Fort Cobb
Watershed Implementation Project

FY 2005 §319(h) Project 5 Task 5.4.4
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Introduction

The water quality of the Fort Cobb reservoir in southwestern Oklahoma and its tributaries has been of concern for more than two decades, with water quality problems first identified in 1981. Currently, Fort Cobb Lake is impaired by turbidity and phosphorus. Three streams that are tributaries to the lake are impaired by bacteria, and one of those is impaired by ammonia as well.

The Oklahoma Conservation Commission (OCC) began a six-year demonstration project in the Ft. Cobb watershed in 2001. After modeling nutrient and sediment loads from upland areas using the Soil and Water Assessment Tool (SWAT) model (Storm et al. 2003), it was estimated that areas of wheat, peanut, and sorghum crops were contributing the largest amounts of sediment and nutrients to the reservoir. Implementation of best management practices (BMPs) was targeted to areas shown in the model to have the potential to contribute a larger amount of nutrients. The top priority was establishing riparian areas; however, the most common practices implemented through the 2001 project were conversion of cropland to pasture land and installation of grade stabilization structures.

In 2005, the Oklahoma Department of Environmental Quality (ODEQ) completed a Total Maximum Daily Load (TMDL) for Fort Cobb Reservoir, recommending a 78% phosphorus load reduction from the loading levels documented between 1998 and 2001 (total of approximately 70,000 kg phosphorus per year). To accomplish this load reduction, the TMDL recommended primarily no-till residue management, in addition to riparian buffer establishment, conversion of the worst cultivated land to pasture, nutrient management plans, and grade stabilization structures.

Based on the approved TMDL recommendations and goals, the OCC decided to supplement the efforts in the watershed in order to focus solely on no-till residue management with the ultimate goal of meeting water quality goals. The project discussed in this report represents the supplemental work and education efforts performed to achieve a large percentage of no-till in the watershed.

Project Location

The Fort Cobb Watershed is located in the Central Great Plains Ecoregion in central western Oklahoma in Caddo, Washita, and Custer Counties in the Upper Washita sub-basin. The watershed is 314 square miles in area (approximately 200,960 acres) and includes two Hydrologic Unit Code (HUC) 11 watersheds: 11130302120 & 11130302130. The Fort Cobb reservoir is a 4,100 acre water supply and recreation lake constructed by the Bureau of Reclamation in 1959 by impounding Cobb Creek three miles north of the town of Fort Cobb. The lake's designated beneficial uses include public and private water supply, warm water aquatic community, agriculture, municipal and industrial uses, primary body contact recreation, and aesthetics. The reservoir is the primary drinking water source for the cities of Anadarko and Chickasha, which have a combined population of 22,495 (2000 Census). It is a popular recreational lake used for fishing, swimming, and boating.

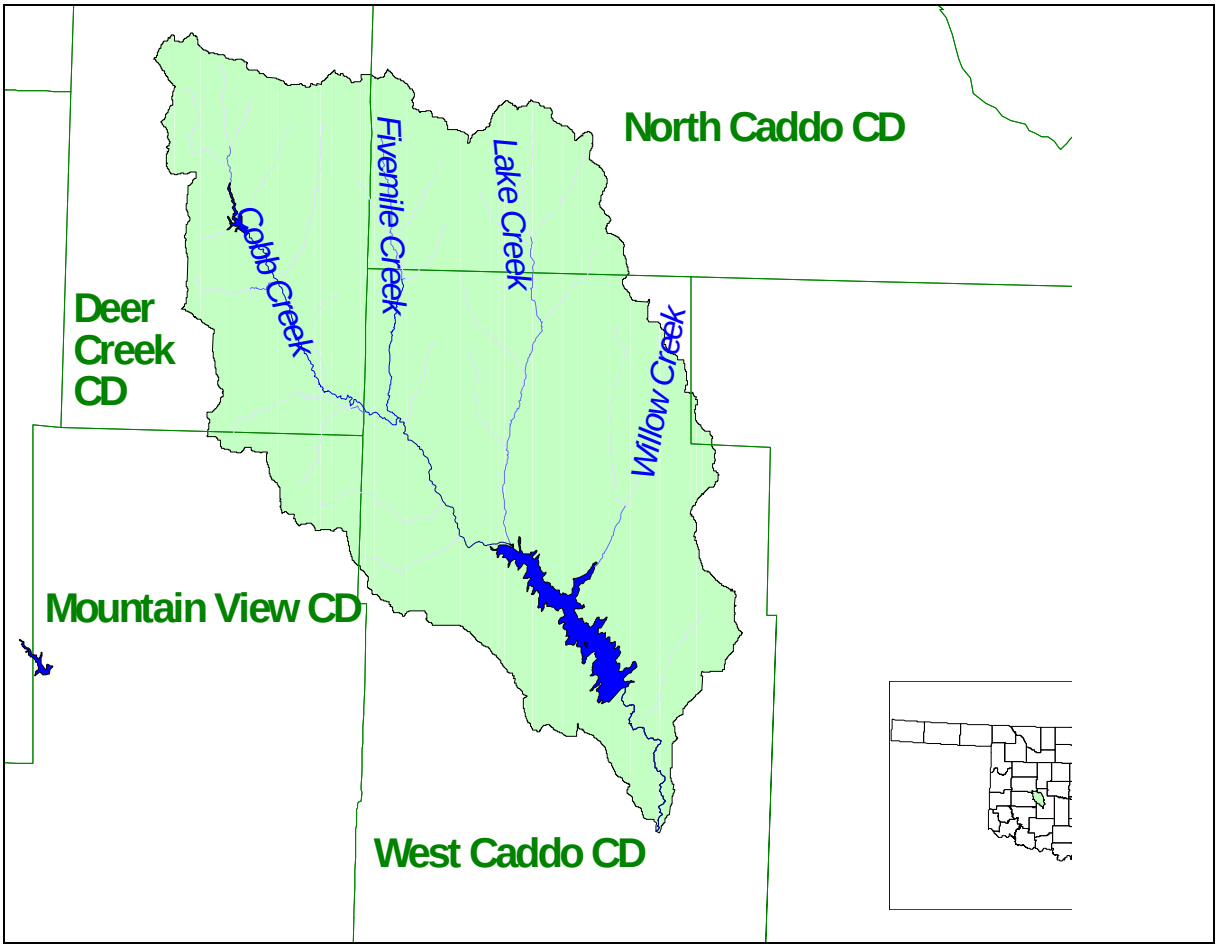

Figure 1. Fort Cobb Watershed Location.

Land use in the watershed is about 50% cropland and about 40% pastureland. There are cattle operations, hog operations, and rural communities in the watershed. Most

soils in the watershed are highly erodible, sandy clays and loams underlain primarily by Permian sandstone, siltstone, and claystone.

Problem Statement

Historically, peanuts and cotton were major crops in the watershed; however, many of these fields have been converted to wheat or to pastureland. Riparian areas in this region are frequently compromised, either through removal of protective vegetation or through uncontrolled access to livestock. The result is streambank erosion, habitat loss, and increased sediment transport in streams.

Oklahoma Water Quality Standards list Fort Cobb Reservoir as a Nutrient Limited Watershed (due to high primary productivity) and a sensitive public and private water supply. Fort Cobb Lake is impaired by turbidity and phosphorus, as indicated on the state's "Comprehensive Waterbody Assessment" (DEQ 2008). In addition, Cobb Creek, Willow Creek, and Fivemile Creek are impaired by bacteria, and Cobb Creek is also impaired by ammonia.

To address these problems, the OCC, in cooperation with the Environmental Protection Agency (EPA), the Office of the Secretary of the Environment (OSE), local conservation districts, and the Oklahoma Department of Agriculture, Food, and Forestry (ODAFF), initiated a watershed project in 2001. Through this cost-share project, local landowners began to demonstrate BMPs. The OCC targeted the implementation of these practices toward areas of the watershed contributing the greatest phosphorus and sediment loading, based on a SWAT model by OSU (Storm et al. 2003).

In 2005, the ODEQ completed a TMDL for the phosphorus impairment in Fort Cobb Lake. The TMDL recommended a 78% phosphorus load reduction from the loading levels documented between 1998 and 2001. The current loading was estimated at approximately 70,000 kg phosphorus per year, so the target was set at 15,400 kg of phosphorus per year in order to bring Fort Cobb Lake into full attainment. The Trophic State Index is less than 62; Fort Cobb Lake as reported in OWRB's BUMP report exceeds that. According to the TMDL, there are no point sources and only four small CAFOs in the watershed (two cattle and two swine), so nonpoint sources (NPS) in the watershed are causing the impairment.

No-till residue management was the primary BMP suggested to achieve the load reduction set by the TMDL, followed by riparian buffer establishment, conversion of the worst cultivated land to pasture, installation of grade stabilization structures, and nutrient management plans. The most common practices implemented through the 2001 project were conversion of cropland to pasture land and grade stabilization structures, so the OCC initiated a program to focus on no-till residue management to meet the water quality goals as established by the TMDL.

Program Partners and Management

The Oklahoma Conservation Commission (OCC), as the state's technical lead nonpoint source agency, managed the project, providing administrative support and technical guidance. The contracts of the local project coordinator and education coordinator from the 2001 Ft. Cobb project were extended. The duties of these personnel included identifying producers in need of conservation plans based on the results of the SWAT targeting, contacting these landowners about becoming cooperators, writing conservation plans for no-till, overseeing the implementation of best management practices, and educating producers on the economic and environmental benefits of no-till management. The OCC worked with local partners to accomplish these tasks, with the ultimate goal of reducing nonpoint source pollution in the watershed. The primary partner agencies in the Fort Cobb Watershed Project included:

- **Deer Creek, West Caddo, North Caddo, and Mountain View Conservation Districts and the Natural Resources Conservation Service (NRCS)**

  The local conservation districts, the NRCS, and the project and education coordinators worked one-on-one with citizens of the watershed to reduce pollution and educate about the importance of protecting water resources. The districts and NRCS also organized or participated in seminars, training sessions, and BMP tours to interact with local people and provide technical assistance and information. These agencies were critical to ensuring participation of local landowners in water quality improvement programs. In addition, the West Caddo County Conservation District (CD) provided office space and support for the project coordinator, while the Deer Creek CD supported the Project Education Coordinator. This support included clerical support, telephone service, and internet service.

  Local agencies often have the most accurate knowledge concerning current land management practices and local needs, so the districts recommended members for the Watershed Advisory Groups, participated in those groups, and worked with landowners to insure that they received their cost-share reimbursements and incentive payments. In addition, these districts continued ongoing programs, including those addressing proper fertilizer and herbicide application, working with landowners to improve water quality in their respective counties within the watershed.

- **Oklahoma State University Cooperative Extension Service (OCES)**

  The OCES worked closely with the local conservation districts and the NRCS to promote water quality awareness through numerous educational programs in the watershed. Staff from OCES provided technical assistance to landowners and participated in workshops and tours to educate producers about the effectiveness

of certain best management practices and on topics such as soil testing, no-till, and pesticide usage.

Targeting NPS Pollution

To accurately target and reduce the sources of pollution in the watershed, a land use database was developed for the watershed based on satellite-imagery data as part of the 2001 project. A SWAT (Soil and Water Assessment Tool) model was then used to predict how phosphorus and sediment loads varied across the Fort Cobb watershed. Areas contributing a disproportionate amount of phosphorus and sediment per unit area were identified, and these areas were targeted as the best places to implement practices to maximally reduce phosphorus loss (Figure 2; Storm et al. 2003). BMP implementation was prioritized so that these "hotspot" areas of phosphorus loading (based on the SWAT model) would be given higher priority if a landowner wanted to participate. This modeling effort was repeated and updated for the TMDL (Storm et al. 2006). The model showed that cropland was the primary source of nutrients and sediment in the basin, accounting for approximately 90% of the phosphorus load (ODEQ 2006).

In Figure 2, the red areas delineated on the map are the 10% (approximately 20,096 acres) of the watershed contributing the greatest portion of the loading (approximately 50% of the total phosphorus loading). The yellow areas are the 10% of the watershed contributing the next highest portion of the loading (approximately 30% of the total phosphorus loading). Therefore, installation of BMPs on these areas could potentially result in phosphorus loading reductions of approximately 80%.

The SWAT model further estimated loading to the lake by tributary (Storm et al. 2006). These estimates suggest that Lake and Willow Creeks, approximately 31% of the watershed area, contribute approximately 34% of the phosphorus load to Fort Cobb Reservoir, while Cobb Creek, approximately 54% of the watershed, contributes approximately 59% of the phosphorus load. This information was used to prioritize incentives for no-till and riparian protection.

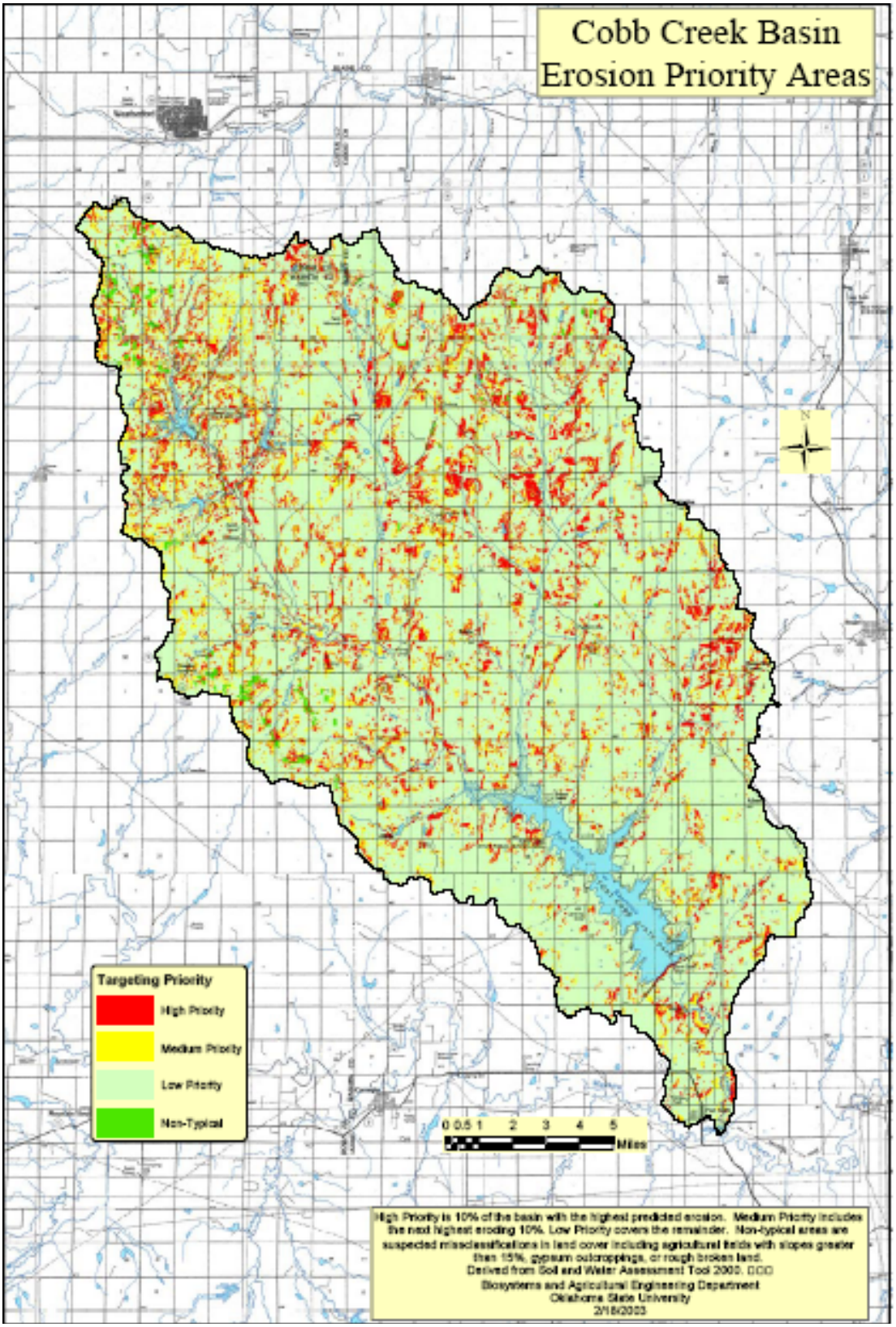

Figure 2. Targeting results for Fort Cobb Watershed (Storm et al. 2003).

Demonstration of Best Management Practices

Implementation of best management practices (BMPs) in this 2005 Fort Cobb Watershed project was based on the recommendations of the TMDL. Several different scenarios were presented in the TMDL which were expected to result in the required 78% reduction in phosphorus loading. **No-till was projected to be one of the most effective practices for reducing both nutrient and sediment loading.** Therefore, one of the primary goals in this project was to attempt to install 30,000 acres of no-till cropland in the Fort Cobb watershed. This amount is approximately 60% of the TMDL no-till goal and has the potential to eventually lead to a phosphorus load reduction of 12% for the Fort Cobb Reservoir.

No-till field

As in the previous project, the OCC partnered with the local Conservation Districts and the local NRCS to facilitate BMP implementation. The project coordinator was responsible for working with the individual landowners to develop conservation plans and agreements to participate in the program, then verifying whether the practices had been implemented and maintained. The specific practices and cost-share rates offered to individual producers through the project were based on NRCS EQIP rates.

Individuals who lived in a critical, hotspot area (based on the SWAT model) were contacted by the project coordinator or education coordinator and the conservation district and strongly encouraged to participate in the program. The coordinator then developed a conservation plan and assigned a ranking index based on the practices that would need to be implemented, the cost for implementation, and the expected impact on water quality improvement. Landowners with the highest rankings were funded first to ensure that the greatest water quality benefit was derived for each dollar spent.

Deer Creek CD no-till drill in use

The sole implementation focus of this project was **no-till**. Incentive payments were provided to landowners who signed up to convert to no-till, and equipment, which was purchased through the project for the conservation districts, was lent to landowners free of charge. The incentive payment for no-till

was $15.00 per acre for the first two years and $19.20 for the last year of the project; the rate was adjusted to match the increase in EQIP rates. The maximum cost-share assistance to any one participant was $30,000.

Sixty landowners installed BMPs through this project. A total of **$865,403** was spent on BMP implementation, of which landowners provided $72,597 (approximately 8% of the total) and the rest was a combination of federal ($290,250) and state ($502,556) funding. **15,288 acres were enrolled in no-till as part of this project,** resulting in about 8% of the watershed area having new no-till land (see Figure 3).

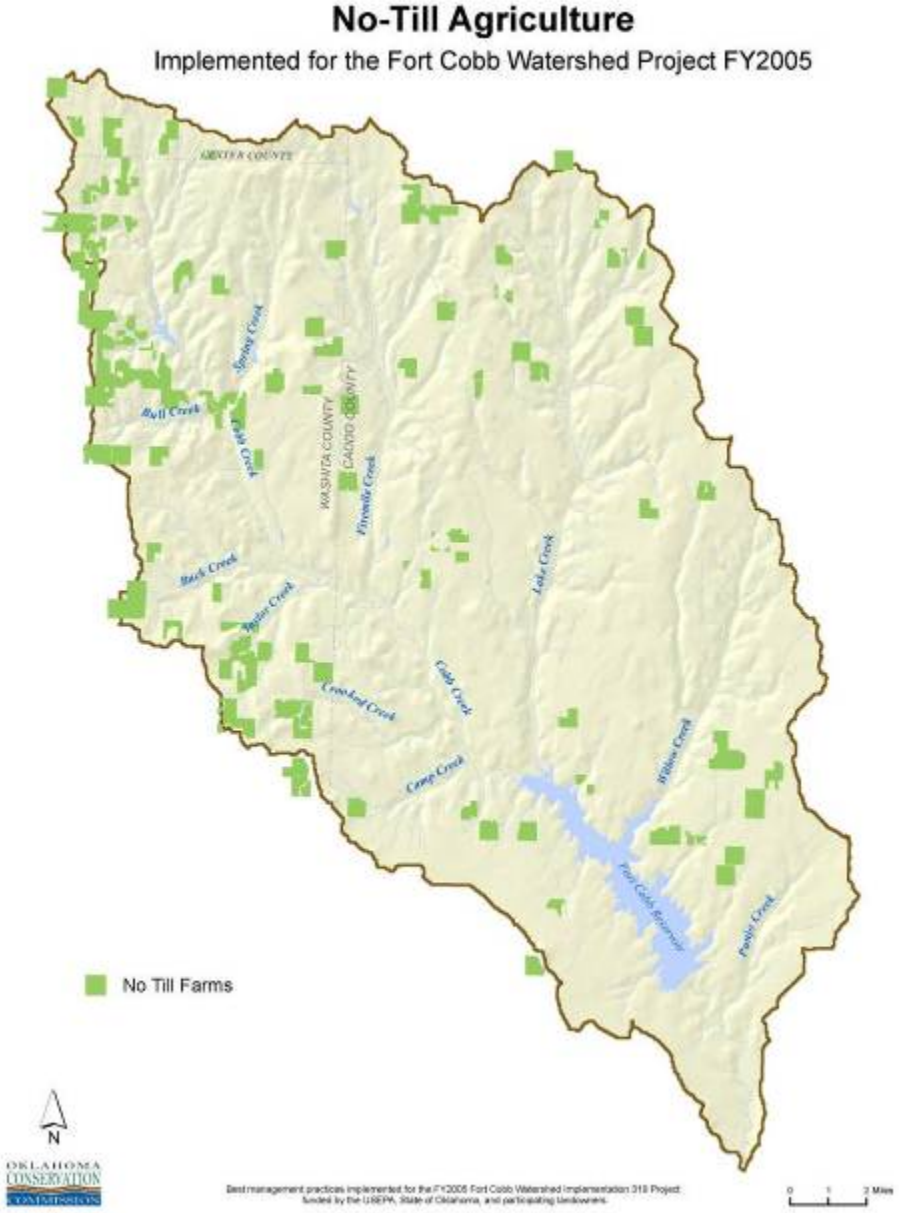

Figure 3. Areas of no-till implementation through the 2005 project.

The amount of no-till implemented was less than the initial project goal for several reasons. First of all, the NRCS raised the incentive rate for no-till, so the OCC had to match that higher rate. The 30,000 acre target was based on the lower rate, so there was not enough funding once the rate increased to cover the entire acreage goal. Also, the switch to no-till requires almost completely new equipment, representing a large financial investment, one which many landowners were reluctant to undertake given the extreme weather events experienced in the watershed during the project period. If landowners wanted to borrow equipment from the district, they had to hope that soil conditions and weather would be appropriate when their turn came. Landowners seemed unusually nervous about how the weather would affect their crops during the project period.

Visible improvements from no-till were observed throughout the watershed. Often, large piles of sandy soil accumulate along fence lines and in fields when dry and windy conditions occur in this area. No-till helped to hold moisture in the soil and reduce the amount of soil lost by wind and rain erosion, as seen in the photos below (Figure 4). The first two photos are of a no-till field, while the next two photos are of an adjacent, conventional till field. Much of the wheat in the conventional till field has been covered by soil which blew or washed over the plants.

Figure 4. Two adjacent wheat fields, the top in no-till and the bottom in conventional till.

Carry-over from 2001 project:
The 2001 Fort Cobb project was plagued by weather extremes; unusual drought conditions followed by record rainfalls prevented some grass plantings and construction of some grade stabilization structures (GSS). As a result, part of the implementation completed during the 2005 project period and reported here includes a one year extension to those 2001 project contracts where grass plantings and grade stabilization structures could not be completed by the end of the 2001 project year due to weather. No new contracts for these practices were developed under the 2005 project. Practices installed during the one-year extension included: **308 acres of cropland converted to pasture, 14 acres of riparian buffer (exclusion) established, and 3 GSS installed.** Figure 5, below, demonstrates these BMPs.

Figure 5. Other BMP types, installed through the 2001 project.

Measures of Success

BMP Implementation:
As stated in the Work Plan, effectiveness of project BMPs will be evaluated primarily with secondary data collected by the USDA Agricultural Research Service (ARS). Due to lack of access to monitoring data from ARS at this time, the success of this project must be measured in terms of behavioral change and expected load reductions based on the amount of BMP implementation.

The OCC's no-till program has resulted in implementation of almost 30% of the TMDL goal for no-till. An additional 30% of row crops have been converted to conservation tillage, so at least 60% of the row crop acreage in the watershed is now in some form of conservation tillage (Table 1). In addition, approximately 63% of the TMDL goal for converting row crops to pasture has been achieved through the §319 program. NRCS EQIP has provided funding for both no-till and conservation tillage as well, so additional progress toward the overall TMDL goal has been made.

Table 1. OCC §319 progress toward TMDL goals, 2001-2008.

Total conventional row crop in basin at start of project: 98,289 acres			
BMP	**Total Amount Implemented (acres)**	**Goal for TMDL (acres)**	**% Towards TMDL Goal**
Row Crop Converted to No-Till	16,401	58,973	27.8
Row Crop Converted to Conservation Tillage	17,286	58,973	29.3
Convert Worst Row Crop to Pasture	12,462	19,658	63.4
Establish Riparian Buffers	169	8,547	2.0

The TMDL states that a 78% reduction in total phosphorus loading is required to improve water quality in the lake. According to the TMDL, a phosphorus load reduction of approximately **20%** has already been accomplished since 2001 due to a dramatic change in crop production in the watershed (ODEQ 2006). Specifically, many acres that were used for peanut production have now been converted to wheat production or pasture.

According to the SWAT watershed model (Storm et al. 2006), if there was 100% conversion of row crops and wheat to no-till, total phosphorus loading would be expected to decrease by 34%. Based on the conversion of 16,000 acres to no-till, total phosphorus loading should be reduced by approximately **6%**. The maturation of other BMPs, installed as part of the 2001 project, will further reduce the phosphorus loading in the watershed.

Approximately one-third of the implementation from 2001-2008 occurred in areas that were expected to be contributing high levels of phosphorus, according to the SWAT model:

- Of the 9,188.6 acres that were in the top 10% of phosphorus load supplying areas, 32% now have BMPs on them;
- Of the 10,033.2 acres in the next 10% of high phosphorus areas, 27% have BMP implementation.

Figure 6, below, shows the overlay of implementation and targeting.

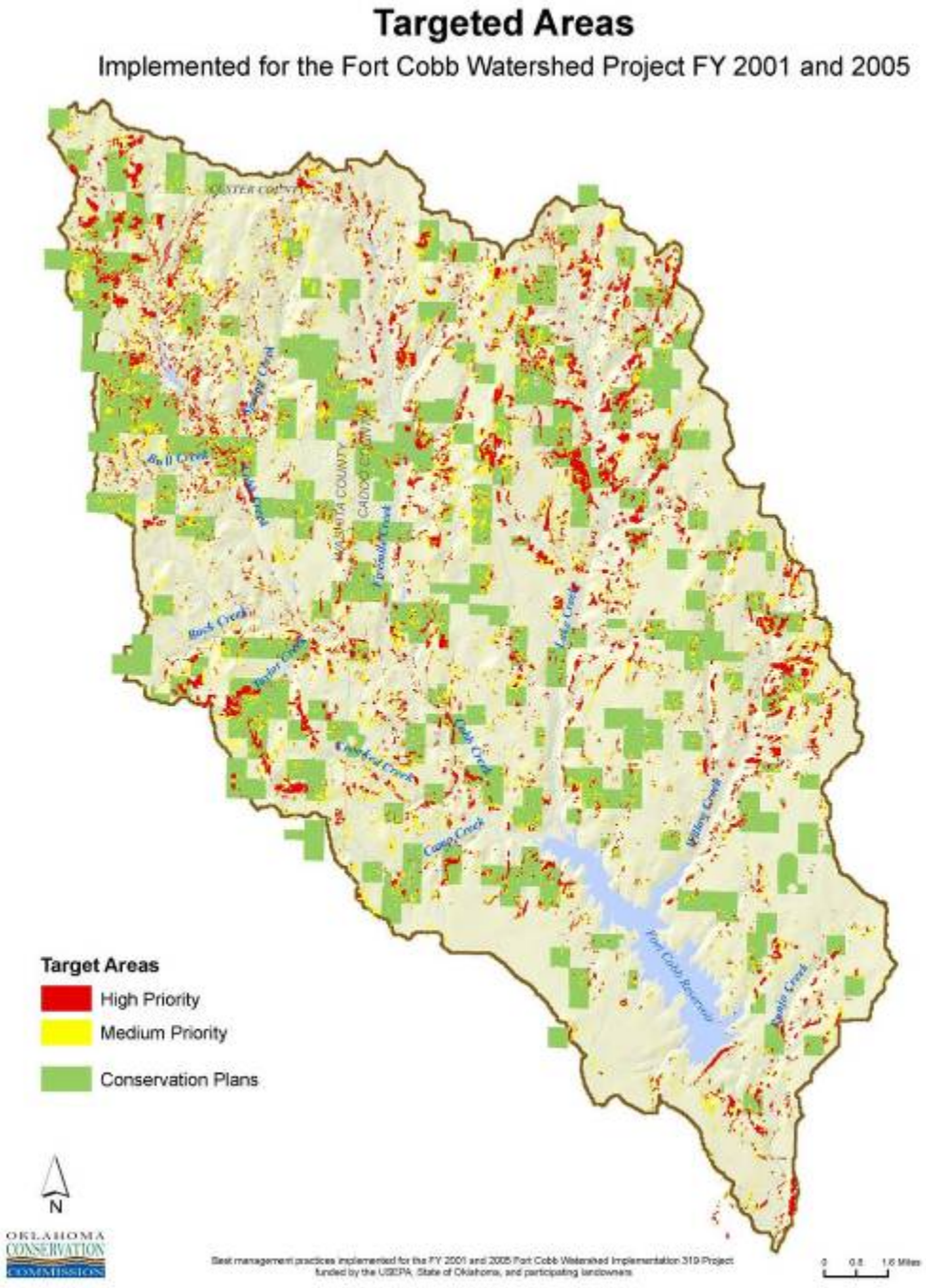

Figure 6. Overlay of regions of high phosphorus loading (targeted regions) onto areas of BMP implementation through the §319 program, 2001-2008

Monitoring:

The ARS began monitoring in the Fort Cobb watershed in 2004 under the USDA Conservation Effects Assessment Program (CEAP). The program monitors at 2 week intervals at 15 sites along the main tributaries into Fort Cobb Reservoir. The data collection will continue for a total of at least 5 years (Steiner personal communication). However, data will not be made available to OCC until approximately 2010, after ARS scientists have published their initial findings. Due to the unavailability of this monitoring data, OCC is not able to determine or discuss in this report water quality improvements that may have resulted from BMP implementation in the Ft. Cobb project. However, OCC has demonstrated through past watershed projects that BMPs reduce NPS loading to streams, and it is expected that this project will show similar results when data are analyzed.

The OCC has two ambient monitoring sites in the Fort Cobb watershed that were monitored every 5 weeks from 2004-2006 as part of the Rotating Basin Program (Figure 7). The data presented in Table 2 is intended to provide a cursory indication of water quality parameters of interest. The data collected from 2004-2006 will provide a baseline from which improvements can be assessed. The OCC will revisit Cobb Creek and Five Mile Creek every 5 weeks from June 2009 to May 2011 as part of the second cycle of the Rotating Basin Ambient Monitoring Program, and observable changes may be evident during this time. In addition, the OCC will obtain the ARS data once the CEAP has concluded in 2010.

Table 2. Data collected as part of the OCC Rotating Basin Program from 2004-2006. Values reported are means based on approximately 20 measurements.

Site Name	DO (mg/L)	Turb (NTU)	Chloride (mg/L)	Sulfate (mg/L)	TotDisSolids (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	TKN (mg/L)	TotOrthoPhos (mg/L)	Total Phosphorus (mg/L)	TotSusSolids (mg/L)
Cobb Creek	8.92	21.03	12.47	213.50	584.7	0.0369	1.2825	0.0585	0.2147	0.0734	0.1304	31.5
Five Mile Creek	8.90	21.06	14.84	44.27	372.9	0.0430	0.7235	0.0305	0.2450	0.0704	0.1193	26.2

The USGS has three current, “real time” gauging stations in the watershed, as shown in Figure 7. Data has been collected at the Lake Creek site since November 2004, while the other sites have been monitored for a longer period of time. Table 3, below, presents the average values at these sites from 2004-2008 for several important parameters. Regression analysis of phosphorus concentration over time did not produce any significant results at any site. Significant, observable decreases in total phosphorus in the watershed are not expected within a short time after BMP implementation; however, it is expected that both phosphorus and sediment loads will eventually be reduced due to the implementation of BMPs both through this project and through other projects such as EQIP.

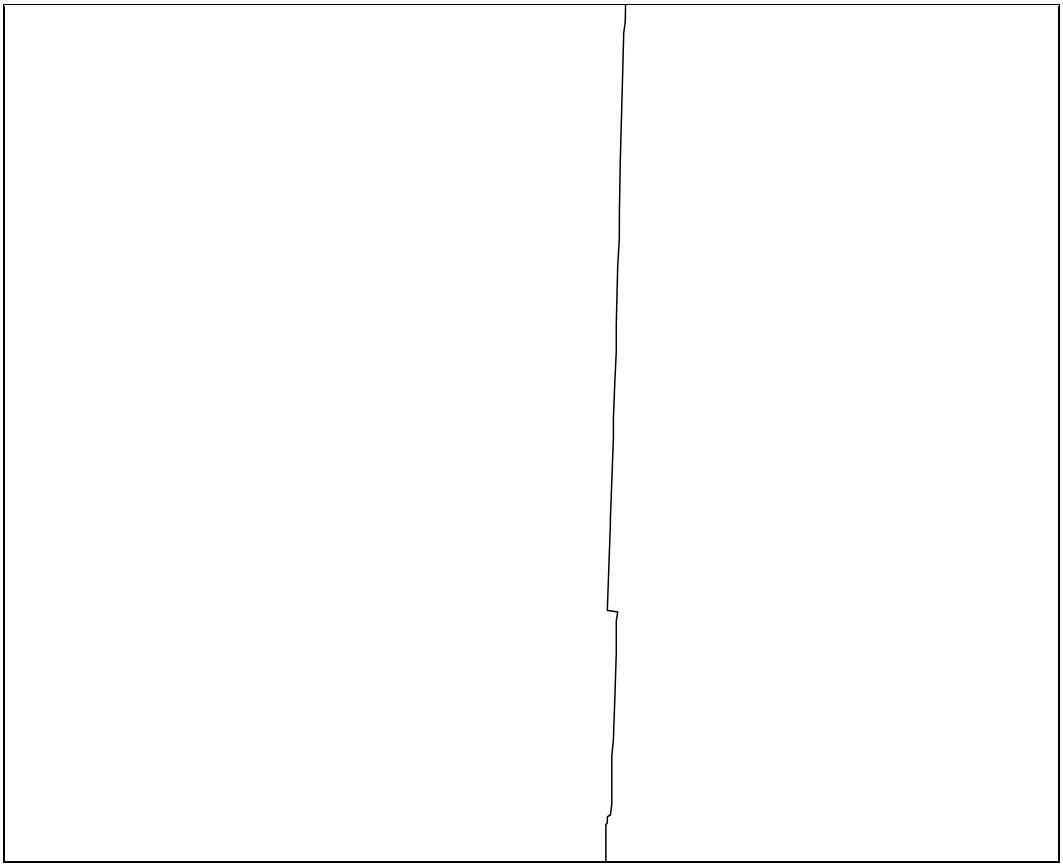

Figure 7. OCC and USGS monitoring sites in the Fort Cobb Watershed.

Table 3. USGS data, averaged from November 2004-November 2008.

Parameter	Site	N	Mean	Standard Deviation
Instantaneous Discharge (cfs)	Cobb Creek	46	408.0	843.0
	Lake Creek	40	195.4	603.6
	Willow Creek	44	52.2	106.0
Dissolved Oxygen (% sat)	Cobb Creek	45	88.89	14.59
	Lake Creek	44	105.55	29.23
	Willow Creek	45	97.62	18.85
Ammonia (mg/L)	Cobb Creek	50	0.1174	0.1247
	Lake Creek	49	0.1214	0.1244
	Willow Creek	49	0.1061	0.1081
Nitrite (mg/L)	Cobb Creek	50	0.0292	0.01682
	Lake Creek	49	0.0252	0.01274
	Willow Creek	49	0.0192	0.01292
Nitrate (mg/L)	Cobb Creek	46	0.9257	0.4491
	Lake Creek	44	0.5264	0.2724
	Willow Creek	45	0.3993	0.2076

Parameter	Site	N	Mean	Standard Deviation
Ammonia + org-N (mg/L)	Cobb Creek	50	2.791	2.752
	Lake Creek	49	3.060	3.751
	Willow Creek	49	2.444	3.212
Phosphorus (mg/L)	Cobb Creek	46	0.1249	0.0743
	Lake Creek	46	0.0853	0.0526
	Willow Creek	46	0.1093	0.0741
ortho-Phosphorus (mg/L)	Cobb Creek	46	0.0967	0.0590
	Lake Creek	46	0.0609	0.0453
	Willow Creek	46	0.0799	0.0624
Suspended Sediment (mg/L)	Cobb Creek	44	2022	2726
	Lake Creek	43	2159	3375
	Willow Creek	43	1547	3067

The data presented in this report will serve as a baseline for comparison in the future. A follow-up evaluation of water quality in this watershed will be performed once data has been received from the ARS. Updated USGS and OCC data will be included in the final assessment. In addition, the Oklahoma Water Resources Board will continue to monitor Fort Cobb Reservoir as part of its Beneficial Use Monitoring Program, so any progress in improving water quality in the lake will be tracked with that data and included in a later water quality assessment report.

Education and Outreach


Farm tour

The goal of the education program was to promote lasting, widespread adoption of practices over the entire watershed. The education program coordinated with ongoing programs in the watershed such as those funded under the 2001 project; however, it focused on promotion of no-till practices and riparian area protection.

The education program was guided and implemented by the Education Coordinator. Tasks completed as part of the Fort Cobb education program included:

1) three no-till workshops, attended by a total of over 400 people;
2) presentations at six Natural Resource Day events, attended by a total of over 1100 people;
3) one pesticide workshop;
4) two Blue Thumb trainings and quarterly Blue Thumb QA sessions;
5) two watershed tours to demonstrate BMP implementation;

6) monthly newsletters and periodic newspaper articles and radio interviews about no-till and watershed protection.


No-till seminar

Detailed reports of education programs were submitted at each conservation district monthly board meeting. The minutes of each meeting along with the reports from the education coordinator have been submitted in hard copy format in fulfillment of workplan require-ments. In addition, hard copies of flyers, newsletters, newspaper articles, and PowerPoint presentations are included in the education binder.


Youth education event


Farm tour


No-till drill demo

Follow-up

Demonstration of the success of the practices installed both through this supplemental, no-till focused project and through the earlier OCC project should help spread the efforts to remaining parts of the watershed. The education programs and tours that were part of this project allowed the visible, tangible improvements resulting from no-till to be seen by local producers. Programs such as EQIP, CRP, CSP, CREP, and the State locally-led cost-share program will be used to promote the BMPs demonstrated with §319 programs beyond the length of the §319 project.

The blossoming NRCS Conservation Securities Program (CSP) that focuses on implementation on a watershed basis requires that no-till management already be in place for a landowner to receive the most lucrative benefits. The Fort Cobb Watershed was included in an area selected as a CSP watershed in 2008. The §319 program should serve as a stepping stone to the CSP program that would ensure longevity of the no-till practices.

Although it was not anticipated that water quality would improve measurably in Fort Cobb Reservoir during the monitoring period, it is anticipated that it will not decline and that improvements may be observed in a couple of years, when additional data is analyzed. The OCC will produce a supplemental data analysis report of Fort Cobb water quality once ARS data has been obtained.

The Fort Cobb Watershed Implementation Project significantly advanced the TMDL goals toward implementing no-till in the watershed: thirty percent of the TMDL no-till goal has now been achieved, and another 30% of the acreage goal is now in conservation tillage rather than conventional tillage. Approximately 63% of the TMDL goal for converting row crop acreage to pasture has also been attained. Drastic, visible changes and testimony from producers who have participated in the §319 program should encourage local landowners to retain BMPs and participate in additional programs.

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