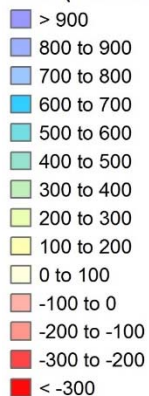
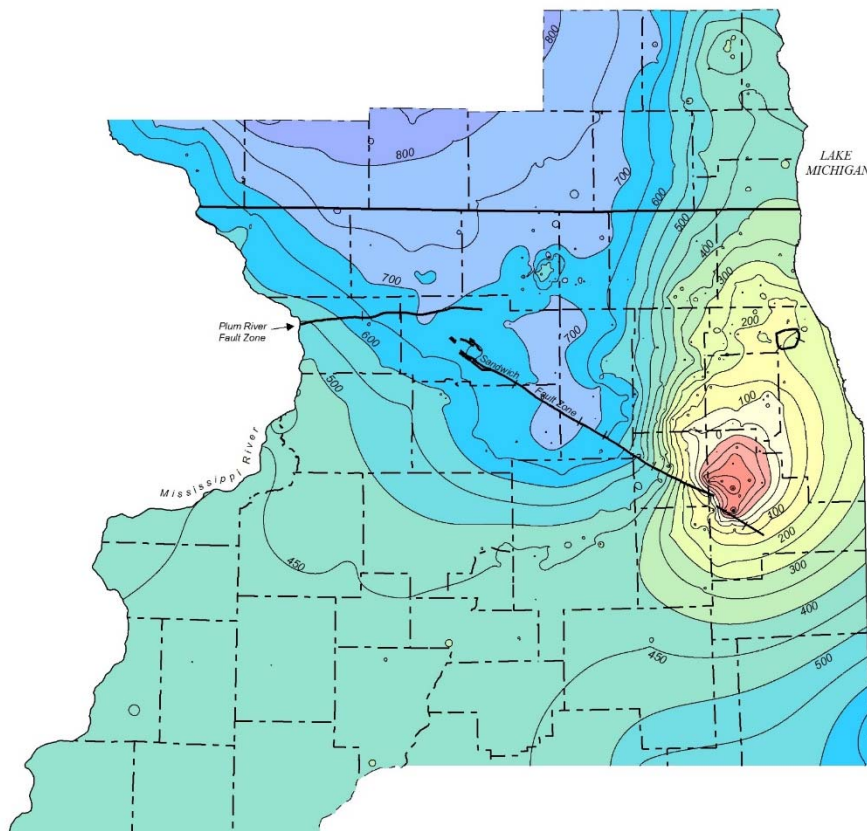
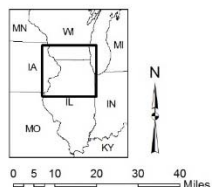


2014

Head (ft above msl)

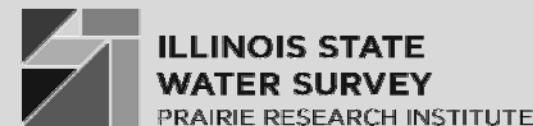
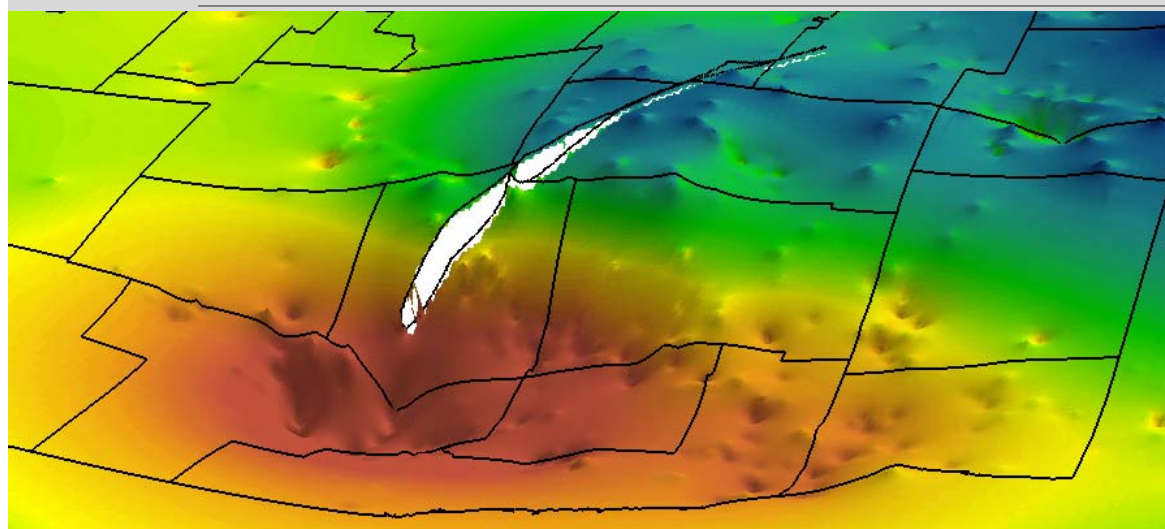


- County Boundary
- Bedrock Fault
- Head Contour (50ft Interval)



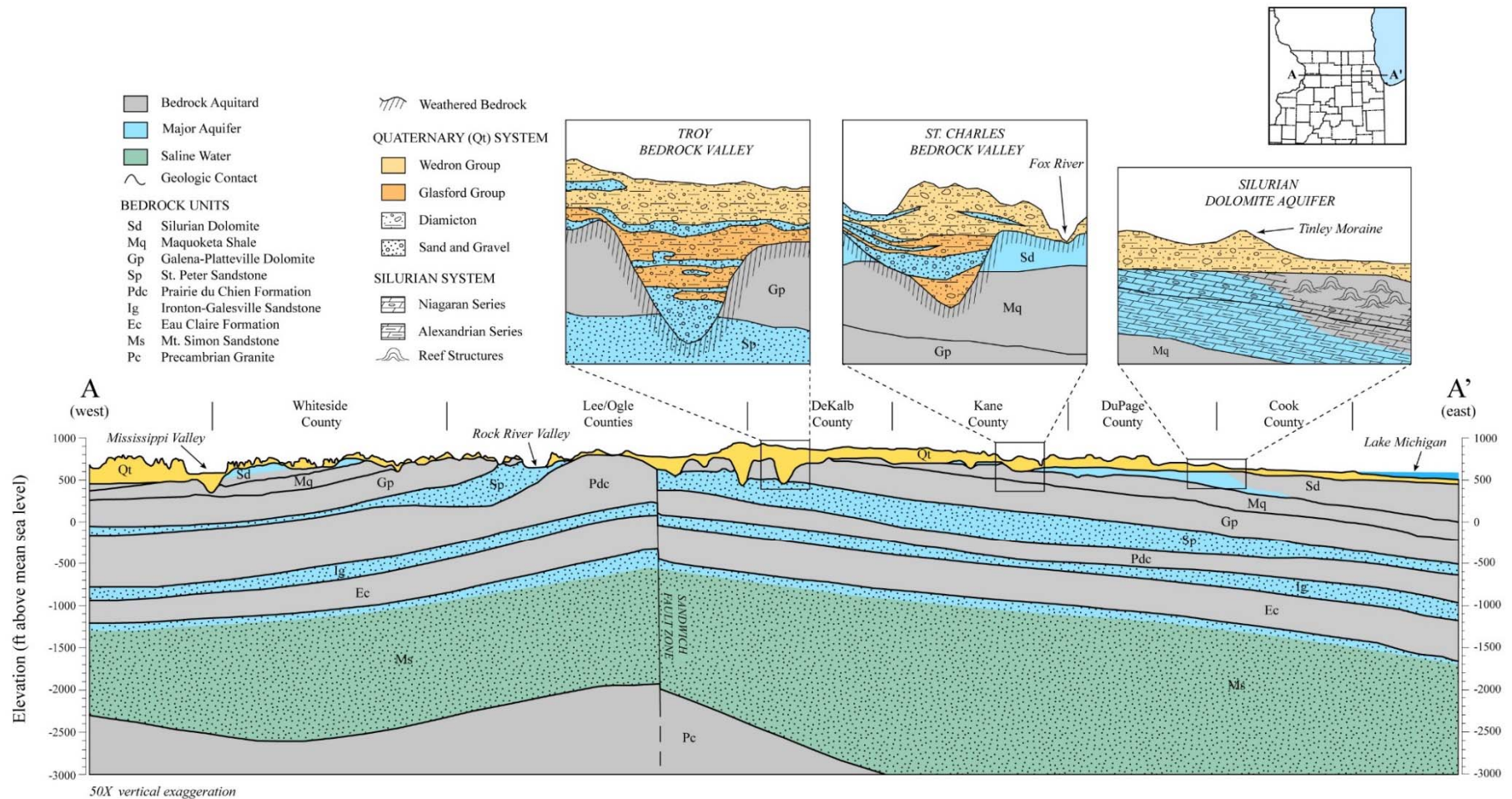
Incorporating anthropogenic stresses into groundwater flow models to improve conceptualization of geology

DANIEL B. ABRAMS  
DEVIN MANNIX  
GEORGE S. ROADCAP  
DANIEL R. HADLEY  
ILLINOIS STATE WATER SURVEY,  
PRAIRIE RESEARCH INSTITUTE



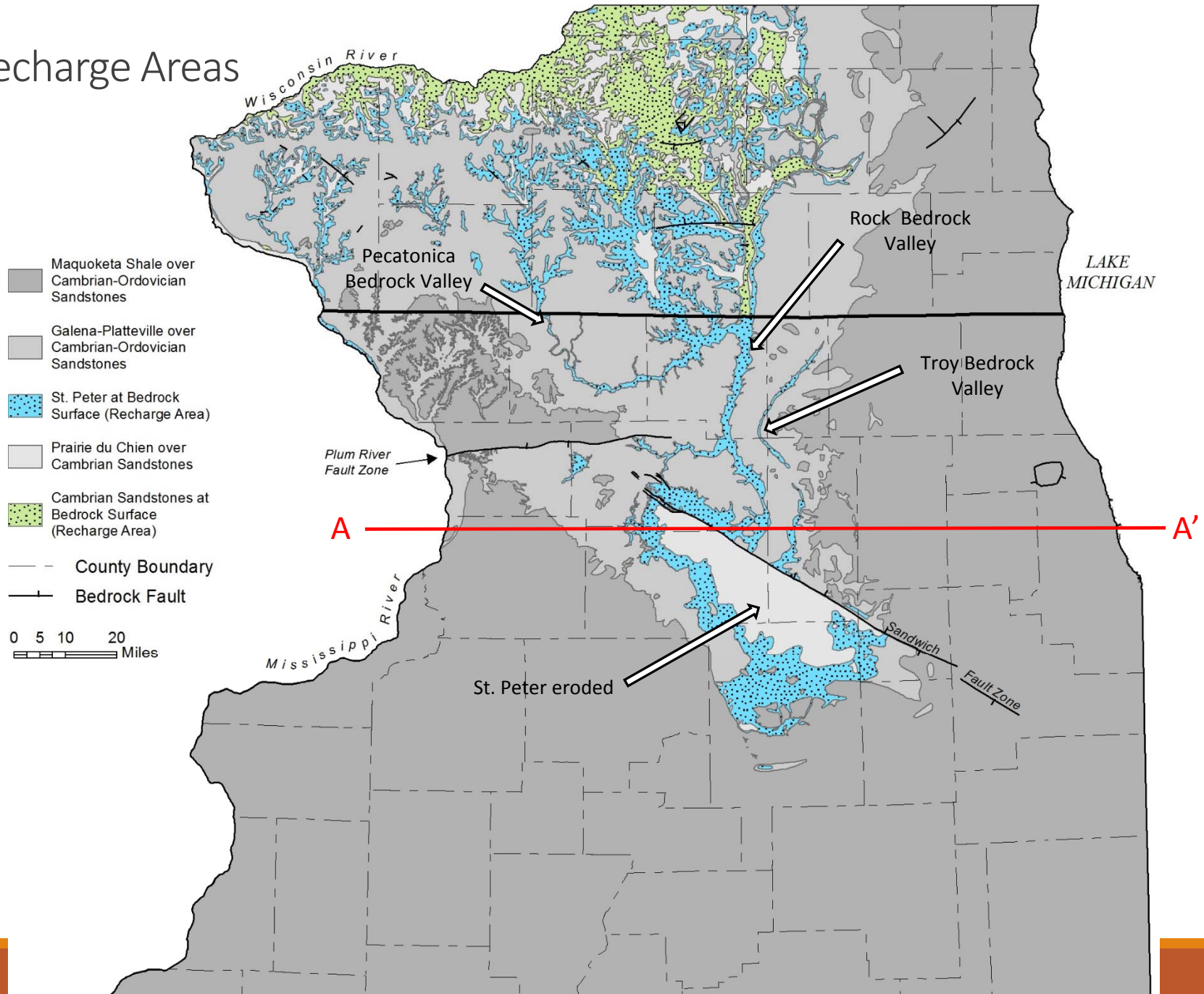
ILLINOIS

# Cambrian-Ordovician sandstone aquifers





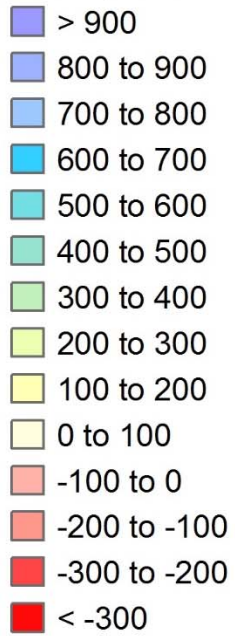
# Recharge Areas



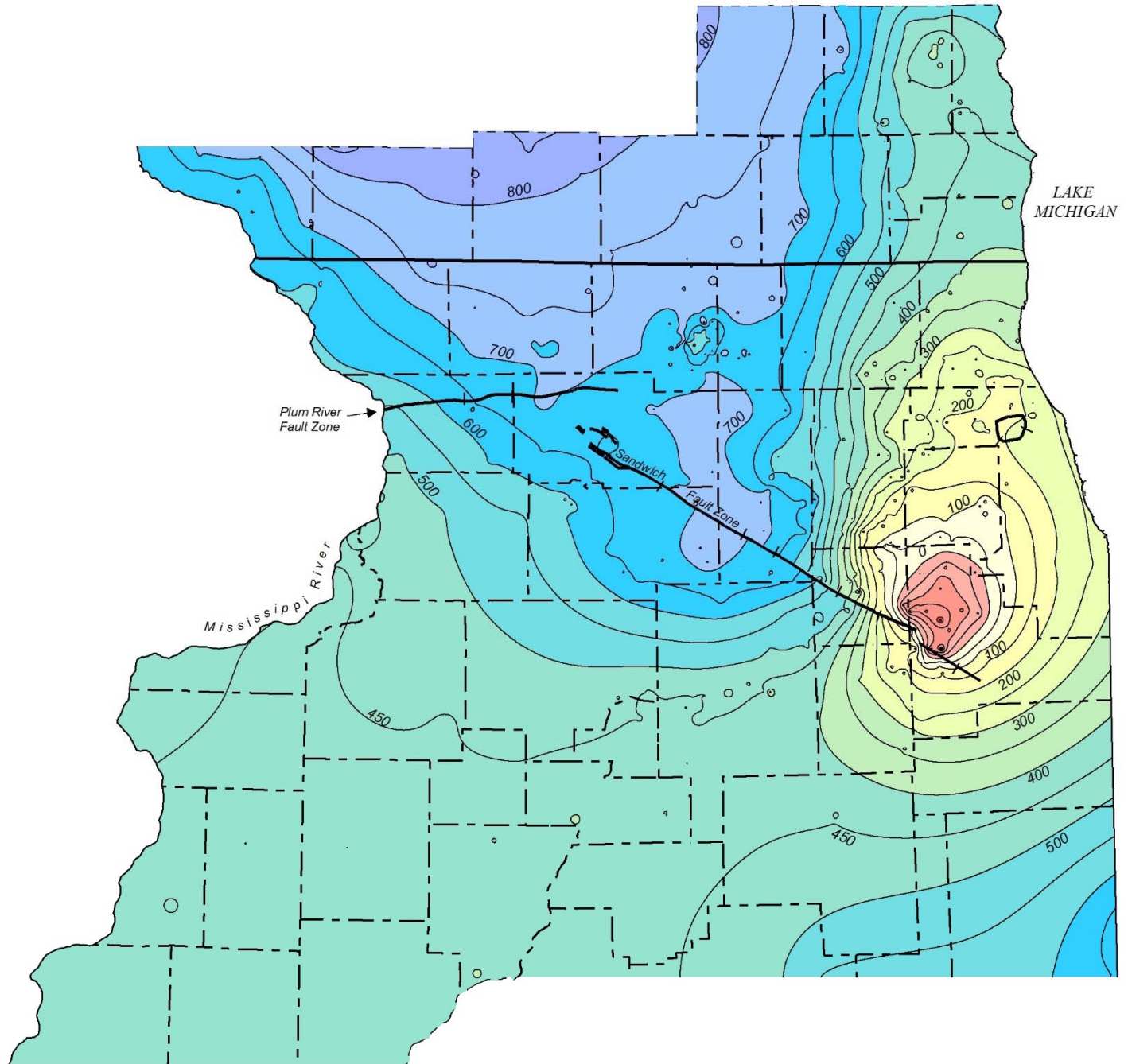
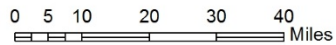
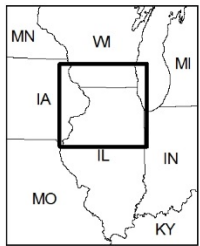
# Results

**2014**

**Head (ft above msl)**

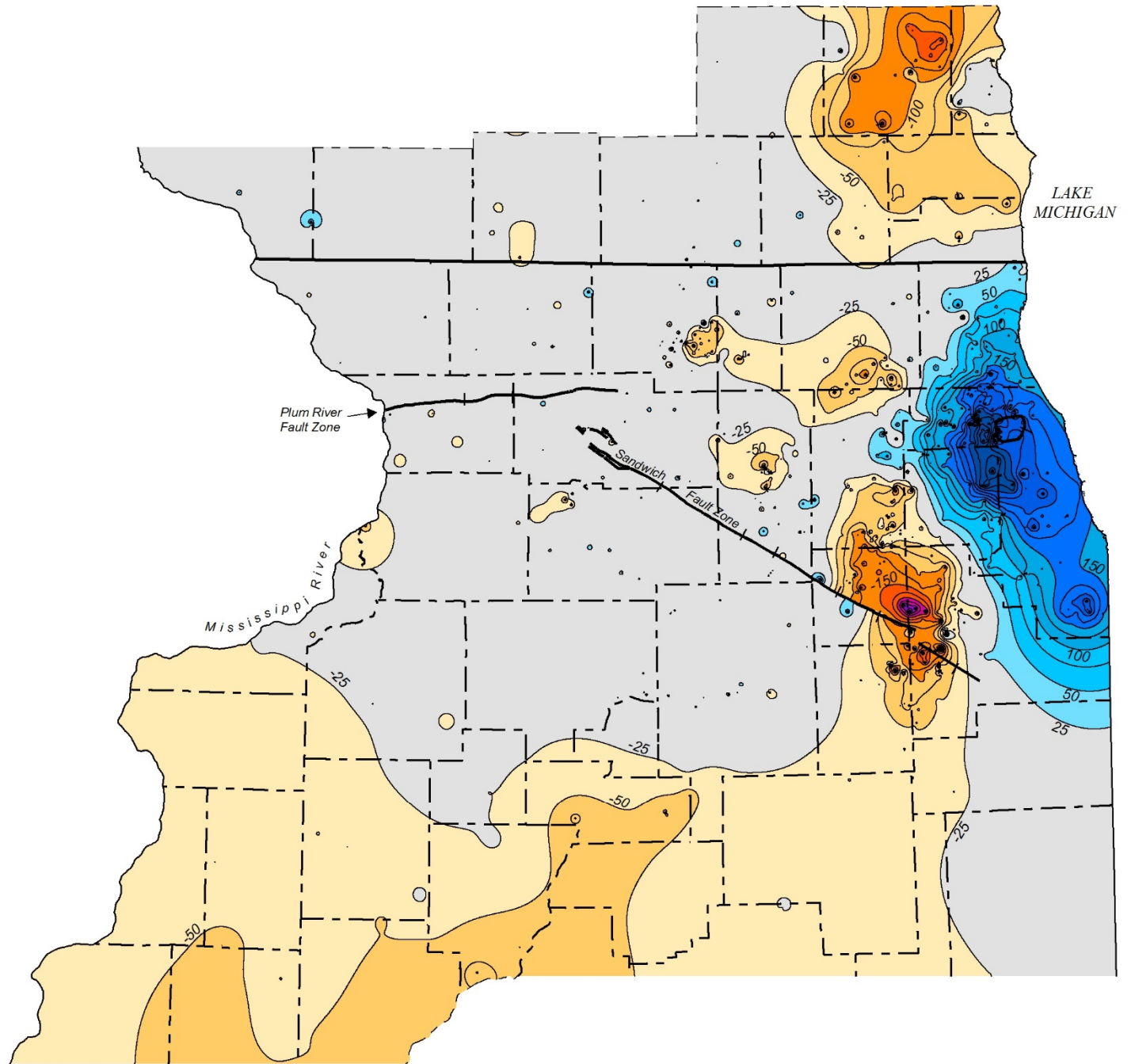
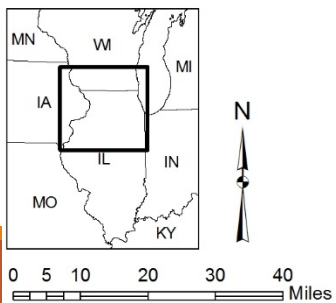


- - County Boundary
- + Bedrock Fault
- Head Contour (50ft Interval)



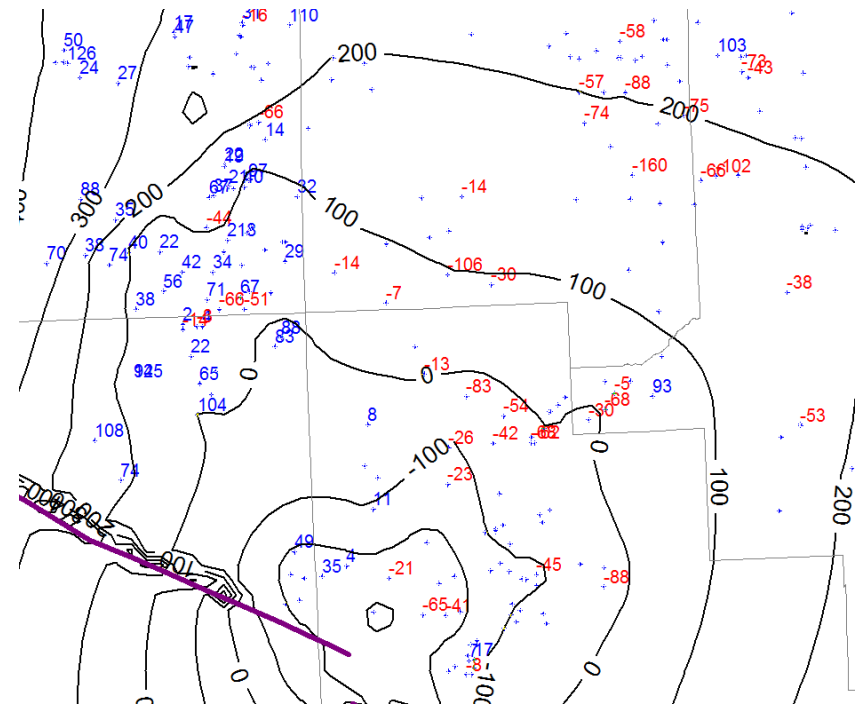
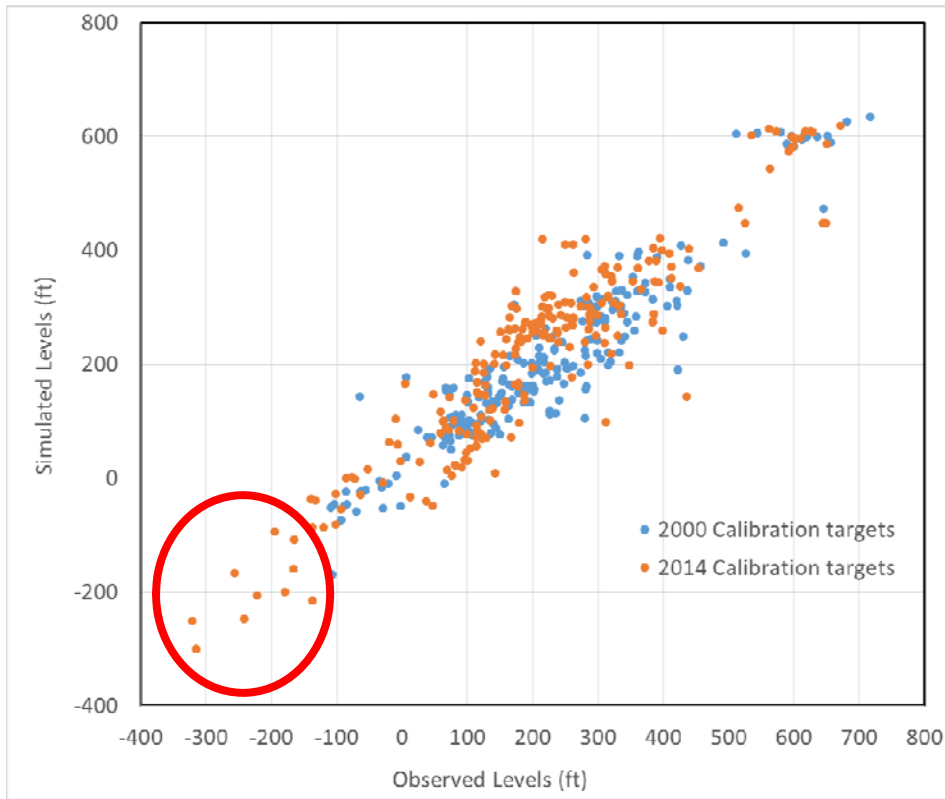
# Results

## 1980 to 2014 Head Change (ft)





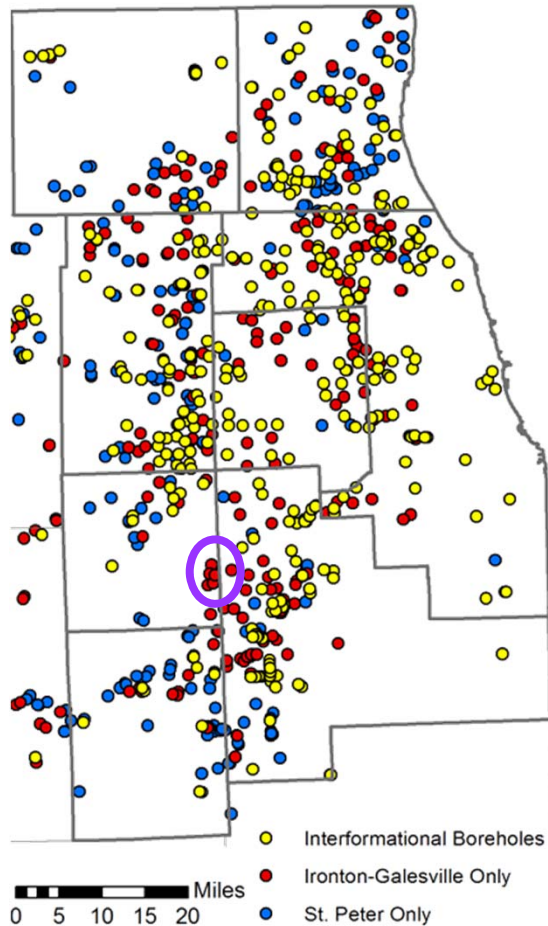
# Calibration to C-O sandstone: 2000 and 2014 Mass Measurement



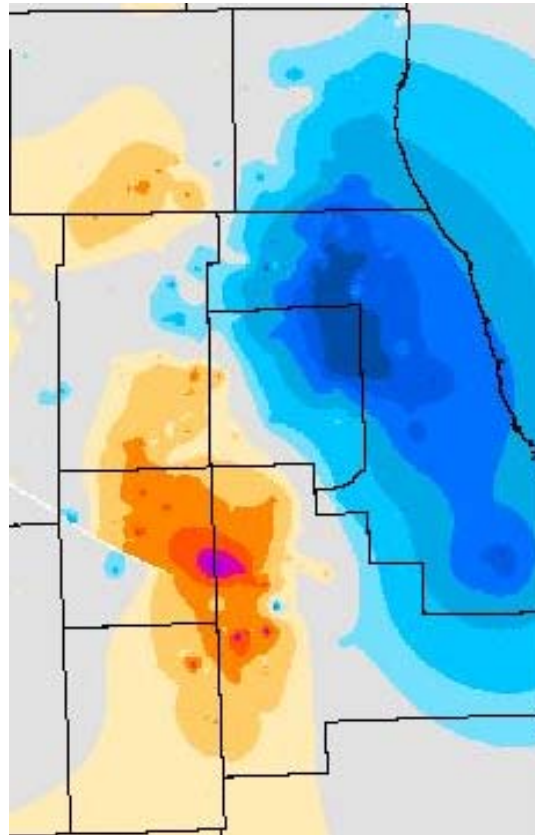
2014

# Interformational boreholes

Active wells in 2014

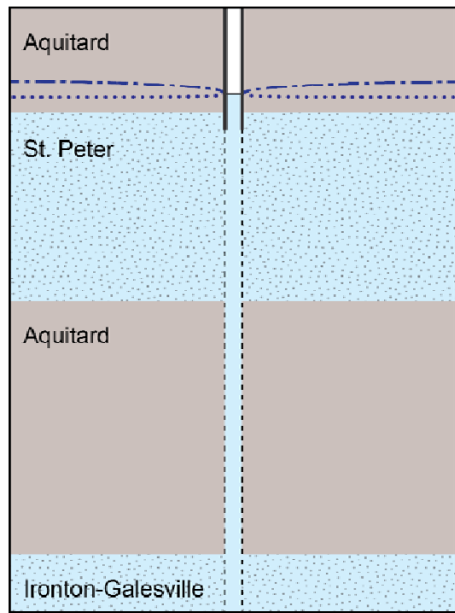


Head change map



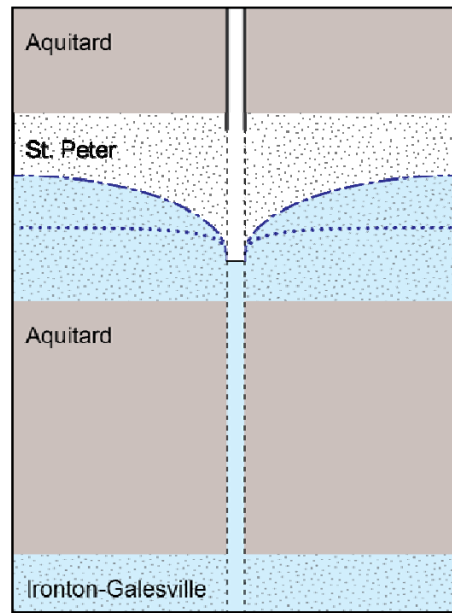
The greatest head change from 1980 to 2014 (shown in purple) coincides with a zone where there are few interformational boreholes that facilitate transfer of water between sandstone layers

# Conceptualization of interformational boreholes



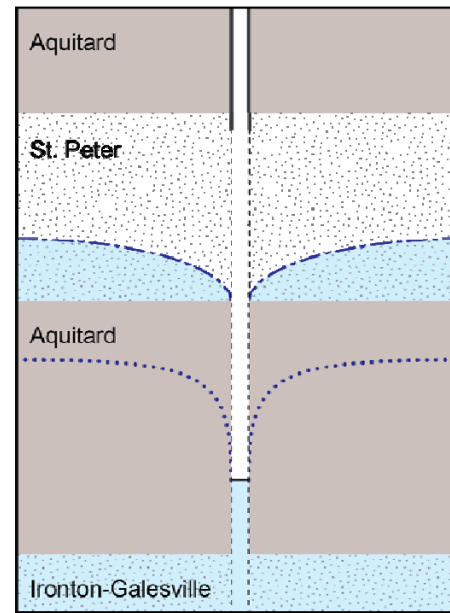
Well through multiple sandstone units

No pumping



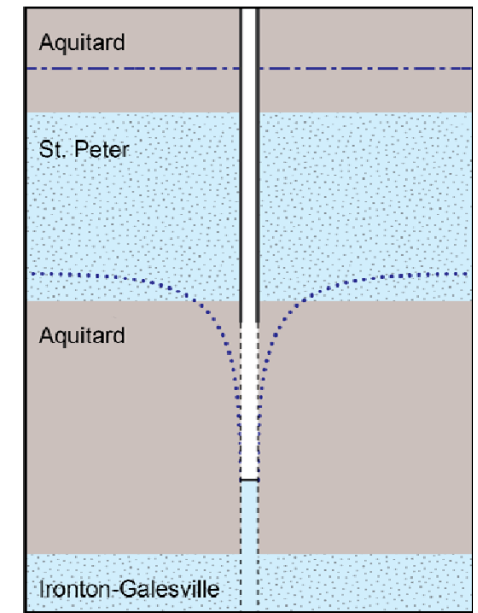
Well through multiple sandstone units

Large pumping



Well through multiple sandstone units

Large pumping, upper sandstone desaturated



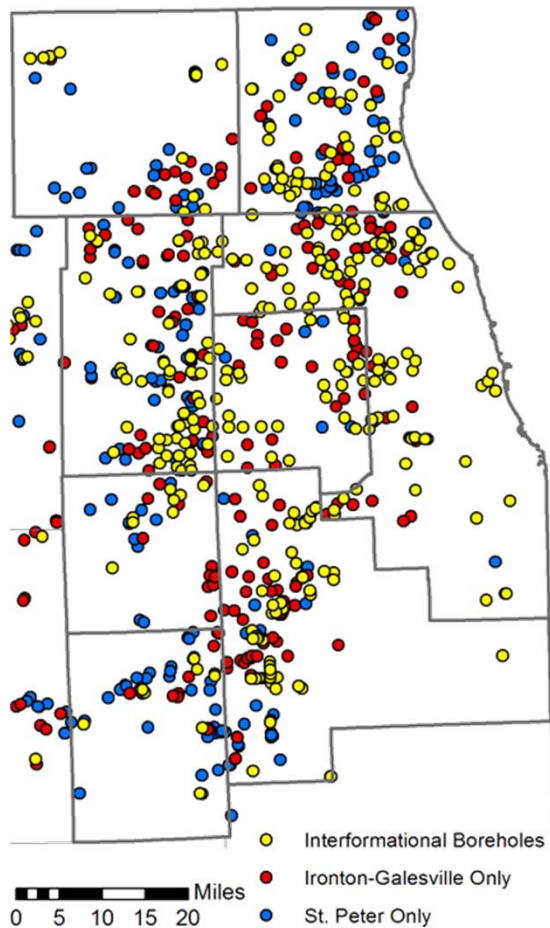
Well through single sandstone unit

Large pumping

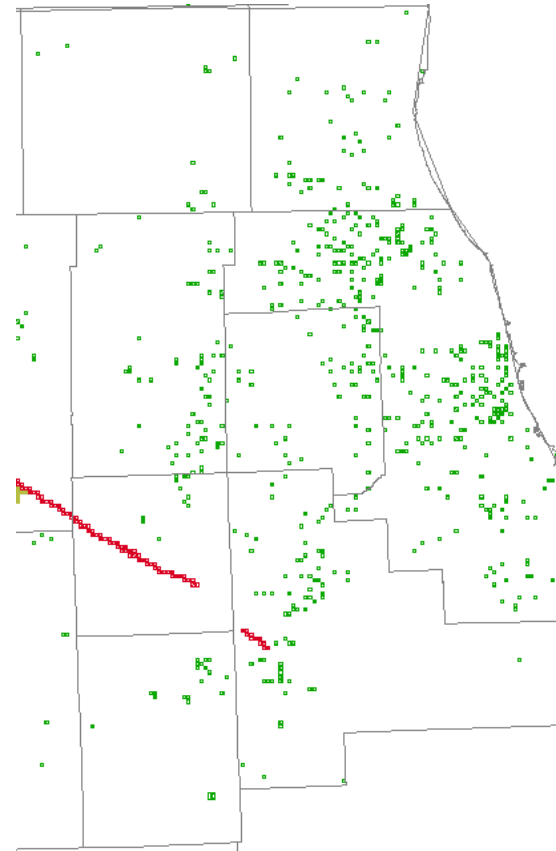


# Simulation of interformational boreholes

Wells in 2014  
(not sealed)



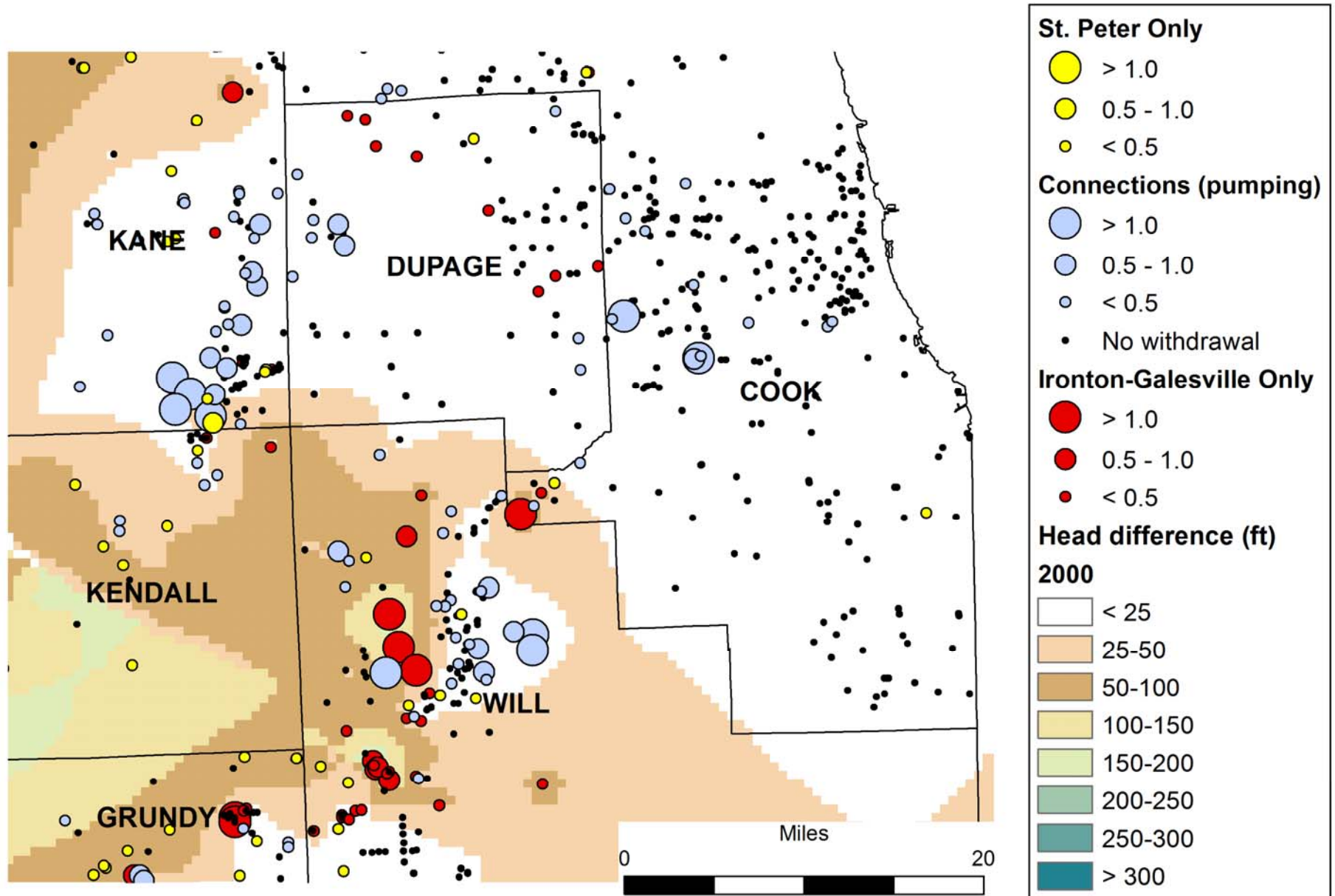
Interformational transfer-  
Low resistance zones (includes sealed wells)



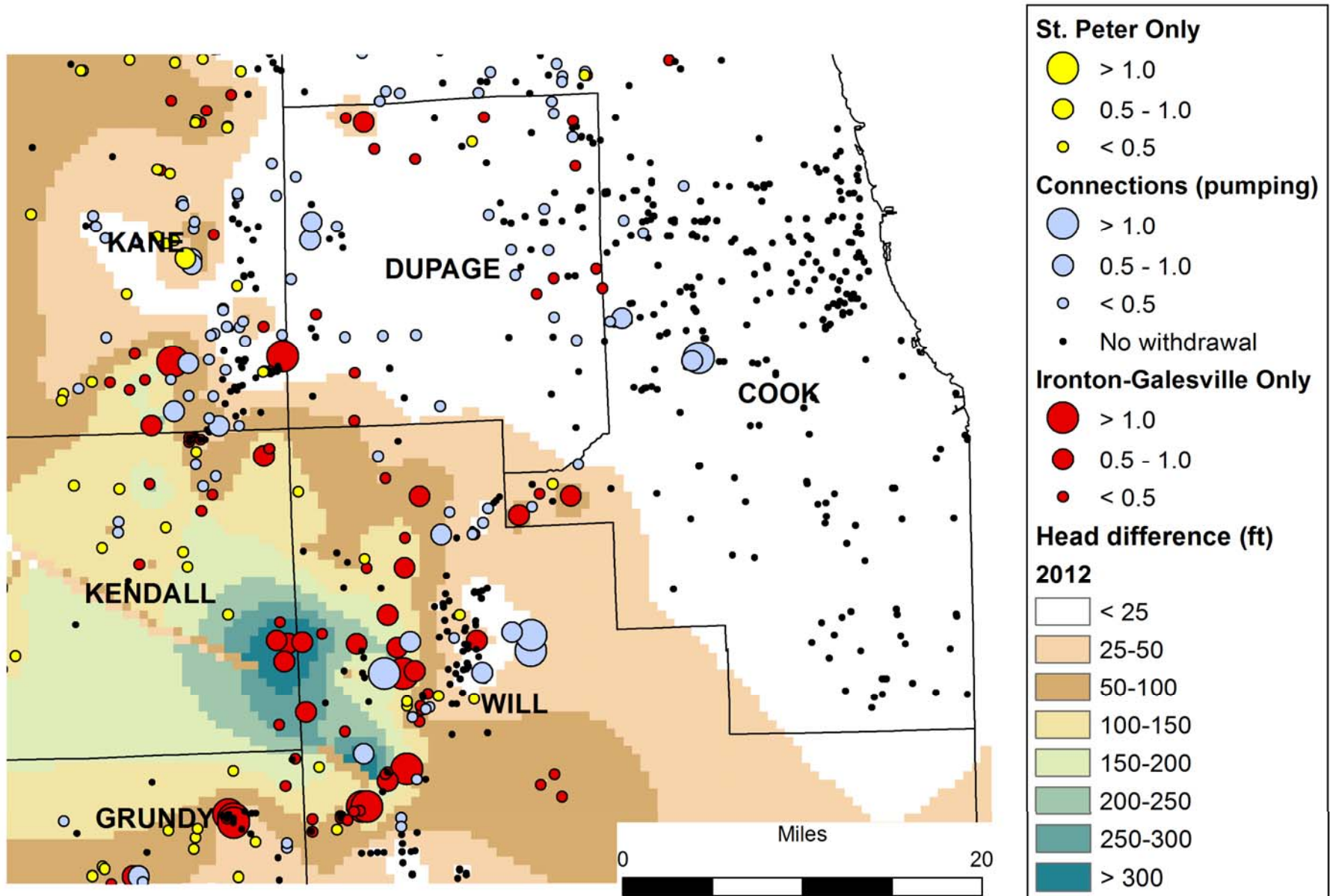
To simulate interformational transfer between an open borehole using MODFLOW-2000 with the traditional well package, we must assign a low resistance zone

Currently researching new techniques (MNW, CLN) to simulate these boreholes

# 2000 head difference



# 2012 head difference



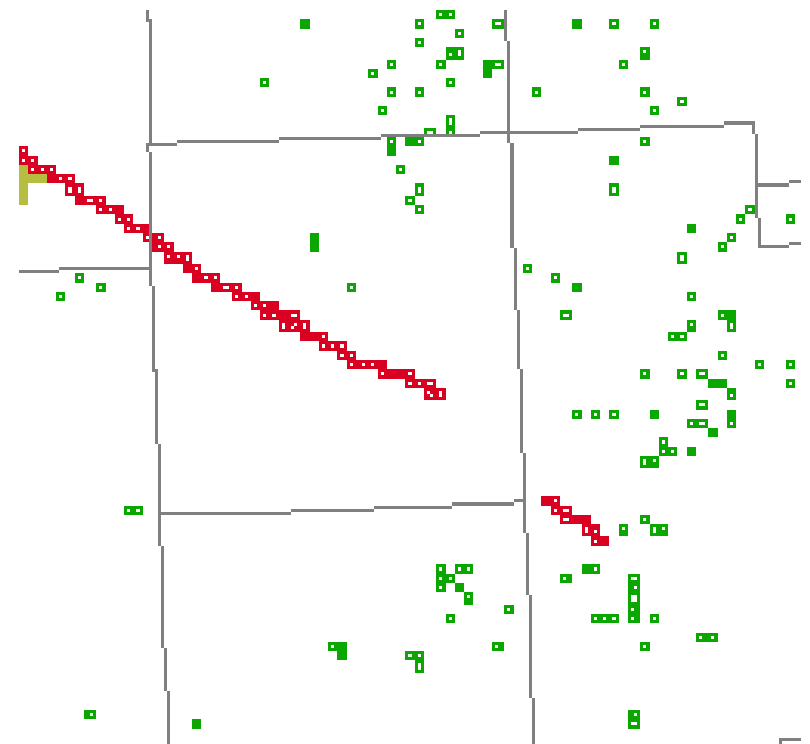
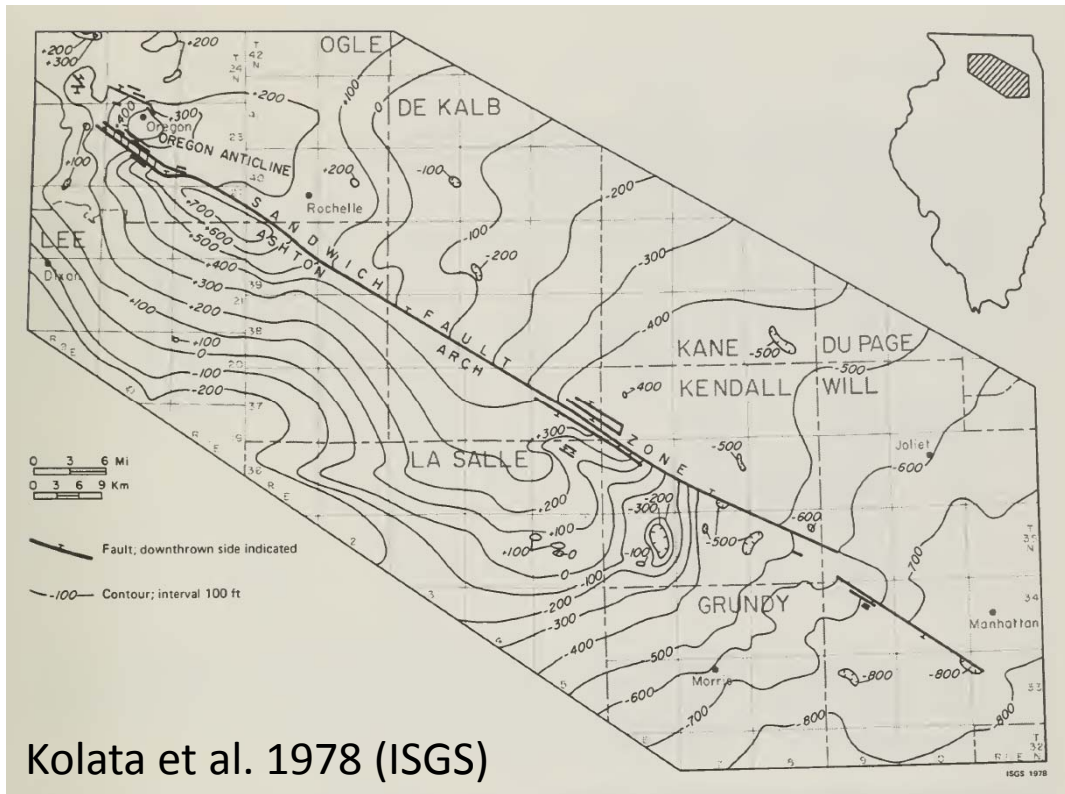


# Next time

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- What are the current and future impacts on the St. Peter and Ironton-Galesville sandstone water levels
  - Water balance discussion
  - Future pumping scenarios and impacts on heads
  - Any suggestions?

# Sandwich Fault Zone



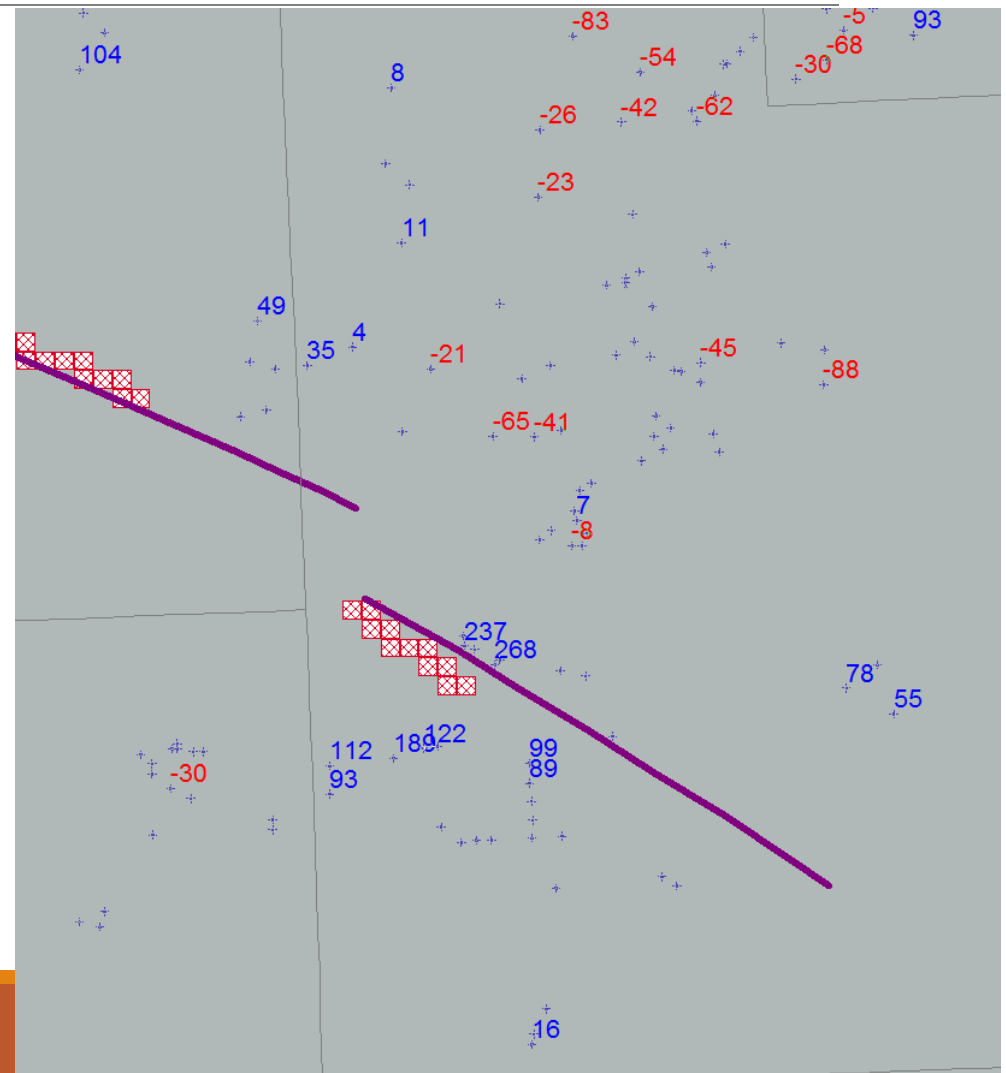
Structural map of the top of the Franconia

Conceptualization in a groundwater flow model (low kx cells)

# Sandwich Fault (regional)

While MODFLOW can't simulate local effects at a 2500 ft grid (as is the case with the northeastern Illinois model)

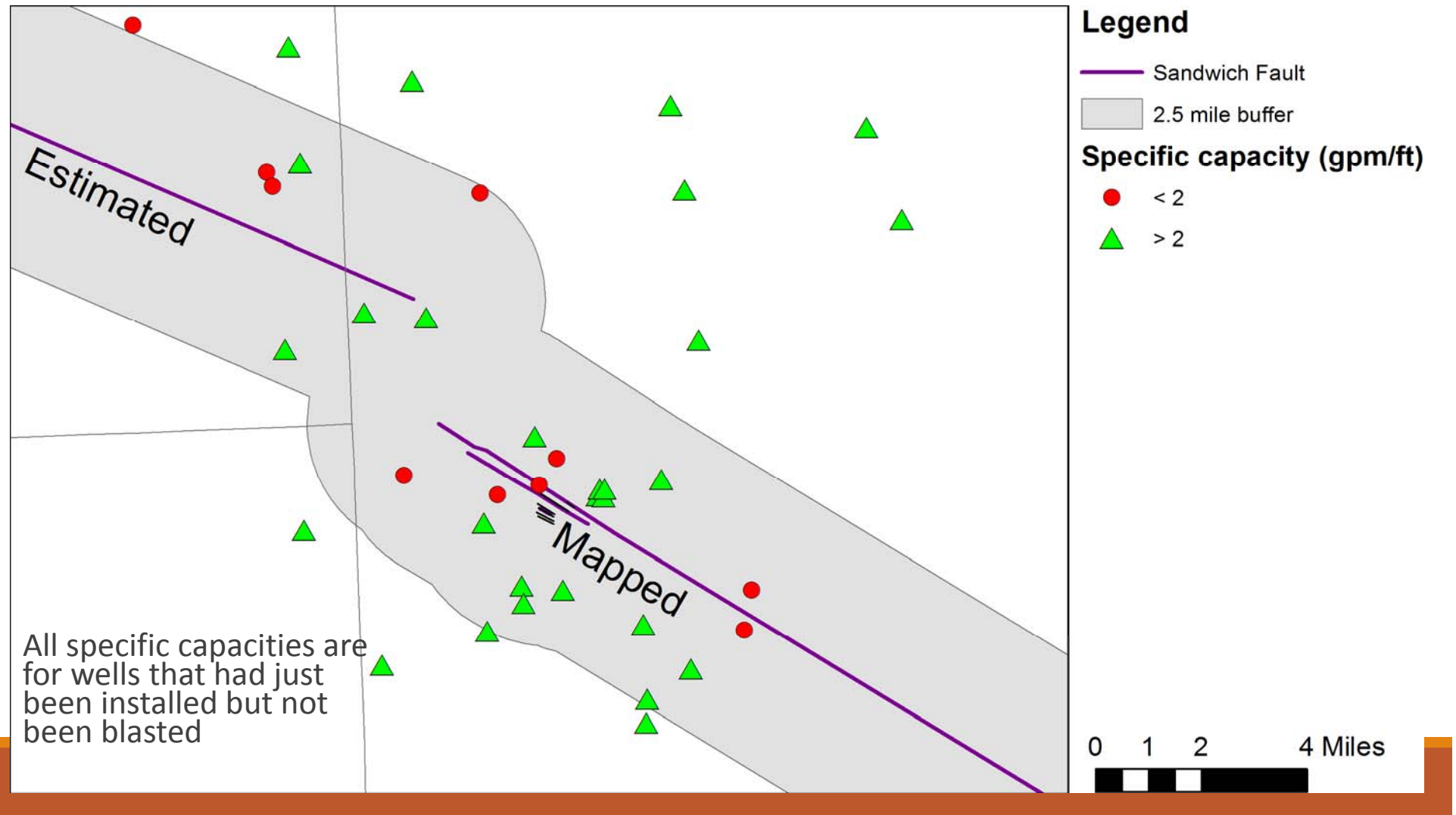
The Sandwich Fault can be treated as a low flow zone to capture regional heads





# Specific Capacity in Sandwich Fault zone

Specific capacity =  $Q/\text{drawdown}$



# Conclusions

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The largest change in heads is observed in an area where pumping has:

- Moved closer to the Sandwich Fault zone
- Moved primarily into the Ironton-Galesville and away from interformational transfers

Groundwater flow models are capable of capturing both effects on a regional scale with proper model design, although local scale effects of wells adjacent to fault blocks cannot be captured with finite difference model unless the resolution is very fine

## Acknowledgements

- Illinois Dept. of Natural Resources
- ISWS Staff
- Water Operators
- Public Water Supply Facilities
- Commercial/Industrial Facilities
- Layne-Christensen, Olsen Well and Pump, Lyons Well Drilling, Peerless Service Co., Albrecht Well Drilling