

Figure 1.

### General Description

The [Smoky Hill-Saline basin](#) lies within the Great Plains and Central Lowland physiographic provinces. The Smoky Hill-Saline basin in Kansas is an elongated drainage area, which extends eastward from the Colorado border approximately 250 miles to the vicinity of Junction City, Kansas. The Smoky Hill-Saline Basin covers all or parts of Sherman, Thomas, Sheridan, Graham, Wallace, Logan, Gove, Trego, Greeley, Wichita, Scott, Lane, Ness, Rooks, Osborne, Mitchell, Cloud, Ellis, Russell, Lincoln, Ellsworth, Dickinson, Geary, Morris, Saline, Rush, Barton, Rice, McPherson and Marion counties (Figure 1). The basin includes subbasins with [hydrologic unit codes](#) (HUCs) 10260001 thru 10260010.

The Smoky Hill River headwaters are located in eastern Colorado where the North and South Forks rise. These forks join in Logan County, Kansas. The Smoky Hill River has a drainage area of about 8,810 square miles. The Smoky Hill River flows eastward to Junction City to the confluence with the Republican River. Below this point the river is known as the Kansas River.

The drainage area of the Saline River is about 3,419 square miles. The Saline River, a tributary of the Smoky Hill, rises near the Sherman-Thomas County line in extreme western Kansas. The Saline River flows eastward to its confluence with the Smoky Hill River several miles east of Salina, Kansas.

The entire Smoky Hill-Saline basin in Kansas has a drainage area of about 12,229 square miles.

Topography within the basin is flat to gently rolling, with narrow, shallow valleys and low relief.

The highest point in Kansas, Mount Sunflower at 4,039 feet above mean sea level (MSL), is located in northwestern Wallace County. From this point, elevations in the basin decrease to approximately 1,087 feet above MSL at the confluence of the Smoky Hill and Republican rivers.



Highest point in Kansas, Mt. Sunflower in Wallace County  
Photo Courtesy of Kansas Geological Survey

### Population and Economy<sup>(1)</sup>

The basin had a [population](#) of 156,161 in 2000. The population of the 32 counties that are entirely or partially in the Smoky Hill-Saline basin was 330,631 in the year 2000 and is projected to be 288,939 in the year 2040. Rural counties have lost population, sometimes more than 10% in the last decade.

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.<sup>(2)</sup>

In 2006 there were an estimated 17,060 farms with 15,966,000 acres in the 32 counties with all or parts in the basin. The average farm is about 936 acres.<sup>(2)</sup>

Recreation is an increasing part of the economics of the basin. The federal reservoirs and associated recreation and wildlife areas draw hunters, fishermen and boaters to the area. In addition, the state supports fishing at: Kanopolis State Park Pond (2 acres, 33 miles SW of Salina on Hwy K-149 & K-141); and Saline State Fishing Lake (Periodically Dry) (38 acres, 2-1/2 N 2 W of Salina). Logan State Fishing Lake (60 acres, 2 N 2 W of Russell Springs) is still listed by Kansas Department of Wildlife and Parks as a fishing opportunity, however it has been dry for many years.

The growing industrial contribution to the basin economy is primarily related to energy production, including ethanol. As of December 2007, two ethanol plants were in operation in the basin.

Higher education opportunities in the basin include; Fort Hays State University; Kansas Wesleyan University, KSU College of Technology and Aviation, Brown Mackie College, North Central Kansas Technical College and Salina Area Technical School.

### Physical Characteristics

#### Geology and Soils

Cretaceous bedrock underlying the basin consists of shale, limestone, and chalk. The most notable being the Niobrara Chalk and the Dakota Sandstone. The river and tributary valleys are comprised of unconsolidated deposits of gravel, sand, silt and clay. The bedrock has an east-to-southeast drainage trend. In the west, the rocks that outcrop are sedimentary in origin and range in age from Cretaceous to Recent.

The Ogallala Formation of Late Tertiary (Pliocene) age uncomfortably overlies these older formations.



Niobrara Chalk Trego County.  
Photo Courtesy of Kansas Geological Survey

Thin, dissected and isolated deposits of sand and gravel of Pleistocene age occur along the larger streams, chiefly the South Smoky Hill and North Smoky Hill Rivers. These deposits have been derived from the Ogallala Formation and lithologically are very similar to the Ogallala. The Smoky Hill River is completely incised into the Cretaceous Niobrara Formation throughout most of Kansas, so has little contact with the Ogallala-High Plains [aquifer](#). However, two major tributaries, the Saline River and Ladder Creek, do have substantial connection.

The terrace deposits and valley fill of the Smoky Hill valley become thicker and of greater areal extent to the east.<sup>(2)</sup>

The Smoky Hill-Saline basin soils vary widely in character. The soils are poor shallow soils in the west along streams with fertile loess soil in the uplands. Shallow, acidic and infertile soils occur through Trego, Ellis and Russell counties. Bottom land soils ranging from sand to clays and from permeable, friable soils to tight soils.<sup>(2,3)</sup>

### Land Use/Land Cover

The basin covers approximately 7,726,235 acres. Over 48% is crop land, and more than 44% in grass. Crop land dominates in the west with grassland dominating through the central section of the basin. The major crops are wheat, sorghum, and corn. Approximately 249,596 acres were reported as irrigated in 2006. A major product is [beef cattle](#).

The Kansas Geological Survey (KGS) categorized riparian land use in 2003. Statewide pasture/grass land is the dominant riparian land use type in Kansas, accounting for over 142,000 bank miles or roughly 38% of all land use types.<sup>(7)</sup> In this basin, the total of 56,730 bank miles vary in the riparian land use type, with 53% of the riparian cover being pasture/grass land. Table 1 provides more detail of riparian land within one mile of streams and water bodies.

### **Climate**

The basin's climate is characterized by the extremes and highly variable [precipitation](#) and temperature common to mid-continent locations.

Average annual temperatures range from 52 degrees (°) in the west to 56° in the east, with wide day to day variations and yearly extremes. Evapotranspiration consumes the major portion of the moisture in the basin.

Average annual precipitation increases from approximately 16 inches in the extreme west to 30 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. Annual snowfall averages from 24

inches in the west to 18 inches in the east.

**Table 2. Climate Summary Smoky Hill-Saline Basin**

Location	Average Annual <sup>1</sup>		Freeze Dates (32 F.) <sup>2</sup>		
	Precipitation (inches)	Temperature (deg. F.)	Last in Spring	First in Fall	Frost Free Days
Sharon Springs	20.11	51.6	Apr. 30	Oct. 9	160
Russell	26.25	54.1	Apr. 24	Oct. 17	176
Abilene	32.74	56.5	Apr. 19	Oct. 11	177

<sup>1</sup> Source: National Climatic Data Center (1971-2000 data)  
<sup>2</sup> Source: KSU Weather Data Library (1961-1990 data)

Flooding, when it occurs, is generally the result of intense storms of short duration on tributaries. The main stem of the Smoky Hill River experiences flooding due to storms covering a wide area of longer duration.<sup>(3)</sup>



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. Kansas has been impacted by severe drought periodically. The western part of the basin is greatly affected by reductions in precipitation. The deficit is offset by ground water pumping to irrigate crop land that has not received sufficient rainfall. Drought increases the demand on the available water supply.

**Table 1. Total Riparian Land Use Bank Miles for Smoky Hill-Saline Basin**

Hydrologic Type	Animal Production	Barren Land	Crop Land	Crop/ Tree Mix	Forest Land	Pasture/Grass Land	Pasture/ Tree Mix	Shrub Land	Urban Land	Urban/ Tree Mix	Total
Intermittent	12	27	13,448	1,782	2,894	28,056	4,389	14	235	95	50,951
Perennial	2	8	89	575	1,711	599	803	15	13	18	3,832
Shoreline	2	48	131	23	94	1401	202.2	13	12.1	21	1,947
Total	16	83	13,668	2,380	4,699	30,056	5,394	42	260	134	56,730

### **Wildlife and Habitat**

The Smoky Hill and Saline rivers landscape is comprised of rolling to nearly level tallgrass and mixed grass prairie vegetation. These contain some large tracts of high quality tallgrass and mixed grass prairie that are currently used primarily for grazing. These native prairie pastures provide important seasonal habitat for migrating birds as well as crucial nesting and brood rearing habitat for grassland nesting birds such as the greater prairie chicken.<sup>(5)</sup>

The Smoky Hill-Saline basin includes the range for numerous endangered or threatened species including the bald eagle, whooping crane, snowy plover, piping plover, peregrine falcon, black footed ferret, eastern spotted skunk, green toad and hornyhead chub. Eastern parts of the basin are also designated as critical habitat for the bald eagle. Wallace and Logan counties are designated critical habitat for the green toad.<sup>(12)</sup>

Cedar Bluff Wildlife Area varies in size with the fluctuating reservoir. At full pool the Reservoir is 6,800 surface acres and the surrounding Wildlife Area lands encompassing approximately 7,000 acres.



**Outcrop north of Smoky Hill River near Schoenchen**  
Photo by Kansas Water Office

The area lies in the mixed grass prairie and chalk bluff region. Cedar Bluff derives its name from a 1/2 mile of 100 foot chalk bluffs located on the southwest portion of the property.

Wilson Wildlife Area is located on the upper end of 9,000 acre Wilson Reservoir. The 8,069 acre public hunting area is made up of 5,000 acres of rugged rolling hills of native prairie, approximately 2,000 acres of cropland,

and 1,000 acres of riparian timber along the Saline River, Cedar Creek, Turkey Creek, and Elm Creek.

Smoky Hill Wildlife Area at Kanopolis Lake offers 4,180 acres of land and 885 acres of water. The reservoir covers approximately 3,000 acres of water and the entire U.S. Army Corps of Engineers (Corps) property extends along the Smoky Hill River for over 15,000 acres.<sup>(6)</sup>

### **Water Resources**

The Smoky Hill River headwaters are located in eastern Colorado where the north and south forks rise. These forks join in Logan County, Kansas. The Smoky Hill flows eastward to Junction City to confluence with the Republican River. Below this point the river is known as the Kansas River. The Saline River, a tributary of the Smoky Hill, rises near the Sherman-Thomas County line in extreme western Kansas. The Saline River flows eastward to its confluence with the Smoky Hill River several miles east of Salina, Kansas.

The streams include 50,951 intermittent stream miles and 3,832 perennial stream miles.<sup>(7)</sup> Drainage density is 0.31 mile per square mile in the basin (perennial streams only).

Minimum Desirable Streamflow (MDS), an amount of flow for instream uses and downstream water rights, has been set for three U.S. Geological Survey (USGS) gages in the basin. These are on the Smoky Hill River near Ellsworth, the Saline River near Russell and Chapman Creek near Chapman. MDS sets monthly flow targets at each gage. Flows have recently been below MDS for significant periods of time.

Three large federal irrigation and/or flood control projects are located in the Smoky Hill-Saline basin. Cedar Bluff Reservoir, a Bureau of Reclamation (Bureau) project, is located on the Smoky Hill River in Trego County. Wilson Lake on the Saline River and Kanopolis Lake on the Smoky Hill River are operated and maintained by the Corps.

Much of the western half of this basin is underlain by the Ogallala-High Plains aquifer, deposits of saturated sands, gravels and silts of Tertiary and Quaternary age. The High Plains aquifer underlies most of western and south central Kansas. The High Plains aquifer consists of several hydraulically connected aquifers, the largest of which is the Ogallala. The Ogallala-High Plains aquifer is distinctive from other aquifers in Kansas because it has low annual recharge.

The Ogallala-High Plains aquifer is found only in small parts of the western half of the Smoky Hill-Saline basin. It occurs in the southern portions of Sherman, Thomas, Sheridan, and Wallace counties and the northern parts of Logan, Gove, Trego, Ellis, Greeley, Wichita, Scott and Lane counties. Within the Smoky Hill-Saline basin the Ogallala-High Plains aquifer saturated thickness is generally less than 100 feet. In a few locations the saturated sediments are 150 or 200 feet thick when combined with the overlying alluvial sediments. Ground water resources also include the alluvial deposits along the rivers and tributaries and the Flint Hills aquifer in the eastern end of the basin.



Smoky Hill River. Photo by Kansas Water Office

The USGS estimated drainable water in storage in the High Plains aquifer in 1992 to be about 3.25 billion acre feet; 10% of that in Kansas.<sup>(8)</sup>

There were 3,593 water rights reporting use in the basin in 2006. These rights reported a total of 282,453 acre feet used from surface and ground water sources. Ground water sources accounted for 268,145 acre feet with the remaining from [surface water](#).<sup>(9)</sup>

The primary [reported water use](#) in the basin was irrigation, at 246,134 acre feet followed by municipal use at 23,820 acre feet. Municipal water use (public water supply) includes communities and rural water districts as well as those industries that obtain water through a public water supply (Figure 2).

There were 99 [public water suppliers](#) in the basin in 2006. In 2006, 721 acre feet of water was marketed from Kanopolis Lake to one public water supplier who in turn supplied 11 other suppliers and rural customers.

Smoky Hill-Saline Basin  
2006 Reported Water Use by Type

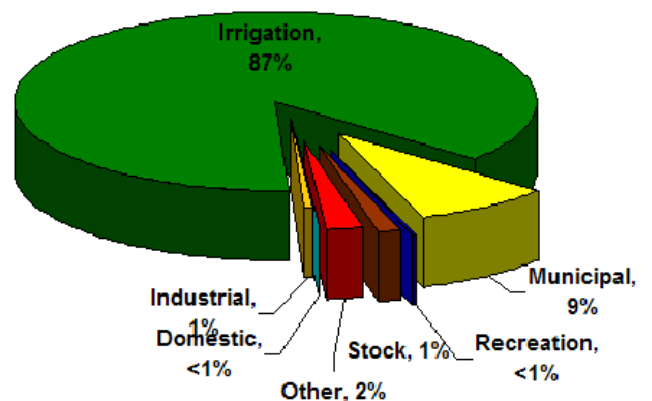


Figure 2.

### Water Management

Western Kansas Groundwater Management District No. 1 (GMD1) and Northwest Kansas Groundwater Management District No. 4 (GMD4) each include portions of three (3) counties in the western end of the basin (Figure 3). The groundwater management districts are pro active in developing local water policy compatible with state Laws.

Water appropriations and use are overseen by the Kansas Department of Agriculture-Division of Water Resources. Most of the streams and alluvial corridors in the basin are closed or restricted for new water appropriations. This has eliminated the possibility of additional appropriations being approved in many areas of the basin. The exception is Ladder Creek and the Saline River which have not been closed to new appropriations.<sup>(11)</sup>

The Chief Engineer ordered Intensive Groundwater Use Control Areas (IGUCA) for two sections of the Smoky Hill River and for an area within the City of Hays. This closed the Smoky Hill River corridor in 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.

States generally have the responsibility to determine the management of the water resources in that state. The exception to this is the management of federal reservoirs by a federal agency. In the Smoky Hill-Saline basin, Cedar Bluff is managed by the Bureau, Wilson and Kanopolis are managed and operated by the Corps. The State of Kansas has purchased [water supply storage](#) in the Kanopolis Lake that provides water to a significant area of the basin.

Numerous other entities related to water resources may exist in the basin to address one or more water related issues. [Watershed districts](#) may be formed to develop and implement a comprehensive plan for a watershed that will provide flood protection for the residents and landowners. Parts of four watershed districts are included in the basin. These cover the watersheds for Spillman Creek Watershed Joint District No. 43 and, Lyons Creek Watershed Joint District No. 41 in Lincoln County, and Turkey Creek Watershed Joint District No. 32 and Lost Creek Watershed District No. 44 in Dickinson County.<sup>(10)</sup>

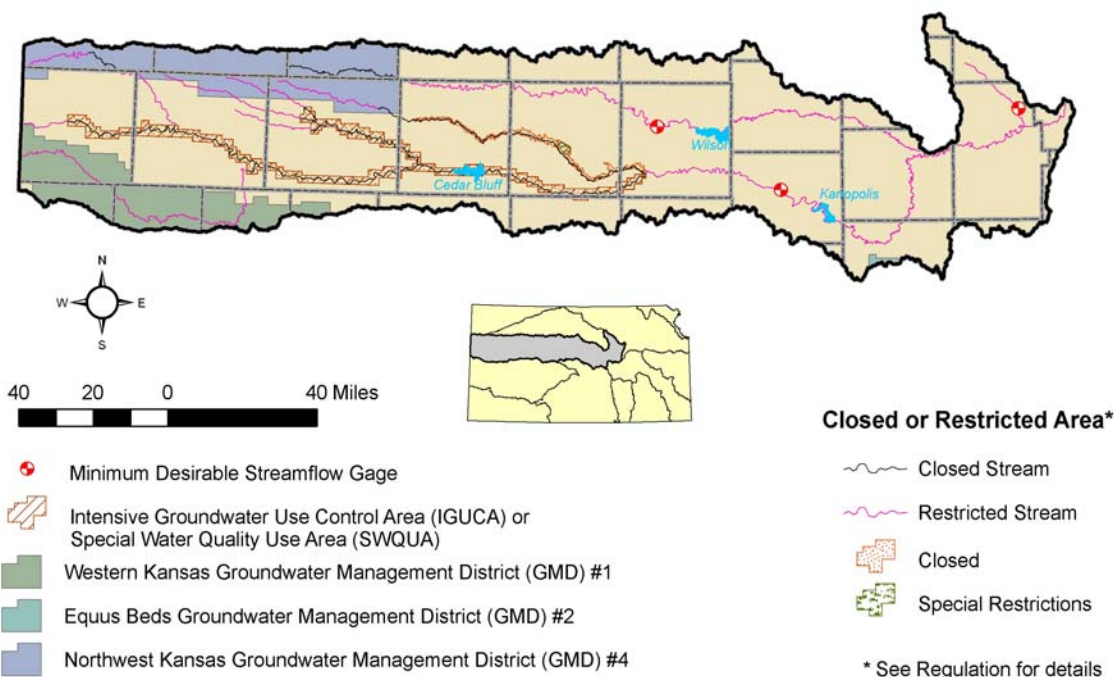
Each county has a county conservation district responsible for the conservation of soil, water, and related natural resources within that county. Multiple county groups may form Resource Conservation and Development areas (RC&Ds) to also address conservation of natural resources. Parts of five RC&Ds cover the Smoky Hill-Saline basin.<sup>(13)</sup>

Addressing water quality are four Watershed Restoration and Protection Strategy (WRAPS) programs that each cover a part of the basin. As of December 2007, all portions of the Smoky Hill River and parts of Big Creek were in some stage of the WRAPS process. In addition, drainage districts may also be formed in order to reclaim and protect land from the effects of water.



**Russell County**  
Photo courtesy of Kansas Geological Survey

## Smoky Hill-Saline Basin Water Management



Source:  
Kansas Department of Agriculture

**Figure 3.**

**Resources**

1. U.S. Census Data, 2000.
2. U.S. Department of Agriculture. 2006. [http://www.nass.usda.gov/Statistics by State/Kansas/Publications/Annual Statistical Bulletin/County Farm Facts/2006/book06.pdf](http://www.nass.usda.gov/Statistics_by_State/Kansas/Publications/Annual_Statistical_Bulletin/County_Farm_Facts/2006/book06.pdf)
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4. Kansas Water Resources Board. June 1961. *Water Plan Studies Part A Section 8 Solomon-Saline Unit*
5. U.S. Fish and Wildlife Service. December 2007. <http://www.fws.gov/mountain-prairie/pfw/kansas/ks3b.htm>
6. Kansas Department of Wildlife land Parks. 2008. [http://www.kdwp.state.ks.us/news/kdwp\\_info/locations/wildlife\\_areas/region\\_1/](http://www.kdwp.state.ks.us/news/kdwp_info/locations/wildlife_areas/region_1/)
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11. Kansas Department of Agriculture-Division of Water Resources, personal communication, Paul Graves, July 3, 2008.
12. Kansas Department of Wildlife and Parks. 2008. [http://www.kdwp.state.ks.us/news/other\\_services/threatened\\_and\\_endangered\\_species/threatened\\_and\\_endangered\\_species/range\\_maps](http://www.kdwp.state.ks.us/news/other_services/threatened_and_endangered_species/threatened_and_endangered_species/range_maps)
13. U.S. Department of Agriculture. 2000. <http://www.nrcs.usda.gov/programs/rcd/photos/RCDmap08.pdf>

## Reservoir Storage in the Smoky Hill-Saline Basin

### Cedar Bluff Dam and Reservoir

Cedar Bluff Reservoir was completed in 1951 by the Bureau of Reclamation for flood control, water supply, irrigation, and other purposes. The main use of the lake was to support the operations of the Cedar Bluff Irrigation District. In 1963, the City of Russell entered into a contract with the Bureau of Reclamation for release of up to 2,000 acre-feet per year to recharge the city's well field.

When inflow into Cedar Bluff Reservoir was severely depleted in the 1960's and 1970's, the irrigation district ceased to be viable with the last delivery of water in 1978. The State of Kansas entered into an agreement with the Bureau of Reclamation and the Cedar Bluff Irrigation District in 1989 closing the irrigation district and giving control of all but 2,700 acre-feet of storage in the conservation pool to the State of Kansas. The main uses for the state storage are fish, wildlife and recreation as well as artificial recharge of the stream and alluvium downstream.

On January 9, 2006, the control of the majority of the stored water owned by the State in Cedar Bluff Reservoir was transferred to Kansas Department of Wildlife and Parks to better identify with the allowed uses of water and historic operations of the Reservoir. The Kansas Water Office retained control of the artificial recharge portion. The City of Russell continues to maintain their contract with the Bureau.

### Kanopolis Dam and Lake

Kanopolis Lake storage of water in the lake began in February 1948. Kanopolis Lake was constructed and is operated by the U.S. Army Corps of Engineers. The lake was constructed to provide flood protection, recreation opportunities, fish and wildlife benefits, and maintain minimum stream flow on the Smoky Hill River.

In 2002, the State of Kansas acquired storage in Kanopolis Lake to be used for municipal and industrial water supply purposes through the State of Kansas Water Marketing Program. As of November 2007, Post Rock Rural Water District has a contract for a maximum quantity of 400 million gallons per year (mgy) or 1,227.555 acre feet (af) from Kanopolis Lake.



Kanopolis Reservoir. Photo by KWO

There are also irrigation and domestic use demands in the alluvial system downstream from the lake.

The Post Rock RWD currently serves retail customers and the cities of Brookville, Ellsworth, Dorrance, Gorham, Luray, Waldo, Paradise; the Wilson Lake Estates of Lincoln County Development; and the rural water districts #5 of Ellis County, #7 of Saline County and #2 of Osborne County. Requests for the remaining water in the Kansas Water Marketing Plan Storage are under consideration at the present time.

### Wilson Dam and Lake

Wilson Dam and Lake, was completed by the U.S. Army Corps of Engineers in 1964. The project was authorized for flood control, irrigation, navigation, recreation, fish and wildlife and water quality purposes. Storage space was constructed for flood control storage, conservation storage and sediment storage. It was later determined that irrigation was not practical due to the concentration of dissolved minerals, primarily chlorides, that accumulate in the reservoir. The lake's maximum capacity is 736,000 acre feet (908 million m<sup>3</sup>).

Presently there is no storage allocated for water supply, but investigation of the use of Wilson to meet increasing needs in the region is underway. Technological advances in water quality treatment have reduced costs to remove the dissolved minerals.



Wilson Lake. Photo courtesy of U.S. Army Corps of Engineers