

Upper Republican River Basin

January 2009

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 short-grass 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.

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.

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.

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⁾

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.

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.

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.

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.

Resources

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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.us/news/other_services/threatened_and_endangered_species/threatened_and_endangered_species/range_maps

Upper Republican River Basin Management Categories

WATER MANAGEMENT CATEGORIES

The following categories include issues identified in the Upper Republican basin plan as items that require attention in addition to the basin priority issues. These issues are addressed in the following management categories:

- Water Management
- Water Conservation
- Public Water Supply
- Water Quality
- Wetland and Riparian Management
- Flood Management
- Water-Based Recreation

These categories also correspond to the statewide management categories and policies of the *Kansas Water Plan* found in [Volume II](#). These documents contain new policy issues and the existing policy and statutory framework that relate to the management categories.

ISSUE: WATER MANAGEMENT

Management of Kansas' ground and [surface water](#) fits into six statewide categories, with five of these applicable in the Upper Republican basin. These are:

- 1) River-Reservoir management
- 2) Streams outside of Minimum Desirable Streamflow protected areas;
- 3) The Ogallala-High Plains aquifer
- 4) Ground water outside of the Ogallala-High Plains aquifer
- 5) Interstate water management

Ground water is the primary water supply in the basin, supplying 98 percent (%) of [water used](#) in 2006. The Ogallala-High Plains aquifer is a major source in the basin. Where it interconnects with alluvial ground water, it may have an affect on streamflow. Ground water recharge rates are generally low throughout the basin. A majority of the basin is restricted or closed for new water appropriations. Water resources in the basin are managed with the local leadership of the Ogallala-High Plains aquifer area by Northwest Kansas Groundwater Management District No. 4 (GMD4). GMD4 has identified six high priority aquifer subunits. Goals and management for each are under development.

In 2008 a computer model developed for the six priority subunits was completed through cooperation of the Kansas Water Office (KWO), GMD4 and the U.S. Bureau of Reclamation (Bureau). The model will aid in development and analysis of management scenarios.

In 2006, the KWO calculated the median annual water level changes from 1981 to 2005. In the northwest Ogallala aquifer area, as of 2005, there has been no statistically significant change (at a 5% error level) in the rate of decline. Reducing the decline rate of the Ogallala-High Plains aquifer is a basin priority issue.

Reduced streamflow and runoff into streams has been reflected in water levels in Keith Sebelius Lake, the federal project in the basin. These conditions and reduced availability of irrigation water stored in the reservoirs have suggested a need to take a fresh look at reservoir management.

Kansas entered into agreement with Colorado and Nebraska in 1943 to divide Republican River and tributary flows. Kansas has met its obligations leaving the state but has been shorted on water entering the Upper Republican basin.

Compliance with the Republican River Compact Settlement and Agreement and management of the Upper Republican River water resources in Kansas is a basin priority issue. Additional information on this issue may be found in the [Upper Republican Basin Priority Issue](#) section.

Applicable *Kansas Water Plan Objectives*

- Reduce water level decline rates within the Ogallala-High Plain aquifer and implement enhanced water management in targeted areas.
- Achieve sustainable yield management of Kansas surface and ground water sources outside of the Ogallala Aquifer and areas specifically exempt by regulation. Sustainable yield management would be a goal that sets water management criteria to ensure long-term trends in water use will move as close as possible to stable ground water levels and maintenance of sufficient streamflows.
- Meet minimum desirable streamflow at a frequency no less than the historical achievement for the individual sites at time of enactment.

Applicable Programs

The following programs help to meet the objectives in the Water Management (quantity) category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Appropriation Program
- Kansas Geological Survey, Kansas Department of Agriculture-Division of Water Resources: Water Well Measurement
- Kansas Geological Survey: High Plains Aquifer Technical Assistance Program
- State Conservation Commission: Water Right Transition Assistance Program
- USDA-Natural Resources Conservation Service: Environmental Quality Incentive Program (EQIP)
- Kansas Water Office: State Water Planning Program

ISSUE: WATER CONSERVATION

Water conservation is essential for the effective management of water resources in the basin to assure that a sufficient, long-term supply of water is available for the beneficial uses of the people of the state. Conservation is defined as a careful preservation and protection of something, especially the planned management of a natural resource to prevent exploitation or destruction. Water conservation is a part of maintaining a long-term water supply for Kansas.

Water conservation activities apply to all uses, irrigation, municipal, industrial, and others, and from all sources. In 2006, irrigation accounted for nearly 98% of all [reported water](#) pumped or diverted in the basin. Municipal use accounted for two percent of water used in the basin, stock, industry, recreation, domestic and other uses for less than one percent each.

Of the 616 [public water suppliers](#) that have an approved conservation plan in place as of December 31, 2008, 11 plans have been approved in the Upper Republican basin. As of August 2006, 210 conservation plans had been approved for irrigation water rights in the basin. The number of diversion points in Kansas that reported irrigation application rates over the regional average fluctuated from about 3,700 to less than 500 from 1991 to 2005. Of the total number of individual points of diversions that were reporting use of a measurable quantity of water in Kansas in 2006, more than 44% reported a metered quantity at least once during that year in the Upper Republican basin. (Source: DWR: Water Right Information System).

Applicable *Kansas Water Plan Objectives*

- Reduce the number of public water suppliers with excessive unaccounted for water by first targeting those with 30% or more unaccounted for water.
- Reduce the number of irrigation points of diversion for which the amount of water applied in acre feet per acre (AF/A) exceeds an amount considered reasonable for the area.
- All non-domestic points of diversion meeting predetermined criteria will be metered, gaged, or otherwise measured.
- Conservation plans will be required for water rights meeting priority criteria under K.S.A. 82a-733 if it is determined that such a plan would result in significant water management improvement.

Applicable Programs

The following programs help to meet the objectives in the Water Conservation category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Appropriation Program
- Kansas State University Research and Extension: Water Conservation and Management Program/MIL
- State Conservation Commission: Water Resources Cost-Share
- State Conservation Commission: Water Right Transition Assistance Program
- Kansas Water Office: Water Conservation Program
- USDA - Natural Resources Conservation Service: Environmental Quality Incentive Program (EQIP)
- USDA - Farm Service Agency: Conservation Reserve Program

ISSUE: PUBLIC WATER SUPPLY

The primary approach to addressing public water supply issues in the basin focuses on ensuring that there are adequate supplies of surface and ground water within the basin to meet future water demands, reducing the number of public water supply systems that are vulnerable to drought, and ensuring that systems have the technical, financial and managerial capacity to meet future needs for water quality and quantity.

In 2006 there were 16 [public water suppliers](#) in the Upper Republican basin. Ground water is the primary source for most public water supplies, accounting for over 95% of the total supply, principally from the Ogallala and Dakota [aquifers](#) and alluvial deposits along major streams. The City of Norton obtains a portion of their water from storage in Keith Sebelius Reservoir.

Among the major river basins, the percentage of drought vulnerable public water suppliers in 2006 ranged from three percent (Neosho Basin) to 42% (Solomon Basin). Comparison of the KWO 2000 and 2006 lists by river basin shows a significant increase in the number of drought vulnerable public water suppliers in most western river basins, but the Upper Republican remained the same at three. One of these communities considered drought vulnerable in 2000 is still considered to be at risk due to basic source limitations in 2006. The other two listed in 2006 were not on the 2000 list.

Applicable *Kansas Water Plan Objectives*

- Ensure that sufficient surface water storage is available to meet projected year 2040 public water supply needs for areas of Kansas with current or potential access to surface water storage.
- Less than five percent of public water suppliers will be drought vulnerable.
- Ensure that all public water suppliers have the technical, financial and managerial capability to meet their needs and to meet Safe Drinking Water Act requirements.

Applicable Programs

The following programs help to meet the objectives in the Public Water Supply category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Appropriation Program
- Kansas Department of Health and Environment: Public Water Supply Program
- Kansas Department of Health and Environment: Kansas Public Water Supply Loan Fund
- Kansas Water Office: Water Conservation Program
- Kansas Water Office: State Water Planning Program

ISSUE: WATER QUALITY

Water quality and related water resource issues are addressed through a combination of watershed restoration and protection efforts utilizing voluntary, incentive based approaches, as well as regulatory programs.

All the counties within the basin have a sanitarian funded by the Local Environmental Protection Program (LEPP).

All conservation districts in the basin have adopted nonpoint source pollution management plans. A buffer coordinator has also been employed in Thomas County to facilitate enrollment of stream buffers in the continuous Conservation Reserve Program (CRP) and State Water Quality Buffer Initiative.

The Clean Water Act requires states to conduct Total Maximum Daily Load (TMDL) studies and develop TMDLs for water bodies identified on the state's List of Impaired Waters (Section 303(d) List). TMDLs are quantitative objectives and strategies needed to achieve the state's surface water quality standards. There are 11 approved TMDLs within the Upper Republican basin; dissolved oxygen on lower Prairie Dog Creek is a high priority for implementation. Colby City pond and Norton Lake are listed as water quality impaired by eutrophic conditions, dissolved oxygen, and/or pH. Other pollutants limiting use of Upper Republican basin streams include fluoride, selenium, pH and sulfate. TMDL development for additional parameters is anticipated in 2009. Kansas Watershed Restoration and Protection Strategy (WRAPS) is a planning and management framework that engages stakeholders within a watershed in a process to:

- Identify watershed restoration and protection needs.
- Establish watershed management goals.
- Create a cost-effective action plan to achieve goals.
- Implement the action plan.

As of March 2008, there were 44 active WRAPS projects located throughout Kansas. One is on Prairie Dog Creek, in the Upper Republican basin, including the watersheds above and below Keith Sebelius Lake.

Applicable *Kansas Water Plan* Objectives

- Reduce the average concentration of bacteria, biochemical oxygen demand, solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas lakes and streams.
- Ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.
- Reduce the average concentration of dissolved solids, metals, nitrates, pesticides and volatile organic chemicals that adversely affect the water quality of Kansas ground water.
- Maintain, enhance, or restore priority wetlands and riparian areas.
- Nutrient reduction goals will be included in all WRAPS projects within the basin.
- All public water suppliers will complete and implement a source water protection plan.

Applicable Programs

The following programs help to meet the objectives in the Water Quality category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Health and Environment: State Water Plan Program (Contamination Remediation)
- Kansas Corporation Commission: Conservation Division Programs

- Kansas Department of Health and Environment: Local Environmental Protection Program
- Kansas Department of Health and Environment: Watershed Management Program
- State Conservation Commission: Nonpoint Source Pollution Control Program
- State Conservation Commission: Water Resources Cost-Share Program

ISSUE: WETLAND AND RIPARIAN MANAGEMENT

The primary approach to wetland and riparian management in the basin focuses on providing technical and financial assistance to landowners to protect and restore these resources in priority watersheds through the implementation of best management practices.

Riparian lands in the Upper Republican basin have been impacted by the invasion and infestation of non-native phreatophytes, although not to the degree as in other western basins. Of greatest concern are the effects tamarisk (salt cedar) and Russian olive on native riparian ecosystems.

Applicable *Kansas Water Plan* Objectives

- Maintain, enhance or restore priority wetlands and riparian areas.

Applicable Programs

The following programs help to meet the objectives in the Wetland and Riparian Management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Forest Service: Forest Stewardship Program and Conservation Tree Planting Program
- State Conservation Commission: Riparian and Wetland Protection Program
- Kansas Water Office: State Water Planning Program
- Kansas Department of Wildlife and Parks: State Parks and Wildlife Areas Planning and Development
- Kansas Department of Wildlife and Parks: Wildlife Habitat Improvement Program

ISSUE: FLOOD MANAGEMENT

Flooding is a natural, recurring event associated with streams and rivers that has resulted in the formation of natural floodplains over time. While this inundation provided benefits under natural conditions, encroachment of urban and agricultural development onto floodplains has resulted in the potential for flood damage. In addition, the Upper Republican basin is particularly prone to flash flooding which is characterized by a rapid rise in water level, fast-moving water and much flood debris.

Significant flooding was experienced during 1903, 1915, 1935 and 1941 on the Upper Republican River. One federal project, Norton Dam and associated Keith Sebelius Lake contributes to flood control in the basin. There are no watershed dam projects in the basin.

Kansas Water Plan flood management guidance has emphasized targeting watershed dam construction assistance to priority watersheds; encouraging participation in the National Flood Insurance Program; and preparing updated floodplain maps for priority communities.

Financial assistance from the State Water Plan Fund has been provided flood mapping as part of the 1993 Kansas Department of Agriculture-Division of Water Resources *Kansas Flood Mapping Initiative*. None has occurred in the Upper Republican basin.

Applicable *Kansas Water Plan* Objectives

- Reduce the vulnerability to damage from floods within identified priority communities or areas.

Applicable Programs

The following programs help to meet the objectives in the Flood Management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Structures Program/Floodplain Management
- Kansas Department of Agriculture-Division of Water Resources: Water Structures Program/Dam Safety
- Kansas Division of Emergency Management: Hazard Mitigation Grants Program
- FEMA: National Flood Insurance Program

ISSUE: WATER-BASED RECREATION

The Upper Republican basin has public water recreation sites on state and federal land. There is a demand for more consistent water levels, and access to water based recreation facilities for area residents that provide recreational income to the economy by attracting sportsmen and women to the area.

The Keith Sebelius Lake and associated recreation areas including Prairie Dog State Park, draw hunters, fishermen and boaters to the area. In addition, state-operated lakes offer fishing in the basin including; Sherman State Fishing Lake when sufficient water is present, and St. Francis sand pits.

Applicable *Kansas Water Plan* Objectives

- Increase public recreational opportunities at Kansas lakes and streams.

Applicable Programs

The following programs help to meet the objectives in the Water-Based Recreation category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Wildlife and Parks: Rivers and Stream Access
- Kansas Department of Wildlife and Parks: State Parks

ISSUES FOR FUTURE ACTION

None identified.

Upper Republican Basin High Priority Issue Ogallala-High Plains Aquifer Declines January 2009

Issue

Long-term management of the Ogallala-High Plains aquifer to extend and conserve the life of the [aquifer](#).

Vision

Sufficient water resources in western Kansas to support healthy, economically strong communities and rural lifestyles, today and for future generations.

Goal

Extend and conserve the life of the Ogallala–High Plains aquifer.

Description

The Ogallala portion of the High Plains aquifer (Ogallala-High Plains aquifer) underlies most of [Upper Republican River basin](#) (Figure 1). Within the basin, the Ogallala underlies all or part of Cheyenne, Rawlins, Decatur, Norton, Phillips, Sherman, Thomas, and Sheridan counties. Thomas and Sherman counties along with parts of Cheyenne, Rawlins, Decatur, and Sheridan counties are in Northwest Kansas Groundwater Management District No. 4 (GMD4). The aquifer fringe, outside GMD4 is managed by the Kansas Department of Agriculture–Division of Water Resources (DWR).

Ground water supplies significant amounts (95% of appropriations in 2006) of municipal, irrigation, industrial and domestic water in the basin.⁽¹⁾ The Ogallala-High Plains aquifer has been developed so extensively that the amount of water withdrawn annually is significantly more than the annual recharge, resulting in ground water declines. As ground water levels decline, the aquifer loses hydraulic connection with the overlying alluvial aquifers and rivers and no longer contributes much, if any, base stream flow. Since the 1950s (predevelopment), Ogallala water levels have declined as much as 75 feet in that portion of Sherman County located in the basin. The majority of Thomas and Sherman counties in the basin have measured declines, some up to 50 feet.

Aquifer water levels in the basin have declined up to 30 feet over the ten-year period from 1996-2006. With the greatest decline centered in southwest Sherman County. Generally, Sherman and Thomas county areas in the basin have declined by 5-20 feet in the ten-year period. The overall decline has contributed to a progressive reduction in surface water flow during the past several decades.

Water users in parts of Wallace, Sherman, Thomas, Sheridan and Graham counties are already experiencing shortages in meeting demand. To extend and conserve the life of the Ogallala–High Plains aquifer, GMD4 and the DWR are defining priority areas and management goals to reduce aquifer declines. Federal and state voluntary incentive programs to reduce water use have been developed and targeted to priority areas.

A 2006 Kansas Water Office (KWO) analysis of water level data indicated that the aquifer decline rate had not been reduced by a statically significant amount between two time periods, 1981-1993, and 1993-2005.⁽²⁾

Water Appropriations

Approximately 530,391 acre feet of the ground water appropriations in the Upper Republican basin. Total appropriations in the basin from the Ogallala-High Plains aquifer are approximately 515,902 acre feet for all beneficial uses. There are about 2,312 active Ogallala-High Plains water rights from 2,683 wells.⁽¹⁾

The majority of the producing wells in the Ogallala-High Plains aquifer and associated alluvium are within the GMD4. The appropriations for these wells total 468,011 acre feet, or about 89% of the Ogallala-High Plains appropriations in the basin.

Water Use

The 2006 reported water use in the basin from the Ogallala-High Plains aquifer was 268,077 acre feet. Reported water use for 2006 within GMD4 in the basin was 242,649 acre feet, from 1,933 wells. Irrigation use was 97% of the Ogallala-High Plains reported use in the basin.

Annual water use reported and quantified by township for 2002-2006 is provided in Table 1, based on data analysis by DWR.⁽³⁾ Some townships have water use in more than one area, such as a GMD and the fringe, therefore the sum of the number of townships analyzed for each area is not the same as those included under ALL in Table 1. The majority of a township may be in another basin or not underlain by the Ogallala aquifer.

There has been widespread adoption of more efficient irrigation systems in the Kansas High Plains shifting from flood and center pivot to center pivot with drop nozzles.⁽⁴⁾ A study by Kansas State University in 2006 found that the number of acres irrigated is a more important determinant of changes in water use than the adoption of more efficient irrigation systems.⁽⁵⁾ The authors concluded that if the irrigated acres are held steady after conversion to a more efficient irrigation system, net water use would, on average, change little; it is with a decrease in irrigated acres that a reduction in water use is assured.

Aquifer Declines

Average water levels in the aquifer within the groundwater management districts have continued to decline over the past ten years (Figure 2).

The overall average water level decline in the Ogallala- High Plains region over the 2005 calendar year was 0.57 feet. This was more than the average decline over 2004 (0.15 feet), but less than the average annual decline rate over the five years since 2001 measurements (approximately 0.98 feet/year).

Figure 3 is an estimated projection of the years until the Ogallala-High Plains aquifer reaches a point where wells will only be able to produce 400 gallons per minute (gpm) assuming ground water level trends from 1996 to 2006 repeat continuously and unchanged into the future. This methodology is best suited to the Ogallala portion of the Ogallala-High Plains aquifer because of the relatively extensive data sets for the Ogallala. The variability of the system is the biggest drawback.

Activities and Progress

Various programs and activities have been initiated to reduce the decline rate of the Ogallala-High Plains aquifer and extend and conserve the aquifer. Tools such as ground water and surface water models and more detailed aquifer characterization have been developed. In the Upper Republican basin, the determination of Ogallala subunit priority areas, setting subunit goals, and developing management plans to reach these goals has been the responsibility of GMD4, and the DWR.

Good data is essential to determine the decline rate. Data development includes calibration of ground water models to better understand the aquifer and subunits. Water meters, now required on almost all wells, provide improved information on withdrawals. All wells in GMD4 should be metered by December 31, 2009. Annual water level measurements, "index" wells and weather station data provide information contributing to better models.

GMD4 has identified six high priority subunits within their area, of which portions of five are in the Upper Republican basin (Figure 4). The GMD4 board is in the process of establishing water use goals and enhanced management actions for the high priority aquifer sub-units. These areas are the target of incentive programs.

The state and GMD4 have modeled management scenarios for the six high priority subunits. Corresponding economic estimates were produced for the anticipated cropping changes as ground water levels change, based on historical farm decision triggers as determined by Kansas State University.⁽⁵⁾

For areas outside GMD4, but still overlying the Ogallala-High Plains aquifer, DWR is to set high priority areas and develop goals.

Voluntary programs have been previously offered and targeted to areas determined by the appropriate management entity. Federal ground and surface water programs of the Environmental Quality Incentive Program (EQIP) were focused for two years on areas selected annually. GMD4 targeted areas utilized all available resources allocated for incentive payments of \$100 per acre annually for three years on eligible acres to convert irrigated land to non-irrigated land.

The Water Right Transition and Assistance Program (WTAP) has been available to retire water rights along portions of Prairie Dog Creek. State programs offer incentives to retire water rights. However that opportunity was not available to the Upper Republican basin Ogallala-High Plains area.

Regulatory programs have included special assistance by DWR to irrigators that have pumped in excess of water rights and the area average.

Progress toward reducing the decline rate was evaluated by the KWO in 2006 using water level data from 1981-2005.⁽²⁾ The median annual water level changes were calculated for each region and standardized or indexed to antecedent moisture conditions using the Palmer Drought Severity Index (PDSI) for the appropriate region. The comparison of 1981-1993 and 1993-2005 periods concluded that there was no discernable change in the rate of water level declines in the Ogallala-High Plains region. It also concluded that in the northwest Ogallala aquifer area (GMD4 and DWR fringe areas), as of 2005, there has been no statistically significant change in the rate of decline.

It should be noted that the percentage of total water use that has been reduced through the voluntary and regulatory programs is small. A reduction of decline rates will likely take many years or decades to be recognizable unless participation and reductions are greater.

Priority Aquifer Subunits

Priority aquifer subunit maps are used to guide state and federal efforts on water conservation. The priority aquifer subunit areas are being further defined by the groundwater management districts inside each district, and the DWR for areas of the Ogallala-High Plains aquifer outside of the districts, with input from the public. Currently, an interim map (Figure 4) is being used until new priority aquifer subunit maps are defined and approved. Specific target areas are defined for areas eligible for enrollment in the Conservation Reserve Enhancement Program (CREP) (Upper Arkansas basin), EQIP quick response areas (statewide) and WTAP (statewide). Eligibility requirements are determined by each program.

The priority rank shown on this map outside GMD4 is based on an area's total score from two databases: estimated usable lifetime and density of ground water use. Useable lifetime is defined as the ability to support a 400 gallons per minute (gpm) well yield, on every quarter section, pumping for 90 days. Rank 1 indicates areas with a short estimated usable lifetime and a history of higher ground water usage. Rank 4, the lowest concern areas, have a relatively long useable lifetime and low total water use.

Recommended Actions

1. DWR identify priority aquifer subunits or areas, and GMD4 and DWR develop specific goals and management strategies to extend and conserve the life of the aquifer.
2. GMD4 and DWR manage aquifer subunits to maintain economic health while ensuring sufficient water resources for future generations of western Kansas communities and rural populations and chosen lifestyles.

3. Provide opportunities to permanently and temporarily reduce water use through voluntary programs (state, federal, and local).
4. Educate water users, decision makers and the general public on the condition of the aquifer and methods and opportunities to reduce water use.
5. port research for high value, low water use crops.
6. Seek crop insurance option for limited irrigation crops from USDA Risk Management Agency.

In order to implement the main actions stated above, the following specific activities are recommended:

- Provide technical support, including hydrologic modeling if appropriate, to project aquifer current and future conditions. Identify and implement activities to promote local conservation to extend the life of the aquifer that accrue to the aquifer subunit or region where water savings has occurred.
- Recognize the benefit of aquifer subunit planning. Management of the aquifer by subunit can benefit the local community economic wellbeing and social connectedness, reduce over pumping and widespread well shut offs from impairments.
 - Encourage ownership in one's aquifer subunit; promote local leadership.
 - Form subunit teams for local leadership of aquifer subunits or other methods of managing local areas/subunits for reduced consumptive water use.
 - Target incentive-based programs to aquifer subunits that have developed a long term vision and plan.
 - Implement aquifer subunit plans that assure water into the future that can help attract industry thus contributing to the economic health of the subunit and area.
- Consider the long term impact of climatic change on the water demands for the region.
- Consider interstate discussions on water conservation and planning.

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Upper Republican Basin High Priority Issue

Republican River System Management: Compact Compliance and Damages

January 2009

Issue

Planning and coordination is needed for the Republican River system in the Upper Republican basin for efficient water use, compliance with the Republican River Compact and the beneficial use of Compact Settlement payments.

Description

Water resource management challenges in the Upper Republican basin include meeting the needs of irrigators and other water users; compact compliance; and the desire for recreation in Keith Sebelius Lake.

The tributaries to the Republican River in Kansas include the Arikaree, South Fork Republican, Sappa (north fork, south fork and main), Beaver, Little Beaver, and Prairie Dog creeks (Figure 1). The basin includes 15,230 intermittent stream miles and 760 perennial stream miles. Drainage density is 0.31 mile per square mile in the basin (perennial streams only).

Keith Sebelius Lake, above Norton Dam, is located on Prairie Dog Creek in the eastern part of the basin. It is a federal lake 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.

Principal [aquifers](#) include the High Plains (Ogallala included) and alluvial aquifers. The alluvial aquifers and portions of the Ogallala-High Plains aquifer in the basin are hydrologically connected to the streams, thus management of the surface water must also consider ground water. The Dakota aquifer is present in the basin but is seldom used due to mineral content. All of the alluvial corridors in the basin are closed to new appropriations.

The Republican River Compact was enacted by Colorado, Nebraska and Kansas to divide the water supply of the Republican River basin. The Republican River basin includes portions of eastern Colorado, northwest Kansas and southwest Nebraska. The Republican River eventually flows through portions of north central Kansas to Milford Reservoir.

The “*Republican River Compact and Settlement Agreement*” (RRCA) requires Kansas to meet specific quantity goals for water leaving the Upper Republican basin. Climatic conditions, lack of runoff, alluvial ground water pumping, and reduced stream flows often limit water leaving the state. During the first accounting period under the settlement agreement (2003-2007), Kansas met its obligations under the compact. Meeting these obligations in the future may prove a challenge under some conditions. Management of the hydrologic system is needed to optimize use in Kansas while meeting flow required under the Settlement.⁽¹⁾

Results of the first accounting period for the RRCA indicate Nebraska and Colorado have not met the terms of the Agreement. Monetary payments as well as water could be received by Kansas.

Substitute for Senate Bill No. 89 was signed by the Governor on April 4, 2008 to address damage payments under the RRCA.⁽²⁾ This bill stipulates the distribution of any cash damage payments from Colorado and Nebraska to the following accounts; the interstate water litigation fund,⁽³⁾ the Republican River water conservation projects-Nebraska (RRNE), and the Republican River water conservation projects - Colorado (RRCO). One-third of the RRNE and RRCO funds are to be credited to the *Kansas Water Plan* Fund for water conservation projects. The portion from Nebraska must enhance the ability of Kansas to remain in compliance with the RRCA. The remaining, two-thirds (the RRCO) are to be expended in the portions of Cheyenne, Decatur, Norton, Phillips, Rawlins, Sheridan, Sherman and Thomas counties in the Upper Republican River basin for conservation, efficiency, administrative and delivery projects. The RRNE are for use in the Lower Republican basin for similar projects .

The director of the Kansas Water Office (KWO) and the chief engineer of the Kansas Department of Agriculture-Division of Water Resources (DWR) shall review and approve each proposed project. The director and the chief engineer shall give priority to: projects needed to achieve or maintain compliance with the Republican River compact, projects that achieve greatest water conservation efficiency for the general good, and projects that have been required by the DWR.

The State of Colorado has proposed delivery of water by pipeline to meet RRCA compliance. This may replace monetary payments from Colorado. In the event additional water is delivered, the uses and transportation of the water from the state line will need to be identified.

Water Management

Numerous factors and entities are involved with the [management](#) of the water resources in the Upper Republican basin in Kansas.

Water appropriations and use are overseen by DWR. All of the streams and alluvial corridors in the basin are either closed to new appropriations or new appropriations are restricted (Figure 2). Compliance with the RRCA is also the responsibility of DWR

All or parts of six counties in the basin are included in Northwest Kansas Groundwater Management District No. 4 (GMD4). GMD4, formed in 1976, is pro active in developing local water policy compatible with state laws. GMD4 has identified six high priority subunits of the Ogallala-High Plains aquifer for priority management and programs. Portions of five of these areas are in Upper Republican basin. DWR identified two additional areas in the basin for targeting of a federal water use reduction program in 2009. Prairie Dog Creek has also been a targeted subbasin area for permanent water right retirement by the state's Water Right Transition Assistance Program (WTAP).⁽⁴⁾

The Bureau of Reclamation operates and maintains Keith Sebelius Lake. Throughout the history of this reservoir, irrigation draw downs and evaporative losses in excess of inflow have occurred. The probability of water levels remaining at or above conservation level in the future are low. Lake water levels frequently due to irrigation releases and inadequate inflow. A ten-year agreement between the Almena Irrigation District and the State of Kansas allows for some additional water to be stored at times. This may contribute to Kansas remaining in Compact compliance. Water stored in Keith Sebelius Lake can aid Compact compliance if water is available for release when needed.

Each county has a conservation district responsible for the conservation of soil, water, and related natural resources. Parts of two Resource Conservation and Development areas (RC&Ds) cover the Upper Republican basin: the Western Prairie and Solomon Valley RC&Ds. The Prairie Dog Creek Water and Sediment Control Basin-Stream Steward Project is in the assessment phase of a Watershed Restoration and Protection Strategy (WRAPS) through local conservation district and RC&D leadership. Projects selected for cost-share through these programs and organizations should consider their impact on Compact compliance but are not obligated to do so.

Recommended Actions

1. Review hydrologic system operation (some modeling may occur by federal agencies).
2. Review Keith Sebelius Lake management and operation.
3. Determine needs in the basin for continued compliance with RRCA. Develop a work plan to address identified needs to maintain compliance.
4. Identify areas where Republican River Compact compliance has restricted water use.
5. Identify potential projects to meet requirements of Senate Substitute Bill 89. Consider the economic benefits to the basin in the use of any financial payments and/or water received.

6. Develop coordination of state-funded projects such as nonpoint source (NPS) cost-share and WRAPS with projects funded by damage payments.
7. Consider benefits to the area economy in determining priority uses for damage payments.
 - a. Consider economic impacts when determining use of payments from Colorado.
 - b. Consider economic impacts when determining use of payments from Nebraska to maintain compact compliance.

Resources

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