

# Environmental Rules to Classify Basins for Sensitivity to Future Energy Development

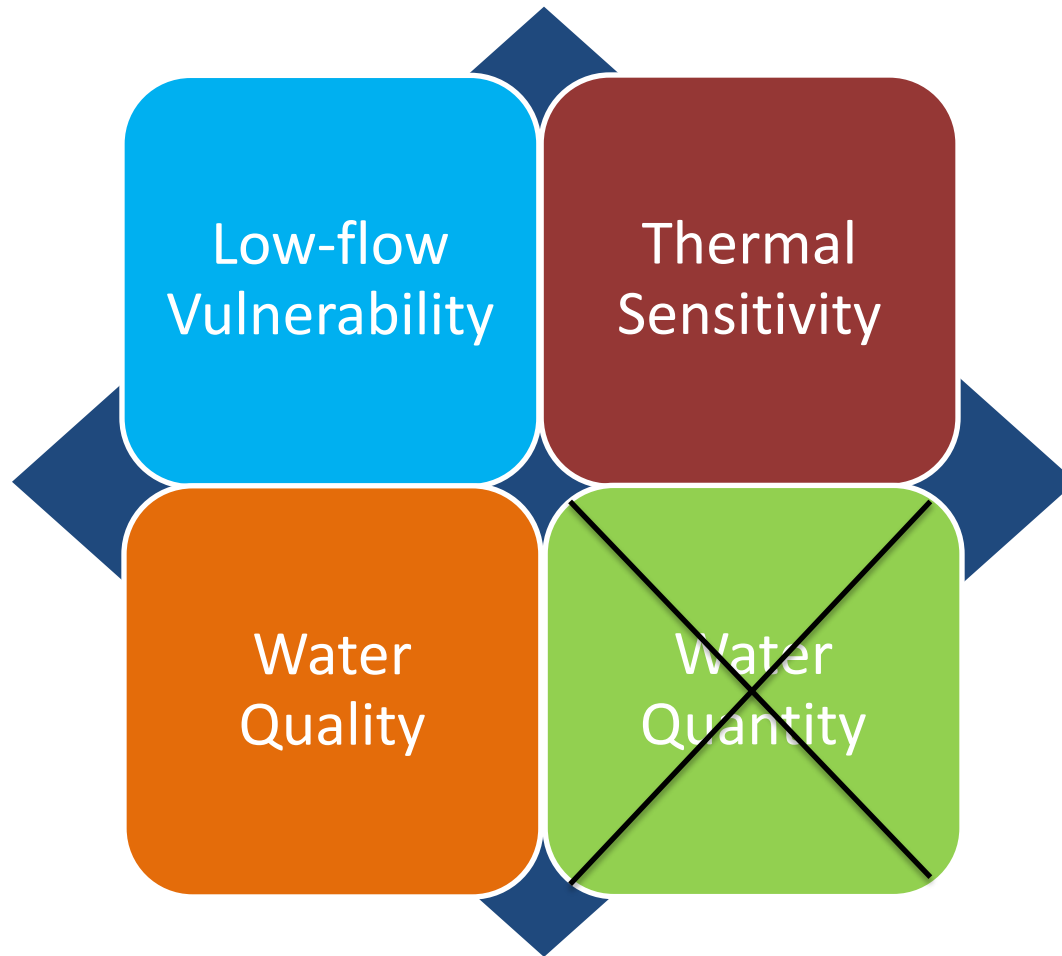
Development of Aquatic Resource Impact  
Metrics for GLEW Phase I

Mark Bain  
Cassie Bradley  
Sept 7-8, 2011

# Environmental Sensitivity Metrics

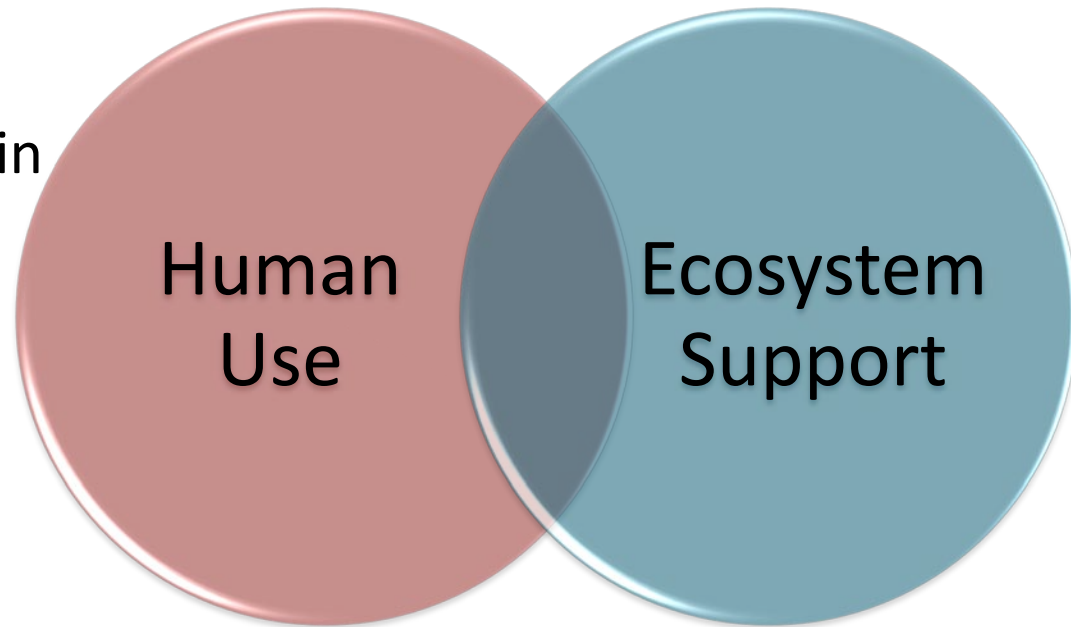
- General indicators of sensitivity to further energy production development
- Compatible with Sandia Model, where results were integrated with other information
- Basin scale: 8-digit HUCs
- Included four factors/metrics related to water use and thermal outputs

# Metrics



# Metric 1: Low-flow Vulnerability

- When water in short supply:
  - Is use of water in the basin near a level where ecosystem support is jeopardized?
  - How much more use of water is okay?



# Metric 1: Low-flow Vulnerability

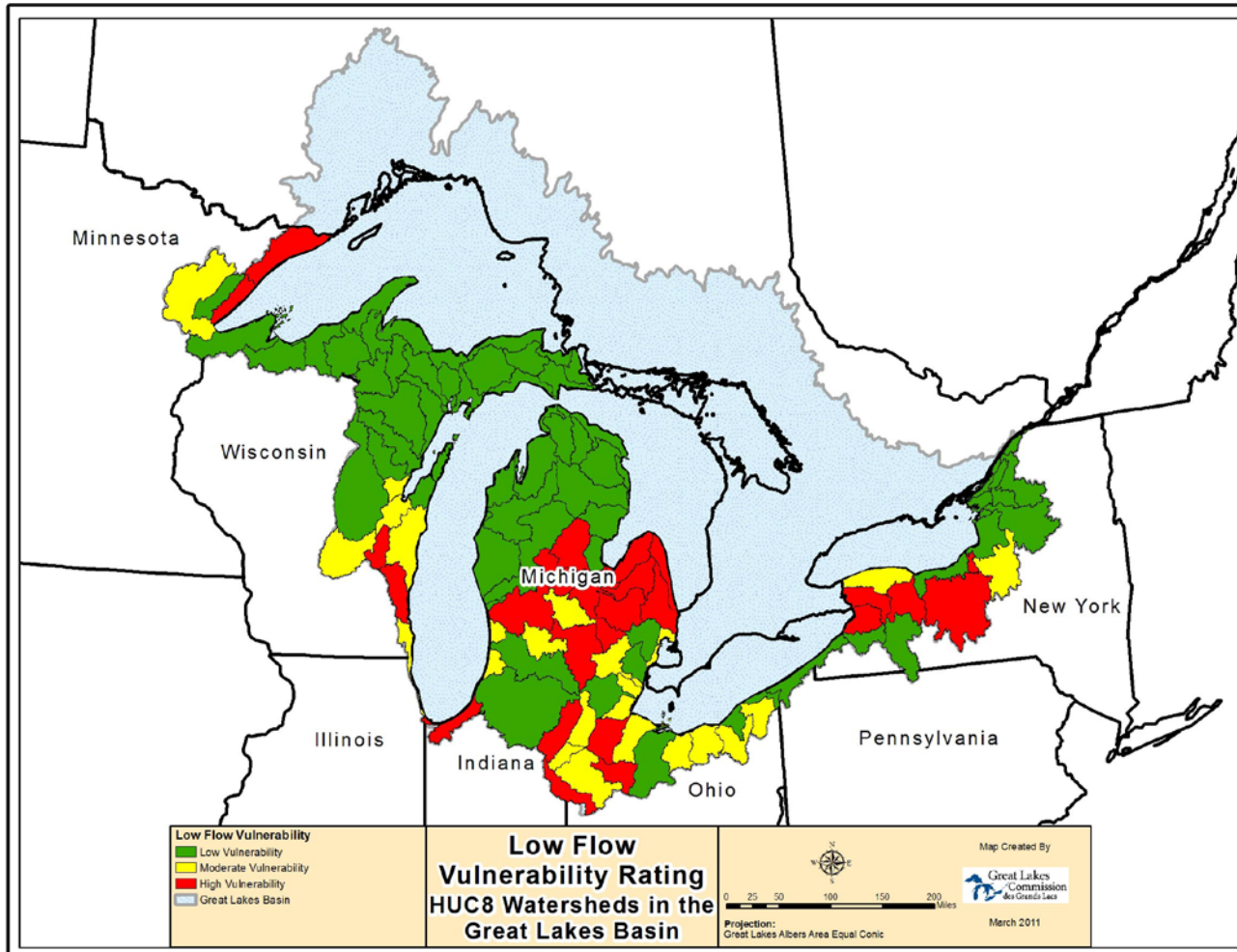
- Reviewed low-flow standards like Michigan's and synthesized this work with emphasis on Michigan standards

$$X (\%) = \frac{\text{Mean basin August streamflow (MGD)}}{((\text{Mean basin August streamflow, MGD}) + (\text{sum of water uses, MGD}))}$$



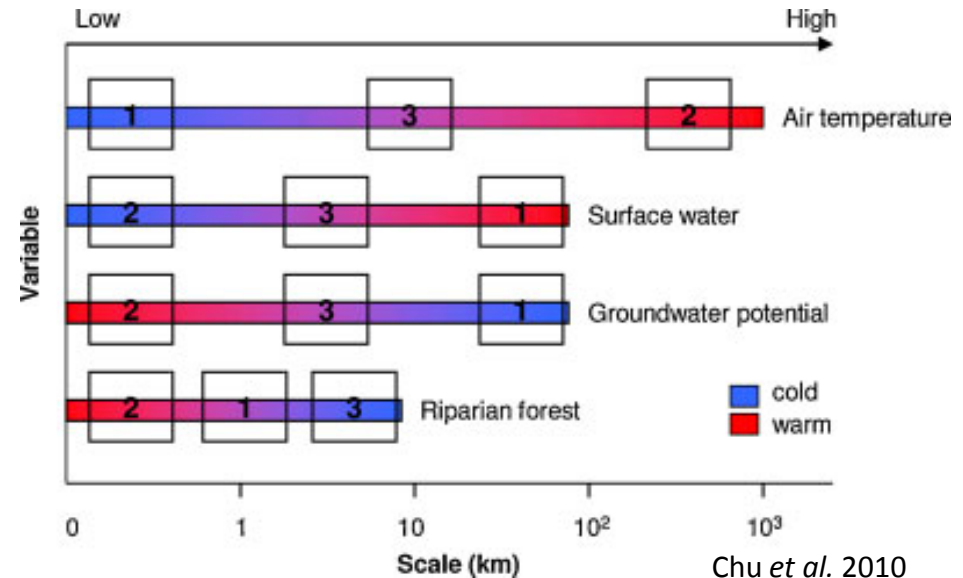
# Metric 1: Low-flow Vulnerability

- Scale: 0 (**high** vulnerability) → 1 (**low** vulnerability)



# Metric 2: Thermal Vulnerability

- How much coldwater resource threatened by change?
  - Warming potential
  - Amount of coldwater resources

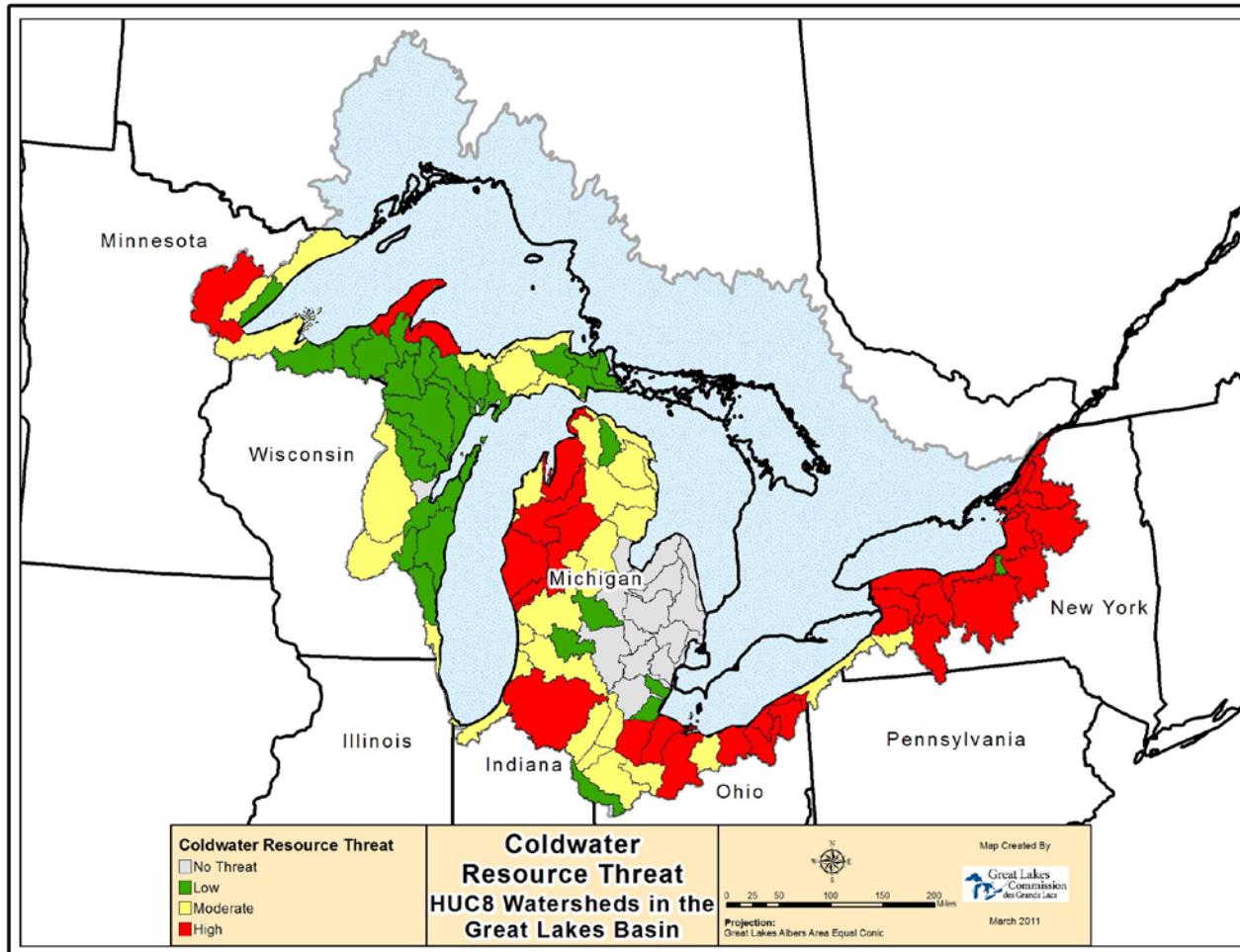


$$\text{Warming Potential} = (52 \text{ (mean annual air temp. rank)} + 22 \text{ (percent surface water rank)} + 18 \text{ (percent non-forest cover rank)} + 8 \text{ (inverse of groundwater potential rank)}) / 100$$

$$\text{Coldwater Resource Threat} = (\text{Warming potential}) * (\text{Miles of coldwater resource})$$

# Metric 2: Thermal Vulnerability

- Scale: 0 (**high** vulnerability) → 1 (**low** vulnerability)





# Metric 3: Water Quality Impairment

- Based on EPA data: extent (%) of impaired waters within a given watershed
- Rate vulnerability to further stresses

Table 5: Water Quality Sensitivity			
Numerical Measure	Percent Impaired Waters	Threat /Vulnerability Ranking	No. of HUC 8 Basins
0.00	>25	<b>Very High</b>	18
0.25	10-25	<b>Moderately High</b>	19
0.50	5-10	<b>Moderate</b>	19
0.75	<5	<b>Low</b>	43
1.0	0	<b>None</b>	3

# Metric 3: Water Quality Impairment

- Scale: 0 (**high** vulnerability) → 1 (**low** vulnerability)

