the first few steps of EVAAL (up from steps 1 and 2a, b and c) to see how the internally drained areas look
  - If it looks good (enough), then you’re done, if not, add more culverts to trouble areas and rerun
- Layer of internally drained areas...does it match what you’d expect?
  - If not, go back, add more or remove some
EVAAL

Other inputs
Soils

- Gridded Soil Survey Geographic Database, or gSSURGO database
- Freely available from the USDA–NRCS Geospatial Datagateway

http://datagateway.nrcs.usda.gov/

- Note that this is a statewide dataset and so is very large and can take several hours to download.

Filename: SDM_State_WI.gdb
Digitize BMPs to remove from analysis
EVAAL

Scenarios
Mitigation Opportunity

\[ A = K(LS)C \]

Cropland data layer

Crop Rotations

SNAP-Plus -> Rotation C Factor

Poor  Good
C Factor Adjustments

USLE w/ Low C Factor

USLE w/ High C Factor
Other Scenarios

- Edit rotation grid
- Edit C factor table

<table>
<thead>
<tr>
<th>ROTATION</th>
<th>SCENARIO</th>
<th>C_FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Grain</td>
<td>High</td>
<td>0.176</td>
</tr>
<tr>
<td>Cash Grain</td>
<td>Low</td>
<td>0.010</td>
</tr>
<tr>
<td>Continuous Corn</td>
<td>Low</td>
<td>0.005</td>
</tr>
<tr>
<td>Continuous Corn</td>
<td>Medium</td>
<td>0.143</td>
</tr>
<tr>
<td>Continuous Corn</td>
<td>High</td>
<td>0.300</td>
</tr>
<tr>
<td>Dairy Potato Year</td>
<td></td>
<td>0.085</td>
</tr>
<tr>
<td>Dairy Rotation</td>
<td>High</td>
<td>0.180</td>
</tr>
<tr>
<td>Dairy Rotation</td>
<td>Low</td>
<td>0.006</td>
</tr>
<tr>
<td>Pasture/Hay/Grassland</td>
<td>High</td>
<td>0.039</td>
</tr>
<tr>
<td>Pasture/Hay/Grassland</td>
<td>Low</td>
<td>0.000</td>
</tr>
<tr>
<td>Potato/Grain/Veggie Rotation</td>
<td>Low</td>
<td>0.181</td>
</tr>
<tr>
<td>Potato/Grain/Veggie Rotation</td>
<td>High</td>
<td>0.305</td>
</tr>
</tbody>
</table>
Existing nutrient management plans
- Soil P
- Animal lots
- Others…. 
EVAAL

In progress
Satellite Imagery Analysis

- Determine percentage of crop residue coverage
- Relate to tillage types
Satellite Imagery Analysis

- Normalized Difference Tillage Index
- NDTI = (band5 - band7) / (band5 + band7)

“Remote Sensing Of Crop Residue Cover Using Multi-temporal Landsat Imagery”
B. Zheng – 2012
NDTI is positively correlated with crop residue cover and green vegetation.
STEPL

Overview
Spreadsheet Tool for Estimating Pollutant Load
Simple model – MS Excel spreadsheet
Data driven and highly empirical
Calculates
- Pollutant loads by land use type and watershed
- Load reductions from implementation of BMPs
- Runoff, nitrogen, phosphorus, BOD5, sediment
STEPL System Requirements

- Windows operating system
- MS Excel 2003/2007/2010
- NOT compatible with Windows 7 OS and MS Excel 2007 combination
- 14 MB hard disk space

- Does require installation to a folder with write access
STEPL Methods

- Hydrology – curve number approach
- Erosion – USLE, urban runoff concentration
- Pollutant load – runoff concentration
STEPL Tools

- **STEPL**
  - Calculates loads for different sources
  - User specified BMPs
  - Urban tool for stormwater BMPs

- **BMP Calculator**
  - Calculate combined efficiency of multiple BMPs
  - Use when more than 1 BMP applied to same land use type

- **Input Data Server**
  - Map interface to generate input data for model at HUC12 level
Data Requirements

- Watershed-level data
  - County & Weather Station
  - Land use distribution
  - Agricultural animal population and number of months manure applied
  - Septic system information

- Land cover specific
  - BMP type and % area applied
  - Urban Land use types for urban BMPs
BMPs Available

- **Cropland**
  - Contour farming
  - Diversion
  - Filter strip
  - Reduced tillage
  - Streambank stabilization
  - Terrace

- **Feedlots**
  - Diversion
  - Filter strip
  - Runoff management system
  - Solids separation basin
  - Waste storage facility

- **Urban**
  - Alum treatment
  - Bioretention
  - Dry/wet detention
  - Grass swales
  - Porous pavement
  - Sand filter
  - Settling basin
  - Street sweeping
  - Wetland detention
  - Rain barrel/cistern
  - Infiltration Trench
  - Filter strips
  - Oil/Grid separator
Online Input Data Server
STEPL Limitations

- Simple, planning tool
- Based on coarse data, give rough estimates
- Pollutant loads by land use type
- Annual average values
- Does not account for drain tiles
Upcoming STEPL Enhancements

- Additional BMPs
  - Several for Pastureland
- Crosswalk to NRCS standards
- Ecoli load reductions
- Flow volume reductions
- Improved guidance and reporting tools
Welcome to STEPL and Region 5 Model

Spreadsheet Tool for Estimating Pollutant Load (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff, nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5), and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and till erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

Region 5 Model is an Excel workbook that provides a gross estimate of sediment and nutrient load reductions from the implementation of agricultural and urban BMPs. The algorithms for non-urban BMPs are based on the "Pollutants controlled: Calculation and documentation for Section 319 watersheds training manual" (Michigan Department of Environmental Quality, June 1999). The algorithms for urban BMPs are based on the data and calculations developed by Illinois EPA. Region 5 Model does not estimate pollutant load reductions for dissolved constituents.

Questions? Please contact:
STEPL E-mail support
Developed for EPA Office of Water
Grants Reporting and Tracking System
By Tetra Tech, Inc.
STEPL Web Resources

- Frequently Asked Questions
- STEPL Slide Shows & Tutorials
- Alternative Models Document

STEPL Support:
- stepl@tetratech.com
Spreadsheet Tool for Estimating Pollutant Loads (STPPL) webinar

The DNR and EPA offered a hands-on technical training on the [Spreadsheet Tool for Estimating Pollutant Loads (STPPL)](exit DNR) on August 5, 2014. A recording of the training session and the presentation materials are available.

- Training video recording [exit DNR]
- Presentation slides [pdf]
- Hands-on training exercises [pdf]

This training was specifically offered for DNR and county LCD staff, particularly those counties who are recurring Targeted Runoff Management (TRM) and Notice of Discharge (NOD) grantees. Beginning with the CY 2015 TRM and NOD grant awards, grantees will be required to provide modeled pollutant load reduction estimates (phosphorus, nitrogen and sediment, as applicable) to the DNR as part of their project evaluation strategy in the reimbursement request/final report. Grantees will have the flexibility to select and use an appropriate model to calculate those load reductions. One of the models that EPA offers, and DNR is subsequently offering to grantees, is STPPL.

Learn more about STPPL:

- [STPPL and Region 5 Model](exit DNR)
STEPL

Inputs
Running STEPL

- Know before you begin:
  - Number of watersheds
  - Number of gullies/streambanks
  - **Tip:** enter more than you need as placeholders

- Check box to turn off Microsoft compatibility checker

- Enable Macros
  - In Excel 2010, Click on File menu > Options > Trust Center > Trust Center Settings > Macro Settings
User defined:
- Land use distribution
- Agricultural animal population and number of months manure applied
- Septic system information

These data are derived from user inputs, but can be modified:
- Soil information (based on county)
- Curve Numbers (land use/soil group)
- Urban land use distribution
- Nutrient concentration in runoff/shallow groundwater

Other optional input data
- Special sediment sources from gullies and impaired streambanks
Land Use Distribution

- STEPL Online Input Data Server
  - By HUC12 only
- National Landcover Dataset (NLCD)
  - 2011 most recent
  - Download from USDA GeoSpatial Data Gateway
    - http://datagateway.nrcs.usda.gov/
  - GIS analysis
- Surface Water Data Viewer
Reach ID 200028511

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach ID</td>
<td>200028511</td>
</tr>
<tr>
<td>Watershed area, upstream total (sq km)</td>
<td>295.48</td>
</tr>
<tr>
<td>Stream gradient (%)</td>
<td>0.0</td>
</tr>
<tr>
<td>Sinuosity</td>
<td>1.44</td>
</tr>
<tr>
<td>Stream order</td>
<td>4</td>
</tr>
<tr>
<td>Distance to Great Lakes (km)</td>
<td></td>
</tr>
<tr>
<td>Distance to large lake (km)</td>
<td>1</td>
</tr>
<tr>
<td>Distance to medium lake (km)</td>
<td>1</td>
</tr>
<tr>
<td>Distance to small lake (km)</td>
<td>10</td>
</tr>
<tr>
<td>Distance to medium river (km)</td>
<td>0.0</td>
</tr>
<tr>
<td>Distance to large river (km)</td>
<td></td>
</tr>
<tr>
<td>Annual precip., upstream watershed avg (mm, 1961-2000)</td>
<td>837</td>
</tr>
<tr>
<td>Annual air temp., upstream watershed avg (C, 1961-2000)</td>
<td>7.8</td>
</tr>
<tr>
<td>Apr-Oct air temp., upstream watershed avg (C, 1961-2000)</td>
<td>15.7</td>
</tr>
<tr>
<td>July air temp., upstream watershed avg (C, 1961-2000)</td>
<td>21.7</td>
</tr>
<tr>
<td>Runoff curve number, upstream watershed avg</td>
<td>76</td>
</tr>
<tr>
<td>Open Water (% of upstream watershed)</td>
<td>1.1</td>
</tr>
<tr>
<td>Developed, Open Space (% of upstream watershed)</td>
<td>5.7</td>
</tr>
<tr>
<td>Developed, Low Intensity (% of upstream watershed)</td>
<td>6.8</td>
</tr>
<tr>
<td>Developed, Medium Intensity (% of upstream watershed)</td>
<td>1.9</td>
</tr>
<tr>
<td>Developed, High Intensity (% of upstream watershed)</td>
<td>0.5</td>
</tr>
<tr>
<td>Barren Land (% of upstream watershed)</td>
<td>0.1</td>
</tr>
<tr>
<td>Deciduous Forest (% of upstream watershed)</td>
<td>3.7</td>
</tr>
<tr>
<td>Evergreen Forest (% of upstream watershed)</td>
<td>0.1</td>
</tr>
<tr>
<td>Mixed Forest (% of upstream watershed)</td>
<td>0.0</td>
</tr>
<tr>
<td>Shrub/Scrub (% of upstream watershed)</td>
<td>0.5</td>
</tr>
<tr>
<td>Grassland/Herbaceous (% of upstream watershed)</td>
<td>0.4</td>
</tr>
<tr>
<td>Pasture/livestock (% of upstream watershed)</td>
<td>16.9</td>
</tr>
<tr>
<td>Cultivated Crops (% of upstream watershed)</td>
<td>56.4</td>
</tr>
<tr>
<td>Woody Wetlands (% of upstream watershed)</td>
<td>0.8</td>
</tr>
<tr>
<td>Emergent Herbaceous Wetlands (% of upstream watershed)</td>
<td>3.2</td>
</tr>
</tbody>
</table>
Web Soil Survey

- Zoom to and set Area of Interest (AOI)
Gully Stabilization

**Volume**
\[
\text{Volume} = \frac{(\text{Top Width} + \text{Bottom Width})}{2} \times \text{Depth} \times \text{Length}
\]

**Load**
- Average annual erosion during the life of the gully (ton/yr)
  \[
  \text{Load} = \text{Volume} \times \text{Soil Weight} / \text{Years}
  \]
- Nutrient load
  \[
  \text{Nutrient load} = \text{Annual Erosion} \times \text{Soil Nutrient Conc.} \times \text{Correction Factor}
  \]

**Load Reduction after implementing gully stabilization**
- Specify reduction efficiency
- Reduction is equal to annual erosion x user-specified efficiency

---

### Table: Gully dimensions in the different watersheds

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Gully</th>
<th>Top Width (ft)</th>
<th>Bottom Width (ft)</th>
<th>Depth (ft)</th>
<th>Length (ft)</th>
<th>Years to Form</th>
<th>BMP Efficiency (0-1)</th>
<th>Soil Textural Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>Gully1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.95</td>
<td>Clay</td>
</tr>
<tr>
<td>W1</td>
<td>Gully2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.95</td>
<td>Clay</td>
</tr>
</tbody>
</table>

---

[Image of Table]
Streambank Erosion

- **Load (Channel Erosion)**
  \[ \text{Load} = \text{Length} \times \text{Height} \times \text{Lateral Recession rate} \times \text{Soil weight} \]

- **Load Reduction**
  \[ \text{Load Reduction} = \text{Load} \times \text{Load reduction efficiency} \]
### Soil Properties and Qualities

**Soil Physical Properties**
- Available Water Capacity
- Available Water Storage
- Available Water Supply, 0 to 100 cm
- Available Water Supply, 0 to 150 cm
- Available Water Supply, 0 to 25 cm
- Available Water Supply, 0 to 50 cm
- Bulk Density, 15 Bar
- Bulk Density, One-Tenth Bar
- Bulk Density, One-Third Bar
- Linear Extensibility
- Liquid Limit
- Organic Matter
- Percent Clay
- Percent Sand
- Percent Silt
- Plasticity Index
- Saturated Hydraulic Conductivity (Ksat)
- Saturated Hydraulic Conductivity (Ksat), Standard Classes

### Surface Texture

#### Summary by Map Unit

**Summary by Map Unit — Waushara County, Wisconsin (W1137)**

<table>
<thead>
<tr>
<th>Map unit symbol</th>
<th>Map unit name</th>
<th>Rating</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad</td>
<td>Adrian muck, 0 to 1 percent slopes</td>
<td>Muck</td>
<td>103.6</td>
<td>10.5%</td>
</tr>
<tr>
<td>Be</td>
<td>Belleville loamy sand, 0 to 2 percent slopes</td>
<td>Loamy sand</td>
<td>20.3</td>
<td>2.1%</td>
</tr>
<tr>
<td>ByB</td>
<td>Boyer loamy sand, 2 to 6 percent slopes</td>
<td>Loamy sand</td>
<td>12.3</td>
<td>1.2%</td>
</tr>
<tr>
<td>CoB</td>
<td>Coloma loamy sand, 2 to 6 percent slopes</td>
<td>Loamy sand</td>
<td>48.6</td>
<td>4.9%</td>
</tr>
</tbody>
</table>

[Map of soil properties and ratings]
Important Parameters

- BMP efficiencies
- New BMP
- USLE factors
- Nutrient concentrations
### BMP List

#### Instruction:
1. Do not delete the grayed rows.
2. BMP efficiencies should be <= 1.
3. If you add a row for a new BMP, you must specify landuse, BMP name, and pollutant removal efficiencies.
4. Type "ND" for no data.
5. Click "Update BMP Data" to update selection boxes on the BMPs sheet.
6. Click "Save Updates" to save the BMP list to external text files in the STEPL/Support folder.

<table>
<thead>
<tr>
<th>Landuse</th>
<th>N</th>
<th>P</th>
<th>BOD</th>
<th>Sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contour Farming</td>
<td>0.485</td>
<td>0.55</td>
<td>ND</td>
<td>0.405</td>
</tr>
<tr>
<td>Contour Farming</td>
<td>0.1</td>
<td>0.3</td>
<td>ND</td>
<td>0.35</td>
</tr>
<tr>
<td>Filter strip</td>
<td>0.75</td>
<td>0.75</td>
<td>ND</td>
<td>0.75</td>
</tr>
<tr>
<td>Streambank stabilization and fencing</td>
<td>0.75</td>
<td>0.75</td>
<td>ND</td>
<td>0.75</td>
</tr>
<tr>
<td>Contour Farming</td>
<td>0.2</td>
<td>0.2</td>
<td>ND</td>
<td>0.85</td>
</tr>
<tr>
<td>Contour Farming</td>
<td>0</td>
<td>0</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>No BMP</td>
<td>0.485</td>
<td>0.55</td>
<td>ND</td>
<td>0.405</td>
</tr>
<tr>
<td>Combined BMPs-Calculated</td>
<td>0</td>
<td>0</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>Road dry seeding</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.41</td>
</tr>
<tr>
<td>Road grass and legume seeding</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.71</td>
</tr>
<tr>
<td>Road hydro mulch</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.41</td>
</tr>
<tr>
<td>Road straw mulch</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.41</td>
</tr>
<tr>
<td>Road tree planting</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.6</td>
</tr>
<tr>
<td>Site preparation/hydro mulch/seed/fertilizer</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.71</td>
</tr>
<tr>
<td>Site preparation/seed/fertilizer/transplants</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.69</td>
</tr>
<tr>
<td>Site preparation/steep slope seeder/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.81</td>
</tr>
<tr>
<td>Site preparation/steep slope seeder/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.69</td>
</tr>
<tr>
<td>Site preparation/straw/crimp seed/fertilizer/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.93</td>
</tr>
<tr>
<td>Site preparation/straw/crimp/not</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.83</td>
</tr>
<tr>
<td>Site preparation/straw/polymer/fertilizer/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.96</td>
</tr>
<tr>
<td>Site preparation/straw/polymer/fertilizer/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.83</td>
</tr>
<tr>
<td>Site preparation/straw/polymer/fertilizer/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.96</td>
</tr>
<tr>
<td>Site preparation/straw/polymer/fertilizer/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.83</td>
</tr>
<tr>
<td>Site preparation/straw/polymer/fertilizer/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.96</td>
</tr>
<tr>
<td>Site preparation/straw/polymer/fertilizer/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.83</td>
</tr>
<tr>
<td>Site preparation/straw/polymer/fertilizer/transplant</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.96</td>
</tr>
<tr>
<td>User Defined 0 No BMP</td>
<td>0</td>
<td>0</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>User Defined Combined BMPs-Calculated</td>
<td>0</td>
<td>0</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>Feedlots</td>
<td>0.45</td>
<td>0.7</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>Filter strip</td>
<td>0.95</td>
<td>0.95</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>Runoff Mgmt System</td>
<td>ND</td>
<td>ND</td>
<td>0.825</td>
<td>ND</td>
</tr>
<tr>
<td>Solids Separation Basin</td>
<td>0.35</td>
<td>0.31</td>
<td>ND</td>
<td>0.35</td>
</tr>
<tr>
<td>Solids Separation Basin/filtered Bed</td>
<td>0.8</td>
<td>0.8</td>
<td>ND</td>
<td>0.85</td>
</tr>
<tr>
<td>Terrace</td>
<td>ND</td>
<td>ND</td>
<td>0.95</td>
<td>ND</td>
</tr>
<tr>
<td>Waste Mgmt System</td>
<td>ND</td>
<td>ND</td>
<td>0.9</td>
<td>ND</td>
</tr>
<tr>
<td>Waste Storage Facility</td>
<td>0.95</td>
<td>0.95</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>Urban</td>
<td>0.6</td>
<td>0.6</td>
<td>ND</td>
<td>0.95</td>
</tr>
<tr>
<td>Urban Alum Treatment</td>
<td>0.6</td>
<td>0.6</td>
<td>ND</td>
<td>0.95</td>
</tr>
<tr>
<td>Urban Bioretenion facility</td>
<td>0.63</td>
<td>0.63</td>
<td>ND</td>
<td>0.95</td>
</tr>
<tr>
<td>Urban Combined BMPs-Calculated</td>
<td>0.9</td>
<td>0.9</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>Urban Concrete Grid Pavement</td>
<td>0.9</td>
<td>0.9</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>Input RIPDs</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Gully &amp; Streambank</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Total Load</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Graphs</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>BMPList</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

**Update BMP Data**

**Save Updates**
**Parameter Adjustments**

4. **Modify the Universal Soil Loss Equation (USLE) parameters**

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Cropland R</th>
<th>K</th>
<th>LS</th>
<th>C</th>
<th>P</th>
<th>Pastureland R</th>
<th>K</th>
<th>LS</th>
<th>C</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>374.689</td>
<td>0.197</td>
<td>0.289</td>
<td>0.200</td>
<td>0.986</td>
<td>374.689</td>
<td>0.197</td>
<td>0.289</td>
<td>0.040</td>
<td>1.000</td>
</tr>
<tr>
<td>W2</td>
<td>374.689</td>
<td>0.197</td>
<td>0.289</td>
<td>0.200</td>
<td>0.986</td>
<td>374.689</td>
<td>0.197</td>
<td>0.289</td>
<td>0.040</td>
<td>1.000</td>
</tr>
</tbody>
</table>

- Can modify C and/or P factors for each land use type with local information

7. **Nutrient concentration in runoff (mg/l)**

<table>
<thead>
<tr>
<th>Land use</th>
<th>N</th>
<th>P</th>
<th>BOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. L-Croplan</td>
<td>1.9</td>
<td>0.3</td>
<td>4</td>
</tr>
<tr>
<td>1a. w/ manure</td>
<td>8.1</td>
<td>2</td>
<td>12.3</td>
</tr>
<tr>
<td>2. M-Croplan</td>
<td>2.9</td>
<td>0.4</td>
<td>6.1</td>
</tr>
<tr>
<td>2a. w/ manure</td>
<td>12.2</td>
<td>3</td>
<td>18.5</td>
</tr>
<tr>
<td>3. H-Croplan</td>
<td>4.4</td>
<td>0.5</td>
<td>9.2</td>
</tr>
<tr>
<td>3a. w/ manure</td>
<td>18.3</td>
<td>4</td>
<td>24.6</td>
</tr>
<tr>
<td>4. Pasturelarn</td>
<td>4</td>
<td>0.3</td>
<td>13</td>
</tr>
<tr>
<td>5. Forest</td>
<td>0.2</td>
<td>0.1</td>
<td>0.5</td>
</tr>
<tr>
<td>6. User Defined</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- Adjust nutrient concentrations in runoff
STEPL – Example

Manure Storage System
### 1. Input watershed land use area (ac) and precipitation (in)

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Urban</th>
<th>Cropland</th>
<th>Pastureland</th>
<th>Forest</th>
<th>User Defined</th>
<th>Feedlots</th>
<th>Feedlot Percent Paved</th>
<th>Total</th>
<th>Annual Rainfall</th>
<th>Rain Days</th>
<th>Avg. Rain/Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>75-100%</td>
<td>0.25</td>
<td>28.25</td>
<td>101.2</td>
<td>0.674</td>
</tr>
</tbody>
</table>

### 2. Input agricultural animals

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Beef Cattle</th>
<th>Dairy Cattle</th>
<th>Swine (hog)</th>
<th>Sheep</th>
<th>Horse</th>
<th>Chicken</th>
<th>Turkey</th>
<th>Duck</th>
<th># of months manure applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

### 3. Input septic system and illegal direct wastewater discharge data

<table>
<thead>
<tr>
<th>Watershed</th>
<th>No. of Septic Systems</th>
<th>Population per Septic System</th>
<th>Septic Failure Rate, %</th>
<th>Wastewater Direct Discharge, # of People</th>
<th>Direct Discharge Reduction, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>2.43</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### 4. Modify the Universal Soil Loss Equation (USLE) parameters

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Cropland</th>
<th>Pastureland</th>
<th>Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td>K</td>
<td>LS</td>
</tr>
<tr>
<td>W1</td>
<td>100.000</td>
<td>0.328</td>
<td>0.410</td>
</tr>
</tbody>
</table>
**Best Management Practice**

Select an appropriate BMP except "Combined BMPs-Calculated" for each subwatershed in each land use table using the pull-down list-box if interactions between BMPs are not considered. Select "Combined BMPs-Calculated" if multiple BMPs and their interactions in the subwatersheds are considered; use BMP calculator (under STEPL menu) to obtain the combined BMP efficiencies and enter them in Table 7.

### Urban BMP Tool

<table>
<thead>
<tr>
<th>Watershed</th>
<th>BMPs</th>
<th>% Area BMP Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cropland</td>
<td>0 No BMP</td>
<td>100</td>
</tr>
<tr>
<td>Pastureland</td>
<td>0 No BMP</td>
<td>100</td>
</tr>
<tr>
<td>Forest</td>
<td>0 No BMP</td>
<td>100</td>
</tr>
<tr>
<td>User Defined</td>
<td>0 No BMP</td>
<td>100</td>
</tr>
<tr>
<td>Feedlots</td>
<td>Waste Storage Facility</td>
<td>100</td>
</tr>
<tr>
<td>Urban</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To change/set BMP/LID for urban land uses, click the 'Urban BMP Tool' button on the top-left of this sheet.
### 1. Total load by subwatershed(s)

<table>
<thead>
<tr>
<th>Watershed</th>
<th>N Load (no BMP)</th>
<th>P Load (no BMP)</th>
<th>BOD Load (no BMP)</th>
<th>Sediment Load (no BMP)</th>
<th>N Reduction</th>
<th>P Reduction</th>
<th>BOD Reduction</th>
<th>Sediment Reduction</th>
<th>N Load (with BMP)</th>
<th>P Load (with BMP)</th>
<th>BOD (with BMP)</th>
<th>Sediment Load (with BMP)</th>
<th>% N Reduction</th>
<th>% P Reduction</th>
<th>% BOD Reduction</th>
<th>% Sed Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>35.0</td>
<td>147.0</td>
<td>980.0</td>
<td>0.0</td>
<td>47.7%</td>
<td>88.2%</td>
<td>0.0</td>
<td>0.0</td>
<td>257.2</td>
<td>58.8%</td>
<td>980.0</td>
<td>0.0</td>
<td>65.0%</td>
<td>68.0%</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>795.0</td>
<td>480.0</td>
<td>3900.0</td>
<td>0.0</td>
<td>47.7%</td>
<td>88.2%</td>
<td>0.0</td>
<td>0.0</td>
<td>257.2</td>
<td>58.8%</td>
<td>980.0</td>
<td>0.0</td>
<td>65.0%</td>
<td>68.0%</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### 2. Total load by land uses (with BMP)

<table>
<thead>
<tr>
<th>Sources</th>
<th>N Load (lb/yr)</th>
<th>P Load (lb/yr)</th>
<th>BOD Load (lb/yr)</th>
<th>Sediment Load (lb/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Cropland</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Pastureland</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Forest</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Feedlots</td>
<td>254.24</td>
<td>58.00</td>
<td>379.36</td>
<td>0.00</td>
</tr>
<tr>
<td>User Defined</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Septic</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Gully</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Streambank</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>254.24</td>
<td>58.00</td>
<td>379.36</td>
<td>0.00</td>
</tr>
</tbody>
</table>
STEPL – Example

BMP Scenarios
### 1. Input watershed land use area (ac) and precipitation (in)

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Urban</th>
<th>Cropland</th>
<th>Pastureland</th>
<th>Forest</th>
<th>User Defined</th>
<th>Feedlots</th>
<th>Feedlot Percent Paved</th>
<th>Total</th>
<th>Annual Rainfall</th>
<th>Rain Days</th>
<th>Avg. Rain/Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>220</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.24%</td>
<td>277</td>
<td>35.01</td>
<td>106.8</td>
<td>0.776</td>
</tr>
<tr>
<td>W2</td>
<td>220</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.24%</td>
<td>277</td>
<td>35.01</td>
<td>106.8</td>
<td>0.776</td>
</tr>
<tr>
<td>W3</td>
<td>220</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0.24%</td>
<td>277</td>
<td>35.01</td>
<td>106.8</td>
<td>0.776</td>
</tr>
</tbody>
</table>

### 2. Input agricultural animals

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Beef Cattle</th>
<th>Dairy Cattle</th>
<th>Swine (Hog)</th>
<th>Sheep</th>
<th>Horse</th>
<th>Chicken</th>
<th>Turkey</th>
<th>Duck</th>
<th># of months manure applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>W2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>W3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

### 3. Input septic system and illegal direct wastewater discharge data

<table>
<thead>
<tr>
<th>Watershed</th>
<th>No. of Septic Systems</th>
<th>Population per Septic System</th>
<th>Septic Failure Rate, %</th>
<th>Wastewater Direct Discharge, # of People</th>
<th>Direct Discharge Reduction, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>2.43</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>W2</td>
<td>0</td>
<td>2.43</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>W3</td>
<td>0</td>
<td>2.43</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### 4. Modify the Universal Soil Loss Equation (USLE) parameters

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Cropland</th>
<th>Pastureland</th>
<th>Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td>K</td>
<td>LS</td>
</tr>
<tr>
<td>W1</td>
<td>100.000</td>
<td>0.223</td>
<td>0.496</td>
</tr>
<tr>
<td>W2</td>
<td>100.000</td>
<td>0.223</td>
<td>0.496</td>
</tr>
<tr>
<td>W3</td>
<td>100.000</td>
<td>0.223</td>
<td>0.496</td>
</tr>
</tbody>
</table>

### 5. Select data input:

- **SHG A**: highest infiltration
- **SHG D**: lowest infiltration

<table>
<thead>
<tr>
<th>Watershed</th>
<th>SHG A</th>
<th>SHG B</th>
<th>SHG C</th>
<th>SHG D</th>
<th>SHG Selected</th>
<th>Soil N conc.%</th>
<th>Soil P conc.%</th>
<th>Soil BOD conc.%</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>🔴</td>
<td>🔴</td>
<td>🔴</td>
<td>🔴</td>
<td>NE</td>
<td>0.082</td>
<td>0.031</td>
<td>0.160</td>
</tr>
<tr>
<td>W2</td>
<td>🔴</td>
<td>🔴</td>
<td>🔴</td>
<td>🔴</td>
<td>NE</td>
<td>0.082</td>
<td>0.031</td>
<td>0.160</td>
</tr>
<tr>
<td>W3</td>
<td>🔴</td>
<td>🔴</td>
<td>🔴</td>
<td>🔴</td>
<td>NE</td>
<td>0.082</td>
<td>0.031</td>
<td>0.160</td>
</tr>
</tbody>
</table>

**Rain correction factors**

- 0.842
- 0.389
1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data

<table>
<thead>
<tr>
<th>Watershed</th>
<th>N</th>
<th>P</th>
<th>BOD</th>
<th>Sediment</th>
<th>BMPs</th>
<th>% Area BMP Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
<tr>
<td>W2</td>
<td>0.275</td>
<td>0.225</td>
<td>ND</td>
<td>0.375</td>
<td>Reduced Tillage Systems</td>
<td>50</td>
</tr>
<tr>
<td>W3</td>
<td>0.14</td>
<td>0.15</td>
<td>ND</td>
<td>0.13</td>
<td>Filter strip</td>
<td>20</td>
</tr>
</tbody>
</table>

2. BMPs and efficiencies for different pollutants on PASTURELAND, ND=No Data

<table>
<thead>
<tr>
<th>Watershed</th>
<th>N</th>
<th>P</th>
<th>BOD</th>
<th>Sediment</th>
<th>BMPs</th>
<th>% Area BMP Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
<tr>
<td>W2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
<tr>
<td>W3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
</tbody>
</table>

3. BMPs and efficiencies for different pollutants on FOREST, ND=No Data

<table>
<thead>
<tr>
<th>Watershed</th>
<th>N</th>
<th>P</th>
<th>BOD</th>
<th>Sediment</th>
<th>BMPs</th>
<th>% Area BMP Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
<tr>
<td>W2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
<tr>
<td>W3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
</tbody>
</table>

4. BMPs and efficiencies for different pollutants on USER DEFINED land use, ND=No Data

<table>
<thead>
<tr>
<th>Watershed</th>
<th>N</th>
<th>P</th>
<th>BOD</th>
<th>Sediment</th>
<th>BMPs</th>
<th>% Area BMP Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
<tr>
<td>W2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
<tr>
<td>W3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
</tbody>
</table>

5. BMPs and efficiencies for different pollutants on FEEDLOTS, ND=No Data

<table>
<thead>
<tr>
<th>Watershed</th>
<th>N</th>
<th>P</th>
<th>BOD</th>
<th>Sediment</th>
<th>BMPs</th>
<th>% Area BMP Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0.65</td>
<td>0.6</td>
<td>ND</td>
<td>ND</td>
<td>Waste Storage Facility</td>
<td>100</td>
</tr>
<tr>
<td>W2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
<tr>
<td>W3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 No BMP</td>
<td>0</td>
</tr>
</tbody>
</table>
### 1. Total load by subwatershed(s)

| Watershed | N Load (no BMP) | P Load (no BMP) | BOD Load (no BMP) | Sediment Load (no BMP) | N Reduction | P Reduction | BOD Reduction | Sediment Reduction | N Load (with BMP) | P Load (with BMP) | BOD (with BMP) | Sediment Load (with BMP) | % N Reduction | % P Reduction | % BOD Reduction | % Sed Reduction |
|-----------|----------------|----------------|-------------------|------------------------|-------------|-------------|--------------|-------------------|-----------------|-----------------|---------------|----------------|-----------------|-----------------|----------------|----------------|----------------|
| W1        | 10352.5        | 1816.2         | 13397.6           | 177.1                  | 3323.9      | 394.7       | 0.0          | 0.0               | 7028.6          | 513.6           | 13397.5       | 177.1           | 32.1           | 16.8           | 0.0            | 0.0              |
| W2        | 1352.5         | 1816.2         | 13397.6           | 177.1                  | 1330.2      | 316.7       | 407.1        | 63.6              | 6362.4          | 1500.2          | 13397.5       | 13.5            | 13.4           | 17.5           | 2.3            | 35.9            |
| W3        | 10352.5        | 1816.2         | 13397.6           | 177.1                  | 674.7       | 187.0       | 141.1        | 22.0              | 9677.5          | 1631.3          | 13397.5       | 155.1           | 6.5            | 10.3           | 1.0            | 12.4            |
| Total     | 31857.6        | 5454.7         | 41392.8           | 531.4                  | 5388.7      | 809.7       | 541.2        | 58.7              | 25680.8         | 4545.0          | 445.8         | 17.4            | 14.8           | 1.3            | 16.1           |                 |

### 2. Total load by land uses (with BMP)

<table>
<thead>
<tr>
<th>Sources</th>
<th>N Load (lb/yr)</th>
<th>P Load (lb/yr)</th>
<th>BOD Load (lb/yr)</th>
<th>Sediment Load (t/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Cropland</td>
<td>1250.06</td>
<td>3293.13</td>
<td>22395.68</td>
<td>423.17</td>
</tr>
<tr>
<td>Pastureland</td>
<td>1143.12</td>
<td>100.17</td>
<td>3624.66</td>
<td>22.01</td>
</tr>
<tr>
<td>Forest</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Feedlots</td>
<td>12017.19</td>
<td>1218.58</td>
<td>15454.24</td>
<td>0.00</td>
</tr>
<tr>
<td>User Defined</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Septic</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Silted</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Streambank</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>25668.63</td>
<td>4644.36</td>
<td>41444.61</td>
<td>445.73</td>
</tr>
</tbody>
</table>

### Table of Nutrient Reductions

<table>
<thead>
<tr>
<th>% N Reduction</th>
<th>% P Reduction</th>
<th>% BOD Reduction</th>
<th>% Sed Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>32.1</td>
<td>16.8</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>13.4</td>
<td>17.5</td>
<td>2.9</td>
<td>35.9</td>
</tr>
<tr>
<td>6.5</td>
<td>10.3</td>
<td>1.0</td>
<td>12.4</td>
</tr>
</tbody>
</table>
STEPL – Example

BMP Efficiency Calculator
<table>
<thead>
<tr>
<th>Practice Combination</th>
<th>% reduction (phosphorus)</th>
<th>% reduction (sediment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contour Farming &amp; Reduced Tillage</td>
<td>75.20</td>
<td>85.10</td>
</tr>
<tr>
<td>NMP (P based) &amp; Reduced Tillage</td>
<td>86.30</td>
<td>75.00</td>
</tr>
<tr>
<td>Cover Crop &amp; Reduced Tillage</td>
<td>58.70</td>
<td>83.70</td>
</tr>
<tr>
<td>NMP (P based), Reduced Tillage, &amp; Cover Crops</td>
<td>89.70</td>
<td>83.70</td>
</tr>
<tr>
<td>Field Border &amp; Reduced Tillage</td>
<td>86.30</td>
<td>91.30</td>
</tr>
<tr>
<td>Field Border &amp; Reduced Tillage &amp; Cover Crops</td>
<td>90.60</td>
<td>92.60</td>
</tr>
<tr>
<td>Conservation Rotation &amp; Reduced Tillage</td>
<td>67.00</td>
<td>88.70</td>
</tr>
<tr>
<td>Conservation Rotation &amp; Reduced Tillage &amp; NMP (P based)</td>
<td>91.80</td>
<td>88.70</td>
</tr>
<tr>
<td>NMP (N&amp;P balanced) &amp; Reduced Tillage</td>
<td>60.40</td>
<td>75.00</td>
</tr>
<tr>
<td>NMP (N&amp;P balanced), Reduced Tillage, &amp; Cover Crops</td>
<td>70.30</td>
<td>83.70</td>
</tr>
<tr>
<td>Conservation Rotation &amp; Reduced Tillage &amp; NMP (N &amp; P balanced)</td>
<td>76.20</td>
<td>88.70</td>
</tr>
<tr>
<td>Average Practice Efficiency</td>
<td>71.04</td>
<td>84.35</td>
</tr>
</tbody>
</table>
## 1. Total load by subwatershed(s)

<table>
<thead>
<tr>
<th>Watershed</th>
<th>P Load (no BMP)</th>
<th>Sediment Load (no BMP)</th>
<th>N Reduction</th>
<th>P Reduction</th>
<th>BOD Reduction</th>
<th>Sediment Reduction</th>
<th>N Load (with BMP)</th>
<th>P Load (with BMP)</th>
<th>BOD (with BMP)</th>
<th>Sediment Load (with BMP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1 (Plum)</td>
<td>35887.4 lb/year</td>
<td>6244.5 t/year</td>
<td>5257.0 lb/year</td>
<td>15152.6 lb/year</td>
<td>10514.1 lb/year</td>
<td>1642.8 t/year</td>
<td>179563.2 lb/year</td>
<td>20734.9 lb/year</td>
<td>394625.0 lb/year</td>
<td>4601.7 t/year</td>
</tr>
<tr>
<td>W2 (Kankapot)</td>
<td>26829.7 lb/year</td>
<td>4605.7 t/year</td>
<td>5068.3 lb/year</td>
<td>11807.8 lb/year</td>
<td>10136.7 lb/year</td>
<td>1583.9 t/year</td>
<td>127446.4 lb/year</td>
<td>15022.0 lb/year</td>
<td>276580.5 lb/year</td>
<td>3021.9 t/year</td>
</tr>
<tr>
<td>Total</td>
<td>62717.2 lb/year</td>
<td>10850.2 t/year</td>
<td>10325.4 lb/year</td>
<td>26960.3 lb/year</td>
<td>20650.8 lb/year</td>
<td>3226.7 t/year</td>
<td>307009.6 lb/year</td>
<td>35756.8 lb/year</td>
<td>671205.5 lb/year</td>
<td>7623.6 t/year</td>
</tr>
</tbody>
</table>

**Note:** "lb/year" and "t/year" stand for pounds per year and tonnes per year, respectively.
STEPL Applications

- Outagamie County
  - Nonpoint Implementation Plan
    - Loads and load reductions from BMPs

- Root–Pike Watershed Initiative Network
  - Pike River Watershed–Based Plan
    - Load and load reductions from BMPs
Contact Info

Theresa M. Possley Nelson, PE
(608) 266-7037
Theresa.Nelson@wisconsin.gov
dnrwaterqualitymodeling@wisconsin.gov