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

WISCONSIN DEPT. OF NATURAL RESOURCES

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

»

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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

Streams[1]

75 µg/L

Reservoirs

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

Inland Lakes[2]

Ranges from 15-30 µg/L

Great Lakes

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

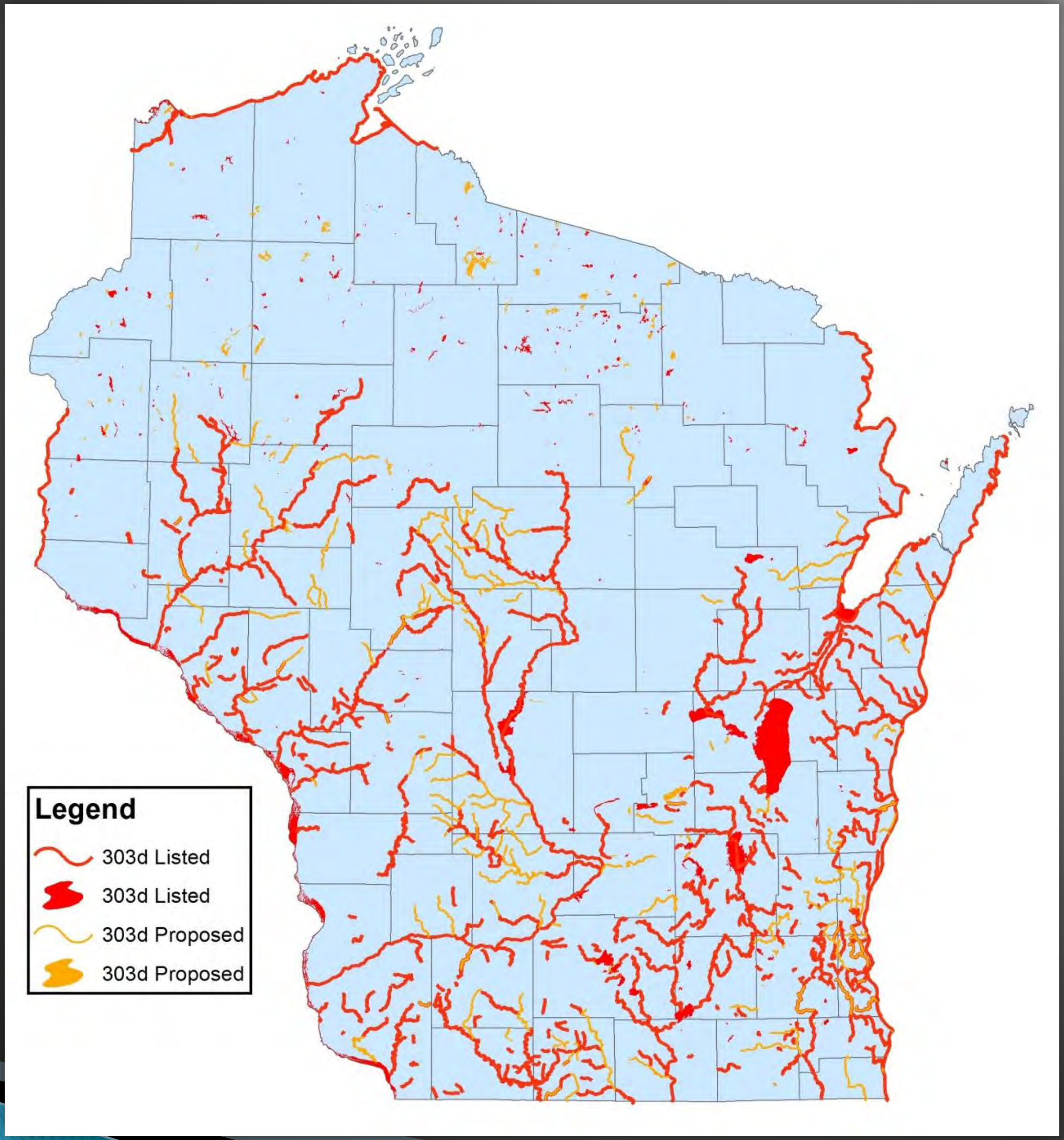
[1]All unidirectional flowing waters not in NR 102.06(3)(a). Excludes Ephemeral Streams.

[2]Excludes 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



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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

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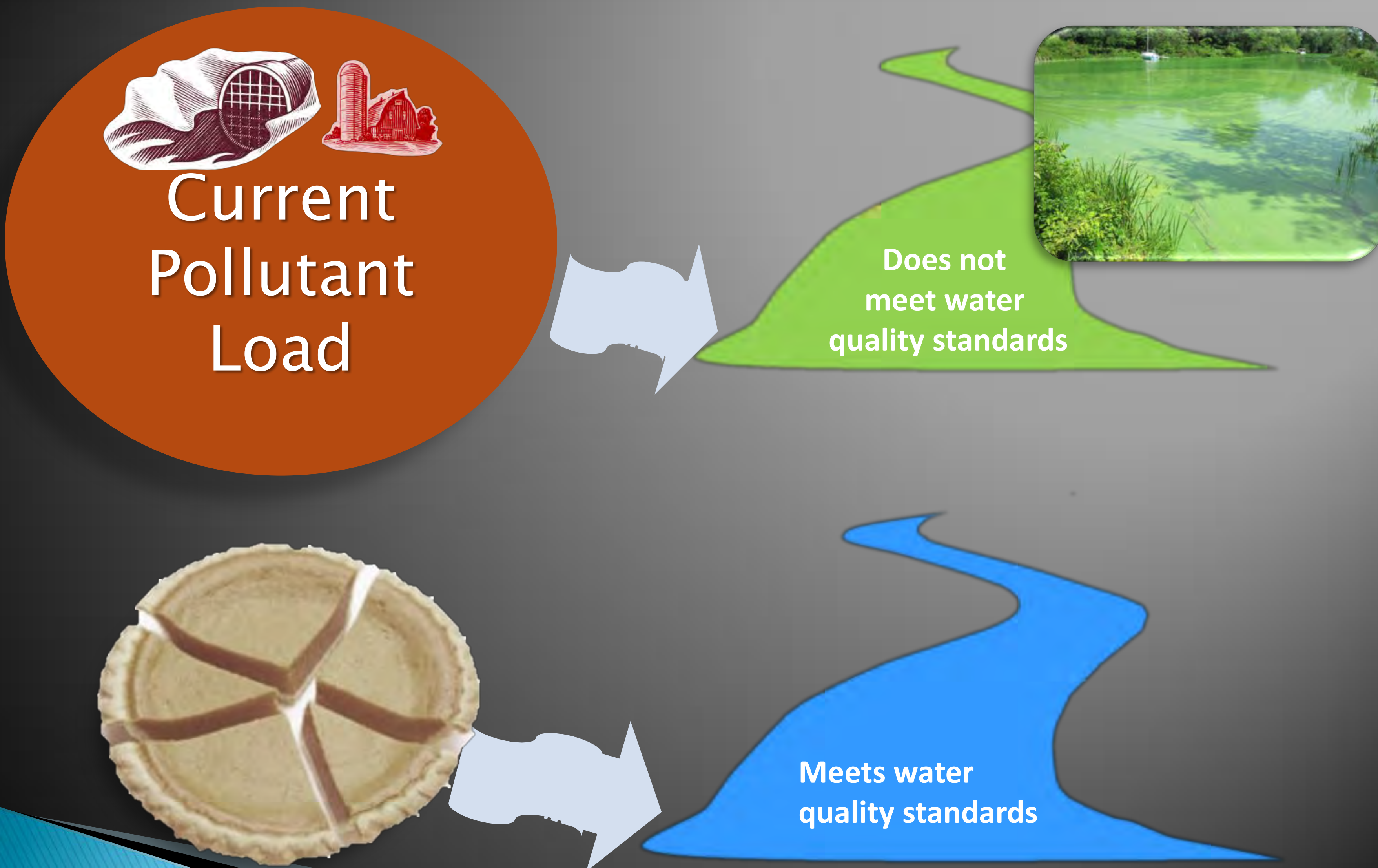
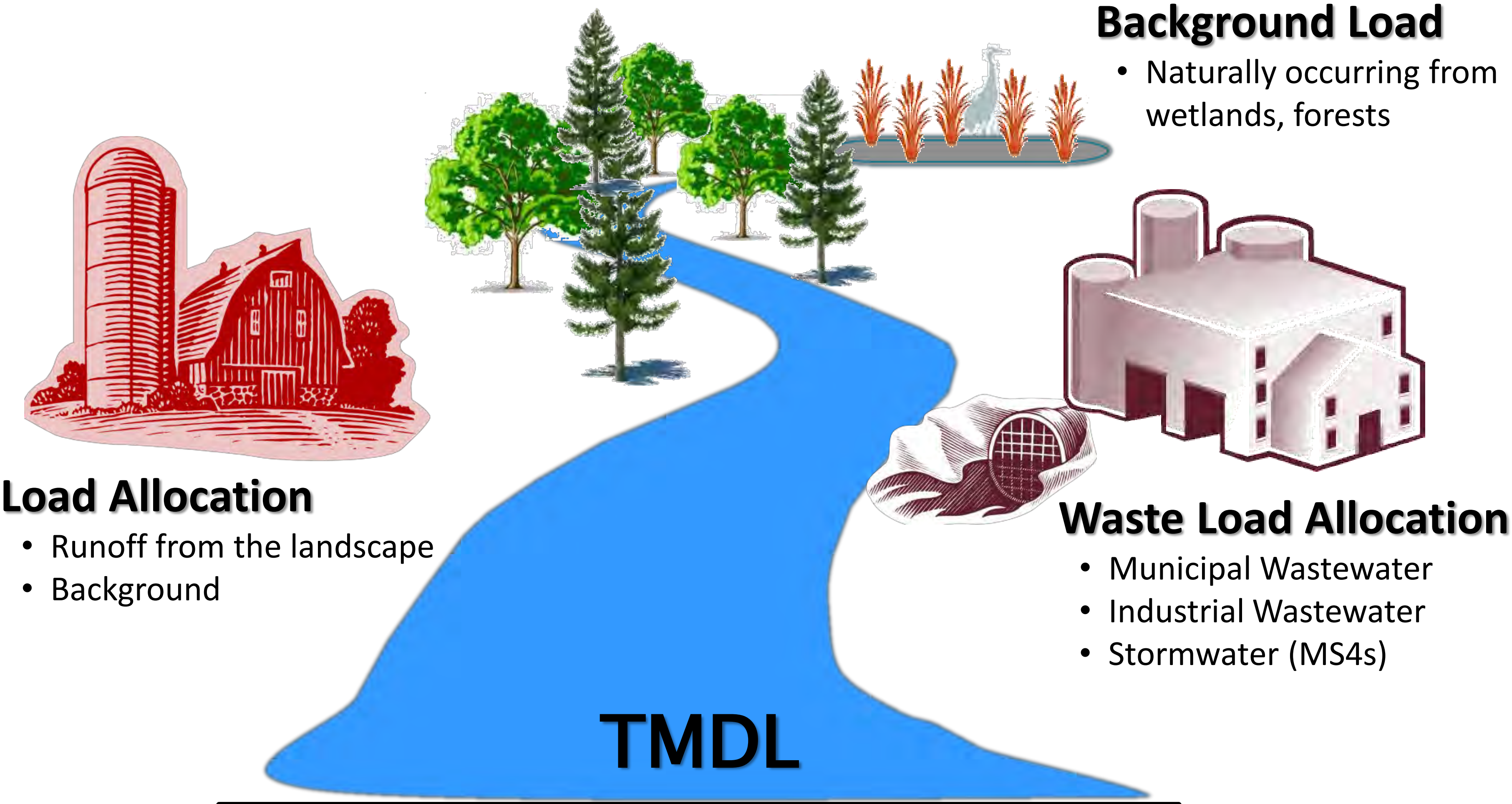
TMDL Purpose



TMDL

Each subwatershed is assessed for:



Load Allocation + Waste Load Allocation + Margin of Safety

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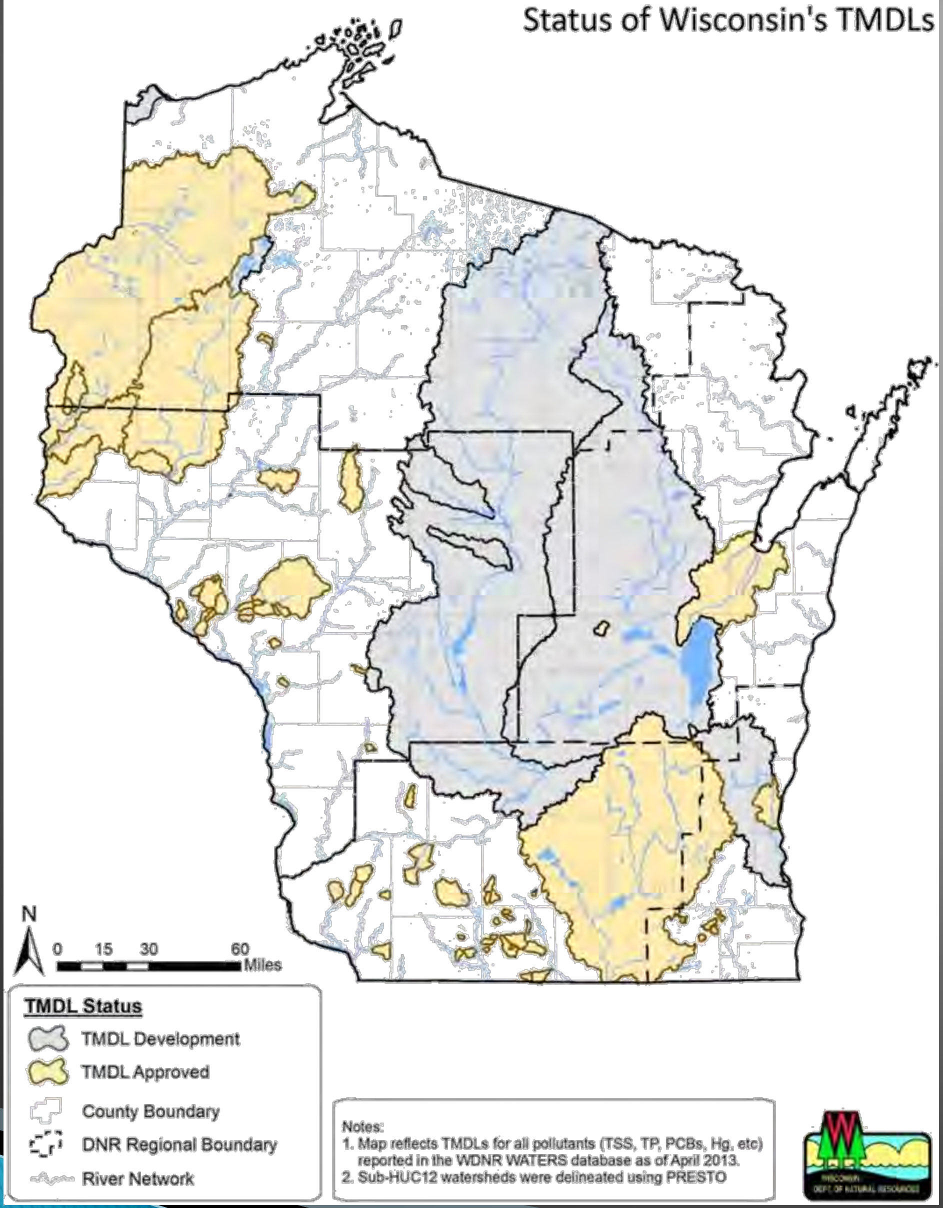
TMDLs Statewide



Alternatives to TMDLs

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

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

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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

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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

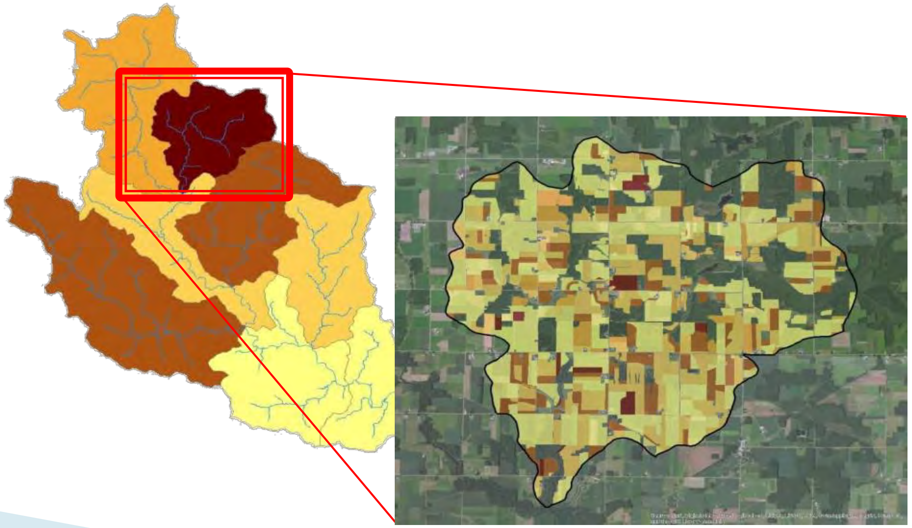
NPS Implementation – County

- 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

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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

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9 Key Elements

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

- **Set of criteria to determine whether load reductions <u>are or are not</u> 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

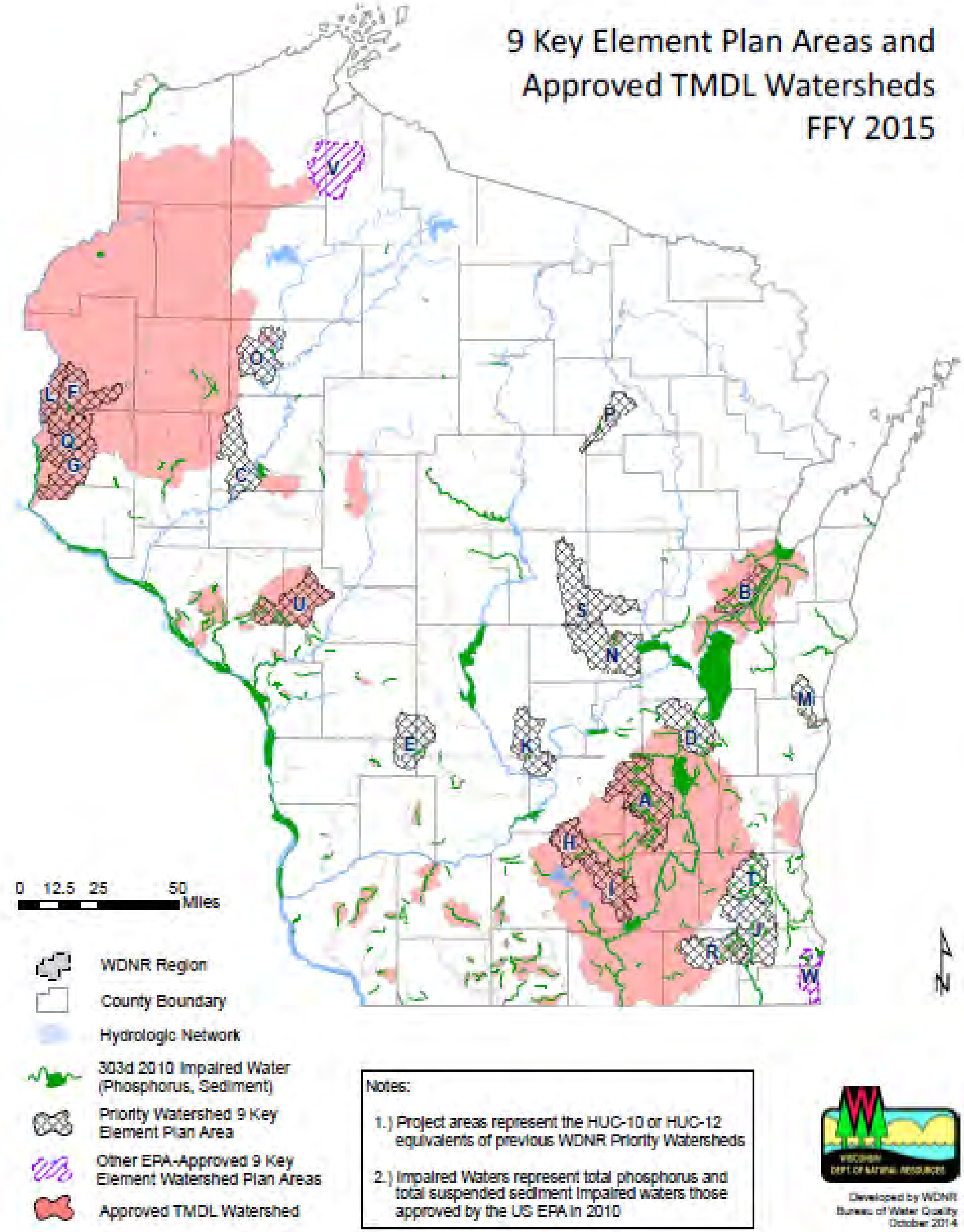
Importance of 9 Element Plans

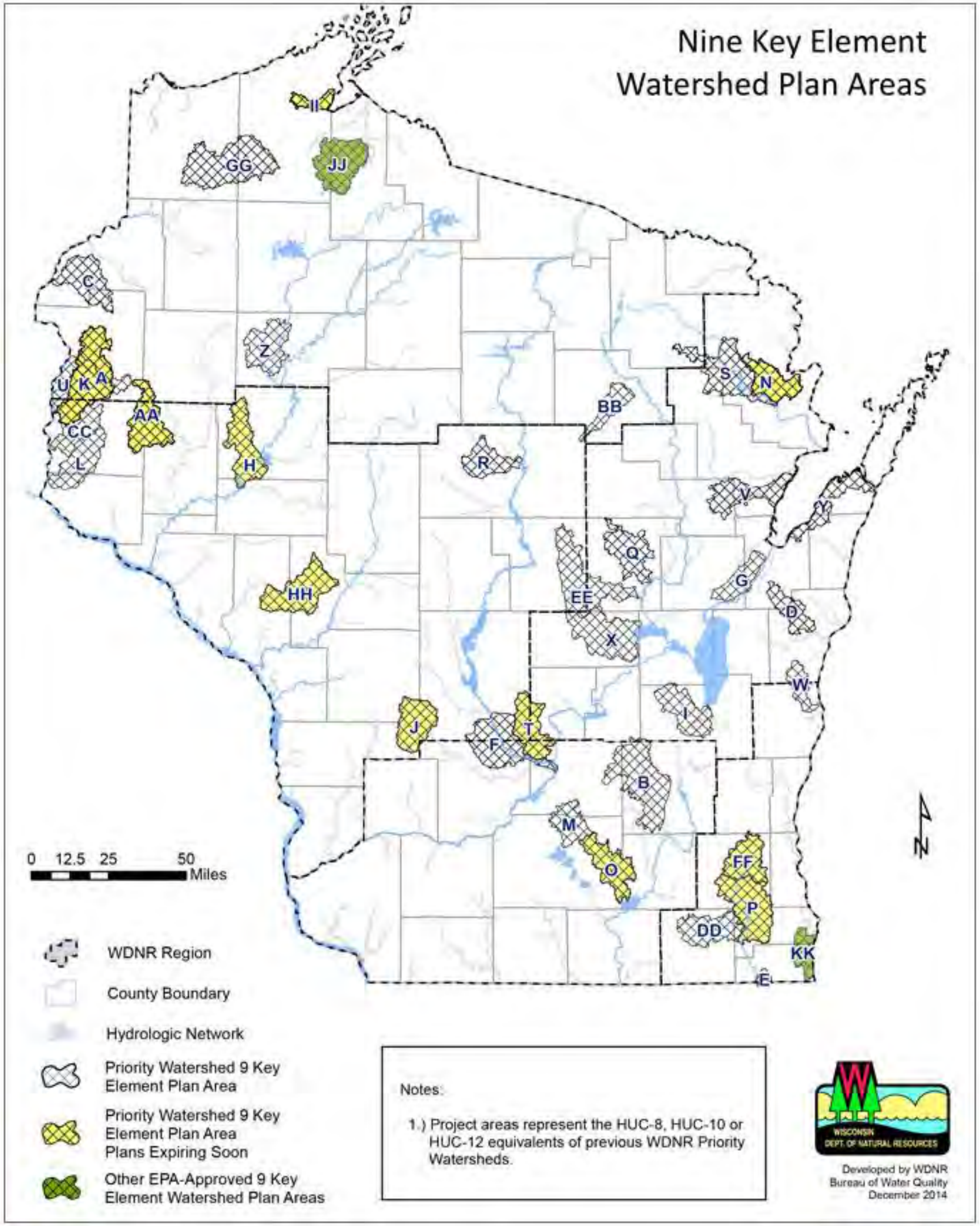
- EPA 2015 grant requirements – October 2014
- DNR Nonpoint activities funded with EPA 319 grant funds should be linked to water quality outcomes
- Focus on restoration of impaired waters via watershed based plans
- At least 50% of 319 funds must be used in 319 eligible areas
- 319 eligible area = has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





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

WDNR – Nine Key Element Website

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

Nine Key Element Plans - W...

Convert | Select

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

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

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

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

EPA Handbook for 9 Key Element WS Plans

2.6 Nine Minimum Elements to Be Included in a Watershed Plan for Impaired Waters Funded Using Incremental Section 319 Funds

Although many different components may be included in a watershed plan, EPA has identified nine key elements that are critical for achieving improvements in water quality. (Go to www.epa.gov/owow/nps/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?

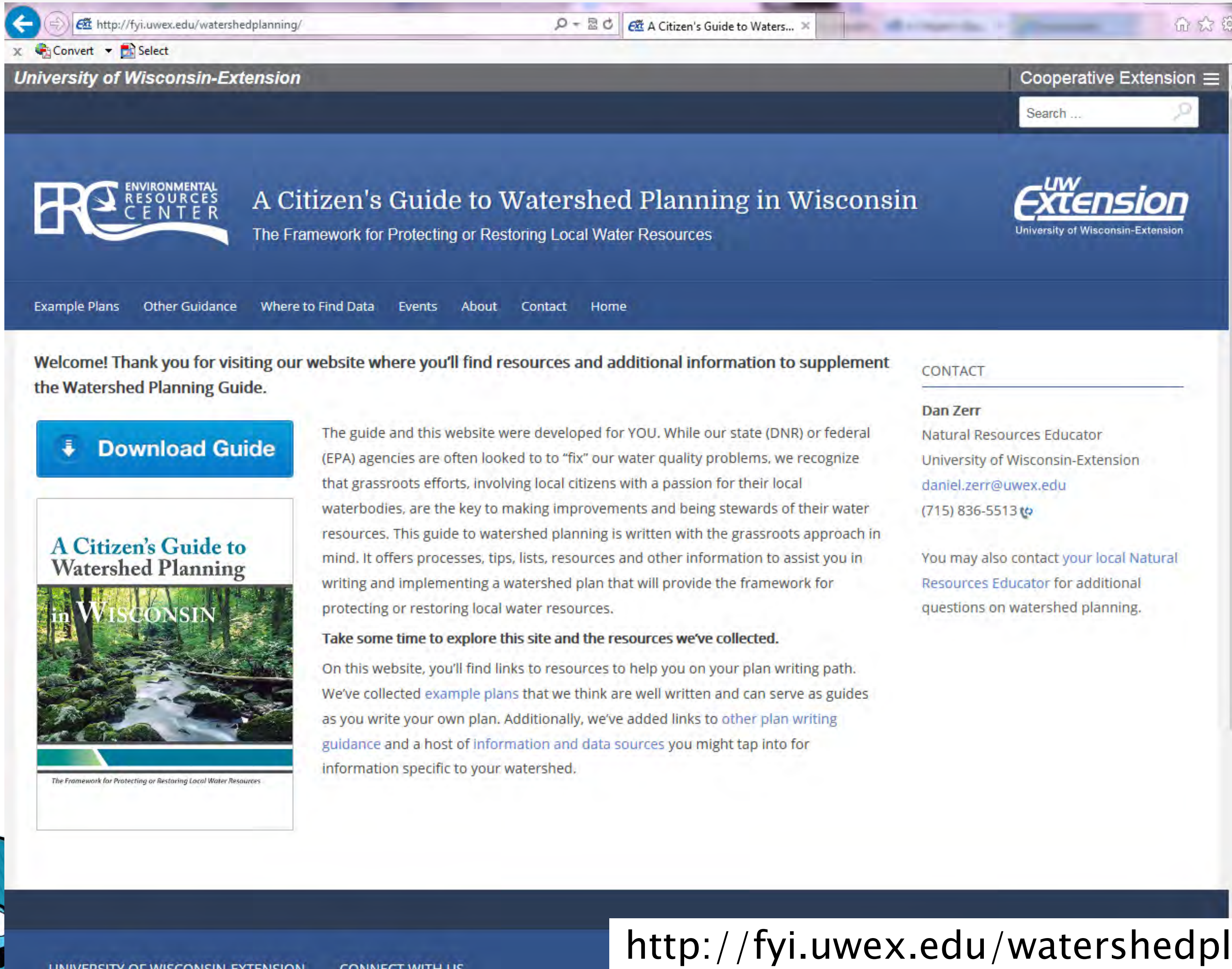
Shows you where one or more of the nine minimum elements are specifically discussed.

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

http://water.epa.gov/polwaste/nps/handbook_index.cfm

UW-Ext Citizen's Guide to 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

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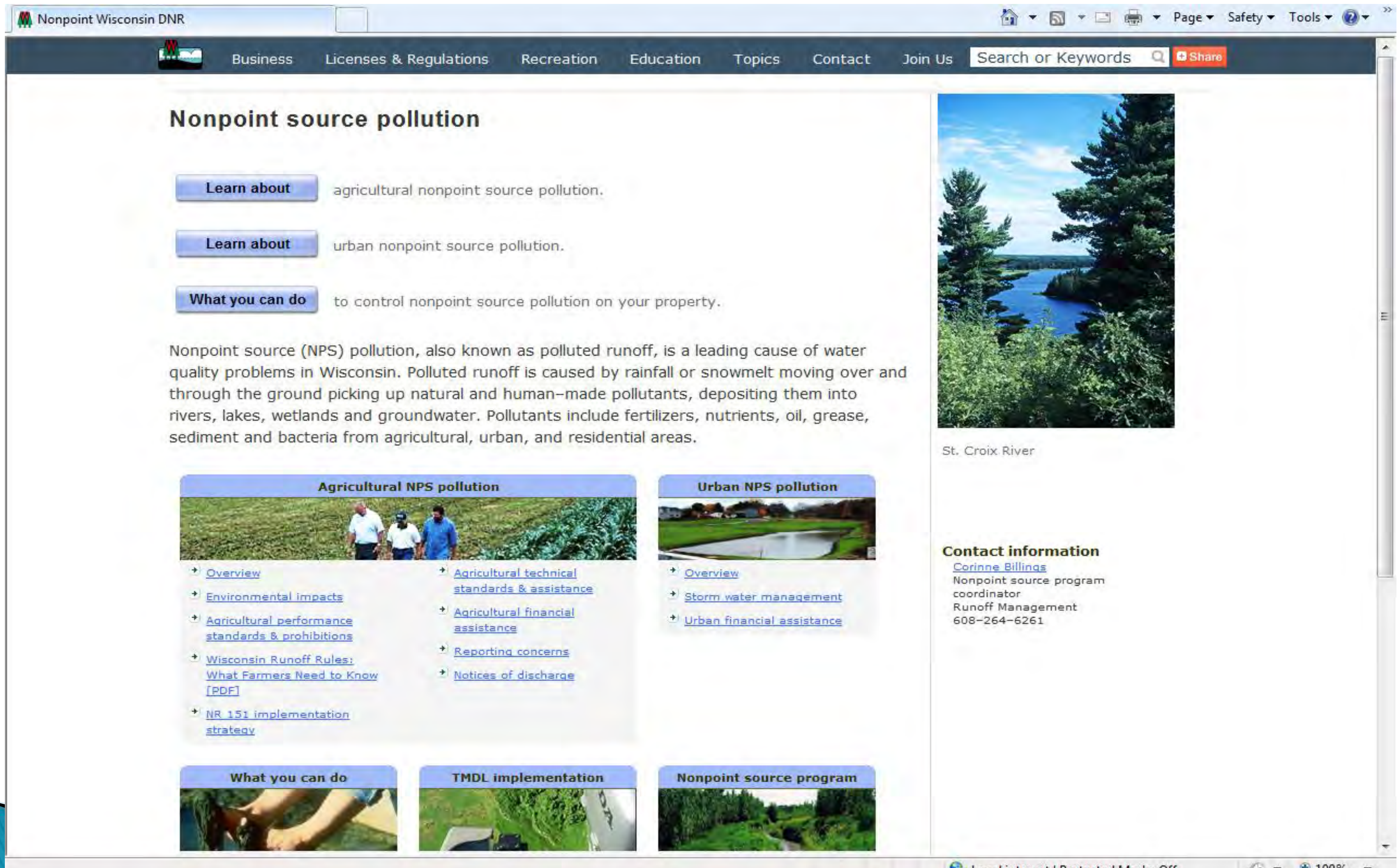
NPS Web Site

- dnr.wi.gov – keyword: **nonpoint**



DNR Contact Info

- Andrew Craig – DNR Nonpoint Source Planning Coordinator

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

dnr.wi.gov – keyword: 9 key

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

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NPS Implementation

"Without a plan,
there's no attack.
Without attack,
no victory."

–Curtis Armstrong,
One Crazy Summer

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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

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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

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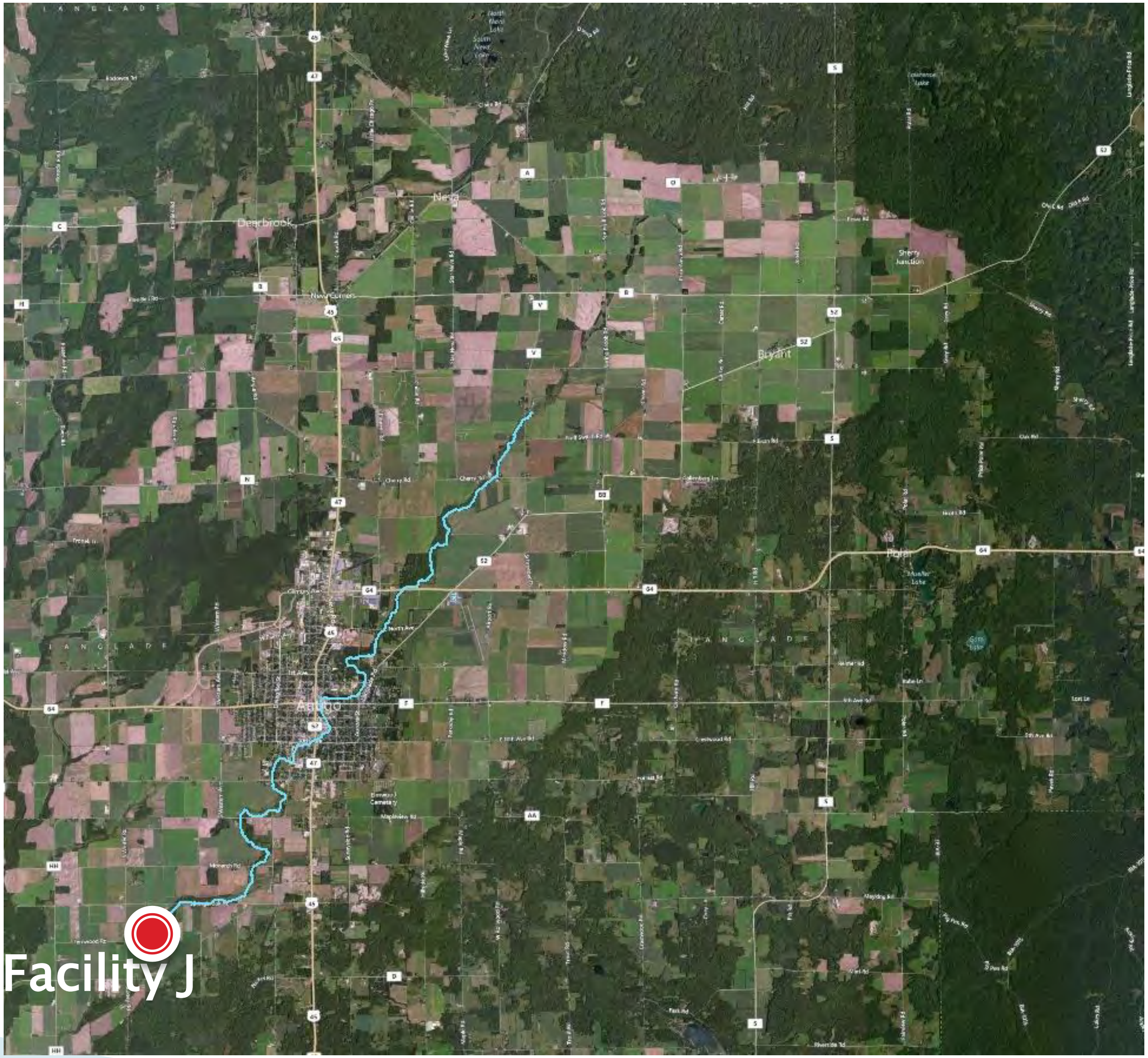
The Concept:

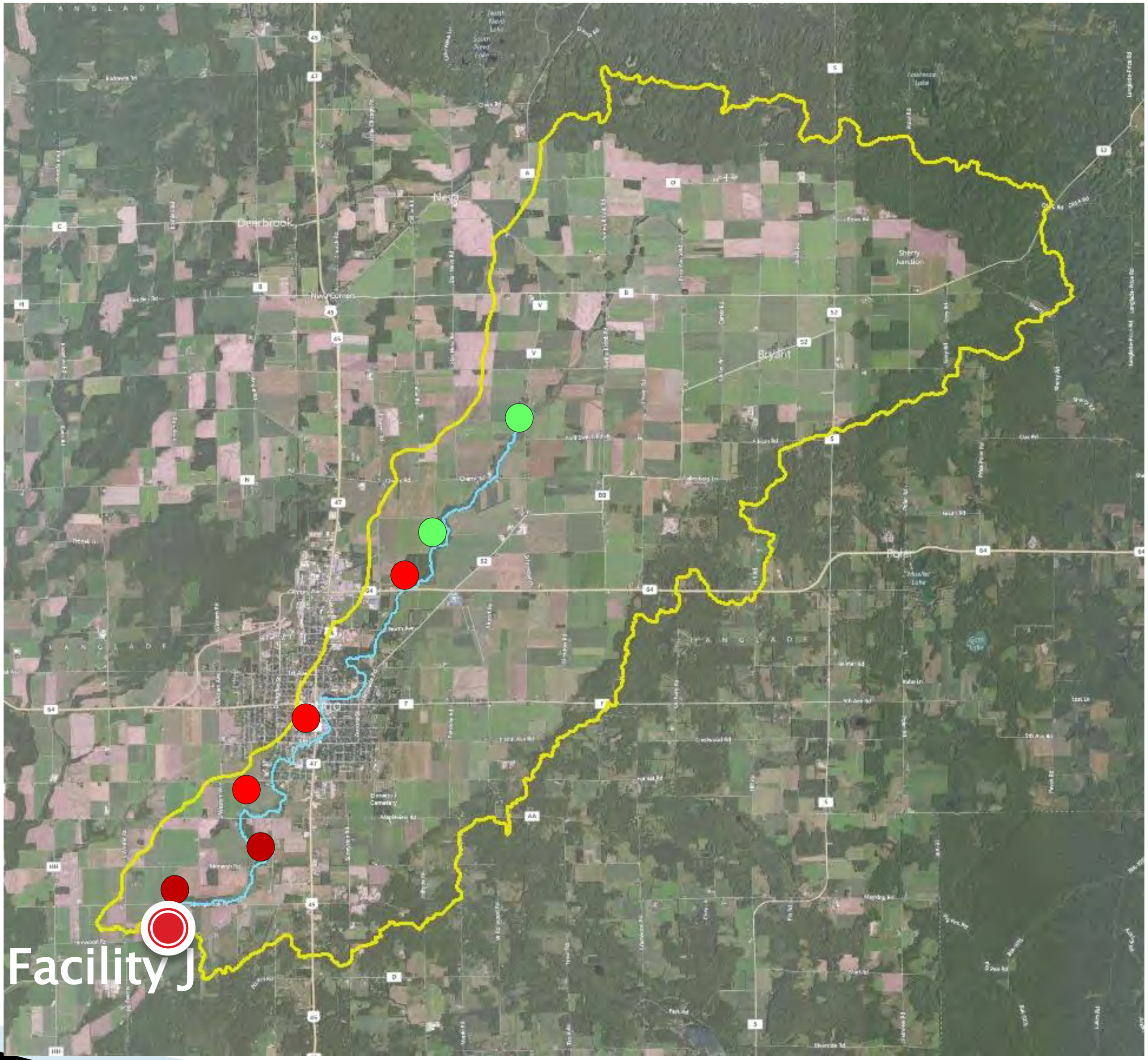
- Facility J has a phosphorus WQBEL equal to 0.075 mg/L.



The Concept:

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

0.041 - 0.075
0.076 - 0.100
0.101 - 0.235



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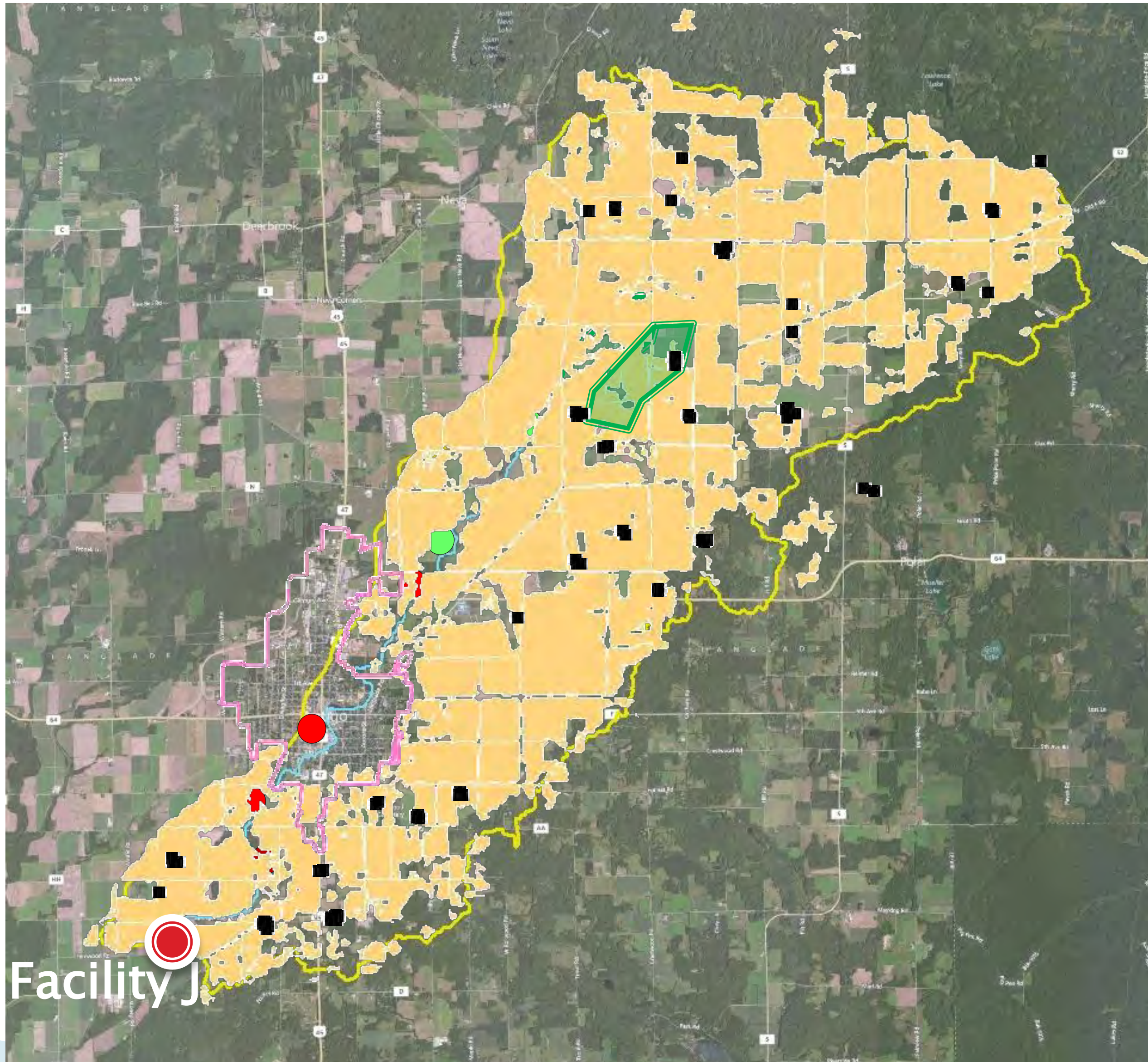
The Concept:

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

  0.041 - 0.075
  0.076 - 0.100
  0.101 - 0.235

- A watershed plan is developed to improve water quality and reduce sources of P from:
  - Barnyards
  - Urban areas
  - Cropland
  - Natural features
  - Other



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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

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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

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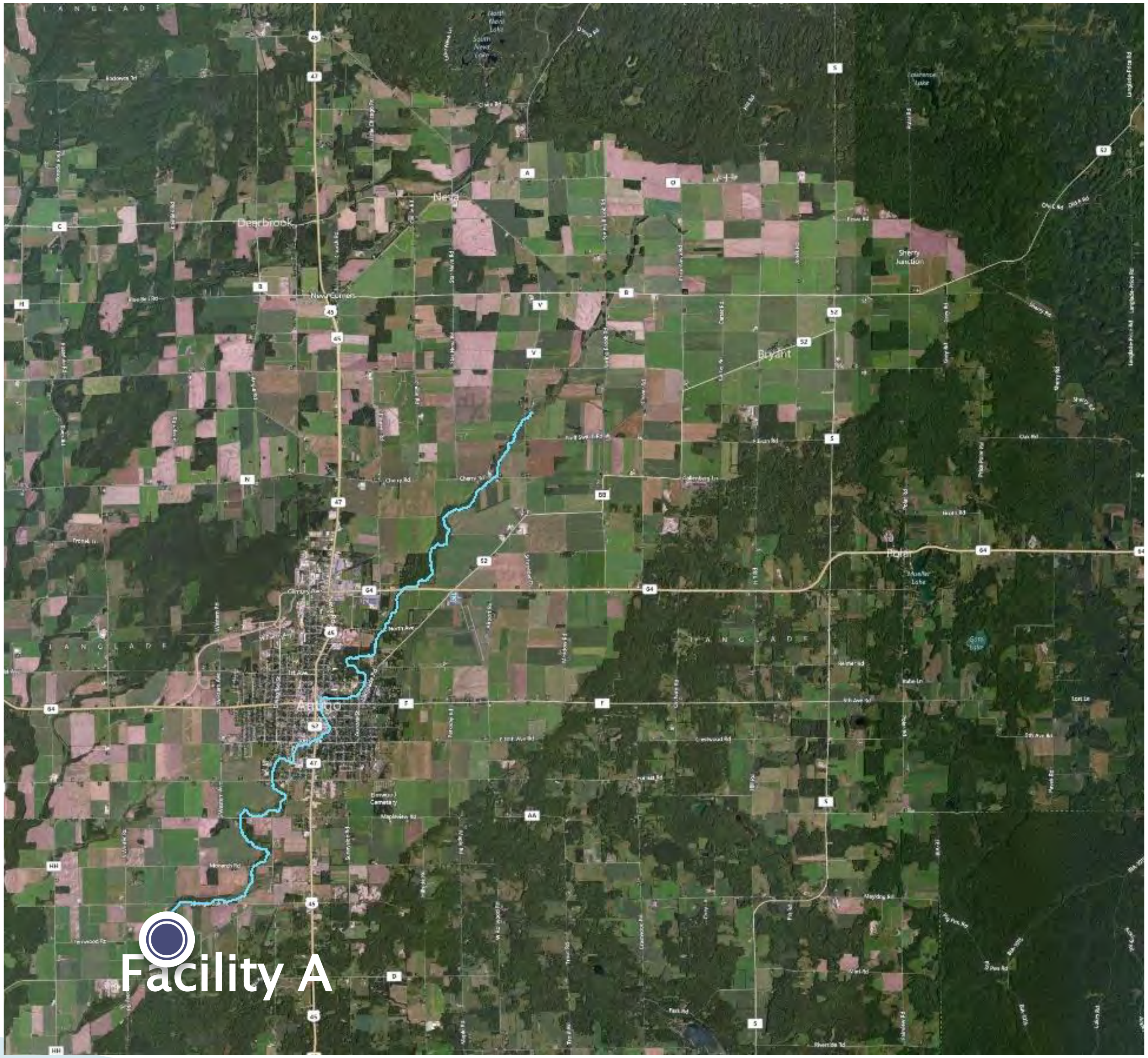
Example:

- 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.

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Map of AM/WQT Projects

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

Adaptive Management and...

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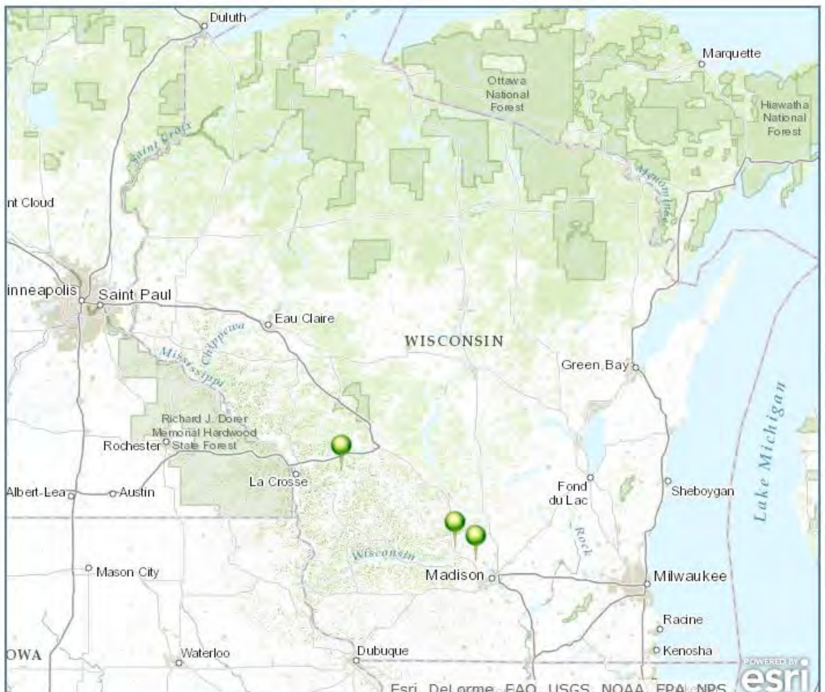
Business | Licenses & Regulations | Recreation | Education | Topics | Contact | Join DNR | Search or Keywords

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

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 managment

- 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

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”)

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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

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

Part 4: Using the P Trade Report in SNAP+

Wednesday, April 22 • 11am-12pm

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 Kevin Kirsch Andrew Craig	Amanda.Minks@Wisconsin.gov Kevin.Kirsch@Wisconsin.gov Andrew.Craig@Wisconsin.gov
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Southern District–East	Mark Riedel TBD	Mark.Riedel@Wisconsin.gov
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”

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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

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Model Comparison

Model Comparison Overview

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

What is a model?

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

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

http://www.rossettiarchive.org

http://farm2.static.flickr.com

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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

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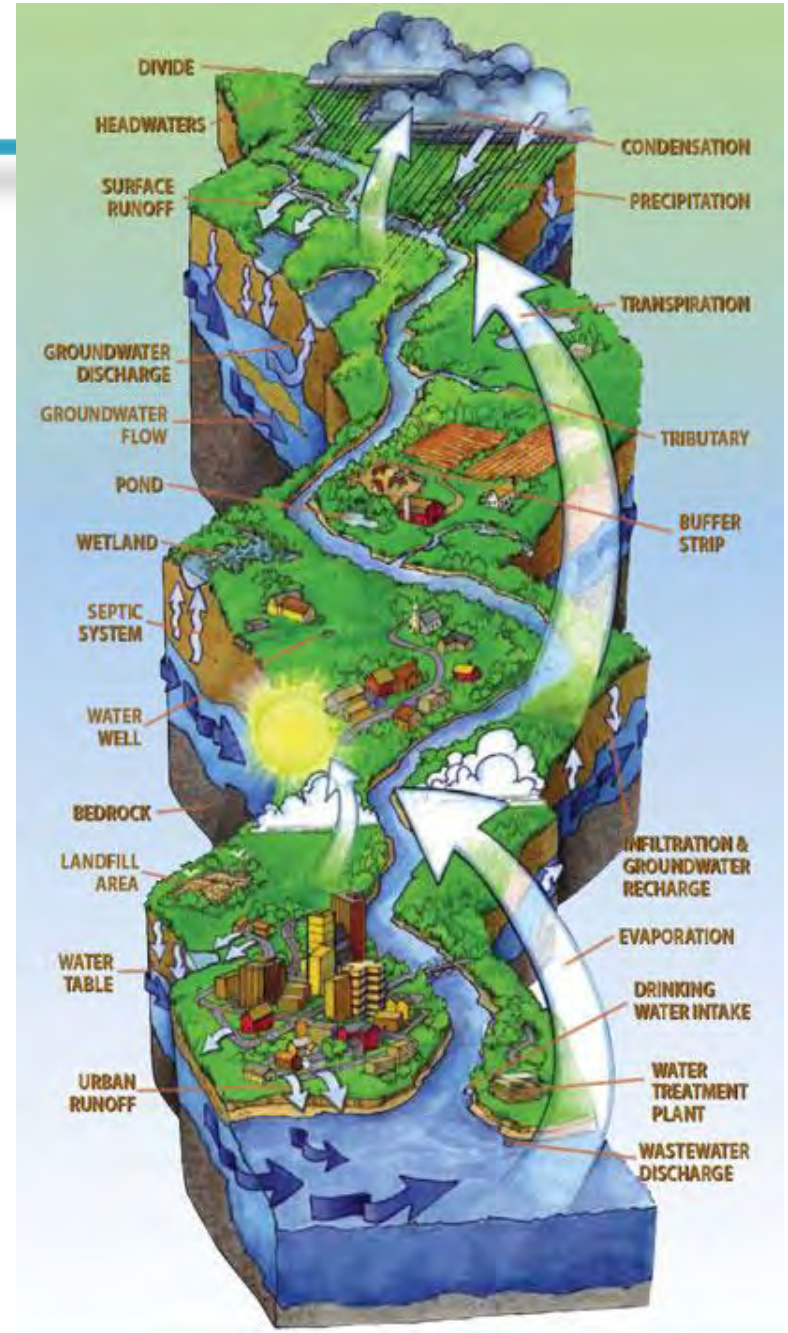
Why use a model?

- Explain scientific phenomena
  - What happened?
- Predict outcomes & behavior
  - Why did it happen?
- Inform decision making process



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

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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

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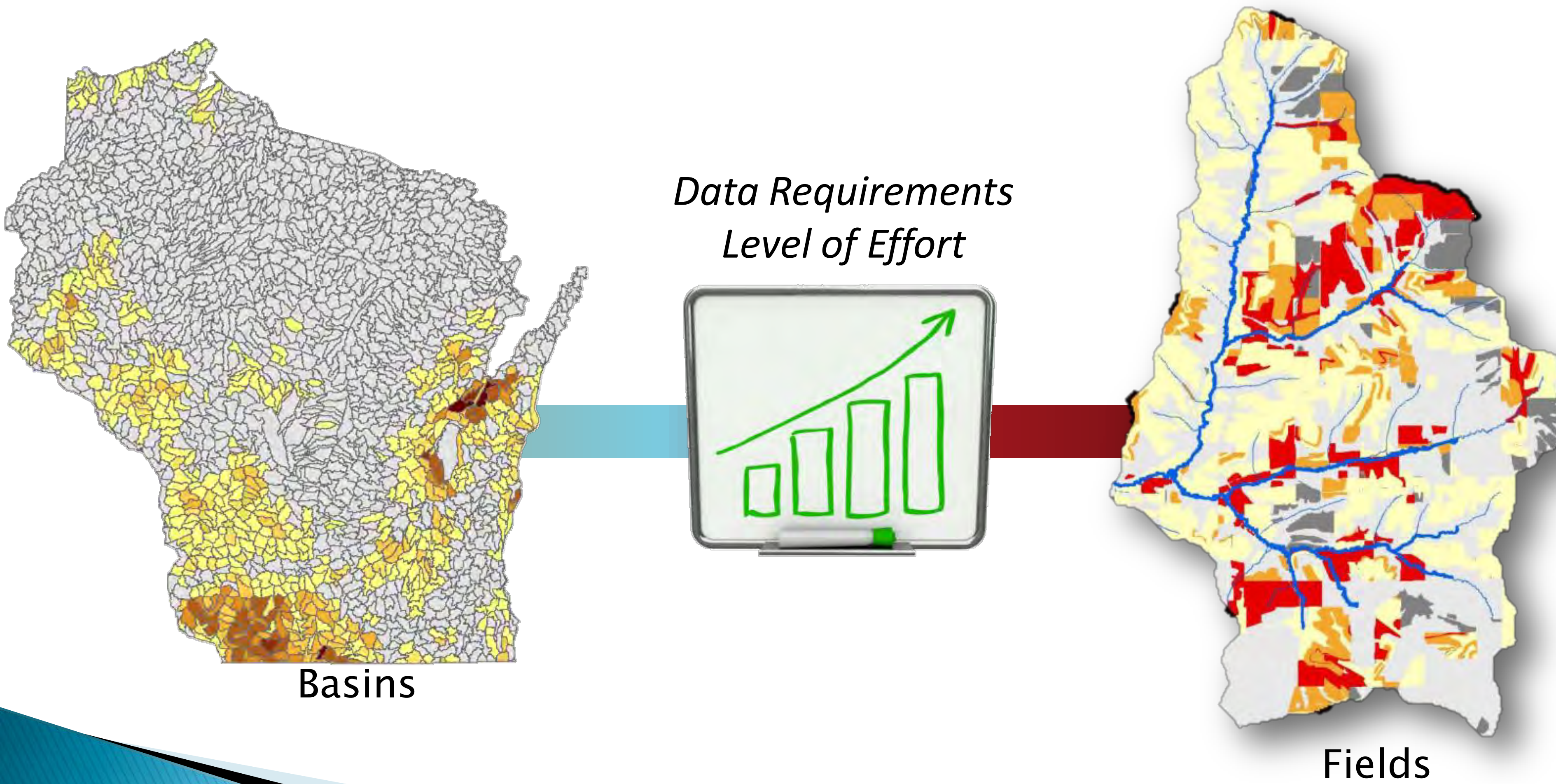
Complexity



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

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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

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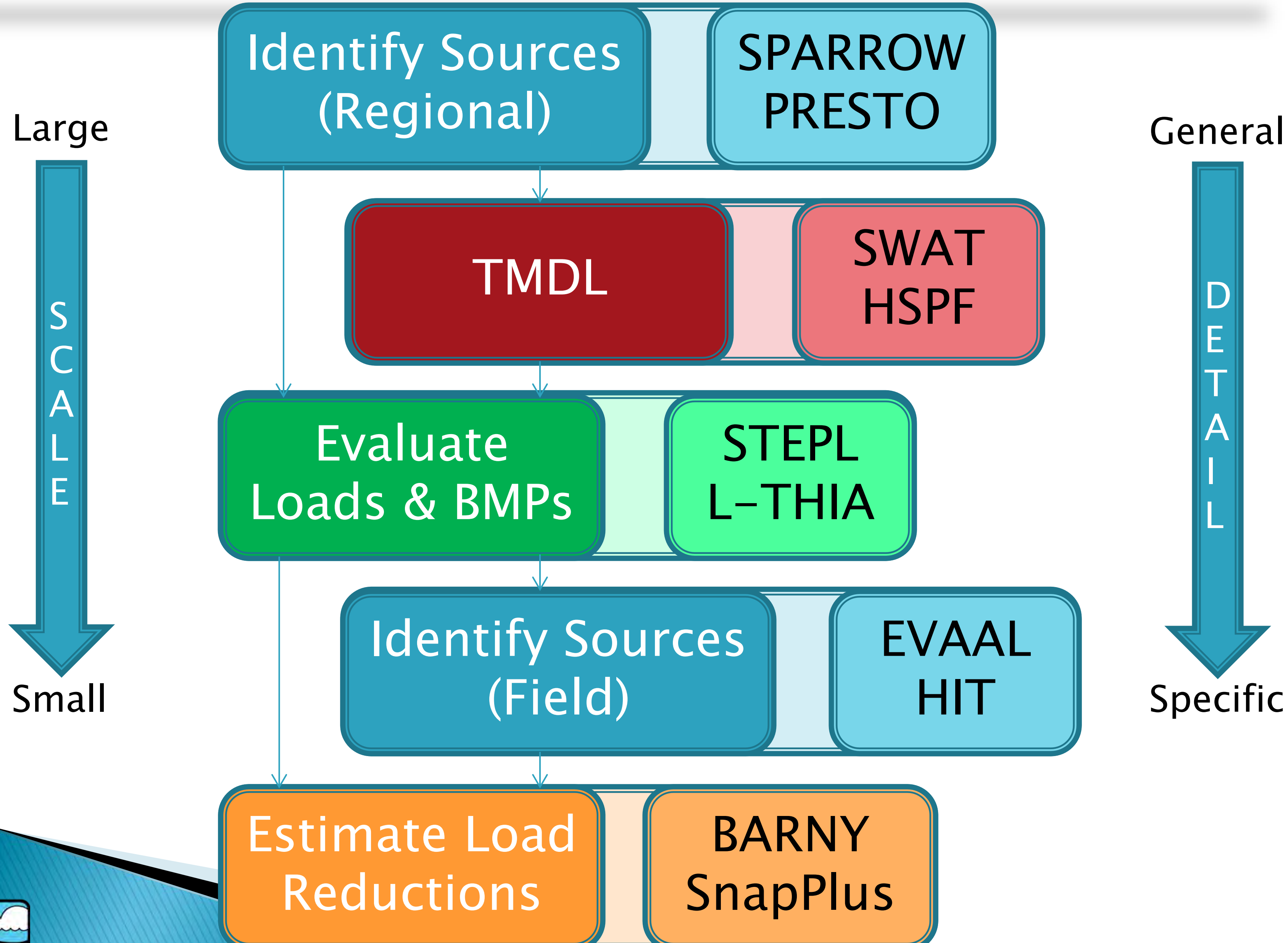
Models Overview



Models

Identify Sources (Regional) — SPARROW, PRESTO

TMDL — SWAT, HSPF

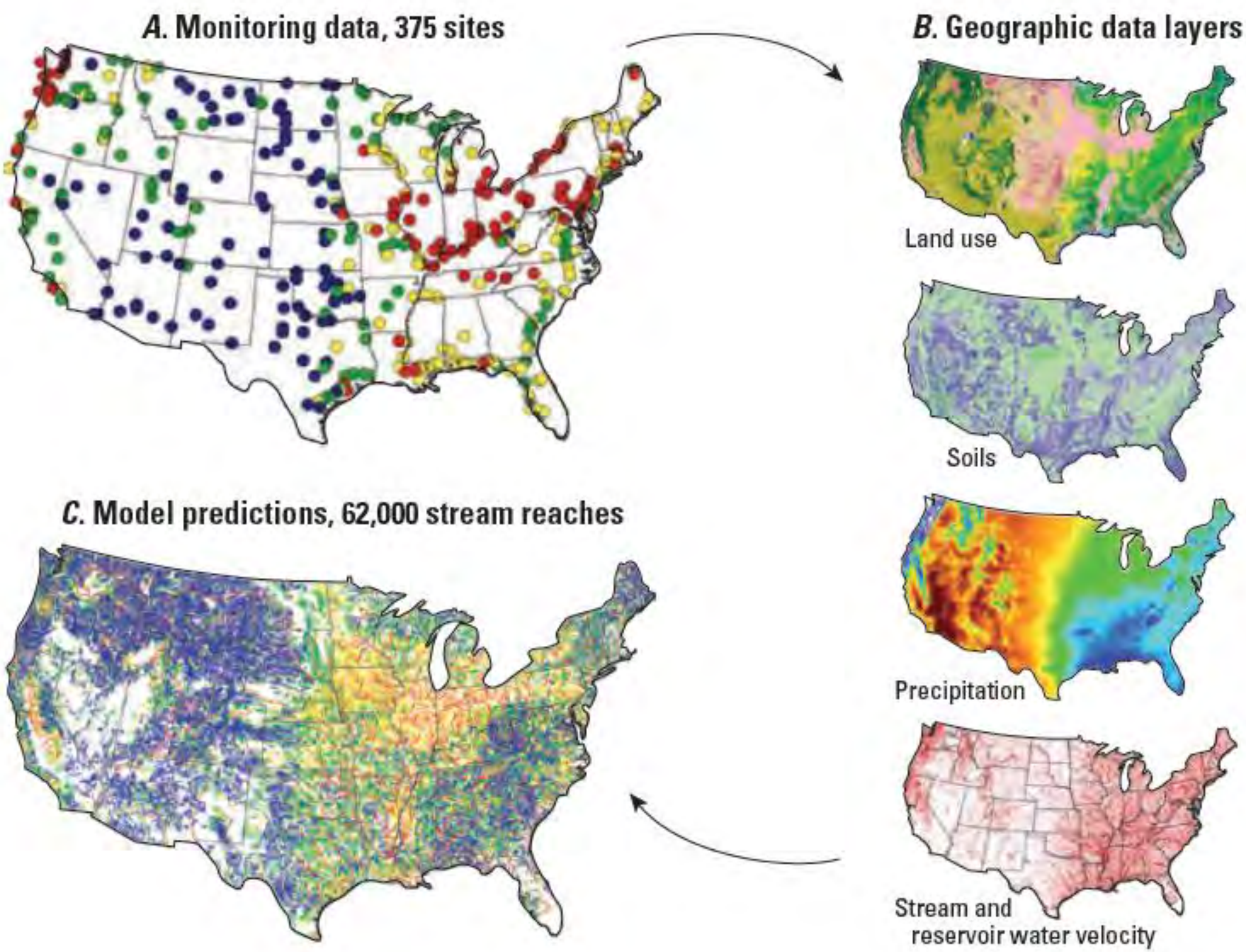
Evaluate Loads & BMPs — STEPL, L-THIA

Identify Sources (Field) — EVAAL, HIT

Estimate Load Reductions — BARNY, SnapPlus

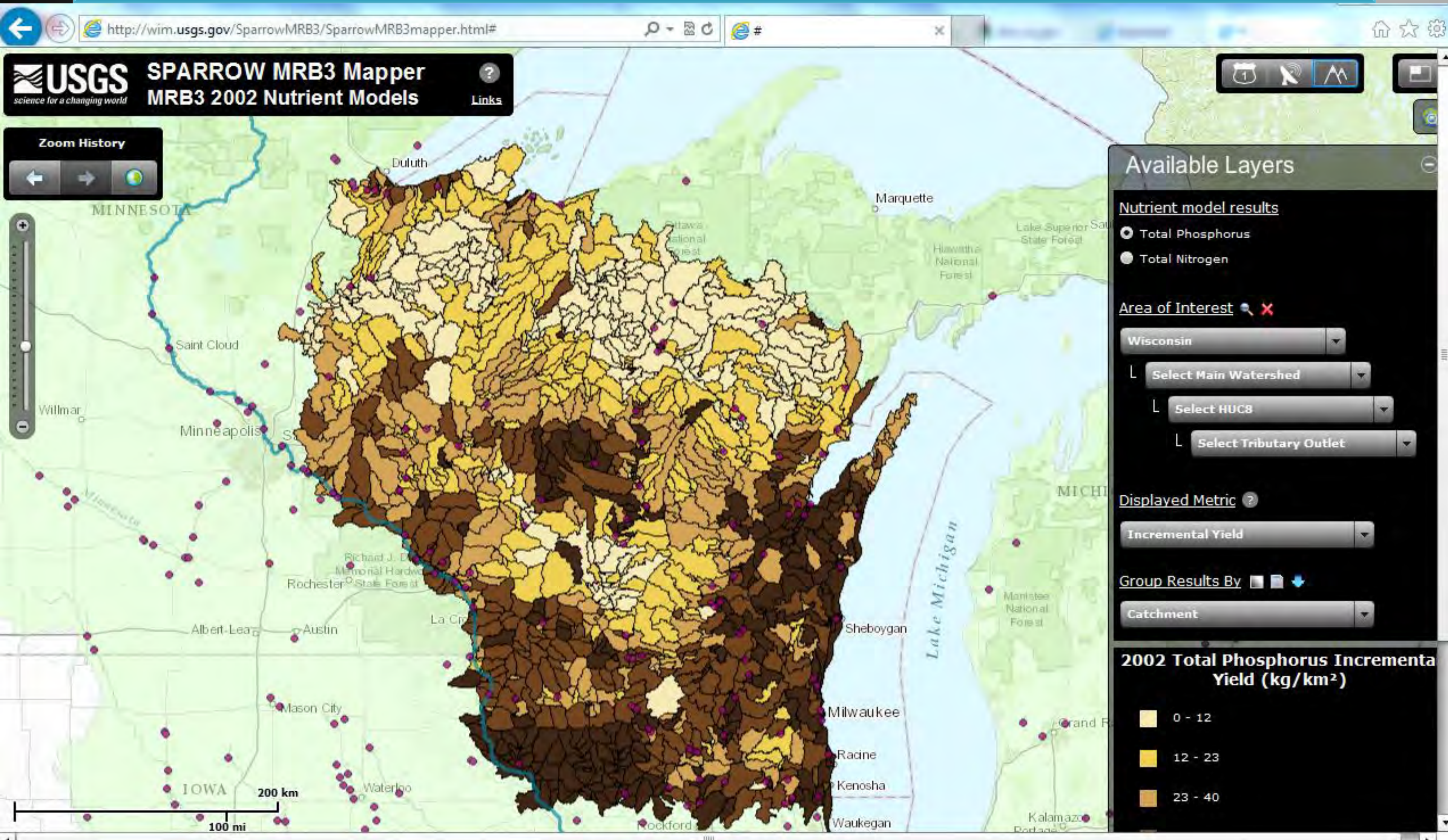
SPARROW

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



http://pubs.usgs.gov/fs/2009/3019/pdf/fs_2009_3019.pdf

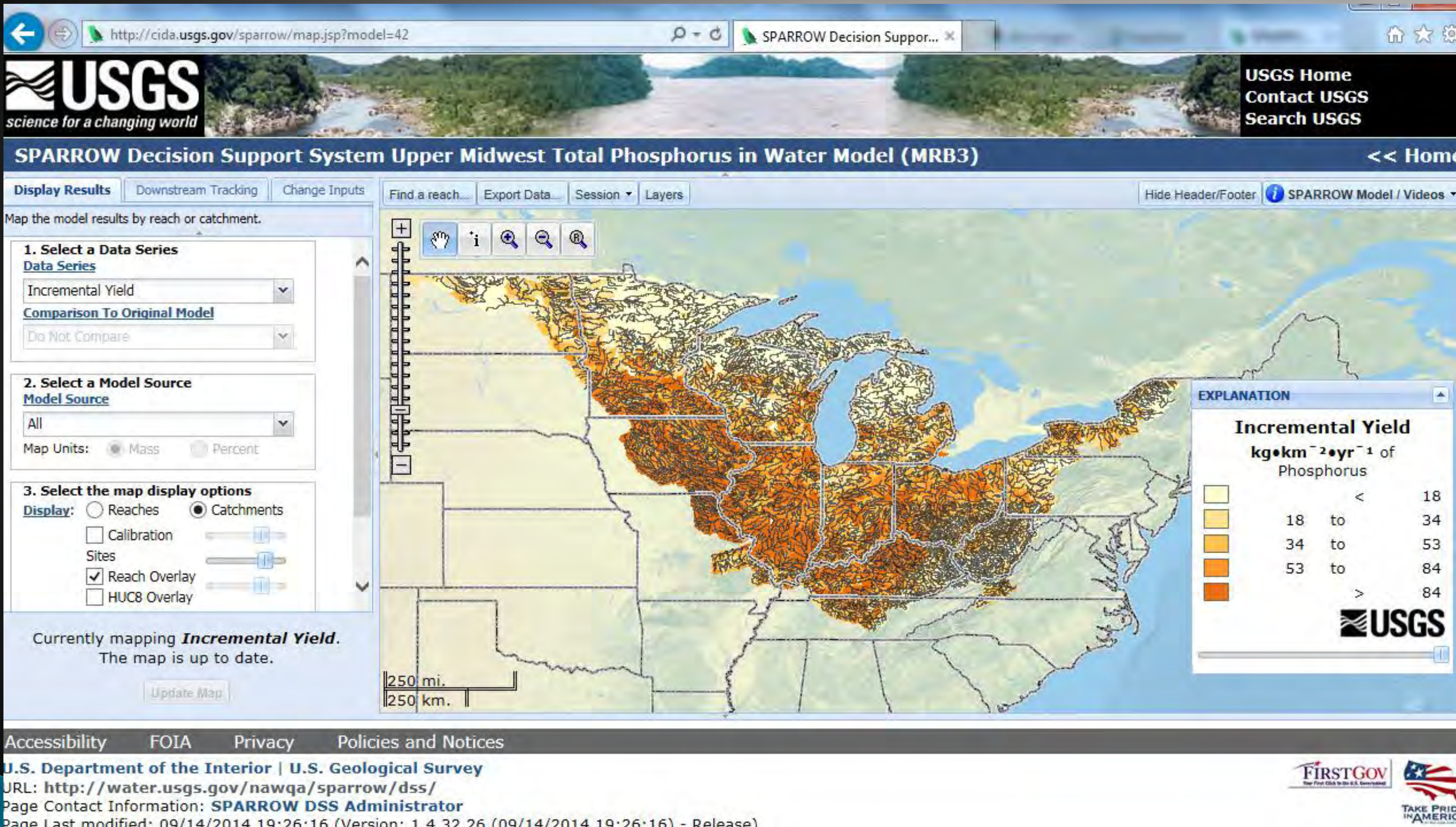
SPARROW – Mapper



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

WISCONSIN DEPT. OF NATURAL RESOURCES

SPARROW – DSS



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

SPARROW

- Main Uses
  - Predicting long-term average values of water characteristics, such as concentrations and amounts of selected constituents that are delivered to downstream receiving waters
  - Decision Support System based on existing or hypothetical source contributions
  - Screening tool
- Limitations/Cautions
  - Limited long-term monitoring data
  - Coarse data inputs
  - Base year 2002

WISCONSIN DEPT. OF NATURAL RESOURCES

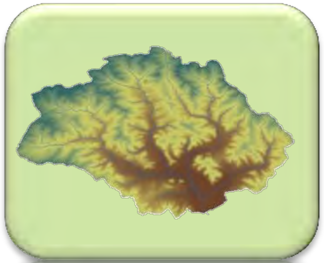
PRESTO

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

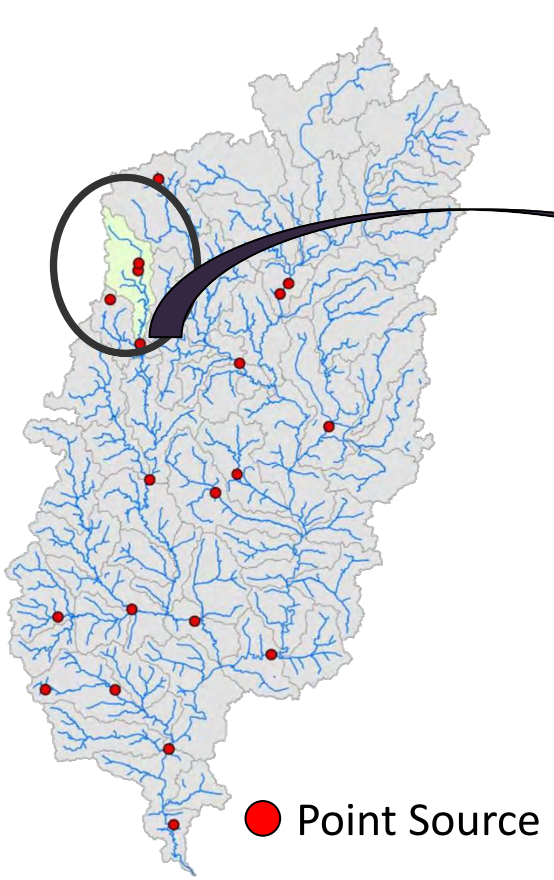


+

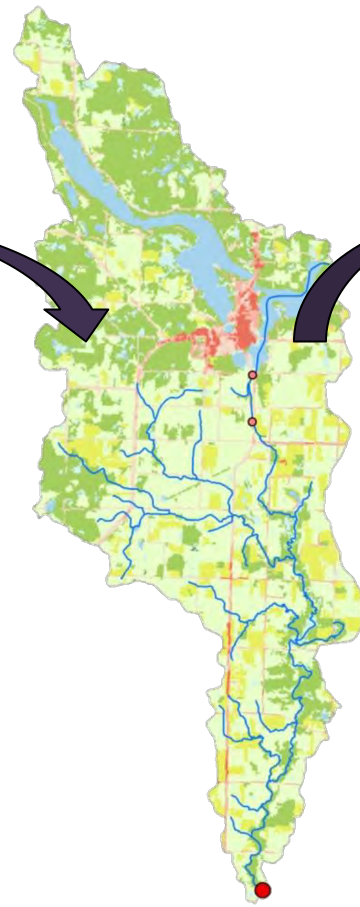
Effluent Aggregation

+

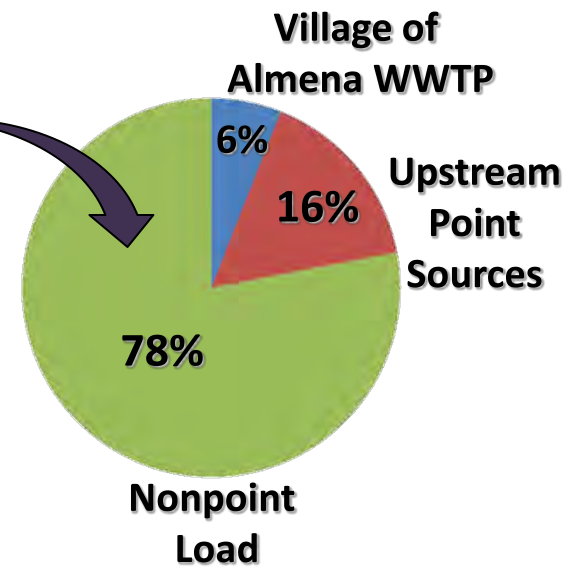
Pollutant Runoff



Red Cedar River Watershed
(HUC 08, 1,890 mi^2)
20 Outfalls



Village of Almena WWTP
Upstream Watershed: 32.9 mi^2

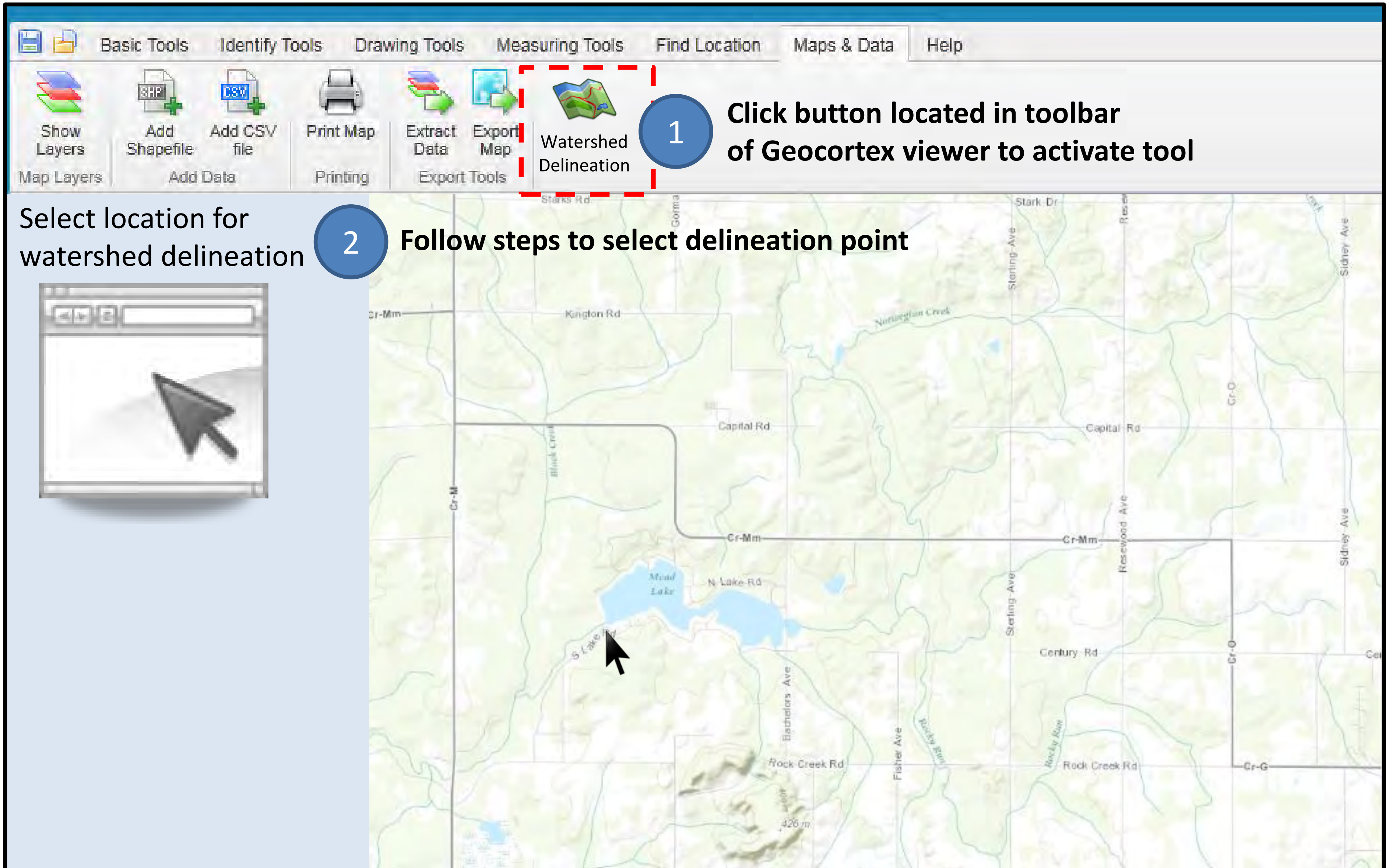


22% : 78%

Point to Nonpoint
Phosphorus Load Ratio

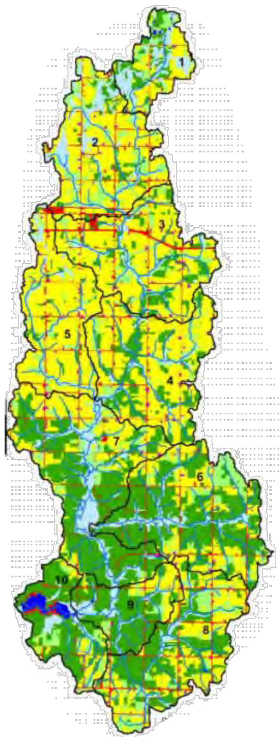
PRESTO-Lite

A Watershed Delineation and Characterization Tool
for Integration into Geocortex Applications



3

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



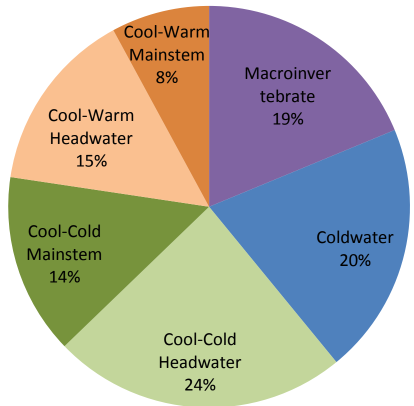
Watershed Name: Wild River

HUC08 Drainage: Chippewa River

Watershed Area: 100 mi²

Stream Type: Cool-Warm Mainstem

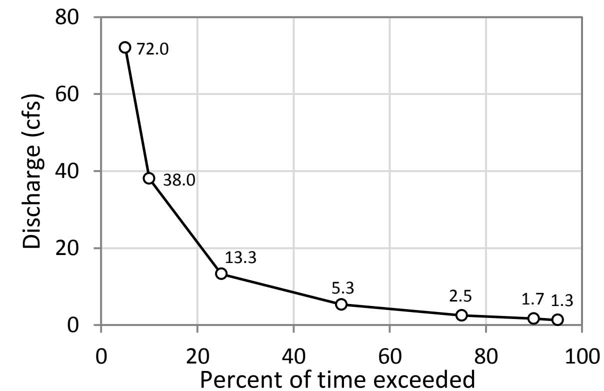
Tributary Stream Types



Landcover

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

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 *(Individual Facility Information on Page 2)*	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%

3

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

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

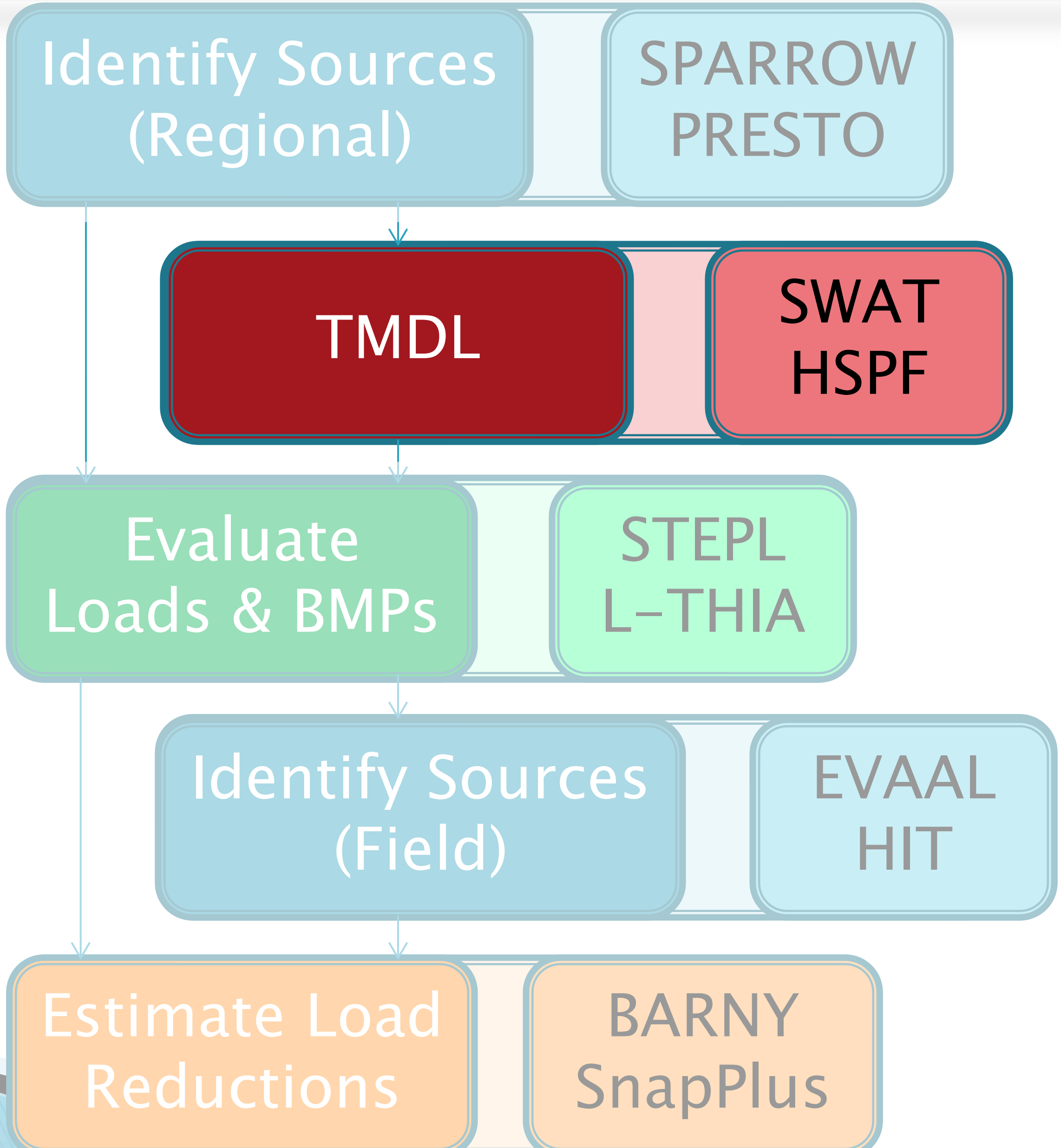
SPARROW

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

PRESTO

- Specific to Wisconsin
- Results run for all WI outfalls
- Custom watershed delineation
- Easy to run for new location
- AM eligibility

Models


Identify Sources (Regional)
SPARROW
PRESTO
TMDL
SWAT
HSPF
Evaluate Loads & BMPs
STEPL
L-THIA
Identify Sources (Field)
EVAAL
HIT
Estimate Load Reductions
BARNY
SnapPlus

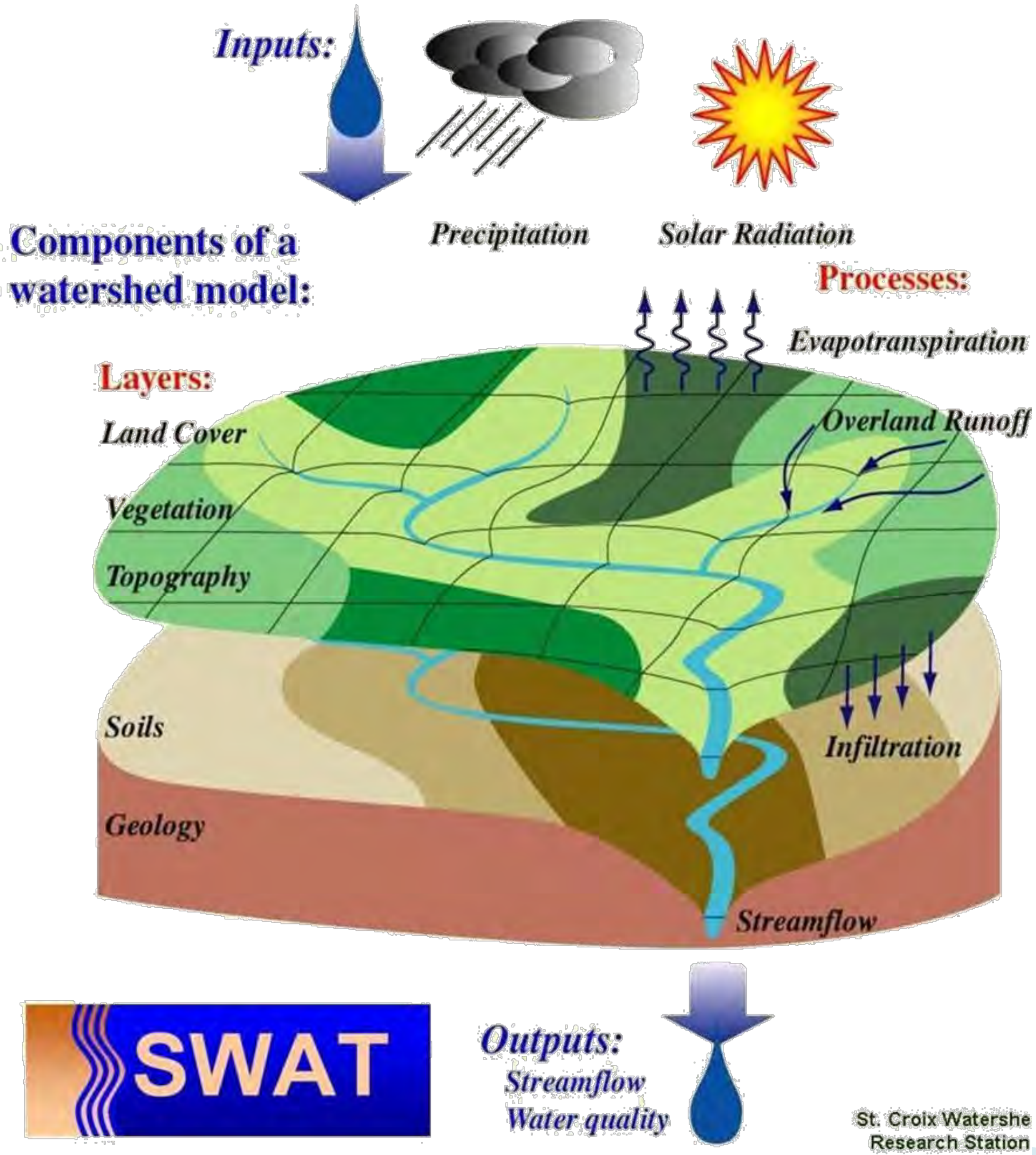
SWAT

SWAT Soil & Water Assessment Tool

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

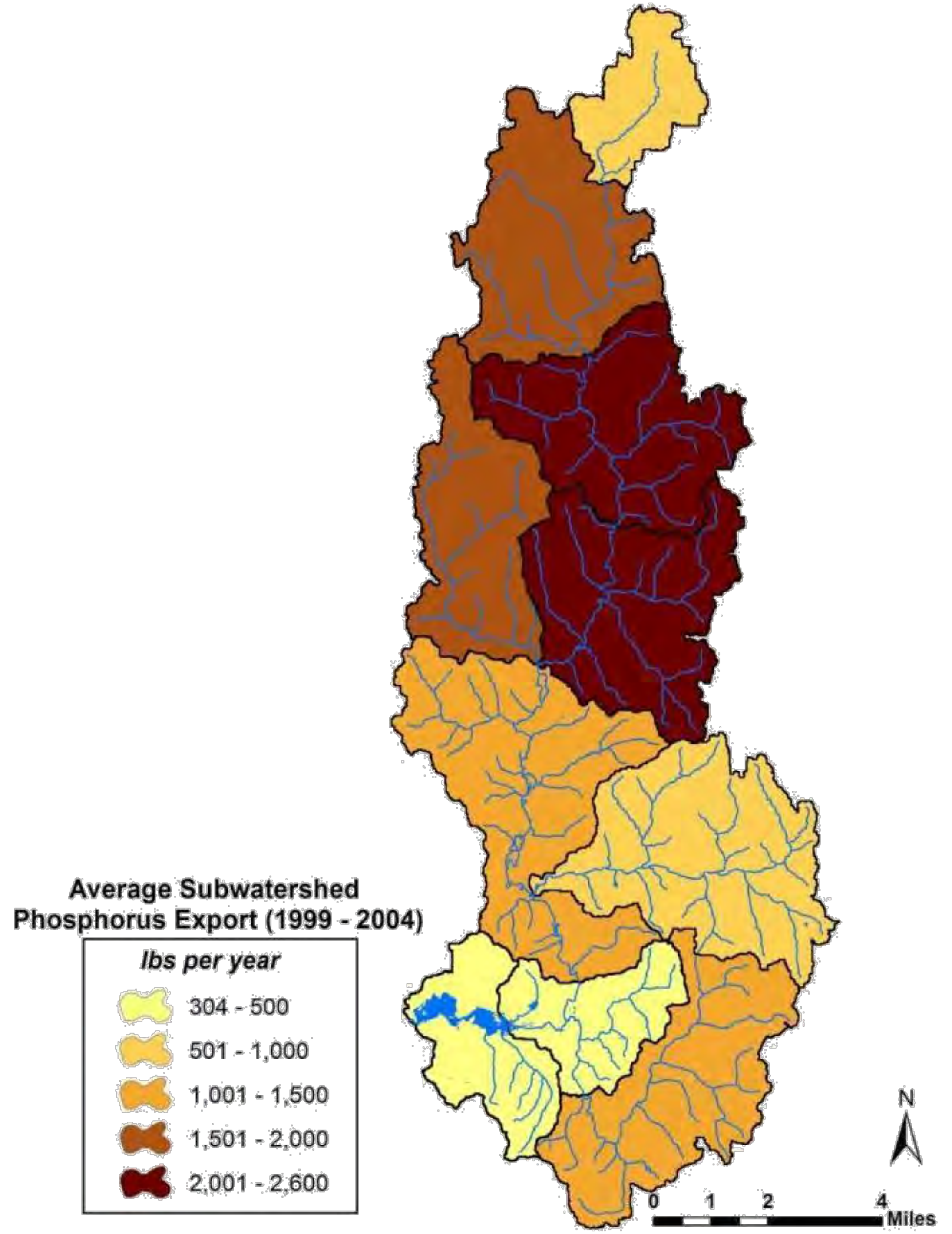
WISCONSIN DEPT. OF NATURAL RESOURCES

SWAT

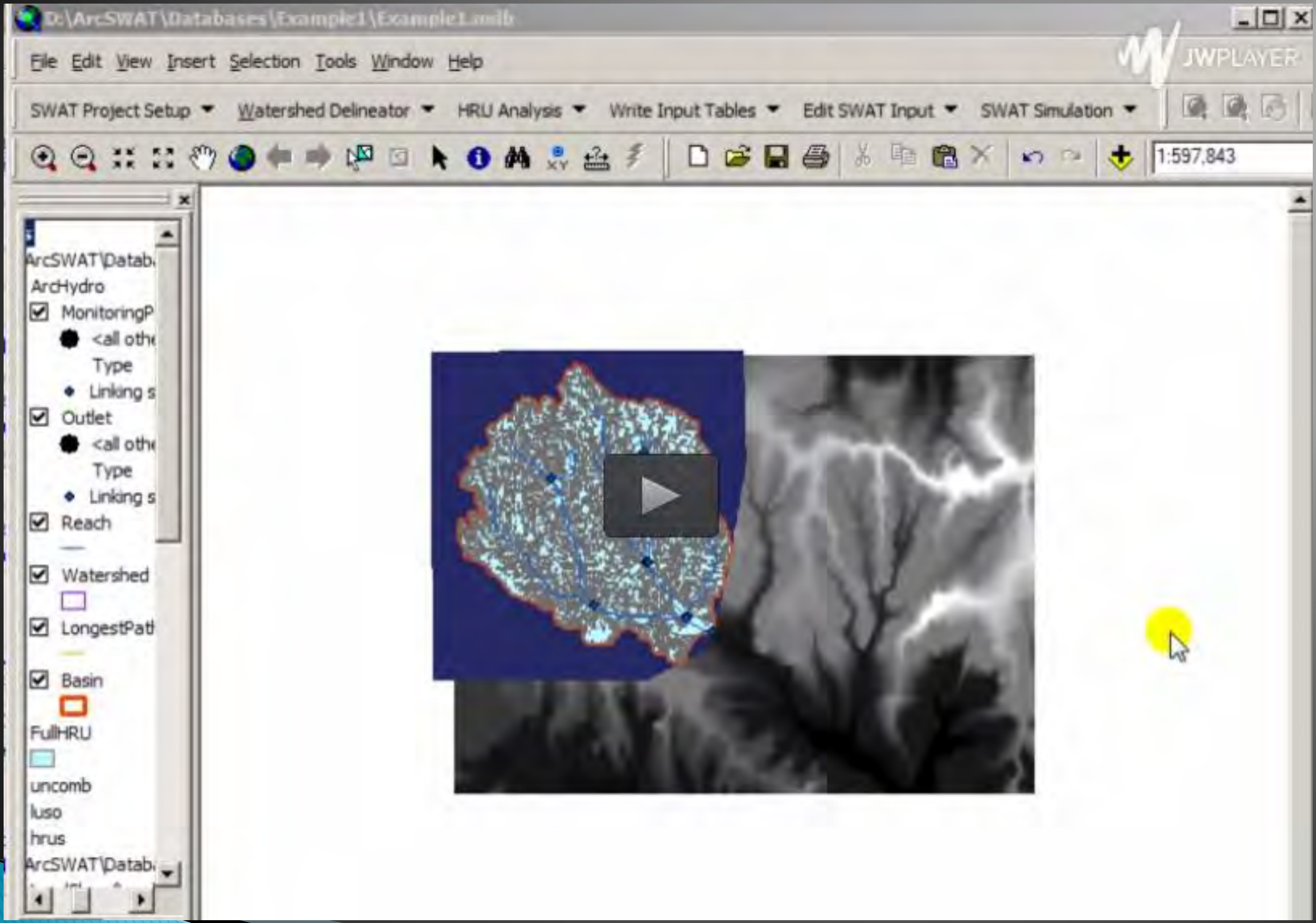


- Simulates conditions on landscape each day based on climate data
- Input data intensive
- Output information is provided for each subwatershed defined
- Outputs include crop yields, discharge, sediment, & water chemistry

SWAT Results



ArcSWAT



WISCONSIN DEPT. OF NATURAL RESOURCES

SWAT

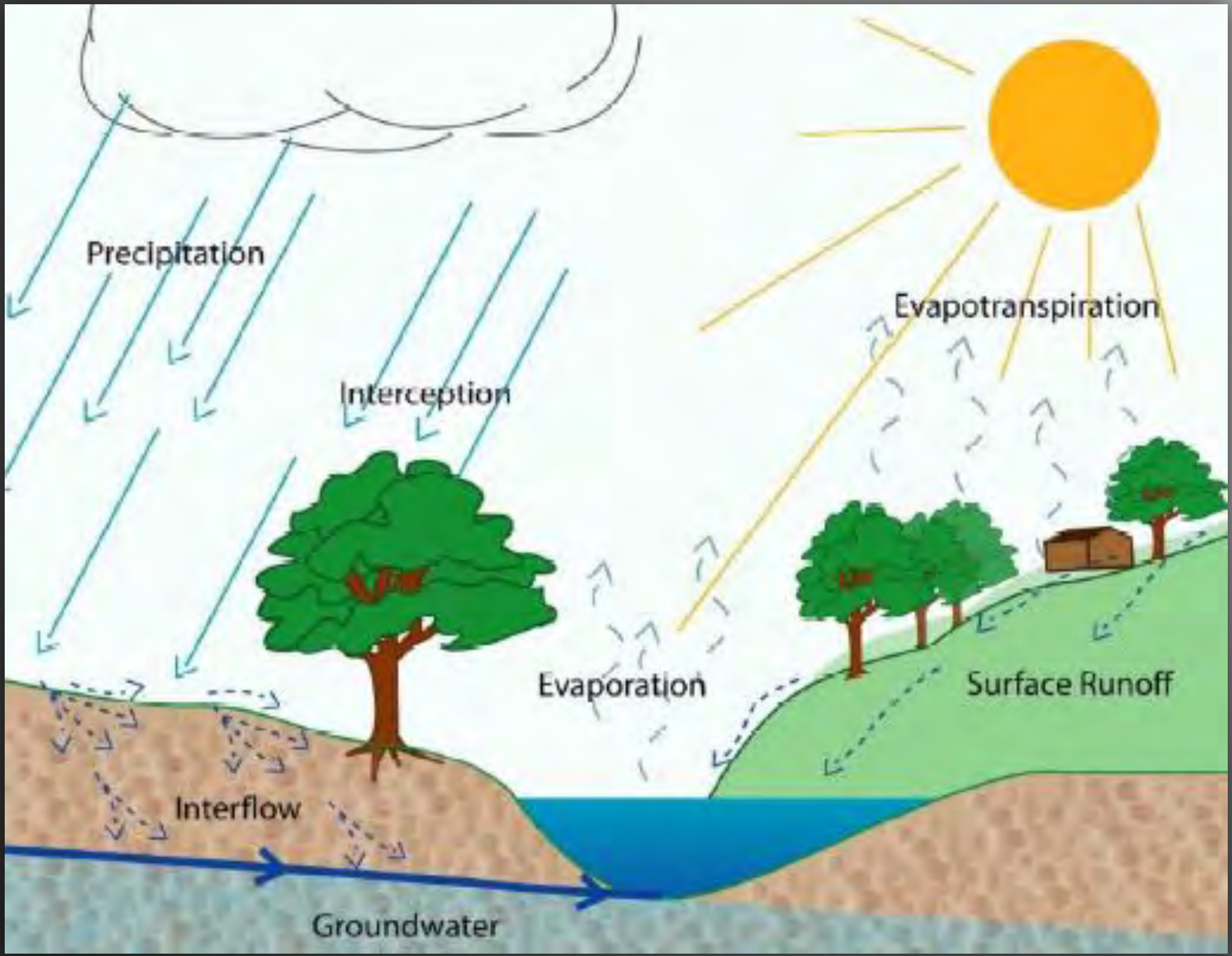
- Main Uses
  - Predicting the impact of land management decisions on water, sediment, nutrient and pesticide yields
  - Evaluating BMPs
  - Developing TMDLs
  - Evaluating scenarios such as climate change or urbanization
- Limitations/Cautions
  - Best for agricultural lands, but fields are not explicit
  - Does not spatially locate loadings within subbasin
  - Does require calibration

WISCONSIN DEPT. OF NATURAL RESOURCES

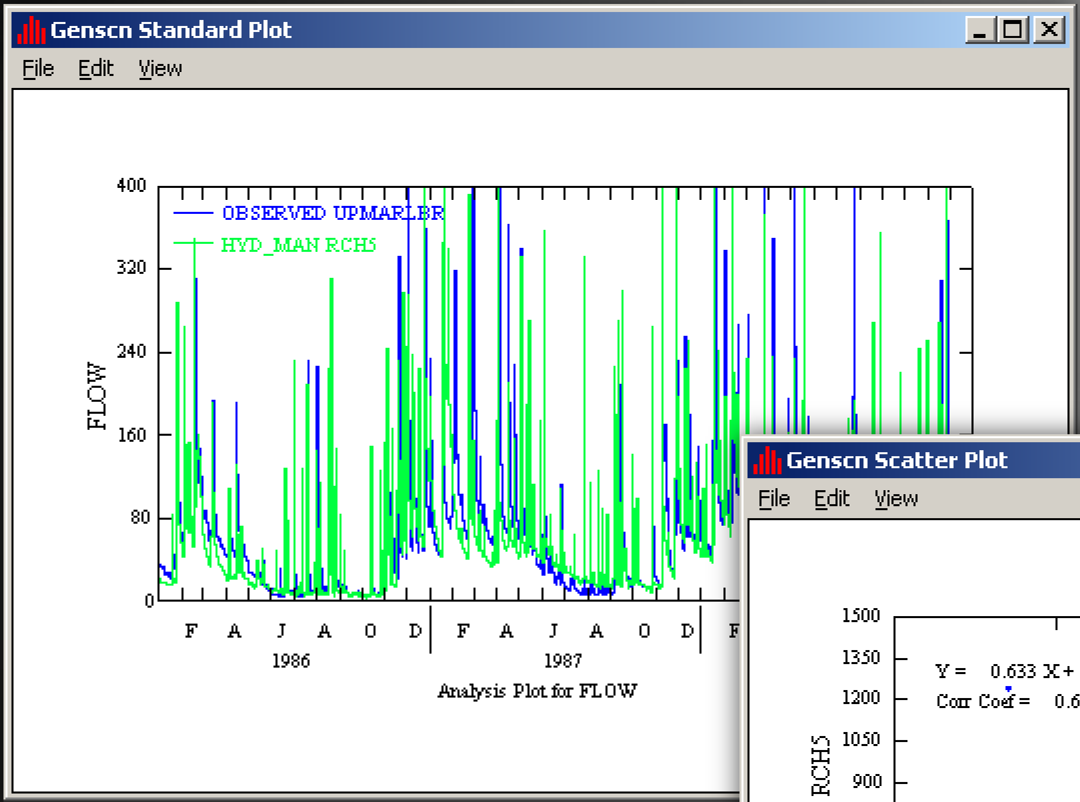
HSPF

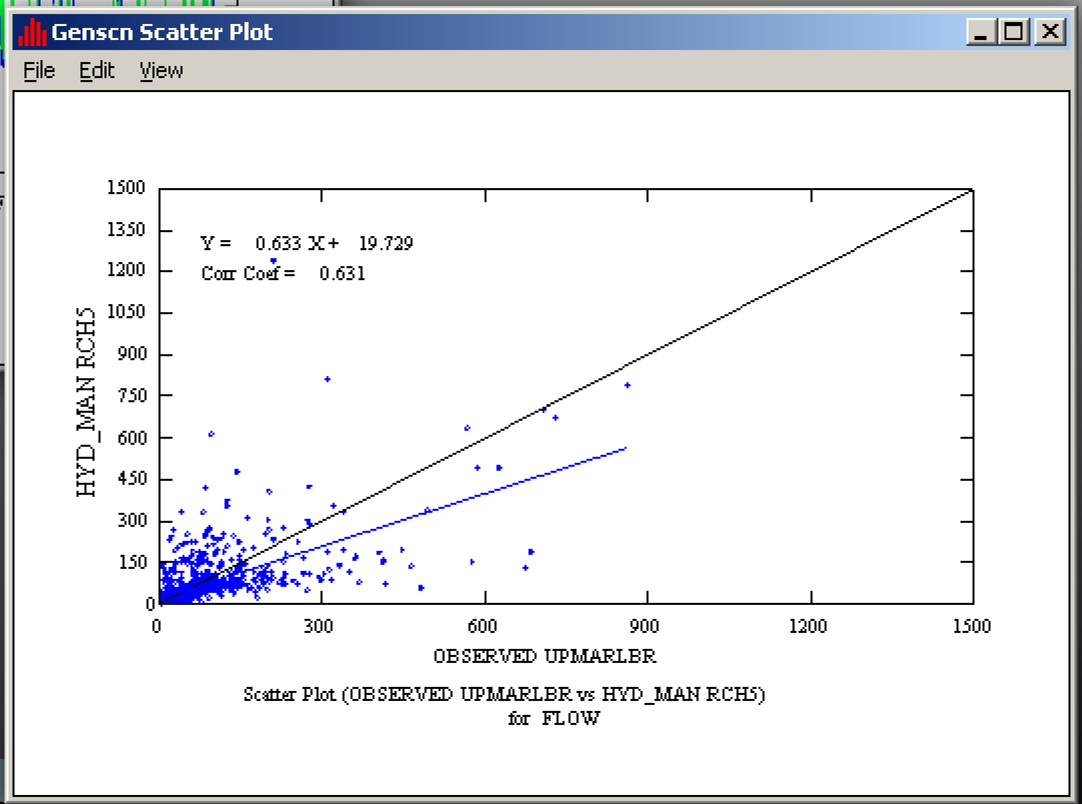
Name:	Hydrological Simulation Program – FORTRAN
Developer:	EPA & USGS
Website:	http://www2.epa.gov/exposure-assessment-models/hspf
Overview:	HSPF is a watershed model that simulates nonpoint source runoff and pollutant loadings for a watershed, combines these with point source contributions, and performs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

HSPF


Precipitation
Interception
Evapotranspiration
Evaporation
Surface Runoff
Interflow
Groundwater

HSPF Results





WISCONSIN DEPT. OF NATURAL RESOURCES

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

WISCONSIN DEPT. OF NATURAL RESOURCES

SWAT vs. HSPF

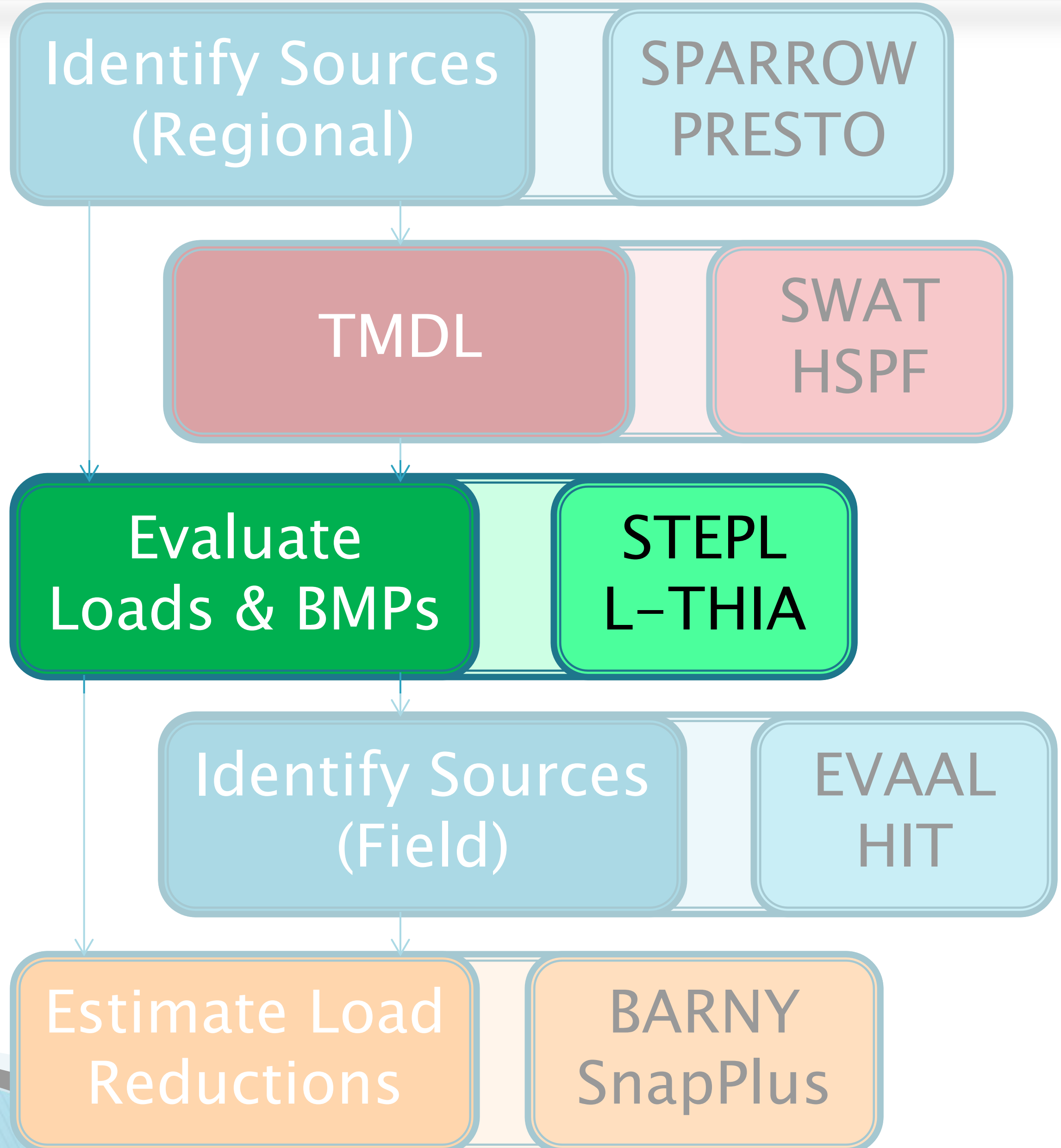
- Better representation of ag land practices
- Explicit plant growth
- Irrigation
- Better user interface

- Toxics
- Better river & lake processes

SWAT

HSPF

Models


Identify Sources (Regional)
SPARROW
PRESTO
TMDL
SWAT
HSPF
Evaluate Loads & BMPs
STEPL
L-THIA
Identify Sources (Field)
EVAAL
HIT
Estimate Load Reductions
BARNY
SnapPlus

STEPL

Name:	Spreadsheet Tool for Estimating Pollutant Load
Developer:	EPA/Tetra Tech
Website:	http://it.tetratech-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

WISCONSIN DEPT. OF NATURAL RESOURCES

STEPL Methods

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


NRCS Photo/Tim McCabe


CPRblog/Dave Owen

WISCONSIN DEPT. OF NATURAL RESOURCES

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	%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

WISCONSIN DEPT. OF NATURAL RESOURCES

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

WISCONSIN DEPT. OF NATURAL RESOURCES

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

https://engineering.purdue.edu/mapserve/www/lthia_wi/

L-THIA 2.0 Watershed Delin...

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.

Search

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.

Delineate

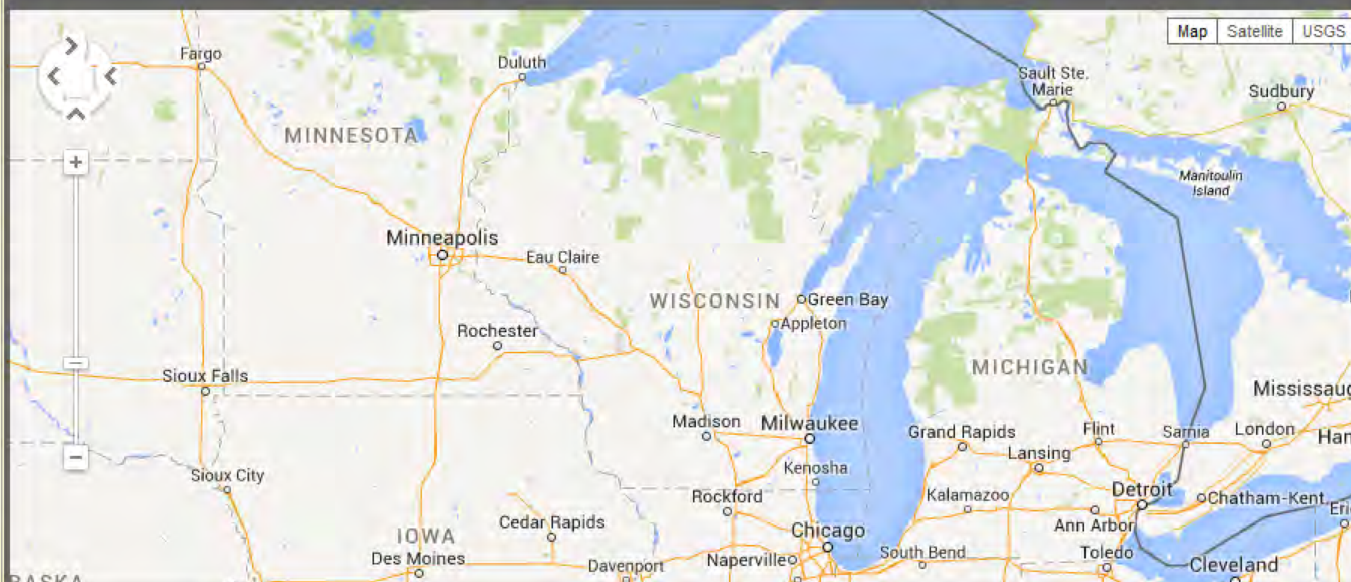
To enter a specific latitude- longitude select "Lat-Lon" button below , longitude with minus sign must be within -92.70000 to -87.00000 and

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

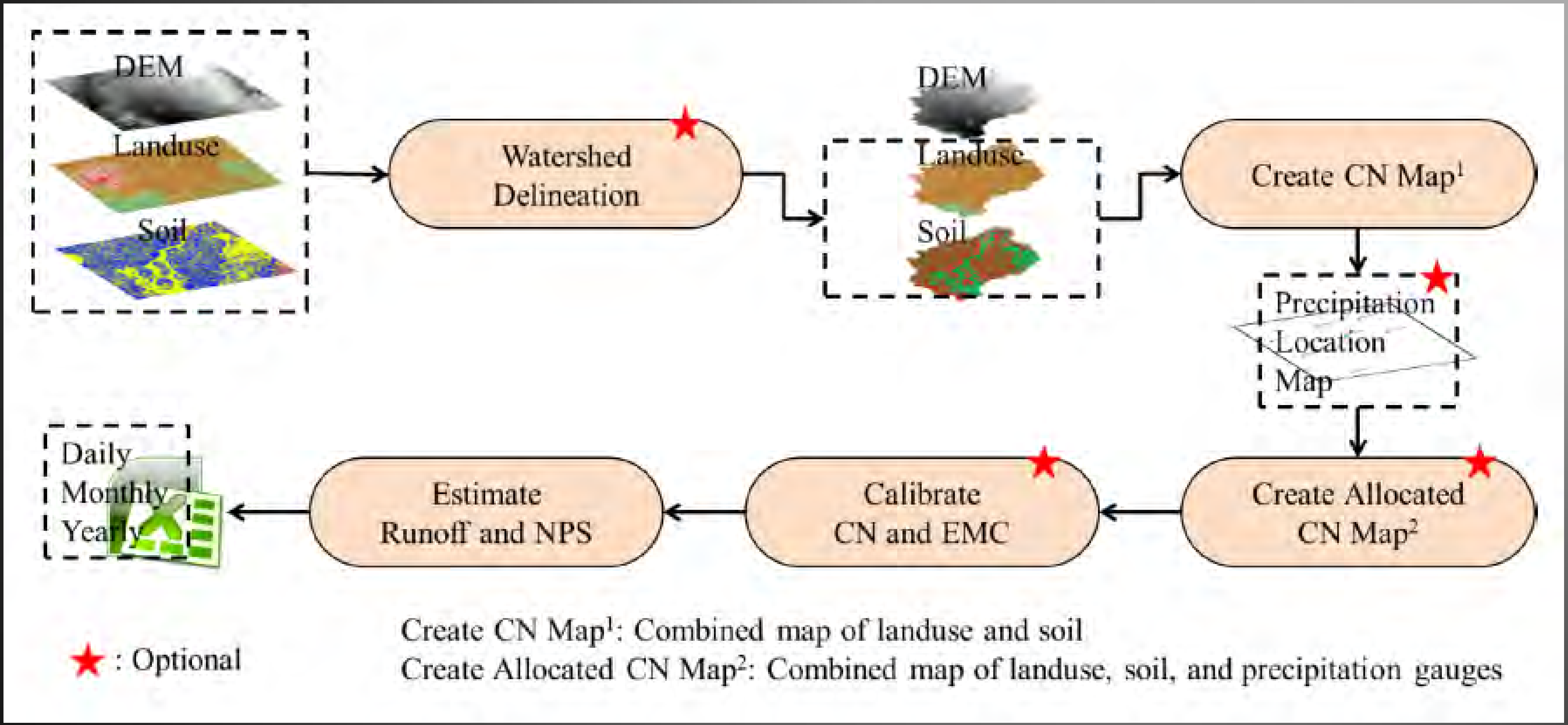
☑ Streaming Layer ☐ HIT Sediment ☐ HIT Erosion ☐ HUC 8, 10, and 12 layer ☐ NHD water layer

Metadata



http://35.8.121.111/glwms/

ArcL-THIA


DEM
Landuse
Soil
Watershed Delineation
DEM
Landuse
Soil
Create CN Map[1]
Precipitation Location Map
Create Allocated CN Map[2]
Calibrate CN and EMC
Estimate Runoff and NPS
Daily
Monthly
Yearly
★ : Optional
Create CN Map[1]: Combined map of landuse and soil
Create Allocated CN Map[2]: 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

Identify Sources (Regional) — SPARROW, PRESTO

TMDL — SWAT, HSPF

Evaluate Loads & BMPs — STEPL, L-THIA

Identify Sources (Field) — EVAAL, HIT

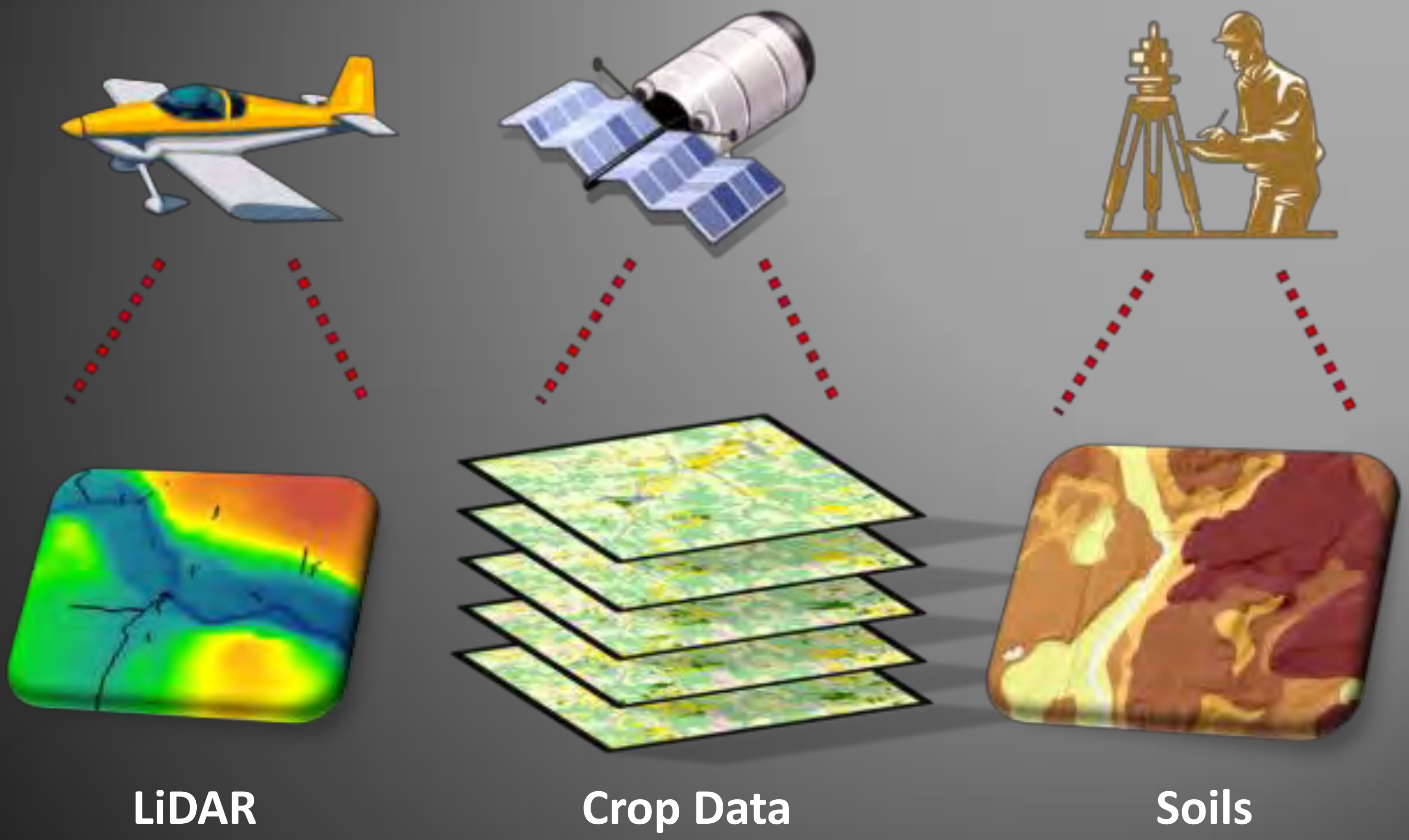
Estimate Load Reductions — BARNY, SnapPlus

WISCONSIN DEPT. OF NATURAL RESOURCES

EVAAL

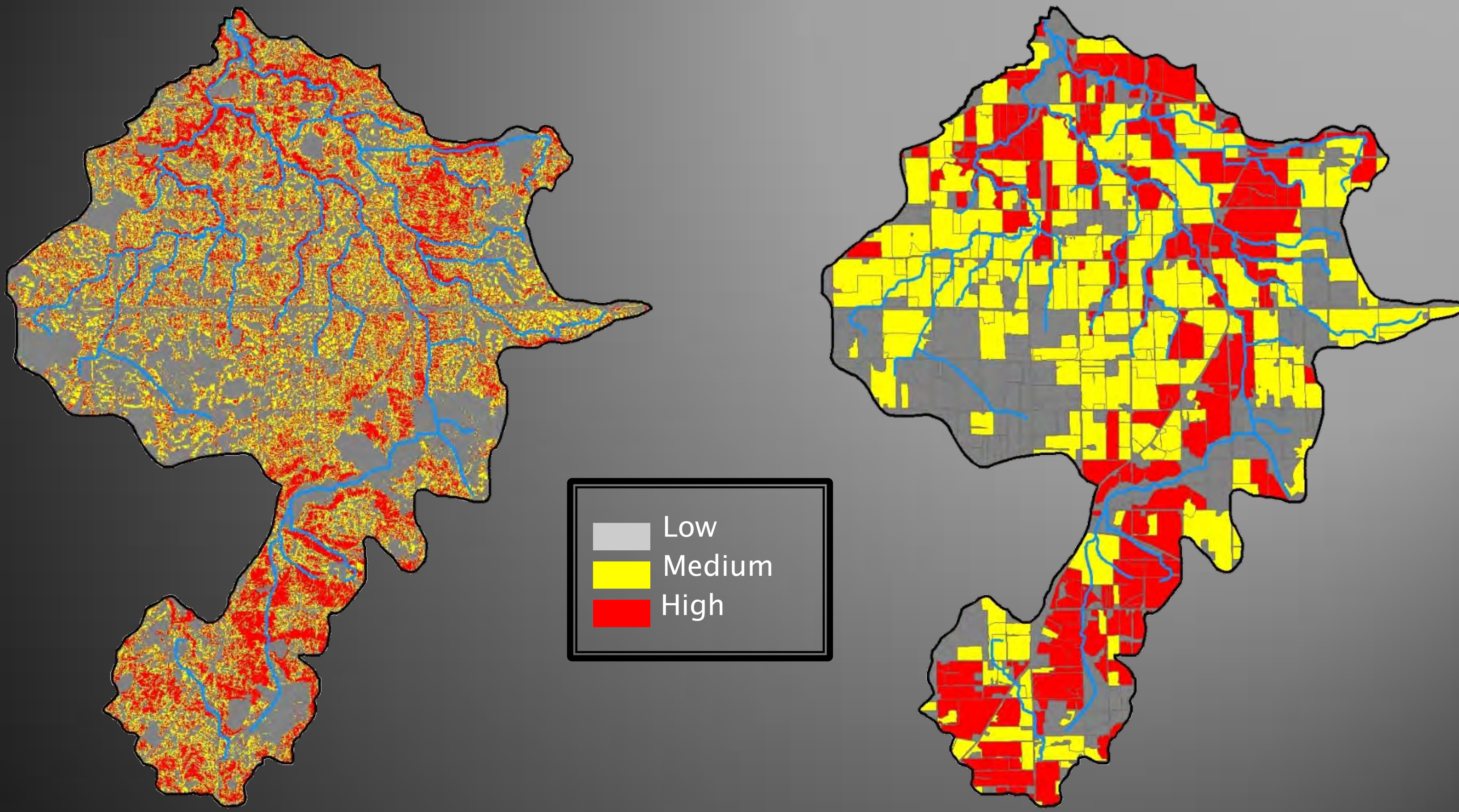
Name:	Erosion Vulnerability Assessment for Agricultural Lands
Developer:	WDNR
Website:	http://dnr.wi.gov/topic/nonpoint/evaal.html
Overview:	EVAAL evaluates locations of relative vulnerability to sheet, rill and gully erosion using information about topography, soils, rainfall and land cover. This tool 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



EVAAL

Erosion Vulnerability



EVAAL

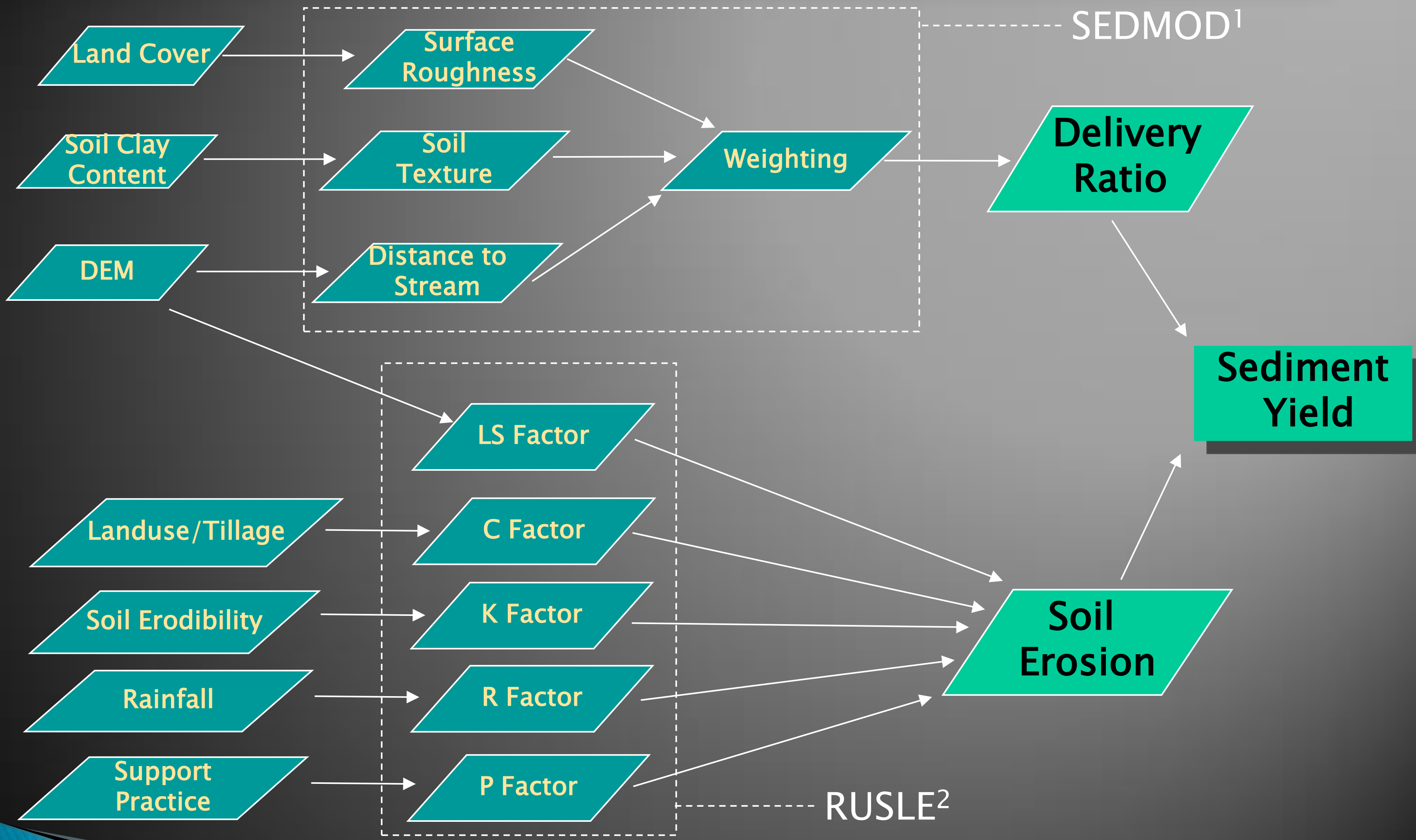
- Main Uses
  - Prioritize areas of highest erosion vulnerability
  - Visualize general crop rotations
  - Identify internally draining areas

- 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

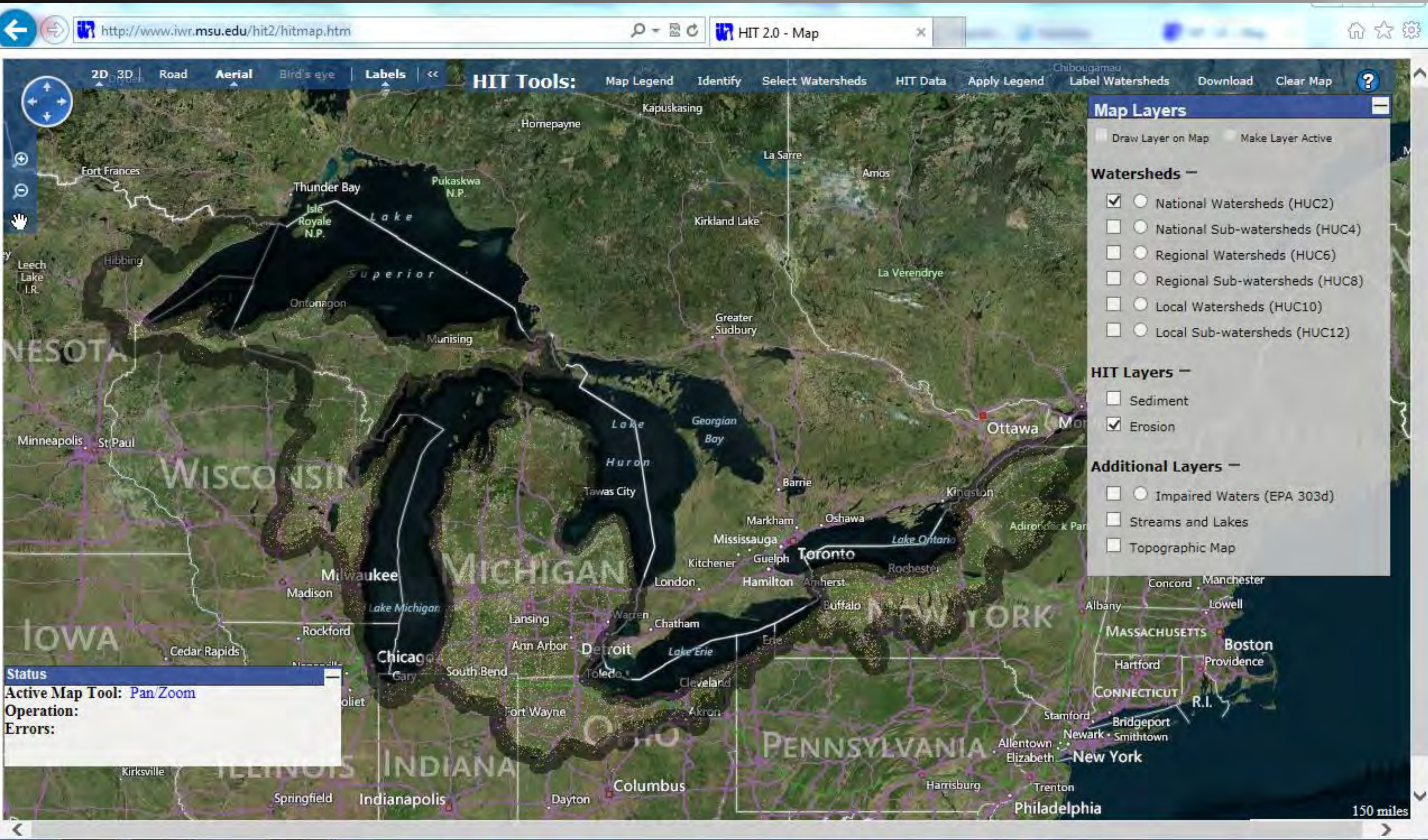
Name:	High Impact Targeting
Developer:	Michigan State University
Website:	http://www.iwr.msu.edu/hit2/
Overview:	HIT is an on-line tool that allows users to prioritize erosion and sedimentation reduction conservation efforts in the Great Lakes Basin. Users can compare watersheds by total erosion or sediment 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



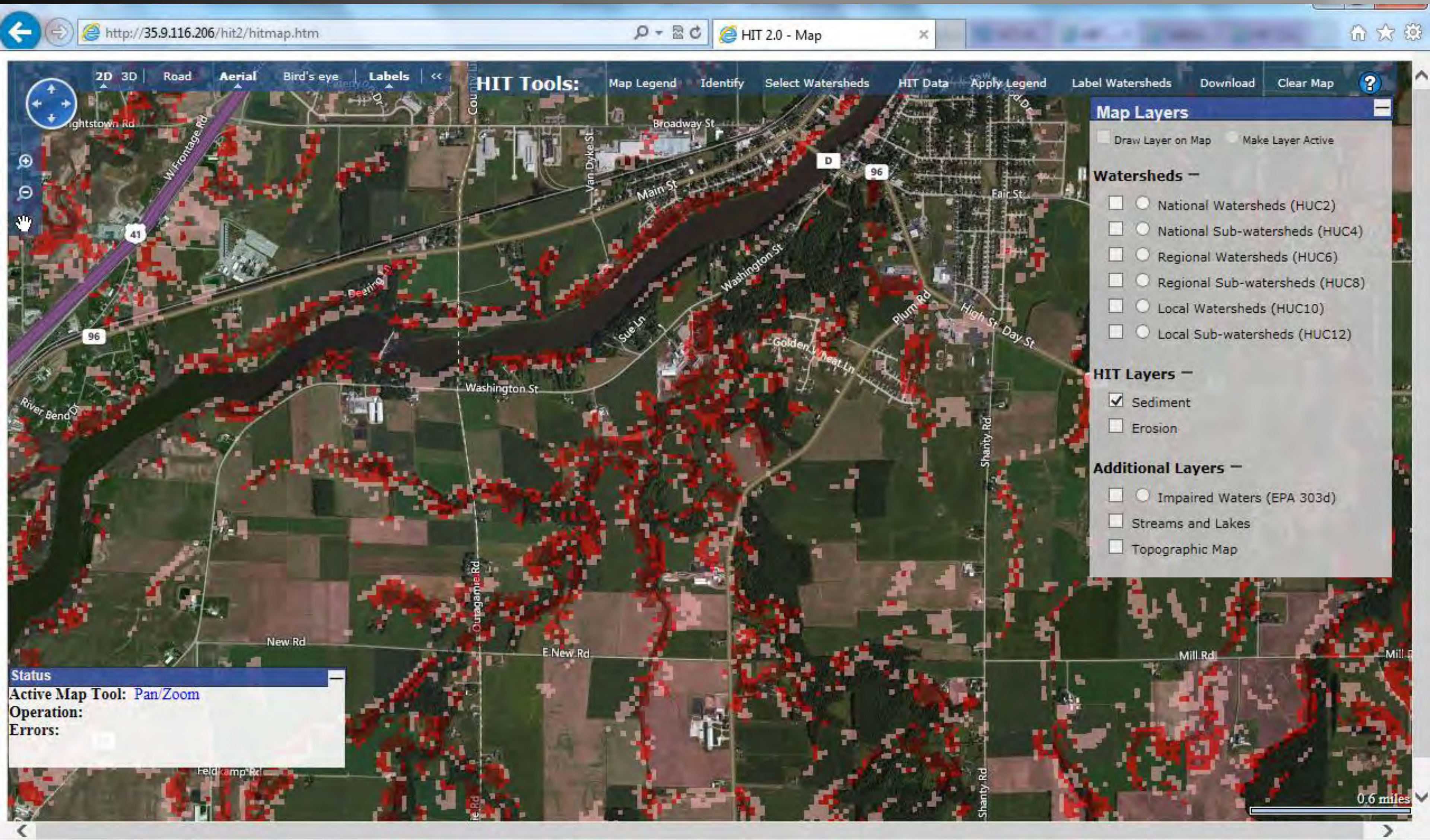
Land Cover
Soil Clay Content
DEM
Surface Roughness
Soil Texture
Distance to Stream
Weighting
SEDMOD[1]
Delivery Ratio
Sediment Yield
LS Factor
Landuse/Tillage
C Factor
Soil Erodibility
K Factor
Rainfall
R Factor
Support Practice
P Factor
RUSLE[2]
Soil Erosion

HIT



http://35.9.116.206/hit2/hitmap.htm

HIT



http://35.9.116.206/hit2/hitmap.htm
HIT 2.0 - Map
2D 3D
Road
Aerial
Bird's eye
Labels
HIT Tools:
Map Legend
Identify
Select Watersheds
HIT Data
Apply Legend
Label Watersheds
Download
Clear Map
Map Layers
Draw Layer on Map
Make Layer Active
Watersheds
National Watersheds (HUC2)
National Sub-watersheds (HUC4)
Regional Watersheds (HUC6)
Regional Sub-watersheds (HUC8)
Local Watersheds (HUC10)
Local Sub-watersheds (HUC12)
HIT Layers
Sediment
Erosion
Additional Layers
Impaired Waters (EPA 303d)
Streams and Lakes
Topographic Map
Status
Active Map Tool: Pan/Zoom
Operation:
Errors:
Broadway St
Main St
Washington St
Fair St
Plum Rd
High St
Day St
Sue Ln
Golden Wheat Ln
Deering Dr
River Bend Dr
W Frontage Rd
Van Dyke St
Shanty Rd
Outagamie Rd
New Rd
E New Rd
Mill Rd
Feldkamp Rd
96
41
D
0.6 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

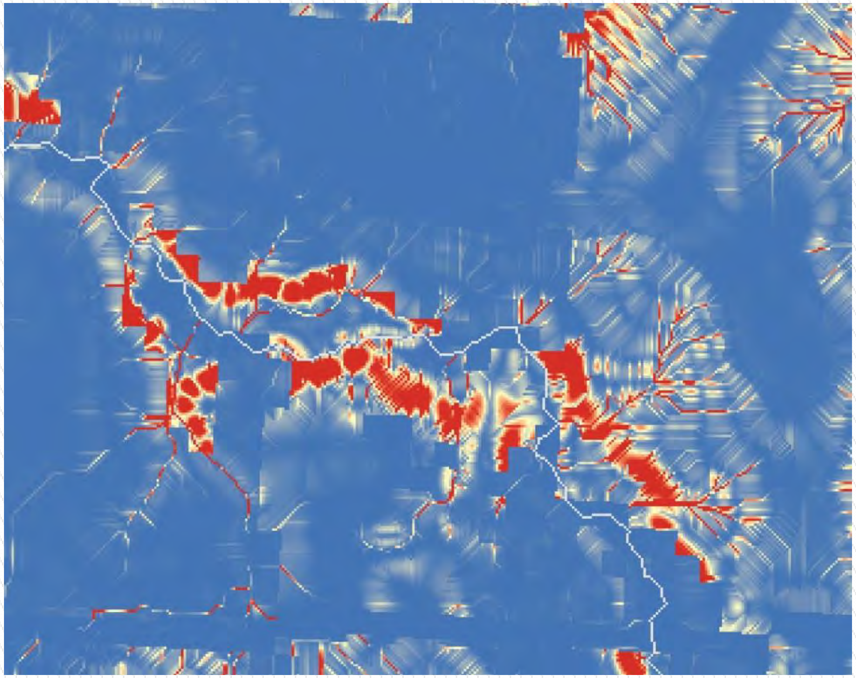
- Specific to Wisconsin
- Uses LiDAR
- Can run analysis on you own data
- Crop rotation info

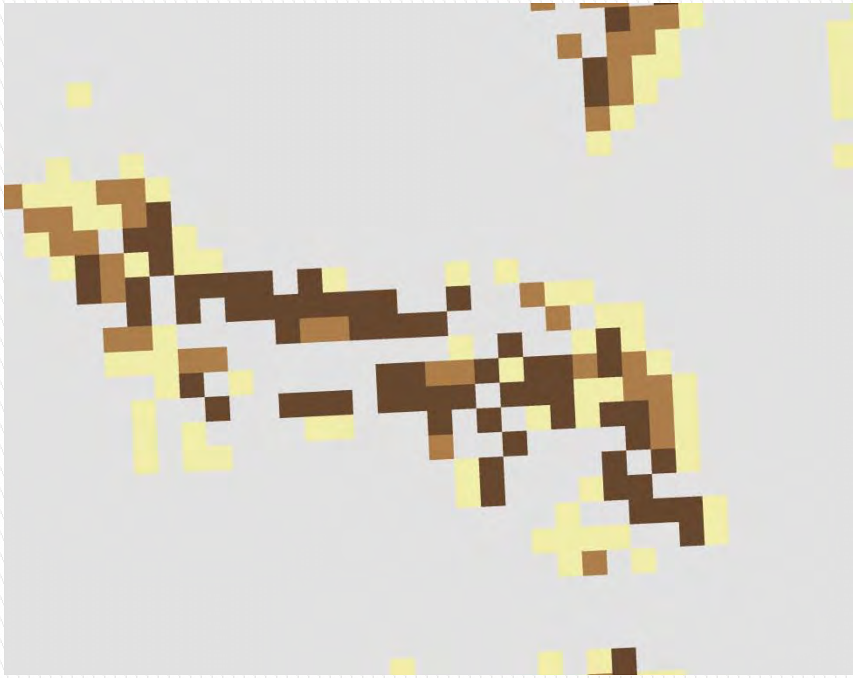
- Easy to view online
- Gives estimate of sediment delivery
- Apply BMPs (only in Fox/Wolf Basin)

EVAAL

HIT

EVAAL vs. HIT





EVAAL

HIT

Models

Identify Sources (Regional)

SPARROW
PRESTO

TMDL

SWAT
HSPF

Evaluate Loads & BMPs

STEPL
L-THIA

Identify Sources (Field)

EVAAL
HIT

Estimate Load Reductions

BARNY
SnapPlus

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

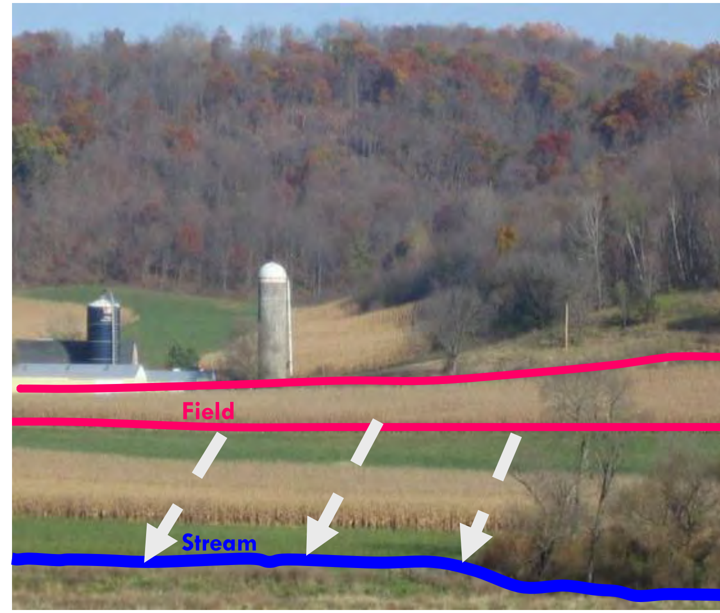
SnapPlus

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

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

→ **Phosphorus Index** →



Annual (Crop Year):

Total P Index

Soluble P Index

Particulate P Index

Rotation:

Average Total P Index

Laura Ward Good

SnapPlus

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

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

WISCONSIN DEPT. OF NATURAL RESOURCES

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

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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)

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P8

Name:	Program for Predicting Polluting Particle Passage thru Pits, Puddles, & Ponds
Developer:	William W. Walker, Jr., Ph.D.
Website:	http://wwwalker.net/p8/
Overview:	P-8 is a model for predicting the generation and transport of storm water runoff pollutants in urban watersheds. The model has been developed for use by engineers and planners in designing and evaluating runoff treatment schemes for existing or proposed urban developments. The model is used to examine the water quality implications of alternative treatment objectives.
Type:	Landscape
Scale:	Basin
Land use:	Urban
Complexity:	Medium-Low
Format:	Software

WISCONSIN DEPT. OF NATURAL RESOURCES

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

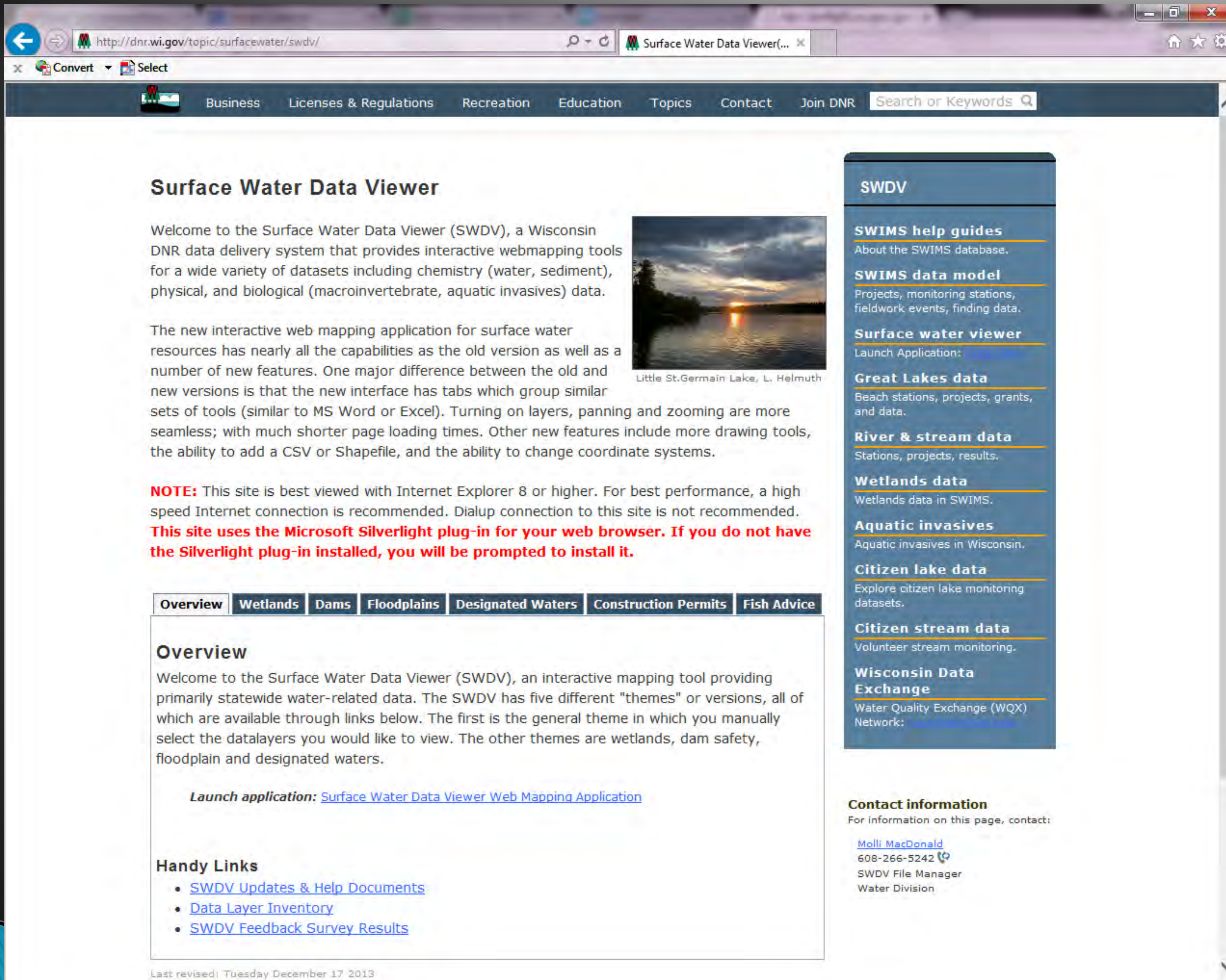
- Interactive Web Mapping Applications
- Online information and data
- GIS Data

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(...

Convert | Select

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:

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.

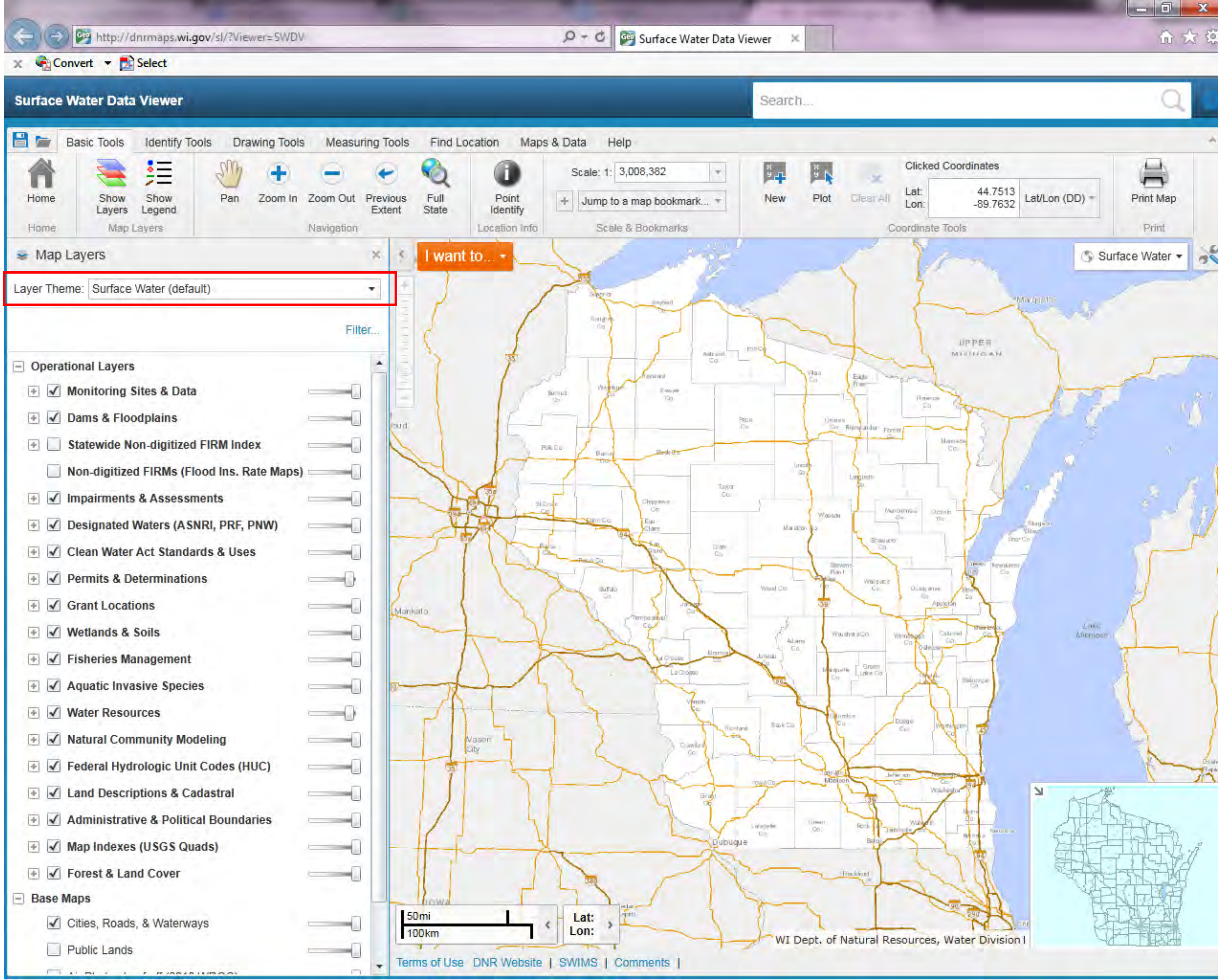
Wisconsin Data Exchange
Water Quality Exchange (WQX) Network:

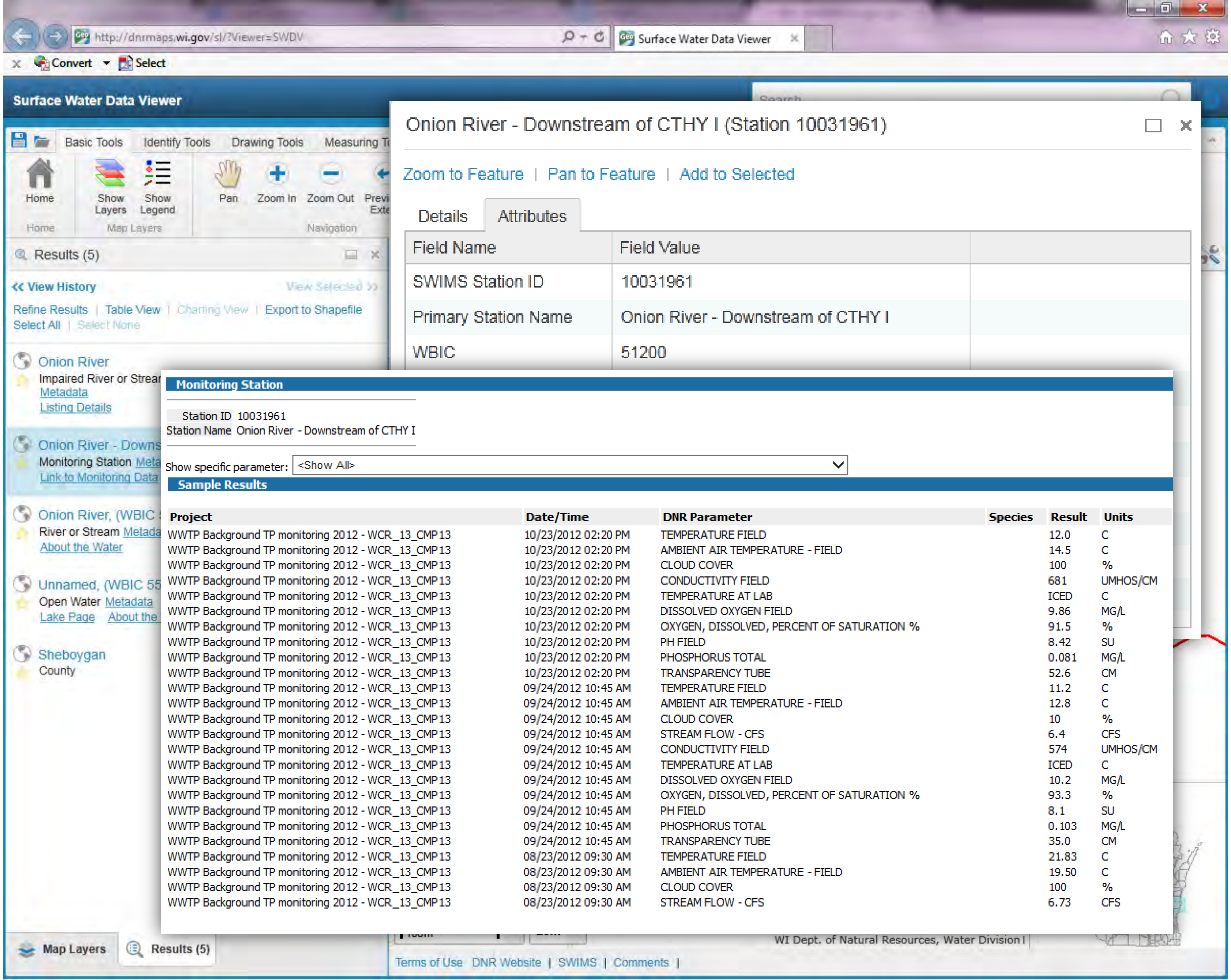
Contact information
For information on this page, contact:

Molli MacDonald
608-266-5242
SWDV File Manager
Water Division

WISCONSIN DEPT. OF NATURAL RESOURCES

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


http://dnrmaps.wi.gov/sl/?Viewer=SWDV
Surface Water Data Viewer
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
Jump to a map bookmark...
New
Plot
Clear All
Clicked Coordinates
Lat: 44.7513
Lon: -89.7632
Lat/Lon (DD)
Print Map
Home
Map Layers
Navigation
Location Info
Scale & Bookmarks
Coordinate Tools
Print
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
I want to...
Surface Water
UPPER MICHIGAN
Lake Michigan
Mankato
Mason City
Dubuque
50mi
100km
Lat:
Lon:
WI Dept. of Natural Resources, Water Division |
Terms of Use | DNR Website | SWIMS | Comments |



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

Surface Water Data Viewer

Convert | Select

Surface Water Data Viewer

Basic Tools | Identify Tools | Drawing Tools | Measuring T

Home | Show Layers | Show Legend | Pan | Zoom In | Zoom Out | Previ Exte

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 Strea
Metadata
Listing Details

Onion River - Downs
Monitoring Station Meta
Link to Monitoring Data

Onion River, (WBIC
River or Stream Metada
About the Water

Unnamed, (WBIC 55
Open Water Metadata
Lake Page About the

Sheboygan
County

Map Layers | Results (5)

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>

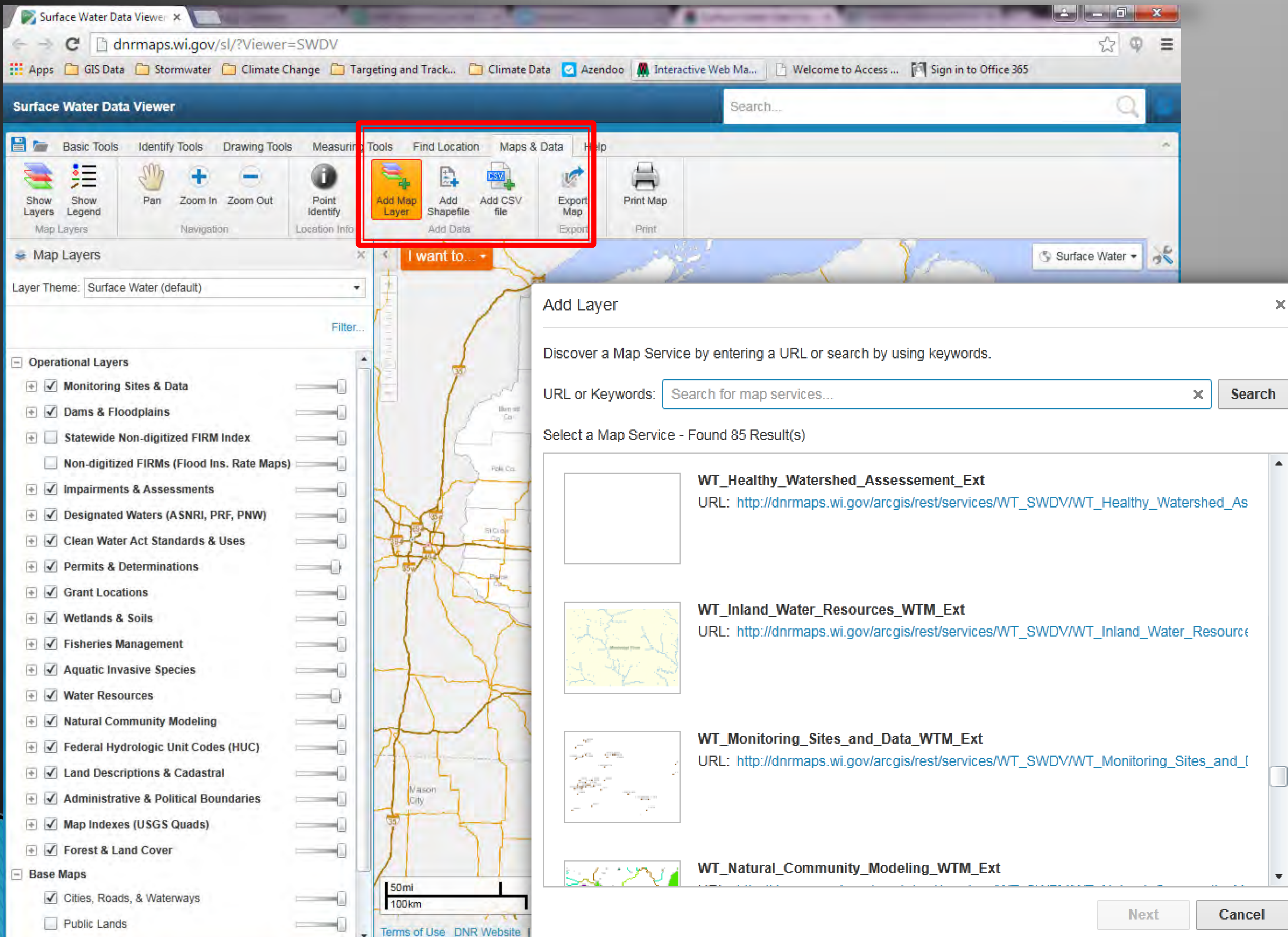
Sample Results

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

WI Dept. of Natural Resources, Water Division |

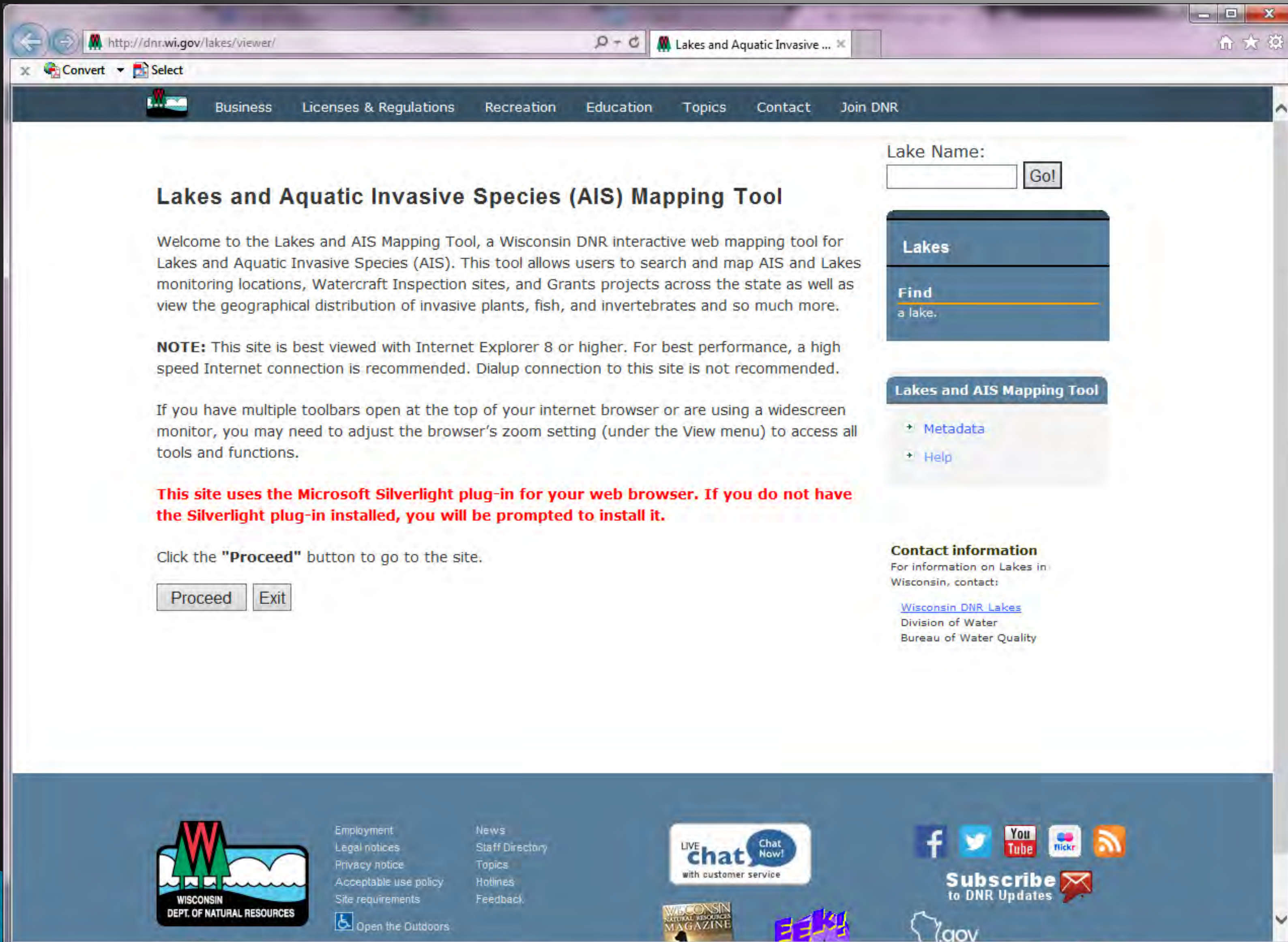
Terms of Use | DNR Website | SWIMS | Comments |

Add Data

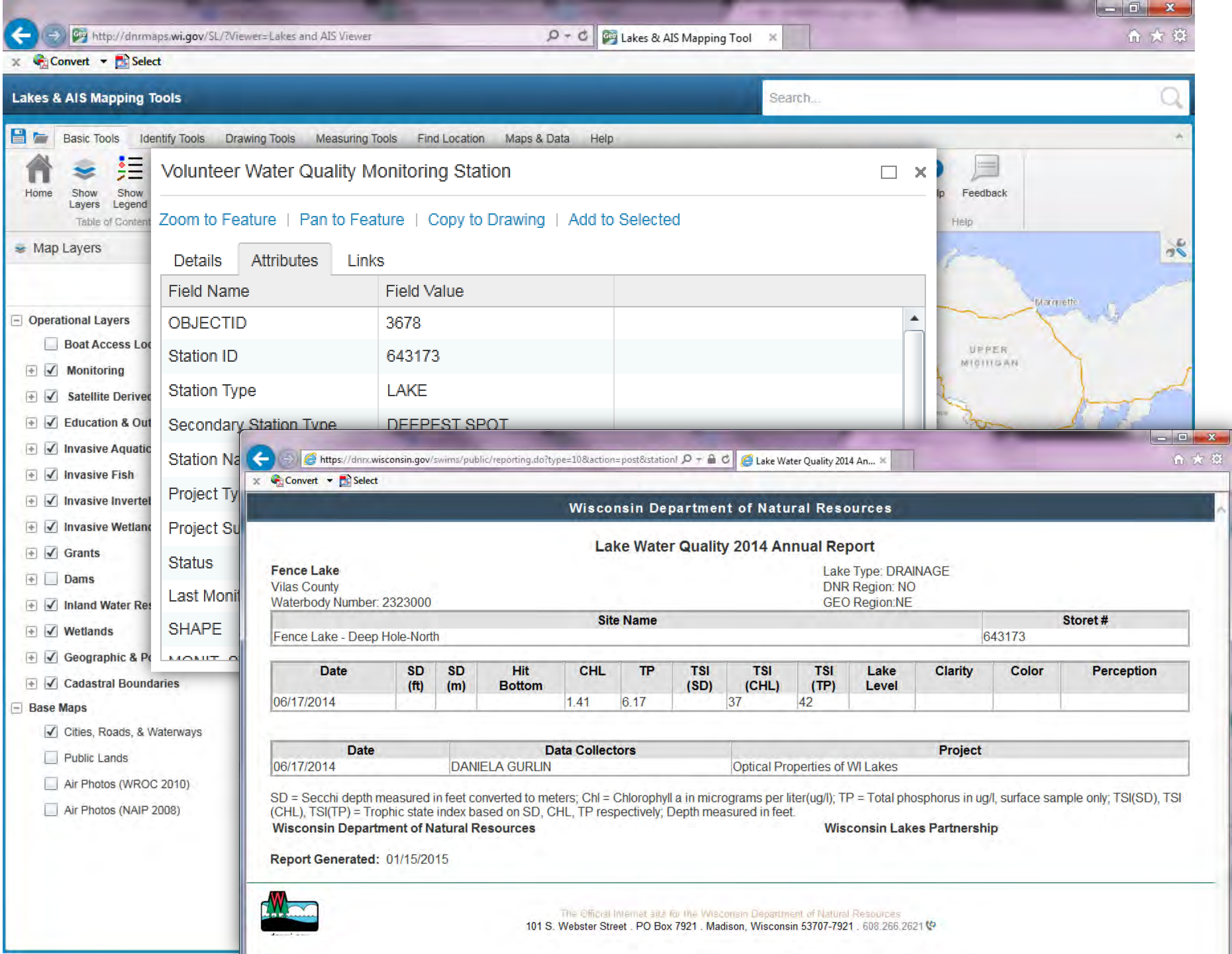


Surface Water Data Viewer
dnrmaps.wi.gov/sl/?Viewer=SWDV
Apps GIS Data Stormwater Climate Change Targeting and Track... Climate Data Azendoo Interactive Web Ma... Welcome to Access ... Sign in to Office 365
Surface Water Data Viewer
Search...
Basic Tools Identify Tools Drawing Tools Measuring Tools Find Location Maps & Data Help
Show Layers Show Legend Pan Zoom In Zoom Out Point Identify Add Map Layer Add Shapefile Add CSV file Export Map Print Map
Map Layers Navigation Location Info Add Data Export Print
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
I want to...
Surface Water
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_Assessement_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_[
WT_Natural_Community_Modeling_WTM_Ext
Next Cancel

Lakes & AIS Viewer



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



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	Storet #
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

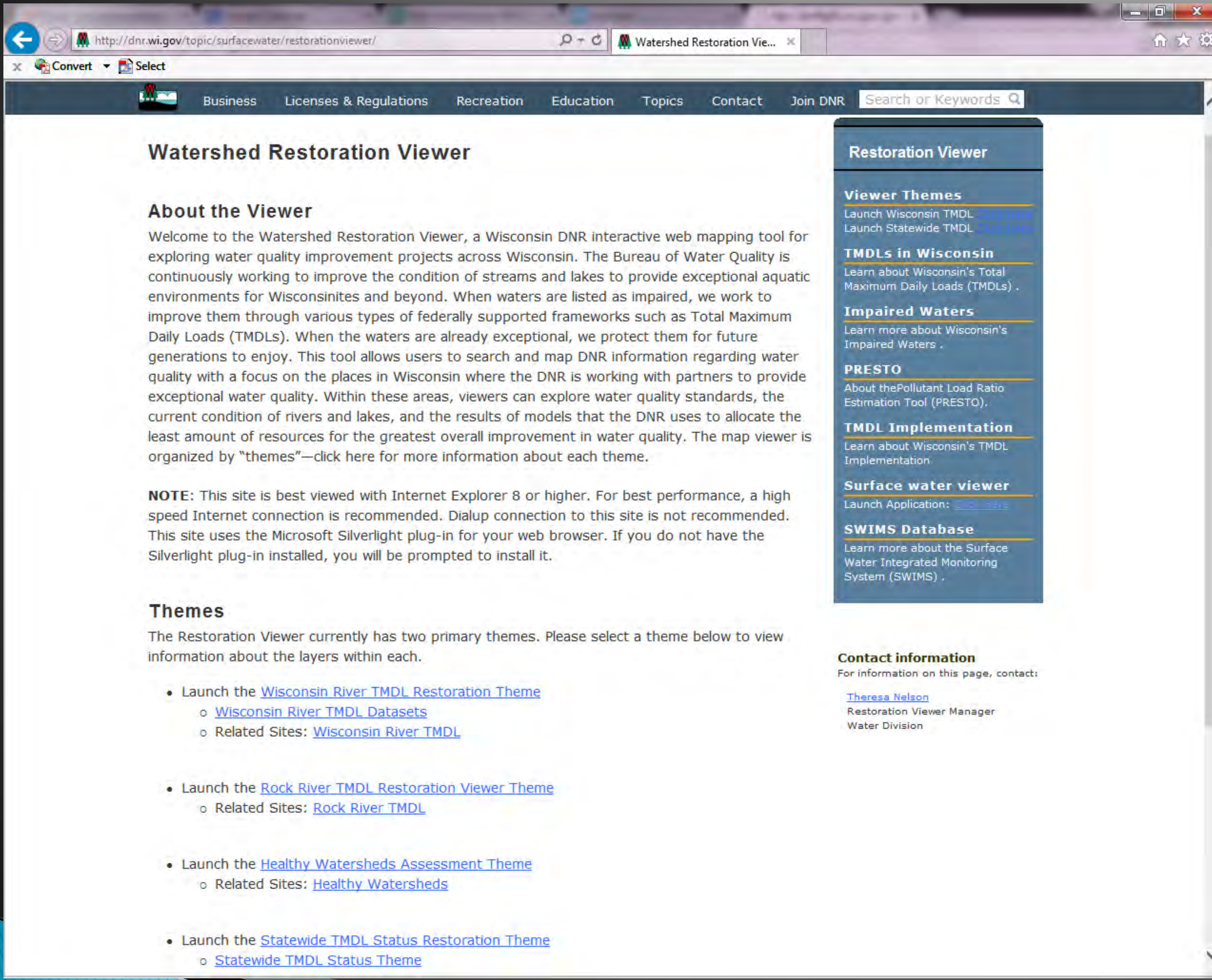
SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI (CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources **Wisconsin Lakes Partnership**

Report Generated: 01/15/2015

The Official Internet site for the Wisconsin Department of Natural Resources
101 S. Webster Street . PO Box 7921 . Madison, Wisconsin 53707-7921 . 608.266.2621

Watershed Restoration Viewer


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

Watershed Restoration Vie...

Convert | Select

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 thePollutant Load Ratio Estimation Tool (PRESTO).

TMDL Implementation
Learn about Wisconsin's TMDL Implementation

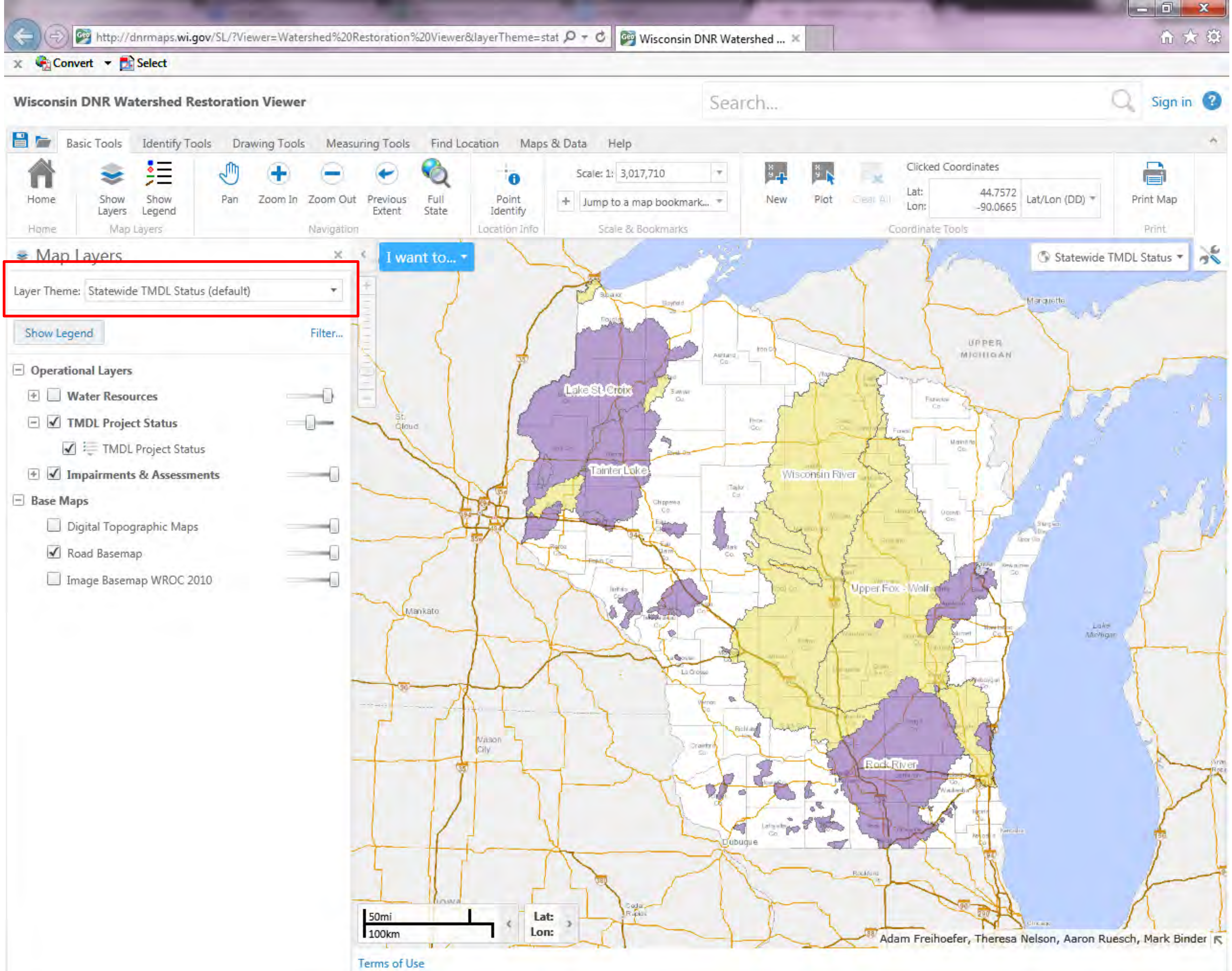
Surface water viewer
Launch Application: Click here

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

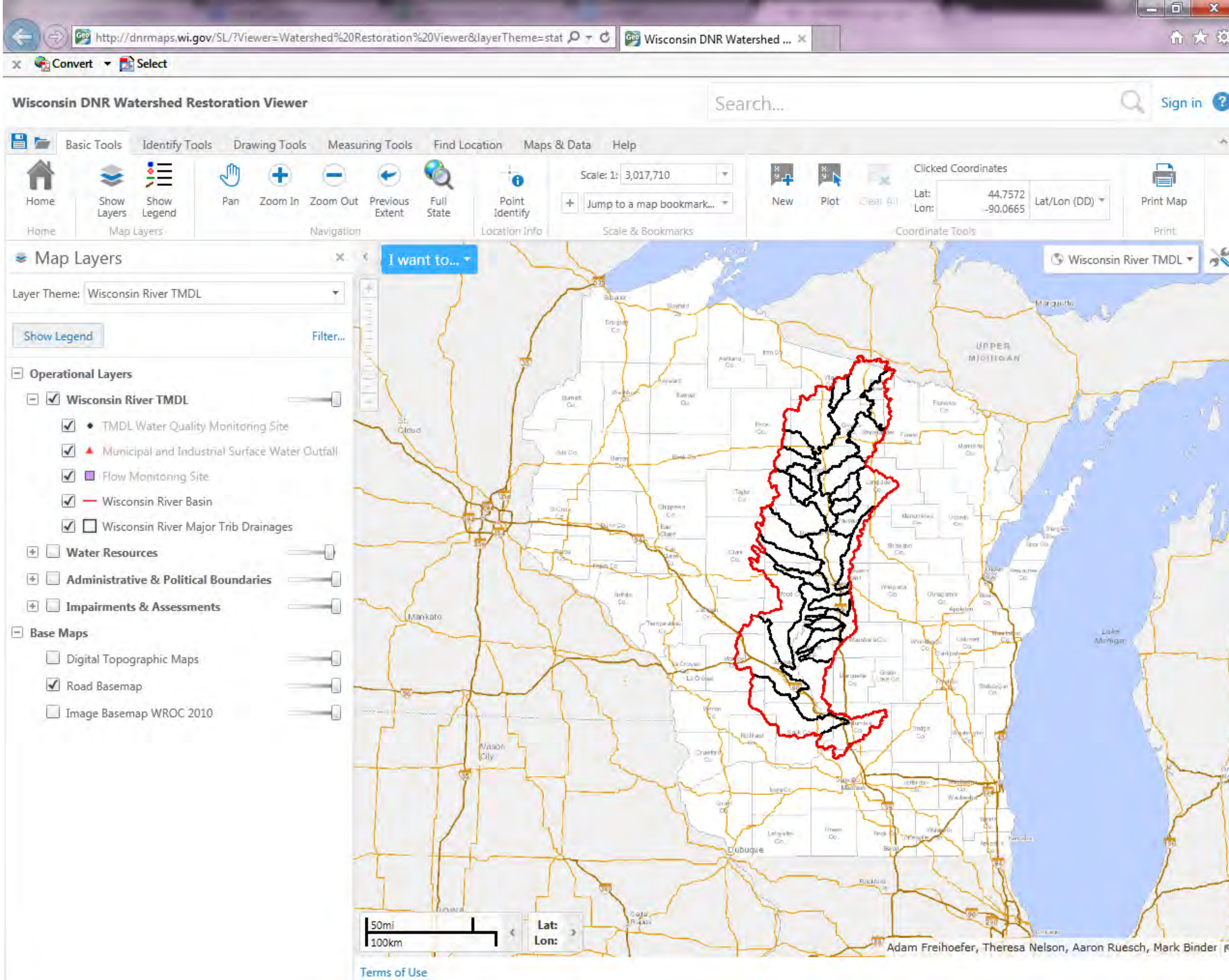
Contact information
For information on this page, contact:

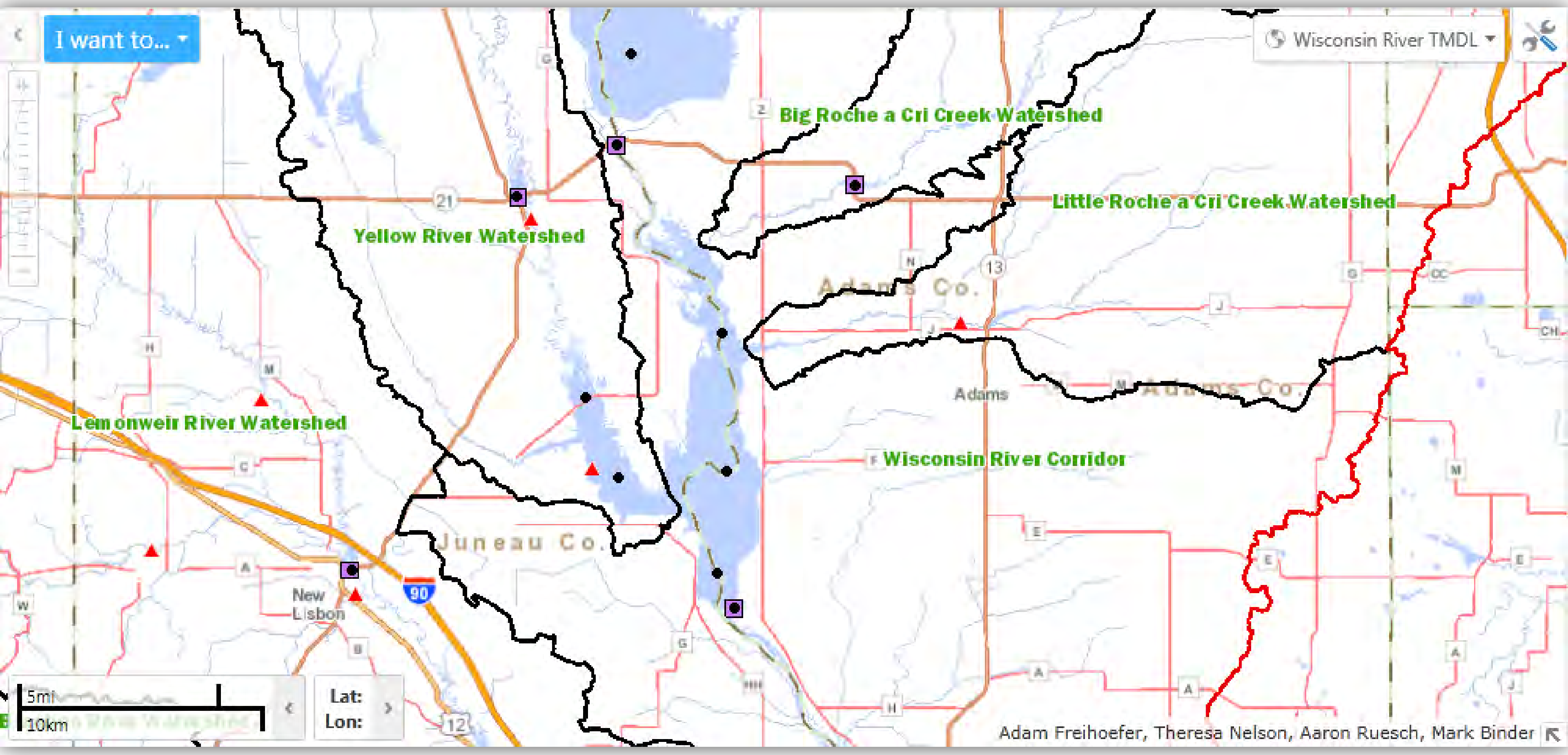
Theresa Nelson
Restoration Viewer Manager
Water Division

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

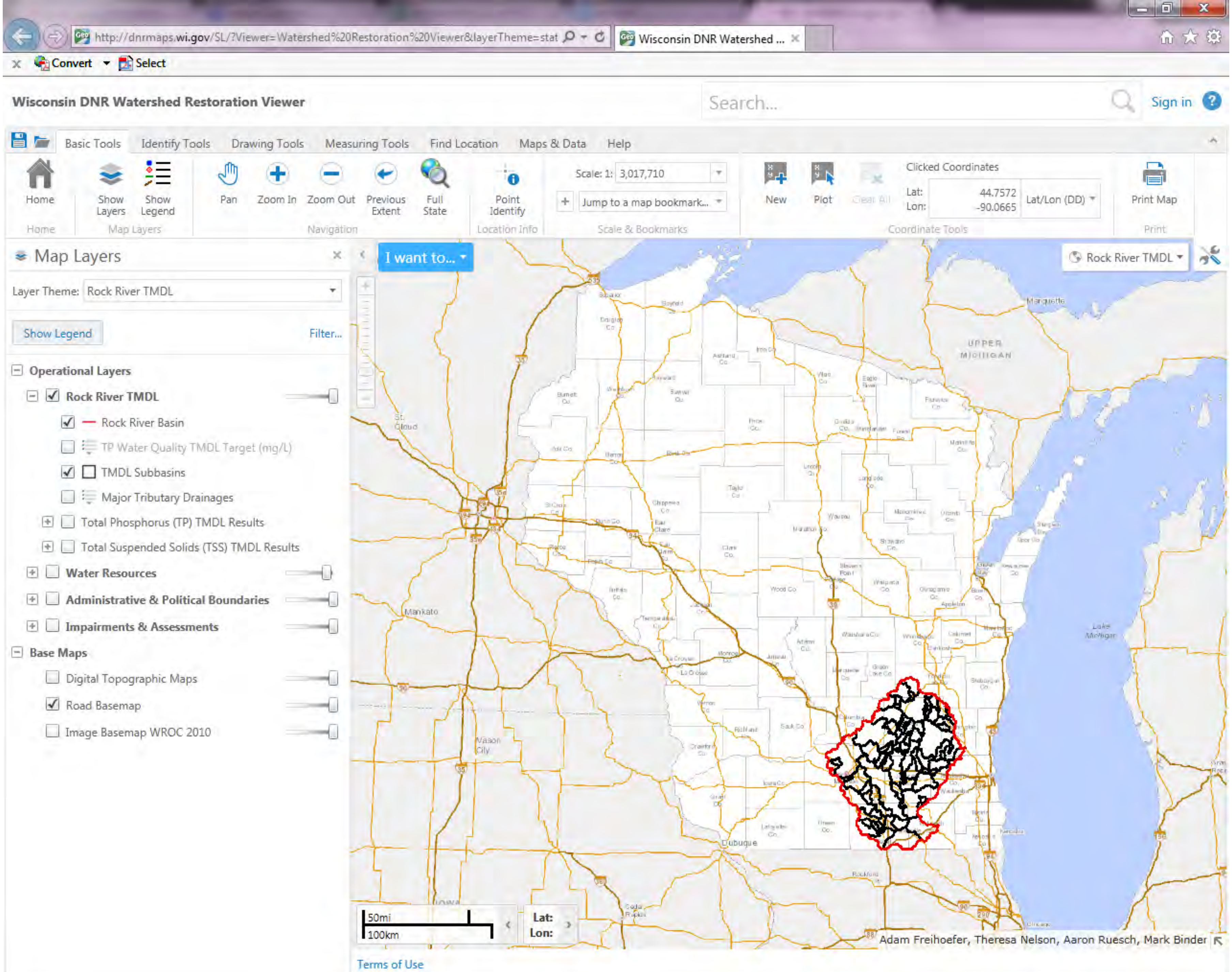


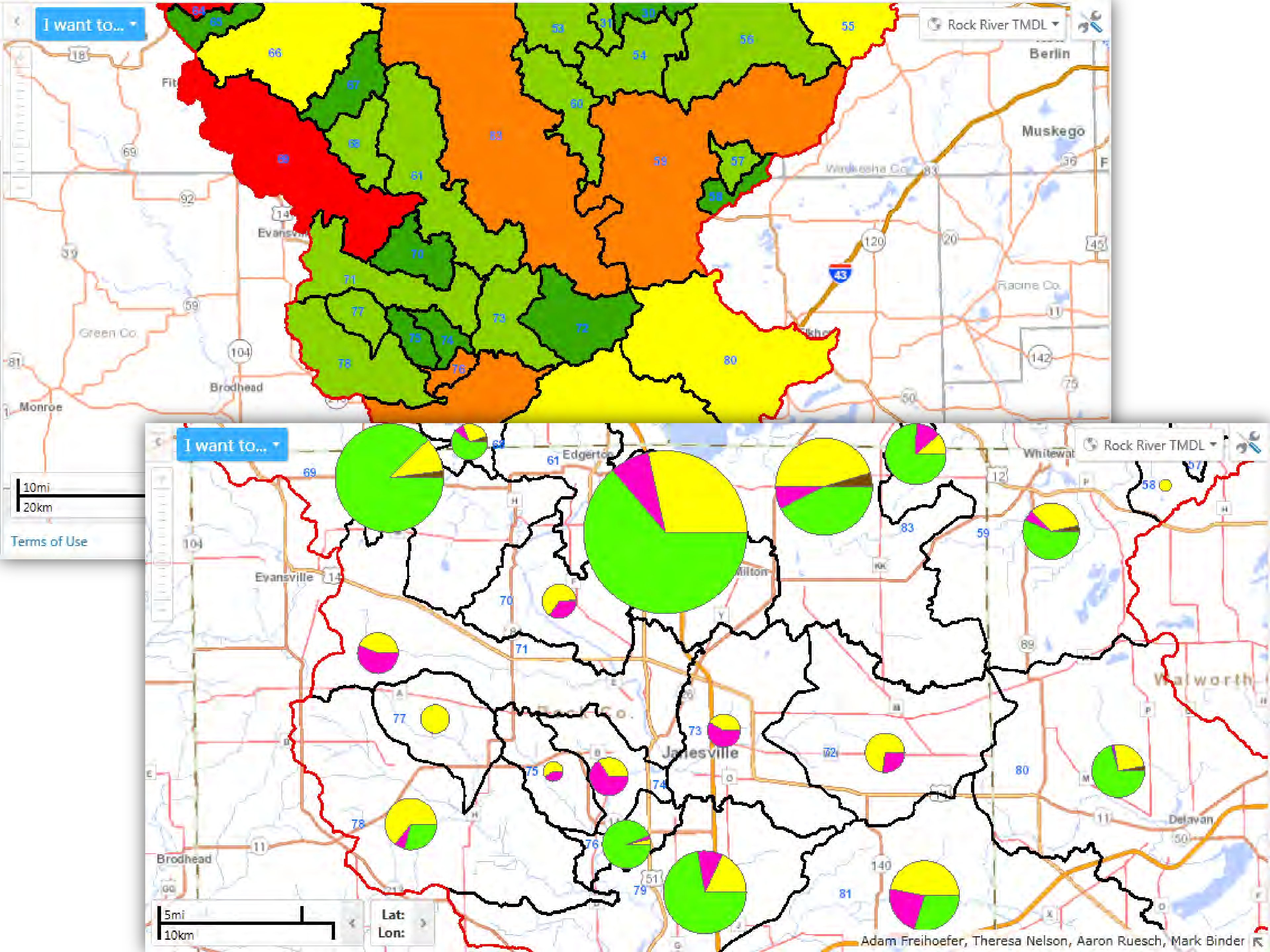
http://dnrmaps.wi.gov/SL/?Viewer=Watershed%20Restoration%20Viewer&layerTheme=stat
Wisconsin DNR Watershed ...
Convert
Select
Wisconsin DNR Watershed Restoration Viewer
Search...
Sign in
Basic Tools
Identify Tools
Drawing Tools
Measuring Tools
Find Location
Maps & Data
Help
Home
Show Layers
Show Legend
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
Home
Map Layers
Navigation
Location Info
Scale & Bookmarks
Coordinate Tools
Print
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
I want to...
Statewide TMDL Status
Lake St. Croix
Tainter Lake
Wisconsin River
Upper Fox - Wolf
Rock River
UPPER MICHIGAN
Marquette
Lake Michigan
Mankato
Mason City
Dubuque
St. Cloud
50mi
100km
Lat:
Lon:
Adam Freihoefer, Theresa Nelson, Aaron Ruesch, Mark Binder
Terms of Use

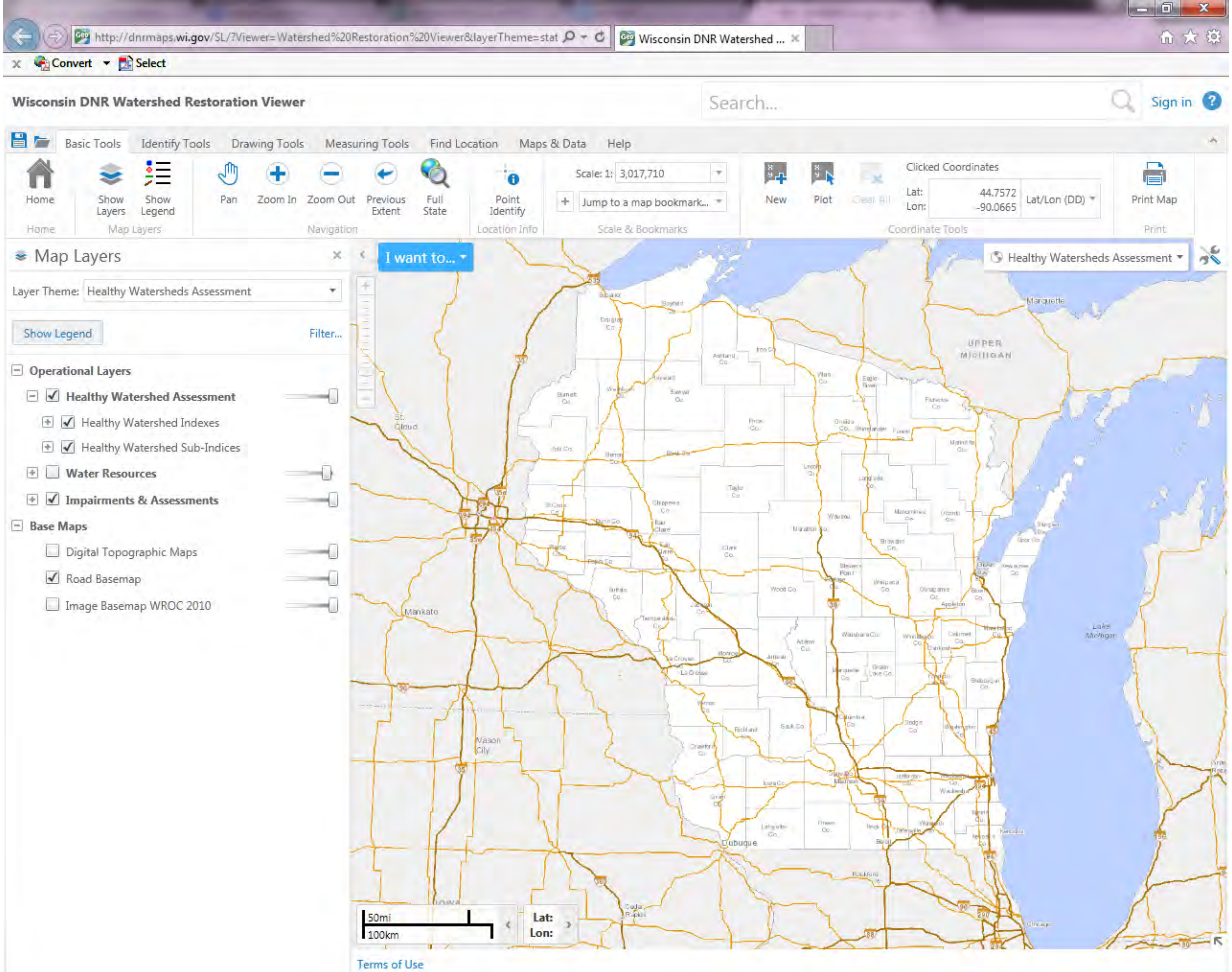

http://dnrmaps.wi.gov/SL/?Viewer=Watershed%20Restoration%20Viewer&layerTheme=stat
Wisconsin DNR Watershed ...
Convert
Select
Wisconsin DNR Watershed Restoration Viewer
Search...
Sign in
Basic Tools
Identify Tools
Drawing Tools
Measuring Tools
Find Location
Maps & Data
Help
Home
Show Layers
Show Legend
Map Layers
Pan
Zoom In
Zoom Out
Previous Extent
Full State
Navigation
Point Identify
Location Info
Scale: 1: 3,017,710
Jump to a map bookmark...
Scale & Bookmarks
New
Plot
Clear All
Clicked Coordinates
Lat: 44.7572
Lon: -90.0665
Lat/Lon (DD)
Coordinate Tools
Print Map
Print
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
I want to...
Wisconsin River TMDL
UPPER MICHIGAN
Lake Michigan
St. Cloud
Mankato
Mason City
Dubuque
50mi
100km
Lat:
Lon:
Adam Freihoefer, Theresa Nelson, Aaron Ruesch, Mark Binder
Terms of Use

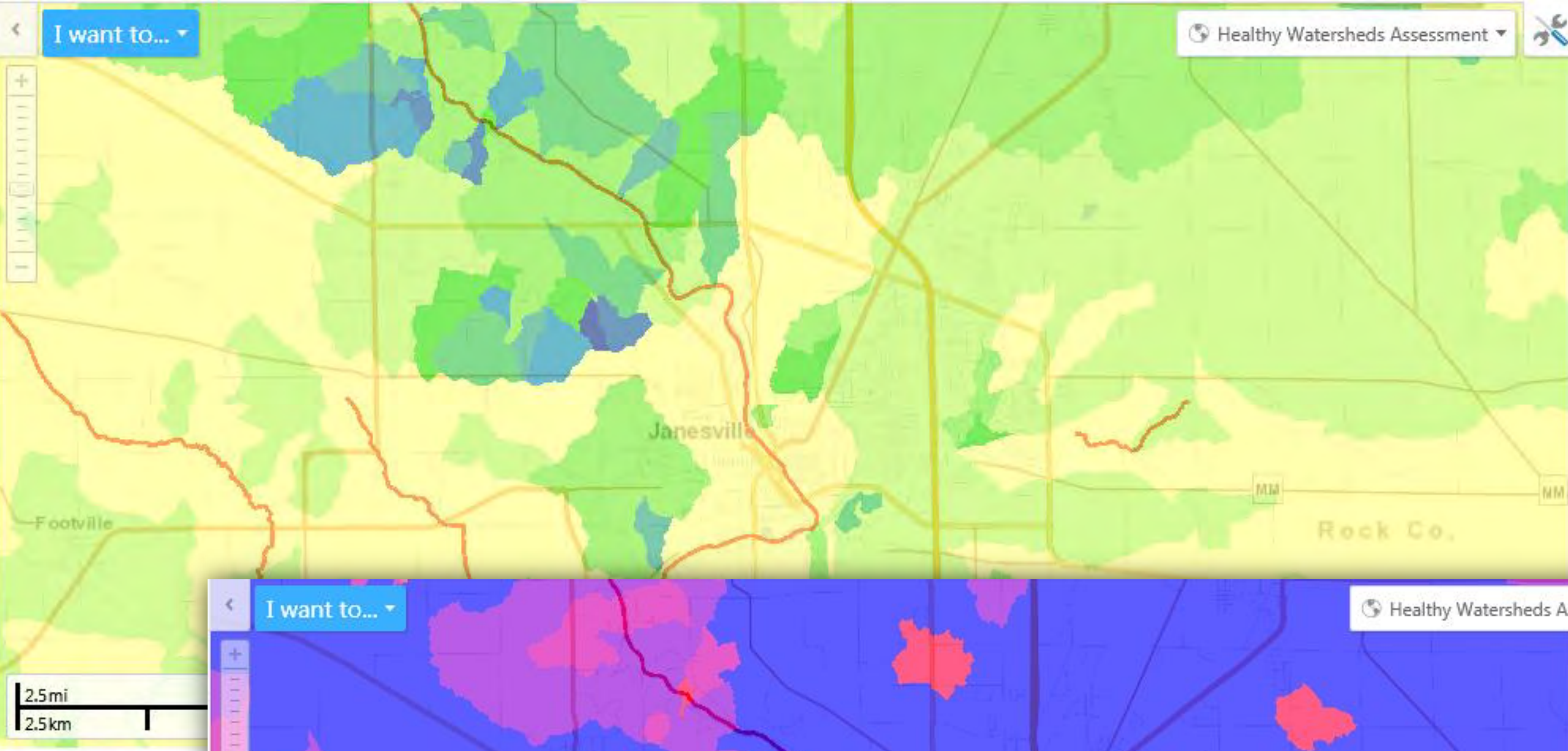


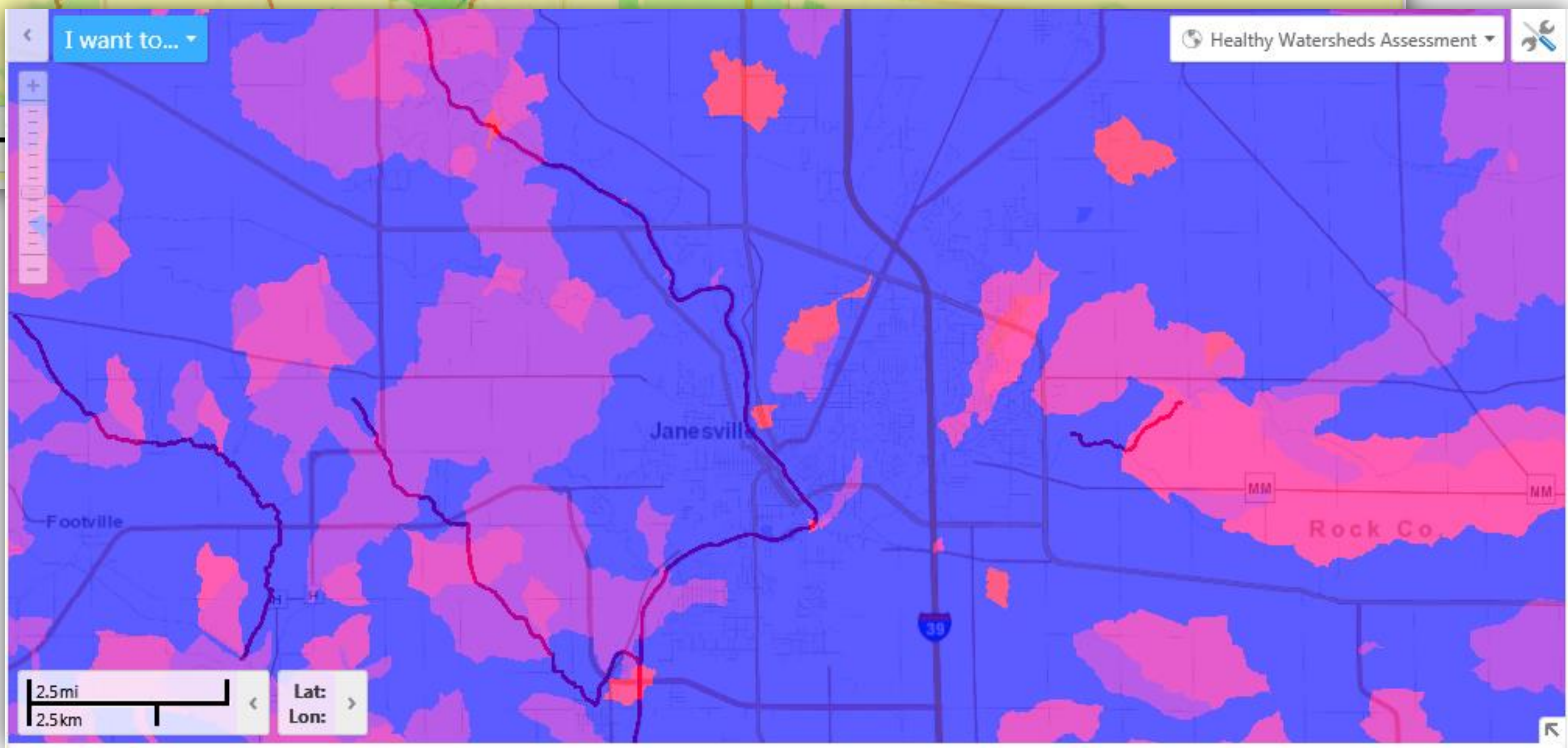
I want to...
Wisconsin River TMDL
Big Roche a Cri Creek Watershed
Little Roche a Cri Creek Watershed
Yellow River Watershed
Lemonweir River Watershed
Wisconsin River Corridor
Adams Co.
Adams
Juneau Co.
New Lisbon
90
21
13
12
5mi
10km
Lat:
Lon:
Adam Freihoefer, Theresa Nelson, Aaron Ruesch, Mark Binder


http://dnrmaps.wi.gov/SL/?Viewer=Watershed%20Restoration%20Viewer&layerTheme=stat
Wisconsin DNR Watershed ...
Convert
Select
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
Map Layers
Pan
Zoom In
Zoom Out
Previous Extent
Full State
Navigation
Point Identify
Location Info
Scale: 1: 3,017,710
Jump to a map bookmark...
Scale & Bookmarks
New
Plot
Clear All
Clicked Coordinates
Lat: 44.7572
Lon: -90.0665
Lat/Lon (DD)
Coordinate Tools
Print Map
Print
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
I want to...
Rock River TMDL
UPPER MICHIGAN
Marquette
St. Cloud
Mankato
Mason City
Dubuque
Lake Michigan
50mi
100km
Lat:
Lon:
Adam Freihoefer, Theresa Nelson, Aaron Ruesch, Mark Binder
Terms of Use

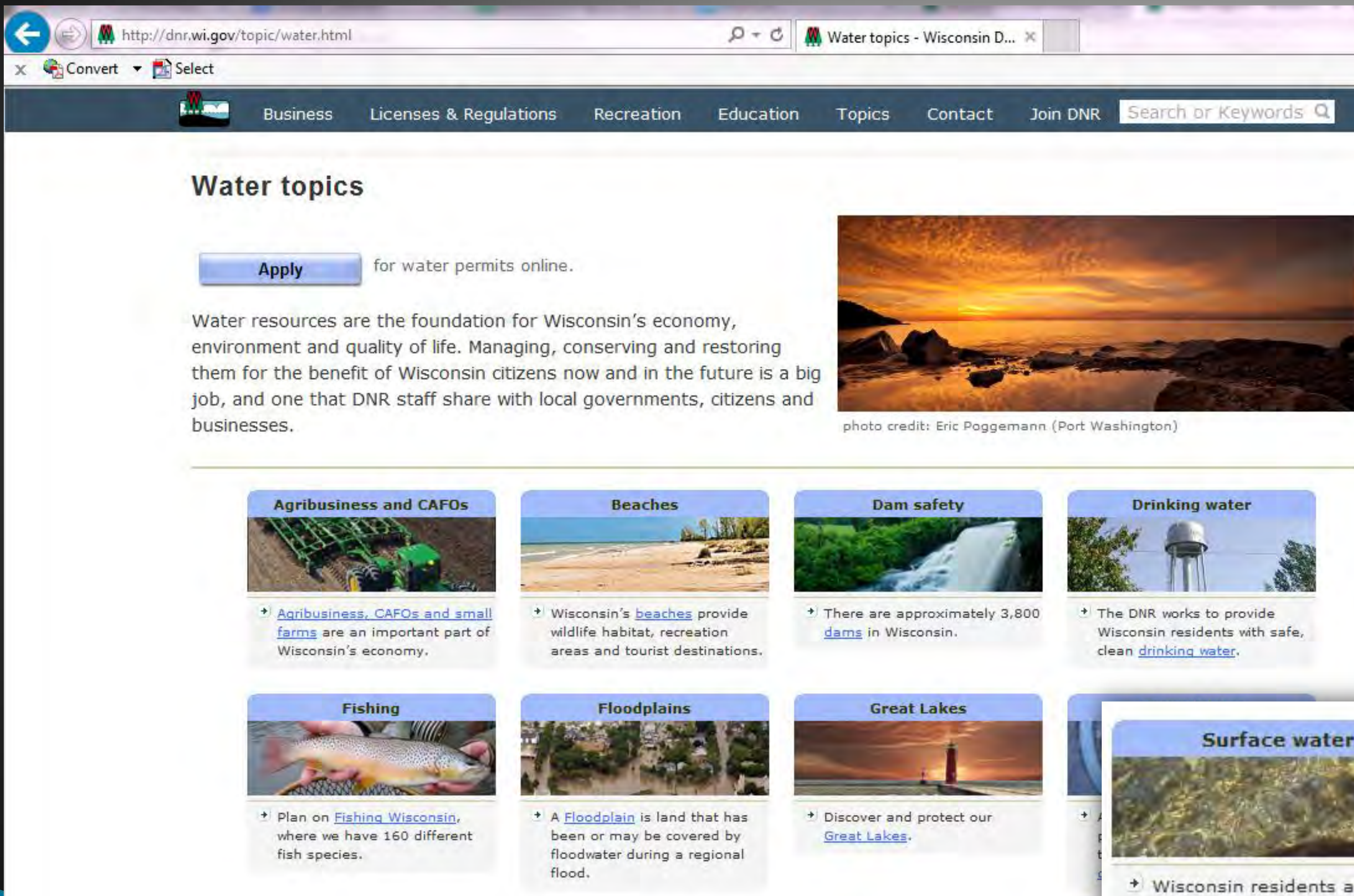

I want to...
Rock River TMDL
Berlin
Muskego
Waukesha Co.
Racine Co.
Green Co.
Brodhead
Monroe
10mi
20km
Terms of Use
I want to...
Rock River TMDL
Edgerton
Whitewat
Evansville
Milton
Janesville
Walworth
Delavan
Brodhead
5mi
10km
Lat:
Lon:
Adam Freihoefer, Theresa Nelson, Aaron Ruesch, Mark Binder


http://dnrmaps.wi.gov/SL/?Viewer=Watershed%20Restoration%20Viewer&layerTheme=stat
Wisconsin DNR Watershed ...
Convert
Select
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
Map Layers
Pan
Zoom In
Zoom Out
Previous Extent
Full State
Navigation
Point Identify
Location Info
Scale: 1: 3,017,710
Jump to a map bookmark...
Scale & Bookmarks
New
Plot
Clear All
Clicked Coordinates
Lat: 44.7572
Lon: -90.0665
Lat/Lon (DD)
Coordinate Tools
Print Map
Print
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
I want to...
Healthy Watersheds Assessment
Marquette
UPPER MICHIGAN
St. Cloud
Mankato
Mason City
Dubuque
Lake Michigan
50mi
100km
Lat:
Lon:
Terms of Use

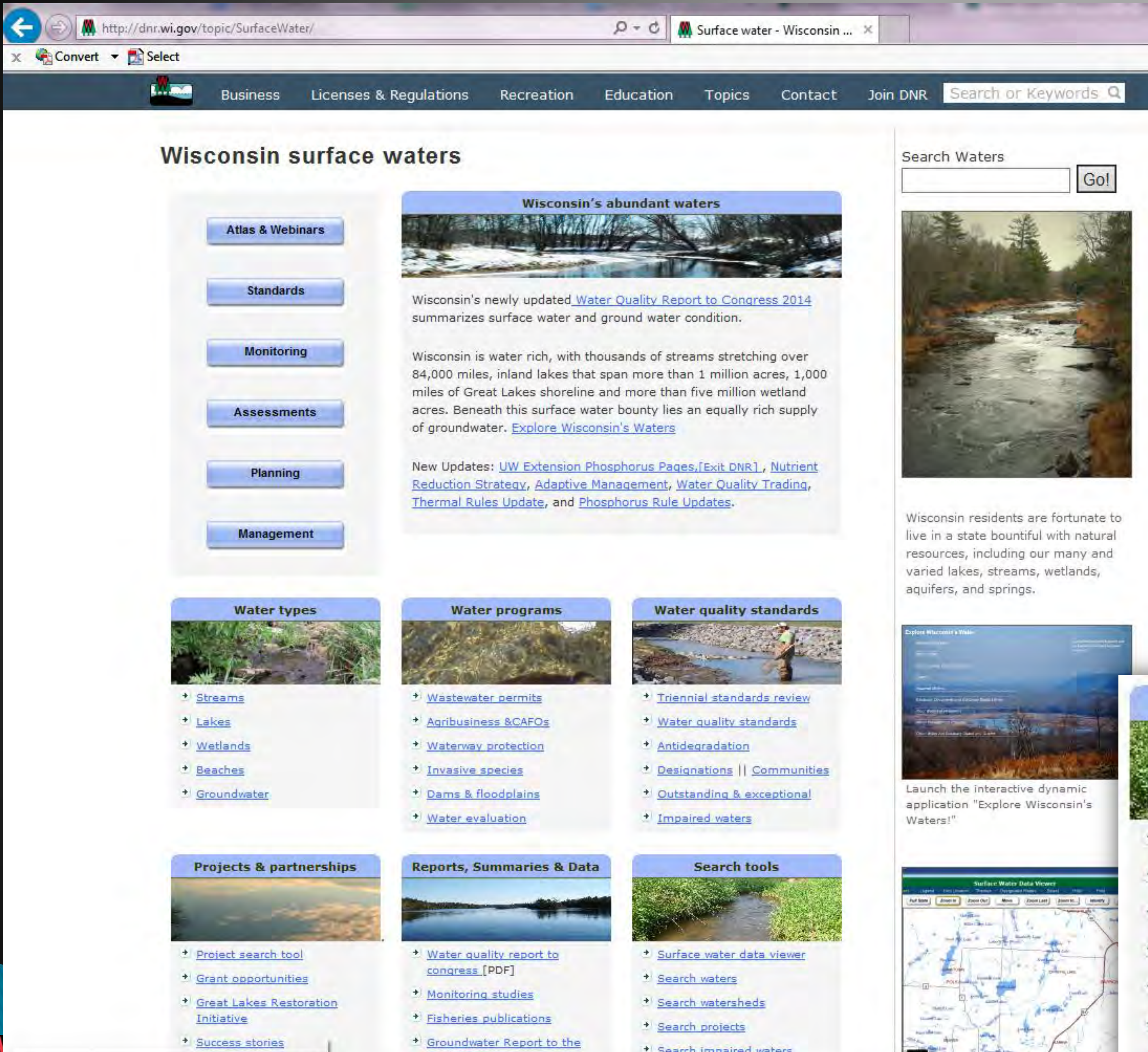

I want to...
Healthy Watersheds Assessment
Janesville
Footville
Rock Co.
MM
MM
2.5mi
2.5km

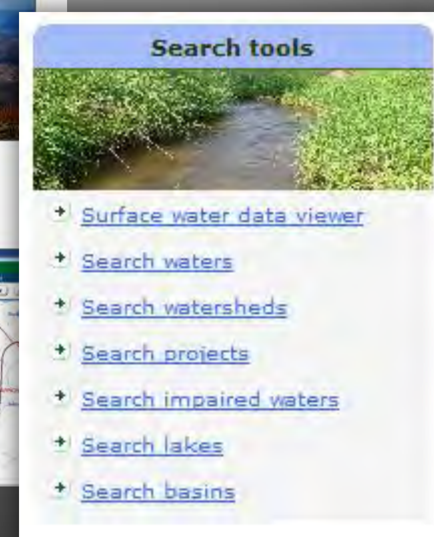

I want to...
Healthy Watersheds Assessment
Janesville
Footville
Rock Co.
MM
MM
39
2.5mi
2.5km
Lat:
Lon:

Online Info & Data



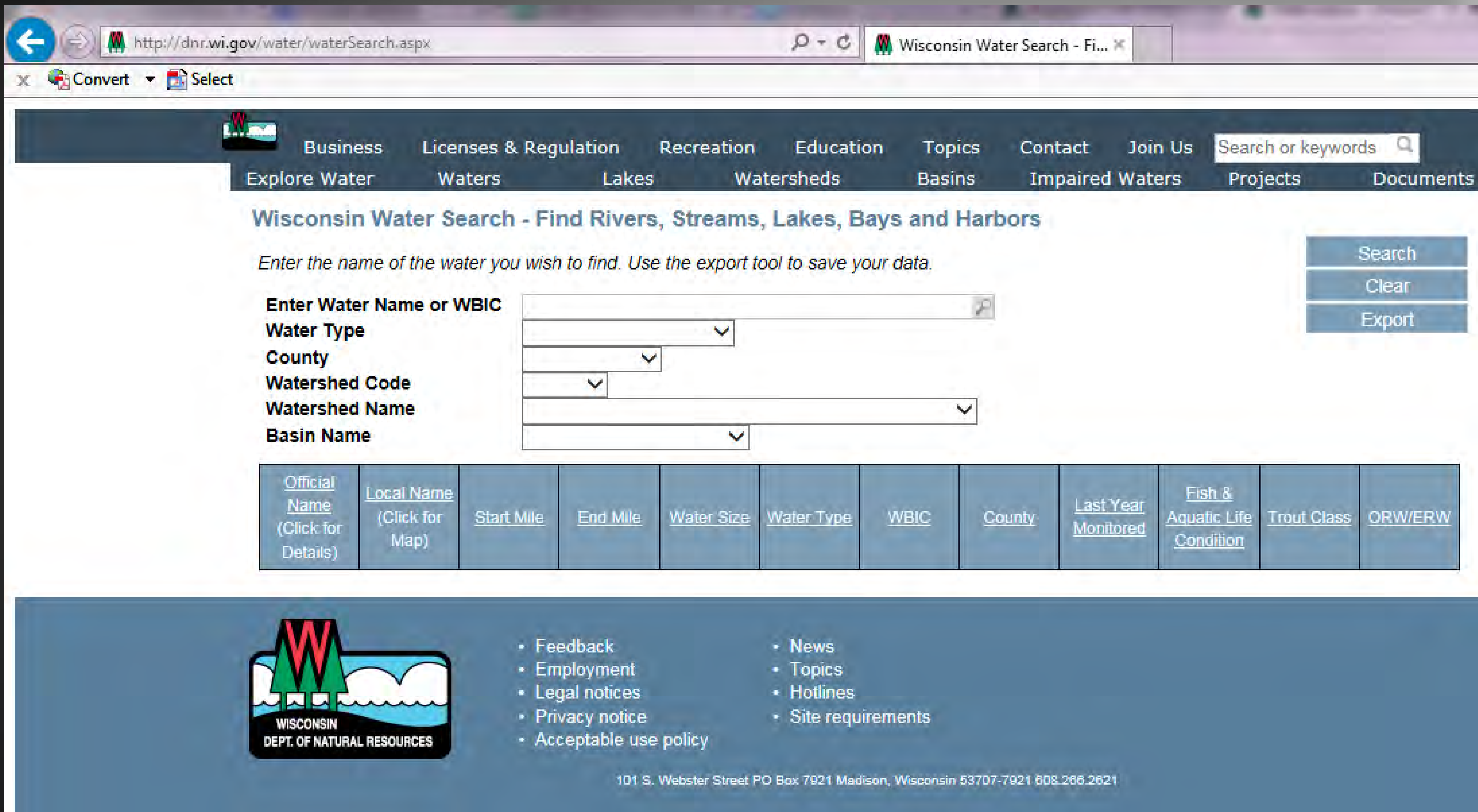
http://dnr.wi.gov/topic/water.html





http://dnr.wi.gov/topic/SurfaceWater/

Search Waters



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

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

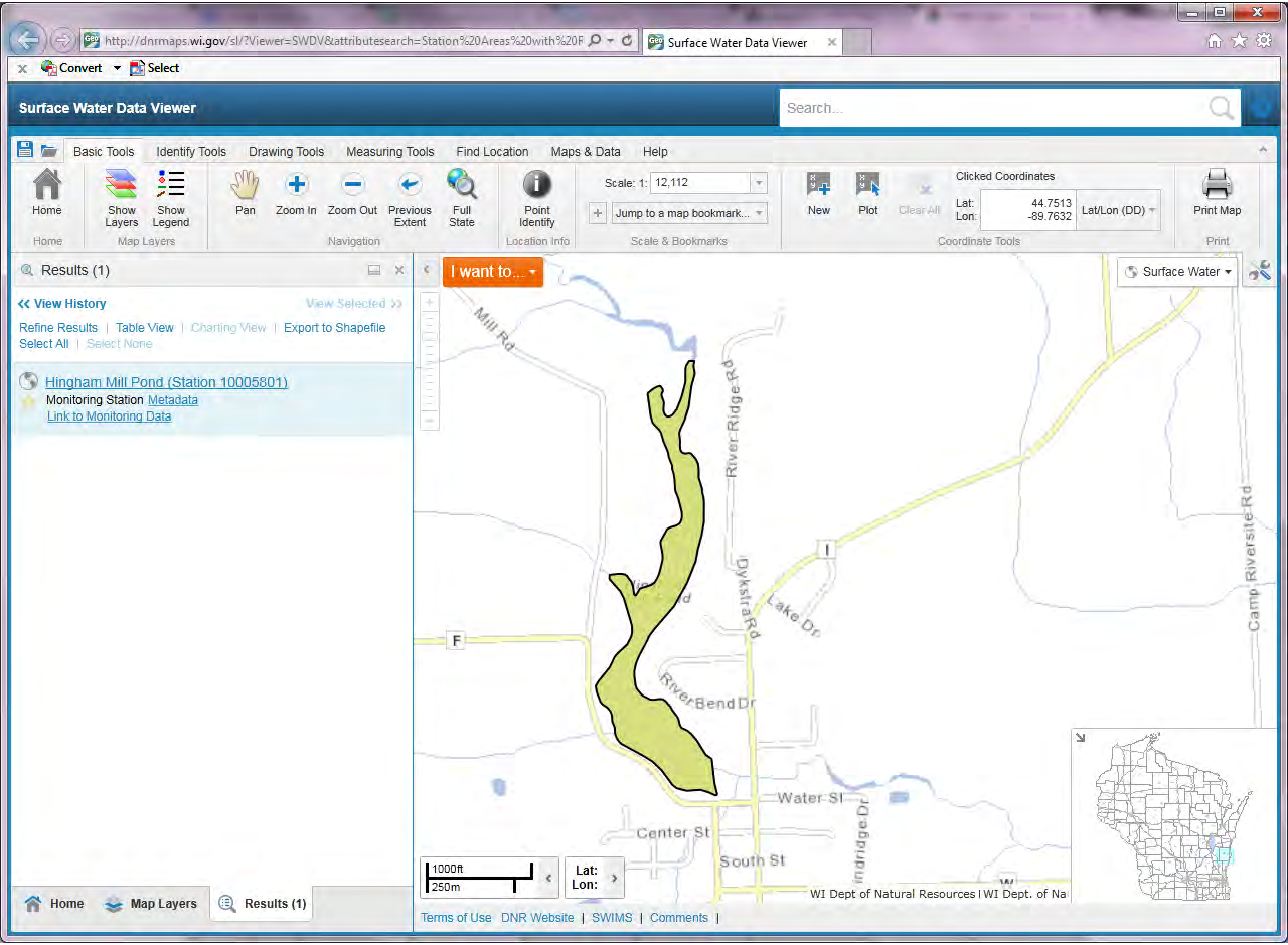
T15N R22E Sec. 36 NESE Stream Length = 44.0 miles
The Onion River discussion is segmented into two sections to represent the different stream classifications and biological characteristics of the stream from its headwaters downstream. The Onion River is classified as a Cold Water Fish Community stream, Class II trout stream from the headwaters downstream to the top of the Waldo Dam impoundment. A Warm Water Sport Fish Community classification exists from the Waldo Impoundment downstream to the confluence with the Sheboygan River.

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

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

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

WDNR personnel surveyed the Onion River approximately 1.6 miles downstream of Ourtown Road in July 2000 (River mile 2.8). The stream reach that was surveyed was within the boundaries of the Pinehurst ("The Bull") Golf Course. The fish community rated good


http://dnrmaps.wi.gov/sl/?Viewer=SWDV&attributesearch=Station%20Areas%20with%20F
Surface Water Data Viewer
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: 12,112
Jump to a map bookmark...
New
Plot
Clear All
Clicked Coordinates
Lat: 44.7513
Lon: -89.7632
Lat/Lon (DD)
Print Map
Home
Map Layers
Navigation
Location Info
Scale & Bookmarks
Coordinate Tools
Print
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
I want to...
Surface Water
Mill Rd
River Ridge Rd
Dykstra Rd
Lake Dr
River Bend Dr
Camp Riverside Rd
Water St
Center St
South St
F
I
1000ft
250m
Lat:
Lon:
WI Dept of Natural Resources | WI Dept. of Na
Home
Map Layers
Results (1)
Terms of Use
DNR Website
SWIMS
Comments

Monitoring Data

https://dnrx.wisconsin.gov/swims/viewStationResults.do?id=45393

dnrx.wisconsin.gov

Convert Select

Monitoring Station

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		

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GIS Data

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

FTP GIS Data

ftp://dnrftp01.wi.gov/geodata

FTP directory /geodata at d...

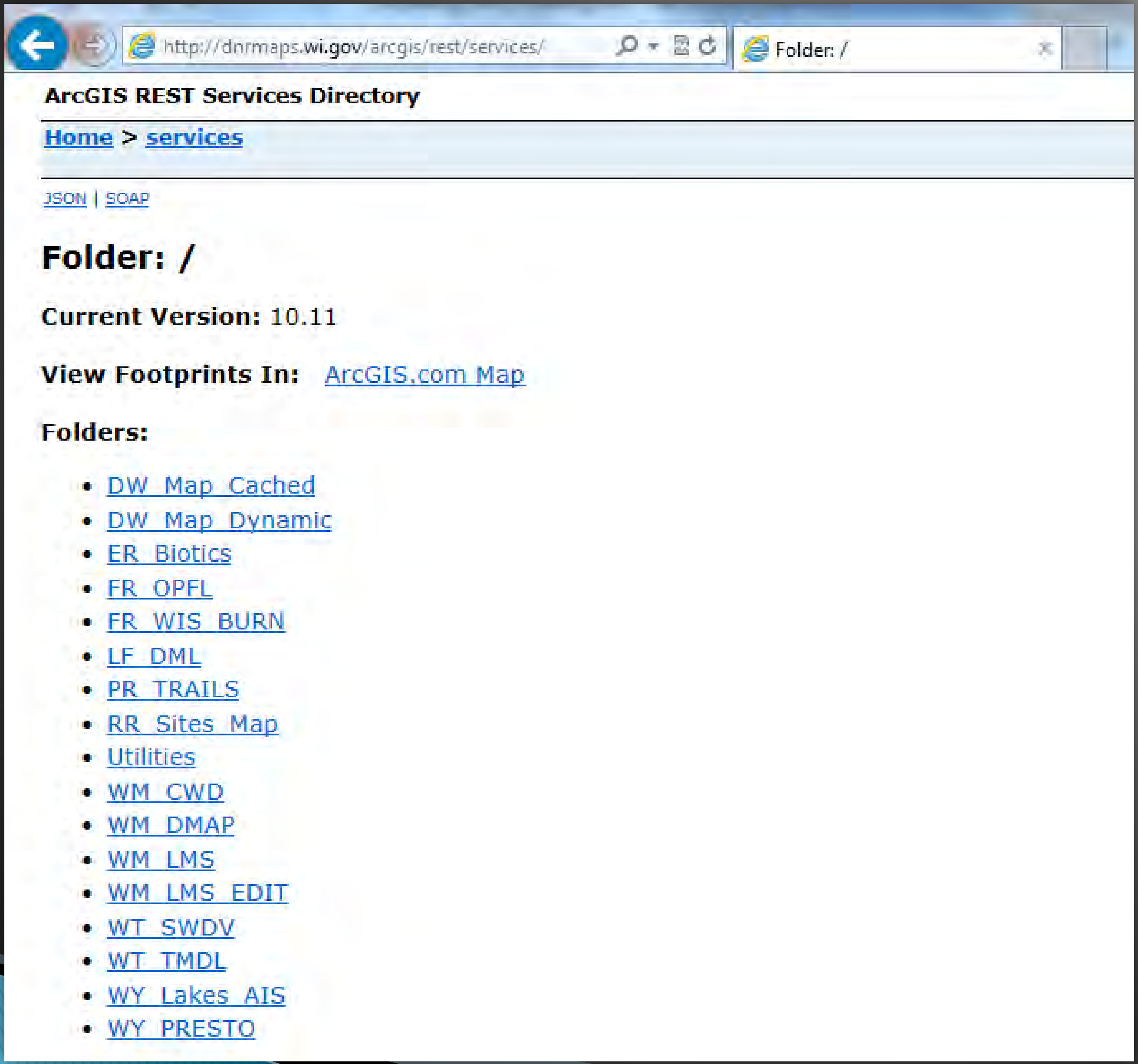
FTP directory /geodata at dnrftp01.wi.gov

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

Up to higher level directory

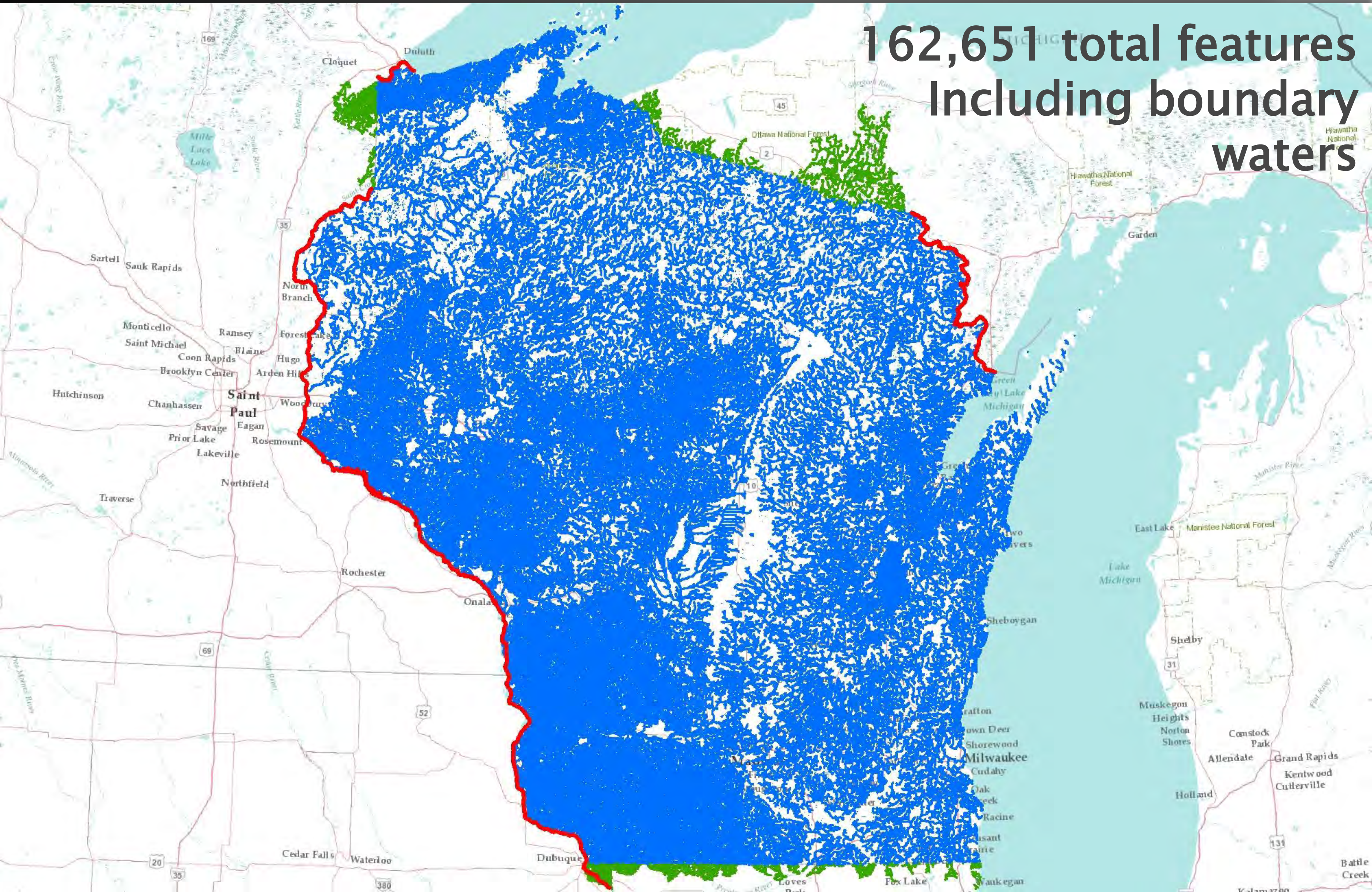
02/13/2012 12:00AM	Directory	county bnds
01/18/2007 12:00AM	3,946	dnrlegal.txt
01/20/2011 12:00AM	Directory	DNR geog mgmt units
10/31/2014 12:00AM	Directory	DNR regions
01/20/2011 12:00AM	Directory	drg 100k
01/20/2011 12:00AM	Directory	drg 250k
01/04/2013 12:00AM	Directory	ecological landscapes
01/20/2011 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	gcsm
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

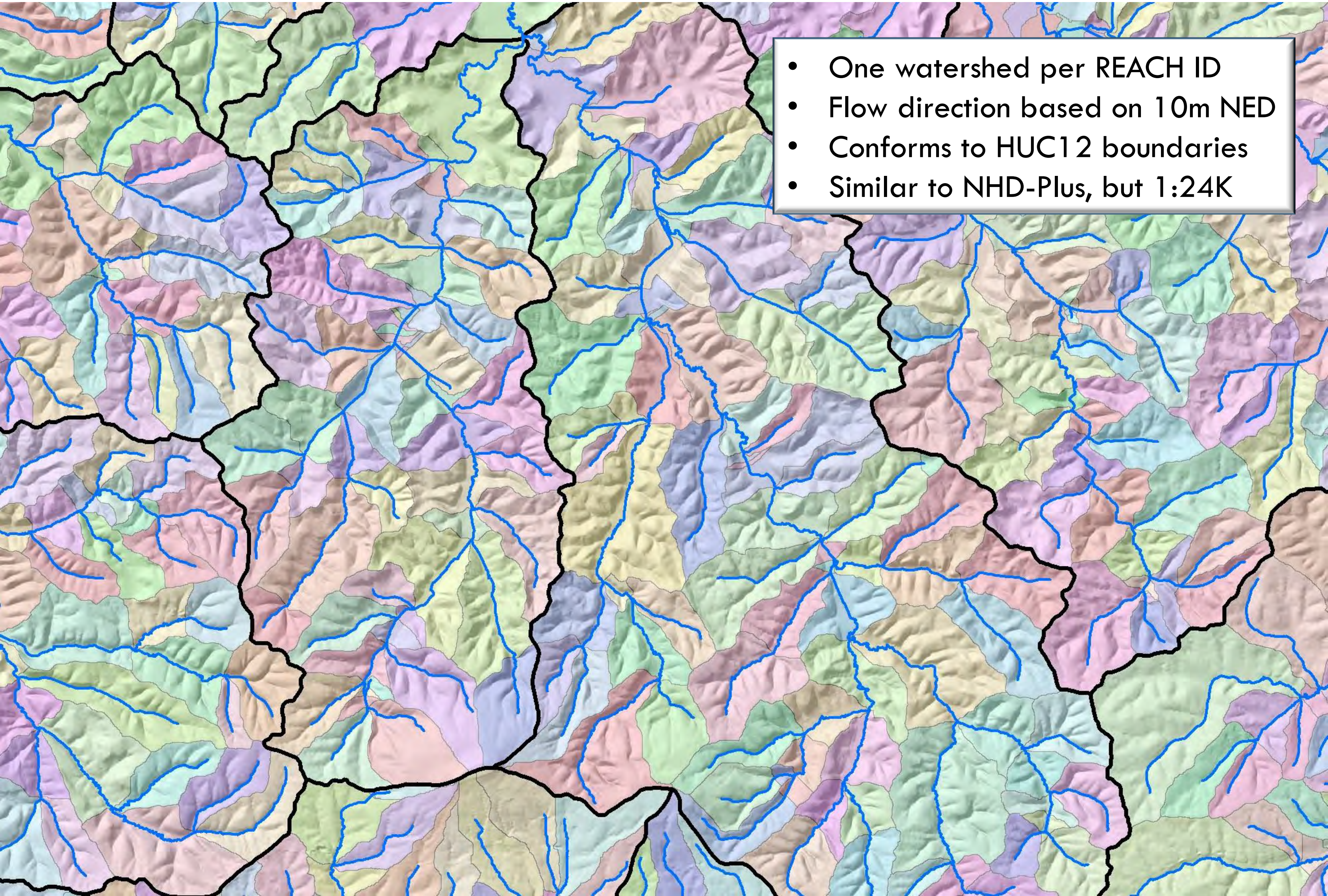


WHDPlus

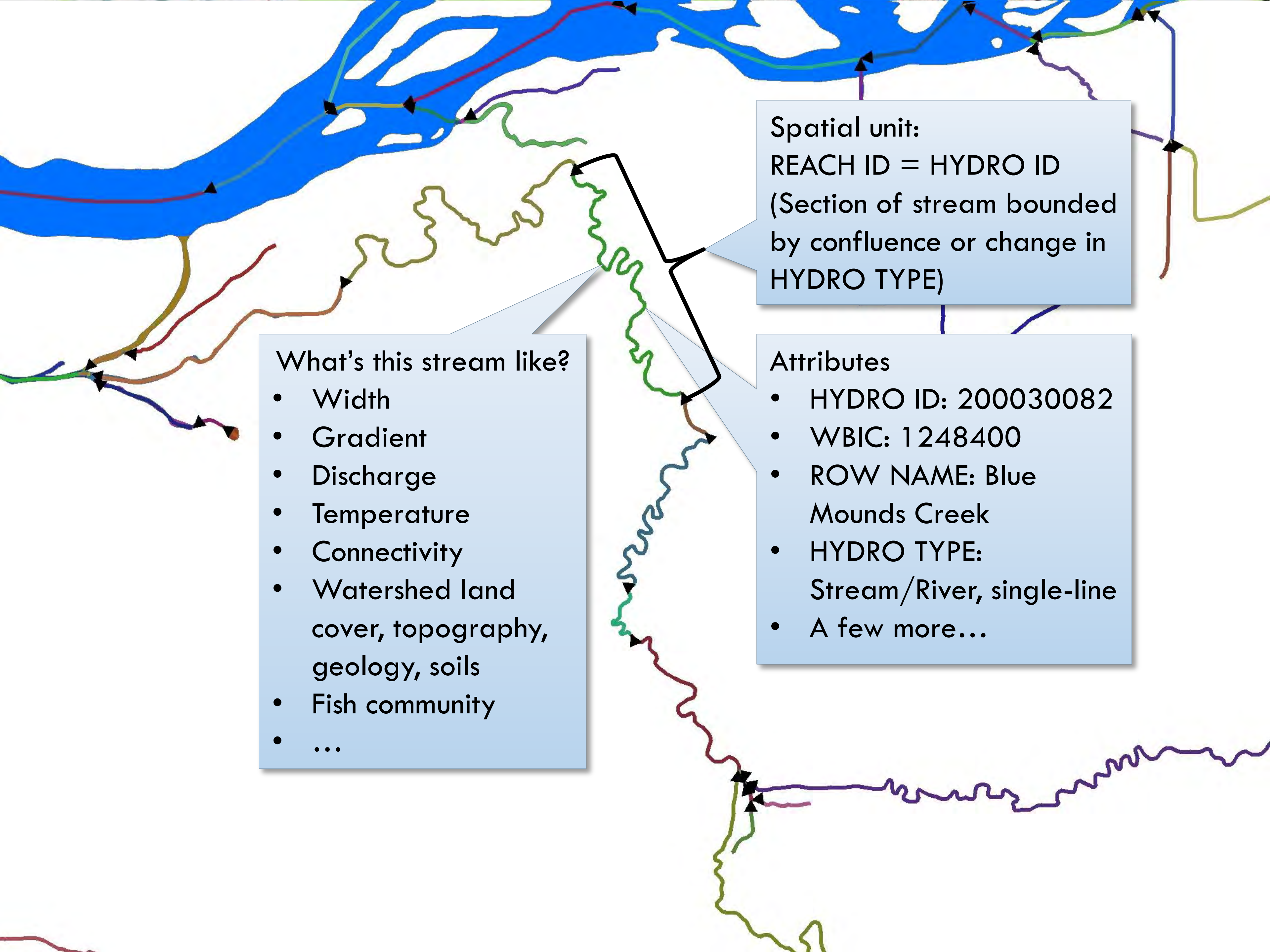
162,651 total features
Including boundary waters



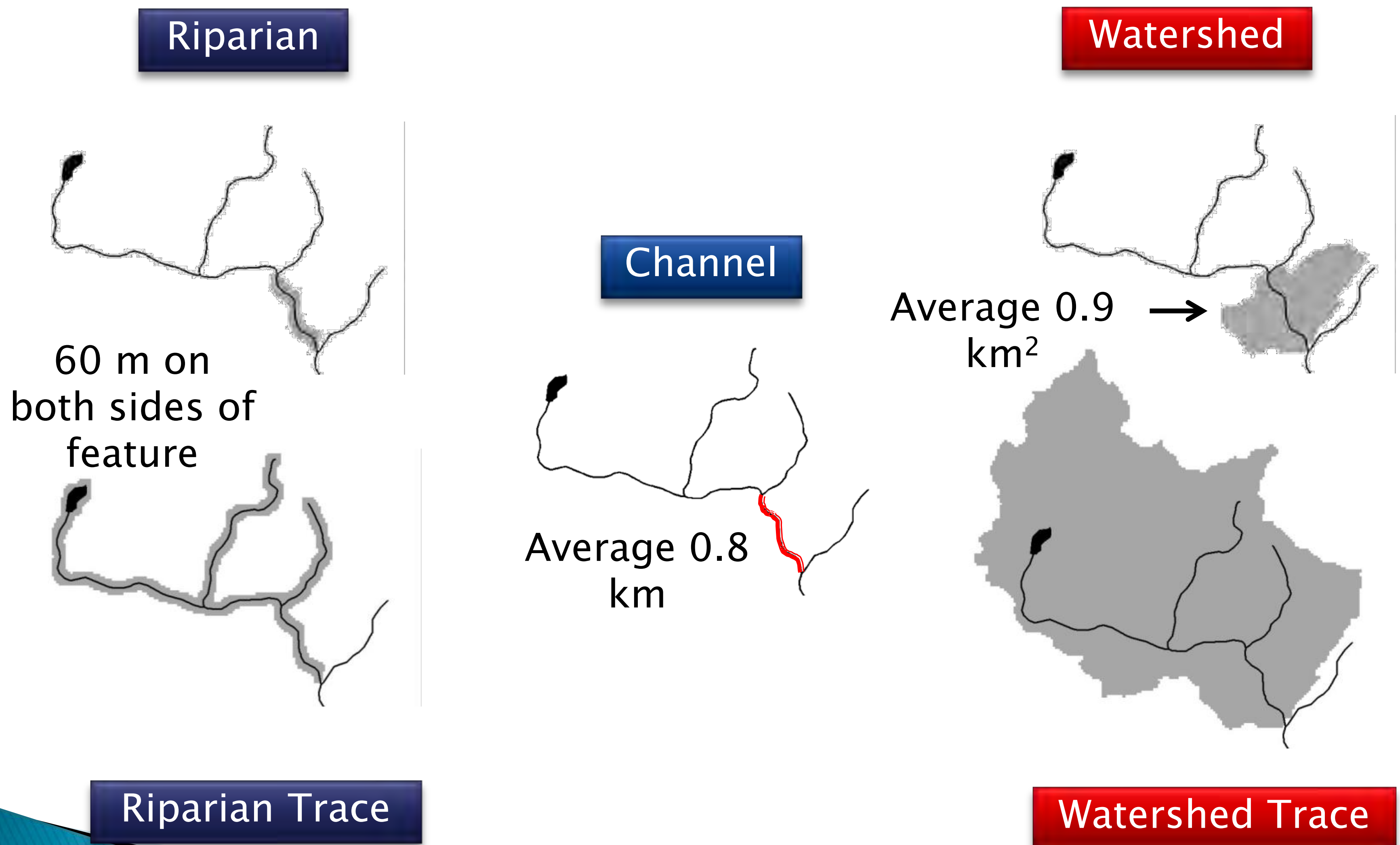
Watershed Delineation



- One watershed per REACH ID
- Flow direction based on 10m NED
- Conforms to HUC12 boundaries
- Similar to NHD-Plus, but 1:24K


Spatial unit:
REACH ID = HYDRO ID
(Section of stream bounded by confluence or change in HYDRO TYPE)
What's this stream like?
• Width
• Gradient
• Discharge
• Temperature
• Connectivity
• Watershed land cover, topography, geology, soils
• Fish community
• …
Attributes
• HYDRO ID: 200030082
• WBIC: 1248400
• ROW NAME: Blue Mounds Creek
• HYDRO TYPE: Stream/River, single-line
• A few more…

Attribute Dimensions



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

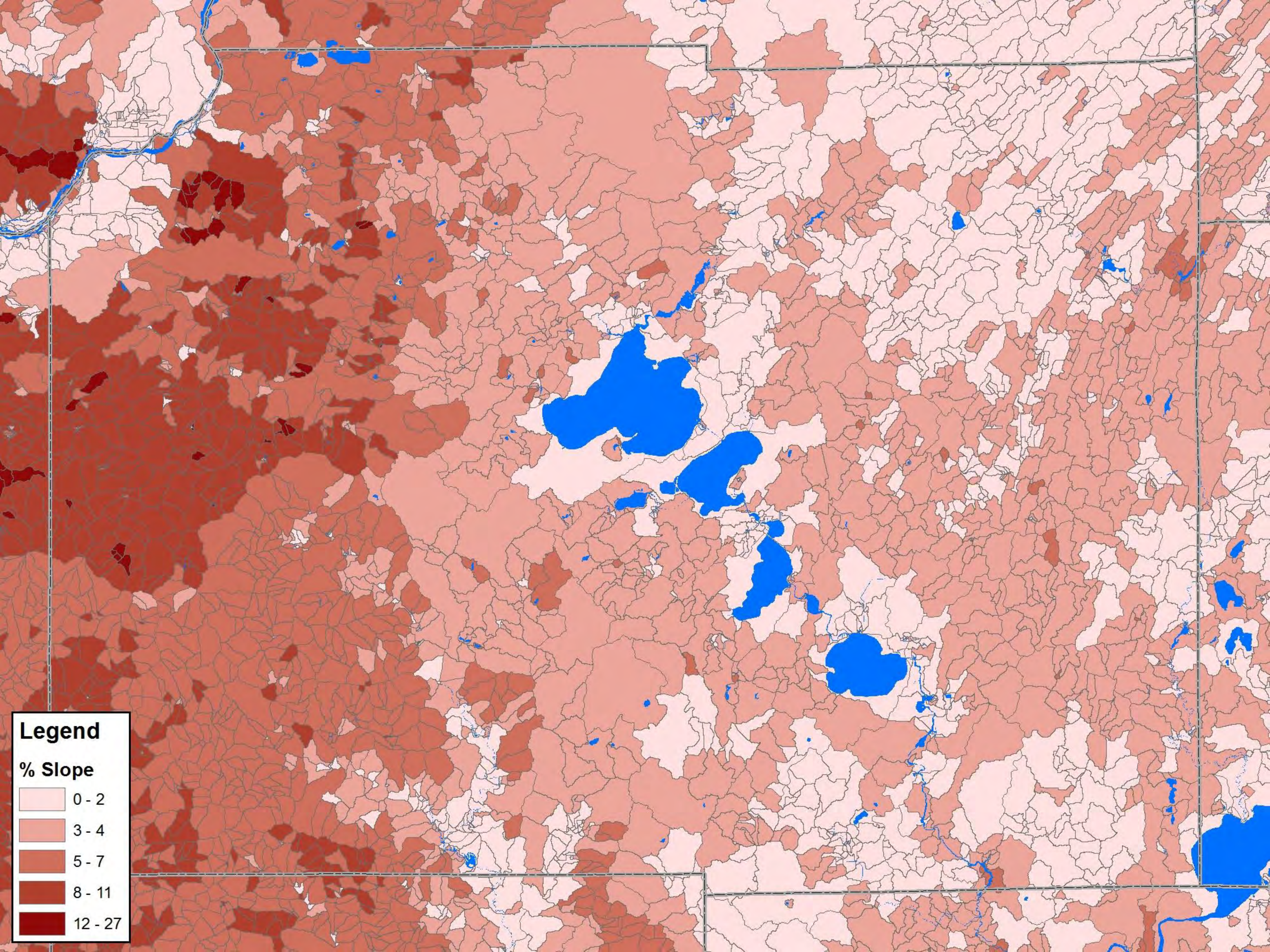
Land Cover

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

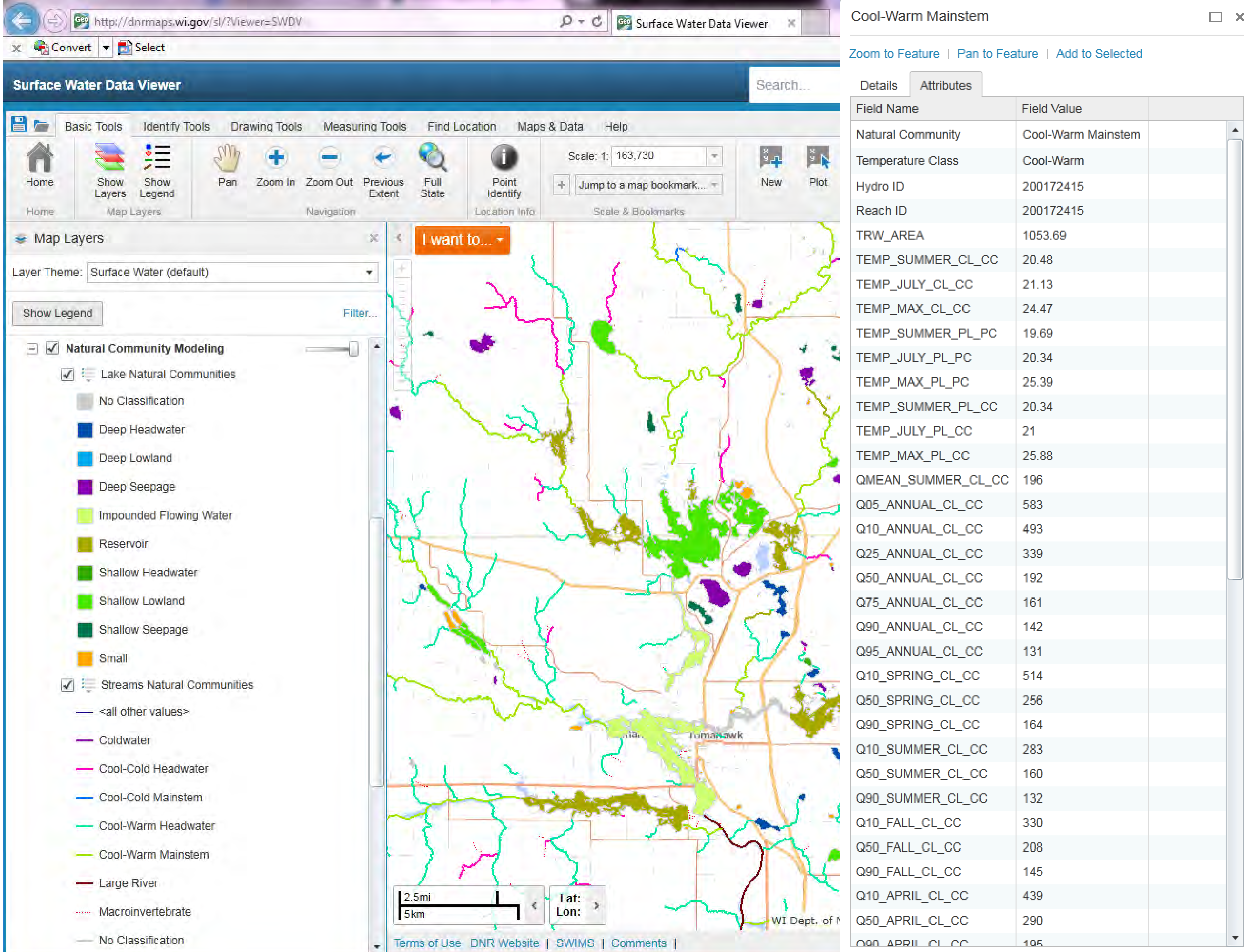
Geology/soils/topography

- 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


http://dnrmaps.wi.gov/sl/?Viewer=SWDV
Surface Water Data Viewer
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: 163,730
Jump to a map bookmark...
New
Plot
Home
Map Layers
Navigation
Location Info
Scale & Bookmarks
Map Layers
Layer Theme: Surface Water (default)
Show Legend
Filter...
Natural Community Modeling
Lake Natural Communities
No Classification
Deep Headwater
Deep Lowland
Deep Seepage
Impounded Flowing Water
Reservoir
Shallow Headwater
Shallow Lowland
Shallow Seepage
Small
Streams Natural Communities
<all other values>
Coldwater
Cool-Cold Headwater
Cool-Cold Mainstem
Cool-Warm Headwater
Cool-Warm Mainstem
Large River
Macroinvertebrate
No Classification
I want to...
Tomahawk
2.5mi
5km
Lat:
Lon:
WI Dept. of
Terms of Use | DNR Website | SWIMS | Comments |
Cool-Warm Mainstem
Zoom to Feature | Pan to Feature | Add to Selected
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

Healthy Watersheds Assessment

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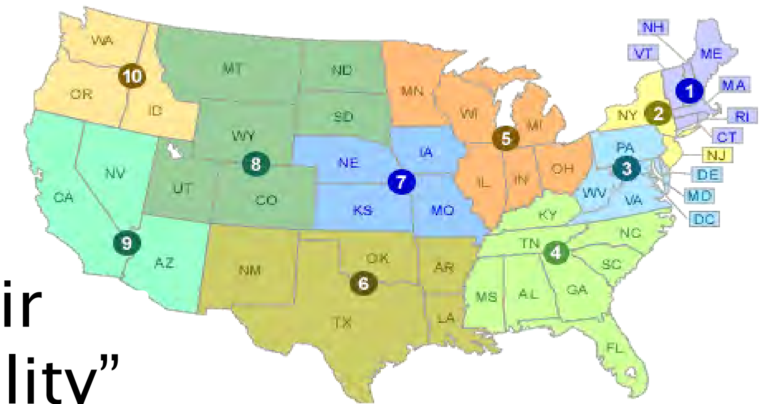
Healthy Watersheds Assessments

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

Healthy Watersheds

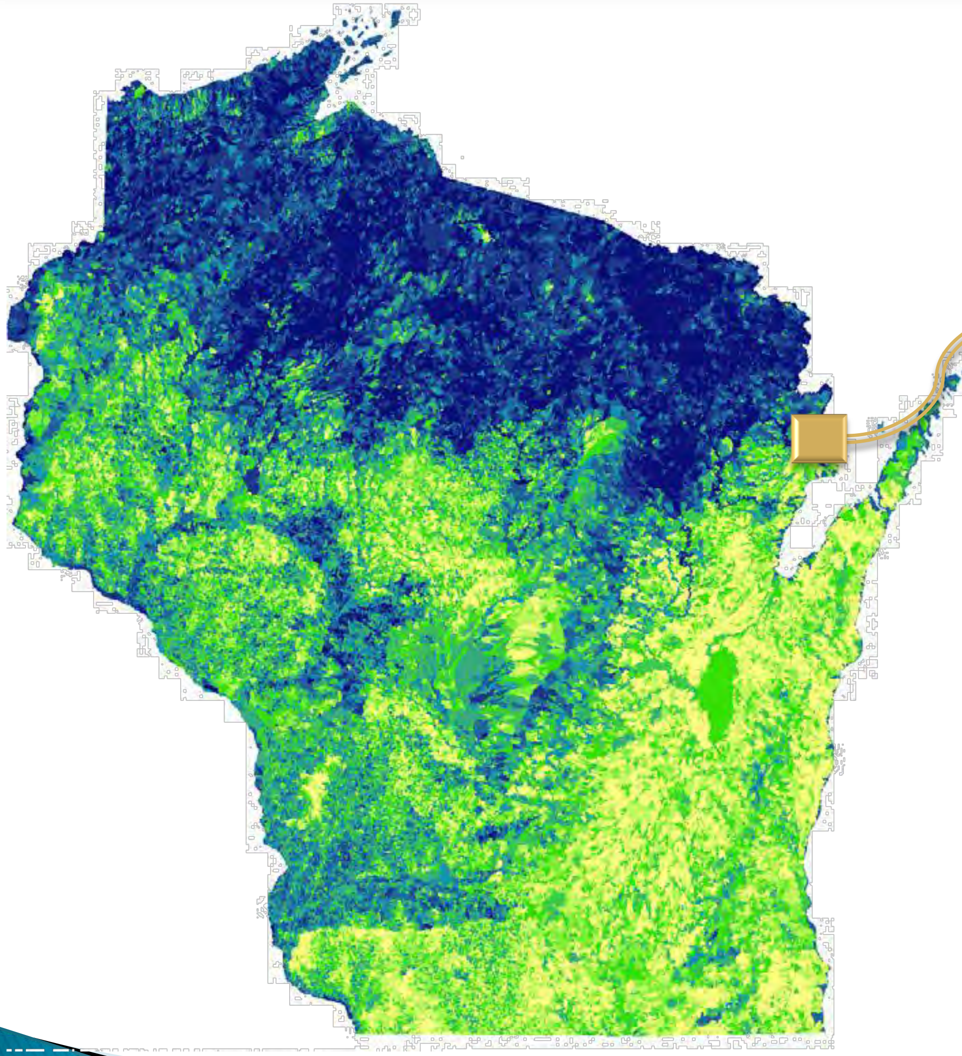
Kristi Minahan
DNR

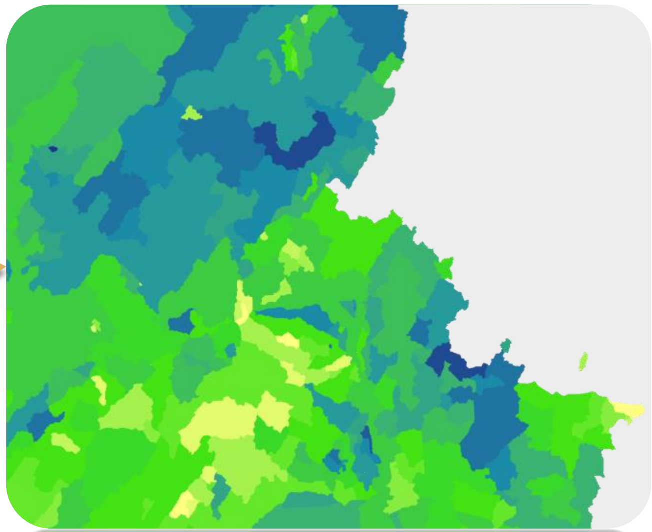
WISCONSIN DEPT. OF NATURAL RESOURCES

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

Aquatic Ecosystem Health

Hydrologic Condition

- Change in flow regime

Habitat Condition/ Geomorphology

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

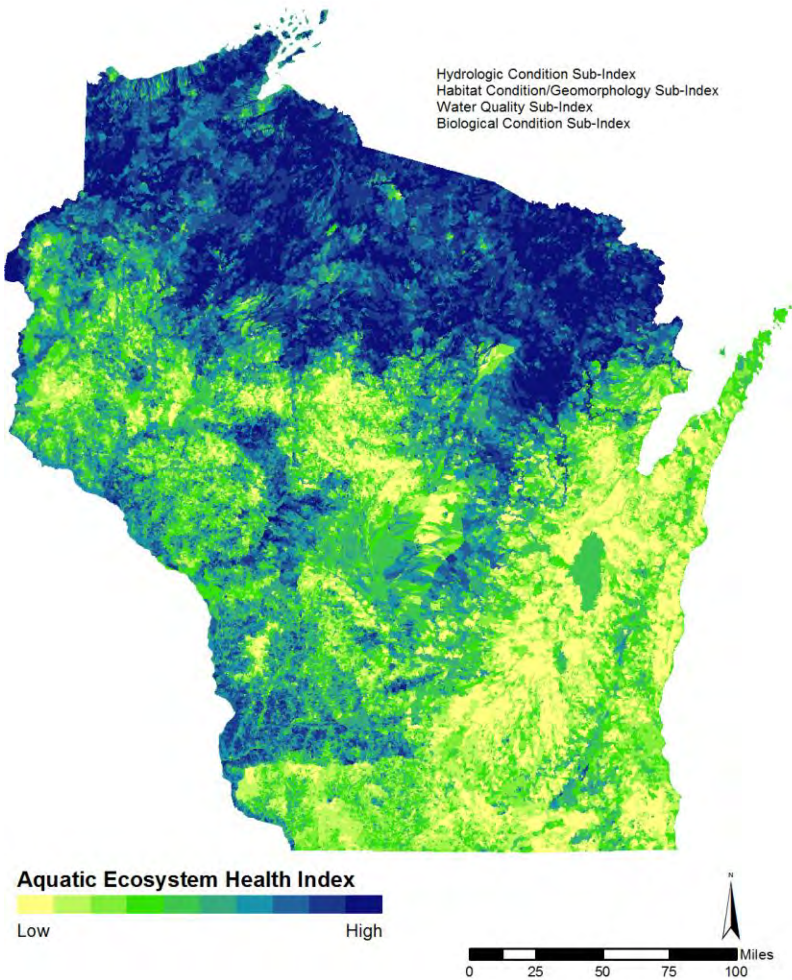
Water Quality

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

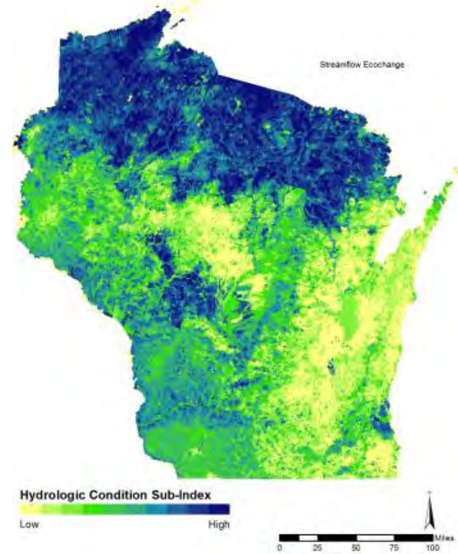
Biological Condition

- Aquatic Insects IBI*

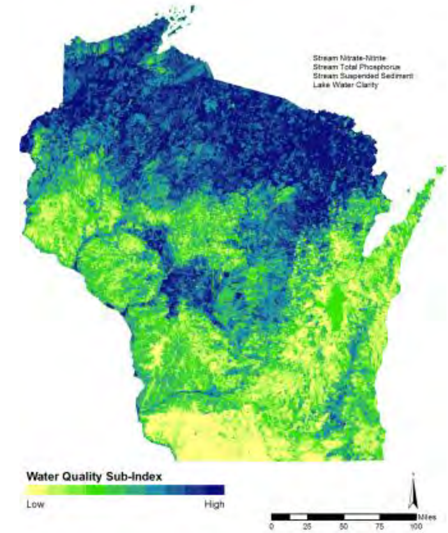
Aquatic Ecosystem Health



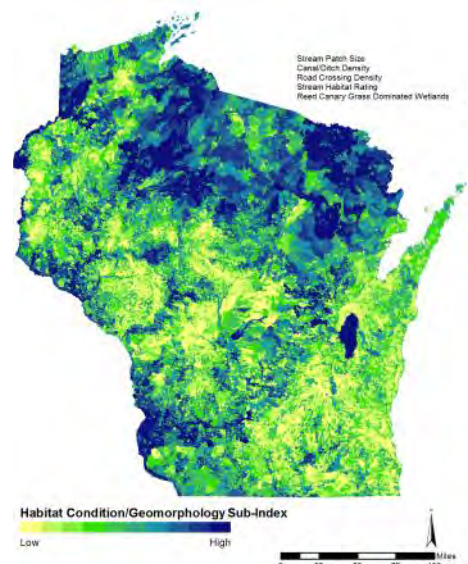
SUBINDICES



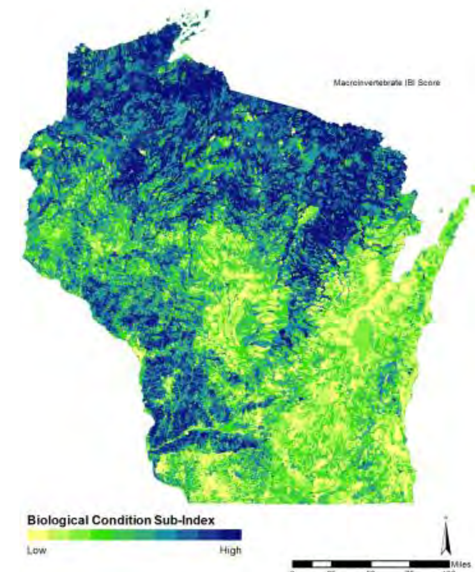
Hydrology



Water Quality



Habitat/Geomorphology



Biology

Watershed Vulnerability

Climate Change

Projected change in:

- Runoff*
- Phosphorus*
- Nitrogen*
- Sediment*

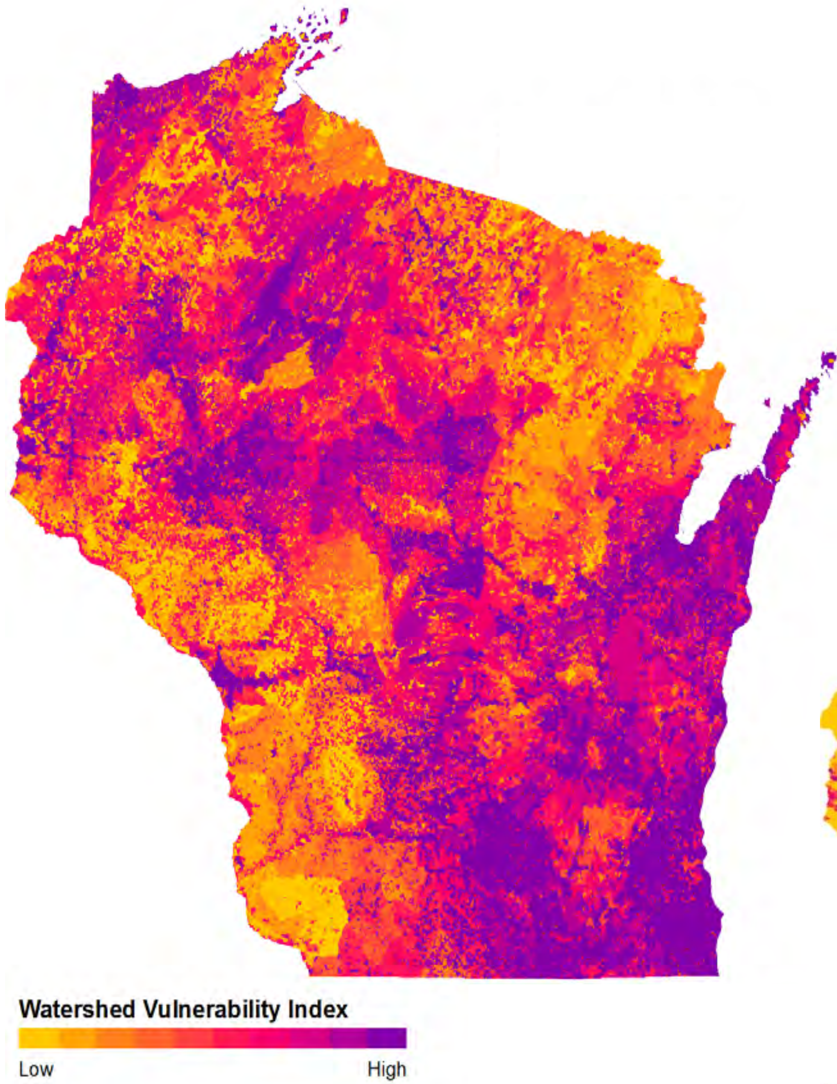
Land Use Change

- Projected change in Land cover*

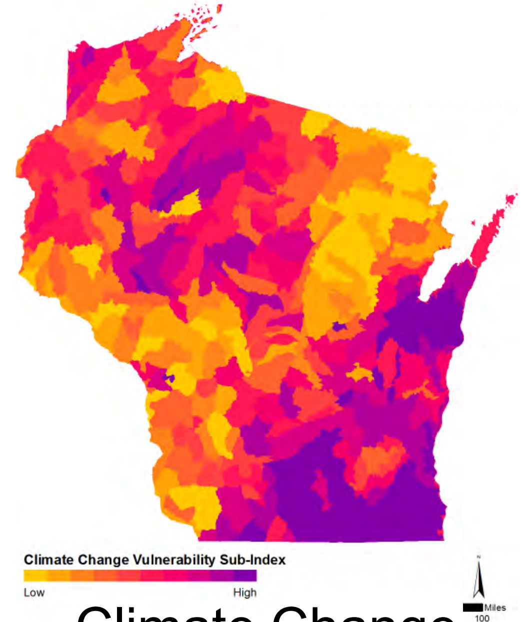
Water Use

- High capacity wells
- Groundwater dependent ecosystems

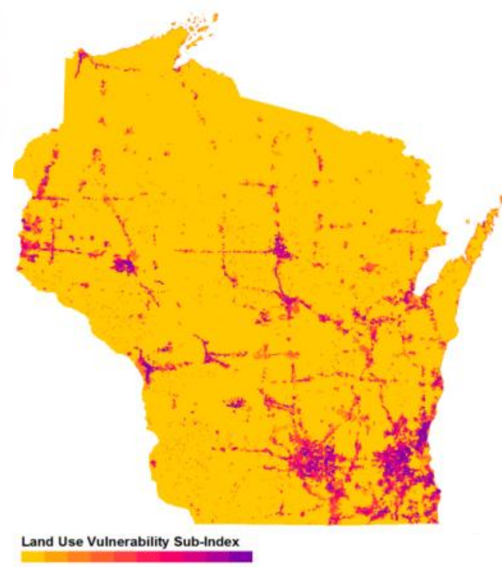
Vulnerability



SUBINDICES



Climate Change

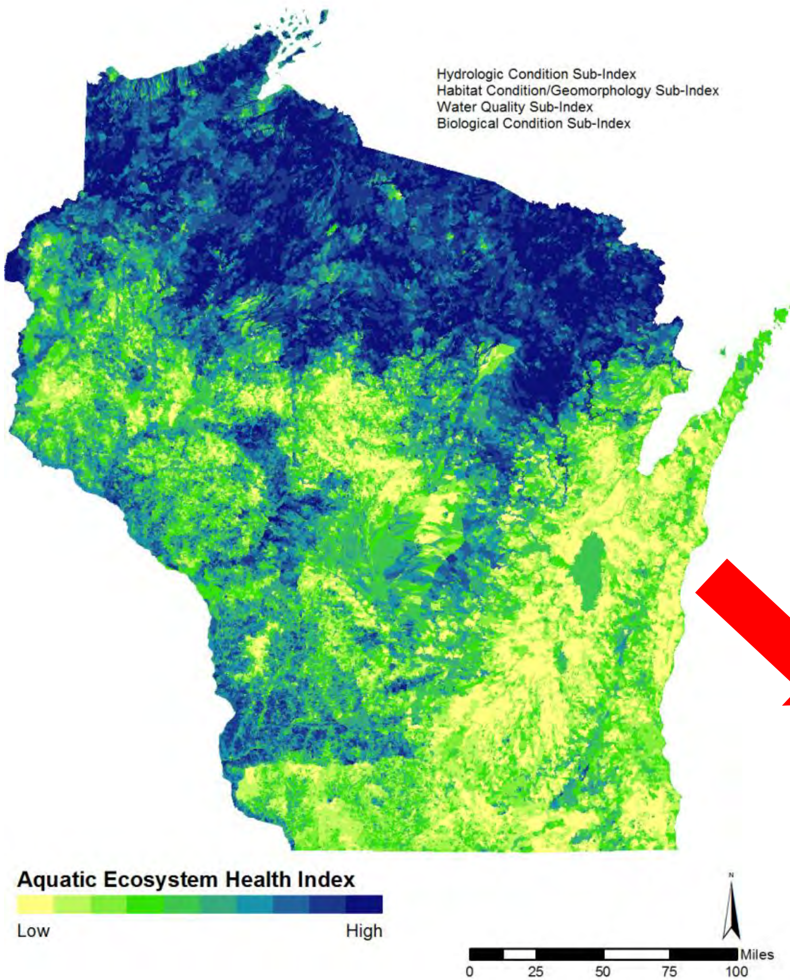


Land Use Change

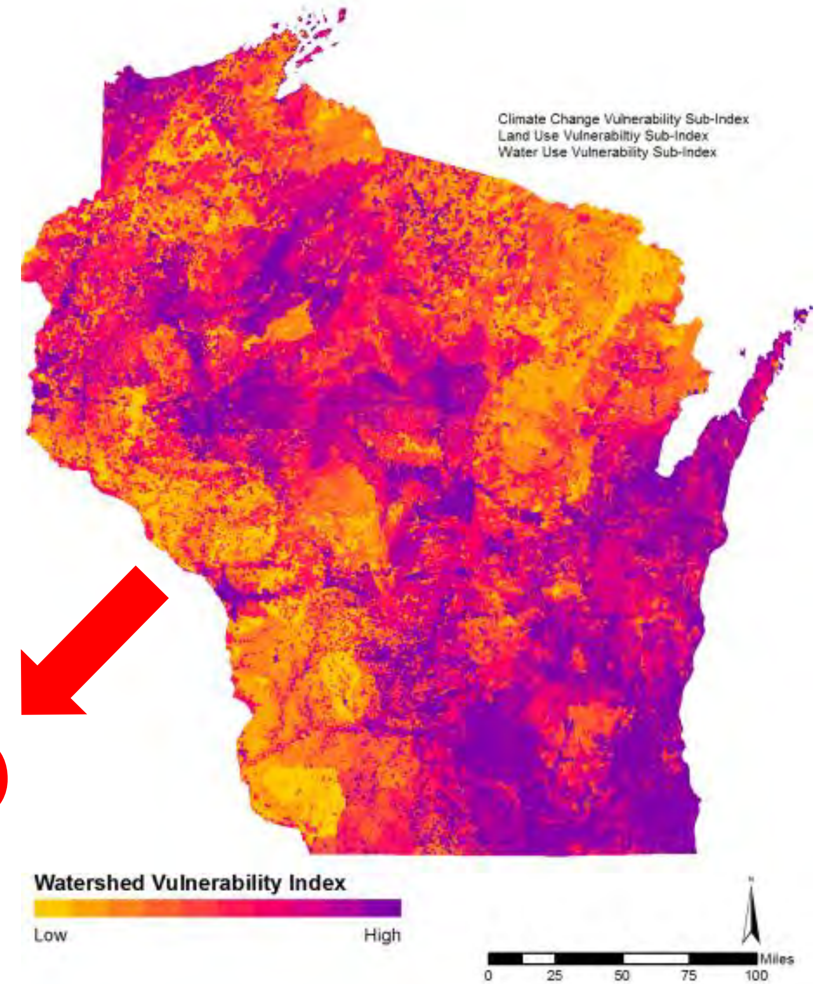
Water Use

Aquatic Ecosystem Health

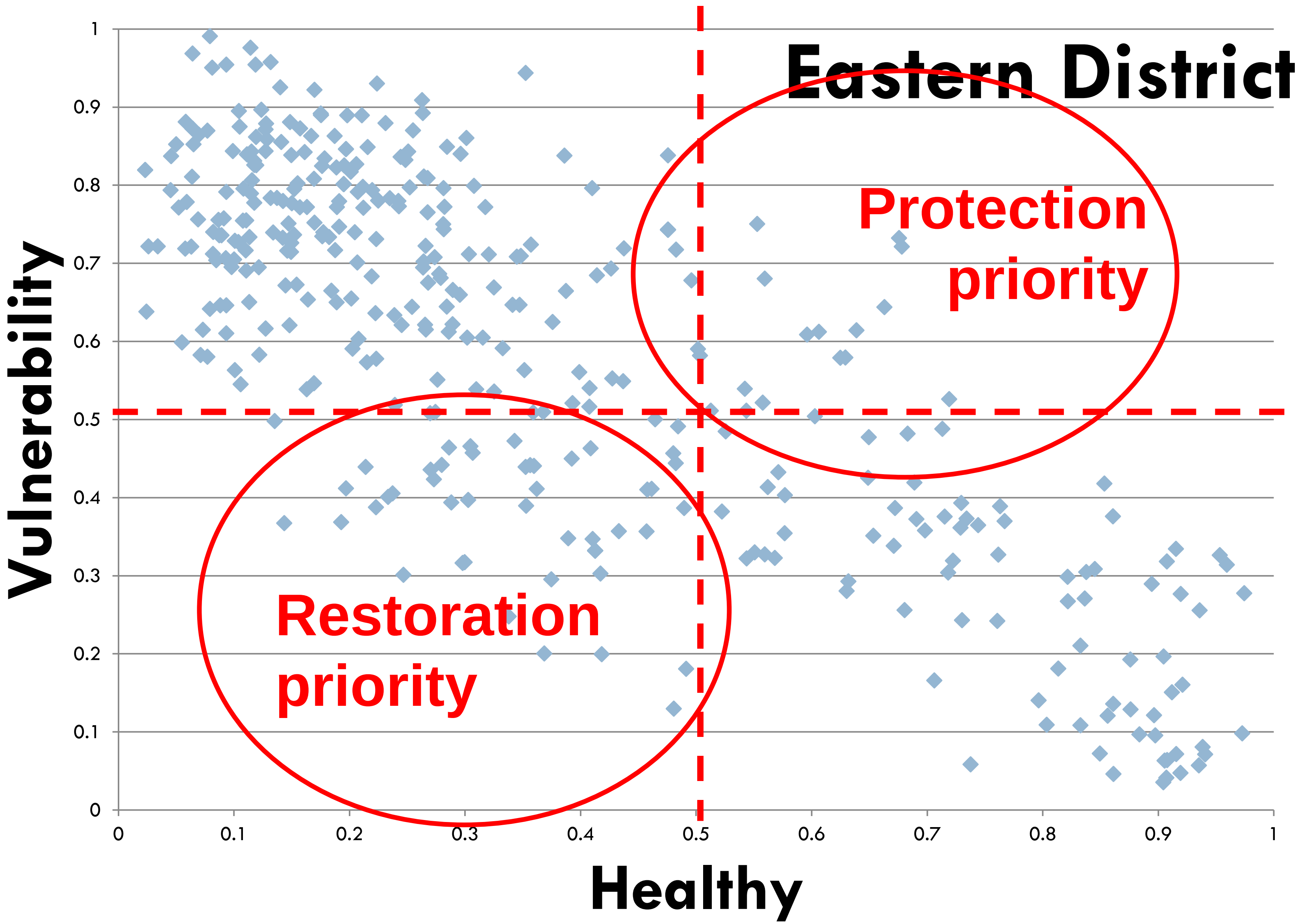
Vulnerability



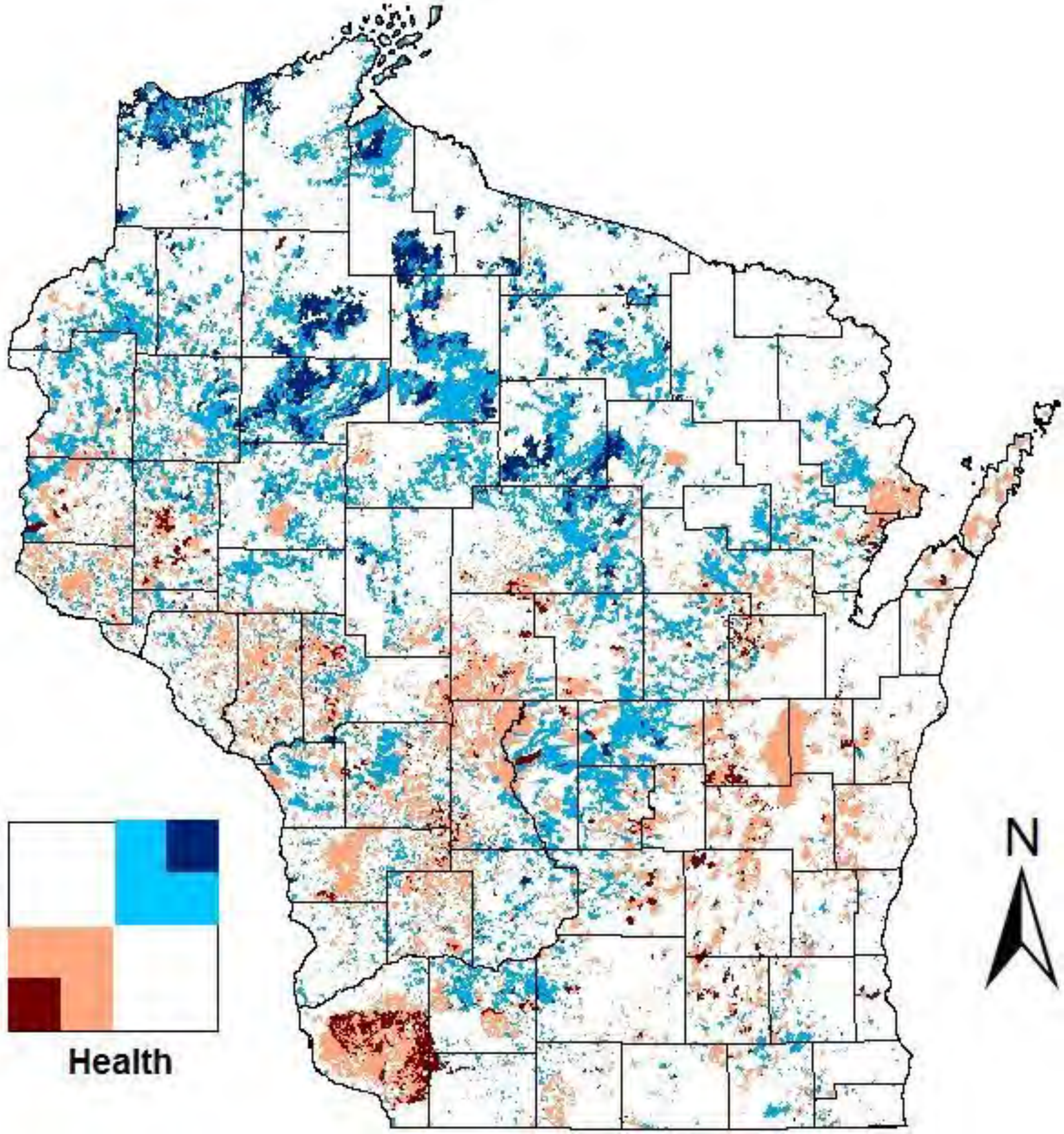
?



Combine Health & Vulnerability Scores…



Combine Health & Vulnerability Scores…

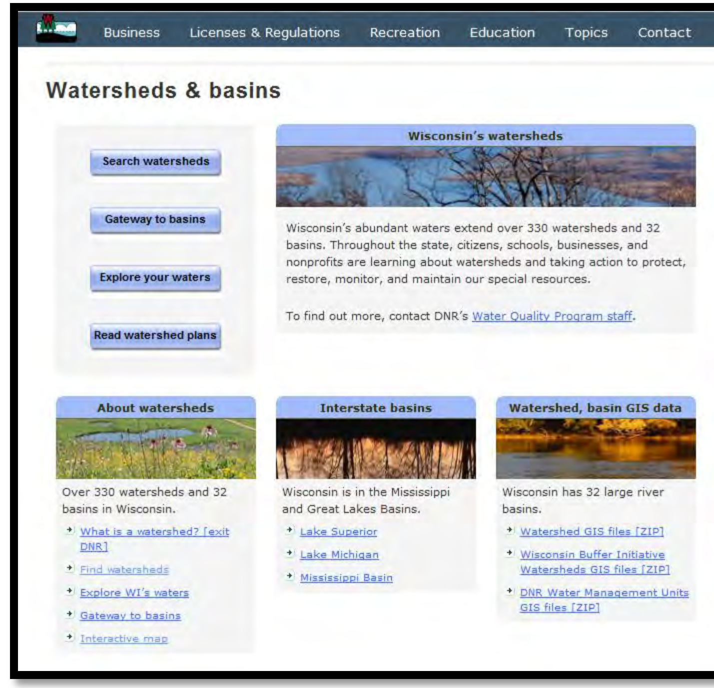


Applications

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

Healthy Watersheds Website

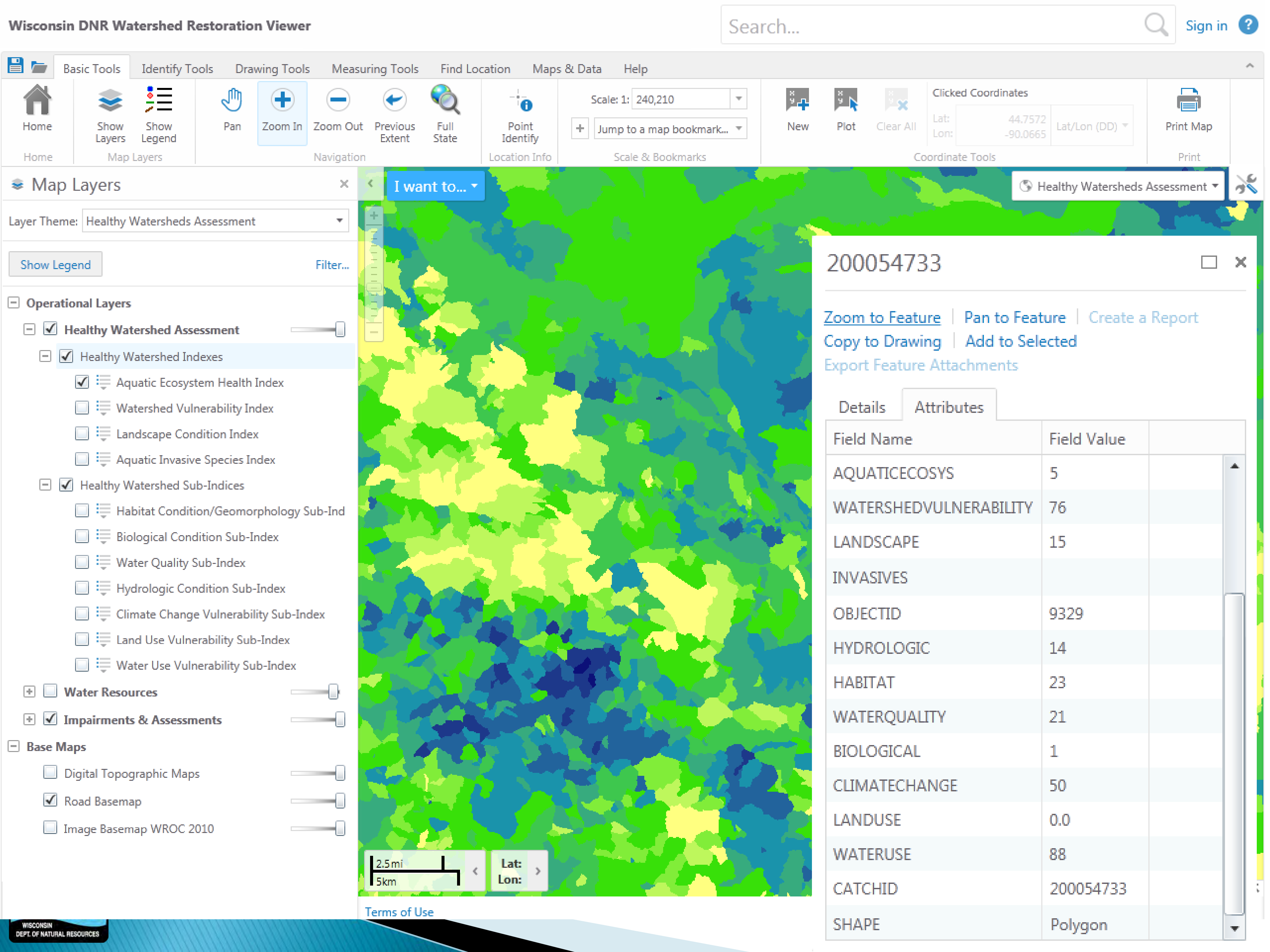
- Download:
  - Final Report
  - PDF maps
  - Shapefiles
  - Raw data



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

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

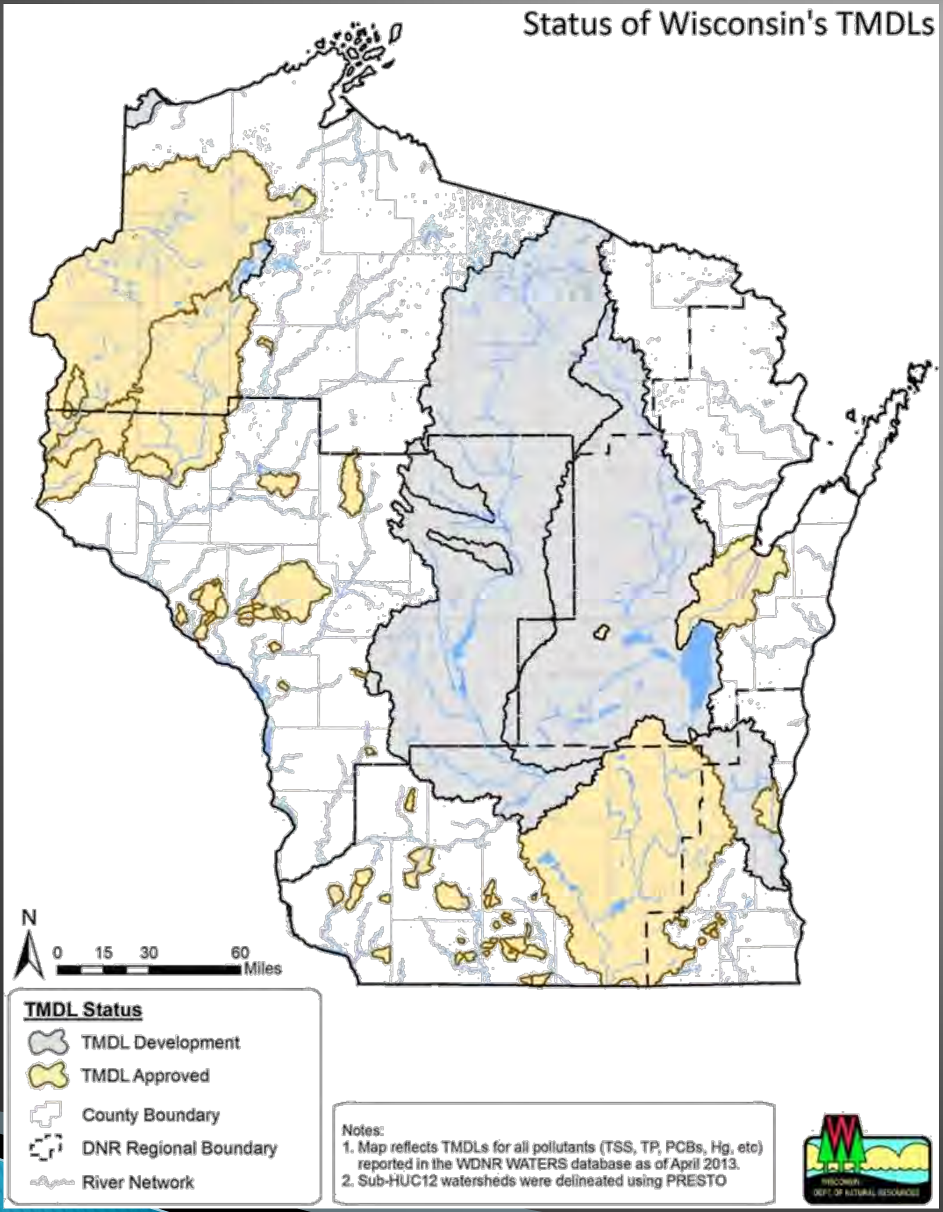
WISCONSIN DEPT. OF NATURAL RESOURCES


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: 240,210
Jump to a map bookmark...
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
I want to...
Healthy Watersheds Assessment
200054733
Zoom to Feature
Pan to Feature
Create a Report
Copy to Drawing
Add to Selected
Export Feature Attachments
Details
Attributes
Field Name
Field Value
AQUATICECOSYS 5
WATERSHEDVULNERABILITY 76
LANDSCAPE 15
INVASIVES
OBJECTID 9329
HYDROLOGIC 14
HABITAT 23
WATERQUALITY 21
BIOLOGICAL 1
CLIMATECHANGE 50
LANDUSE 0.0
WATERUSE 88
CATCHID 200054733
SHAPE Polygon
2.5 mi
5km
Lat:
Lon:
Terms of Use
WISCONSIN DEPT. OF NATURAL RESOURCES

EVAAL

- Overview

TMDLs Statewide



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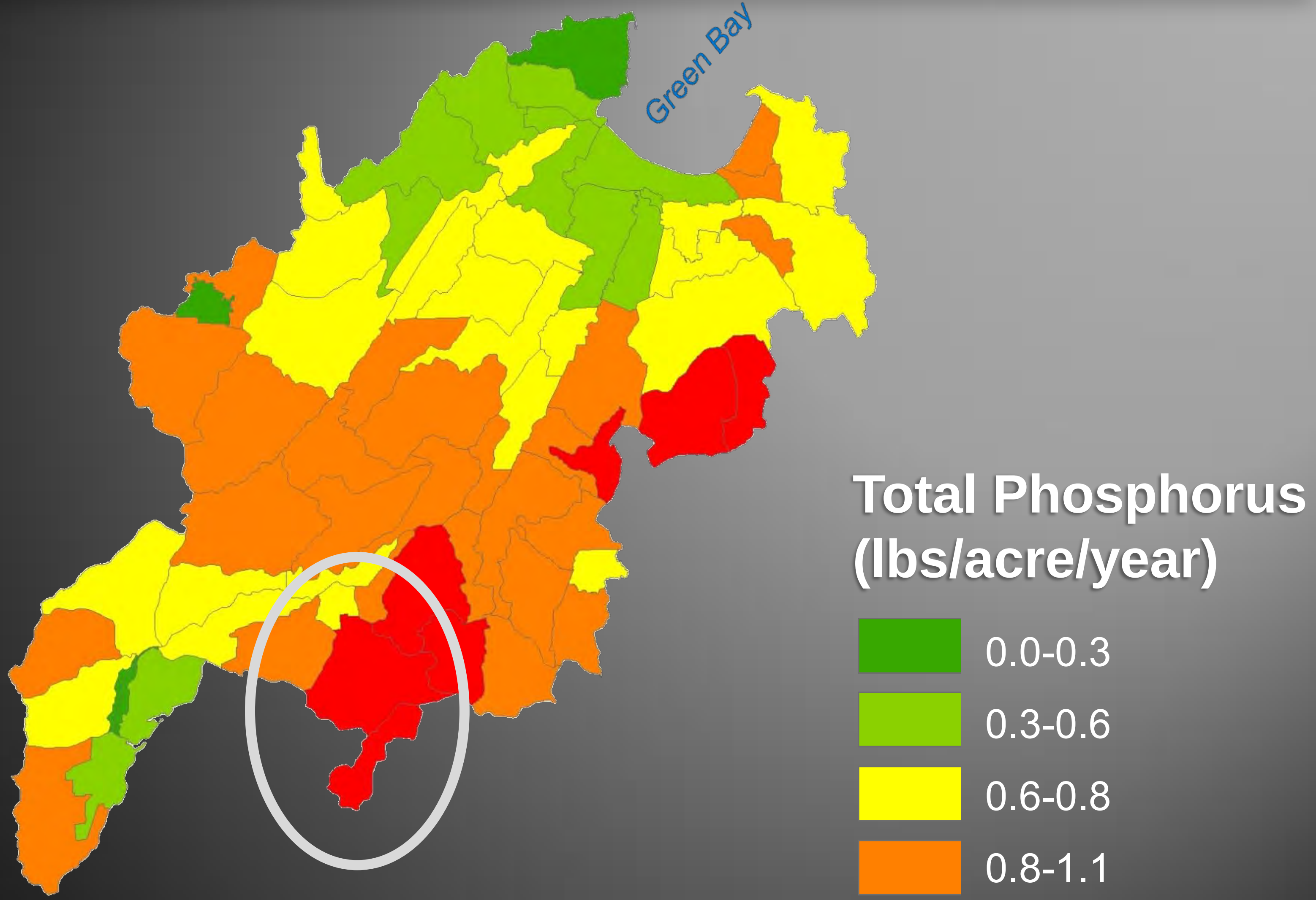
TMDL Results



Watershed

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

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DEPT. OF NATURAL RESOURCES

EVAAL

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

EVAAL
Erosion Vulnerability Assessment
for Agricultural Lands

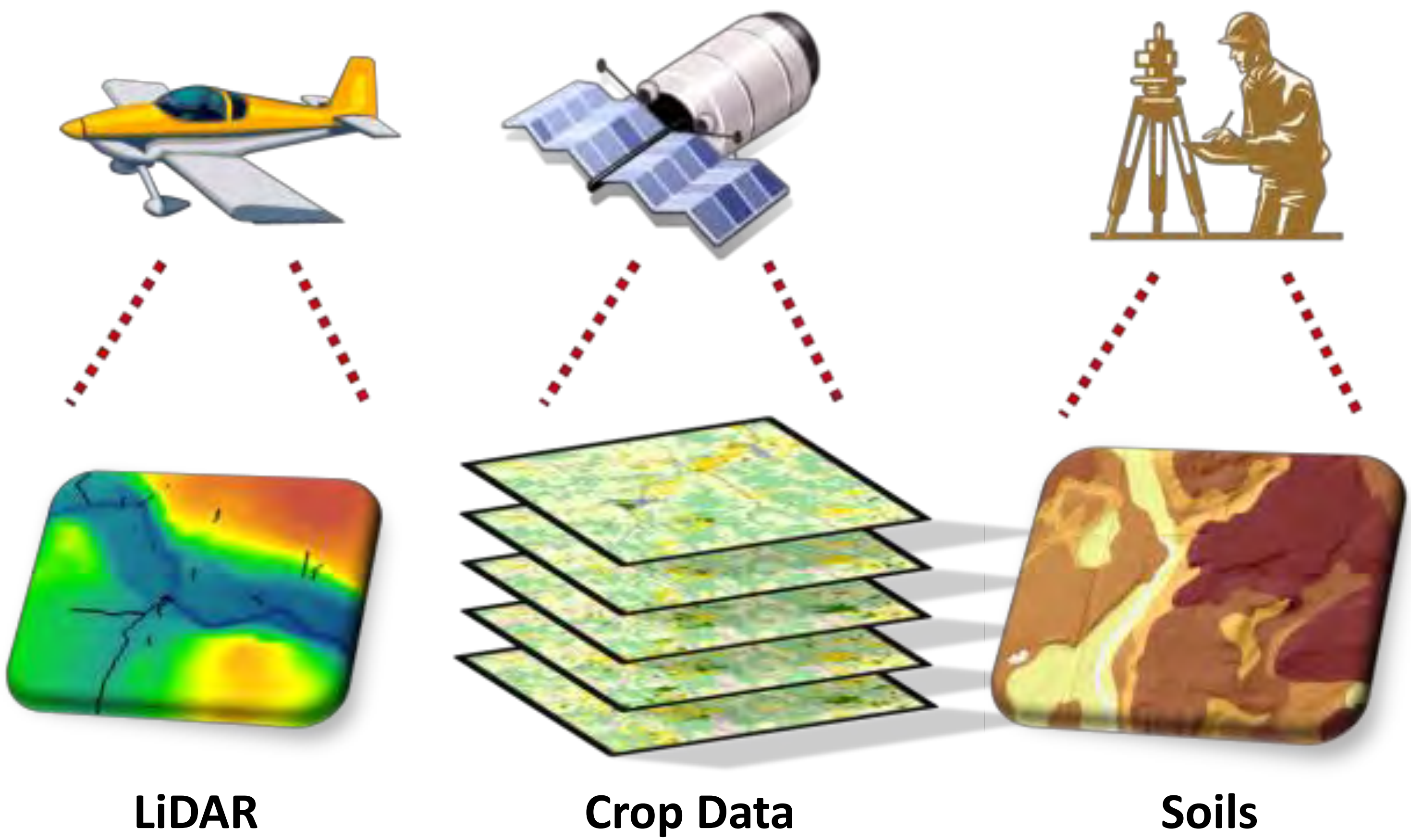
WISCONSIN
DEPT. OF NATURAL RESOURCES

EVAAL System Requirements

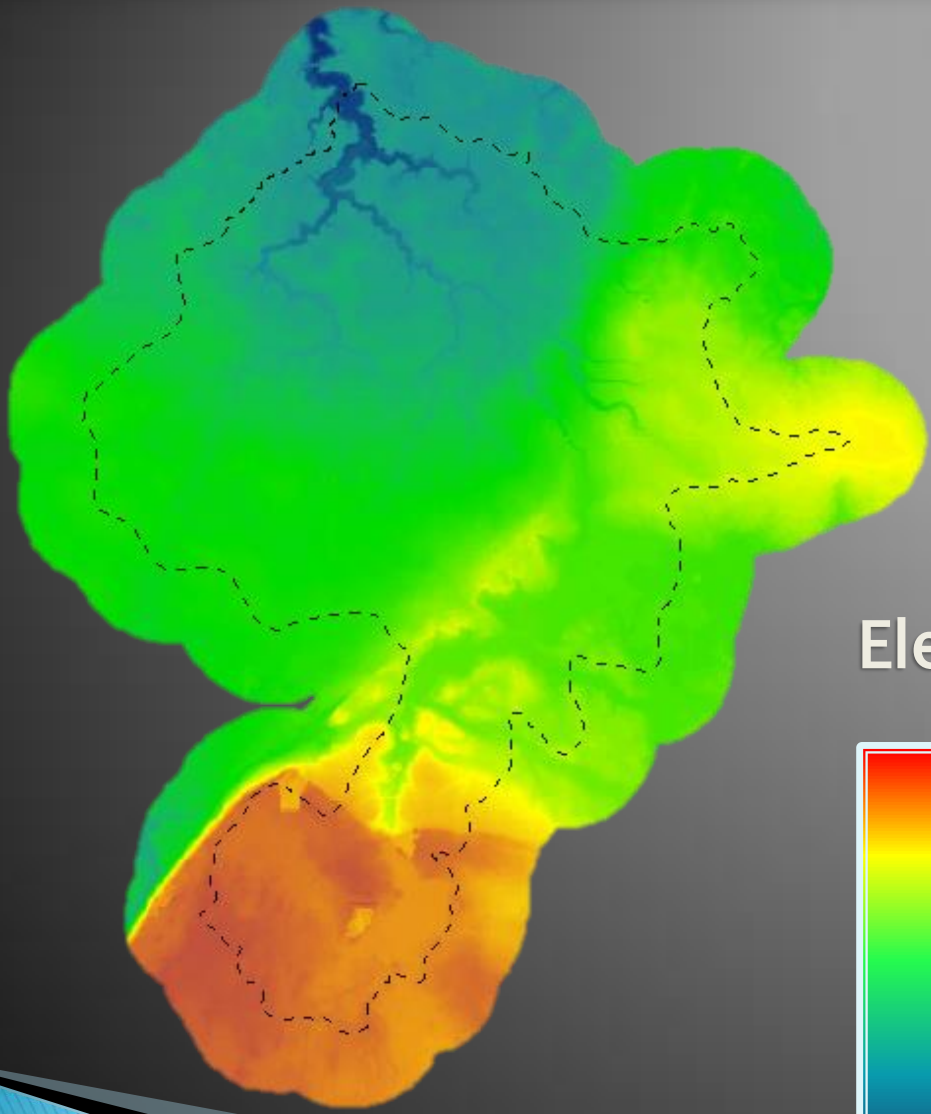
- Windows operating system
- ArcGIS Desktop 10.1 or 10.2
- ArcGIS Spatial Analyst 10.1 or 10.2
- 1.5 GB RAM minimum

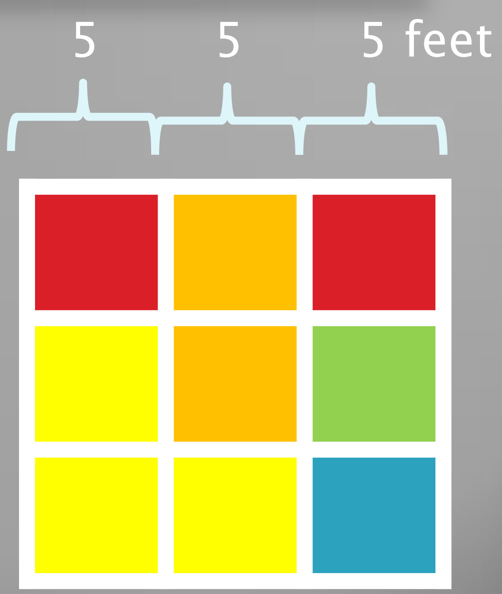
- Does not require any installation, but does need write access to file folder

Available Datasets

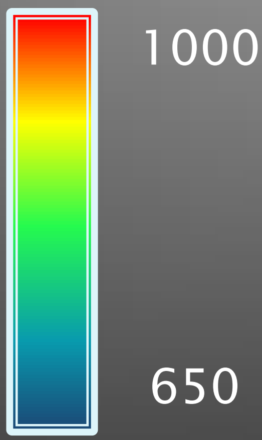


LiDAR Data

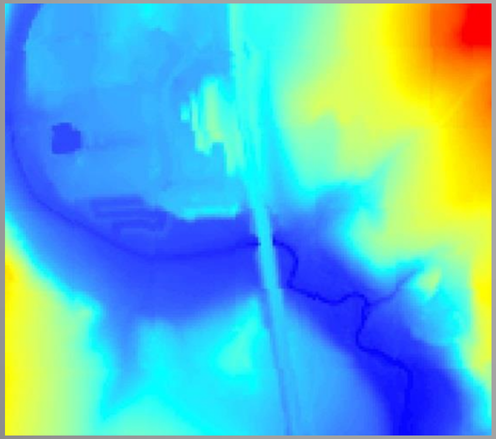


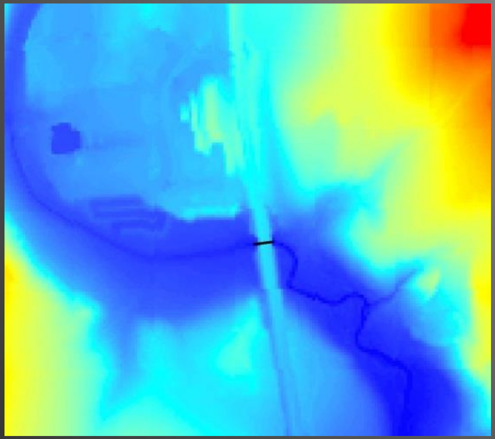


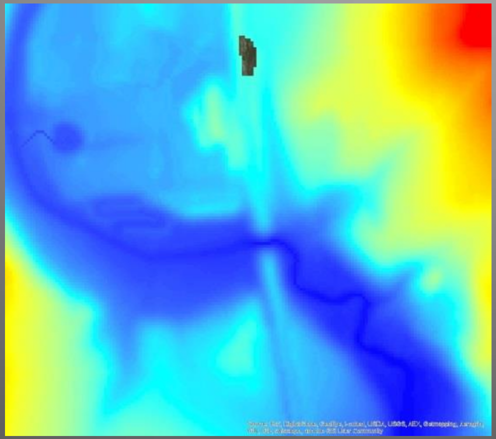
Elevation (feet)



Digital Dams







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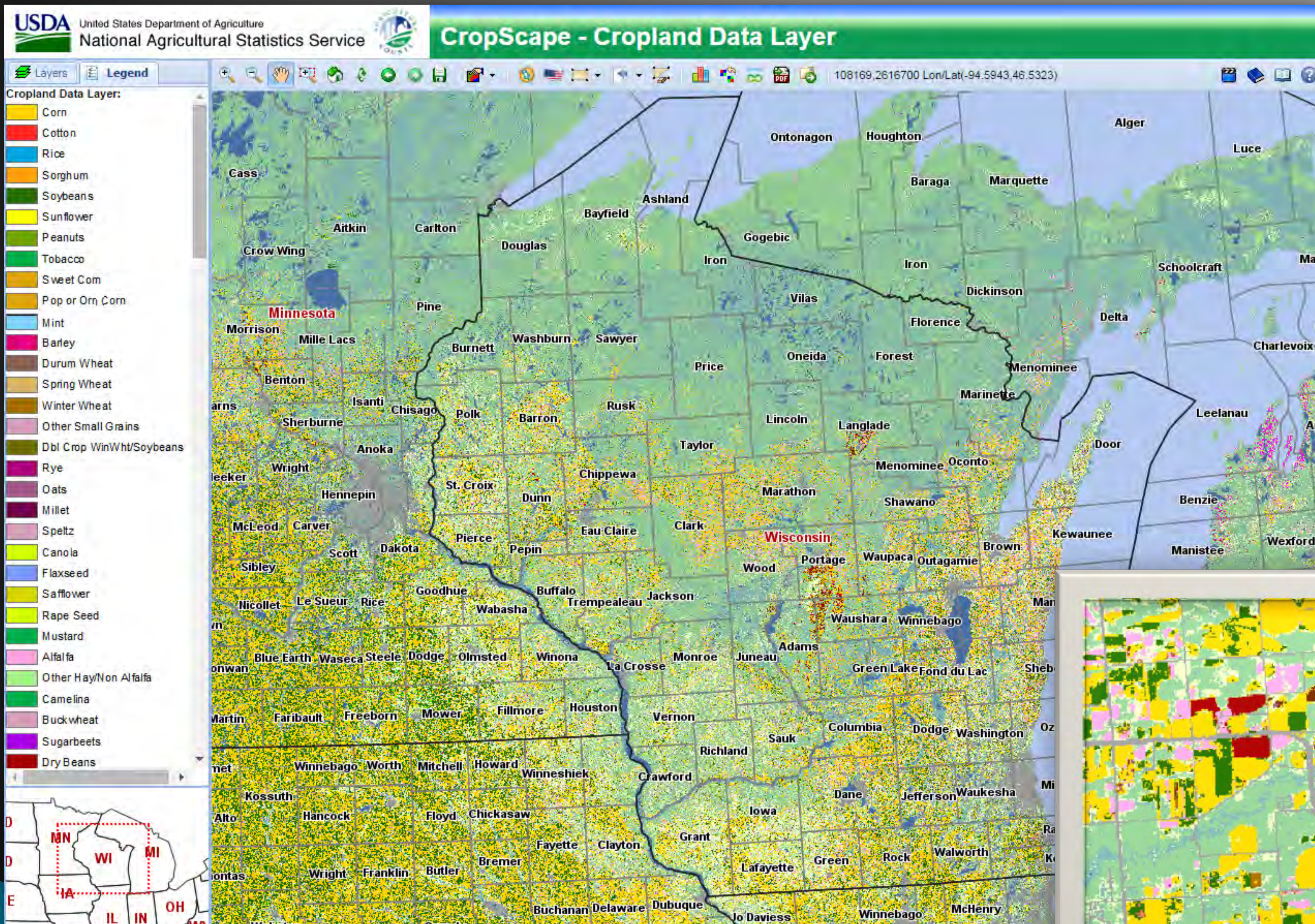
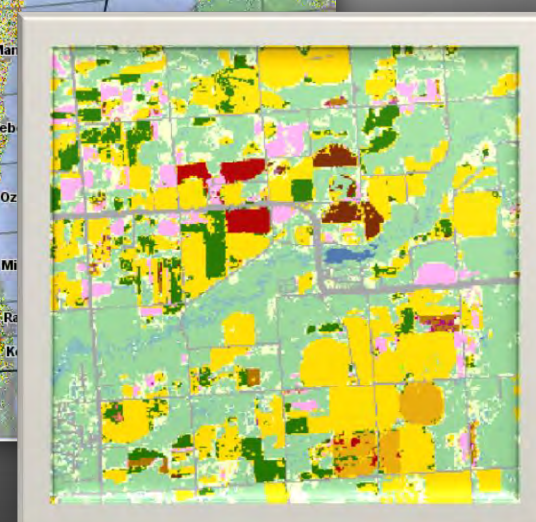
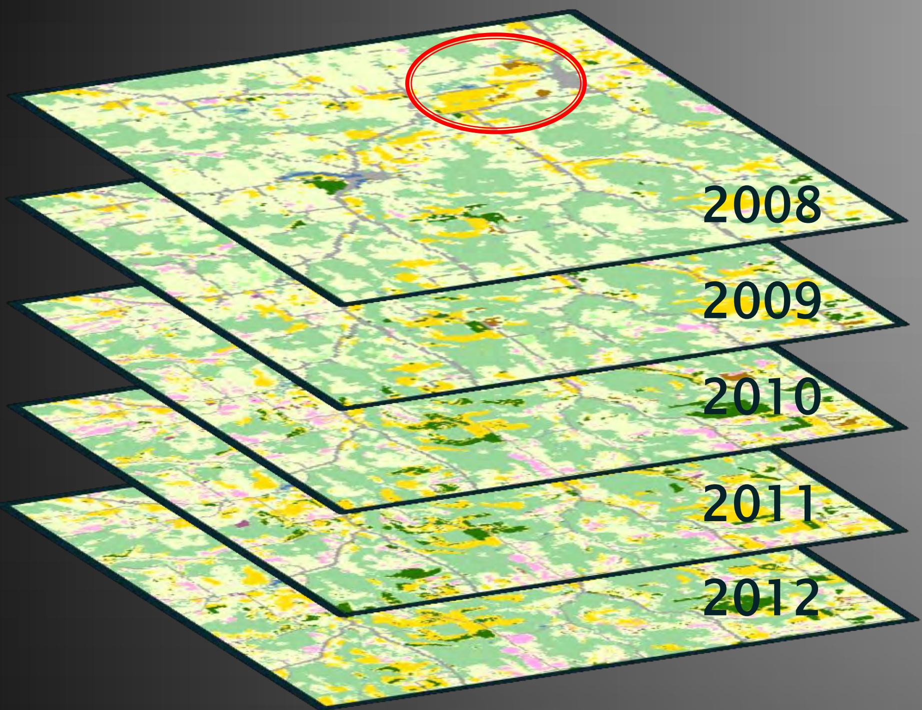
Crop Data





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

Crop Rotations



Corn

Soybean

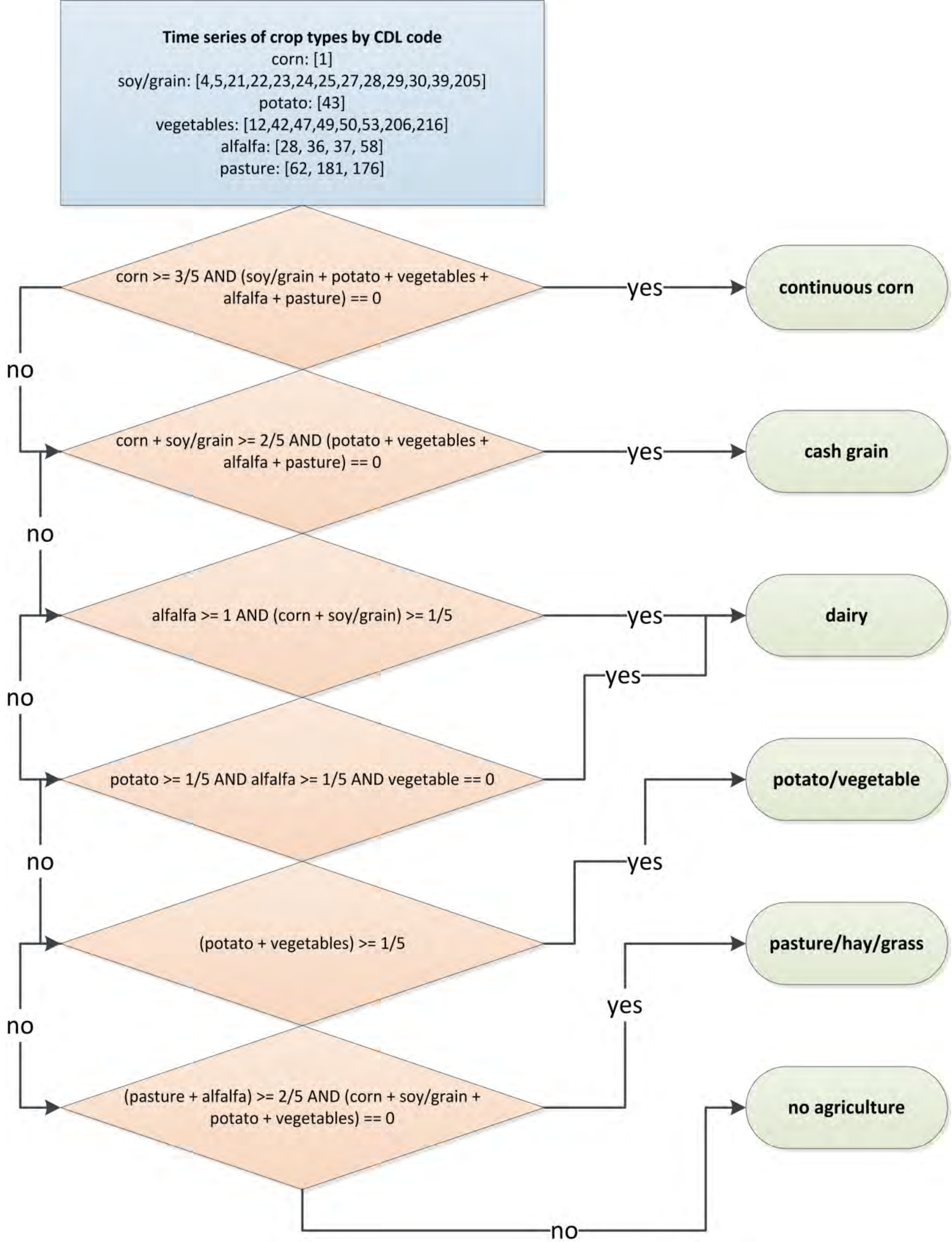
Corn

Corn

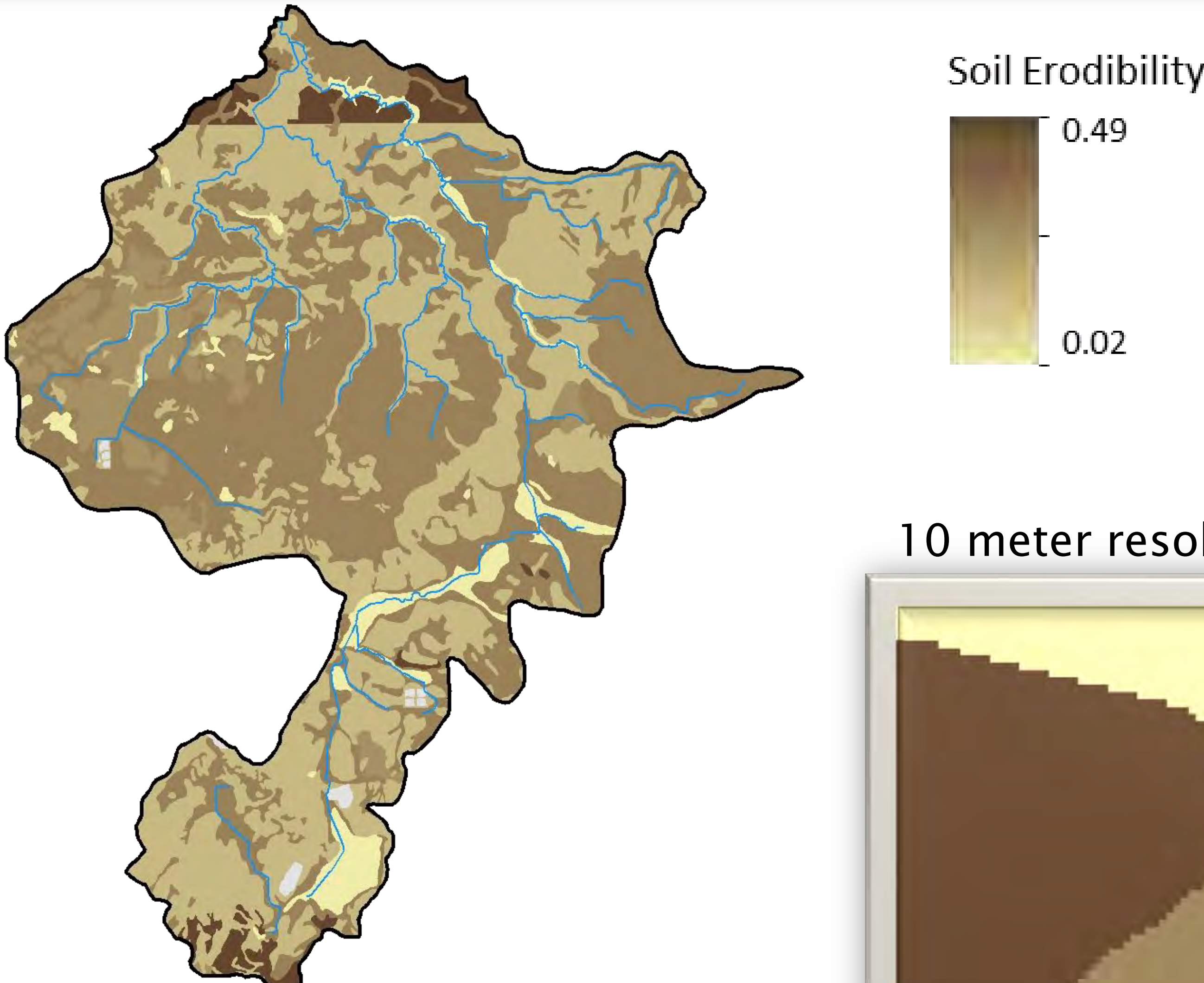
Soybean

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

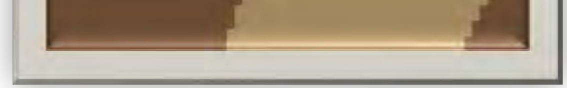
= **Cash Grain Rotation**


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]
corn >= 3/5 AND (soy/grain + potato + vegetables + alfalfa + pasture) == 0
yes
continuous corn
no
corn + soy/grain >= 2/5 AND (potato + vegetables + alfalfa + pasture) == 0
yes
cash grain
no
alfalfa >= 1 AND (corn + soy/grain) >= 1/5
yes
dairy
yes
no
potato >= 1/5 AND alfalfa >= 1/5 AND vegetable == 0
potato/vegetable
no
yes
(potato + vegetables) >= 1/5
pasture/hay/grass
yes
no
(pasture + alfalfa) >= 2/5 AND (corn + soy/grain + potato + vegetables) == 0
no agriculture
no

Soils – gSSURGO



10 meter resolution



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

Erosion Vulnerability Analysis

USLE + SPI – IDA



= EVAAL

Erosion Vulnerability Assessment for Agricultural Lands

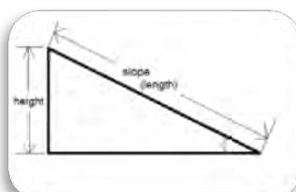
Universal Soil Loss Equation

- Sheet and rill erosion

$$A = RK(LS)CP$$

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






Universal Soil Loss Equation

- Sheet and rill erosion

$$A = RK(LS)CP$$

Constant

Constant

Universal Soil Loss Equation

- Sheet and rill erosion

$$A = \cancel{R}K(LS)C\cancel{P}$$

Constant Constant

$$A = K(LS)C$$

Universal Soil Loss Equation

- Sheet and rill erosion

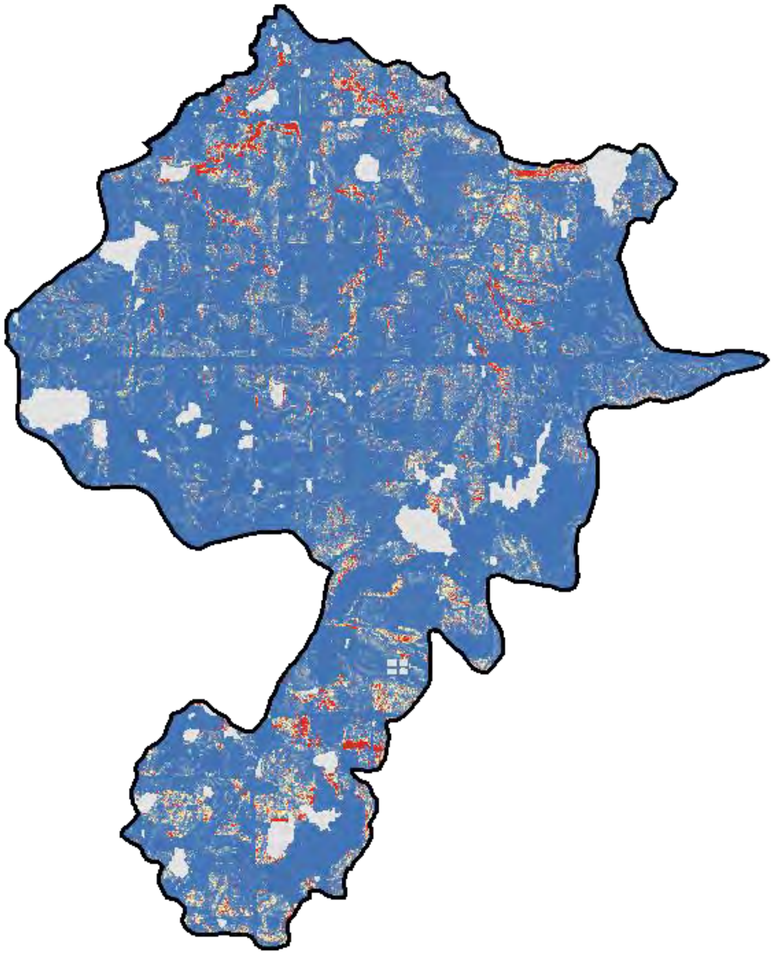
$$A = K(LS)C$$

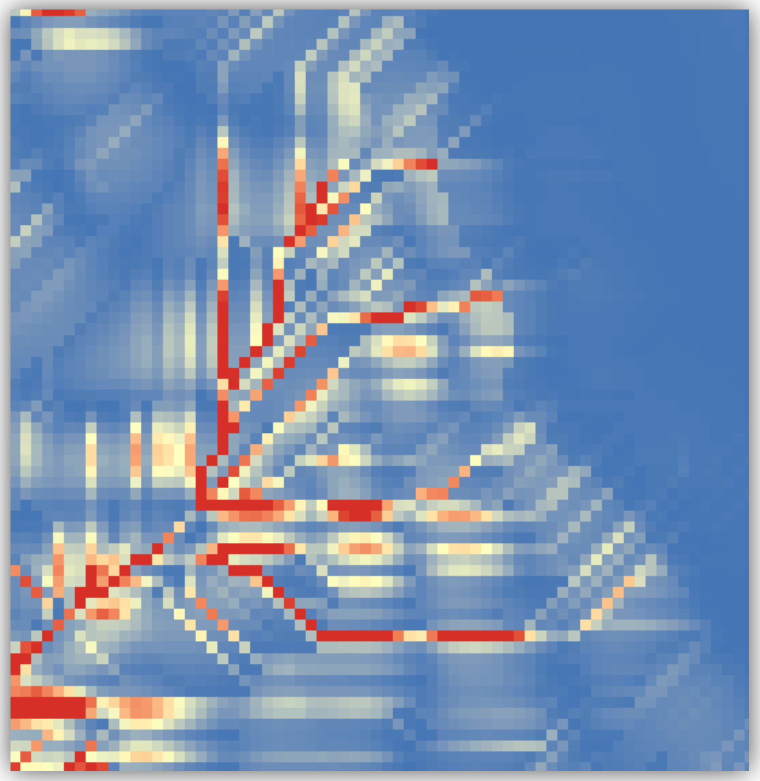
SSURGO soils

DEM

Cropland data layer

Universal Soil Loss Equation

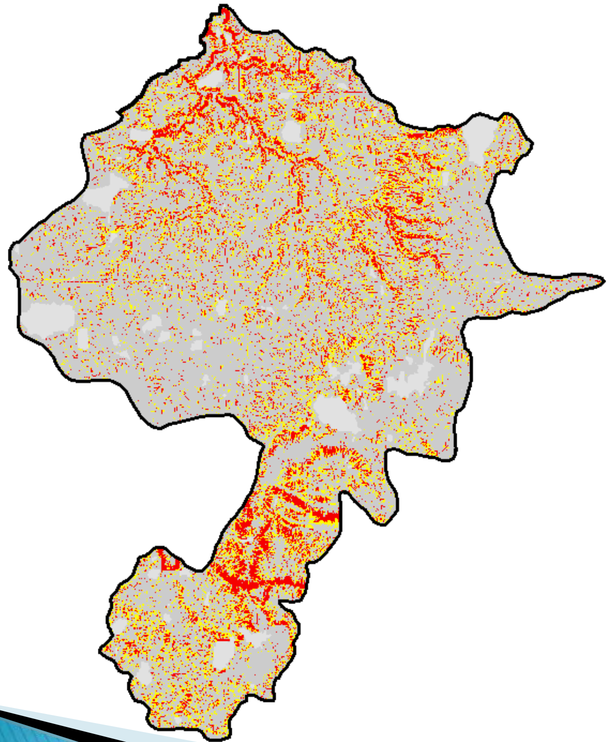




Stream Power Index

- Potential for gully erosion

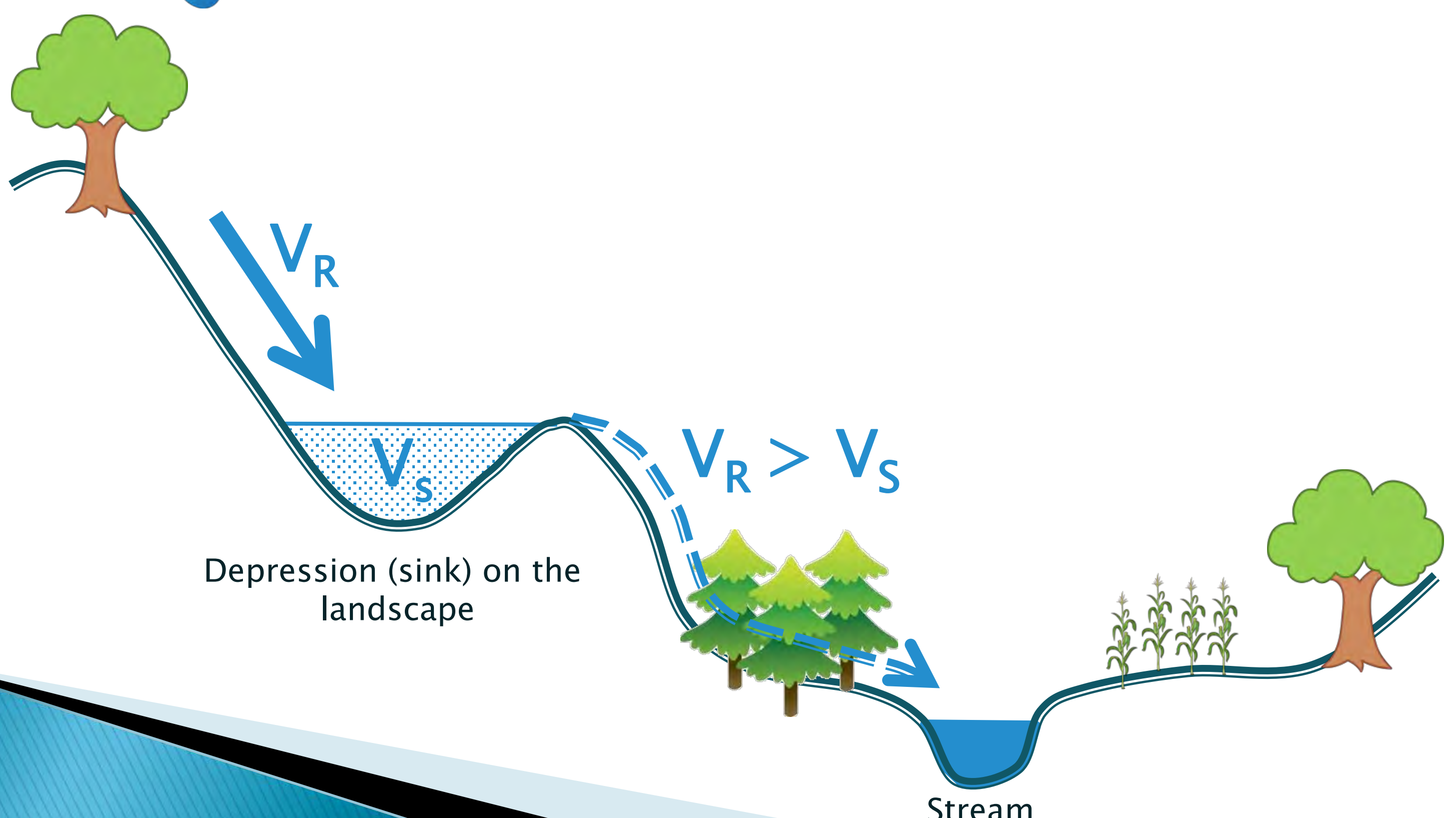
$$\mathrm{SPI} = f(\mathrm{slope}, \mathrm{catchment\ area})$$



Internally Draining Areas

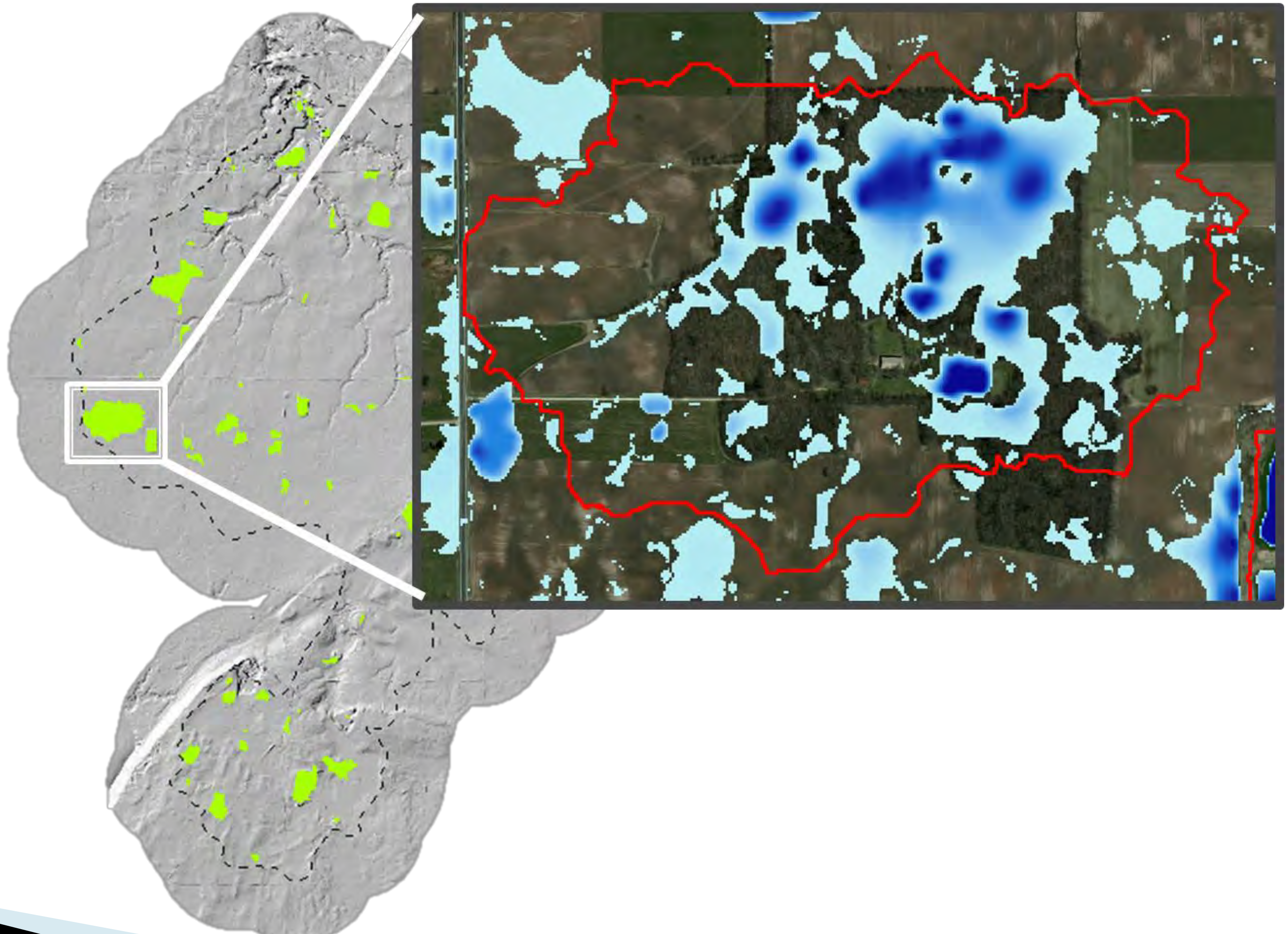
- Areas that do not contribute to surface waters

$$\begin{cases} Vs \geq Vr, \textit{Internally drained} \\ Vs < Vr, \textit{Not internally drained} \end{cases}$$



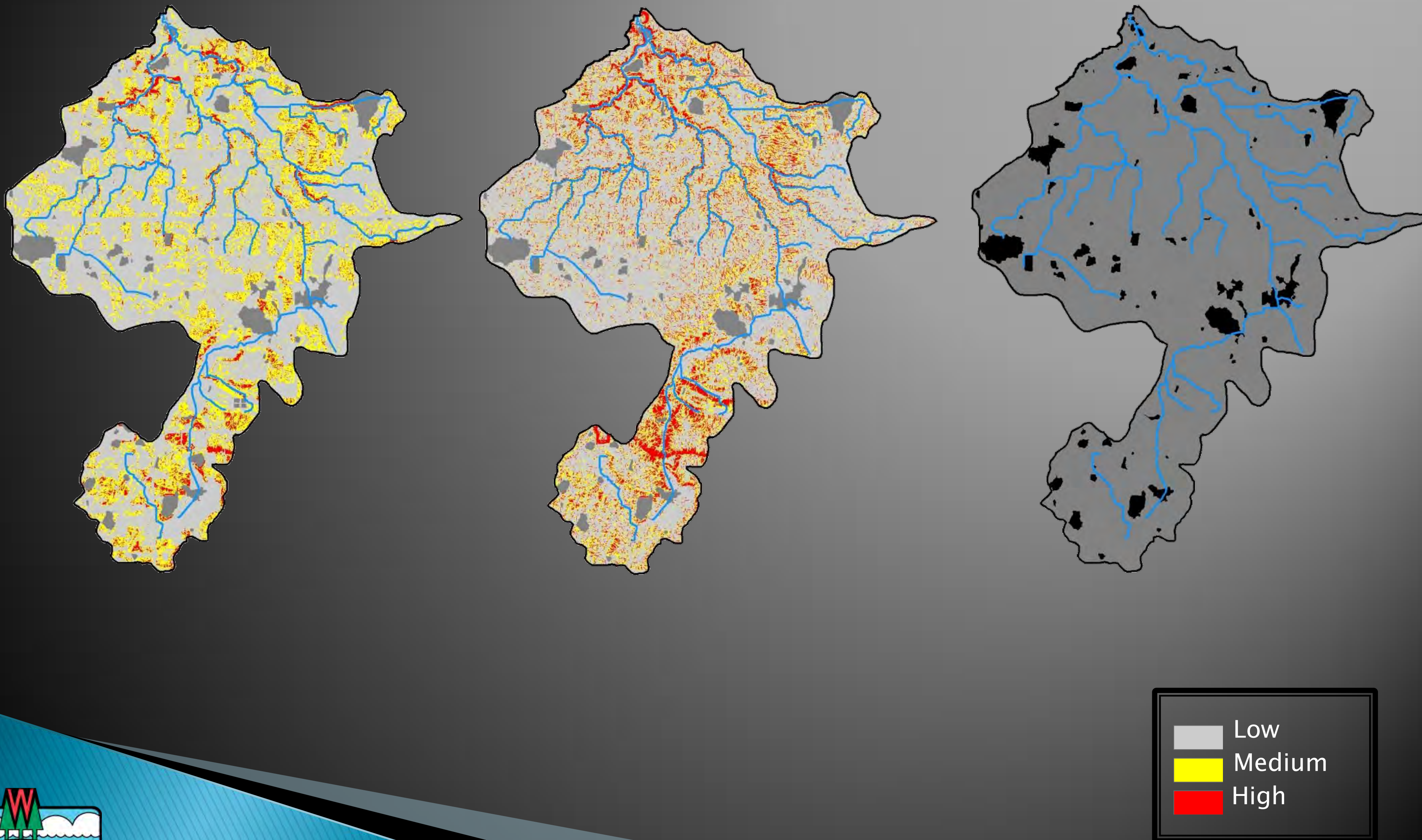
Internally Draining Areas

- Areas that do not contribute to surface waters



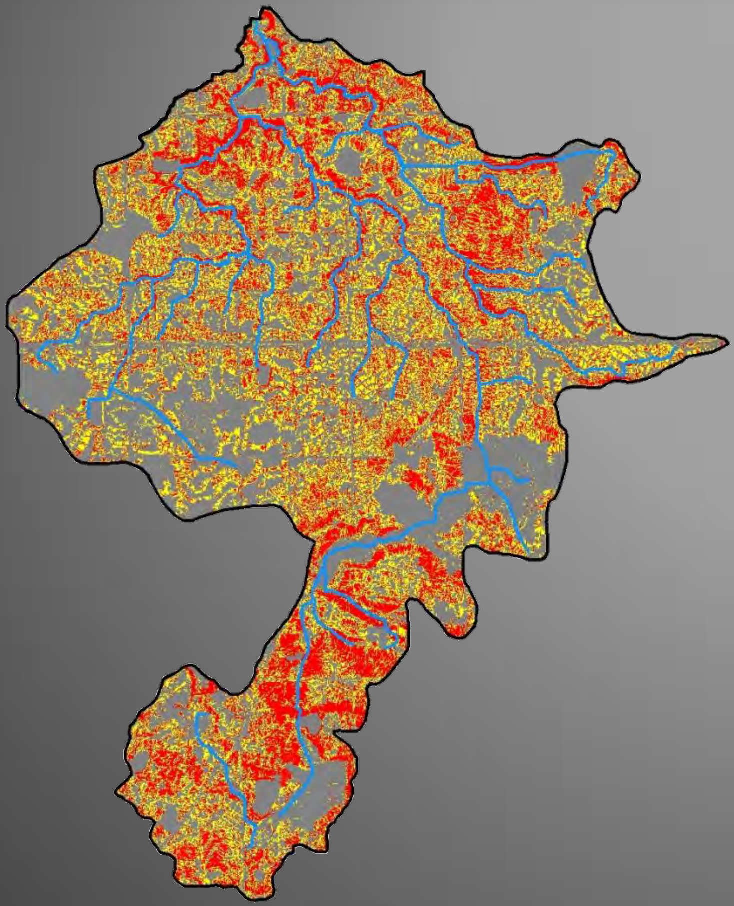
Results

USLE SPI NC Areas

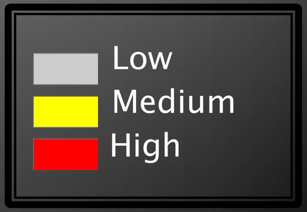


WISCONSIN DEPT. OF NATURAL RESOURCES

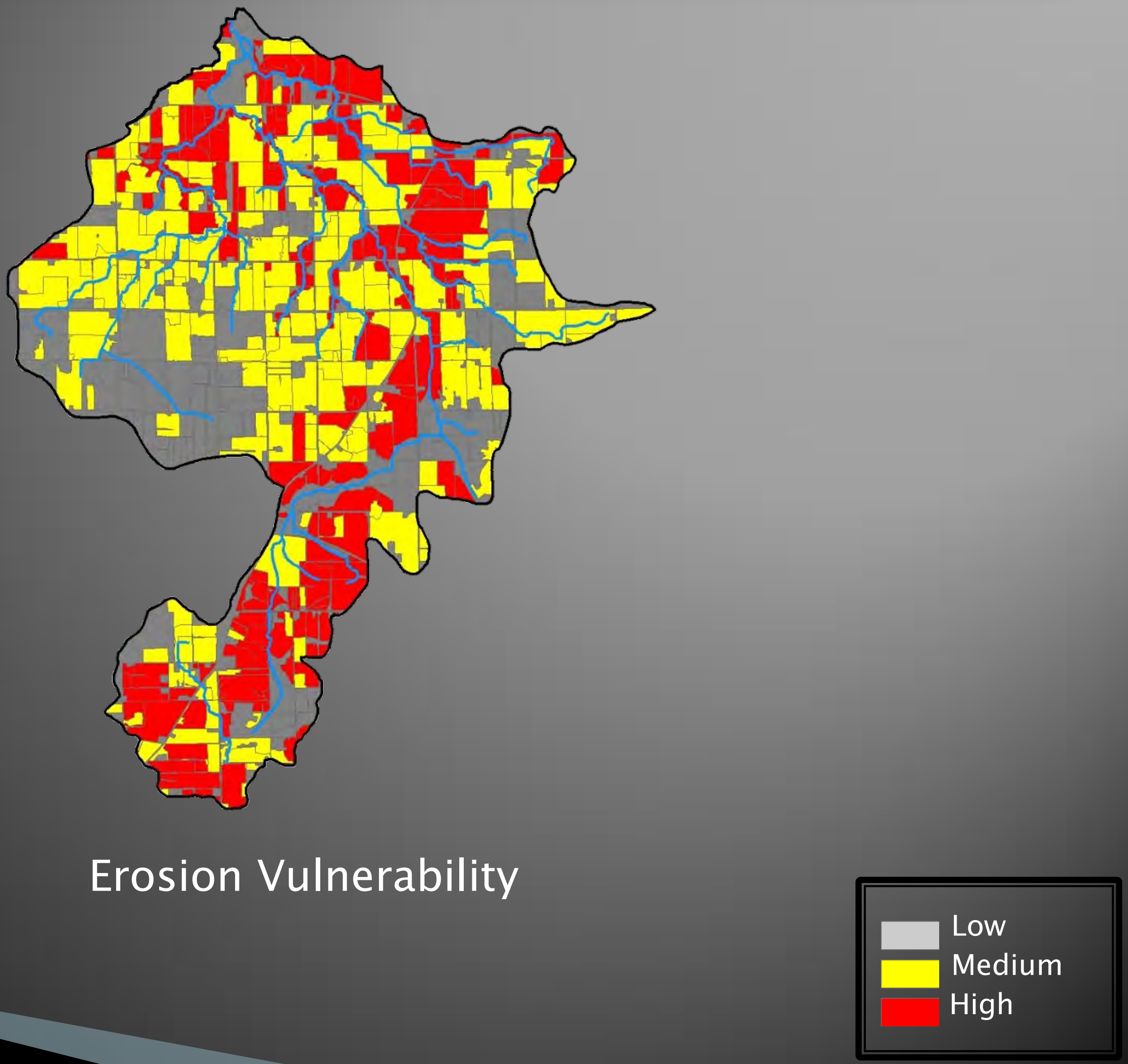
Results



Erosion Vulnerability

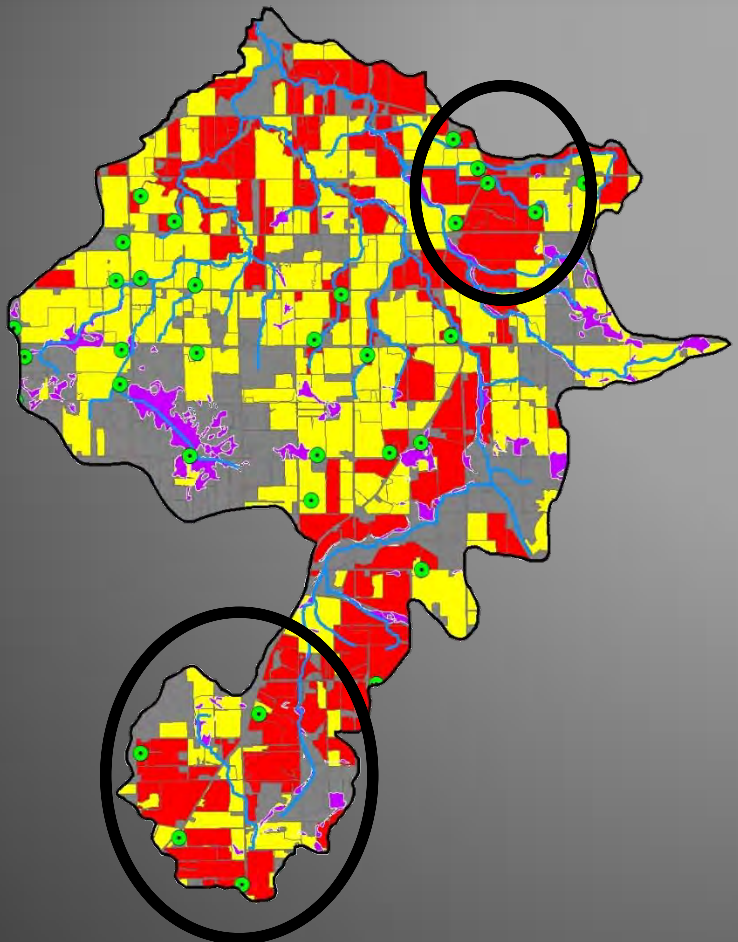


Results

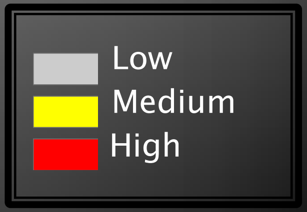


Erosion Vulnerability

Results



Prioritization

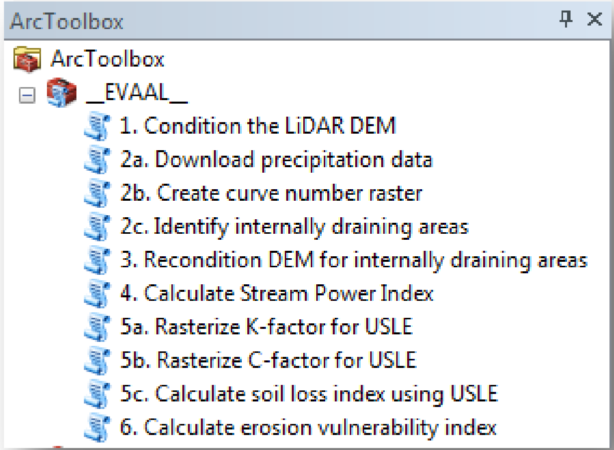


Limitations

- 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



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

Agricultural NPS pollution

Erosion Vulnerability Assessment for Agricultural Lands (EVAAL)

EVAAL Erosion Vulnerability Assessment for Agricultural Lands

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.

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 [exit 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

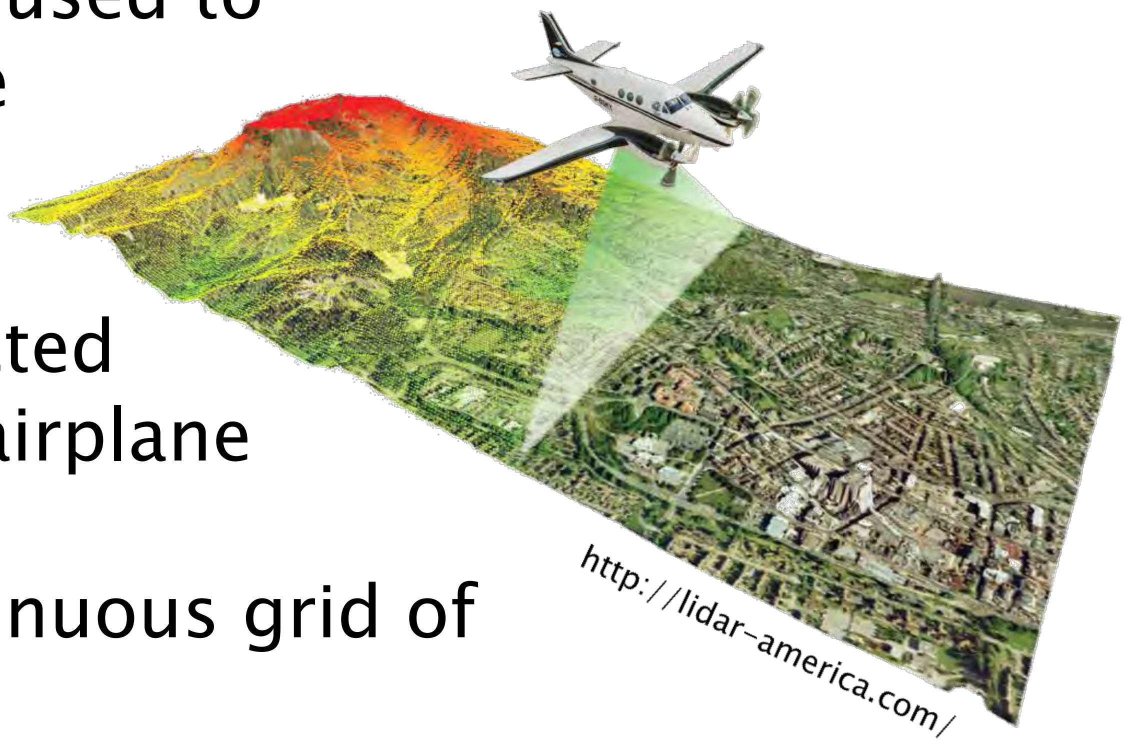
- Outagamie County LWCD
  - NPS Implementation Plan
    - Rotation analysis
    - Stream Power Index
    - Erosion Vulnerability
- The Nature Conservancy
  - Mullet Creek Watershed
    - Erosion vulnerability to prioritize field inventories
- Engineering Consultants
  - Watershed assessments

EVAAL

- LiDAR & DEM processing

What is LiDAR?

- **L**ight **D**etection **A**nd **R**anging
- 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



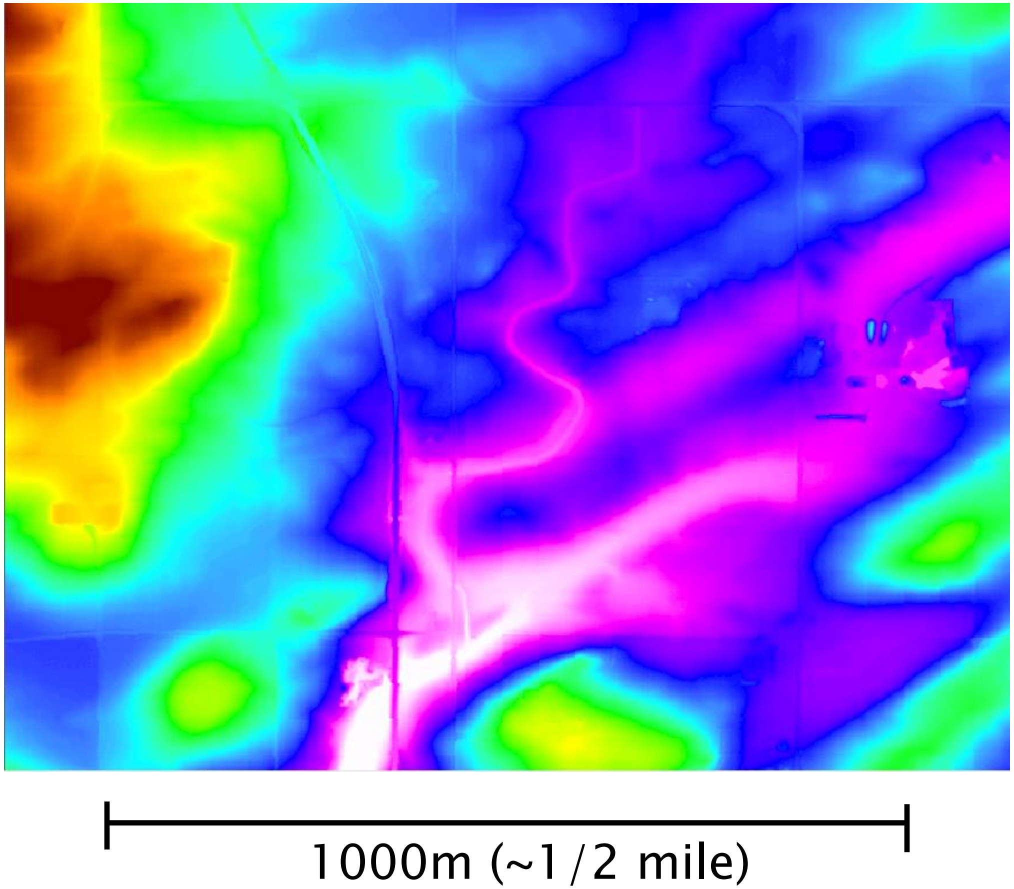
Elevation Data

- 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

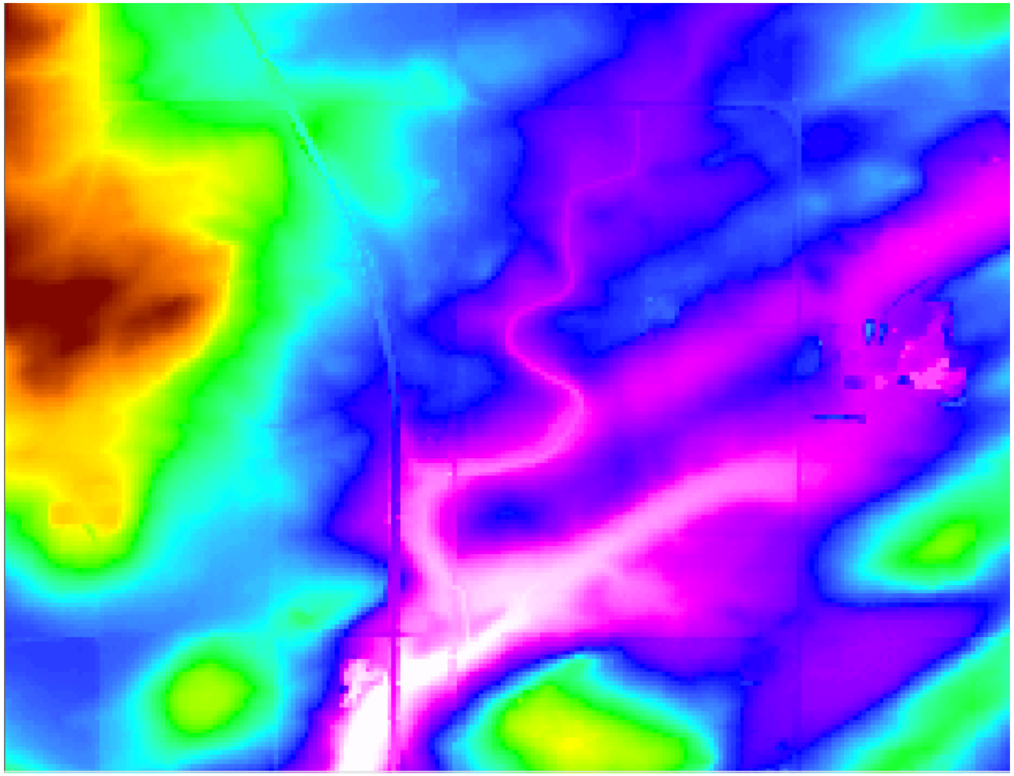
3 meter LiDAR



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

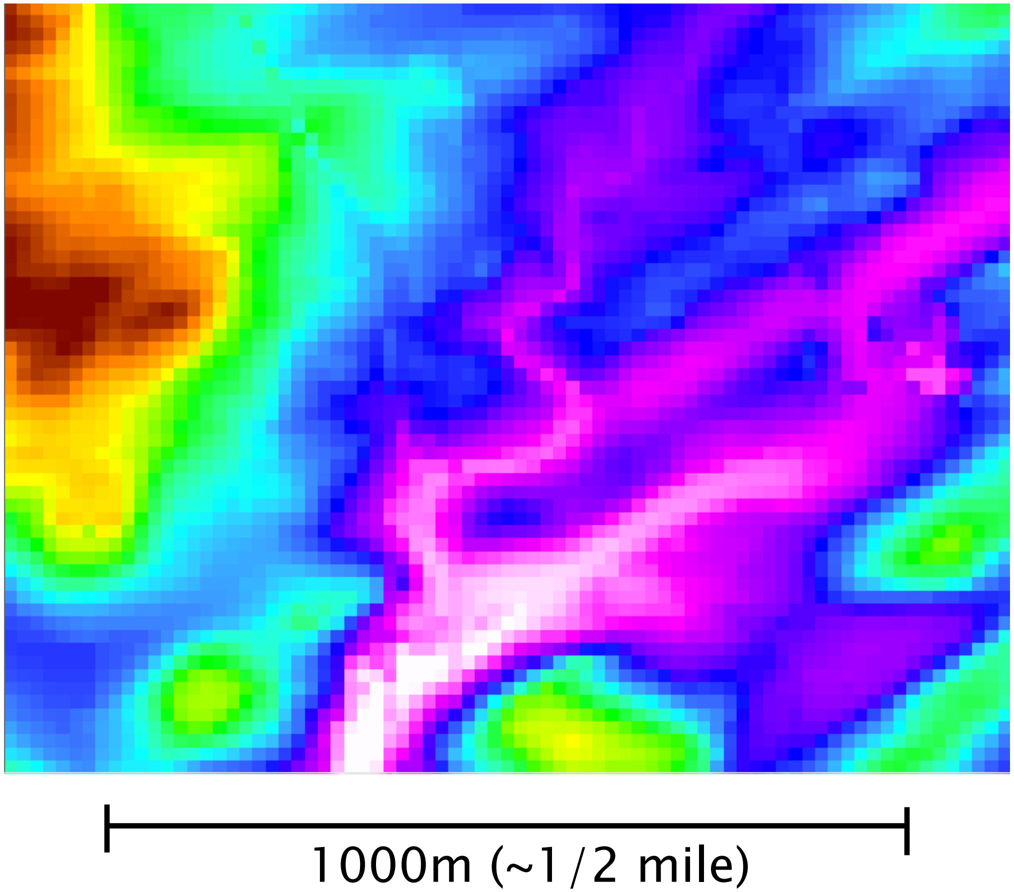


1000m (~1/2 mile)

Resolution

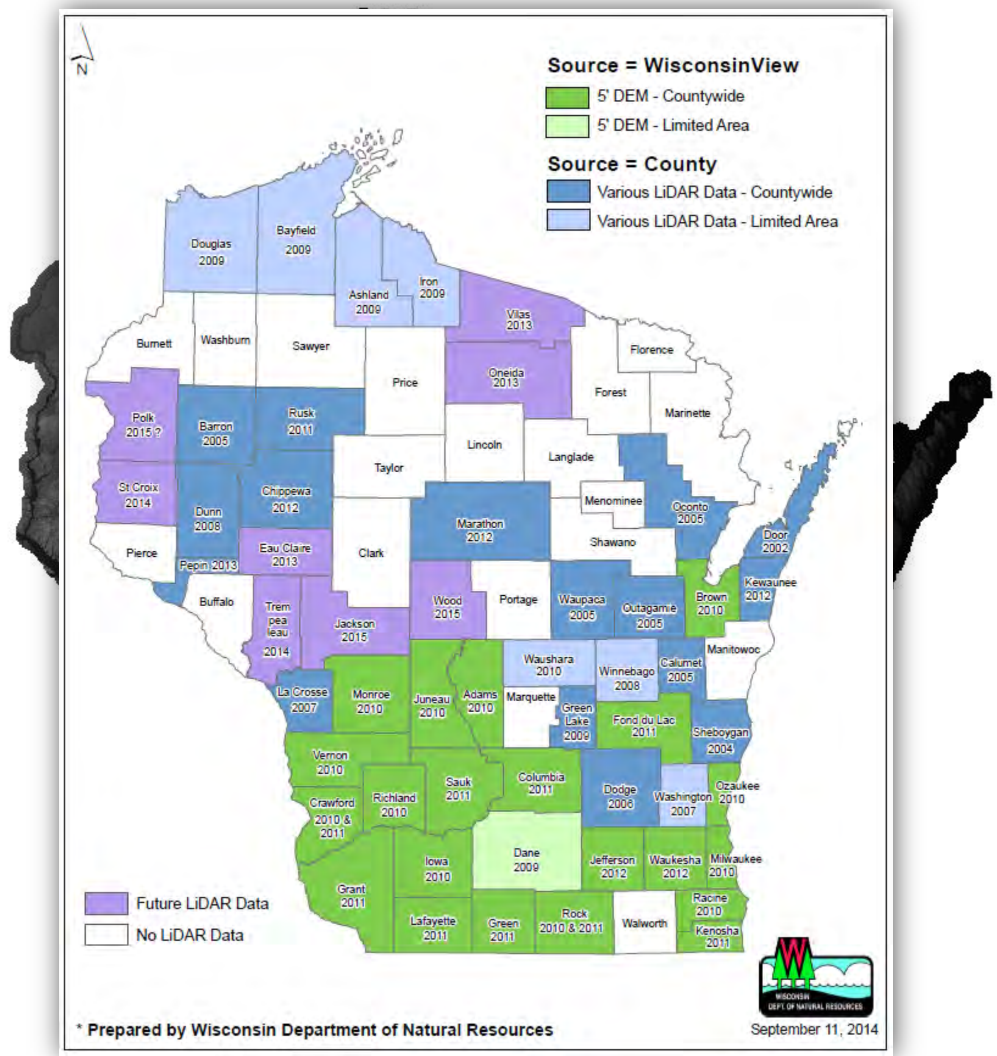
- Often described by the resolution of one grid cell or pixel (e.g., 3 meter, etc.)
- Large effect on fine scale detail of landscape

30 meter



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



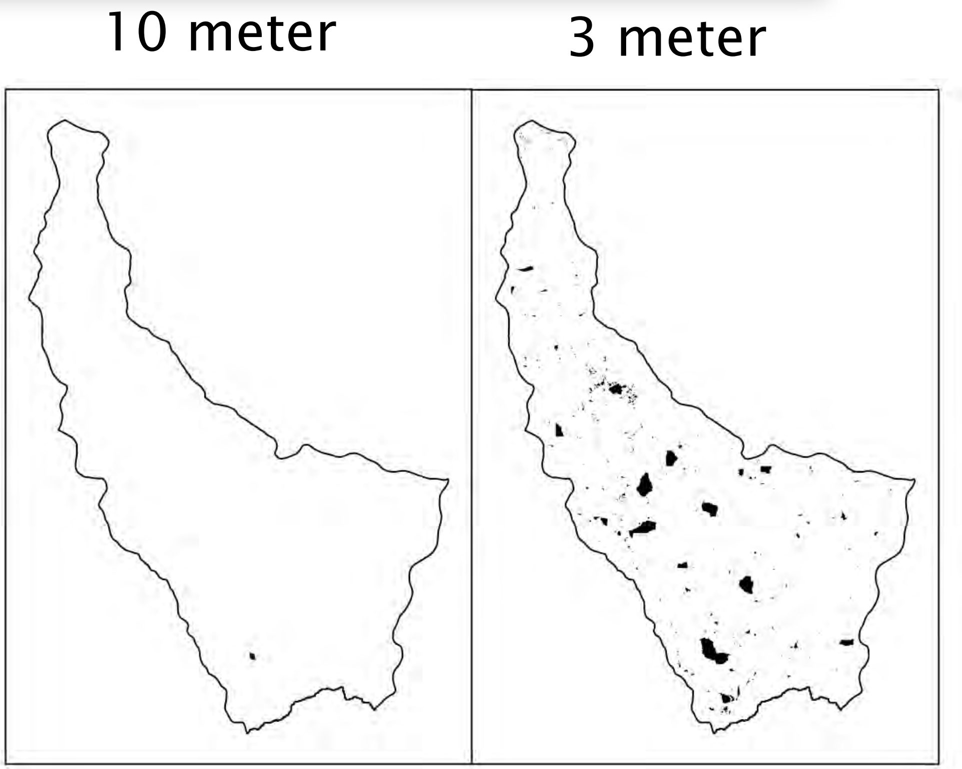
http://www.wisconsinview.org/

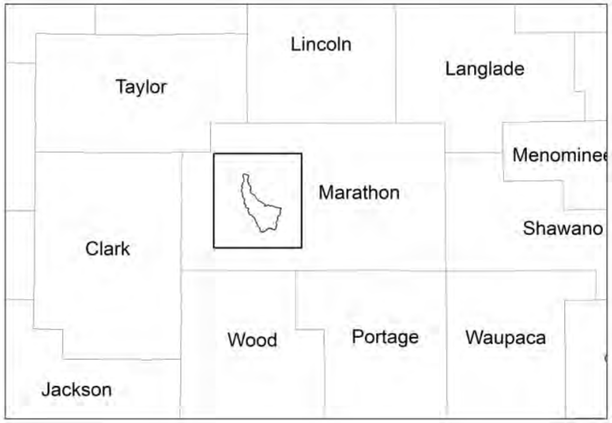
Can I run EVAAL without LiDAR?

- EVAAL is intended to be used with high-resolution elevation data, LiDAR data
- This provides highly detailed maps of where potential areas of erosion exist
- However, **Yes**, EVAAL can still be used with lower resolution elevation data
- **Note: The lower resolution will affect the results!**

Difference in IDAs

- Internally drained areas
  - Modeled hydrology is different
  - For example: 80 times more internally drained area with the LiDAR data



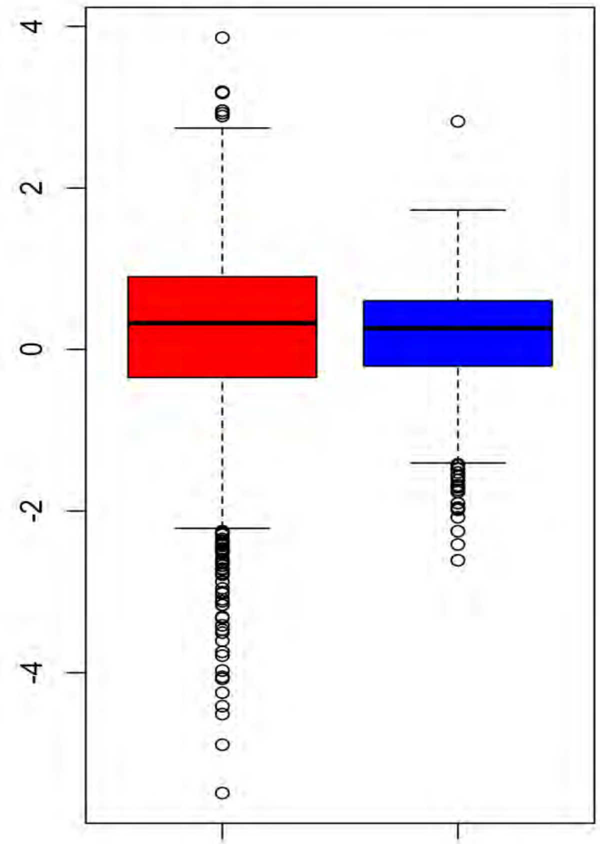


Erosion Vulnerability Difference

- 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

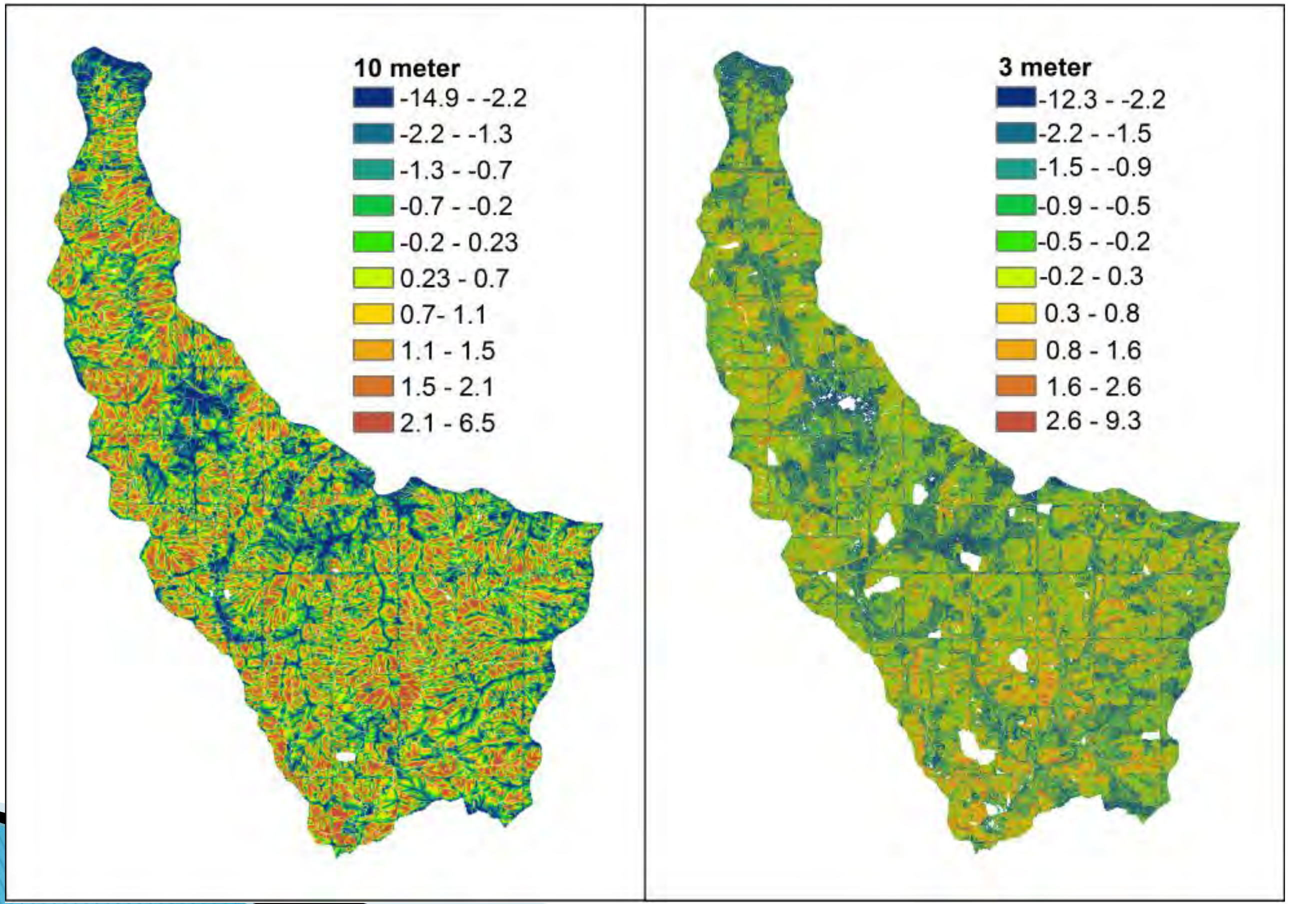
Mean Vulnerability



10 meter 3 meter

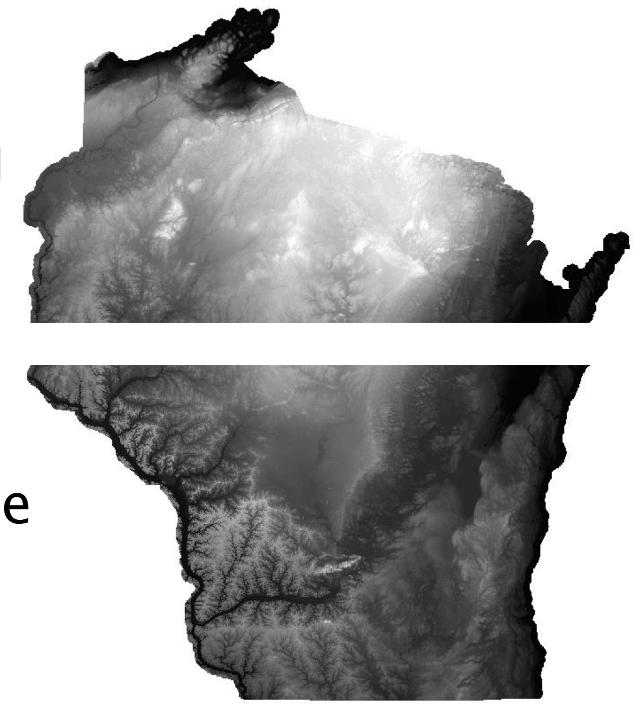
Erosion Vulnerability Difference

- 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

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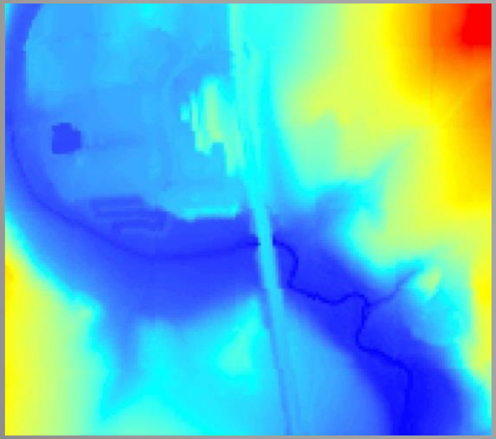
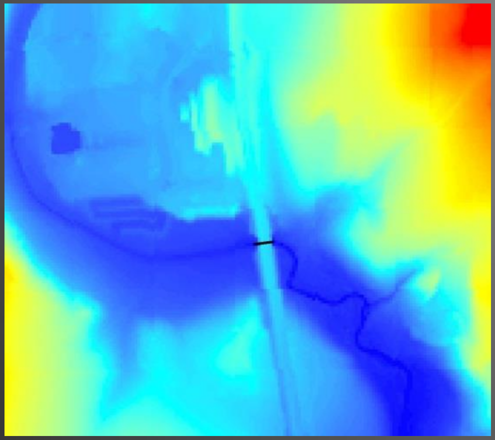
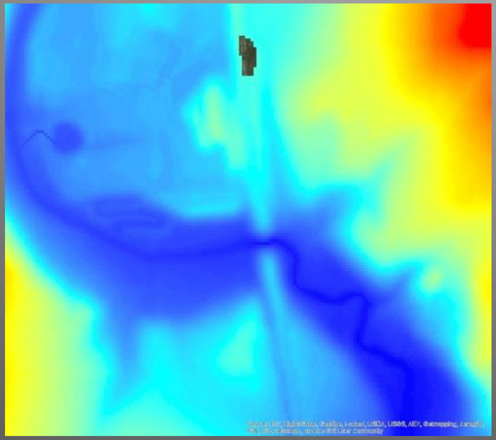
EVAAL

- Culvert processing

Digital Dams







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Digital Dams & Culverts

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

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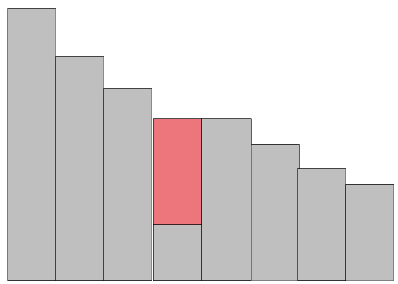
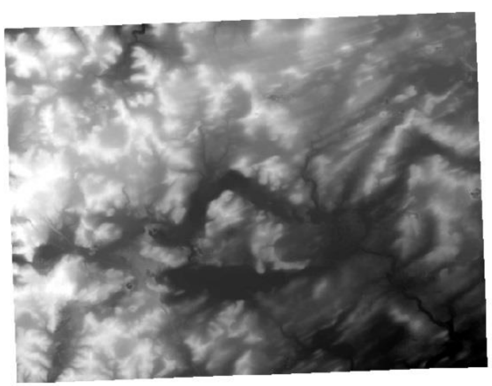
Locate Depressions

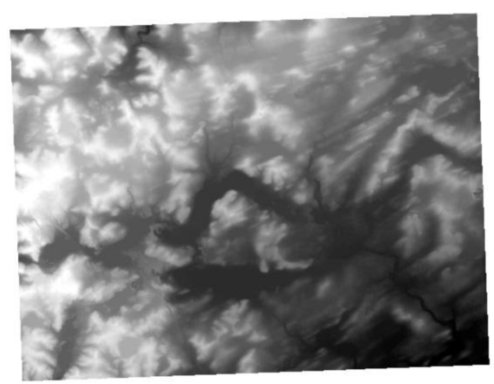
- Create filled DEM
  - Spatial Analyst Toolbox – Hydrology – Fill

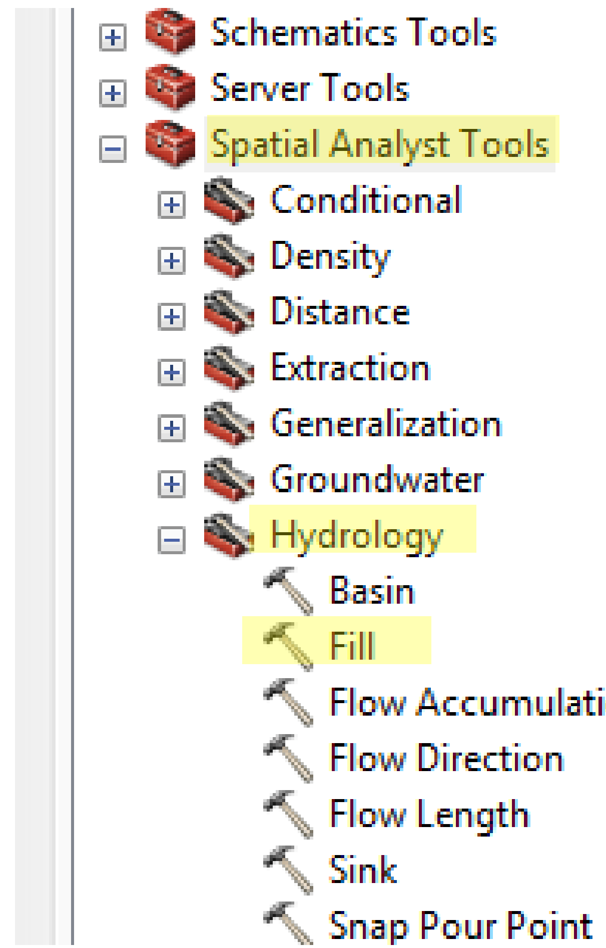


Raw



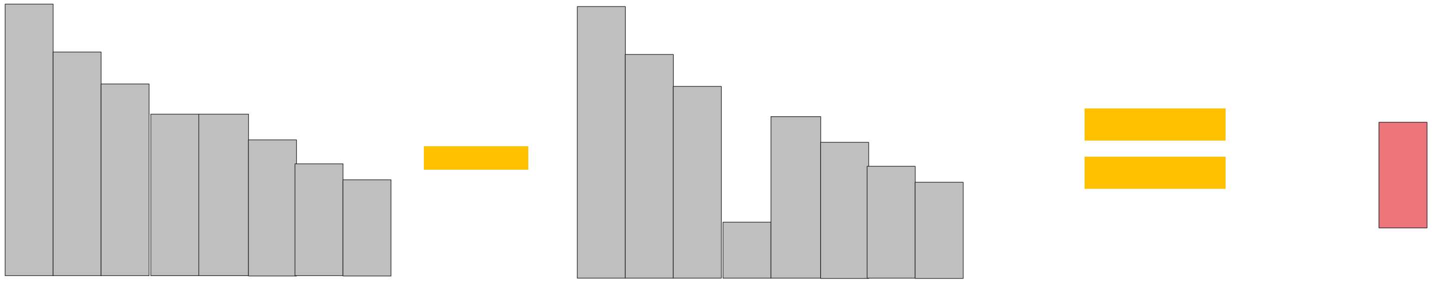
Filled





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



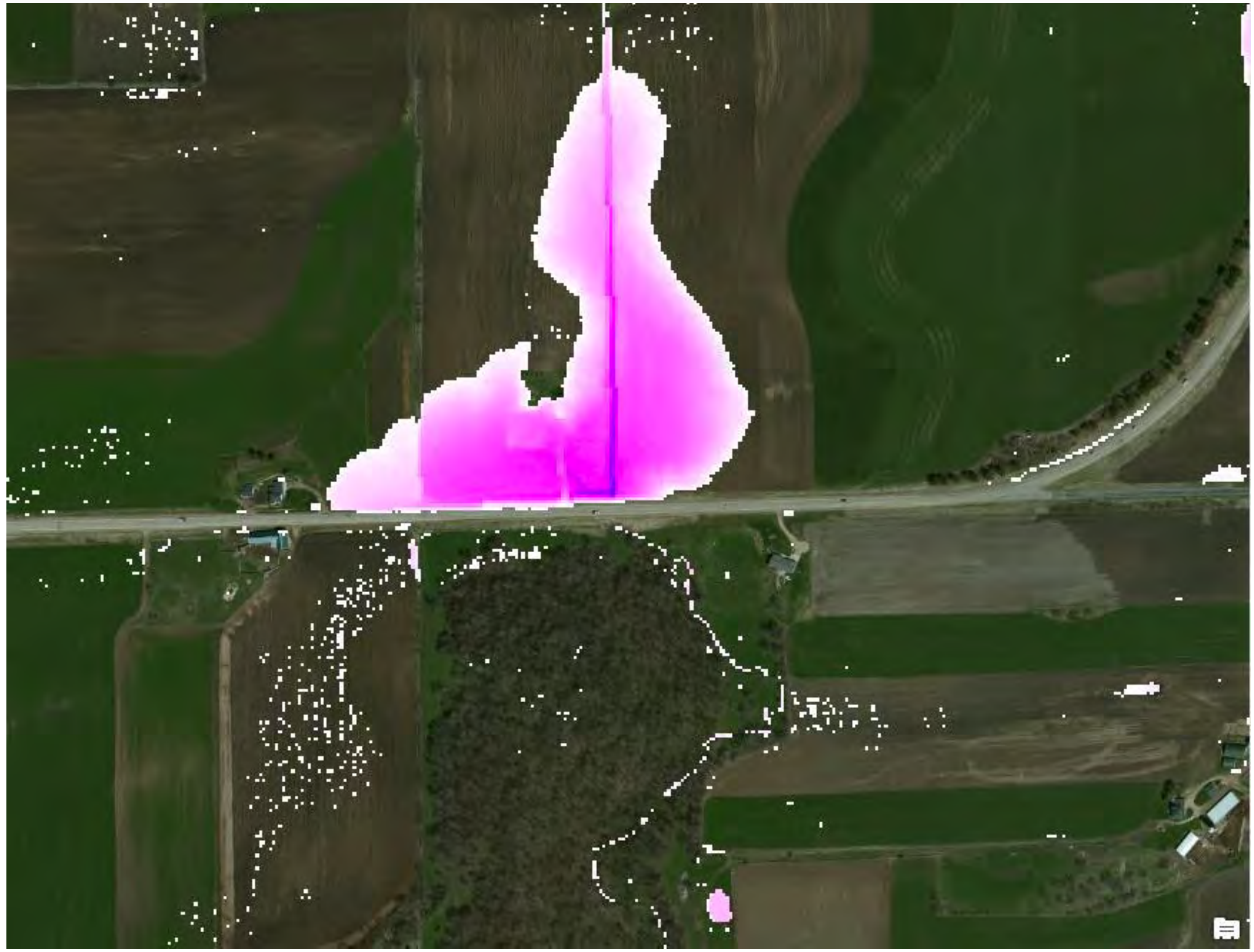
Locate Depressions

- 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

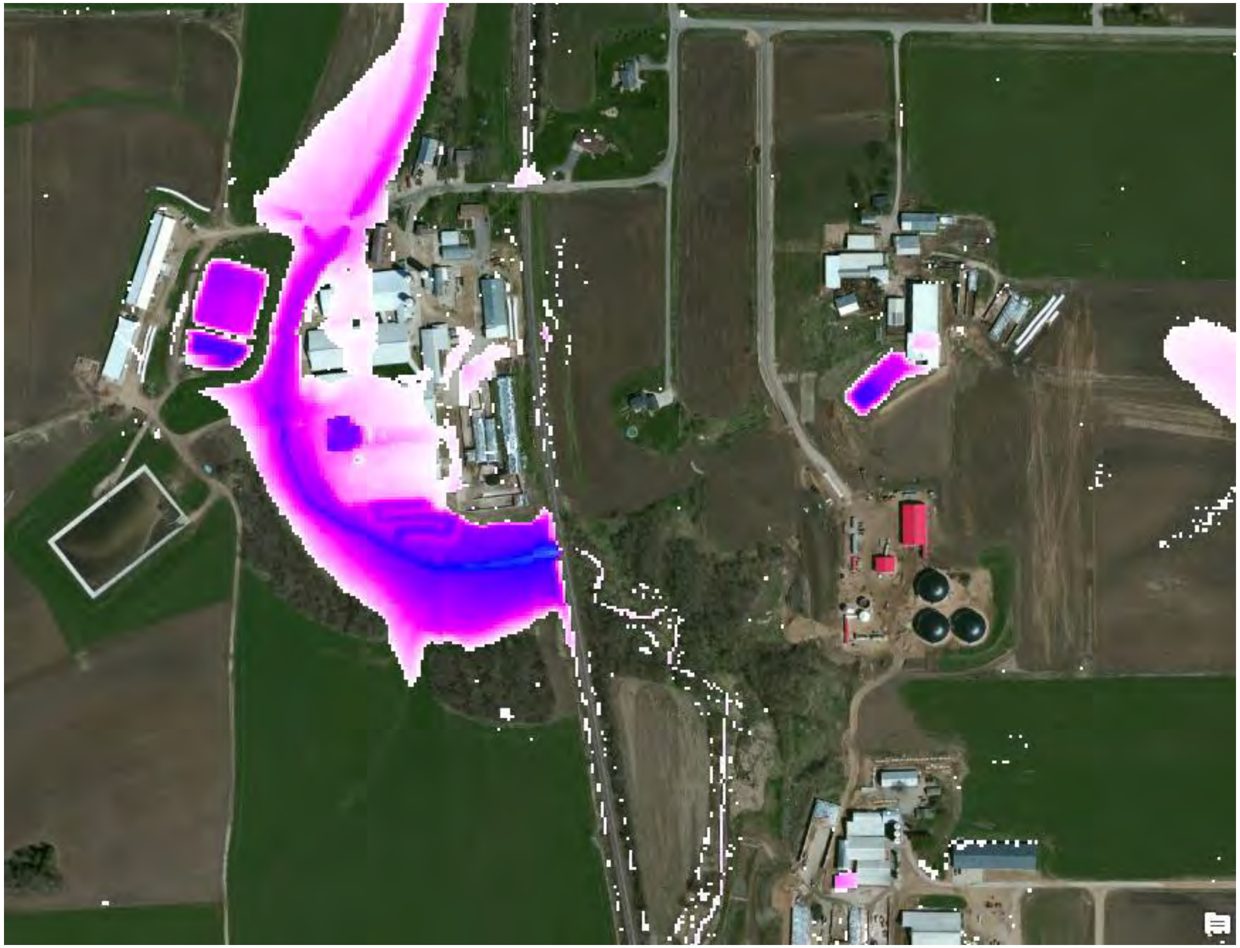
Locate Depressions

- Ditches
- Notice the flat side



Locate Depressions

- Small streams
- Flat side again

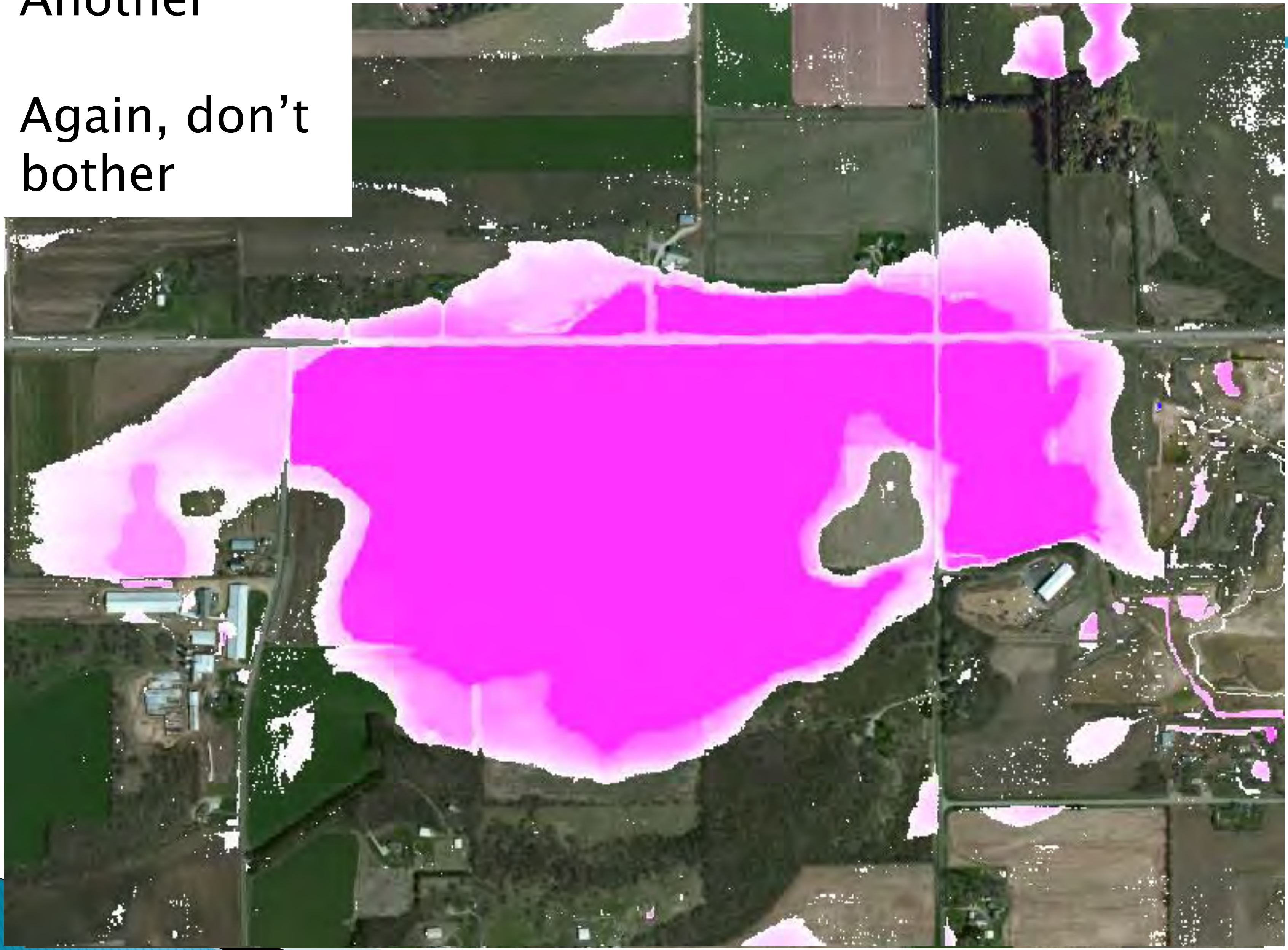


- Completely round…

- Don't bother trying to cut these

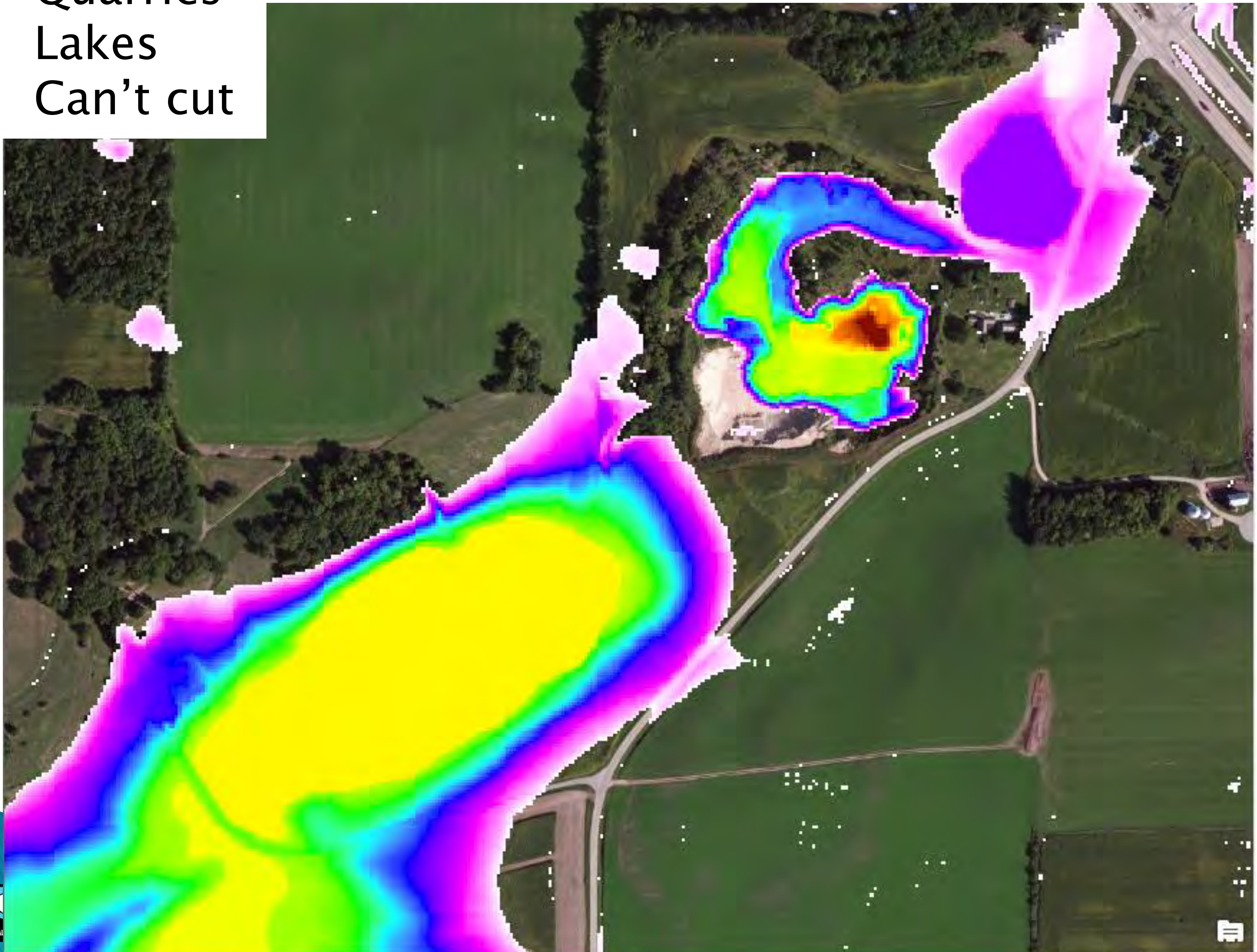
- Completely round…
- Don't bother trying to cut these

- 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

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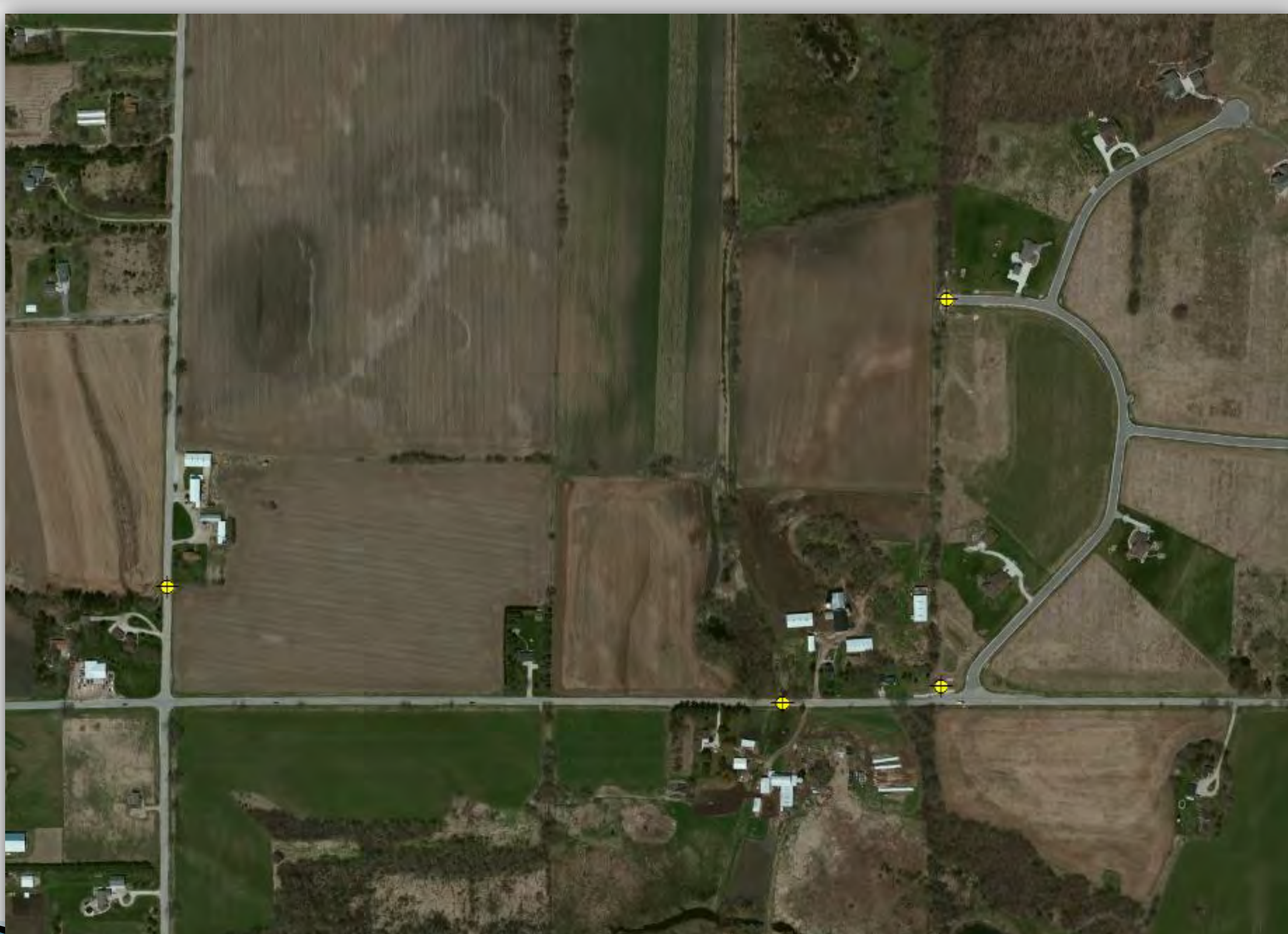
GPS Culvert Locations



Google Street View

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Google Street View

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Google Street View

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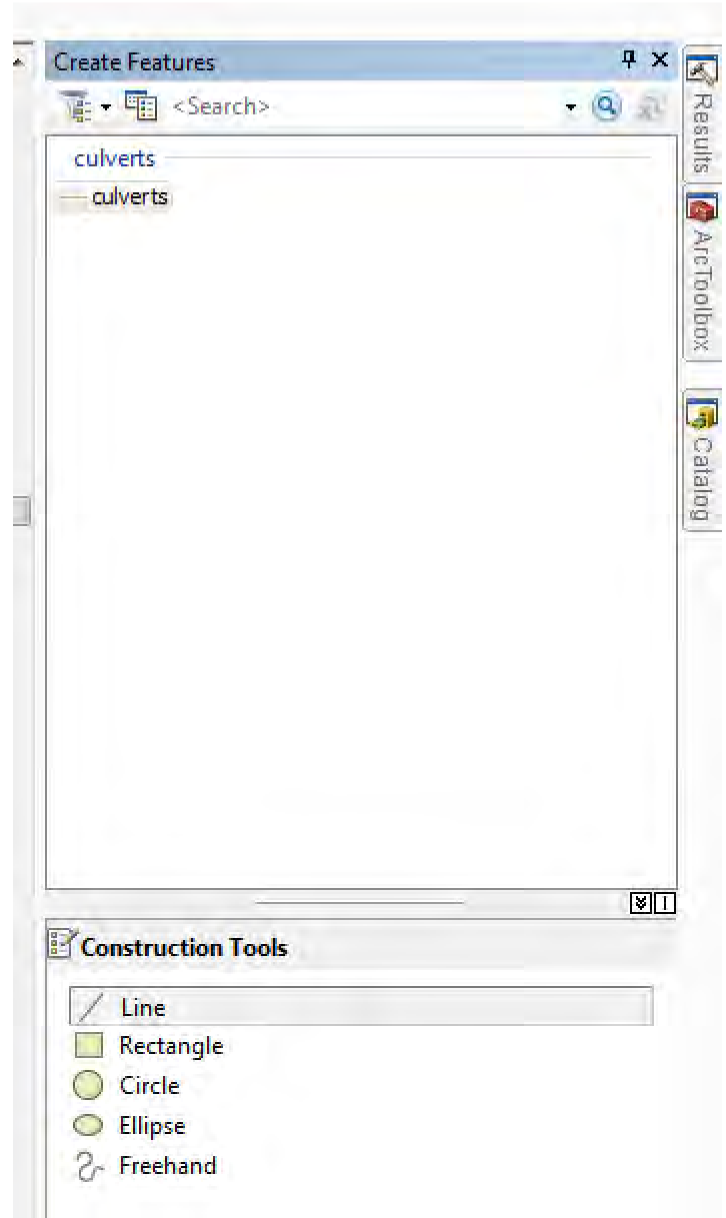
Create Culvert Layer

- 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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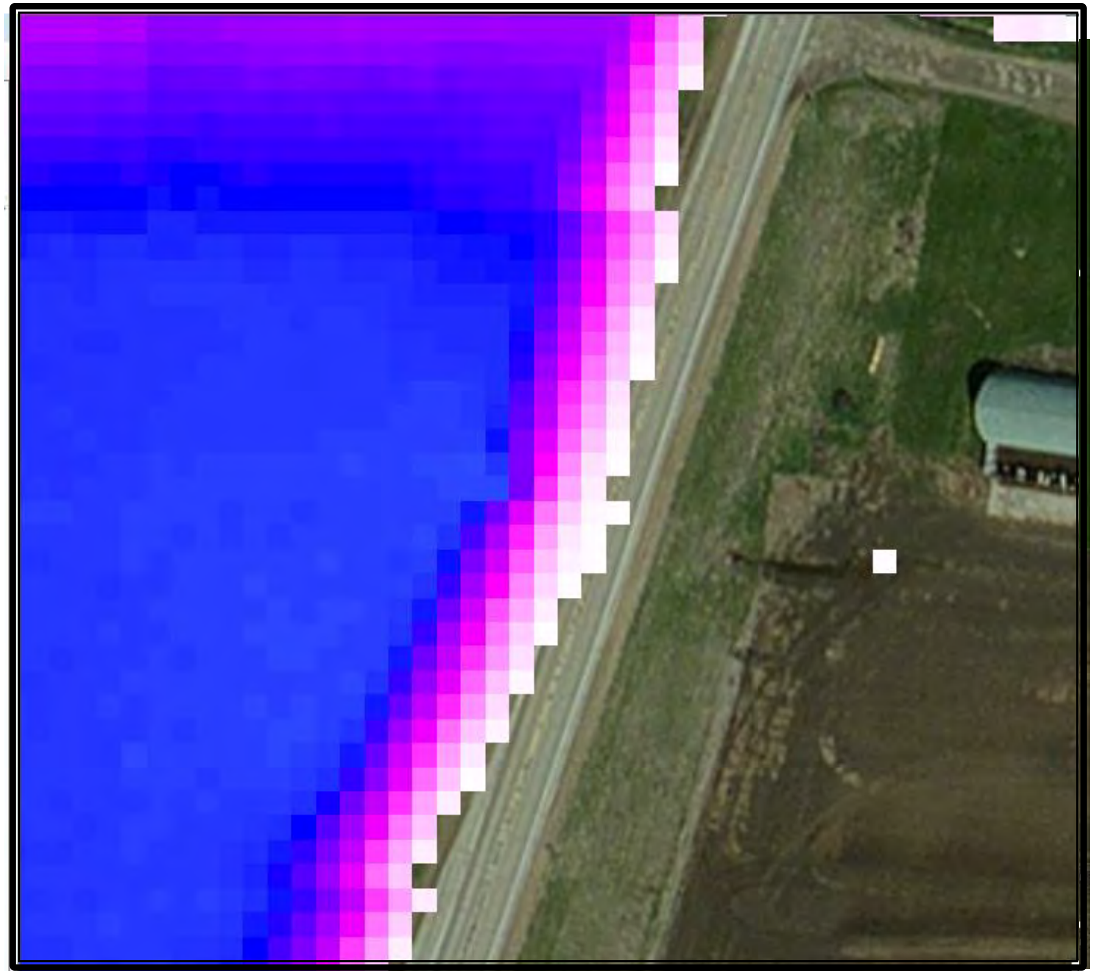


Once you've selected the line tool in the create features box:

- 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.

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

EVAAL

- Scenarios

Mitigation Opportunity

$$A = K(LS)C$$

Cropland data layer

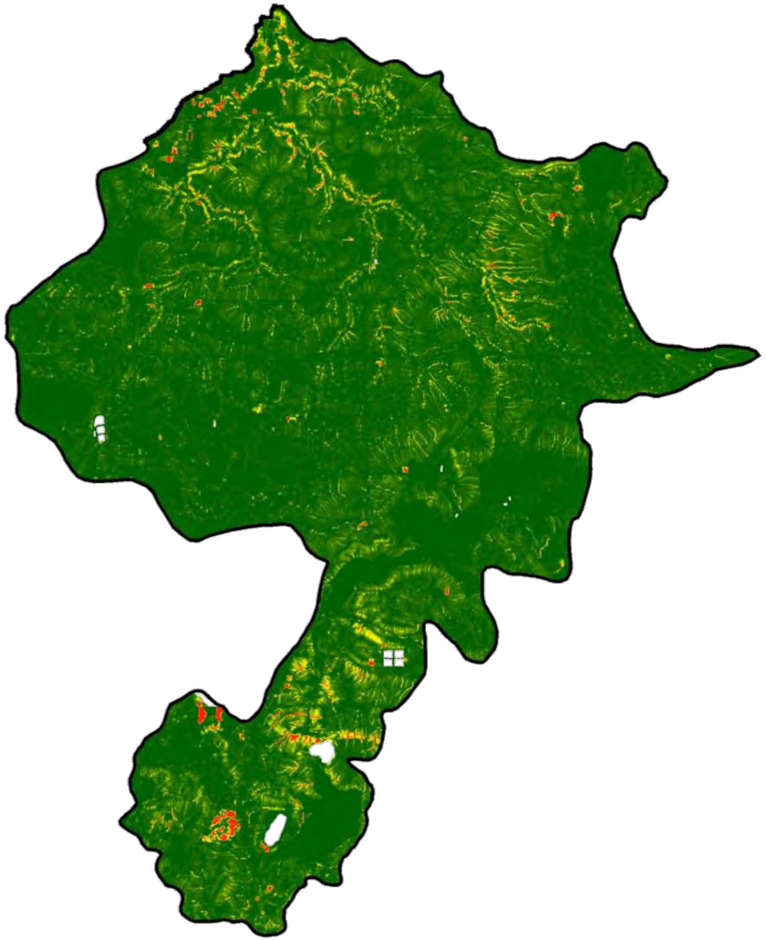
Crop Rotations

SNAP-Plus -> Rotation C Factor

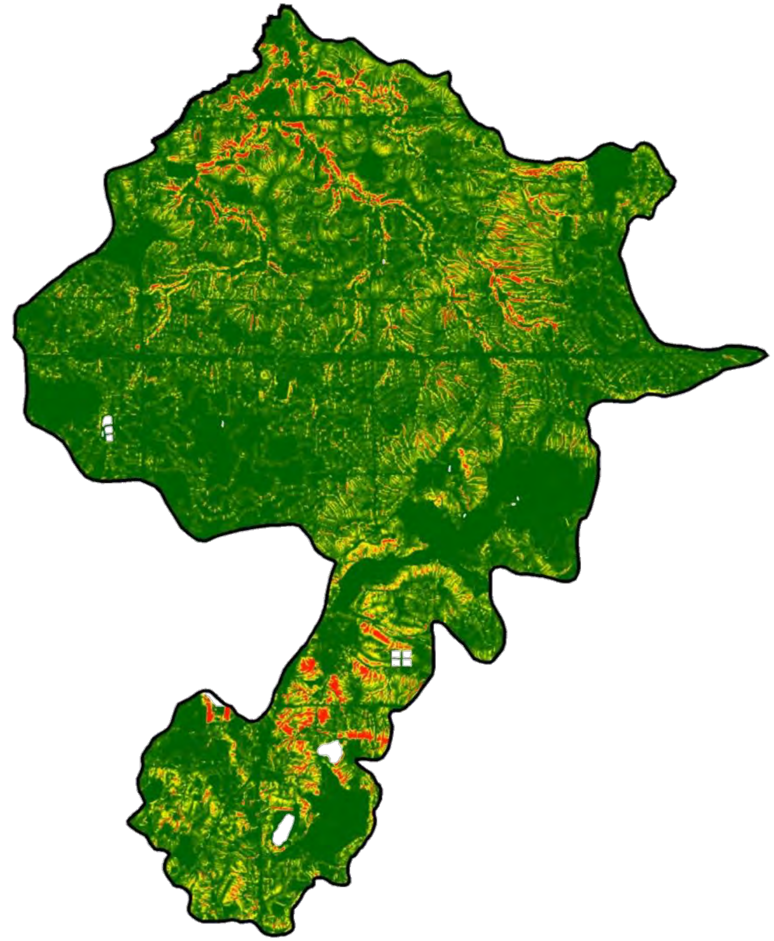
Poor

Good

C Factor Adjustments

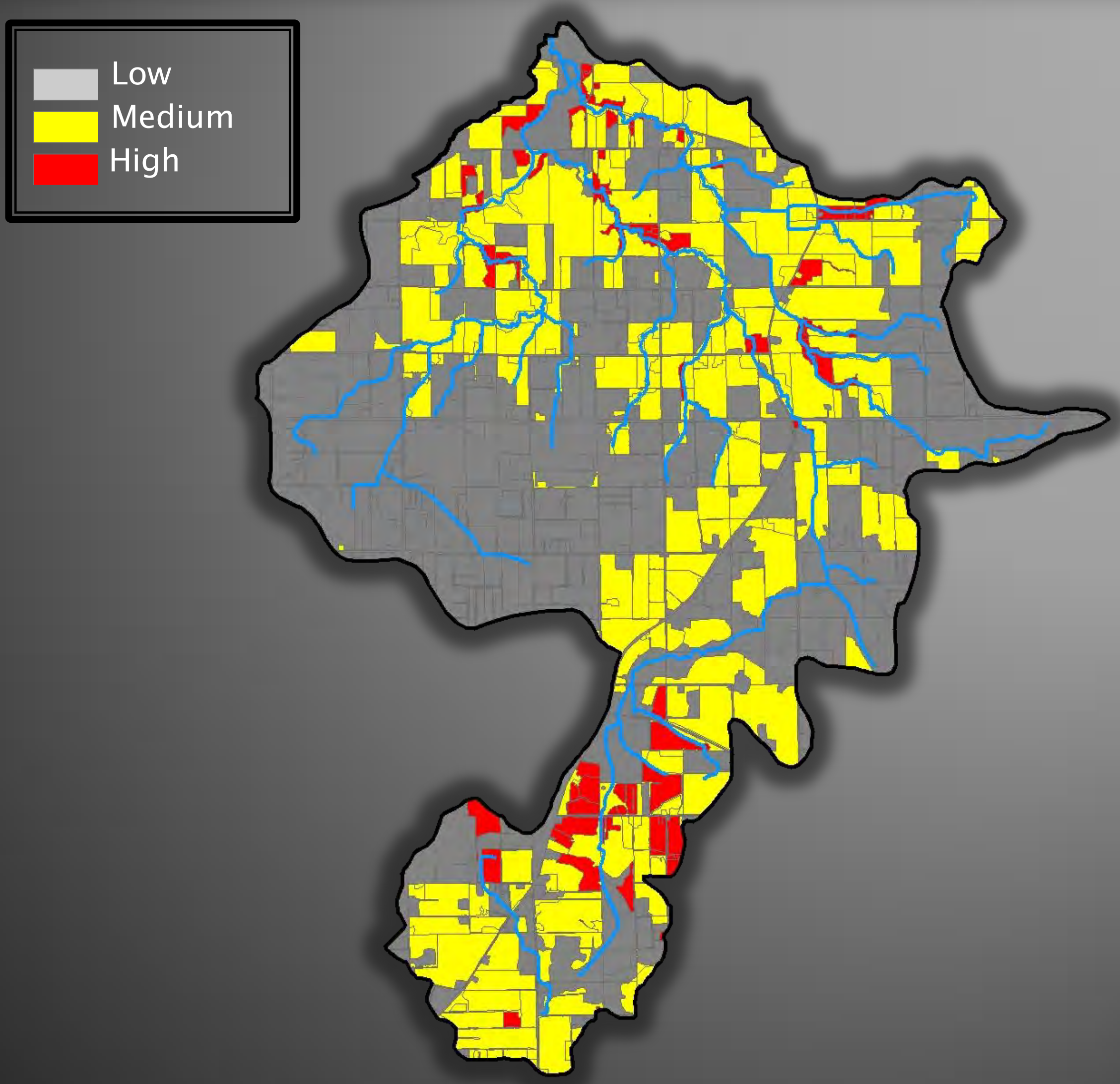


USLE w/ Low C Factor



USLE w/ High C Factor

Mitigation Opportunity



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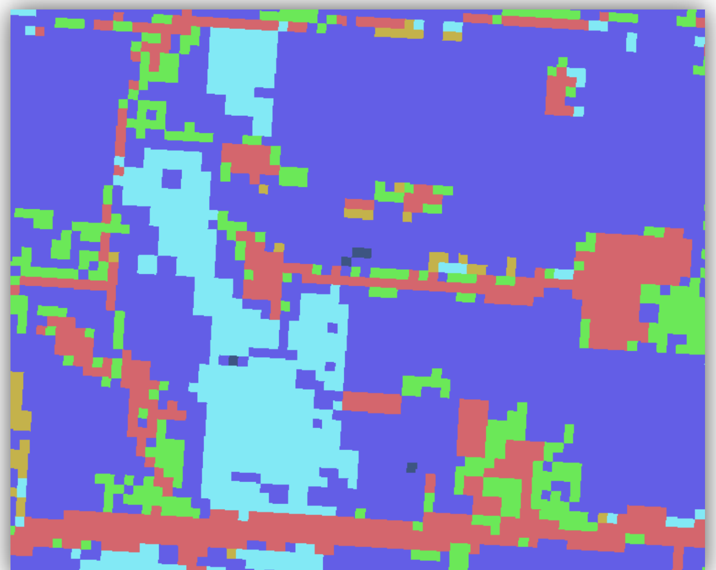
Other Scenarios

- 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

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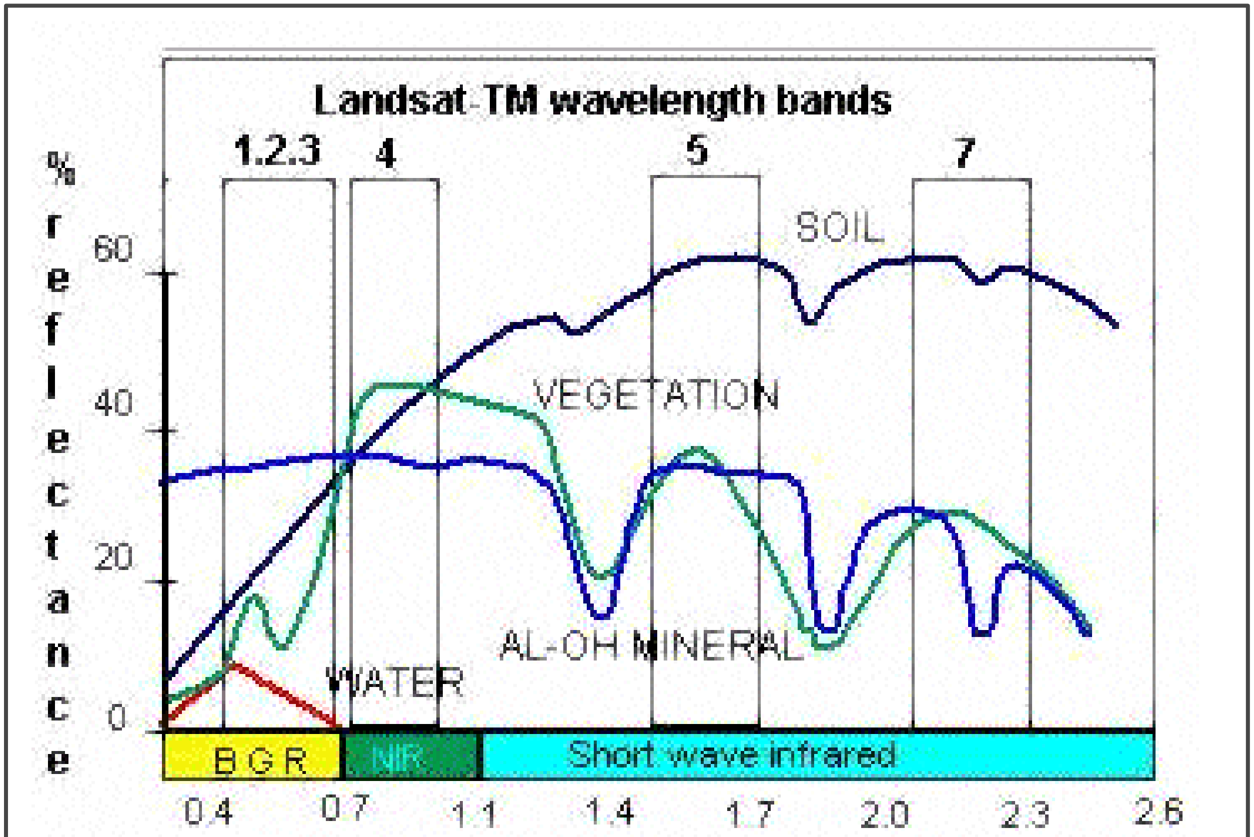
Satellite Imagery Analysis

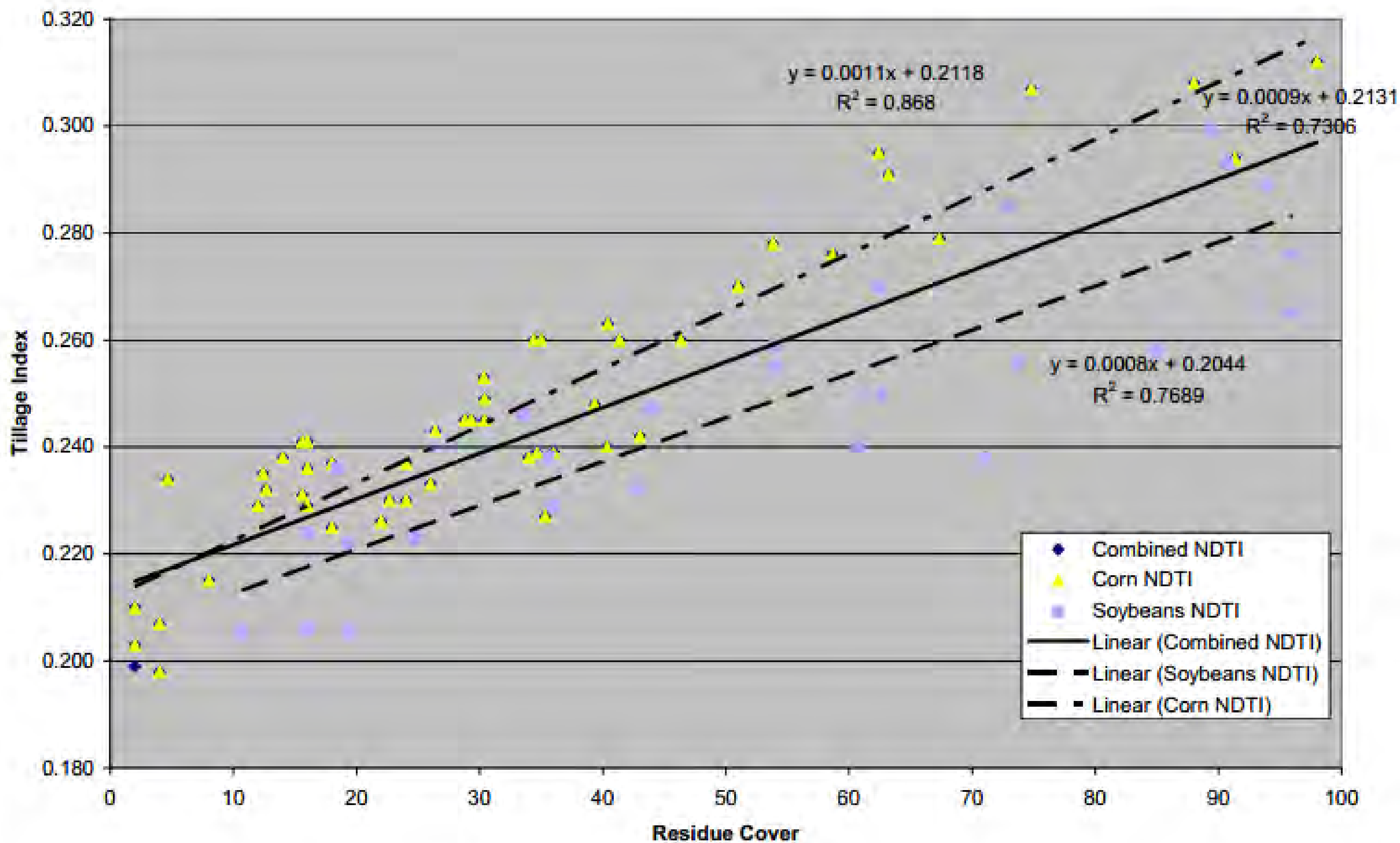
- Normalized Difference Tillage Index
- NDTI = (band5 – band7) / (band5 + band7)



"Remote Sensing Of Crop Residue Cover Using Multi-temporal Landsat Imagery"
B. Zheng – 2012

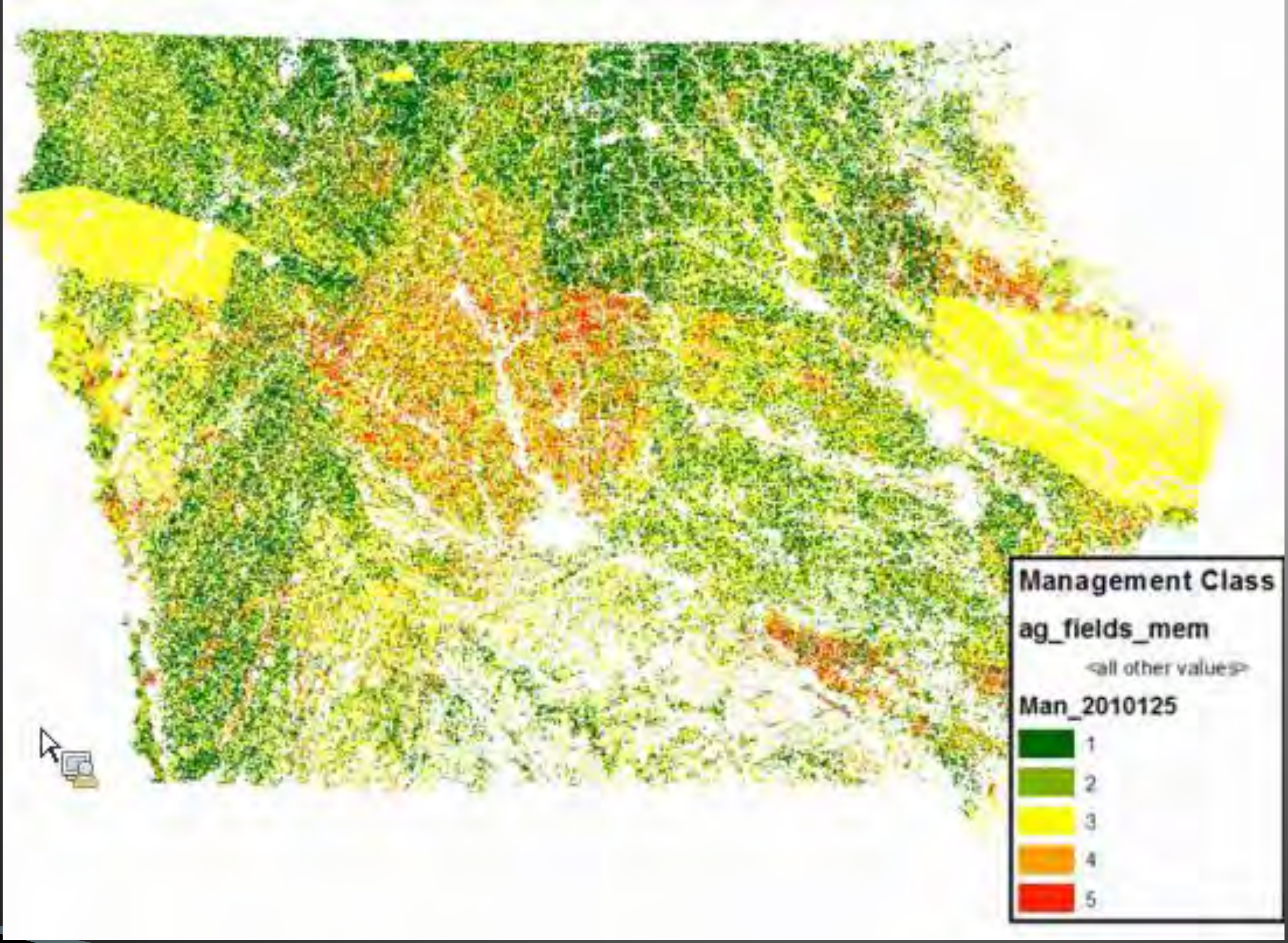
Normalized difference tillage index

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



Brian Gelder, Iowa State

Iowa Example

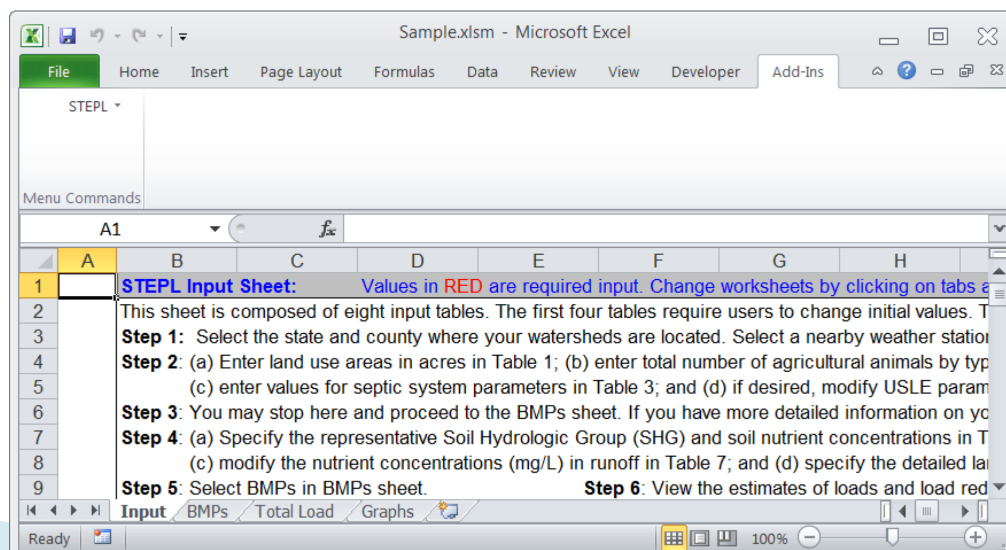


STEPL

- 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

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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

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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

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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

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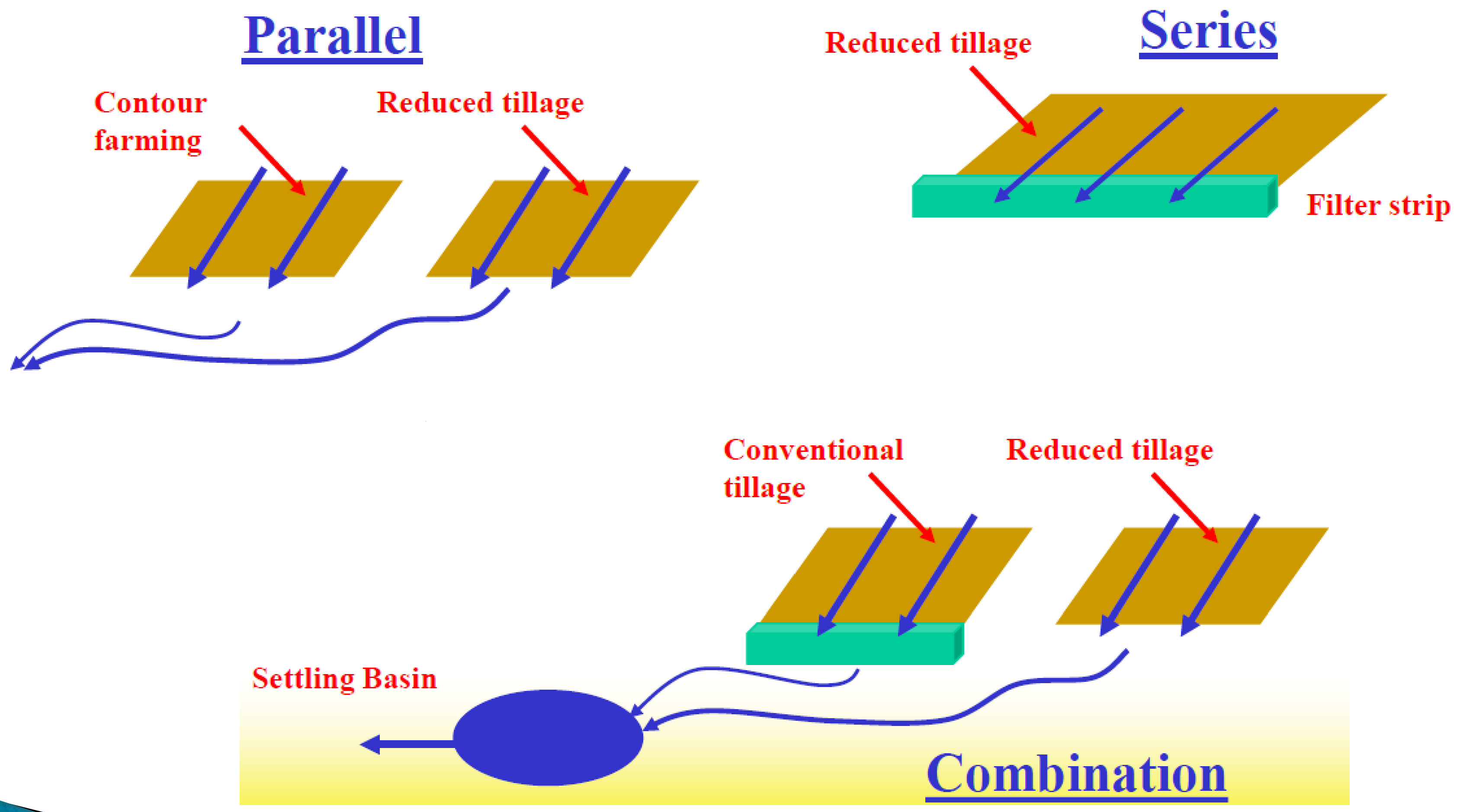
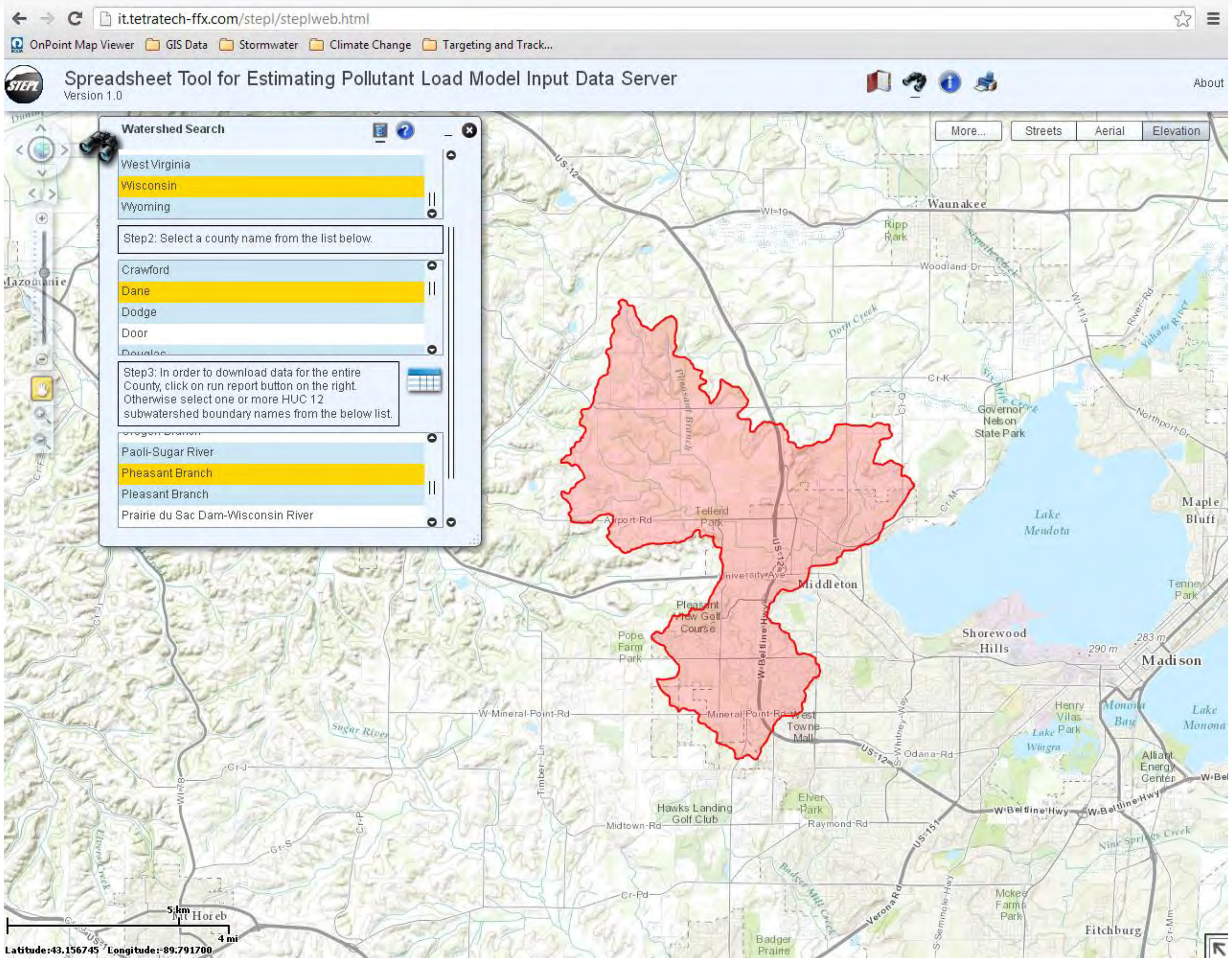
STEPL BMP Calculator



Online Input Data Server



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http://it.tetratech-ffx.com/steplweb/steplweb.html

STEPL Model Input Data Ser...

File Edit View Favorites Tools Help

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-Pige	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

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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

http://it.tetratech-fx.com/steplweb/default.htm

Home

STEPL Data Server for Sample Input Data

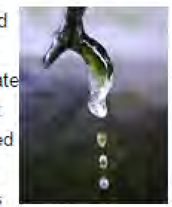
Models and Documentation

Frequently Asked Questions

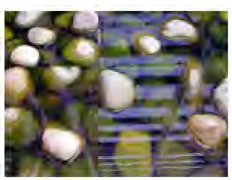
You are here: EPA Home » STEPL

Share

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@tetratech.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]

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

Last revised: Monday September 29 2014

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

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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

WISCONSIN DEPT. OF NATURAL RESOURCES

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

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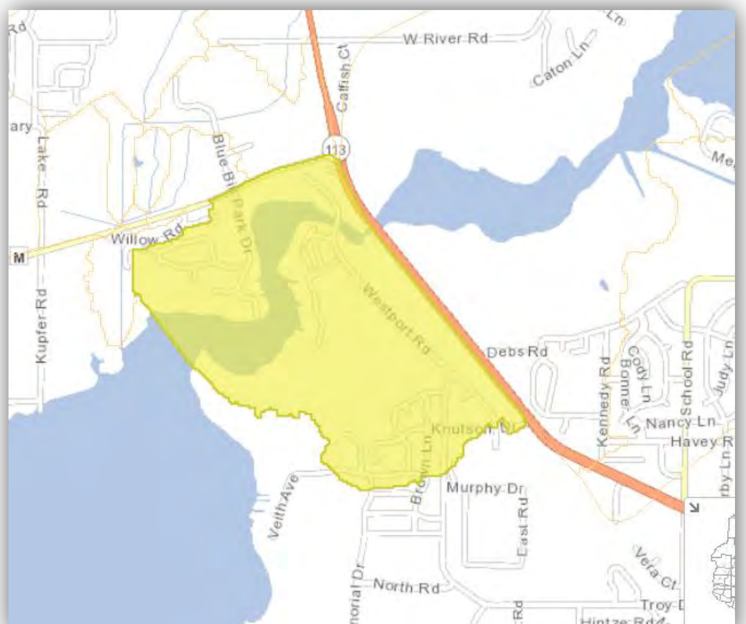
- Water Resources
  - Watersheds
  - Great Lakes & Mississippi Basins
  - DNR Water Management Units
  - Intermittent Streams
  - Stream Order
  - WI Hydro Data-Plus Catchments
  - Waterbody Details

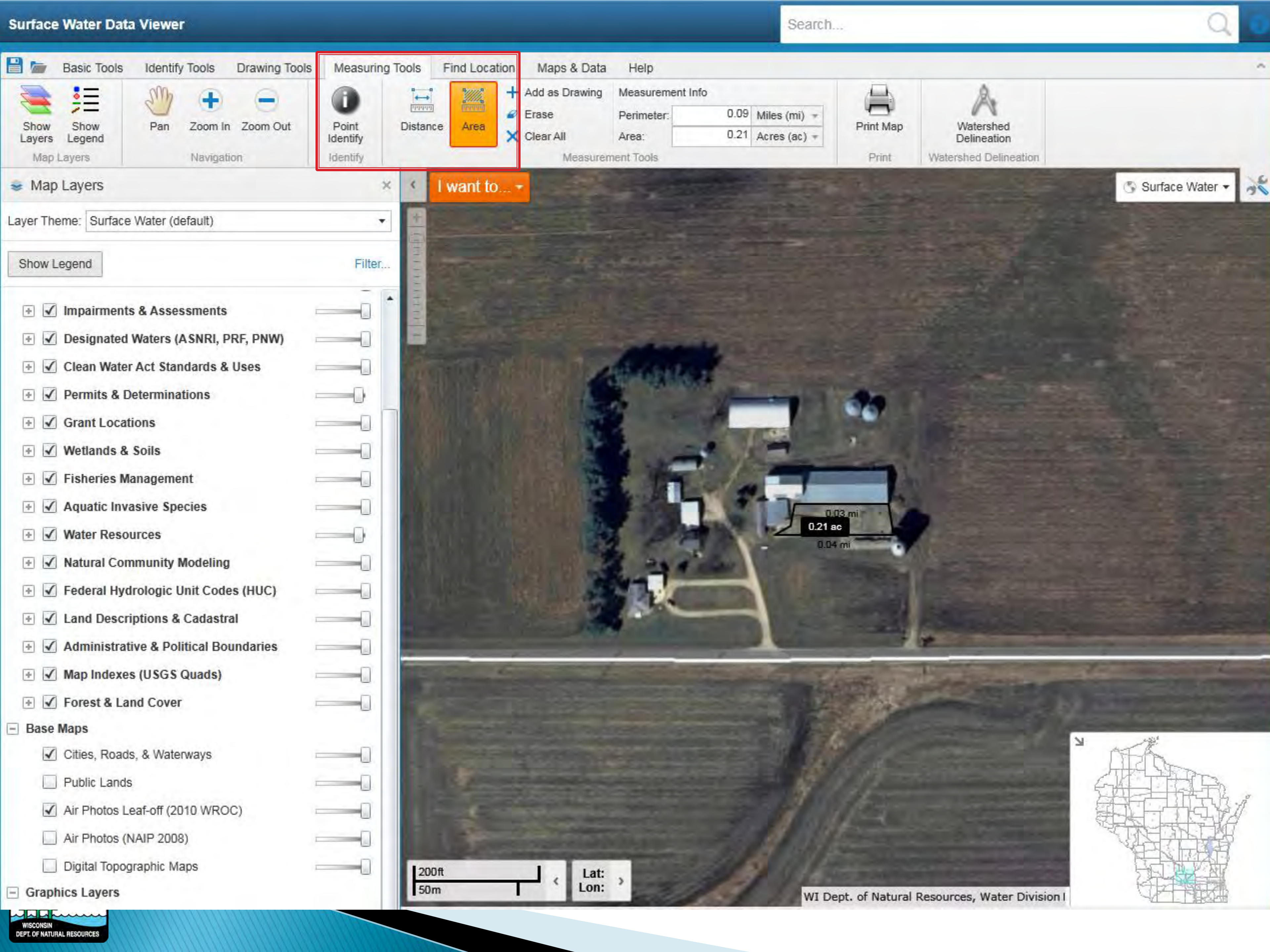


Reach ID 200028511

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


Surface Water Data Viewer
Search...
Basic Tools
Identify Tools
Drawing Tools
Measuring Tools
Find Location
Maps & Data
Help
Show Layers
Show Legend
Map Layers
Pan
Zoom In
Zoom Out
Navigation
Point Identify
Identify
Distance
Area
Add as Drawing
Erase
Clear All
Measurement Info
Perimeter: 0.09 Miles (mi)
Area: 0.21 Acres (ac)
Measurement Tools
Print Map
Print
Watershed Delineation
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
0.03 mi
0.21 ac
0.04 mi
200ft
50m
Lat:
Lon:
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Soils

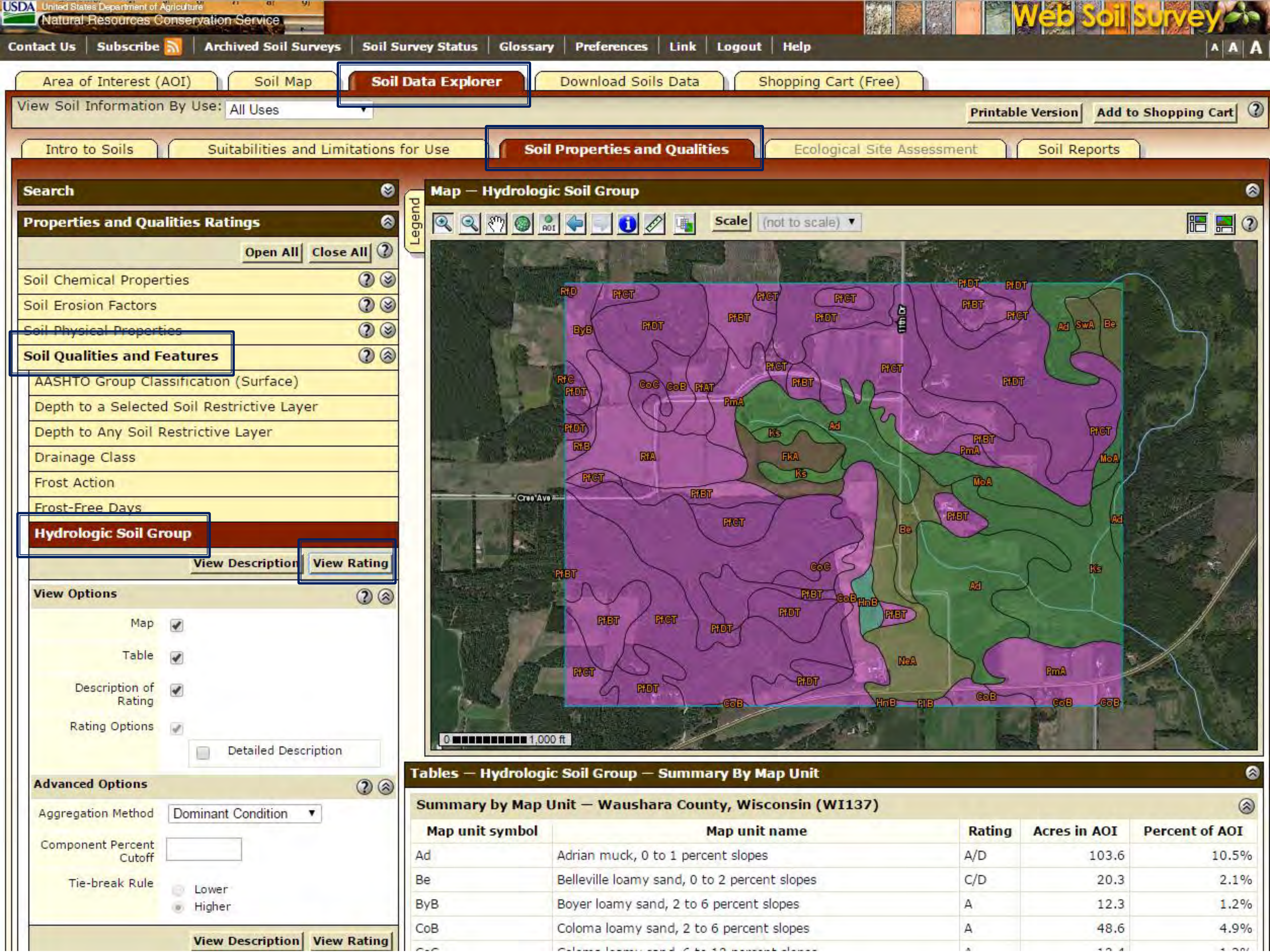
Show optional input tables? Yes No

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	○	●	○	○	B	0.080	0.031	0.160
W2	○	●	○	○	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)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Suitabilities and Limitations for Use
Soil Properties and Qualities
Ecological Site Assessment
Soil Reports
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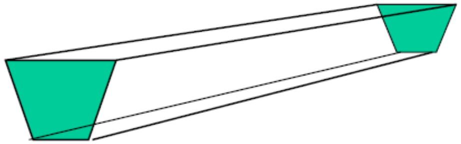
Properties and Qualities Ratings
Open All
Close All
Soil Chemical Properties
Soil Erosion Factors
Soil Physical Properties
Soil Qualities and Features
AASHTO Group Classification (Surface)
Depth to a Selected Soil Restrictive Layer
Depth to Any Soil Restrictive Layer
Drainage Class
Frost Action
Frost-Free 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
Legend
Scale
(not to scale)
0 1,000 ft
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%

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

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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

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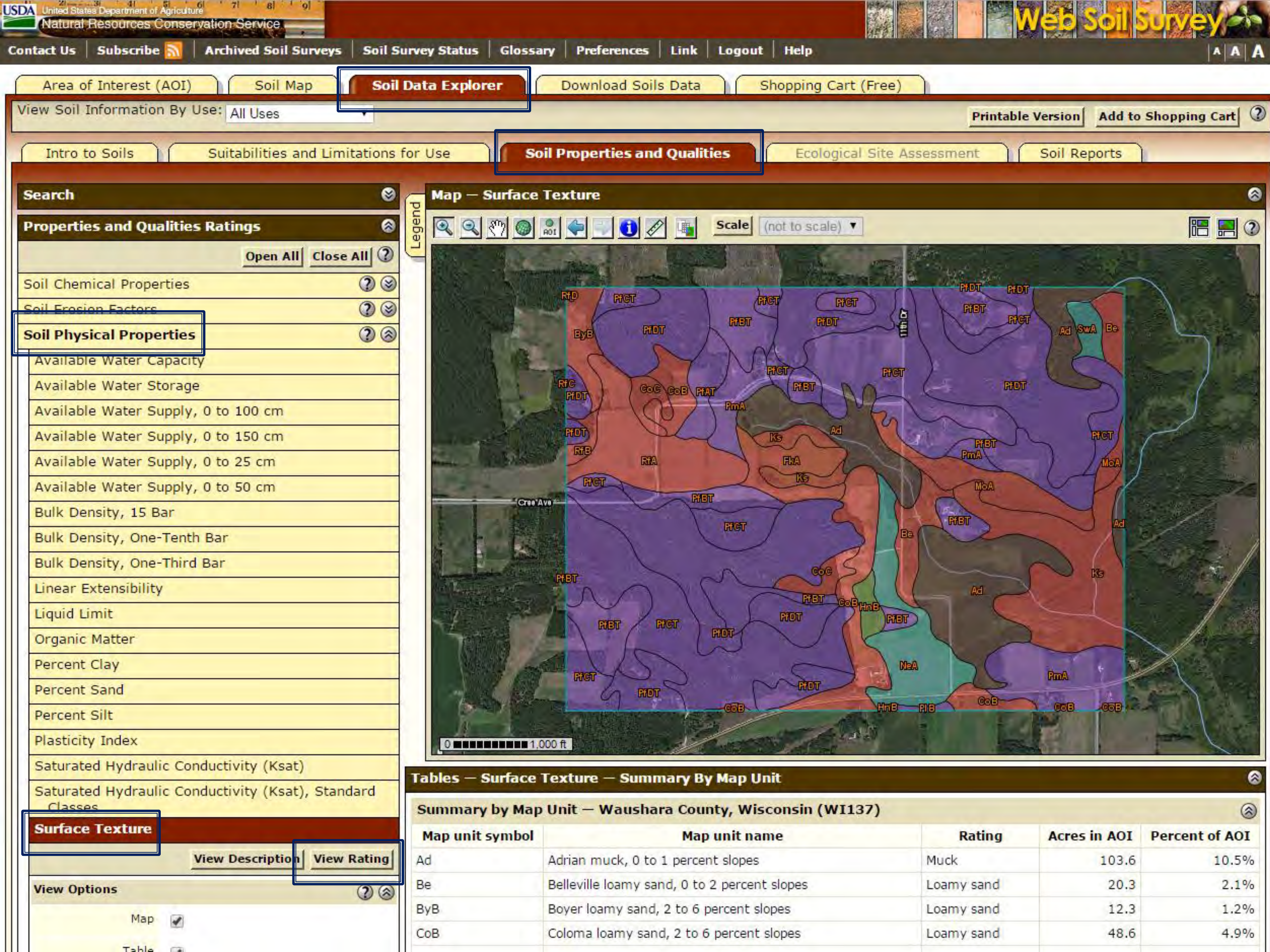
USDA United States Department of Agriculture
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Glossary
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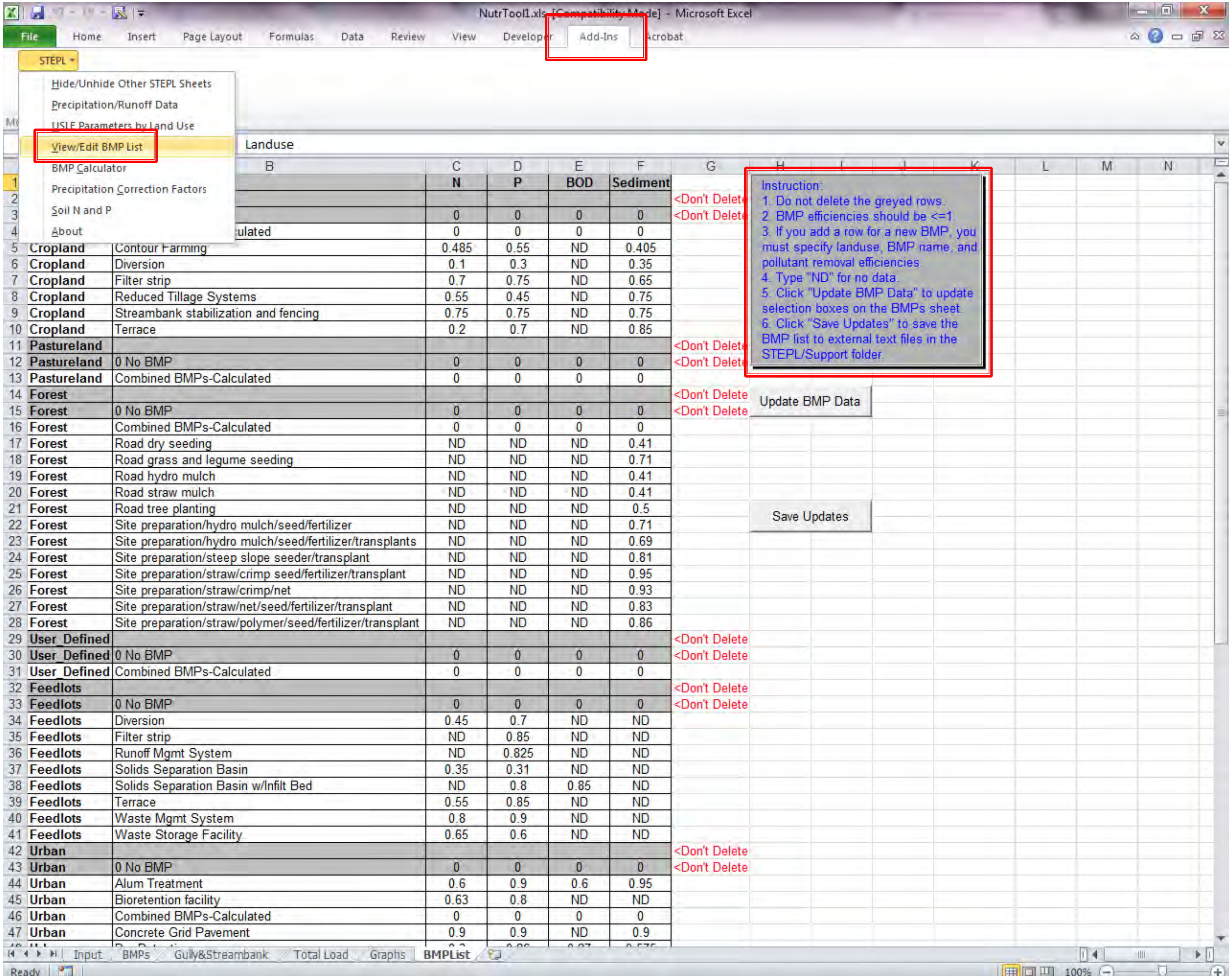
Intro to Soils
Suitabilities and Limitations for Use
Soil Properties and Qualities
Ecological Site Assessment
Soil Reports
Search
Properties and Qualities Ratings
Open All
Close All
Soil Chemical Properties
Soil Erosion Factors
Soil Physical Properties
Available Water Capacity
Available Water Storage
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
Legend
Map — Surface Texture
Scale
(not to scale)
Cree Ave
0 1,000 ft
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



	A	B	C	D	E	F	G
1			N	P	BOD	Sediment	
2							<Don't Delete
3			0	0	0	0	<Don't Delete
4		ulated	0	0	0	0	
5	Cropland	Contour Farming	0.485	0.55	ND	0.405	
6	Cropland	Diversion	0.1	0.3	ND	0.35	
7	Cropland	Filter strip	0.7	0.75	ND	0.65	
8	Cropland	Reduced Tillage Systems	0.55	0.45	ND	0.75	
9	Cropland	Streambank stabilization and fencing	0.75	0.75	ND	0.75	
10	Cropland	Terrace	0.2	0.7	ND	0.85	
11	Pastureland						<Don't Delete
12	Pastureland	0 No BMP	0	0	0	0	<Don't Delete
13	Pastureland	Combined BMPs-Calculated	0	0	0	0	
14	Forest						<Don't Delete
15	Forest	0 No BMP	0	0	0	0	<Don't Delete
16	Forest	Combined BMPs-Calculated	0	0	0	0	
17	Forest	Road dry seeding	ND	ND	ND	0.41	
18	Forest	Road grass and legume seeding	ND	ND	ND	0.71	
19	Forest	Road hydro mulch	ND	ND	ND	0.41	
20	Forest	Road straw mulch	ND	ND	ND	0.41	
21	Forest	Road tree planting	ND	ND	ND	0.5	
22	Forest	Site preparation/hydro mulch/seed/fertilizer	ND	ND	ND	0.71	
23	Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	ND	ND	ND	0.69	
24	Forest	Site preparation/steep slope seeder/transplant	ND	ND	ND	0.81	
25	Forest	Site preparation/straw/crimp seed/fertilizer/transplant	ND	ND	ND	0.95	
26	Forest	Site preparation/straw/crimp/net	ND	ND	ND	0.93	
27	Forest	Site preparation/straw/net/seed/fertilizer/transplant	ND	ND	ND	0.83	
28	Forest	Site preparation/straw/polymer/seed/fertilizer/transplant	ND	ND	ND	0.86	
29	User_Defined						<Don't Delete
30	User_Defined	0 No BMP	0	0	0	0	<Don't Delete
31	User_Defined	Combined BMPs-Calculated	0	0	0	0	
32	Feedlots						<Don't Delete
33	Feedlots	0 No BMP	0	0	0	0	<Don't Delete
34	Feedlots	Diversion	0.45	0.7	ND	ND	
35	Feedlots	Filter strip	ND	0.85	ND	ND	
36	Feedlots	Runoff Mgmt System	ND	0.825	ND	ND	
37	Feedlots	Solids Separation Basin	0.35	0.31	ND	ND	
38	Feedlots	Solids Separation Basin w/Infilt Bed	ND	0.8	0.85	ND	
39	Feedlots	Terrace	0.55	0.85	ND	ND	
40	Feedlots	Waste Mgmt System	0.8	0.9	ND	ND	
41	Feedlots	Waste Storage Facility	0.65	0.6	ND	ND	
42	Urban						<Don't Delete
43	Urban	0 No BMP	0	0	0	0	<Don't Delete
44	Urban	Alum Treatment	0.6	0.9	0.6	0.95	
45	Urban	Bioretention facility	0.63	0.8	ND	ND	
46	Urban	Combined BMPs-Calculated	0	0	0	0	
47	Urban	Concrete Grid Pavement	0.9	0.9	ND	0.9	

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-Croplan	1.9	0.3	4
1a. w/ manure	8.1	2	12.3
2. M-Croplan	2.9	0.4	6.1
2a. w/ manure	12.2	3	18.5
3. H-Croplan	4.4	0.5	9.2
3a. w/ manure	18.3	4	24.6
4. Pasturelar	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

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? Yes No ☐ **Treat all the subwatersheds as parts of a single watershed** ☐ **Groundwater load calculation**

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

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

Rain correction factors: 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.

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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

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STEPL – Example

- BMP Scenarios

State	County	Weather Station (for rain correction factors)
Wisconsin	Sheboygan	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	○	○	◉ RUE	○	C	0.080	0.031	0.160
W2	○	○	◉ RUE	○	C	0.080	0.031	0.160
W3	○	○	◉ RUE	○	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					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
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					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
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					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
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					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
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					
	N	P	BOD	Sediment	BMPs	%Area BMP Applied
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

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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

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STEPL Applications

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

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

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