Catchment-scale accounting of large-quantity withdrawals in the Water Withdrawal Assessment Process: status and next steps

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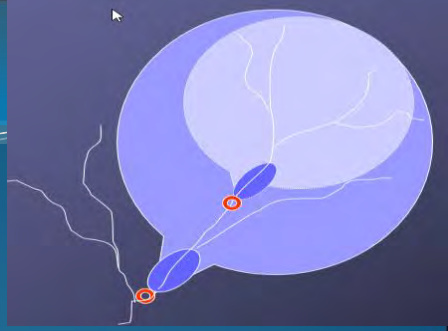
Background

- WWAP purpose: regulate new or increased LQWs while keeping index flows above ARI levels; protect stream ecosystems and their characteristic fishes
- 2008 Great Lakes Compact: identified a common, resource-based conservation standard of "no significant individual or *cumulative* adverse impacts…"
- Zorn et al. 2008: Models relating flow reduction to changes in characteristic fish communities.
  - Basis for legally defining allowable index flow reductions in each stream type (Hamilton and Seelbach 2011)
- Intent and efforts are to prevent individual or cumulative impacts

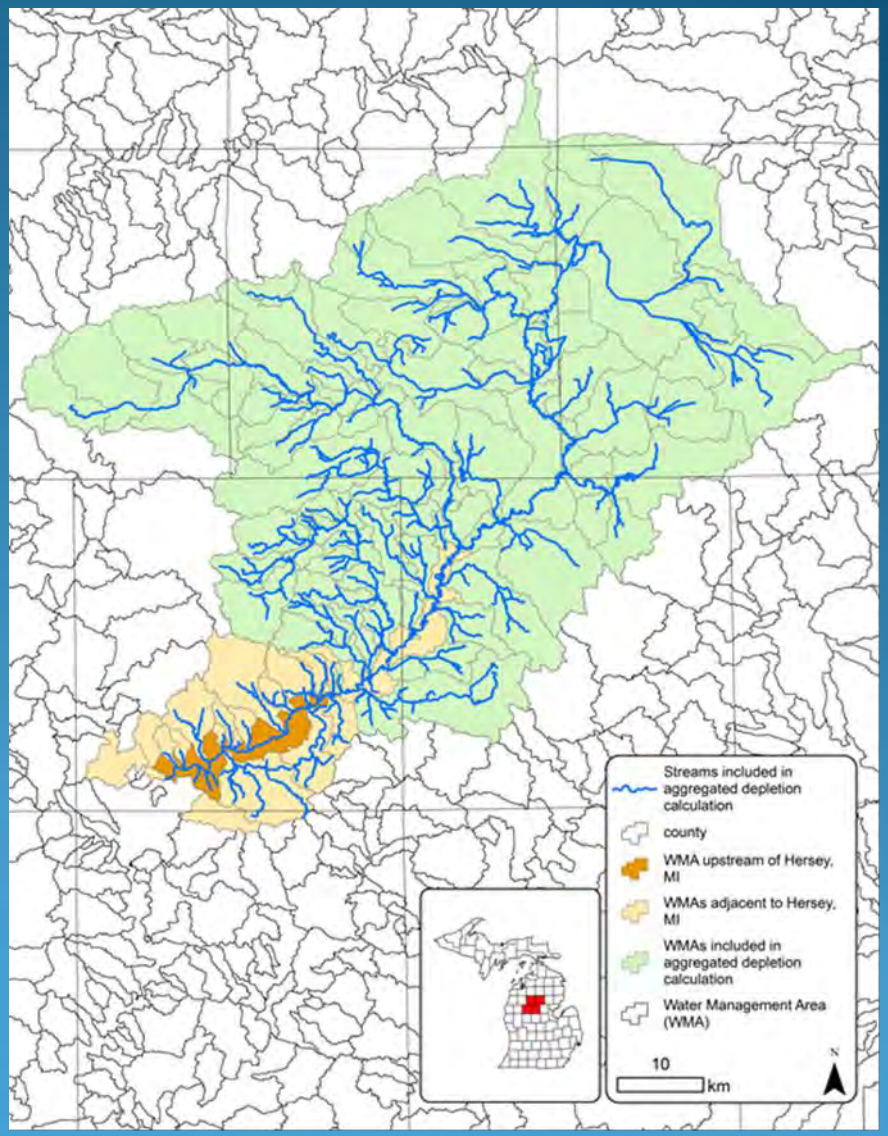
Catchments



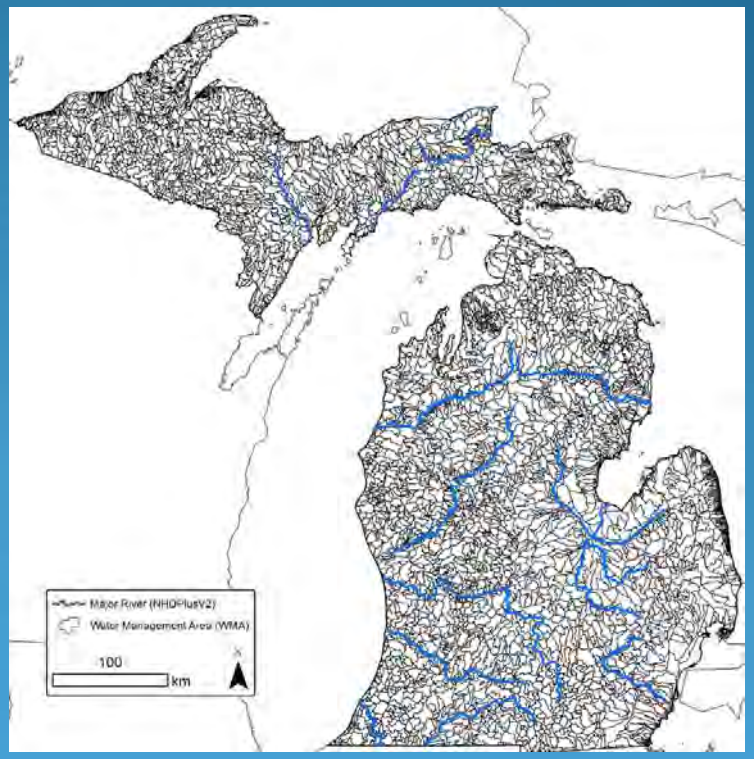
- Definition: area that drains water to a specific location on a stream
- Properties measured at the catchment scale collectively shape physical and biological characteristics at the site.
  - Examples: catchment area, climate, geology, topography, land use (urban, agric, forestry), & surface/ground water use
- Index flow estimates in WWAP are predicted from catchment-scale variables: catchment area, aquifer transmissivity, forest cover, annual precipitation, and soil permeability (Hamilton et al. 2008)
- What is happening throughout the catchment, including LQWs, clearly has an important influence on flow conditions at a site

Cumulative effects, catchments, & WWAP

- When a new LQW is proposed, the WWAP looks at adjacent WMAs.
  - Catchment level accounting for WMAs made up of 1-2 WMAs.
- But… Muskegon R. at Evart

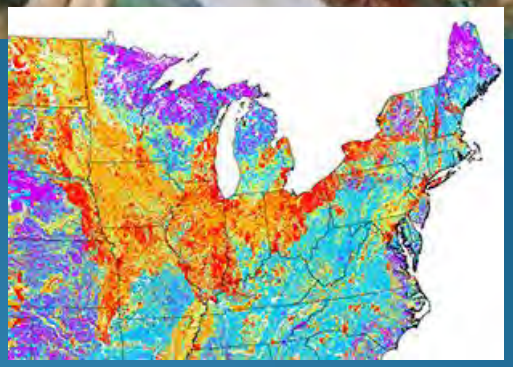


- For larger streams, WWAP could suggest more water is available than is the case since withdrawals in much of the catchment are ignored.
  - Technical Underpinning Work Group item #3 (p. 112) in 2014 "Final report of the WUAC"
  - Assessing cumulative effects is potentially a widespread issue.
  - Cumulative accounting is feasible



Water Management Areas

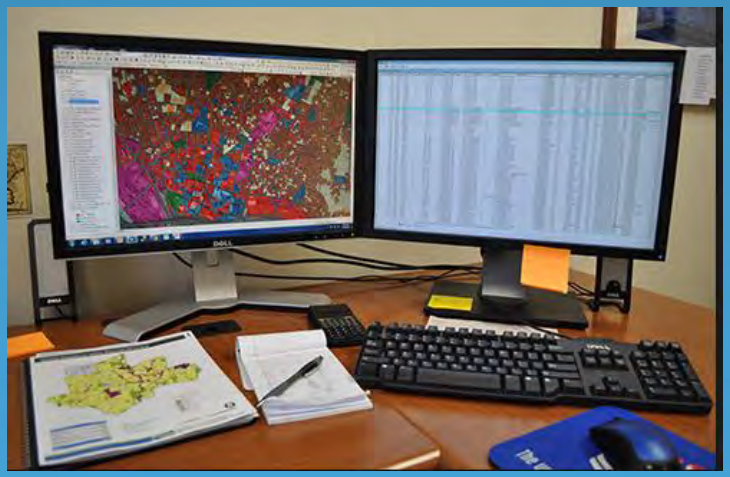
A solution within reach



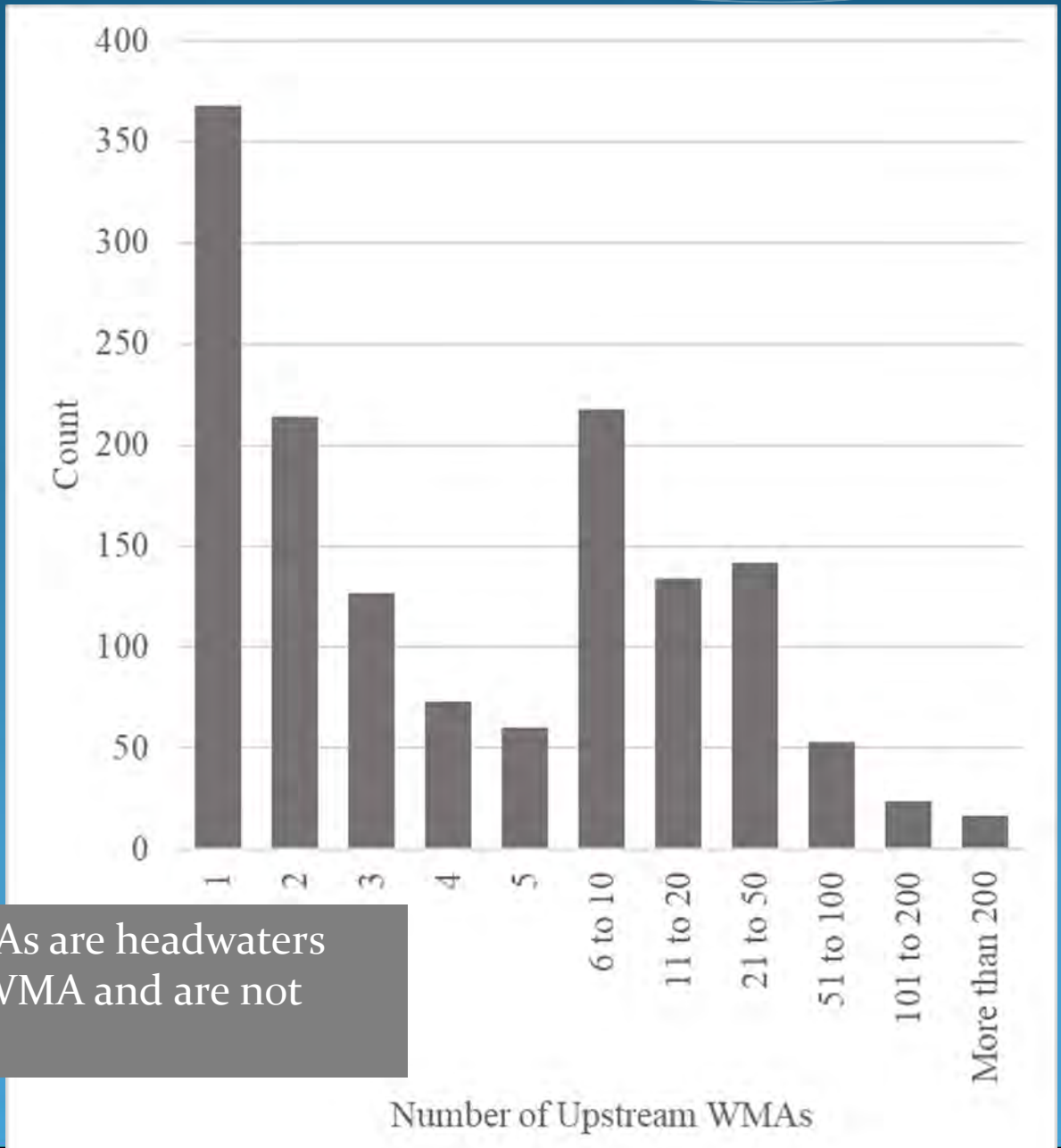
- Available resources
  - Dr. Dana Infante & Kyle Herreman at MSU
  - MDEQ database
- Catchment-level accounting is desirable because it:
  - Is consistent with current hydrologic modelling and landscape ecology principles;
  - Is aligned with the intent and spirit of the Great Lakes Compact
  - Could improve and increase the validity of the WWAP.
- State Wildlife Grant funding
- Objectives
  1. To demonstrate the feasibility of incorporating catchment-level accounting summaries into the WWAP;
  2. To depict the status of Michigan WMAs if all registered streamflow depletions were accumulated for the entire catchment of each WMA;
  3. To explore options for incorporating catchment level accounting into the WWAP.

Steps

1. Acquire data from MDEQ
    1. Volumes of water depleted by WMA
    2. Topological relationships among WMAs for MI river networks
2. Review and reverse topological coding to “look upstream”
3. Run aggregation coding to sum all withdrawals upstream of each WMA
    1. Double-checked topological relationships with these data

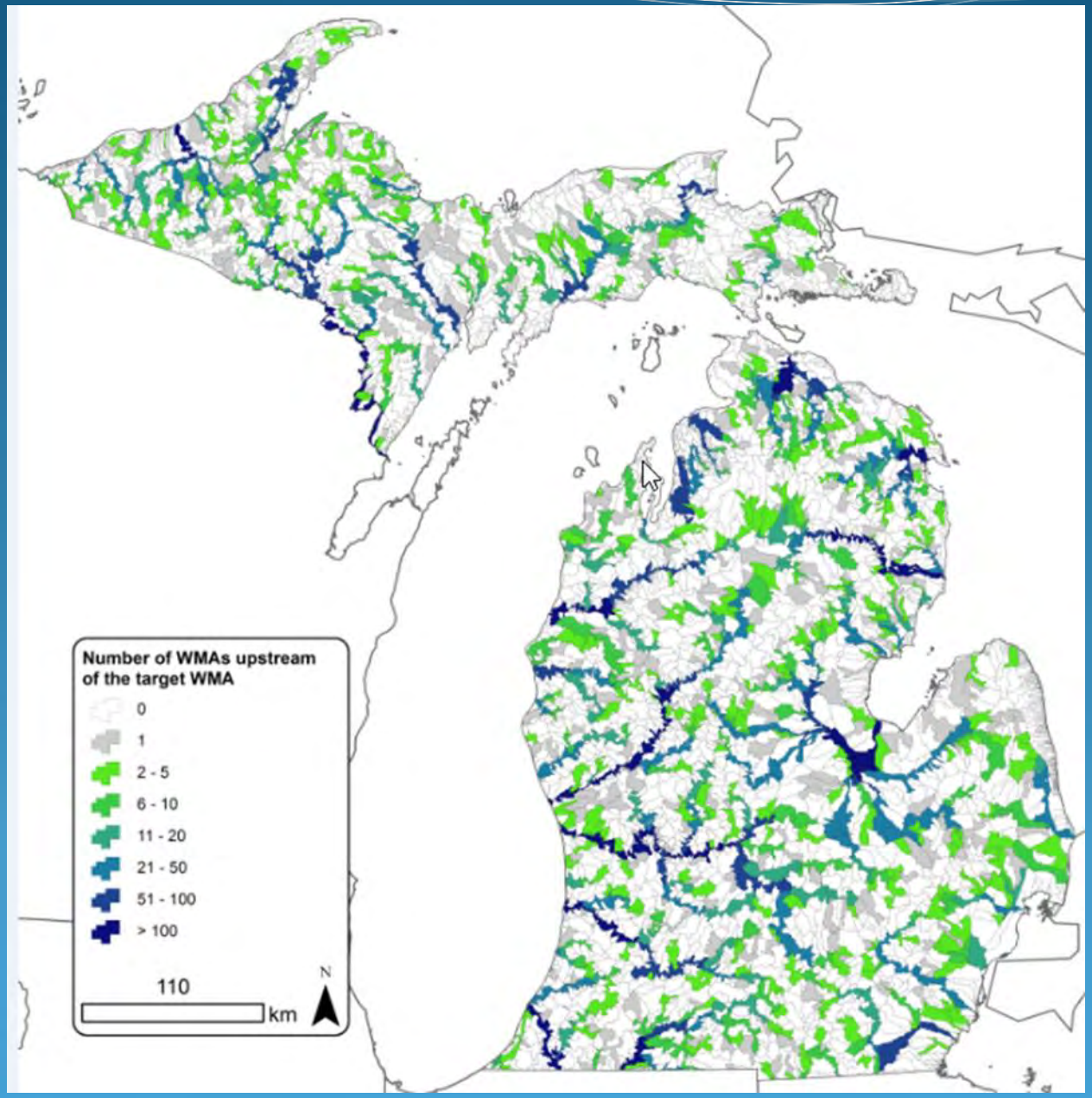


Results: Number of WMAs with "X" WMAs upstream.

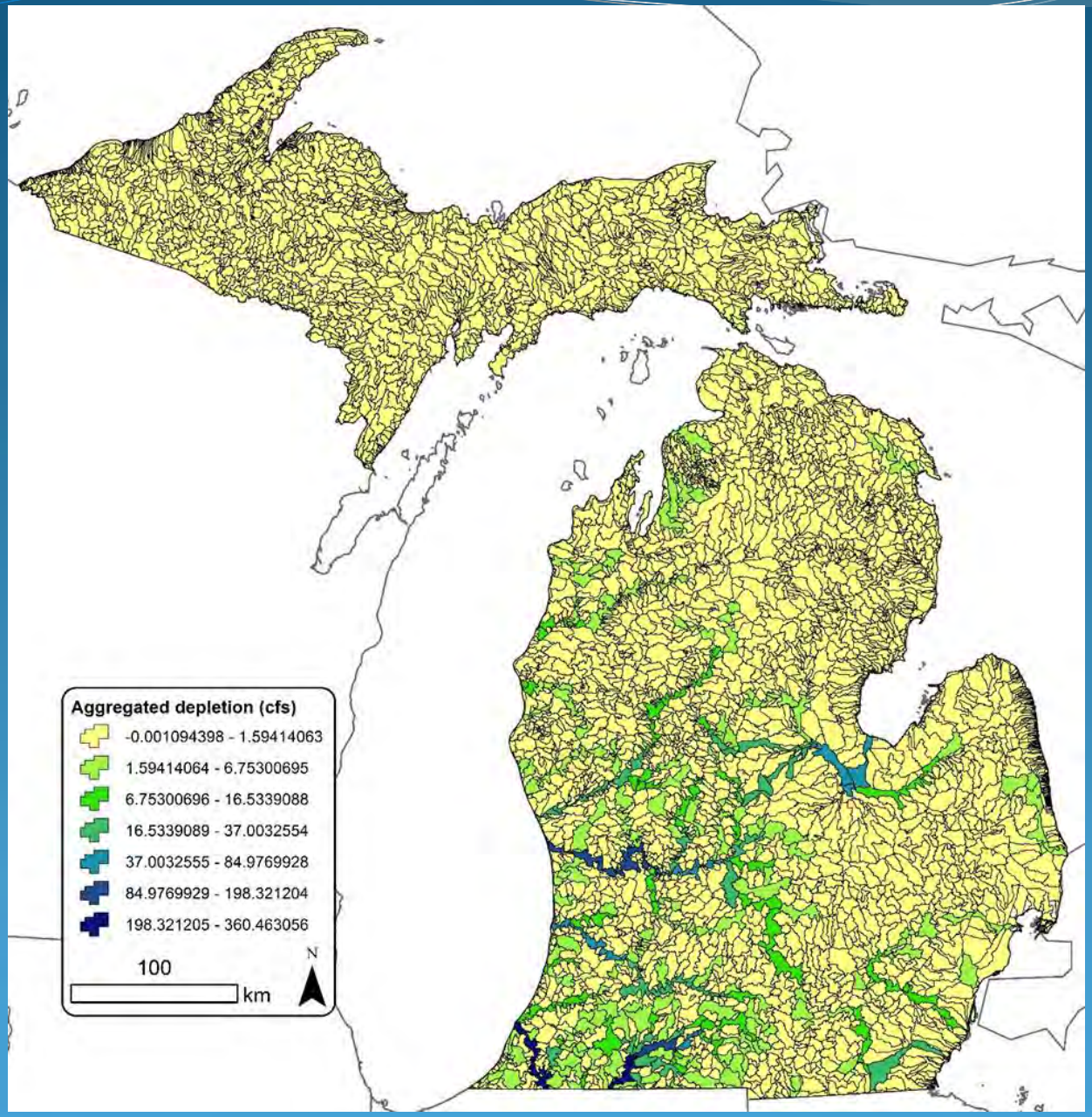


Note that 4158 WMAs are headwaters with no upstream WMA and are not shown.

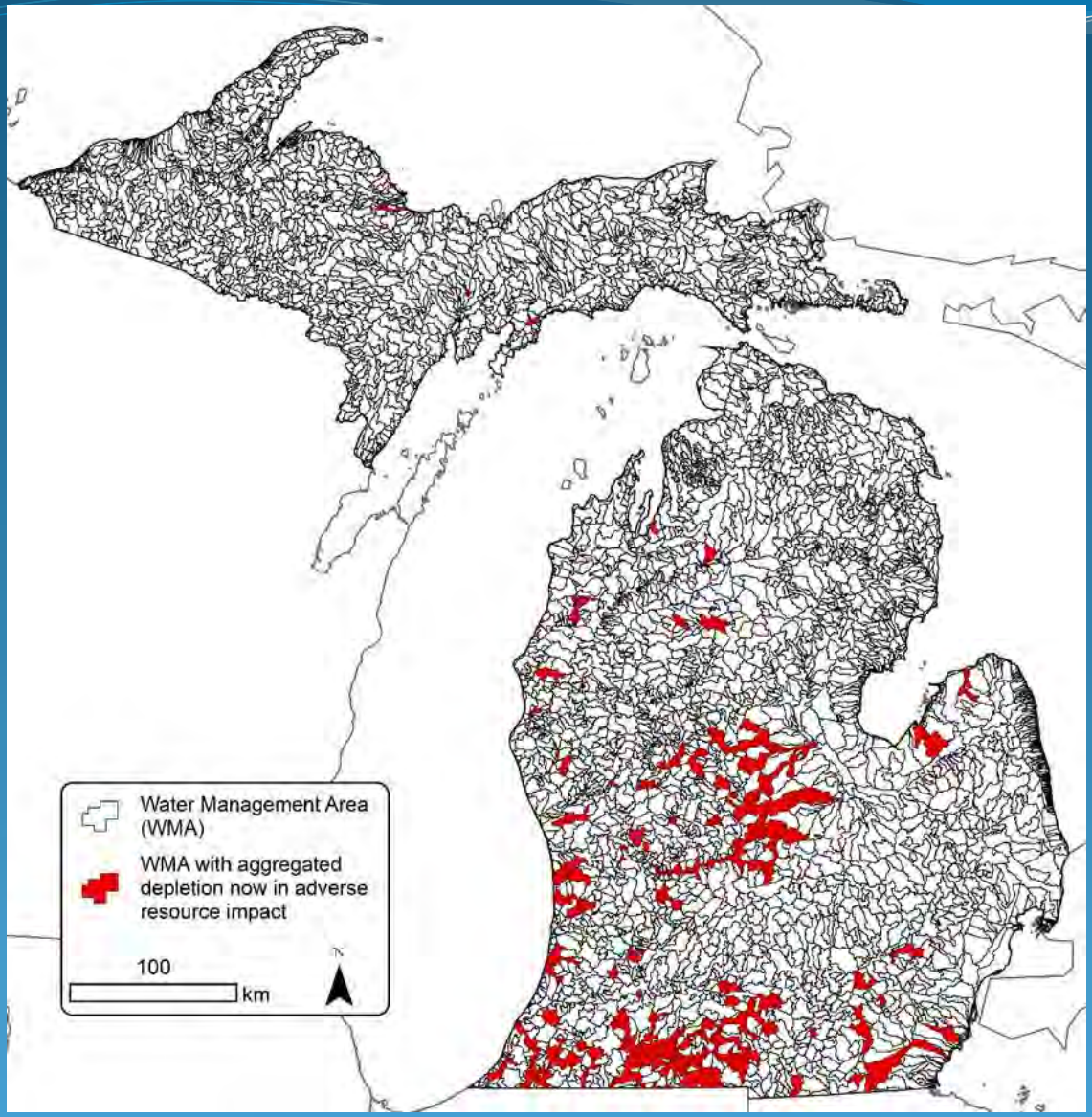
Results: Larger systems potentially more vulnerable to cumulative effects



Results: Cumulative depletions for catchment of each WMA.



Results: Potential WMAs of concern due to cumulative withdrawals



Flow condition for WMA's in red: Estimated index flow minus sum of approved LQW's for catchment result in flow being at or below ARI level.

Summary

- Demonstrated that cumulative withdrawals and return flows can be readily incorporated into the WWAP.
  - It's technically feasible.
- Addressing this deficiency would maintain the public's confidence in the WWAP.
- This information can help fill a key knowledge gap.
- Cumulative withdrawal info can also aid in identifying areas for further investigation.

Next steps:

- We think that further investigation of this issue is warranted.
- Our recommendation:
  - Maintain the status quo in the WWAP for now.
  - Examine approaches for understanding cumulative effects of withdrawals and return flows at the catchment scale.
  - Incorporate this knowledge into the WWAP, as appropriate.

"…understanding cumulative impacts of multiple withdrawals within a watershed is paramount to a sustainable approach for both the aquatic ecosystem and the human users of the resource."

Hamilton and Seelbach (2011)