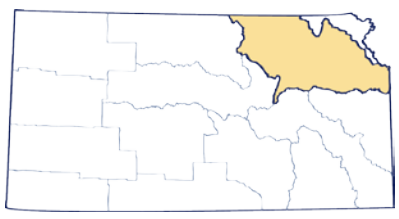
State of the Resource & Regional Goal Action Plan Implementation Report

August 2018

Kansas

Regional Planning Area



Kansas Water Office

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Executive Summary

The Kansas State of the Resource & Regional Goal Action Plan Implementation Report is intended to provide a background of the regional issues and record activities and progress toward regional goals and the *Long-Term Vision for the Future of Water Supply in Kansas (The Vision)* objectives utilizing the most up to date data available at the time of report development.

The primary concern within the Kansas Region is reservoir sedimentation and harmful algal blooms (HABs). The Kansas River serves as a critical drinking water supply for more than 800,000 people, in addition to being used for irrigation, municipal wastewater, and industrial discharges. It also serves as cooling water for three coal-fired power plants, and a source of supply for commercial sand and gravel.

Surface and groundwater resources within the Kansas Region suffered from lower than normal precipitation from 2010 to 2015. Due to very low precipitation in 2012, water use spiked at just over 300,000 acre-feet for the region, with irrigation use from groundwater sources just over 85,000 acre-feet in 2012.

Streambank stabilization work to stabilize eroding banks on property of volunteer landowners above reservoirs is still ongoing, with more projects planned for 2018. To date, 139 actively eroding streambank hotspot sites have been stabilized, reducing the sediment load by an estimated 512,560 tons annually. Currently there are 296 sites that remain to be completed.

Implementation of Best Management Practices (BMPs) is underway in the region. To date, previous BMP implementation has reduced the sediment load by an estimated 125,597 tons annually. Combined, both practices have a sediment reduction rate of 638,157 tons per year, with 80% of the average annual sedimentation reduction occurring from implementing streambank stabilization projects, while 20% reduction occurs from the implementation of BMPs.

Changes in reservoir sedimentation from the implementation of load reduction practices show the most significant reductions are in the Tuttle Creek Lake watershed, accounting for more than 14% of the annual sedimentation. Benefits of sediment reduction practices are estimated to extend the lifetime of Tuttle Creek Lake from 2078 to 2090. Although, given the projected sedimentation and demands within the entire Kansas Region, results indicate the basin supply will be insufficient by the year 2057.

Harmful Algal Blooms continue to plague the region, with Milford and Perry reservoirs experiencing blooms in 2017. Three other small lakes within the region also reached warning level. In addition to the HABs, the infestation of zebra mussels, an invasive species of mussel, were documented in Tuttle Creek Lake in the fall of 2017.

The Kansas Water Office (KWO) was recently awarded $2.88 million through the Natural Resources Conservation Service (NRCS) Regional Conservation Partnership Program (RCPP) to improve water quality conditions within the Milford Lake Watershed. Runoff from precipitation events is a source of HABs within Milford Lake; runoff also erodes soil, which ends up in waterways and is transported downstream, eventually contributing to the sedimentation of the lake.

Water Use Trends

Surface and groundwater are used equally in this region (Figure 1), with municipal use as the largest water user in the region at 53.6%, followed by irrigation (24%) and industrial (17.7%). From 2011 to 2013, overall water usage increased but as precipitation returned to more normal ranges, both surface water and groundwater use dropped below pre-drought conditions (Figure 2).

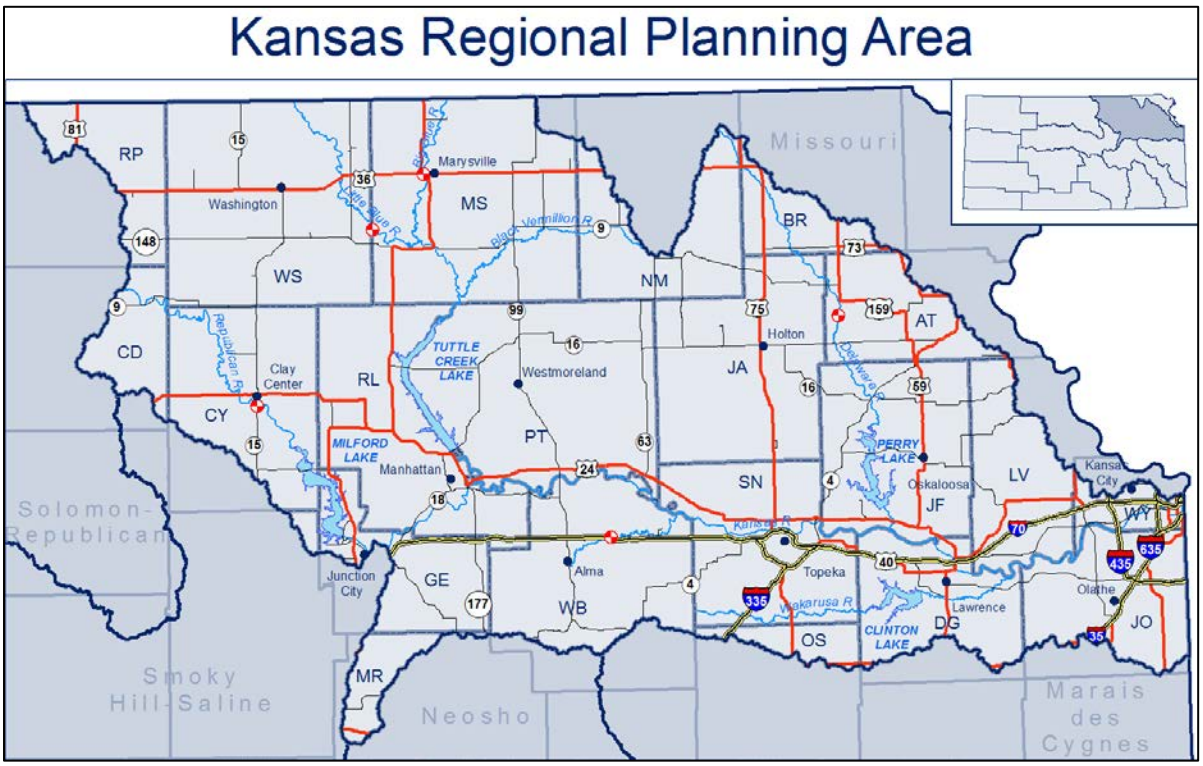
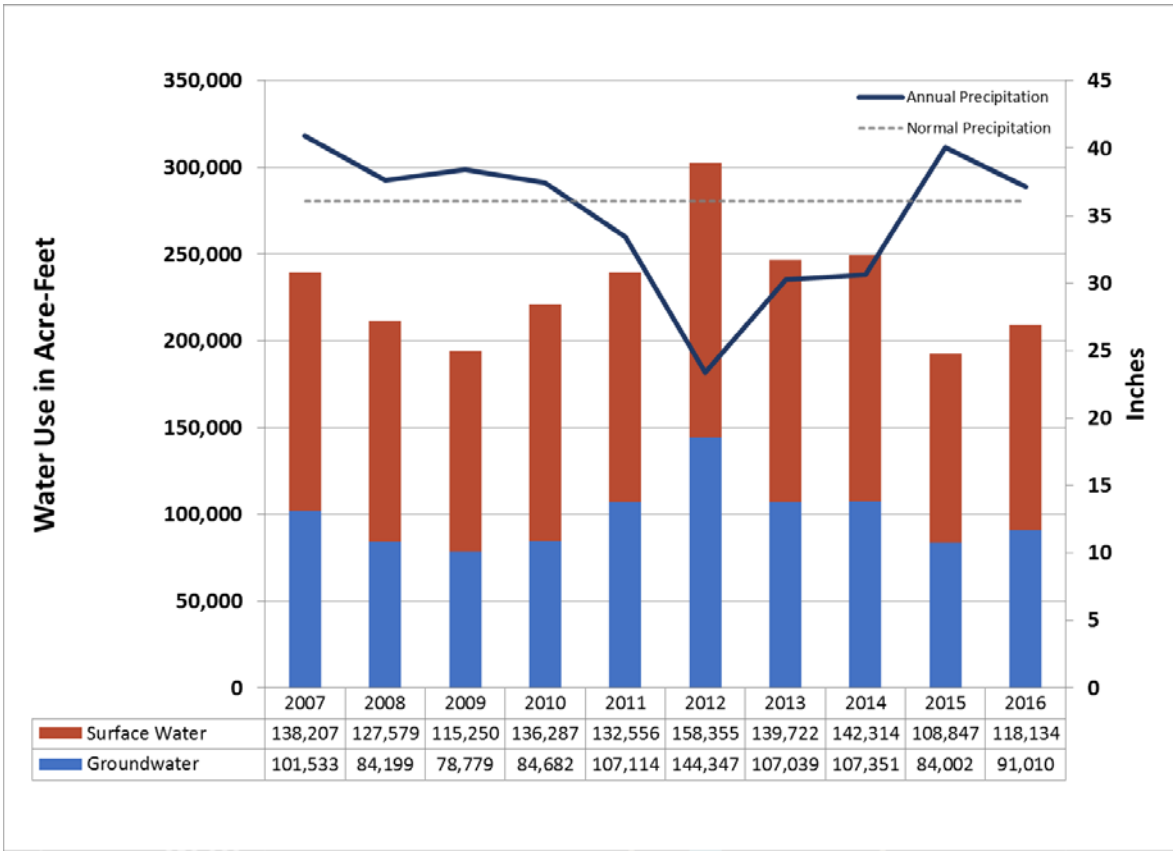


Figure 1: Kansas Regional Planning Area



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Surface Water	138,207	127,579	115,250	136,287	132,556	158,355	139,722	142,314	108,847	118,134
Groundwater	101,533	84,199	78,779	84,682	107,114	144,347	107,039	107,351	84,002	91,010

Figure 2: Annual surface and ground water reported use with precipitation data, Kansas Region

Annual reported water use for the region fluctuates based on climate conditions present, with higher water use resulting from periods of hot and dry weather during the growing season and lower water use taking place during periods of cooler and/or wetter weather.

Water Resource Conditions

Groundwater

Groundwater is available throughout the region, located primarily in three aquifers: the Dakota, the Glacial Drift and the Alluvial Aquifers (Figure 3). The Dakota is found in Washington and Clay counties and westward. The Glacial Drift aquifer occupies the area roughly north of the Kansas River and east of the Big Blue River. Groundwater from this aquifer is not widely available and can be very localized. The alluvial aquifers occupy the valleys of the Kansas, Republican and Blue Rivers, and some tributaries.

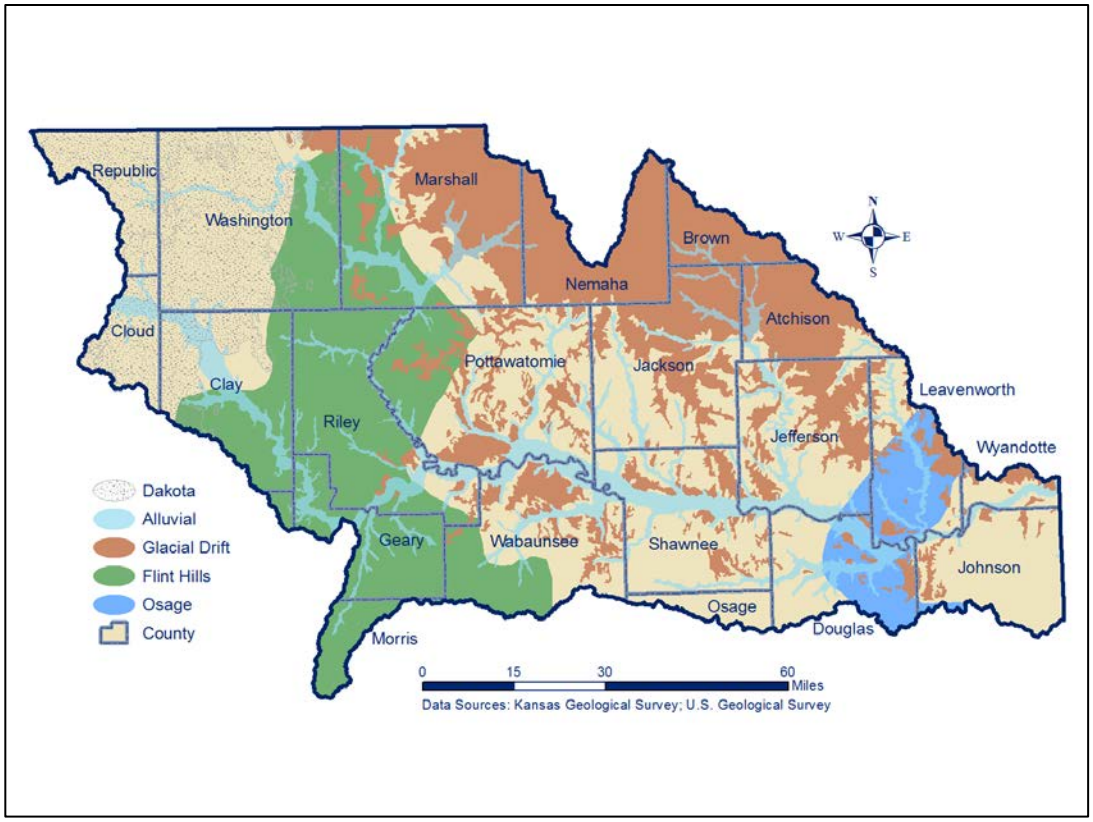


Figure 3: Aquifers of the Kansas Region

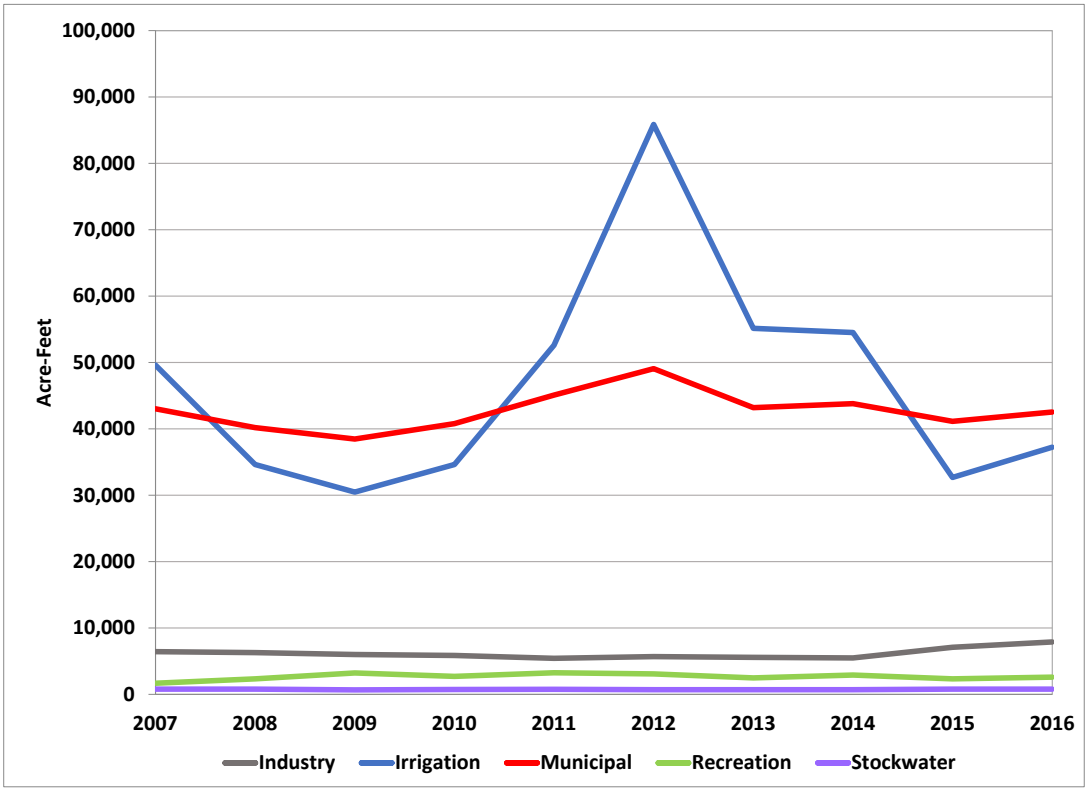


Figure 4: Annual reported groundwater use by type

Surface Water

Major rivers and streams within the region are: the Upper Kansas; Vermillion; Mill and Soldier Creeks; Blue, the Little Blue River; the Delaware and Lower Kansas, as well as the Wakarusa River and Stranger Creek. There are four major federal reservoirs in the region: Clinton Lake, Milford Lake, Perry Lake, and Tuttle Creek Lake. All four reservoirs store water for public water supply. In addition, there are three multipurpose lakes with water supply storage: Centralia, Banner Creek and Mill Creek reservoirs.

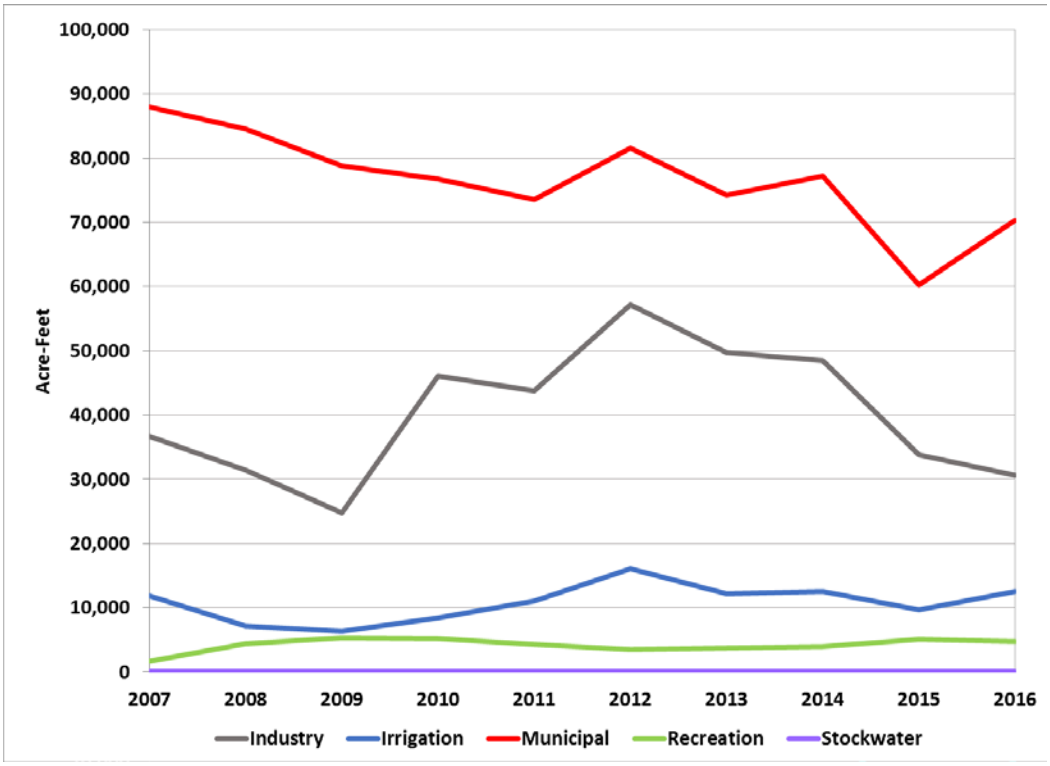


Figure 5: Annual surface water use by type of use

Lake Level Management Plans (LLMPs) are currently in place in the Kansas Region to help manage pool elevations within the basin for specific operating rules (Figure 6-9). A conservation pool is maintained in accordance with the lake level management plans to optimize conditions for fish and wildlife benefits and recreational uses.

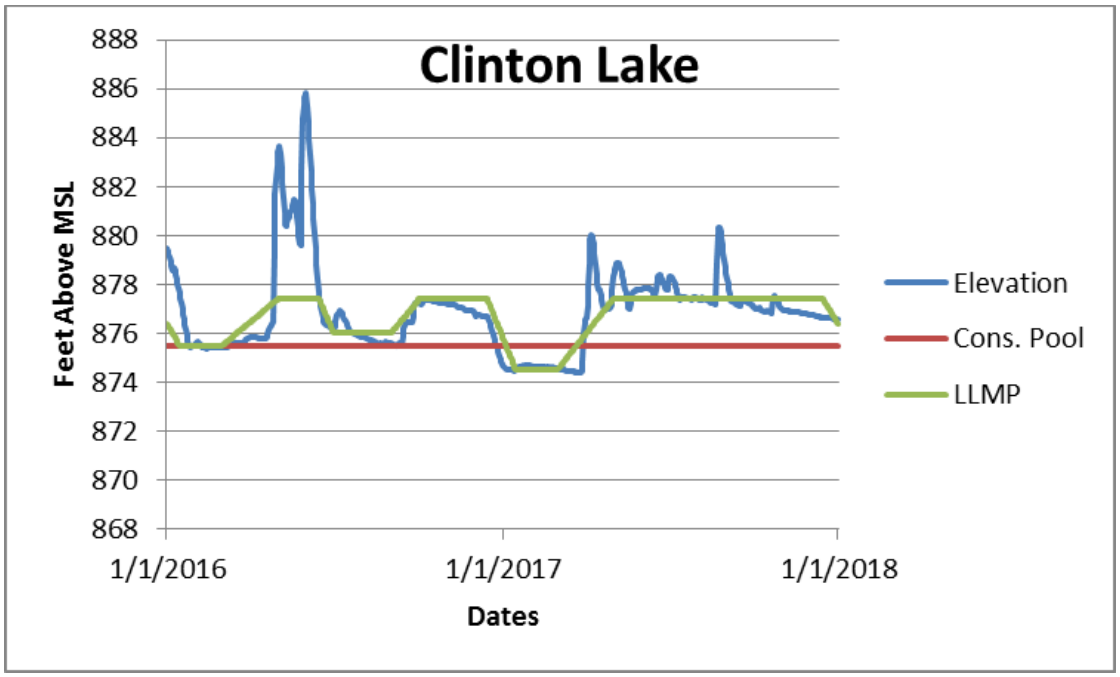


Figure 6: Clinton Lake 2016-2017 water level information

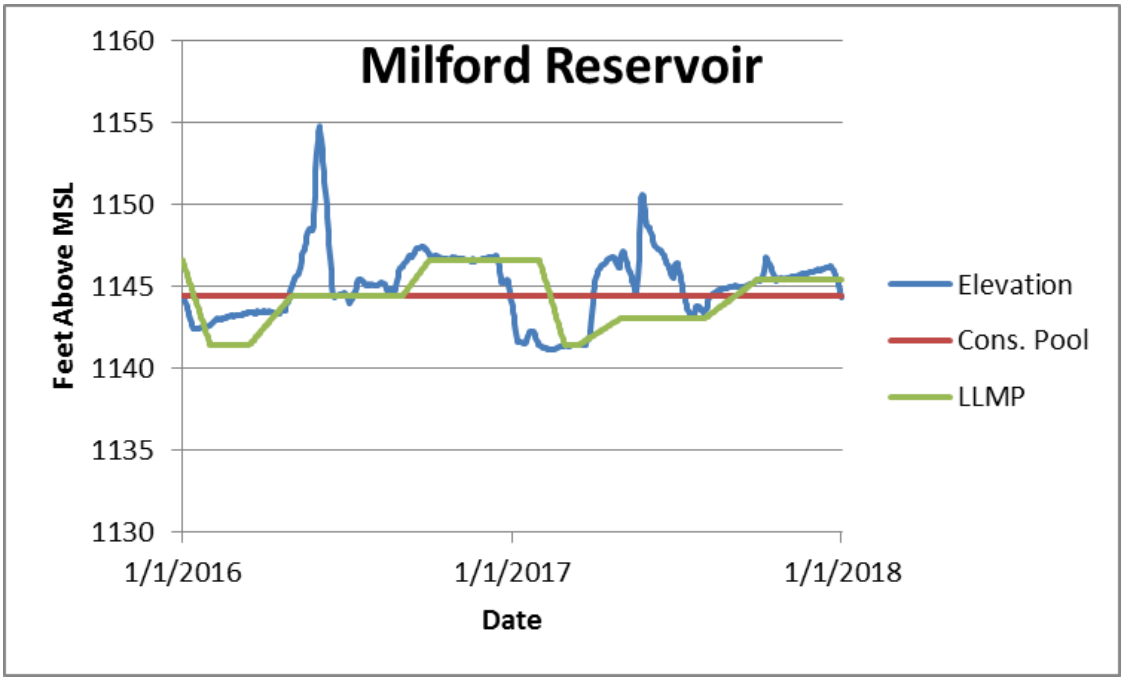


Figure 7: Milford Reservoir 2016-2017 water level information

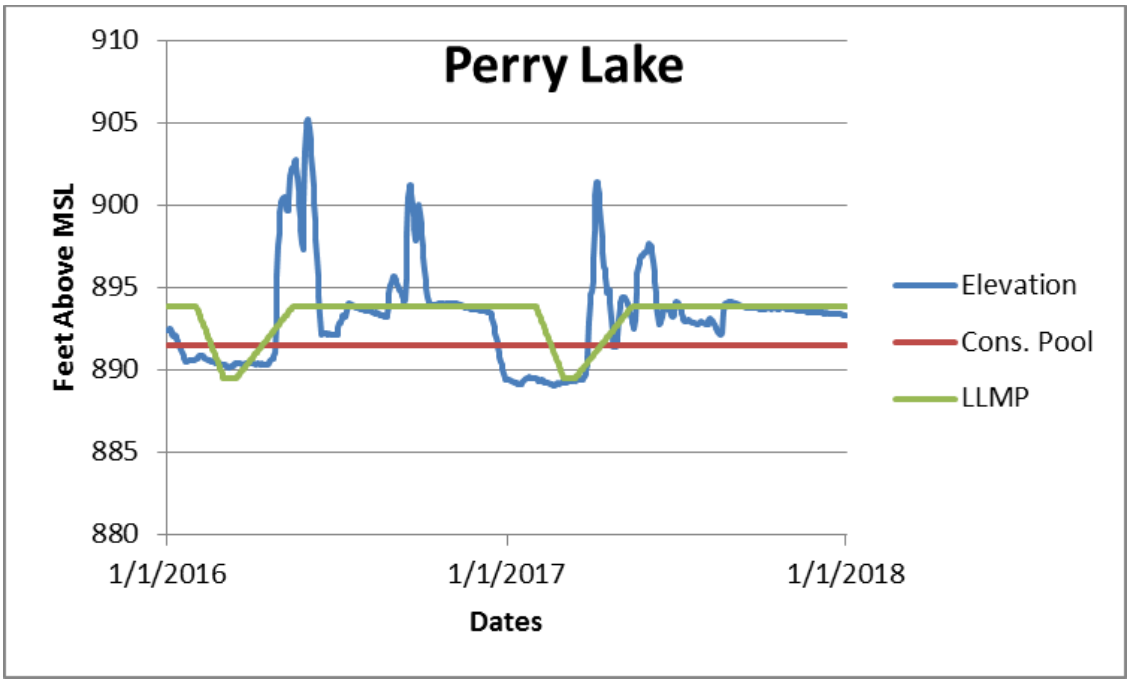


Figure 8: Perry Lake 2016-2017 water level information

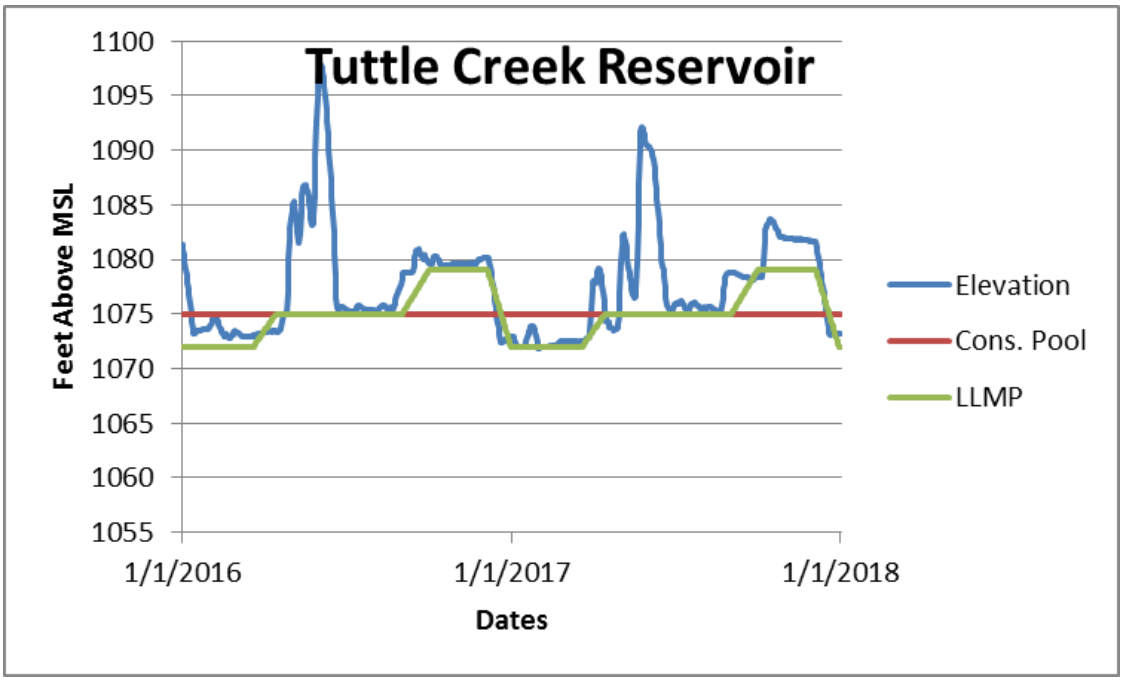


Figure 9: Tuttle Creek Lake 2016-2017 water level information

The fluctuation in lake levels is due to precipitation trends and water management strategies to operate the lakes for the Water Assurance District and the Water Marketing Program. The water stored within the federal reservoirs is separated into various pools and are operated as a system to supply the needs of the municipal and industrial users in the region. Purchasing this storage and securing it for the future use of Kansans is one of the major goals identified by the Kansas Regional Advisory Committee (RAC).

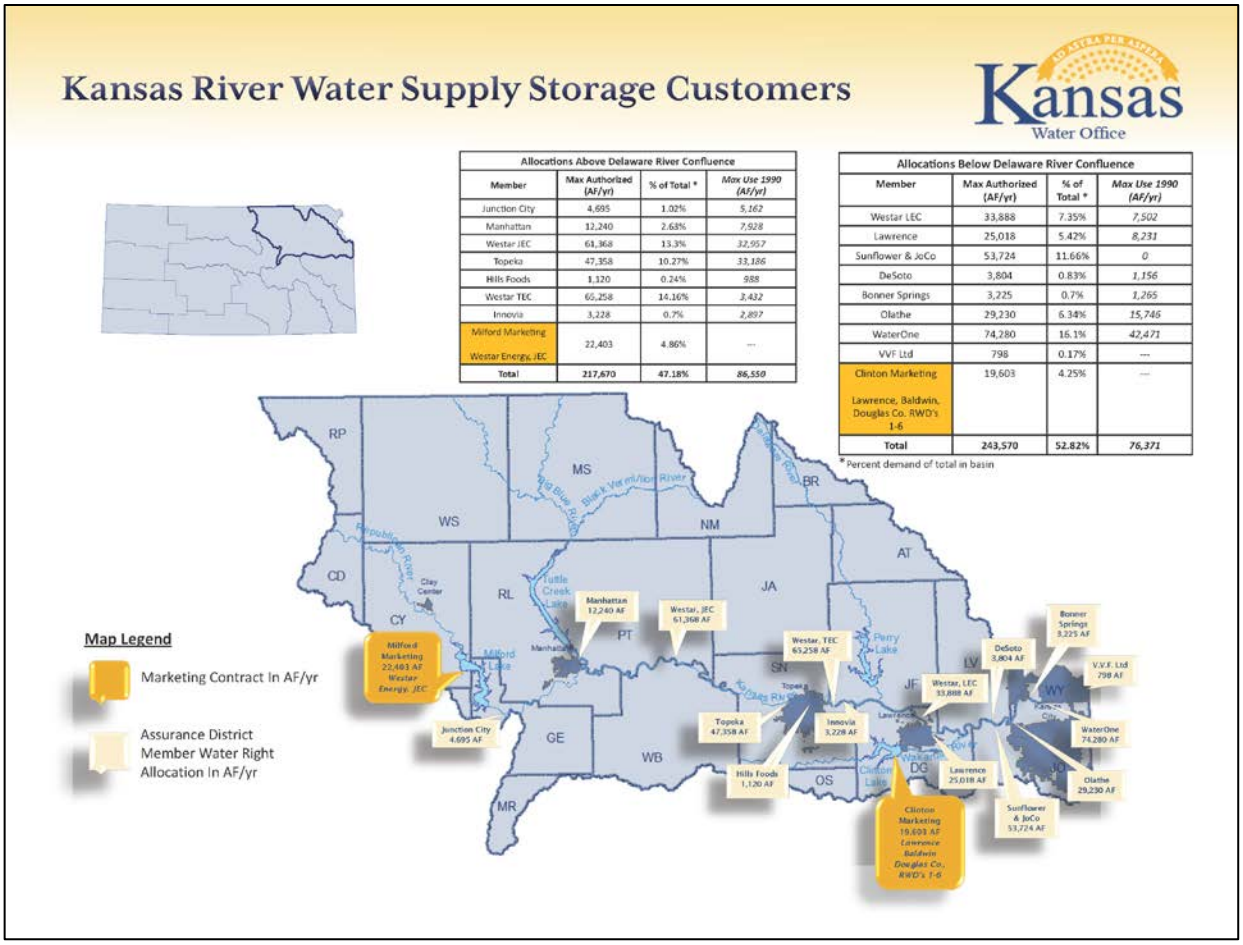


Figure 10: Water Supply Storage Customers for Kansas Region

Water Quality

Surface Water

Water quality and related water resource issues are addressed through a combination of watershed restoration and resource protection efforts utilizing voluntary, incentive-based approaches, as well as regulatory programs. The Clean Water Act requires states to conduct Total Maximum Daily Load (TMDL) studies and develop TMDLs for water bodies identified on the state's List of Impaired Waters (Section 303(d) List). Total Maximum Daily Loads are quantitative objectives and strategies needed to achieve the state's surface water quality standards. A list of all impaired/potentially impaired water for the Kansas Basin can be found on the Kansas Department of Health and Environment (KDHE) impaired waters website.

The 2014 303(d) list for the Kansas Region had 299 stream impairments and 20 lake impairments. Changes from the 2014 list to the 2016 303(d) list: five bodies of water delisted, five water bodies need additional information, four water bodies that have new TMDLs developed for, and five waters requiring development of a TMDL because of an impairment.

Harmful Algal Blooms

Harmful Algal Blooms are common in bodies of water when nutrient loading is excessive during periods of elevated temperatures. Health effects of HAB's are well documented and range from flu like symptoms in humans to the death of pets. In 2017, HAB conditions were reported on Milford Lake beginning in the middle of June until the end of August. Perry Lake was also affected in 2017. Additionally, Central Park Lake, South Park Lake and Overbook City Lake experienced warning levels in 2017 (Figure 11).

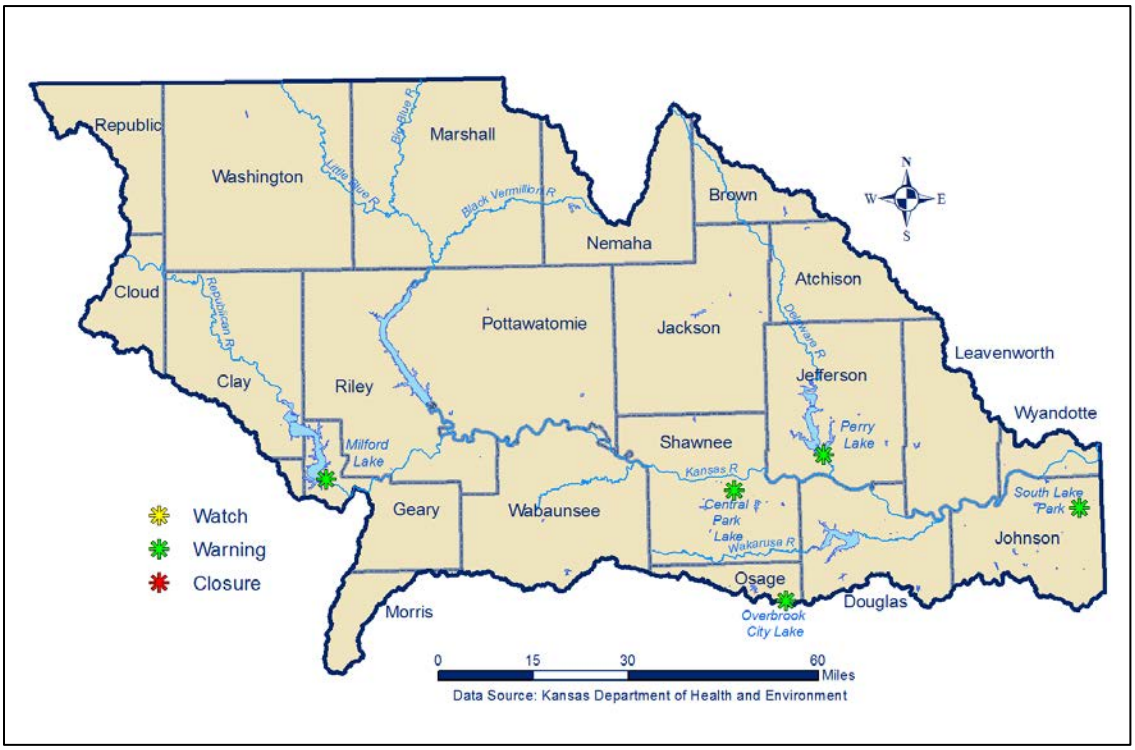


Figure 11: 2017 Harmful Algal Blooms in the Kansas Region

Sedimentation

Sedimentation in lakes is a major problem in eastern Kansas. Soil type, land practices and extreme rainfall events are the main causes that lead to reservoir sedimentation. High flow events following heavy rainfall account for a large portion of the siltation that takes place in reservoirs. Periodic bathymetric surveys are necessary to monitor this loss of capacity. In 2009, bathymetric surveys were completed in all four of the region's reservoirs.

The Kansas RAC has included the management and mitigation of sediment into their action plan to help reduce water supply storage capacity loss due to sedimentation.

Figure 12: Kansas Regional Planning Area streambank stabilization projects

Much of the sedimentation rate in the Kansas Region is due to streambank erosion above each reservoir. Currently, there are 435 streambank hotspots above the four federal reservoirs in the Kansas Region (Figure 12) and 139 of these 435 sites have been stabilized, reducing the sediment load by an estimated 512,560 tons per year. There are 296 sites that remain to be completed, which, if completed, will reduce the sediment load by an additional estimated 581,193 tons per year.

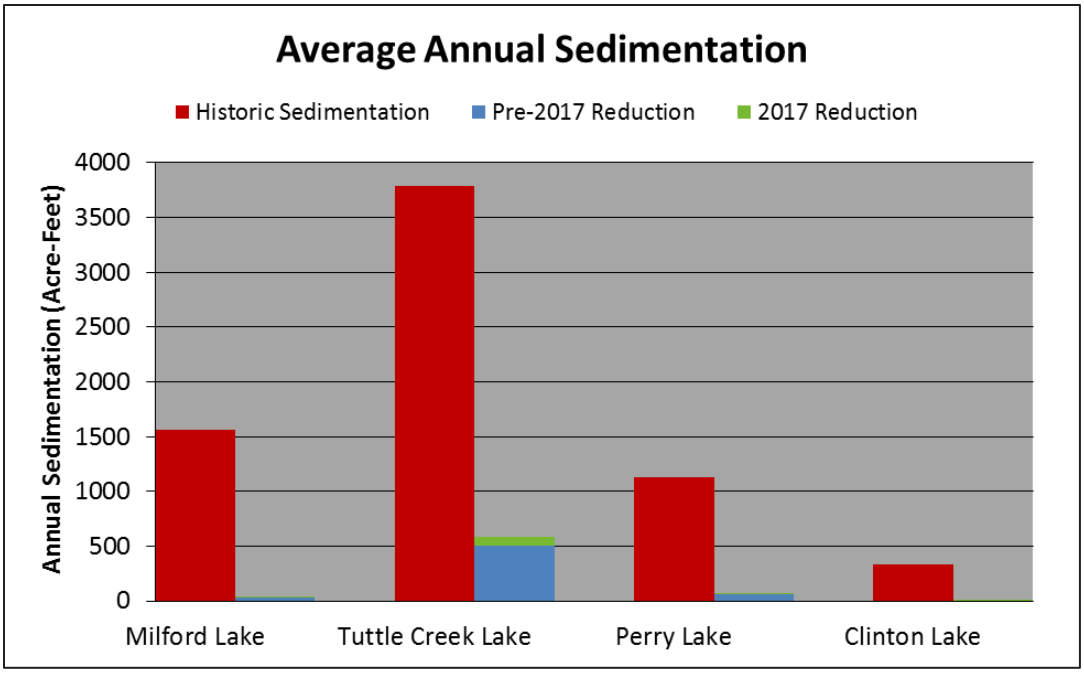


Figure 13: Average annual sedimentation in Kansas Region reservoirs

Figure 13 shows the average annual sedimentation in each reservoir. The average annual sedimentation rate is estimated using the change in conservation storage between bathymetric surveys, compared to the estimated sediment load reduction due to the BMPs and streambank stabilization project implementation.

The estimated annual reductions compare total implementation prior to 2017 (beginning in 2004) to reduction in 2017. The results show Tuttle Creek Lake has a historical sedimentation rate of nearly 3,800 acre-feet per year, higher than Milford Lake, Perry Lake and Clinton Lake combined.

Prior to 2017, 82% of the average annual sedimentation reduction occurred from implementing streambank stabilization projects, while 18% occurred from the implementation of BMPs. In 2017, 67% occurred from streambank stabilization projects and 33% from implementation of BMPs, respectively.

Figure 14 shows the change in reservoir sedimentation from the implementation of load reduction practices. Results show the most significant reductions are in the Tuttle Creek Lake watershed, accounting for more than 14% of the annual sedimentation. However, the estimated load reduction from implemented practices for all lakes only accounts for a small fraction of the total historical sedimentation.

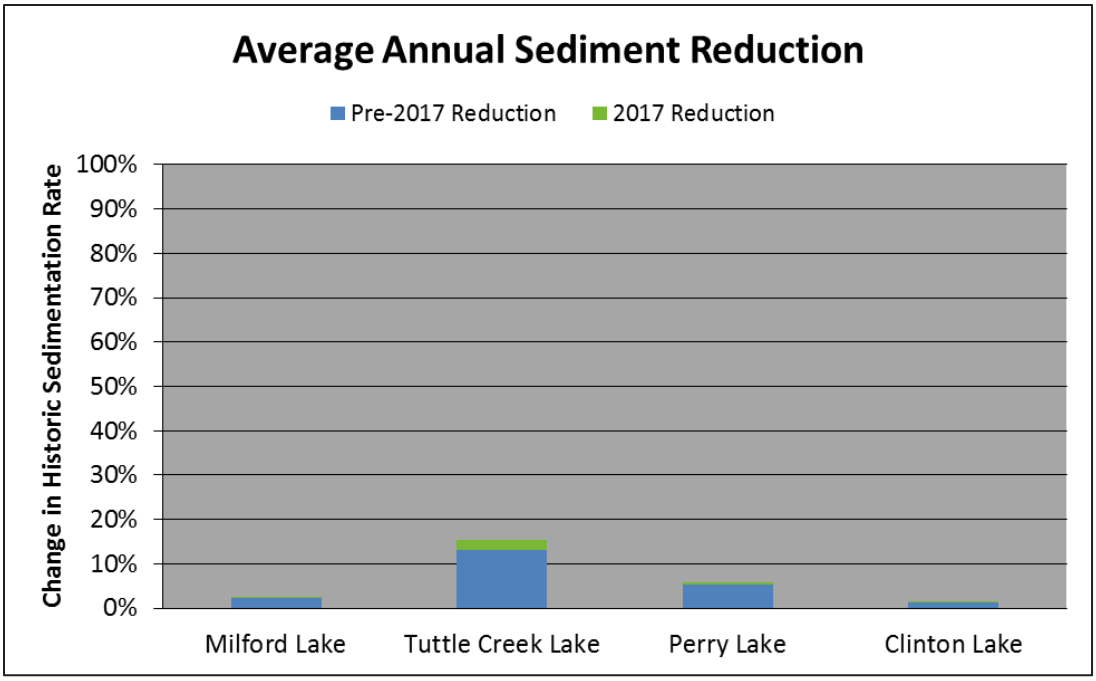


Figure 14: Average annual sediment reduction in Kansas Region reservoirs

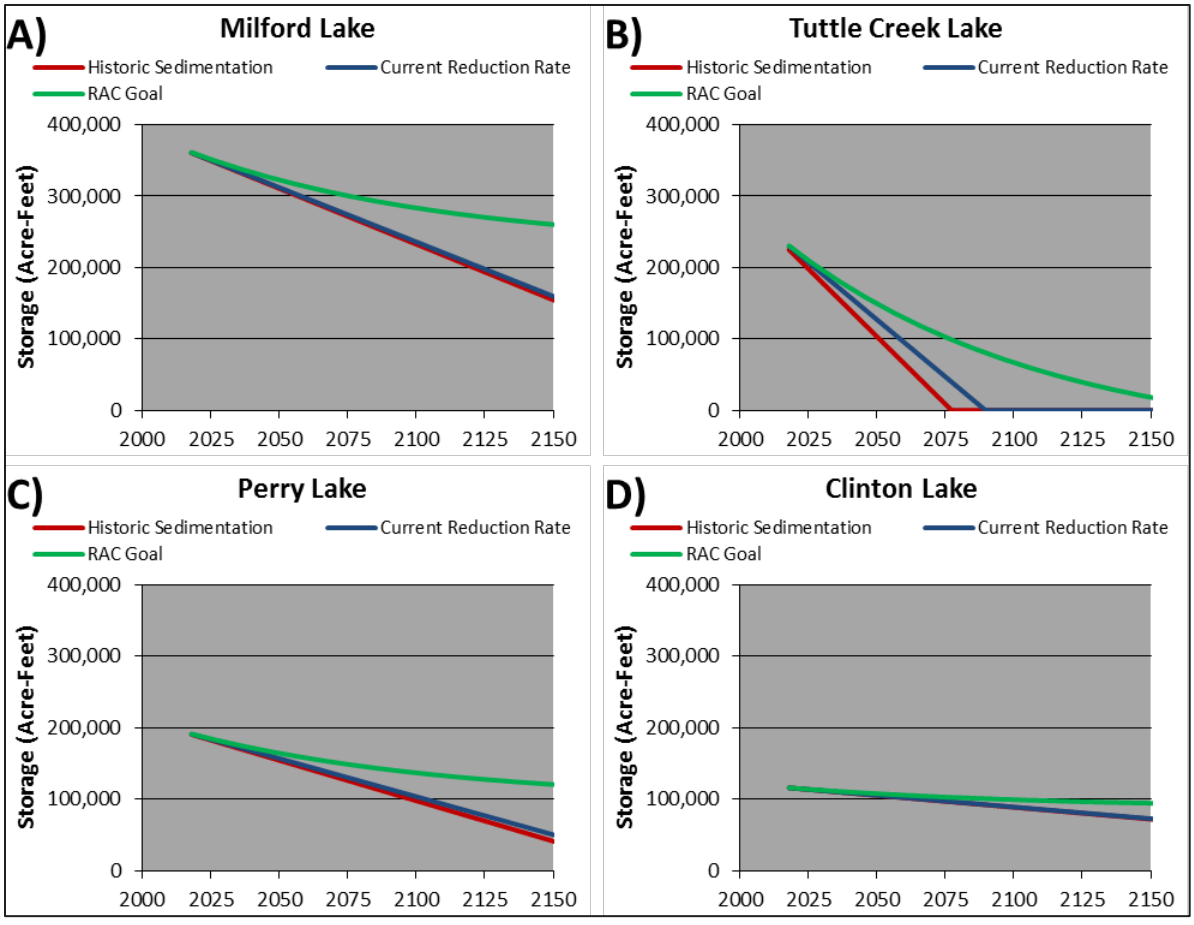


Figure 15: Reservoir capacity at conservation pool for Kansas Region reservoirs

The benefits of sediment reduction practices are shown in Figure 15, extending the lifetime of Tuttle Creek Lake from 2078 to 2090. However, Figure 15 also shows there would still be a substantial decline in total reservoir storage even if the current RAC sediment reduction goal was met.

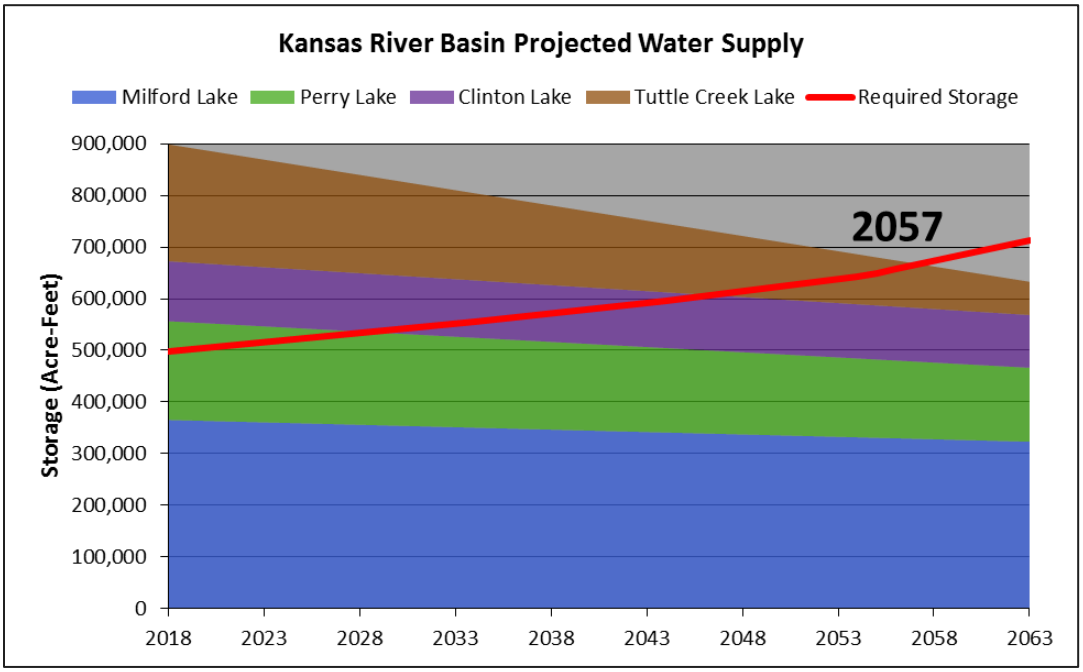


Figure 16: Kansas Region projected water supply storage

Figure 16 shows the projected reservoir storage at conservation pool given the historic rate of reservoir sedimentation based on the change in bathymetric surveys (earliest survey versus most recent survey), along with the storage required to meet the system's demands and targets.

The location of the required storage line indicates the total required storage between all four federal reservoirs. Given the projected sedimentation and demands, results indicate the basin supply will be insufficient to fully meet projected demands through a 1950's type drought by the year 2057.

Zebra Mussels

Zebra Mussels, one of the Aquatic Nuisance Species (ANS) affecting Kansas waters, had been found in Clinton, Milford, and Perry reservoirs prior to 2017. On August 18, 2017, the presence of Zebra Mussels was confirmed in Tuttle Creek Lake. These small non-native mussels are prolific producers of off-spring and can be transported very easily by recreationalists. This particular invasive species has been linked to increasing HABs due to their feeding habits.

Asian Carp are common in the Missouri River and a limited number have made their way to Bowersock Dam at Lawrence. The Kansas Department of Wildlife, Parks, and Tourism (KDWPT) has worked diligently on education and management plans to mitigate the problem and work to slow the spread of these species (Figure 17). The final Kansas ANS Plan is located on the KDWPT website.

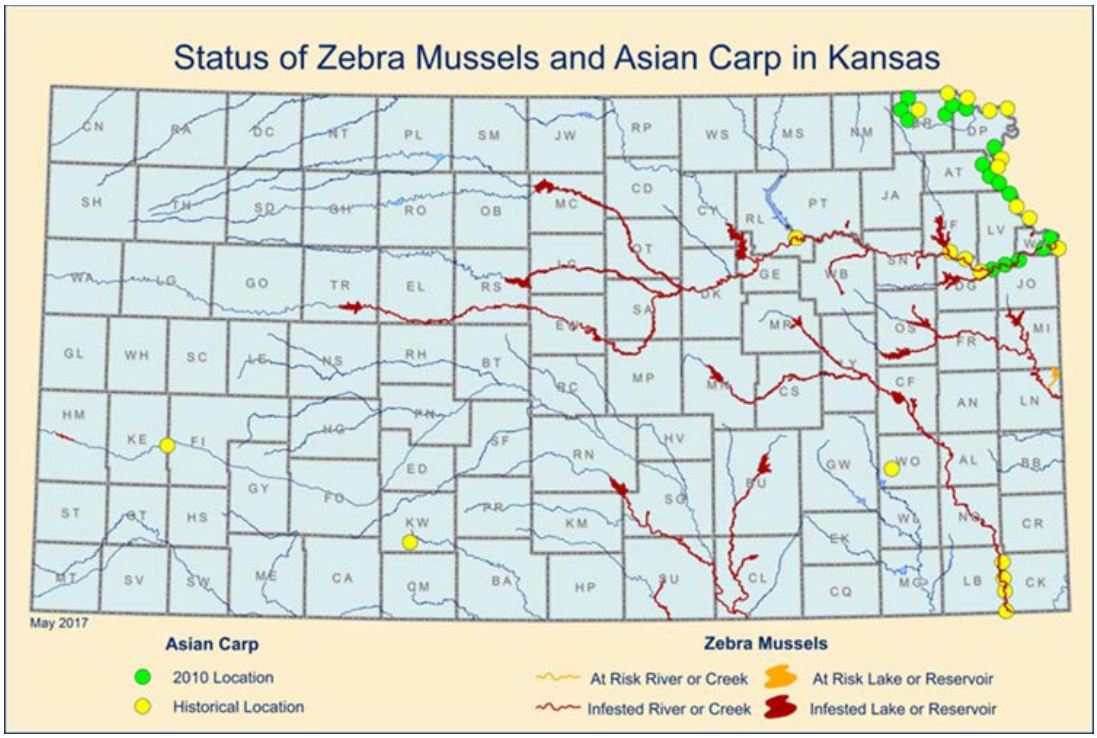


Figure 17: Status of Zebra mussels and Asian carp in Kansas

Implementation Progress

Best Management Practices are vegetative, structural, or management practices that when implemented, reduce pollutants that reach surface and groundwater. BMPs may be incorporated independently or in combination with other BMPs, compounding their positive effects. Table 1 shows 2016 load reductions, estimated as a result of collaborative efforts between Watershed Restoration and Protection Strategy (WRAPS), Natural Resource Conservation Service (NRCS) and Kansas Department of Agriculture-Division of Conservation (KDA-DOC) to implement load-reducing BMPs in the region. WRAPS worked with many stakeholders in the Kansas watershed to address TMDL impairments in the targeted HUC 12s. Table 2 illustrates the investment that NRCS has made in this region since 2015, over $9.8 million.

Table 1: 2016 Kansas watershed targeted HUC 12 load reductions

Region	Nitrogen (lbs./yr)	Phosphorus (lbs./yr)	Sediment (tons/yr)
Kansas	96,867	51,354	32,383

Table 2: FY2015-FY2017 Environmental Quality Incentives Program and Regional Conservation Partnership Program contacts - NRCS

Region	Number of Contracts	Contract Acres	Contract Obligations
Kansas	390	41,245	$9,864,840.39

The conservation practices implemented through the above mentioned partners are compiled on an annual basis by KDHE, with load reduction estimates from these efforts being calculated and reported to the Environmental Protection Agency (EPA) to show progress made within Kansas to reduce nutrient and sediment runoff from non-point sources of pollution. These annual load reduction estimates can then be compared to load reduction targets identified within WRAPS watershed plans to evaluate annual watershed plan implementation progress in relation to overall watershed plan goal targets (Table 3). The percentage of target achieved is less than 3.5**%** for all watersheds for nitrogen, phosphorus, and sediment.

Streambank stabilization projects and BMPs implemented to date have reduced the sediment load by an estimated 638,000 tons annually, which equates to a 6% reduction of the total sediment load entering the four federal reservoirs. The stabilization of streambanks, along with the implementation BMPs, has assisted in reducing the amount of sediment that accumulates within these reservoirs, however more work needs to be done to reduce the total additional accumulation.

Table 3: Watershed load reductions

Watershed	Load Reduction Information	Nitrogen (lbs./yr)	Phosphorus (lbs./yr)	Sediment (tons/yr)
Not Above a Reservoir	2017 Reported Load Reductions	11,664	5,706	1,505
	WRAPS Watershed Plan Reduction Target	N/A	N/A	18,436
Clinton Lake	2017 Reported Load Reductions	1,935	1,086	760
	WRAPS Watershed Plan Reduction Target	N/A	220,000	N/A
	% Target Achieved	N/A	0.50%	N/A
Milford Lake	2017 Reported Load Reductions	2,732	1,598	1,134
	WRAPS Watershed Plan Reduction Target	N/A	152,000	32,999
	% Target Achieved	N/A	1.10%	3.40%
Perry Lake	2017 Reported Load Reductions	16,796	9,068	4,904
	WRAPS Watershed Plan Reduction Target	856,170	209,720	284,860
	% Target Achieved	2.00%	1.90%	1.70%
Tuttle Creek Lake	2017 Reported Load Reductions	40,333	20,564	19,454
	WRAPS Watershed Plan Reduction Target	N/A	2,850,000	3,000,000
	% Target Achieved	N/A	0.45%	1.60%

The Kansas Geological Survey (KGS) entered into a contract with the KWO on August 2, 2017 to review information on the Kansas River alluvial aquifer. The project entails using online data and drilling logs to determine bedrock surface topography, saturated thickness and depth to water. In addition, five new wells will be installed and a total of 10 wells will be fitted with real-time monitoring equipment. This is similar to the index well system in the western portion of the state. To date, one well is online and recording data, which can be viewed on the KGS website. Location of proposed and completed wells can be seen in Figure 18.

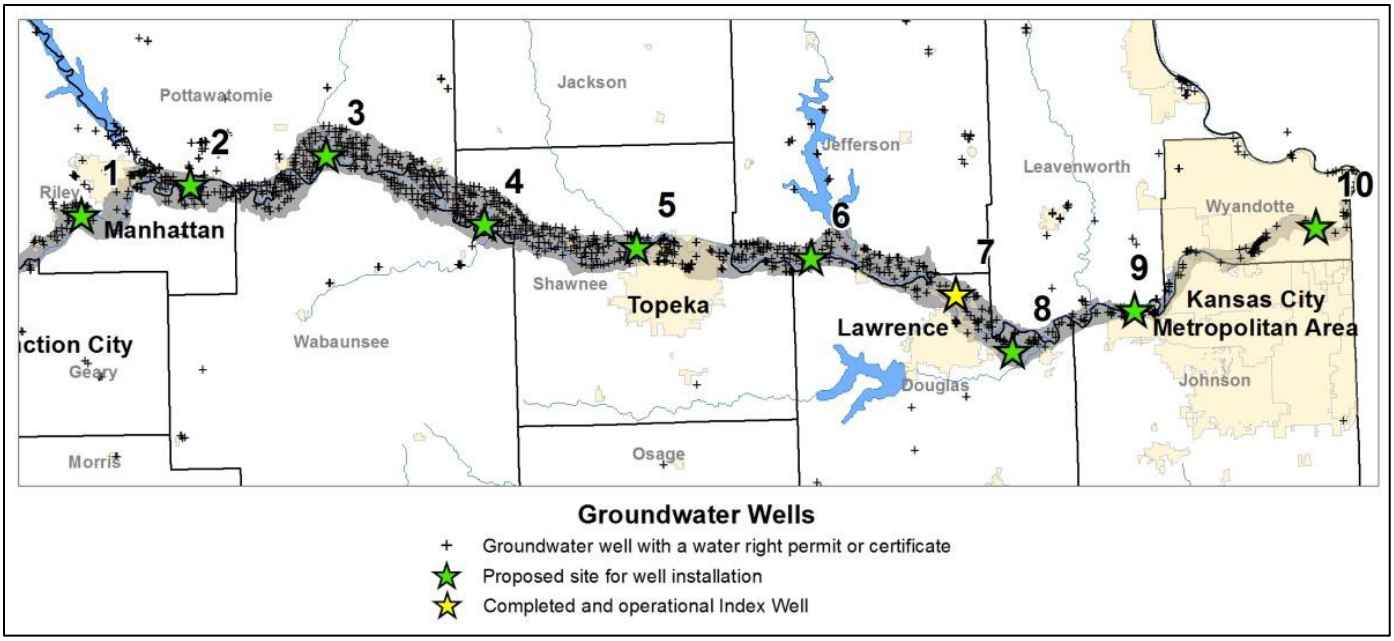


Figure 18: Map of proposed sites for monitoring (index) well in the Kansas River alluvial aquifer

The Kickapoo Tribe Water Rights Settlement Agreement was signed on September 8, 2016. Under the Water Right Settlement Agreement, the Tribe may divert or redivert, as available, up to 4,705 acre-feet of water per year with a priority date of October 24, 1832 for any direct use for the Tribe. The Tribe may store water in one or more reservoirs, for the purpose of subsequent direct use, up to a combined volume of 18,520 acre-feet. On February 13, 2017, the Tribal, State and Federal parties filed a Joint Stipulation for Dismissal of the litigation.

In coordination with the U.S. Army Corps of Engineers (USACE), a sediment modeling project is underway using existing data for the Kansas Region and evaluating different sediment loads on the system. Another project is looking at various ways to remove sediment from particular reservoirs, in particular Tuttle and Milford reservoirs. These projects are made possible by funding through the Public Assistance to States.

The Sustainable Rivers Project (SRP) is another collaborative effort between The Nature Conservancy (TNC) and the USACE looking at ecological flows and sediment needs on the Kansas River. The SRP is designed to evaluate flows without affecting current operations and has the intent of improving the health of the river.

With much of the region's sediment occurring from eroding streambanks, hotspots have been identified by the KWO. Utilizing a Streambank Team, comprised of members from the KWO, KDHE, and KDA-DOC, streambank hotspots are systematically being evaluated and stabilized. Currently, streambank stabilization projects are funded through the DOC, Kansas Water Pollution Control Revolving Loan Fund (KDHE), EPA 319 Program, Kansas State Water Plan Fund, and the KWO Water Marketing Program Funds. Currently projects are focused within the Tuttle Creek Lake and Perry Lake watersheds. Completed projects within these particular watersheds have a combined savings of just over 580,000 tons of sediment a year.

The KWO has served as lead partner on the Milford Lake Watershed RCPP. This project focuses on increasing funding for BMP's in the Milford Lake Watershed to reduce nutrient delivery to Milford Lake with the assistance of 30 partners. The current level of EQIP program funding is $2.88 million over five years. The initial partner match was approximately $4 million, which can be increased over the life of the project if more partners join in or existing partners increase contributions of cash or in-kind services.

Implementation Needs

While the Kansas Region has started to address the water quality concerns within the region, continued work needs to be completed. With the Kansas Water Authority's (KWA) approval of the RAC's plans of action, the following items need to be addressed:

Conservation practice implementation continues to be necessary to reduce nutrient and sediment runoff impacting the surface waters of the Kansas Region. Progress made within the region can be compared to the remaining needs identified to quantify the overall financial need to fully implement watershed plans in this region (Table 4). These figures include costs associated with conservation practice implementation, as well as technical assistance needs to help landowners implement conservation practices. Overall, the total remaining need to fully implement WRAPS watershed plans for the region is $193 million.

Table 4: 2017 costs by region

RAC Area	Number of plans	State Interest Priority Score Rank	Updated Information and Education Costs	Updated Total Livestock and Cropland Plan Costs	Updated Technical Assistance Plan Costs	Updated Total Implementation Plan Costs
	(7) Plan					
Kansas	Upper Wakarusa	9	$3,504,166.67	$2,413,745.40	$3,362,396.00	$6,131,874.73
	Delaware	5	$1,331,437.50	$11,885,065.31	$11,050,189.69	$23,539.439.00
	Lower Kansas	6	$146,054.40	$141,499.20	$95,280.00	$236,779.20
	Tuttle	1	$4,516,348.45	$83,945.172.05	$10,744,678.60	$130,392,951.65
	Milford	19	$3,001,150.80	$25,882,721.10	$1,366,357.50	$27,766,505.60
	Middle Kansas	16	$79,627.50	$3,078,475.20	$785,760.00	$4,402,732.20
	Clarks Creek	34	$321,600.00	$426,648.00		$426,648.00
Total			**$12,900,385.32**	**$127,773,326.26**	**$40,725,605.00**	**$192,896,930.38**

- Increase funding for BMPs to improve water quality in region
- Work with USACE and KDWPT on land managed around reservoirs
- Increase funding for bathymetric surveys to update reservoir capacities
- Complete sediment modeling on the Kansas River system
- Purchase future use storage where available within the next five years

- Work with the USACE and other partners on solutions for HAB occurrences in the region's reservoirs
- Host soil health workshops in the region to help educated landowners on the benefits of management practices

Regional Goals & Action Plan Progress

While *The Vision* provides a framework for the management of the state's water supply overall, regional goals identify and address issues at the local level. In 2015, Regional Goal Leadership Teams were developed for each of the 14 regional planning areas. These teams were comprised of local water users along with input from area stakeholders to help develop regional water supply goals. These goals were adopted by the KWA in August of 2015 and members for the 14 Regional Advisory Committees (RAC) were appointed. The first task for the newly formed RACs was to develop action plans to correspond with their regional goals. The Kansas RAC completed action plans for their regional goals in the fall of 2016. Information included within this section highlights recent progress made on Regional Goal Action Plan implementation.

Regional Goal #1 & #2	**Goal Theme**	**Annual Progress**			
		2017	**2018**	**2019**	**2020**
Increase water storage capacity and availability in federal reservoirs. By 2020, purchase all available storage in federal reservoirs to secure an adequate water supply for the region. By 2025, evaluate the ability to raise the conservation pool in each federal reservoir. By 2050, explore additional storage possibilities such as construction of multipurpose lakes so that new water sources can be brought online.	Water Storage			--	--
Progress Legend: Not Started | In Progress | Delayed | Cannot Complete | Complete					
2018 Update: • The Kansas River Alluvium Study by KGS is underway, well selection site completed • Kansas RAC developed a PowerPoint to educate user groups on water issues across Kansas, as well as this region • Submitted FY 2020 recommendations to the legislature to purchase storage in reservoirs and fund Water Injection Dredging (WID) program					
Next Step(s): Install remaining wells and continue to monitor sites.					

Regional Goal #3	**Goal Theme**	**Annual Progress**			
		2017	**2018**	**2019**	**2020**

Reduce the cumulative sediment rate of federal reservoirs and other water supply lakes by 10 percent in the Kansas Region every 10 years through implementation of watershed BMPs.	Sedimentation			--	--

Progress Legend	Not Started	In Progress	Delayed	Cannot Complete	Complete

2018 Update:

- Sediment modeling projects underway to use existing data to evaluate different sediment loads on the Kansas River system
- The SRP collaborative effort between TNC and the USACE is continuing to look at ecological flows on the Kansas River
- Streambank stabilization projects continue to be located, engineered, and constructed on property of willing landowners in the region
- KWO awarded $2.88 million for the Milford Lake Watershed RCPP to improve water quality within the Milford Lake Watershed
- Initial meeting was held between KS RAC subcommittee and USACE and KDWPT to discuss management practices on property around reservoirs

Next Step(s):

- Continue streambank stabilization projects above Tuttle Creek and Perry reservoirs
- Work to implement Kansas Basin Watershed Management System (KBWM System)
- Continue to work with USACE and KDWPT to implement BMPs on managed property

Regional Goal #4	**Goal Theme**	**Annual Progress**			
		2017	**2018**	**2019**	**2020**
By 2035, reduce per capita water consumption by 10 percent by 2035 through conservation, education and pricing mechanisms.	Water Consumption			--	--

Progress Legend	Not Started	In Progress	Delayed	Cannot Complete	Complete

2018 Update: No progress has been made.

Next Step(s): Education piece of the Vision – curriculum implementation

Regional Goal #5	**Goal Theme**	**Annual Progress**			
		2017	**2018**	**2019**	**2020**
After 2020, reduce duration and frequency of harmful algal blooms disrupting recreation in lakes such that blooms last under a week and do not occur until after Labor Day.	Algal Blooms			--	--

Progress Legend	Not Started	In Progress	Delayed	Cannot Complete	Complete

2018 Update:

- With cooperation of Milford Lake stakeholders, the Lake Level Management Plan (LLMP) was modified for the 2017 season in an effort to limit the effects of HAB effects on lake users

• Annual HAB meeting with stakeholders • RAC subcommittee involvement in the Milford Lake Watershed RCPP
Next Step(s): The 2017 plan has been adopted again for the 2018 season and results will be compared to previous years.

References

"Kansas Aquatic Nuisance Species Management Plan." *Kansas Department of Wildlife, Parks & Tourism,* https://ksoutdoors.com/Media/Files/Kansas-Aquatic-Nuisance-Species-Management-Plan.

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"KDHE TMDL Finder." *Kansas Department of Health and Environment*, maps.kdhe.state.ks.us/kstmdl/.

"Lake Level Management Plans Water Year 2018." *Kansas Water Office*, kwo.ks.gov/docs/default-source/reservoirs/rpt_llmp_wy2018_101217_tj_formattedd1f0e11da40b6667970cff000032a16e.pdf?sfvrsn=0.

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