Cheney Lake Watershed

Conservation Practice Implementation History and Trends

Evaluating water quality improvements, resulting from conservation practice implementation, is difficult. It requires a detailed knowledge of the trends in water quality conditions and the type, number, and location of the conservation practices adopted in the watershed of interest. Location of conservation practices implemented is particularly important. If the practices are implemented in critical areas, which generate the majority of nonpoint source pollution, they will have a greater impact on water quality than practices implemented in less critical areas.

A watershed-scale conservation practice, or best management practice (BMP), history can be useful for several water quality related objectives beyond water quality improvement. A BMP history is necessary to determine the progress of watershed projects in achieving BMP implementation goals. Land use history, including changes resulting from BMP implementation, is an important input for watershed-scale models, which can be used for additional evaluation of water quality trends and improvement. The extent of critical area protection can be determined with location-based BMP histories. Finally, conservation practice implementation rates and trends can be used to identify landowner preferences for BMPs.

The Cheney Lake Watershed in south-central Kansas has been the focus of multiple water quality related research, extension, and education projects for approximately 15 years.

Watershed Background

Cheney Lake Watershed is a 933-square-mile area located on the North Fork Ninnescah River (HUC 11030014) and associated tributaries in five south-central Kansas counties. The lake was constructed between 1962 and 1965 to provide drinking water, to control downstream flooding, for recreational use, and to benefit wildlife. The city of Wichita uses Cheney Lake as a primary water supply for more than 350,000 residents. Land use in the watershed is predominantly agricultural, with crop production accounting for more than 50 percent of the total area (Table 1). Primary crops are wheat, grain sorghum, corn, and soybean. The watershed population is fewer than 4,000, many of whom are associated with approximately 1,000 farms. The six largest cities have populations ranging from fewer than 200 to slightly more than 1,200.

Table 1. *Land use in the Cheney Lake Watershed (1997).*

Land Use	acres	% of watershed
Cropland	349,000	58
Pasture/Range	120,000	20
Conservation Reserve Program	92,000	15
Forest	9,000	2
Urban/Farm	8,000	1
Water/Other	23,000	4

In the early 1990s, phosphorus induced eutrophication (algae growth) in the lake resulted in considerable taste and odor complaints from Wichita residents. In 1994, local conservation districts and the city of Wichita established funding for enhanced cost sharing of conservation practices within the watershed. A project office staffed with a project manager, technician, and clerical staff was established to coordinate project operations, which included tracking conservation practice implementation. This project office later developed into the non-profit organization, Cheney Lake Watershed, Inc. Cheney Lake Watershed, Inc. has continued to assist with conservation practice implementation through contract management and securing additional cost share funding.

In 1996, the U.S. Geological Survey (USGS) began a 5-year study to document water quality in the watershed and to identify potential sources of water quality impairment. Their study concluded that watershed streams had elevated phosphorus (P) concentrations and agricultural sources of P were a primary cause of water quality impairment. Sediment and pesticides also were identified as water quality concerns. The Cheney Lake task force committee established a water quality goal of maintaining stream water P concentrations to less than 0.10 parts per million.

How Practice Information Was Collected

Data on conservation practices, their locations, and times of implementation were primarily obtained from a database maintained by Cheney Lake Watershed, Inc. The Cheney Lake Watershed, Inc. database contained information on all practices cost-shared through their funding sources. Many of the records in their database contained information on specific practice components rather than entire practices. For example, a waste management facility may have had records for earthwork, a record for concrete, and a record for fencing. To avoid counting the same practice multiple times, the practice components were grouped as a single practice. Watershed staff collected additional information on practices that were not tracked in the Cheney Lake Watershed, Inc. database. All efforts were made to ensure that practices were not double counted when including data from multiple sources. Watershed land use was determined with a GIS land-use database developed in 1997 by the Natural Resources Conservation Service (NRCS) in the initial stages of the watershed project. Pre-study terrace information (before 1992) was also obtained through the NRCS.

Information on changes in Conservation Reserve Program (CRP) acres during the study period was analyzed for two watersheds, Red Rock Creek and Goose Creek, and data for this conservation practice was included in this report. In addition, data on no-tillage implementation for Red Rock Creek and Goose Creek was collected by Cheney Lake Watershed, Inc. staff.

The method of counting the change in conservation practices over time was dependent on the type of practice. Practices that were structural in nature (e.g., wells, waste management systems, or terraces) were assumed to remain functional for each year following implementation. However, incentive-based conservation practices, or nonstructural practices (e.g., nutrient management, residue management, etc.) were only counted during the year for which the contract was made. As a result, nonstructural conservation practices were counted each year of the implementation contract, whereas structural conservation practices were only counted the initial year of implementation. Data on changes in nutrient management or tillage that were not a result of a contract with NRCS or Cheney Lake Watershed, Inc. were not available (except for CRP and no-tillage in Red Rock and Goose Creeks). Therefore, these and any other voluntarily adopted practices were not included in this publication.

Practices Implemented in the Watershed

A total of 1,369 conservation practices were implemented from 1994 through 2006, protecting more than 77,800 acres of land, or approximately 17 percent of the total agricultural land in the watershed. Conservation practices were implemented on 15 and 25 percent of the cropland and pastureland, respectively. After accounting for the expired

Figure 1. *Increases in the land area protected by conservation practices and the number of conservation practices implemented in the Cheney Lake Watershed since 1994 through 2006.*

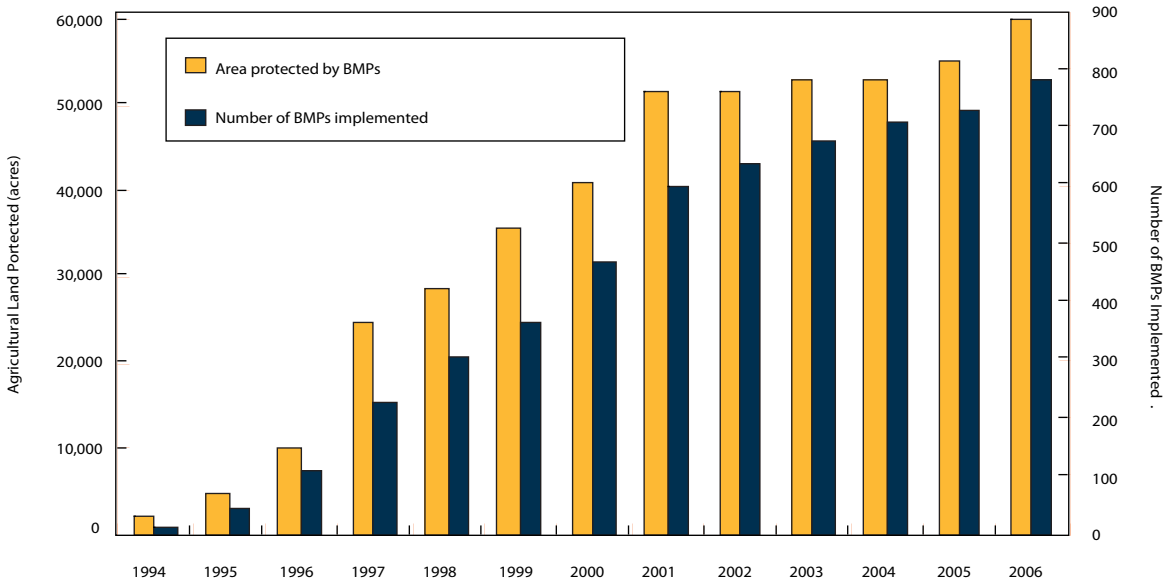


Figure 2. *Annual land area impacted by nutrient management planning or conservation tillage conservation practice contracts since 1997 through 2006 in the Cheney Lake watershed.*

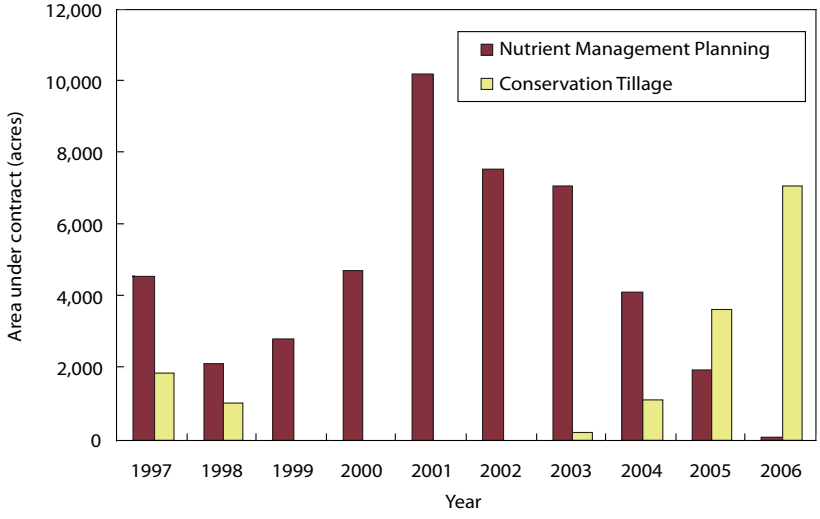


Table 2. *Conservation practices implemented from 1994 through 2006 in the Cheney Lake Watershed, including the number of contracts, number of fields, and area protected for each conservation practice.*

BMP	contracts	fields/sites	acres	Rank (contracts)	Rank (area protected)
Nutrient Management	486	167	17,586	1	2
Terrace	156	130	19,132	2	1
Household Waste	134	134		3	
Conservation Tillage	132	76	9,945	4	3
Grassed Waterway	63	60	8,445	5	5
Well	60	57	8,771	6	4
Fence	48	44	6,724	7	6
Brush Management	38	36	5,486	8	8
Trough Or Tank	34	30	5,611	9	7
Range Planting	23	22	2647	10	10
Conservation Crop Rotation	20	20	2,408	11	11
Pond	18	18		12	
Proper Grazing Use	17	17	1,958	13	12
Waste Storage Facility	16	14		14	
Pasture And Hay Planting	13	13	1,106	15	16
Grade Stabilization Structure	12	11	1,663	16	13
Waste Management System	12	12		16	
Critical Area Planting	11	11	979	18	18
Water And Sediment Control Basin	10	9	1,310	19	15
Planned Grazing Systems	8	8	4,153	20	9
Pipeline	8	7	1,550	20	14
Terrace Maintenance	7	5	681	22	20
Diversion	7	7		22	
Underground Outlet	6	6	1,012	24	17
Pumping Plant For Water Control	6	6	947	24	19
Wetland Restoration	4	4		26	
Field Windbreak	2	2	209	27	22
Pond Sealing Or Lining	2	2		27	
Manure Transfer	2	2	185	27	23
Windbreak/Shelterbelt Establishment	2	2	120	27	25
Wetland Enhancement	2	2		27	
Cover And Green Manure Crop	2	2	58	27	27
Waste Utilization	2	1	31	27	28
Use Exclusion	1	1	234	34	21
Spring Development	1	1	154	34	24
Upland Wildlife Habitat Management	1	1	105	34	26
Access Road	1	1		34	
Filter Strip	1	1	21	34	29
Woodland Direct Seeding	1	1	8	34	30

incentive contracts, there was a net increase of 781 conservation practices in place, impacting 60,050 acres (Figure 1).

There were 39 different types of conservation practices implemented, with the top four practices accounting for 65 percent of all BMP contracts (Table 2). Nutrient management was the most commonly implemented practice, which may be due to the method of accounting. Although the practice was implemented more than 480 times, it occurred on only 167 fields, with an average recurrence of 2.9 times per field. A total of 17,586 acres were put under nutrient management contracts during the study period (5 percent of all cropland). The cropland area under nutrient manage-

ment planning contracts peaked at more than 10,200 acres in 2001, then declined to 100 acres in 2006 (Figure 2).

Although nutrient management planning contracts declined during the past 5 years, the watershed area protected by conservation tillage contracts increased steadily, peaking at slightly more than 7,000 acres under contract in 2006 (Figure 2). In total, 9,945 acres were placed under conservation tillage contracts during the study period, equaling 2.8 percent of all cropland. Although it is hoped that producers would continue the incentive-based conservation practices after the contract has expired, there is not a record of whether or not they continued. In this report, we simply report the contracts that were made for these practices. Conservation tillage BMPs are more likely to continue than nutrient management BMPs since implementation of conservation tillage requires the purchase of equipment and major changes in management.

Because the data only reflect tillage changes related to conservation practice contracts, additional data on tillage changes from 1997 to 2007 were collected for two sub-basins in the watershed. The additional data account for tillage changes resulting from educational efforts or economic influences as well as BMP implementation programs. Based on BMP contracts, Red Rock Creek sub-watershed (11030014030020) had an increase of 1,570 acres of no-till from 1997 to 2007, however, our survey indicated a total increase of 9,120 acres of no-till land (Figure 11). However no-till adoption was much less in the Goose Creek sub-watershed (11030014020040), where there were not any tillage BMP contracts and a total increase of only 370 acres of no-till land. No-till acreage accounts for 42 percent of the cropland in Red Rock Creek Watershed and only 3 percent of the cropland in Goose Creek Watershed. These two watersheds also demonstrate the high degree of spatial variability of BMP adoption. Goose Creek Watershed has greater increases in CRP and terrace BMPs but less no-till adoption as compared to Red Rock Creek Watershed.

Terrace installation was the top ranked conservation practice implemented in terms of area impacted and the second ranked practice in terms of number of contracts. The best estimate of the watershed area protected by terraces before 1994 is slightly more than 44,000 acres of cropland with terraces, or about 12.7 percent of all cropland in the watershed. During the study period, terraces were installed on 19,132 acres; however, only 12,478 acres did not have terraces before 1994. Producers installing additional terraces in fields that already had some terraces installed or older terraces that were rebuilt explains the overlap. Terraces also were installed multiple times

Figure 3. *Increase in the number of terrace contracts and the land area with terraces in the Cheney Lake Watershed from 1994 through 2006.*

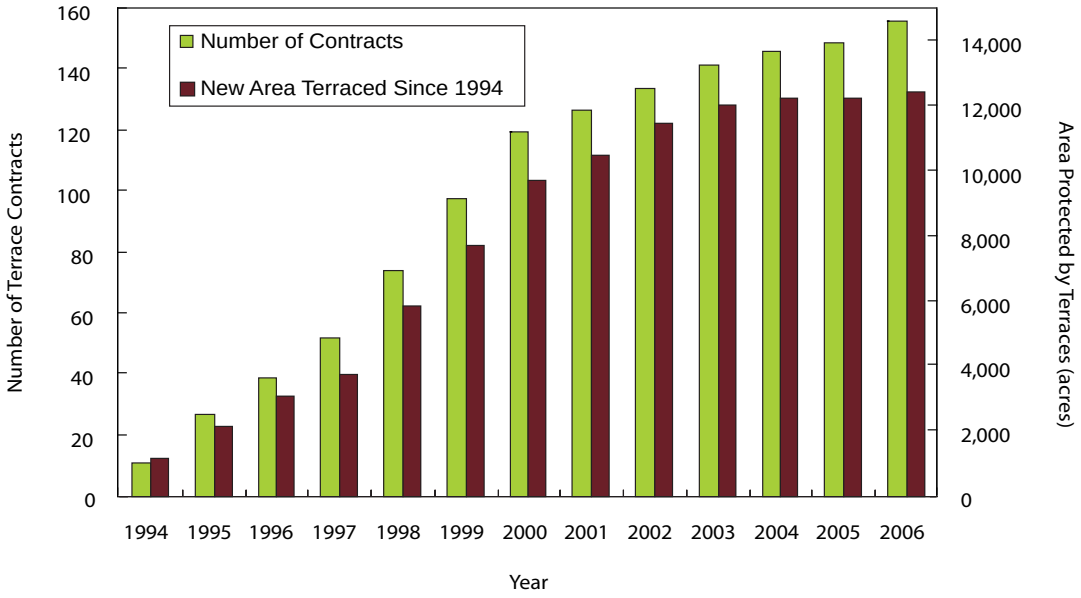
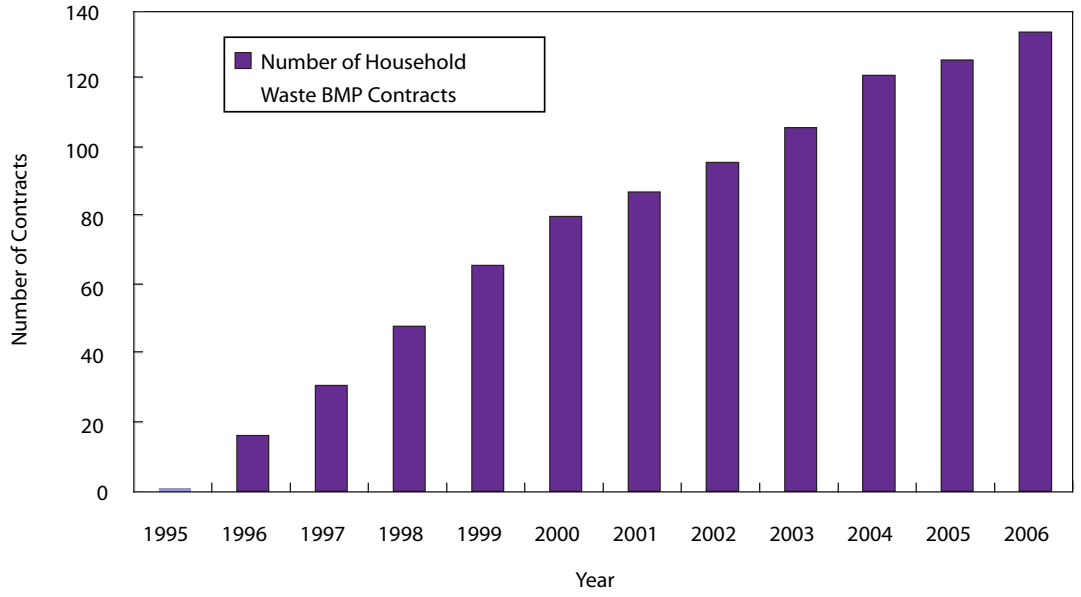
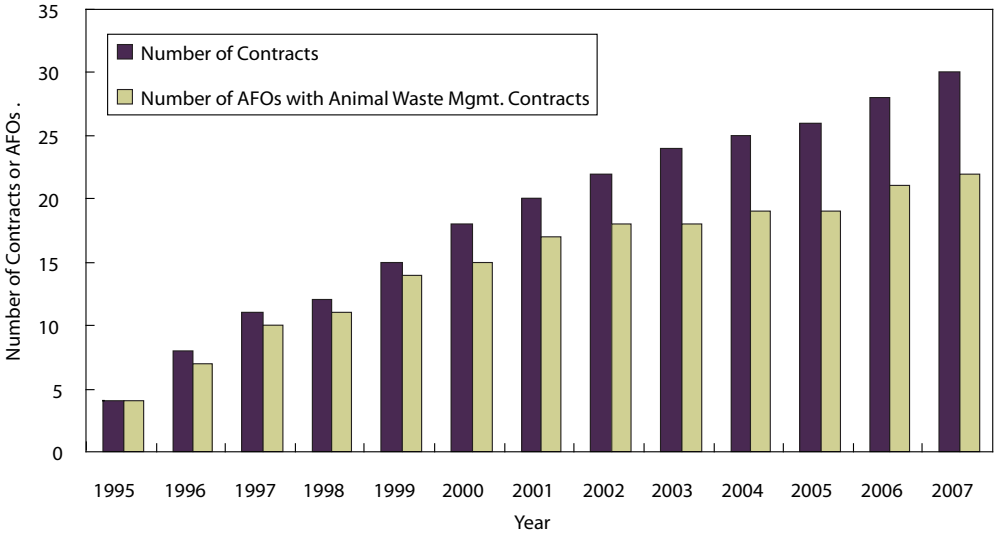


Figure 4. *The number of household waste contracts in the Cheney Lake Watershed from 1995 through 2006.*



in several fields during the study period, as indicated by the continued increase in the number of terrace contracts after 2002, but with little or no increase in the cropland area protected by terraces (Figure 3). These additional terraces would increase the level of BMP protection for the impacted fields, but do not increase the distribution of BMPs throughout the watershed.

Figure 5. *The number of animal waste management contracts and animal feeding operations (AFOs) with BMP contracts from 1995 through 2007.*



Although there is not an NRCS conservation practice standard for improvements in household waste systems (i.e., on-site septic systems), funds were available from state and local funding sources to cost-share these improvements. Household waste improvements were the third most common conservation practice implemented in the watershed. Based on the year 2000 US Census data, there are 1,327 rural households in Cheney Lake Watershed. Assuming that all of the rural households are on septic systems, approximately 10 percent of the septic systems were improved through cost-share conservation practice funding. However, these BMPs were upgrades to failing systems; therefore, not all homes with septic systems would need the BMPs or upgrades. As opposed to the terrace adoption, adoption of household waste BMPs remained fairly consistent during the study period (Figure 4). The reason for consistent adoption is the cost share is limited and demand is high.

Cheney Lake Watershed contains 103 animal feeding operations (AFOs) ranging from 15 animal units to 3,500 animal units. Some AFOs are open-lots that only operate for 30 days per year while others are confined operations operating the full year. There are 41 AFOs that maintain full confinement and/or operate for 365 days per year. These confined and/or year-round AFOs are mainly dairies and beef feed lots.

Waste management or treatment related conservation practices implemented at animal feeding operations (AFOs) within the watershed did not rank high in terms of number of contracts. However, AFOs can concentrate large quantities of nutrients and can present considerable potential for water quality impairment when BMPs are not present. Therefore, a relatively small number of contracts could have a large affect on water quality. Thirty waste management related contracts, such as improved waste treatment, storage, and handling systems, were installed on 22 AFOs in the watershed, including 18 of the 41 confined and/or year-round AFOs. The remaining AFOs may not have a significant need for waste treatment or they may have implemented BMPs without the use of cost-share programs. The majority of these improvements were associated with small to moderate sized dairies (50 to 150 head of milking cows). The number of farms implementing BMPs did not increase much after 2001, yet the number of contracts continued to increase (Figure 5), indicating that the same producers installed multiple BMPs after the first 6 to 7 years of the study period.

Trends in BMP implementation were different depending on the BMP installed. Numbers of nutrient management planning and conservation tillage contracts were highly variable over years during the period examined. This could be a result of the changes in cost share programs, influences of weather, crop prices, or other variables affecting the willingness of producers to adopt these BMPs. Data collection for these BMPs was also difficult due to changes in tracking procedures by NRCS, therefore, the data may not be complete.

Trends in terrace and waste management conservation practices were similar in that the majority of the contracts issued after the year 2000 were issued for locations that had previously implemented the conservation practice. This indicates that the same producers were returning to add additional practices. The same producers may have returned for additional cost-share funds because they are comfortable with working in the cost-share program and/or they appreciate the benefits received from the BMPs previously installed. The additional water quality benefits of increased BMP intensity in a single location is hard to determine, but the benefits would be dependent on multiple site-specific soil, landscape, cropping, and management factors.

Household waste BMPs increased steadily in number during the entire study period. The rate of increase declined slightly in recent years, but not as much as the terrace and waste management BMPs. This indicates that the household waste BMPs are being readily adopted by many people in the watershed and continued cost-share programs are likely to influence more sites in the watershed.

In 1997, CRP contracts covered approximately 12 percent and 18 percent of the land area in Red Rock

Creek and Goose Creek, respectively. Comparing 2002 to 1997, no additional CRP acreage was added in Red Rock Creek. In Goose Creek, CRP protected approximately 20 percent of the acreage by 2007. There was a large difference between the two watersheds comparing implementation of no-tillage. By 2007, approximately 38 percent of the acreage was in no-tillage in Red Rock Creek, compared to less than 2 percent in no-tillage in Goose Creek.

Trends in the Location of BMP Implementation

Conservation practice implementation was not evenly distributed throughout the watershed during the study period (Figure 6). The spatial distribution of BMPs was evaluated by determining BMP implementation in each of the 14-digit hydrologic unit code (HUC) sub-watersheds within Cheney Lake Watershed. The number of BMP contracts per 14-digit HUC ranged from 14 to 219 contracts during the 13-year study period (Figure 7). The sub-watershed with the greatest number of contracts was Goose Creek Watershed (11030014020040). The majority of the contracts in Goose Creek Watershed were for nutrient management planning (136 contracts). The other commonly implemented BMPs were terraces and household waste system improvements. BMPs were implemented at 83 different locations in Goose Creek Watershed, more than any other sub-watershed.

The percent of agricultural land area impacted by BMPs during the study ranged from 1 to 43 percent (Figure 8). Although the Goose Creek Watershed had the greatest land area protected by BMPs (7,730 acres), the sub-watershed containing Irish Creek (11030014030010) had the greatest relative BMP coverage based on land area, with 43 percent of the agricultural land protected by BMPs. Primary BMPs implemented in Irish Creek Watershed were nutrient management planning, conservation tillage, and terraces.

Seventy percent of all animal waste BMPs was implemented in Red Rock Creek Watershed (11030014030020), which contains about 46 percent of the confined and/or year-round AFOs in Cheney Lake Watershed. Animal waste BMPs were implemented at 14 of the 19 confined and/or year-round AFOs, more locations than any other Cheney Lake sub-watershed (Figure 9). Red Rock Creek Watershed also had the greatest variety of BMPs implemented (25 different BMPs) and the greatest number of structural BMPs.

Household waste BMP implementation also exhibited high spatial variability (Figure 10). Goose Creek Watershed had the highest number of households implementing household waste BMPs, with 16 of the 64 rural households being impacted. Although the eastern Cheney Lake Watershed sub-watersheds had greater numbers of household waste BMPs implemented, the western sub-watersheds had higher percentages of homes with BMPs in place due to the lower population of the western half of the watershed (data not shown).

Figure 6. *Locations of best management practices (BMPs) implemented in Cheney Lake Watershed from 1994 through 2006 in relation to the 14-digit hydrologic unit code (HUC) sub watersheds.*

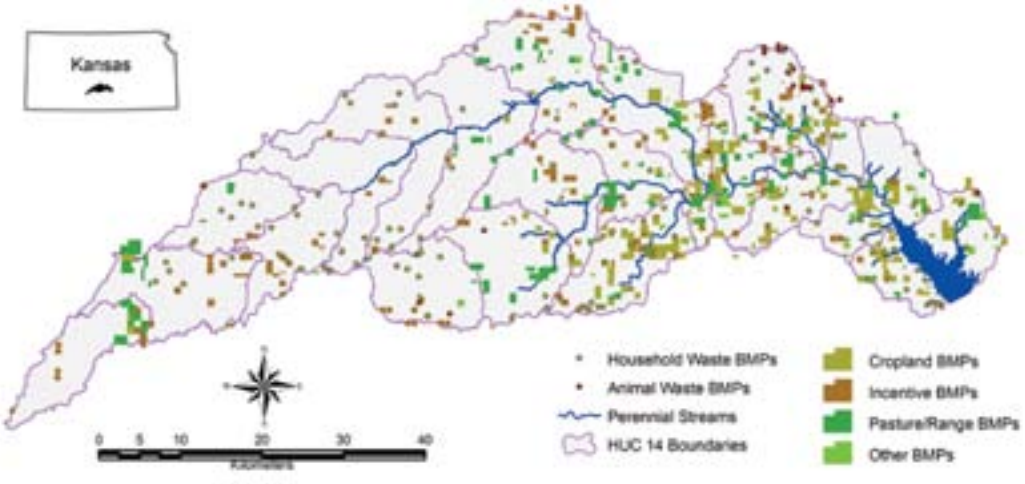


Figure 7. *Number of best management practice (BMP) contracts implemented in each 14-digit hydrologic unit code (HUC) sub-watershed of Cheney Lake Watershed from 1994 through 2006..*

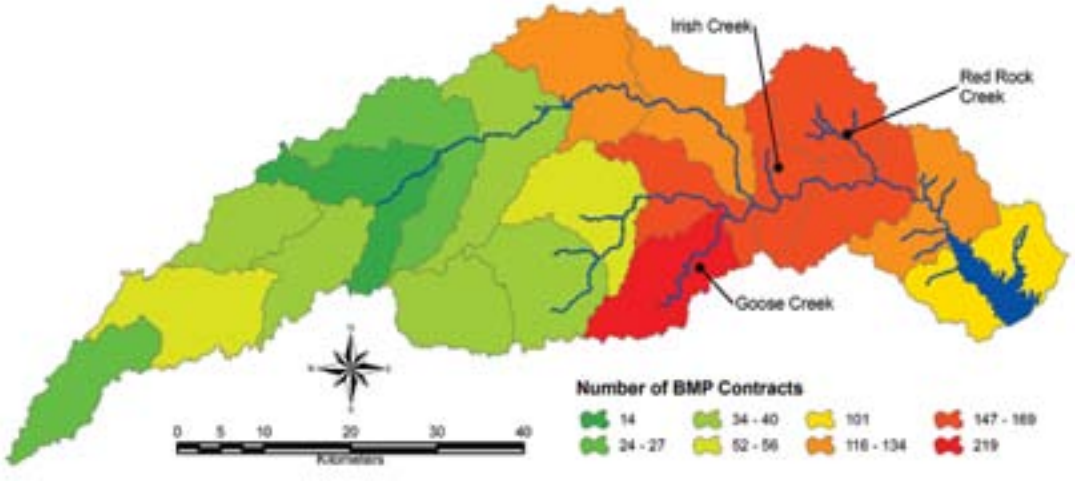


Figure 8. *Percent of agricultural land (cropland, pasture, and rangeland) protected by best management practice (BMP) contracts for each 14-digit hydrologic unit code (HUC) sub-watershed of Cheney Lake Watershed since 1994 through 2006.*

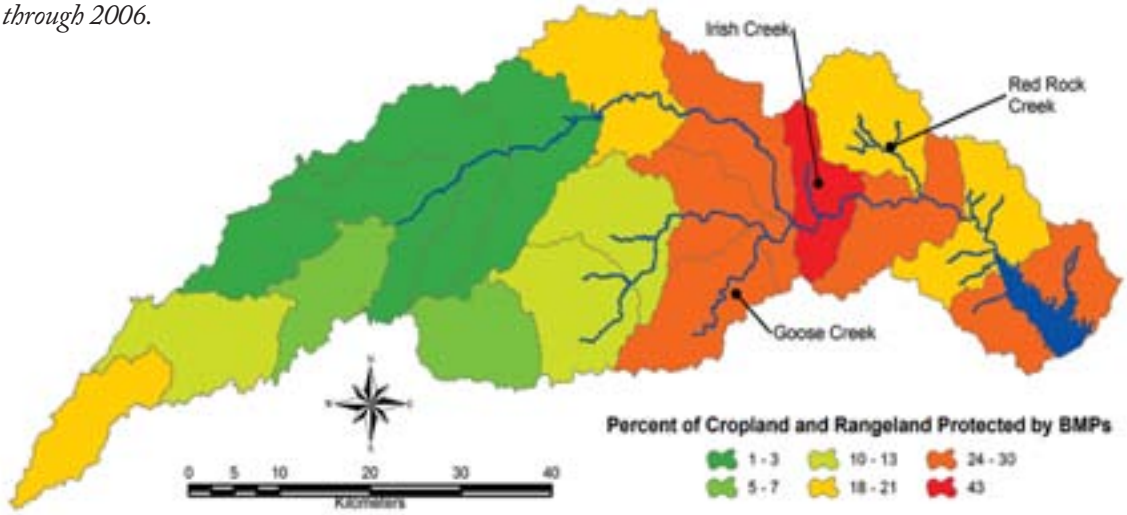


Figure 9. *The percent of animal feeding operations (AFOs) that installed new best management practices (BMP) through cost-share contracts in each 14-digit hydrologic unit code (HUC) sub-watershed of Cheney Lake Watershed from 1994 through 2007. Locations of the AFOs that installed practices are also shown as discreet points.*

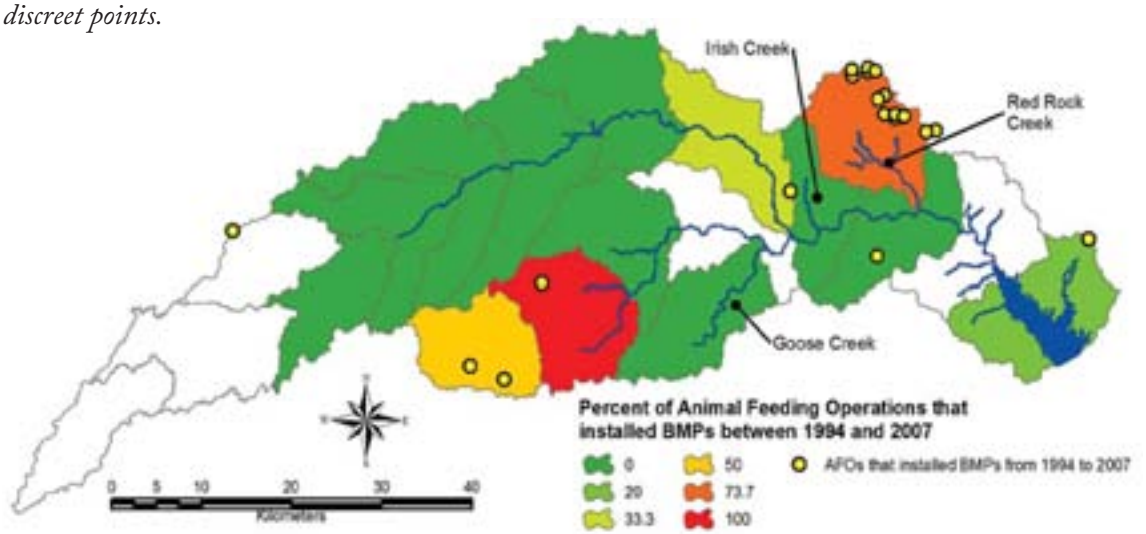


Figure 10. *Percent of rural households with household waste best management practice (BMP) contracts in each 14-digit hydrologic unit code (HUC) sub-watershed of Cheney Lake Watershed from 1994 through 2006. Locations of household waste BMPs are also shown as discreet points.*

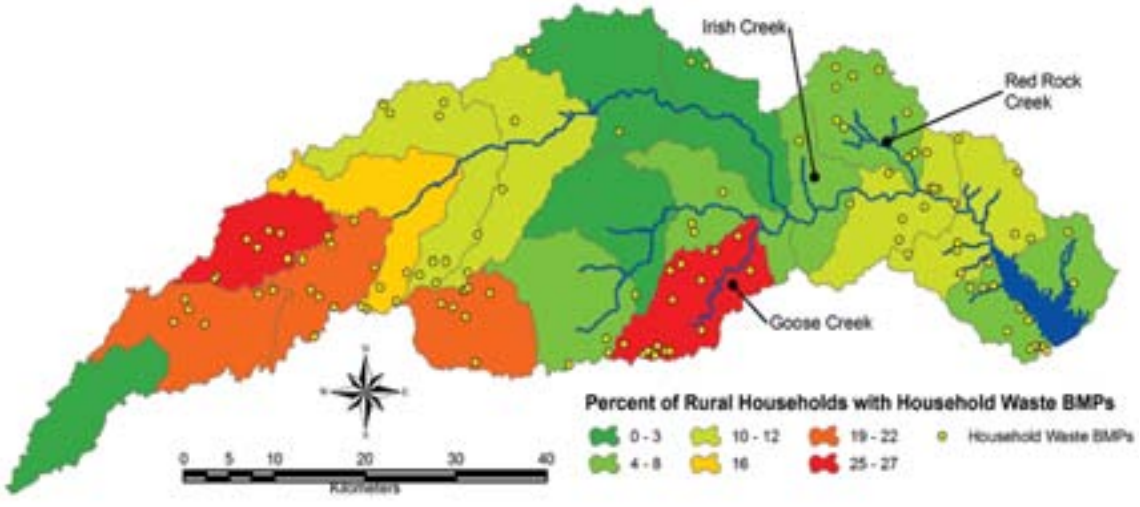
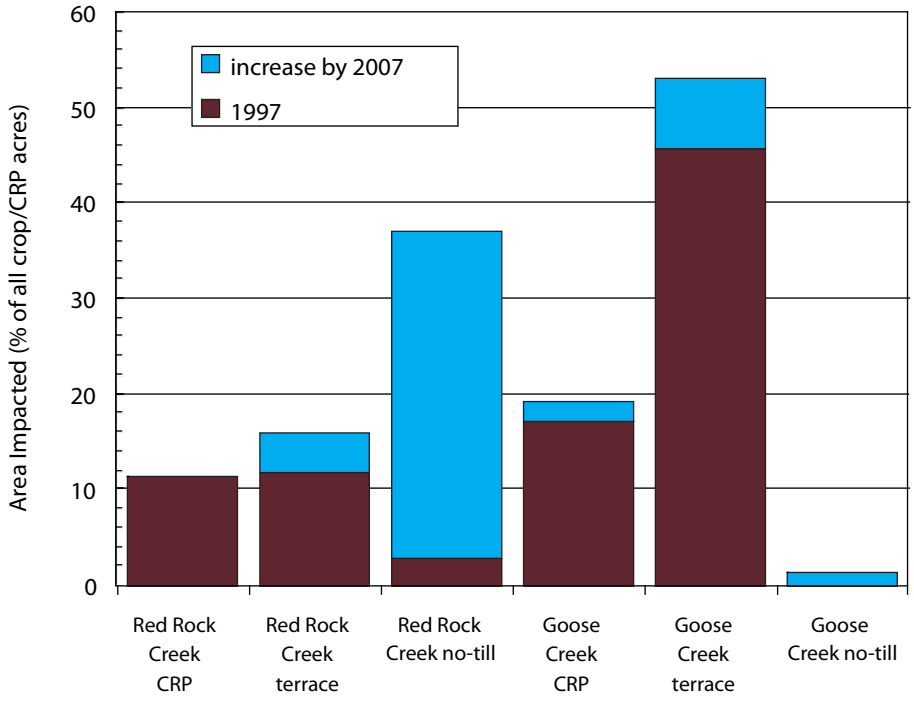


Figure 11. *Conservation Reserve Program (CRP), terrace, and no-till BMP implementation in 1997 and 2007 for two sub-watersheds within the Cheney Lake watershed.*



Daniel Devlin
Department of Agronomy

Nathan Nelson
Department of Agronomy

Lisa French
Cheney Lake Watershed Inc.

Howard Miller
Cheney Lake Watershed Inc.

Philip Barnes
Department of Biological and Agricultural Engineering

Lyle Frees
Natural Resources Conservation Service

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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