Kansas-Lower Republican Basin High Priority Issue
Water Supply Management and Conservation
January 2009

Issue

Increasing population and development in portions of the Kansas River corridor along with aging reservoirs and public water supply infrastructure, indicates a need to evaluate the river/reservoir system capacity to meet future water supply needs in the basin.

In 2007, the Kansas Water Office (KWO) prepared an analysis of *Surface Water Supply and Demand Projections for Selected Basins in Eastern Kansas*.(1) The analysis utilized historic streamflow, estimated reservoir yields, and projected population information to predict the total water supply and demand in the Kansas River basin over time. In those counties primarily served by the Kansas River and supported by federal reservoirs, the preliminary finding was that demand was predicted to exceed the total existing supply during a two percent probability drought in the year 2090 (Figure 1). This estimate includes the current supply owned by the State of Kansas along with the purchase of water supply storage reserved for future state use. Without the purchase of storage reserved for future use, demand is predicted to exceed supply in the year 2057. The analysis did not include the Lower Republican watershed, including Lovewell Reservoir or other areas of the Kansas River basin not served by the mainstem of the Kansas River.

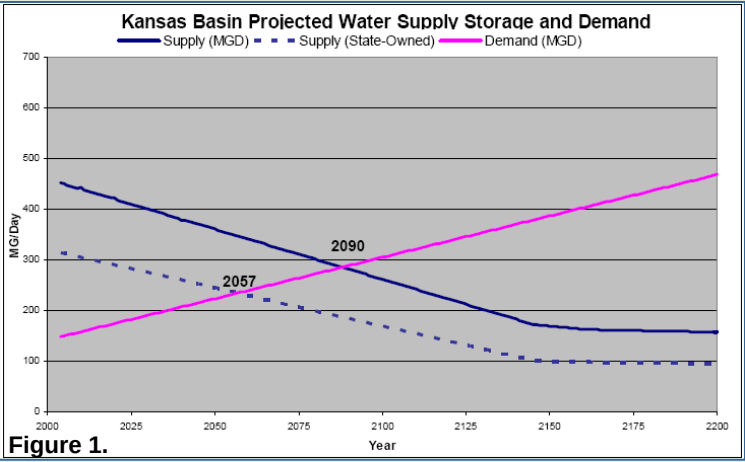

Figure 1.

Also in 2007, KWO released updated *Municipal Water Conservation Plan Guidelines* with practices for use by public water suppliers.(3) While the supply and demand analysis did include implementation of some conservation practices during drought, demand management could extend water supplies. Controlling water loss and enhancing treatment efficiency could further enhance demand management.

In 2008, KWO initiated the Reservoir Sustainability Initiative to conserve and potentially restore reservoir storage capacity and provide for long-term public water supply needs.(2) Four federal reservoirs in the Kansas River basin were constructed by the U.S. Army Corps of Engineers (Corps) from 1963 (Tuttle Creek) to 1977 (Clinton). Each reservoir pool was designed with storage designated for accumulated sediment. The estimated period to fill this storage was 50 years at Tuttle Creek and 100 years for the remaining three lakes. Public water supply storage has been impacted by sedimentation in all the Corps lakes in the Kansas River basin. Maintaining this storage is critical to meeting future public water supply needs.

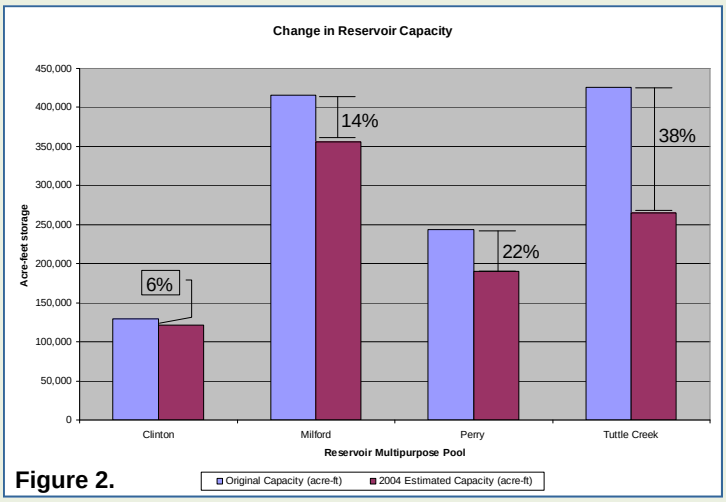

Figure 2.

Description

Water Supply

Water supply in the Kansas River basin is primarily provided by four Corps lakes, Milford, Tuttle Creek, Perry, and Clinton; along with four State Multipurpose Small Lakes; multiple city-owned lakes; ground water wells; and natural stream flows. Based on bathymetric survey information and projected sedimentation rates, estimated reservoir water supply storage and yield over time was updated by the KWO in 2002.(4) The 2007 analysis of supply and demand in the Kansas River basin used the previously calculated yield available from the federal reservoirs along with natural flows to estimate the total water supply available during a severe drought similar to the 1950s (Figure 3).

The 2007 analysis was not structured to account for the quantity of water supply available in specific stream reaches under different conditions. The initial analysis indicated a more robust water supply in the Kansas

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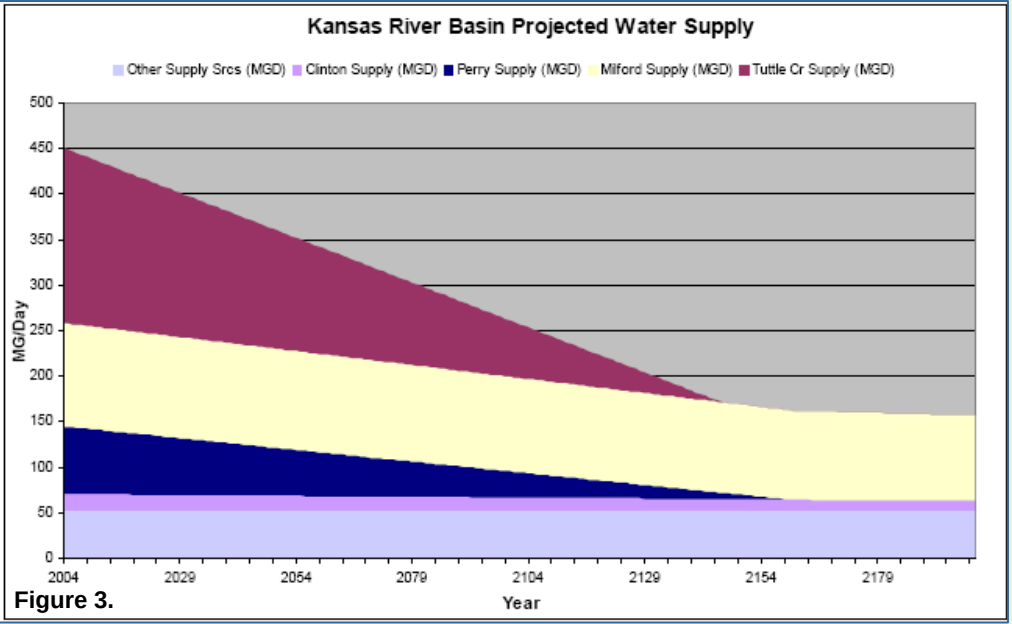

Figure 3.

River than in other eastern Kansas basins. A computer model to estimate the available water supply at specific demand points under various conditions in the Kansas River basin will be developed on a priority basis. In the future, KWO staff will be assigned to work with water supply utilities, industry, other water users, and the Kansas-Lower Republican Basin Advisory Committee (BAC) to obtain detailed information on expected water demand. Releases to support water quality and aquatic life would be accounted for in the computer model.

Marketing and Assurance

Reservoirs provide dependable water supplies in streams with highly variable flow, in addition to providing flood control, recreation, and other benefits. The 1958 Federal Water Supply Act made storage in federal reservoirs available to local governments if they agreed to repay the cost of construction, operation, and maintenance of the water supply storage. The State of Kansas has purchased water supply storage in each of the federal reservoirs in the Kansas River basin.[4]

The Water Marketing Program provides long-term (10 - 40 years) contracts for water supply for municipal and industrial uses only Customers of the Water Marketing Program pay for water on a per 1,000 gallon basis and the state pays the costs of capital investment and the annual operation and maintenance costs of the reservoir storage to the federal government. The marketing rate is based on the combined costs for the ten reservoirs where the state has purchased storage. The state currently has storage in Milford and Clinton lakes committed to the Water Marketing Program. Reserve storage at Tuttle Creek lake is owned by the state but currently not committed to either the Water Marketing or Assurance programs. This storage will be brought into service incrementally as demand requires (Table 1).

A determination is made by the Kansas Water Authority (KWA) prior to entering into negotiation for a contract with any applicant that the proposed withdrawal and use of water is in the interest of the people of the State of Kansas. The amount of water that can be contracted is limited to a quantity (yield capability) that is estimated to be available during a significant drought. Water not needed to meet long-term contract obligations can be acquired under a surplus contract. Surplus contracts are only good for one calendar year. These contracts have been written for irrigation purposes due to special authorizing language by Congress. There have been no surplus contracts for water in reservoirs in the Kansas River basin.

Table 1.

Reservoir	Water Assurance*	Water Marketing	Future Use or Reserve	Total Storage
Milford	55,000	46,650	198,350	300,000
Tuttle Creek	41,350	0	8,650	50,000
Perry	25,000	0	125,000	150,000
Clinton	0	53,500	35,700	89,200

*Storage expressed in acre-feet
** as per contract with Corps of Engineers

Access to water in storage is also available through the Water Assurance Program that operates the reservoirs in the basin as a system, maximizing the availability of water. Through this program, municipal and industrial water right holders that have formed a water assurance district can purchase storage in these reservoirs. Under agreements negotiated with the state, water in that portion of storage is released during dry periods to support the water rights of water assurance district members. These releases are protected from being diverted by other users. The Kansas River Water Assurance District No. 1 was formed in 1991 with 15 municipal and industrial water right holders. The Water Assurance District has purchased a portion of the state-owned storage in Milford, Tuttle Creek, and Perry lakes.

The key difference between the Water Assurance Program and the Water Marketing Program is that the water

Kansas-Lower Republican Basin High Priority Issue
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assurance districts own the storage in the reservoirs in the particular basin and pay only those costs associated with the principal and interest, operation and maintenance for those reservoirs, along with the costs of administration and enforcement dedicated to the program. By contract, these costs are pooled for all state-owned reservoir storage in the Water Marketing Program and customers pay a statewide averaged cost.

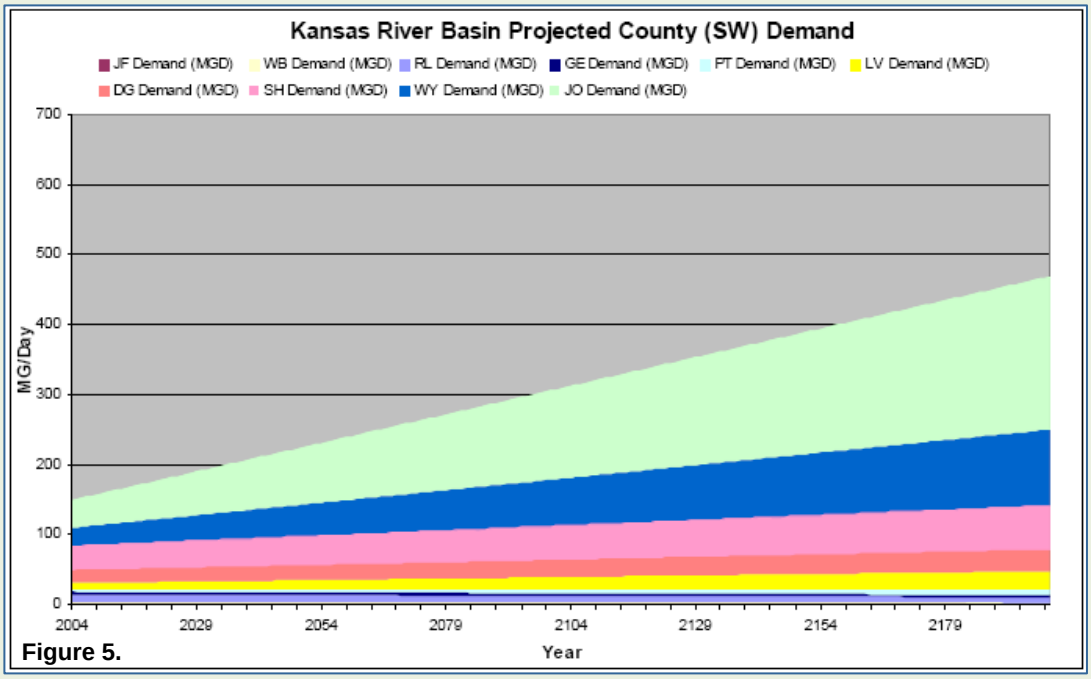

Figure 5.

Water Demand

In the 2007 KWO supply and demand analysis, demand was combined for the Kansas River basin in the same manner as water supply. Entire counties were assigned to the basin based upon predominance of area and existence of larger incorporated areas (Figure 4). For the analysis, the Kansas River corridor included Geary, Riley, Pottawatomie, Wabaunsee, Shawnee, Jefferson, Douglas, Leavenworth, Johnson, and Wyandotte counties. Population estimates were developed from the Kansas Division of Budget projections to the year 2027. These trends were further projected as necessary in the supply and demand analysis (Figure 5).

Municipal and Industrial Demand

Water demand associated with population projections is based on municipal water use measured in gallons per capita per day (gpcd) reported to the Kansas Department of Agriculture-Division of Water Resources (DWR) for 2000 through 2004 by suppliers in the Kansas River basin.[6] The quantity of water that municipalities sold for non-domestic use is not included in those gpcd calculations but was added to the total. To develop the projected water use from industry, commerce, agriculture, and recreation, all non-municipal surface water points of diversion within five miles of the mainstem of the Kansas River were selected. The surface water demand increase on the Kansas River corridor is primarily associated with Johnson, Wyandotte, Shawnee, Douglas, and Leavenworth counties, specifically the future population growth projected to occur in those counties. Only 45% of the population growth in Johnson County was assumed to be supplied by surface water sources in the Kansas River basin.[1] This generally reflects the current

Counties Supplied by the Kansas River Corridor

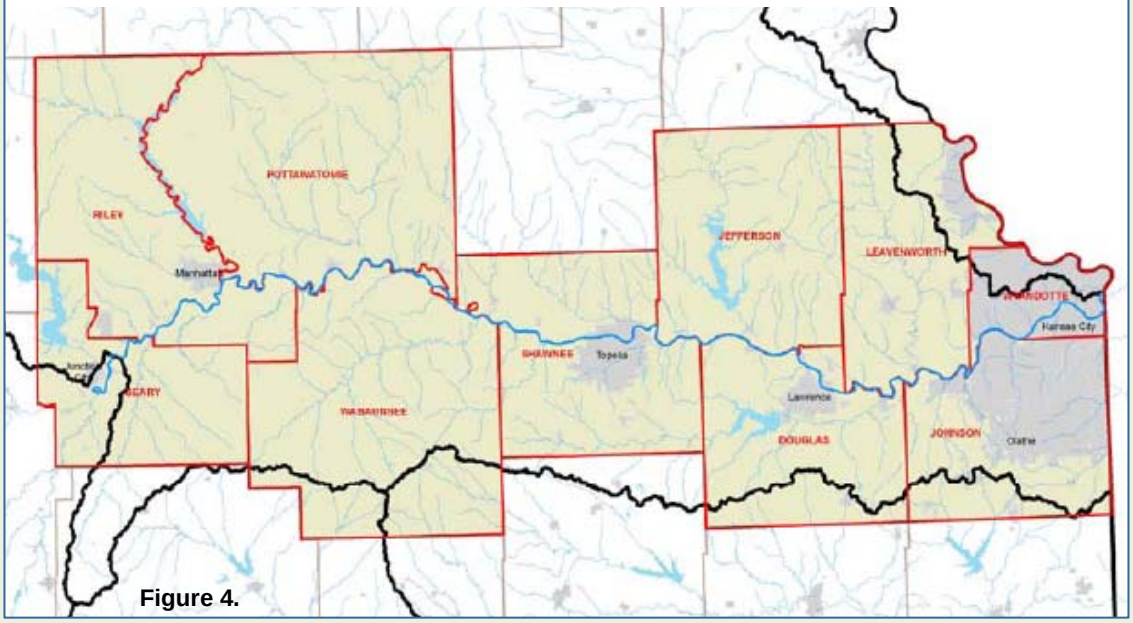

Figure 4.

percent of supply coming from the Kansas River basin for that county (the Missouri River supplies the balance of the demand).

Refining Supply and Demand Projections

The KWO plans to use the Operational Analysis and Simulation of Integrated Systems (OASIS) computer model to analyze water supply and demand for the Kansas River basin. OASIS models the operations of the river/reservoir system by simulating the routing of water though a system represented by nodes (reservoirs, cities, etc.) and arcs (rivers). OASIS can account for physical constraints such as reservoir capacity, evaporation, and sedimentation. The model can also account for system management issues such as minimum release requirements and lake level management plans.

An advantage of OASIS modeling is that it can simulate the interaction of multiple reservoirs and rivers in a system. It improves the ability to simulate system management issues. OASIS can also identify "problem" areas in a system and evaluate alternative improvements to the system (off-stream storage, new reservoirs, dredging, reallocation, etc.). The KWO will be working with all users in the Kansas River corridor to identify supply and demand options. These options will be tested through the OASIS model and the results shared with basin stakeholders.

Conservation

The objective of water conservation is to achieve efficient use of the state's limited water resources through cost-effective practices to curtail the waste of water and to ensure water use does not exceed reasonable needs. In the Kansas River basin, conservation includes efficiency management in public water supply along with maintaining existing reservoir storage and water supply.

Local land use planning and zoning authorities provide cities and counties with effective tools to minimize the potential impacts of development on water resources. Counties with planning and zoning regulations often require landscape plans for new development. While landscaping can provide aesthetic and environmental benefits, heavily irrigated landscape designs can increase demand on public water supplies. Of the counties supplied by the mainstem of the Kansas River, all are zoned except Geary County.

Demand management is an important component of extending water supplies, but has not typically been incorporated into water utility operations. With the recognition of the potential for future water supply shortages, water suppliers and communities should begin to incorporate this concept into operational planning. Demand management may include less water intensive landscaping, low water use plumbing, conservation design for urban areas, water reuse, and other elements promoting responsible use of water contained in the *2007 Municipal Water Conservation Guidelines*. A movement beyond excessive use of water into more sustainable long-term management is needed. Increases in consumptive use cannot occur under existing, vested or otherwise fully perfected water rights. If a municipality is considering substantial changes in their system to reuse water, DWR must be consulted.

Conservation of reservoir storage has received attention as the impacts of sedimentation become increasingly apparent. While supply in the Kansas River basin is adequate in the near term, the closure of recreation areas in the upper reaches of Tuttle Creek and Perry lakes due to siltation is an indication of loss of water supply storage. Research has been conducted addressing the causes of reservoir storage loss and identifying solutions.[5] These measures generally fall into short-term strategies such as enhancing efficiency of reservoir operations and longer-term restoration of storage. Examples of reservoir efficiency include pool reallocation, raising dams/pools and modification of operational rules. Restoration includes dredging, reservoir flushing, treatment of the upstream watershed to limit erosion or other means of removing accumulated sediment.

Recommended Actions

1. Work with stakeholders to identify options for supply and demand management including: reservoir pool raise, pool reallocation, dredging, new supplies, modification of reservoir operations, operation of Water Marketing and Water Assurance programs and conservation measures.
    a. Test various options through the Kansas River basin model.
    b. Share information with stakeholders from the basin model including supply and demand information for specific stream segments.
    c. Implement the most beneficial and cost-effective options.
2. Encourage incorporation of water demand management into utility operating plans. Demand management should include education and interaction with the development community and existing local authorities.

Kansas-Lower Republican Basin High Priority Issue
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Resources

1. Kansas Water Office. 2007. *Surface Water Supply and Demand Projections for Selected Basins in Eastern Kansas.*

2. Kansas Water Office. 2006. *Kansas Municipal Water Use.*

3. Kansas Water Office. 2007. *Kansas Municipal Water Conservation Plan Guidelines*.

4. Kansas Water Office. 2002. *Status Report: State of Kansas, Water Marketing and Assurance Programs, Multipurpose Small Lakes Program.*

5. Kansas Water Office, Kansas State University. 2008. *Sedimentation in Our Reservoirs: Causes and Solutions, Kansas Center for Agriculture and the Environment*.

6. Kansas Department of Agriculture - Division of Water Resources. 2006. *Public Water Suppliers: Sources and Purchasers.*

Clinton Dam. Photo courtesy KGS.