

Kansas-Lower Republican Basin High Priority Issue

Lower Republican River System Management

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Issue

The lower Republican River basin has many competing needs for the limited water supplies: irrigation, recreation, wildlife areas, municipalities, industries, and minimum desirable streamflow. During recent years, many of these users have had reduced water due to reduced supplies or regulation of Minimum Desirable Streamflow. The basin is also directly affected by the Republican River compact. Nebraska exceeded its allocation during the water short years of 2005-2006, and also during the five year time period that ended in 2007. Consequently, Kansas did not get its full allocation. Along with compact compliance, there is a pressing need to use the water as efficiently and effectively as possible. Towards this goal, there are potential changes that can be made to the storage and management of the water in the basin to improve supplies for users in the basin.

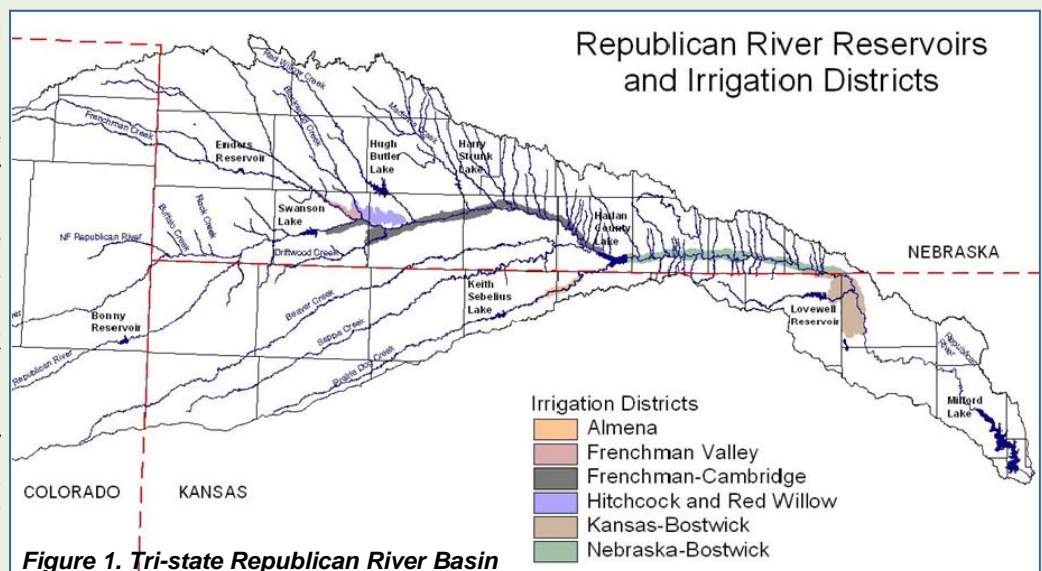
Description

The Republican River has historically experienced severe droughts and floods. It was the droughts of the 1930s and the flood of 1935 that first led Congress to authorize the Bureau of Reclamation (Reclamation) and the U.S. Army Corps of Engineers (Corps) to construct a series of dams, reservoirs and associated irrigation projects along the Republican River valley. The cooperative effort between Reclamation and Corps was done under the 1944 Flood Control Act, Pick-Sloan Missouri River Basin Program. Beginning at the upper end of the Republican River valley, these structures include Bonny Reservoir in Colorado, Enders, Swanson, Hugh Butler, Harry Strunk and Harlan County reservoirs in Nebraska, and Keith Sebelius and Lovewell reservoirs in Kansas (Figure 1). In 1962, the Corps built Milford Reservoir at the lower end of the basin. Milford is federally authorized for flood control, water supply, water quality, navigation, recreation and wildlife.

Although all the reservoirs influence the lower Republican River water supply, it is Harlan County and Lovewell reservoirs that provide the irrigation storage to meet the needs of the Bostwick Irrigation District in Nebraska and the Kansas Bostwick Irrigation District (KBID). Harlan County Reservoir is a Corps lake with Reclamation responsibilities for irrigation releases, and Lovewell is a Reclamation lake with Corps' responsibilities for flood protection.

The lower Republican River and Milford Reservoir have had reduced flow during the water years 2000 to 2006 (October 1, 1999 to September 30, 2006). A U.S. Geologic Survey (USGS) study indicates that the Republican River, along with other north-central Kansas streams, had lower stream flow levels during this recent period than during the droughts of the 1930s and 1950s, even though there was more precipitation (Putnam, 2008). Record low annual flows on the Republican River were recorded at the gages near Hardy, Nebraska, Concordia and Clay Center. The low stream flows also led to a record low level at Milford Reservoir in 2003. The low flows led to a curtailment of junior water rights to maintain Minimum Desirable Streamflow. The USGS study indicated there was a change in the runoff-precipitation relation for the most recent drought period compared to earlier droughts. It suggests that average stream flow levels may be lower in the future than occurred under historical conditions with similar [precipitation](#) events. In addition to [land use](#) changes that may be retaining more precipitation on the land, low flow concerns also arose from Nebraska's Republican River compact non-compliance.

Republican River Compact. The Republican River is subject to an interstate compact entered into by Colorado, Nebraska and Kansas. In 1943, the entire virgin water supply of the Republican River valley was allocated among the three states, with an approximate allocation of Colorado getting 11% of the supply, Nebraska getting 49% and Kansas 40% for both the upper and lower basins. Kansas' allocation under the Compact provided 52,300 acre-feet to the upper Republican basin and another 138,000 acre-feet to the lower Republican River basin. This amount is adjusted annually based on the actual water supply.



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Despite the improvements made through the Compact and the water control structures, there continue to be shortages in the lower Republican River basin, with many users not having sufficient supplies. Most visible are the problems due to Compact violations by the upstream states, with Nebraska's overuse directly affecting the lower portion of the basin in Kansas. Starting in 1985, Kansas began raising serious concerns about Nebraska's continued development and overuse of groundwater in the Republican River Basin. In 1998, Kansas filed a Motion for Leave to file a Bill of Complaint with the U.S. Supreme Court alleging that Nebraska was violating the compact. The Court referred the matter to a Special Master, who ruled that the Compact included groundwater that was connected to surface flows in the Basin. After that ruling, the States entered negotiations for settlement. In 2003, the Court adopted by decree the Final Settlement Stipulation (FSS), which brought the litigation to a formal end. Through the FSS, Nebraska and Kansas, in agreement with the United States, agreed to minimize bypass at the Superior-Courtland Diversion Dam (bypass is water that is not diverted into the Superior or Courtland Canals, which remains in the main stem). Kansas can receive all or any portion of its allocation at the diversion dam. The States also agreed to pursue system improvements in the basin, including measures to improve the ability to utilize the water supply below Hardy, Nebraska, on the main stem. The Compact and the FSS do not directly address flow requirements in the Republican River at the state line.

The Republican River Compact Administration (RRCA), through the FSS, adopted accounting procedures that include an extensive groundwater model (which does not extend in the Lower Republican Basin in Kansas). The FSS also provided for a moratorium of new groundwater wells, and accounts for groundwater pumping from tableland wells and all reservoirs 15 acre-feet or larger within the basin. A running five year accounting period was agreed upon, with the first period beginning in 2003. Additionally, the States agreed to a two year accounting period for Nebraska and Kansas in water short years, defined as any year in which the projected irrigation water supply at Harlan County reservoir is less than 119,000 acre-feet as of June 30th.

Compact accounting indicates that Nebraska did not meet its first normal compliance year in 2007, using a running five year average. Nebraska also overused for the water short year of 2006 (accounted for by the water short year and the immediately preceding year.) The amount Nebraska's overused in 2005 and 2006 upstream of Guide Rock totaled 78,960 acre-feet. If addi-

tional supply had been available in Harlan County Reservoir, KBID would have called for releases from Harlan County Reservoir for deliveries. These additional releases would also have contributed to the Republican River streamflow downstream of KBID. Within KBID, irrigators above Lovewell did not receive any water in 2005 and only a fraction of their base level in 2006. KBID irrigators below Lovewell Reservoir received approximately 6 inches per acre in 2005 and 8 inches per acre in 2006. Actual KBID deliveries for 2005 and 2006 were about 28% and 43% of normal, respectively. Private irrigators (non-KBID) would also have used more irrigation water if it had been available. During the water short years, Minimum Desirable Streamflow (MDS) was not met and approximately 150 water rights users junior to MDS were administered.



Lovewell Reservoir.

The problems arising from the non-compliance of the 2005-2006 water short years were then subject to non-binding arbitration as required by the FSS. Arbitration was conducted during the first half of 2009. The arbitrator's report, filed June 30, 2009, agreed with Kansas that Nebraska has not complied with the Compact and the FSS, and that Kansas has incurred damages. However, the arbitrator failed to provide a final damage figure.

The 2008 State Legislature designated where compensation that Kansas may receive due to Republican River compact violations is to be directed (Sub. SB89). The first priority is to fill the Interstate Litigation Fund that is used to protect the State's interstate water interests. This fund caps out at \$20 million. After that, where funds are directed depends on where they are received. If payments come from Nebraska, two-thirds go into a Lower Republican Water Conservation Projects Fund (WCPF), to be spent in the basin on projects that improve the efficiencies or water conservation. The WCPF is administered by the Director of the Kansas Water Office. The remaining one-third would go into the State Water Plan

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Fund for water conservation projects, with priority for the upper Republican River efforts to assure Kansas remains in compliance on the Republican River compact. If funds are received from Colorado, and the interstate litigation fund is full, two thirds would go into a WCPF for the upper Republican basin, to implement projects that improve water efficiencies or conservation. This fund is also administered by the Director, Kansas Water Office. The remaining one third would go into the State Water Plan Fund for water conservation projects.

In January, 2009, the Director of the Kansas Water Office appointed the Lower Republican River Basin Stakeholder Advisory Committee to develop recommendations for projects that could be funded through the WCPF to improve the water management in the basin.

Water Users in Lower Republican Basin

Kansas Bostwick Irrigation District (KBID) The KBID has a very senior right in the Lower Republican Basin (#385, priority date 1948) with a diversion point at Superior-Courtland Diversion Dam near Guide Rock, Nebraska, and gets most of its water from irrigation releases in Harlan County Reservoir as well as natural flows in the Republican River. Its water right allows up to 102,521 acre-feet to be diverted annually, at a diversion rate not to exceed 700 cfs (314,160 gallons per minute), for use on 42,500 acres of KBID project lands (above and below Lovewell Reservoir) located in Jewell and Republic Counties. KBID typically irrigates 12,800 acres above Lovewell, and 25,150 acres below. Lovewell Reservoir is filled with Courtland Canal water, along with natural flows of White Rock Creek. KBID's water right #4673 (priority date 1955), provides for the diversion of White Rock Creek at a rate not to exceed 635 cfs, or up to

19,700 acre-feet annually, for irrigation. The natural flows of White Rock Creek in excess of that needed for direct diversion and use may be accumulated in Lovewell Reservoir to a maximum extent of 41,690 acre feet for subsequent irrigation use by KBID. Lovewell can currently hold 51,377 acre-feet at the top of its conservation pool.

KBID recently entered into a 40 year contract with Reclamation. Part of the negotiated contract is for KBID to improve delivery efficiencies by six percent, based on a full supply. KBID has been making efficiency improvements by replacing open ditch laterals with buried pipe, burying laterals and lining sections of canals. Delivery system losses are estimated at 20,000 acre-feet annually, depending on how much flow occurs in the canals. However, many water users and streams have benefited from the return flows from the canal seepage and operation wastes. Delivery system improvements will reduce these recharge benefits.

Lovewell Reservoir is a 3,000 surface acre lake managed by Reclamation used for flood protection, storage of irrigation water, fisheries and recreation. Through a lease agreement with Reclamation, the Kansas Department of Wildlife and Parks manages Lovewell State Park, a 1,160 acre state park adjacent to the reservoir and 2,215 acre wildlife area adjacent to the reservoir. Seven boat ramps and several cabins are part of the recreational amenities. Lovewell provides recreation for many park visitors, and revenues for the park consistently rank Lovewell among the top Kansas State Parks. In addition to the State Park, there are also a number of private cabin and trailer owners that lease property from Reclamation.

Since the 1980s, KBID has requested a deviation from the lake management manual in water short years for a 2 foot rise into the flood pool for seasonal irrigation water storage. The current conservation pool storage is permitted entirely to KBID. The Corps completed an Environmental Assessment of this seasonal pool rise in 2009 and recommended it be formally adopted into the Lake Management Manual. If approved, this will allow additional irrigation storage at Lovewell Reservoir to continue, dependent on the irrigation storage available at Harlan County Reservoir.

Non-KBID Irrigators. There are irrigators relying on the natural flow in the mainstem or its tributaries, above and below White Rock Creek. Some irrigators rely on the Republican River flows as it enters Kansas. There are also



Superior-Courtland Diversion Dam

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irrigators below White Rock Creek, both senior and junior to Minimum Desirable Streamflow (MDS). [Irrigators](#) along the river outside of KBID were also short on water in 2005 and 2006, including those with water rights senior to MDS.

[Municipalities](#). Morganville, Concordia and Clay Center have water rights that are junior to MDS. Other cities that rely on the Republican River valley water include Scandia, Norway, Republic, Clyde, Clifton and Clay Center. Water quality can become a concern with low stream flows.

[Jamestown Wildlife Area](#). Jamestown Wildlife Area is a series of interconnected marshes, pools and upland areas that has been under state management since 1932. Of the 4,729 acres of wildlife managed land, over 1,900 acres are wetlands. This area is located along a major migration route for the Central Flyway. The Jamestown Wildlife Area provides recreational opportunity for hunters, birdwatchers and photographers, with roughly 14,700 visitor-days annually.



Jamestown Wildlife Area Pelicans.

The Kansas Department of Wildlife and Parks is actively converting marginal cropland back to wetlands. Future development may increase the wildlife area by 1,200 acres. Plans include new wetlands, new water control structures and renovation of existing wetlands by subdividing into units so water and vegetation can be managed more effectively. The goal of the renovation is to provide optimum wildlife habitat, improved user opportunities and play an important role in the overall Lower Republican River [watershed management](#) and life span of the marshes.

The wildlife area has water rights authorized for water storage; two of these rights are senior and four are junior to MDS. The junior water rights are required to bypass inflows during MDS administration of the Republican River.

[Minimum Desirable Streamflow](#) was established at two locations within the basin: as measured at the U.S. Geological Survey's stream gage near Concordia and the USGS stream gage near Clay Center (Figure 2). The MDS target flows vary by month and location, ranging from a high of 250 cfs (Clay Center, April through June) to a low of 65 cfs (Concordia, October). The Water Appropriation Act was amended in 1984 to protect waters necessary to establish and maintain streamflows at or above the minimum desired levels. The 1984 amendment also established a priority date of April 12, 1984, giving MDS many of the same properties associated with a water right. Water rights that would affect the flow at the gages and are issued after this priority date are junior to MDS and subject to being administered if the flow levels are not met for 7 days or more. Roughly 150 water rights downstream of Nebraska – Kansas state line are junior to MDS at one of these gages.

[Milford Reservoir](#) is the state's largest lake at 16,200 surface acres. The reservoir is managed by the Corps, and the surrounding park is managed by the Kansas Department of Wildlife and Parks. Recreation includes boating, fishing, camping, trails, a marina and yacht club, and the nearby Milford Nature Center and Milford Fish Hatchery. The State owns 15.6% of the reservoir's conservation storage, which is used in the [Water Marketing Program](#). Westar Energy is the Water Marketing Program's only current customer. The Kansas River Water



Milford Reservoir.

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Assurance District owns 18.3% of the conservation storage, for its customers that are downstream of the lower Republican River basin. That leaves 66% of the conservation pool, or just over 229,200 acre-feet, open to future use.

Possible Improvement

Possible improvements to the system have been the focus of several studies by Reclamation, including: 1) Technical Assistance to States Study, Lower Republican River, Kansas, Water Augmentation Analysis, May 2002; 2) Value Study Report, Proposals for More Efficient Management of the Lower Republican River Water Supplies, December, 2002; and 3) an Appraisal Report, Lower Republican River Basin, January, 2005. A five year study of the quantitative effects of non-federal reservoirs and land terracing practices on Republican River water supplies above Hardy, Nebraska was also required by the Settlement; this study was initiated in 2004.

The Appraisal Report determined there is a need and federal interest for a Feasibility Study. The Feasibility Study was authorized by Congress (P.L. 110-229) in the Consolidated Natural Resources Act of 2008. However, to date it has not had funds appropriated for it. The law specifically recommends the Reclamation study to determine the feasibility of improving the water supply reliability between Harlan County Reservoir in Nebraska and Milford Reservoir in Kansas, of increasing the water storage through modification of existing projects or new projects, and improving the water management efficiency through conservation and integrated water resource management. The feasibility study requires a 50 percent non-federal cost share and would be completed through a cooperative agreement with the States of Kansas and Nebraska.

The Lower Republican River Stakeholder Advisory Committee made recommendations for system improvements (January, 2010), to be considered by state and federal agencies. In addition to improvements for increasing basin residency time (storage) and management, the committee report emphasized that any basin improvements are secondary to the importance of enforcement of the Republican River Compact. The Committee report recommended seeking improvements to the basin above Milford with any compact non-compliance financial award from Nebraska. Improving the river flow will also benefit the inflow to Milford.

Increased Lovewell Storage. Increased storage at Lovewell Reservoir appears to be a viable alternative.

The least radical change would be to raise the dike 2 feet to the same elevation as the dam. This would increase the conservation pool storage by an additional 16,000 acre-feet. The water level would rise about 4 feet, with some loss of recreational areas and a need to protect the shoreline from increased erosion. The other main option proposed is to increase both the dike and dam crest elevations to gain 35,000 acre-feet in additional conservation storage. This would raise the lake level further, causing much more recreational area facility loss and relocation needs. It would also require modification of the spillway radial gates. An increase in the spillway capacity may also be necessary, to assure adequate flood protection and ability to convey high flows.

To provide water to fill the additional storage, winterizing the Superior-Courtland Diversion Dam would allow the Courtland Canal to carry water during the off season. Under current design, the canal system is shut down during the winter season due to potential canal system damage from icy conditions.



Courtland Canal Diversion Dam Gate.

KBID would like additional storage to help meet KBID project irrigation needs. There is also interest in some of the additional storage at Lovewell by various users in the basin downstream of Lovewell. These include irrigators and municipalities subject to administration when the MDS is not met at the Concordia or Clay Center stream gages. Water that is stored for a minimum of two weeks is no longer subject to meet MDS. Stored water can be released for water rights holders junior to MDS for their use. An evaluation would be needed of the legal options and estimated cost to develop access to water storage at Lovewell Reservoir.

New Reservoirs. There have been a number of potential new reservoir sites recommended for further evaluation

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in previous Reclamation studies. One that the Lower Republican Basin Stakeholder Advisory Committee cited for further study is on Beaver Creek below Lovewell (see Figure 2). This off stream storage site could potentially hold 8,500 acre-feet, and provide a secure water source by water right holders junior to MDS. This quantity could allow a release of 100 cfs for 42 days. There have been a few producers in the lower Republican Basin who have sought this water security through private off-stream storage. However, storage is expensive, and requires the water to be pumped twice, first into the pond and later onto the field. Additional storage that benefits a group of producers and other users may be more viable.

from the Courtland West Canal into Marsh Creek, above Jamestown Wildlife Area (Figure 2, option A). Releases of flood flow from Lovewell to Marsh Creek for Jamestown Wildlife Area should also be evaluated. Another option is to divert excess water further up the Courtland Canal to supplement seasonal storage at Jamestown, an option that might require a purchase of water (Figure 2, option B). A canal or pipeline would need to be constructed for delivery of the water. Kansas Department of Wildlife and Parks is interested in a seasonal 18 inch rise at the Gamekeeper Marsh, for an additional 1,500 acre-feet of storage. In 2007, when the Gamekeeper Dam slide gate was replaced, it was pre-engineered for a potential 18-inch rise. Additional land acquisition would be necessary for this increase.

for this increase.

Aquifer recharge. Further evaluation for aquifer storage and recovery appears warranted for the alluvial aquifer. High flows could be directed to [aquifer](#) recharge sites. The alluvium is highly permeable and conditions may be favorable to improve baseflow contributions. One drawback is that depth to water is relatively shallow ranging from 7.5 to 50 feet below ground surface, so there isn't much space to store water. However, aquifer storage and recovery could be beneficial to the system as a baseflow augmentation.

Modeling. Hydrologic modeling of the Republican River valley below the Hardy, Nebraska stream gage would provide a more precise analytical tool for managing resources,

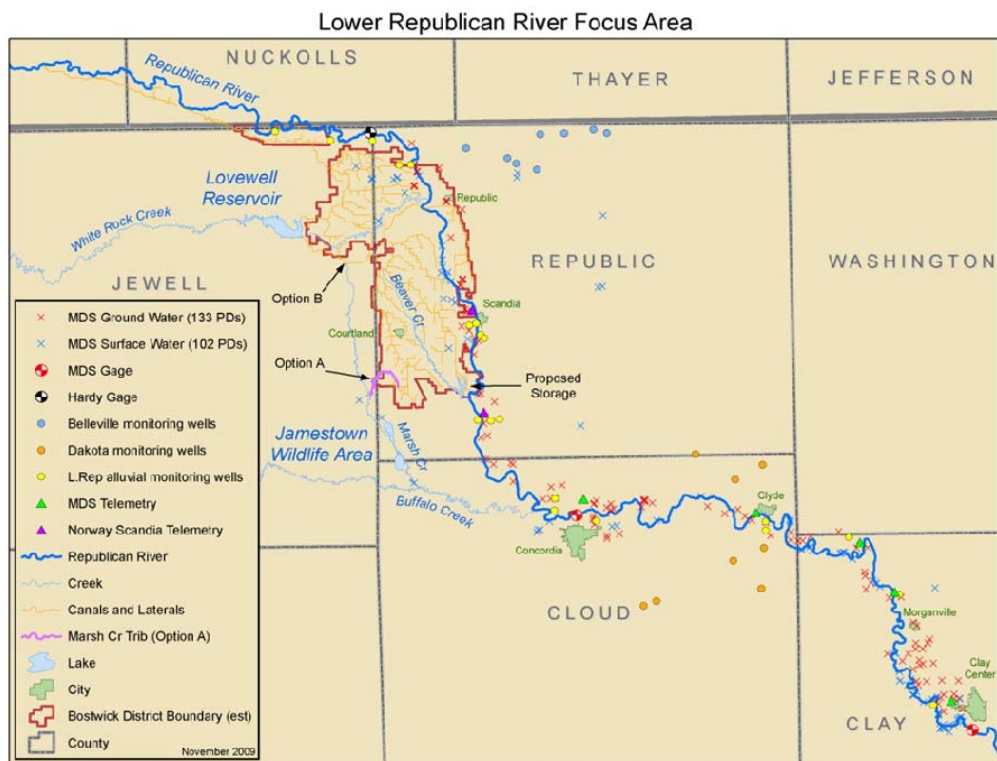


Figure 2. Kansas-Lower Republican Basin Water Users and Options to Evaluate.

Multi-User Water Management. This management approach seeks to maximize the benefit of the water available through a multi-user water management plan. The Jamestown Wildlife Area is south-southeast of Lovewell Reservoir. Water is released from Jamestown in late winter to early summer for management of the wetlands. Additional water storage could be released later in the spring, at times to help meet MDS and restore the alluvial groundwater levels. However, this release would require an assurance of water delivery from another upstream source during early fall and winter for migrating fowl to use. It is a "pay it forward" water management proposal. One source of additional water is the end of irrigation season water that remains in the Courtland Canal. There is the option to empty end of season water

appropriating water and administering MDS. A surface water model for evaluation of increased storage options and improved reservoir management is needed, and is a proposed task in the Lower Republican River feasibility study. Additionally, a groundwater – [surface water](#) interactive model would be a valuable management and evaluation tool. In water short areas, it is critical to have a thorough understanding of the surface and ground water interactions, and how changes may impact the hydrologic system. The regional hydrology is fairly complex, with various alluvial, ancestral channel, and bedrock aquifers, several tributaries, and drains in the Kansas Bostwick Irrigation District that historically contributed measurably to flows of tributaries and the Republican River.

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Construct a groundwater flow model of the Lower Republican River basin, from the Nebraska-Kansas state-line down to Milford Reservoir. The intent would be to make the model compatible for linking with the Republican River [surface water](#) model to provide a more complete understanding of surface- and groundwater interactions in the system.

Improve water security for water uses outside of KBID.

Irrigators and other water users that rely on the Republican River mainstem and tributary flows, and ground water sources that are not recharged from the diversions at Guide Rock for use in the KBID system, have increased water insecurity with no minimum flow requirement at the Hardy gage at stateline. Upgrades to the irrigation systems' efficiencies would help producers maintain their current crop yields with less water diverted. Seek state and federal cost share to upgrade the irrigation systems to subsurface drip irrigation or other highly efficient system, and to provide technical support for the use of irrigation scheduling to maximize the beneficial timing of irrigation water. Also explore options to capture diversion waters that are in excess to the needs of KBID from the Courtland Canal once it has entered Kansas. Crop insurance for a deficit irrigated crop through the USDA-Risk Management Agency would also be beneficial.

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Recommended Actions

1. Encourage State agencies to use the Lower Republican Basin Stakeholder Advisory Committee report recommendations as guidance for Lower Republican River System improvements.
2. Seek federal appropriation for a feasibility study on the Lower Republican River from Harlan County Reservoir to Milford Reservoir.
3. Develop hydrologic models of the Lower Republican River basin that cover the major surface water sources and ground water interactions.
4. Evaluate potential for system improvements, particularly those that provide more storage in the basin and use multi-user management. These may include additional storage at Lovewell reservoir, new storage at a downstream site, additional seasonal storage at Jamestown Wildlife Area, potential to provide more water and/or improve efficiencies for water users above Kansas Bostwick Irrigation District, and the potential for aquifer storage and recovery along the lower Republican River.
5. Update the bathymetric survey of Lovewell Reservoir.