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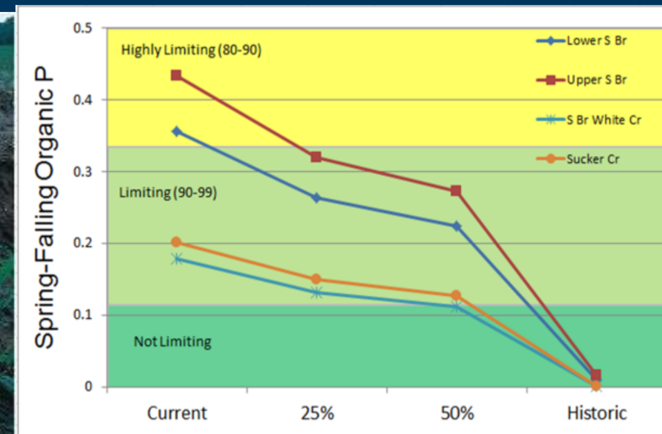
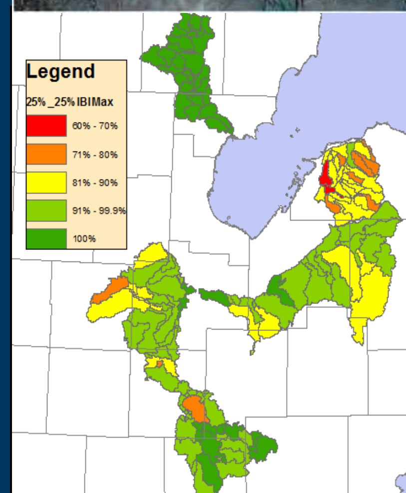
How Much is Enough?
Lessons from the Saginaw Bay Watershed





Mary Fales

March 7, 2014

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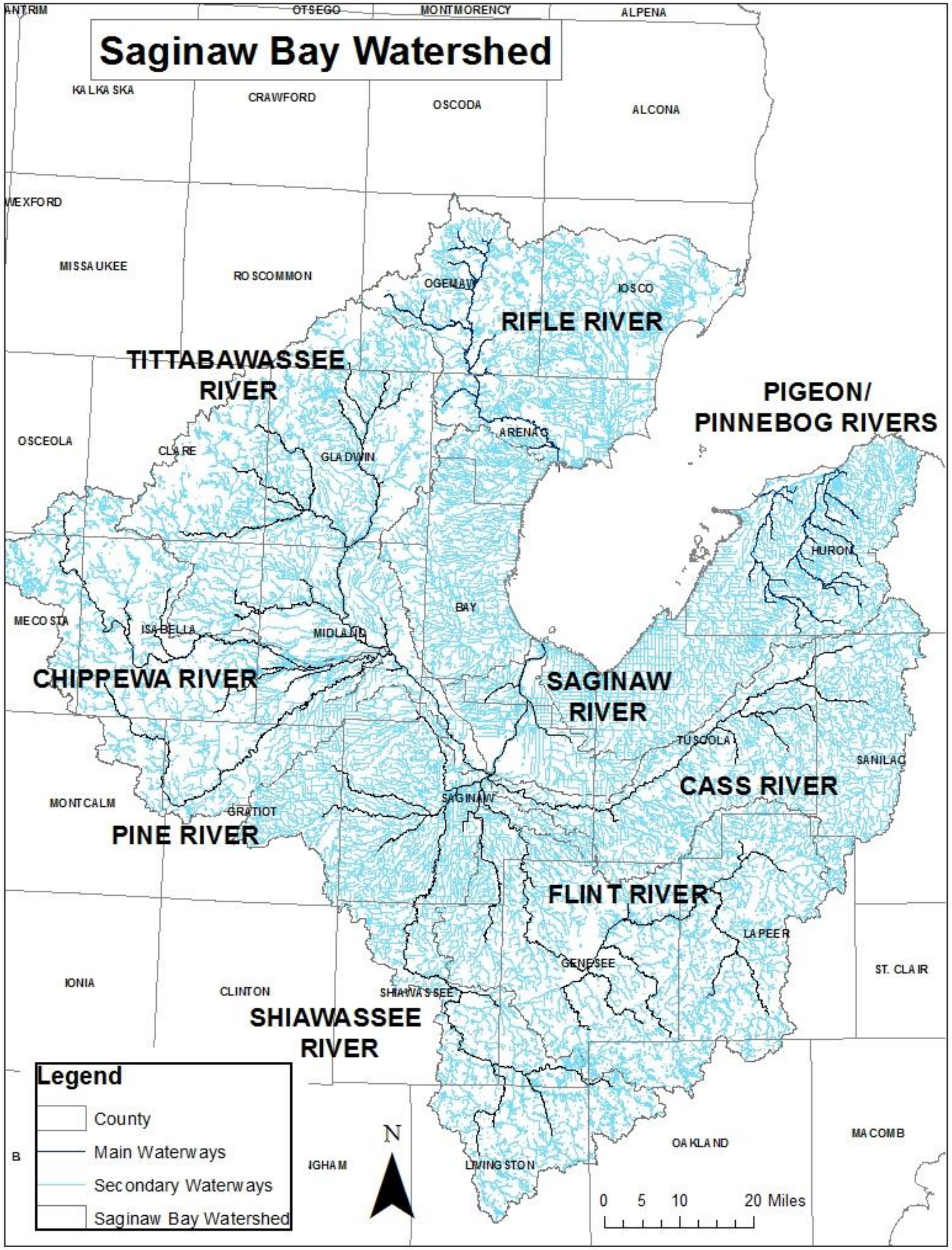
Presentation Outline

- Model and data analysis we developed to answer the question "How Much is Enough?"
- Online tools to help track ecological benefits of conservation
- Implementation Projects
- New funding models



Saginaw Bay Watershed

Michigan's Largest Watershed

- Drains 8,709 mi^2
- Covers 22 counties
- 15% of MI's total land area
- 7,000 miles of rivers!

45% agricultural land use

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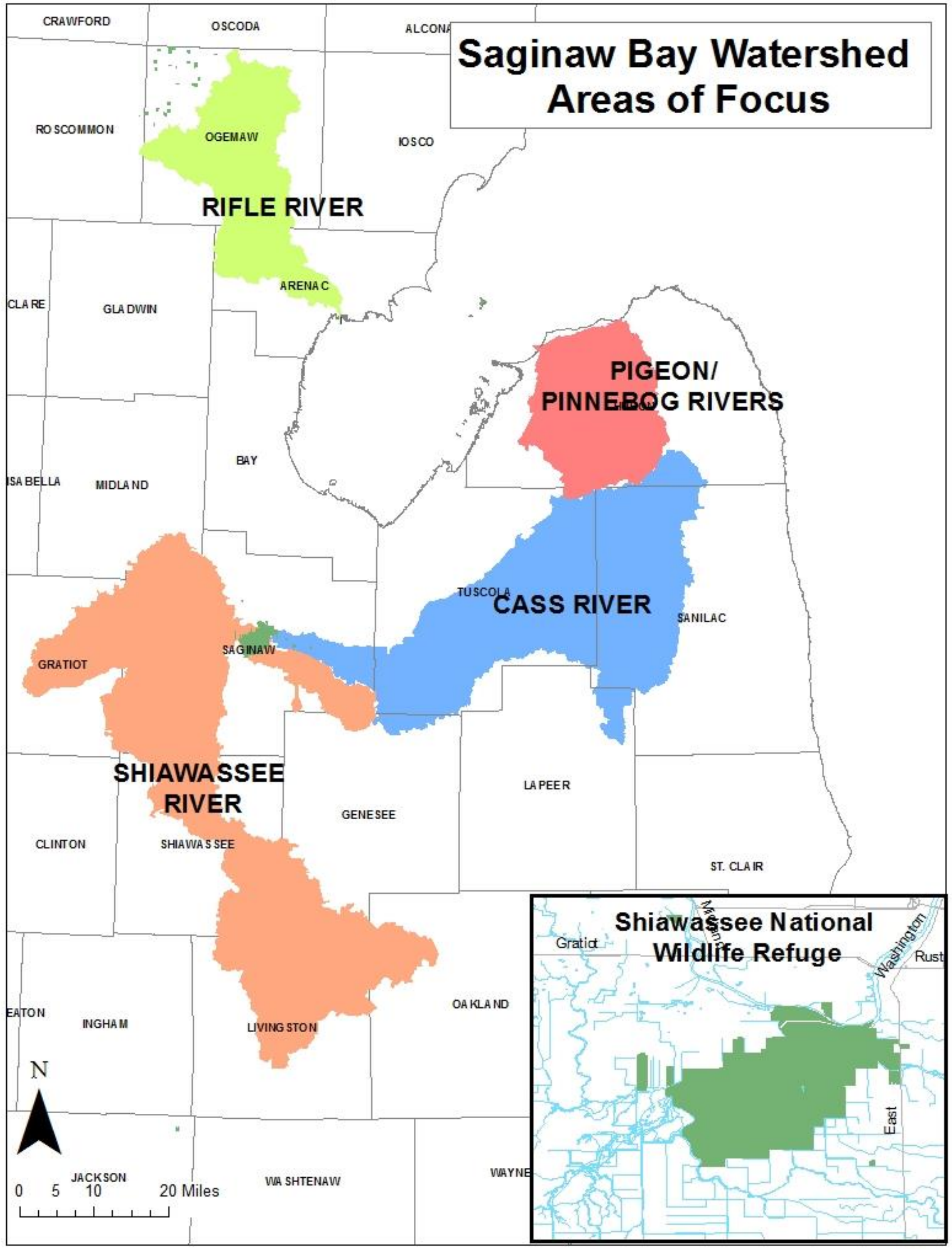
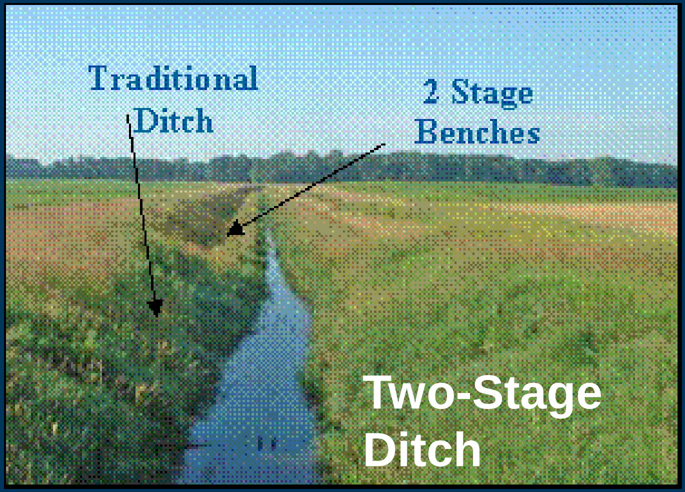


The Focal Problem

- Agriculture has significantly altered freshwater ecosystems in the US
- We spend $4.5 Billion on conservation provision of Farm Bill…$50 million per year in MI
- Perception is this should be enough, but is it?
- Not an easy question to answer

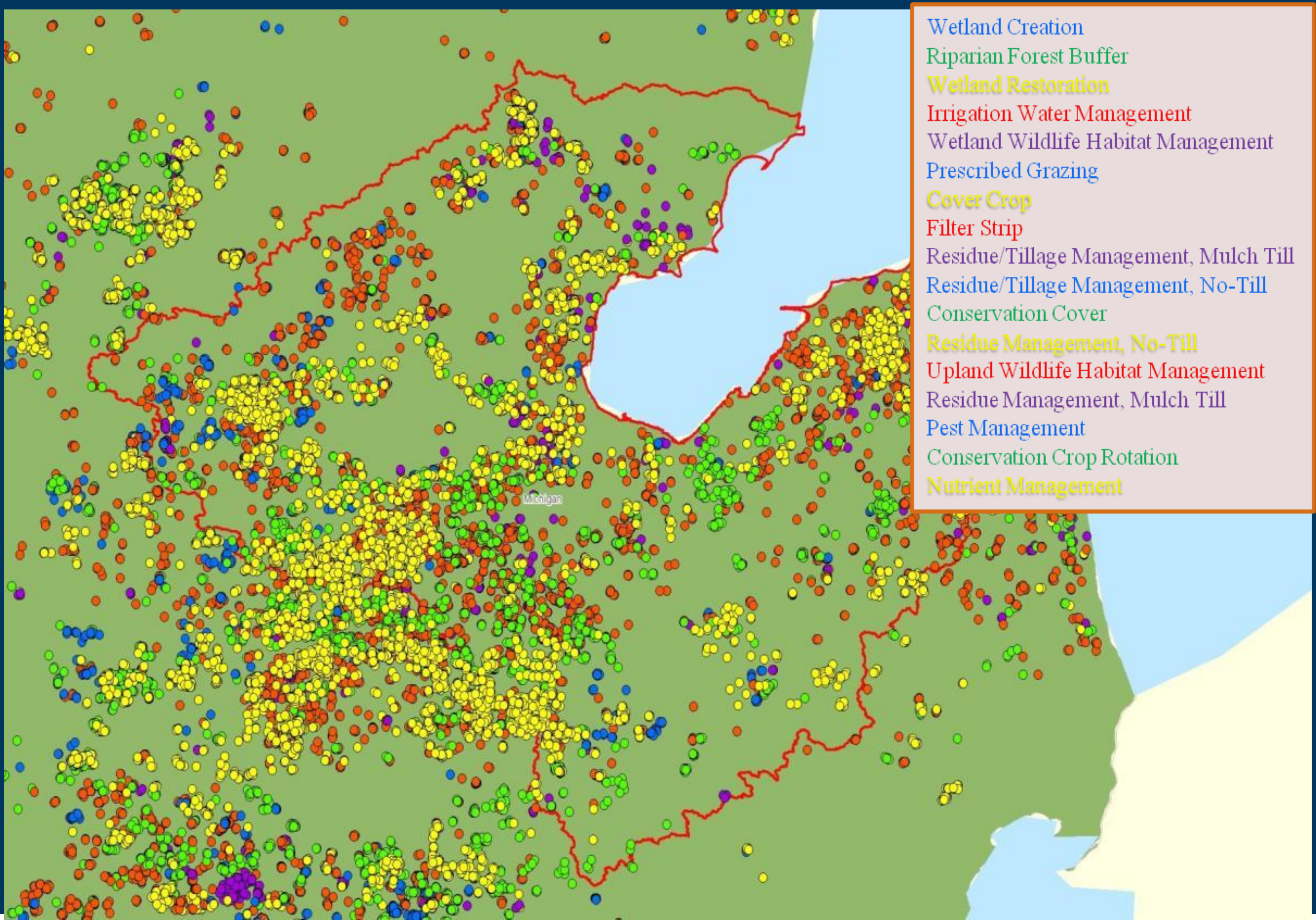
Traditional Approach in Agricultural Watersheds

Where will they have the most impact?



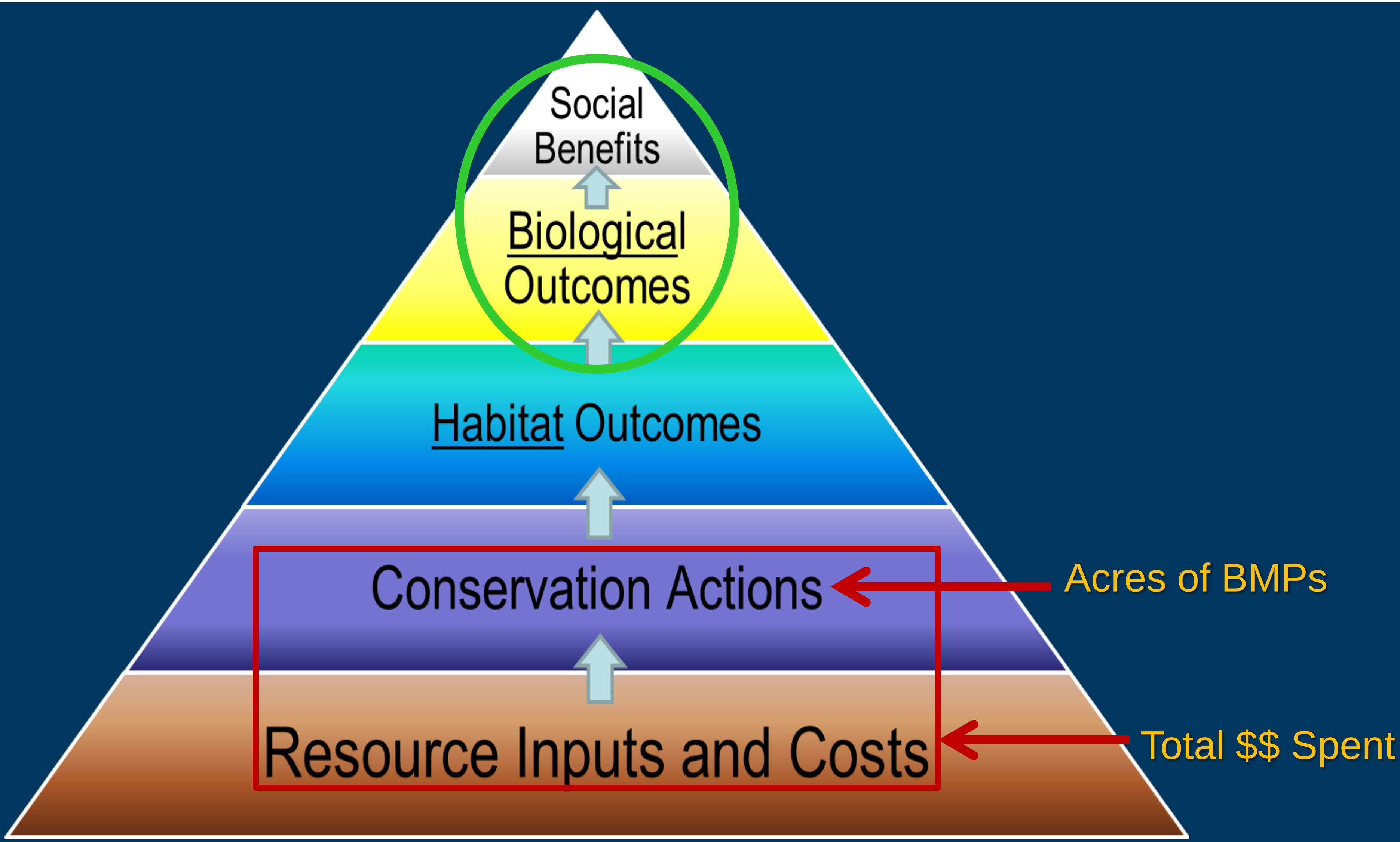
How much is enough?

How Much is Enough?



Algae Blooms

It Depends on Your Goal



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Importance of Being Outcome-Based

- Get Healthier?
  - Outcome: Certain Goal Weight or Cholesterol Level
- Get Financially Stable?
  - Outcome: 6 months of savings

- Improve Water Quality
  - Measure: Healthy Fish Community

(Index of Biotic Integrity of 90 or higher)

Outcome-Based: Identifying Action Steps

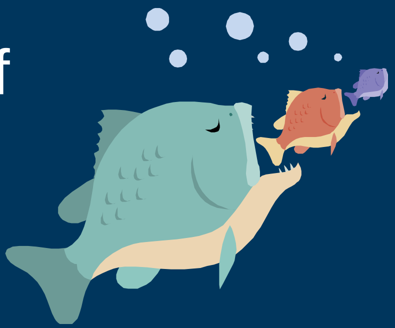
- Get Healthier?
  - Outcome: Certain Goal Weight or Cholesterol Level
  - Tasks: Limit fat and calories to X per day

- Get Financially Stable?
  - Outcome: 6 months of savings
  - Task: Save $$ per month, reduce expenses by X%

Outcome-Based: Identifying Action Steps

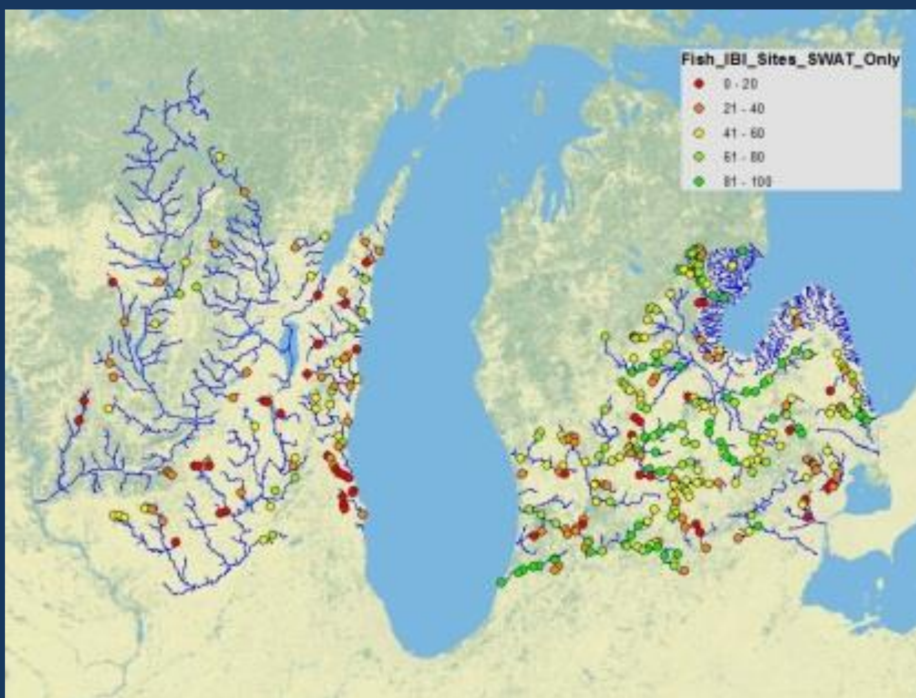
- Improve Water Quality
  - Measure: Healthy Fish Community (Index of Biotic Integrity of 90 or higher)

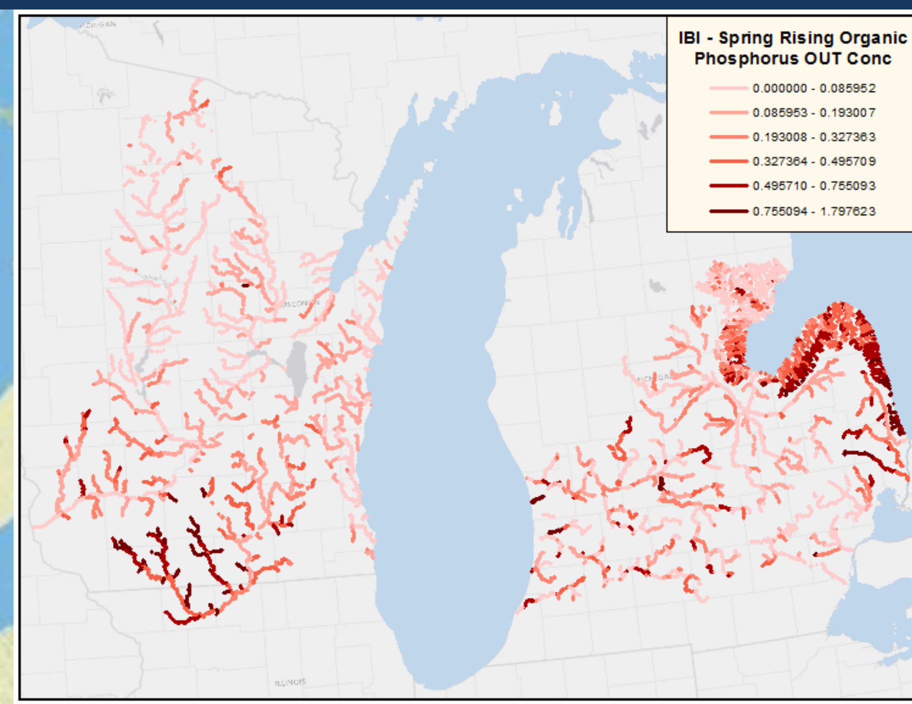
  - Tasks:
    - Reduce sediment and nutrient levels to a point where they no longer limit the fish community health
    - Implement conservation practices
    - But How Much is Enough?



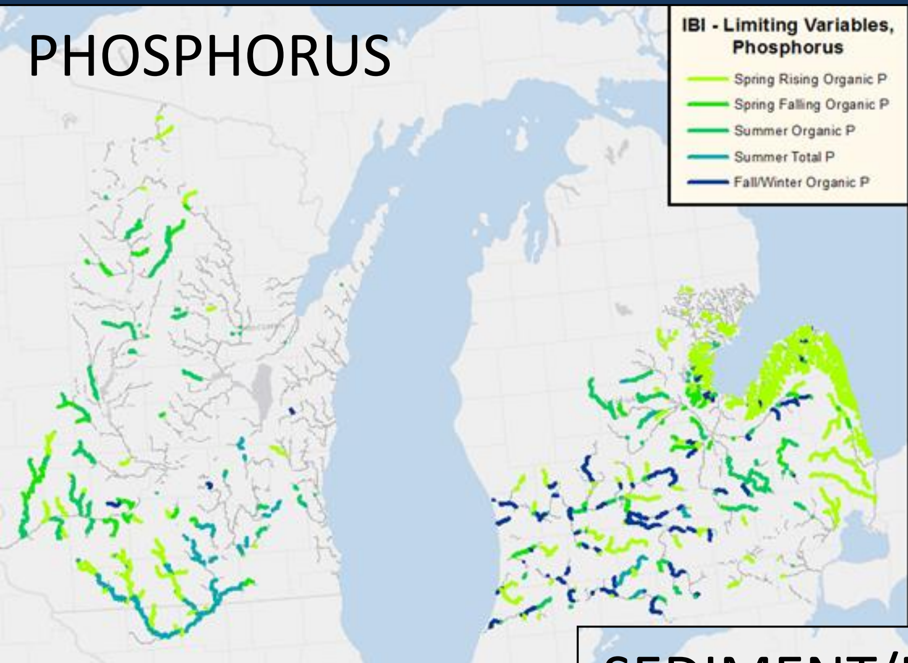
Models Linking Fish Communities to Water Quality

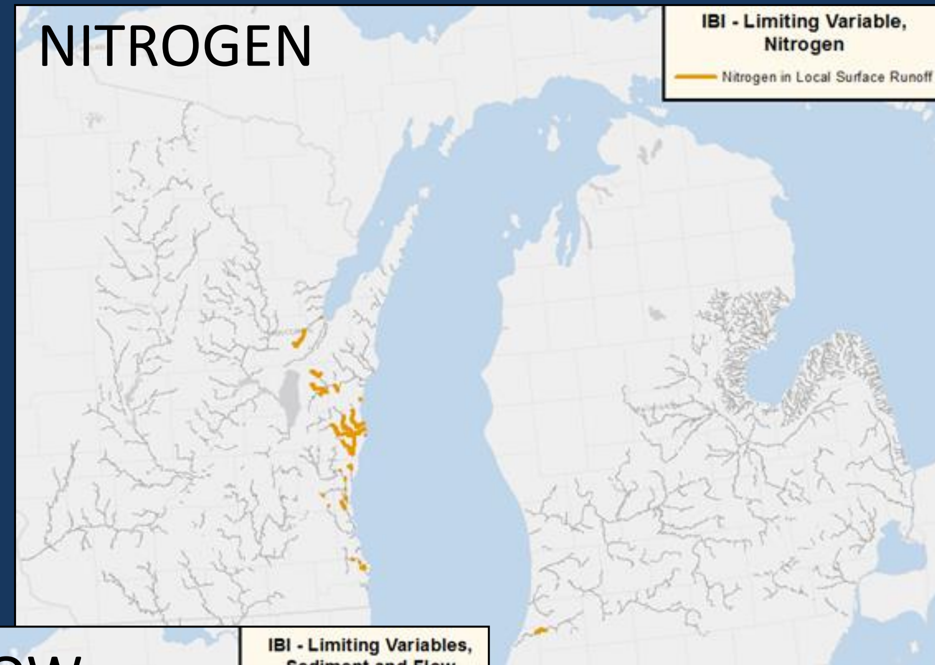
- Actual Fish community health data vs. Predicted water quality (SWAT modeling)

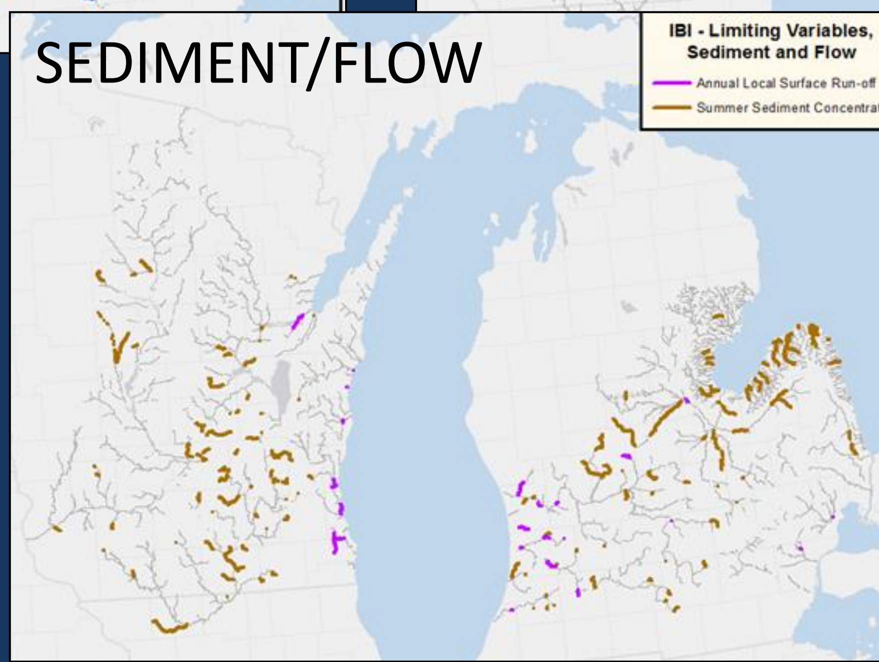




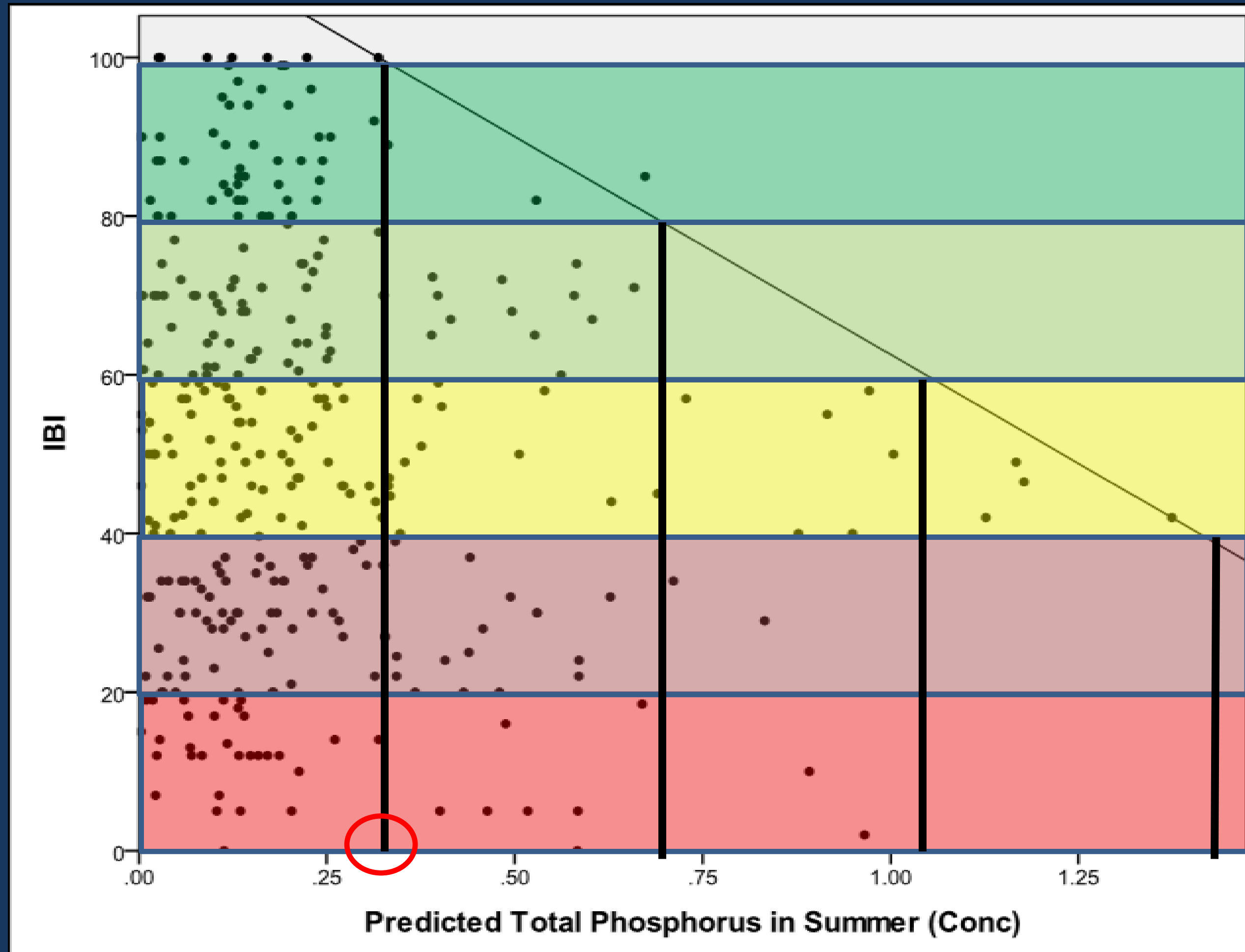
Which Variables Are Limiting and Where?

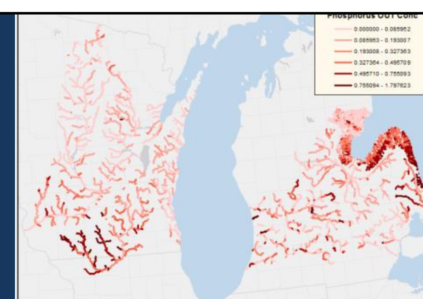






Phase 1 – Identify "ceilings" to set goals

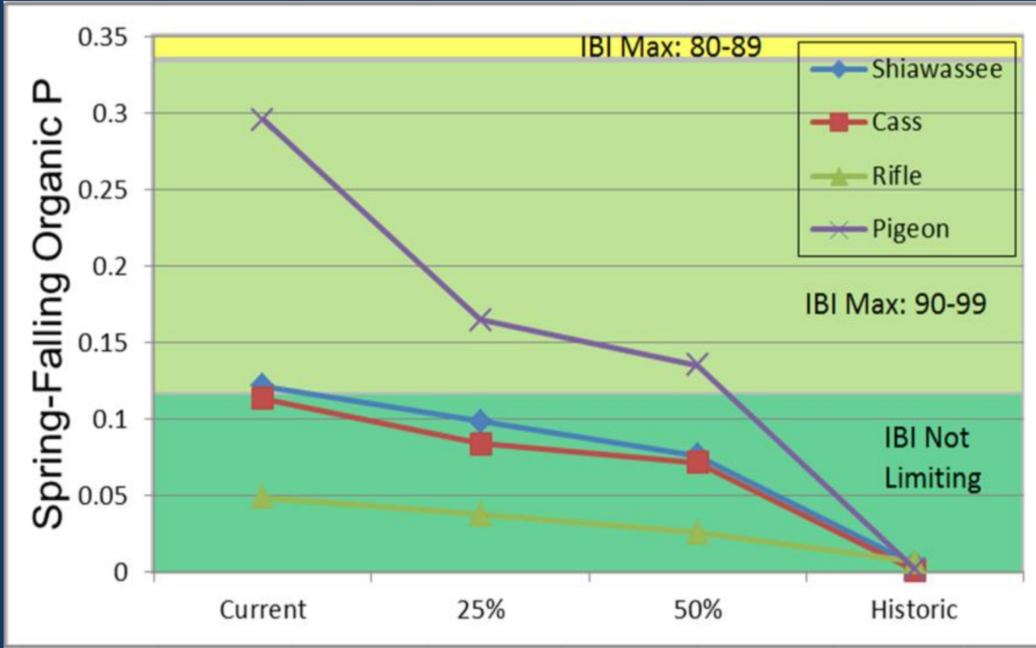




Phase 2: Linking Practices to Water Quality and Fish

- Within 4 watersheds of Saginaw Bay

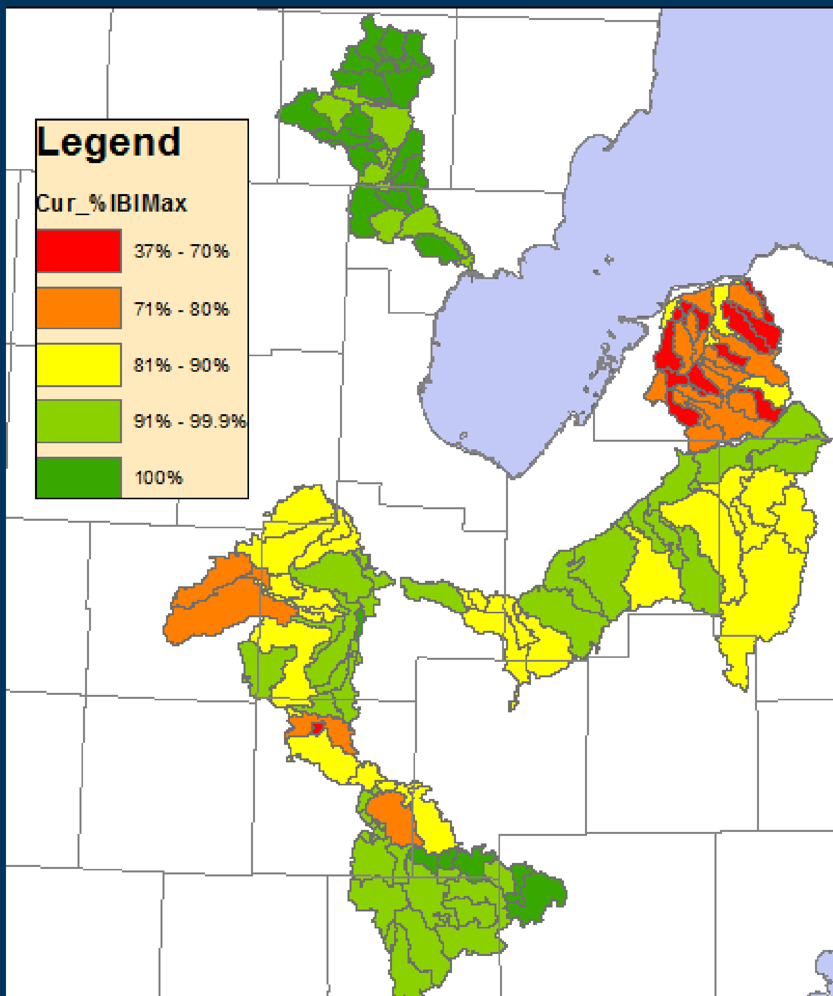
- Used SWAT to model changes in water quality under different scenarios (12 BMPs)
  - Current condition
  - Medium (25%)
  - High (50%)
  - Historic Condition



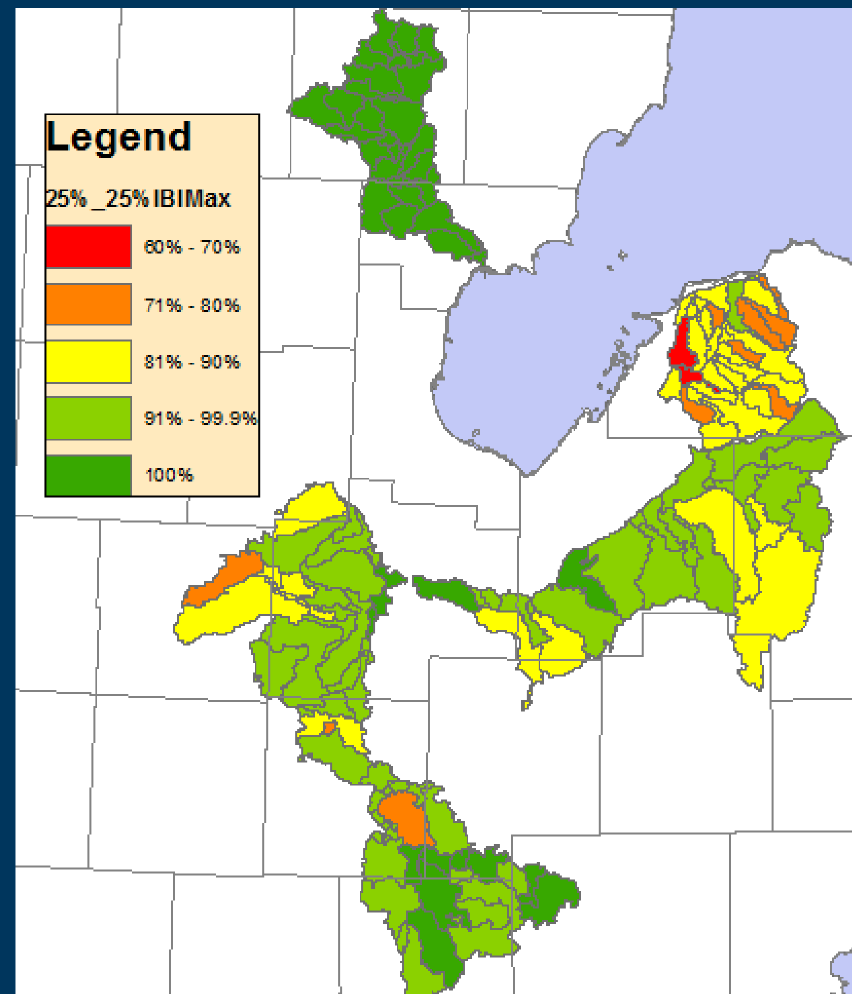
- Assess costs and benefits
  - 25% scenario costs $22 M
  - 50% scenario costs $44 M

Sub-watershed Comparison: Fish Community Health

Current Condition

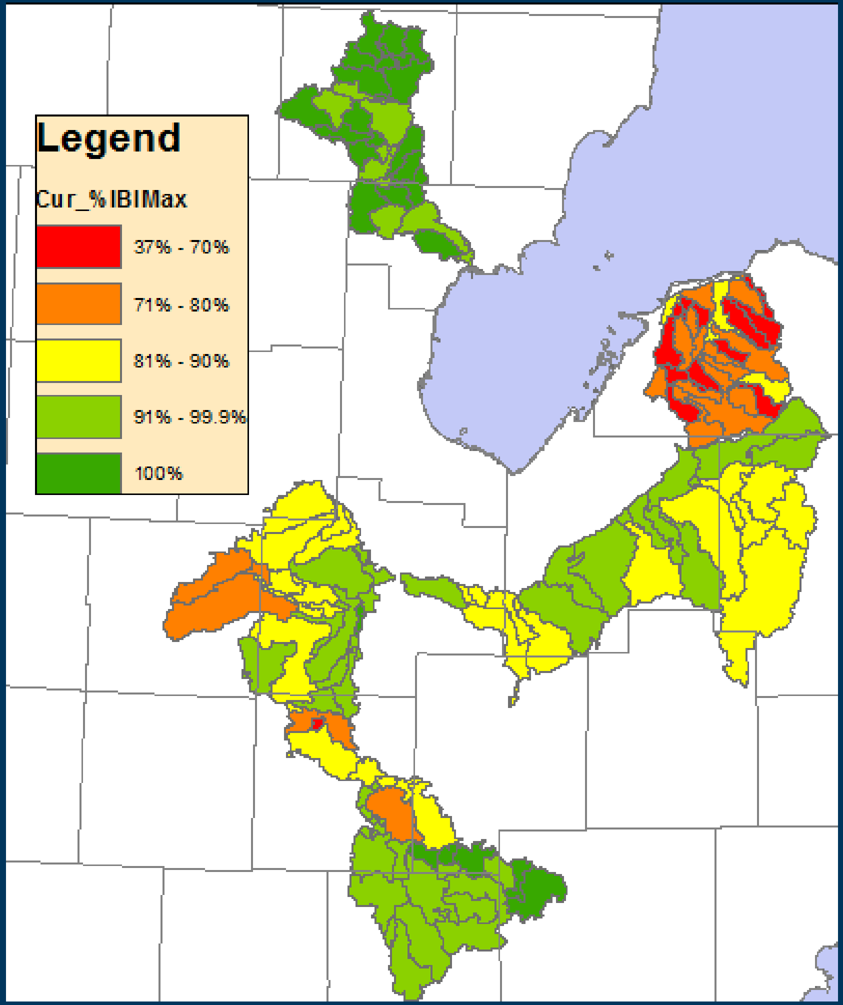


25% BMP

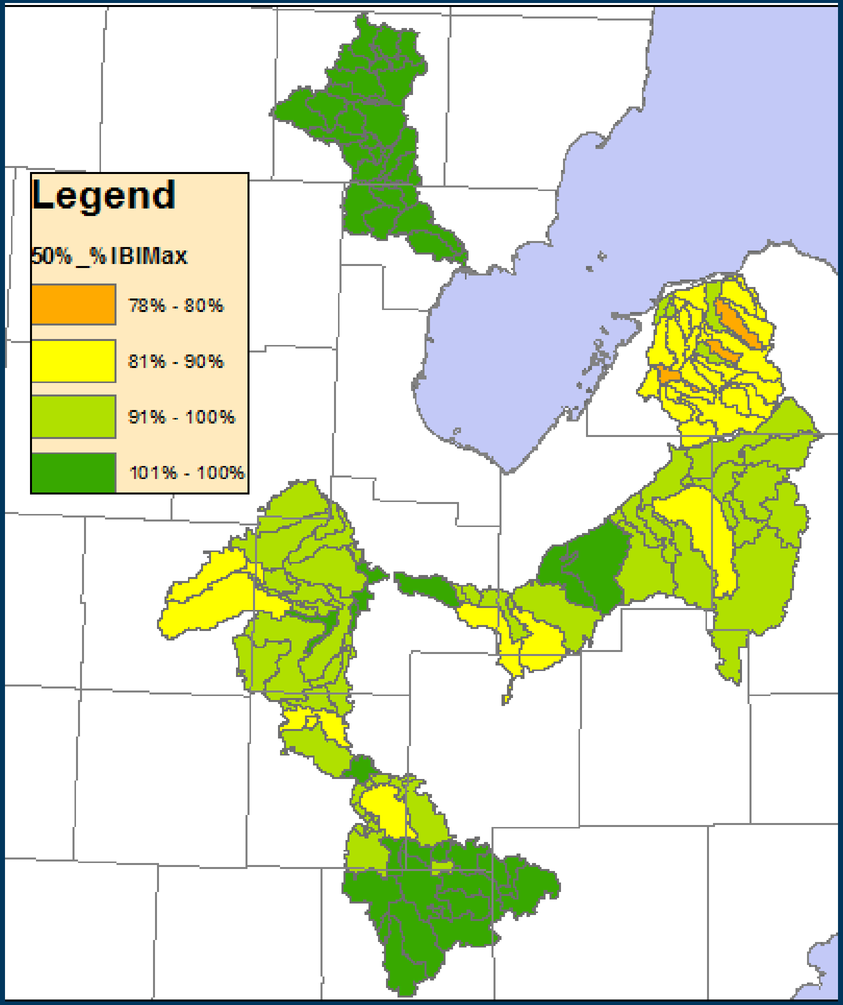


Sub-watershed Comparison: Fish Community Health

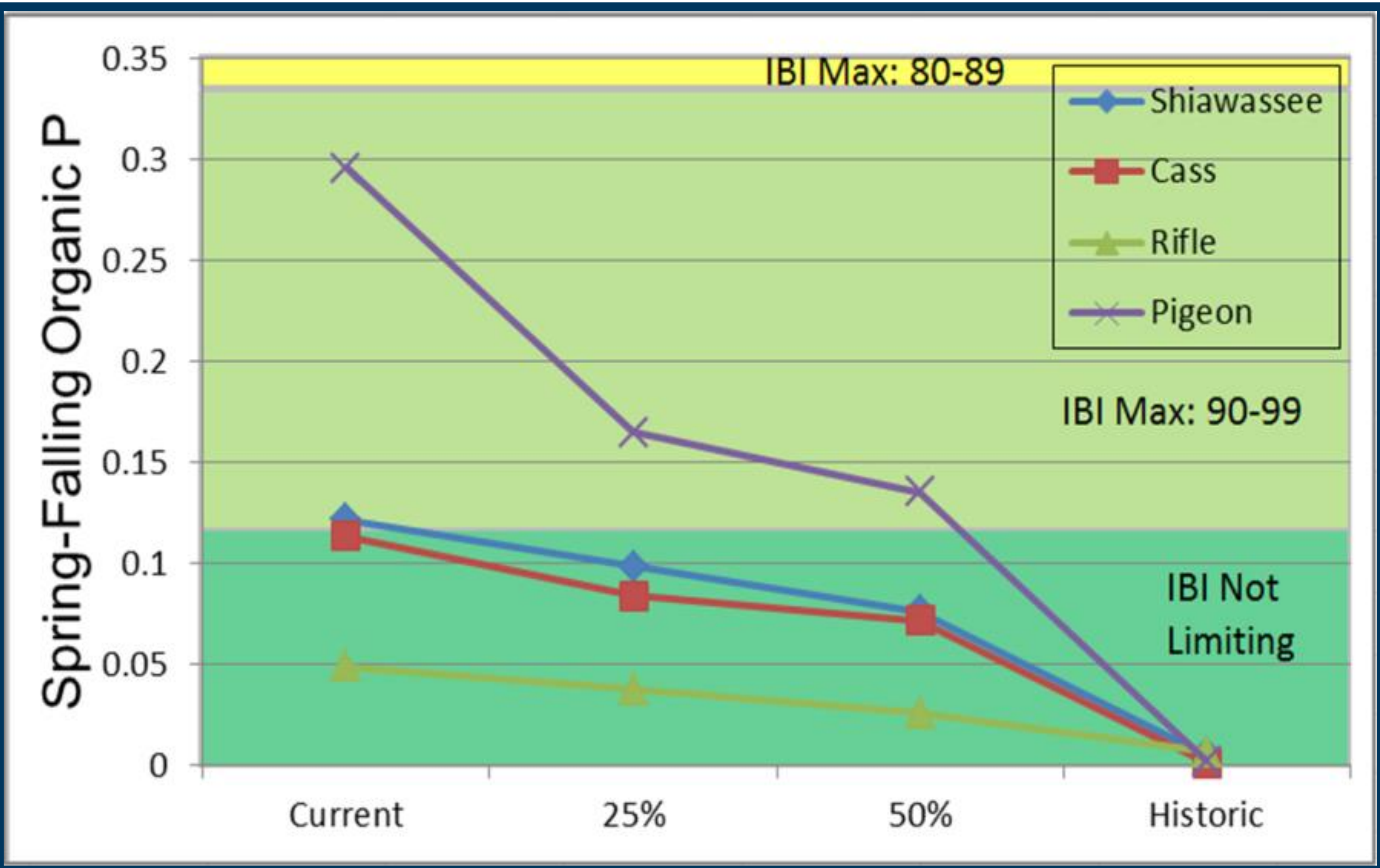
Current Condition



50% BMP



Dose Response Curve



QUICK SUMMARY

TNC and partners have developed the science so we can determine:

1. HOW MUCH: What percentage of the land needs to be treated with practices

2. WHERE: Where conservation practices need to be implemented

3. OUTCOME ORIENTED: All the work is tied to improving fish community health

Calculator Tools in the Saginaw Bay Watershed

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Technology to target and track progress towards the goal:

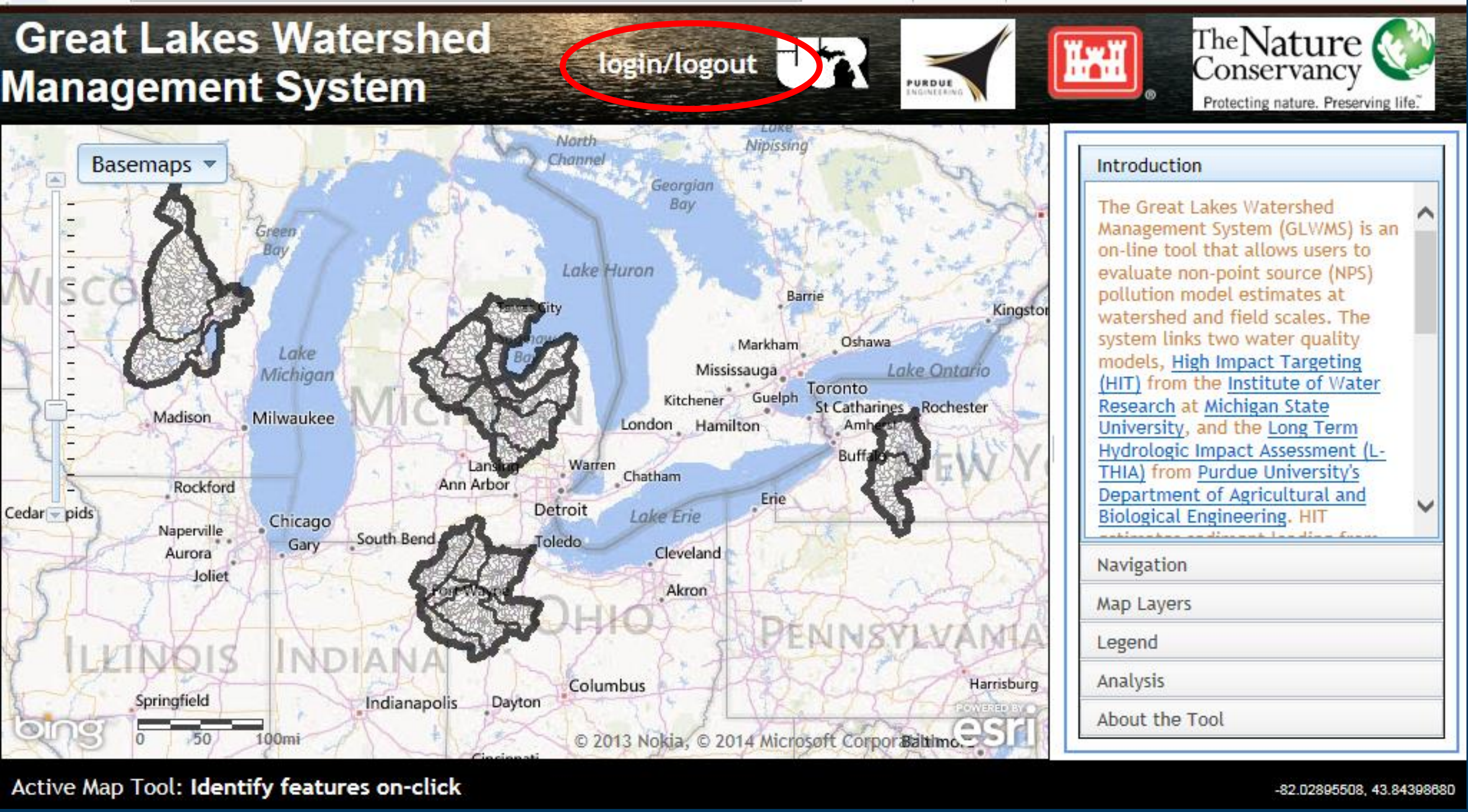
1. Sediment Calculator
2. Nutrient Calculator
3. Groundwater Recharge Calculator
4. Accounting System (BMP tracker)

All currently being developed by MSU-IWR

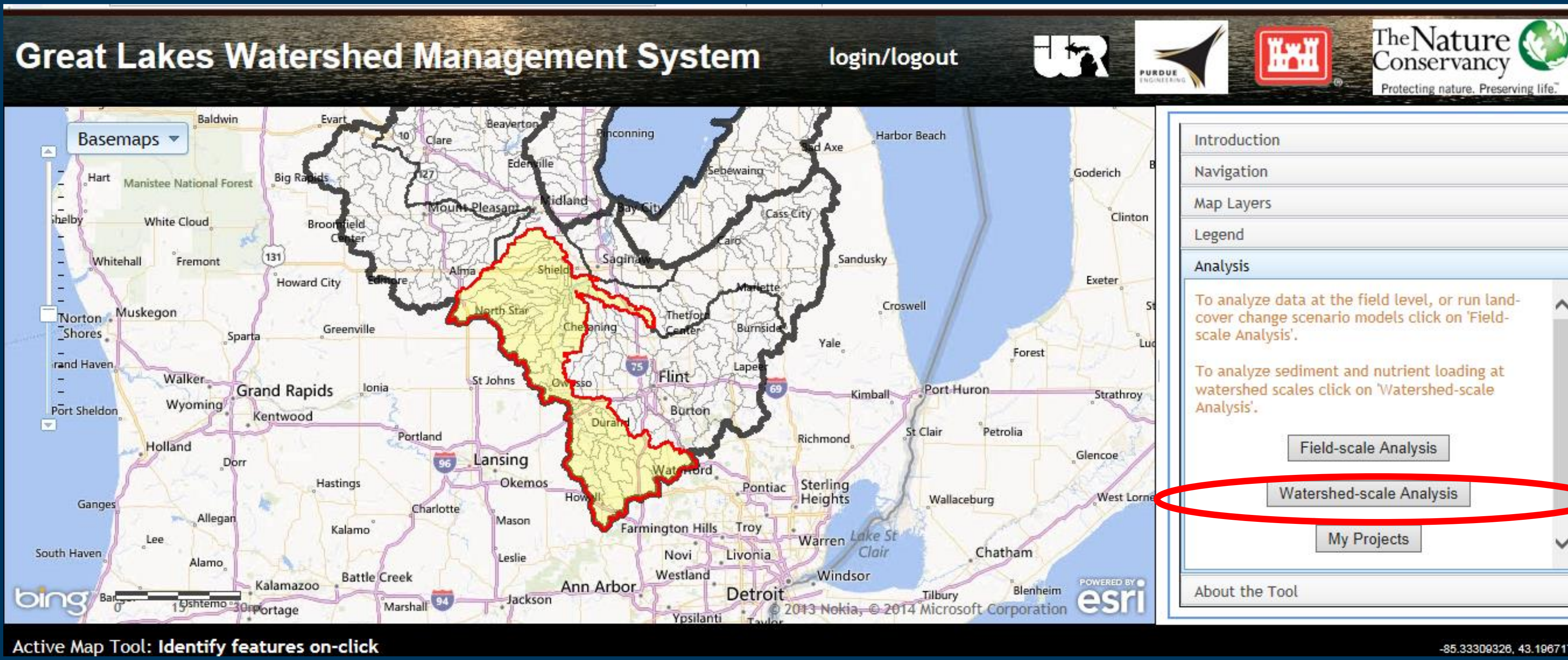
Will be completed by March 2014 & available online

Sediment and Nutrient Calculators

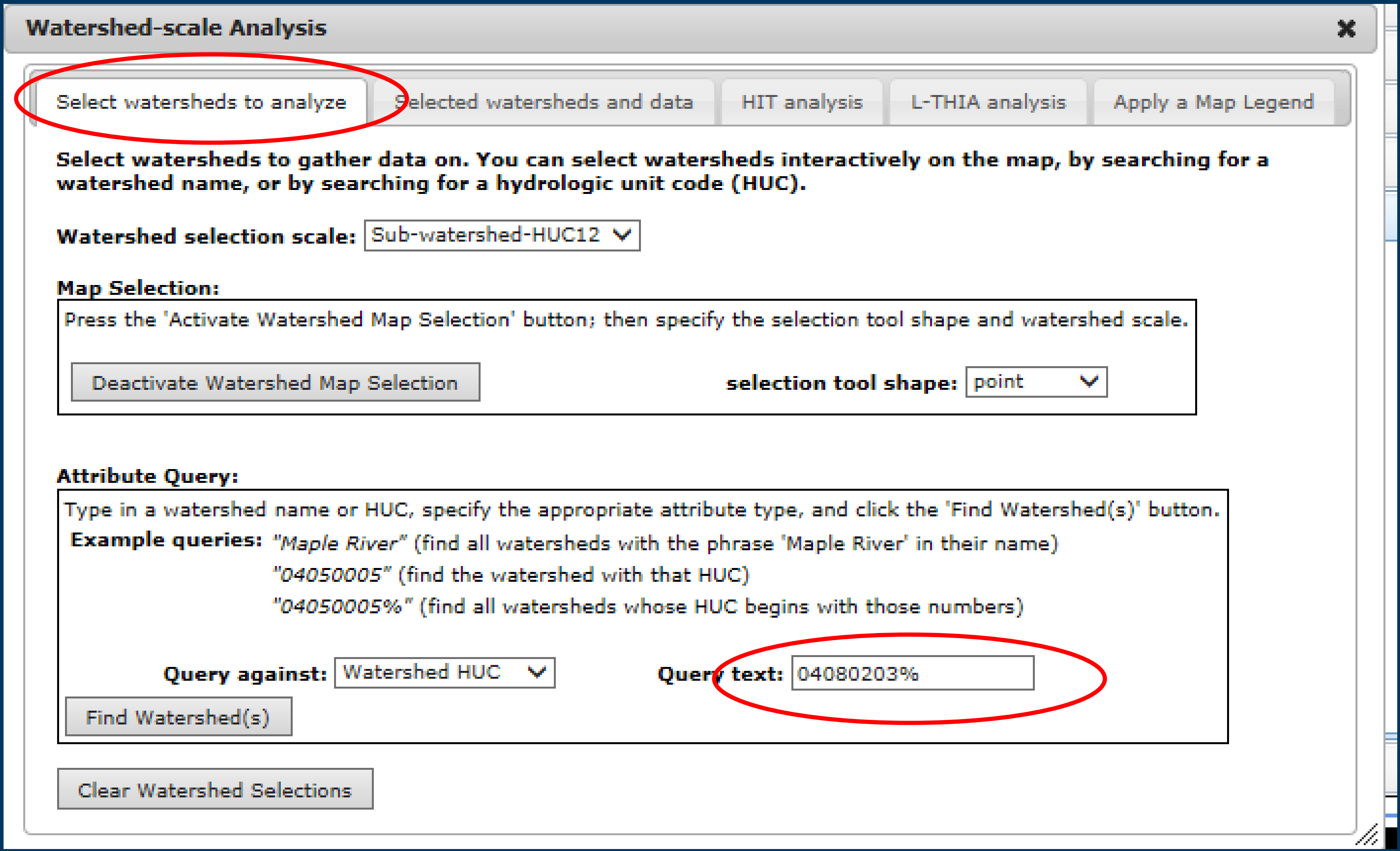
http://35.8.121.111/glwms/



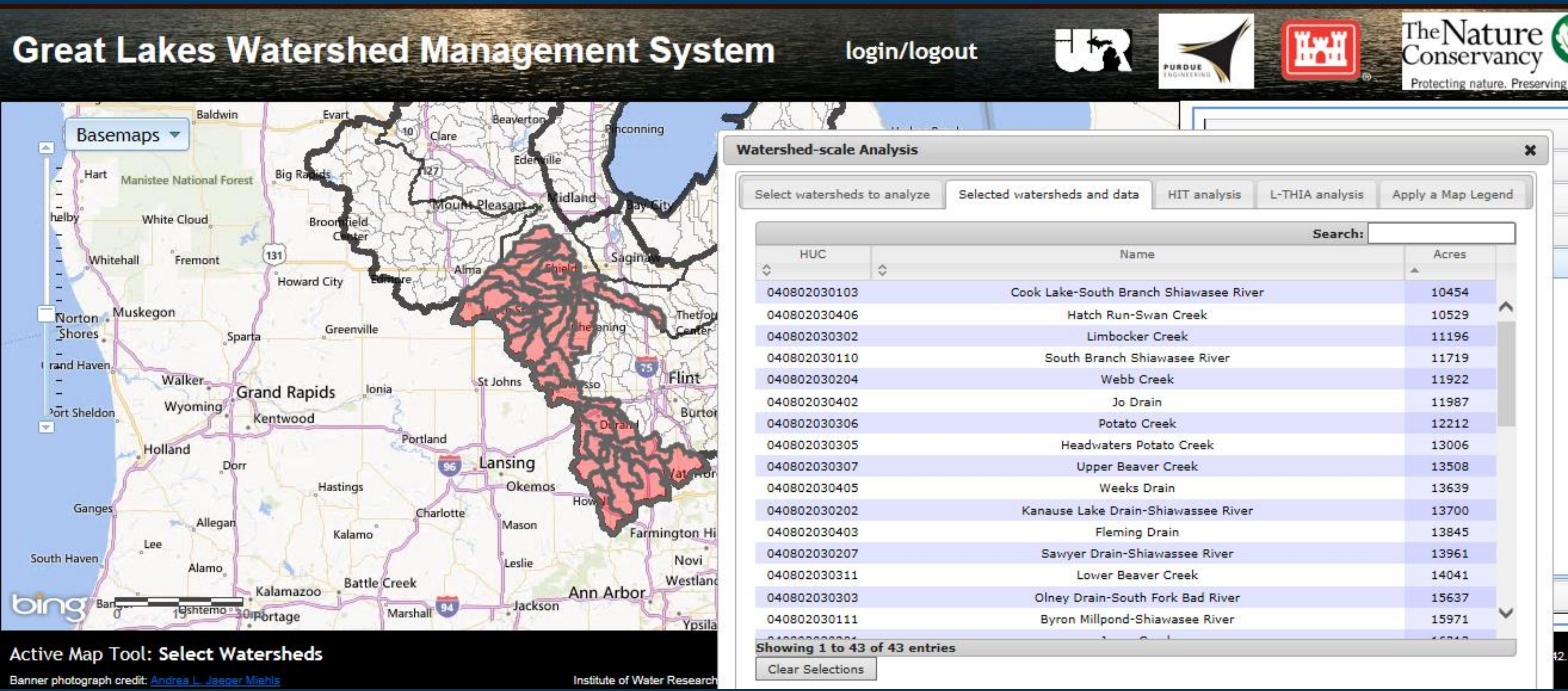
Watershed Scale Analysis



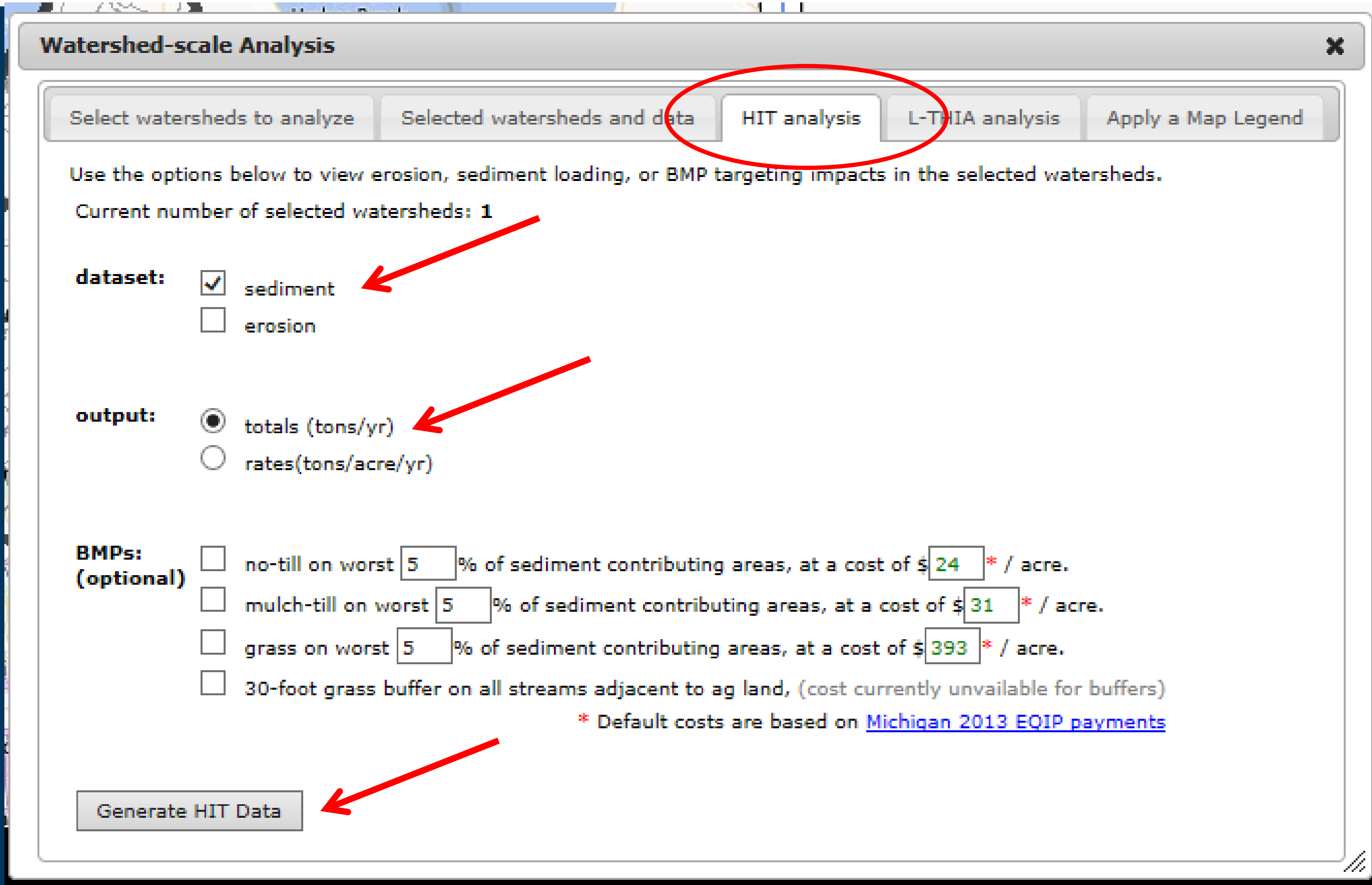
Select Watersheds to Analyze



Select Watersheds to Analyze



HIT Analysis: Sediment



HIT Analysis: Sediment

Watershed-scale Analysis

Select watersheds to analyze | Selected watersheds and data | HIT analysis | L-THIA analysis | Apply a Map Legend

Search:

HUC	Name	Acres	Sediment loading (t/yr)
040802030301	Brady Creek-Bad River	18791	2573
040802030309	Shad Creek-Bad River	22998	2207
040802030208	Mickels Creek-Shiawassee River	24642	2193
040802030304	Lamb Creek	24267	2188
040802030401	Bear Creek	30450	1942
040802030203	Holly Drain	22627	1724
040802030201	Jones Creek	16212	1704
040802030206	Osburn Drain-Shiawassee River	22182	1522
040802030205	Scribner Drain-Shiawassee River	20193	1511
040802030307	Upper Beaver Creek	13508	1455
040802030209	Deer Creek-Shiawassee River	20061	1356
040802030106	North Ore Creek	37922	1169
040802030312	Pickerel Creek	17339	1094
040802030407	Swan Creek	21891	1053
040802030409	Birch Run	25480	1040
040802030207	Sawyer Drain-Shiawassee River	13961	1035
[illegible]	[illegible]	[illegible]	[illegible]
Totals		810045	43815

Showing 1 to 43 of 43 entries

Clear Selections

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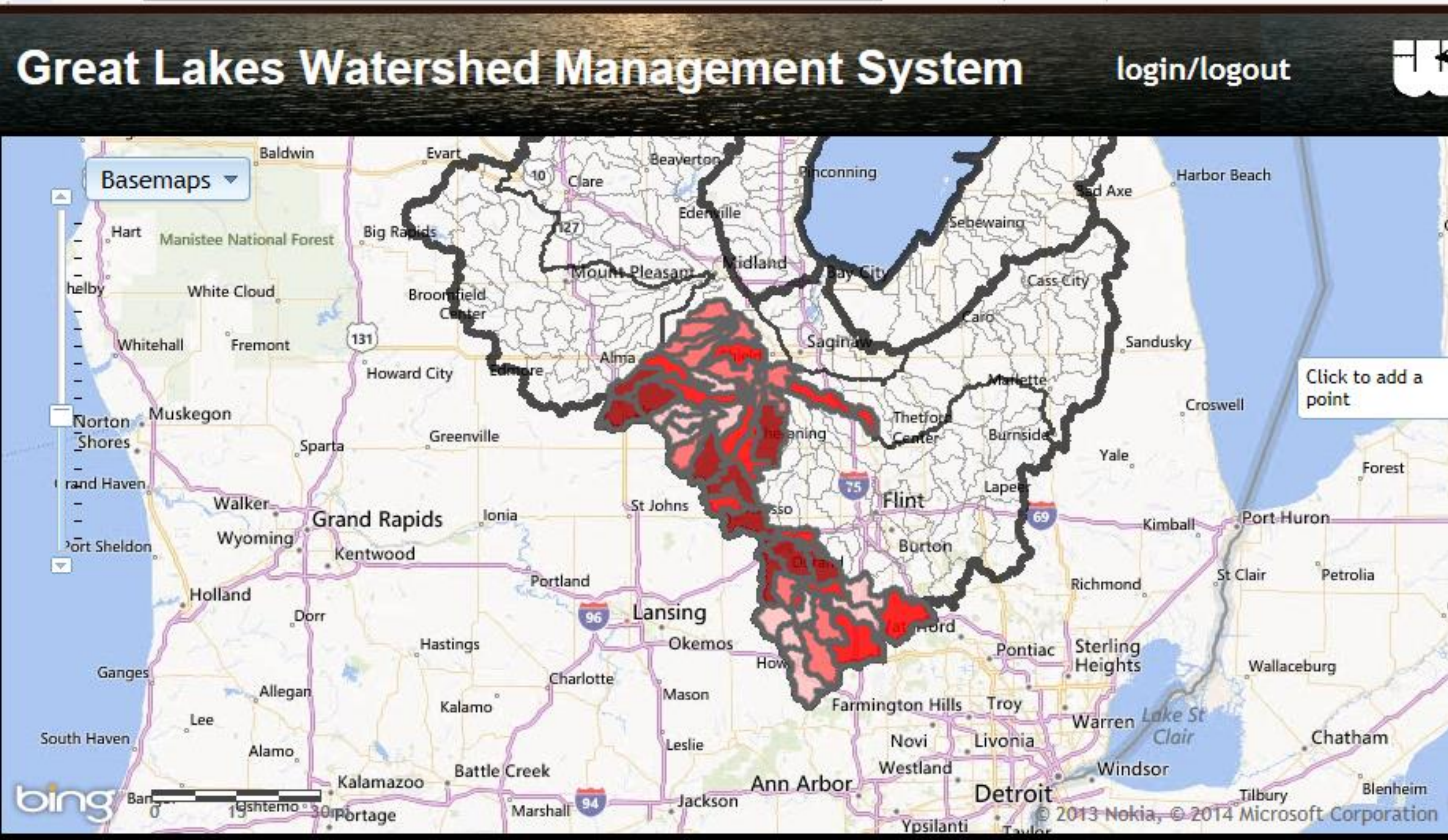
Total Sediment Loading



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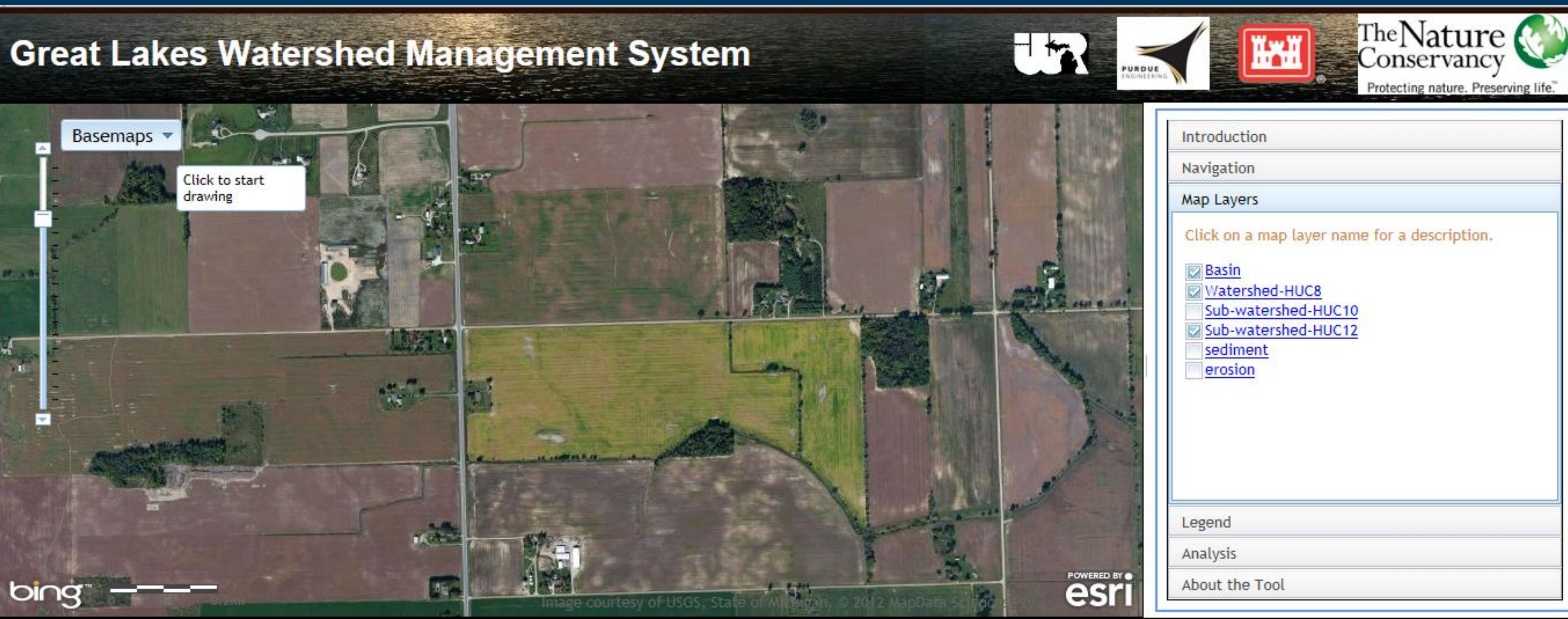
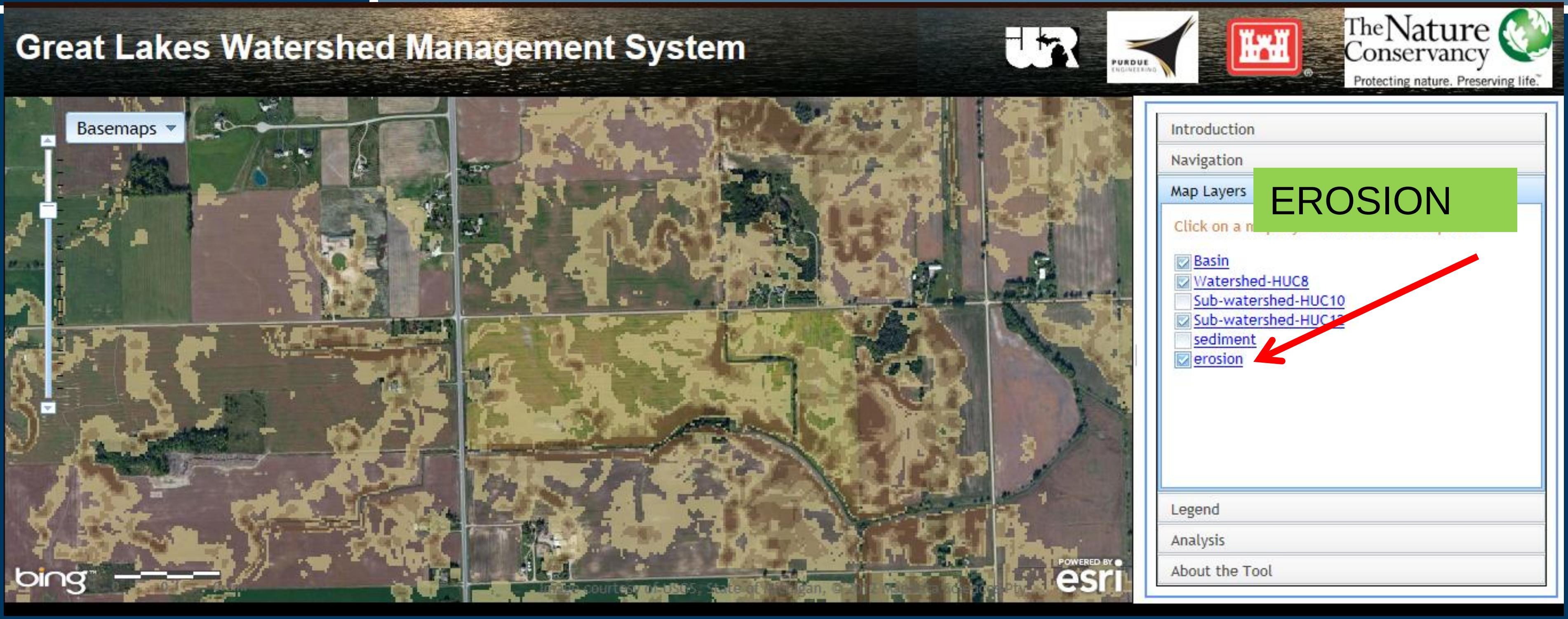
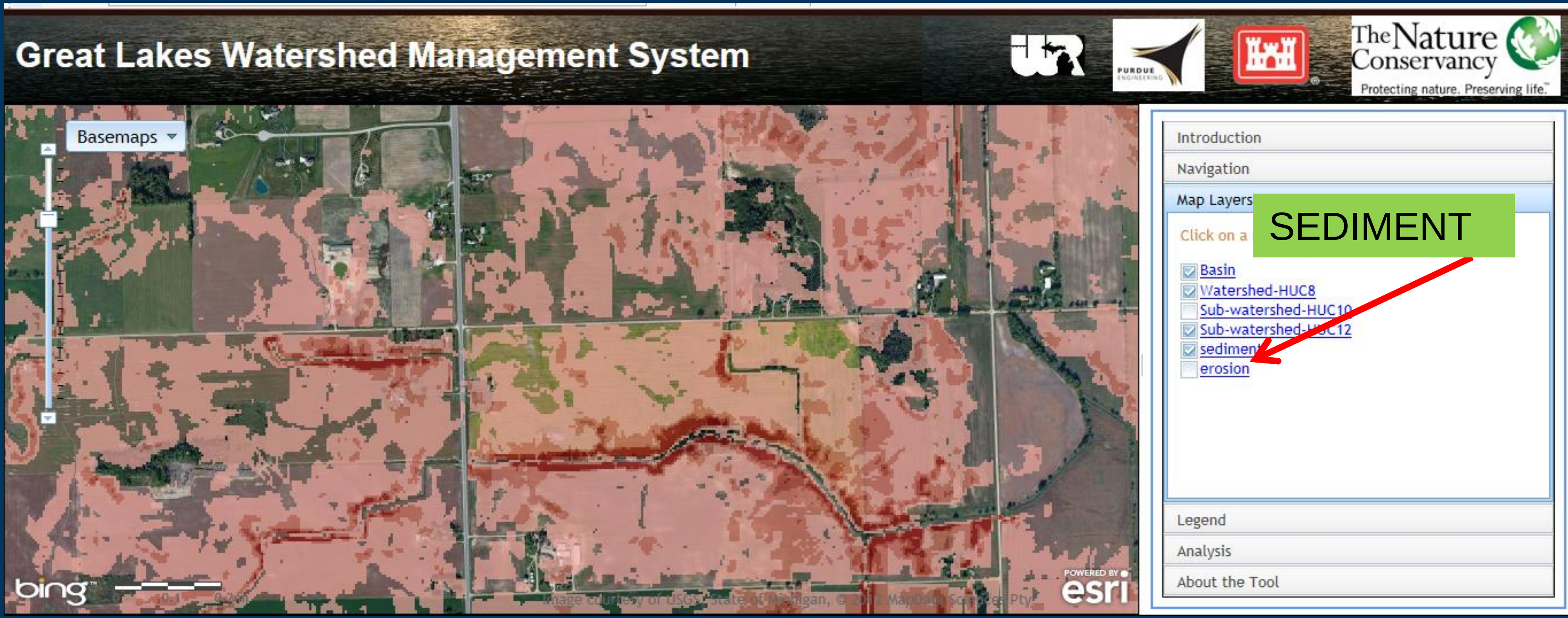
Zooming in on Specific Farm Field



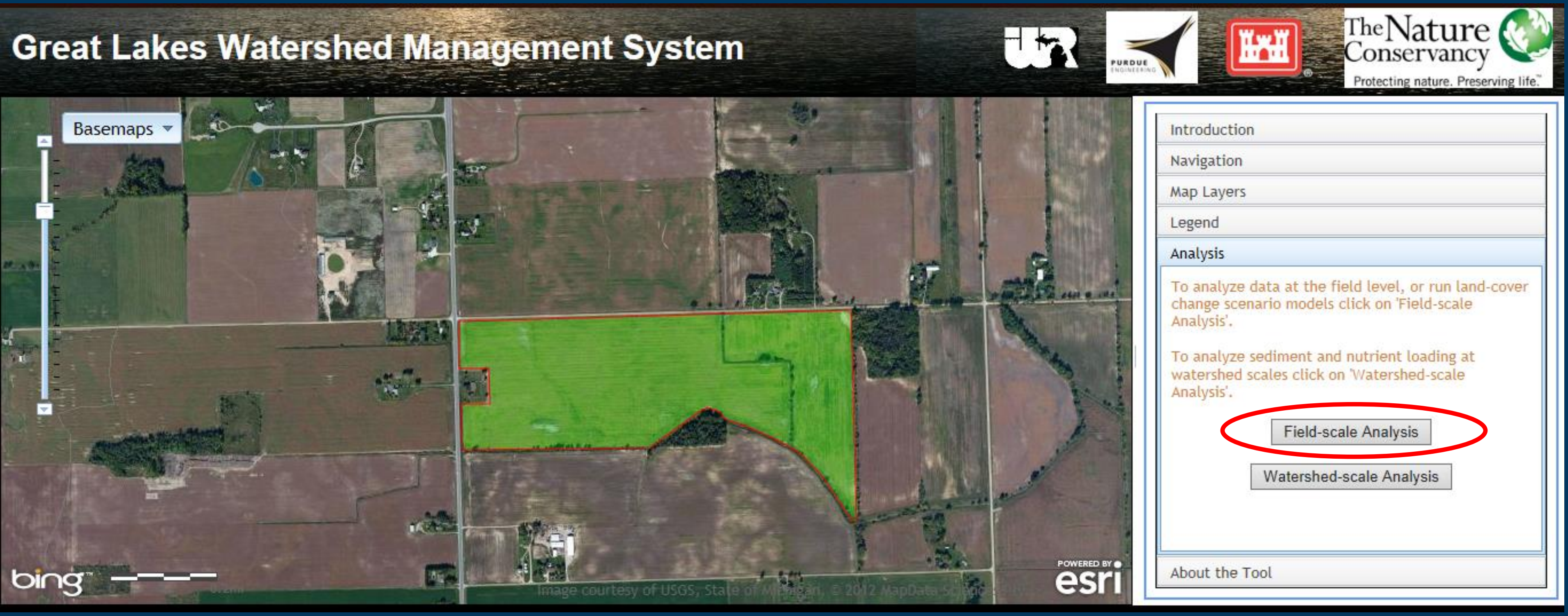
Look at Risks on a Specific Farm Field



Look at Risks on a Specific Farm Field



Drawing Specific Parcel Boundaries



Running Field Scale Analysis

Field-scale Analysis

View Baseline NPS | Calculate a Baseline Change | Compare 2 Scenarios | Results

Click the 'Activate' button to activate the digitizer, then draw an area to see how erosion, sediment loading, runoff, or pollutant loading may change between two different land cover scenarios.

Digitizer: De-activate | Clear Digitized Features

Project Name: Project 1 (for saving and organizing results)

Model(s) to use:
- [x] HIT (for soil erosion and sediment loading to streams from ag lands)
- [ ] L-THIA (for surface run-off volumes and pollutant loading to streams)

(click on a column title for a description)

Edit optional HIT parmaters +

		Feature ID - Scenario	HIT: LC Change/BMP	Acres	Cost/acre ($)
X	✓	3-1	CTL	113.9	Click to edit
		3-2	NCC	113.9	Click to edit

Calculate

Conventional till to No till with Cover Crops

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Selecting BMPs to Model Sediment Loading (HIT Model)

HIT: LC Change/BMP

- ALF (alfalfa)
- GRA (grass)
- FOR (forest)
- PAS (pasture)
- RCA (row-crop agriculture)
- WET (wetland)
- BUF (buffer strip)
- GRW (grass waterway)
- NTL (no-till)
- MTL (mulch-till)
- CTL (conventional-till)
- NCC (no-till with cover crop)
- MCC (mulch-till with cover crop)
- CCC (conventional-till with cover crop)
- MAN: manually selected parameters

optional HIT parmaters

		Feature ID - Scenario	HIT: LC Change/BMP	Acres	Cost/acre ($)	C Factor	K Factor	LS Factor	R Factor	Surface Roughness	Delivery Ratio
X	☑	1-1	MAN	140.3	Click to edit	Click to edit	Click to edit	Click to edit	Click to edit	Click to edit	Click to edit

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Evaluating Erosion Results:
Conventional Till –to- No Till w/Cover Crops

Field-scale Analysis

View Baseline NPS | Calculate a Baseline Change | Compare 2 Scenarios | Results

Results:

Project 1() + remove

Project 1() - remove

Calculation type: Change in NPS between two scenarios
digitized acres: 113.9 (**green** area on map)
total acres (including affected upland): 287.8 (**blue** area on map)
HIT land cover change / BMP: CTL to NCC

HIT Results:
Job ID: j6ce06a980e9e4d3b86f6796c60e4646f

Erosion in affected areas, Scenario 1 (tons/yr):	384.35
Erosion in affected areas, Scenario 2 (tons/yr):	234.27
*Erosion **DECREASE** (tons/yr):*	150.08
Sed. load in affected areas, Scenario 1 (tons/yr):	80.83
Sed. load in affected areas, Scenario 2 (tons/yr):	31.91
*Sediment loading **DECREASE** (tons/yr):*	48.92

150 ton/yr reduced erosion

49 tons/yr reduced sediment loading

61% reduction!

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Selecting BMPs to Model Nutrient Loading: LTHIA Model

Agriculture
- No Till (100 %)
- Conservation Tillage (30%)
- Reduced Till
- Mulch Till
- 30 ft grass buffer
- Riparian Buffer Strip
- Detention Basin
- Grass swale
- Cropland generalized
- Row Crops (5-20% residue)
- Small Grain (5-20% residue)
- Small Grain st rows
- Close Seeded legumes
- Row Crops (5-20% residue and contour)
- Small Grain (5-20% residue and contour)
- Close Seeded legumes contour
- Pasture/Hay

Forest
- Forest/Woods
- Trees/Orchard
- Woods fair
- Woods good
- Woods poor

Impervious surfaces
- Impervious surface-10%
- Impervious surface-20%
- Impervious surface-30%
- Impervious surface-40%
- Impervious surface-50%
- Impervious surface-60%
- Impervious surface-70%
- Impervious surface-80%
- Impervious surface-90%
- Impervious surface-100%

Industrial/Urban
- Commercial
- Commercial/Industrial/Transportatio
- Industrial
- Parking lot
- Parking lot with porous pavement g
- Parking lot with porous pavement fa
- Parking lot with porous pavement p
- Paved street with curbs and gutters
- Paved Surface Driveway or Parking
- Street/Road
- Street with curbs and gutters and p
- Street with swales
- Street with swales and porous pave
- Streets / other
- roof cistern
- green roof

- Grass land
- Open space-dirt or grass cover < 50%
- Open space-gravel or grass cover 50%-75%
- Open space-wooded or grass cover > 75%
- Open Space/Park
- Open space with bioretention
- Other Open/Unused Land
- Barren Land

Residential
- High-density Res. (townhomes - 1/4 ac lots)
- Low-Density Residential (general 1/3 - 2 ac lots)
- Residential - 1 ac lots
- Residential - 1/2 ac lots
- Residential - 1/3 ac lots
- Residential - 1/4 ac lots
- Residential - 1/8 ac lots
- Residential - 2 ac lots
- Driveway with porous pavement
- Patio
- Permeable patio
- Roof
- Roof rain barrel
- Sidewalk
- Sidewalk with porous pavement

Water
- Open Water
- Perennial ice or snow

Wetlands
- Emergent Wetlands (marsh)
- Woody Wetlands (swamp)

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Evaluating Nutrient Reduction Results

Field-scale Analysis ✖

View Baseline NPS | Calculate a Baseline Change | Compare 2 Scenarios | Results

Results:

Project 1() + remove

Project 1() + remove

Project 1() - remove

Calculation type: Change in NPS between two scenarios
digitized acres: 113.9 (**green** area on map)
total acres (including affected upland): 287.8 (**blue** area on map)
L-THIA land cover change / BMP: CROPGEN to NTL

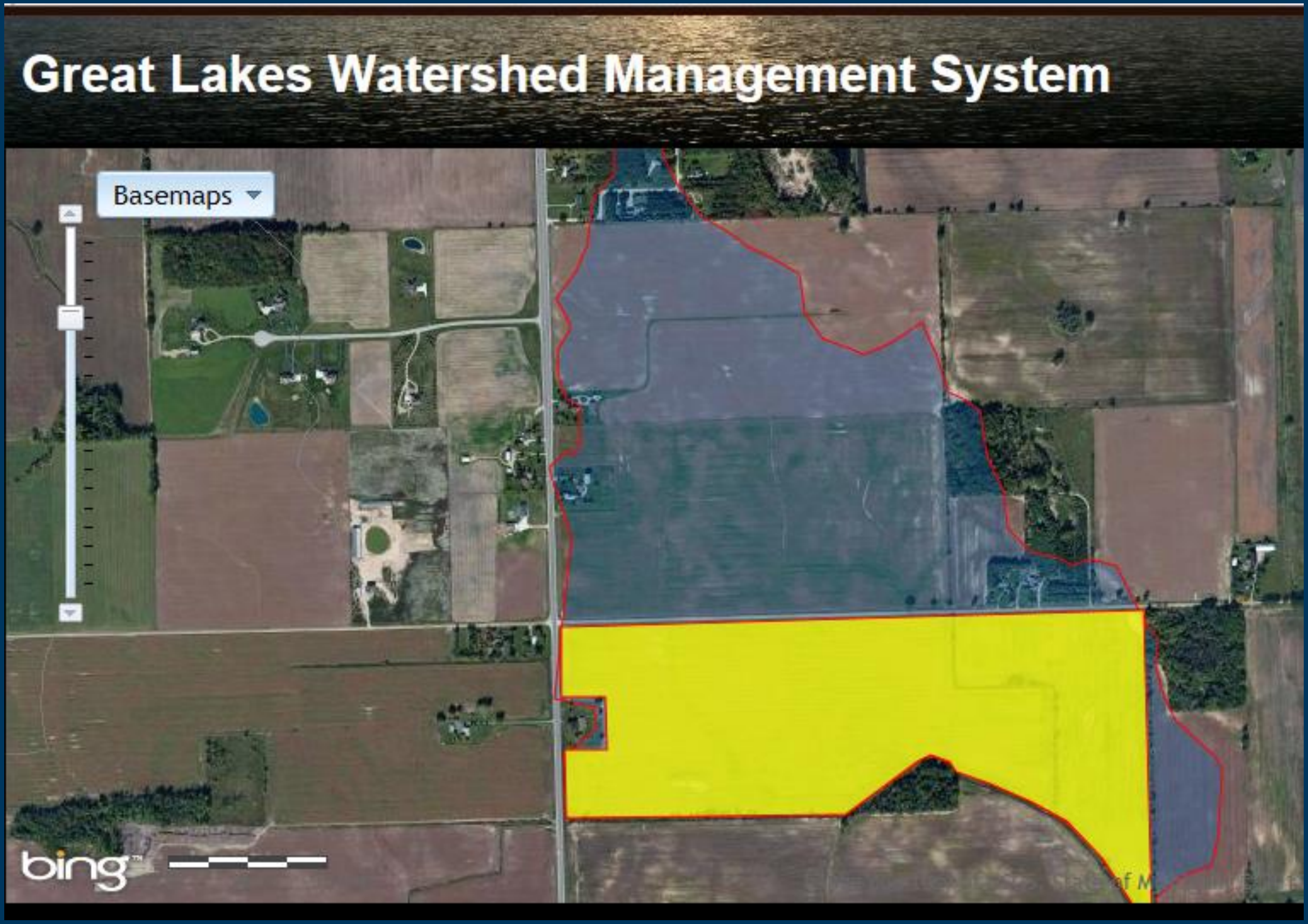
L-THIA Results:

total runoff (acre-ft/yr) ***DECREASE***:	27.55
nitrogen (lbs/yr) ***DECREASE***:	8016.79
phosphorus (lbs/yr) ***DECREASE***:	97.4
suspended solids (lbs/yr) ***DECREASE***:	329.66
lead (lbs/yr) ***DECREASE***:	0.11
copper (lbs/yr) ***DECREASE***:	0.11
zinc (lbs/yr) ***DECREASE***:	1.2
E coli (MPN/100mL) ***DECREASE***:	638910772449999

8017 lbs/yr reduced nitrogen loss

97 lbs/yr reduced phosphorus loss

Affected Area Shaded in Blue



Putting the Science into Practice

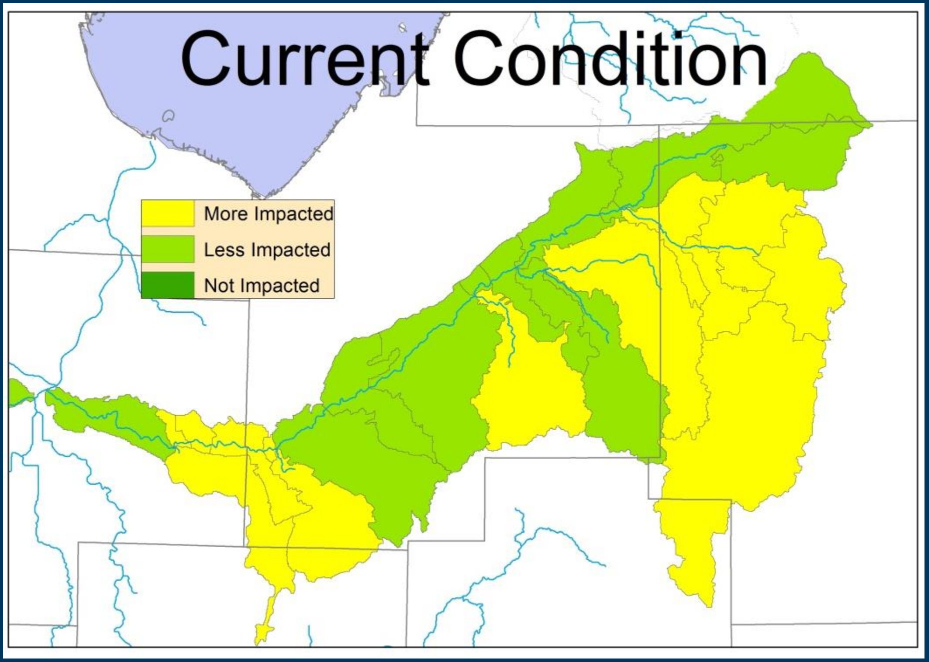
1. Via traditional Farm Bill cost-share programs
2. Via the Supply Chain Influences
3. Via Pay for Performance

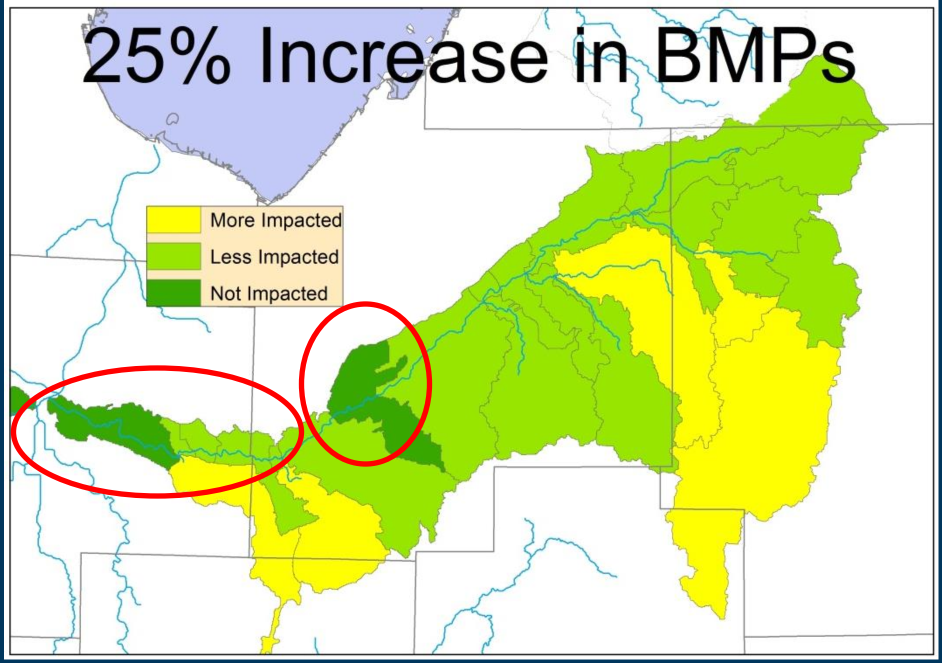
PROJECT: Cass River Watershed

– Partnering with Conservation Districts
  • $120,000 C.S. Mott Foundation
– Targeted outreach to areas with largest potential for impact

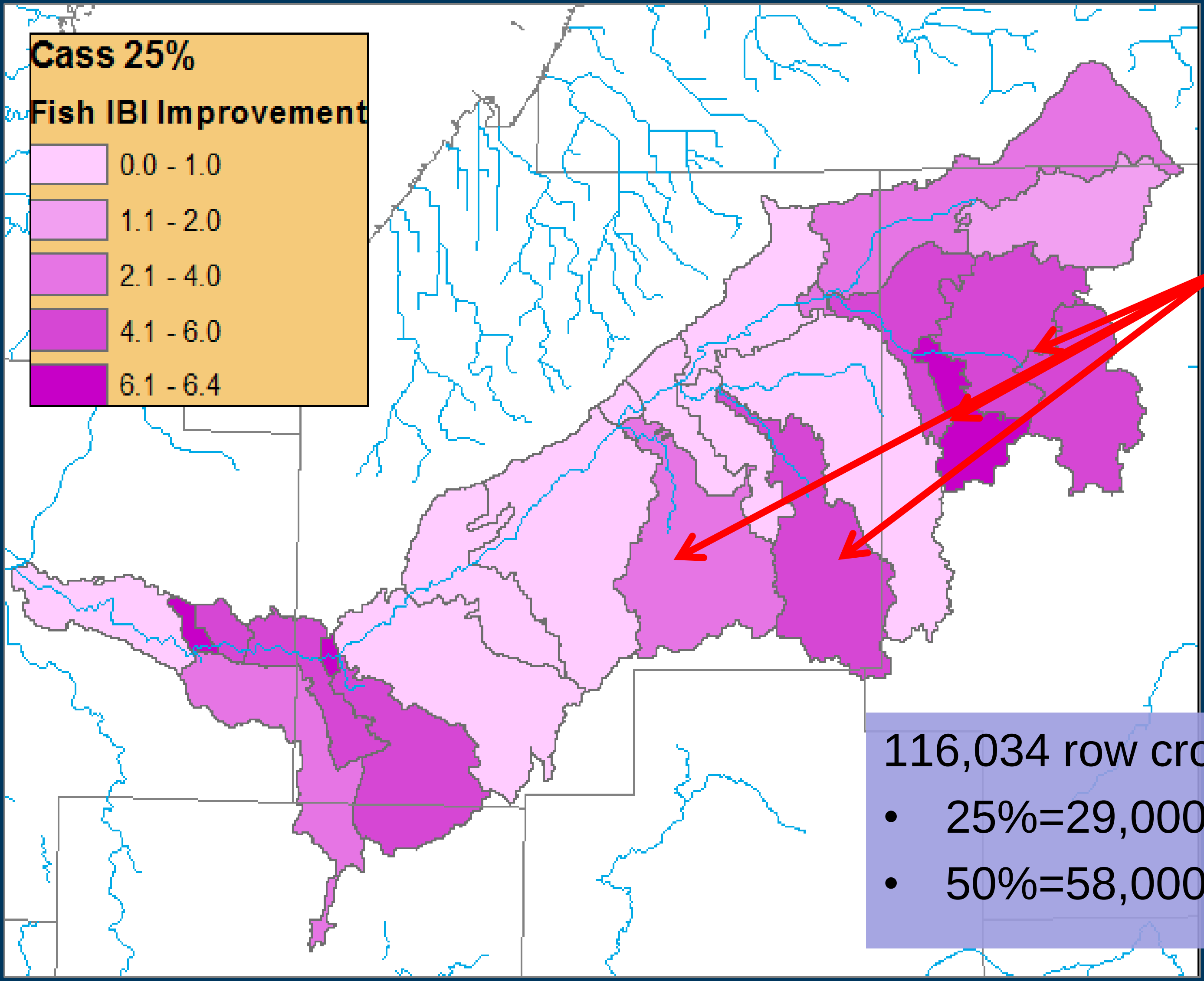
Cass River Subwatershed Comparison

Health of the Local Fish Community





Where do fish improve the most?



Sanilac and Tuscola Conservation Districts will be focusing in these areas for Implementation

116,034 row crop acres total

- 25%=29,000 acres
- 50%=58,000 acres

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Cass River Watershed Demo Project

STRIP TILL

COVER CROPS

WETLAND RESTORATION

EDUCATION

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Cass River Watershed Demo Project

Practice	Goal Acres	Oct 2013 Update
Nutrient Management	12,000	8,687
Conservation Crop Rotation	3,000	1,191
Tillage Mgt (No Till, Strip Till, Mulch Till)	15,000	1,506
Cover Crop	3,000	881
Filter Strip		7.3 acres
Wetland Creation/Restoration	5-7 sites (min 1 acres)	13 acres (8 sites)

These goals are contingent on securing funding via Farm Bill program.

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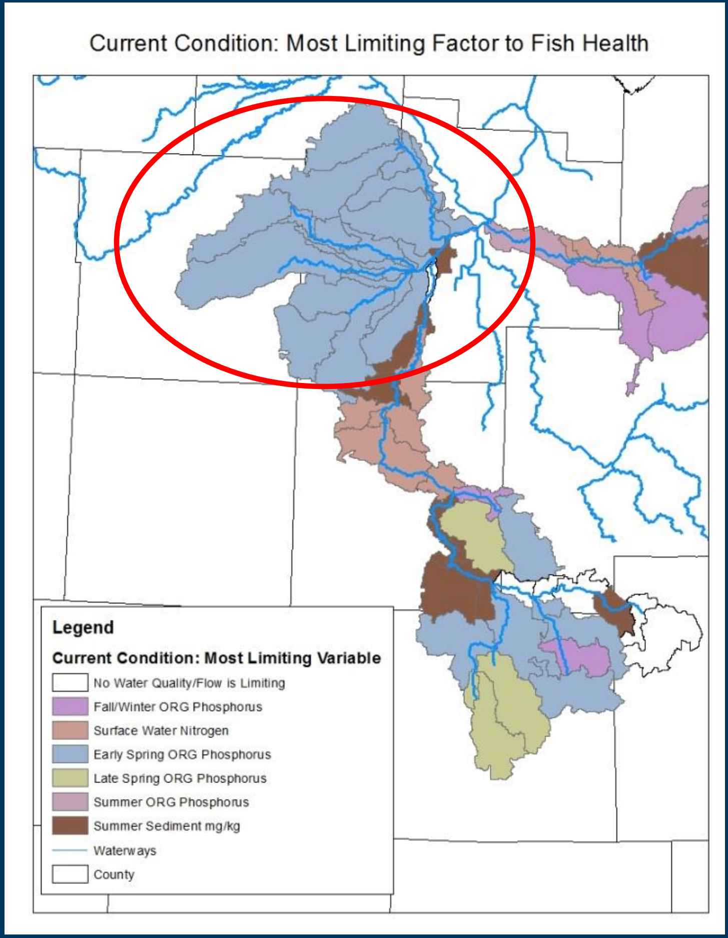
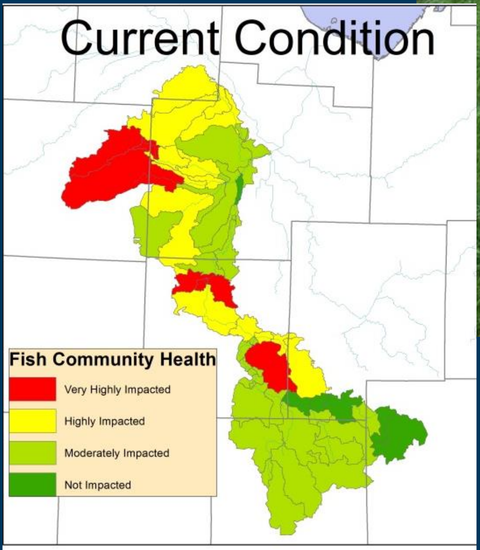
Testing Transactions: Pay for Performance

Sediment Reduction in the Bad River Watershed



- Partner: Gratiot Conservation District, NRCS
- Great Lakes Commission Grant ($250,000)
- Develop a watershed goal for sediment reduction
- Set a payment rate for sediment reduction ($/ton)
- Using the sediment calculator to determine reduction amount

Testing Transactions: Drain Fee Reduction Project



Shiawassee River Watershed

- Partners: County Drain Commissioner, MSU-IWR, local conservation district
- Cook Family Foundation invited proposal
- Develop a watershed goal for sediment reduction
- Set a discount value for sediment reduction ($/ton)
- Using the sediment calculator to determine reduction amount

Supply Chain: Kellogg influences wheat farmers to implement conservation practices

Cass River Pilot Project

- Partners: Kellogg, Star of the West Milling Co, MSU-IWR
- Set a watershed sustainability goal (P reduction in lbs)
- Train crop advisors on use of calculators
- Voluntary implementation
- Track progress towards goal using BMP tracker

Many Stakeholders Involved in Implementation!

Funders

- C.S. Mott Foundation
- USDA-NRCS CEAP
- Great Lakes Commission
- Great Lakes Protection Fund
- Kellogg Company
- U of M Water Center (Erb)
- Cook Family Foundation
- Herrick Foundation
- Americana Foundation

Partners/Stakeholders

- MSU-IWR, SVSU
- County Drain Commissioners
- Conservation Districts
- Private Companies (Star of the West, Michigan Sugar)
- Natural Resources Conservation District (NRCS)
- MDEQ, MDNR, MDARD
- USFWS, USGS
- Saginaw Bay WIN
- Farm Bureau
- Legislative Leaders
- Cass River Greenway, Friends of the Shiawassee River

The Nature Conservancy
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Great Lakes Project
AG Strategy: Theory of Change