Upper Republican River Basin January 2009

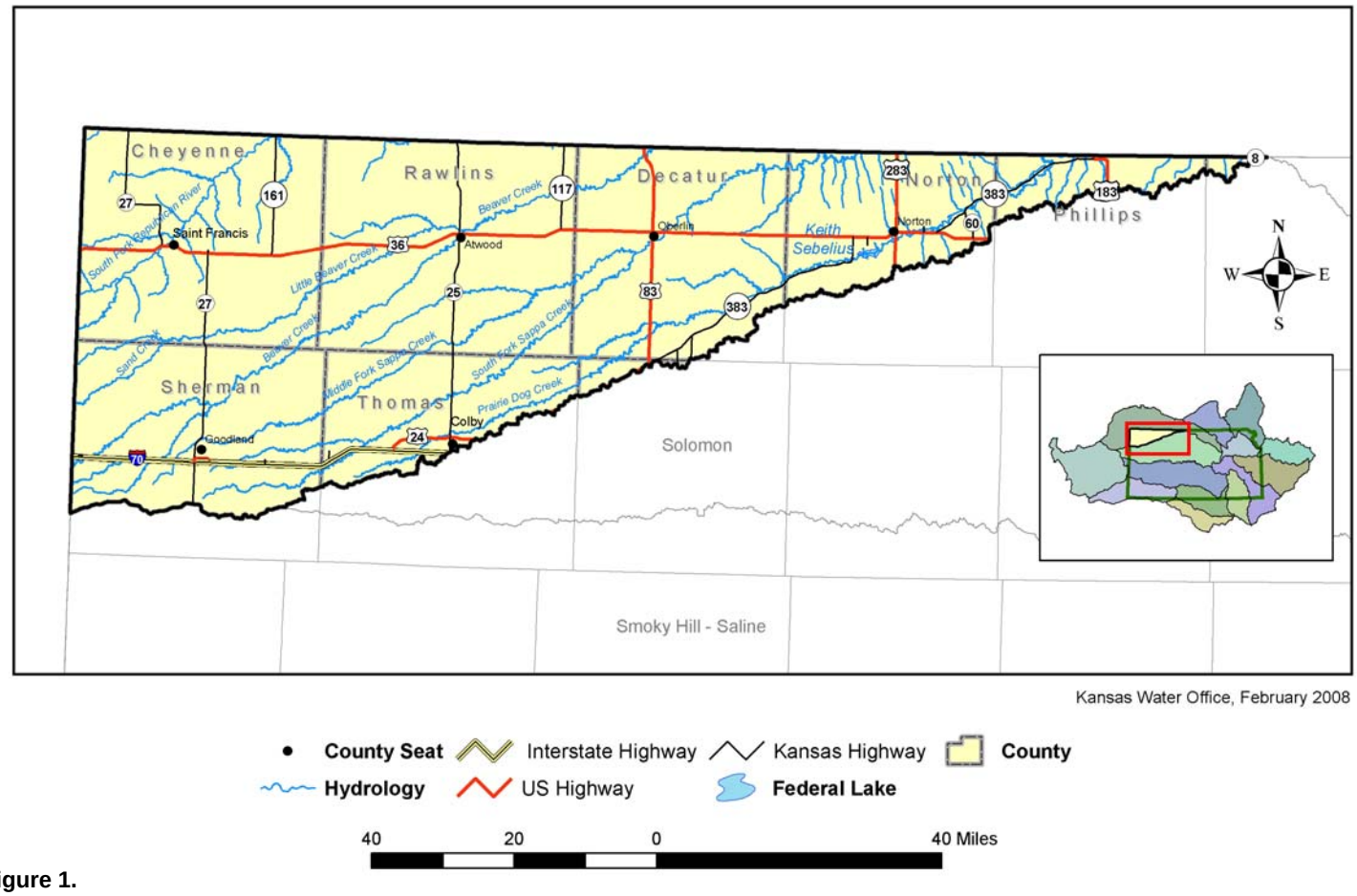

Figure 1.

General Description

The Upper Republican River basin is located in the High Plains physiographic region of western Kansas. The Kansas portion of the basin is bordered by Colorado on the west and Nebraska on the north covering approximately 4,900 square miles. The basin covers all or parts of Cheyenne, Rawlins, Decatur, Norton, Phillips, Sherman, Thomas and Sheridan counties. The Upper Republican basin includes hydrologic unit codes (HUCs) 10250001, 10250003, 10250012, 10250013, 10250014 and 10250015.

The High Plains region is an open expanse of flatlands and gently rolling hills that were once covered by shortgrass prairie. Much of the land is now farmed and only small areas of prairie remain. Land surface elevation ranges from nearly 4,000 feet above mean sea level (msl) in southwest Sherman County to less than 2,000 feet above msl in north central Phillips County. This region was once crossed by many rivers that carried sediment such as sand and gravel when the Rocky Mountains were forming millions of years ago. The stream valleys in the basin are mostly broad and shallow, however, in some localities the relief is as much as 200 feet.

The Upper Republican basin in Kansas is part of the Republican River system that begins in the plains of northeast Colorado. The Republican River then flows through northwest Kansas and southwest Nebraska and ultimately returns to Kansas, emptying into Milford Lake in the Kansas-Lower Republican basin.

Principal tributaries in the Upper Republican basin are Beaver, Sappa and Prairie Dog creeks. A small portion of the Arikaree River flows through the northwest corner of Cheyenne County.

Population and Economy

There were an estimated 28,480 residents in the basin in the year 2000.[1] The population of the nine counties that are entirely or partially in the Upper Republican basin was 43,721 in the year 2000 and is projected to be 41,063 by the year 2040. In the past 40 years, two trends have dominated the state. Rural counties have lost population, sometimes more than 10% every decade. Urban counties are gaining population at an even faster rate. In the Upper Republican basin, every county but Thomas has lost population in the past 40 years.

Typical of this trend is Rawlins County, which had a population of 5,279 in 1960 and a population of 2,918 in 2000.

In 2006, there were an estimated 4,070 farms with 5,189,000 acres in the nine counties entirely or partially in the basin. The average farm is about 1,275 acres.

Agriculture is the basis of the economy of the basin. Crops grown include wheat, corn, grain sorghum, soybeans, forage sorghum, alfalfa and sunflower. Irrigation is widespread and extremely important to the area economics. Crop value in 2006 was estimated by the U.S. Department of Agriculture (USDA) in farm facts as nearly $361 million.[3] Livestock production is an important part of the area's agriculture. Beef cattle are the predominant livestock raised in the basin.

Recreation is an increasing part of the economics of the basin. Keith Sebelius Lake and associated recreation and wildlife areas draw hunters, fishermen and boaters to the area. In addition, state operated lakes offer fishing in the basin including; Sherman State Fishing Lake (210 acres, 10 S 2 W of Goodland); and St. Francis Sand Pits, (5 acres, 1 W 2 S of St. Francis). Sherman State Fishing Lake is listed by Kansas Department of Wildlife and Parks (KDWP)[8] as a fishing opportunity although noted as periodically dry. It has been reported as dry for the past 20 years.[7]

The growing industrial contribution to the basin economy is primarily related to energy production, including ethanol. As of December 2008, one ethanol plant was in operation in the basin.

High Plains Irrigation
Photo courtesy of Kansas Geological Survey

Educational opportunities in the basin include Colby Community College, and Northwest Kansas Technical College.

Physical Characteristics

Geology and Soils

The Quaternary age, Ogallala Formation underlies the basin, as do the older Cretaceous age units. Outcrops of these sedimentary origin formations occur as well. The Ogallala Formation consists of sand, gravel and silt beds, cropping out in stream valleys in all but the north and east edges of the basin and may be as thick as 300 feet in the southwest part of the basin.

Windblown silt (loess), alluvial and terrace deposits and minor amounts of dune sand cover most of the basin. Upland soils in the basin are primarily those derived from loess. Topography varies from relatively flat undulating plains to rolling uplands and some steep hills and bluffs.

Most of the river valleys contain a more granular soil type resulting from stream-laid deposits. About 95 percent (%) of the basin consists of upland soil associations.

East of Decatur County, the level uplands consist of relatively deep Hastings-Holdrege association of silt loams. The sloping lands are covered by the shallower Colby silt loam.

The primary soils overlying the western part of the basin is the Keith silt loam on the upland. This is a relatively deep soil, subject to erosion on the long gentle slopes as well as the steeper slopes.[3]

Land Use/Land Cover

The Upper Republican basin covers approximately 3,169,099 acres. In 2005, over 59% was cropland, with grassland covering over 36%. A very minor, less than one percent, of the land in the basin was involved in residential and industrial uses.

Over 1.9 million acres were reported as crop acres in 1990. In 2006, 233,447 acres are reported as irrigated according to water right records. The Kansas Geological Survey (KGS) categorized riparian land use in 2003.[4] Statewide, pasture/grassland is the dominant riparian land use type in Kansas, accounting for over 142,000 bank miles or roughly 38% of all land use types. The predominant riparian land use for the 16,321 bank miles was pasture/grassland (68%) in this basin.

Table 1 identifies land cover in more detail for riparian land within one mile of streams and water bodies.

Ogallala Outcrop Cheyenne County
Photo courtesy of Kansas Geological Survey

Climate

The climate of the basin is characterized by moderate to low precipitation, relatively high wind velocities, fairly rapid rates of evaporation, a wide range of temperatures and abrupt, sometimes violent changes in weather. Average annual precipitation amount varies from 17 inches in the west to 22 inches in the east. According to the National Climatic Data Center, average annual temperature was 51 degrees Fahrenheit from 1971-2000. First frost generally occurs in late September or early October depending on location. The average annual runoff varies from about 0.2 inches in the west to 1.1 inches in the east.

Most of the precipitation occurs April through September. Evaporation averages 55 inches per year from impoundments. High wind and low humidity of the region contribute to the high evaporation rate. Evaporation from land surfaces is also high in this basin.

Drought is a naturally recurring feature of this climate, as exemplified by the Dust Bowl of the 1930's and the severe drought of 1952-1957. From 1952-1956, the town of St. Francis averaged only 11.77 inches of rain. Kansas has been impacted by severe drought periodically throughout the present decade, increasing the demand on the available water supply.(2)

Excessive rainfall can occur, primarily from thunderstorms of short duration in a localized area. The most common flood months have been June and July, but flood problems have occurred throughout the year. The combination of limited channel capacity and flat floodplain can result in large portions of the valleys being inundated.

Table 2. Climate Summary Upper Republican Basin

	Average Annual[1]		Freeze Dates (32 F.)[2]		
Location	Precipitation (inches)	Temperature (deg. F.)	Last in Spring	First in Fall	Frost Free Days
Goodland	19.76	50.7	May 3	Oct. 6	156
Atwood	22.75	50.6	May 8	Sep. 29	144
Norton	24.89	51.0	Apr. 30	Oct. 8	164

[1] Source: National Climatic Data Center (1971-2000 data)
[2] Source: KSU Weather Data Library (1961-1990 data)

Wildlife and Habitat

Key wildlife habitats include cropland, rangeland, weedy and brushy fence rows and ungrazed areas, riparian areas, streams and wetlands. Key wildlife species include ring-necked pheasants, greater prairie chicken, bobwhite quail, whitetail and mule deer.(3)

Historic range for numerous endangered species include parts of the basin. These include the bald eagle, black footed ferret, eastern spotted skunk, flathead chub, piping plover, peregrine falcon, whooping crane and the Topeka shiner. In addition, critical habitat for the bald eagle has been designated in Cheyenne County.(9)

Table 1. Total Riparian Land Use Bank Miles for Upper Republican Basin

Hydro Type	Animal Prod. Area	Barren Land	Crop Land	Crop/ Tree Mix	Forest Land	Pasture/ Grass Land	Pasture/ Tree Mix	Shrub Land	Urban Land	Urban/ Tree Mix	Total
Intermittent Stream	7	10	2,759	364	395	10,838	795	12	38	12	15,230
Perennial Stream	0	11	15	168	320	56	171	15	0.2	4	760
Shoreline	1.7	3	84	1	2	224	14	0	1	0.1	330.8
Total	8.7	24	2,858	533	717	11,118	980	27	39.2	16.1	16,320.8

Water Resources

The major streams in the basin (from west to east) are the South Fork Republican River, Beaver Creek, Sappa Creek and Prairie Dog Creek.

Keith Sebelius Lake is located on Prairie Dog Creek in the eastern part of the basin. It is a federal project built for flood control, municipal and industrial water supply, recreation and irrigation. The lake is operated and maintained by the U.S. Department of the Interior, Bureau of Reclamation (Bureau).

The basin streams include 15,230 intermittent stream miles and 760 perennial stream miles. Drainage density is 0.31 miles per square mile in the basin (perennial streams only).[4]

Principal aquifers include the High Plains (Ogallala included) and alluvial aquifers. The Dakota aquifer is present in the basin but is seldom used due to high mineral content. All of the alluvial corridors in the basin are closed to new water right appropriations.

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 in that it generally low annual recharge.

The majority of ground water outside of the Ogallala-High Plains aquifer is alluvial ground water. A portion of the natural recharge that reaches the alluvial aquifer may contribute to stream base flow.

Ground water is the principal water supply source in the Upper Republican River basin, accounting for about 98% of reported water use in 2006. Irrigation is the predominant use of water.

There were 2,395 water rights reporting water use in 2006. These reported a total of 275,419 acre feet surface and ground water used. Surface sources accounted for 502 acre feet. The majority, 274,917 acre feet, was reported used from ground water.[5]

The primary reported water use in the basin is irrigation, with over 267,207 acre feet used in 2006 (Figure 2). Municipal water use (communities and rural water districts) is the next largest user at 5,386 acre feet authorized. There are 16 public water suppliers in the basin.

Water Management

All or part of six counties in the basin are included in Northwest Kansas Groundwater Management District No. 4 (GMD4), which is the local water management entity for areas over the Ogallala-High Plains aquifer. GMD4, formed in 1976, is 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 (DWR). All of the streams and alluvial corridors in the basin are either closed to new appropriations or new appropriations are restricted. Minimum desirable streamflow has not been set at any sites in the basin. Generally, the Ogallala-High Plains aquifer has no new appropriations available. In limited cases a new water appropriation for ground water, limited to quantities under 15 acre-feet, can be obtained by meeting some very specific criteria within GMD4.

States generally have the responsibility to determine the management of their water resources. The exception to this is the management of federal reservoirs by a federal agency. In the Upper Republican basin Norton Dam, is managed by the U.S. Bureau of Reclamation (Bureau). The State of Kansas has not purchased any water supply storage in Keith Sebelius Lake, the reservoir formed by construction of Norton Dam.

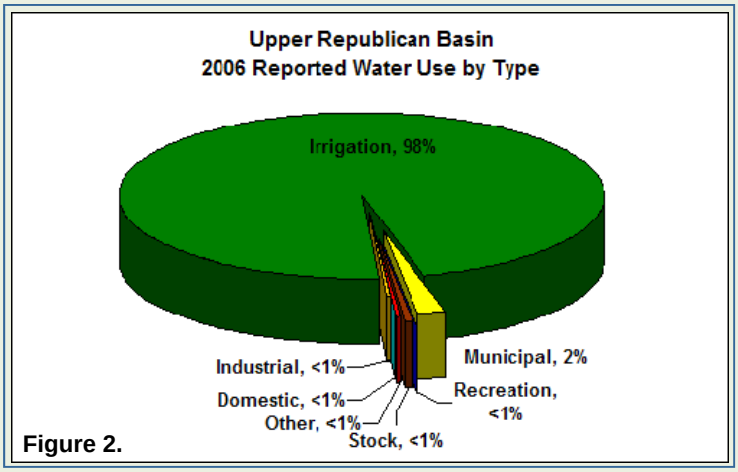

Figure 2.

One irrigation district (Almena) operates using releases from Keith Sebelius Lake at Norton Dam.

When water is available from storage there is the possibility to irrigate up to 5,763 acres in the irrigation district.

Numerous other entities 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. There are no watershed districts in the Upper Republican basin.

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 two RC&Ds cover the Upper Republican Basin.(6)

Addressing water quality are two Watershed Restoration and Protection Strategy (WRAPS) programs that cover parts of the basin.

Keith Sebelius Dam, Norton County
Photo courtesy of Kansas Geological Survey

Resources

1. U.S. Census data. 2000.

2. Kansas Water Resources Board. 1960. *State Water Plan Studies Part A Section 6*. Upper Republican Unit.

3. U.S. Department of Agriculture. 2008. http://www.ks.nrcs.usda.gov/programs/csp/

4. Wilson, Brownie. 2003. http://hercules.kgs.ku.edu/geohydro/ofr/2003_55/riparian/ofr_2003_55e.htm

5. Kansas Department of Agriculture-Division of Water Resources, WRIS database, December 13, 2007

6. U.S. Department of Agriculture. 2008. http://www.ks.nrcs.usda.gov/partnerships/rcd/

7. Kansas Department of Agriculture-Division of Water Resources. 2008. Personal communication.

8. Kansas Department of Wildlife and Parks, 2008. http://www.kdwp.state.ks.us/news/fishing/where_to_fish_in_kansas/Fishing_locations_public_waters/region_1

9. Kansas Department of Wildlife and Parks. 2008. http://www.kdwp.state.ks.usnews/other_services/threatened_and_endangered_species/threatened_and_endangered_species/range_maps

Republican River Compact and Settlement

The Republican River and its tributaries are resources important to Kansas. Kansas interests in the basin include ground water and surface water rights in the Upper Republican River tributaries of northwest Kansas including the South Fork Republican River, Sappa Creek, Beaver Creek and Prairie Dog Creek.

The Republican River Compact was formally signed on December 31, 1942 by the states of Colorado, Kansas and Nebraska (Figure 3). The Compact makes specific allocations to each of the three states in 14 different subbasins and includes provisions related to the federal government's ability to develop projects within the basin.

In May 1998, Kansas filed a lawsuit before the U.S. Supreme Court for breached terms of the Compact by Nebraska for proliferation and use of ground water wells connected to the Republican River and its tributaries, and by failing to protect the surface flows from other unauthorized appropriations. As part of the settlement agreement, the Republican River Compact Administration (RRCA) ground water model was developed. The model is a tool used to quantify ground water consumptive use by each state as part of the compact's accounting procedures.

The first compliance check of consumptive use was the five-year running average for the years 2003-2007. The settlement also prescribes more restrictive compliance requirements during water-short conditions, including two-year averaging. The first water-short compliance check was for the years 2005-2006. Accounting indicated Kansas met it's obligations, but did not receive it's allotted share.

Keith Sebelius Lake

Norton Dam, constructed by the U.S. Bureau of Reclamation in 1964 to form Keith Sebelius Lake, is a valuable source of water in northwest Kansas. It was built for flood control, irrigation and public water supply. Although recreation is an authorized use, no storage space in the lake has been dedicated to that purpose.

Releases for irrigation purposes are controlled by the Almena Diversion Dam, about 11 miles downstream from Norton Dam. Water diverted from Prairie Dog Creek is carried by the Main and South Canals and a system of laterals to the lands of the Almena Irrigation District No. 5.

Beginning in 2007, the Almena Irrigation District entered into a ten-year agreement with the state to achieve a minimum conservation pool in the lake. This pool provides suitable habitat for fisheries production, safe access to the lake by anglers and boaters, and habitat for water fowl and other wildlife.

Keith Sebelius Reservoir. KWO photo.

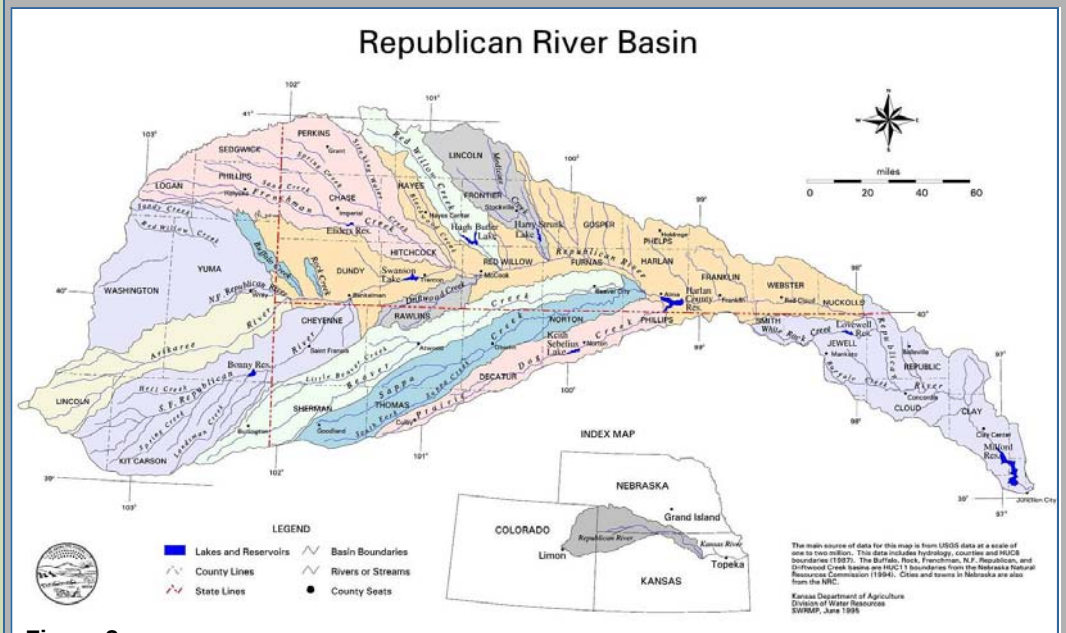

Figure 3.