EPA 319(h) Nonpoint Source Project
Phase I Final Report

"An Evaluation of Best Management Practices Installed in the Peyton Creek Watershed on Stream Water Quality: A Paired Watershed Approach"

Submitted by
The Kentucky Heritage Resource Conservation and Development Council, Inc.
227 Morris Drive
Harrodsburg, Kentucky 40330

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Executive Summary

The Peyton Creek Watershed project had two key components. First was the coordinated implementation of BMPs to reduce the impact of agricultural activities on receiving waters, and second was a monitoring program designed to discern the success of the BMP program.

Emphasis, in the Peyton Creek watershed was on the adoption of a management system for individual landowners rather than individual BMPs. This approach provides a more coherent management strategy that can produce synergistic improvements from the BMPs that are implemented.

Information from the "Peyton Creek Watershed Water Quality Report" was excerpted here to provide monitoring results through July, 2008. The final water quality report for the project is not due until September, 2009 after monitoring is complete

The Peyton Creek watershed project has been very successful from the perspective of landowner participation and the quality of the management systems and BMPs installed in the watershed. The water quality monitoring program has provided valuable insight into the effectiveness of the management systems. However, extreme weather conditions have compromised the ability of the monitoring to assess the management systems effectiveness. Indications are that reductions in solids and fecal coliform bacteria have been achieved but these may have resulted from the reduced streamflow and lack of runoff into the system.

Visual observations indicate considerable success. During the 2004 and 2005 sampling years neither fish nor crayfish were evident at the Peyton Creek sampling site PC1 although they were always noted in the field log at Frog Branch (FB1). By the summer of 2007 minnows and crayfish were abundant at PC1 during all but the few storm events that were sampled. Exclusion of cattle from the creek at this point and upstream dramatically changed the riparian landscape and the amount of erosion contributing directly to the stream. After 2005 manure was not observed in the stream, whereas before the fencing manure mixed with unconsolidated sediment made fish and crayfish habitat impossible to find.

It will likely require several years for the materials once contributed to the stream network to "flush" out even if any new material is excluded. A few good wet years may return Peyton Creek to an ecologically hospitable environment for native aquatic life, although, this will require maintenance of the new management systems and the BMPs that have been installed over the past few years.

Introduction and Background

Nonpoint source (NPS) pollution is the largest cause of water quality impairment in the United States (USEPA, 1995). Agriculture is estimated to be a source for pollution contributed to 48% of all impaired river miles (USEPA 2003). A multitude of processes or activities may be responsible for this source of pollution. The activities of people living in, working in, or traveling through a watershed may have negative water quality impacts. Often the individuals impacting water quality don't understand the consequences of watershed activities on creeks and rivers (Thom, 2002). Educational programs and Best Management Practices (BMPs) are among the most effective tools available to prevent or reduce the impact of human activities on the waters of rural watersheds (USEPA 1997). Kentucky promotes the use of these tools both in a statewide strategy and with local watershed projects to address NPS pollution within the Commonwealth (KDOW 200b).

The Kentucky Heritage Resource Conservation and Development Council, Inc. (KHRC&D) has identified water quality as one of their primary focuses of concern within the ten county RC&D area (**Figure 1**). Beginning in 1992 with the Salt River HUA, the Council has been involved with many NPS projects. After the completion of the HUA, the Council applied for various 319(h) projects. These included the Salt River Riparian Project, the Cedar Creek Watershed, the Spears Creek-Mocks Branch Project, and the Spears Creek-Mocks Branch-Hanging Fork Watershed projects. Many other projects throughout the RC&D area have also been proposed.

The KHRC&D believes the best way to lead is by example. Therefore the 319(h) grant program that demonstrates the implementation of BMPs throughout watershed areas seemed like a logical fit. However, documenting positive results has been difficult with previous projects the KHRC&D has been involved in. The length of the post-BMP monitoring period, the selection of watersheds that are too large, and climatic extremes have constrained the effectiveness of previous monitoring programs. In addition, other factors such as the shifting commitment of landowners to participate in the BMP program, the change in landuse upstream of the monitoring location (independent of the BMP implementation), and changing economic conditions, made it difficult to document the effectiveness of BMPs in projects like Spears Creek - Mocks Branch Watershed project (KHRC&D 2004). These are common problems for many projects (Kingsolver and others; KDOW 2000a).

The Peyton Creek Watershed was chosen for BMP demonstrations for three reasons. 1.) It is a small watershed (3,820 acres) yet important in that it is a sub-watershed of the larger Hanging Fork Creek which is a tributary of the Dix River and ultimately Herrington Lake. 2.) Peyton Creek had documented NPS pollution problems. 3.) The project is in Lincoln County, an economically distressed area with full time farmers who would respond favorably when given assistance to correct water quality problems in the watershed and help maintain sustainable production.

Peyton Creek watershed is made up primarily of full-time farmers whose sole family income is derived from agriculture, and who do not earn supplemental income assistance from a second part-time job. As such, the farmers in this watershed have limited funds available to address water quality issues. Rather, they try to get as much production from their land as is physically possible

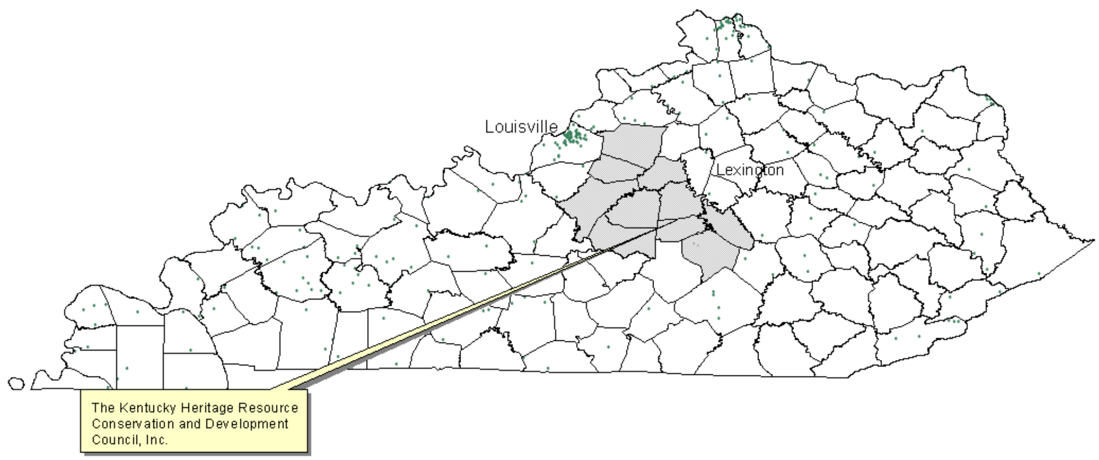

Figure 1. Ten counties served by the Kentucky Heritage Resource Conservation and Development Council, Inc.

In 2003, when this project started beef cattle numbers had been increasing in Lincoln County since the turn of the century reaching the largest numbers in 20 years (**Figure 2**). Weaning lots were over-crowded, cattle had free access to creeks for shade and water, and there were no rotational grazing systems or cross-fencing in riparian areas resulting in improper stocking rates and soil erosion.

This project assisted farmers by offering them incentives to install demonstration BMPs. New concepts were offered and showcased at field days. To improve participation the 60:40 cost share rate was adjusted to 90:10. This was justified by the low per capita income of residents from within this project area. This was accomplished by using "local match" from other state cost share projects, and applying it to the match of producers in Peyton Creek Watershed

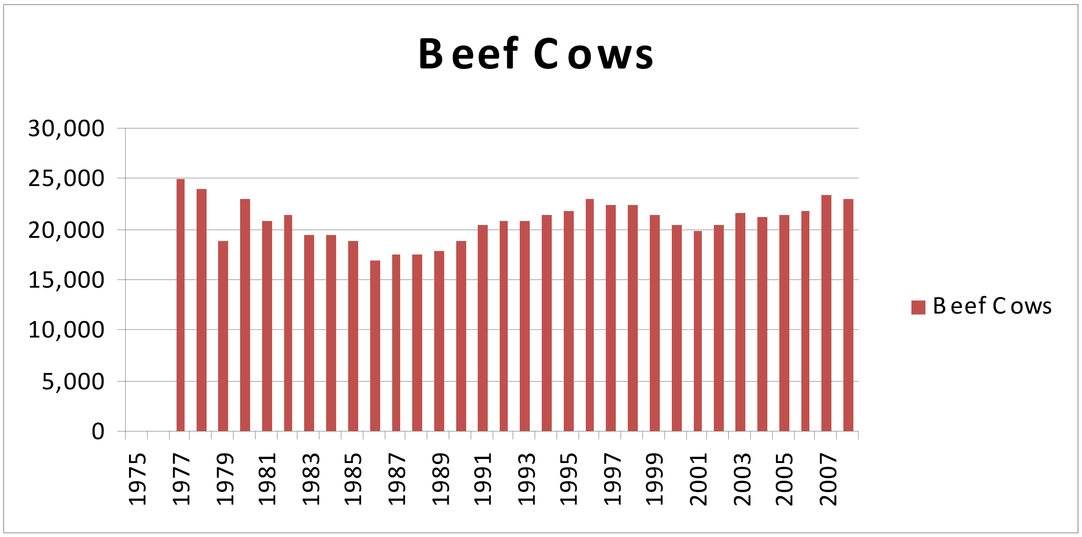

Figure 2. Beef cattle numbers per year in Lincoln County, KY. (Source**:** National Agricultural Statistics Service: http://www.nass.usda.gov/QuickStats/Create_County_All.jsp)

Peyton Creek watershed was selected to provide a demonstration of BMP implementation throughout a watershed to educate producers on technologies available to protect water quality. The BMP Plan was designed to emphasize streamside protection, proper manure handling and utilization and conversion to rotational grazing systems. This was especially needed for farms that include wooded riparian areas, since cattle have been reported to spend more time near shade and water sources (Blackshaw and Blackshaw 1994). Emphasis in the project was placed on the adoption of a management system rather than individual BMPs.

Continuously recording remote water quality monitors and discrete water quality sampling were used within a paired watershed sampling design. The paired watershed sampling design used a *control* watershed, Frog Branch, and a *treatment* watershed, Peyton Creek, to increase the statistical power of the water quality data. The monitoring was initiated prior to BMP (pre-BMP) installation and after BMPs (post-BMP) were installed to evaluate water quality changes associated with BMP implementation within the *treatment* watershed. More than 530,000 water quality data points have been collected to date from the two watersheds.

Information from the "Peyton Creek Watershed Water Quality Report" is excerpted here to provide monitoring results through July, 2008. The final water quality report for the project is not due until September, 2009 after monitoring is complete

Materials and Methods

1. *Description of the Project Area*

The Peyton Creek Watershed project is comprised of two small drainage basins, Peyton Creek and Frog Branch (**Figure 3**). Best Management Practices (BMPs) were installed in Peyton Creek watershed (*treatment*) and water quality was monitored at the station PC1. The Frog Branch watershed was used as a *control*, meaning that water quality monitoring was conducted there, at the station FB1, but BMPs were not applied.

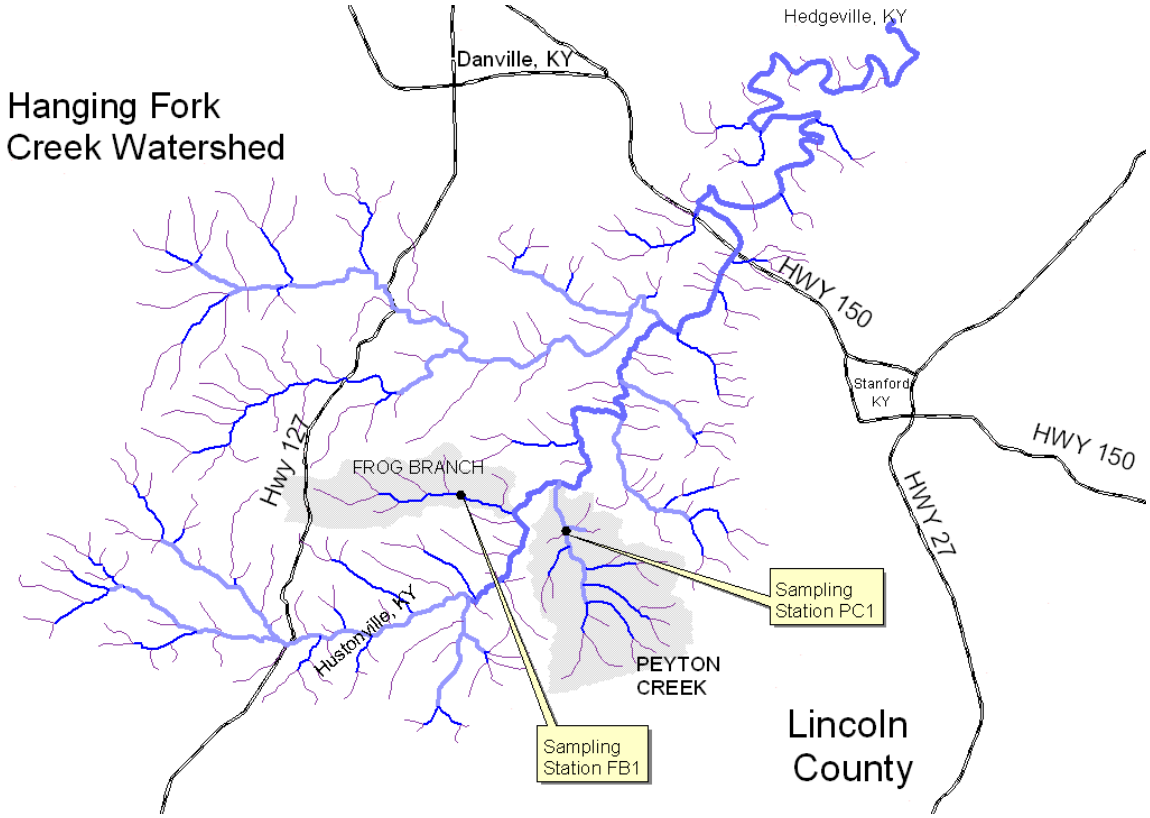

Figure 3. Depiction of *treatment* (Peyton Creek) and *control* (Frog Branch) watersheds within the Hanging Fork Creek watershed.

Peyton Creek, a tributary to Hanging Fork Creek, drains approximately six square miles surface area in Lincoln County, KY (**Table 1**). The watershed is located in the Interior Bluegrass Ecoregion at the edge of the Outer Bluegrass and Knobs Physiographic Regions. It is located near the community of McKinney, Kentucky in rural southern Lincoln County.

The Inner Bluegrass Ecoregion is underlain by Middle Ordovician Lexington limestone. Very fertile Alfisols and Mollisols have developed from the underlying phosphatic limestone (Ecoregions of Kentucky Map). Peyton Creek is a 3rd order stream and the watershed has approximately 27.4 miles of streams.

Table 1. Watershed information for Peyton Creek and Frog Branch. HUC refers to the Hydrologic Unit Code.

Watershed	HUC	Area (Square Miles)
Peyton Creek	05100205180060	5.969
Frog Branch	05100205180040	3.303

Frog Branch, a 3.3 square mile, 2nd order tributary to Hanging Fork served as a control watershed in this project. This watershed has very similar land uses and soils but a slightly steeper topography. Best Management Practices (BMPs) were not implemented in this watershed.

Both creeks have rock, cobble and sand streambeds with intermittent silt deposits. Bed slopes are relatively gentle.

Cattle have considerable access to Peyton Creek from the head waters to near the mouth of the stream. Access to Frog Branch is more restricted. The Peyton Creek station where the continuously recording remote monitor is deployed had frequent cattle loafing during the pre-BMP period. The stream banks were scarred where access has been unrestricted (**Figure 4**).

Figure 4. Photos of Peyton Creek sampling station PC1 before BMPs were applied. From left to right on the top, photos taken on July 7, 2004 and August 26, 2004, respectively. From left to right on the bottom photos taken on August 24, 2005 and looking upstream from the sample station on the same date.

Based on data from the early to mid-1990's, land use in Peyton Creek is almost entirely pastureland (~5.5 square miles), with small areas of forest and residential development (**Figure 5**). All residences, in both Peyton Creek and Frog Branch are served by on-site wastewater treatment facilities commonly septic tanks that use leach fields for subsurface disposal of wastewater. There are currently no point source discharges in the Peyton Creek watershed.

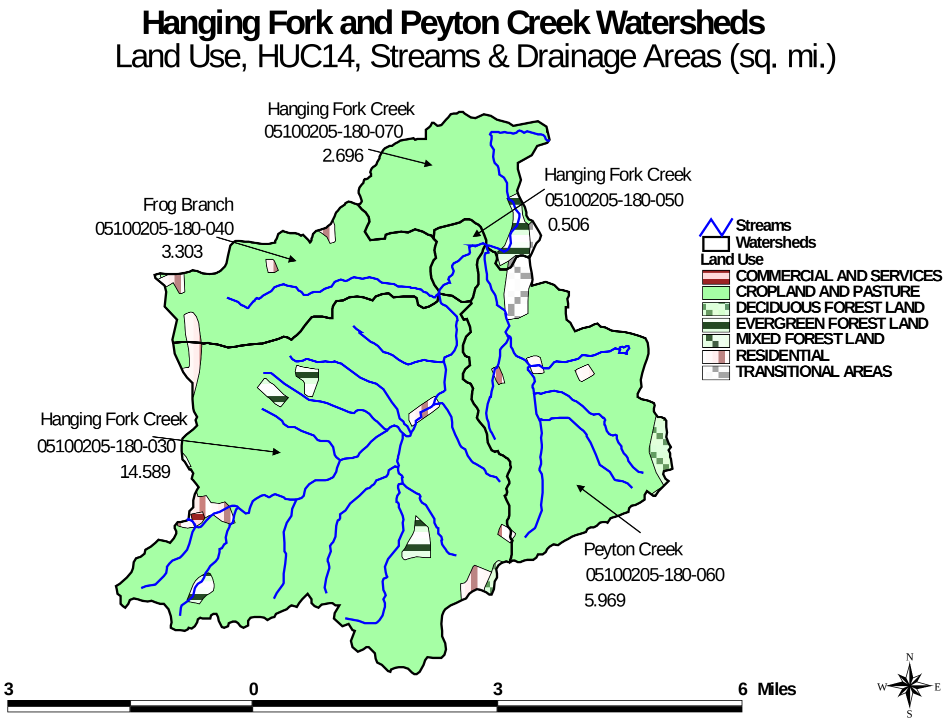

Figure 5. Landuse map of upper Hanging Fork watershed including Peyton Creek and Frog Branch.

Soils are relatively high in phosphorus and their erosion into the stream provides a relatively stable background source of phosphorus to both watersheds' surface drainage systems. Nitrogen is also generally available from soils and organic material being washed into the system.

2. Description of all methods used to obtain the results of the project.

Water Quality BMPs used as match and funded via the Kentucky Soil Erosion and Water Quality Cost Share Program were installed per the current *"Kentucky Soil Erosion and Water Quality Cost-Share Program Manual."* The manual, cites the regulation

> KRS 146.110-121, states the intent of the cost-share program, and describes the eligibility process, application process, selection criteria, operation and maintenance requirements, etc. These BMPs will be demonstrated in accordance with guidance provided by the Division of Conservation.

BMPs

The Peyton Creek watershed is heavily concentrated with farming operations. Most farms are comprised of full time farmers trying to get as much production from their land as physically possible. Resultant environmental problems addressed by this project include: cattle's free access to creeks, lack of fencing/rotational grazing systems, eroded crossings and feeding areas, lack of proper water management, overgrazing and improper stocking rate, poor pasture and hayland management, and soil erosion from cropping practices. See Appendix C and E.

The Best Management Practices and technologies, selected by the Watershed Coordinator, were oriented around reducing pathogens, nutrients, and sediment. The efforts were centered primarily on encouraging the adoption of rotational grazing systems, the development of alternative water supplies or providing limited stream access to cattle. The construction of well designed and sited animal feeding/waste storage areas was another primary objective.

Other BMPs that addressed the target pollutants were eligible for systems other than rotational grazing. Since this was a technology based demonstration project with primarily educational objectives, at least one farm needing several of the referenced BMPs was identified to facilitate demonstration of the BMPs by conducting two field days. BMPs were selected that met the needs of the operation while providing the best resource protection.

A BMP Implementation Plan (Appendix C) was developed along the lines of the one used in an adjacent 319 project – Spears Creek/Mocks Branch/Hanging Fork. A project Oversight Committee was formed at the onset comprised of local farmers from within the watershed, and agency personnel from NRCS, DOC, DOW, and the Conservation District.

During the winter of 2003 – 2004, the Watershed Coordinator sent out letters to all farmers in the watershed explaining the purpose and goals of this project. Interested farmers were asked to come in to develop a conservation plan that would address resource concerns in the Peyton Creek Watershed. Once all plans were completed, the Project Oversight Committee met to determine what BMPs should be targeted to get the most water quality benefit with the amount of funds available. Of the 30 active farms in the Peyton Creek watershed nearly 50% participated in improved landscape management.

BMPs were targeted to areas of the watershed that were identified as susceptible to producing water quality impacts. However, the ultimate selection of the BMP locations was based on producer interest. Selection of farms for BMP implementation was based on the following priority factors:

1. Conservation needs were identified by the Watershed Coordinator that would improve water quality and meet the needs of the cooperating farmer.
2. The ensuing educational benefits that could be realized through educational tours and on farm field days.
3. Cost share contributions from other programs (EQIP, State Cost Share, CRP).
4. Length or percentage of stream protected from unrestricted livestock access (higher percentages and greater lengths were a higher priority).
5. Overall cost of BMPs for rotational grazing systems per stream mile protected.

Some restrictions imposed on the implementation of BMPs included:

- Size of ponds were based on reasonable livestock watering needs. Additional costs associated with larger pond capacity were borne by the producer.
- Any BMP or system receiving funding under this program was reviewed for the potential to improve water quality. BMPs or systems that were primarily for improving production or efficiency of the producer's operation were not eligible for funding.

- Costs for alternative water supplies are only eligible if livestock are excluded from streams or other water bodies.

This project complements other federal funding programs under which specific BMP locations are protected under the Freedom of Information Act. Therefore, the cooperating Conservation District will maintain the specific location of BMPs. Specific location information for BMPs funded by this project, matching State Cost Share funds, and/or other funding programs (as appropriate) will be provided to DOC, at a minimum, by 14 digit HUC.

Water Quality Monitoring

Information from the "Peyton Creek Watershed Water Quality Report" is excerpted here to provide monitoring results through July, 2008. The final water quality report for the project is not due until September, 2009 after monitoring is complete

The water quality monitoring used in this project was implemented within a paired watershed design (Grabow and others 1998, 1999a, 1999b; Clausen and Spooner, 1993) using the Frog Branch watershed as the *control* and Peyton Creek as the *treatment* watershed. The paired watershed design was combined with pre-BMP and post-BMP monitoring in each watershed to provide a powerful tool for discerning water quality improvements. The statistical analysis of this sample design is often referred to as Before-After Control-Impact analysis (BACI: Murtaugh 2000; McDonald and others 2000; Conquest 2000; Benedetti-Cecchi 2001; Loftis and others 2001). This approach is one of the earliest and most popular approaches for evaluating BMPs (KDOW 1993; USEPA 1997; Spooner and others 1985).

The two watersheds have similar size, soils, topography, and landuse. Monitoring was conducted over a five year period, from 2004 through 2005. The first two-year interval (pre-BMP: 2004 – 2005) preceded or was in the early stages of BMP implementation. Monitoring was suspended in 2006 coinciding with the most active period of BMP implementation. The final 2 year period (post-BMP: 2007 – 2008) followed the majority of BMP implementations. More than 530,000 water quality data points have been collected to date in Peyton Creek and nearby Frog Branch since May, 2004.

Sampling Strategy

This project used a combination of continuously recording remote monitors and discrete-monitoring (also called grab-samples) to evaluate water quality (**Tables 2**) each of the two monitoring stations PC1 and FB1. The remote monitors provide a robust approach to reliably assess water quality criteria and dynamics for dissolved oxygen, pH and temperature. The latter approach produces generally less reliable data but is necessary to assess attributes of water quality that can't be evaluated with electronic probes.

The continuous monitors used in this project included probes to collect water quality data for the parameters shown in **Tables 2**. Data was logged on frequent time intervals (15 minutes). Because the time interval is so short, the monitors are considered "continuous". **Figure 6** provides a photograph of a continuous monitor deployed at the Frog Branch station.

Table 2. Water quality criteria and collection methods for monitoring program attributes

Parameter (Units)	Acute Criterion	Chronic Criterion	401 KAR 5:031 Subsection	Collection Method
Continuous monitoring attributes				
Dissolved Oxygen (DO) (mg/l)	≥ 4.0 instantaneous	≥5.0 daily avg.	4 (1)(e) 1	Continuous Monitor
% DO Saturation	NA	NA	NA	Calculated
pH (pH units) **(1)**	≥ 6.0 and ≤ 9.0	n/a	4 (1)(b)	Continuous Monitor
Temperature (°C) **(2)**	31.7	n/a	4 (1)(d)	Continuous Monitor
Specific Conductivity (SC) (uS/cm @ 25 °C)	NA	NA	NA	Continuous Monitor
Turbidity **(3)**	Narrative Criterion		2 (1)(a) & (c)	Continuous Monitor
Discrete monitoring attributes				
Total Solids (TS) (mg/l)	NA	NA	NA	Grab Sample
Total Dissolved Solids (TDS) (mg/l) **(3)**	Narrative Criterion		4 (1)(f)(1)	Calculated
Total Suspended Solids (TSS) (mg/l) **(3)**	Narrative Criterion		4 (1)(f)(2)	Grab Sample
Fecal Coliform (CFU/100 ml) **(4)**	**May 1 – Oct 31:** Geomean ≤ 200 FC/ 100 ml and ≤ 20% of samples ≤ 400 FC/ 100 ml		6 (1)(a)	Grab Sample
	Nov 1 – Apr 30: Geomean ≤ 1000 FC/ 100 ml and ≤ 20% of samples ≤ 2000 FC/ 100 ml			

Table 2 Notes:

(1) pH: in addition to these numerical criteria, 401 KAR 5:031, Section 4(1)(b) also specifies that pH shall not fluctuate more than 1.0 pH units over 24 hours. Unlike grab samples, continuous monitoring data will allow assessment of this aspect of the pH criterion.

(2) Temp: in addition to this numerical criterion, 401 KAR 5:031, Section 4(1)(d)(1) also specifies that the normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained. 401 KAR 5:031, Section 4(1)(d)(2) provides for site-specific temperature criteria.

(3) NTU: Nephelometric turbidity units. Narrative criteria for solids: Total dissolved solids shall not be changed to the extent that the indigenous aquatic community is adversely affected. Total suspended solids shall not be changed to the extent that the indigenous aquatic community is adversely affected. Turbidity: Surface waters shall not be aesthetically or otherwise degraded by substances that: (a) Settle to form objectionable deposits; (c) Produce objectionable color, odor, taste, or turbidity.

(4) Fecal Coliform: Geometric mean based on at least 5 samples in 30 days. Fecal coliform criteria are intended to protect human health and are applicable in waters designated for recreational use and apply May 1 through Oct. 31, with less stringent criteria applicable from Nov 1 through Apr. 30.

Figure 6. Photograph of continuous monitor deployed at the Frog Branch monitoring station FB1.

Discrete water samples were collected at both sampling locations and transported to Fouser Environmental Services, Ltd in Versailles, KY to be analyzed for fecal coliform bacteria, total solids, and total suspended solids.

The Surface Water Standards for fecal coliform require collection of 5 or more samples per month with samples analyzed within 6 hours for regulatory purposes. In this project, samples were collected twice per month, analyzed within 24 hours, and the data was used to evaluate pre-and post-BMP conditions. Therefore, fecal coliform data should not be used for regulatory purposes.

Figure 7. Discrete samples collected from Frog Branch monitoring station FB1.

On February 22, 2005 members of the Peyton Creek 319 project team met to discuss the 2004 sampling results as presented in the data report "Peyton Creek Data Report 2004" (CEG 2004). Results from the report indicated that continuous monitoring data provided reliable and interpretable information regarding Peyton Creek ecosystem function and watershed impacts. The data from the continuous monitors also demonstrated that Peyton Creek data could be reliably compared to Frog Branch (the control basin) data. This will make it possible for the Heritage RC&D to test the null hypothesis that the two watersheds have changed in the same direction at the same rate. Since best management practices (bmp) are being implemented in Peyton Creek but not in Frog Branch we expect that water quality should improve in Peyton Creek at a faster rate than in Frog Branch.

However, grab sample results did not exhibit the same level of reliability because of the small number of samples designed to be collected. Natural system variability in Peyton Creek and Frog Branch is large because both watersheds are small and relatively steep resulting in rapid response times to storm events. The physiography and demography of the watersheds combined with an abundant and metabolically active aquatic biota contribute to a dynamic watershed drainage system both in terms of water quantity and water quality.

To improve the utility and reliability of the grab sampling the CEG proposed to modify the program. The new program increased the number of samples collected at the stations fitted with the multi-probe monitors, Peyton Creek 1 (PC1) and Frog Branch 1 (FB1) and eliminated sampling at Peyton Creek 2 and Peyton Creek 3 and at Frog Branch 2. A proposal to modify the sampling plan was submitted by the Heritage RC&D on March 8, 2005. The modification was approved by letter from the KY Division of Water (KYDOW) on April 7, 2005.

The new sampling program proposed that 22 samples, for each of the three attributes, be collected per year at each station PC1 and FB1. In addition 3 QAQC samples for each attribute should be collected at each station.

Fifteen of the samples, at each station, were to be collected during five different storm events and seven samples were to be collected during non-storm flows. During each of the five storms 3 samples were to be collected for each attribute at each station. An effort was to be made to collect the samples during the rising limb of the storm flow, near the peak of the storm flow and during the receding limb of the storm flow. All protocols specified in the projects Quality Assurance Project Plan (QAPP) were followed.

Lack of precipitation during the 2005, 2007, and 2008 sampling periods made it impossible to achieve the distribution of samples specified in the amendment. All storms that occurred between May and October were sampled, however, there were only five storms and only 2 produced enough runoff to affect streamflow and justify sampling over the hydrograph. Instead of the 25 samples projected to be collected on average only 22 samples were collected because of dry conditions.

Data Analysis

Several approaches were used to assess the large amount of data generated by the monitoring program including; empirical modeling, statistical techniques, and summaries of data relative to water quality standards. The Surface Water Standards (401 KAR

5:031) were used to provide the "yardstick" for evaluating BMP performance for three important water quality criteria, water temperature, dissolved oxygen, and pH. Surface Water Standards have been adopted in Kentucky to protect human health and aquatic life from the adverse effects of water pollution.

The designated uses of Kentucky streams are described in 401 KAR 5:026. Streams in the Peyton Creek watershed are classified as warm water aquatic habitat and primary contact for recreational uses. Numerical and narrative water quality criteria relevant to this project are found at 401 KAR 5:031, Section 2 (Minimum Criteria), Section 4 (Aquatic Life) and Section 6 (Recreational).

Empirical Modeling

The paired watershed design was combined with pre-BMP and post-BMP monitoring in each watershed to provide a powerful tool for discerning water quality improvements. The statistical analysis of this sample design is often referred to as Before-After Control-Impact analysis. An empirical relationship, using ordinary least squares (OLS) regression, was established for five water quality attributes of the pre and post-BMP data. After the pre-BMP period, BMPs were implemented in the Peyton Creek watershed only. Both watersheds were then subsequently monitored. Watershed responses are compared with those predicted by the regression equations (in the general form of **Equation 1**) to determine if the BMPs had an effect, (Grabow and others 1998; Schilling and others 2002; Dillaha 1990).

$$Y_t = b_0 + b_1X_t + b_2X_e + b_3 X_t X_e + e_t \quad \textbf{Equation 1}$$

where:

Y_t = water quality time series from Peyton Creek
X_t = water quality time series from Frog Branch
X_e = indicator variable such that $X_e = 0$ are the pre-BMP dates and $X_e = 1$ are the post-BMP dates
e_t = unexplained or residual error
b_0, b_1, b_2, & b_3 = regression coefficients representing intercept and slope, respectively.

Model residuals were analyzed to assure that the basic assumptions of regression analysis were not violated. Two key assumptions, the independence of the residuals and their normal distribution are critical.

The Durbin-Watson D statistic was used to compute the 1st-order autocorrelation for the variables of interest and to test if the autocorrelation is zero. A D value near 2 indicates that errors are uncorrelated.

Two methods are used to evaluate the assumption of normality. Graphically, histogram plots of the residuals provide a valuable visual assessment of the variables distribution. The histogram of the data has a model of normal data superimposed.

A numerical technique, the Kolmogorov-Smirnov One Sample Test (K-S), is also used to provide an additional tool to evaluate normality. K-S is a nonparametric test of equality of one-dimensional probability distributions. The technique calculates a maximum distance between the empirical distribution function of the sample and the cumulative distribution function of the reference distribution. The statistic is calculated under the null hypothesis that the sample is drawn from the reference distribution.

Education

A field day sponsored by the Lincoln County Conservation District (LCCD) was held at Lowell Atwood's farm during the summer of 2007. A brochure was developed (Appendix D) and distributed to surrounding offices, local feed stores, farm stores, Extension Service offices, and mailings. The field day was held on September 20, 2007 with approximately 150 persons in attendance. The activities included four stops. Attendees were transported over the farm on hay wagons. The stops included discussions on the following topics: Cattle Handling Facilities, Nutrient Management, Conservation Practices, Water Quality Monitoring, and Nonpoint Source Pollution.

The LCCD hosted a second Field Day in the Peyton Creek Watershed again at Lowell Atwood's farm on Thursday September 18, 2008 from 10:00 am to noon. The Field Day was attended by FFA students from the Lincoln County High School as well as local farmers and local, state and federal personnel.

3. Description of Specialized Materials

Water Quality Monitoring

An overview of continuous monitors is provided here because this type of sampling is significantly different from typical monthly or quarterly sampling (i.e., grab sampling) used to characterize water quality.

The continuous monitors used in this project included probes (**Figure 8**) to collect water quality data for the parameters shown in **Table 3**. Data were logged on frequent time intervals of 15 minutes. Because the time interval is so short, the monitors are considered "continuous".

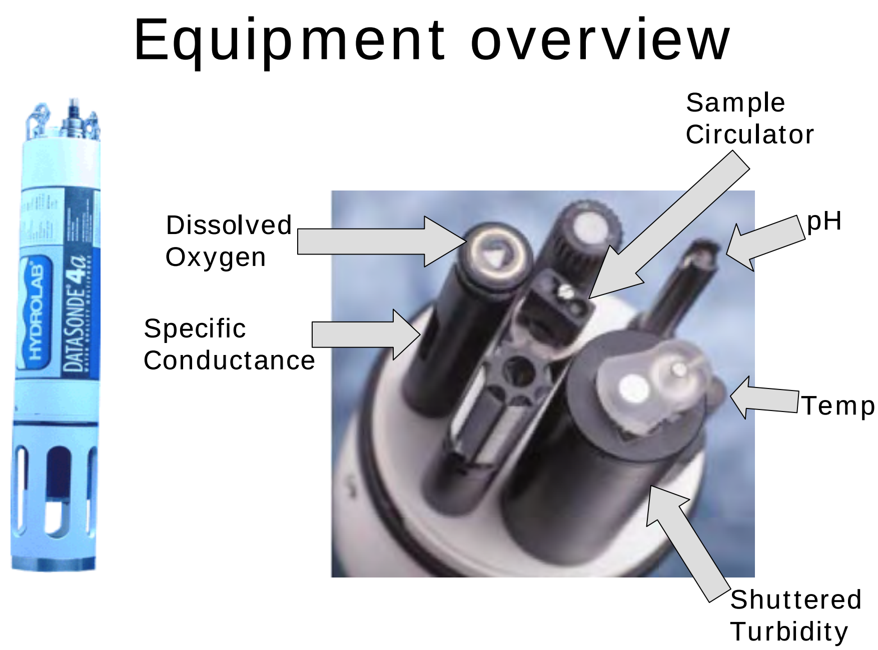

Figure 8. Overview of one of the continuous monitors that was deployed during this project.

Table 3. Continuous monitoring parameters used in this study and their STORET code numbers.

STORET #	Description
00010	Water Temperature (°Celsius)
00300	Dissolved oxygen (mg/l)
00301	Dissolved oxygen (% saturation)
00400	pH - Water, Whole, Field, Standard units
00095	Specific Conductance (micro-siemens /cm @ 25 °C)
00076	Turbidity (NTU)

Approximately 35,040 data for each parameter may be collected over 1 year with data logged every 15 minutes. For this study data was to be collected for a six month interval (@17,520 datapoints) for each of four years. The 15 minute data were then aggregated to hourly intervals by using the average of the four 15-minute data. The resulting target was @4,380 hours of data per year for each of four years. A total of @17,520 hours of data were expected to be collected. When coupled with precipitation data and gage height or other measures of flow, continuous water quality monitors provide resource managers with a very robust dataset to characterize water quality changes and processes in detail through the seasons and through many flow regimes. It may be useful to think of continuous monitors as a "water quality video camera", while collecting grab samples is similar to using a still camera with a timer. Continuous monitors provide data that can be used to clearly evaluate average and instantaneous DO and identify episodes of DO criteria violations that may not have been found using traditional sampling methods.

Although only a few water quality characteristics can be monitored at this frequent time scale, the monitored parameters can be especially important from both a scientific and regulatory perspective. The increased sensitivity of continuous monitoring will highlight water quality changes related to storm events, changes in land use practices and other impacts such as spills, sewer overflows, or bypasses.

It is important to note that continuous monitors require diligent calibration and servicing to minimize problems associated with probe drift, fouling and interference. In addition, management, analysis and interpretation of the large databases produced by continuous monitors present new challenges. Probes are also available to collect chlorophyll a, ammonia-nitrogen and other parameters. However, data quality may be lower with the probes currently available for these parameters and are not used in this study.

Hydrolab Series 4a, 4x, and 5x Data Sondes were used for this project. Additional information regarding these monitors is available at http://www.hydrolab.com. Detailed procedures for continuous monitors are provided in USGS Water-Resources Investigations Report 00-4252 Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. (Wagner and others, 2000).

Results and Discussion

The management of the Peyton Creek watershed landscape to protect water quality has been advanced with the operation of this project. Watershed management practices coupled with water quality monitoring have not only reduced sources of pollutants in the watershed but have made local landowners aware of the actions they can take to improve their environment and maintain profitability.

BMP

BMP installation was very successful in Peyton Creek requiring additional funding to meet the needs of the watershed's farmers. Twelve of the 30 active farmers in the watershed participated in the implementation of one or more management practices.

Eleven different practices were installed to meet the management objectives described above. Nearly 9,000 feet of fencing was installed in the watershed restricting access to Peyton Creek. This along with 18 tanks and more than 17,000 feet pipeline has provided significant protection for the Peyton Creek and has maintained the farmer's profitability (**Table 4**). Nearly 63,000 square feet of improvements to heavy use areas along with over 3 acres of critical area treatment and eight animal waste storage facilities has reduced erosion and the runoff of manure laden soils significantly. Nearly 150 acres of prescribed grazing and flash grazing has been introduced into the watershed further protecting the Peyton Creek from extensive animal loafing and destruction of important riparian areas.

The overwhelming majority of BMPs were implemented upstream of the water quality monitoring station PC1. Photographs of some of the BMPs are provided in **Appendix D**.

Table 4. Quantification of the BMPs installed in the Peyton Creek watershed between 2005 and 2008.

BMP (units)	NRCS Practice Code	Results	HUC 14	Lat/Long	Watershed Name
Animal Waste Storage (#)	313	8	05100205180060	NA*	Peyton Creek
Fence (Linear feet)	382	8,800	05100205180060	NA	Peyton Creek
Critical Area Treatment (# of Acres.)	342	3	05100205180060	NA	Peyton Creek
Heavy Use Area ($Feet^2$)	561	62,800	05100205180060	NA	Peyton Creek
Pipeline (Linear feet)	516	17,318	05100205180060	NA	Peyton Creek
Tank (#)	614	18	05100205180060	NA	Peyton Creek
Spring Developments (#)	574	1	05100205180060	NA	Peyton Creek
Pasture & Hayland seeding (Acres)	512	268	05100205180060	NA	Peyton Creek
Prescribed Grazing (Acres)	528A	103	05100205180060	NA	Peyton Creek
Flash Grazing (Acres)		43	05100205180060	NA	Peyton Creek
Stream Crossings (#)	576	2	05100205180060	NA	Peyton Creek

* NRCS cannot provide these locations because they are protected by the Freedom of Information Act (FOIA).

Water Quality Results

The following information is excerpted from the projects Water Quality Report which is a work in progress and is not due until September, 2009 after sampling is complete. The following is a summary of findings to date but is necessarily incomplete.

The Hanging Fork Watershed, including Peyton Creek and Frog Branch, were subject to severe drought conditions during the 2005, 2007, and 2008 sampling periods. Loss of flow and stagnant water conditions developed by late July in each of the three years and the creeks were completely dry for much of August, September, and October of each year. Rainfall data from the USGS station 03285000 on the Dix River near Danville, KY and upstream of Herrington Lake is presented in **Figure 9**.

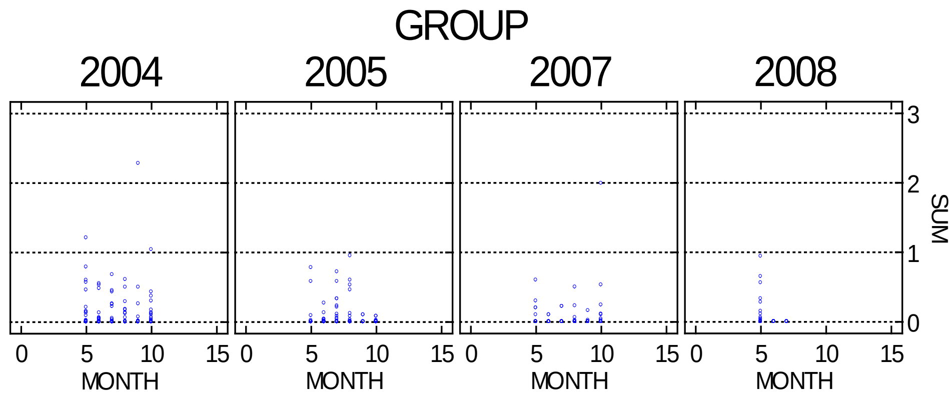

Figure 9. Precipitation plots for the months May through October for the years 2004 through 2008. The data was collected at the USGS station 03285000 on the Dix River near Danville, KY. This data is provisional.

Figure 10 depicts the monthly flow conditions at the USGS station on the Dix River for the drought years relative to the wetter years; 2003 – 2004, and 2006.

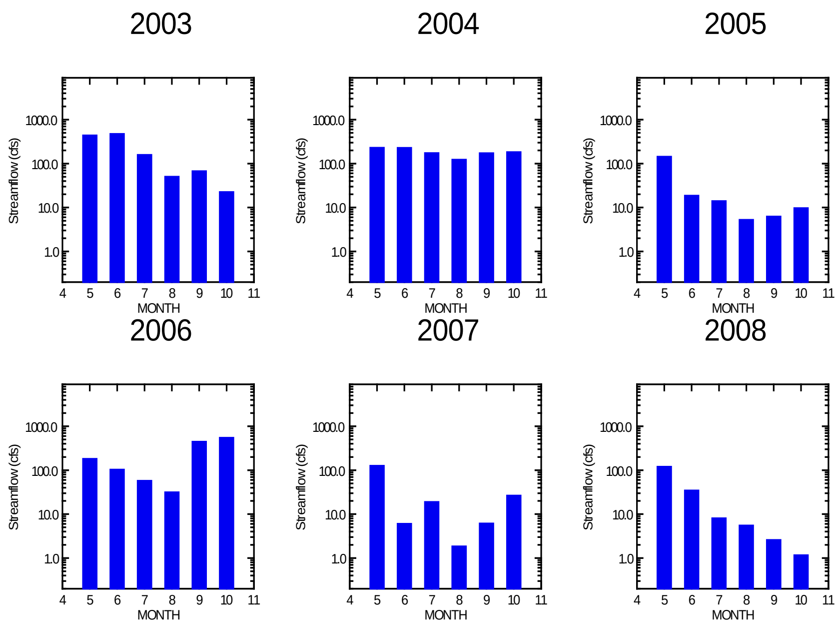

Figure 10. Monthly streamflow May through October at the USGS station 03285000 on the Dix River for the interval 2003 through 2008.

Dry periods such as these are often cited as justification for the need for longer term sampling (Richards 2008).

Quality Assurance and Quality Control Measures

Several approaches were used to ensure the quality of the data collected in this effort. The Quality Assurance Project Plan is attached with this submission; however, the results of the analyses of the Quality Assurance / Quality Control (QAQC) data will be presented in detail in the Peyton Creek Water Quality report. A summary of the components of that effort is presented below. Table 5 presents the Data Quality Objectives (DQOs) of the project. While most of the DQOs were met with the large majority of the data some data were outside the range of acceptability and were purged from the database. Description of the processes used in that effort will be elaborated on in the Peyton Creek Water Quality report.

Table 5. Data Quality Objectives (DQO) for monitoring program attributes.

Parameter (Units)	MDL/ Range	Accuracy	Precision/ Resolution
Continuous monitoring attributes			
Dissolved Oxygen (DO) (mg/l)	0 to 20 mg/L	±0.2	0.01 mg/L
% DO Saturation			
pH (pH units)	0 to 14	±0.2	0.01 units
Temperature (°C)	-5 to 50	±0.15	0.01°C
Specific Conductivity (SC) (uS/cm @ 25 °C)	0 to 100 uS/cm	±0.5% of range	4 digits
Turbidity	0 to 1000 mg/L	The greater of ± 5 % or 2 NTU	
Discrete monitoring attributes			
Total Solids (TS) (mg/l)	10 – 20,000 mg/L	NA	±30%
Total Dissolved Solids (TDS) (mg/l)	10 – 20,000 mg/L	NA	±30%
Total Suspended Solids (TSS) (mg/l)	4 – 20,000 mg/L	91%	±6%
Fecal Coliform (CFU/100 ml)	1 – 10^6 CFU/100 ml	±50%	±10%

Precision is a measure of variance between duplicate samples (i.e., are measurements reproducible?). Precision is often expressed as relative percent difference (RPD) between duplicates. **Table 6** presents a summary of the data collected for the continuous monitors. The data in the table are differences between the field meter and the standard meter used for comparison. The data was collected by deploying the standard meter beside the field meter for up to two hours at the beginning of a deployment and then again at the end of the deployment usually about two weeks. The meters logged 15-minute data from the same environment. At the beginning of a deployment both meters have been cleaned and calibrated and should read approximately the same. At the end of the deployment fouling and/or drift may affect the field meter and it may read different from the standard meter which has been recently cleaned and calibrated. For practical purposes the calculation of the residuals is done by subtracting the standard meter value from the field meter value. If the field meter is underestimating the true value of the water quality attribute the resulting residual value is negative if it is overestimating the true value the residual is positive.

Table 6. Summary statistics of the precision data collected for the four continuous monitors used in this study.

Statistic	Water Temperature	Dissolved Oxygen	pH	Turbidity	Specific Electrical Conductance
	Celsius	mg/l	su	ntu	microsemiens
Peyton Creek					
N of cases	630	626	630	630	630
Minimum	-0.2	-4.4	-0.2	-26.3	-52.0
Median	0.0	-0.6	0.1	-0.3	-8.4
Mean	0.0	-0.4	0.1	9.1	-7.3
Maximum	0.3	2.7	0.8	76.1	10.0
C.V.	1.816	-1.772	1.708	3.090	-1.525
Frog Branch					
N of cases	646	622	646	646	646
Minimum	-0.1	-6.8	-0.3	-26.3	-26.8
Median	0.1	-0.7	0.1	11.8	-5.9
Mean	0.1	-0.5	0.1	19.3	-5.2
Maximum	0.3	7.0	0.6	99.6	14.0
C.V.	1.269	-3.221	1.779	1.598	-1.744

Accuracy is a measure of the ability to correctly determine concentration. The target accuracy of continuous monitors is established by the manufacturer and evaluated in the field through relative percent difference (RPD) of pre- and post-calibration readings.

Representativeness expresses the extent to which the analytical data reflect the actual media at the site. Representativeness was evaluated using best professional judgment (BPJ) with respect to general sample management issues including sample documentation, preservation, handling and transport as well as a discussion of representativeness with respect to analytical-method specific issues such as method deviations. The data collected to date is judged to be of high quality and represents the FB1 and PC1 stations adequately.

In order to obtain representative data from grab samples, the monitoring program attempted to emphasize storm events; 70% of samples were to be collected under elevated flow conditions and 30% were to be baseflow samples. However, as has been discussed above severe drought conditions during the 2005, 2007, and 2008 sampling periods made accomplishment of this goal impossible.

Completeness is a measure of the amount of usable data; field and laboratory completeness will be evaluated separately. Completeness may be reduced by flow conditions in the streams, field equipment failure, exceedence of holding times, broken sample containers, etc. The completeness DQO for sample collection was 90%; for laboratory analyses, the completeness DQO was 95% and for the continuous monitors 90%. Completeness objectives were not met because of drought conditions resulting in a loss of flow for much of the summers in 2005, 2007, and 2008. **Table 7** presents the percentage of data collected

Table 7. Completeness data calculated as the number of samples collected divided by the number of samples expected to be collected.

Attribute	Peyton Creek	Frog Branch
Water Temperature (c)	64%	65%
Dissolved Oxygen (mg/l	60%	65%
pH (su)	64%	65%
Turbidity (ntu)	53%	65%
Specific Electrical Conductance (microsemiens)	64%	65%
Total Solids (mg/l)	49%	42%
Total Suspended Solids (mg/l)	49%	42%
Fecal Coliform bacteria (cfu/100 ml)	50%	44%

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability of the sampling and analytical programs was evaluated separately.

Sampling comparability was evaluated based on the following:

- A consistent approach to sampling was applied throughout the program;
- Sampling was consistent with established methods for the media and analytical procedures;
- Samples were properly handled and preserved.

Analytical comparability was evaluated based upon the following:

- Consistent methods for sample preparation and analysis;
- Sample preparation and analysis was consistent with specific method requirements;
- The analytical results for a given analysis were reported with consistent detection limits and consistent units of measure.

All of the above criteria were me for both the discrete and continuous monitoring programs.

Continuous monitoring

A brief summary of some of the key findings to date are presented below. More details will be provided in the Peyton Creek Water Quality report. Table 8 provides a summary of the water quality attributes remotely monitored at high frequencies (15-minute time intervals) in each watershed and divided into pre-BMP and post-BMP intervals. Inter-annual differences in weather can potentially account for most differences observed in the water quality data between the intervals obscuring the impacts of the BMPs installed in the watershed.

Water temperatures were higher in the post-BMP interval and as presented above conditions were also much dryer. Mean and median dissolved oxygen levels were lower in both Peyton Creek (*treatment*) and in Frog Branch (*control*) watersheds. The variability of both dissolved oxygen and pH, as presented by the coefficient of variation (C.V.), is greater in both watersheds. This variability of these attributes, especially given the large number of data, often indicates greater metabolic activity in the stream system suggesting that nutrients are still abundant in the stream networks. Turbidity is also higher in both watersheds even with lower flow suggesting a biogenic source.

Table 8. Summary of the continuous monitoring data divided into pre-BMP and post BMP periods.

	Water Temperature (Celcius)		Dissolved Oxygen (mg/l)		pH (su)		Specific Electrical Conductance (microsemiens		Turbidity (ntu)	
	pre-BMP	post-BMP	pre-BMP	post-BMP	pre-BMP	post-BMP	pre-BMP	post-BMP	pre-BMP	post-BMP
Peyton Creek										
N of cases	9,054	4,809	8,707	4,397	9,107	4,805	9,103	4,809	8,450	3,470
Minimum	0.0	4.0	0.0	0.1	6.8	7.1	0	16	0	0
Median	20.5	22.5	7.8	6.1	8.0	7.8	389	394	36	130
Mean	17.6	21.6	7.6	6.4	8.0	8.0	389	404	71	258
Maximum	35.4	34.8	20.0	20.0	9.9	9.4	935	607	1,610	3,000
C.V.	0.49	0.29	0.60	0.72	0.05	0.06	0.30	0.17	1.84	1.48
Frog Branch										
N of cases	9,426	4,864	9,268	4,863	9,426	4,864	9,249	4,864	9,298	4,859
Minimum	0.4	2.7	0.0	0.7	6.8	7.2	3	16	0	0
Median	20.4	21.3	8.2	5.8	8.0	7.9	354	368	22	31
Mean	17.2	19.8	8.6	6.6	7.9	7.9	343	371	43	97
Maximum	30.8	29.1	49.8	19.0	9.4	16.1	517	517	905	2,779
C.V.	0.48	0.28	0.52	0.55	0.04	0.06	0.21	0.16	1.57	2.51

Three of the attributes measured are regulated under 401 KAR 5:031 Section 4 Aquatic Life as warmwater aquatic habitat. The regulated attributes are water temperature, dissolved oxygen, and pH. Analysis of the data indicated there were 94 violations of the 31.7 c water temperature threshold, all in Peyton Creek, compared to none in 2004. There are two criteria for dissolved oxygen, chronic and acute. The chronic criterion requires that daily (24 hour) averages cannot be less than 5.0 mg/l while the acute standard states that the waterbody cannot at any time have dissolved oxygen levels below 4.0 mg/l.

Based on the hourly data in Peyton Creek (PC1) there were 142 days in violation of the acute dissolved oxygen standard in the pre-BMP period (May through October; 2004 – 2005) this amounted to 52% of the days sampled for dissolved oxygen. In the post-BMP period (2007 – 2008) dissolved oxygen conditions worsened, 69% of the 189 days sampled were in violation of the acute dissolved oxygen standard. Also in Peyton Creek there were 102 days (37% of the days sampled for dissolved oxygen) in violation of the chronic dissolved oxygen criterion in the pre-BMP years 2004 and 2005. In the post-

BMP interval (2007 – 2008) dissolved oxygen conditions improved slightly with 56 days or 30% of the day's sampled being in violation.

In Frog Branch (FB1) there were 65 days (23% of the time) in violation of the acute dissolved oxygen standard in the pre-BMP period (2004 – 2005) versus 82 days (40% of the time) in the post-BMP period (2007 – 2008). There were 61 (22%) days with chronic violations at FB1 in the pre-BMP years versus 63 (31%) days in the post-BMP interval.

There were no pH violations below pH=6 at any time at either location during the four years of sampling. However, there were 18 days (6.5%) with pH > 9 at PC1 in 2004 - 2005 versus 28 days (13.7%) with exceedences in the post-BMP interval. At FB1 there was 1 day (0.4%) with a pH value greater than nine during the pre-BMP period but that increased to 21 days (13.7%) in the post-BMP period. All of these violations appear to be associated with photosynthesis and respiration not influent materials other than plant nutrients. There were no violations of the 1 standard unit changes in 24 hour criterion for either stream.

Discrete Sampling Program

The discrete sampling program was severely affected by the dry conditions experienced in the watershed in 2005, 2007, and 2008. The objective of the program was to collect 70% of the samples during storm events. However, the storms didn't materialize. Several sampling trips, each year were made to the watershed in anticipation of wet weather yet very few expectations were met. The complete loss of flow in Peyton Creek was also unexpected. Local farmers, including Mr. Paul Jeffries, have stated that these are some of the driest conditions they have experienced. In hindsight, more samples might have been collected in May or June when flows were stable. However, as can be seen from the 2003, 2004 and 2006 years it was difficult to anticipate the extreme summer dryness.

Table 9 summarizes the discrete sampling data by watershed and relative to BMP installation. Considerable decreases in all of the solids components and fecal coliform bacteria, in the *treatment* watershed Peyton Creek, may be accounted for by the reduced flow conditions of the post-BMP interval. Similar reductions were observed in the *control* watershed, Frog Branch, although average fecal coliform concentrations increased mainly as a function of the higher maximum values observed. The median value exhibited a decrease similar to the treatment watershed.

An analysis of the fecal coliform bacteria, total solids, and total suspended solids data using the methods of Grabow and other (1998) is excerpted here and will be presented in more detail in the Peyton Creek Water quality report.

Table 9. Summary statistics of the discrete sampling effort. The values outside the parentheses are pre-BMP data and inside the parentheses are post-BMP data.

	Total Solids (mg/l)	Total Suspended Solids (mg/l)	Total Dissolved Solids (mg/l)	Fecal Coliform bacteria (cfu/100 ml)
Peyton Creek				
N of cases	31 (14)	31 (14)	31 (14)	31 (15)
Minimum	29 (208)	1 (1)	28 (168)	880 (70)
Median	288 (269)	25 (10)	263 (243)	9,690 (1,100)
Mean	628 (322)	289 (63)	339 (259)	15,273 (10,765)
Maximum	5,498 (607)	3,580 (397)	1,918 (414)	85,500 (120,000)
C.V.	1.65 (0.37)	2.49 (1.77)	1.00 (0.28)	1.18 (2.85)
Frog Branch				
N of cases	27 (15)	27 (15)	27 (15)	28 (15)
Minimum	167 (204)	1 (1)	159 (196)	60 (200)
Median	243 (234)	13 (7)	232 (215)	2,280 (1,260)
Mean	263 (245)	37 (14)	225 (231)	4,636 (24,251)
Maximum	832 (300)	596 (45)	264 (299)	51,700 (120,000)
C.V.	0.45 (0.14)	3.02 (1.00)	0.12 (.15)	2.07 (1.96)

Fecal coliform bacteria

Forty-six reliable fecal coliform bacteria samples were collected during the four years of sampling. The full model for fecal coliform bacteria ($\log_{10}$ transformed) is presented as **Equation 2**

$Y_t = 3.88 + 0.03X_t + -3.03X_e + 0.63\, X_t\, X_e$ **Equation 2**

where:

$Y_t =$ fecal coliform bacteria ($\log_{10}$ transformed) from Peyton Creek
$X_t =$ fecal coliform bacteria ($\log_{10}$ transformed) from Frog Branch
$X_e =$ indicator variable such that $X_e = 0$ are the pre-BMP dates and $X_e = 1$ are the post-BMP dates

$b_0, b_1, b_2, \& \ b_3 =$ regression coefficients.

The statistical analysis of the model is presented below. The model coefficients indicate that the model for the calibration period is represented by **Equation 3**

$Y_t = 3.88 + 0.03X_t$ **Equation 3**

Equation 4 represents the treatment period

$Y_t = 3.88 + -3.03 + (0.03+0.63)\, X_t$ **Equation 4**

```
Dep Var: Yt   N: 40   Multiple R: 0.7435   Squared multiple R: 0.5529

Adjusted squared multiple R: 0.5156   Standard error of estimate: 0.5305
```

Effect		Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	(b_0)	3.8761	0.7357	0.0000	.	5.2687	0.0000
X_t	(b_1)	0.0288	0.2224	0.0259	0.3096	0.1294	0.8978
X_e	(b_2)	-3.0325	0.9061	-1.8870	0.0391	-3.3467	0.0019
X_t*X_e	(b_3)	0.6270	0.2681	1.4041	0.0345	2.3385	0.0250

Effect	Coefficient	Lower < 95%>	Upper
CONSTANT	3.8761	2.3841	5.3682
X_t	0.0288	-0.4223	0.4799
X_e	-3.0325	-4.8702	-1.1948
X_t*X_e	0.6270	0.0832	1.1708

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	12.5293	3	4.1764	14.8376	0.0000
Residual	10.1332	36	0.2815		

The Durbin-Watson D statistic indicates that the model errors are uncorrelated. The Durbin-Watson D statistic for the residuals of the model equals 1.766 which is close enough to 2.00 and the First Order Autocorrelation (0.104) is close enough to 0.00 that autocorrelation does not appear to be a problem for the model.

The maximum difference as computed by the K-S test of the fecal coliform bacteria model is 0.1825 with a 2-tailed probability (P) of 0.1394. P is significantly larger than an alpha of 0.05 suggesting that the null hypothesis that the sample could have been drawn from a normal reference distribution should not be rejected. The graphical assessment supports the assumptions that the residuals are normally distributed (**Figure 11**).

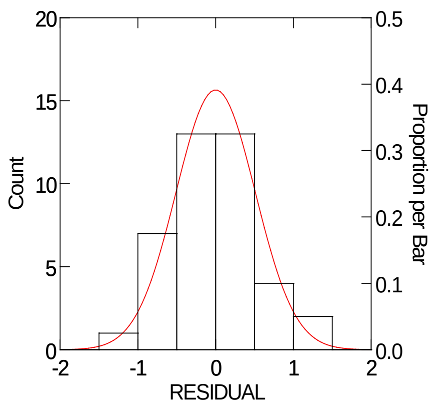

Figure 11. Histogram of the model residuals and kernal smooth for the normal distribution.

The P value of the b_2 coefficient (0.0019) indicates that there is a statistically significant difference in the y-intercepts of the calibration period and the treatment period. The b_2 coefficient -3.0325 reveals the magnitude of the difference with the negative sign indicating that the intercept of the treatment period is lower than the calibrations period documenting that Peyton Creek had a decrease in fecal coliform bacteria relative to Frog Branch.

The P value of the b_3 coefficient (0.0250) indicates that there is a statistically significant difference in the slopes of the regression models. The slope of the treatment model ($b_3 = 0.6270$) is greater by 0.6270 log units than that of the calibration model. The positive nature of the coefficient indicates that the difference is more prominent at lower levels of fecal coliform bacteria than at the higher levels.

The average difference for the 'full' model was derived by setting X_t = average of all the Frog Branch fecal coliform data (both calibration and treatment periods). This value can be found from the results as equal to 3.34 $\log_{10}$ fecal coliform bacteria units. Substituting this value for X_t in **Equations 5** and **6** results in the following functions:

Equation 5 represents the calibration period

$Y_{tc} = 3.88 + 0.03*3.34$ **Equation 5**

$Y_{tc} = 3.98$

Equation 6 represents the treatment period

$Y_{tt} = 3.88 + -3.03 + (0.03+0.63)\ 3.34$ **Equation 6**

$Y_{tt} = 3.05$

Equation 7 can be used to estimate the percent decrease of fecal coliform bacteria in Peyton Creek relative to the control watershed Frog Branch.

$1-(10^{Ytt}/10^{Ytc})$ **Equation 7**

substituting results in $1-(10^{3.05}/10^{3.98}) = 0.88$ or an 88% reduction.

A very powerful graphical nonparametric tool reveals the same basic conclusion reached by the statistical model. **Figure 12** indicates that fecal coliform bacteria concentrations were significantly lower in the post-BMP period in Peyton Creek than in the pre-BMP period. Differences in the control watershed, Frog Branch were not significant between the two periods.

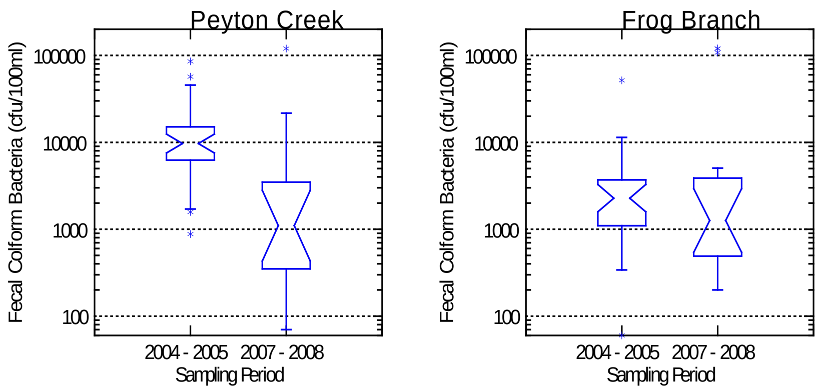

Figure 12. Notched box plots depicts the difference between the pre-BMP and post-BMP sampling intervals for both watersheds.

Total solids

Thirty-nine pairs of reliable total solids samples were collected during the four years of sampling. Using the log (base 10) transformed data did not produce a reliable model total solids. However, use of the untransformed data in the model produced even more unreliable results.

The full model for total solids ($\log_{10}$ transformed) is presented as **Equation 8**

$Y_t = -0.8607 + 1.4324X_t + -1.3516X_e + 0.5277\ X_t\ X_e$ **Equation 8**

where:

$Y_t =$ total solids ($\log_{10}$ transformed) from Peyton Creek
X_t = total solids ($\log_{10}$ transformed) from Frog Branch
X_e = indicator variable such that $X_e = 0$ are the pre-BMP dates and $X_e = 1$ are the post-BMP dates

$b_0, b_1, b_2, \& \ b_3$ = regression coefficients.

The statistical analysis of the model is presented below. The model coefficients indicate that the model for the calibration period is represented by **Equation 9**

$Y_t = -0.8607 + 1.4324X_t$ **Equation 9**

Equation 10 represents the treatment period

$Y_t = -0.8607 + -1.3516 + (1.4324+0.5277)\ X_t$ **Equation 10**

```
Dep Var: Yt    N: 39    Multiple R: 0.4575    Squared multiple R: 0.2094

Adjusted squared multiple R: 0.1416    Standard error of estimate: 0.3281
```

Effect		Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	(b_0)	-0.8607	1.2872	0.0000	.	-0.6687	0.5081
X_t	(b_1)	1.4324	0.5357	0.4208	0.9124	2.6740	0.0113
X_e	(b_2)	-1.3516	4.3791	-1.7848	0.0007	-0.3087	0.7594
X_t*X_e	(b_3)	0.5277	1.8314	1.6656	0.0007	0.2882	0.7749

Effect	Coefficient	Lower < 95%>	Upper
CONSTANT	-0.8607	-3.4738	1.7524
X_t	1.4324	0.3449	2.5198
X_e	-1.3516	-10.2416	7.5384
X_t*X_e	0.5277	-3.1901	4.2456

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	0.9975	3	0.3325	3.0892	0.0396
Residual	3.7673	35	0.1076		

The Durbin-Watson D statistic indicates that the model errors are uncorrelated. The Durbin-Watson D statistic for the residuals of the model equals 1.384 which is close enough to 2.00 and the First Order Autocorrelation (0.306) is close to 0.00 but autocorrelation may be a slight problem for the model.

The maximum difference as computed by the K-S test of the fecal coliform bacteria model is 0.4065 with a 2-tailed probability (P) of 0.0000. P is significantly smaller than an alpha of 0.05 suggesting that the null hypothesis that the sample could have been drawn from a normal reference distribution should be rejected. The graphical assessment supports the assumptions that the residuals are not normally distributed (**Figure 13**).

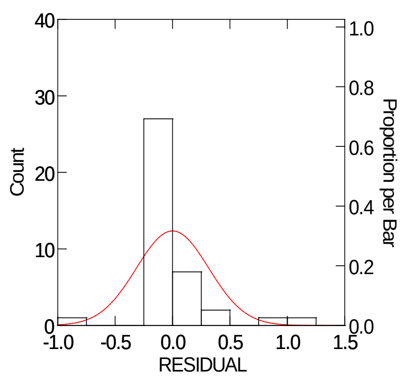

Figure 13. Distribution of residuals relative to the normal distribution. The fit is not as good as for the fecal coliform bacteria data but is still acceptable.

The P value of the b_2 and b_3 coefficients (0.7594 and 0.7749 respectively) indicates that there are not statistically significant differences in the y-intercepts or slopes of the calibration period and the treatment period. Consequently, evaluation of the coefficients is not advisable.

A very powerful graphical nonparametric tool reveals the same basic conclusion reached by the statistical model. **Figure 14** indicates that total solids concentrations were significantly lower in the post-BMP period in Peyton Creek than in the pre-BMP period. Differences in the control watershed, Frog Branch were not significant between the two periods.

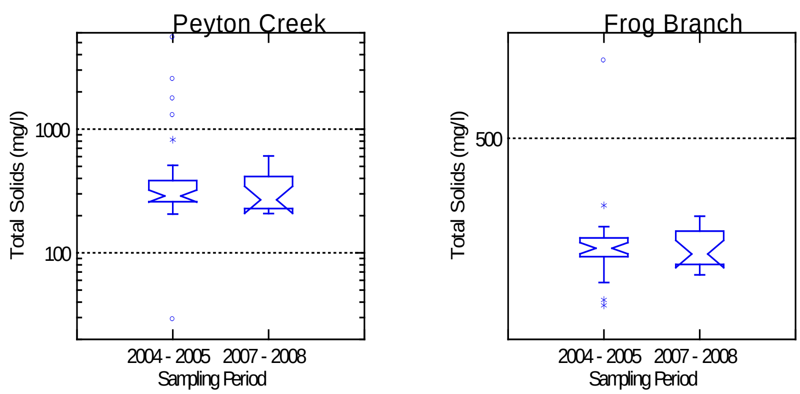

Figure 14. Notched box plots depict the difference between the pre-BMP and post-BMP sampling intervals for both watersheds.

Total suspended solids

Forty-six reliable total suspended solids samples were collected during the four years of sampling.

The full model for total suspended solids (log_{10} transformed) is presented as **Equation 11**

$Y_t = 0.8417 + 0.7340X_t + -0.6819X_e + 0.1920\ X_t\ X_e$ **Equation 11**

where:

$Y_t =$ total suspended solids (log_{10} transformed) from Peyton Creek
X_t = total suspended solids (log_{10} transformed) from Frog Branch
X_e = indicator variable such that $X_e = 0$ are the pre-BMP dates and $X_e = 1$ are the post-BMP dates

$b_0, b_1, b_2, \& b_3$ = regression coefficients.

The statistical analysis of the model is presented below. The model coefficients indicate that the model for the calibration period is represented by **Equation 12**

$Y_t = 0.8417 + 0.7340X_t$ **Equation 12**

Equation 13 represents the treatment period

Y_t = 0.8417 + -0.6819 + (0.7340+0.1920) X_t **Equation 13**

Dep Var: Y_t N: 39 Multiple R: 0.5792 Squared multiple R: 0.3354

Adjusted squared multiple R: 0.2785 Standard error of estimate: 0.6989

Effect		Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	(b_0)	0.8417	0.3294	0.0000	.	2.5555	0.0151
X_t	(b_1)	0.7340	0.2689	0.4447	0.7156	2.7298	0.0099
X_e	(b_2)	-0.6819	0.5819	-0.3875	0.1736	-1.1718	0.2492
X_t*X_e	(b_3)	0.1920	0.5127	0.1245	0.1717	0.3744	0.7103

Effect	Coefficient	Lower < 95%>	Upper
CONSTANT	0.8417	0.1731	1.5104
X_t	0.7340	0.1881	1.2798
X_e	-0.6819	-1.8631	0.4994
X_t*X_e	0.1920	-0.8489	1.2329

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	8.6275	3	2.8758	5.8884	0.0023
Residual	17.0938	35	0.4884		

The Durbin-Watson D statistic indicates that the model errors are uncorrelated. The Durbin-Watson D statistic for the residuals of the model equals 1.360 which is close enough to 2.00 and the First Order Autocorrelation (0.318) is close to 0.00 but autocorrelation may be a slight problem for the model.

The maximum difference as computed by the K-S test of the fecal coliform bacteria model is 0.1843 with a 2-tailed probability (P) of 0.1412. P is significantly larger than an alpha of 0.05 suggesting that the null hypothesis that the sample could have been drawn from a normal reference distribution should not be rejected. The graphical assessment does not clearly support the assumption that the residuals are normally distributed but is close (**Figure 15**).

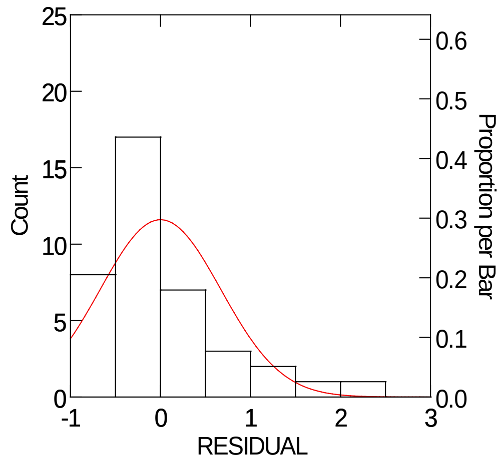

Figure 15. Distribution of residuals relative to the normal distribution. The fit is not good as for these residuals indicating that this model is not acceptable.

The P values of the b_2 and b_3 coefficients (0.2492 and 0.7103 respectively) indicate that there are not statistically significant differences in the y-intercepts or slopes of the calibration period and the treatment period. Consequently, evaluation of the coefficients is not advisable.

A very powerful graphical nonparametric tool reveals the same basic conclusion reached by the statistical model. **Figure 16** indicates that total suspended solids concentrations were significantly lower in the post-BMP period in Peyton Creek than in the pre-BMP period. Differences in the control watershed, Frog Branch were not significant between the two periods.

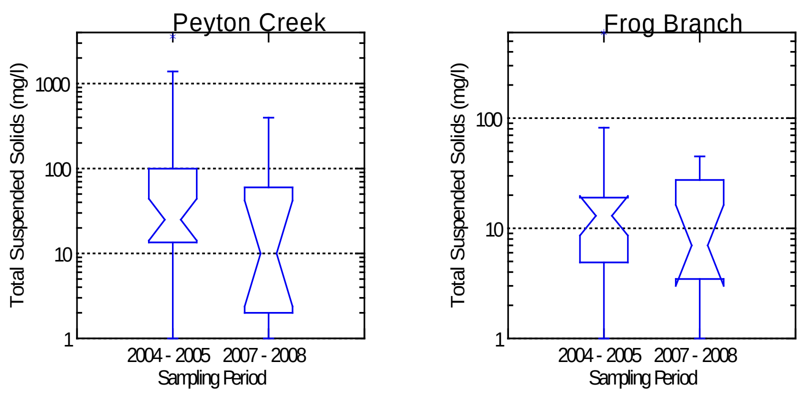

Figure 16. Notched box plots depict the difference between the pre-BMP and post-BMP sampling intervals for both watersheds. Although, the post-BMP median and quartiles are lower than for the pre-BMP period the difference is not statistically significant.

Conclusions

When selecting a watershed for this project, size was an important consideration since it is more likely that results (analytical and social) can be quantified on a smaller watershed within the limited funding and time frame and of the program requirements. However, smaller watersheds means a smaller farm pool from which volunteer farmers can be enticed to cooperate with the BMP program. In addition, smaller watersheds are more severely impacted by weather conditions such as high storm flow and/or drought where the entire creek system may go dry such as occurred in Peyton Creek and Frog Branch in 2005, 2007 and 2008.

As the partners mature in implementing 319 projects, the system tends to run better and all can benefit from lessons learned in the past. One of the inherent difficulties of implementing water quality projects such as this is to document an improvement in water quality given the confines of time, money, and climate. Funding is never enough, the weather never cooperates, and we never have enough time to document positive changes. Richards and others (2008) document that it takes several decades of abundant data "to demonstrate that trends are due to the way we use the land and not just the quirks of the weather."

The Peyton Creek watershed project has been very successful from the perspective of landowner participation and the quality of the management systems and BMPs installed in the watershed. The water quality monitoring program has provided valuable insight into the effectiveness of the management systems. However, extreme weather conditions have compromised the ability of the monitoring to assess the management systems effectiveness. Indications are that reductions in solids and fecal coliform bacteria have been achieved but these may have resulted from the reduced streamflow and lack of runoff into the system.

Visual observations indicate considerable success. During the 2004 and 2005 sampling years neither fish nor crayfish were evident at the Peyton Creek sampling site PC1 although they were always noted in the field log at Frog Branch (FB1). By the summer of 2007 minnows and crayfish were abundant at PC1 during all but the few storm events that were sampled. Exclusion of cattle from the creek at this point and upstream dramatically changed the riparian landscape and the amount of erosion contributing directly to the stream. After 2005 manure was not observed in the stream, whereas before the fencing manure mixed with unconsolidated sediment made fish and crayfish habitat impossible to find.

It will likely require several years for the materials once contributed to the stream network to “flush” out even if any new material is excluded. A few good wet years may return Peyton Creek to an ecologically hospitable environment for native aquatic life, although, this will require maintenance of the new management systems and the BMPs that have been installed over the past few years.

Lessons Learned

The long history of 319(h) projects in KY and elsewhere has produced several lessons that guided or influenced the design and implementation of the Peyton Creek Watershed Project. An important lesson was the need for a committed watershed coordinator for the project (KHRC&D 2004; KDOW 2000a). The selection of Mr. Paul Jeffries a farmer that lives in the Frog Branch watershed was fortuitous because of his relationship with local land owners. His knowledge of the local farming practices and influence with the local farmers obviated many of the BMP implementation problems that have affected other projects such as Spears Creek - Mocks Branch Watershed (KHRC&D 2004).

Unpredictable climatic conditions during the monitoring period also contributed to the unexpected results. The sampling period suffered a severe drought. These drought conditions resulted in lower flow, higher temperatures and lower dissolved oxygen concentrations. Many of the issues associated with this project and projects such as the Mocks Branch Watershed project could have been addressed if the project had a longer monitoring period. Many other 319 projects have had similar problems and also concluded that an extended monitoring period, of up to 10 years, would generate better results and provide the data necessary to evaluate the effectiveness of BMPs (Kingsolver and others 2001; KDOW 2000a). The results of this project may also be relevant to other watersheds with similar NPS issues.

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Appendices

Appendix A. Financial & Administrative Closeout

Workplan Outputs

	Workplan Output	Finalized/produced
1.	Submit all draft materials to the Cabinet for review And approval.	12/16/08
2.	Submit advanced written notice on all workshops, Demonstrations, and/or field days to the Cabinet.	12/16/08
3.	Submit QAPP to the Cabinet for review and Approval.	9/17/03
4.	Establish meeting schedule for Project Oversight Committee.	2/03
5.	Develop and submit BMP Implementation Plan to Cabinet for review and approval.	9/17/08
6.	Conduct pre-BMP monitoring.	10/04
7.	Employ Watershed Coordinator.	12/16/08
8.	Install BMPs.	12/16/08
9.	Conduct post-BMP monitoring.	12/16/08
10.	Conduct field day.	9/20/07
11.	Upon request of the Division of Water, submit Annual Report and/or participate in the Cabinet Sponsored biennial NPS Conference.	12/16/08
12.	Submit three copies of the Final Report and submit Three copies of all products produced by this project.	12/16/08

Budget Summary

Original Detailed Budget

	319(h)	non-fed match	Total
Personnel	$100,000	$11,111	$111,111
Supplies			
Equipment			
Travel			
Contractual			
BMPs	$225,000	$288,889	$513,889
Monitoring	$125,000		$125,000
Operating Costs			
Other			
Total	$450,000	$300,000	$750,000
	60%	40%	100%

Revised Detailed Budget

	319(h)	non-fed match	Total
Personnel	$28,050.00	$18,700.00	$46,750.00
Supplies			
Equipment			
Travel			
Contractual			
BMPs	$367,121.75	$244,747.83	$611,869.59
Monitoring	$54,828.25	$36,552.17	$91,380.41
Operating Costs			
Other			
Total	$450,000.00	$300,000.00	$750,000.00
	60%	40%	100%

BMP category was over-expended. Revisions to Personnel and Monitoring were made to correct deficiency.

Final Budget

	319(h)	non-fed match	Total	Final Expenditures
Personnel	$100,000	$11,111	$111,111	$46,750.00
Supplies				
Equipment				
Travel				
Contractual				
BMPs	$225,000	$288,889	$513,889	$611,869.59
Monitoring	$125,000		$125,000	$91,380.41
Operating Costs				
Other				
Total	$450,000 60%	$300,000 40%	$750,000 100%	$750,000.00

The Kentucky Heritage RC&D Council, Inc. was reimbursed $450,000. All dollars were spent; there were no excess project funds to reallocate.

Equipment Summary

No equipment was purchased for this project.

Special Grant Conditions

There were no Special Grant Conditions placed on this project by EPA.

Appendix B

Quality Assurance/Quality Control for Water Monitoring

Ø 1-16

Peyton Creek Phase II

A subproject of the
Herrington Lake-Dix River
Clean Water Action Plan
And the Peyton Creek Watershed Project
Supplemental Proposal
Through
99 CWAP Funds

Submitted by the
Kentucky Heritage RC&D Council, Inc.
227 Morris Drive
Harrodsburg, Kentucky 40330-1086

January 2005

peytonphaseIIworkplanJan05.doc

Summary Page

Due to the *overwhelming* success and popularity of the 01-16 Peyton Creek Watershed Project, we are requesting additional funding to implement BMPs and carry out the goals of the original 01-16 project workplan.

The project will continue to implement the watershed demonstration project focusing on agriculture in the Peyton Creek subwatershed of Herrington Lake – Dix River. The 3,883 acre watershed was originally selected due to the concentration of farming operations in this area which are believed to be an important contributor to the nutrient and pathogen related impairments of the receiving watershed. Additionally, the small size of the Peyton Creek Watershed makes it more likely that results (analytical and social) can be quantified within the project timeframe.

Peyton Creek Watershed is primarily made up of full-time farmers whose sole family income is derived from agriculture, and who do not earn supplemental income assistance from a second part-time job. As such, the farmers in this watershed have limited funds available to address water quality issues. Rather, they try to get as much production from their land as is physically possible. Weaning lots are over crowded, cattle have free access to creeks for shade and water, and there are no rotational grazing systems or cross-fencing which leads to improper stocking rates and soil erosion.

This project will continue to assist these farmers by offering them incentives to install demonstration BMPs to promote livestock exclusion from streamside areas and the conversion to rotational grazing systems. New concepts will continue to be offered and showcased at field days. The monitoring associated with the project is intended to show farmers that the "hard to sell" concept of livestock exclusion from streamside areas will result in an improvement in water quality while the adoption of rotational grazing maintains their current stocking rates.

Introduction

The overall goal of the Herrington Lake-Dix River Clean Water Action Plan is to reduce non-point source pollution and improve the bacterial and biological integrity of Herrington Lake and the streams within the Dix River watershed. Dix River was selected as one of five priority Clean Water Action Plan (CWAP) watersheds through the Unified Watershed Assessment process in 1998 and is a "Category One-Watershed In Need of Restoration." Dix River Basin carries a 303(d) status of First Priority for non-support of primary contact recreation (swimming) and a 303(d) status of second priority for partial support of aquatic life. Herrington Lake, the water supply for the City of Danville and surrounding areas, impounds the Dix River. Herrington Lake has been assessed as in non-support of aquatic life and a TMDL for nutrients is under development. The Herrington Lake-Dix River CWAP addresses Herrington Lake and the upstream portion of the Dix River watershed.

Until the TMDL and TMDL Implementation Plan are completed and contributions from nonpoint sources are more clearly identified, efforts are being directed toward the demonstration of innovative and/or "hard-to-sell" Best Management Practices (BMPs) to the agricultural community. An agricultural BMP demonstration project was funded under the 1997 Nonpoint Source base 319(h) grant in two subwatersheds of the Dix River, Spears Creek and Mocks Branch, prior to initiation of the TMDL. A second agricultural BMP demonstration project in the Hanging Fork and Cane Run subwatersheds was funded under the 1999 incremental 319(h) grant. A third project, 2001 Peyton Creek, installed agricultural demonstration BMPs. This current project will continue to implement a watershed demonstration project focusing on agriculture in the Peyton Creek subwatershed.

Summary Page

The overall goal of the Herrington Lake – Dix River Clean Water Action Plan is to reduce nonpoint source pollution and improve the bacterial and biological integrity of Herrington Lake and the streams within the Dix River watershed. Dix River was selected as one of five priority Clean Water Action Plan (CWAP) watersheds through the Unified Watershed Assessment process in 1998 and is in non-support of primary contact recreation and partially supports aquatic life. A TMDL for Herrington Lake is under development. Herrington Lake – Dix River CWAP addresses Herrington Lake and the upstream portion of the Dix River Watershed.

Until the TMDL is completed, efforts are being directed toward the demonstration of innovative and "hard to sell" Best Management Practices (BMPs) to the agricultural community. Three agricultural BMP demonstration projects were funded under the 1997, 1999, and 2001 Nonpoint Source 319(h) grants in subwatershed of the Dix River (Spears Creek and Mocks Branch – 1997; Hanging Fork and Cane Run – 1999 CWAP, and Peyton Creek, 2001.

This current project will continue with the implementation of the watershed demonstration project focusing on agriculture in the Peyton Creek subwatershed. This 3,883 acre subwatershed was selected due to the concentration of farming operations in this area which are believed to be an important contributor to the nutrient and pathogen related impairments of the receiving watershed. Additionally, the small size of the subwatershed make it more likely that results (analytical and social) can be quantified within the project timeframe.

The successful installation of BMPs during the 2001 Peyton Creek Project, warrants the need for additional funds at this time, and is the sole purpose of this proposal.

Peyton Creek Watershed is made up primarily of full-time farmers whose sloe family income is derived from agriculture, and who do not earn supplemental income assistance from a second part-time job. As such, the farmers in this watershed have limited funds available to address water quality issues. Rather, they try to get as much production from their land as is physically possible. Weaning lots are over crowded, cattle have free access to creeks for shade and water, and there are no rotational grazing systems or cross-fencing leading to improper stocking rates and soil erosion.

The Peyton Creek Phase II project will continue to assist these farmers by continuing to offer them incentives to install more demonstration BMPs to promote livestock exclusion from streamside areas and the conversion to rotational grazing systems. New concepts will be offered and showcased at field days, as stipulated in the 2001 agreement. The monitoring associated with the project is intended to show farmers that the "hard to sell" concepts of livestock exclusion from streamside areas will result in an improvement in water quality while the adoption of rotational grazing maintains their current stocking rates.

Introduction

A Watershed Restoration Action Strategy (WRAS) for Herrington Lake – Dix River is incorporated into this project workplan. The problem definition and physical description elements are presented in this section while the Plan of Work includes the remaining elements of proposed actions, partners, and measures of success.

The overall goal of the Herrington Lake – Dix River Clean Water Action Plan is to reduce non-point source pollution and improve the bacterial and biological integrity of Herrington Lake and the streams within the Dix River Watershed. Dix River was selected as one of five priority Clean Water Action Plan (CWAP) watershed through the Unified Watershed Assessment process in 1998 and is a "category One-Watershed In Need of Restoration." (*1998, KDOW Clean Water Action Plan*). Dix River Basin carries a 303(d) status of First Priority for non-support of primary contact recreation (swimming) and a 303(d) status of second priority for partial support of aquatic life. Herrington Lake, the water supply for the City of Danville, impounds the Dix River. Herrington Lake has been assessed as in non-support of aquatic life and a TMDL for nutrients is under development. (*1998, KY 303(d) List of Waters of KY*). The Herrington Lake - Dix River CWAP addresses Herrington Lake and the upstream portion of the Dix River Watershed.

Until the TMDL and TMDL Implementation Plan are completed and contributions from nonpoint sources are more clearly identified, efforts are being directed toward the demonstration of innovative and /or "hard to sell" Best Management Practices to the agricultural community. An agricultural BMP demonstration project was funded under the 1997 Nonpoint Sources base 319(h) grant in two subwatersheds of the Dix River, Spears Creek and Mocks Branch, prior to initiation of the TMDL. A second agricultural BMP demonstration project in the Hanging Fork and Cane Run subwatersheds was funded under the 1999 incremental 319(h) grant. A third, Peyton Creek Watershed, was funded in 2001. This current project will implement a watershed demonstration project focusing on agriculture in the Peyton Creek Subwatershed.

When selecting a subwatershed for the 2001 Peyton Creek Watershed project, size was an important consideration since it is more likely that results (analytical and social) can be quantified on a small watershed within the limited time frame of the project. The 3,883 acre Peyton Creek Watershed was selected due to the concentration of farming operations and the water quality concerns related to the farming methods in use in the area. Due to depressed incomes, farmers in this area are trying to get as much production from their land as possible. For example, when a weaning lot is needed for their cattle, the obvious location is next to the creek, where water is plentiful, readily available, and easily accessible. The lot is generally overcrowded due to the farmer's continuing need to get as much from this land as is physically possible. Environmental problems within the Peyton Creek subwatershed that will continue to be addressed by the funding of this project include: cattle's free access to creeks, lack of fencing/rotational grazing systems, eroded crossings and feeding areas, lack of proper waste management, over grazing and improper stocking rates, poor pasture and hayland management, and soil erosion from cropping practices. Due to the economic distress of the local farming population, a higher cost share rate will be considered for the project area.

The objective of this project is the same as the 2001 Peyton Creek Watershed project; to improve water quality within the Peyton Creek watershed by installing BMPs that emphasize streamside protection, proper manure handling and utilization, and conversion to rotational grazing systems. Once these BMPs have been in place and accepted, we have found that other producers are more apt to convert to more innovative conservation practices that are more economical, and environmentally friendly.

This project will continue to help farmers by offering them incentives to install demonstration BMPs through the 319(h) grant program, and employ a Watershed Coordinator to aid in implementing this project. Watershed meetings in partnership with DOW and DOC will be held so farmers can tell us what types of BMPs would best suit their operations. New concepts, such as flash grazing and rental payments for riparian areas will be offered and showcased at field days. BMPs that reduce soil erosion such as riparian buffers and filter strips will be offered as well.

New and innovative solutions to the problems these farmers face each day will be offered. The farmers know cattle should not have free access to streams and creeks. They know animal waste should not enter the creeks. They know soil erosion is detrimental to their farms and harmful to the environment. This project will offer them a means of maintaining their livelihood in a way that is affordable and reasonable, and most of all, protects the water resources within Peyton Creek Watershed, and that of the state.

Peyton Creek Watershed is located in Lincoln County and is a tributary of Hanging Fork, which is a portion of the Herrington Lake-Dix River Watershed, and a part of the Kentucky River Basin. The Dix River-Herrington Lake watershed (HUC 051002-05-170) includes the western edge of Garrard County, part of northern Lincoln County, and eastern portions of Boyle and Mercer Counties. The land is in the inner subregion of the Bluegrass physiographic region, characterized by undulating terrain and moderate rates of both surface runoff and groundwater drainage. Most of the watershed lies above thick layers of easily dissolved limestone that form carbonate aquifers. Groundwater flows through channels in the limestone, so caves and springs are common in regions with this geology. Some areas lie above interbedded limestones and shales (>20% limestone), allowing groundwater flow where clay content is low enough. Land in the watershed is almost 90% agricultural and almost 5% residential. The surface waters of the watershed supply the drinking water for the municipal systems of Lancaster, Danville, and Boyle County. Livestock density is substantially higher than average for the Kentucky River basin. -*Kentucky River Basin Management Plan, http://www.uky.edu/WaterResources/Watershed/KRBMP/KRB_MP02.htm*

Plan of Work

Lead Agency

Kentucky Heritage RC&D Council, Inc.

Partnerships

Cumberland Environmental Group, LLC
Kentucky Division of Conservation
Kentucky Division of Water
Lincoln County Conservation District
Lincoln County Cooperative Extension Service
Local Landowners
USDA-Natural Resources Conservation Service

Project Activities

Water quality will continue to be improved in the Peyton Creek Watershed by installing BMPs that emphasize streamside protection, proper manure handling and utilization, and conversion to rotational grazing systems. Monitoring of water quality will continue as detailed in the 2001 grant. The BMPs will be demonstrated at a local field day, as described in the 2001 agreement.

BMPs will be installed in accordance with USDA-NRCS's standards and specifications, the Kentucky Agricultural Water Quality Act, and Forest Conservation Act as appropriate. The Watershed Coordinator and/or a NRCS representative will oversee BMP installation. Some BMPs may require incentive payments for producers to implement. These payments will be made at a rate that is acceptable based on local landowner input.

The BMP Implementation Plan submitted for the 2001 grant will be used for this project. The BMP Implementation Plan includes: (1) a list of BMP technologies to be installed; (2) a description of the technology selection process, to include the estimated cost, relative treatment efficiency, and the minimum operation and maintenance required for the BMP to operate efficiently; (3) a description of how BMPs will be targeted to specific locations and if locations are know, a map(s) clearly showing the location where the BMP technologies will be demonstrated; (4) a means of notifying the Division of Water, NPS Section prior to BMP implementation (if locations were not previously identified, submit a BMP location map at this time; (5) a financial plan of action that describes how financial assistance will be provided for technology demonstration; and (6) the type of maintenance agreement to be made wit the landowner.

Streambank restoration or bank stabilization is not anticipated in this project area. Pre- and Post- BMP monitoring will continue as described in the 2001 agreement.

A Quality Assurance/Quality Control (QA/QC) Plan has been approved and is in effect for the 2001 agreement. This project will follow those guidelines.

A Watershed Coordinator will continue to be employed to assist with project implementation and administration. The Coordinator will prepare invoices, project progress reports, in addition to assisting landowners with selection and installation of BMPs that will address water quality issues within the Peyton Creek basin. The BMPs identified will be those that the producers have determined they might need during meetings with the Watershed Coordinator, the Lincoln County Conservation District, the USDA-Natural Resources Conservation Service, and the Lincoln County Cooperative Extension Service.

In addition to demonstration of the BMP's effectiveness via water quality monitoring, demonstrations of BMPs will take place at a field day and at special presentations as described in the 2001 agreement. The field day will be hosted by the Lincoln County Conservation District near the end of this project to show other farmers new methods and practices that are available to control water quality issues on their farms. Special presentations will be conducted by the Watershed Coordinator, District Conservationist (or his staff), or the local Cooperative Extension Service's Agricultural Agent as opportunities arise. The field day and presentations will showcase information about the BMPs (cost, pollution control effectiveness, installation requirements, maintenance requirements, other funding sources, etc.) to others. The goal is to persuade people to implement BMPs on their own (or with other funding sources). Target audiences are those producers who have not installed these technologies. Demonstrations will be tailored to these audiences in order to maximize the number of individuals effected by the demonstrations. To insure demonstrations are as effective as possible, producers from Lincoln County will be notified through USDA and/or CES newsletters and mailings. The Kentucky Division of Water will be given advance notice of the scheduling of any workshops, demonstrations, or field days in order for them to help provide the opportunity for technology transfer.

BMPs installed under the Kentucky Soil Erosion and Water Quality Cost Share Program (state cost share program) will be used as match, along with the producer's in-kind match. Any state cost share BMPs installed in the Peyton Creek Watershed will be demonstrated by the pre- and post- BMP monitoring conducted under this project while BMPs installed elsewhere will be demonstrated via new articles, publications, field days, public meetings, or personal tours of the BMPs.

The Kentucky Heritage RC&D Council will administer this project. Cumberland Environmental Group, LLC (or other environmental consultant) will perform monitoring operations. The Kentucky Division of Conservation and the Kentucky Division of Water will assist the Kentucky Heritage RC&D Council in administering this project from the state level.

All existing materials and drafts of all printed materials (e.g. agendas, training materials, manuals, pamphlets, newsletters, news articles, etc.), video scripts and other products will be submitted to the Division of Water for review and approval prior to final product development and/or distribution. Review and approval of new, as well as existing materials ensures that the most appropriate and up-to-date educational materials are being used.

Any AFO (Animal Feeding Operation) receiving financial assistance from 319(h) funds will implement a nutrient management plan. AFOs are defined as any lot or facility where animals are stabled or confined and fed or maintained for a total of 45 days out of a 12 month period, and where crops, vegetation, forage growth, or post harvest residues are not sustained over any portion of the lot or facility in the normal growing season.

Measures of Success

Success will be measured by continued implementation of agricultural BMPs in the Peyton Creek Watershed, and by monitoring data developed from 2001 agreement showing an improvement in water quality.

Milestone Schedule

Milestone	begin		completion
1. Execute MOA	1/05		1/05
2. Submit Agendas, Articles, etc. to DOW for approval	1/05	thru	12/05
3. Install BMPs	1/05		10/05
4. Prepare and submit Final and Closeout Report	9/05		12/05

Project Budget

Budget Summary

	BMP Implementation	Project Management	Public Education	Monitoring	Technical Assistance	Other	TOTAL
Personnel	$ 7,000	$	$	$	$3,000	$	$10,000
Supplies							
Equipment							
Travel							
Contractual	144,030.41			15,869.59			159,900
Operating Costs							
Other							
TOTAL	151,030.41			$ 15,869.59	$3,000		$169,900

Detailed Budget

Budget Categories (itemize all categories)	**Section 319(h)**	**Non-Federal Match**	**Total**
Personnel	$10,000		$10,000
Supplies			
Equipment			
Travel			
Contractual -BMPs -monitoring	76,130.41 15,869.59	67,900	144,030.41 15,869.59
Operating Costs			
Other			
TOTAL	102,000	67,900	169,900
	60%	40%	100%

Budget Narrative

Detailed Budget:

Personnel costs are those associated with employing a Watershed Coordinator to be paid solely with 319 funds. Match will be made through state cost share program, and will not be required by the vendor.

Contractual BMPs are the costs associated with installing BMPs on the ground. Most of the non-federal match will come from state cost-share program. Producers will be required to match 10% of the cost of the BMP.

Contractual Monitoring costs will bé paid solely with 319 funds. Match will be made through state cost-share program, and will not be required by the vendor.