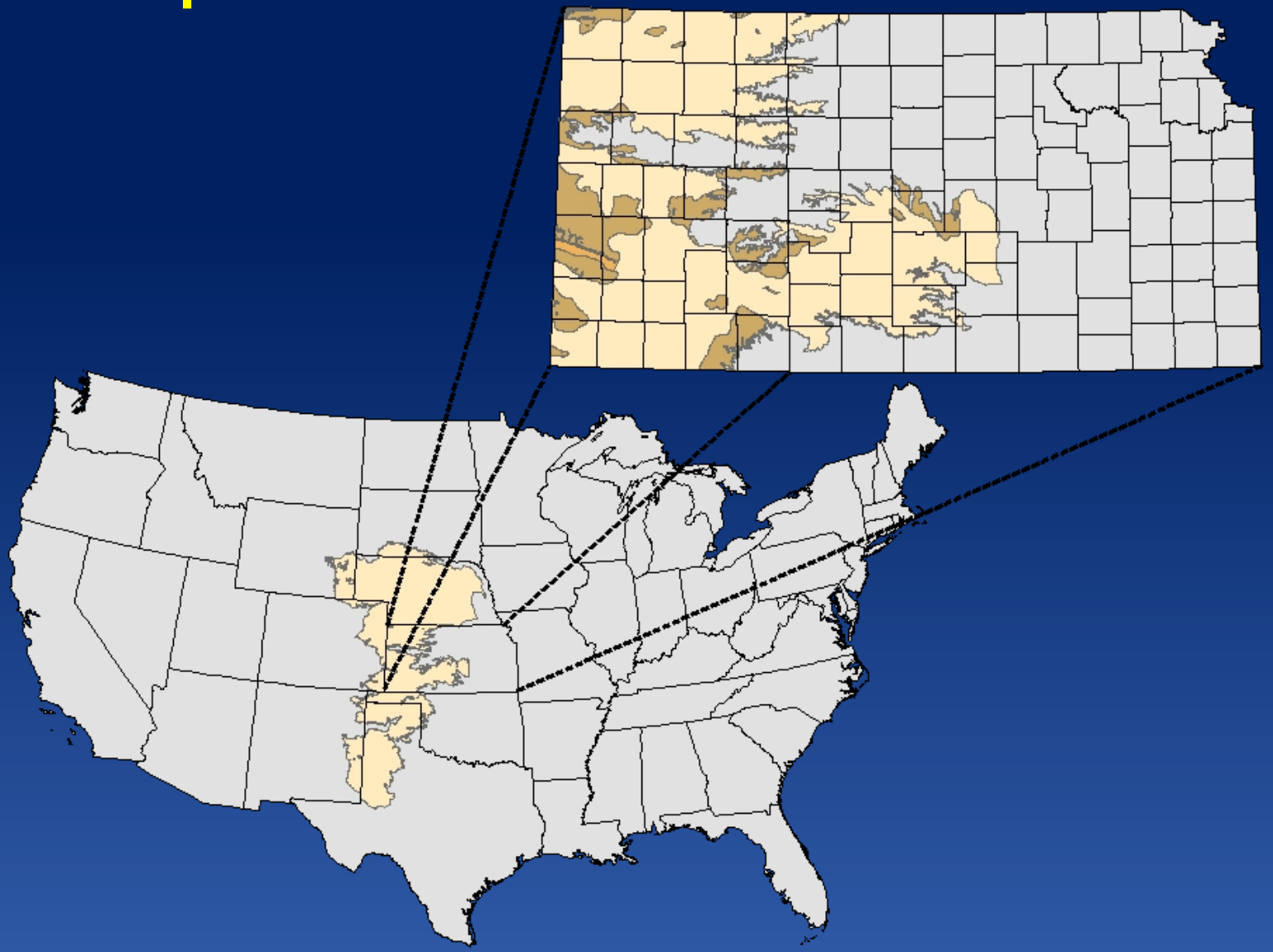
Condition and Trends in the Ogallala/High Plains Aquifer

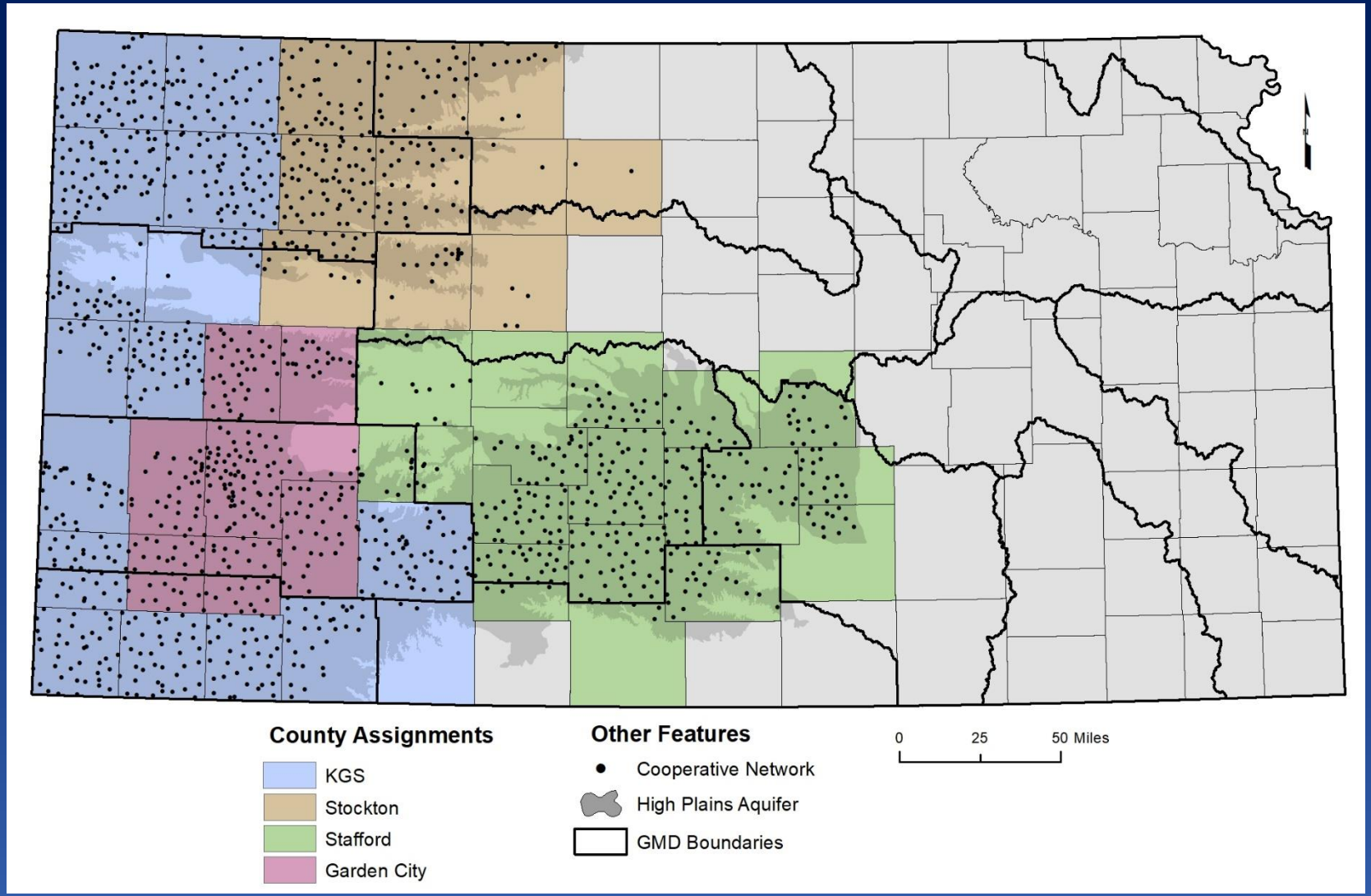
Upper Smoky Hill and Upper Republican
Regional Advisory Committee Meetings
April 2 and 3, 2019

Kansas Geological Survey
University of Kansas

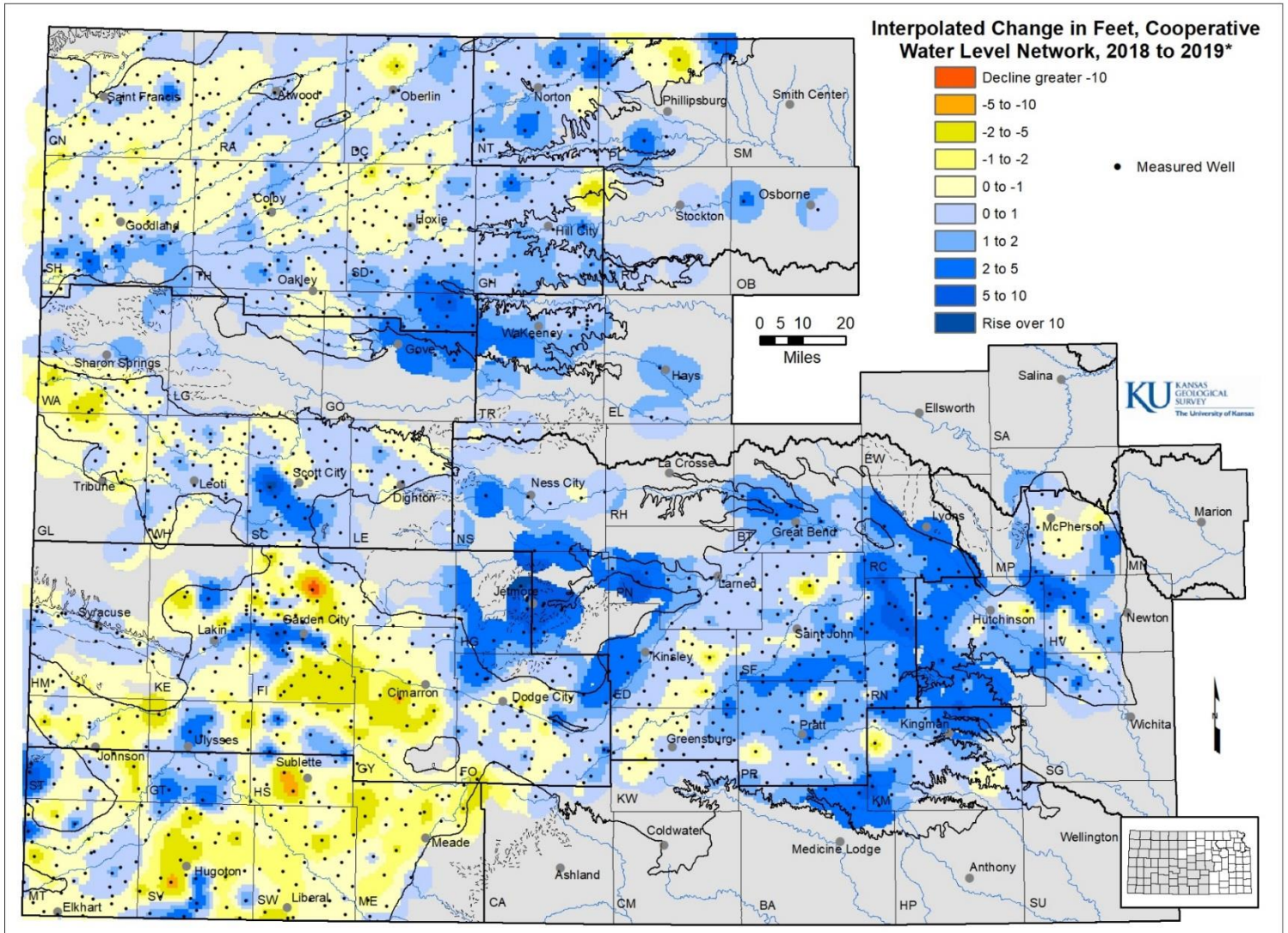
The High Plains Aquifer



2019 Cooperative Water Level Program



2018 - 2019 Provisional Water-Level Change

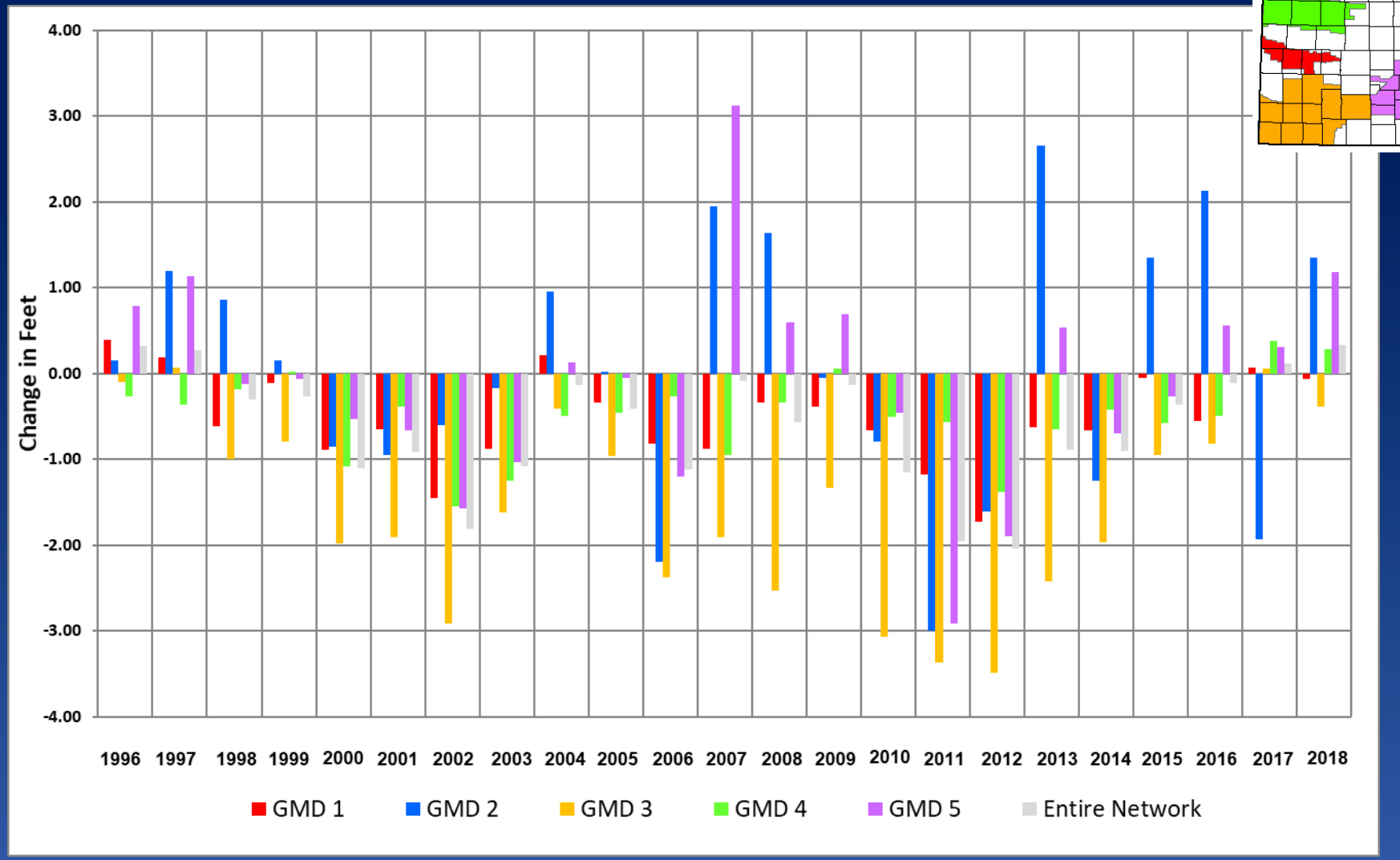


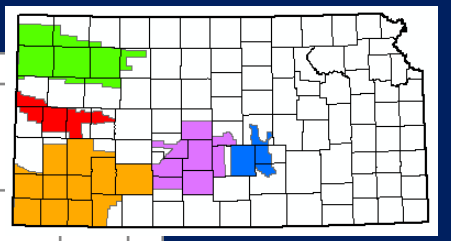
*Results are based only on the cooperative network (KGS and KDA-DWR) and do not include sub-regional networks from the KGS, KDA-DWR or local GMDs.

Average 2018 to 2019* Water-Level Change (ft)

- Upper Republican: 0.25
- Upper Smoky: 0.10
- Upper Arkansas: -0.01
- Cimarron: -0.62
- Great Bend Prairie: 1.34
- Equus- Walnut: 1.35

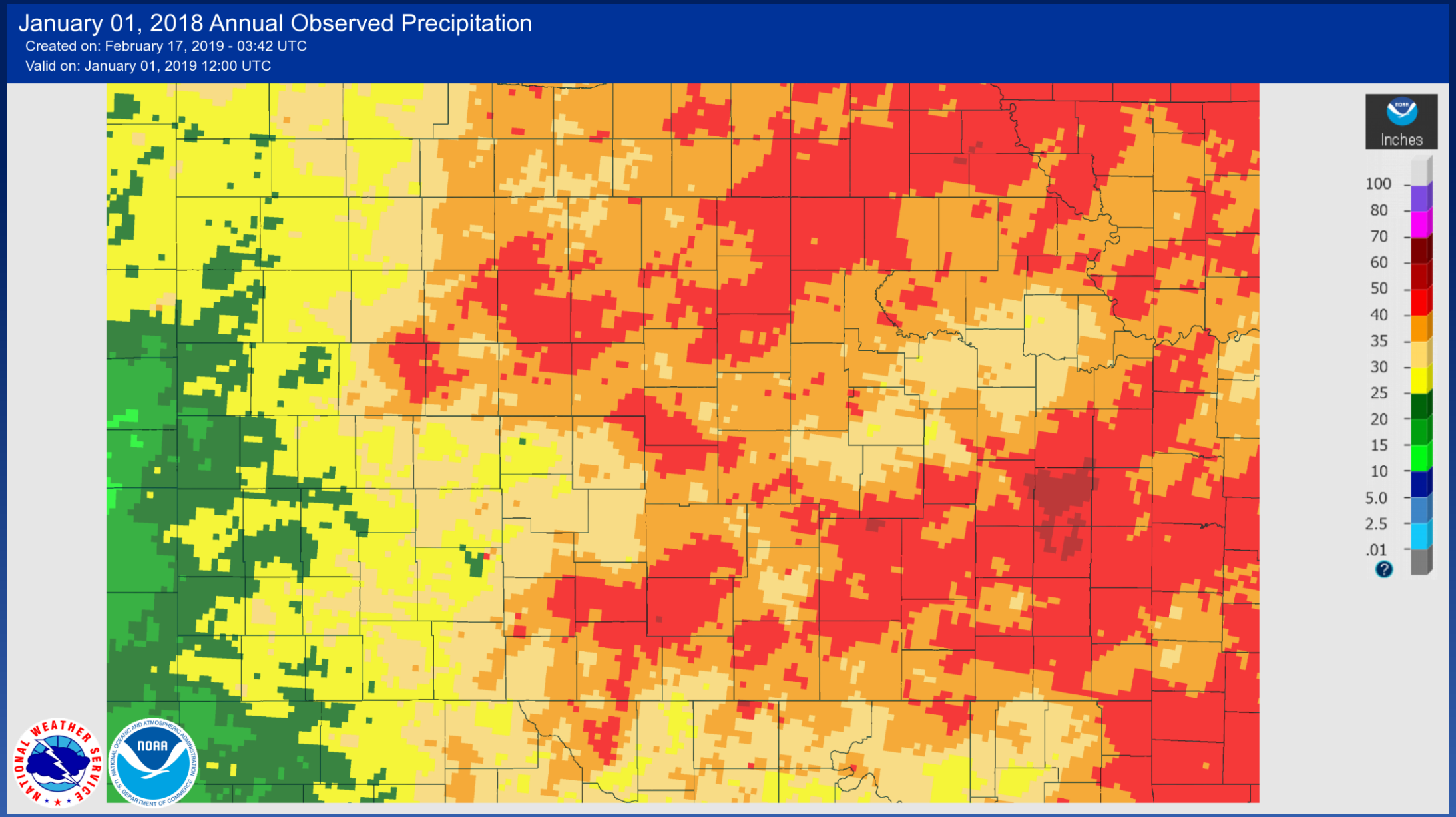
Average Change by GMD



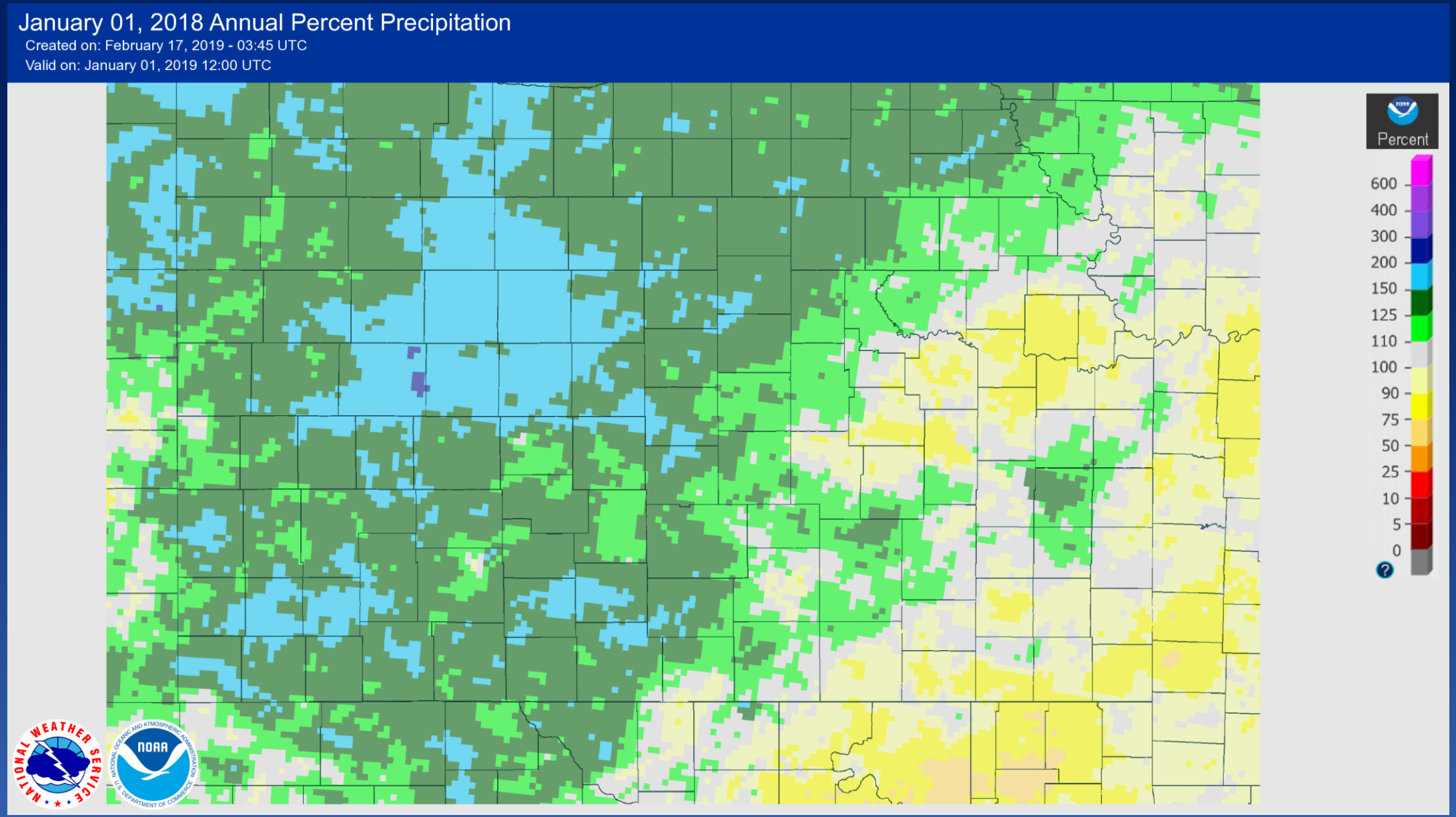


*Results are based only on the cooperative network (KGS and KDA-DWR) and do not include sub-regional networks from the KDA-DWR, KGS, or local GMDs. 2019 water levels are provisional.

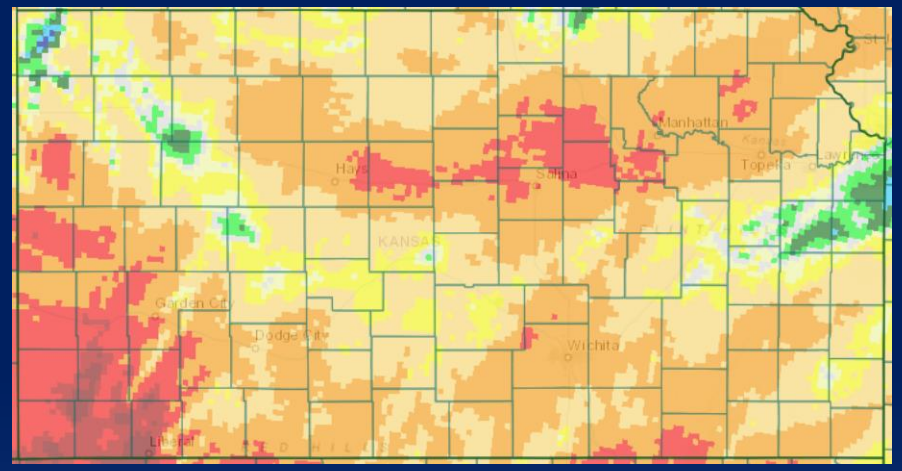
2018 Total Precipitation



Percent Departure from Normal Precipitation



March



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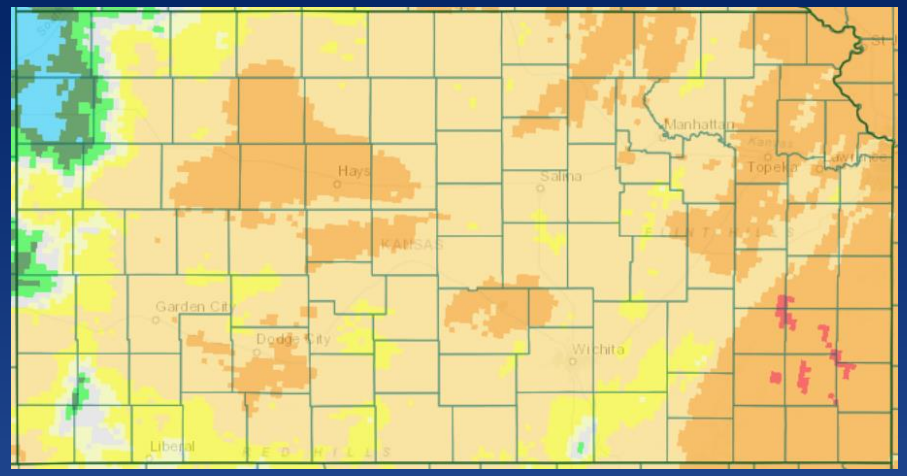

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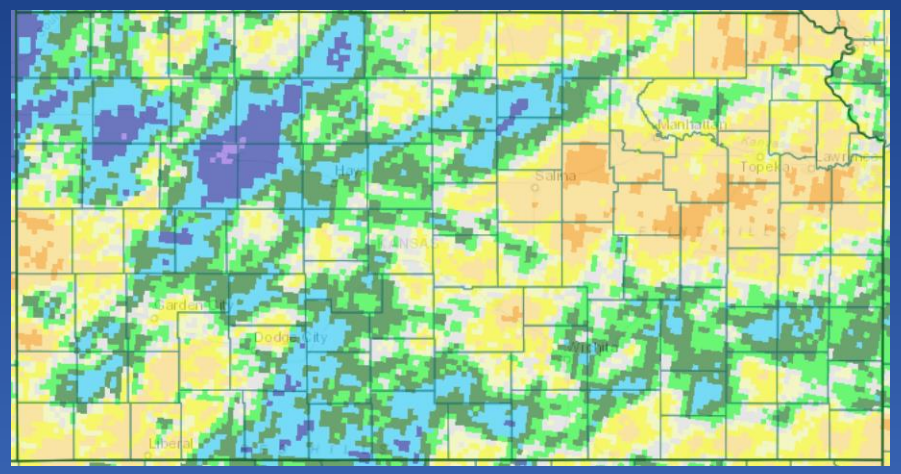

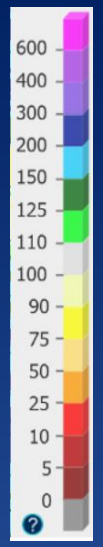

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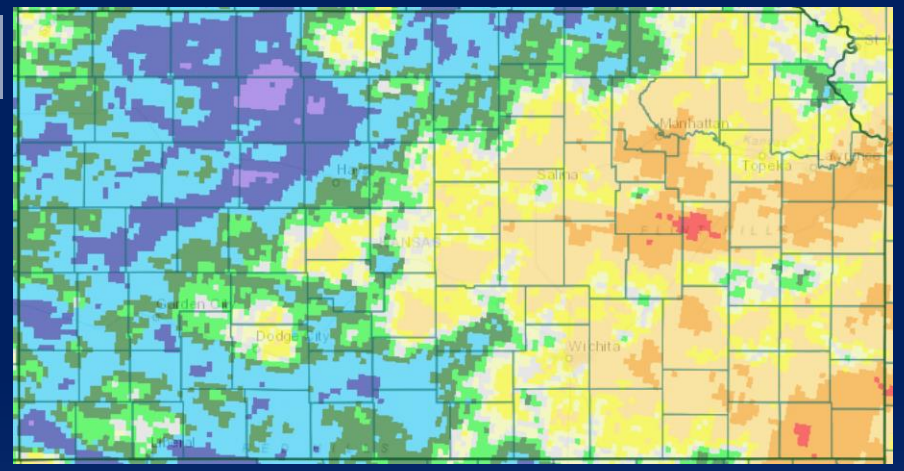

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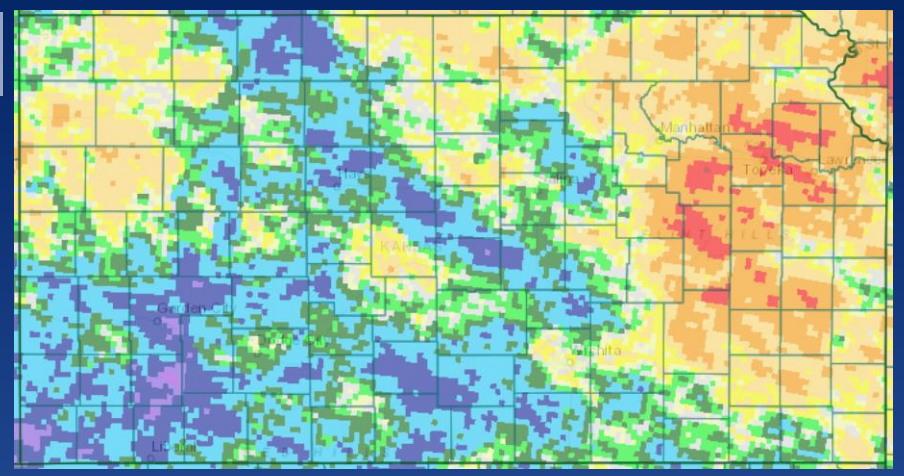
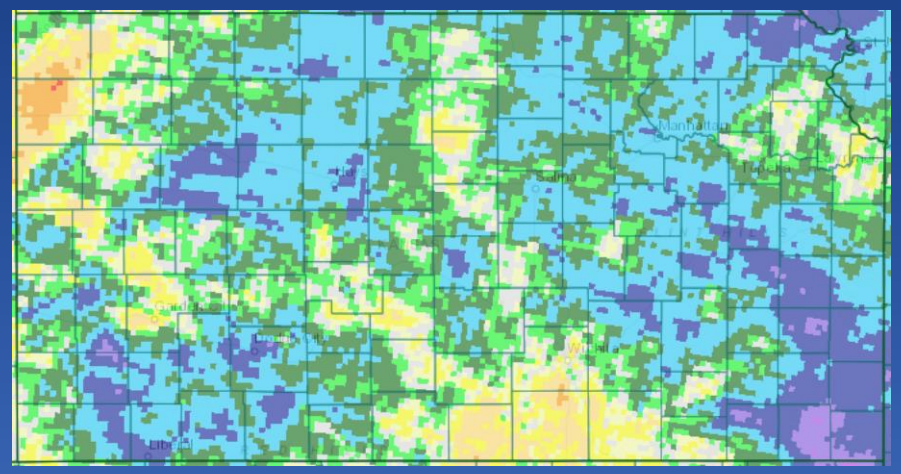
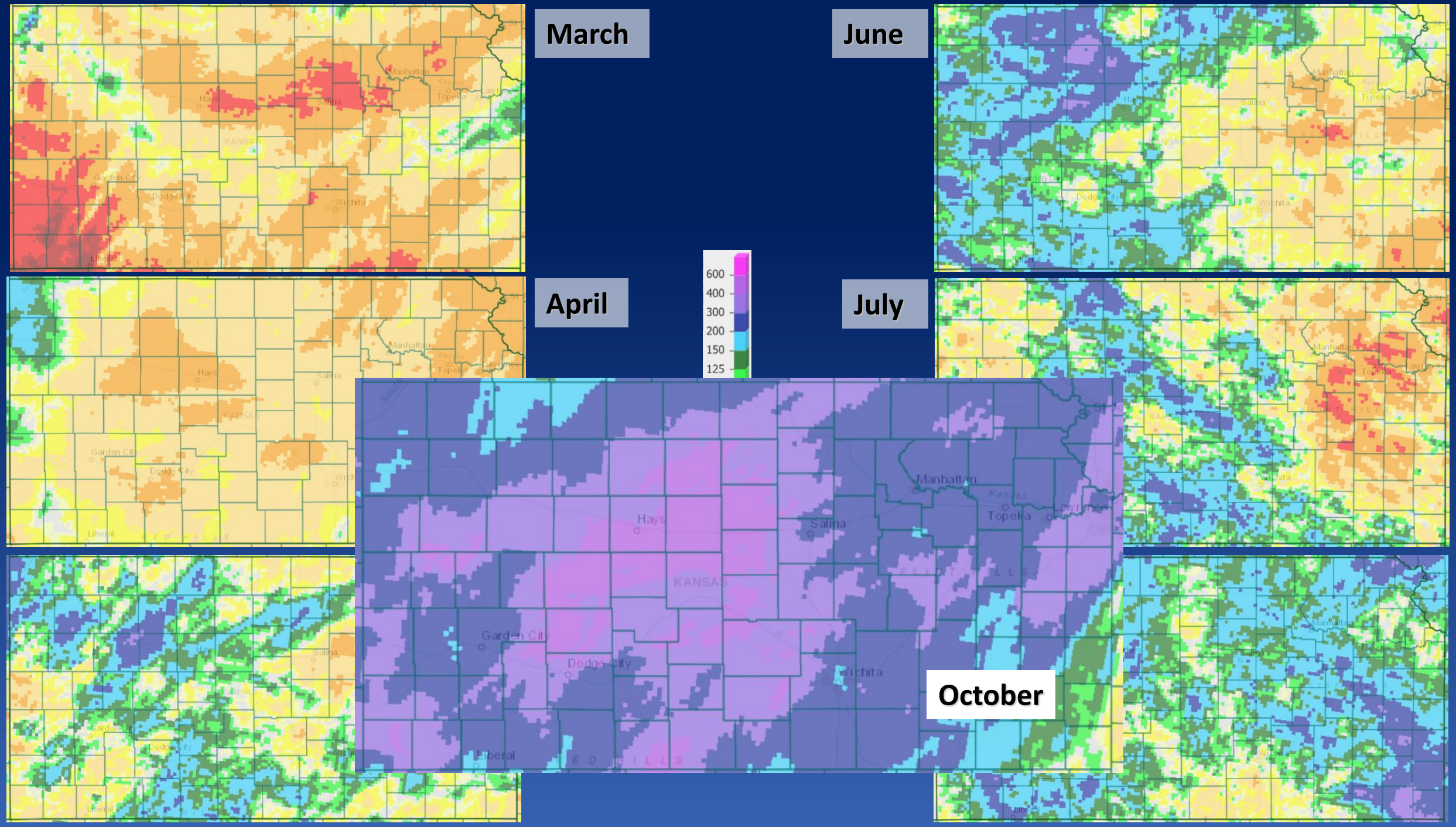
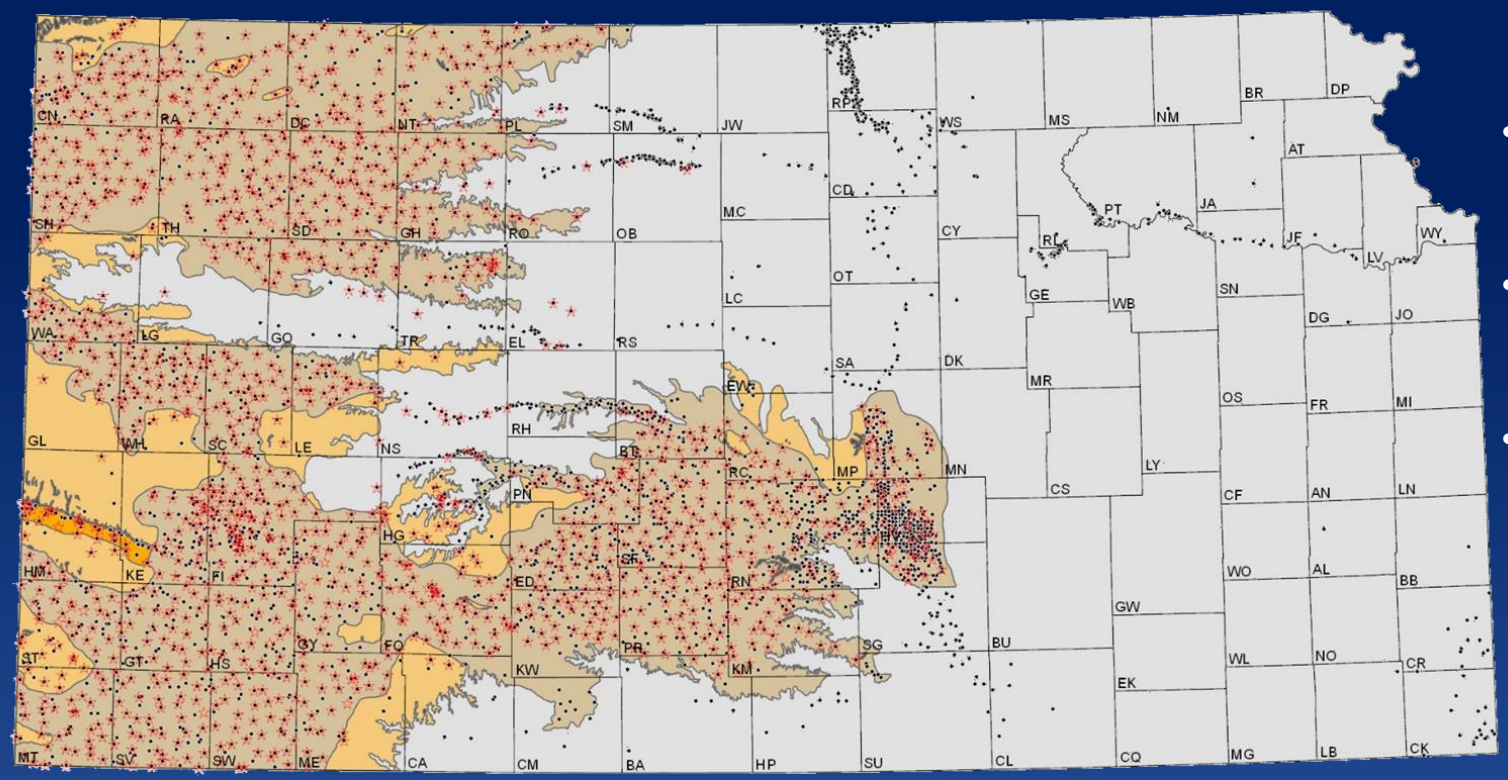


August

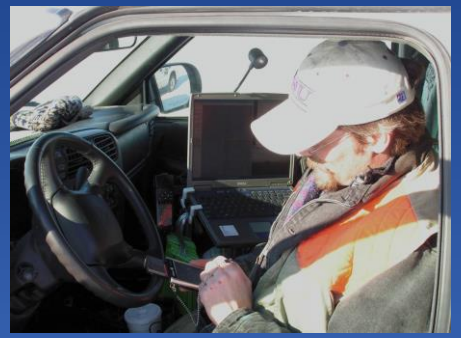



March
June
April
July
October
600
400
300
200
150
125
Manhattan
Topeka
Salina
Hays
Garden City
Dodge City
Wichita
Liberal
KANSAS

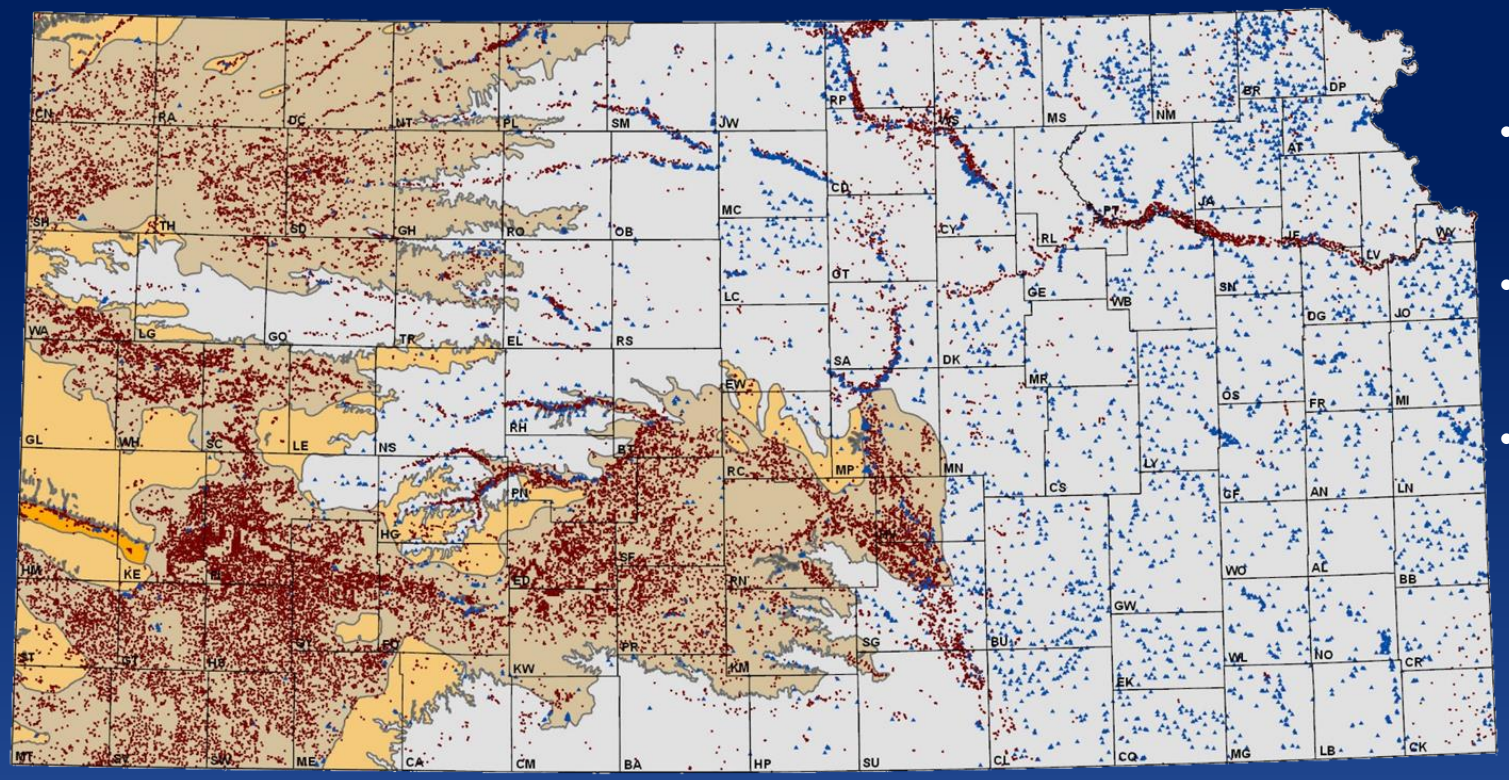
Measured Wells in Kansas



- 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



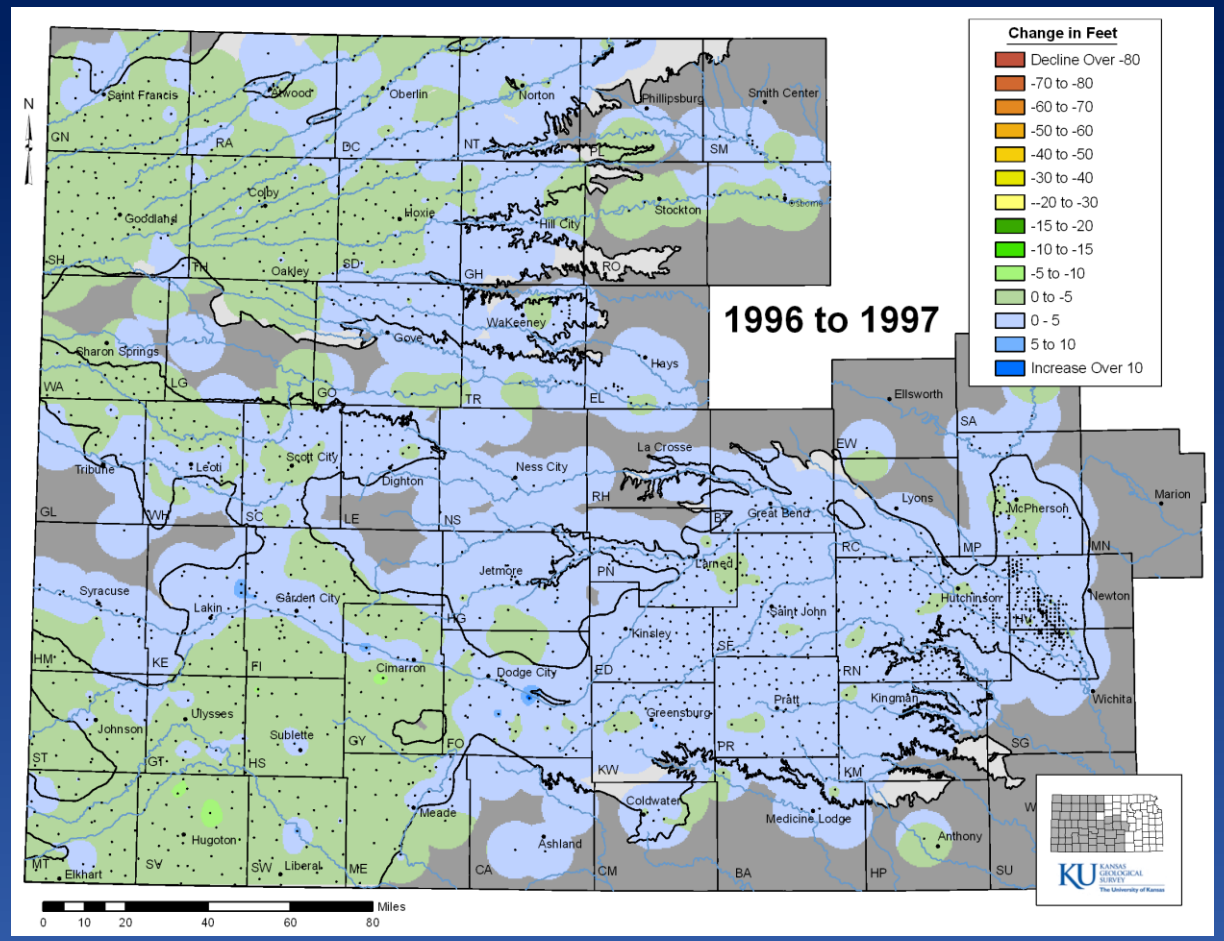
Reported Water Use in Kansas



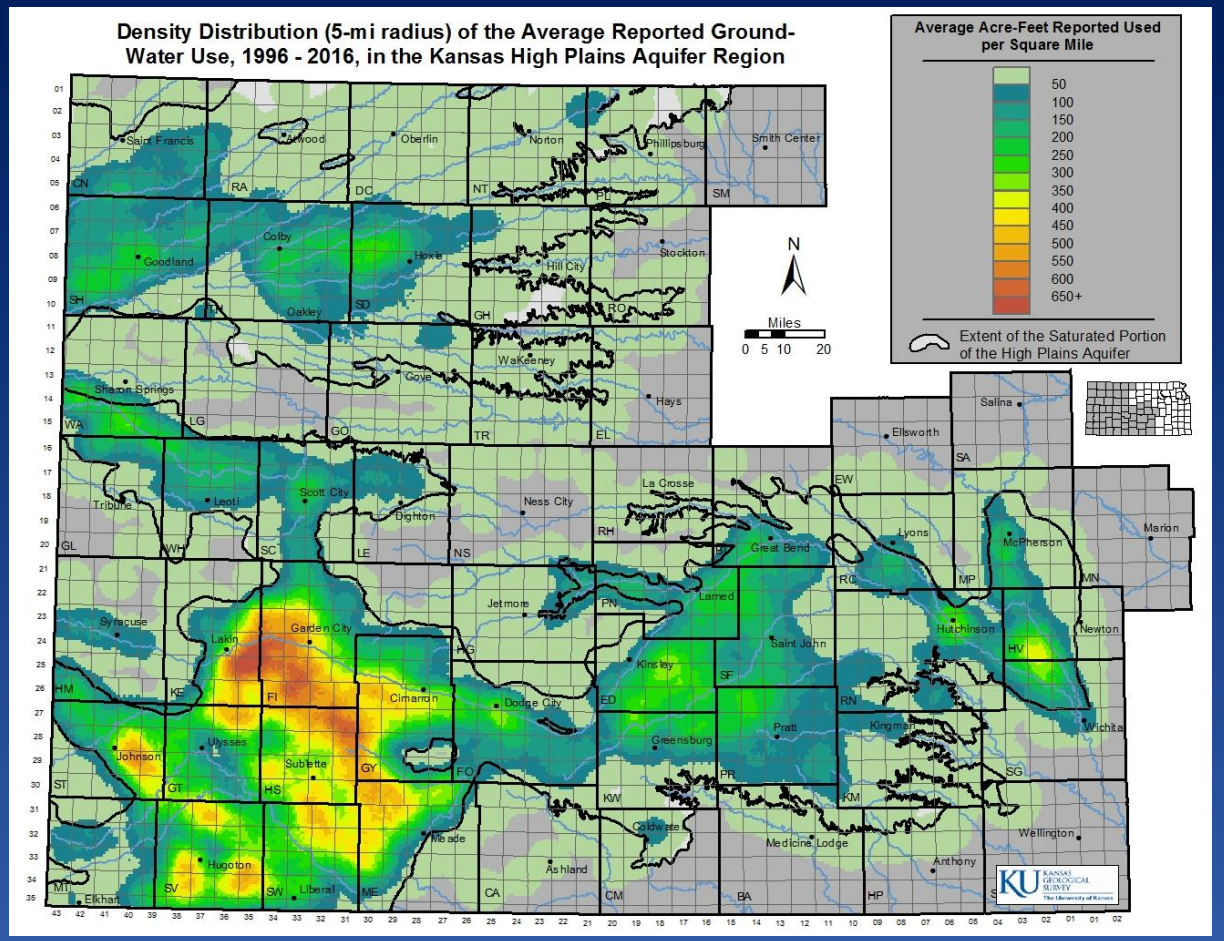
- Water Information Management and Analysis System (WIMAS)
- Kansas Department of Agriculture, Division of Water Resources
- Water Rights
  - Authorized Annual Permits/Certificates
  - Historic Reported Water Usage
  - Over 95% wells metered in High Plains aquifer region

How far out of whack are we?

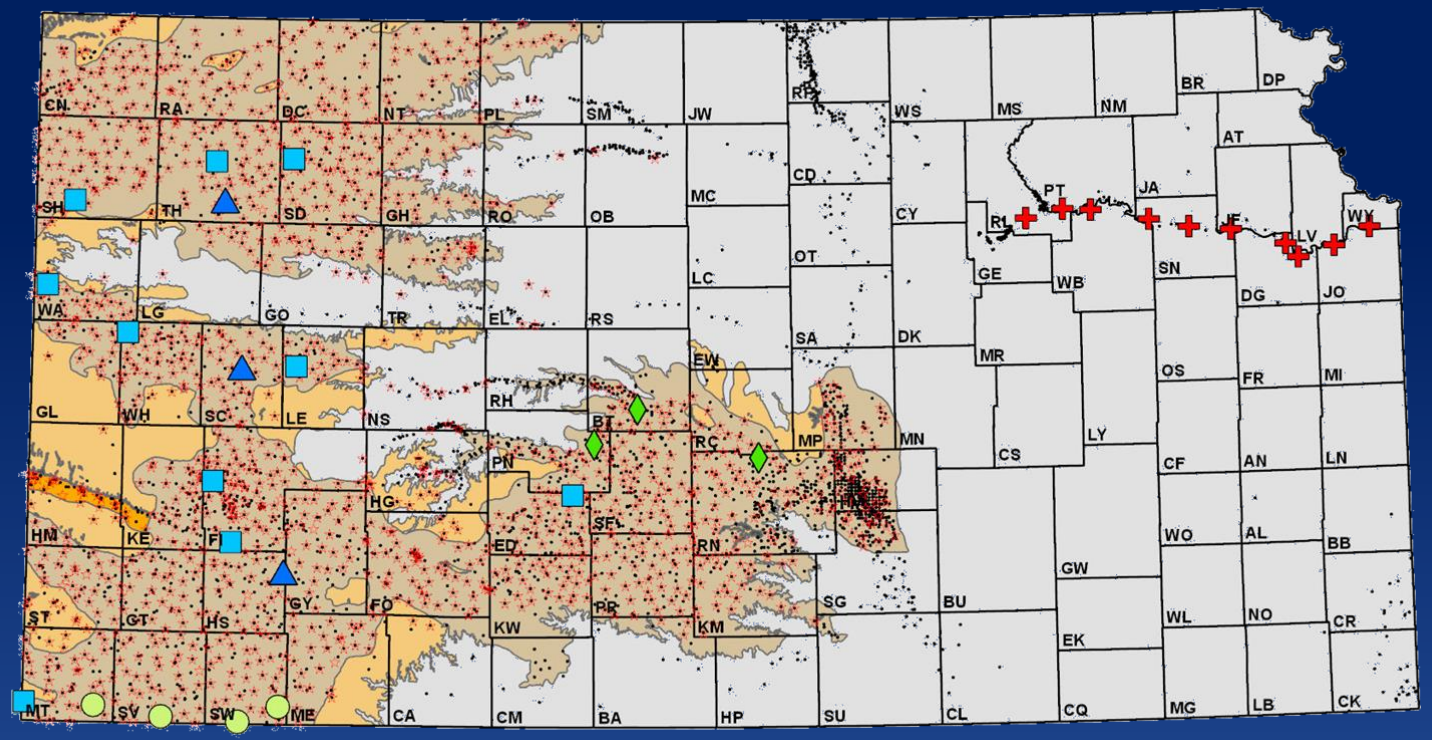
Water Level Change



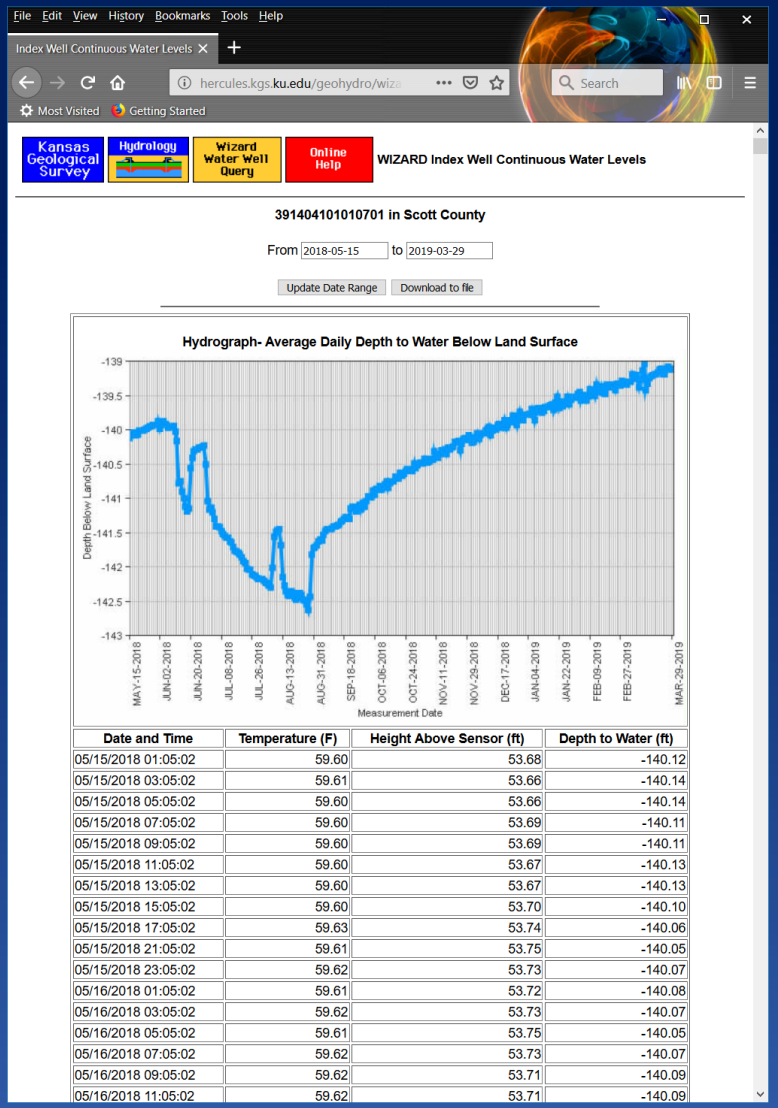
Groundwater Usage



Kansas Index Well Program

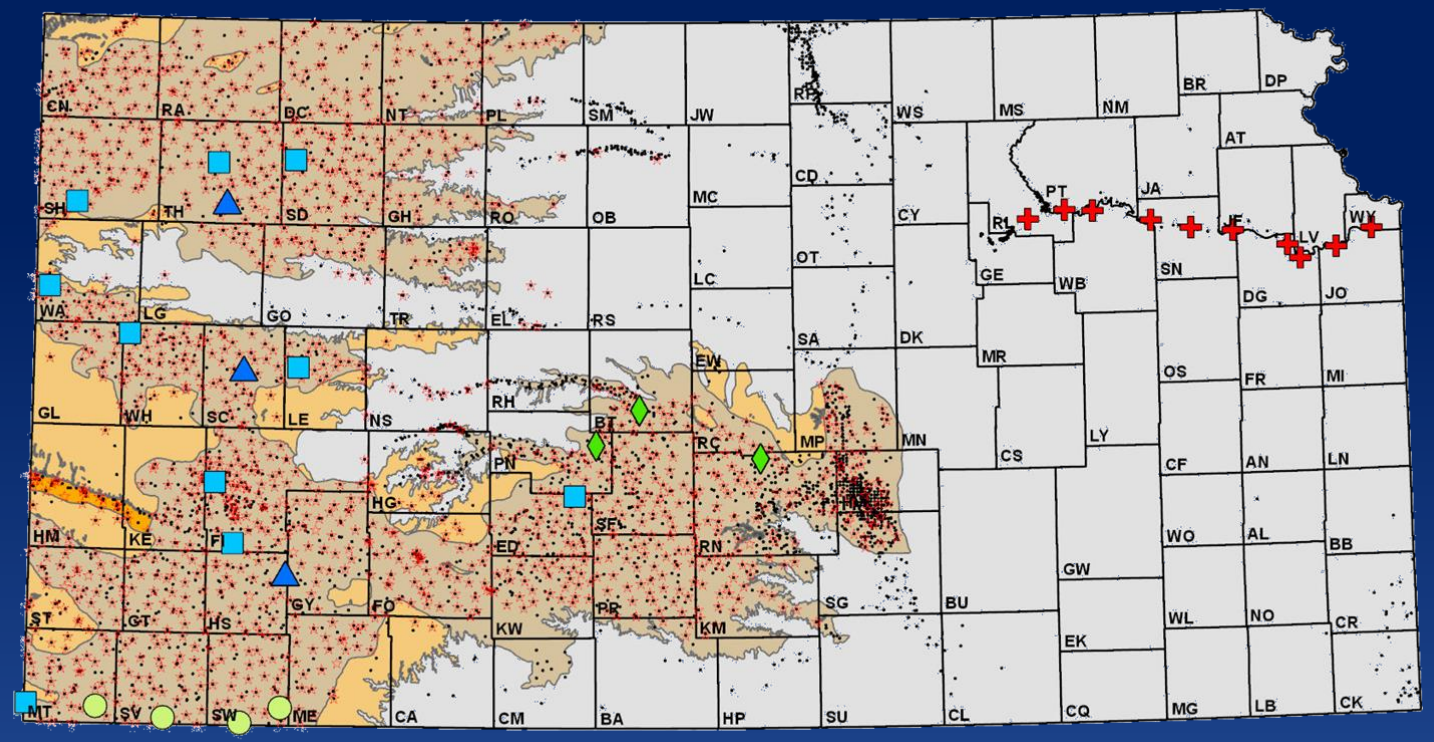


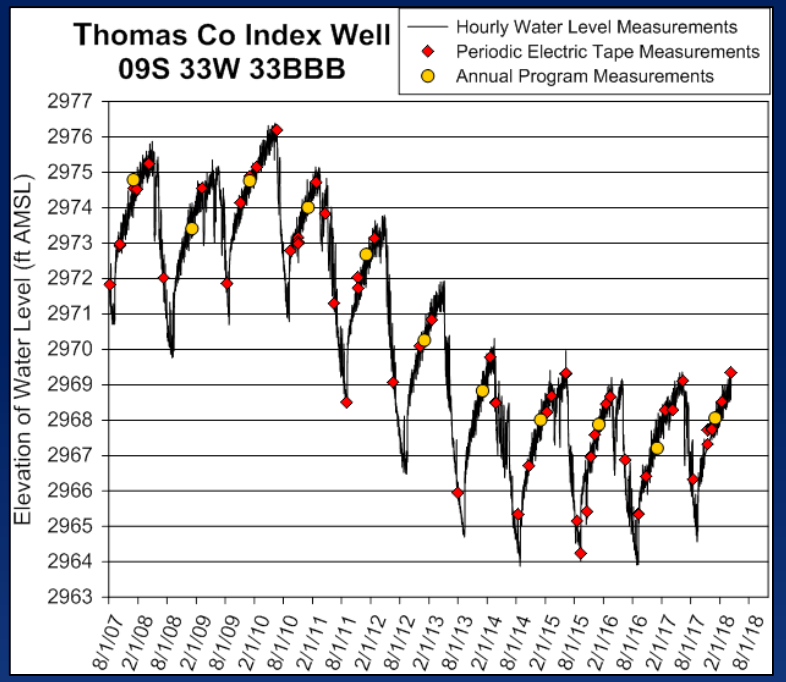
- First installed in 2007 through the Kansas Water Plan Fund
- Continuous, real-time water-level recordings
- Characterizations at the local scale

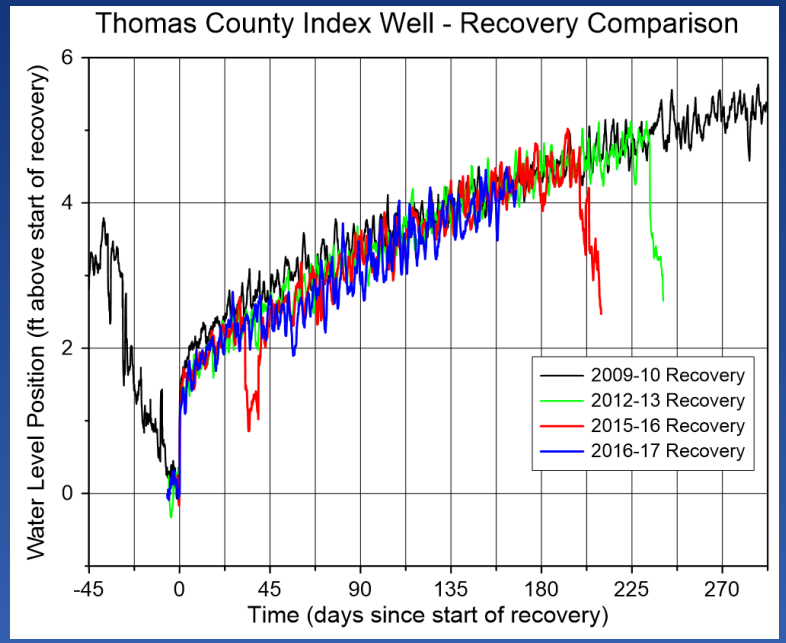


Date and Time	Temperature (F)	Height Above Sensor (ft)	Depth to Water (ft)
05/15/2018 01:05:02	59.60	53.68	-140.12
05/15/2018 03:05:02	59.61	53.66	-140.14
05/15/2018 05:05:02	59.60	53.66	-140.14
05/15/2018 07:05:02	59.60	53.69	-140.11
05/15/2018 09:05:02	59.60	53.69	-140.11
05/15/2018 11:05:02	59.60	53.67	-140.13
05/15/2018 13:05:02	59.60	53.67	-140.13
05/15/2018 15:05:02	59.60	53.70	-140.10
05/15/2018 17:05:02	59.63	53.74	-140.06
05/15/2018 21:05:02	59.61	53.75	-140.05
05/15/2018 23:05:02	59.62	53.73	-140.07
05/16/2018 01:05:02	59.61	53.72	-140.08
05/16/2018 03:05:02	59.62	53.73	-140.07
05/16/2018 05:05:02	59.61	53.75	-140.05
05/16/2018 07:05:02	59.62	53.73	-140.07
05/16/2018 09:05:02	59.62	53.71	-140.09
05/16/2018 11:05:02	59.62	53.71	-140.09

Thomas County Index Well



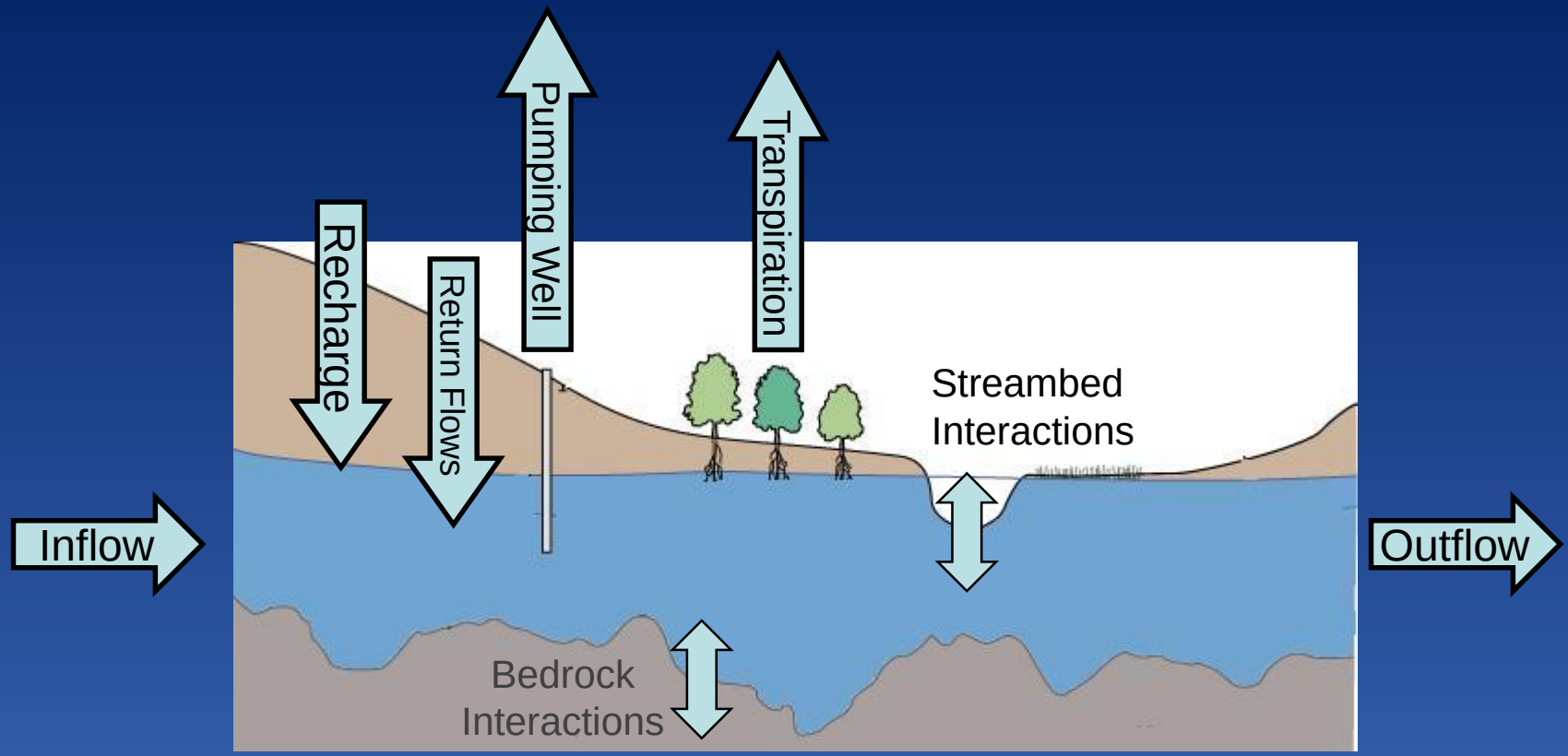




- Water levels are not in a constant state of decline
- End-of-season recovery is similar regardless of past pumping or climatic conditions

Aquifer Water Balance

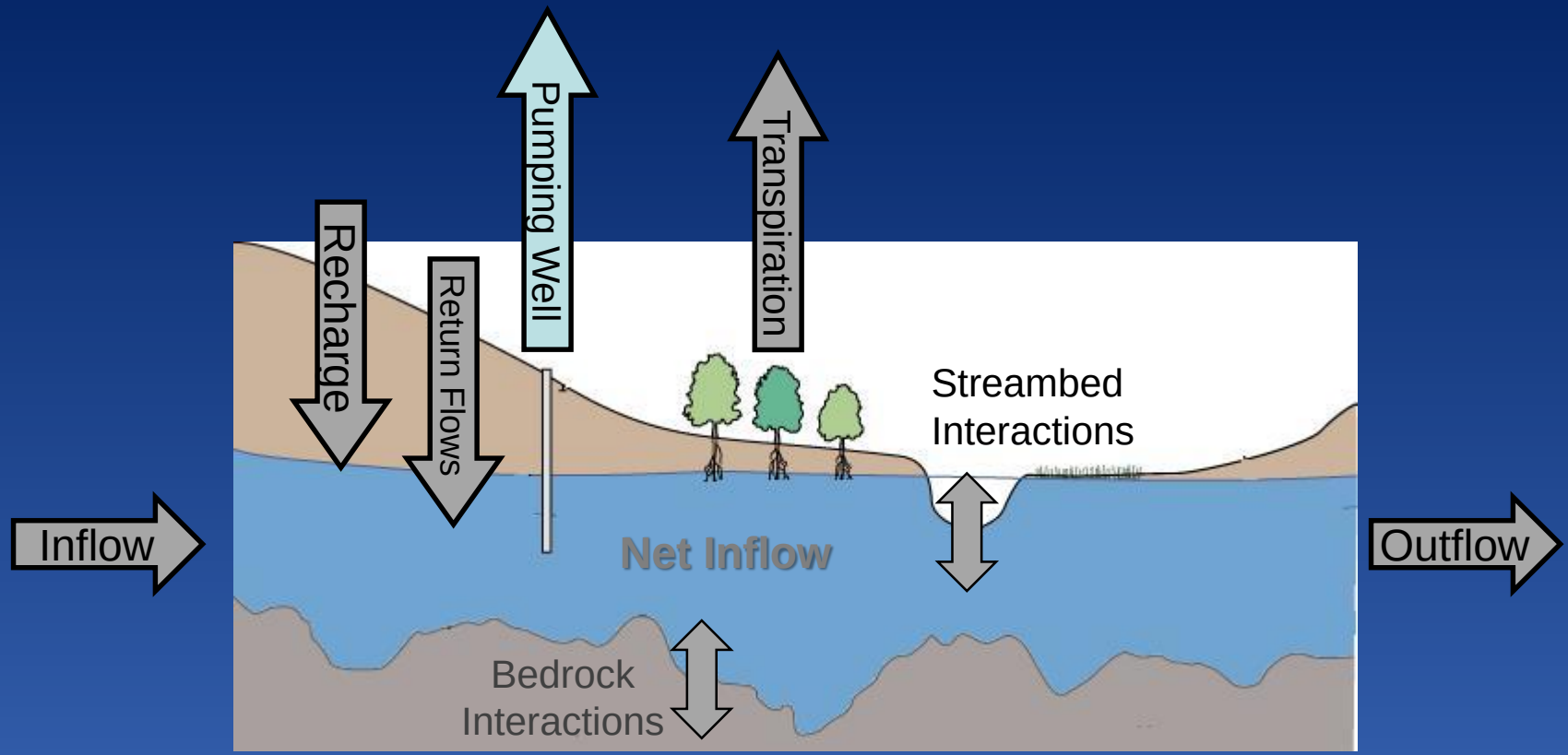
Water Volume Change in Aquifer =
Inflows into Aquifer – Outflows from Aquifer



Rewrite for Net Inflow and Pumping

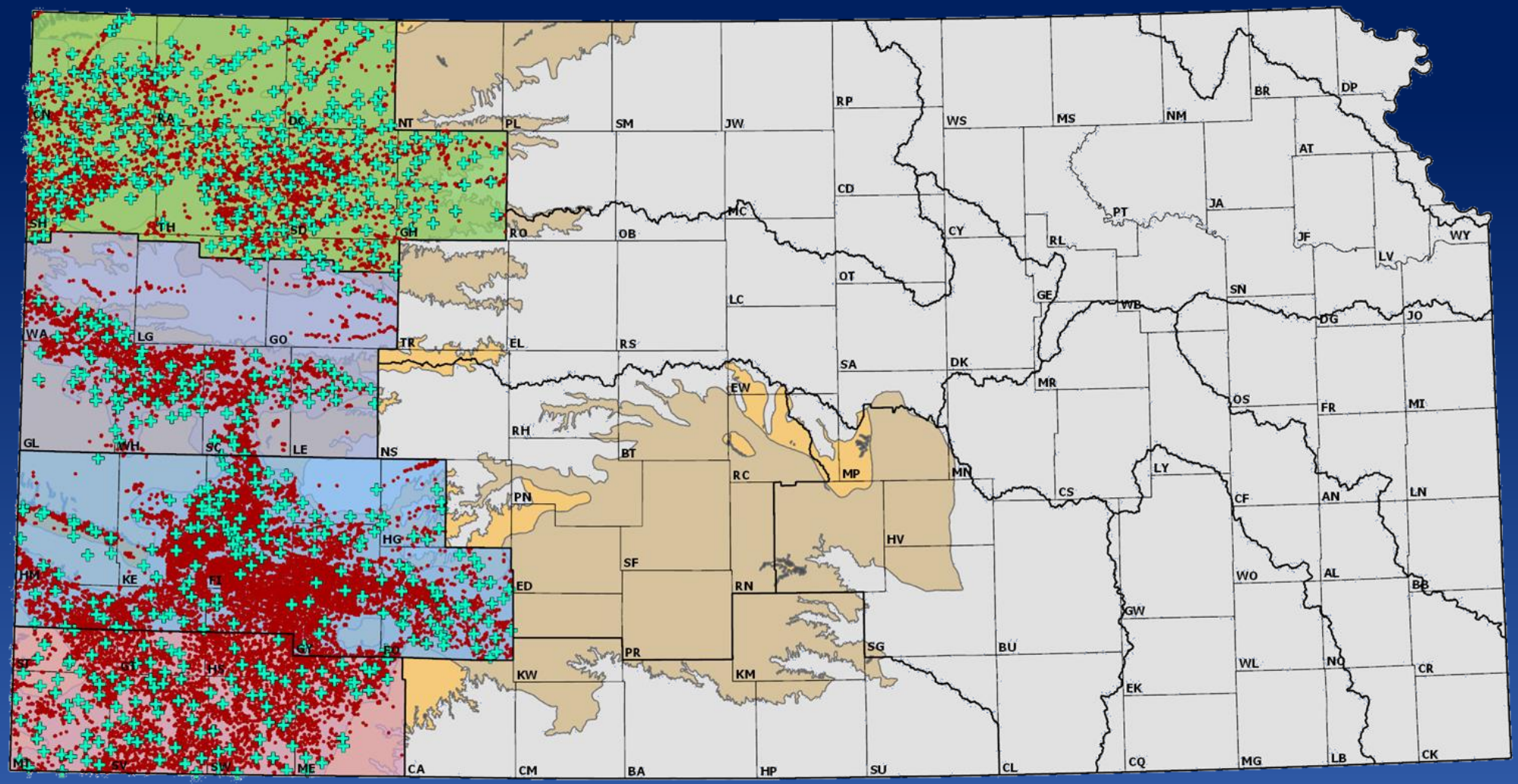
Water Volume Change in Aquifer =
Inflows into Aquifer – Outflows from Aquifer

Water Volume Change in Aquifer =
Net Inflow – Pumping



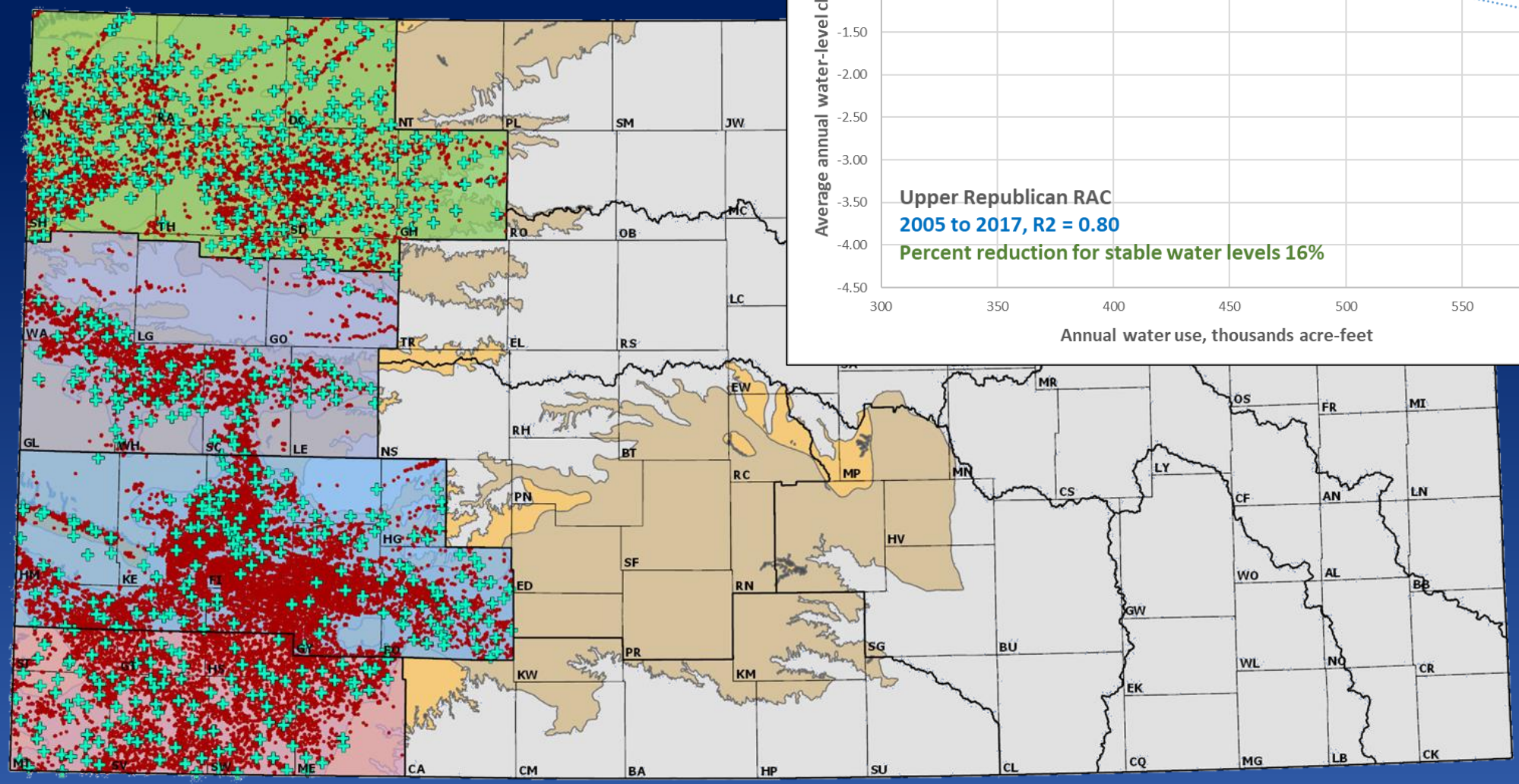
Water-Level Change vs Reported Water Use

Selected KWO Regional Advisory Committee Areas

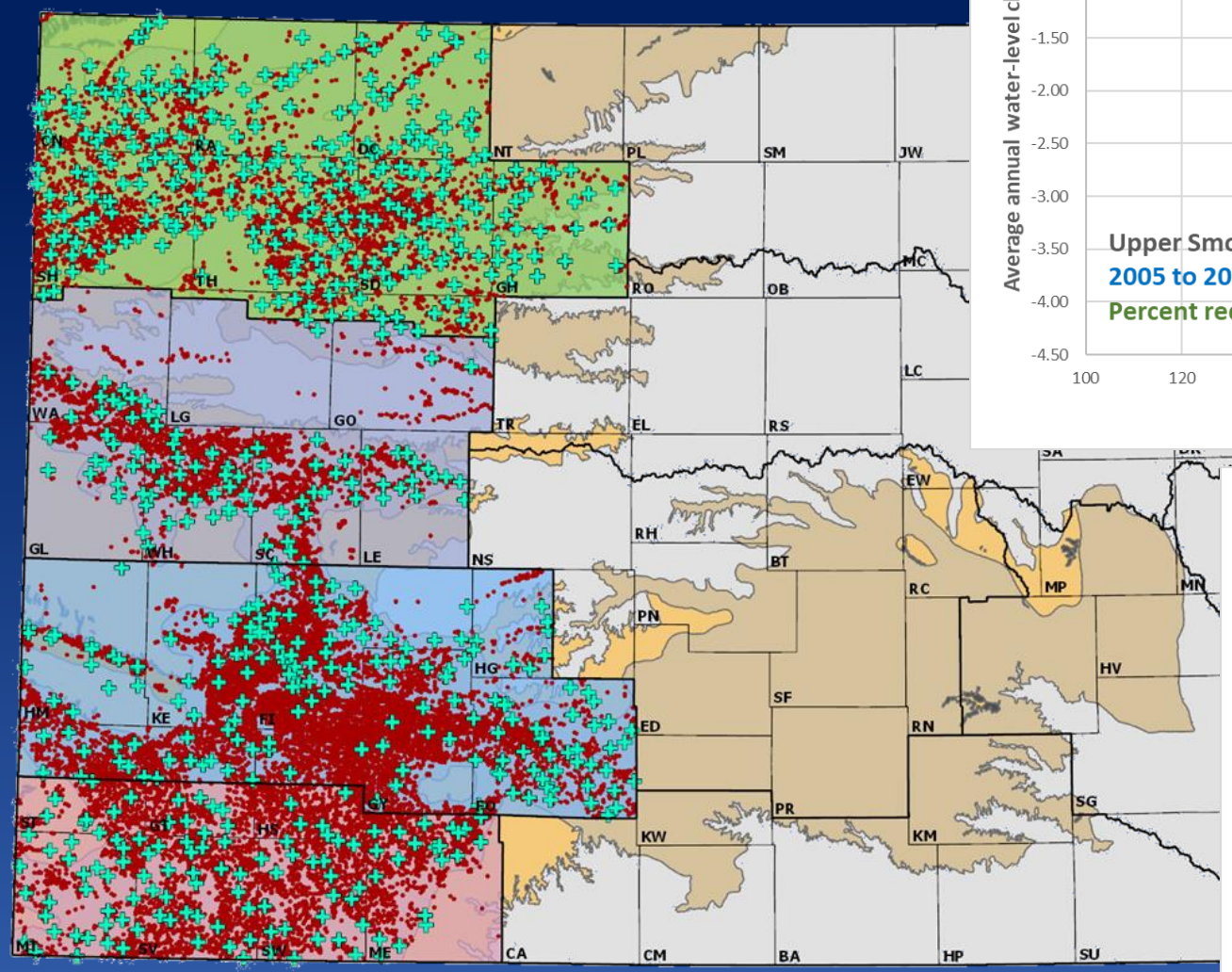


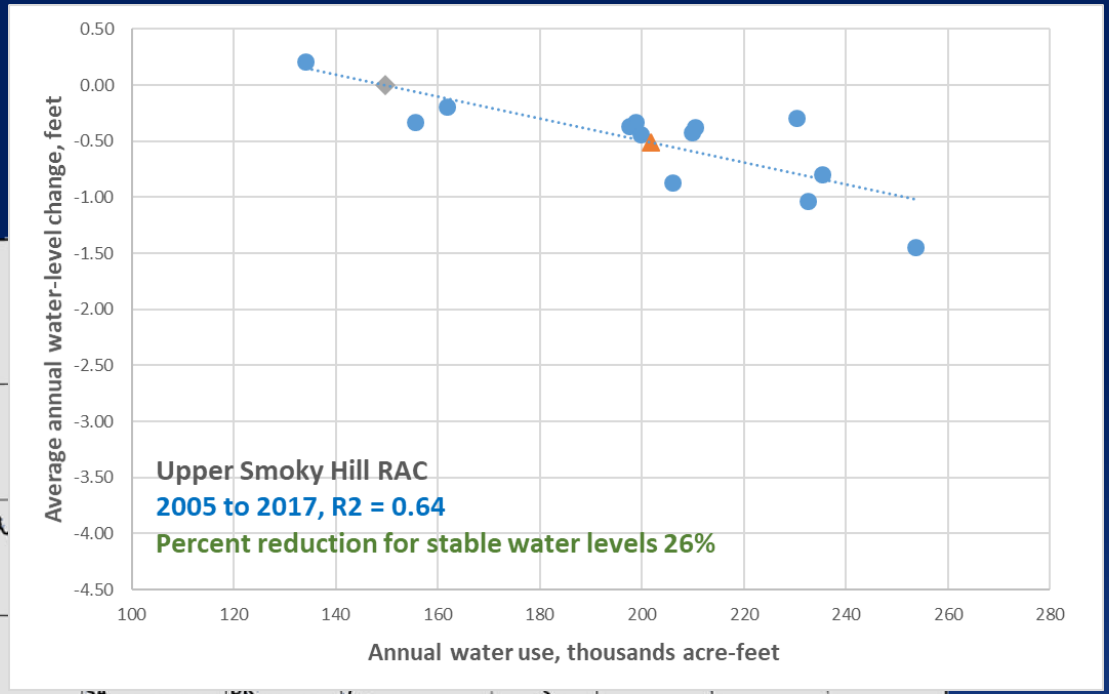
- Water right permitted groundwater well
- Continuously measured (annual) groundwater well, 2005 to 2018

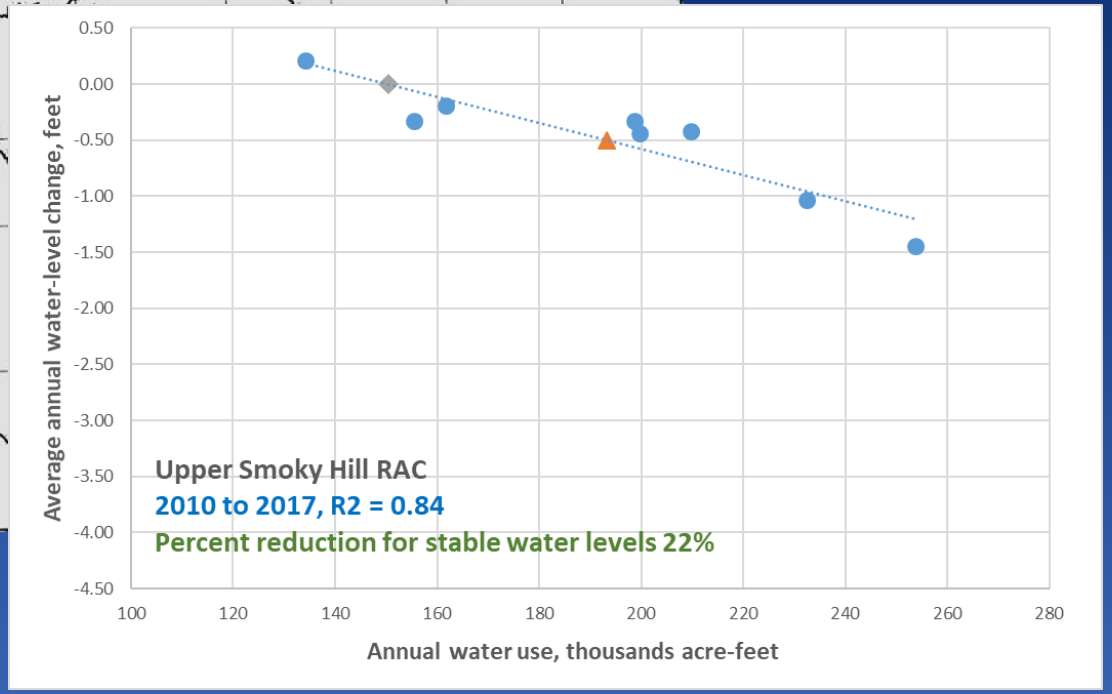
Upper Republican RAC



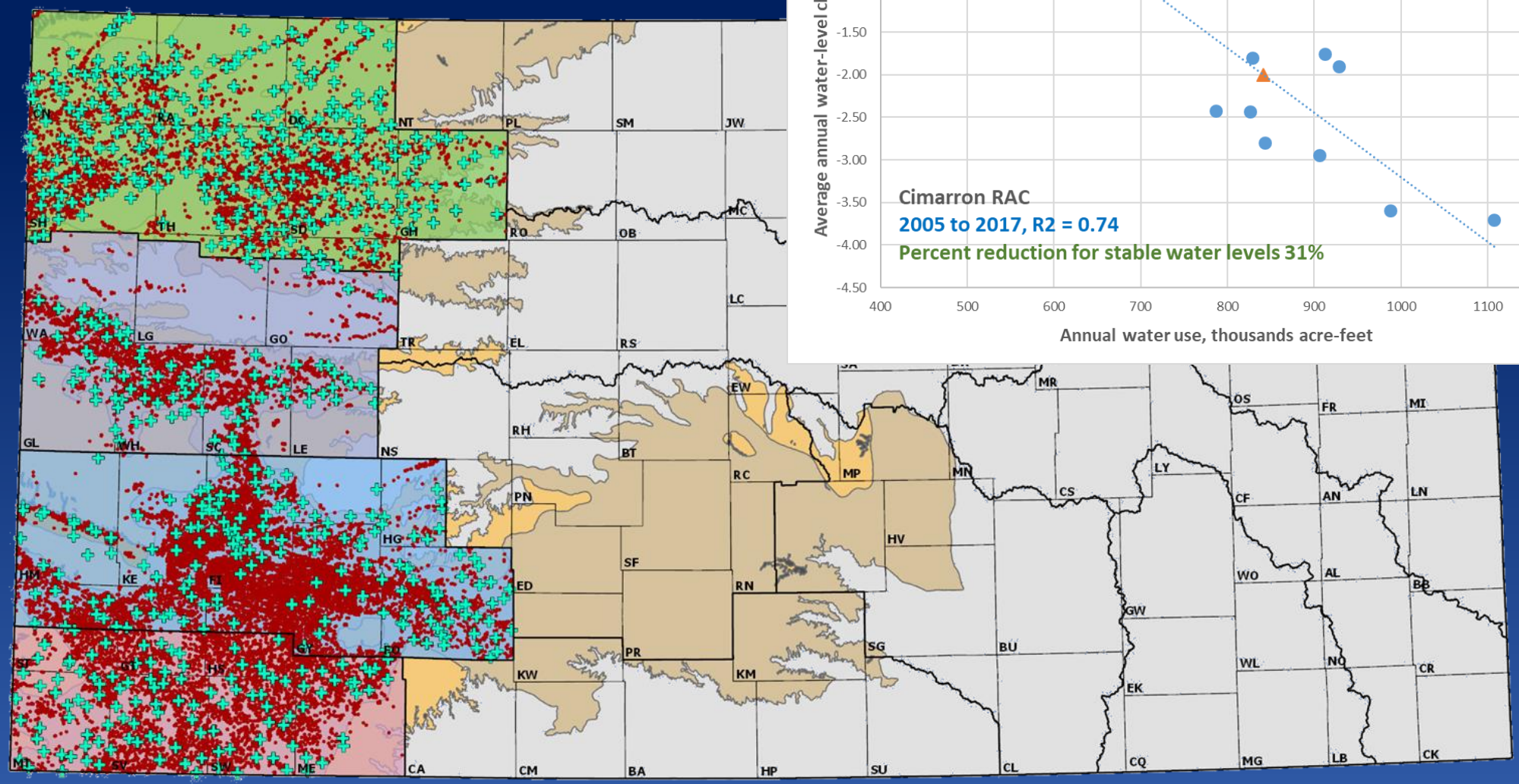
Upper Smoky Hill RAC



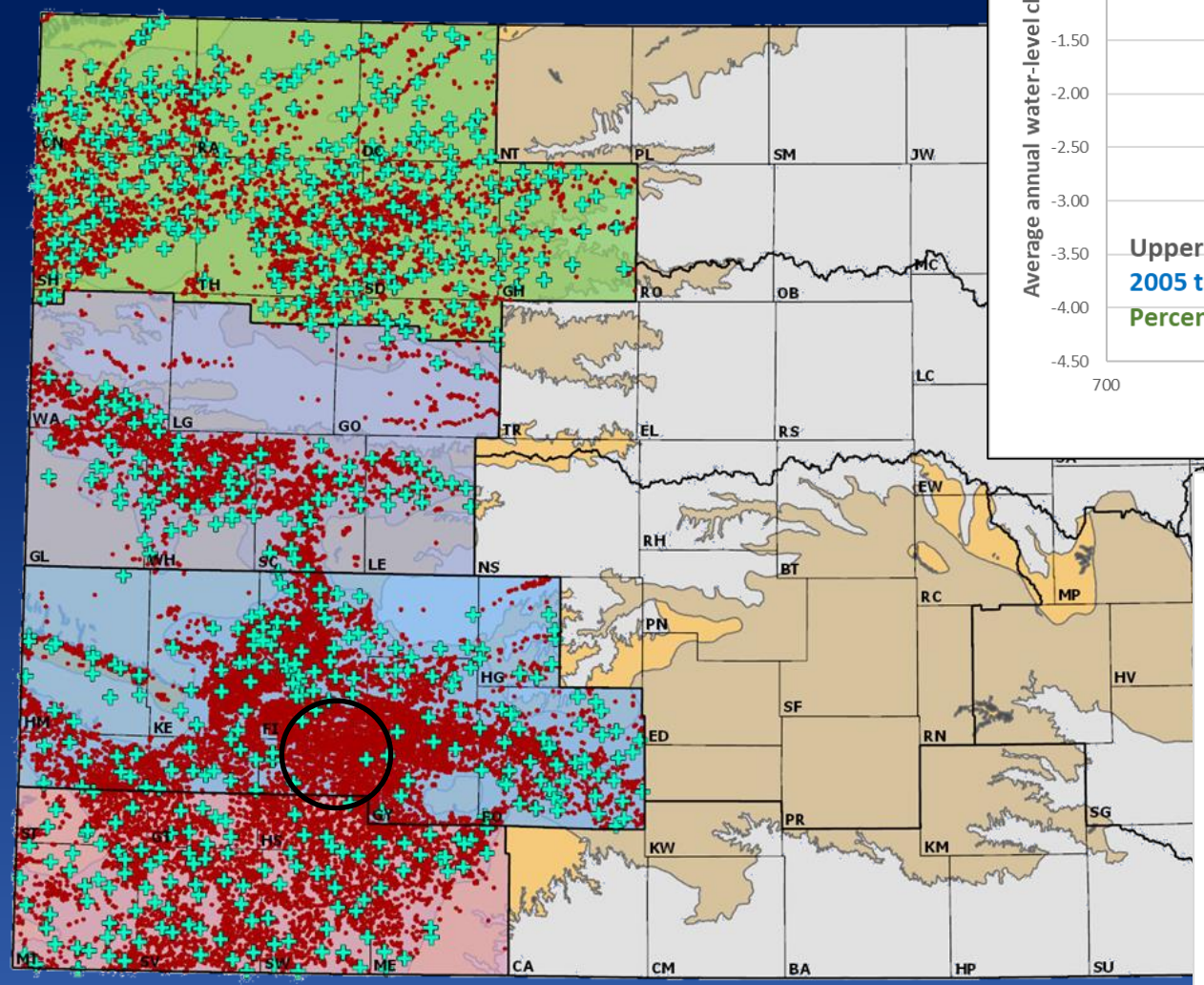


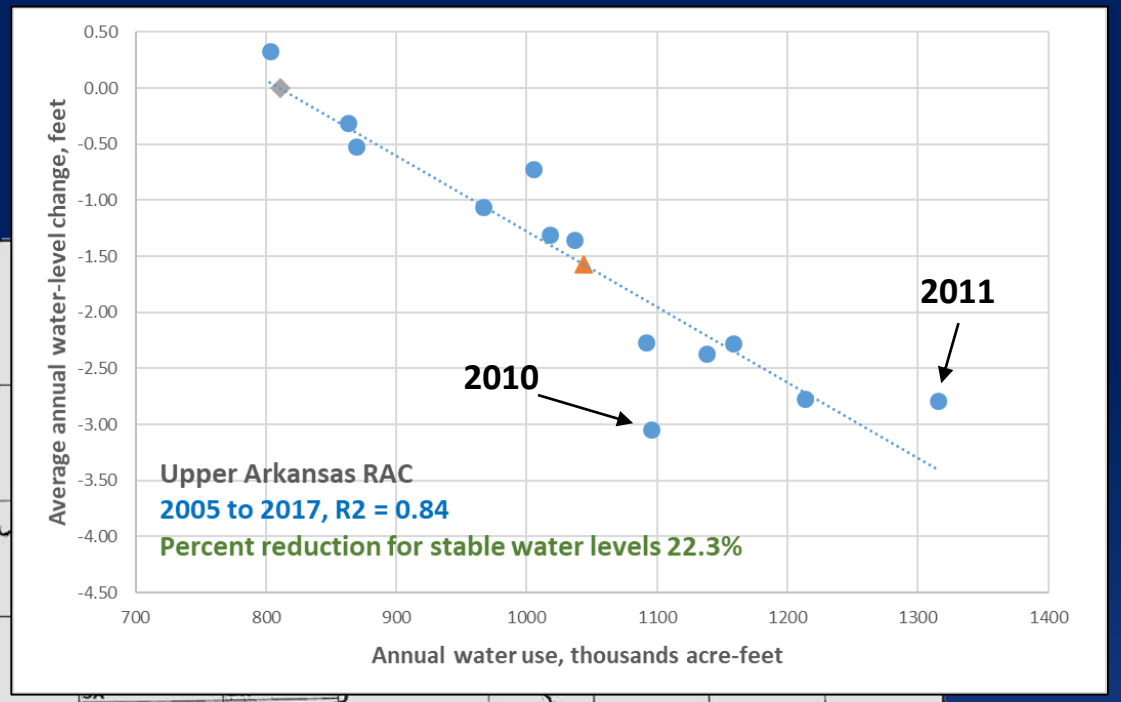


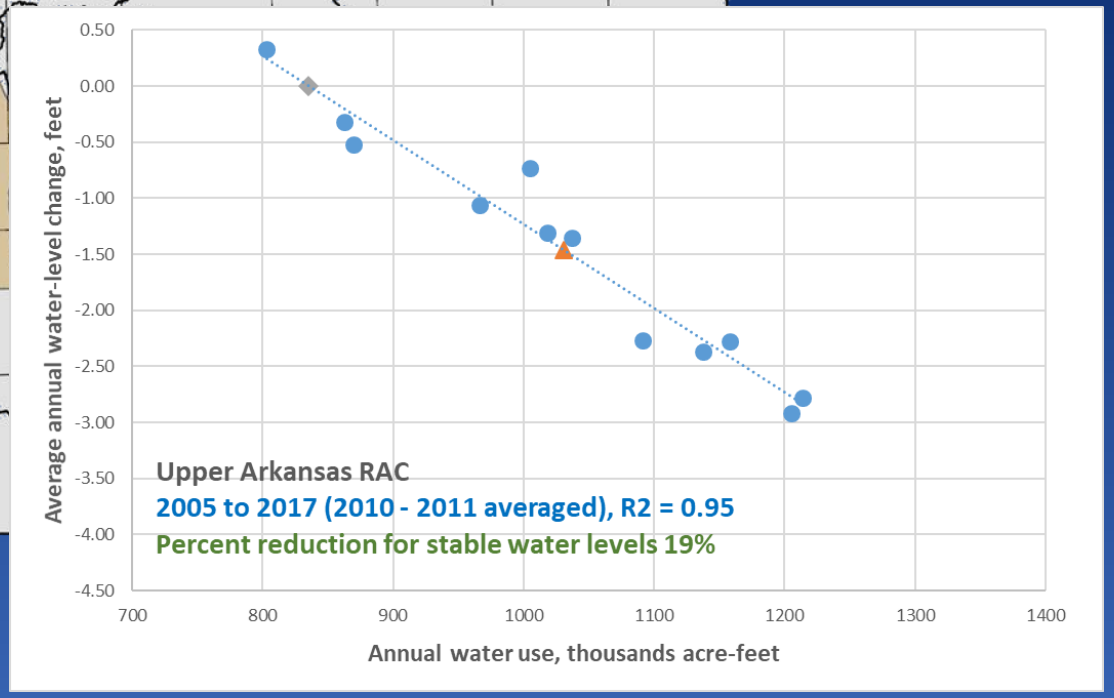
Cimarron RAC



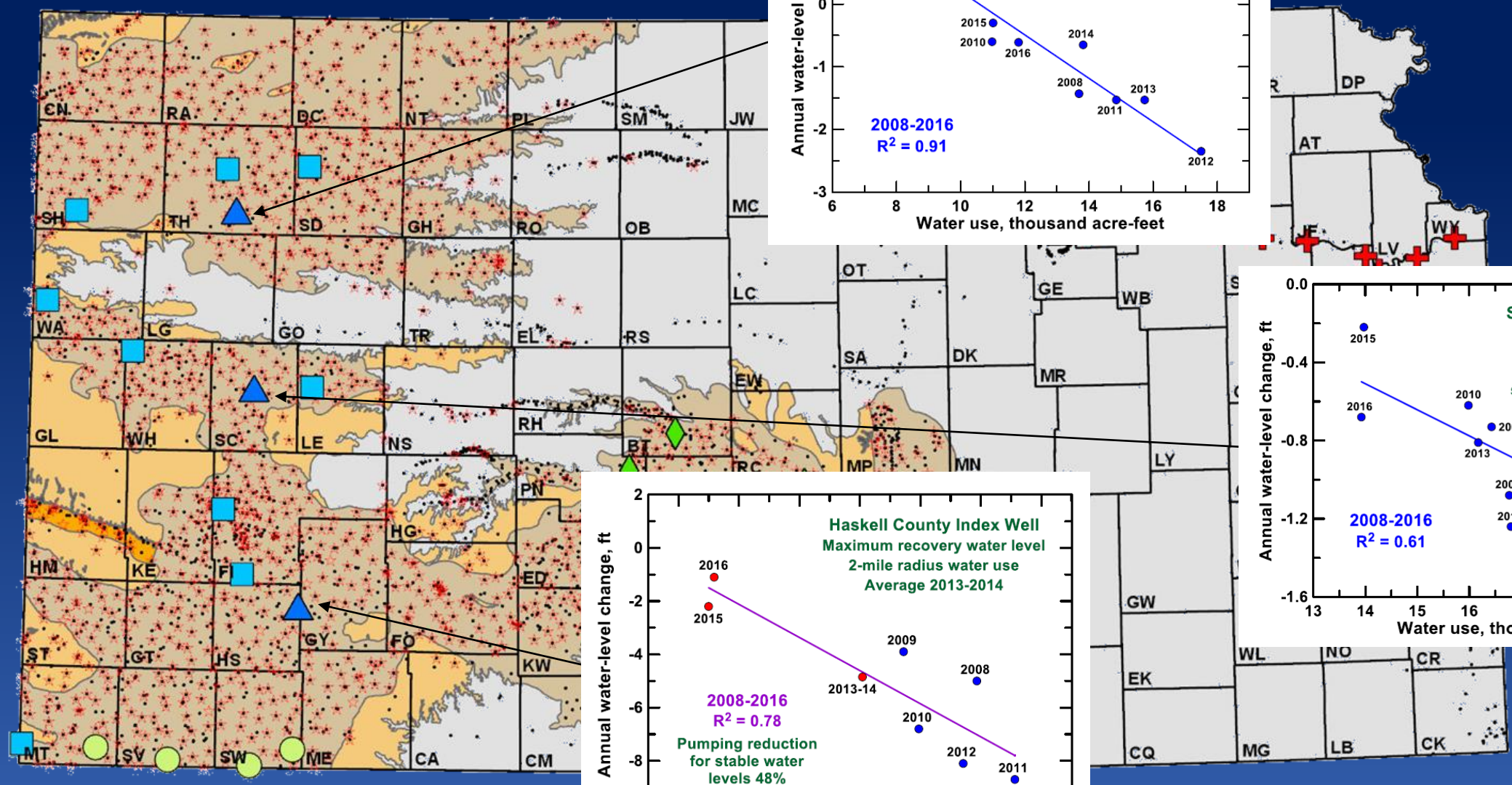
Upper Arkansas RAC





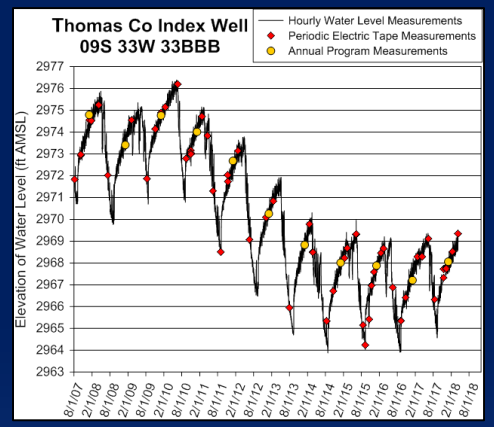


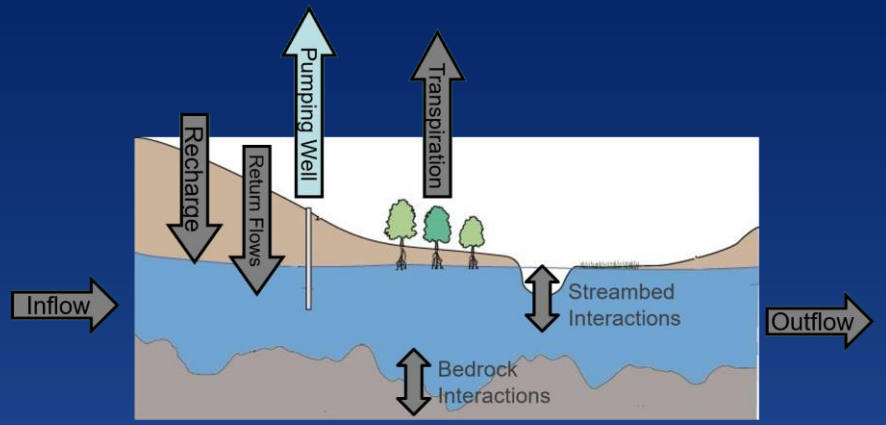
Kansas Index Wells

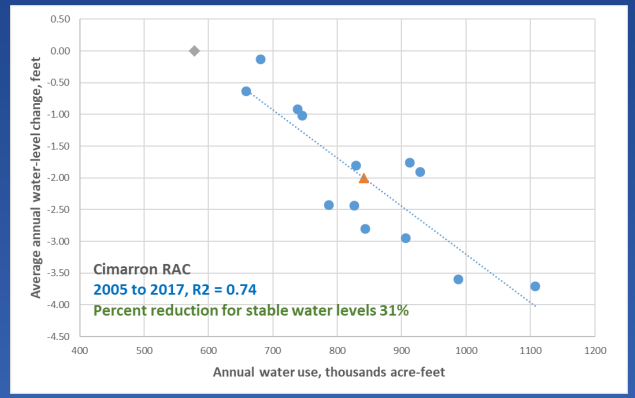


Water Balance Approach in Summary

- 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.





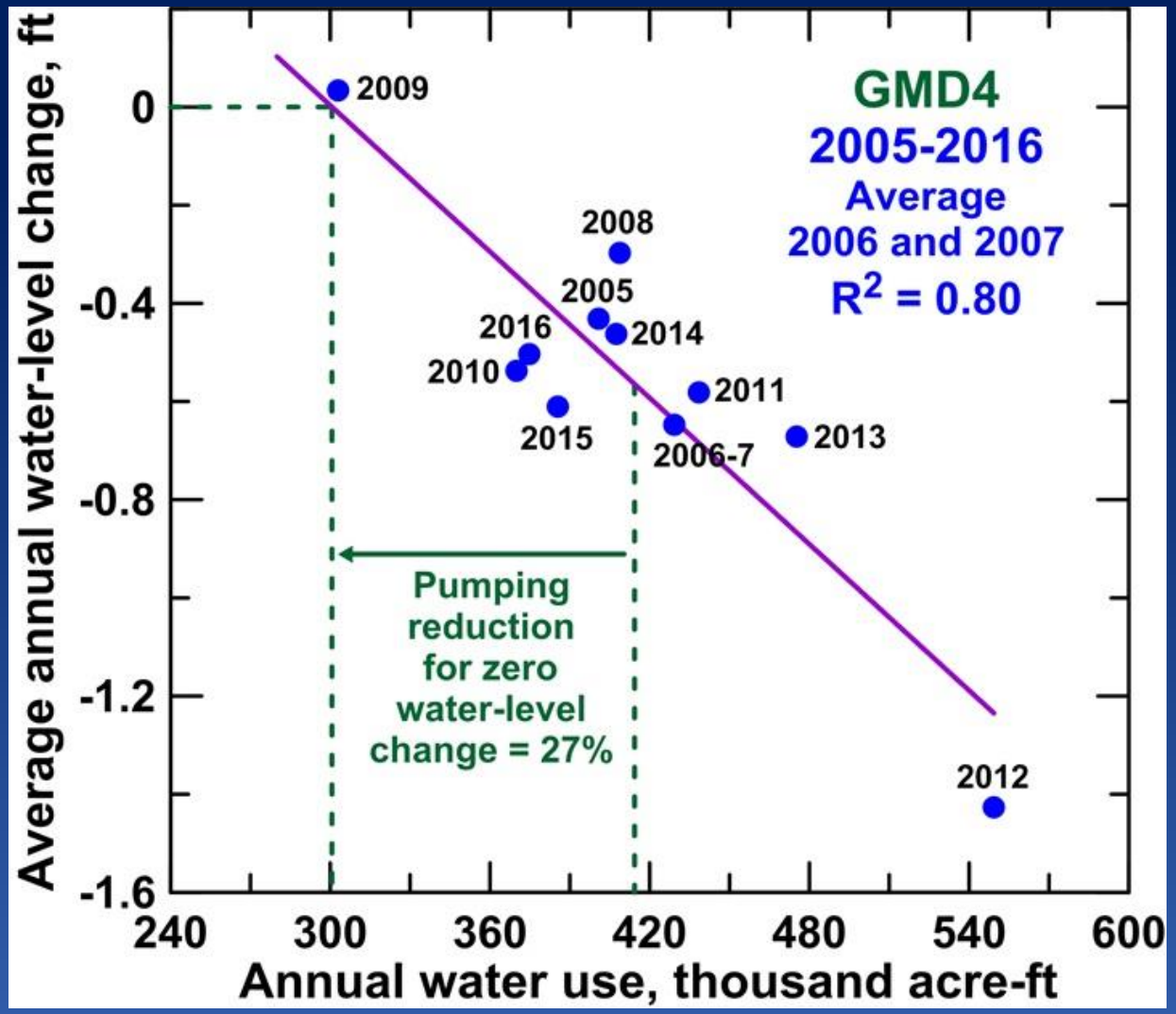


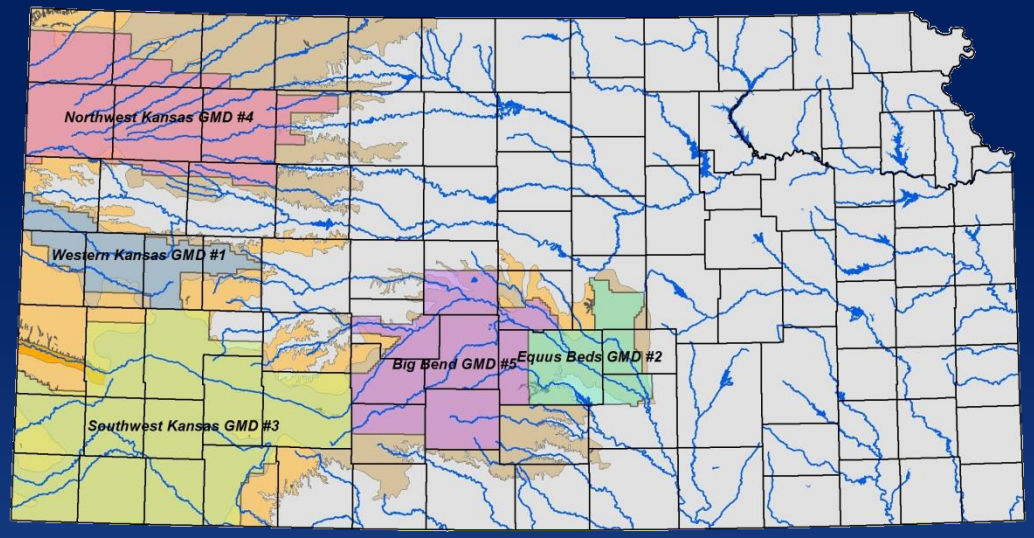
Questions????

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

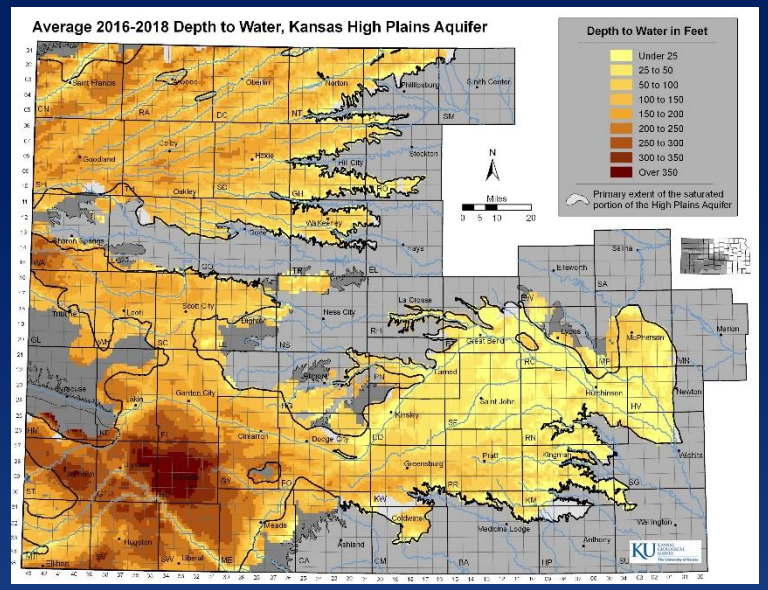


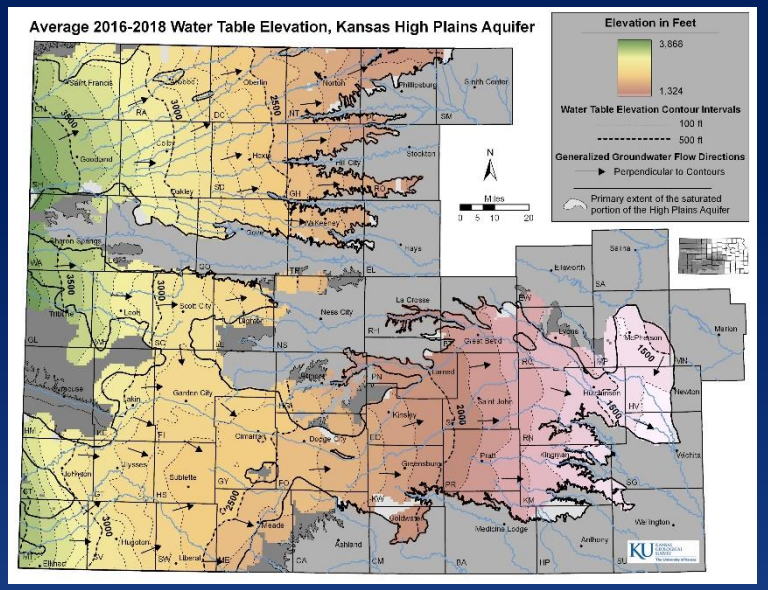


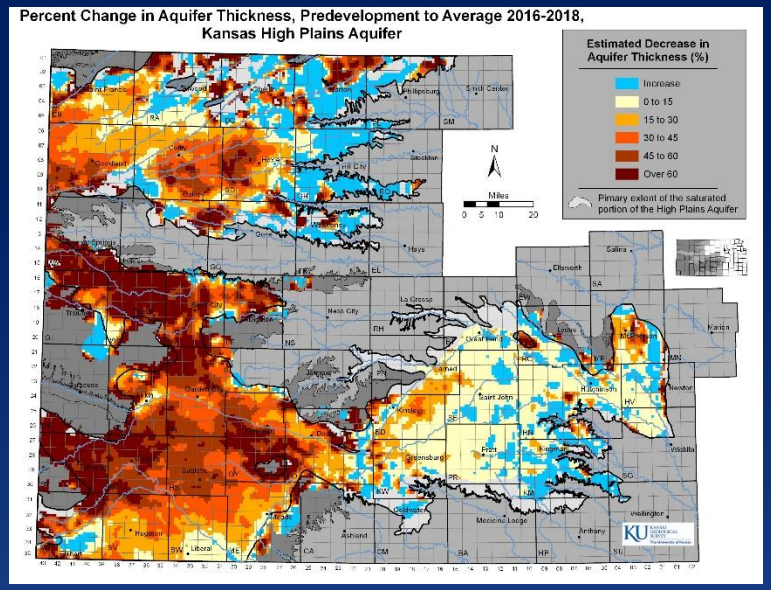
- Based on the data from 2005 to 2016
  - 27% reduction in the average amount of water reported used would produce stable water levels
  - Net inflow (water use at 0 decline) is 1.2 inches per year

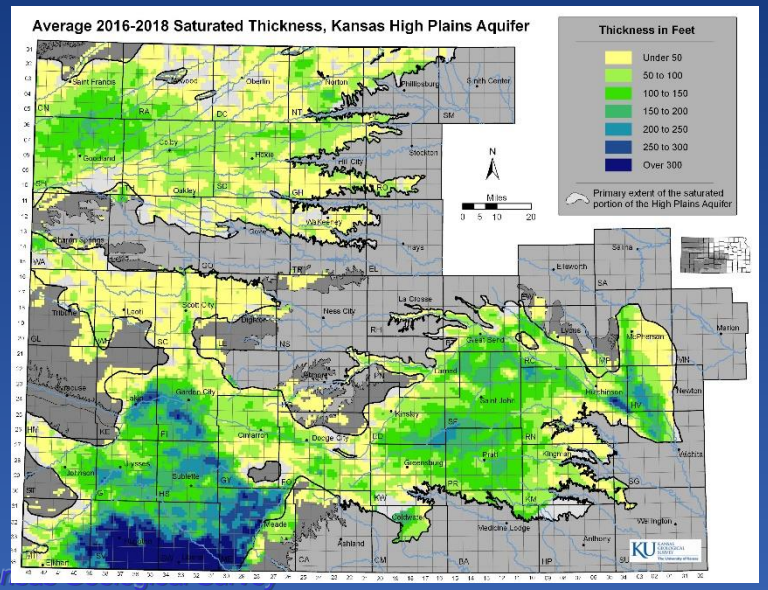
The High Plains Aquifer Atlas

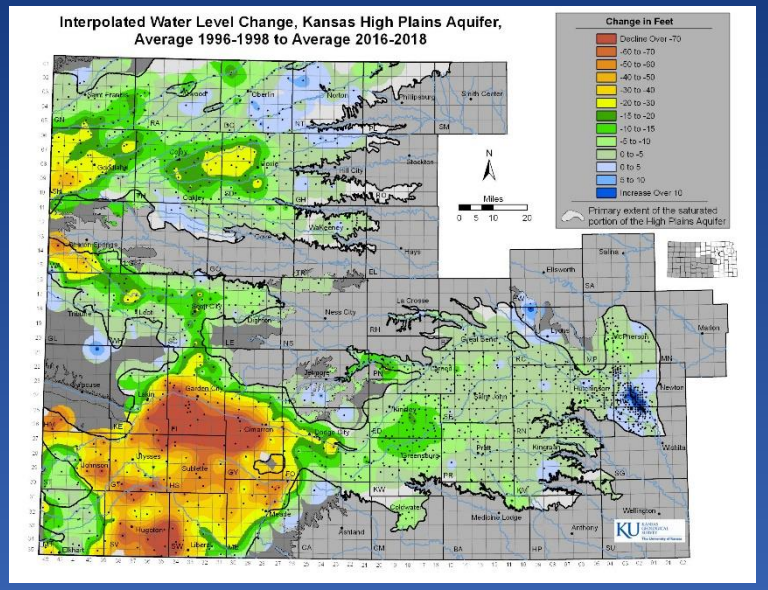
http://www.kgs.ku.edu/HighPlains/HPA_Atlas/index.html

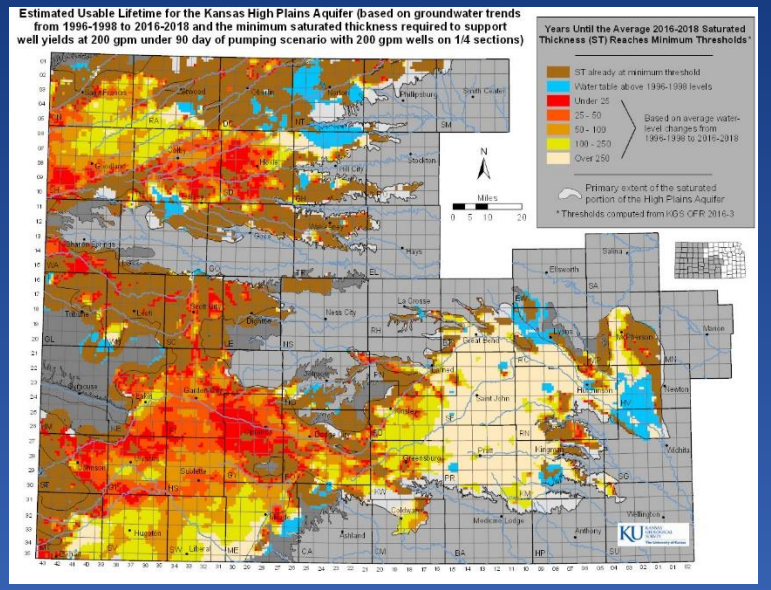






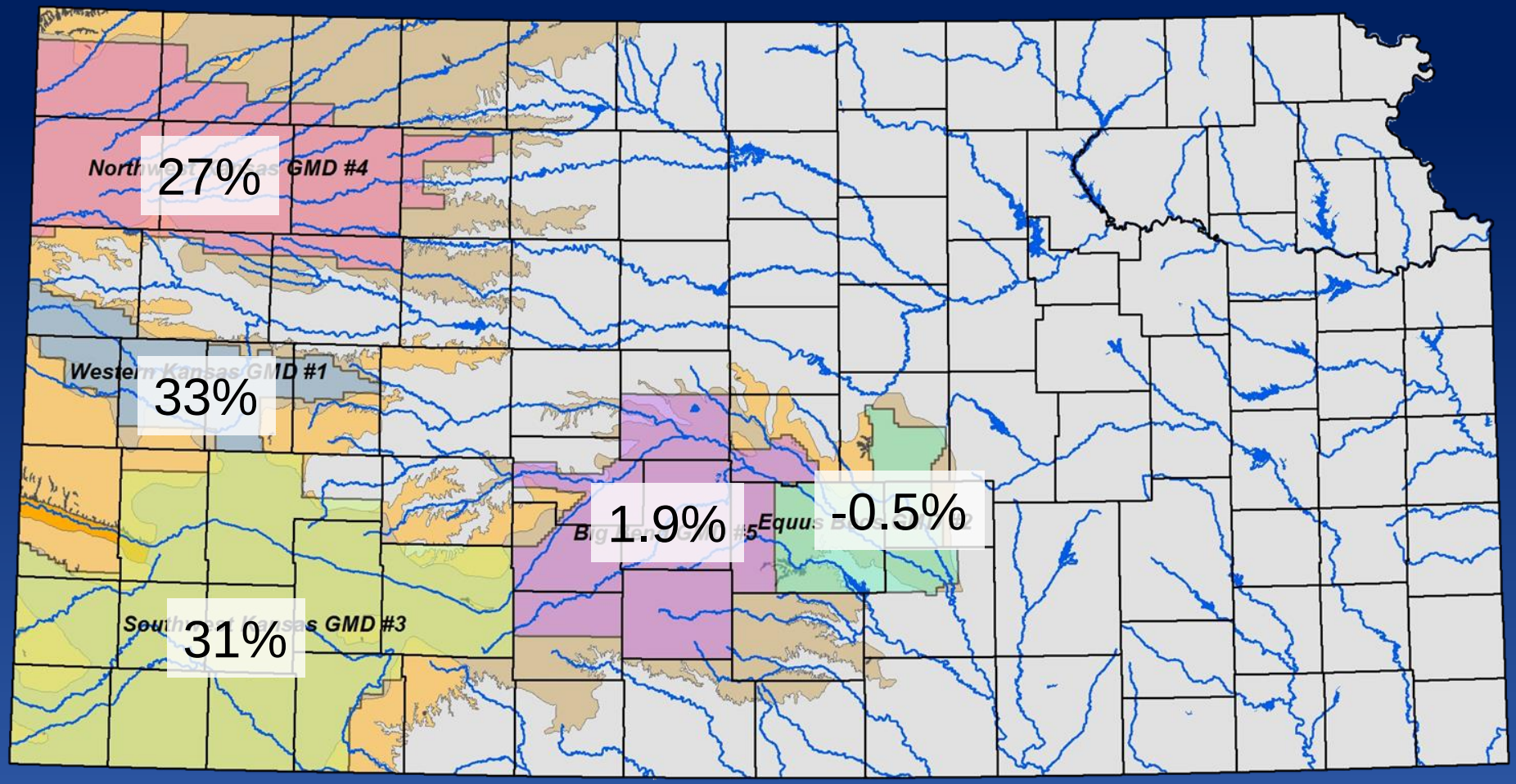






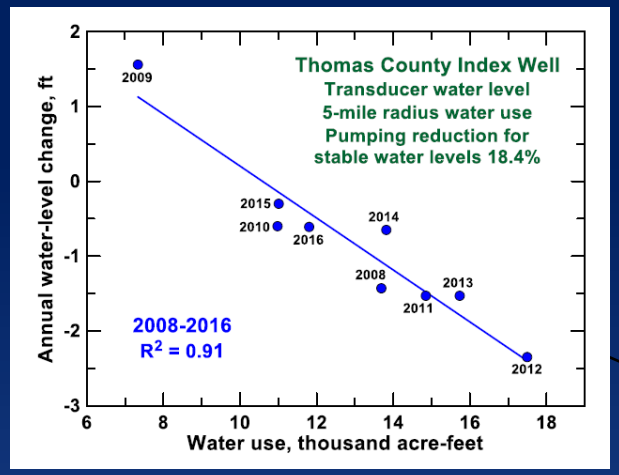
Reductions in Pumping Needed to Achieve Stable Water Levels

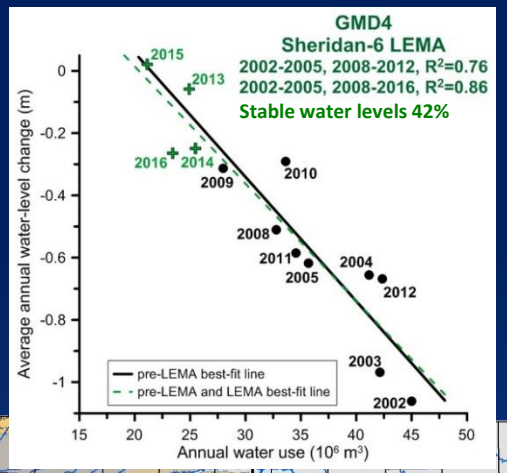
Groundwater Management Districts

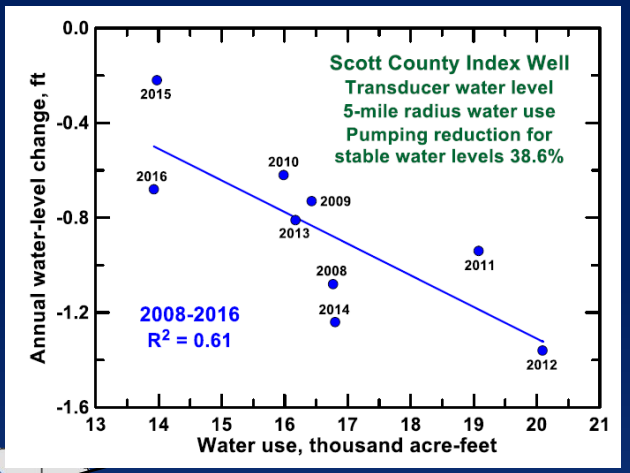


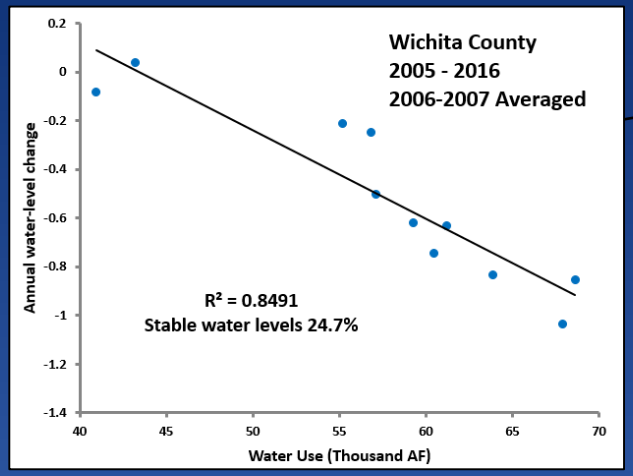
Reductions in Pumping Needed to Achieve Stable Water Levels

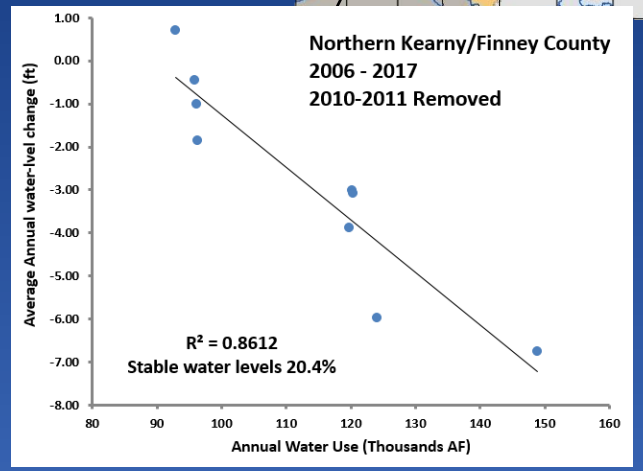
Special Areas and Selected Index Well Sites

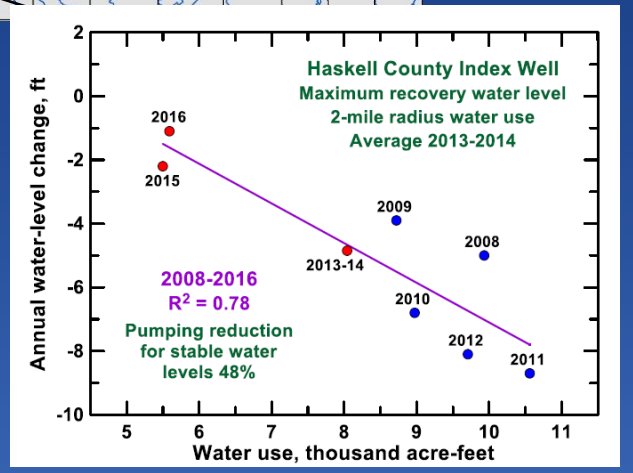


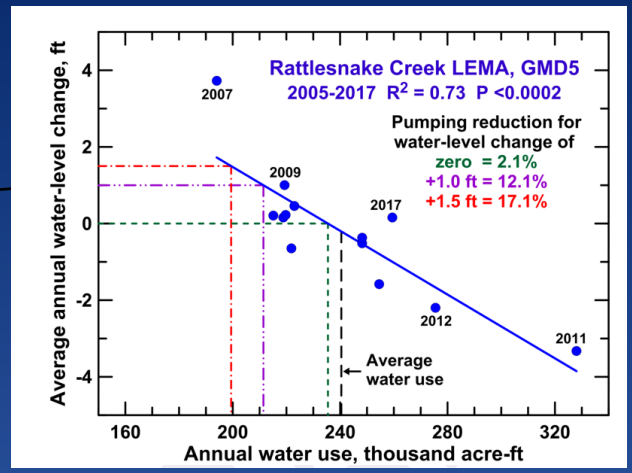


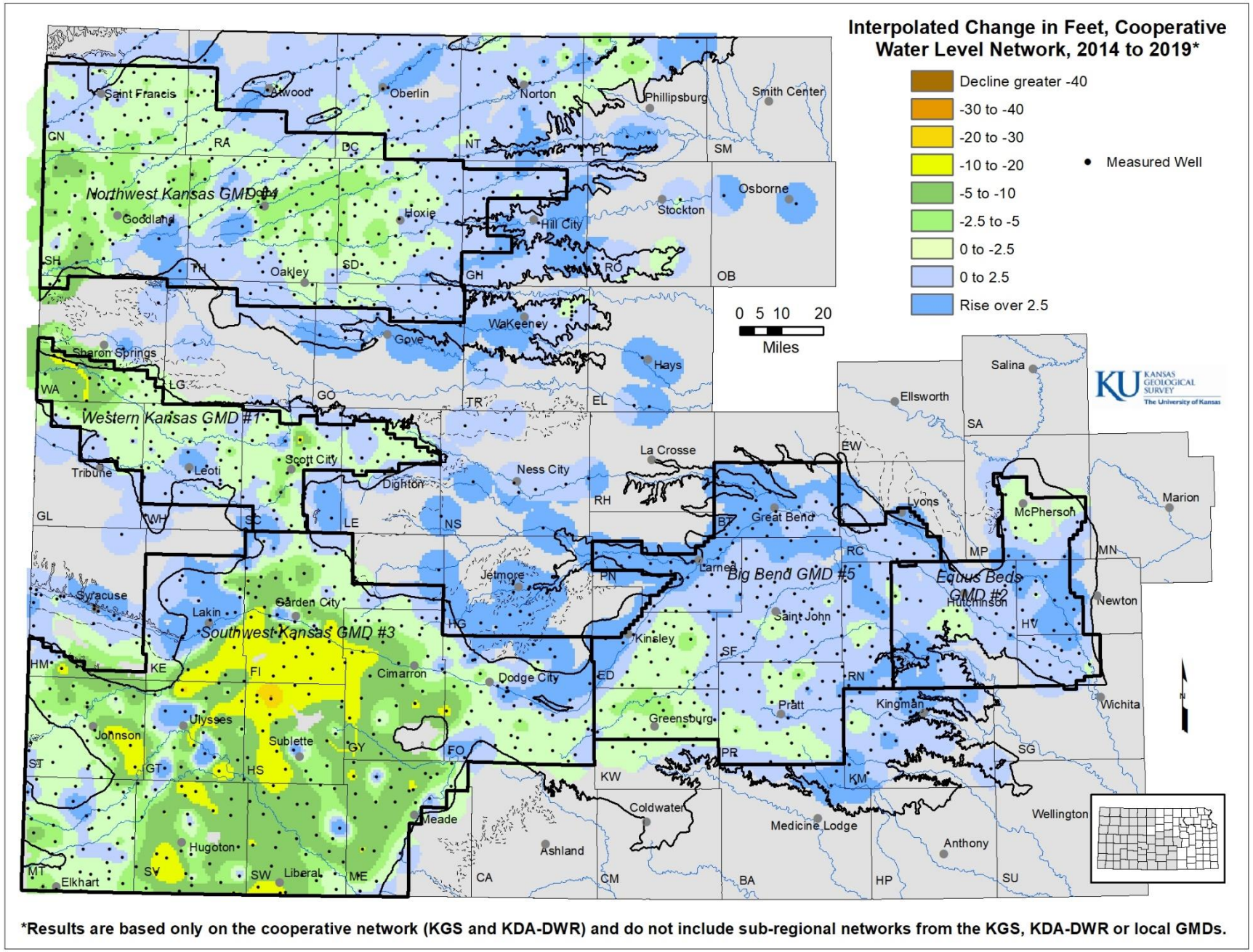






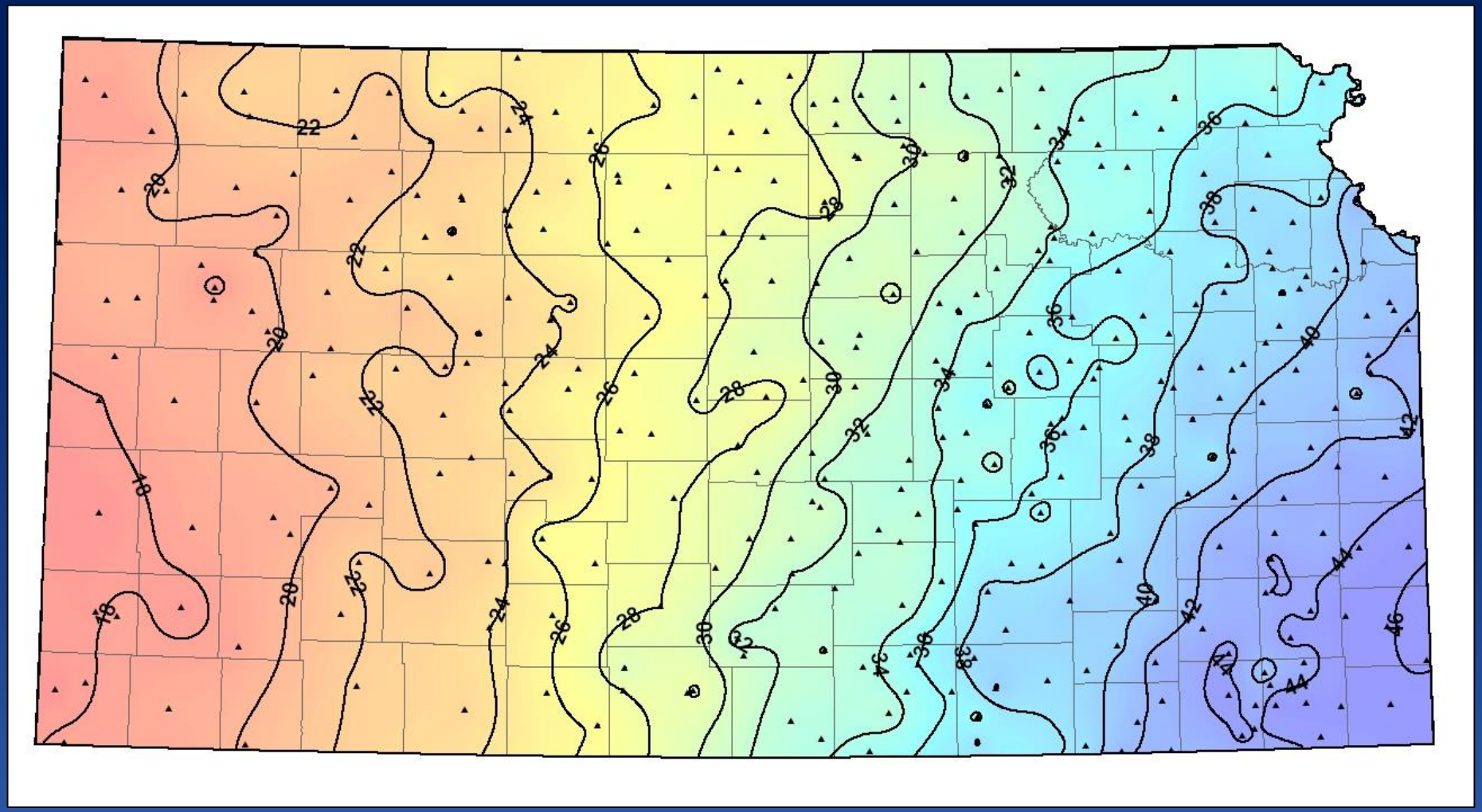






*Results are based only on the cooperative network (KGS and KDA-DWR) and do not include sub-regional networks from the KGS, KDA-DWR or local GMDs.

1981 to 2010 Normal Precipitation



Source- National Oceanic and Atmospheric Administration (NOAA)