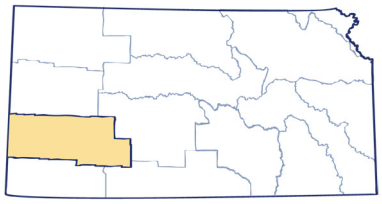
State of the Resource & Regional Goal Action Plan Implementation Report

August 2018

Upper Arkansas Regional Planning Area



Kansas Water Office

Table of Contents

Executive Summary

The Upper Arkansas State of the Resource & Regional Goal Action Plan Implementation Report is intended to provide a background of the regional issues and record activities and progress toward regional goals and the *Long-Term Vision for the Future of Water Supply in Kansas* (*The Vision*) objectives utilizing the most up to date data available at the time of report development.

The principal aquifers in this region include the Ogallala-High Plains and alluvial aquifers. The High Plains Aquifer consists of several hydraulically connected aquifers, the largest of which is the Ogallala. The Ogallala-High Plains Aquifer is distinctive from other aquifers in Kansas due to the fact it generally has low annual recharge.

Groundwater resources have benefitted from reduced water use the past two years with above normal precipitation being received during the irrigation season within the region, though water levels in the Upper Arkansas portion of the Ogallala Aquifer have continued to decline each year.

Every year, the Kansas Geological Survey (KGS) and Kansas Department of Agriculture-Division of Water Resources (KDA-DWR) measure water levels for nearly 1,400 wells in central and western Kansas, including 284 wells within the Upper Arkansas region. From 2007 through 2016, these water level measurements showed average groundwater levels declined every year, with an average annual decline of 1.98 feet and a 10 year cumulative decline of 18.86 feet.

There are currently no Local Enhanced Management Areas (LEMAs) in place for the region. Eight Water Conservation Area (WCA) plans have been adopted by landowners as voluntary water conservation measures; with two additional plans pending approval. These WCAs cover 15,762 acres of the 833,781 irrigated acres in the region, covering fewer than 2% of the total irrigated acres.

Two Water Technology Farms (Tech Farms) continue in 2018 with the addition of a third farm; T&O Farms, Roth/Garden City Company, and the new Harshberger Farm. On the Roth/Garden City Company Tech Farm, with assistance from higher than average precipitation in 2017, one field had a yield of 241 bushels of corn per acre using only 5.78” of irrigation water. Both of the farms were initiated in 2016 and will continue to be evaluated in 2018.

There was increased surface water use in 2015 and 2016 with more water available in the Arkansas River. The Arkansas River seldom flows east of Garden City and the last time the river was recorded as flowing to Dodge City was 2003. Lower quality water of the Arkansas River continues to infiltrate into the groundwater aquifer and degrade water quality conditions in areas where surface water has historically been used. The Kansas Department of Health and Environment (KDHE) is monitoring this situation.

A Water Conservation Field Day was held in Garden City in April 2018. The field day highlighted projects and conservation efforts taking place in Garden City to reduce water use and increase awareness and education. Topics included regional goals and focus, water use comparison reports, the installation of sub-surface drip irrigation on a city baseball field, and a feasibility study on the treatment and reuse of wastewater.

Water Use Trends

Groundwater is the primary source of water in the region, accounting for 98% of the total supply, principally from the High Plains Aquifer and alluvial deposits along major streams (Figure 1). Surface water in the Arkansas River is used, when available, for irrigation uses. Irrigation use accounts for 95% of the reported water use of the region, with municipal usage representing 2% of water use followed by stock water at 2% with the remainder accounted for by industrial, recreational, and other uses, less than 1% of total use for each (Figure 2).

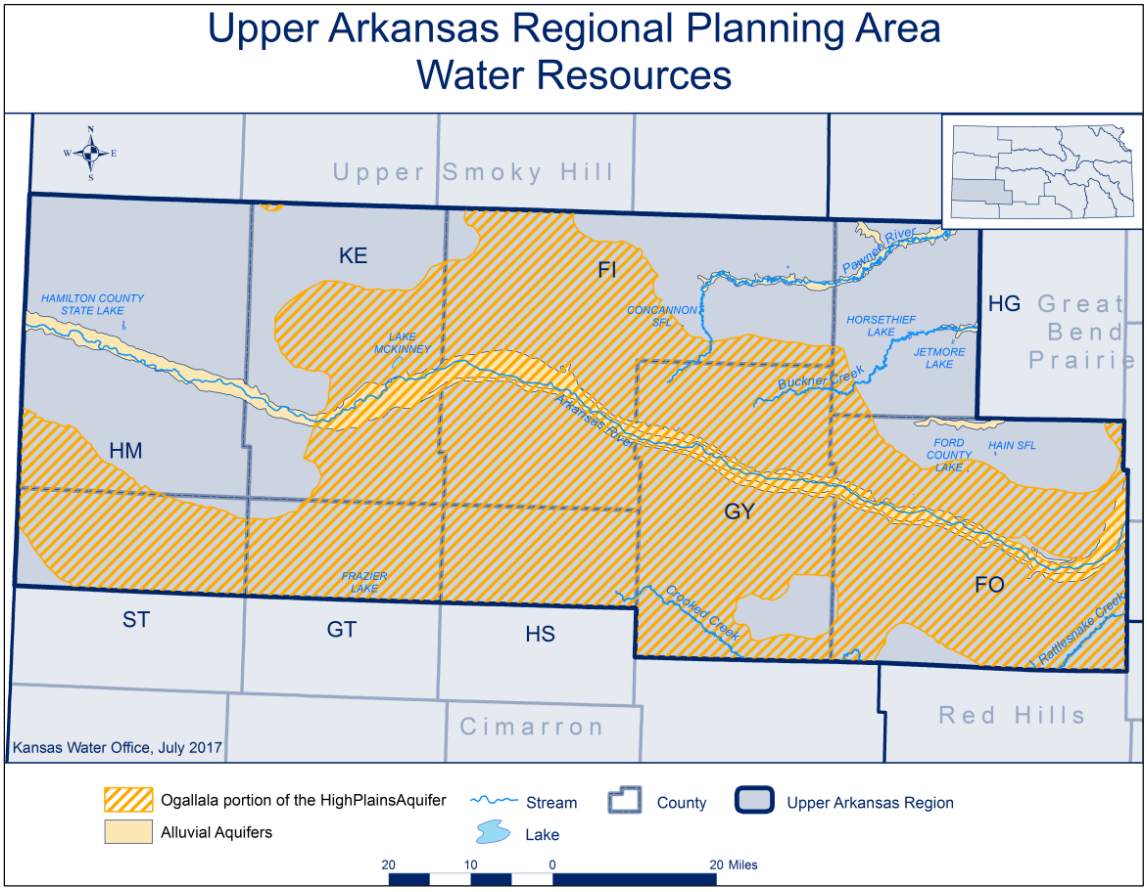


Figure 1: Upper Arkansas Regional Planning Area and generalized aquifer extent

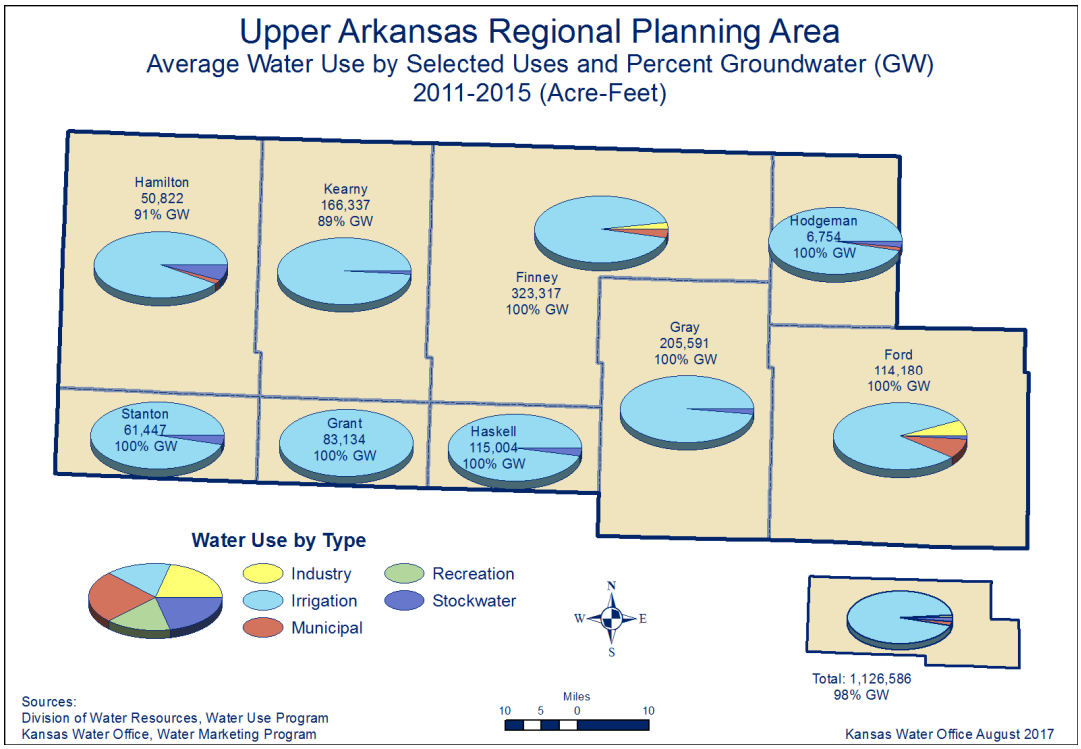
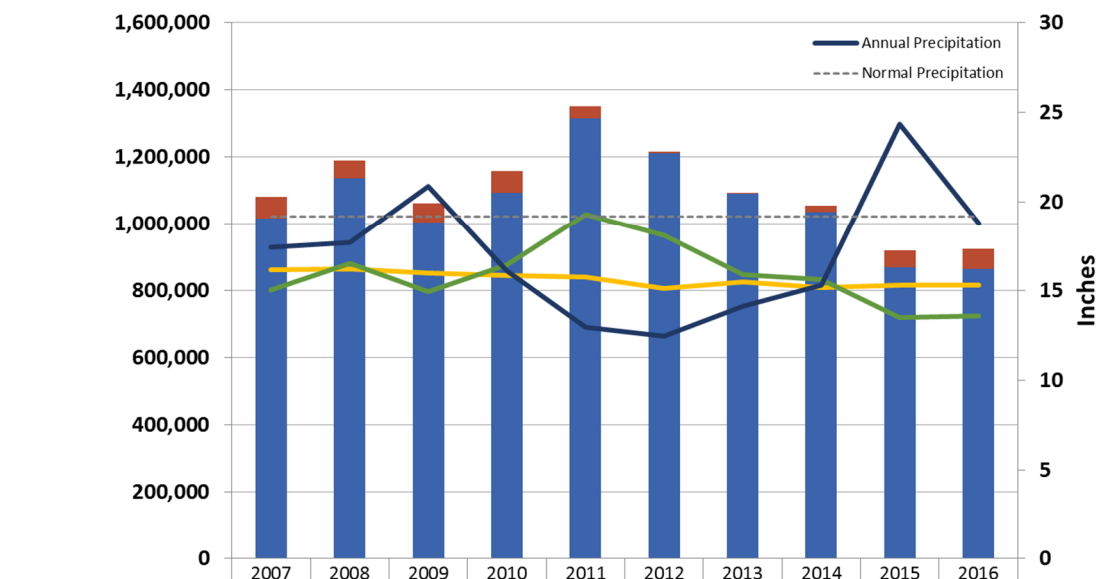


Figure 2: Water use by type of use for the Upper Arkansas Region



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Surface Water (AF)	64,080	53,132	58,783	63,403	36,012	4,734	3,559	18,501	50,043	59,752
Groundwater (AF)	1,017,50	1,137,11	1,003,53	1,094,20	1,314,29	1,212,63	1,090,45	1,036,33	869,030	864,246
Irrigated Acres	862,117	865,232	852,964	845,327	839,928	806,016	824,939	809,319	816,142	815,824
Acre Inches per Acre	15.05	16.51	14.95	16.43	19.29	18.12	15.91	15.64	13.51	13.59

Figure 3: Surface water and groundwater use for years 2007- 2016 within the Upper Arkansas Region, with annual precipitation, irrigated acres, and acre inches per acre displayed

Water use has historically followed in relation to yearly precipitation, with years of below normal precipitation showing an increase in water use demand (Figure 3).

Water Resource Conditions

Groundwater

The Ogallala-High Plains Aquifer is the principal groundwater source within the Upper Arkansas Region. Other aquifers present within the region include the Dakota along with alluvial aquifers along and near major river reaches.

The KGS and KDA-DWR measure water levels in 1,400 wells in central and western Kansas, including 284 wells within the Upper Arkansas Region. From 2007 through 2016, these water level measurements showed average groundwater levels declined every year, with an average annual decline of 1.98 feet and a 10-year cumulative decline of 18.86 feet (Figure 4).

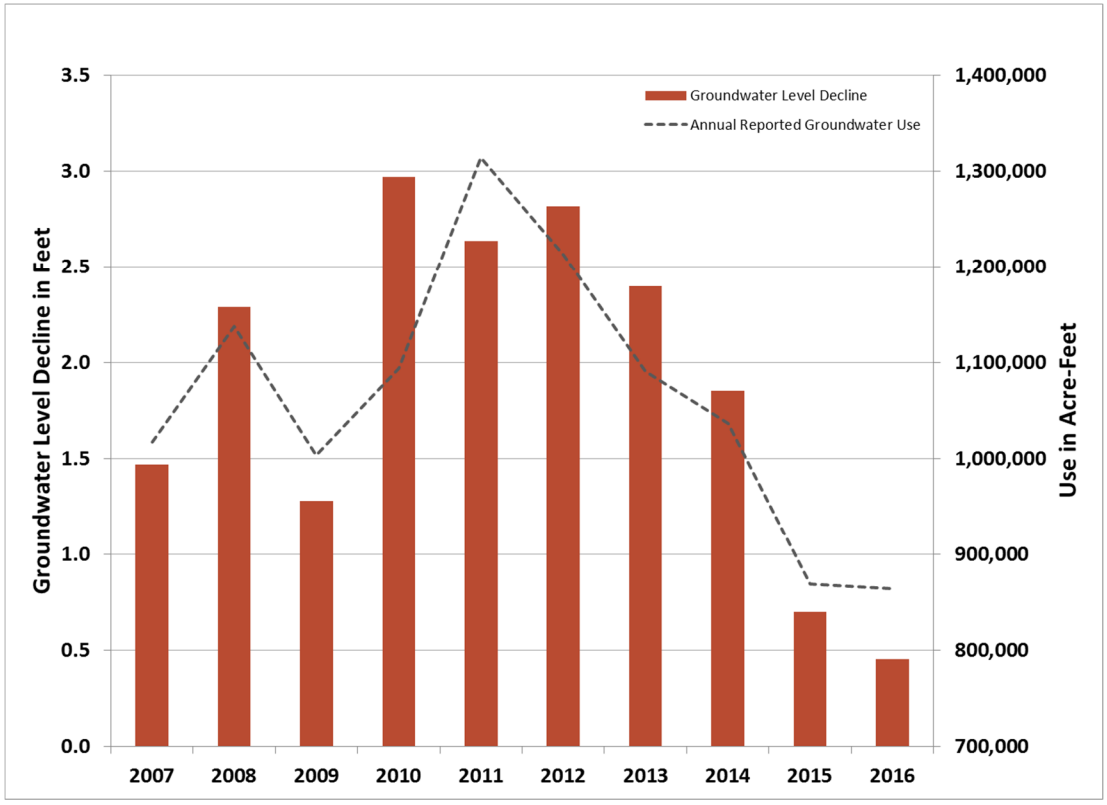


Figure 4: Groundwater level changes from 2007 to 2016

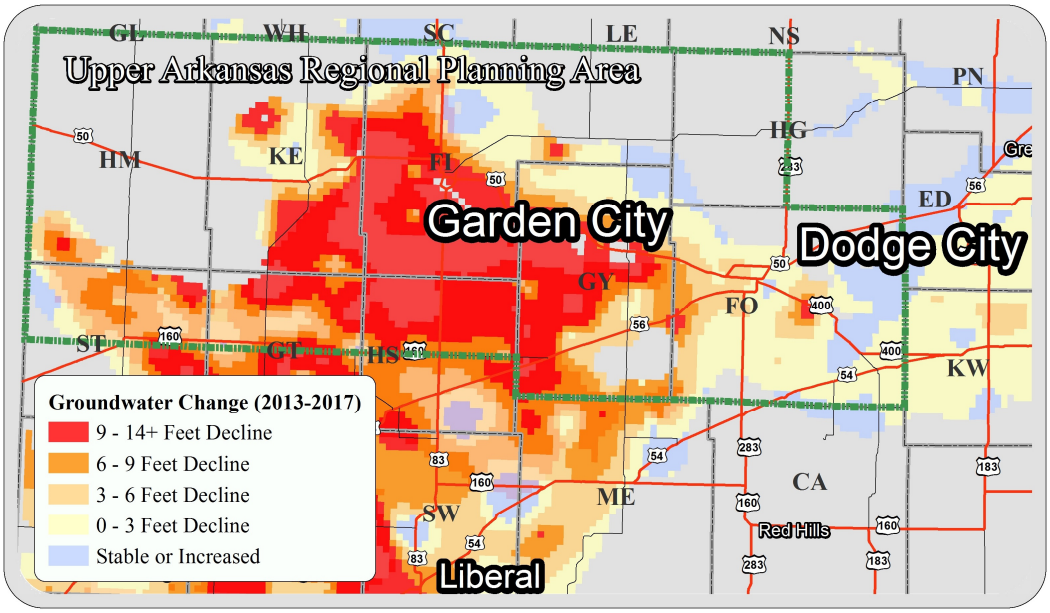


Figure 5: Groundwater level declines for 2013 to 2017, with data from the KGS water level monitoring program

Table 1: Groundwater level changes for 2007 to 2016 by High Plains Aquifer Regional Planning Area

Region	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	10 Year Change	Average Annual Change (2007-16)
Cimarron	-2.37	-2.90	-1.65	-2.52	-3.93	-3.63	-1.72	-1.90	-0.91	-1.29	-22.81	-2.28
Equus-Walnut	1.87	1.56	0.00	-0.80	-2.96	-1.48	2.44	-1.21	1.38	1.94	2.74	0.27
Great Bend Prairie	3.11	0.59	0.70	-0.46	-2.88	-1.89	0.55	-0.68	-0.26	0.51	-0.69	-0.07
Upper Arkansas	-1.47	-2.29	-1.28	-2.97	-2.64	-2.82	-2.40	-1.85	-0.70	-0.45	-18.86	-1.89
Upper Republican	-0.69	-0.20	0.18	-0.39	-0.42	-1.40	-0.64	-0.39	-0.53	-0.29	-4.77	-0.48
Upper Smoky Hill	-0.87	-0.41	-0.22	-0.52	-1.01	-1.41	-0.63	-0.44	-0.13	-0.32	-5.96	-0.60
ENTIRE HIGH PLAINS AQUIFER REGION	-0.09	-0.60	-0.24	-1.08	-1.93	-1.98	-0.65	-0.93	-0.39	-0.12	-8.00	-0.80

Increase =
Decrease =
Unchanged =

Figure 6: Hydrograph showing the decline of the Ogallala Aquifer through time, with well measurements near Lakin in Kearny County

Figure 7: Hydrograph showing the decline of the Ogallala Aquifer through time, with well measurements near Garden City in Finney County

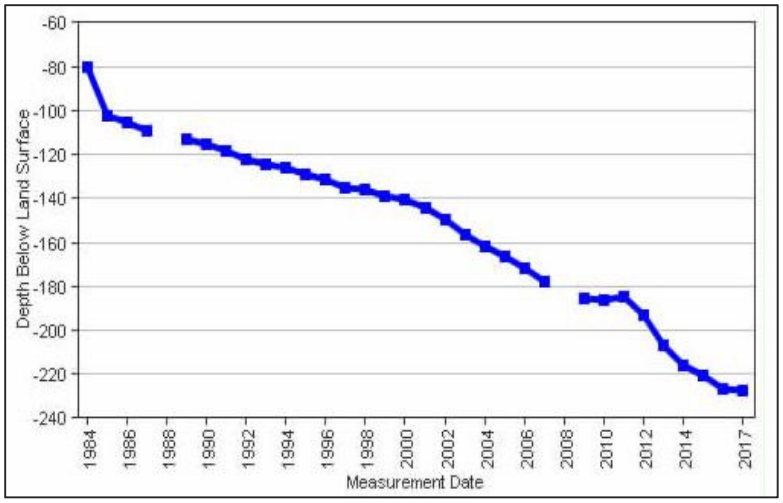


Figure 8: Hydrograph showing the decline of the Ogallala Aquifer through time, with well measurements near Cimarron in Gray County

Figure 9: Hydrograph showing the decline of the Ogallala Aquifer through time, with well measurements near Dodge City in Ford County

Groundwater level declines have been prevalent in the region since the proliferation of high volume pumps for irrigation use in the 1950s and 1960s.

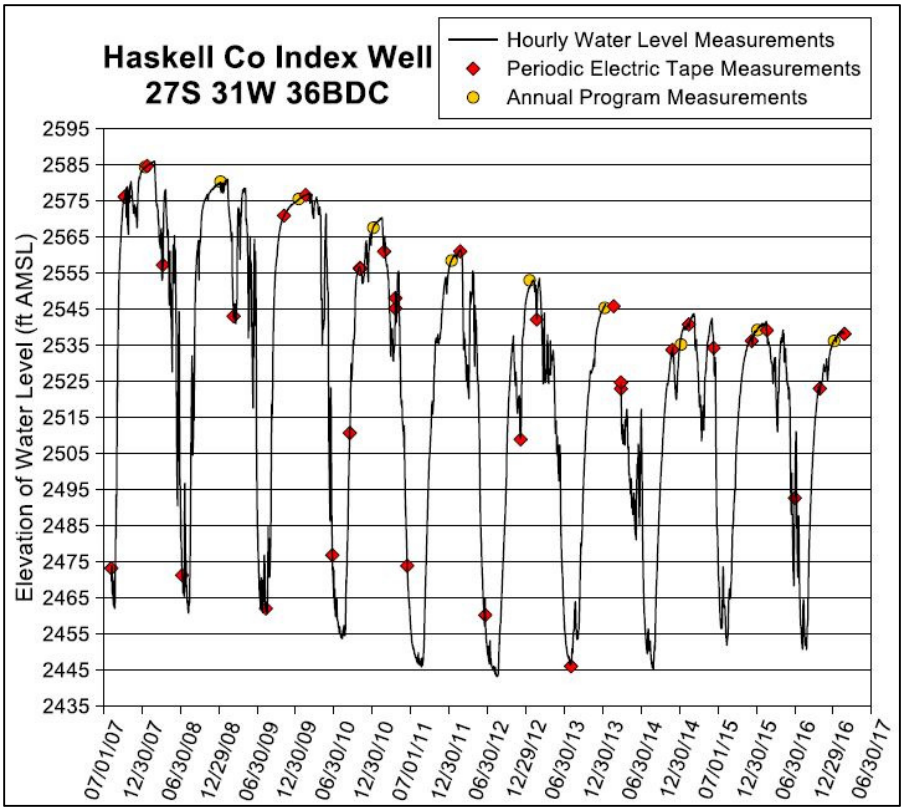


Figure 10: Kansas Geological Survey Haskell County index well hydrograph

The KGS operates three index wells within the region in addition to the annual water level measurement wells. These index wells provide near real time measurements of the aquifers water level status and allow for the study of the aquifer drawdown and recovery properties in different areas of the aquifer. The Haskell County index well shows the continued decline of the aquifer from 2007 to 2014, with a slight recovery starting in 2015. The hydrograph clearly shows the annual drawdown and recovery that occurs in relation to the area's irrigation pumping trends (Figure 10).

Surface Water

Surface water in the Upper Arkansas Region includes the Arkansas River from the Colorado-Kansas border to the eastern edge of Ford County and a few small lakes and surface impoundments. Use of surface water is limited to the flows of the river, which is now generally an intermittent stream downstream of Garden City, and Kansas water designated by the Arkansas River Compact with Colorado. Compact waters are used by senior water rights of the river, which are the irrigation ditch companies in Hamilton, Kearny and Finney counties.

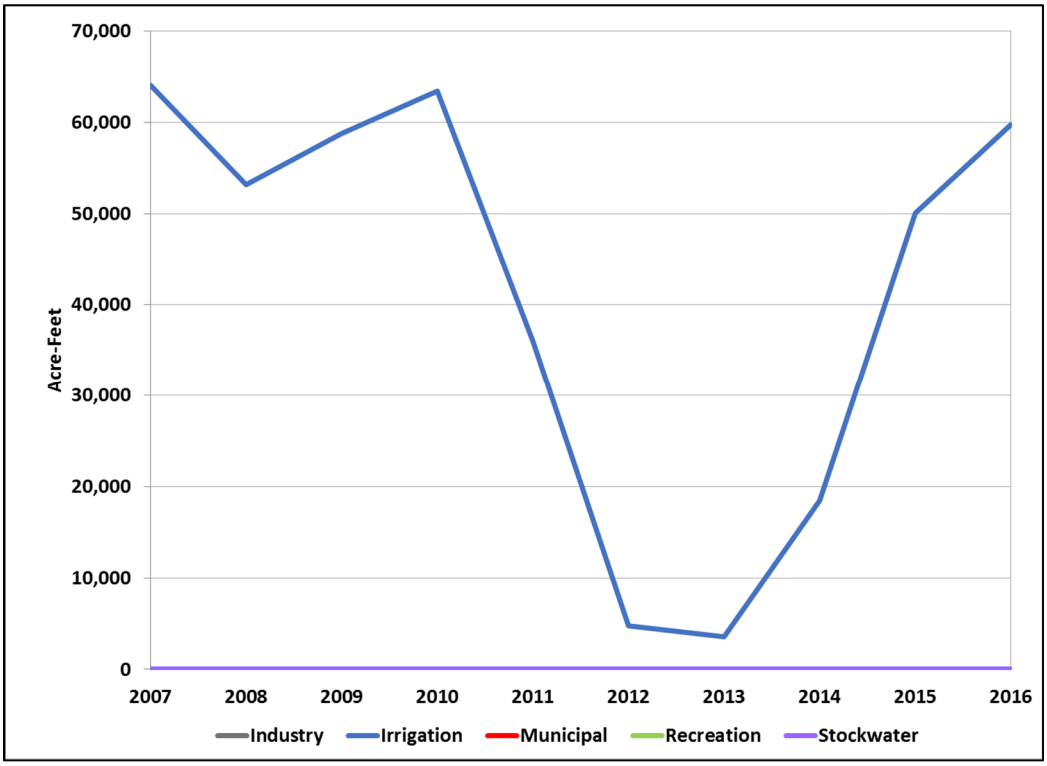


Figure 11: Annual surface water use by type of use

Surface water from the Arkansas River is diverted between the Colorado-Kansas state line and Garden City to six active Kansas irrigation ditches. This water is diverted under appropriated water rights, but no quantity is specified in the Compact. Instead, the Compact designates the Upper Arkansas Region 40% of the water stored in Colorado's John Martin Reservoir. The 1980 operating plan allows the Kansas irrigation ditches to call for water anytime, including during peak growing demand of summer crops.

Water Quality

Groundwater

Groundwater quality varies greatly throughout the region. Lower quality water of the Arkansas River is infiltrating the groundwater aquifer and degrading water quality conditions in areas where surface water has historically been used.

The movement of lower quality water is depicted in Figure 12, which shows the migration of lower quality water into areas of the Ogallala Aquifer. Figures 13-15 show the detected concentrations of uranium in public water supply wells within the region and Figures 16-18 show the concentrations of nitrates reported.

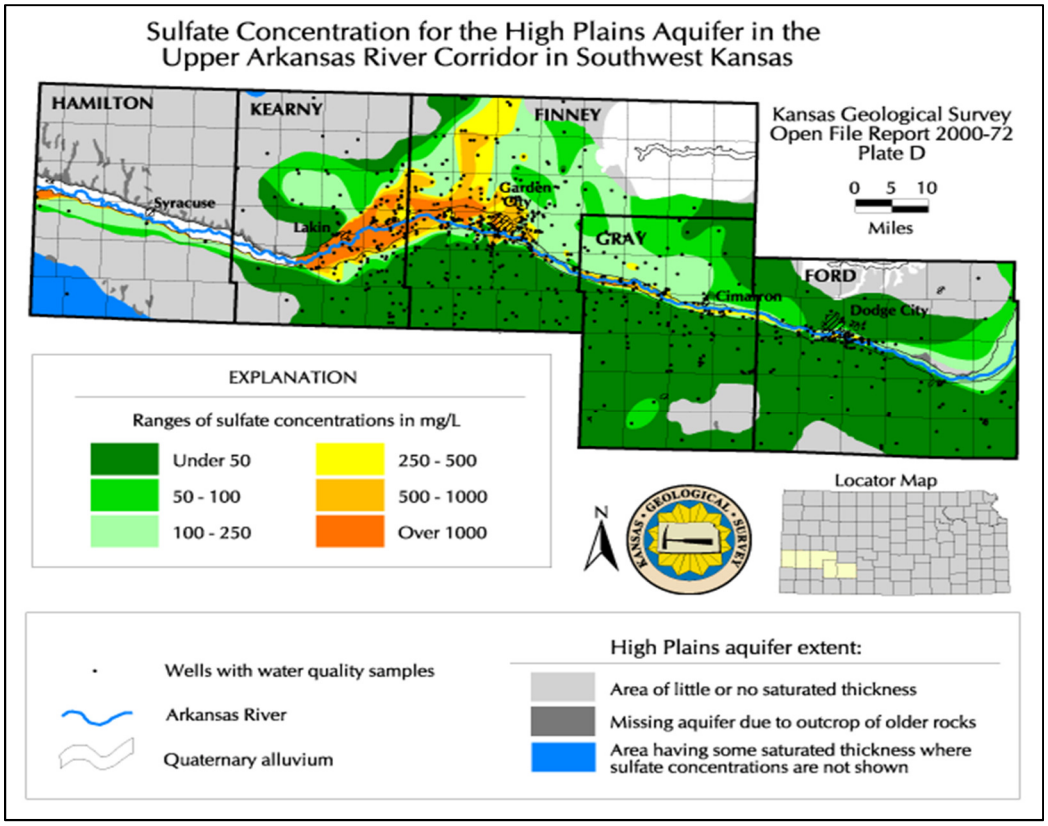


Figure 12: Spread of sulfate concentrations in High Plains Aquifer. From Kansas Geological Survey OFR 2000-72

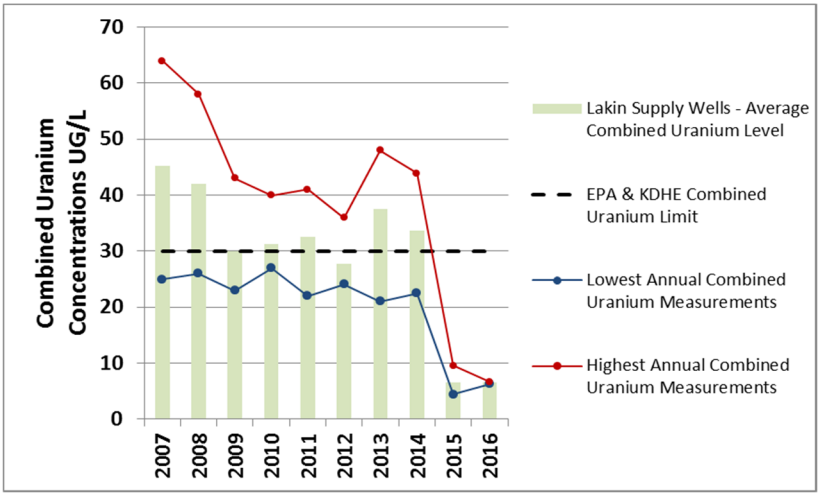


Figure 13: Uranium levels reported in City of Lakin public water supply wells. Data from KDHE Water Watch System

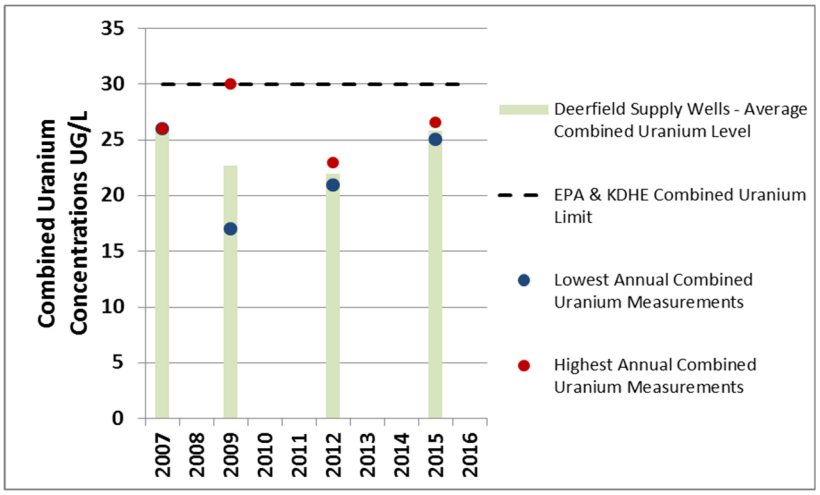


Figure 14: Uranium levels reported in City of Deerfield public water supply wells. Data from KDHE Water Watch System

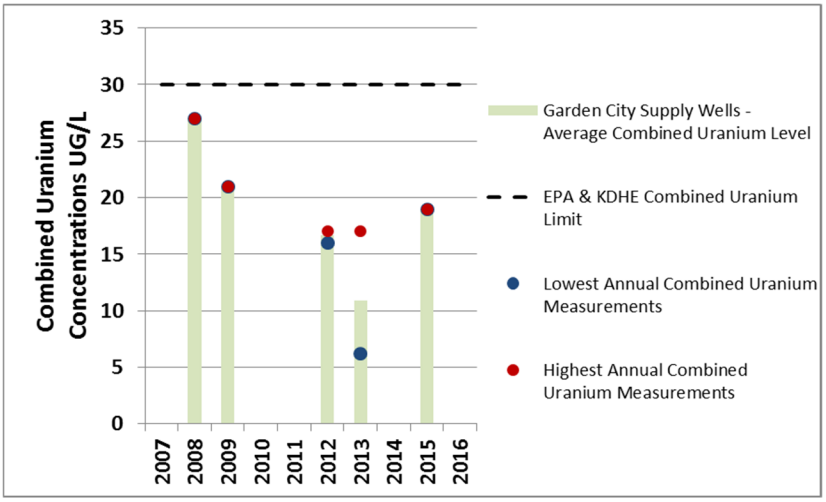


Figure 15: Uranium levels reported in City of Garden City public water supply wells. Data from KDHE Water Watch System

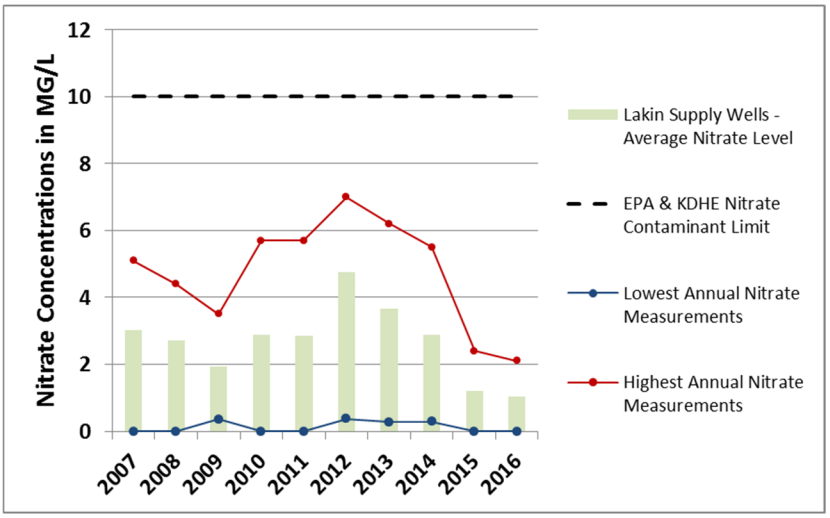


Figure 16: Nitrate levels reported in the City of Lakin public water supply wells. Data from KDHE Water Watch System

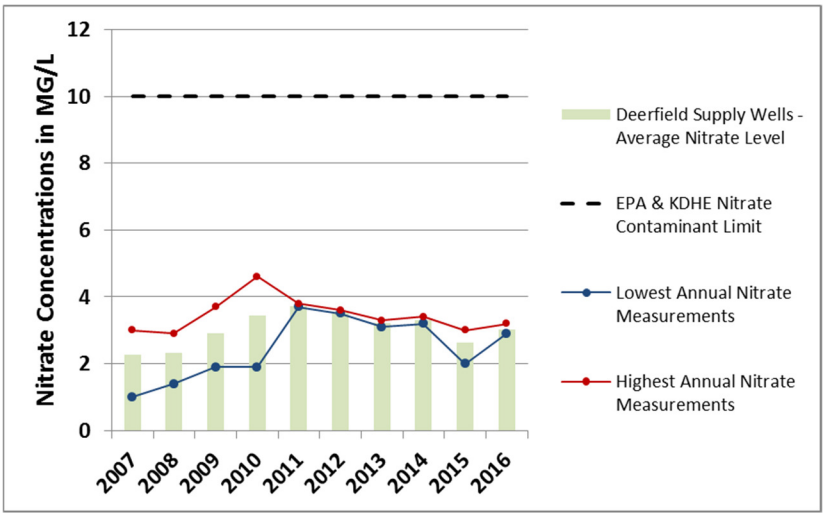


Figure 17: Nitrate levels reported in the City of Deerfield public water supply wells. Data from KDHE Water Watch System

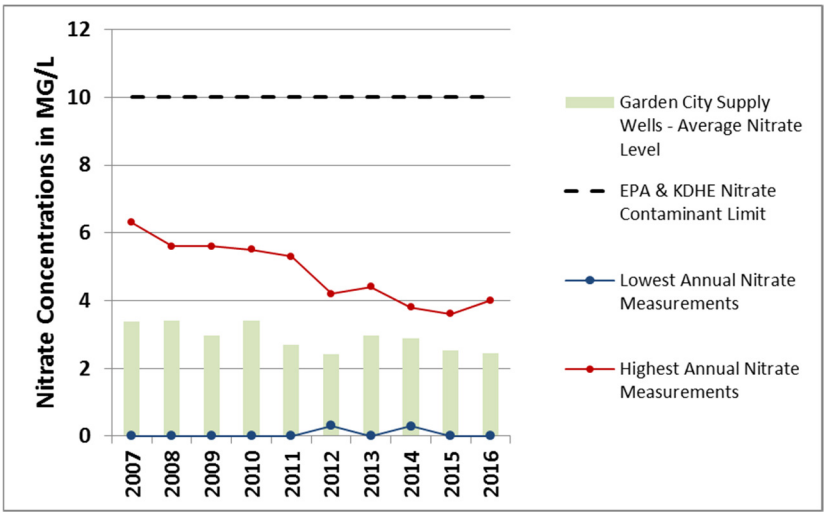


Figure 18: Nitrate levels reported in the Garden City public water supply wells. Data from KDHE Water Watch System

Surface Water

All the counties within the region have adopted and are enforcing sanitary codes to help manage bacteria and nutrient inputs into surface and groundwater. All conservation districts in the region have adopted nonpoint source pollution management plans.

The Clean Water Act requires states to conduct Total Maximum Daily Load (TMDL) studies and develop TMDLs for water bodies identified on the state's List of Impaired Waters (Section 303(d) List). TMDLs are quantitative objectives and strategies needed to achieve the state's surface water quality standards. In the Upper Arkansas Region, TMDLs have been developed to address gross alpha (bundled with uranium), chloride, eutrophication, dissolved oxygen, fluoride, E. coli, fecal coliform bacteria, aquatic plants, boron, siltation, pH, atrazine, copper, selenium, sulfate, total phosphorus, and total suspended solids. With 41 TMDLs in place, additional information on TMDLs and the Section 303(d) list of impaired waters can be found at the Kansas Department of Health and Environment website.

The Arkansas River is considered saline, with elevated total dissolved solids (TDS) especially sulfate, limiting the use of Arkansas River water. Currently TDS entering Kansas can exceed 4,000 mg/L, compared to the 1980s and 1990s concentrations ranging from 700 to 2,600 mg/L. In addition, selenium, uranium/gross alpha, boron, fluoride, and other components threaten the safety of the drinking water supply from the river.

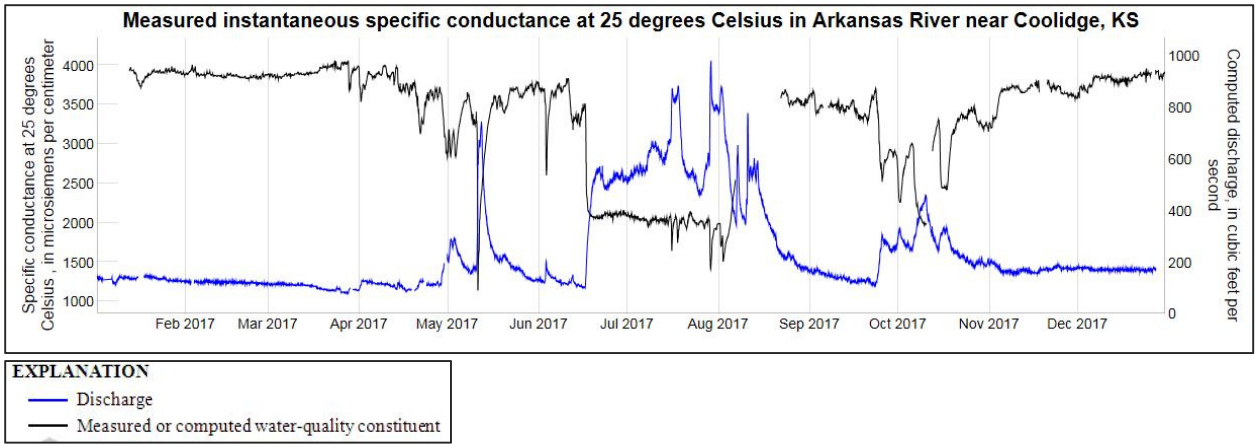


Figure 19: 2017 Arkansas River flow and specific conductance at Coolidge, the KS River gage near Colorado state line

The salinity enters the alluvial groundwater as river flows recharge the aquifer, degrading the alluvial supply and, when hydrologically connected, affects the High Plains Aquifer. Since groundwater is the source for drinking water in the region, this affects the safety of domestic wells and some of the public water supplies along the river.

Sediment and nutrient impairments are on record for parts of the region's surface waters, mostly focused on the Pawnee River and tributaries in the eastern part of the region. Sediment is also considered to impair some use for the Arkansas River in Hamilton and Kearny counties, and the Hamilton County State Fishing Lake and the Hamilton Wildlife Refuge.

Implementation Progress

Sustainability

Using water level and water use data, KGS scientists have developed a method to determine how much of a reduction in water use would be needed to achieve a specific decline rate or even stabilize water levels in the aquifer. Based on recent analyses, they assert this can be achieved with 25 to 45% reductions in most areas. The needed reduction depends on the specific area being considered.

The KGS has estimated for GMD3, a 31% reduction in average annual water use would have stabilized averaged water levels from 2005 to 2016. Aquifer conditions vary considerably across GMD3, so further work is needed to assess sustainability prospects at the scale of individual counties.

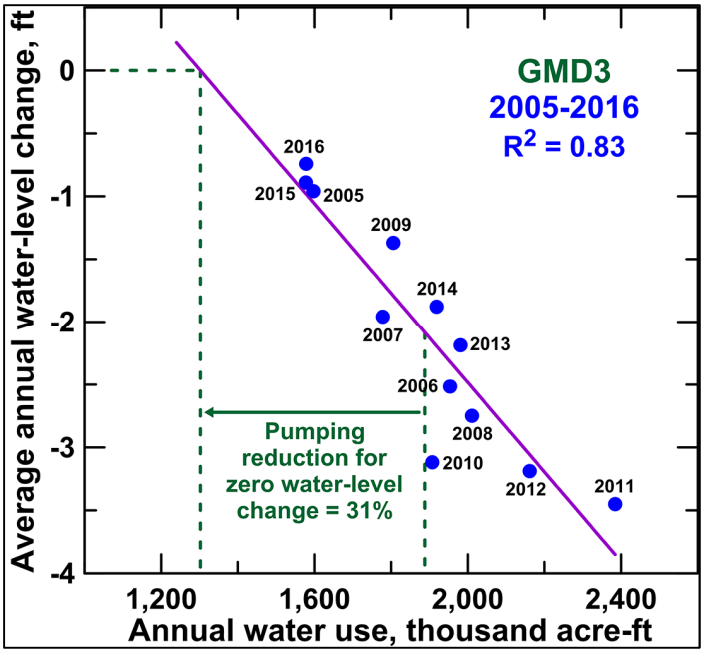


Figure 20: Data from KGS comparing water level change vs. annual water use to determine the pumping reduction needed in GMD3 to reach zero water level change

Water Conservation Areas

Water Conservation Areas (WCAs) were signed into law in April 2015 and are a simple and flexible tool that allows any water right owner or group of owners the opportunity to develop a management plan to reduce withdrawals in an effort to extend the usable life of the Ogallala-High Plains Aquifer.

Eight WCA plans have been adopted by landowners as voluntary water conservation measures; with two additional plans pending approval. These WCAs cover 15,762 acres of the 833,781 irrigated acres in the region, equating to 1.9% of the average total of irrigated acres (Figure 21).

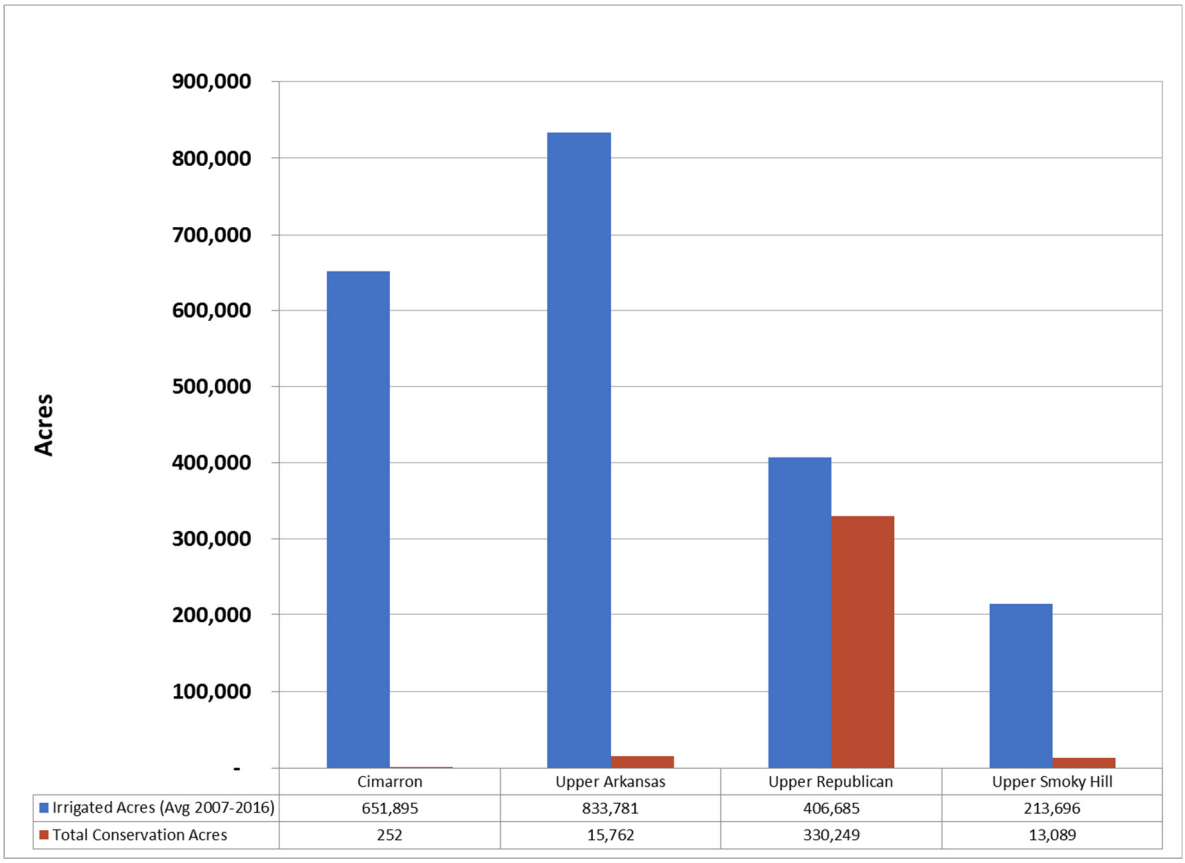


Figure 21: Total conservation acres compared to irrigated acres in the four western RACs

Water Technology Farms

Water Technology Farms (Tech Farms) are a Phase II action item from the Ogallala-High Plains Aquifer section of *The Vision*. These demonstration projects allow irrigation technology options to be implemented and tested on a field scale with the oversight of Kansas State University Southwest Extension personnel. Three Tech Farms are established within the region, with two farms enrolled in a WCA plan designed by their landowners.

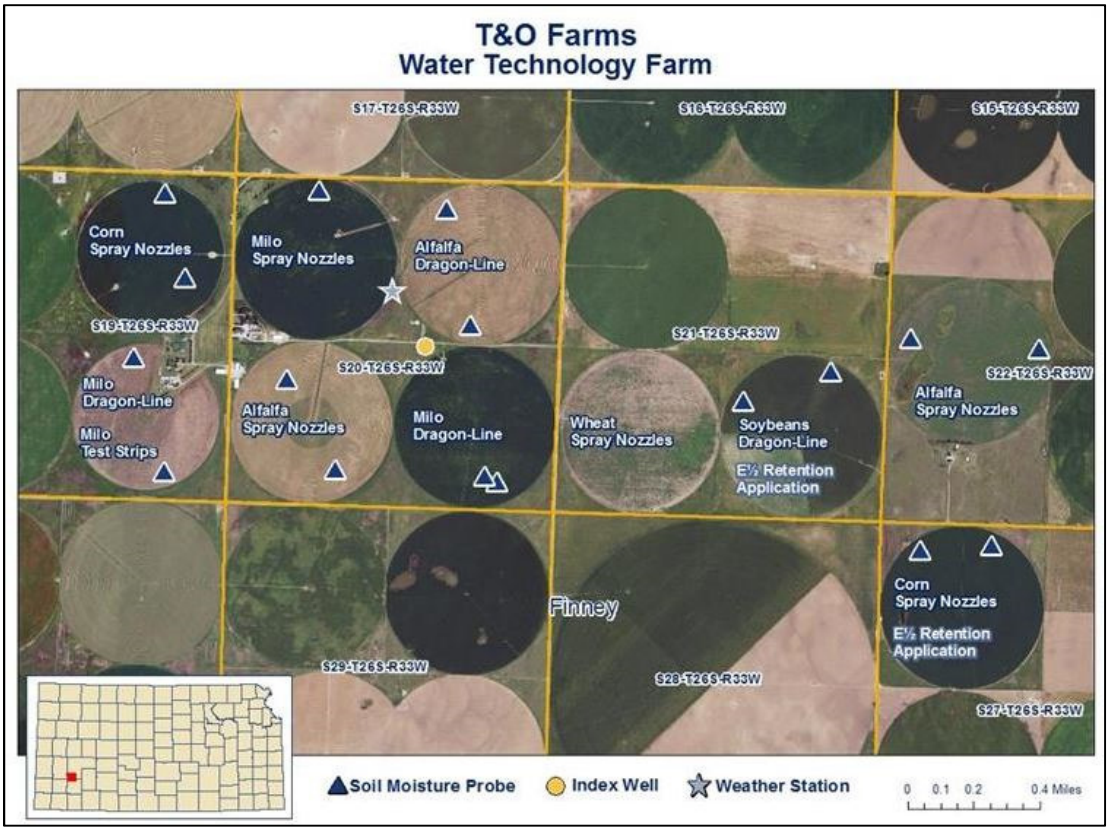


Figure 22: T&O Farms Water Technology Farm layout

On the T&O Farms Tech Farm, different types of soil moisture probes are being utilized and compared on 10 fields being irrigated with center pivot systems. Spray nozzles and mobile drip irrigation are being compared on adjacent irrigation center pivots, with multiple crops. A weather station has been installed; seeding rates and polyacrylamide application are also being tested. The KGS has installed an index well, which provides real time monitoring of the local aquifer conditions and its response to water conservation activities in the area.

At the Roth/Garden City Company Tech Farm, there are side-by-side assessments of mobile drip irrigation, bubbler nozzles and iWob nozzles. This farm is also demonstrating the capabilities of soil moisture probes in making efficient irrigation management decisions. The farm has had soil and aerial mapping conducted, which allows the field's variable soil types to be considered and variable rate irrigation implemented. In 2017, one field had a yield of 241 bushels of corn per acre using only 5.78" of irrigation water and another field with a yield of 227 bushels of corn per acre using 6.2" of water. With this reduction in water use, the producer saw a reduction of input costs and realized a greater profit for the operation. It should be noted there was higher than average precipitation in 2017 for Finney County, with 21.65" of precipitation officially recorded compared to the historic yearly average of 19.76".

The Harshberger Farm is the newest Tech Farm in the region, having been established in 2018. This farm located south of Dodge City utilizes soil moisture probes for irrigation management and mobile drip irrigation.

Limited Irrigation Crop Insurance

A Phase I Statewide Action Item in *The Vision* includes working with the United States Department of Agriculture's Risk Management Agency (USDA-RMA) to address crop insurance policies that disincentive water conservation. Working with the USDA-RMA, limited irrigation crop insurance coverage was expanded to 47 counties for corn and 28 counties for soybeans in Kansas, making Kansas the first and only state in the nation with a limited irrigation crop insurance option available to mitigate risk for those wishing to implement water conservation practices and reduce their historical water use. In September 2016, the Kansas Water Office (KWO) was awarded a USDA-RMA Education Partnerships Program grant to build a limited irrigation crop insurance calculator and hold public awareness educational events.

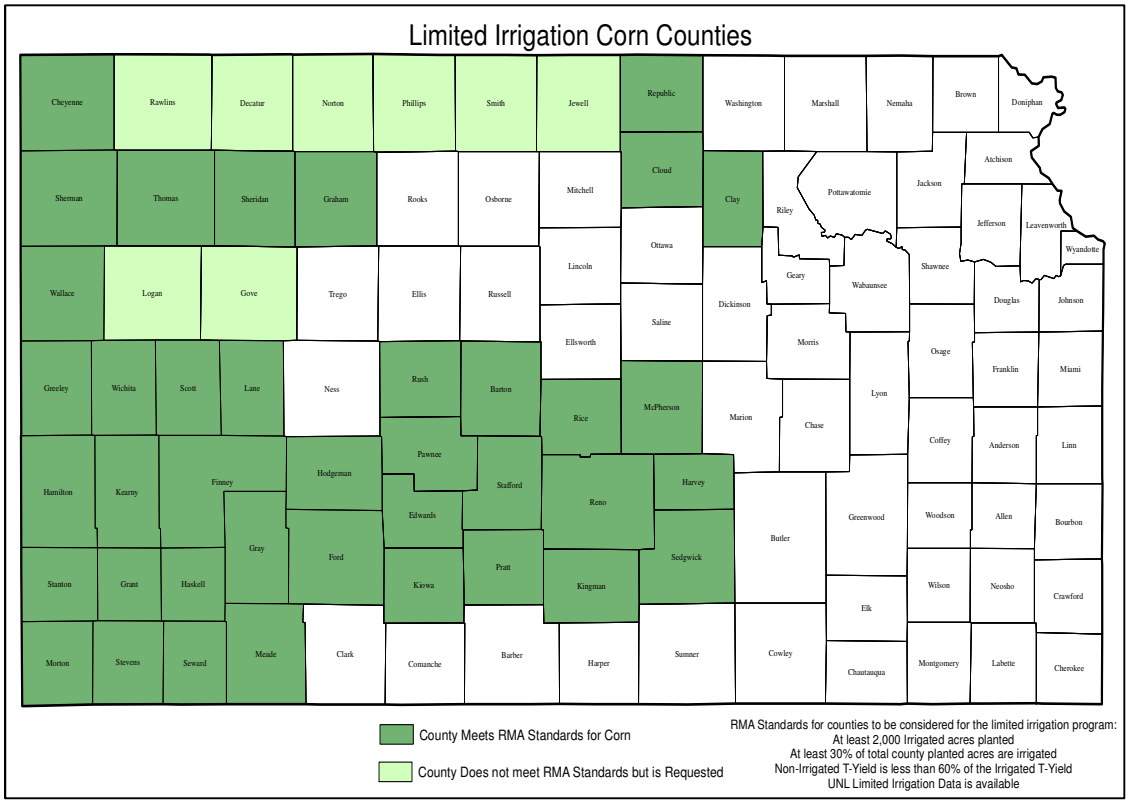


Figure 23: Counties where limited irrigation insurance is available for corn

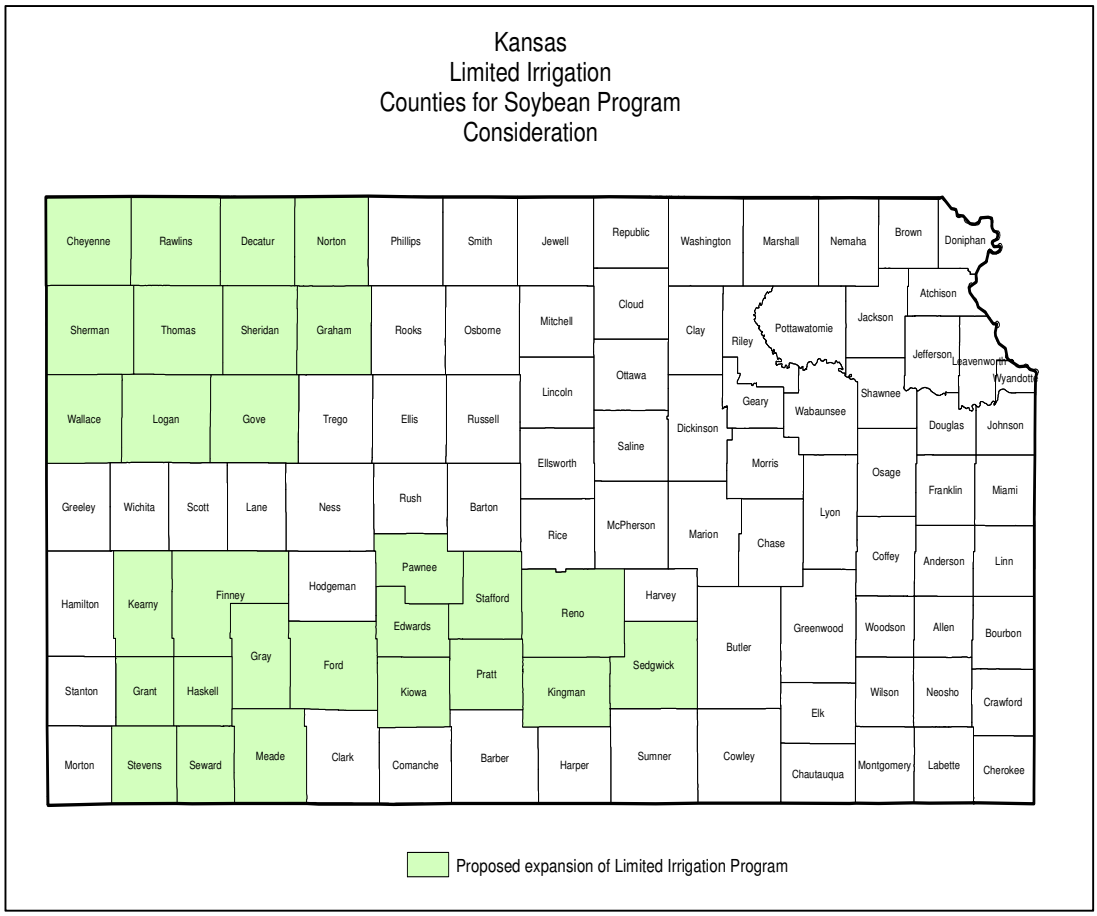


Figure 24: Counties where limited irrigation insurance is available for soybeans

Conservation Incentives

The State of Kansas worked with the United States Department of Agriculture's Natural Resources Conservation Service (USDA NRCS) in 2017 to revise the ranking criteria within the Environmental Quality Incentives Program (EQIP) to further incentivize water conservation within the state. Starting in 2018, EQIP applications located within a LEMA, WCA, or Intensive Groundwater Use Control Area (IGUCA) shall be designated as high priority applications. Producers will have to show there will be a net water savings from the previous five years of water use.

In 2015, the GMD3 was awarded a $2.4 million dollar Regional Conservation Partnership Program (RCPP) grant from the USDA NRCS to help incentivize Advanced Irrigation Water Management across the region. The grant can be used to partially cover the cost of soil moisture probes, telemetry enabled flowmeters, and other irrigation technologies. There have been four contracts signed under the grant program for 2016 and 2017, totaling $81,633 of incentive payments to landowners within the Upper Arkansas Region (Figures 25 and 26).

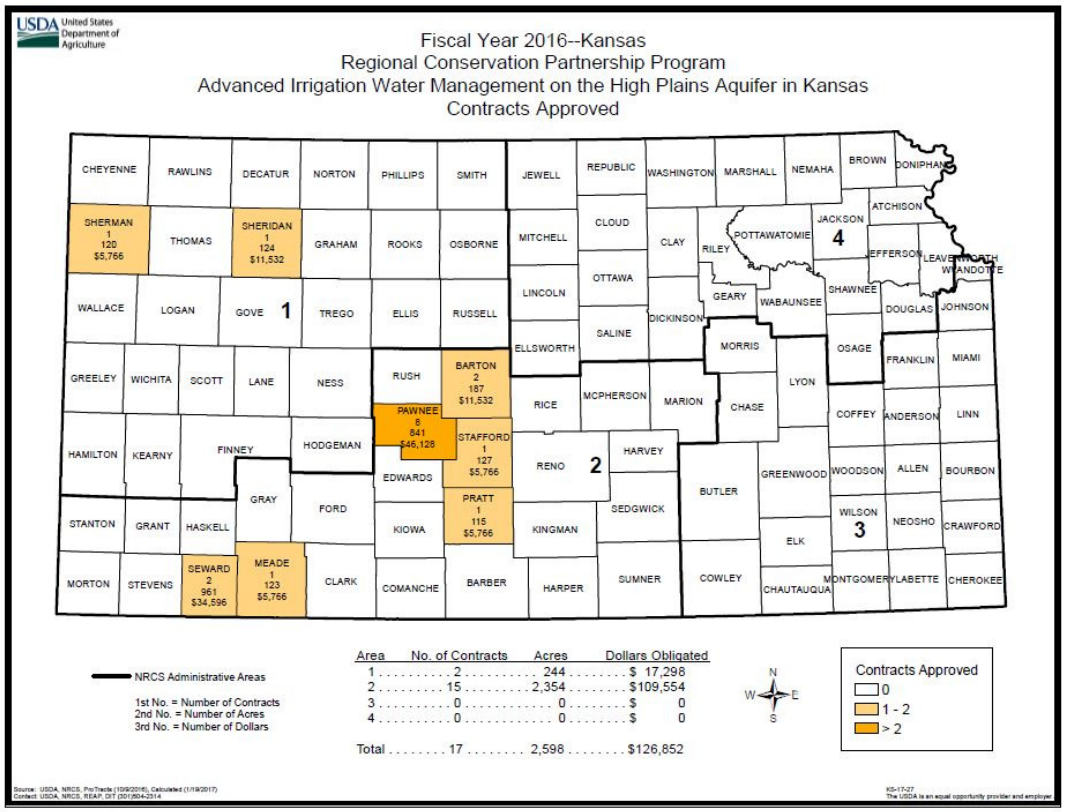


Figure 25: RCPP Advanced Irrigation Water Management contracts approved for 2016

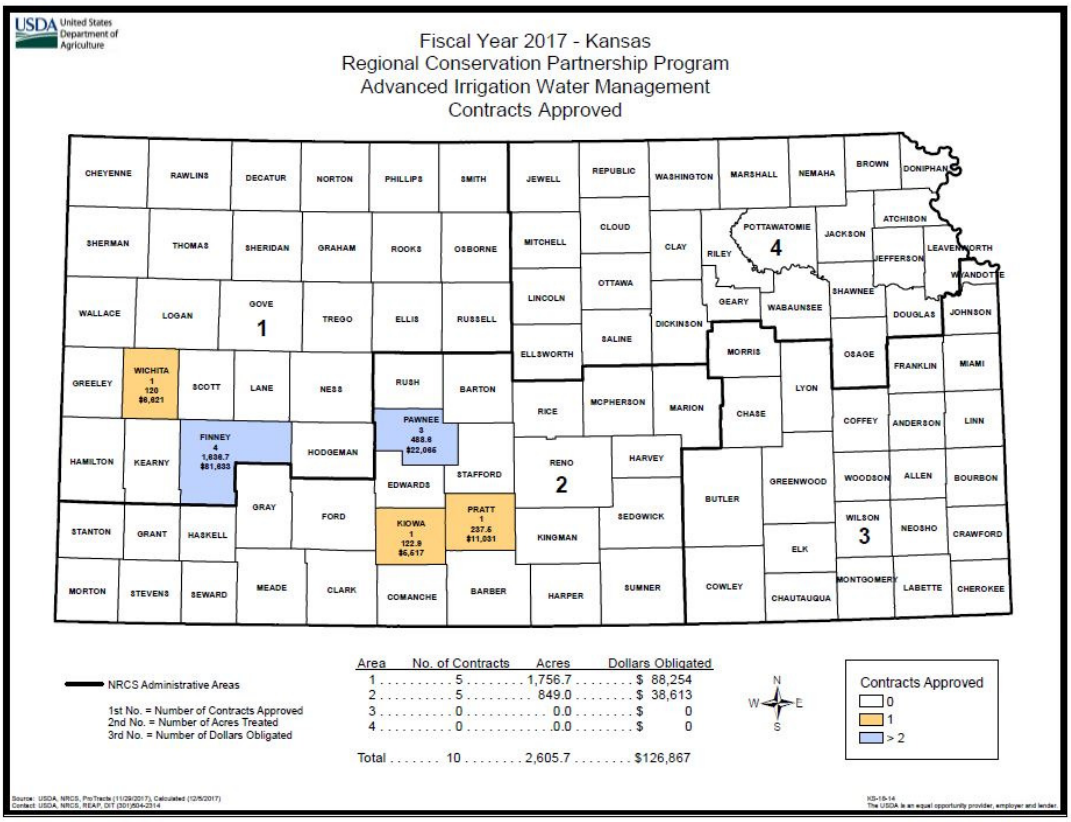


Figure 26: RCPP Advanced Irrigation Water Management contracts approved for 2017

The Upper Arkansas Conservation Reserve Enhancement Program (CREP), which includes the Arkansas River corridor in Hamilton, Kearny, Finney, Gray, and Ford counties, offers federal or state assistance to retire eligible water rights in portions of the region. Within this region, the Upper Arkansas CREP recorded the enrollment of 150.5 acres from Finney County in 2017. A total of 18,051.4 acres and 37,113 AF of authorized quantity have been retired in the region since enrollment began in 2007.

Table 2: Enrollment in CREP in Upper Arkansas Region (FY2017 Annual Report-Upper Arkansas CREP)

County	2007 – 2008	2008 – 2009	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014	2014 – 2015	2015 – 2016	2016 – 2017	Total Acres Approved
Hamilton									242.9		242.9
Kearny	4,203.8	605.0	251.9		1,520.0			162.9	610.2		7,353.8
Finney	129.4	574.2	76.5		1,338.6			412.7	475.9	150.5	3,157.8
Gray	2,677.8	723.5	1,318.6	247.1	1,087.4	673.9		613.8			7,296.9*
Ford											0
TOTAL	7,011.0	1,902.7	1,647.0	247.1	3,946.0	673.9	0	1,189.4	1,329.0	150.5	18,051.4*

*These figures adjusted by -45.2 acres from 2016 to match & reflect FSA records

Education and Information

Following the creation of the action plans, one of the Upper Arkansas RACs needs was to communicate the goals for the region to the public and stakeholders. In February 2017, the first Water Talk Series meeting was in Garden City, Kansas. The event was supported by the USDA-RMA Education Partnerships Program grant and was an opportunity to communicate with stakeholders the newly available USDA-RMA limited irrigation crop insurance option, while also communicating information on the region's approved goals, water conditions, conservation programs available, the economic impacts of water conservation, and the conclusion of the area's recent water right impairment court case.

Tech Farms were hosts to field demonstration days conducted within the region, with multiple irrigation technology companies participating and sharing information on their products with local producers. At these field days, area water users are able to discuss how new irrigation technologies can be used to maintain economic levels of production while reducing water use.

The first Winter Water Technology Expo was held in January 2018 in Garden City, with more than 200 attendees and sponsorships from industry and producer groups.

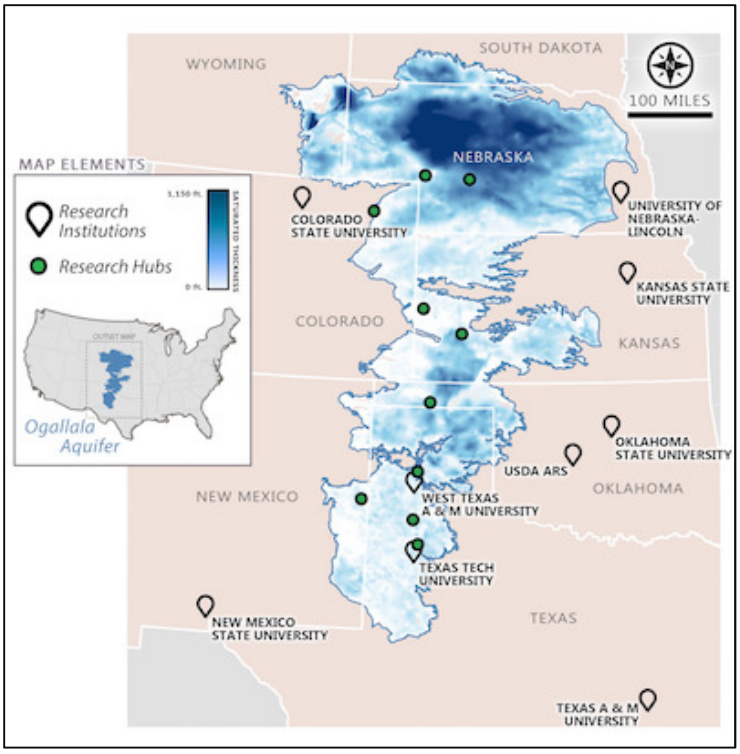


Figure 27: Locations of the OWCAP's research team

In April 2018, the first Ogallala Aquifer Summit was held in Garden City with over 200 participants from all eight states overlying the Ogallala Aquifer. The Summit was organized as a part of The Ogallala Water Coordinated Agriculture Project (OWCAP). This project, funded by the United States Department of Agriculture–National Institute of Food and Agriculture, focuses on addressing issues related to groundwater decline and long-term agricultural sustainability through multidisciplinary research and outreach in the High Plains Region (Figure 27). The summit worked towards *The Vision* goal of improving interstate cooperation through the sharing of programs, current initiatives, ideas and perspectives while focusing on cooperative efforts to face similar challenges with common goals across the states.

A Water Conservation Field Day was held in Garden City in April 2018. The field day highlighted projects and conservation efforts taking place in Garden City to reduce water use and increase awareness and education. Topics included regional goals and focus, water use comparison reports, the installation of sub-surface drip irrigation on a city baseball field, and a feasibility study on the treatment and reuse of wastewater.

Implementation Needs

The largest implementation need is an aquifer status evaluation. In order to reevaluate the aquifer and its anticipated usable lifetime and economic stability in the region, continuous monitoring of water use and water levels is needed. Evaluation and quantification of water use reductions, as well as their effects on the aquifer, is needed to enable informed management decisions by producers and other water users. This would include the following:

- Continuation of the Ogallala-High Plains Aquifer Assessment Program to provide data, research, and technical support for assessment, planning, and management of the groundwater resources of western Kansas
- Use of the KGS tool for potential LEMAs and WCAs groups to quickly assess how much reduction in water-level declines will be achieved by a given reduction in pumping
- Continuation and expansion of the Index Well Program to interpret water-level responses at the section to township scale and provide the detailed information to reliably assess aquifer responses throughout the growing season and what the future holds for the High Plains Aquifer in western and south-central Kansas
- Continuation of Groundwater Modeling to keep models current and assess the aquifer response to various proposed future pumping and climatic conditions

Another large implementation need is water use efficiency improvement. Financial and technological support for voluntary incentive programs to reduce water use are key to producer adoption of water management and water conservation techniques to aid in reducing the pumping from the aquifer while maintaining economically healthy producer and local economies.

A final implementation need is for education and information. Demonstrations, evaluation of technologies, evaluation of water management techniques and tools must be disseminated to producers and others. Understanding of the appropriate tools is needed to encourage adoption of water saving tools by more producers. Continued support of water technology farms and associated study is one such activity.

Some implementation needs recently identified are to develop a communications plan for the region, so users of water within the region have a good source of pertinent information and are aware of water events, programs, and the work of the RAC. Some examples include conducting a review the City of Garden City's water reuse initiatives and evaluating how water reuse efforts could be expanded to other uses and users of water in the region, and to actively seek partnerships to find additional sources of water, places to store water, and aquifer recharge opportunities.

Regional Goals & Action Plan Progress

While *The Vision* provides a framework for the management of the state's water supply overall, regional goals identify and address issues at the local level. In 2015, Regional Goal Leadership Teams were developed for each of the 14 regional planning areas which were comprised of local water users along with input from area stakeholders to help develop regional water supply goals. These goals were adopted by the Kansas Water Authority in August 2015 and 14 RAC members were appointed. The first task for the newly formed RACs was to develop action plans to correspond with the regional goals. The Upper Arkansas RAC completed action plans for their regional goals in the fall of 2016. Information included within this section highlights recent progress made on regional goal action plan implementation.

Regional Goal #1	Goal Theme	Annual Progress			
		2017	2018	2019	2020
Extend the usable lifetime of the Ogallala Aquifer for at least 25 years in the planning region through the promotion of multiple Local Enhanced Management Areas (LEMAs), Water Conservation Areas (WCAs) and other incentive-based programs. Slow the depletion of the Ogallala Aquifer by 25% in 10 years in the planning region maximizing the opportunity to make use of emerging technologies. Encourage conservation through added flexibility. Find additional sources of water and a place to store water for irrigation and recharge. Increase the opportunity to use wastewater for other beneficial uses. Increase education of aquifer conditions.	Aquifer Sustainability			--	--

Progress Legend	Not Started	In Progress	Delayed	Cannot Complete	Complete

2018 Update:

- Two new WCA Plans in the region pending approval

Next Step(s):

- Continue to support development of LEMAs and WCAs plans within the region
- Continue to search for financial support to hold demonstration projects, outreach events, and incentivize conservation.

Regional Goal #2	Goal Theme	Annual Progress			
		2017	2018	2019	2020
By 2020, continue to re-establish and maintain flows along the Upper Arkansas River in the amount of one cubic feet per second at the USGS gage located at Dodge City for 100% of Kansas' share of compact water and a	Water Conservation			--	--

quantified share of high flows that is currently stored in Colorado that is over and above the compact amount through management of river flows and maintenance of open channel conveyance through 100% of tamarisk control. Ensure we maintain compact compliance and enforce the compact when necessary.					
Progress Legend	Not Started	In Progress	Delayed	Cannot Complete	Complete

2018 Update: No progress to report.

Next Step(s):

- Support funding of interstate Compact Compliance position at Garden City Division of Water Resources office
- Kansas Forest Service revising Tamarisk control plan, funding will be required to implement the proposed corrective controls of plan

Regional Goal #3 & #4	Goal Theme	Annual Progress			
		2017	2018	2019	2020
Maximize available water and promote conservation of municipal use through incentives, education and outreach, reduced water loss, and increased data availability to reduce gallons per capita per day usage. Maximize available water and promote conservation of industrial use through incentives, education and outreach, benchmarking efforts, and increased data availability to reduce gallons per production unit usage.	Water Conservation			--	--
Progress Legend	Not Started	In Progress	Delayed	Cannot Complete	Complete

2018 Update:

- Garden City Water Conservation Field Day held
- RAC Member outreach to industries with high water use in the region

Next Step(s):

- Increase education initiatives to cover various water user groups on the region's water situation
- Hold State of the Resource public outreach events
- Work with regional public water suppliers to identify water losses and water quality concerns

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