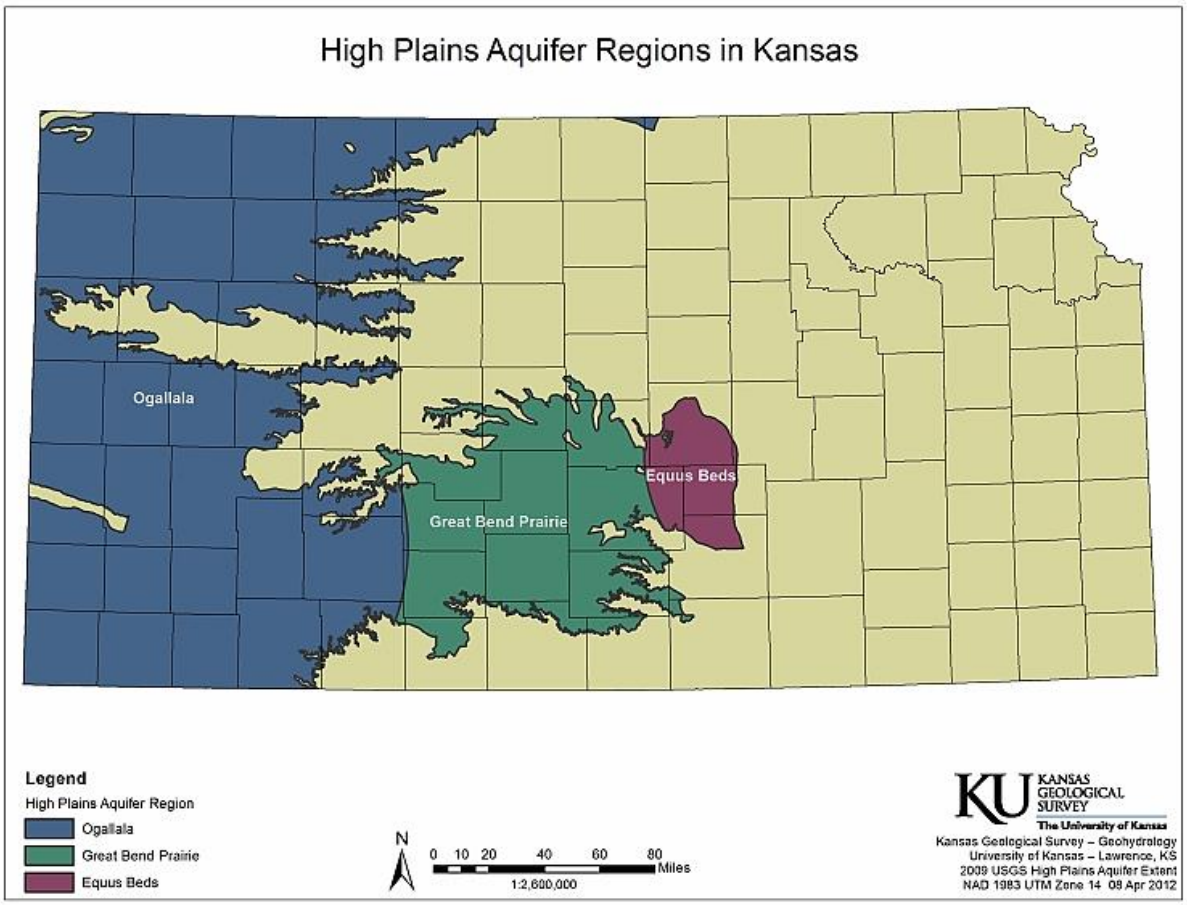
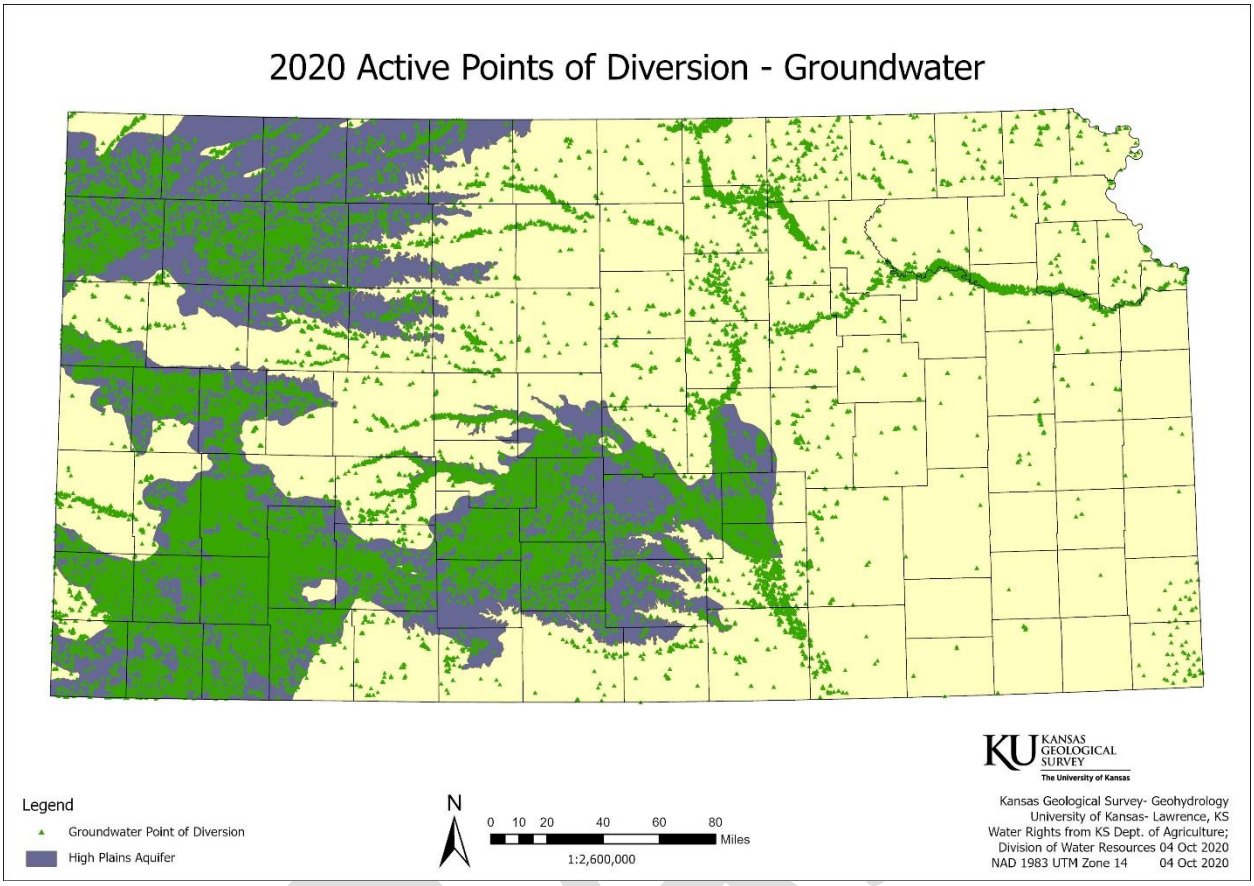
Conserving & Extending the High Plains Aquifer

Background & Issue

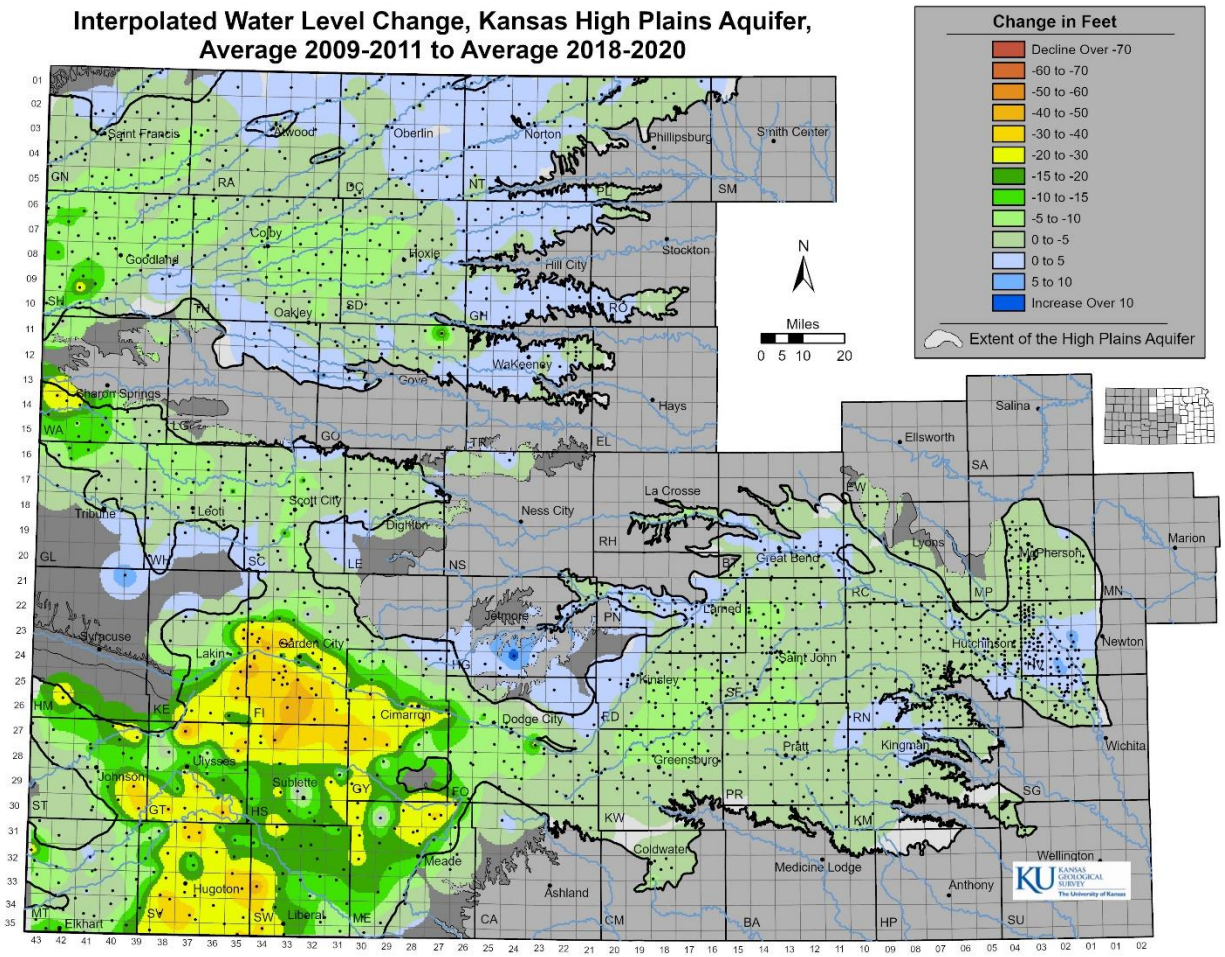
The High Plains Aquifer (HPA) is the largest, most economically important groundwater source in Kansas. It underlies western and south-central Kansas and is composed of several hydraulically connected aquifers. The Ogallala, which is the largest of these, occurs in the western third of Kansas, an area that is semi-arid with limited surface water. The eastern extension of the High Plains Aquifer is composed of younger sediments that make up the Great Bend Prairie and Equus Beds aquifers. Lying above the Ogallala Formation are Pleistocene and younger stream valley deposits that bear water; where these are connected to the underlying aquifer, they are considered part of the High Plains aquifer.



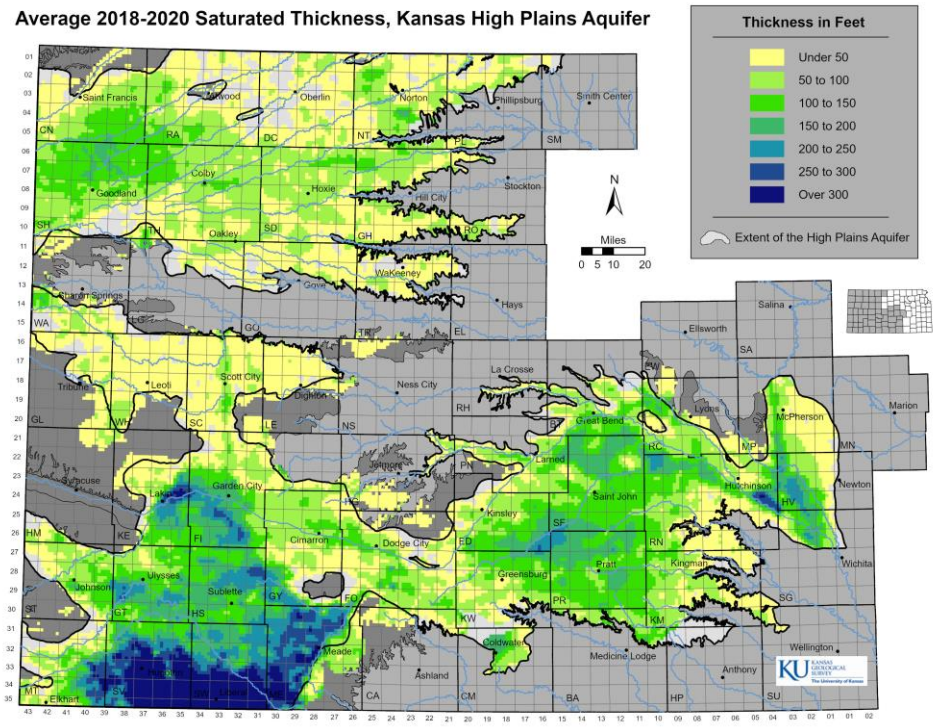
In western and south-central Kansas, groundwater has historically been the most reliable source of large volumes of water for irrigation, municipal, and industrial use. To date, there have been over 50,000 water rights approved in all of Kansas with a majority of those approved for groundwater use in the HPA.



The total irrigated acres in the HPA are estimated to have been around 2.3 million acres in 2019. Corn has been the most commonly grown crop in recent years. Given that corn may need up to 2 acre-foot per acre per year, the HPA region may require up to 5.58 million acre-feet of water per year to grow corn and other crops. Although this total includes contribution from precipitation and some surface water, groundwater from the HPA will be a very significant contributor.



When pumping demands exceed the amount of water that recharges an aquifer, groundwater declines occur. In the Kansas HPA, the saturated thickness and rates of groundwater decline are highly variable. While some areas of the aquifer have effectively been depleted, other areas have substantial volumes of water still in storage. The Ogallala portion of the High Plains aquifer with its greater depths to water, lower precipitation, and lower recharge rates typically has higher groundwater declines relative to south-central Kansas. The rate of water-level decline typically ranges from only a few inches to several feet per year. During drought conditions, rates of decline can be as much as 15+ feet per year. Under current pumping demands, many areas of the aquifer have already experienced, or are projected within the next decade, significant reductions in well yields.


Average 2018-2020 Saturated Thickness, Kansas High Plains Aquifer
Thickness in Feet
Under 50
50 to 100
100 to 150
150 to 200
200 to 250
250 to 300
Over 300
Extent of the High Plains Aquifer
N
Miles
0 5 10 20
Saint Francis
Atwood
Oberlin
Norton
Phillipsburg
Smith Center
Colby
Goodland
Hoxie
Hill City
Stockton
Oakley
WaKeeney
Hays
Ellsworth
Salina
Tribune
Leoti
Scott City
Dighton
Ness City
La Crosse
Great Bend
Lyons
McPherson
Marion
Larned
Hutchinson
Newton
Garden City
Lakin
Kinsley
Saint John
Cimarron
Dodge City
Greensburg
Pratt
Kingman
Wichita
Johnson
Ulysses
Sublette
Meade
Ashland
Coldwater
Medicine Lodge
Anthony
Wellington
Elkhart
Hugoton
Liberal
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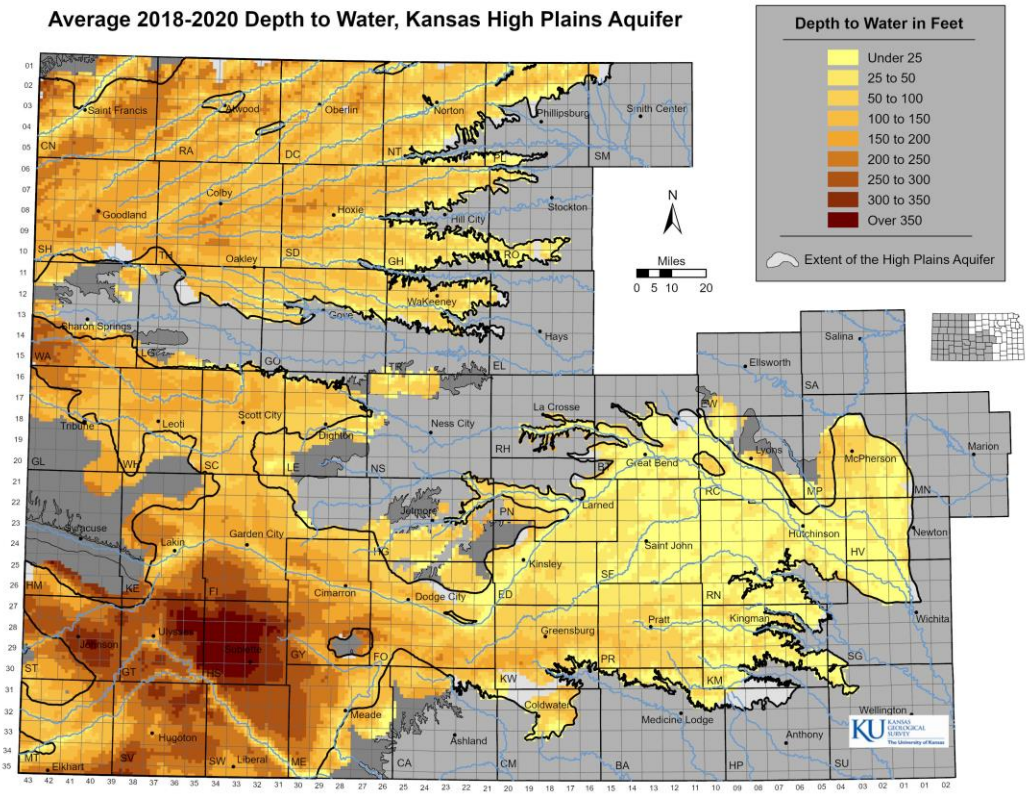
Average 2018-2020 Depth to Water, Kansas High Plains Aquifer
Depth to Water in Feet
Under 25
25 to 50
50 to 100
100 to 150
150 to 200
200 to 250
250 to 300
300 to 350
Over 350
Extent of the High Plains Aquifer
N
Miles
0 5 10 20
Saint Francis
Atwood
Oberlin
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The HPA supports an extensive agricultural complex including irrigated crops, a large cattle and dairy industry, meat packing plants, and biofuel plants in Kansas. Research has shown that the value of water, as measured in revenue generated, continues to increase for irrigated crops with more efficient crop water management, higher yielding crops, and higher prices. A separate economic study completed in 2013 by the Kansas Department of Agriculture showed that the statewide revenue for irrigated and dryland corn was 513 million and 43 million dollars, respectively. Clearly, water resources are an important linchpin of the local and statewide economy. Thus, we should all strive to ensure that groundwater and surface water will be available for future generations of Kansans.

As the population continues to grow, there is a need for more crops, cattle, and energy. Each of these needs requires water for production. With the finite amount of water available in Kansas, we must strive to make every drop count and learn ways to make less water go further. The conservation efforts listed below are being utilized within the state to help conserve water and other resources. The state vision is to Conserve and Extend the High Plains aquifer for generations to come.

Management Approach

The High Plains aquifer is essential to the economy and environment, as well as the well-being of our citizenry. A variety of local, state, and federal groups and agencies work together to help implement water conservation efforts within the region with the commitment to make every drop count. Local Groundwater Management Districts (GMDs), along with state and federal agencies like KWO, KDA-DWR, KDA-DOC, KDHE, KGS, K-State Research and Extension, USDA-NRCS, USDA-FSA, and Conservation District offices provide assistance to producers within the region through cost-share and incentives programs, conservation and environment programs, and education and outreach. New water appropriations are closed across most of the region by order of either the Chief Engineer or local GMDs, or are effectively closed through safe yield rules and regulations. Water rights owners adhere to a seniority system with "first in time, first in right" when it comes to water right disputes. It is through the willingness of water right owners in the region, who recognized the need for change, that so many of the conservation efforts being made have had positive impacts to the aquifer.

The Mission from the *Vision for the Future of Water Supply in Kansas*, "Provide Kansans with the framework, policy and tools, developed in concert with stakeholders, to manage, secure and protect a reliable, long-term statewide water supply while balancing conservation with economic growth", describes the goal of the management approaches that are being implemented. The four guiding principles that helped to direct the development of the state Vision document are listed below. These principles will continue to guide the implementation and development of all future management approaches.

- Locally driven solutions have the highest opportunity for long term success. Therefore, the intentional focus of the action items presented in the Vision are to provide the necessary tools and support to allow for greater flexibility and management of water resources at the local level.

- Policies and programs should not unintentionally penalize those who have already demonstrated good stewardship with the state's water resources.
- Voluntary, incentive and market-based water conservation and land management activities are the preferred tools for ensuring a reliable statewide water supply.
- Action is necessary now to ensure a reliable supply into the future.

The conservation efforts listed in the following table are some of the efforts currently being utilized within the state of Kansas to help conserve water and other resources.

Regional Conservation Efforts		
Cost-Share & Incentives	Water Transition Assistance Program (WTAP)	A program offered by KDA-DOC that pays water right owners in targeted areas that are closed to new water rights appropriations, to permanently dismiss all or a portion of their active water right(s). (Click here for more information)
	Conservation Reserve Enhancement Program (CREP) – Kansas Upper Arkansas River	USDA-FSA offers a program to producers in the Upper Arkansas River counties in Kansas that pays irrigators to permanently transition acreage out of irrigated production and into grasslands or other conservation practices. (Click here for more information)
	Water Banking	A market-based program currently in south central Kansas that provides water conservation measures and allows the movement of water right allocations to areas of need within the same sub-basin, through long term leases of water rights. (Click here for more information)
	Irrigation Technology Initiative	KDA-DOC offers cost-share funds to assist landowners with irrigation efficiency technology. This initiative is designed to promote irrigation efficiency and water conservation by providing cost-share assistance to landowners for automated soil moisture probes. (Click here for more information)
	Environmental Quality Incentives Program (EQIP)	USDA-NRCS program that provides financial and technical assistance to producers to implement water conservation practices. (Click here for more information)
Conservation & Environment	Regional Advisory Group (RAC)	Regional planning committees were established by KWA to focus on priority goals for the region and develop an action plan to help address water concerns and other issues within their region. (Click here for more information)
	Local Enhanced Management Area (LEMA)	A program that allows a Groundwater Management District (GMD) to take action to conserve water usage in portions or all of their district. If recommended by the

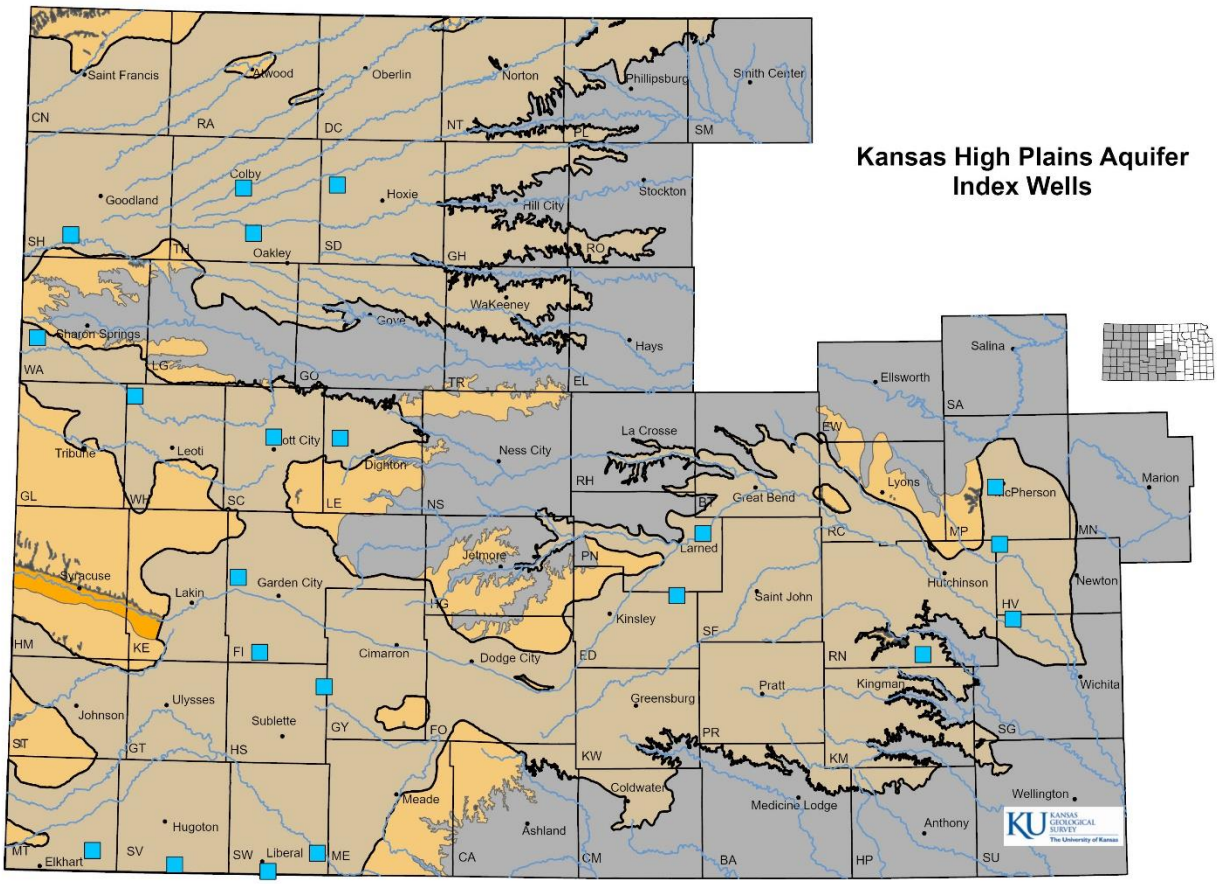
		GMD and ordered by the Chief Engineer, the conservation measures temporarily override the appropriated water rights in the region. A LEMA has the potential to be highly effective due to local commitments and changes in farming practices. (Click here for more information)
	Water Conservation Areas (WCA)	A program offered by KDA-DWR that allows individual farms the flexibility of their water right(s) on their land for a limited time period, as long as they officially agree to reduce water use during that period. (Click here for more information)
Education & Outreach	K-State Research and Extension	Offers information and guidance through their Mobile Irrigation Lab, KanSched, and Crop Water Allocator that help producers make the most efficient, economic use of their crop water. Also are looking into more water tolerant crops and are experimenting with multiple crop varieties in order to learn what works best in different climates and if any new crop variety can be obtained for further water conservation. (Click here for more information)
	Water Technology Farms	Kansas Water Office (KWO) offers producers free enrollment into the program to help demonstrate and educate other producers on the benefits of utilizing new irrigation technologies, practices, and services. (Click here for more information)
	HPA Index Well Network	A Kansas Geological Survey (KGS) program that is focused on developing an improved understanding of aquifer dynamics at scales appropriate for management. The program has a monitoring network of 25+ wells with much of the data being presented in real-time on the KGS website to allow Kansans to understand conditions in the HPA in their area. An additional goal is to directly examine issues and areas of particular interest to the GMDs and KDA-DWR. (Click here for more information)

Measuring Success

Much of the Ogallala portion of the High Plains aquifer has been heavily depleted since predevelopment. Projections in some areas, such as portions of Haskell County, show no more than 20 years of available water remaining if pumping continues at current rates. Other areas in west central Kansas have already reached the point of no return where many acres of once irrigated land has now been converted to dryland crops or cattle grazing. Some small areas in southwestern Kansas show more than 100 years of available water remaining but this is far from the rule in most of the HPA in western Kansas.

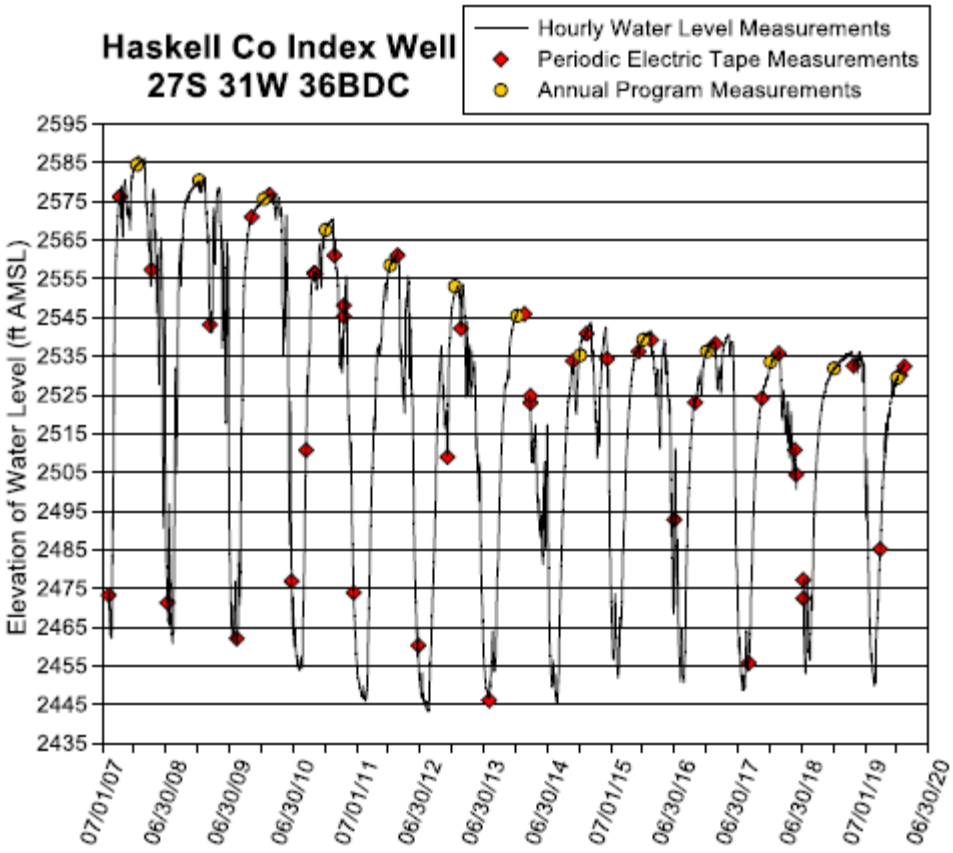
Although there are economic advantages to conserving water for future use, as well as consideration of future generations' needs, many producers still use their water rights to maximize the current benefit. Yet recent studies have shown that the same amount of yield or more can be accomplished with less water if new farming practices are introduced.

The KGS currently has over 25 "Index Wells" that have been installed in the High Plains aquifer region that are continuously recording water levels every hour. The first three sites were drilled in 2007 and are located in Haskell (GMD3), Scott (GMD1), and southern Thomas (GMD4) counties. Below you will see three graphs. These graphs show changes in the water table for all three well since they were installed.



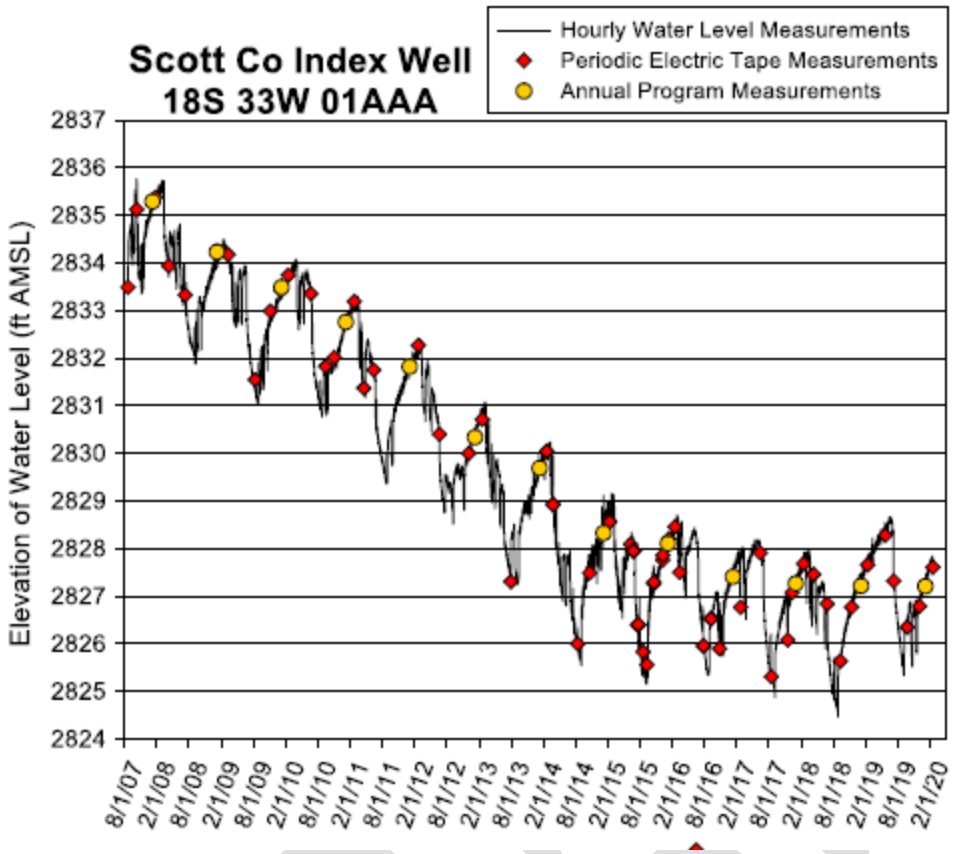
Haskell County KGS Index well

Hydrograph- Annual Average Depth to Water Below Land Surface



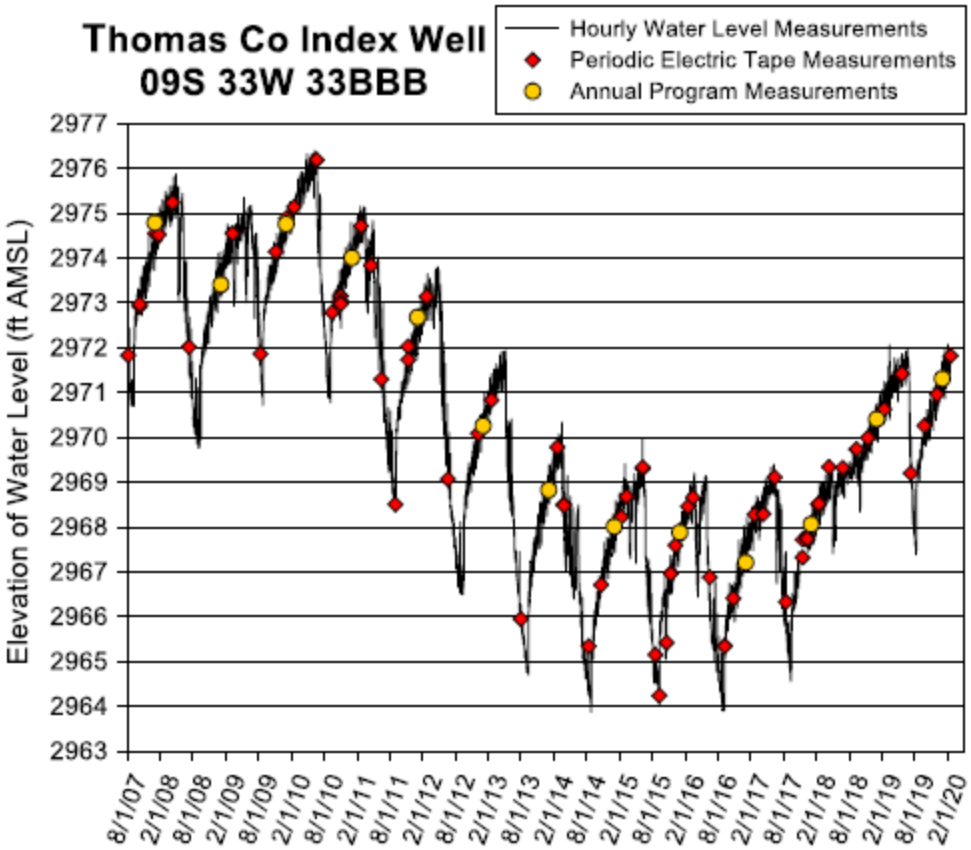
Scott County KGS Index well

Hydrograph- Annual Average Depth to Water Below Land Surface



Thomas County KGS index well

Hydrograph- Annual Average Depth to Water Below Land Surface



As can be seen in the graphs, water levels can vary substantially in a single year in response to irrigation-based pumping during the growing season and climatic conditions. In recent years, the overall rate of decline has improved as much of the HPA region has seen above average precipitation rates and resulting lesser pumping demands. When favorable and timely rains do not occur, groundwater withdrawals increase and water levels typically fall.

In addition to the index well program, the KGS and KDA-DWR measure roughly 1,400 wells across the High Plains aquifer each winter to monitor regional changes in the groundwater supply. The data collected can be accessed through the KGS WIZARD Water Well Levels Database (click here for more information) available on the KGS website.

Precipitation-based aquifer recharge is highly variable across Kansas. It can be influenced by a variety of factors including depth to water, intensity of water inflow, and total precipitation and rate, temperatures, soil types, and regular land use. Research is also being conducted to show if there is potentially a recharge source from the 20,000 plus playa lakes in central and western Kansas. While recharging the ground can be helpful, it may take years to decades or even longer for a drop of water to travel from the surface to the water table depending on the location, depth, and material in the subsurface. The best method to keep groundwater available longer is to pump less.

Groundwater water rights in Kansas allow for specific annual authorized quantities and uses that can be pumped year to year. Stakeholders have incentives to use all they are entitled to from a common pool, to reap short term benefits, when the negatives (water declines) are spread across many users. However, common pool resources have been successfully managed by and for those that rely on it, particularly with a locally developed plan that has clearly defined goals, rules, and regulatory oversight; an example of this is the Local Enhanced Management Area (LEMA) program.

The first approved LEMA in the state of Kansas is the SD-6 LEMA in Sheridan County. This ongoing LEMA has a water conservation goal of a 20% reduction in groundwater pumping, and that goal was exceeded in the first five year cycle. LEMA participants renewed the program for another 5-year cycle in 2018. As a result of the success of the SD-6 LEMA, GMD#4 initiated a district-wide LEMA in 2018 and LEMAs are being considered by at least one other GMD in western Kansas.

Then Governor Brownback signed a bill in April of 2015 that allowed for the establishment of Water Conservation Areas (WCAs). WCAs are a simple, streamlined, 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 aquifer in their area. To date, 53 WCA plans have been approved in the High Plains Aquifer region with a total of over 86,000 irrigated acres.

As of 2020, there are 17 farms enrolled in the Water Technology Farm program. This program is for the demonstration of technologies, such as soil moisture probes, mobile drip irrigation (MDI), sub-surface drip irrigation (SDI), more efficient nozzle packages, variable rate pivot systems, observational index wells, farm weather stations, direct crop sensing probes, dairy ice sweepers & water reuse systems, and services, such as aerial imagery, soil sampling and mapping, soil health analysis, water tracking, cover crops, and no-till farming practices. With growing interest each year, more and more producers are realizing the impact that water smart technology can have on their operations and the water-saving benefits for future generations.

Recent studies show that by using less water and introducing new farming practices, the same amount of yield or more can be produced. Thus, bringing to mind the concept of “less water use with a greater economic return”, encouraging producers in the region to consider adopting new tools and practices.

Helping to educate and change the mindset of Kansans in the High Plains aquifer region is crucial in helping to conserve water. Seeing the numbers and results of efforts being made proves that these methods work. It is all about making every drop count.

Recommended Actions and Strategies

Throughout the course of a calendar year, the Kansas Water Authority and Regional Advisory Committees meet regularly to address resource concerns and future agendas. Starting in the fall of 2019, the KWO held regional meetings with local stakeholders to discuss concerns in their areas and recommendations on steps to resolve such issues. Based on stakeholder feedback, it is

suggested to take these steps to help conserve and extend the High Plains Aquifer in the Kansas. These steps can help make a difference now but may also make an impact for generations to come.

- Improve coordination on water related issues with the state's primary water related agencies through the creation of the Governor's Water Resources Subcabinet at the Executive level with additional regular agency collaboration to implement joint activities
- Policy or Program Recommendations
    - Increased incentives for water conservation program
    - Continue to support the KGS Index Well Program
    - Provide more support to DWR for Compliance and Enforcement
    - Increase support and promotion of Local Enhanced Management Areas (LEMAs)
        - Provide greater support to local entities in LEMA development and management
        - Target water conservation incentives, including existing cost share program and new incentives, to established LEMAs to support implementation of lower water consumption actions
- Implementation Actions
    - Sharing Information
    - Developing a curriculum to be taught in schools
- Data, Research, and Studies
    - Increased support for Water Technology Farms
    - Research on drought tolerant and low water crops
    - Providing to the public more reports that include studies that demonstrate the benefits of pumping less water
- Funding and Resource Needs
    - Make the State Water Funding a priority
    - Coordinate with the Kansas Department of Commerce and the Marketing Division of the Kansas Department of Agriculture to consider incentives to recruit businesses and focus economic development on businesses that value water conservation, use water efficient technologies and reduce the removal of water from the state
        - Encourage value added processing within Kansas by providing financial or water right credit incentives to dairies and feedlots