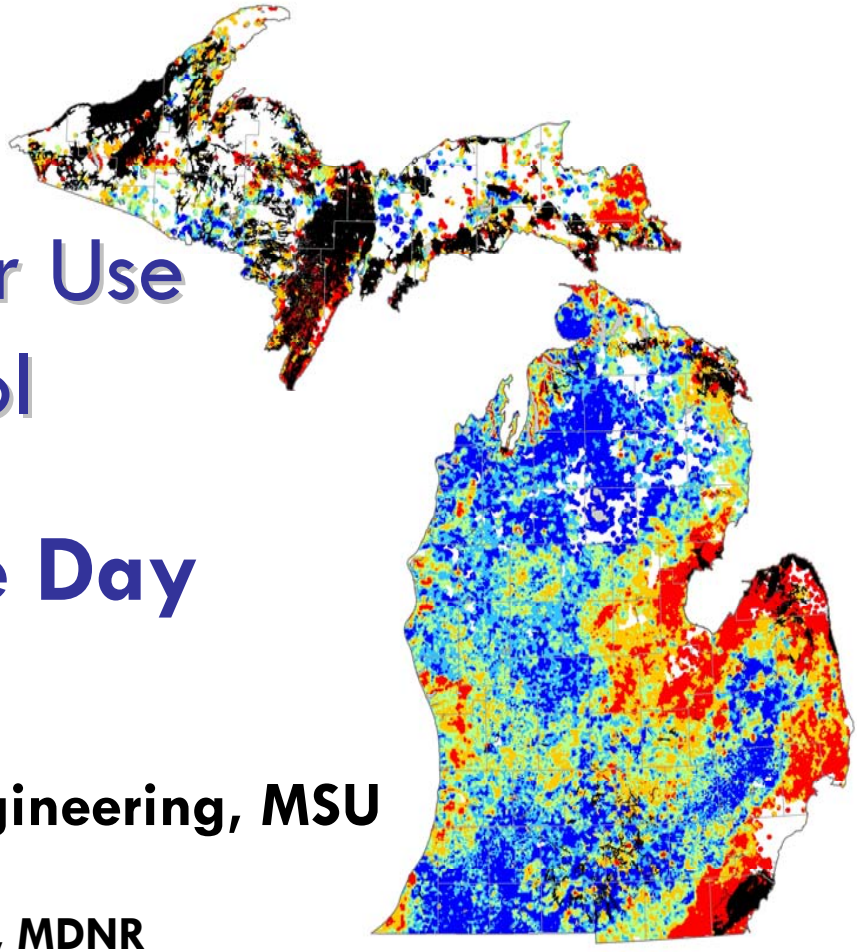
Water Issues Large Scale Water Use Assessment Tool



MBG Horticulture Day

Steve Miller

Biosystems and Agricultural Engineering, MSU

With slides from Paul Seelbech, MDNR

Lyndon Kelley, MSUE

Jon F. Bartholic and Jeremiah Asher

Institute of Water Research, MSU

March 12, 2008

Riparian Doctrine

- From the public trust doctrine
- Tidelands held by the king for the benefit of all English subjects
- Navigable lakes and streams held in trust for benefit of the people of the state
- Riparian rights subservient to state's public trust authority

Prior Appropriation

West of Mississippi

- first in use, first in right
- allows transfer of water rights

Riparian Doctrine

East of Mississippi

- based on Common Law
- handed down from British law
- legal “doctrines”
- interpreted by the courts
  - sets precedents
- may be modified by legislative action

Annex 2001

- States and provinces will manage their own in-basin withdrawals
- Basin-wide, resource-based standard
  - flexible application
- Each jurisdiction will commit to establishing a program, including thresholds, to manage or regulate new or increased withdrawals consistent with the standard.

Water in the news

Humans need H2O, but lawns can wait

Nestle sues over restrictive water-use permit

Environmentalists make new push for water protection

Great Lakes water could flow west

Is water a resource or a commodity?

Appeals judges wade into water use case

Granholm shoves after Legislature refuses to push for water laws

PA 177 of 2004

Act 177 allows owner of a “small quantity well” to file a complaint with MDEQ (or MDA) if well:

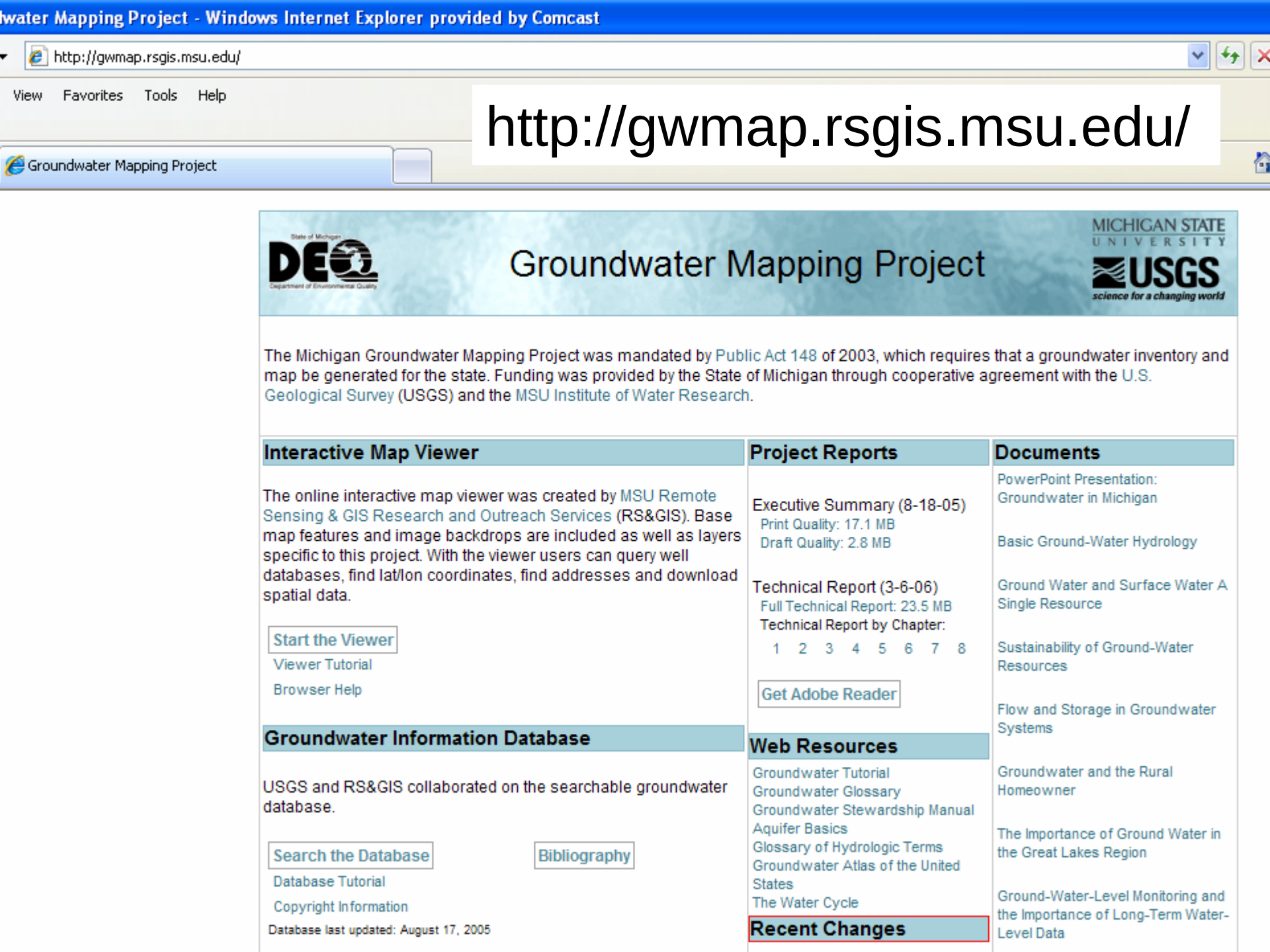
- Fails to furnish normal water supply
- Fails to provide potable water

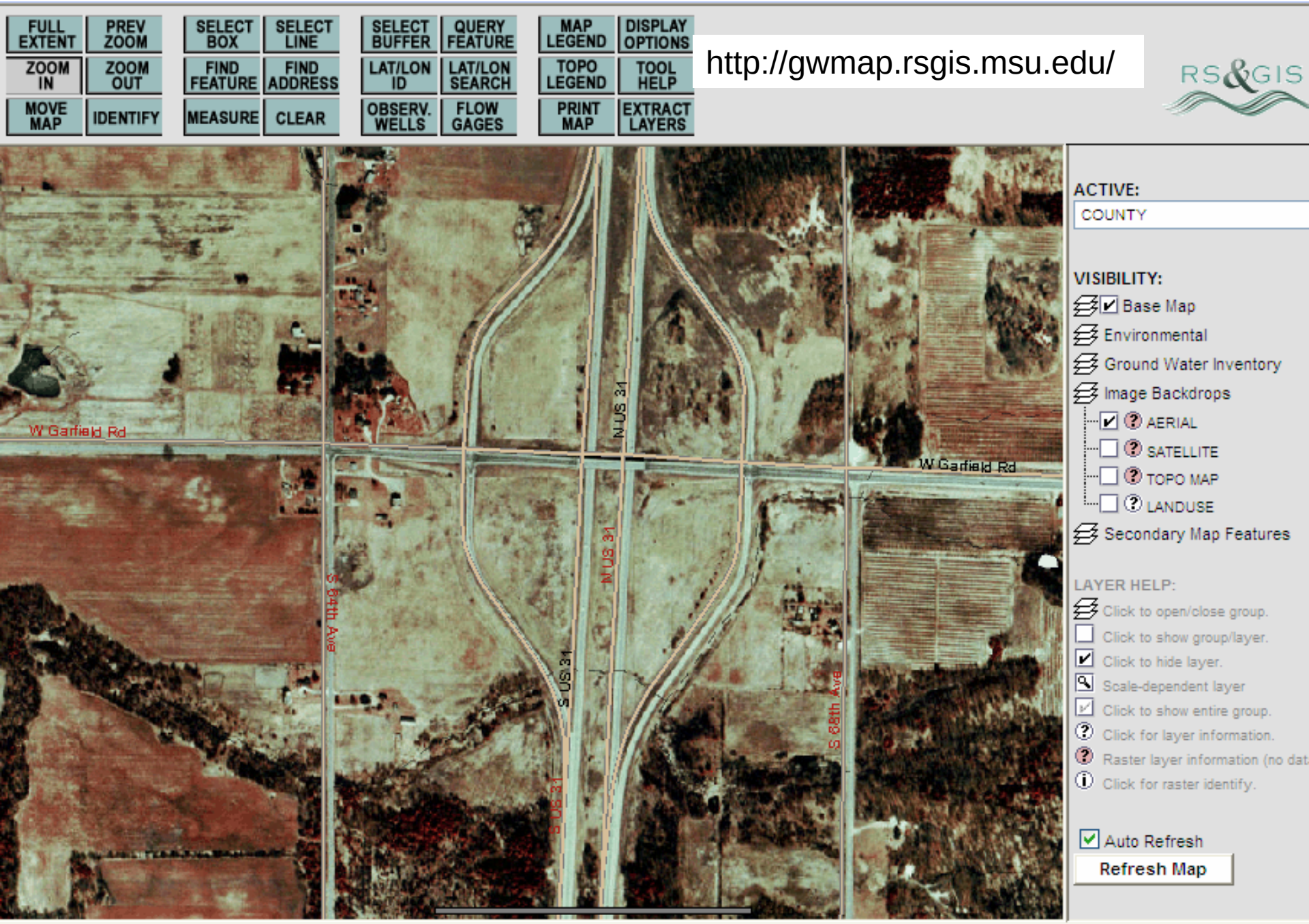
Complainant must have a credible reason to believe that the problem is caused by a HIGH CAPACITY WELL

PA 177

In 2007 there where

- 13 complaints filed under Act 177, involving 6 wells in four locations
- 11 complaints required large volume user to pay for improvement to affected small well
- 1 complaint solved by farmer moving large well
- 1 complaint was solved by homeowner paid solution


hwater Mapping Project - Windows Internet Explorer provided by Comcast
http://gwmap.rsgis.msu.edu/
View Favorites Tools Help
http://gwmap.rsgis.msu.edu/
Groundwater Mapping Project
Groundwater Mapping Project
MICHIGAN STATE UNIVERSITY
USGS
science for a changing world
The Michigan Groundwater Mapping Project was mandated by Public Act 148 of 2003, which requires that a groundwater inventory and map be generated for the state. Funding was provided by the State of Michigan through cooperative agreement with the U.S. Geological Survey (USGS) and the MSU Institute of Water Research.
Interactive Map Viewer
The online interactive map viewer was created by MSU Remote Sensing & GIS Research and Outreach Services (RS&GIS). Base map features and image backdrops are included as well as layers specific to this project. With the viewer users can query well databases, find lat/lon coordinates, find addresses and download spatial data.
Start the Viewer
Viewer Tutorial
Browser Help
Groundwater Information Database
USGS and RS&GIS collaborated on the searchable groundwater database.
Search the Database
Bibliography
Database Tutorial
Copyright Information
Database last updated: August 17, 2005
Project Reports
Executive Summary (8-18-05)
Print Quality: 17.1 MB
Draft Quality: 2.8 MB
Technical Report (3-6-06)
Full Technical Report: 23.5 MB
Technical Report by Chapter:
1 2 3 4 5 6 7 8
Get Adobe Reader
Web Resources
Groundwater Tutorial
Groundwater Glossary
Groundwater Stewardship Manual
Aquifer Basics
Glossary of Hydrologic Terms
Groundwater Atlas of the United States
The Water Cycle
Recent Changes
Documents
PowerPoint Presentation: Groundwater in Michigan
Basic Ground-Water Hydrology
Ground Water and Surface Water A Single Resource
Sustainability of Ground-Water Resources
Flow and Storage in Groundwater Systems
Groundwater and the Rural Homeowner
The Importance of Ground Water in the Great Lakes Region
Ground-Water-Level Monitoring and the Importance of Long-Term Water-Level Data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LAT/LON ID
LAT/LON SEARCH
TOPO LEGEND
TOOL HELP
MOVE MAP
IDENTIFY
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OBSERV. WELLS
FLOW GAGES
PRINT MAP
EXTRACT LAYERS
http://gwmap.rsgis.msu.edu/
RS&GIS
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N US 31
W Garfield Rd
S 64th Ave
N US 31
S US 31
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COUNTY
VISIBILITY:
Base Map
Environmental
Ground Water Inventory
Image Backdrops
AERIAL
SATELLITE
TOPO MAP
LANDUSE
Secondary Map Features
LAYER HELP:
Click to open/close group.
Click to show group/layer.
Click to hide layer.
Scale-dependent layer
Click to show entire group.
Click for layer information.
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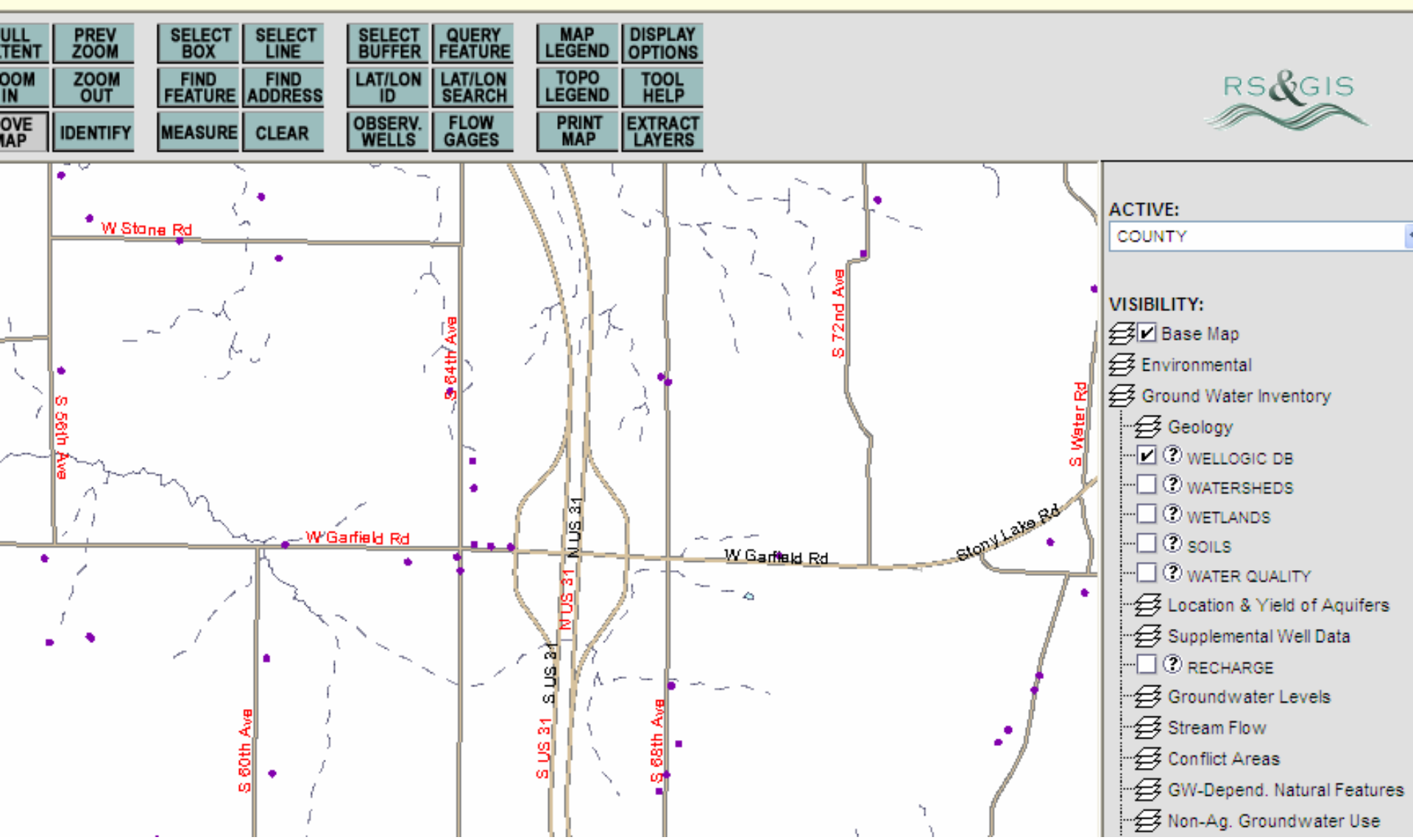
Auto Refresh
Refresh Map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S Water Rd
W Garfield Rd
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S 60th Ave
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COUNTY
VISIBILITY:
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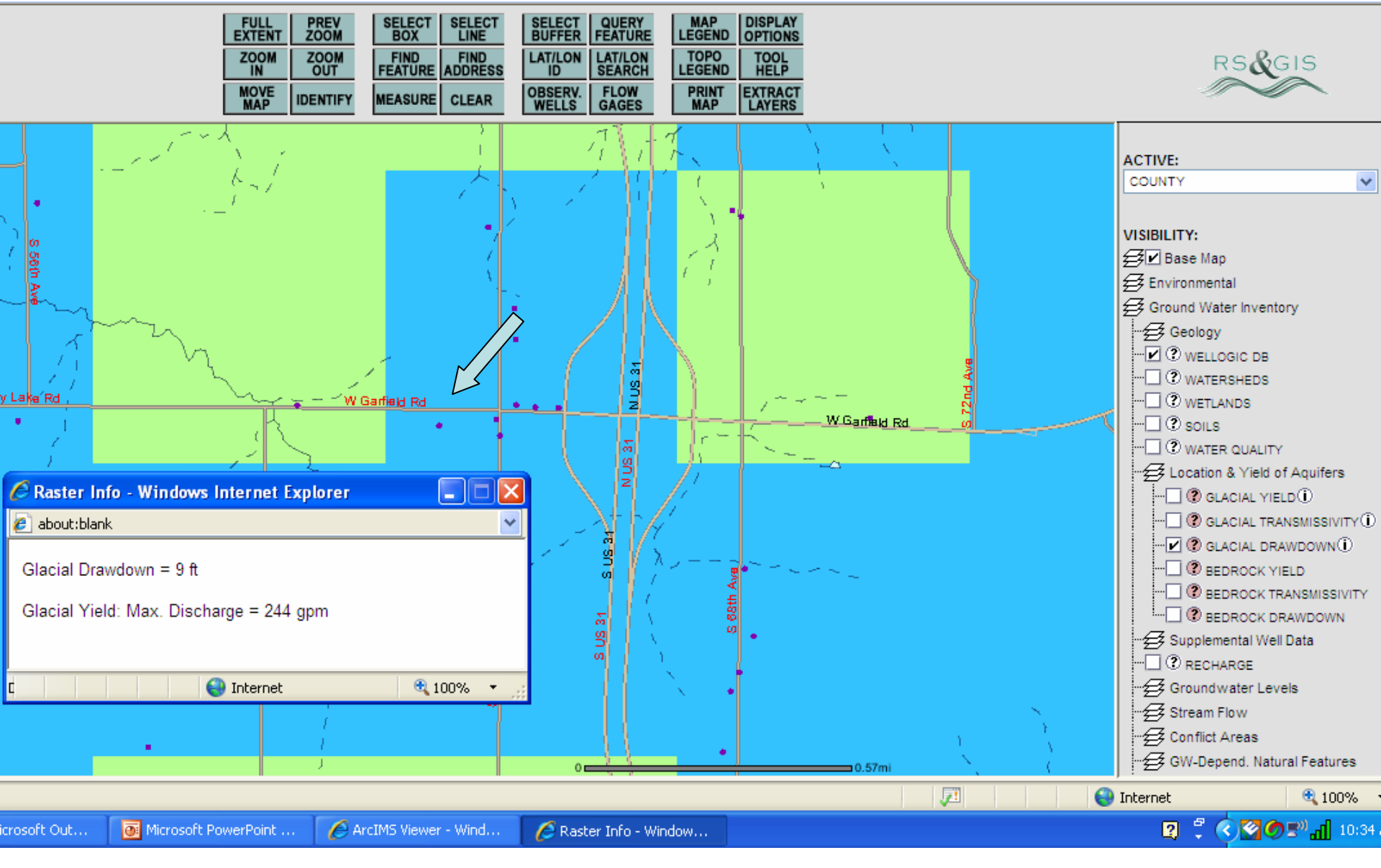
Environmental
Ground Water Inventory
Geology
WELLOGIC DB
WATERSHEDS
WETLANDS
SOILS
WATER QUALITY
Location & Yield of Aquifers
Supplemental Well Data
RECHARGE
Groundwater Levels
Stream Flow
Conflict Areas
GW-Depend. Natural Features
Non-Ag. Groundwater Use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Location & Yield of Aquifers
GLACIAL YIELD
GLACIAL TRANSMISSIVITY
GLACIAL DRAWDOWN
BEDROCK YIELD
BEDROCK TRANSMISSIVITY
BEDROCK DRAWDOWN
Supplemental Well Data
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Groundwater Levels
Stream Flow
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Glacial Yield: Max. Discharge = 244 gpm
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Raster Info - Window...
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2006 Water Use Laws

- PA 33 - Water Use Reporting
- PA 34 – Groundwater Conservation Advisory Council – develops an Assessment Tool
- SB 35 – Registration
- SB 36 – Water User Committees
- SB 37 - Adds requirements to the Safe Drinking Water Act

Large Quantity Withdrawal – Must Report

- Cumulative total over 100,000 gals/day
- Averaged over 30 days
- That supply a common distribution system
- From “waters of the State” including groundwater, lakes, streams …
- Permits for withdrawals over 2,000,000 gals/day –consistent with “Great Lakes – St Lawrence River Basin Water Resources Compact

Baseline Capacity – 2006 had been a one time opportunity

- “**Baseline Capacity”** - Rated capacity of the system as of February 28, 2006, reported as pump capacity in gal/min.

- Under SB 860, water withdrawal prior to February 2006 that are registered by February 2009 are granted a rebuttable presumption of no "adverse resource impact.”

Baseline Capacity

Increasing a water withdrawal by more than 70 gal./min. beyond the baseline, constitutes a new water withdrawal, loosing the rebuttable presumption of no "adverse resource impact”

If no “Baseline Capacity” volume are recorded your 2004-2005 records will be used to determine a baseline.

Most farmers rated pump capacity is far greater than their water use in 2004 or 2005.

New vs. Old Water Withdrawals

Old water withdrawal have a rebuttable presumption of no "adverse resource impact”

- withdrawal must be established prior to February 28th of 2006
- Properly registered have reported
- Not expanded by > 70 gpm

New water withdrawals must meet the no "adverse resource impact” standard

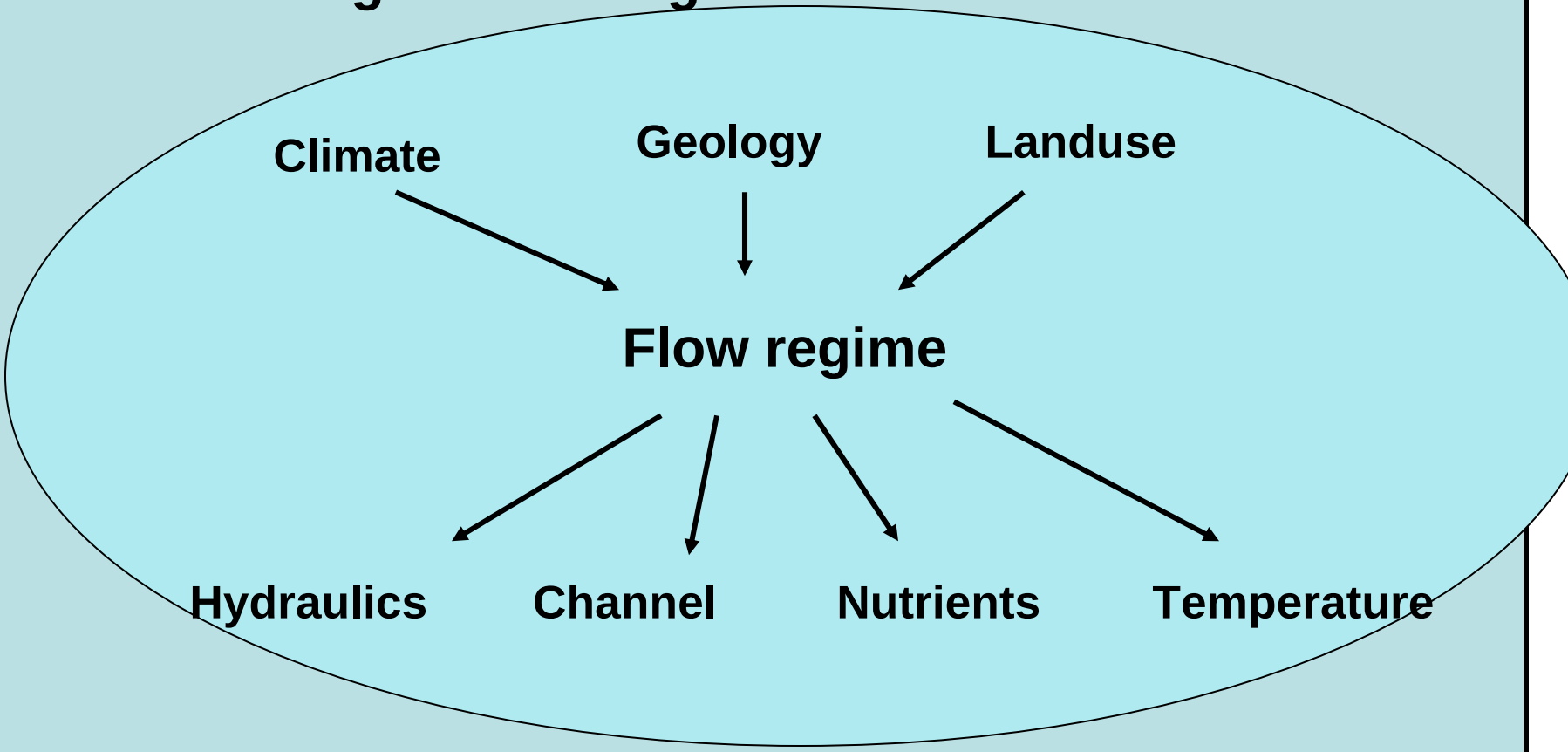
Major issues depends on legislative actions

"The Tool"
Philosophy behind the Approach

- Integrated, science-based approach
- Develop new thinking in integrating the pieces
- Use a National Scientific Peer Review Panel
- Base the approach on Michigan data and State modeled relationships
  - Science team: USGS, MDEQ, MDNR, UM, MSU
- An inclusive, seeking participation
  - Council & guests (across all sectors)
    - Technical and Legal and Mitigation Subcommittees
  - MDA, MDEQ & MDNR on Council

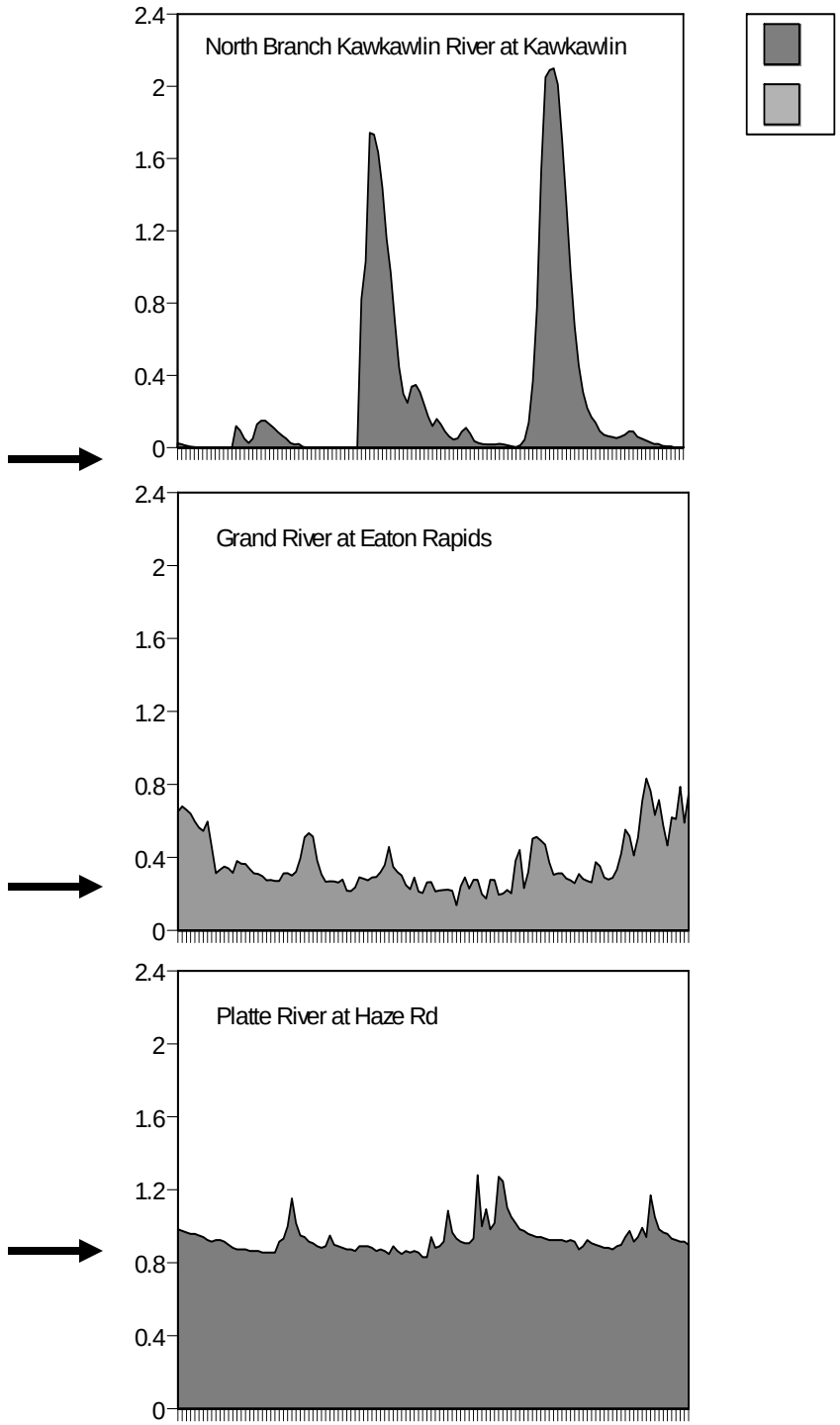
From Paul Seelbach, MDNR

The Flow Regime Paradigm



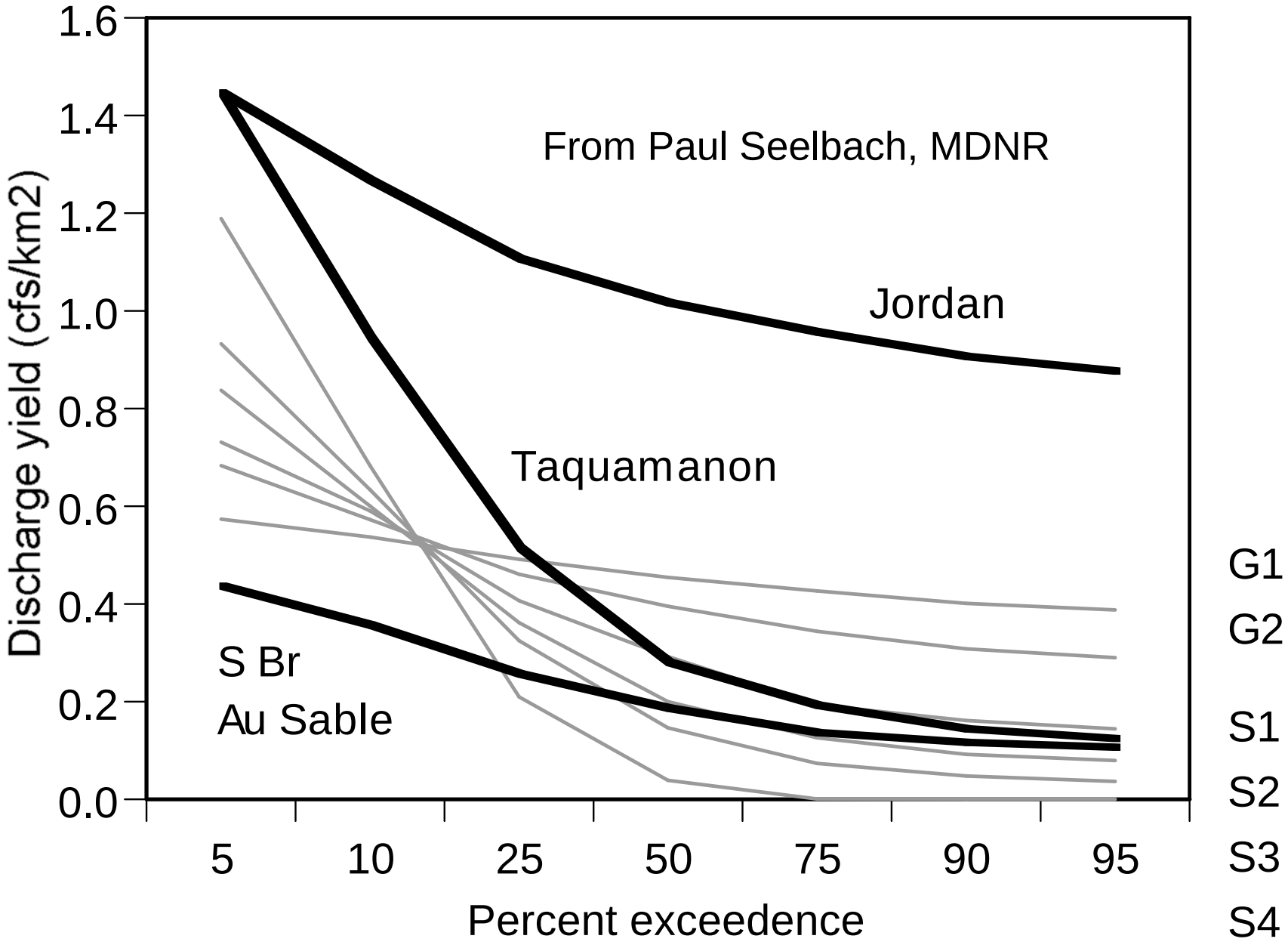
-- There is a geography of flow regimes

-- Fish species are adapted to habitats controlled by certain quantities of, and variability in, river flows

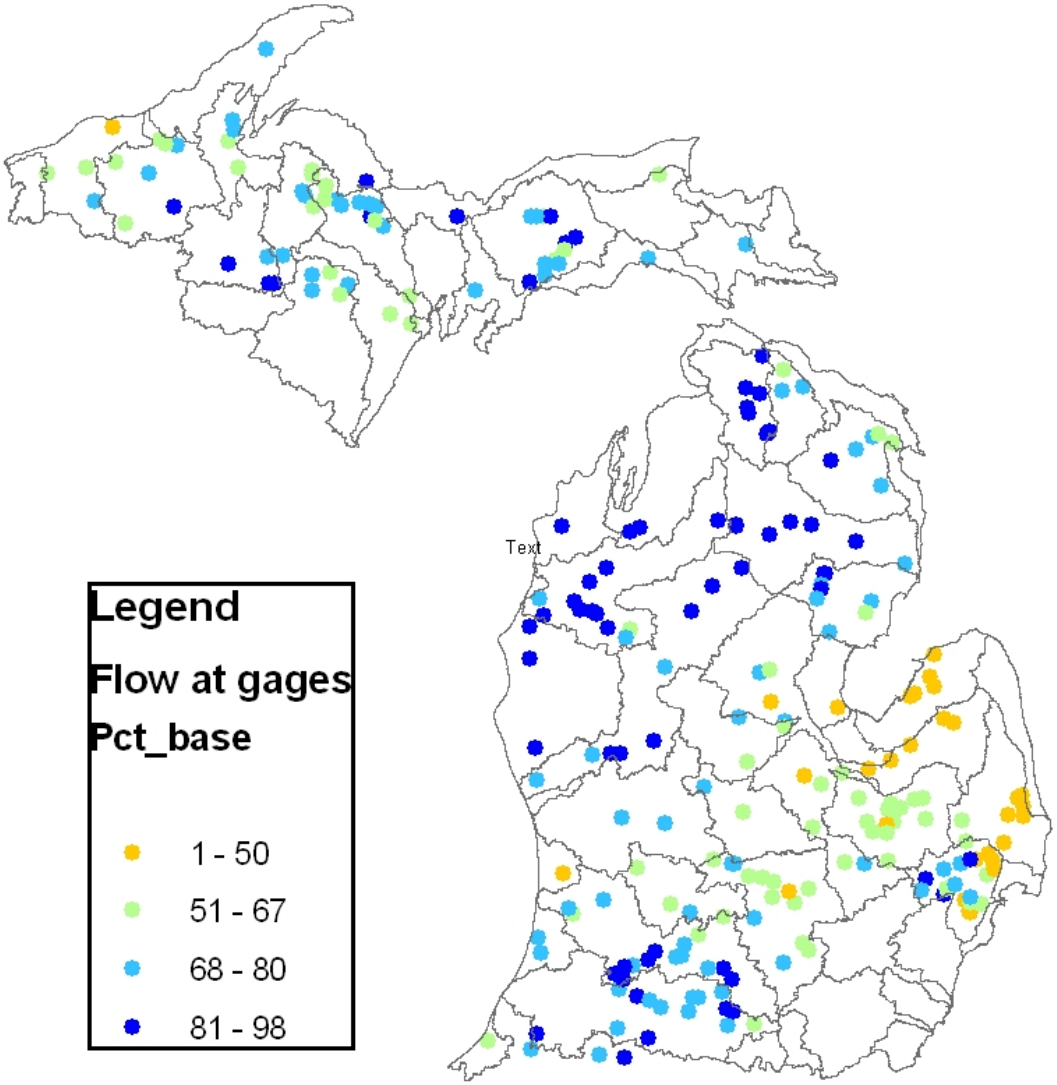


From Paul Seelbach, MDNR

Michigan rivers naturally have different flow regimes, and thus different habitat conditions, biological communities, sensitivity to disturbance, and potential for fishery management .


1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Discharge yield (cfs/km2)
From Paul Seelbach, MDNR
Jordan
Taquamanon
S Br
Au Sable
5
10
25
50
75
90
95
Percent exceedence
G1
G2
S1
S2
S3
S4

Streamflow at gages



Landscape-based modeling and applications for Michigan rivers

An introduction to rivers

Wiley and Seelbach
MDNR Fisheries Special Report 20

Rivers must be viewed and understood as systems

- landscape-scale
- hydrologic
- geomorphic
- biologic

ArcView GIS Version 3.1

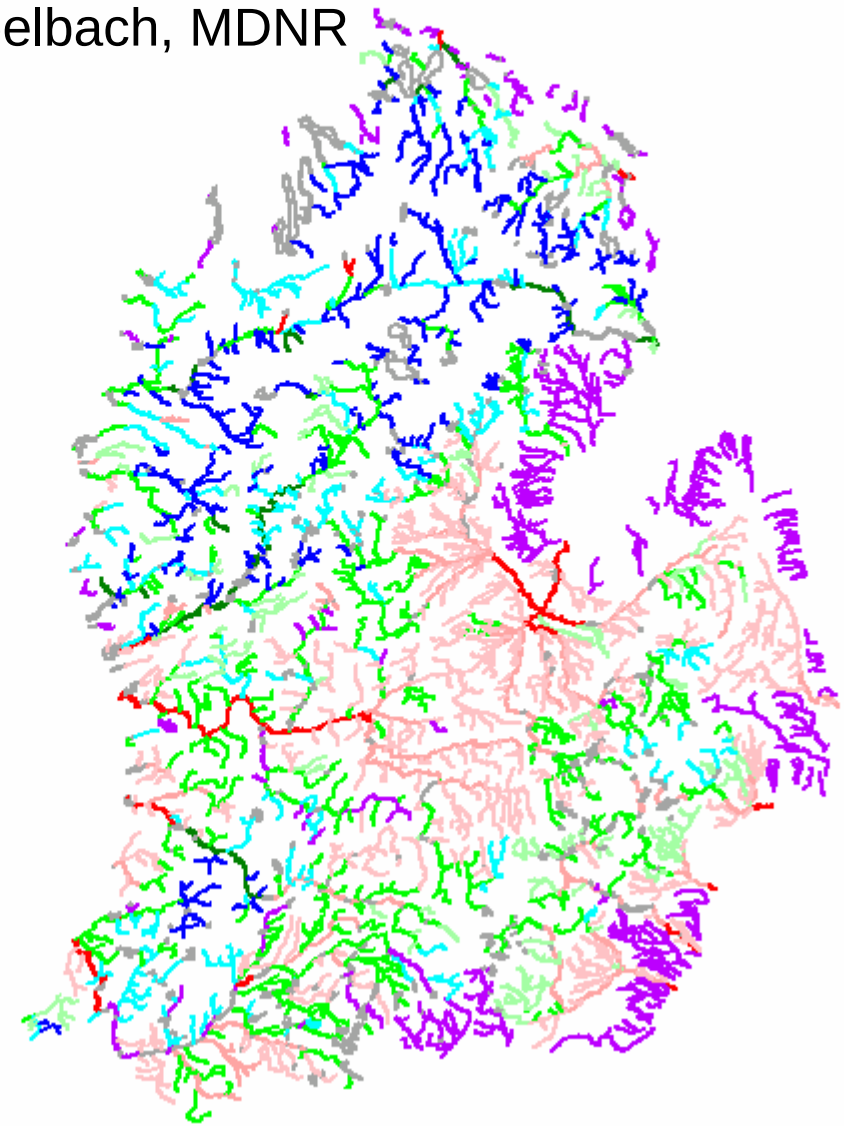
File Edit View Theme Graphics Window Help

Scale 1:

View1

- Lakeerie.shp
- Solakemichigan.shp
- Solakehuron.shp
- Nolakehuron.shp
- Nolakemichigan.shp
  - Cold mean, low variation
  - Cold mean, mod variation
  - Cool mean, low variation
  - Cool mean, mod variation
  - Cool mean, high variation
  - Warm mean, low variation
  - Warm mean, mod variatio
  - Warm mean, high variatio
  - Lakes, ponds, etc.
  - Missing data

From Paul Seelbach, MDNR



The Water Withdrawal Assessment Process

science

- Develop methods, criteria, and definitions for establishing 'adverse resource impacts' for streams and lakes.

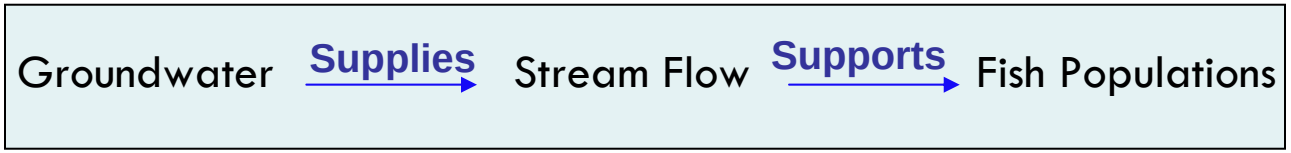
policy

- Make recommendations on the policy aspects of the model.

Groundwater → Stream Flow → Fish Populations

Adverse Resource Impact Means: Decreasing that part of the flow such that the streams ability to support *Characteristic Fish Populations* is *Functionally Impaired.*

The Water Withdrawal Assessment Process



- Three Models Interact within the impact assessment model

  Streamflow Model - How much water is flowing in the stream during summer low flow periods

  Groundwater Model - What impact will water withdrawn from the aquifer have on stream flow

  Fish Impact Model - What fish are in the stream and what is the likely effect of removing water on those groups of fish

The Streamflow Model

- Need to Know How Much Flow is in **any** Stream Segment
- "Index flow"; low flow period in the year
- Look at the segments where you know about flow (135 stream gauges in the State) and extrapolate these to the streams you do not have monitored or gauged – regression statistics

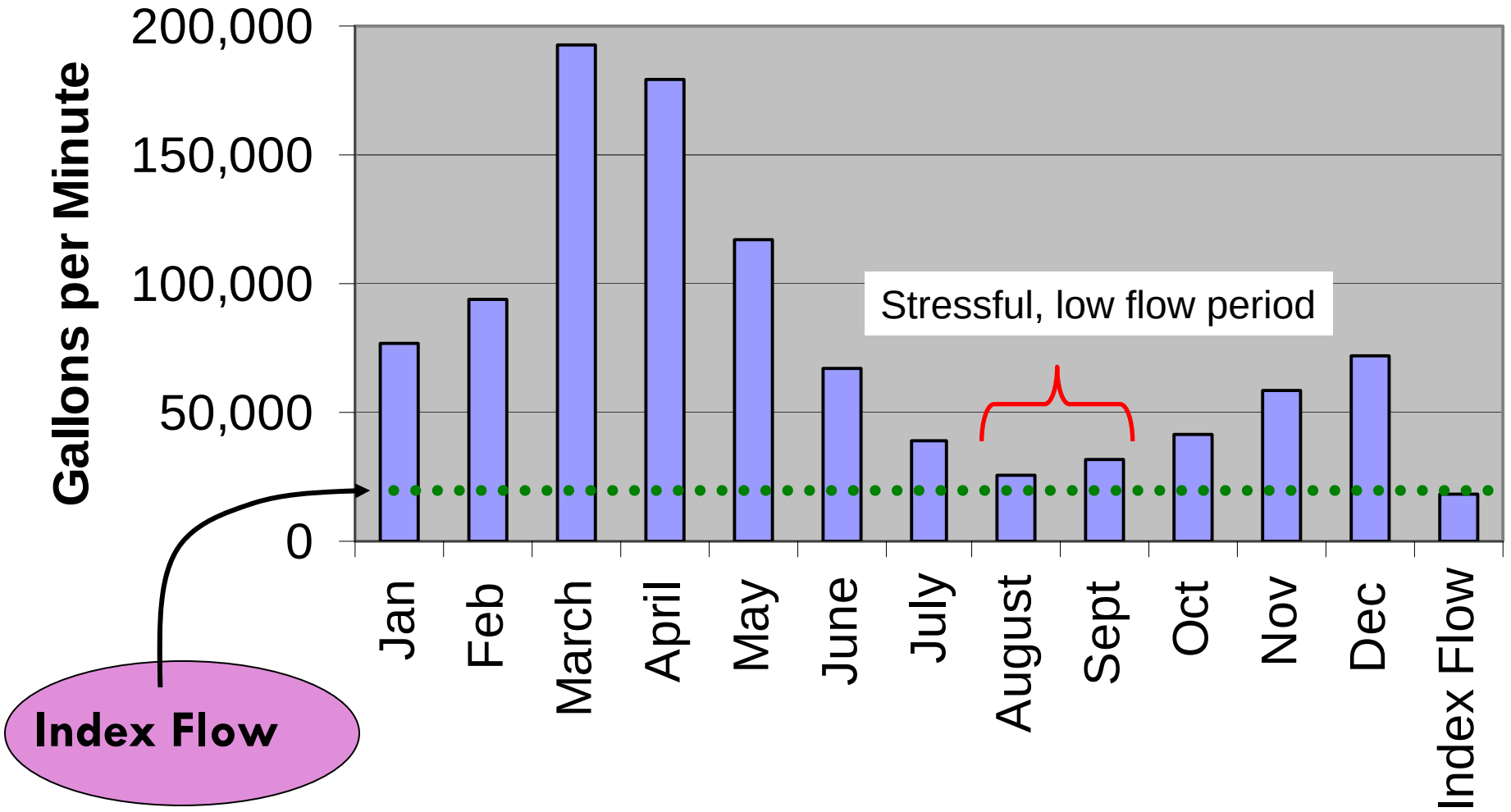
Major Factors Used

- Drainage Basin Size
- Forest Cover, Land Use
- Geology and Soils
- Region
- Uncertainty in statistics
  - Under or over estimate flow

PA 33 0f 2006 - Index Flow

- 50% excedance flow - Lowest month
- Extrapolated from stream gauges
- Large Quantity withdraw requirements and meeting Great Lakes Annex expectations

Looking Glass River near Eagle
Mean Monthly Flows



Characteristics of the Groundwaater Model

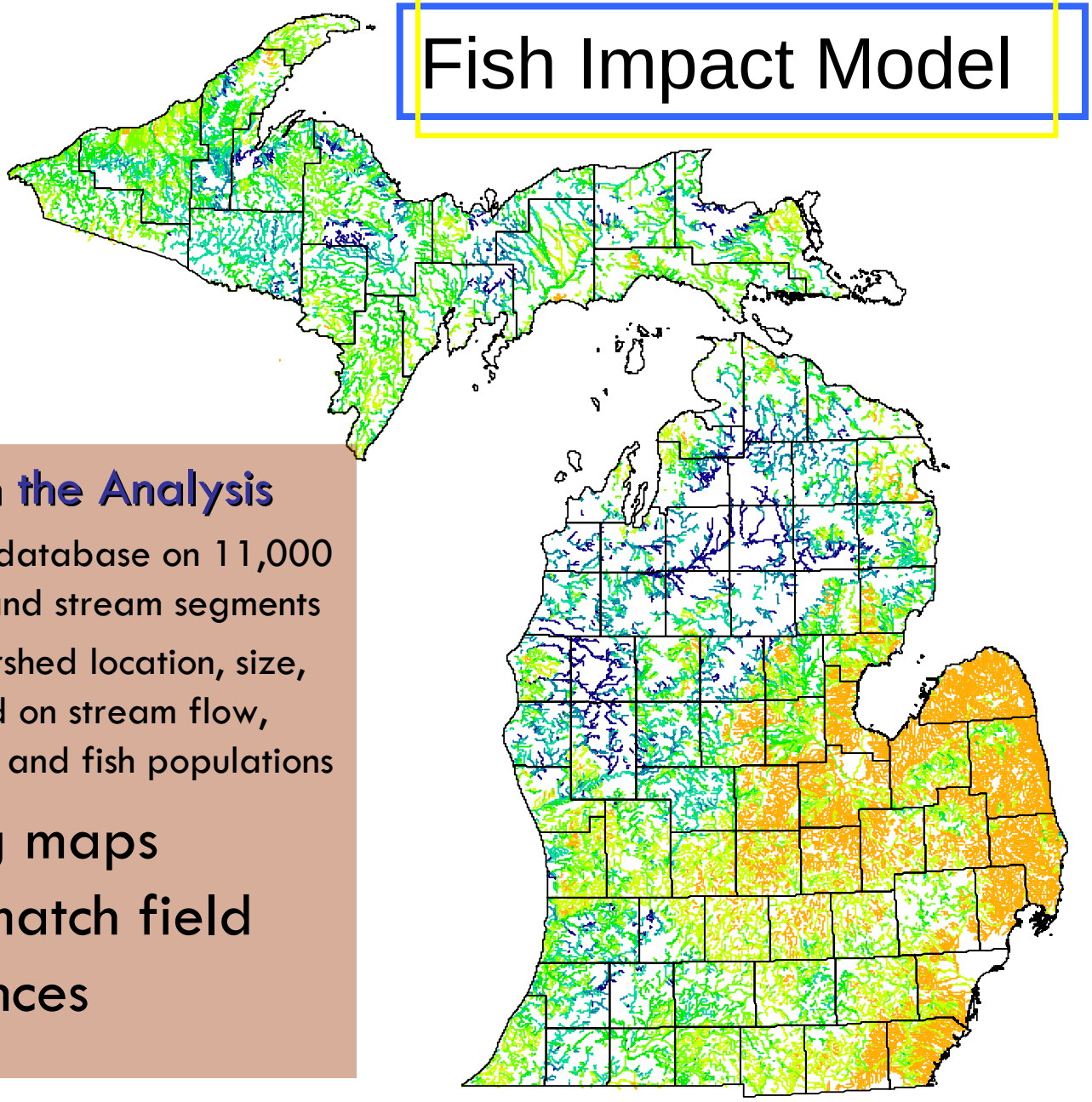
- Distance
  - A well adjacent to a river or stream get water either from water that would have gone to the river or directly from the river

  Depth

  - In Glacial Aquifers
  - In Bedrock

- Geology Matters
  - Clay - “tight” - water does not move easily
  - Sandy - “loose” - water flows quickly

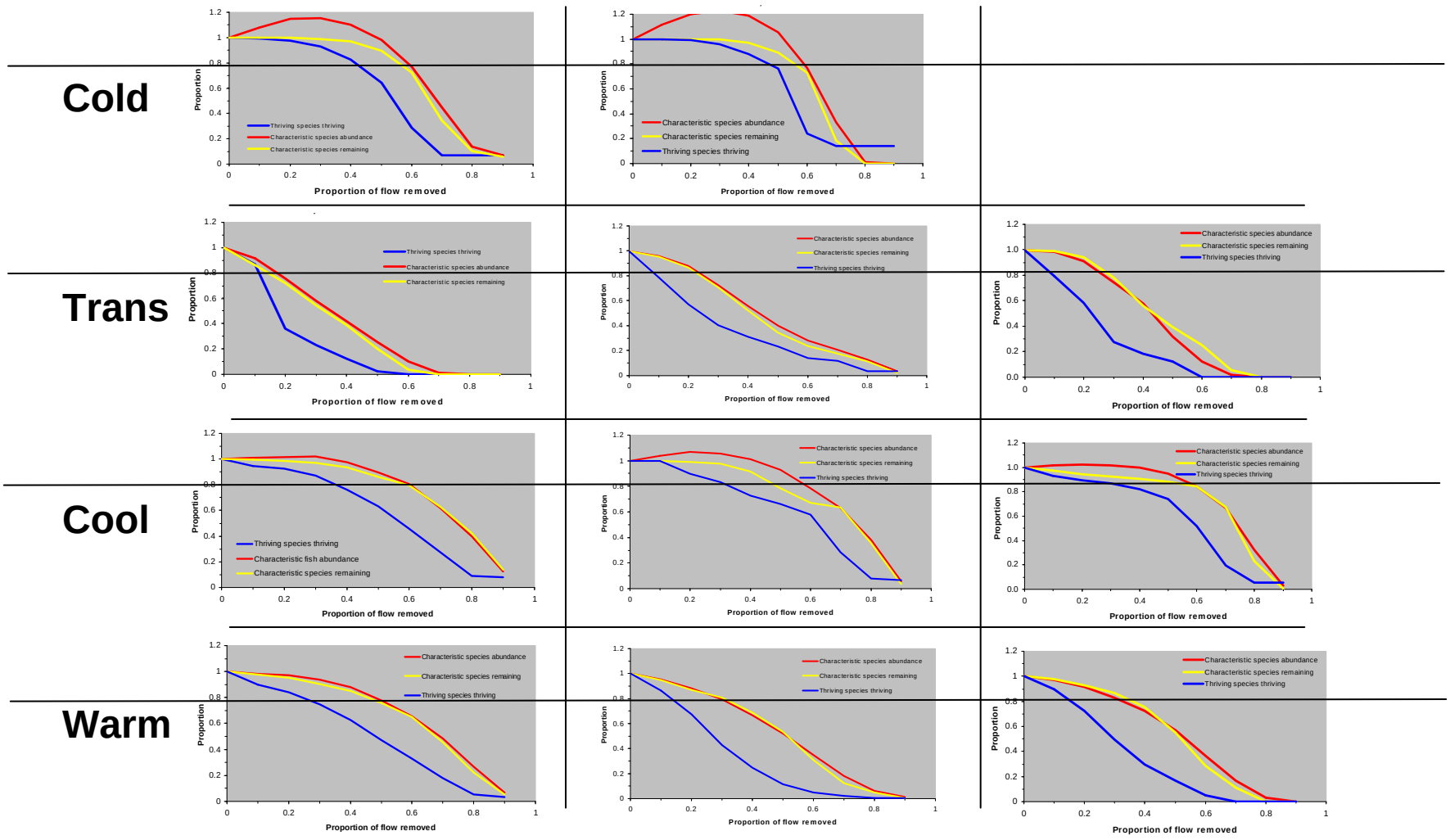
Fish Impact Model



Major Factors in the Analysis

- Geographic database on 11,000 watersheds and stream segments
- Info on watershed location, size, geology; and on stream flow, temperature, and fish populations
- Resulting maps closely match field experiences

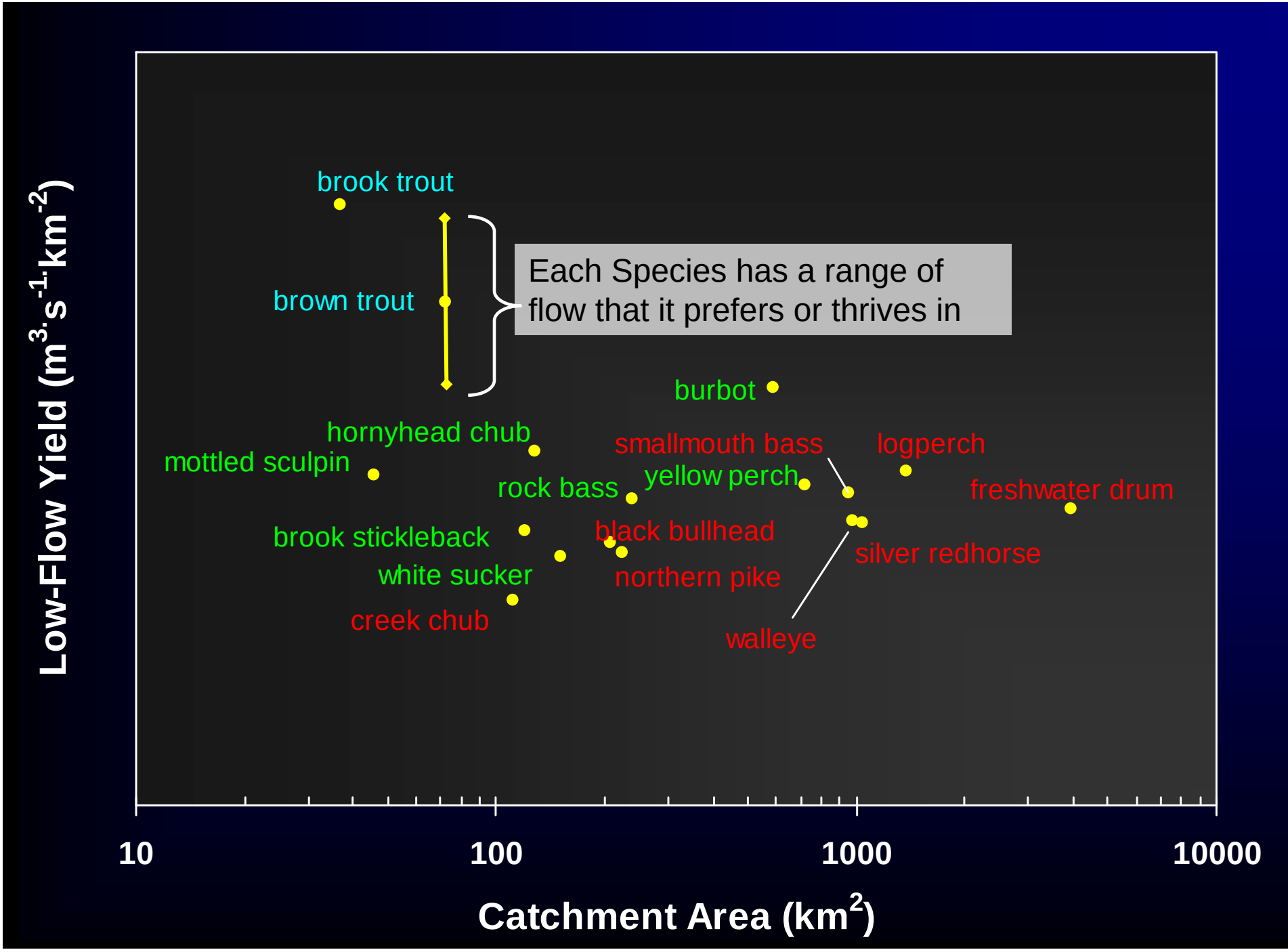
We grouped Michigan streams into types and developed response models using an average of ~ 20 specific segments per type



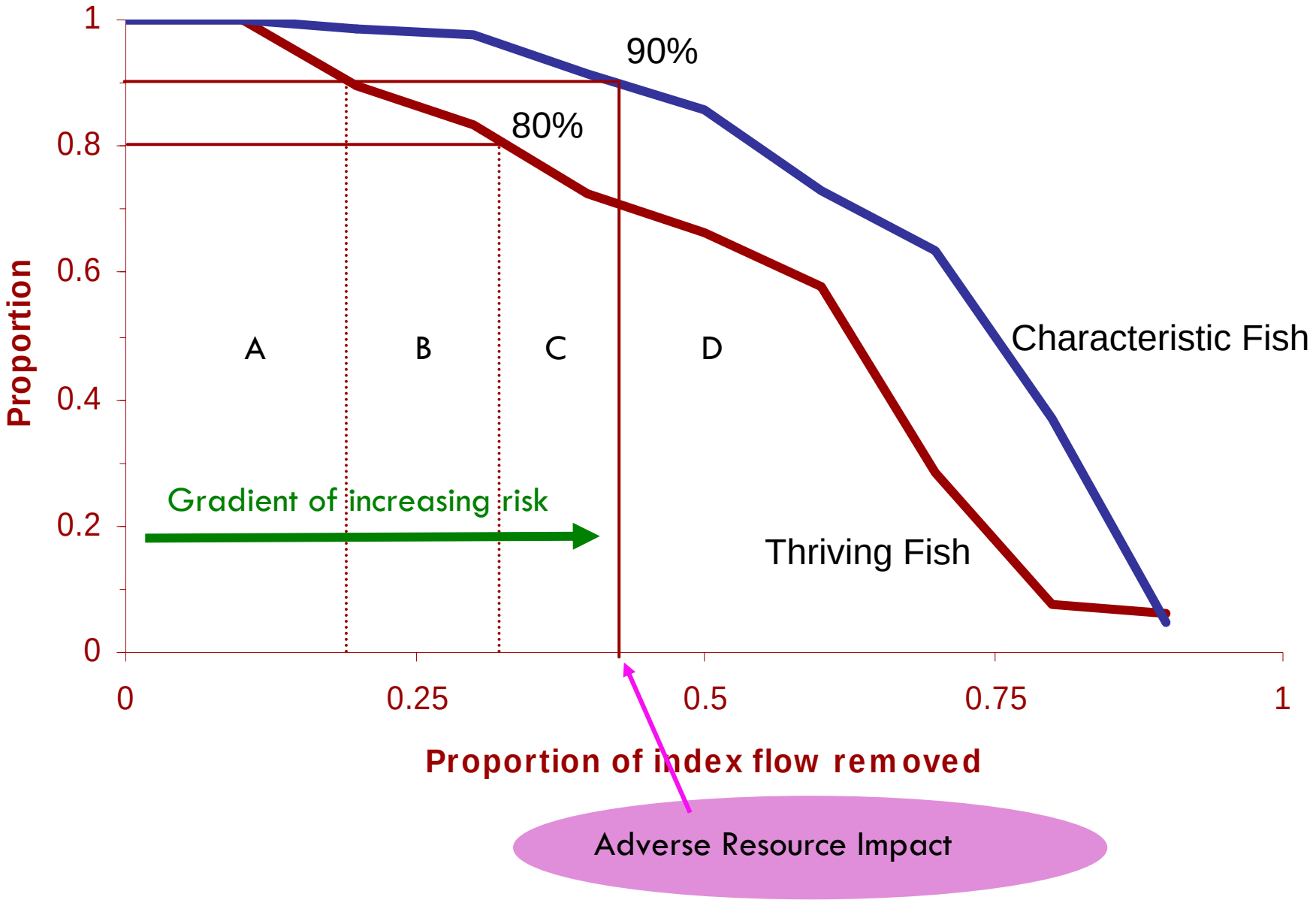
3. The Fish Response Model

- What fish populations live where in the streams and how do they respond to flow reductions in the summer (at low flow)
- Two Key Issues to Review
  - ✓ Define Stream Types and "Characteristic Fish Populations"
  - ✓ Define "Functional Impairment" to Characteristic Fish Populations due to water withdrawals
- Fish are representative of the stream ecosystem


brook trout
brown trout
Each Species has a range of flow that it prefers or thrives in
Low-Flow Yield ($m^3.s^{-1}.km^{-2}$)
10
100
1000
10000
Catchment Area (km^2)


brook trout
brown trout
Each Species has a range of flow that it prefers or thrives in
burbot
hornyhead chub
mottled sculpin
smallmouth bass
logperch
yellow perch
rock bass
freshwater drum
brook stickleback
black bullhead
silver redhorse
white sucker
northern pike
creek chub
walleye
Low-Flow Yield ($m^3.s^{-1}.km^{-2}$)
10
100
1000
10000
Catchment Area (km^2)

Interpreting the Fish Curves With an Eye to Policy



Michigan's Water Withdrawal Assessment Tool - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search

http://www.iwr.msu.edu/wwat/

Address http://35.9.116.207/wwat/address.asp Go Links

WATER WITHDRAWAL ASSESSMENT TOOL

Home | Quick Tour | Run WWAT

Related Articles

- New Regulations
- Advisory Council

Collaborators

Department of Environmental Quality

Department of Natural Resouces

United States Geologic Survey

Institute of Water Research

Finding the Location of Your Water Withdrawal

Please select one of the following options for locating the position of your water withdrawal.

Locate by Address

Enter the address and zipcode at or near the withdrawal location. Please spell street names correctly in order to ensure system accuracy.

Address:

Zip Code:

Find Address

Locate by Navigation

To select the county where the water withdrawal will occur, click the map or choose from the drop down menu.

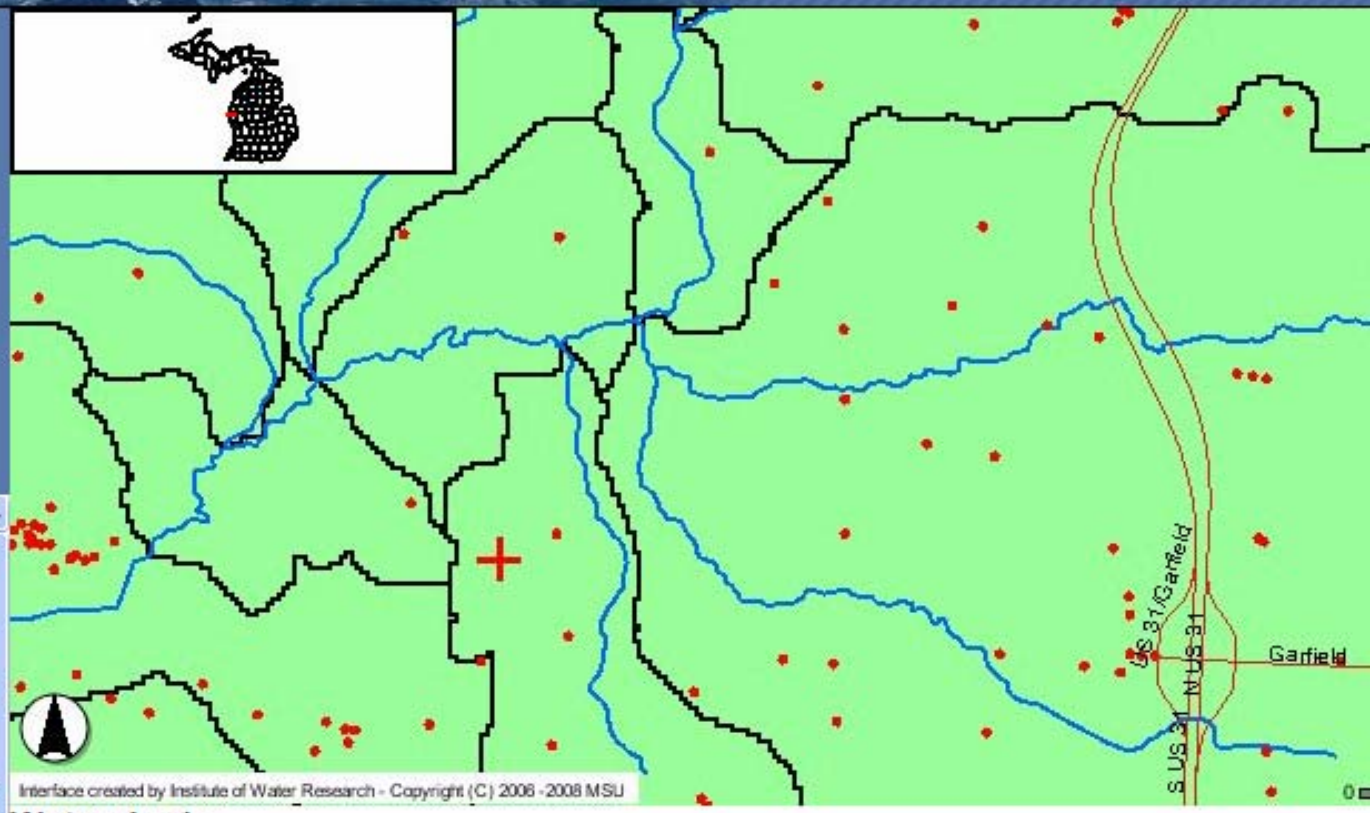
Alcona

Find County

http://35.9.116.206/wwat/

Internet

WATER WITHDRAWAL ASSESSMENT TOOL



GIS Tools

Zoom In	Zoom Out
Address	Move Map
Back	Erase
Identify	Toggle Legend
Measure	Set Scale
Overview Map	Print
New Withdrawal	

Data Layers

- All Layers
  - Roads
  - State Roads
  - Existing Wells
  - Streams
  - Lakes
  - Watersheds
  - Reach Watershed
  - County

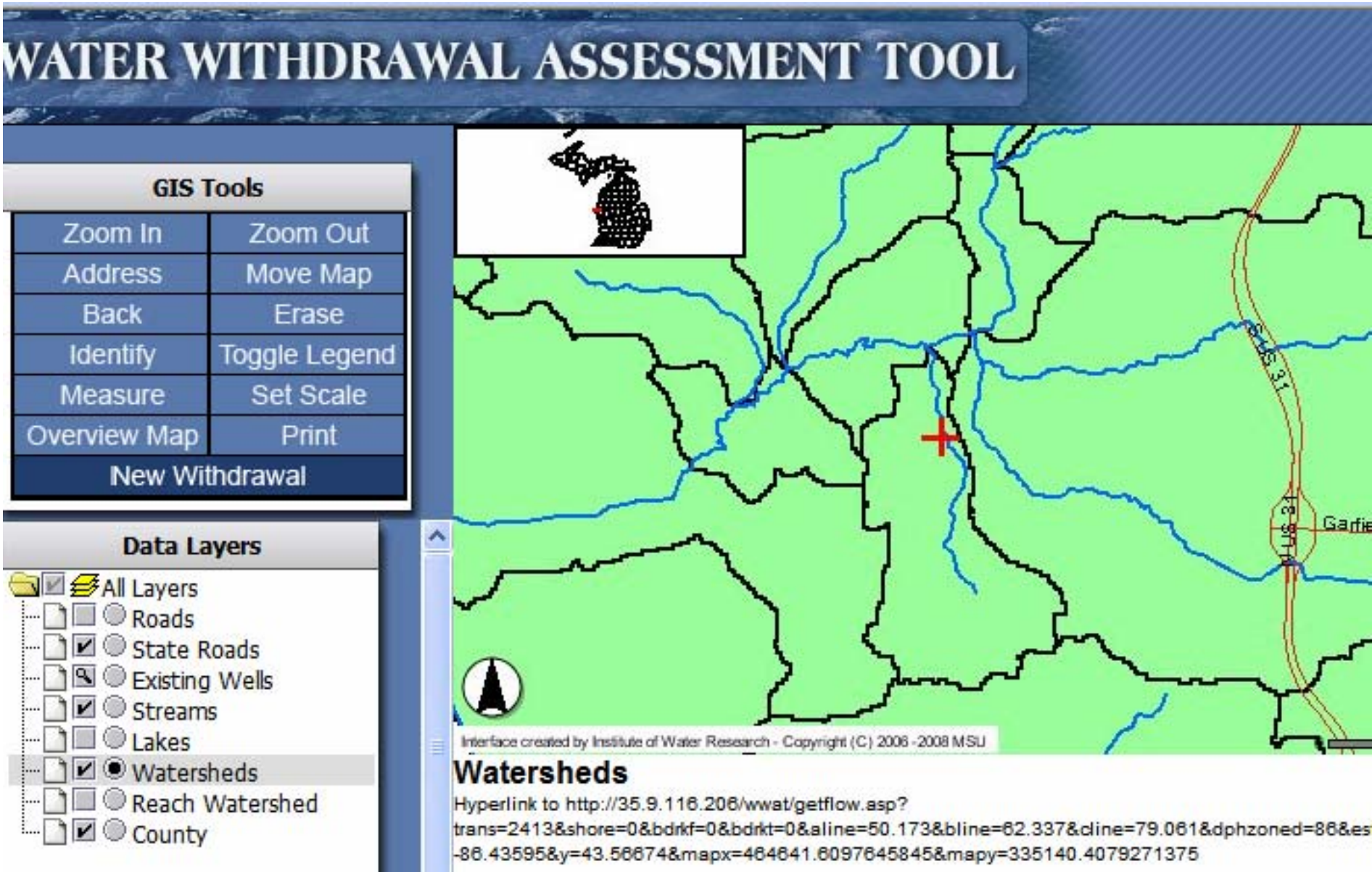
Refresh Map

Auto Refresh

Data Layer Help?

Watersheds

Hyperlink to http://35.9.116.206/wwat/getflow.asp?trans=2413&shore=0&bdrkf=0&bdrkt=0&aline=50.173&bline=62.337&cline=79.0
86.441917&y=43.663673&mapx=464157.96115975303&mapy=334802.1878387703


WATER WITHDRAWAL ASSESSMENT TOOL
GIS Tools
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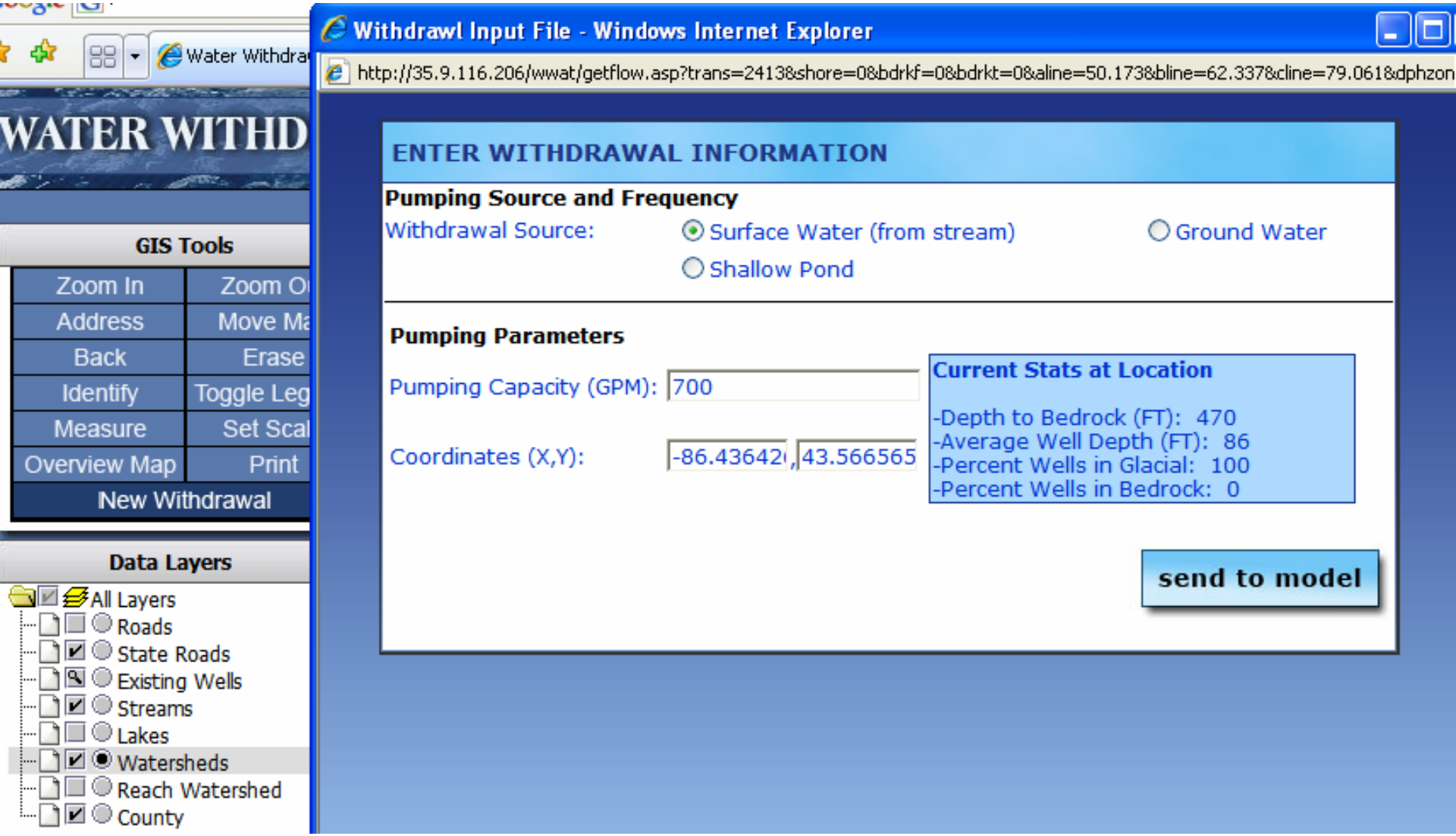
Data Layers
All Layers
Roads
State Roads
Existing Wells
Streams
Lakes
Watersheds
Reach Watershed
County
Interface created by Institute of Water Research - Copyright (C) 2006 -2008 MSU
Watersheds
Hyperlink to http://35.9.116.206/wwat/getflow.asp?
trans=2413&shore=0&bdrkf=0&bdrkt=0&aline=50.173&bline=62.337&cline=79.061&dphzoned=86&es
-86.43595&y=43.56674&mapx=464641.6097645845&mapy=335140.4079271375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State Roads
Existing Wells
Streams
Lakes
Watersheds
Reach Watershed
County
Withdrawl Input File - Windows Internet Explorer
http://35.9.116.206/wwat/getflow.asp?trans=2413&shore=0&bdrkf=0&bdrkt=0&aline=50.173&bline=62.337&cline=79.061&dphzon
ENTER WITHDRAWAL INFORMATION
Pumping Source and Frequency
Withdrawal Source:
Surface Water (from stream)
Ground Water
Shallow Pond
Pumping Parameters
Pumping Capacity (GPM): 700
Coordinates (X,Y): -86.43642 , 43.566565
Current Stats at Location
-Depth to Bedrock (FT): 470
-Average Well Depth (FT): 86
-Percent Wells in Glacial: 100
-Percent Wells in Bedrock: 0
send to model

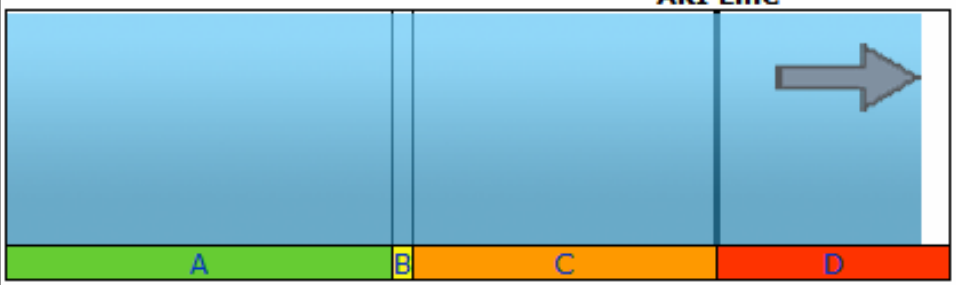
Screening Results - Windows Internet Explorer

http://35.9.116.206/wwat/response.asp?id=perem709&a=21.2857&b=21.3009&c=38.0101&welltype=Surface%20Water&rate=70

Water Withdrawal Screening Results

WARNING: For demonstration purpose only..

Adverse Resource Impact (ARI) Graph



The ARI graph above illustrates the estimated removal of water from a nearby stream and its potential for causing an adverse resource impact (ARI). Estimated 700 GPM

The proposed withdrawal has faild in Zone D, and is likely to have an adverse resource impact.

Screening Results - FAILED

Instructions:

The proposed withdrawal lies within 'Zone D' and is likely to cause an adverse resource impact. By reducing the flow taken from a nearby stream, you may be able to avoid these impacts and pass the screening process. Here are several examples of what you could do to help avoid adverse resource impacts:

- Increase Distance From Nearby Streams
- Increase Well Depth
- Reduce Pumping Rate

To modify withdrawal characteristics and rerun the screen press 'Rerun'.

Actions:

Help
Rerun
Register Now
Feedback
View Google Map
Print Report
Exit

WATER WITHD

GIS Tools

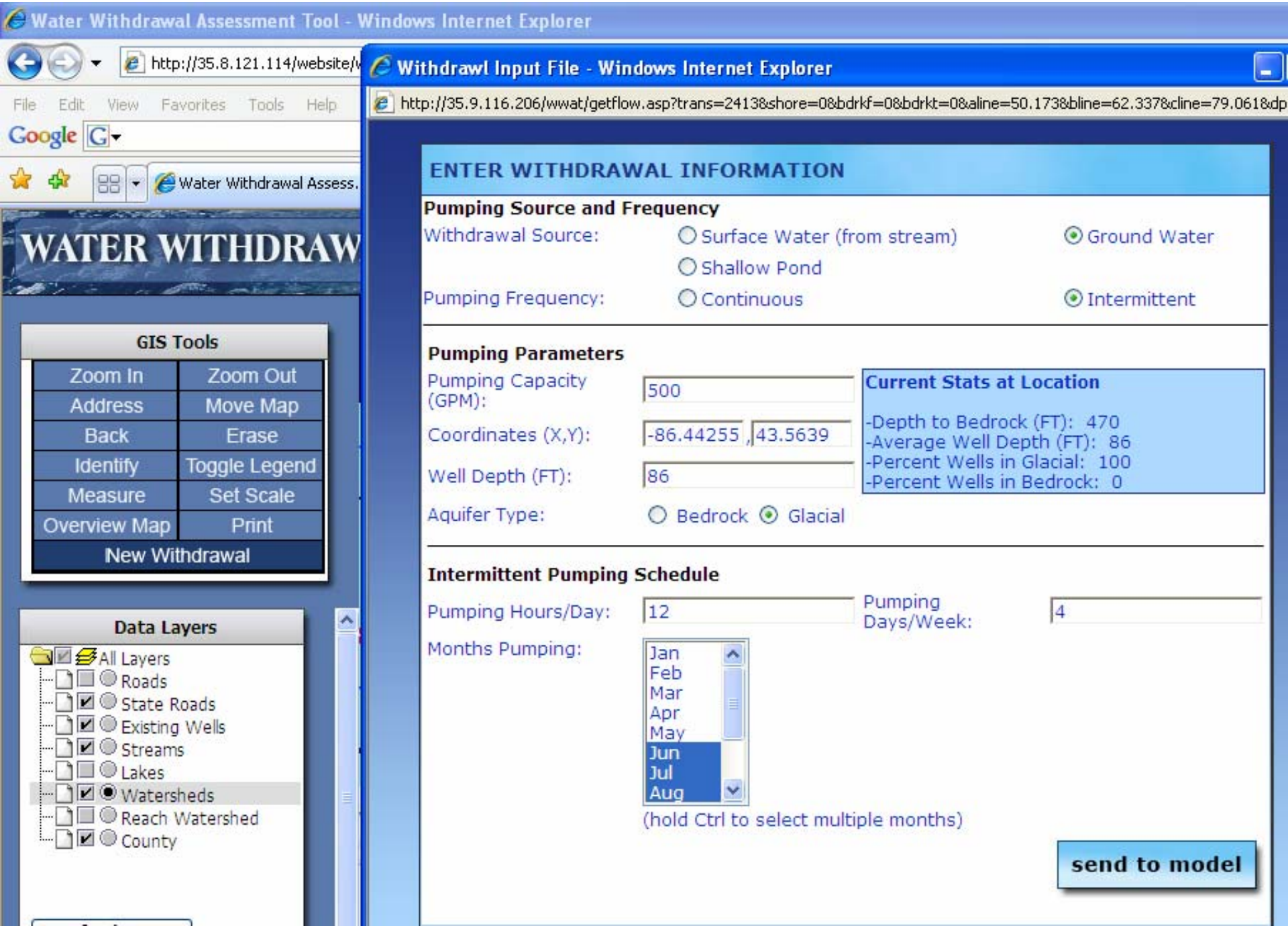
Zoom In	Zoom O
Address	Move Ma
Back	Erase
Identify	Toggle Leg
Measure	Set Scal
Overview Map	Print
New Withdrawal	

Data Layers

- All Layers
  - Roads
  - State Roads
  - Existing Wells
  - Streams
  - Lakes
  - Watersheds
  - Reach Watershed
  - County

Refresh Map

Auto Refresh


Water Withdrawal Assessment Tool - Windows Internet Explorer
http://35.8.121.114/website/
File Edit View Favorites Tools Help
Google
Water Withdrawal Assess.
WATER WITHDRAW
GIS Tools
Zoom In
Zoom Out
Address
Move Map
Back
Erase
Identify
Toggle Legend
Measure
Set Scale
Overview Map
Print
New Withdrawal
Data Layers
All Layers
Roads
State Roads
Existing Wells
Streams
Lakes
Watersheds
Reach Watershed
County
Withdrawl Input File - Windows Internet Explorer
http://35.9.116.206/wwat/getflow.asp?trans=2413&shore=0&bdrkf=0&bdrkt=0&aline=50.173&bline=62.337&cline=79.061&dp
ENTER WITHDRAWAL INFORMATION
Pumping Source and Frequency
Withdrawal Source:
Surface Water (from stream)
Ground Water
Shallow Pond
Pumping Frequency:
Continuous
Intermittent
Pumping Parameters
Pumping Capacity (GPM):
500
Coordinates (X,Y):
-86.44255
43.5639
Well Depth (FT):
86
Aquifer Type:
Bedrock
Glacial
Current Stats at Location
-Depth to Bedrock (FT): 470
-Average Well Depth (FT): 86
-Percent Wells in Glacial: 100
-Percent Wells in Bedrock: 0
Intermittent Pumping Schedule
Pumping Hours/Day:
12
Pumping Days/Week:
4
Months Pumping:
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
(hold Ctrl to select multiple months)
send to model

http://35.8.121.114/website/

File Edit View Favorites Tools Help

Google

Water Withdrawal Assess...

WATER WITHDRAW

GIS Tools

Zoom In	Zoom Out
Address	Move Map
Back	Erase
Identify	Toggle Legend
Measure	Set Scale
Overview Map	Print
New Withdrawal	

Data Layers

- All Layers
  - Roads
  - State Roads
  - Existing Wells
  - Streams
  - Lakes
  - Watersheds
  - Reach Watershed
  - County

Refresh Map

Auto Refresh

Data Layer Help?

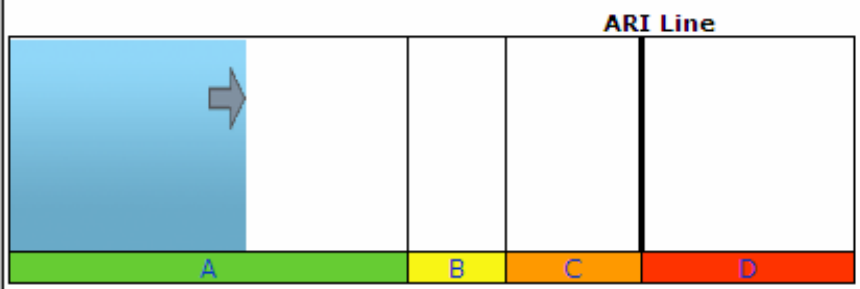
Screening Results - Windows Internet Explorer

http://35.9.116.206/wwat/response.asp?count=6&id=7522,7517,9761,10775,11483,14601&estrm=29.9848495646157,10.004034

Water Withdrawal Screening Results

WARNING: For demonstration purpose only..

Adverse Resource Impact (ARI) Graph



The ARI graph above illustrates the estimated removal of water from a nearby stream and its potential for causing an adverse resource impact (ARI). Estimated 30 GPM

The proposed withdrawal has passed in Zone A.

Screening Results - PASSED

Instructions:

The proposed withdrawal has passed the screening process.

This withdrawal lies within 'Zone A' and is unlikely to have an adverse resource impact. Water withdrawals with a capacity of over 70 gpm are required to register with the Michigan Department of Environmental Quality before beginning the withdrawal, and report the actual water use every year.

Actions:

- Help
- Rerun
- Register Now
- Feedback
- View Google Map
- Print Report
- Exit

DISCLAIMER:

Done Internet 100%

Go Back

Registration Form

Welcome to the water withdrawal registration form. By completing and submitting this form, you will register your withdrawal with the Department of Environmental Quality.

Contact Information

First Name: Last Name:

Address:

City: State:

Zip:

Phone:

e-mail:

Well Information

Watershed ID: 7522

Pumping Rate (GPM): 500

Well Depth (FT): 86

Latitude: 43.5639

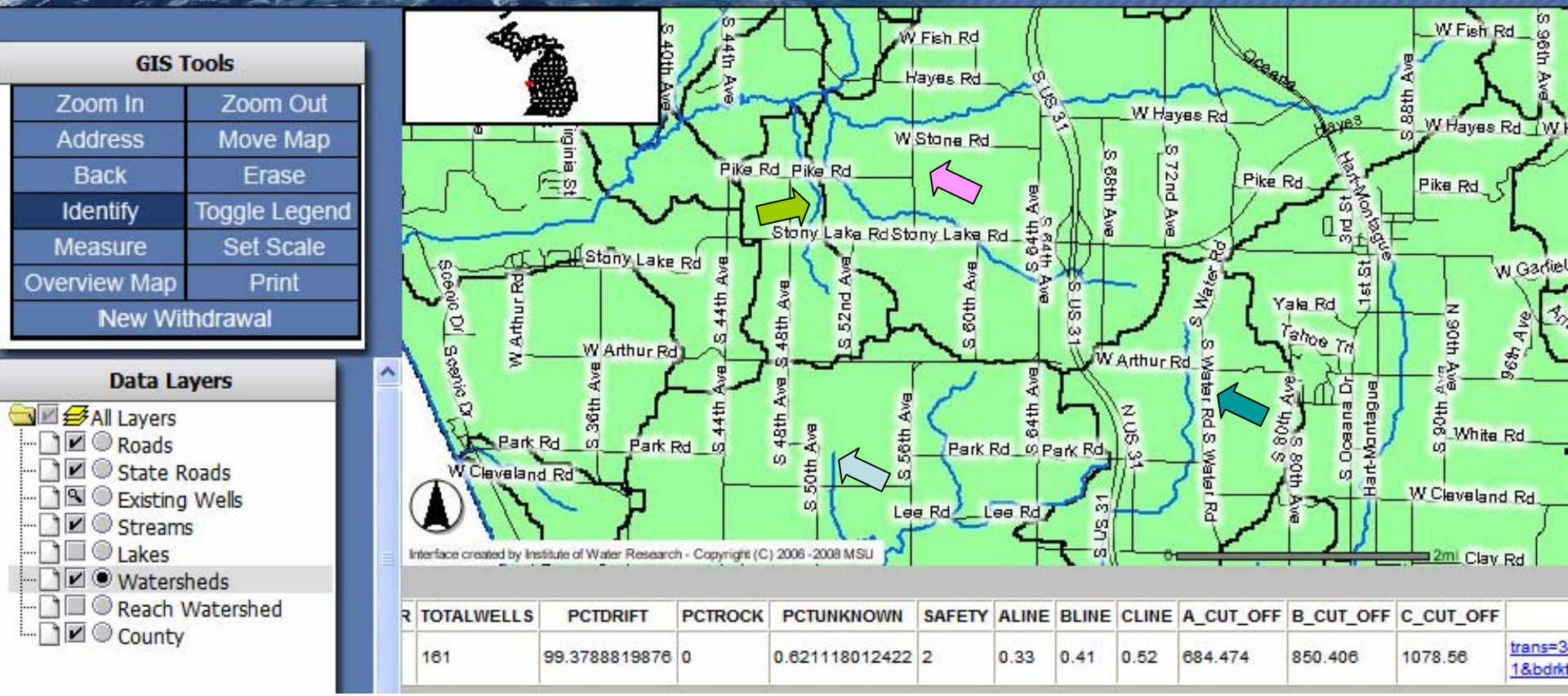
Longitude: -86.442551

Water Removal From Nearby Streams

Watershed	Removal (GPM)
7522	29
7517	10
9761	14
10775	16
11483	5
14601	20

Register Withdrawal

WATER WITHDRAWAL ASSESSMENT TOOL



R	TOTALWELLS	PCTDRIFT	PCTROCK	PCTUNKNOWN	SAFETY	ALINE	BLINE	CLINE	A_CUT_OFF	B_CUT_OFF	C_CUT_OFF	
	161	99.3788819876	0	0.621118012422	2	0.33	0.41	0.52	684.474	850.406	1078.56	trans=3 1&bdrkf

The tool can supply an estimate of the amount of water needs to remain in the stream to prevent causing a resource impact.

- C cut off - in gallon per minute:

1902 gpm ← 1078 gpm ←

109 gpm ← 79 gpm ←

Water Withdrawal Legislation Updates
Senate Bill No. 212

- The water resources conservation advisory council

- The person making the appointment shall give consideration and deference to individuals who served on the former ground water conservation advisory council.

Water Withdrawal Legislation Updates
Senate Bill No. 212

- The council shall appoint a technical advisory committee of individuals with specific technical and legal expertise relevant to the council's responsibilities.

- The council shall do all of the following:
  a) Study the sustainability of the state's water use
  b) Develop criteria and indicators to evaluate the sustainability of the state's water use
  c) Make recommendations regarding the implementation and effectiveness of the water withdrawal assessment tool as provided for in part 327

Water Withdrawal Legislation Policy Issues

Major Issue Areas to Solve

- Presumptions Afforded by the Use of the Tool
- What happens in Zones B, C and D
- Mitigation – where and when – limited by what?
- Permitting Applicability
- Water User Responsibilities
- The Role of Water Users Committees at the Local Level

Water Withdrawal Legislation Policy Issues – Cont.

- Capacity versus Withdrawal
- Return Flow – Included, how and when
- New Interim Lake Standard and Future Process
- Other Sensitive Areas (e.g. Fens, Bogs, etc)
- Updates to the model
- **Other Issues from the House Democratic Package**
  - HB 5065-5073
  - The Role of Citizen Participation
  - Bottled Water

Latest substitute for SB 860

- The assessment tool is not required to go online until December 31, 2008, giving time for continued improvements including collection and analysis of data
- Small watersheds are being integrated into larger watersheds
- A methodology and protocol to collect and use actual stream flow measurements will lead to greater reliability and robustness of the assessment tool
- Groundwater withdrawal can now replace or substitute for a surface water withdrawal while maintaining the stream’s baseline capacity

Large Scale Water Use Assessment Tool

- Existing water withdrawals are reflected in the data only to the degree that they affect the flow of the 135 USGS gauged streams
- There are impacts of human actions on stream flow and characteristic fish populations - Some watercourses used for drainage have become ephemeral, intermittent or seasonal with changing fish population expectations

Enviro-weather: Weather for IPM decisions in Michigan - Windows Internet Explorer

http://www.enviroweather.msu.edu/home_map.asp

File Edit View Favorites Tools Help

Enviro-weather: Weather for IPM decisions in Michigan

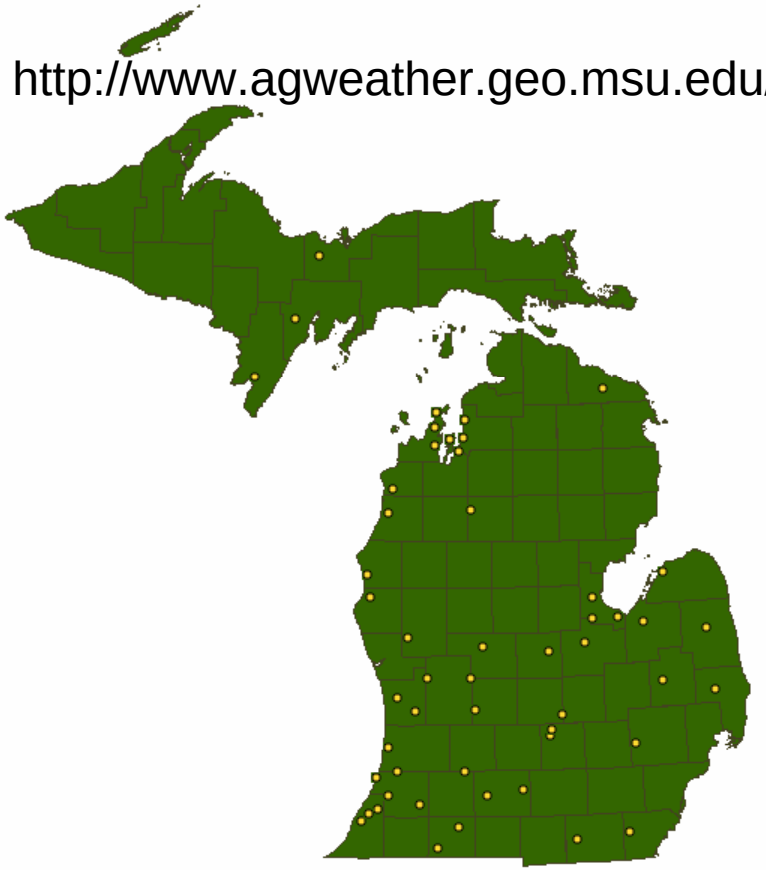
Back to home

Enviro-weather

Weather-based pest, natural resource, and production management tools

MICHIGAN STATE UNIVERSITY

http://www.agweather.geo.msu.edu/



- News and updates
- Getting started with Enviro-weather (Requires Adobe Flash Player)

Select a weather station location from the map to view weather data, integrated pest management models, natural resource and production models, forecasts and related links for specific commodities. (View alphabetical list of stations.)

The products in this web site are designed to aid agriculture and the green industry in making management decisions. The Michigan Automated Weather Network (MAWN) based at Michigan State University generates the data from the weather stations. MSU scientists have created or adapted the decision-making models for Michigan conditions.

Funding: We thank the following for major financial support of this web site: Project GREEEN, the Michigan Agricultural Experiment Station, MSU Extension, and private donors.

Enviro-weather is a collaborative project between the Michigan Climatological Resources Program and the MSU Integrated Pest Management Program as supported by Project GREEEN, the Michigan Agricultural Experiment Station, MSU Extension, private

Questions?

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