Water Resource Management and Irrigation in Kansas: Current Concerns and Emerging Issues

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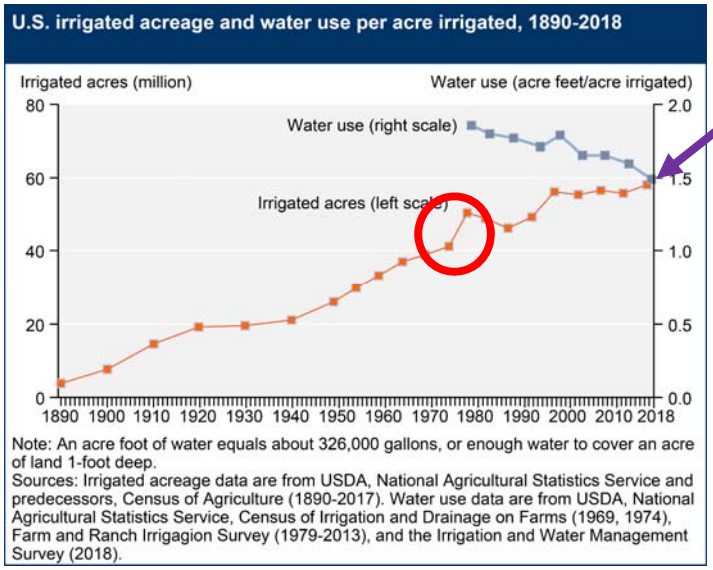
K-STATE Research and Extension

Outline

- History of irrigation development
- Recent trends in Kansas
- Regional trends in withdrawals and irrigated acreage
- Current opportunities and concerns by region
- Discussion

What do you think are the most pressing water resource concerns for Kansas?

United States Irrigation Development



24.3 million hectare

	Country/Territory/Region	Irrigated land (km^2)
	World	3,242,917
1	India	715,539
2	China	691,600
3	United States	234,782
4	Pakistan	193,400
5	European Union	154,540
6	Bangladesh	81,270
7	Iran	79,721
8	Brazil	69,029
9	Indonesia	67,220
10	Thailand	64,150

https://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use/

U.S. Irrigation Development

Share of Irrigated Land

- NE: 14.8%
- CA: 13.5%
- AR: 8.4%
- TX: 7.5%
- ID: 5.9%
- CO: 4.8%
- KS: 4.3%

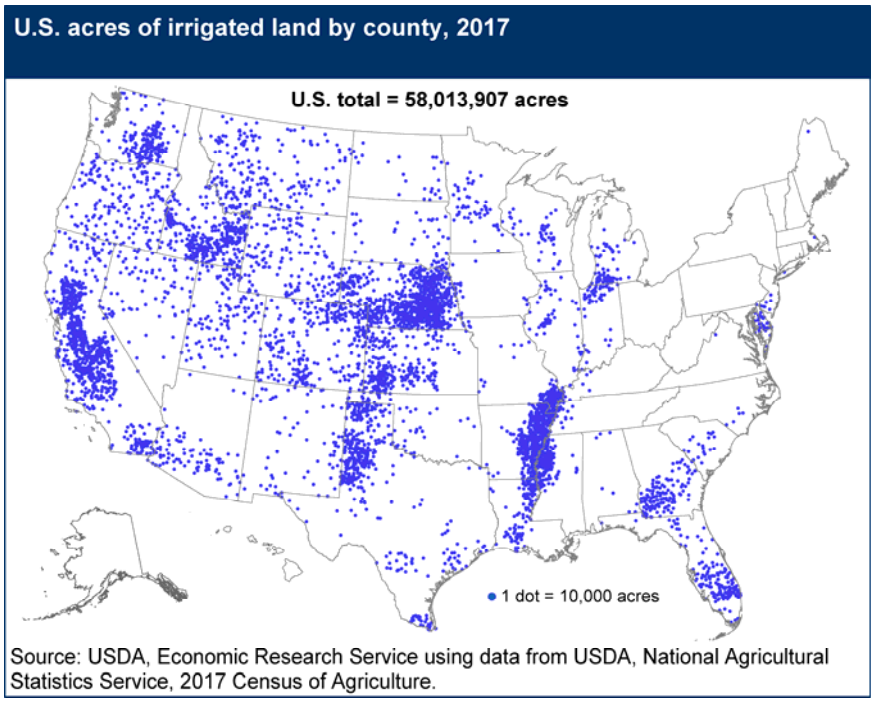
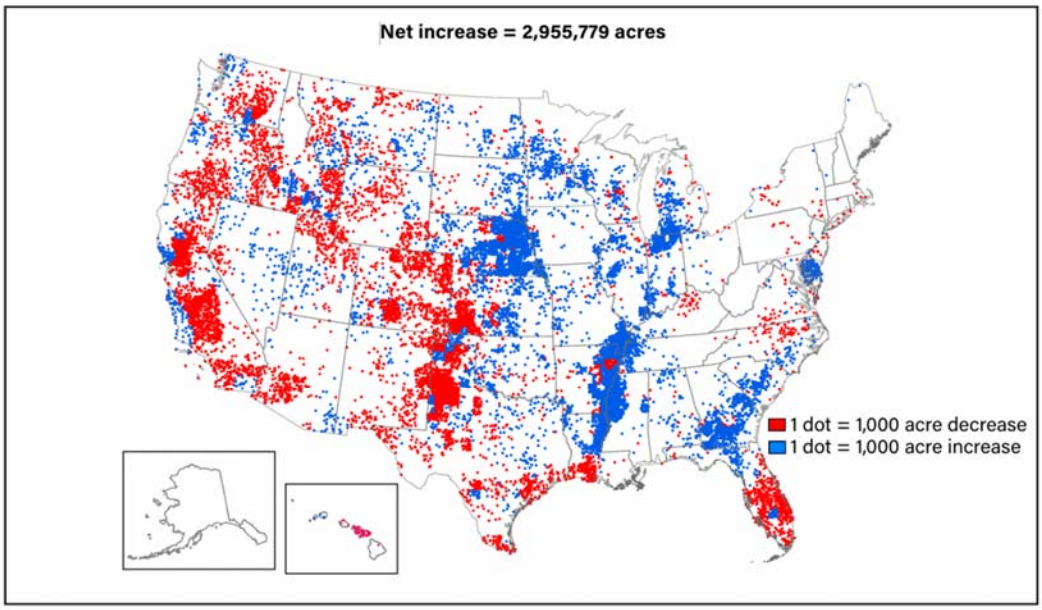


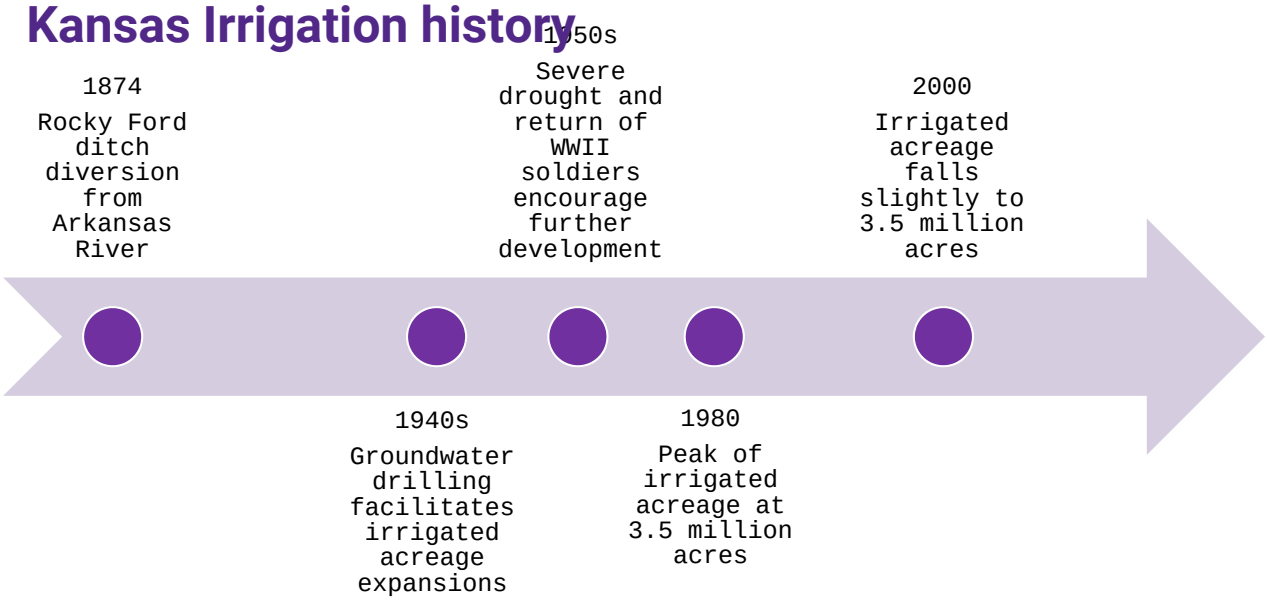
Figure 6

Spatial distribution of changes in irrigated acreage, 1997–2017



Source: Hrozencik and Aillery (2021)

Kansas Irrigation history



Number of Permits (1944 – 1984)

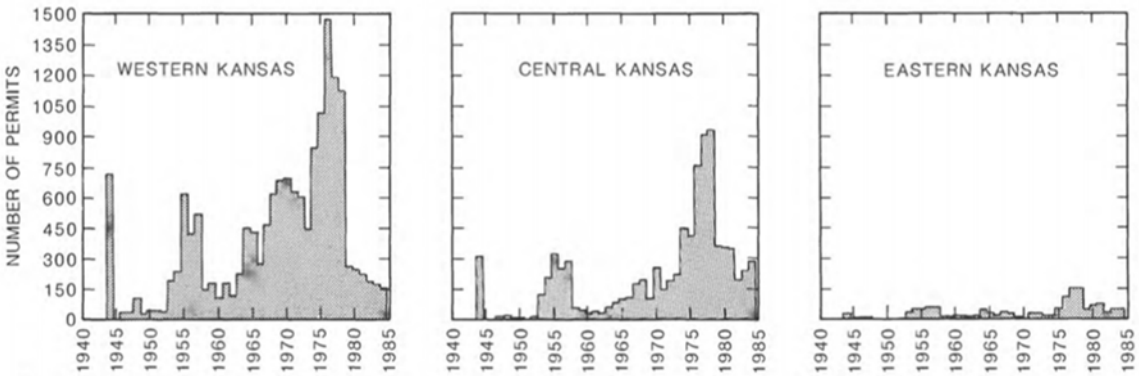


Figure 9.--Number of permits issued to appropriate water for irrigation, 1944-84.

Western KS Sandhills area south of the Arkansas River:

- Center Pivots increased from 1,084 to 2,826 from 1972 to 1975.

Great Bend Prairie south of Arkansas River:

Kenny (1986): Water Demands in Kansas,

Rapid Expansion of Irrigation – 1970's

Economic Drivers
- Global commodity boom: 1972 USSR grain deal boosted U.S. exports & prices (Gardner, 2002)
- Inflation: Farmland & irrigation systems seen as safe investments (Gardner, 2002)
- Low pumping energy costs early in decade (Sloggett, 1992)

Technological Advances
- Center pivot irrigation perfected late 1960s, widely adopted in 1970s (Wheeler & Riggs, 1976)
- Center pivot patent expired in 1969, spurring manufacturer competition & adoption (Opie, 2000)
- Turbine & submersible pump improvements increased reliability (Keller & Bliesner, 1990)
- PVC/aluminum pipe lowered installation

Policy & Institutional Support
- USDA loan and cost-share programs accelerated adoption (USDA-ERS, 1982)
- States clarified or expanded water rights, prompting rapid drilling (Opie, 2000)
- Bureau of Reclamation projects delivered new surface water (BoR, 1977)

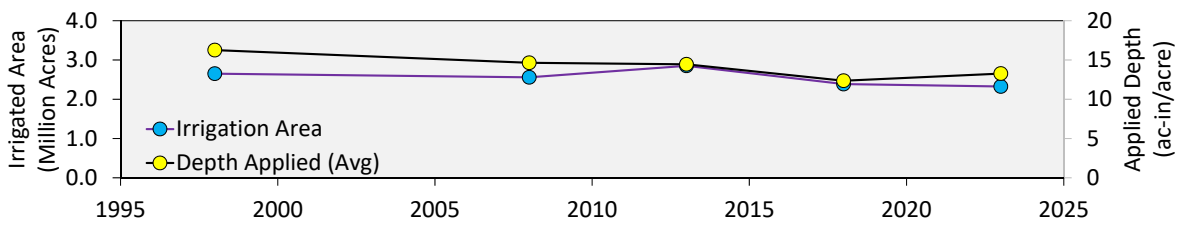
Climatic & Social Context
- Early 1970s droughts increased irrigation demand (Opie, 2000)
- Farm consolidation enabled large-scale capital investment (Gardner, 2002)
- Shift to high-value crops made irrigation economically essential (Stulp, 1978)

KS Irrigation History

USDA United States Department of Agriculture
Census of Agriculture Historical Archive

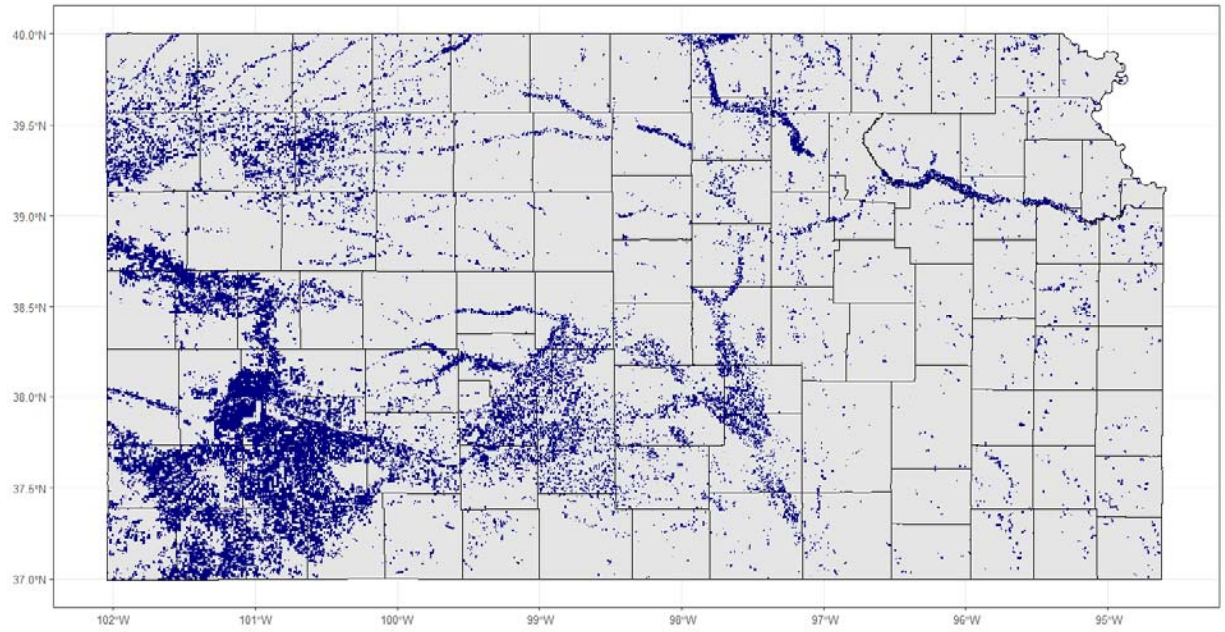
Table 1. Irrigated area, mean depth of water applied, and percentage of the irrigated area that depends on groundwater in the ten Great Plains states overlying the High Plains aquifer in 1998, 2008, 2013 and 2018, ranked by irrigated area in 2018. (USDA-NASS, 1998, 2008, 2013, 2019a).

	Irrigated Area (ha)					Depth of Water Applied (mm)				Percentage of Irrigated Area Dependent on Groundwater (%)			
State	2018	2013	2008	1998		2018	2013	2008	1998	2018	2013	2008	1998
Nebraska	3,102,274	3,357,977	3,331,418	2,303,608		193	296	243	266	91	92	94	89
Texas	1,652,515	1,817,882	2,110,132	2,119,621		399	394	388	435	83	90	87	87
Kansas	965,776	1,153,912	1,035,545	1,072,637		314	367	372	413	96	98	97	97
Colorado	994,767	934,659	1,109,453	1,190,704		476	546	490	523	47	43	43	45
Montana	865,979	757,745	735,328	704,522		363	407	419	505	3	3	2	3
Wyoming	631,920	573,972	572,963	620,586		443	449	617	553	11	10	7	6
New Mexico	273,200	281,114	322,431	291,509		604	575	696	732	58	58	66	59
Oklahoma	243,415	172,643	184,756	182,836		335	373	345	457	83	88	83	79
South Dakota	153,096	149,682	144,904	120,277		211	240	229	320	55	65	57	46
North Dakota	120,192	86,495	98,367	66,670		195	212	275	260	64	73	68	63
Total:	9,003,135	9,286,081	9,645,297	8,672,970	Mean:	353	386	407	446				

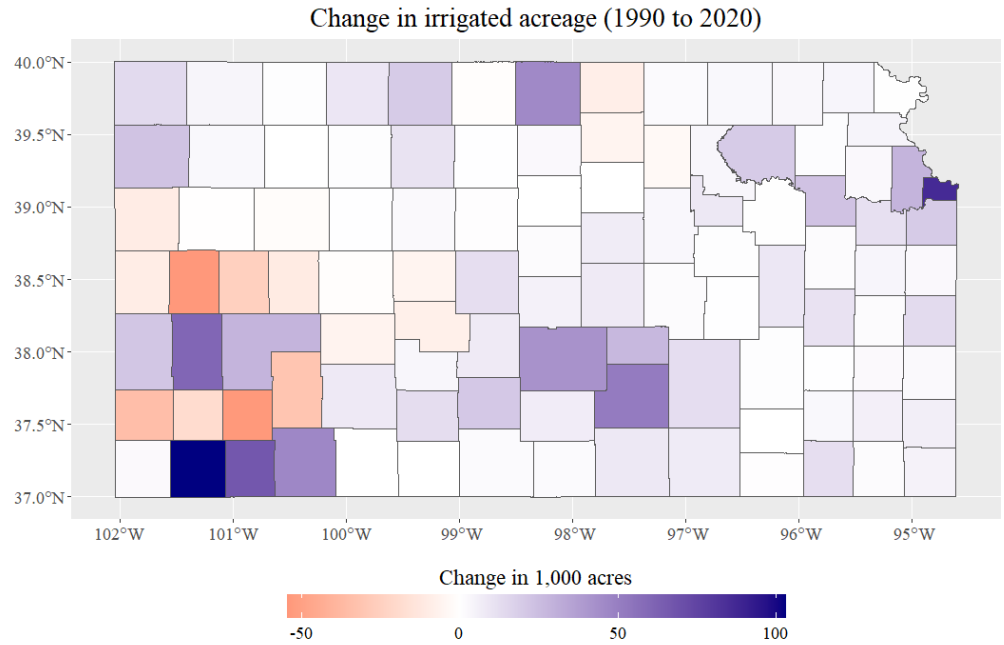


Irrigation technologies in KS

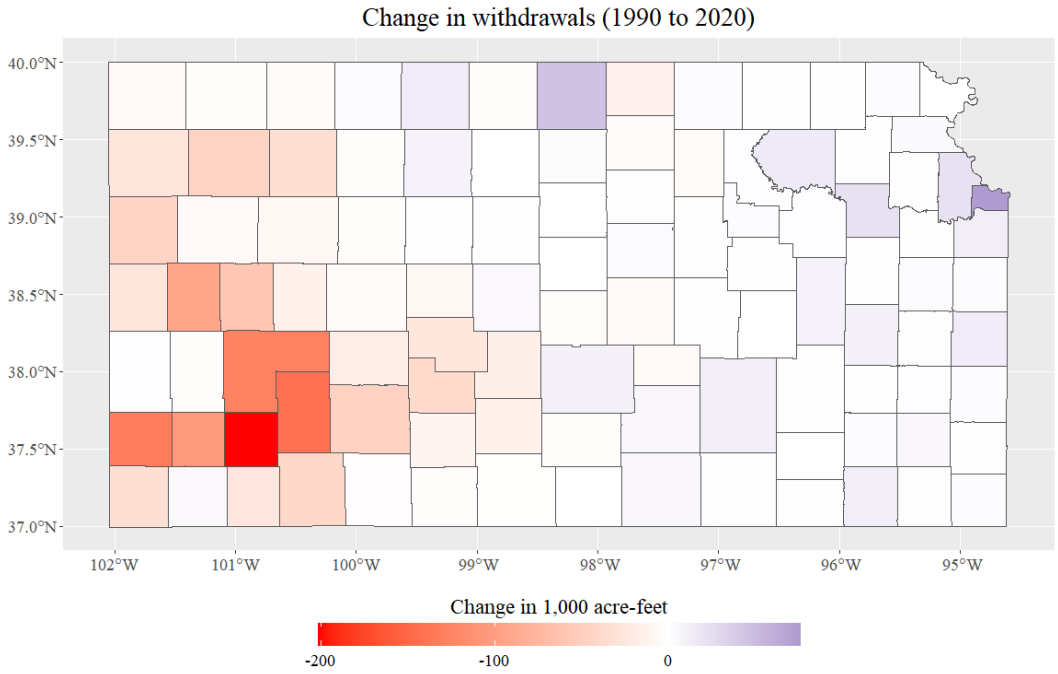
Authorized Places of Use (2020)



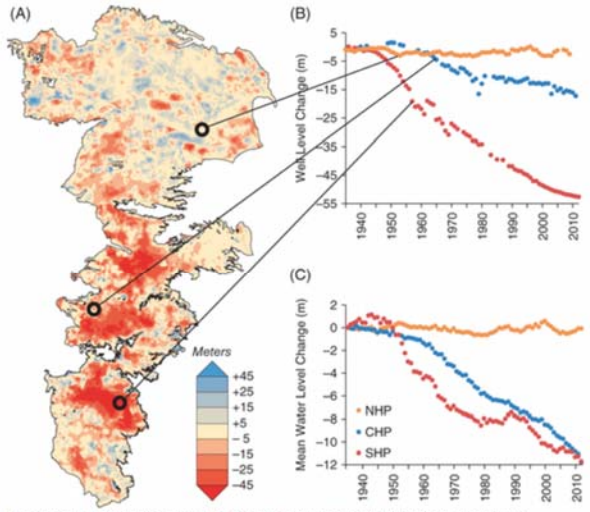
Recent changes in irrigated acreage



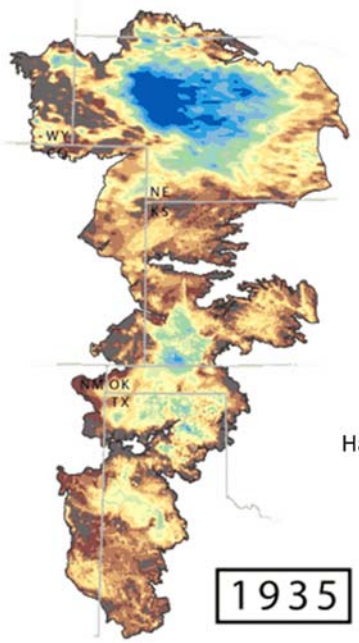
Recent changes in total withdrawals



Ogallala Aquifer – Saturated Thickness

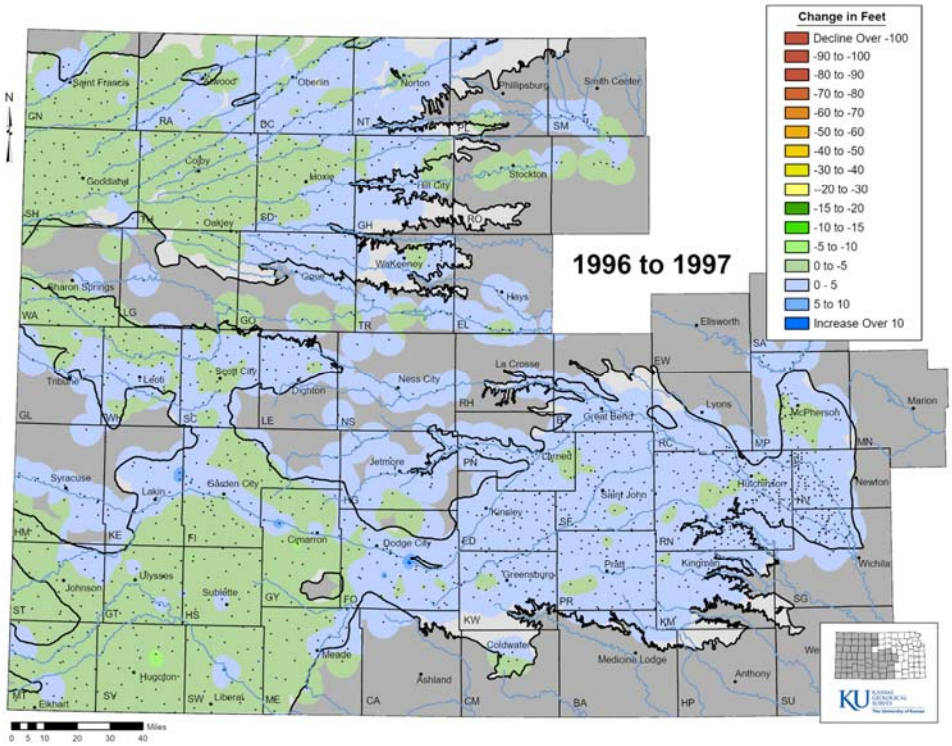


E. Haacker et al. (2015). Water Level Declines in the High Plains Aquifer: Predevelopment to Resource Senescence 54 (2): 231-242. DOI: 10.1111/gwat.12350

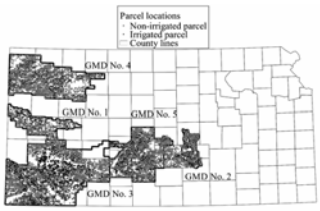


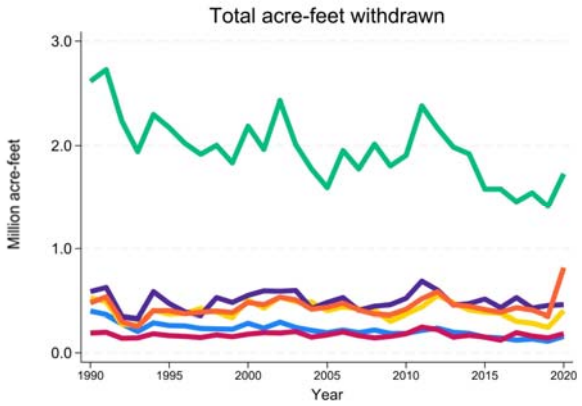
Haacker et al. 2015

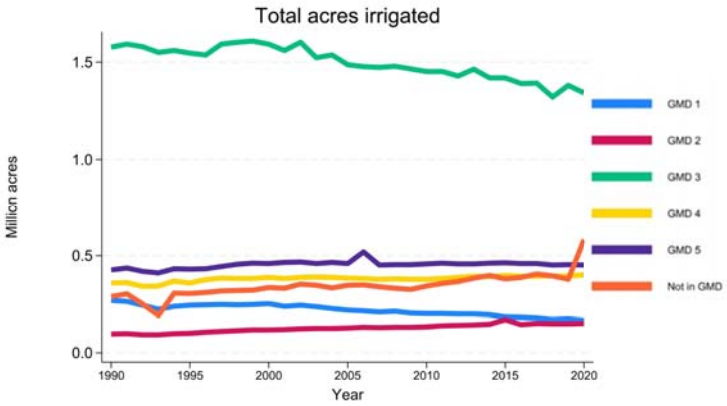
Changes in Ogallala-High Plains Aquifer in Kansas



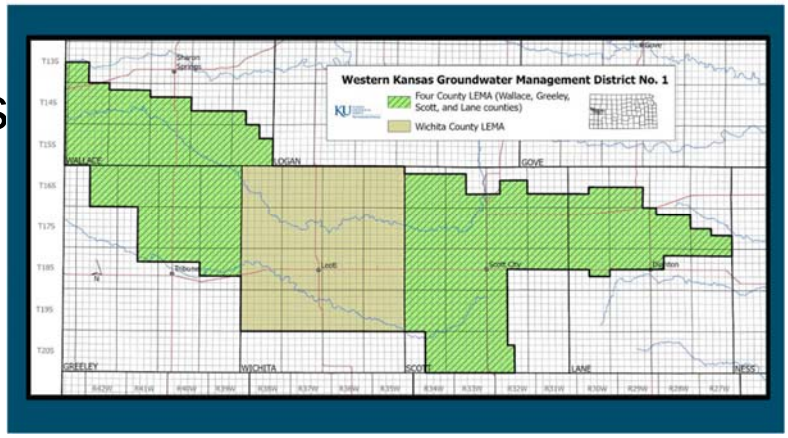
Current regional trends







GMD1 Western Kansas

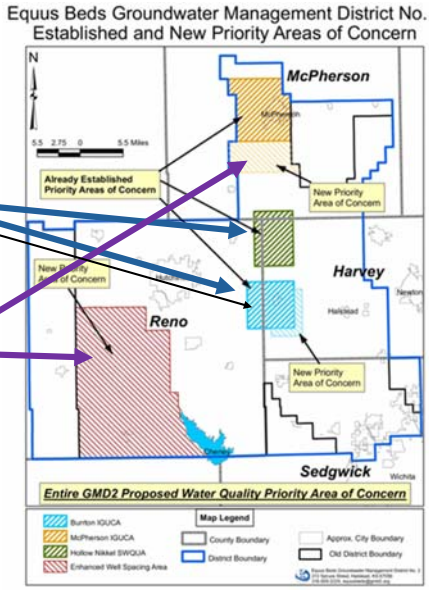


- Wichita County Water Conservation Area
  - Savings from 2017-2023 doubled projections (4,711 acre-ft/year).
- Wichita County LEMA
  - Approved for 2021-2025. Use over first 3 years indicates 47% decrease from 2009-2015 use.
  - Much of Wichita County approaching Q-Stable.
- Four County LEMA
  - Approved for 2023-2027. Plan requires 10% reduction from 2011-2020 average overall; individual reductions from 0-25% of 2011-2020 historic average.

GMD2 - Equus Beds

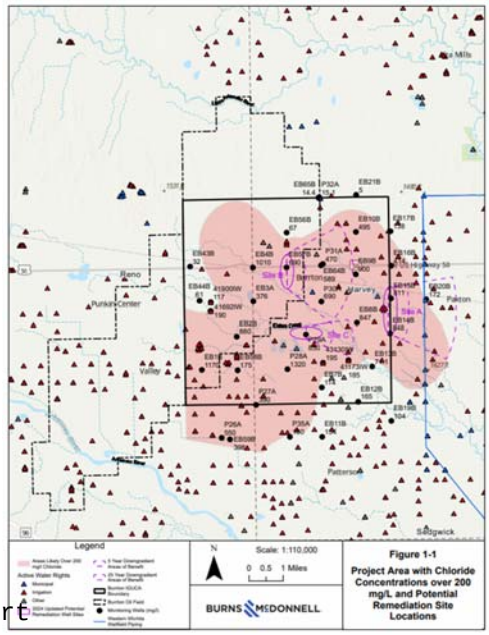
Quality

Quantity



Source: 2024 GMD2 Annual Report

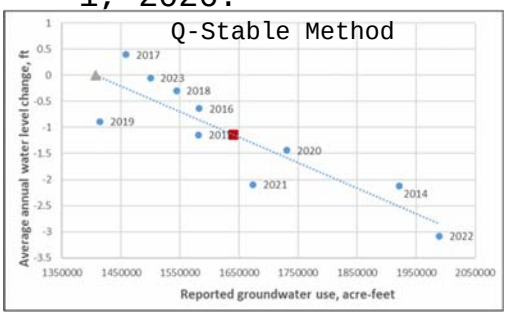
Burton Oil Field Chloride Plume
KDHE Report 2024

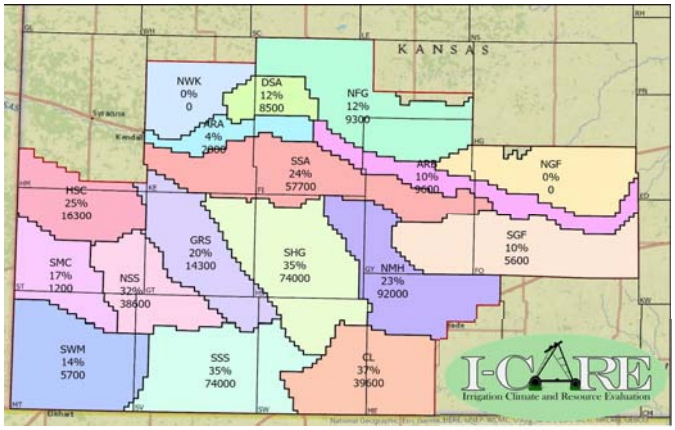


Which is a more pressing issue?

GMD3 Southwest Kansas

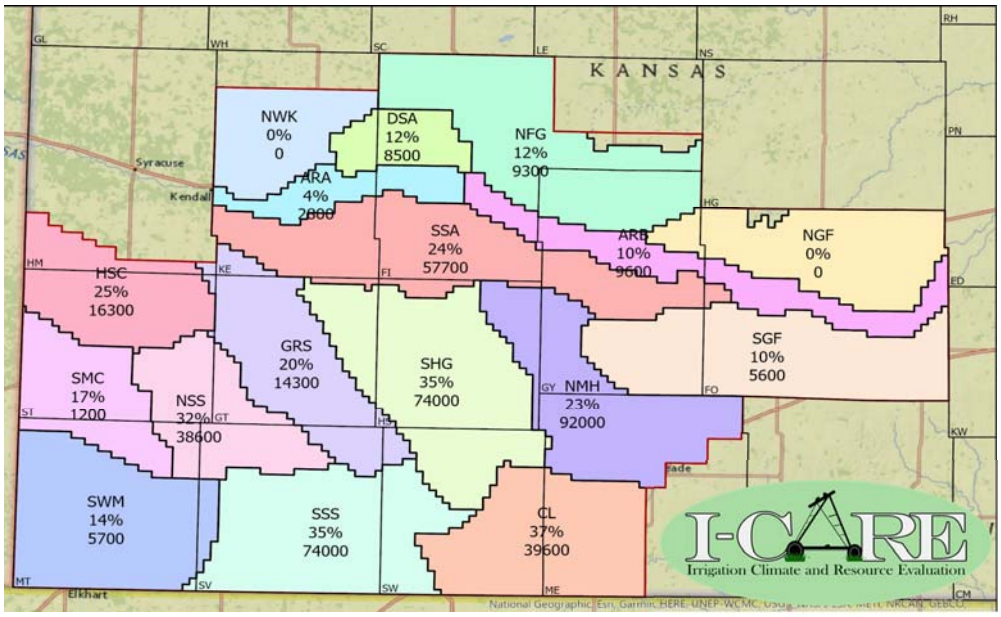
- Legislative directive K.S.A. 82a-1044:
  1. Identify priority areas by July 1, 2024.
  2. Submit action plan to chief engineer by July 1, 2026.





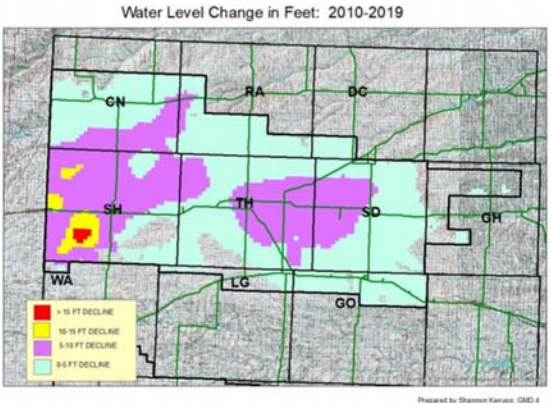
Upper number represents percent reduction needed to achieve Q-Stable. Lower number is the reduction in acre-feet.

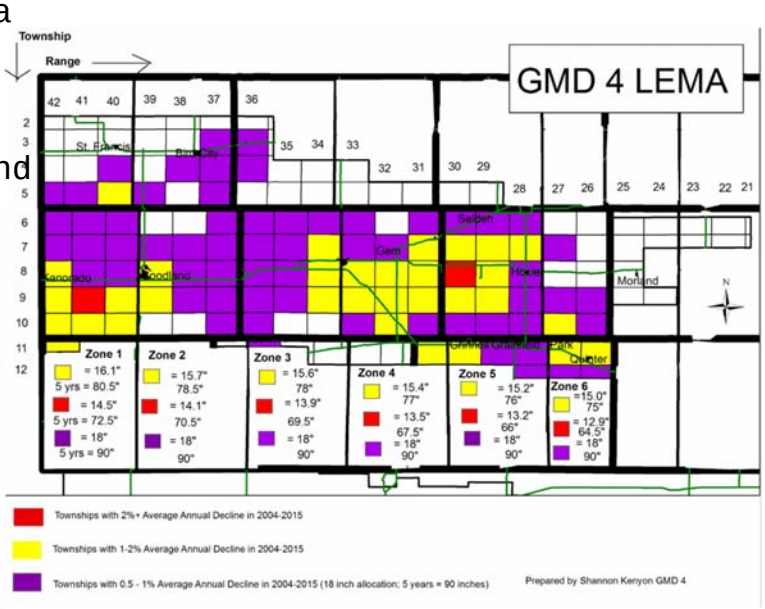
GMD3 Southwest Kansas

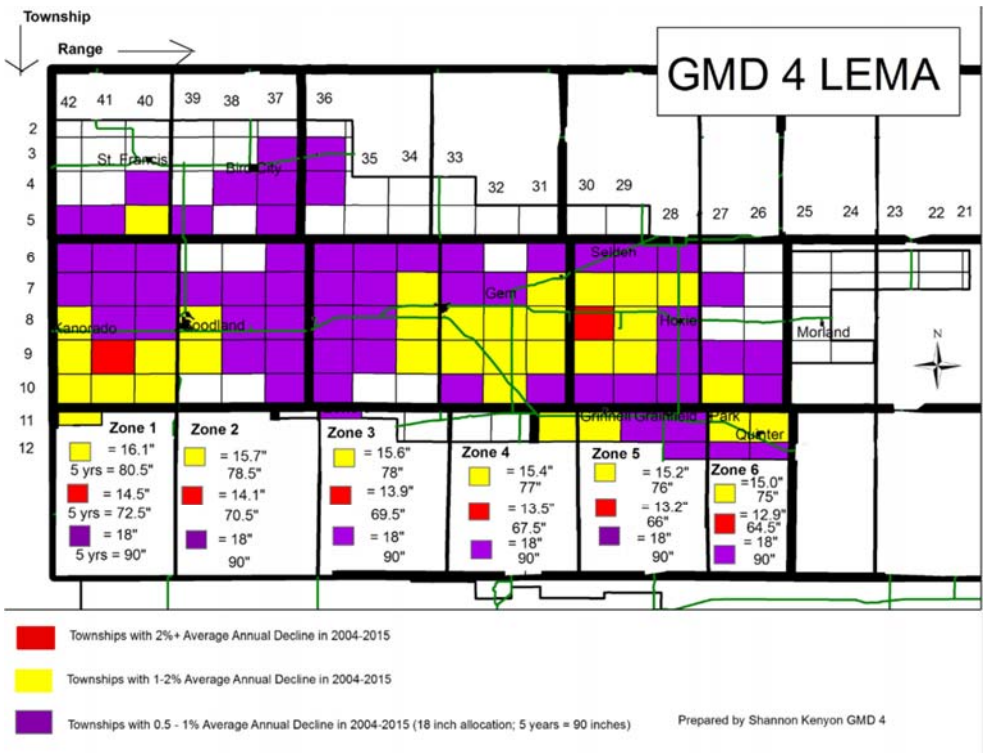


GMD4 Northwest Kansas

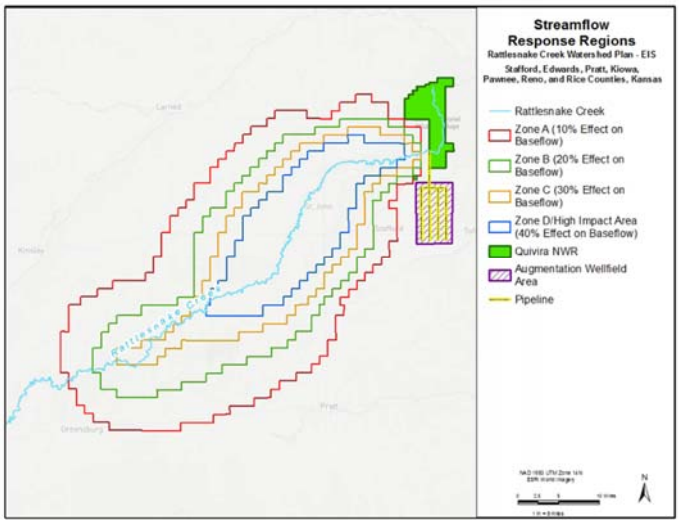
- GMD4 still considers area over-appropriated.
- Maximize efficiency in present, facilitate long term transition to dryland





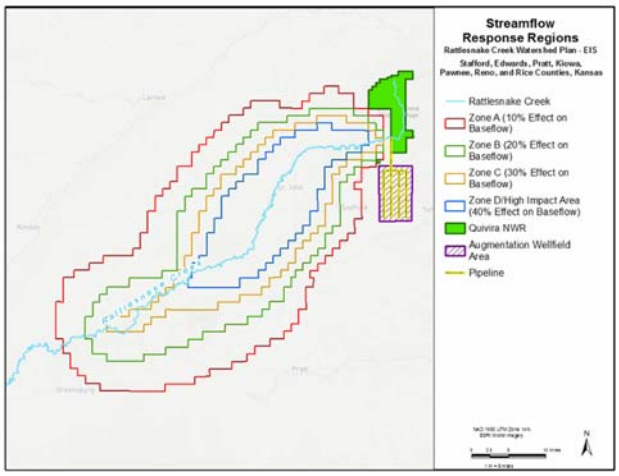


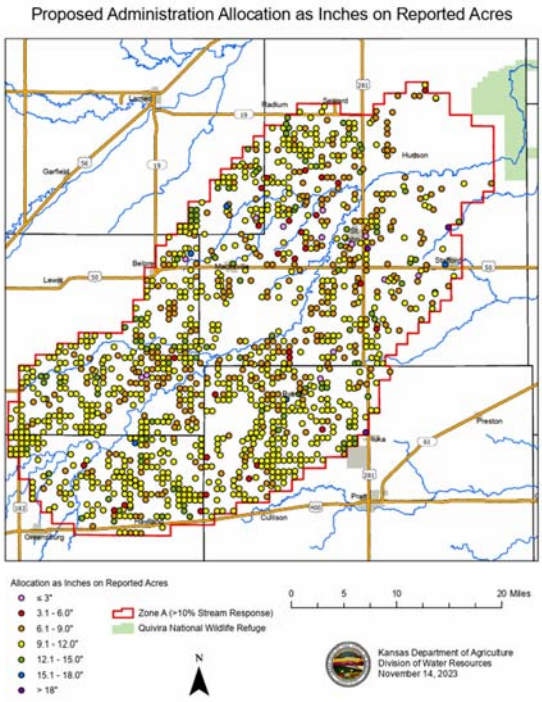
GMD5 Big Bend



- Currently addressing Quivira National Wildlife Refuge impairment.
- Developed Watershed Plan-Environmental Impact Statement in 2023.
- Proposed plan involves:
  1. Groundwater augmentation project upstream of Quivira NWR
  2. Decreased water right retirements in Zone D
- Decrease in the agricultural economy expected due to water right retirements. Estimates suggest loss of $160,000 annually.

GMD5 Big Bend



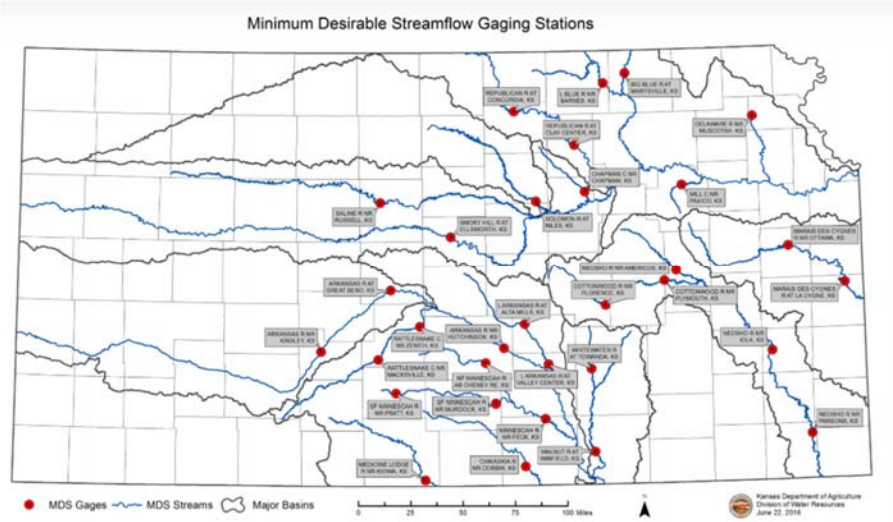


Minimal Desirable Streamflow

Currently administered on:

1. Republican River
2. Rattlesnake Creek

Rattlesnake Creek Example: “Beginning in 2025, you will receive an order to cease diversions through groundwater pumping should the stream flow at the downstream gage fall below the established MDS threshold for at least seven consecutive days.”



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How to change the design

What water resource issues do you think deserve more attention?

Questions?

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