

# ‘Bundled Benefits’



## Conservation Practices As Tools To Address Water Quality And Climate Change: Three Case Studies

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Through an agreement with Redlands Community College, Division of Agriculture



## Summary

The Federal Government of the United States has invested billions of dollars in conservation practices on privately owned working lands since the initial response to the Dust Bowl of the 1930's. Often these efforts have focused on the control of soil erosion from farm and ranch land in an effort to maintain a productive agricultural base into the future. Starting with the efforts of the U.S. Department of Agriculture's (USDA) Soil Conservation Service (now the Natural Resources Conservation Service, NRCS) and continuing through the efforts of numerous other agencies such as the Farm Services Agency (FSA), the Environmental Protection Agency (EPA), and the U.S. Fish and Wildlife Service (USFWS), our Nation has assisted farmers, ranchers, and forest landowners with the implementation of conservation practices designed to continue the production of food and fiber while protecting our natural resource base.

These programs have shown varying degrees of success, with some of the best results unfortunately not widely known. The slowing and eventual reversal of the desertification that was underway in the Southern Plains of the United States during the 1930's is a prime example of an outstanding achievement that has been generated through these efforts. The continued reduction in erosion rates and the resulting gradual improvement of water quality have both been shown to be possible through the administration of voluntary, locally led conservation work with financial and technical assistance provided by the Federal Government. What rarely has been documented, however, is the ability of practices often implemented to address a specific problem (soil erosion) having the corresponding result of generating additional, co-benefits (controlling run-off, therefore improving water quality). This has been especially true when considering the potential positive impact that these practices can have on climate change through carbon sequestration and avoided emissions.

What follows in this report is a series of three case studies that attempt to highlight the dual benefits of improved water quality and reduced greenhouse gas levels in the atmosphere that can result from the implementation of conservation practices on working lands. It should be noted that the practices utilized in the sub-watersheds described in these studies were almost exclusively installed utilizing Farm Bill conservation title programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP), and were not implemented as part of a focused water quality initiative.

In Oklahoma, the nonpoint source pollution technical-lead agency, the Oklahoma Conservation Commission (OCC), uses a small watershed monitoring system

designed to determine places where waters are either impacted by nonpoint source-related activities or improved through conservation programs such as those offered by USDA NRCS. NRCS and the OCC work together to identify the watersheds of high conservation practice implementation. The OCC and local conservation districts also provide additional cost-share assistance, public education, local leadership, and community outreach concerning these efforts. EPA Clean Water Act Section 319 funds are also utilized for education, outreach, and monitoring.

Through this partnership, monitoring of the conservation practices in these designated areas have shown improvements in water quality significant enough to justify the removal of these sub-watersheds from the list of impaired streams in the Oklahoma (303d list) for bacteria, and in the case of the Pond Creek sub-watershed, for turbidity and dissolved oxygen levels as well. Additional review of the conservation practices implemented in these sub-watersheds utilizing the NRCS COMET PLANNER tool ([www.comet-planner.com](http://www.comet-planner.com)) also estimated that these practices generated significant reductions in greenhouse gas emissions and enhanced carbon sequestration in healthy soils. When combined, the conservation practices implemented in these designated areas showed an overall estimated reduction of 35,471 tons of carbon dioxide equivalent annually. This translates to a total estimated greenhouse gas reduction equivalent of taking 7,547 cars off the road annually<sup>1</sup>.

It is our hope that this report helps inform discussions on the role conservation practices can and do play in protecting our Nation's environment, and that it can in some way stimulate additional action to document the multiple, positive, "bundled benefits" that these practices are currently generating on our nations working lands.

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<sup>1</sup> Carbon dioxide equivalent reductions calculated against average typical passenger vehicle emissions rates per EPA Office of Transportation and Air Quality Fact Sheet (EPA-420-F-14-040a).

# Implementation Of Conservation Practices Improves Bacteria Levels In Commission Creek While Reducing Greenhouse Gas Levels By 500 Tons Of CO<sub>2</sub> Equivalent Per Year

High levels of *Escherichia coli* (*E. coli*) bacteria, caused in part by cattle production, led to Commission Creek being added to Oklahoma's 2002 Clean Water Act (CWA) Section 303(d) list of impaired waters. Implementing a system of conservation practices to improve grazingland and exclude livestock from riparian areas resulted in decreased bacteria in the creek. As a result, Commission Creek was removed from Oklahoma's 2008 CWA Section 303(d) list for *E. coli* impairment and is in partial attainment of its primary body contact recreation designated use. In addition to measured improvements in water quality, the conservation practices installed in the watershed also resulted in an overall reduction of 500 tons of total CO<sub>2</sub> equivalent through carbon sequestration in healthy soils.



Twelve-mile-long Commission Creek flows through Ellis County on the western Oklahoma border with Texas. The majority of the land in the 31,543-acre area is used for wheat and cattle production. A small amount of cotton and sorghum is also produced. Erosion of grazingland, coupled with improper management of livestock wastes and direct livestock access to streams, was potentially the largest nonpoint source (NPS) problem in the watershed, contributing to high levels of fecal bacteria in the stream. In the 2002 water quality assessment, *E. coli* levels exceeded the state criterion, with a geometric mean of 146 colony forming units/100 milliliters (CFU). The primary body contact recreation designated use is considered impaired if the geometric mean exceeds 126 CFU for *E. coli*. A Total Maximum Daily Load (TMDL) for *E. coli* and *Enterococcus* was implemented by Oklahoma in 2006.

## Project Highlights

Landowners implemented conservation practices with funds from the U.S. Department of Agriculture's (USDA's) Natural Resources Conservation Service (NRCS) Environmental Quality

Incentives Program (EQIP) and Wildlife Habitat Incentive Program (WHIP), U.S. Department of Agriculture's Farm Services Agency (FSA) Conservation Reserve Program (CRP,) and the Oklahoma Conservation Commission's (OCC's) Locally Led Cost Share Program (LLCS).

The focus of most of the conservation practices in this watershed was to improve rangeland quality and restore natural habitat. Improved water quality was expected from decreased runoff from poor quality land that can carry both sediment and fecal bacteria into surface waters. From 2006 to 2014, landowners installed eight alternative water supplies and implemented 2,784 acres of prescribed grazing. Brush management on 660 acres also helped improve range quality. In addition, upland wildlife habitat management occurred on 2,466 acres, which produced high quality, diverse, natural vegetation which is less susceptible to erosion.

## Results

The OCC Rotating Basin Monitoring Program, a statewide nonpoint source ambient monitoring program, documented improved water quality in Commission Creek due to the conservation efforts. The grazingland and nutrient management conservation practices decreased erosion and bacteria loading, and the conservation practices designed to improve rangeland and wildlife habitat resulted in denser vegetation and fewer bare spots, which equated to less runoff of soil, nutrients and bacteria from animal wastes into waterbodies. Monitoring data showed that the geometric mean of *E. coli* in the 2008 assessment was 93 CFU, below the state standard of 126 CFU. Hence, Commission Creek was removed from the 2008 CWA Section 303(d) list for *E. coli* impairment. The geometric mean in the 2014 assessment was even lower, at 50 CFU, indicating that *E. coli* in Commission Creek has remained low, and the creek is in partial attainment of the primary body contact recreation use. With continued good management, the waterbody is expected to fully attain its primary recreation designated use. Additional climate change mitigation benefits were calculated by utilizing the NRCS COMET PLANNER tool to determine the overall estimated impact changes in land use practices in the watershed would have on carbon dioxide, nitrous oxide and methane levels in the atmosphere. Calculations determined by COMET PLANNER showed that through the enrollment of 2,784 acres in prescribed grazing practices, an overall estimated reduction of 500 tons of carbon dioxide equivalent per year were occurring due to these conservation practices.

## Partners and Funding

The improvement in water quality in Commission Creek was documented by OCC's statewide NPS ambient monitoring effort known as the Rotating Basin Monitoring Program (RBMP). The RBMP is funded in part with U.S. Environmental Protection Agency (EPA) CWA Section 319 funds at a total annual cost of \$1 million. This funding supports personnel, supplies, lab analyses and other associated costs. Sampling efforts comprise 20 water quality collections at approximately 100 sites every five weeks per five-year cycle. Instream habitat, fish and macro-invertebrate samples are also collected during this period. Statewide educational efforts through OCC's Blue Thumb program are also funded by EPA Section 319 at a cost of approximately \$600,000 annually. The Ellis County Conservation District and landowners in the

watershed contributed approximately \$5,000 through Oklahoma's LLCS program. NRCS spent a little over \$1 million through its programs for implementation of conservation practices in Ellis County from 2006 through 2014, and implementation continues in the area through various programs. The calculations of greenhouse gas reductions were determined utilizing the NRCS COMET PLANNER tool through a partnership effort of Oklahoma NRCS and the USDA Southern Plains Climate Hub.

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# Implementing Agricultural Conservation Practices Improves Dissolved Oxygen, Turbidity And Bacteria Levels In Pond Creek With An Annual Result Of 28,561 Metric Tons Of Greenhouse Gas Reductions

High turbidity, bacteria, and low dissolved oxygen resulted in the impairment of Pond Creek and placement on Oklahoma’s Clean Water Act (CWA) Section 303(d) list of impaired waters in 2004 and subsequent years. Corn, wheat and cattle production contributed to these impairments, and implementation of a system of conservation practices to promote better quality grazingland, as well as cropland decreased sediment and bacteria loading into the creek, improved dissolved oxygen levels. As a result, the entire length of Pond Creek was removed from Oklahoma’s 2010 CWA 303(d) list for turbidity and dissolved oxygen impairments, and from the 2014 list for *Escherichia coli* (*E. coli*) impairment. Pond Creek is now in full attainment of its fish and wildlife propagation designated use and in partial attainment of its primary body contact recreation use. The conservation practices installed in the watershed have also resulted in annual reductions of 27,380 tons of carbon dioxide and 1,181 tons CO<sub>2</sub> E<sub>Q</sub> of nitrous oxide (N<sub>2</sub>O expressed in CO<sub>2</sub> E<sub>Q</sub>) in the atmosphere for an overall reduction of 28,561 tons of carbon dioxide equivalent (CO<sub>2</sub> E<sub>Q</sub>) per year.



## Problem

Pond Creek is a 60-mile-long stream in Grant County in north central Oklahoma. Land use in the 198,000-acre watershed is primarily cultivated cropland with corn, wheat, sorghum, and soybean production. About a third of the watershed is pasture for cattle production.

Poor grazingland and cropland management contributed to excess sedimentation, high levels of bacteria and low dissolved oxygen in Pond Creek. It was listed as impaired for *E. coli* bacteria in

2004 when the geometric mean was 162 colony forming units/100 milliliters (CFU), higher than the criterion of 126 CFU. In the 2006 water quality assessment, monitoring showed that 50 percent of Pond Creek's seasonal baseflow water samples exceeded 50 nephelometric turbidity units (NTU). A stream is considered impaired by turbidity if more than 10 percent of the seasonal base flow water samples exceed 50 NTU (based on five years of data before the assessment year). In addition, 14 percent of dissolved oxygen values in the 2006 assessment were below the seasonal criteria for warm water aquatic communities; impairment results if more than 10 percent of samples (based on five years of data before the assessment year) fall below 6.0 milligrams per liter (mg/L) from April 1 through June 15 or below 5.0 mg/L during the remainder of the year. On the basis of these assessment results, Oklahoma added the entire length of Pond Creek to the 2004 CWA Section 303(d) list for nonattainment of the primary body contact recreation designated use, and to the 2006 303(d) list for nonattainment of the fish and wildlife propagation designated use due to turbidity and dissolved oxygen impairments. In 2011 Oklahoma completed Total Maximum Daily Loads (TMDLs) for turbidity and bacteria.

## Project Highlights

Landowners implemented conservation practices through the local USDA's Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP), Wetlands Reserve Program (WRP), Conservation Stewardship Program (CSP), and general conservation technical assistance program, as well as the USDA's Farm Services Agency (FSA) Conservation Reserve Program (CRP) and Oklahoma's Locally Led Cost Share (LLCS) program. From 2005 to 2009, landowners improved many acres of pastures and rangeland, which reduced runoff of bacteria, nutrients and sediment. Conservation practices installed to accomplish this improvement included 9,226 acres of prescribed grazing, 327 acres of forage planting, 911 acres of nutrient management, 1,732 acres of integrated pest management, 565 acres of brush management, 15 ponds, 8,770 feet of pipeline, eight water tanks for alternative water sources, and 16,474 acres of upland wildlife habitat management.

To reduce erosion of soil and the runoff of nutrients from cropland, landowners also implemented conservation cover crops on 3,774 acres and no-till/reduced till/mulch till/residue management on 4,069 acres. Range planting occurred on 6,765 acres, which helps stabilize soils by converting croplands or degraded range to perennial vegetation. Contour farming was implemented on 685 acres, which included more than 75,000 linear feet of terraces, and more than 140 acres of critical area planting and grassed waterways. Three acres of filter strips and two grade stabilization structures further reduced erosion potential from croplands. Proper nutrient management on 9,755 acres and integrated pest management on 13,936 acres improved cropland condition and reduced excess nutrient runoff and erosion. Through the CRP, landowners restored 2,175 acres of "rare and declining habitat" that had been cropland and enrolled 16,474 acres into "upland wildlife habitat management." In addition, 100 acres had wetland restoration and enhancement. These practices return degraded land to a more natural, less-erosive state.

Conservation work continues in the watershed. Since 2010, an additional 40,049 acres of cropland have converted to no-till, reduced till, cover crop and conservation crop rotations.

Landowners installed seven more grade stabilization structures, 71,796 linear feet of terraces, 79 acres of grassed waterways, and 21 new ponds, and implemented prescribed grazing on 9,864 acres of pasture and range.

## Results

Through its statewide nonpoint source ambient monitoring program, the OCC documented improved water quality in Pond Creek due to landowners implementing conservation practices. Data showed that turbidity and dissolved oxygen have met applicable criteria since 2010, and *E. coli* met criterion in 2014 (Figure 2). On the basis of these data, Pond Creek was removed from Oklahoma's CWA Section 303(d) list for turbidity and dissolved oxygen impairments in 2010, resulting in the full attainment of its fish and wildlife propagation designated use. Pond Creek's *E. coli* impairment was removed in 2014.

The conversion of 44,118 acres from conventional till cropping to no-till was shown through NRCS COMET PLANNER to have an annual estimated reduction of carbon dioxide levels of 18,500 tons. Conversion to prescribed grazing of 19,090 acres showed an estimated reduction of 4,960 tons of carbon dioxide and 210 acres of grassed waterways showed an estimated reduction of 210 tons of carbon dioxide and 61 tons CO<sub>2</sub> Eq. of nitrous oxide (N<sub>2</sub>O expressed in CO<sub>2</sub> Eq.). Cover crop plantings on 3,774 acres showed a combined estimated 1,210 tons of carbon dioxide reductions and 160 tons CO<sub>2</sub> Eq. of nitrous oxide reductions (N<sub>2</sub>O expressed in CO<sub>2</sub> Eq.), while a combined conversion of 2,175 acres of crop land to rare and declining habitat under CRP, the planting of 327 acres of forage, and the range planting on 6,765 acres resulted in an estimated reduction of 2,500 tons of carbon dioxide 930 tons CO<sub>2</sub> Eq. of nitrous oxide (N<sub>2</sub>O expressed in CO<sub>2</sub> Eq.). All totaled, conservation practices undertaken in the watershed, calculated through NRCS COMET PLANNER, show an estimated reduction of 28,561 tons of carbon dioxide equivalent annually.

## Partners and Funding

The Rotating Basin Monitoring Program is supported by EPA CWA Section 319 funds at an average annual cost of \$1 million. Monitoring costs include personnel, supplies, and lab analyses for 18 parameters from samples collected every five weeks at about 100 sites, for a total of 20 episodes per five-year cycle. Instream habitat, fish and macroinvertebrate samples are also collected. Approximately \$600,000 in EPA CWA Section 319 supports statewide education, outreach and monitoring efforts through the Blue Thumb program. The OCC LLCs program provided \$158,833 in state funding for conservation practices in this watershed through the Grant County Conservation District, and landowners contributed \$76,256 in matching funds. NRCS spent approximately \$1.23 million for implementation of conservation practices in Grant County from 2005 to 2009 through NRCS EQIP, CSP, WRP, general technical assistance funds, and FSA CRP with another \$2.74 million added from 2010 to 2014. Landowners provided a significant percentage of funding toward conservation practices implementation in these programs as well. The calculations of greenhouse gas reductions were determined utilizing the NRCS COMET PLANNER tool through a partnership effort of Oklahoma NRCS and the USDA Southern Plains Climate Hub.

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## Conservation Practices Result In Improved Bacteria Levels In Walnut Creek While Annually Reducing 6,410 Tons Of Greenhouse Gasses From The Atmosphere

Walnut Creek was impaired for *Escherichia coli* (*E. coli*) bacteria and was added to Oklahoma's Clean Water Act (CWA) Section 303(d) list of impaired waters in 2006. Due in part to practices associated with cattle and hog production, the impairment was addressed through implementation of a system of conservation practices that focused on improving grazingland and excluding livestock from riparian areas. This effort led to a sustained decrease in bacteria in the creek, resulting in removal of Walnut Creek for *E. coli* impairment from Oklahoma's CWA Section 303(d) list in 2014. In addition, the conservation practices installed to improve water quality also show an annual reduction of 6,140 tons of carbon dioxide and 270 tons CO<sub>2</sub> E<sub>Q</sub> of nitrous oxide (N<sub>2</sub>O expressed in CO<sub>2</sub> E<sub>Q</sub>) for an overall reduction of 6,410 tons of CO<sub>2</sub> equivalent per year.



Twenty-eight-mile-long Walnut Creek flows through McClain County in central Oklahoma. The majority of the land in the 129,852-acre watershed is used for wheat and cattle production. Many hogs are also produced, in addition to corn, sorghum, and soybeans. Erosion of both cropland and grazingland, coupled with improper management of livestock wastes and direct livestock access to streams, were potentially the largest nonpoint source (NPS) problems in the watershed, contributing to high levels of fecal bacteria in the stream. In the 2006 water quality assessment, *E. coli* bacteria levels exceeded the state criterion, with a geometric mean of 179 colony forming units/100 milliliters (CFU). The primary body contact recreation designated use is considered impaired if the geometric mean exceeds 126 CFU for *E. coli*.

## Project Highlights

Landowners implemented numerous conservation practices with assistance and funding from the USDA's Natural Resources Conservation Service (NRCS) general technical assistance programs and the Environmental Quality Incentives Program, as well as support from the Oklahoma Conservation Commission's (OCC's) Locally Led Cost Share (LLCS) program. Most conservation practices in this watershed focused on proper grazing management, including fencing livestock out of streams, and improved pasture and rangeland quality, as runoff from poor quality land can carry both sediment and fecal bacteria into waterbodies.

From 2009 to 2012, landowners installed 30,619 linear feet of fence and implemented 10,837 acres of prescribed grazing. Sixteen new ponds provided alternative water supplies for livestock after cross-fencing to optimize grazingland usage. Landowners also cooperated in nutrient management planning on nearly 9,000 acres. Brush management on more than 1,200 acres helped improve pasture and range quality, as did 1,500 acres of supplemental biomass and critical area planting and 7,330 acres of pest management. Cover crops increased the soil health of more than 1,800 acres of pasture and range, and no-till or reduced till methods were used in these areas. To reduce erosion from sloped areas, producers installed grassed waterways, terraces, diversions and grade stabilization structures. Upland wildlife habitat management practices were implemented on 149 acres, and stream habitat improvement and management conservation practices were conducted over 89 acres.

Oklahoma's NPS education program, Blue Thumb, held several volunteer monitoring trainings in the area. A local high school teacher and her students monitored Walnut Creek for a year, and another group of citizens collected water quality, benthic macroinvertebrates, and fish data for two years.

Landowners installed additional conservation practices from 2013 through 2014 that have enhanced the initial improvements. Conservation practices installed during this period included prescribed grazing management (4,570 acres), nutrient management (159 acres), grazing management (4,122 acres), supplemental vegetation planting (285 acres), and fencing practices (3,700 linear feet).

## Results

The OCC's statewide NPS ambient monitoring program documented improved water quality in Walnut Creek due to conservation efforts. The installed grazingland and nutrient management conservation practices worked to decrease erosion and reduce bacteria loading. Conservation practices designed to improve pasture and rangeland resulted in denser vegetation and fewer bare spots, which reduced runoff of soil, nutrients and bacteria from animal wastes into waterbodies. In the 2014 assessment, monitoring data showed that the geometric mean of *E. coli* had decreased to 46 CFU, which is significantly below the state standard of 126 CFU. Hence, Walnut Creek was removed for *E. coli* impairment from the 2014 CWA Section 303(d) list and is in partial attainment of the primary body contact recreation use. With continued good management, the waterbody is expected to fully attain its primary recreation designated use.

In addition to water quality improvements, the conservation practices installed in the watershed also show an annual estimated greenhouse gas reduction of 6,410 tons of carbon dioxide equivalent as calculated utilizing NRCS COMET PLANNER. The planting of cover crops on 1800 acres showed an estimated reduction of 6,140 tons of carbon dioxide equivalent (carbon expressed as carbon CO<sub>2</sub> E<sub>Q</sub>) and a reduction of 270 tons CO<sub>2</sub> E<sub>Q</sub> of nitrous oxide (N<sub>2</sub>O expressed in CO<sub>2</sub> E<sub>Q</sub>). Prescribed grazing practices contribute an estimated 5,080 tons of carbon dioxide reductions while supplemental vegetative plantings and supplemental biomass plantings on a combined 1,785 acres contribute reductions of an estimated 480 tons of carbon dioxide and 90 tons CO<sub>2</sub> E<sub>Q</sub> of nitrous oxide annually (N<sub>2</sub>O expressed in CO<sub>2</sub> E<sub>Q</sub>).

## Partners and Funding

The improvement in water quality in Walnut Creek was documented by OCC's statewide nonpoint source ambient monitoring effort known as the Rotating Basin Monitoring Program (RBMP). The RBMP is funded in part with U.S. Environmental Protection Agency (EPA) CWA Section 319 funds at a total annual cost of \$1 million. This funding supports personnel, supplies, lab analyses and other associated costs. Sampling efforts comprise 20 water quality collections at approximately 100 sites every five weeks per five-year cycle. Instream habitat, fish, and macroinvertebrate samples are also collected during this period. Statewide educational efforts through OCC's Blue Thumb program are also funded by EPA Section 319 at a cost of approximately \$600,000 annually. These funds support costs associated with volunteer monitoring at nearly 100 sites, volunteer trainings, and many outreach activities. The OCC LLCs program provided \$60,000 in state funding for conservation practice implementation in this watershed through the McClain Conservation District with landowners contributing \$43,148 in match. The NRCS spent a little over \$1 million through its financial assistance programs for conservation practices implementation in McClain County from 2009 through 2012 (pre-delisting period). Implementation is still ongoing, with NRCS spending an additional \$500,000 since 2013. The calculations of greenhouse gas reductions were determined utilizing the NRCS COMET PLANNER tool through a partnership effort of Oklahoma NRCS and the USDA Southern Plains Climate Hub.

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