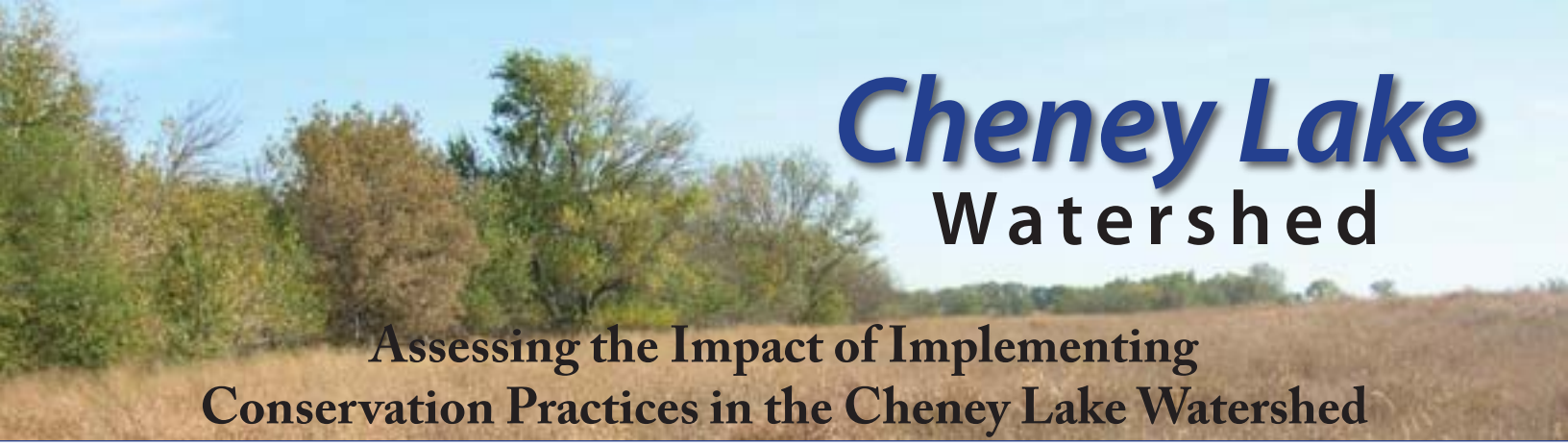


Cheney Lake Watershed

Assessing the Impact of Implementing Conservation Practices in the Cheney Lake Watershed

Cheney Lake Watershed is a 933-square-mile watershed located on the North Fork Ninnescah River and associated streams in five south-central Kansas counties (Figures 1 and 2). The reservoir was constructed between 1962 and 1965 to serve as a drinking water source, for downstream flood control, for recreational use, and to provide wildlife benefits.

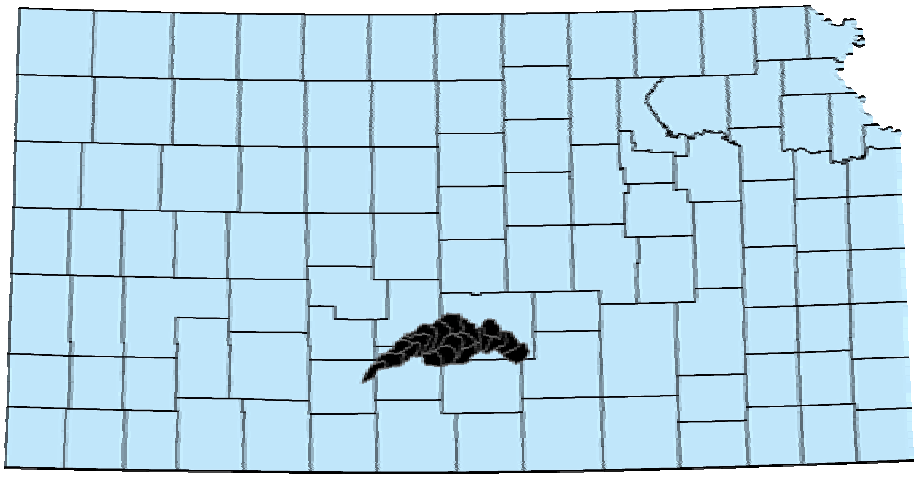
The city of Wichita, Kansas acquires 60 to 70 percent of its daily water supply for about 400,000 people from Cheney Lake. Algal blooms in Cheney Lake have occurred during the summer months. These blooms have caused taste and odor problems in drinking water from the reservoir. Excessive phosphorus concentrations contribute to these blooms. Historical water quality data indicate that sedimentation is an additional problem in the lake. Total maximum daily loads (TMDLs) were set by the Kansas Department of Health and Environment (KDHE) for eutrophication (excessive growth of algae and other aquatic plants) and silt. A task force representing stakeholders was formed in 1992 to study and develop a plan to identify and control potential sources of pollution in the watershed. Implementation of the plan began in 1994 under the leadership of the Reno County Conservation District and later with Cheney Lake Watershed, Inc. (*www.cheneylake-watershed.org)*, a group consisting of local citizens. Implementation of best management practices (BMPs) to mitigate the impacts of agricultural pollution and sedimentation has occurred throughout the watershed. Agricultural BMPs adopted in the watershed include cover crops, filter strips, crop rotations, management intensive grazing systems, strip cropping, no-till planting techniques, grassed waterways, and terraces. Seventeen percent of the land in the watershed has been enrolled in USDA's Conservation Reserve Program (Personal comm., NRCS).

Land use is predominantly agricultural (greater than 98 percent) and consists mainly of pasture and cropland. Crops are produced on 72 percent of the land area and include corn, grain sorghum, soybeans, wheat, and former crop acres currently enrolled in the Conservation Reserve Program. In 1995, there were 27,000 acres of corn, 51,000 acres of grain sorghum, 5,000 acres of soybeans, and 200,000 acres of wheat in the watershed. Livestock in the watershed include 76,000 cattle (as of Jan. 1, 1996) and 14,000 hogs (as of Dec. 1, 1995) (Christensen and Pope, 1997).

The human population of the Cheney Lake Watershed is fewer than 4,000. Populations of the six largest towns in the watershed range from 200 to slightly more than 1,200 people. There are approximately 1,000 farms in the watershed. Because of the small population in the watershed, the potential for point source pollution is considered to be small, as verified by a low-flow investigation. Five National Pollutant Discharge Elimination System (NPDES) permitted facilities are located within the watershed. These point sources contribute an estimated 2 percent of total annual phosphorus loads.

Since 1994, there have been more than 1,369 conservation practices implemented in Cheney Lake Watershed to protect water quality.

Figure 1. *Location of Cheney Lake watershed in Kansas.*



Water Quality Monitoring

There has been extensive surface water monitoring within the watershed. Surface water monitoring began in 1962. Since that time, The KDHE has continued monitoring a number of locations in the watershed (KDHE, 2000c). Between 1975 and 1999, the KDHE participated in eight Cheney Lake water quality surveys. The KDHE reported that the watershed is ranked seventh throughout the state of Kansas in priority for watershed restoration and has established TMDLs for eutrophication and silt. They determined the primary source to be runoff from agricultural fields. Throughout the years of monitoring, chlorophyll *a* (a measure of algal growth) concentrations in Cheney Lake have averaged 3.42 ppb. The chlorophyll *a* concentration has increased over time from 1.98 ppb in 1987 to 6.10 ppb by 1999. Furthermore, sampling by KDHE showed elevated total phosphorus concentrations in the lake (averaging 0.12 mg L^{-1}). KDHE estimates an annual phosphorus load of 213,850 pounds per year is required to create the concentrations observed in the lake.

Figure 2. *North Fork Ninnescah River near Pretty Prairie, KS.*

The U.S. Geological Survey (USGS) conducted extensive water quality studies of Cheney Lake Watershed from 1996 through 2000, including detailed streamflow and water quality monitoring at five locations in the watershed (Pope, 1998; Mau et al., 1997; Milligan and Pope, 2001; Pope et al., 2002). The long-term average stream water-quality goal for total phosphorus established by the Cheney Lake Watershed, Inc. of 0.10 mg L^{-1} was exceeded by average concentrations of total phosphorus in water samples collected from 1996 through 2001 from all five surface water-sampling sites upstream from Cheney Lake. These average phosphorus concentrations ranged from 0.23 to 0.50 mg L^{-1}, which indicates enrichment by agricultural activities or large natural concentrations in soils. However, historical (1965-1998) average total phosphorus concentrations in the surface inflow to the lake were 0.76 mg L^{-1}, as calculated on the basis of phosphorus deposited in the lake sediment. An analysis of lake bottom sediment indicated an increasing trend (since lake construction in 1965) in total phosphorus concentrations in water from Cheney Lake Watershed.

USGS reported that agricultural activities accounted for 65 percent of the phosphorus transported to Cheney Lake. It was estimated that from 1965 to 1998, 8.4 million pounds of phosphorus were transported to Cheney Lake. USGS suggested the best strategy for reducing phosphorus transport to the lake involves a combination of approaches such as reducing phosphorus fertilizer application and to making changes in land use, land management, and agricultural practices.

Conservation Practices Implemented in the Watershed

The Cheney Lake Watershed has gained attention as a national example of how voluntary implementation of conservation practices can be successful. A significant achievement of the Cheney Lake Watershed is the partnership of rural and urban stakeholders. Because the city of Wichita recognized the value of correcting pollution problems before water enters the lake, the city agreed to provide farmers partial reimbursement for implementing structural practices and incentives for improved management. The majority of practices implemented in the watershed have been eligible for federal (Natural Resource Conservation Service or Environmental Protection Agency 319) or state (Kansas State Conservation Commission) cost share or incentive programs that typically have a cost share rate of 50 to 70 percent. The city of Wichita agreed to pay all or most of the remainder of farmers' costs (typically 30 to 40 percent). This greatly increased implementation of practices within the watershed.

Since 1994, 1,369 cost shared and incentive payment contracts have been voluntarily implemented within the watershed. These target agricultural practices such as, cover crops, filter strips, riparian buffers, crop rotations, management intensive grazing systems, strip cropping, no-till planting techniques, waterways, and terraces. Seventeen percent of the land in the watershed has been enrolled in USDA's Conservation Reserve Program and planted to permanent vegetation.

Determining the Effectiveness of Installed Conservation Practices

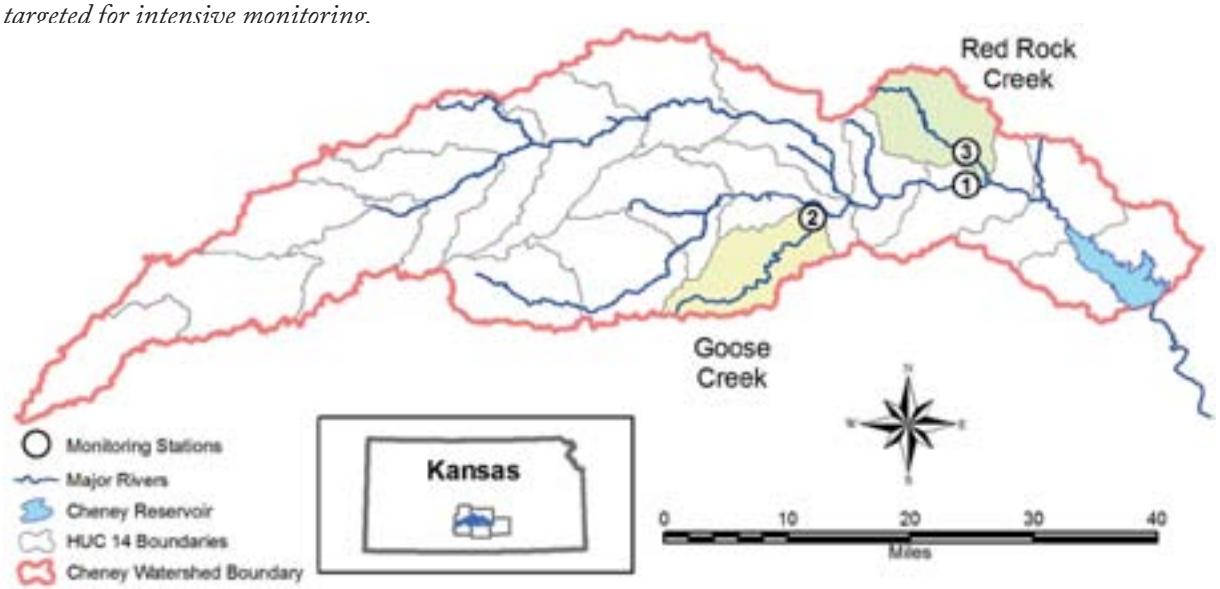
There has been little effort in determining how effective the installed conservation practices are in reducing erosion and phosphorus loadings to surface waters in Cheney Lake Watershed and to improving the water quality in Cheney Lake. Understanding the effectiveness of the installed conservation practices will help:

- the city of Wichita determine if their water supply from Cheney Lake is improving. The city needs to know if practices they helped cost-share led to improved water quality. This will allow the city to determine if they should continue funding practices in the watershed.
- federal and state agencies evaluate the effectiveness of their technical assistance, cost-share and incentive programs in improving water quality, and help them determine future program needs.
- provide landowners and operators information to make future land management decisions.

Because of the need to evaluate the effectiveness of conservation practices in Cheney Lake Watershed, Kansas State University and the Cheney Lake Watershed, Inc. have partnered to conduct a series of studies that will use a combination of data sources from field monitoring, computer modeling, producer interviews, and historical data coupled with statistical, spatial, economic, and social analysis to answer the following several questions:

1. Determine the history (1993-present) of conservation practice implementation in Cheney Lake Watershed by practice and location.
2. Using computer modeling techniques to compare current soil erosion rates to soil erosion rates occurring before 1993.
3. Determine the effects of current BMPs on water quality trends in Cheney Lake Watershed.
4. Establish a surface water monitoring system in the watershed to compare current water quality conditions with water quality conditions in the 1990s. Additional water quality monitoring sites will be re-established on Red Rock Creek and Goose Creek (locations 2 and 5 in Figure 3) to determine current water quality. These results will be combined with previous water quality data (1996-1999) and analyzed for water quality trends over a 12-year period. Trends in water quality will be compared to best management practice implementation trends.
5. Determine the best locations within the watershed for installing future BMPs and determine the water quality effects from installing practices in the most optimal locations.
6. Identify the social factors that have influenced BMPs adoption and maintenance in the watershed.
7. Evaluate the economic impact of BMPs. Net return for production systems with and without BMP implementation will be computed at the farm scale. These results will be analyzed to examine the tradeoffs in net return per acre, variability in net return per acre, and water quality for different BMP implementation scenarios.

Figure 3. *Water quality monitoring sites and Cheney Lake Watershed sub-basins targeted for intensive monitoring.*



Expected Project Outcomes

Project outcomes will include a history of BMP implementation by practice and location, an analysis of soil erosion reductions and improvements in surface water quality, detailed maps showing the areas of the watershed in greatest need of best management practices, and identification of the social and economic factors that would be most influential in encouraging BMPs placement and maintenance.

For more information on this project, contact Daniel Devlin (e-mail: *ddevlin@ksu.edu)* or telephone (785) 532-0393).

Figure 4. *Entering the Cheney Lake water quality area.*

Figure 5. *Red Rock Creek.*

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