

# Kansas River Reservoirs Flood and Sediment Study Executive Summary



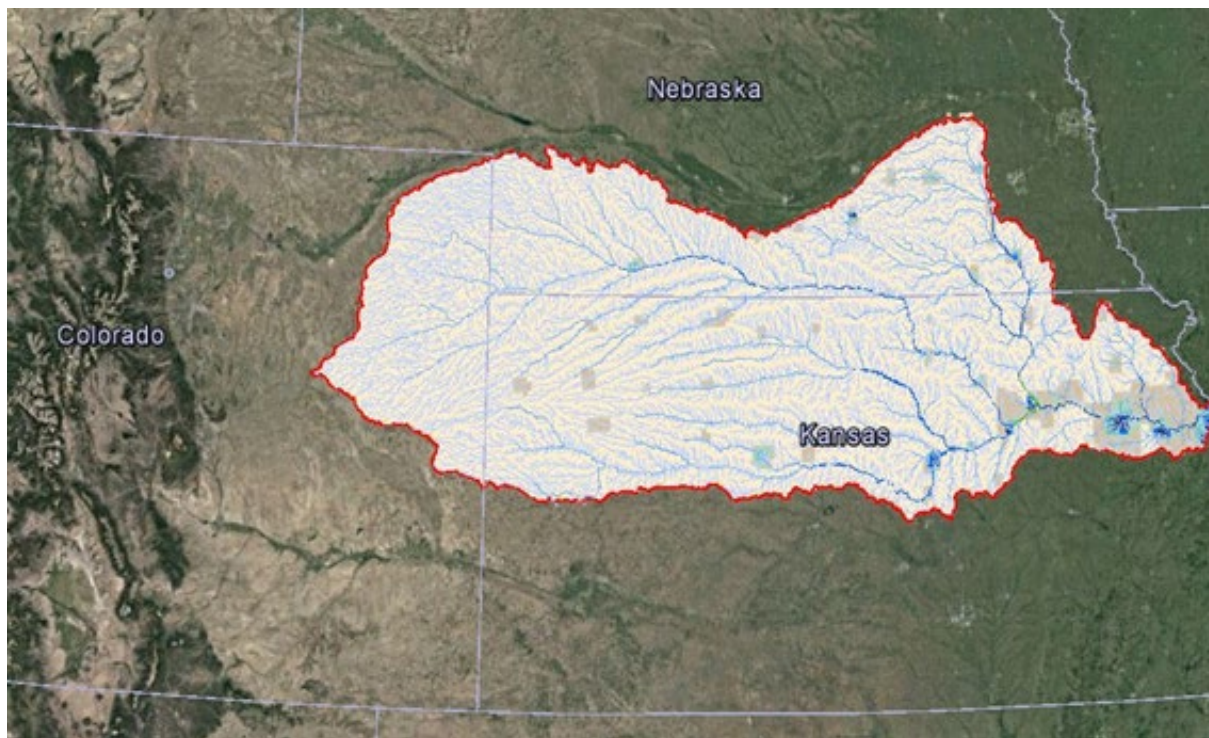
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## Introduction

The Kansas River is an important resource for the State of Kansas. The Kansas River begins at the confluence of the Republican and Smoky Hill Rivers near Junction City and flows 173 miles to Kansas City, where it joins the Missouri River. The Kansas River Basin drains almost the entire northern half of Kansas, as well as part of Nebraska and Colorado (60,580 square miles in all). About 42 percent of the total land area of the state of Kansas lies within the Kansas River Basin. It is the longest prairie based river in the world. There are roughly 640 freshwater stream miles below all major dams, and approximately 100,000 acres of federally owned freshwater impoundments, including U.S. Army Corps of Engineers (USACE) and U.S. Bureau of Reclamation (USBR) reservoirs, in the Kansas River Basin. It serves as a critical drinking water supply for more than 600,000 people in addition to being used for irrigation, municipal wastewater and industrial discharges, power generation, and as a source of commercial sand and gravel. In addition to flood risk reduction benefits from the reservoirs (more than \$22B in flood damages prevented in the basin since construction through 2018), there are several federal levee projects located on the banks of the Kansas River that provide flood risk reduction benefits (\$2M in flood damages prevented in the basin since construction through 2018), mainly to larger urban areas such as Topeka and Kansas City, Kansas. Additionally, recreation use in the Kansas River Basin (boating, kayaking, camping, picnicking, fishing, swimming, hunting, wildlife viewing, etc.) provides substantial benefits to the local, regional, and national economy.

The Watershed Study is a collaborative effort between the USACE and the State of Kansas including the KWO and the Kansas Department of Wildlife, Parks and Tourism (KDWP). The Watershed Study will utilize the planning information available from the state's ongoing planning efforts and will leverage, as appropriate, state agencies' planning and investigation capabilities.



**Kansas River Basin**

## Background

The Kansas River Basin includes 18 federal reservoirs, 12 of which reside in the State of Kansas, 5 in Nebraska, and 1 in Colorado. The dams at these reservoirs regulate 85% of the drainage area in the basin, and the reservoirs supply flood damage risk reduction to major population centers along the Kansas River such as Manhattan, Topeka, Lawrence, and Kansas City, as well as flood damage risk reduction and navigation flow support to communities along the Missouri River. Additionally, these reservoirs provide discharges to the Kansas River used for critical drinking water supply for more than 600,000 people, as well as being used for irrigation and power generation.

### Kansas River Water Management Projects

Water Management Project	Basin or Stream	Operating Agency
<b>Republican River Basin</b>		
Bonny Dam - Colorado	South Fork Republican River	Bureau of Reclamation
Trenton Dam (Swanson Lake) - Nebraska	Republican River	Bureau of Reclamation
Enders Dam - Nebraska	Frenchman Creek	Bureau of Reclamation
Red Willow Dam (Hugh Butler Lake) - Nebraska	Red Willow Creek	Bureau of Reclamation
Medicine Creek Dam (Harry Strunk Lake) - Nebraska	Medicine Creek	Bureau of Reclamation
Norton Dam (Keith Sebelius Lake) - Kansas	Prairie Dog Creek	Bureau of Reclamation
Harlan County Dam - Nebraska	Republican River	USACE, Kansas City District
Lovewell Dam - Kansas	White Rock Creek	Bureau of Reclamation
Milford Dam – Kansas	Republican River	USACE, Kansas City District
<b>Smoky Hill River Basin</b>		
Kanopolis Dam - Kansas	Smoky Hill River	USACE, Kansas City District
Glen Elder Dam (Waconda Lake) - Kansas	Solomon River	Bureau of Reclamation
Wilson Dam – Kansas	Saline River	USACE, Kansas City District
Cedar Bluff Dam - Kansas	Smoky Hill River	Bureau of Reclamation
Webster Dam - Kansas	South Fork Solomon River	Bureau of Reclamation
Kirwin Dam – Kansas	North Fork Solomon River	Bureau of Reclamation
<b>Lower Kansas River Basin</b>		
Clinton Dam - Kansas	Wakarusa River	USACE, Kansas City District
Perry Dam – Kansas	Delaware River	USACE, Kansas City District
Tuttle Creek Dam – Kansas	Big Blue River	USACE, Kansas City District

The Watershed Study will investigate water resource issues and opportunities in the Kansas River Basin to recommend comprehensive, long-term solutions based on a Shared Vision for the basin. These long-term solutions may include recommendations for potential involvement by the USACE, other federal agencies, or non-federal interests. The Watershed Study will integrate water and related land resource management considerations seeking sustainable water resources management and taking into account various additional considerations. Ultimately, the Watershed Study should inform multiple stakeholders and decision makers at all levels of government and provide a strategic roadmap to inform future



investment decisions by multiple agencies. Significant need and opportunities exist in the areas of sediment management, flood risk management, water supply availability and sustainment, as well as other related purposes, such as ecosystem restoration, navigation, and recreation. This integrated Watershed Study will focus attention on multiple objectives and tradeoffs, provide better accounting for uncertainty, and accommodate the concepts of adaptive management, stakeholder collaboration, and systems analysis for watershed-scale planning and evaluation.

The Watershed Study will build from the extensive research, planning, outreach and documentation in the *Kansas Water Plan (2014)* and *Vision for the Future of Water Supply in Kansas (2015)(Vision)*. The *Kansas Water Plan* is one of the primary tools used by the State of Kansas to address current water resource issues for future needs. The Kansas Water Office (KWO), in coordination with local, state, federal and interstate partners, updates the *Kansas Water Plan* every 5 years. Water resource issues addressed in the *Kansas Water Plan* extend beyond water supply and include goals and priorities, such as improving the state's water quality and improving recreational opportunities available to citizens. The *Kansas Water Plan* serves as the implementation plan for the *Vision*, providing 5-year milestone events to measure success towards achieving the *Vision*. An update to the *Vision* is currently under development. Any revisions to the *Vision* will be used to develop the Watershed Study as information is available.

## Authority

The Watershed Study is authorized by the Resolution of the Senate Committee on Environment and Public Works, Kansas River and Tributaries, May 23, 2006 and Section 729 of the Water Resources Development Act (WRDA) of 1986 as amended. Section 729 of WRDA 1986, as amended and other specifically authorized watershed authorities allow USACE to study the federal, state, tribal, interstate, and local government entities. The study is authorized at \$3 million and requires a 75 percent federal/25 percent non-federal Cost Share Agreement.

## Watershed Planning Guidance

The USACE watershed studies use an Integrated Water Resource Management (IWRM) strategy, which provides a holistic focus on water resource challenges and opportunities that reflect coordinated management of water resources. The principles of IWRM include focused attention on multiple objectives and tradeoffs, better accounting for uncertainty, and accommodation for the concepts of adaptive management, stakeholder collaboration, and systems analysis for watershed-scale planning and evaluation.

The following elements are key components of an effective watershed planning process:

1. Identify Problems and Opportunities
2. Inventory and Forecasting
3. Identify and Screen Measures
4. Formulate Initial Array of Strategies
5. Refine Initial Array of Strategies and Evaluate Focused Array of Strategies
6. Strategy Comparison and Selection

Watershed studies provide recommendations for actions that can be taken to solve the identified problems. The conclusions and recommendations should have broad implications for decision makers at all levels of government. Such recommendations should provide a strategic roadmap that identifies the sequencing of priorities, including where federal authorities and appropriations are available, and where new ones may be needed.

The Watershed Study is not a project implementation document. The level of detail in investigations is at a scale adequate for making watershed-level resource assessments and recommendations. If specific projects are identified for potential implementation under existing authorities of the USACE (for example, flood damage reduction or ecosystem restoration), separate interim reports will be required that will

include specific project features and include a detailed engineering appendix and appropriate National Environmental Policy Act (NEPA) documentation.

The Watershed Study will present the findings and recommendations for future efforts, including potential future projects and studies in which the USACE could partner with the State of Kansas, sister agencies, and other non-federal entities.

## **Study Information and Scope**

There are significant water resource challenges that need to be met over the near and long term in the Kansas River Basin. The 18 federal reservoirs operated by the USACE and the USBR and levees in the Kansas River Basin, originally authorized from 1938 to 1962, are now being asked to meet the multi-purpose needs and values of today's modern society, including an increased demand for flood risk management benefits to large and small communities, recreation facilities, agricultural areas, an increased demand on water supply, a changing climate, and an increased societal value on protecting and restoring the ecosystem. As such, it is necessary to reinvestigate the existing system to optimize its operation and functionality where possible, and to remove, repair, rehabilitate, or upgrade the facilities to reduce risk and provide benefits to society, as needed. It is also necessary to revise the system to account for the demand and need for integrated water resources management to provide benefits to flood risk management, water supply, and ecosystem restoration.

The scope of the study will include a comprehensive and strategic evaluation of the Kansas River Basin system operating plan, reservoir operations and manuals, reservoir facilities and features, conditions upstream and downstream of reservoirs, infrastructure, and other related needs in the system. This includes a comprehensive existing and future conditions update of flood risk, drought risk and preparedness, ecosystem degradation, and water supply availability and sustainment.

## **Shared Vision Statement**

A Shared Vision Statement was developed collaboratively between the USACE, KWO, and KDWPT. The purpose is to define the overall Shared Vision for the watershed, water, and related resources as developed by partners involved in the Watershed Study and to present the coordinated study framework and associated activities that clearly support the Shared Vision. The Shared Vision Statement is broad enough to encompass various goals and objectives of individual partners and stakeholders, but sufficiently detailed to allow for subsequent development of planning goals and objectives.

## **Issues and Opportunities**

The purpose of the Watershed Study is to develop a comprehensive and holistic long-term (50 – 100 year) plan for addressing the multiple water resource problems within the basin, including flood risk management, stream erosion, sediment loading of reservoirs, reductions of flood storage and water supply availability, water quality issues, and drought. It will be necessary to fully define and describe the problems, needs and opportunities in the watershed by involving study partners, water resources and related stakeholders, resource agencies, and the public to collect a broad view of problems, needs, and opportunities and reaffirm the purpose of the Watershed Study.

In the Watershed Study, identified problems will focus on past extreme events, local needs, legislation that bears on local resources, local government interests, and the affected public. It is therefore critical that the study effort identifies problems and opportunities that reflect the priorities and preferences of the federal government, the non-federal sponsors, and other groups participating in the study process. The Watershed Study will focus on three primary focus areas, including (1) sediment management; (2) reservoir operations; and (3) flood risk management. Issues and opportunities to be considered and refined in the Watershed Study include water supply availability and sustainment, infrastructure investment, ecosystem preservation and restoration, water quality, and recreation, which are described in the *Kansas Water Plan* and the *Vision*.

## **Sediment Management**

Sedimentation in reservoirs within the basin is an emerging problem that needs to be addressed in the future so that benefits provided by the reservoirs for water quality, water supply, fish and wildlife, recreation, and flood control can be realized into the future. Sediment on the main stem of the Kansas River is important to infrastructure, such as water supply intakes, irrigation diversion structures, and other uses such as recreation, and ecological resources.

Sedimentation in the reservoirs threatens crucial benefits provided for flood risk management, critical drinking water supply for more than 600,000 people, irrigation, and power generation. Without intentional action, sediment will significantly reduce project benefits, increase Operations & Maintenance costs, and increase safety risks over the next 50 years. Meanwhile, the river channels downstream from the dams, including the Kansas River, are suffering bed degradation and habitat impairment due to a lack of sediment. Riverbed degradation is a consideration that can impact river banks both on the main stem and tributaries, public infrastructure, and the long-term sustainability of flood risk reduction (levees). Expanding shallow zones in reservoirs from sedimentation also reduce water quality as well as operational storage capacity for public water supply and recreation.

Without intentional action, the benefits of these crucial benefits will continue to diminish. Historical data and projected estimates indicate that the multi-purpose pools of the reservoirs will continue to fill with sediment, some nearly half full and losing at rates of one to two percent a year. Additionally, sediment accumulation could impede the ability to maintain the function of flood control gates and other appurtenances, which could seriously impact the flood risk mission of the USACE.

## **Reservoir Operations**

USACE dams manage water flowing from a majority of the Kansas River watershed with a total of approximately 45,800 square miles upstream of USACE dams. Including Glen Elder Dam (USBR), approximately 50,850 square miles, or 84 percent of the watershed area is regulated. Approximately 9,730 square miles of unregulated areas remain below major dams and the mouth of the Kansas River.

Significant critical infrastructure is located downstream of the reservoirs, including water and wastewater treatment plants, power plants, fire stations, schools, and military installation facilities. Sustaining the ability of reservoirs to provide these benefits into the future is crucial, as there is no feasible way to replace these benefits.

An assessment of system management to identify areas of concern and to evaluate alternative improvements to the system is needed. The assessment would evaluate the potential for water supply shortages, minimum stream flow deficiencies, recreation impacts, instream water quality, and drought related issues. Conditions that influence storage in the various pools within a reservoir affect the ability to meet releases for uses downstream (e.g., water marketing and assurance customer shortages, downstream water quality minimum release targets not met). Strategies and alternatives that could improve reliability include sediment removal, reallocation, structural restoration, demand management, reservoir operational changes, new reservoirs, off-stream storage, and watershed management.

## **Flood Risk Management**

Flooding is a reoccurring challenge in Kansas that can be costly, both in property lost and more significantly in loss of lives. Due to the high cost of flood damage and the even more significant potential loss of life, flood control measures such as reservoirs, dams, and levees are necessary. Flooding in the Kansas River Basin has historically caused damage to structures, critical infrastructure, and public facilities. Since the completion of the dams within the Kansas River Basin in the 1970's, significant flood events have occurred. In the 20<sup>th</sup> century, notable flooding occurred on the Kansas River in 1903, 1951, 1993, and 2019. These floods damaged millions of dollars of private property and crop land, as well as critical infrastructure such as interstate highways, railroads, state highways, in addition to damages and

lost revenue at recreational facilities managed by federal and state agencies, private entities, and non-profit organizations.

Structural flood control projects seek to control the flow of water and are intended to prevent flood waters from reaching land, structures, or other property at risk of damage. Large federal reservoirs have been constructed in Kansas by the USACE and the USBR (Table 1). Additional funding for watershed dams has been provided by the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). The primary purpose of these reservoirs is flood control. Federally funded levees also provide a measure of structural flood protection. Multiple communities are located along the Kansas River and its tributaries downstream of USACE dams. The system of dams and reservoirs in the Kansas River Basin is designed to manage flood risk for these communities.

Aging infrastructure is a national problem and increases the risk that dams and levees could fail during a flooding event. Failures could be disastrous due to the development below dams and behind levees. Federal, state, and local action is needed to ensure the safety of communities thought to be protected from flooding by dams and levees.

### **Water Supply Availability and Sustainment**

Lack of reliable water supply and shortages of water could have a devastating effect on the economy of Kansas and the health and welfare of its citizens. Every industry from agriculture, electric power generation and manufacturing to tourism relies on water to grow and ultimately sustain its business. Developing and implementing plans and tools that secure and improve the reliability of state water supplies is essential for the future prosperity of Kansas communities and public health of citizens. Water supplies can be affected by competing and multiple uses, including the USACE releases of water from Kansas River reservoirs to support navigation on the Missouri River. In addition, planning for extreme events, such as drought, is necessary to reduce vulnerability and create resiliency to ensure clean water delivery to Kansas citizens.

### **Infrastructure Investment**

Water infrastructure in Kansas—dams, levees, reservoirs, treatment plants, distribution lines—was mostly developed 50 to 60 years ago and is in need of upgrade, repair or replacement. Reservoirs are filling with sediment, reducing the ability to capture flood waters, and many levees and dams may no longer be able to provide the desired or needed level of public safety protection. A report completed in 2010 estimates that the financial needs to secure, protect and restore storage is over \$483 million in the next 10 years, increasing to \$3.9 billion over the next 40 years. This estimate includes rehabilitation of dams to assure safety, but does not include the needed costs associated with levee rehabilitation which is important to protect life and property from catastrophic failure during floods (Kansas Water Plan, 2014). The estimate also does not include costs to remove accumulated sediments.

### **Ecosystem Preservation and Restoration**

Water management in the form of dams, levees, and floodplain development have disrupted the natural flow patterns that are critical to river health. Seasonal patterns of high and low river flows support animal and plant lifecycles, preserve water quality, and maintain diverse habitats. The Kansas River is part of the Sustainable River Program (SRP) to promote seasonal flows to mimic natural river flow patterns that yield diverse benefits for ecosystems and people. In addition, invasive and non-native species can degrade and impact natural ecosystem functions. For example, the infestation of zebra mussels, an invasive species of mussel, were discovered in Tuttle Creek Lake in 2012. Furthermore, sediment trapping by reservoirs results in artificially clear releases. Some native aquatic species in the Kansas River are in decline due to lack of turbidity.

Dams also serve as important barriers that prevent the upstream spread of invasive species, such as Asian Carp. However, timing and volume of releases from reservoirs may enable the passage and spread of invasive species over smaller downstream barriers, such as the Bowersock Dam in Lawrence.

### **Water Quality**

The availability of high quality water for commercial, industrial and residential uses is vitally important for the water users of Kansas. Activities to further protect and improve the water quality of Kansas to avoid degradation of the State's water resources are imperative for current and future water users. Harmful Algal Blooms (HABs) continue to plague the region, with Milford and Perry reservoirs experiencing blooms in 2017. Three other small lakes within the region also reached warning levels. As accumulation of sediment reduces storage capacity of reservoirs, water quality problems are expected to intensify.

As water quality conditions degrade within a water body, use of water from that source as well as downstream uses can be negatively impacted. Negative impacts from degrading/poor water quality conditions can include: increased costs to treat water for public water supply needs, decreased yields for agricultural producers, decreased recreational opportunities, fish consumption advisories, and diminished biological diversity in streams and lakes.

### **Recreation**

Recreational opportunities (e.g., boating, fishing, hunting, camping, and kayaking) improve the quality of life for the citizens of Kansas and contribute to the state's economy. The availability of recreational destinations and activities provides Kansas the opportunity to prosper economically and increases the value of natural resources in the state. While recreational opportunities are currently available in the State, more focus on promoting, expanding and protecting recreational activities is needed. Water-based recreational opportunities are threatened by low water levels, reservoir sedimentation, poor water quality, diminished in-stream flows, and invasive species.

### **Alternatives/Strategies Development**

Alternatives/strategies development will identify all of the possible management measures that address the planning goals and objectives. Measures will be screened initially by using information from experts, constraints, metrics, and specific screening criteria. The measures will be evaluated by the Watershed Study team for effectiveness in meeting the study goals and objectives. Measures will be grouped into an initial set of strategies/alternatives and refined and evaluated to provide a final set of strategies/alternatives. If appropriate, the watershed may be divided into geographic focus or opportunity areas (e.g. state planning areas) within which measures could be applied and would have independent benefits and costs.

### **Management Measures**

Management measures will be developed to address one or more of the planning objectives and will fall under one of the three primary focus areas (i.e. sediment management, reservoir operations, and flood risk management) with additional consideration of the issues and opportunities described for the Watershed Study (i.e. water supply availability and sustainment, infrastructure investment, ecosystem preservation and restoration, water quality, and recreation). Some measures may go beyond that which can be constructed or built, including public outreach, proposed regulatory actions, or a programmatic approach for requirements. Measures will be grouped by one or multiple issues that the measure addresses (for example, erosion prevention upstream of reservoirs will address goals for water supply, water quality, and flood risk management).



## Strategies/Alternatives

Strategies/alternatives will be developed in the context of options or choices and their projected outcomes, and will be developed based on reputable and readily available science and technical analyses. A range of alternatives or strategies, comprised of multiple measures, to meet the goals and objectives of the Watershed Study will be developed. Strategies and alternatives could be prioritized and recommendations made to address the watershed-wide issues.

In consultation with the Watershed Study partners and experts, the alternatives and strategies will be evaluated in terms of meeting the identified problems, while focusing on the collective values, missions, and the Shared Vision. There may be a number of ways to address the needs within a watershed; a structured assessment of the pros and cons of each strategy/alternative will be used to inform a trade-off analysis.

The strategies/alternatives will clearly describe the overall benefits towards advancing the Shared Vision and a general assessment of cost effectiveness, sequencing and priority of actionable items, and associated needs. The primary responsible federal and non-federal partner(s) and their associated missions, authorities, programs, and sources for potential future appropriations will also be identified to inform a strategic roadmap that guides implementation and provides measurable value to the Nation.

## Conclusions and Recommendations

The strategies/alternatives will be compared against one another, noting trade-offs between strategies/alternatives, and selecting the best-suited strategy for meeting the Watershed Study Shared Vision, goals, and objectives. The Watershed Study will provide a strategic overview that illustrates how the individual recommendations cohesively tie together to advance the Shared Vision and further achieve the desired end state. The conclusions and recommendations will have broad implications for decision makers at all levels of government. The study conclusions will provide a strategic roadmap that identifies the sequencing of priorities, including where federal authorities and appropriations are available.

## Implementation and Investment Strategy

Where the USACE has authority, recommendations and next steps can include activities under Flood Plain Management Services, Planning Assistance to States, and Tribal Partnership Program, or the Continuing Authorities Program. This study may also recommend the initiation of site-specific feasibility studies where there is potential federal interest in a project that would require Congressional authorization.

The study conclusions will provide a description of the next steps, near-term and mid- to long-term studies (i.e. spin-off and off-shoot studies), and other tasks for the implementation of the selected strategy/alternative, including the roles and responsibility of the USACE, state agencies, and local governments in implementing and/or funding studies and actions to further the Watershed Study recommendations.

## Schedule

The Watershed Study will be completed within a 3-5 year timeframe. Approximate dates for completion of tasks for the Watershed Study milestones are included below.

- Shared Vision Milestone – November 2020
- Recommendations Milestone – May 2023
- Final Watershed Study Report – Fall 2023