Surface Water Quantity: Current Risks, Future Risks, and Current Interventions

Overview & How We Got Here

Major Surface Water Sources - Federal

- **Federal Authorizations**
  - **Flood Control Acts of 1944 & 1954**
  - **Water Supply Act of 1958**
    - Authorized inclusion of water supply storage in Federal projects
    - Required assurances of need and acceptance of financial obligation from the State of Kansas
    - State financial commitment to be local water supply interest
  - **Flood of 1951 and Drought of 1952-1957 impacts on Kansans**

Major Surface Water Sources - Federal

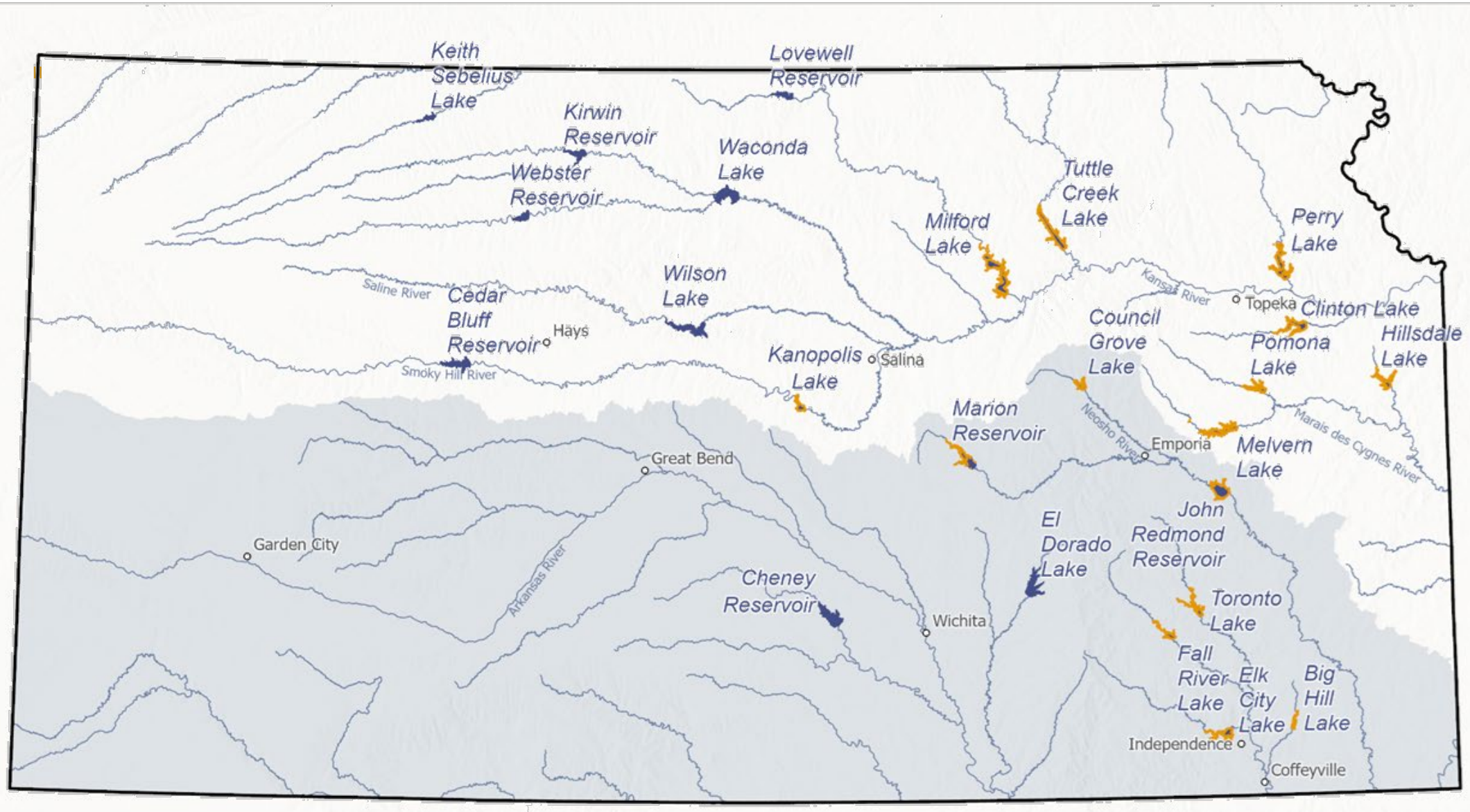
- **The Kansas Constitution (1958)**
  - Amended to authorize the state to participate in works for the conservation and development of water resources
    - **(Article 11,9)**

- **The Legislature of the State of Kansas by House Concurrent Resolution (1961)**
    - **(Chapter 479 of the Session Laws of Kansas of 1961)**
  - Notified the U.S. Army Chief of Engineers **(USACE)** that the state would fulfill obligations for water supply storage interests
  - Initial water supply requests for Milford, Perry, John Redmond, Elk City, and Council Grove reservoirs

Major Surface Water Sources - Federal

- **State Water Resource Planning Act (1963)**
  - KWO (Kansas Water Resources Board) authorized to recommend water supply inclusion and contract for storage with the federal government
  - 82a-929. Same; state responsibility for water. The state of Kansas hereby recognizes its responsibility and jurisdiction to protect, conserve, and control all waters affecting the people of the state, including those waters impounded in projects constructed pursuant to programs of the federal government.

Public Water Supply Reservoirs



Public Water Supply Reservoirs (Managed by the Kansas Water Office) Federal Reservoirs USACE - Tulsa District

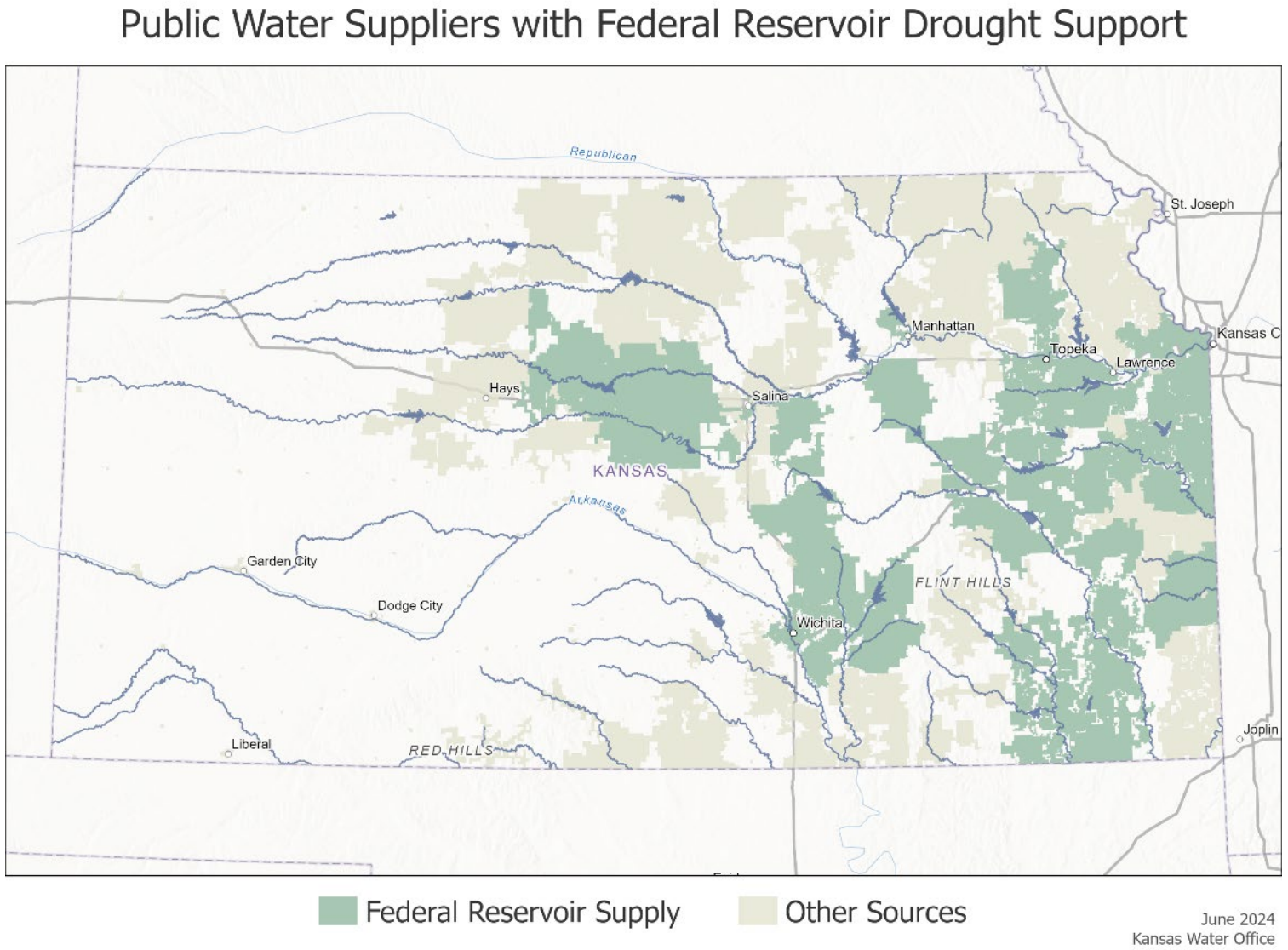
August 2021
Kansas Water Office

Major Surface Water Sources - Federal

- **State Water Plan Storage Act (1974)**
  - Water reservation rights (acquired by the Director)
  - Water Marketing Program
    - Water purchase contracts, direct withdrawal or downstream
- **Water Assurance Program (1986)**
  - Supplemental downstream flow support to groups of Municipal & Industrial water rights that have organized legal entities
  - Certain municipal and industrial water rights required to be members as determined by the Chief Engineer
- **Lower Smoky Hill Water Supply Access Program (2011)**
  - Supplemental downstream flow support for water rights

Major Users and Economic Impact

- Reservoirs support water use for many rural and urban communities in Kansas.
- Energy generation at four power plants supported by reservoir water supply
- Large metro areas and their industries supported



State Funded Portion of Federal Project Maintenance and Operations (O&M)

State Fiscal Year Budgeted	SFY2025	SFY2026	SFY2027	SFY2028	SFY2029	SFY2030
Calendar Year Work Done	2022	2023	2024	2025	2026	2027
	Actual	Actual	Estimated	Estimated	Estimated	Estimated
All KC Corps Reservoirs						
Joint-Use O&M	$ 13,585,354	$ 13,214,246	$ 18,432,395	$ 14,130,000	$ 14,652,000	$ 15,855,000
Major Capital Replacement	$ 570,698	$ 742,500	$ 1,110,609	$ 5,000,000	$ 1,100,000	$ 500,000
Reconstruction, Rehab, Replacement	$ 339,377	$ 7,948,600	$ 10,229,965	$ 464,828	$ 200,000	$ 376,000
Total: KC Corps of Engineers	$ 14,502,854	$ 31,795,346	$ 37,384,969	$ 20,794,828	$ 16,357,000	$ 16,731,000
All Tulsa Corps Reservoirs						
Joint-Use O&M	$ 6,038,130	$ 6,286,017	$ 5,194,633	$ 6,387,888	$ 4,738,745	$ 8,315,756
R,R, & R	$ 4,305,670	$ 1,718,166	$ 3,412,720	$ 5,358,406	$ 1,531,280	$ 1,076,106
Dam Safety	$ -	$ -	$ -	$ -	$ -	$ -
Total: Tulsa Corps of Engineers	$ 10,343,800	$ 8,004,183	$ 8,607,353	$ 11,746,295	$ 6,270,025	$ 9,391,863
Overall Total	**$ 24,846,654**	**$ 39,799,529**	**$ 45,992,322**	**$ 32,541,123**	**$ 22,627,025**	**$ 26,122,863**
State Portion due to USACE	**$ 2,004,313**	**$ 3,115,457**	**$ 3,898,034**	**$ 3,484,945**	**$ 2,199,240**	**$ 2,396,941**

- **Portions of O&M defined per contract for each reservoir**
- **Assurance Districts, Access District, Water Marketing Programs pay proportional share of the State Portion for their committed storage**

Recent Federal Maintenance Projects

- Council Grove
- Clinton
- Kanopolis
- Melvern
- Pomona
- Hillsdale
- Marion
- Tuttle Creek



Marion

- Gates

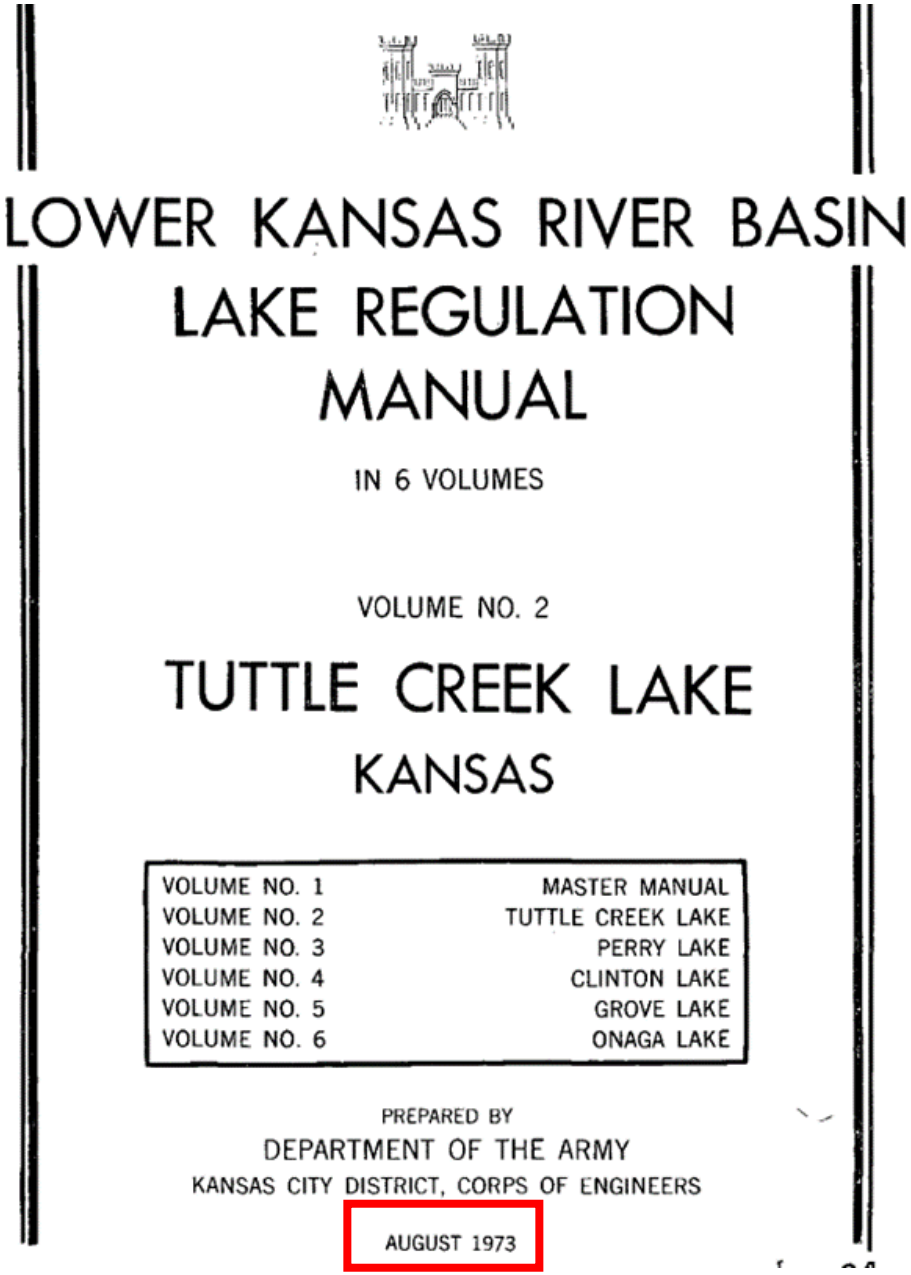


Tuttle Creek

- Outlet channel and dam face projects

Federal Regulation Manuals

- **Specify operational constraints of Federal projects**
- **Federal Water Control Manual updates ongoing (KC District)**
  - Potential for further operational efficiencies
  - Or shifting Federal priorities



LOWER KANSAS RIVER BASIN

LAKE REGULATION MANUAL

IN 6 VOLUMES

VOLUME NO. 2

TUTTLE CREEK LAKE

KANSAS

VOLUME NO. 1	MASTER MANUAL
VOLUME NO. 2	TUTTLE CREEK LAKE
VOLUME NO. 3	PERRY LAKE
VOLUME NO. 4	CLINTON LAKE
VOLUME NO. 5	GROVE LAKE
VOLUME NO. 6	ONAGA LAKE

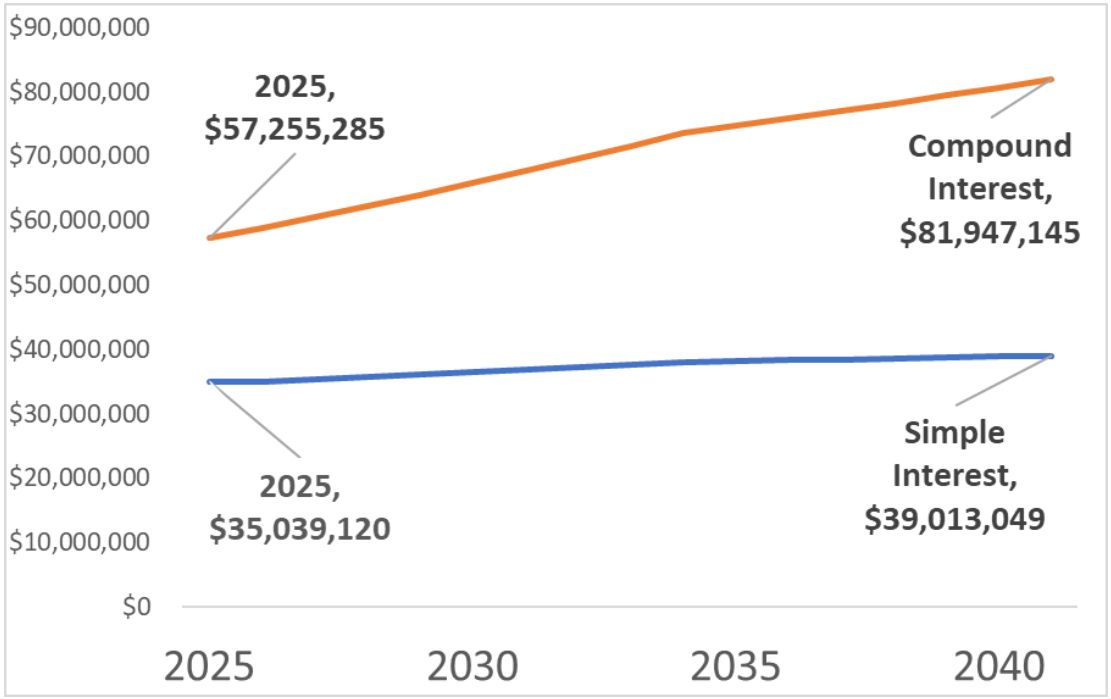
PREPARED BY

DEPARTMENT OF THE ARMY

KANSAS CITY DISTRICT, CORPS OF ENGINEERS

AUGUST 1973

Reservoir Debt for Milford and Perry - Treasury Bill Funds



- **$52M invested in Treasury Bills after 2023 Legislative action (HB2302)**
  - Current Treasury Bill valuation $39.7M
  - $12M used following 2025 Legislative Action
    - $5M to University Campus Restoration
    - $7M to other State Water Plan Fund items

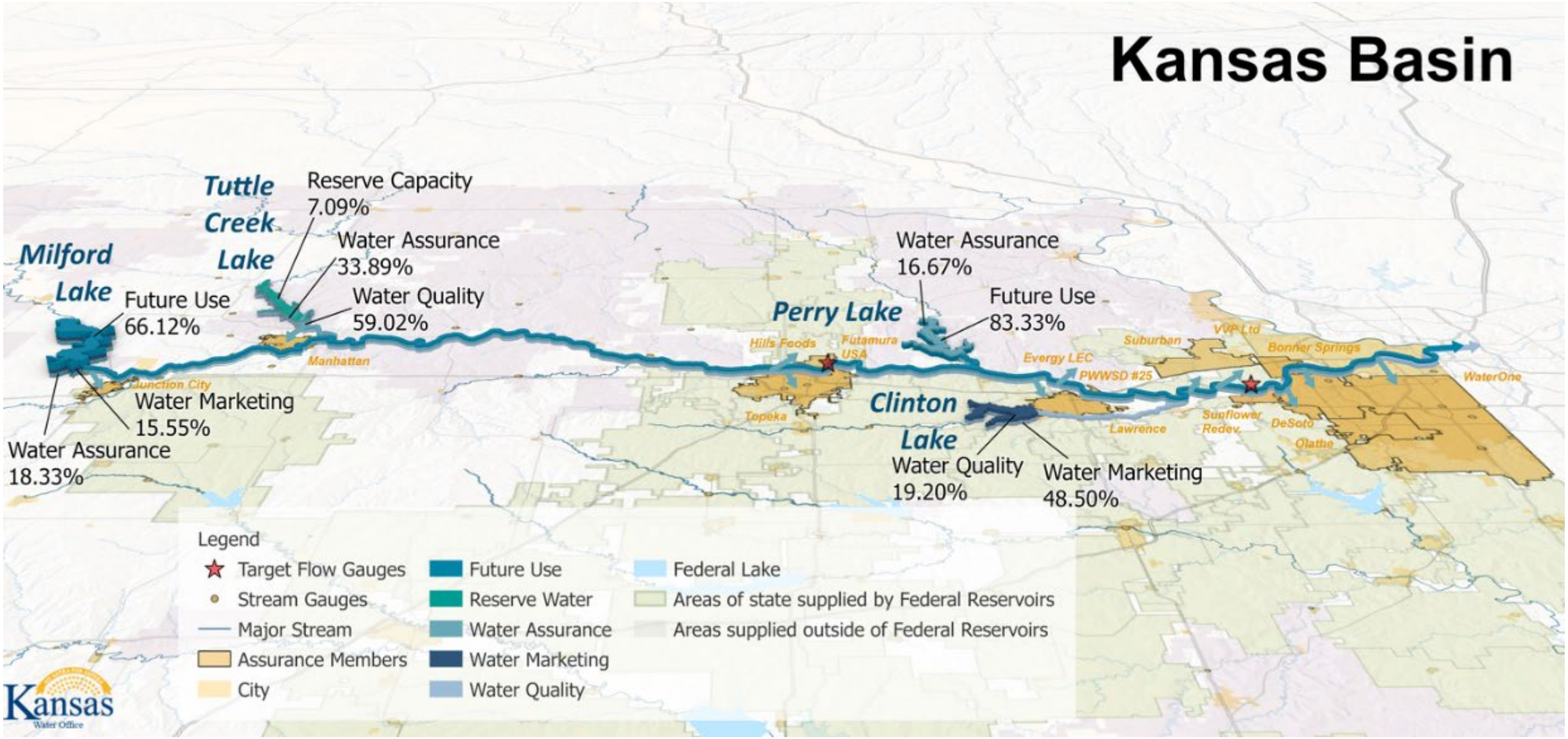
Federal law change 1/4/2025 (WRDA 2024)

- Changed state storage contracts from compound to simple interest

Reservoir Debt for Milford and Perry - Treasury Bill Funds

- **For an April 2026 debt payoff: $35.2M needed.**

- **If let contracts go to full terms of 2034 & 2041**
  - Compounding interest would have been $82M debt
  - Simple interest would be $39M debt
  - Overall potential savings to Kansans of $43M if debts went full contract terms without contracting changes
- **Storage availability and security for Kansans**
  - Growing demand forecasts related to northeast Kansas economic development conversations



- **Rural and Urban Water Systems Supplied or Interconnected**

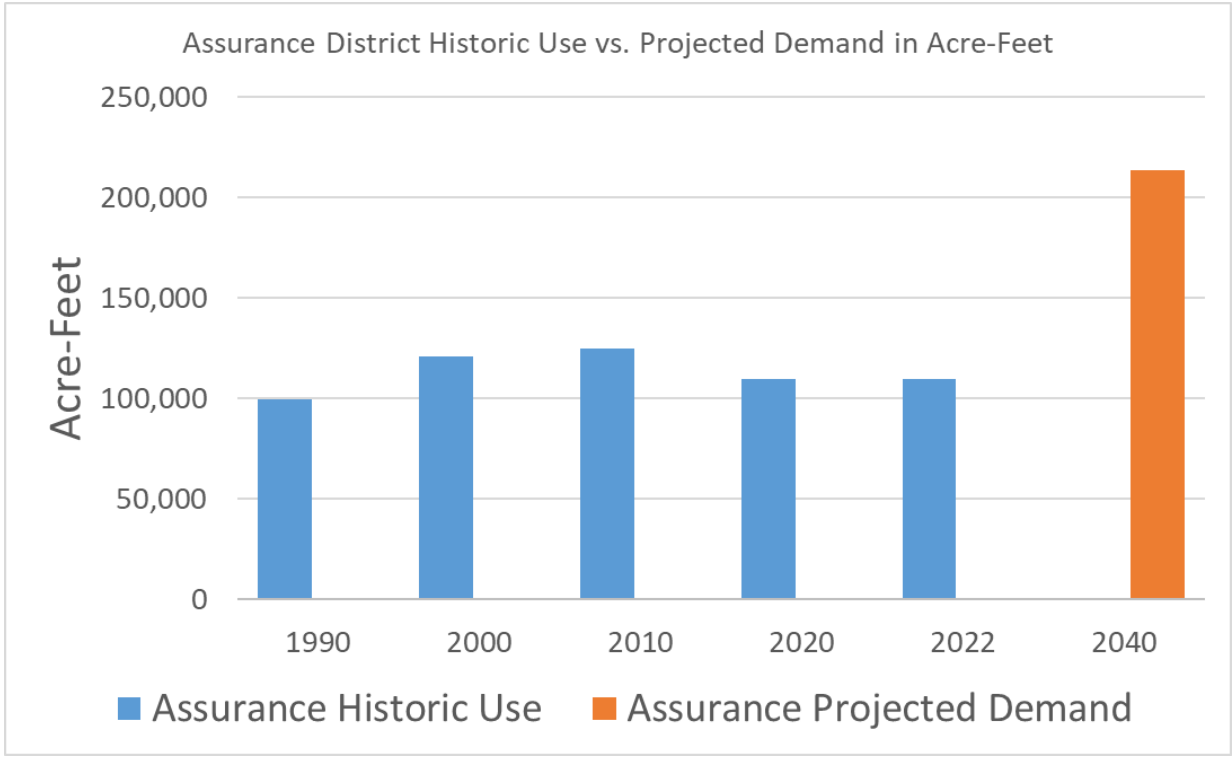
Kansas River Basin

- **Assurance District:**
  - Contracts for storage in Milford, Perry, and Tuttle Creek Reservoirs
  - Pays share of Federal bills
  - Operations of storage defined in Operations Agreement with KWO
  - Provides 20 year demand projections from member water suppliers = local water supply

Kansas River Water Assurance Program
Operations Agreement

As of May 17, 2021

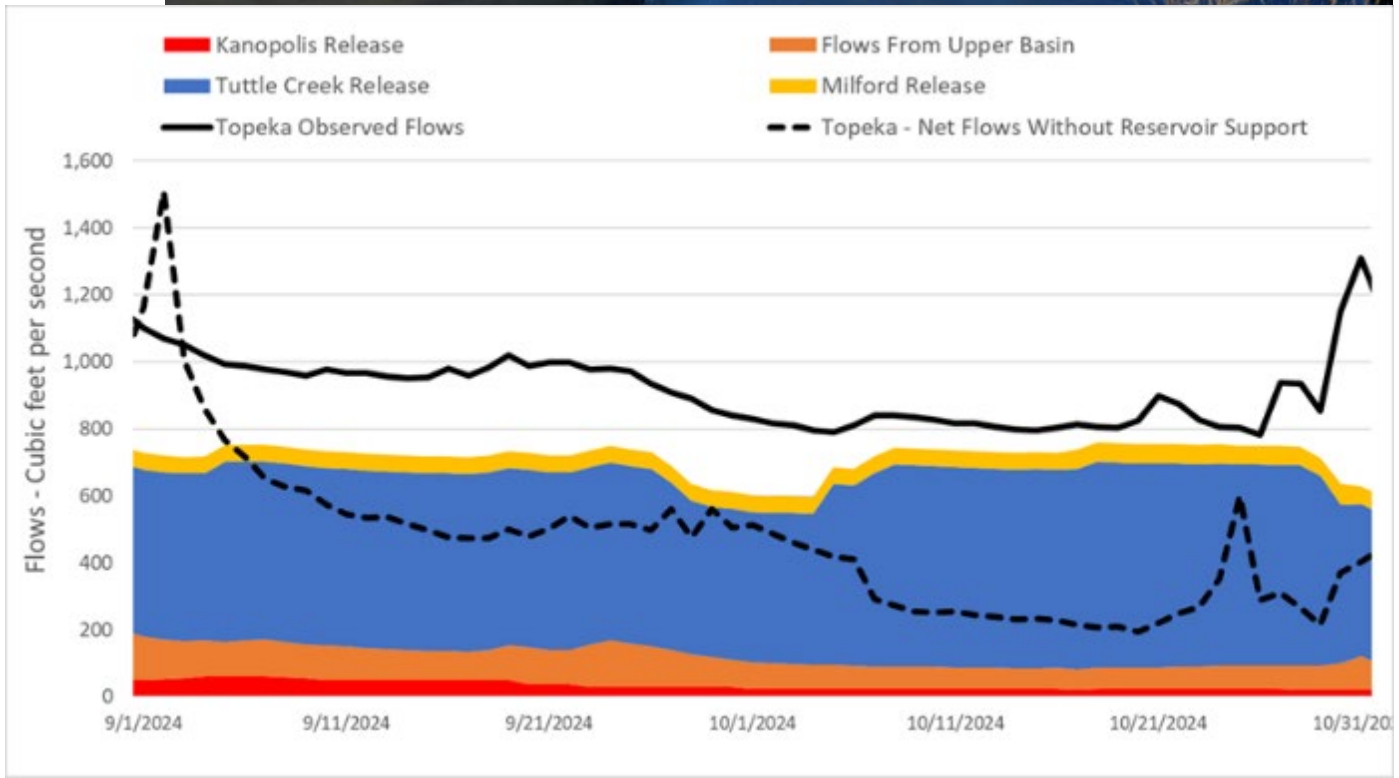
Pursuant to the contract signed on December 22, 1989, between the Kansas Water Office (hereinafter referred to as "the KWO") and the Kansas River Water Assurance District No. 1 (hereinafter referred to as "the District"), this Operations Agreement constitutes the policies and responsibilities of operating the storage identified in Section 1 for the Kansas River Water Assurance Program (hereinafter referred to as "the Assurance Program"). Furthermore, this



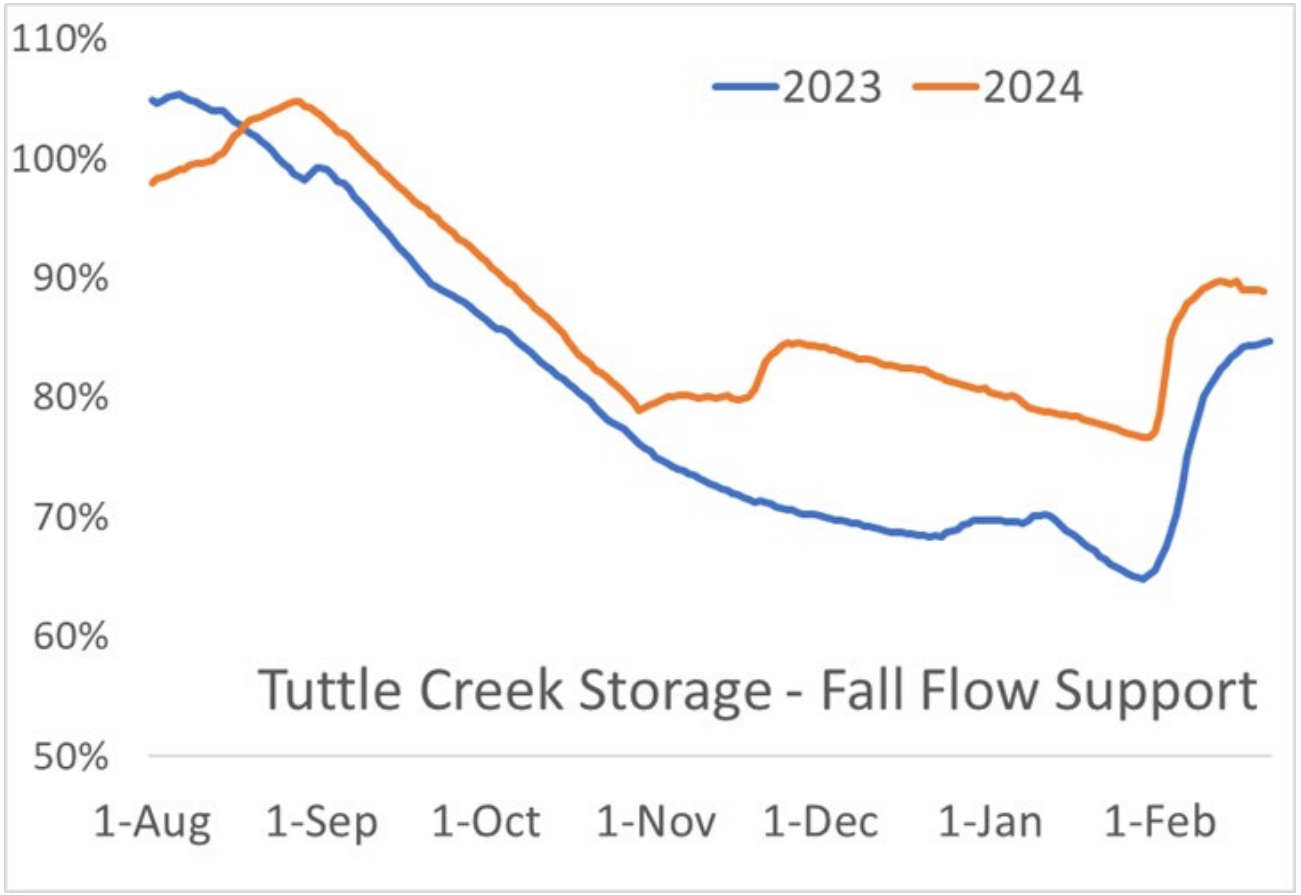
Kansas River Basin

- **Past 3 years with drought periods, flow support**
  - Periods with over 75% of flow coming from reservoir storage releases
- **Elevating flows for icing impacts**
- **Dilution of chlorides for water quality**





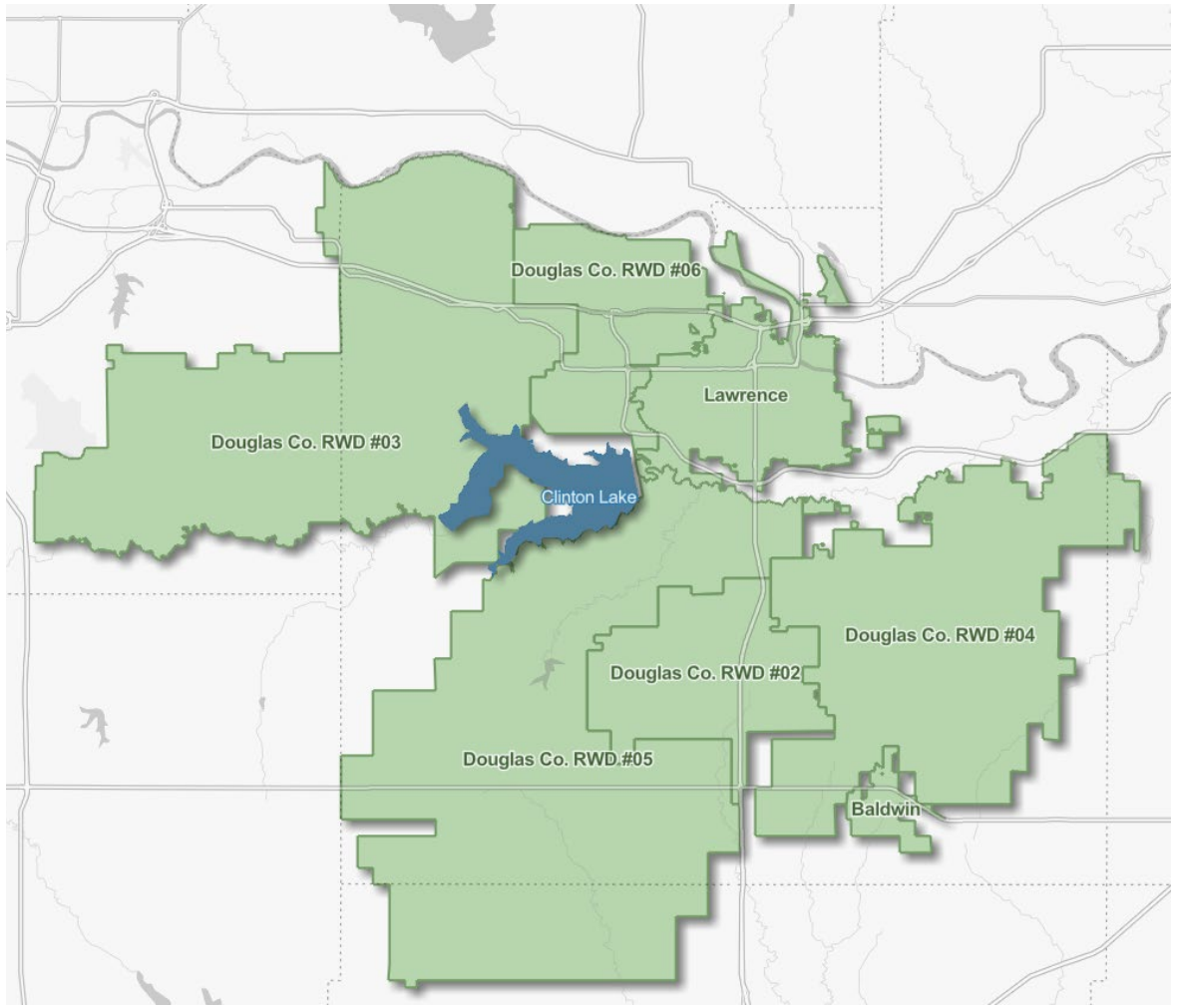
Kansas River Basin



- **Reservoir volume = time able to sustain needs of Kansans through drought.**
- Supports demands through longer and more intense droughts
- Supports higher demands from economic development or population growth
- Firm Yield needed to back up water supply interests

Kansas River Basin

- **Water Marketing**
- **Clinton Reservoir**
  - **Water Marketing** contracts with local water suppliers
  - Kansas Water Authority review and approval
  - Storage allocated to local water suppliers
  - Water Quality storage to maintain minimum release schedule



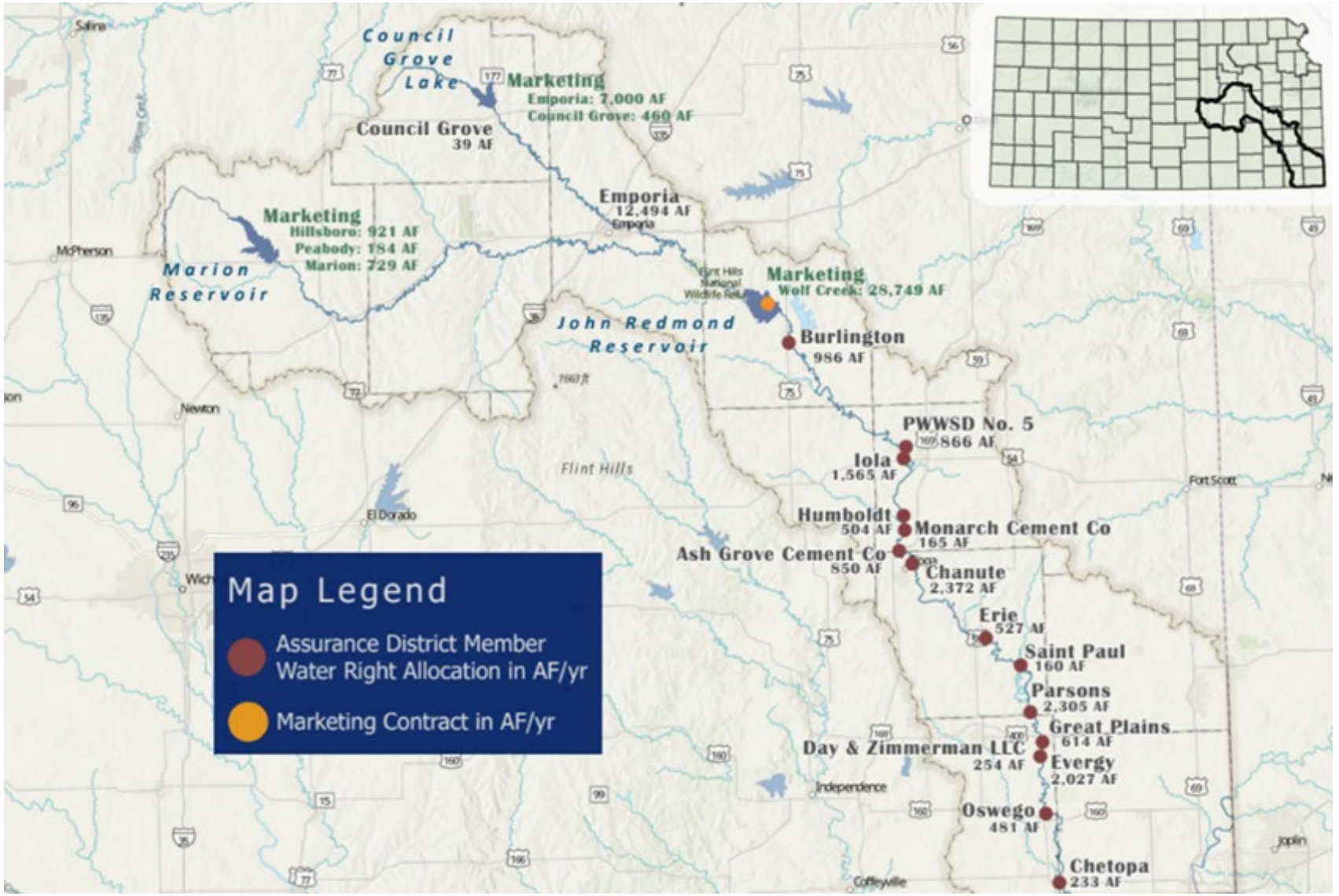
Marais des Cygnes River Basin

- **Assurance District**
  - Melvern and Pomona Reservoirs
- **Marketing Contracts**
  - Hillsdale: fully committed to local water supply
  - Melvern and Pomona: allocation remaining

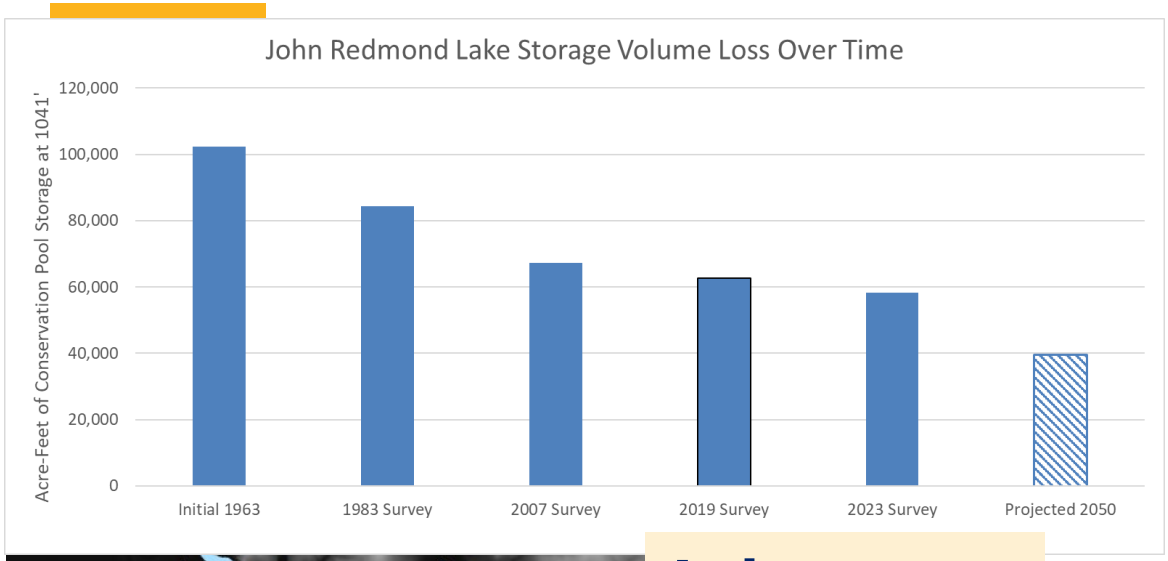


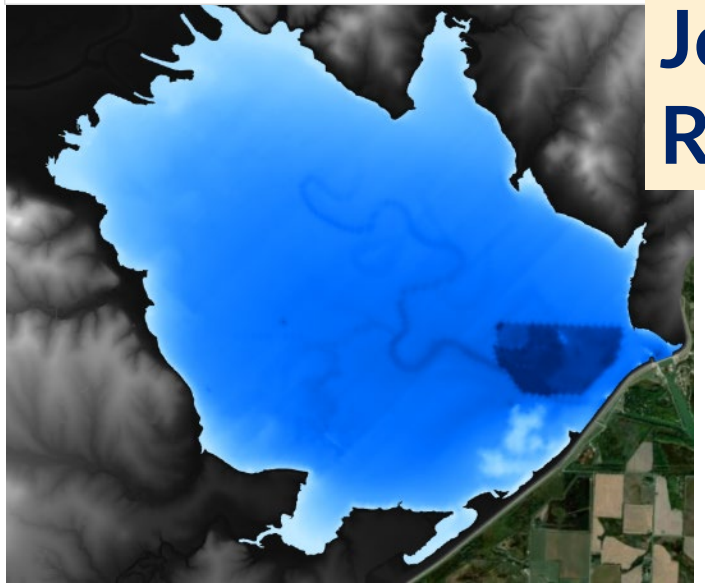
Neosho River Basin

- Assurance District
- Marketing Contracts
- Limited storage available for future demand development

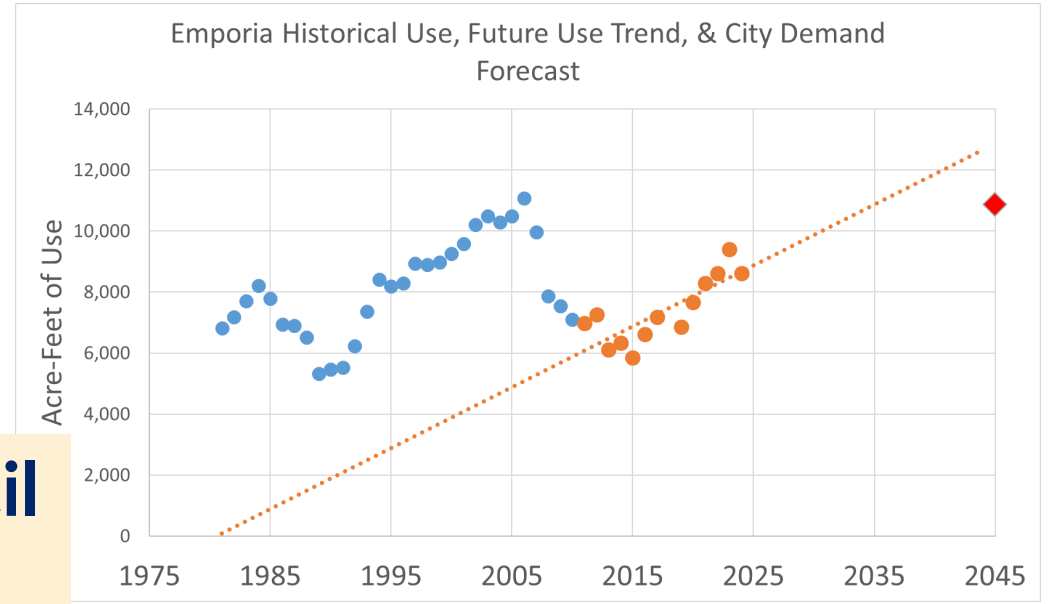


Neosho River Basin

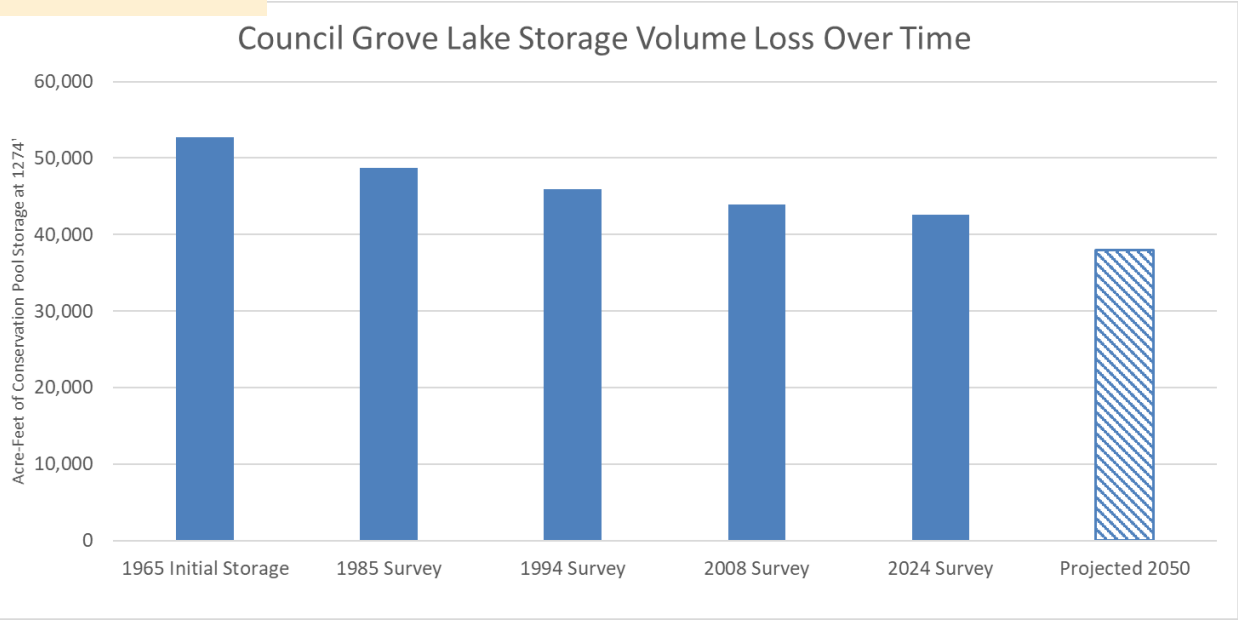




John Redmond

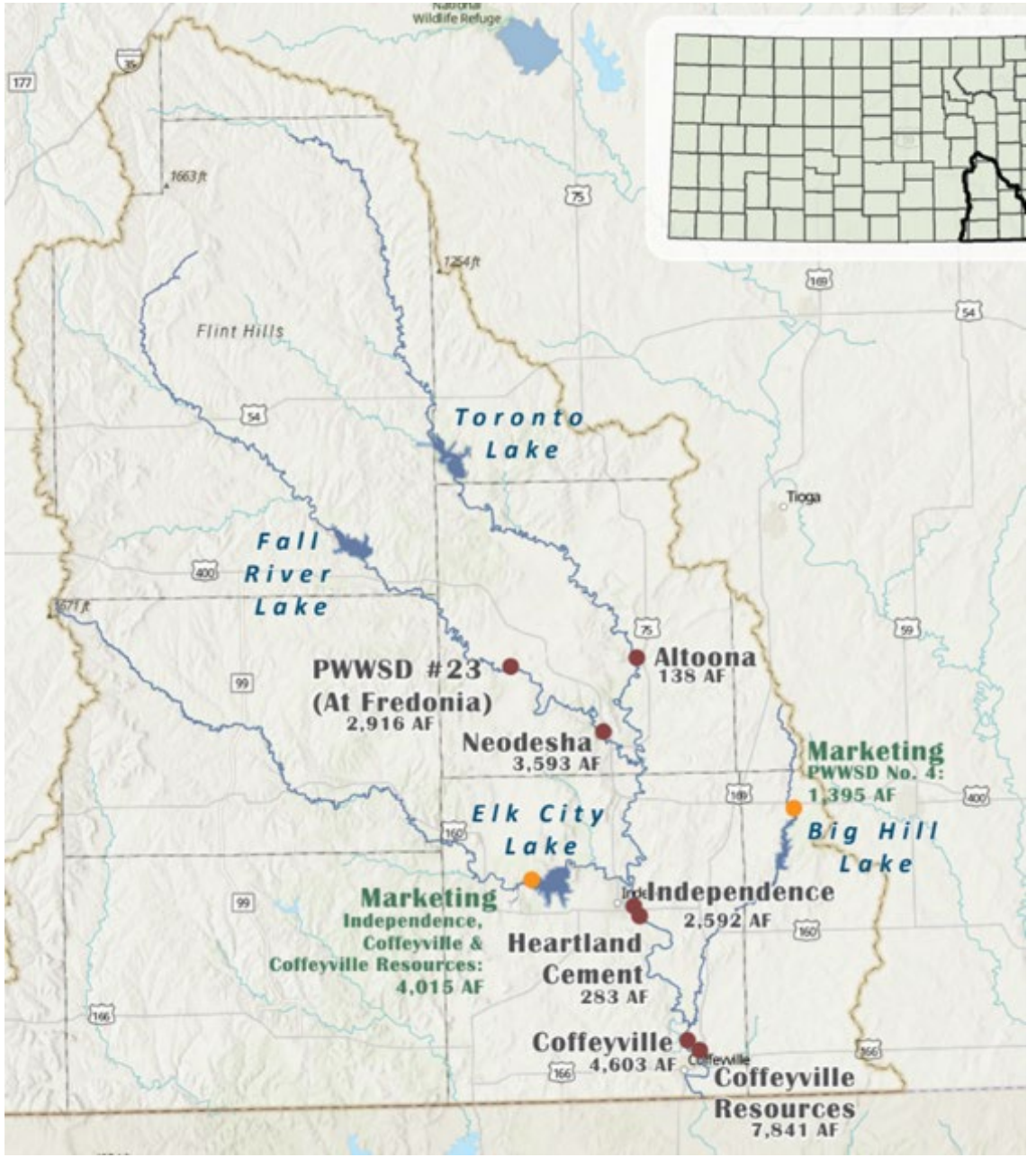


Council Grove

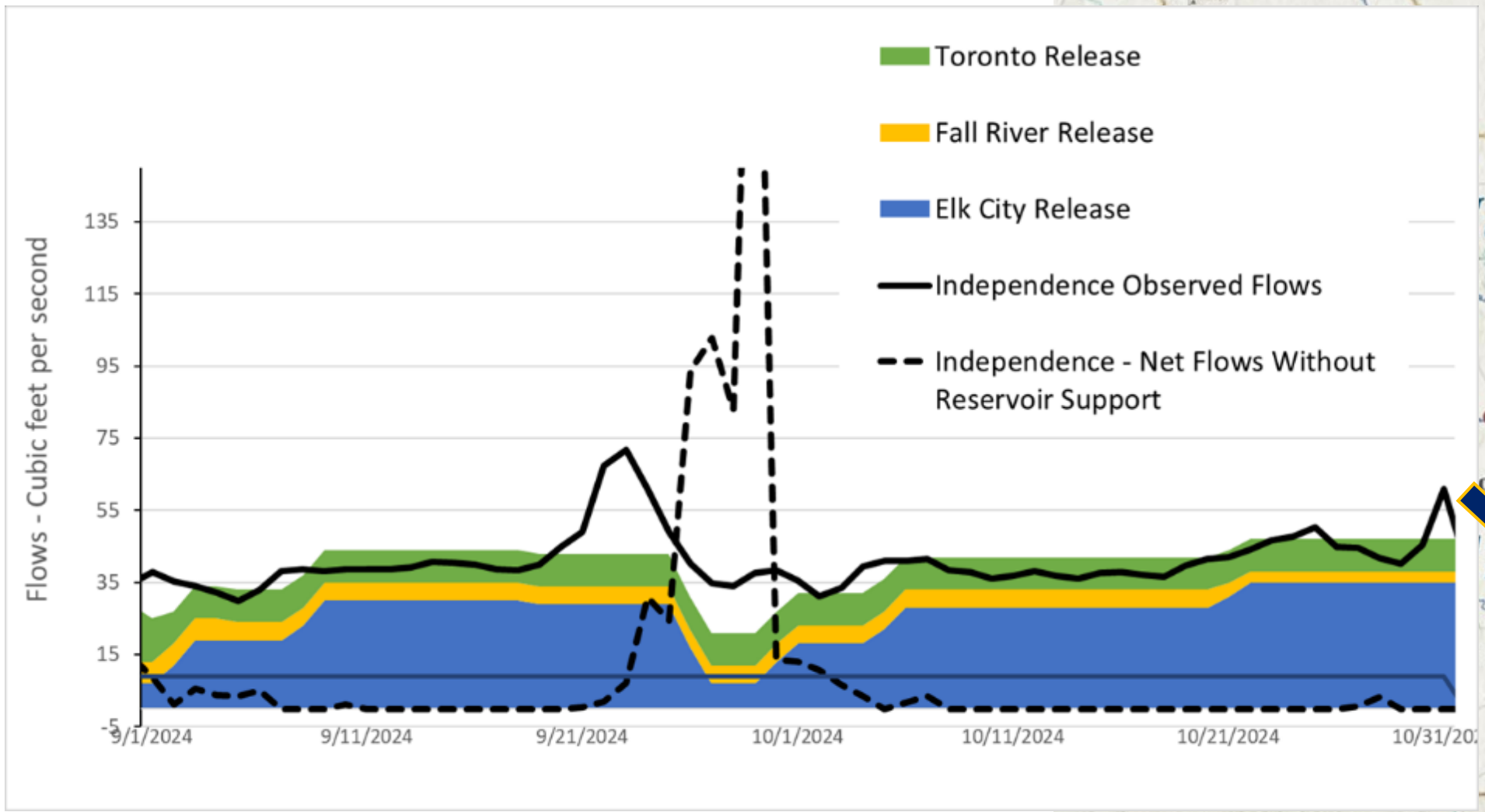


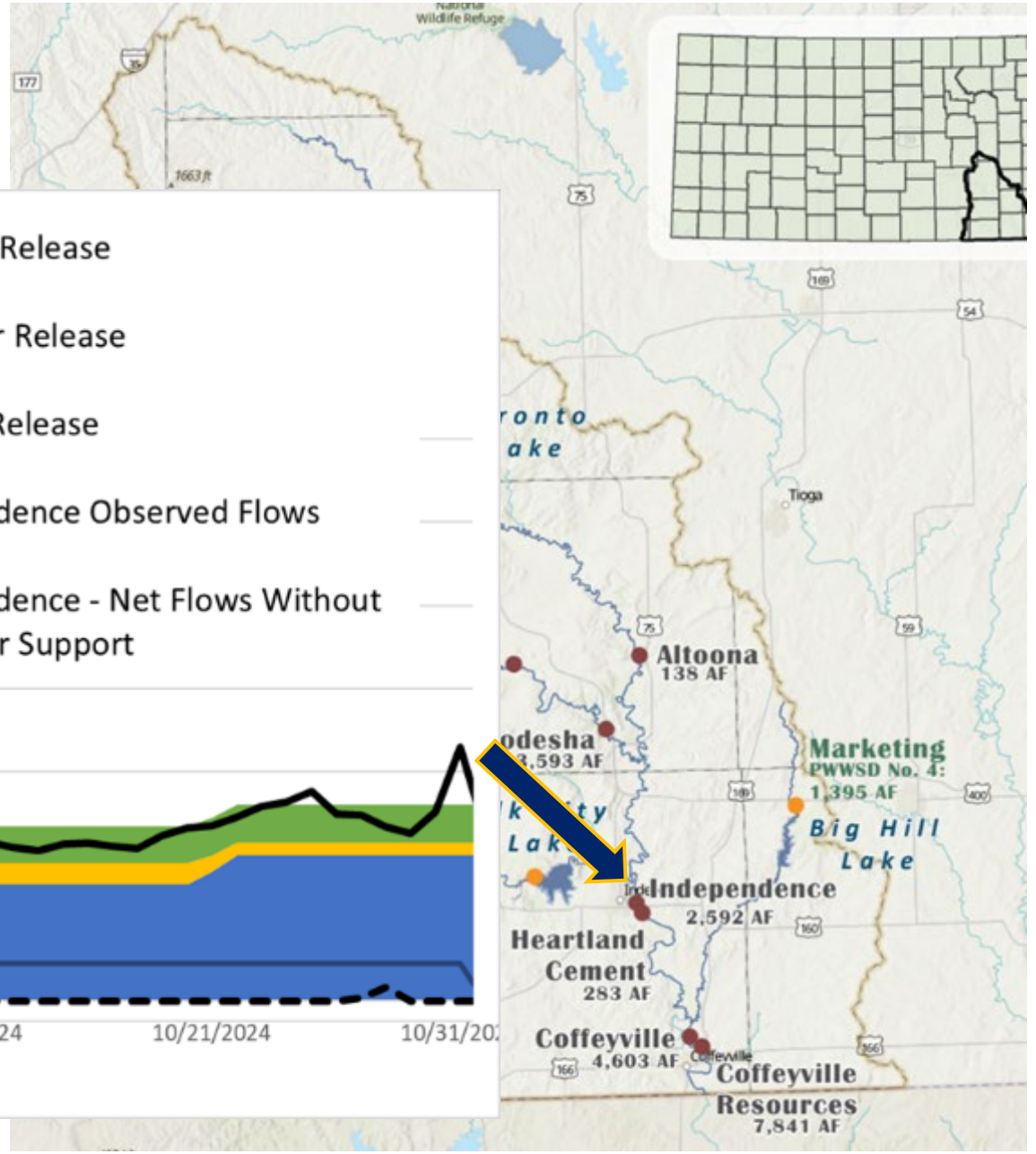
Verdigris River Basin

- **Marketing Contracts**
  - Elk City Lake being used to support economic growth and water right development
- **MOU with USACE for Operations**
- **Big Hill Lake**
  - Available allocations for demand development



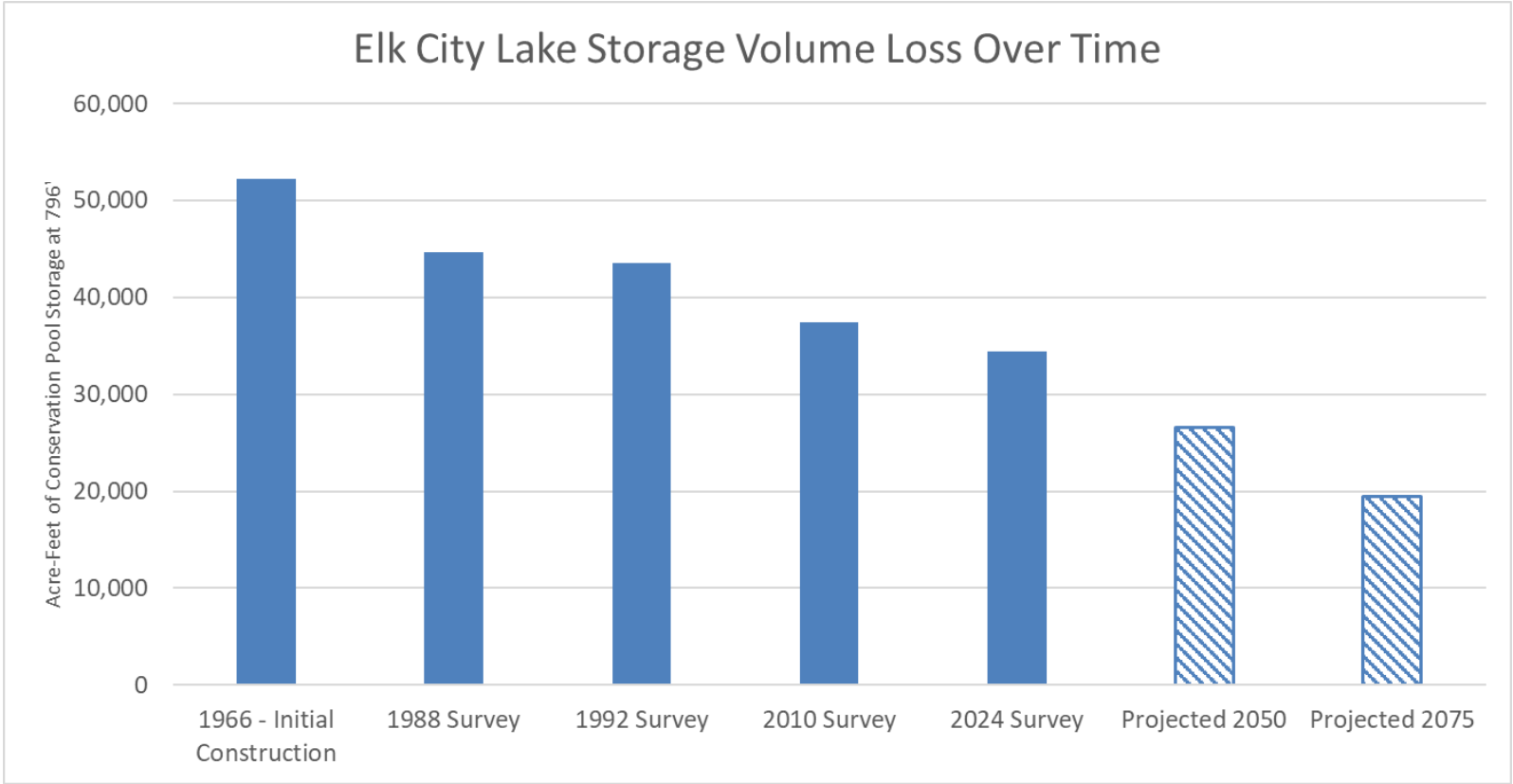
Verdigris River Basin





Verdigris River Basin

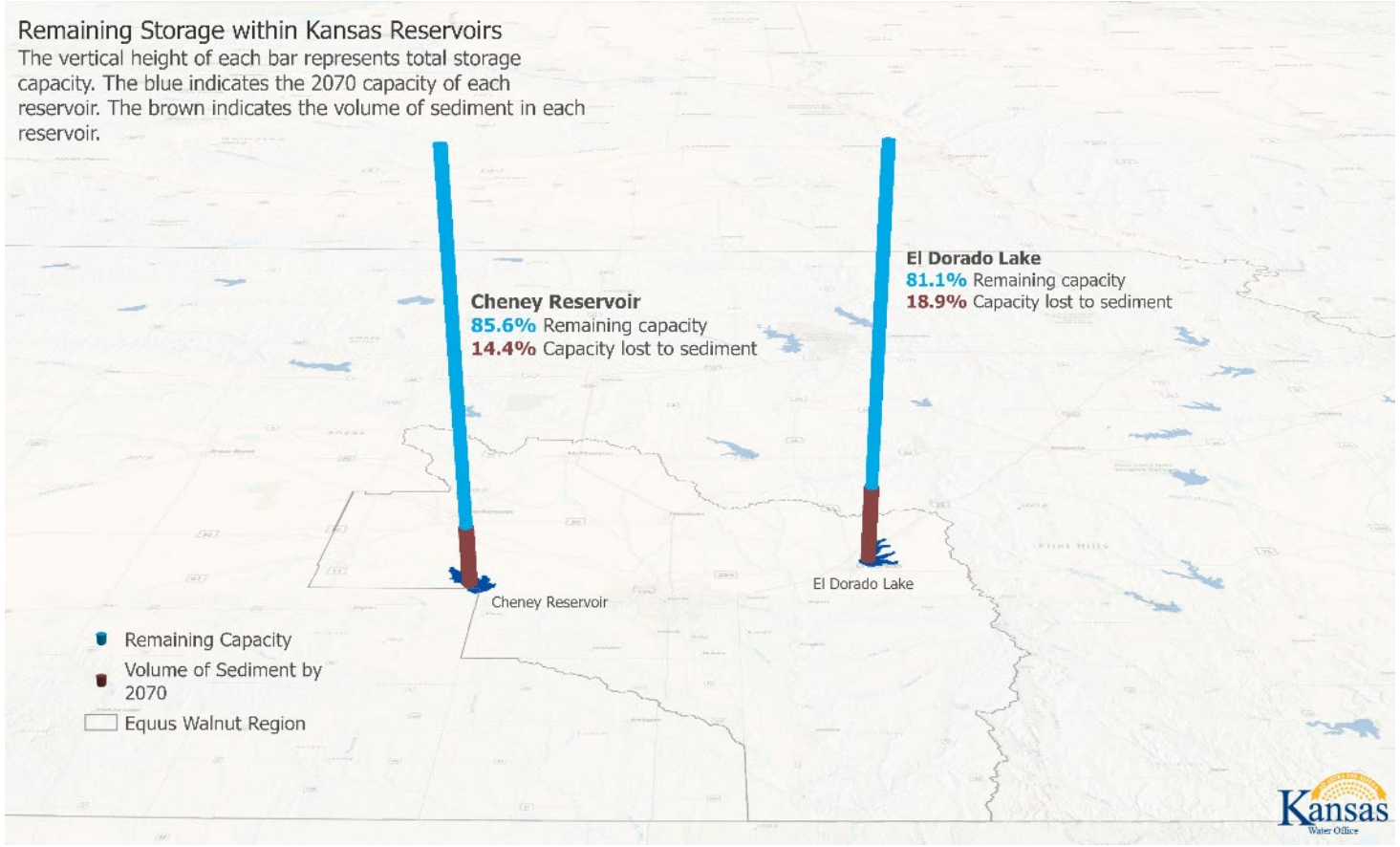
- **Recent surveys (bathymetric) for the region's reservoirs show continued loss of storage**
  - Elk City Lake – completed 2024
  - Toronto & Fall River Lakes– In Progress 2025



- **Current path will limit future economic development and sustainment of water demands longer term without intervention**

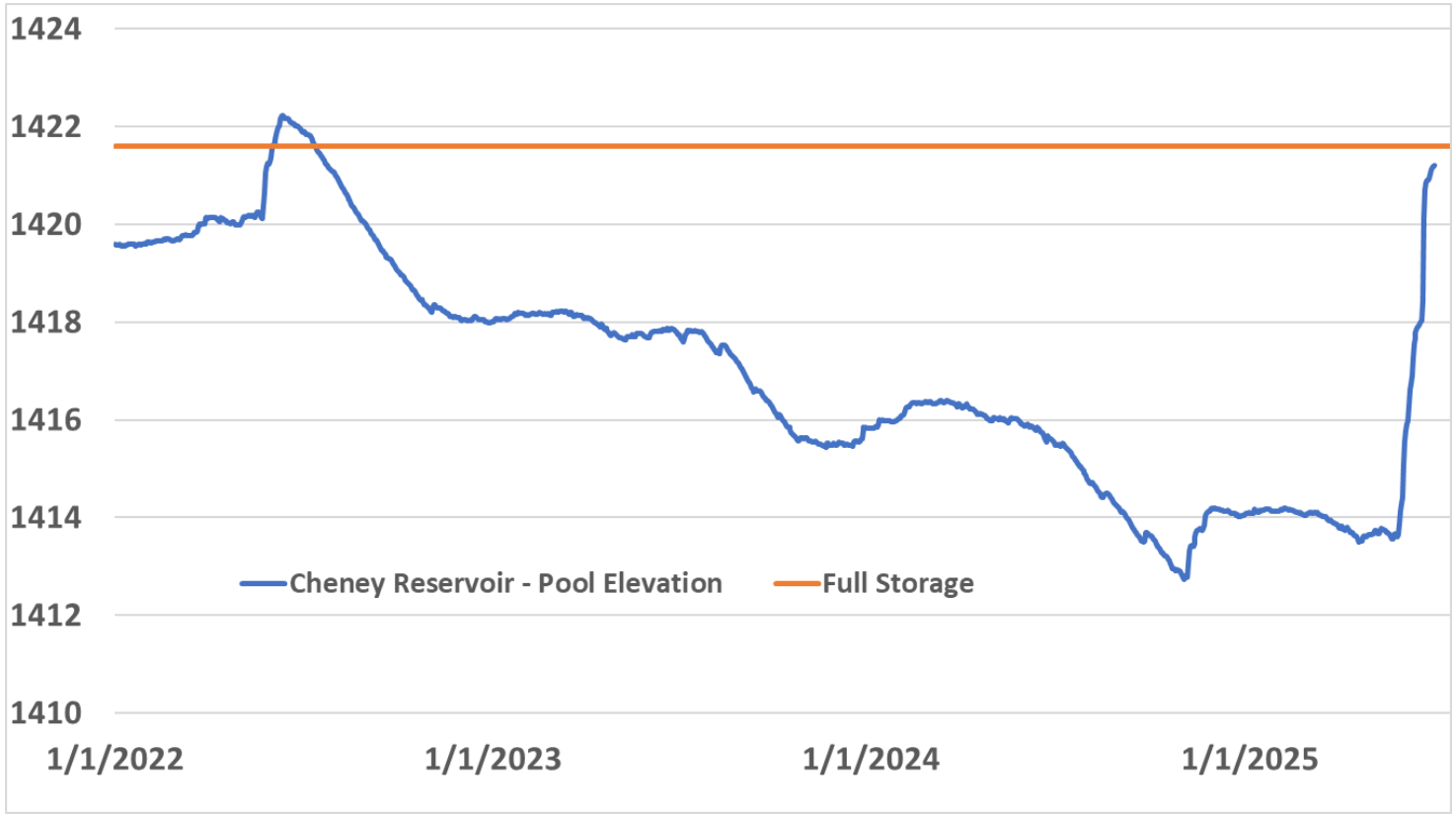
Equus-Walnut Region

- **Municipal and Industrial water supply connected to Cheney and El Dorado Reservoirs**
  - City of Wichita area contracts with Bureau of Reclamation
  - City of El Dorado area contract with USACE



Equus-Walnut Region

- **Cheney Reservoir water supply role last 3 years**
  - 1 of 2 primary water sources for city of Wichita area
  - Serves population of 500,000 or 1 in 6 Kansans
  - Serves 8 surrounding communities and 3 rural water districts

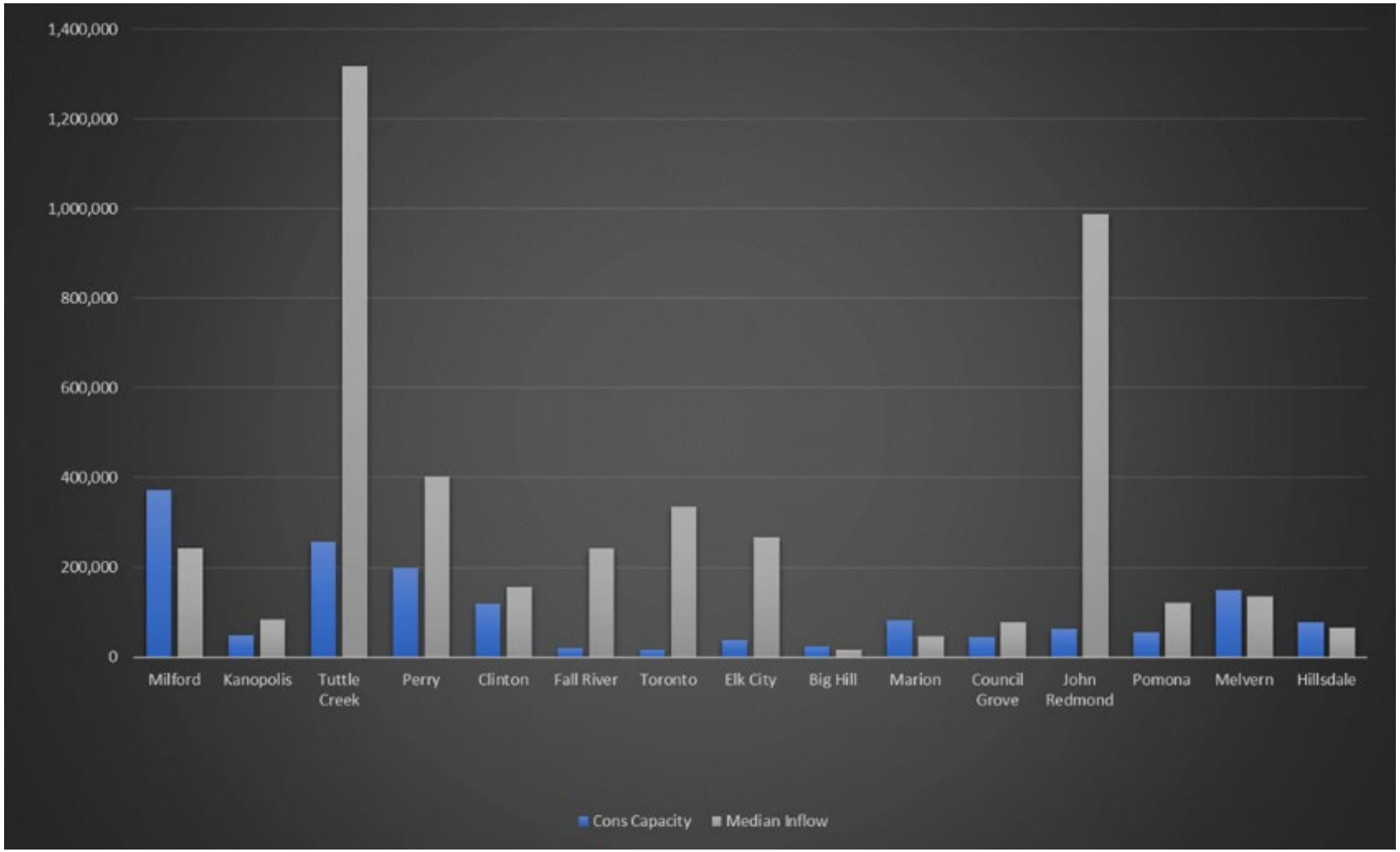


Equus-Walnut Region

- USGS data showed lowest inflows since 1960's construction
- Wichita investment and support of watershed management programs to maintain reservoir storage
- Real-time water quality monitoring upstream of reservoir
- KWO & Wichita partnering with USGS to complete full coverage reservoir bathymetric survey

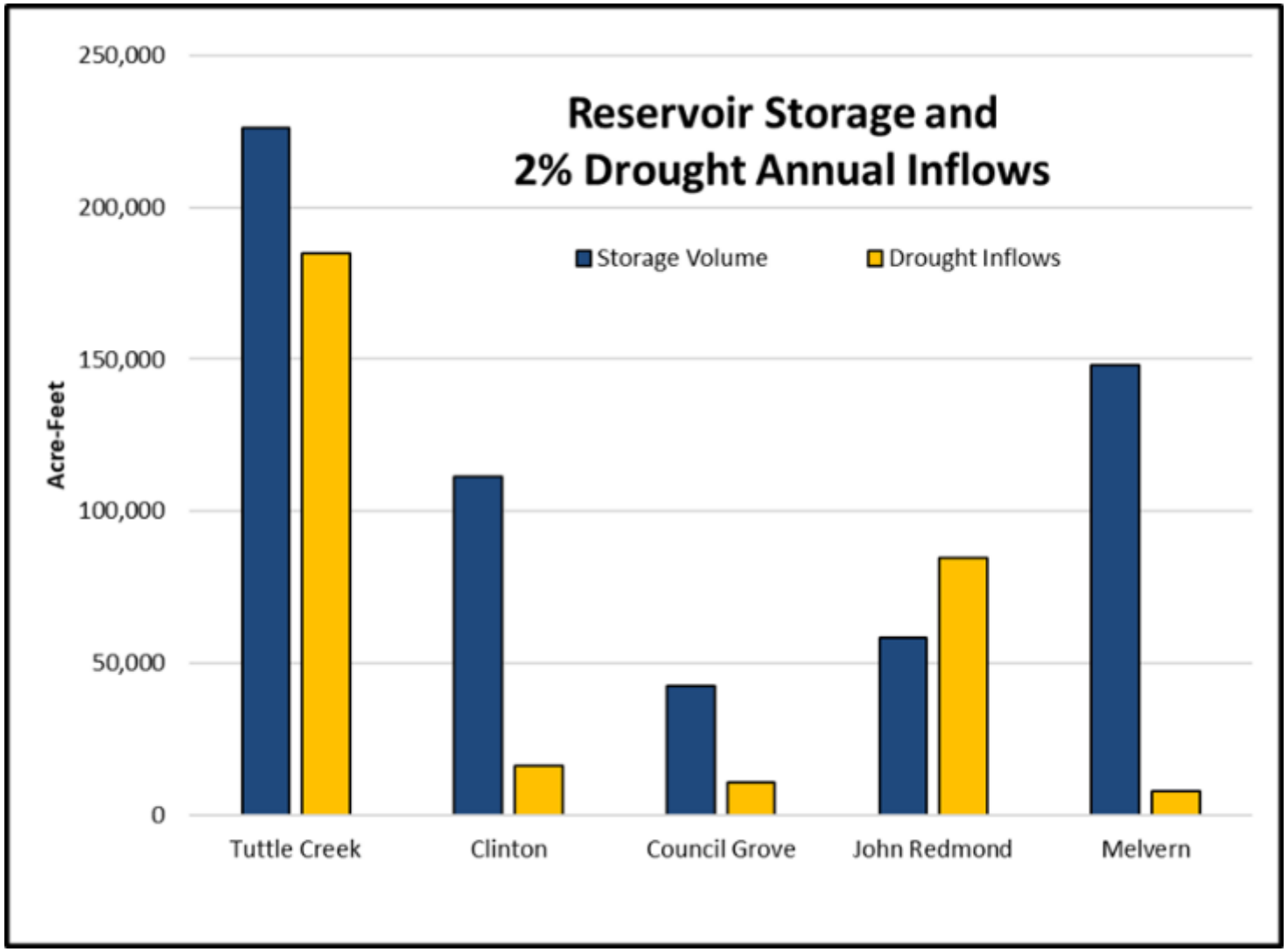
Not All Reservoirs Are Equal For Water Supply

- **Some reservoirs have significantly more median inflow than storage available**
  - Refill potential and greater yield
  - Higher inflows, more sediment potential



Not All Reservoirs Are Equal For Water Supply

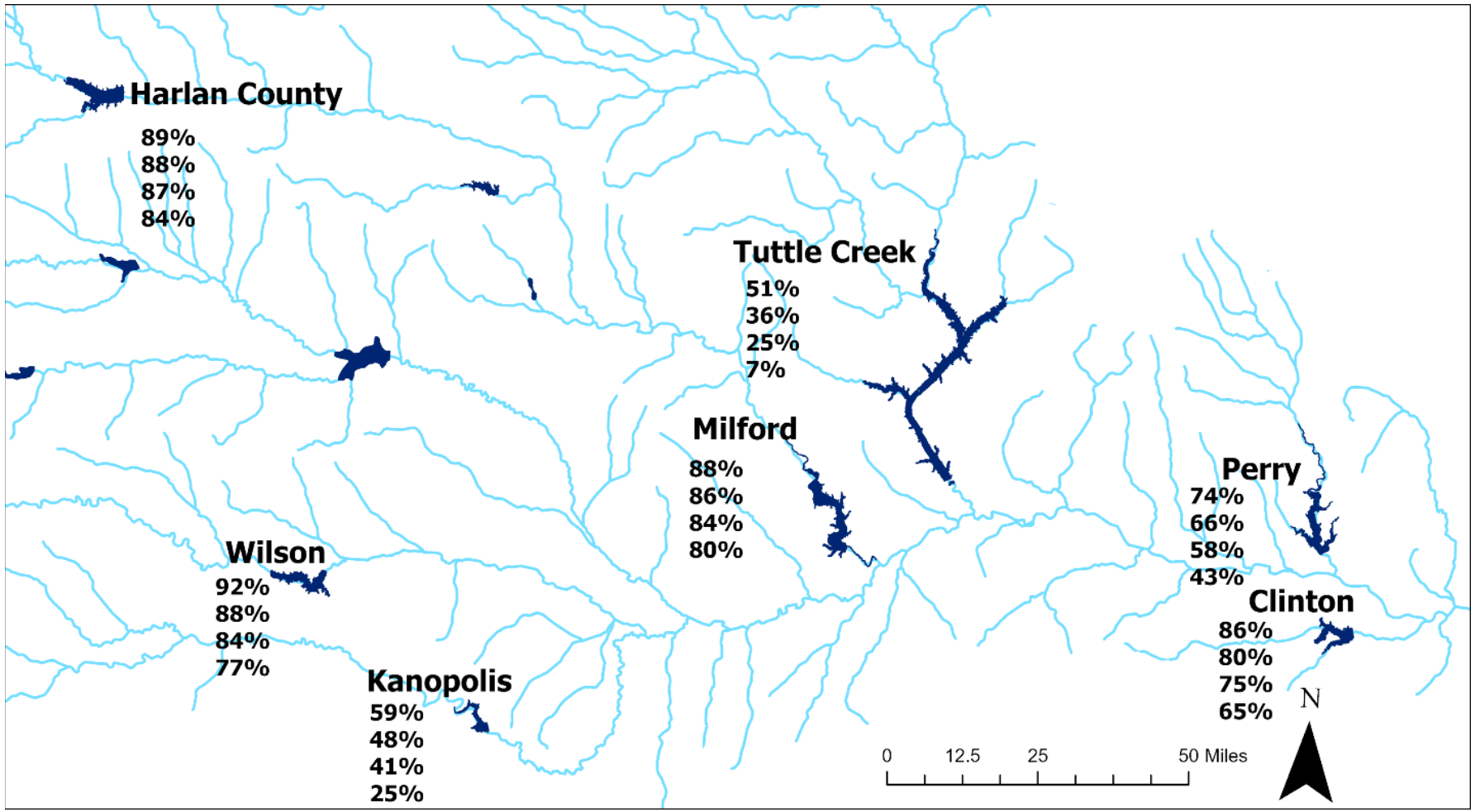
- Some reservoirs receive more inflows during drought than others
- Different operational constraints per reservoir
- Different designs



Risks: Current and Future

Risk #1: Declining Reservoir Capacity

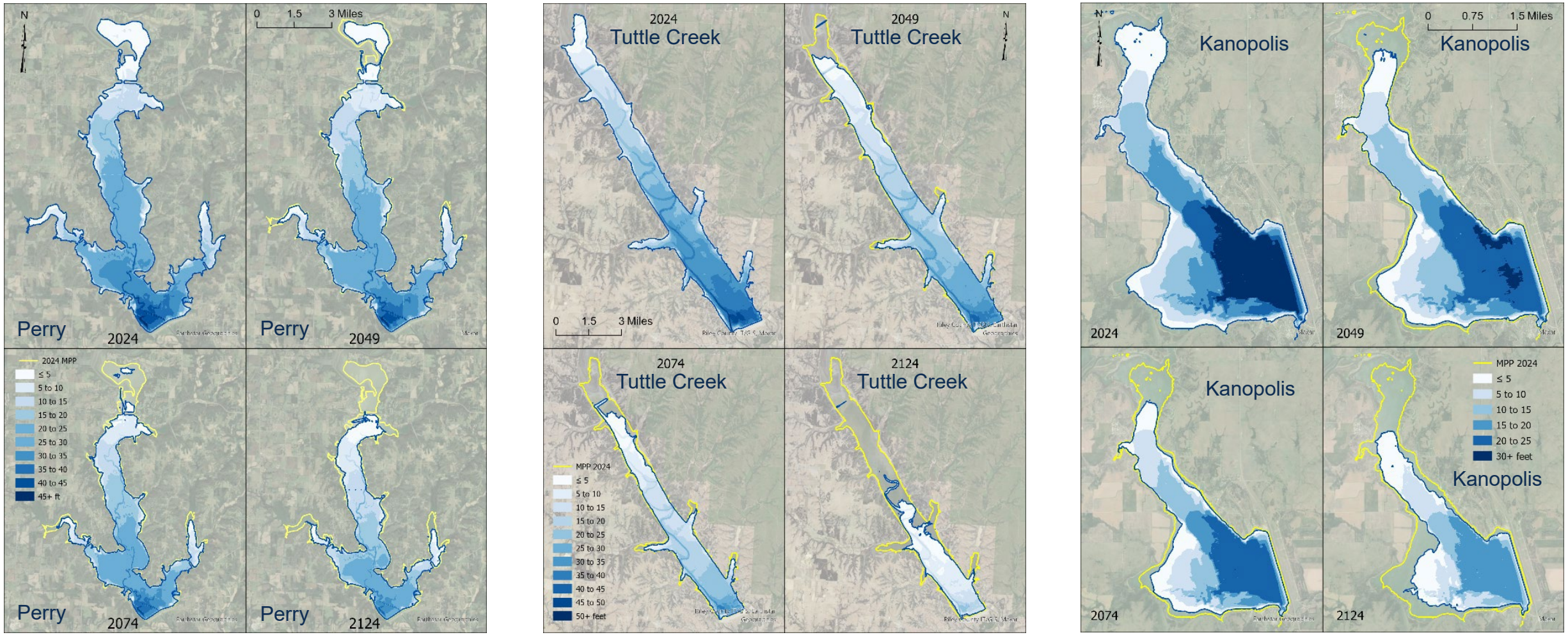
- Kansas River Reservoirs Flood and Sediment Study
  - U.S. Army Corps of Engineers
  - Kansas Water Office
  - Kansas Department of Wildlife and Parks



Projected percent of the original multipurpose pool remaining in 2024, 2049, 2074, and 2124

Figure 3-101 from the Kansas River Reservoirs Flood and Sediment Study - Final Watershed Study Report

Risk #1: Declining Reservoir Capacity



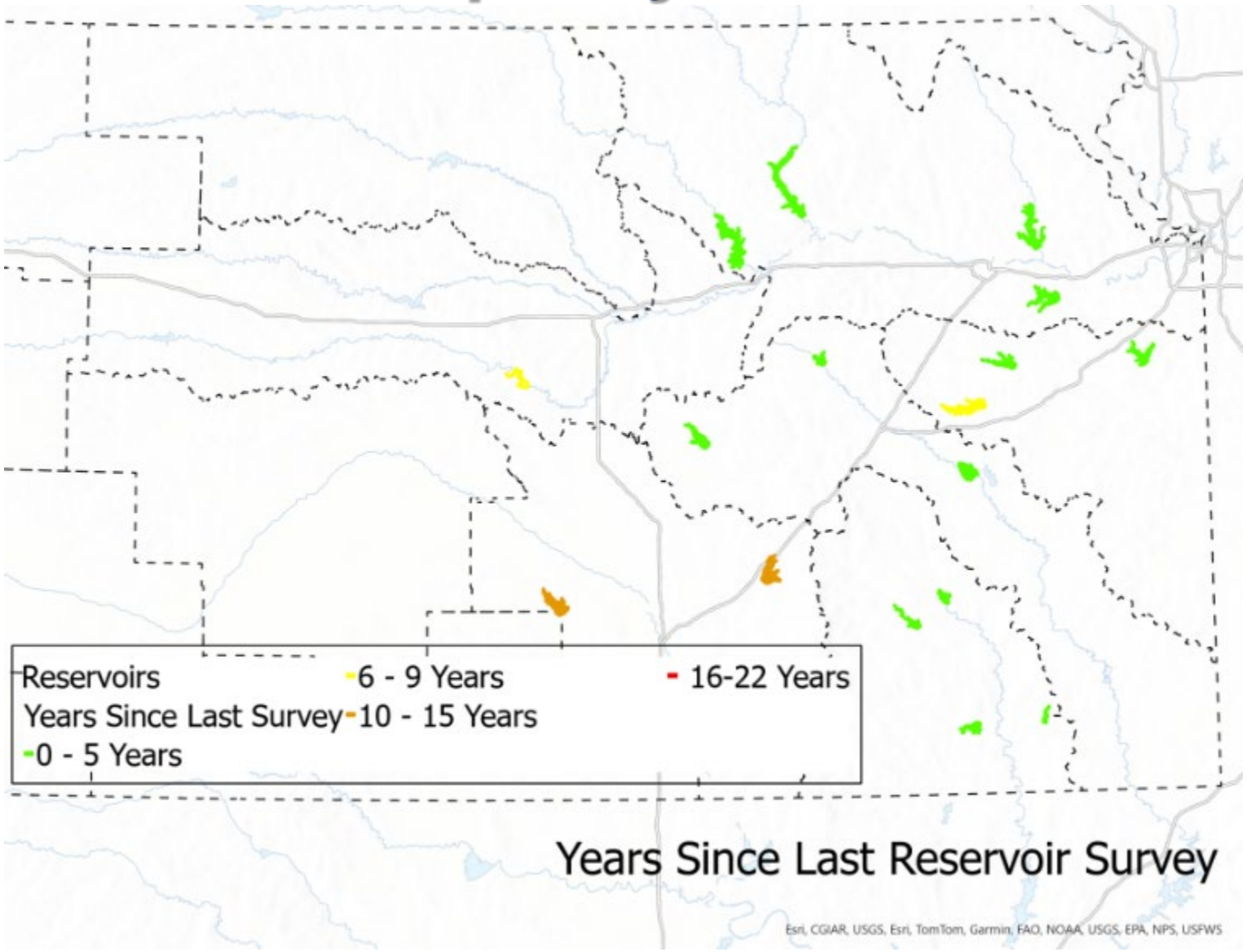
Projected depth of the multipurpose pool without action at Perry, Tuttle Creek, and Kanopolis

Figure 3-103 from the Kansas River Reservoirs Flood and Sediment Study - Final Watershed Study Report

Risk #1 Declining Reservoir Capacity

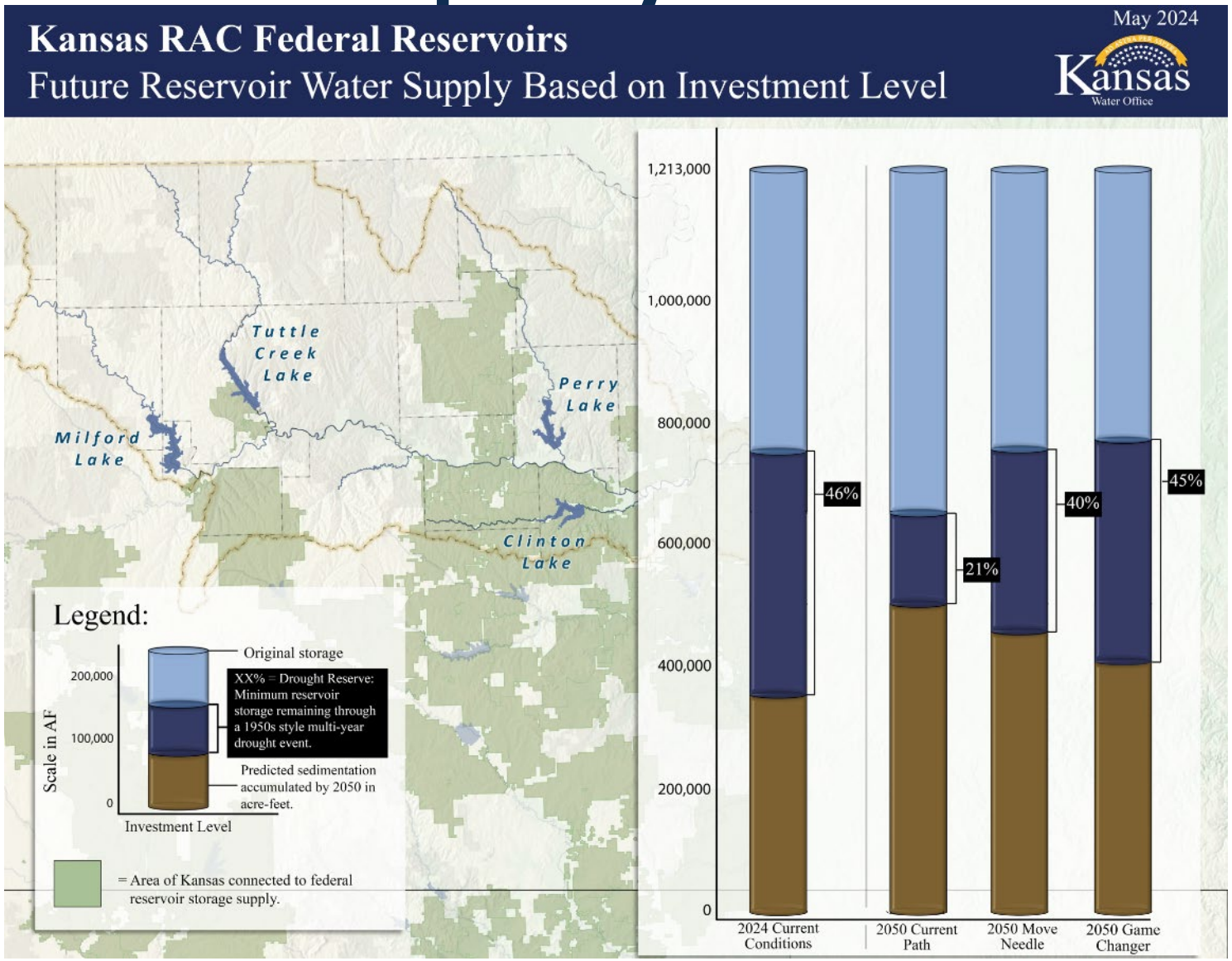


Perry Lake
Sediment Inflow
and Storage Loss



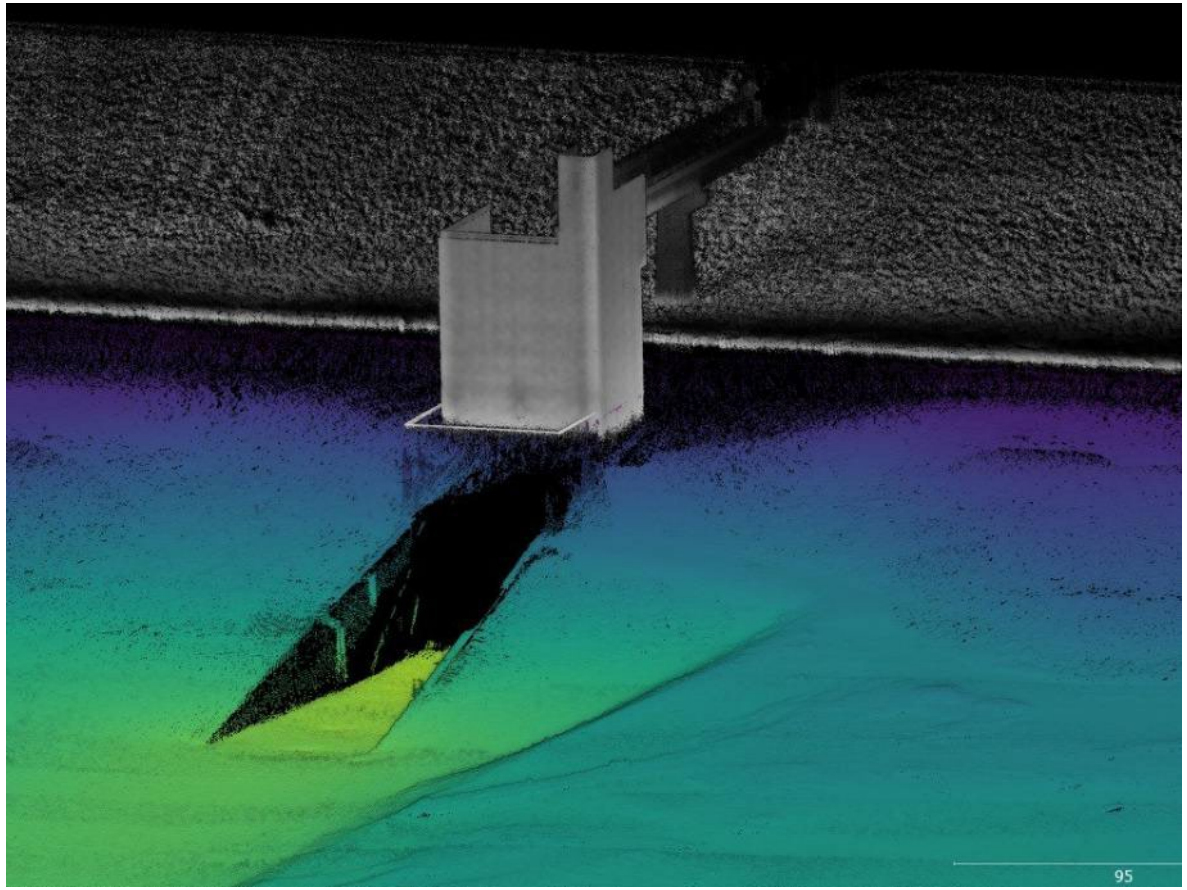
Risk #1: Declining Reservoir Capacity

- Assumes a drought similar to the 1950's historical drought were to occur with today's reservoir conditions and demands.
- Drought Reserve is ability to persist through more severe event or greater demands



Risk #1: Declining Reservoir Capacity

- **Some reservoirs accumulating sediment around outlet gates and water supply intakes**
  - Impacts water supply release operations
  - Impacts **water quality** in some reservoirs
    - Manganese: water discoloration
    - Hillsdale & Marion Reservoirs
    - **Increasing operational treatment costs/rates**



Multibeam bathymetric survey of outlet structure

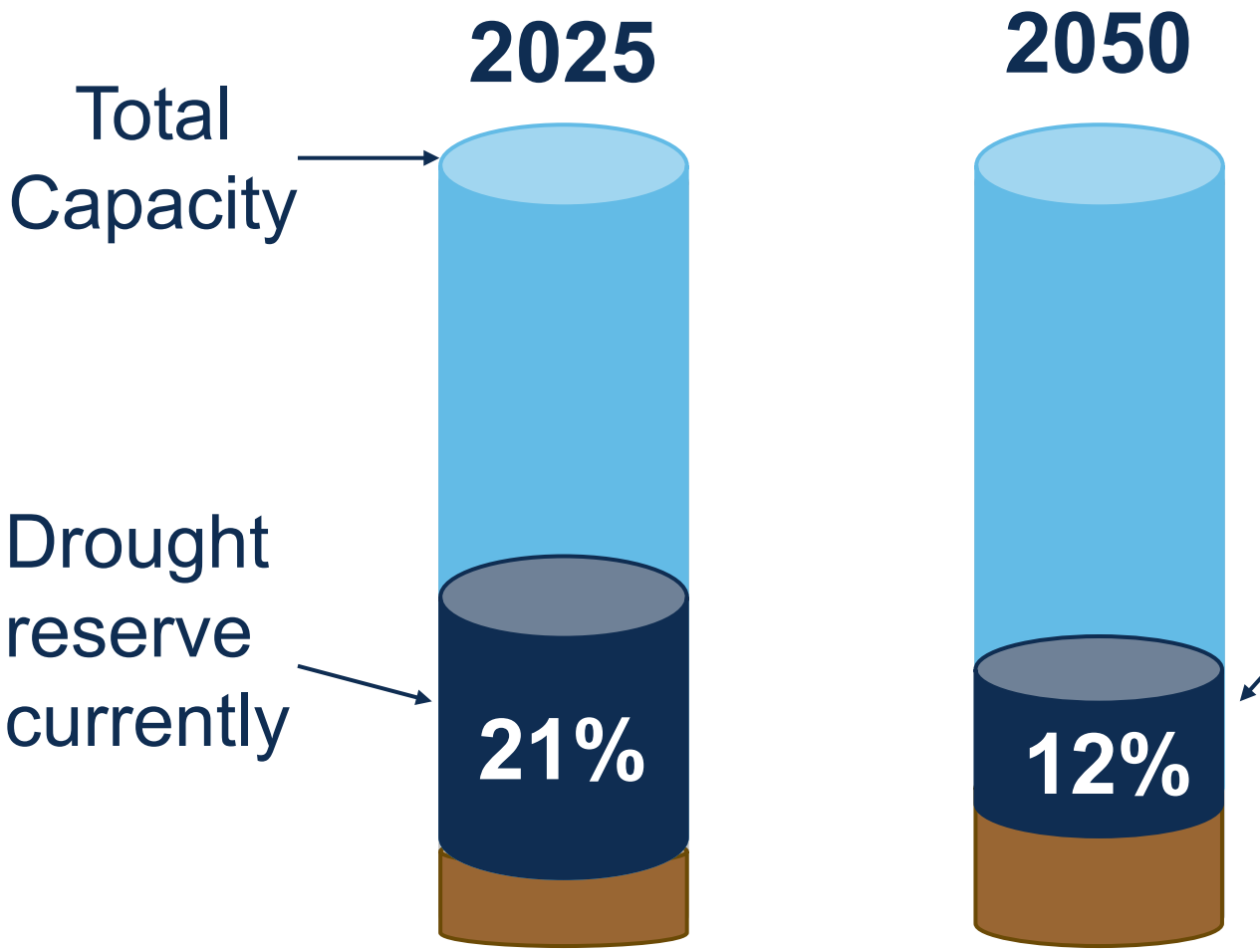
Risk #1: Declining Reservoir Capacity

- **The two major sources of reservoir sediment are land and streambanks that erode upstream of the reservoir.**
  - Rivers are natural erosion machines
  - Naturally move sediment downstream.
  - Dams were built and trap high percentage of sediment.



Risk #2: Sudden Demand Increases

Current Path, drought reserve declines



Hillsdale Reservoir Example

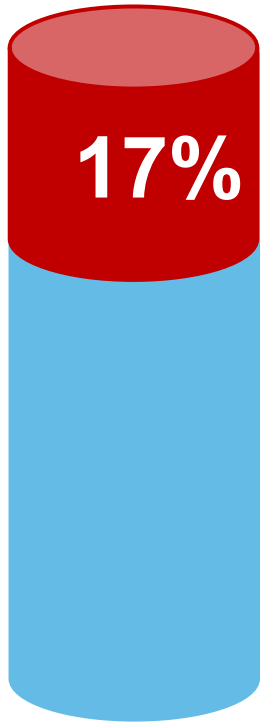
Drought reserve nearly cut in half due to increased population demands & accumulation of sediment

Risk #2: Sudden Demand Increases

Water Supply Needed

Shortage/Gap

Hillsdale Reservoir Example



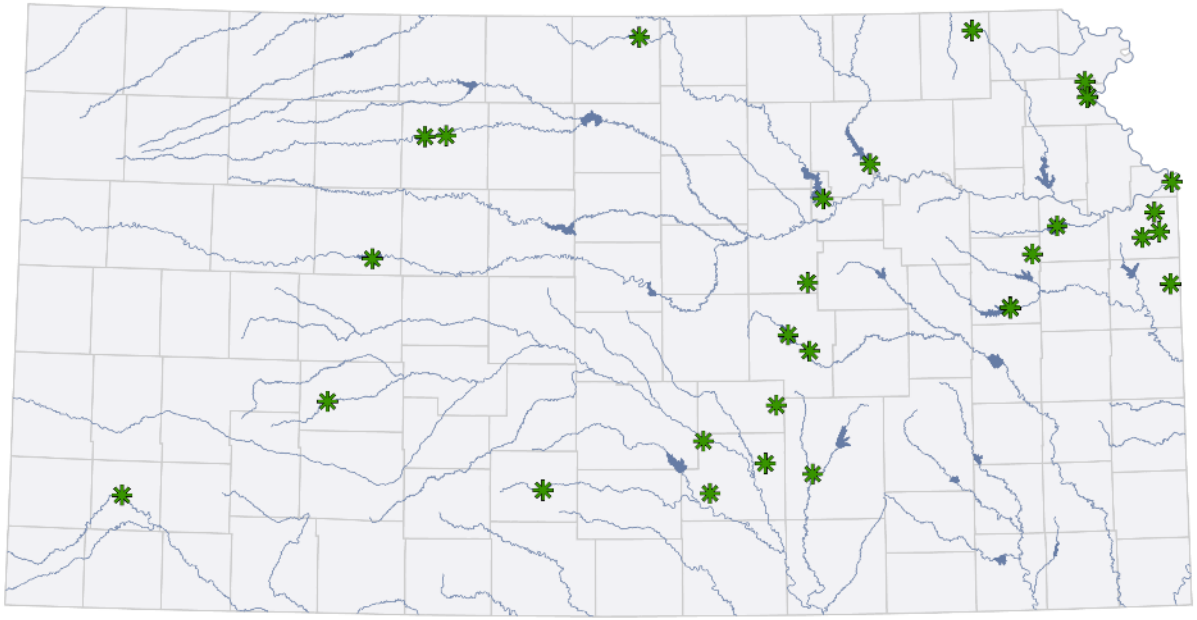
<u>Demand Disrupters</u> for new data centers or similar large industry demands exceeds capacity – unless changes are made

Without investment, we will not meet the water demands that economic opportunities require in some areas of state.

Risk #3: Harmful Algal Blooms



Public Waterbodies Confirmed
with Harmful Blue-Green Algae Blooms (HABs)



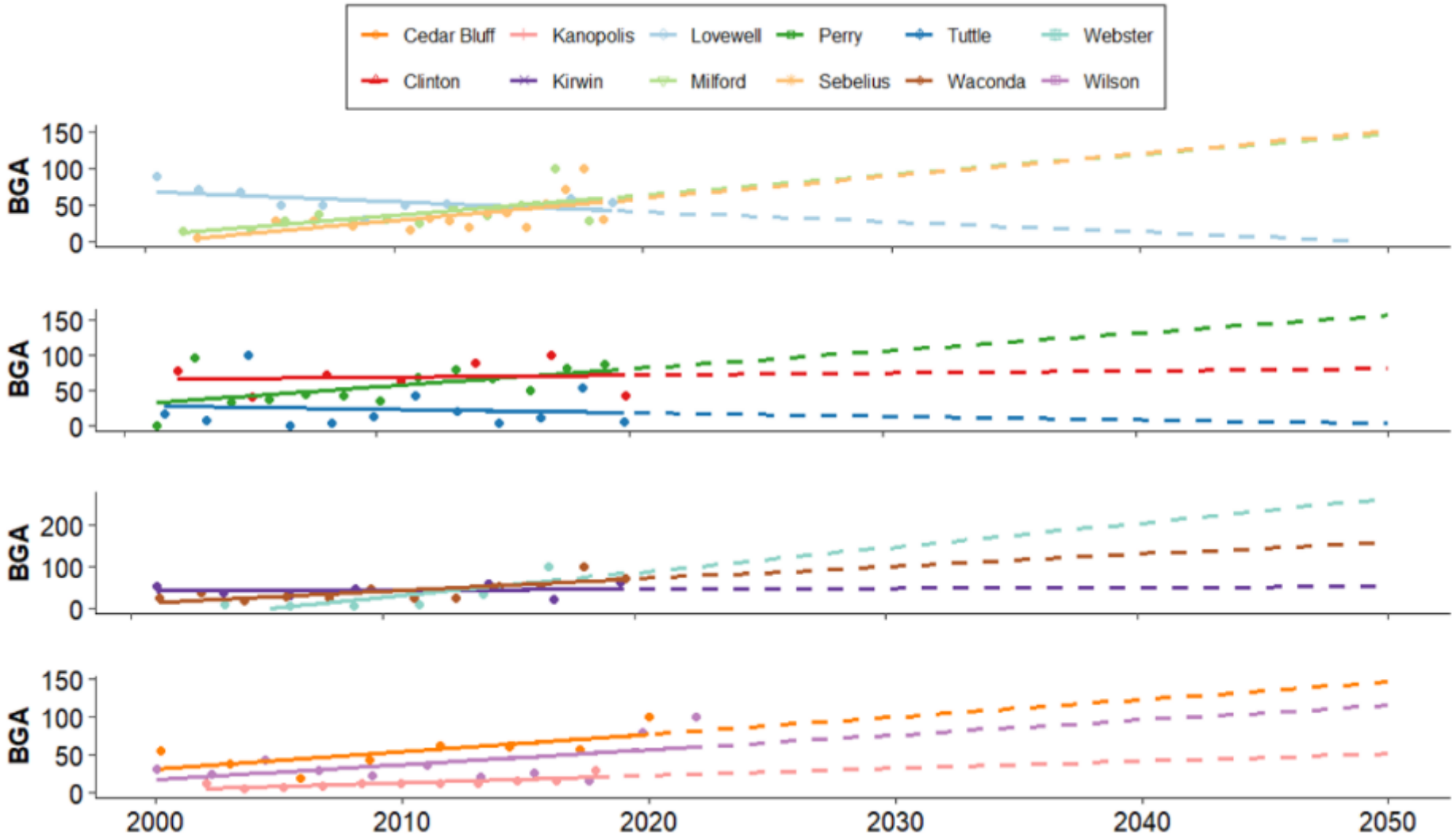
Confirmed 2024 HAB locations

Data Source: KDHE Bureau of Water, & Bureau of Environmental Field Services



Risk #3: Harmful Algal Blooms

- Blue-Green Algal Trends and Projections Kansas Basin
- Dr. Ted Harris
- December 2024
- Kansas Biological Survey Report No. 219



Types of Interventions – Programs and Investments

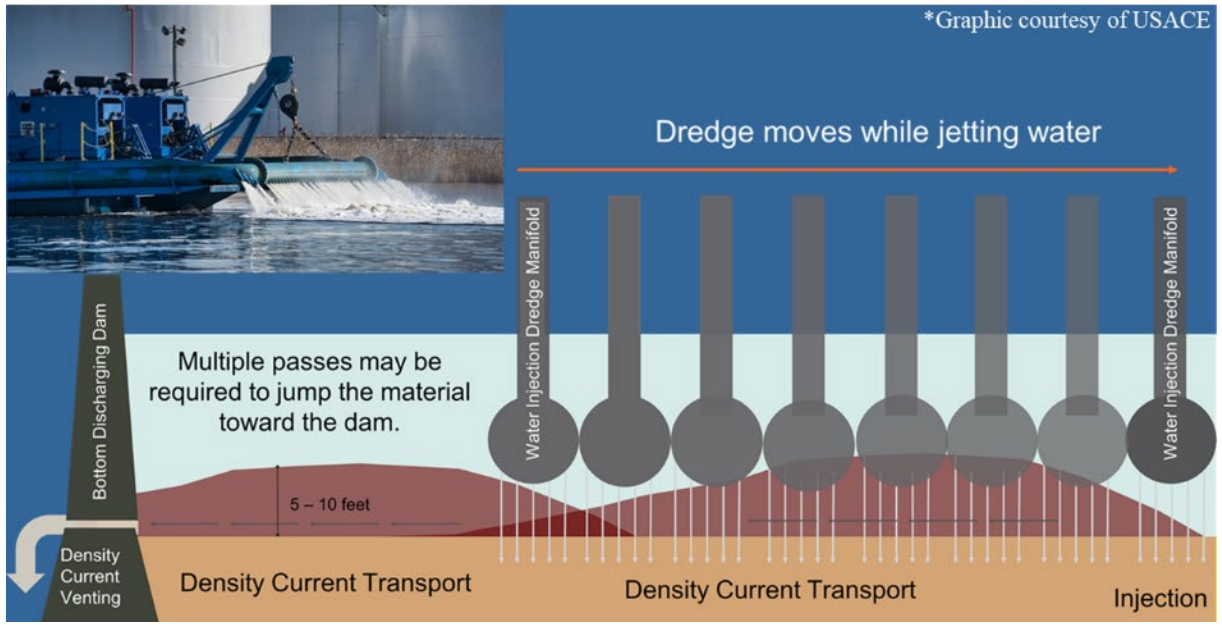
Investment Type #1: In-Lake Sediment Management

- **Work with the U.S. Army Corps of Engineers to collect sediment data, assess reservoir sediment issues, and determine solutions.**
  - Evaluate existing technologies
  - Create long-term reservoir sediment management plans for Kansas reservoirs.
- **Goal: Determine and implement cost-effective strategies to manage reservoir sediment and achieve reservoir sustainability.**
- **Current Investments and Progress**
  - Tuttle Creek Lake Water Injection Dredging Demonstration (2025-2026)
  - John Redmond Reservoir Hydrosuction Demonstration (TBD)
- **Effectiveness**
  - Currently being evaluated

Investment Type #1: In-Lake Sediment Management

Tuttle Creek Lake Water Injection Dredging (WID) Demonstration

- Project with the U.S. Army Corps of Engineers
- Assess the effectiveness of WID for managing reservoir sediment
- Monitor and evaluate the downstream impacts of passing sediment from the reservoir



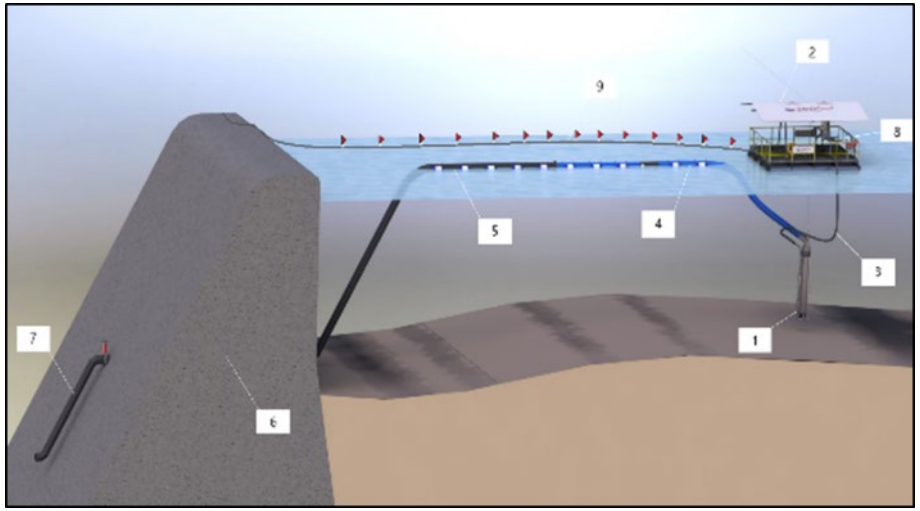


Investment Type #1: In-Lake Sediment Management

John Redmond Hydrosuction

- Hydrosuction utilizes a siphon to remove and transport reservoir sediment downstream.
- A report with a preliminary design and cost estimate is currently being finalized.
- Data collection and analysis are being completed in preparation for the project.
- Discussions are ongoing about the best approach for a state partnership with USACE on a demonstration.
- $1.5M in State FY26 budget for the demonstration





Investment Type #2: Upstream Sediment Reduction

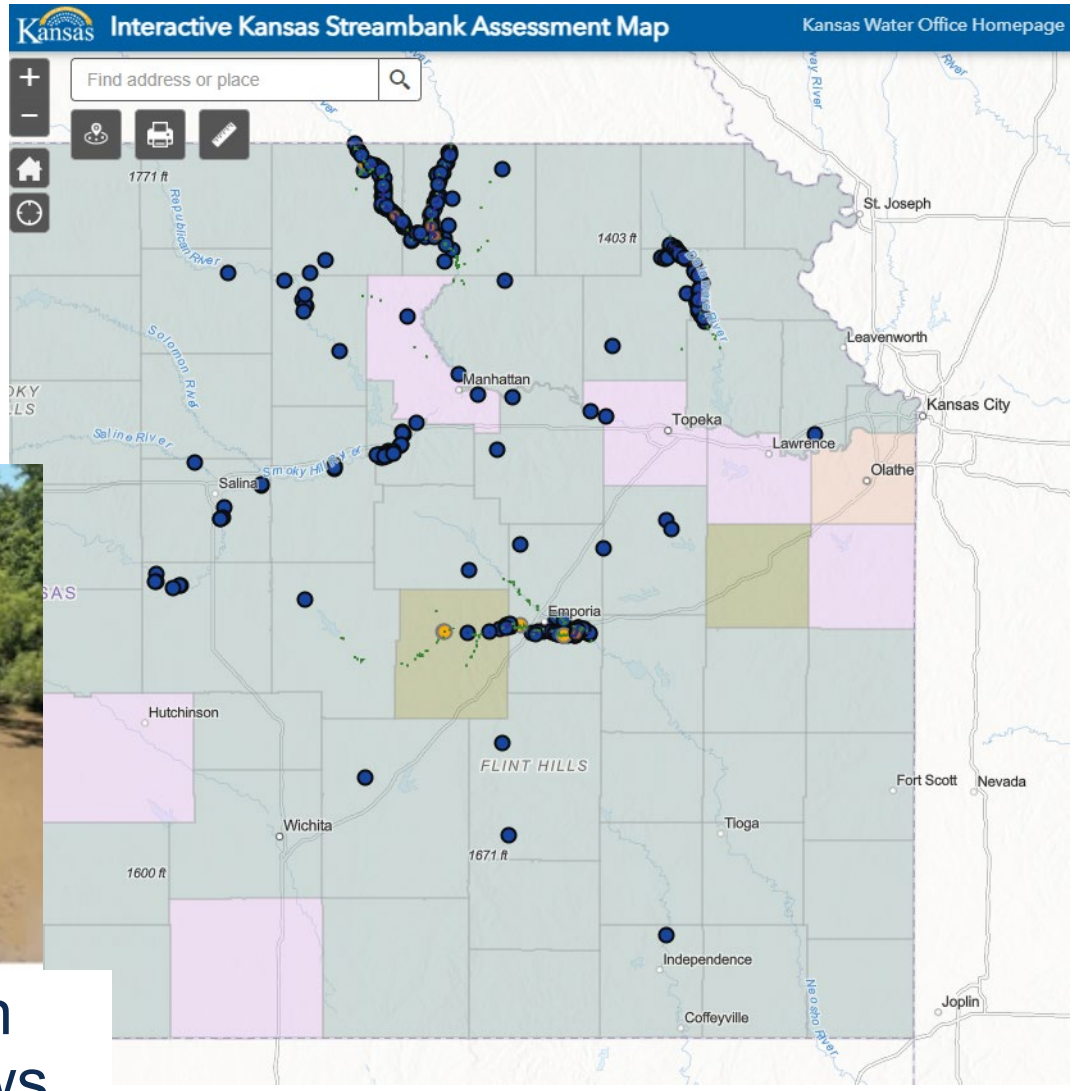
- **Watershed initiatives that reduce the sediment load to reservoirs by stabilizing streambanks and promoting land use best management practices that lessen soil erosion.**
- **Goal:**
  - Identify and stabilize streambank erosion hotspots.
  - Increase land use best management practices in watersheds upstream of critical reservoirs.
- **Current Investments and Progress**
  - Kansas Reservoir Protection Initiative (KRPI)
  - Streambank Stabilization
- **Effectiveness**
  - Program Evaluation underway on BMP effectiveness
  - Recent study done on streambank stabilization project effectiveness post construction

Investment Type #2: Upstream Sediment Reduction

- **Historical streambank stabilization projects**
  - Areas upstream of Tuttle Creek, Perry, and John Redmond Reservoirs historically prioritized



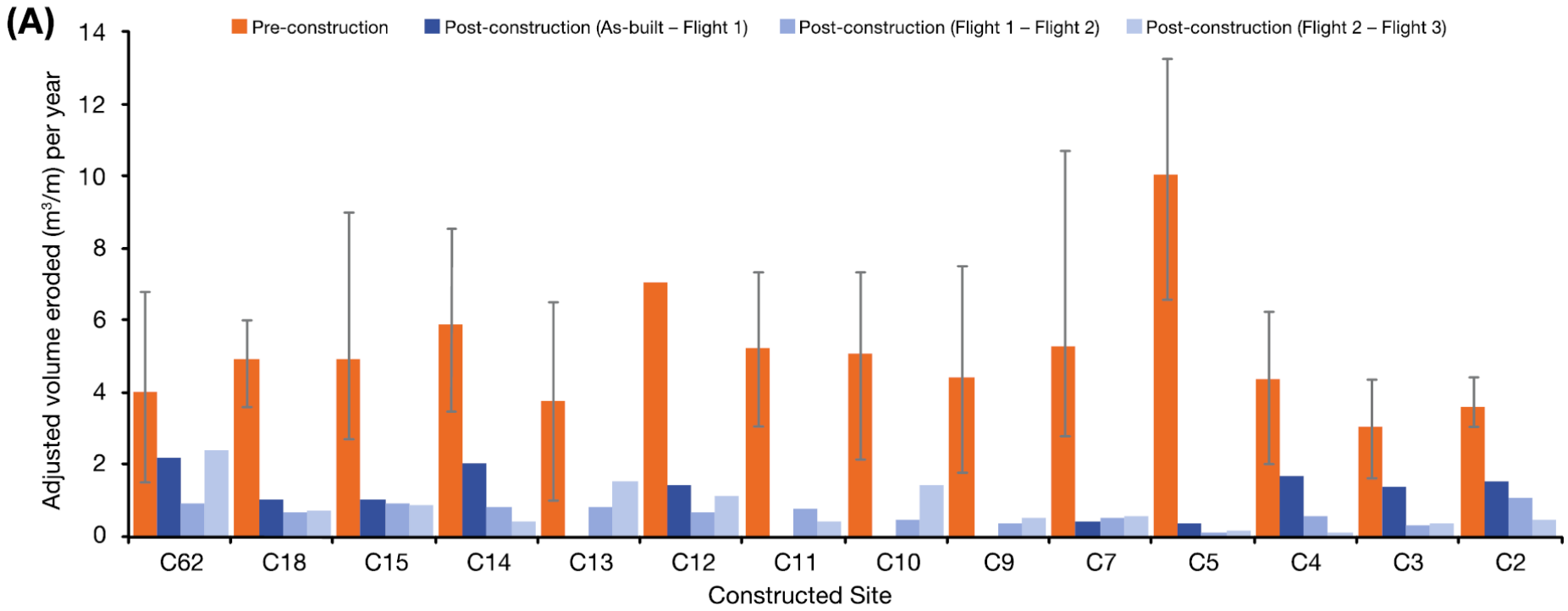
Cottonwood River stabilized site upstream of John Redmond Reservoir: Left low flows Right high flows



Investment Type #2: Upstream Sediment Reduction

- **Historical streambank stabilization projects**
  - Post-Construction Effectiveness study completed
    - Kansas Geological Survey – Dr. Tony Layzell

62-94% decrease in sediment yield on average



Investment Type #2: Upstream Sediment Reduction

- **Ongoing sediment fingerprinting project with the University of Kansas** (Kansas Geological Survey)
- Goal: determine dominant sources of sediment to reservoirs and inform sediment management decisions.

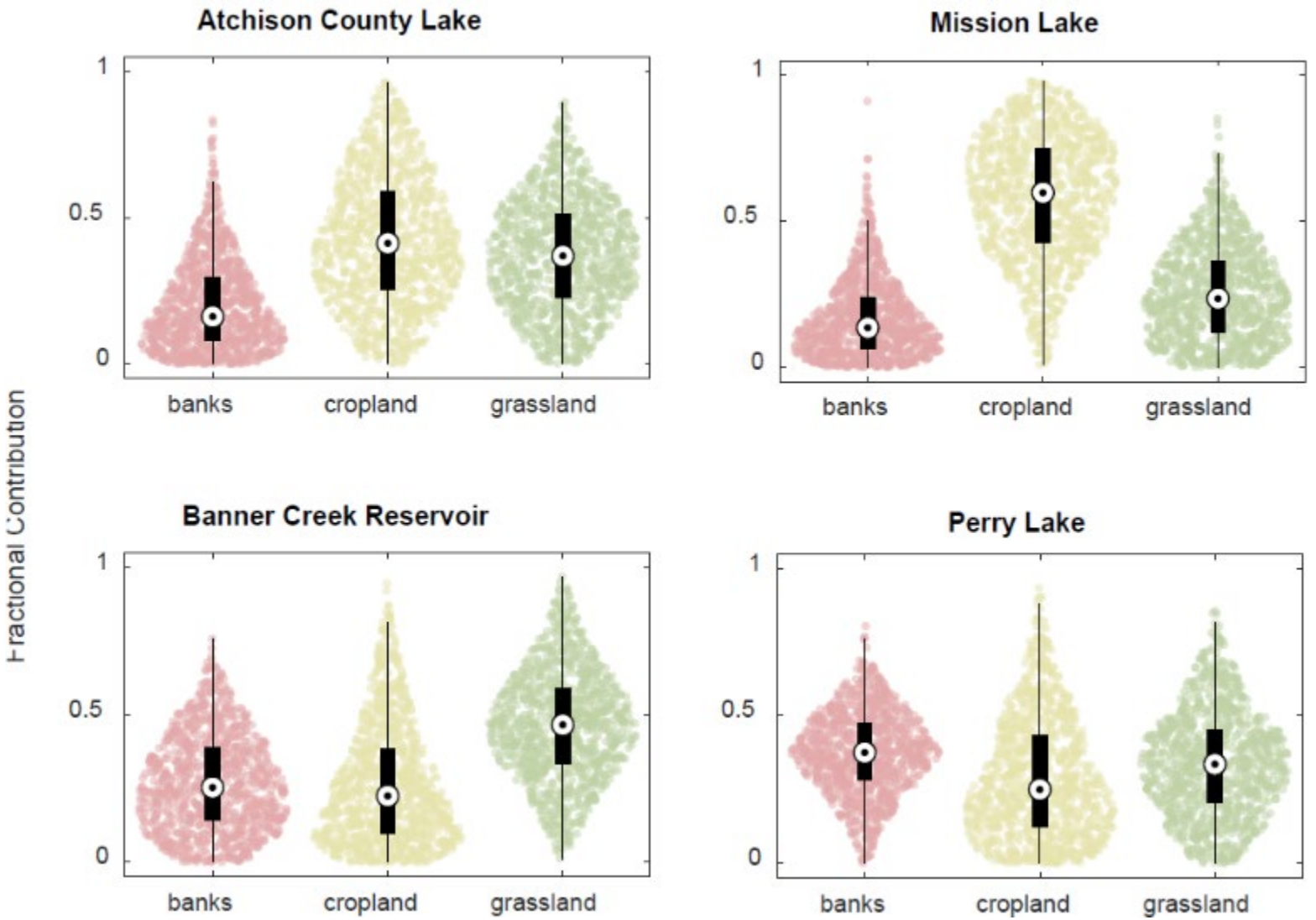
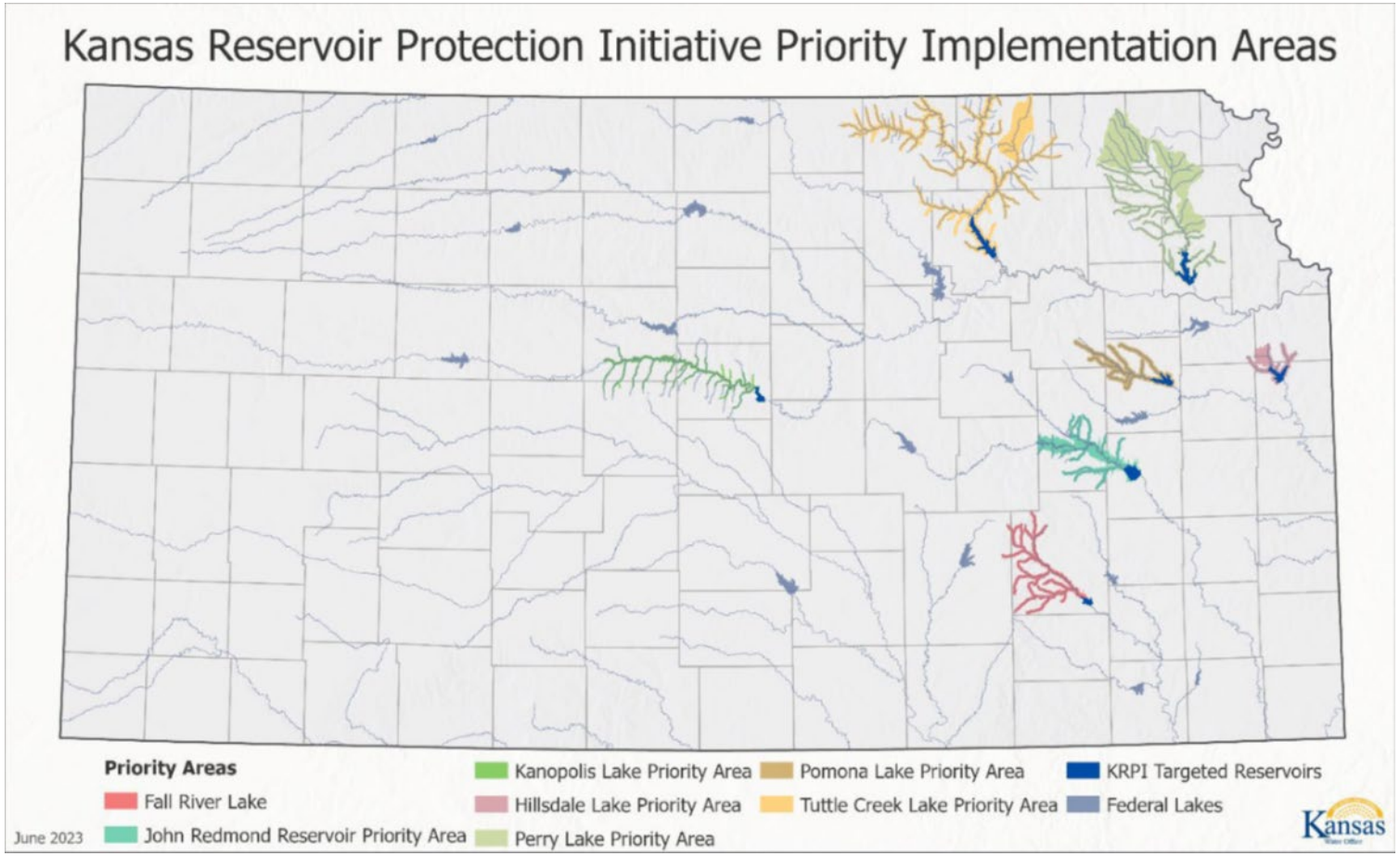


Figure from Husic, A. (2023, November 16) Sediment Fingerprinting of Sources of Reservoir Infilling in an Eastern Kansas Basin, USA [Conference presentation]. 2023 Governor's Conference on the Future of Water in Kansas. https://www.kwo.ks.gov/home/showpublisheddocument/2160/638481727980130000.

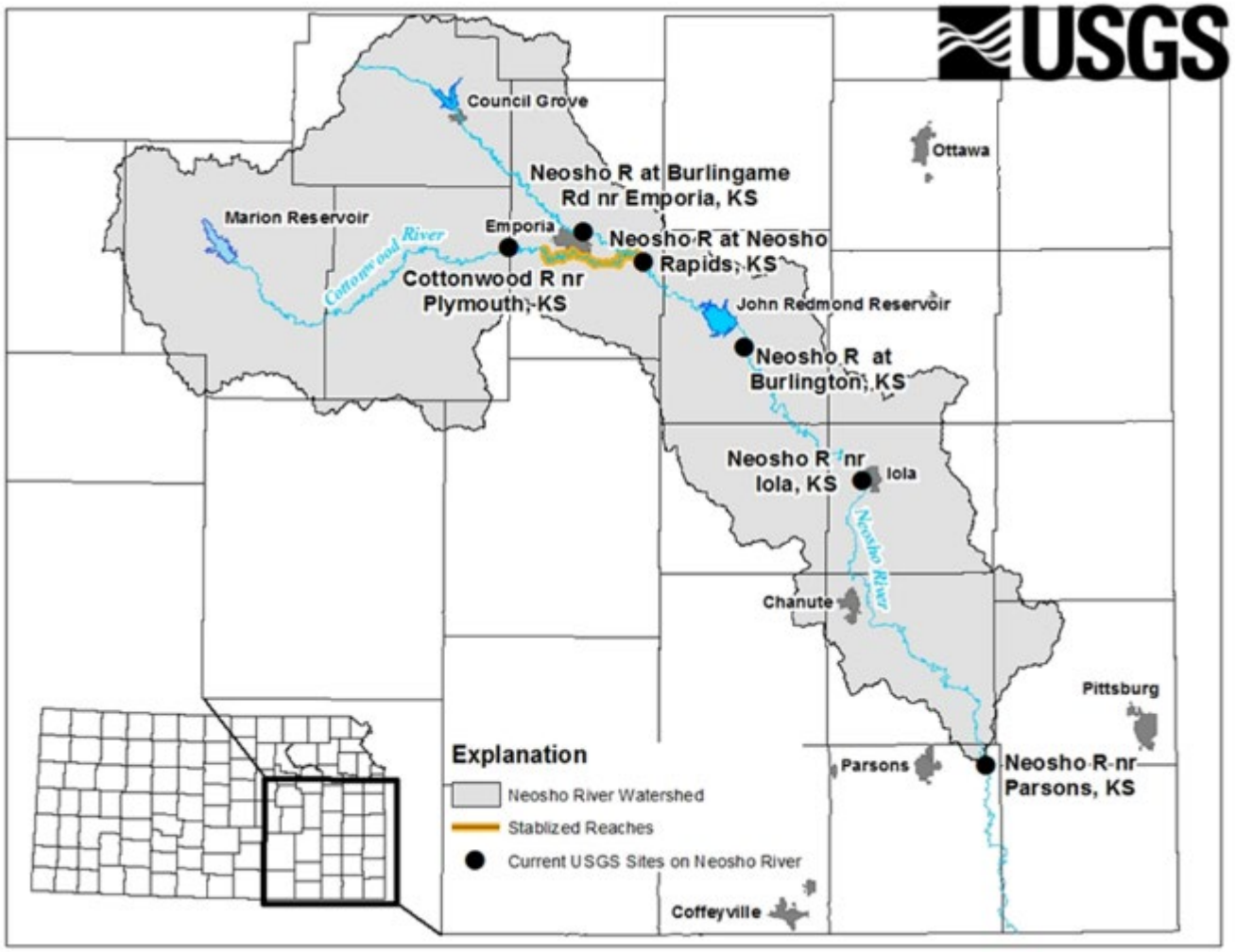
Investment Type #2: Upstream Sediment Reduction

- **The Kansas Reservoir Protection Initiative (KRPI)**
  - Promotes land use best management practices that:
    - Benefit soil health and conservation
    - Improve water quality
    - Reduce sediment loading to streams and rivers upstream of reservoirs



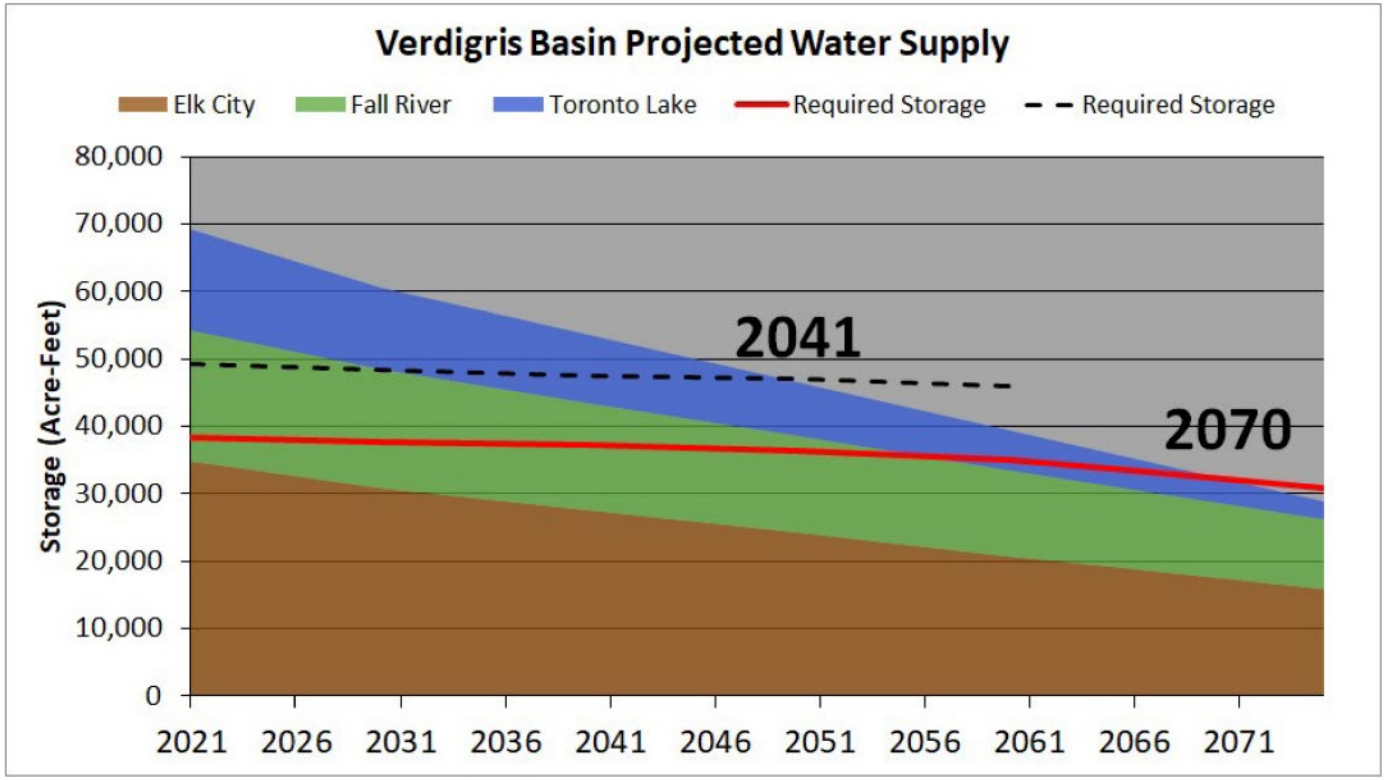
Investment Type #2: Upstream Sediment Reduction

- **Recent investment in Kansas River Sediment Monitoring Network with U.S. Geological Survey**
  - Real-time water quality monitoring and sampling for more reservoirs
  - Kanopolis, John Redmond, Tuttle Creek, Elk City, Council Grove



Investment Type #3: Improve Downstream Infrastructure

- **Potential Actions**
  - Operational efficiencies with downstream infrastructure upgrades
  - Dam and water intake modifications
  - Reduction of low flow needs and sending water out of state during drought



Modelled outcomes of when current resources and flow requirements through a 1950's style drought would be insufficient.

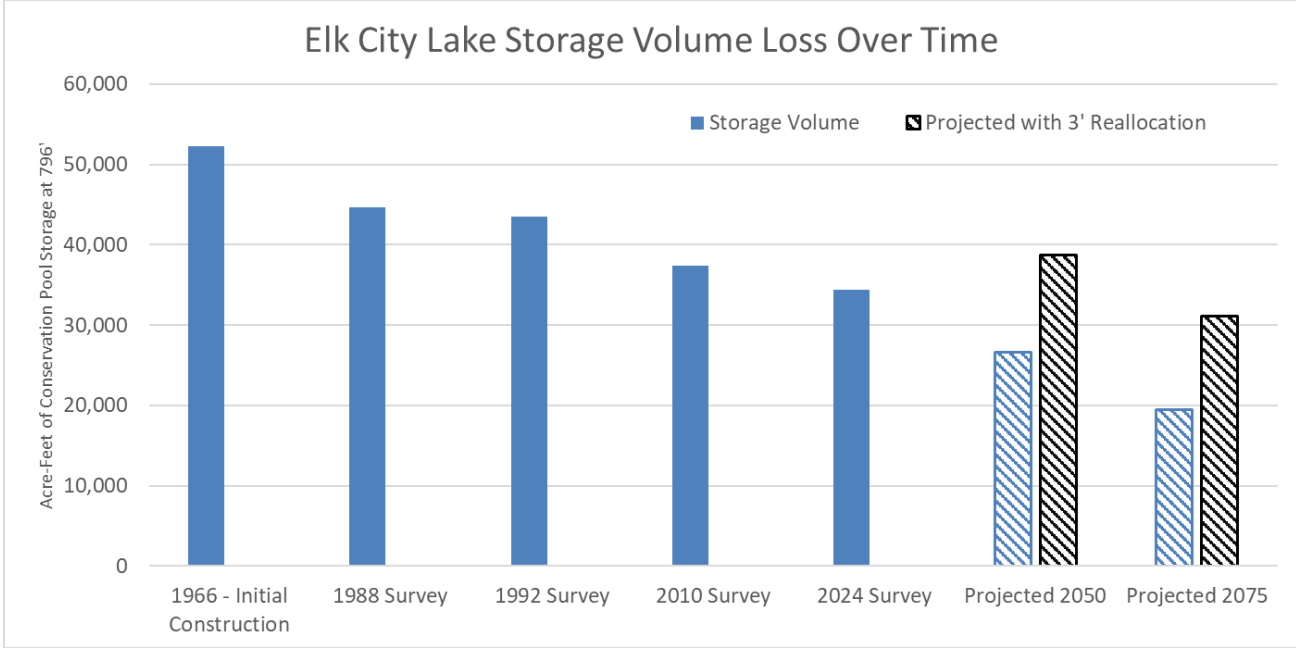
Current operations shown as dashed line. Increased efficiencies shown as red line. 2022 Kansas Water Plan

Investments and Programs: Future Opportunities

- **Pursue additional reservoir storage contracts within Federal projects**
  - Almost all available conservation storage already under contract
- **Some reservoirs may have possibilities of reallocating Flood storage to Conservation/Water Supply storage**
  - Previously done in Kansas
    - John Redmond and Kanopolis Reservoirs – Melvern ongoing
  - Reallocation studies needed
    - 10-15 year process with current USACE processes and resources
    - WRDA Federal Legislation could speed up process or add more resources

Future Investment Type #4: Additional Storage Acquisition

- **Not a potential at all reservoirs: USACE Constraints**
- **Verdigris Basin**
  - Elk City Reservoir pool rise and acquire storage
- **Marais des Cygnes Basin**
  - Hillsdale Reservoir pool rise and acquire storage: Intake benefits
- **Kansas Basin**
  - Clinton Reservoir pool rise and acquire storage: Intake benefits and yield for demand growth



Questions?

