

General Description

The [Upper Arkansas basin](#) covers 10,300 square miles of west central Kansas. The basin includes all or parts of 20 counties. The Arkansas River is the dominant river. It receives water from snow and rain run off resulting in periodic high flows. There are no major tributaries to the Arkansas River until Mulberry Creek in Ford County; west of this, flows are highly dependent on flows entering from Colorado. The Pawnee River, Walnut Creek and Coon Creek are major tributaries of the Arkansas River in this basin. Declines in the alluvial [aquifer](#) have reduced or ceased baseflow contributions for most of the river west of Kinsley, with discharge from the alluvial aquifer only after high flow events have recharged bank storage. Some or all of the Arkansas River flow is lost as infiltration from the stateline to Dodge City. White-woman Creek and James Draw drain a portion of the basin but end in depressions. Remaining areas of the basin are drained by numerous small direct tributaries of the Arkansas River.

Kansas Arkansas River basin overlies the High Plains aquifer. The High Plains aquifer, of which the Ogallala is

the dominant portion, has been identified as a national concern regarding water quantity.

Population and Economy

There were an estimated 128,500 residents in the basin in the year 2000.⁽¹⁾ According to the Kansas Division of Budget, the total [population](#) of the 19 counties that are contained in whole or in part by the Upper Arkansas basin had a population of 171,733 in 2000. By 2040, the county population is projected to decrease to 163,207.⁽²⁾

This basin illustrates major demographic changes that are taking place in Kansas. In the past 40 years, two trends have dominated the state and the basin: 1) Rural counties have lost population, sometimes more than 10 percent every decade; 2) Urban counties particularly in the great Wichita area and Kansas City area are gaining population at an even greater rate.

In the Upper Arkansas basin counties with meat packing plants in the immediate vicinity are gaining population. Finney County went from a population of 16,093 in 1960 to 40,712 in 2000.

Ford County went from a population of 16,093 in 1960 to 40,712 in 2000. Other rural counties, however, are losing population. Greeley County, with a population of 2,087 in 1960, had only 1,537 people in 2000. Ness County, which had 5,470 people in 1960, lost more than 2000 residents by the year 2000.

The economy of the basin is based primarily on agriculture and manufacturing. The major [crops](#) are wheat, grain sorghum, corn and alfalfa with a sizable portion of this acreage being irrigated. Irrigation has helped stabilize the agricultural economy in this area of marginal precipitation.⁽⁵⁾

The total value of regional economic activity was about \$10.3 billion in 2003. Manufacturing, where meat packing and other food processing is represented, is by far the largest economic sector. Regional employment totaled more than 83,000 jobs. This economic activity generated about \$3.8 billion in value added income, the most important measure of regional household welfare associated with regional economic activity.⁽³⁾

Dodge City, Garden City and Barton County Community Colleges offer opportunities for higher education.

Recreation is an increasing part of the economics of the basin. The state parks and associated recreation and wildlife areas draw hunters to the region. There is one Multipurpose Small Lake, Jetmore Lake in Hodgeman County, located in the basin. In April 2008, construction began on HorseThief Reservoir, a 450-acre watershed lake. The lake will provide flood control and water-based recreation for the region.

A growing contribution to the basin economy is related to energy production, including ethanol. As of December 2008, two ethanol plants are located in Finney County and one in Wichita County. One additional ethanol plants is planned for Ford County.

Physical Characteristics

Geology and Soils

The [Tertiary and Quaternary undifferentiated sediments](#) deposits in the area are underlain by Cretaceous age bedrock deposits. The bedrock has an east-to-southeast drainage trend. Major structural controls are the Bear Creek fault in Hamilton and Kearny counties, and Crooked Creek-Fowler fault in Ford County. These faults created a vertical displacement up to 250 feet, and bound a subsidence that filled with the younger, unconsolidated sediments of the aquifer. West of Bear Creek fault, alluvial sediments overlie Cretaceous bedrock and the High Plains aquifer is not present. The impermeable nature of this bedrock allows for minimal to no infiltration beyond the alluvial deposits. East of the fault, the alluvial sediments overlie the Tertiary and Quaternary deposits in which the High Plains aquifer occurs.

Land features are comprised predominantly of level to gently rolling tableland that is dissected with narrow drainage ways. Soils are deep on the ridge tops and moderately deep to shallow on the side slopes. Soil texture ranges from medium to fine.

Several different soil associations are found in the basin. Along the Arkansas River floodplain and terraces, sandy, loamy and clay soils predominate. South of the river, there are also areas of sand hills, classified as

duny soils.

Land Use/Land Cover

[Land use](#) in the basin typically is dominated by cropland (64.6%) or grassland (24.1%) or Conservation Reserve Program land (10.3%). Less than one percent of land within the basin is comprised of residential, commercial/industrial and municipal use, open water and barren ground.

The Upper Arkansas basin has 28,531 stream bank miles. Within a 100-foot corridor along each bank, about 52% of the land is pasture/grassland followed by cropland (37%).



View from Pawnee Rock, Barton County.
Photo courtesy of Kansas Geological Survey.

While comprising less than one percent of the bank miles, the Upper Arkansas basin has the most animal production stream bank area of the Kansas basins.⁽⁶⁾

Climate

The basin climate is characterized by the extremes and variability of [precipitation](#) and temperature common to mid-continent locations. Average annual precipitation increases from approximately 16 inches at the Colorado border to 26 inches in the east. These annual quantities are subject to wide fluctuation, with thunderstorms accounting for most of the annual rainfall. Most of the precipitation occurs between April and September.

Temperatures tend to increase from west to east across the basin in response to declining elevations. At Garden City the average annual temperature is 53.1° F. while at Great Bend it is 56.0° F. The frost free period shows a similar west-to-east pattern (Table 1).

Location	Average Annual ¹		Freeze Dates (32 F.) ²		
	Precipitation (inches)	Temperature (F)	Last	First	Days Between
Garden City	18.77	53.3	Apr. 26	Oct. 13	169
Great Bend	26.45	56.1	Apr. 15	Oct. 21	191

¹Source: National Climatic Data Center (1971-2000 data)

²Source: KSU Weather Data Library (1961-1990 data)

Drought is a naturally recurring feature of this climate as exemplified by the Dust Bowl of the 1930s and the severe drought of 1952-1957. It is perhaps the most pervasive natural hazard affecting Kansas and other agricultural areas of the central United States. Kansas has been impacted by severe drought periodically throughout the present decade.



Windswept dune, Sandhill south of Arkansas River in Kearny County. Photo courtesy Kansas Geological Survey.

The Upper Arkansas River basin is greatly affected by reductions in precipitation that are offset by ground water pumping to irrigate cropland that has not received sufficient rainfall. Drought increases the demand on the available water supply. Precipitation events moisten the soils near the surface but soil moisture needed for crops is lacking, reservoirs water levels are at record lows and streamflow is down.

Wildlife and Habitat

The Upper Arkansas River basin encompasses a wide array of habitat types that support rich and extremely diverse wildlife populations. The wildlife community includes 54 reptiles and amphibians, 48 fish, 54 mammals, and 283 bird species. Fifteen state or federally listed threatened or endangered species share a probable or historic range or critical habitat within the basin.

In 1996, the U.S. Geological Survey (USGS) reported that Kansas has about 435,000 acres of wetlands, which include sandhill pools along the Arkansas River, playa lakes in western Kansas, freshwater marshes such as those in Cheyenne Bottoms, and salt marshes such as those in Quivira National Wildlife Refuge.

Kansas has lost about one-half its wetlands during the last 200 years, mostly due to conversion to cropland, and depletion of surface and ground water by irrigation withdrawals.

Water Resources

The Arkansas River receives water from snow and rain run off resulting in periodic high flows associated with precipitation. Colorado Rocky Mountain snowmelt and runoff have a major impact on water flowing in the river as well as runoff in Kansas. There are no major tributaries to the Arkansas River in Kansas until Mulberry Creek in Ford County.

The principal sources of ground water in the basin are the saturated sands, gravels and silts in the thick deposits of Tertiary and Quaternary age. This includes the alluvial deposits along the river and tributaries and the Ogallala Formation of the High Plains aquifer.

The thickness of the Arkansas River alluvium ranges from about 10 feet to over 80 feet. Alluvial ground water levels are highly variable but a steady decline throughout the basin has occurred, with significant declines east of Garden City.



Aerial view of center pivots in Kearny County.
Photo courtesy Kansas Geological Survey.

The Upper Arkansas basin contains 13,165 miles of intermittent and 843 miles of perennial streams for a total of 14,008 stream miles. The density of 1.3 stream miles per square mile, places the basin second to last among the twelve major river basins.

Minimum Desirable Streamflow (MDS) has been set for two USGS gages inside the basin: one near Great Bend and one near Kinsley. On average, streamflow has been insufficient to meet the MDS goals at these locations (Great Bend, 66-88%; Kinsley 55-66%). During the recent drought, the frequency at which these locations have been able to meet MDS has decreased.

Ground water is the source for 96% of supply for all reported uses in 2006. Irrigation accounted for nearly 95% of [all reported water pumped](#) or diverted. Municipal use accounted for two percent of water used in the basin, industry for one percent and recreation, stockwater and other uses combined equal about two percent (2006).⁽⁷⁾

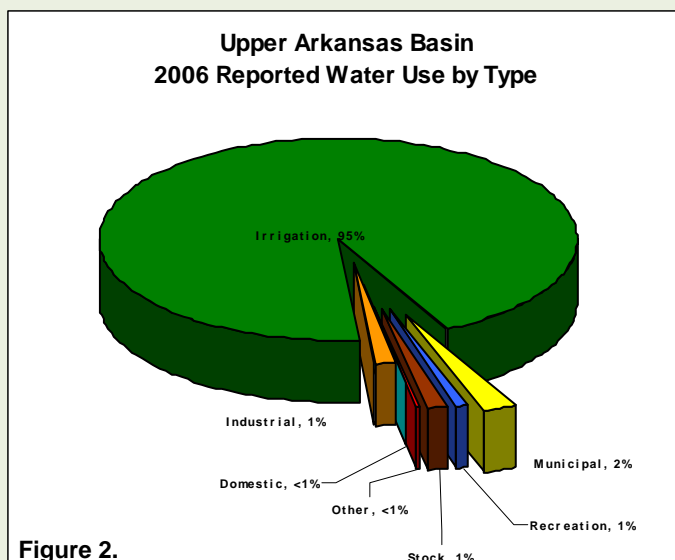


Figure 2.

Authorized withdrawals for irrigated agriculture use the majority of all water used in the Upper Arkansas River basin. The ground water levels have declined due to the withdrawals that exceed recharge. Saturated thickness of the aquifer system in the basin has decreased generally between 10 and 50 ft, but as much as 150 feet in parts of the Finney County. This translates to greater than 60% reduction in saturated thickness since predevelopment of irrigation in the 1940s.⁽¹⁴⁾

Water Management

Groundwater Management District Nos. 1, 3, and 5 are [major local water management entities](#) in the basin.

Several townships in the Arkansas River basin are closed to new appropriations. The closures were proposed by the local GMDs, under authorities established in the Groundwater Management District Act. The adoption of these rules and regulations eliminated the possibility of additional appropriations being approved in many areas of the basin.

In 1986 and amended in 1987, the Chief Engineer ordered an Intensive Groundwater Use Control Area (IGUCA),⁽¹³⁾ which closed the Arkansas River corridor in Hamilton, Kearny, Finney, Gray and Ford counties to further ground or surface water appropriations. An IGUCA can provide more comprehensive water management tools than provided under strict water right administration based on priority.

Arkansas River flows in Colorado are contained and then released from John Martin Reservoir near Lamar Colorado. An interstate compact between Kansas and Colorado apportions the river flows with minimum flows at the State line and required usage prior to the gage at Garden City. These flows are primarily withdrawn by irrigation districts.

Six active irrigation ditches, Frontier, Amazon, Great Eastern, Garden City, South Side and Farmers, in southwest Kansas are supplied from streamflow in the Arkansas River. The irrigation ditches historically served approximately 70,000 acres; more recently, they have provided [surface water](#) supply to approximately 44,000 acres in Hamilton, Kearny and Finney counties.

Parts of five [watershed districts](#) are included in the basin: Cimarron Watershed District No. 3, James Draw Watershed Joint District No. 87, Lakin Watershed District No. 49, Pawnee Watershed Joint District No. 81 and Wet Walnut Creek Watershed Joint District No. 58.

The county conservation district is the primary local unit of government responsible for the conservation of soil, water and related natural resources within the county boundary. Each county within the Upper Arkansas River basin has a county conservation district. Four Resource Conservation and Development (RC&D) districts serve the counties of the Upper Arkansas basin: the Santa Fe Trail, Coronado Crossing, Central Prairie and Smoky Hill. The RC&Ds are designed to help community leaders develop rural economies by improving and conserving local natural, human and economic resources.⁽⁶⁾

Resources

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Arkansas River, Kendal, KS, Oct. 2007.
Photo courtesy of Kevin Salter

Upper Arkansas River Compact

Kansas and Colorado have had a long history of litigation over the apportionment of the waters of the Arkansas River with interstate litigation filed before the United States Supreme Court in the early 1900s. As Special Master Arthur Littleworth described it, "The meaning of the Arkansas River Compact cannot be fully understood apart from the rich history of controversy over the river, and the early efforts to apportion its waters between the two states. Nor can its meaning be divorced from the views of the men in both states who fought the apportionment issues for more than a decade"⁽¹¹⁾ The Arkansas River Compact, ratified in 1948, was the culmination of decades of failed settlements and temporary agreements. The Compact sought to protect the status quo between the states as well as allocate the benefits of John Martin Reservoir. The Compact recognized there would be additional development in both states, but such development should not materially deplete flows that would otherwise be available to Kansas.

What the Compact did not do was provide a definite allocation of water supply to either state. With regard to water stored (conservation storage) in John Martin Reservoir, either state acting alone or both states together, could release that water up to a maximum rate. Without a specific allocation, both Kansas and Colorado sought to utilize any stored water quickly, before the other state used it all up, causing what was known as the 'race to the reservoir.' If one state called for a release, the other state generally called for its release as well.



Lake McKinney, Kearny County. Photo courtesy of Grace Muilenburg, KGS.

In the late 1970s it was recognized that conservation storage in John Martin Reservoir could be used more effectively. In 1980, an operating plan was developed that provided water stored in John Martin Reservoir under the Compact would be allocated 40% to Kansas and 60% to Colorado. This allocation was accomplished through the use of separate accounts for each state. These separate accounts have allowed both states to improve the effectiveness of the use of water

stored in John Martin Reservoir.

There are six active Kansas irrigation ditches which divert surface water from the Arkansas River between the Colorado-Kansas stateline and Garden City. These ditches benefit under the terms of the operating plan, since they can call for water at any time and any rate, while being assured 40% of the water stored under the Compact. This allows the Kansas ditches to call for water during peak growing demand of summer crops, usually in July. This is in stark contrast to when Kansas had to call for water in April or May when releases were being called for by Colorado ditches.

The Arkansas River flows in both States have been appropriated by existing water rights and are diverted from the Arkansas River. Therefore, the river flow in southwestern Kansas is highly dependent on the irrigation demands of Kansas ditches, which have been diverting surface water since the 1880s. Water called for by the six Kansas irrigation ditch companies is put to beneficial use in Hamilton, Kearny and western Finney county as permitted under their vested water rights.

Since the adoption of the Compact, Colorado allowed the construction of hundreds of high capacity wells along the Arkansas River. Kansas filed *Kansas v. Colorado*, No. 105, Original, in 1985 to enforce the terms of the Arkansas River Compact. In 1994, Special Master Littleworth recommended that the Supreme Court determine that Colorado had violated terms of the Arkansas River Compact by means of post-compact well pumping in Colorado. The United States Supreme Court agreed. As the result of the damages and remedies phase, Colorado paid Kansas more than \$34 million for Colorado's compact violations during the period 1950 through 1999. In 2006, Colorado paid Kansas an additional \$1.1 million. This money has been deposited in three funds created by statute that specify generally how and where the money will be spent. One fund, the Western Water Conservations Projects Fund, is administered by Southwest Kansas Groundwater Management District No. 3 with input from the Arkansas River Litigation Fund Advisory Committee, and is to be spent on improved water efficiencies, water conservation, recharge and similar projects in the area impacted by past compact violations. The Director of the Kansas Water Office must approve all final projects.

The Special Master submitted his Fifth and Final Report⁽¹²⁾ to the United States Supreme Court in January 2008, including the Judgment and Decree which was jointly developed by Kansas and Colorado. Colorado compliance with the Compact will be determined using a hydrologic-institutional model and accounting procedures as set out in the decree. In December 2008, the Special Master's Fifth and Final Report and the Kansas Exception went before the U.S. Supreme Court.

