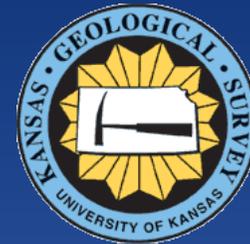
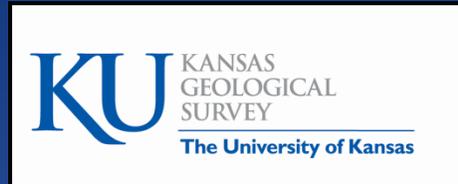


AEM Mapping plus Water Use and Water-Level Trends in GMD1

GMD1 Outreach Meetings
December 2025



Kansas Geological Survey
University of Kansas

Flying in the Wind: An Airborne Electromagnetic (AEM) Survey of the High Plains Aquifer in West-Central Kansas

Jim Butler¹, Geoff Bohling¹, Jared Abraham², Ted Asch²,
Steve Knobbe¹, Scott Ishman¹ and Gaisheng Liu¹

¹Kansas Geological Survey
University of Kansas

²Aqua Geo Frameworks, Inc.

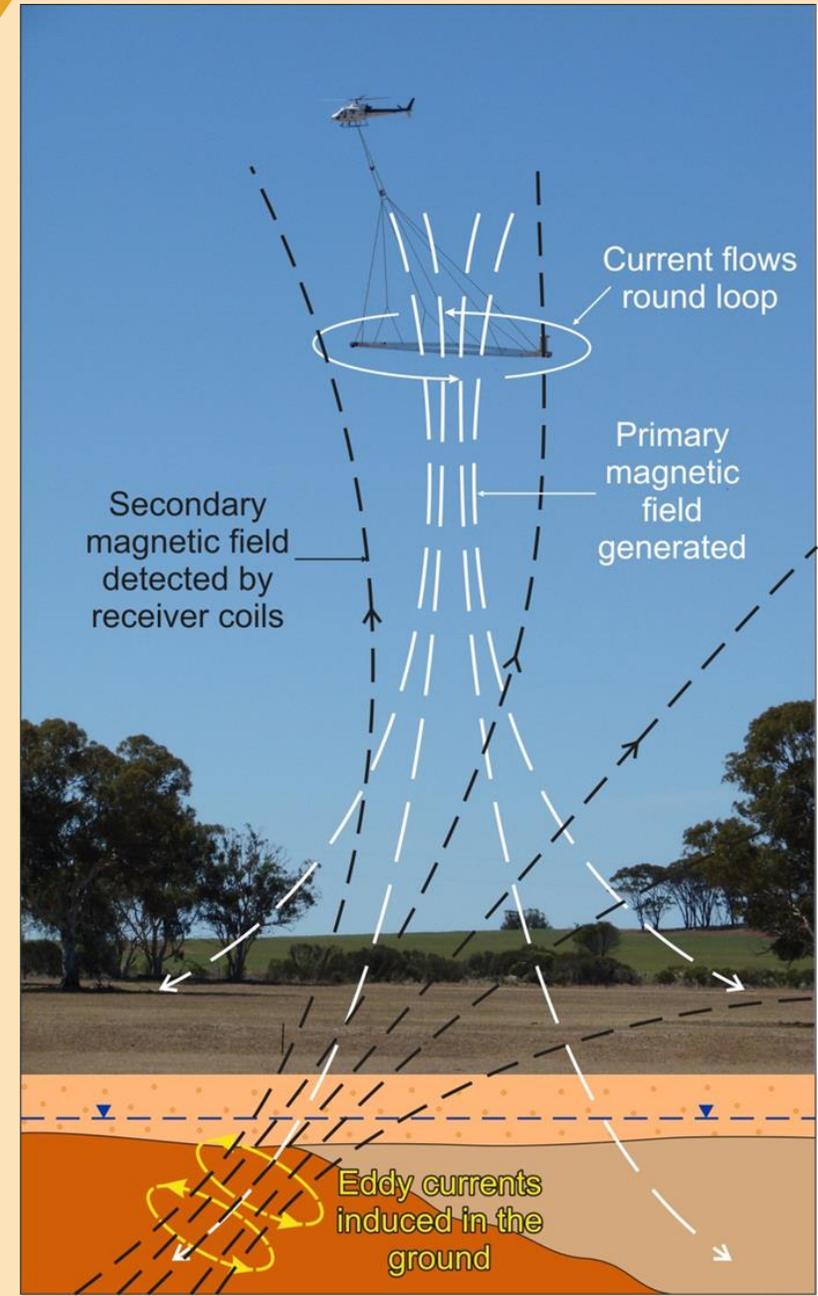
Governor's Conference on the Future of Water in Kansas

Manhattan, Kansas

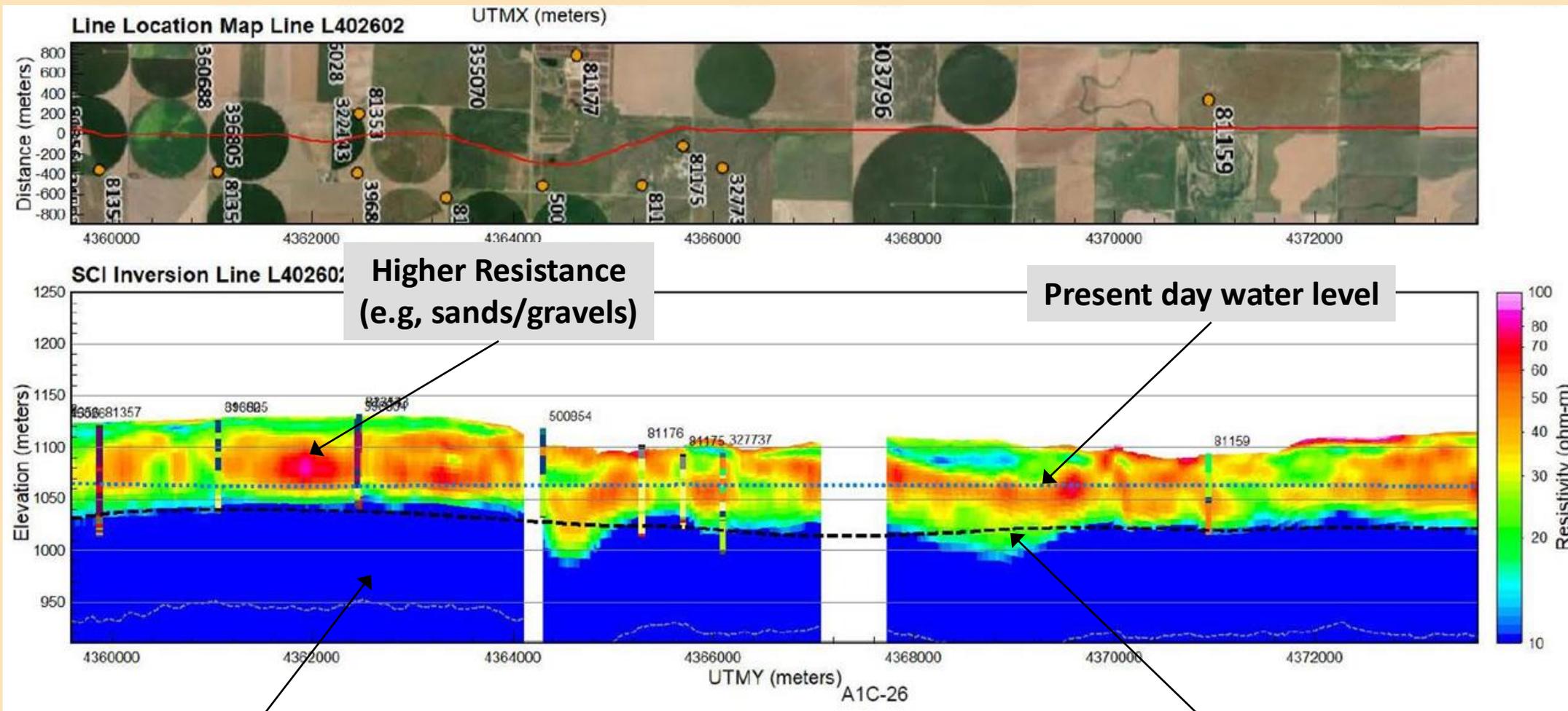
November 13, 2025

How AEM Works

- The transmitter fires discrete electromagnetic pulses that generate a primary magnetic field.
- The pulses induce eddy currents in the subsurface that generate a secondary magnetic field.
- This measurement provides information on electrical resistivities in the subsurface.
- Sands and gravels tend to have higher resistivities, while clays, silts, and shale bedrock have lower resistivities.
- We are taking a measurement every ≈ 85 ft as we are flying at 50-55 mph.
- Avoids things like power lines, pipelines, windmills, houses, feedlots, major highways, etc...
- Used in combination with drillers/lithologic logs.



Example AEM Flight Line – GMD4

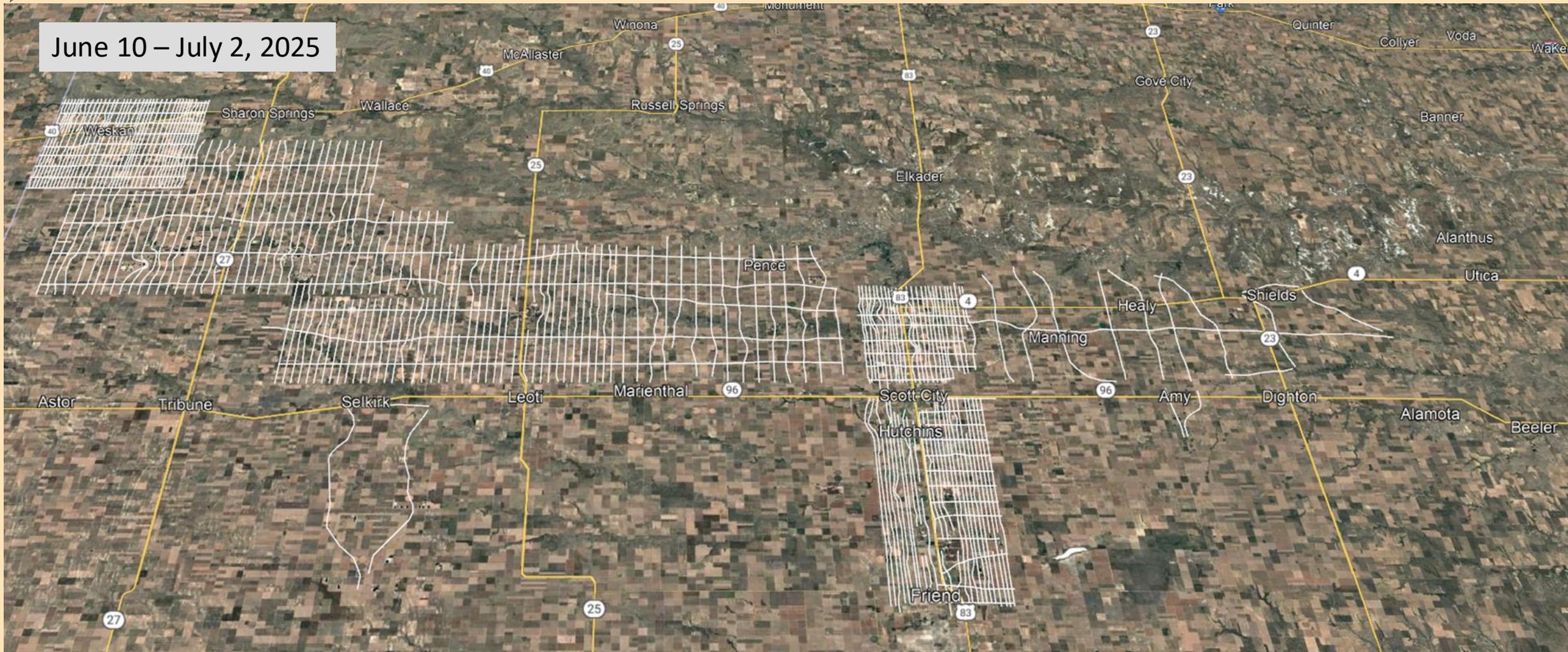


Lower Resistance
(e.g, shales)

Current bedrock estimate

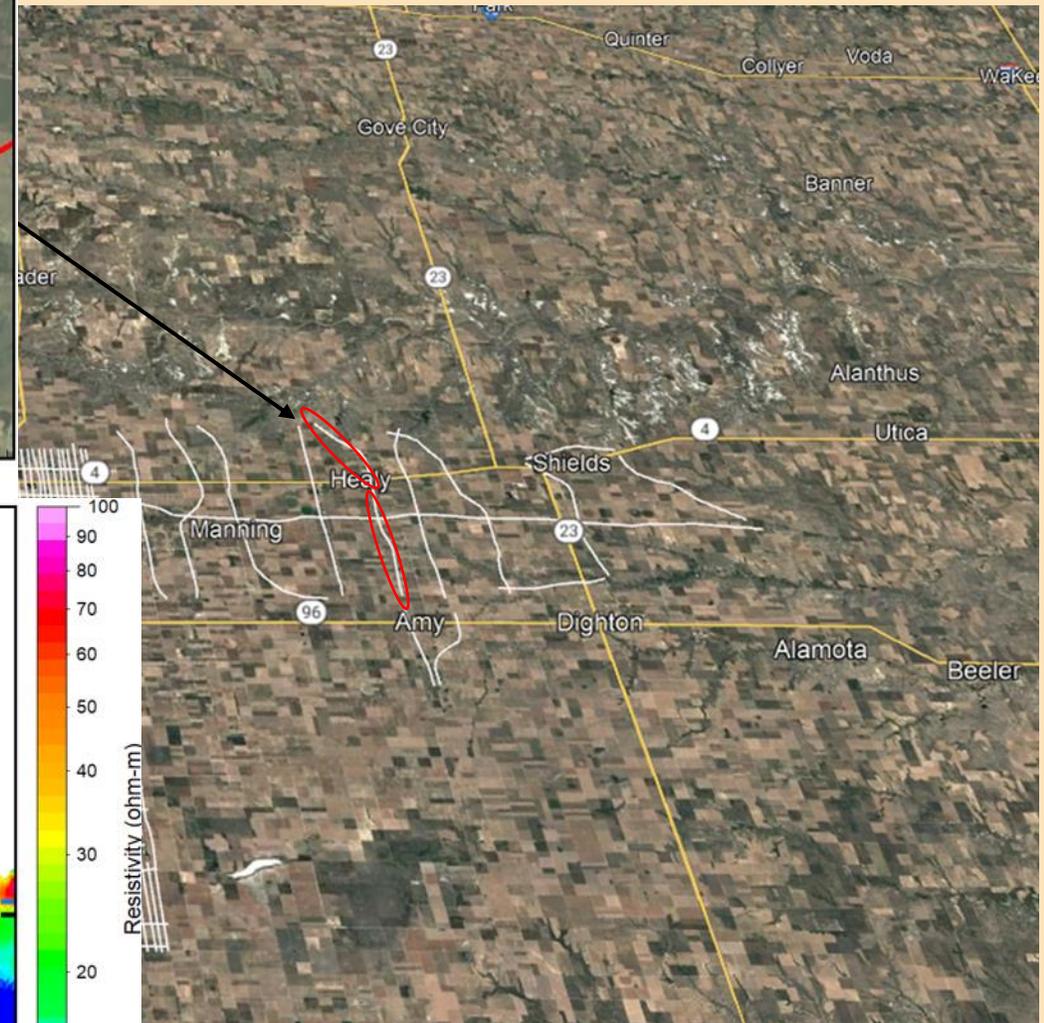
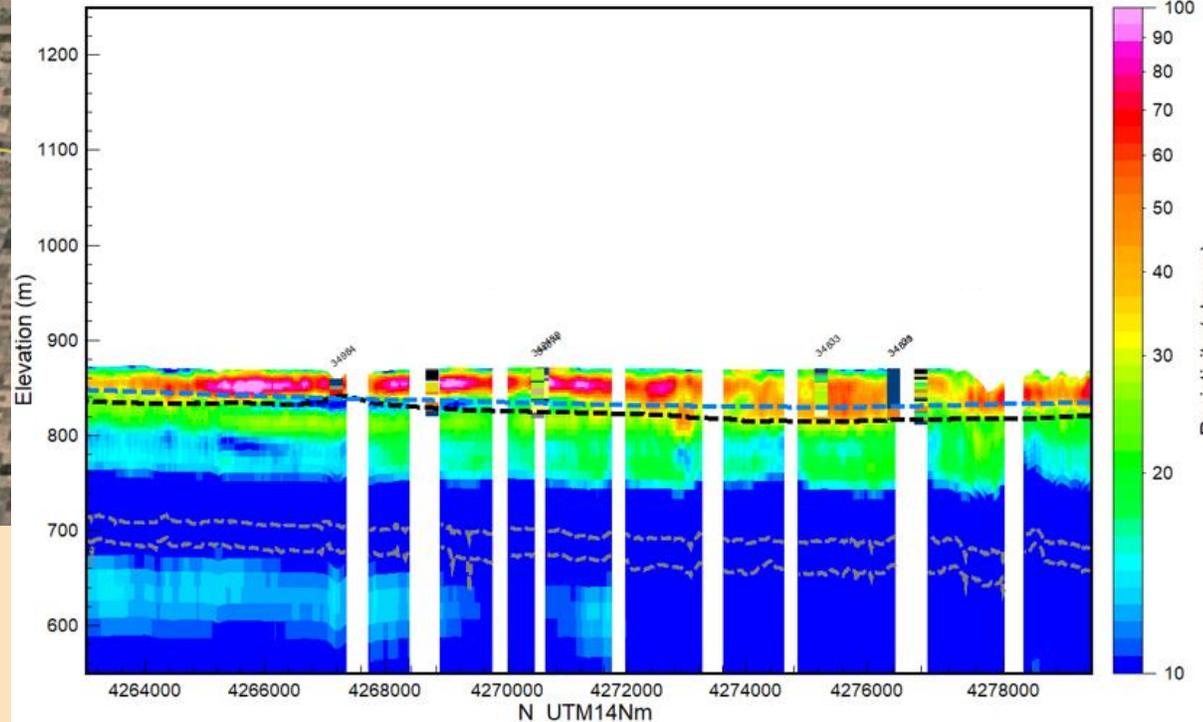
AEM Flight Lines in GMD1 – 2,883 miles

June 10 – July 2, 2025



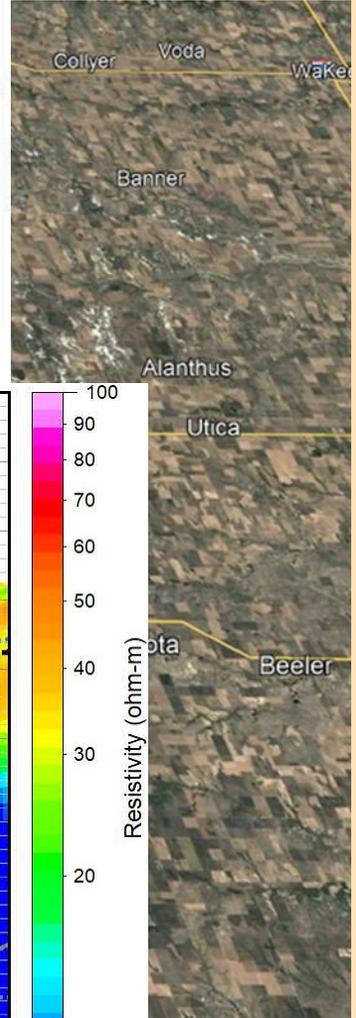
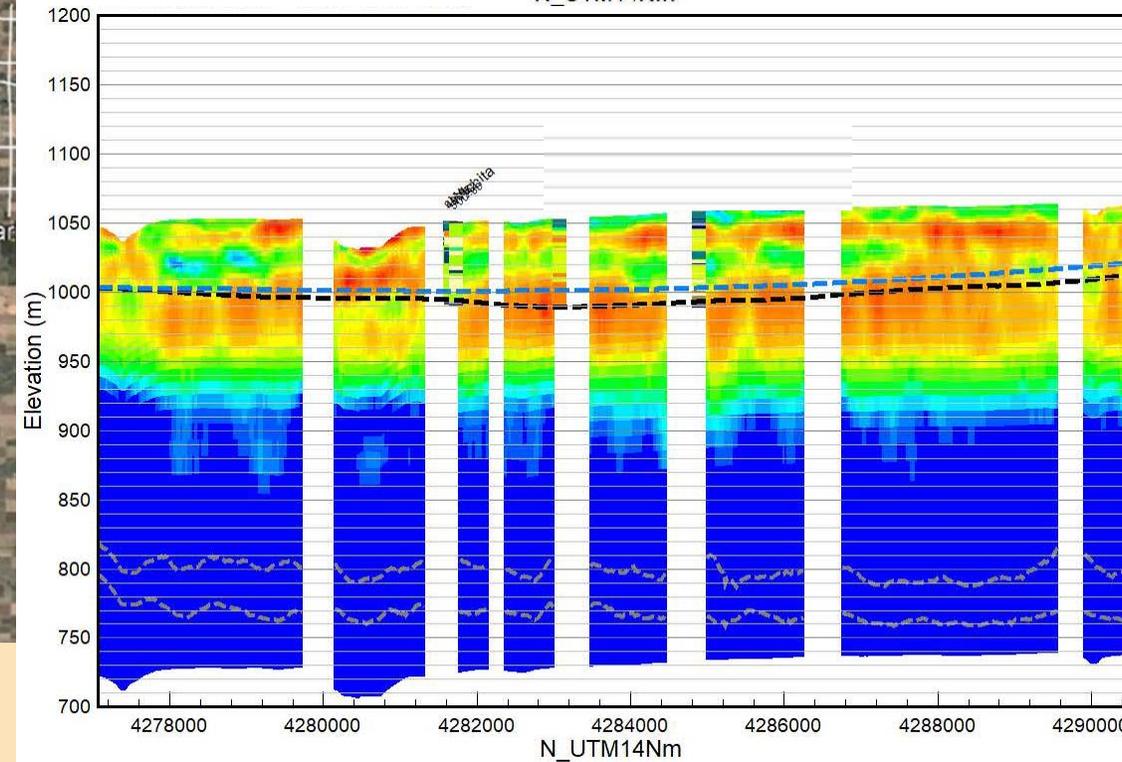
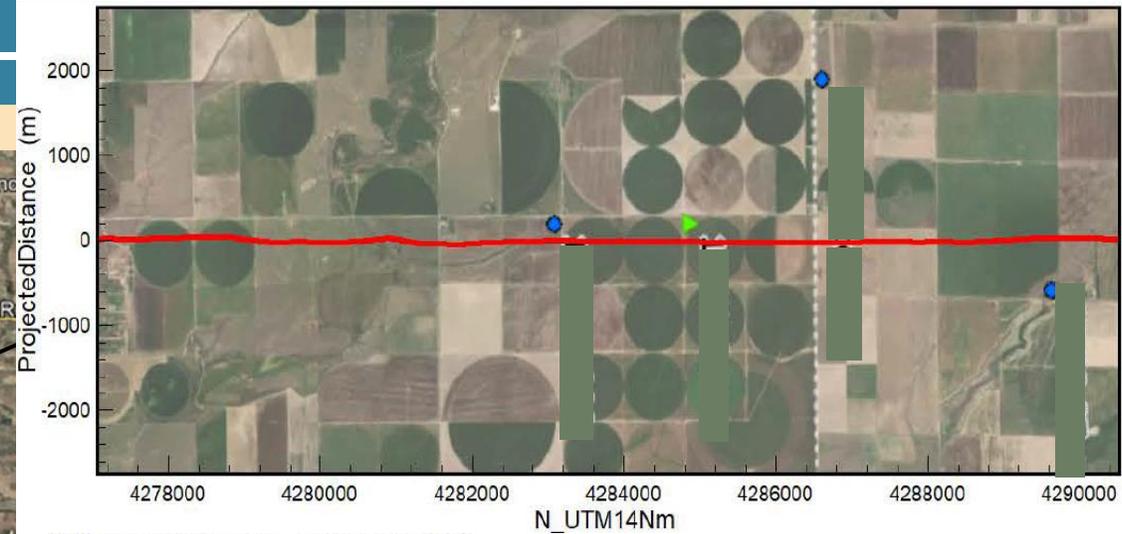
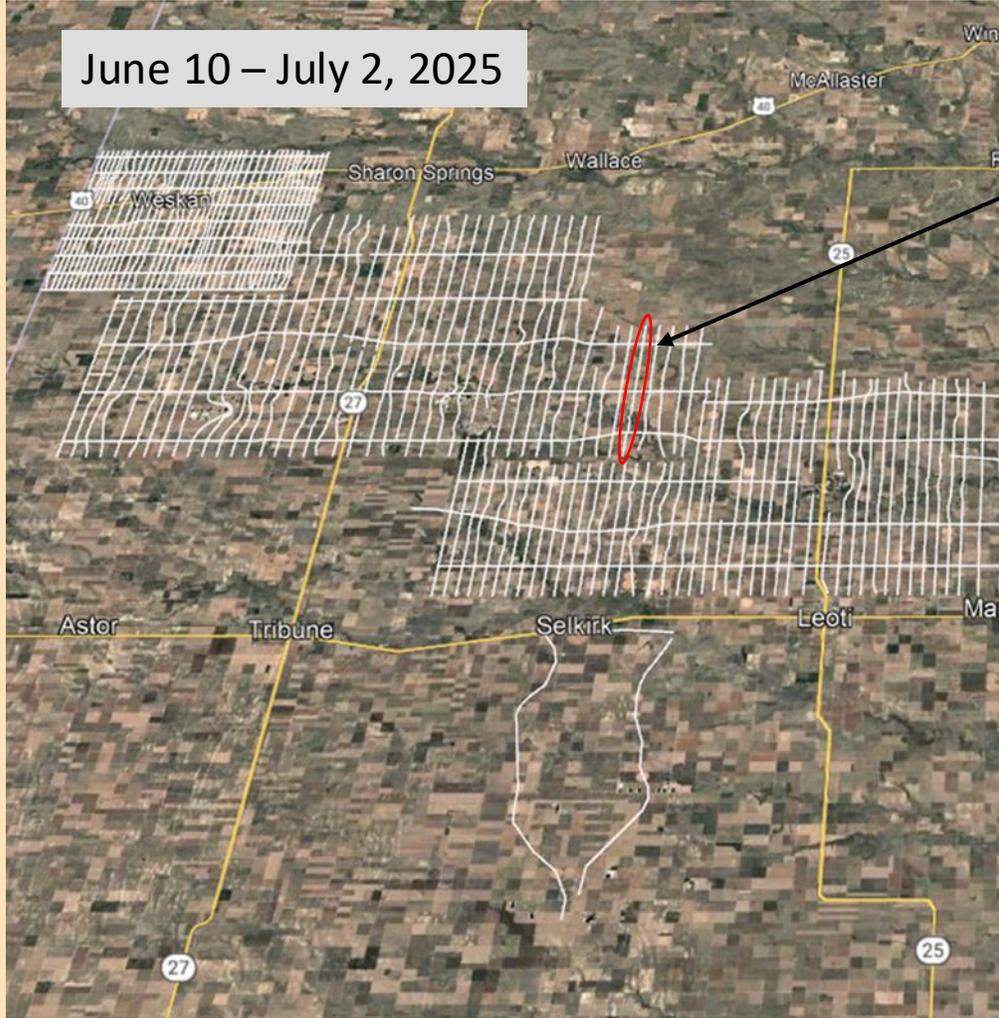
AEM Flight Lines in GMD1 – 2,883 miles

June 10 – July



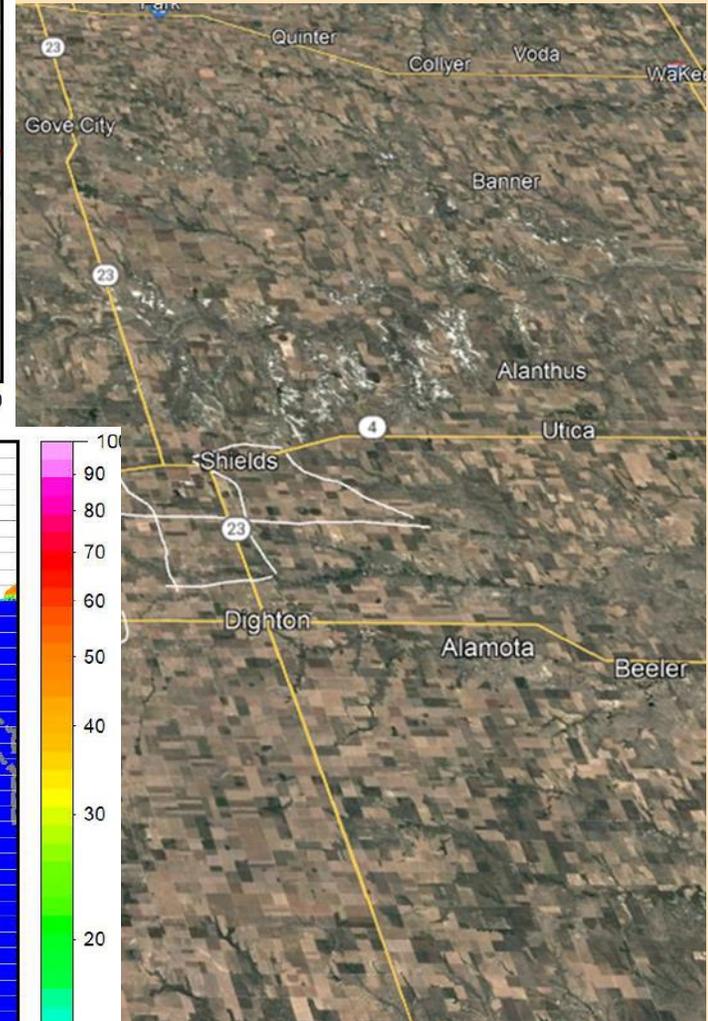
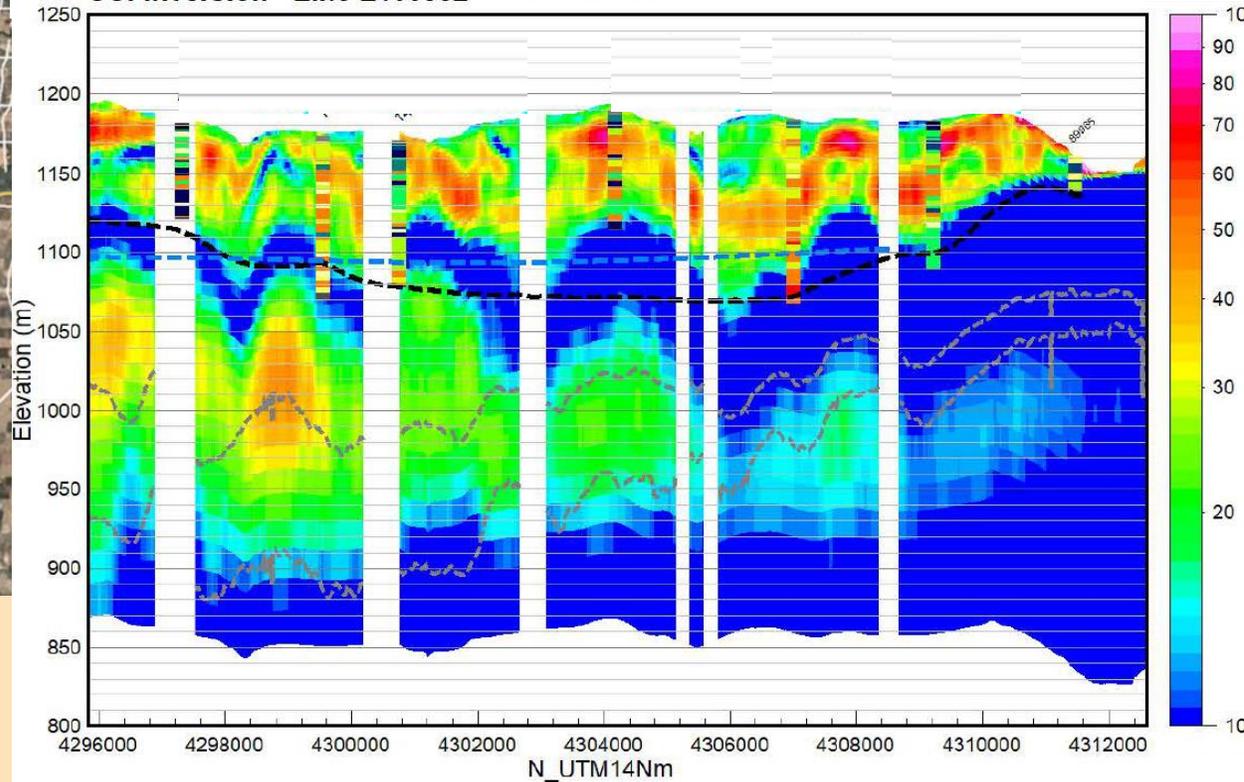
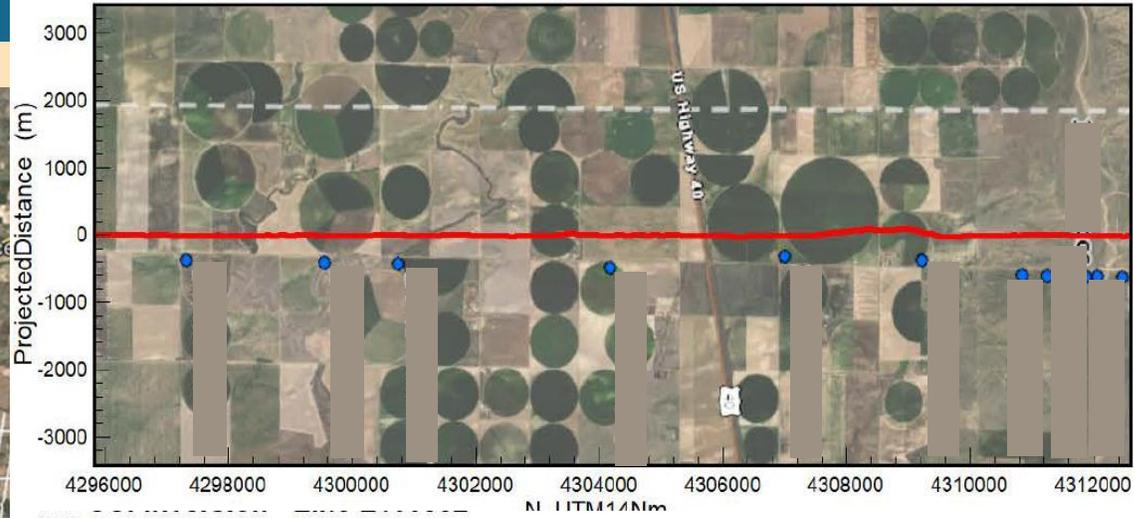
AEM Flight Lines in GMD1

June 10 – July 2, 2025

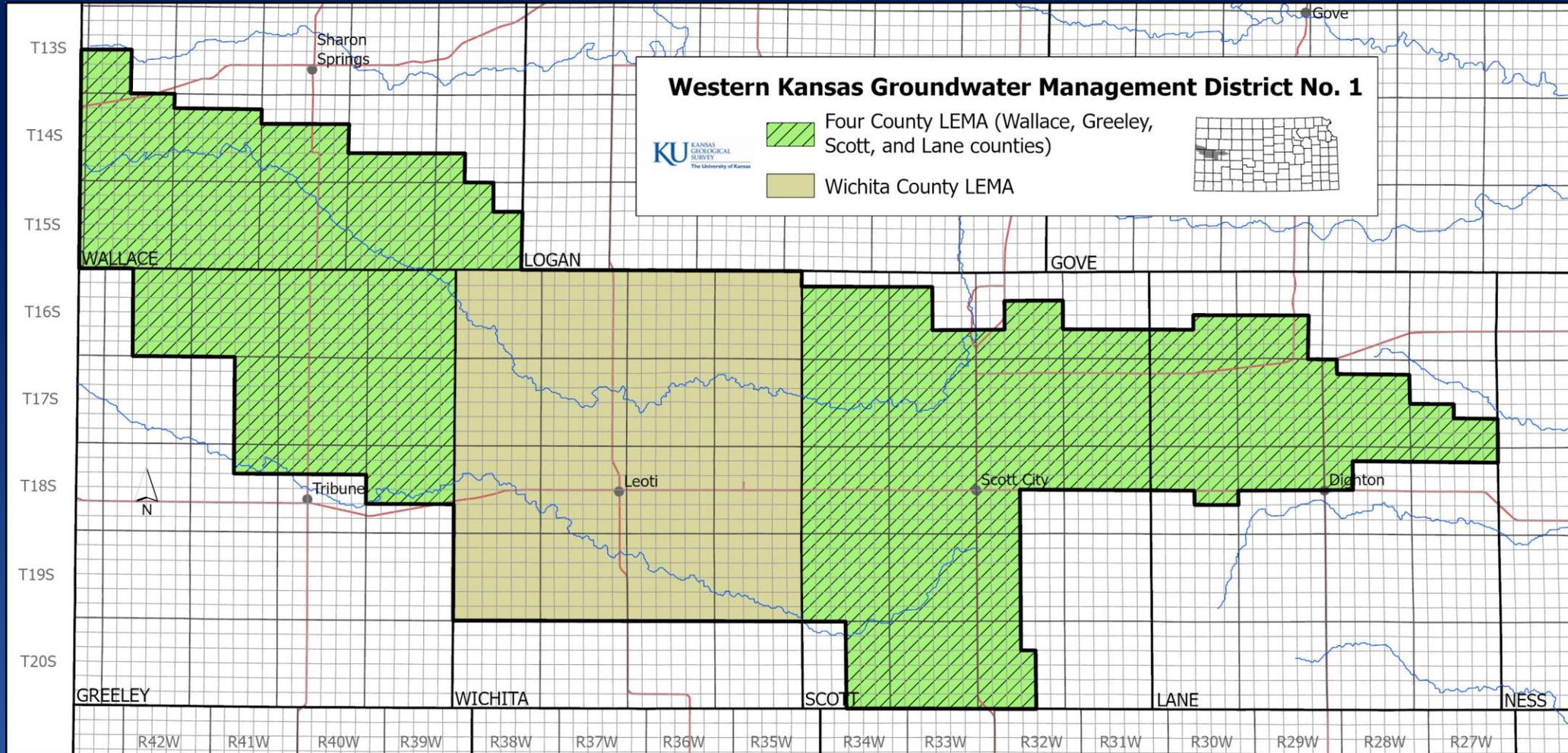


AEM Flight Lines in GMD1 – 2 883 miles

June 10 – July 2, 2025



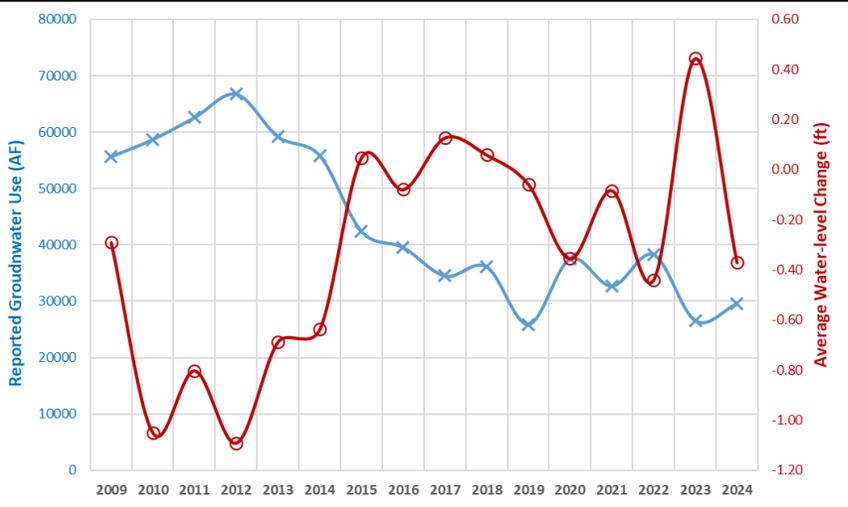
Local Enhanced Management Areas (LEMAs) in GMD1



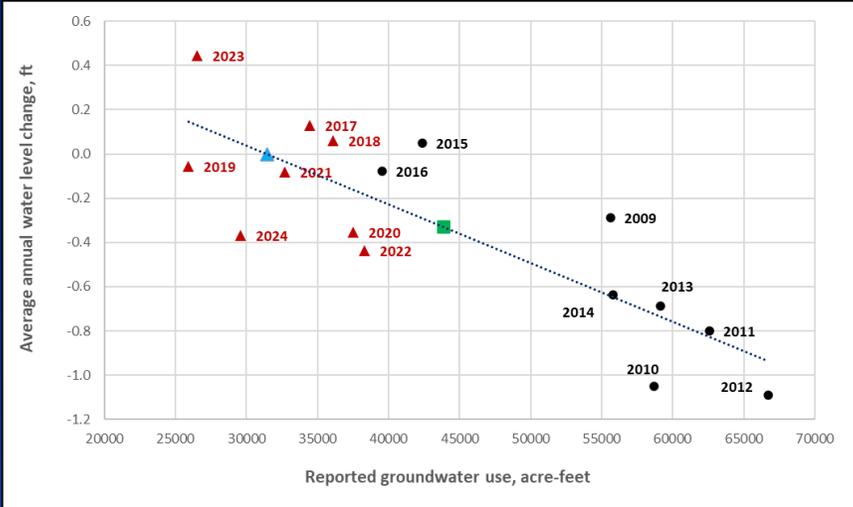
- Wichita County LEMA (2021) and WCA (2017)
- Four County LEMA (2023)

Wichita County, 2009 to 2024

Water-level change and water use trends

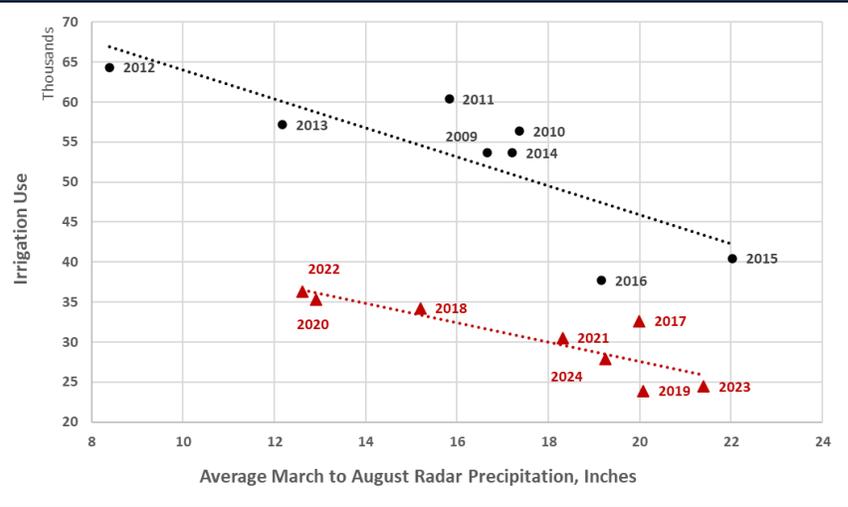


Water-level change vs water use (Q Stable)

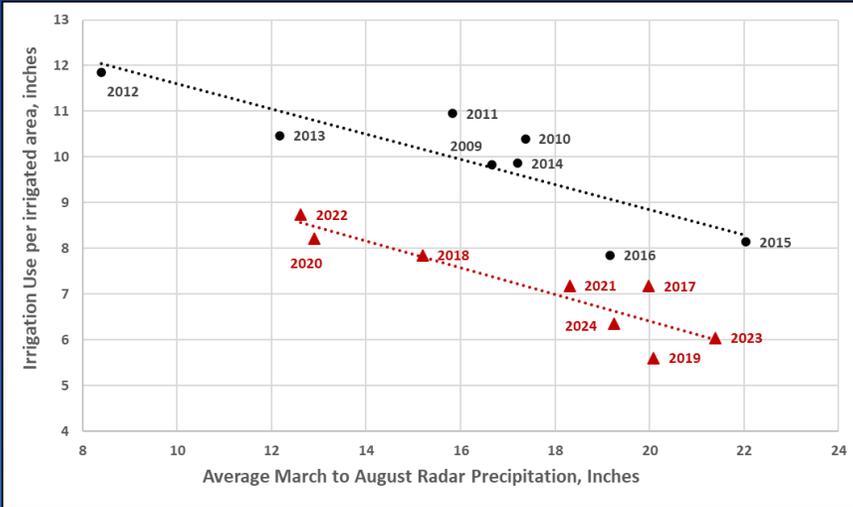


- **R-squared = 0.69, P < 0.00008**
- **Net Inflows = 31,400 AF**
- **Percent reduction to achieve stabilized water levels:**
 - Average conditions = 28%
 - 2009-2016 = 43%
 - 2017-2024 = 4%
- **~40% reduction since 2016**
 - Caused by a reduction in usage

Irrigation Use and Precipitation (Mar to Aug)

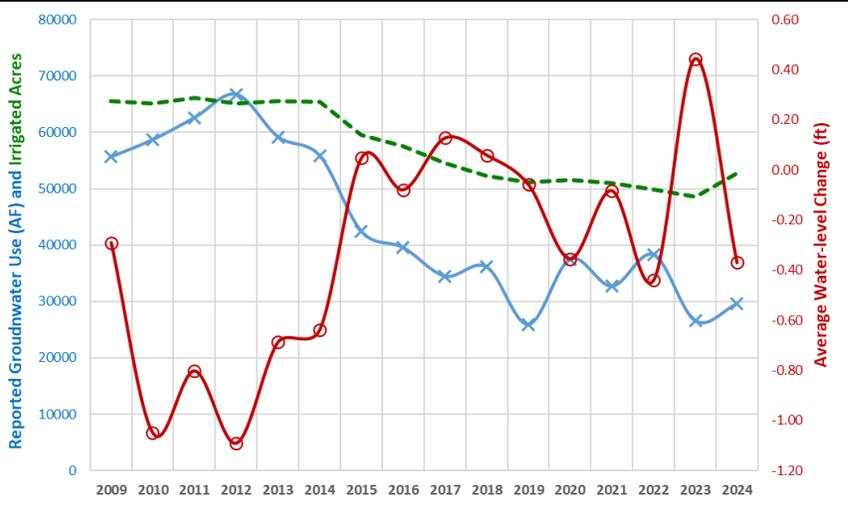


Irrigation AF/A and Precipitation (Mar to Aug)

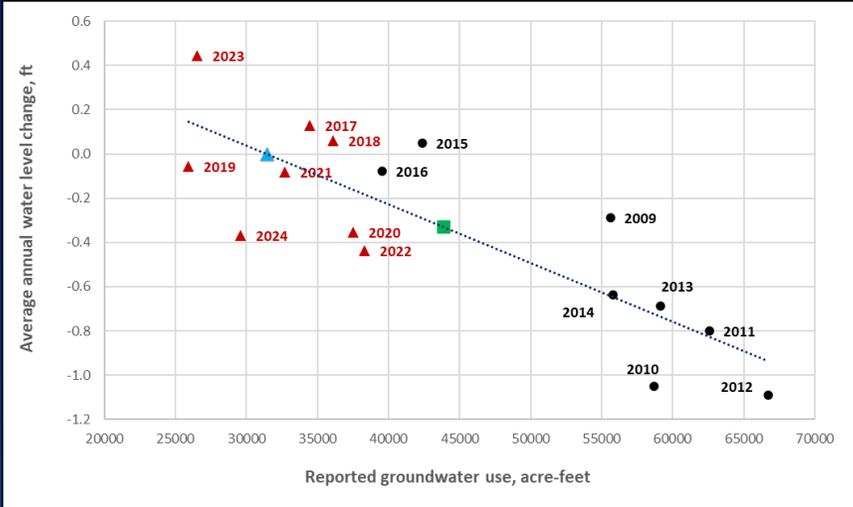


Wichita County, 2009 to 2024

Water-level change and water use trends

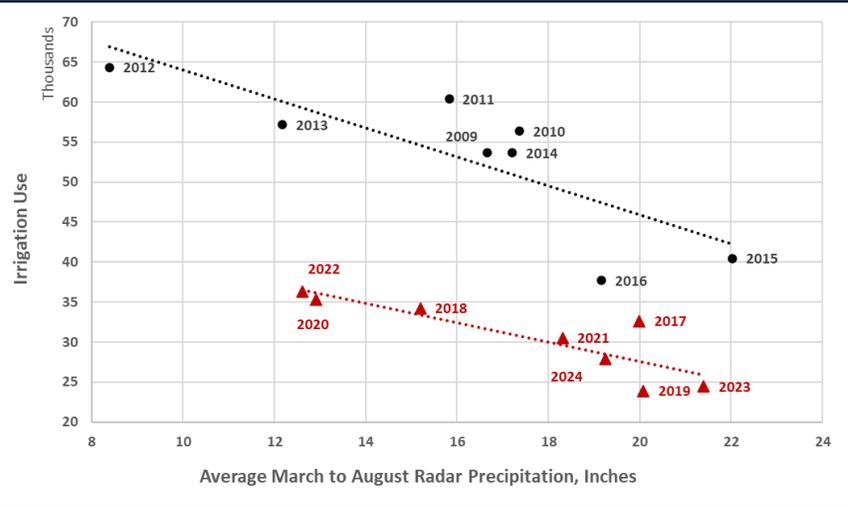


Water-level change vs water use (Q Stable)

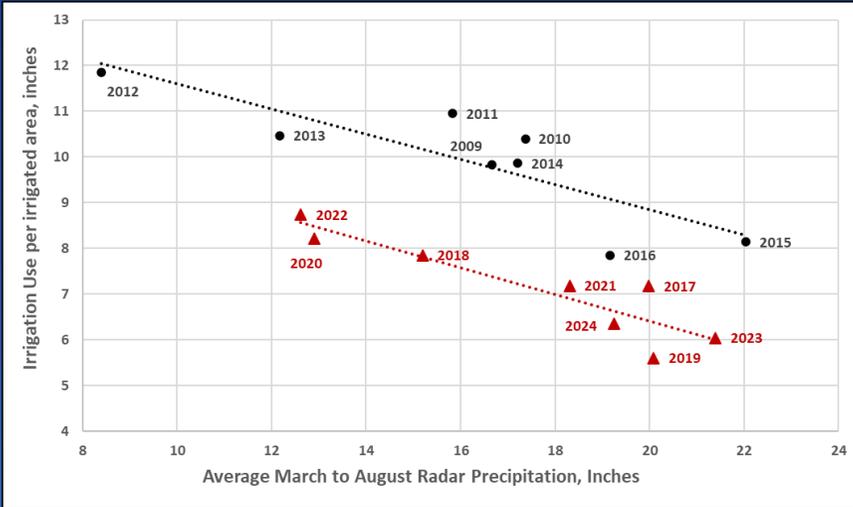


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- **Percent reduction to achieve stabilized water levels:**
 - Average conditions = 28%
 - 2009-2016 = 43%
 - 2017-2024 = 4%
- **~40% reduction since 2016**
 - Caused by a reduction in usage and irrigated acres

Irrigation Use and Precipitation (Mar to Aug)

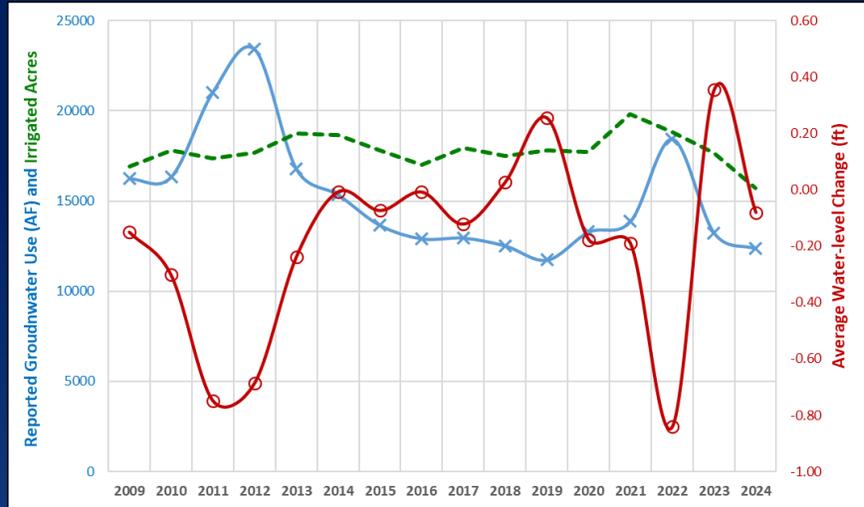


Irrigation AF/A and Precipitation (Mar to Aug)

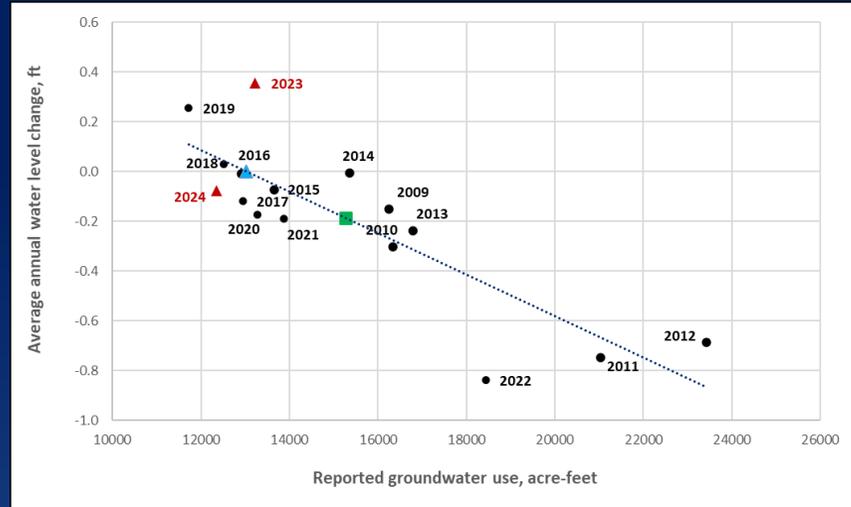


Lane County, 2009 to 2024

Water-level change and water use trends

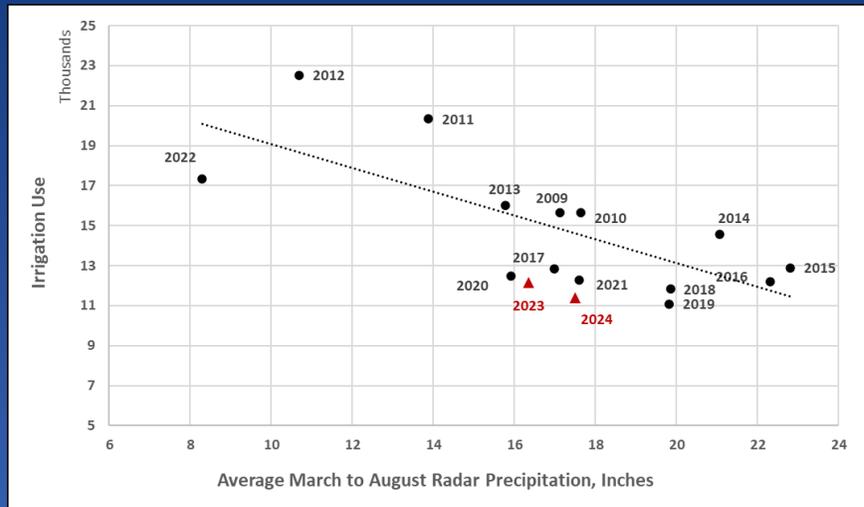


Water-level change vs water use (Q Stable)

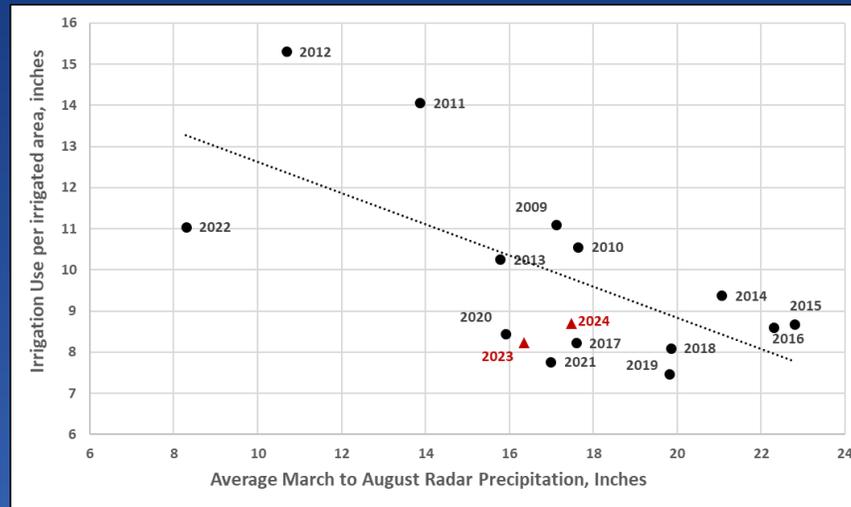


- **R-squared = 0.71, P < 0.00005**
- **Net Inflows = 13,00 AF**
- **Percent reduction to achieve stabilized water levels:**
 - **Average conditions = 15%**
 - **2020-2024 = 6%**

Irrigation Use and Precipitation (Mar to Aug)

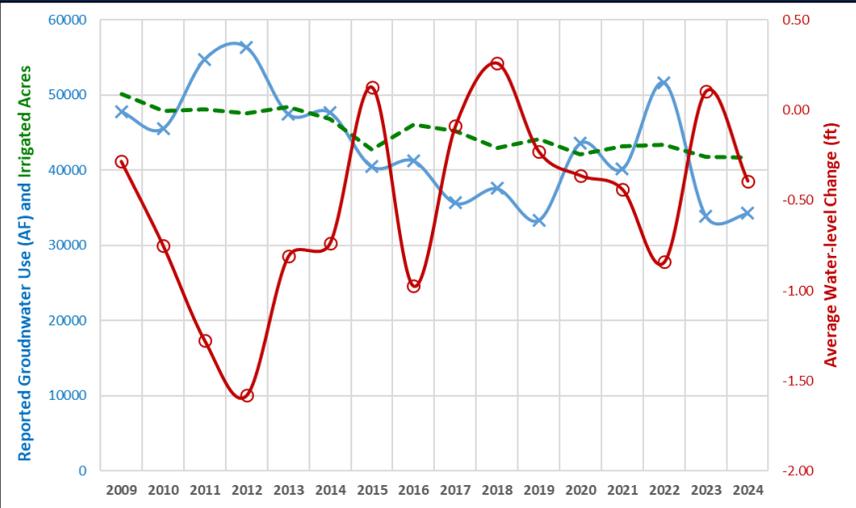


Irrigation AF/A and Precipitation (Mar to Aug)

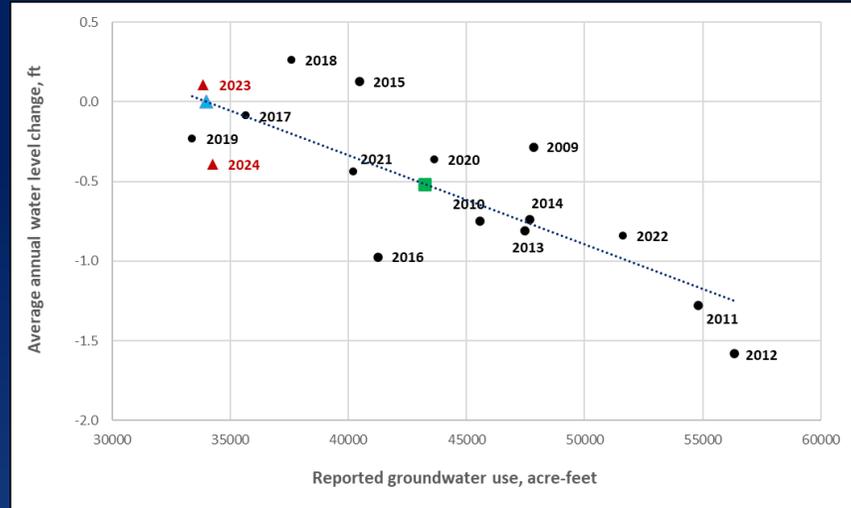


Scott County, 2009 to 2024

Water-level change and water use trends

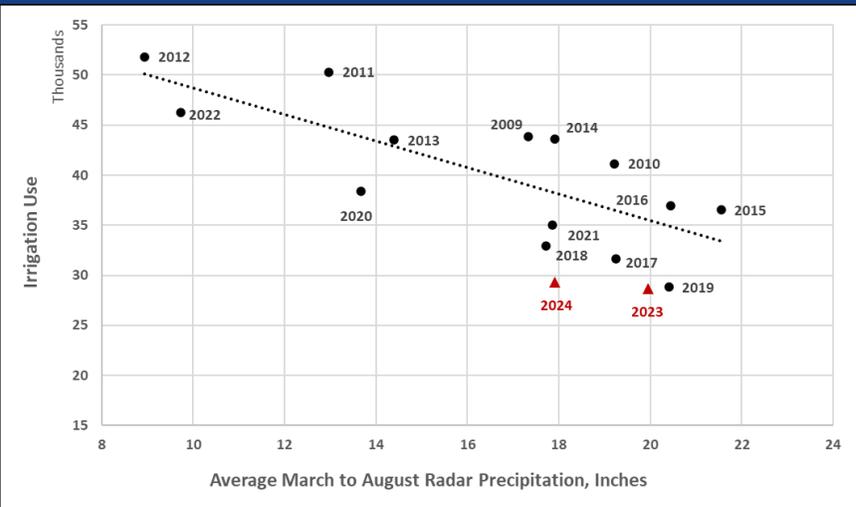


Water-level change vs water use (Q Stable)

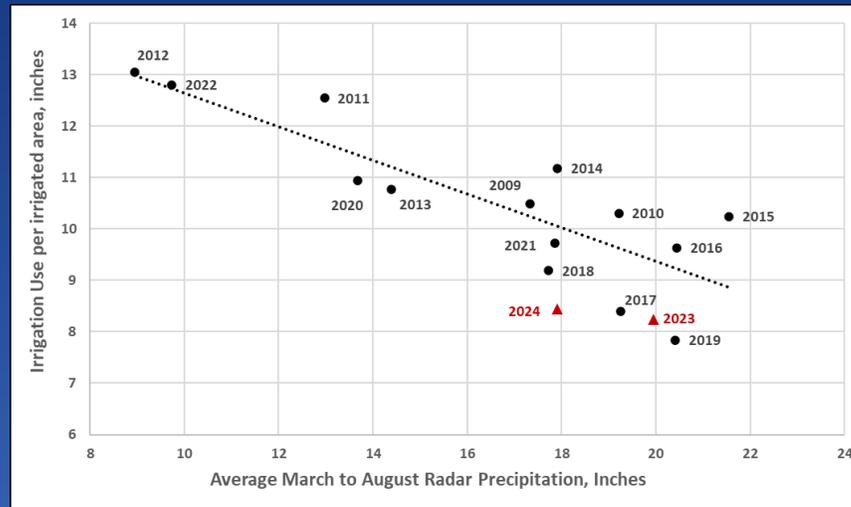


- **R-squared = 0.64, P < 0.0003**
- **Net Inflows = 34,000 AF**
- **Percent reduction to achieve stabilized water levels:**
 - **Average conditions = 21%**
 - **2020-2024 = 16%**

Irrigation Use and Precipitation (Mar to Aug)

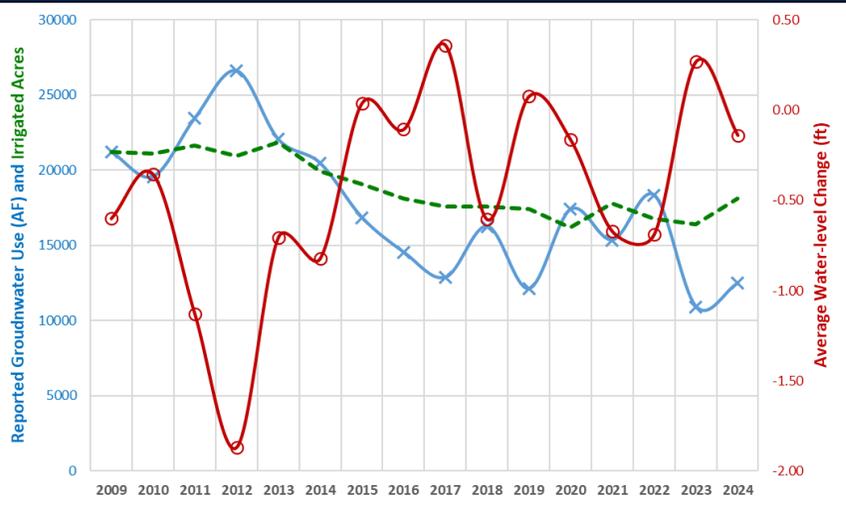


Irrigation AF/A and Precipitation (Mar to Aug)

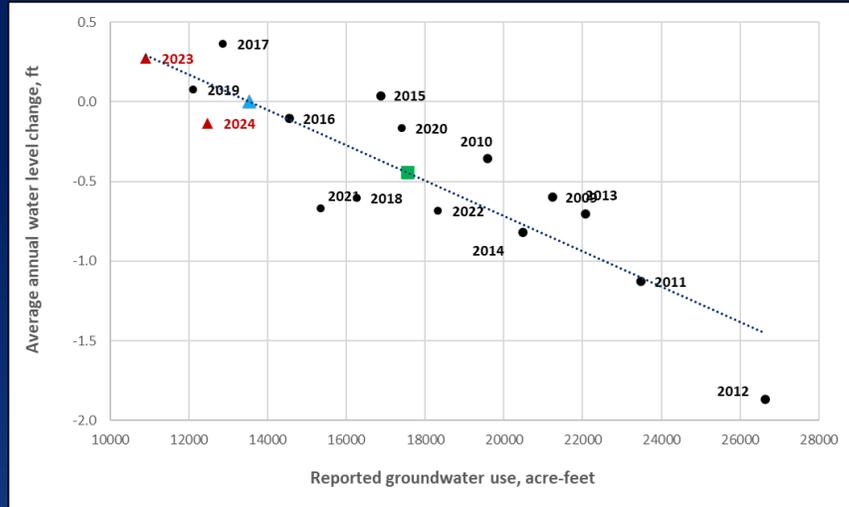


Greeley County, 2009 to 2024

Water-level change and water use trends

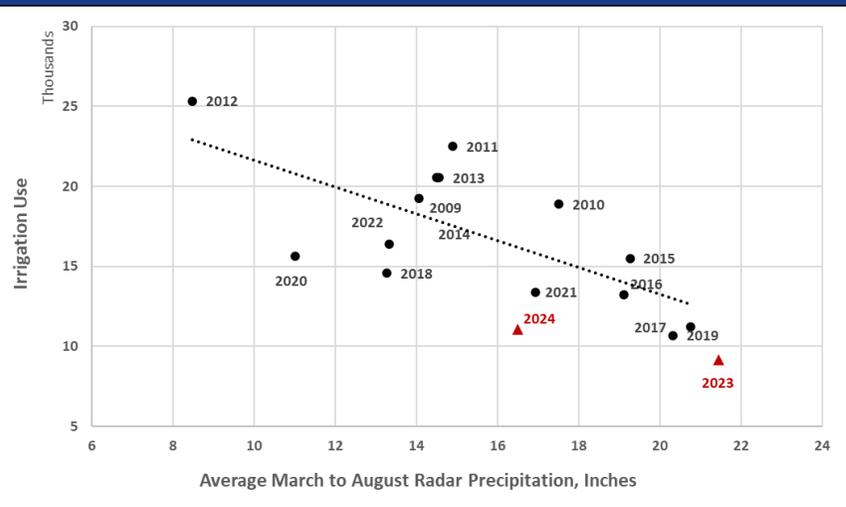


Water-level change vs water use (Q Stable)

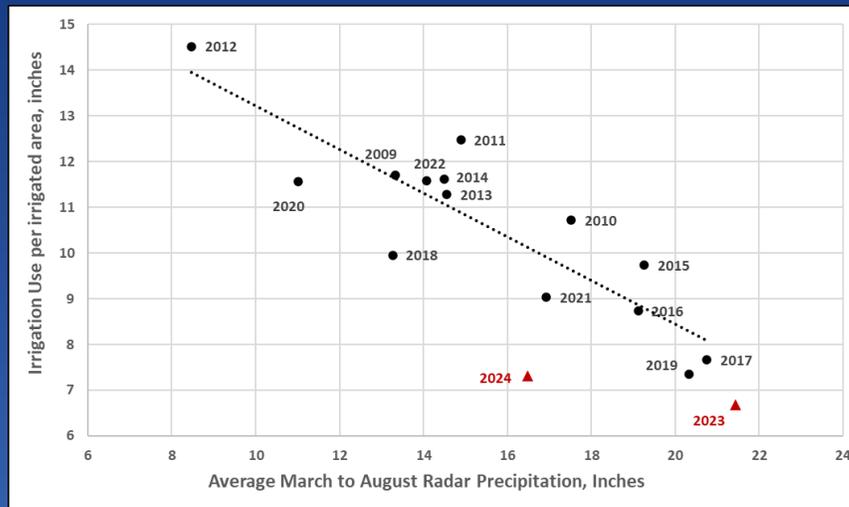


- **R-squared = 0.77, P < 0.000009**
- **Net Inflows = 13,500 AF**
- **Percent reduction to achieve stabilized water levels:**
 - **Average conditions = 23%**
 - **2020-2024 = 6%**

Irrigation Use and Precipitation (Mar to Aug)

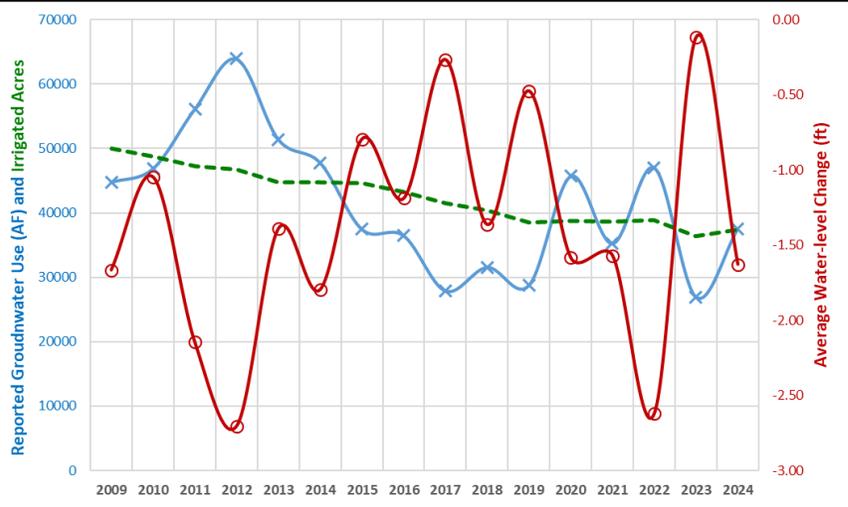


Irrigation AF/A and Precipitation (Mar to Aug)

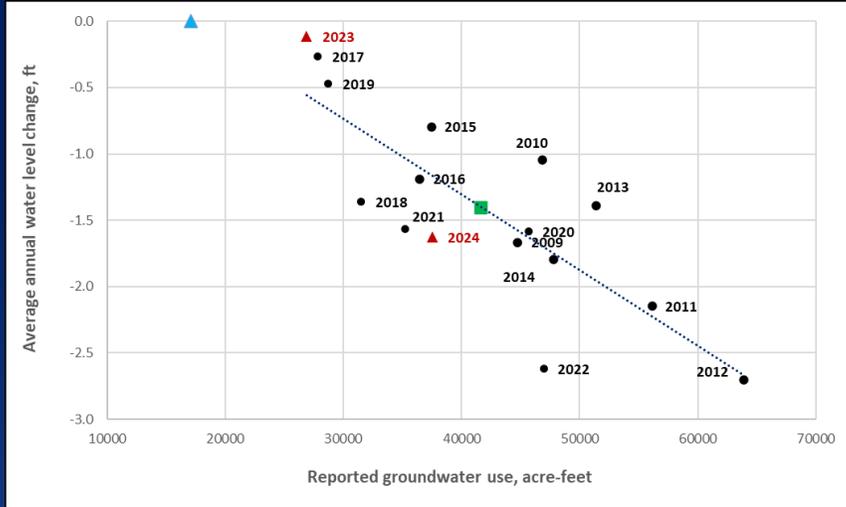


Wallace County, 2009 to 2024

Water-level change and water use trends

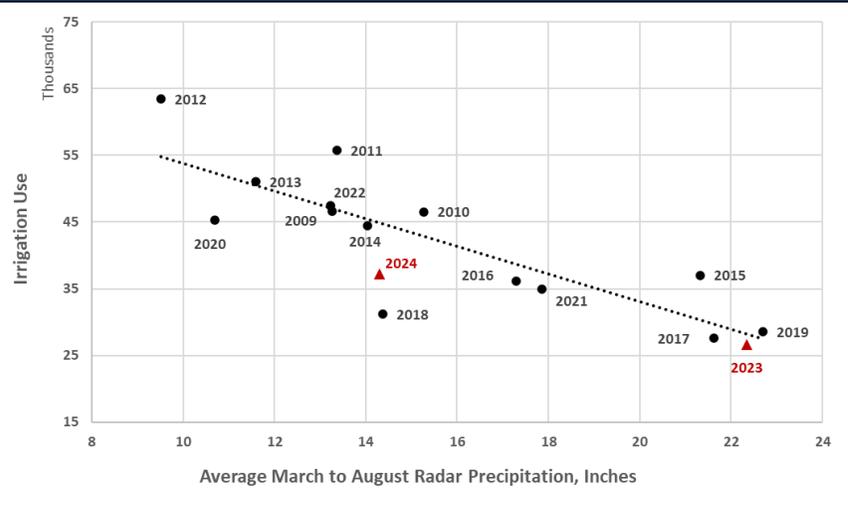


Water-level change vs water use (Q Stable)

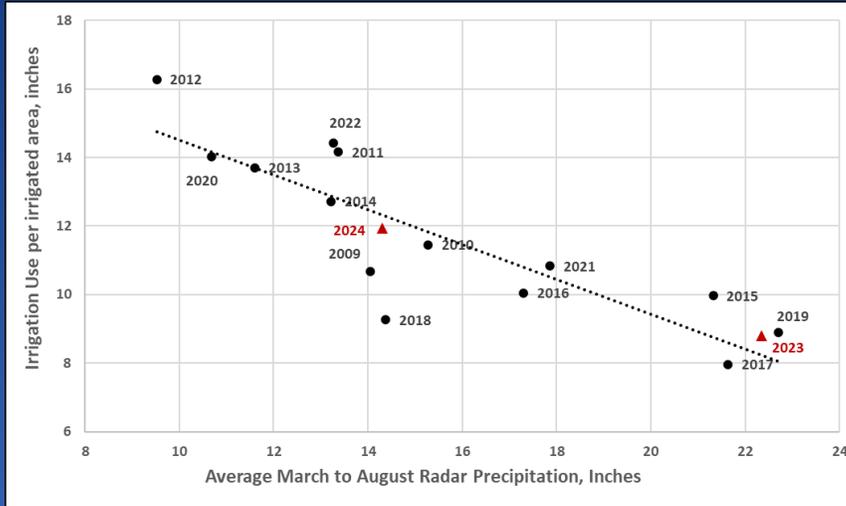


- **R-squared = 0.66, P < 0.0002**
- **Net Inflows = 17,000 AF**
- **Percent reduction to achieve stabilized water levels:**
 - **Average conditions = 59%**
 - **2020-2024 = 54%**

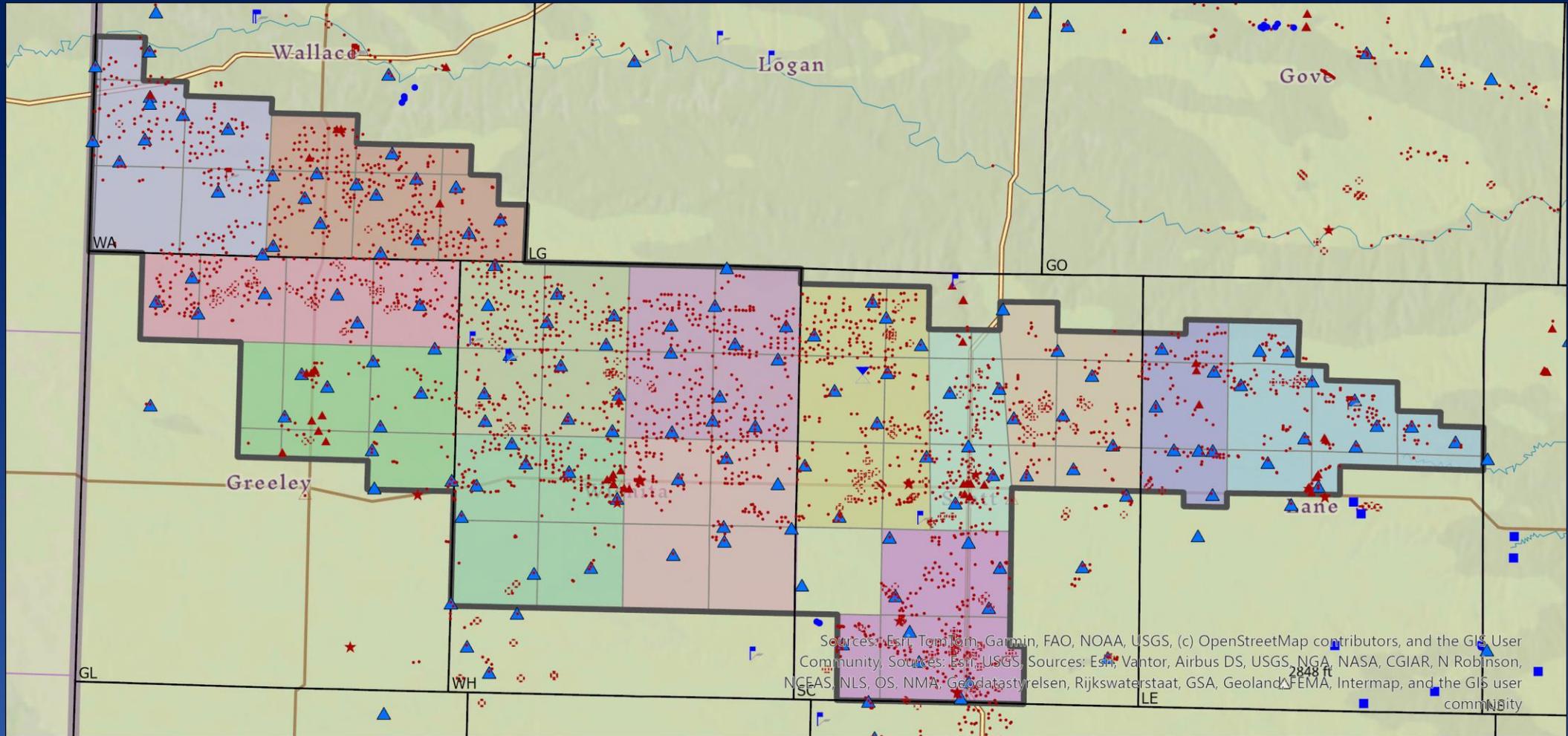
Irrigation Use and Precipitation (Mar to Aug)



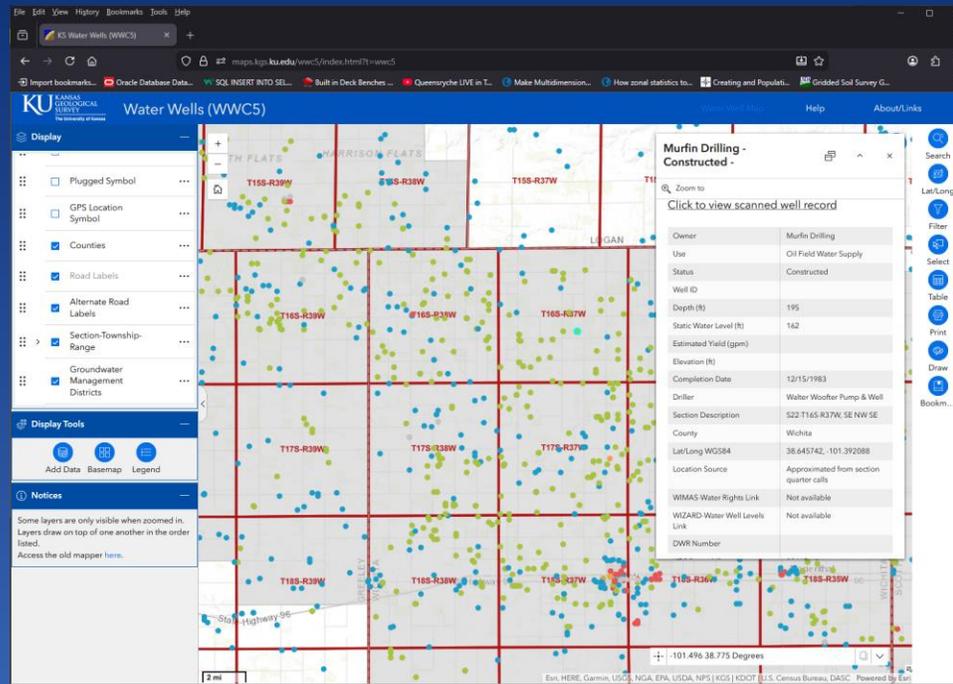
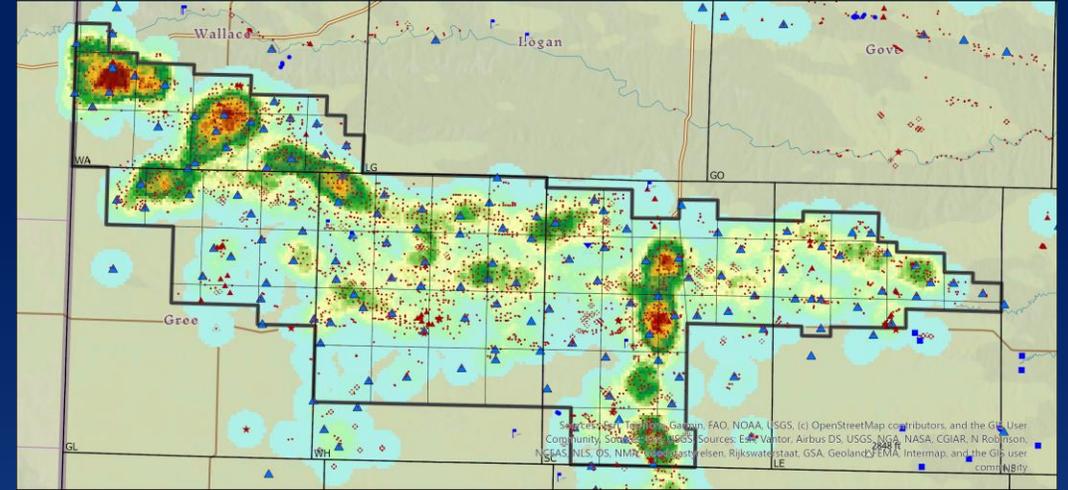
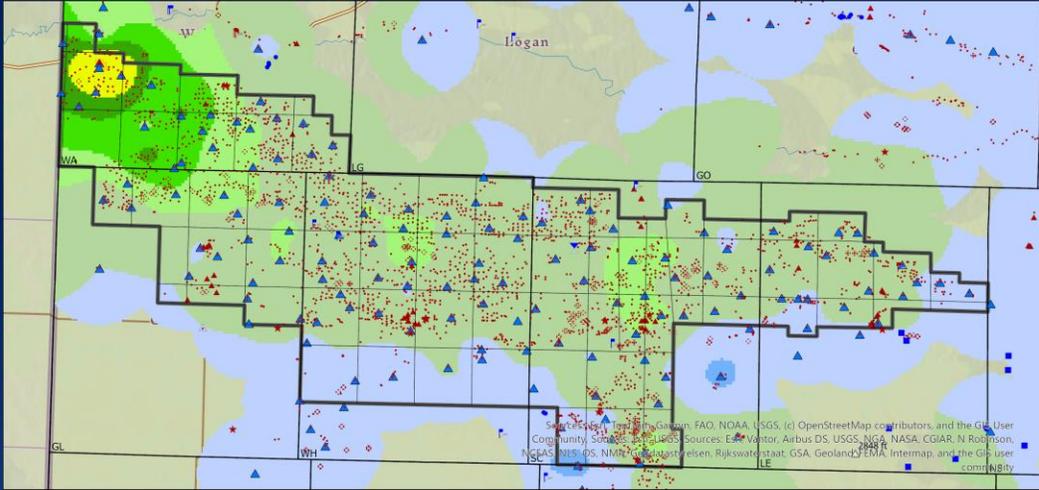
Irrigation AF/A and Precipitation (Mar to Aug)



Coming soon...hopefully....a township Q stable tracker.....



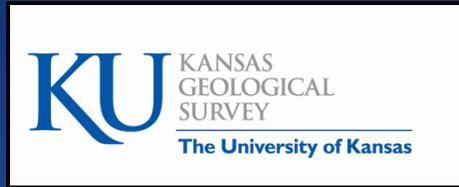
Coming soon....hopefully....a township Q stable tracker.....



- Use interpolated surface to estimate net inflows at the township scale
- Develop web app to track annual water usage relative to net inflows
- Still in the conceptual “What if...” phase

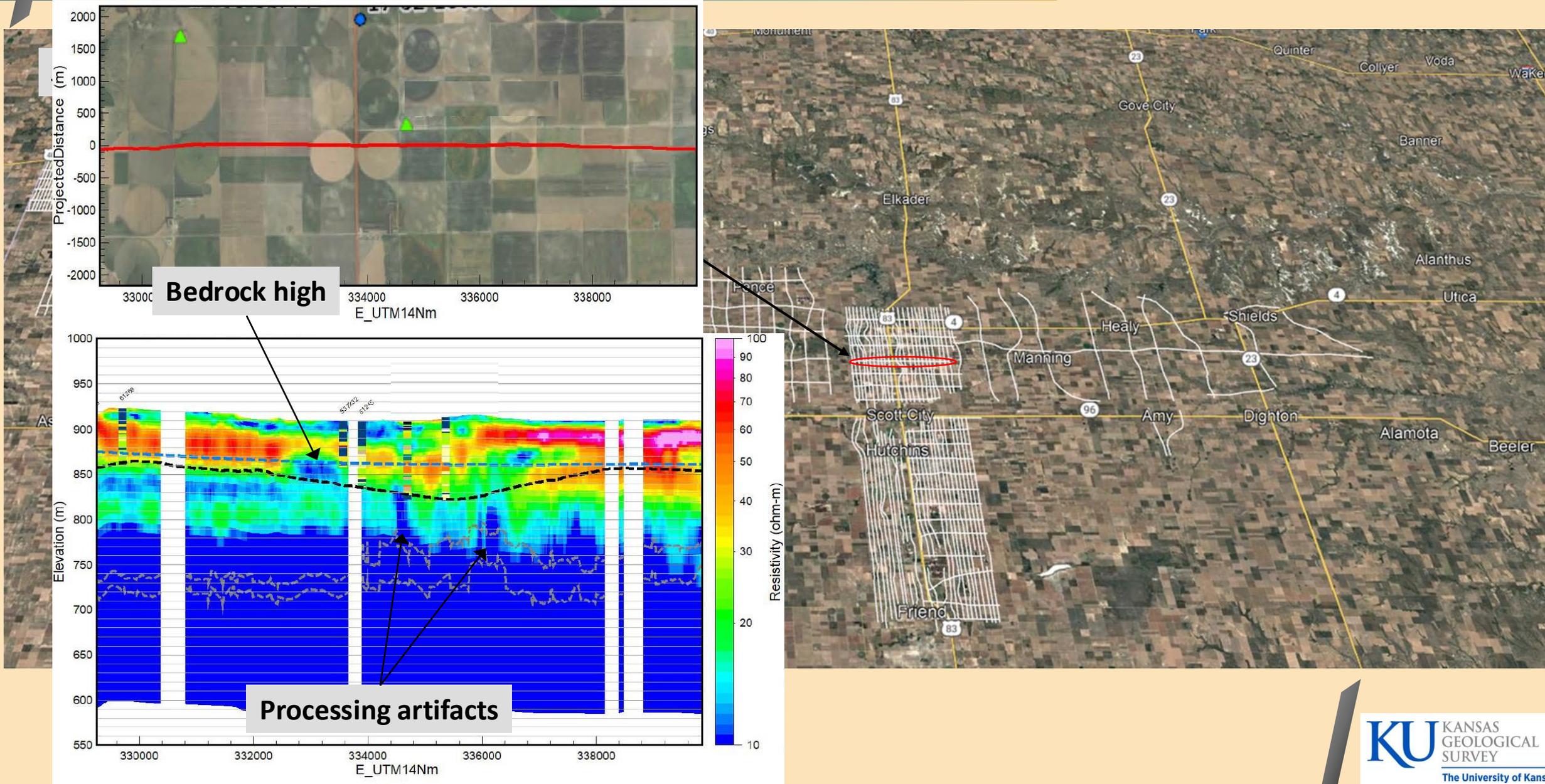
Questions????

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

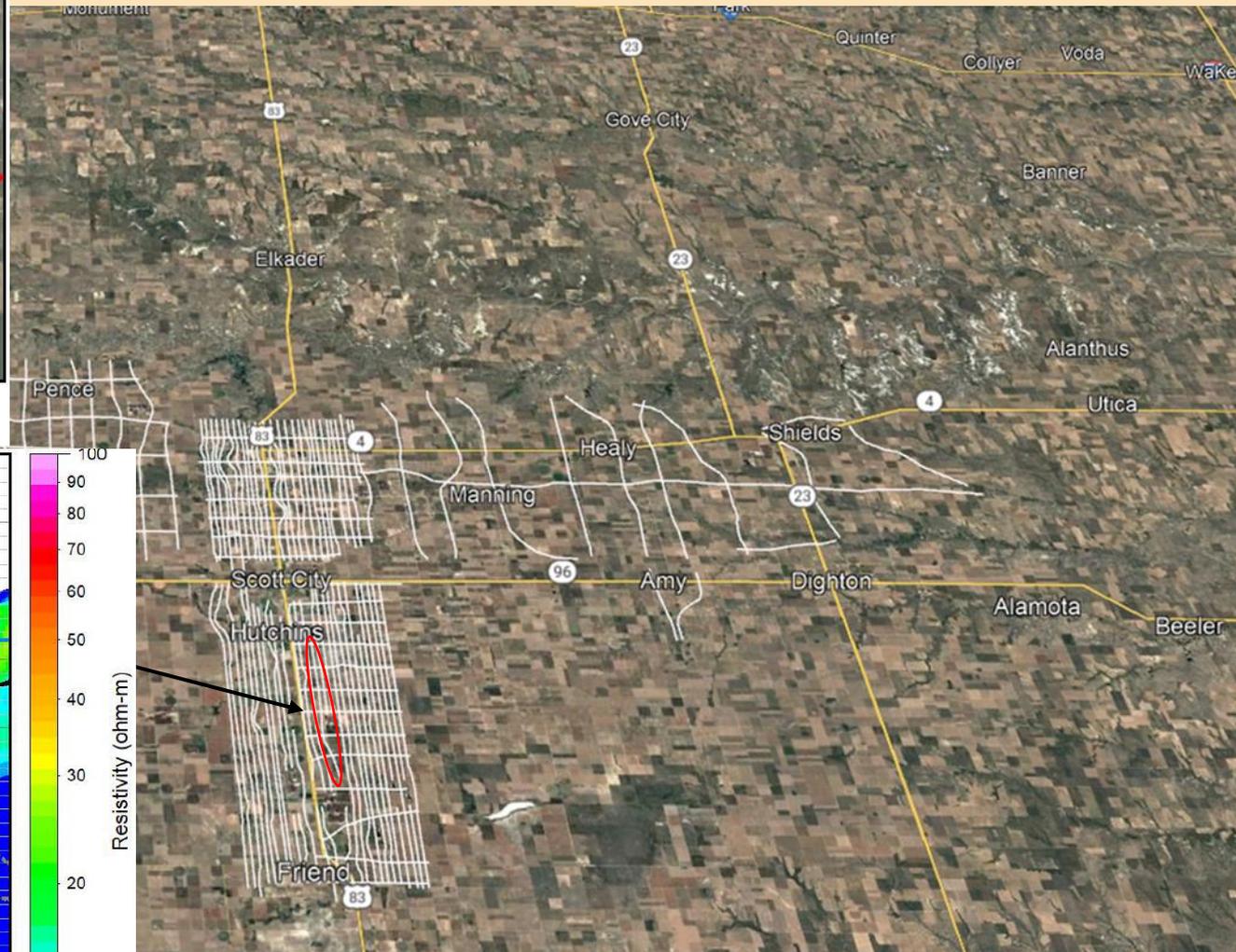
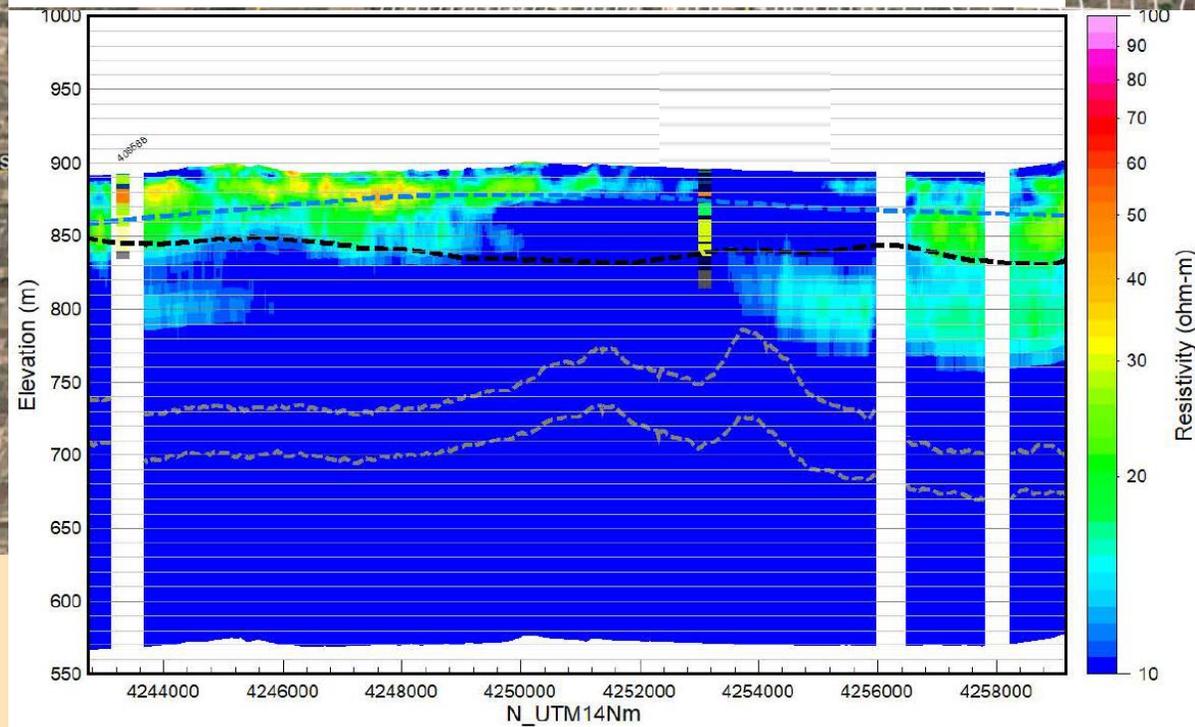
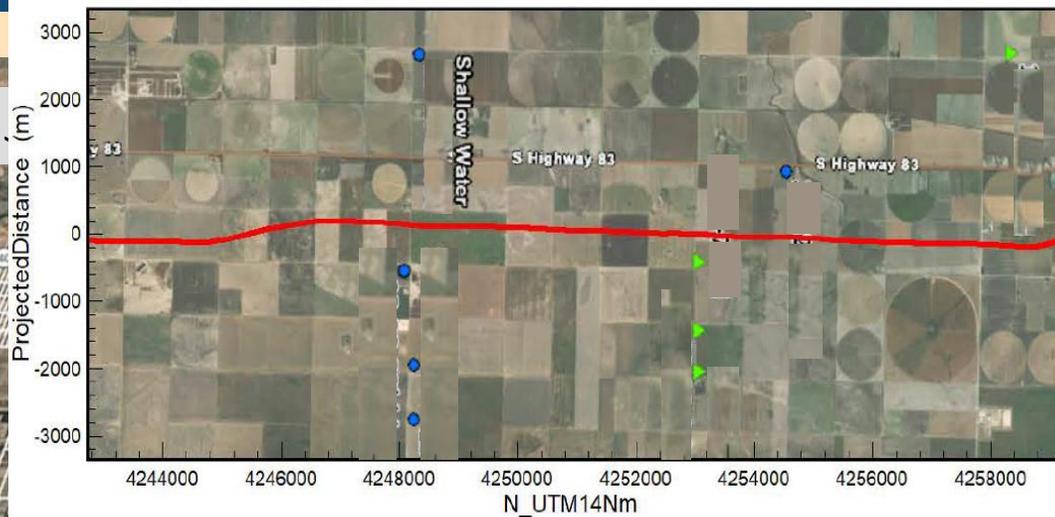


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<http://www.kgs.ku.edu>

AEM Flight Lines in GMD1 – 2,883 miles



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June 10 – July 2, 2025

