The Upper Arkansas River Watershed Restoration Plan

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Contents

1. Introduction

The Upper Arkansas River Watershed

The Upper Arkansas River Watershed is located within portions of Hamilton, Greeley, Wichita, Kearny, Scott, and Finney Counties, Kansas. The watershed covers 1,471,856 acres and includes the cities of Coolidge, Syracuse, Lakin, Deerfield, Holcomb, and Garden City. The group boundary is the portion of the Middle Arkansas-Lake McKinney Hydrologic Unit Code (HUC) designated by the United States Geological Survey (USGS) that is located within Kansas. See Figure 1 for a map of the watershed group area.

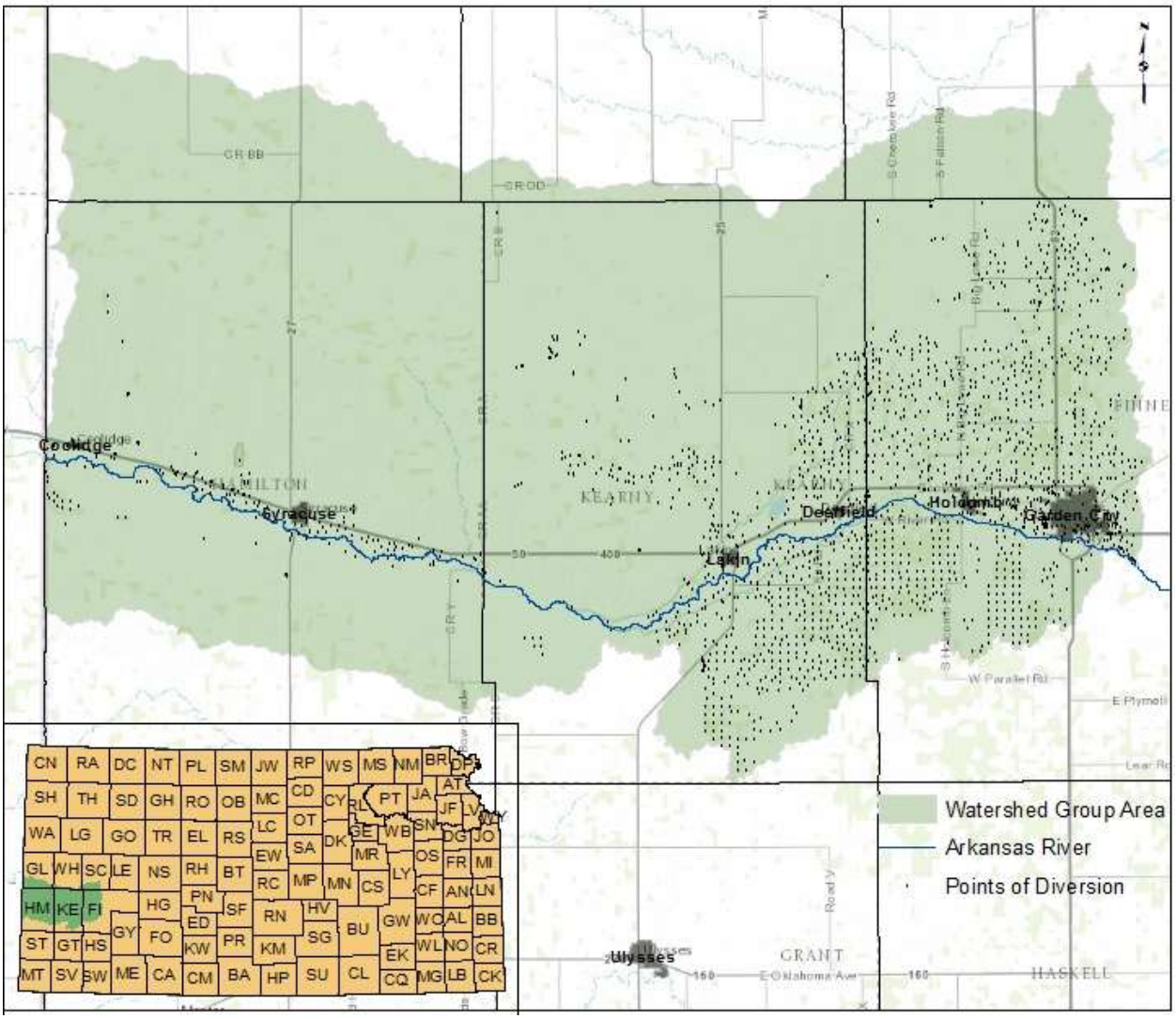


Figure 1. Watershed Group Area.

The watershed is in the semi-arid high plains. Average rainfall is about 19 inches, with severe drought occurring frequently. As climate changes, drought will become more frequent. Warmer winters are currently creating a noticeable impact on water availability, with less snowpack in the

Rocky Mountains reaching John Martin Reservoir upstream of the watershed due to melting in the winter months.

The primary source of water within the area is the Ogallala/High Plains Aquifer. The Ogallala Aquifer is an abundant water resource, located beneath the High Plains of the United States. It extends northward from western Texas to South Dakota. The Ogallala is the leading geologic formation in what is known as the High Plains Aquifer System (HPA). The entire system underlies about 174,000 square miles of eight states. Although there are several other minor geologic formations in the HPA system, such as the Tertiary Brule and Arikaree and Dakota formation of the Cretaceous, these several units are often referred to as the Ogallala Aquifer. It is the largest single water-bearing unit in North America. Agricultural irrigation from the Ogallala is depleting the aquifer, which increases the rate of recharge from the Arkansas River and diminishes streamflow. See Figure 2 for a map of the extent of the High Plains Aquifer.

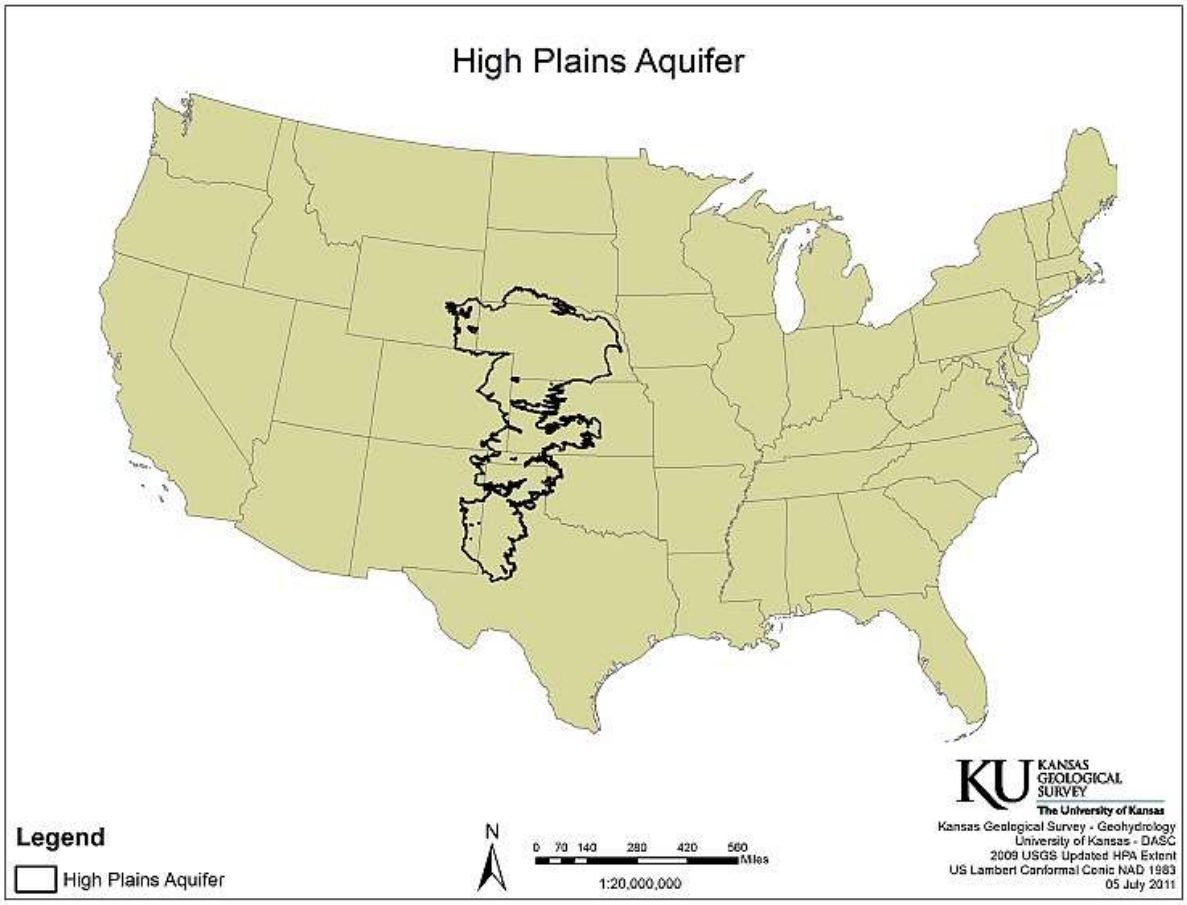


Figure 2. Map of the High Plains Aquifer extent.

The Arkansas River alluvium is hydraulically connected to the Ogallala Aquifer, but its material has higher permeability and there is a relatively impermeable zone between them. The alluvium consists of course-grained deposits of Pleistocene age overlain by fine-grained deposits of Holocene age. These deposits are more permeable than the underlying Ogallala Aquifer. Clay is

generally found at or near the base of the alluvium. The alluvial valley ranges in width from 2 to 3 miles in Hamilton County, to less than 1 mile near the former town of Hartland. East of Hartland the valley broadens and attains a maximum width of about 5 miles near Lakin. The thickness of the alluvium is generally between 50 and 60 ft in Hamilton County, between 40 and 50 ft in Kearny County, and about 40 ft in Finney County.

The Arkansas River also serves as an important renewable source of water for many users and provides substantial local recharge to the aquifer. The Upper Arkansas River in Kansas has low annual flows and poor water quality. Streamflow is intermittent. Flows rarely reach Garden City. Due to slowed rate of flow, infiltration, and diversions, bedload sediment accumulates within the river channel, filling the river system and reducing the overall efficiency of flow and ability to divert through existing infrastructure. This creates concerns for those who divert surface water and alters the extent and elevations of the floodway. It is in the best interest of all project partners to ensure that the Arkansas River maintains a reasonable flow and water quality. Figure 3 shows annual flows and losses in the Arkansas River channel.

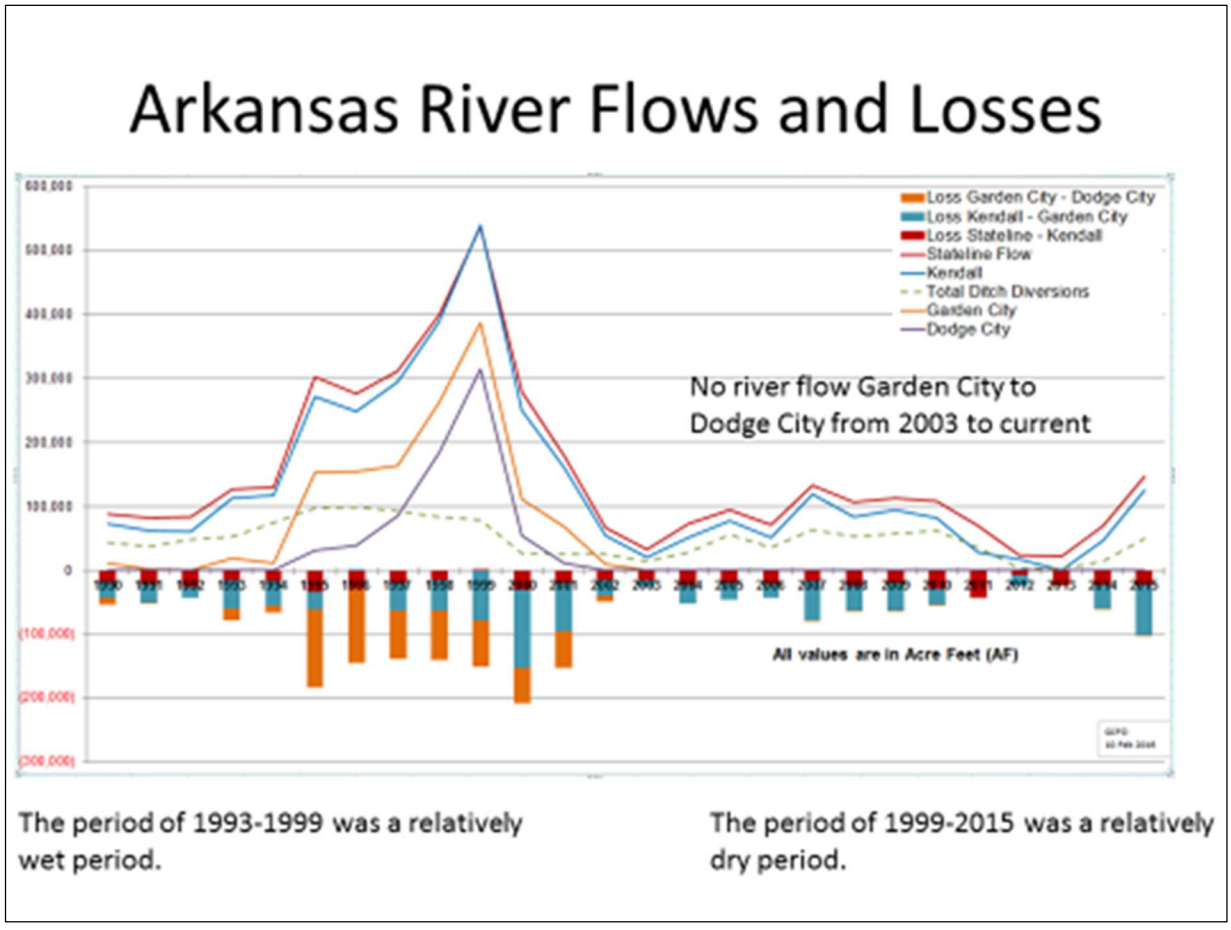


Figure 3. Year-to-year Arkansas River flows and losses. Created by the Kansas Department of Agriculture, Division of Water Resources.

The watershed area includes 2,412 points of diversion (PD) with water rights, including 2,026 irrigation PDs, 87 industrial PDs, 152 municipal PDs, 12 recreational PDs, 5 thermal exchange

PDs, 127 stock water PDs. There are also many active domestic PDs in the area that are not required to have water rights. Average annual reported water use within the watershed area over the past 10 years was 360,257 acre-feet (AF).

The watershed area includes some county and state fishing parks, which are operational when there is sufficient streamflow to elevate the local groundwater level enough to provide water for the fisheries. These parks provide recreation for the surrounding communities and wildlife habitat.

Playa Lakes

Playa lakes are temporary, shallow, circular depressions in the ground that form in arid or semi-arid regions. They occur naturally at the lowest points of a watershed basin with clay-lined basins when rainfall or runoff fills them. Healthy playa lakes enhance recharge when they are dry, due to cracking in the clay. As the playa fills, the clay swells and the cracks get filled, creating standing water that provides habitat for wetland species. Efforts to restore playas will create habitat for waterfowl and other wetland species, provide hunting opportunities, and increase recharge. There are 5,470 probable playa acres within the watershed, as identified by Ducks Unlimited. See Figure 4 for a map of probable playa acres.

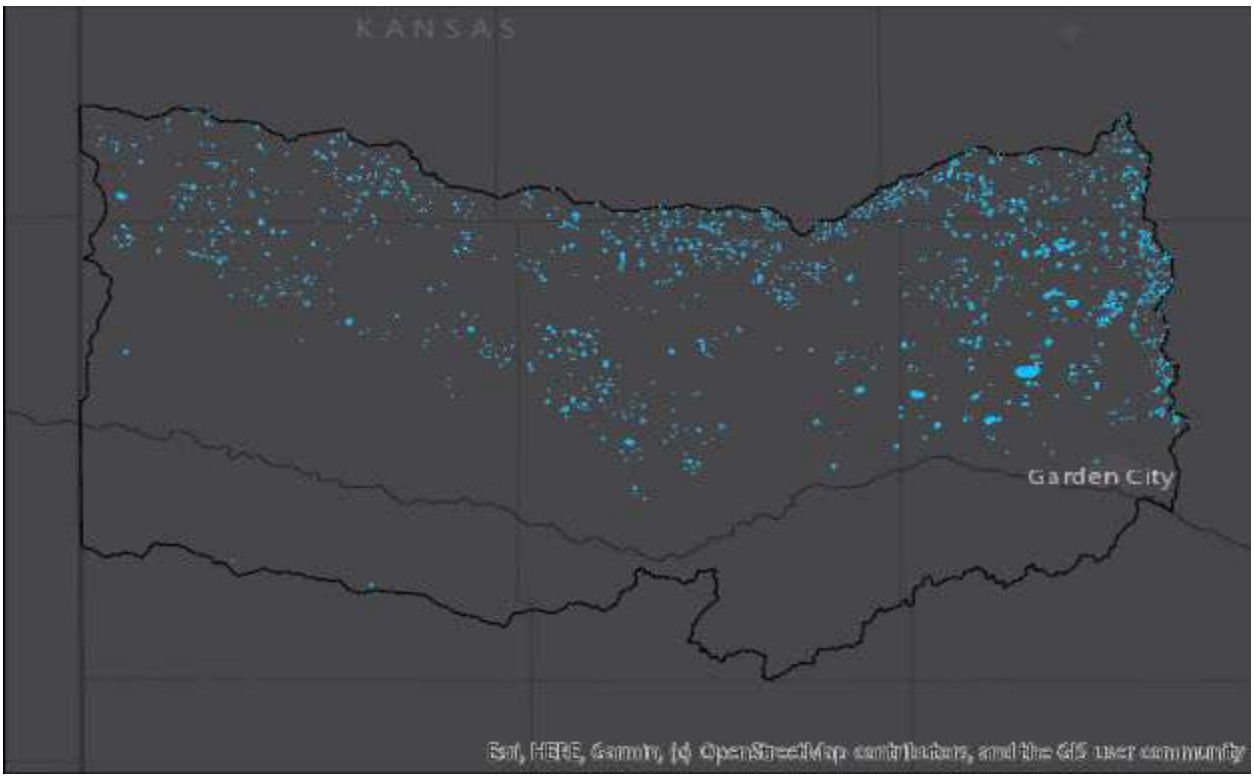


Figure 4. Map of probable playa lake locations within the watershed group boundary.

Species of Concern

The following species have been listed as threatened and endangered within the watershed boundary:

Flathead Chub

The Flathead Chub is a large chub species, growing up to 9 inches. It has a broad wedge-shaped head, large mouth, and one small barbel on each side of the mouth. It is light greenish or brown on the back and plain silvery on the sides. Since 1995, the only documented populations of this species in Kansas have been in the upper reaches of the Arkansas River and in the south Fork of the Nemaha River. They are known to still occur in out-of-state reaches of the Arkansas and Cimarron Rivers so may still occur in Kansas during high flow periods. The Flathead Chub occurs from the Rio Grande to the Arctic Circle in small creeks and the largest rivers that have turbid fluctuating water levels and unstable sand bottoms. As with several other plains fishes, the chub relies on flood flows to successfully spawn. Kansas lists the Flathead Chub as a threatened species with designated critical habitat within all reaches of the main stem Arkansas River located within Hamilton and Kearny counties. Any time an eligible project is proposed that will impact the species' preferred habitats within its probable range, the project sponsor must contact the Ecological Services Section, Kansas Department of Wildlife and Parks, 512 SE 25th Ave., Pratt, KS 67124 for advisement on permit requirements.

Least Tern

The Least Tern is the smallest of the North American terns at 8-10 inches long with a wingspread of about 20 inches. The adult is white below and grayish above with a black cap and white forehead. The leading edge of the wing primaries is also black. Least terns nest in Kansas during the summer and have been recorded in six central and western Kansas counties. Terns require barren areas near water such as saline flats in salt marshes, sand bars in riverbeds, and shores of large impoundments. A dependable food supply of small fish and aquatic crustaceans must be nearby. Kansas lists the Least Tern as an endangered species. Least Terns may occur occasionally anywhere in Kansas. They have been observed in Hamilton, Kearny, and Finney Counties. No area of the watershed boundary is designated critical habitat.

Piping Plover

The Piping Plover is a small whitish plover the color of dry sand. It has a narrow black band above the forehead which reaches from eye to eye, a complete or incomplete dark ring around the neck, and yellow legs. In summer, the bill is yellow with a dark tip. In winter, its bill and legs are dark. Kansas lists the Piping Plover as a threatened species. Piping plovers may occur occasionally anywhere in the state where suitable habitat is found. They have been observed within Finney County, but no area of the watershed boundary is designated critical habitat.

Snowy Plover

The Snowy Plover is about 6 inches in length with a wingspread of 13-14 inches. Very light color with a thin black bill, black mark behind each eye and over forecrown, dark legs and feet, and black slash mark on each side of the lower throat. The Snowy Plover prefers open salt flats, beaches and bars of rivers, and wetlands. Nesting occurs in scattered locations in central and southwestern Kansas where open salt flats or sandy areas near water occur. Kansas lists the Snowy Plover as a threatened species. It has been observed in Kearny and Finney Counties, but no area of the watershed boundary is designated critical habitat.

Green Toad

The Green Toad is a small brightly colored toad. Its ground color is green to greenish yellow, with yellow spots surrounding brown tipped warts, and having randomly scattered black spots or streaks. The belly is yellowish and may have dark spots. The continental range of the Green Toad extends from western Kansas into central Mexico. The animal is restricted to the short grass prairies on the high plains, typically not found below elevations of 3,000 ft. The preferred habitat for the Green Toad is grassland plains and valleys with few or no trees or shrubs. Soils with good water holding capacity seem to be required. Kansas lists the Green Toad as a threatened species. No area of the watershed boundary is designated critical habitat.

Eastern Spotted Skunk

The Eastern Spotted Skunk is more weasel-like in body shape than the more familiar striped skunk. The Spotted Skunk's stripes are broken in pattern, giving it a "spotted" appearance. Spotted Skunks prefer forest edges and upland prairie grasslands, especially where rock outcrops and shrub clumps are present. In western counties, it relies heavily on riparian corridors where woody shrubs and woodland edges are present. Woody fencerows, odd areas, and abandoned farm buildings are also important habitats for Spotted Skunks. The state of Kansas has listed the Eastern Spotted Skunk as a threatened species. It has designated all suitable habitat within a riparian corridor along the main stem Arkansas River in Finney, Ford and Gray counties as critical habitat. Any time an eligible project is proposed that will impact the species' preferred habitats within its probable range, the project sponsor must contact the Ecological Services Section, Kansas Department of Wildlife and Parks, 512 SE 25th Ave., Pratt, KS 67124 for department personnel to advise them on permit requirements.

Black-Footed Ferret

Black-Footed Ferrets have a pale buff background color nearly white on the face, throat, and ventral half of the body. The top of the head and saddle area of the back are brown. There is a black mask across the eyes and the feet, while the legs and terminal fourth of the tail are black to blackish brown. Ferrets depend on prairie dog burrows for cover and depend on prairie dogs and other small mammals for food. Black-Footed Ferrets once ranged over approximately the western 2/3 of Kansas in association with black-tailed prairie dogs. Extensive conversion of rangeland to cropland plus widespread poisoning of prairie dogs have destroyed most of the state's ferret habitat. There remain some larger areas of short-grass prairie in western Kansas that

may still have isolated prairie dog towns capable of supporting Black-Footed Ferrets. The U.S. Fish and Wildlife Service reintroduced captive-bred Black-Footed Ferrets onto two ranches in Logan County in 2007 and has been monitoring them since. The population is not large, but annual fall surveys document that reproduction has occurred every year. Supplemental releases have occurred since 2007, but reproduction of existing animals on site remains the primary means of maintaining the population. Prior to reintroductions in Local County in 2007, the last confirmed record of a live ferret in Kansas was in Sheridan County in December 1957. The state of Kansas lists the Black-Footed Ferret as an endangered species. It has been previously observed in Hamilton County, but no area within the watershed boundary has been designated critical habitat.

Plains Minnow

The Plains Minnow was once considered one of the most common bait fishes due to its size and abundance. The species is now scarce where it was the most predominant fish in the 1950s. The Plains Minnow can be found in the Republican, Smoky Hill, and Arkansas rivers. It remains a significant portion of the fish fauna in the Cimarron River. It needs sufficient water flow and flow rates with high and low extremes to complete its life cycle. The Plains minnow is partly herbivorous and has a long gut and black-lined body cavity. It feeds in schools near the bottom where sediments accumulate on sandy substrates. High flows during the summer trigger spawning and the semi-buoyant eggs hatch as they are carried downstream where flow is more reliable. Few of these minnows live longer than 2 years. The Plains Minnow has small eyes, thin lips and grows to 5 inches but is otherwise nondescript. The state of Kansas lists the Plains Minnow as a threatened species. No area within the watershed boundary has been designated critical habitat.

Whooping Crane

The Whooping Crane is the tallest North American bird and has a 7-8 ft wingspan. Adults are white with black wing tips and a red face. Young may be whitish gray with rusty wash color on their head and neck and scattered reddish brown feathers over their back and sides. Whooping Cranes are regular spring and fall transients through Kansas. Preferred resting areas are wetlands in level to moderately rolling terrain away from human activity where low, sparse vegetation permits ease of movement and an open view. The state of Kansas lists the Whooping Crane as an endangered species. Whooping Cranes have been observed in Kearny and Finney counties, but no area within the watershed boundary has been designated critical habitat.

The Stakeholder Group and Restoration Planning Process

The mission of the Upper Arkansas River Watershed Group is to improve and protect the quality and quantity of the Arkansas River and connected aquifers for the sustainability of life in the basin. Funded by the US Bureau of Reclamation and coordinated by Southwest Kansas Groundwater Management District 3, 52 stakeholders representing 31 organizations and several family farms have participated in the planning process to create this restoration plan.

Monthly meetings were held through this process to build consensus on the group's mission, form, and function. Bylaws and articles of incorporation were drafted, an initial board of directors was selected, and the group completed the incorporation process to become a 501(c)(3) not-for-profit organization in November 2023.

2. Issues of Concern

Over-Appropriation of Groundwater

Large-scale irrigation development began occurring in the watershed in the 1950s. It became apparent that irrigation was developing at an unsustainable rate by the 1970s, when the state of Kansas passed laws such as the Groundwater Management District (GMD) Act, and the GMDs that formed began to take action to set rules curtailing further expansion. In 2014, Southwest Kansas Groundwater Management District No. 3 (GMD3) formally requested to the Chief Engineer that a rule eliminating new appropriations of water other than term permits and 15-AF exemptions for small projects be established within the boundaries of GMD3. This closure of the district was issued under a moratorium in 2014, and formally adopted into rules and regulations in 2016. The watershed group boundary within Kearny and Finney Counties lies within GMD3 and is closed to any further appropriation. The boundary within Hamilton County is not in a GMD and new appropriations for water use may be issued if safe yield standards are met.

Since large-scale irrigation development in the 1950s, there have been substantial water table declines across southwest Kansas. Areas near the river channel within the watershed group boundary have relatively small declines, but other areas, particularly in the sand hills south of the river, have seen declines of over 200 ft. Most of the aquifer within the watershed boundary in Kearny, Finney, and Scott Counties has consumed 30-60% of the water that was available prior to irrigation development, over the course of about 70 years of water use. See Figures 5 and 6. Note that the gray areas on Figures 5 and 6 are areas where the HPA does not exist. There is some well development along the river alluvium and within the extent of a paleo-channel that exists south of the Arkansas River in Hamilton County. The water table in this area is experiencing little or no decline.

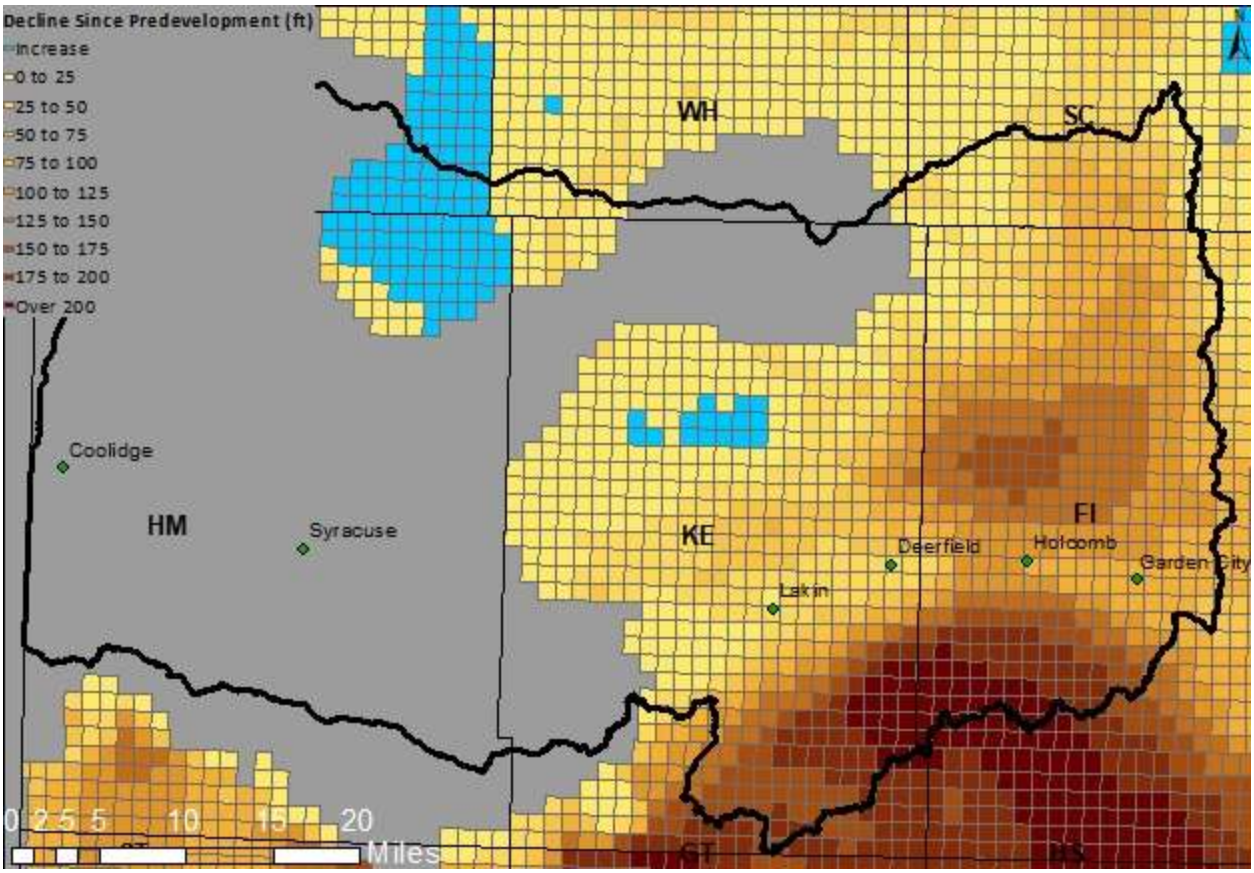


Figure 5. Decline of the High Plains Aquifer since Predevelopment (ft).

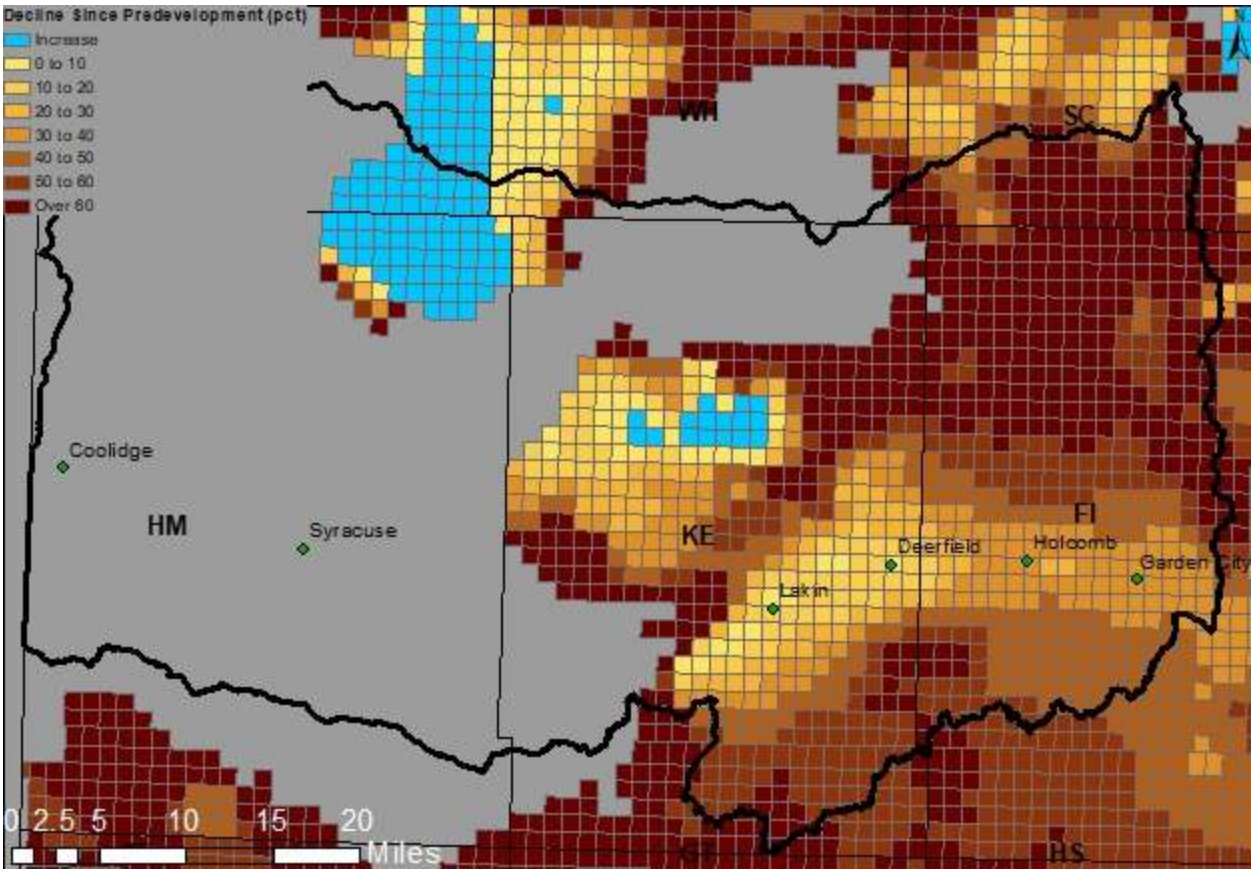


Figure 6. Decline of the High Plains Aquifer since Predevelopment (pct).

Recent work completed under a US Department of the Interior, Bureau of Reclamation (Reclamation) WaterSMART Drought Response grant to GMD3, in collaboration with the Kansas Geological Survey (KGS), Finney County Economic Development Corporation, and the City of Garden City split the aquifer areas of GMD3 into regions mostly defined by aquifer characteristics, and subregions based on similar patterns of water use. Within the watershed group boundary, these regions include Northwest Kearny County, the Ditch Service Area, the Arkansas River above Garden City, The Arkansas River below Garden City, and the Sand Hills South of the Arkansas River. See Figure 7. Note that not all of the watershed group boundary lies within the GMD3 boundary. Gray areas on Figure 7 are outside of GMD3 and were not defined by the work under the Drought Response project. The number beneath the region label indicates the reduction that would be required to halt aquifer declines. The value in the Northwest Kearny County region is negative because the water table elevation in that area increased on average over the last 10 years.

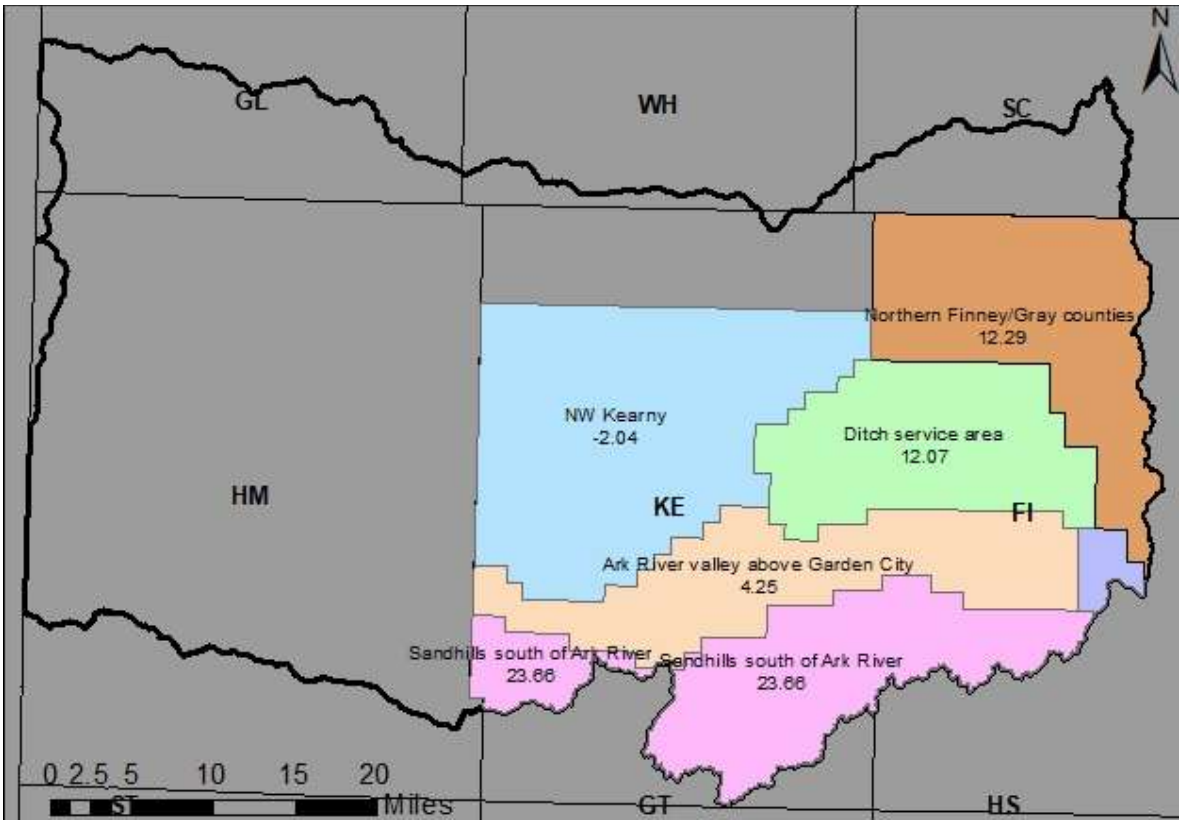


Figure 7. GMD3-Defined Aquifer Areas within the Watershed Group Boundary

The Kansas Legislature in 2023 passed House Bill 2279, requiring GMDs to identify priority areas of concern and identify action plans by July 2026 to address those concerns. The colored areas identified in Figure 7, outside of the NW Kearny area, are likely to have action plans that require a reduction in water use. This creates the need for additional funding for water use efficiency projects, voluntary land or water right easements to reduce or eliminate water use, and technical assistance to facilitate implementation of improved farm practices and technologies.

Changes to the Hydrologic System

Surface and groundwater irrigation, dewatering of the underlying aquifer in Kansas, and upstream reservoir operations have drastically reduced the amount of water that was flowing in the Arkansas River prior to development. Improved efficiencies of farming and conservation practices have also reduced return flows. Large stretches of the river are often dry and by an interstate compact between Kansas and Colorado, all water called for from John Martin Reservoir must be put to immediate beneficial use. This usually results in 100% of the flow that is not recharged in transit within the river being diverted into the various irrigation ditches during times that their users are irrigating. Flows east of Hamilton County are intermittent, with flow rarely reaching Garden City. The river to the east of the watershed boundary has been perpetually dry for the past 20 years. This has made it impossible to satisfy downstream surface water rights.. It has also drastically reduced the health of the riparian ecosystem.

Degraded Water Quality

The Arkansas River entering Kansas is one of the most saline rivers in the United States. A recent study using data collected from 1963-2010 found that average dissolved solids concentration near the state line was 3,260 mg/L, more than 6 times the secondary standard of 500 mg/L recommended by the EPA. The chemical type of the water is typically sodium, calcium-sulfate. Average sulfate concentration was 1,960 mg/L, while chloride content was 137 mg/L. River water is also high in uranium. Samples by the KGS and Kansas Department of Health and Environment (KDHE) during 2009-2010 had an average uranium concentration of 63.5 µg/L, more than twice the maximum contaminant level (MCL) of 30 µg/L.

The salinity and uranium in Arkansas River water are naturally derived, but the high concentration of dissolved solids is exacerbated by human actions. Cretaceous shales in eastern Colorado contain sulfide minerals that weather to produce secondary gypsum and release uranium, selenium, and other elements. River water is diverted to farms that overlay these shales, and most of this water is consumed by evapotranspiration, leaving behind the salts in irrigation return flow and moisture. This return flow is eventually flushed back to the river system over the surface or as groundwater discharge.

The salinity of the groundwaters of the alluvial aquifer and nearby HPA range substantially from fresh to saline. The chemical water type is mixed cation-sulfate. Sulfate concentration is typically more than 7 times chloride concentration and can be about 14 times the chloride concentration in the most saline waters. See Figure 8 for a map of sulfate concentration in the alluvium and HPA.

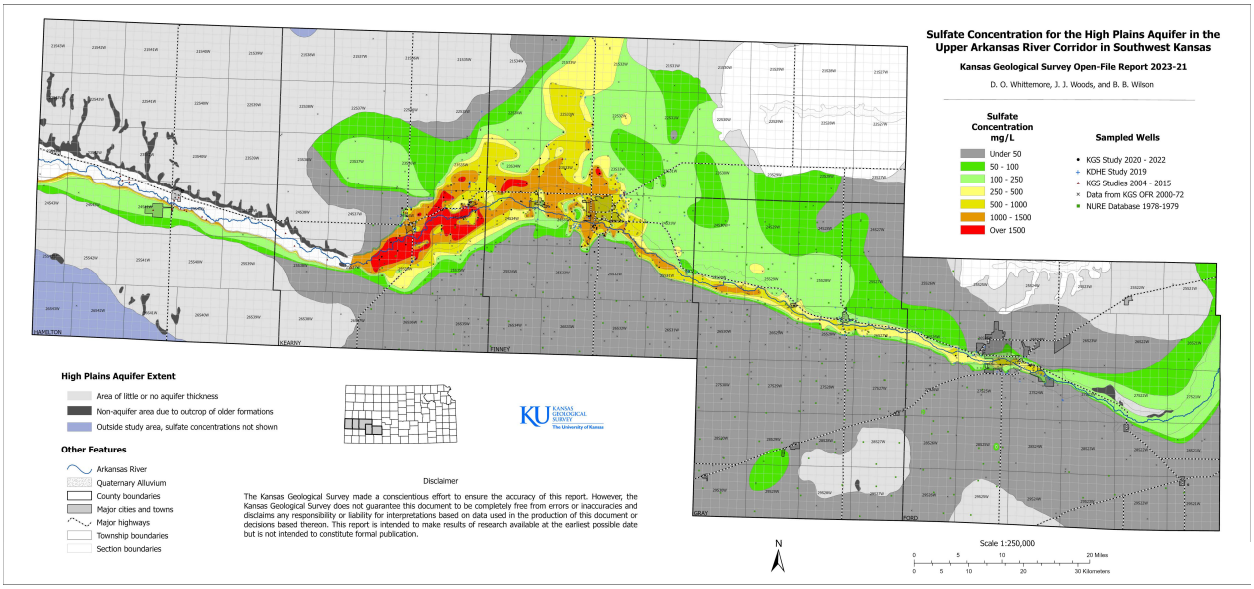


Figure 8. Distribution of sulfate concentration in the HPA in the upper Arkansas River corridor. Image taken from Whittemore 2023.

Areas with uranium concentrations within the alluvium and HPA exceeding the 30 µg/L MCL are generally located where sulfate concentration exceeds 1000 mg/L, but some areas north of Garden City have higher uranium than would be expected based on sulfate concentrations. Areas with high uranium concentration are predominantly located north of the river.

The cities of Lakin, Deerfield, Holcomb, and Garden City, KS rely on groundwater from the HPA to meet their municipal water use demands. The well fields supplying Lakin, Deerfield, and Holcomb are being contaminated by infiltration of water from the Arkansas River. The city of Lakin recently constructed a nano-filtration facility and deep wastewater disposal well, at a cost of about $6 million, to meet the Environmental Protection Agency's (EPA) standards for uranium. This is a significant cost for a community with a population of 2200. The cities of Deerfield and Holcomb are currently working on identifying solutions to growing uranium problems that will need to be addressed soon. Uranium levels have also been getting higher over time in the cities of Holcomb and Garden City.

Poor water quality has also impacted local farmers and ranchers. The water is highly corrosive, impacting the usable life and operation of center pivots and other water delivery infrastructure. The sulfate concentration of the water negatively impacts crop yields and increases overall water use demand. Ranchers must closely monitor livestock diets to account for the salt and sulfur levels in the water supply. The water has a laxative effect and can negatively impact weight gain and overall animal health without a diet that accounts for the salt and sulfur.

Devegetation of the Sand Hills

Much of the sand hills region, located just south of the Arkansas River, has been converted from sagebrush prairie to irrigated agriculture. These dune sand soils have poor water retention, meaning that an irrigator is likely to need to apply more water than is needed in other regions to get a crop to harvest. The poor water retention, as well as the topography of the region makes the ground unsuitable for dryland farming and makes it difficult to establish native grasses to restore the native prairie if the irrigation system is removed or inoperable. Declining well yields make it difficult for farmers in some areas to maintain a crop during severe drought, and this has caused some instances of local sandstorms and drifting sands that have buried roads and portions of neighboring fields.

The Conservation Reserve Enhancement Program (CREP) is a Federal/state partnership that provides payments to producers in this region to enroll eligible irrigated acres for 14–15-year contracts with the Farm Service Agency (FSA), permanently retire the associated state water rights on the enrolled acres and establish an approved land cover on the same acreage. The producer receives an annual rental payment, plus additional cost-share opportunities for specific conservation practices from FSA, plus an upfront incentive payment from The Kansas Department of Agriculture, Division of Conservation. Some producers have struggled to establish adequate ground cover in the CREP program, due to lack of available water supply, severe drought, and/or strict program requirements that limit what type of restoration practices can be established. See Figure 9 (a) for an image of a CREP field with poor vegetative cover and (b) for a CREP field with well-established grass.

Due to soils unsuitable for dryland farming, aquifer depletion creates a more severe set of issues than in other regions. Farmers who lose the ability to irrigate will have a difficult time establishing grass for grazing, and lack of land cover will create drifting sand dunes that block access roads, bury fence lines, and damage nearby fields. Blowing sand will also create storms

that detract from quality of life in nearby communities, including Coolidge, Syracuse, Lakin, Deerfield, Holcomb, Garden City, Ingalls, Cimarron, Montezuma, Ulysses, and Sublette. These storms have resulted in some traffic accidents and loss of life. In comparing average reported acres in the region between the 10-year periods of 2003-2012 and 2013-2022, 31,397 irrigated acres have been lost in the region, a decline of about 15%. 19,249 acres in the region are enrolled in the CREP program to transition to grass and provide the ability to use the land for grazing, while also creating wildlife habitat. The CREP program is certainly very helpful here, but either an expansion of the program or an additional program with different rules and incentives is needed to address the gap between retired acres and CREP enrollees. Wind speeds in the region often exceed 50 mph, and bare earth will frequently blow. This region was the epicenter of the 1930s dust bowl.

(a) **(b)**

Figure 9. Images of (a) a CREP field with poor ground cover and (b) good ground cover.

3. Water Distribution Systems

Water supply options for Hamilton, Kearny, and Finney Counties consist of four sources; the local Arkansas River/Arkansas River alluvium, the Dakota aquifer, the Ogallala aquifer, and a local aquifer described as a paleo aquifer on the south side of the Arkansas River in Hamilton County. In addition to the thousands of irrigation wells that draw groundwater from the local aquifers, the cities of Coolidge, Syracuse, Lakin, Deerfield, Holcomb, and Garden City use local aquifers, with various needs for treatment. Hamilton County Rural Water District 1 (Hamilton RWD1) and Finney County Rural Water District 1 (Finney RWD1) also have municipal distribution systems that withdraw groundwater. The Associated Ditches of Kansas, including the Frontier Ditch, the Amazon Ditch, the Great Eastern Ditch, the South Side Ditch, the Farmers Ditch, and the Garden City Ditch have surface water rights to divert the Arkansas River for direct irrigation use. Each system is detailed below.

City of Coolidge

Coolidge has a population of 78 with 47 service connections and obtains its water from two wells drilled into the Dakota. Total demand is about 30 AF of water per year. Coolidge has adequate water rights to meet its demands. The city's municipal wells can produce about 150 gpm each and the average production of the system is capable of 29,600 gallons per day. Coolidge has utilized an ion exchange (IX) facility to treat water since 2005 due to issues with high iron content, gross alpha particles, and radium. The IX facility currently has the capacity to treat water at a rate of 165 gallons per minute.

City of Syracuse

Syracuse has a population of 1,807 with 954 service connections. Syracuse currently has four wells located within the paleo aquifer south of the Arkansas River. One well is located just south of the city. The other three wells are located approximately two miles south and three miles west of Syracuse. The water only requires chlorination for treatment, but the wells near the river sometimes degrade in quality during the summer when the water table around the city wells is low. This is believed to be because when the water table is lowered, water from the Arkansas alluvium contaminates the clean water in the Paleo aquifer locally.

Water quality monitoring at the state line indicates that the paleo aquifer is being contaminated, either from the river channel locally or from upstream sub-surface flow. Conditions have been worsening since 2019. If conditions continue to worsen, this will eventually pose a threat to the water supply downstream, where Syracuse draws water to meet its municipal demands. See Figure 10 for changes in specific conductance in the paleo aquifer at the state line over time.

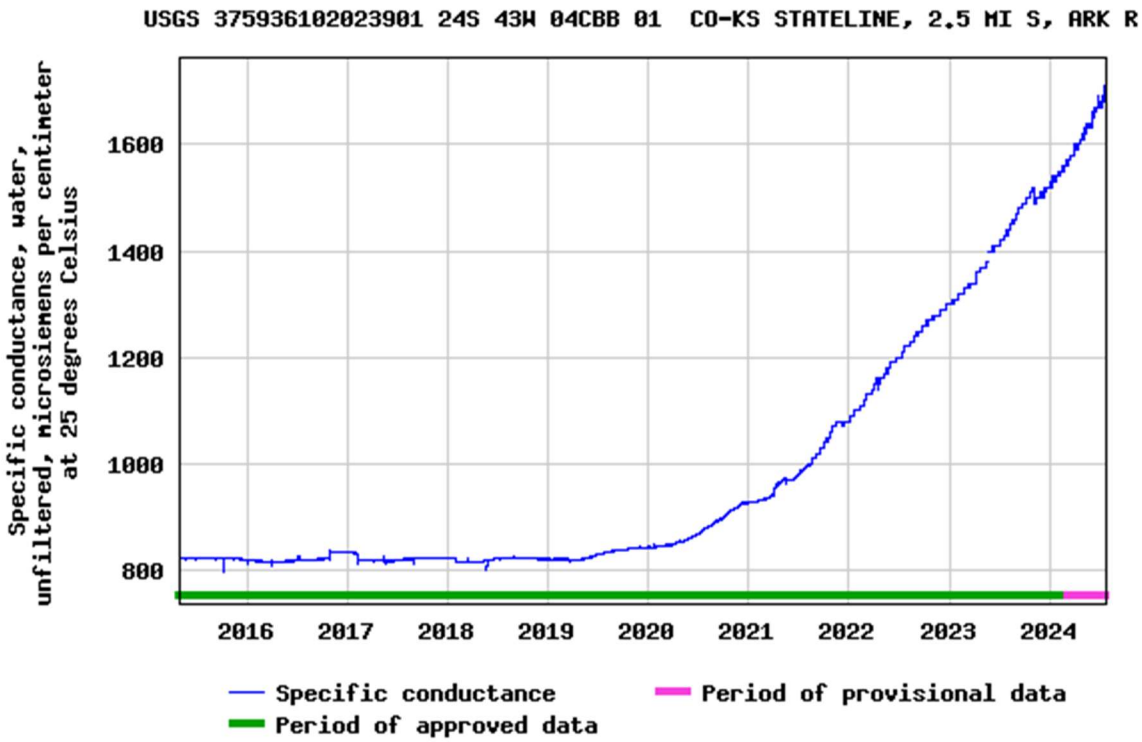


Figure 10. Specific conductance, in µS/cm at a USGS groundwater gage installed within the paleo aquifer at the state line.

Hamilton County Rural Water District No. 1

Hamilton RWD1 sources its water from two wells drilled into the Dakota aquifer. These wells were completed in 1983 at 382' depth, with a design capacity of 40 gpm each. Water quality problems include high iron content. Water is treated by chlorination and iron sequestration.

Lakin

Lakin has a population of 2,166. It obtains its water from eight wells drilled into the Ogallala aquifer. At one point, Lakin only had two wells that met the drinking water MCL for uranium. The city identified construction of a nanofiltration facility as its best course of action to address its water supply reliability issues. This facility was brought online in 2015. The facility came at great cost to the small community, about $6 million, with ongoing operations and maintenance costs. Initially, the city had to roughly double its municipal water rates. The city has been able to pay off the plant and rates have dropped, but are not as low as they were prior to constructing the facility. The nanofiltration facility was constructed with excess capacity to be able to handle any foreseeable increase in population. The facility could also be used to treat water for nearby water users.

Deerfield

Deerfield has a population of 692. Deerfield has three municipal wells drawing water from the Ogallala aquifer. One of these wells last tested at 32 µg/L uranium, exceeding the MCL of 30 µg/L. This well has been converted to strictly supply irrigation projects, while the other two wells provide municipal drinking water. The remaining wells last tested at 25 µg/L and 29 µg/L. There will be some opportunity to blend the wells to keep overall water quality below the 30 µg/L MCL in the immediate future, but as quality continues to deteriorate, a permanent solution, either through purchasing treated water, constructing their own treatment plant, or locating a cleaner source of water and piping it back to the city, must be found. Deerfield is currently in the process of seeking funding for engineering to evaluate their options and formulate a plan to move forward that will solve their water reliability issues.

Holcomb

Holcomb has a population of 2,228 with 666 service connections. Holcomb has five wells in the Ogallala. These wells have issues with hardness, uranium, iron, manganese, and/or iron bacteria. Currently, Holcomb is treating its water with chlorination. Holcomb's latest water sampling had uranium levels ranging from 26-30 µg/L, just at or below the 30 µg/L MCL set by the EPA. Holcomb is currently seeking solutions to this issue. Holcomb has obtained additional water rights to the west of the city limits but has not begun developing wells there.

Wheatland Water

Wheatland Water is a branch of Wheatland Electric Co-op. It was formed in 2000 to address water quality issues in the area by constructing and operating a reverse osmosis water treatment facility, located in western Garden City. Wheatland Water sells water wholesale to four customers, including Tyson Fresh Foods, Sunflower Electric, Finney County Rural Water District 1, and the City of Garden City. Wheatland Water operates several irrigation wells that can be converted to municipal use if needed. These wells are currently enrolled in a Water Conservation Area (WCA) to allow flexibility of use between wells while conserving water. Two Wheatland wells and three City of Garden City wells feed the plant. The plant is currently operating at 2/5 capacity. It treats 2200 gpm, about 6 million gallons per day. At full capacity, the plant could treat about 15 million gallons per day. The plant disposes of wastewater in a horizontal well drilled into the Arbuckle formation. It is permitted for two additional disposal wells. About 15% of water that enters the treatment plant is needed for disposal.

Finney County Rural Water District 1

Finney County Rural Water District 1 services about 700 connections. Its service area runs from the railroad tracks to 2/3 mile north of Garden City, ending near the travel plaza. All water distributed by the district is produced by Wheatland Water.

Garden City

Garden City has a population of 27,856. The city has 16 municipal wells that source water from the Ogallala aquifer. 9 of these wells are located within city limits and 7 wells are located in the sand hills south of town. The wells in town are blended with treated water from Wheatland Water to reduce the concentration of uranium and other dissolved solids and to improve the overall quality of the water supply. The wells in the sand hills are treated with chlorination. The city has long-term concerns related to the dewatering of the Ogallala aquifer and loss of future water availability, especially in the sand hills wells that are further from the river channel. The city is currently working toward addressing this issue with a water reuse and recharge project, detailed in the "Ongoing Work" section of this Plan.

Garden City also supplies municipal water to various surrounding rural residents, including Towns Riverview, the Kansas State University Ag Research Station, Johnson Rentals, and the Country Acres subdivision.

Associated Ditches

The Associated Ditches of Kansas include the Frontier Ditch, the Amazon Ditch, the Great Eastern Ditch, the South Side Ditch, the Farmers Ditch, and the Garden City Ditch. They have water rights totaling 145,800 AF to divert available surface water flows. Some of the surface water is stored in John Martin Reservoir near Caddoa, Colorado.. The Associated Ditches can call for water stored in John Martin Reservoir accounts that Kansas has access to for their benefit. Generally, these calls occur at times to supplement groundwater pumping during peak irrigation season demands. See Figure 11 for a map of the Associated Ditch System.

The availability of stored water to the Associated Ditches depends on hydrologic conditions primarily above John Martin Reservoir, which in its entirety is within Colorado. From data on the water available in John Martin Reservoir to Kansas on April 1st each year for the period of 2014-2023, the average was over 44,400 AF with a maximum year of 122,265 AF in 2018 and a low of about 11,500 AF in 2022. April 1st conditions are not always representative of what is eventually available to Kansas surface water ditches. It should be noted that in 2023, 43,353 AF was released from John Martin Reservoir to Kansas despite only 14,674 AF being available on April 1st.

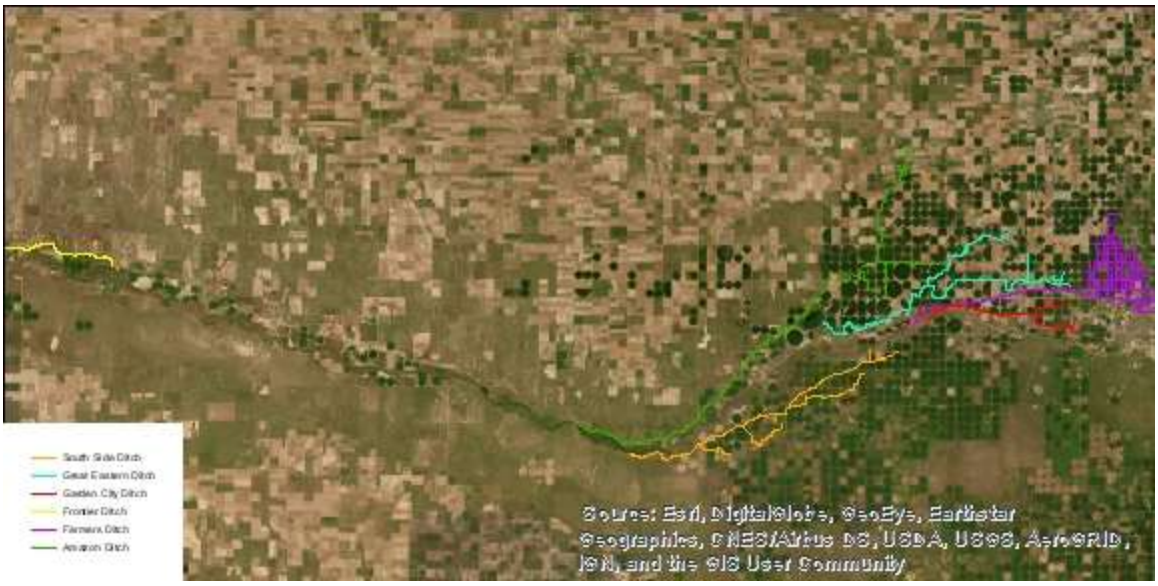


Figure 11. Map of the Associated Ditch System.

Frontier Ditch

The Frontier Ditch diverts water in Colorado and uses the water in Kansas. It is authorized 6,946 AF. Over the past 10 years, it has used an average of 4,970 AF on 2,554 acres.

Figure 12. Map of the Frontier Ditch.

South Side Ditch

The Southside Ditch diverts water from the river southwest of Lakin. Its service area is located entirely within Kearny County. It is authorized 20,000 AF. Over the past 10 years, an average of 5948.9 AF has been diverted for use on 8,000 acres.

Figure 13. Map of the South Side Ditch.

Amazon and Great Eastern Ditches

The Great Eastern Ditch and Amazon Ditch share a headgate, where water is diverted between Kendall and Lakin. Each ditch has its own water right. The Great Eastern Ditch water right is authorized 60,000 AF and the Amazon Ditch can divert 31,000 AF. Over the last 10 years, the Great Eastern Ditch has average use of 14,306.7 AF per year on 6576 acres and the Amazon Ditch has average use of 11,033 AF on 6,000 acres.

Lake McKinney

Lake McKinney is used to temporarily store and regulate water to be run down the Great Eastern Ditch. Significant restoration work was done on the lake to restore capacity in 2011, and an alternate bypass canal was built to significantly reduce transit loss in the lake and reduce sediment load into the lake during periods when water does not need to be stored.

Figure 14. Map of the Amazon Ditch.

Figure 15. Map of the Great Eastern Ditch.

Farmers Ditch

The Farmers Ditch diverts water just east of Deerfield, near the Kearny/Finney County line. It is authorized 20,000 AF. Average use over the last 10 years has been 5,119 AF on 8,750 acres.

Figure 16. Map of the Farmers Ditch.

The Garden City Ditch water right, FI 217 is authorized 4000 AF. This ditch shares a headgate with the Farmers Ditch and has not been used in over 10 years.

4. Ongoing/Completed Projects

The following projects and programs have been completed or are currently underway to address the issues of concern detailed in section 2.

Education and Outreach Work

Several local organizations within the watershed boundary regularly participate in programs and projects to educate local citizens and water users of all ages on their water supply, the challenges it faces, and the things they can do to improve the situation. The Kearny, Finney, and Gray County Conservation Districts hold an annual Ark River Water Festival in Garden City schools, targeting 5th and 6th grade students. The festival educates kids on water conservation, the importance of watersheds, water pollution, aquifer declines, etc. and reaches 800 – 1500 kids each year. The Ark River Water Festival gets regular participation from several local government agencies, nonprofit organizations, and local producers.

The Kearny, Hamilton, Finney, Wichita, Greeley, Scott, Grant, Stevens, Seward, Haskell, and Stanton County Conservation Districts also hold an annual Bottom Line Conference, which is a two-day event concentrating on water issues, soil health, range health, regenerative farming, soil and water conservation, etc. Conservation Districts host a poster contest each year in their respective schools, usually targeting 1st through 5th grades. The topics range from water, watersheds, soil, forestry, etc. Conservation Districts also hold farmer-to-farmer meetings with a wide range of topics including the decline of the Ogallala Aquifer, the Kansas Water Plan, cost-share programs, etc.

Figure 17. Ark River Water Festival at Chales Stone Elementary School, Garden City, KS.

Water Conservation Areas

Kansas Law allows individual or multiple producers to enroll land and water into Water Conservation Areas (WCA). WCAs are intended to be a simple, streamlined, and flexible tool that allows for the development of a management plan to reduce withdrawals to extend the usable life of the Ogallala-High Plains Aquifer. There are two Water Conservation Areas (WCA) within the watershed group boundary. One is operated by Circle Land and Cattle and the other is operated by Wheatland Electric Cooperative, Inc. These plans enroll 12,642 irrigated acres, 90 irrigation wells, and 14 industrial wells. The total annual conservation goal between the two management plans is 2,311 AF. Both WCAs have been renewed with savings that exceeded the conservation goals.

Four County LEMA

Western Kansas Groundwater Management District No. 1 implemented a Four County Local Enhanced Management Area (LEMA) in 2023. The portion of southern Scott County that falls within the watershed group boundary is also within the boundary of the LEMA. The goal of the LEMA is to limit irrigation pumping of non-vested rights within the LEMA boundaries, for the five-year period of 2023 to 2027, to 472,000 AF, which would accomplish a reduction of 10% in use from the 2011-2020 average use of those water rights. Each water right under the LEMA has been re-allocated using a sliding scale based on water use from 2011-2020. Rights that produced less than 3 inches of water per authorized acre received no reduction. Rights that produced more than 12 inches per authorized acre received a 25% reduction. A sliding scale was applied to water use values between 3 and 12 inches. Water users have the flexibility to use five times their LEMA allocation over the five-year LEMA period. See https://www.gmd1.org/wp-content/uploads/2023/05/Four-County-LEMA-Report.pdf for the full LEMA plan.

Garden City Water Reclamation and Reuse Project

Garden City is in the planning stages of a water reclamation and reuse project that will play a key role in preserving existing industry and population. The city has advanced discussions to provide reuse water or reclaimed water to a nearby irrigation user in exchange for curtailing the use of groundwater resources during the growing season. This opportunity will allow continued agriculture production while reducing the aquifer demand in an area immediately adjacent to the city's water supply wellfield.

This Managed Aquifer Recharge (MAR) project will take reclaimed water from the city and Dairy Farmers of America (DFA) wastewater treatment plants and transmit the water via a reclaimed water main to the vicinity of the city's sand hills well field to recharge the aquifer.

There are two components to the city's MAR concept:

- Use reclaimed water to offset groundwater pumping by partnering with existing groundwater users to curtail pumping in exchange for a reclaimed water resource. The reclaimed water resources and the corresponding reduction of groundwater pumping will be facilitated through legally binding agreements.
- Use reclaimed water to recharge the aquifer via infiltration basins in the vicinity of the city's sand hills well field.

MAR has unique advantages over a traditional aquifer storage and recovery (ASR)-type project for the city. It requires less treatment, as water used for irrigation purposes is a commonly accepted practice in Kansas. In the non-growing season, the city can divert water to infiltration basins. The unique geology of the sandhills south of the city provides the needed filtration as the water permeates to the aquifer.

This project will reduce groundwater pumping in the vicinity of the city water supply and stabilize aquifer levels to improve the reliability of the city water supply.

The city has identified the following phases for the water reclamation and reuse project. Phase I will be implemented during the preliminary planning for Phase II. Phases III and IV will be incorporated into the city's water reclamation and reuse project should the opportunity or need arise.

Phase I: Reclaimed water for irrigation in-lieu of groundwater pumping, including installation of a new pump station and reclaimed water main with future connections for follow-on phases.
Phase II: Additional irrigation opportunity at the Sandsage Bison Refuge and a MAR system via infiltration basins. Detailed design and construction will occur in the future, but planning should occur to define pipeline routing and flow rates during this phase.
Phase III: Industrial reuse consists of non-potable reuse opportunities with local industries.
Phase IV: Direct potable reuse (DPR) with an advanced water treatment facility.

Garden City is currently working with Circle Land and Cattle and Wheatland Electric Cooperative, Inc. to use the recycled water in exchange for offsetting groundwater use. Circle Land and Cattle will receive approximately 3000 AF for use on 12 fields. Wheatland electric will use the water for water balancing and for cooling at the Sunflower electric plant.

Studying the Viability of Solar Power Generation on the Corners of Center Pivot Irrigation Fields

The Kansas Geological Survey currently is conducting a study in partnership with Circle Land and Cattle and Wheatland Electric to enhance recharge and generate power by installing solar panels on the corners of a field with center pivot irrigation. The goal of the project is to demonstrate how a similar project created on a large scale can enhance recharge, generate power, and stimulate the economy.

Solar panels will be installed as an array with a guttering system to run water into infiltration basins. Assuming roughly ¼" of rainfall would be needed to generate recharge with this system, an estimated 1.25" of recharge would be generated at each field during an average rainfall year. If the project were to be implemented at a large scale covering all fields within 100 mi^2 around Garden City, this could potentially generate roughly 2 GW of power. By comparison, the nuclear plant at Wolf Creek in Burlington, KS generates about 1.2 GW of power and provides electricity to about 20% of Kansans.

There is a plan for further research to be focused on preserving vegetation beneath the panels and creating habitat for pollinators, grass species, and animals.

Conservation Reserve Enhancement Program

The CREP program provides benefits to producers for land and water conservation in 13 counties along Rattlesnake Creek and the Upper Arkansas River. Landowners who enroll in CREP will receive up to 15 years of federal rental payments and a state sign-up bonus to put irrigated acres into a conservation planting. The irrigation water rights associated with the

enrolled land will be permanently retired. Enrollment is on a first-come, first-served basis, with acreage caps applied to individual counties.

CREP is a targeted, enhanced Conservation Reserve Program (CRP), a federal program administered by the United States Department of Agriculture's (USDA) Farm Service Agency (FSA). CRP was designed to prevent soil erosion, but also provides water quality and wildlife habitat benefits. CREP adds additional focus on water conservation.

The CREP program reduces irrigation demands on the stream-aquifer system, reducing aquifer declines. This reduces the spread of saline river water into the aquifer and helps restore stream and riparian health. Most acres enrolled have highly erodible, sandy soils.

Cash rental rates for CREP within the watershed district area range from $158/acre to $169/acre for each year of the contract, up to 15 years. Temporary irrigation is permitted to establish a suitable land cover. Among the approved practices eligible for cost share money are the establishment of permanent native grasses, permanent wildlife habitats, shallow water areas for wildlife, filter strips, wetland restoration, and prairie strips.

The program places priority on critical management acreage where the retirement of irrigated land and associated water rights will protect highly erodible soils and have the greatest water conservation benefit for landowners and the state of Kansas. The conservation practices to be implemented open a host of opportunities for wildlife and landowner revenue related to hunting, recreation, and other forms of agritourism.

Kansas Regional Conservation Partnership Program

In 2024, the State of Kansas was awarded a Regional Conservation Partnership Program RCPP grant from the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) in the amount of $25 million, including $18 million in direct financial assistance for farmers to implement more efficient technology and adopt best farm practices, and $7 million for local partners to provide technical assistance to producers. This program will allow farmers within the state of Kansas, including the watershed area, to participate and improve water use efficiency. Local partners that are providing technical assistance include the Kansas Department of Agriculture, Division of Conservation, the Kansas Water Office, and the Kansas GMDs.

Southern Alternative Delivery System

The main stem of the South Side Ditch was restored in 2011. Portions of the ditch were lined with material from Lake McKinney to reduce infiltration loss. A southern alternative delivery system was also constructed to deliver water more efficiently to the Farmers Ditch headgate by using the South Side Ditch instead of the Arkansas River during periods of low flow. This delivery system is not currently in use due to disagreement between the South Side Ditch and Farmers Ditch over maintenance and payments, but the system is still in place and could be used if the need and desire were to exist.

Lake McKinney Bypass

A bypass around Lake McKinney was constructed in 2011. This bypass allows the Great Eastern Ditch to run water into Lake McKinney to help control flows when desirable, or to bypass the lake when it would be inefficient. This project has greatly reduced transit losses in the ditch system.

Water Quality Testing

The Kearny County Conservation District, with funding from the Kansas Department of Agriculture, Division of Conservation, has a program where anyone with a well in the area of the watershed affected by uranium contamination can get a free water quality test. Those who have wells where uranium is at unsafe levels will be eligible for a free under-the-sink reverse osmosis system to provide clean drinking water to their household. Anyone interested in a sample should contact the Kearny County Conservation District.

Removal of Tamarisk

Ducks Unlimited has recently started work on a project to remove tamarisk along the Arkansas River channel between Dodge City, KS and Lamar, CO. The project is being funded through a grant from the North American Wetlands Conservation Act (NAWCA). The project has enough funding to remove 2,352 acres of tamarisk and restore Arkansas River Cottonwood savanna riparian habitat.

The tamarisk being removed by this project is an invasive species that has become dominant over native plant species. It has contributed to channelizing the stream and adds to the already high salinity levels of the river channel and adjacent seed bad, creating a loss of native forbs and grasses and degrading soil health, water supply, and natural hydrology of the riverine system. This has created a loss of wildlife habitat, including that utilized by waterfowl, and a loss of rangeland productivity and soil health.

Ducks Unlimited is partnering in the project with the Syracuse Dairy, who has identified the importance of removing tamarisk on their lands to improve forage quality and enhance wildlife benefits. The Dairy has contributed significantly to this restoration effort, independently conducting large-scale removal efforts over the last several years. To date, the dairy has restored 1,176 acres of wetland habitat along the river and is committed to doing another 1,176 acres in new habitat delivery through this grant program, restoring over 25 miles of river frontage.

Other project partners include Star Seed, Mule Deer Foundation, Kearny County Conservation District, Kansas Alliance of Wetland and Streams, and the Kansas Department of Agriculture, Division of Conservation. Contributions include funding for the removal efforts as well as the cost of seed and installation of a native riparian seed mix that will be installed in the areas where Salt-cedar was removed. This mix was designed to mimic the species of native grasses and forbs that would have historically been part of the Cottonwood Savanna Riparian areas along the Arkansas River, providing the diversity necessary to withstand floods, droughts, periods of full saturation or inundation while providing native wildlife habitat. Some of these species were also

selected for their preference of the higher soil salinity that is present after Salt-cedars are removed as well as this area having higher soil salinity that is found in and around other portions of the Arkansas River and associated wetlands.
This project creates a win-win scenario through creative partnerships to improve the local ecology while improving the profitability of local businesses and improving streamflow.

Deerfield Reliable Water Supply Project

The City of Deerfield currently has a project scoped to produce a plan to mitigate its growing problem with uranium contamination in its wells. The project will identify, design, and engineer a reliable water supply for the community. Deerfield provides water and wastewater services to retail customers and wholesale agencies in eastern Kearny County, Kansas, serving a population of 711 people. The city is applying for funding to evaluate four alternatives to address the loss of water supply reliability that they are suffering due to rising levels of uranium in their municipal wells. The top alternative will be selected, and all surveying and engineering design will be completed under this project. This project will build from an Upper Arkansas River Basin Public Water Supply Alternatives Viability Analysis that was completed in 2014 by the Bureau of Reclamation Great Plains Region, Oklahoma-Texas Area Office, the Kansas Water Office, and Southwest Kansas GMD3. The project will take three years to complete.

The four alternatives to be evaluated are as follows:

1. Find and purchase a new well with better water quality that could be mixed with the city's existing wells to provide the necessary water for the city.
2. Install a new water line from the City of Lakin to Deerfield to bring treated water to mix with the existing water from the city's wells.
3. Install a central reverse osmosis (RO) water treatment plant, or an RO treatment skid at the two larger well houses to treat the water from the city's existing wells.
4. Conduct testing to determine to what extent uranium concentrations vary with depth and seal more shallow layers on the existing wells to lower the concentration of water being pumped.

Deerfield has three municipal wells. One well currently does not meet drinking water standards for uranium and is currently only being used for irrigation projects. The other two wells last tested at 29 µg/L and 25 µg/L uranium. The EPA maximum contaminant limit is 30 µg/L. The wells are progressively testing at higher concentrations, so while the city currently meets drinking water standards and can change some operational practices to blend water to stay below the standard in the short term, action will need to be taken soon to address this growing problem.

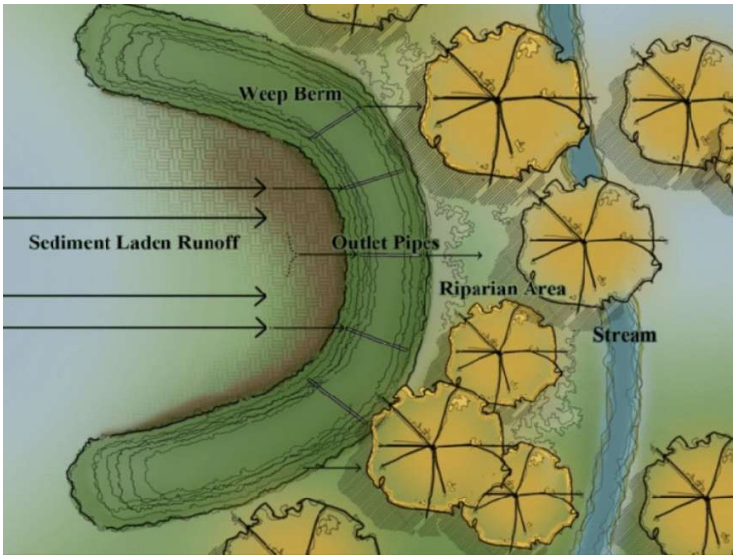
This project allows Deerfield to be proactive and select the most cost-effective alternative to provide clean, safe drinking water to its citizenry. This grant opportunity has come at just the right time for the community to develop a plan and put that plan into action as soon as it is required. This planning would come at significant cost to Deerfield were they to have to pay for it themselves, as the city has a population of less than 1,000 people and the population ranks in the 73rd percentile nationally for low income.

Deerfield has received funding from the Kansas Water Office's Technical Assistance Fund and will begin work on this project in 2024.

Infiltration Catchment Pilot Project

The KGS is running a pilot project in Western Kansas Groundwater Management District 1 (GMD1), just north of the watershed, to implement infiltration catchments that serve as "recharge conduits." Two sites are being sampled for water quality, with plans to install monitoring wells and sensors in 2026. At least one year of data will be collected to determine to what extent recharge is being enhanced.

Infiltration catchments capture rainwater from ag lands before flowing into the Upper Arkansas River, allowing it to infiltrate into the groundwater to combat the outward spread of saline water in the Arkansas River. This encourages healthy soils with improved infiltration with soil biology and structure. These catchments may be implemented with miles of vegetative berms or Hickenbottom drains to move water from the surface past the less permeable layers of soil and root zone into the more permeable zones below. Illustrations of vegetative berm and Hickenbottom drain systems are below.



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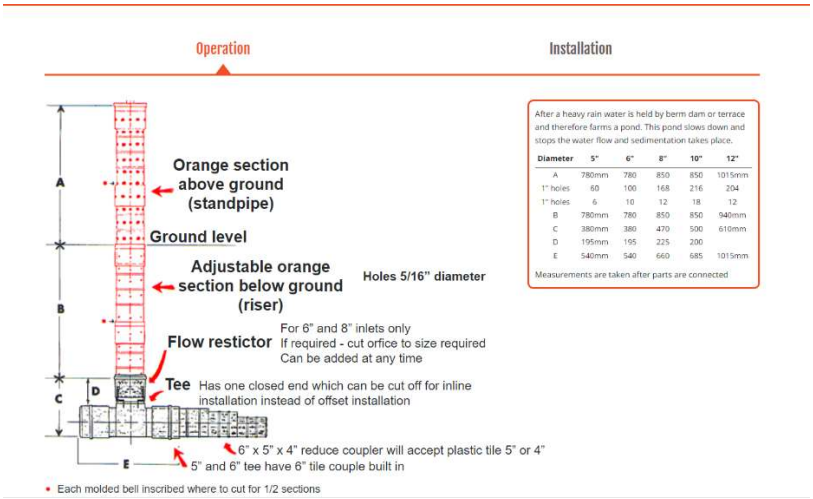

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Figure 18. Illustration of infiltration catchments using (a) vegetative berms or (b) Hickenbottom drains. Note that the illustration of vegetative berms is not to scale.

Preliminary modeling performed by the KGS indicates that a similar project may have potential to significantly impact water quality locally and there may be some utility to locating catchments near municipal well fields. See Figure 19 for modeled results if implemented near Holcomb's well fields.

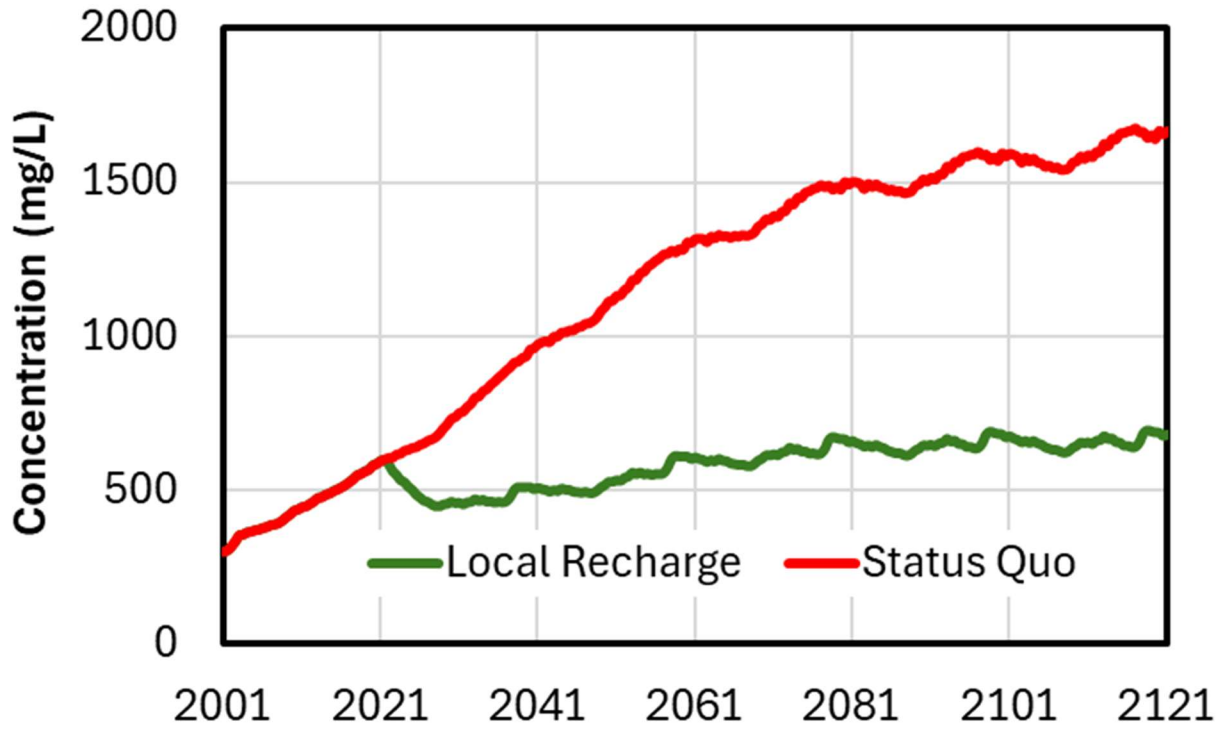

Figure 19. Simulated Sulfate Concentration at the Holcomb Wellfield (South) Centroid.

5. Proposed Projects and Strategies

Stabilization and/or Improvement of the Aquifer

The Upper Arkansas River Watershed Group fully supports any measures that will promote stabilization and/or improve the aquifer. The group also supports projects that improve water use efficiency within or adjacent to the watershed boundary. This can include projects that create management areas such as WCAs and LEMAs, projects that provide direct incentive for reduced water use, projects that provide cost-share for efficiency improvements, and projects that create decision support tools for water users. Projects that provide consideration for prior appropriation and allow for water marketing are more desirable than projects that do not.

The long-term goal of groundwater use reductions is to stabilize groundwater declines. In some areas of the watershed, this will require a reduction from recent use as high as 24%. In other areas, the required reduction is as low as 4%. The elimination of groundwater declines will stabilize well pumping capacities and ensure long-term viability of irrigated agriculture, the backbone of the local economy, throughout the watershed. It will greatly reduce the rate of further diminishment of water quality through surface water infiltration and maintain a constant quantity of water below ground for dilution.

Projects that conserve water while expanding on other existing conservation or providing environmental benefit should be prioritized. Existing water conservation work that might compliment a groundwater conservation project includes:

Water Conservation Areas

There are currently two WCAs within the watershed, with an additional eight WCAs adjacent to the watershed, within counties that the watershed extends into. These WCAs cover 45,373 acres and conserve 8,223 acre-ft per year. Potential water conservation projects could incorporate additional water conservation areas to add to this savings total.

LEMAs

A portion of the Four County LEMA is within the watershed boundary and the Wichita County LEMA is just to the north of the boundary. GMD3 is currently working toward setting goals and action plans for priority areas and may implement one or more LEMAs within the watershed. Any water conservation project that falls within a LEMA boundary should follow the rules set by the LEMA and compliment and expand on the water savings goal that has been set.

Cost-Share for Technology Improvements

NRCSoffers cost-share opportunities through their Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP) for producers to receive cost-share

payment to implement new technologies and to build on existing conservation efforts. NRCS also offers grant programs for state and local agencies and 501(c)(3) corporations to target or expand adoption of specific practices. These opportunities include the Regional Conservation Partnership Program (RCPP), Conservation Innovation Grants (CIG), and Conservation Collaboration Agreements (CCA). The Kansas Department of Agriculture, Division of Conservation has recently been awarded an RCPP grant that will greatly expand the availability of cost-share programs for irrigation technology throughout Kansas. GMD3 has submitted a CCA grant to form a Master Irrigator programs in Kansas to provide education and technical support to farmers.

Decision Support Tools

Frequent drought, declining well capacity, and poor water quality create the need for municipalities and other water users to have effective decision support tools to establish long-term plans to conserve water, mitigate drought, and protect the environment. The Reclamation WaterSMART Drought Response Program offers grants to projects that increase the reliability of water supplies through infrastructure improvements, improve water management through decision support tools, modeling, and measurement, and/or provide protection for fish, wildlife, and the environment. GMD3 has recently been awarded a Drought Response grant to create a tool to break the district into regions, identify subregions with similar water users and well capacities, and generate an annual report to irrigators that detail their water use, the water use of other irrigators in their subregion, and aquifer characteristics and trends within their region. See http://gmd3.org/icare.

Improved Efficiency of Surface Water Irrigation

The Frontier Ditch, the Amazon Ditch, the Great Eastern Ditch, the South Side Ditch, the Farmers Ditch, and the Garden City Ditch own vested surface water rights to divert water from the Arkansas River for irrigation use. Irrigators who utilize this water do not always receive sufficient irrigation flow, so groundwater is used to supplement flows. Improvements to the efficiency of surface water deliveries advance the ability of the ditch systems to share the river and reduce groundwater demand. These improvements include lining of irrigation ditch to prevent seepage, conversion of open ditch to pipe, conversion of flood irrigation to center pivot, and implementation of farming practices that save water. Improvements may also be other infrastructure improvements that reduce losses. The following opportunities exist for improved efficiency in surface water systems:

Frontier Flume Upgrade

The Frontier Ditch, located near Coolidge, Kansas, is one of the six active irrigation ditches in the watershed area. It is measured by the U.S. Geological Survey using a Parshall flume. It is unclear when the current steel flume was installed, but it is believed to be at least forty years old, possibly dating to 1950, and is in very poor condition. DWR is pursuing several funding sources, including Bureau of Reclamation grants and the Arkansas River Compact Administration (ARCA) to replace the flume with a more durable stainless steel or concrete flume. This will not only make measurements more accurate but also ensure the flume does not fail during the

irrigation season. Due to the ditch's location, this flume is one of two sites that make up the Kansas-Colorado State line flow as defined in the Compact, and so this site is critical to ensuring compact compliance. The goal is to install the new flume, stilling wells, staff gages, and gage house over the winter of 2025-26.

DWR and the Frontier Ditch are also exploring options for improving the ditch's headgate, which may include upgrades to the control system, replacing components of the gate itself, and possible automation.

Figure 20. The Frontier Ditch flume, proposed to be replaced.

Improvement or Mitigation of Poor Water Quality

Projects that improve or mitigate poor water quality within the watershed will be a priority of the Upper Arkansas River Watershed Group. These can be projects for cities to plan or implement water treatment or alternative supplies, projects to provide enhanced recharge from rainfall or another clean water source near wells with a threatened or impaired water supply, studies that will provide water users with information on how to best farm or ranch with the water in the basin, projects that provide well testing and treatment for domestic water users, and other similar projects.

Groundwater Level and Specific-Conductance Monitoring in the Arkansas River Valley – Colorado-Kansas

The United States Geological Survey developed a proposal in 2023 in response to concerns about increasing specific conductance in groundwater on the Colorado-Kansas border south of the Arkansas River, providing a scope of work and costs for additional monitoring of groundwater

levels and water quality (specific conductance, temperature) in the area to characterize groundwater flow direction and water quality.

The proposal included installing eight monitoring wells in addition to monitoring wells that are already within the region, including four wells in each of the regions identified on the map in Figure 18. Well drilling was not included as part of the project scope but may be required, depending on the availability of existing wells. The proposal included total costs of $696,500 for 41 months of continuous real time data, $647,500 for 41 months of continuously recorded data, or $336,800 for 41 months of discreet measurements.

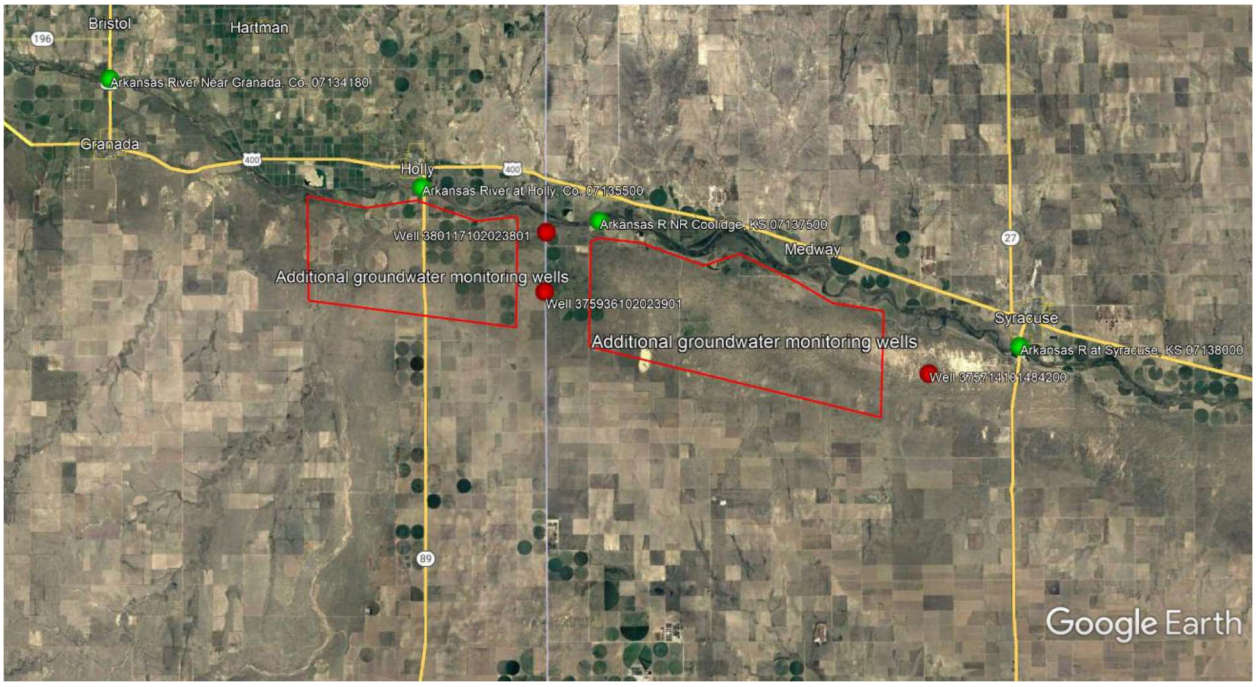

Figure 21. Location of study area, existing streamflow stations (green circles), monitoring wells (red circles), and areas for additional groundwater monitoring data (outlined) in red.

Addressing the Desertification of the Sand Hills (CREP Enhancement)

Programs that address the desertification of the sand hills are a priority of the watershed group. NRCS has partnered with the Kansas Department of Agriculture, Division of Conservation, with cost share support from GMD3, to implement the CREP program for conversion of irrigated ground to native grass. This program has been successfully used by some irrigators to establish Conservation Reserve Program (CRP) grasses, but some producers have failed to successfully establish grass and some acreage on the sand hills has ceased irrigation without enrolling in CREP or transitioning to grass. This poses a significant problem to other irrigated fields and local communities because this soil is unsuitable for dryland farming and if no ground cover is established, bare rolling sand dunes will create sandstorms and drift onto neighboring land.

A program that compliments CREP could allow the producer to keep a reduced water right, rather than retire it. Payment for reduction of water right is available under the WaterTAP program, offered by the Department of Conservation. This payment could be the basis for any

required cost share, or in the cases that the program being cost shared is funded under the Bipartisan Infrastructure Law, the Build Kansas Fund could be utilized for any required cost share. Local biologists and conservationists should set standards and practices that others have been successful with. Irrigators would be able to obtain a conservation easement to ensure that land does not return to irrigated agriculture. This provides a tax benefit on top of the payment offered by the program.

Improving Ecological Resiliency

Removal of Tamarisk

There is some opportunity to expand on the above-mentioned project to remove tamarisk along the Arkansas River. Some local producers are reluctant to clear the tamarisk on their land because of perceived benefits to deer populations. The effectiveness of the existing project could be improved by providing compensation to landowners beyond the cost of removal and seeding.

Playa Restoration

The watershed group boundary contains up to 5,526 playa acres. Of these, projects have restored 1,384 acres into functioning playas. There is some opportunity to restore more playas to their natural functioning state. Playa lakes on average recharge about three inches per year and provide natural filtration to improve water quality. They also provide habitat for waterfowl, creating hunting opportunities when they are full.

Recreational Opportunity

Mixed Use Trails

Finney County Public Works has developed some alternatives for constructing mixed use trails in rural areas outside of Garden City. One trail follows the river corridor between Garden City and Holcomb and another connects Garden City to the Southwind Development south of town. These projects are intended to provide and promote outdoor recreational opportunities for Finney County residents and they could also be a useful tool to provide water and nature education through strategic signage.

6. Ranking of Proposed Projects and Strategies

The following ranking criteria was voted on by the Board of Directors of the Upper Arkansas River Watershed Group. All projects listed are considered worthwhile and may be worked on by the Watershed Group. Membership is encouraged to recommend additional projects not listed for inclusion in the restoration plan in further refinements. Projects may be worked on and/or supported by the Watershed Group in a different order than is listed below. The rankings are intended to provide guidance to the group for prioritizing work in the case that potential projects are competing for the same time and money.

Aquifer Stabilization/Improvement Projects

All projects that further the goal of aquifer stabilization are critical to the long-term viability of the region. The Watershed Group ranks these projects as follows:

1. Water Conservation Areas
2. Cost share for technology improvements
3. Decision support tools
4. LEMAs

Improved Efficiency of Surface Water Irrigation

The surface water irrigation system within the watershed is very water-short. Projects that improve efficiency will help to reduce the risk of conflict between surface water users. These projects will also reduce the need for groundwater pumping by delivering more surface water to the field. The Watershed Group ranks these projects as follows:

1. Canal lining/piping focused on more efficient delivery
2. Canal lining/piping focused on water quality improvement
3. More efficient check/lateral structures
4. Conversion from flood to center pivot

Special consideration will be given to any of the above projects that incorporate elements to improve or mitigate poor water quality.

Improving Ecological Resiliency

Projects that improve ecological resiliency will provide wildlife habitat, improve stream health, and improve quality of life in the region. The Watershed Group ranks these projects as follows:

1. Removal of tamarisk
2. CREP enhancement/alternatives
3. Playa lake restoration

7. Funding of Proposed Projects

The following funding opportunities have been identified for proposed projects and strategies:

Bureau of Reclamation Grants

WaterSMART Water and Energy Efficiency Grants (WEEG)

Reclamation offers WEEG grants for projects that improve water use efficiency and create renewable energy. The objective of the program is to invite eligible applicants to leverage their money and resources by cost sharing with Reclamation on projects that seek to conserve and use water more efficiently; increase the production of renewable energy; mitigate conflict risk in areas with a high risk of future water conflict; enable farmers to make additional on-farm improvements in the future, including improvements that may be eligible for Natural Resources Conservation Service (NRCS) funding; and accomplish other benefits that contribute to sustainability in the West. Award maximums are broken into three funding groups. Funding group I is for smaller projects, with a maximum award of $500,000. Funding group II is for larger projects, with a maximum award of $2,000,000. Funding group III is for even larger projects, with a maximum award of $5,000,000. The ability to generate hydroelectric power is very limited on the Arkansas River in Kansas, so applications for this program within the watershed have been limited to the funding pool for smaller projects. A project that incorporates solar power and will create significant water savings might be able to successfully seek a larger grant. GMD3 recently submitted a WEEG on behalf of the South Side Ditch to convert three ditch laterals to PVC pipe.

WaterSMART Small Scale Water Efficiency Projects

Reclamation Small Scale Water Efficiency Projects grants fund projects that are very similar to what would be funded from the WEEG program. This grant was created to provide opportunity for smaller projects with a total cost of $200,000 or less.

WaterSMART Planning and Project Design Grants

Reclamation's Planning and Project Design Grants offer funding for projects that fall under the category of water strategy, project design, or drought contingency planning.

Water strategy grants provide a cost share to entities for the purpose of creating initial, or early-stage planning activities, including research and collaboration, technical analyses and assessments, project scoping activities to identify and prioritize potential implementation projects, and to develop a strategy document for water supply projects, water marketing activities, water management projects, and/or activities and river restoration activities, including planning projects to restore a natural feature or to use a nature-based feature to reduce water supply and demand imbalances or the risk of drought or flooding; and projects that otherwise mitigate against the impacts of climate change to fish and wildlife habitats. Maximum award amounts are $400,000. GMD3 was recently awarded a Project Design Grant to hold producer meetings to set conservation goals and action plans. Funding helps to cover costs for facility rental and meeting facilitation, creation of a forage production model, and a statistical analysis on changes to irrigated acreage on various soil types and aquifer characteristics. For water strategy grants with ecological benefits, applicants must provide 25% cost share. All other applicants must provide 50% cost share.

Project Design Grants are for leveraging money and resources by cost sharing with Reclamation the final design of medium and large-scale on-the-ground water supply construction (including domestic water supply projects for Tribes, insular areas, and disadvantaged communities), water

management construction and restoration projects. Applicants are expected to have already performed some general planning work and preliminary studies that led to the identification of a specific location for project design. No cost share is required for projects that provide domestic water supplies to disadvantaged communities. All other applicants must provide 50% cost share.

Drought Contingency Planning grants support a proactive approach to drought by providing financial assistance to develop and update comprehensive drought plans. Reclamation provides funding for planning that, when implemented, will increase water reliability and improve water management through the use of expanded technologies and improved modeling capabilities. Proposals may develop a new drought contingency plan or update and existing plan. All proposals must be phased, with Phase I including the establishment of a drought planning task force, development of a detailed work plan, and development of a communication and outreach plan. Phase II designates a planning lead to develop the plan or plan update. Applicants must provide 50% cost share. In exceptional circumstances, Reclamation may waive the cost share requirement, if an overwhelming Federal interest and a significant financial need are identified.

Environmental Water Resource Projects

The Environmental Water Resource Projects grants are for the purpose of leveraging money and resources by cost sharing with Reclamation on environmental water resource projects, including water conservation and efficiency projects that result in quantifiable and sustained water savings and benefit to ecological values or watershed health, water management or infrastructure improvements to benefit ecological values or watershed health, and restoration projects benefitting ecological values or watershed health that have a nexus to water resources or water resources management. Projects that 1) increase water supply reliability for ecological values; 2) are developed as part of a collaborative process by a watershed group or by a water user and one or more stakeholders with diverse interests; and 3) have the majority of benefits being for the purpose of advancing one or more components of an established strategy or plan to increase the reliability of a water supply for consumptive and non-consumptive ecological values are eligible for a 25% cost share. Projects that do not meet those three requirements must provide a 50% cost share. Maximum awards are $3,000,000, though non-profit conservation organizations, including watershed groups, may be awarded up to $15,000,000 if partnered with different states, tribes, irrigation districts, water districts, other state, regional, or local authorities with water or power delivery authority, or other organizations with water or power delivery authority.

Applied Science Grants

The Reclamation Applied Science Grants program allows applicants to cost share with Reclamation on applied science projects to improve access to and use of hydrologic data, develop and improve water management tools, and improve modeling and forecasting capabilities. Results from these projects are to be used by water managers to increase water supply reliability, provide flexibility in water operations, improve water management, and support nature-based solutions. Project results must be readily applicable by managers – resulting in tools and information that can be used to support: water supply reliability, water delivery management, water marketing activities, drought management activities, conjunctive use of ground and surface water, water rights administration, ability to meet endangered species

requirements, watershed health, conservation and efficiency, support for nature-based solutions and other water management activities. Applicants whose project primarily provides ecological benefits must provide a 25% cost-share. All other applicants must provide 50% cost-share. The maximum award under this grant is $400,000.

Drought Response Program

The Reclamation Drought Response Program supports a proactive approach to drought by providing assistance to water managers to: develop and update comprehensive drought plans and implement projects that will build long-term resiliency to drought. Program areas include contingency planning, resiliency projects, and emergency response actions. Eligible projects under this program are broken down under the following tasks:

Task A: Increasing the reliability of water supplies through infrastructure improvements.
Task B: Increasing the reliability of water supplies through groundwater.
Task C: Projects to improve water management through decision support tools, modeling, and measurement.
Task D: Construction of domestic water supply projects for Tribes or disadvantaged communities that do not have reliable access to water supplies.

Projects under tasks A-C have a maximum award of $3,000,000 per project. Projects under Task D have a maximum award of $10,000,000. Applicants for projects that fall under Tasks A-C must provide a 50% cost-share. Applicants for projects that fall under Task D must provide a 5% cost-share. There are portions of the watershed boundary, including all of Kearny County, that are currently identified as disadvantaged by Reclamation.

Natural Resource Conservation Service Grants

National Water Quality Initiative

The Kansas Department of Health and Environment (KDHE) helped facilitate a grant that has recently been awarded to GMD3 under the National Water Quality Initiative (NWQI) grant program from NRCS for creating a plan to address poor water quality in the Arkansas River Basin, with the ability to seek an implementation grant to fund practices that save water and improve water quality. This implementation grant will direct targeted funding to water and land users within the watershed to improve efficiencies and soil health and reduce the infiltration of poor-quality water from the surface and improve the ability to improve groundwater quality at key locations by increasing rainfall recharge. This and nutrient management should help increase the infiltration rate of better quality water in key locations and dilute the underlying uranium-laden water.

Regional Conservation Partnership Program (RCPP)

The Regional Conservation Partnership Program (RCPP) is a grant provided by NRCS as a partner-driven approach to conservation that funds solutions to natural resource challenges on

agricultural land. It provides funding to support conservation activities done for or on behalf of producers, landowners, and other entities. RCPP projects may include land management/land improvement/restoration practices, land rentals, entity-held easements, United States-held easements, and/or public works/watersheds.

Conservation Innovation Grants

The NRCS Conservation Innovation Grants program supports the development of new tools, approaches, practices, and technologies to further natural resource conservation on private lands. Projects funded under this program demonstrate innovative approaches to address resource concerns identified by NRCS that are not possible under existing NRCS programs. These projects are conducted in a similar manner to a research project, but they are intended to use scientific methods to demonstrate the effectiveness of proven technology, rather than to identify whether a technology or approach is effective. Funding is specifically not for research projects. Applicants must provide a 50% cost share, and half of the cost share must be cash.

State of Kansas Grants

HB 2302 Grant Programs

The Kansas Water Office HB 2302 Grant Programs offer financial assistance to applicants under two funds: the Technical Assistance Grant Fund and the Water Projects Grant Fund. The Technical Assistance Grant Fund is for planning, engineering, managing and other technical assistance that may be necessary in the development of plans for water infrastructure projects, or for processing grant and loan applications for such water infrastructure projects. The Water Projects Grant Fund is for construction, repair, maintenance or replacement of water-related infrastructures and any related construction costs; matching moneys for grant or loan applications for water-related infrastructure projects; and application of the funds to an outstanding loan balance from the Public Water Supply Loan Fund or the Kansas Pollution Control Fund. Technical Assistance Grants may not exceed $1,000,000 and Water Projects Grants may not exceed $8,000,000. Neither grant has a matching funds requirement. The City of Deerfield was successful in obtaining a Technical Assistance grant and has begun work to evaluate alternatives and develop a plan to mitigate the rising uranium levels that have imperiled their drinking water supply.

KDHE Ditch Lining and Recharge Basins

The KDHE is implementing a program for strategic canal lining within the watershed to reduce the infiltration of poor-quality water near domestic and municipal wells. They also have funding to create recharge basins to help offset the loss of recharge to local well users. This is a pilot project that includes Kansas Water Plan funds of $1,000,000 for ditch lining or piping and $500,000 for construction of recharge basins.

Build Kansas Fund

The Build Kansas Fund provides state matching dollars for projects that successfully apply for Federal grants under the Bipartisan Infrastructure Law. This fund authorizes up to $200 million in funds for match to be spent through June 30, 2027. This presents a tremendous opportunity for all stakeholders in the watershed to cost-share projects with Federal funds that they would not otherwise have the financial resources available for.

Funding Opportunity	Potential Projects		
Planning and Project Design	Conservation Areas (WCAs and LEMAs)	Water quality mitigation	Decision Support Tools
RCPP	Cost-share for technology improvements		
Small Scale Water Efficiency Projects	Improved Efficiency of Surface Water Irrigation		
Water and Energy Efficiency Grants	Improved Efficiency of Surface Water Irrigation		
Build Kansas Fund	Any project where a source of funding is BIL		
KDHE Ditch Lining and Recharge Basins	Improved Efficiency of Surface Water Irrigation		
HB 2302 Grant Programs	Water quality mitigation		
National Water Quality Initiative	Cost-share for technology improvements		
Environmental Water Resources Projects	Removal of tamarisk	Playa restoration	
Conservation Innovation Grants	CREP enhancement/alternatives		
Applied Science Grants	Decision Support Tools		
Drought Response Grants	Decision Support Tools	Improved Efficiency of Surface Water Irrigation	