Illinois River and Baron Fork Watershed Implementation Project

OCC Task 113
FY 1999 319(h) Task 800

Submitted by:

Oklahoma Conservation Commission
Water Quality Division
2401 Lincoln Boulevard, Will Rogers Building, Ste. 224
PO Box 53134
Oklahoma City, Oklahoma 73152-3134

Final Report
December 2004

Table of Contents

List of Figures

List of Tables

Introduction

Oklahoma's 2000 Nonpoint Source (NPS) Management Program sets a goal that the State will implement at least one large-scale implementation/demonstration project each year. These projects use assessment, planning, education, and demonstration / implementation of best management practices to address NPS-derived causes and sources of impairment.

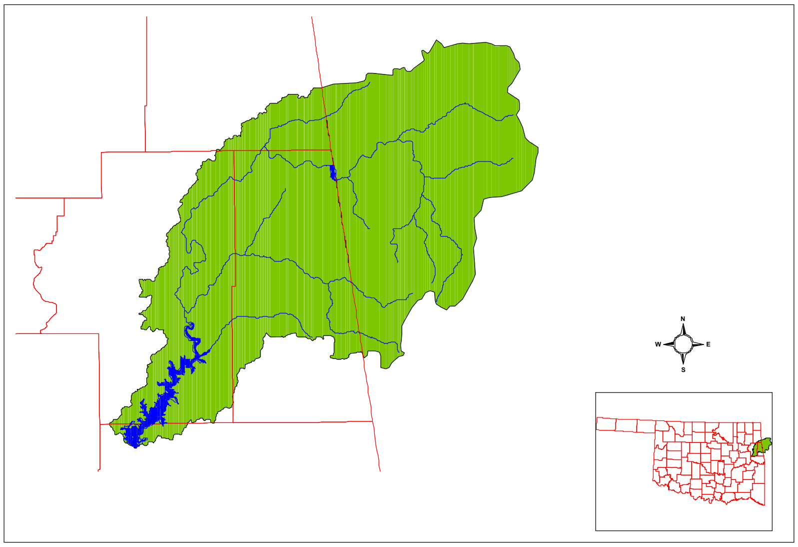
These projects have been chosen based on the 1998 Unified Watershed Assessment list of priority watersheds, further prioritized by Oklahoma's NPS Working Group. The Illinois River/Baron Fork Watershed was the second large-scale priority watershed project to be undertaken following the goals outlined in the 2000 NPS Management Program.

Project Location

Illinois River and Baron Fork

The Illinois River watershed straddles the Oklahoma / Arkansas border and of its 1,069,530 total acres, 576,030 (approximately 54% of the total basin area) are located in Oklahoma (USDA 1992). The basin is located in Delaware, Adair, Cherokee, and Sequoyah counties in northeastern Oklahoma (Figure 1).

Illinois River Watershed



F
Figure 1. Watershed Location.

The average flow of water in the river as it enters Oklahoma near Watts is 703 cfs, which increases to 1095 cfs as the river reaches Tahlequah (USGS database, period of record 10/81 - 09/91), shortly after which it flows into Lake Tenkiller. The major tributaries of the Illinois River in Oklahoma are the Baron Fork River, Caney Creek, and Flint Creek. The river is classified as a state scenic river from the Lake Frances Dam up to its confluence with the Baron Fork, a distance of approximately 70 miles. A 35-mile segment of the Baron Fork River and a 12-mile segment of Flint Creek are classified as scenic rivers upstream from their confluence with the Illinois River. The rest of the river basin in Oklahoma consists of Tenkiller Ferry Reservoir and a short segment downstream of the dam to its confluence with the Arkansas River. The watershed can be sub-divided into 60 smaller watersheds ranging in size from 2,382 to 31,046 acres with a mean size of 8,825 acres.

Problem Statement

Numerous threats and impairments to the Illinois River and Baron Fork have been documented through monitoring by the Oklahoma Conservation Commission, Oklahoma Scenic Rivers Commission, Oklahoma Department of Environmental Quality, U. S. Geological Survey, and Oklahoma Water Resources Board. Water quality problems in the watershed include excessive sediment in the tributaries, rivers, and upper end of Lake Tenkiller, excessive nutrient loading, pesticides, organic enrichment, and metals. Gravel mining and water withdrawal are more controversial potential impairments within the watershed. Both the Illinois River and Baron Fork have been shown to be getting shallower and wider with increasing stream bank erosion and less stable, larger gravel deposits. The sources of pollutants have been attributed to non-irrigated crop production, specialty crops, pasture land, range land, feedlots (all types), animal holding / management, silviculture, on-site waste water treatment systems, removal of riparian vegetation, stream bank modification / destabilization, and recreation. Conversion of forestland to pasture, especially on steep slopes, has been recently observed as contributing to the problem.

Considerable resources have already been devoted to monitoring and preserving the water quality in the Illinois River watershed. Education, cost share, and demonstration directed at the poultry and recreation industries have been successful only at slowing the degradation of water quality. Priority in the watershed must now be given to reducing the overall load of nutrients reaching Tenkiller Ferry Lake by as much 40% to meet the goals of the initial agreement between Oklahoma and Arkansas to address water quality problems in the watershed. Riparian reestablishment and stream bank protection to maintain the stream habitat quality are of equal importance. This project addresses the Baron Fork and Illinois River watersheds as a single unit. Technical assistance, education and cost sharing are planned for the entire combined watershed.

The Illinois River and its tributaries are viewed as outstanding water resources for purposes of recreation, wildlife propagation, and aesthetic values. It is further recognized that the Illinois River and its tributaries are the primary sources of water for Tenkiller Ferry Reservoir, another outstanding water resource, and as such are highly correlated with reservoir water quality.

Oklahoma's goal is to maintain the quality of these water resources at the highest practical level by decreasing the impacts of significant nonpoint sources of pollution. This will be accomplished through the identification and prioritization of problem areas followed by implementation of practices or procedures to lessen the impact of individual sources to a practical minimum.

The Illinois and Baron Fork watersheds were identified as priority watersheds in the Oklahoma Unified Watershed Assessment. These watersheds were also selected as second and third priority by the Oklahoma NPS Working Group. This project was designed to initiate work towards reducing nutrient and sediment loading.

Program Partners

This program would not have been as effective without the cooperation of the local conservation districts in Adair and Cherokee Counties. In addition to housing the project coordinator and project education coordinator, the districts recommended potential members for the Watershed Advisory Groups, participated in those groups, and worked with the cooperators to insure that they received their cost-share reimbursements and incentive payments. The districts played a critical role in promoting the program and cooperation with complementary programs such as NRCS EQIP and Cooperative Extension Education programs.

Other partners critical to the success of the project and a short summary of the roles they played include:

- The Environmental Protection Agency (EPA) for guidance and funding of the project
- The Oklahoma State Legislature for matching funds to increase the amount of best management practices that could be installed;
- The Oklahoma Secretary of the Environment who coordinated program activities and outputs between the EPA and OCC;
- The Oklahoma Water Resources Board and U.S. Geological Survey (USGS) who collected water quality data in the watershed that can be used (now and in the future) to evaluate the water quality impacts of the program;
- The Oklahoma Department of Agriculture, Food and Forestry who regulate compliance with the State's poultry regulations and in doing so, monitor litter application, soil phosphorus and litter phosphorus content in the watershed, in addition to promoting implementation of sound best management practices associated with the industry;
- The Oklahoma Department of Environmental Quality who has been working to develop the TMDL that this program will help work towards and who also has been encouraging through permitting, the upgrade of point source dischargers in the watershed to reduce the impacts from those sources;
- OSU Cooperative Extension Service whose long-standing education programs in the watershed have helped increase awareness of the water quality problems, knowledge about potential solutions to those problems, and receptiveness towards implementing solutions to those problems through changing behaviors;

- Natural Resource Conservation Service (NRCS) and Farm Services Agency whose programs provide funding and technical support to implement best management practices that expand the effects of this project both during and beyond the project period;
- Poultry Integrators who are working with the States of Oklahoma and Arkansas and their contract growers to reduce the impacts of the industry by requiring BMPs, training, and certification of growers, providing funding that is used to match federal funds to address the problems, and providing technical assistance to address the problems; **and most importantly**
- Landowners and local producers in the watershed who were receptive to information provided to them and willing to invest their time, finances, and risk potential short-term impacts to their bottom-line that would lead to improved water quality, conserve the additional natural resources in the area, and ultimately improve their productivity.

Assessment

Water Quality Monitoring is critical to the project for purposes of:

- determining the causes and sources of NPS-derived pollution in the watershed
- ascertaining whether or not project efforts have had an effect on water quality, or whether or not the project has been a success.

As a Scenic River Watershed and a top priority for the State for many years, a considerable amount of water quality monitoring has occurred and is ongoing in the Illinois River Watershed. Therefore, for purposes of this project, monies were devoted to other activities such as education or demonstration of best management practices (BMPs), rather than to duplicate ongoing water quality monitoring funded through other programs. Results of historical water quality monitoring and project concurrent water quality monitoring were considered relative to the project.

The following discussion summarizes the historical studies and current water quality monitoring efforts in the watershed.

Historical Water Quality Studies in the Illinois River Basin

Ten waterbody segments including Tenkiller Lake are listed on the 2002 Integrated Report as being impaired by one or more of the following; low dissolved oxygen, pathogens, phosphorus, turbidity, nitrate, and cause unknown (due to poor fish collections). The most frequent causes for listing are phosphorus and pathogens. These listings include 6,450 lake acres and 72 miles of stream.

The 1996 Diagnostic and Feasibility Study on Tenkiller Lake (OSU 1996) summarized a number of historical reports and collected watershed and lake water quality data to determine that the main pollutant of concern was phosphorus. The study went further to recommend at least a 40% reduction in phosphorus loading to the lake to prevent the lake water quality from continuing to significantly degrade and an 80% reduction to return the lake to more acceptable conditions.

The Arkansas Water Resources Center Water Quality Lab (AWRC) assessed pollutant concentrations of the Illinois River obtained from samples taken at the U. S. Geological Survey gauging station located at the Arkansas Highway 59 Bridge (Nelson and Cash. 2004). From 1996 to 1997, nitrate nitrogen levels rose from 2.0 mg/l to 2.24 mg/l. Total Kjeldahl Nitrogen, total phosphate and total suspended solids all decreased during this year. However, those parameters all increased the following year. Nitrate nitrogen rose to 2.45 mg/l from 1998 to 1999, fell to 2.06 mg/l from 1999 to 2000, rose again (2.86 mg/l) in 2001 and fell to 2.52 in 2002. Total Kjeldahl Nitrogen maintained a fairly constant level ranging from 0.81 to 0.84 from 1998 through 2001 and then fell to 0.55 mg/l in 2002. Total phosphorus rose steadily from 0.39 mg/l in 1998 to 0.53 mg/l in 2000 and then fell to 0.41 mg/l in 2002. Total suspended solids ranged from 118 mg/l to 123.5 mg/l from 1998 to 2000, rose to 133 mg/l in 2001 and then fell to 73 mg/l in 2002. All parameters fell from 2002 to 2003; Nitrate nitrogen fell to 2.04 mg/l, Total Kjeldahl Nitrogen to 0.5 mg/l, total phosphorus to 0.22 mg/l and total suspended solids to 41 mg/l. AWRC found that total phosphorus loads increased by 70,000 kg/year from 1997-1999 and then decreased by about 30,000 kg/year from 1999 to 2003. These variations in average concentration and loading are most likely highly correlated with runoff volume, but overall, suggest that phosphorus loading is continuing to increase over time.

In 2003, the Arkansas Department of Environmental Quality assessed water quality and biological integrity of sites located in the Illinois River watershed to determine attainment for aquatic life use and discern if municipal point sources negatively impacted water quality downstream (Parsons. 2004). They found that low dissolved oxygen and exceedences of Arkansas' 24-hour dissolved oxygen fluctuation standard subjected aquatic life to stress. This study also found that nutrient levels and total dissolved solids were consistently higher at sites downstream of wastewater treatment plants (WWTP) as opposed to sites upstream of the plants. Fourteen percent of the TDS samples exceeded Arkansas' standards. Total phosphorus frequently surpassed Arkansas' 0.1 mg/l standard—most notably at every site located immediately downstream of a WWTP. This study found that nutrient loading at the sites selected was due to WWTP discharge and noted that these findings could be influenced by the nature of the low flow condition sampling. The two sites on the Illinois River immediately upstream of Oklahoma yielded results indicating that they had habitats supportive of aquatic life, despite high phosphorus levels and an overabundance of periphyton. The lack of many sensitive macroinvertebrate species was noted as a concern. Sedimentation and alteration of the hydrologic regime were proposed reasons for the reduced numbers of pollution-intolerant species. Urban and agricultural sediment loads contributed phosphorus to the stream, while decreasing valuable habitat for aquatic organisms. Thus, in the headwaters, sediment is considered to be the pollutant of greatest concern, as opposed to lower in the watershed, where phosphorus is the pollutant of concern.

Studies prior to this found that in-stream sediments acted as a phosphorus sink at sites immediately downstream of WWTPs, releasing high levels of phosphorus to the streams (Parsons. 2004). Another Arkansas study compared total phosphorus data from previous studies with results from recent collections. The results indicated that total phosphorus concentrations in storm flow had decreased while those of base flow remained stable, suggesting that best management practices in the watershed were reducing the amount of total phosphorus reaching the Illinois River (Parsons. 2004).

The United States Geological Survey (USGS) performed a study to determine the status of water quality at Oklahoma sites in the Illinois River basin from 1997-2001 (Pickup et al. 2003). Their findings indicated that runoff-events resulted in increased phosphorus concentrations. Release of phosphorus from the streambed, eroding stream banks, and contributions of phosphorus by nonpoint sources could all factor in this result. Increasing base-flow yielded reduced phosphorus concentrations due to dilution. Both mean annual phosphorus loads and base-flow phosphorus loads tended to be greater at the sites located on the Illinois River than those on Flint Creek or Baron Fork. Phosphorus loading was highest in the spring and the lowest in autumn.

In order to monitor progress towards the 40% phosphorus load reduction goal, Oklahoma and Arkansas, through the Arkansas-Oklahoma Compact Commission, have focused on eight sites in the Illinois River basin, using data from 1980 to the present (OWRB. 2004). Four of these sites are in Oklahoma; two at USGS sites on the Illinois River, one near Watts and the other near Tahlequah. These two sites yielded similar results in total phosphorus loadings, with peaks in 1993 and declines in 1997. A gradual increase in loadings from 1998 through 2001 occurred at the site located near Watts, with levels reducing from 2001 to 2003. The highest level during this time was 200,549 Pt kg/year in 2001, falling to the lowest level of 48,035 Pt kg/year in 2003. The site at Tahlequah increased rapidly from 1998 to 1999, falling gradually to 145,766 Pt kg/year in 2001. After a brief increase from 2001 to 2002, total phosphorus loadings fell to 42,690 Pt kg/year in 2003 in conjunction with a corresponding decrease in stream flow. Once again, these variations in loading are highly correlated with runoff and rainfall volumes. For instance, 2003 was a much drier year than 2001 or 2002.

At the USGS site located on Flint Creek near Kansas, total phosphorus loading increased from 1980 through 1985, with a very rapid rise in the loadings occurring from 1983 to 1985 when loadings rose from 12,415 Pt kg/year to 47,591 Pt kg/year (OWRB. 2004). A rapid decrease in total phosphorus loading took place from 1985 to 1987 when total phosphorus loadings fell to 19,840 Pt kg/year, with another rise in levels from 1987 to 1989. After a hiatus in monitoring, total phosphorus loadings appeared to have decreased upon the resumption of monitoring in 1993. Levels ranged from 9,871 Pt kg/year to 25,359 Pt kg/year, with annual increases and decreases in loading between 1993 and 2003.

The final Oklahoma site in this study was located on Baron Fork at Eldon (OWRB. 2004). This site also saw variable total phosphorus loadings, with levels increasing from 1991 to 1993, falling from 1993 to 1994, and peaking at 98,819 Pt kg/year in 1995.

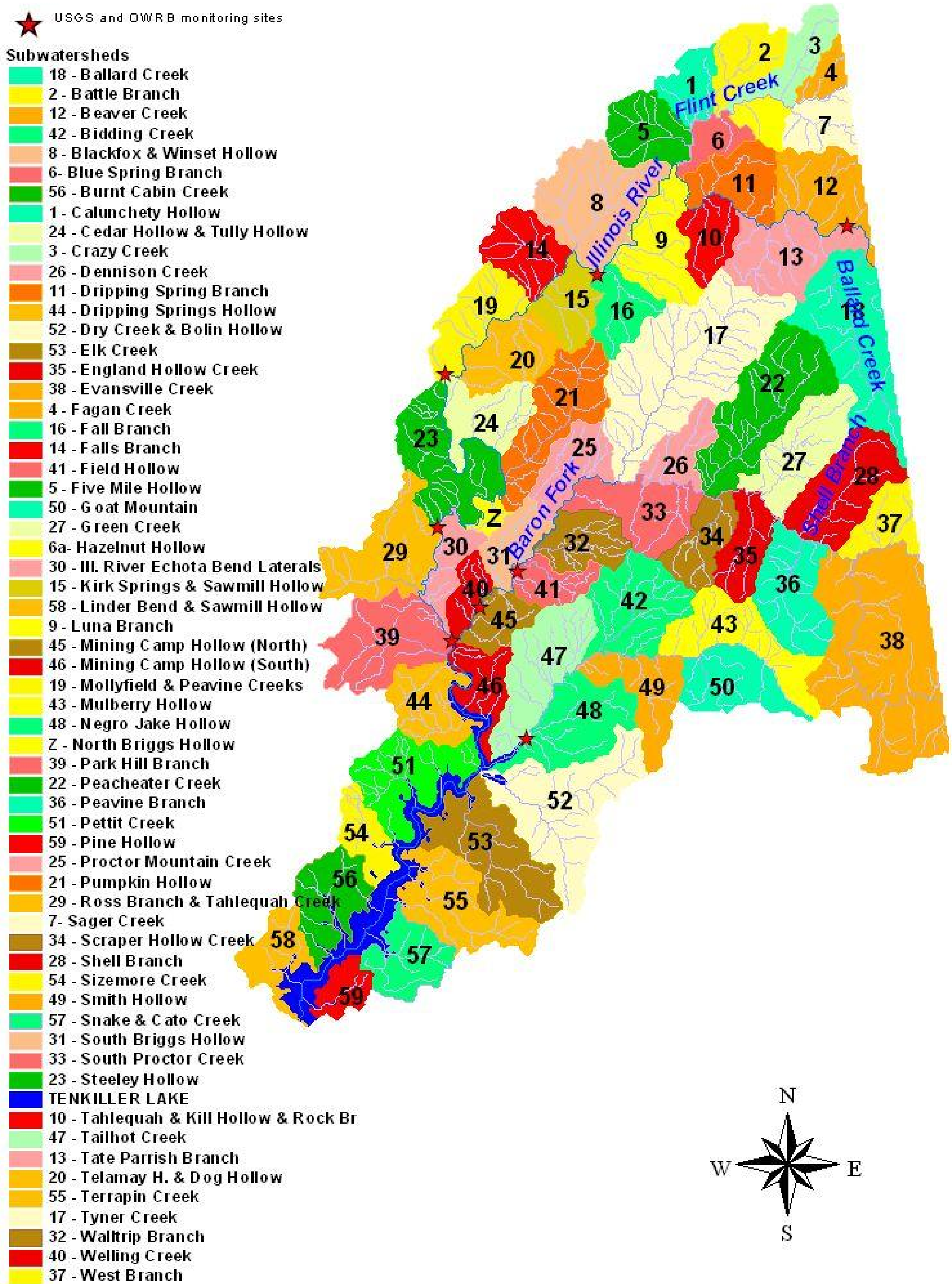
Loadings significantly decreased in 1996, with the lowest level reported in 1997 when levels decreased to 6,671 Pt kg/year. After a gradual increase over the years from 1997 to 2000, levels began to decrease, achieving a new low of 3,237 Pt kg/year in 2003, also associated with a corresponding decrease in flow. Both this site and Flint Creek near Kansas had lower loadings than either site on the Illinois River.

Project-Related Water Quality Summary

Many state and federal agencies, as well as universities, local governments, tribes, and private citizens have collected water quality and supporting data in the Illinois River Basin. The OWRB and USGS had developed rather extensive monitoring programs in the watershed that were being used to provide information related to beneficial use support, water quality trends, progress towards meeting the 40% phosphorus load reduction agreed upon by Oklahoma and Arkansas, and for other purposes related to watershed issues. Because of the size of the watershed, and the funding that would be necessary to develop a solely NPS-based water quality monitoring network associated with the project, it was determined that the project would rely upon existing water quality monitoring programs. This would allow more project funds to go toward installation of BMPs and load reduction activities.

OCC analyzed data collected by the USGS and the Oklahoma Water Resources Board (OWRB) concurrent with project efforts and at stations potentially affected by the project in order to determine whether project activities would show measurable water quality results during the project period. Three of the sites analyzed in the Arkansas-Oklahoma Compact Study occur in Adair and Cherokee Counties, the focus area of this project. Those are the sites on the Illinois River near Watts and near Tahlequah, and Baron Fork near Eldon. Both base flow and high flow data from these three sites were used in this analysis, in addition to data from five other USGS stations. Those include sites on the Illinois River near Chewey, near Moodys, and near Park Hill and a site on Caney Creek near Barber (Figure 1). Data from 1999 through 2004 was obtained for these sites. The USGS discontinued monitoring the Illinois River site near Chewey in 2000, Baron Fork near Welling in 2001, and the remaining sites in 2002. The OWRB has monitored the Illinois River sites near Watts and near Tahlequah, Baron Fork near Eldon, and Caney Creek near Barber through 2004. Water quality data used for this analysis is included in Appendix A.

In comparing the general trends of the parameters over time, two sites on the Illinois River (near Watts and near Tahlequah) were selected as both sites had been monitored for a longer time and included dates after 2002. Additionally, the site on Caney Creek near Barber was also selected because monitoring spanned a longer time frame and the site could allow comparison with the Illinois River.



Illinois River Subwatersheds.

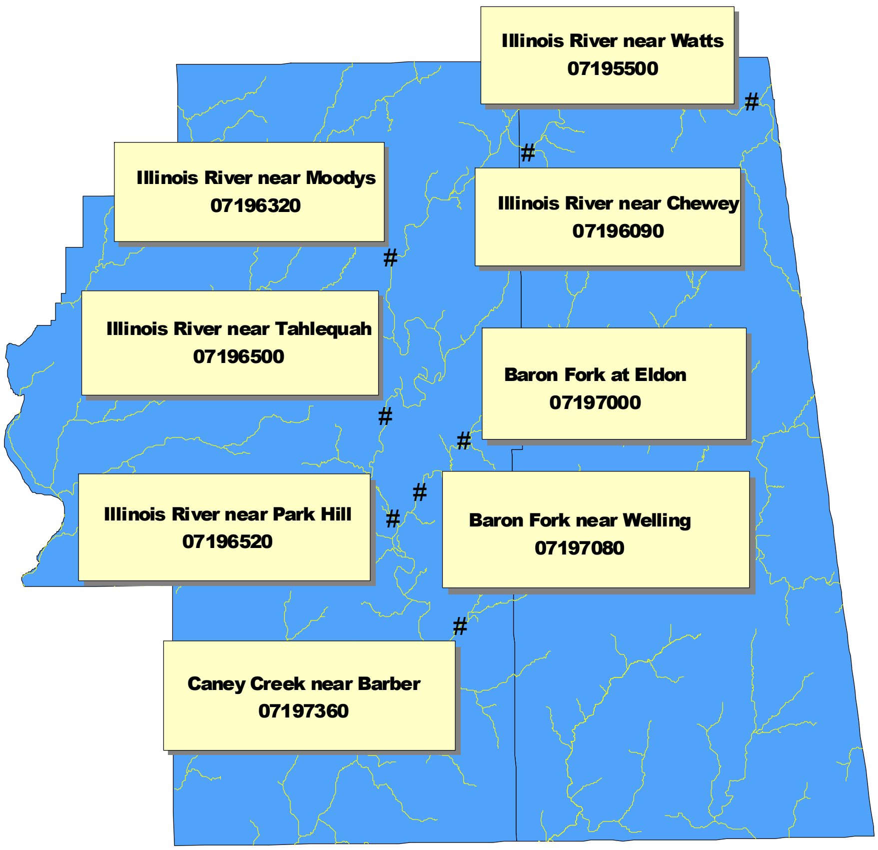


Figure 2: Cherokee and Adair Counties contained the USGS sites used in the data analyses.

The site on the Illinois River near Moodys generally had higher discharge than the other sites (Table 1, Figure 3). Discharge on the Illinois River in Oklahoma increased from the site near Watts until it reached Moodys and then began to decrease, reaching lowest levels at the site near Park Hill. These variations suggest that the Illinois River at Tahlequah may be a losing stream while at Moodys it is a gaining stream. Discharge impacts the effect of nutrients on streams; low discharge allows equivalent concentrations of nutrients to have greater localized effects (higher primary productivity and associated dissolved oxygen swings and other problems) than at higher discharge. Higher may or may not coincide with higher concentrations of nutrients, but almost always coincide with higher loading rates that impact downstream Lake Tenkiller.

Table 1: Summary statistics of instantaneous discharge in cfs at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	86	260	815	2497	2410	24100	55
Illinois River near Chewey	117	314	1110	3861	4130	34700	57
Illinois River near Moodys	223	1501	3665	5507	9868	16800	14
Illinois River near Tahlequah	91	340	970	3580	2710	33900	57
Illinois River near Park Hill	168	353	558	495	656	772	17
Caney Creek near Barber	11	25	56	190	110	3250	41

Baron Fork near Eldon	27	110	231	2035	985	49100	55
Baron Fork near Welling	32	56	202	751	571	4790	15

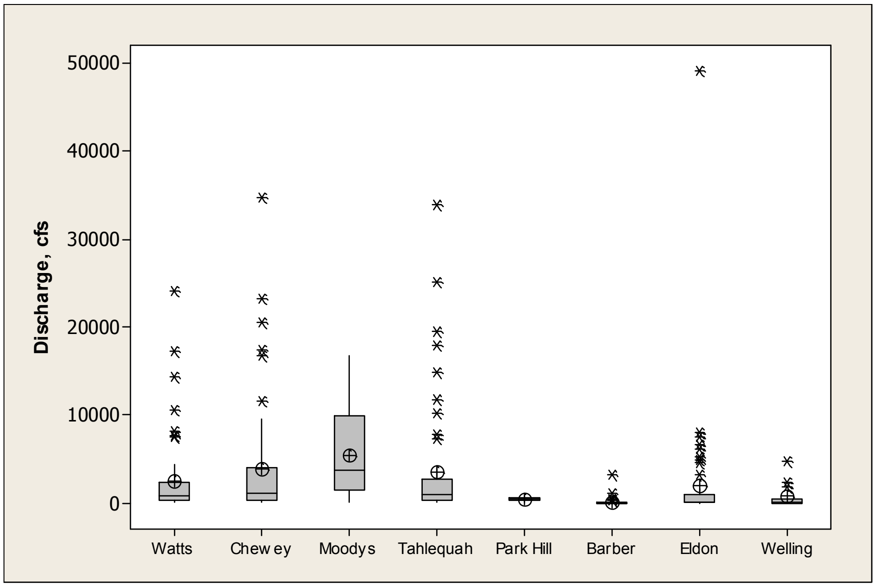


Figure 3: Interquartile ranges, means and outliers of instantaneous discharge in cfs of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on the Illinois River near Moodys had higher discharge, while the site Caney Creek near Barber reported the least.

Dissolved oxygen (D.0.) levels were generally at appropriate levels to support aquatic biota (Table 2, Figure 4). The minimum reported D.O. concentrations at the sites on the Illinois River near Chewey and Park Hill and Baron Fork near Welling were still safe for aquatic life (Table 2). The only site to fall below 4.0 mg/l D.O. was Caney Creek near Barber (Table 2). From 1999 to 2004, D.O. levels appear to have remained relatively consistent, with no clearly discernible trend (Figure 5).

Table 2: Summary statistics of dissolved oxygen in mg/L at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	4.51	7.90	9.08	9.38	10.32	15.82	110
Illinois River near Chewey	6.40	7.68	8.90	9.60	11.20	16.40	58
Illinois River near Moodys	5.70	6.88	10.05	9.24	10.50	12.2	14
Illinois River near Tahlequah	4.66	7.13	8.97	9.14	10.78	14.09	112
Illinois River near Park Hill	7.60	9.00	9.80	10.31	12.05	13.50	17
Caney Creek near Barber	3.94	7.92	9.70	9.50	10.90	15.40	87
Baron Fork near Eldon	4.43	7.70	9.11	9.02	10.40	13.23	111
Baron Fork near Welling	7.10	8.90	10.70	10.58	12.30	13.80	15

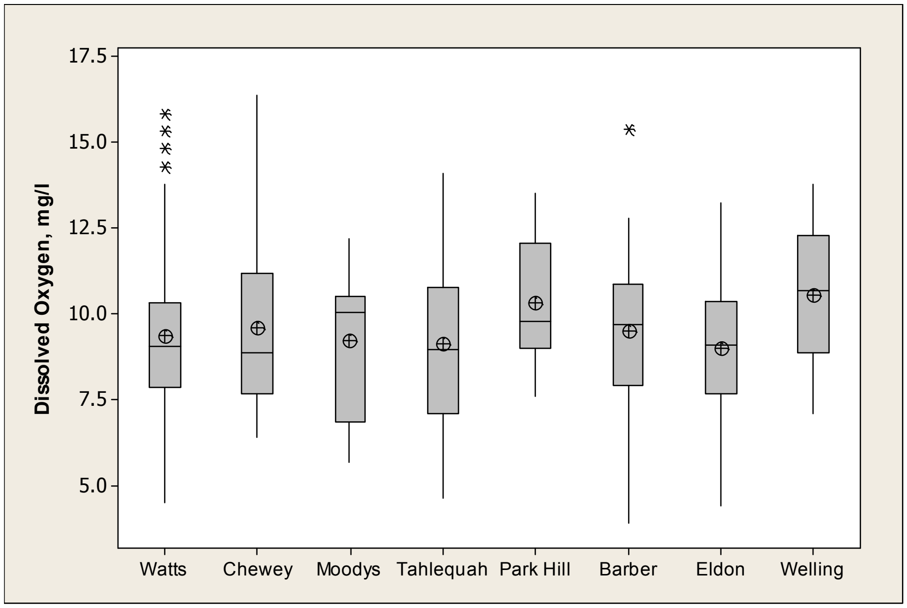


Figure 4: Interquartile ranges, means and outliers of dissolved oxygen in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on Baron Fork near Welling consistently had higher dissolved oxygen concentrations, while the site on the Illinois River near Tahlequah reported the least.

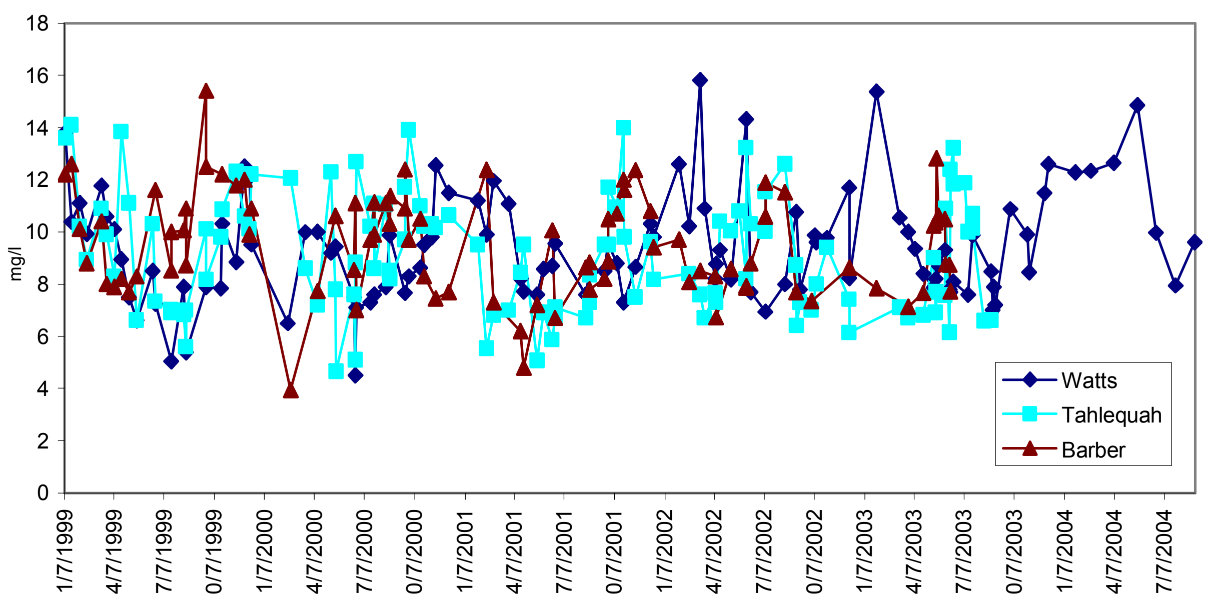


Figure 5: Dissolved oxygen for the sites on the Illinois River near Watts and near Tahlequah and the site on Caney Creek near Barber from 1999 through 2004. Dissolved oxygen levels have remained relatively consistent.

Dissolved nitrogen-ammonia concentrations were generally similar among sites with most remaining below 0.050 mg/l the majority of the time (Table 3, Figure 6). The highest reported concentration was 1.530 mg/l on Baron Fork near Eldon (Table 3). All other sites never surpassed 0.090 mg/l (Table 3). From 1999 to 2004, the sites on the Illinois River near Watts and near Tahlequah have remained stable with no obvious trend (Figure 7).

Table 3: Summary statistics of dissolved nitrogen ammonia in mg/l as N at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	0.007	0.040	0.050	0.050	0.050	0.267	104
Illinois River near Chewey	0.005	0.015	0.030	0.035	0.040	0.100	58
Illinois River near Moodys	0.030	0.040	0.040	0.050	0.060	0.090	14
Illinois River near Tahlequah	0.008	0.020	0.050	0.041	0.050	0.090	106
Illinois River near Park Hill	0.020	0.020	0.040	0.032	0.040	0.050	15
Caney Creek near Barber	0.020	0.040	0.050	0.041	0.050	0.060	81
Baron Fork near Eldon	0.005	0.030	0.050	0.055	0.050	1.530	104
Baron Fork near Welling	0.020	0.020	0.020	0.027	0.040	0.040	15

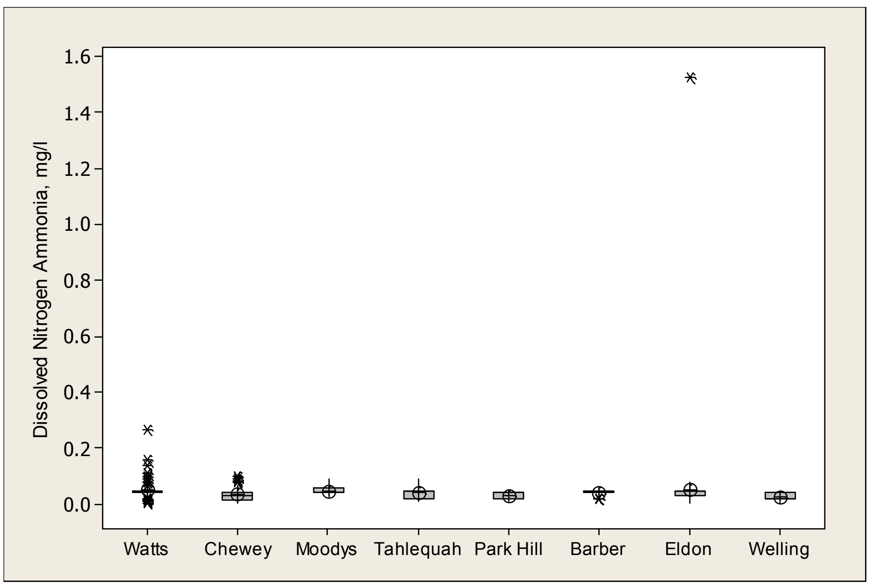


Figure 6: Interquartile ranges, means and outliers of dissolved nitrogen ammonia in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on Baron Fork near Welling reported the least.

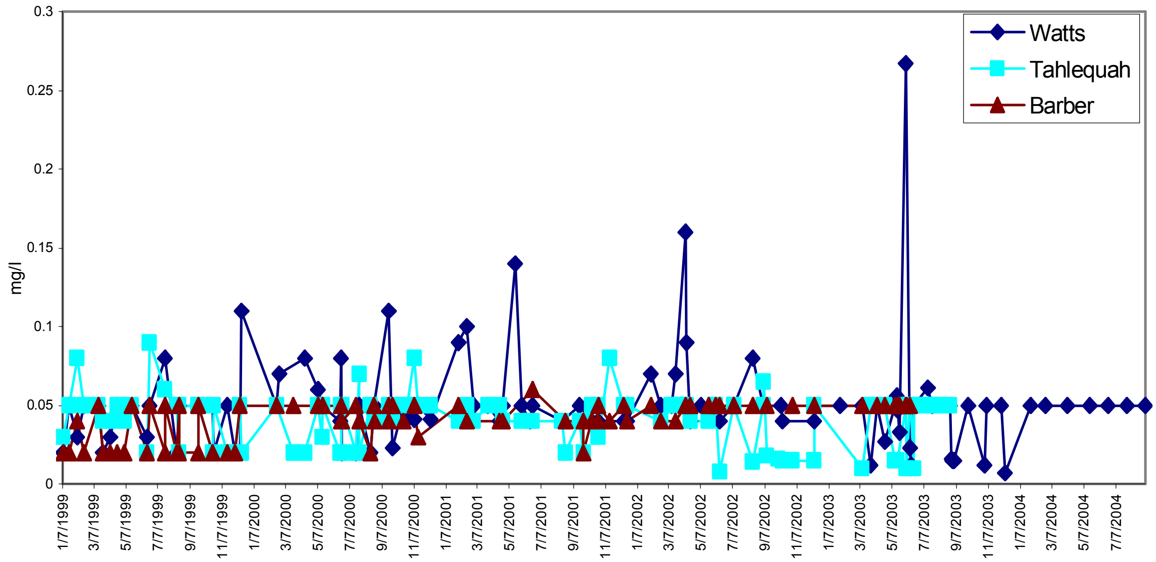


Figure 7: Dissolved nitrogen ammonia for the sites on the Illinois River near Watts and near Tahlequah and the site on Caney Creek near Barber from 1999 through 2004.

Concentrations of dissolved nitrogen ammonia have remained consistent.

Nitrogen-ammonia plus organic nitrogen concentrations were highest at the site on the Illinois River near Moodys and lowest at Baron Fork near Welling (Table 4, Figure 8). The site at Baron Fork near Eldon achieved the highest level at 4.400 mg/l, while the site on the Illinois River near Park Hill never exceeded 0.380 mg/l (Table 4). No obvious trend was evident for this parameter between 1999 and 2004 (Figure 9).

Table 4: Summary statistics of nitrogen ammonia plus organic total in mg/l as N at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	0.100	0.218	0.355	0.651	1.100	2.600	54
Illinois River near Chewey	0.110	0.198	0.305	0.694	1.125	2.600	58
Illinois River near Moodys	0.100	0.275	0.855	1.074	1.700	2.400	14
Illinois River near Tahlequah	0.070	0.183	0.280	0.536	0.688	3.100	56
Illinois River near Park Hill	0.120	0.160	0.180	0.201	0.230	0.380	15
Caney Creek near Barber	0.060	0.100	0.140	0.244	0.198	1.800	40
Baron Fork near Eldon	0.040	0.100	0.165	0.462	0.328	4.400	54
Baron Fork near Welling	0.040	0.090	0.120	0.250	0.250	1.300	15

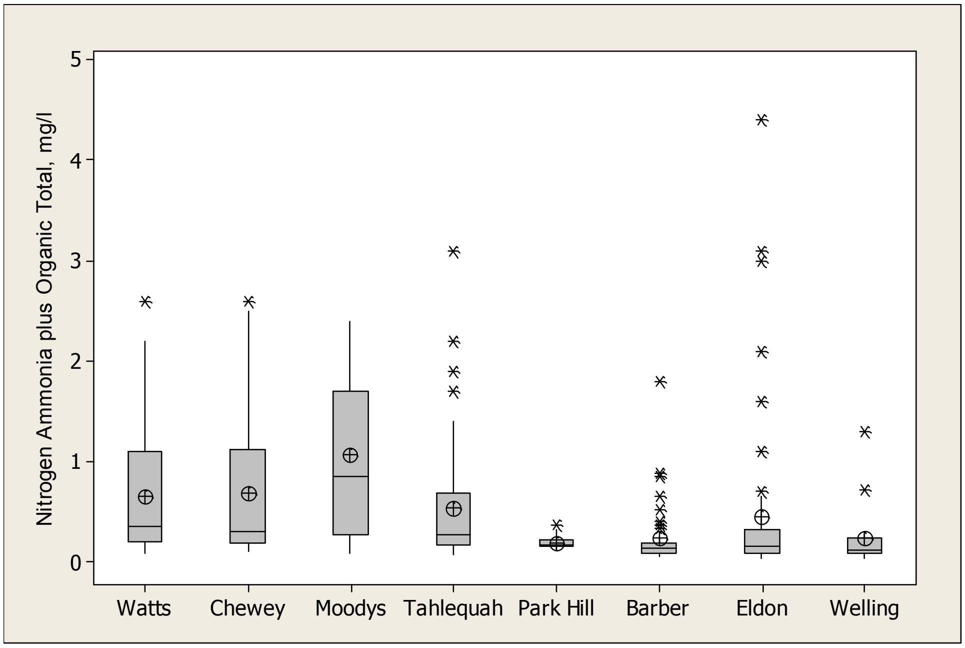


Figure 8: Interquartile ranges, means and outliers of nitrogen ammonia plus organic total in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on the Illinois River near Moodys exhibited the highest ammonia plus organic nitrogen concentration, while the site on Baron Fork near Welling reported the least.

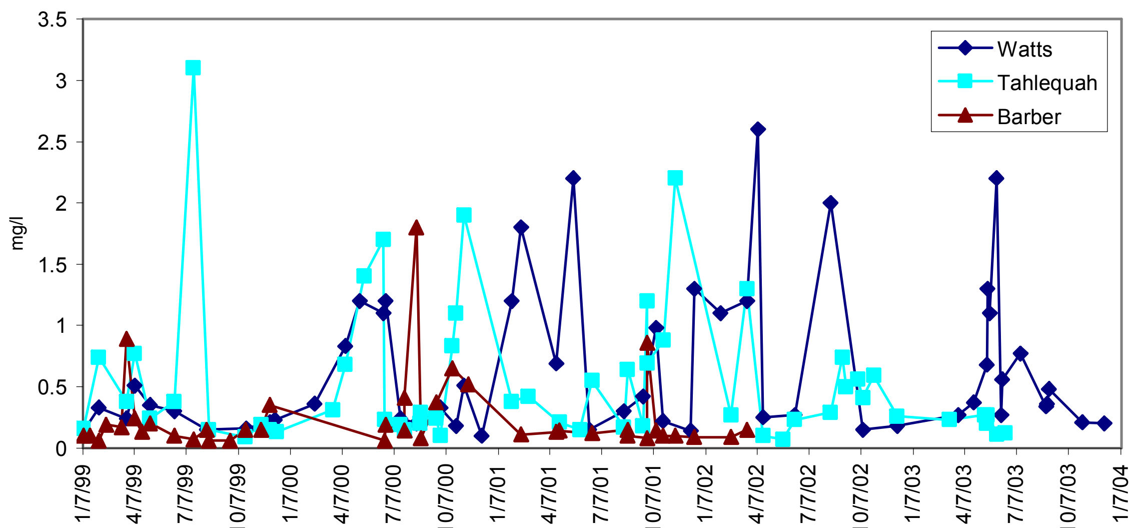


Figure 9: Nitrogen ammonia plus organic total for the sites on the Illinois River near Watts and near Tahlequah and the site on Caney Creek near Barber from 1999 through 2004.

Nitrite plus nitrate concentrations ranged from a low of 0.030 mg/l at the site on the Illinois River near Watts to 3.740 mg/l at the same site (Table 5). The site on the Illinois River near Moodys tended to have higher concentrations than the other sites (Table 5, Figure 10). Caney Creek near Barber reported the lowest concentrations of nitrite plus nitrate (Table 5, Figure 10). The concentrations at this site have remained about the same, exhibiting no obvious trend (Figure 11). The sites on the Illinois River appear to show a slight decline in this parameter (Figure 11). Of the nutrient or nutrient-related parameters, this is the only one to reflect any sort of trend.

Table 5: Summary statistics of dissolved nitrogen nitrite plus nitrate in mg/l as N at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	0.030	1.405	1.945	1.989	2.505	3.740	54
Illinois River near Chewey	0.402	1.463	1.920	1.857	2.215	3.120	58
Illinois River near Moodys	0.780	1.665	2.055	1.926	2.295	2.520	14
Illinois River near Tahlequah	0.098	1.338	1.550	1.567	1.838	2.820	56
Illinois River near Park Hill	0.330	1.250	1.650	1.589	1.930	2.810	15
Caney Creek near Barber	0.320	0.855	1.220	1.295	1.693	3.380	40
Baron Fork near Eldon	0.290	0.966	1.290	1.481	1.870	3.320	54
Baron Fork near Welling	0.480	0.720	1.280	1.419	2.440	2.790	15

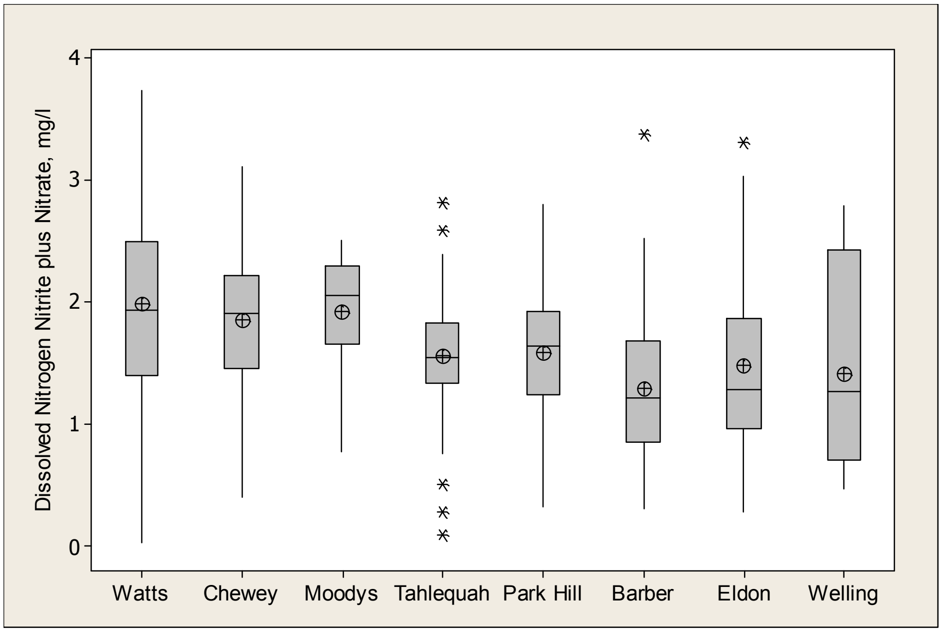


Figure 10: Interquartile ranges, means and outliers of dissolved nitrogen nitrite plus nitrate in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on the Illinois River near Moodys exhibited the highest nitrite plus nitrate concentration, while the site on Caney Creek near Barber reported the lowest.

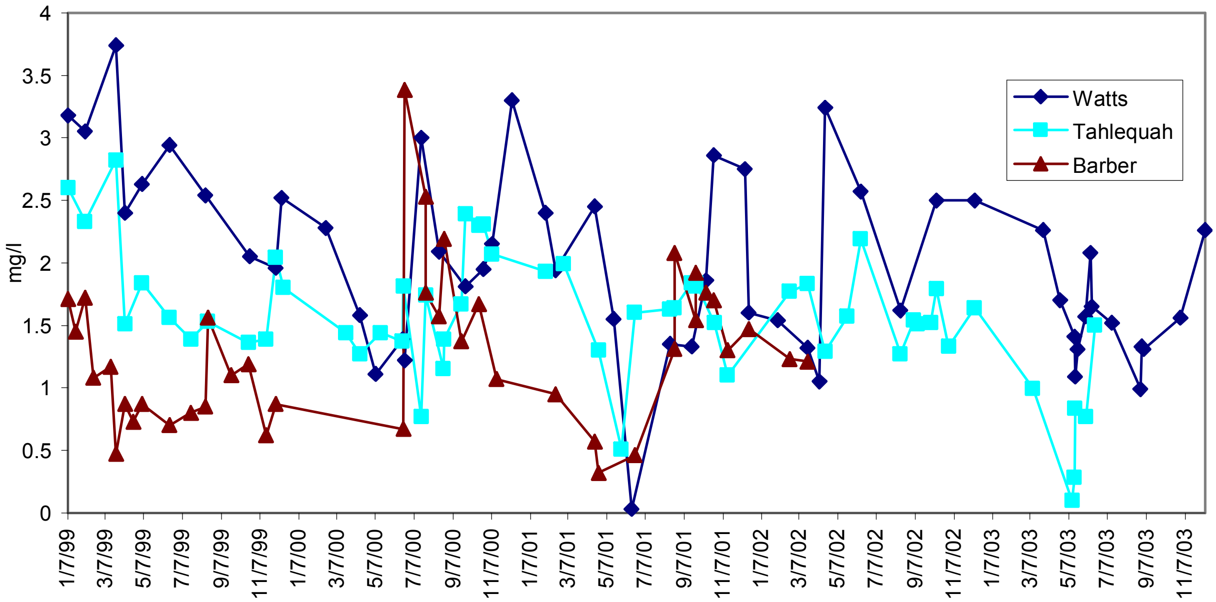


Figure 11: Dissolved nitrogen nitrite plus nitrate for the sites on the Illinois River near Watts and near Tahlequah and the site on Caney Creek near Barber from 1999 through 2004. The sites on the Illinois River exhibit a slight declining trend, while that of Caney Creek near Barber has remained nearly the same.

Nitrite levels at all sites remained below 0.050 mg/l (Table 6). The site maintaining higher levels was Caney Creek near Barber at 0.050 mg/l (Table 6, Figure 12). From 1999 to 2004 nitrite concentrations remained constant, exhibiting no trend (Figure 13).

Table 6: Summary statistics of dissolved nitrogen nitrite in mg/l as N at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	0.002	0.010	0.030	0.031	0.050	0.160	106
Illinois River near Chewey	0.002	0.006	0.009	0.009	0.010	0.038	58
Illinois River near Moodys	0.004	0.006	0.008	0.009	0.012	0.016	14
Illinois River near Tahlequah	0.002	0.008	0.020	0.029	0.050	0.060	107
Illinois River near Park Hill	0.003	0.005	0.008	0.008	0.010	0.013	15
Caney Creek near Barber	0.003	0.008	0.050	0.031	0.050	0.070	87
Baron Fork near Eldon	0.001	0.008	0.020	0.029	0.050	0.060	107
Baron Fork near Welling	0.005	0.010	0.010	0.011	0.010	0.030	15

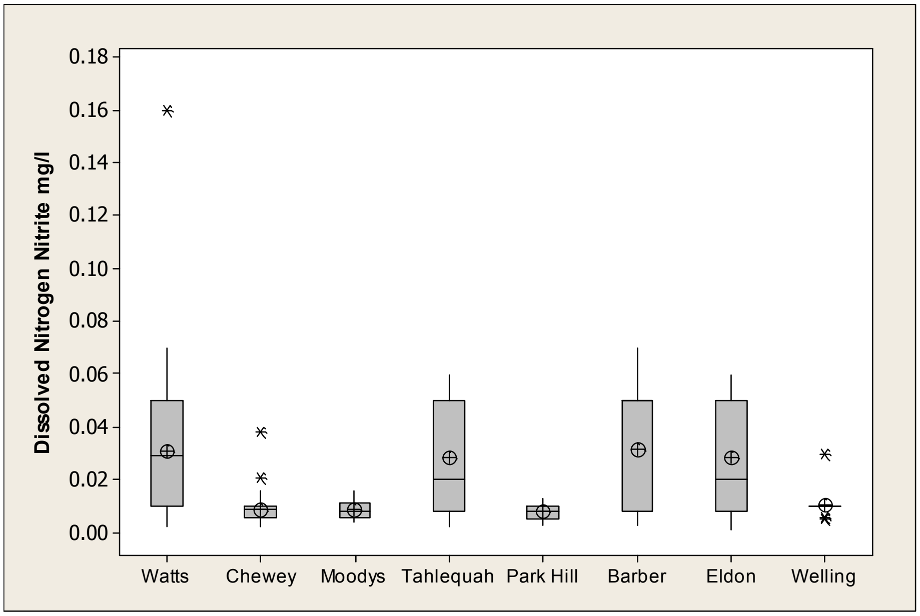


Figure 12: Interquartile ranges, means and outliers of dissolved nitrogen nitrite in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on Caney Creek near Barber exhibited the highest nitrite concentrations, while the sites on the Illinois River near Moodys and near Park Hill reported the lowest.

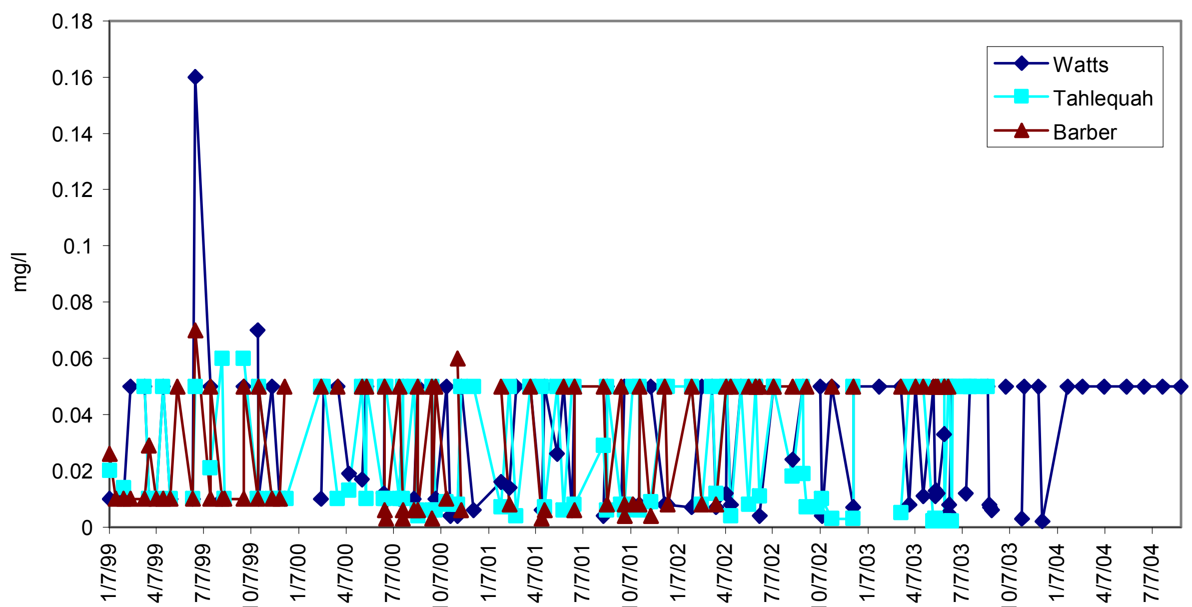


Figure 13: Dissolved nitrogen nitrite for the sites on the Illinois River near Watts and near Tahlequah and the site on Caney Creek near Barber from 1999 through 2004. Dissolved nitrogen nitrite levels have remained consistent.

Dissolved phosphorus levels were higher at all sites on the Illinois River than those on the Baron Fork or Caney Creek (Table 7, Figure 14). The site on the Illinois River near Watts had the highest measured concentration at 0.680 mg/l (Table 7). Caney Creek near Barber tended to have the lowest dissolved phosphorus levels, never exceeding 0.09 mg/l (Table 7). Over time (1999 to 2004), dissolved phosphorus concentrations showed no obvious trend (Figure 15).

Table 7: Summary statistics of dissolved phosphorus in mg/l as P at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	0.227	0.130	0.210	0.227	0.300	0.680	54
Illinois River near Chewey	0.185	0.132	0.181	0.185	0.230	0.380	58
Illinois River near Moodys	0.205	0.175	0.210	0.205	0.253	0.280	14
Illinois River near Tahlequah	0.132	0.090	0.125	0.133	0.160	0.330	56
Illinois River near Park Hill	0.082	0.070	0.080	0.082	0.100	0.130	15
Caney Creek near Barber	0.049	0.040	0.050	0.049	0.060	0.090	40
Baron Fork near Eldon	0.061	0.030	0.050	0.061	0.060	0.270	54
Baron Fork near Welling	0.060	0.040	0.050	0.060	0.060	0.120	15

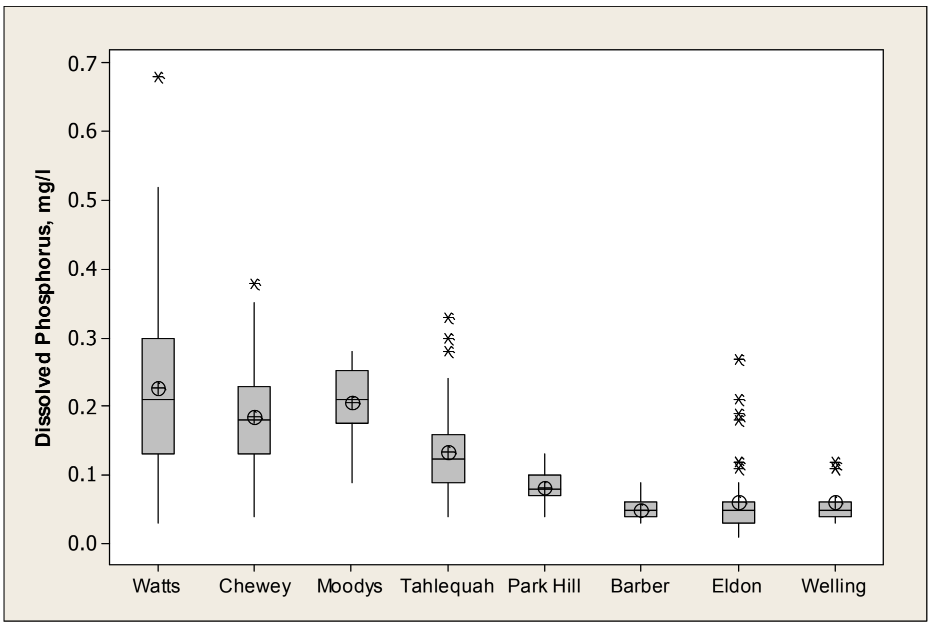


Figure 14: Interquartile ranges, means and outliers of dissolved phosphorus in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the sites on the Illinois River near Watts and near Moodys exhibited the highest dissolved phosphorus concentrations, while the Baron Fork sites and the site on Caney Creek near Barber reported the lowest.

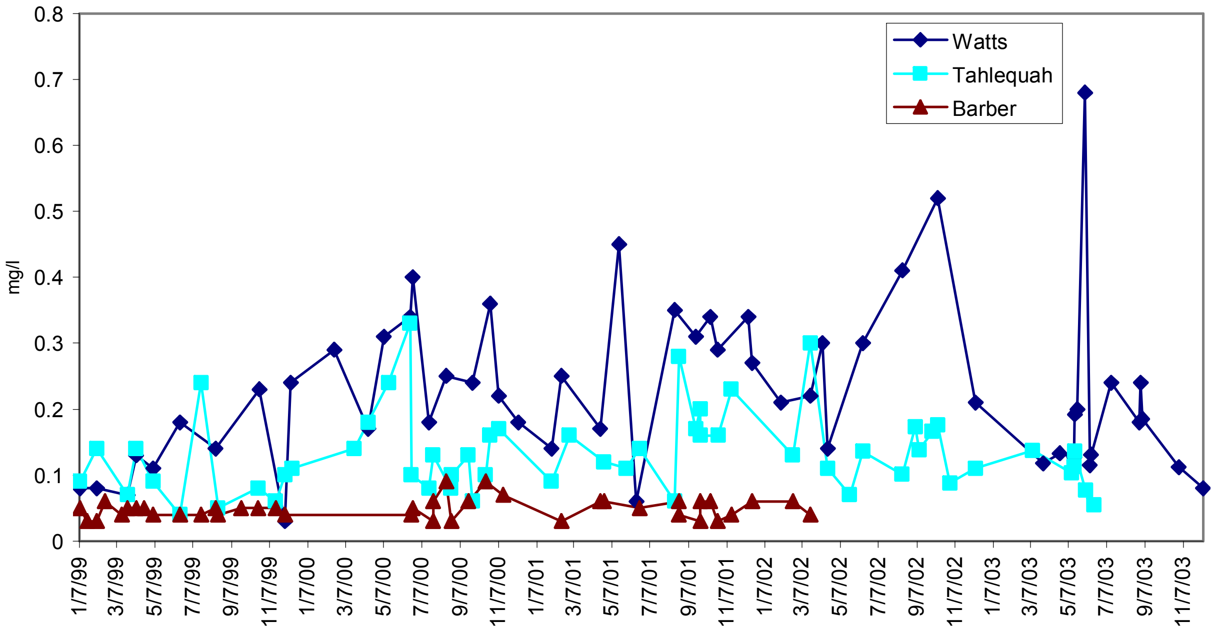


Figure 15: Dissolved phosphorus for the Illinois River near Watts and near Tahlequah and Caney Creek near Barber from 1999 through 2004. Dissolved phosphorus levels displayed no obvious trend during the project period.

Orthophosphate concentrations were highest on Caney Creek near Barber and the Illinois River near Watts (Table 8, Figure 16). The site on the Illinois River near Moodys generally maintained higher orthophosphate levels than the other sites. All sites on the Illinois River had higher concentrations of orthophosphate than the sites on Baron Fork or Caney Creek (Table 8, Figure 16). No discernible trend was obvious in orthophosphate levels between 1999 and 2004 (Figure 17).

Table 8: Summary statistics of dissolved phosphorus orthophosphate in mg/l as P at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	0.010	0.109	0.180	0.192	0.250	0.620	107
Illinois River near Chewey	0.031	0.120	0.164	0.167	0.203	0.320	58
Illinois River near Moodys	0.090	0.160	0.190	0.191	0.225	0.300	14
Illinois River near Tahlequah	0.018	0.070	0.098	0.102	0.126	0.280	109
Illinois River near Park Hill	0.040	0.070	0.070	0.079	0.100	0.140	15
Caney Creek near Barber	0.010	0.023	0.030	0.041	0.039	0.641	86
Baron Fork near Eldon	0.005	0.018	0.022	0.034	0.034	0.240	108
Baron Fork near Welling	0.010	0.020	0.020	0.035	0.050	0.100	15

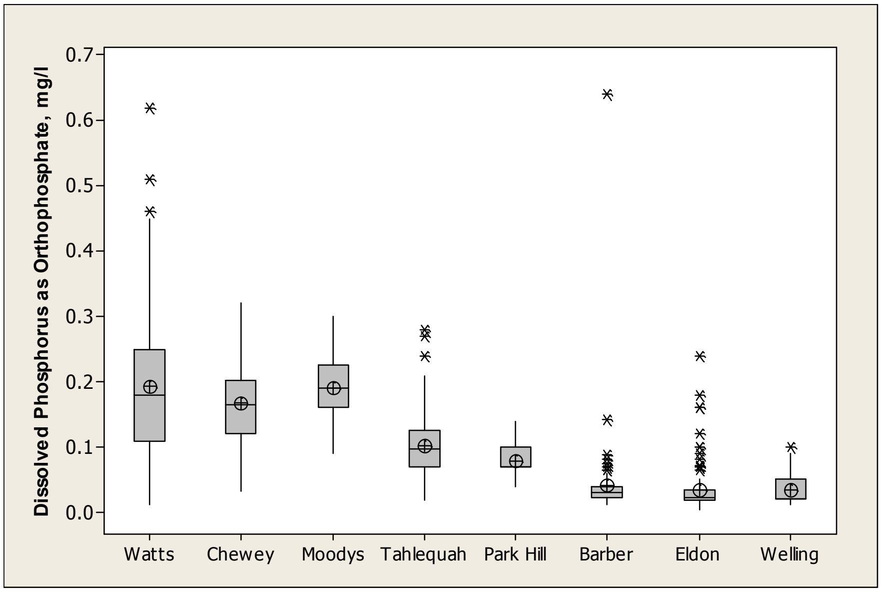


Figure 16: Interquartile ranges, means and outliers of orthophosphate in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on the Illinois River near Moodys exhibited the highest orthophosphate concentration, while Baron Fork near Welling reported the lowest.

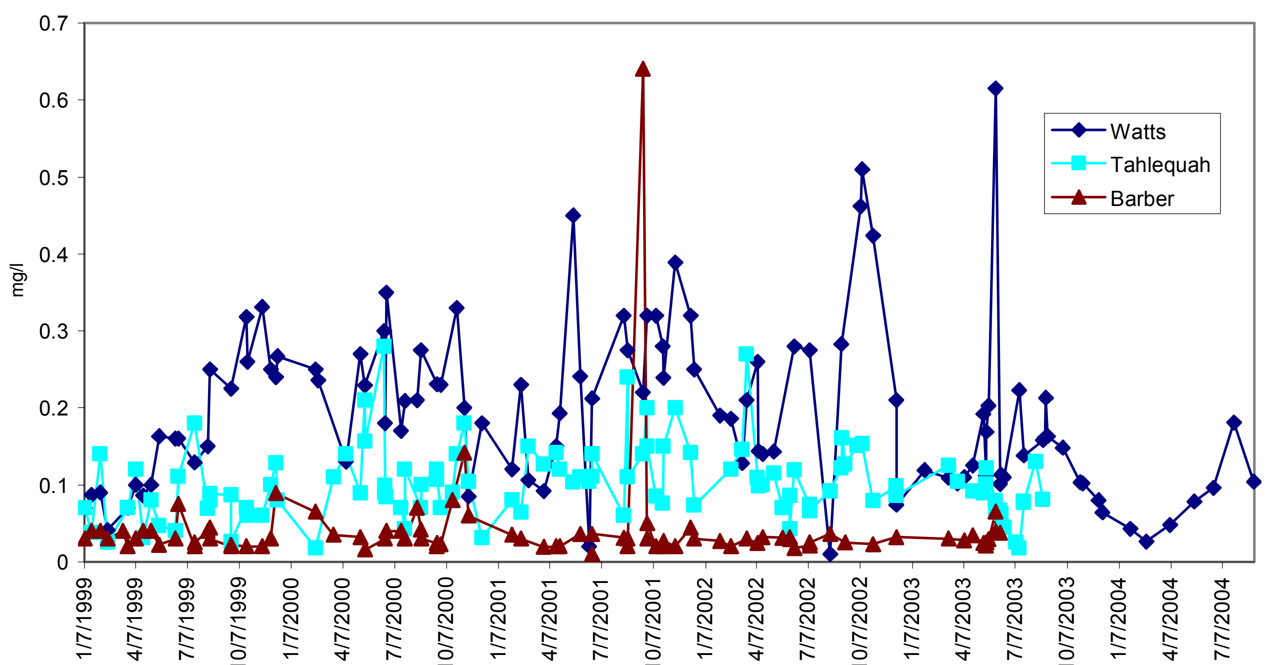


Figure 17. Dissolved orthophosphate for the sites on the Illinois River and Caney Creek from 1999 through 2004. While rates have fluctuated, no significant trend was apparent.

Total phosphorus for all sites typically exceeds Oklahoma's Scenic River 0.037 mg/l standard. The site on the Illinois River near Moodys maintained higher total phosphorus levels than the other sites (Table 9, Figure 18). All sites on the Illinois River were higher than those on Baron Fork or Caney Creek. High levels of total phosphorus, as well as the other nutrients mentioned above, contribute to the growth of algae and can allow them to reach harmful levels. Total phosphorus concentrations on the Illinois River at the sites near Watts, Chewey, Moodys, and Tahlequah are all above 0.1 mg/l. Total phosphorus concentrations have not exhibited a discernible change from 1999 to 2004 (Figure 19).

Table 9: Summary statistics of total phosphorus in mg/l as P at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	0.037	0.160	0.250	0.296	0.357	1.153	106
Illinois River near Chewey	0.051	0.151	0.215	0.314	0.423	0.960	58
Illinois River near Moodys	0.100	0.235	0.410	0.427	0.585	0.820	14
Illinois River near Tahlequah	0.032	0.094	0.130	0.180	0.182	1.140	105
Illinois River near Park Hill	0.050	0.080	0.090	0.092	0.110	0.130	15
Caney Creek near Barber	0.022	0.038	0.050	0.089	0.060	1.532	83
Baron Fork near Eldon	0.005	0.029	0.040	0.102	0.070	1.650	104
Baron Fork near Welling	0.030	0.050	0.050	0.093	0.060	0.490	15

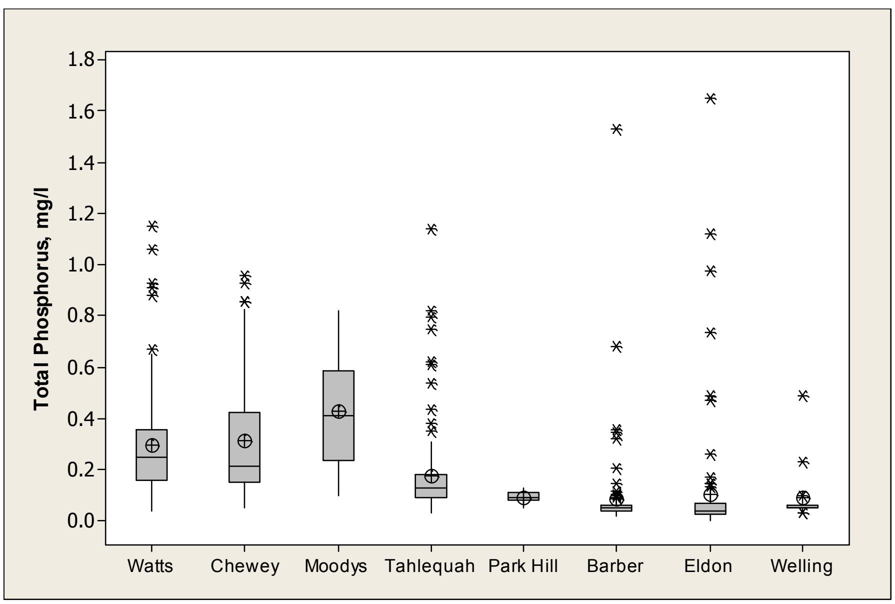


Figure 18: Interquartile ranges, means and outliers of total phosphorus in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on the Illinois River near Moodys consistently exhibited the highest total phosphorus concentrations, while the site on Caney Creek near Barber reported the lowest.

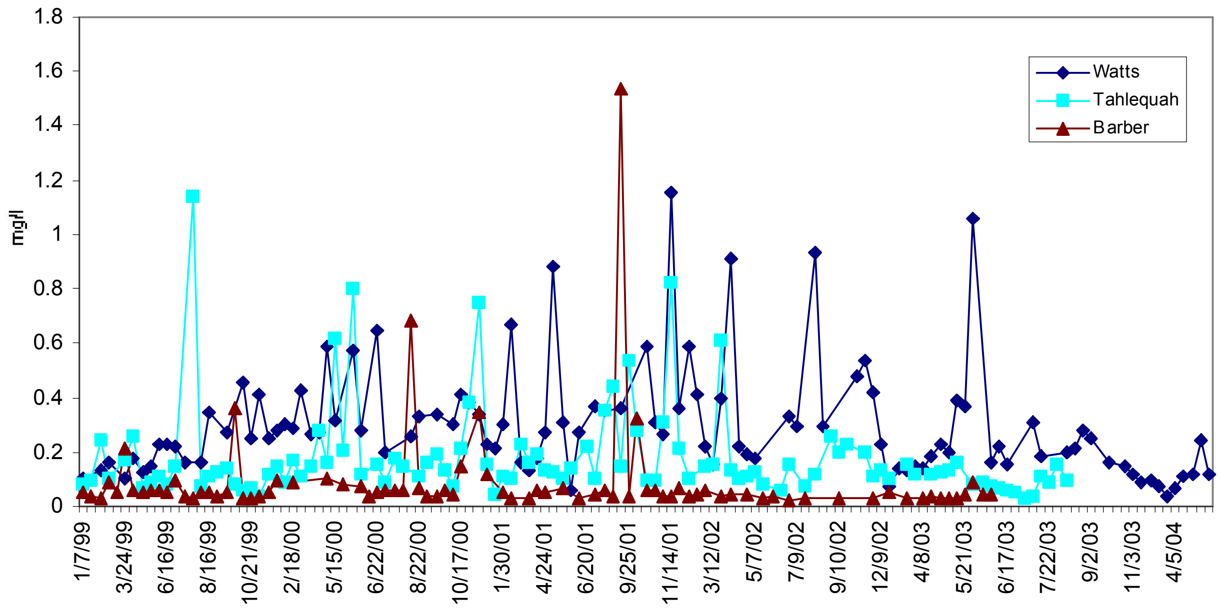


Figure 19: Total phosphorus for the sites on the Illinois River near Watts and near Tahlequah and the site on Caney Creek near Barber from 1999 through 2004. While rates have fluctuated, total phosphorus concentrations have remained relatively consistent.

The percentage of sediments finer than 0.062 mm were highest at the site on the Illinois River near Watts and Baron Fork near Welling and lowest at Caney Creek near Barber (Table 10, Figure 20). Excluding the site on Caney Creek, the sites generally had similar levels of fine sediments. The percentage of fine sediments has remained relatively consistent from 1999 to 2004 (Figure 21).

Table 10: Summary statistics of the percentage of suspended sediment finer than 0.062 mm sieve diameter at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	75	94	96	95	98	100	50
Illinois River near Chewey	24	91	93	90	97	100	51
Illinois River near Moodys	84	88	95	93	97	100	14
Illinois River near Tahlequah	72	89	92	92	97	100	53
Illinois River near Park Hill	84	93	94	94	97	99	14
Caney Creek near Barber	71	72	81	82	94	96	4
Baron Fork near Eldon	62	83	92	90	97	100	50
Baron Fork near Welling	87	88	96	94	100	100	7

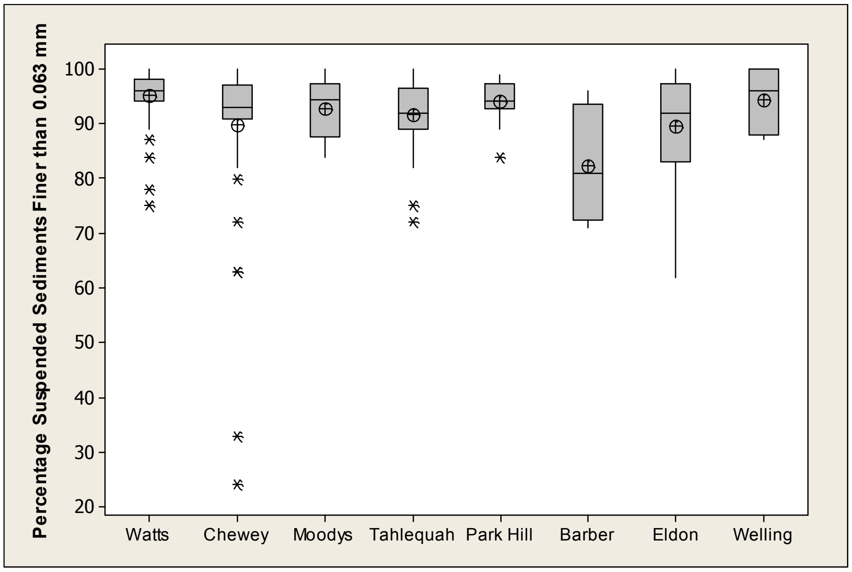


Figure 20: Interquartile ranges, means and outliers of fine sediments of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on the Illinois River near Watts and the site on Baron Fork near Welling exhibited the highest concentration of fine sediments, while the site on Caney Creek near Barber reported the least.

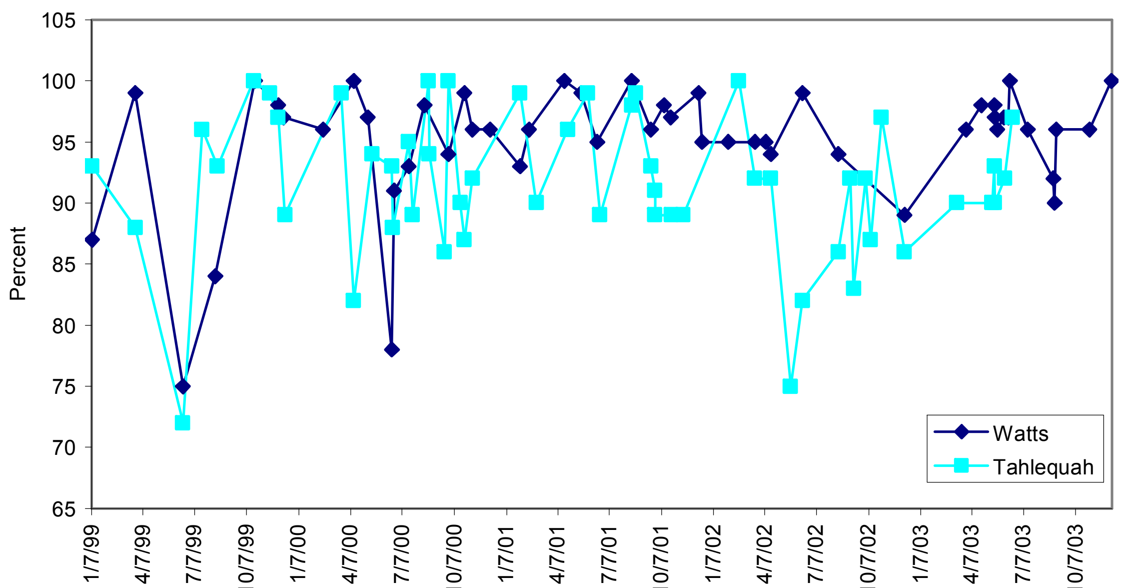


Figure 21: Suspended sediment finer than 0.062 mm sieve diameter for the sites on the Illinois River near Watts and near Tahlequah from 1999 through 2004. Fine suspended sediments have remained relatively consistent through the project period.

Suspended sediment was much higher at the Illinois River near Moodys in comparison to the other sites (Table 11, Figure 22). Baron Fork near Welling regularly exhibited lower suspended sediment concentrations than the other sites, while the site at Baron Fork near Eldon exhibited the most variation. From 1999 to 2004, the sites on the Illinois River near Watts and Tahlequah did not show a discernible trend (Figure 23).

Table 11: Summary statistics of suspended sediment in mg/l at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	3	40	62	128	185	689	50
Illinois River near Chewey	1	25	37	146	261	713	51
Illinois River near Moodys	24	34	159	270	470	712	14
Illinois River near Tahlequah	1	27	37	112	92	869	53
Illinois River near Park Hill	19	22	27	27	33	39	14
Caney Creek near Barber	51	53	86	279	699	894	4
Baron Fork near Eldon	1	17	23	156	58	1760	50
Baron Fork near Welling	15	15	16	17	19	20	7

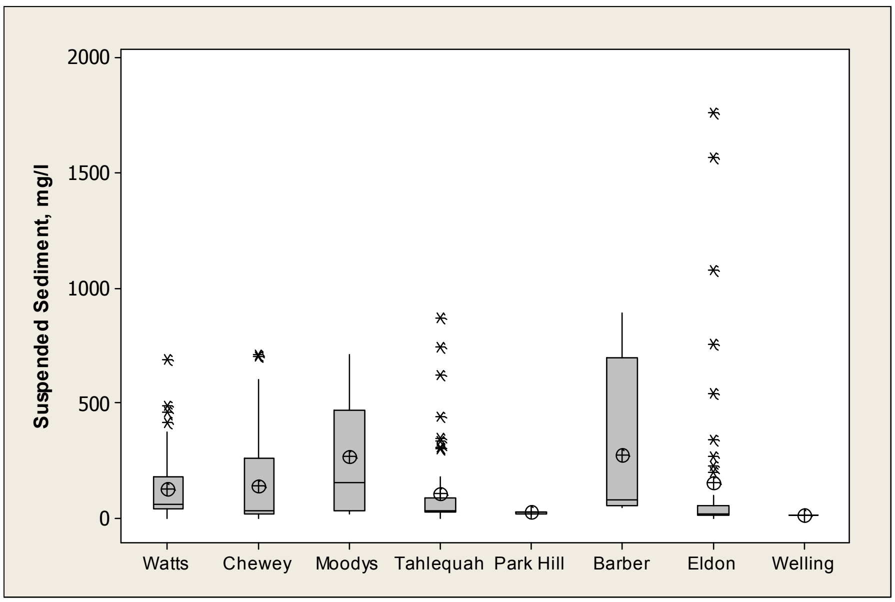


Figure 22: Interquartile ranges, means and outliers of suspended sediment in mg/l of sites on the Illinois River, Baron Fork, and Caney Creek indicated that the site on the Illinois River near Moodys exhibited the highest concentration of suspended sediments, while the site on Baron Fork near Welling reported the least.

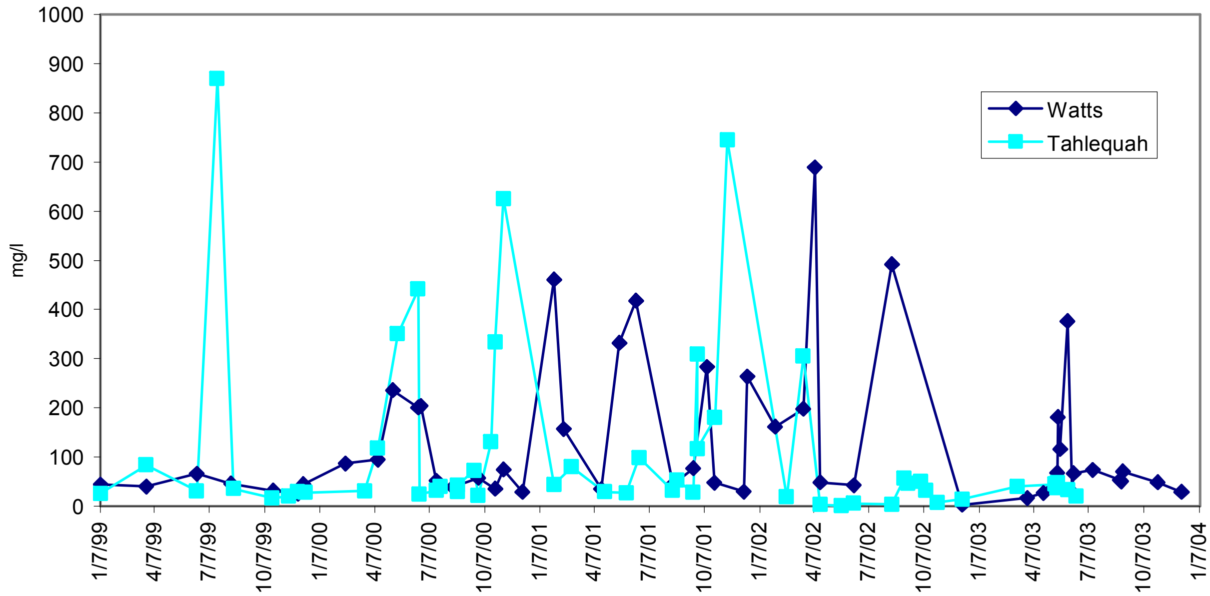


Figure 23: Total suspended sediments for the sites on the Illinois River near Watts and near Tahlequah from 1999 through 2004. While rates have fluctuated, total suspended sediments have remained relatively consistent.

Dissolved solids data was only available for the sites on the Illinois River near Watts and near Tahlequah and for the site on Baron Fork near Eldon from 1999 to 2004. Both sites on the Illinois River had levels of dissolved solids higher than Baron Fork near Eldon (Table 12, Figure 24). The site on the Illinois River near Watts had the highest levels of dissolved solids, but the site on Baron Fork near Eldon had the highest peak concentration (457 mg/l). Dissolved solids do not exhibit a strong trend for the years 1999 to 2004 (Figure 25).

Table 12: Summary statistics of dissolved solids in mg/l at Oklahoma sites in the Illinois River basin.

Station Name	Minimum	Q1	Median	Mean	Q3	Maximum	Observations
Illinois River near Watts	88.0	164.3	183.8	179.4	201.3	299.5	82
Illinois River near Tahlequah	79.0	142.3	160.0	157.7	174.7	291.5	82
Baron Fork near Eldon	12.9	108.0	117.0	120.2	126.5	457.0	81

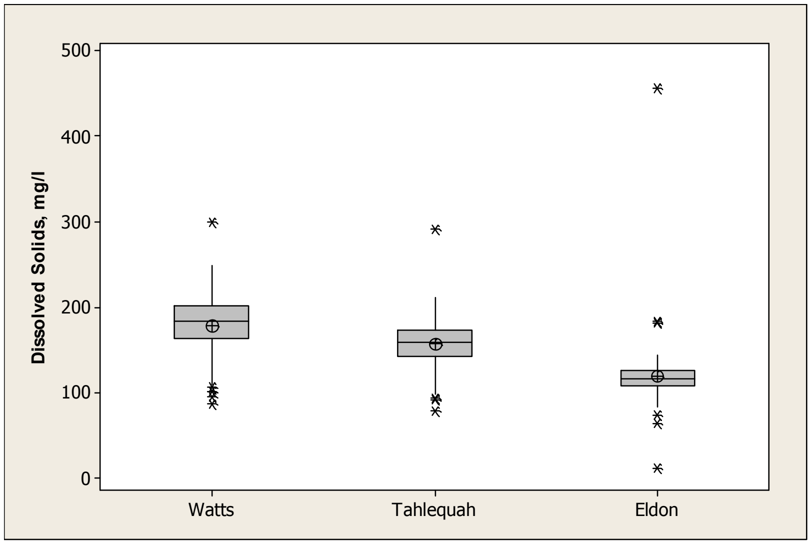


Figure 24: Interquartile ranges, means, and outliers for dissolved solids in mg/l indicated that the site located on the Illinois River near Watts reported a slightly higher level than that located near Tahlequah. Baron Fork near Eldon had lower dissolved solids concentrations.

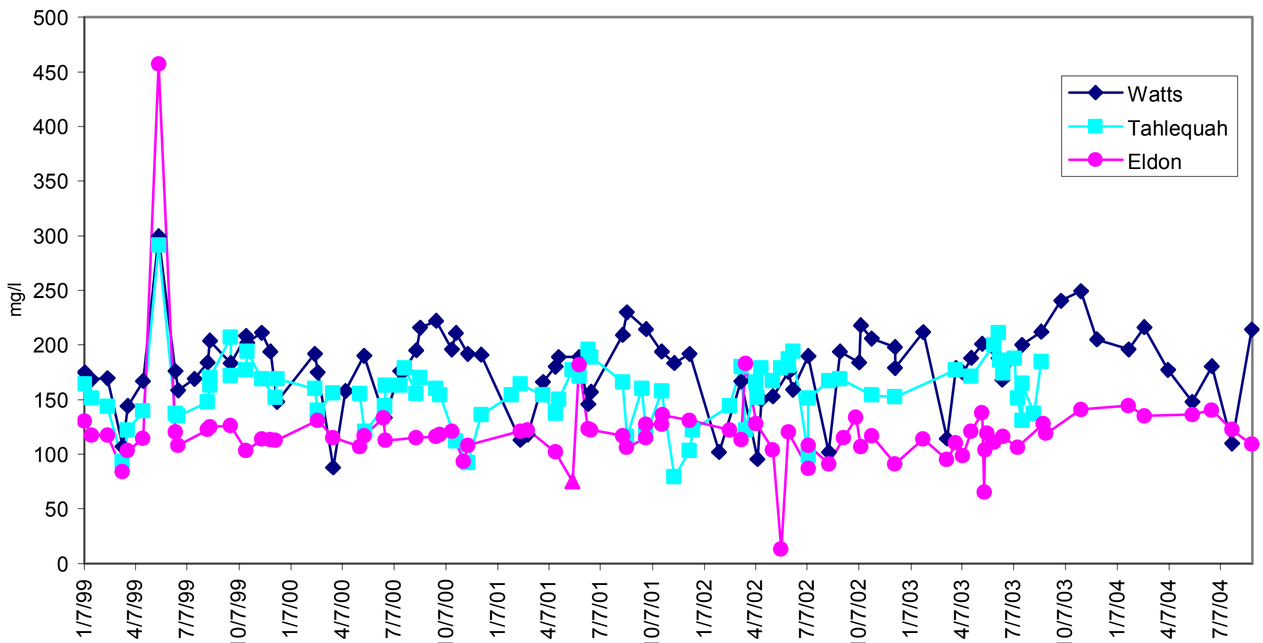


Figure 25: Dissolved solids for the Illinois River near Watts and near Tahlequah and the site on Baron Fork near Eldon from 1999 through 2004. While rates have fluctuated, dissolved solids have remained relatively consistent.

In conclusion, water quality data collected during the project period did not show discernable water quality changes associated with the project. This is not surprising given the relatively short time frame of the project and the size of the watershed. In addition, much of the implementation of practices occurred during the last few years of the project. Many watershed soils and particularly the streambank and streambed sediments are heavily loaded with phosphorus. It will likely require years for this phosphorus to be depleted to a level where it no longer leaches significantly in rainfall events, even if phosphorus application in the watershed is significantly decreased. Therefore, we expect the full water quality benefits of the project will not be seen for a number of years after the project has been completed.

Water quality monitoring will continue in the watershed in an effort to determine progress towards meeting Oklahoma's Scenic Rivers Phosphorus Standard of 0.037 mg/l, as well as trends in other water quality parameters. This data will continually be analyzed by the Arkansas River Compact Commission and other groups to look for trends beyond the life of this project.

Planning

The intent of this project was to demonstrate the benefits of best management practices on the water resources of the Illinois River and Baron Fork watershed. Objectives of the project were to:

- Implement practices that will reduce nutrient loading to help meet the goal of 40% reduction of phosphorus loading to Tenkiller Ferry Lake
- implement practices and programs identified by the Watershed Restoration Action Strategy to improve water quality,
- demonstrate practices necessary to achieve the nutrient control needed to protect the Illinois River and Baron Fork,
- promote protection and re-establishment of buffer zones and riparian areas,
- provide technical assistance to producers in the development of total resource conservation plans,
- provide educational assistance to producers through producer meetings, workshops, and individual contact,
- coordinate the activities of the various agencies and groups working within the watershed and,
- determine the effectiveness of the project.

To achieve those objectives required the participation of many different groups including OCC, Adair and Cherokee County Conservation Districts, Oklahoma Department of Agriculture, Oklahoma Department of Environmental Quality, Oklahoma Water Resources Board, Oklahoma State University Cooperative Extension Service, NRCS, local producers, poultry integrators, and animal waste marketers. Most importantly, success of the program relied heavily upon interaction with and buy-in from the local watershed residents, the people who would have to change their behaviors in order for the program to make a difference.

The project sought local buy-in in several ways. The first was to partner with the local Conservation Districts. Conservation Districts and their boards consist largely of local agricultural producers or persons with a strong tie to the local agricultural industry. The districts are well known to the local producers and have worked with many of them in the past and will into the future. Districts also have a well-established partnership with local NRCS offices and are the most effective means to involve and coordinate with NRCS at a local level.

Secondly, the project hired a local project coordinator, rather than someone from outside the area. This person was familiar with the landowners and the issues in the watershed. This person lived in the area so landowners would see them at local restaurants and church, etc, rather than just at meetings about the project. In this manner, the local landowners would be more likely to place their trust in this person than in a stranger.

This local coordinator was responsible for:

- identifying and scheduling producers in need of conservation planning,
- assisting with local producer and other meetings held in the watershed,
- working with local clean-out groups to determine availability of excess litter,
- coordinating the tracking of conservation plans and practices recommended with OCC through a GIS-based system,
- working with NRCS to ensure that water quality concerns are addressed,
- holding periodic meetings with the various groups working in the watersheds(Watershed Advisory Group Meetings, etc),
- identifying potential animal waste market groups,
- participating in watershed educational activities,
- coordinating demonstration watershed implementation activities as outlined in the Work plan,
- identifying and coordinating programs between Arkansas and Oklahoma as appropriate, and
- coordinating the demonstration watershed advisory group.

The project coordinator had an office at the Cherokee County Conservation District, and worked several days a week out of the Adair County Conservation District Office.

Finally, the project assembled a local Watershed Advisory Group (WAG) to recommend practices to be offered through the program and the cost-share rates at which to fund the practices. This group of individuals, recommended by the Cherokee and Adair County Conservation District Boards, was selected to represent the NPS interests in the watershed. Ideally, this would mean that the WAG would include a poultry producer, poultry integrator, nursery representative, resident homeowner, cattle beef/dairy producer, Conservation District Board Members from Adair and Cherokee counties, minority representative(s), representatives from a river recreational outfitter, the City Of Tahlequah, Tenkiller Ferry Lake Association, an environmental association, the Scenic Rivers Commission, and a forest landowner. WAG meeting minutes are available in Appendix B.

The Illinois River WAG consisted of eight members from each county to represent the conservation district boards, dairy producers, beef producers, recreational interests, forestry, minorities, and cities and towns. Members in Adair County included: Cliff Alewine, Mark Bradford, Myrna Cusick, Mildred Hamilton, Larry Pharr, John Phillips, Cecil Sisk, Jr., and Kenneth Snodgrass. Cherokee County members included Bill Blackard, Jerry Cook, Larry Emerson, Brian Jenni, Jim Lamb, Jim Loftin, David Morrison, and Garland Phillips.

This group considered the problem and recommended three groups of practices aimed at the major NPS problems in the watershed- nutrients (primarily phosphorus), fecal bacteria, and sediment. They chose different priorities for the three major groups of practices, based on what they felt would be most beneficial for the watershed. They then assigned cost-share rates to those groups of practices based on priority and rates they believed that would be necessary to get landowners to participate. The recommendations of the WAG were then evaluated and approved by the Oklahoma Conservation Commission.

The details of the practices chosen and the results of the implementation will be discussed later in the report. The result of allowing local input into the types of practices offered and cost-share rates was that almost all of the practices offered were implemented, with the exception of streambank stabilization, a practice that can be very expensive to implement. Another benefit was that these sixteen people became intimately aware of the project and could share the knowledge about the program with their peers, rather than having just one or two staff members who could share information about the program.

Education Program

One of the most important components of the project revolves around the related education program. 319 projects are designed as demonstration projects; money is not available to holistically solve the water quality problems, rather it is used to demonstrate effective methods of solving the problem. The intent is that once people become educated about what the problem is and what they can do to fix it, that they will begin to adopt those strategies on their own or through similar programs such as NRCS EQIP or CRP. The intent is to get people to change their behaviors by educating them about the problems and solutions.

Like the demonstration of best management practices, education may be more palatable and therefore more effective if it comes from a familiar source, so the program worked through the local conservation districts and hired a local project education coordinator to be housed out of the Adair County Conservation District Office and spend time in the Cherokee County District Office. This person was charged with chairing the Education Watershed Advisory Group (EdWAG) and with insuring that the goals the EdWAG establishes for the program are met.

The Educational Watershed Advisory Group (EdWAG) was created to identify specific educational goals for this project and to draft an education plan for the watershed to meet those goals. The group identified appropriate agents to implement this plan. The

EdWAG was composed of individuals from many agencies including Oklahoma State University Extension Service, Northeastern State University, public schools, poultry producers and integrators, landowners at large, nurseries, Oklahoma Department of Agriculture, Oklahoma Forestry and Wildlife Conservation, Natural Resources Conservation Services, local conservation districts, and the Oklahoma Conservation Commission. The educational plan that was constructed to support the 319 program, but includes activities that will be continued in the watershed by the Conservation Districts, OSU Cooperative Extension, and other groups long after the 1999 project has been completed.

Monthly training sessions for volunteer monitors were conducted in both Adair and Cherokee Counties. Volunteers began monthly monitoring at two sites in Adair County and nine sites in Cherokee County. There have been fifty-eight people trained in Blue Thumb and are forty-seven active monitors. This number includes twenty-five Tahlequah high school students who monitor as part of their classes. Monitoring included invertebrate collections, fish collections, and water quality parameters. Over 1,000 volunteer work hours have been documented.

Educational activities were presented to both Adair and Cherokee County residents with over 21,000 contacts being made throughout the life of the program. Landowners, foresters and producers were given the opportunity to attend many workshops and tours that would benefit them as well as meet their poultry credit hours.

Tailgate sessions with landowners and loggers were a way to give guidance and explain better ways in which practices could be used to slow down erosion on cleared land. Landowners and loggers were open to ideas. They discussed BMPs such as installing landings, skid trails, stream crossings, streamside management zones, temporary roads and permanent roads.

The district personnel noted that there has been an increase in requests for all services within the program. For example, the Adair County office began selling Geotextile in January of 2004 and in less than nine months sold 4,500 square yards to cooperators.

One hundred percent of the schools in both counties were repeat participants in the Illinois River Project education portion of the program. The Illinois Jones Program was taken into most schools in both Adair and Cherokee counties with over 1350 students receiving an Illinois Jones coloring book after having been read the story. On many occasions, Illinois Jones himself would make a personal appearance during the story, which was an exciting time for the students.

Figure 26: Tailgate sessions for landowners and loggers provided information on BMPs for logging to reduce erosion

Storm Sewer in a Suitcase and Enviroscape were tools used in teaching the importance of keeping our water clean. Over 1,750 students and adults used these learning tools and had a chance to assist during the presentations. It was a very effective tool.

Earth Fairs and Natural Resource Days were opportunities for schools in both Adair and Cherokee to get involved. These events usually experienced a very large turn out, reaching over 2000 students in the past two years. Presenters covered items such as butterflies, forestry, trash, invertebrates, birds, reptiles, soils, archeology, plants, water safety, wildlife and fish. Students as well as teachers and parents always enjoy themselves at these educational events.

Other educational activities included Edible Wetlands, Dirt Babies, Life Bracelets, OH Fish!, and Plant a Tree programs. Presentations were also made for Girl Scout groups, Cattlemen's Association, farm shows, lawn and garden shows, summer school programs, fishing clinics, river cleanups, agricultural producers, and educational tours.

Outdoor Classrooms were established in both Adair and Cherokee county. Continued development is planned through efforts from local communities. Local partners have shown specific interest in sponsoring the Adair County Outdoor Classroom and will be working to add water and electric utilities to it.

The Illinois River Project also partnered and networked with other agencies in the area to make this program a success including OSU Extension, Oklahoma Scenic Rivers Commission, Oklahoma Parks Services, as well as other state and local agencies. The Illinois River Watershed 319 Implementation Project has been completed; however, it is ongoing with local residents, stakeholders, and communities planning to continue the program long after the life of the project. More details about the education component of the project are detailed in a separate report on that component.

Demonstration of Best Management Practices

The primary goal of this project was to demonstrate methods of land management that would reduce NPS pollution. Although the education program included all causes and sources of NPS pollution, the demonstration portion of the program focused on agricultural sources, primarily those associated with animal waste. The most significant landuse in the watershed relative to nonpoint source pollution is related to the poultry, beef, and dairy production in the watershed. Although the number of dairies has decreased over time, there are still quite a few in the watershed and most are fairly small and may not have the same pollution control structures and procedures as the larger dairies. Dairy cattle often spend significant concentrations of time in dry lots rather than open pasture and these areas can accumulate a great deal of waste that is susceptible to being washed off during rainfall events.

The poultry industry is well established in the Illinois River Watershed and there has never been a cost-effective mechanism for disposing of the nutrient-rich poultry litter other than to spread it on pastureland in the watershed. The litter is an excellent fertilizer and allows the pastureland in the watershed to support a much higher cattle-stocking rate than it otherwise would without the fertilization. However, the litter nutrient ratio is much higher in phosphorus than the plants require and as such, soils have become saturated with phosphorus and a significant quantity runs off in rainfall events.

Therefore, the primary focus of the program was to demonstrate practices that landowners could use that would reduce the impacts of these industries on receiving waters and hopefully at the same time, not be an unreasonable financial burden for the landowners. Many practices are even designed to improve productivity and reduce operating costs in the long run.

All agriculture producers and individual rural residents in the Illinois River Watershed in the counties of Adair and Cherokee were eligible for cost-share assistance regardless of size of land ownership. There was no minimum cost-share payment to any applicant. The maximum cost-share assistance to any one participant was $20,000.00. If the total value of the practices (cost-share assistance plus landowner's share) to be installed exceeded this cap, practices were installed and cost shared in the following order of priority: 1. Riparian area establishment/management; 2. Stream bank protection; 3. Stream crossing; 4. Pasture management; and 5. Waste management structures. Thus riparian areas were the top priority for installation.

Because of the large size of the watershed compared to the funding available for implementation, the Watershed Advisory Group was instructed that their task was to recommend practices and cost-share rates that would maximize the amount of implementation that could occur with the project, focusing on practices with the greatest potential to improve water quality. At the time the program was initiated, a watershed-wide model detailing areas of the watershed contributing most significantly to total loading was not universally agreed upon among State agencies (or the two States). Therefore, it was determined that implementation would be targeted towards types of practices that were suspected to contribute most significantly to water quality problems, rather than a program focused towards specific subwatersheds.

Interested landowners visited the Adair or Cherokee County Conservation District office to learn about the program and sign up to have a conservation plan either drafted or updated for their land. The Project Coordinator then visited the farm, interviewed the landowner about their operation, detailing current, and as possible, future management and discussing conservation needs with the landowner. The Coordinator and landowner would then discuss implementation options to meet conservation needs and agree upon the recommended practices to address those needs. The individual plans were then ranked based on the types of practices in the plan. Plans received points based on the types of practices included with practices that would achieve the greatest loading reduction receiving the highest points, as shown in the following table.

Riparian Fencing, Vegetative Establishment, Offsite Watering or stream crossing	20 points/acre (Total Exclusion)
	15 points/acre (Hay Production)
Waste Management Systems	
Rural Waste Systems, Dairy or Poultry Lagoons	30 points each practice
Filter Strips	20 points each practice
Pasture Management Cross Fencing, Off-site water, streambank protection, stream crossing, heavy use area	10 points each practice

Plans that received the highest rankings were funded first. Although not all interested landowners who initially signed-up and went through the planning process were initially funded, as the project progressed and landowners initially signed up were unable to complete their agreements due to lack of funding, deaths, or other reason, landowners lower on the list were offered the opportunity to participate. When the project was completed and available funding utilized, approximately forty potential cooperators remained on the lists from both Conservation Districts.

A total of $1,335,860 was available to support installation of practices associated with this project. These included $763,475 federal dollars, $333,533 state dollars, and a required $238,852 match from landowners. This amount was far short of the amount needed to address all sources of NPS pollution in the watershed and therefore, monies were targeted towards the most significant sources and implemented in such a way to encourage nonparticipating landowners to later implement them on their own or as part of another program such as EQIP, CRP, or similar programs.

The implementation of these practices is documented in conservation plans developed for each of the 177 cooperators (Figure 27). An additional 20 new conservation plans were developed for cooperators who dropped out of the program, primarily for financial reasons. Implementation of the practices was converted from paper copies to digital records by the Cherokee County Conservation District and OCC personnel. These

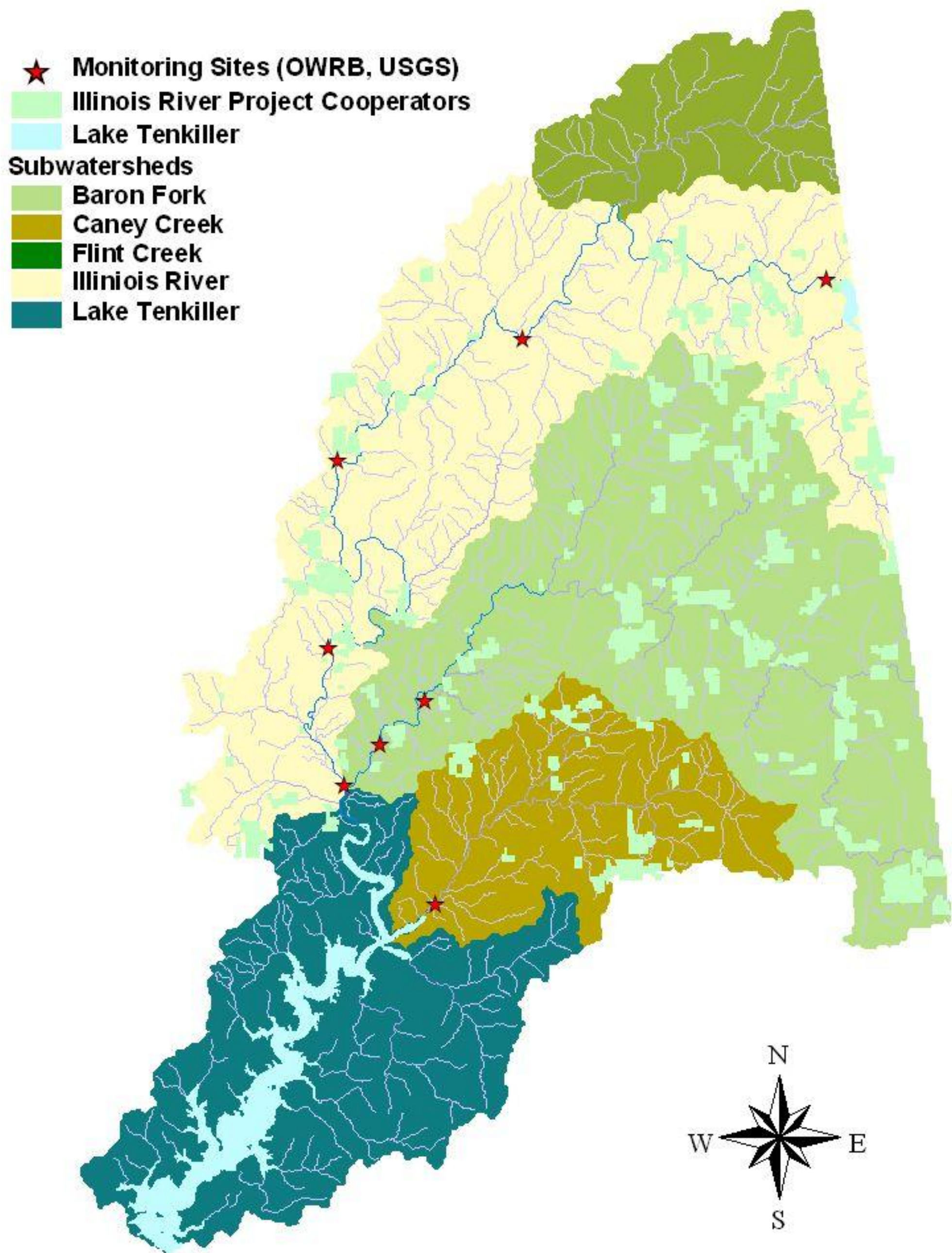


Figure 27. Cooperators in the Illinois River Watershed.

digital records of implemented practices, detailed in the following maps, can also be used in future targeting exercises to pinpoint areas still in greatest need of BMPs.

The number one priority practice for the program was riparian area establishment and protection (Figure 28, Figure 30). With relatively low capital investments required (mainly fencing and alternative water supply costs) and an extremely high efficiency for phosphorus removal (as high as 75 – 80%), this is the most cost-effective method to reduce nonpoint source pollution in watersheds like the Illinois River. In addition, to filtering nutrients, sediment, and other pollutants from runoff, riparian zones also help stabilize streambanks and can, over time improve channel stability and instream habitat. Aside from environmental benefits, restricting cattle access to streams and allowing riparian vegetation to develop can also improve herd health, reduce the amount of near-stream land lost to erosion, and help retain nutrients onsite that can eventually be exported from the farm as a product such as hay, milk, or beef. Unfortunately, these benefits directly to the producer are not as obvious as those from a practice such as pasture planting or as well known as those from a practice such as terracing. As such farmers are more reluctant to implement riparian protection than more traditional practices.

However, this is not the first NPS-directed demonstration/implementation effort in the Illinois River Watershed and these producers have been listening to water quality educators, Scenic Rivers Commission, OCC, Conservation District and NRCS personnel explain the virtues of riparian zones for a over a decade. In addition, in order to encourage landowners to implement this practice, a cost-share rate of 80% was offered, requiring only a 20% match from the landowner. As a result, landowners were more receptive to riparian practices than landowners in neighboring watersheds with similar programs. The program installed over 1300 acres of protected riparian area in the watershed and provided alternative water supplies when this eliminated a drinking water source for livestock. This installation is the equivalent to over fifty miles of protected riparian zone on either side of the Illinois River. An estimated 933 miles of stream are in direct contact with pastureland in the watershed (both Oklahoma and Arkansas). Assuming an even split between Oklahoma and Arkansas, this would indicate that the program protected at least 10% of the areas in the watershed where riparian protection was lacking.

Another 11 miles of field buffer strips were protected with fencing. Three of these sites totaling about four acres required vegetative establishment but the remainder just needed to be protected from livestock access.

Figure 28. April 2004 (top) and October 2004(bottom) pictures of the same protected riparian area. The buffer is much better established in the October photo, which illustrates how a fence can result in dramatic changes in vegetation.

Figure 29. Within a few months of installation, riparian fencing has allowed the protection and new growth of numerous forbs and various woody plants that will ultimately grow into a stabilizing, filtering strip between grazed pasture and the stream.

Table 13. Riparian and Buffer Practices Implemented by the Program.

Practice	# Participants	Units	Cost			
			landowner	state	federal	total
Riparian Area Total Exclusion	46	1145.4 acres	$0	$85,454.00	$128,181.00	$213,635.00
Riparian Area Total Exclusion with Hay Prod.	15	197.7 acres	$0	$11,458.60	$17,187.90	$28,646.50
Riparian Area Offsite Watering-Pond	13	17 ponds	$14,356.00	$114.38	$21,705.57	$36,175.95
Riparian Area Offsite Watering-Freeze-proof tank	3	3 tanks	$638.81	$349.03	$1481.77	$2,469.61
Riparian Area Offsite Watering Pipeline PVC	3	1700 feet	$188.04	$101.53	$434.36	$723.93
Riparian Area Access Lane to Stream Grading and Shaping	4	4 lanes	$854.80	$397.20	$1,878.00	$3,130.00
Riparian Area Access Lane to Stream Gravel Fill Geo-cell and Geo-textile	3	3 lanes	$1,959.00	$583.00	$3,813	$6,355.00
Riparian Area Forest Buffer	1	1107 trees	$1,229.51	$0	$442.80	$1,672.31
Riparian Area Permanent Vegetative Establishment	1	1 acre	$18.49	$18.49	$55.46	$92.44
Riparian Area Fencing	8	8.8 miles	$10,265.71	$2,985.24	$19,876.42	$33,127.37
Buffer-Filter Strip Establishment	3	4 acres	$0	$297.00	$445.50	$742.50
Buffer-Filter Strip Fencing	19*	11.53 miles	$17,967.66	$5,702.84	$35,505.76	$59,176.26
Streambank Stabilization Fencing	3	1.13 miles	$3,814.95	$0	$4,678.40	$8,493.35
Totals			$51,292.97	$107,461.31	$235,685.94	$394,440.22

* 16 producers fenced buffer areas but did not receive incentive payments for buffer establishment. These producers had vegetation already established, but the area was overused and fencing was sufficient to allow the area to function as a filter strip.

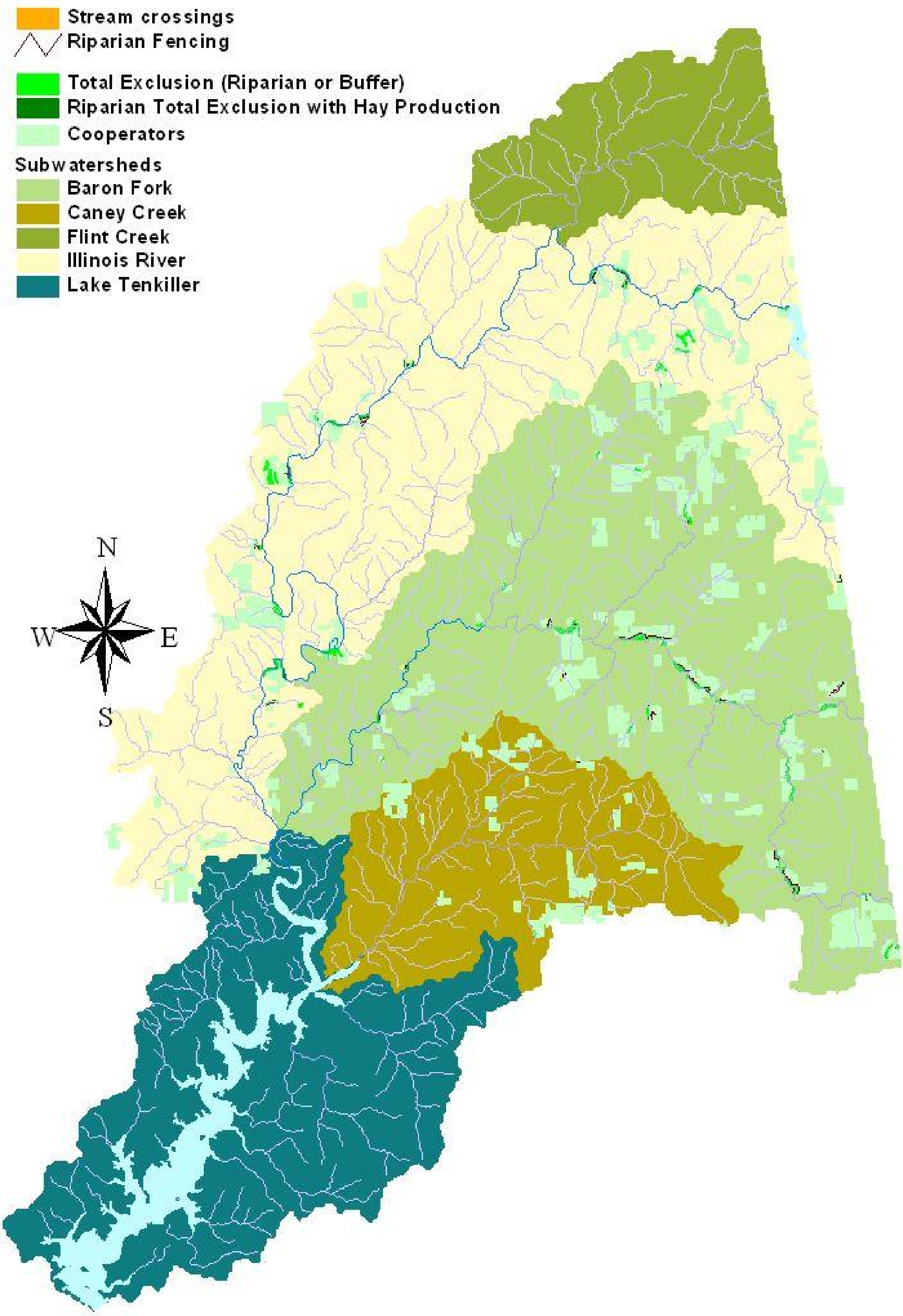


Figure 30: Riparian Areas Implemented Associated with the 319 Project.

The second highest priority practices were waste management structures, both to address animal waste and human waste. These practices included filter strips, lagoons, composters, cakeout and dry stack structures for poultry litter, and septic tanks and were offered at a cost-share rate of 70%. A special category, winter feeding barns was added later in the project at a rate of 75%.

Lagoons for dairies and composters, cakeout and dry stack structures for poultry growers are an obvious benefit in that they reduce the amount of raw waste exposed to runoff and allow waste to be land-applied at a more appropriate time to reduce nutrient runoff. Landowners readily understand the benefits and value of these practices; however, as structural practices, they can be fairly expensive to install. Many producers are unable to afford them without some cost-share assistance. The program installed 3 new lagoons and cleaned out and land applied based on soil tests the waste from 11 lagoons. These lagoons addressed the waste from 671 cows (approx 16% of the dairy cattle in the watershed). Five cakeout litter storage houses and one full cleanout litter storage house were constructed. These cakeout structures addressed the waste from approximately 26 40,000-bird capacity poultry houses. These houses likely produce over five million birds a year.

Although NRCS programs offer some of the same practices, they do not offer septic tank replacement as a fundable practice. Past work in the Illinois and neighboring watersheds has suggested that the majority of older homes have improperly functioning (or non-existent) septic systems. In addition, site visits as part of the conservation plan development process revealed that many homeowners with improperly functioning septic systems have no idea that their systems are failing. Although the relative contribution from septic systems to the total phosphorus load in the watershed may be small, the NPS load reduction required to meet water quality standards may be as high as 80-90%, which means that every source of NPS pollution in the watershed will need to be addressed. The program installed eighteen tanks and upgraded the lateral fields of five additional systems. This suggests that the waste from approximately fifty people in the watershed is less likely to be affecting water quality downstream. Assuming that twenty percent of septic tanks in the watershed are failing, this program addressed approximately six percent of failing tanks in the Oklahoma portion of the watershed.

Feeding facilities are a BMP used to winter-feed beef cattle or feed dairy cattle year round. The facility is divided between a waste storage area and a feeding area and designed to fit the number of cattle fed at the site (41 sq. ft per cow). Sixty-three percent of the facility is used for feeding and 37% for waste storage. That waste capacity is equivalent to three-months worth of waste that can then be properly (timing and rate) land applied as fertilizer. The program installed 29 of these feeding facilities that addressed the waste from 1,457 cattle either seasonally or year-round.

The third priority group of practices offered through the program focused on prescribed grazing and were funded at a 60% cost-share rate. These included practices such as filter strips, streambank protection, watering facilities, spring development, cross-fencing, and

Figure 31. A winter-feeding facility is designed to collect and store waste until it can be properly land applied. At the same time, it offers cattlemen a protected area to feed, thereby reducing waste and improving cattle health.

heavy use area protection. These practices are intended to reduce pollutants in runoff from grazed areas by improving the quality of vegetative cover in pastureland.

Pasture management practices were the most commonly adopted practice, even at the lower cost-share rate because cattlemen can easily understand the economic benefits of pasture management. It improves their bottom line by improving forage quality and therefore beef production. They see higher weight gain with lower inputs of supplemental feed or they can stock higher densities of cattle. However, that increased forage quality also improves the filtering capacity of the pastureland and allows more pollutants to remain onsite, rather than being washed off. Alternative water supplies and heavy use feeding areas encourage cattle to spend more time away from stream channels and therefore reduce pollutant load reaching those areas.

The program installed about 56 miles of fencing, improving vegetative cover and pollutant retention on approximately sixteen thousand acres of pastureland. The program installed sixty-one ponds, 120 freeze-proof tanks, and one spring box associated with pasture management. In addition, over ten miles of PVC pipe were installed associated with the ponds and tanks. These efforts addressed approximately seventeen percent of the pastureland in the Oklahoma portion of the watershed.

Table 14. BMPs Implemented to Directly Reduce the Impacts of Animal Waste.

Practice	# Participants	Units	Cost			
			landowner	state	federal	total
Feeding Facility	28	1457 cows	$116,740.17	$51,366.75	$252,160.40	$420,267.30
Feeding Facility- Geotextile	28		$2,581.68	$1,093.21	$5,512.34	$9,187.23
Feeding Facility- Rock Fill	29		$9,379.45	$0	$13,655.36	$23,034.81
Feeding Facility- Freeze Proof Tank	9	10 tanks	$2,103.18	$1,259.23	$5,043.62	$8,406.03
Feeding Facility- PVC Pipeline	9	4,185 feet	$463.07	$553.64	$1,525.06	$2,541.77
Heavy Use Areas Concrete Pads for Round Bale Feeding	4	440 cows	$8,056.14	$0	$11,026.06	$19,082.20
Heavy Use Areas Geotextile	6		$11,087.20	$0	$9,313.97	$20,401.17
Animal Waste System Evacuation (Lagoon Clean-out)	11	9,814 yd^3 of waste	$9,338.99	$0	$5,408.81	$14,747.80
Animal Waste System PVC Pipe	4	140 cows	$1,288.17	$13.79	$1,952.93	$3,254.89
Animal Waste System Concrete reinforced/formed (Lagoon construction)	3		$1,000.11	$247.18	$1,870.93	$3,118.22
Animal Waste System Fencing	3		$2,684.21	$0	$1,109.85	$3,794.06
Cakeout Storage with Concrete Floor	3	5,200,000 birds	$11,482.33	$3442.60	$22,387.40	$37,312.33
Cakeout Storage with Earthen Floor	2		$11,936.73	$0	$17,248.00	$29,184.73
Full Cleanout Storage with Concrete Floor	1		$4,300.00	$500	$7,200	$12,000.00
Totals			$42,030.54	$4203.57	$57,177.92	$103,412.03

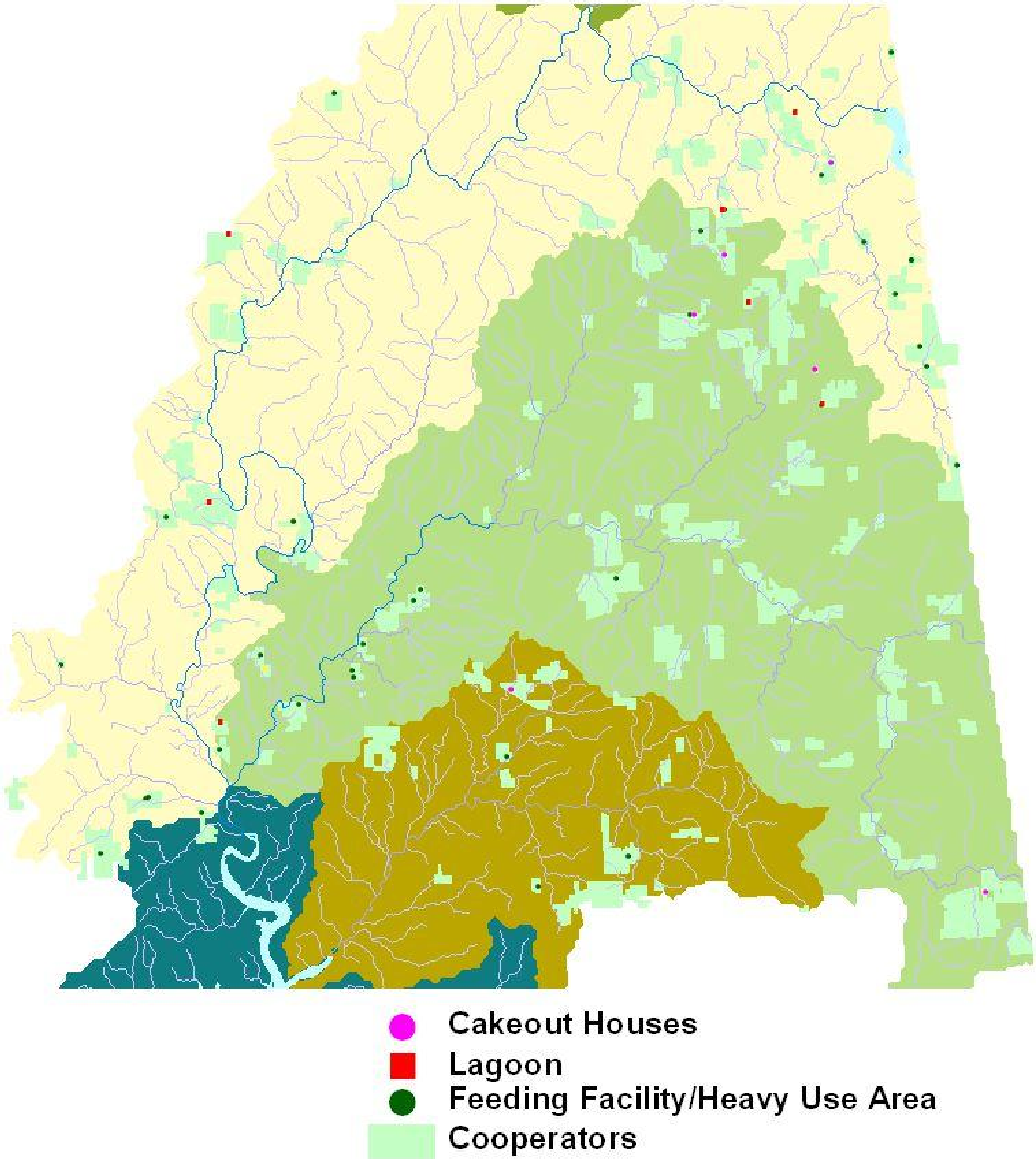


Figure 32: Heavy Use Areas, Feeding Facilities, Lagoons, and Composters.

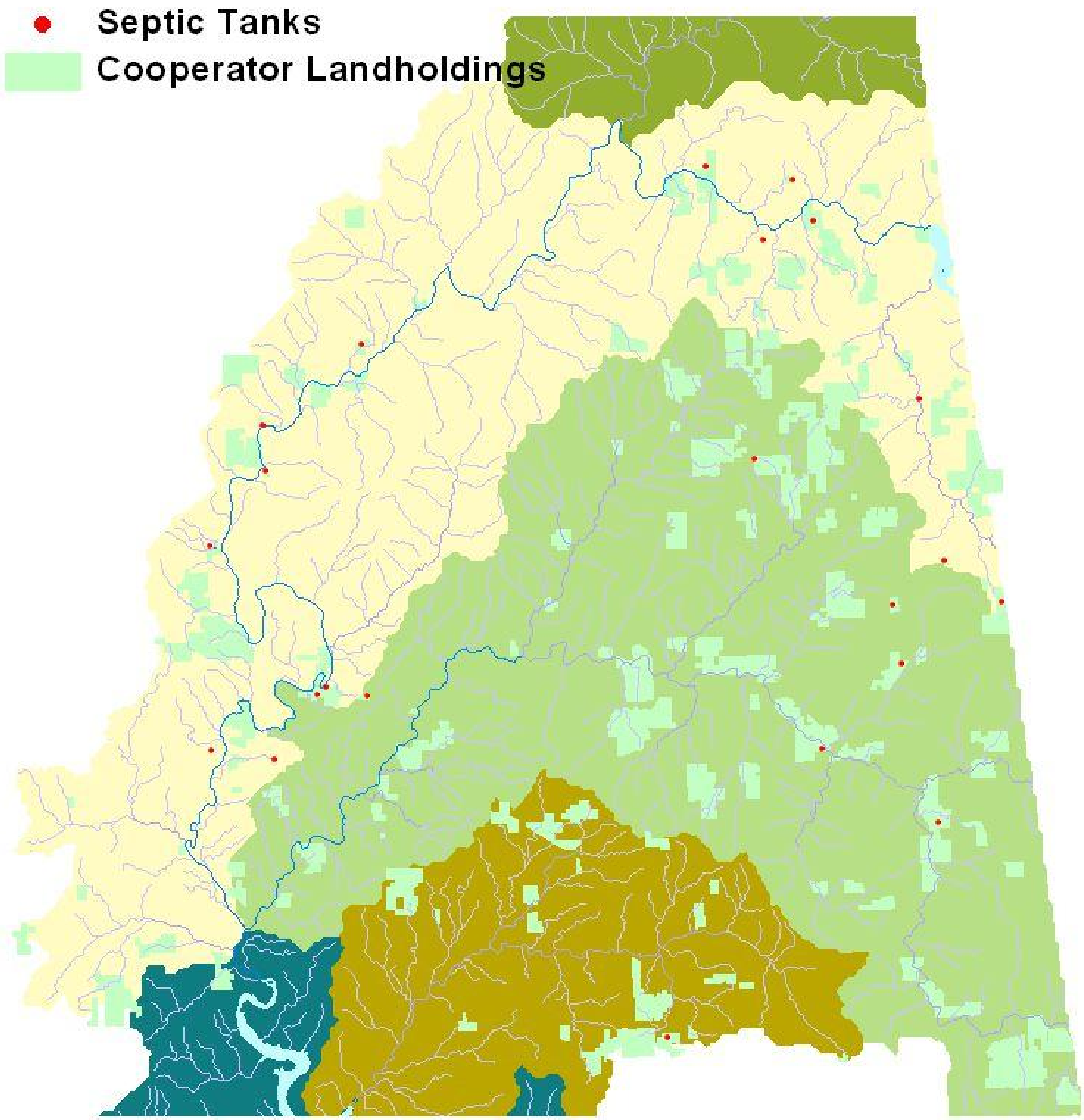


Figure 33. Upgrades and Replacements of Failing Septic Tanks.

Table 15. Pasture Management and Septic Tank Replacements Associated with the Program.

Practice	# Participants	Units	Cost			
			landowner	State	federal	total
Pasture Management Fencing	70	56.05 miles	$143,285.40	$0.00	$149,138.10	$292,423.50
Pasture Management Pond	40	61 ponds	$56,803.29	$0.00	$48,337.17	$105,140.46
Pasture Management Fencing Freeze-proof Tank	40	120 Tanks	$41,764.12	$0.00	$52,613.78	$94,377.90
Pasture Management PVC Pipeline	38	10.25 miles	$25,799.78	$0.00	$22,339.43	$48,139.21
Total			$267,652.59	$0.00	$272,428.48	$540,081.07
Septic Tank	18	21 tanks	$6,132.50	$0.00	$5,285.00	$11,417.50
Tank Installation	17	20 tanks	$937.00	$0.00	$693.00	$1,630.00
Lateral Line Installation	22	2.26 miles	$11,441.94	$2,393.39	$20,753.00	$34,588.33
Percolation Test	21	24 tests	$2,316.42	$0.00	$2,334.50	$4,650.92
Total			$20,827.86	$2,393.39	$29,065.50	$52,286.75

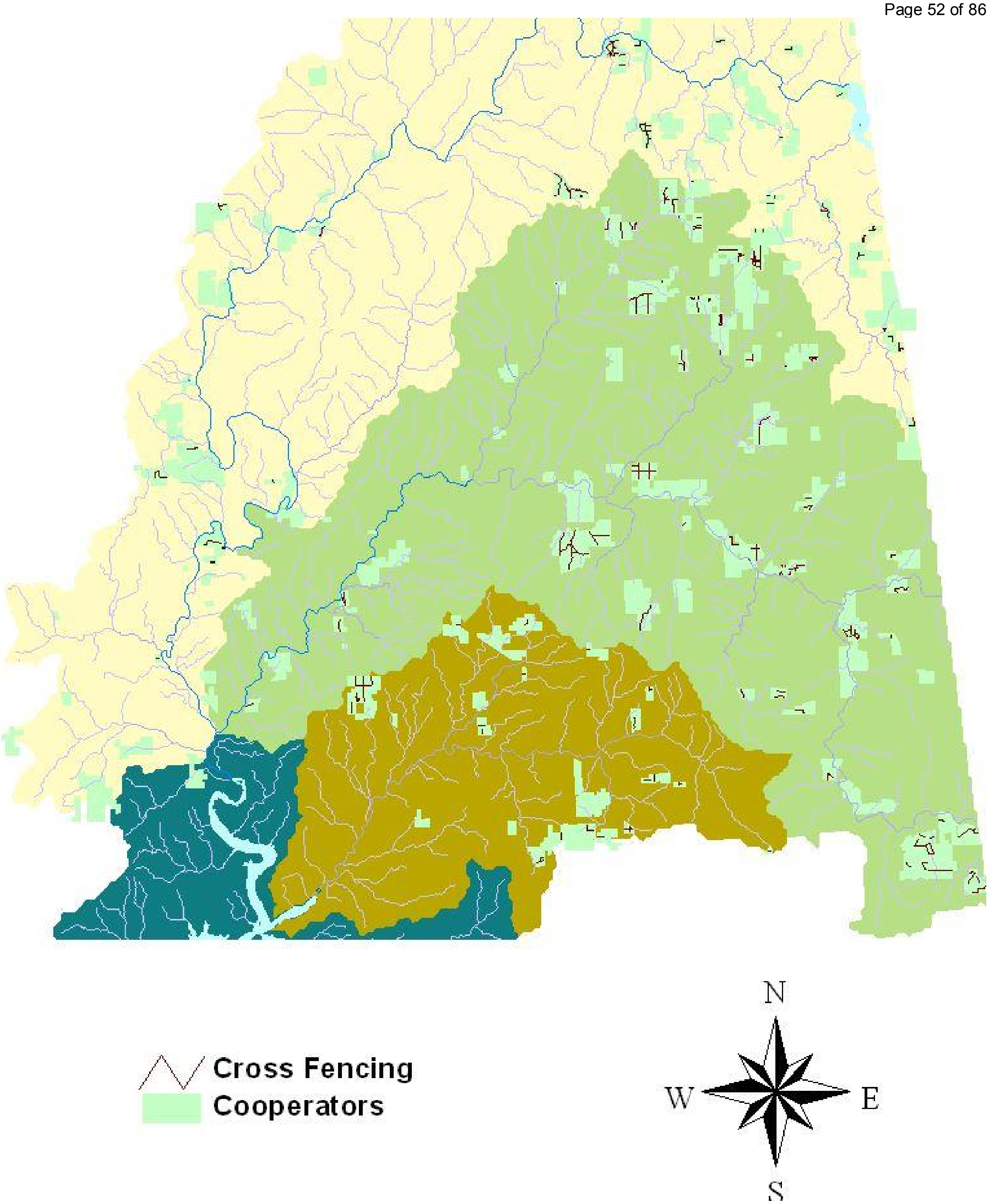


Figure 34: Cross Fencing and Pasture Management Locations.

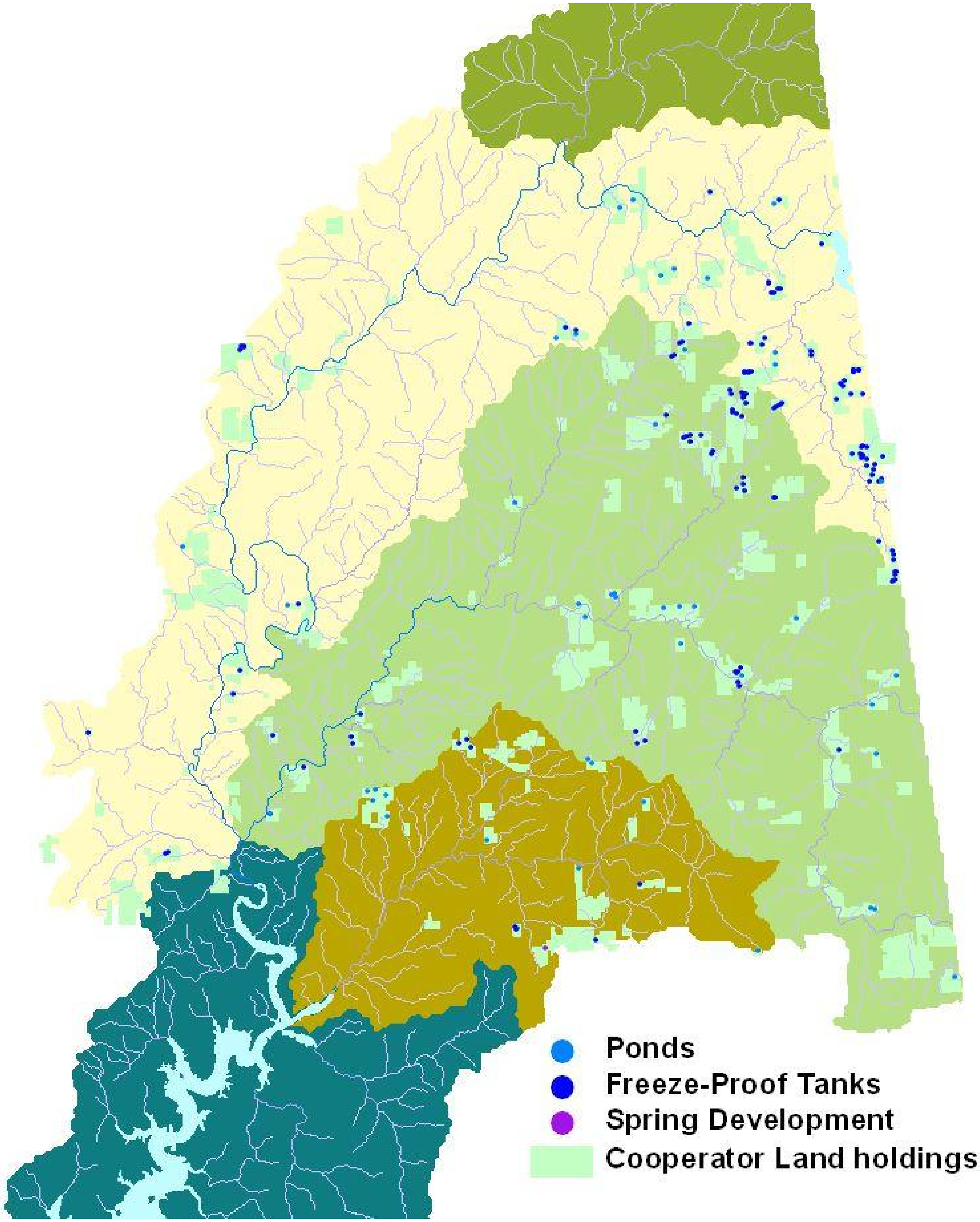


Figure 35. Alternative Water Supply Installations.

Figure 36. Cattle loafing in the shade in forested pasture along a riparian area protected through fencing. Although grass is green with new growth, cattle trampling and loafing in the area has some obvious effects shown by bare areas and with continued access, the entire area will be poorly vegetated.

Figure 37. Winter feeding facility.

Cattle congregate around feeding areas and trample the vegetation and deposit copious amounts of waste. Landowners often locate their feeding areas on flat ground, which generally tends to be closer to the creek in this hilly watershed. As a result, significant amounts of sediment, fecal bacteria, nutrients, and organic matter can be easily transported to the stream, with every runoff event. By creating a heavy use area that is correctly contoured and protected to reduce erosion and runoff and by locating it farther away from the stream channel, the amount of waste reaching the stream is greatly reduced. Six landowners installed heavy use areas that reduced erosion and waste runoff from cattle feeding and watering areas. These areas reduced pollution due to 440 cattle.

Figure 38. April 2004 (top) and October 2004 (bottom) photos in the same pasture as the previous page along a riparian area fence where pasture management has directed removal of cattle from low-productivity forest, allowing vegetation to grow back.

Photodocumentation of the Effects of BMP Implementation

The intent of photodocumentation was to display and quantify through visual representation the differences between sites before and after implementation of BMPs or sites with and without BMPs. In other words, the purpose is to quantify the onsite effects of the BMP, as opposed to a water quality measure that quantifies the off-site effects of the BMPs.

In order for the optimum comparisons using photodocumentation, it is critical that before and after or presence/absence photographs represent subjects taken from the same perspectives such that, in the case of before and after photographs, landmarks and other points of reference should almost exactly overlap. Presence absence photographs should also be taken from the same perspective such that if one is comparing one side of the fence to the other, the same total percentage of land on each side is considered.

It is surprisingly difficult to collect before and after photographs that meet these requirements, and therefore, only a limited number of the photographs collected for the analysis could actually subjected to actual quantification. Given that this project represents the OCC's first attempt to quantify the effects of BMPs through photodocumentation, we anticipate our data collection efforts will improve over time. The discussion below illustrates the photos that could be used for photodocumentation and summarizes the results of that documentation. These photos were imported into Arcview and areas for comparison outlined using Arcview's polygons feature. This allowed areas of these polygons to be calculated for comparison, rather than relying a more subjective measure of grid interpretation.

Figure 39 documents a pasture bordered by a riparian zone in April, near the beginning of the growing season. The pasture vegetation and riparian vegetation are the same height because they had been treated nearly identically during the winter and previous growing season. Both were grazed and hayed. With the exception of a few bare spots of soil on the pasture road (not visible in this picture), both riparian area and pasture have fairly uniform vegetative cover, all of which is at an adequate height to stabilize soil and trap sediment and nutrients in runoff (Prosser and Karssies 2001).

Figure 40, taken from what appeared to be the same position, was angled slightly different than the pre-implementation picture, and therefore, analysis between the two photographs was more limited than if they had been more exact matches. Therefore, only portions of the photographs, as outlined in the figures, were considered for analysis to insure that the total area of the two types of practices was consistent between the before and after photos. In other words the ratio of pasture area to riparian area is the same for the before and after photos, as is the ratio of road area to pasture area. The post-implementation photo, taken in late summer approximately four months after the pre-implementation photo, shows the difference between the pastureland and protected riparian zone after months of grazing and one hay cutting. The difference is much more pronounced, with pasture grasses significantly shorter than riparian grasses and more bare soil areas

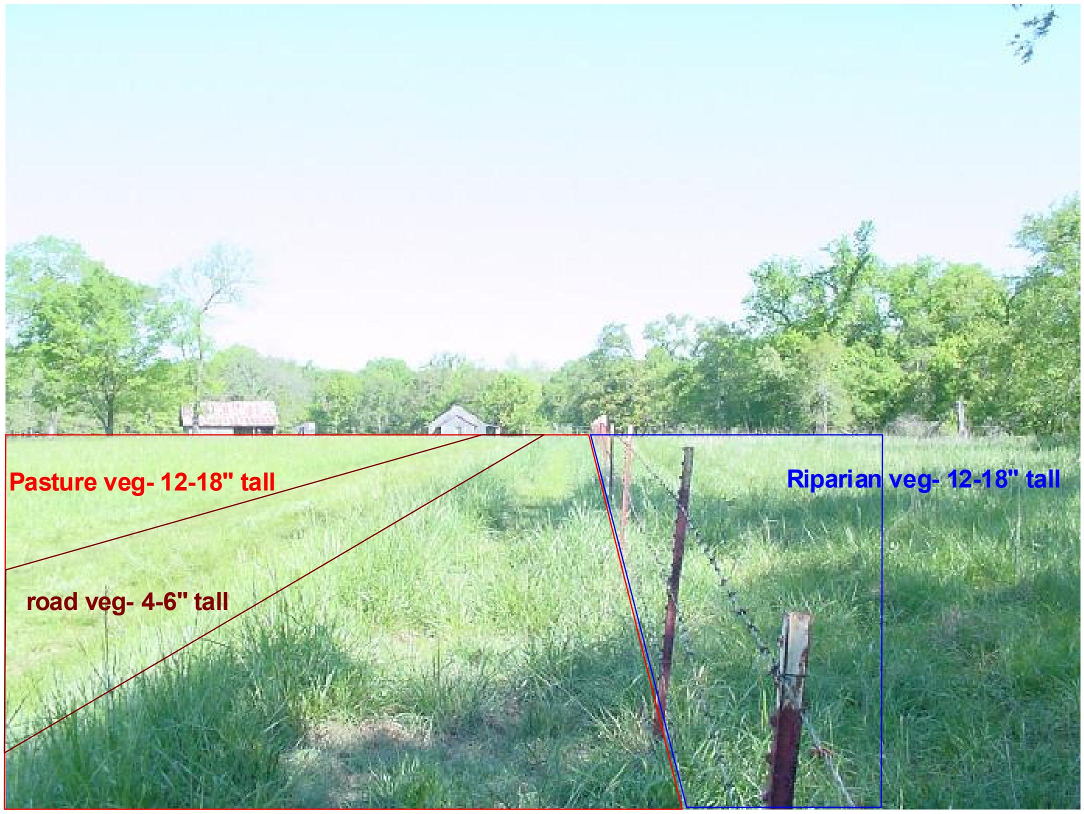


Figure 39. Early growing season in a pasture with an installed riparian area. Note that, with the exception of a driving path, vegetation in the pasture and riparian area is approximately the same height. This pasture is used for grazing and haying. The road is well vegetated, with few bare spots, none of which are visible in this photo.

exposed along the road than before. Vegetation on the road is no longer tall enough to trap sediment and nutrient particles (Prosser and Karssies 2001).

The types of comparisons between the before and after photos were limited to ratios and percentages because the photos were not exact matches. Also, because of the limited amount of photographs where comparisons could be made, it was not appropriate to test for statistically significant differences between pre and post-implementation. However, as seen in Table 16, protection of a riparian area increased the volume of vegetation in the protected area (and therefore the mass of nutrients retained in that vegetation) and reduced the amount of area with vegetation heights too short to reduce sediment particle filtering during runoff events.

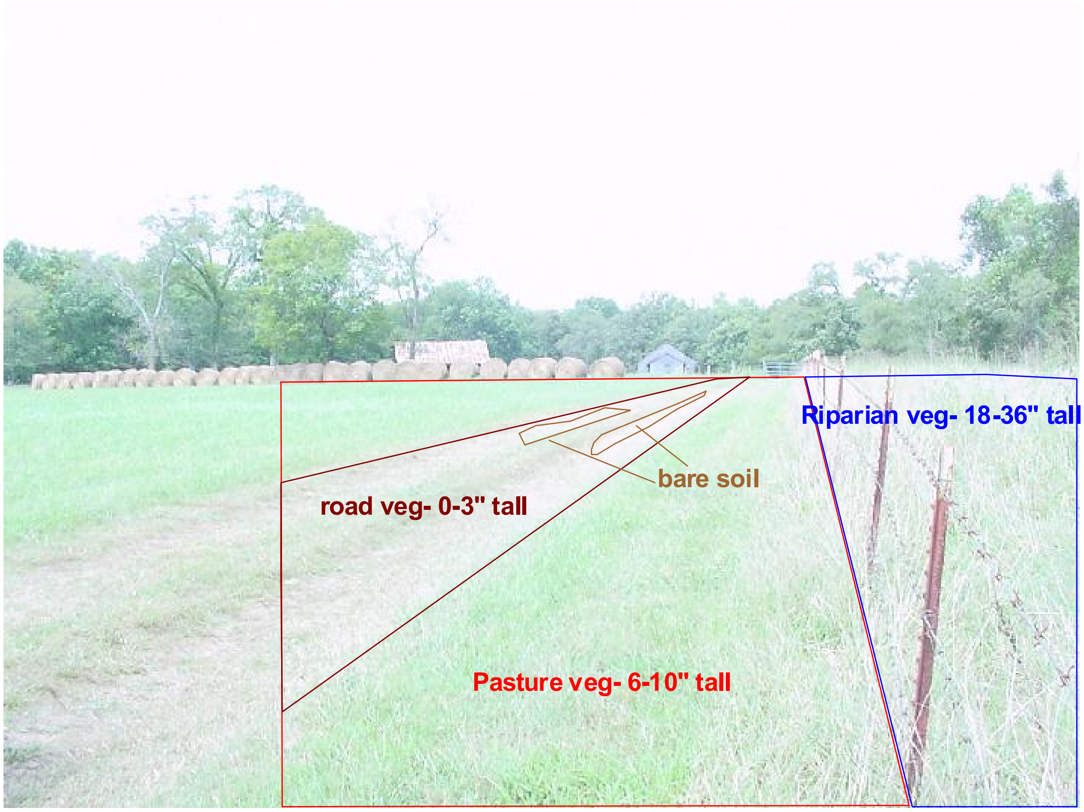


Figure 40. Same Site as previous photo, taken late summer, approximately 4 months later. Pasture has been grazed, then hayed, and road has been heavily used. Note pasture vegetation now significantly shorter than riparian vegetation, and road vegetation shorter and significantly absent in areas.

Table 16. Comparisons between pre- and post-implementation photos Figures 39 and 40.

	Pre-implementation	Post-implementation	Difference
Ratio of Pasture to Riparian Area	0.383	0.383	0.000
Ratio of Road to Pasture Area	0.226	0.225	0.001
Ratio of Bare Soil to Total Pasture Area	0	0.009	0.009
Ratio of pasture vegetation volume to riparian area vegetation volume	2.019	0.675 – 0.563	1.344 – 1.456
% pasture area with forage height too low for particle trapping	0	22.508	22.508

Figure 41. Early growing season (April) photo of the second year of a protected riparian area, compared to a stocked pasture. Note the trampled areas in the pasture, although early spring rains have insured an adequate stand of vegetation in the remainder of the pasture. The riparian area has a good stand of vegetation with little visible bare soil.

Figure 41 documents early growing season condition at another protected riparian site. Although pasture vegetation is in good condition, areas of bare soil remain from winter and the previous season. Cattle loaf in this shaded, protected area of the field and one can surmise that the fenced off riparian area would have also endured the same fate. This photo was not taken immediately after installation of the riparian fence, but at least one growing season after that installation. It is also evident from this photo that high water may frequently reach this corner of the pasture, further illustrating the need to vegetate this riparian zone and keep it free of cattle droppings.

Figure 42 documents the same site from a slightly different angle four months later, in late August. Although cattle have been removed from the pasture, it has been overgrazed, and more of the visible area is bare soil. Because of the different angle of the picture and the different location from where the photograph was taken, only portions of the photographs could be compared to one another (as identified by outlined sections), and numbers could only be compared as percentages of the total. In the early growing season photo, approximately 11% of the pasture area is bare soil. Riparian vegetation seems to provide

Figure 42. A photo of the same area four months later, after cattle have trampled or grazed out most of the grasses in the area, and left unpalatable forbs. The riparian forbs and grasses have gained biomass through the growing season, offering even greater filtering capacity in the event of a runoff.

complete coverage of the soil. Percent of pasture area as bare soil increases to 34% four months later and although riparian vegetation is lusher and more established than in the early growing season photo, we can assume that without riparian protection, the riparian area would have suffered similarly to the pasture area. Although this landowner has allowed overgrazing in this pasture, the riparian area should help filter out some of the constituents in the runoff and should help stabilize streambanks and maintain the fence.

Figure 43 documents a set of early/late growing season photographs from another riparian site. Because the photos were taken from slightly different vantage points, no quantifiable comparison can be made between the two photographs. However, the photographs do document visually the effect riparian protection can have on a site.

Although some of the photos collected for photodocumentation were similar enough to be used to compare presence/absence or pre- and post- implementation conditions, the effort was not as successful in this first attempt because we spent too much time in the development stage of the QAPP without conducting trial and error exercises to see

Figure 43. These photographs, although taken from a similar angle, were taken from slightly different spots and therefore, it is more difficult to make quantifiable comparisons between the two. Only visual comparisons can be made.

whether or not we produced comparable photographs. In addition, we did not adequately convey the needed similarities between before and after photographs to our photographers to insure comparable photographs. In addition, because much of the implementation took place during the final years of the project, we were not able to document as great a change between pre- and post-implementation or presence/absence photographs as we would have been had there been a longer time frame between. This exercise has allowed us to determine what steps we will need to take to insure that future photodocumentation is a more useful exercise.

Predicting Loading Reductions Associated with Project

Many of the practices implemented during the project were not put in place until the final year of the project. This was due to many factors, although the most commonly supplied reason was related to the economy. Only during the final year of the project, when beef prices soared, did many of the producers have the financial resources to provide their portion of the required match.

Regardless of the reason for delaying the implementation, the result is that load reductions associated with implementation are less likely to be seen during the project period, and indeed, water quality data collected concurrent with the project does not indicate decreased loading. However, it is still possible to estimate the load reduction that should eventually be measurable based on the practices that were implemented.

Using EPA's Spreadsheet Tool for Estimating Pollutant Load (STEPL) model, it is possible to estimate the load reduction that should result from the project implementation. Using EPA's STEPL Input Data Server and selecting the portions of the Illinois River Watershed where implementation occurred (Illinois River HUC 11110103, 100% of subwatershed 13231 and 70% of watershed 13236), we estimated the landuse, livestock numbers, and septic tank information for the watershed. STEPL uses this information to calculate the pre-implementation loading of sediment, nitrogen, phosphorus, and BOD_5.

EPA's STEPL input data server estimated 105.84 acres of feedlots. According to Oklahoma Statute, all these feedlots have waste management systems or waste storage structures. However, this project did install any of those structures. There was no way to reflect those facts with this model run, a designation of feedlot BMPs would have over-estimated the load reduction that should be seen related to this project. Therefore, the model was run assuming there were no feedlots in the watershed. In addition, the input data server estimated a septic failure rate of zero, which we know to be false based on our work in the watershed. Based on this information, a conservative failure rate of 20% was used.

Table 17: Input parameters from STEPL Input Data Server.

	Urban	Cropland	Pastureland	Forest	Feedlots			
Acres	9,970	2,800	179,170	214,490	0			
	Beef cattle	Dairy Cattle	Hogs	Sheep	Horse	Chickens	Turkey	Duck
animals	27,657	4,182	249	188	1,445	2,368,674	218,785	29
	# Septic Systems		Population Per Septic System		Septic Failure Rate			
	6,457		2.38		20%			

Accurate reflection of all the BMPs installed in the watershed required the addition of four new BMPs to the Pastureland BMP list. Those BMPs were feeding facilities/heavy use areas, streambank stabilization and fencing, cross fencing, and composters/lagoons. Estimates of removal efficiencies were based on literature review.

Table 18. Removal Efficiencies used for the STEP L model.

Removal Efficiency	Nitrogen	Phosphorus	BOD	Sediment
Feeding Facilities / Heavy Use Areas	0.65[1]	0.60[1]	ND[1]	ND[1]
Composters/Lagoons	0.65[1]	0.6[1]	ND[1]	ND[1]
Cross Fencing	0.30[2]	0.35[2]	ND[2]	0.30[2]
Streambank Stabilization	0.60[3]	0.65[3]	ND[3]	0.65[3]

[1]- based on removal efficiencies in similar or identical feedlot BMP section
[2]- Bottcher, A. and H. Harper. 2003
[3]- Durham, S. 2003

The BMP calculator was used to estimate the combined effect of these BMPs on loading from pastureland. The pre-BMP loads associated with each section were calculated from the pastureland or animal units affected by the BMP and by the total load estimated to be coming from pastureland. For the BMP calculator exercise, phosphorus loads, rather than acreage, was used as the preimplementation measure and therefore, nitrogen and sediment load reduction predictions are not considered valid.

Table 19. STEPL Estimated Total Load by Land Uses (Pre-Implementation.

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	acres
Urban and Septic	87682.1	9845.1	351407.1	3812.5	9970.0
Cropland	108383.4	24564.9	149141.8	1642.3	2800.0
Pastureland	1064445.4	100683.0	3375376.5	21017.7	179170.0
Forest	48634.4	23622.7	118566.6	1887.1	214490.0
Feedlots	336505.8	67301.2	448674.4	0.0	105.8
User Defined	0.0	0.0	0.0	0.0	0.0

Table 20: Load information used to estimate pre-implementation loads related to each BMP.

	Acreage Affected	# Animals Affected	Associated N Load (pre-imp.) lbs/yr	Associated P Load (pre-imp. lbs/yr
Cross Fencing	15,720		93,392	8,834
Streambank Stabilization	1,347		8,002	3,785
Feeding Stations / Heavy Use Areas	3,819	1,897	273,168	64,498
Lagoons / Composters		671 cows & 5,200,000 birds	682,004	199,614

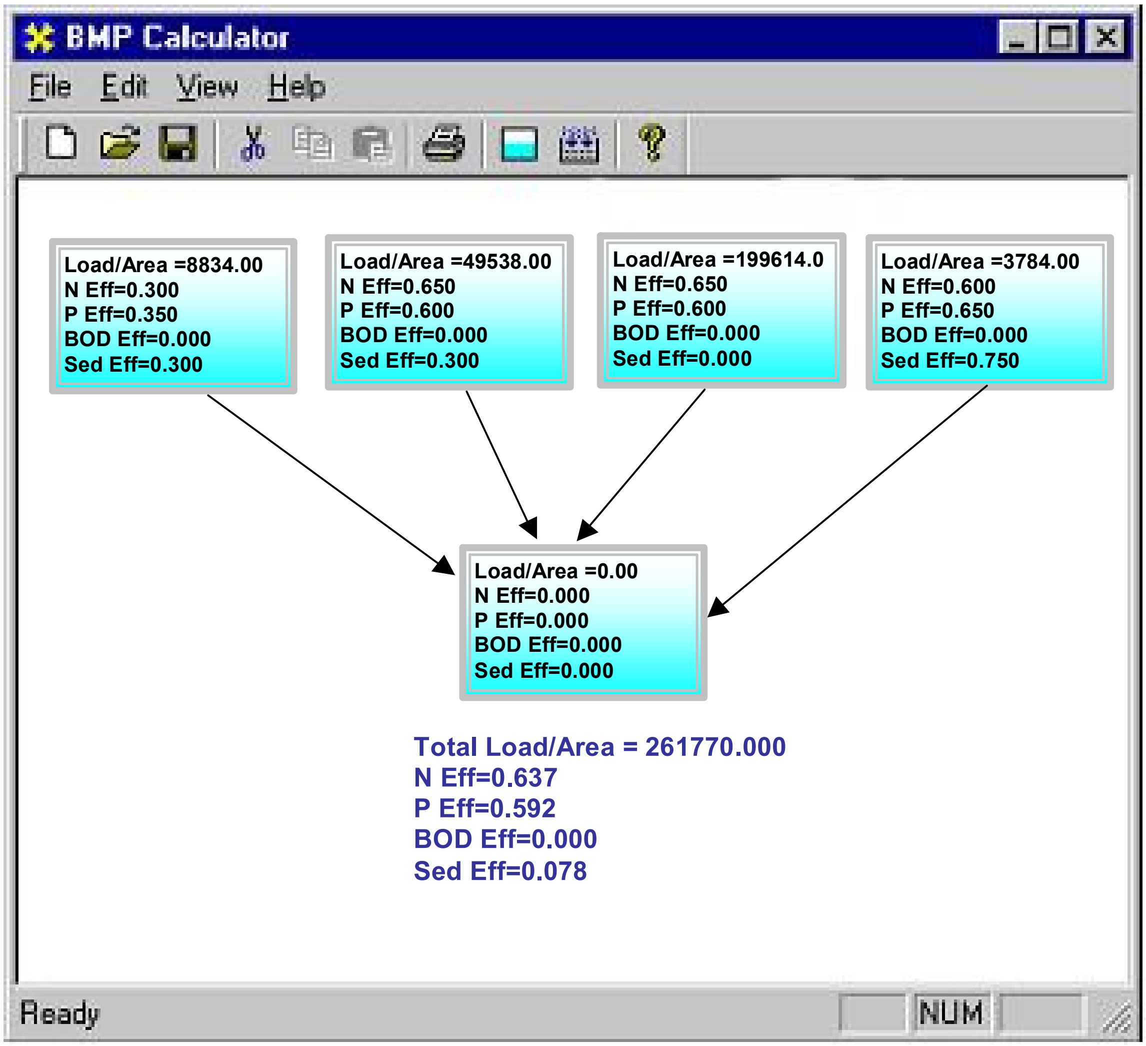


Figure 44: BMP calculator inputs.

The resulting phosphorus load reductions predicted by STEPL suggest that implementation could result in load reductions on the order of 30%. This estimate is a conservative estimate in that it does not take into account the effects that the demonstration will have on watershed landowner behavior. Landowners who did not sign up for the program have seen the practices on their neighbor's land or heard their neighbor talk about it and are beginning to request information on the practice. Some are asking for NRCS assistance with the cost of implementation, some are funding the implementation on their own. Districts are reporting increased requests for technical assistance. Cooperators who completed some, but not all of their recommended practices may choose to implement the remaining practices once they are satisfied with what they've done, or what they've seen on their neighbor's place.

This load reduction estimate may also under-predict the load reduction that can be achieved through this project in that the load reduction efficiencies selected for most of the practices were conservative and may actually result in greater load reductions. For instance, the 65% phosphorus removal efficiency for riparian zone protection was conservative in that many studies show as high as an 80 – 90% phosphorus removal capacity.

This 30% estimate also does not take into account the load reduction expected from septic tank replacement. Phosphorus loading from 26 improperly functioning septic tanks would be approximately (assumes P load of 1.946 lbs/cap/yr; Wilson, G. and T. Anderson. 2004) 136.5 lbs per year. Therefore, septic tank upgrades resulted in less than 1% load reduction. However, many landowners with failing septic systems are completely unaware of the failure. One result of the demonstration is that many more landowners are aware that their septic tanks are failing. Some of them will likely upgrade their systems at their own expense.

Table 21. Total Load and Reductions as Estimated From STEPL.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	1311020.6	159450.3	4002128.9	28362.8	640455.8	46295.2	10493.4	1639.6	670564.7	113155.2	3991635.5	26723.2	48.9	29.0	0.3	5.8
Total	1311020.6	159450.3	4002128.9	28362.8	640455.8	46295.2	10493.4	1639.6	670564.7	113155.2	3991635.5	26723.2	48.9	29.0	0.3	5.8

Table. 22. Total Load by Land Use (With BMPs Implemented)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban and Septic	89547.4	10575.7	359023.8	3812.5
Cropland	108384.0	24565.2	149143.1	1642.5
Pastureland	423998.2	54391.2	3364900.4	19380.8
Forest	48635.2	23623.0	118568.2	1887.3
Feedlots	0.0	0.0	0.0	0.0
User Defined	0.0	0.0	0.0	0.0

Conclusion

The Illinois River and Baron Fork Watershed Implementation Project was intended to demonstrate and implement practices to reduce nutrient loading to meet the goal of a 40% reduction in phosphorus loading to Lake Tenkiller and to protect the lake and its watershed. The program promoted the protection and re-establishment of buffer zones and riparian areas and provided technical and educational assistance to producers to aid them in the implementation of these practices. The program was targeted at the most significant sources of the problem, animal waste, riparian degradation, and pasture management. The program used assessment, planning, education, and demonstration / implementation to address these goals and sources.

Based on the significant monitoring efforts ongoing in the watershed by the USGS and OWRB, the project diverted monies that would have gone into monitoring towards demonstration of practices. However, review of those data showed that no decreasing trend in water quality data, particularly regarding the parameters of concern, phosphorus and sediment was evident during the project period. However, no increasing trend was obvious either, which is good news in a watershed that continues to be developed. This lack of water quality "success" is not wholly unexpected due to the fact that much of the implementation did not occur until the last few years of the project and that many of the watershed soils and particularly the streambank and streambed sediments are highly saturated with phosphorus. It could take anywhere from a few years, to decades, even with load reductions for this phosphorus to be depleted to a degree that concentrations in the river and Lake Tenkiller decline.

Planning the project involved efforts at the statewide and local level. State-level efforts included selection of the watershed as a priority watershed project, coordination of monitoring activities, and determination that the project would include elements of assessment, planning, education, and implementation. Planning at the local level involved hiring a local project coordinator and education coordinator to oversee the project. The project coordinator assessed each potential demonstration site based on need for BMPs according to the project's priorities and developed, along with the landowner, a conservation plan to reduce NPS pollution. The project coordinator also kept the local conservation district boards and the WAG current on different issues related to the project. The WAG was another mechanism to insure that local citizens were part of the planning process in that the WAG recommended the practices and cost share rates that should be offered through the program, along with selecting priorities for the source-directed suites of practices. Finally, local involvement in the planning process was ensured through the EdWAG's development of the education plan for the project. The EdWAG, like the WAG, was composed of local citizens with expertise related to the sources of pollution in the watershed, and played an important role in guiding the progress of the project.

The Illinois River Project education program partnered with other agencies in the area to make this program a success including OSU Extension, Oklahoma Scenic Rivers Commission, Oklahoma Parks Services, as well as other state and local agencies. The Illinois River Watershed 319 Implementation Project has been completed; however, education efforts continue with local residents, stakeholders, and communities planning to continue the volunteer monitoring, school program long after the life of the project.

Demonstration or Implementation of Best Management Practices was the primary focus of the program and the most direct means of reducing phosphorus, sediment, and fecal bacterial loading to the Illinois River and Lake Tenkiller. Although water quality monitoring concurrent with implementation did not demonstrate notable changes related to the implementation, the program, nonetheless, implemented a significant number of practices that should ultimately result in demonstrable reduced loading to the watershed. The program included 117 cooperators in two counties in Oklahoma. As a result, approximately 51 miles of riparian area were protected, twenty-three inadequate septic systems were replaced, and waste from over 2500 cattle and 5,200,000 broilers was more appropriately dealt with. Also as a result, almost 16,000 acres of pastureland in the watershed could be better maintained and over 200 alternative water supplies were established that would encourage better pasture utilization and significantly reduce the amount of time cattle spent in or near streams. In addition, only 17 or 15% of the landowners cooperator landholdings did not include blueline stream channels, meaning that the majority of implementation occurred within the most critical areas of the watershed related to potential for pollutant delivery to a stream. Given the topography of the area and the fact that most blueline drainages have countless intermittent drainages that feed into them, the majority of installed practices are likely to directly affect runoff in the watershed As a result, it is estimated that theses practices could ultimately reduce phosphorus loading by as much as 30%.

Measures of Success

The overall measure of success for activities in the Illinois River and Baron Fork Watershed is intended to be reversal of the eutrophication of Illinois River, Baron Fork, and Lake Tenkiller. However, this is effect is expected to be beyond the scope of this project, given the timeline of the project. Analysis of the water quality data collected concurrent with project activities indicated no apparent trends towards improving water quality could be detected at this time.

However, more attainable measures of success (MOS) specific to the activities in the project were planned in the workplan as:

- Full implementation of best management practices as planned.

- A substantial part of the project funding is going toward personnel to work in the watershed to establish and or update conservation plans. The goal for this effort is for 95% of all landowners in the Illinois River and Baron Fork watershed to have current conservation plans. We will expect that 60% of those will actively implement the practices recommended in the plans.
- Because much of the controversy within the Illinois River and Baron Fork watershed has focused upon animal waste, this project needs to meet a goal of 90% compliance with animal waste plans in the Illinois River and Baron Fork watersheds.
- Photo documentation on a representative sample of approved BMP's implemented within the Illinois River and Baron Fork watershed quantifying the landuse changes/cover attributed to the watershed implementation plan.

Relative to meeting these specific MOS, the following results were achieved:

- Full implementation of best management practices as planned.
  - All of the monies planned for implementation were devoted to demonstration of best management practices, targeted at the major sources of nonpoint source pollution in the watershed, according to the strategy recommended by the locally-led WAG and approved by the OCC. Ultimately, the practices implemented associated with this project could reduce phosphorus loading from that portion of the watershed by at least thirty percent.
- A substantial part of the project funding is going toward personnel to work in the watershed to establish and or update conservation plans. The goal for this effort is for 95% of all landowners in the Illinois River and Baron Fork watershed to have current conservation plans. We will expect that 60% of those will actively implement the practices recommended in the plans.
  - The project resulted in updated conservation plans for 197 landowners or approximately sixteen percent of the estimated 1,225 landowners in the watershed. However, complimentary activities related to the poultry regulations in the State required that poultry producers have updated animal waste management plans (which contain most of the information included in a conservation plan. Approximately 130 of the landowners are poultry producers, so an additional eleven percent of the landowners have updated plans through that avenue. In addition, NRCS has updated an estimated sixty plans during the project period, which overall results in at least percent of the landowners having plans that were updated during the project period. Not all of these landowners are agricultural producers; many own weekend retreats, retirement homes, or simply rural homesteads that are not used for agricultural production. Therefore a conservation plan update would not be

necessary for these homeowners. Assuming that 70% of the landowners in the watershed are involved in agricultural production, it can be estimated that at least 45% of the agricultural producers in the watershed had updated conservation plans during the project period.

Following the same assumptions, approximately thirty percent of the landowners in the watershed took new steps to implement those plans using the 319 project, EQIP funds, or according to the State Poultry Regulations.

- Because much of the controversy within the Illinois River and Baron Fork watershed has focused upon animal waste, this project needs to meet a goal of 90% compliance with animal waste plans in the Illinois River and Baron Fork watersheds.
  - Enforcement of poultry and related animal waste regulations by the Oklahoma Department of Agriculture, Food, and Forestry has been very successful in this and other watersheds. This success has been reinforced and encouraged by the poultry integrators to a degree that at least 90% of the producers comply with the State requirements related to Animal Waste Plans.
- Photo documentation on a representative sample of approved BMP's implemented within the Illinois River and Baron Fork watershed quantifying the landuse changes/cover attributed to the watershed implementation plan.
  - Photodocumentation was not as effective as anticipated because of tardiness on OCC's part in developing an approved method and completing the necessary QAPPs. In addition, because many of the BMPs were not installed until the end of the project, before and after or presence/absence photos did not show as big a difference. Although some of the photos collected could be used in quantifiable comparisons, most were of limited use. As the use of this method continues to develop, we should be able to collect more photos that can be used in photodocumentation. In addition, we will revisit some of these sites to more correctly mimic the pre-implementation photos in subsequent years and continue to track changes due to this implementation.

Additional measures of success became evident as the project progressed that may be useful in the development of future projects. These included measures ranging from the satisfaction of the landowners with the practices implemented to the types of practices that they were willing to implement. For instance, one landowner was so happy with his protected riparian area that he converted from cattle pasture to a pecan orchard, that he purchased more land and encouraged his neighbors to consider the program. Many, if not all, of the landowners who implemented the heavy use areas and winter feeding facilities were so thrilled with the practices that they told their neighbors about how much it was helping them and encouraged them to implement the same practice. As a result, more requests were made for these practices than the available funds would support.

The program was also successful in spreading the demonstration of practices throughout the watershed in Adair and Cherokee Counties, rather than sticking to one area. Given the satisfaction of the landowners with the practices, this should help encourage nonparticipating landowners to implement some of the practices on their own or through other programs such as EQIP.

One of the most impressive measures of success of this combined with previous education efforts in the watershed was the willingness of landowners to implement riparian protection. Previous projects in the watershed met with little or no success with respect to implementation of riparian protection. In one subwatershed, landowners went so far as to clear their riparian zones in response to what was perceived as unwanted government intrusion. However, year-by-year, with a few, prominent landowners implementing and praising riparian protection and with continued emphasis on riparian benefits from NRCS, OSU Extension, Conservation District, and OCC education programs, this project found landowners more receptive to riparian protection than ever before.

Future activities in the watershed will include continued monitoring efforts to determine whether or not these, and related activities will eventually result in decreased loading to Lake Tenkiller. In considering these future improvements, in addition to continued water quality monitoring, it will be necessary to track BMP implementation in the watershed. BMP tracking will also be beneficial for TMDL development and other modeling exercises in the watershed to determine areas where future BMPs could be concentrated. The BMP tracking associated with this project is the first major step towards an electronic, geo-referenced database that can be used in these two efforts.

Oklahoma and Arkansas will continue to work together to address the water quality concerns in the Illinois River. The States are working through the Arkansas River Compact Commission to develop a monitoring plan to monitor progress toward meeting the Scenic River Water Quality Standard of 0.037 mg P/l and have also agreed to develop a joint Watershed Based Plan for the watershed. This effort will include development of an updated water quality model for the watershed to predict the areas contributed the greatest portions of the loading (most likely utilizing the SWAT model). This effort will be coordinated with Arkansas and shared with NRCS and similar agencies for targeting of efforts.

The data and information gathered associated with this project will be incorporated into ongoing and future efforts to address problems in the watershed. Ongoing projects include litter transfer efforts in both Arkansas and Oklahoma as well as projects or programs to find alternative uses of the litter such as production of heat energy or electricity or production of concentrated liquid fertilizer or compost that can be available for retail sale. The location of BMPs and contacts developed during this project will be useful in another current effort to implement riparian conservation easements in the Illinois River Watershed.

The Watershed Advisory Group can be reconvened and perhaps expanded to help with future programs in the watershed such as:

- reviewing the watershed based plan that Oklahoma and Arkansas will develop
- promoting new programs such as the CREP or Riparian Conservation Easement Programs
- updating State and Federal government about developing concerns of local citizens in the watershed.

Literature Cited

Bottcher, A. and H. Harper. 2003. Estimation of Best Management Practices and Technologies Phosphorus Reduction Performance and Implementation Costs in the Northern Watershed of Lake Okeechobee. Letter report to SFWMD.

Durham. S. 2003. Designing the Best Possible Conservation Buffers. Agricultural Research Magazine. 51: 4-7.

Nelson, M. A. and L. W. Cash. 2004. Illinois River 2003 Pollutant Loads at Arkansas Highway 59 Bridge. Publication No. MSC-316. Arkansas Water Resource Center Water Quality Lab. Fayetteville, Arkansas.

Oklahoma State University. 1996. Diagnostic and Feasibility Study on Tenkiller Lake, Oklahoma. Environmental Institute, Oklahoma State University. June 1996.

Oklahoma Water Resources Board. 2004. Water Quality Monitoring Report: Illinois River Basin Arkansas-Oklahoma Compact CY 2003.

Parsons, 2004. Draft Report: Water quality and biological assessment of selected segments in the Illinois River and Kings River watersheds, Arkansas. Austin, Texas.

Pickup, B.E., W. J. Andrews, B. E. Haggard, and W. R. Green. 2003. Phosphorus Concentrations, Loads, Yields in the Illinois River Basin, Arkansas and Oklahoma, 1997-2001. Water-Resources Investigations Report 03-4168. USGS, Oklahoma City.

Prosser, I. & L. Karssies. 2001. Designing filter strips to trap sediment and attached nutrients. Riparian Land Management Technical Guideline Update, Land & Water, Australia, Canberra.

Wilson, G. and T. Anderson. 2004. Final – Detailed Assessment of Phosphorus Sources to Minnesota Watersheds – Individual Sewage Treatment Systems/Unsewered Communities. Technical Memorandum, Minnesota Pollution Control Agency. 23/62-853 ISTS 009.

APPENDIX A:

Water Quality Data

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25° C)	Water Temp. (° C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 °C(mg/L)
Barber	USGS	1/4/1999	11:30	51	761	12.2	8.1	242	5.8	0.02	0.1	1.71	0.026	0.05	0.03	0.05	2	7	448									
Barber	USGS	2/1/1999	15:00	66	755	12.6	8.1	242	11	0.02	0.1	1.45	0.01	0.03	0.04	0.04	1	8	120									
Barber	USGS	3/23/1999	10:40	209	757	10.1	7.6	192	12.1	0.04	0.06	1.72	0.01	0.03	0.04	0.03	42	5	18									
Barber	USGS	4/5/1999	11:45	247	745	8.8	7.9	207	14.9	0.02	0.19	1.08	0.01	0.06	0.03	0.09	150	210	150									
Barber	USGS	5/3/1999	13:00	102	745	10.4	7.9	209	16.9	0.05	0.17	1.17	0.01	0.04	0.04	0.05	23	44	26									
Barber	USGS	6/7/1999	14:00	88	754	8	8.6	180	23.6	0.02	0.89	0.47	0.029	0.05	0.02	0.21	13	7	4									
Barber	USGS	6/23/1999	12:42	62	747	7.9	7.9	228	21.1	0.02	0.24	0.87	0.01	0.05	0.03	0.06												
Barber	USGS	7/27/1999	11:07	33	757	8.2	7.4	240	26.6	0.02	0.13	0.73	0.01	0.05	0.04	0.05	2	1	20									
Barber	USGS	8/10/1999	12:45	23	750	7.7	7.4	235	29	0.02	0.2	0.87	0.01	0.04	0.04	0.06	22	20	43									
Barber	USGS	9/13/1999	12:35	24	755	8.3	8	245	24.4	0.050			0.050		0.022	0.058	5	20	19									
Barber	OWRB	9/22/1999	16:40				7.6	201.6	23.63	0.02	0.1	0.7	0.01	0.04	0.03	0.05												
Barber	USGS	10/19/1999	14:20	11	763	11.6	7.6	247	19.1	0.050			0.070		0.075	0.094	120	88	140									
Barber	OWRB	10/19/1999	15:45			8.51	7.24	218.8	19.84	0.02	0.07	0.8	0.01	0.04	0.02	0.04												
Barber	USGS	11/3/1999	10:15	16	762	10	7.3	246	14.8	0.050			0.050		0.025	0.032	15	20	28									
Barber	OWRB	11/16/1999	14:40			10.05	7.45	240.6	17.62	0.02	0.15	0.85	0.01	0.05	0.04	0.05												
Barber	USGS	12/1/1999	10:44	16	762	10.9	7.8	253	12.6	0.050					0.044	0.050	5	40	20									
Barber	OWRB	12/13/1999	16:15			8.73	7.36	259.9	13.1	0.02	0.06	1.56	0.01	0.04	0.03	0.04												
Barber	USGS	1/20/2000	11:15	24	766	15.4	7.8	249	8.6	0.02	0.06	1.1	0.01	0.05	0.02	0.05	11	18	19									
Barber	USGS	2/15/2000	12:00	21	754	12.5	7.8	254	19	0.050			0.050		0.022	0.360	1	1	3									
Barber	OWRB	2/23/2000	15:20							0.02	0.15	1.19	0.01	0.05	0.02	0.03												
Barber	USGS	3/21/2000	12:25	40	757	12.2	8.3	247	13				0.050			0.031	7	12	8									
Barber	OWRB	3/21/2000	13:55			11.77	7.8	202	13.89	0.02	0.15	0.62	0.01	0.05	0.02	0.04												
Barber	USGS	4/18/2000	16:20	34	753	12	8.2	239	19	0.02	0.35	0.87	0.01	0.04	0.03	0.05	6	3	17									
Barber	USGS	5/10/2000	11:15	118	754	9.9	7.6	251	17.7	0.050			0.050		0.089	0.097	55	58	110									
Barber	OWRB	5/15/2000	16:53			10.89	8	260	20																			
Barber	OWRB	5/16/2000								0.050			0.050		0.065	0.090	134	10.0										
Barber	OWRB	6/20/2000	17:45			3.94	7.75	196.7	22.44																			
Barber	OWRB	6/20/2000								0.050			0.050		0.035		169	170.0										
Barber	OWRB	7/25/2000	15:17			7.73	7.32		24																			
Barber	OWRB	7/25/2000								0.050			0.050		0.032	0.106	20	10.0										
Barber	OWRB	8/22/2000	16:01			10.61	7.05	201	29																			
Barber	OWRB	8/23/2000								0.050			0.050		0.016	0.078	5	5.0										
Barber	OWRB	9/19/2000	15:28			8.54	7.4	214	25																			
Barber	OWRB	9/19/2000								0.050			0.050			0.072	10	100.0										
Barber	OWRB	10/18/2000	15:10			11.09	8.04	174.1	20.21	0.04	0.06	0.67	0.006	0.04	0.03	0.04												
Barber	USGS	10/25/2000	9:40	29	760	7	7.4	242	19.2	0.04	0.19	3.38	0.003	0.05	0.04	0.05	32	28	54									
Barber	USGS	11/7/2000	10:45	286	755	9.7	7.6	247	15.3	0.050			0.050		0.040	0.057												
Barber	OWRB	11/14/2000	16:44			11.12	7.6	211	13	0.04	0.14	2.53	0.006	0.03	0.03	0.06												
Barber	USGS	12/7/2000	9:00	56	759	9.9	7.4	225	8.1	0.04	0.41	1.76	0.003	0.06	0.03	0.06	26	22	23									
Barber	USGS	1/29/2001	13:42	226	746	11.1	7.5	206	7.8	0.02	1.8	1.57	0.006	0.09	0.07	0.68	68	310	1100									
Barber	USGS	2/24/2001	11:27	3250	750	10.3	6.8	107	9.5	0.050			0.050		0.042	0.063	4200	6400	11000	71	894							
Barber	OWRB	2/27/2001	17:23			11.37	7.38	123	11	0.04	0.08	2.19	0.006	0.03	0.03	0.04												
Barber	USGS	3/14/2001	11:40	138	750	10.9	7.6	188	11.1	0.050			0.050		0.024	0.037	11	10	16									
Barber	OWRB	3/26/2001	17:00			12.39	7.79	150	12.22	0.04	0.37	1.37	0.003	0.06	0.02	0.06												
Barber	USGS	4/19/2001	13:05	62	754	9.7	7.9	220	16.1	0.050			0.050		0.023	0.046	23	26	24									
Barber	OWRB	4/23/2001	17:41			10.51	7.89	212	19	0.04	0.65	1.67	0.01	0.09	0.08	0.15												
Barber	USGS	5/18/2001	17:00	40	746	8.3	7.7	223	22.5								170	60	92	86	51							
Barber	OWRB	5/23/2001								0.050			0.060		0.142	0.343	5	5.0										
Barber	OWRB	5/29/2001	18:48			7.44	7.36	157	20	0.03	0.52	1.07	0.006	0.07	0.06	0.12												
Barber	USGS	5/30/2001	12:15	562	755	7.7	7	175	17.7								3600	3800	22000	76	59							
Barber	OWRB	6/18/2001								0.050			0.050		0.035	0.054	5	5.0										
Barber	OWRB	6/19/2001	16:28			12.38	7.71	193	27	0.04	0.11	0.95	0.008	0.03	0.03	0.03												
Barber	USGS	6/26/2001	8:57	49	760	7.3	7.2	241	22.5								18	23	37									
Barber	OWRB	7/23/2001											0.050		0.019	0.032	31	50.0										
Barber	OWRB	7/24/2001	14:00			6.2		229.9	29.26	0.04	0.13	0.57	0.003	0.06	0.02	0.06												
Barber	USGS	7/25/2001	9:20	15	753	4.8	7.1	245	26.4	0.04	0.14	0.32	0.006	0.06	0.02	0.05	59	86	220									
Barber	USGS	8/20/2001	12:00	13	755	7.2	7.6	234	27.3								20	23	87									

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Barber	OWRB	8/20/2001											0.050		0.036	0.065	10	30.0										
Barber	OWRB	8/21/2001	16:38			10.06	7.69	238	29																			
Barber	OWRB	9/17/2001								0.06	0.12	0.46	0.006	0.05	0.01	0.03	5	60.0										
Barber	USGS	9/19/2001	11:10	25	755	6.7	7.4	253	23.1				0.050		0.036		37	120	200									
Barber	OWRB	9/24/2001	17:15			8.63	7.67	248.2	22.81				0.050		0.031	0.041												
Barber	OWRB	10/23/2001	16:56			8.84	7.84	215	21	0.04	0.15	1.31	0.008	0.06	0.02	0.06												
Barber	USGS	10/24/2001	13:25	24	750	7.8	7.6	262	20.1	0.04	0.1	2.08	0.008	0.04	0.03	0.04	8	20	28									
Barber	USGS	11/8/2001	13:35	95	768	8.2	7.7	231	17.5				0.050		0.641	1.532	87	50	135									
Barber	OWRB	11/13/2001	17:30			8.87	7.97	241.1	16.13	0.04	0.08	1.54	0.008	0.03	0.03	0.04												
Barber	USGS	12/10/2001	13:00	46	765	10.5	7.4	234	11.2	0.02	0.86	1.92	0.004	0.06	0.05	0.32	4	2	13									
Barber	USGS	12/17/2001	15:30	1180	750	10.7	7.5	167	13.6	0.04	0.14	1.76	0.008	0.06	0.02	0.06	1500	570	4600	96	112							
Barber	USGS	1/23/2002	10:00	37	760	12	7.6	217	9.8	0.04	0.1	1.7	0.008	0.03	0.02	0.06	7	5	24									
Barber	USGS	2/13/2002	9:45	73	771	11.6	7.3	214	7.8	0.050			0.050		0.027	0.038	41	57	17									
Barber	OWRB	3/13/2002	13:30			12.37	8.44	219.9	12.77	0.04	0.1	1.3	0.004	0.04	0.02	0.04												
Barber	USGS	3/18/2002	17:00	69	760	10.8	7.4	221	11.7	0.050			0.050		0.044	0.064	47	58	25									
Barber	OWRB	4/10/2002	15:00			9.42		167.3	15.86	0.04	0.09	1.47	0.008	0.06	0.03	0.04												
Barber	USGS	4/17/2002	11:40	190	765	9.7	7.5	190	17.2	0.050			0.050		0.027	0.044	7	8	11									
Barber	OWRB	5/8/2002	11:25			8.07	7.63	162	20	0.04	0.09	1.23	0.008	0.06	0.02	0.06												
Barber	USGS	5/28/2002	12:15	73	762	8.5	7.3	234	18.6								110	120	272									
Barber	OWRB	6/3/2002								0.04	0.15	1.21	0.008	0.04	0.03	0.04	20	10										
Barber	USGS	6/10/2002	11:34	72	760	8.3	7.3	247	22	0.050			0.050		0.024	0.045	68	58	45									
Barber	OWRB	7/10/2002	14:00			6.73	8.02	231.8	28.09																			
Barber	OWRB	7/10/2002								0.050			0.050		0.032	0.043	10	20										
Barber	OWRB	9/4/2002	12:47			8.57	7.78	209	27																			
Barber	OWRB	9/4/2002								0.050			0.050		0.031	0.033	10	10										
Barber	OWRB	10/8/2002	09:50			7.86	7.36	170	19.99				0.050		0.032	0.038												
Barber	OWRB	10/30/2002	08:14			7.92	7.54	201	16	0.050			0.050		0.029													
Barber	OWRB	12/10/2002	13:00			8.79	8.05	208.5	10.52	0.050			0.050		0.018	0.022												
Barber	OWRB	1/29/2003	08:48			10.58	7.55	241.3	7.55	0.050			0.050		0.021													
Barber	OWRB	3/12/2003	10:38			11.89	8.32	122.6	10.58	0.050			0.050		0.025	0.033												
Barber	OWRB	4/9/2003	17:30			11.52	8.21	193.1	15.36	0.050			0.050		0.036													
Barber	OWRB	5/12/2003	17:20			7.7	7.33	211	23																			
Barber	OWRB	5/13/2003															10	10.0										
Barber	OWRB	6/3/2003								0.050			0.050		0.025	0.033	10	10.0										
Barber	OWRB	6/18/2003	12:00			7.35	7.43	215.4	23.43																			
Barber	OWRB	6/18/2003															20	30.0										
Barber	OWRB	7/8/2003															10	170.0										
Barber	OWRB	7/22/2003								0.050			0.050		0.023	0.031	10	200.0										
Barber	OWRB	7/23/2003	13:30			8.62	7.46	244.6	26.96																			
Barber	OWRB	8/12/2003								0.050			0.050		0.032	0.049	10	50.0										
Barber	OWRB	8/26/2003	13:56			7.84	7.41	219	29																			
Barber	OWRB	9/16/2003								0.050			0.050		0.030	0.032	10	20.0										
Barber	OWRB	9/30/2003	09:22			7.13	7.7	271.5	19.87																			
Barber	OWRB	9/30/2003								0.050			0.050		0.028	0.031	10	10.0										
Barber	OWRB	11/4/2003	11:04			7.66	7.38	270.1	20.19	0.050			0.050		0.034	0.035												
Barber	OWRB	12/1/2003	12:24			10.23	7.69	248	13	0.050			0.050		0.024	0.031												
Barber	OWRB	1/27/2004	08:24			10.37	7.7	243.5	4.09	0.050			0.050		0.021	0.026												
Barber	OWRB	2/24/2004	11:00			12.81	8.34	249.5	9.49	0.050			0.050		0.025	0.029												
Barber	OWRB	4/6/2004	10:35			10.62	7.9	214.9	13.26	0.050			0.050		0.029	0.042												
Barber	OWRB	5/17/2004	17:00			10.49	8.16	171	21.8	0.050			0.050		0.065	0.089												
Barber	OWRB	6/21/2004	16:57			8.76	7.71	203.6	23.34	0.050			0.050		0.039	0.047												
Barber	OWRB	7/27/2004	11:26			8.74	7.65	194.3	22	0.050			0.050		0.038	0.042												
Barber	OWRB	8/31/2004	18:04			7.72	7.77	218.1	26.19																			
Chewey	USGS	1/6/1999	15:10	590	745	16.4	8.7	279	4.9	0.03	0.21	2.95	0.038	0.08	0.07	0.07		18	89									
Chewey	USGS	2/2/1999	9:20	1320	754	10.4	7.9	248	8.7	0.04	0.49	2.61	0.01	0.12	0.12	0.17		270	760									
Chewey	USGS	3/15/1999	17:00	4660	754	11.2	7.3	175	9.8	0.03	0.47	2.82	0.01	0.12	0.11	0.2		180	420									
Chewey	USGS	4/6/1999	14:00	3600	750	9	7.6	201	15.9	0.02	0.77	1.95	0.01	0.12	0.09	0.21		2400	5400									

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Chewey	USGS	5/4/1999	9:05	3240	735	8.3	7.4	164	16.5	0.06	1.4	1.47	0.01	0.19	0.16	0.43		7200	24000									
Chewey	USGS	6/24/1999	15:36	1610	748	8.5	7.6	260	21.8	0.02	0.3	2.49	0.01	0.16	0.13	0.2		72	1000									
Chewey	USGS	7/1/1999	10:46	23300	749	6.4	6.8	115	22.1	0.07	2.5	1	0.021	0.26	0.19	0.93	7800	6000	19000	93	575							
Chewey	USGS	8/13/1999	10:48	282	750	7.5	7.8	304	28.4	0.02	0.2	2.04	0.01	0.12	0.12	0.14	11	24	190	98	25							
Chewey	USGS	10/20/1999	15:50	194	762	13.4	8.1	335	16.3	0.02	0.23	1.9	0.01	0.14	0.15	0.12	9	5	25	98	21							
Chewey	USGS	12/1/1999	12:25	203	760	14	8	322	10.2	0.02	0.13	1.98	0.01	0.18	0.14	0.15	13	15	8	87	19							
Chewey	USGS	12/11/1999	11:40	886	753	11.2	7.8	291	9.4	0.02	0.22	2.58	0.01	0.19	0.18	0.21	280	360	410	98	30							
Chewey	USGS	2/16/2000	11:05	231	760	10.6	7.8	328	9	0.02	0.17	2.01	0.01	0.17	0.14	0.17	3	6	16	95	26							
Chewey	USGS	4/12/2000	14:45	1400	757	8.7	7.7	273	14.2	0.09	0.92	1.83	0.016	0.27	0.23	0.37	18000	16000	13000	96	69							
Chewey	USGS	5/7/2000	14:42	3340	745	8.2	7.3	235	19.6	0.02	1.4	1.38	0.01	0.23	0.2	0.47	6400	4400	14000	91	429							
Chewey	USGS	6/18/2000	12:06	16800	750	7.4	7	130	19.1	0.04	1.9	1.11	0.011	0.29	0.25	0.86	21000	14000	55000	94	513							
Chewey	USGS	6/22/2000	12:36	34700	750	7.5	6.9	108	19.8	0.03	2.2	1.12	0.01	0.35	0.3	0.96	15000	13000	43000	72	713							
Chewey	USGS	8/16/2000	13:10	251	755	8.1	7.8	312	28.6	0.02	0.19	1.71	0.01	0.16	0.13	0.16	38	28	6	100	26							
Chewey	USGS	9/26/2000	13:30	840	759	8.8	7.7	293	18.6	0.02	0.26	1.88	0.01	0.2	0.2	0.23	110	85	180	97	37							
Chewey	USGS	10/23/2000	14:30	230	750	10.3	7.9	344	18.8	0.04	0.15	1.83	0.004	0.21	0.18	0.22	41	40	63	100	24							
Chewey	USGS	11/7/2000	12:30	1900	747	9.9	7.7	302	14.7	0.04	0.35	2.25	0.006	0.21	0.19	0.27				91	49							
Chewey	USGS	12/7/2000	12:55	415	757	12.3	8.1	292	6.9	0.04	0.11	3.12	0.006	0.14	0.13	0.14	3	2	6	100	26							
Chewey	USGS	1/30/2001	12:45	4980	743	10.6	7.3	208	7.4	0.1	1.4	2.31	0.014	0.14	0.12	0.4	1700	1700	5200	92	261							
Chewey	USGS	2/15/2001	13:28	6670	750	9.9	7.2	192	10	0.08	2.6	2.49	0.012	0.18	0.17	0.83	12000	12000	18000	93	702							
Chewey	USGS	2/25/2001	9:55	20600	756	10.2	6.8	129	8.7	0.07	1.1	2.62	0.007	0.22	0.2	0.46	3200	7000	17000	95	270							
Chewey	USGS	4/18/2001	17:15	518	758	10.8	8.3	273	16.8	0.04	0.38	2.32	0.004	0.13	0.12	0.14	6	1	3	99	24							
Chewey	USGS	5/18/2001	16:35	1220	756	7.3	7.7	295	23.5	0.04	0.24	2.05	0.003	0.21	0.22	0.24	3700	3500	20000	98	34							
Chewey	USGS	6/27/2001	9:39	376	758	7.2	7.3	283	24.1	0.04	0.19	1.66	0.008	0.19	0.19	0.18	4	20	68	97	29							
Chewey	USGS	8/15/2001	13:00	200	750	7.3	7.4	335	27	0.04	0.2	1.08	0.006	0.23	0.24	0.25	40	20	83	91	37							
Chewey	USGS	10/11/2001	16:03	1110	750	8	7.3	259	18.1	0.04	0.29	1.91	0.008	0.21	0.18	0.22	2400	1000	1830	92	43							
Chewey	USGS	12/11/2001	12:05	335	765	11.2	7.9	305	7.9	0.04	0.14	2.49	0.008	0.25	0.23	0.26	10	10	22	97	31							
Chewey	USGS	12/17/2001	17:40	17400	743	9.9	7.6	130	10.4	0.03	1.9	1.66	0.007	0.38	0.32	0.86	8900	6400	50000	92	446							
Chewey	USGS	2/1/2002	13:45	7420	768	11.6	7.3	150	7	0.08	1.4	1.34	0.006	0.23	0.21	0.53	16000	7700	29500	95	280							
Chewey	USGS	3/20/2002	12:20	9540	766	10.3	7.1	148	11.1	0.09	2	1.2	0.007	0.23	0.21	0.65	7300	8400	42000	92	413							
Chewey	USGS	4/8/2002	14:00	11600	754	7.4	7.2	157	11.5	0.1	2.1	1.52	0.01	0.29	0.27	0.78	15000	20000	67500	91	602							
Chewey	USGS	6/14/2002	10:40	1640	760	7.6	7.2	266	22.2	0.04	0.31	2.16	0.008	0.25	0.24	0.27	290	290	459	98	32							
Chewey	USGS	8/15/2002	11:50	3230	760	6.9	7.1	183	22	0.02	0.83	1.93	0.012	0.32	0.28	0.44	700	730	1950	96	109							
Chewey	USGS	10/17/2002	13:15	156	764	11.4	8.2	340	14.4	0.04	0.12	2.1	0.008	0.29	0.29	0.3	14	20	5	24	7							
Chewey	USGS	12/11/2002	10:00	216	763	10.2	7.6	338	6.8	0.04	0.16	2.21	0.005	0.14	0.14	0.15	7	7	13	33	1							
Chewey	USGS	3/27/2003	1315	584	760	14.1	8.8	280	15.1	0.015	0.2	2.08	0.006	0.111	0.098	0.123	2	11	9	63	7							
Chewey	USGS	4/23/2003	1320	293	756	11.2	8.2	323	17.4	0.017	0.27	1.56	0.013	0.132	0.128	0.144	10	20	22	63	5							
Chewey	USGS	**5/16/2003**	1815	1440	749	7	7.3	212	19.6	0.031	0.59	1.59	0.01	0.167	0.153	0.21	4000	5000	1600	92	40							
Chewey	USGS	**5/17/2003**	1120	5030	750	7.9	7.1	173	18.4	0.039	1.5	1.29	0.014	0.177	0.158	0.51	6400	6600	24000	95	273							
Chewey	USGS	**5/21/2003**	1335	2730	750	7.3	7.6	195	18.1	0.015	0.87	1.49	0.011	0.199	0.178	0.35	5500	4500	17000	93	101							
Chewey	USGS	6/2/2003	1520	621	751	7.8	7.8	263	21.1	0.015	0.4	1.87	0.007	0.129	0.118	0.151	330	570	1600	80	13							
Chewey	USGS	**6/3/2003**	1340	2000	756	7.7	7.4	260	19.4	0.015	0.64	1.98	0.012	0.199	0.185	0.28	1800	2900	7000	93	92							
Chewey	USGS	**6/12/2003**	1550	1380	753	7.7	7.8	312	24.3	0.015	0.29	2.09	0.004	0.144	0.13	0.18	5	5	200	95	20							
Chewey	USGS	7/14/2003	1610	951	765	6.9	7.7	321	27.6	0.015	0.45	1.44	0.006	0.2	0.196	0.25	420	280	453	92	66							
Chewey	USGS	**8/30/2003**	1945	286	745	7.8	7.9	346	27.7	0.015	0.24	0.776	0.003	0.167	0.153	0.183				94	40							
Chewey	USGS	8/27/2003	1730	117	744	9.6	8.1	357	30.2	0.015	0.22	0.402	0.003	0.16	0.141	0.172				95	34							
Chewey	USGS	9/2/2003	1430	845	763	6.9	7.9	325	24.6	0.015	0.3	1.26	0.003	0.182	0.168	0.21				92	44							
Chewey	USGS	10/28/2003	1530	162	756	11.6	8.1	356	16.2	0.005	0.18	1.23	0.004	0.112	0.101	0.122				94	43							
Chewey	USGS	12/8/2003	1415	234	757	14.5	7.6	333	9.2	0.005	0.17	2.09	0.002	0.081	0.067	0.088				100	20							
Chewey	USGS	**3/4/2004**	1345	5120	730	10.1	7.6	195	15.1	0.085	1.2	2.1	0.011	0.2	0.179	0.42				93	186							
Chewey	USGS	2/19/2004	1530	425	760	14.9	8.2	296	10.9	0.005	0.19	2.26	0.006	0.04	0.031	0.051				88	27							
Chewey	USGS	4/14//04	1255	669	765	13.1	8.1	251	13.4	0.01	0.34	1.68	0.004	0.062	0.049	0.075				82	31							
Chewey	USGS	**4/23/2004**	1310	9590	762	8.2	7	144	16.5	0.064	2	1.17	0.012	0.26	0.231	0.77				89	469							
Chewey	USGS	6/17/2004	1225		762	8.3	7.2	313	24.8	0.01	0.14	2.04	0.004	0.121	0.105	0.199				96	25							
Chewey	USGS	8/18/2004	1130	379	760	8.1	7.8	304	23.4	0.009	0.15	2.23	0.004	0.103	0.09	0.109												
Eldon	USGS	1/5/1999	9:45	211	761	11.9	8.3	222	5.2	0.03	0.1	2.81	0.02	0.05	0.02	0.05	8	10	6	97	20	37.1	1.93	1.86	3.22	5.7	8	130
Eldon	OWRB	1/19/1999	15:00			11.13	8.11	206.4	9.95	0.050					0.015											4.1	8.0	117.5
Eldon	USGS	2/1/1999	11:20	565	755	10.1	7.3	214	9.7	0.04	0.3	2.7	0.01	0.04	0.04	0.08		340	280									

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Eldon	OWRB	2/16/1999	14:30			9.70	7.75	191.0	12.17	0.050			0.060		0.005	0.005										5.0	5.6	117.5
Eldon	OWRB	3/15/1999	14:10			10.93	6.89	119.0	10.48	0.050			0.050													5.0	8.5	84.0
Eldon	USGS	3/23/1999	16:45	831	755	10.1	7.8	169	12.3	0.03	0.14	2.6	0.01	0.05	0.03	0.04	28	4	10	94	25	29.2	1.73	1.75	2.6	4.28	6.5	103
Eldon	USGS	4/5/1999	14:20	1000	744	9.6	7.3	173	15.4	0.02	0.28	1.59	0.01	0.04	0.04	0.09		470	130									
Eldon	OWRB	4/20/1999	14:45			11.84	8.60	177.4	17.74	0.050			0.050		0.007	0.023										5.0		114.5
Eldon	USGS	5/3/1999	11:05	481	745	9.2	7.5	183	15.7	0.05	0.14	1.64	0.01	0.04	0.03	0.05		48	24									
Eldon	OWRB	5/18/1999	15:15			6.62	7.78	713.0	19.75	0.050					0.018	0.061										5.0	6.4	457.0
Eldon	USGS	6/7/1999	11:35	361	750	9.3	7.8	200	22	0.02	0.2	1.42	0.01	0.05	0.02	0.04	12	16	16	90	13	32	1.65	2.04	2.99	4.08	5.1	120
Eldon	OWRB	6/21/1999	14:10			7.74	7.37	190.4	21.86	0.050			0.050		0.031	0.055											40.0	108.0
Eldon	OWRB	6/21/1999															52	20										
Eldon	USGS	6/23/1999	14:03	258	745	8.8	7.7	204	21.4																			
Eldon	OWRB	7/20/1999	15:35			5.82	8.32	200.2	26.82	0.050			0.050		0.024	0.032										5.0	5.2	122.5
Eldon	OWRB	7/20/1999															31	30										
Eldon	USGS	8/11/1999	8:30	44	751	5.5	7.1	212	25.5	0.02	0.19	0.91	0.01	0.05	0.02	0.05	42	54	140	83	37	34.6	1.74	2.22	3.15	4.99	5.2	125
Eldon	OWRB	8/16/1999	15:50			6.12	7.81	197.2	28.15	0.050					0.025	0.036										5.0	5.6	126.0
Eldon	OWRB	8/16/1999															52	5										
Eldon	OWRB	9/22/1999	15:25			8.73	7.60	157.0	23.00	0.050			0.060		0.028	0.044											6.2	103.0
Eldon	OWRB	9/22/1999															51	10										
Eldon	OWRB	10/19/1999	13:30			8.20	7.12	178.3	18.41	0.050			0.050		0.031	0.047										5.0	5.0	113.6
Eldon	USGS	10/20/1999	8:45	30	764	8.8	7.2	202	15.8	1.53	0.09	0.72	0.01	0.03	0.02	0.05	57	78	98	91	13	32	1.65	2.01	3.12	5.96	4.8	113
Eldon	OWRB	11/16/1999	12:20			9.51	7.23	189.0	16.06	0.050			0.050		0.007	0.010										5.0	5.0	112.5
Eldon	USGS	12/2/1999	8:09	44	752	8.4	7.6	195	13.3	0.03	0.13	0.74	0.01	0.04	0.04	0.05	230	440	140	94	17	34.2	1.77	1.78	3.5	6.51	4.9	
Eldon	USGS	12/10/1999	11:15	225	761	11.4	7.2	192	12.1	0.02	0.21	1.27	0.01	0.05	0.02	0.05	230	380	990	97	17							
Eldon	OWRB	12/13/1999	14:00			8.98	7.16	212.7	11.97	0.050					0.050	0.055										5.0	8.1	131.0
Eldon	USGS	2/16/2000	7:30	66	760	9.4	7.3	207	9.1	0.02	0.08	1.48	0.01	0.04	0.02	0.05	28	30	33	87	20	34.3	1.75	1.69	3.17	6.47	7.6	115
Eldon	OWRB	2/23/2000	13:15							0.050			0.050		0.023	0.050										5.0		
Eldon	OWRB	3/21/2000	12:14			11.07	7.55	168.0	11.62				0.050			0.021										5.0	6.4	107.0
Eldon	USGS	4/13/2000	10:50	350	760	10.9	7.8	210	14.1	0.02	0.12	1.41	0.01	0.05	0.01	0.05	270	200	61	95	23	36.2	1.8	1.92	3.21	5.19	8	117
Eldon	USGS	5/7/2000	16:45	985	750	9.3	7.4	199	19.4	0.02	0.31	1.08	0.01	0.04	0.03	0.08	2000	1400	2600	89	37							
Eldon	OWRB	5/15/2000	14:55			10.97	8.00	220.0	18.00	0.050			0.050		0.023	0.050										2.1		133.0
Eldon	OWRB	5/16/2000															86	100										
Eldon	USGS	6/17/2000	15:26	7520	750	9.5	7.2	122	18.9	0.07	3	1.08	0.011	0.21	0.18	1.12	29000	23000	70000	81	1080							
Eldon	OWRB	6/20/2000	15:40			4.43	7.53	165.7	21.36	0.070			0.050		0.065	0.093										5.0		112.5
Eldon	OWRB	6/20/2000															146	200										
Eldon	USGS	6/21/2000	12:47	49100	755	8.2	6.7	79	19.2	0.05	4.4	0.78	0.01	0.27	0.24	1.65	50000	41000	140000	92	1570							
Eldon	USGS	6/28/2000	16:30	5350	749	9.3	7.1	115	20.6	0.02	3.1	1.32	0.01	0.12	0.1	0.98	19000	23000	140000	64	1760							
Eldon	USGS	7/20/2000	9:30	150	757	5.8	7.4	192	24.5	0.02	0.16	1.68	0.01	0.05	0.02	0.04	250	230	600	100	18	30.8	1.58	2.34	2.78	4.78	5.3	115
Eldon	OWRB	7/25/2000	12:54			7.75	7.31		23.00	0.050			0.050		0.032											5.0	8.8	
Eldon	OWRB	7/25/2000															10	30										
Eldon	OWRB	8/22/2000	13:06			11.33	7.06	174.0	27.00	0.050			0.050		0.024	0.055										5.0	5.1	116.0
Eldon	OWRB	8/23/2000															41	30										
Eldon	USGS	8/30/2000	11:00	50	753	7.3	7.3	202	25.5	0.02	0.12	1.02	0.01	0.05	0.01	0.05	81	110	43	100	19	33.2	1.65	2.4	3	5.3	5	118
Eldon	OWRB	9/19/2000	13:05			9.59	7.40	189.0	23.00	0.050			0.050		0.011	0.079										5.0	33.3	121.0
Eldon	OWRB	9/19/2000															121	300										
Eldon	OWRB	10/18/2000	12:00			8.73	7.45	147.2	18.40	0.050			0.050			0.030										5.0	5.0	93.0
Eldon	USGS	10/24/2000	14:35	51	762	10.3	7.6	200	20.5	0.04	0.06	0.84	0.006	0.03	0.02	0.06	45	41	69	98	16	34.8	1.68	1.8	2.9	5.87	4.9	108
Eldon	USGS	10/27/2000	13:19	110	758	8.2	7.4	189	18.8	0.04	0.22	1.11	0.006	0.06	0.02	0.04	350	400	1400	89	27							
Eldon	USGS	11/7/2000	9:30	1180	748	9.3	7.5	210	15.4	0.04	0.28	3.32	0.006	0.09	0.08	0.1				82	52							
Eldon	OWRB	11/14/2000	13:34			11.41	7.35	190.0	13.00	0.050			0.050		0.029	0.034											5.1	121.0
Eldon	USGS	12/20/2000	15:30	192	752	11.8	7.9	217	7	0.04	0.04	3.02	0.005	0.06	0.02	0.06	1	1	6			34.7	1.79	1.74	3.36	6.23	7.7	122
Eldon	USGS	1/30/2001	10:15	1270	732	10.5	7.1	183	8	0.04	0.65	2.84	0.004	0.06	0.04	0.13	400	510	3000	85	75							
Eldon	USGS	2/16/2001	11:45	3300	761	11	7	147	8.1	0.04	0.47	3.04	0.004	0.06	0.05	0.17	1900	930	7900	71	230	25.3	1.45	1.93	2.52	3.93	6.6	102
Eldon	USGS	2/25/2001	12:40	4900	750	10.4	6.9	125	9.4	0.04	0.7	2.87	0.003	0.07	0.07	0.26	2000	2300	6000	75	342							
Eldon	OWRB	2/28/2001	09:54			10.28	7.43	117.0	9.00	0.050			0.050		0.041	0.089										5.0	8.4	75.0
Eldon	OWRB	3/27/2001	10:22			9.26	7.42	285.0	8.46	0.050			0.050		0.016	0.023										5.0	6.2	182.0
Eldon	USGS	4/23/2001	16:10	153	759	9.4	7.7	191	18	0.04	0.12	2.02	0.006	0.06	0.02	0.06	34	35	40	98	23	32.3	1.6	1.91	2.98	5.42	6.3	123
Eldon	OWRB	4/24/2001	09:38			6.58	7.19	191.0	14.00	0.050			0.050		0.013	0.035										5.0	6.9	122.0

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Eldon	USGS	5/18/2001	15:00	673	747	8.3	7.5	178	21.3	0.04	0.12	1.29	0.004	0.04	0.03	0.04	22	74	161	99	26							
Eldon	OWRB	5/30/2001	09:28			7.67	7.34	183.0	18.00	0.050			0.050		0.023	0.047										5.0	7.5	117.0
Eldon	OWRB	5/30/2001															259	200										
Eldon	OWRB	6/20/2001	08:48			9.55	7.24	166.0	22.00	0.050			0.050		0.039	0.148										5.0	6.5	106.0
Eldon	OWRB	6/20/2001															131	190										
Eldon	USGS	6/25/2001	16:24	231	756	10	7.7	199	25.1	0.04	0.17	1.5	0.008	0.06	0.03	0.04	6	37	67	95	21	31.4	1.54	2.39	3.03	5.23	5.4	115
Eldon	OWRB	7/25/2001	10:00			7.15	8.82	199.0	25.36				0.050		0.015	0.023										5.0	6.1	127.4
Eldon	OWRB	7/25/2001															30	60										
Eldon	USGS	8/16/2001	9:30	51	755	5.8	7.1	199	24.8	0.03	0.18	0.66	0.006	0.06	0.02	0.03	97	110	220	100	21	32.5	1.62	2.36	3.14	5.26	5.1	127
Eldon	OWRB	8/22/2001	09:14			6.39	7.23	212.0	25.00				0.050		0.022	0.044										5.0	5.9	136.0
Eldon	OWRB	8/22/2001															20	60										
Eldon	OWRB	9/25/2001	10:15			7.20	7.29	204.3	19.91				0.050		0.024											5.0	5.4	130.8
Eldon	OWRB	9/25/2001															10	20										
Eldon	USGS	10/11/2001	17:45	927	752	7.8	7.4	188	18.6	0.04	0.64	1.24	0.008	0.07	0.05	0.15	14000	8400	14800	87	100							
Eldon	USGS	10/23/2001	15:55	136	746	8.5	7.1	210	21	0.04	0.17	1.86	0.008	0.12	0.12	0.13	25	20	40	92	22	34.7	1.75	2.12	3.19	5.49	5.9	122
Eldon	OWRB	10/24/2001	09:24			8.80	7.41	176.0	19.00				0.050		0.023	0.027										5.0	6.7	113.0
Eldon	OWRB	11/14/2001	11:00			7.61	7.58	286.2	17.92				0.050		0.017	0.096										5.0	7.1	183.1
Eldon	USGS	12/5/2001	12:45	231	764	9.6	7.2	214	14.5	0.04	0.38	1.56	0.008	0.04	0.02	0.04	42	29	137	93	22	35.1	1.82	2.13	3.3	5.89	8.1	128
Eldon	USGS	12/17/2001	14:00	6650	747	11.4	6.9	143	14	0.03	0.4	2.15	0.005	0.09	0.09	0.15	4100	3100	2600	99	201							
Eldon	USGS	2/1/2002	10:45	1700	759	12.3	6.5	156	8	0.03	0.44	1.9	0.008	0.08	0.07	0.15	2600	1400	9100	99	83							
Eldon	USGS	2/15/2002	16:15	215	769	12.7	7.8	184	8.9	0.04	0.06	2.17	0.008	0.03	0.02	0.06	3	1	9	100	19	30.8	1.58	1.75	2.87	5.2	7.6	104
Eldon	OWRB	2/20/2002	11:00			10.71	7.32	20.2	9.84	0.050			0.050		0.045	0.069										5.0	11.4	12.9
Eldon	OWRB	3/13/2002	09:30			12.35	8.04	187.6	8.80	0.050			0.050		0.013	0.018										5.0	7.1	120.1
Eldon	USGS	3/20/2002	10:15	6200	766	10.5	7	121	10.7	0.03	1.1	1.25	0.008	0.11	0.1	0.47	5300	5300	41500	62	542							
Eldon	USGS	4/8/2002	16:07	8030	735	12.1	6.8	109	12.7	0.08	1.6	1.15	0.004	0.18	0.16	0.49	4500	4500	210	96	273							
Eldon	OWRB	4/10/2002	11:00			9.74		136.1	13.91	0.050			0.050		0.071	0.134										5.0	19.0	87.1
Eldon	USGS	4/17/2002	9:45	928	762	8.8	7.3	181	16.2	0.04	0.22	2.12	0.008	0.04	0.04	0.09	1200	1200	1640	92	50	29.7	1.62	2.12	2.8	4.32	6.8	108
Eldon	OWRB	5/8/2002	08:37			7.67	7.32	143.0	19.00	0.050			0.050		0.014	0.027										5.0	6.8	91.0
Eldon	OWRB	5/8/2002															10	20										
Eldon	OWRB	6/3/2002															10	10										
Eldon	USGS	6/13/2002	8:53	174	760	7	7.5	218	21.5	0.04	0.11	1.23	0.008	0.06	0.024	0.03	89	72	195	100	14	34.8	1.74	2.16	3.06	5.22	5.8	115
Eldon	OWRB	7/10/2002	11:00			7.58	7.75	208.8	25.64	0.050			0.050		0.022	0.029										5.0	6.0	133.6
Eldon	OWRB	7/10/2002															20	10										
Eldon	USGS	8/14/2002	13:40	4580	760	7.7	7.3	153	21.6	0.04	2.1	1.8	0.01	0.19	0.16	0.74	2500	2000	13600	82	757	24.8	1.45	3.5	2.24	4.33	5.5	107
Eldon	OWRB	9/4/2002	10:00			6.83	7.45	183.0	0.50	0.050			0.050		0.019	0.029										5.0	6.8	117.0
Eldon	OWRB	9/4/2002															20	40										
Eldon	OWRB	10/8/2002	07:40			6.67	7.11	143.0	19.29	0.050			0.050		0.021	0.025										5.0	6.7	91.0
Eldon	USGS	10/23/2002	10:30	41	767	7.9	7.3	202	17.8	0.04	0.06	0.82	0.008	0.03	0.02	0.04	30	61	43	78	2	35.3	1.73	2.09	3.03	5.9	5.3	114
Eldon	OWRB	10/29/2002	14:17			8.92	7.35	148.0	17.00				0.050		0.021	0.026										5.0	6.2	95.0
Eldon	USGS	12/9/2002	11:30	51	772	10.1	7.3	199	10.6	0.04	0.06	0.89	0.008	0.02	0.01	0.04	20	29	33	75	1	33.6	1.72	1.71	3.09	5.6	5.3	110
Eldon	OWRB	12/10/2002	10:00			8.06	7.53	154.3	10.30	0.050			0.050		0.019											5.0	5.9	98.8
Eldon	OWRB	1/29/2003	11:36			13.23	7.48	188.9	7.98	0.050			0.050		0.010	0.014										10.0	10.0	121.0
Eldon	USGS	2/22/2003	1155	258	757	11.8	7.8	210	8.4	0.015	0.09	1.7	0.003	0.02	0.015	0.02	40	54	68	83	2	36.6	1.84	1.69	3.41	7.31	9.4	138
Eldon	OWRB	3/12/2003	08:43			9.55	7.69	102.1	8.94	0.050			0.050		0.012											10.0	10.0	65.3
Eldon	OWRB	4/8/2003	11:00			11.35	7.88	300.1	9.55	0.050			0.050		0.012	0.019										10.0	10.0	103.8
Eldon	USGS	4/21/2003	1145	94	765	10.6	7.8	209	15.5	0.01	0.15	1.29	0.006	0.01	0.009	0.02	3	6	5	71	2	35.2	1.75	1.94	3.38	6.1	7.2	119
Eldon	OWRB	5/12/2003	15:07			8.55	7.27	173.0	21.00	0.050			0.050		0.024											10.0	10.0	111.0
Eldon	OWRB	5/13/2003															10	30										
Eldon	USGS	5/16/2003	1200	228	753	8.1	7.4	213	19.1	0.012	0.14	1.06	0.004	0.03	0.028	0.04	1000	1500	1100	95	24							
Eldon	USGS	6/3/2003	1120	561	766	8.3	7.6	206	18.9	0.015	0.25	1.16	0.006	0.06	0.05	0.08	1100	1600	5600	92	30							
Eldon	OWRB	6/3/2003															341	2000										
Eldon	USGS	6/10/2003	950	133	752	8.4	7.6	210	20.5	0.009	0.11	0.985	0.003	0.02	0.015	0.03	1	1	45	100	1	35.9	1.82	2.26	3.24	4.83	6.2	116
Eldon	USGS	6/12/2003	1015	441	757	6.9	7.3	207	21.6	0.015	0.26	0.99	0.003	0.04	0.034	0.07	16	33	1100	95	9							
Eldon	OWRB	6/17/2003	18:07			8.32	7.77	166.4	23.47	0.050			0.050		0.019	0.027										10.0	10.0	106.3
Eldon	OWRB	6/18/2003															10	10										
Eldon	OWRB	7/8/2003															10	10										
Eldon	USGS	7/15/2003	1310	120	762	7.7	7.3	225	26.9	0.013	0.1	0.56	0.002	0.02	0.02	0.03	33	20	137	90	31							

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Eldon	OWRB	7/22/2003															10	90										
Eldon	OWRB	7/23/2003	11:15			8.06	7.36	199.7	24.86	0.050			0.050		0.018	0.028										10.0	10.0	127.8
Eldon	OWRB	8/12/2003															10	10										
Eldon	OWRB	8/26/2003	09:36			5.37	7.37	185.0	25.00	0.050			0.050		0.018	0.030										10.0	10.0	119.0
Eldon	USGS	8/28/2003	810	27	744	4.6	7.2	241	24.7	0.015	0.07	0.29	0.002	0.02	0.015	0.03	--	--	--	88	18							
Eldon	USGS	8/30/2003	2320	61	745	6	7.3	227	25.1	0.015	0.1	0.377	0.002	0.02	0.017	0.03	--	--	--	90	19							
Eldon	USGS	9/3/2003	1049	211	763	7.4	7.7	225	24.1	0.015	0.12	0.48	0.002	0.03	0.023	0.04	--	--	--	90	22							
Eldon	OWRB	9/16/2003															10	100										
Eldon	OWRB	9/29/2003	16:46			9.11	7.49	219.9	21.45	0.050			0.050		0.021	0.026										10.0	10.0	140.8
Eldon	OWRB	9/30/2003															31	40										
Eldon	USGS	10/28/2003	1245	45	757	9.8	8.3	226	17.6	0.005	0.07	0.635	0.002	0.02	0.015	0.03	--	--	--	83	26							
Eldon	OWRB	11/4/2003	09:49			6.97	7.11	225.6	19.22	0.050			0.050		0.019	0.024										10.0	10.0	144.4
Eldon	OWRB	12/1/2003	14:46			10.33	7.52	210.0	13.00	0.050			0.050		0.023	0.025										10.0	10.0	135.0
Eldon	USGS	12/8/2003	1230	147	757	11.8	7.9	223	11.8	0.005	0.07	1.57	0.001	0.02	0.017	0.02	--	--	--	100	14							
Eldon	OWRB	1/26/2004	14:32			11.97	7.56	212.8	8.49	0.050			0.050		0.018	0.027										10.0	12.2	136.2
Eldon	OWRB	2/24/2004	09:15			10.60	7.75	219.4	8.79	0.050			0.050		0.009	0.016										10.0	10.0	140.4
Eldon	OWRB	4/6/2004	08:52			9.28	7.49	191.2	12.48	0.050			0.050		0.012	0.015										10.0	10.0	122.4
Eldon	OWRB	5/17/2004	14:45			9.97	7.54	121.0	19.95	0.060			0.050		0.022	0.036										10.0	11.3	109.0
Eldon	OWRB	6/22/2004	08:01			8.83	7.21	181.5	21.41	0.050			0.050		0.022	0.027										10.0	10.0	116.1
Eldon	OWRB	7/27/2004	08:28			6.83	7.31	184.8	21.24	0.050			0.050		0.038	0.050										10.0	10.0	118.0
Eldon	OWRB	9/1/2004	09:49			7.52	7.26	209.8	22.92	0.050			0.050		0.022	0.030										10.0	10.0	134.3
Moodys	USGS	1/30/2001	14:51	4710	750	10.5	7.1	222	7.5	0.09	1.6	2.45	0.015	0.12	0.1	0.43	1400	1700	6000	89	348							
Moodys	USGS	2/15/2001	16:00	7270	750	10.2	7.3	187	9.6	0.06	2.4	2.52	0.011	0.2	0.17	0.76	10000	9800	17000	84	712							
Moodys	USGS	2/24/2001	16:50	16800	750	10.5	6.8	131	8.8	0.04	2	2.14	0.005	0.16	0.16	0.63	6900	10000	25000	87	671							
Moodys	USGS	4/19/2001	10:55	514	752	9.9	8	267	15.3	0.04	0.28	2.11	0.004	0.09	0.09	0.1	13	14	50	99	24							
Moodys	USGS	5/19/2001	11:15	1830	752	5.7	7.1	247	21.9	0.04	0.76	2	0.013	0.28	0.26	0.4	4600	4200	28000	97	82							
Moodys	USGS	6/16/2001	9:40	2620	757	6	7.2	206	22.2	0.03	0.85	1.75	0.016	0.28	0.3	0.42	2500	2500	2600	96	118							
Moodys	USGS	8/15/2001	9:50	223	751	6.5	7.4	314	26.5	0.04	0.14	0.78	0.006	0.18	0.16	0.16	48	45	100	88	32							
Moodys	USGS	10/12/2001	13:27	2100	750	7	7.4	256	18.5	0.04	0.59	1.81	0.008	0.22	0.2	0.31	4100	2800	5330	96	106							
Moodys	USGS	12/11/2001	9:35	366	765	10.3	7.6	292	7.8	0.04	0.1	2.19	0.008	0.18	0.18	0.19	29	26	32	100	26							
Moodys	USGS	12/18/2001	13:24	9790	758	9.9	7.1	158	10.5	0.03	0.86	2.4	0.006	0.2	0.18	0.39	3300	2300	5600	87	200							
Moodys	USGS	2/1/2002	12:45	7300	760	12.2	6.8	198	7.4	0.06	1.5	1.7	0.006	0.25	0.2	0.55	2300	5700	8700	98	396							
Moodys	USGS	3/20/2002	15:50	10100	765	10.2	7.2	153	11.8	0.06	1.6	1.29	0.008	0.22	0.21	0.57	8300	8400	49000	90	421							
Moodys	USGS	4/8/2002	17:30	11500	734	11.7	7.2	151	14.2	0.09	2.1	1.56	0.01	0.26	0.24	0.82	2600	10000	21000	93	616							
Moodys	USGS	6/14/2002	13:53	1980	762	8.7	7.6	274	23.6	0.04	0.26	2.26	0.008	0.23	0.22	0.25	150	180	200	96	34							
Park Hill	USGS	1/6/1999	8:35	722	760	13.5	7.2	262	3.6	0.03	0.16	2.34	0.013	0.04	0.04	0.05		59	96									
Park Hill	USGS	7/27/1999	13:42	529	757	9.8	8.2	269	30.6	0.02	0.27	1.69	0.01	0.07	0.07	0.09			18	93	29							
Park Hill	USGS	8/10/1999	17:20	350	750	9.1	8.2	275	31.9	0.02	0.19	1.39	0.01	0.07	0.07	0.08	29	24	48	89	34							
Park Hill	USGS	9/13/1999	13:35	356	762	11.9	8.1	286	28.6	0.02	0.18	1.25	0.01	0.07	0.08	0.1	5	21	17	99	24							
Park Hill	USGS	7/26/2000	15:50	597	756	9.6	7.9	257	26.9																			
Park Hill	USGS	7/26/2000	16:02	597	756	9.8	8.1	258	27.2	0.02	0.19	1.64	0.01	0.09	0.07	0.11	32	40	62	94	32							
Park Hill	USGS	8/30/2000	16:20	186	755	10.7	8.1	278	30.8	0.02	0.16	0.68	0.01	0.09	0.07	0.1	16	18	21	98	29							
Park Hill	USGS	9/19/2000	11:10	180	753	9.4	7.8	299	22.2	0.02	0.16	0.58	0.01	0.09	0.07	0.08	38	40	16	92	23							
Park Hill	USGS	3/29/2001	14:49	688	753	12.6	8.4	239	10.2	0.04	0.33	2.57	0.005	0.04	0.04	0.06	7	7	16	84	22							
Park Hill	USGS	4/19/2001	16:04	631	753	11	8.2	259	16.4	0.04	0.38	1.93	0.006	0.06	0.06	0.07	23	15	22	99	20							
Park Hill	USGS	6/20/2001	11:30	558	760	9	7.8	257	25.5	0.05	0.19	1.39	0.005	0.1	0.14	0.11	13	17	21	94	34							
Park Hill	USGS	6/26/2001	11:27	558	760	9	7.8	257	25.7																			
Park Hill	USGS	8/23/2001	12:55	168	758	7.6	7.8	291	27.8	0.04	0.18	0.33	0.003	0.08	0.08	0.1	25	35	72	93	39							
Park Hill	USGS	10/24/2001	10:50	385	745	8.6	7.9	284	20	0.04	0.14	1.65	0.008	0.11	0.1	0.09	40	31	62	94	28							
Park Hill	USGS	12/10/2001	15:09	460	765	12.2	8.1	277	9.8	0.04	0.13	1.84	0.008	0.12	0.11	0.12	6	7	13	95	26							
Park Hill	USGS	2/15/2002	15:00	680	770	12.5	7.8	250	7.9	0.04	0.12	2.81	0.008	0.07	0.08	0.09	4	3	5	97	22							
Park Hill	USGS	6/11/2002	13:28	772	762	9	8	264	25.2	0.04	0.23	1.75	0.004	0.13	0.11	0.13	21	41	43	95	19							
Tahlequah	USGS	1/5/1999	7:55	785	762	13.6	8.1	290	1.9	0.03	0.16	2.6	0.02	0.09	0.07	0.08	2	33	50	93	26					11.3	12.9	164
Tahlequah	OWRB	1/19/1999	15:55			14.09	8.99	264.2	8.87	0.050					0.038	0.096										9.9	11.7	151.5
Tahlequah	USGS	2/1/1999	12:40	1940	755	10.2	7.5	251	8.9	0.08	0.74	2.33	0.014	0.14	0.14	0.24		2800	2000									
Tahlequah	OWRB	2/16/1999	15:35			8.94	7.50	231.0	11.91	0.050					0.025	0.103										5.8	5.0	143.5
Tahlequah	OWRB	3/15/1999	15:10			10.90	7.07	130.0	8.93	0.050			0.050													5.0	12.2	93.5

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Tahlequah	USGS	3/23/1999	13:30	2230	757	9.9	7.8	196	12.3	0.04	0.38	2.82	0.01	0.07	0.07	0.17	65	50	280	88	84					7.25	9.1	122
Tahlequah	USGS	4/5/1999	13:35	3590	743	8.3	7.3	184	16.2	0.04	0.77	1.51	0.01	0.14	0.12	0.26		4400	2400									
Tahlequah	OWRB	4/20/1999	13:40			13.83	9.19	220.7	17.42	0.050			0.050		0.031	0.068										5.3		139.5
Tahlequah	USGS	5/3/1999	14:50	1160	743	11.1	8.1	227	17.7	0.04	0.24	1.84	0.01	0.09	0.08	0.09		27	220									
Tahlequah	OWRB	5/18/1999	14:10			6.62	7.78	713.0	18.96	0.050					0.047	0.108										5.0	8.0	291.5
Tahlequah	USGS	6/8/1999	11:25	970	752	10.3	8.2	234	24.4	0.02	0.38	1.56	0.01	0.04	0.04	0.08	24	40	9	72	31					7.16	7	137
Tahlequah	OWRB	6/21/1999	13:00			7.34	7.53	234.1	21.64	0.090			0.050		0.111	0.149	52	60								5.6	7.7	135.0
Tahlequah	USGS	6/23/1999	10:43	1260	744	7	8.1	244	21.8																			
Tahlequah	USGS	7/1/1999	16:15	11800	749	6.9	7.1	146	22.2	0.06	3.1	1.39	0.021	0.24	0.18	1.14	2300	1800	20000	96	869							
Tahlequah	OWRB	7/20/1999	14:30			6.83	9.29	254.3	28.55	0.050			0.060		0.069	0.070	20	20								5.8	8.1	147.5
Tahlequah	USGS	8/11/1999	10:45	302	751	5.6	7.5	283	29	0.02	0.15	1.53	0.01	0.05	0.08	0.11	42	54	80	93	36					10.9	9.3	163
Tahlequah	OWRB	8/16/1999	16:50			6.99	8.52	266.1	29.32	0.050					0.088	0.126	5	20								7.8	9.6	170.0
Tahlequah	OWRB	9/22/1999	14:40			10.11	8.32	238.6	21.44	0.050					0.087	0.139	10	10									10.5	207.0
Tahlequah	OWRB	10/19/1999	14:30			8.17	7.47	270.3	16.62	0.050			0.060		0.026	0.081										19.1	9.1	171.5
Tahlequah	USGS	10/20/1999	10:50	162	764	9.8	7.7	304	15.3	0.02	0.09	1.36	0.01	0.08	0.07	0.06	51	49	300	100	17					15.7	11.8	177
Tahlequah	OWRB	11/16/1998	13:10			10.86	8.01	289.4	14.85	0.050			0.050		0.060	0.063										5.0	6.7	194.1
Tahlequah	USGS	12/1/1999	14:00	223	760	12.3	8.1	299	12.1	0.02	0.19	1.39	0.01	0.06	0.06	0.04	1	10	2	99	20					17.2	12.8	169
Tahlequah	USGS	12/11/1999	14:00	856	754	10.6	8	261	10.2	0.02	0.15	2.04	0.01	0.1	0.1	0.12	88	80	93	97	30							
Tahlequah	OWRB	12/13/1999	15:15			10.11	7.79	270.6	10.77	0.050					0.128	0.145										8.6	10.6	151.6
Tahlequah	USGS	2/15/2000	17:00	268	753	12.2	8	300	11.2	0.02	0.13	1.8	0.01	0.11	0.08	0.09	3	2	4	89	28					15.5	13.5	169
Tahlequah	USGS	2/23/2000								0.050			0.050		0.018	0.171										11.5		160.0
Tahlequah	OWRB	3/21/2000	13:00			12.06	8.13	219.0	12.01				0.050			0.108										7.7	10.5	140.0
Tahlequah	USGS	4/13/2000	9:10	1150	760	8.6	7.8	278	13.9	0.02	0.31	1.44	0.01	0.14	0.11	0.15	1800	1100	670	99	31					12.2	12.2	156
Tahlequah	USGS	5/8/2000	9:20	3010	748	7.2	7.3	224	19.7	0.02	0.68	1.27	0.013	0.18	0.14	0.28	1600	1700	1900	82	118							
Tahlequah	OWRB	5/15/2000	15:47			12.29	8.30	250.0	19.00	0.050			0.050		0.089	0.158	20	20								4.8	6.3	155.5
Tahlequah	USGS	6/18/2000	16:15	14800	750	7.8	7.1	154	19.4	0.03	1.4	1.44	0.01	0.24	0.21	0.62	19000	15000	50000	94	350							
Tahlequah	OWRB	6/20/2000	14:30			4.66	7.66	178.7	21.97	0.050			0.050		0.157	0.206	197	500								5.0		120.6
Tahlequah	USGS	6/22/2000	16:30	33900	750	7.6	6.9	114	20.3	0.02	1.7	1.37	0.01	0.33	0.28	0.8	12000	10000	30000	93	441							
Tahlequah	USGS	7/20/2000	12:00	677	756	5.1	7.7	253	26.6	0.02	0.23	1.81	0.01	0.1	0.09	0.12	360	300	490	88	25					8.24	9.2	143
Tahlequah	OWRB	7/25/2000	13:57			8.82	7.79		25.00	0.050			0.050		0.099		31	50								5.0	12.3	144.0
Tahlequah	OWRB	8/22/2000	14:14			12.68	7.60	261.0	29.00	0.050			0.050		0.084	0.157	20	40								7.2	7.3	163.0
Tahlequah	USGS	8/29/2000	16:30	189	753	10.2	8	282	30	0.02	0.19	0.77	0.01	0.08	0.07	0.09	38	41	35	95	32					12.5	11	163
Tahlequah	OWRB	9/19/2000	13:51			11.07	7.90	279.0	24.00	0.070			0.050		0.043	0.175										12.3	10.2	179.0
Tahlequah	USGS	9/26/2000	10:45	1040	762	8.6	7.7	315	18.2	0.02	0.15	1.74	0.01	0.13	0.12	0.15	210	220	320	89	40							
Tahlequah	OWRB	10/18/2000	13:30			11.05	8.10	243.1	18.69	0.050			0.050				0.091									11.3	12.4	155.6
Tahlequah	USGS	10/19/2000	14:15	251	760	8.5	8.2	272	19.3	0.04	0.2	1.15	0.006	0.08	0.07	0.11	66	120	120	100	29					16	14.2	170
Tahlequah	USGS	10/27/2000	16:01	582	758	8.2	7.6	277	18.4	0.04	0.29	1.39	0.004	0.1	0.1	0.16	690	550	1600	94	43							
Tahlequah	USGS	11/7/2000	14:00	1540	745	9.7	7.8	275	14.9	0.04	0.24	1.67	0.006	0.13	0.12	0.19				86	73							
Tahlequah	OWRB	11/14/2000	17:16			11.71	7.59	250.0	11.00	0.050			0.050		0.107	0.133											9.1	160.0
Tahlequah	USGS	12/12/2000	12:15	420	760	13.9	8.3	269	4.9	0.04	0.1	2.39	0.006	0.06	0.07	0.07	2	2	2	100	22					11.4	12.3	154
Tahlequah	USGS	1/31/2001	10:40	3840	735	11	7.2	204	7	0.05	0.83	2.3	0.009	0.1	0.09	0.21	730	880	3400	90	131							
Tahlequah	USGS	2/16/2001	13:15	10200	760	10.2	7.1	164	8.4	0.05	1.1	2.31	0.008	0.16	0.14	0.38	4500	5900	9800	87	334					5.94	8.7	112
Tahlequah	USGS	2/25/2001	14:40	25200	756	10.3	6.9	118	9.1	0.08	1.9	2.07	0.008	0.17	0.18	0.75	5200	5900	25000	92	625							
Tahlequah	OWRB	2/28/2001	08:01			10.16	7.52	145.0	9.00	0.050			0.050		0.104	0.155										5.0	12.8	92.0
Tahlequah	OWRB	3/27/2001	07:42			10.63	7.70	213.0	9.56	0.050			0.050		0.031	0.045										6.6	9.9	136.0
Tahlequah	USGS	4/23/2001	14:30	588	760	9.5	8	253	18.9	0.04	0.38	1.93	0.007	0.09	0.08	0.11	200	150	49	99	44					10.4	10	154
Tahlequah	OWRB	4/24/2001	08:38			5.53	7.62	256.0	16.00	0.050			0.050		0.064	0.103										6.8	9.4	164.0
Tahlequah	USGS	5/19/2001	14:10	2070	752	6.8	7.4	280	23.8	0.04	0.42	1.99	0.004	0.16	0.15	0.23	950	1600	8000	90	80							
Tahlequah	OWRB	5/30/2001	08:19			6.99	7.47	241.0	20.00	0.050			0.050		0.127	0.158	487	1000								7.6	14.6	154.0
Tahlequah	OWRB	6/20/2001	07:58			8.43	7.35	215.0	24.00	0.050			0.050		0.142	0.189	31	80								7.0	11.4	137.0
Tahlequah	USGS	6/26/2001	15:30	645	756	9.5	8	256	27.1	0.04	0.21	1.3	0.007	0.12	0.12	0.13	51	62	20	96	29					10.3	9.1	150
Tahlequah	OWRB	7/25/2001	08:00			5.07	277.0	177.3	28.81				0.050		0.103	0.127	20	5								10.5	10.8	177.3
Tahlequah	USGS	8/16/2001	11:10	312	756	6.9	7.6	278	27.2	0.04	0.15	0.51	0.006	0.11	0.11	0.1	280	240	280	99	27					16	12.1	171
Tahlequah	OWRB	8/22/2001	07:54			5.86	7.53	307.0	27.00				0.050		0.104	0.137	5	60								11.7	11.8	196.0
Tahlequah	OWRB	9/25/2001	08:15			6.74	7.43	295.0	19.48				0.050		0.111		31	20								12.5	11.0	189.0
Tahlequah	USGS	10/12/2001	10:54	2660	752	7.1	7.4	247	18.3	0.04	0.55	1.6	0.008	0.14	0.14	0.22	2200	2000	2600	89	99							
Tahlequah	USGS	10/24/2001	8:50	368	743	6.7	7.4	265.5	19.2	0.04	0.17	1.63	0.029	0.06	0.06	0.1	46	76	113	98	32					11.2	11.5	166

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Tahlequah	USGS	11/5/2001	12:50	1690	765	7.3	7.2	231	17.2	0.02	0.64	1.64	0.006	0.28	0.24	0.35	1000	1400	1050	99	53							
Tahlequah	OWRB	11/14/2001	09:30			8.36	7.68	181.1	17.52				0.050		0.110	0.438										10.2	12.1	115.9
Tahlequah	USGS	12/5/2001	13:30	828	764	9.5	7.5	271	13.6	0.04	0.18	1.84	0.008	0.17	0.14	0.15	38	31	59	93	28					12.5	13.5	160
Tahlequah	USGS	12/18/2001	11:50	19500	763	9.5	7	136	10.3	0.02	1.2	1.81	0.006	0.2	0.2	0.54	5700	3800	13100	91	309							
Tahlequah	USGS	2/2/2002	11:00	4090	770	11.7	7.2	177	6.3	0.04	0.69	1.84	0.008	0.16	0.15	0.28	4800	2400	5800	89	117					6.7	9.4	118
Tahlequah	OWRB	2/20/2002	10:00			10.95	7.73	23.9	9.63	0.050			0.050		0.085	0.096										6.3	11.7	
Tahlequah	OWRB	3/13/2002	11:00			13.98	8.74	246.1	10.32	0.050			0.050		0.076	0.099										6.8	9.6	157.5
Tahlequah	USGS	3/21/2002	12:00	7940	771	9.8	7.2	140	10.6	0.03	0.88	1.52	0.006	0.16	0.15	0.31	4200	2000	10900	89	180							
Tahlequah	USGS	4/9/2002	11:30	17900	763	7.5	7	123	11.8	0.08	2.2	1.1	0.009	0.23	0.2	0.82	15000	12000	47500	89	744					3.55	5.5	79
Tahlequah	OWRB	4/10/2002	09:00			9.62		161.4	12.72	0.050			0.050		0.142	0.213										5.0	25.9	103.3
Tahlequah	OWRB	5/8/2002	10:09			8.17	7.83	191.0	21.00	0.050			0.050		0.073	0.102	63	200								5.5	9.0	122.0
Tahlequah	OWRB	6/3/2002											0.050				10	30										
Tahlequah	USGS	6/10/2002	13:13	794	758	8.4	7.8	262	24.4	0.04	0.27	1.77	0.008	0.13	0.12	0.15	41	59	88	100	19					8.14	9.3	144
Tahlequah	OWRB	7/10/2002	09:30			7.60	8.11	280.9	28.51	0.050			0.050		0.146	0.153	10	20								7.6	9.4	179.8
Tahlequah	USGS	8/15/2002	14:47	7360	760	6.7	7.1	179	22.9	0.05	1.3	1.83	0.012	0.3	0.27	0.61	670	670	833	92	305					6.05	8.9	122
Tahlequah	OWRB	9/4/2002	11:20			7.65	7.85	259.0	27.00	0.050			0.050		0.109	0.130	52	90								8.7	11.0	166.0
Tahlequah	OWRB	10/8/2002	08:40			7.31	7.49	238.0	18.87	0.050			0.050		0.098	0.103										5.0	14.4	152.0
Tahlequah	USGS	10/23/2002	11:45	192	767	10.4	8	317	16	0.04	0.1	1.29	0.004	0.11	0.1	0.11	20	32	28	92	3					18	15.7	179
Tahlequah	OWRB	10/29/2002	16:01			10.03	265.0	167.0	15.00				0.050		0.115	0.128										14.8	13.5	167.0
Tahlequah	USGS	12/9/2002	10:10	293	772	10.8	7.4	323	7.4	0.04	0.07	1.57	0.008	0.07	0.07	0.08	23	22	13	75	1					16.8	17	179
Tahlequah	OWRB	12/10/2002	08:00			8.20	7.75	283.5	8.29	0.050			0.050		0.086											15.0	18.9	180.9
Tahlequah	OWRB	1/29/2003	10:37			13.22	7.62	292.1	6.59	0.050			0.050		0.043	0.061										13.9	11.3	186.9
Tahlequah	USGS	2/22/2003	1000	738	757	10.3	7.8	313	8.3	0.008	0.23	2.19	0.011	0.14	0.119	0.15	28	46	56	82	6					18.4	18.1	194
Tahlequah	OWRB	3/12/2003	07:52			10.02	7.89	153.7	8.94	0.050			0.050		0.074											12.2	13.5	98.4
Tahlequah	OWRB	4/9/2003	09:30			11.54	7.90	236.2	10.14	0.050			0.050		0.066	0.076										10.8	14.0	151.2
Tahlequah	USGS	4/21/2003	1340	304	765	12.6	8.2	292	18.3	0.014	0.29	1.27	0.018	0.10	0.092	0.11	7	14	7	86	4					13.5	15	167
Tahlequah	OWRB	5/12/2003	16:40			8.72	7.45	264.0	23.00	0.050			0.050		0.122		10	10								13.0	13.9	169.0
Tahlequah	USGS	5/16/2003	1020	2090	760	6.4	7.2	231	20	0.065	0.74	1.54	0.019	0.17	0.161	0.26	1000	1100	2400	92	57							
Tahlequah	USGS	5/19/2003	1030	2760	750	7.3	7.3	211	19.5	0.018	0.5	1.51	0.007	0.14	0.127	0.20	320	270	1100	83	46							
Tahlequah	USGS	5/22/2003	1030	2480	766	7	7.6	210	18	0.016	0.56	1.52	0.007	0.17	0.151	0.23	860	860	1500	92	51							
Tahlequah	OWRB	6/3/2003															884	2000										
Tahlequah	USGS	6/4/2003	1120	1900	760	8	7.5	251	19.7	0.015	0.41	1.79	0.01	0.18	0.153	0.20	200	310	690	87	32							
Tahlequah	USGS	6/10/2003	1200	512	752	9.4	8.1	267	22.8	0.015	0.59	1.33	0.003	0.09	0.079	0.11	2	1	33	97	8					10.8	11.9	154
Tahlequah	USGS	6/13/2003	915	1270	760	7.4	7.7	289	22.8	0.015	0.26	1.64	0.003	0.11	0.098	0.13	39	5	150	86	14							
Tahlequah	OWRB	6/18/2003	07:17			6.14	7.87	237.9	23.67	0.050			0.050		0.086	0.106	31	30								10.0	12.1	152.3
Tahlequah	OWRB	7/8/2003															10	10										
Tahlequah	USGS	7/15/2003	1130	886	763	7.1	7.5	320	28.5	0.01	0.23	0.996	0.005	0.14	0.125	0.16	100	240	242	90	40							
Tahlequah	OWRB	7/23/2003	09:00			6.71	7.43	277.0	25.92	0.050			0.050		0.104	0.121	10	100								11.8	10.1	177.3
Tahlequah	OWRB	8/12/2003															10	20										
Tahlequah	OWRB	8/26/2003	11:53			6.82	7.36	268.0	29.00	0.050			0.050		0.092	0.117										15.2	14.2	171.0
Tahlequah	USGS	8/28/2003	1830	91	744	9	8.2	317	30.7	0.015	0.27	0.098	0.002	0.10	0.089	0.13	--	--	--	90	45							
Tahlequah	USGS	8/30/2003	2200	205	745	6.9	7.7	308	27.2	0.015	0.2	0.283	0.003	0.11	0.101	0.13	--	--	--	93	37							
Tahlequah	USGS	9/3/2003	1245	750	763	7.7	7.9	333	25	0.015	0.27	0.834	0.003	0.14	0.122	0.16	--	--	--	90	48							
Tahlequah	OWRB	9/16/2003															10	100										
Tahlequah	OWRB	9/30/2003	07:56			7.57	7.57	312.8	19.44	0.050			0.050		0.079	0.084	10	110								15.1	17.6	200.2
Tahlequah	USGS	10/28/2003	1330	180	757	10.9	8.1	324	16.6	0.01	0.11	0.77	0.002	0.08	0.068	0.09	--	--	--	92	33							
Tahlequah	OWRB	11/4/2003	08:38			6.15	7.38	329.5	18.95	0.050			0.050		0.067	0.075										15.1	15.8	210.9
Tahlequah	OWRB	12/1/2003	13:44			12.39	7.92	290.0	11.00	0.050			0.050		0.063	0.065										11.9	13.8	186.0
Tahlequah	USGS	12/8/2003	1145	293	757	13.2	8.4	309	9.2	0.01	0.12	1.5	0.002	0.06	0.044	0.06	--	--	--	97	20							
Tahlequah	OWRB	1/26/2004	15:07			11.82	7.74	271.8	8.03	0.050			0.050		0.044	0.053										10.0	14.4	173.9
Tahlequah	OWRB	2/24/2004	10:00			11.87	8.10	292.9	9.20	0.050			0.050		0.025	0.032										11.1	13.9	187.5
Tahlequah	OWRB	4/6/2004	09:30			10.01	8.24	236.1	13.51	0.050			0.050		0.018	0.040										10.0	13.3	151.0
Tahlequah	OWRB	5/17/2004	16:00			10.70	8.05	204.0	20.85	0.050			0.050		0.077	0.107										10.0	10.0	131.0
Tahlequah	OWRB	6/21/2004	18:03			10.14	8.01	257.3	24.54	0.050			0.050		0.078	0.086										10.1	11.9	164.7
Tahlequah	OWRB	7/27/2004	10:39			6.59	7.31	213.3	23.00	0.050			0.050		0.130	0.155										10.0	14.7	137.0
Tahlequah	OWRB	9/1/2004	08:50			6.62	7.49	288.1	24.16	0.050			0.050		0.081	0.092										10.0	12.5	184.4
Watts	USGS	1/7/1999	10:30	404	755	13.8	8.1	289	4.6	0.02	0.14	3.18	0.01	0.08	0.07	0.1	11	19	60	87	44	44.4	2.2	3.08	9.7	11.4	13.4	175

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Watts	OWRB	1/19/1999	12:05			10.38	8.40	316.7	7.46	0.050					0.087											12.3	13.6	168.5
Watts	USGS	2/3/1999	8:50	709	743	11.1	7.9	265	8.1	0.03	0.33	3.05	0.01	0.08	0.09	0.13		1	72									
Watts	OWRB	2/16/1999	13:10			9.93	7.75	267.0	10.52	0.050			0.050		0.041	0.158										6.8	7.1	169.5
Watts	OWRB	3/15/1999	12:45			11.77	7.08	153.0	8.42	0.050			0.050													5.0	12.0	107.0
Watts	USGS	3/24/1999	12:30	1220	753	10.6	7.8	235	11.5	0.02	0.24	3.74	0.01	0.07	0.07	0.1	66	64	160	99	40	38.6	2.06	2.77	6	8	9.4	144
Watts	USGS	4/7/1999	10:40	1840	752	10.1	7.5	212	14.8	0.03	0.51	2.4	0.01	0.13	0.1	0.18		35	240									
Watts	OWRB	4/20/1999	11:50			8.95	7.94	264.8	15.17	0.050			0.050		0.086	0.124										6.4		167.0
Watts	USGS	5/4/1999	10:35	1370	728	7.5	7.6	271	17.8	0.05	0.35	2.63	0.01	0.11	0.1	0.15		1300	2000									
Watts	OWRB	5/18/1999	11:50			6.62	7.78	713.0	18.96	0.050					0.163	0.226										5.0	9.6	299.5
Watts	USGS	6/16/1999	12:37	562	750	8.5	7.7	275	20.9	0.03	0.3	2.94	0.01	0.18	0.16	0.23	40	18	260	75	66	42.8	1.97	3.57	8.2	9	8.3	176
Watts	OWRB	6/21/1999	11:10			7.25	7.39	268.1	19.43	0.050			0.160		0.160	0.224										7.2	8.2	158.5
Watts	OWRB	7/20/1999	12:55			5.04	7.94	292.5	25.57	0.080			0.050		0.129	0.158										7.4	8.0	169.0
Watts	OWRB	7/20/1999															74	10										
Watts	USGS	8/12/1999	8:10	260	746	7.9	7.9	325	28	0.02	0.15	2.54	0.01	0.14	0.15	0.16	300	120	260	84	46	47.7	1.96	3.73	11.6	13.1	8.5	184
Watts	OWRB	8/16/1999	14:35			5.38	8.28	318.1	26.30	0.050					0.250	0.346										10.7	9.4	204.0
Watts	OWRB	8/16/1999															10	50										
Watts	OWRB	9/22/1999	11:35			7.88	7.86	283.6	18.75	0.050			0.050		0.225	0.272											9.9	183.5
Watts	OWRB	9/22/1999															31	20										
Watts	OWRB	10/19/1999	12:10			7.84	7.77	328.2	15.22	0.050			0.070		0.318	0.454										17.5	13.6	208.3
Watts	USGS	10/21/1999	11:15	148	753	10.3	8	358	15.5	0.02	0.16	2.05	0.01	0.23	0.26	0.25	25	36	38	100	32	46.3	1.92	4.22	18.6	19.4	12.7	202
Watts	OWRB	11/16/1999	11:15			8.85	7.83	349.1	13.66	0.050			0.050		0.331	0.414										16.8	11.1	211.2
Watts	USGS	12/1/1999	14:20	158	758	12.5	7.7	340	10.1	0.02	0.21	1.96	0.01	0.03	0.25	0.25	15	12	3	98	26	49.9	2	4	17.4	18.1	13.7	194
Watts	USGS	12/10/1999	16:10	729	754	12.1	7.7	313	10.5	0.02	0.23	2.52	0.01	0.24	0.24	0.28	860	1200	1300	97	45							
Watts	OWRB	12/13/1999	12:35			9.52	7.08	238.0	9.38	0.110					0.267	0.303										5.9	18.4	148.0
Watts	USGS	2/18/2000	8:35	1560	745	6.5	7.9	337	10	0.05	0.36	2.28	0.01	0.29	0.25	0.29	2500	2100	12000	96	87	44.6	2.16	4.15	16.9	17.2	18.7	192
Watts	OWRB	2/23/2000	11:50							0.070			0.050		0.236	0.424										13.1		175.0
Watts	OWRB	3/21/2000	11:20			9.99	7.73	275.0	11.58				0.050			0.262										10.7	14.0	88.0
Watts	USGS	4/12/2000	9:20	1270	756	10	7.7	273	13.8	0.08	0.83	1.58	0.019	0.17	0.13	0.27	12000	9000	12000	100	95	41.5	2.34	3.75	9.3	10.2	14.7	158
Watts	USGS	5/7/2000	10:52	2410	746	9.2	7.3	210	18.5	0.06	1.2	1.11	0.017	0.31	0.27	0.59	46000	16000	40000	97	236							
Watts	OWRB	5/15/2000	13:24			9.44	8.10	310.0	18.00	0.050			0.050		0.229	0.316										8.4	10.4	190.0
Watts	OWRB	5/16/2000															41	50										
Watts	USGS	6/18/2000	9:35	10600	750	7.5	7	149	19.3	0.04	1.1	1.39	0.012	0.34	0.3	0.57	18000	17000	32000	78	201							
Watts	OWRB	6/20/2000	14:15			4.51	7.79	207.8	21.21	0.080			0.050		0.180	0.276										5.0		133.5
Watts	OWRB	6/20/2000															435	630										
Watts	USGS	6/22/2000	7:45	24100	750	7.1	7	117	19.4	0.02	1.2	1.22	0.01	0.4	0.35	0.65	16000	12000	45000	91	204							
Watts	USGS	7/18/2000	13:45	398	750	7.3	7.8	302	25.8	0.02	0.24	3	0.01	0.18	0.17	0.2	93	90	160	93	52	45	2.09	3.82	9.6	10.8	10	176
Watts	OWRB	7/25/2000	11:34			7.60	7.59		23.00	0.050			0.050		0.209											5.6	12.5	177.0
Watts	OWRB	7/25/2000															41	60										
Watts	USGS	8/15/2000	14:45	191	753	7.9	7.8	342	28.9	0.02	0.2	2.09	0.01	0.25	0.21	0.26	48	37	200	98	39	45.6	1.97	4.46	15.2	15.2	13.1	195
Watts	OWRB	8/22/2000	11:34			9.86	7.52	339.0	27.00	0.050			0.050		0.275	0.333										12.5	13.7	216.0
Watts	OWRB	8/23/2000															10	20										
Watts	OWRB	9/19/2000	11:34			7.66	7.80	346.0	22.00	0.110			0.050		0.231	0.338										17.7	16.8	222.0
Watts	OWRB	9/19/2000															20	220										
Watts	USGS	9/26/2000	15:30	341	755	8.3	7.7	273	17.4	0.023	0.33	1.81	0.01	0.24	0.23	0.3	370	360	460	94	58							
Watts	OWRB	10/17/2000	9:00			8.62	7.86	306.0	17.00	0.050			0.050			0.415										15.8	14.8	196.0
Watts	USGS	10/24/2000	10:30	176	759	9.5	7.8	379	18	0.041	0.18	1.95	0.004	0.36	0.33	0.38	86	60	110	99	36	51.9	2.13	4.44	19.7	22.3	17.5	211
Watts	USGS	11/7/2000	7:20	1400	748	9.8	7.7	276	14.6	0.041	0.51	2.15	0.004	0.22	0.2	0.34				96	75							
Watts	OWRB	11/14/2000	11:19			12.55	7.49	300.0	8.00	0.050			0.050		0.085	0.228											9.8	192.0
Watts	USGS	12/8/2000	14:30	279	755	11.5	7.9	329	7	0.041	0.1	3.3	0.006	0.18	0.18	0.21	6	6	21	96	29	51.5	2.34	3.5	16.2	14.1	16	191
Watts	USGS	1/30/2001	11:00	2740	740	11.2	7.1	199	7	0.09	1.2	2.4	0.016	0.14	0.12	0.3	1800	1900	6000	93	461							
Watts	USGS	2/15/2001	11:00	7660	750	9.9	7.2	161	10.5	0.1	1.8	1.94	0.014	0.25	0.23	0.67	15000	10000	14000	96	157	23.6	1.83	4.19	4.7	5.4	9.4	113
Watts	OWRB	2/28/2001	12:17			11.95	7.96	184.0	9.00	0.050			0.050		0.106	0.165										5.0	10.9	118.0
Watts	OWRB	3/27/2001	11:14			11.07	7.61	259.0	9.42	0.050			0.050		0.092	0.129										8.2	10.5	166.0
Watts	USGS	4/18/2001	11:15	352	760	8.2	7.8	295	14.4	0.04	0.69	2.45	0.006	0.17	0.15	0.18	21	20	21	100	35	45.2	2.01	3.39	10.5	11.8	11.2	180
Watts	OWRB	4/24/2001	12:00			7.72	7.92	295.0	18.00	0.050			0.050		0.193	0.269										8.9	9.9	189.0
Watts	USGS	5/18/2001	11:20	851	746	7.6	7.2	167	20.8	0.14	2.2	1.55	0.026	0.45	0.45	0.88	29000	16000	33000	99	332							
Watts	OWRB	5/30/2001	12:30			8.57	7.65	296.0	20.00	0.050			0.050		0.241	0.306										11.0	14.6	189.0

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Watts	USGS	6/15/2001	12:51	3930	752	8.7	7.5	248	22.8	0.04	0.15	0.03	0.006	0.06	0.02	0.06	18000	13000	58000	95	418	34.5	1.86	4.75	10.2	12.6	9.9	146
Watts	OWRB	6/20/2001	10:12			9.55	7.44	245.0	24.00	0.050			0.050		0.212	0.273										8.2	12.1	157.0
Watts	OWRB	6/20/2001															86	90										
Watts	USGS	8/15/2001	15:30	163	748	7.6	7.5	343	27.4	0.04	0.3	1.35	0.004	0.35	0.32	0.37	40	28	85	100	44	42.8	1.93	4.98	18.8	19.3	16.8	209
Watts	OWRB	8/22/2001	11:19			8.43	7.89	359.0	28.00				0.050		0.275	0.356										15.6	15.1	230.0
Watts	OWRB	8/22/2001															5	30										
Watts	USGS	9/18/2001	12:59	815	754	8.5	7.5	300	21.8	0.05	0.42	1.33	0.008	0.31	0.22	0.36	2500	1800	4800	96	77							
Watts	OWRB	9/25/2001	12:10			9.54	7.96	334.8	20.09				0.050		0.320											14.4	13.0	214.3
Watts	OWRB	9/25/2001															10	30										
Watts	USGS	10/11/2001	12:30	2490	750	8.8	7.4	312	17.4	0.04	0.98	1.86	0.008	0.34	0.32	0.59	9000	6000	14600	98	283							
Watts	USGS	10/23/2001	8:17	236	740	7.3	7.2	351	18	0.04	0.22	2.86	0.008	0.29	0.28	0.31	90	100	135	97	48	48.8	2.28	4.75	16.2	16.9	15.6	194
Watts	OWRB	10/24/2001	11:28					296.0					0.050		0.239	0.265										14.4	14.6	
Watts	OWRB	11/14/2001	14:30			8.66	7.62	287.2	15.31				0.050		0.389	1.153										14.5	14.8	183.5
Watts	USGS	12/11/2001	15:15	284	765	10.3	7.8	322	7.8	0.04	0.14	2.75	0.008	0.34	0.32	0.36	54	25	41	99	30	49	2.41	4.24	14	16.2	14.6	192
Watts	USGS	12/17/2001	14:20	17300	743	9.8	7.6	138		0.04	1.3	1.6	0.008	0.27	0.25	0.59	6400	5000	56000	95	264							
Watts	USGS	2/1/2002	11:15	4400	769	12.6	7.6	151	6.6	0.07	1.1	1.54	0.007	0.21	0.19	0.41	13000	8300	34000	95	162	21.5	1.6	3.21	4.3	5.65	8.2	102
Watts	OWRB	2/20/2002	10:00			10.22	6.51	15.8	10.53	0.050			0.050		0.186	0.223										8.6	11.7	
Watts	OWRB	3/12/2002	17:04			15.82	9.03	260.6	10.92	0.050			0.050		0.128	0.155										7.7	96.8	166.8
Watts	USGS	3/20/2002	11:08	8210	761	10.9	7.2	147	11	0.07	1.2	1.32	0.007	0.22	0.21	0.4	7200	6400	9820	95	198							
Watts	USGS	4/8/2002	12:15	14400	756	8.2	7	124	10.9	0.16	2.6	1.05	0.012	0.3	0.26	0.91	24000	25000	62000	95	689							
Watts	OWRB	4/10/2002	13:00			8.78		149.1		0.090			0.050		0.144	0.221										5.0		95.4
Watts	USGS	4/17/2002	7:55	1170	757	9.3	7.3	253	17.5	0.04	0.25	3.24	0.008	0.14	0.14	0.19	200	290	178	94	49	38.5	1.92	3.06	6.92	8.12	9.6	150
Watts	OWRB	5/7/2002	13:30			8.18	7.62	240.0	20.00	0.050			0.050		0.143	0.177										7.2	10.2	153.0
Watts	OWRB	5/22/2002															20	40										
Watts	OWRB	6/4/2002	11:30			14.31	7.92	273.3	23.98																			175.1
Watts	OWRB	6/4/2002															31	30										
Watts	USGS	6/12/2002	15:26	562	755	7.7	7.7	302	23.2	0.04	0.27	2.57	0.004	0.3	0.28	0.33	510	270	1200	99	43	42.4	1.99	3.78	9.82	9.56	10.7	159
Watts	OWRB	7/9/2002	15:00			6.94	8.17	296.6	28.08	0.050			0.050		0.275	0.297										8.5	8.7	189.8
Watts	OWRB	7/9/2002															10	60										
Watts	USGS	8/14/2002	16:40	7490	760	8	7.4	155	21.2	0.08	2	1.62	0.024	0.41	0.01	0.93	3500	3600	15000	94	492	21.4	1.45	5.47	4.33	5.06	7.7	102
Watts	OWRB	9/3/2002	15:03			10.76	8.43	303.0	28.00	0.050			0.050		0.283	0.297										12.5	13.0	194.0
Watts	OWRB	9/4/2002															10	40										
Watts	USGS	9/10/2002	10:20	163	760	7.8	7.6	347	25																			
Watts	OWRB	10/1/2002															31	80										
Watts	OWRB	10/7/2002	11:30			9.87	7.95	288.0	19.19	0.050			0.050		0.462	0.475										17.3	18.8	184.0
Watts	USGS	10/10/2002	7:30	146	760	9.6	7.6	369	17	0.04	0.15	2.5	0.004	0.52	0.51	0.54	77	78	81			49.4	2.12	4.85	21.4	19.2	18.2	218
Watts	OWRB	10/29/2002	11:34			9.77	7.81	321.0	14.00				0.050		0.424	0.417										20.0	17.1	206.0
Watts	USGS	12/9/2002	14:00	169	772	11.7	8	352	8.3	0.04	0.18	2.5	0.007	0.21	0.21	0.23	1	2	13	89	3	48.9	2.09	4.4	19.1	17.9	16.4	198
Watts	OWRB	12/9/2002	16:00			8.24	7.78	279.7	8.26	0.050			0.050		0.074	0.077										15.0	18.4	179.0
Watts	OWRB	1/28/2003	16:33			15.36	8.16	330.9	5.09	0.050			0.050		0.119	0.143										18.1	13.8	211.8
Watts	OWRB	3/11/2003	14:15			10.55	7.85	178.6	8.08	0.050			0.050		0.109	0.133										14.2	16.4	114.3
Watts	USGS	3/27/2003	1030	429	751	10	8	304	13.6	0.012	0.27	2.26	0.008	0.12	0.10	0.14	21	21	10	96	17	46.3	2.29	3.48	11.6	13.4	15.8	179
Watts	OWRB	4/8/2003	19:00			9.35	8.10	272.9	11.95	0.050			0.050		0.110	0.140										13.4	14.8	174.7
Watts	USGS	4/23/2003	1045	219	757	8.4	7.7	327	17.5	0.027	0.37	1.7	0.011	0.13	0.13	0.18	9	33	45	98	27	47.5	2.22	4.12	15.3	16.3	17.1	188
Watts	OWRB	5/12/2003	13:09			7.87	7.31	314.0	22.00	0.050			0.050		0.192	0.229										18.2	17.3	201.0
Watts	USGS	5/16/2003	1400	911	752	8.2	7.2	220	19.5	0.056	0.68	1.41	0.011	0.13	0.11	0.20	2300	2000	2100	98	68	--	--	--	--	--	--	--
Watts	USGS	5/17/2003	920	3590	753	8.9	7.1	168	19.3	0.047	1.3	1.09	0.013	0.19	0.17	0.39	6900	5600	19000	97	181	--	--	--	--	--	--	--
Watts	USGS	5/21/2003	1150	1970	765	8.7	7.5	190	17.5	0.033	1.1	1.31	0.012	0.20	0.20	0.37	6300	6000	22000	96	116	--	--	--	--	--	--	--
Watts	USGS	6/2/2003	1145	2490	750	9.3	7.7	163	18.3	0.267	2.2	1.57	0.033	0.68	0.62	1.06	66000	30000	>50000	97	376	--	--	--	--	--	--	--
Watts	OWRB	6/3/2003															1565	6000										
Watts	USGS	6/10/2003	745	312	752	7.8	7.8	310	21.3	0.023	0.27	2.08	0.005	0.12	0.10	0.16	40	1	110	97	28	46.5	2.22	3.97	11.4	12.8	13.8	188
Watts	USGS	6/12/2003	1250	1160	753	7.7	7.5	266	21.9	0.012	0.56	1.65	0.008	0.13	0.11	0.22	10	20	2800	100	67	--	--	--	--	--	--	--
Watts	OWRB	6/17/2003	11:00			8.08	8.10	262.6	23.43	0.050			0.050		0.110	0.151										11.3		168.1
Watts	OWRB	6/18/2003															20	50										
Watts	OWRB	7/8/2003															10	10										
Watts	USGS	7/14/2003	1355	817	765	7.6	7.6	105	24.3	0.061	0.77	1.52	0.012	0.24	0.22	0.31	2000	4000	4000	96	74	--	--	--	--	--	--	--
Watts	OWRB	7/22/2003	16:00			9.86	8.01	312.5	29.45	0.050			0.050		0.138	0.187										14.0	12.3	200.0

Station ID	Agency Code	Date	Time	Inst. Discharge (CFS)	Bar. Press. (mm of Hg)	D.O. (mg/L)	pH	Specific Conduct. (microsiemens/cm @ 25º C)	Water Temp. (º C)	Ammonia nitrogen, diss. (mg/L as N)	Ammonia Nitrogen plus total organic (mg/L as N)	Diss. nitrate plus nitrite nitrogen (mg/L as N)	Diss. nitrite nitrogen (mg/L as N)	Diss. Phos. (mg/L as P)	Diss. Orthophos. (mg/L as P)	Total Phos. (mg/L as P)	E. colil MTEC MF Water (Col/ 100 ML)	Fecal Coliform .7 UM-MF (Col./ 100 ml)	Fecal Strep., KF Strep. MF Method, Water, Col./100 ml	Susp. Sed. Sieve Diam. % Finer than .062 mm	Susp. Sed. (mg/l)	Diss. Calcium (mg/L as Ca)	Diss. Magnesium (mg/L as Mg)	Diss. Potassium (mg/L as K)	Diss. Sodium (mg/L as Na)	Diss. Chloride (mg/L as Cl)	Diss. Sulfate (mg/L as SO_4)	Diss. Solids, residue on evap. at 180 ºC(mg/L)
Watts	OWRB	7/22/2003															31	80										
Watts	OWRB	8/12/2003															10	100										
Watts	OWRB	8/25/2003	16:38			8.48	7.67	331.0	31.00	0.050			0.050		0.158	0.196										21.9	21.0	212.0
Watts	USGS	8/28/2003	1100	86	744	7	7.9	407	28.3	0.016	0.34	0.991	0.008	0.18	0.16	0.21	--	--	--	92	53	--	--	--	--	--	--	--
Watts	USGS	8/30/2003	1815	410	745	7.9	7.7	378	25.7	0.015	0.36	1.33	0.007	0.24	0.21	0.28	--	--	--	90	51	--	--	--	--	--	--	--
Watts	USGS	9/2/2003	1200	997	763	7.2	8.3	294	23.9	0.015	0.48	1.31	0.006	0.19	0.16	0.25	--	--	--	96	71	--	--	--	--	--	--	--
Watts	OWRB	9/16/2003															20	20										
Watts	OWRB	9/29/2003	13:55			10.87	8.28	375.9	20.24	0.050			0.050		0.148	0.160										20.0	23.3	240.6
Watts	OWRB	9/30/2003															20	10										
Watts	USGS	10/30/2003	800	120	750	9.9	8	396	14.1	0.012	0.21	1.56	0.003	0.11	0.10	0.14	--	--	--	96	49	--	--	--	--	--	--	--
Watts	OWRB	11/3/2003	16:15			8.45	8.04	389.5	19.68	0.050			0.050		0.102	0.114										22.2	19.3	249.3
Watts	OWRB	12/1/2003	17:35			11.48	7.81	320.0	9.00	0.050			0.050		0.080	0.091										12.8	14.7	205.0
Watts	USGS	12/8/2003	1630	185	757	12.6	7.3	368	7.9	0.007	0.2	2.26	0.002	0.08	0.06	0.10	--	--	--	100	29	--	--	--	--	--	--	--
Watts	OWRB	1/26/2004	11:46			12.27	7.77	306.2	8.19	0.050			0.050		0.043	0.072										11.3	18.3	196.0
Watts	OWRB	2/23/2004	14:41			12.34	8.41	337.6	9.81	0.050			0.050		0.026	0.037										13.7	16.4	216.1
Watts	OWRB	4/5/2004	16:41			12.65	8.41	277.0	16.10	0.050			0.050		0.048	0.064										10.8	16.4	177.3
Watts	OWRB	5/18/2004	15:50			14.85	7.91	231.0	21.58	0.050			0.050		0.078	0.107										10.0	10.8	148.0
Watts	OWRB	6/21/2004	14:00			9.97	7.81	262.0	22.96	0.050			0.050		0.096	0.117										11.7	13.3	180.5
Watts	OWRB	7/27/2004	16:11			7.95	7.31	171.4	22.40	0.050			0.050		0.181	0.243										10.0	16.6	109.7
Watts	OWRB	8/31/2004	14:47			9.60	7.95	334.7	26.00	0.050			0.050		0.104	0.119										12.5	13.9	214.2
Welling	USGS	1/4/1999	13:50	229	759	12.5	8.5	214	5.8	0.04	0.1	2.71	0.03	0.05	0.02	0.05		3	6									
Welling	USGS	2/1/1999	14:40	571	753	11.9	7.5	208	10.6	0.03	0.22	2.5	0.01	0.03	0.03	0.04		180	190									
Welling	USGS	3/15/1999	14:30	2460	759	10.7	7.3	150	10.7	0.02	0.25	2.44	0.01	0.04	0.05	0.1		160	180									
Welling	USGS	4/6/1999	9:00	1940	757	9	7.4	156	13.9	0.03	0.72	1.28	0.01	0.11	0.08	0.23		10000	18000									
Welling	USGS	5/5/1999	10:30	4790	741	8.3	7	123	16.4	0.04	1.3	1.1	0.01	0.11	0.09	0.49		14000	19000									
Welling	USGS	6/8/1999	9:36	376	752	7.1	7.6	196	21.5	0.02	0.12	1.31	0.01	0.12	0.1	0.03		18	25									
Welling	USGS	8/10/1999	15:35	63	750	8.8	7.7	202	29.5	0.02	0.13	0.72	0.01	0.05	0.02	0.05	31	57	70	88	20							
Welling	USGS	10/19/1999	16:40	32	763	13.4	7.9	190	18.7	0.02	0.09	0.48	0.01	0.03	0.02	0.03	21	23	47	98	15							
Welling	USGS	12/1/1999	12:16	49	760	12.1	8	190	12.2	0.02	0.28	0.6	0.01	0.05	0.02	0.05	3	6	13	91	15							
Welling	USGS	2/15/2000	14:10	70	753	12.3	7.9	197	11.9	0.02	0.1	1.37	0.01	0.05	0.01	0.05	11	9	6	87	16							
Welling	USGS	4/18/2000	13:14	202	753	13.8	8.3	200	17.9	0.02	0.16	1.14	0.01	0.05	0.01	0.05	3	2	7									
Welling	USGS	7/26/2000	14:55	167	756	8.9	7.5	187	25.7	0.02	0.1	1.36	0.01	0.04	0.02	0.05	11	29	41	96	18							
Welling	USGS	8/30/2000	17:55	34	755	9.2	7.6	196	28.1	0.02	0.07	0.78	0.01	0.05	0.02	0.05	46	44	45	100	19							
Welling	USGS	10/25/2000	12:15	56	760	9.1	7.6	198	19.7	0.04	0.04	0.7	0.006	0.06	0.02	0.06	21	35	22	100	16							
Welling	USGS	12/20/2000	13:25	219	752	11.6	7.7	207	7.3	0.04	0.07	2.79	0.005	0.06	0.01	0.06	1	1	6									

APPENDIX B:

Watershed Advisory Group Meeting Minutes and Agendas