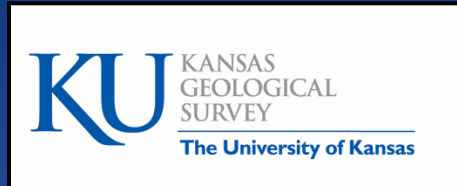


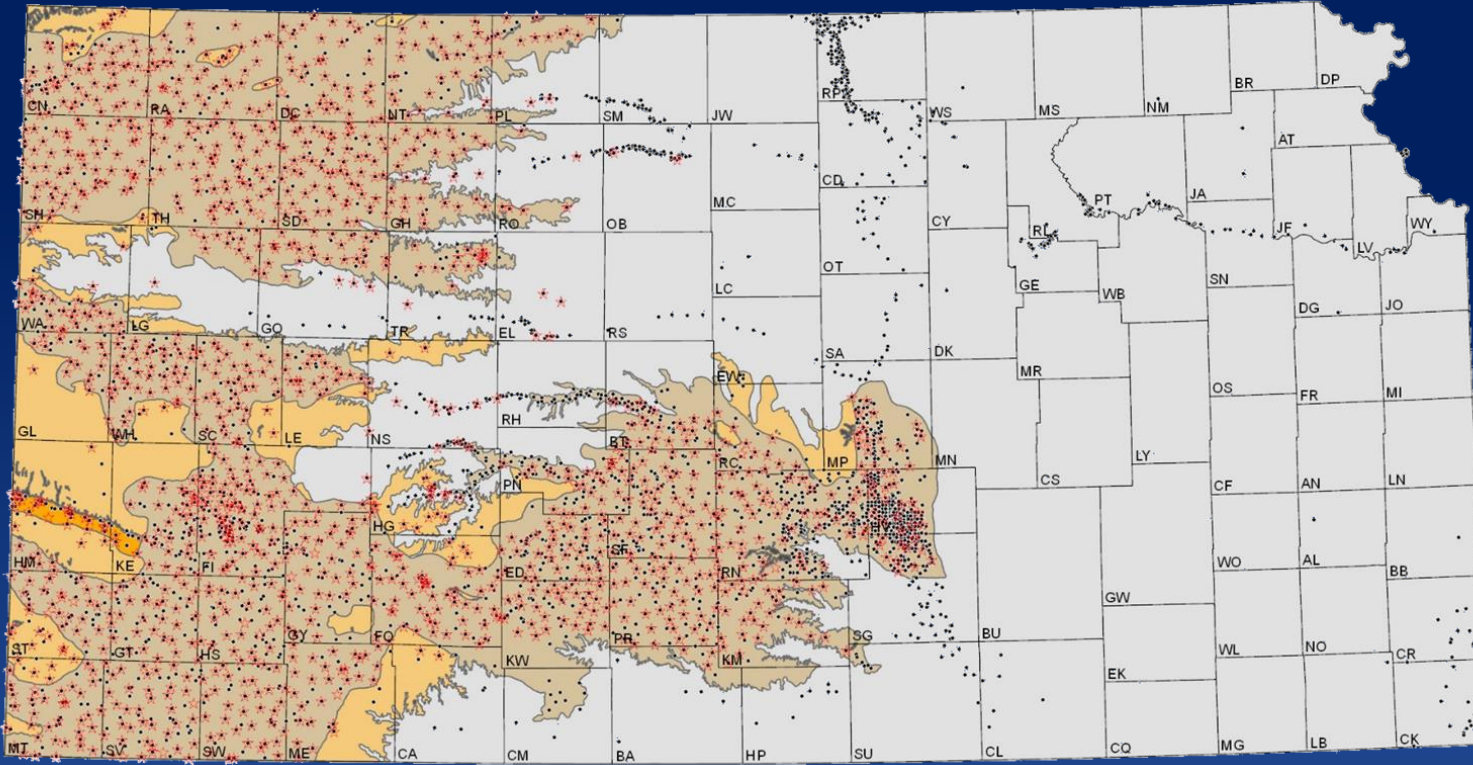
Groundwater Use and Water Level Change Relationships

KWO Cimarron and Upper Arkansas Regional Advisory Committee Meeting
January 25th, 2019



Kansas Geological Survey
University of Kansas

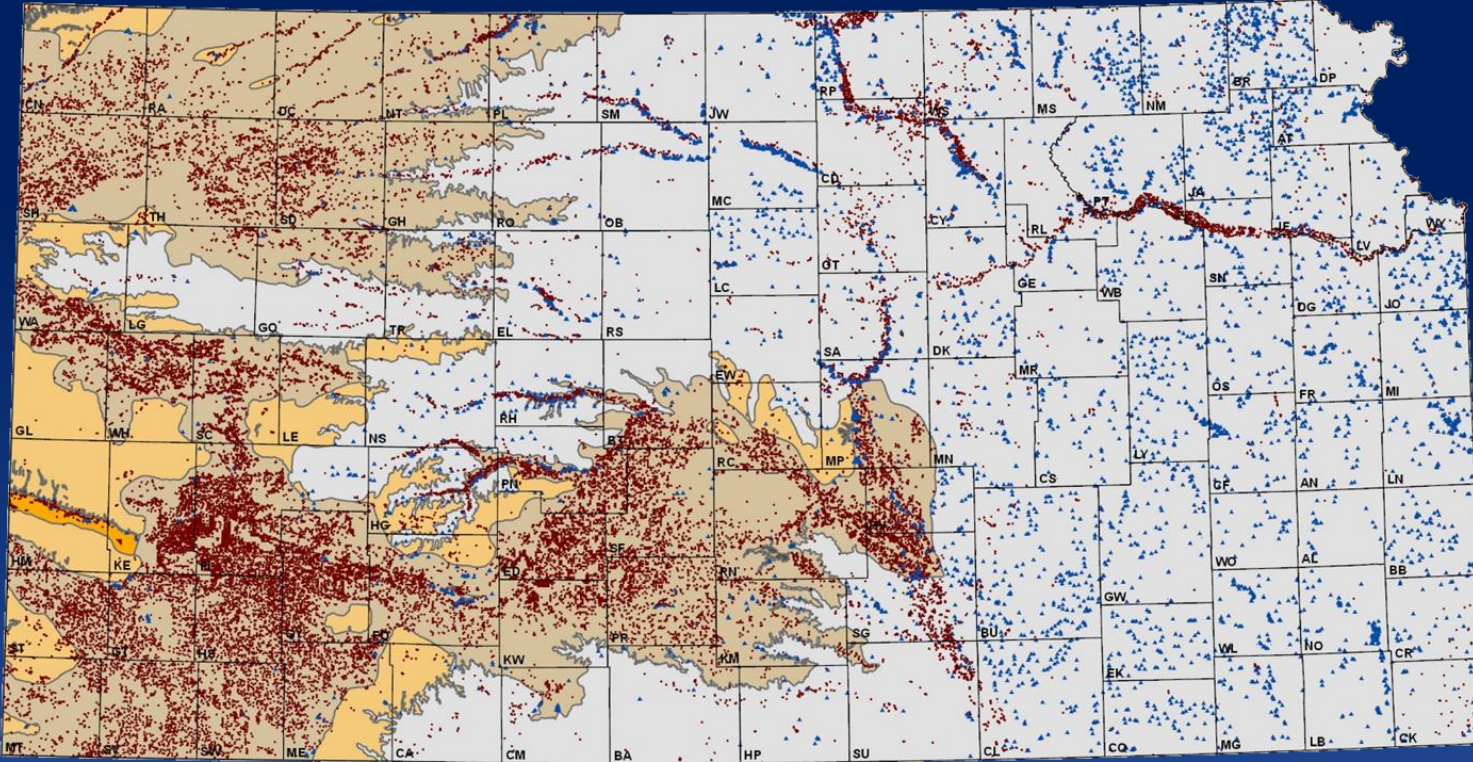
Measuring Wells in Kansas



- **Water Information Storage and Retrieval database (WIZARD)**
- **Wells measured by the GMDs 2 and 5, KDA-DWR, USGS, and the KGS**
- **Cooperative Water Level Network**
 - **Focused on High Plains aquifer**
 - **Annual measurements**
 - **Regional aquifer characterizations**



Reported Water Use in Kansas

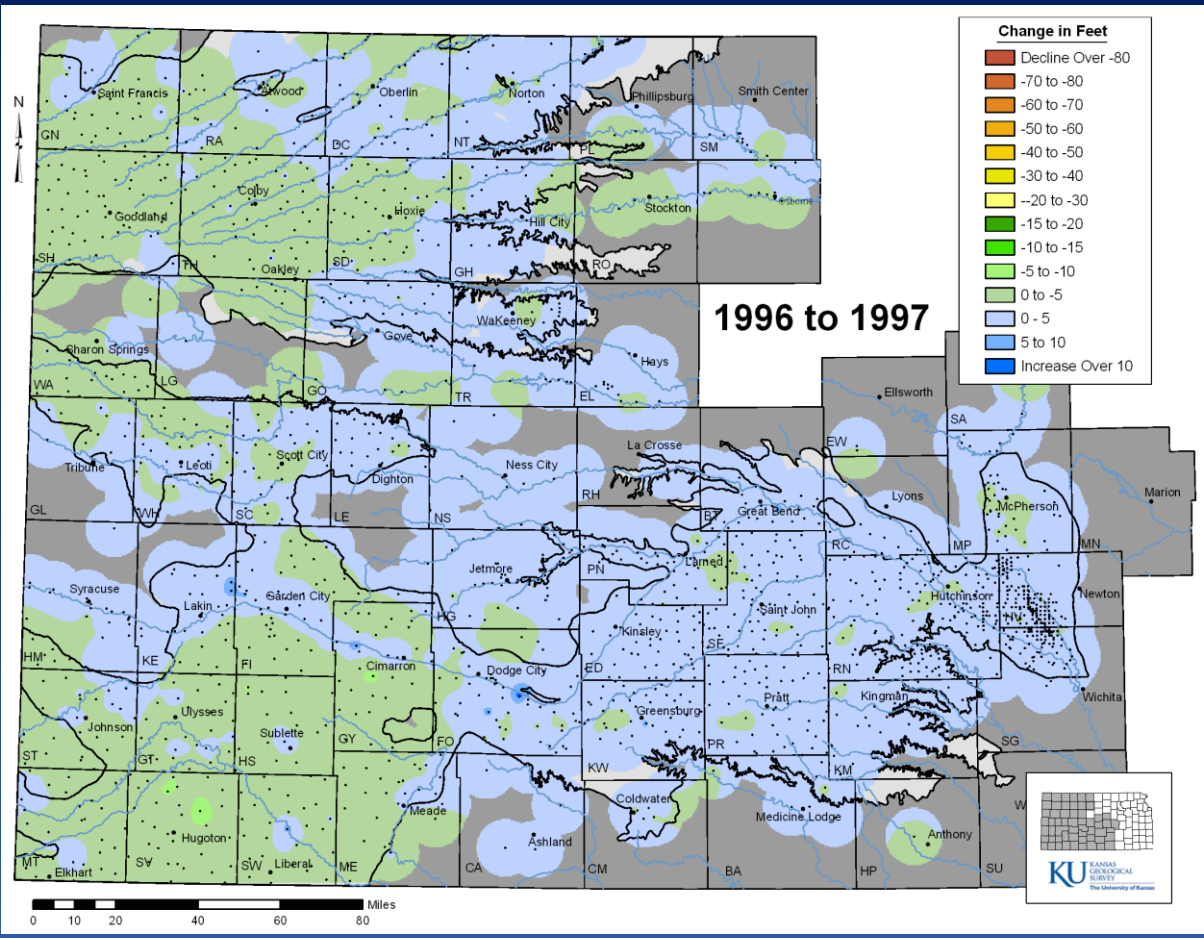


- Water Information Management and Analysis System (WIMAS)
- Kansas Department of Agriculture, Division of Water Resources
- Water Rights
 - Authorized Annual Permits/Certificates
 - Historic Reported Water Usage

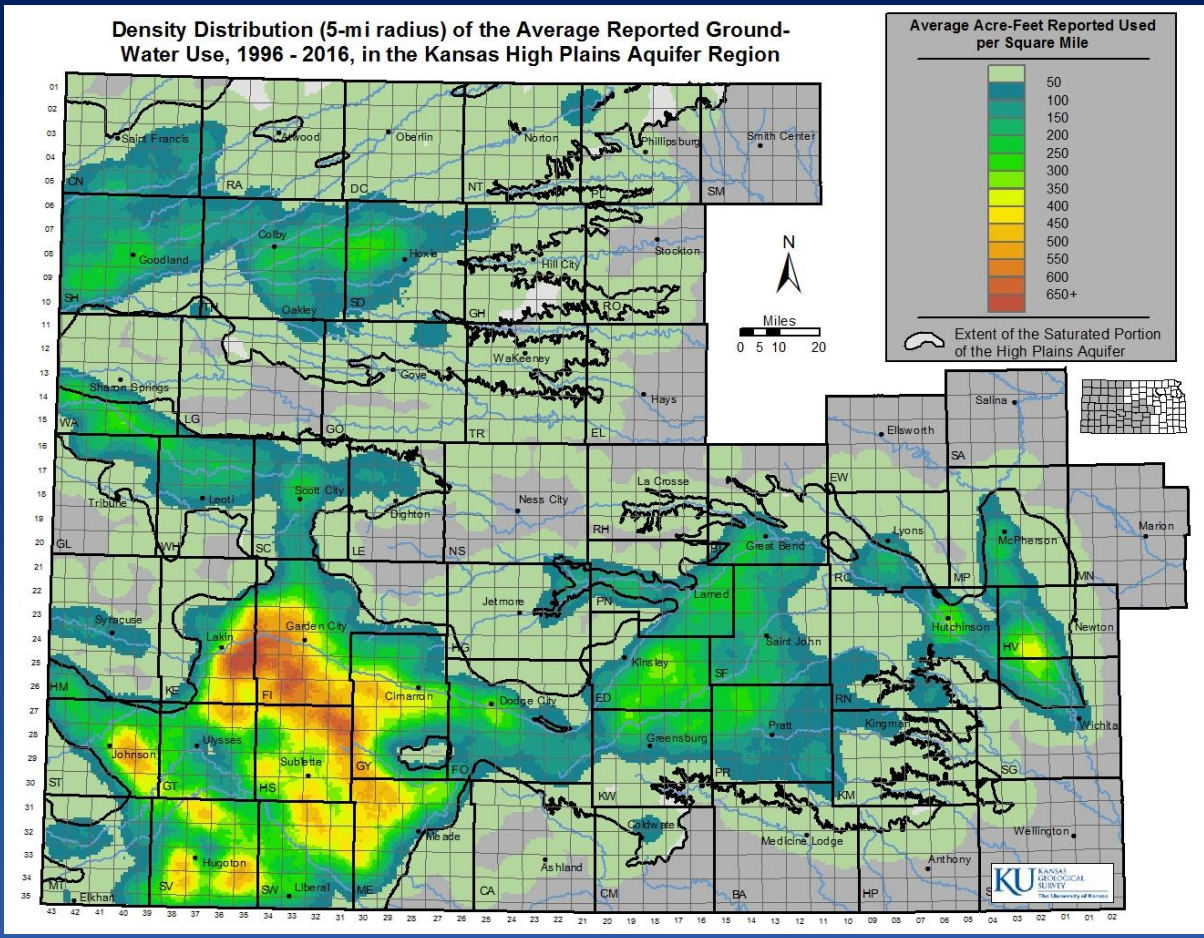


How far out of whack are we?

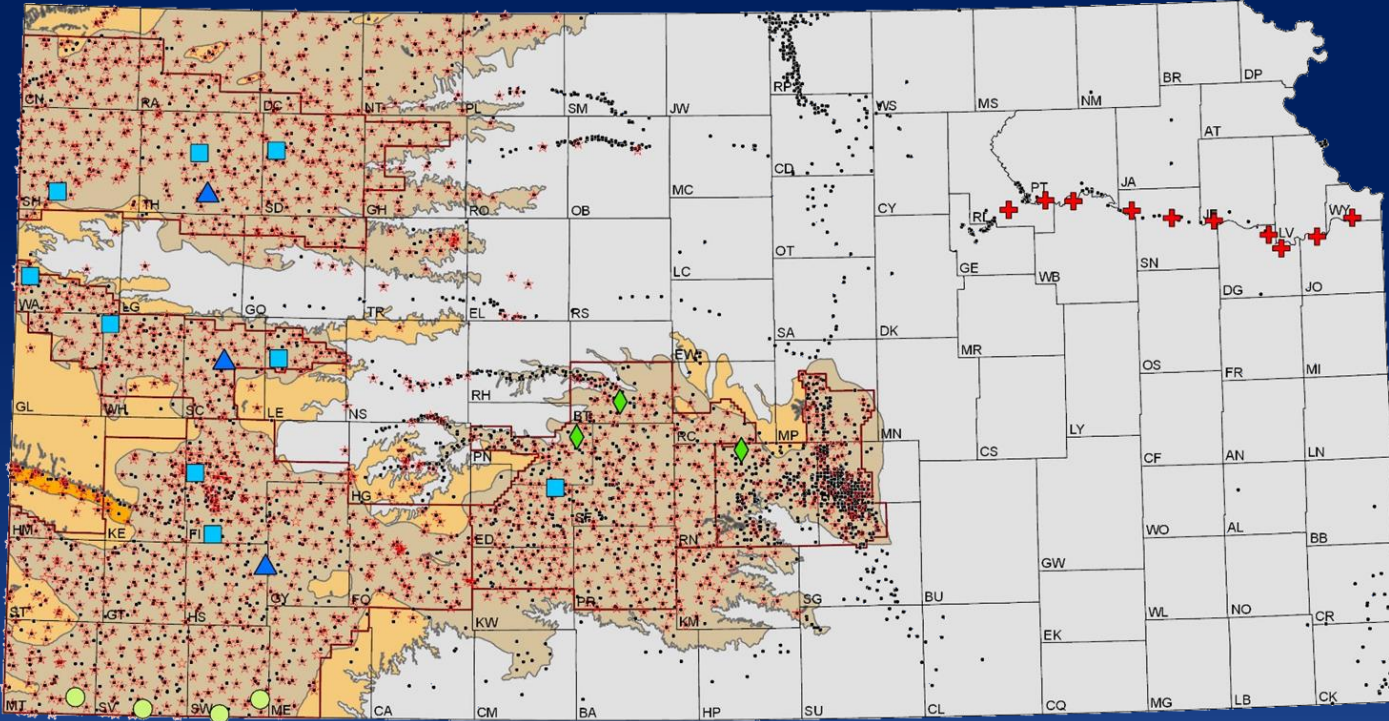
Water Level Change



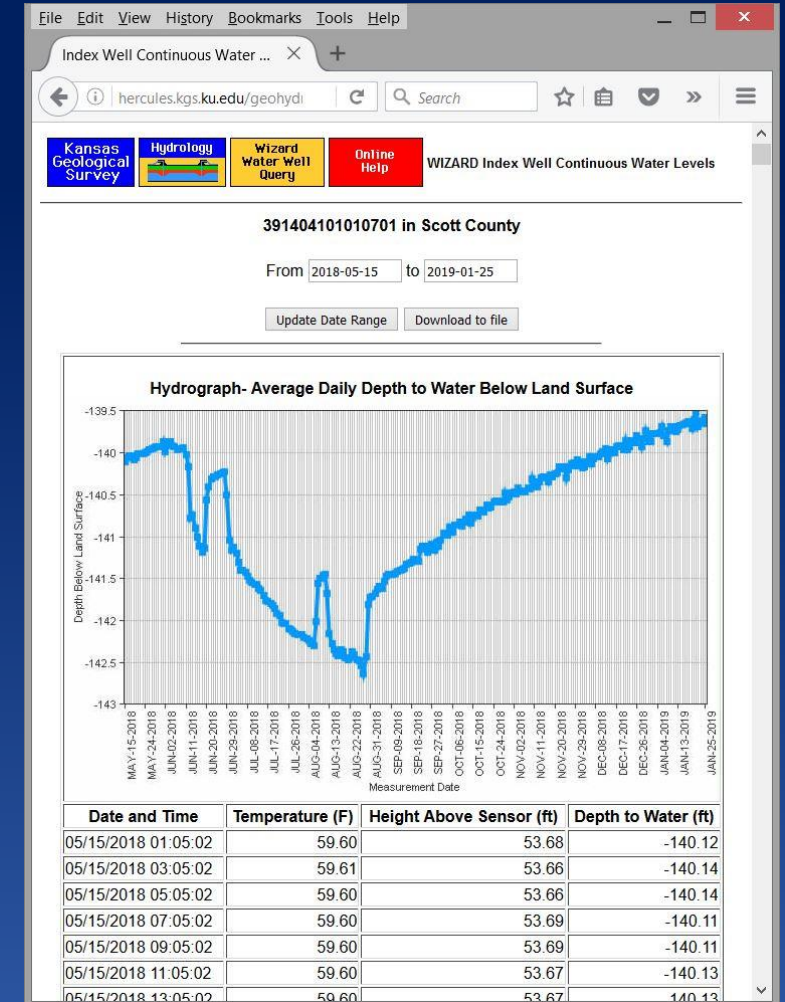
Groundwater Usage



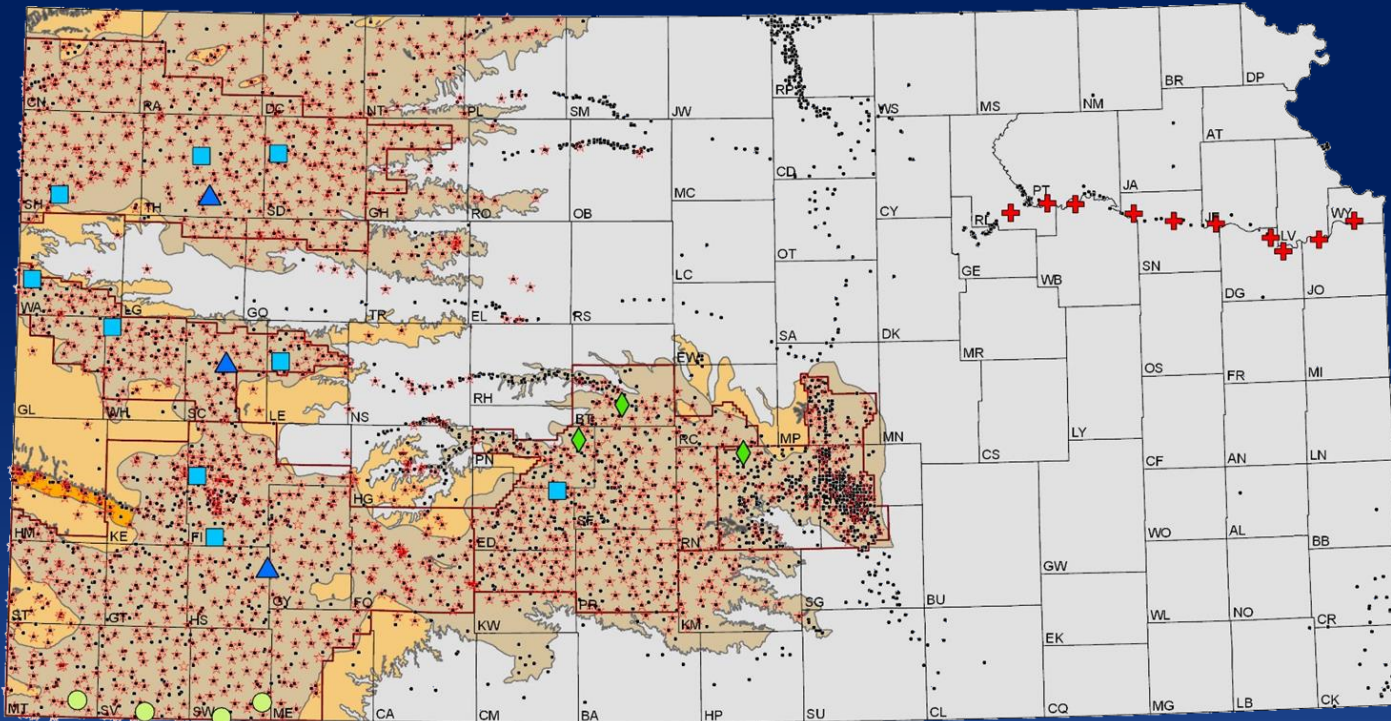
Kansas Index Well Program



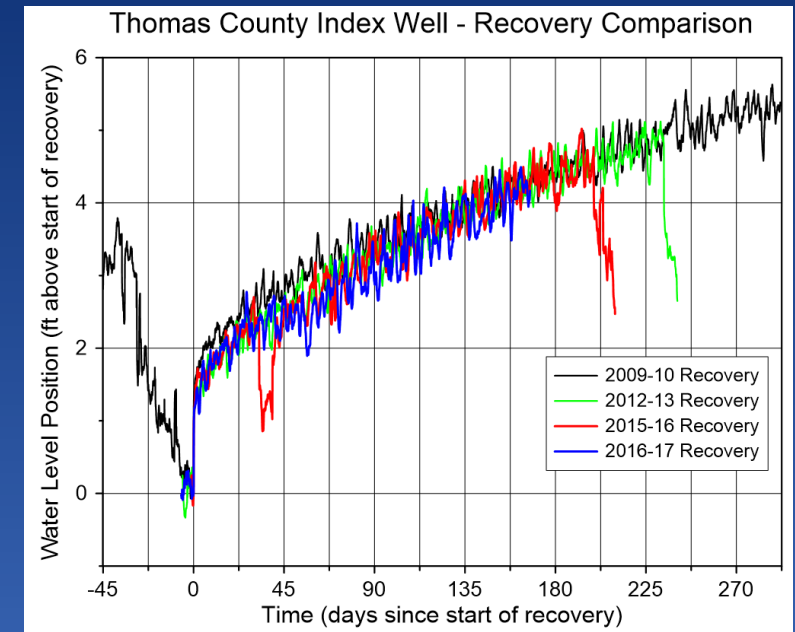
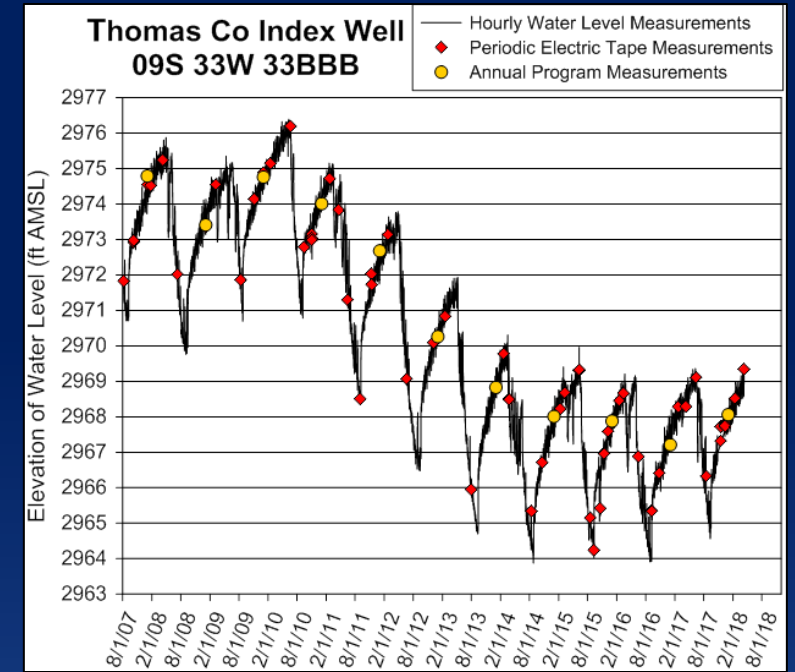
- First installed in 2007 through the Kansas Water Pan Fund
- Continuous, real-time water-level recordings
- Characterizations at the local scale



Thomas County Index Well

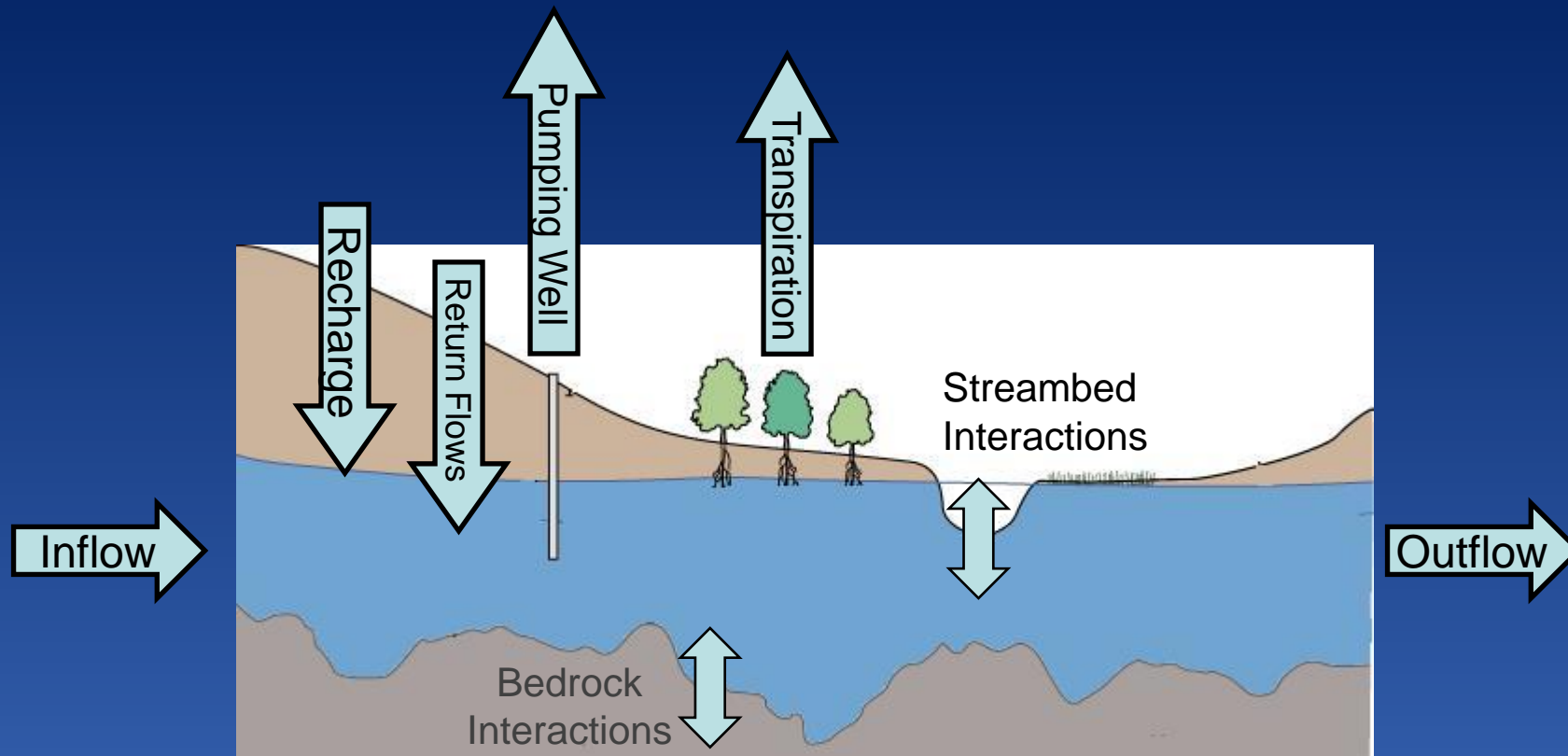


- Water levels are not in a constant state of decline
- End-of-season recovery is similar regardless of past pumping or climatic conditions



Aquifer Water Balance

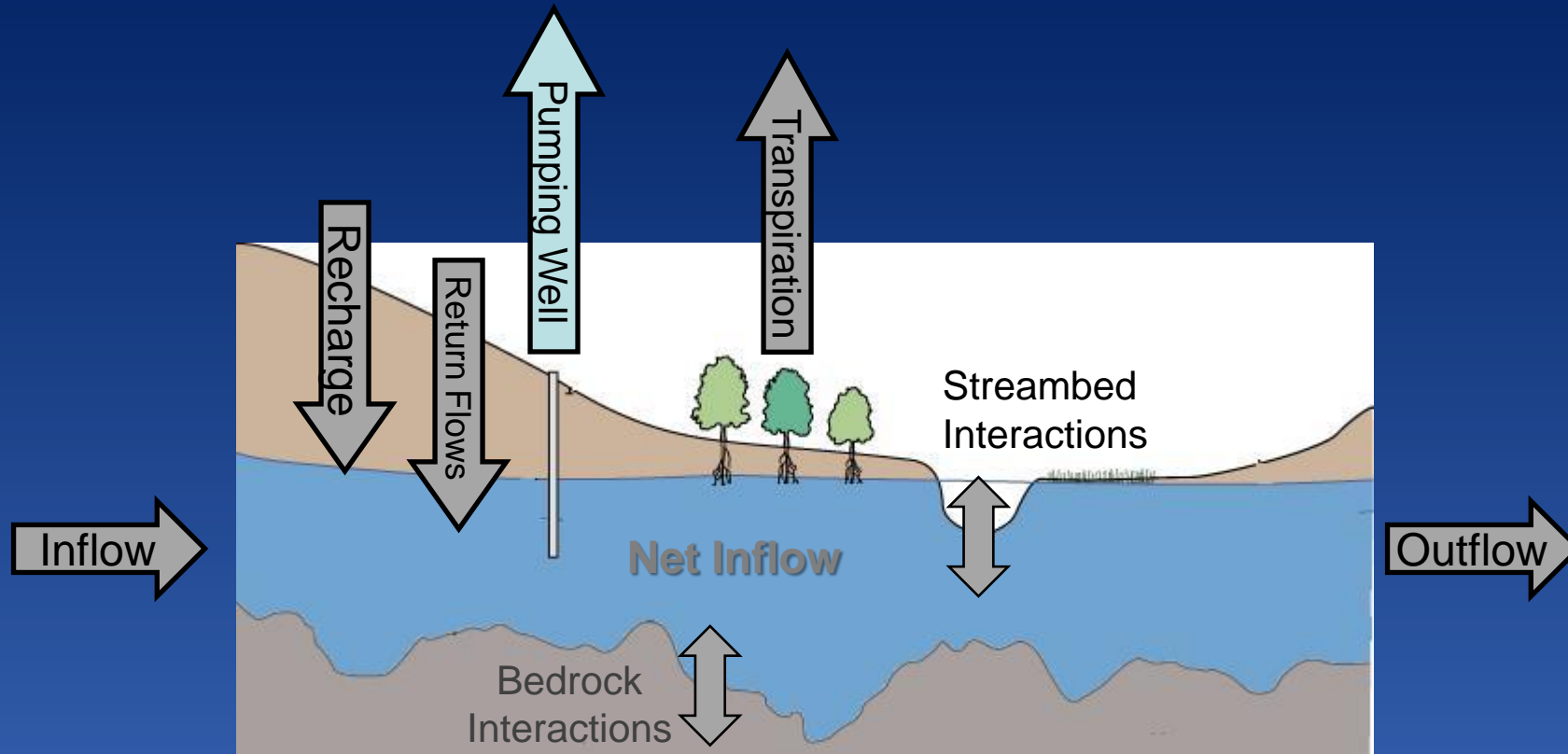
Water Volume Change in Aquifer =
Inflows into Aquifer – Outflows from Aquifer



Rewrite for Net Inflow and Pumping

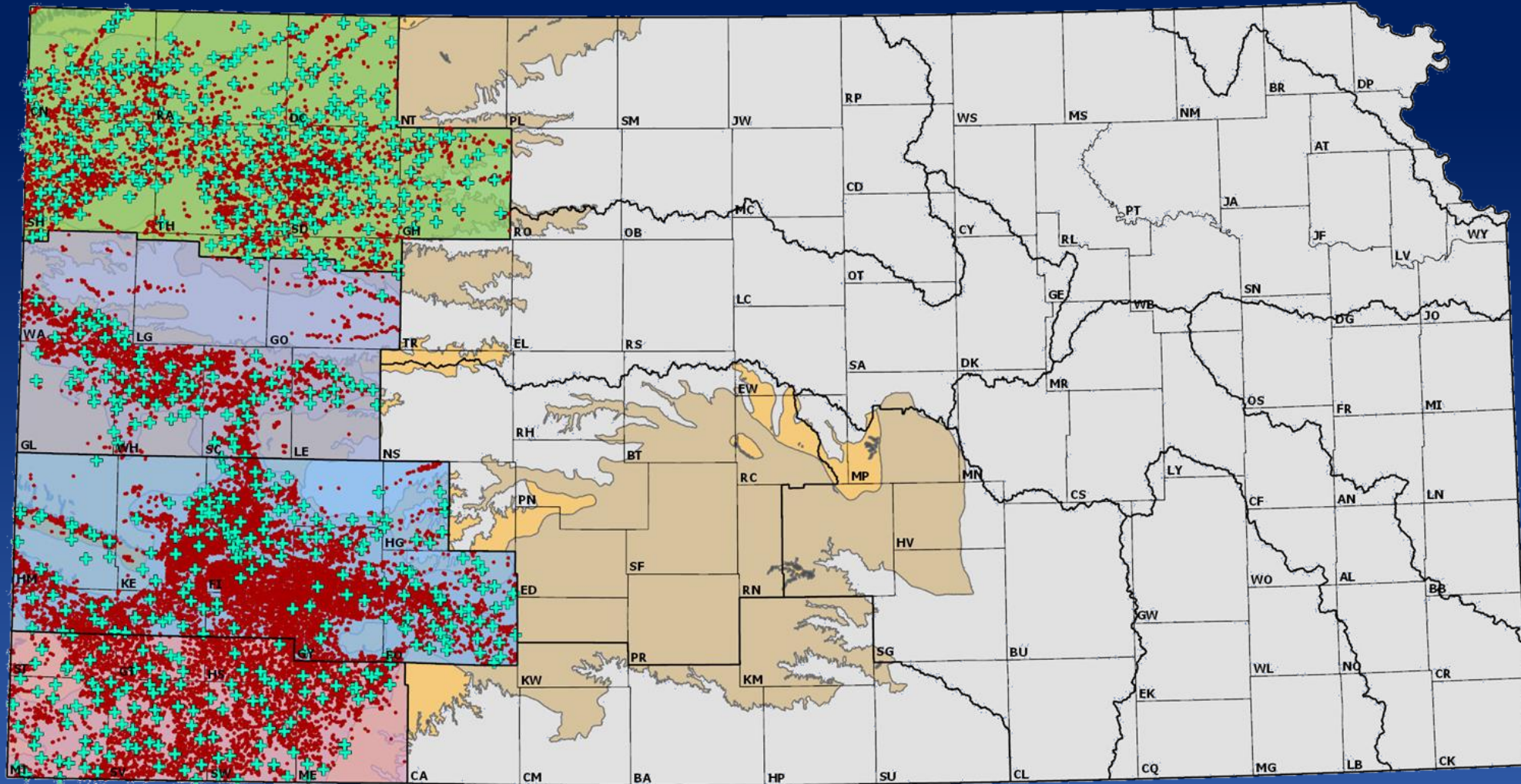
Water Volume Change in Aquifer =
Inflows into Aquifer – Outflows from Aquifer

Water Volume Change in Aquifer =
Net Inflow – Pumping



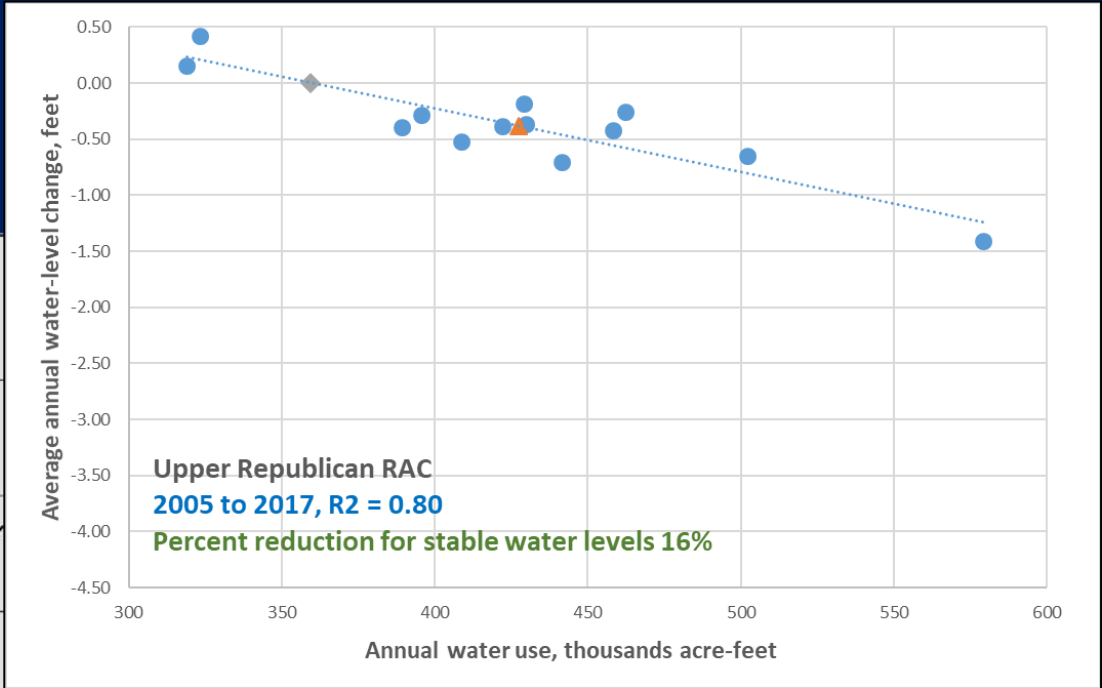
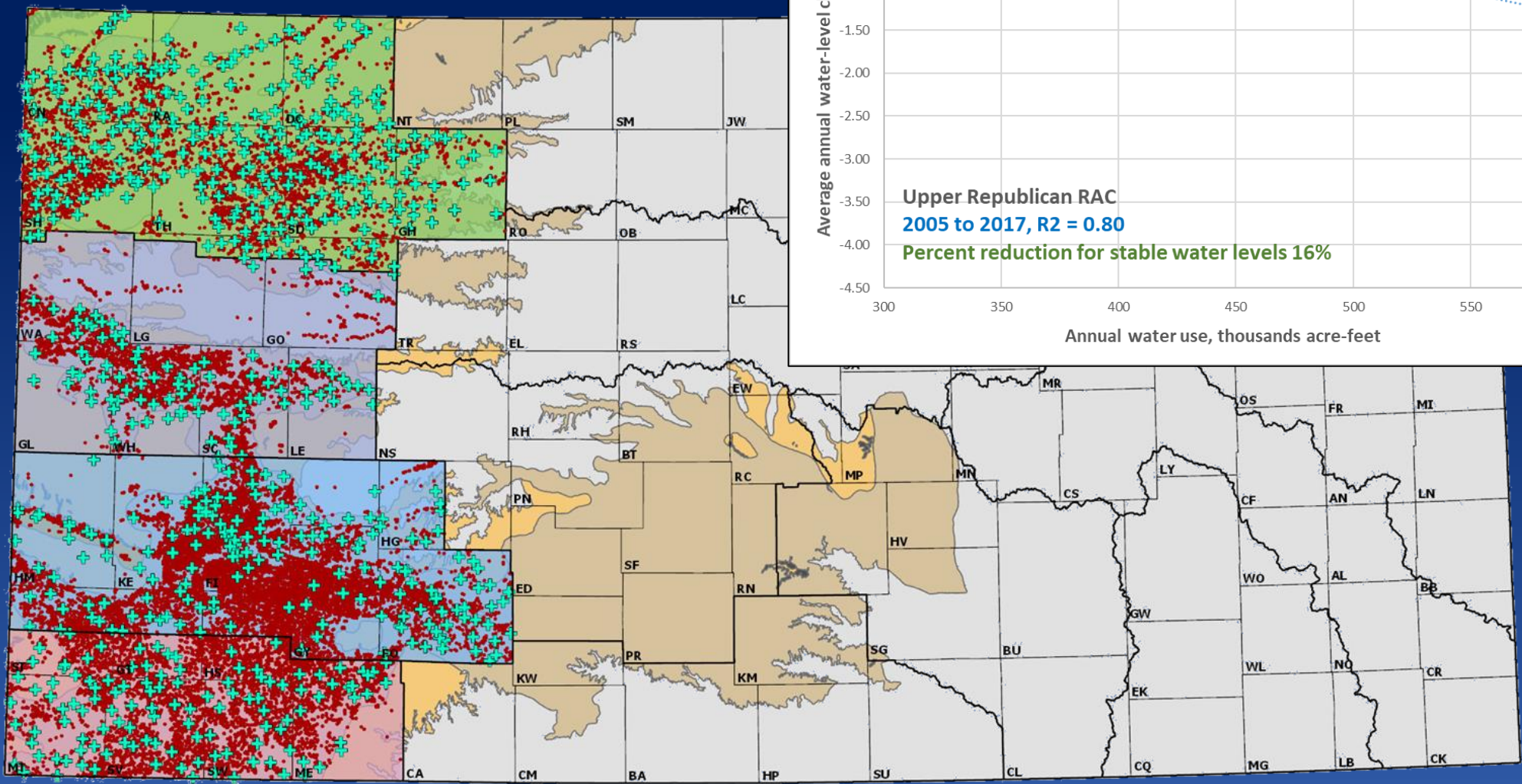
Water-Level Change vs Reported Water Use

Selected KWO Regional Advisory Committee Areas

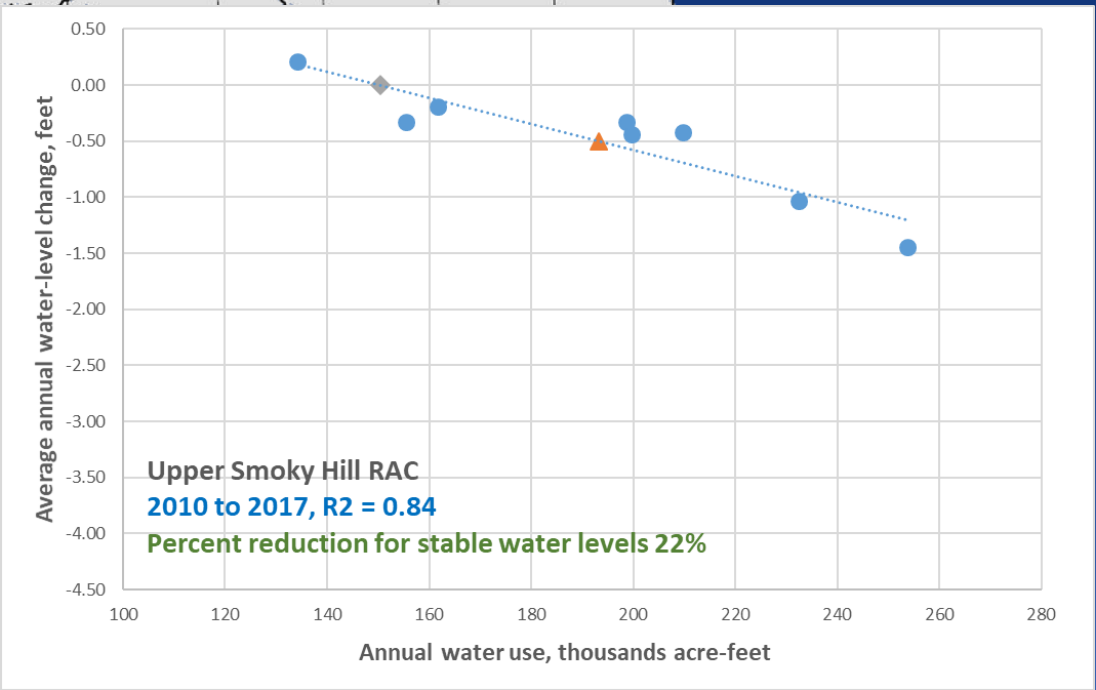
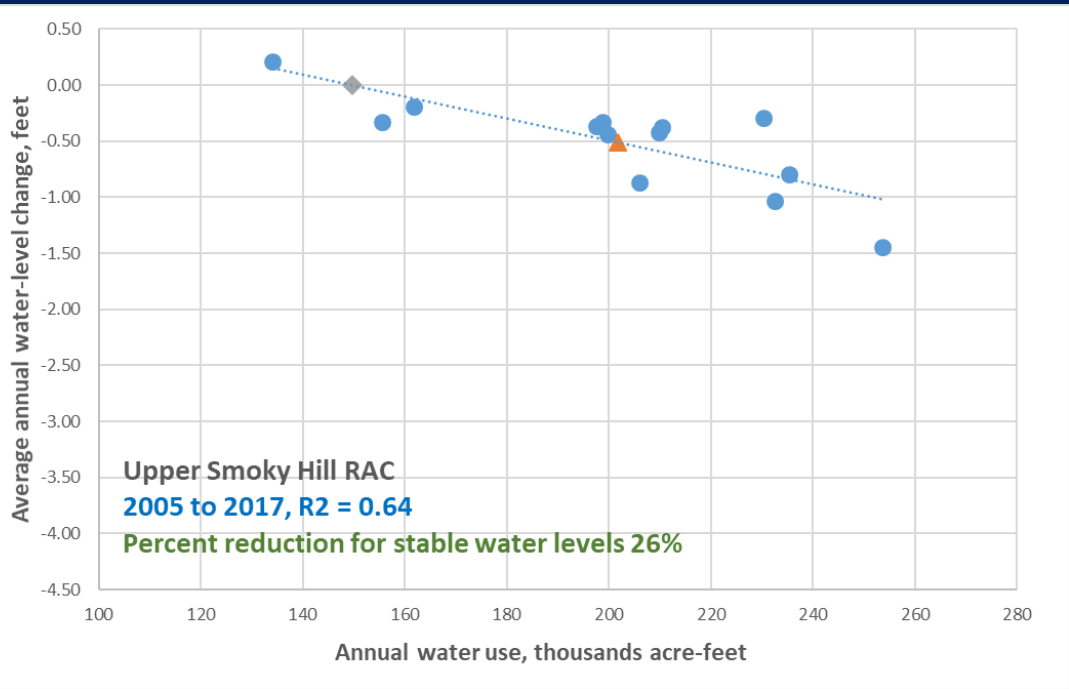
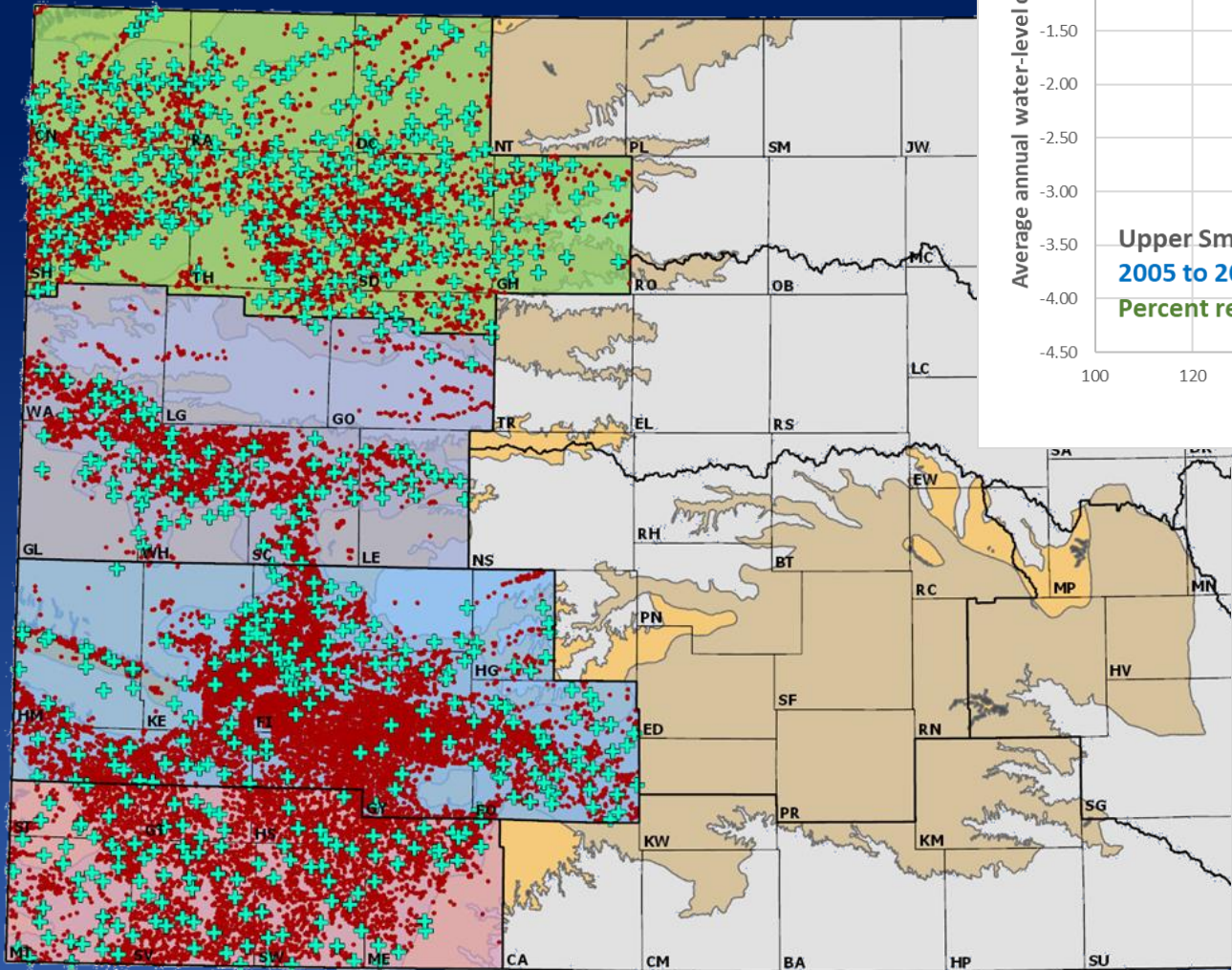


- Water right permitted groundwater well
- + Continuously measured (annual) groundwater well, 2005 to 2018

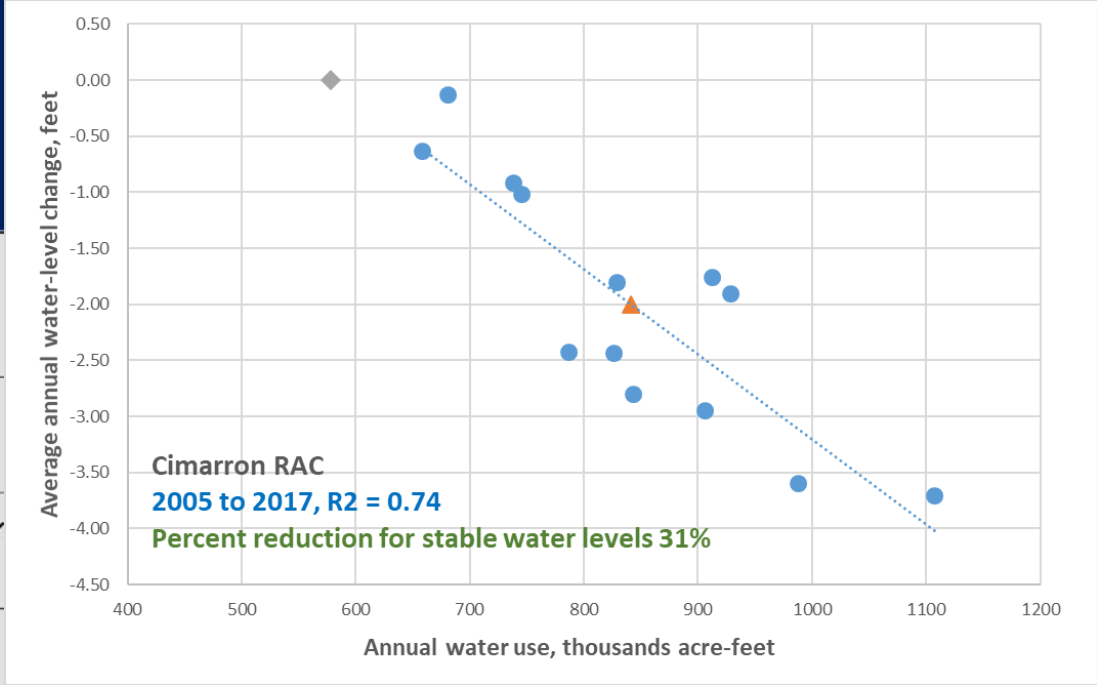
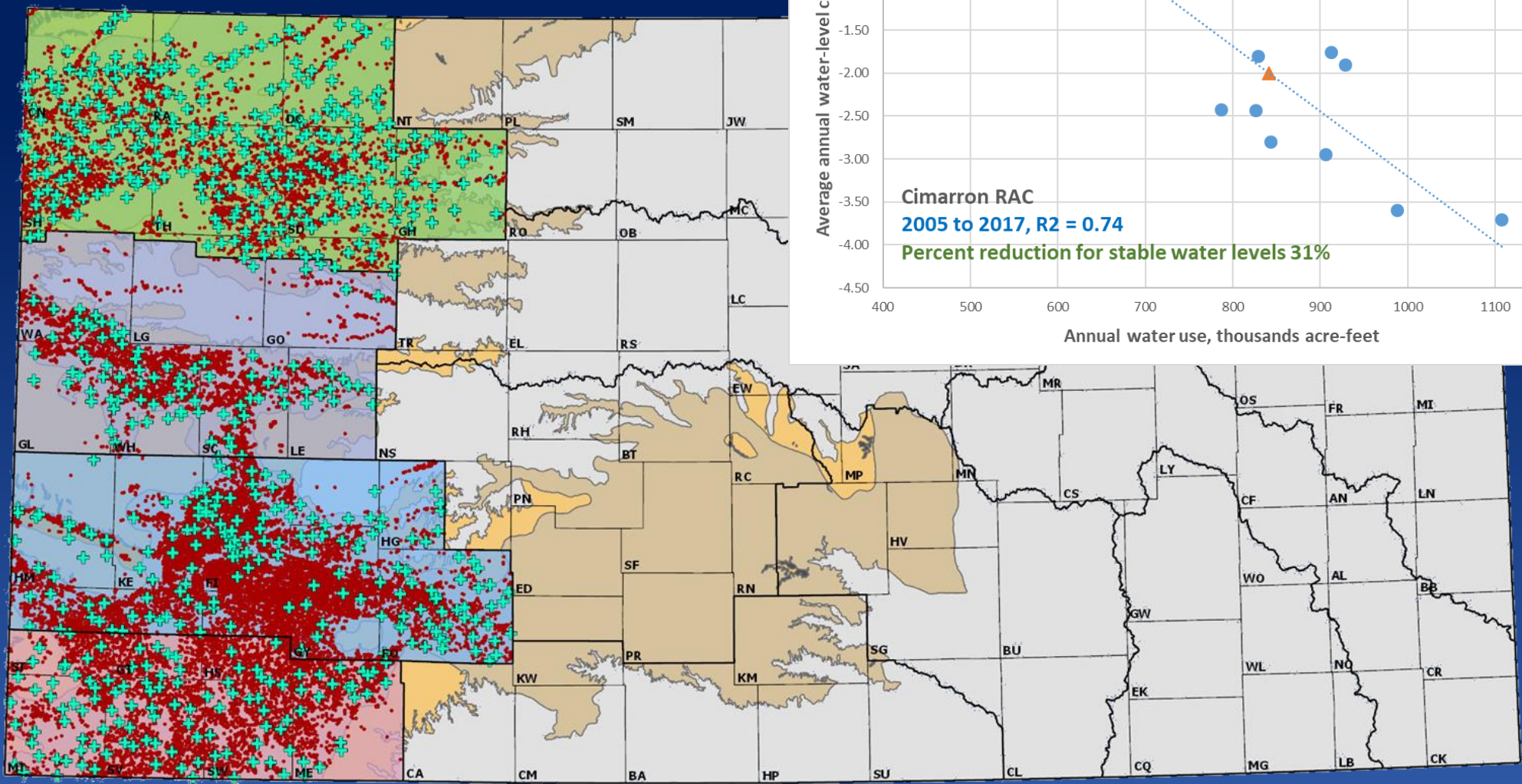
Upper Republican RAC



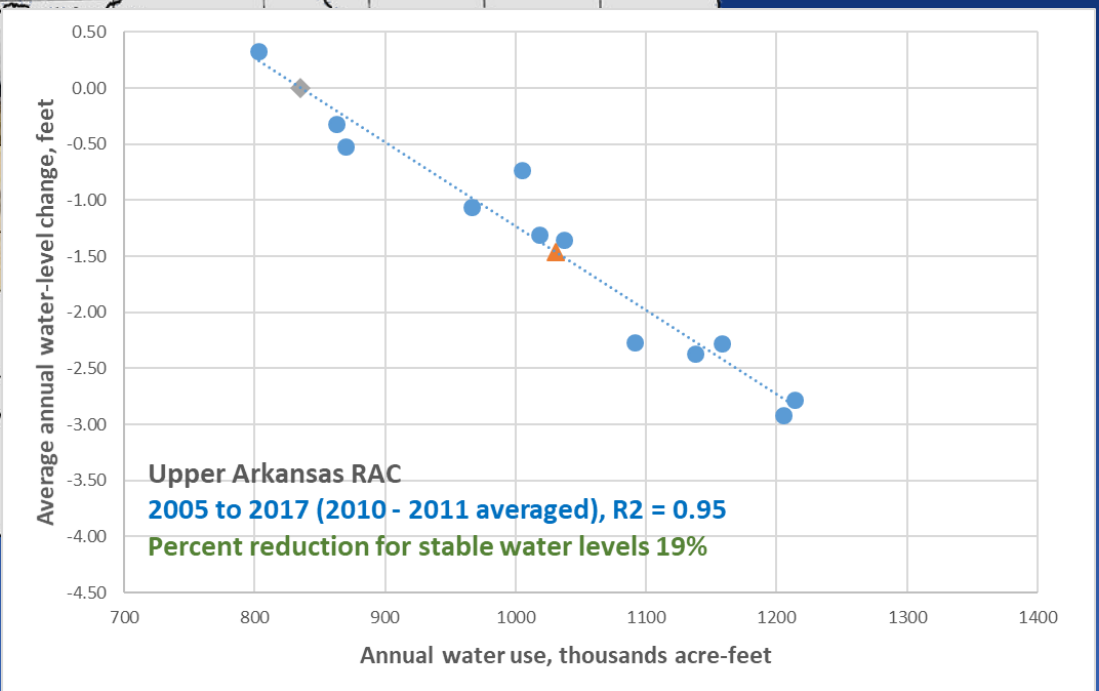
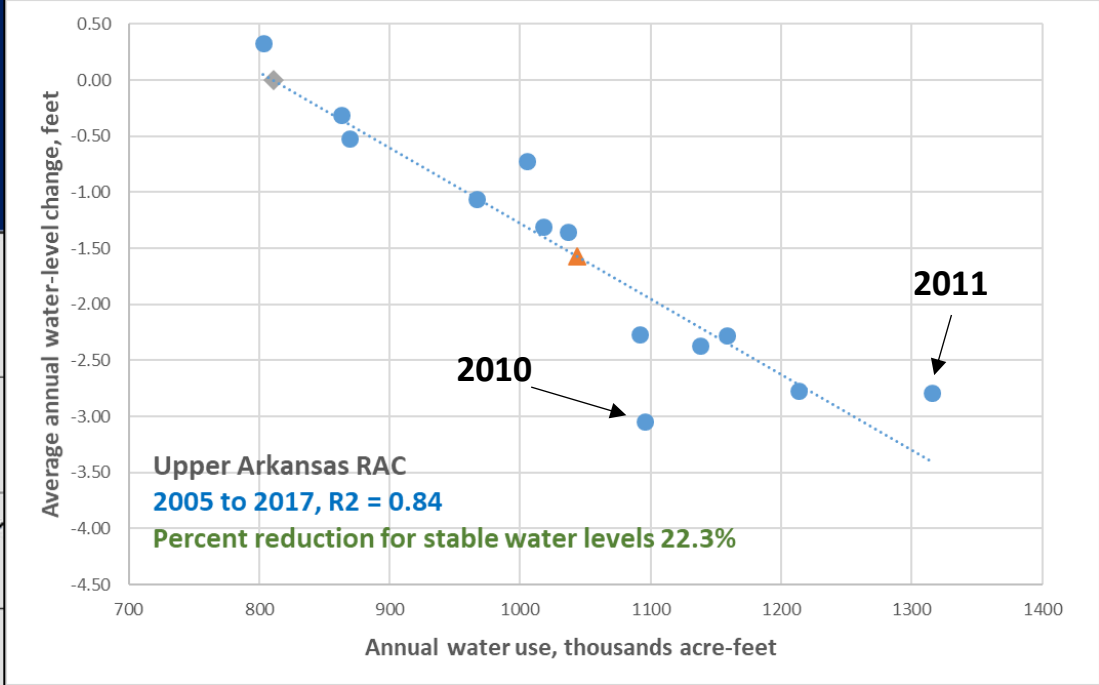
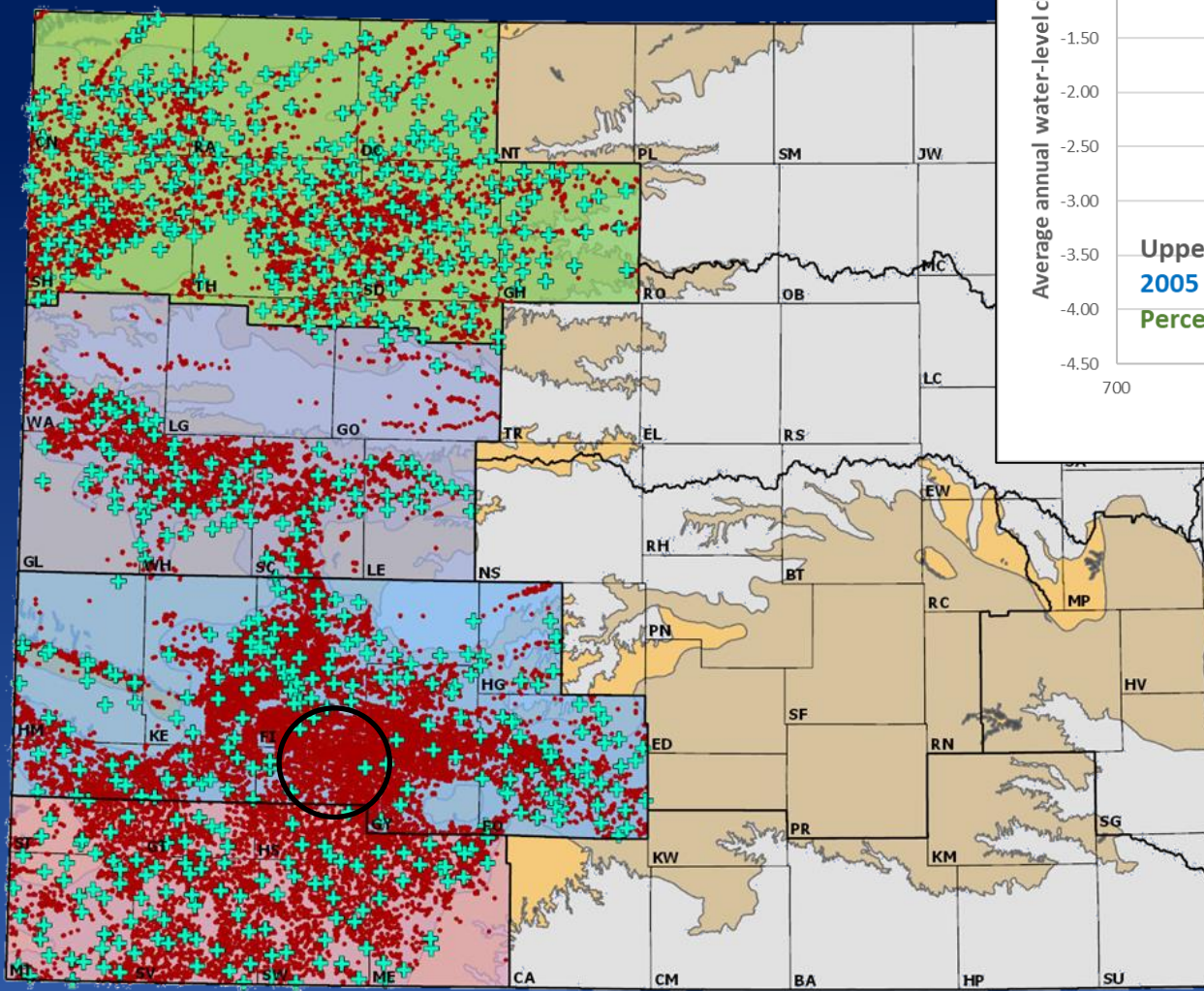
Upper Smoky Hill RAC



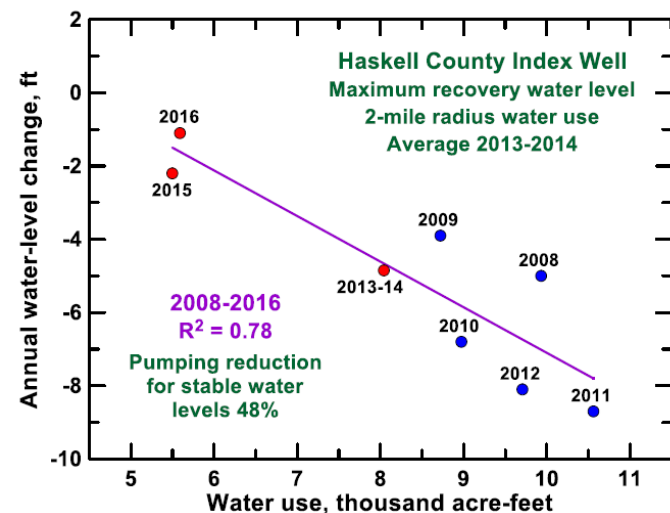
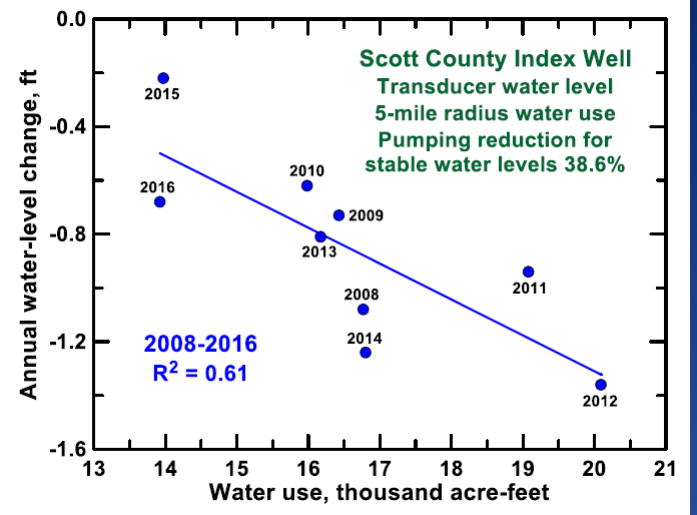
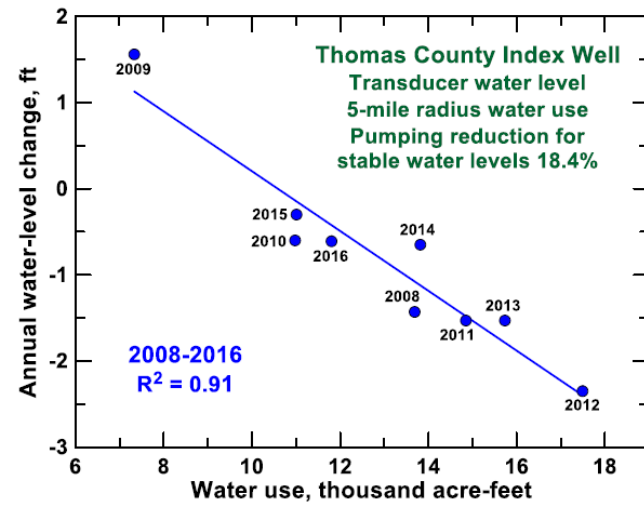
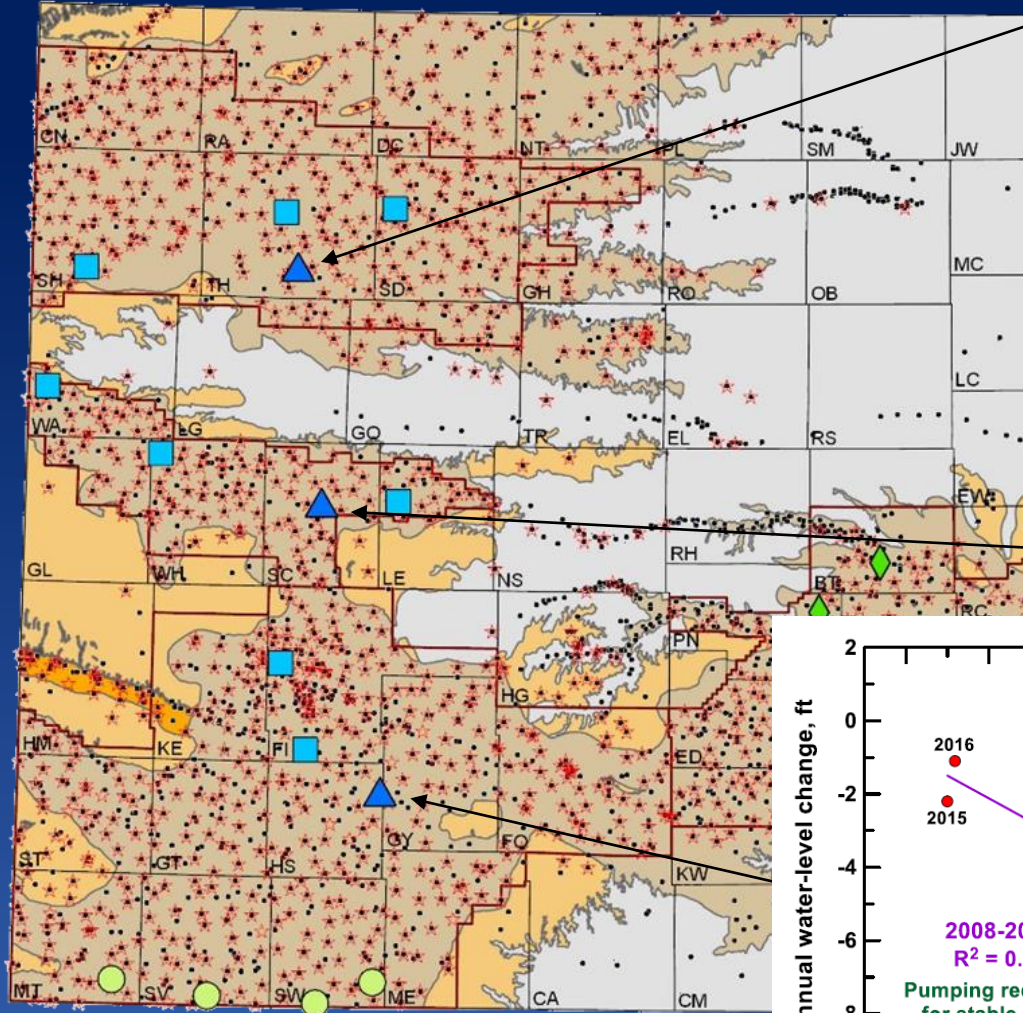
Cimarron RAC



Upper Arkansas RAC

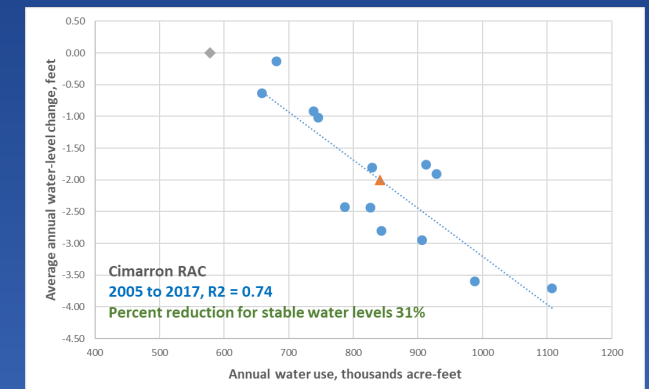
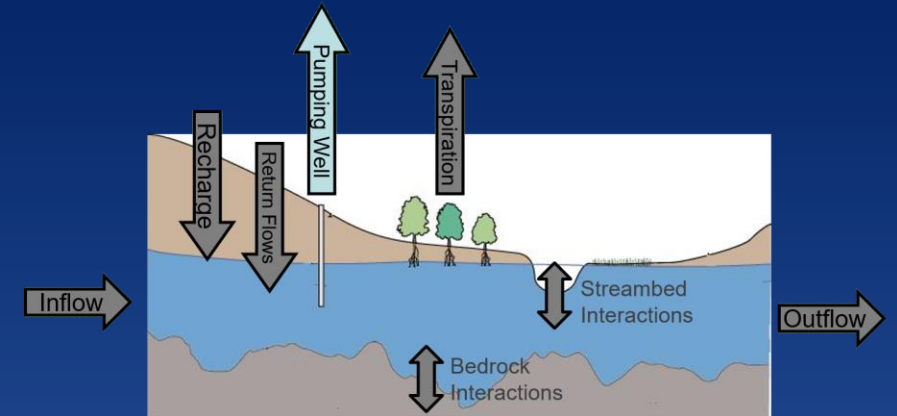
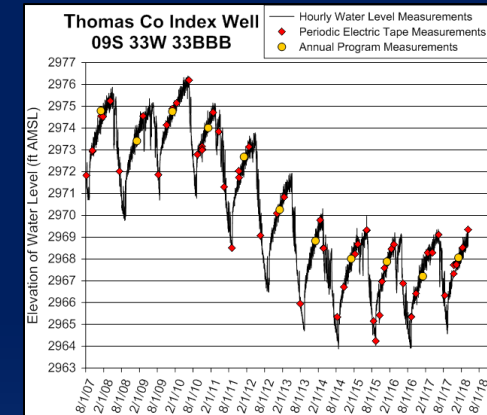


Kansas Index Wells

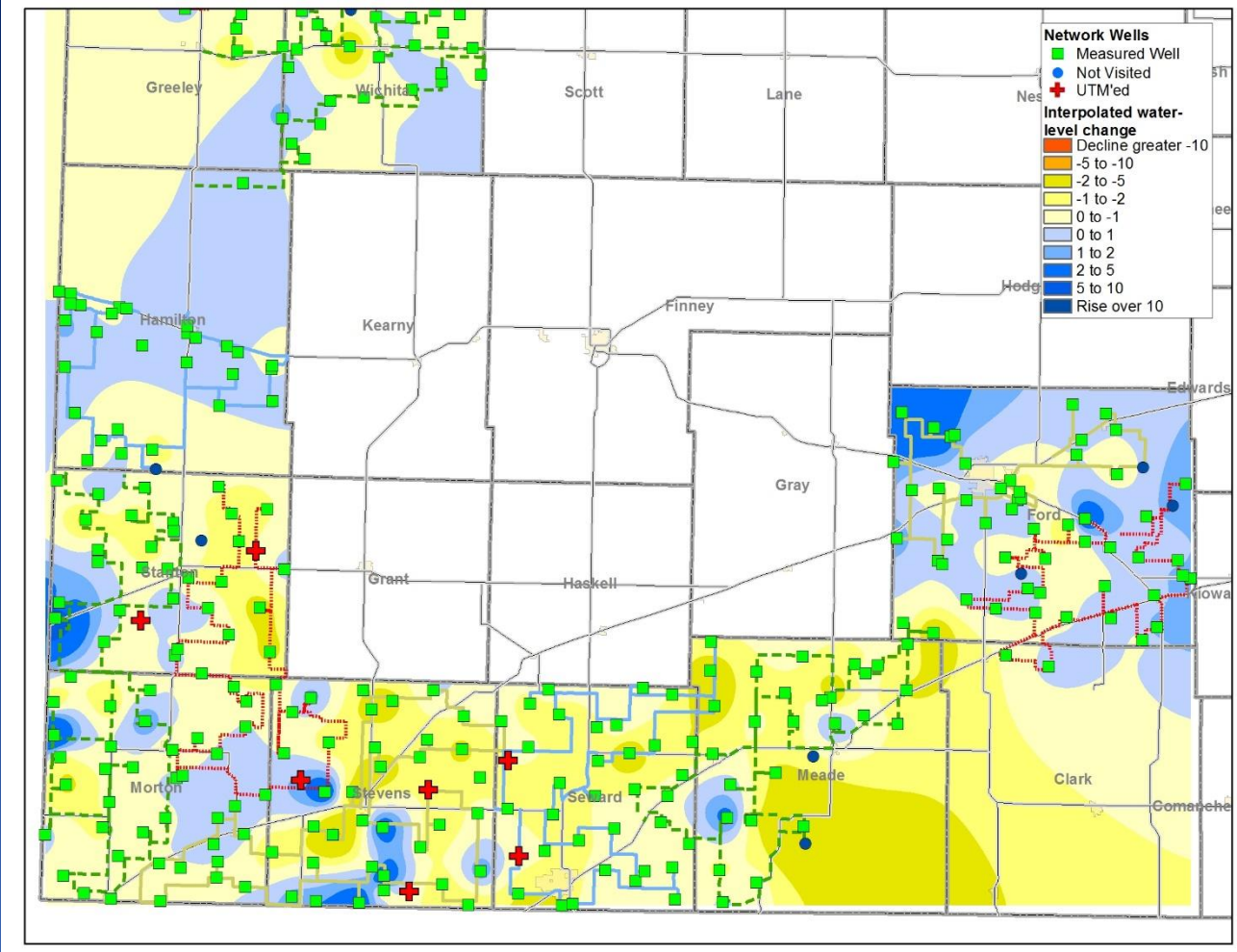
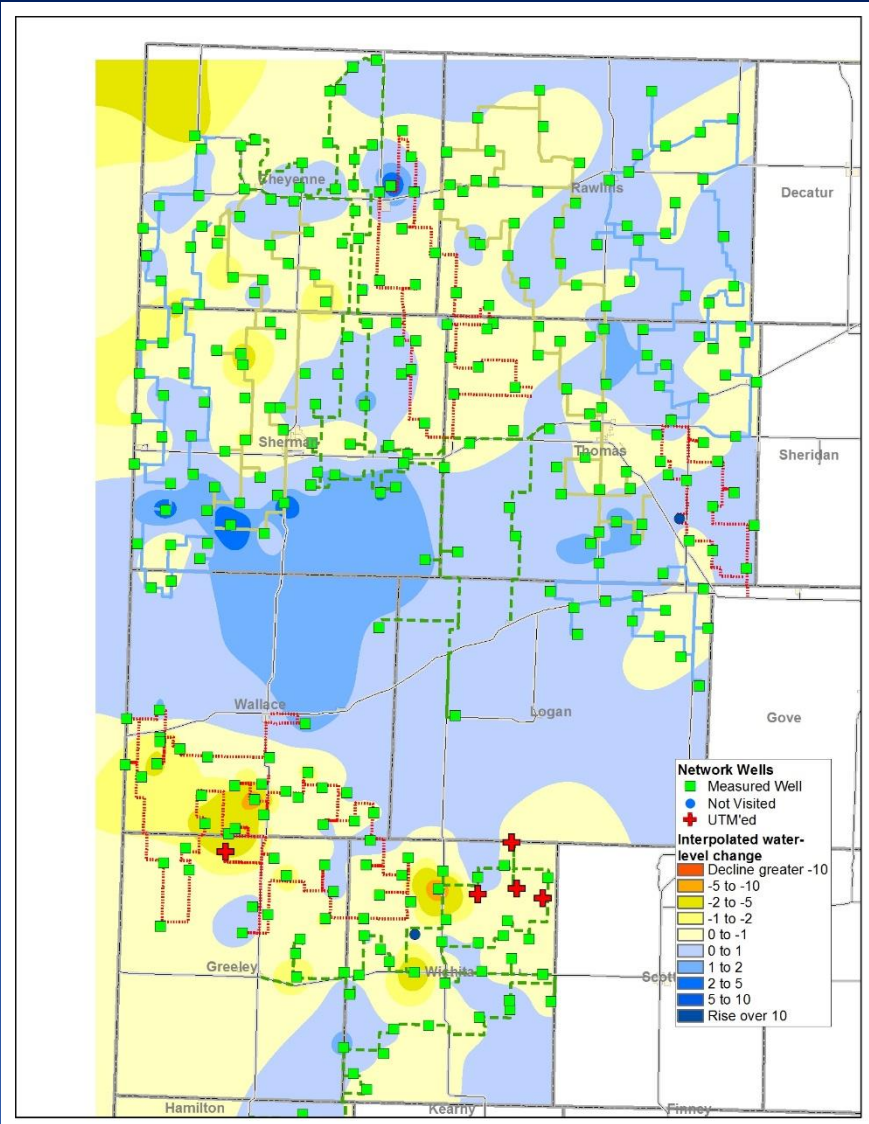


Water Balance Approach in Summary

- Data-driven approach that allows quick assessments of aquifer responses to changes pumping.
- Key findings over traditional estimates:
 - Lower percent reduction in pumping to achieve stable water levels.
 - Larger-than-expected net inflows.
 - Lower Specific Yield values.
- Not meant to be a replacement for numerical flow models, rather help constrain and form modeled aquifer parameters.
- Areas should be reassessed over time to take into account changes pumping and climatic conditions.

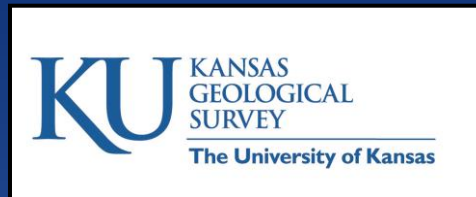


Super Preliminary and Incomplete 2018-2019 Water-Level Results



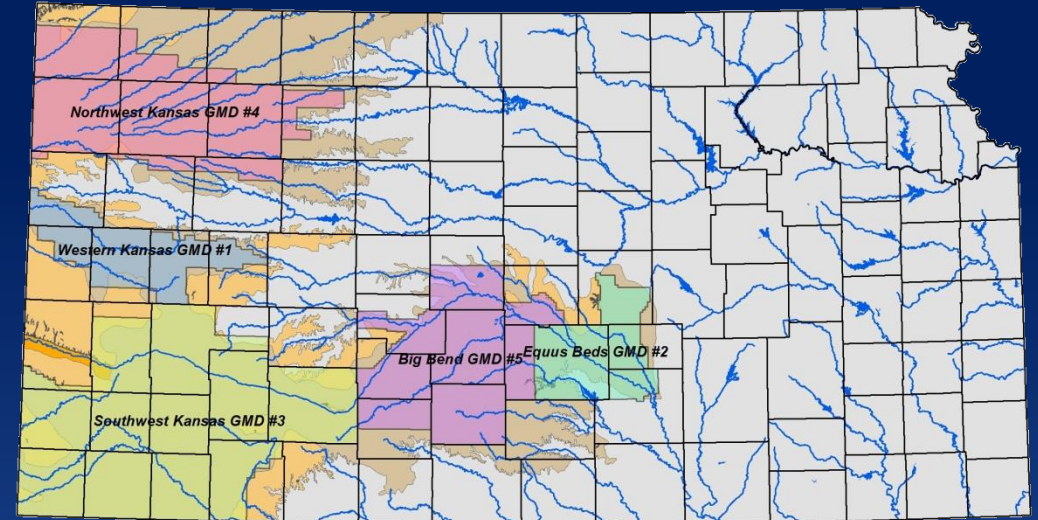
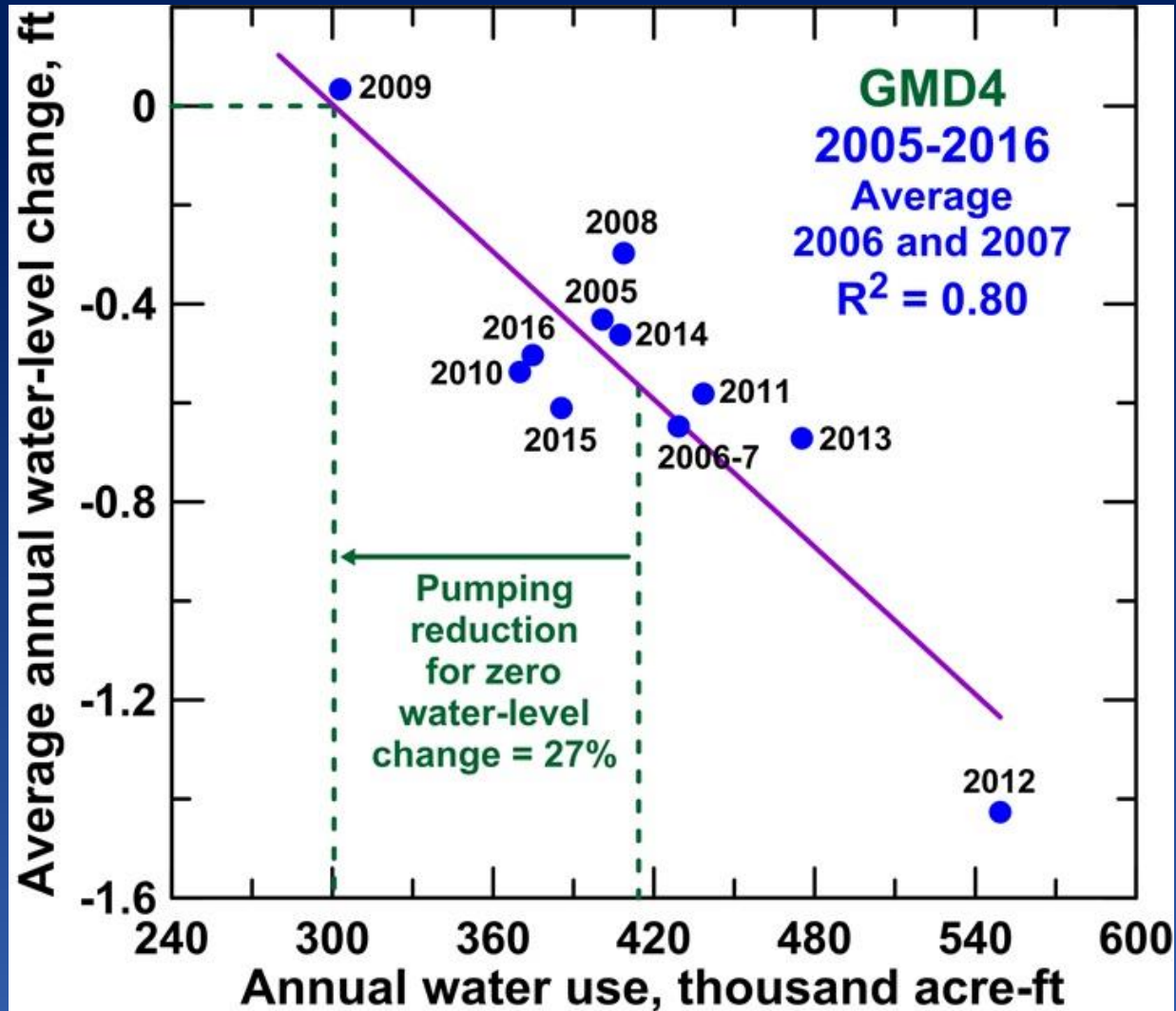
Questions????

**Kansas Geological Survey
1930 Constant Ave
Lawrence, KS 66047
785-864-2118**



Visit our site at
<http://www.kgs.ku.edu>

GMD4- Water Use and Water Level Change

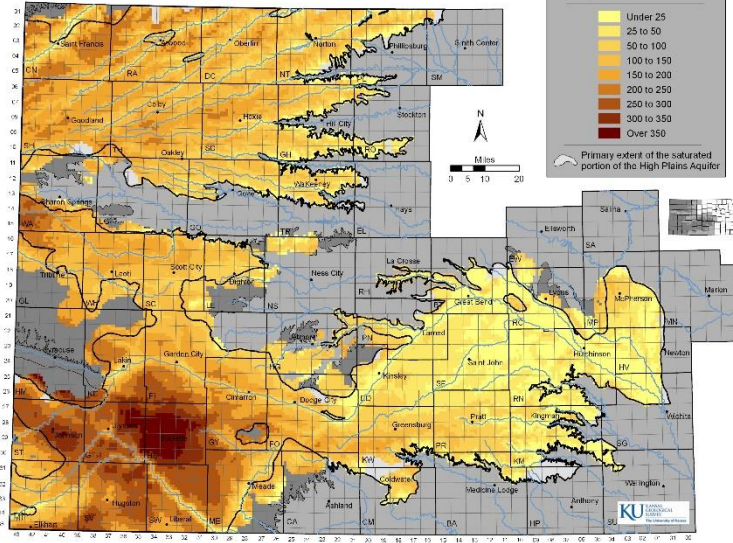


- Based on the data from 2005 to 2016
 - 27% reduction in the average amount of water reported used would produce stable water levels
 - Net inflow (water use at 0 decline) is 1.2 inches per year

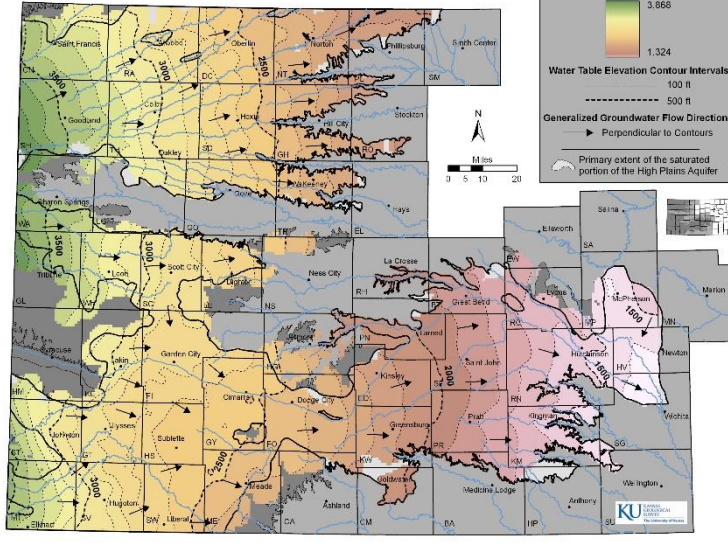
The High Plains Aquifer Atlas

http://www.kgs.ku.edu/HighPlains/HPA_Atlas/index.html

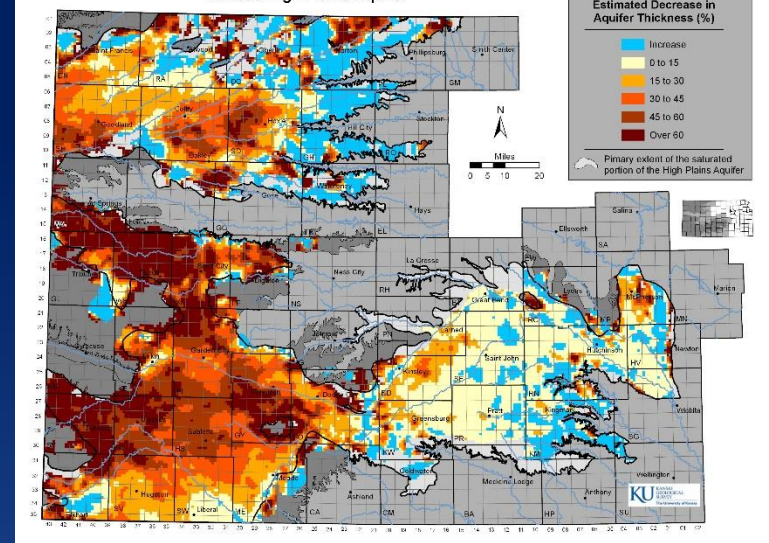
Average 2016-2018 Depth to Water, Kansas High Plains Aquifer



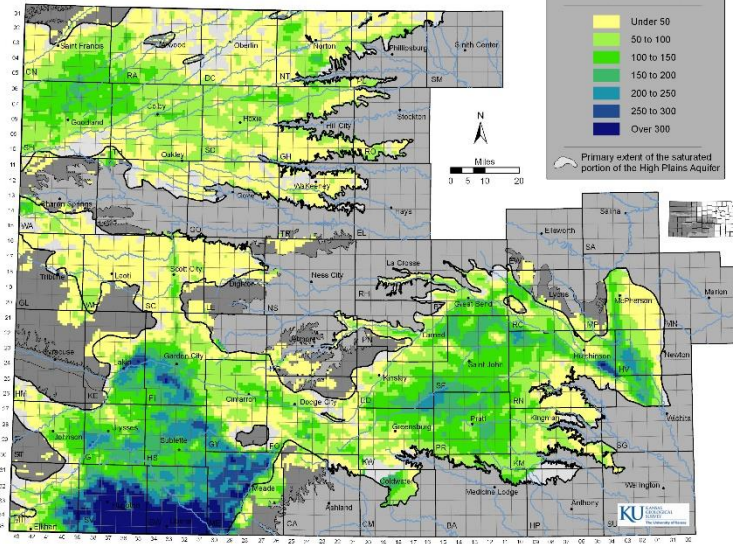
Average 2016-2018 Water Table Elevation, Kansas High Plains Aquifer



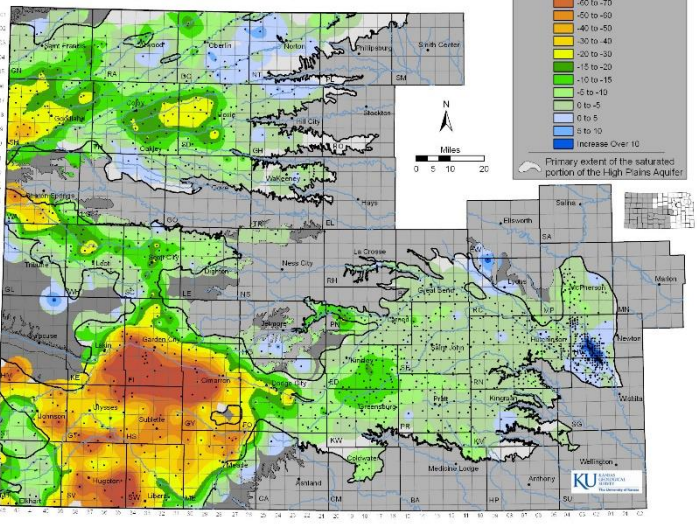
Percent Change in Aquifer Thickness, Predevelopment to Average 2016-2018, Kansas High Plains Aquifer



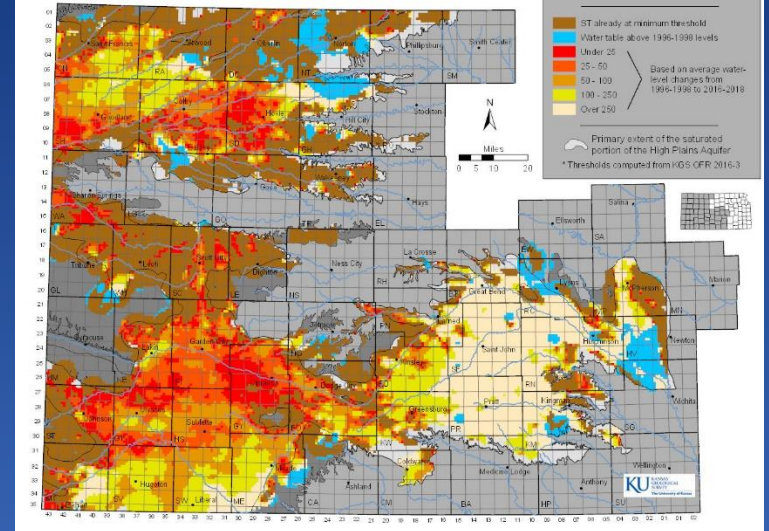
Average 2016-2018 Saturated Thickness, Kansas High Plains Aquifer



Interpolated Water Level Change, Kansas High Plains Aquifer, Average 1996-1998 to Average 2016-2018

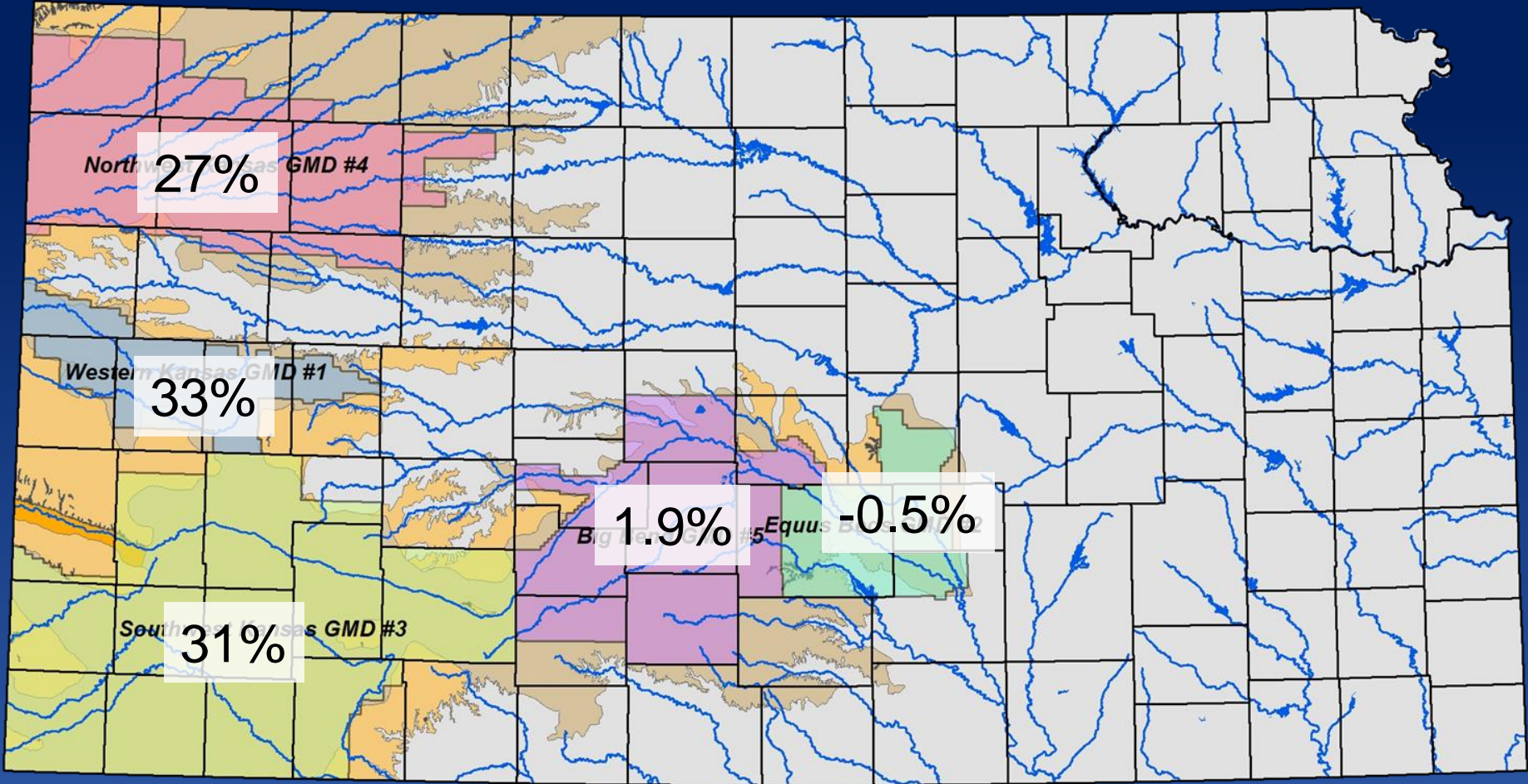


Estimated Usable Lifetime for the Kansas High Plains Aquifer (based on groundwater trends from 1996-1998 to 2016-2018 and the minimum saturated thickness required to support well yields at 200 gpm under 90 day of pumping scenario with 200 gpm wells on 14 sections)



Reductions in Pumping Needed to Achieve Stable Water Levels

Groundwater Management Districts



Reductions in Pumping Needed to Achieve Stable Water Levels

Special Areas and Selected Index Well Sites

