

Modeling & Analysis Tools for Nonpoint Source Implementation

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Special Thanks

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- ▶ Local County, UW–Extension, and WDNR

Acknowledgements

- ▶ Aaron Ruesch
- ▶ Dave Evans
- ▶ Corinne Billings
- ▶ Andrew Craig
- ▶ Amanda Minks
- ▶ Adam Freihoefer
- ▶ 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

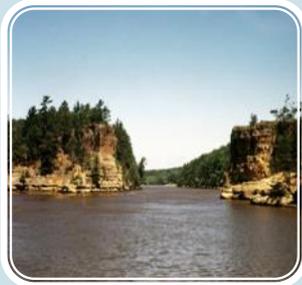
Impaired Waters & TMDLs



Introduction

- ▶ 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



Rivers

100 µg/L



Streams¹

75 µg/L



Reservoirs

- Not Stratified = 40 µg/L
- Stratified = 30 µg/L



Inland Lakes²

Ranges from
15-30 µg/L



Great Lakes

- Lake Michigan = 7 µg/L
- Lake Superior = 5 µg/L

¹All unidirectional flowing waters not in NR 102.06(3)(a). Excludes Ephemeral Streams.

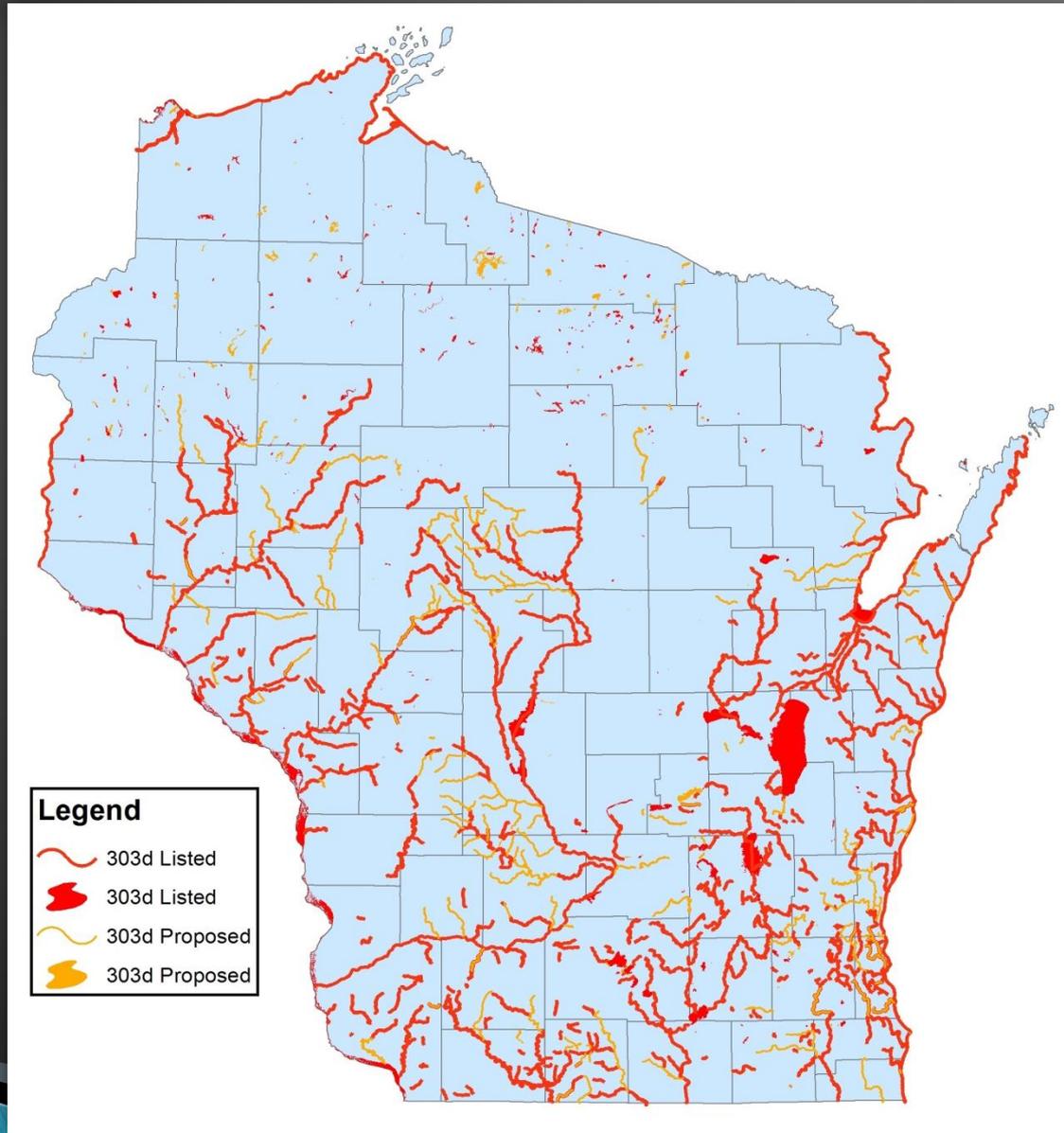
²Excludes wetlands and lakes less than 5 acres

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



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

TMDL Purpose



Current
Pollutant
Load



Does not
meet water
quality standards



Meets water
quality standards



TMDL

Each subwatershed is assessed for:



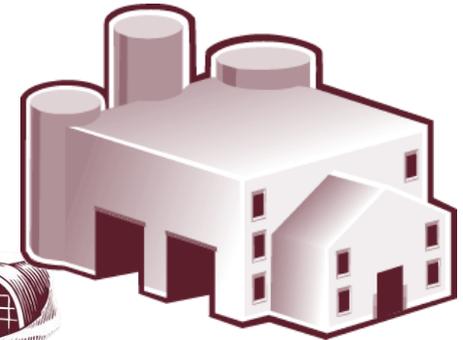
Load Allocation

- Runoff from the landscape
- Background



Background Load

- Naturally occurring from wetlands, forests



Waste Load Allocation

- Municipal Wastewater
- Industrial Wastewater
- Stormwater (MS4s)

TMDL

Load
Allocation

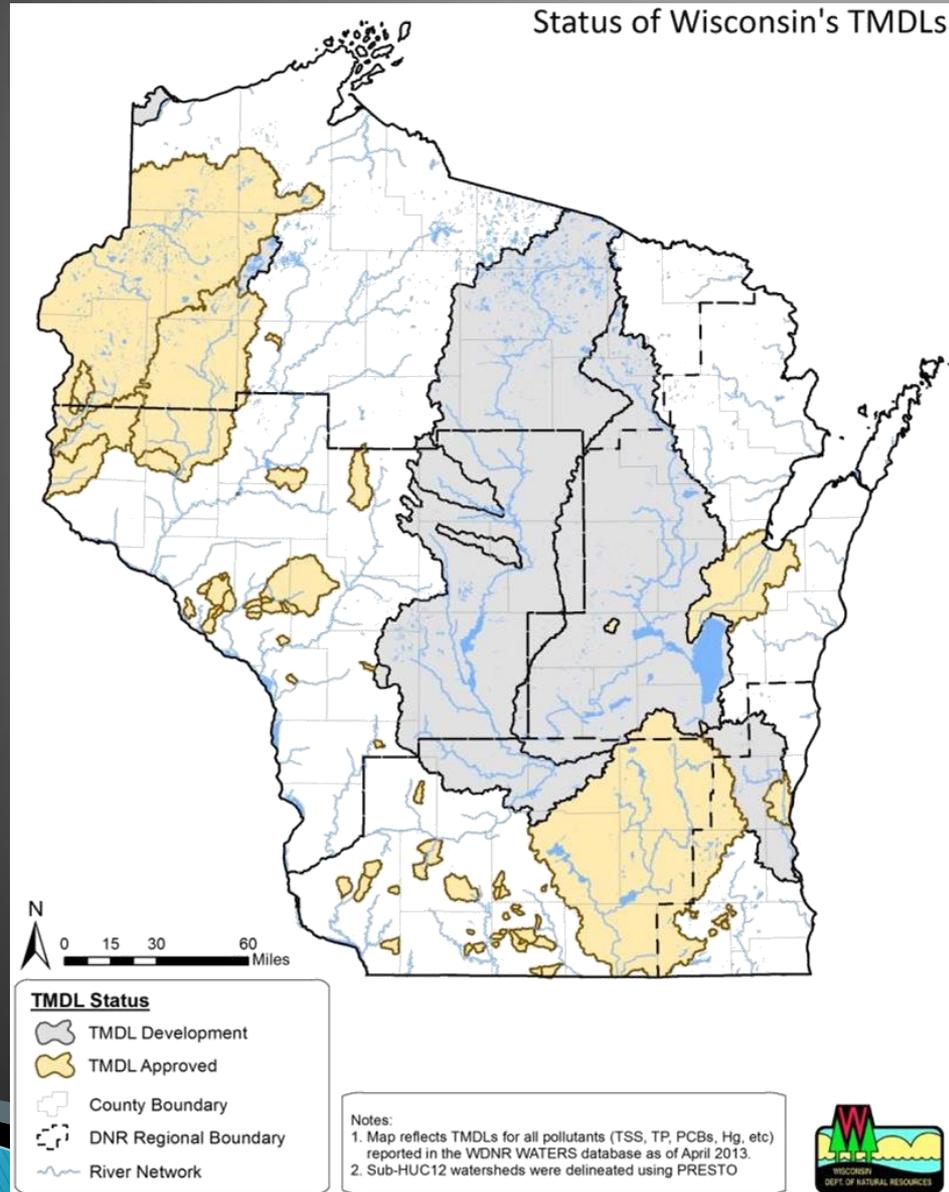
+

Waste Load
Allocation

+

Margin of
Safety

TMDLs Statewide



Alternatives to TMDLs

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

 - Examples:
 - Watershed plan developed
 - Must include EPA's 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

PERMIT

▶ Nonpoint Sources

- Agricultural Lands

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

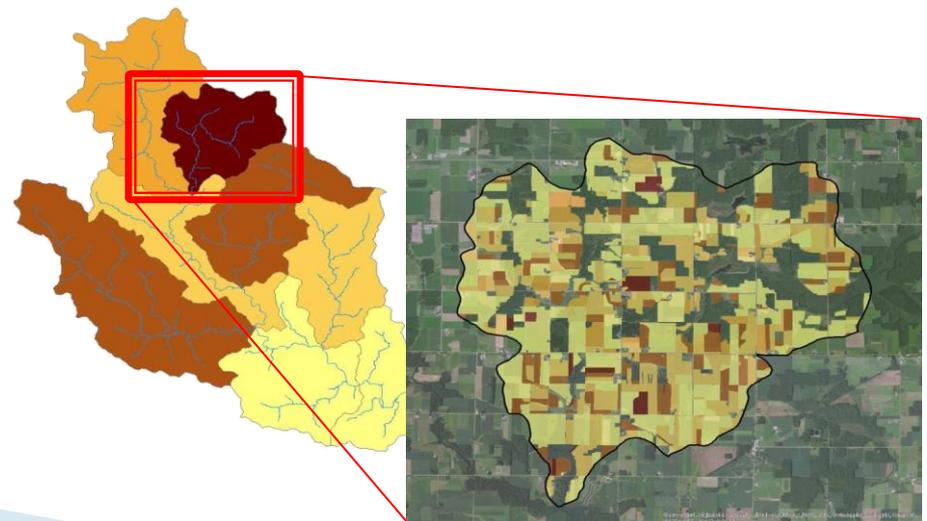
NPS Implementation – County

- ▶ 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

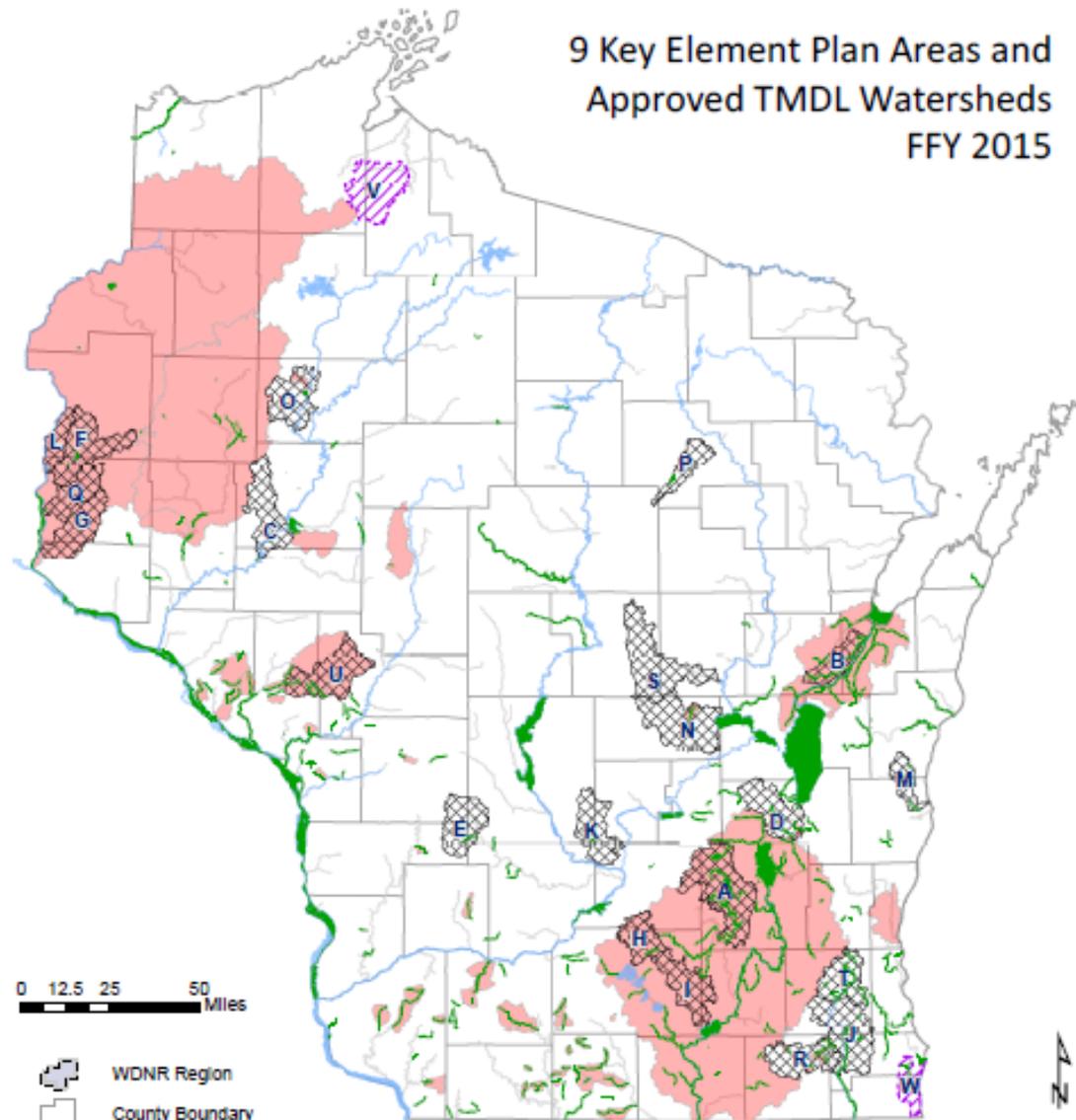
- ▶ EPA 2015 grant requirements – October 2014
- ▶ DNR Nonpoint activities funded with EPA 319 grant funds should be linked to water quality outcomes
- ▶ Focus on restoration of impaired waters via watershed based plans
- ▶ At least 50% of 319 funds must be used in 319 eligible areas
- ▶ 319 eligible 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

9 Key Element Plan Areas and Approved TMDL Watersheds FFY 2015



0 12.5 25 50
Miles

-  WDR Region
-  County Boundary
-  Hydrologic Network
-  303d 2010 Impaired Water
(Phosphorus, Sediment)
-  Priority Watershed 9 Key
Element Plan Area
-  Other EPA-Approved 9 Key
Element Watershed Plan Areas
-  Approved TMDL Watershed

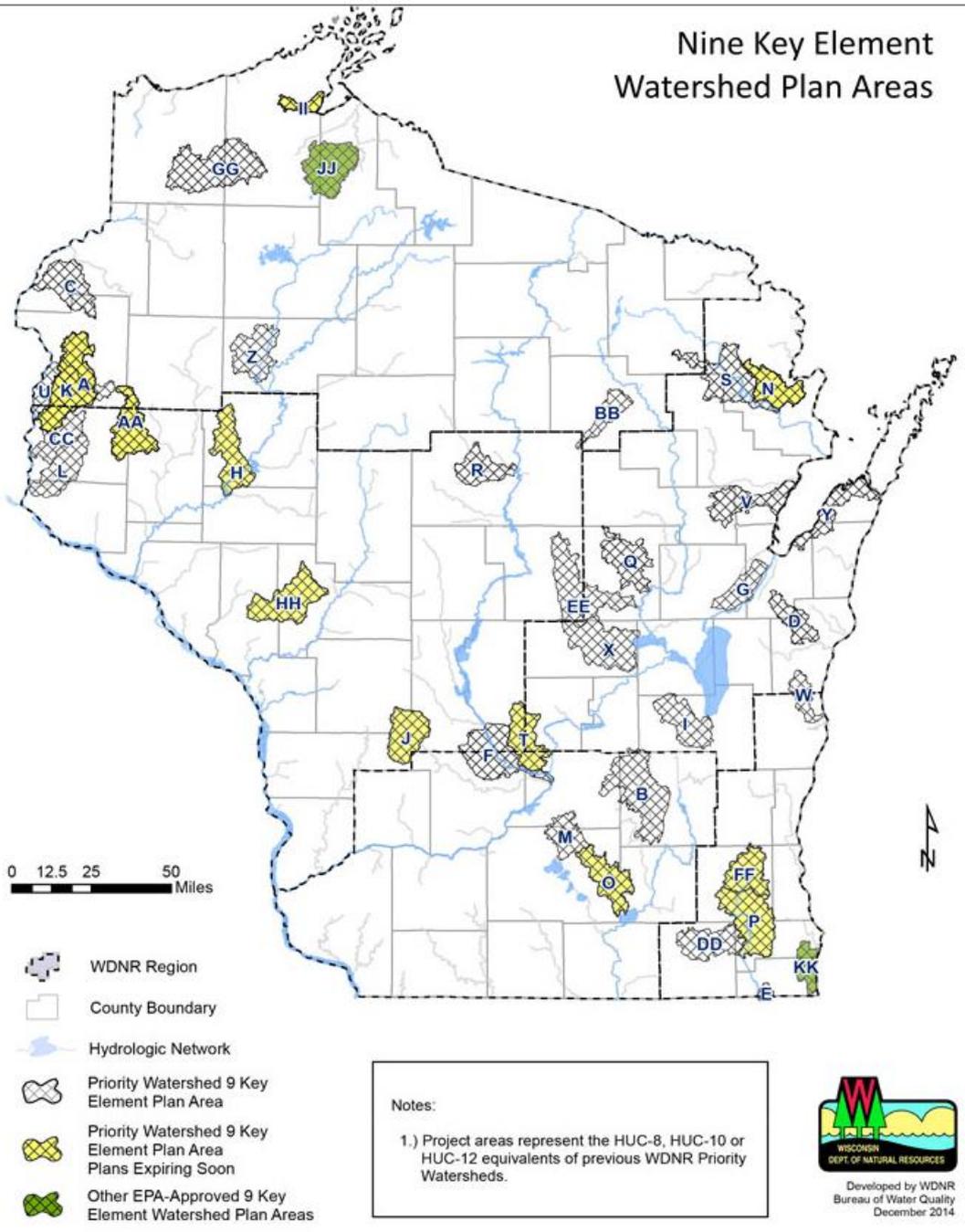
Notes:

- 1.) Project areas represent the HUC-10 or HUC-12 equivalents of previous WDR Priority Watersheds
- 2.) Impaired Waters represent total phosphorus and total suspended sediment Impaired waters those approved by the US EPA in 2010



Developed by WDR
Bureau of Water Quality
October 2014

Nine Key Element Watershed Plan Areas



WDNR – Nine Key Element Website

http://dnr.wi.gov/topic/nonpoint/9keyelementplans.html

Business Licenses & Regulations Recreation Education Topics Contact Join DNR Search or Keywords Share

Nine key element watershed plans

Implementing plans on a watershed basis to restore and protect Wisconsin's waters

Overview Maps Plans Guidance Tools Funding

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](#) [exit DNR]
- [TMDL implementation plans](#)
- [lake management and protection plans](#)
- [river protection plans](#)
- [other watershed-based plans](#)

Summary of the Nine Minimum Elements

- Identify the causes and sources
- Estimate pollutant loading into the watershed and the expected load reductions
- Describe management measures that will achieve load reductions and targeted critical areas
- Estimate the amounts of technical and financial assistance and the relevant authorities needed to implement the plan
- Develop an information/education component
- Develop a project schedule
- Develop the interim, measurable milestones
- Identify indicators to measure progress and make adjustments
- Develop a monitoring component

Nonpoint source pollution

Agricultural nonpoint source pollution

Learn more about agricultural nonpoint source pollution

Urban nonpoint source pollution

Learn more about urban nonpoint source pollution

What you can do

Learn more about controlling nonpoint source pollution in your area

TMDL implementation

Learn more about what the DNR is doing to control nonpoint source pollution

Related links

- [Program partners](#)
- [Nonpoint contacts](#)
- [Targeted Runoff Management Grant Program](#)
- [Urban Nonpoint Source & Storm Water Management Grant Program](#)

Contact information

For more information on nine key element plans, contact:

[Andrew Craig](#)
Nonpoint source planning coordinator
Runoff Management, Bureau of Watershed Management

EPA Handbook for 9 Key Element WS Plans

Handbook for Developing Watershed Plans to Restore and Protect Our Waters

2.6 **9** 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/cwact.html for a copy of the FY 2004 *Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories*).

What Does This Mean?

9 Shows you where one or more of the nine minimum elements are specifically discussed.

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



UW-Ext Citizen's Guide to Watershed Planning

University of Wisconsin-Extension

Cooperative Extension

Search ...

ERC ENVIRONMENTAL RESOURCES CENTER

A Citizen's Guide to Watershed Planning in Wisconsin

The Framework for Protecting or Restoring Local Water Resources

UW Extension
University of Wisconsin-Extension

Example Plans Other Guidance Where to Find Data Events About Contact Home

Welcome! Thank you for visiting our website where you'll find resources and additional information to supplement the Watershed Planning Guide.

[Download Guide](#)

A Citizen's Guide to Watershed Planning in WISCONSIN

The Framework for Protecting or Restoring Local Water Resources

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.

CONTACT

Dan Zerr
Natural Resources Educator
University of Wisconsin-Extension
daniel.zerr@uwex.edu
(715) 836-5513

You may also contact [your local Natural Resources Educator](#) for additional questions on watershed planning.

<http://fyi.uwex.edu/watershedplanning/>

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**

The screenshot displays the Wisconsin DNR website's nonpoint source pollution page. The browser address bar shows "Nonpoint Wisconsin DNR". The navigation menu includes "Business", "Licenses & Regulations", "Recreation", "Education", "Topics", "Contact", and "Join Us". A search bar contains "Search or Keywords" and a "Share" button. The main content area is titled "Nonpoint source pollution" and features three "Learn about" buttons for agricultural, urban, and residential pollution, and a "What you can do" button for controlling pollution. A paragraph explains that nonpoint source (NPS) pollution is a leading cause of water quality problems in Wisconsin, caused by rainfall or snowmelt moving over and through the ground, depositing pollutants into rivers, lakes, wetlands, and groundwater. Below this are three columns of links for "Agricultural NPS pollution", "Urban NPS pollution", and "What you can do". A large image of the St. Croix River is shown on the right, with contact information for Corinne Billing, the nonpoint source program coordinator, listed below it. The footer includes "Local intranet | Protected Mode: Off" and a 100% zoom level.

Nonpoint Wisconsin DNR

Business Licenses & Regulations Recreation Education Topics Contact Join Us Search or Keywords Share

Nonpoint source pollution

Learn about agricultural nonpoint source pollution.

Learn about urban nonpoint source pollution.

What you can do to control nonpoint source pollution on your property.

Nonpoint source (NPS) pollution, also known as polluted runoff, is a leading cause of water quality problems in Wisconsin. Polluted runoff is caused by rainfall or snowmelt moving over and through the ground picking up natural and human-made pollutants, depositing them into rivers, lakes, wetlands and groundwater. Pollutants include fertilizers, nutrients, oil, grease, sediment and bacteria from agricultural, urban, and residential areas.

Agricultural NPS pollution

- Overview
- Environmental impacts
- Agricultural performance standards & prohibitions
- Wisconsin Runoff Rules: What Farmers Need to Know [PDF]
- NR 151 implementation strategy
- Agricultural technical standards & assistance
- Agricultural financial assistance
- Reporting concerns
- Notices of discharge

Urban NPS pollution

- Overview
- Storm water management
- Urban financial assistance

What you can do

TMDL implementation

Nonpoint source program



St. Croix River

Contact information

[Corinne Billing](#)
Nonpoint source program coordinator
Runoff Management
608-264-6261

Local intranet | Protected Mode: Off 100%

DNR Contact Info

- ▶ Andrew Craig – DNR Nonpoint Source Planning Coordinator

Andrew.craig@wisconsin.gov

[\(608\)267-7695](tel:(608)267-7695)

dnr.wi.gov – keyword: [9 key](#)

<http://dnr.wi.gov/topic/nonpoint/9keyelementplans.html>

NPS Implementation

“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

Compliance Options Available

- ▶ 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?

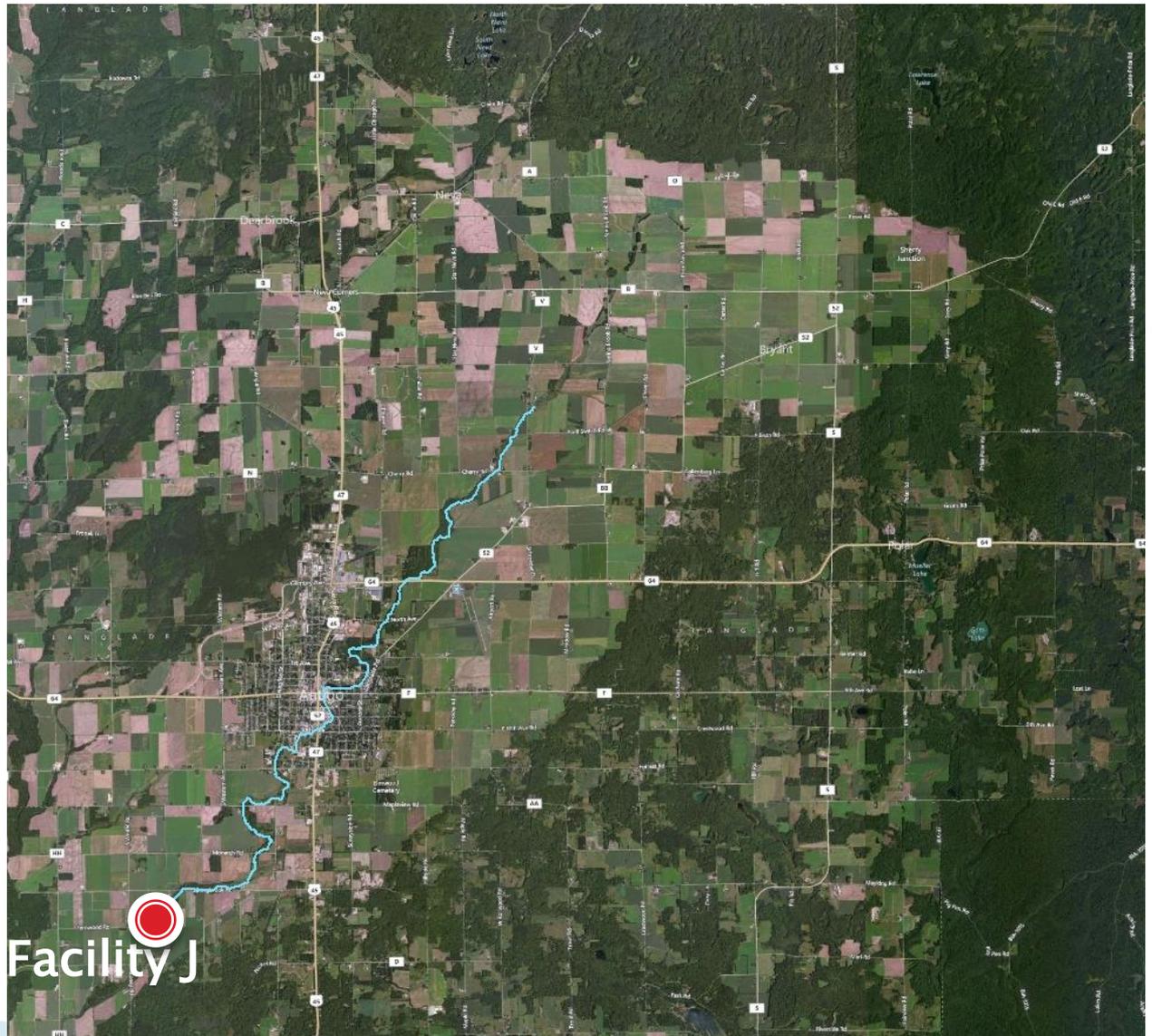
- ▶ Allows point sources to take credit for phosphorus reductions made within their watershed to comply with permit requirements
- ▶ Create partnerships to achieve water quality goals in the most economically feasible manner possible
- ▶ Voluntary permit compliance option

A Closer Look at Adaptive Management

- ▶ 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

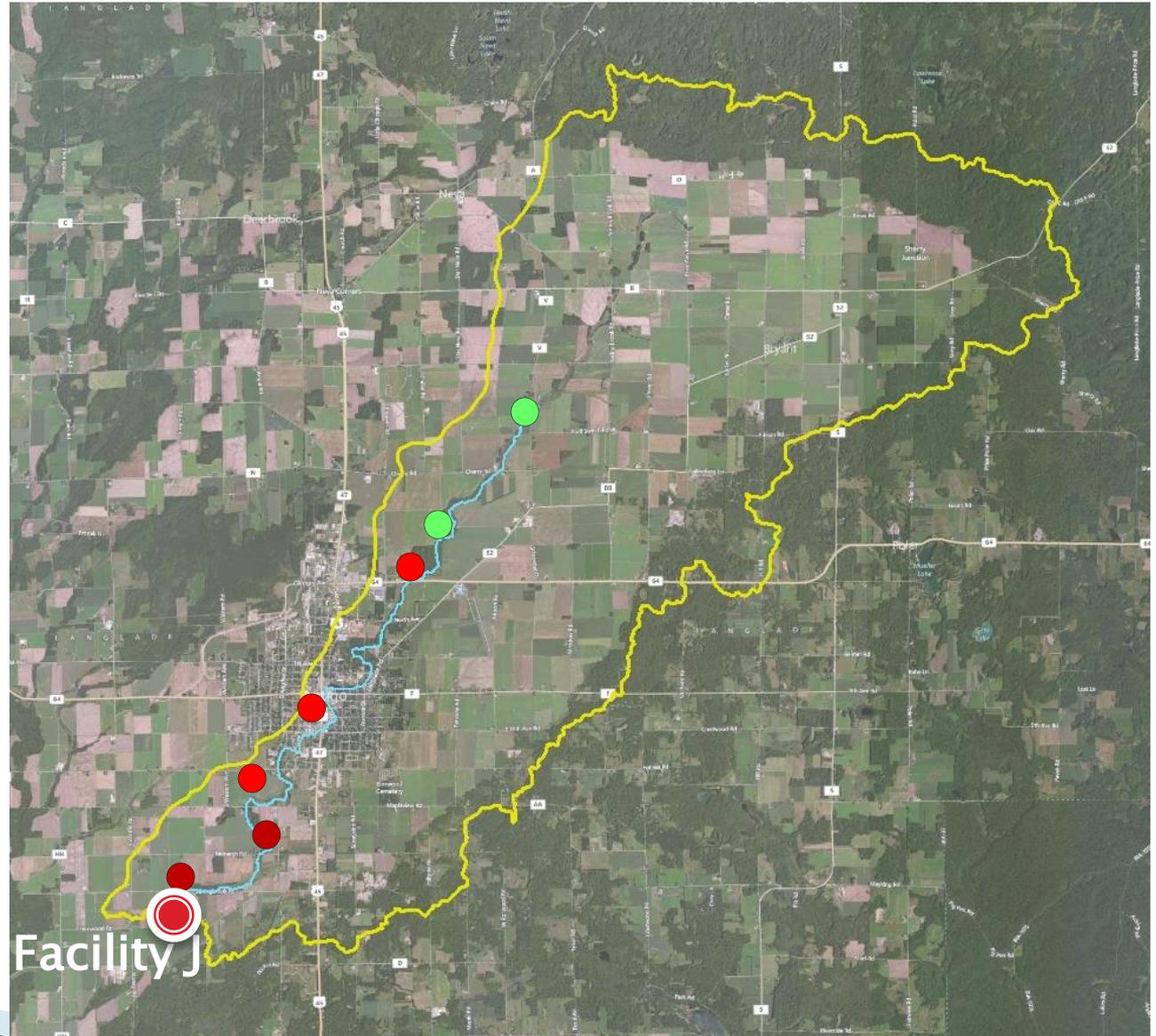
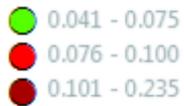
The Concept:

- ▶ Facility J has a phosphorus WQBEL equal to 0.075 mg/L.



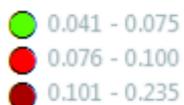
The Concept:

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



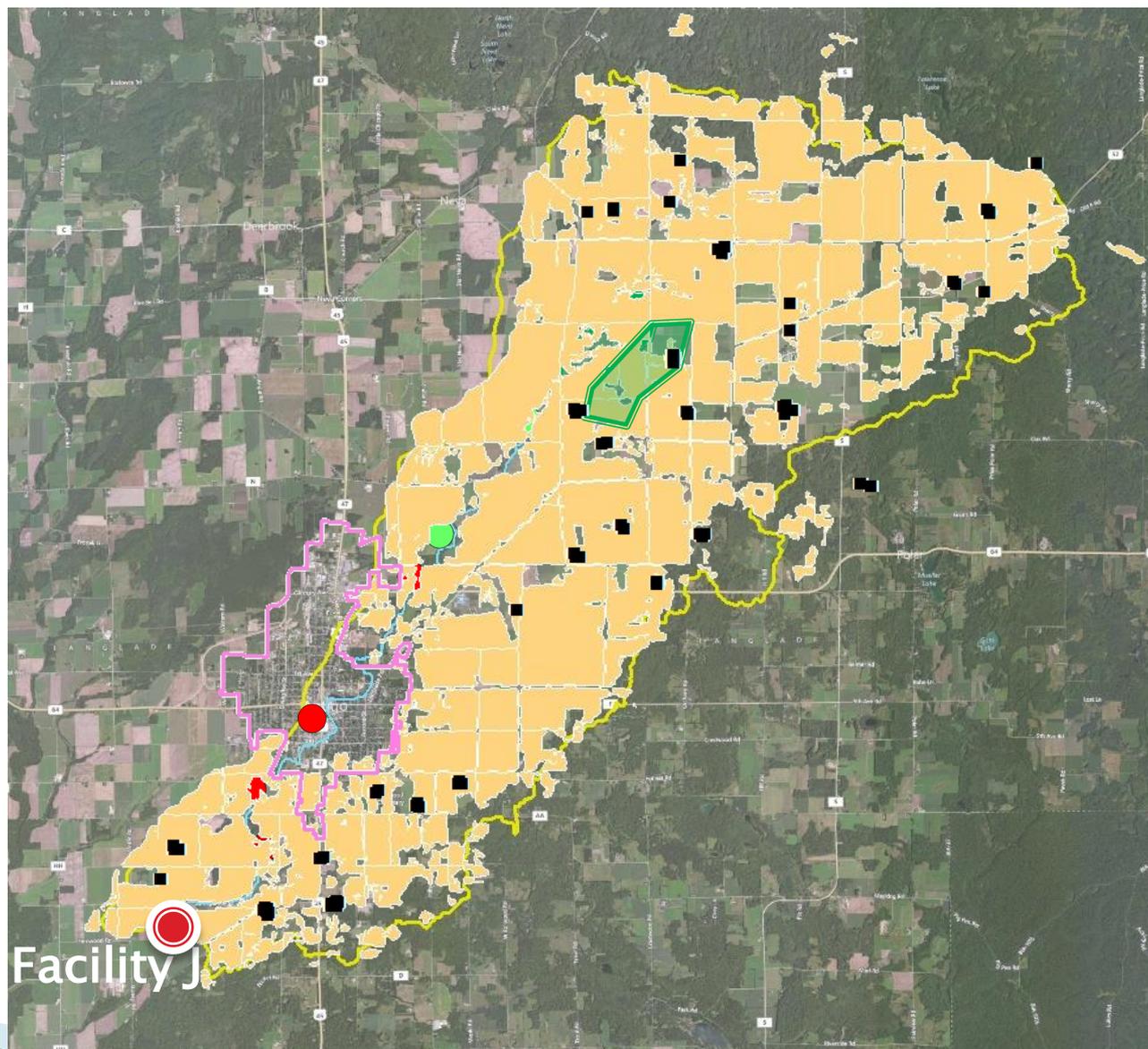
The Concept:

- ▶ 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



Keys to Adaptive Management

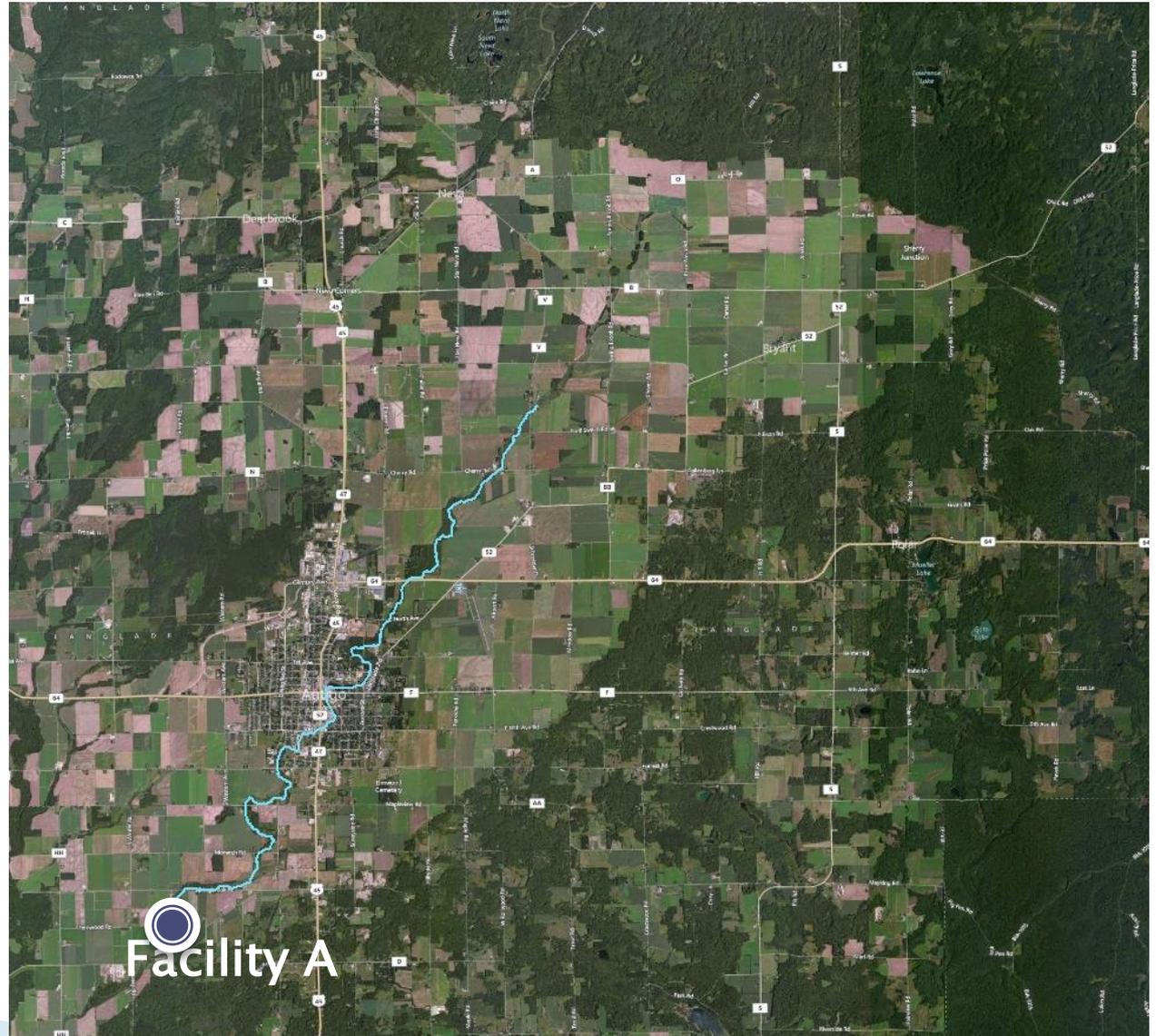
- ▶ Adaptive management has a 10–15 year project life
- ▶ Less restrictive interim limits are included in permit instead of the restrictive WQBEL
- ▶ In-stream monitoring required
- ▶ Adaptive management can be rolled over into water quality trading if insufficient water quality improvements are demonstrated

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.



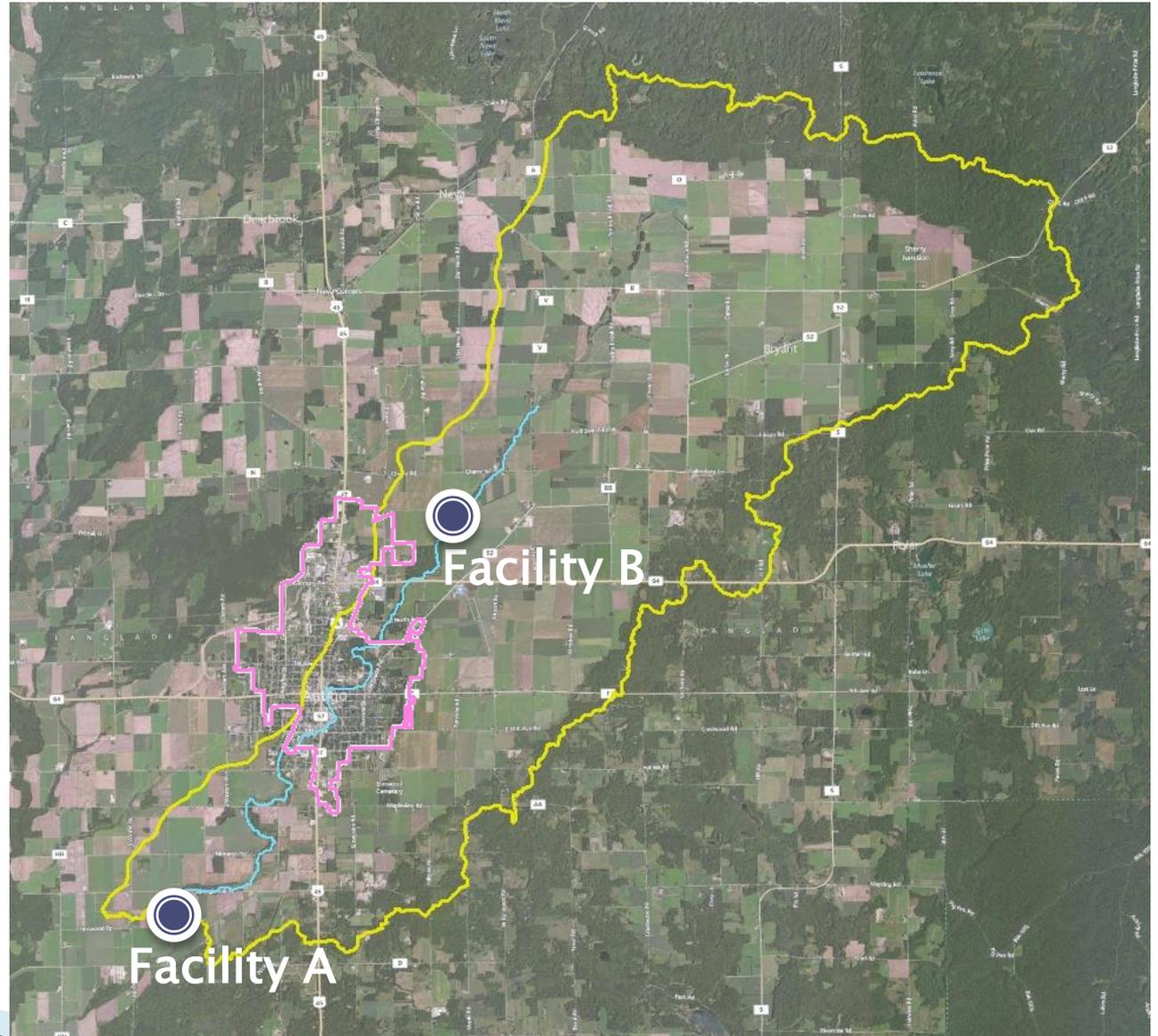
Example:

- ▶ 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 of 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

The screenshot shows a web browser window with the URL <http://dnr.wi.gov/topic/SurfaceWater/AmWqtMap.html>. The page title is "Adaptive Management and Water Quality Trading project locations". Below the title is a paragraph explaining that the map shows WPDES permit holders who have selected adaptive management or water quality trading as their preferred phosphorus compliance option. It provides instructions on how to use the map and contact information for Amanda Minks.

[Subscribe to phosphorus rule updates.](#)

Adaptive Management and Water Quality Trading project locations

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 submitted 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 submittals contact [Amanda Minks](#).

The map displays the state of Wisconsin with several green pins indicating project locations. The pins are located in the central and eastern parts of the state, near major water bodies like Lake Michigan and the Wisconsin River. The map includes labels for major cities like Duluth, Marquette, Green Bay, Madison, and Milwaukee, as well as various national and state forests.

Surface waters

- Atlas data, webinars, reports**
About Wisconsin's waters.
- Standards**
Goals for water resources.
- Monitoring**
Monitoring water quality.
- Assessments & reporting**
Evaluating condition.
- Planning**
Planning for water quality.
- Management**
Managing water resources.

Water management

- Adaptive management
- Water quality trading
- Phosphorus rules
- Use designations
- Antidegradation
- ORW/ERW waters
- Triennial standards review
- Water quality based effluent limitations

Water resources

- Explore WI waters
- Surface Water Viewer
- Water search
- Watershed search

The information shown on these maps has been obtained from various sources, and are of varying age, reliability and

<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

<http://dnr.wi.gov/topic/SurfaceWater/WaterQualityTrading.html>

(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

Location	Contact Information	DNR Office/Email
Statewide coordinators	Amanda Minks	Amanda.Minks@Wisconsin.gov
	Kevin Kirsch	Kevin.Kirsch@Wisconsin.gov
	Andrew Craig	Andrew.Craig@Wisconsin.gov
Northern District	Lonn Franson	Lonn.Franson@Wisconsin.gov
Southern District–West	Amy Schmidt	Amy.Schmidt@Wisconsin.gov
Southern District–East	Mark Riedel	Mark.Riedel@Wisconsin.gov
	TBD	
Eastern District	Keith Marquardt	KeithA.Marquardt@Wisconsin.gov
Western District	Mike Vollrath	Michael.Vollrath@Wisconsin.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

$$\textit{Average Annual Soil Loss} = R \times K \times L \times S \times C \times P$$



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



Model Categories

- ▶ Type
- ▶ Scale
- ▶ Land use setting
- ▶ Complexity

Type

- ▶ 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

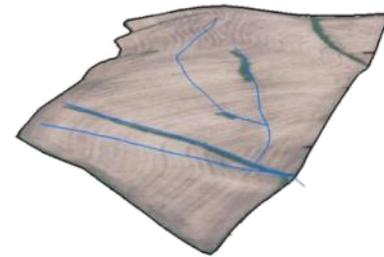
- ▶ Regional
- ▶ Basin
- ▶ Field



Regional



Basin



Field

Land use setting

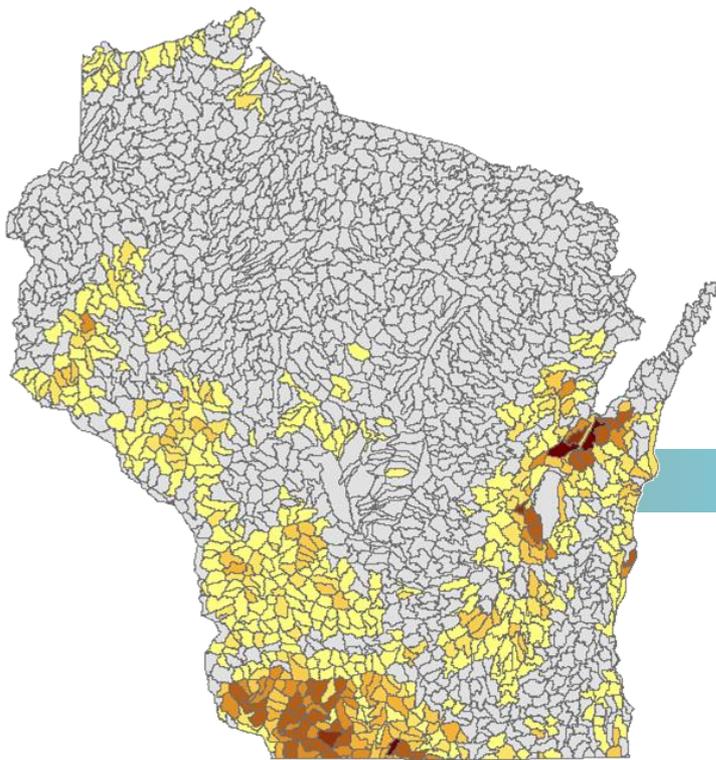
- ▶ Agricultural
- ▶ Urban
- ▶ Mixed land use



Complexity

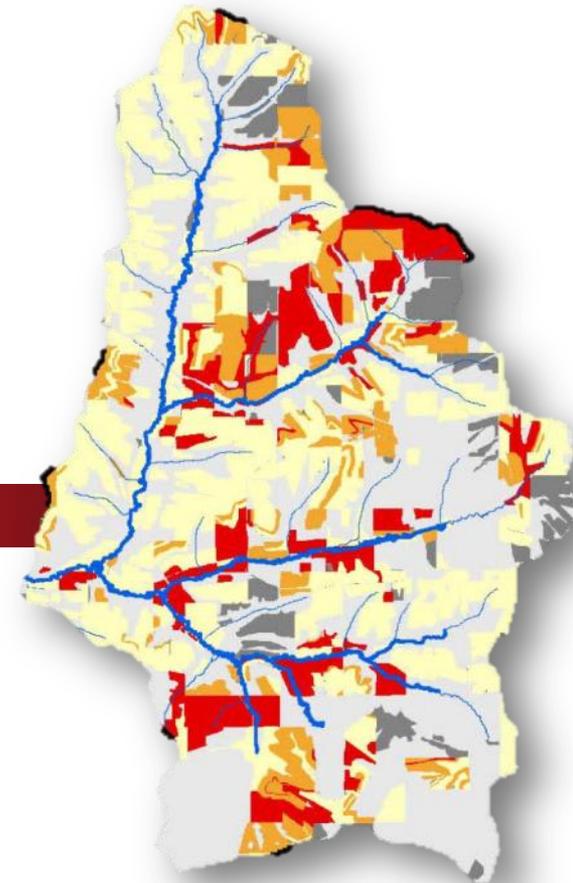
- ▶ **Low**
 - Screening
 - Risk potential
 - Long-term averages
 - Large geographic scope
 - Little to no variation in space and time
 - Little data required
- ▶ **Medium**
 - More process-based
 - Monthly or annual averages
 - May vary in time and space
 - Some data required
- ▶ **High**
 - Process-based
 - Daily (or less) representation of system
 - Variation in time and space (more than one dimension)
 - A lot of data required

Complexity



Basins

*Data Requirements
Level of Effort*



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

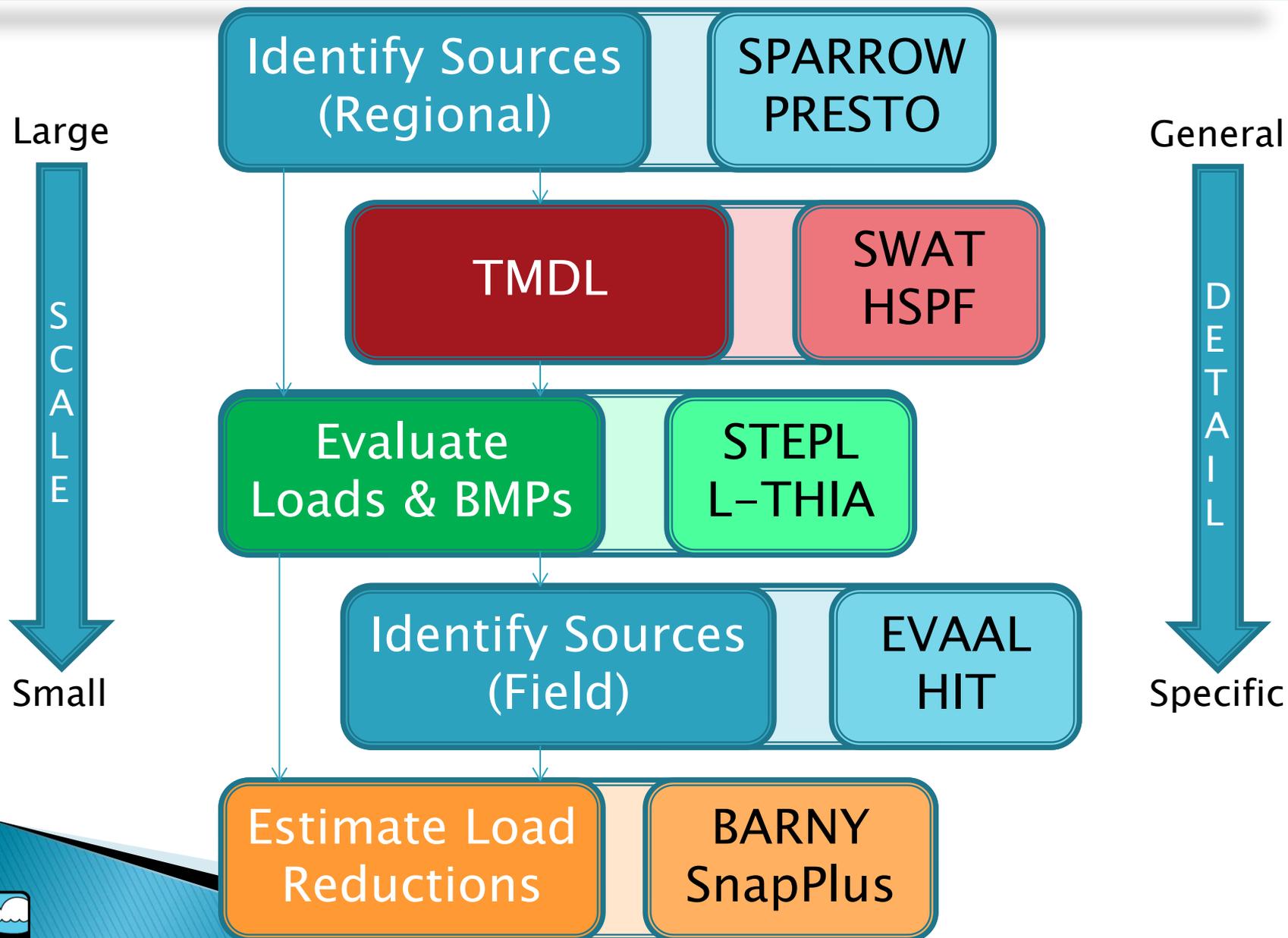
“All models are wrong;
some models are useful”

–George E.P. Box

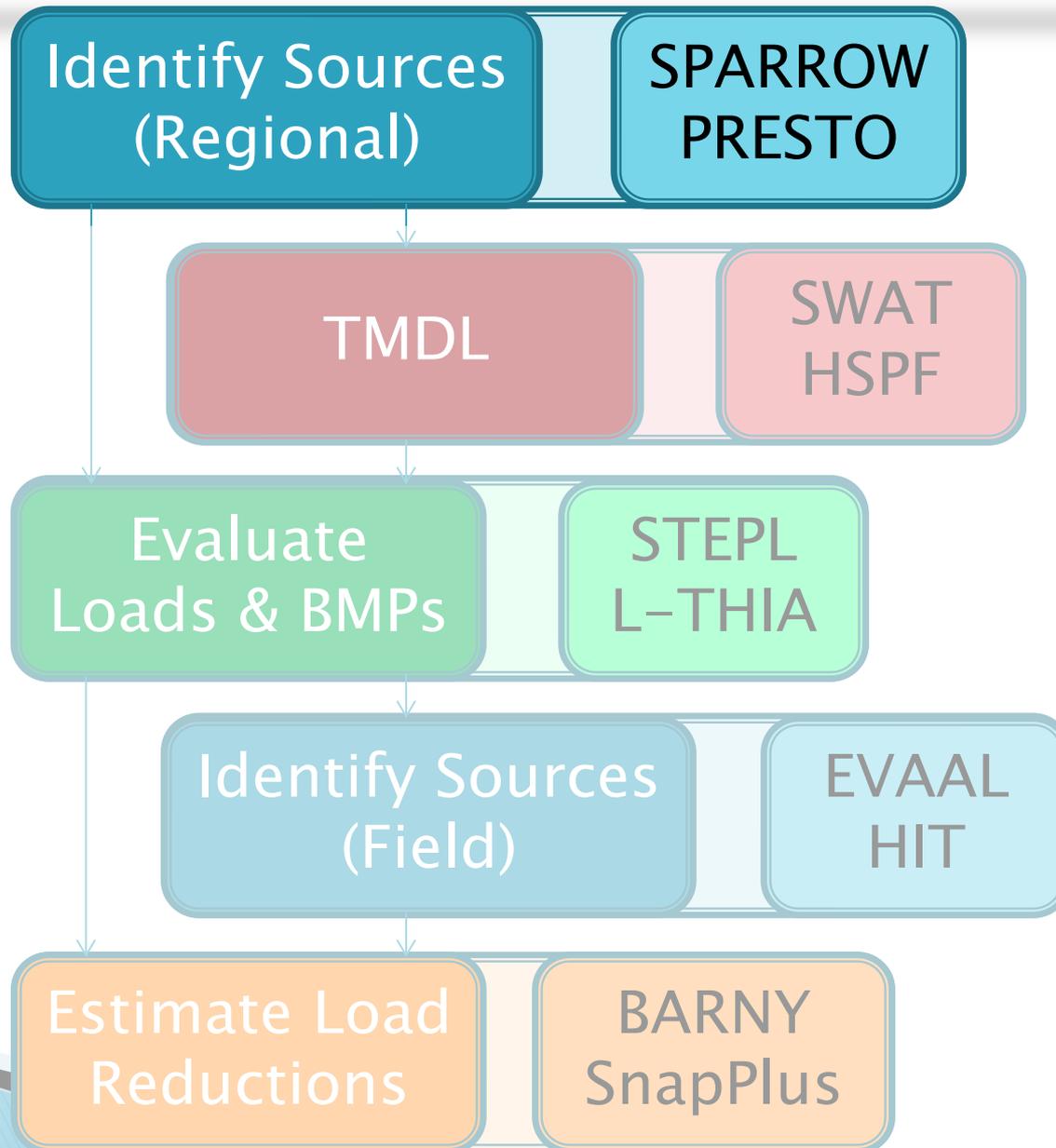
Start Implementation Plan

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



Models

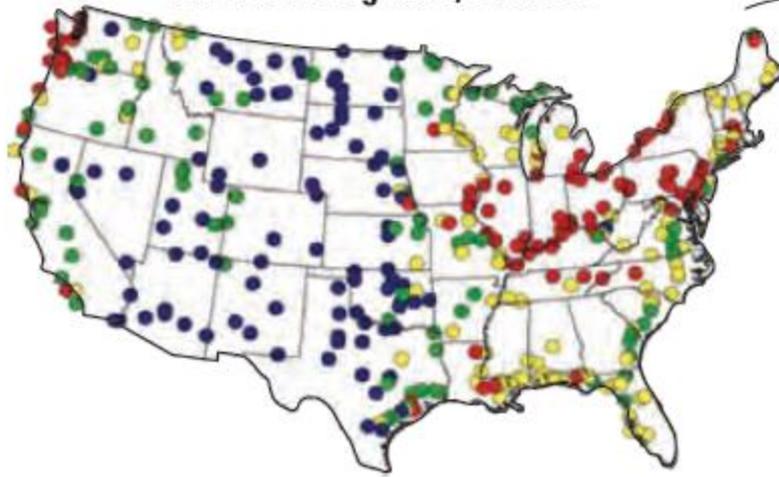


SPARROW

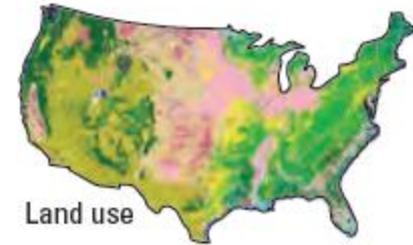


Name:	Spatially-referenced Regression on Watershed Attributes
Developer:	USGS
Website:	http://water.usgs.gov/nawqa/sparrow/
Overview:	The SPARROW model relates in-stream water-quality measurements to spatially referenced characteristics of watersheds, including contaminant sources and factors influencing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

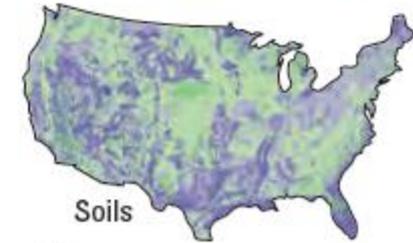
A. Monitoring data, 375 sites



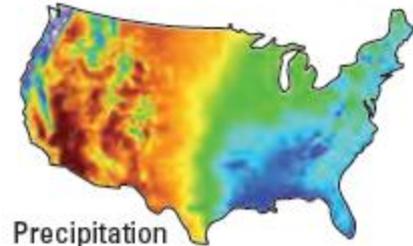
B. Geographic data layers



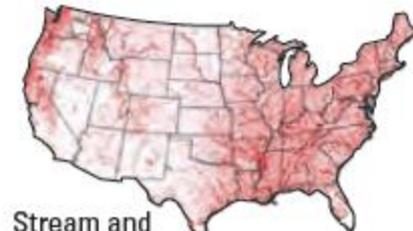
Land use



Soils

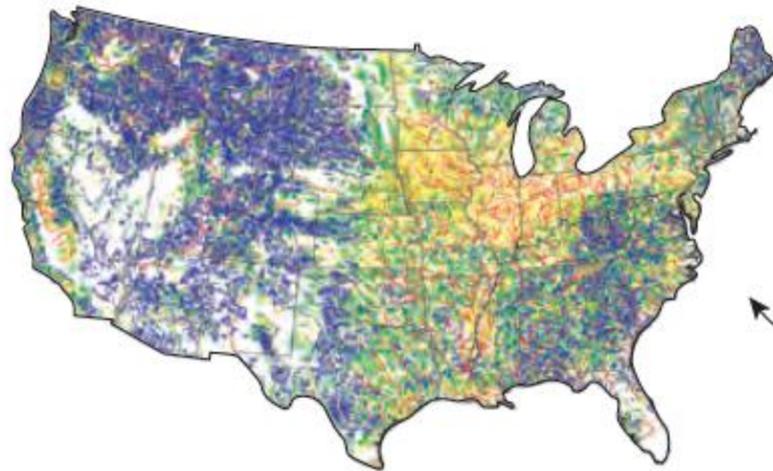


Precipitation

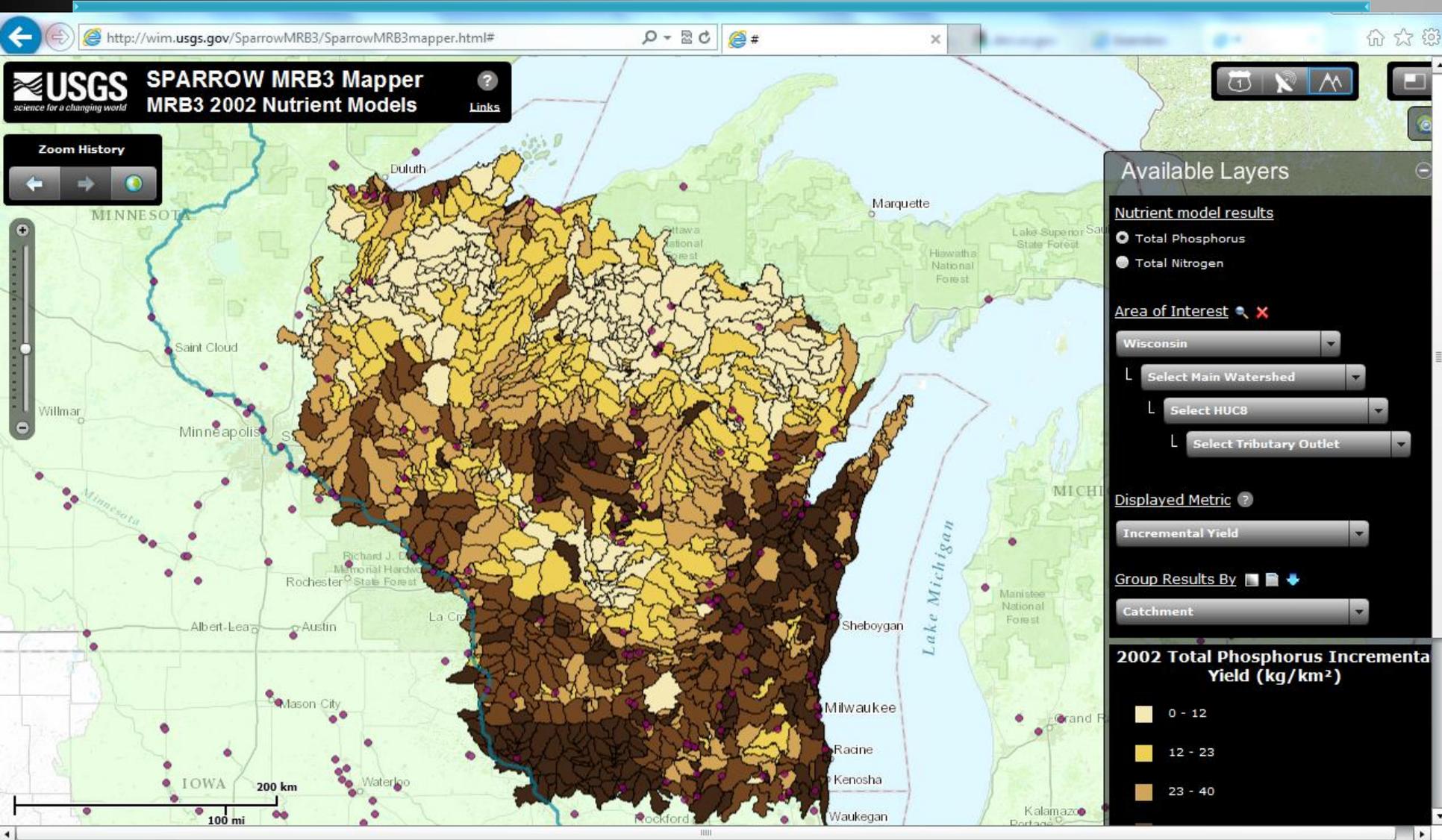


Stream and
reservoir water velocity

C. Model predictions, 62,000 stream reaches

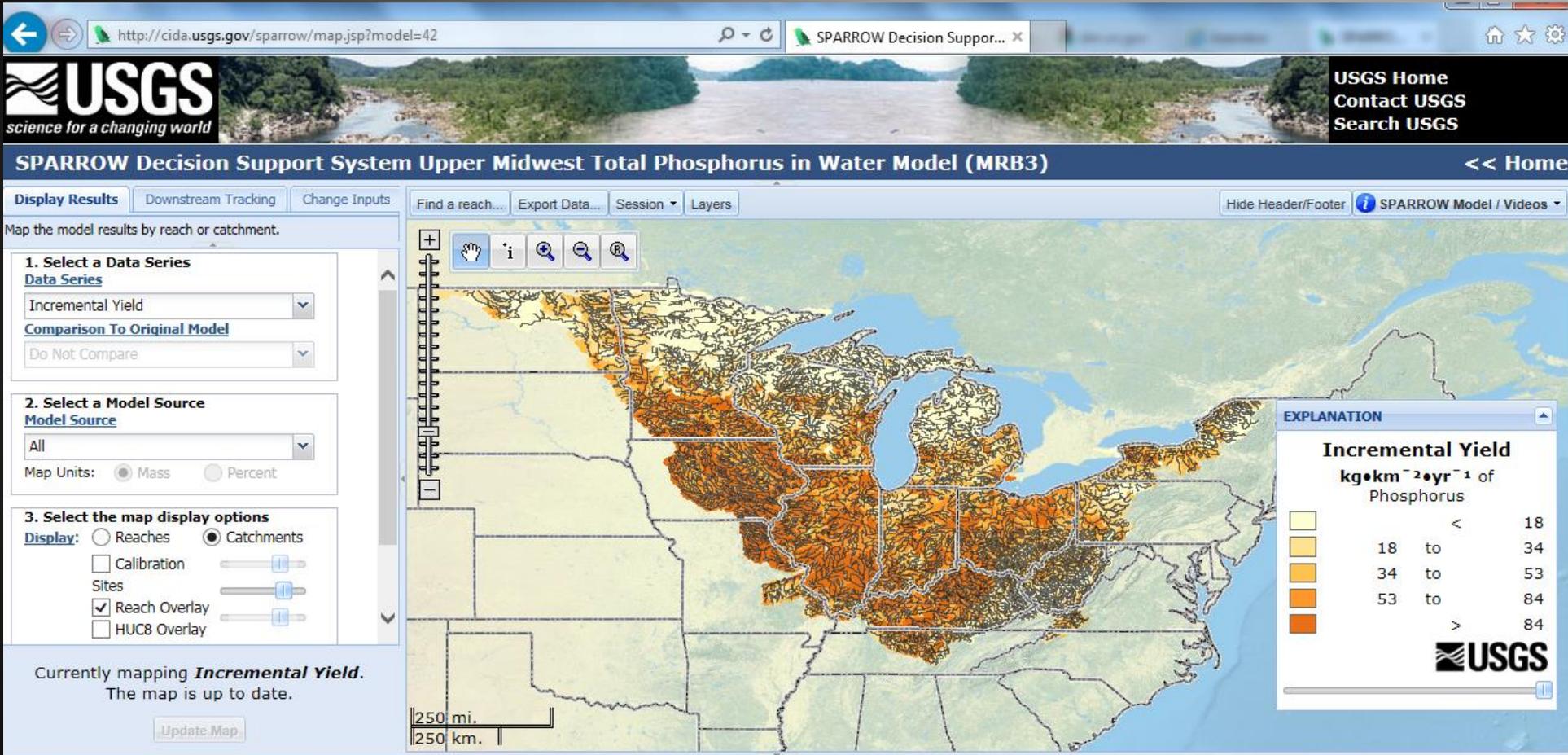


SPARROW – Mapper



<http://wim.usgs.gov/SparrowMRB3/SparrowMRB3mapper.html#>

SPARROW – DSS



Accessibility | FOIA | Privacy | Policies and Notices

U.S. Department of the Interior | U.S. Geological Survey

URL: <http://water.usgs.gov/nawqa/sparrow/dss/>

Page Contact Information: **SPARROW DSS Administrator**

Page Last modified: 09/14/2014 19:26:16 (Version: 1.4.32.26 (09/14/2014 19:26:16) - Release)



<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

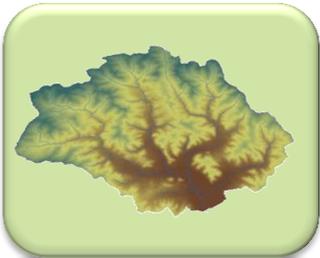
Name:	Pollutant–Load Ratio Estimate Tool
Developer:	WDNR
Website:	http://dnr.wi.gov/topic/SurfaceWater/presto.html
Overview:	PRESTO is a GIS–based tool that compares the average annual phosphorus loads originating from point and nonpoint sources within a watershed. The comparison provides a screening 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.
Type:	Watershed
Scale:	Basin
Land Use:	Mixed (Ag)
Complexity:	Low
Format:	ArcGIS Toolbox; results for statewide outfalls on web; web–based version under development

presto

Pollutant Load Ratio
Estimation Tool



**Watershed
Delineation**

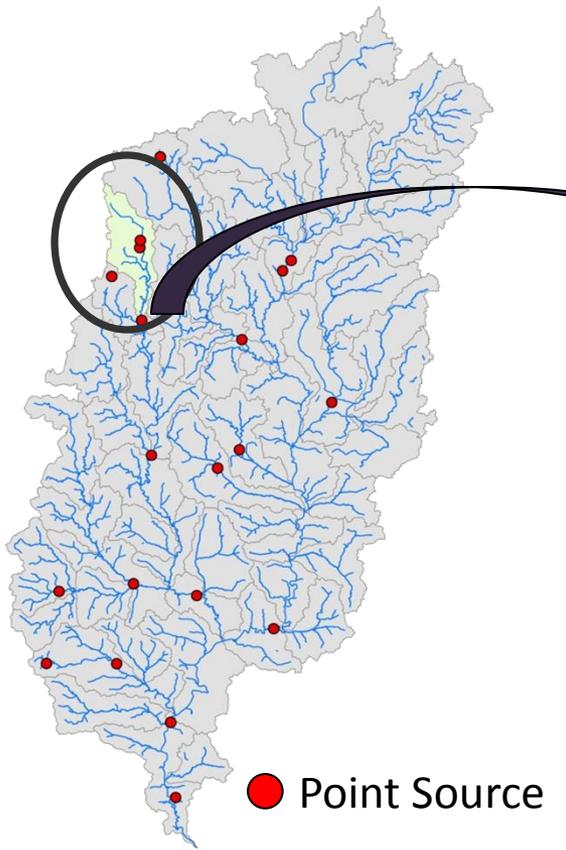


**Effluent
Aggregation**

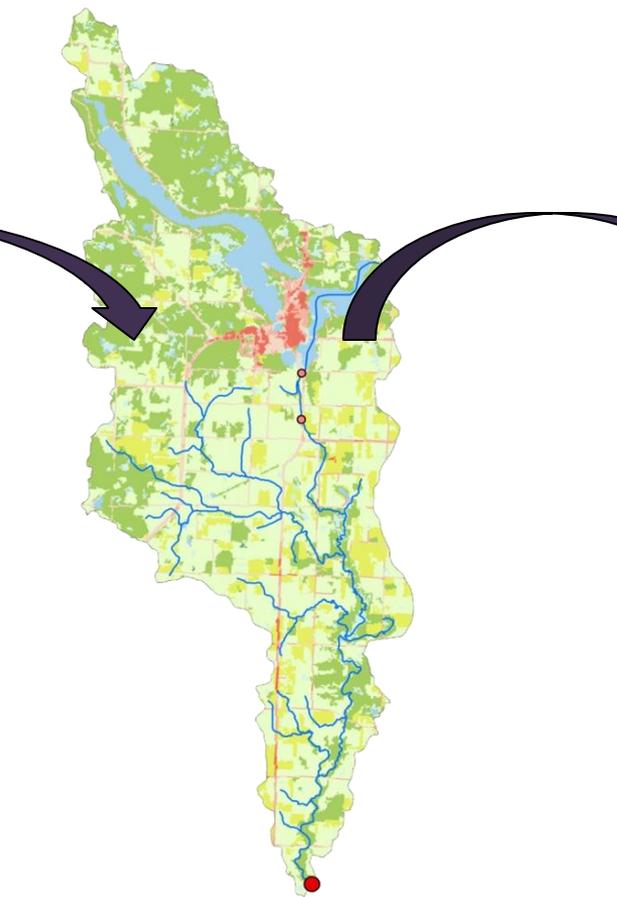


**Pollutant
Runoff**

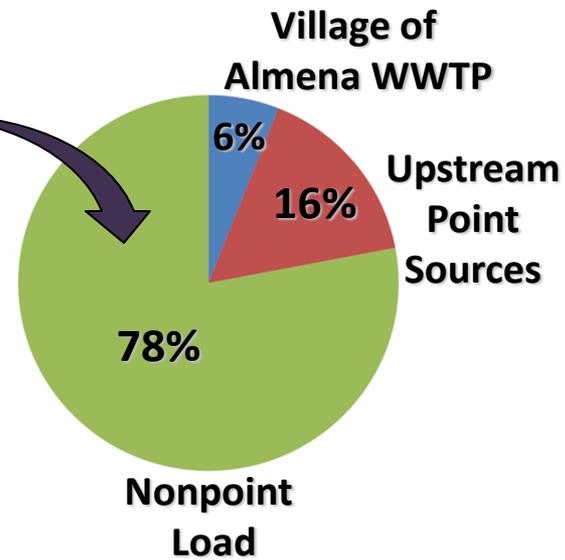




Red Cedar River Watershed
(HUC 08, 1,890 mi²)
20 Outfalls



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

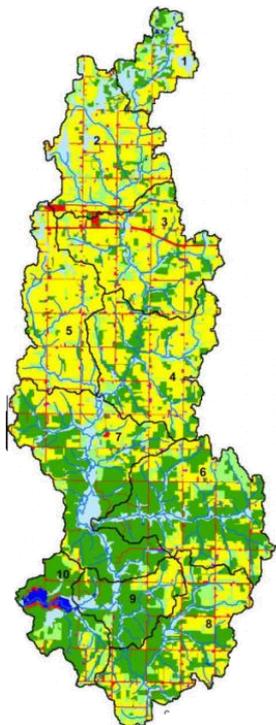
The screenshot displays the PRESTO-Lite software interface. The top menu bar includes 'Basic Tools', 'Identify Tools', 'Drawing Tools', 'Measuring Tools', 'Find Location', 'Maps & Data', and 'Help'. The toolbar below contains several icons: 'Show Layers', 'Add Shapefile', 'Add CSV file', 'Print Map', 'Extract Data', 'Export Map', and 'Watershed Delineation'. The 'Watershed Delineation' button is highlighted with a red dashed box and a blue circle containing the number '1'. To the right of this button, text reads: 'Click button located in toolbar of Geocortex viewer to activate tool'. Below the toolbar, a map shows a topographic view of a region with roads and water bodies. A blue circle containing the number '2' is positioned to the left of the map, with text: 'Follow steps to select delineation point'. An inset window on the left shows a mouse cursor clicking on a point on the map. The map features labels for roads such as 'Starks Rd', 'Kingdon Rd', 'Capital Rd', 'N. Lake Rd', 'Rock Creek Rd', and 'Basinators Ave', and water bodies like 'Mead Lake' and 'Nottingham Creek'. A red dashed box on the map highlights a specific point on the shoreline of Mead Lake, with a black arrow pointing to it.

1 Click button located in toolbar of Geocortex viewer to activate tool

2 Follow steps to select delineation point

Select location for watershed delineation

Based on user-defined point, upstream watershed report is produced



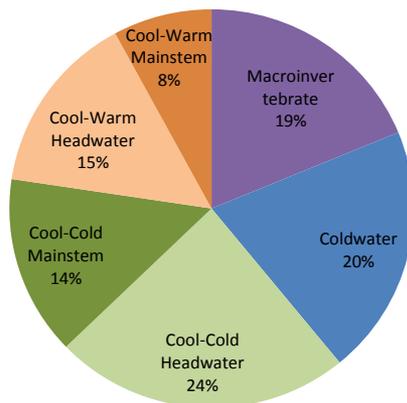
Watershed Name: Wild River

HUC08 Drainage: Chippewa River

Watershed Area: 100 mi²

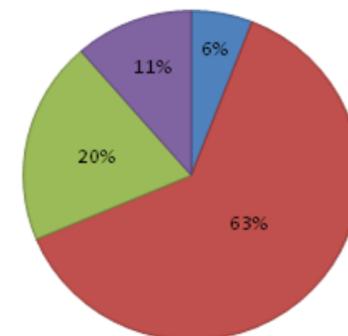
Stream Type: Cool-Warm Mainstem

Tributary Stream Types

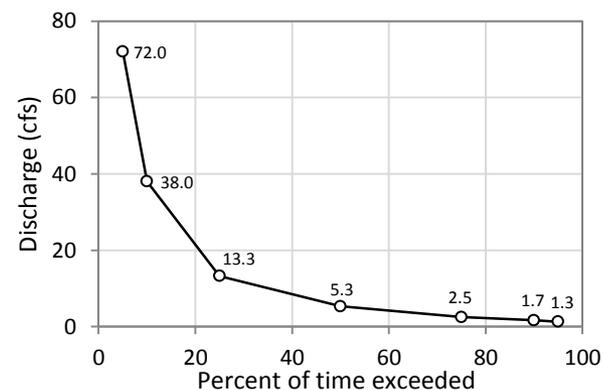


Landcover

Developed Land	6 mi ²
Forest	63 mi ²
Agriculture	20 mi ²
Wetland	11 mi ²



Stream Flow



PRESTO Phosphorus Load Estimate

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

Adaptive Management Results – Facilities Discharging to the Wild River Watershed

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

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>)
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>

PRESTO

▶ 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

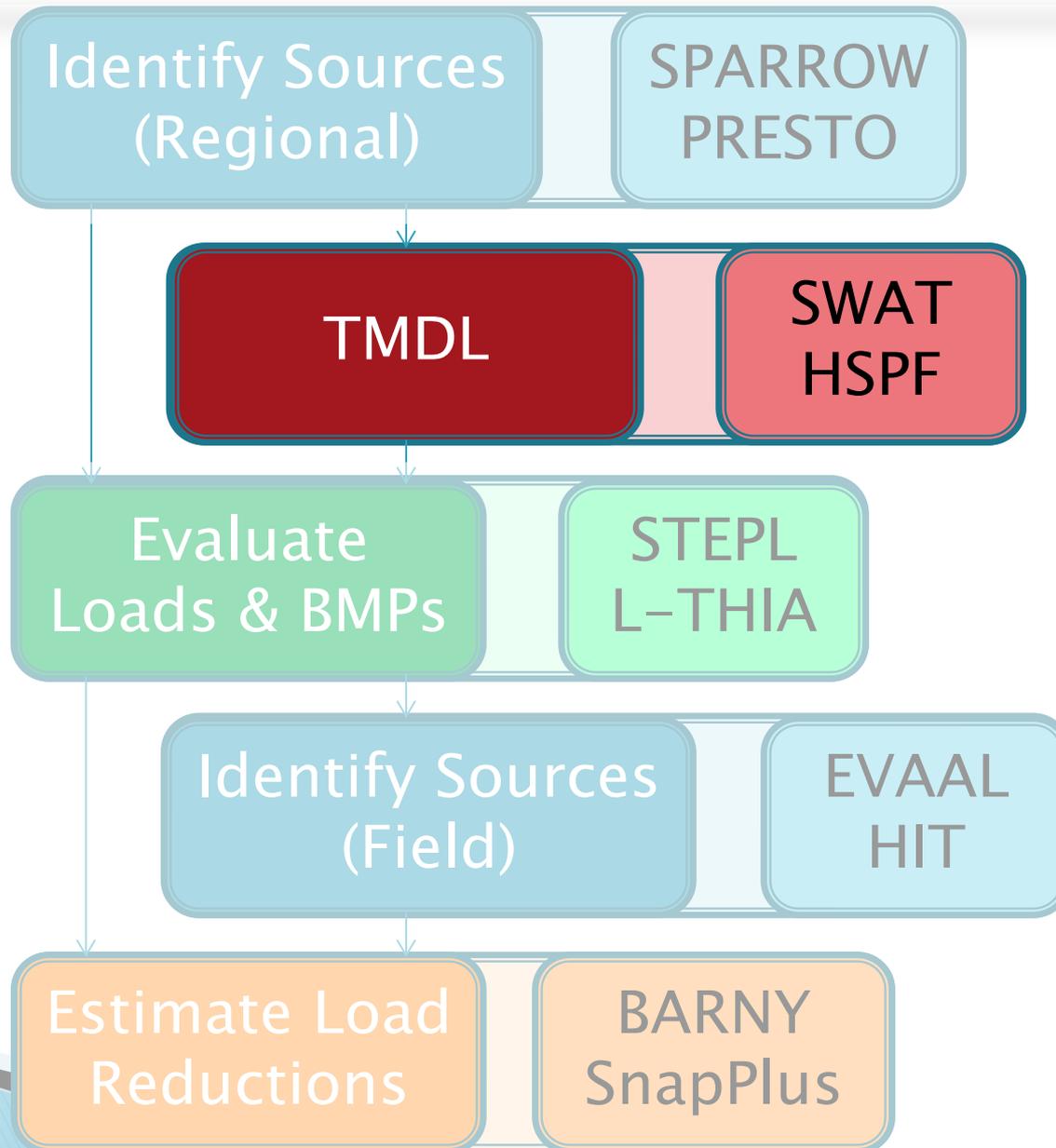
SPARROW vs. PRESTO

- ▶ 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

SPARROW

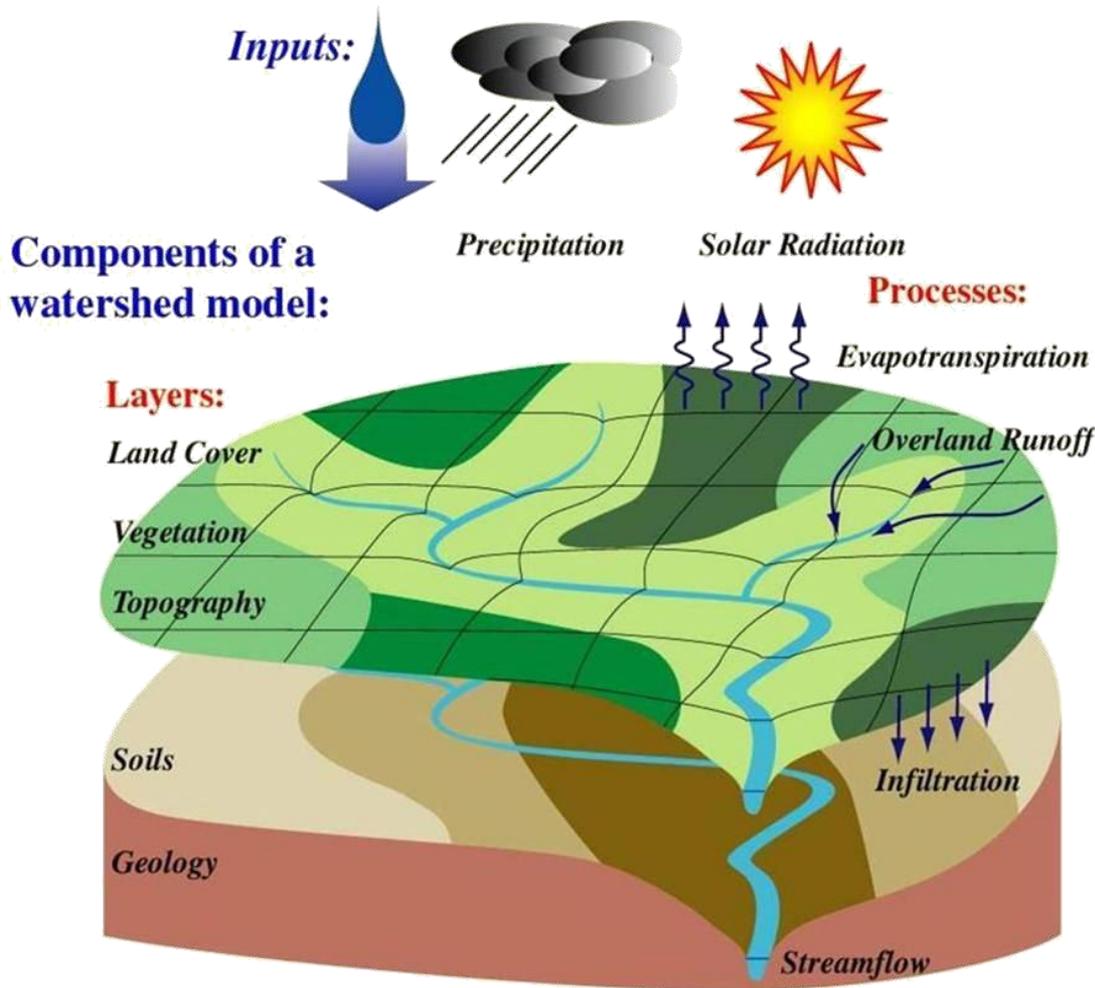
PRESTO

Models



Name:	Soil Water Assessment Tool
Developer:	USDA ARS & Texas A&M
Website:	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

SWAT



- 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

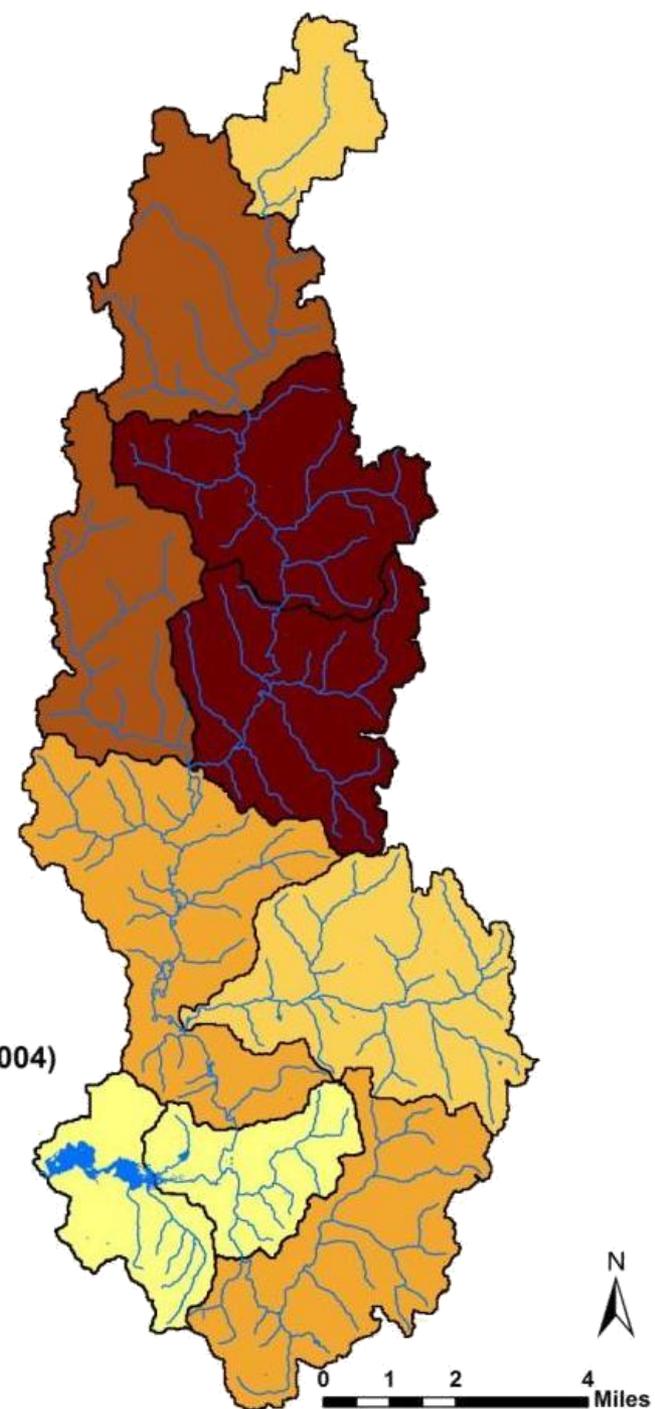
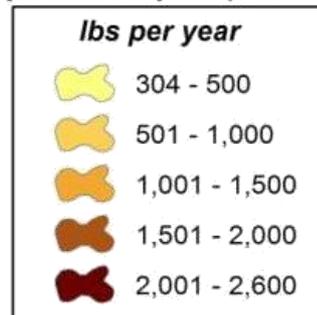


Outputs:
Streamflow
Water quality

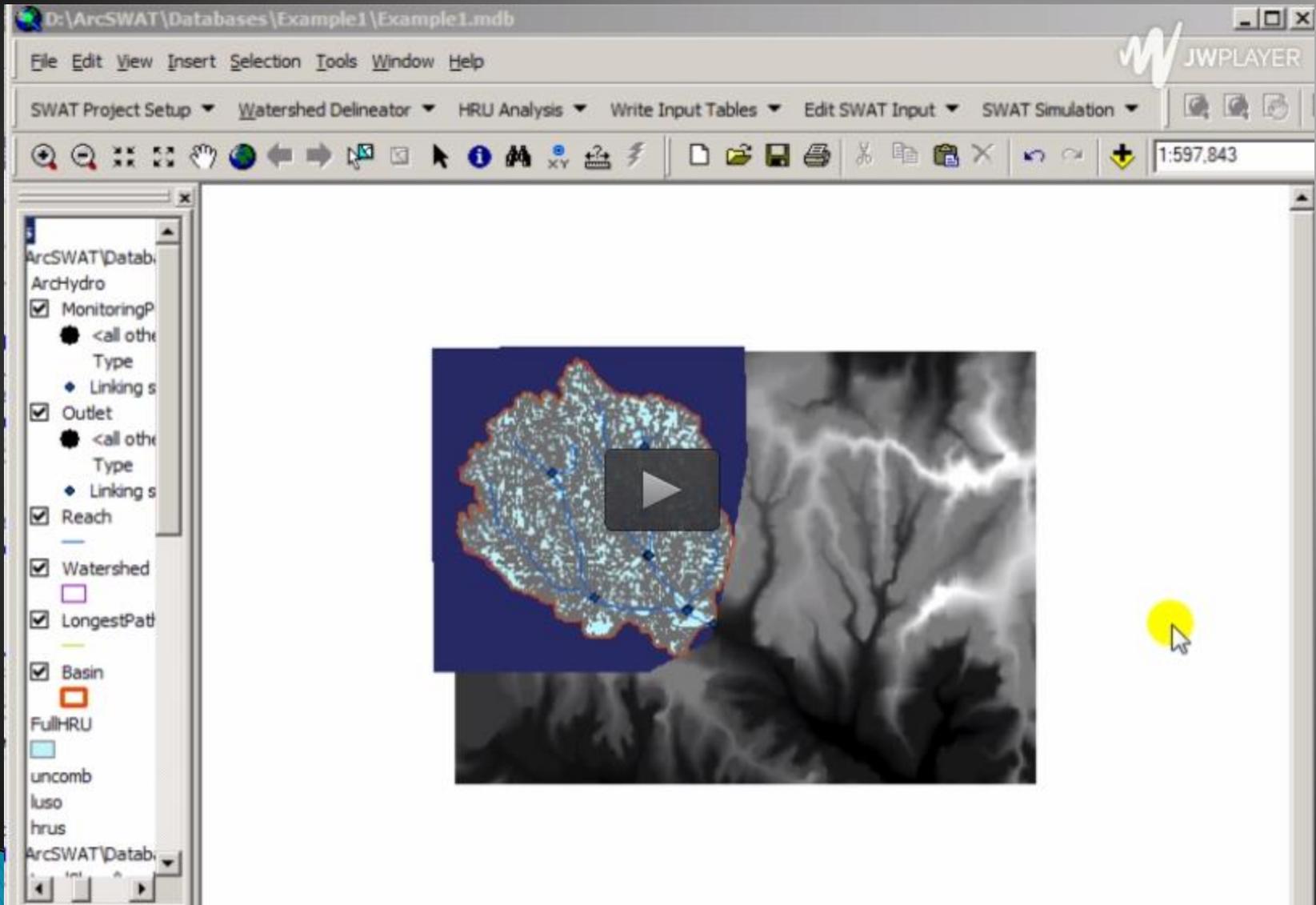


SWAT Results

Average Subwatershed
Phosphorus Export (1999 - 2004)



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

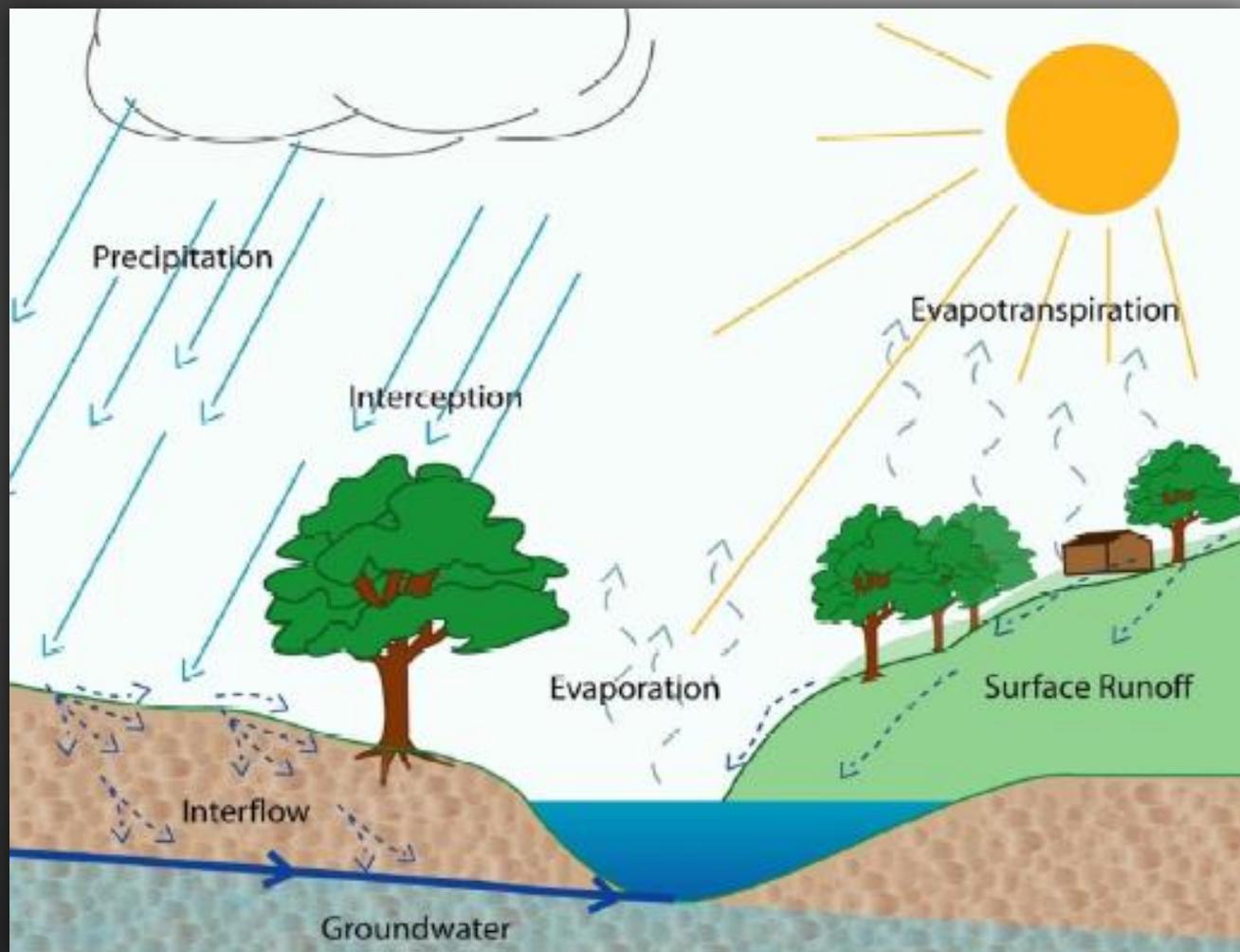
▶ Limitations/Cautions

- Best for agricultural lands, but fields are not explicit
- Does not spatially locate loadings within subbasin
- Does require calibration

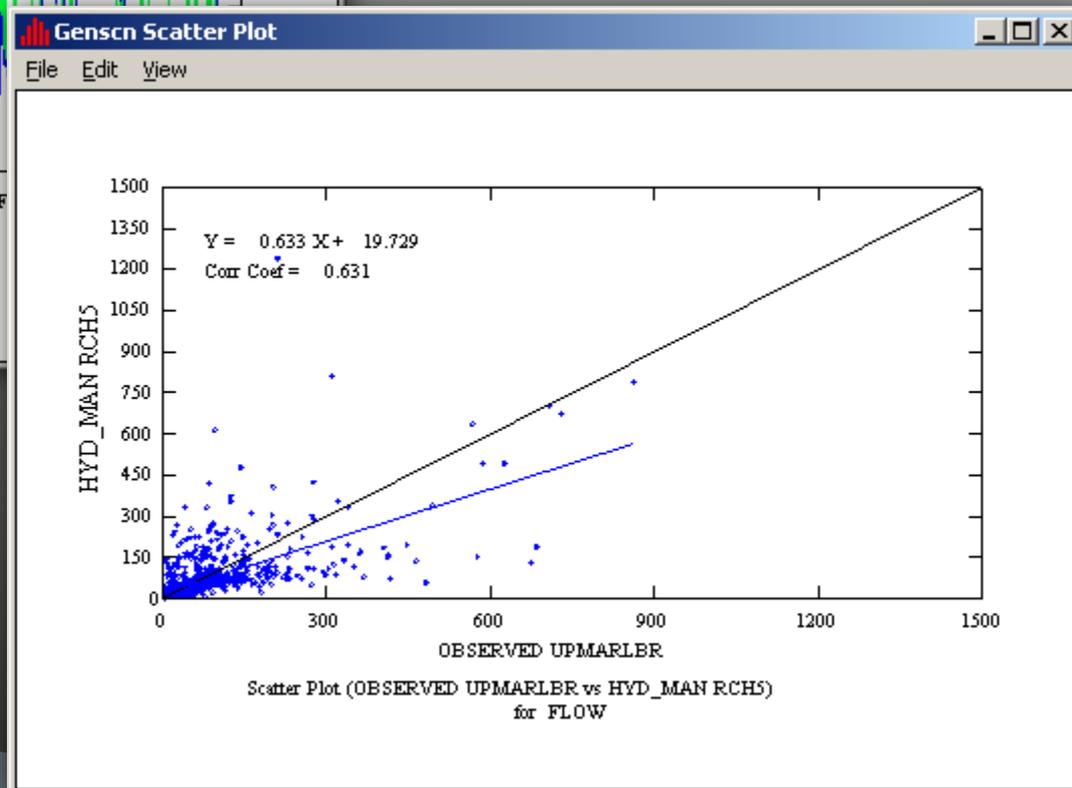
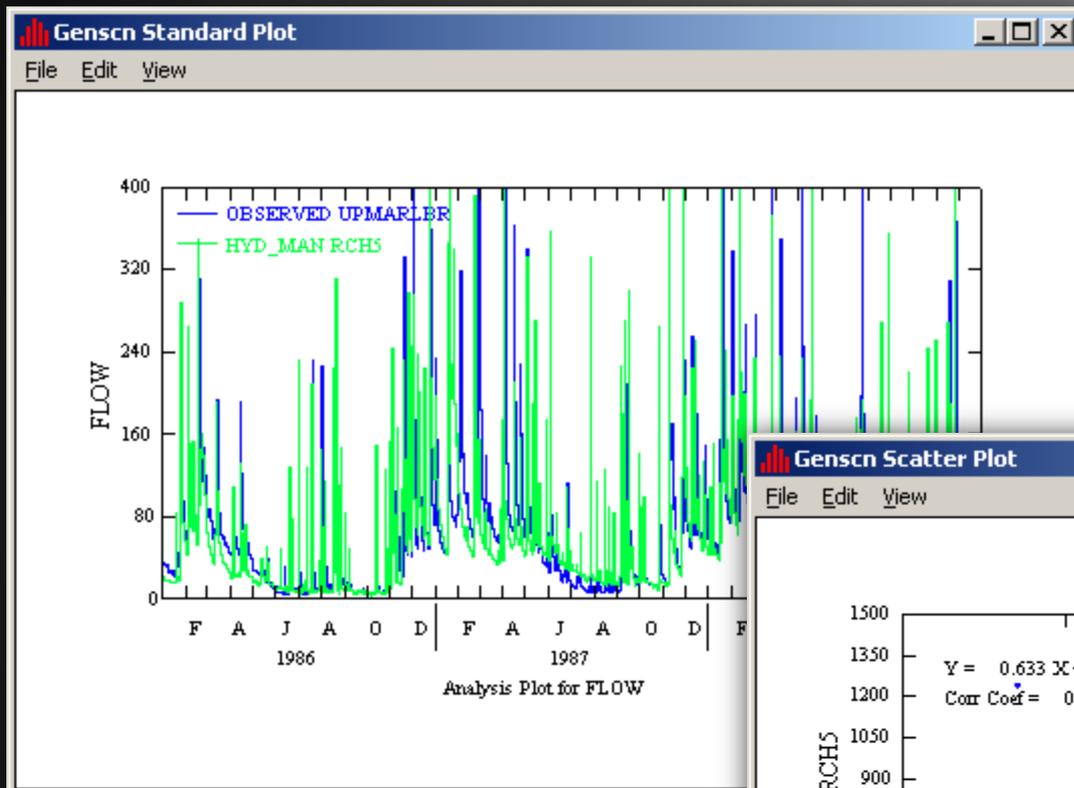
HSPF

Name:	Hydrological Simulation Program – FORTRAN
Developer:	EPA & USGS
Website:	http://www2.epa.gov/exposure-assessment-models/hspf
Overview:	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.
Type:	Watershed
Scale:	Basin
Land use:	Mixed
Complexity:	High
Format:	Executable; included in BASINS, WMS

HSPF



HSPF Results



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

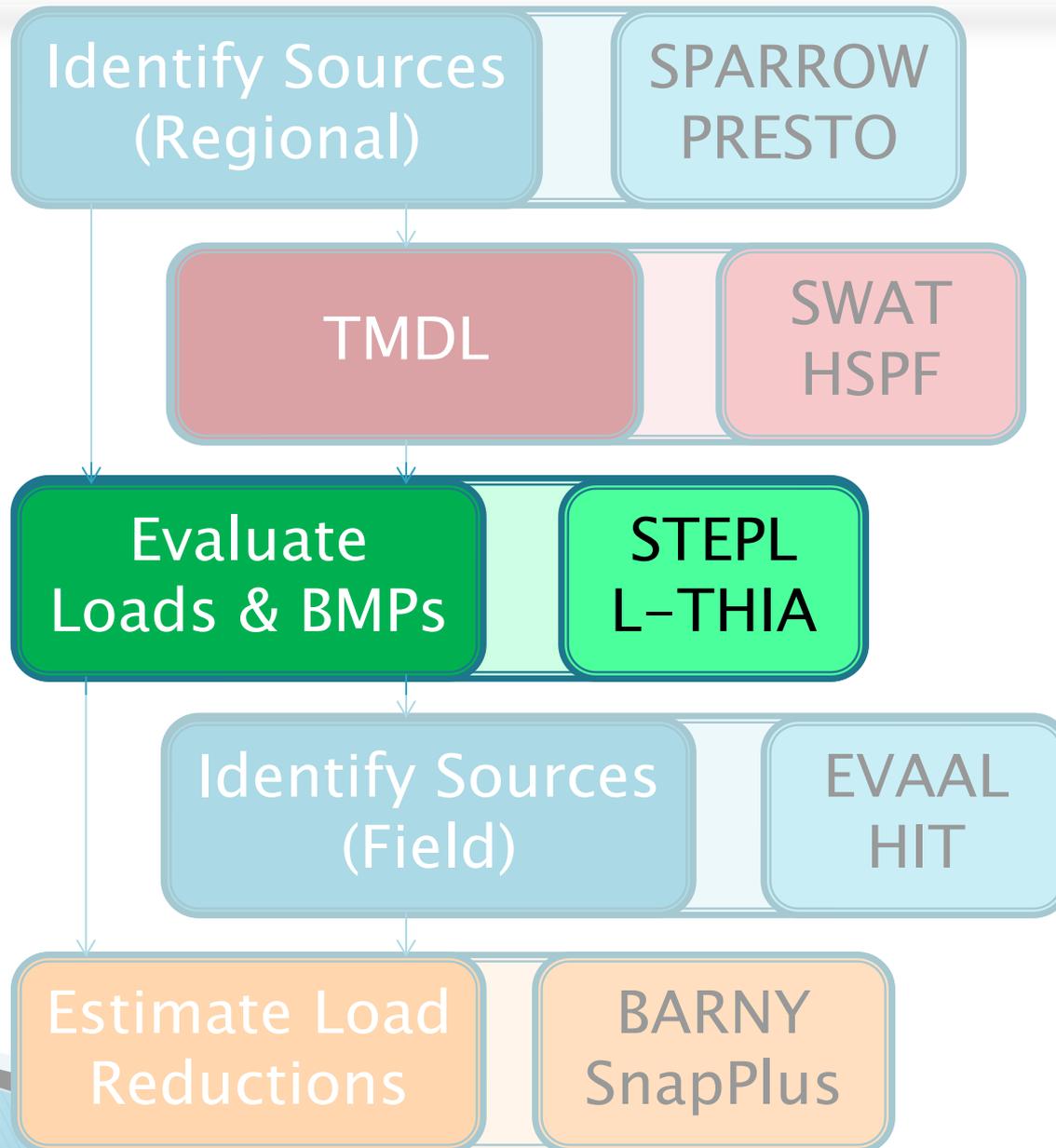
SWAT vs. HSPF

- ▶ Better representation of ag land practices
- ▶ Explicit plant growth
- ▶ Irrigation
- ▶ Better user interface
- ▶ Toxics
- ▶ Better river & lake processes

SWAT

HSPF

Models



STEPL



Name:	Spreadsheet Tool for Estimating Pollutant Load
Developer:	EPA/Tetra Tech
Website:	http://it.tetrattech-ffx.com/steplweb/default.htm
Overview:	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.
Type:	Landscape
Scale:	Basin
Land use:	Mixed
Complexity:	Low
Format:	Software interface for MS Excel

STEPL Methods

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



NRCS Photo/Tim McCabe



CPRblog/Dave Owen

STEPL Results

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	1287.4	495.7	2574.9	804.7	1223.1	470.9	2446.1	764.4	64.4	24.8	128.7	40.2	95.0	95.0	95.0	95.0
Total	1287.4	495.7	2574.9	804.7	1223.1	470.9	2446.1	764.4	64.4	24.8	128.7	40.2	95.0	95.0	95.0	95.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	0.00	0.00	0.00	0.00
Cropland	0.00	0.00	0.00	0.00
Pastureland	0.00	0.00	0.00	0.00
Forest	0.00	0.00	0.00	0.00
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	64.37	24.78	128.74	40.23
Groundwater	0.00	0.00	0.00	0.00
Total	64.37	24.78	128.74	40.23

STEPL

▶ 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

L-THIA

Name:	Long Term Hydrologic Impact Analysis
Developer:	Purdue University
Website:	https://engineering.purdue.edu/~lthia/
Overview:	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
Type:	Landscape
Scale:	Basin
Land use:	Mixed
Complexity:	Medium-Low
Format:	Online viewer/model; ArcGIS extension

L-THIA online



L-THIA HOME

[MSDSS LTHIA tutorials and help](#)

Process: 3 separate ways to locate your point:

A) [Search / Zoom](#) and Click "Delineate",

B) [select 12 digit HUC](#)

C) or [type in your location coordinates](#).

Search for or Zoom-in to your area.

Select "Delineate" button and click on the stream whose watershed you plan to analyze. Your location is sent to our L-THIA engine and the watershed of that point is calculated; then you can run L-THIA model on it to predict runoff.

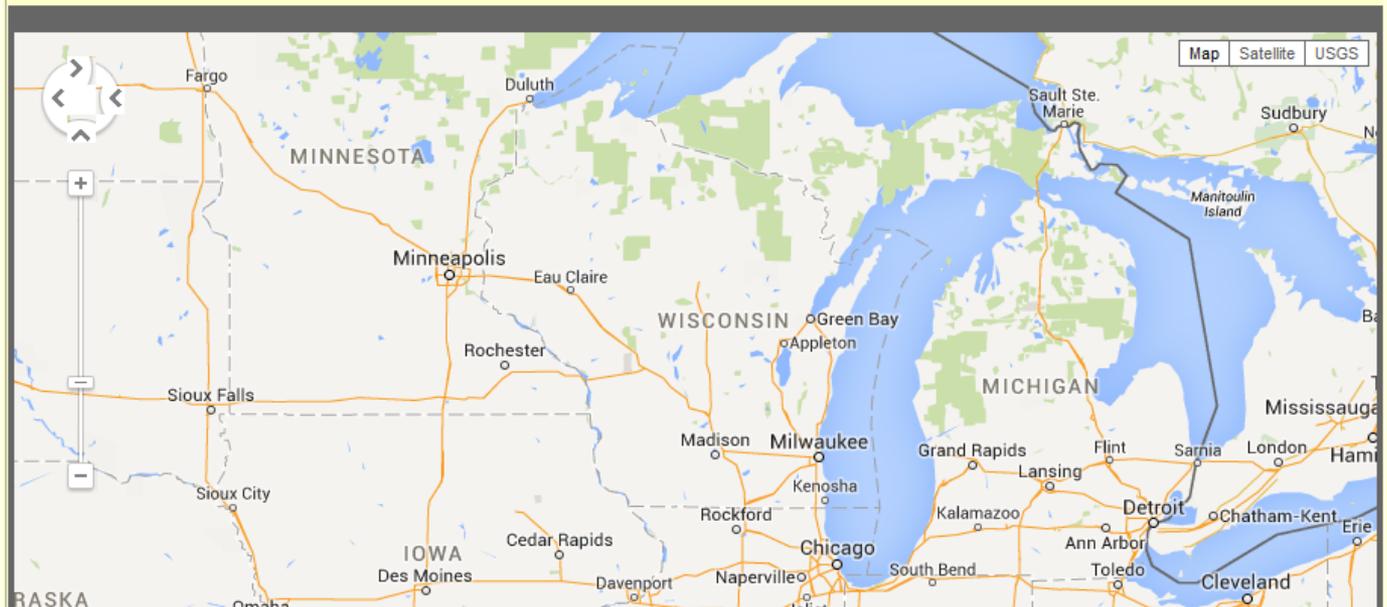
To enter a specific latitude- longitude select "Lat-Lon" button below , longitude with minus sign must be within -92 70000 to -87 00000 and

This Online Watershed Delineation (OWL) tool will delineate the area that flows to pour 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

[Metadata](#)





Introduction

The Great Lakes Watershed Management System (GLWMS) is an on-line tool that allows users to evaluate non-point source (NPS) pollution model estimates at watershed and field scales. The system links two water quality models, [High Impact Targeting \(HIT\)](#) from the [Institute of Water Research at Michigan State University](#), and the [Long Term Hydrologic Impact Assessment \(L-THIA\)](#) from [Purdue University's Department of Agricultural and Biological Engineering](#). HIT estimates sediment loading from agricultural lands to nearby streams; L-THIA estimates run-off volumes and pollutant loads.

The GLWMS allows users to view HIT and L-THIA estimates at watershed scales, and conduct field scale scenario evaluations of land cover changes or best management practices (BMPs).

The system is currently available for the priority

Navigation

- Map Layers
- Legend
- Analysis
- About the Models
- About the Tool

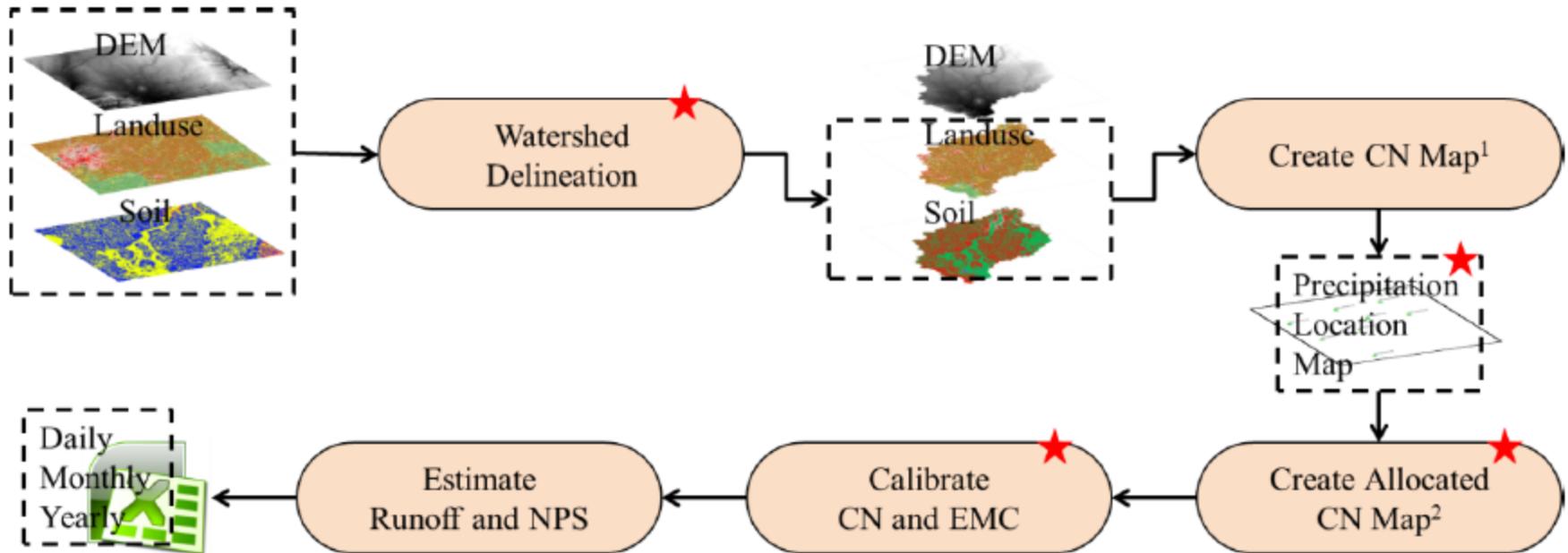
Active Map Tool: **Identify features on-click**

Banner photograph credit: [Andrea L. Jaeger Miehs](#)

Institute of Water Research at Michigan State University, all rights reserved 2015

-76.75551758, 47.00418589

ArcL-THIA



★ : Optional

Create CN Map¹: Combined map of landuse and soil

Create Allocated CN Map²: Combined map of landuse, soil, and precipitation gauges

L-THIA

▶ 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

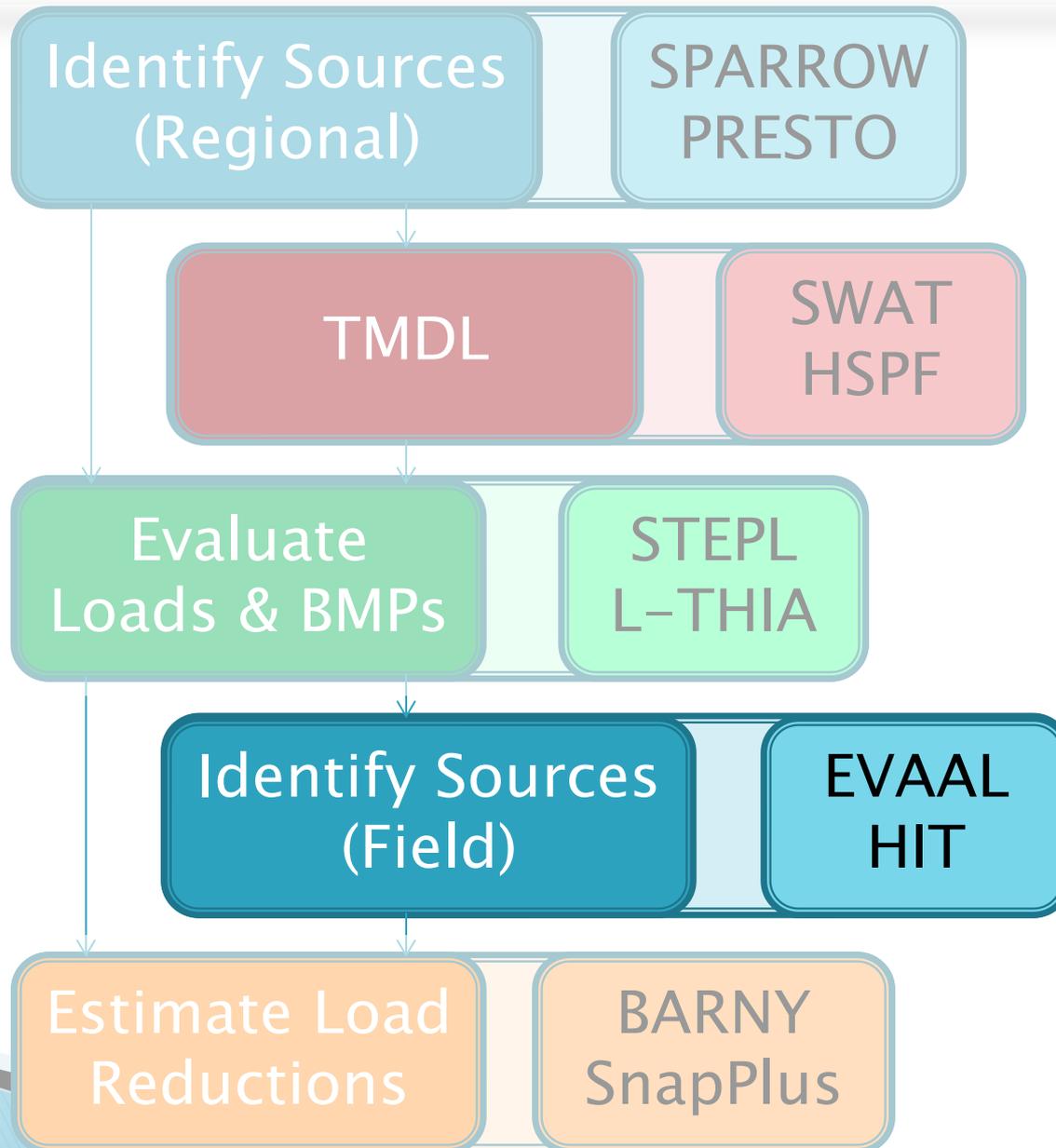
STEPL vs. L-THIA

- ▶ Easy-to-use spreadsheet
- ▶ Numerous BMPs
- ▶ EPA supported
- ▶ Online interface
- ▶ Automatically determines land use and soils
- ▶ GIS interface

STEPL

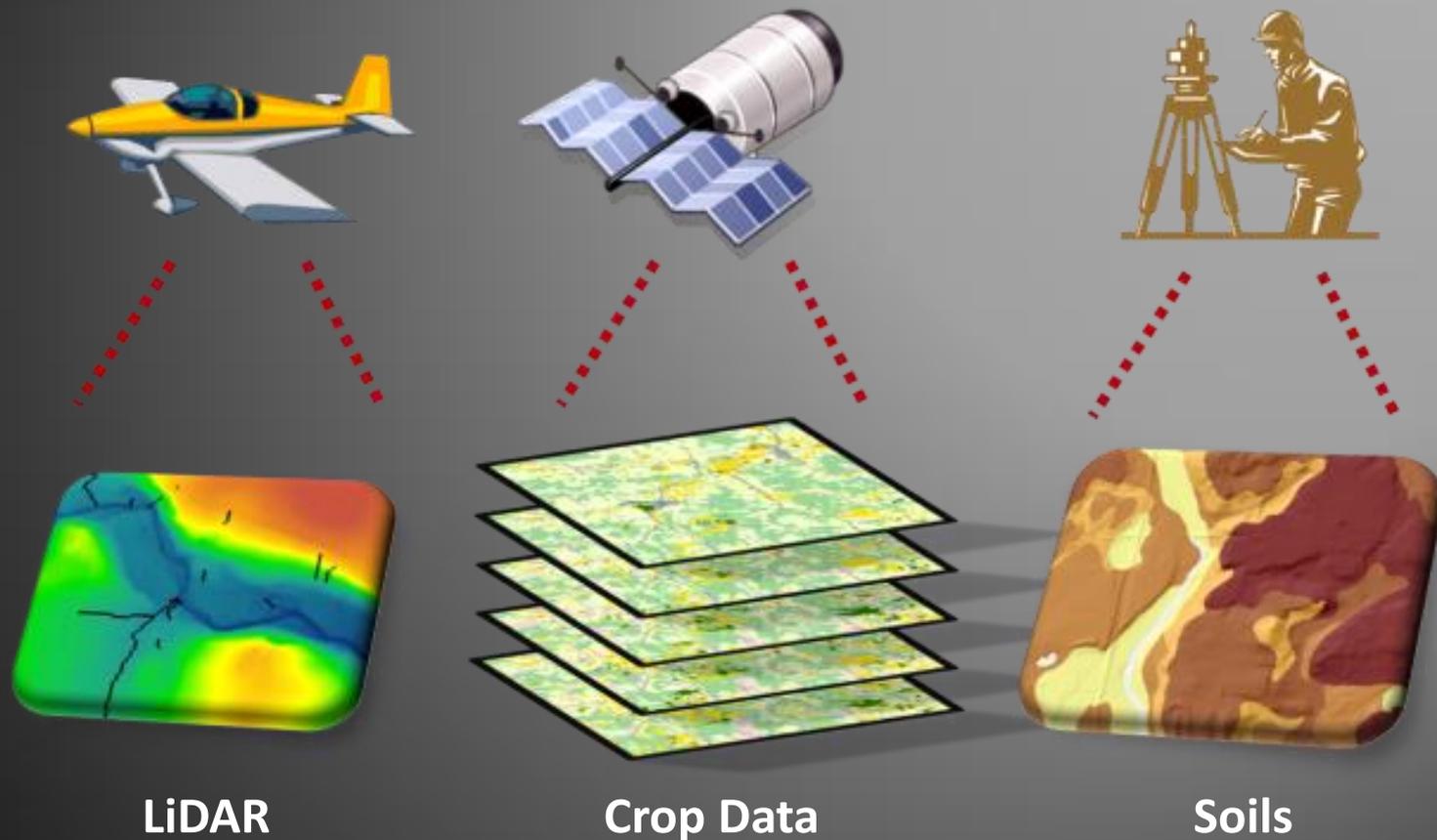
L-THIA

Models

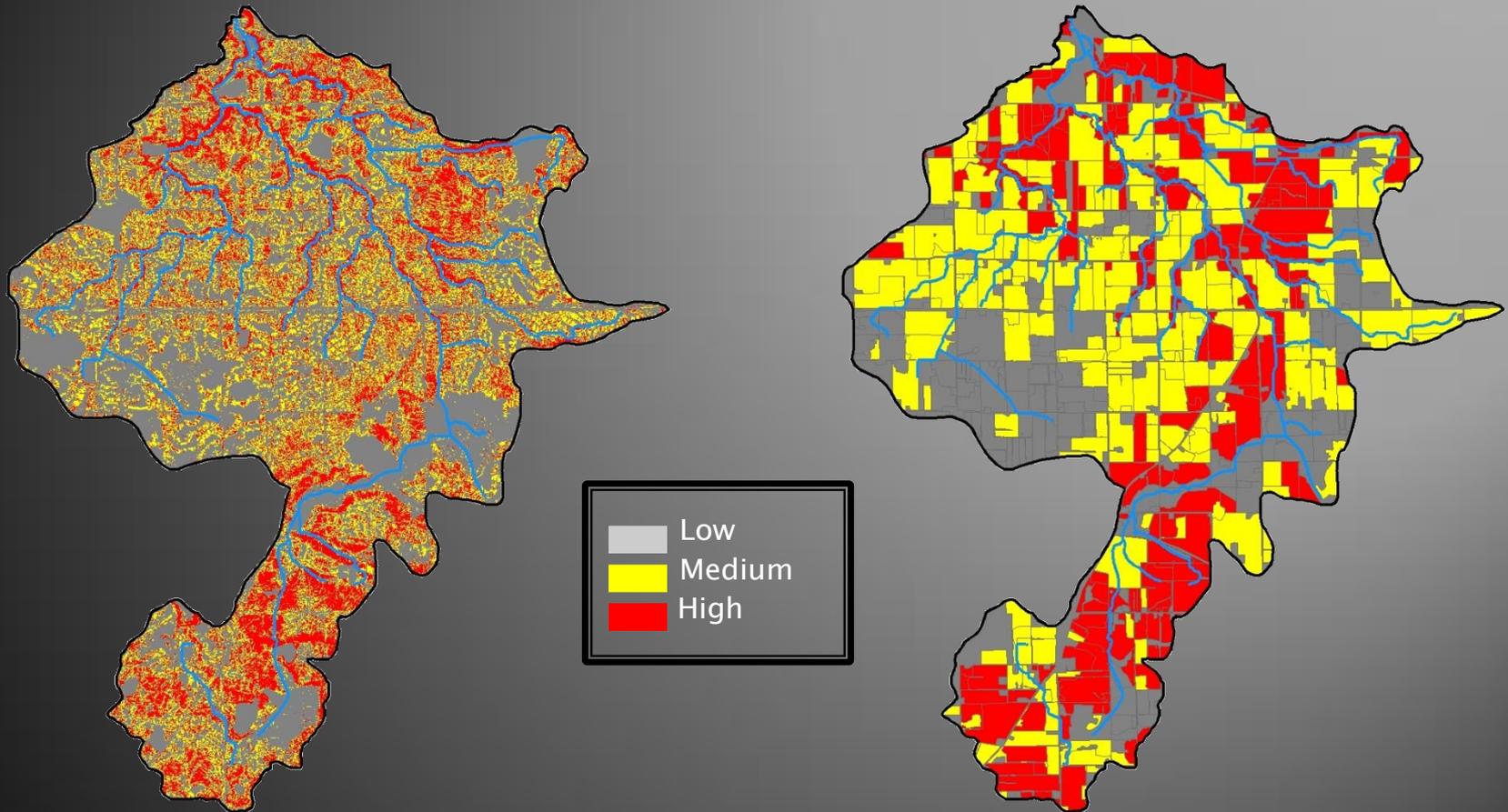


Name:	Erosion Vulnerability Assessment for Agricultural Lands
Developer:	WDNR
Website:	http://dnr.wi.gov/topic/nonpoint/eval.html
Overview:	EVAAL evaluates locations of relative vulnerability to sheet, rill and gully erosion using information about topography, soils, rainfall and land cover. This tool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

EVAAL



Erosion Vulnerability



EVAAL

▶ Main Uses

- Prioritize areas of highest erosion vulnerability
- Visualize general crop rotations
- Identify internally draining areas

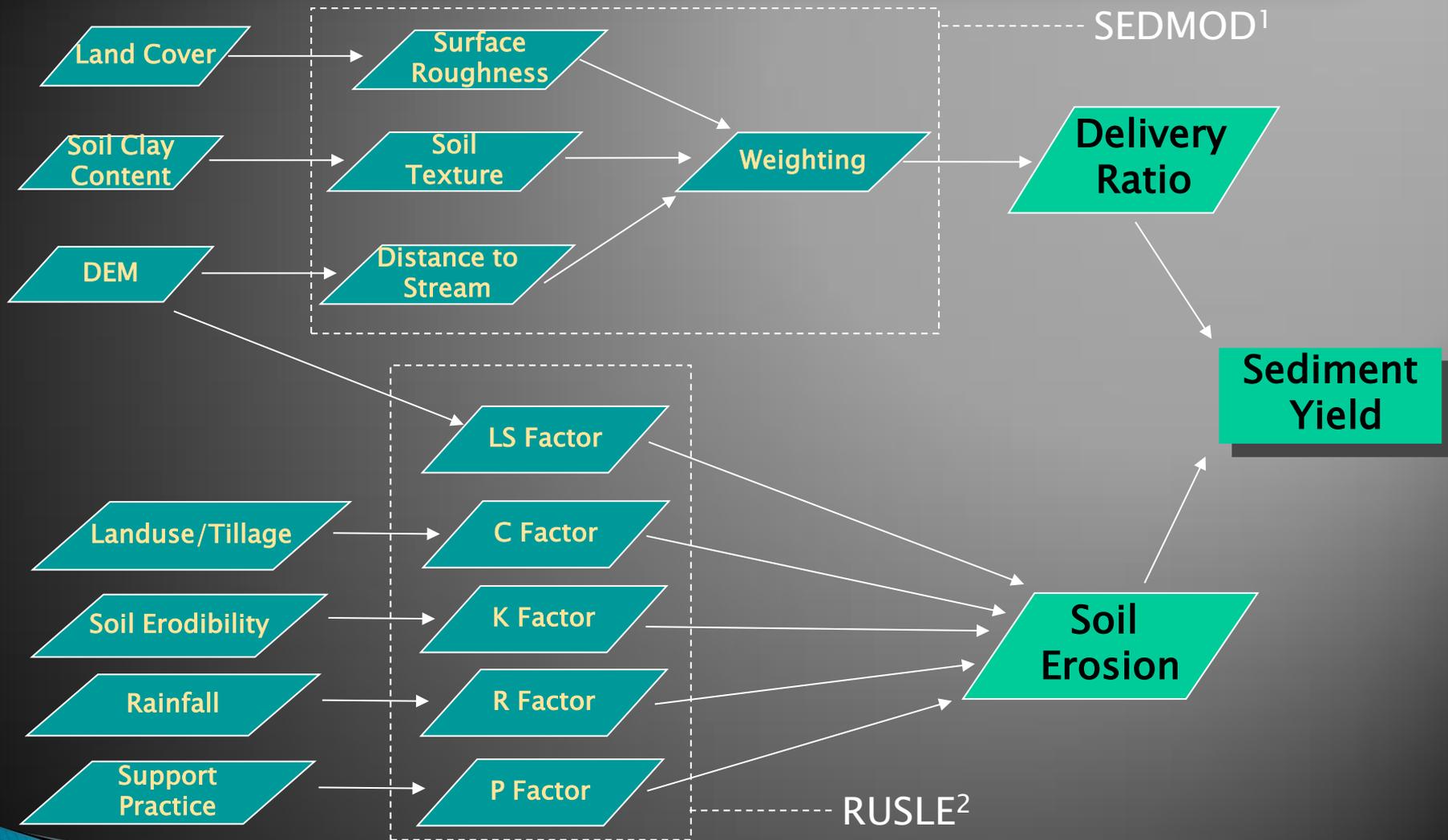
▶ Limitations/Cautions

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

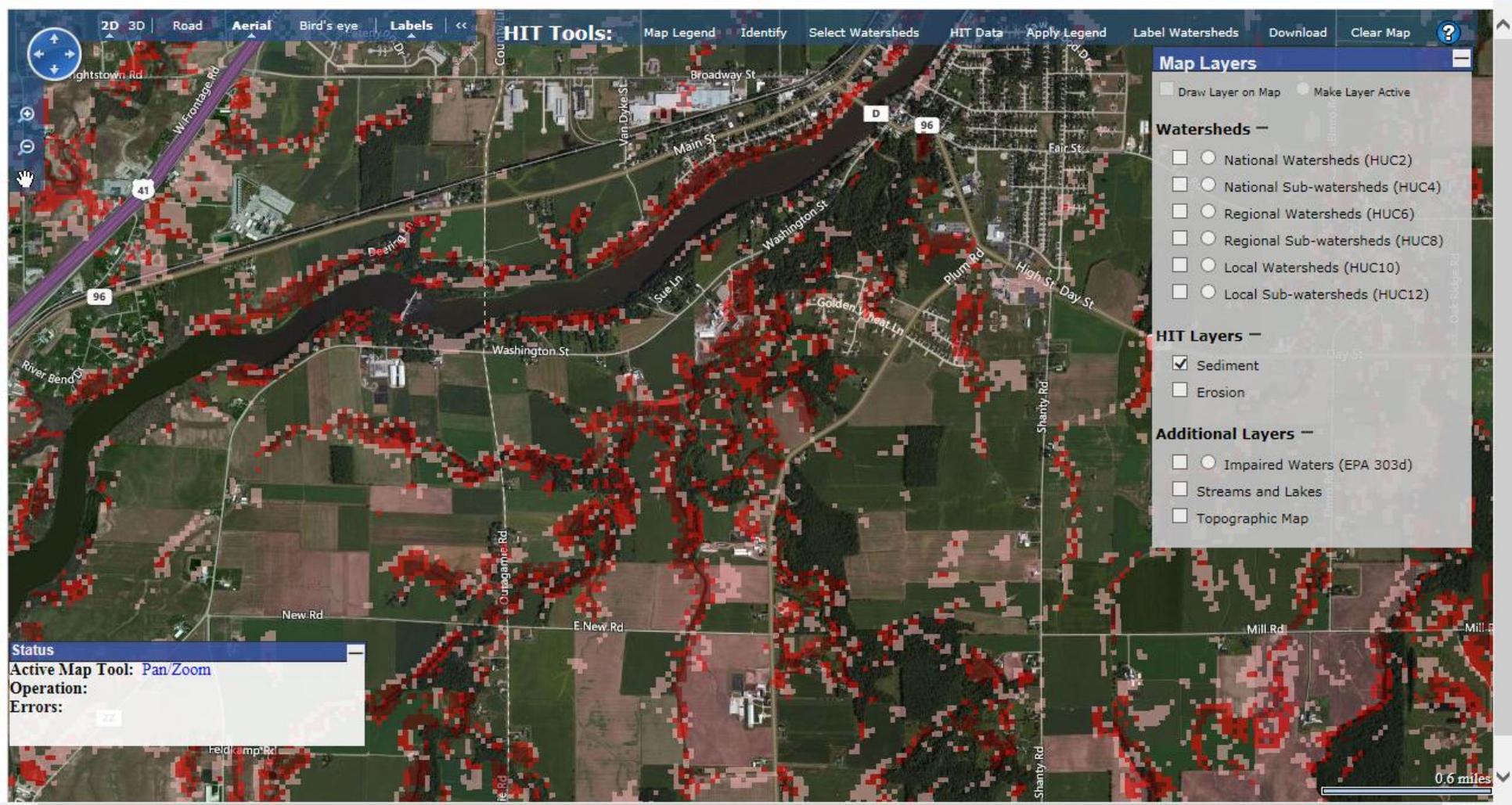
HIT

Name:	High Impact Targeting
Developer:	Michigan State University
Website:	http://www.iwr.msu.edu/hit2/
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.
Type:	Landscape
Scale:	Regional – Basin
Land use:	Agricultural
Complexity:	Low
Format:	Online viewer; download model results

HIT



The screenshot displays the HIT 2.0 web application interface. At the top, a browser address bar shows the URL <http://www.iwr.msu.edu/hit2/hitmap.htm>. The main interface features a top toolbar with navigation and tool options: 2D, 3D, Road, Aerial, Bird's eye, Labels, HIT Tools, Map Legend, Identify, Select Watersheds, HIT Data, Apply Legend, Label Watersheds, Download, and Clear Map. A secondary toolbar on the left includes a compass, zoom controls, and a hand icon. The central map area shows a topographic view of the Great Lakes basin, with watershed boundaries overlaid in white. Major cities and states are labeled, including Chicago, Detroit, Toronto, and New York. A right-hand panel titled 'Map Layers' contains several sections: 'Map Layers' with 'Draw Layer on Map' and 'Make Layer Active' options; 'Watersheds' with radio buttons for National Watersheds (HUC2), National Sub-watersheds (HUC4), Regional Watersheds (HUC6), Regional Sub-watersheds (HUC8), Local Watersheds (HUC10), and Local Sub-watersheds (HUC12); 'HIT Layers' with checkboxes for 'Sediment' and 'Erosion'; and 'Additional Layers' with checkboxes for 'Impaired Waters (EPA 303d)', 'Streams and Lakes', and 'Topographic Map'. A bottom-left status box shows 'Active Map Tool: Pan/Zoom', 'Operation:', and 'Errors:'. A scale bar at the bottom right indicates 150 miles.



HIT

▶ 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

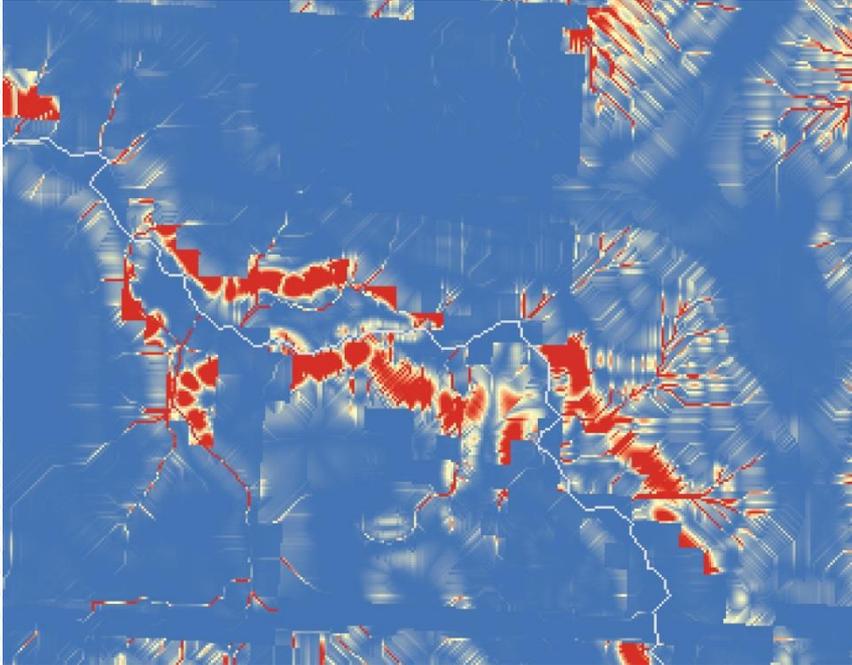
EVAAL vs. HIT

- ▶ 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

HIT

EVAAL vs. HIT

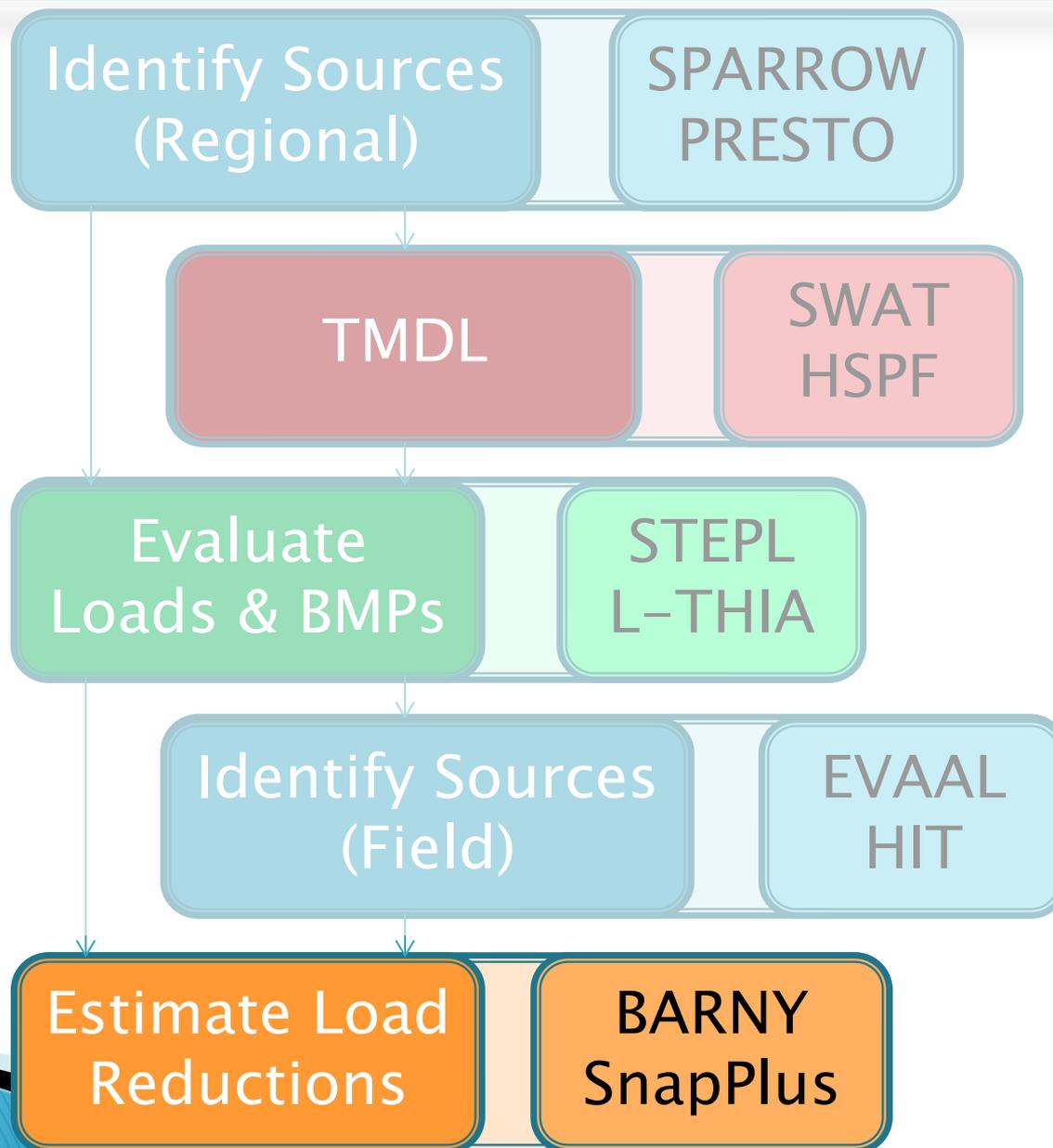


EVAAL



HIT

Models



BARNY

Name:	Barnyard Runoff Model
Developer:	WDNR
Website:	http://datcp.wi.gov/uploads/Environment/xls/BARNY.xls
Overview:	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.
Type:	Landscape
Scale:	Field (barnyard)
Land use:	Agricultural
Complexity:	Low
Format:	MS Excel Spreadsheet

BARNY

▶ Main Uses

- Evaluating phosphorus export from barnyards
- Evaluating phosphorus load reductions due to barnyard management activities

▶ Limitations / Cautions

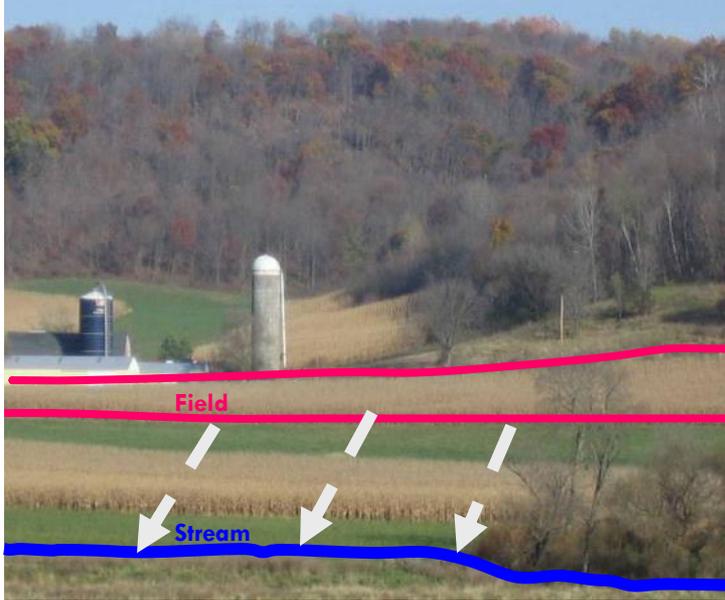
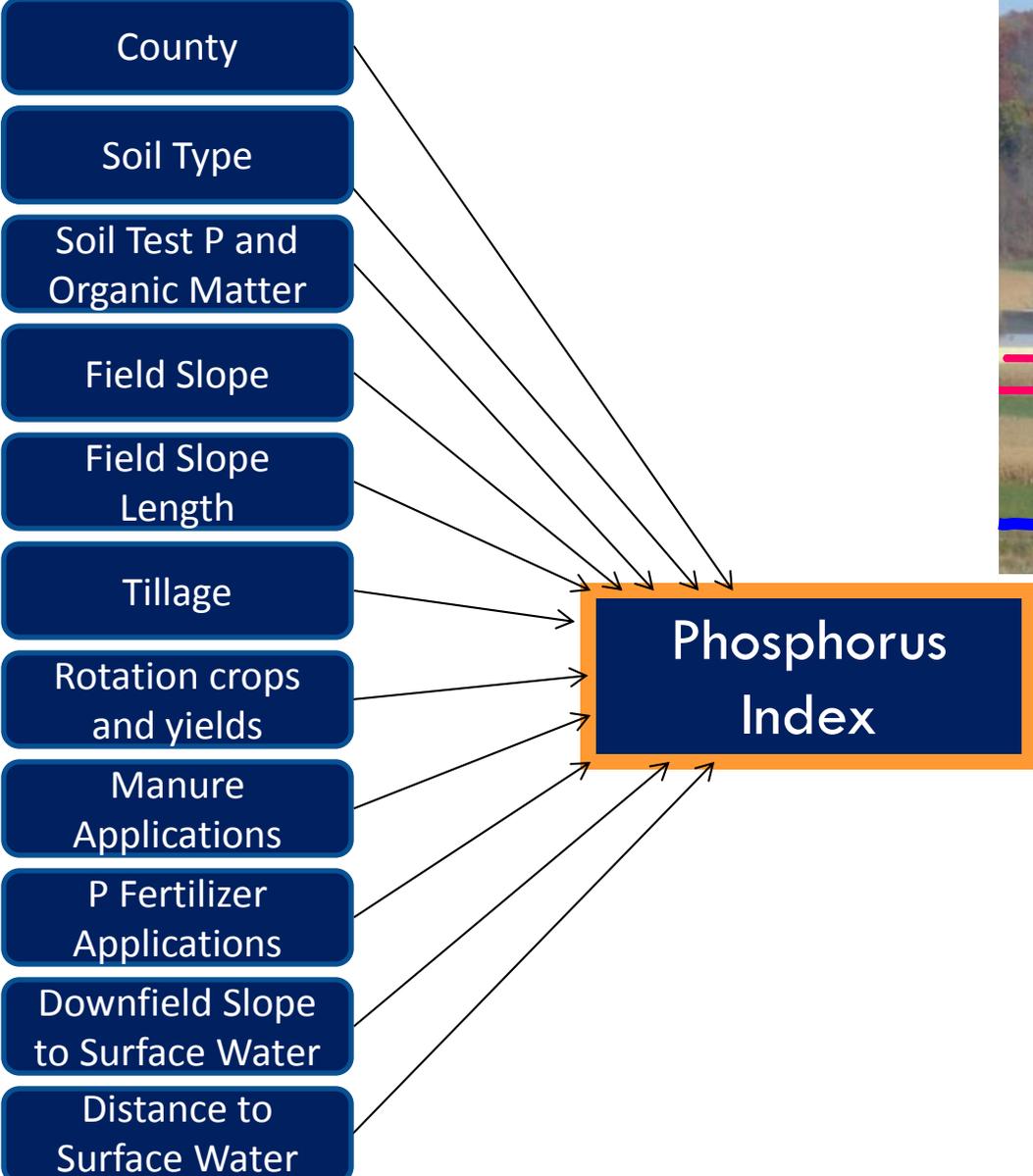
- Buffer effectiveness pretty good, other calcs questionable
- Streams flowing across yard are usually over-rated
- Roof gutter are usually under-rated
- Good comparison as long as upstream drainages are no larger than the lot itself

SnapPlus



Name:	Soil Nutrient Application Planner
Developer:	University of Wisconsin
Website:	http://snapplus.wisc.edu/
Overview:	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.
Type:	Landscape
Scale:	Field
Land Use:	Rural (ag)
Complexity:	Medium - High
Format:	Software

P Index: Nutrient Management Planning Information Is Used to Estimate Annual P Delivery 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 gully erosion is addressed
- Assumes field is uniform
- Uses simplified delivery to stream

Some Additional Models

- ▶ Lake Response
 - WiLMS
- ▶ Urban
 - WinSLAMM
 - P8

WiLMS

Name:	Wisconsin Lake Modeling Suite
Developer:	WDNR
Website:	http://dnr.wi.gov/lakes/model/
Overview:	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.
Type:	Watershed
Scale:	Basin
Land use:	Mixed
Complexity:	Low–Medium
Format:	Software

WinSLAMM



Name:	Source Loading and Management Model for Windows
Developer:	PV & Associates
Website:	http://winslamm.com/
Overview:	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.
Type:	Landscape
Scale:	Basin
Land use:	Urban
Complexity:	Medium
Format:	Proprietary software (fee)

P8

Name:	Program for Predicting Polluting Particle Passage thru Pits, Puddles, & Ponds
Developer:	William W. Walker, Jr., Ph.D.
Website:	http://www.walker.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

WinSLAMM

P8

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>
- ▶ Surface Water Data Viewer
- ▶ Lakes & AIS Viewer
- ▶ Watershed Restoration Viewer

Surface Water Data Viewer (SWDV)

http://dnr.wi.gov/topic/surfacewater/swdv/

Surface Water Data Viewer

Business Licenses & Regulations Recreation Education Topics Contact Join DNR Search or Keywords

Surface Water Data Viewer

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 invasives) data.



Little St.Germain Lake, L. Helmuth

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 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.**

Overview Wetlands Dams Floodplains Designated Waters Construction Permits Fish Advice

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 datalayers 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](#)

Last revised: Tuesday December 17 2013

SWDV

SWIMS help guides
About the SWIMS database.

SWIMS data model
Projects, monitoring stations, fieldwork events, finding data.

Surface water viewer
Launch Application: [SWIMS Data](#)

Great Lakes data
Beach stations, projects, grants, and data.

River & stream data
Stations, projects, results.

Wetlands data
Wetlands data in SWIMS.

Aquatic invasives
Aquatic invasives in Wisconsin.

Citizen lake data
Explore citizen lake monitoring datasets.

Citizen stream data
Volunteer stream monitoring.

Wisconsin Data Exchange
Water Quality Exchange (WQX)
Network: [WQX Data Layer](#)

Contact information

For information on this page, contact:

[Melli MacDonald](#)
608-266-5242
SWDV File Manager
Water Division

<http://dnr.wi.gov/topic/surfacewater/swdv/>



Convert Select

Surface Water Data Viewer

Search...

Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help

Home Show Layers Show Legend Pan Zoom In Zoom Out Previous Extent Full State Point Identify

Scale: 1: 3,008,382

Clicked Coordinates Lat: 44.7513 Lon: -89.7632 Lat/Lon (DD)

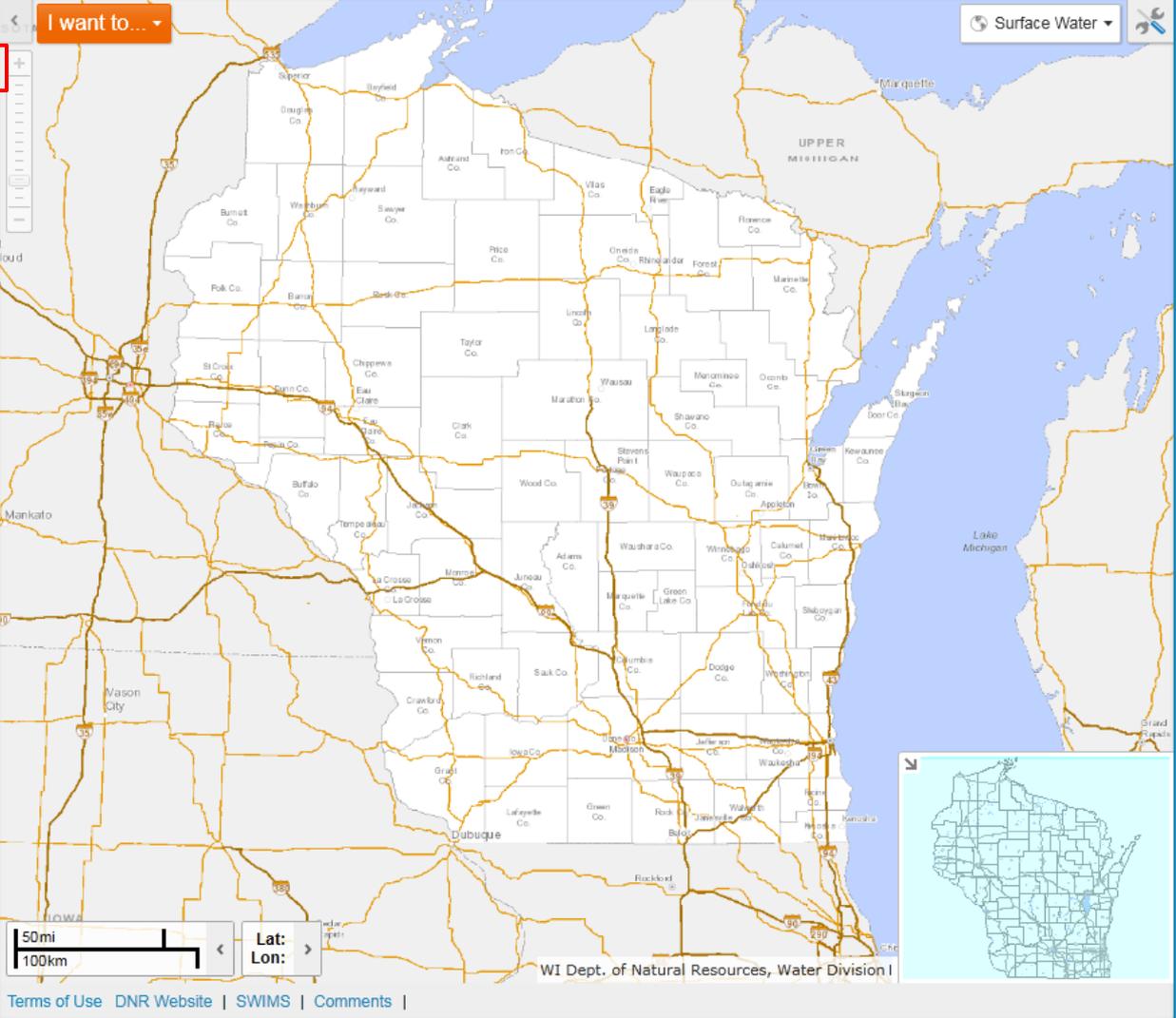
Home Map Layers Navigation Location Info Scale & Bookmarks Coordinate Tools Print

Map Layers

I want to...

Layer Theme: Surface Water (default)

- Filter...
- Operational Layers
 - Monitoring Sites & Data
 - Dams & Floodplains
 - Statewide Non-digitized FIRM Index
 - Non-digitized FIRMs (Flood Ins. Rate Maps)
 - Impairments & Assessments
 - Designated Waters (ASNRI, PRF, PNW)
 - Clean Water Act Standards & Uses
 - Permits & Determinations
 - Grant Locations
 - Wetlands & Soils
 - Fisheries Management
 - Aquatic Invasive Species
 - Water Resources
 - Natural Community Modeling
 - Federal Hydrologic Unit Codes (HUC)
 - Land Descriptions & Cadastral
 - Administrative & Political Boundaries
 - Map Indexes (USGS Quads)
 - Forest & Land Cover
 - Base Maps
 - Cities, Roads, & Waterways
 - Public Lands



Surface Water Data Viewer

Basic Tools Identify Tools Drawing Tools Measuring Tools

Home Show Layers Show Legend Pan Zoom In Zoom Out Previous

Home Map Layers Navigation

Results (5) View History View Selected

Refine Results Table View Charting View Export to Shapefile Select All Select None

- Onion River
 - Impaired River or Stream Metadata Listing Details
- Onion River - Downstream of CTHY I
 - Monitoring Station Metadata Link to Monitoring Data
- Onion River, (WBIC 55)
 - River or Stream Metadata About the Water
- Unnamed, (WBIC 55)
 - Open Water Metadata Lake Page About the Water
- Sheboygan County

Onion River - Downstream of CTHY I (Station 10031961)

Zoom to Feature | Pan to Feature | Add to Selected

Details Attributes

Field Name	Field Value
SWIMS Station ID	10031961
Primary Station Name	Onion River - Downstream of CTHY I
WBIC	51200

Monitoring Station

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

Show specific parameter: <Show All>

Sample Results

Project	Date/Time	DNR Parameter	Species	Result	Units
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	TEMPERATURE FIELD		12.0	C
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	AMBIENT AIR TEMPERATURE - FIELD		14.5	C
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	CLOUD COVER		100	%
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	CONDUCTIVITY FIELD		681	UMHOS/CM
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	TEMPERATURE AT LAB		ICED	C
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	DISSOLVED OXYGEN FIELD		9.86	MG/L
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	OXYGEN, DISSOLVED, PERCENT OF SATURATION %		91.5	%
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	PH FIELD		8.42	SU
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	PHOSPHORUS TOTAL		0.081	MG/L
WWTP Background TP monitoring 2012 - WCR_13_CMP13	10/23/2012 02:20 PM	TRANSPARENCY TUBE		52.6	CM
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	TEMPERATURE FIELD		11.2	C
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	AMBIENT AIR TEMPERATURE - FIELD		12.8	C
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	CLOUD COVER		10	%
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	STREAM FLOW - CFS		6.4	CFS
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	CONDUCTIVITY FIELD		574	UMHOS/CM
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	TEMPERATURE AT LAB		ICED	C
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	DISSOLVED OXYGEN FIELD		10.2	MG/L
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	OXYGEN, DISSOLVED, PERCENT OF SATURATION %		93.3	%
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	PH FIELD		8.1	SU
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	PHOSPHORUS TOTAL		0.103	MG/L
WWTP Background TP monitoring 2012 - WCR_13_CMP13	09/24/2012 10:45 AM	TRANSPARENCY TUBE		35.0	CM
WWTP Background TP monitoring 2012 - WCR_13_CMP13	08/23/2012 09:30 AM	TEMPERATURE FIELD		21.83	C
WWTP Background TP monitoring 2012 - WCR_13_CMP13	08/23/2012 09:30 AM	AMBIENT AIR TEMPERATURE - FIELD		19.50	C
WWTP Background TP monitoring 2012 - WCR_13_CMP13	08/23/2012 09:30 AM	CLOUD COVER		100	%
WWTP Background TP monitoring 2012 - WCR_13_CMP13	08/23/2012 09:30 AM	STREAM FLOW - CFS		6.73	CFS

Add Data

The screenshot shows the 'Surface Water Data Viewer' web application. The browser address bar displays 'dnrmaps.wi.gov/sl/?Viewer=SWDV'. The application header includes a search bar and navigation tabs for 'Basic Tools', 'Identify Tools', 'Drawing Tools', 'Measuring Tools', 'Find Location', 'Maps & Data', and 'Help'. The 'Maps & Data' tab is active, and the 'Add Map Layer' button is highlighted with a red box. Below the toolbar, the 'Map Layers' section shows a list of layers under 'Operational Layers' and 'Base Maps'. The 'Operational Layers' list includes: Monitoring Sites & Data, Dams & Floodplains, Statewide Non-digitized FIRM Index, Impairments & Assessments, Designated Waters (ASNRI, PRF, PNW), Clean Water Act Standards & Uses, Permits & Determinations, Grant Locations, Wetlands & Soils, Fisheries Management, Aquatic Invasive Species, Water Resources, Natural Community Modeling, Federal Hydrologic Unit Codes (HUC), Land Descriptions & Cadastral, Administrative & Political Boundaries, Map Indexes (USGS Quads), and Forest & Land Cover. The 'Base Maps' list includes: Cities, Roads, & Waterways and Public Lands. The 'Add Layer' dialog box is open, showing a search bar for 'URL or Keywords' and a list of search results. The results include: WT_Healthy_Watershed_Assesment_Ext, WT_Inland_Water_Resources_WTM_Ext, WT_Monitoring_Sites_and_Data_WTM_Ext, and WT_Natural_Community_Modeling_WTM_Ext. The dialog box also has 'Next' and 'Cancel' buttons at the bottom.

Surface Water Data Viewer

dnrmaps.wi.gov/sl/?Viewer=SWDV

Surface Water Data Viewer

Search...

Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help

Show Layers Show Legend Pan Zoom In Zoom Out Point Identify

Map Layers

Layer Theme: Surface Water (default)

Filter...

Operational Layers

- Monitoring Sites & Data
- Dams & Floodplains
- Statewide Non-digitized FIRM Index
 - Non-digitized FIRMs (Flood Ins. Rate Maps)
- Impairments & Assessments
- Designated Waters (ASNRI, PRF, PNW)
- Clean Water Act Standards & Uses
- Permits & Determinations
- Grant Locations
- Wetlands & Soils
- Fisheries Management
- Aquatic Invasive Species
- Water Resources
- Natural Community Modeling
- Federal Hydrologic Unit Codes (HUC)
- Land Descriptions & Cadastral
- Administrative & Political Boundaries
- Map Indexes (USGS Quads)
- Forest & Land Cover

Base Maps

- Cities, Roads, & Waterways
- Public Lands

50mi 100km

Terms of Use DNR Website

Add Layer

Discover a Map Service by entering a URL or search by using keywords.

URL or Keywords: Search for map services... Search

Select a Map Service - Found 85 Result(s)

 - WT_Healthy_Watershed_Assesment_Ext**
URL: http://dnrmaps.wi.gov/arcgis/rest/services/WT_SWDV/WT_Healthy_Watershed_As
 - WT_Inland_Water_Resources_WTM_Ext**
URL: http://dnrmaps.wi.gov/arcgis/rest/services/WT_SWDV/WT_Inland_Water_Resource
 - WT_Monitoring_Sites_and_Data_WTM_Ext**
URL: http://dnrmaps.wi.gov/arcgis/rest/services/WT_SWDV/WT_Monitoring_Sites_and_I
 - WT_Natural_Community_Modeling_WTM_Ext**

Next Cancel

Lakes & AIS Viewer

The screenshot shows a web browser window with the URL <http://dnr.wi.gov/lakes/viewer/>. The browser's address bar and tabs are visible. The website has a dark blue navigation bar with links for Business, Licenses & Regulations, Recreation, Education, Topics, Contact, and Join DNR. The main content area features a search box for "Lake Name:" with a "Go!" button. Below the search box is a "Lakes" section with a "Find a lake." input field. A "Lakes and AIS Mapping Tool" section contains links for "Metadata" and "Help". A "Contact information" section provides details for the Wisconsin DNR Lakes Division of Water, Bureau of Water Quality. A "Proceed" button is located at the bottom left of the main content area. The footer includes the Wisconsin Department of Natural Resources logo, a "LIVE chat" widget, social media icons for Facebook, Twitter, YouTube, and Flickr, and a "Subscribe to DNR Updates" button. The footer also contains logos for "WISCONSIN NATURAL RESOURCES MAGAZINE", "EELK", and "GOV".

http://dnr.wi.gov/lakes/viewer/

Lakes and Aquatic Invasive ...

Convert Select

Business Licenses & Regulations Recreation Education Topics Contact Join DNR

Lakes and Aquatic Invasive Species (AIS) Mapping Tool

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

Lake Name: Go!

Lakes

Find
a lake.

Lakes and AIS Mapping Tool

- Metadata
- Help

Contact information
For information on Lakes in Wisconsin, contact:
[Wisconsin DNR Lakes](#)
Division of Water
Bureau of Water Quality

WISCONSIN DEPT. OF NATURAL RESOURCES

Employment
Legal notices
Privacy notice
Acceptable use policy
Site requirements
Open the Outdoors

News
Staff Directory
Topics
Hotlines
Feedback

LIVE chat
Chat Now!
with customer service

WISCONSIN NATURAL RESOURCES MAGAZINE

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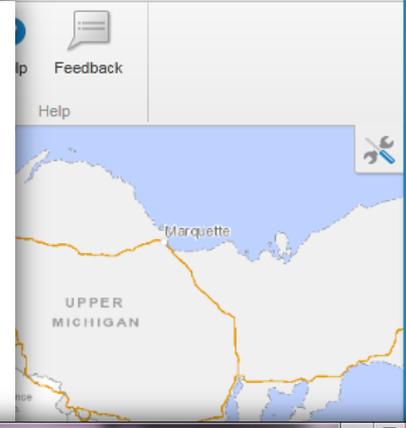
<http://dnr.wi.gov/lakes/viewer/>

Home Show Layers Show Legend Table of Content

Volunteer Water Quality Monitoring Station

Zoom to Feature | Pan to Feature | Copy to Drawing | Add to Selected

Field Name	Field Value
OBJECTID	3678
Station ID	643173
Station Type	LAKE
Secondary Station Type	DEEPEST SPOT



- Map Layers
- Operational Layers
- Boat Access Loc
 - Monitoring
 - Satellite Derived
 - Education & Out
 - Invasive Aquatic
 - Invasive Fish
 - Invasive Inverte
 - Invasive Wetland
 - Grants
 - Dams
 - Inland Water Res
 - Wetlands
 - Geographic & P
 - Cadastral Boundaries
- Base Maps
- Cities, Roads, & Waterways
 - Public Lands
 - Air Photos (WROC 2010)
 - Air Photos (NAIP 2008)

Wisconsin Department of Natural Resources

Lake Water Quality 2014 Annual Report

Fence Lake
 Vilas County
 Waterbody Number: 2323000

Lake Type: DRAINAGE
 DNR Region: NO
 GEO Region: NE

Site Name		Store #
Fence Lake - Deep Hole-North		643173

Date	SD (ft)	SD (m)	Hit Bottom	CHL	TP	TSI (SD)	TSI (CHL)	TSI (TP)	Lake Level	Clarity	Color	Perception
06/17/2014				1.41	6.17		37	42				

Date	Data Collectors	Project
06/17/2014	DANIELA GURLIN	Optical Properties of WI Lakes

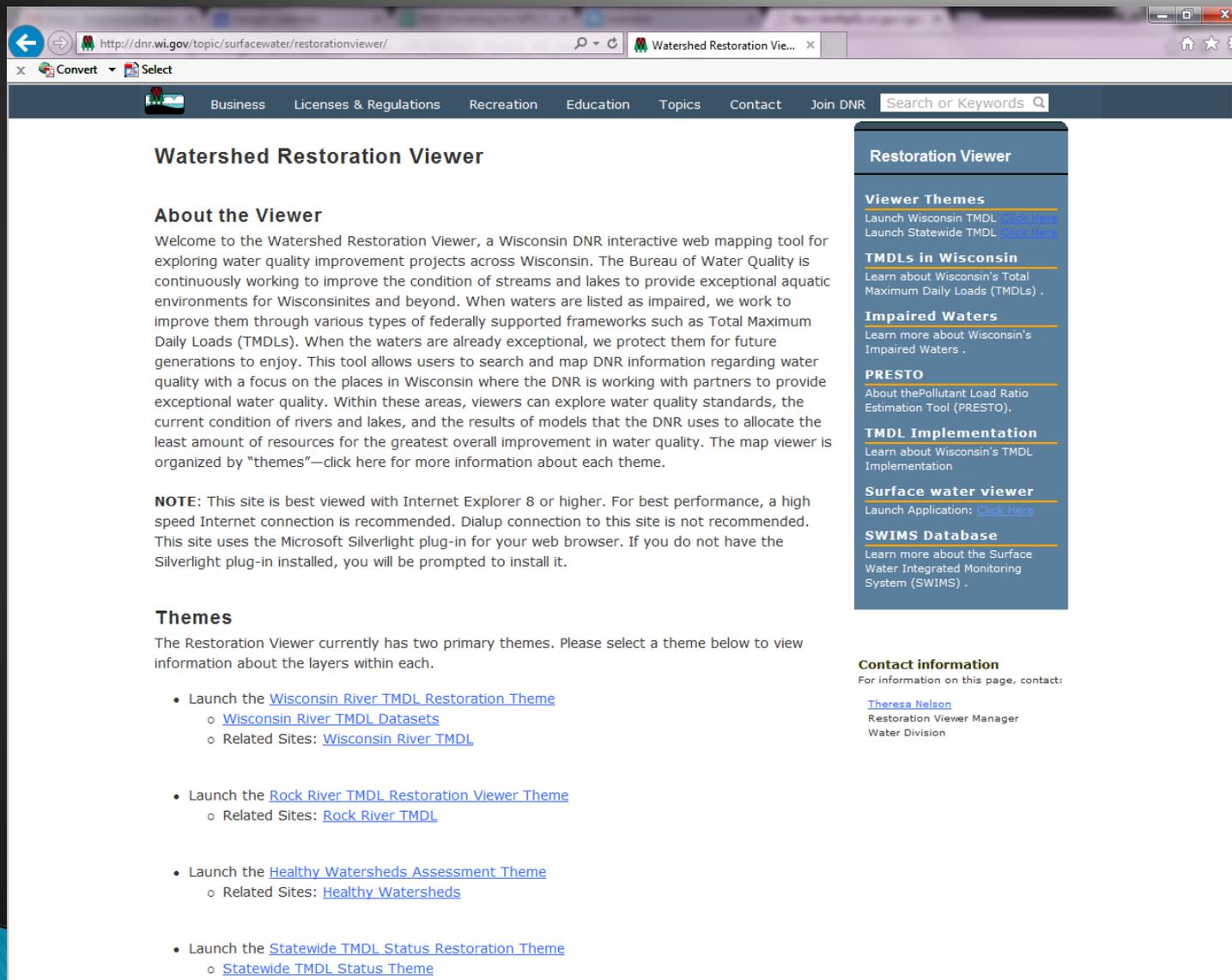
SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI (CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources Wisconsin Lakes Partnership

Report Generated: 01/15/2015



Watershed Restoration Viewer



The screenshot shows a web browser window displaying the Watershed Restoration Viewer website. The browser's address bar shows the URL: <http://dnr.wi.gov/topic/surfacewater/restorationviewer/>. The website has a dark blue navigation bar with the DNR logo and menu items: Business, Licenses & Regulations, Recreation, Education, Topics, Contact, and Join DNR. A search bar is located on the right side of the navigation bar. The main content area is titled "Watershed Restoration Viewer" and includes an "About the Viewer" section, a "NOTE" about browser requirements, a "Themes" section with a list of theme links, and a "Restoration Viewer" sidebar with links to various tools and databases. The footer of the website features the Wisconsin Department of Natural Resources logo.

<http://dnr.wi.gov/topic/surfacewater/restorationviewer/>

Business Licenses & Regulations Recreation Education Topics Contact Join DNR Search or Keywords

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](#)

Restoration Viewer

Viewer Themes

Launch Wisconsin TMDL [Click Here](#)
Launch Statewide TMDL [Click Here](#)

TMDLs in Wisconsin

Learn about Wisconsin's Total Maximum Daily Loads (TMDLs) .

Impaired Waters

Learn more about Wisconsin's Impaired Waters .

PRESTO

About the Pollutant Load Ratio Estimation Tool (PRESTO).

TMDL Implementation

Learn about Wisconsin's TMDL Implementation

Surface water viewer

Launch Application: [Click Here](#)

SWIMS Database

Learn more about the Surface Water Integrated Monitoring System (SWIMS) .

Contact information

For information on this page, contact:

[Theresa Nelson](#)
Restoration Viewer Manager
Water Division



Wisconsin DNR Watershed Restoration Viewer

Search... Sign in ?

Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help

Home Show Layers Show Legend Pan Zoom In Zoom Out Previous Extent Full State Point Identify Scale: 1: 3,017,710 Jump to a map bookmark... New Plot Clear All Clicked Coordinates Lat: 44.7572 Lon: -90.0665 Lat/Lon (DD) Print Map

Map Layers

Layer Theme: Statewide TMDL Status (default)

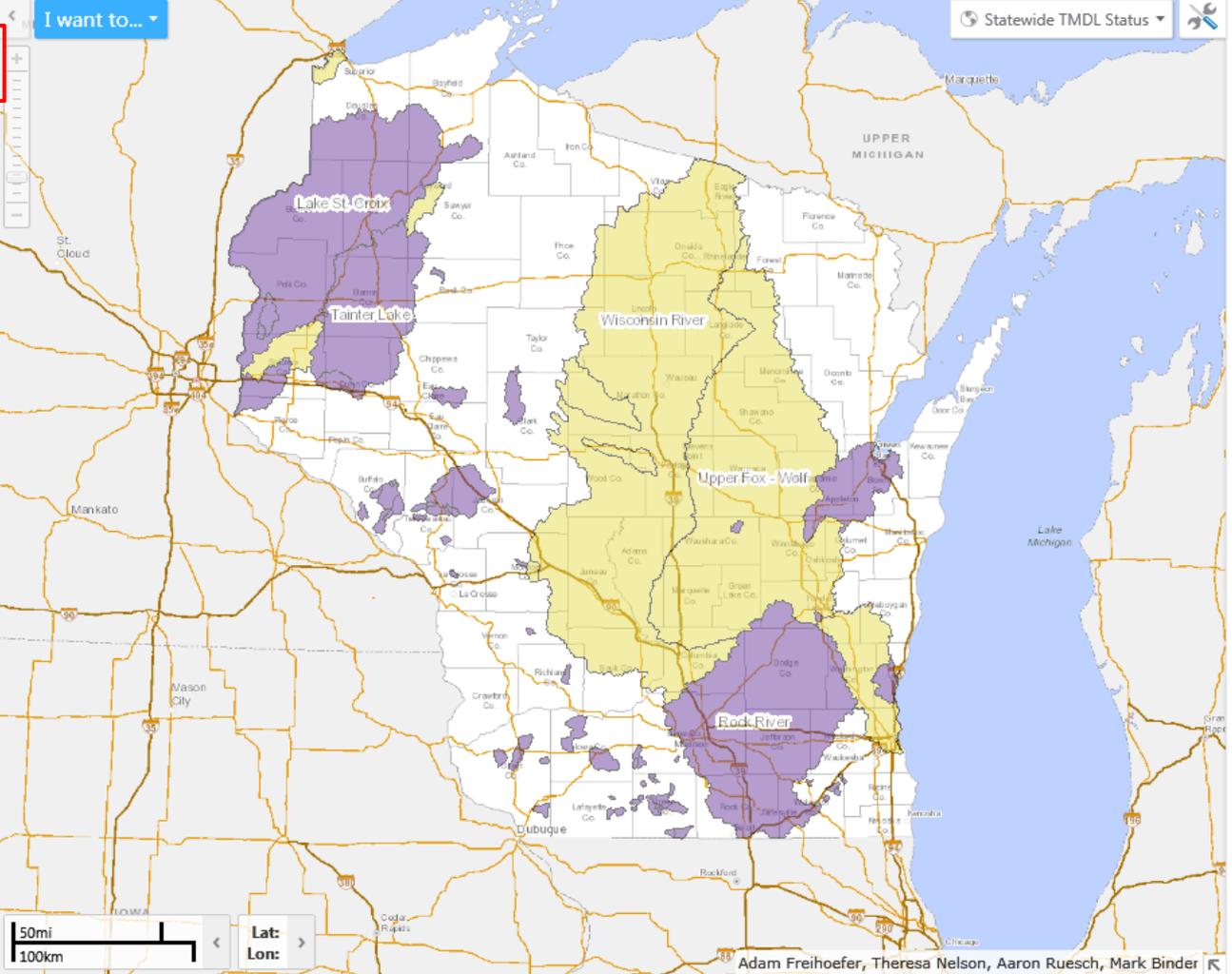
Show Legend Filter...

Operational Layers

- Water Resources
- TMDL Project Status
 - TMDL Project Status
- Impairments & Assessments

Base Maps

- Digital Topographic Maps
- Road Basemap
- Image Basemap WROC 2010



Wisconsin DNR Watershed Restoration Viewer

Search... Sign in ?

Basic Tools | Identify Tools | Drawing Tools | Measuring Tools | Find Location | Maps & Data | Help

Home | Show Layers | Show Legend | Pan | Zoom In | Zoom Out | Previous Extent | Full State | Point Identify | Scale: 1: 3,017,710 | New | Plot | Clear All | Clicked Coordinates: Lat: 44.7572, Lon: -90.0665 | Print Map

Map Layers

Layer Theme: Wisconsin River TMDL

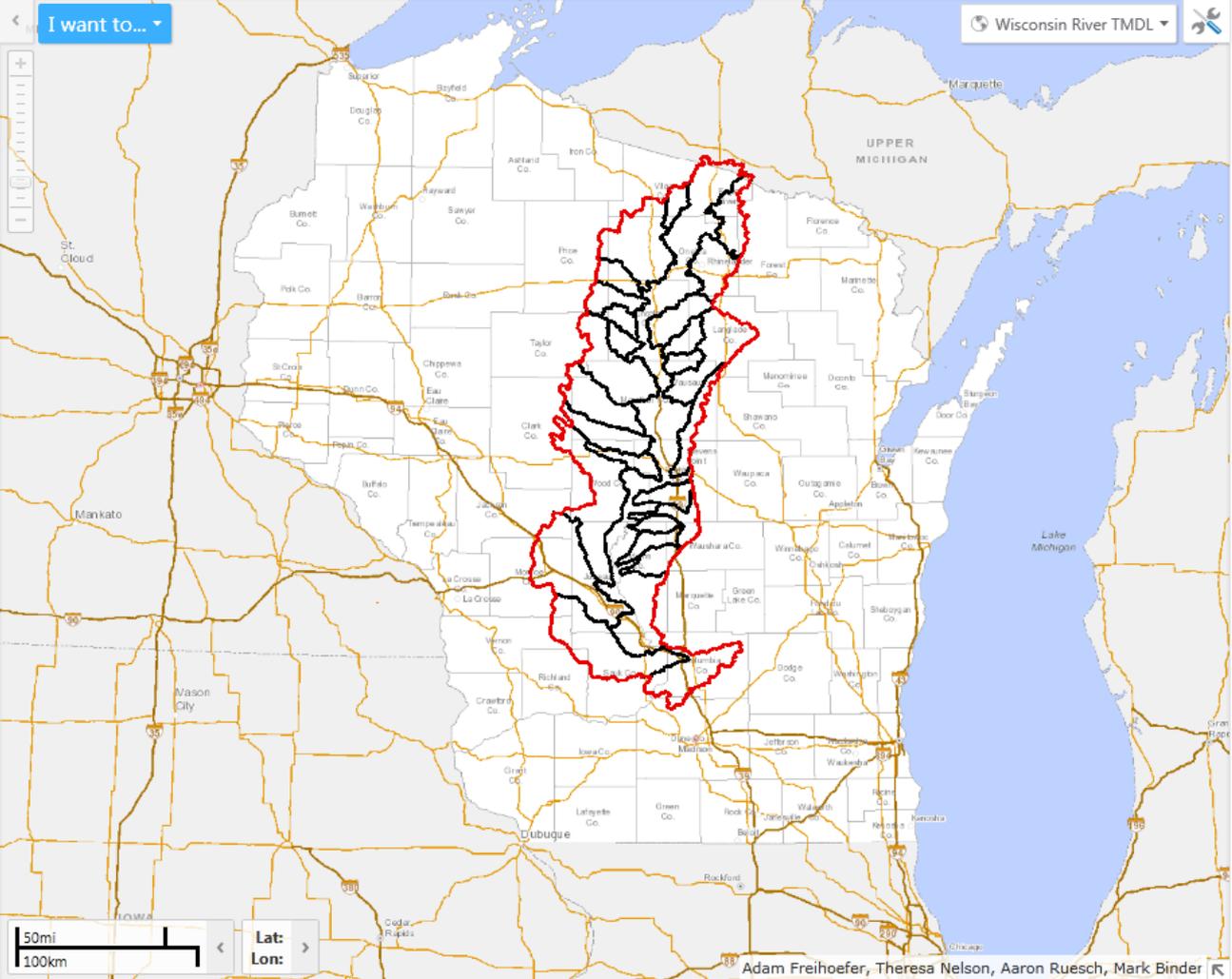
Show Legend | Filter...

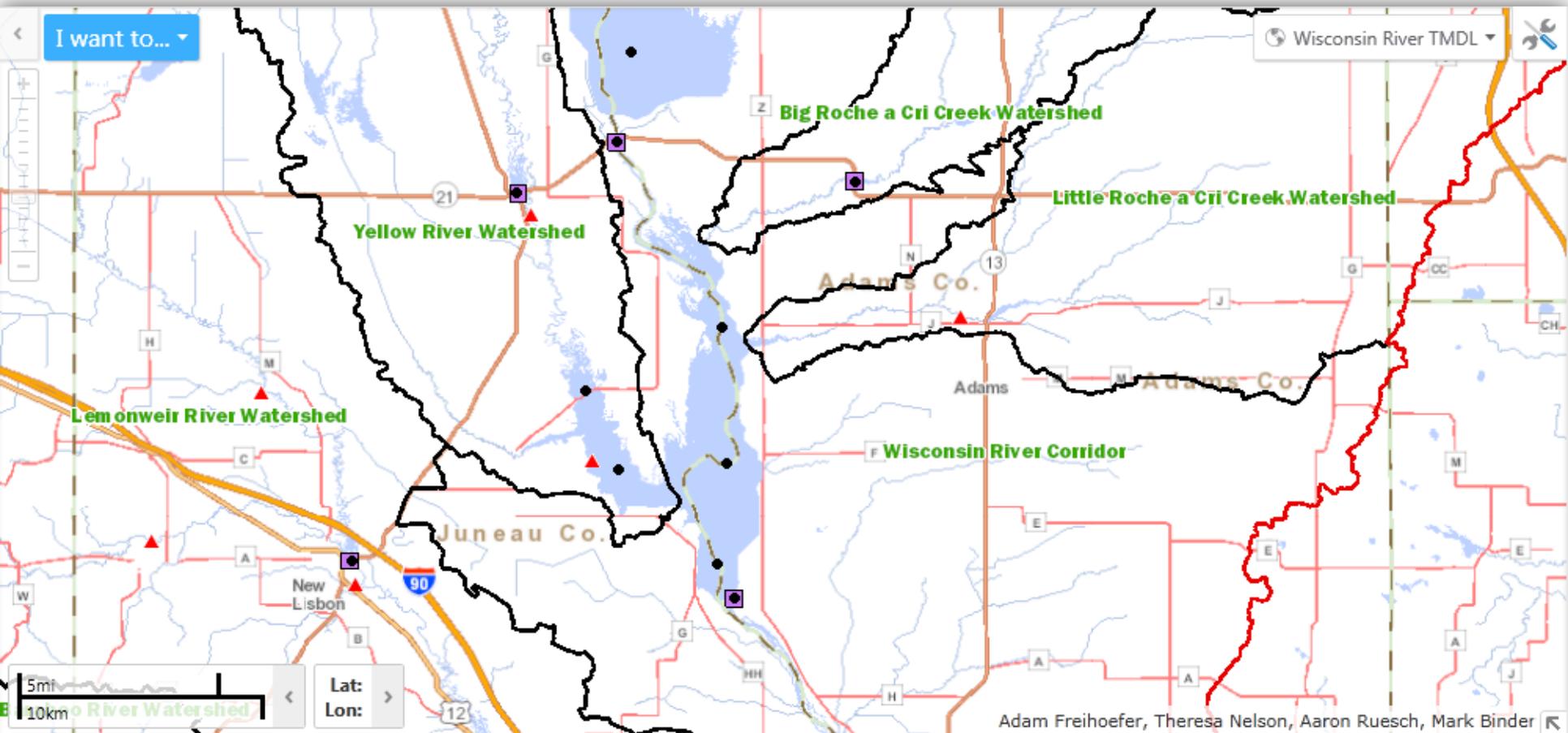
Operational Layers

- Wisconsin River TMDL
 - TMDL Water Quality Monitoring Site
 - Municipal and Industrial Surface Water Outfall
 - Flow Monitoring Site
 - Wisconsin River Basin
 - Wisconsin River Major Trib Drainages
- Water Resources
- Administrative & Political Boundaries
- Impairments & Assessments

Base Maps

- Digital Topographic Maps
- Road Basemap
- Image Basemap WROC 2010





Wisconsin DNR Watershed Restoration Viewer

Search... Sign in ?

Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help

Home Show Layers Show Legend Pan Zoom In Zoom Out Previous Extent Full State Point Identify

Scale: 1: 3,017,710 Jump to a map bookmark... New Plot Clear All

Clicked Coordinates Lat: 44.7572 Lon: -90.0665 Lat/Lon (DD) Print Map

Map Layers

Layer Theme: Rock River TMDL

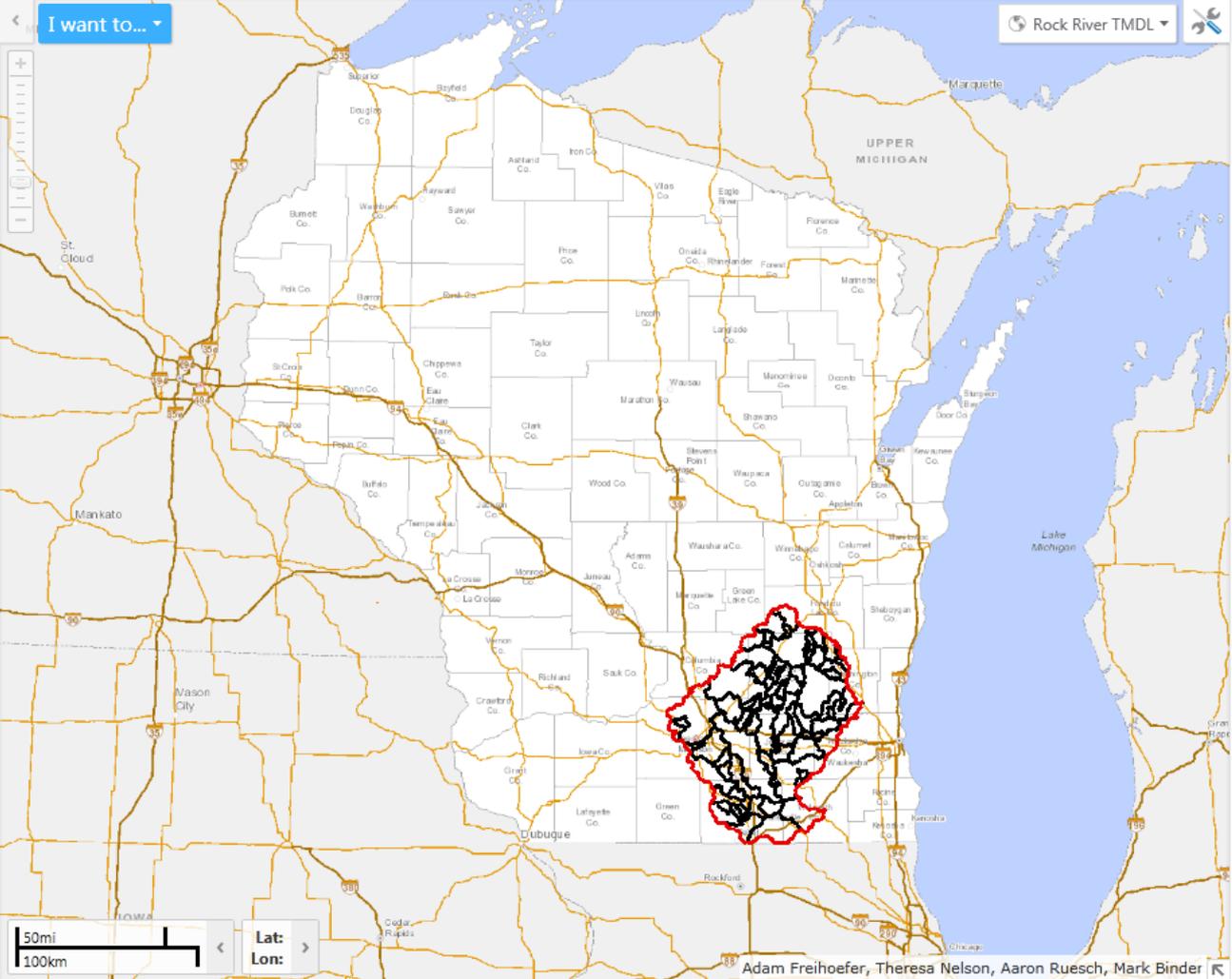
Show Legend Filter...

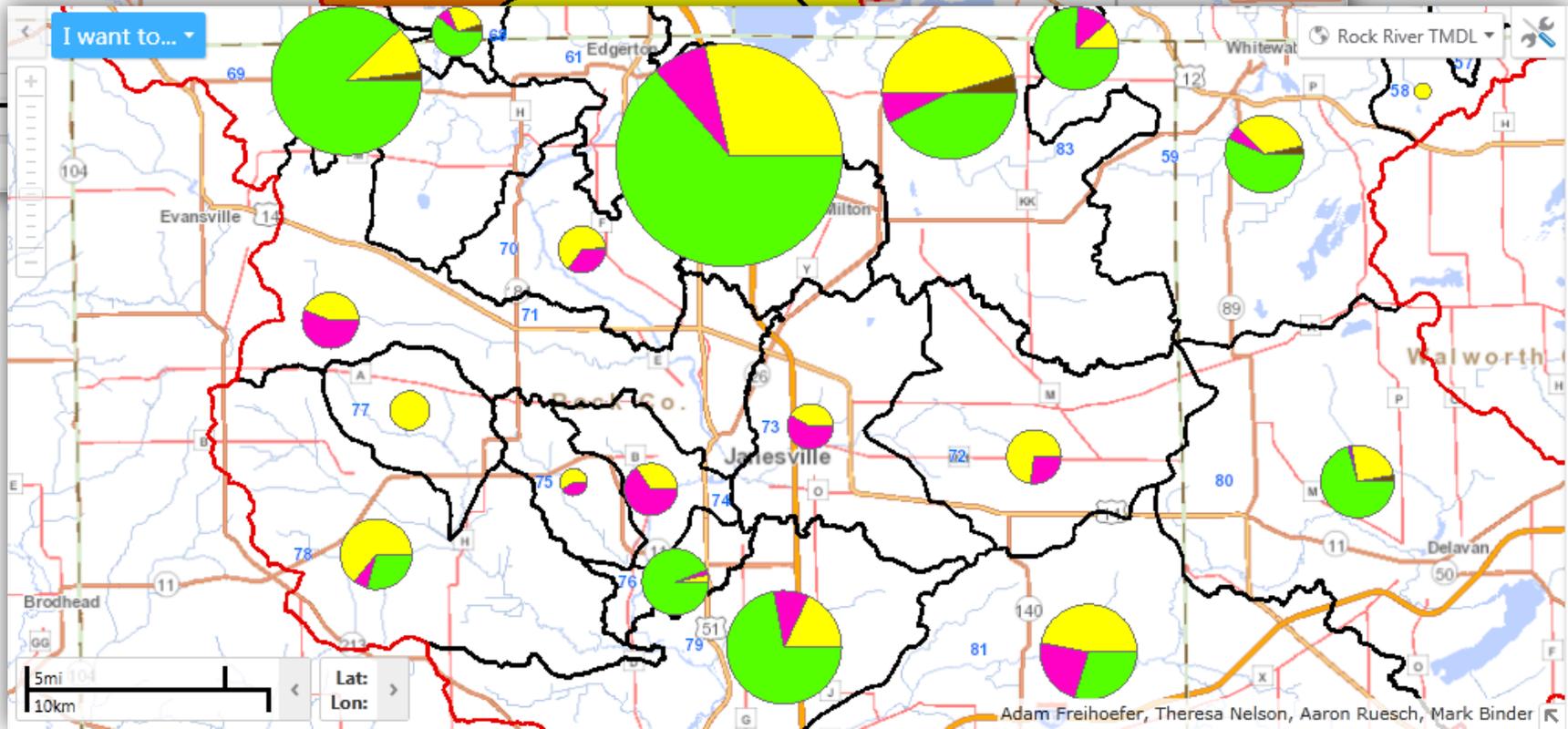
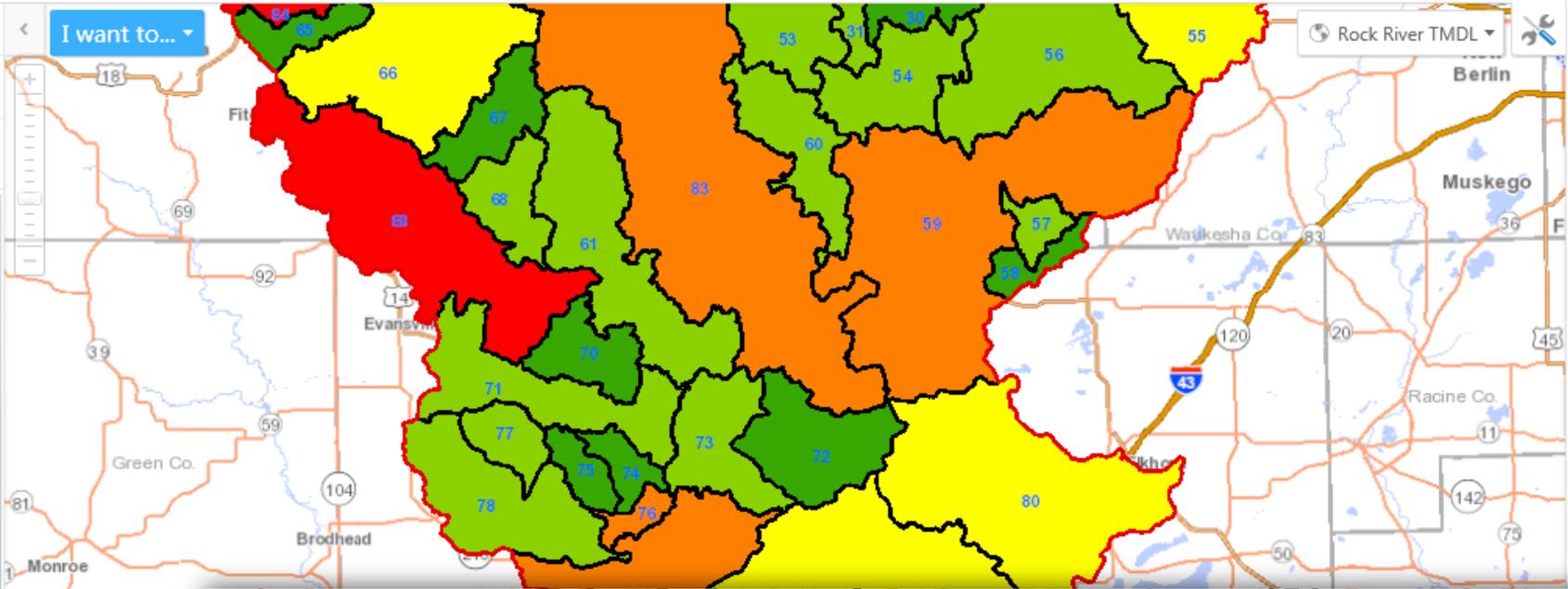
Operational Layers

- Rock River TMDL
 - Rock River Basin
 - TP Water Quality TMDL Target (mg/L)
 - TMDL Subbasins
 - Major Tributary Drainages
- Total Phosphorus (TP) TMDL Results
- Total Suspended Solids (TSS) TMDL Results
- Water Resources
- Administrative & Political Boundaries
- Impairments & Assessments

Base Maps

- Digital Topographic Maps
- Road Basemap
- Image Basemap WROC 2010





Wisconsin DNR Watershed Restoration Viewer

Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help

Home Show Layers Show Legend Pan Zoom In Zoom Out Previous Extent Full State Point Identify Scale: 1: 3,017,710 Jump to a map bookmark... New Plot Clear All Clicked Coordinates Lat: 44.7572 Lon: -90.0665 Lat/Lon (DD) Print Map

Map Layers

Layer Theme: Healthy Watersheds Assessment

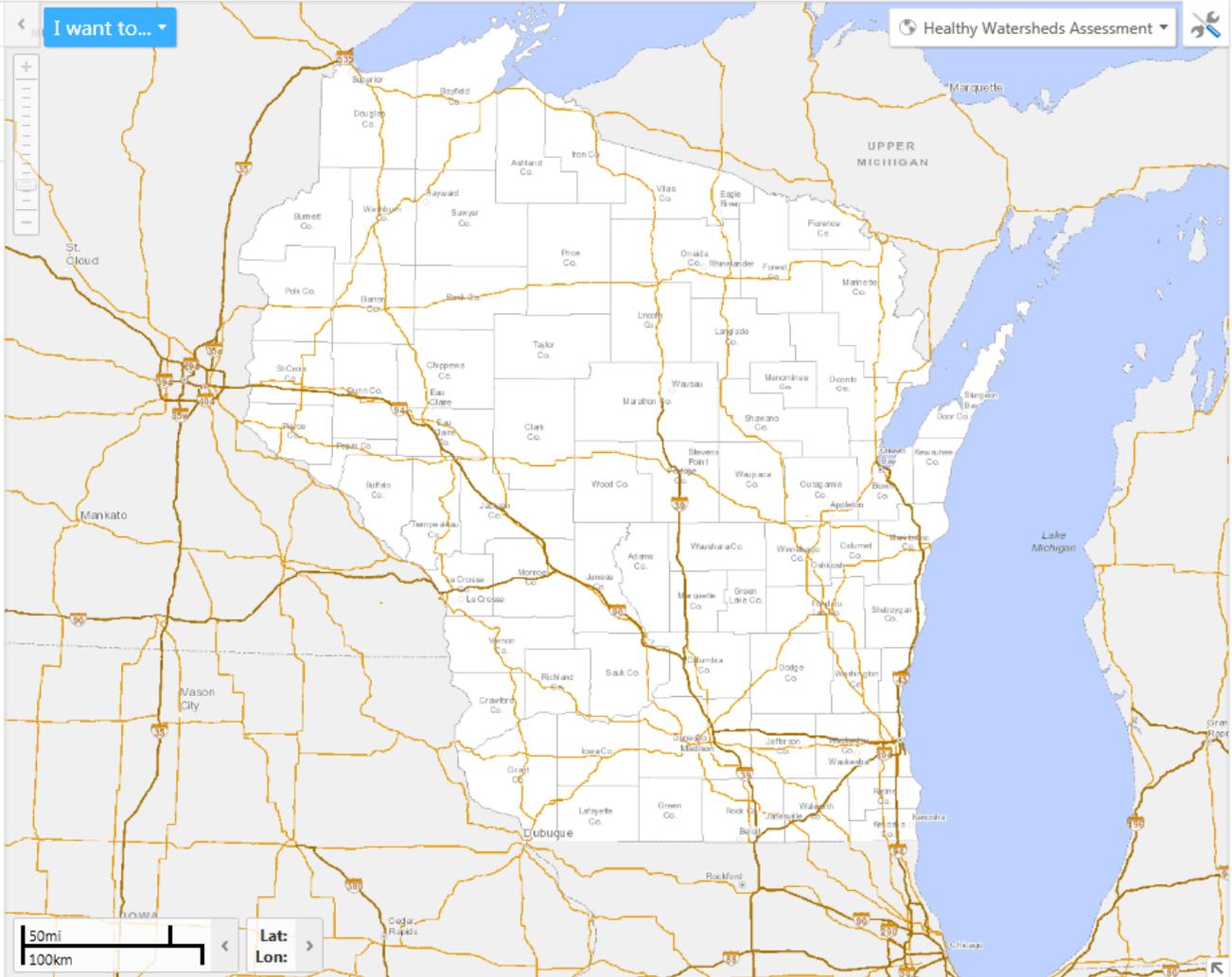
Show Legend Filter...

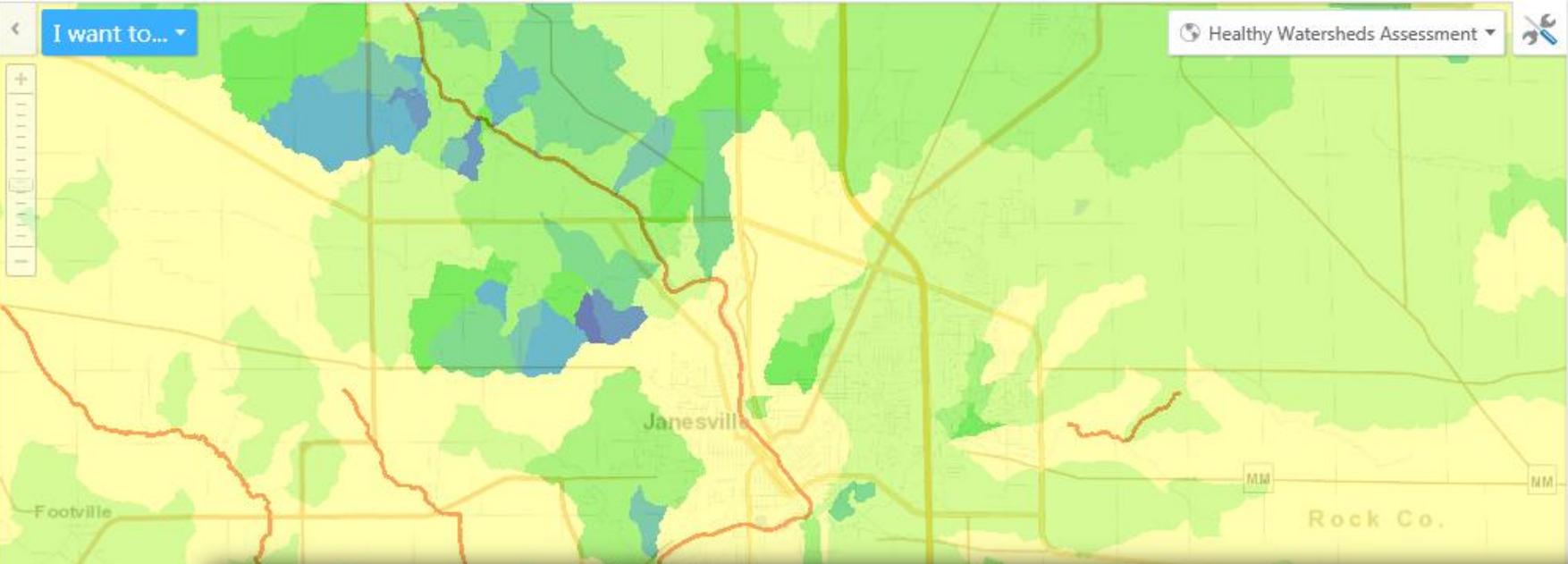
Operational Layers

- Healthy Watershed Assessment
- Healthy Watershed Indexes
- Healthy Watershed Sub-Indices
- Water Resources
- Impairments & Assessments

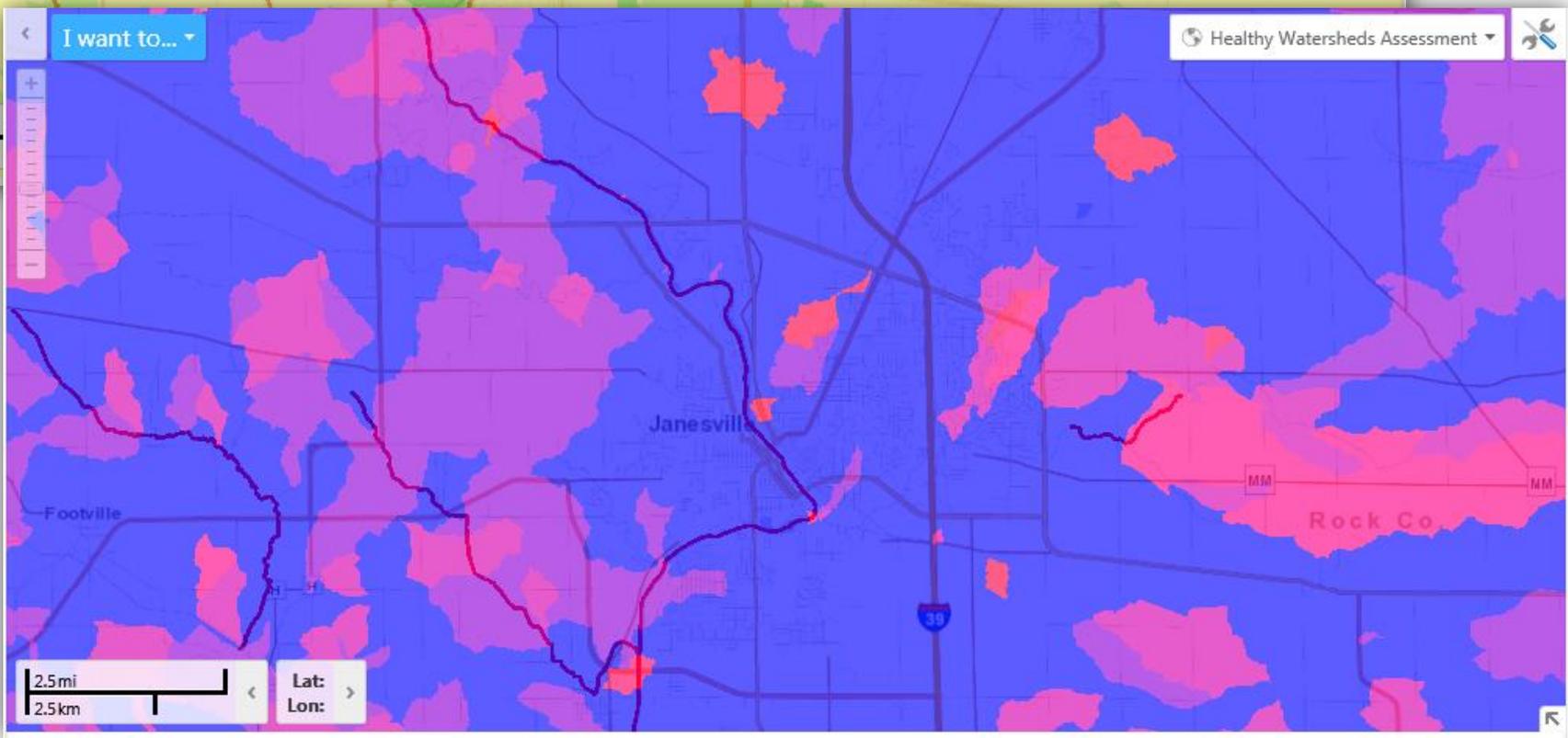
Base Maps

- Digital Topographic Maps
- Road Basemap
- Image Basemap WROC 2010





2.5mi
2.5km



2.5mi
2.5km

Lat: >
Lon: >

Online Info & Data

http://dnr.wi.gov/topic/water.html

Water topics - Wisconsin DNR

Business Licenses & Regulations Recreation Education Topics Contact Join DNR Search or Keywords

Water topics

[Apply](#) for water permits online.

Water resources are the foundation for Wisconsin's economy, environment and quality of life. Managing, conserving and restoring them for the benefit of Wisconsin citizens now and in the future is a big job, and one that DNR staff share with local governments, citizens and businesses.

photo credit: Eric Poggemann (Port Washington)

- Agribusiness and CAFOs**

Agribusiness, CAFOs and small farms are an important part of Wisconsin's economy.
- Beaches**

Wisconsin's beaches provide wildlife habitat, recreation areas and tourist destinations.
- Dam safety**

There are approximately 3,800 dams in Wisconsin.
- Drinking water**

The DNR works to provide Wisconsin residents with safe, clean drinking water.
- Fishing**

Plan on Fishing Wisconsin, where we have 160 different fish species.
- Floodplains**

A Floodplain is land that has been or may be covered by floodwater during a regional flood.
- Great Lakes**

Discover and protect our Great Lakes.
- Surface water**

Wisconsin residents are fortunate to live in a state bountiful with natural resources, including our many surface waters.

<http://dnr.wi.gov/topic/water.html>

Wisconsin surface waters

- [Atlas & Webinars](#)
- [Standards](#)
- [Monitoring](#)
- [Assessments](#)
- [Planning](#)
- [Management](#)

Wisconsin's abundant waters



Wisconsin's newly updated [Water Quality Report to Congress 2014](#) summarizes surface water and ground water condition.

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](#)

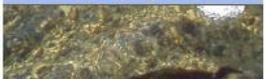
New Updates: [UW Extension Phosphorus Pages](#), [Exit DNR1](#), [Nutrient Reduction Strategy](#), [Adaptive Management](#), [Water Quality Trading](#), [Thermal Rules Update](#), and [Phosphorus Rule Updates](#).

Water types



- [Streams](#)
- [Lakes](#)
- [Wetlands](#)
- [Beaches](#)
- [Groundwater](#)

Water programs



- [Wastewater permits](#)
- [Agriculture & CAFOs](#)
- [Waterway protection](#)
- [Invasive species](#)
- [Dams & floodplains](#)
- [Water evaluation](#)

Water quality standards



- [Triennial standards review](#)
- [Water quality standards](#)
- [Antidegradation](#)
- [Designations || Communities](#)
- [Outstanding & exceptional](#)
- [Impaired waters](#)

Projects & partnerships



- [Project search tool](#)
- [Grant opportunities](#)
- [Great Lakes Restoration Initiative](#)
- [Success stories](#)

Reports, Summaries & Data



- [Water quality report to congress \[PDF\]](#)
- [Monitoring studies](#)
- [Fisheries publications](#)
- [Groundwater Report to the Legislature](#)

Search tools



- [Surface water data viewer](#)
- [Search waters](#)
- [Search watersheds](#)
- [Search projects](#)
- [Search impaired waters](#)

Search 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.



Launch the interactive dynamic application "Explore Wisconsin's Waters!"



Search tools



- [Surface water data viewer](#)
- [Search waters](#)
- [Search watersheds](#)
- [Search projects](#)
- [Search impaired waters](#)
- [Search lakes](#)
- [Search basins](#)



Search Waters

The screenshot shows a web browser window with the URL <http://dnr.wi.gov/water/waterSearch.aspx>. The page features a navigation menu with links for Business, Licenses & Regulation, Recreation, Education, Topics, Contact, and Join Us. Below this is a secondary menu with links for Explore Water, Waters, Lakes, Watersheds, Basins, Impaired Waters, Projects, and Documents. A search bar is located in the top right corner.

Wisconsin Water Search - Find Rivers, Streams, Lakes, Bays and Harbors

Enter the name of the water you wish to find. Use the export tool to save your data.

Enter Water Name or WBIC

Water Type

County

Watershed Code

Watershed Name

Basin Name

Search
Clear
Export

Official Name (Click for Details)	Local Name (Click for Map)	Start Mile	End Mile	Water Size	Water Type	WBIC	County	Last Year Monitored	Fish & Aquatic Life Condition	Trout Class	ORW/ERW
--	---	----------------------------	--------------------------	----------------------------	----------------------------	----------------------	------------------------	-------------------------------------	---	-----------------------------	-------------------------



- Feedback
- Employment
- Legal notices
- Privacy notice
- Acceptable use policy
- News
- Topics
- Hotlines
- Site requirements

101 S. Webster Street PO Box 7921 Madison, Wisconsin 53707-7921 608.266.2621

<http://dnr.wi.gov/water/waterSearch.aspx>



Onion River, Mullet River, Onion River, Sheboygan River Watershed (SH03, SH04, SH05)

[Return to Search](#)
[Go to Watersheds](#)

Onion River (51200)

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



- Overview
- Conditions
- Goals
- Monitoring & Projects
- Ecosystem Challenges
- Fish & Habitat
- Photo Gallery
- Map Gallery

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.

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

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

Surface Water Data Viewer

Search...

Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help

Home Show Layers Show Legend Pan Zoom In Zoom Out Previous Extent Full State Point Identify

Scale: 1: 12,112 Jump to a map bookmark...

New Plot Clear All

Clicked Coordinates Lat: 44.7513 Lon: -89.7632 Lat/Lon (DD)

Print Map

Results (1)

[View History](#) [View Selected >>](#)

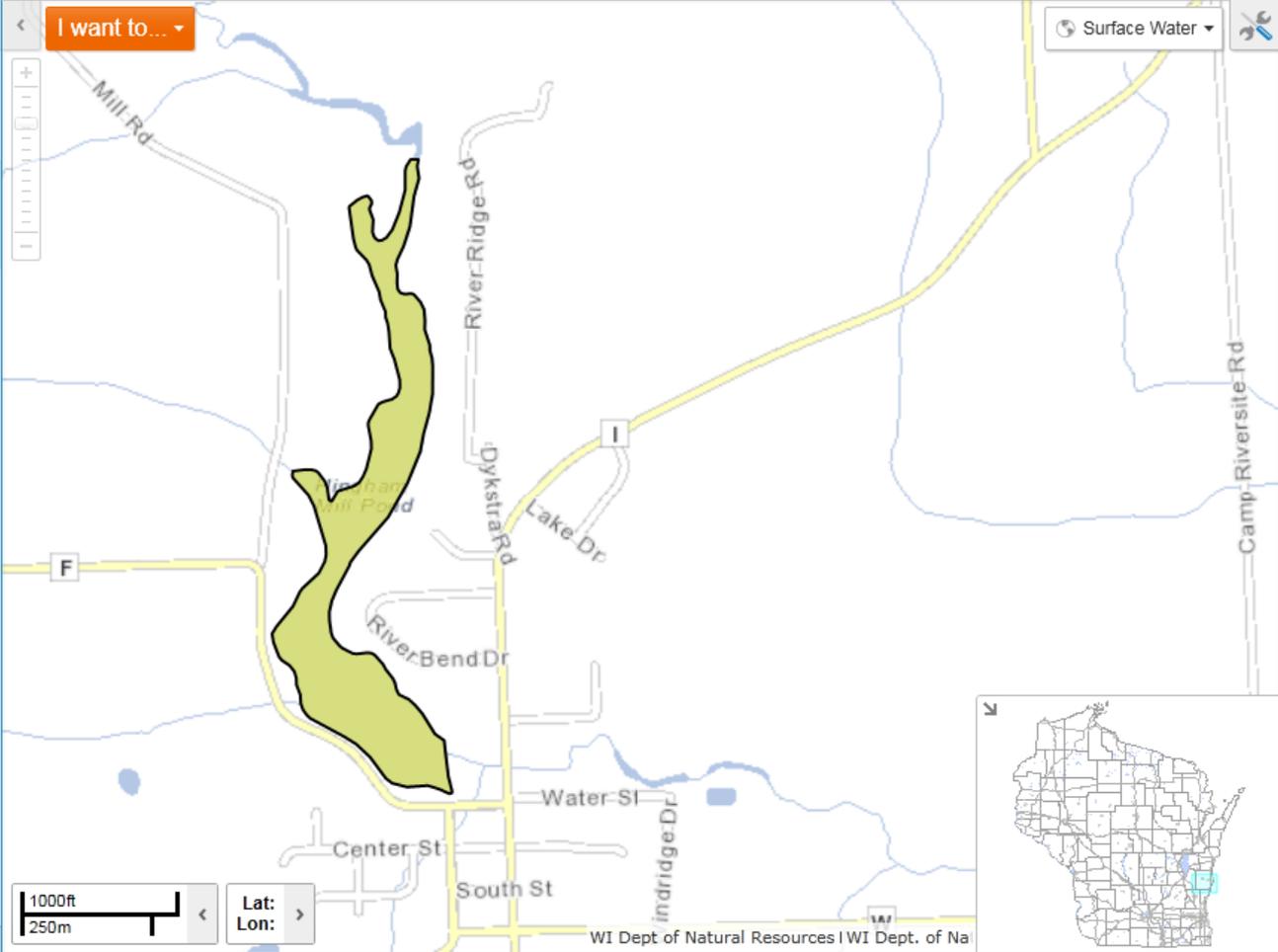
[Refine Results](#) | [Table View](#) | [Charting View](#) | [Export to Shapefile](#)

[Select All](#) | [Select None](#)

[Hingham Mill Pond \(Station 10005801\)](#)

[Monitoring Station Metadata](#)

[Link to Monitoring Data](#)



Monitoring Data

Browser address bar: <https://dnrx.wisconsin.gov/swims/viewStationResults.do?id=45393>

Station ID 10005801
Station Name Hingham Mill Pond

Show specific parameter: <Show All>

Sample Results

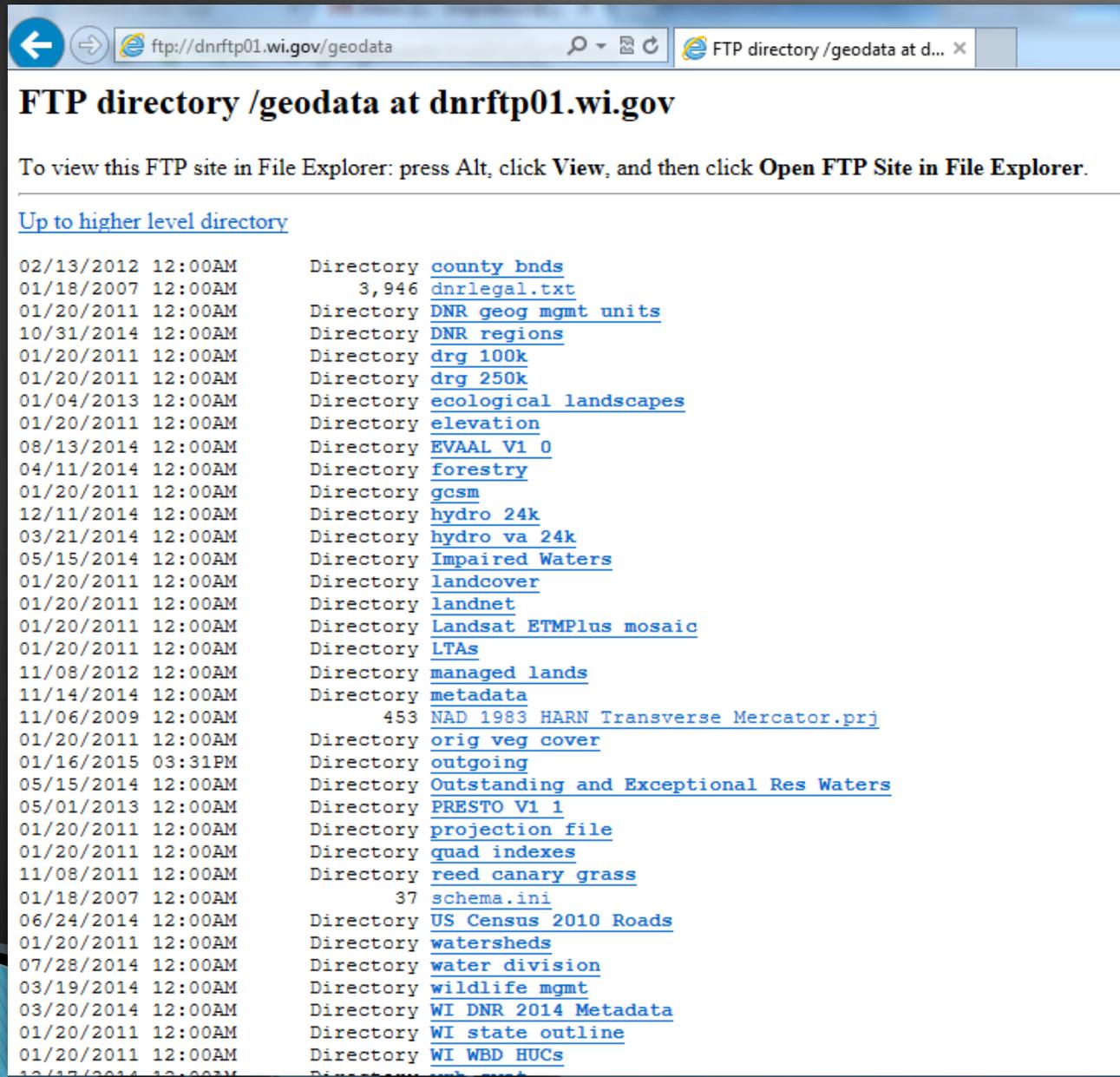
Previous 1-25 of 26 Next

Project	Date/Time	DNR Parameter	Species	Result	Units	Present/Absent	Lab Comments
Satellite Lake Clarity Monitoring 2011	09/15/2011 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		1.29036500059487	FEET		
Satellite Lake Clarity Monitoring 2011	09/15/2011 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2011	09/07/2011 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		1.40784912895166	FEET		
Satellite Lake Clarity Monitoring 2011	09/07/2011 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2011	08/22/2011 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		.883342236360989	FEET		
Satellite Lake Clarity Monitoring 2011	08/22/2011 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2011	07/29/2011 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		.471534599468733	FEET		
Satellite Lake Clarity Monitoring 2011	07/29/2011 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2011	07/21/2011 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		3.09663297706342	FEET		
Satellite Lake Clarity Monitoring 2011	07/21/2011 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2010	09/28/2010 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		1.59941598398941	FEET		
Satellite Lake Clarity Monitoring 2010	09/28/2010 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2010	09/12/2010 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		1.00673314878298	FEET		
Satellite Lake Clarity Monitoring 2010	09/12/2010 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2010	08/27/2010 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		.968748427229305	FEET		
Satellite Lake Clarity Monitoring 2010	08/27/2010 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2009	08/24/2009 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		4.643051	FEET		
Satellite Lake Clarity Monitoring 2009	08/24/2009 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2009	07/07/2009 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		1.606779	FEET		
Satellite Lake Clarity Monitoring 2009	07/07/2009 12:00 AM	Satellite derived water clarity greater than max depth of lake		N			
Satellite Lake Clarity Monitoring 2007-2008	08/28/2008 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		1.28	FEET		
Satellite Lake Clarity Monitoring 2007-2008	08/03/2007 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		1.36	FEET		
Satellite Lake Clarity Monitoring 2003-2005	07/25/2004 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		2	FEET		
Satellite Lake Clarity Monitoring 2003-2005	09/17/2003 12:00 AM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		1.79	FEET		
Satellite Lake Clarity Monitoring 1999-2001	07/09/2001 12:00 PM	Water Clarity - Predicted Secchi Depth Derived from Satellite Imagery		0.40	M		

GIS Data

- ▶ FTP site:
 - <ftp://dnrftp01.wi.gov/geodata>
- ▶ ArcGIS REST Services Directory
 - <http://dnrmaps.wi.gov/arcgis/rest/services/>

FTP GIS Data



The screenshot shows a web browser window with the address bar containing the URL `ftp://dnrftp01.wi.gov/geodata`. The page title is "FTP directory /geodata at dnrftp01.wi.gov". Below the title, there is a text instruction: "To view this FTP site in File Explorer: press Alt, click View, and then click **Open FTP Site in File Explorer**." A link "Up to higher level directory" is provided. The main content is a directory listing with columns for date, time, and file/directory names.

Date	Time	File/Directory Name
02/13/2012	12:00AM	Directory county bnds
01/18/2007	12:00AM	3,946 dnrlegal.txt
01/20/2011	12:00AM	Directory DNR geog mgmt units
10/31/2014	12:00AM	Directory DNR regions
01/20/2011	12:00AM	Directory drg 100k
01/20/2011	12:00AM	Directory drg 250k
01/04/2013	12:00AM	Directory ecological landscapes
01/20/2011	12:00AM	Directory elevation
08/13/2014	12:00AM	Directory EVAAL V1 0
04/11/2014	12:00AM	Directory forestry
01/20/2011	12:00AM	Directory gcsn
12/11/2014	12:00AM	Directory hydro 24k
03/21/2014	12:00AM	Directory hydro va 24k
05/15/2014	12:00AM	Directory Impaired Waters
01/20/2011	12:00AM	Directory landcover
01/20/2011	12:00AM	Directory landnet
01/20/2011	12:00AM	Directory Landsat ETMPlus mosaic
01/20/2011	12:00AM	Directory LTAs
11/08/2012	12:00AM	Directory managed lands
11/14/2014	12:00AM	Directory metadata
11/06/2009	12:00AM	453 NAD 1983 HARN Transverse Mercator.prj
01/20/2011	12:00AM	Directory orig veg cover
01/16/2015	03:31PM	Directory outgoing
05/15/2014	12:00AM	Directory Outstanding and Exceptional Res Waters
05/01/2013	12:00AM	Directory PRESTO V1 1
01/20/2011	12:00AM	Directory projection file
01/20/2011	12:00AM	Directory quad indexes
11/08/2011	12:00AM	Directory reed canary grass
01/18/2007	12:00AM	37 schema.ini
06/24/2014	12:00AM	Directory US Census 2010 Roads
01/20/2011	12:00AM	Directory watersheds
07/28/2014	12:00AM	Directory water division
03/19/2014	12:00AM	Directory wildlife mgmt
03/20/2014	12:00AM	Directory WI DNR 2014 Metadata
01/20/2011	12:00AM	Directory WI state outline
01/20/2011	12:00AM	Directory WI WBD HUCs



ArcGIS REST Services Directory

← → <http://dnrmaps.wi.gov/arcgis/rest/services/> Folder: /

ArcGIS REST Services Directory

[Home](#) > [services](#)

[JSON](#) | [SOAP](#)

Folder: /

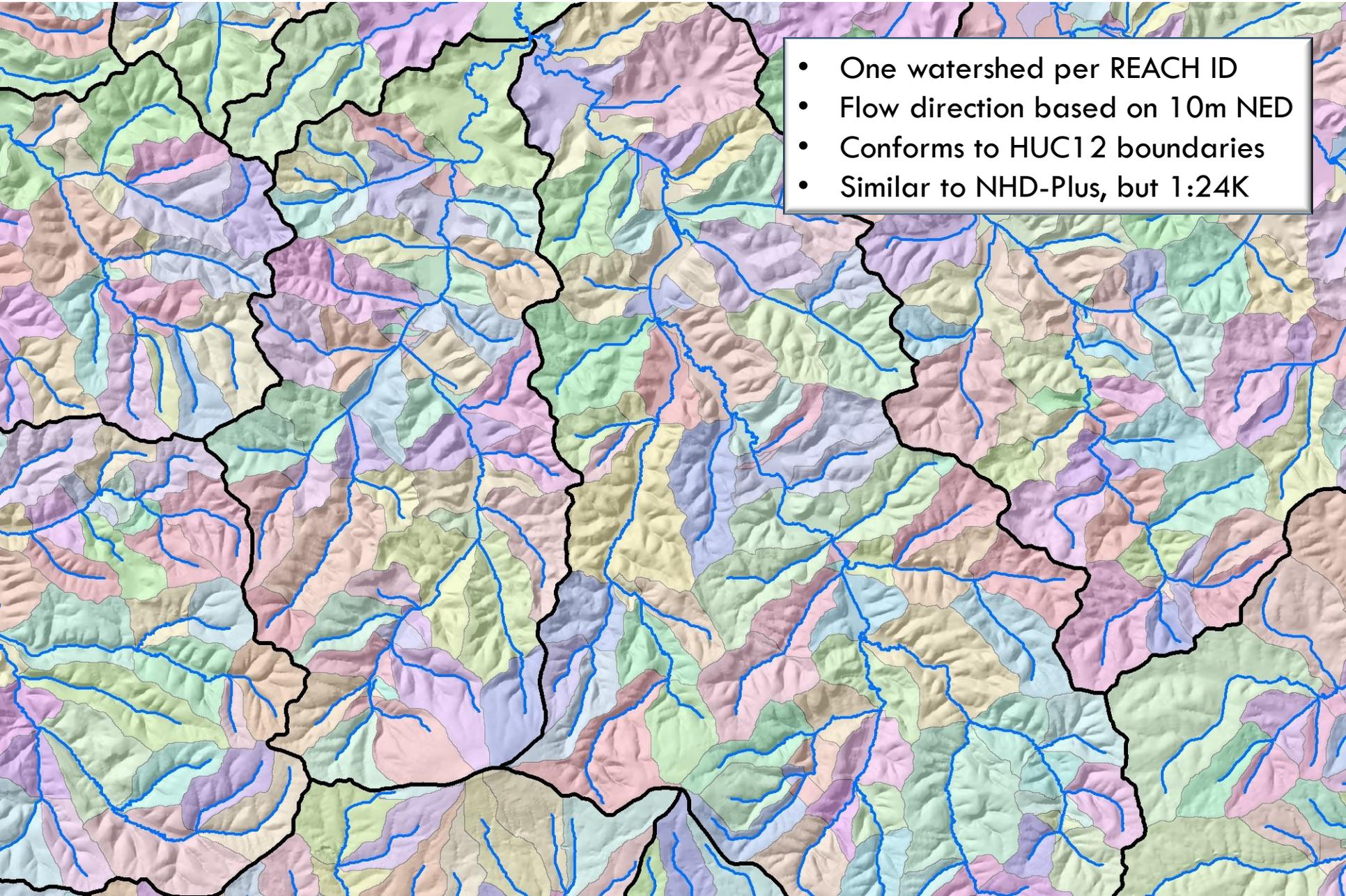
Current Version: 10.11

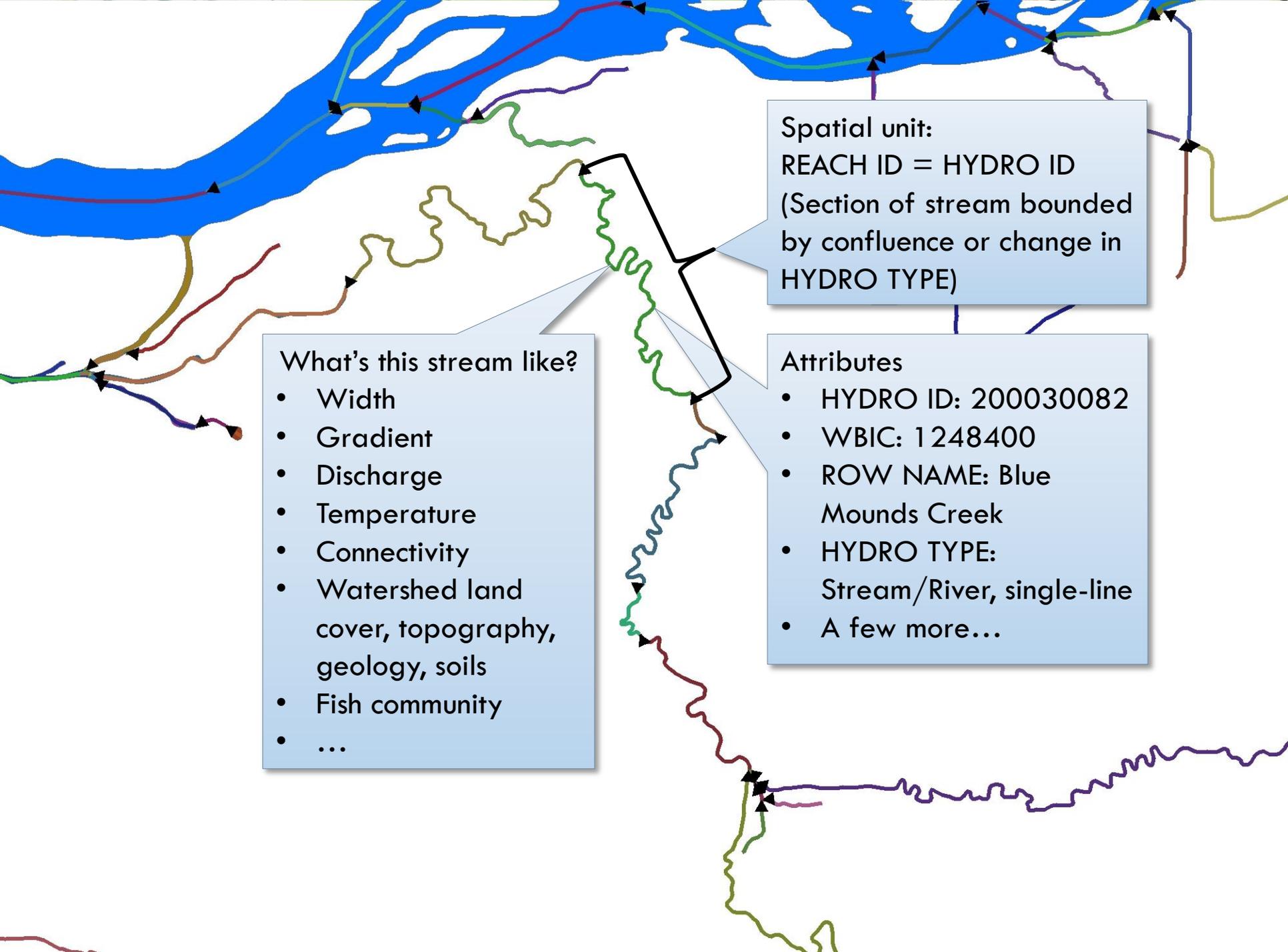
View Footprints In: [ArcGIS.com Map](#)

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](#)

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
- ...

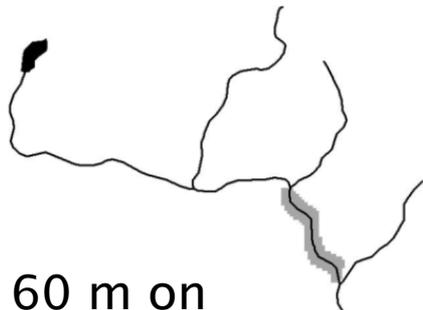
Spatial unit:
REACH ID = HYDRO ID
(Section of stream bounded by confluence or change in HYDRO TYPE)

Attributes

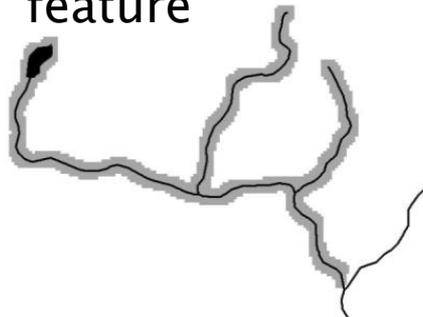
- HYDRO ID: 200030082
- WBIC: 1248400
- ROW NAME: Blue Mounds Creek
- HYDRO TYPE: Stream/River, single-line
- A few more...

Attribute Dimensions

Riparian

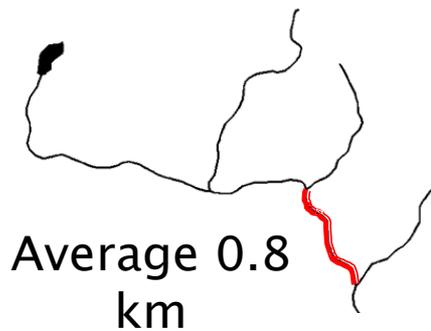


60 m on both sides of feature



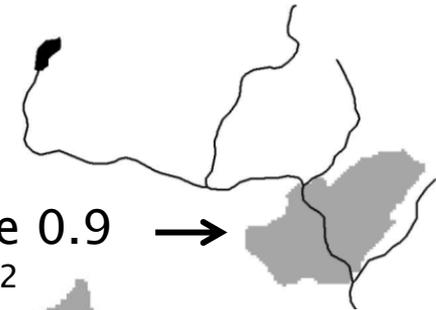
Riparian Trace

Channel



Average 0.8 km

Watershed



Average 0.9 km²



Watershed 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

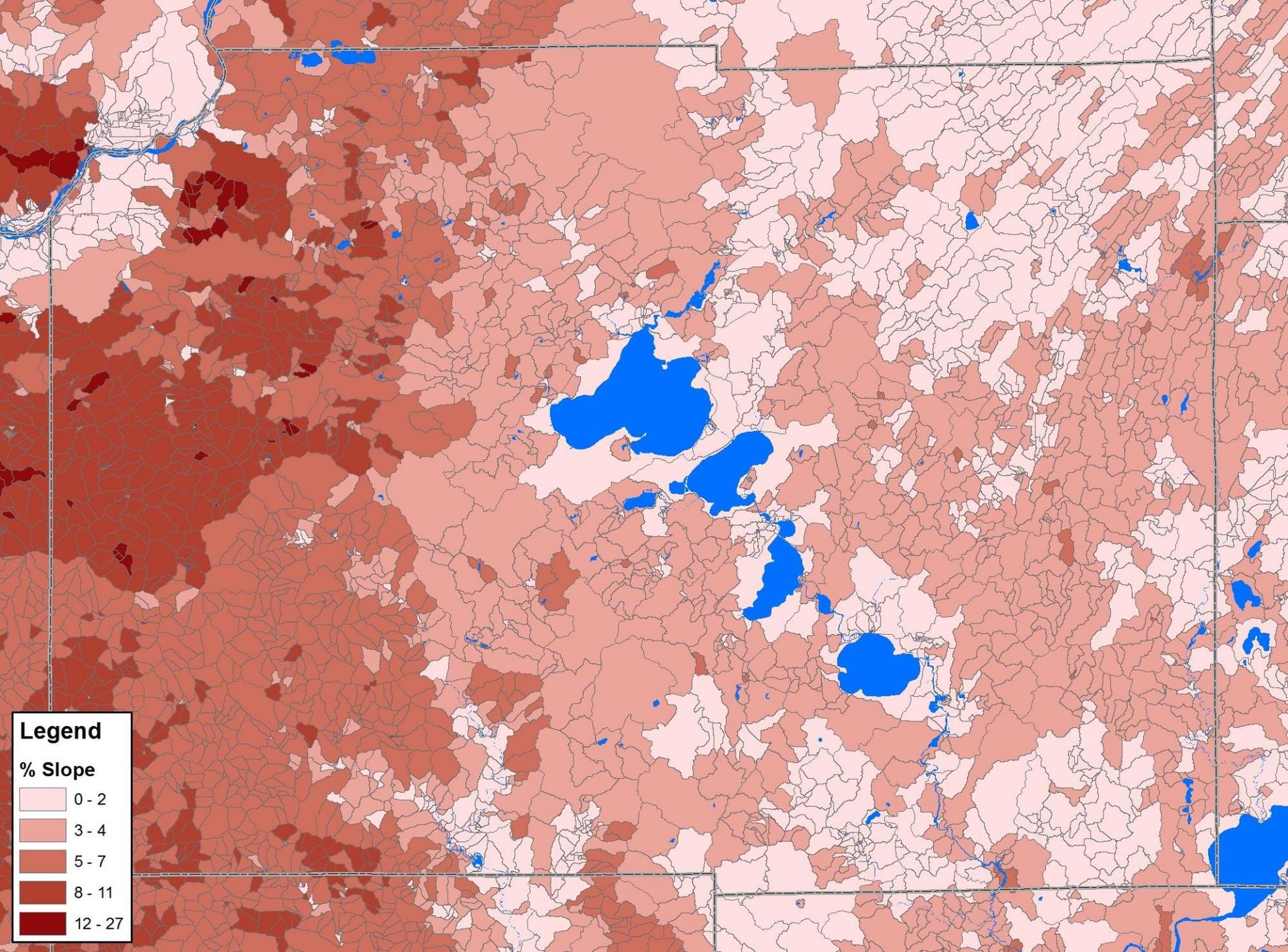
Land Cover

- ▶ 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



Legend

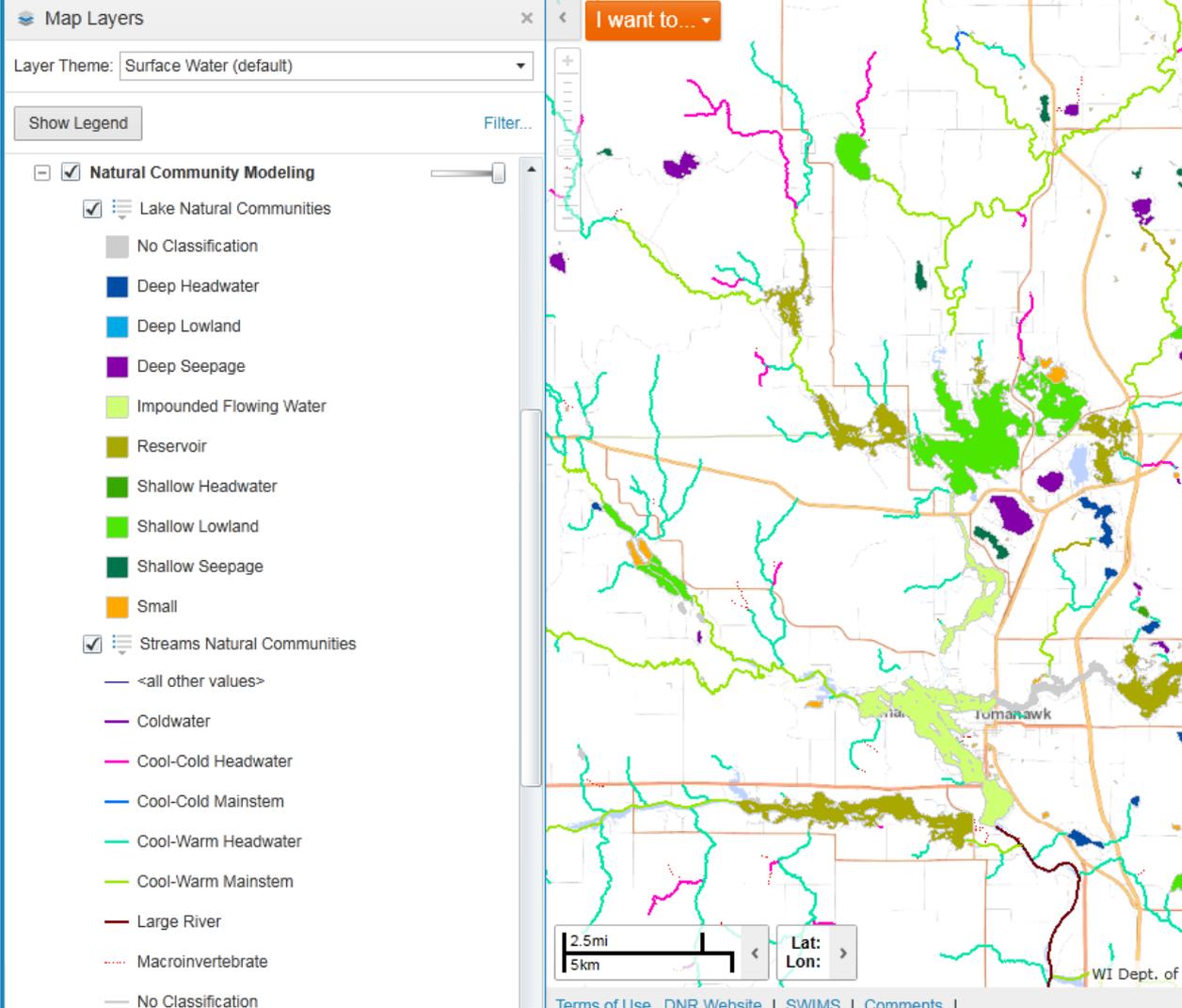
% Slope

- 0 - 2
- 3 - 4
- 5 - 7
- 8 - 11
- 12 - 27

Surface Water Data Viewer Search...

Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help

Home Show Layers Show Legend Pan Zoom In Zoom Out Previous Extent Full State Point Identify Scale: 1: 163,730 Jump to a map bookmark... New Plot



Details Attributes

Field Name	Field Value
Natural Community	Cool-Warm Mainstem
Temperature Class	Cool-Warm
Hydro ID	200172415
Reach ID	200172415
TRW_AREA	1053.69
TEMP_SUMMER_CL_CC	20.48
TEMP_JULY_CL_CC	21.13
TEMP_MAX_CL_CC	24.47
TEMP_SUMMER_PL_PC	19.69
TEMP_JULY_PL_PC	20.34
TEMP_MAX_PL_PC	25.39
TEMP_SUMMER_PL_CC	20.34
TEMP_JULY_PL_CC	21
TEMP_MAX_PL_CC	25.88
QMEAN_SUMMER_CL_CC	196
Q05_ANNUAL_CL_CC	583
Q10_ANNUAL_CL_CC	493
Q25_ANNUAL_CL_CC	339
Q50_ANNUAL_CL_CC	192
Q75_ANNUAL_CL_CC	161
Q90_ANNUAL_CL_CC	142
Q95_ANNUAL_CL_CC	131
Q10_SPRING_CL_CC	514
Q50_SPRING_CL_CC	256
Q90_SPRING_CL_CC	164
Q10_SUMMER_CL_CC	283
Q50_SUMMER_CL_CC	160
Q90_SUMMER_CL_CC	132
Q10_FALL_CL_CC	330
Q50_FALL_CL_CC	208
Q90_FALL_CL_CC	145
Q10_APRIL_CL_CC	439
Q50_APRIL_CL_CC	290
Q90_APRIL_CL_CC	105

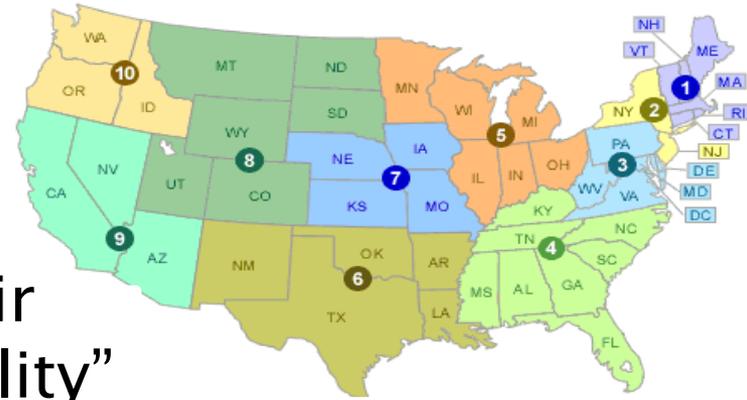
Healthy Watersheds Assessment



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

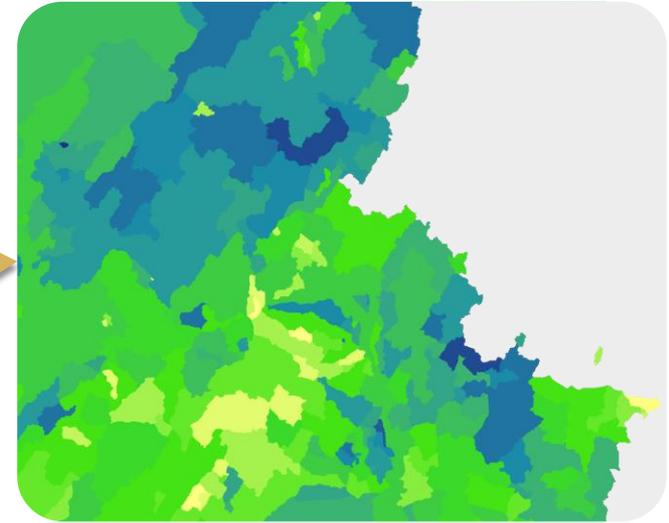
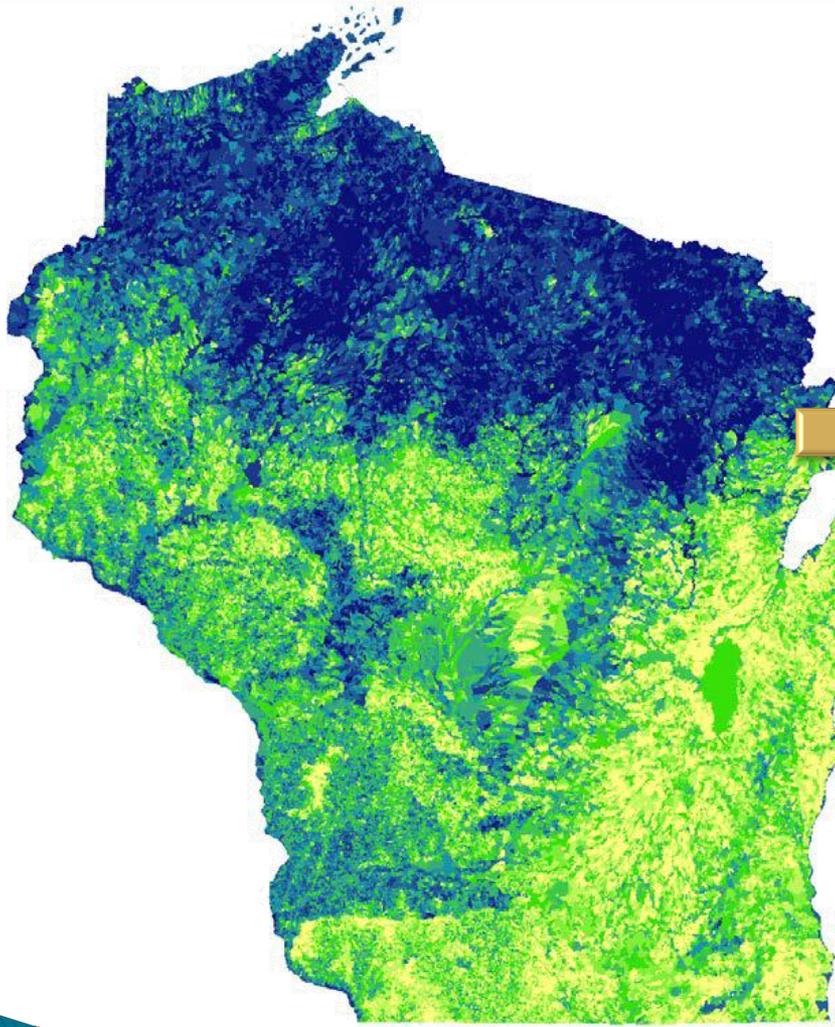


Project Partners

- ▶ WI DNR
- ▶ EPA Headquarters
- ▶ EPA Region 5
- ▶ The Nature Conservancy
- ▶ USGS
- ▶ Cadmus consulting



Scale



- ▶ WHDPlus scale
(similar to HUC 16 or NHD+)
- ▶ 0.5 km² (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.*

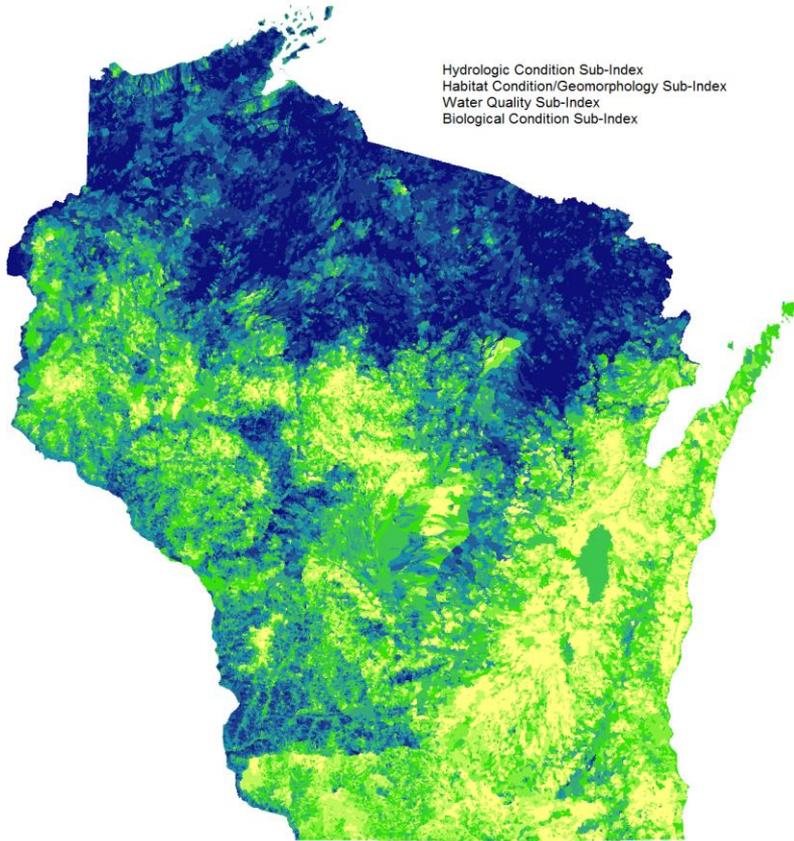
Susp.
Sediment*

Lake
Clarity

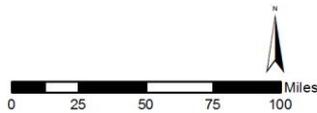
Biological Condition

Aquatic
Insects IBI*

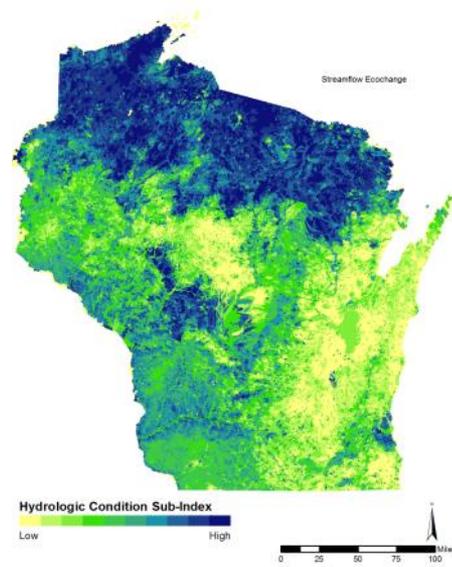
Aquatic Ecosystem Health



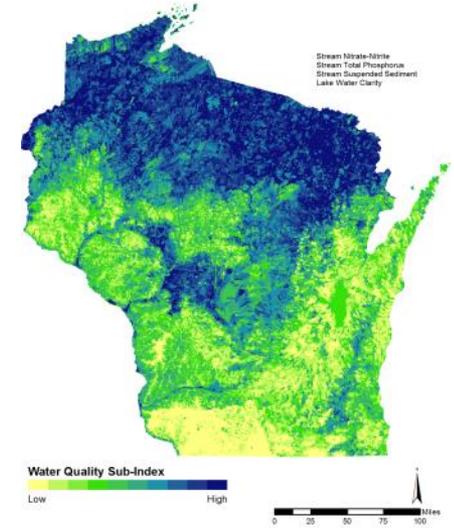
Aquatic Ecosystem Health Index
Low High



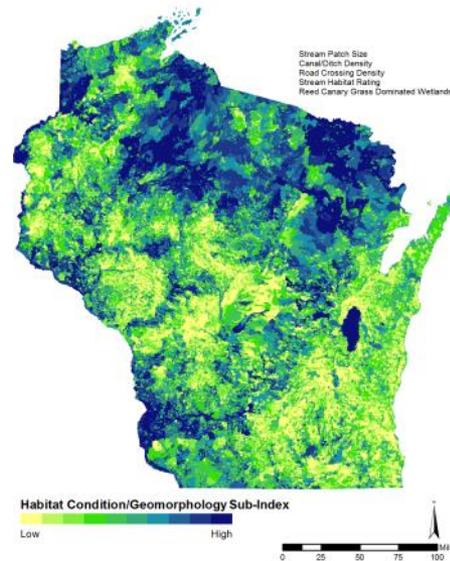
SUBINDICES



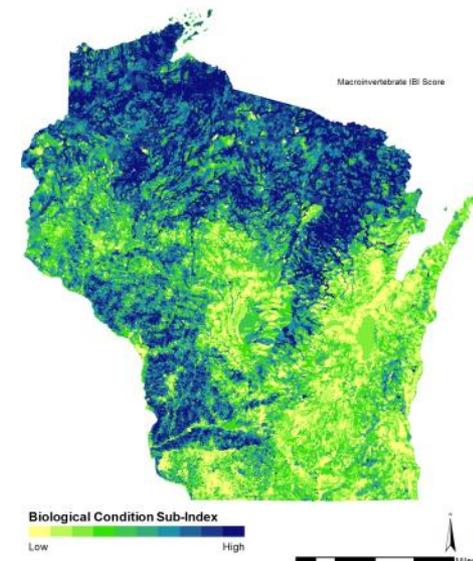
Hydrology



Water Quality



Habitat/Geomorphology



Biology

Watershed Vulnerability

Climate Change

Projected change in:

Runoff*

Phosphorus*

Nitrogen*

Sediment*

Land Use Change

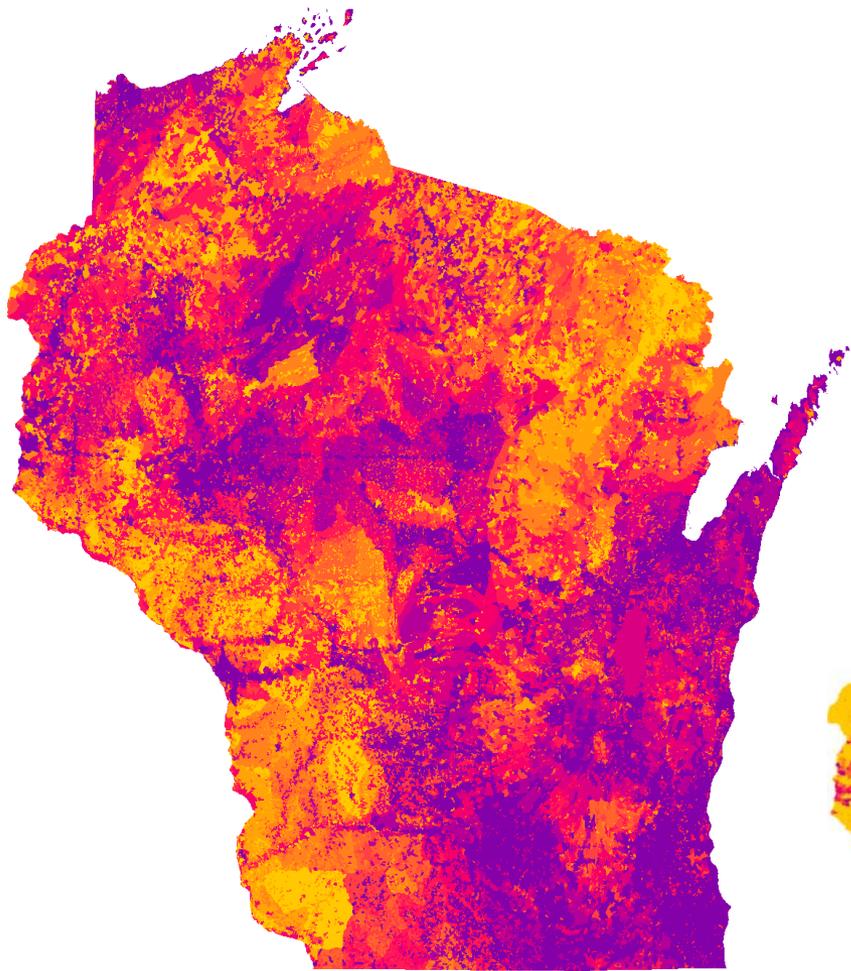
Projected change in Land cover*

Water Use

High capacity wells

Groundwater dependent ecosystems

Vulnerability



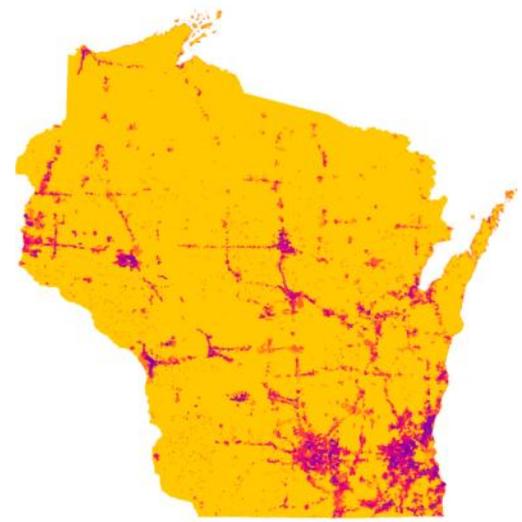
Watershed Vulnerability Index
Low High

SUBINDICES



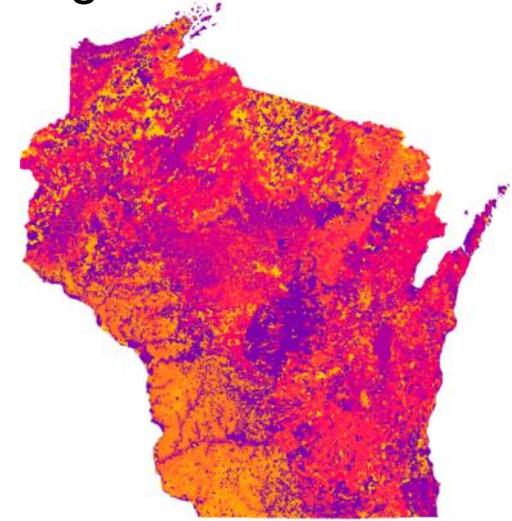
Climate Change Vulnerability Sub-Index
Low High

Climate Change



Land Use Vulnerability Sub-Index
Low High

Land Use Change

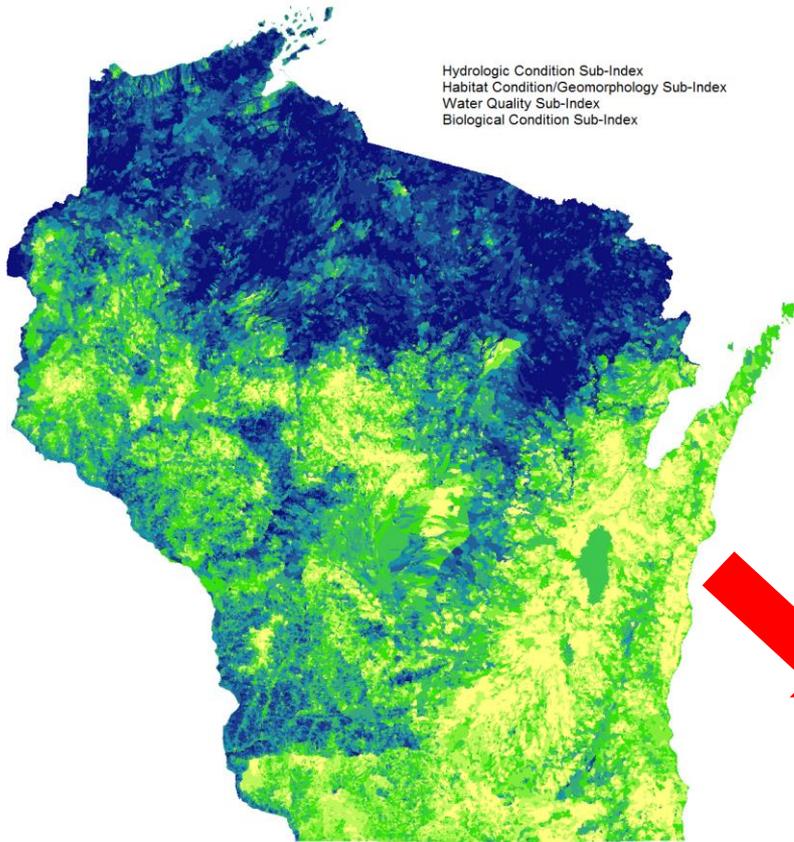


Water Use Vulnerability Sub-Index
Low High

Water Use

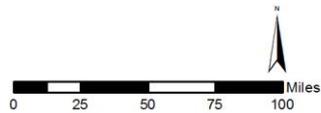


Aquatic Ecosystem Health

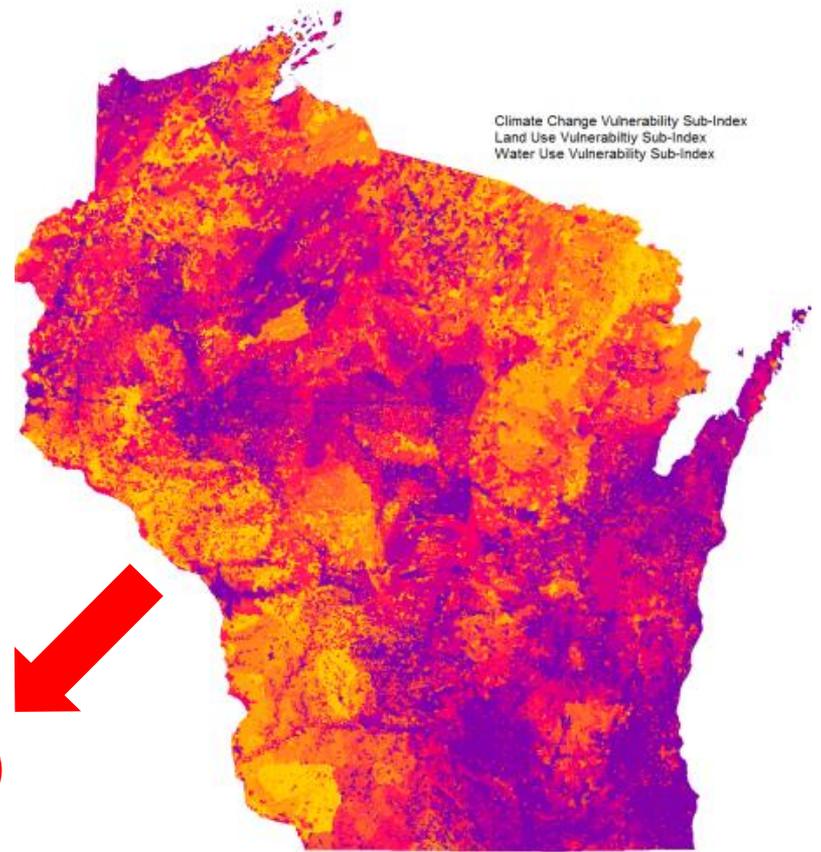


Hydrologic Condition Sub-Index
Habitat Condition/Geomorphology Sub-Index
Water Quality Sub-Index
Biological Condition Sub-Index

Aquatic Ecosystem Health Index

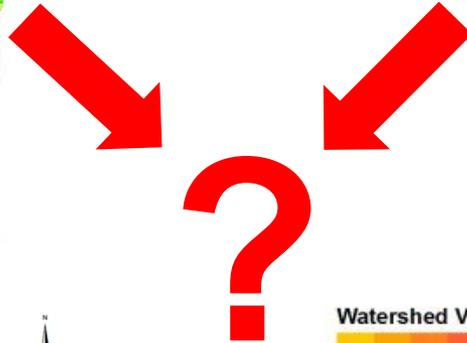
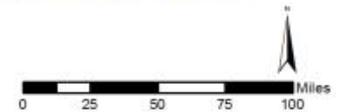


Vulnerability

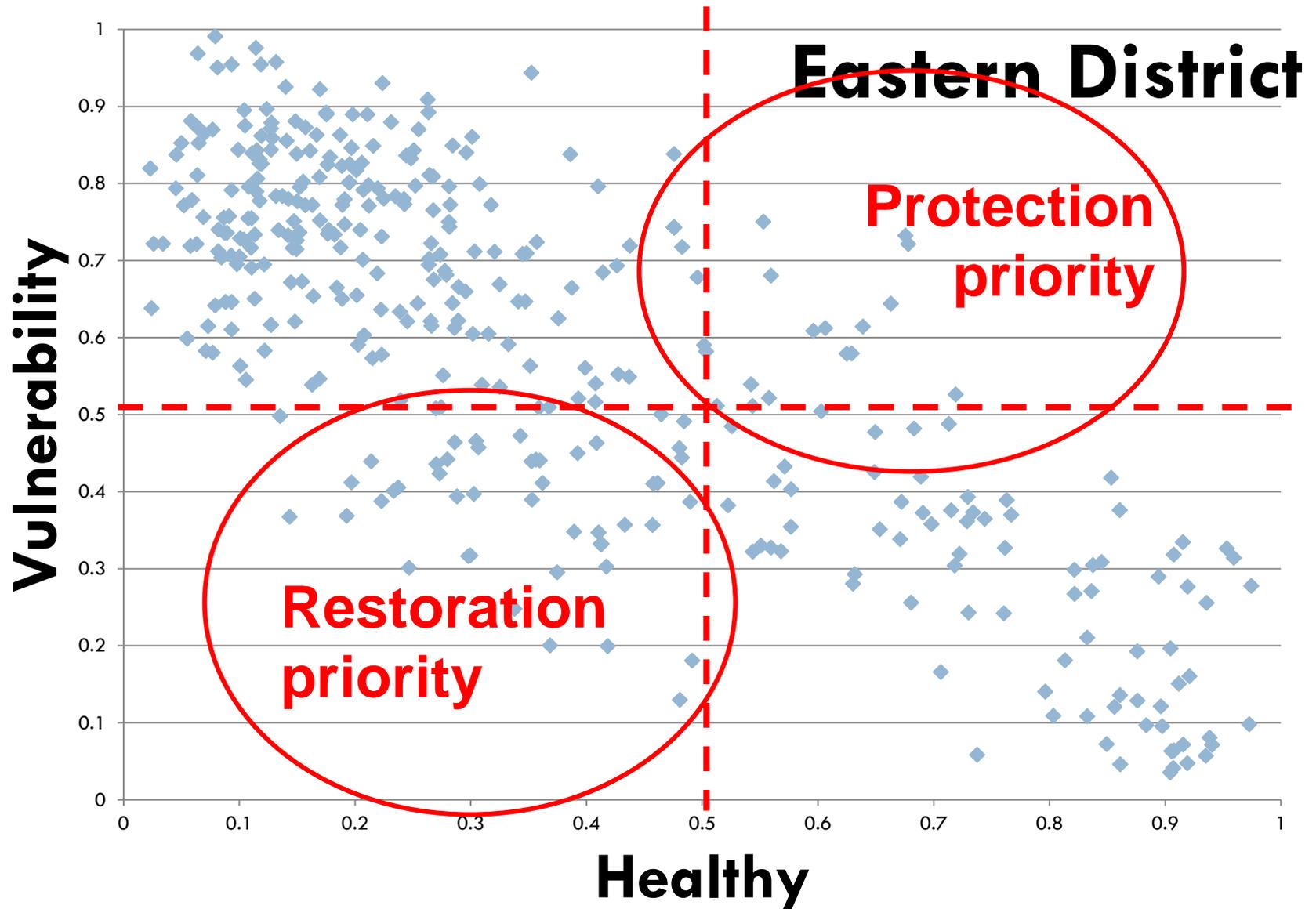


Climate Change Vulnerability Sub-Index
Land Use Vulnerability Sub-Index
Water Use Vulnerability Sub-Index

Watershed Vulnerability Index



Combine Health & Vulnerability Scores...



Combine Health & Vulnerability Scores...

Protection Priority

 25% Most Healthy & 25% Most Vulnerable

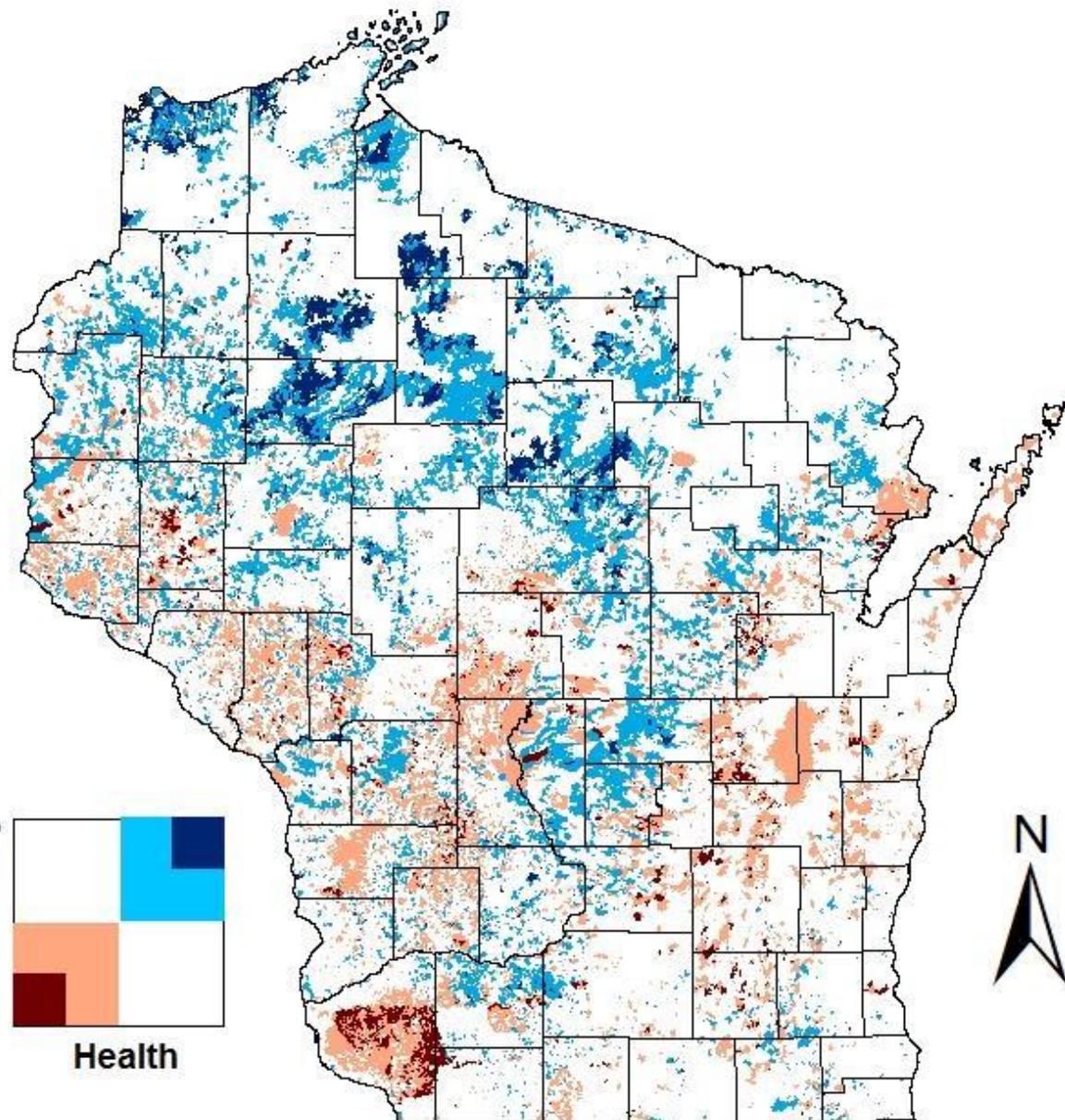
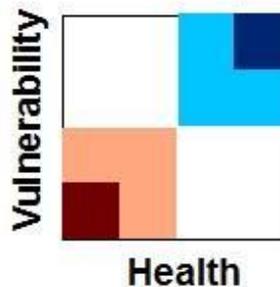
 50% Most Healthy & 50% Most Vulnerable

Restoration Priority

 25% Least Healthy & 25% Least Vulnerable

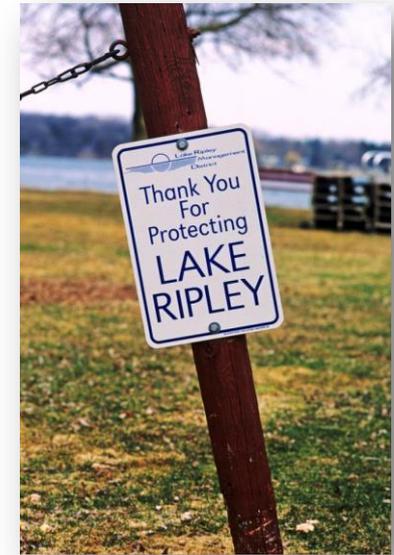
 50% Least Healthy & 50% Least Vulnerable

0 25 50 100 Miles



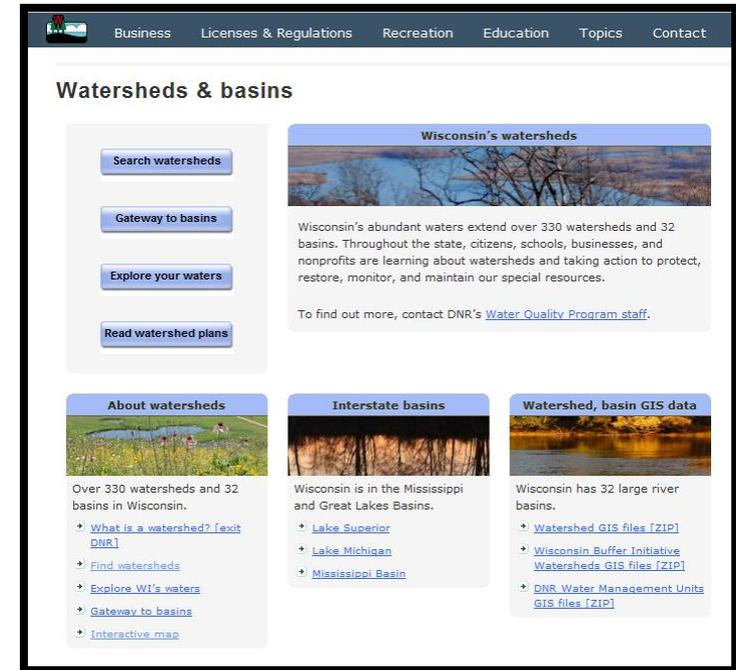
Applications

- ▶ 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>

Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help

Home Show Layers Show Legend Pan Zoom In Zoom Out Previous Extent Full State Point Identify Scale: 1: 240,210 New Plot Clear All Clicked Coordinates Lat: 44.7572 Lon: -90.0665 Lat/Lon (DD) Print Map

Home Map Layers Navigation Location Info Scale & Bookmarks Coordinate Tools Print

Map Layers

Layer Theme: Healthy Watersheds Assessment

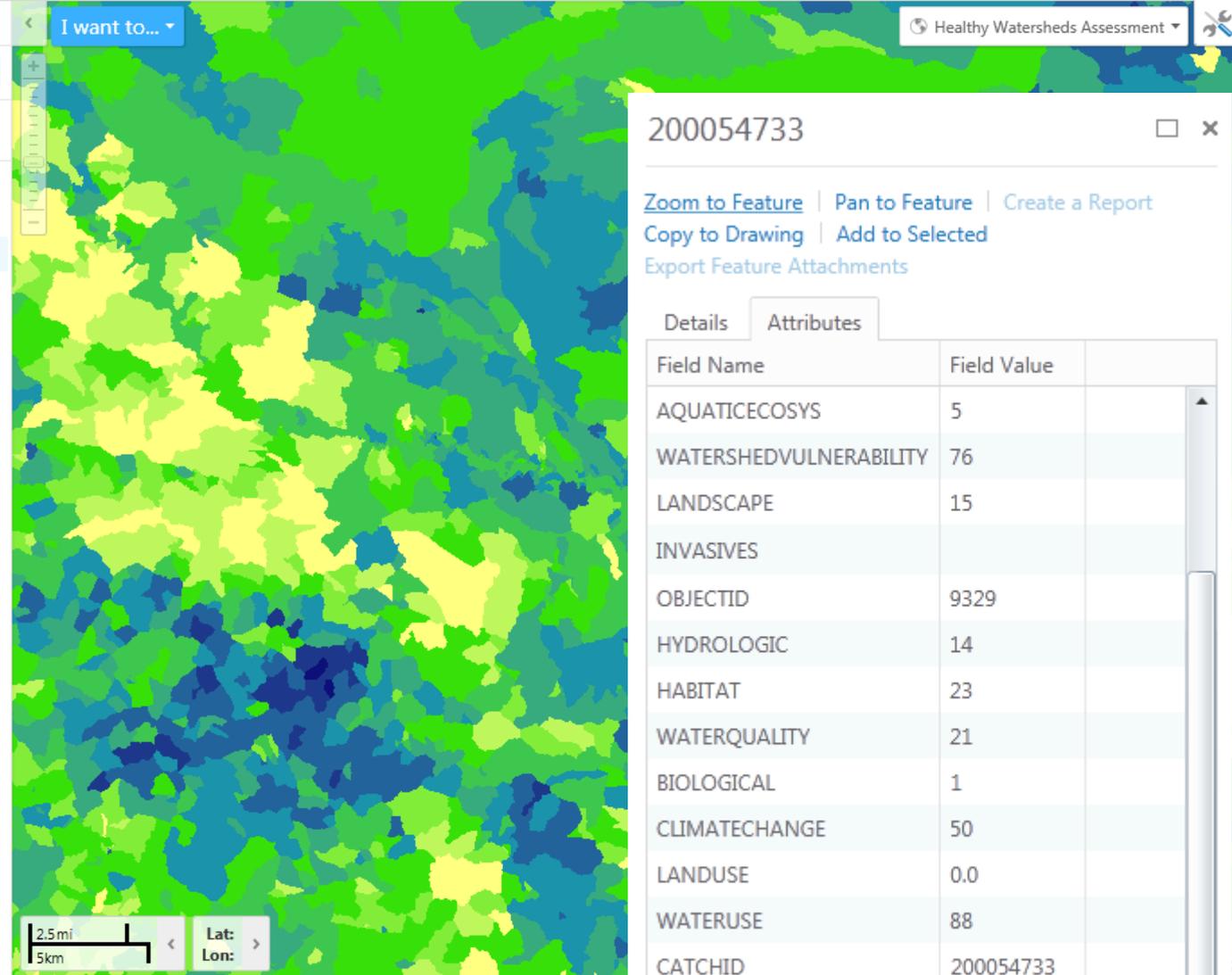
Show Legend Filter...

Operational Layers

- Healthy Watershed Assessment
 - Healthy Watershed Indexes
 - Aquatic Ecosystem Health Index
 - Watershed Vulnerability Index
 - Landscape Condition Index
 - Aquatic Invasive Species Index
 - Healthy Watershed Sub-Indices
 - Habitat Condition/Geomorphology Sub-Ind
 - Biological Condition Sub-Index
 - Water Quality Sub-Index
 - Hydrologic Condition Sub-Index
 - Climate Change Vulnerability Sub-Index
 - Land Use Vulnerability Sub-Index
 - Water Use Vulnerability Sub-Index
- Water Resources
- Impairments & Assessments

Base Maps

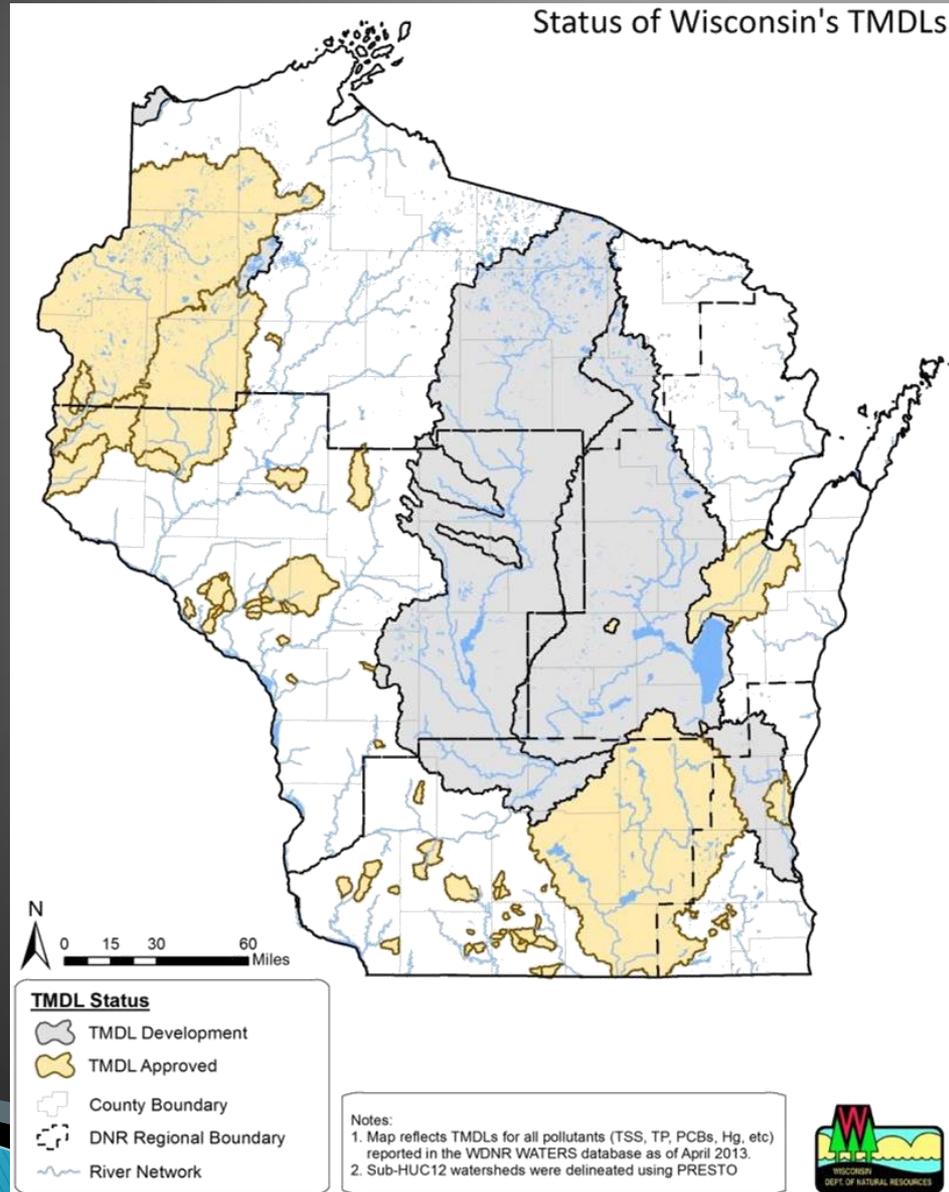
- Digital Topographic Maps
- Road Basemap
- Image Basemap WROC 2010



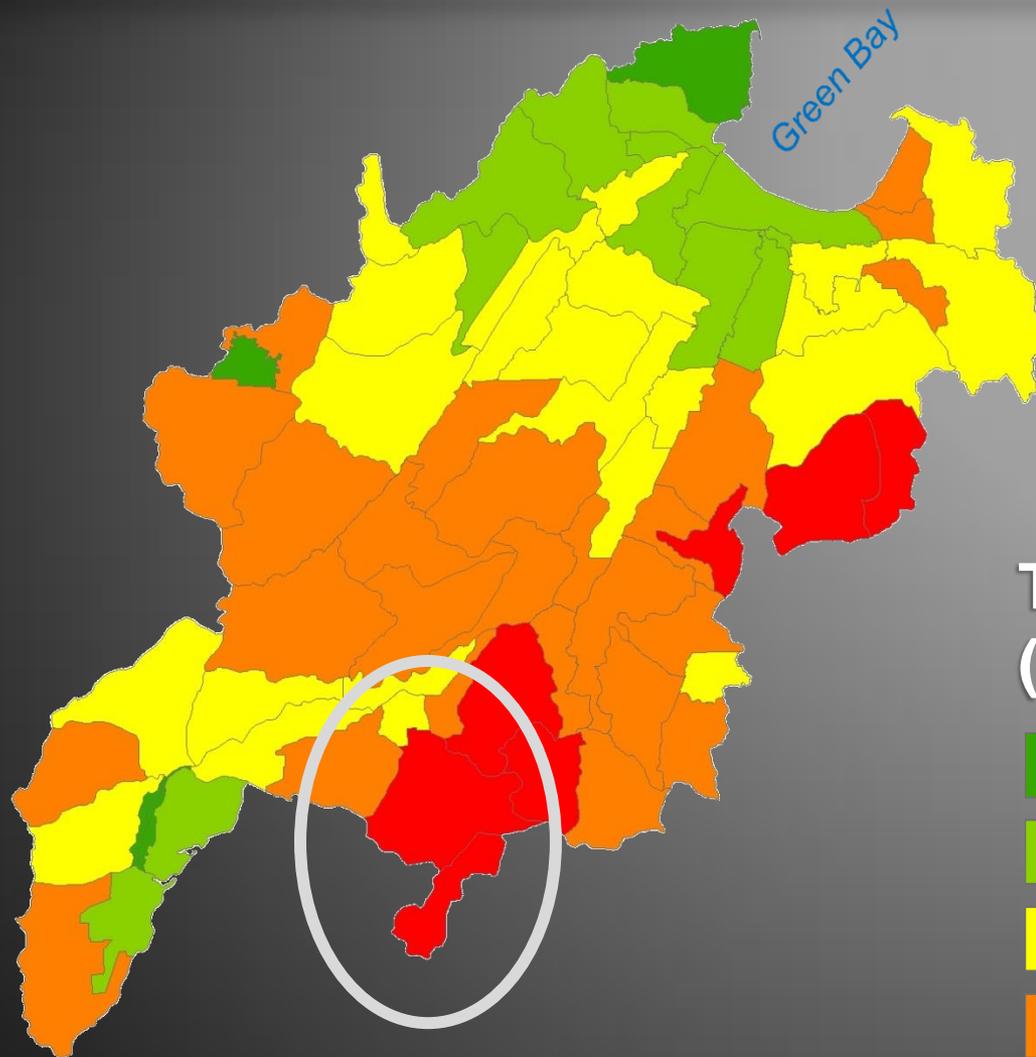
EVAAL

»» Overview

TMDLs Statewide



TMDL Results



**Total Phosphorus
(lbs/acre/year)**



Watershed



- 23 square miles
- 187 farms
- 1,129 fields

EVAAL

- ▶ **Erosion Vulnerability Assessment for Agricultural Lands**
- ▶ GIS-based model
- ▶ Vulnerability to erosion and nutrient export
- ▶ Deprioritizes internally draining areas



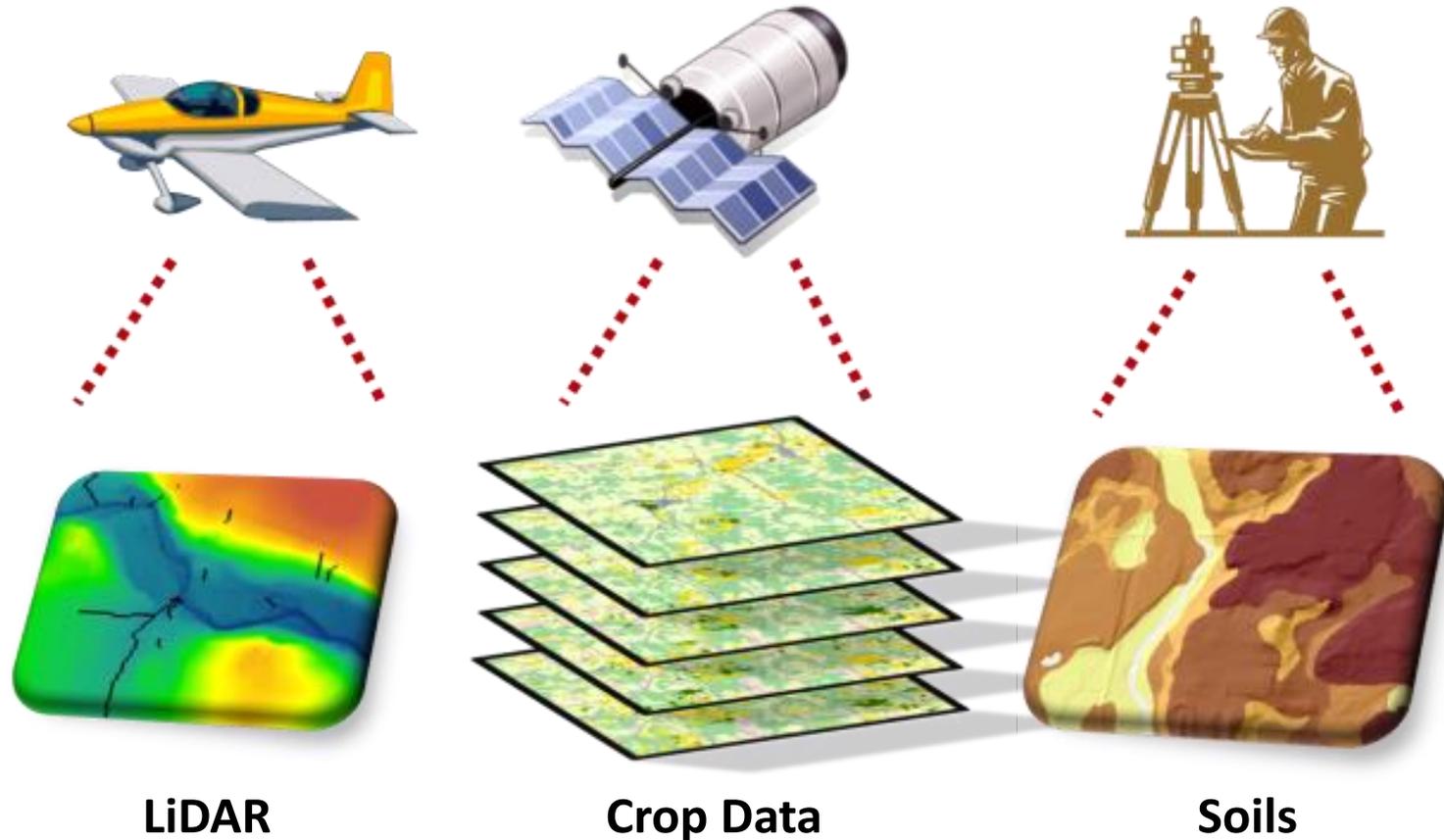
EVAAL System Requirements

- ▶ 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

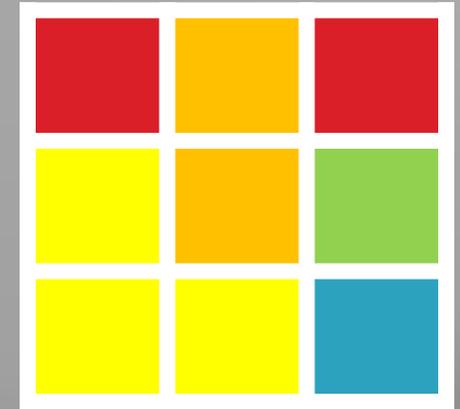
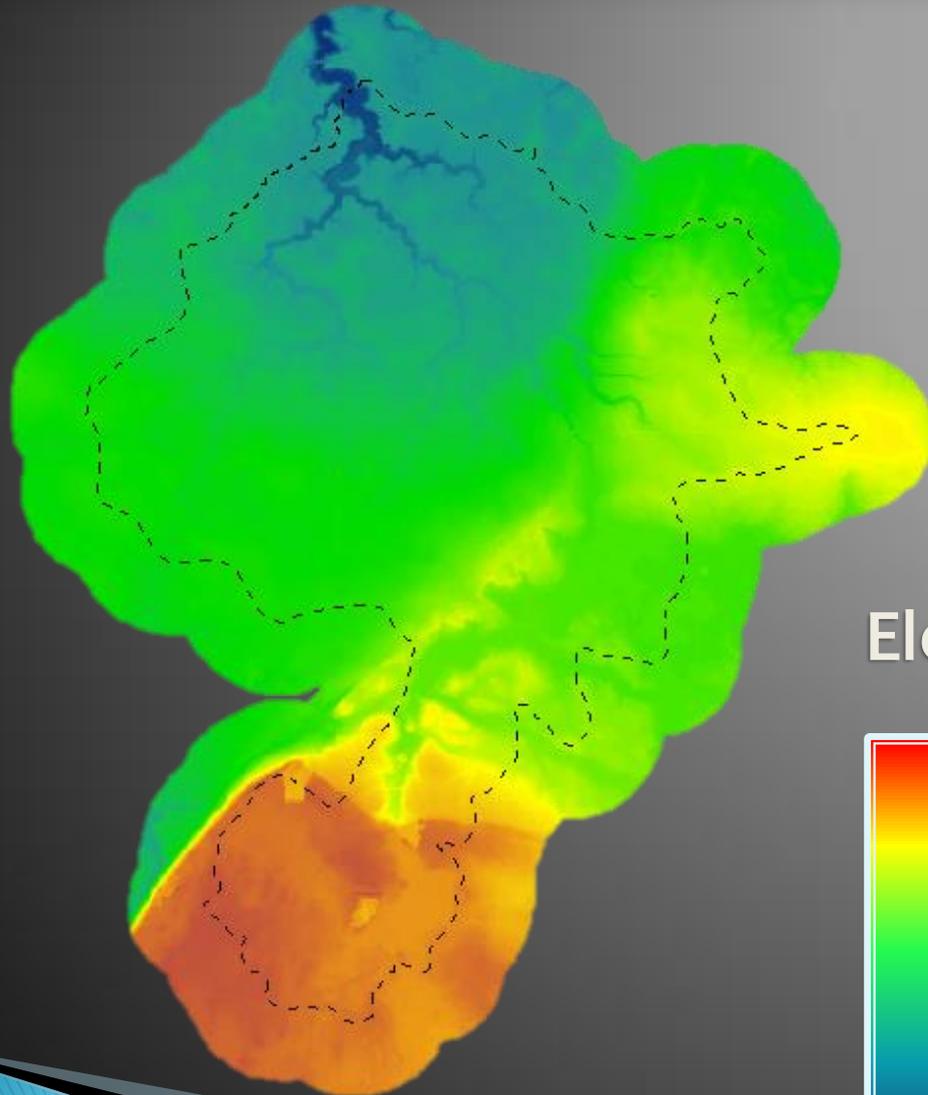


LiDAR

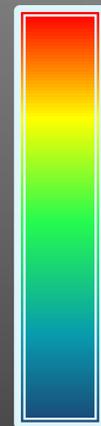
Crop Data

Soils

LiDAR Data



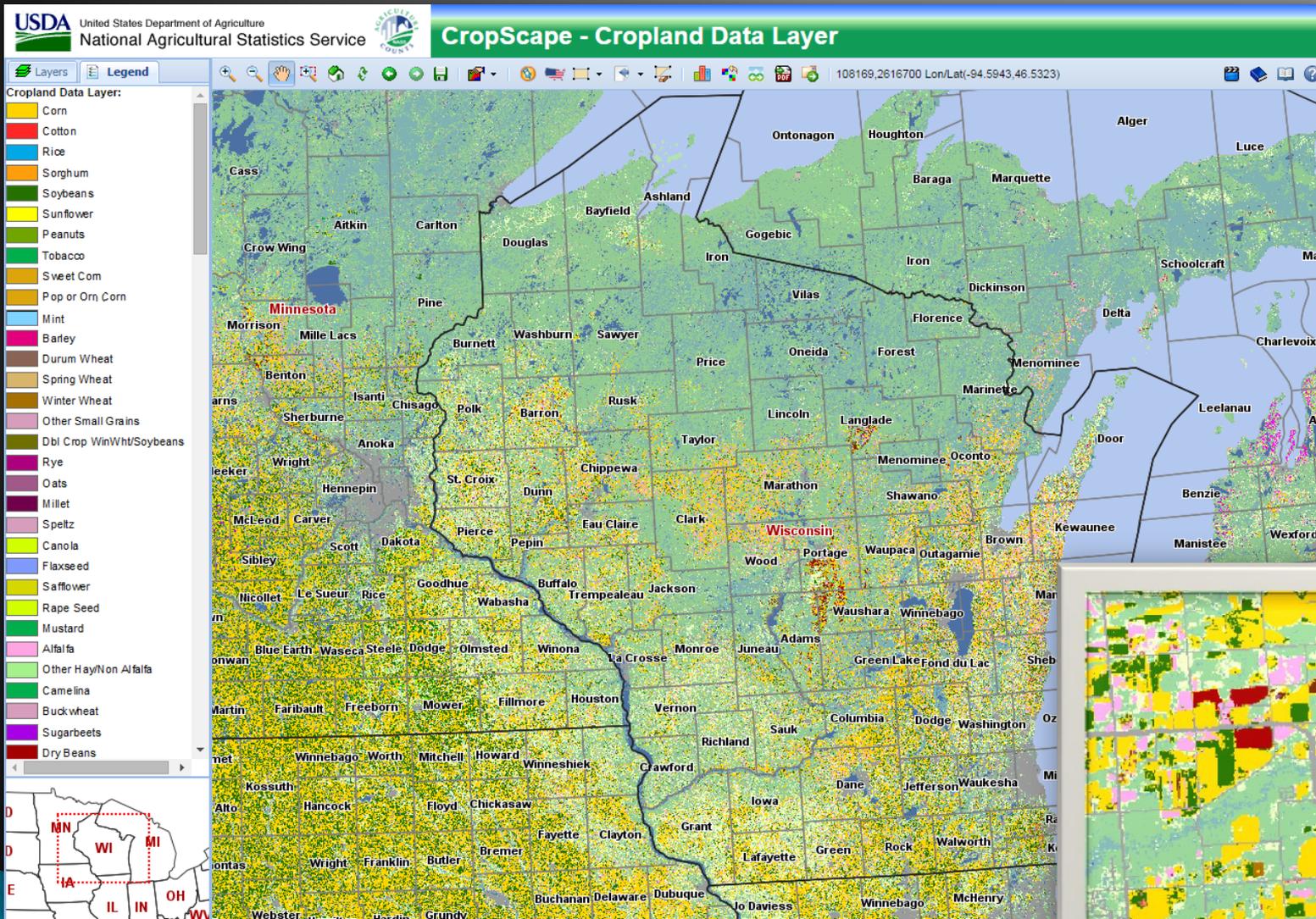
Elevation (feet)



1000

650

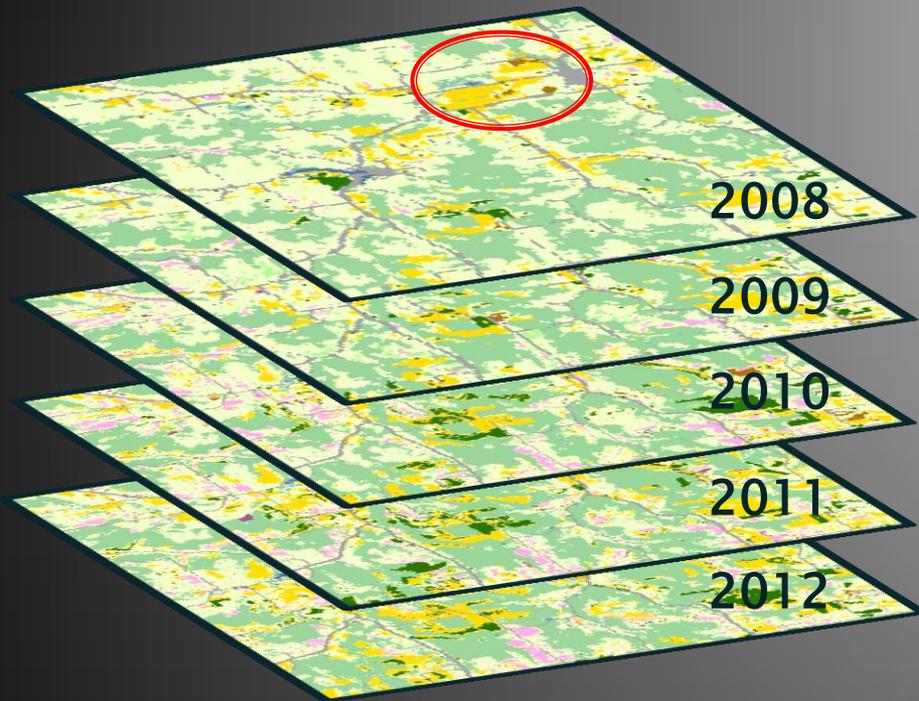
Crop Data



<http://nassgeodata.gmu.edu/CropScape/>



Crop Rotations



Corn

Soybean

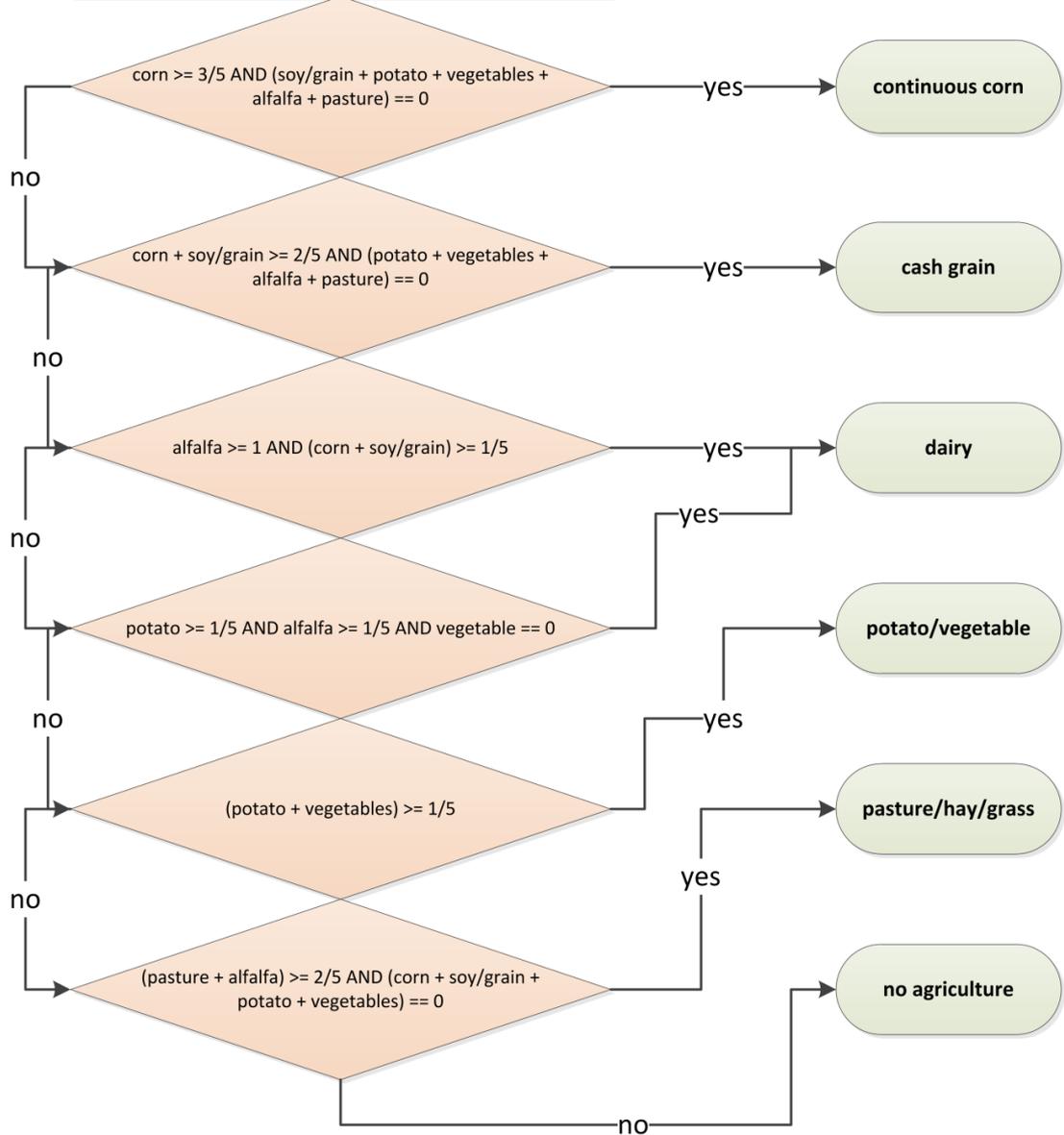
Corn

Corn

Soybean

C-C-S-C-C, C-S-C-S-C, S-C-C-S-C, C-C-C-C-S, S-S-S-S-C
= Cash Grain Rotation

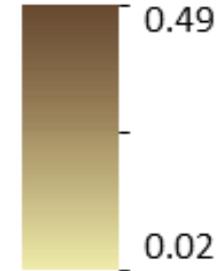
Time series of crop types by CDL code
corn: [1]
soy/grain: [4,5,21,22,23,24,25,27,28,29,30,39,205]
potato: [43]
vegetables: [12,42,47,49,50,53,206,216]
alfalfa: [28, 36, 37, 58]
pasture: [62, 181, 176]



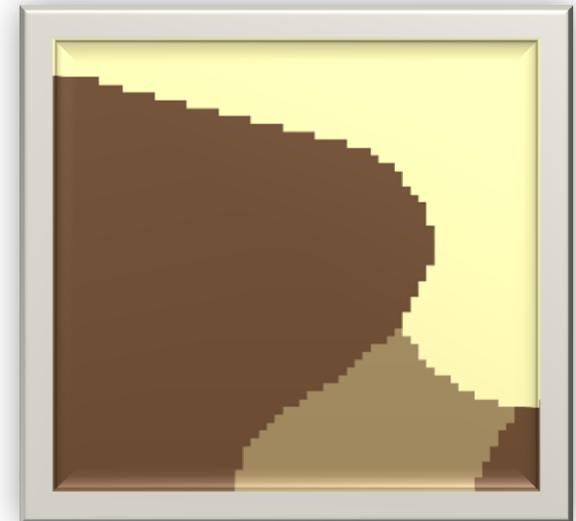
Soils – gSSURGO



Soil Erodibility



10 meter resolution



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

Erosion Vulnerability Analysis

USLE + SPI - IDA



= **E**  **AAL**

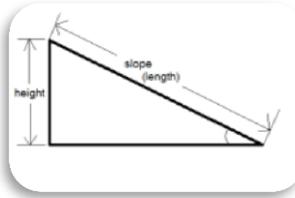
**Erosion Vulnerability Assessment
for Agricultural Lands**

Universal Soil Loss Equation

▶ Sheet and rill erosion

$$A = RK(LS)CP$$

- Rainfall erosivity
- Soil erodibility
- Slope/Slope–Length
- Cover factor
- Practice Factor



Universal Soil Loss Equation

- ▶ Sheet and rill erosion

$$A = RK(LS)CP$$

Constant

Constant

Universal Soil Loss Equation

- ▶ Sheet and rill erosion

$$A = RK(LS)CP$$

Constant

Constant

$$A = K(LS)C$$

Universal Soil Loss Equation

- ▶ Sheet and rill erosion

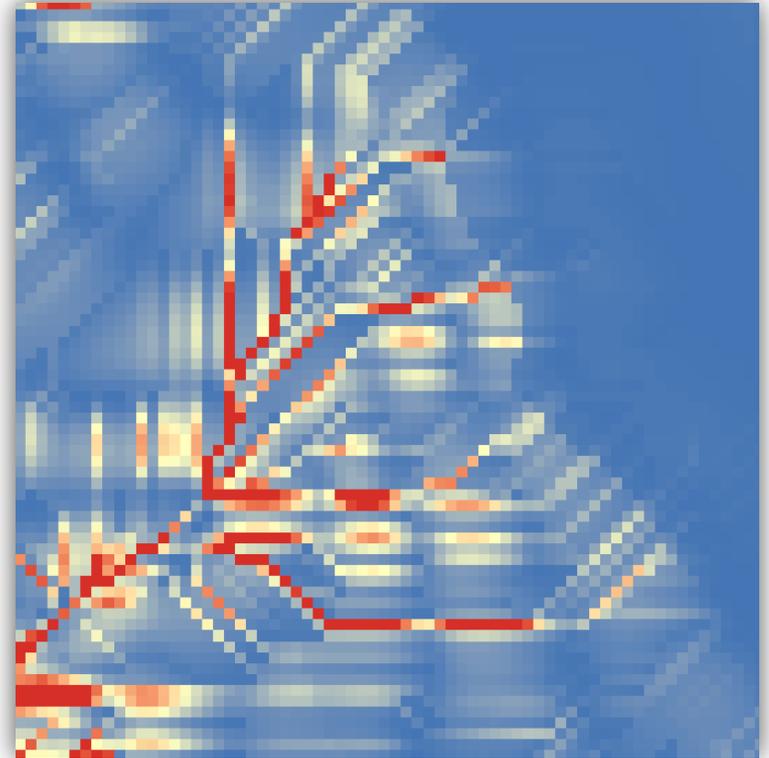
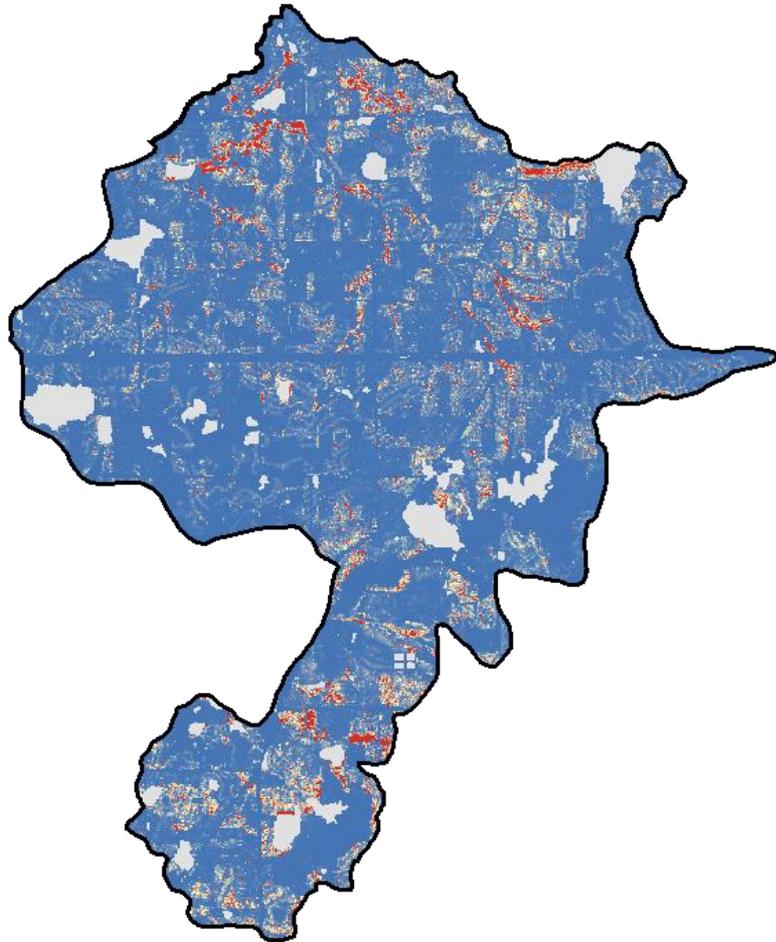
$$A = K(LS)C$$

SSURGO
soils

DEM

Cropland data layer

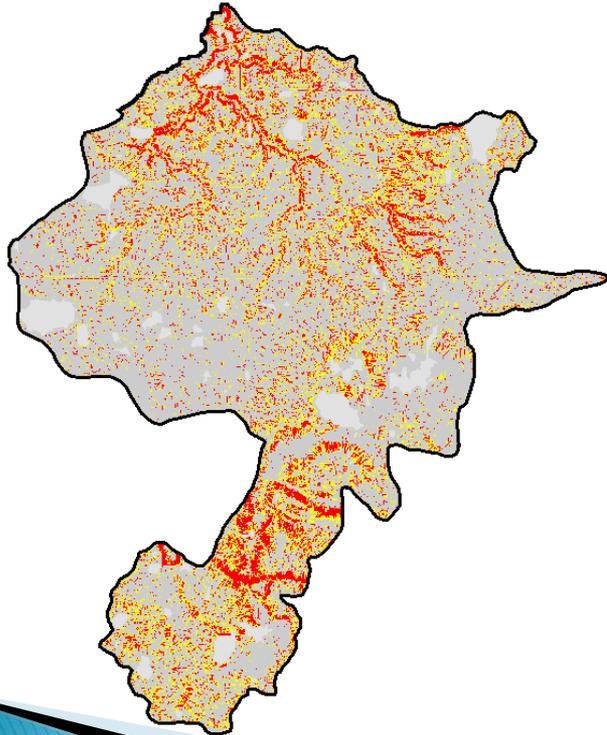
Universal Soil Loss Equation



Stream Power Index

- ▶ Potential for gully erosion

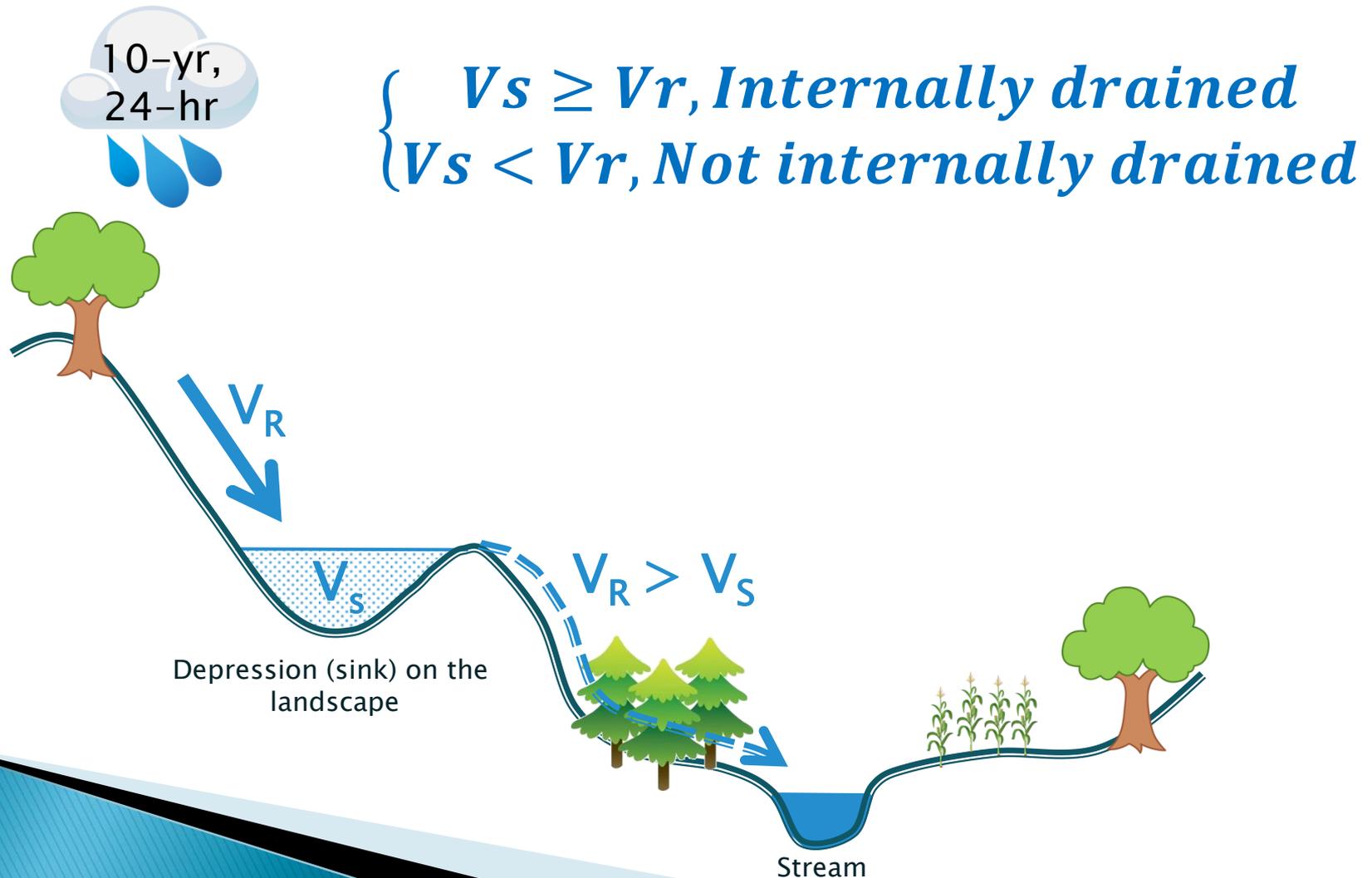
$$\text{SPI} = f(\text{slope, catchment area})$$



Source: Esri, DigitalGlobe, GeoEye, IGN, GeoEye, USDA, USGS, AeroGRID, IGN, Esri, Swire, and the GIS User Community

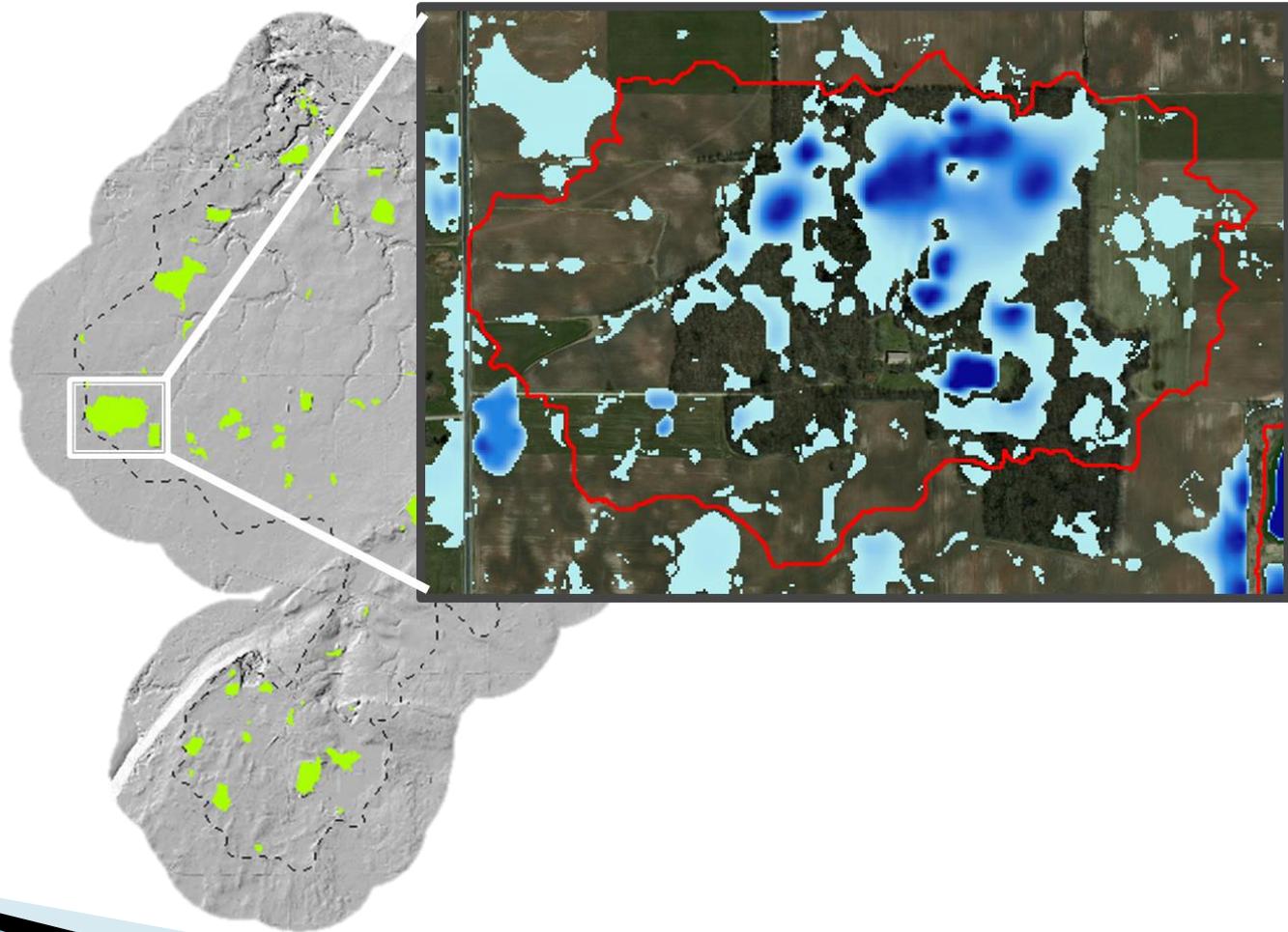
Internally Draining Areas

- ▶ Areas that do not contribute to surface waters



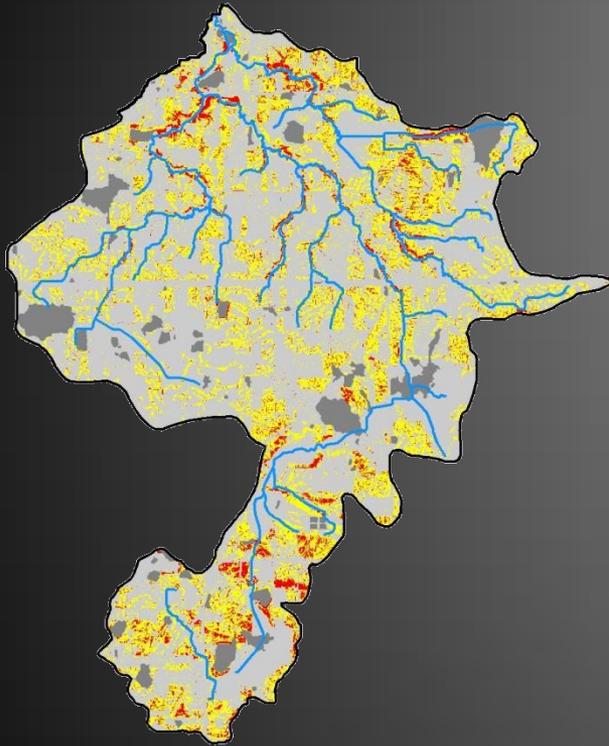
Internally Draining Areas

- ▶ Areas that do not contribute to surface waters

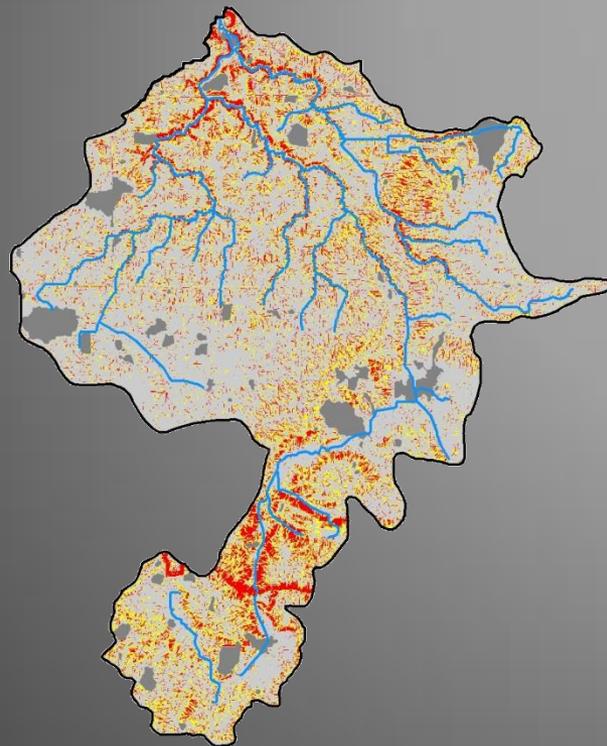


Results

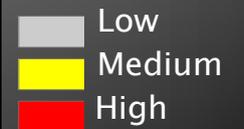
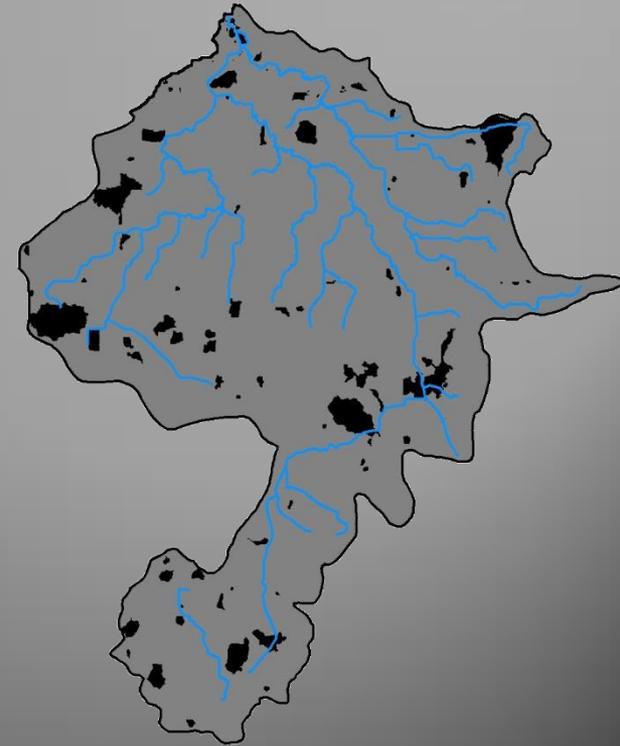
USLE



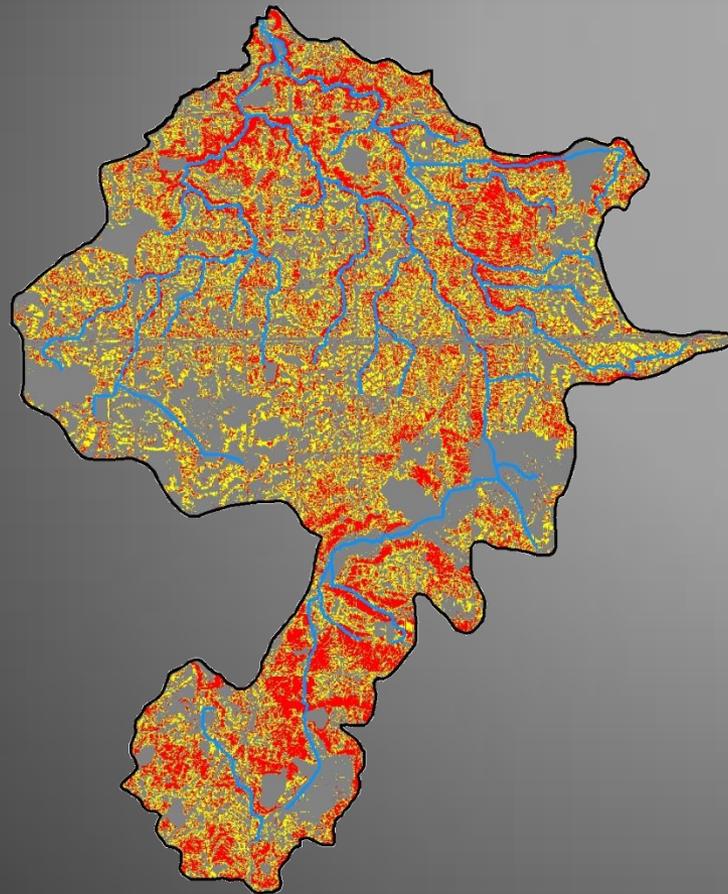
SPI



NC Areas



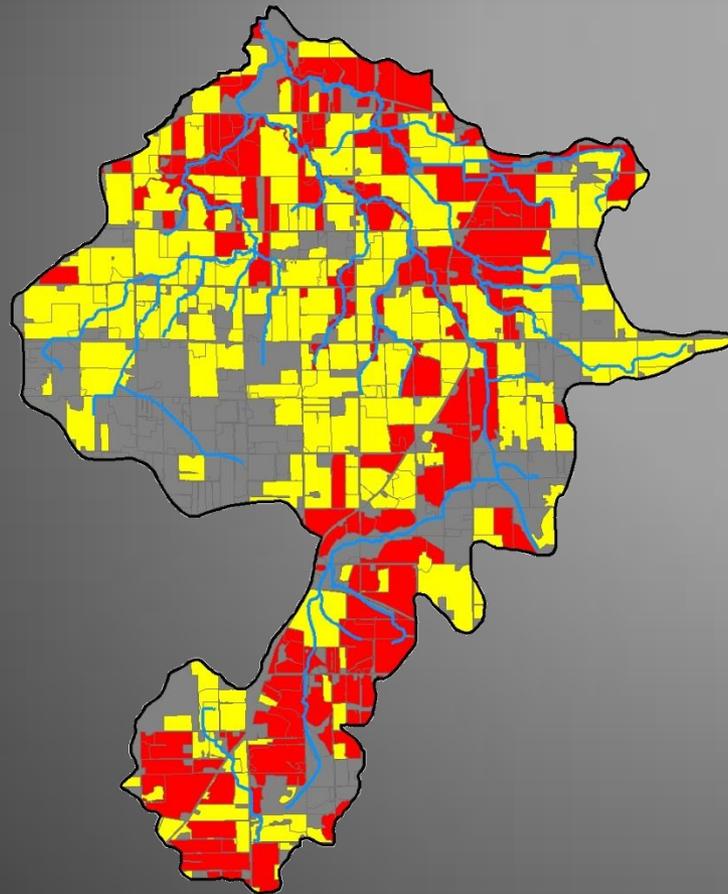
Results



Erosion Vulnerability



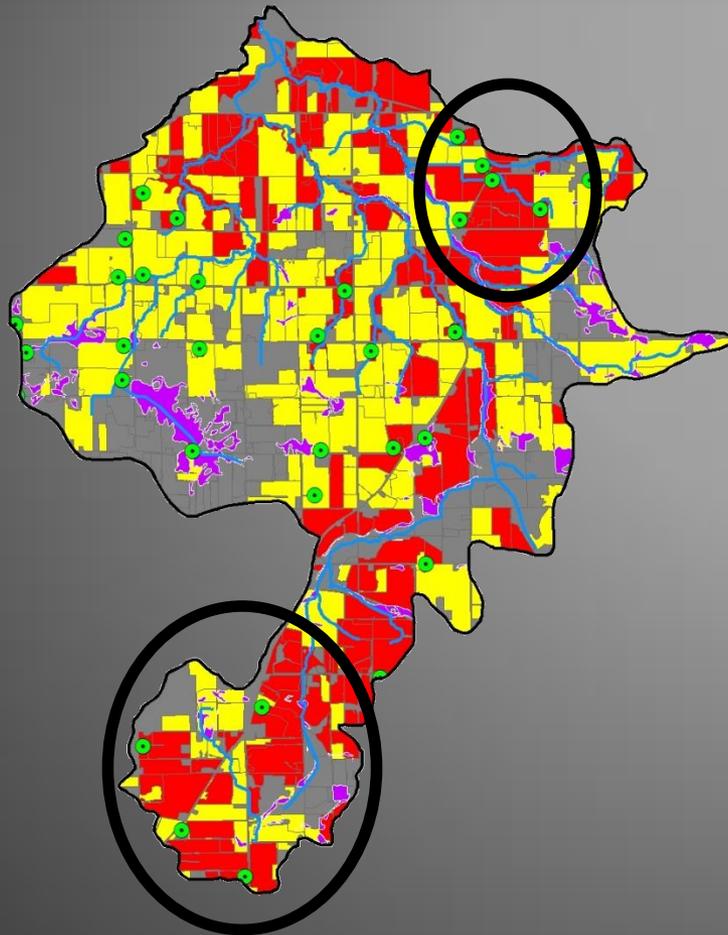
Results



Erosion Vulnerability



Results



Prioritization



Limitations

- ▶ 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

ArcToolbox

ArcToolbox

▣ EVAAL_

1. Condition the LiDAR DEM
- 2a. Download precipitation data
- 2b. Create curve number raster
- 2c. Identify internally draining areas
3. Recondition DEM for internally draining areas
4. Calculate Stream Power Index
- 5a. Rasterize K-factor for USLE
- 5b. Rasterize C-factor for USLE
- 5c. Calculate soil loss index using USLE
6. Calculate erosion vulnerability index

Business Licenses & Regulations Recreation Education Topics Contact Join DNR Search or Keywords Share

EVAAL

Erosion Vulnerability Assessment for Agricultural Lands

Agricultural NPS pollution

Erosion Vulnerability Assessment for Agricultural Lands (EVAAL)

The Wisconsin Department of Natural Resources (WDNR) Bureau of Water Quality has developed the Erosion Vulnerability Assessment for Agricultural Lands (EVAAL) toolset to assist watershed managers in prioritizing areas within a watershed which may be vulnerable to water erosion (and thus increased nutrient export) and thus may contribute to downstream surface water quality problems. It evaluates locations of relative vulnerability to sheet, rill and gully erosion using information about topography, soils, rainfall and land cover. This tool enables watershed managers to prioritize and focus field-scale data collection efforts, thus saving time and money while increasing the probability of locating fields with high sediment and nutrient export for implementation of best management practices (BMPs).

Erosion Vulnerability Index

EVAAL was designed to quickly identify areas vulnerable to erosion, and thus more likely to export nutrients like phosphorus, using readily available data and a user-friendly interface. This tool estimates vulnerability by separately assessing the risk for sheet and rill erosion (using the Universal Soil Loss Equation, USLE), and gully erosion (using the Stream Power index, SPI), while deprioritizing those areas that are not hydrologically connected to surface waters (also known as internally drained areas, IDA). These three pieces are combined to produce an erosion vulnerability index value that can be assessed at the grid scale or aggregated to areas, such as field boundaries.

USLE + SPI - IDA = EROSION VULNERABILITY INDEX

Legend: Low (grey), Medium (yellow), High (red)

EVAAL, Version 1.0 (August 2014)

- [Fact Sheet \(PDF\)](#)
- [Tutorial \(PDF\)](#)
(Includes installation instructions to be read prior to downloading EVAAL model files)
- [Methods Documentation \(PDF\)](#)
- [EVAAL Model Files \(text DNR\)](#)
- [EVAAL Tutorial Data \(FTP site, ZIP file format\)](#)

Contact information

For questions or information about this model, please contact:

[Theresa M. Possley Nelson, P.E.](#)
TMDL modeling engineer
Project manager

Last revised: Friday September 26 2014

Nonpoint source pollution

Agricultural nonpoint source pollution

Learn more about agricultural nonpoint source pollution

Urban nonpoint source pollution

Learn more about urban nonpoint source pollution

What you can do

Learn more about controlling nonpoint source pollution in your area

TMDL implementation

Learn more about what the DNR is doing to control nonpoint source pollution

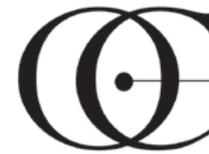
Related links

- Environmental impacts
- Wisconsin Runoff Rules: What Farmers Need to Know (PDF)
- NR 151 implementation strategy
- Agricultural technical standards & assistance
- Financial assistance
- Discharges, complaints & assistance
- Notices of discharge
- Nonpoint program contacts

<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



OUTAGAMIE COUNTY
LAND CONSERVATION DEPARTMENT
3365 W. BREWSTER, WISCONSIN 54914

The Nature
Conservancy

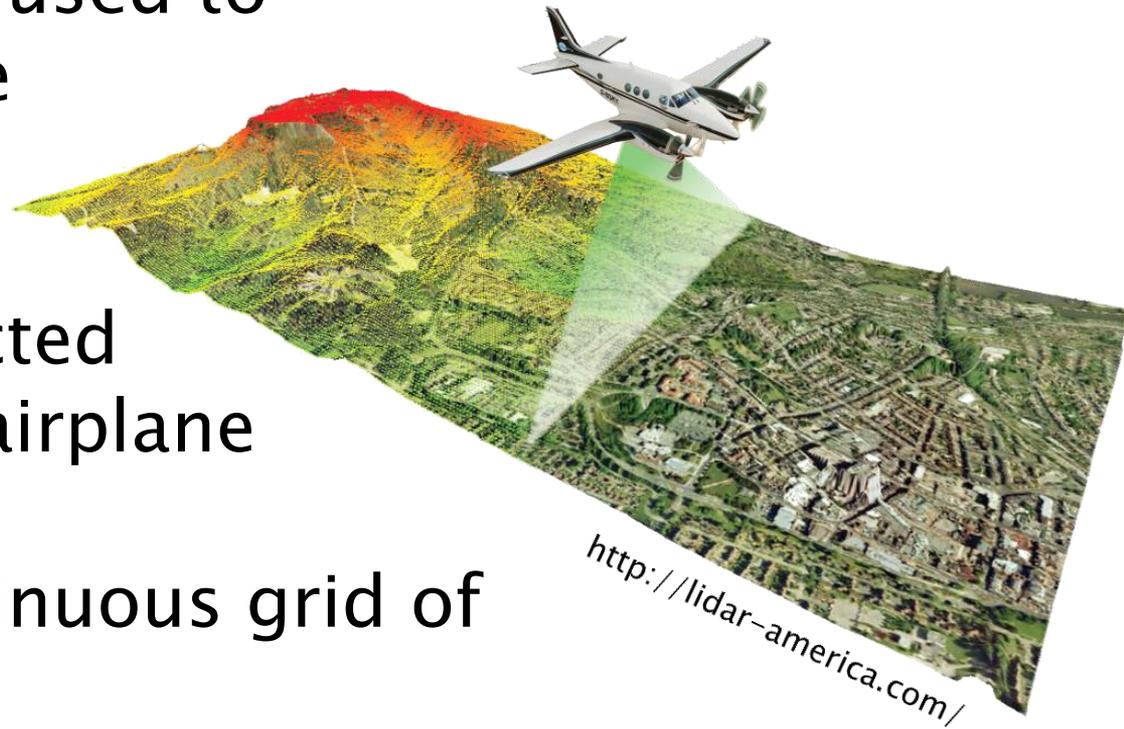


EVAAL

»» 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



Elevation Data

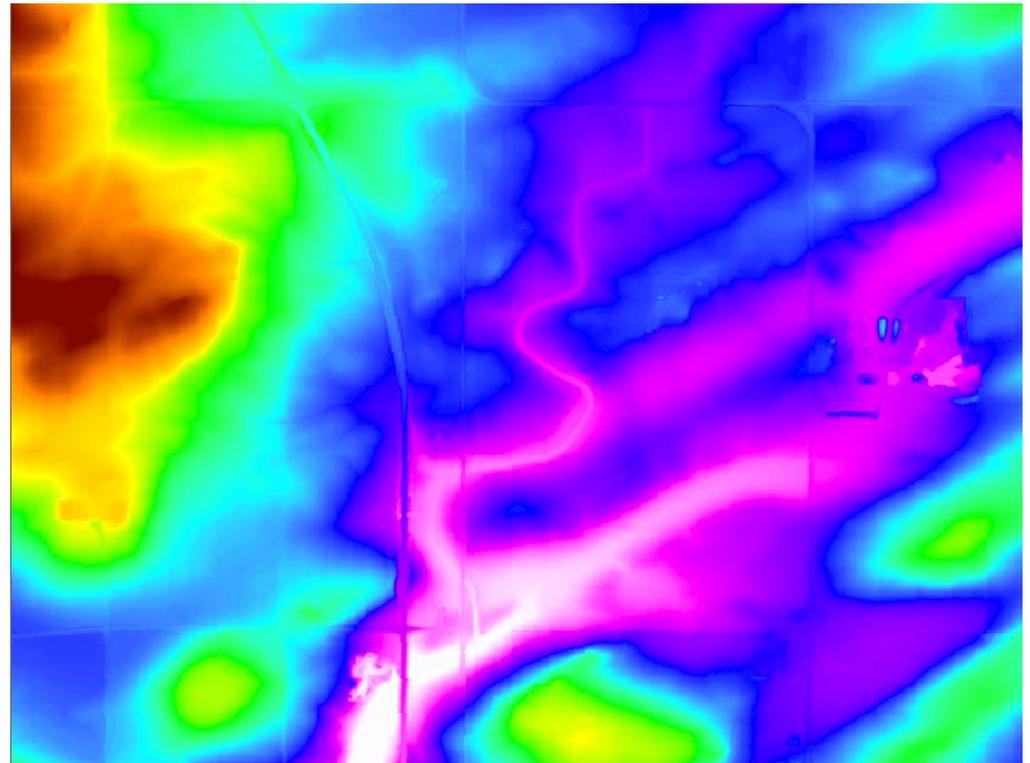
- ▶ Continuous grid = raster data
- ▶ File formats:
 - GeoTIFF (.tif)
 - ERDAS Imagine (.img)
 - ESRI raster geodatabase
(no extension)
 - LiDAR specifically:
 - Any of above or
 - Point clouds
 - .LAS or .LAZ
 - Requires additional processing



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

3 meter LiDAR

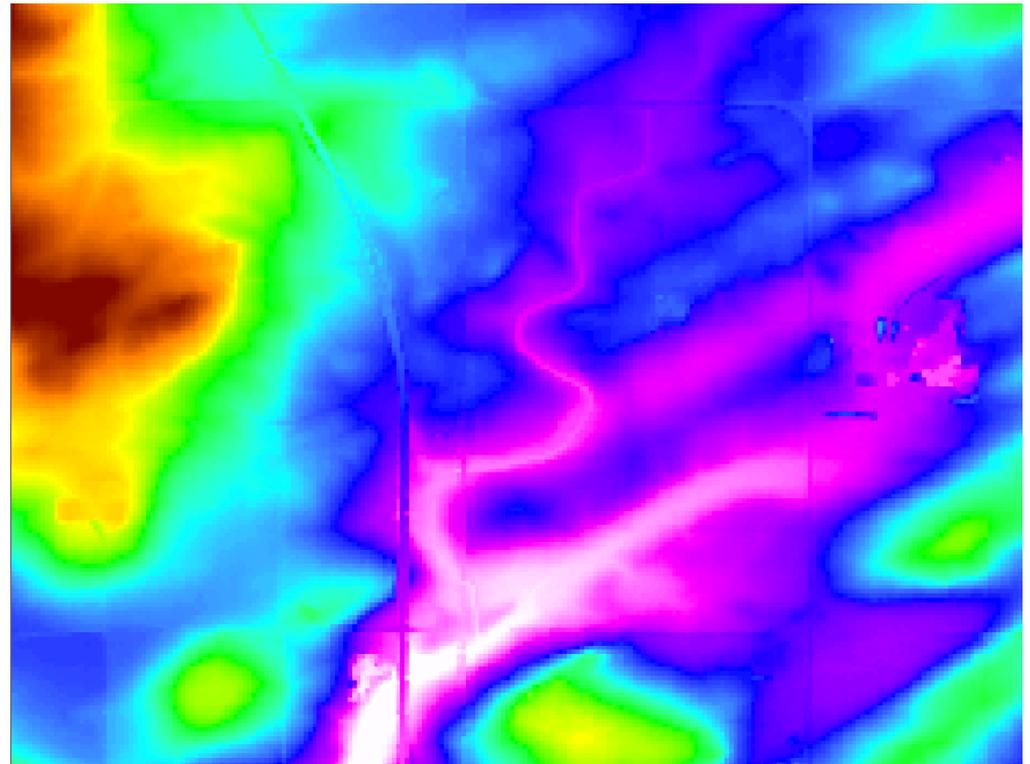


1000m (~1/2 mile)

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

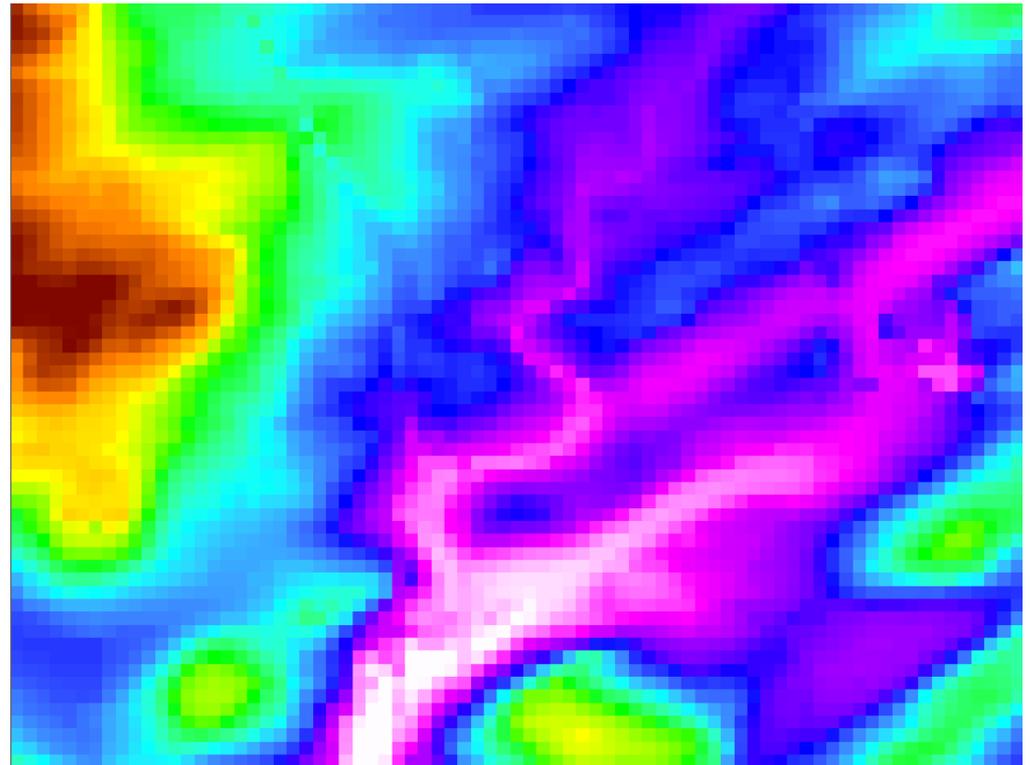


1000m (~1/2 mile)

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

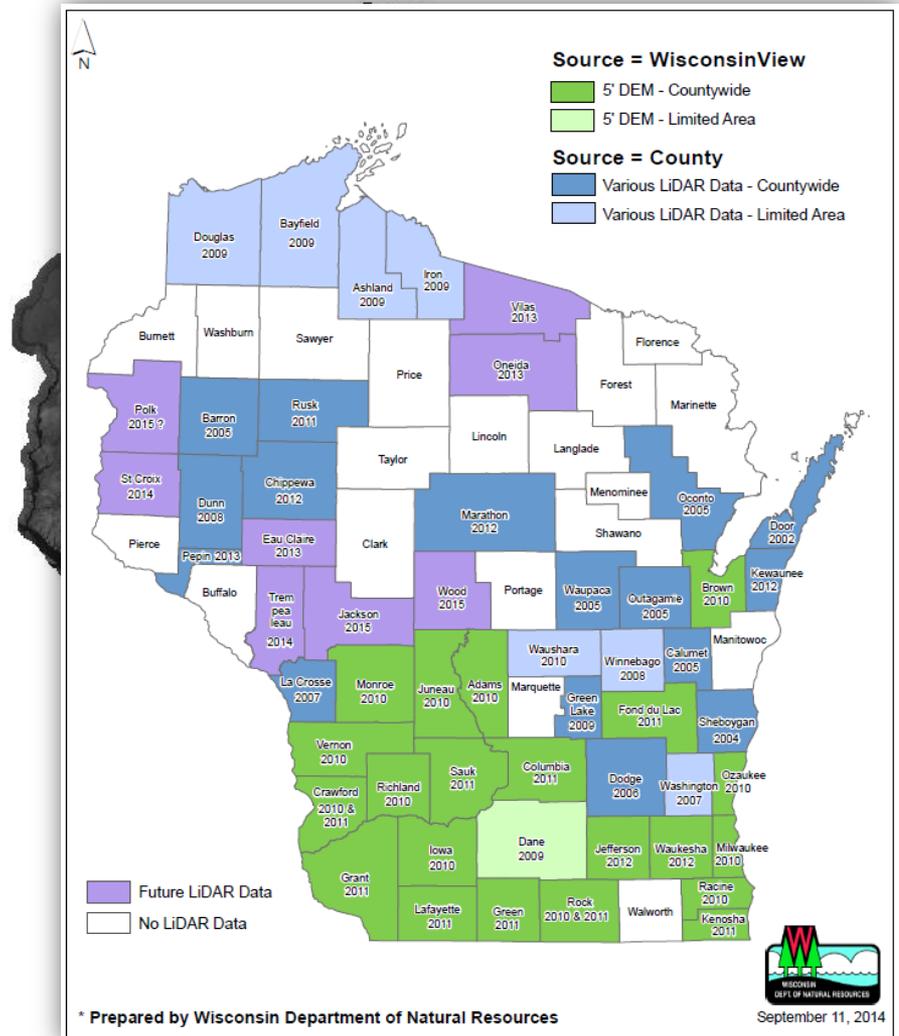
30 meter



1000m (~1/2 mile)

Availability

- ▶ 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



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

10 meter

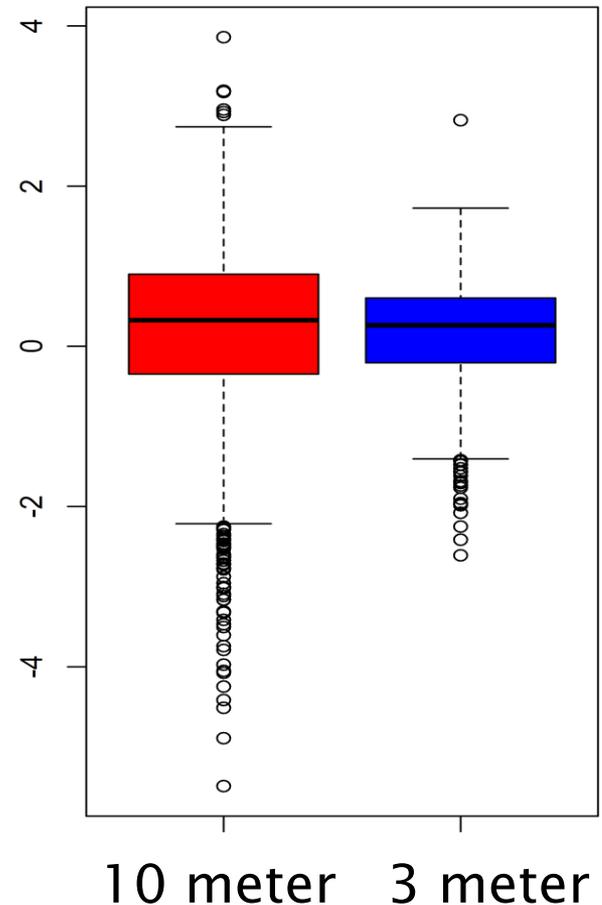
3 meter



Erosion Vulnerability Difference

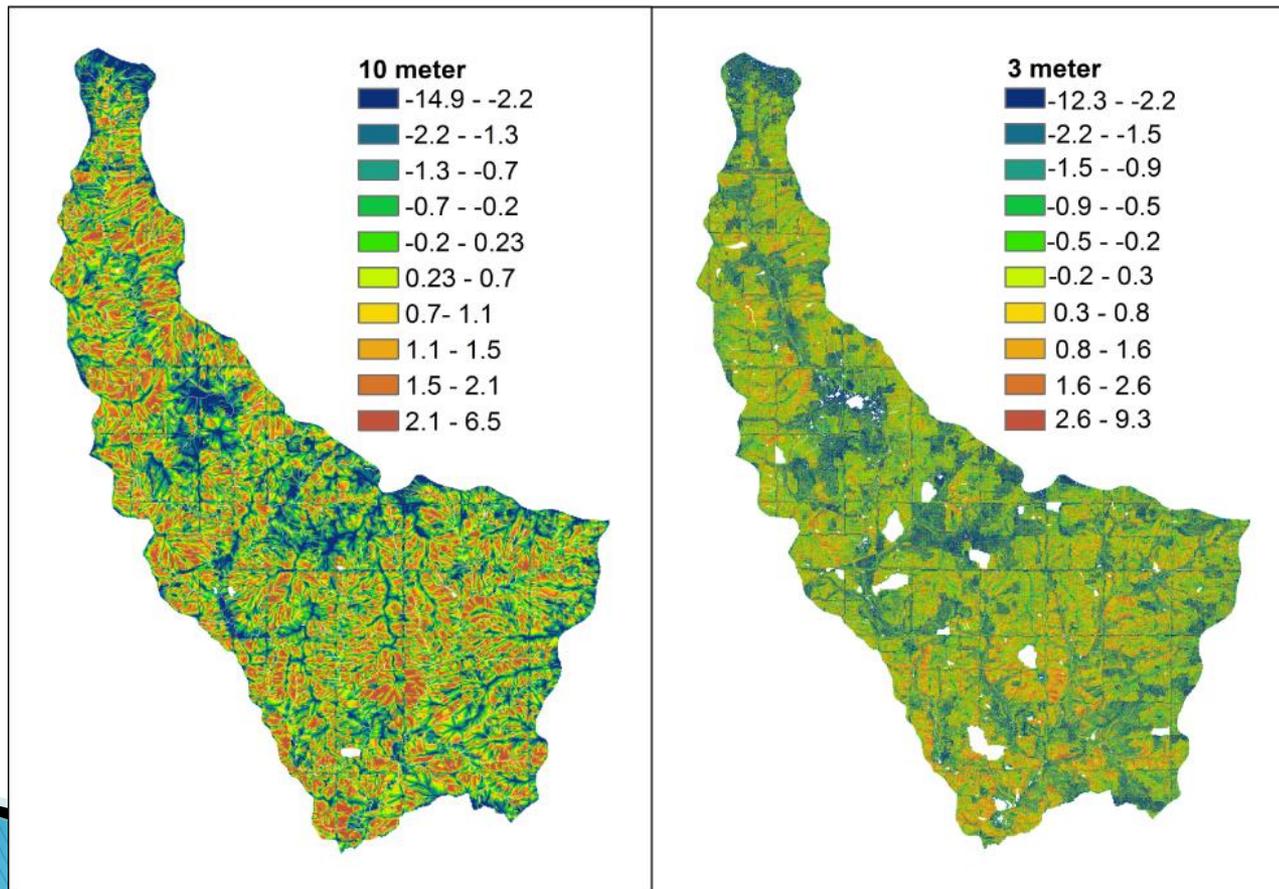
- ▶ Erosion vulnerability is a relative metric, changes based on which areas are included in the analysis
- ▶ Less area included (because more internally drained) means different range of values
- ▶ Compared to LiDAR data, erosion vulnerability is more variable, and a slightly higher mean
- ▶ **NOTE:** this relationship may not always hold true

Mean Vulnerability



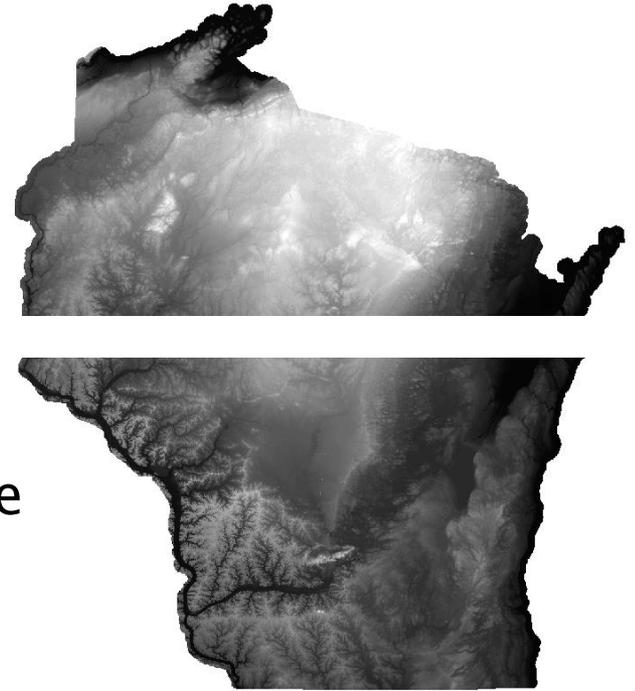
Erosion Vulnerability Difference

- ▶ Beware the relative nature, only looking within the watershed
- ▶ Assess only as relative values



Elevation Data Processing

- ▶ 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

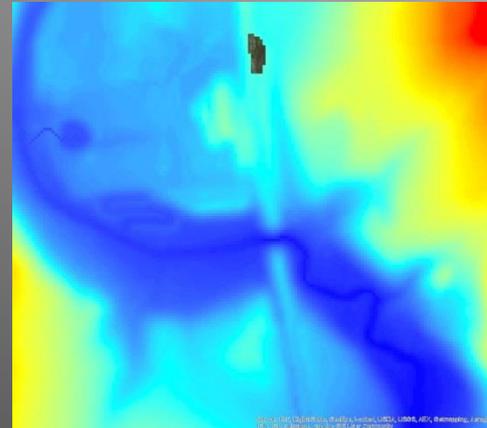
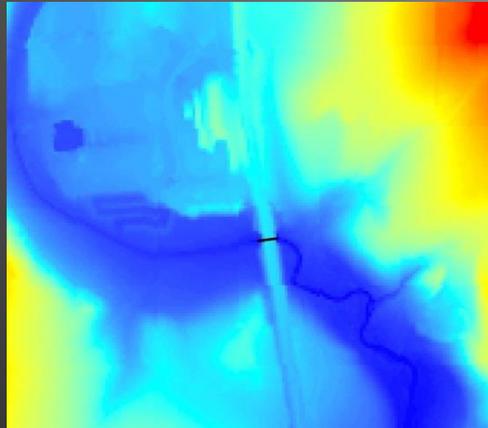
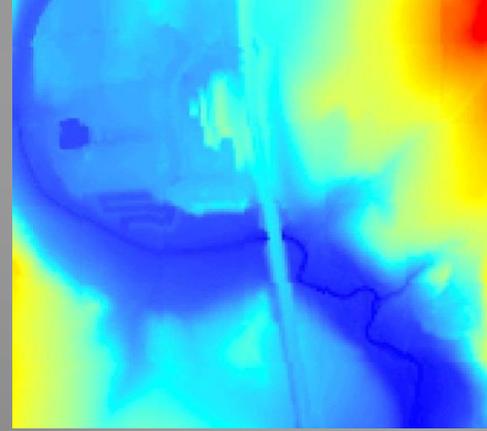
- ▶ EVAAL outputs a relative erosion score, take care in assessing output from different model runs!
 - Normalizes values across watershed
 - Cannot compare values from different watersheds
 - Look at relative values for one run

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

EVAAL

»» Culvert processing

Digital Dams

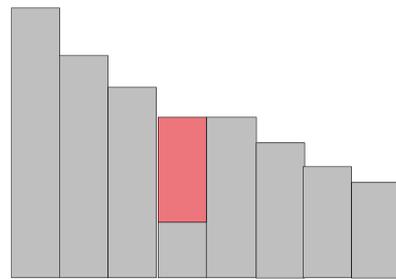


Digital Dams & Culverts

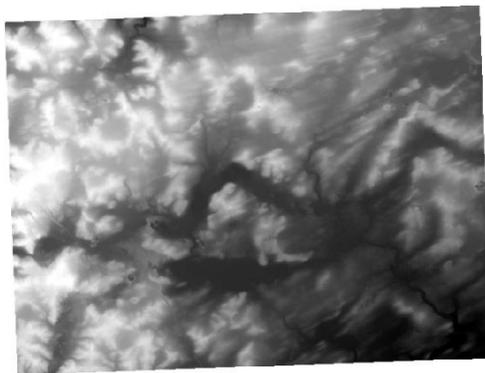
- ▶ Locate depressions
- ▶ Create culverts
- ▶ Run EVAAL step 1, DEM processing, and check internally draining areas
- ▶ Repeat if necessary

Locate Depressions

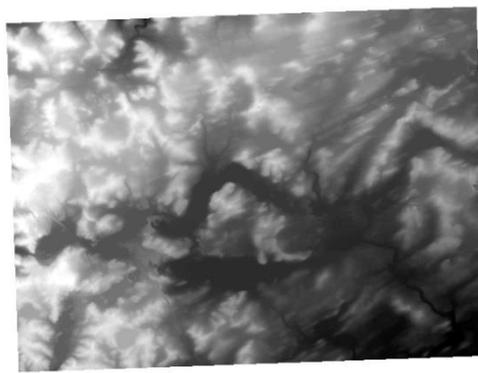
- ▶ Create filled DEM
 - Spatial Analyst Toolbox – Hydrology – Fill



Raw



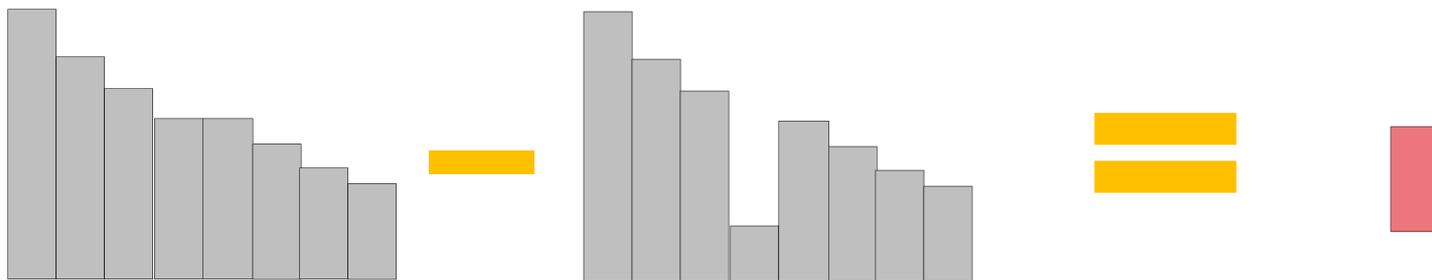
Filled



- + Schematics Tools
- + Server Tools
- Spatial Analyst Tools
 - + Conditional
 - + Density
 - + Distance
 - + Extraction
 - + Generalization
 - + Groundwater
 - Hydrology
 - Basin
 - Fill
 - Flow Accumulation
 - Flow Direction
 - Flow Length
 - Sink
 - Snap Pour Point

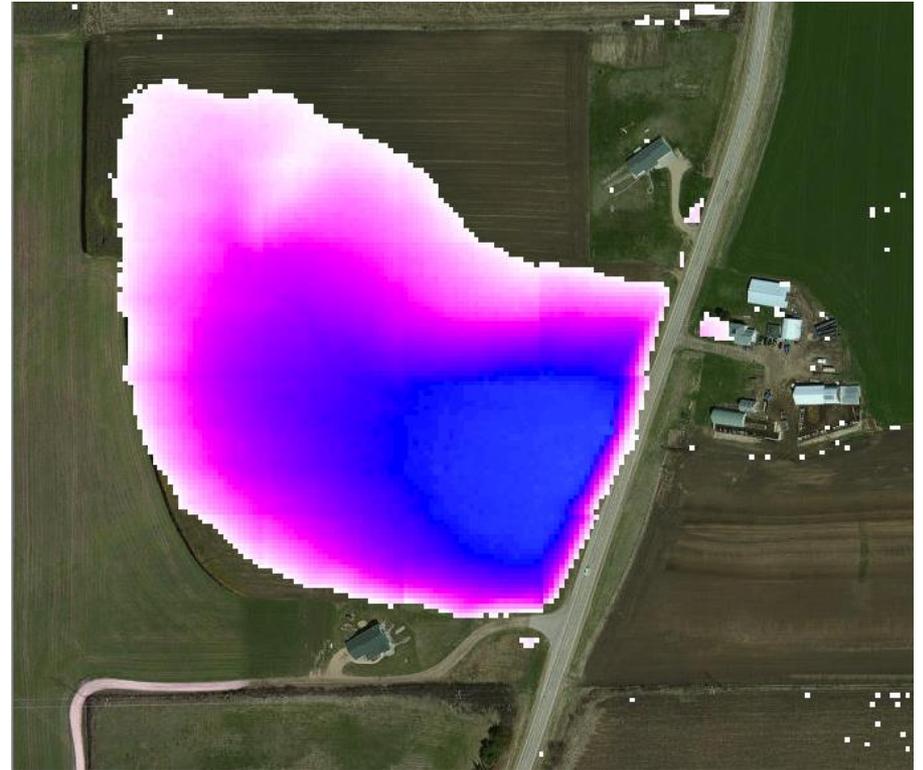
Locate Depressions

- ▶ Subtract rawDEM from filledDEM to get depressions (a.k.a. sinks)
 - Some are real
 - Lakes, quarries, etc.
 - Some are product of LiDAR DEM



Locate Depressions

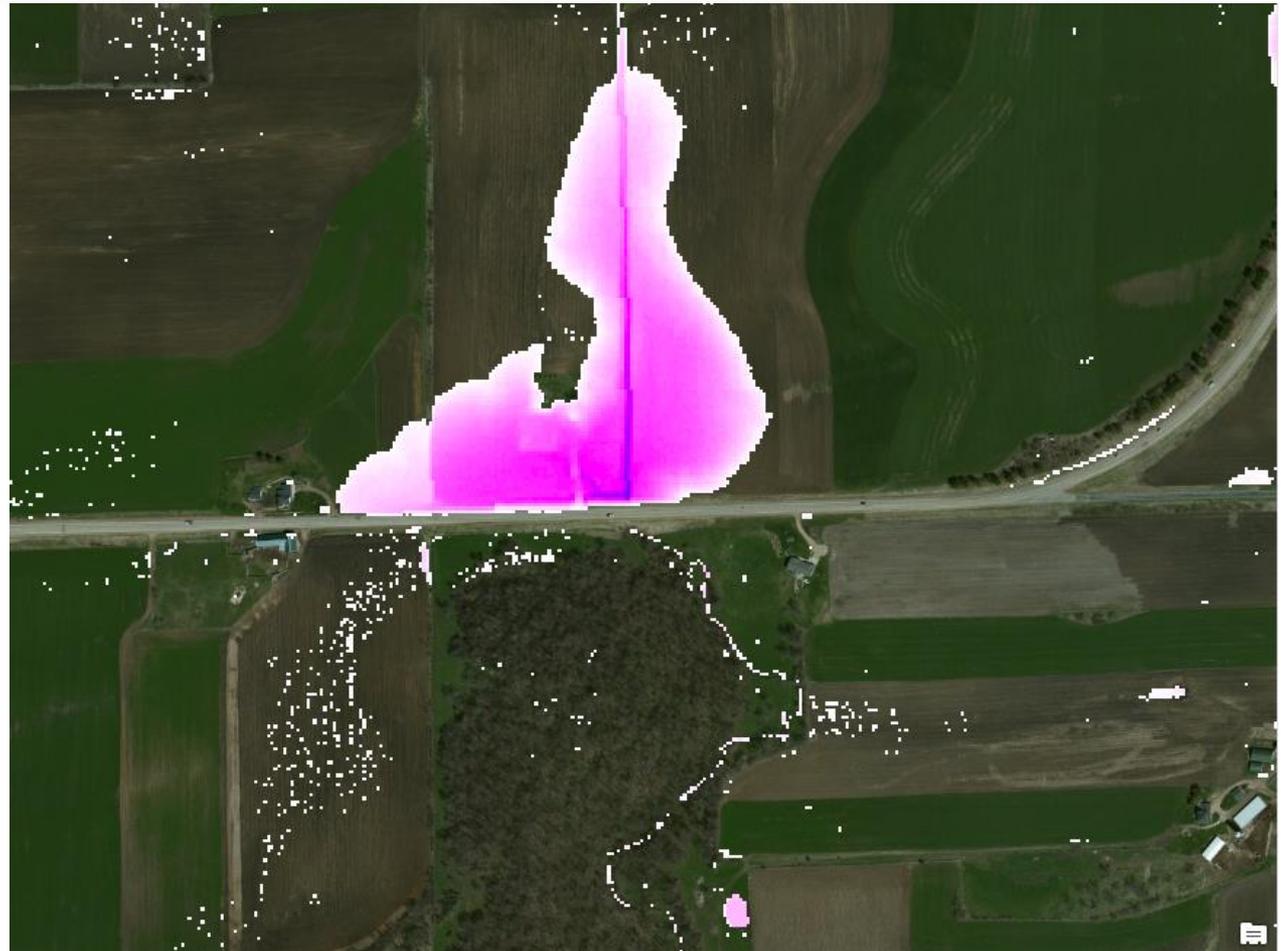
- ▶ How to differentiate between real and “fake” depressions
 - Overlay lakes
 - View only very deep depressions
 - Look for tell-tale flat sided depression (road berm)



Classic case

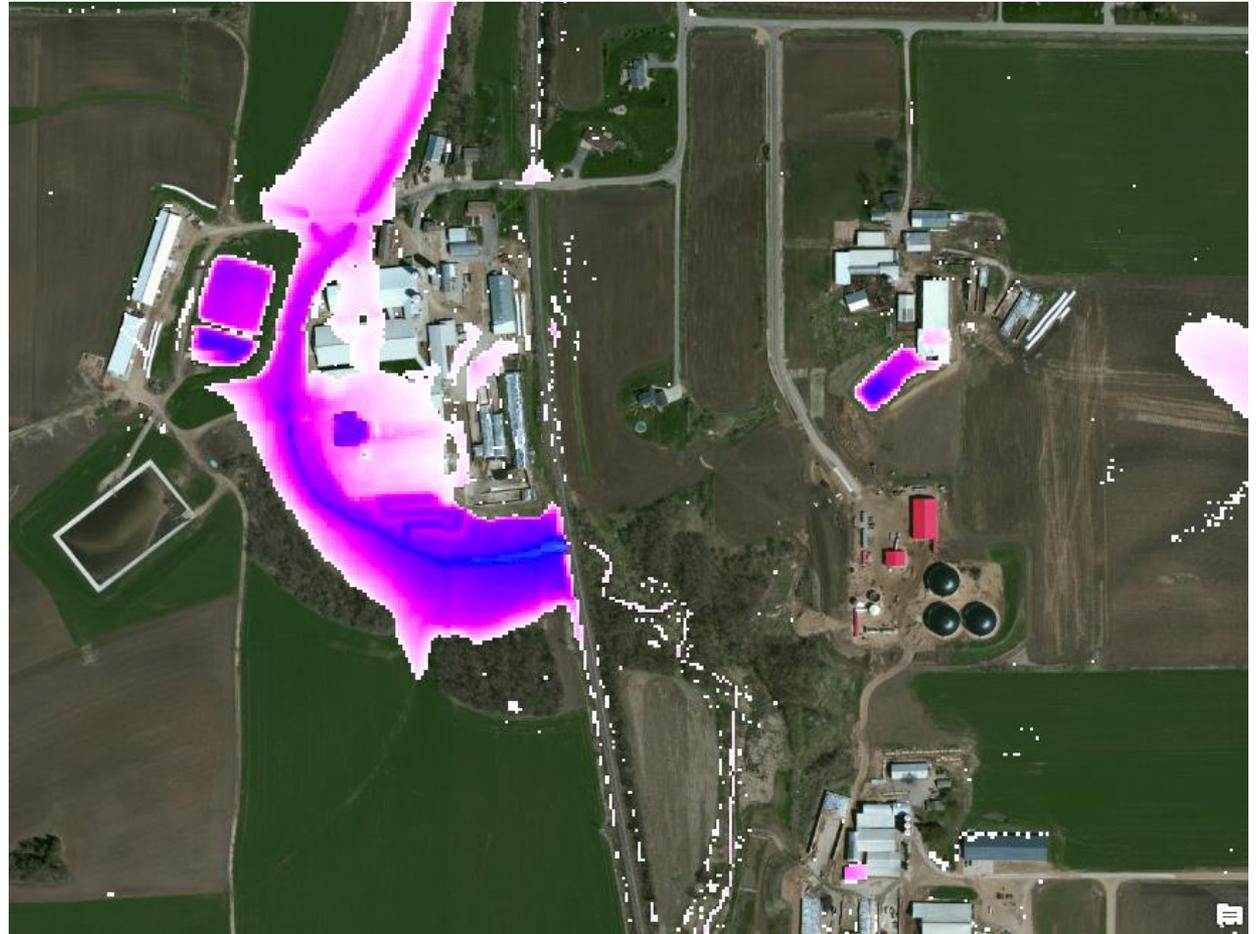
Locate Depressions

- Ditches
- Notice the flat side

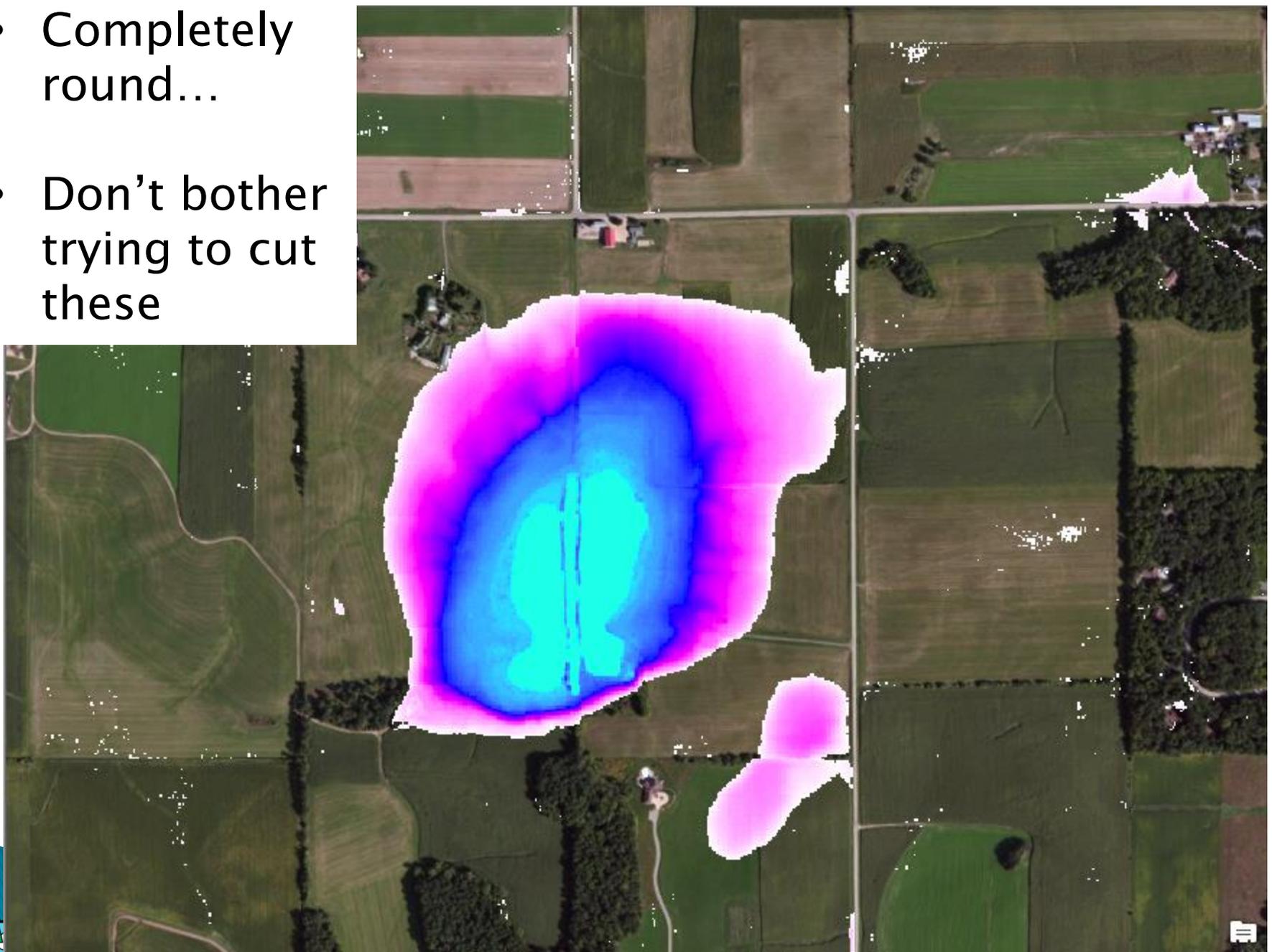


Locate Depressions

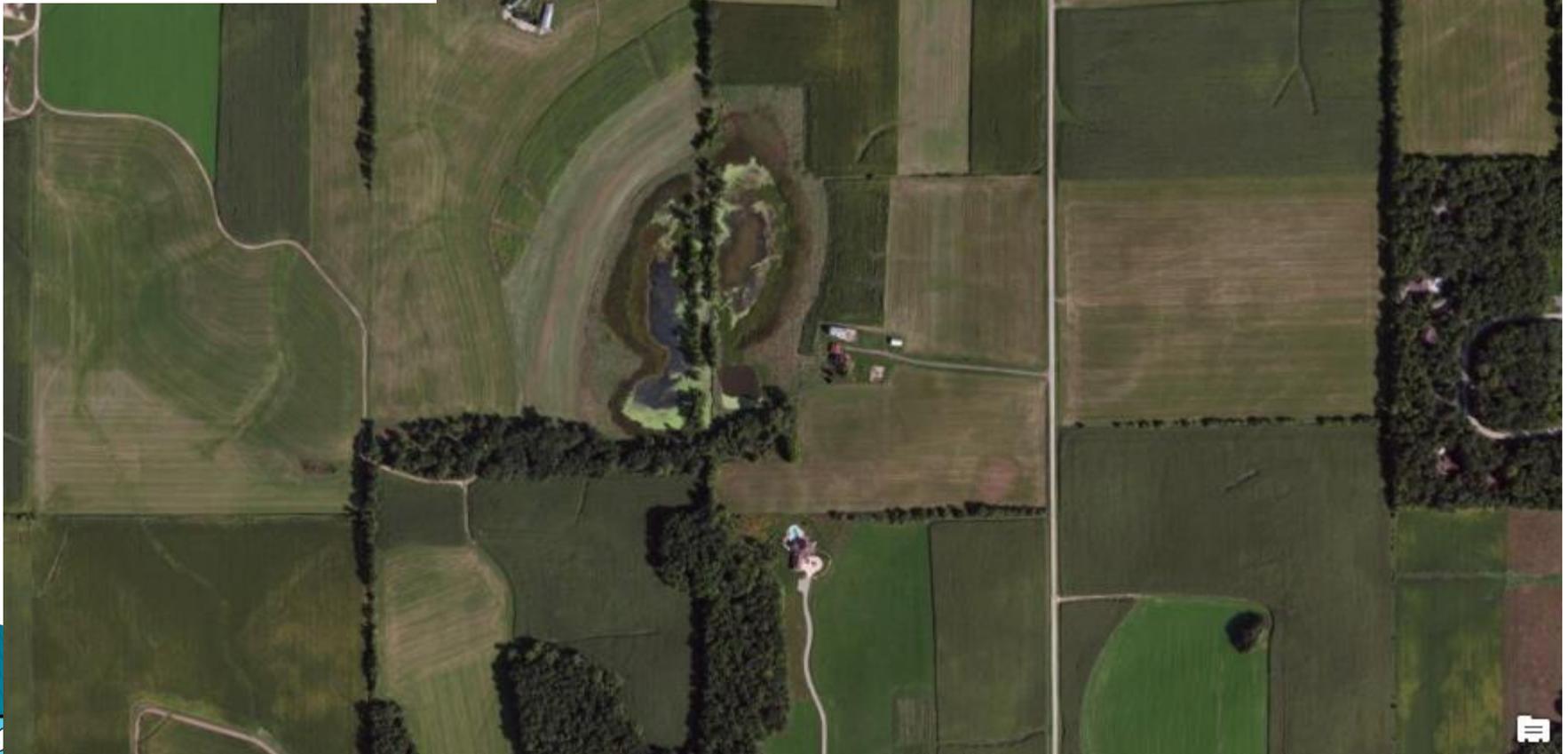
- Small streams
- Flat side again



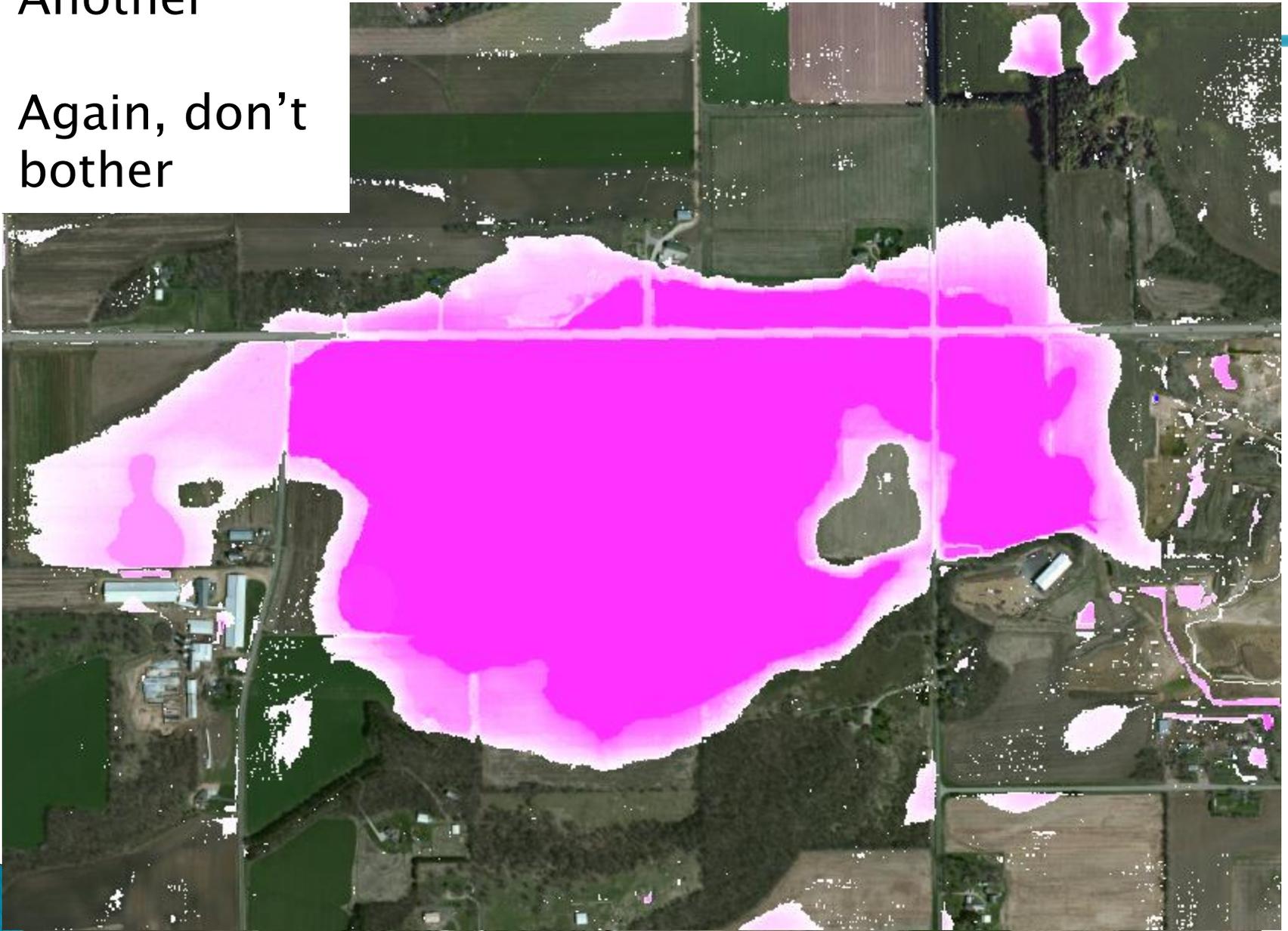
- Completely round...
- Don't bother trying to cut these



- Completely round...
- Don't bother trying to cut these



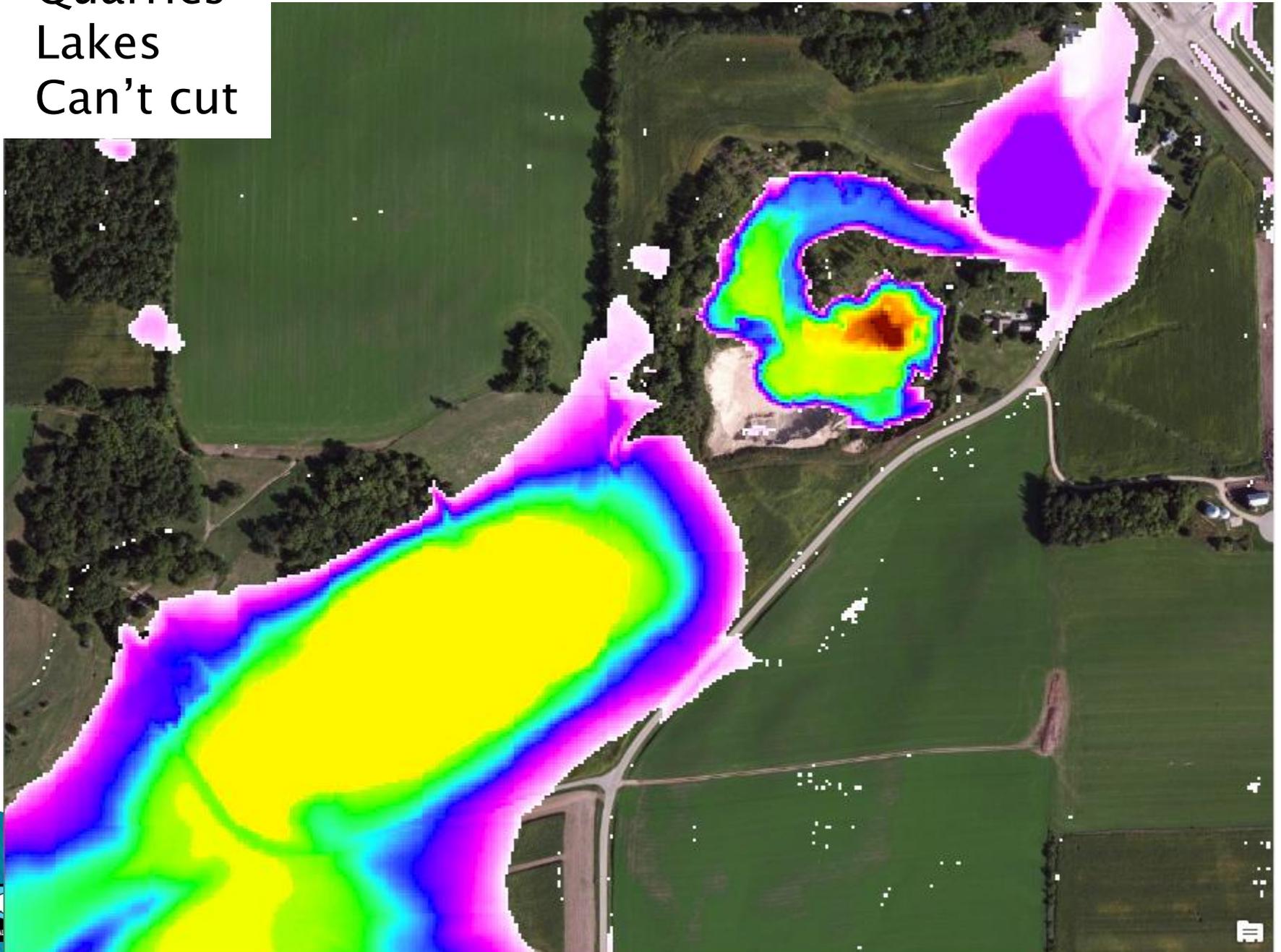
- Another
- Again, don't bother



- 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

GPS Culvert Locations



Google Street View



Google Street View

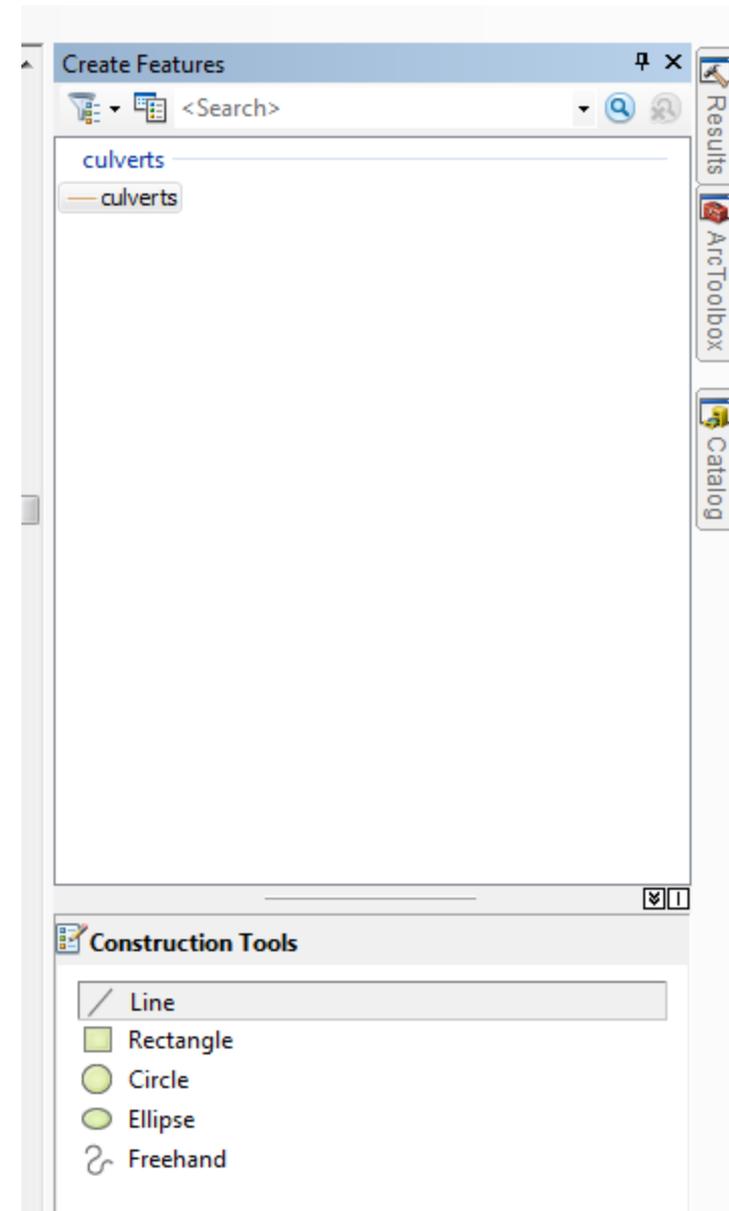


Google Street View



Create Culvert Layer

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

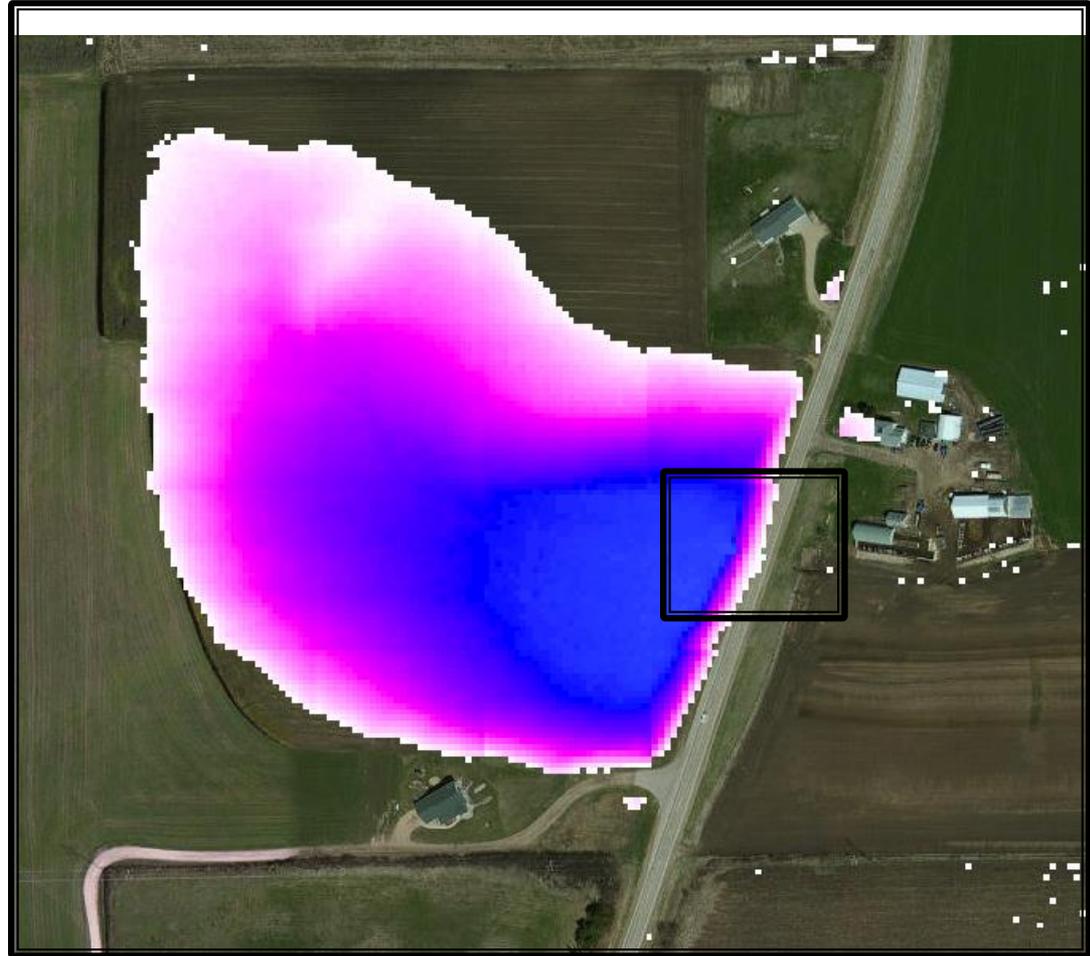


Create Culverts

- ▶ **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.

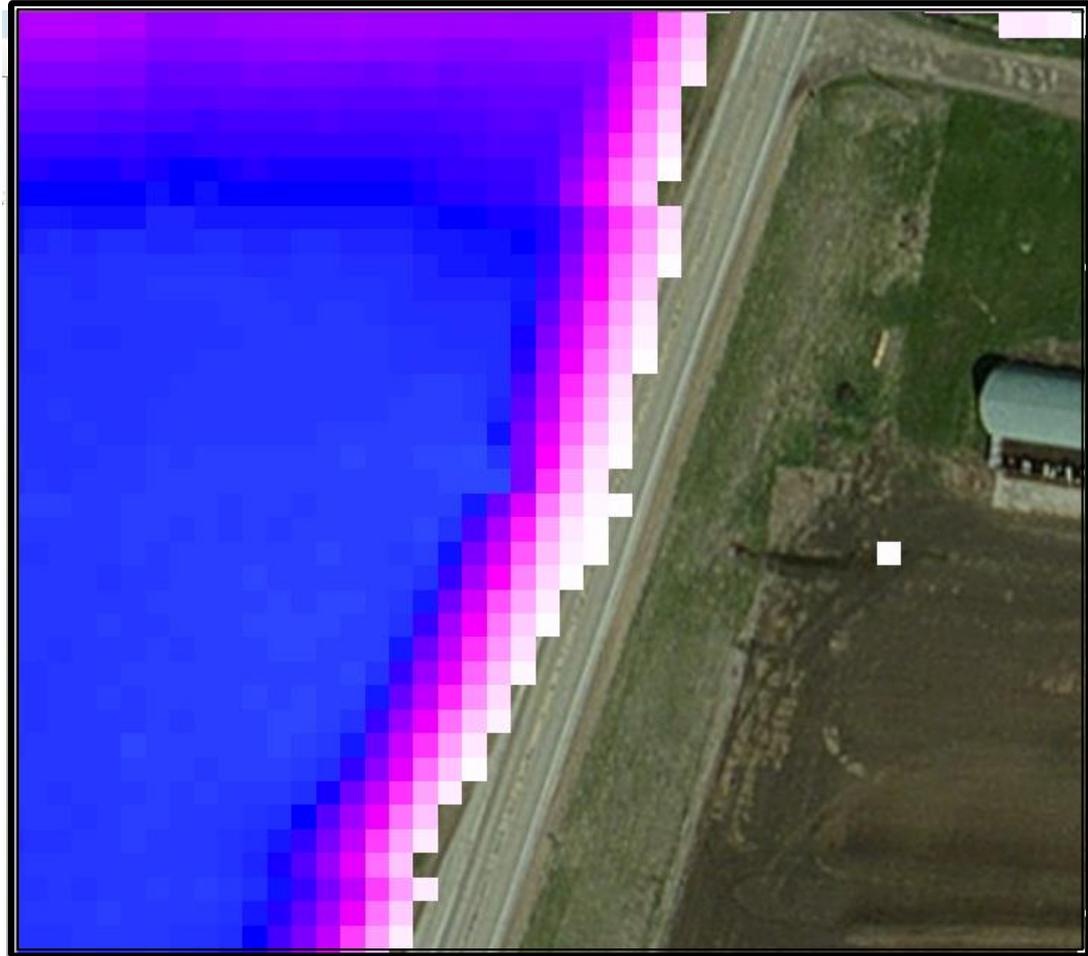
Input Culverts

- ▶ 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



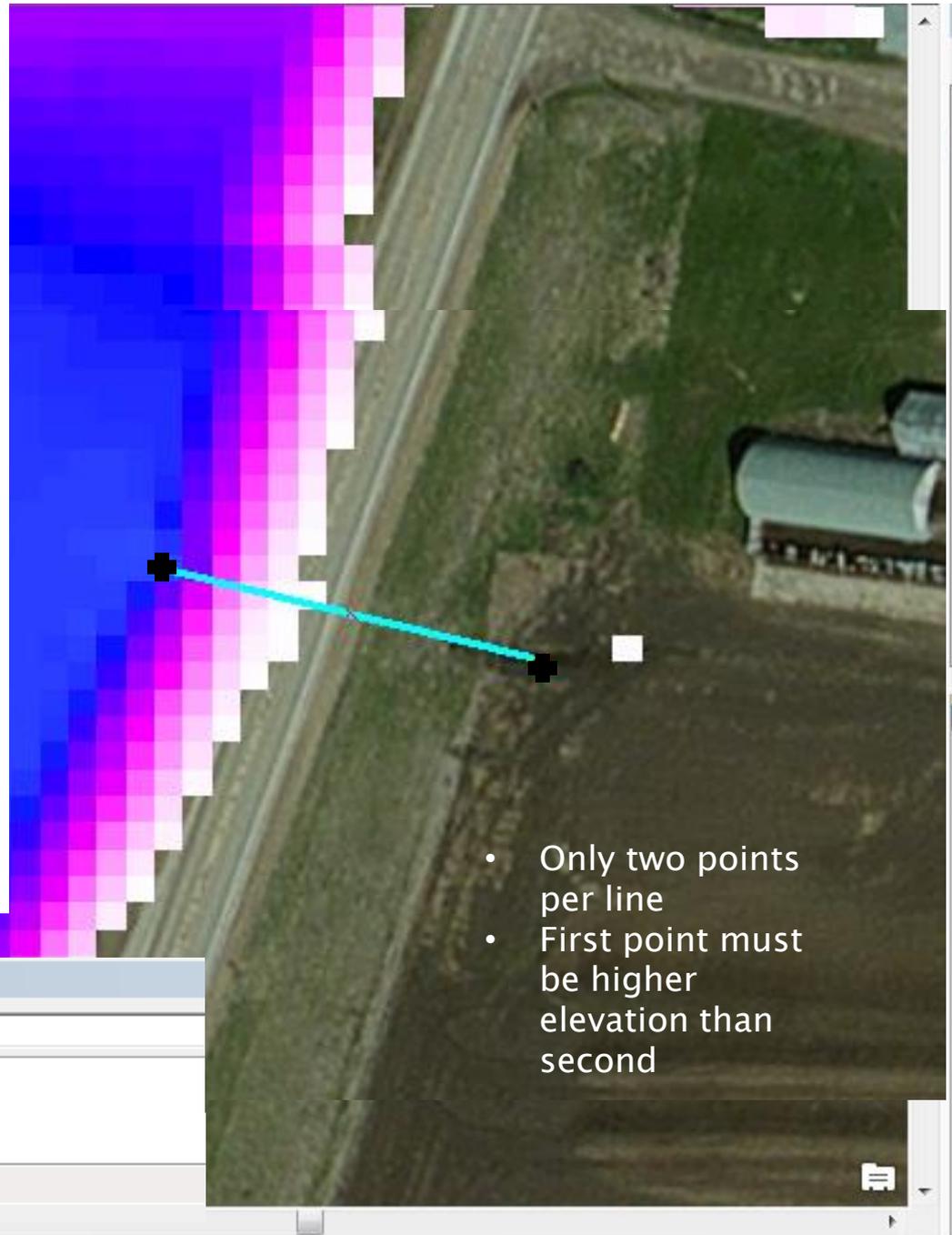
Input Culverts

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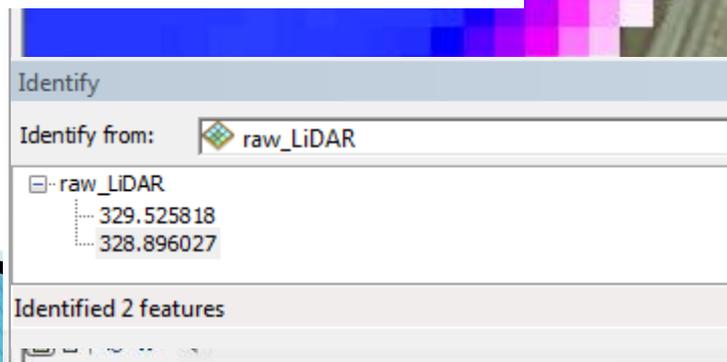


Once you've selected the line tool in the create features box:

- 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

BMP Layer

- ▶ Digitize BMPs to remove from analysis



Source: Esri, DigitalGlobe, GeoEye, Earthstar, USDA, USGS, AeroGRID, IGN, IGP, swisstopo, and the GIS User Community

EVAAL

»» Scenarios

Mitigation Opportunity

$$A = K(LS)C$$

Cropland data layer

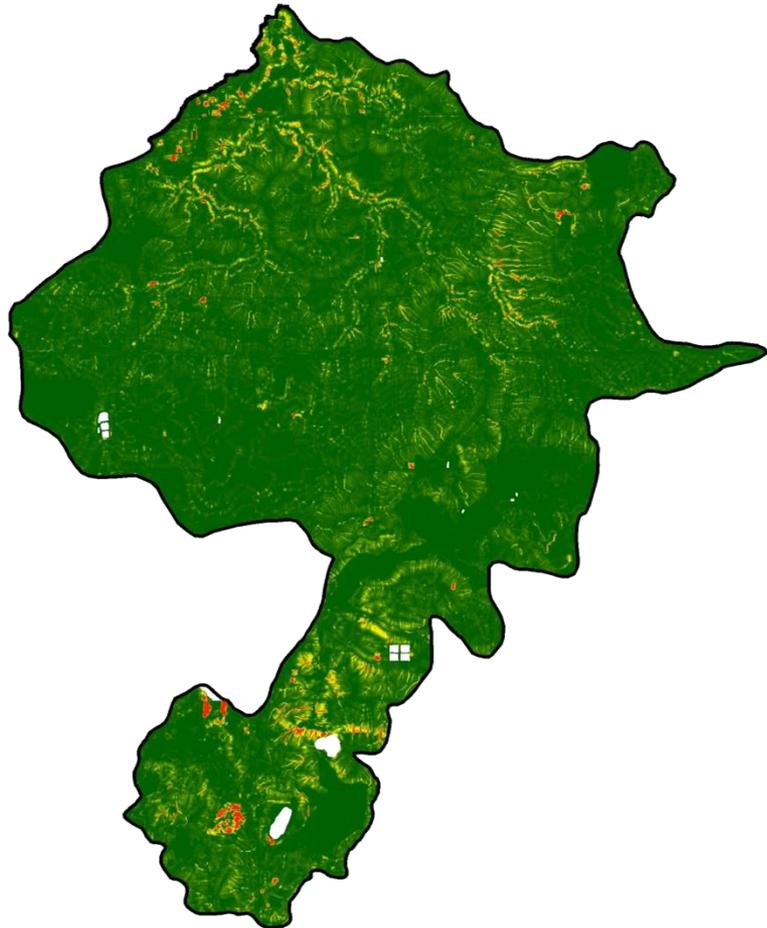
Crop Rotations

SNAP-Plus → Rotation C Factor

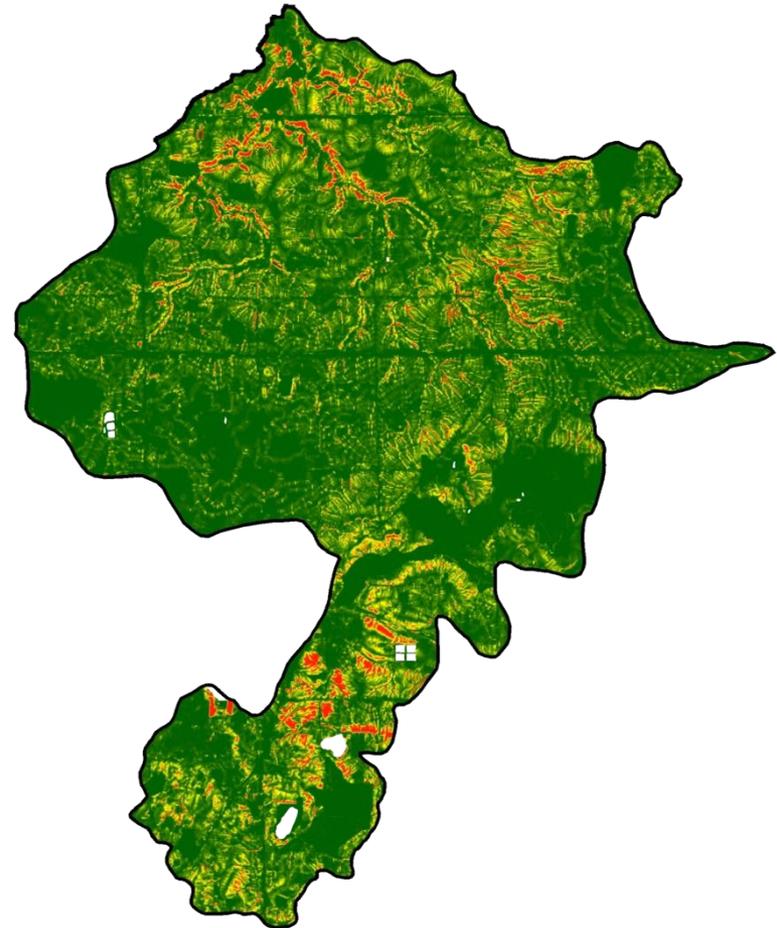
Poor

Good

C Factor Adjustments

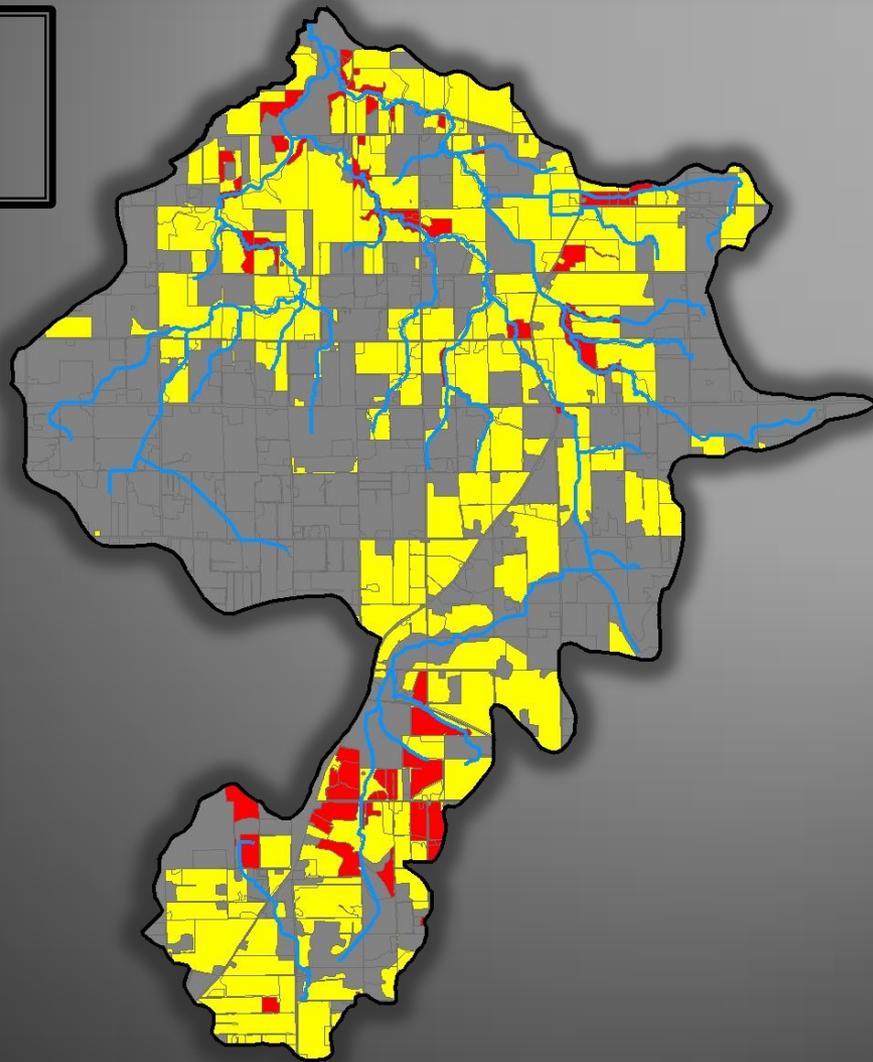


USLE w/ Low C Factor



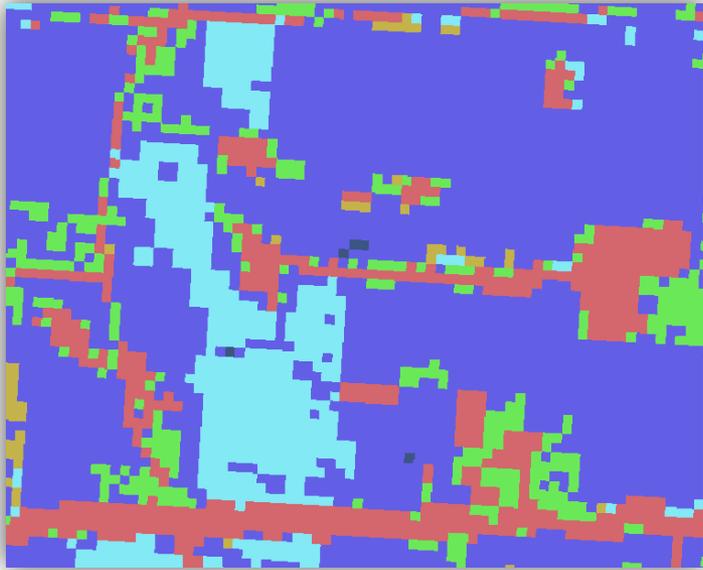
USLE w/ High C Factor

Mitigation Opportunity



Other Scenarios

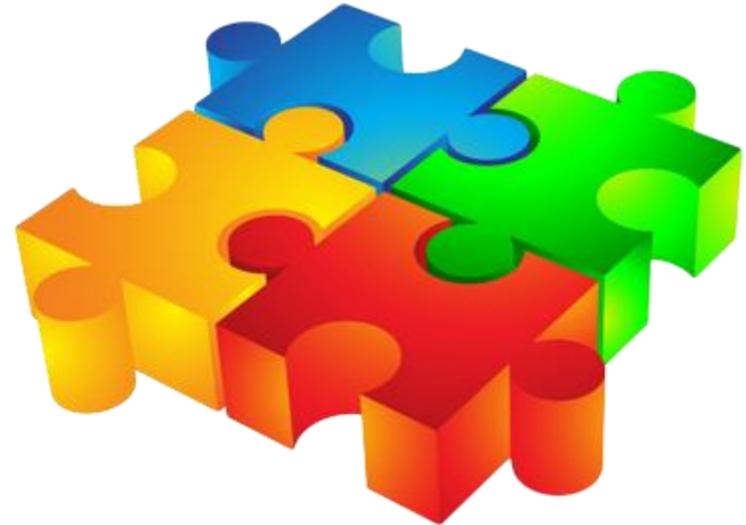
- ▶ Edit rotation grid
- ▶ Edit C factor table



ROTATION	SCENARIO	C_FACTOR
Cash Grain	High	0.176
Cash Grain	Low	0.010
Continuous Corn	Low	0.005
Continuous Corn	Medium	0.143
Continuous Corn	High	0.300
Dairy Potato Year		0.085
Dairy Rotation	High	0.180
Dairy Rotation	Low	0.006
Pasture/Hay/Grassland	High	0.039
Pasture/Hay/Grassland	Low	0.000
Potato/Grain/Veggie Rotation	Low	0.181
Potato/Grain/Veggie Rotation	High	0.305

Overlay EVAAL

- ▶ Existing nutrient management plans
- ▶ Soil P
- ▶ Animal lots
- ▶ Others....



EVAAL

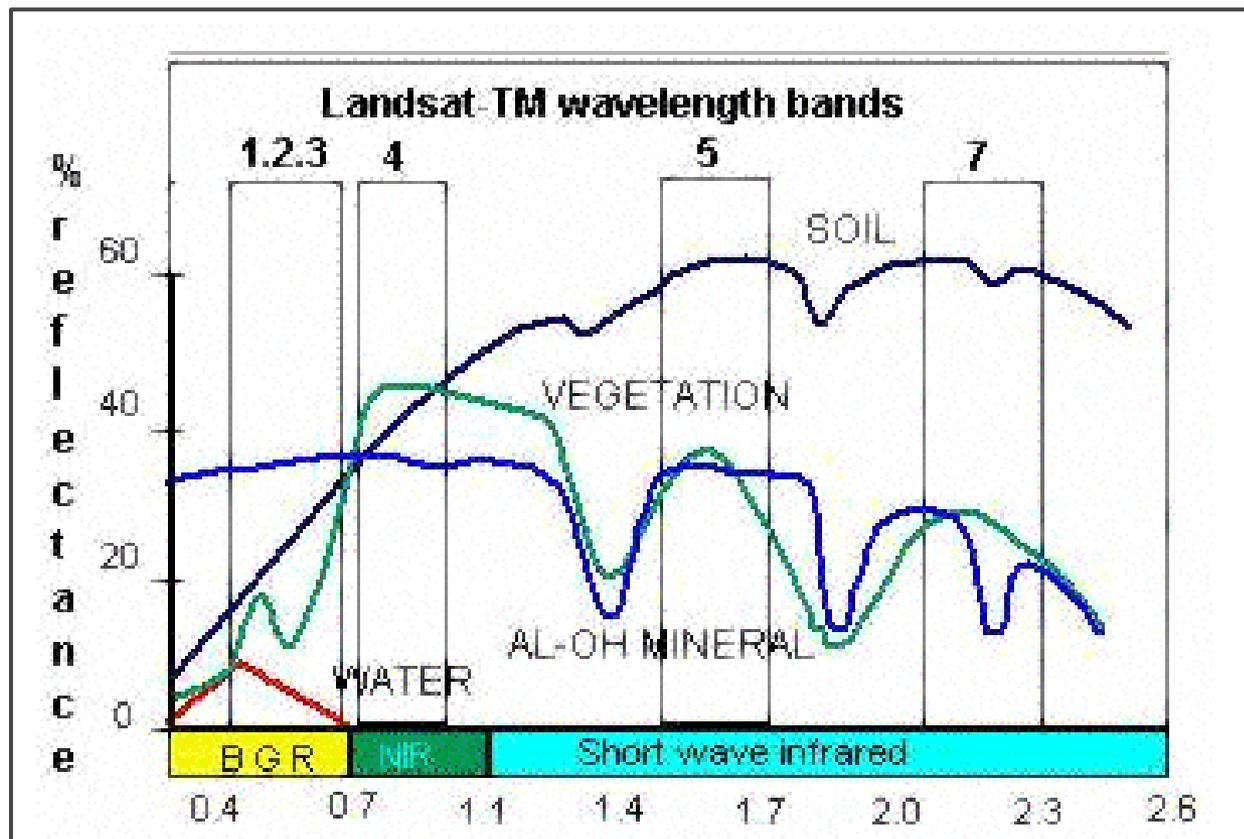
»» In progress

Satellite Imagery Analysis

- ▶ Determine percentage of crop residue coverage
- ▶ Relate to tillage types

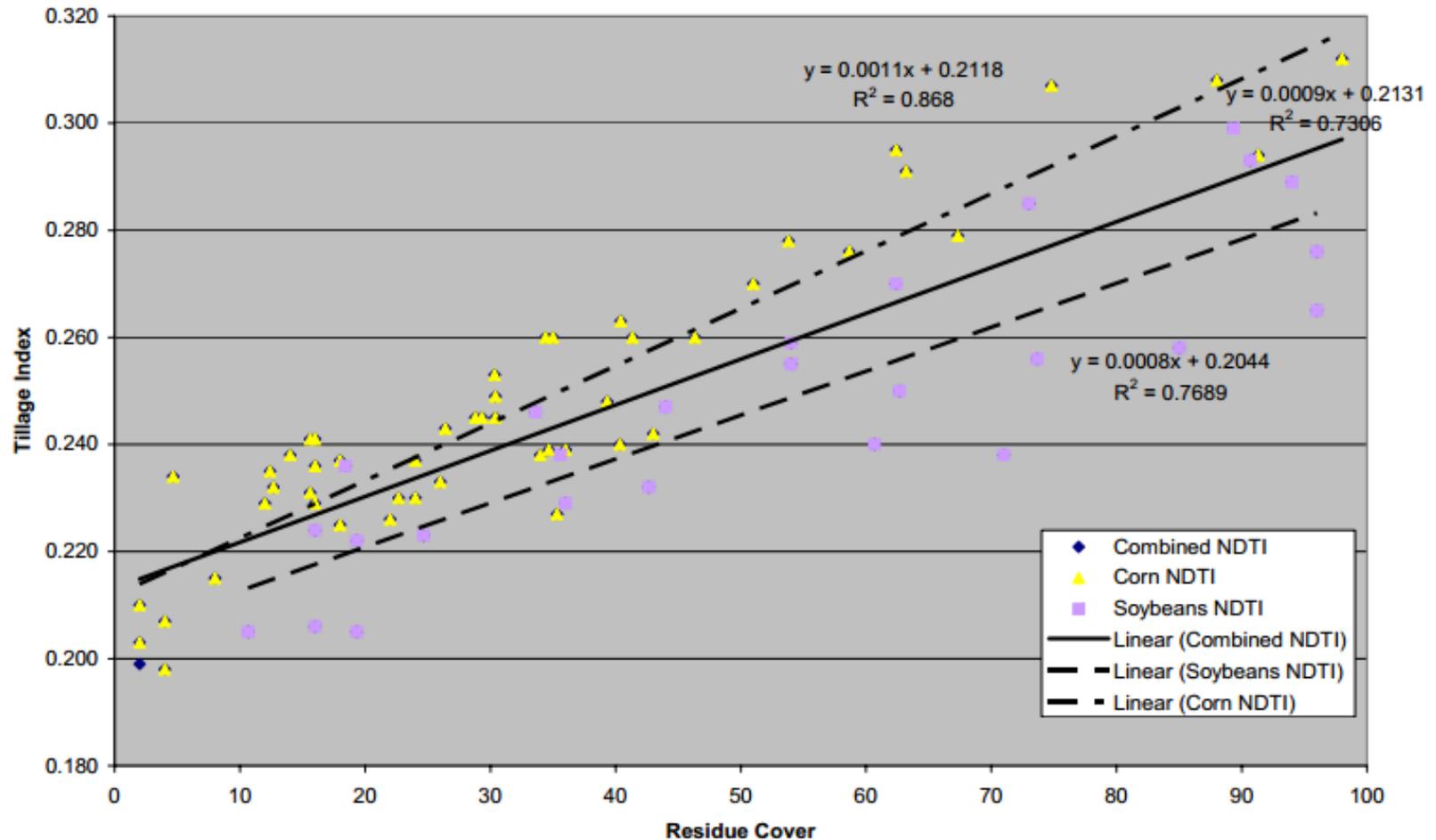
Satellite Imagery Analysis

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

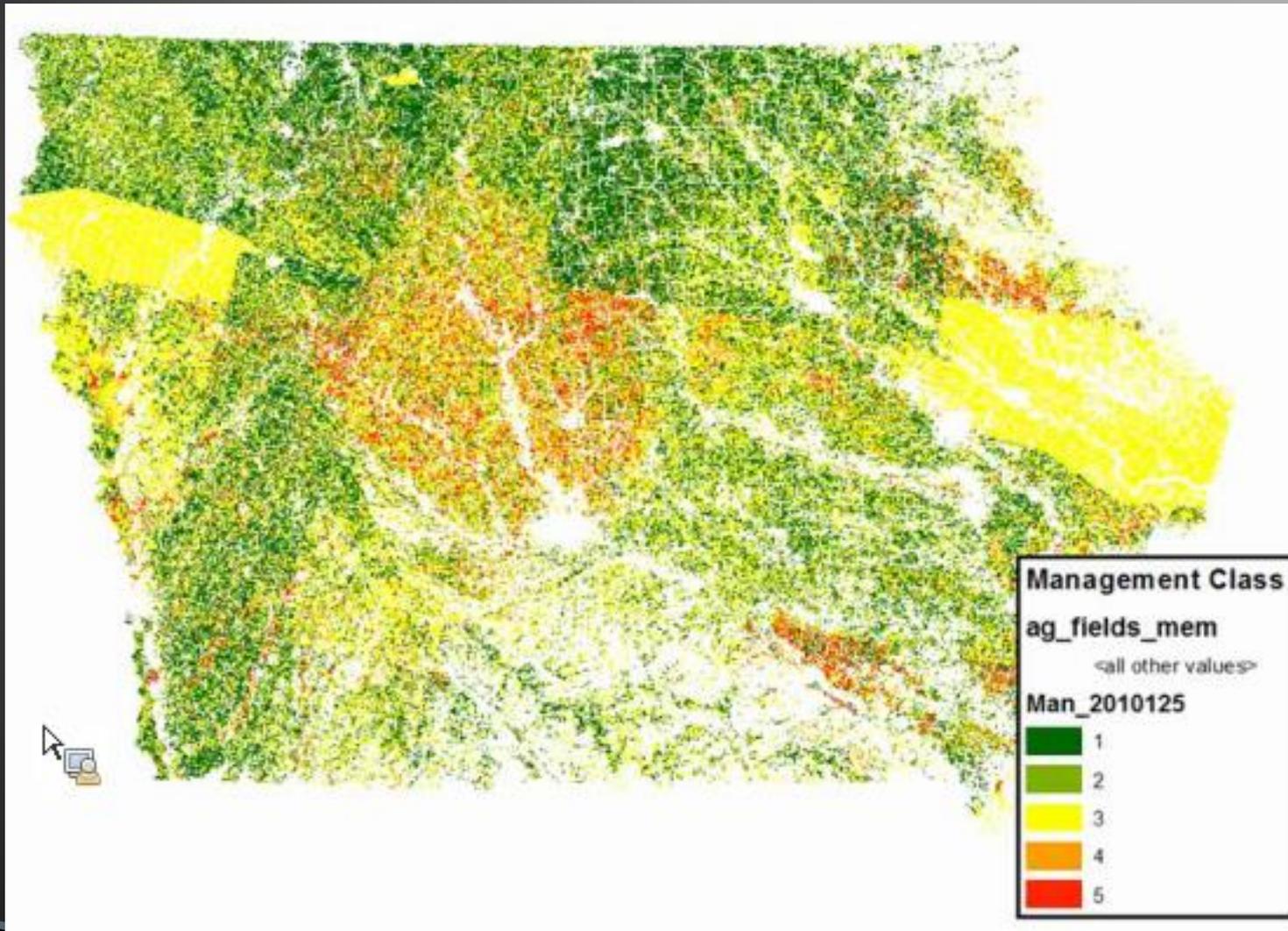


Normalized difference tillage index

- ▶ NDTI is positively correlated with crop residue cover and green vegetation



Iowa Example

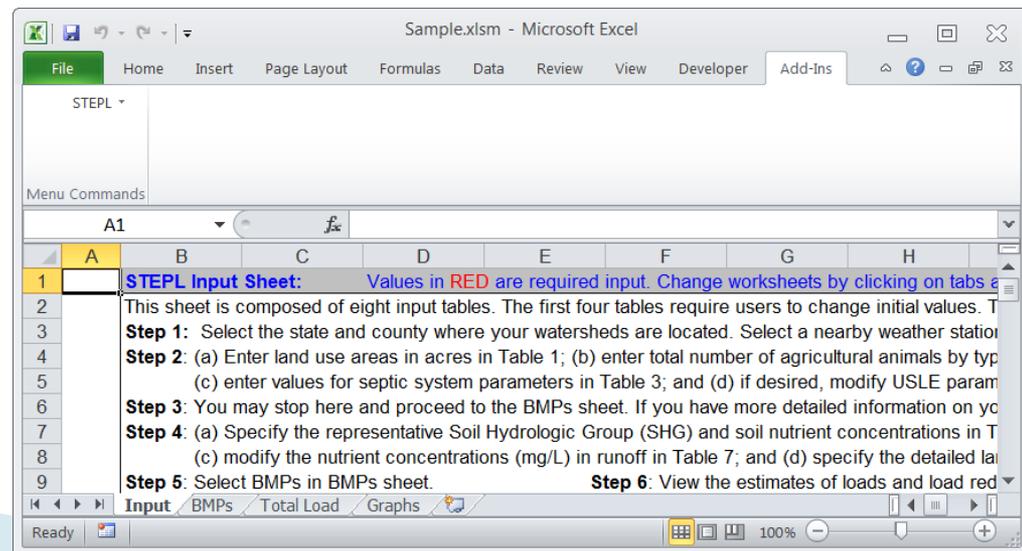


STEPL

»» Overview

STEPL

- ▶ 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



NRCS Photo/Tim McCabe



CPRblog/Dave Owen

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

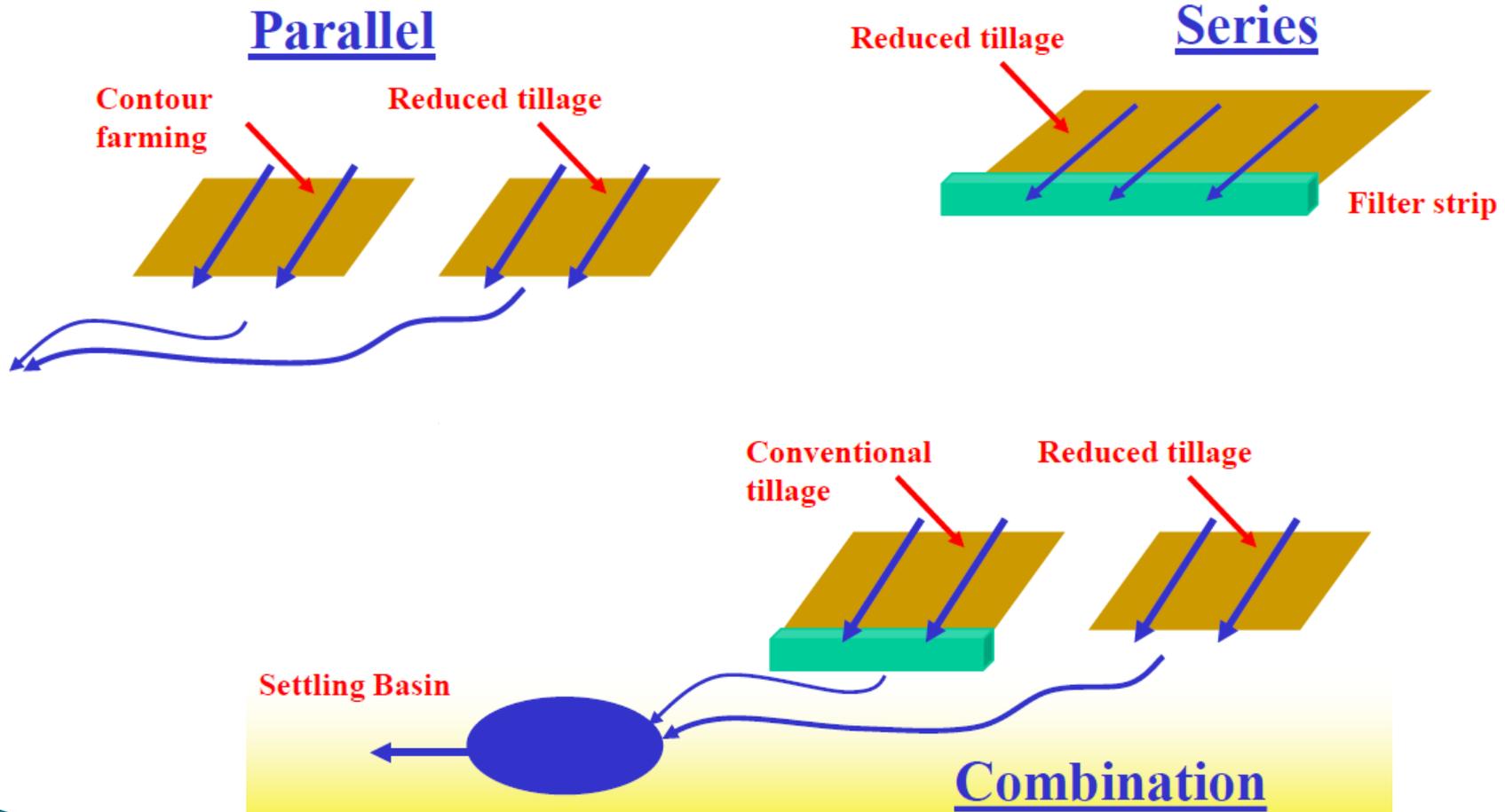
- Diversion
- Filter strip
- Runoff management system
- Solids separation basin
- Waste storage facility



▶ 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

STEPL BMP Calculator



Online Input Data Server

it.tetrattech-ffx.com/step1/step1web.html

OnPoint Map Viewer GIS Data Stormwater Climate Change Targeting and Track...

STEPA Spreadsheet Tool for Estimating Pollutant Load Model Input Data Server
Version 1.0

More... Streets Aerial Elevation

Watershed Search

West Virginia
Wisconsin
Wyoming

Step2: Select a county name from the list below.

Crawford
Dane
Dodge
Door
Douglas

Step3: In order to download data for the entire County, click on run report button on the right. Otherwise select one or more HUC 12 subwatershed boundary names from the below list.

Paoli-Sugar River
Pheasant Branch
Pleasant Branch
Prairie du Sac Dam-Wisconsin River

Latitude: 43.156745 Longitude: -89.791700

5 km 4 mi

Map labels: Waunakee, Rippl Bank, Woodland Dr, Don Creek, Governor Nelson State Park, Lake Mendota, Maple Bluff, Tenny Park, Shorewood Hills, Madison, Henry Vilas Lake Park, Wings, Alliant Energy Center, W Bel Air Hwy, W Bel Air Hwy, Nink Springs Creek, Fitchburg, Mckeel Farms Park, Badger Prairie, Elver Park, Raymond Rd, Hawks Landing Golf Club, Mineral Point Rd, Pleasant Hill Golf Course, W Bel Air Hwy, University Ave, Tellerd Park, Airport Rd, Sugar River, W Mineral Point Rd, Midtown Rd, Cr Pd, Cr S, Cr D, Cr A, Cr B, Cr C, Cr E, Cr F, Cr G, Cr H, Cr I, Cr J, Cr K, Cr L, Cr M, Cr N, Cr O, Cr P, Cr Q, Cr R, Cr S, Cr T, Cr U, Cr V, Cr W, Cr X, Cr Y, Cr Z, Cr AA, Cr AB, Cr AC, Cr AD, Cr AE, Cr AF, Cr AG, Cr AH, Cr AI, Cr AJ, Cr AK, Cr AL, Cr AM, Cr AN, Cr AO, Cr AP, Cr AQ, Cr AR, Cr AS, Cr AT, Cr AU, Cr AV, Cr AW, Cr AX, Cr AY, Cr AZ, Cr BA, Cr BB, Cr BC, Cr BD, Cr BE, Cr BF, Cr BG, Cr BH, Cr BI, Cr BJ, Cr BK, Cr BL, Cr BM, Cr BN, Cr BO, Cr BP, Cr BQ, Cr BR, Cr BS, Cr BT, Cr BU, Cr BV, Cr BW, Cr BX, Cr BY, Cr BZ, Cr CA, Cr CB, Cr CC, Cr CD, Cr CE, Cr CF, Cr CG, Cr CH, Cr CI, Cr CJ, Cr CK, Cr CL, Cr CM, Cr CN, Cr CO, Cr CP, Cr CQ, Cr CR, Cr CS, Cr CT, Cr CU, Cr CV, Cr CW, Cr CX, Cr CY, Cr CZ, Cr DA, Cr DB, Cr DC, Cr DD, Cr DE, Cr DF, Cr DG, Cr DH, Cr DI, Cr DJ, Cr DK, Cr DL, Cr DM, Cr DN, Cr DO, Cr DP, Cr DQ, Cr DR, Cr DS, Cr DT, Cr DU, Cr DV, Cr DW, Cr DX, Cr DY, Cr DZ, Cr EA, Cr EB, Cr EC, Cr ED, Cr EE, Cr EF, Cr EG, Cr EH, Cr EI, Cr EJ, Cr EK, Cr EL, Cr EM, Cr EN, Cr EO, Cr EP, Cr EQ, Cr ER, Cr ES, Cr ET, Cr EU, Cr EV, Cr EW, Cr EX, Cr EY, Cr EZ, Cr FA, Cr FB, Cr FC, Cr FD, Cr FE, Cr FF, Cr FG, Cr FH, Cr FI, Cr FJ, Cr FK, Cr FL, Cr FM, Cr FN, Cr FO, Cr FP, Cr FQ, Cr FR, Cr FS, Cr FT, Cr FU, Cr FV, Cr FW, Cr FX, Cr FY, Cr FZ, Cr GA, Cr GB, Cr GC, Cr GD, Cr GE, Cr GF, Cr GG, Cr GH, Cr GI, Cr GJ, Cr GK, Cr GL, Cr GM, Cr GN, Cr GO, Cr GP, Cr GQ, Cr GR, Cr GS, Cr GT, Cr GU, Cr GV, Cr GW, Cr GX, Cr GY, Cr GZ, Cr HA, Cr HB, Cr HC, Cr HD, Cr HE, Cr HF, Cr HG, Cr HH, Cr HI, Cr HJ, Cr HK, Cr HL, Cr HM, Cr HN, Cr HO, Cr HP, Cr HQ, Cr HR, Cr HS, Cr HT, Cr HU, Cr HV, Cr HW, Cr HX, Cr HY, Cr HZ, Cr IA, Cr IB, Cr IC, Cr ID, Cr IE, Cr IF, Cr IG, Cr IH, Cr II, Cr IJ, Cr IK, Cr IL, Cr IM, Cr IN, Cr IO, Cr IP, Cr IQ, Cr IR, Cr IS, Cr IT, Cr IU, Cr IV, Cr IW, Cr IX, Cr IY, Cr IZ, Cr JA, Cr JB, Cr JC, Cr JD, Cr JE, Cr JF, Cr JG, Cr JH, Cr JI, Cr JJ, Cr JK, Cr JL, Cr JM, Cr JN, Cr JO, Cr JP, Cr JQ, Cr JR, Cr JS, Cr JT, Cr JU, Cr JV, Cr JW, Cr JX, Cr JY, Cr JZ, Cr KA, Cr KB, Cr KC, Cr KD, Cr KE, Cr KF, Cr KG, Cr KH, Cr KI, Cr KJ, Cr KK, Cr KL, Cr KM, Cr KN, Cr KO, Cr KP, Cr KQ, Cr KR, Cr KS, Cr KT, Cr KU, Cr KV, Cr KW, Cr KX, Cr KY, Cr KZ, Cr LA, Cr LB, Cr LC, Cr LD, Cr LE, Cr LF, Cr LG, Cr LH, Cr LI, Cr LJ, Cr LK, Cr LL, Cr LM, Cr LN, Cr LO, Cr LP, Cr LQ, Cr LR, Cr LS, Cr LT, Cr LU, Cr LV, Cr LW, Cr LX, Cr LY, Cr LZ, Cr MA, Cr MB, Cr MC, Cr MD, Cr ME, Cr MF, Cr MG, Cr MH, Cr MI, Cr MJ, Cr MK, Cr ML, Cr MM, Cr MN, Cr MO, Cr MP, Cr MQ, Cr MR, Cr MS, Cr MT, Cr MU, Cr MV, Cr MW, Cr MX, Cr MY, Cr MZ, Cr NA, Cr NB, Cr NC, Cr ND, Cr NE, Cr NF, Cr NG, Cr NH, Cr NI, Cr NJ, Cr NK, Cr NL, Cr NM, Cr NN, Cr NO, Cr NP, Cr NQ, Cr NR, Cr NS, Cr NT, Cr NU, Cr NV, Cr NW, Cr NX, Cr NY, Cr NZ, Cr OA, Cr OB, Cr OC, Cr OD, Cr OE, Cr OF, Cr OG, Cr OH, Cr OI, Cr OJ, Cr OK, Cr OL, Cr OM, Cr ON, Cr OO, Cr OP, Cr OQ, Cr OR, Cr OS, Cr OT, Cr OU, Cr OV, Cr OW, Cr OX, Cr OY, Cr OZ, Cr PA, Cr PB, Cr PC, Cr PD, Cr PE, Cr PF, Cr PG, Cr PH, Cr PI, Cr PJ, Cr PK, Cr PL, Cr PM, Cr PN, Cr PO, Cr PP, Cr PQ, Cr PR, Cr PS, Cr PT, Cr PU, Cr PV, Cr PW, Cr PX, Cr PY, Cr PZ, Cr QA, Cr QB, Cr QC, Cr QD, Cr QE, Cr QF, Cr QG, Cr QH, Cr QI, Cr QJ, Cr QK, Cr QL, Cr QM, Cr QN, Cr QO, Cr QP, Cr QQ, Cr QR, Cr QS, Cr QT, Cr QU, Cr QV, Cr QW, Cr QX, Cr QY, Cr QZ, Cr RA, Cr RB, Cr RC, Cr RD, Cr RE, Cr RF, Cr RG, Cr RH, Cr RI, Cr RJ, Cr RK, Cr RL, Cr RM, Cr RN, Cr RO, Cr RP, Cr RQ, Cr RR, Cr RS, Cr RT, Cr RU, Cr RV, Cr RW, Cr RX, Cr RY, Cr RZ, Cr SA, Cr SB, Cr SC, Cr SD, Cr SE, Cr SF, Cr SG, Cr SH, Cr SI, Cr SJ, Cr SK, Cr SL, Cr SM, Cr SN, Cr SO, Cr SP, Cr SQ, Cr SR, Cr SS, Cr ST, Cr SU, Cr SV, Cr SW, Cr SX, Cr SY, Cr SZ, Cr TA, Cr TB, Cr TC, Cr TD, Cr TE, Cr TF, Cr TG, Cr TH, Cr TI, Cr TJ, Cr TK, Cr TL, Cr TM, Cr TN, Cr TO, Cr TP, Cr TQ, Cr TR, Cr TS, Cr TT, Cr TU, Cr TV, Cr TW, Cr TX, Cr TY, Cr TZ, Cr UA, Cr UB, Cr UC, Cr UD, Cr UE, Cr UF, Cr UG, Cr UH, Cr UI, Cr UJ, Cr UK, Cr UL, Cr UM, Cr UN, Cr UO, Cr UP, Cr UQ, Cr UR, Cr US, Cr UT, Cr UU, Cr UV, Cr UW, Cr UX, Cr UY, Cr UZ, Cr VA, Cr VB, Cr VC, Cr VD, Cr VE, Cr VF, Cr VG, Cr VH, Cr VI, Cr VJ, Cr VK, Cr VL, Cr VM, Cr VN, Cr VO, Cr VP, Cr VQ, Cr VR, Cr VS, Cr VT, Cr VU, Cr VV, Cr VW, Cr VX, Cr VY, Cr VZ, Cr WA, Cr WB, Cr WC, Cr WD, Cr WE, Cr WF, Cr WG, Cr WH, Cr WI, Cr WJ, Cr WK, Cr WL, Cr WM, Cr WN, Cr WO, Cr WP, Cr WQ, Cr WR, Cr WS, Cr WT, Cr WU, Cr WV, Cr WX, Cr WY, Cr WZ, Cr XA, Cr XB, Cr XC, Cr XD, Cr XE, Cr XF, Cr XG, Cr XH, Cr XI, Cr XJ, Cr XK, Cr XL, Cr XM, Cr XN, Cr XO, Cr XP, Cr XQ, Cr XR, Cr XS, Cr XT, Cr XU, Cr XV, Cr XW, Cr XX, Cr XY, Cr XZ, Cr YA, Cr YB, Cr YC, Cr YD, Cr YE, Cr YF, Cr YG, Cr YH, Cr YI, Cr YJ, Cr YK, Cr YL, Cr YM, Cr YN, Cr YO, Cr YP, Cr YQ, Cr YR, Cr YS, Cr YT, Cr YU, Cr YV, Cr YW, Cr YX, Cr YZ, Cr ZA, Cr ZB, Cr ZC, Cr ZD, Cr ZE, Cr ZF, Cr ZG, Cr ZH, Cr ZI, Cr ZJ, Cr ZK, Cr ZL, Cr ZM, Cr ZN, Cr ZO, Cr ZP, Cr ZQ, Cr ZR, Cr ZS, Cr ZT, Cr ZU, Cr ZV, Cr ZW, Cr ZX, Cr ZY, Cr ZZ

Browser: <http://it.tetrattech-ffx.com/steplweb/steplweb.html> | STEPL Model Input Data Ser... x

File Edit View Favorites Tools Help

STEPL Spreadsheet Tool for Estimating Pollutant Load Model Input Data Server
Version 1.0

STEPL Input Data Report

Watershed **Landuse Area** Agricultural Animals Count Septic System Hydrologic Soil Group

Watershed Name	HUC12	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Water	Others
West Branch Extension-Pigeon	040801030203	1616.582	22635.702	1742.012	1402.861	0.000	1.074	22.239	1179.800

Watershed Landuse Area **Agricultural Animals Count** Septic System Hydrologic Soil Group

Watershed Name	HUC12	Beef Cattle	Dairy Cattle	Swine	Sheep	Horse	Chicken	Turkey	Duck
West Branch Extension-Pigeon	040801030203	36	742	1005	41	17	0	3	8

Watershed Landuse Area Agricultural Animals Count **Septic System** Hydrologic Soil Group

Watershed Name	HUC12	Septic Systems	Population per Septic System	% Septic Failure Rate
West Branch Extension-Pigeon River	040801030203	725	2	1.14

Watershed Landuse Area Agricultural Animals Count Septic System **Hydrologic Soil Group**

Watershed Name	HUC12	Hydrologic Soil Group
West Branch Extension-Pigeon River	040801030203	C

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

- Home
- STEPL Data Server for Sample Input Data
- Models and Documentation
- Frequently Asked Questions

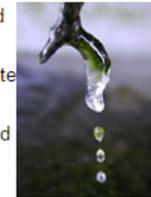
You are here: [EPA Home](#) » [STEPL](#)



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 rill 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@tetrattech.com



Spreadsheet Tool for Estimating Pollutant Loads (STEPL) webinar

The DNR and EPA offered a hands-on technical training on the [Spreadsheet Tool for Estimating Pollutant Loads \(STEPL\)](#) [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 STEPL.

Learn more about STEPL:

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

Last revised: Monday September 29 2014

Nonpoint source pollution

Agricultural nonpoint source pollution
Learn more about agricultural nonpoint source pollution

Urban nonpoint source pollution
Learn more about urban nonpoint source pollution

What you can do
Learn more about controlling nonpoint source pollution in your area

TMDL implementation
Learn more about what the DNR is doing to control nonpoint source pollution

Related links

- [Environmental impacts](#)
- [Wisconsin Runoff Rules: What Farmers Need to Know](#) [PDF]
- [Nonpoint program contacts](#)



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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

Input Data

- ▶ 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

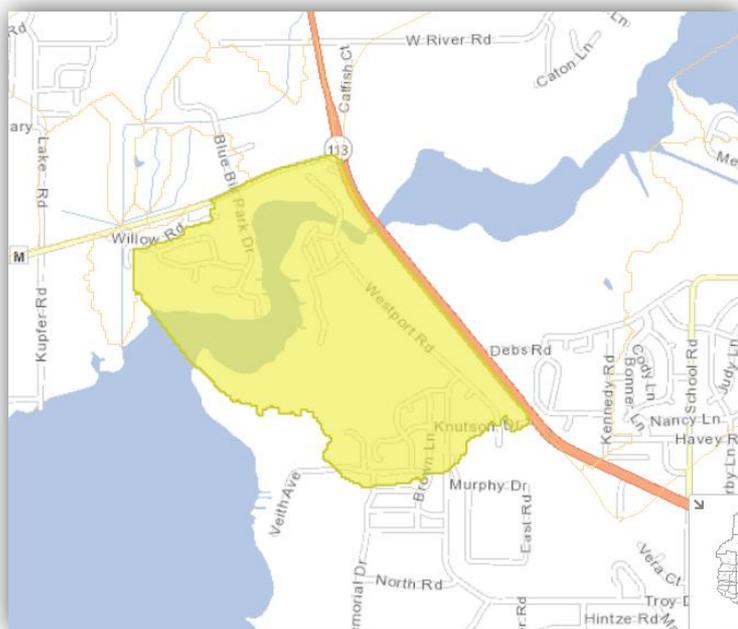
Land Use Distribution

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

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots
W1	0	0	0	0	0	0
W2	0	0	0	0	0	0

- ▶ 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

- Water Resources**
 - Watersheds
 - Great Lakes & Mississippi Basins
 - DNR Water Management Units
 - Intermittent Streams
 - Stream Order
 - WI Hydro Data-Plus Catchments
 - Waterbody Details



Reach ID 200028511



[Zoom to Feature](#) | [Pan to Feature](#) | [Add to Selected](#)

Details **Attributes**

Field Name	Field Value
Reach ID	200028511
Watershed area, upstream total (sq km)	295.48
Stream gradient (%)	0.0
Sinuosity	1.44
Stream order	4
Distance to Great Lakes (km)	
Distance to large lake (km)	1
Distance to medium lake (km)	1
Distance to small lake (km)	10
Distance to medium river (km)	0.0
Distance to large river (km)	
Annual precip., upstream watershed avg (mm, 1961-2000)	837
Annual air temp., upstream watershed avg (C, 1961-2000)	7.8
Apr-Oct air temp, upstream watershed avg (C, 1961-2000)	15.7
July air temp, upstream watershed avg (C, 1961-2000)	21.7
Runoff curve number, upstream watershed avg	76
Open Water (% of upstream watershed)	1.1
Developed, Open Space (% of upstream watershed)	5.7
Developed, Low Intensity (% of upstream watershed)	6.8
Developed, Medium Intensity (% of upstream watershed)	1.9
Developed, High Intensity (% of upstream watershed)	0.5
Barren Land (% of upstream watershed)	0.1
Deciduous Forest (% of upstream watershed)	3.7
Evergreen Forest (% of upstream watershed)	0.1
Mixed Forest (% of upstream watershed)	0.0
Shrub/Scrub (% of upstream watershed)	0.5
Grassland/Herbaceous (% of upstream watershed)	0.4
Pasture/Hay (% of upstream watershed)	16.9
Cultivated Crops (% of upstream watershed)	58.4
Woody Wetlands (% of upstream watershed)	0.8
Emergent Herbaceous Wetlands (% of upstream watershed)	3.2

Basic Tools Identify Tools Drawing Tools **Measuring Tools** Find Location Maps & Data Help

Show Layers Show Legend Pan Zoom In Zoom Out

Point Identify Identify Distance Area

Add as Drawing Erase Clear All

Measurement Info

Perimeter:	0.09	Miles (mi)
Area:	0.21	Acres (ac)

Print Map Watershed Delineation

Print Watershed Delineation

Map Layers

Layer Theme: Surface Water (default)

Show Legend Filter...

- Impairments & Assessments
- Designated Waters (ASNRI, PRF, PNW)
- Clean Water Act Standards & Uses
- Permits & Determinations
- Grant Locations
- Wetlands & Soils
- Fisheries Management
- Aquatic Invasive Species
- Water Resources
- Natural Community Modeling
- Federal Hydrologic Unit Codes (HUC)
- Land Descriptions & Cadastral
- Administrative & Political Boundaries
- Map Indexes (USGS Quads)
- Forest & Land Cover

Base Maps

- Cities, Roads, & Waterways
- Public Lands
- Air Photos Leaf-off (2010 WROC)
- Air Photos (NAIP 2008)
- Digital Topographic Maps

Graphics Layers

I want to...

Surface Water

200ft 50m

Lat: Lon:

WI Dept. of Natural Resources, Water Division I

Soils

Show optional input tables?

Yes

No

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc. %	Soil P conc. %	Soil BOD conc. %
W1	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	B	0.080	0.031	0.160
W2	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	B	0.080	0.031	0.160

▶ Web Soil Survey

- <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>
- Zoom to and set Area of Interest (AOI)

Area of Interest (AOI) | Soil Map | **Soil Data Explorer** | Download Soils Data | Shopping Cart (Free)

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[Intro to Soils](#) | [Suitabilities and Limitations for Use](#) | **Soil Properties and Qualities** | [Ecological Site Assessment](#) | [Soil Reports](#)

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Soil Chemical Properties

Soil Erosion Factors

Soil Physical Properties

Soil Qualities and Features

AASHTO Group Classification (Surface)

Depth to a Selected Soil Restrictive Layer

Depth to Any Soil Restrictive Layer

Drainage Class

Frost Action

Frost-Free Days

Hydrologic Soil Group

[View Description](#) | [View Rating](#)

View Options

Map

Table

Description of Rating

Rating Options

Detailed Description

Advanced Options

Aggregation Method: Dominant Condition

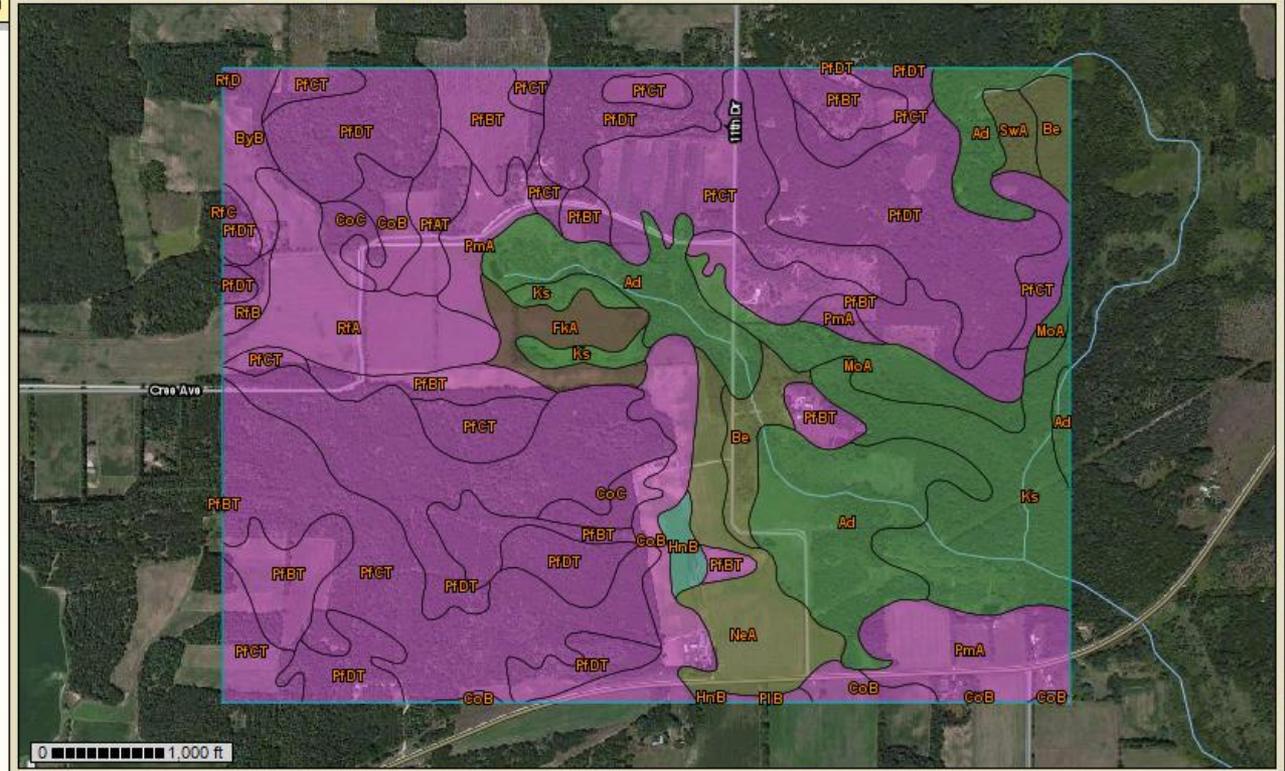
Component Percent Cutoff:

Tie-break Rule: Lower Higher

[View Description](#) | [View Rating](#)

Map — Hydrologic Soil Group

Scale: (not to scale)



Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Waushara County, Wisconsin (WI137)

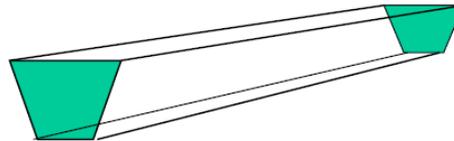
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ad	Adrian muck, 0 to 1 percent slopes	A/D	103.6	10.5%
Be	Belleville loamy sand, 0 to 2 percent slopes	C/D	20.3	2.1%
ByB	Boyer loamy sand, 2 to 6 percent slopes	A	12.3	1.2%
CoB	Coloma loamy sand, 2 to 6 percent slopes	A	48.6	4.9%
CoC	Coloma loamy sand, 6 to 10 percent slopes	A	12.4	1.2%
FKA	Farmington loam, 0 to 2 percent slopes	C/D	10.1	1.0%
HnB	Hannock loamy sand, 2 to 6 percent slopes	A	12.3	1.2%
Ks	Knox loam, 0 to 2 percent slopes	C/D	20.3	2.1%
MeA	Madison loam, 0 to 2 percent slopes	C/D	20.3	2.1%
MoA	Madison loam, 2 to 6 percent slopes	A	12.3	1.2%
NeA	Neshanic loam, 0 to 2 percent slopes	C/D	20.3	2.1%
PmA	Prairie du Sac loam, 0 to 2 percent slopes	C/D	20.3	2.1%
PmB	Prairie du Sac loam, 2 to 6 percent slopes	A	12.3	1.2%
PmC	Prairie du Sac loam, 6 to 10 percent slopes	A	12.3	1.2%
PmD	Prairie du Sac loam, 10 to 15 percent slopes	A	12.3	1.2%
PmE	Prairie du Sac loam, 15 to 20 percent slopes	A	12.3	1.2%
PmF	Prairie du Sac loam, 20 to 25 percent slopes	A	12.3	1.2%
PmG	Prairie du Sac loam, 25 to 30 percent slopes	A	12.3	1.2%
PmH	Prairie du Sac loam, 30 to 35 percent slopes	A	12.3	1.2%
PmI	Prairie du Sac loam, 35 to 40 percent slopes	A	12.3	1.2%
PmJ	Prairie du Sac loam, 40 to 45 percent slopes	A	12.3	1.2%
PmK	Prairie du Sac loam, 45 to 50 percent slopes	A	12.3	1.2%
PmL	Prairie du Sac loam, 50 to 55 percent slopes	A	12.3	1.2%
PmM	Prairie du Sac loam, 55 to 60 percent slopes	A	12.3	1.2%
PmN	Prairie du Sac loam, 60 to 65 percent slopes	A	12.3	1.2%
PmO	Prairie du Sac loam, 65 to 70 percent slopes	A	12.3	1.2%
PmP	Prairie du Sac loam, 70 to 75 percent slopes	A	12.3	1.2%
PmQ	Prairie du Sac loam, 75 to 80 percent slopes	A	12.3	1.2%
PmR	Prairie du Sac loam, 80 to 85 percent slopes	A	12.3	1.2%
PmS	Prairie du Sac loam, 85 to 90 percent slopes	A	12.3	1.2%
PmT	Prairie du Sac loam, 90 to 95 percent slopes	A	12.3	1.2%
PmU	Prairie du Sac loam, 95 to 100 percent slopes	A	12.3	1.2%

Gully Stabilization

1. Gully dimensions in the different watersheds

Watershed	Gully	Top Width (ft)	Bottom Width (ft)	Depth (ft)	Length (ft)	Years to Form	BMP Efficiency (0-1)	Soil Textural Class
W1	Gully1	0	0	0	0	1	0.95	Clay
W1	Gully2	0	0	0	0	1	0.95	Clay

- ▶ Volume = (Top Width + Bottom Width) / 2 x Depth x Length



- ▶ Load
 - Average annual erosion during the life of the gully (ton/yr) = Volume x Soil Weight / Years
 - Nutrient load = Annual Erosion x Soil Nutrient Conc. x Correction Factor
- ▶ Load Reduction after implementing gully stabilization
 - Specify reduction efficiency
 - Reduction is equal to annual erosion x user-specified efficiency

Streambank Erosion

2. Impaired streambank dimensions in the different watersheds

Watershed	Strm Bank	Length (ft)	Height (ft)	Lateral Recession	Rate Range (ft/yr)	Rate (ft/yr)	BMP Efficiency (0-1)	Soil Textural Class
W1	Bank1	0	0	1. Slight	0.01 - 0.05	0.03	0.9	Clay
W1	Bank2	0	0	1. Slight	0.01 - 0.05	0.03	0.9	Clay

- ▶ Load (Channel Erosion)
= Length * Height * Lateral Recession rate * Soil weight

Determining Lateral Recession Rate by Field Observation

Lateral Recession Rate (ft/yr)	Category	Description
0.01 – 0.05	Slight	Some bare bank, no exposed roots
0.06 – 0.2	Moderate	Bank is mostly bare
0.3 – 0.5	Severe	Bank is bare with exposed roots
0.5+	Very Severe	Bank is bare with fallen trees

- ▶ Load Reduction
= Load * Load reduction efficiency



[Area of Interest \(AOI\)](#) | [Soil Map](#) | **[Soil Data Explorer](#)** | [Download Soils Data](#) | [Shopping Cart \(Free\)](#)

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Soil Chemical Properties

Soil Erosion Factors

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

[View Description](#) | [View Rating](#)

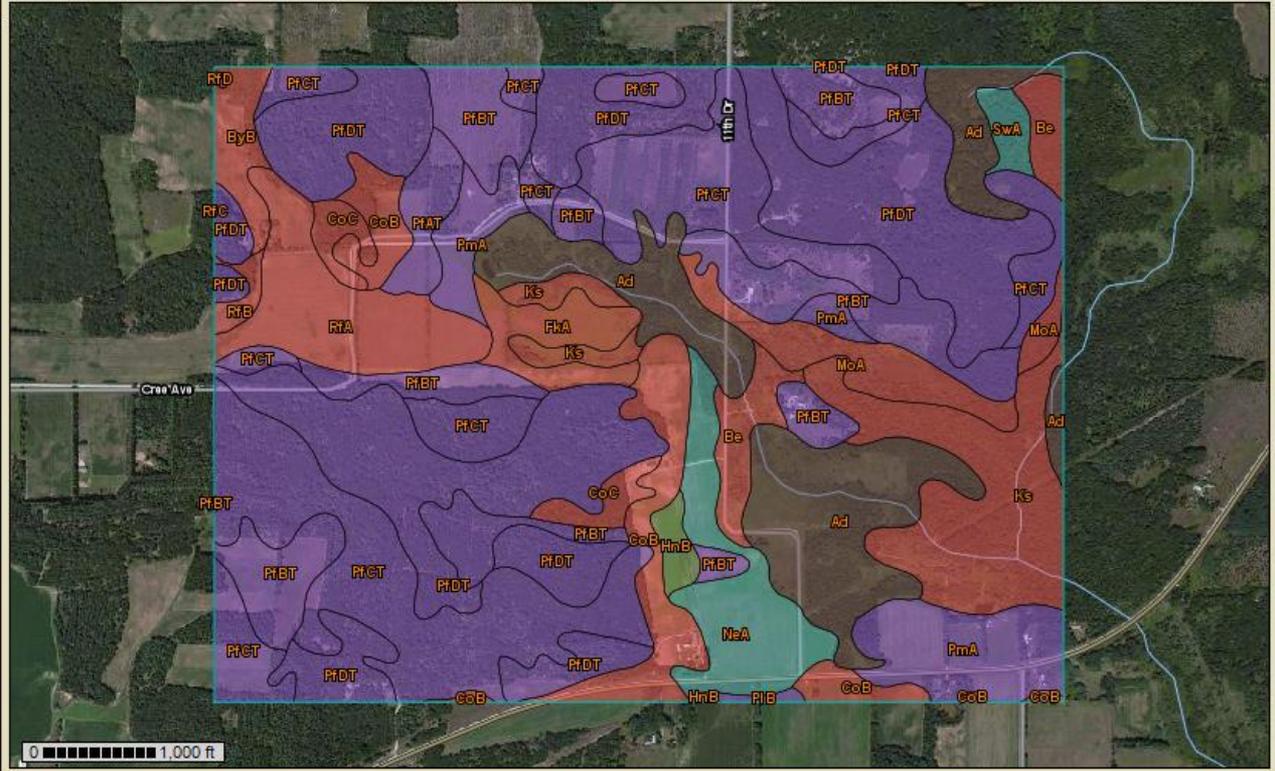
View Options

Map

Table

Map — Surface Texture

Scale (not to scale)



Legend

Tables — Surface Texture — Summary By Map Unit

Summary by Map Unit — Waushara County, Wisconsin (WI137)

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

Important Parameters

- ▶ BMP efficiencies
- ▶ New BMP
- ▶ USLE factors
- ▶ Nutrient concentrations

STEPL

- Hide/Unhide Other STEPL Sheets
- Precipitation/Runoff Data
- USLE Parameters by Land Use
- View/Edit BMP List**
- BMP Calculator
- Precipitation Correction Factors
- Soil N and P
- About

Landuse

	B	C	D	E	F
	N	P	BOD	Sediment	
1					
2		0	0	0	0
3		0	0	0	0
4		0	0	0	0
5	Cropland	0.485	0.55	ND	0.405
6	Cropland	0.1	0.3	ND	0.35
7	Cropland	0.7	0.75	ND	0.65
8	Cropland	0.55	0.45	ND	0.75
9	Cropland	0.75	0.75	ND	0.75
10	Cropland	0.2	0.7	ND	0.85
11	Pastureland				
12	Pastureland	0	0	0	0
13	Pastureland	0	0	0	0
14	Forest				
15	Forest	0	0	0	0
16	Forest	0	0	0	0
17	Forest	ND	ND	ND	0.41
18	Forest	ND	ND	ND	0.71
19	Forest	ND	ND	ND	0.41
20	Forest	ND	ND	ND	0.41
21	Forest	ND	ND	ND	0.5
22	Forest	ND	ND	ND	0.71
23	Forest	ND	ND	ND	0.69
24	Forest	ND	ND	ND	0.81
25	Forest	ND	ND	ND	0.95
26	Forest	ND	ND	ND	0.93
27	Forest	ND	ND	ND	0.83
28	Forest	ND	ND	ND	0.86
29	User Defined				
30	User Defined	0	0	0	0
31	User Defined	0	0	0	0
32	Feedlots				
33	Feedlots	0	0	0	0
34	Feedlots	0.45	0.7	ND	ND
35	Feedlots	ND	0.85	ND	ND
36	Feedlots	ND	0.825	ND	ND
37	Feedlots	0.35	0.31	ND	ND
38	Feedlots	ND	0.8	0.85	ND
39	Feedlots	0.55	0.85	ND	ND
40	Feedlots	0.8	0.9	ND	ND
41	Feedlots	0.65	0.6	ND	ND
42	Urban				
43	Urban	0	0	0	0
44	Urban	0.6	0.9	0.6	0.95
45	Urban	0.63	0.8	ND	ND
46	Urban	0	0	0	0
47	Urban	0.9	0.9	ND	0.9

<Don't Delete
<Don't Delete

Instruction:

1. Do not delete the greyed 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.

Update BMP Data

Save Updates

Parameter Adjustments

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

Watershed	Cropland					Pastureland				
	R	K	LS	C	P	R	K	LS	C	P
W1	374.689	0.197	0.289	0.200	0.986	374.689	0.197	0.289	0.040	1.000
W2	374.689	0.197	0.289	0.200	0.986	374.689	0.197	0.289	0.040	1.000

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

7. Nutrient concentration in runoff (mg/l)

Land use	N	P	BOD
1. L-Cropland	1.9	0.3	4
1a. w/ manure	8.1	2	12.3
2. M-Cropland	2.9	0.4	6.1
2a. w/ manure	12.2	3	18.5
3. H-Cropland	4.4	0.5	9.2
3a. w/ manure	18.3	4	24.6
4. Pastureland	4	0.3	13
5. Forest	0.2	0.1	0.5
6. User Defin	0	0	0

- ▶ Adjust nutrient concentrations in runoff

STEPL – Example

»» Manure Storage System

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom. You entered 1 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to change.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Table 4.

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2; (c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in row 10 to display optional input tables.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table 6; (c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6:** View the estimates of loads and load reductions in Total Load and Graphs sheets.

Show optional input tables? Treat all the subwatersheds as parts of a single watershed Groundwater load calculation

State: Wisconsin County: Brown Weather Station (for rain correction factors): WI GREEN BAY WSO

Rain correction factors

1. Input watershed land use area (ac) and precipitation (in)										0.818	0.339	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event	
W1	0	0	0	0	0	0.25	75-100%	0.25	28.25	101.2	0.674	

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied
W1	0	190	0	0	0	0	0	0	8
Total	0	190	0	0	0	0	0	0	

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	0	2.43	2	0	0

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

Watershed	Cropland					Pastureland					Forest		
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS
W1	100.000	0.328	0.410	0.200	0.982	100.000	0.328	0.410	0.040	1.000	100.000	0.328	0.410



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

Gully and Streambank Erosion

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

Watershed	Cropland						
	N	P	BOD	Sediment	BMPs		% Area BMP Applied
W1	0	0	0	0	0 No BMP		100

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

Watershed	Pastureland						
	N	P	BOD	Sediment	BMPs		% Area BMP Applied
W1	0	0	0	0	0 No BMP		100

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

Watershed	Forest						
	N	P	BOD	Sediment	BMPs		% Area BMP Applied
W1	0	0	0	0	0 No BMP		100

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

Watershed	User Defined						
	N	P	BOD	Sediment	BMPs		% Area BMP Applied
W1	0	0	0	0	0 No BMP		100

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

Watershed	Feedlots						
	N	P	BOD	Sediment	BMPs		%Area BMP Applied
W1	0.65	0.6	ND	ND	Waste Storage Facility		100

6. BMPs and efficiencies for different pollutants on URBAN

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** This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

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)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	735.0	147.0	980.0	0.0	477.7	88.2	0.0	0.0	257.2	58.8	980.0	0.0	65.0	60.0	0.0	0.0
Total	735.0	147.0	980.0	0.0	477.7	88.2	0.0	0.0	257.2	58.8	980.0	0.0	65.0	60.0	0.0	0.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	0.00	0.00	0.00	0.00
Cropland	0.00	0.00	0.00	0.00
Pastureland	0.00	0.00	0.00	0.00
Forest	0.00	0.00	0.00	0.00
Feedlots	257.24	58.80	979.96	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	257.24	58.80	979.96	0.00



STEPL – Example

»» BMP Scenarios

State: Wisconsin County: Sheboygan Weather Station (for rain correction factors): WI MILWAUKEE WSO AIRPOR

Rain correction factors

0.842 0.359

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

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1	0	225	50	0	0	2	0-24%	277	35.01	105.8	0.776
W2	0	225	50	0	0	2	0-24%	277	35.01	105.8	0.776
W3	0	225	50	0	0	2	0-24%	277	35.01	105.8	0.776

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied
W1	0	100	0	0	0	0	0	0	12
W2	0	100	0	0	0	0	0	0	12
W3	0	100	0	0	0	0	0	0	12
Total	0	300	0	0	0	0	0	0	

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	0	2.43	2	0	0
W2	0	2.43	2	0	0
W3	0	2.43	2	0	0

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

Watershed	Cropland						Pastureland						Forest		
	R	K	LS	C	P		R	K	LS	C	P		R	K	LS
W1	100.000	0.223	0.496	0.200	1.000		100.000	0.223	0.496	0.040	1.000		100.000	0.223	0.496
W2	100.000	0.223	0.496	0.200	1.000		100.000	0.223	0.496	0.040	1.000		100.000	0.223	0.496
W3	100.000	0.223	0.496	0.200	1.000		100.000	0.223	0.496	0.040	1.000		100.000	0.223	0.496

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc. %	Soil P conc. %	Soil BOD conc. %
W1	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	C	0.080	0.031	0.160
W2	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	C	0.080	0.031	0.160
W3	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	C	0.080	0.031	0.160



Urban BMP Tool

Gully and Streambank Erosion

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

Watershed	Cropland						% Area BMP Applied
	N	P	BOD	Sediment	BMPs		
W1	0	0	0	0	0 No BMP	0	
W2	0.275	0.225	ND	0.375	Reduced Tillage Systems	50	
W3	0.14	0.15	ND	0.13	Filter strip	20	

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

Watershed	Pastureland						% Area BMP Applied
	N	P	BOD	Sediment	BMPs		
W1	0	0	0	0	0 No BMP	0	
W2	0	0	0	0	0 No BMP	0	
W3	0	0	0	0	0 No BMP	0	

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

Watershed	Forest						% Area BMP Applied
	N	P	BOD	Sediment	BMPs		
W1	0	0	0	0	0 No BMP	0	
W2	0	0	0	0	0 No BMP	0	
W3	0	0	0	0	0 No BMP	0	

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

Watershed	User Defined						% Area BMP Applied
	N	P	BOD	Sediment	BMPs		
W1	0	0	0	0	0 No BMP	0	
W2	0	0	0	0	0 No BMP	0	
W3	0	0	0	0	0 No BMP	0	

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

Watershed	Feedlots						%Area BMP Applied
	N	P	BOD	Sediment	BMPs		
W1	0.65	0.6	ND	ND	Waste Storage Facility	100	
W2	0	0	0	0	0 No BMP	0	
W3	0	0	0	0	0 No BMP	0	



Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

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
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	10352.5	1818.2	13997.6	177.1	3323.9	304.7	0.0	0.0	7028.6	1513.6	13997.6	177.1	32.1	16.8	0.0	0.0
W2	10352.5	1818.2	13997.6	177.1	1390.2	318.1	407.1	63.6	8962.4	1500.2	13590.5	113.5	13.4	17.5	2.9	35.9
W3	10352.5	1818.2	13997.6	177.1	674.7	187.0	141.1	22.0	9677.9	1631.3	13856.5	155.1	6.5	10.3	1.0	12.4
Total	31057.6	5454.7	41992.8	531.4	5388.7	809.7	548.2	85.7	25668.8	4645.0	41444.6	445.8	17.4	14.8	1.3	16.1

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	0.00	0.00	0.00	0.00
Cropland	12508.52	3318.13	22365.68	423.17
Pastureland	1143.12	108.17	3624.68	22.61
Forest	0.00	0.00	0.00	0.00
Feedlots	12017.19	1218.68	15454.24	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	25668.83	4644.98	41444.61	445.79

%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
%	%	%	%
32.1	16.8	0.0	0.0
13.4	17.5	2.9	35.9
6.5	10.3	1.0	12.4



STEPL – Example

»» BMP Efficiency Calculator

Practice Combination	% reduction (phosphorus)	% reduction (sediment)
Contour Farming & Reduced Tillage	75.20	85.10
NMP (P based) & Reduced Tillage	86.30	75.00
Cover Crop & Reduced Tillage	58.70	83.70
NMP (P based), Reduced Tillage, & Cover Crops	89.70	83.70
Field Border & Reduced Tillage	86.30	91.30
Field Border & Reduced Tillage & Cover Crops	90.60	92.60
Conservation Rotation & Reduced Tillage	67.00	88.70
Conservation Rotation & Reduced Tillage & NMP (P based)	91.80	88.70
NMP (N&P balanced) & Reduced Tillage	60.40	75.00
NMP (N&P balanced), Reduced Tillage, & Cover Crops	70.30	83.70
Conservation Rotation & Reduced Tillage & NMP (N & P balanced)	76.20	88.70
Average Practice Efficiency	71.04	84.35

1. Total load by subwatershed(s)

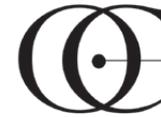
Watershed	P Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)
	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1 (Plum)	35887.4	6244.5	5257.0	15152.6	10514.1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



STEPL Applications

▶ Outagamie County

- Nonpoint Implementation Plan
 - Loads and load reductions from BMPs



OUTAGAMIE COUNTY
LAND CONSERVATION DEPARTMENT
3365 W. BREWSTER, WISCONSIN 54914

▶ Root–Pike Watershed Initiative Network

- Pike River Watershed–Based Plan
 - Load and load reductions from BMPs





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