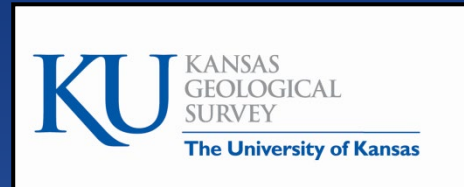


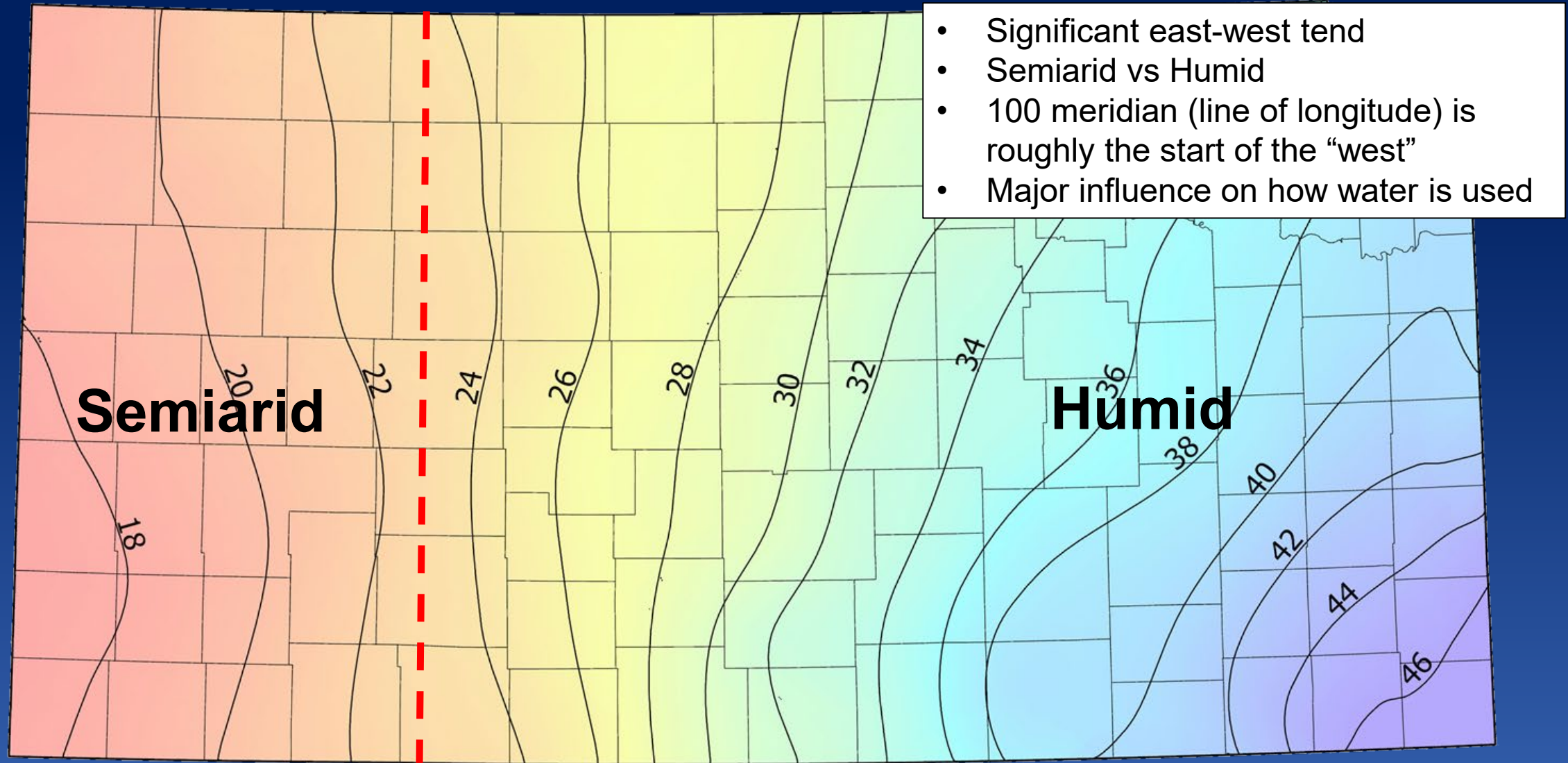
Conditions and Trends of the Kansas High Plains Aquifer

OAP Big Forage Research Planning Meeting
December 10, 2024



Kansas Geological Survey
University of Kansas

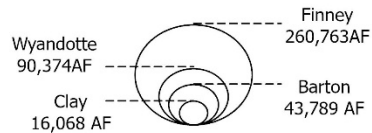
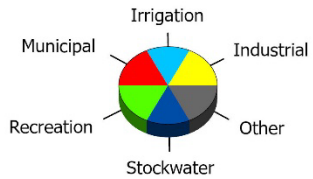
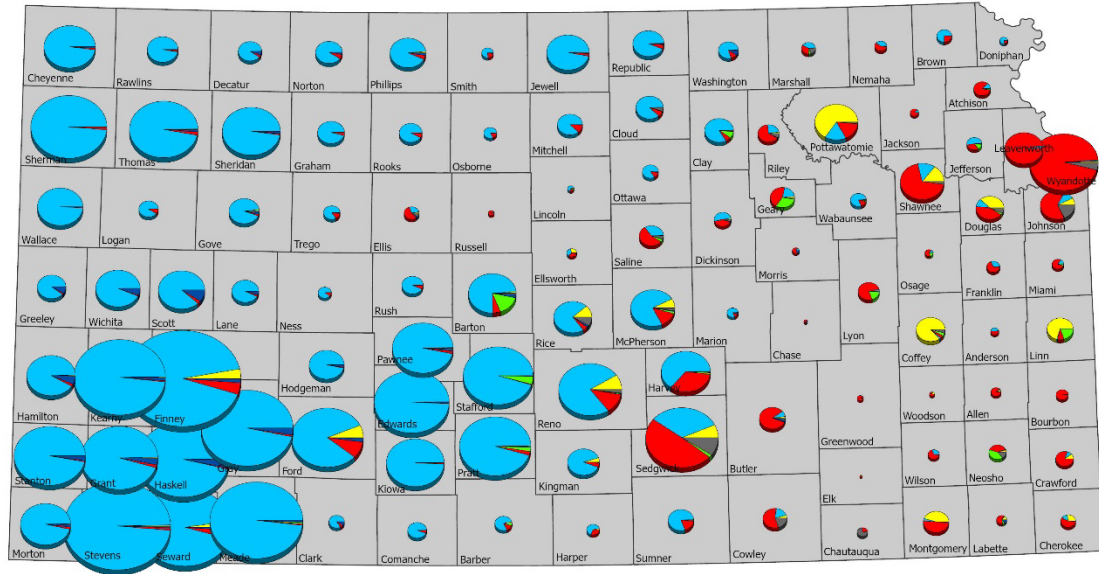
1991-2020 Normal Precipitation and Climate Zones



Source- Kansas State University Weather Data Library

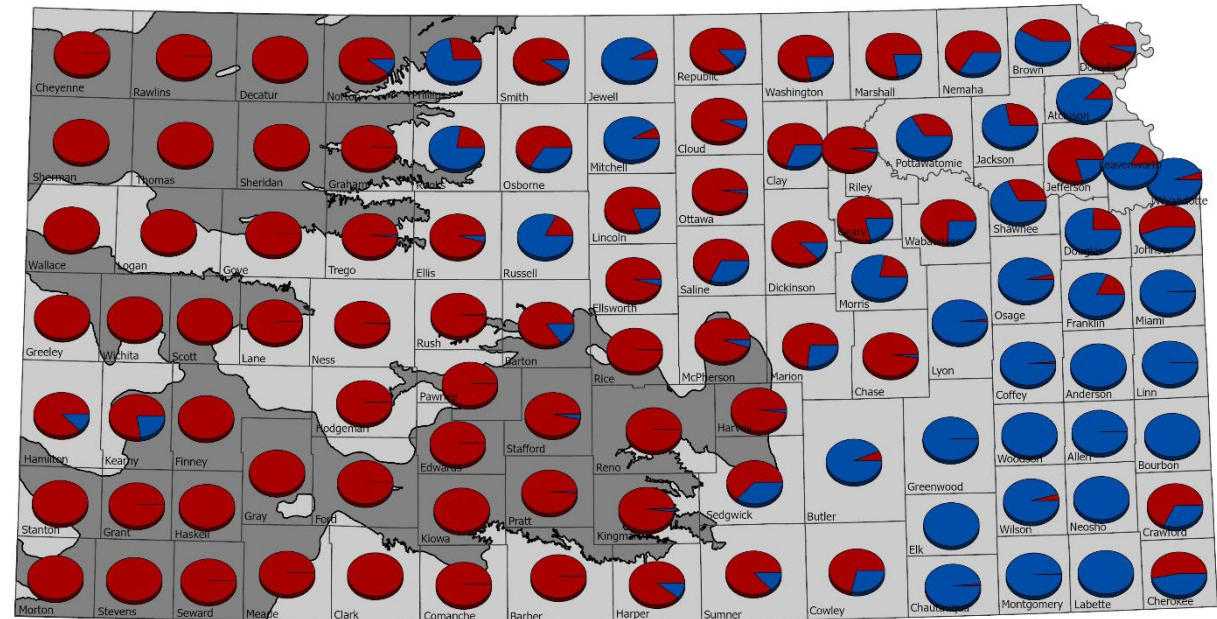
Average Water Use in Kansas, 2014 to 2023

Use Made of Water



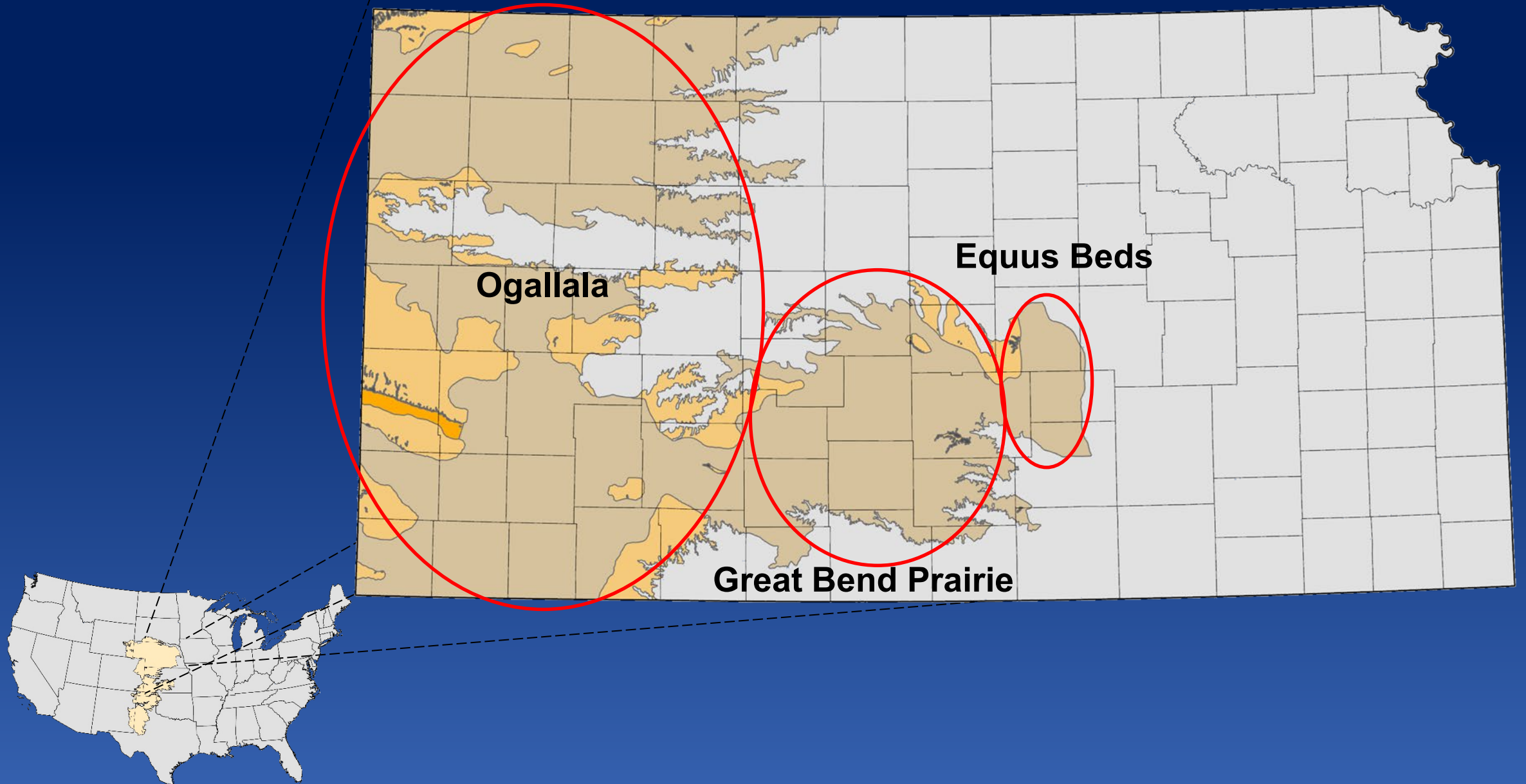
*Excludes Bowersock Mill and Power Company (Other) in Douglas County

Source of Supply

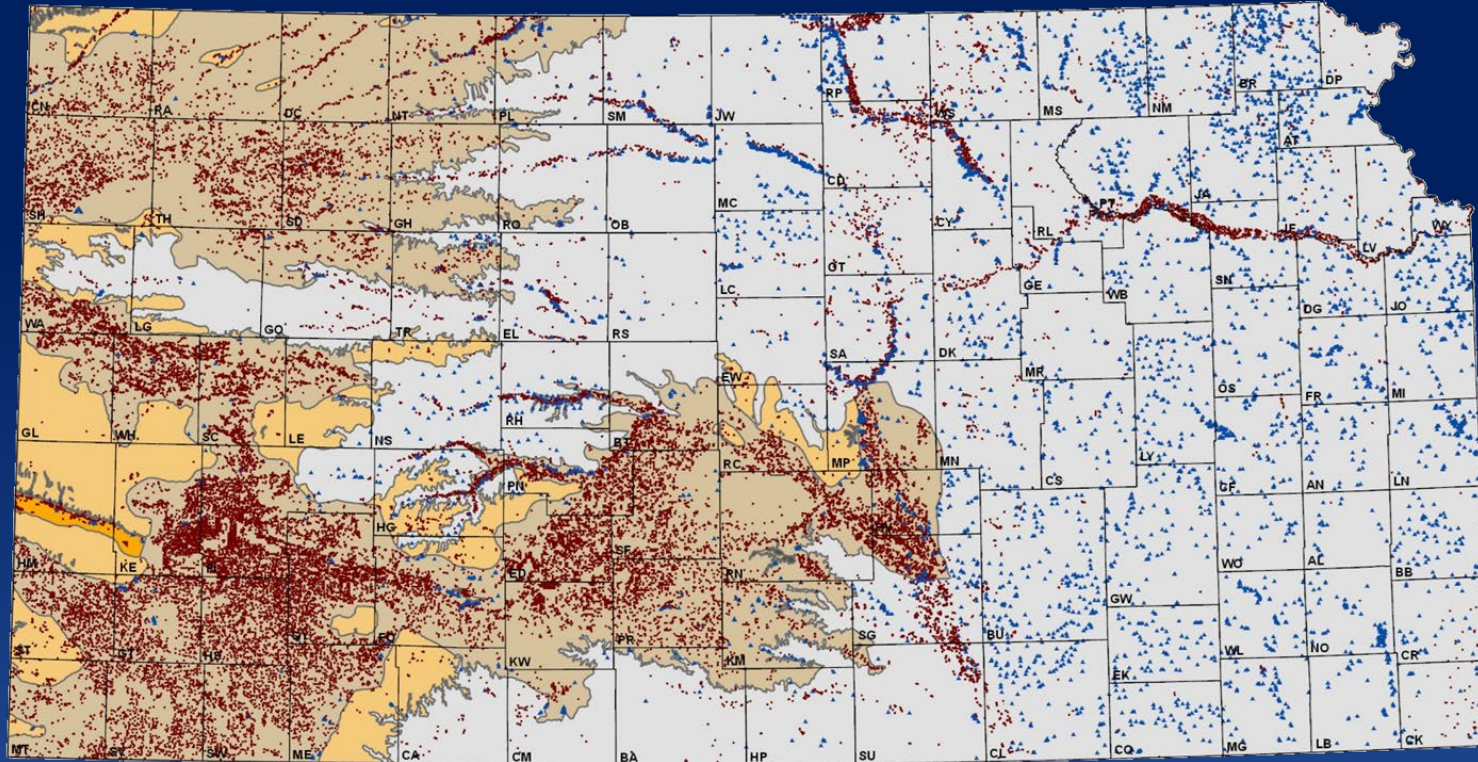


*Excludes Bowersock Mill and Power Company in Douglas County

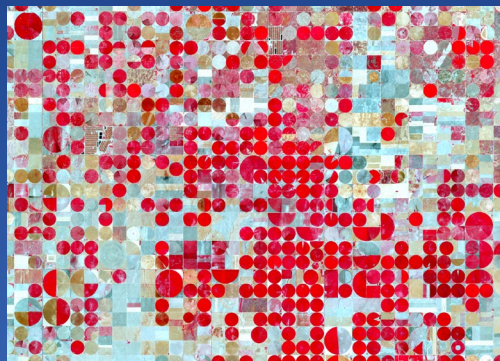
The High Plains Aquifer



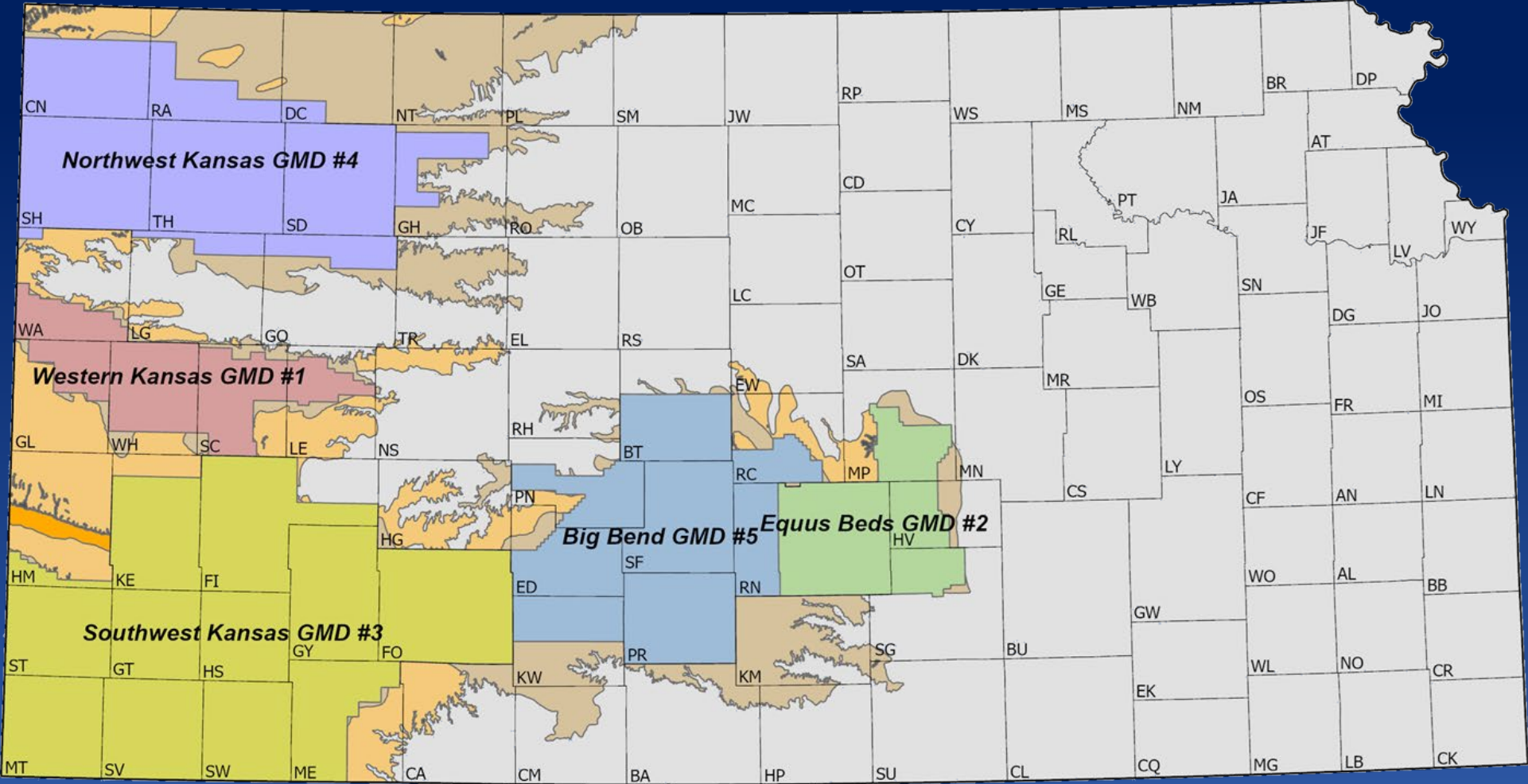
Water Right Development in Kansas



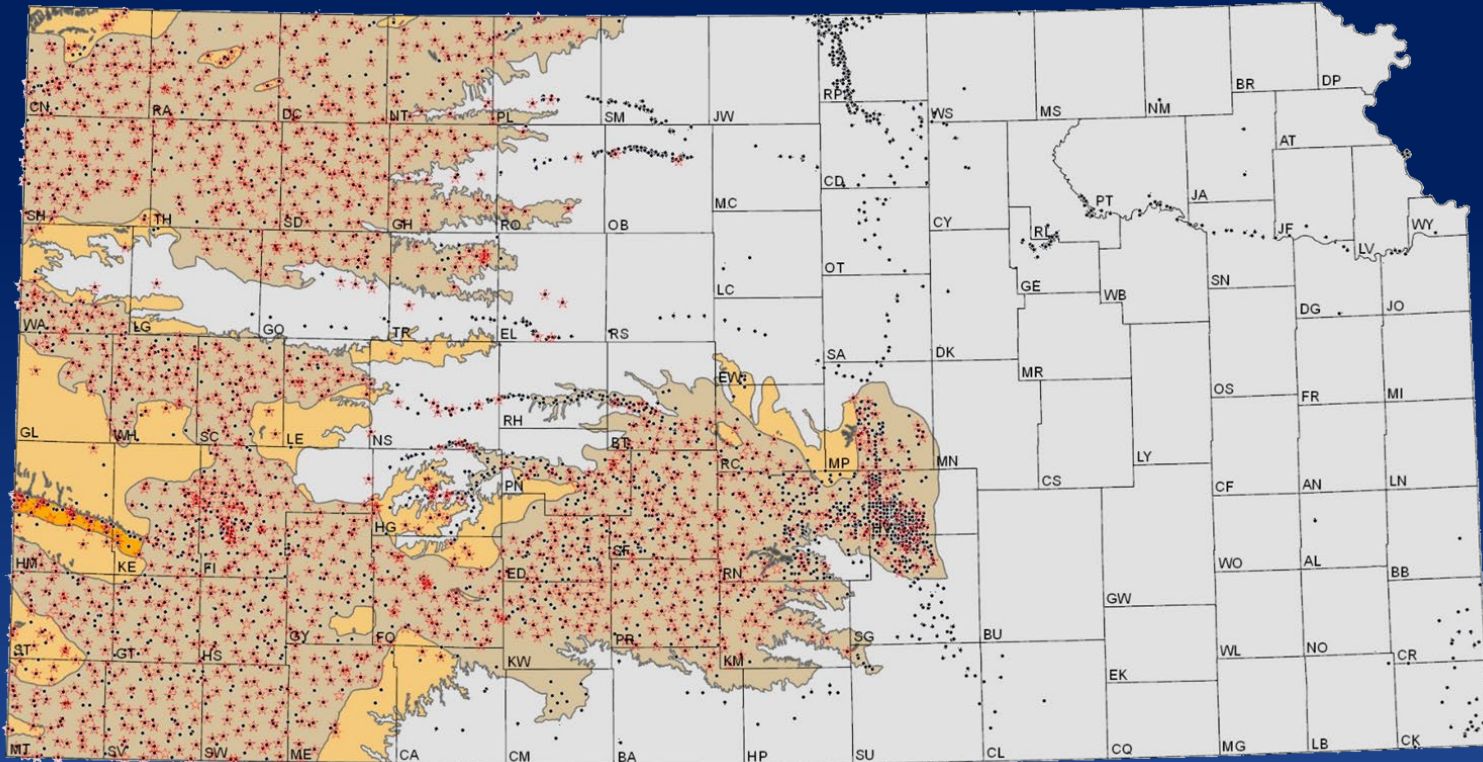
- Water Rights
 - Authorized Annual Permits/Certificates
 - Historic Reported Water Usage
 - Over 95% of the wells in the Kansas High Plains aquifer have flow meters installed
- Most of the High Plains aquifer region was developed by the early 1980s
- Last 10 years:
 - 87% of Kansas water use originates from groundwater
 - 89% of the groundwater used is for irrigation
 - 85% of the groundwater irrigation use occurred over the High Plains aquifer



Groundwater Management Districts



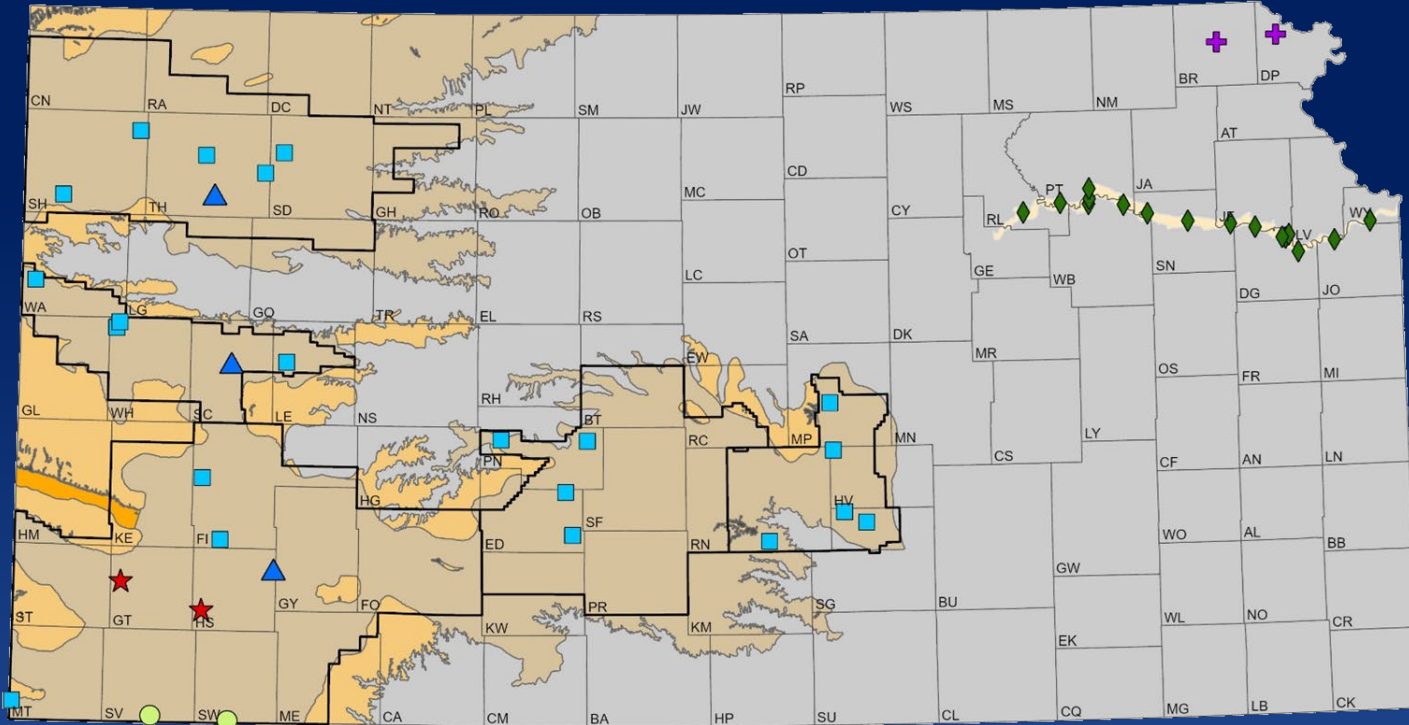
Measuring Wells in Kansas



- Wells depth-to-water measurements
- Data from GMDs 2 and 5, KDA-DWR, USGS, and the KGS
- Cooperative Water Level Network
 - Focused on High Plains aquifer
 - Annual measurements by the KGS and KDA-DWR
 - Regional aquifer characterizations



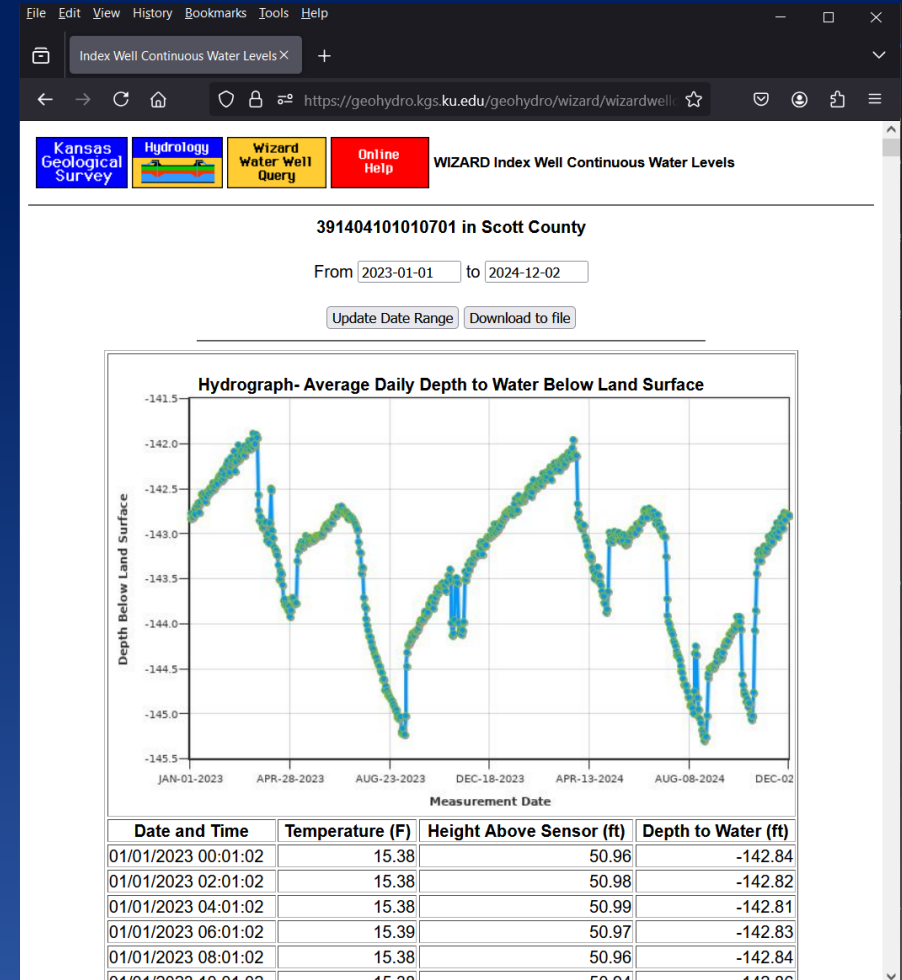
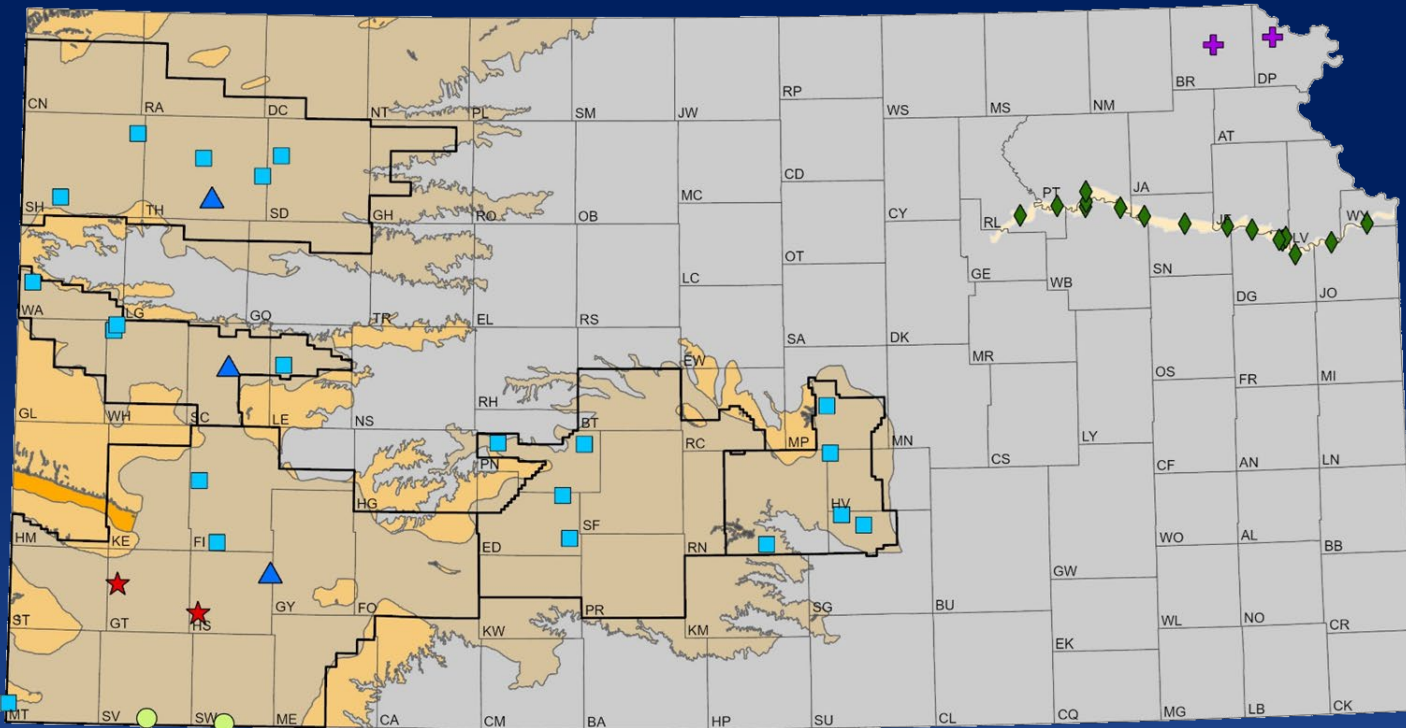
Kansas Index Well Program



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

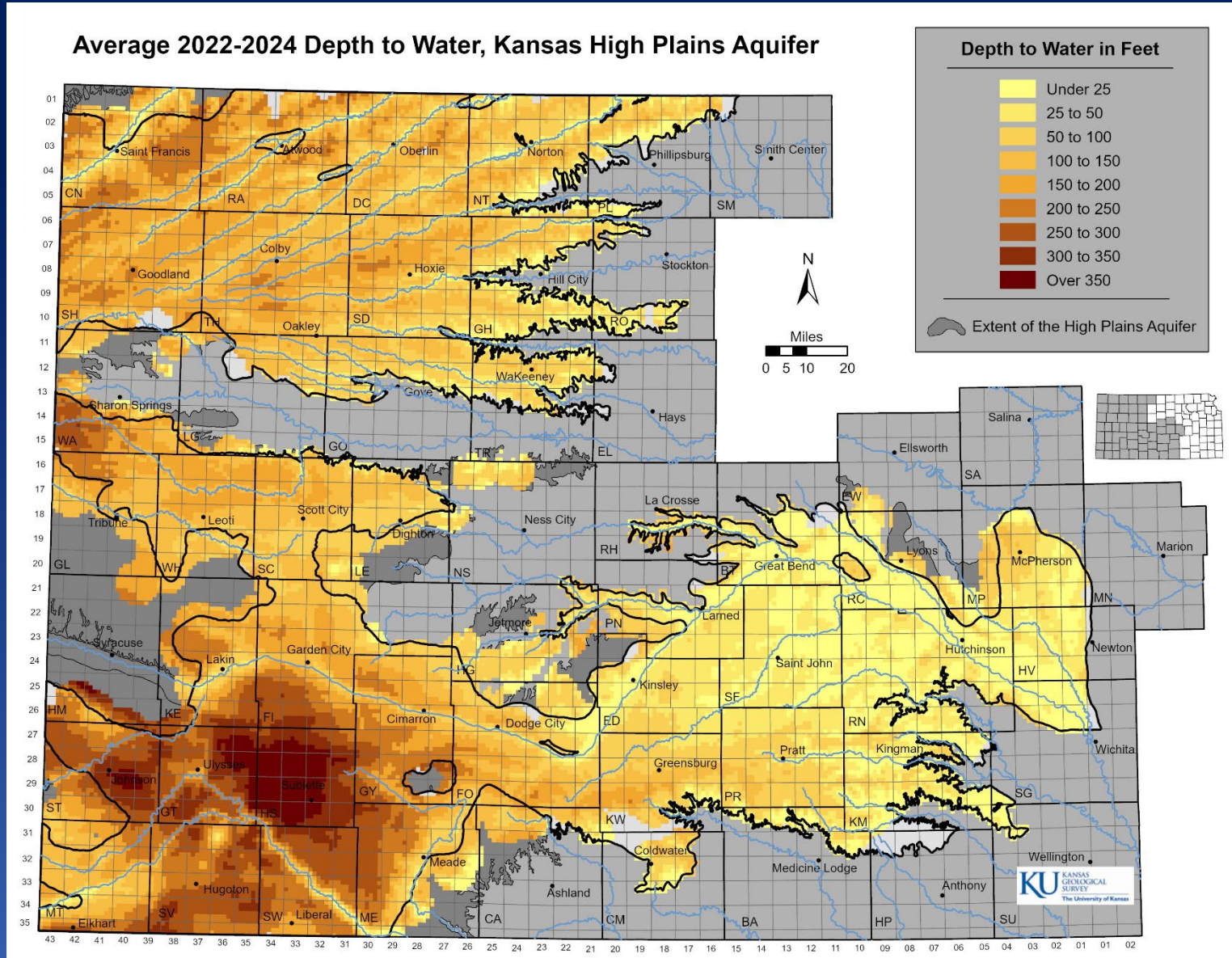


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Depth to Water, Kansas High Plains Aquifer

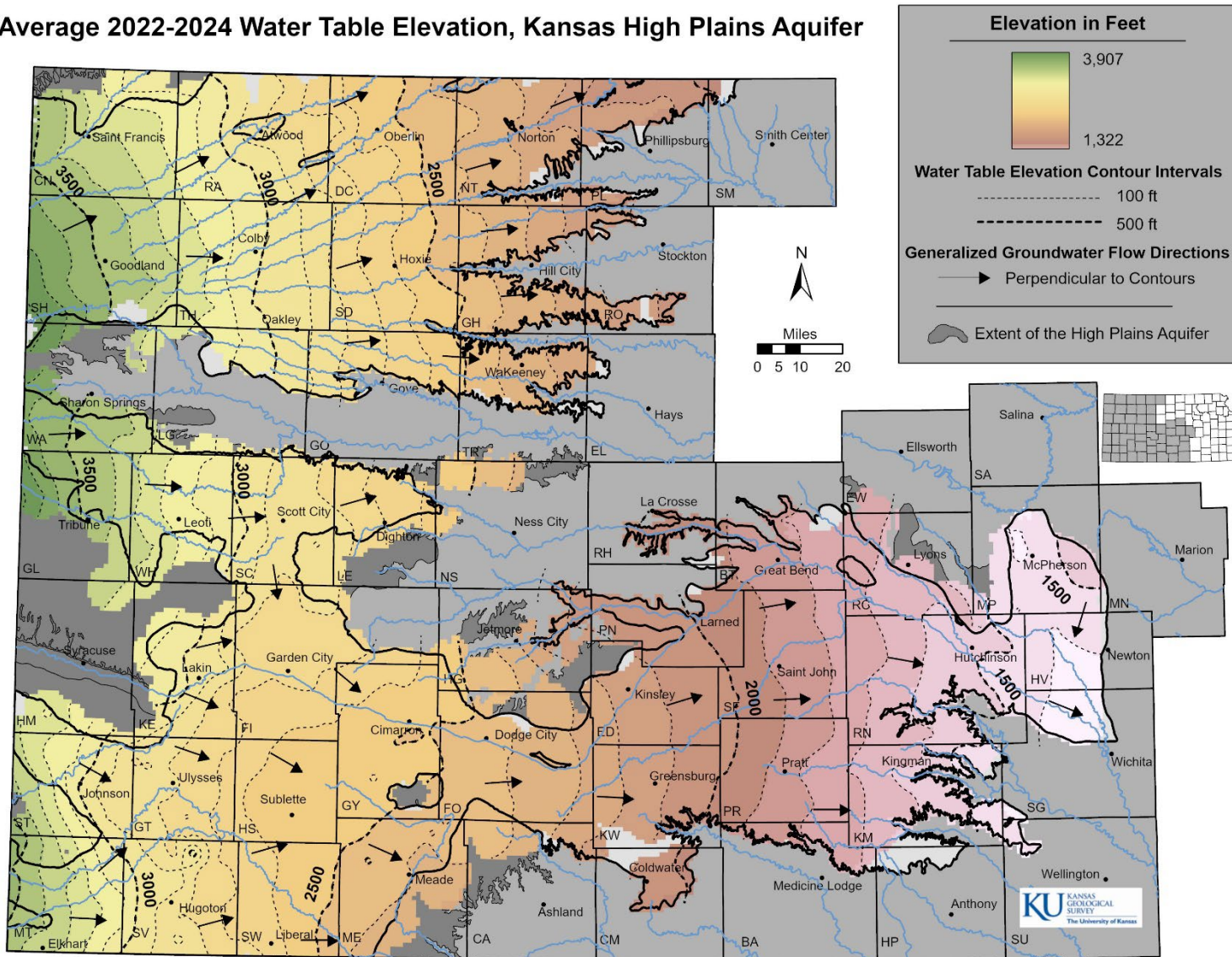


Depth to water ranges from:

- At or near the land surface
- Over 400 ft (Haskell County)

Water Table Elevation, Kansas High Plains Aquifer

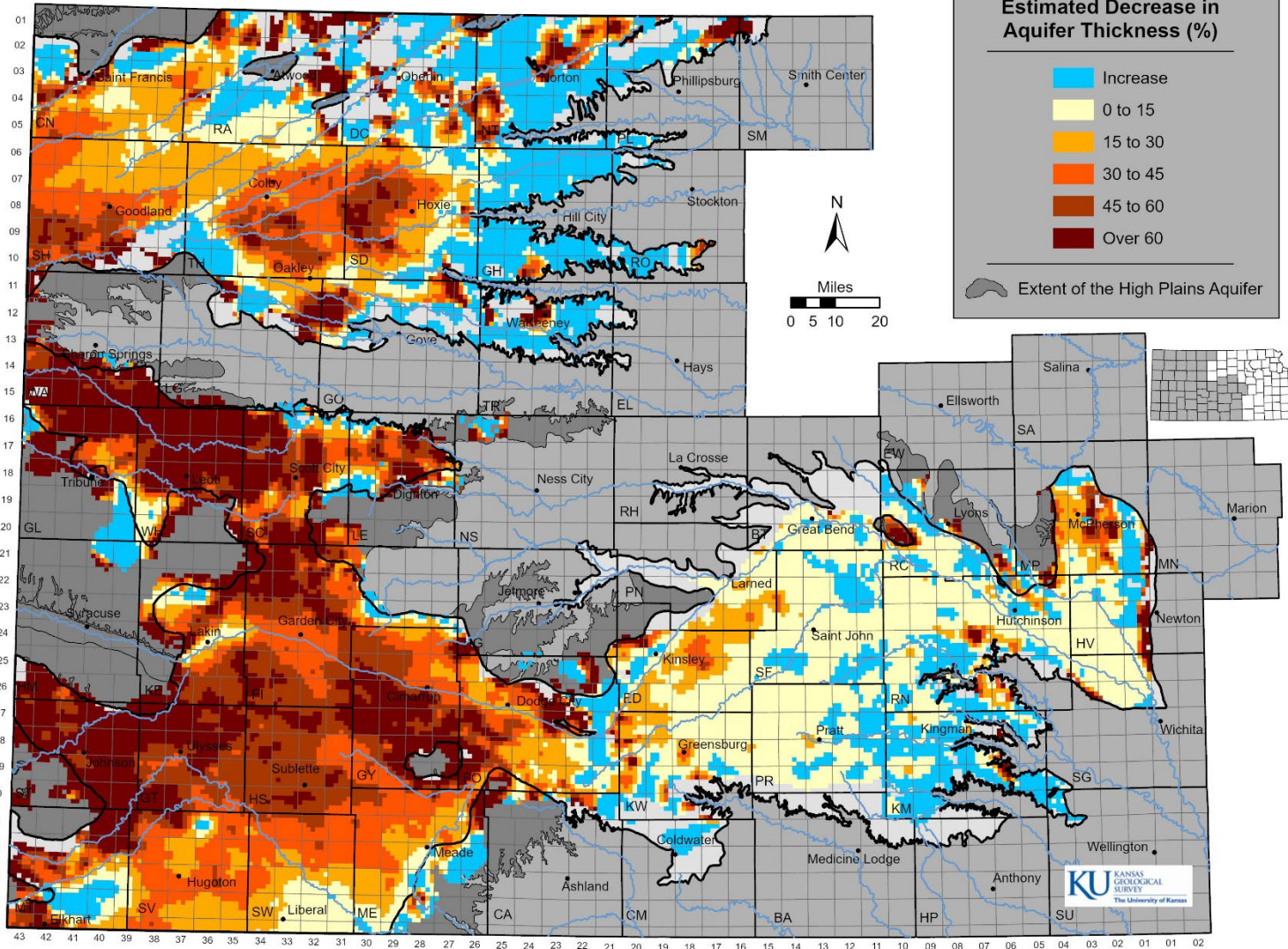
Average 2022-2024 Water Table Elevation, Kansas High Plains Aquifer



- Generally follows land surface
- Flow paths are generally west to east with some local variations
- Non-pumping, linear flow velocities
 - Range from 1 ft per 1 to 4 days
 - Years to decades to go a mile

Percent Change from Predevelopment to Present

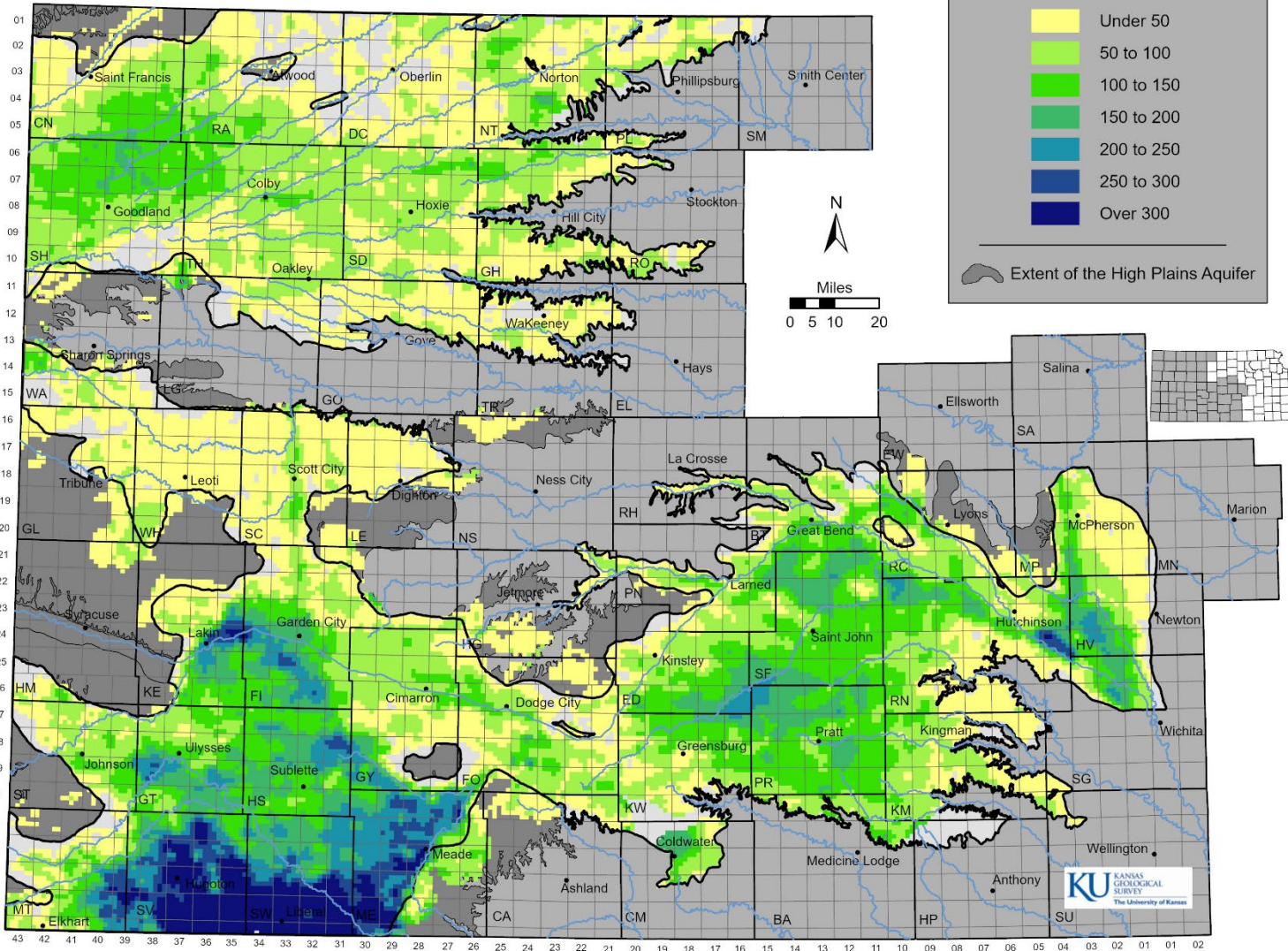
Percent Change in Aquifer Thickness, Predevelopment to Average 2022-2024,
Kansas High Plains Aquifer



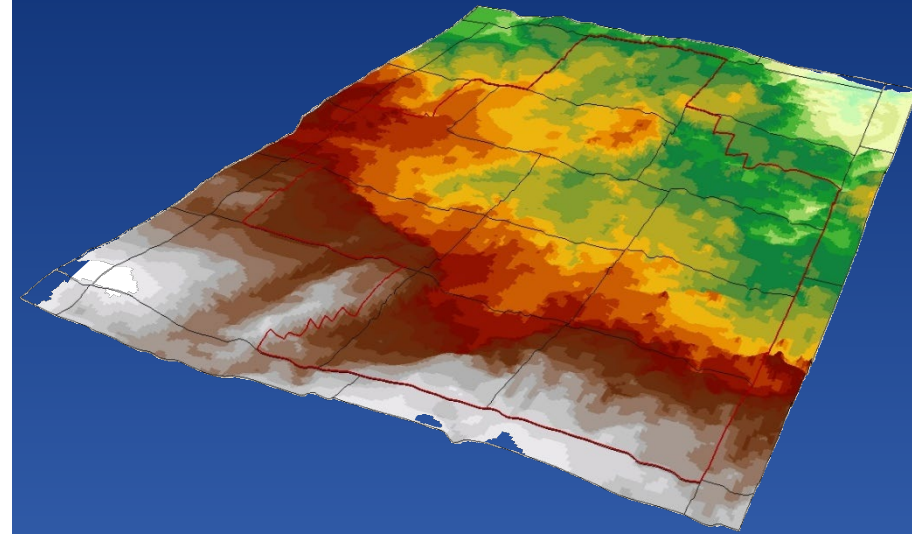
- **Western 1/3 of Kansas**
 - Ogallala portion of High Plains aquifer
 - Relatively deeper, semi-arid climate, lower recharge rates
 - Typically experiences groundwater declines
- **South-central Kansas**
 - Great Bend Prairie and Equus Beds regional aquifers
 - Closer to land surface, more responsive to recharge events
 - Localized declines
 - Challenges with stream-aquifer interactions and water quality

Aquifer Thickness, Kansas High Plains Aquifer

Average 2022-2024 Aquifer Thickness, Kansas High Plains Aquifer

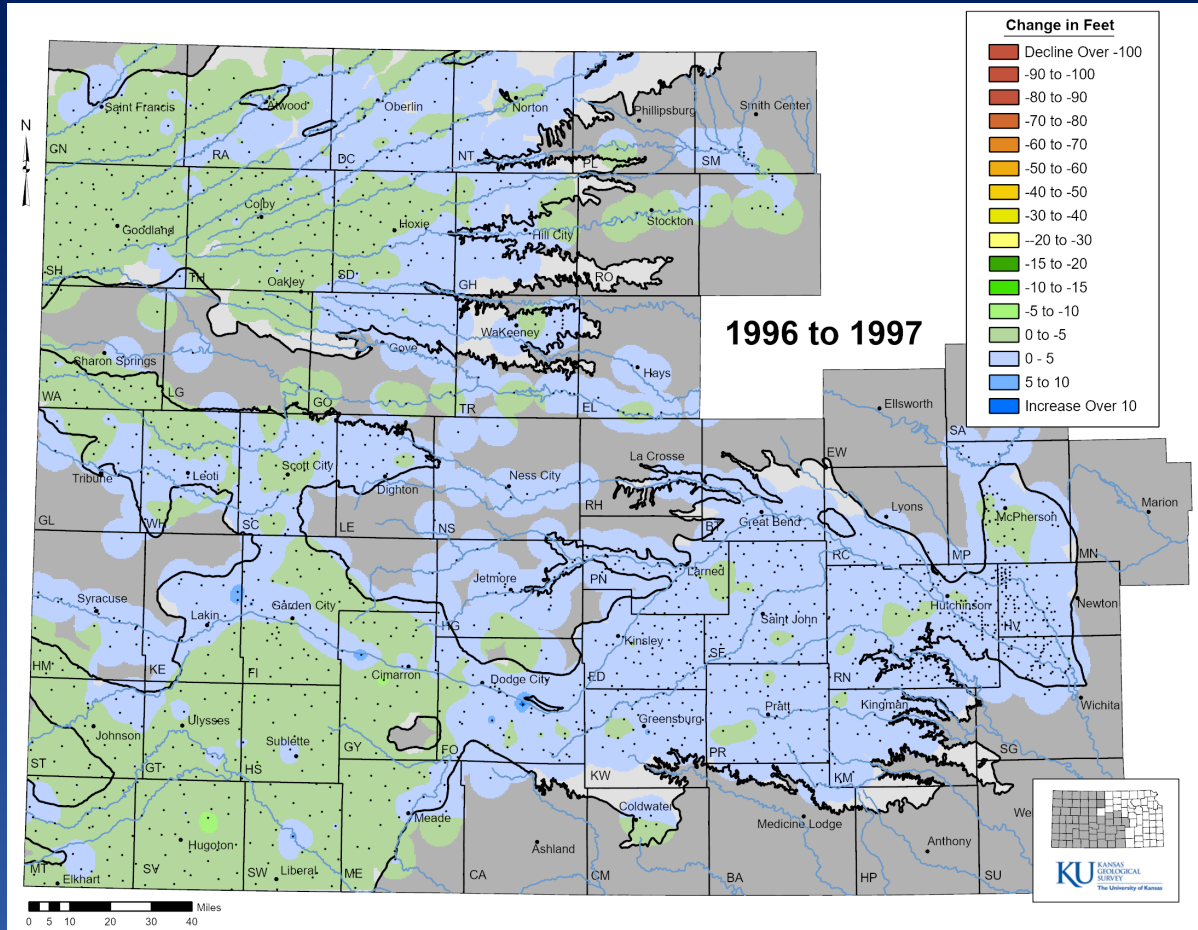


- Ranges from 0 to 500 ft (Seward County).
- Variability driven by bedrock surface.

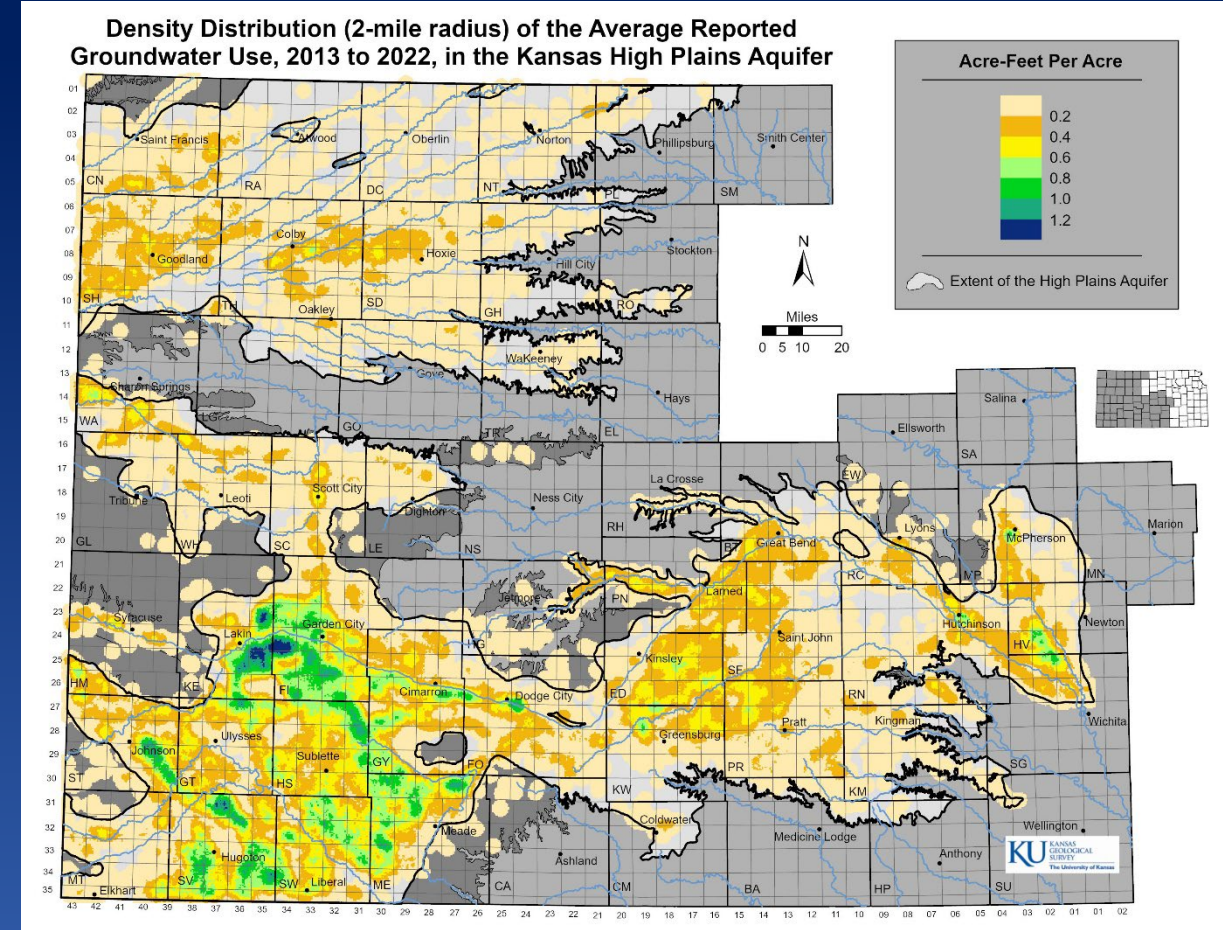


Water-Level Change vs Reported Water Use

Water-Level Change

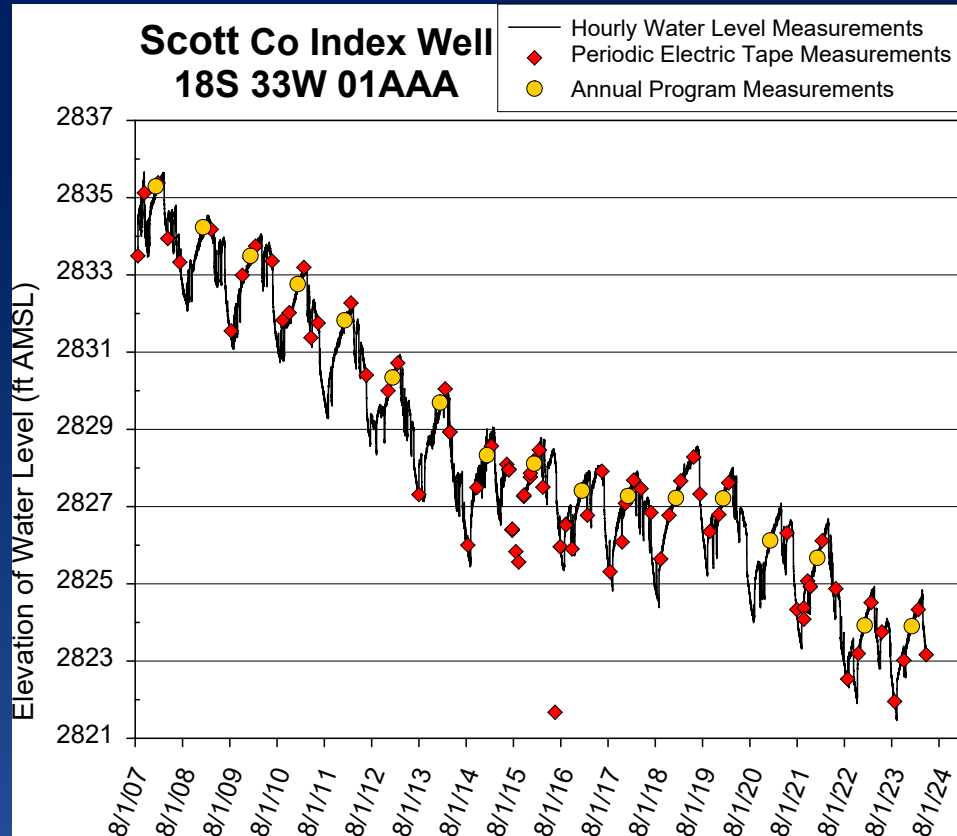


Groundwater Use

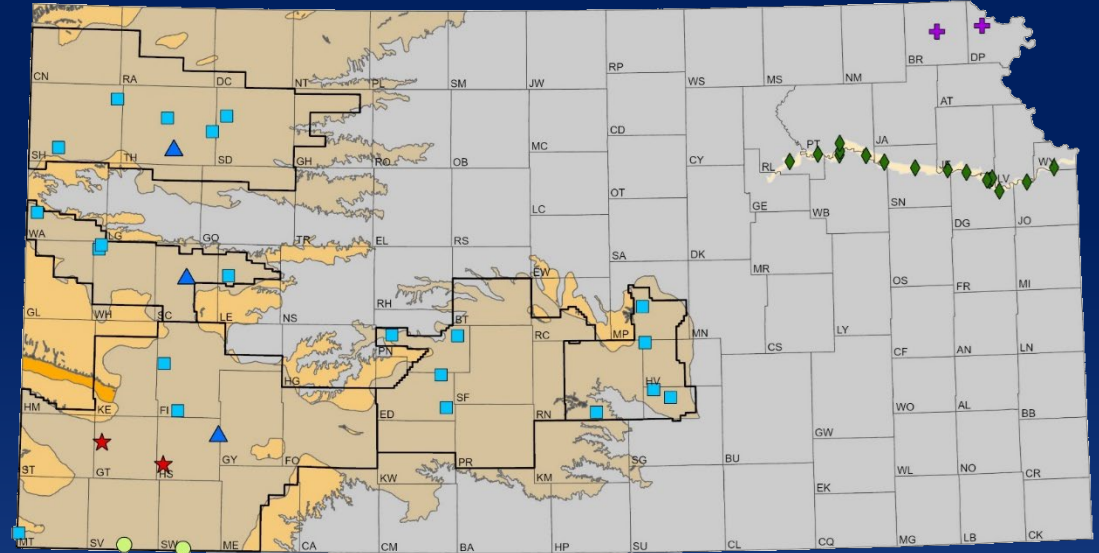


How far out of whack are we?

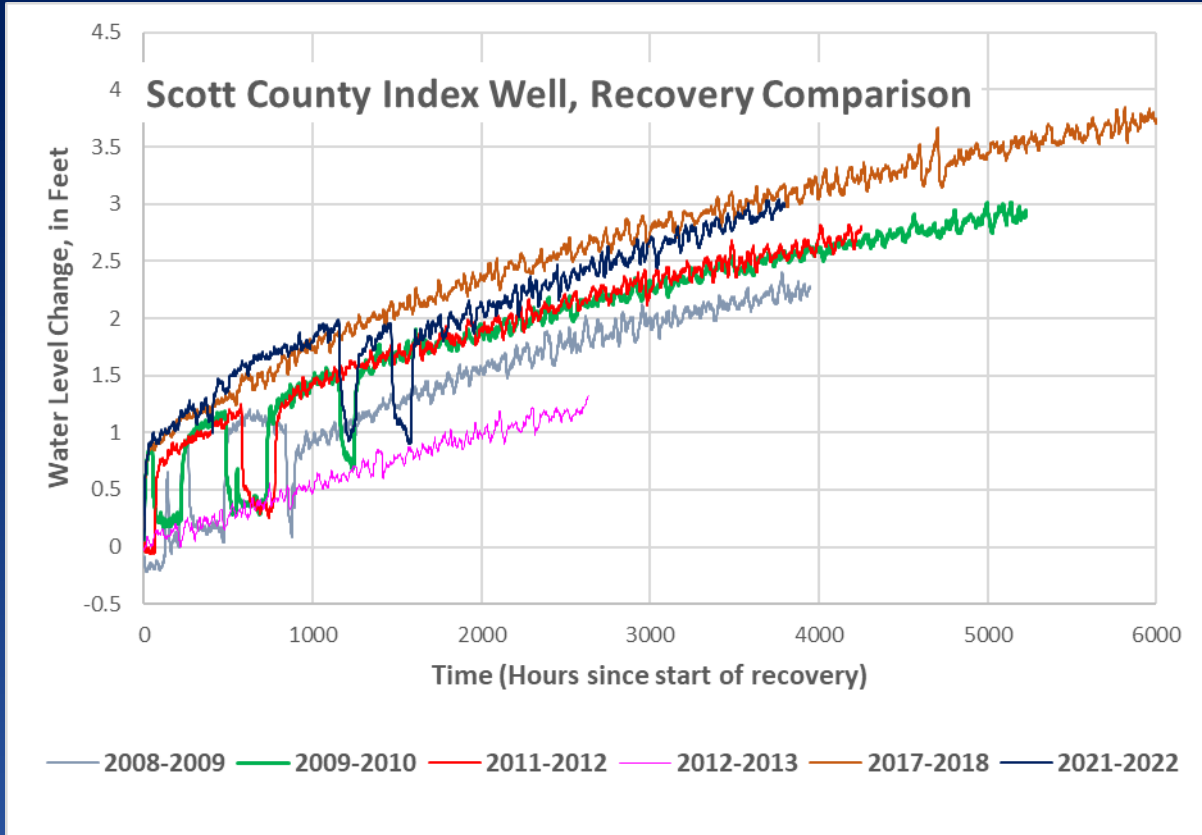
Kansas Index Well- Recovery Curves



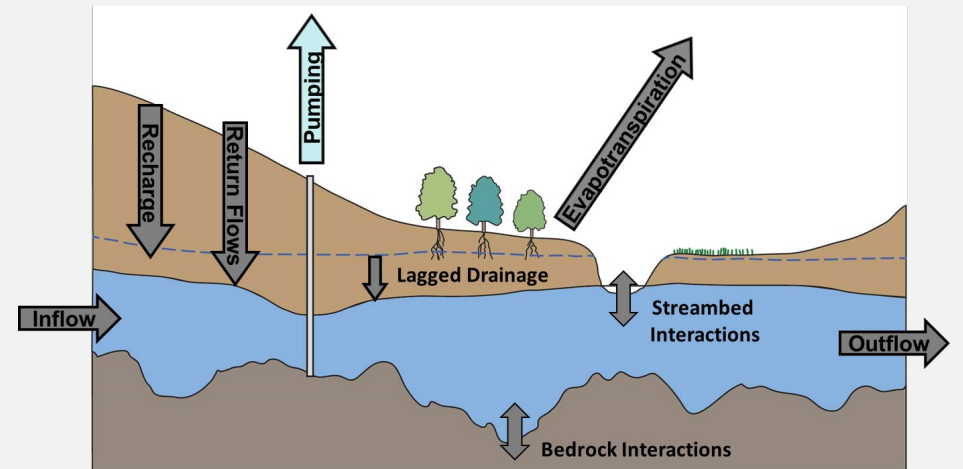
Over the last decade, end-of-season recovery is similar regardless of past pumping or climatic conditions



Index Wells Recovery Curves, Scott County



- Water level change starting at the end-of-season pumping (September to April~June)
- Recovery is similar each year
- “Net Inflow”
Everything flowing in and out of the aquifer except pumping



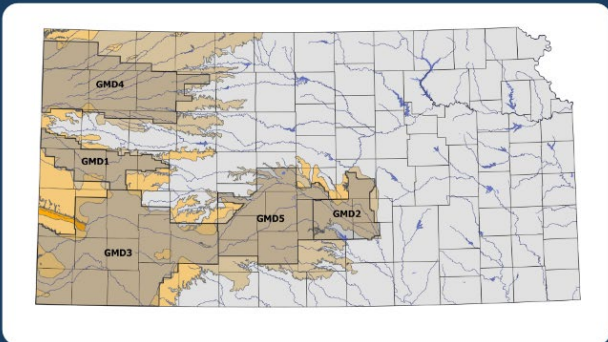
Status of the High Plains Aquifer in Kansas

KGS Technical Series 25- <https://kgs.ku.edu/2023-status-high-plains-aquifer-kansas>

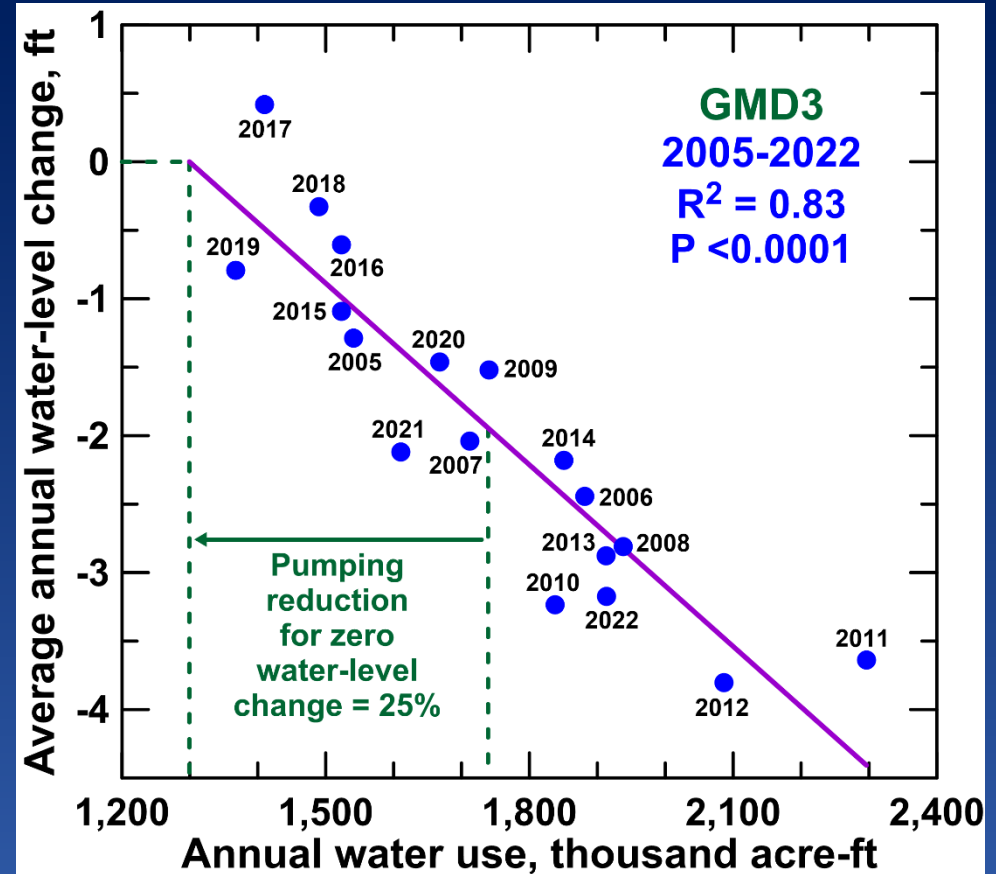
KANSAS GEOLOGICAL SURVEY

2023 Status of the High Plains Aquifer in Kansas

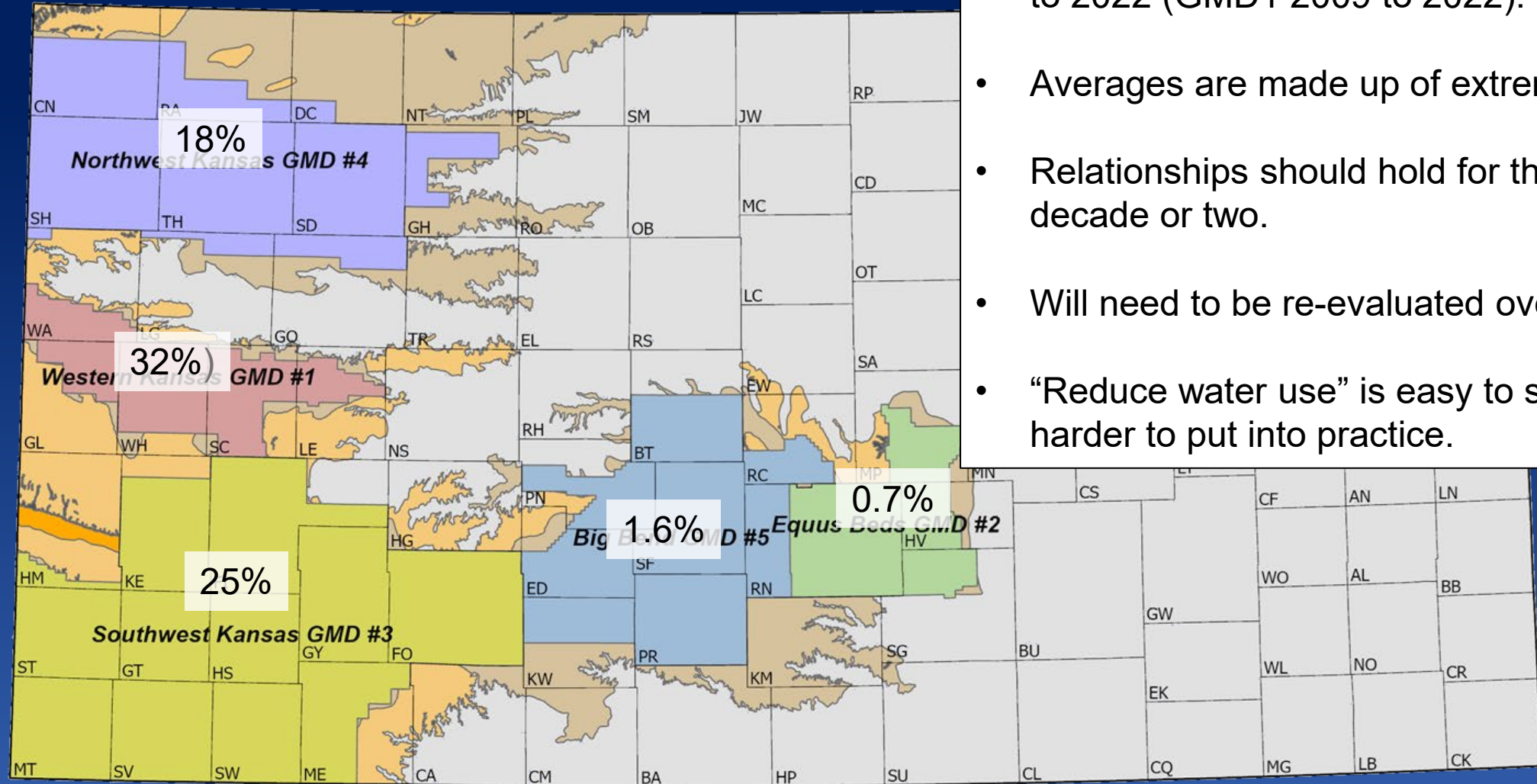
Donald O. Whittemore
James J. Butler, Jr.
B. Brownie Wilson



TECHNICAL SERIES 25 | 2023

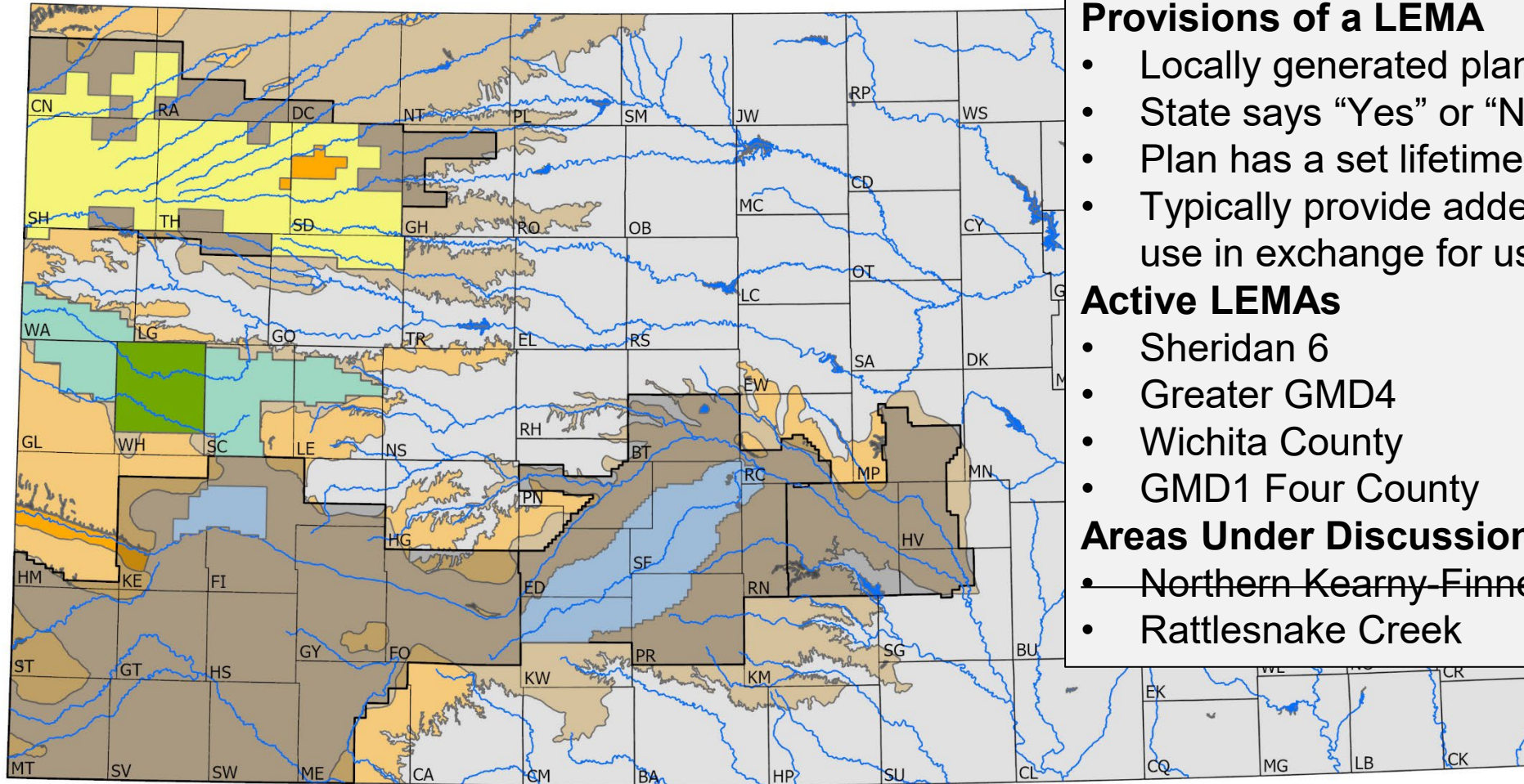


Reductions in Reported Water Use, by GMD, Needed to Stabilize Water Levels



- Based on average conditions from 2005 to 2022 (GMD1 2009 to 2022).
- Averages are made up of extremes.
- Relationships should hold for the next decade or two.
- Will need to be re-evaluated over time.
- “Reduce water use” is easy to say, harder to put into practice.

Local Enhanced Management Areas (LEMA)



Provisions of a LEMA

- Locally generated plan within a GMD
- State says “Yes” or “No”
- Plan has a set lifetime (~ 5 years)
- Typically provide added flexibilities in water use in exchange for use reductions

Active LEMAs

- Sheridan 6
- Greater GMD4
- Wichita County
- GMD1 Four County

Areas Under Discussion

- ~~Northern Kearny-Finney Counties~~
- Rattlesnake Creek

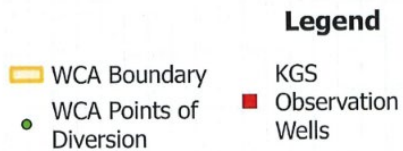
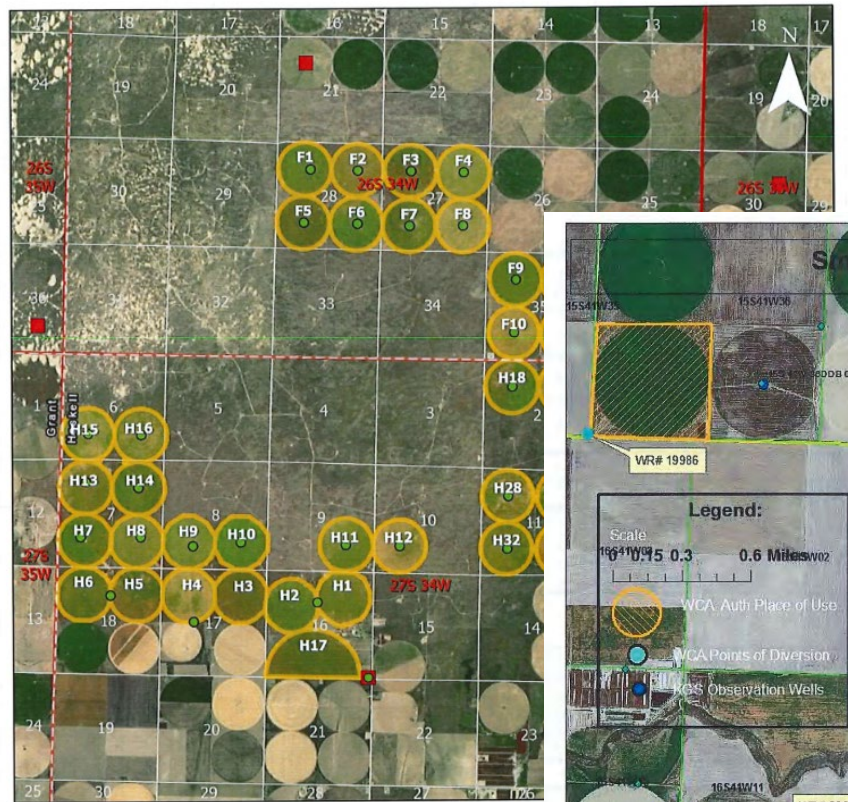
Existing LEMAs

Greater GMD4
 Sheridan 6
 Wichita County
 GMD1 Four County

Past/Potential LEMA Discussions

KFL and Rattlesnake Creek Subbasin

Water Conservation Areas (WCA)

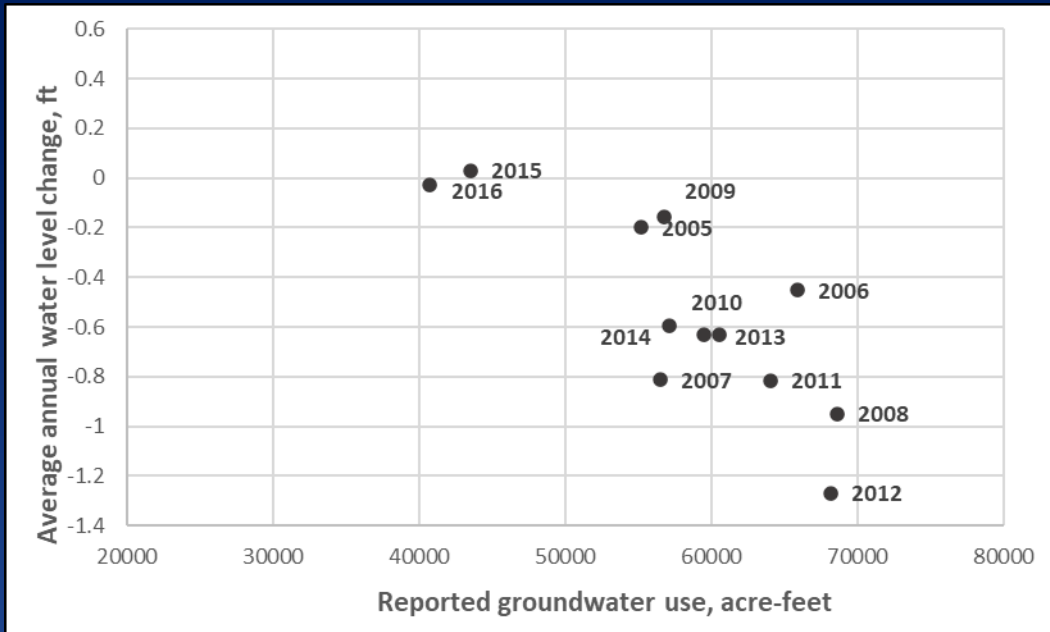


Provisions of a Water Conservation Area

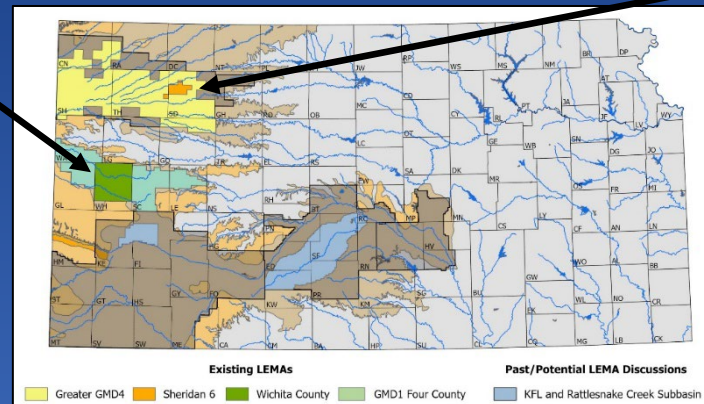
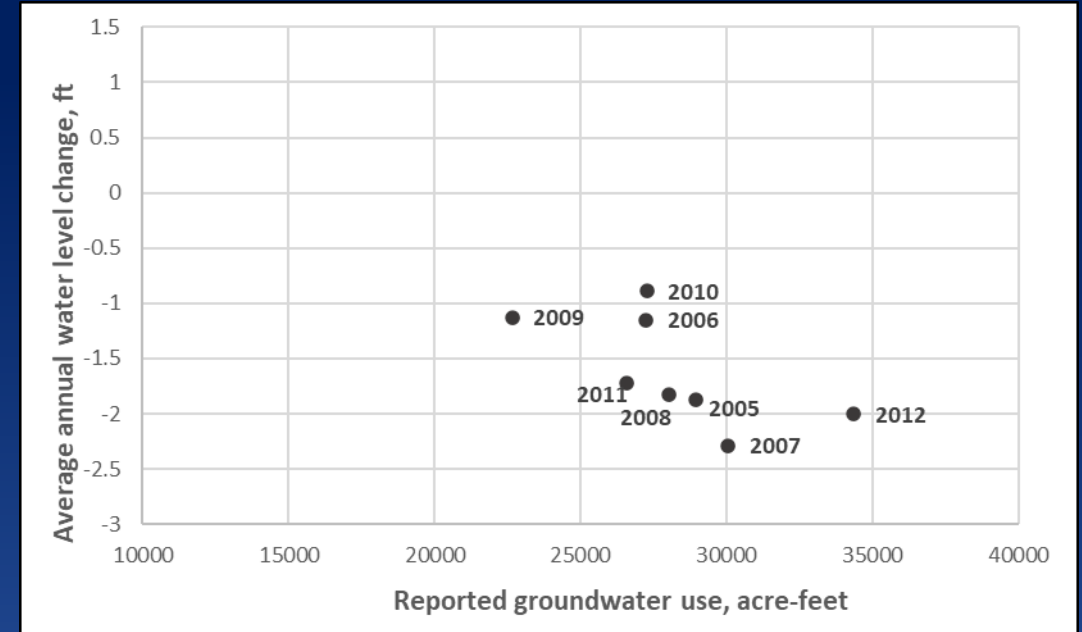
- Does NOT have to be generated plan within a GMD
- Individual agreement between water user(s) and the KDA-DWR
- Individual LEMA
 - Greater flexibility
 - Less red tape

Water Use vs Water-Level Change

Wichita County LEMA/WCA

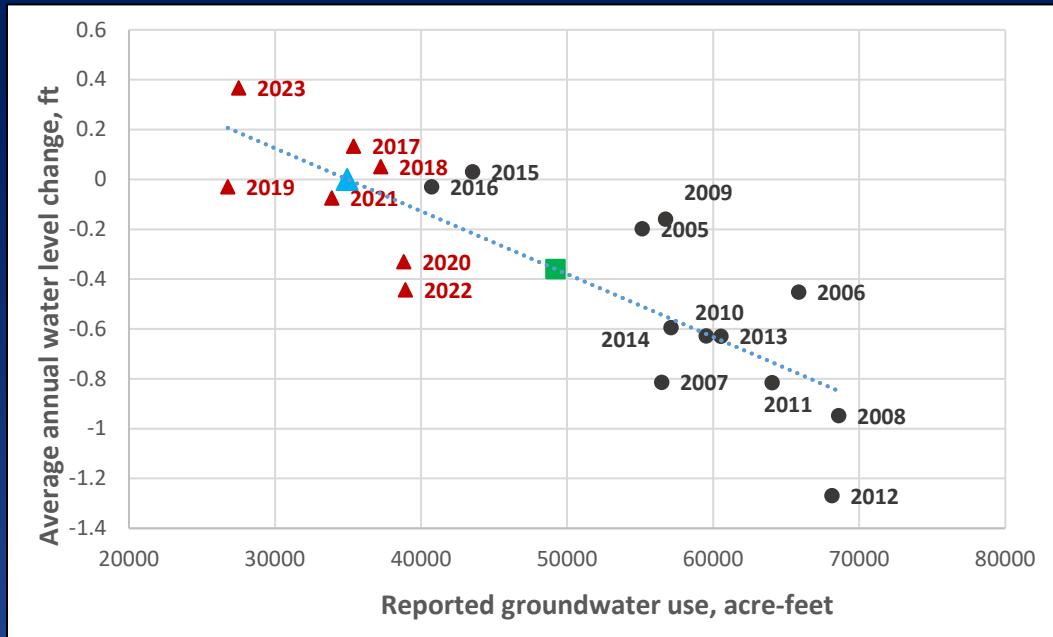


Sheridan 6 LEMA

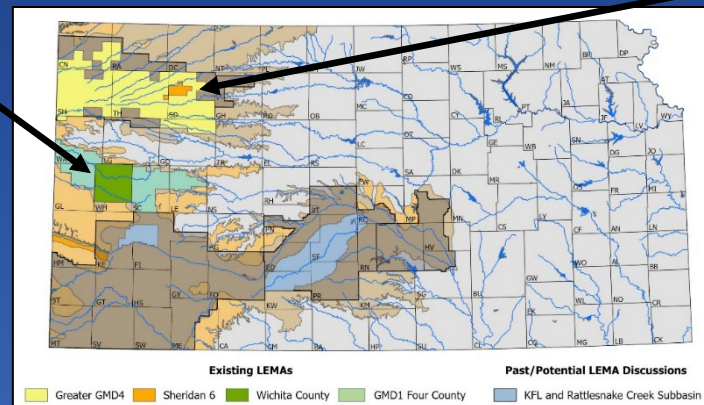
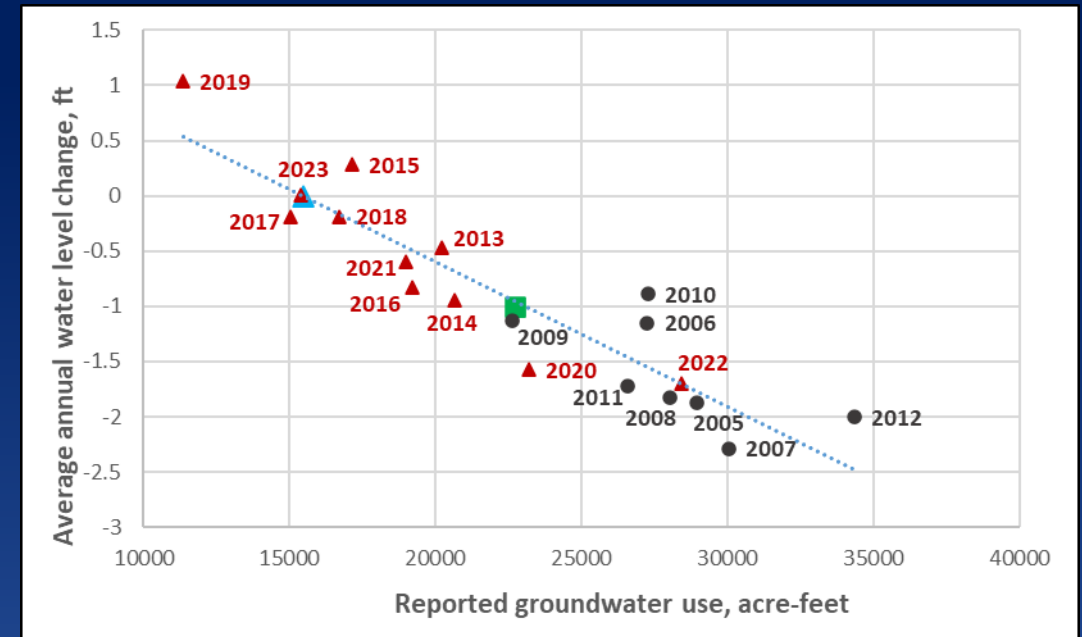


Water Use vs Water-Level Change

Wichita County LEMA/WCA

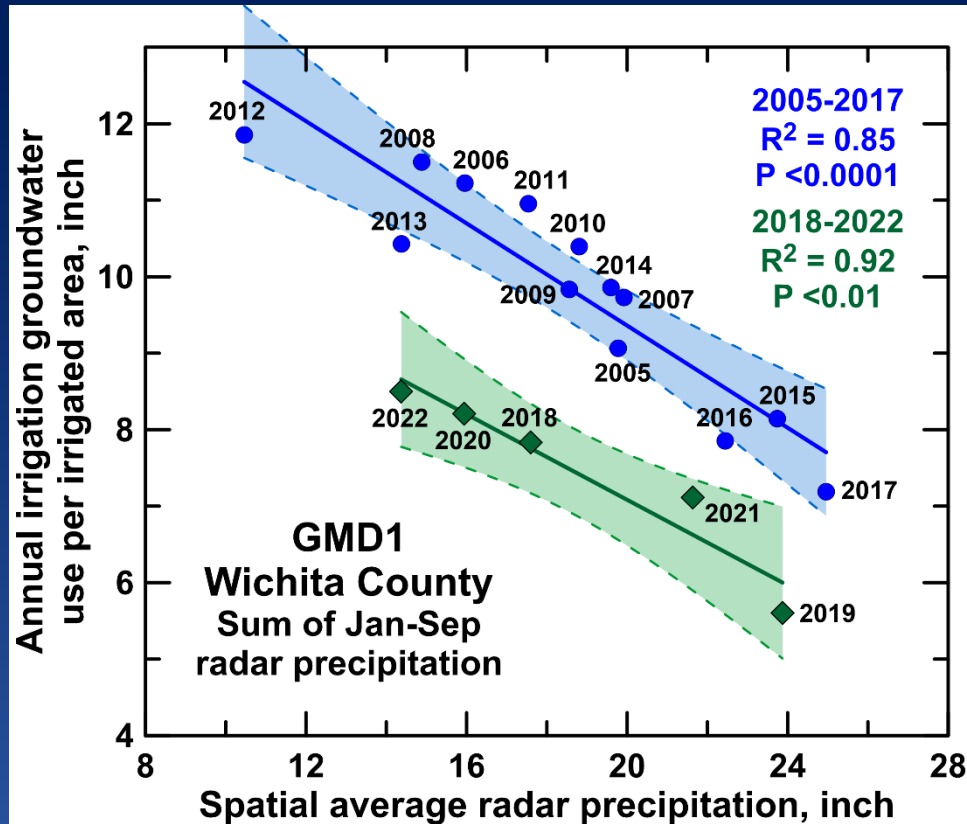


Sheridan 6 LEMA

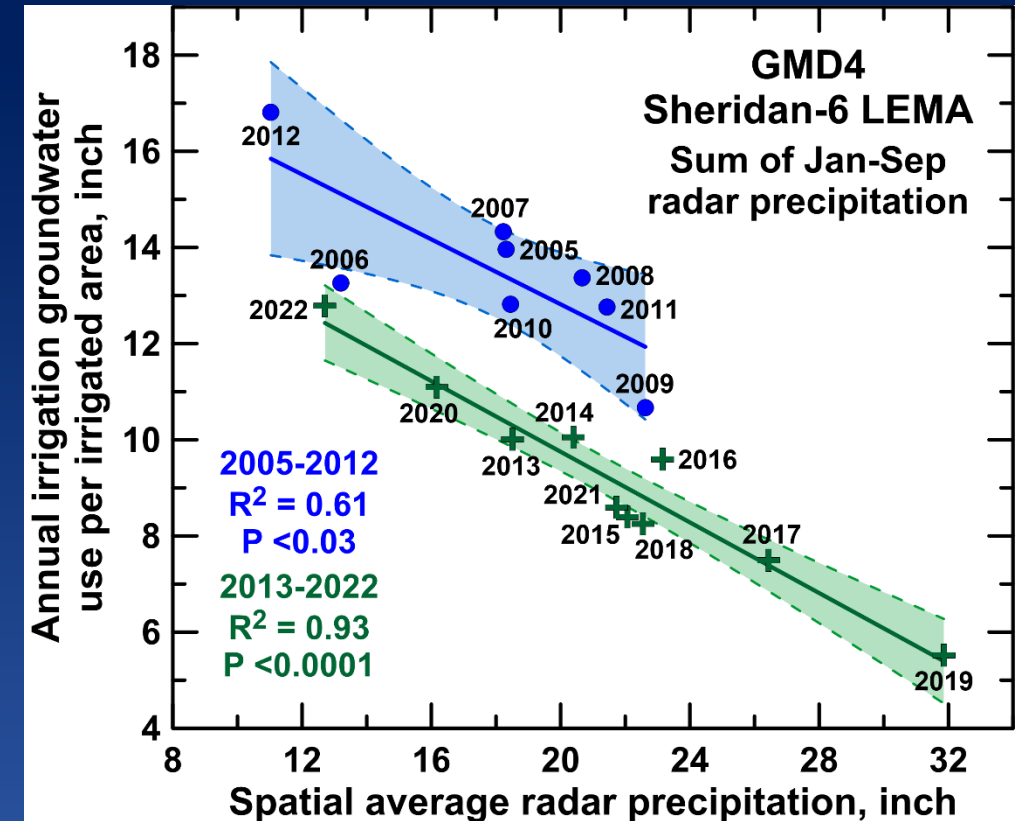


Water Use vs Precipitation

Wichita County LEMA/WCA



Sheridan 6 LEMA



- Pre- and post-LEMA, water usage is influenced by precipitation.
- Post-LEMA water savings is intentional conservation.

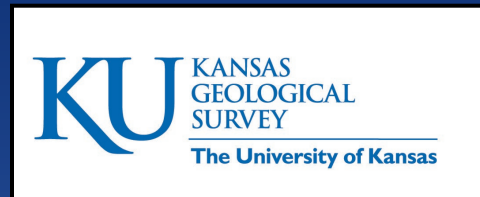
Conclusions and Observations

- **Kansas Water Use is highly influenced by climate and water supply**
 - Significant precipitation gradient west to east.
 - Surface water in the east, groundwater in the west.
- **Water-level change versus water usage relationships**
 - Modest reductions in pumping, 10 to 15%, will reduce decline rates.
 - Benefits to water conservation efforts stay local.
 - Conditions will likely hold for the next decade or two but will need to be revisited, especially with prolonged wet or dry conditions.
 - Even with reductions on the short-term, long-term sustainability in the Ogallala will still be challenging



Questions????

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



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