Banklick Creek Watershed Planning, Implementation, and Results Final Report

Final Report

Banklick Watershed Council

December, 2014

Report for

Kentucky Division of Water

Banklick Creek Watershed Planning, Implementation, and Results Final Report

Grant Number: C9994861-07

Application Title: Banklick Creek Watershed Planning, Implementation, and Results

Application Number: 07-07

Memorandum of Agreement Number: PON21290700006624

Project Period: February 2008 to November 2014

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November, 2014

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Funding for this project was provided in part by a grant from the U.S. Environmental Protection Agency (USEPA) through the Kentucky Division of Water, Nonpoint Source Section, to the Banklick Creek Watershed Council as authorized by the Clean Water Act Amendments of 1987, §319(h) Nonpoint Source Implementation Grant # C9994861-07. Mention of trade names or commercial products, if any, does not constitute endorsement. This document was printed on recycled paper.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Banklick Watershed Council (BWC) was the recipient of a 319(h) grant from the United States Environmental Protection Agency (USEPA) and the Kentucky Division of Water to develop a Watershed Based Plan and to begin implementation of that plan.

To accomplish this project, the BWC partnered with Strand Associates (Strand) and Sanitation District No. 1 (SD1) to collect and analyze data and to develop the Watershed Based Plan. The team developed a plan that focused in the upper half of the watershed and involved four control measures:

- Establishing Streamside Vegetated Buffers and Conserving Streamside Land
- Fencing Livestock to Prevent Stream Access
- Improving Failing Septic Systems
- Increasing Infiltration With BMPs

The Watershed Based Plan was approved by KDOW in April 2010, and the BWC began implementing the plan immediately. The elements of the plan that were successfully implemented as part of this grant include:

- Repair of 6 failing septic systems
- Assistance with construction of a rain garden on Turkeyfoot Rd.
- A reforestation project in conjunction with a school
- Protection of 26.5 acres of land adjacent to Doe Run Lake
- Protection of 48.3 acres including 6,000 feet of high quality stream frontage along Brushy Fork
- Protection of 14.3 acres of high quality forest along Stephens Rd.
- Construction of 2 detention basin retrofit projects
- Numerous education and outreach efforts

SECTION 1
ACKNOWLEDGEMENTS

1.01 ACKNOWLEDGEMENTS

The following list of groups and people were instrumental in the development and implementation of activities associated with the *Banklick Creek Watershed Planning, Implementation, and Results* Project.

A. Banklick Watershed Council
- Sherry Carren, President Banklick Watershed Council
- Sharmili Reddy
- Gary Mattson
- Wilhelm Kossenjans
- Mary Pat Behler
- Jim Kreissl
- Rodney Crice
- Donna Horine
- Marc Hult

B. Sanitation District No. 1
- Jim Gibson
- Craig Frye
- Matt Wooten
- Dave Rager

C. Northern Kentucky Health Department
- Tony Powell

D. Northern Kentucky Urban & Community Forestry Council
- Kris Stone

E. City of Fort Wright, Kentucky

F. City of Erlanger, Kentucky

G. Kentucky Division of Water
- Brooke Shireman
- Daniel Bishop
- Chad Von Gruenigen
- James Roe
- Lajuanda Haight-Maybrier

H. Northern Kentucky University - Center for Applied Ecology
- Jessica Metzger
- Scott Fennell

I. Planning and Development Services of Kenton County
- Sharmili Reddy
- Ed Dietrich

J. Kenton County Conservation District
- Mary Katherine Dickerson
- Marc Hult

K. City of Covington, Kentucky
- Mayor Sherry Carran

L. Kenton County Fiscal Court
- Scott Kimmich

M. United States Geological Survey
- Michael Griffin

N. Kentucky Transportation Cabinet
- Mike Bezold

O. Boone County Planning Commission
- Kevin Costello

P. Kenton Conservancy
- Gary Wolnitzek

Q. Strand Associates, Inc.©
- John Lyons, PE
- Kelly Kuhbander, PE, LEED® AP
- Stephanie Glossner, PE

R. Sustainable Streams
- Bob Hawley, PE, PhD
- Katie MacMannis, PE
- Nora Korth, PE

SECTION 2
INTRODUCTION AND BACKGROUND

2.01 PURPOSE, OBJECTIVE, AND GOALS

A. Purpose

Water quality impairments, habitat alteration, and overall stream health within Banklick Creek were large concerns at the beginning of this grant. While Sanitation District No. 1 (SD1) was making progress in the realms of combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), and various other stormwater issues, there were still impairments of Banklick Creek that were neglected as they fall outside the realm of traditional sanitary and stormwater agencies' work. These impairments are problems such as stream channelization, habitat alteration, and reduced riparian corridors. A holistic approach of remediating both traditional and non-traditional impairments was needed to truly better the Banklick Creek Watershed.

B. Project Objective

The main objective of this project was to update the existing watershed based plan (WBP) for Banklick Creek in order to identify sources of pollution along the creek that impact the quality of the waters. Based on the 2003 Nonpoint Source Program and Grants Guidelines for States and Territories by the USEPA, the nine elements of a WBP were to be addressed. Following the creation of the new WBP, implementation measures were to be put into place to combat the sources of nonpoint source pollution in the creek. The objective of implementing these measures was to verify improved water quality in Banklick.

C. Goals

One goal of creating the Banklick WBP was to create the basis for project implementation within the watershed. By gathering results from the implementation of projects, the goal was to see improved water quality in Banklick Creek. The WBP was the avenue to achieve the ultimate goal of improved water quality and restored habitat of the Banklick Creek. The BWC has established goals of the organization, which are to clean the water, reduce flooding, restore the banks, and honor the heritage.

2.02 OTHER PERTINENT AND RELATED WORK

In 2007, the entire length of Banklick Creek was listed as a 1st priority stream by Kentucky Division of Water (KDOW) on the state's 303(d) list for impaired waters, making it one of the three "highest priority" watersheds in the Licking River basin. Impaired uses include aquatic life and primary contact recreation resulting from nutrients, organic enrichment/low dissolved oxygen, habitat alteration (non-flow), and pathogens. Figure 2.02-1 outlines the locations of impairments to the creek. Pollution sources within the watershed include CSOs, SSOs, stormwater runoff, failing septic systems and NPS runoff. Additionally, the problem of habitat alteration is suspected to be from human modifications rather than by natural flow. SD1 has established programs to address CSOs and SSOs along Banklick Creek, but the additional problems of habitat loss, stream channelization, and riparian corridor reduction have only now begun to be addressed.

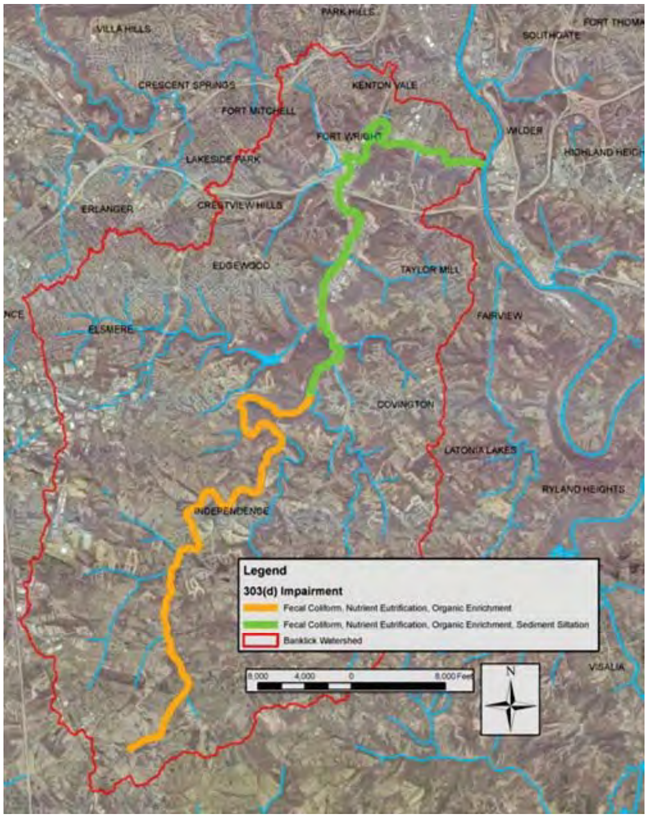

Figure 2.02-1 303(d) Impairments to Banklick Creek

Prior to this grant, resources had been devoted to data collection within the Banklick Creek watershed. Wet and dry weather data had been collected for a thorough understanding of existing conditions and environmental stressors at the beginning of the grant. Table 2.02-1 summarizes the findings of the data collection efforts.

SD1 has invested many resources into evaluating the watershed. Between 2001 and 2003, a biological community assessment was conducted to record biological diversity and determine baseline conditions for habitat quality. The goal of this assessment was to used it in future water quality enhancement activities to measure efficiency.

From this assessment, a report titled *Habitat and Biological Community Assessment of Banklick Creek, Kentucky,* July 2003, was developed. The report found that site variation could best be explained by a linear combination of five variables: Habitat Assessment Score, Composite Periphyton Biomass, Total Macroinvertebrate Individuals, Percent EPT and Total Fish Taxa. These are the parameters suggested to be the focus of any future analysis. The five variables were then ranked to better explain the observed variation. The ranking, from high to low, is:

1. Habitat Assessment Score
2. Total Fish Taxa
3. Total Macroinvertebrate Individuals
4. Composite Periphyton Biomass (Composite Chlorophyll a)
5. Percent EPT

Parameter	Location
Fecal Coliform	Entire Length
Phosphorous	Entire Length
Sediment	Between RM 0-12
Copper	In vicinity of RM 0.5 and 8
Lead	Between RM 0.5 and 12
Dissolved Oxygen	Lower 3.5 miles
Habitat alterations	Entire Length

Table 2.01-1 Existing Stream Conditions and Environmental Stressors of Banklick Creek

In addition, SD1 developed an independent WBP focused on CSO and SSO control as well as stormwater management. Efforts by the BWC did not replace or fulfill any of SD1's regulatory requirements or mandates. However, coordination did occur between the two organizations to provide maximum overall benefit to the watershed.

SECTION 3
MATERIALS AND METHODS

3.01 PROJECT AREA

1. Watershed Boundaries

The Banklick Watershed, one of the largest in Northern Kentucky, is 58 square miles and lies in both Kenton and Boone Counties. The 19 mile long creek begins near the county line, then runs to the north, eventually tying into the Licking River approximately 4.7 miles from the Licking's confluence with the Ohio River. Figure 3.01-1 displays the geographic location of Banklick Watershed within Kentucky and the watershed.

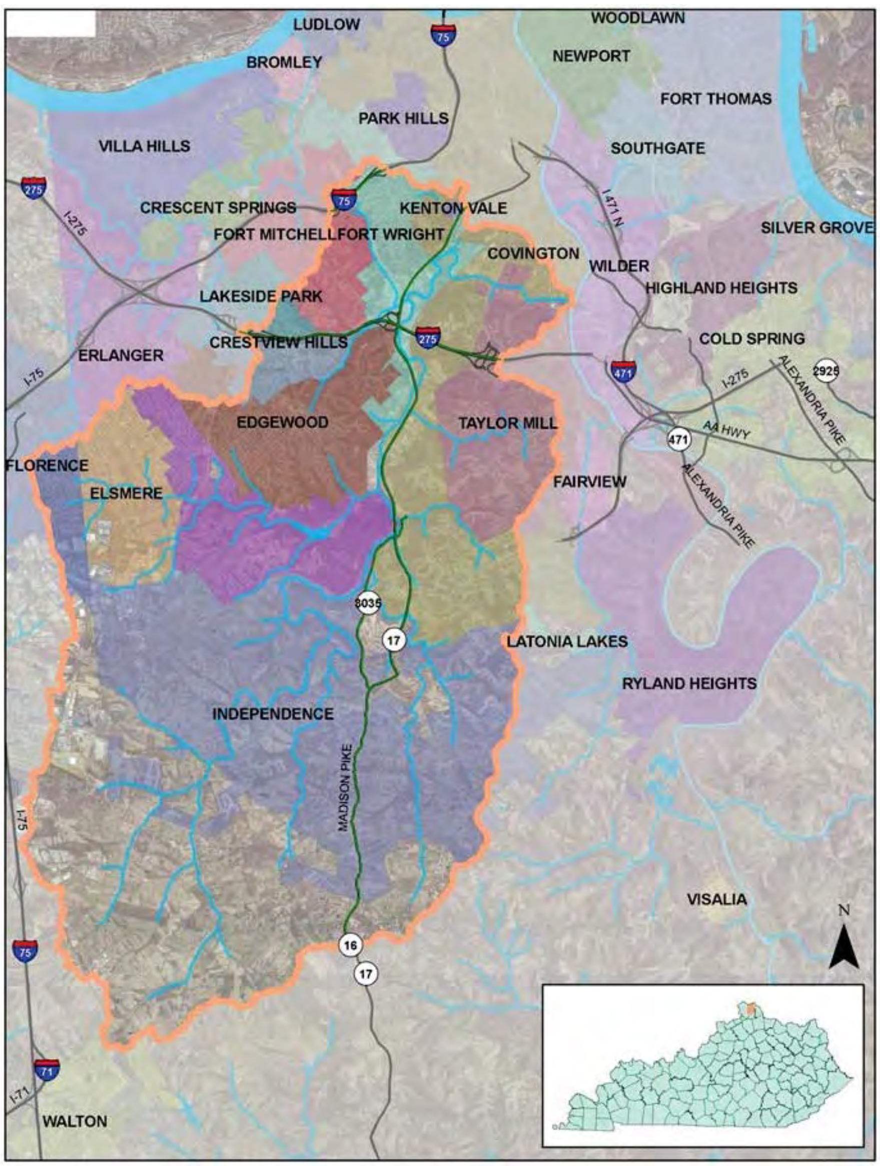

Figure 3.01-1 Banklick Watershed Map

2. Topography and Geomorphology

The topography in the Banklick Watershed varies from steep to sloping hillsides. Mean sea elevations range from 960 feet at the upstream end and 450 at the confluence with the Licking River. [United States Department of Agriculture (USDA) 1973)]

In 2008, LimnoTech, Inc. (LTI) found the average stream bed slope to be 0.4 percent over its 19-mile length. In a separate study, Strand and SD1 measured the bed slope at five locations (River Mile (RM) 5.5, 8.1, 17.6, 17.8, and 18.0); the findings showed a range of 0.4 to 0.8 percent. Steeper slopes can be found in the adjoining tributaries where slopes reach up to approximately 2 percent (100 ft/mi) (USACE), 2000)).

3. Hydrology

Banklick Creek is a perennial stream, receiving its baseflow primarily from groundwater supplies. At times, the Licking River flows upstream into Banklick Creek for 30 to 40 feet and has an influence on its temperature, dissolved oxygen, and other stream parameters (LTI, 1998).

There are many tributaries to Banklick Creek. The major tributaries, from upstream to downstream, are Wolf Pen Branch, Brushy Fork, Fowler Creek, Wayman Branch, Bullock Pen Creek, Holds Branch, and Horse Branch. Numerous unnamed tributaries also exist. Doe Run Lake, a 51-acre flood control reservoir within the watershed, was constructed on Bullock Pen Creek between 1978 and 1982 (USDA 1973, LTI, 2004).

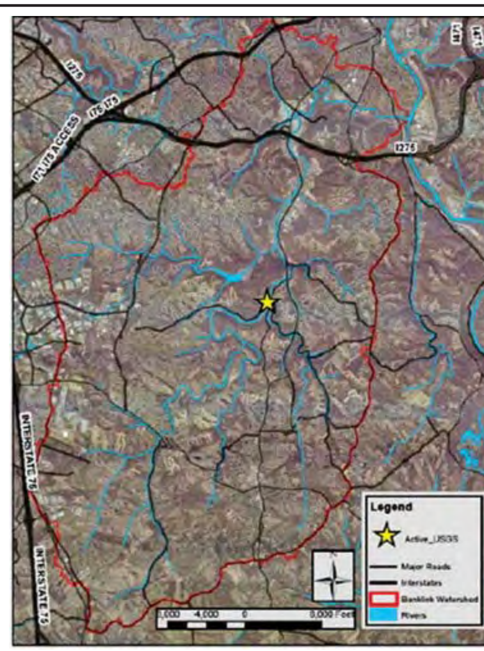

Figure 3.01-2 Map of USGS Gauge No. 03254550

Flows within the creek are measured by the US Geological Survey (USGS) Gauge No. 03254550, installed in April of 1999. The gauge is at RM 8.0, at the intersection with Kentucky Highway 1829, shown in Figure 3.01-2. The regime found at the gauge is flashy, meaning that it has large increases in flows during rain events and that instantaneous peak flows are generally much larger than the corresponding mean daily flow. Instantaneous flows are recorded once every 15 minutes, which are then averaged every 24 hours to determine the mean daily flow (i.e. 'daily flow') of each day.

Using data collected from April 1999 to March 2008, conclusions were made on the flow regime.

The average of all mean daily flows, (i.e. the average daily flow) is approximately 42 cubic feet per second (cfs). The maximum of all mean daily flows, (i.e. the maximum daily flow) is 2,130 cfs (February 18, 2000), while the maximum of all instantaneous flows (i.e. the maximum peak flow) is 9,570 cfs (April 21, 2002). Seventy percent of mean daily flows are less than approximately 25 cfs, 85 percent are less than approximately 50 cfs, and 95 percent are less than approximately 150 cfs. Base flows have been less than 0.5 cfs. Flows have increased by three orders of magnitude during storm events.

Flooding is a serious problem within the watershed, especially in the Pioneer Park area. (LTI, 2008). Flood damages within the Banklick Watershed have three key influences, according to United States Army Corp of Engineers (USACE). (USACE, 2000) These are:

a. The concentration of early development along stream channels

b. The extremely steep slopes of Banklick Creek and its tributaries

c. Extraordinary recent development in the watershed along ridgelines and hillsides

5. Soils and Geology

Most soils in the watershed were formed from shale, limestone, and sandstone. The principal upland soils include Eden, Cynthiana, Faywood and Nicholson and are relatively well-drained. Major bottomland and terrace soils include Newark, Nolin, Captina, and Licking. Ninety-three percent of the soils in the watershed are classified by the USGS as hydrologic group C, which indicates slow infiltration rates. Sixty percent of the soils in the watershed are classified as highly erodible, and the remaining soils are considered fairly erodible. Soil layers in the watershed are relatively shallow (less than 10 feet deep). (LTI, 2008) Bed material in the lower reaches of the creek as well as downstream tributaries is composed of broken limestone clasts in gravel/cobble range; it is still underlain by bedrock layers of limestone and shale. (USDA 1973). The Banklick Watershed is located in the Bull Fork formation in the Bluegrass Region and is underlain by interbedded limestone and shale. Because of the presence of shale within the limestone, the conduits formed from dissolved limestone do not extend very far horizontally or vertically. Most of the area is moderately dissected by surface streams and contains local karst drainage (LTI, 2008). Karst can dampen the potential attenuation of pollutant loads in the subsurface by providing direct conduits between surface water and shallow and/or deep aquifers.

3.02 METHODS

Completion of the Watershed Based Plan was the first and most important accomplishment of this project. This accomplishment was achieved by leveraging the vast amount of information that SD1 had already collected throughout the watershed, and using this information to determine the recommended course of action for the watershed plan. All information used in the planning was obtained by SD1 and was collected in accordance with the project QAPP.

Once the watershed plan was completed, the implementation of the plan was the next step. The below sections briefly outline the methods for accomplishing implementation under each category.

1. Reestablishment/Restoration of Riparian Buffers

The Watershed Council accomplished this objective through partnership with the Planning and Development Services of Kenton County (PDS) who proved to be an invaluable partner in the pursuit of lands for acquisition and protection. Additionally, the BWC was able to develop a strong partnership with the Kenton Conservancy who is an official land trust and was able to hold the acquired lands in conservation in perpetuity. Through partnership with PDS, and the Kenton Conservancy the BWC was successful in obtaining multiple important pieces of land within the watershed and placing them under a conservation deed to protect them. These specific pieces of land are discussed in more detail in the results section of this report.

2. Livestock and Pasture Management

The BWC identified locations where cattle were accessing the stream and damaging the banks as well as polluting the water. The Council made efforts to improve these situations by reaching out to the Cattleman's Association and the Kenton County Conservation District (KCCD). The results of this effort are discussed in the results section of this report.

3. Septic System Programs

The BWC was successful in implementing repairs to failing septic systems by coordinating closely with staff from the Northern Kentucky Independent Health Department (NKIHD). The NKIHD is the organization that receives notifications regarding septic system violations and based on their role, they were able to direct homeowners with failing septic systems to the BWC. The NKIHD was also a strong partner for the BWC in terms of providing inspection of the septic system to validate the potential projects and determine the appropriate level of repairs. More information on the results of this program are included in the results section of this report.

4. Shallow Infiltration Promotion

To locate potential projects to promote shallow infiltration and recharge the stream flows the BWC was successful in collaborating with area partners to identify appropriate projects. For example, BWC coordinated with SD1 to identify detention basin retrofit projects, the Kenton Conservancy to identify a stream restoration and bench full wetland project, and Kenton County School District for a rain garden installation and a reforestation project.

SECTION 4
RESULTS AND DISCUSSION

4.01 WATERSHED BASED PLAN RESULTS

The first phase of the Banklick Watershed Planning, Implementation, and Results project was to complete a watershed based plan to outline necessary implementation measures as well as the expected and desired results of those measures. The framework for the plan was developed using the USEPA's nine elements that must be addressed in order to receive 319(h) grant funding as well as the existing watershed plan and the goals of the BWC. The four goals of the BWC are to clean the water, reduce flooding, restore the banks, and honor the heritage. The following narrative describes the efforts taken for each of the nine elements. Additional information can be found in *The Banklick Watershed Based Plan* which is included as an appendix to this final report. *The Banklick Watershed Based Plan* was approved by KDOW in April of 2010.

A. Element A: Causes and Sources of Pollution

In order to properly evaluate the causes and sources of pollution with Banklick Creek, it was necessary to first review the United States and Kentucky standards and regulations for water quality. Resources that were reviewed include the federal Clean Water Act (CWA), Section 1 of Kentucky's Antidegradation Policy, and the Kentucky Agriculture Water Quality Act of 1994. In addition, the Integrated Report to Congress on Water Quality in Kentucky, published every two years, details water impairments and their sources. This information was compiled for Banklick Creek. Some results of that effort can be found in Tables 4.01-1 and 4.01-2.

Banklick Segment by River Mile	Designated Uses
0 to 3.5	Warm Water Aquatic Habitat, Fish Consumption, Primary Contact Recreation, Secondary Contact Recreation, Domestic Water Supply
3.5 to 8.2	Warm Water Aquatic Habitat, Fish Consumption, Primary Contact Recreation, Secondary Contact Recreation
8.2 to 19.2	Warm Water Aquatic Habitat, Fish Consumption, Primary Contact Recreation, Secondary Contact Recreation, Domestic Water Supply

Source: 2008 Integrated Report to Congress on Water Quality in Kentucky

Table 4.01-1 Banklick Creek Designated Uses 305(b)

Applicable policy aspects were compiled along with information regarding the impairments and their sources within Banklick. In order to achieve the state's water quality standards (WQS), the criteria for warm water aquatic habitat (WAH) and primary contact recreation (PCR) must be met for the entire length of Banklick Creek; this became the basis for all implementation actions and desired results that were developed.

Banklick Segment by River Mile	Use	Impairment	Suspected Source
0 to 3.5	PCR	Fecal Coliform	Municipal Point Source Discharges, Unspecified Urban Stormwater
0 to 3.5	WAH	Nutrient/Eutrophication Biological Indicators	Municipal Point Source Discharges
0 to 3.5	WAH	Organic Enrichment (Sewage) Biological Indicators	Municipal Point Source Discharges
0 to 3.5	WAH	Sedimentation/Siltation	Highways, Roads, Bridges, Infrastructure (New Construction), Urban Runoff/Storm Sewers
3.5 to 8.2	PCR	Fecal Coliform	Agriculture, On-site Treatment systems (septic systems and similar decentralized systems)
3.5 to 8.2	WAH	Nutrient/Eutrophication Biological Indicators	Agriculture
3.5 to 8.2	WAH	Organic Enrichment (Sewage) Biological Indicators	On-site Treatment systems (septic systems and similar decentralized systems)
3.5 to 8.2	WAH	Sedimentation/Siltation	Agriculture
8.2 to 19.2	PCR	Fecal Coliform	Agriculture, On-site Treatment systems (septic systems and similar decentralized systems)
8.2 to 19.2	WAH	Nutrient/Eutrophication Biological Indicators	Agriculture
8.2 to 19.2	WAH	Organic Enrichment (Sewage) Biological Indicators	On-site Treatment systems (septic systems and similar decentralized systems)

Source: 2008 Integrated Report to Congress on Water Quality in Kentucky

Table 4.01-2 Banklick Creek Designated Uses 303(d)

1. Causes of Pollution

The next phase of this element was to collect data on the creek. While a large amount of data existed, older information was kept for reference purposes only while the more recent data was used for analysis. BWC and SD1 worked in tandem, with SD1 sharing the information they had gathered.

a. Public input was gathered using surveys and public meetings. Appendix C contains the tools used to gather the public's input. Two PowerPoint presentations were given at each of three separate public meetings held in various parts of the watershed, with the intention of encouraging the entire watershed to attend. KDOW and Strand presented information regarding overall watershed health and Banklick-specific information. To conclude these meetings, residents were encouraged to share their thoughts about problems and issues in the watershed. 500 surveys were also distributed to watershed residents, with 81 returned. The results of these surveys can also be found in Appendix C.

b. A habitat assessment was completed by evaluating both physical and chemical components of the stream in order to gauge habitat alteration for plants and animals. 10 characteristics of the stream were evaluated ranging from bank stabilization to type of natural features in the stream and adjacent riparian areas. 8 stream locations were evaluated with scores ranging from 88 to 118 out of 200. The low habitat scores were primarily due to a lack/condition of riparian area, lack of bank stability, and lack of vegetated protection.

c. Macroinvertebrates were studied to determine the Kentucky Macroinvertebrate Index (MBI), a “multi-metric” approach evaluating many attributes of the macroinvertebrate. Species richness, tolerance values, and feeding guilds are examined, and the rating are calibrated to the watershed size and location. The same eight sites from the habitat assessment were observed, and all MBI scores equated to ratings of “poor”, with one site having a “fair” rating. These low ratings can be attributed to the dominance of chirinomids and oligochaetes and lack of mayflies, stoneflies, and caddisflies within the samples.

d. Fish surveys were completed at six of the eight sites; two were excluded due to low water levels. Using the Kentucky Index of Biotic Integrity (KIBI), the fish community structure was evaluated. The most upstream site was awarded an “excellent” classification, with the other five sites falling into the “good” and “fair” categories. With these results, care should be taken as it is the opinion of local biologists that macroinvertebrate surveys provide a more accurate depiction of stream condition, as the KIBI still needs refinement to better evaluate Bluegrass ecoregion streams, especially in watersheds less than 10 mi^2.

e. Hydromodification, a cause of problems like changes in flow and increased sedimentation, is growing in popularity as a characteristic of interest in stream projects. In Banklick, five locations were evaluated for hydromodification evaluations. The information was used to determine critical flow rates within the stream channel that cause sediment transport and degrade stream quality. The effort was led by SD1, who is continuing collection of this data of additional Northern Kentucky streams.

f. A watershed characterization report was completed in 2008 by LTI, in which historical and new data was compiled to provide an analysis of the Banklick Watershed. Water quality monitoring results was paired with computer modeling and the creation of a Watershed Assessment Tool to conduct the analysis. In measuring bacteria, most base flows met the fecal coliform concentration requirement of 400 cfu/100ml while every storm flow measured did not. The results from monitoring the biological conditions showed eutrophication as a problem in sections of the creek. In respect to stream metabolism, which measures the complex interactions between instream conditions and watershed conditions, appeared to be relatively well-balanced for the small study that was completed.

2. Sources of Pollution

Once the water quality information had been gathered, time was spent understanding the reasoning behind the water quality. Point and non-point sources were both assessed.

a. For point source pollution, there are 17 Kentucky Pollutant Discharge Elimination System (KPDES) permitted dischargers, 22 permitted outfalls within the watershed. In addition, there are five current combined sewer overflows (CSOs) and 27 sanitary sewer overflows (SSOs) within the watershed. As point source pollution is not applicable for 319(h) funding, no further analysis was completed.

b. There are ample nonpoint sources of pollution within the watershed. 47 percent of Banklick is developed, allowing urban activities such as pet waste, improper disposal, and lawn care, to greatly contribute as nonpoint sources. Two dairy operations are within the watershed where cows have direct access to the stream; horse hobbyists are in the area. The wastes from these animals and manure spread over agricultural lands contribute to fecal coliform concentrations in Banklick. It is estimated that roughly 16,500 tons of manure are produced in the watershed each year. Fertilizer can also be used on agricultural lands, fertilizer is used, leaching phosphorus and nitrogen into the creek. It is estimated that an additional 140,000 pounds of loadings enter Banklick Creek each year.

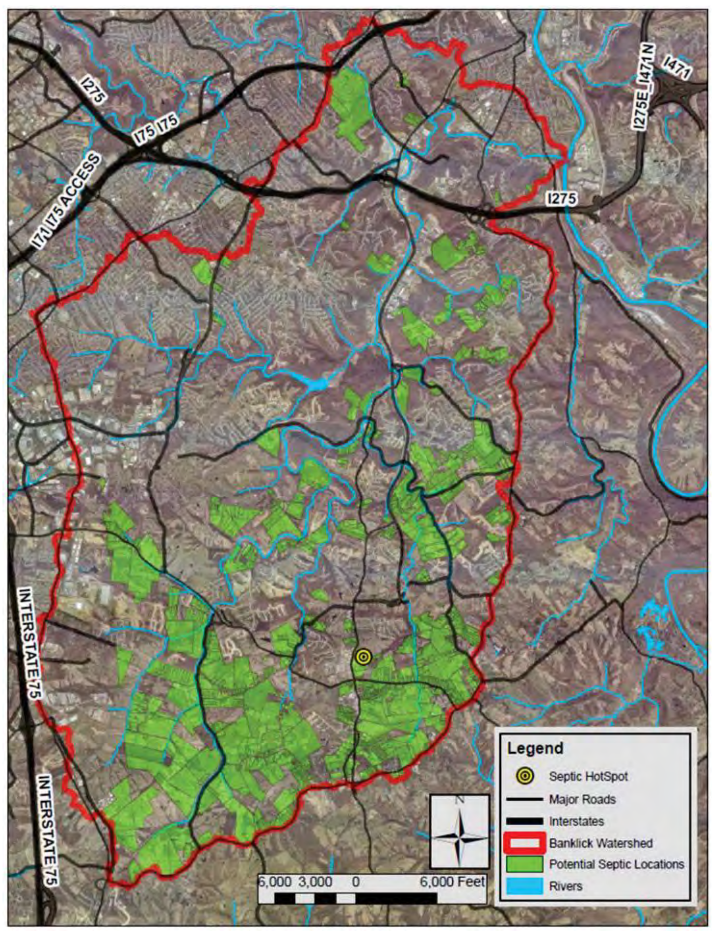

Figure 4.01-1 Banklick Watershed Septic Systems

Septic systems account for roughly 5 percent of the total lots within the watershed, mostly prevalent within the southern portions. These septic systems are shown in Figure 4.01-1. The "Septic Hotspot" identified in the figure is called out as an area that either has very small lots that have unrepairable failing systems or has systems that have been repaired to the extent practicable on the site but that are not fully functional.

In addition, a few other constituents were evaluated. Stream channelization by farmers and developers was assessed. Through these actions, riparian areas along waterways decreases. This removes shade from the streams which increases temperatures and also reduces the dissolved oxygen in the water. Construction activities, a significant contributor to nonpoint source pollution, has been regulated by SD1; by following the established rules and regulations, construction activities should not impair Banklick's water quality. Wildlife, especially waterfowl, have been shown to increase sediment loading and concentrations of ammonia, organic nitrogen, and *E.coli* bacteria (USGS 1997). Lastly, 162 suspended illicit activities (SIA) were identified during SD1's stormwater mapping project, and SD1 will continue efforts to determine their recurrence.

c. The results of the findings from the source assessment showed fecal impairment causes in Banklick Creek to be a result of CSOs, SSOs, septic systems, KPDES outfalls, stormwater runoff, livestock, and Licking River backwater. Figures 4.01-2 through 4.01-4 provide the watershed's total suspended solids total phosphorus, and fecal loadings, respectively. Additional detail on these loadings can be found in Appendix X.

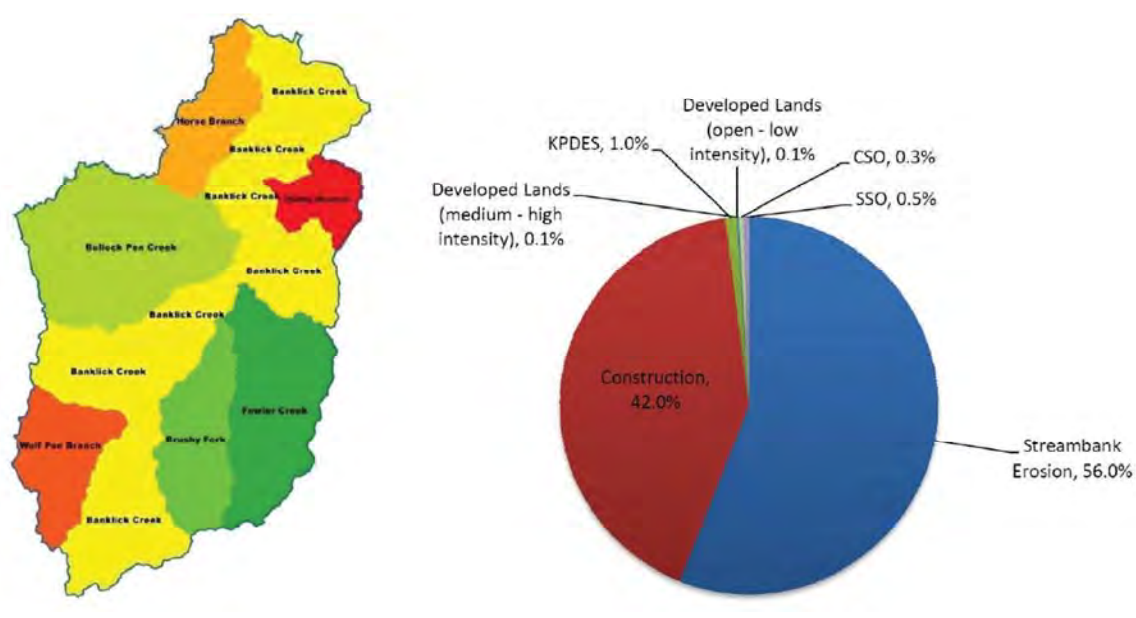

Figure 4.01-2 Total Suspended Solids Loading Allocation in Banklick Watershed

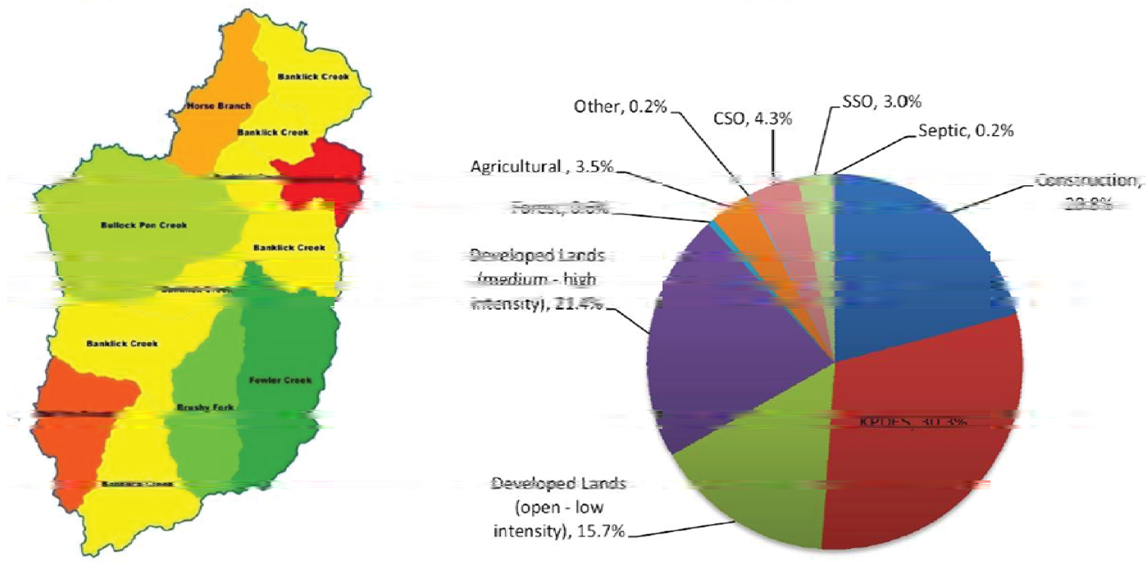

Figure 4.01-3 Total Phosphorus Loading Allocation in Banklick Watershed

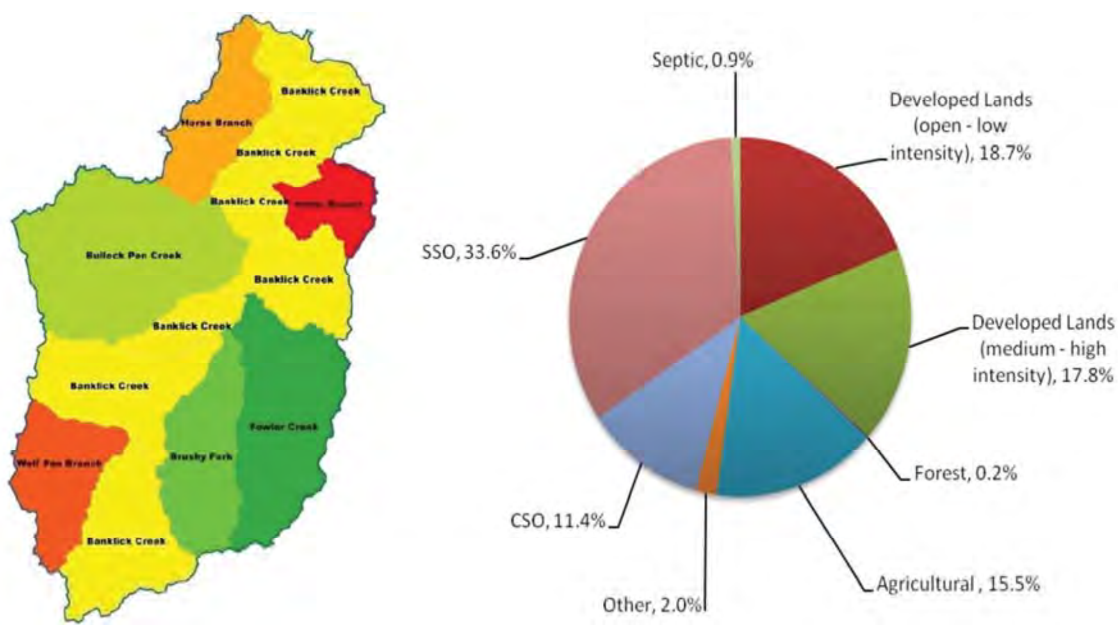

Figure 4.01-4 Fecal Loading Allocation in Banklick Watershed

B. Element B: Load Reduction Estimates

Modeling efforts necessary to estimate load reductions in the watershed were completed by SD1. SD1 used three constraints to represent water quality in the modeling: fecal coliform for bacteria, total suspended solids (TSS) for sediment, and phosphorus for nutrients. While modeling results were considered preliminary for TSS and phosphorus, it was assumed that no greater effort could have been conducted by BWC alone due to financial limitations so these constraints were used.

A Hydrologic Simulation Program in Fortran was developed for modeling purposes and infrastructure models were incorporated. Details on the calibration of the model can be found in Appendix H of *The Banklick Watershed Based Plan*.

	Modeled Annual Fecal Loading (Trillions of cfu)	Estimated Mean Annual Concentration* (cfus/100mL)	Necessary Load Reduction to Achieve WQS
Banklick Creek 1	3,119	67,556	99.4%
Horse Branch	2,069	39,487	99.0%
Banklick Creek 3	1,553	75,068	99.5%
Holds Branch	779	26,778	98.5%
Banklick Creek 5	2,582	130,615	99.7%
Bullock Pen Creek	4,127	30,304	98.7%
Banklick Creek 7	1,026	21,799	98.2%
Fowler Creek	1,043	10,608	96.2%
Banklick Creek 9	320	14,173	97.2%
Brushy Fork	652	10,092	96.0%
Banklick Creek 11	1,811	27,708	98.6%
Wolf Pen Branch	972	17,652	97.7%
Banklick Creek 13	1,129	16,883	97.6%

*arithmetic mean based on modeled annual loadings and average annual flow volume

Table 4.01-3 Estimated Annual Fecal Loading and Necessary Load Reduction by Subwatershed

Results from the modeling efforts showed all subwatersheds with estimated mean annual loading concentrations higher than the required 400 cfu/100 mL water quality standard. Concentrations were so high that every subwatershed required load reductions in excess of 95 percent to reach the WQS. These results are located in Table 4.01-3. While the values provided in the table seem high, reasoning for it was explained as the arithmetic mean is presented, a value typically higher than the geometric mean. The arithmetic mean was used as the geometric mean could not be calculated to express the total annual loadings without rigorous modeling. Also, the breakdown of fecal coliform by vegetation or stream fate was not included. Further information on this analysis is presented in Chapter 6 of *The Banklick Watershed Based Plan*.

Through the modeling efforts, estimated annual loadings of TSS and phosphorus were also calculated by subwatershed. TSS loading ranged from 91 mg/L to 638.94 mg/L. Phosphorus loadings ranged from 0.30 mg/L to 5.23 mg/L.

C. Element C: Water Quality-Based Goals

The water quality-based goal that the BWC set to meet was that of reducing fecal loading to 400cfu/100mL. At the time of the WBP completion, no WQS existed for TSS or phosphorus. Rather than trying to determine an appropriate load reduction target without a WQS or guidance, the watershed plan utilized the WQS for fecal coliform as a surrogate target value to determine the necessary management measures for the watershed. Based on these management measures, the resulting reductions in phosphorous and TSS can be calculated for documentation of progress. It would be possible to update the plan with target values of load reductions in TSS and/or phosphorus if future WQS are developed and funding becomes available.

Prior to outlining the specific ways to address the WQS attainment goals of the BWC, it was important to outline the ongoing and planned projects addressing constituents of concern currently in the pipeline for the watershed. Through this effort, efforts could be more easily focused on areas with no current projects. Through this effort, numerous projects were identified both through SD1, USACE, KyTC, and individual cities and counties.

Based on water quality impairment and existing project locations, the BWC defined a focus area for their efforts. Originally, there were five subwatersheds identified as the focus area, but Appendix K in *The Banklick Watershed Based Plan* called for the addition of Bullock Pen Branch. Bullock Pen Branch was added to include other partnering opportunities, such as the Kenton County Science Technology Engineering and Mathematics (STEM) Campus. The area, herein referred to as Focus Area, is highlighted in Figure 4.01-5. Directing efforts to these areas will allow for a targeted approach providing meaningful and measurable results.

Figure 4.01-5 Updated Banklick Watershed Council Focus Area for Targeted Management Measures with 319(h) Funding

After the focus area was determined, a coarse evaluation of loading allocations was completed. It revealed that, within these six subwatersheds, the majority of fecal loading was from SSOs, agriculture, and developed lands, the majority of TSS loading was from construction and SSOs, and the majority of phosphorus loading was from developed lands and construction.

Following this analysis, applicable management measures were identified. Recommendations from leading identified management efforts were divvied up between organizations with ties to the watershed; the organizations were SD1, the BWC with 319(h) grant funding, and other partnering organizations such as the Soil and Water Conservation District. Table 4.01-4 shows examples of structural and nonstructural management practices that were suggested.

Table 4.01-4 - Examples Of Structural and Nonstructural Management Practices

	Structural Practices	Nonstructural Practices
Agriculture	▪ Contour buffer strips* ✓ ¥ ▪ Grassed waterway ✓ ▪ Herbaceous wind barriers ▪ Mulching ▪ Live fascines ▪ Live staking ▪ Livestock exclusion fence (prevents livestock from wading into streams) ✓ ¥ ▪ Revetments ▪ Riprap ▪ Sediment basins* ▪ Terraces ▪ Waste treatment lagoons	▪ Brush management ▪ Conservation coverage ¥ ▪ Conservation tillage ¥ ▪ Educational Materials* ✓ ▪ Erosion and sediment control plan ¥ ▪ Nutrient management plan ¥ ▪ Pesticide management ¥ ▪ Prescribed grazing ▪ Residue management ▪ Requirement for minimum riparian buffer ¥ ▪ Rotational grazing ¥ ▪ Workshops/training for developing nutrient management plans ¥
Forestry	▪ Broad-based dips ▪ Culverts ▪ Establishment of riparian buffer* ✓ ▪ Mulch ▪ Revegetation of firelines with adapted herbaceous species ▪ Temporary cover crops ▪ Windrows	▪ Education campaign on forestry related nonpoint source controls ¥ ▪ Erosion and sediment control plans ¥ ▪ Forest chemical management ▪ Fire management ▪ Operation of planting machines along the contour to avoid ditch formation ▪ Planning and proper road layout and design ▪ Preharvest planning ▪ Training loggers and landowners about forest management practices, forest ecology, and silviculture
Urban	▪ Bioretention cells* ✓ ▪ Breakwaters ▪ Brush layering ▪ Infiltration basins* ✓ ▪ Green roofs* ▪ Live fascines ▪ Marsh creation/restoration ▪ Establishment of riparian buffers* ✓ ¥ ▪ Riprap* ▪ Stormwater ponds* ▪ Sand filters* ▪ Sediment basins* ▪ Tree revetments* ¥ ▪ Vegetated gabions ▪ Water quality swales* ✓ ▪ Clustered wastewater treatment systems*	▪ Planning for reduction of impervious surfaces (e.g. eliminating or reducing curb and gutter) * ▪ Management programs for on-site and clustered (decentralized) wastewater treatment systems* ▪ Educational materials* ✓ ¥ ▪ Erosion and sediment control plan* ¥ ▪ Fertilizer management ✓ ¥ ▪ Ordinances* ▪ Pet waste programs ✓ ¥ ▪ Pollution prevention plans* ▪ No-wake zones ▪ Setbacks ▪ Stormdrain stenciling* ▪ Workshops on proper installation of structural practices* ✓ ▪ Zoning overlay districts ▪ Perservation of open space ✓ ▪ Development of greenways in critical areas ✓

* To be considered for implementation by SD1.
✓ Recommended for implementation under the 319(h) grant
¥ Recommended for implementation through partnering organizations (Soil and Water Conservation District, Natural Resourced Conservation Service, Forestry Council etc.)

D. Element D: Technical and Financial Assistance

1. Technical Assistance

A large variety of organizations and individuals across Northern Kentucky played an active role in the development and implementation of the WBP. Additional information, including how to contact them, is located in *The Banklick Watershed Based Plan*.

2. Financial Assistance

The largest source of funding currently available for the implementation of the management measures described above is the 319(h) nonpoint source pollution grant that the BWC received from KDOW. This funding, along with some local funding, will be used to implement the management measures to improve water quality in Banklick Watershed. The BWC did not use any of the funds from the 319(h) grant for KPDES permit-related activities such as municipal separate storm sewer system or CSO compliance. In addition, considerable investments will be made in the Banklick Watershed by SD1 as they work towards compliance with their consent decree requirements. A total breakdown of allocated funds can be found in Appendix A.

E. Element E: Information and Education

Public outreach, a staple in the on-going success of BWC, has continued with the WBP. The public involvement goal for this project will be to create an informed community, including stakeholders, government officials, and the general public. To date, informational meetings were held, and a public input survey was disseminated to the area. Also, in determining management measures, nearly each measure has an educational component, a testament to the importance of educating the public. Educational efforts will always be on-going within the watershed as the dynamic of the watershed and regulations change.

F. Element F: Schedule

The implementation schedule of the WBP outlines the main management measures, their subtasks, and denotes the timeline for completion. The schedule information can be found in the Watershed Based Plan document.

G. Element G: Milestones

A total of 12 milestones were created to provide a measure of success for the implementation of the WBP. Additional information, such as short-term and long-term breakdowns of these milestones can be found in the WBP. The milestones are listed below.

1. Obtain conservation easements or donated land for conservation in the Watershed.
2. Protect or enhance riparian buffers.
3. Allocate funding for urban runoff controls in the Focus Area.

4. Gather information on interest in a livestock fencing program and potential participants.
5. Distribute educational materials on dangers of unfenced livestock and results stream impairments.
6. Implement a pasture improvement program for livestock in the Focus Area.
7. Publish septic system informational articles in a local paper for public education.
8. Distribute educational materials-on property septic system maintenance and what to do in the case of a septic system failure-to 80 percent of known septic system owners.
9. Implement a cost-share program to encourage septic system owners to improve their failing systems.
10. Conduct infiltration best management practice demonstration workshops.
11. Explore opportunities to direct flows to low flow streams.
12. Allocate funding for visible demonstration BMPs in the Watershed.

H. <u>Element H: Criteria</u>

Benchmarks were set to evaluate the effectiveness of the management measures over the course of the project. The benchmarks were evaluated through collection of water quality data, calculations, and estimations.

I. <u>Element I: Monitoring</u>

Monitoring the watershed will help demonstrate progress toward set goals as well as improve the effectiveness of the program. SD1 will continue to monitor water quality, conducted in accordance with the Quality Assurance Project Plan in Appendix A of *The Banklick Watershed Based Plan.* Collected over the course of the 6 years this project was completed in, analysis was possible throughout the project. This was important to evaluate the time, cost, and effectiveness of implementation to adjust accordingly during the project timeline.

Overall, the development of the WBP was a success, as KDOW approved the plan in April 2010.

4.02 IMPLEMENTATION OF THE WATERSHED BASED PLAN

The successful implementation projects of the Banklick WBP are highlighted in the following sections.

A. <u>Reestablishment/Restoration of Riparian Buffers</u>

Protecting key riparian areas within the watershed was a huge part of the success of the WBP implementation. The BWC worked with KDOW and PDS to develop conservation deed language that provides adequate protections for acquired lands. The BWC was very successful in protecting three key properties within the watershed as listed in the table 4.02-1.

Location	Area (Acres)	Location	Property Description
Doe Run Lake	26.5	Doe Run Estates Erlanger, KY	Property around Doe Run Lake
Petty Property	14.3	Stephens Road, Independence, KY	High quality riparian areas
Canberra Ridge	48.3	Brushy Fork Tributary in Canberra Ridge subdivision	6,000 feet of high quality stream frontage

Table 4.02-1 Protected Riparian Areas

B. Livestock and Pasture Management

The pasture management program has not been successful for the BWC thus far. With only a few livestock owners in the target areas along the streams, there were limited opportunities to implement BMPs in this category. The council was unable to find willing livestock owners in the target area to coordinate with on a project.

C. Septic System Programs

In 2010, the septic repair program commenced. A grant application was sent to interested residents regarding a septic system repair grant. Residents were to complete an application form and submit it to BWC. The site was then evaluated by Northern Kentucky Health Department (NKHD) to determine what was necessary for the repair to be completed. Based on the NKHD inspector's ranking of the existing system's impact on water pollution in nearby streams, the highest ranking septic systems would qualify for repair first. For those selected applicants, Certified Septic System Installers were required to be contacted to evaluate the site and prepare bids. This documentation was also submitted to BWC. Once the installer was selected and the permit obtained, the work was able to be completed. This was also an opportunity to educate the residents about the importance of maintaining their septic systems. The program was successful, and six failing septic systems were repaired with 319 funding.

D. Shallow Infiltration Promotion

The shallow infiltration promotion efforts were very successful. The Council completed a number of projects in conjunction with various watershed partners. These projects are summarized as follows:

- Twenhofel reforestation project - 3,100 seedlings planted at a school with volunteer assistance and outreach.

- Scheper Court and Nicole Drive Detention Basin Retrofits - these retrofit projects involved the retrofit of an existing basin to promote greater overall water quality and hydromodification benefits. Two methods of retrofitting detention basins were compared as part of this project and ongoing monitoring is being conducted by SD1 to learn about the performance of these projects.

- Stream stabilization and bench full wetland project in Wolsing Woods - although this project was only advanced through the preliminary stages as part of this grant, it is an important project that the Council plans to continue implementing.

E BMP Locations

The following table provides the locations of each BMP installed as part of the watershed plan implementation.

BMP Name	Latitude	Longitude
Septic Repair	38.937523	-84.52795
Reforestation at Twenhofel	38.91311	-84.527015
Scheper Basin Retrofit	38.974700	-84.535043
Nicole Dr. Basin Retrofit	38.952452	-84.544409
Petty Property Purchase	38.934743	-84.516428
Brushy Fork Property Purchase	38.962305	-84.550815
Septic Repair	38.931906	-84.541512
Septic Repair	38.931973	-84.541855
Septic Repair	38.931706	-84.542069
Septic Repair	38.905111	-84.581959
Septic Repair	38.916982	-84.58065
Rain Garden Installation	39.01054	-84.581122
Doe Run Lake Property Acquisition	38.988394	-84.558922

Table 4.02-2 BMP Locations

SECTION 5
CONCLUSIONS

5.01 CONCLUSIONS

This section provides an overview of the measures of success as outlined in the project application.

1. Objective: Identify impaired waters and causes/sources of impairments

Measure of Success	Status at Project Completion
Obtain baseline water quality conditions for Banklick Creek and major tributaries	Accomplished through partnership with SD1
Obtain baseline physical conditions for Banklick Creek and major tributaries	Accomplished through partnership with SD1
Obtain baseline biological assessment of Banklick Creek and major tributaries	Accomplished through partnership with SD1
Submit a summary report that documents the causes and sources of impairments in the Banklick Creek watershed	Accomplished through partnership with SD1

2. Objective: Identify threats to other waters

Measure of Success	Status at Project Completion
Submit a summary report that documents threats to other, non-impaired waters in the Banklick Creek watershed	Accomplished through WBP submittal

3. Objective: Identify point source controls and nonpoint source management measures needed to attain and maintain water quality standards

Measure of Success	Status at Project Completion
Identify potential control measures to address impairments	Accomplished through WBP submittal
Select activities based on lasting impact, feasibility, and cost	Accomplished through WBP submittal
Submit a summary report that documents NPS control measures needed to attain and maintain water quality standards	Accomplished through WBP submittal

4. Objective: Identify who will be responsible for implementation of controls and measures

Measure of Success	Status at Project Completion
Identify responsible parties for implementation of control measures	Accomplished through WBP submittal
Invest responsible parties in the project and/or site legal standards documenting which parties are responsible	Accomplished through WBP submittal

5. Objective: Estimate load reductions that will be achieved

Measure of Success	Status at Project Completion
Submit a summary report that documents estimations of load reductions that will be achieved by implementing control measures	Accomplished through WBP submittal

6. Objective: Provide an implementation schedule with interim milestones

Measure of Success	Status at Project Completion
Prioritize activities based on impact, feasibility and available funding	Accomplished through WBP submittal
Submit implementation schedule	Accomplished through WBP submittal
Inform/invest responsible parties of the schedule	Accomplished through WBP submittal and monthly BWC meetings

7. Objective: Estimate implementation costs and identify financing sources

Measure of Success	Status at Project Completion
Submit implementation cost estimates	Accomplished through WBP submittal
Identify financing sources and inform them of the results of the WBP	Accomplished through WBP submittal

8. Objective: Identify technical assistance, outreach and education needed

Measure of Success	Status at Project Completion
Identify and obtain needed technical assistance	Accomplished through WBP submittal, pursuit of additional grant funding, and partnerships with other agencies
Identify and develop outreach material	Accomplished through WBP submittal and other outreach initiatives including website development
Identify and develop necessary educational material	Accomplished through WBP submittal and other initiatives including septic educational outreach
Inform/educate government officials of the importance of the WBP	Accomplished through engaging entities in the WBP process and stakeholder group
Market WBP and implementation efforts	Accomplished through the website and other environmental education events

9. Objective: Establish a monitoring plan and adaptive implementation process

Measure of Success	Status at Project Completion
Submit post-construction monitoring plan	Accomplished through detention basin retrofit

	monitoring and ongoing monitoring through SD1
Perform KDOW approved post-construction monitoring for activities completed during the implementation phase of this project (6 ½ years)	Partially accomplished through detention basin retrofit monitoring and ongoing monitoring through SD1

10. Objective: Create and involve Stakeholder Group throughout the project

Measure of Success	Status at Project Completion
Identify a range of stakeholder interests within the Banklick Creek watershed	Accomplished through WBP development and implementation and council meetings
Form a Stakeholder Group	Accomplished through WBP development and implementation and council meetings
Attendance at group meetings	Accomplished through council meetings

11. Objective: Identify and acquire Conservation Easements on selected properties to benefit water quality

Measure of Success	Status at Project Completion
Identify property owners with stream front property on Banklick Creek and its tributaries, as well as other properties that should be considered as candidates for conservation easements	Accomplished through WBP development
Develop Conservation Easement Deed with cooperation of KDOW and USEPA for the Banklick Creek	Accomplished in coordination with KDOW and PDS
Gain KDOW and USEPA approval of Conservation Easement Deed	Accomplished in coordination with KDOW and PDS
Acquire selected conservation easements from property owners for a nominal fee	Accomplished in coordination with PDS, and the Kenton County Conservancy

12. Objective: Implement selected activities of the WBP that lie within the scope of this project budget

Measure of Success	Status at Project Completion
Identify aspects of the WBP that are attainable within the scope of this project budget and that the BWC will pursue for implementation	Accomplished through WBP development
Solicit and work with necessary partners to ensure effective implementation	Accomplished in coordination with KDOW and PDS
Perform the selected remediation activity(s) according to the WBP and project partners	Partially accomplished through the completion of the BMP projects

5.02 RECOMMENDATIONS AND LESSONS LEARNED

Throughout the duration of this project, our team was able to identify methods that worked really well, as well as some methods that were not as effective. This section outlines our recommendations based on what we have learned through this project.

A. Designer Input and Review During Construction

One shortcoming our team identified was not allowing for enough input from the Design team during the construction process. Because of the unique nature of BMP construction, it is very important to monitor the construction process and ensure all elements are installed properly and all materials are appropriate. Our team has learned it is important to plan and scope adequate time for the designers to visit the site throughout construction to allow for these inspections.

B. Budget Management

Our team learned that with a fixed grant budget it is important to make the final project come in right on budget. This is a challenging task, and to accomplish this task, it was important for our group to have several alternative project options that were adaptable in scale and could be scaled up and down to adjust to the remaining budgets.

C. Match Management

With all 319 projects managing the match is critical because your 319 dollars depend on your ability to provide the match. We have found the identifying a reliable source of match early and building up the match makes it much easier to pay contractor invoices as they come in. Another interesting lesson we learned with the acquisition of properties which required large sums of money was when we did not have enough money in our accounts to make the full payment, we were able to negotiate a system with two separate payments which allowed us to invoice KDOW for the first payment, receive the reimbursement which was then available to be used for the second payment.

D. BMP Maintenance

As part of this project, several BMPs were constructed, and the BWC realized that these BMPs could only be successful if their long term maintenance is a top priority. To ensure this, the BWC coordinated with SD1 who agreed to take on the maintenance of the constructed BMPs. Having a plan of action in place early before constructing the BMPs was a very important element of the success of these projects.

E. Property Acquisition Challenges

The BWC spent time targeting the acquisition of several properties that ultimately did not come to fruition. The lesson that was learned as part of this process was that property acquisition is a very involved, challenging, and cumbersome process. There are a lot of moving pieces, and you really cant count on an acquisition being successful until the deed is signed.

SECTION 6
LITERATURE CITED

6.01 LITERATURE CITED

Limno-Tech, Inc. 2008. Banklick Creek Watershed Characterization Report. Preliminary Working Draft Watershed Conscent Decree. Prepared for Sanitation District No. 1 of Northern Kentucky.

Limno-Tech, Inc. 1998. Water quality assessment of Banklick Creek and the Lower Licking River. Prepared for Sanitation District No.1 in association with Woolpert LLP.

Limno-Tech, Inc. 2004. Watershed Assessment Protocol–Application to Banklick Creek. Prepared for Sanitation District No.1 of Northern Kentucky.

U.S. Army Corps of Engineers, Louisville District. Banklick Creek Watershed Kenton County, Kentucky Flood Danage Reduction/ Ecosystem Restoration Section 905(b) (WRDA 1986) Analysis. September 2000.

U.S. Department of Agriculture, Soil Conservation Service. 1973. Final environmental statement–Banklick Creek Watershed, Kenton and Boone Counties, Kentucky. USDA-SCS-ES-WS-(ADM)-72-25-(F).

U.S. Geological Survey, Bureau of Reclamation. Nitrogen and Phosphorus Loading from Drained Wetlands Adjacent to Upper Klamath and Agency Lakes, Oregon. April 1997. *The Banklick Watershed Based Plan*.

APPENDIX A
Financial and Administrative Close Out

Application Outputs

Banklick Watershed Council's Milestones

Milestone	Expected Begin Date	Expected End Date	Actual Begin Date	Actual End Date
1. ID and involve needed technical assistance.	Duration	Duration	---	11/14
2. QAPP Approval from KDOW.	2/08	3/08	N/A	N/A
3. Review and Summarize existing water quality (biological, chemical, and physical) data.	2/08	3/08	3/08	4/09
4. Collect Year 1 Water Quality Monitoring (as needed).	2/08	10/08	2/08	5/09
5. Collect Year 1 Physical (Habitat) data (as needed).	2/08	12/08	2/08	5/09
6. Form Stakeholder Group.	2/08	6/08	3/08	10/14
7. Develop Conservation Easement Deed.	2/08	2/08	5/08	12/09
8. ID properties to target for conservation easements.	Duration	Duration	---	11/14
9. Submit Conservation Deed to KDOW for review and approval.	4/08	8/08	8/09	12/09
10. Submit Draft WBP w/ Conservation Deed Focus to KDOW for review and acceptance.	4/08	9/08	11/09	4/10
11. Adopt Conservation Deed.	4/08	9/08	11/09	01/10
12. Acquire Conservation Easements.	4/08	10/13	4/08	10/14
13. ID impaired waters & threats to non-impaired waters.	5/08	9/08	5/08	6/09
14. ID necessary control measures.	5/08	11/08	8/08	10/09
15. Estimate Load Reductions.	6/08	11/08	9/08	10/09
16. Estimate Costs of control measures.	6/08	11/08	8/09	10/09
17. Hold Regular Stakeholder Group Meetings.	Duration	Duration	---	---
18. ID, inform, and involve responsible parties.	6/08	10/13	3/09	10/14
19. ID, inform, and involve funding agencies.	7/08	10/13	7/08	10/14
20. Prioritize control measures.	9/08	11/08	9/09	10/09
21. Submit implementation schedule.	10/08	12/08	10/09	11/09
22. Submit WBP to NPS Staff for review and acceptance.	11/08	2/09	11/09	4/10

23. Identify Implementation Projects and submit BMP Implementation Plan to KDOW for review and approval.	11/08	10/13	5/10	6/12
24. Implement targeted activities.	11/08	10/13	5/10	10/14
25. Submit Draft Educational & Outreach material to NPS Staff (as needed).	Duration	Duration	---	11/14
26. Perform post-construction monitoring on implemented projects (as needed).	1/10	10/13	1/14	10/14
27. Adapt implementation schedule as needed.	11/10	10/13	11/13	10/14
28. Submit Annual Report (w/BMP load red. estimates) upon request by KDOW.	Duration	Duration	---	11/14
29. Submit Final Project Report to NPS Staff in accordance with the final report guidelines to KDOW for review and approval.	9/13	10/13	10/14	11/14
30. Submit all draft materials to KDOW for review and approval.	Duration	Duration	---	11/14
31. Submit advanced notice to KDOW for all workshops, demonstrations, and/or field days.	Duration	Duration	---	11/14

Budget Summary

ORIGINAL Budget			
Budget Categories (Itemize all Categories)	§319(h)	Non-Federal Match	TOTAL
Personnel	$0	$19,800	$19,800
Supplies	$15,600	$0	$15,600
Equipment	$200	$0	$200
Travel	$400	$0	$400
Contractual	$510,000	$0	$510,000
Operating Cost	$0	$0	$0
Other	$73,800	$380,200	$454,000
Total	**$600,000**	**$400,000**	**$1,000,000**

REVISED Budget (08/2011)			
Budget Categories (Itemize all Categories)	§319(h)	Non-Federal Match	TOTAL
Personnel		$75,000	$75,000
Supplies	$2,500		$2,500
Equipment			
Travel		$250	$250
Contractual	$722,500		$722,500
Operating Cost			
Other	$75,000	$458,083	$533,083
Total	**$800,000**	**$533,333**	**$1,333,333**

The 08/2011 budget revision included the additional reallocation of grant funding to this project.

REVISED Budget (10/2012)			
Budget Categories (Itemize all Categories)	§319(h)	Non-Federal Match	TOTAL
Personnel		$75,000	$75,000
Supplies	$508.70	$1,335.15	$1,843.85
Equipment			
Travel		$167.96	$167.96
Contractual	$796,291.30		$796,291.30
Operating Cost			
Other	$3,200	$456,829.89	$460,029.89
Total	**$800,000**	**$533,333**	**$1,333,333.33**

The 10/2012 budget revision was updated to re-allocate funds to align with available match, and anticipated future expenditures.

REVISED Budget (5/2013)			
Budget Categories (Itemize all Categories)	§319(h)	Non-Federal Match	TOTAL
Personnel		$75,000	$75,000
Supplies	$508.70	$1,335.15	$1,843.85
Equipment	$12,000		$12,000
Travel		$167.96	$167.96
Contractual	$784,291.30		$784,291.30
Operating Cost			
Other	$3,200	$456,829.89	$460,029.89
Total	**$800,000**	**$533,333**	**$1,333,333.33**

The 5/2013 budget revision was updated to re-allocate funds to align with available match, and anticipated future expenditures.

REVISED Budget (11/2014)			
Budget Categories (Itemize all Categories)	§319(h)	Non-Federal Match	TOTAL
Personnel		$75,000	$75,000
Supplies	$568.59	$1,335.15	$1,903.74
Equipment	$8,229.87		$8,229.87
Travel		$167.96	$167.96
Contractual	$625,425.96		$625,425.96
Operating Cost			
Other	$165,775.58	$456,829.89	$622,605.47
Total	**$800,000**	**$533,333**	**$1,333,333.33**

The 11/2014 budget revision was updated to re-allocate funds to align with the actual final expenditures.

The Banklick Watershed Council was reimbursed $800,000. All dollars were spent; there were no excess project funds to reallocate.

Equipment Summary

The following flow monitoring equipment was purchased as part of this project and had a total purchase value of $8,229.87:

- ISCO Teledyne Flow Monitor, Sensor, Data Cable, Mounting Ring and Battery Pack 2 Each
- Novalynx Rain Gauge, Data Logger, Tipping Bucket, and Mounting Bracket 2 Each
- Water Quality Sampling Materials

The equipment will remain in the possession of the Banklick Watershed Council to be utilized for future monitoring projects.

Special Grant Conditions

No special conditions were placed on this grant.

ATTACHMENT A

Section 319(h) Nonpoint Source Project Progress Report

Reporting Period: Sept thru October **Grant No:** C9994861-07 **State:** Kentucky

Project Name: Banklick Creek Watershed Based Planning, Implementation, and Results

Contractor: Banklick Watershed Council
927 Forest Avenue
Covington, KY 41016

Budget Period Start Date: _9/12/14_ **End Date:** 10/31/14

Total Project Cost: _$1,333,333.33_

Expended this Period: $ 107,387.04
Total Expenditures to Date: $1,333,333.33

Waterbody/Watershed Identification: Banklick Creek Watershed and all sub watersheds (Wolf Pen Branch, Banklick Creek (7), Bullock Pen Creek, Horse Branch, Holds Branch, Fowler Creek, and Brushy Fork)

NPS Category: Watershed Based Plan with selected Implementation

Purpose Statement: To establish a comprehensive watershed based plan (WBP) that identifies the sources of pollution negatively impacting the Banklick and address the nine elements of a WBP.

BWC's Milestones

Milestone	Expected Begin Date	Expected End Date	Actual Begin Date	Actual End Date
1. ID and involve needed technical assistance.	Duration		---	---
2. QAPP Approval from KDOW.	2/08	3/08	N/A	N/A
3. Review and Summarize existing water quality (biological, chemical, and physical) data.	2/08	3/08	3/08	4/09
4. Collect Year 1 Water Quality Monitoring (as needed).	2/08	10/08	2/08	5/09
5. Collect Year 1 Physical (Habitat) data (as needed).	2/08	12/08	2/08	5/09

6. Form Stakeholder Group.	2/08	6/08	3/08	10/14
7. Develop Conservation Easement Deed.	2/08	2/08	5/08	12/09
8. ID properties to target for conservation easements.	Duration	Duration	---	---
9. Submit Conservation Deed to KDOW for review and approval.	4/08	8/08	8/09	12/09
10. Submit Draft WBP w/ Conservation Deed Focus to KDOW for review and acceptance.	4/08	9/08	11/09	4/10
11. Adopt Conservation Deed.	4/08	9/08	11/09	01/10
12. Acquire Conservation Easements.	**4/08**	**10/13**	**4/08**	**10/14**
13. ID impaired waters & threats to non-impaired waters.	5/08	9/08	5/08	6/09
14. ID necessary control measures.	5/08	11/08	8/08	10/09
15. Estimate Load Reductions.	6/08	11/08	9/08	10/09
16. Estimate Costs of control measures.	6/08	11/08	8/09	10/09
17. Hold Regular Stakeholder Group Meetings.	**Duration**	**Duration**	**---**	**---**
18. ID, inform, and involve responsible parties.	**6/08**	**10/13**	**3/09**	**10/14**
19. ID, inform, and involve funding agencies.	**7/08**	**10/13**	**7/08**	**10/14**
20. Prioritize control measures.	9/08	11/08	9/09	10/09
21. Submit implementation schedule.	10/08	12/08	10/09	11/09
22. Submit WBP to NPS Staff for review and acceptance.	11/08	2/09	11/09	4/10
23. Identify Implementation Projects and submit BMP Implementation Plan to KDOW for review and approval.	11/08	10/13	5/10	6/12
24. Implement targeted activities.	**11/08**	**10/13**	**5/10**	**10/14**

25. Submit Draft Educational & Outreach material to NPS Staff (as needed).	Duration	Duration	---	---
26. Perform post-construction monitoring on implemented projects (as needed).	**1/10**	**10/13**	**1/14**	**10/14**
27. Adapt implementation schedule as needed.	**11/10**	**10/13**	**11/13**	**10/14**
28. Submit Annual Report (w/BMP load red. estimates) upon request by KDOW.	Duration	Duration	---	---
29. Submit Final Project Report to NPS Staff in accordance with the final report guidelines to KDOW for review and approval.	**9/13**	**10/13**	**10/14**	**11/14**
30. Submit all draft materials to KDOW for review and approval.	Duration	Duration	---	---
31. Submit advanced notice to KDOW for all workshops, demonstrations, and/or field days.	Duration	Duration	---	---

Status of BWC's Milestones

Provide a brief sentence or two explaining the progress of each milestone.

1.) Strand Associates, Inc. has been contracted to help manage the 319 Grant and with the development of the WBP. Sanitation District No. 1 and Limno Tech, Inc. are being utilized for water quality information pertaining to the Banklick. As the project continues other technical resources may be identified. Northern Kentucky Independent Health District is providing technical assistance based on their experience with a septic system program recently completed in Grant County. Wilhelm Kossenjans, a university biology professor from UC will be taking a sabbatical, and would like to assist with the Banklick project. Wilhelm began to attend BWC meetings, and become familiar with the project. Casey Mattingly, a stream restoration engineer with MacTec, has also started attending BWC meetings and will provide assistance with the project.

2.) N/A

3.) Limno Tech has provided a DRAFT report on the water quality of the Banklick. This report is to be finalized in 09/08, resulting in a more detailed evaluation of the data. The draft version of the report is being reviewed by Strand Associates for applicable content. The appropriate information is being utilized to revise and update the Banklick Watershed Based Plan. LimnoTech has not finalized their water quality report. SD1 and Strand reviewed all of the water quality data that SD1 has on file for the Banklick and its tributaries. Due to the large amount of data, the most pertinent data will be selected for use in the plan. A meeting took place in October between Strand Associates and SD1 staff to sort through existing water quality and water sampling data. Relevant data includes biological and habitat assessments, wet and dry weather bacteria sampling, and USGS gage data. The review of this data was helpful in assessing the sources of pollution and defining the target areas for this grant to focus on. The final Banklick Creek Watershed Characterization report was finalized by Limno Tech in February 2009. The final document has been reviewed to help identify and assess the sources of pollution and to provide information for the scheduled public meetings. As of 4/09 all of the data that will be collected for this grant has been collected and summarized for the watershed based plan. This task is complete.

4.) SD1 conducted wet weather sampling in May. This information was collected for SD1 in addition to the 319 grant, and therefore was collected using the procedures identified in SD1's QAPP, and not the QAPP specified for this project (see milestone 2). No additional water quality data will be collected for year 1, this task is complete.

5.) SD1 conducted macro sampling in May. This information was collected for SD1 in addition to the 319 grant, and therefore was collected using the procedures identified in SD1's QAPP, and not the QAPP specified for this project (see milestone 2). Riparian buffer analysis, and stream conditions were assessed via SD1 hydromodification projects. No additional habitat data will be collected for year 1, this task is complete.

6.) BWC has a stakeholder group that was formed for the publishing of the Banklick Watershed Action Plan. This group is being reformulated, others may be added. Group continues to meet on a regular basis as issues arise and discussions are needed. New members of the stakeholder group are being identified. A UC Biology Professor and a stream restoration engineer at MacTec have recently joined the group (see milestone 1). A meeting with KDOW in Oct – revealed the need for a more comprehensive stakeholder group. The BWC collected several names of individuals and groups that should be represented in the stakeholder group. The BWC will renew efforts to enhance and grow the existing stakeholder group. BWC is working to attract more members to join the stakeholder group through public meetings. The first meeting was held March 23, some interest was shown for continued involvement with the council by the public attendees. The BWC continued working to attract more members to join the stakeholder group through public meetings. The second meeting was held April 16 and the third meeting was held April 30, some interest was shown for continued involvement with the council by the public attendees. In addition, the BWC previously sent out surveys to 500 residences within the Banklick watershed. Valuable insight was collected based on the personal knowledge of the 81 survey respondents. The Council has reached out to new members and has invited Rodney Crice and Gary Mattson to participate in the Council more actively. The council has voted Rodney and Gary to become new council members - both accepted the positions.

7.) A sample Conservation Easement Deed is under review between Strand and BWC to ensure the language is acceptable for use as in-kind match. The deed is now being reviewed by NKAPC, and will be sent to KDOW for language review. Sherry Carran and Sharmali Sampath had a meeting with KDOW to discuss what needed to be included in the deed language to meet the criteria for this grant match. The language is being revised by Sherry and an internal meeting is scheduled with Strand and BWC to review the language and try to finalize it for approval. The meeting is scheduled for May 5. Sherry Carren, Sharmali Sampath, and Kelly Kaufman meet on May 5 to draft the final changes to the deed language. The BWC had the updated language reviewed by Dick Spore, an attorney in Northern Kentucky, to make sure the language was representative of a legal deed. He suggested a few minor changes. BWC submitted the updated deed language to KDOW for review. KDOW raised some issues and wanted language added regarding their 60% interest in the property. BWC has raised some concerns regarding the use of that language and Kenton Conservancy's willingness to approve that statement as part of the deed. BWC and KDOW are currently in the process of dealing with this concern. In addition BWC was having the property in question appraised. BWC continues to try to reach an understanding with KDOW on the conservation deed language. This has become a significant barrier to progress on land acquisition and grant implementation. To gain further input BWC asked a representative of EPA region 4 BWC needs KDOW approval for the deed language, and hope to work through this issues soon. The Conservation easement has been approved by KDOW, and the Kenton Conservancy. This task is complete.

8.) BWC is continuously looking for opportunities for conservation easements. Sherry Carran has identified several potential land areas that may be donated for conservation. A large piece of land near Doe Run Lake has been identified and may be donated to the KCCD due to Sherry's efforts. The Doe Run Lake land will be donated, and the dollar value match for that land, as well as the conservation deed language have not been finalized. The property owners along the Banklick Creek are being identified (via GIS parcel data) for potential land easement candidates. Based on the problems identified along the southern/headwaters portions of the Banklick during the March 23 public meeting, key property owners were identified for potential conservation easements. Based on input from the second and third public meetings, as well as the survey responses, properties with interested owners have been identified. In addition, BWC has begun discussions with a local developer regarding a plot of land with high quality forests. BWC continues to pursue land acquisition opportunities. BWC is having more success with outright land donation versus conservation easements at this time, which we view as a positive. Several key property owners have been contacted, and others have been identified for future discussions. The council continues to contact and work with property owners who may be interested in donating their land into conservation. This quarter, the first property will be able to be counted as match. The council continues to contact and work with property owners who may be interested in donating their land into conservation. The council identified a property along Banklick Creek owned by Eastern Kentucky Power. This property is extremely unique and had a very large stream frontage. The Eastern Kentucky Power company has the land for sale, the asking price for the land is more than the appraised value. The council is pursuing the purchase of the land, but can only offer the appraised value.

9.) The deed language was reviewed by NKAPC and sent to KDOW for approval – it is necessary to approve this language so that land near Doe Run Lake can be officially entered into conservation easement. BWC and KDOW are currently in the process of dealing with some language concerns from the Kenton Conservancy, discussed in milestone 8. Still pending acceptance of deed language by KDOW. KDOW approved the deed language. This task is complete.

10.) Draft WBP was submitted to KDOW in November for review. Comments were made on the November submittal by seven reviewers. A meeting was scheduled with Sherry Carran, Sharmili Reddy, Matt Wooten, John Lyons, Kelly Kuhbander, Brooke Shireman and Lajuanda Haight-Maybriar to review the comments on January 22. Strand and the council addressed all of the comments and re-submitted the watershed plan to KDOW for approval on March 24. KDOW approved the WBP. This task is complete.

11.) The Watershed Council has submitted the conservation deed language to a lawyer for a few tweaks to ensure that it is a legal document. The Council will adopt the deed as soon as it is legal. The watershed council adopted the conservation deed language in January of 2010, this task is complete.

12.) Discussions with potential landowners have begun; no easements have been acquired to date. Doe Run lake land will be donated as a match. Efforts continue to find landowners. BWC is discussing the deed language with KDOW, BWC has also acquired an attorney to review the deed for legality. Once this language is agreed upon, Doe Run Lake may be deeded over for match. Additionally, discussions have begun with a developer for easement or donation of land with high quality forest along Brushy Fork. The BWC has continued to work with land owners to acquire land. Current opportunities with high potential for success include the 26 acres at Doe Run Lake, 10 acres at hickory valley, 19 acres at fowler ridge, as well as potential streamside land on two developments in brushy fork. The council will be recording its first conservation deed this quarter as match. The council continues to work on obtaining more land. The council is actively pursuing the purchase of a large parcel of EKy Power Land with large stream frontage. This unique parcel is for sale, but will not be donated. The council worked with KDOW as well as property owners to put in an offer on this land. Once acquired, a conservation deed will be placed on the land, and it will be give to the Kenton Conservancy to hold in perpetuity. The council has made an offer on the property and is waiting for the final details to be worked out. The council is facing a challenge finding an appropriate entity to hold the permanent conservation deed. Kenton Conservancy does not want to hold it due to conflicts of interest. Hillside Trust does not want to hold the deed due to lack of stewardship funds. USFWS is unable to hold the deed. The EKy Power Property acquisition is not going to go through due to the inability of an organization to hold the property and perform needed maintenance. The council has move on to other opportunities. The council is pursuing 3 new land acquisition opportunities - John Woods property, Canberra Ridge Berling property, and Gary Petty property. The Council decided to pursue a property appraisal for the Canberra ridge - Berling property. The council will only be able to afford a portion of what is available on this land. The property appraisal will allow us to determine of the owner is willing to sell for the state appraised value. The second payment was made to the Petty Family for the remainder owed on the property purchase. Two appraisals were performed on the Carol Ann Lane property. The council has acquired a portion of the Brushy Fork property from Berling's Canberra Ridge development. This property has been placed into a conservation deed and was turned over to the Kenton Conservancy to hold the land in perpetuity. **Final payments have been made. This task is complete.**

13.) Impaired waters are being reviewed at this time – all waters in the Banklick are on the 303 (d) list. Additional water quality information and land use data is being investigated. Threats are being identified by creating map files of crop and livestock farms, septic tank properties, and CAFOs. Additional information is being collected and reviewed. The assessment of pollutant loadings and impaired waters continued in October in conjunction with the water quality data analysis. Detailed maps were created to identify target areas and the most likely sources of water impairment. Additionally, a stream walk or the Banklick headwaters was conducted to identify visual threats, riparian condition, and stream conditions. Based on the information gathered by the participants at the March 23 public meeting there are several concerns in the southern/headwater portions of the Banklick. Residents reported sediment build-up in the headwaters, flash flooding during rain events, large amounts of debris, and potential issues with an undersized culvert under a nearby railroad. The public meetings and the survey results from the residents helped finalize the impaired waters and threats to the waters. These results were the last information gathered for this task – this task is complete.

14.) Based on the data collected to date, possible control measures are being investigated. These control measures consist of cattle fencing, septic tank repair, and riparian buffer restoration. More details have been collected on potential control measures and their relative contributions, but this cannot be finalized until all water quality data and impaired waters have been completely assessed. Based on comments during the public meeting the BWC has identified potential areas for controls as well as property owners who may be willing to participate with the control projects. BWC has the potential to work with these owners to stabilize the Banklick on and around their property. As the draft of the Banklick watershed plan was being finalized, all of the data had been assessed, and all of the public comments had been considered in the identification of control measures. All control measures suggested in the EPA guidance book were considered and those that were applicable were noted in the watershed plan. This task was completed through the preparation of the watershed based plan. This task is now complete.

15.) Based on rough figures, general load reductions are being calculated for different control situations. As the watershed plan was being completed, load reductions were calculated for proposed management measures. Load reductions were considered both in comparison to water quality standards, and also as unit load reductions based on the level of implementation. This task was completed through the preparation of the watershed based plan. This task is now complete.

16.) Costs of control measures were considered on a unit cost basis and are included in the watershed plan. Costs were considered on a unit basis due to the uncertain level of implementation of each management measure. This task was completed through the preparation of the watershed based plan. This task is now complete.

17.) A BWC meeting is scheduled for the beginning of September. Strand Associates has met with Sherry Carran several times to communicate project objectives and progress. BWC meetings were held on July 25 and Sept 18. A BWC meeting was held with KDOW in attendance on October 28. A BWC meeting was held on February 5, to begin preparation for the first of three public meetings. Several committee members were involved with the preparation and distribution of the flyers as well as discussions on the topics and agenda for the public meetings. The BWC met on Sept 29 to review and discuss the draft watershed plan. The council is still working to incorporate input from additional stakeholders. Several stakeholders who are not members of the council have been regularly attending meetings. conversations to date have been dealing with finalization of the easement deed language. BWC continues to have council meetings, and open dialogues with KDOW throughout the project. The council met on Oct 13th, and December 7th 2009. The council has begun to hold regular meetings on the first Monday of the month at 3:00 at the NKAPC building. Council meetings were held on 4/5/10, 5/3/10 and 6/7/10. Council meetings were held on 7/6/10, 8/2/10 and 9/7/10. Council meetings were held on 10/4/10 and 11/1/10. The December meeting was cancelled. Council meetings were held in Jan, Feb and March of 2011. Council meetings were held in April, May, and June 2011. Council meetings we held in July, August and September 2011. Council Meetings were held January February and March of 2012. Council Meetings were held April, May and June of 2012. **Council meetings were held monthly. This task is complete.**

18.) Ongoing. BWC sent out 500 flyers to the residents in the southern/headwater portion of the watershed notifying them of the public meeting on March 23. Each participating resident was given the opportunity to highlight areas of the Banklick where they knew of problems or had concerns. Two additional public meetings were held this quarter, on April 16th and April 30th. These meetings were held at various locations throughout the watershed so that all residents had an opportunity to attend. The BWC also sent out surveys for those who could not attend the meetings – they received 81 responses from the distributed surveys. The survey results provided useful information about the problems throughout the watershed, according to the residents. This is an ongoing effort that the Council continues, new residents occasionally attend a council meeting to learn more about the council. The council continues to engage and involve the stakeholders when appropriate. As the plan is approved, the BWC intends to present the information to all relevant stakeholders. The council continues to inform and involve people as much as possible. Sherry Carran met with the president of the Cattleman's association in the hope of getting assistance and support for our pasture management program. **The council continues to involve key stakeholders including KDOW, NKy Health Department, SD1, etc. This task is now complete.**

19.) KDOW has been informed with each invoice submittal of the progress of the grant. A KDOW field visit with BWC and the consultant team is scheduled for 10-28. KDOW has been informed of the progress of the plan is it moves forward, and they were in attendance at the 10/28 BWC meeting. Representatives from KDOW attended the first BWC Public Meeting on March 23. BWC and KDOW continue to have regular conversations regarding the Banklick grant. KDOW representatives have attended both council meetings this quarter. KDOW representatives are invited to all BWC events and meetings. This quarter the KDOW representatives were in attendance at all council meetings and also met to review the comments on the plan. KDOW representatives are invited to all BWC events and meetings. KDOW representatives were informed and invited to all BWC events. KDOW was informed and invited to all events and meetings. Additionally, KDOW was closely coordinating with the council to approve the purchase of the EKY Power property. **KDOW was informed and invited to all events and meetings. This task is now complete.**

20.) Using the data gathered at the public meetings, and all of the watershed information and data previously gathered, the team has begun to prioritize the problems in the watershed and prioritize the appropriate control measures. As the draft watershed plan was completed, the control measures were prioritized in a way that focused efforts on the upper portions of the watershed, and allowed public agencies to focus in the lower portions. Specific controls were then prioritized based on the impact that they could have in the watershed. Control measures were prioritized through the development of the watershed based plan – this task is now complete.

21.) An implementation schedule was included as part of the watershed based plan submittal. This task is now complete.

22.) The watershed based plan was submitted to KDOW for review and approval in November 2009. The watershed plan was reviewed by KDOW, and comments were provided back to the group on Jan 22. The comments were addressed and the plan was re-submitted to KDOW on March 24. The Watershed Based Plan was approved by KDOW.

23.) The Council has begun to identify implementation projects from the watershed based plan. The council has already been working on the acquisition of conservation easements, and this quarter they began to develop their Septic Program. An Implementation Plan was submitted and approved by KDOW for this program. The council has begun to plan for the next implementation project for pasture improvement. The council has had various discussions with the conservation district on how to supplement their programs with the 319 funding. SD1 has provided the council with detailed information from their source identification program. This information will be used to target specific property owners. This information will be used to target livestock owners whose animals have access to the streams. The council is actively pursuing the purchase of a large parcel of EKy Power Land with large stream frontage. This unique parcel is for sale, but will not be donated. The council worked with KDOW as well as property owners to put in an offer on this land. BMP implementation plans were prepared for pasture management and infiltration practices. BMP implementation plans for pasture management and infiltration practices were submitted to KDOW and approved. This task is now complete.

24.) The council began to implement the septic program this quarter. The council continued to implement the Septic System program this quarter. 5 properties signed up for the initial round of septic improvements. The council feels that this is a good start and more will sign up next year as the word is spread. The council is staring to locate property owners to participate in the livestock program. Since this program will be very site specific, BMP Implementation plans will be prepared once specific BMPs have been determined. The council also supported the Kenton County School District, in the development and construction of their green campus in Edgewood, KY. Kenton County School District (KCSD) spent $216,248.77 on green controls in the Banklick Watershed above and beyond what was needed for the KCSD 319 grant match. KCSD has allowed Banklick to use this excess match for the current 319 grant. The council continues to implement the septic system program, it is pursuing purchase of riparian areas for protection, and it is getting ready to start the pasture management program. The council is implementing a round of septic repairs in the Walnut Hall Area where failing septics are a known problem. Currently the council is focusing on spending the remaining grant funding on the activities identified in the watershed plan. The target activities currently being implemented are the septic program, property acquisitions, and detention basin retrofits for water quality and hydromodification improvements. Banklick asked SD1 to partner on the detention basin retrofits, and SD1 has agreed. The council is currently pursuing retrofits of 2 basins - one is in a privately owned residential area, and the other is owned by a developer. We have worked to create an easement agreement that allows SD1 access to the site to perform basin maintenance. SD1 has agreed to perform maintenance on these basins after the grant comes to completion so that they can learn from these demonstration projects. SD1 has also agreed to use their field crews to perform basin monitoring as needed. The council paid a contractor for septic tank repairs in the Walnut Hall area in July. BWC is continuing its partnership with SD1 on detention basin retrofits. Periodic site visits were conducted at the Scheper Court bioretention basin retrofit project in the spring and summer. Coordination with the contractor occurred to discuss remedial measures needed to remove sediment from the bioretention basin and to stabilize areas upstream from the bioretention basin with the re-establishment of vegetation. Post-construction flow monitoring data collected by SD1 at the detention basin retrofit projects was initially reviewed. Flow monitoring data is continuing to be collected by SD1 in an effort to determine the benefits provided by the detention basin retrofit projects. Activities implemented include the purchase of the Brushy Fork Property, collection of field data on the Wolsing Woods property where the council is collaborating with the Kenton Conservancy to design a stream and detention improvement, and updates to the Scheper basin project. **This task is now complete.**

25.) Educational materials have been filtered through KDOW for approval before they are used. Materials that were approved this quarter included powerpoint slides for public meetings, mailings, survey/handouts, maps for visual display, and informational pamphlets. Materials approved last quarter were used for both the second and third public meetings. Educational materials were submitted and approved by KDOW as part of the septic BMP implementation plan.

26.) **Post construction flow monitoring is being performed by SD1 on both of the basin retrofit project sites. This task is now complete as part of this grant, but SD1 will continue monitoring efforts as part of the next grant.**

27.) The council updated the anticipated project implementation schedule to lay out the plan for completing the implementation and spending all remaining funds within the grant timeline. **This task is now complete.**

28.) Completed in November 2008. Completed in November 2010. Completed November 2011. Completed November 2012. Completed November 2013. **Completed November 2014.**

29.) **Final Report has been submitted to KDOW for review and approval. Pending KDOW approval, this task is now complete.**

30.) All public meeting materials were approved by KDOW staff prior to use. Basin retrofit plans were submitted to KDOW and approved prior to advertisement for bid.

31.) KDOW staff were invited to all public meetings and were in attendance. Lajuanda Haight-Maybrier (KDOW) presented a brief introduction to watersheds at each of the public meetings.

Note: This is the final invoice and final grant report - this report concludes this grant reporting.

PREPARED by: Kelly Kuhbander, P.E., Project Engineer

STRAND ASSOCIATES®

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November 2014

Daniel Bishop
Kentucky Division of Water
Nonpoint Source Branch
14 Reilly Road
Frankfort, Kentucky 40601

Re: Banklick Watershed – 319 Grant# C9994861-07
Sept 12, 2014 through October 31, 2014

Dear Mr. Bishop:

Please find attached the updated progress and billing summaries for September 12 through October 31, 2014 for the 319 Grant in Banklick Watershed. This letter is transmitted as a request for payment for the above mentioned funds. Please note that this is the final submittal and will close out this grant.

If you should have any questions, please do not hesitate to contact me at (513) 861-5600.

Sincerely,

STRAND ASSOCIATES, INC.

Kelly Kuhbander

Kelly Kuhbander, P.E., LEED AP

Attachments: 319 Grant Billing Summary
Invoices
Attachment A Progress Update

cc: Sherry Carran – Banklick Watershed Council
Donna Horine - Banklick Watershed Council

INVOICE

Section 319(h) Nonpoint Source Project

Reporting Period: Sept. 12, 2014 - October 31, 2014 Grant # C9994861-07

Project Name: Banklick Creek Watershed
927 Forest Avenue
Covington, KY 41016

Contractor: Banklick Watershed Council

BILLING THIS PERIOD:

Budget Categories	319(h) Dollars	Match	Total
Personnel			$ -
Supplies			$ -
Equipment			$ -
Travel			$ -
Contractual	$44,811.46		$ 44,811.46
Operating Costs			$ -
Other	$62,575.58		$ 62,575.58
TOTAL:	**$ 107,387.04**	**$ -**	$ 107,387.04

REIMBURSEMENT AMOUNT (60% of Total) = $	**$ 64,432.22**

CUMULATIVE BILLING:

Budget Categories	319(h) Dollars	Match	Total
Personnel	$ -	$ 75,000.00	$ 75,000.00
Supplies	$ 568.59	$ 1,335.15	$ 1,903.74
Equipment	$ 8,229.87	$ -	$ 8,229.87
Travel	$ -	$ 167.96	$ 167.96
Contractual	$ 625,425.96	$ -	$ 625,425.96
Operating Costs	$ -	$ -	$ -
Other	$ 165,775.58	$ 456,829.89	$ 622,605.47
TOTAL:	**$ 800,000.00**	**$ 533,333.00**	**$ 1,333,333.00**

Starting Grant Award	$ 600,000.00	$ 400,000.00	$ 1,000,000.00
Re-Obligation Funds	$ 200,000.00	$ 133,333.00	$ 333,333.00
Remaining	**$ -**	**$ -**	**$ -**

Summary of Expenses				
Expense	**Cost**	**Date**	**Note**	**Documented**
Thelen, Sustainable Streams, Strand	$21,159.61	September + October	all combined on Strand invoice	X
Property Purchase (partial payment)	$61,100.00	10/28/2014	second and final payment - Brushy Fork Property	X
Brass Eagle	$23,187.85	October	Final work on scheper basin	X
Rain Guage Data Logger Purchase	$101.00	11/6/2014	replacing data logger	X
Attorney Title Work	$363.00	10/9/2014	for Brushy fork property	X
Property Purchase (partial payment)	$17,835.59	10/31/2014	second and final payment - Brushy Fork Property	X
ADJUSTMENT Property Purchase (carry to next grant)	-$16,360.01		Adjustment made to complete grant amount...overage will be counted on the next grant cycle.	
Total for this invoice	**$107,387.04**			

ATTACHMENT A

Section 319(h) Nonpoint Source Project Progress Report

Reporting Period: Sept thru October **Grant No:** C9994861-07 **State:** Kentucky

Project Name: Banklick Creek Watershed Based Planning, Implementation, and Results

Contractor: Banklick Watershed Council
927 Forest Avenue
Covington, KY 41016

Budget Period Start Date: _9/12/14_ **End Date:** 10/31/14

Total Project Cost: $1,333,333.33

Expended this Period: $ 107,387.04
Total Expenditures to Date: $1,333,333.33

Waterbody/Watershed Identification: Banklick Creek Watershed and all sub watersheds (Wolf Pen Branch, Banklick Creek (7), Bullock Pen Creek, Horse Branch, Holds Branch, Fowler Creek, and Brushy Fork)

NPS Category: Watershed Based Plan with selected Implementation

Purpose Statement: To establish a comprehensive watershed based plan (WBP) that identifies the sources of pollution negatively impacting the Banklick and address the nine elements of a WBP.

BWC's Milestones

Milestone	Expected Begin Date	Expected End Date	Actual Begin Date	Actual End Date
1. ID and involve needed technical assistance.	Duration		---	---
2. QAPP Approval from KDOW.	2/08	3/08	N/A	N/A
3. Review and Summarize existing water quality (biological, chemical, and physical) data.	2/08	3/08	3/08	4/09
4. Collect Year 1 Water Quality Monitoring (as needed).	2/08	10/08	2/08	5/09
5. Collect Year 1 Physical (Habitat) data (as needed).	2/08	12/08	2/08	5/09

6. Form Stakeholder Group.	2/08	6/08	3/08	10/14
7. Develop Conservation Easement Deed.	2/08	2/08	5/08	12/09
8. ID properties to target for conservation easements.	Duration	Duration	---	---
9. Submit Conservation Deed to KDOW for review and approval.	4/08	8/08	8/09	12/09
10. Submit Draft WBP w/ Conservation Deed Focus to KDOW for review and acceptance.	4/08	9/08	11/09	4/10
11. Adopt Conservation Deed.	4/08	9/08	11/09	01/10
12. Acquire Conservation Easements.	**4/08**	**10/13**	**4/08**	**10/14**
13. ID impaired waters & threats to non-impaired waters.	5/08	9/08	5/08	6/09
14. ID necessary control measures.	5/08	11/08	8/08	10/09
15. Estimate Load Reductions.	6/08	11/08	9/08	10/09
16. Estimate Costs of control measures.	6/08	11/08	8/09	10/09
17. Hold Regular Stakeholder Group Meetings.	**Duration**	**Duration**	**---**	**---**
18. ID, inform, and involve responsible parties.	**6/08**	**10/13**	**3/09**	**10/14**
19. ID, inform, and involve funding agencies.	**7/08**	**10/13**	**7/08**	**10/14**
20. Prioritize control measures.	9/08	11/08	9/09	10/09
21. Submit implementation schedule.	10/08	12/08	10/09	11/09
22. Submit WBP to NPS Staff for review and acceptance.	11/08	2/09	11/09	4/10
23. Identify Implementation Projects and submit BMP Implementation Plan to KDOW for review and approval.	11/08	10/13	5/10	6/12
24. Implement targeted activities.	**11/08**	**10/13**	**5/10**	**10/14**

25. Submit Draft Educational & Outreach material to NPS Staff (as needed).	Duration	Duration	---	---
26. Perform post-construction monitoring on implemented projects (as needed).	**1/10**	**10/13**	**1/14**	**10/14**
27. Adapt implementation schedule as needed.	**11/10**	**10/13**	**11/13**	**10/14**
28. Submit Annual Report (w/BMP load red. estimates) upon request by KDOW.	Duration	Duration	---	---
29. Submit Final Project Report to NPS Staff in accordance with the final report guidelines to KDOW for review and approval.	**9/13**	**10/13**	**10/14**	**11/14**
30. Submit all draft materials to KDOW for review and approval.	Duration	Duration	---	---
31. Submit advanced notice to KDOW for all workshops, demonstrations, and/or field days.	Duration	Duration	---	---

Status of BWC's Milestones

Provide a brief sentence or two explaining the progress of each milestone.

1.) Strand Associates, Inc. has been contracted to help manage the 319 Grant and with the development of the WBP. Sanitation District No. 1 and Limno Tech, Inc. are being utilized for water quality information pertaining to the Banklick. As the project continues other technical resources may be identified. Northern Kentucky Independent Health District is providing technical assistance based on their experience with a septic system program recently completed in Grant County. Wilhelm Kossenjans, a university biology professor from UC will be taking a sabbatical, and would like to assist with the Banklick project. Wilhelm began to attend BWC meetings, and become familiar with the project. Casey Mattingly, a stream restoration engineer with MacTec, has also started attending BWC meetings and will provide assistance with the project.

2.) N/A

3.) Limno Tech has provided a DRAFT report on the water quality of the Banklick. This report is to be finalized in 09/08, resulting in a more detailed evaluation of the data. The draft version of the report is being reviewed by Strand Associates for applicable content. The appropriate information is being utilized to revise and update the Banklick Watershed Based Plan. LimnoTech has not finalized their water quality report. SD1 and Strand reviewed all of the water quality data that SD1 has on file for the Banklick and its tributaries. Due to the large amount of data, the most pertinent data will be selected for use in the plan. A meeting took place in October between Strand Associates and SD1 staff to sort through existing water quality and water sampling data. Relevant data includes biological and habitat assessments, wet and dry weather bacteria sampling, and USGS gage data. The review of this data was helpful in assessing the sources of pollution and defining the target areas for this grant to focus on. The final Banklick Creek Watershed Characterization report was finalized by Limno Tech in February 2009. The final document has been reviewed to help identify and assess the sources of pollution and to provide information for the scheduled public meetings. As of 4/09 all of the data that will be collected for this grant has been collected and summarized for the watershed based plan. This task is complete.

4.) SD1 conducted wet weather sampling in May. This information was collected for SD1 in addition to the 319 grant, and therefore was collected using the procedures identified in SD1's QAPP, and not the QAPP specified for this project (see milestone 2). No additional water quality data will be collected for year 1, this task is complete.

5.) SD1 conducted macro sampling in May. This information was collected for SD1 in addition to the 319 grant, and therefore was collected using the procedures identified in SD1's QAPP, and not the QAPP specified for this project (see milestone 2). Riparian buffer analysis, and stream conditions were assessed via SD1 hydromodification projects. No additional habitat data will be collected for year 1, this task is complete.

6.) BWC has a stakeholder group that was formed for the publishing of the Banklick Watershed Action Plan. This group is being reformulated, others may be added. Group continues to meet on a regular basis as issues arise and discussions are needed. New members of the stakeholder group are being identified. A UC Biology Professor and a stream restoration engineer at MacTec have recently joined the group (see milestone 1). A meeting with KDOW in Oct – revealed the need for a more comprehensive stakeholder group. The BWC collected several names of individuals and groups that should be represented in the stakeholder group. The BWC will renew efforts to enhance and grow the existing stakeholder group. BWC is working to attract more members to join the stakeholder group through public meetings. The first meeting was held March 23, some interest was shown for continued involvement with the council by the public attendees. The BWC continued working to attract more members to join the stakeholder group through public meetings. The second meeting was held April 16 and the third meeting was held April 30, some interest was shown for continued involvement with the council by the public attendees. In addition, the BWC previously sent out surveys to 500 residences within the Banklick watershed. Valuable insight was collected based on the personal knowledge of the 81 survey respondents. The Council has reached out to new members and has invited Rodney Crice and Gary Mattson to participate in the Council more actively. The council has voted Rodney and Gary to become new council members - both accepted the positions.

7.) A sample Conservation Easement Deed is under review between Strand and BWC to ensure the language is acceptable for use as in-kind match. The deed is now being reviewed by NKAPC, and will be sent to KDOW for language review. Sherry Carran and Sharmali Sampath had a meeting with KDOW to discuss what needed to be included in the deed language to meet the criteria for this grant match. The language is being revised by Sherry and an internal meeting is scheduled with Strand and BWC to review the language and try to finalize it for approval. The meeting is scheduled for May 5. Sherry Carren, Sharmali Sampath, and Kelly Kaufman meet on May 5 to draft the final changes to the deed language. The BWC had the updated language reviewed by Dick Spore, an attorney in Northern Kentucky, to make sure the language was representative of a legal deed. He suggested a few minor changes. BWC submitted the updated deed language to KDOW for review. KDOW raised some issues and wanted language added regarding their 60% interest in the property. BWC has raised some concerns regarding the use of that language and Kenton Conservancy's willingness to approve that statement as part of the deed. BWC and KDOW are currently in the process of dealing with this concern. In addition BWC was having the property in question appraised. BWC continues to try to reach an understanding with KDOW on the conservation deed language. This has become a significant barrier to progress on land acquisition and grant implementation. To gain further input BWC asked a representative of EPA region 4 BWC needs KDOW approval for the deed language, and hope to work through this issues soon. The Conservation easement has been approved by KDOW, and the Kenton Conservancy. This task is complete.

8.) BWC is continuously looking for opportunities for conservation easements. Sherry Carran has identified several potential land areas that may be donated for conservation. A large piece of land near Doe Run Lake has been identified and may be donated to the KCCD due to Sherry's efforts. The Doe Run Lake land will be donated, and the dollar value match for that land, as well as the conservation deed language have not been finalized. The property owners along the Banklick Creek are being identified (via GIS parcel data) for potential land easement candidates. Based on the problems identified along the southern/headwaters portions of the Banklick during the March 23 public meeting, key property owners were identified for potential conservation easements. Based on input from the second and third public meetings, as well as the survey responses, properties with interested owners have been identified. In addition, BWC has begun discussions with a local developer regarding a plot of land with high quality forests. BWC continues to pursue land acquisition opportunities. BWC is having more success with outright land donation versus conservation easements at this time, which we view as a positive. Several key property owners have been contacted, and others have been identified for future discussions. The council continues to contact and work with property owners who may be interested in donating their land into conservation. This quarter, the first property will be able to be counted as match. The council continues to contact and work with property owners who may be interested in donating their land into conservation. The council identified a property along Banklick Creek owned by Eastern Kentucky Power. This property is extremely unique and had a very large stream frontage. The Eastern Kentucky Power company has the land for sale, the asking price for the land is more than the appraised value. The council is pursuing the purchase of the land, but can only offer the appraised value.

9.) The deed language was reviewed by NKAPC and sent to KDOW for approval – it is necessary to approve this language so that land near Doe Run Lake can be officially entered into conservation easement. BWC and KDOW are currently in the process of dealing with some language concerns from the Kenton Conservancy, discussed in milestone 8. Still pending acceptance of deed language by KDOW. KDOW approved the deed language. This task is complete.

10.) Draft WBP was submitted to KDOW in November for review. Comments were made on the November submittal by seven reviewers. A meeting was scheduled with Sherry Carran, Sharmili Reddy, Matt Wooten, John Lyons, Kelly Kuhbander, Brooke Shireman and Lajuanda Haight-Maybriar to review the comments on January 22. Strand and the council addressed all of the comments and re-submitted the watershed plan to KDOW for approval on March 24. KDOW approved the WBP. This task is complete.

11.) The Watershed Council has submitted the conservation deed language to a lawyer for a few tweaks to ensure that it is a legal document. The Council will adopt the deed as soon as it is legal. The watershed council adopted the conservation deed language in January of 2010, this task is complete.

12.) Discussions with potential landowners have begun; no easements have been acquired to date. Doe Run lake land will be donated as a match. Efforts continue to find landowners. BWC is discussing the deed language with KDOW, BWC has also acquired an attorney to review the deed for legality. Once this language is agreed upon, Doe Run Lake may be deeded over for match. Additionally, discussions have begun with a developer for easement or donation of land with high quality forest along Brushy Fork. The BWC has continued to work with land owners to acquire land. Current opportunities with high potential for success include the 26 acres at Doe Run Lake, 10 acres at hickory valley, 19 acres at fowler ridge, as well as potential streamside land on two developments in brushy fork. The council will be recording its first conservation deed this quarter as match. The council continues to work on obtaining more land. The council is actively pursuing the purchase of a large parcel of EKy Power Land with large stream frontage. This unique parcel is for sale, but will not be donated. The council worked with KDOW as well as property owners to put in an offer on this land. Once acquired, a conservation deed will be placed on the land, and it will be give to the Kenton Conservancy to hold in perpetuity. The council has made an offer on the property and is waiting for the final details to be worked out. The council is facing a challenge finding an appropriate entity to hold the permanent conservation deed. Kenton Conservancy does not want to hold it due to conflicts of interest. Hillside Trust does not want to hold the deed due to lack of stewardship funds. USFWS is unable to hold the deed. The EKy Power Property acquisition is not going to go through due to the inability of an organization to hold the property and perform needed maintenance. The council has move on to other opportunities. The council is pursuing 3 new land acquisition opportunities - John Woods property, Canberra Ridge Berling property, and Gary Petty property. The Council decided to pursue a property appraisal for the Canberra ridge - Berling property. The council will only be able to afford a portion of what is available on this land. The property appraisal will allow us to determine of the owner is willing to sell for the state appraised value. The second payment was made to the Petty Family for the remainder owed on the property purchase. Two appraisals were performed on the Carol Ann Lane property. The council has acquired a portion of the Brushy Fork property from Berling's Canberra Ridge development. This property has been placed into a conservation deed and was turned over to the Kenton Conservancy to hold the land in perpetuity. **Final payments have been made. This task is complete.**

13.) Impaired waters are being reviewed at this time – all waters in the Banklick are on the 303 (d) list. Additional water quality information and land use data is being investigated. Threats are being identified by creating map files of crop and livestock farms, septic tank properties, and CAFOs. Additional information is being collected and reviewed. The assessment of pollutant loadings and impaired waters continued in October in conjunction with the water quality data analysis. Detailed maps were created to identify target areas and the most likely sources of water impairment. Additionally, a stream walk or the Banklick headwaters was conducted to identify visual threats, riparian condition, and stream conditions. Based on the information gathered by the participants at the March 23 public meeting there are several concerns in the southern/headwater portions of the Banklick. Residents reported sediment build-up in the headwaters, flash flooding during rain events, large amounts of debris, and potential issues with an undersized culvert under a nearby railroad. The public meetings and the survey results from the residents helped finalize the impaired waters and threats to the waters. These results were the last information gathered for this task – this task is complete.

14.) Based on the data collected to date, possible control measures are being investigated. These control measures consist of cattle fencing, septic tank repair, and riparian buffer restoration. More details have been collected on potential control measures and their relative contributions, but this cannot be finalized until all water quality data and impaired waters have been completely assessed. Based on comments during the public meeting the BWC has identified potential areas for controls as well as property owners who may be willing to participate with the control projects. BWC has the potential to work with these owners to stabilize the Banklick on and around their property. As the draft of the Banklick watershed plan was being finalized, all of the data had been assessed, and all of the public comments had been considered in the identification of control measures. All control measures suggested in the EPA guidance book were considered and those that were applicable were noted in the watershed plan. This task was completed through the preparation of the watershed based plan. This task is now complete.

15.) Based on rough figures, general load reductions are being calculated for different control situations. As the watershed plan was being completed, load reductions were calculated for proposed management measures. Load reductions were considered both in comparison to water quality standards, and also as unit load reductions based on the level of implementation. This task was completed through the preparation of the watershed based plan. This task is now complete.

16.) Costs of control measures were considered on a unit cost basis and are included in the watershed plan. Costs were considered on a unit basis due to the uncertain level of implementation of each management measure. This task was completed through the preparation of the watershed based plan. This task is now complete.

17.) A BWC meeting is scheduled for the beginning of September. Strand Associates has met with Sherry Carran several times to communicate project objectives and progress. BWC meetings were held on July 25 and Sept 18. A BWC meeting was held with KDOW in attendance on October 28. A BWC meeting was held on February 5, to begin preparation for the first of three public meetings. Several committee members were involved with the preparation and distribution of the flyers as well as discussions on the topics and agenda for the public meetings. The BWC met on Sept 29 to review and discuss the draft watershed plan. The council is still working to incorporate input from additional stakeholders. Several stakeholders who are not members of the council have been regularly attending meetings. conversations to date have been dealing with finalization of the easement deed language. BWC continues to have council meetings, and open dialogues with KDOW throughout the project. The council met on Oct 13th, and December 7th 2009. The council has begun to hold regular meetings on the first Monday of the month at 3:00 at the NKAPC building. Council meetings were held on 4/5/10, 5/3/10 and 6/7/10. Council meetings were held on 7/6/10, 8/2/10 and 9/7/10. Council meetings were held on 10/4/10 and 11/1/10. The December meeting was cancelled. Council meetings were held in Jan, Feb and March of 2011. Council meetings were held in April, May, and June 2011. Council meetings we held in July, August and September 2011. Council Meetings were held January February and March of 2012. Council Meetings were held April, May and June of 2012. **Council meetings were held monthly. This task is complete.**

18.) Ongoing. BWC sent out 500 flyers to the residents in the southern/headwater portion of the watershed notifying them of the public meeting on March 23. Each participating resident was given the opportunity to highlight areas of the Banklick where they knew of problems or had concerns. Two additional public meetings were held this quarter, on April 16th and April 30th. These meetings were held at various locations throughout the watershed so that all residents had an opportunity to attend. The BWC also sent out surveys for those who could not attend the meetings – they received 81 responses from the distributed surveys. The survey results provided useful information about the problems throughout the watershed, according to the residents. This is an ongoing effort that the Council continues, new residents occasionally attend a council meeting to learn more about the council. The council continues to engage and involve the stakeholders when appropriate. As the plan is approved, the BWC intends to present the information to all relevant stakeholders. The council continues to inform and involve people as much as possible. Sherry Carran met with the president of the Cattleman's association in the hope of getting assistance and support for our pasture management program. **The council continues to involve key stakeholders including KDOW, NKy Health Department, SD1, etc. This task is now complete.**

19.) KDOW has been informed with each invoice submittal of the progress of the grant. A KDOW field visit with BWC and the consultant team is scheduled for 10-28. KDOW has been informed of the progress of the plan is it moves forward, and they were in attendance at the 10/28 BWC meeting. Representatives from KDOW attended the first BWC Public Meeting on March 23. BWC and KDOW continue to have regular conversations regarding the Banklick grant. KDOW representatives have attended both council meetings this quarter. KDOW representatives are invited to all BWC events and meetings. This quarter the KDOW representatives were in attendance at all council meetings and also met to review the comments on the plan. KDOW representatives are invited to all BWC events and meetings. KDOW representatives were informed and invited to all BWC events. KDOW was informed and invited to all events and meetings. Additionally, KDOW was closely coordinating with the council to approve the purchase of the EKY Power property. **KDOW was informed and invited to all events and meetings. This task is now complete.**

20.) Using the data gathered at the public meetings, and all of the watershed information and data previously gathered, the team has begun to prioritize the problems in the watershed and prioritize the appropriate control measures. As the draft watershed plan was completed, the control measures were prioritized in a way that focused efforts on the upper portions of the watershed, and allowed public agencies to focus in the lower portions. Specific controls were then prioritized based on the impact that they could have in the watershed. Control measures were prioritized through the development of the watershed based plan – this task is now complete.

21.) An implementation schedule was included as part of the watershed based plan submittal. This task is now complete.

22.) The watershed based plan was submitted to KDOW for review and approval in November 2009. The watershed plan was reviewed by KDOW, and comments were provided back to the group on Jan 22. The comments were addressed and the plan was re-submitted to KDOW on March 24. The Watershed Based Plan was approved by KDOW.

23.) The Council has begun to identify implementation projects from the watershed based plan. The council has already been working on the acquisition of conservation easements, and this quarter they began to develop their Septic Program. An Implementation Plan was submitted and approved by KDOW for this program. The council has begun to plan for the next implementation project for pasture improvement. The council has had various discussions with the conservation district on how to supplement their programs with the 319 funding. SD1 has provided the council with detailed information from their source identification program. This information will be used to target specific property owners. This information will be used to target livestock owners whose animals have access to the streams. The council is actively pursuing the purchase of a large parcel of EKy Power Land with large stream frontage. This unique parcel is for sale, but will not be donated. The council worked with KDOW as well as property owners to put in an offer on this land. BMP implementation plans were prepared for pasture management and infiltration practices. BMP implementation plans for pasture management and infiltration practices were submitted to KDOW and approved. This task is now complete.

24.) The council began to implement the septic program this quarter. The council continued to implement the Septic System program this quarter. 5 properties signed up for the initial round of septic improvements. The council feels that this is a good start and more will sign up next year as the word is spread. The council is staring to locate property owners to participate in the livestock program. Since this program will be very site specific, BMP Implementation plans will be prepared once specific BMPs have been determined. The council also supported the Kenton County School District, in the development and construction of their green campus in Edgewood, KY. Kenton County School District (KCSD) spent $216,248.77 on green controls in the Banklick Watershed above and beyond what was needed for the KCSD 319 grant match. KCSD has allowed Banklick to use this excess match for the current 319 grant. The council continues to implement the septic system program, it is pursuing purchase of riparian areas for protection, and it is getting ready to start the pasture management program. The council is implementing a round of septic repairs in the Walnut Hall Area where failing septics are a known problem. Currently the council is focusing on spending the remaining grant funding on the activities identified in the watershed plan. The target activities currently being implemented are the septic program, property acquisitions, and detention basin retrofits for water quality and hydromodification improvements. Banklick asked SD1 to partner on the detention basin retrofits, and SD1 has agreed. The council is currently pursuing retrofits of 2 basins - one is in a privately owned residential area, and the other is owned by a developer. We have worked to create an easement agreement that allows SD1 access to the site to perform basin maintenance. SD1 has agreed to perform maintenance on these basins after the grant comes to completion so that they can learn from these demonstration projects. SD1 has also agreed to use their field crews to perform basin monitoring as needed. The council paid a contractor for septic tank repairs in the Walnut Hall area in July. BWC is continuing its partnership with SD1 on detention basin retrofits. Periodic site visits were conducted at the Scheper Court bioretention basin retrofit project in the spring and summer. Coordination with the contractor occurred to discuss remedial measures needed to remove sediment from the bioretention basin and to stabilize areas upstream from the bioretention basin with the re-establishment of vegetation. Post-construction flow monitoring data collected by SD1 at the detention basin retrofit projects was initially reviewed. Flow monitoring data is continuing to be collected by SD1 in an effort to determine the benefits provided by the detention basin retrofit projects. Activities implemented include the purchase of the Brushy Fork Property, collection of field data on the Wolsing Woods property where the council is collaborating with the Kenton Conservancy to design a stream and detention improvement, and updates to the Scheper basin project. **This task is now complete.**

25.) Educational materials have been filtered through KDOW for approval before they are used. Materials that were approved this quarter included powerpoint slides for public meetings, mailings, survey/handouts, maps for visual display, and informational pamphlets. Materials approved last quarter were used for both the second and third public meetings. Educational materials were submitted and approved by KDOW as part of the septic BMP implementation plan.

26.) **Post construction flow monitoring is being performed by SD1 on both of the basin retrofit project sites. This task is now complete as part of this grant, but SD1 will continue monitoring efforts as part of the next grant.**

27.) The council updated the anticipated project implementation schedule to lay out the plan for completing the implementation and spending all remaining funds within the grant timeline. **This task is now complete.**

28.) Completed in November 2008. Completed in November 2010. Completed November 2011. Completed November 2012. Completed November 2013. **Completed November 2014.**

29.) **Final Report has been submitted to KDOW for review and approval. Pending KDOW approval, this task is now complete.**

30.) All public meeting materials were approved by KDOW staff prior to use. Basin retrofit plans were submitted to KDOW and approved prior to advertisement for bid.

31.) KDOW staff were invited to all public meetings and were in attendance. Lajuanda Haight-Maybrier (KDOW) presented a brief introduction to watersheds at each of the public meetings.

Note: This is the final invoice and final grant report - this report concludes this grant reporting.

PREPARED by: Kelly Kuhbander, P.E., Project Engineer

STRAND ASSOCIATES®

Strand Associates, Inc.
910 West Wingra Drive
Madison, WI 53715
(608) 251-4843

Invoice

November 14, 2014
Project: No: 1901.001
Invoice No: 0108143

Sherry Carren
Banklick Watershed Council
927 Forest Avenue
Covington, KY 41016

Project: 1901.001 Banklick Watershed Based Planning and Implementation

Professional Services: October 01, 2014 through October 31, 2014

Professional Personnel

	Hours	Rate	Amount	
ENGINEER				
	2.50	242.17	605.43	
	2.75	201.25	553.44	
	.75	198.07	148.55	
	4.00	170.64	682.56	
	37.50	112.68	4,225.50	
	.75	108.30	81.23	
	16.75	106.94	1,791.25	
	.50	105.05	52.53	
	37.00	98.15	3,631.55	
	15.00	89.49	1,342.35	
	10.00	87.70	877.00	
	18.25	84.61	1,544.13	
TECHNICIAN				
	27.00	90.25	2,436.75	
	4.75	57.58	273.51	
SECRETARY				
	12.50	82.15	1,026.88	
	190.00		19,272.66	
Total Labor				**19,272.66**
Total Expenses				**1,886.95**
			Total this Invoice	**$21,159.61**

Outstanding Invoices

Number	Date	Balance
0106337	8/13/2014	39,465.53
0106702	9/11/2014	19,805.95
0107245	10/9/2014	4,383.15
Total		**63,654.63**

Contract Amount 386,700.00

Total Billings to Date 319,871.71

TERMS: Payment is due within 30 days of the date on this invoice.

FIFTH THIRD BANK

(NORTHERN KENTUCKY)
P.O. BOX 630900 CINCINNATI OH 45263-0900

BANKLICK WATERSHED COUNCIL
524 E SOUTHERN AVE
COVINGTON KY 41015-1532

0

660

Statement Period Date: 10/1/2014 - 10/31/2014
Account Type: Bus Basics Checking
Account Number: 30389520

Banking Center: Ft Mitchell
Banking Center Phone: 859-341-5920
Business Banking Support: 877-534-2264

BANKLICK WATERSHED COUNCIL
524 E. SOUTHERN AVE.
COVINGTON, KY 41015

Visit us at www.53.com

73-23/421 290

Oct. 9, 2014 Date

Pay to the Order of J. Ed. Norland Jr. $363.00

Three hundred sixty three and 00/100 Dollars

FIFTH THIRD BANK

For Brushy Fork Prop.

Donna M. Horine

⑆042100230⑆ 00303895 20⑈ 0290

10/15/2014 290 $363.00

BANKLICK WATERSHED COUNCIL
524 E. SOUTHERN AVE.
COVINGTON, KY 41015

Visit us at www.53.com

73-23/421 292

Oct. 28, 2014 Date

Pay to the Order of Heritage Bank $61,100.00

Sixty-one thousand one hundred and 00/100 Dollars

FIFTH THIRD BANK

For 2nd payment - Brushy Fork

Donna M. Horine

⑆042100230⑆ 00303895 20⑈ 0292

10/30/2014 292 $61,100.00

Save this Copy
for your records.

FIFTH THIRD BANK

22780837

CASHIER'S CHECK - Customer Receipt

February 07, 2014

Pay to the Order of: Gary Petty ***

$*******82,500.00

Amount: *EIGHTY TWO THOUSAND FIVE HUNDRED 00/100 US DOLLARS*

Memo:	balance of payment for property
Purchased by:	Donna Horine
Transaction #:	601138701
Cost Center:	0395
Method of Purchase:	Transfer

NON-NEGOTIABLE

The purchase of a Surety Bond may be required before any Cashier's Check on this bank will be replaced or refunded in the event it is lost, misplaced, or stolen.

Order Confirmation/Pro-forma Invoice

11/6/2014 1:42:55 PM
Onset Computer Corporation
470 MacArthur Blvd
Bourne MA 02532

Taken By: CN3 CS

Freight Terms: Prepaid

Collect ID:

Fed ID: 04-2710064

Customer: C026817

Donna Horine

Banklick Watershed Council
524 E Southern Ave
Covington KY 41015
United States

Ship To: 1

Donna Horine

Banklick Watershed Council
524 E Southern Ave
Covington KY 41015
United States

Email: donnahorine@gmail.com

Cust Currency: USD

Phone: 859-261-3525

Order	Cust PO	Ship Via	Date Order	Terms	Confirmation Date
WOG1056664		UPS - Ground	11/6/2014	Cyber CC VISA/MC	11/6/2014

Line/Release	Due Date	UM	Qty	Item	Unit Price	Net Amount
1			1		92.00000	92.00
	11/6/2014	EA		UX90-001		
				HOBO State/Pulse/Event/Runtime 128K		

Card Type: MC
Last 4 Digits: 2297
Card Holder: Donna M Horine
Exp Date: 12/16
Auth Code: 47286Z
Amount Charged: 101.00

#296
11-16-14
To Donna Horine -
reimbursement
for upfront payment

Order Confirmation/Pro-forma Invoice

11/6/2014 1:42:55 PM

Sales Amount:	**92.00**
Sales Tax:	**0.00**
Freight:	**9.00**
Misc:	**0.00**
Prepaid:	**0.00**
Total:	**101.00**

APPENDIX B
QAPP

Report for

Banklick Watershed Council

QA Project Plan for the Data Collection Program of the Banklick Creek Watershed Based Plan

Prepared by:

STRAND ASSOCIATES, INC.®
990 St. Paul Place
Cincinnati, OH 45206
www.strand.com

On Behalf of:

Banklick Creek Watershed Council

May 2005

Submitted for Approval to:

The Kentucky Natural Resources and
Environmental Protection Cabinet Department
for Environmental Protection Division of Water,
Nonpoint Source Section

Signature of Approving Official:

____

STRAND
ASSOCIATES, INC.®
ENGINEERS

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PROJECT MANAGEMENT

1.01 PROJECT MANAGEMENT

A. Problem Background

Northern Kentucky continues to grow at one of the fastest rates in the State of Kentucky, becoming one of the State's premier economic engines. Much of the development connected to the region's economic success has occurred in the Banklick Creek Watershed in North and Central Kenton County. Banklick Creek is the principal watershed in Kenton County, Kentucky, located directly across the Ohio River from downtown Cincinnati. Of the 58 square mile watershed, approximately 75% lies within urbanized areas such as Covington, Ft. Wright and Independence. The watershed includes aging communities, rapidly expanding suburbs, and agricultural areas.

Banklick Creek has been designated as one of the three "highest priority" watersheds in the Licking River basin. Its entire length is designated as a 1st-priority 303(d) listed stream (KDOW 1999). Impaired uses include aquatic life and primary contact recreation resulting from nutrients, organic enrichment/low dissolved oxygen, habitat alteration (non-flow), and pathogens. Pollution sources within the watershed include CSOs, SSOs, stormwater runoff, failing septic systems and NPS runoff. Additionally, the problem of habitat alteration is suspected to be from human modifications rather than by natural flow.

Yet, despite what appears to be a desperate picture, several plans are in place that suggest a possible recovery for the Banklick Creek Watershed. Beginning with the progressive leadership of Sanitation District Number 1 (SD1), the region's sanitary, combined, and storm sewers are now under the well-planned direction of one organization. With oversight from KDOW and USEPA, SD1 has entered into an agreement which lays out a process to mitigate the sanitary and combined sewer overflows. SD1 is also implementing a comprehensive urban stormwater program. Local municipalities are also discussing water quality in the planning process by considering conservation and greenspace opportunities.

As SD1 establishes programs to address CSOs, SSOs and stormwater issues, considerable improvement in the Banklick's water quality are anticipated. However, despite the efforts of SD1, the problem of Habitat Alteration falls outside the traditional purview of sanitary and storm water agencies. Moreover, data suggests that no matter the gains in water quality, the problems of habitat loss, reduced riparian corridors, and stream channelization will prevent the stream from being able to fully support aquatic life and meet its designated uses.

The goal of this project is to establish a comprehensive watershed based plan (WBP) that identifies the activities and the responsible parties necessary to reduce point and nonpoint sources of pollution negatively impacting the Banklick Creek. The WBP will be the avenue to achieve the ultimate goal of improved water quality and restored habitat of the Banklick Creek.

B. Project Description

Significant resources have been invested in the generation of physical, chemical and biological data throughout the length of the Banklick Creek in both wet and dry weather. This effort has resulted in a thorough understanding of the existing conditions of the stream and the environmental stressors and their relative significance throughout the watershed.

These studies have revealed the following impairments:

Parameter	Location
Fecal Coliform	Entire Length
Phosphorous	Entire Length
Sediment	Between RM 0-12
Copper	In vicinity of RM 0.5 and 8
Lead	Between RM 0.5 and 12
Dissolved Oxygen	Lower 3.5 miles
HABITAT ALTERATIONS	Entire Length

Additionally, a biological community assessment was conducted by the Sanitation District between 2001 and 2003. This project was designed to initiate a record of the creek's biological diversity and habitat quality that was used to establish baseline conditions to measure the efficiency of future water quality enhancement activities.

The Report titled *Habitat and Biological Community Assessment of Banklick Creek, Kentucky*, July 2003 states "Based on the discriminant analysis, additional data collected from Banklick Creek in the future can be classified using the linear functions developed. As more data are collected for different years or different seasons, the relationships could also be recalculated to strengthen the analysis.

Key points from this exercise are:

- A linear combination of five variables (Habitat Assessment Score, Composite Periphyton Biomass, Total Macroinvertebrate Individuals, % EPT and Total Fish Taxa) are sufficient to explain most of the site variation observed. Future analytical results should focus on these parameters."
- The ranking of the five variables in terms of explaining the observed variation are Habitat Assessment Score, fish IBI or fish taxa, macroinvertebrate – total individuals, composite chlorophyll a, and percent EPT. If economic reasons limit sampling efforts, this information can be used to decide which variables should be analyzed."

These extensive data sets have been generated over the past few years and therefore are still considered relevant in defining existing conditions. However, the over $1,000,000 investment by SD1 in this data will quickly diminish over time as result of the rapidly changing conditions within the watershed. In order to capitalize on this baseline information and to minimize the need for additional data, it is imperative to begin this project as soon as possible.

Based on the available data, it is not anticipated that additional water chemistry, geomorphic, or biological data will be needed at the beginning of the project. The existing data, valued at over $1,000,000, will be used as the project baseline. Focused post-construction monitoring will occur for any BMPs that are implemented during the 6.5-year project to serve as a measure of success. A post-construction monitoring plan will be developed as a part of the WBP.

Should any additional data (pre or post-construction) be required during the project, it will be collected in accordance with the Quality Assurance Project Plan (QAPP) as presented herein.

C. Quality Objectives and Criteria

C1. Water Chemistry Data

Should water chemistry data be collected, Table 1.01-1 summarizes the quality objectives and criteria for the water quality monitoring.

Type of QA/QC Check	Frequency Required	Total Number of Analyses	Acceptance Criteria
Matrix Spike (MS)	One sample per stream per year	One per year	Percent recovery should be greater than or equal to 20%
Matrix Spike Duplicate (MSD)	One sample per stream per year	One per year	Relative Percent Difference should less than or equal to 71%
Laboratory Blank	One per twenty samples analyzed or one at the beginning of the week	Subject to change, absolute minimum of three	No false positive
Laboratory Ongoing precision and recovery (OPR)	One per twenty samples analyzed or one at the beginning of the week	Subject to change, absolute minimum of three	Percent recovery should be greater than or equal to 20%

Table 1.01-1 Summary of Quality Objectives and Criteria

The percent recovery will be computed by the following formula:

$$R = 100 \times ([Nsp - Ns] / T)$$

Where:

- R is the percent recovery;
- Nsp is the number of colonies detected in the spiked sample;

- Ns is the number of colonies detected in the unspiked sample;
- T is the number of colonies added to the spiked sample (during the spiking process).

The relative percent difference (RPD), which is a quantitative measure of the laboratory's precision and difference in interference between the MS and the MSD sample matrix, will be calculated by the following formula:

RPD = 100 x ([=RMS - RMSD=] / $X_{(mean)}$)

Where:

- RPD is the relative percent difference
- RMS is the number of colonies detected in the matrix spike sample
- RMSD is the number of colonies detected in the matrix spike duplicate sample
- $X_{(mean)}$ is the mean of the MS and MSD recoveries

C2. <u>Geomorphic Data</u>

Should geomorphic data be required, the objective of the geomorphic assessment is to determine the primary causes of sediment and habitat impairment. An evaluation of in-channel sediment sources will be obtained from estimates of bank erosion rates and estimated rates of sediment production from other sources such as roadway ditches, construction sites and agricultural lands. Assessment of habitat will be evaluated based on EPA rapid bioassessment procedures conducted in a separate part of this project. Three basic groups of data will be collected: sediment samples, streambank samples, and stream geometric characteristics.

Surveying techniques that provide accuracy of about 1 cm in all directions will be used with the total station equipment that will be employed for stream geometric data collection. Also standard sieve analysis procedures employed by the geomechanics laboratory using standard ASTM techniques for fine and coarse aggregates will provide data for sediment size gradation to high precision. Large variations in geometric characteristics (typically on the order of 0.3 m) are associated with the subjective selection of bankfull elevations based on field indicators; therefore all bankfull indicators will be measured and flow levels associated with each indicator will be reported. These indicators include tops of coarse bar deposits, tops of fine bar deposits, low vegetation lines, tops of banks and floodplain elevations.

Sediment sampling in coarse bed channels is limited by the ability to only sample a very small portion of the streambed. Four techniques will be used to assess sediment in gravel and cobble bed streams:

1) pebble counts on each riffle studied

2) riffle subsurface bulk samples
3) bar bulk samples
4) 30 largest particles on the bar

Amounts of gravel required to characterize the active streambed will be determined according to Bunte and Abt (2001), Rosgen (1996) and Kappesser (2002).

To ensure consistency in the selection of sampling locations for bankfull indicators, for collection of geometric stream characteristics and for sampling of bar materials, the QA manager will conduct on-site quality checks.

C3. Biological Data

Should it be required, assessments of habitat will be evaluated based on EPA rapid bioassessment procedures. There will be quality objectives and controls on all biological sample types (algal, macroinvertebrate, and fish). To ensure quality on the smaller specimen, samples of algae and macroinvertebrates will be randomly selected from each sampling event and sent to outside authorities for independent taxononmic confirmation. An average of 10% of the total samples will be selected for independent verification.

The laboratory that performs the identification for the bulk of the samples (approximately 90% of the algal and macroinvertebrate samples) will adhere to its internal QA/QC program. Voucher species along with reference details and authorities consulted will be maintained in the laboratory.

D. Special Training/Certification

D1. Water Chemistry Data

Sampling technicians will be given training and instruction on the proper collection of environmental samples according to the procedure outlined in Section 2.2. An experienced sampling technician will direct the training. Laboratories conducting analytical work must be certified by US EPA and pass annual Kentucky Performance Evaluations.

D2. Geomorphic Data

The QA manager and project team have academic as well as professional training in applied morphology and the techniques necessary to collect and analyze the required geomorphic data. This training includes extensive academic and professional training in surveying, sediment sampling, hydraulic and hydrologic modeling, and geomorphic assessment.

D3. Biological Data

Sampling and Lab personnel must have proper training for both collection and identification techniques for biological sampling. Equipment operators and the QA manager must have documentation of having received all necessary training for operation of the manufacturers equipment used in this project.

E. Documents and Records

The identified QA/QC officer at Strand Associates will be responsible for ensuring appropriate project personnel have the most current approved version of the QA Project Plan. After the QA Project Plan has been approved by KDOW, it will be sent electronically to all appropriate personnel who will acknowledge their receipt and concurrence of the plan by e-mail reply. Should any revisions be necessary to the plan, the recipients will be sent the revised plan, and will be required to discard the old plan. Recipients will acknowledge their receipt and concurrence with the revised version by e-mail reply. The electronic circulation will save paper, time, and energy, while still ensuring the highest quality.

Analytical data from the laboratory(s) will be reported to Strand Associates. At a minimum, the data report will include the following:

- Date and time samples were collected,
- Date and time samples were received,
- Date and time samples were analyzed,
- Sample name and location,
- Analysis name and method,
- Results of analysis,
- Units of results,
- Reporting limit of analysis,
- Initials of technician(s) performing analysis,
- Results of laboratory blanks and other QA/QC.

At a minimum, field sampling notes will include:

- Location of sample source,
- Names of sampling technicians,
- Narrative summary of field conditions, including general weather conditions, stream flow, and any other noteworthy observations,
- Results of stream temperature, pH conductivity and dissolved oxygen levels,
- Date and time samples were collected.

Data and reports sent to Strand Associates will be reduced into a technical report deliverable once all samples due that year have been collected. This technical report will serve as a chapter of the Watershed Based Plan. The report will include the following information:

- Data summary and interpretation,
- Baseline conditions of waters in the Banklick Creek Watershed,
- Effects of Watershed Based Plan,
- Summaries of any problems and observations during sample collection and analysis,
- Complete listings of all collected data and chains of custody.

Technical reports, data, and the final Watershed Based Plan will be submitted to the Banklick Creek Watershed Council, Kentucky Division of Water, and stored at the Cinicinnati, OH office of Strand Associates for a period of not less than ten years.

SECTION 2
DATA GENERATIION AND ACQUISITION

2.01 DATA GENERATION AND ACQUISITION

A. Sampling Design

In order to develop a Watershed Based Plan that will protect and enhance the water quality of the Banklick Creek Watershed, a comprehensive understanding of the baseline health of the watershed must be established. Based on data from previous efforts and the current plans of Sanitation District Number 1, it is anticipated that minimal to no additional data collection will be required under the umbrella of this project. BWC will solicit technical assistance from experienced experts where needed, for example, the Center for Applied Ecology at Northern Kentucky University.

If it is determined that additional data needs to be collected, the sampling methods listed below are to be used.

B. Sampling Methods

B1. Water Chemistry Data

Should water quality data be required for this project, it will be generated by using any of the following methods: grab samples from stream banks or bridges, with auto-samplers connected to stream flow-meters,

1. Sampling from Stream Banks or Bridges/Overpasses

Samples will be collected from stream banks or bridges to minimize safety concerns. The procedures described below assume that a two-person sampling team with some basic knowledge of the accepted procedures used to collect environmental samples will take the samples. The two-person team will have decided before beginning work who will be the “Clean hands” and who will be the “Dirty hands”. The designation will determine the division of labor between them. In general, “Clean Hands” will be in charge of any activities that might involve direct contact with the sample, while “Dirty Hands” will handle equipment, take notes, and any other activities that do not involve direct contact with the sample. The specific duties of each individual are described below.

a. Before arriving on site both team members should have thoroughly washed and dried their hands and forearms. Soap and water should be kept on hand at all times in case a team member’s hands become excessively dirty.

b. Immediately upon arriving on site both team members should set-up any necessary safety equipment such as lights or cones. In cases where the bank slope is steep or slippery, or whenever there is a risk of a team member falling, especially if falling could results in being swept away in a fast moving stream, it may be necessary to 'tie-off' to a static object. It is highly recommended that a self-retracting lifeline, with a built in winch, be used to decrease the risk of falling and, if necessary, pull a team member out of the stream and/or up the bank without exposing other team members to the same hazards. It may be necessary to have a third team member available to act as a safety supervisor and lifeline operator.

c. Once all of the necessary equipment is set-up and it is safe to begin work, "Clean Hands" should put on a fresh pair of non-talc latex gloves and begin triple rinsing the pre-cleaned sampling bucket. If metals are among the analtyes to be tested, then the bucket should be made from a non-reactive plastic such as Nalgene; otherwise the bucket should be made from stainless steel.

d. While "Clean Hands" rinses the sampling bucket, "Dirty Hands" should be filling out the necessary field paper work, including preparing the label for the sample bottle(s), and begin taking any environmental readings (temperature, DO, pH, etc.)

e. After the bucket has been properly rinsed and the paperwork completed, "Dirty Hands" should put on a pair of non-talc latex gloves to assist "Clean Hands" in the sample collection.

f. "Dirty Hands" should throw the bucket into the water body, while only holding onto the rope and being careful to not touch the bank, tree branches, or anything else. Once the bucket is filled, "Dirty Hands" may pull in the bucket, being extremely careful not to let the bucket touch the bank, to "Clean Hands" who will empty the bucket back into the water body. This process needs to be repeated twice more to "river rinse" the bucket. This can be a tedious and time-consuming task, so in cases where it is possible to fill and empty the bucket without pulling it back to the bank or having the bucket touch anything, it is recommended to do so.

g. Now that the bucket has been 'river rinsed', the sample can be collected. "Dirty Hands" should follow the same procedure to lower and raise the bucket in Step 6, so that "Clean Hands" can submerge the sample bottle into the bucket to collect the sample while minimizing, to the greatest extent possible, the amount of exposure the sample has to the open air. Whenever possible, it is preferable that the bucket be submerged and the sample pulled up from beneath the surface.

h. Now that the sample has been collected, “Dirty Hands” should label and store the sample on ice in a clean cooler while “Clean Hands” changes gloves.

i. For analyses that require more than one bottle for sampling to be completed Steps 7 and 8 should be repeated (including the replacement of gloves) until enough volume has been collected.

j. When the sample needs to be composited over time, or if the sample site is not in a good mixing zone and the sample needs to be composited across the stream, it will be necessary to use a churn splitter. In that case, “Clean Hands” will need to have triple washed the churn splitter using deionized water and, if possible, a river rinse from the water body, making sure that all surfaces (including the lid) that may come in contact with the sample are rinsed and purged. The spigot should be purged with each washing.

k. The general process will remain the same when collecting time composited samples except that when “Clean Hands” has control of the sampling bucket, he will pour the sample into the churn splitter and immediately close the lid. This process will repeat until enough samples have been collected over the specified period of time.

l. In cases where the samples must be composited from aliquots from the left bank, right bank, and middle of the stream, the bucket should be thrown to one section of the stream by “Dirty Hands”, pulled across to “Clean Hands”, who will pour it directly into the churn splitter and immediately close the lid. This will need to be repeated at the next section until a cross-section of the stream has been collected into the churn splitter.

m. Now that the sample is ready to be collected, “Dirty Hands” should ‘churn’ the sample using at least ten slow strokes of the churn. It is very important that the churn never breaks the surface of the sample as this can introduce additional oxygen into the sample.

n. “Clean Hands” should purge excess samples before filling the sample bottles.

The following guidelines will help reduce the opportunity for contamination to enter the sample:

i. Be sure to position the churn splitter so that it is fairly level and the spigot is not touching anything.

ii. Avoid resting the churn splitter under trees, wires, poles etc.

iii. Minimize the amount of time the lid of the churn splitter is not secured over the churn splitter.

iv. When rinsing the churn splitter, use copious amounts of de-ionized water.

v. Before arriving on site, the churn splitter should have been thoroughly washed and dried. The churn splitter still needs to be triple rinsed once the team has arrived on site. If a bucket will be used to transport sample from the water body, it should also be washed and dried before arriving on site, in addition to being triple rinsed before sampling.

vi. If multiple sites are going to be sampled using the same equipment, sample in the order of the site with the lowest expected concentrations to the one with the highest. For example, if samples are going to be taken near a discharge point, the upstream sample should be taken first, then the downstream sample, and finally the sample nearest the discharge point.

vii. The churn splitter must be triple rinsed between every sample. It is preferred that it be cleaned as close in time as possible to the collection of the sample.

2. Collecting Samples Using a Flow Triggered Automatic Sampler

The procedures described below assume that a two-person sampling team with some basic knowledge of the accepted procedures used to collect environmental samples will take the samples. The two-person team will have decided before beginning work who will be the “Clean hands” and who will be the “Dirty hands”. The designation will determine the division of labor between them. In general, “Clean Hands” will be in charge of any activities that might involve direct contact with the sample, while “Dirty Hands” will handle equipment, take notes, and any other activities that do not involve direct contact with the sample. The specific duties of each individual are described below. The procedure described in this protocol assumes that the automatic sampler will be left in place at the sampling site and that a sampling team will collect the samples some time after an event is completed. Please refer to the user manual for information on setting-up and programming specific pieces of equipment.

a. Before arriving on site both team members should have thoroughly washed and dried their hands and forearms. Soap and water should be kept on hand at all times in case a team member’s hands become excessively dirty.

b. Immediately upon arriving on site both team members should set-up any necessary safety equipment such as lights, cones, or traffic barricades.

c. Once all of the necessary equipment is set-up and it is safe to begin work, “Clean Hands” should put on a fresh pair of non-talc latex gloves.

d. “Dirty Hands” should fill out the necessary field paper work, including preparing the label for the sample bottle(s), and begin taking any environmental readings (temperature, DO, pH, etc.) Once that is completed, “Dirty Hands” should put on a fresh pair of non-talc latex gloves to assist in the sample collection.

e. “Dirty Hands” should unlock the sample bottle compartment and open up the automatic sampler so that “Clean Hands” has free and easy access to the sample bottles.

f. “Dirty Hands” should then open the bags containing the automatic sampler bottle caps but should not actually touch the caps. “Clean Hands” should reach into the bags and bring out each cap for the bottles.

g. After all of the sample bottles have been sealed, they can be removed from the automatic sampler, labeled, and stored on ice in a clean cooler.

h. In cases where the sample must be transferred to a “traditional” sample bottle, the sample should be carefully poured from the automatic sampler bottle into the “traditional” sample bottle. At no time should the automatic sampler bottle touch the “traditional” bottle. The use of a funnel is strongly discouraged however if it is necessary the funnel should be pre-cleaned thoroughly and stored in at least two airtight bags made of non-reactive plastic.

i. If several bottles are going to be composited for analysis the use of a churn splitter will be necessary. In that case, “Clean Hands” will need to have triple washed the churn splitter using deionized water, paying close attention to be sure that all surfaces, including the lid, that may come in contact with the sample are rinsed and purged the spigot with each washing.

j. The appropriate automatic sampler bottles should be poured into the churn splitter and the lid closed immediately.

k. Now that the sample is ready to be collected, “Dirty Hands” should ‘churn’ the sample using at least ten slow strokes of the churn. It is very important that the churn never breaks the surface of the sample as this can introduce additional oxygen into the sample.

l. "Clean Hands" should purge with excess sample before filling the sample bottles.

The following guidelines will help reduce the opportunity for contamination to enter the sample:

i. Be sure to position the churn splitter so that it is fairly level and the spigot is not touching anything.

ii. Avoid resting the churn splitter under trees, wires, poles etc.

iii. Minimize the amount of time the lid of the churn splitter is not secured over the churn splitter.

iv. When rinsing the churn splitter, use copious amounts of de-ionized water.

v. Before arriving on site, the churn splitter should have been thoroughly washed and dried. The churn splitter still needs to be triple rinsed once the team has arrived on site. If a bucket will be used to transport sample from the water body, it should also be washed and dried before arriving on site, in addition to being triple rinsed before sampling.

vi. If multiple sites are going to be sampled using the same equipment, sample in the order of the site with the lowest expected concentrations to the one with the highest. For example, if samples are going to be taken near a discharge point, the upstream sample should be taken first, then the downstream sample, and finally the sample nearest the discharge point.

vii. The churn splitter must be triple rinsed between every sample. It is preferred that it be cleaned as close in time as possible to the collection of the sample.

The following general guidelines should be followed to insure the highest quality results are achieved when using automatic samplers:

i. Automatic samplers should be cleaned and maintained regularly according to their manufacturer's recommendation. Careful attention should be paid to the tubing running to and from the sampler and the pump when being cleaned as they come in direct contact with the sample. In cases where ultra-low detection levels are called for it may be necessary to install pre-cleaned tubing and pump right before sampling is set to begin.

ii. The bottles in the automatic sampler should be pre-cleaned before being set-up.

iii. The bottle storage compartment should be closed tight enough so that no possible contaminant such as rain, leaves, or other debris could enter the sample bottle.

iv. Automatic samplers should be placed to the greatest extent possible in a flat, dry location with the smallest chance of the sampler being submerged.

v. Caps to the automatic sampler bottles can be left in the automatic sampler, or carried with the sampling team. In either case they should be pre-cleaned and stored in at least two airtight bags made from a non-reactive plastic.

vi. When opening and closing the sample bottle compartment, be careful not to accidentally knock any dirt or debris that may be attached to the automatic sampler into a sample bottle. Additionally, the top of the automatic sampler should not be placed down so that the bottom rim is in the dirt or mud.

The automatic samplers will be triggered by flow meters that will simultaneously collect flow date from the streams during sample collection. Flow data will be collected by connected to the flow meter via a laptop computer or other device and downloaded using the appropriate software. Flow data should be reviewed in the field to verify that the flow meter is working correctly. Field crews should attempt to correct any malfunctions in the field as soon as possible to return the meter to a calibrated state before leaving the site. If time does not allow for adjustments to be made then the field team should return as soon as possible to address the flow meter.

B2. <u>Geomorphic Assessment</u>

Should geomorphic assessment(s) be required, the effort can be grouped into two categories: (1) surveying for channel geometric characteristics and (2) sediment sampling. Table 2.01-1 describes the types of data to be sampled and the methods used to sample.

Table 2.01-1 Geomorphic Sampling Methods

Type of Data	Method	Reference
Channel cross section	Total station survey	Rosgen (1996)
Channel profile	Total station survey	Rosgen (1996)
Channel planform	Total station survey	Rosgen (1996)
Riffle surface sediment grain size distribution	Wolman pebble counting	Bunte and Abt (2001)

Subsurface sediment grain size distribution	Fine and coarse sieve analysis	Bunte and Abt (2001)
Bar sediment grain size distribution	Fine and coarse sieve analysis	Rosgen (1996) and Bunte and Abt (2001)

Survey data will be checked during the surveying process by intermittently checking elevations at monumented locations. Any error in survey information will be apparent by following standard professional surveying procedures. A resurvey will be initiated when errors occur.

Total sediment weight before and after sieve analysis will be used to determine the error in sieve analysis procedures. Samples with an error greater than 8% will not be used, and the reasons for the errors will be determined and corrective action will be taken. The QA manager will be responsible for reviewing the sediment grain size distribution error analysis to determine the need to repeat the analysis.

Survey errors are most often apparent in the field when control points are recorded. Maximum errors at control points will be recorded. Surveys will be repeated where the errors at monuments are greater than 2 cm. The QA manager will review survey error measures at each site to ensure that inaccurate surveys are repeated.

B3. Biological Sampling

Should biological data collection be necessary, sampling methods will adhere to industry standard procedures and protocol to ensure high quality samples with no cross contamination. Personnel will thoroughly wash their hands and forearms prior to arriving on site, along with their equipment including all nets, sieves, and so forth.

Additional equipment rinsing will take place between samples to prevent cross-sample contamination. This includes thoroughly rinsing all nets and sieves with filtered water between each biological sample. As a rule, all biological sampling (fish, macroinvertebrates, algae) will follow the protocols outlined in Methods for Assessing Biological Integrity of Surface Waters (Kentucky, 2002).

COC# | CHAIN OF CUSTODY | PAGE 1 OF 1

Client:
Project Name:
Project # : Acct # :
Quote # : P.O. # :
Project Contact:
Phone # :
Collected By :
Landfill License # : / PWS ID # :

EnviroData Group
2520 Regency Road, Lexington KY 40503-2421
Phone: 859-276-3506
Toll Free: 1-800-489-3506
Fax: 850-278-5665

Mail Report To:
Company:
Address:
City/State/Zip:
Invoice To:
Company:
Address:
City/State/Zip:

Shipped Via: Fed-Ex / UPS / Courier / *HES*
Airbill # :
COC Seal # :
Turnaround Time:
10-Day / 5-Day / 3-Day / 24-Hours / Other
Date / Time Needed
QC Level :

* Matrix
A - Air
DW - Drinking Water
GW - Ground Water
L - Liquid
SE - Sediment
S - Soil
LS - Liquid Sludge
ST - Stormwater
SS - Solid Sludge
SU - Surface Water
WW - Wastewater
W - Water
O - Other

* * Preservation Type

Requested Analysis

Field Measurements

* * Preservation Code
AA - Ascorbic Acid
AC - NH_4Cl
E - EnCore
HA - HCl
M - Methanol
NA - HNO_3
SA - H_2SO_4
SH - NaOH
SS - Na_2SO_3
ST - $Na_2S_2O_3$
ZA - Zinc Acetate
O - Other ______

Sample I.D.	Location	Collection Date	Collection Time	Matrix	Grab / Comp	Field Y/N							Temp. (C)	pH	Cond. (umhos/cm)	DO (mg/L)	EDG Lab #	Comments

Relinquished By:	Date / Time	Received By:	Date / Time

Properly Preserved: (Yes / No) Headspace: (Yes / No)
COC Seals Intact: (Yes / No / NA) Bottles Intact: (Yes / No)
Temp. Upon Receipt (C) ______ By: ______
Field Document Attached: (Yes / No)

Notes:

Figure 2.01-2 Example Chain of Custody Form

C. Sampling Handling and Custody

C1. Water Chemistry Data

Once samples are collected, a member of the sampling team will drop off the samples to a representative of the Laboratory to be transported for analysis. Samples will be kept in coolers on ice before and during transport. Table 2.01.2 summarizes the potential analytical testing that may be required for this project. Copies of all paperwork, including field sheets and chains of custody, will be signed and exchanged. Figure 2.01-1 shows an example of a sample label and Figure 2.01-2 shows an example of a chain of custody that will be used.

Client:____
Sample ID:_____________________________________
Location:______________________________________
Collection Time:_________________________________
Collection Date:_________________________________
Analysis:______________________________________
Preservation:___________________________________

Figure 2.01-1 Example Sample Label

Parameter	Method	Reporting Limit	Preservation	Holding Time
BOD_5	EPA 405.1	1 mg/L	Unpreserved	48 Hours
Total Suspended Solids	EPA 160.2	3 mg/L	Unpreserved	Seven Days
Nutrients	EPA 300.0 and 350	Varies	H_2SO_4 (as necessary)	28 Days
Metals	EPA 200.7	Varies	HNO_3	Six Months
Fecal Coliform	SM 9222D	1 colonies/100 mL	$Na_2S_2O_3$	Six Hours

Table 2.01-2 Summary of Analytical Testing

C2. Geomorphic Data

Total station survey data will be collected in electronic format on data loggers and downloaded each day to a laptop computer.

Pebble count and other sediment data will be recorded on data forms and typed into a database.

Sediment samples will be labeled in the field and transported directly to the geomechanics laboratory. Grain size analysis will be conducted in the laboratory within one month of sample collection. Grain size analysis will be completed and data will be directly entered into a computer database.

The data will be archived by the project QA manager.

C3. Biological Data

For biological samples, chain of custody procedures will be adapted from those of the Kentucky Natural Resources and Environmental Protection Cabinet. Forms include entries, to be filled by the sampler, of sample number, date and time, station description, method, type, size, type of preservation, and analysis requested. The sampler will carry the samples and records to either the lab, or a courier, who must also sign the form. The lab staff member designated to receive the samples, either the shift supervisor or assistant, will then sign the form. At all transactions, both the relinquishing and receiving parties will sign the chain of custody form. Sample labels and chain of custody forms are included in the packet.

D. Instrument/Equipment QA/QC

Before any test is run, laboratory technicians will run an initial test to demonstrate that the capabilities to run the test per method is there. Equipment is checked and maintained according to manufacturers' standards, or testing standards, whichever is more stringent.

E. Inspection/Acceptance of Supplies and Consumable

All sample containers will be inspected for defects and will only be accepted with a certification of proper cleaning.

F. Data Management

Data results from analytical testing will be entered into the laboratory's LIMS system after an initial review of the data against method criteria. A secondary reviewer then reviews the data before it is released to Strand Associates. Should errors arise in the laboratory, a non-conformance report/corrective action report is generated. This report identifies the problem or error, gives planned corrective action and corrective action follow-up procedures. This form is reviewed and agreed to by the laboratory section manager, project manager, QA manager, and analyst. All completed forms are kept in the QA Manager's possession.

Upon receipt of the data, Strand Associates will perform a review of the quality assurance checks and report any variances back to the laboratory for rectification. Should no variances arise, the data will be accepted and used.

SECTION 3
ASSESSMENT AND OVERSIGHT

3.01 ASSESSMENT AND OVERSIGHT

A. Reports to Management

Should data collection be required, Strand Associates, on behalf of the Banklick Creek Watershed Council, will prepare a technical report for each sample collection year to be submitted to the Kentucky Division of Water (KDOW). The report will discuss the results of the monitoring, the quality of the data, any quality assurance problems and the steps taken to solve them. KDOW will then be able to comment on the report and make recommendations. The report will also suffice as a chapter of the Watershed Based Plan. The Watershed Based Plan and general summary of the project will be included in a final project report for KDOW upon project completion.

SECTION 4
DATA VALIDATION AND USABILITY

4.01 DATA VALIDATION AND USABILITY

A. Data Review, Verification and Validation

Quantitative and qualitative descriptions of the validity will be included in the technical reports. Data will be validated using principle data quality indicator's precision, bias, accuracy, and completeness. These will be reported as the relative standards deviation, relative percent difference (RPD), percent recovery, and percent complete. Data validity descriptions will also include the results of laboratory blanks.

APPENDIX A
DISTRIBUTION LIST/PROJECT TEAM

DISTRIBUTION LIST/PROJECT TEAM

1. Sherry Carran
   Banklick Creek Watershed Council
   927 Forest Avenue; Covington, KY 41016

2. John Lyons, P.E.
   Project Manager – Strand Associates
   990 St. Paul Place; Cincinnati, OH 45206

3. Paul Maron, P.E.
   Quality Assurance Manager – Strand Associates
   325 West Main Street, Suite 710; Louisville, KY 40202

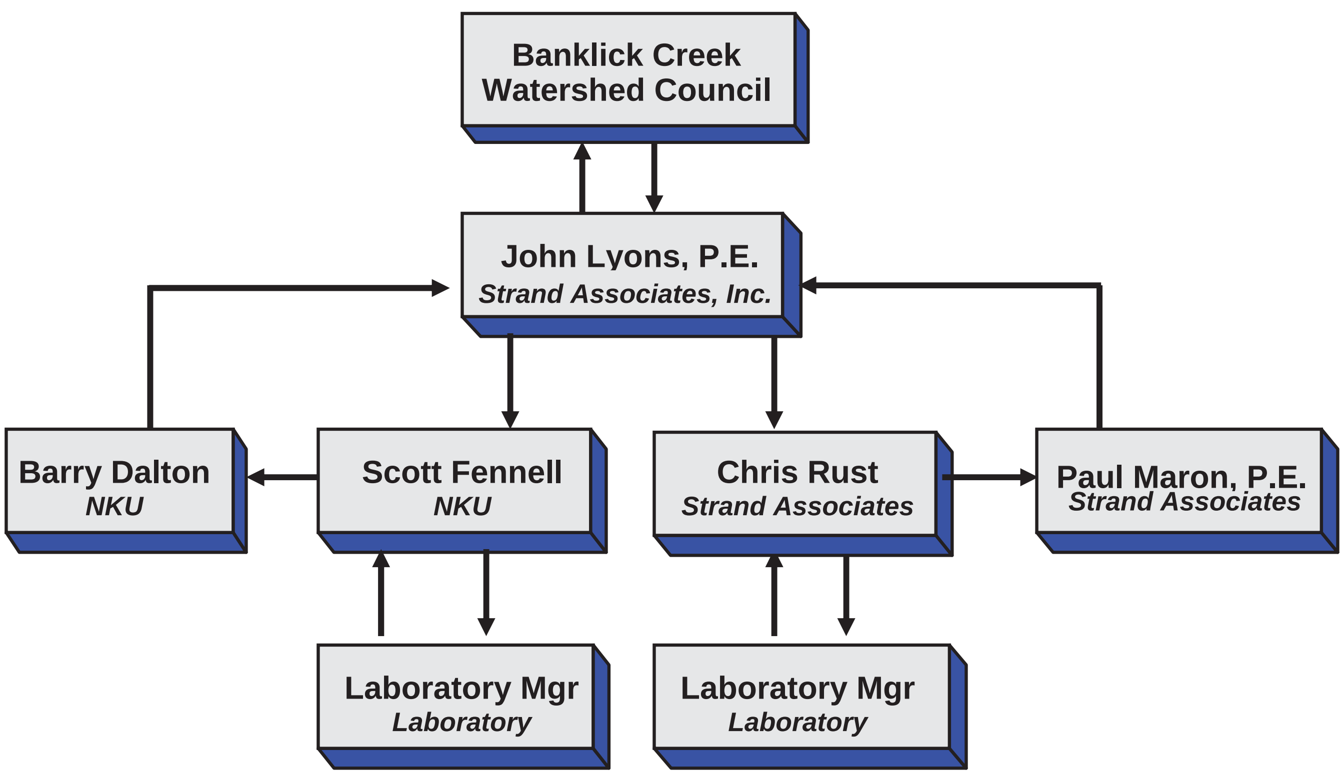
4. Chris Rust
   Environmental Data Collection Manager – Strand Associates
   990 St. Paul Place; Cincinnati, OH 45206

5. Laboratory Analysis Project Manager
   Laboratory yet to be determined

6. Barry Dalton
   Geomorphic & Biological Quality Assurance Manager –
   Northern Kentucky University, Center for Applied Ecology
   510 Johns Hill Road; Highland Heights, KY 41076

7. Scott Fennell
   Geomorphic & Biological Data Collection Manager –
   Northern Kentucky University, Center for Applied Ecology
   510 Johns Hill Road; Highland Heights, KY 41076

The following organizational chart shows the relationships and lines of communication among all project participants:



July 18, 2002 – Thomas More College, Holbrook Center

Those in attendance: See attached list of participants

Meeting convened at 11:30 with lunch
Introductions were made by all participants, led by Marc Hult, Chairman. Agenda was reviewed.

Marc Hult gave an introduction on the status and purpose of the Banklick Watershed Council. He discussed the prioritization process coordinated by the Division of Water that identified problem watersheds and where an action plan could be of help. Of the sixty-nine subwatersheds in the Licking River the Banklick rated 3. The Kentucky Waterways Alliance was introduced as a group that fosters local watershed action by looking for local energy. This group made available a$5000 grant for the Banklick Watershed Council's nonprofit incorporation. A grant proposal was written for the EPA 104b grant which was a multi state competition. The Banklick Watershed Council received approximately $117,000 of that money.

Banklick Watershed Council objectives include:

- Improve and protect the physical, chemical and biological integrity of Banklick Creek, its tributaries, and watersheds. Research, design, obtain funding for, and conduct projects to improve the watershed.
- Build a reputation for excellence as the primary, community-based organization concerned with the Banklick Watershed: an organization that is respected by citizens, public officials, and the corporate community. Become an organization that the citizens can identify with and to which citizens feel comfortable in voicing their concerns and in reporting problems.
- Build a broad sense of partnership among stakeholders: those who live in or those who have an interest in the Banklick watershed. Facilitate collaboration between the many parties that are investigating, planning, and implementing projects related to the physical, chemical, and biological integrity of the Banklick watershed. Cooperate with all agencies, governmental or private, which have an interest in water resources management, water quality, water quantity and the well-being of the streams, wetlands, and reservoirs in the Banklick watershed.
- Foster public enjoyment, health and pride in the Banklick Creek, its tributaries, and watersheds.
- Collect and assemble scientific studies and literature pertaining to the Banklick Creek Watershed. Scientifically investigate and characterize the hydrologic, human, botanic and ecological resources and conditions and health of the streams and the land in the watershed of the Banklick watershed.
- Scientifically explore the social and economic resources and conditions in the Banklick watershed, including options for managing and conserving the ecological and environmental resources and health of the Banklick watershed.
- Educate the public within and around the watershed in all aspects related to the physical, chemical and biological health of the Banklick watershed. Prepare, disseminate, copyright and register periodicals, pamphlets, books, and materials pertaining to the water resources and related subjects.
- Sponsor and conduct meetings for the study and discussion of water resources and matters pertaining thereto.
- Promote sound water resource management practices and conservation.

Initial Project Objectives Include:

- Raise community concern about impairments and increase support for remedies.
- Establish programs to disconnect household storm water drains from sanitary sewers.

- Identify and seek funding for a pilot project for decentralized wastewater options
- Assess geomorphologic stream health and facilitate restoration projects
- Convene and coordinate stakeholders to develop a comprehensive Watershed Action Plan
- Build capacity of the Banklick Watershed Council for long term action
- Foster public enjoyment, health and pride in the Banklick Creek

Floor was opened for questions and comments:

Q: How bad is the Banklick?
A: Several issues are currently being addressed by the Sanitation District and through the Phase II Regulations, and through the Corps of Engineers. Banklick is a priority because of the bacterial count and the continuing pressure of people and growth that it is constantly trying to keep up with.

Q: How far has the Mill Creek Watershed Council come since start up?
A: They are currently working for a tunnel to deal with CSO's. First goal is to make the Mill Creek safe to come in contact with. Often industrial water is cleaner than the creek water because of NPDES requirements. The Mill Creek Greenway Master Plan has been completed. This is a multi-objective and community based effort dealing with watersheds, tributaries and riparian corridor studies and projects.

Q: Where and when are we testing water quality and who has the information?
A: The Sanitation District and the Watershed Watch are some of the organizations testing at various times and in various places. One of the Banklick Watershed Council's goals is to find out the specific answer to that question and where the holes are that we can address and to make information easily available to the public.

12:15 – Ms. Wood introduced the issues and questions that were to be discussed in a roundtable format. See the following outlines.

ISSUES and active parties as listed by meeting participants

<u>Aquatic life habitat:</u>
- Sanitation District
- Fish & Wildlife
- Watershed Watch (Licking & Doe Run)
- KYTC Environmental Assessments
- Division of Water

<u>Bacteriological conditions: human & other animal waste:</u>
- Sanitation District
- Health Department (Enforcement)
- Division of Water
- Natural Resource Conservation Service
- Watershed Watch
- Conservation District (animal waste)

<u>Biological diversity:</u>

- Sanitation District
- Fish & Wildlife
- NKU/ERMC
- Urban Forestry

<u>Botanical resources:</u>

- Urban Forestry
- Fish & Wildlife (habitat improvements)
- Northern Kentucky University

<u>Chemical Conditions:</u>

- Sanitation District
- Water District
- DOW
- EM. Management
- EPA

<u>Recreational Resources:</u>

- KC Parks, Rec, & Cities (Independence, Ft. Wright, Edgewood, Erlanger, Covington (RGI))
- Forward Quest
- OKI

<u>Adequacy of Riparian Corridor (physical encroachments):</u>

- ERMC
- NRCS
- Fish & Wildlife
- Urban Forestry

<u>Regulations Impacting Water Resources:</u>

- Government

<u>Brownfields:</u>

- City of Covington

<u>Community Growth & Planning:</u>

- Northern Kentucky Area Planning Commission
- Home Builders Association
- Ft. Wright (and other cities)
- Conservation District
- Park's Master Plan
- KYTC
- Smart Growth Coalition

<u>Cultural attitudes towards the watershed's natural resources:</u>

- Sierra Club
- OKI
- Conservation District

- NFFC

Flooding:
- NFFC
- Kenton County Fiscal Court
- Emergency Management
- Northern Kentucky Area Planning Commission
- Urban Forestry
- NKADD
- Corps.
- Division of Water

Hydrologic balance (flow regimes):
- Sanitation District
- Corps.
- Urban Forestry
- Northern Kentucky Area Planning Commission

Impacts of impermeable surfaces/soils:
- Conservation District
- Northern Kentucky Area Planning Commission
- NKU/ERMS
- NRCS

Management of toxins in the watershed:
- EM Management WK ADD
- DOW
- Health Department
- Sierra Club
- Northern Kentucky Water District
- Division of Water

Public awareness of the facts related to the issues:
- Conservation District
- Residents
- HBA
- Health Department
- NFFC
- Kenton Co.

Storm management:
- Sierra Club
- HBA
- Northern Kentucky Area Planning Commission
- DOW

Trash, litter:

- ADD
- Kenton County Parks
- Conservation District
- Sierra Club
- CRIK
- Ft. Wright

Dams:

- Corps.
- DOW
- Conservation District/NRCS

Combined sewer overflows:

- Sanitation District
- Division of Water

Stream Banks/Erosion

What Issues Might the Council Best Address, and How?
How Could the Council Enhance Activities Already Underway?

1. Consensus building from stakeholders
2. Watershed tours
3. PRIDE – legislation
4. Slow development in growth areas
5. Get with business communities as stakeholders
6. Be a representative for the watershed
7. Resource information compilation & identify voids to develop action plan (what do we have/need) to make a decision
8. Get historical information – how vegetation/land use changed/oral history
9. Coordination of efforts – esp. **Education**
10. Being a central source (clearing house) of information
11. Enforcement/be a watchdog/voice/follow up
12. Existing subdivisions – BMPs/tools for storm water runoff minimization
    - Demonstrations
13. Develop plan identifying positive aspects of Banklick
14. Outreach/media
15. Find funding for home owners to fix problems related
16. Demonstration project – **NOW**! (something people can “see” and relate too)
17. Validate information – help people understand citizens & organizations
    - Credibility
18. Develop better – more greenways/space
    - Increase Awareness
    - Advocate
19. Support/enhance buyout program
20. Support better storm water quantity (reduction)/quality programs/BMP’s during development & after
21. Find the good spots in watershed
22. Take the lead in developing interest in creek as a resource & not a liability

23. Put resources ($) into making a media team
24. Involve universities/students – fund leadership for the future
25. Inventory Banklick
26. Involve youth
27. Engage the arts

Banklick WATERSHED COUNCIL

Meeting Minutes
January 21, 2009
3:00 – 4:30 PM

The first meeting of 2009 was called to order by Chair – Sherry Carran at NKAPC. In attendance were Donna Horine, Sharmili (Sampath) Reddy, Lajuanda Haight-Maybriar, Lorna Harrell, Matt Wooten, Marc Hult and Kelly Kaufman.

The purpose of the meeting was to discuss plans for the public input meetings on the revised draft of the Council's Watershed Plan. These meetings will be educational not only for the general public but also for the Council. The meetings are an important step to completing the revised Watershed Plan, which is the key component to the Council's EPA 319 Grant.

Lajuanda noted that public meetings are a way of 'ground-truthing', identifying and calculating water source problems. She also noted that the desired outcome of the meetings is to get a list of the public's concerns and questions; the Council should then follow up.

There was discussion on where, when and what materials will be used.

The thought was to have the first public meeting in the southern part of the watershed because of NKAPC's work in 2006 on the South Banklick Study. Sharmili supplied a list of property owners in the area, along with a map.

Marc wondered about the approach and how would the rest of the watershed be addressed. Sherry thought the public meetings could be sectioned into the rural, the suburban and the urban parts of the watershed. Other thoughts were to section by south, east, west and north.

Discussion then went to when the meetings would be held. It was decided that meetings should be completed before May as it is hard to get people attending once school lets out. With that kind of time line it was decided to keep it to three meetings: southern, middle and northern sections of the watershed. It was also decided that all the meeting dates should be set before the first meeting so they can be announced at the first meeting. It was recommended that it would be best to alternate the days and times of the meetings. Lorna recommended a 'catch statement' in meeting announcements to get people's attention.

Sherry said she would contact the new library in Independence to see if the first meeting could be held there as this would be convenient for the people living in the southern part.

There was then discussion about materials that would be used. All materials will have to be approved by KY Div. of Water (KDOW). Lajuanda advised that the materials could be sent by email if possible for approval and that it could take 2-4 weeks. Most thought that past materials that have been developed from past projects, whether parts or all, should be forwarded to KDOW and that way once approved they can be used when needed.

It was decided to meet Thursday Feb. 5th at 3PM to go over the materials. Sharmili said we could meet at NKAPC. Matt noted that the materials should not be too technical but also advised "don't dumb it down".

It was discussed that a brief overview of watershed issues and planning should start the public meetings then break out into smaller groups. The groups could be based on the four goals of the watershed: Clean the waters; Reduce flooding; Restore the banks; and Honor the Heritage.

The next item of discussion was the language that needed be included in deeds to land or easements given for conservation purpose that the Council would be using as in-kind match. Sharmili and Sherry had a conference call with KDOW as to what they would require. KDOW did send a sample deed to help. The language needs to be worked out so it can be included in the property (26.5 acres) that the Kenton Conservancy has received around Doe Run Lake as the hope is to use this as match. This property was recorded to the Kenton Conservancy on April 15th, 2008 with the value set at $449,700. Sherry had contacted the original owner, Mr. List, a number of years ago about giving the land to the Kenton Conservancy. When Mr. List sold the property to a developer he requested the forested hillside portion of the property be given to the Conservancy.

Sherry is going to work on the language. Kelly said she could help as Strand was involved with the sample deed project.

Sherry reported that she has transferred the Council's banking to Donna. Donna reported that she did not have exact figure but there is around $5,000 in the account. Sherry explained that this is the money from the Council's first grant through Kentucky Waterways Alliance 319 Grant back in 2002. Donna also reported that the Council did receive the first payment from KDOW and that money was then used to pay Strand. Note, exact figures are: bank balance - $5,070.49; 319 payment from KDOW - $10,364.26; payment to Strand - $10,364.26.

Sherry asked everyone to keep track of the hours they contribute to the Council's 319 Project, this includes attending meetings. These hours are needed to report in-kind. She explained that she has been keeping track for the invoicing so far but it is best that each person keep track of their own hours for now on.

Meeting was adjourned.

Respectfully submitted,
Sherry Carran

Meeting Minutes
February 5, 2009
3:00 – 4:30 PM

The first meeting was called to order by Chair – Sherry Carran at NKAPC. In attendance were Donna Horine, Sharmili (Sampath) Reddy, Lorna Harrell, Matt Wooten, Marc Hult and Kelly Kaufman. Sherry noted that Lajuanda Haight-Maybriar had called earlier to apologize that she could not make the meeting.

The purpose of the meeting was to plan for the upcoming public meetings, including the materials that would be used.

Discussion started around the materials. Examples of power points, brochures and reports were shared. It was decided to send everything to KDOW to get approval for it all if possible.

Kelly turned the discussion towards developing an outline for how the public meetings would be conducted. After much discussion this is the outline:

1. Sign in - include if possible that the attendee can get their watershed address. Sharmili explained how something on this order is done when NKAPC participates in the Kenton County Fair. A handout will be put together to have at the sign-in table that will list the Council's contact info and list upcoming events in the watershed such as clean-ups and the next public input meetings.
2. Power point introduction (15 minutes) – explaining what is a watershed and a few principles of watershed management; background on the Council and their past projects; and explanation on the current 319 Project and why the public meetings are important.
3. Break out into 4 stations based on the goals of Clean the waters; Reduce flooding; Restore the banks; and Honor the Heritage. People will have the option of participating in all of the stations or only what they choose, especially if they are limited on time. At the stations, people's concerns or info they can contribute will be listed on flip charts. Watershed maps will be at each station. It was discussed about having an extra (parking) station where things could be listed that did not fit the 4 goals. Note: Approach people by how can they get involved to meet goals. (10 minutes per station X 4 = 40 minutes)
4. Wrap up with THANK YOU (5 minutes)

Objective is to have everything completed in an hour.

There was discussion about having hand-out materials available, either all at one table or pertinent hand-outs at each station. It was noted that there would not be much available on 'Honoring the Heritage'.

Kelly suggested having a small survey available as another way to list people's concerns and to get their contact info.

It was decided that invitations to the meeting would go out by letter to property owners in the area, by press release and by sending to email list serves of Council's 319 Project partners. Sharmili volunteered to work on the letter. Sherry will work with Sharmili on developing the mailing list.

The first meeting will be held at the Durr Branch of the Kenton County Library (1992 Walton-Nicholson Rd, Independence, KY 41051, 859-962-4030) on Monday, March 23rd. The meeting has been reserved from 6:00 – 8:00 PM, with meeting from 6:30 - 7:30.

Sherry asked who would be able to attend and assist with the public meeting. Marc, Matt, Kelly, Sharmili, Donna and Lorna all said they would be able to. Sherry thought that Lajuanda and Wilhelm may also be able to.

Lorna suggested that possible meeting dates be discussed for the following public meetings. Thursday, April 16th and Monday, May 4th were dates that seemed to work. We will try to have one of the meetings at SD#1 to cover the northern part of the watershed and the other one at Summit View Middle School to cover the middle part.

Matt shared with the Council some of his work on stream monitoring. His work showed documentation of how stream health was directly related to having stream banks in good condition. Steams with good riparian areas had higher macroinvertebrate counts indicating better water quality. Most of us knew this kind of relationship existed but to have it actually documented is very important.

Sherry turned over the second payment from KDOW of $6,477.61 to Donna. She noted that the invoicing from Strand did not show the Council's last payment of $10,364.26 and that a payment that was showing was one not made by the Council. Kelly said she would check on it.

Donna said she would keep track of in-kind time for meeting attendance.

Meeting was adjourned.

Respectfully submitted,
Sherry Carran

17 July 2002

The following information was compiled from Kenton County Conservation District records of Agriculture Water Quality Plan Certification forms on file in our office as of 8 July 2002.

This list is not a complete survey of the watershed, as we do not have the statistics on how much land in the watershed is in farms. Not all of the farms have Ag Water Quality Plans on file, and we do not have some of them classified yet by watershed. I can give you more information as it becomes available.

Banklick Creek 11- digit Watershed – Hydrologic Unit # 05100101290

Total Acres:	37,259.63
Total Acres with Ag Water Quality Plan Certification on file:	2,527.60
Total Farms with Ag Water Quality Plan Certification on file:	52

Total operations by class: (most farms have more than one production class)

Beef	22
Dairy	5
Equine	3
Hay/Forage	28
Row Crops	19
Swine	0
Poultry	0

14 Digit Watersheds Breakdown (These are the only 14 digit watersheds we have plans for right now.)

Banklick Creek – 14 digit Watershed - Hydrologic Unit # 05100101290010 (3,439.65 acres)

Acres with Ag Water Quality Plan Certification on file: 1,601.56
Farms with Ag Water Quality Plan Certification on file: 42
Operations by class: (most farms have more than one production class)

Beef	18
Dairy	0
Equine	3
Hay/Forage	25
Row Crops	13
Swine	0
Poultry	0

Wolf Pen – 14 digit Watershed - Hydrologic Unit # 05100101290020 (2,835.08 acres)

Acres with Ag Water Quality Plan Certification on file: 511.55
Farms with Ag Water Quality Plan Certification on file: 7
Operations by class: (most farms have more than one production class)

Beef	2
Dairy	3
Equine	0
Hay/Forage	1
Row Crops	4
Swine	0
Poultry	0

Banklick – 14 digit Watershed - Hydrologic Unit # 05100101290040 (3,327.48 acres)
Acres with Ag Water Quality Plan Certification on file: 133.31
Farms with Ag Water Quality Plan Certification on file: 1
Operations by class: (most farms have more than one production class)

Beef	0
Dairy	0
Equine	0
Hay/Forage	1
Row Crops	0
Swine	0
Poultry	0

Bullock Pen – 14 digit Watershed - Hydrologic Unit # 05100101290080 (7,017.96 acres)
Acres with Ag Water Quality Plan Certification on file: 280.80
Farms with Ag Water Quality Plan Certification on file: 2
Operations by class: (most farms have more than one production class)

Beef	2
Dairy	2
Equine	0
Hay/Forage	2
Row Crops	2
Swine	0
Poultry	0

END

Source: SD1

2008 Banklick Creek Watershed Characterization Report

Confidential Preliminary Working Draft

Watershed Consent Decree

Prepared for: Sanitation District No. 1 of Northern Kentucky

January 2009

LimnoTech
Water | Environment | Scientists | Engineers

Ann Arbor, Michigan
www.limno.com

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1. WATERSHED SUMMARY

Watershed characterization reports are being developed for sixteen watersheds located in Northern Kentucky that lie within Sanitation District No. 1's (SD1's) service area. The purpose of the watershed characterization reports is to describe the physical and natural features, land cover, infrastructure, waterbody conditions, potential pollutant sources and other features in each watershed. This information will allow SD1 and other interested parties to develop an understanding of important features, pollutant sources and water quality in the watersheds. This information will also assist SD1 and others in goal-setting, prioritization of improvement projects, and assessment of the effectiveness of these projects. The watershed characterization reports meet the system characterization element for the receiving water that is required for a combined sewer overflow (CSO) Long-Term Control Plan (LTCP). Additionally, the Consent Decree requires that the Watershed Plans include elements of a LTCP.

The 58.2-square mile Banklick Creek watershed is located in Kenton and Boone Counties, in the Central Study Basin (Figure 1). Development is found throughout most of this watershed, although the headwaters are currently much less developed. The topography is fairly steep and flooding has been a recurring issue in this watershed. Doe Run Lake, a 51-acre reservoir (normal pool), is located on Bullock Pen Creek. This reservoir was constructed between 1978 and 1982 to help control flooding, but flooding problems persist.

Banklick Creek and its tributaries are designated for warm water aquatic habitat, primary contact recreation, secondary contact recreation and domestic water supply, at applicable points of withdrawal. Doe Run Lake and the entire length of Banklick Creek appear on the 303(d) list of impaired waterbodies (KDOW, 2008). A comparison of recent water quality data to applicable water quality criteria revealed elevated levels of bacteria. Violations of dissolved oxygen, temperature and pH have historically been observed at the USGS continuous monitoring station between 2001 and 2005, but the more recent data from this location are still being reviewed and are not yet included in this assessment.

Potential pollutant sources in this watershed include combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), septic systems, KPDES-permitted discharges, livestock, storm water and streambank erosion. Backwater from the Licking River is a potential source in the downstream end of the creek. The potential for these sources (except backwater) to generate fecal coliform loads has been assessed using a Watershed Assessment Tool (WAT!)[1]. The WAT! identifies the potential sources within a watershed and estimates their possible impact. It also allows SD1 to compare and rank the 16 different Northern Kentucky watersheds.

The WAT! calculated an approximately average fecal coliform loading potential for the Banklick Creek watershed for year-round conditions. Overland runoff is predicted to be the dominant source under year-round conditions. Under base flow conditions, septic

[1] The WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

systems and non-CSO KPDES-permitted discharges are predicted to be the primary sources of bacteria.

The WAT! ranking is one of several factors that should be considered when prioritizing watersheds for improvement projects. Other factors include high public interest, the presence of one aquatic-dependent threatened and endangered species, the location of a drinking water intake just upstream of the Banklick confluence with the Licking River, and the location of portions of this watershed in a source water assessment and protection zone (SWAPP zone 1) for this intake.

Since improvement projects are planned to reduce collection system overflows in this watershed, next steps might include the application of the Banklick Creek model, the Ohio River model and WAT!, to better understand the appropriate level of control for the watershed. No additional monitoring, beyond what is currently planned, is recommended for this watershed.

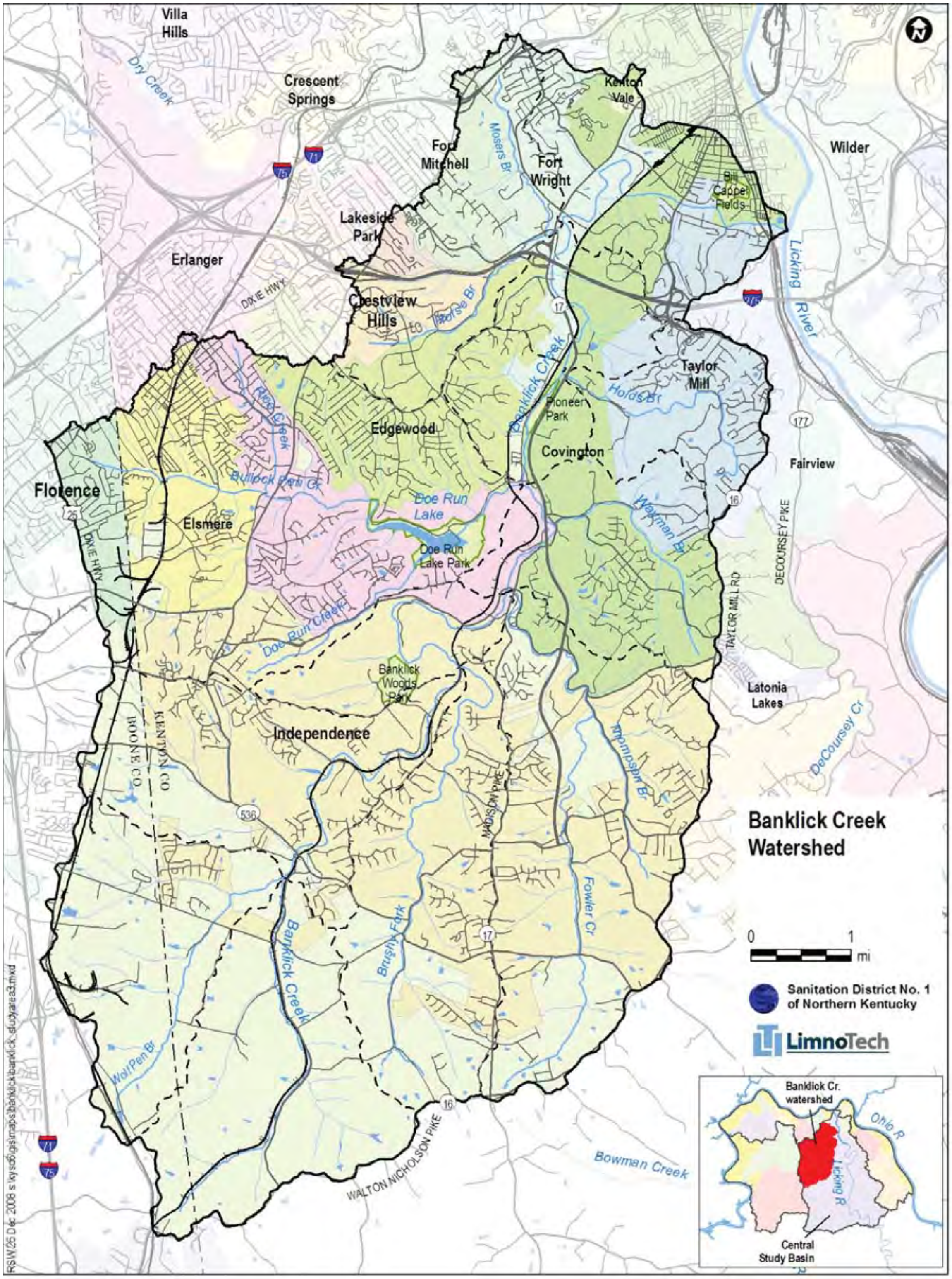

Figure 1. Banklick Creek Watershed

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2. WATERSHED FEATURES

Banklick Creek originates in Boone County and flows northward through Kenton County to the Licking River. The watershed area for this creek is 58.2 square miles.

2.1 PHYSICAL AND NATURAL FEATURES

The following sections describe key features of the watershed and creek, including hydrology, geology, topography, soils, climate, and habitat. These features are important because they affect land uses, and shape the chemical, biological, and hydrological characteristics of Banklick Creek.

2.1.1 Hydrology

Banklick Creek is a 19.2-mile long perennial stream and has six major tributaries. These tributaries are, in order from downstream to upstream: Horse Branch, Holds Branch, Bullock Pen Creek, Fowler Creek, Brushy Fork, and Wolf Pen Branch. The creek is shallow through most of its length and has been observed to go dry upstream of river mile (RM) 8.1. The stream gradient is highest near the upstream and middle reaches of the creek. Near the confluence with the Licking River (approximately 0.75 miles upstream from the mouth), the gradient is much lower and the channel widens. Near the mouth, flow is hydraulically influenced by the Licking River and backwater effects are thought to extend upstream to approximately RM 3.8. The spatial extent of backwater effects depends on Ohio River stage levels.

Banklick Creek flows are measured at an active USGS continuous monitoring station (03254550) located on Banklick Creek at Richardson Road near Erlanger, KY, which is at approximately RM 8.1 (see Figure 1). The watershed area draining to the station is 30 square miles, comprising approximately 58% of the Banklick Creek watershed. Daily discharge measurements are available at the station from April 1999 to the present[2]. The average flow is 38 cfs (4/1/1999 - 9/30/2007), and 95% of flows are less than 138 cfs. Base flows at this location have been measured at less than 2 cfs, with flows increasing by up to three orders of magnitude during a storm event. The maximum flow recorded at the USGS station is 2,130 cfs. The periods of high flow tend to be very brief and only last one to two days. In contrast, during extended periods of dry weather, flows at the station become intermittent. Between April 1999 and September 2007 there were 49 days with zero flow.

Flooding has been a recurring problem in the Banklick Creek watershed, particularly in the Pioneer Park area. The United States Army Corps of Engineers (USACE) – Louisville District, has identified five primary flood damage areas along Banklick Creek that are located between RM 0.0 and RM 10.3. Previous major floods have been documented (USACE, 2000) as occurring in 1937, 1962, 1967, 1979, 1991, 1992, 1995 and 1996 with flooding occurring not only on Banklick Creek, but also Fowler Creek. The USACE (2000) study identifies three primary factors that have contributed to flood damages in the watershed. These are: 1) the concentration of early development along

[2] This analysis only uses approved data from USGS, and at the time of the analysis data was approved through 9/30/2007.

stream channels; 2) the extremely steep slopes of Banklick Creek and its tributaries; and 3) extraordinary recent development in the watershed along ridgelines and hillsides.

Agencies investigating flooding in this watershed have included the United States Department of Agriculture (USDA), Federal Emergency Management Agency (FEMA), and the Louisville District of the Corps of Engineers. Several reports have also been developed by residents. As a result of these studies, several projects have been implemented to reduce flooding impacts. These are:

- 1982 – completion of a 51-acre reservoir (normal pool), Doe Run Lake, on Bullock Pen Creek to help control flooding.
- 1980s - Removal of 36 trailer homes from the floodplain near I-275
- 1980s – Some channel realignment
- Elevation of mobile homes above most major flood levels (USACE, 2000).

Additional detail on other more recent ongoing projects is found in Sections 2.3 and 2.5.

2.1.2 Geology

The Banklick Creek watershed is located in the Outer Bluegrass Physiographic[3] Region which is underlain primarily by Ordovician-age interbedded limestone and shale (Ray et. al., 1994). Although most of this watershed is underlain by bedrock with a moderate potential for karst development (Paylor and Currens, 2002), rocks in this region generally contain higher percentages of shale layers and do not develop extensive karst features (Ray et al., 1994)[4].

The headwaters of this creek traverse the rolling hills of the Grant Lake Limestone/ Fairview formation, which produces broad stream valleys. The middle portion of the creek, as well as some tributaries (Fowler Creek, Bullock Pen Creek) cut through the erodible shale found in the Kope formation. Downstream of Bullock Pen Creek, Banklick Creek traverses alluvium comprised of unconsolidated sediments.

Groundwater yield varies depending on geological formation. Except near the headwaters, groundwater is generally unavailable on ridgetops and hillsides. In contrast, wells in the valley bottoms may yield 100-500 gallons per day. This water is hard and may contain salt and hydrogen sulfide. Water obtained from the alluvium may also be high in iron (Carey and Stickney, 2004, Carey and Stickney, 2005).

2.1.3 Topography

The Banklick Creek watershed is characterized by rolling hills with more gentle slopes in the headwaters. In the downstream half of the watershed, the ground tends to slope steeply toward the creek. The adjoining hillsides and tributaries also have steep slopes;

[3] Physiographic regions are based on differences in geology, topography and hydrologic regime. The State of Kentucky is divided into five physiographic regions.
[4] In areas with karst, an almost immediate connection between groundwater and surface water can exist, short-circuiting any attenuation of pollutant loads that might otherwise occur.

slopes in excess of 100 feet per mile are not uncommon for many of these tributaries (USACE, 2000).

The highest elevations in the watershed (966 feet) are found near the intersection of Walton-Nicholson Pike and Dixie Highway at the southernmost part of the watershed, and near the intersection of Mt. Zion Road and Dixie Highway on the western edge of the watershed. The lowest elevation in the watershed (453.6 feet at normal Ohio River pool) occurs at the confluence of Banklick Creek with the Licking River.

2.1.4 Soils

The nature of soils and topography in a watershed play an important role in both the amount of runoff generated and the amount of soil erosion that can occur. Most (93%) of the soils in the Banklick Creek watershed are classified as hydrologic soil group C (NRCS, 2006), meaning they have slow infiltration rates when thoroughly wetted. Roughly 60% of the soils in the watershed are ranked “highly erodible”, and the remaining 40% of the watershed soils are ranked “fairly erodible” as indicated by an index for erodibility (NRCS, 2006). The erodibility of soils is important when soils are disturbed through activities such as land clearing for new development. Portions of the watershed, especially within the City of Independence and near the Banklick Creek headwaters, are undergoing significant development, as discussed in Section 2.2.2, and areas of severe erosion have been observed in this watershed (Figure 2).

Figure 2. Banklick Creek at RM 5.5

2.1.5 Climate

The temperatures in this area are generally lowest in January and highest in July. Precipitation averages 41.2 inches annually, with the wettest months observed between March and July. Minimum precipitation is recorded in the fall and late winter as shown in Figure 3 (NCDC, 2008).

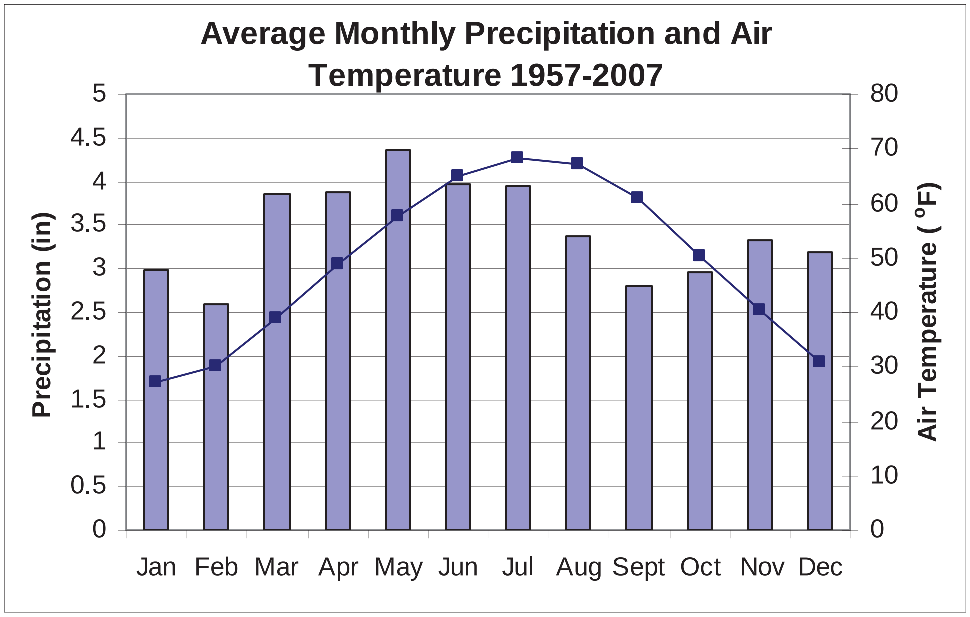

Figure 3. Average Monthly Precipitation and Air Temperature at the Cincinnati Northern Kentucky Airport (1957-2007)

2.1.6 Habitat

The Banklick Creek watershed lies within the Outer Bluegrass ecoregion[5], which is characterized by sinkholes, springs, entrenched rivers and intermittent and perennial streams (Woods et al., 2002). Wetlands are not common in this ecoregion and comprise less than 1% of this watershed. Streams typically have relatively high levels of suspended sediment and nutrients. Glacial outwash, which tends to be highly erodible, exists in a few areas.

Pre-settlement conditions in this ecoregion consisted of open woodlands with barren openings, and vegetation was mostly oak-hickory, with some white oak, maple-oak-ash and American beech-sugar maple forests (Woods et al., 2002). As described in Section 2.2.1, natural habitats have been altered from pre-settlement conditions.

Habitat assessments have been conducted at many sites within the watershed. Habitat rankings reflect variable conditions (Table 1) and range from not supporting to partially supporting as calculated using EPA-established protocols, and from fair to good using the QHEI[6]. A habitat assessment of ten sites in 2001 found the site at RM 0.4 consistently

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[5] Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources (Woods et al., 2002).

[6] These assessments were generally conducted using EPA-established protocols. KDOW rated several components of physical habitat within the stream such as epifaunal substrate, embeddedness, sediment deposition, channel flow status, bank stability and riparian vegetation zone width, among others. In 1996, some sites were assessed using a different protocol, Qualitative Habitat Evaluation Index (QHEI).

had the poorest habitat, followed by the site at RM 3.9, due to the lower stream gradient, sedimentation, stream modifications and backwater flows. The lower habitat scores at RM 15 and 18.2 were directly related to the fact that they are low order streams (Strand and Associates, 2003).

Table 1. Aquatic Habitat and Biological Sampling

		Monitoring[a]							
		Habitat		Macroinvertebrates		Diatoms		Fish	
Stream	River Mile	Year	Ranking	Year(s)	Ranking[b]	Year	Result	Year	Result[b]
Banklick Creek	0.3	1996	Fair[c]	1996	N/A[d]				
Banklick Creek	0.4	2001	Not supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001 2002, 2002, 2003	Very poor Fair, Fair, Poor
Banklick Creek	1.2	1996, 1999	Good[c], Not supporting	1996, 1999	N/A[d] Poor	1999	Poor	1999	Fair
Banklick Creek	2.5	2001	Partially supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair, Poor, Excellent, Fair
Banklick Creek	3.9	1996, 2001	Good[c], Not supporting	1996, 2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair, Poor, Fair, Fair
Banklick Creek	5.4	2001	Partially supporting	2001, 2002, 2002 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair, Fair, Excellent, Fair
Banklick Creek	8.1	2001	Partially supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair
Banklick Creek	10.1	2001	Partially supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair
Banklick Creek	13.5	2001	Not supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Good, Fair, Good, Fair
Banklick Creek	15	2001	Not supporting	2001, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2003	Good, Excellent, Excellent

Table 1. Aquatic Habitat and Biological Sampling - Continued

Stream	River Mile	Monitoring[a]							
		Habitat		Macroinvertebrates		Diatoms		Fish	
		Year	Ranking	Year(s)	Ranking[b]	Year	Result	Year	Result[b]
Banklick Creek	18.2	2001	Not supporting	2001, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2003	Excellent
Bullock Pen Creek	0.1	2001	Partially supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A\[e]	2001, 2002, 2002, 2003	Excellent, Fair, Excellent, Good
Unnamed tributary to Bullock Pen Ck. at RM 3.2	0.8					1993	Poor		
Unnamed tributary to Bullock Pen Ck. at RM 3.2	2.1					1993	Poor		
Unnamed tributary to Bullock Pen Ck. at RM 3.2	2.2					1993	Poor		

[a] SD1 completed sampling in 2008. These data were not available at the time of this report, but will be included in future updates.

[b] When results for all sampling periods were the same, the value is only shown once.

[c] At these sites, habitat was assessed using the Qualitative Habitat Evaluation Index (QHEI) and have a slightly different scale.

[d] Results are not available because some parameters needed to calculate the MBI were not measured.

[e] Results are not available because some parameters needed to calculate the DBI were not measured.

2.2 LAND COVER CHARACTERISTICS

Land cover and land use play an important role in the quantity and quality of runoff into receiving waters. Current and future land cover is described below.

2.2.1 Current Land Cover

The Kentucky Division of Geographic Information, Commonwealth Office of Technology provided a GIS dataset showing 2005 Kentucky land cover. This dataset was updated and improved to approximate 2007 land cover conditions (Figure 4) using a variety of other datasets that represent current impervious conditions (roads, parking lots, buildings), open space lands (including parks), and surface waters.

47% of this watershed is developed, with development concentrated in the central and northern (downstream) portions of the watershed. Developed areas include the communities of Independence, Covington, Erlanger, Taylor Mill, Edgewood, Elsmere, Fort Wright, Fort Mitchell, Florence, Crestview Hills, and very small portions of Lakeside Park, Kenton Vale, Latonia Lakes, Walton and Wilder. Roughly 11% of the watershed is impervious.

The headwaters of Banklick Creek are still primarily undeveloped and agricultural in nature. Forest and pasture/hay comprise the majority of the undeveloped land in the watershed. The larger parks in this watershed are shown in Figure 1 and include Doe Run Lake Park, and several community parks such as Banklick Woods Park, Pioneer Park and Bill Cappel Fields. There are also many smaller neighborhood parks and ball fields associated with schools.

2.2.1.a Animal operations

There are no concentrated animal feeding operations (CAFOs) in this watershed (Kentucky Geographic Network, 2008). There are two animal feeding operations (AFOs) in the watershed (Kentucky Geographic Network, 2008a). These are dairy operations with 40-45 animals and are located in the Bullock Pen Creek watershed.

Other livestock present, but not prevalent in the watershed include cattle and horses (Kenton County Conservation District, 2007), which are primarily found in the upstream portions of the watershed. Most manure spreading occurs on hayfields on average every few months and some cows are thought to have access to Banklick Creek and its tributaries.

2.2.1.b Septic Systems

SD1 estimates that approximately 5% of all parcels in the Banklick Creek watershed are potentially serviced by septic systems. Properties potentially served by septic systems are found throughout the watershed, but are more concentrated in the southern (headwater) portion, both inside and outside SD1’s sanitary sewer service area.

Estimates of septic system failure rates are not available for Kenton and Boone Counties; however anecdotal reports from Health Department inspectors suggest that 10% of the septic systems may be operating improperly due to incorrect installation, lack of maintenance or age of the system (NKHD, 2008).

In addition, one septic area (hot spot area) was identified as having problems in the Fowler Creek subwatershed. This is an area in an older subdivision that either has very small lots that have unrepairable failing systems, or has systems that have been repaired to the extent practicable on the site, but are not fully functional (NKHD, 2008a).

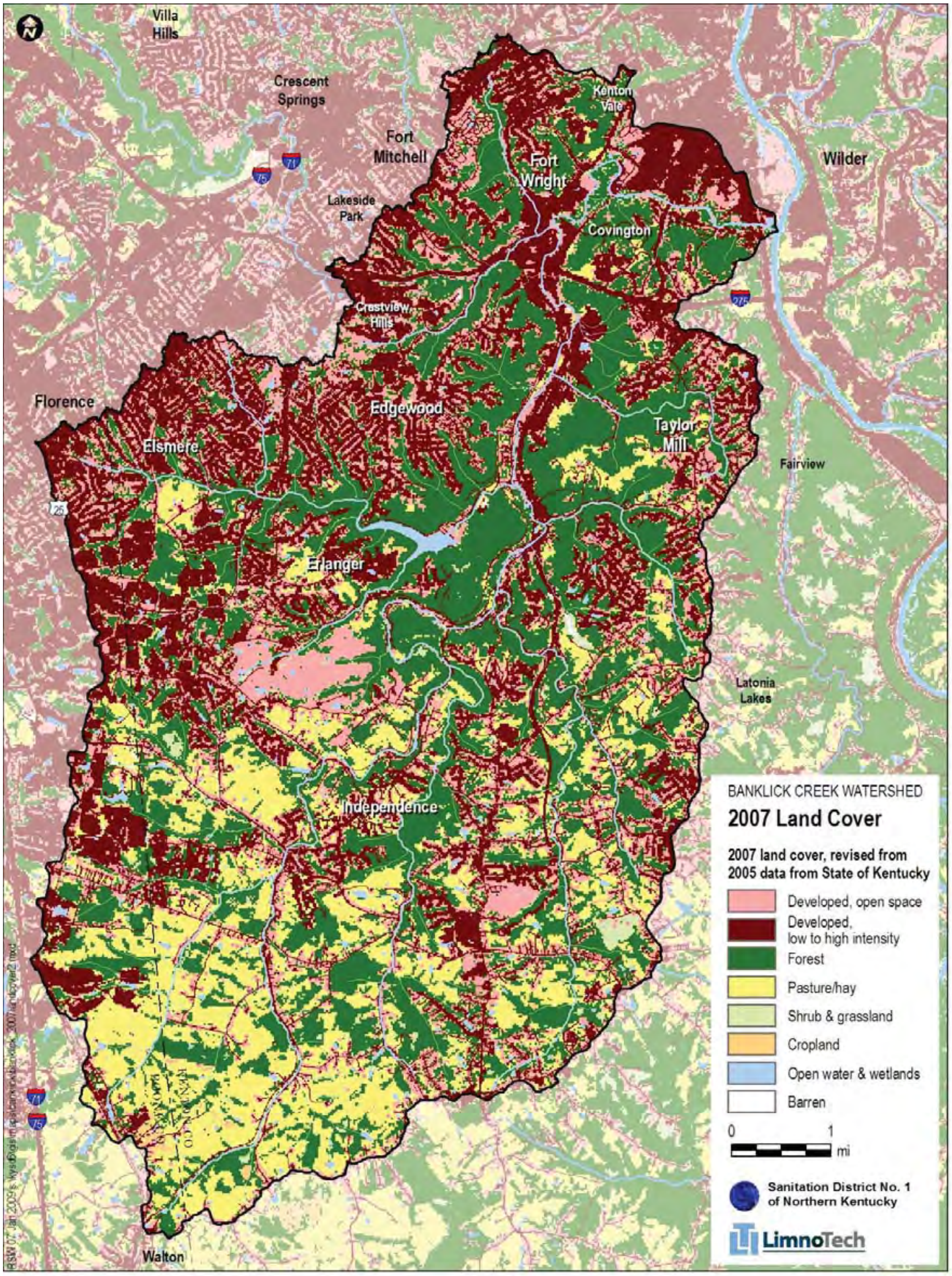

Figure 4. 2007 Land Cover

2.2.2 Future Conditions

Portions of the Banklick Creek watershed are developing at a fairly rapid pace, with urban-suburban developments replacing rural areas. In recent years (2000-2005), population growth in the watershed has been focused in the City of Independence (NKAPC, 2006), although Erlanger, Taylor Mill and Crestview Hills have also seen growth due to new home construction. In the unincorporated portions of the watershed, growth has expanded towards Walton. Between 2005 and 2010, it is anticipated that most of the new residential development will continue to occur in the City of Independence and in areas north of Walton, since urban areas will be nearing saturation. These areas correspond to the less developed headwater areas (NKAPC, 2006).

Several road construction, relocation or improvement projects are planned within the watershed. In the vicinity of Independence, KY 17 is being widened and relocated to the east of the city, essentially bypassing the downtown area, and additional road reconstruction is planned for route 536. Other planned road projects in the watershed includes portions of Turkeyfoot Road, KY 16, and I-275 (KYTC, 2006).

2.2.2.a Future land cover

Future land cover was developed by modifying 2007 land cover to reflect potential future conditions (roughly 2030) obtained from SD1 and the Northern Kentucky Area Planning Commission (NKAPC). It is predicted that development will comprise 70% of this watershed, with most development replacing forest and pasture/hay (Figure 5). Imperviousness is predicted to increase from 11% to 17%. Because flat land is becoming scarce, this development is expected to occur more frequently in areas with steep slopes (NKAPC, 2006).

The Kenton County Comprehensive Plan (NKAPC, 2006) outlines measures to reduce the impact of development. These include, but are not limited to, land use recommendations (e.g., conservation subdivisions, concentration of new developments in areas where urban services can be extended in a timely fashion, encouragement of mixed land use development) and protection of sensitive areas (e.g., greenways, riparian areas and hillsides).

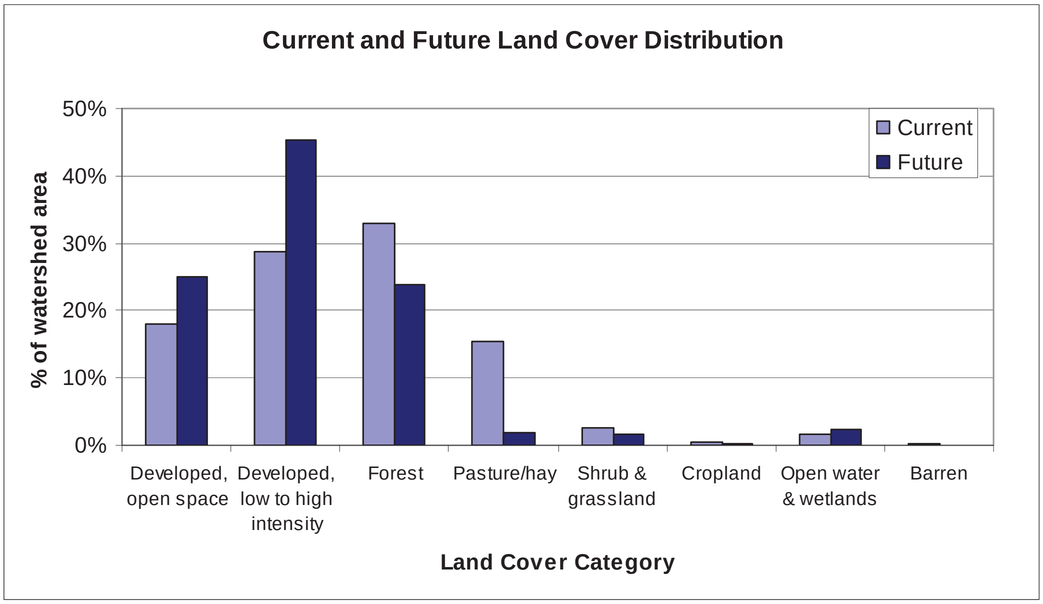

Figure 5. Current and Predicted Future Land Cover

2.3 INFRASTRUCTURE FEATURES

This section summarizes infrastructure features for the Banklick Creek watershed[7].

Approximately 2% of the Banklick Creek watershed is serviced by SD1's combined sanitary sewer area. In addition, approximately 83% of the watershed is serviced by SD1's 48.05 square mile separate sanitary sewer (Figure 6). Of that area, the City of Walton owns approximately 0.03 square miles of the separate sanitary sewer area in this watershed, but contracts with SD1 for operation and maintenance. In total, there are approximately 386.2 miles of separate sanitary sewer lines and approximately 19.2 miles of combined sanitary sewer lines that are operated and maintained by SD1.

Approximately 2% of the Banklick Creek watershed is located within the City of Florence's sanitary sewer service area, which contains approximately 13.4 miles of separate sanitary sewer lines.

Approximately 98% of the Banklick Creek watershed lies within SD1's storm water service area. Within the service area, the storm water system is comprised of approximately 607 miles of streams and channels and approximately 188.9 miles of pipes. Approximately 2% of the Banklick Creek watershed is located within the City of Florence's storm water service area. The Florence storm water system is comprised of approximately 9.7 miles of streams and channels; the extent of the piped storm water system has not been mapped.

The extent of the sanitary sewer, combined sewer and storm water service areas in this watershed is shown in Figure 6.

[7] SD1 is undertaking a characterization and assessment of the sewer system, and overflows identified herein are subject to change. Information on the sanitary and storm water system in Section 2.3 was queried from SD1's geodatabase accessed on November 21, 2008.

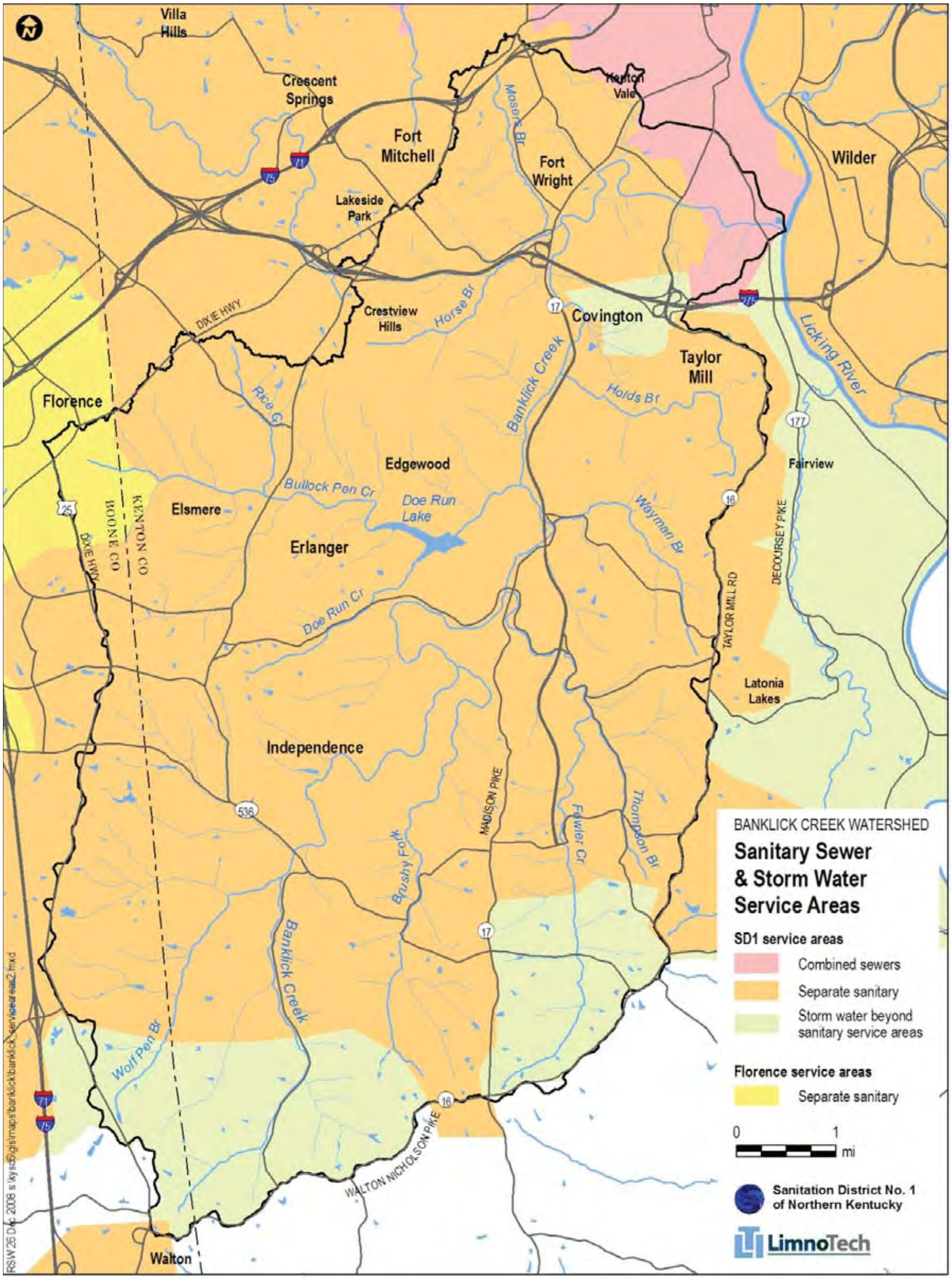

Figure 6. Sanitary Sewer, Combined Sewer and Storm Water Service Areas

2.3.1 Point Sources and Infrastructure

The occurrence of KPDES dischargers, sewer overflows and storm water discharges are described below.

2.3.1.a KPDES dischargers

There are 21 KPDES-permitted dischargers in the Banklick Creek watershed with a total of 32 currently-permitted outfalls. Fifteen of these outfalls are for sanitary wastewater, seven of which are covered under general permits for residences. The remaining outfalls are for storm water runoff, cooling water, a sedimentation basin drain, and concrete mixer truck washout water. Permitted CSOs are not included in this tally and are discussed separately. Permitted dischargers, excluding CSOs, are presented in Table 2.

Based on a review of recent effluent monitoring data (January 2007 to June 2008), it was observed that 18 of the permitted dischargers in the Banklick Creek watershed have violated their permit limits for at least one of the following parameters: total chlorine, total ammonia, fecal coliform, oil and grease, total zinc, total suspended solids (TSS), pH, total phenolics, and 5-day carbonaceous biochemical oxygen demand ($CBOD_5$). KDOW requires effluent monitoring for residential general permits (monitoring is required twice per year); however, data were not available for four of these facilities in this watershed. KDOW estimates that residential dischargers fail at a rate that is believed to be higher than 10% (KDOW, 2007).

Table 2. Permitted Dischargers

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?[a]	Permit Violations
Wolf Pen Branch	KY0033057	Eaton Asphalt Frogtown Plant	0011	Minor	New sanitary wastewater plant	N	NA
Wolf Pen Branch	KY0101591	Bp Oil Co Richwood Bulk Plant	0012	Minor	Storm water runoff	Y	NA
Wolf Pen Branch	KYG400896	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Fowler Creek	KY0034207	Colony House Apts	0012	Minor	Sanitary wastewater	Y	Total chlorine, total ammonia
Fowler Creek	KY0040631	Whites Tower Elem School	0011	Minor	Sanitary wastewater	Y	NA
Fowler Creek	KY0040690	Old Twenhofel Middle School	0011	Minor	Sanitary wastewater	Y	Total chlorine
Fowler Creek	KY0075833	Nixutil Sanitation Assoc Inc	0012	Minor	Sanitary wastewater	Y	Fecal coliform, total ammonia
Fowler Creek	KY0080802	Regency Manor Inc	0012	Minor	Sanitary wastewater	Y	Total ammonia
Fowler Creek	KY0101672	Kenton Co Bd of Ed	0012	Minor	Whites Tower Elem School	Y	Total ammonia
			0022	Minor	Simon Kenton High School	N	Total ammonia
			0062	Minor	Twenhofel Jr High School	Y	$CBOD_5$, fecal coliform, total ammonia, TSS
Fowler Creek	KYG400090	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Fowler Creek	KYG400482	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Fowler Creek	KYG400719	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Bullock Pen Creek	KY0075485	Graham Packaging Plastic Prods	0011	Minor	Cooling water and sanitary	Y	Fecal coliform
Bullock Pen Creek	KY0090191	Camco Chemical Co Inc	0011	Minor	Storm water runoff	Y	pH
			0021	Minor	Storm water runoff	Y	pH
			0031	Minor	Storm water runoff	Y	pH
Bullock Pen Creek	KYG400111	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Thompson Branch	KYG400625	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA

Table 2. Permitted Dischargers - Continued

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?[a]	Permit Violations
Banklick Creek	KY0089524	Interplastic Corp Thermoset	0011	Minor	Storm water runoff - plant grds	Y	Oil and grease, total zinc, TSS
			0012	Minor	Storm water runoff - plant grds	Y	None
			0021	Minor	Storm water runoff - west side	N	Total zinc, TSS
			0022	Minor	Storm water runoff - west side	N	NA
			0041	Minor	Storm water runoff - east side	Y	Total zinc, TSS
			0042	Minor	Storm water runoff - east side	Y	None
Banklick Creek	KY0101052	Moraine Materials Co Plt #29	0011	Minor	Concrete mixer trk washout wtr	Y	Oil and grease, TSS
Banklick Creek	KY0101222	BP Amoco Sohio Refinery	0011	Minor	Groundwater remediation	N	Naphthalene
			0021	Minor	Groundwater remediation	N	Total iron
			0031	Minor	Storm water runoff	Y	NA
			0032	Minor	Storm water runoff	Y	NA
			0041	Minor	Storm water runoff	Y	Total phenolics
			0042	Minor	Storm water runoff	Y	NA
Banklick Creek	KYG400514	Residence	0011	Minor	Sanitary wastewater Type B	Y	Total ammonia
Banklick Creek	KYG500131	KTC Kenton Co Maint Garage	SW10	Minor	Storm water runoff	Y	None
			SW20	Minor	Storm water runoff	Y	Oil and grease
			SW30	Minor	Storm water runoff	Y	NA
Banklick Creek	KYG640158	Taylor Mill WTP	0011	Minor	Sedimentation basin drain	Y	TSS

[a] Discharge is permitted as of June 2008.

NA – Monitoring data were not available.

2.3.1.b Sewer overflows

There are five current combined sewer overflows (both permitted and "to be permitted") in the Banklick Creek watershed. These overflows are listed in Table 3. All of these CSOs are located in the watershed draining the lower 2.3 miles of Banklick Creek.

There are twenty-seven sanitary sewer overflows (SSOs) in this watershed (Table 4). Two of these are located at pump stations that have historically been shown to have a lack of wet weather capacity. The Lakeview pump station is located along the Banklick Creek mainstem within the City of Fort Wright, and the Meadow Hill pump station is located in the southern portion of the City of Covington.

Table 3. Combined Sewer Overflow Points

Manhole ID	Common Name	Direct Discharge to Waterbody	Typical Year Spill Frequency (# spills)[a]	Typical Year Volume (Million gallons)[a]
1870194 (outfall 79)	47th Street	Banklick Cr.	4	0.13
1850158 (outfall 76)	Church Street	Banklick Cr.	74	56.26
1870193 (outfall 78)	Decoursey Ave.	Banklick Cr.	24	1.29
1840130[b]	Latonia	Banklick Cr. trib.	25	1.12
1510245[b]	Henry Clay	Banklick Cr. trib.	0	0

[a] The results presented were generated by models based on SD1's current (2008) understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

[b] These are "to be permitted" CSOs, i.e., SD1 has (or will) identified these locations for KPDES permitting.

Table 4. Sanitary Sewer Overflow Points

Manhole ID	Direct Discharge to Waterbody	Typical Year Spill Frequency (# spills)[a,b]	Typical Year Volume (Million Gallons)[a,b]
1040060	Tributary to Bullock Pen Creek	3	0.1
1090069	Tributary to Bullock Pen Creek	0	0.0
1110025	Tributary to Bullock Pen Creek	4	0.2
1110067	Tributary to Bullock Pen Creek	5	0.4
1110161	Tributary to Bullock Pen Creek	2	0.1
1110294	Tributary to Bullock Pen Creek	5	0.1
1570100	Tributary to Horse Branch	7	0.2
1760047	Tributary to Bullock Pen Creek	0	0.0
1760048	Tributary to Bullock Pen Creek	0	0.0
1860108	Banklick Creek	0	0.0
1870013	Banklick Creek	0	0.0
1950199	Tributary to Banklick Creek	0	0.0
1960012	Horse Branch	0	0.0
2030097	Tributary to Bullock Pen Creek	0	0.0
2090001	Bullock Pen Creek	0	0.0
2090026	Bullock Pen Creek	0	0.0
2110002	Tributary to Bullock Pen Creek	10	1.0
2120001	Tributary to Bullock Pen Creek	5	0.2
2120002	Tributary to Bullock Pen Creek	0	0.0
2120041	Tributary to Bullock Pen Creek	4	0.1
2160036	Tributary to Horse Branch	NA	NA
2280010	Wolf Pen Branch	0	0
2280011	Wolf Pen Branch	10	0.4
2280012	Wolf Pen Branch	0	0.0
2300123	Banklick Creek	27	6.1
1950PS1 (Lakeview PS)	Banklick Creek	17	10.6
2020PS2 (Meadow Hill PS)	Tributary to Banklick Creek	NA	NA

[a] The results presented were generated by models based on SD1's current (2008) understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

[b] NA means no model data are available.

2.3.1.c Storm water discharges

Storm water pipe outlets are located throughout most of the Banklick Creek watershed with the highest concentration in north and west portions of the watershed where development is denser. In addition to storm water outfalls, there are approximately 162 suspected illicit activity (SIA) points which are located throughout the Banklick Creek watershed, with the greatest concentrations to the north and west. SIAs are locations where there was possible evidence of illicit discharges during SD1's storm water mapping project (2001-2002). These locations are being further investigated to determine if they are recurring.

A small portion of this watershed is located outside of SD1's storm water service area, so outfalls and other illicit discharges may be located in these areas, but were not inventoried by SD1. Storm water outfalls covered by individual KPDES permits are discussed in Section 2.3.1.a.

2.3.2 Recently Completed Infrastructure Projects

SD1 has completed numerous projects, including the following:

- Lakeview Pump Station Capacity Upgrade, completed in 2005, involved the repair and rehabilitation of the existing pump station and increased the capacity of the Lakeview Pump Station to approximately 22 MGD, reducing overflows at the pump station bypass and upstream as well.
- Banklick Pump Station Screening Facility project, completed in 2006, installed a new bar screen to remove solids and floatables that were clogging the pumps and preventing the pump station from running properly during wet weather. The pump station can now run continuously without clogging reducing the frequency and volume of CSOs upstream.
- The Wilson Road Sewer Assessment project was completed in 2005 and involved extending sewer lines, giving 6 properties the opportunity to connect to sewer service.
- The Taylor Mill Sewer Assessment project was completed in 2005 and involved extending sewer lines, giving 15 properties the opportunity to connect to sewer service.
- The Pleasure Isle Sewer Assessment project was completed in 2005 and involved extending sewer lines, giving 10 properties the opportunity to connect to sewer service.
- The Cadillac Drive Sewer Assessment project was completed in 1999 and involved extending sewer lines, giving 73 properties the opportunity to connect to sewer service.
- Brookwood Subdivision SSES Study, completed in 2006, evaluated the sanitary sewer and storm sewers in the Brookwood subdivision to identify locations of storm water inflow and infiltration (I/I) into the separate sanitary sewer system in

order to identify projects to be performed to remove this identified I/I. Flows from this area are tributary to the Lakeview pump station service area.

- Stevenson Road Relief Sewer Project Phase II project, completed in 2006, was constructed to increase the wet weather capacity in the Lakeview pump station service area collection system to reduce the frequency and volume of known SSOs.
- McMillan Pump Station Removal project, completed in 2006, provided increased dry and wet weather sewer capacity by constructing a new sewer to eliminate an existing maintenance intensive pump station.
- Apple Drive Sewer Outfall project, completed in 2006, extended sanitary sewer service to remove a package treatment plant.
- KY Transportation Cabinet - KY17 / Pelly to Nicholson project, completed in 2006, relocated and upsized existing sewers to provide additional dry and wet weather capacity in an area upstream of Lakeview pump station.
- Fort Wright Sanitary Sewer Rehabilitation project, completed in 2006, was a result of the Fort Wright Illicit Discharge Removal Project and installed new sanitary and storm sewers to separate sanitary and storm flows in this area. This project resulted in eliminating sewage from getting into existing storm sewers and the local creeks and reduced wet weather flow tributary to the Lakeview pump station service area, thereby reducing overflows downstream.
- Fort Wright Outfall Sewer Phase II, completed in 2006, constructed a new sanitary sewer to remove the existing sanitary sewer from the creek, thereby reducing inflow and infiltration from storm and creek water into the sanitary sewer.
- South Hills Outfall, completed in 2007, included the construction of a new 24-inch sewer via horizontal directional drilling on grade (first in the country of this size and slope) to eliminate a CSO at a street intersection. This new sewer has been successful in diverting combined sewer flows from the Lakeview pump station service area, and into the Bromley pump station combined sewer service area, thereby consolidating flows within the combined system and reducing overflow volume at the Lakeview pump station. This project also eliminated a failing sewer located within a landslide area that has resulted in past sanitary sewer overflows.
- Latonia Combined Sewer Separation project, first phase completed in 2007, provided sewer separation through the construction of a new storm sewer to separate and intercept storm water flow to keep it out of the combined sewers in Latonia. This project has helped to reduce basement backups in this area and reduce the overflow volume from downstream CSOs. Additional phases of this work could be completed in the future if monitoring proves that it would be beneficial.

- Bluegrass Swim Club Sewer Separation, completed in 2007, removed existing storm water connections to the sanitary sewers in Fort Wright, thereby reducing wet weather flows in SD1's sanitary sewer system.

2.3.3 Ongoing or Planned Infrastructure Improvement Projects

SD1 has several ongoing and planned projects for the Banklick Creek watershed including:

- Western Regional - Narrows Road Diversion Pump Station and Industrial Road Force Main. This project will divert flow from the Lakeview pump station service area, which experiences overflows at the pump station and from manholes upstream. This project will: (1) free up capacity at the Dry Creek Treatment Plant; and (2) increase capacity in the conveyance system tributary to Lakeview, decreasing overflows in this system.
- Western Regional – KY Transportation Cabinet - Turkeyfoot Road Force Main, partially completed, is the first construction piece of the new Diversion Pump Station system that will eventually divert flow from the Lakeview Pump Station service area.
- Three locations where the sewerline crosses Banklick Creek are being fixed using stream stabilization techniques such as J hooks and riffles, to stop headcutting. These are located along the mainstem of Banklick Creek, just upstream of Banklick Woods Park. Another manhole and exposed pipe are being surveyed to determine the best solution for that site, which is also along the mainstem of Banklick Creek, near River mile 9.5.

Project information is presented in Table 5.

Table 5. Ongoing or Planned Infrastructure Improvement Projects

Capital Improvement Project Title	Goals	Anticipated Start Date	Anticipated Completion Date	Project Total
Western Regional - Narrows Road Diversion Pump Station	Decrease overflows in the Lakeview service area	2010	2013	$11,565,000
Western Regional - Turkeyfoot Industrial Road Force Main	Decrease overflows in the Lakeview service area	2010	2013	$3,045,000
Stream crossing projects and problem manhole	Decrease potential for stream inflow into District sanitary sewers	To be determined	To be determined	To be determined

2.4 SENSITIVE AREAS

The federal CSO Control Policy (USEPA, 1994) states EPA's expectation that a permittee's Long-Term Control Plan (LTCP) give the highest priority to controlling CSOs in sensitive areas. The CSO Control Policy indicates that sensitive areas include:

- Waters designated as Outstanding National Resource Waters (ONRW);
- Waters with threatened or endangered species and their habitat;

- Waters with primary contact recreation, such as bathing beaches;
- Public drinking water intakes and their designated protected areas;
- National Marine Sanctuaries; and
- Shellfish beds.

These six criteria were evaluated individually. None of the waters in the Banklick Creek watershed have been designated by the State of Kentucky as ONRW (401 KAR 10:030) and no National Marine Sanctuaries have been designated (NOAA, 2008). There are no known commercial shellfish beds within the Banklick Creek watershed, nor is shellfish harvest for consumption by private individuals known to occur. The remaining three criteria are discussed below.

2.4.1 Threatened and Endangered Species or Their Designated Critical Habitat

Threatened and endangered species, species of concern and their designated critical habitat within the Banklick Creek watershed were identified by contacting the Kentucky State Nature Preserves Commission (KSNPC). KSNPC identified five species (Table 6), one of which (Running buffalo clover) is an threatened and endangered species. There is no critical habitat designated for any of the five species.

Table 6. Endangered Species, Threatened Species and Species of Concern

Taxonomic Group	Scientific name	Common name	Status[a]	Last Observed	Habitat(s)	Identified Threats
Vascular Plants	*Trifolium stoloniferum*	Running buffalo clover	Federal - Endangered State - Threatened	2003	Riparian areas, upland areas	Habitat loss, non-native species, bison decline,
Breeding Birds	*Ammodramus henslowii*	Henslow's sparrow	Federal – SOMC State-Special Concern	1950	Grasslands, savannahs	Habitat loss
Breeding Birds	*Tyto alba*	Barn owl	State – Special Concern	1987	Farms and farm structures	Habitat loss
Amphibians	*Plethodon cinereus*	Redback salamander	State – Special Concern	1998	Woodlands	Habitat loss, habitat degradation
Amphibians	*Rana pipiens*	Northern leopard frog	State - Special Concern	1934	Ponds, wetlands, grasslands	Habitat loss, non-native species, commercial overexploitation

Source: KSNPC, 2006; KSNPC, 2007

[a] Species of Management Concern (SOMC) is a Federal/ESA Designation

Running buffalo clover is a small herbaceous plant (Figure 7) that inhabits streambanks and upland areas, and erosion is noted as the biggest threat (KSNPC, 2006). Other factors contributing to population declines are loss of bison populations, non-native plants, and overall habitat loss (USFWS, 2003).

Source: US Fish & Wildlife Service; Sarena Selbo

Figure 7. Running Buffalo Clover, *Trifolium stoloniferum*

The northern leopard frog is an aquatic-dependent species, which is a state species of special concern. The northern leopard frog inhabits various habitats including slowly flowing areas in creeks and rivers, springs, the nearshore area of lakes, bogs, fens, herbaceous wetlands, riparian areas and grasslands (NatureServe, 2007). Threats to the northern leopard frog include habitat loss, commercial overexploitation, and competition with introduced species (NatureServe, 2007).

Three of the species identified by KSNPC are neither aquatic nor dependent on riparian habitats. These are Henslow's sparrow, the barn owl and the redback salamander. Henslow's sparrow inhabits grassland and savannah habitats and the greatest threat to the species is loss of habitat (Reinking, 2002). The barn owl inhabits farms and farm structures, and loss of farmland to commercial development, changes in farming practices (e.g., reduction in dairy and sheep farming) and a general decline in the number of farms have been cited as contributing to population declines (NatureServe, 2007). The redback salamander, a woodland species, is sensitive to localized habitat loss, mainly due timber removal and habitat degradation (NatureServe, 2007).

2.4.2 Primary contact recreation waters

Kentucky does not have a tiered approach for primary contact recreation (PCR). This means that the State has designated that all PCR waters should be suitable for full body contact recreation during the recreation season of May 1 through October 31 (401 KAR 10:001E). The State water quality standards do not define full body contact recreation, so the bacteria criteria developed are based on the presumption that people will ingest water and could become ill if the water was sufficiently contaminated with bacteria.

Banklick Creek and its tributaries are designated for PCR. It is not clear whether or not swimming occurs in the creek, as public surveys regarding that information are unavailable. No public swimming beaches were identified in the watershed. Wading has been observed in Banklick Creek. Additional data will be gathered about uses of the creek.

2.4.3 Public drinking water intakes or their designated protection areas

There are no public drinking water intakes from surface waters or public groundwater wells in this watershed. The nearest intake is located on the Licking River just upstream of the Banklick Creek confluence. Northern Kentucky Water District (NKWD) is responsible for the drinking water intake on the Licking River.

Source Water Assessment and Protection Areas (SWAPPs) for the water intake on the Licking River have been delineated to identify potential contaminants upstream of the water intake. The SWAPP zones are not used in a regulatory sense but are used to support identification of sources potentially impacting the intakes. Due to the location of the NKWD intake, portions of this watershed lie within SWAPP Zone 1, which extends 5 miles upstream on Banklick Creek from the mouth. The remainder of the watershed lies within SWAPP Zones 2 and 3, because they are farther from the intake.

Drinking water supply features are shown in Figure 8.

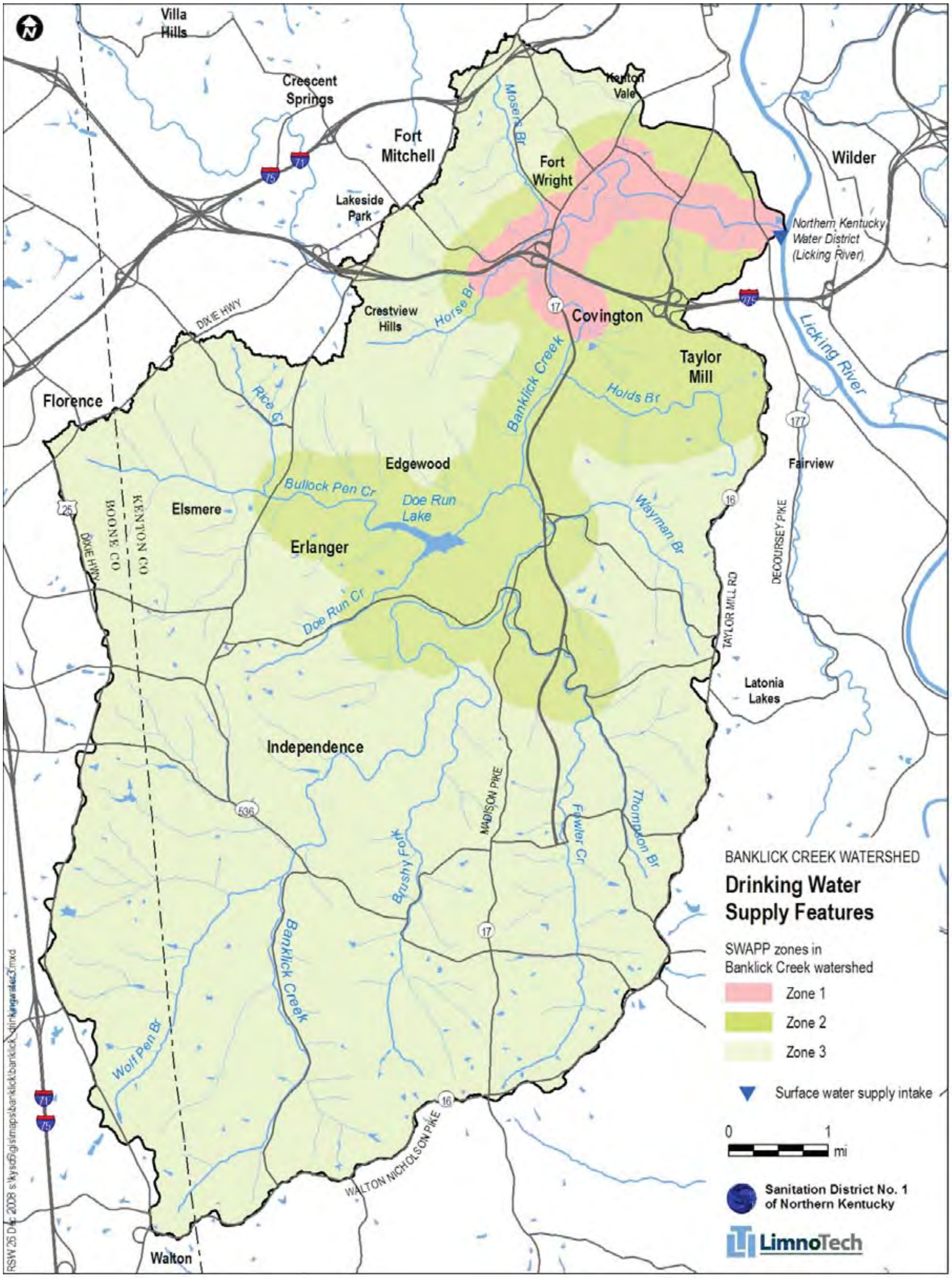

Figure 8. Drinking Water Supply Features

2.5 PUBLIC INTEREST/WATERSHED GROUP ACTIVITIES

Interest in this watershed is considered high, and is gauged through an active watershed council, past studies and improvement projects, and past sampling.

The Banklick Watershed Council was formed in 2002 “to make Banklick Creek once again “swimmable and fishable” and a safe, public amenity without dangerous flooding and pollution” (http://www.banklick.org/index.htm). A watershed action plan was developed in 2005 using 104(b)(3) funds (Banklick Watershed Council, 2005), and more recently, the watershed council was awarded 319(h) grant funding to revise the existing watershed plan and continue restoration activities.

Many organizations have been active in this watershed, including SD1, the Banklick Creek Watershed Council, the U.S. Army Corps of Engineers, the Northern Kentucky Health Department, the Local Alliance for Nature and Development, Kenton County Conservation District, Licking River Watershed Watch, the Area Development District and the Licking Region Basin Team. Some studies and projects in this watershed are briefly described below. Projects more directly related to infrastructure improvements are discussed in Sections 2.3.2 and 2.3.3.

- SD1 has been conducting monitoring and modeling studies in this watershed since 1995 and has been responsible for funding or conducting numerous investigations, reports and projects aimed at improving the health of the watershed.
- The USDA, FEMA and the USACE have been involved in projects to investigate and reduce flooding in the watershed (See Section 2.1.1).
- A 2006 small area study (NKAPC, 2006a) examined potential future land uses in the headwaters of Banklick Creek, and identified key natural features for preservation. The study provides recommendations for greenways, riparian buffers along perennial and intermittent streams, hillside protection, stream restoration.
- A $1 million 319(h) project is underway to modify the existing watershed plan and conduct restoration activities in this watershed over the next 6.5 years (Kentucky Energy and Environment Cabinet, 2008).
- A preliminary scope has been developed to conduct stream and wetland restoration along Banklick Creek, in the 38-acre Wolsing Preserve. This work will involve removal of a low water bridge, sewer crossing restoration, Cody Road crossing removal, restoration of a 100 foot riparian buffer, and wetlands enhancement. This project is proposed by the Northern Kentucky University Center for Applied Ecology through the Northern Kentucky Stream and Wetland Restoration Fund, with some funding also being provided by Kenton County Conservation District. The Kenton and Boone County Conservation Districts, and the USDA Natural Resources Conservation Service also continue to promote riparian buffers (Banklick Watershed Council, 2005).

- A master plan has been developed for Doe Run Lake to protect and enhance the lake, link adjacent areas using trails, greenways, stream or wildlife corridors, and provide opportunities for education and increasing awareness of this resource (Human Nature, 2003).
- The Madison Pike (KY 17) Corridor Study was developed to guide development of the area adjacent to Banklick Creek. Among other things, this plan includes objectives to maximize Banklick Creek as an asset to the surrounding area and provide recreational opportunities in the corridor. Riparian protection/buffers and hillside protection areas are discussed (City of Fort Wright, Kentucky, 2004).

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3. WATERBODY USES

This section describes designated and current uses for Banklick Creek and its tributaries.

3.1 DESIGNATED USES

Banklick Creek and its tributaries are designated for warm water aquatic habitat, primary contact recreation, secondary contact recreation and domestic water supply, applicable at existing points of public water supply withdrawal (401 KAR 10:026). These are defined below.

- **Warm water aquatic habitat** means any surface water and associated substrate capable of supporting indigenous warm water aquatic life.
- **Primary contact recreation** waters means those waters suitable for full body contact recreation during the recreation season of May 1 through October 31.
- **Secondary contact recreation** waters means those waters that are suitable for partial body contact recreation, with minimal threat to public health due to water quality.
- **Domestic water supply** means surface waters that with conventional domestic water supply treatment are suitable for human consumption through a public water system as defined in 401 KAR 8:010, culinary purposes, or for use in any food or beverage processing industry; and meet state and federal regulations under the Safe Drinking Water Act, as amended, 42 U.S.C. 300f - 300j.

3.2 CURRENT USES

An assessment of available information found the following:

- Fish IBI scores for Banklick Creek ranged from poor to excellent. Benthic algal surveys revealed high levels of eutrophication throughout the creek. The most diverse aquatic macroinvertebrate communities were found in the upper watershed and outside of urban areas (Strand Associates, 2003).
- There is a swimming advisory for the entire length of Banklick Creek, based on bacteria measurements in the creek (KDOW, 2007b).
- Wading in the creek has been observed along the mainstem of the Banklick Creek in the Pioneer Park area.
- There are no boat launches or marinas on the creek, however recreational boating may occur on Banklick Creek. Banklick Creek is listed on the American Whitewater website and a description of the creek between Independence Station Road and the Doe Run confluence is provided, which provides the class of the creek, the gradient and the length of this reach (http://www.americanwhitewater.org/rivers/id/3132).
- A boat launch ramp for Doe Run Lake is located within Doe Run Lake Park.
- A statewide fish consumption advisory was issued on April 11, 2000 due to low levels of organic mercury found in fish taken from Kentucky waters (KDOW, 2007a).

- Fishing is permitted at Doe Run Lake Park and Banklick Woods Park. Fishing has also been observed along the mainstem of the Banklick in the areas of Pioneer Park and SD1's Public Service Park.
- There are no water supply intakes from surface waters in the Banklick Creek watershed.
- There are no active public water supply groundwater wells in this watershed (KDOW, 2008a; KDOW, 2007c).

4. WATERBODY CONDITIONS

This section describes monitoring programs and observed water quality and biological conditions in this watershed.

4.1 303(d) STATUS AND POLLUTANTS OF CONCERN

The entire length of Banklick Creek and one lake appear on Kentucky's 2008 303(d) list of impaired waters (Table 7; KDOW, 2008).

Table 7. 303(d)-listed Waterbodies

Waterbody Segment	Designated Uses (use support)	Pollutants	Suspected Sources
Banklick Creek RM 0.0 – 3.5	Primary contact recreation (Not supporting) Warm water aquatic habitat (Partially supporting)	Fecal coliform Nutrient/eutrophication biological indicators; Organic enrichment (sewage) biological indicators; Sedimentation/siltation	Highways, Roads, Bridges, Infrastructure (New construction), municipal point source discharges, unspecified urban storm water, urban runoff/storm sewers
Banklick Creek RM 3.5 – 8.2	Primary contact recreation (Not supporting) Warm water aquatic habitat (Not supporting)	Fecal coliform Nutrient/eutrophication biological indicators; Organic enrichment (sewage) biological indicators; Sedimentation/siltation	Agriculture, on-site treatment systems (septic systems and similar decentralized systems)
Banklick Creek RM 8.2 – 19.2	Primary contact recreation (Partially supporting) Warm water aquatic habitat (Partially supporting)	Fecal coliform Nutrient/eutrophication biological indicators; Organic enrichment (sewage) biological indicators	Agriculture, on-site treatment systems (septic systems and similar decentralized systems)
Doe Run Lake 51 acres	Warm water aquatic habitat (Partially supporting)	Dissolved oxygen; Nutrient/eutrophication biological indicators; Dissolved gas supersaturation	Source unknown, upstream source

TMDL development is planned for Banklick Creek. KDOW may collect additional sediment data if needed and once data collection is complete, KDOW will develop the sediment TMDLs. KDOW will pursue development of nutrient and organic enrichment TMDLs when nutrient targets are available (KDOW, 2008).

4.2 MONITORING PROGRAMS

Water quality data have been collected in this watershed by KDOW, Northern Kentucky University (NKU), Licking River Watershed Watch (LRWW), USGS and SD1. Data currently compiled by SD1 from known monitoring programs are presented in Table 8, however, only data which have been fully analyzed are discussed in Section 4.3 Water Quality Data Analysis. Available data exists for the main stem of Banklick Creek, Bullock Pen Creek, Fowler Creek, Mosers Branch as well as Doe Run Lake.

Data not included in this report will be reviewed and included in subsequent updates.

Table 8. Summary of Water Quality Monitoring Data

Entity	Dates	Parameters Sampled	Sampling Locations[b]	Number of Samples
KDOW	1985	Fecal coliform, Fecal strep	Banklick Cr. RM 5.9, 0.3, 1.2	1/month March & July
KDOW	1989, 1994, 1995,	Alkalinity, chloride, chlorophyll-a, DO, DO % Sat, 1% light compensation point, pH, conductivity, TSS, VSS, TOC, DOC, transparency (secchi disc), temperature, nutrients	Doe Run Lake (Bullock Pen Cr. RM 0.9)	3/yr May-October
KDOW	1991-2005	Fecal coliform, Fecal strep or entero, E. coli, alkalinity, chloride, chlorophyll-a, DO, DO % Sat, 1% light compensation point, pH, conductivity, TSS, transparency (secchi disc), temperature, nutrients	Banklick Cr. RM 0.2, 0.3, 1.2, 2.4, 3.3, 3.6, 4.0, 8.1	Numerous sampling dates between Apr & Nov
KDOW	1996	DO, pH, conductivity, transparency (secchi disc), turbidity, temperature	Banklick Cr. RM 0.3	13 days in June, July, Aug, & Sept.
KDOW	1999	Fecal coliform	Bullock Pen Cr. RM 0.1	2/month May, Aug, Sept
KDOW	1999	DO, DO % Sat, pH, conductivity, temperature	Banklick Cr. RM 1.2	1 sample (8/19/1999)
KDOW	1999-2000	Fecal coliform, biochemical oxygen demand (5 Day), TSS, nutrients	Banklick Cr. RM 0.3, 1.2, 3.9, 8.2, 8.1, 11.6, 17.7; Fowler Cr. RM 0.1	10 samples from Apr 1999 to Mar 2000 (no sample in June, Oct, & Jan, but two samples for Feb)
LRWW	1999	Fecal coliform	Banklick Cr. RM 0.2, 5.7	1 sample (7/16/1999)
LRWW	2002	Fecal coliform	Banklick Cr. RM 0.1, 0.2, 5.7; Fowler Cr. RM 0.1, 1.7; Mosers Br. RM 0.7	1 sample (7/12/2002)
LRWW	2003	Fecal coliform	Banklick Cr. RM 7.7	2 samples (5/14/2003 & 7/10/2003)
LRWW	2004	Fecal coliform, *E. coli*	Banklick Cr. RM 0.1, 0.2, 0.8, 5.7; ; Bullock Pen Cr. RM 0.1, 1.8; Mosers Br. RM 0.7	3 samples (May, July, Sept)
NKU	1998	Alkalinity, bromide, chloride, fluoride, hardness, conductivity, sulfate, TOC, TSS, nutrients, metals	Banklick Cr. RM 0.2, 5.7	1 sample (10/11/1998)
NKU	1998	Fecal coliform	Banklick Cr. RM 0.2, 5.7	1 sample (7/14/1998)
NKU	1998	Alachlor, atrazine, chlorpyrifos-methyl, metolachlor, 2,4-D, Dichlorophenoxyacetic acid	Banklick Cr. RM 0.2, 5.7	1 sample (5/17/1998)
NKU	1999	Atrazine, chlorpyrifos-methyl, 2,4-D, Dichlorophenoxyacetic acid	Banklick Cr. RM 0.2, 5.7	1 sample (5/23/1999)
NKU	1999	Alkalinity, chloride, hardness, conductivity, sulfate, TOC, TSS, nutrients	Banklick Cr. RM 0.2, 5.7	1 sample (9/13/1999)
NKU	2000	Alkalinity, chloride, hardness, conductivity, DO, pH, sulfate, TOC, TSS, temperature, nutrients	Banklick Cr. RM 0.2, 5.7	1 sample (Sept.)
NKU	2000	Fecal coliform, Fecal Streptococci	Banklick Cr. RM 0.2, 5.7	1 sample (7/15/2000)
NKU	2000	Atrazine, metolachlor	Banklick Cr. RM 0.2, 5.7	1 sample (5/21/2000)
NKU	2001	Atrazine, metolachlor	Banklick Cr. RM 0.1, 0.2, 5.7	1 sample (June)

Table 8. Summary of Water Quality Monitoring Data - Continued

Entity	Dates	Parameters Sampled	Sampling Locations[b]	Number of Samples
NKU	2001	Fecal coliform, Fecal Streptococci	Banklick Cr. RM 0.1, 0.2, 5.7	1 sample (7/14/2000)
NKU	2001	Fecal coliform, E. coli, DO, pH, temperature	Banklick Cr. RM 15.6; Bullock Pen Cr. RM 0.4, 2.7; Fowler Cr. RM 1.7; Mosers Br. RM 0.7	1 sample (8/25/2001)
NKU	2002	Atrazine, DO, pH, temperature	Banklick Cr. RM 15.6; Bullock Pen Cr. RM 0.4, 2.7; Fowler Cr. RM 0.1, 1.7; Mosers Br. RM 0.7	1 sample (May)
NKU	2003	Fecal coliform, DO, pH, conductivity, temperature	Banklick Cr. RM 0.1, 0.2, 0.8, 5.7; Mosers Br. RM 0.7	1 sample (5/17/2003)
NKU	2003	Fecal coliform, alkalinity, boron, chloride, DO, hardness, pH, conductivity, silicon, sulfur, sulfate, TSS, temperature, nutrients, metals	Banklick Cr. RM 0.2, 5.7; Mosers Br. RM 0.7	1 sample (Sept.)
NKU	2003	Fecal coliform	Banklick Cr. RM 0.1, 0.2, 5.7; Mosers Br. RM 0.7	1 sample (7/10/2003)
SD1	1995-1996	Fecal coliform, E. coli, biochemical oxygen demand (5 Day), carbonaceous biochemical oxygen demand (5-day), chlorophyll a, cyanide, DO, hardness, oil and grease, pH, settleable solids, conductivity, TOC, total solids, TSS, transparency (secchi disc), turbidity, VSS, temperature, nutrients, metals	Banklick Cr. RM 0.3, 1.2, 3.9	12 wet/dry weather events (33 samples from each station for all of the events)
SD1	1996	DO, pH, conductivity, transparency (secchi disc), temperature	Banklick Cr. RM 0.3, 1.2, 3.9	1/month June, Aug, & Sept
SD1	1996	WQ: DO, pH, conductivity, turbidity, temperature, transparency (secchi disc) Sediment: chemical oxygen demand, oil and grease, total solids, total volatile solids, toluene, nutrients, metals	Banklick Cr. RM 0.3	1 sample (8/8/1996)
SD1	2001-2003	DO, pH, conductivity, transparency (secchi disc), turbidity, TSS, temperature, nutrients	Banklick Cr. RM 0.4, 2.5, 3.8, 5.4, 8, 10.1, 13.5, 15, 18.2; Bullock Pen Cr. RM 0.1	Four sampling events (Sept & Oct of 2001, May & June of 2002, Sept of 2002, & April & May of 2003) -- parameters and sampled stations vary from each event
SD1	2002-2003	Fecal coliform, E. coli, carbonaceous biochemical oxygen demand (5-day), DO, hardness, pH, conductivity, TSS, VSS, temperature, nutrients, metals	Banklick Cr. RM 0.3, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; Fowler Cr. RM 0.1	3 wet and 3 dry weather events (21samples from each station for all of the events)

Table 8. Summary of Water Quality Monitoring Data - Continued

Entity	Dates	Parameters Sampled	Sampling Locations[b]	Number of Samples
SD1	2002-2003	Gage height, discharge, DO, pH, conductivity, temperature	Banklick Cr. RM 0.3, 1.2	5- & 15-minute intervals
SD1	2007	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Banklick Cr. RM 0.3, 1.2, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; Fowler Cr. RM 0.1	1 sample (6/26/2007)
SD1	2008	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Banklick Cr. RM 0.3, 1.2, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; Fowler Cr. RM 0.1	1 Wet Weather Event in May (Eight samples from each station for the event)
SD1	2008[a]	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Banklick Cr. RM 0.3, 1.2, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; Fowler Cr. RM 0.1	1 sample (6/25/2008)
University of Kentucky	1993	Fecal coliform, Fecal strep, biochemical oxygen demand (5 Day), DO, TSS	Banklick Cr. RM 1.2, 2.4, 3.6, 4.0	10 samples for Aug, 5 samples for Sept, & 2 samples for Nov
USGS	1999-present[a]	Gage height, discharge, precipitation, DO, DO % sat, DO equilibrium, pH, conductivity, turbidity, temperature	USGS Station No. 03254550; Banklick Cr. RM 8.1	15-minute intervals

[a]Data not analyzed in Section 4.3, including USGS data collected after WY 2005

[b] RM = River mile

4.2.1 Future Sampling

Both instream and outfall sampling are currently planned.

SD1 plans to continue monitoring this watershed during base flow conditions with at least one survey per year. The eight sampling locations are: Banklick Cr. RM 0.3, 1.2, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; and Fowler Cr. RM 0.1. Typical analyses will include bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters.

SD1 is planning to collect wet weather data at four locations in this watershed in 2009. The four locations are: Banklick Creek RM 0.3, 1.2, 3.9 and 8.1. Attempts will be made to sample three events of varying characteristics (total rainfall, maximum intensity). Samples may be analyzed for bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters. Within each event, samples will be collected near hour 0, 2, 4, 6, 12, 24, 36, and 48 hours of the start of the storm, though these intervals are dependent on the storm characteristics and may be changed if necessary. Additionally, surveys to assess the degree of stream hydromodification are currently underway by SD1.

The USGS will continue to operate the stage gage, measure flow, and water quality (physical parameters) at RM 8.1 (station 03254550). This station is operated and funded via a cooperative agreement between USGS and SD1.

Outfall sampling was initiated in 2007 to better characterize water quality and loadings from CSOs, SSOs and storm water runoff. Six outfalls are being sampled in the Banklick Creek watershed and analyzed for bacteria, nutrients, solids, metals and oxygen-demanding constituents. The outfalls being sampled include the Lakeview pump station, the Church Street CSO and four storm water outfall locations. This sampling program plan is anticipated to continue until ten events are monitored.

4.3 WATER QUALITY DATA ANALYSIS

Water quality data have been collected in the Banklick Creek watershed since 1985. Historical water quality data (1985-2005) have been analyzed to identify past water quality problems in this watershed. Historical exceedances of bacteria, dissolved oxygen, metals, temperature, pH and alkalinity (Doe Run Lake only) have been observed. Temperature and pH violations were only observed at the USGS continuous monitoring station.

Recent data (2006-present) have been analyzed in more detail to describe current stream conditions, because these data better reflect the effect of existing sources on instream water quality. Analysis of recent data collections indicate elevated bacteria levels. It should be noted that the data collected at the USGS station are not included in this assessment of recent data. These data are being reviewed and will be included in the next update of this report.

4.3.1 Historical Data

Both discrete measurements and the continuous water quality data were analyzed to identify historical water quality problems. The 15-minute data collected at the USGS continuous monitoring station through water year 2005 have been previously analyzed and documented in report by Cumberland Environmental Group (2007). This report is used to as the basis for the continuous data analysis.

Historical sampling data, as well as the 15-minute USGS data, reveal numerous exceedances of water quality criteria (Tables 9-12). Locations and parameters not discussed met their applicable water quality standards.

Table 9. Historical Bacteria Exceedances

Stream	River Mile	Parameters exceeding criteria				
		Fecal coliform			*E. coli*	
		Season	# samples	% of samples exceeding criteria[a]	# samples	% of samples exceeding criteria[a]
Banklick Creek	0.1	May-Oct	6	83%	1	100%
Banklick Creek	0.2	May-Oct Nov-Apr	101 6	61% 17%	3 ---	67% n/a
Banklick Creek	0.3	May-Oct Nov-Apr	58 7	86% 100%	50 ---	90% n/a
Banklick Creek	0.4	May-Oct	3	67%	3	67%
Banklick Creek	0.8	May-Oct	2	100%	---	n/a
Banklick Creek	1.2	May-Oct Nov-Apr	125 13	75% 23%	27 ---	93% n/a
Banklick Creek	2.4	May-Oct Nov-Apr	68 8	54% 38%	---	n/a
Banklick Creek	3.3	May-Oct	12	58%	---	n/a
Banklick Creek	3.6	May-Oct Nov-Apr	93 8	68% 38%	---	n/a
Banklick Creek	3.9	May-Oct Nov-Apr	51 5	82% 40%	47 ---	85% n/a
Banklick Creek	4.0	May-Oct Nov-Apr	112 8	72% 13%	---	n/a
Banklick Creek	5.7	May-Oct	10	80%	---	n/a
Banklick Creek	7.7	May-Oct	2	100%	---	n/a
Banklick Creek	8.1	May-Oct Nov-Apr	60 7	68% 14%	21 ---	81% n/a
Banklick Creek	11.6	May-Oct	24	75%	21	81%
Banklick Creek	15.6	May-Oct	22	77%	21	81%
Banklick Creek	17.7	May-Oct	1	100%	---	n/a
Bullock Pen Creek	0.1	May-Oct	26	65%	23	78%
Fowler Creek	0.1	May-Oct Nov-Apr	24 1	88% 100%	21 ---	81% n/a
Mosers Branch	0.7	May-Oct	8	50%	3	67%

[a] There are no instances where 5 samples were collected from a single location within a 30-day period. Therefore the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, "Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for *E. coli*." Even this comparison is conservative as the criterion is meant to be applied to a dataset of 5 or more samples collected over a 30-day period.

--- is used to indicate no data; n/a indicated not applicable

Table 10. Historical Dissolved Oxygen Violations

Stream	River Mile	Parameters violating criteria: Dissolved oxygen[a] # measurements	% of measurements in violation
Banklick Creek	0.2	67	7%
Banklick Creek	0.3	76	7%
Banklick Creek	1.2	114	11%
Banklick Creek	2.4	70	9%
Banklick Creek	3.6	81	20%
Banklick Creek	4.0	82	1%
Banklick Creek	8.1	60	2%
Bullock Pen Creek	0.9	186	66%

[a] The dissolved oxygen criterion is 4 mg/l.

Table 11. Historical Metals Violations

		Parameters violating criteria							
		Cadmium [a]		Copper [a]		Iron [b]		Zinc [a]	
Stream	River Mile	# samples	% of samples in violation	# samples	% of samples in violation	# samples	% of samples in violation	# samples	% of samples in violation
Banklick Creek	0.3	44	7%	54	2%	---	n/a	---	n/a
Banklick Creek	1.2	30	23%	---	n/a	---	n/a	---	n/a
Banklick Creek	3.9	29	17%	---	n/a	---	n/a	---	n/a
Banklick Creek	5.7	---	n/a	---	n/a	5	50%	---	n/a
Banklick Creek	8.1	---	n/a	20	5%	---	n/a	---	n/a
Banklick Creek	11.6	---	n/a	20	5%	---	n/a	---	n/a
Fowler Creek	0.1	---	n/a	20	10%	---	n/a	20	5%

[a] Acute criteria to protect aquatic life are hardness-dependent. Individual criteria were calculated for each sampling event based on hardness at the time of sampling. Acute cadmium criteria ranged from 1.9 ug/l to 8.5 ug/l. Acute copper criteria ranged from 12.7 ug/l to 50.5 ug/l. Acute zinc criteria ranged from 110 ug/l to 380 ug/..

[b] The acute water quality criterion for iron is 4,000 ug/l

--- is used to indicate no data; n/a indicated not applicable

Table 12. Historical Alkalinity Violations

Stream	River Mile	Parameters violating criteria	
		Alkalinity[a]	
		# samples	% of samples in violation
Bullock Pen Creek	0.9	3	100%

[a] The alkalinity criterion is 20 mg/l $CaCO_3$

The dissolved oxygen, temperature and pH violations discussed below were all observed at the USGS station on Banklick Creek at RM 8.1.

Violations of the 4.0 mg/l dissolved oxygen criteria have been reported in 2001 (May and September), 2002 (June), and 2003 (July). In general, flows were very low on days where dissolved oxygen was less than 4 mg/l.

Infrequent violations of the temperature criteria (31.7^{o}C) were observed in 2001, 2002 and 2005. These violations occurred during the summer months when flows were low.

Infrequent pH violations at the USGS gage were observed in 2002 and 2005, where the pH at RM 8.1 was observed to change more than 1 su in a 24-hour period. These violations occurred over a range of flow conditions. There were no observations of pH greater than 9.0 su or less than 6.0 su. The Synthesis Report suggests that the cause of most pH violations is algal growth and photosynthesis (CEG, 2007).

4.3.2 Recent Data

Recent water quality data were available for six locations along the mainstem of Banklick Creek (RM 0.3, 1.2, 3.9, 8.1, 11.6, and 15.6), as well as one location on Bullock Pen Creek (RM 0.1) and one location on Fowler Creek (RM 0.1). Eight fecal coliform samples and eight *E. coli* samples were available for each location.

Recent bacteria exceedances were observed (Table 13). Measurements for parameters not shown met water quality criteria. Recent data collected at the USGS station are being reviewed and will be included in the next update of this report.

Table 13. Recent (2006-2008) Bacteria Exceedances

Stream	River Mile	Parameters exceeding criteria			
		Fecal coliform[a]		*E. coli*[a]	
		# samples	% of samples exceeding criteria	# samples	% of samples exceeding criteria
Banklick Creek	0.3	8	75%	8	75%
Banklick Creek	1.2	8	63%	8	75%
Banklick Creek	3.9	8	50%	8	88%
Banklick Creek	8.1	8	50%	8	75%
Banklick Creek	11.6	8	50%	8	63%
Banklick Creek	15.6	8	50%	8	75%
Bullock Pen Creek	0.1	8	50%	8	50%
Fowler Creek	0.1	8	25%	8	63%

[a] There are no instances where 5 samples were collected from a single location within a 30-day period. Therefore the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, “Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for *E. coli*.” Even this comparison is conservative as the criterion is meant to be applied to a dataset of 5 or more samples collected over a 30-day period.

4.3.2.a Bacteria

Fecal coliform and *E. coli* data were available for both base flow and storm conditions. Storm flow results for bacteria are presented as an average over the storm event. As shown in Figure 9, fecal coliform concentrations exceeded the applicable criterion in Banklick Creek and Bullock Pen Creek. Four of the 16 base flow samples exceeded the fecal coliform criterion, and storm flow samples exceeded the criterion at every location except Fowler Creek at RM 0.1. The maximum base flow fecal coliform concentration, 1,530 cfu/100 ml, was observed at Bullock Pen Creek RM 0.1, while the maximum storm event concentration, 1,697 cfu/100 ml, was observed at Banklick Creek RM 0.3.

E. coli concentrations exhibited a similar pattern, as shown in Figure 10. Eight of the 16 base flow measurements exceeded the applicable criterion, with exceedances observed at all sampling locations. The maximum base flow *E. coli* concentration, 1,333 cfu/100 ml, was observed at Bullock Pen Creek RM 0.1. Storm flow measurements exceeded the criterion at all locations, with a maximum concentration of 1,972 cfu/100 ml observed at Banklick Creek RM 0.3.

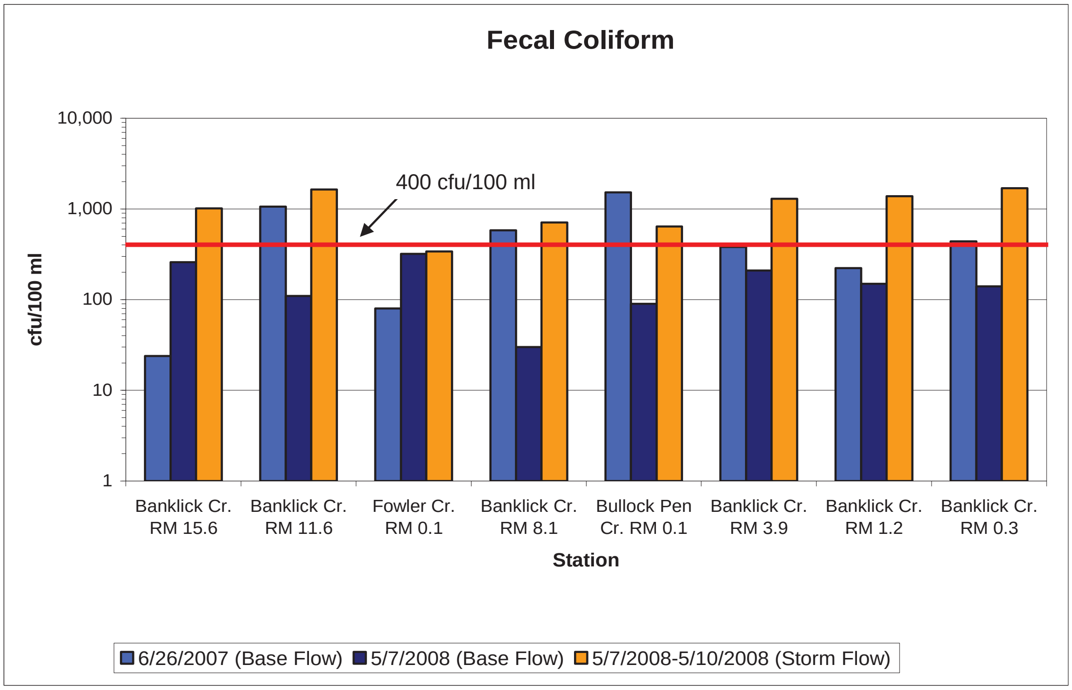

Figure 9. 2006-08 Base Flow and Average Storm Flow Fecal Coliform Concentrations Compared to 400 cfu/100 ml Criterion

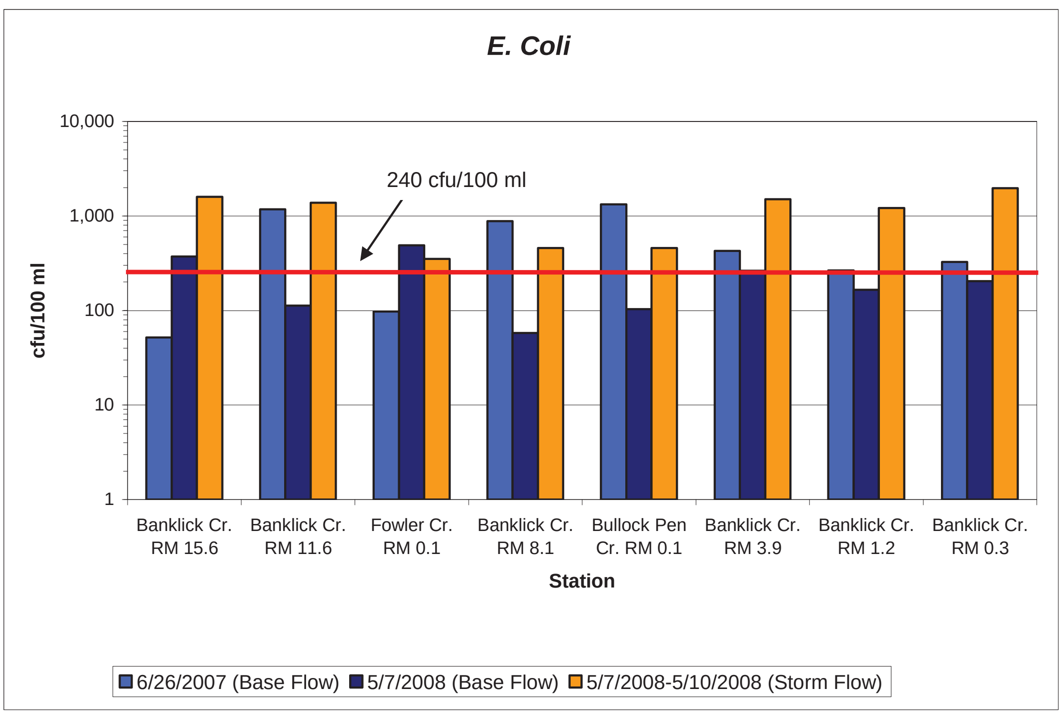

Figure 10. 2006-08 Base Flow and Average Storm Flow *E. Coli* Concentrations Compared to 240 cfu/100 ml Criterion

4.4 BIOLOGICAL CONDITIONS

Macroinvertebrate communities are susceptible to water quality and habitat degradation, and data from these communities are used as a tool to detect changes in habitat and water quality and assessing stream health (KDOW, 2008b).

KDOW sampled macroinvertebrates in 1999 at Banklick Creek RM 1.2, which yielded a MBI[8] rank of "poor" (Table 1). KDOW and Strand Associates also collected macroinvertebrate samples in 1996 and 2001-2003, respectively, but these data are not compatible with calculating the MBI. The 2001-2003 data indicate, with a few exceptions in locations where the creek is ephemeral, that areas upstream in the watershed had higher percentages of desirable macroinvertebrate individuals (Strand Associates, 2003). This is likely due to the lower level of land use disturbance in the primarily agricultural area compared to the high level of disturbance farther down the watershed where urban development exists. The urbanized areas have altered aquatic habitats, reduced riparian zones and increased siltation. Desirable macroinvertebrates were also low at the Bullock Pen Creek site and at sites closest to the mouth of Banklick Creek (Strand Associates, 2003). The downstream sites in Banklick Creek are also subject to backwater flows from the Licking and Ohio Rivers that cause siltation and further reduce desirable macroinvertebrates.

Benthic algae are useful biological indicators of water quality because they are sensitive to changes in water quality and are primary producers within aquatic ecosystems. Diatoms are benthic algae that are useful indicators of biological integrity because at least a few can be found under almost any condition and they are identifiable to species (KDOW, 2008b). In 1993, an unnamed tributary to Bullock Pen Creek received a poor rating based on diatom measurements (Table 1). Benthic algae were also measured in total biomass by Strand Associates between 2001 and 2003 (Strand Associates, 2003). The results of this sampling showed that eutrophication is a problem in some sections of the creek during some seasons (Strand Associates, 2003). The Bullock Pen Creek site often had chlorophyll-a measurements exceeding 300 mg/m^2. High algal levels were also observed in the uppermost portion of the creek, which is surrounded by agricultural lands and subject to low flows, especially during the fall. In the most downstream portions of Banklick Creek, periphyton levels were high only during extended periods of low flow (Strand Associates, 2003).

KDOW and Strand Associates sampled several sites within the Banklick Creek watershed for fish. The calculated KIBI scores[9] varied in ratings (Table 1).

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[8] The macroinvertebrate data collected by KDOW were used to calculate the macroinvertebrate biotic index (MBI). The MBI compiles attributes of the macroinvertebrate community such as taxa richness, pollution tolerant species and pollution intolerant species. Additional metrics are added depending on the stream size and/or ecoregion.

[9] The data from this survey were used to calculate the Kentucky Index of Biotic Integrity (IBI), a multimetric index using fish as an indicator of stream health. The IBI compiles attributes of the fish community such as taxa richness and abundance, pollution tolerance/ intolerance, feeding and reproductive needs, and presence or absence of native species in order to provide a numerical value and corresponding narrative classification for streams.

4.5 STREAM METABOLISM

Stream metabolism can be used as a measure of ecosystem health because it responds to the complex interactions between instream conditions (physical, biological and chemical) and watershed conditions. It can be assessed by looking at the ratio of primary production (P), which is influenced by instream conditions (light and nutrient inputs), to respiration (R), which is influenced by watershed conditions (other nutrient and detritus inputs). This ratio can be calculated using continuous instream dissolved oxygen measurements, because dissolved oxygen responds to both instream and watershed inputs. Smaller ratios (e.g., P:R less than 1) suggest that stream system health is more strongly affected by watershed inputs than by instream and near stream processes.

Stream metabolism has been analyzed at eight USGS continuous monitoring stations which deploy multi-parameter sondes. These stations are located in watersheds that have varying levels of watershed impacts; however, none are located in an unimpacted or reference watershed. For the 2000-2005 period, all eight sites have ratios that indicate the health of these streams is more strongly affected by watershed inputs than instream and near stream inputs.

Instream and watershed inputs appear to be relatively well balanced in Banklick Creek at RM 8.1, because this site has a P:R ratio close to 1. Because there are no reference sites in this region that can be used for comparison, it is not known how this ratio compares to that for an unimpacted watershed. Longer-term monitoring of dissolved oxygen at the Banklick Creek site may prove useful in understanding how stream and watershed level changes affect the stream metabolism balance at this site.

5. SOURCE ANALYSIS

This section summarizes potential pollutant sources in the Banklick Creek watershed and some of its tributaries. Conclusions are based on the watershed characterization and recent water quality data.

5.1 WATERSHED SOURCES ANALYSIS

Potential sources of bacteria were identified within the Banklick Creek watershed, based on the watershed characterization information discussed previously. Bacteria exceedances have been observed during both base flow and storm flow conditions at all locations recently monitored. These sources are summarized in Table 14 and their location is shown in Figure 11.

Table 14. Summary of Potential Sources

	Banklick Creek Headwaters to RM 8.2 (excluding Fowler Ck)	Fowler Creek	Bullock Pen	Banklick Creek RM 8.2 - mouth (excluding Bullock Pen)
Recent observed Impairments=>	Bacteria 303(d): Nutrients, organic enrichment [c] Flooding reported upstream to RM 10.3	Bacteria Flooding reported	Bacteria 303(d): Doe Run Lake DO, nutrients, dissolved gas supersaturation [d]	Bacteria[b] 303(d): Nutrients, organic enrichment, sedimentation/siltation[e] Flooding reported
CSO[a]				5
SSO[a]	4		15	6
SSO-pump station[a]				2
Septic	Numerous	Numerous 1 septic "hot spot"	Few	Few
KPDES-sanitary outfalls[f]	2	11	2	
KPDES-storm water/other outfalls[g]	2		4	12
Storm water runoff	Urban and rural	Urban and rural	Urban; Small portion in Florence	Urban
Livestock	Cattle, horses		2 AFOs (cattle)	
Licking River backwater				Affects lower reaches of Banklick Creek
Watershed improvements	*Planned stream and wetland restoration along Banklick Creek in Wolsing preserve.* *3 projects planned on mainstem of Banklick Creek near RM 10.5, to address streambank erosion.*		*Doe Run Lake Master Plan developed to protect and enhance the lake and link the lake to adjacent areas using greenways, trails or stream corridors.*	*Several projects completed to increase capacity at, and divert flows from Lakeview PS to reduce overflows at PS and upstream.* *Latonia sewer separation project to reduce overflow from downstream CSOs.* *Bluegrass Swim Club sewer separation to reduce wet weather flows into sanitary system.* *Several improvement projects planned to divert flow from Lakeview PS to reduce overflows* *Madison Pike Corridor Study to maximize Banklick Creek as an asset.*

[a] SD1 is undertaking a characterization and assessment of the sewer system, and sources are subject to change.

[b] DO, pH and temperature violations have historically been observed at the USGS station, but recent data have not been reviewed.

[c] Agriculture and on-site treatment systems are identified as potential sources contributing to the impaired primary contact recreation and warm water aquatic habitat uses (KDOW, 2008).

[d] An upstream source and unknown source are identified as potential sources contributing to the impairment of the warm water aquatic habitat use (KDOW, 2008).

[e] Highways, roads bridges, infrastructure (new construction), municipal point source discharges, unspecified urban storm water runoff, urban runoff/storm sewers, agriculture and on-site treatment systems are identified as potential sources contributing to impairment of the primary contact recreation and warm water aquatic habitat uses (KDOW, 2008).

[f] Excludes CSOs. Includes currently permitted facilities only.

[g] One outfall is included twice because it covers sanitary and cooling water. Includes currently permitted facilities only.

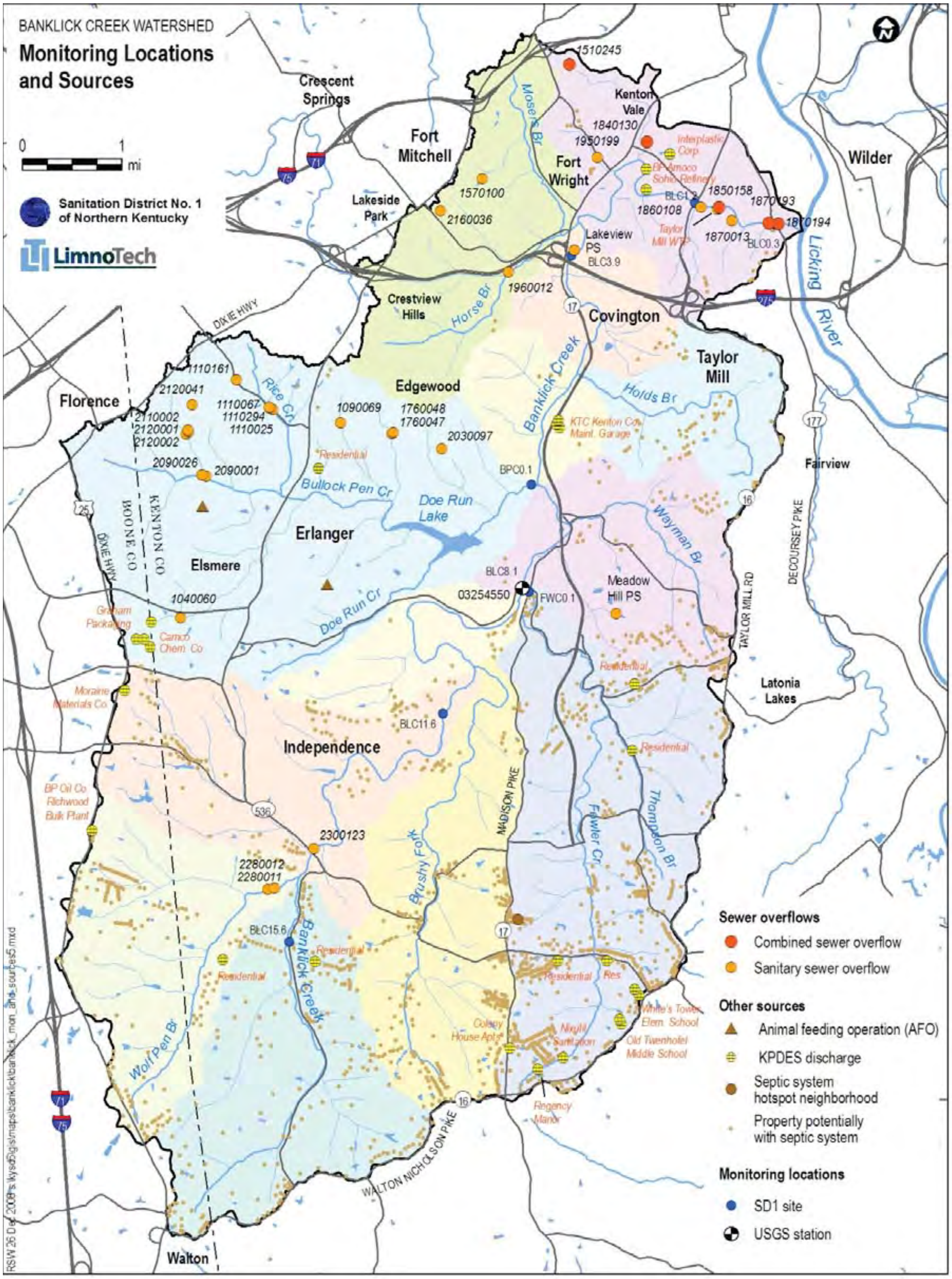

Figure 11. Monitoring Locations and Sources

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6. RANKING

6.1 SUMMARY OF RESULTS

The WAT! is a tool that assesses the potential for point and nonpoint sources to generate fecal coliform, total solids and total phosphorus pollutant loads. WAT! was developed for these three pollutants because data to support modeling were readily available and they are representative indicators of potential water quality conditions. Calibration of the WAT! tool for total solids and total phosphorus is planned, and results should be available in future reports. Results for fecal coliform are discussed below.

This analysis was conducted for each of the sixteen watersheds located within SD1's study area. In addition to assessing pollutant loading potential by source, the WAT! also assesses pollutant loading potential by watershed, which allows for ranking and comparisons among the 16 watersheds.

WAT! results[10] indicate that the Banklick Creek watershed has a roughly average ranking (analogous to load) for bacteria under year-round conditions, relative to the sixteen identified watersheds in SD1's service area.

In addition to watershed rank, other factors such as public interest and the presence of a SWAPP zone, may affect watershed prioritization. These and other ranking considerations are summarized in Table 15.

Table 15. Watershed Ranking Considerations

CSO (#)	SSO (#)	SWAPP Zone	Aquatic-dependent T&E Species[a] (#)	Special Designations	Public Interest	WAT! Rank, year-round conditions[b]
						Bacteria
5	27	Zone 1, 2 and 3 (due to Licking River intake)	1	None	High	7 of 16

[a] There is also one aquatic-dependent and three terrestrial species of State special concern. One terrestrial species is also a federal species of management concern.

[b] The WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

T&E = Threatened and endangered species

6.2 SCREENING TO DETERMINE IF ADDITIONAL DATA ARE NEEDED

Sufficient data and information are currently available or planned for collection to support a good understanding of current conditions in the Banklick Creek watershed. Additionally, watershed and water quality models have been developed which could be applied to examine the effects that future activities (e.g., development or improvement projects) will have on the creek.

[10] WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

Elevated bacteria concentrations have been observed in the watershed during base flow conditions. Preliminary WAT! results indicate septic systems are the primary bacteria source during base flow conditions, but other potential sources, such as: livestock, KPDES-permitted facilities, pets, and wildlife may also be contributing.

6.2.1 Data Gap Analysis

A site visit to the watershed to investigate dry weather bacteria sources is recommended. Additionally, coordination with the health department and KPDES-permitting agency is may also be useful for identifying and addressing improperly operating systems and facilities.

No additional water quality or biological data collection is recommended beyond that already planned, to characterize current conditions in this watershed.

6.3 SOURCE PRIORITIZATION

The sources identified through the process of watershed characterization have been quantified using the WAT!. WAT! has been applied for a five-year period (1992-1996 climatological conditions), to quantify fecal coliform contributions by source. Together the characterization and WAT! results help inform source prioritization for improvement or elimination.

6.3.1 WAT! Results

The relative fecal coliform load generated by source is shown in Figure 12. These WAT! results incorporate predicted sewer overflow volumes from infrastructure model simulations for 1992-1996 climatological conditions[11]. Flow estimates are available for four of the CSOs and thirteen of the SSOs in this watershed.

Under year-round conditions, the largest source of fecal coliform is overland storm water runoff. Septic systems are not a significant contributor to the total annual bacteria load; however, during base flow conditions they are estimated to contribute the majority of the fecal coliform load.

[11] The results presented were generated by models based on SD1's current understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual measured field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

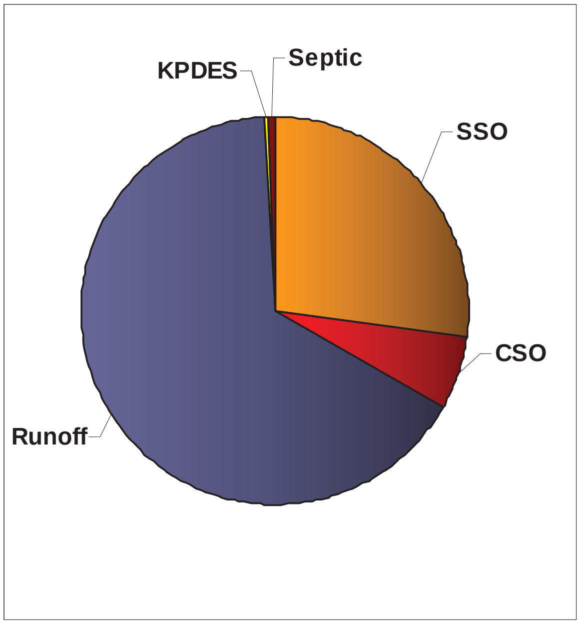

Figure 12. Initial Year-Round WAT! Results for Fecal Coliform

WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive .

WAT! results should be considered preliminary as ongoing work may affect the WAT! source analysis and rankings. Work is currently ongoing to refine the bacteria contribution from septic systems.

6.4 WATERSHED RANKING

The WAT! produced a ranking, by watershed for sixteen watersheds, based on their potential to generate fecal coliform loads over a 1-year period. The water quality impact score (analogous to load) for each of the sixteen watersheds was used as a ranking metric. Additional detail on the ranking is available in the WAT! documentation.

The WAT! produces rankings of the watersheds for both base flow and year-round conditions. By separating base flow conditions, the impacts of dry weather sources on stream conditions can be differentiated from the combined impact of dry and wet weather sources. The ranking of the Banklick Creek watershed during year-round and base flow conditions is provided in Table 16.

Table 16. WAT! Watershed Rankings

	Rank for Year-Round Conditions[a,b]	Rank for Base flow Conditions[a,b]
Fecal coliform	7	9

[a]Rank ranges from 1 to 16. A rank of 1 indicates a high water quality impact score which is analogous to load. The lowest possible rank is 16.

[b]WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

The WAT! analysis for both total solids and total phosphorus will be presented in future reports upon completion of the WAT! calibration. Future monitoring will further populate and refine modeling results, aiding in identification and characterization of potential sources.

7. REFERENCES

Banklick Watershed Council. 2005. The Banklick Watershed Action Plan; A Comprehensive Approach to Watershed Management. URL: http://www.banklick.org/Banklick_Watershed_Plan_Nov_2005.pdf

Carey, D. I. and J.F. Stickney, 2004. Groundwater Resources of Boone County, Kentucky. Kentucky Geological Survey County Report 8, Series XII, ISSN 0075-5567.

Carey, D.I. and J.F. Stickney, 2005. Groundwater Resources of Kenton Co. Kentucky. Kentucky Geological Survey County Report 59, Series XII. ISSN 0075-5567.

City of Fort Wright, Kentucky, 2004. Madison Pike Corridor land Use and Economic Development Plan. October 2004.

Cumberland Environmental Group, LLC (CEG), 2007. Continuous Monitoring Network Synthesis Report Water Years 2001 – 2005. Prepared for Sanitation District No. 1 of Northern Kentucky. Draft.

Grace, M. and S. Imberger 2006. Stream Metabolism: Performing & Interpreting Measurements. New South Wales Department of Environmental Conservation stream metabolism workshop. May 2004, Sydney Australia. Workshop developed technical manual. Accessed at http://www.sci.monash.edu.au/wsc/docs/tech-manual-v3.pdf

Human Nature, 2003. Doe Run Lake Master Plan-Inventory/Analysis.

Kenton County Conservation District, 2007. Agricultural Water Quality Self Certification Tracking Sheet.

Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 001E. Statement of Emergency Regulation. Definitions for 401 KAR Chapter 10.

Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 026. Designation of Uses of Surface Waters. Administrative Register of Kentucky. Technical Amendment August 9, 2007.

Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 030. Antidegradation Policy Implementation Methodology.

Kentucky Commonwealth Office of Technology, 2005. 2005 Kentucky Land Cover. Obtained in November, 2007.

Kentucky Division of Water (KDOW), 2007. Personal communication, Florence Regional Office. April 9, 2007.

Kentucky Division of Water (KDOW), 2007a. Fish Consumption Advisories in Kentucky. www.water.ky.gov/sw/advisories/fish.htm Last modified 7/25/2007. Accessed 7/25/2007.

Kentucky Division of Water (KDOW). 2007b. Swimming Advisories in Kentucky. URL: http://www.water.ky.gov/sw/advisories/swim.htm. Last modified 1/3/07.

Kentucky Division of Water (KDOW), 2007c. Personal communication on status of domestic and public water wells. December 2007.

Kentucky Division of Water (KDOW), Kentucky Environmental and Public Protection Cabinet. 2008. 2008 Integrated Report to Congress on the Condition of Water Resources in Kentucky. Volume II. 303(d) List of Surface Waters. Final. May, 2008.

Kentucky Division of Water (KDOW), 2008a. Kentucky Drinking Water Watch Database Version 1.2. Accessed March 2008.

Kentucky Division of Water (KDOW), Natural Resources and Environmental Protection Cabinet. 2008b. Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky. February.

Kentucky Energy and Environment Cabinet, Office of Communications and Public Outreach, 2008. Governor Beshear Presents $1 Million Grant to Protect Banklick Creek. URL: http://www.eppc.ky.gov/press/press2008/april/4-23banklick.htm. July 3, 2008.

Kentucky Geographic Network, 2008. April 9, 2008. http://kygeonet.ky.gov/geographicexplorer/explorer.jsf

Kentucky Geographic Network, 2008a. August 11, 2008. http://kygeonet.ky.gov/geographicexplorer/explorer.jsf

Kentucky State Nature Preserves Commission (KSNPC). 2006. Boone County Report of Endangered, Threatened, and Special Concern Plants, Animals, and Natural Communities of Kentucky. Frankfort, KY. February.

Kentucky State Nature Preserves Commission (KSNPC). 2007. Natural Heritage Program Database Review. Data Request 07-097. February 14.

Kentucky Transportation Cabinet. 2006. Kenton County Six-Year Plan Projects. FY-2006 thru FY-2012.

McTammany, M.E., E.F. Benefeld and J.R. Webster. 2007. Recovery of stream ecosystem metabolism from historical agriculture. Journal of the North American Benthological Society 26(3):532-545.

National Climatic Data Center (NCDC), NOAA Satellite and Information Service. 2008. Data obtained for Cincinnati Northern KY Airport, Covington/Cincinnati, KY, United States. WBAN 93814.

National Oceanic and Atmospheric Administration (NOAA). 2008. National Marine Sanctuaries. http://sanctuaries.noaa.gov/welcome.html. Revised February 7, 2008. Accessed February 11, 2008.

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 5, 2007).

Northern Kentucky Area Planning Commission (NKAPC). 2006. Comprehensive Plan Update. 2006 – 2026. An Area-wide Vision for Kenton County.

Northern Kentucky Area Planning Commission (NKAPC). 2006a. South Banklick Small Area Study. September.

Northern Kentucky Health Department (NKHD). 2008. Personal communication February 2008.

Northern Kentucky Health Department (NKHD). 2008a. Personal communication August 2008.

Northern Kentucky Water District (NKWD). 2003. Source Water Assessment and Protection Plan, Susceptibility Analysis and Protection Recommendations for Campbell County.

Natural Resources Conservation Service (NRCS), 2006. SSURGO/GIS format. [online] http://datagateway.nrcs.usda.gov/

Odum, E.P. 1956. Primary production in flowing waters. Limnology and Oceanography. 1:102-117.

Paylor, R.L. and J.C. Currens. *Karst Occurrence in Kentucky*. University of Kentucky, Kentucky Geological Survey. 2002. http://kgsweb.uky.edu/olops/pub/kgs/mc33_12.pdf. Accessed on May 21, 2007.

Ray, J.A., Webb, J.S., O'Dell, P.W. (Kentucky Department of Environmental Protection, Division of Water, Groundwater Branch), 1994. Groundwater Sensitivity Regions of Kentucky.

Reinking, D. L. 2002. Rare, local, little-known, and declining North American breeders a closer look: Henslow's sparrow. American Birding. April. 146-153.

Strand Associates. 2003. Final Report for Northern Kentucky Sanitation District No. 1, Part 1 of 2: Final Report Habitat and Biological Community Assessment of Banklick Creek, Kentucky. Madison, WI. July.

United States Army Corps of Engineers (USACE), 2000. Banklick Creek Watershed Kenton County, Kentucky. Flood Damage Reduction/Ecosystem Restoration Section 905(b) (WRDA 1986) Analysis. September 2000.

United States Environmental Protection Agency (USEPA). April 19, 1994. Combined Sewer Overflow (CSO) Policy. *Fed. Regist*. Vol. 59 pg. 18688.

United States Fish and Wildlife Service (USFWS), 2003. Running Buffalo Clover *Trifolium stoloniferum*. Fort Snelling, Minnesota. July.

Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor. 2002. Ecoregions of Kentucky. Color poster with map, descriptive text, summary tables, and photographs, U.S. Geological Survey (map scale 1:1,000,000), Reston, VA.

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Kentucky County Data - Livestock

Commodity ↑	Year	State	County	District	Cattle All	Beef Cows
Cattle & Calves	2005	Kentucky	Boone	40	8,900 head	5,600 head
Cattle & Calves	2005	Kentucky	Campbell	40	7,800 head	4,000 head
Cattle & Calves	2005	Kentucky	Kenton	40	6,200 head	3,100 head
Cattle & Calves	2006	Kentucky	Boone	40	10,300 head	5,300 head
Cattle & Calves	2006	Kentucky	Campbell	40	7,700 head	4,400 head
Cattle & Calves	2006	Kentucky	Kenton	40	6,900 head	3,700 head
Cattle & Calves	2007	Kentucky	Boone	40	10,700 head	5,900 head
Cattle & Calves	2007	Kentucky	Campbell	40	8,500 head	4,600 head
Cattle & Calves	2007	Kentucky	Kenton	40	7,000 head	4,000 head
Cattle & Calves	2008	Kentucky	Boone	40	10,500 head	6,200 head
Cattle & Calves	2008	Kentucky	Campbell	40	8,400 head	4,300 head
Cattle & Calves	2008	Kentucky	Kenton	40	7,200 head	3,800 head

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Kentucky County Data - Livestock					
Commodity ↑	Year	State	County	District	Hogs All
Hogs & Pigs	1987	Kentucky	Kenton	40	700 head
Hogs & Pigs	1988	Kentucky	Kenton	40	700 head
Hogs & Pigs	1989	Kentucky	Kenton	40	400 head
Hogs & Pigs	1991	Kentucky	Kenton	40	600 head
Hogs & Pigs	1992	Kentucky	Kenton	40	600 head

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Kentucky County Data - Livestock

Commodity ↑	Year	State	County	District	Hogs All
Hogs & Pigs	1993	Kentucky	Boone	40	1,400 head
Hogs & Pigs	1993	Kentucky	Campbell	40	700 head
Hogs & Pigs	1994	Kentucky	Boone	40	1,300 head
Hogs & Pigs	1994	Kentucky	Campbell	40	700 head
Hogs & Pigs	1995	Kentucky	Boone	40	1,200 head
Hogs & Pigs	1995	Kentucky	Campbell	40	800 head
Hogs & Pigs	1996	Kentucky	Boone	40	700 head
Hogs & Pigs	1996	Kentucky	Campbell	40	800 head
Hogs & Pigs	1997	Kentucky	Boone	40	600 head
Hogs & Pigs	1997	Kentucky	Campbell	40	800 head
Hogs & Pigs	1998	Kentucky	Boone	40	500 head
Hogs & Pigs	1998	Kentucky	Campbell	40	700 head

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Census, State - County Data
Table 1. County Summary Highlights: 2002

Geographic area ↑	Item	Data
Kentucky\Kenton	Farms (number)	495
Kentucky\Kenton	Land in farms (acres)	46,479
Kentucky\Kenton	Land in farms - Average size of farm (acres)	94
Kentucky\Kenton	Land in farms - Median size of farm (acres)	68
Kentucky\Kenton	Estimated market value of land and buildings 1/ - Average per farm (dollars)	310,436
Kentucky\Kenton	Estimated market value of land and buildings 1/ - Average per acre (dollars)	3,775
Kentucky\Kenton	Estimated market value of all machinery and equipment 1/ - Average per farm (dollars)	32,786
Kentucky\Kenton	Farms by size - 1 to 9 acres	33
Kentucky\Kenton	Farms by size - 10 to 49 acres	157
Kentucky\Kenton	Farms by size - 50 to 179 acres	241
Kentucky\Kenton	Farms by size - 180 to 499 acres	55
Kentucky\Kenton	Farms by size - 500 to 999 acres	9
Kentucky\Kenton	Farms by size - 1,000 acres or more	-
Kentucky\Kenton	Total cropland (farms)	463
Kentucky\Kenton	Total cropland (acres)	26,577
Kentucky\Kenton	Total cropland - Harvested cropland (farms)	409
Kentucky\Kenton	Total cropland - Harvested cropland (acres)	13,042
Kentucky\Kenton	Irrigated land (farms)	20
Kentucky\Kenton	Irrigated land (acres)	32
Kentucky\Kenton	Market value of agricultural products sold (See Text) ($1,000)	5,311
Kentucky\Kenton	Market value of agricultural products sold (See Text) - Average per farm (dollars)	10,730
Kentucky\Kenton	Market value of agricultural products sold (See Text) - Crops ($1,000)	2,825
Kentucky\Kenton	Market value of agricultural products sold (See Text) - Livestock, poultry, and their products ($1,000)	2,486
Kentucky\Kenton	Farms by value of sales - Less than $2,500	224
Kentucky\Kenton	Farms by value of sales - $2,500 to $4,999	79
Kentucky\Kenton	Farms by value of sales - $5,000 to $9,999	77
Kentucky\Kenton	Farms by value of sales - $10,000 to $24,999	69
Kentucky\Kenton	Farms by value of sales - $25,000 to $49,999	25
Kentucky\Kenton	Farms by value of sales - $50,000 to $99,999	9
Kentucky\Kenton	Farms by value of sales - $100,000 or more	12
Kentucky\Kenton	Government payments (farms)	63
Kentucky\Kenton	Government payments ($1,000)	106
Kentucky\Kenton	Total income from farm-related sources, gross before taxes and expenses (See Text) (farms)	182
Kentucky\Kenton	Total income from farm-related sources, gross before taxes and expenses (See Text) ($1,000)	914
Kentucky\Kenton	Total farm production expenses 1/ ($1,000)	3,713
Kentucky\Kenton	Total farm production expenses 1/ - Average per farm (dollars)	7,500
Kentucky\Kenton	Net cash farm income of operation (See Text) 1/ (farms)	495

Kentucky\Kenton	Net cash farm income of operation (See Text) 1/ ($1,000)	-316
Kentucky\Kenton	Net cash farm income of operation (See Text) 1/ - Average per farm (dollars)	-639
Kentucky\Kenton	Principal operator by primary occupation - Farming (number)	235
Kentucky\Kenton	Principal operator by primary occupation - Other (number)	260
Kentucky\Kenton	Principal operator by days worked off farm - Any (number)	290
Kentucky\Kenton	Principal operator by days worked off farm - Any - 200 days or more (number)	229
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory (farms)	274
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory (number)	7,208
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory - Beef cows (farms)	255
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory - Beef cows (number)	(D)
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory - Milk cows (farms)	6
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory - Milk cows (number)	(D)
Kentucky\Kenton	Livestock and poultry - Cattle and calves sold (farms)	229
Kentucky\Kenton	Livestock and poultry - Cattle and calves sold (number)	3,366
Kentucky\Kenton	Livestock and poultry - Hogs and pigs inventory (farms)	10
Kentucky\Kenton	Livestock and poultry - Hogs and pigs inventory (number)	205
Kentucky\Kenton	Livestock and poultry - Hogs and pigs sold (farms)	8
Kentucky\Kenton	Livestock and poultry - Hogs and pigs sold (number)	178
Kentucky\Kenton	Livestock and poultry - Sheep and lambs inventory (farms)	13
Kentucky\Kenton	Livestock and poultry - Sheep and lambs inventory (number)	91
Kentucky\Kenton	Livestock and poultry - Layers 20 weeks old and older inventory (farms)	21
Kentucky\Kenton	Livestock and poultry - Layers 20 weeks old and older inventory (number)	1,496
Kentucky\Kenton	Livestock and poultry - Broilers and other meat-type chickens sold (farms)	1
Kentucky\Kenton	Livestock and poultry - Broilers and other meat-type chickens sold (number)	(D)
Kentucky\Kenton	Selected crops harvested - Corn for grain (farms)	14
Kentucky\Kenton	Selected crops harvested - Corn for grain (acres)	94
Kentucky\Kenton	Selected crops harvested - Corn for grain (bushels)	7,932
Kentucky\Kenton	Selected crops harvested - Corn for silage or greenchop (farms)	18
Kentucky\Kenton	Selected crops harvested - Corn for silage or greenchop (acres)	231
Kentucky\Kenton	Selected crops harvested - Corn for silage or greenchop (tons)	3,687
Kentucky\Kenton	Selected crops harvested - Wheat for grain, All (farms)	8
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all (acres)	60
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all (bushels)	2,256
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all - Winter wheat for grain (farms)	8
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all - Winter wheat for grain (acres)	60
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all - Winter wheat for grain (bushels)	2,256
Kentucky\Kenton	Selected crops harvested - Oats for grain (farms)	-
Kentucky\Kenton	Selected crops harvested - Oats for grain (acres)	-
Kentucky\Kenton	Selected crops harvested - Oats for grain (bushels)	-
Kentucky\Kenton	Selected crops harvested - Barley for grain (farms)	-
Kentucky\Kenton	Selected crops harvested - Barley for grain (acres)	-
Kentucky\Kenton	Selected crops harvested - Barley for grain (bushels)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for grain (farms)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for grain (acres)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for grain (bushels)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for silage or greenchop (farms)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for silage or greenchop (acres)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for silage or greenchop (tons)	-
Kentucky\Kenton	Selected crops harvested - Soybeans for beans (farms)	2

Kentucky\Kenton	Selected crops harvested - Soybeans for beans (acres)	(D)
Kentucky\Kenton	Selected crops harvested - Soybeans for beans (bushels)	(D)
Kentucky\Kenton	Selected crops harvested - Dry edible beans, excluding limas (farms)	-
Kentucky\Kenton	Selected crops harvested - Dry edible beans, excluding limas (acres)	-
Kentucky\Kenton	Selected crops harvested - Dry edible beans, excluding limas (cwt)	-
Kentucky\Kenton	Selected crops harvested - Tobacco (farms)	194
Kentucky\Kenton	Selected crops harvested - Tobacco (acres)	399
Kentucky\Kenton	Selected crops harvested - Tobacco (pounds)	691,805
Kentucky\Kenton	Selected crops harvested - Potatoes (farms)	1
Kentucky\Kenton	Selected crops harvested - Potatoes (acres)	(D)
Kentucky\Kenton	Selected crops harvested - Potatoes (cwt)	(D)
Kentucky\Kenton	Selected crops harvested - Sweet potatoes (farms)	-
Kentucky\Kenton	Selected crops harvested - Sweet potatoes (acres)	-
Kentucky\Kenton	Selected crops harvested - Sweet potatoes (cwt)	-
Kentucky\Kenton	Selected crops harvested - Forage - land used for all hay and all haylage, grass silage, and greenchop (See Text) (farms)	353
Kentucky\Kenton	Selected crops harvested - Forage - land used for all hay and all haylage, grass silage, and greenchop (See Text) (acres)	12,202
Kentucky\Kenton	Selected crops harvested - Forage - land used for all hay and all haylage, grass silage, and greenchop (See Text) (tons, dry)	25,187
Kentucky\Kenton	Selected crops harvested - Sunflower seed, All (farms)	-
Kentucky\Kenton	Selected crops harvested - Sunflower seed, all (acres)	-
Kentucky\Kenton	Selected crops harvested - Sunflower seed, all (pounds)	-
Kentucky\Kenton	Selected crops harvested - Vegetables harvested for sale (See Text) (farms)	4
Kentucky\Kenton	Selected crops harvested - Vegetables harvested for sale (See Text) (acres)	16
Kentucky\Kenton	Selected crops harvested - Land in orchards (farms)	10
Kentucky\Kenton	Selected crops harvested - Land in orchards (acres)	17

The following footnotes, headnotes, abbreviations and symbols are used throughout this table:

(D) Withheld to avoid disclosing data for individual farms.
- Represents zero.

1/ Data are based on a sample of farms.

110 Records displayed

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Main Menu Help

Our Water

Lajuanda Haight-Maybriar

Licking River Basin Coordinator
Kentucky Division of Water
Kentucky Department for Environmental Protection

Anything we do to the land will affect our water.

We pave over it

We build houses on it

We farm it

We mine it

We log it

We treat our poop on it or in it,
or

——not

Our animals poop on it

We dump trash, used oil, gasoline, paint, etc. on it

Ponds and their watersheds

What is a watershed?

A watershed is the land in an area where all of the water running off that land and soaking into that land drains to a specific point in a stream

Watersheds are "nested" - each smaller watershed is also part of a larger watershed

Very large watersheds are often called basins. Here is a map of the major river basins in Eastern Kentucky. Which basin do you live in?

The spring in Magoffin County that is the beginning of the Licking River – the headwaters

The mouth of the Licking River on the Ohio River across from Cincinnati

Anything <u>we</u> do to the land will affect <u>our</u> water.

Sign Up Sheet
Banklick Watershed Council Public Meeting – March 23, 2009

Name	Address	Phone no.	email
Wilhelm Kossenjans	3870 Richardson Rd Independence	283-1282	Wilhelm.Kossenjans @uc.edu
Brooke Shireman	200 Fair Oaks Frankfort, KY	502-564-3410	brooke.shireman@ky.gov
Lajuanda Haight-Maybriar	525 Hecks Plaza Dr. Morehead KY 40351	606 783 8655	lajuanda.haight-maybriar@ky.gov
Kelly Kaufman	615 Elsinore Pl Cincinnati OH	513 861 5600	kelly.kaufman@strand.com
Mary Pat Behler	806 Stablewatch Dr. Independence, KY 41051	(859) 356-0297	behlers5@zoomtown.com
Lorna Harrell	686 Ridge Rd Taylor Mill, Ky 41015	859.581.8052	harrellky@fuse.net
Casey Mattingly	437 Ripple Creek Dr Elsmere, Ky 41018	859.445.1682	clmattingly@mactec.com
Charlotte Thompson	11015 Banklick Rd	356-9713	
John Wood	PO Box 11 Indep Ky	356-1360	

Sign Up Sheet

Banklick Watershed Council Public Meeting – March 23, 2009

Name	Address	Phone no.	email
Matt Wooten	SD1	859-578-6887	mwooten@SD1.org
Lennie Collins	1518 Walton Nich	859-356-5751	
John Lyons	Strand	513-861-5600	john.lyons@strand.com
Donna Horine	524 E. Southern Ave. Covington Ky 41015	859-261-3525	dmhorine@zoom.com
Kevin Bramlage	11209 Banklick Road Walton, Ky 41094	859-653-2550	

Banklick Watershed 319(h) Non-Point Source Grant Public Input Meeting

Strand Associates, Inc.

John Lyons, P.E.

April 16, 2009

BANKLICK WATERSHED CHARACTERISTICS

Legend

Banklick Watershed

Data Source:
Sanitation District No. 1

BANKLICK WATERSHED CHARACTERISTICS

Legend

Strand Sampling Points

Kentucky 303(d) List

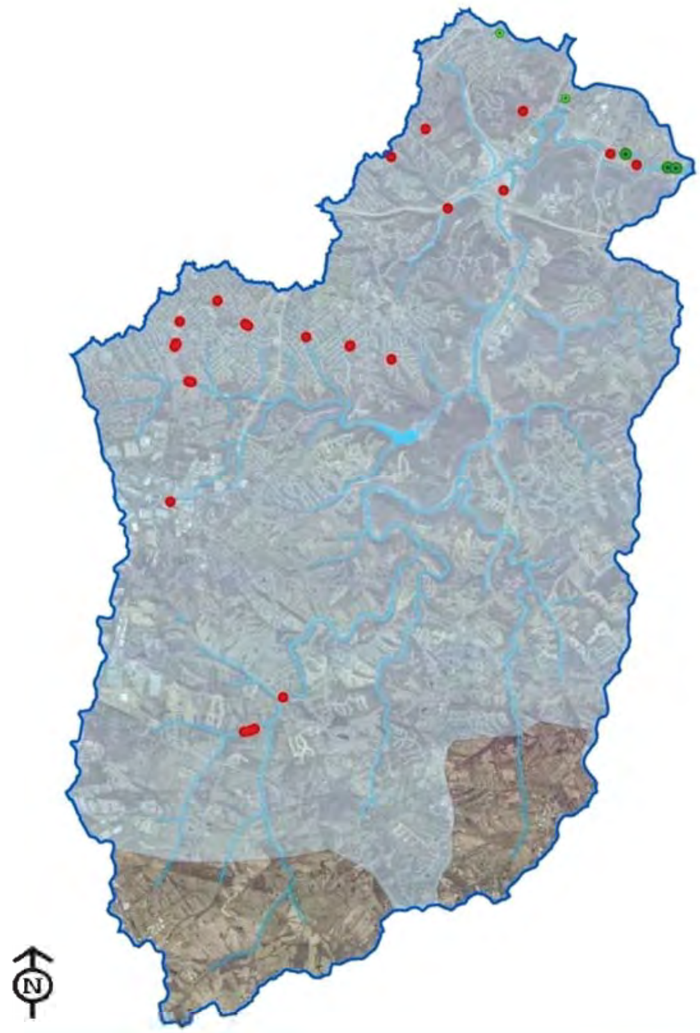
FC/NE/OE

FC/NE/OE/SS

Banklick Watershed

Data Source:
Sanitation District No. 1
Strand Associates, Inc.
2008 303(d) List

BANKLICK WATERSHED CHARACTERISTICS



Legend

Overflow Locations

- CSO
- CSO - To Be Permitted
- SSO
- SD1 Service Area
- Banklick Watershed

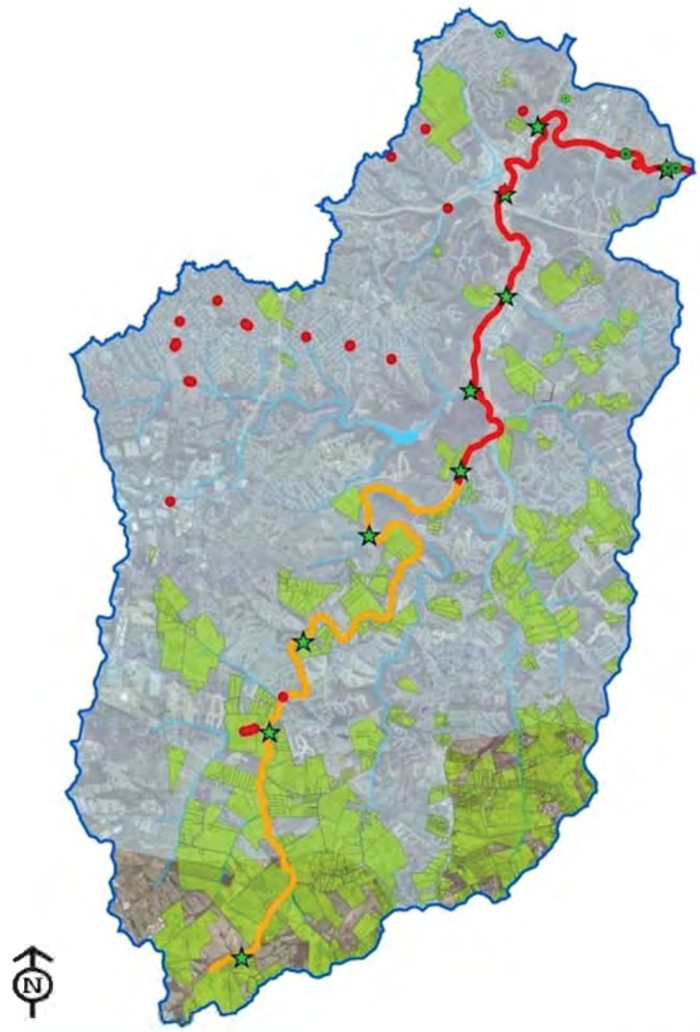
Data Source:
Sanitation District No. 1

BANKLICK WATERSHED CHARACTERISTICS

Legend

- Potential Septic Systems
- Banklick Watershed

Data Source:
Sanitation District No. 1



BANKLICK WATERSHED CHARACTERISTICS

Legend

Overflow Locations

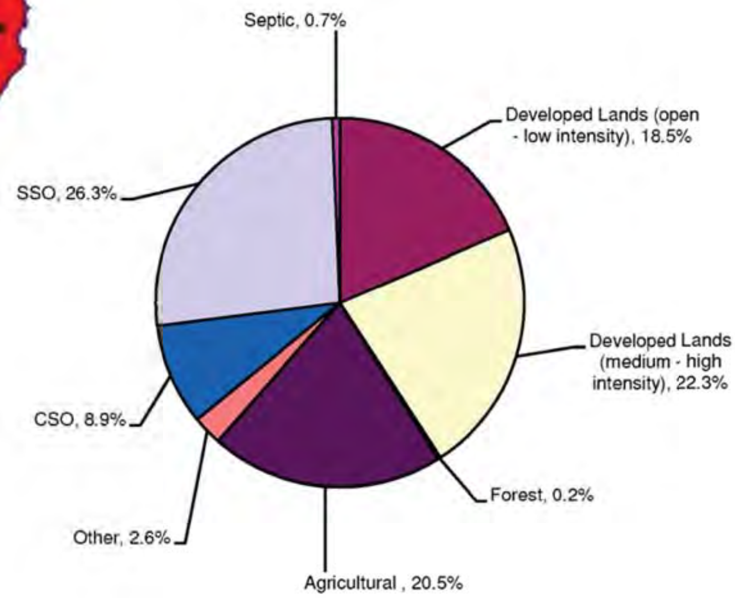
- CSO
- CSO - To Be Permitted
- SSO
- Strand Sampling Points

Kentucky 303(d) List

- FC/NE/OE
- FC/NE/OE/SS
- Potential Septic Systems
- SD1 Service Area
- Banklick Watershed

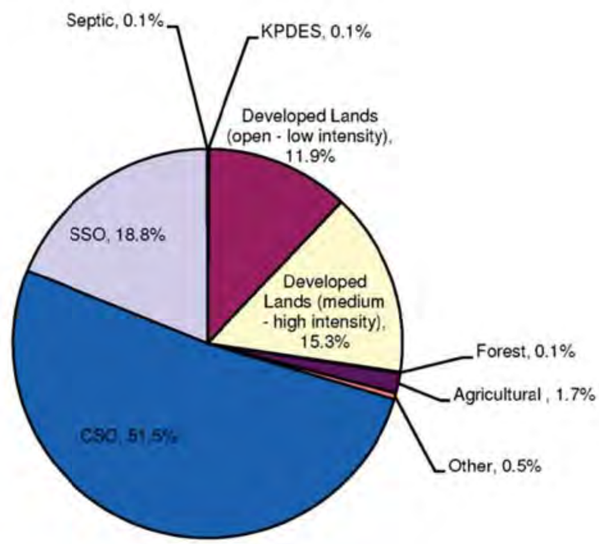
Data Source:
Sanitation District No. 1
Strand Associates, Inc.
2008 303(d) List

BANKLICK WATERSHED FECAL LOADINGS



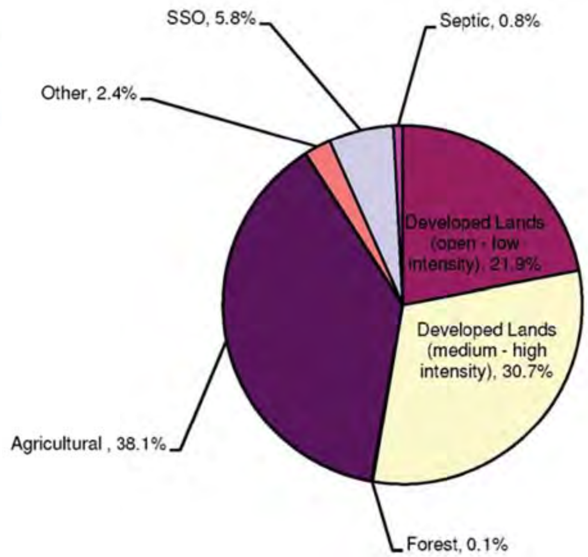
Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

BANKLICK CREEK SUBWATERSHED-01 FECAL LOADINGS

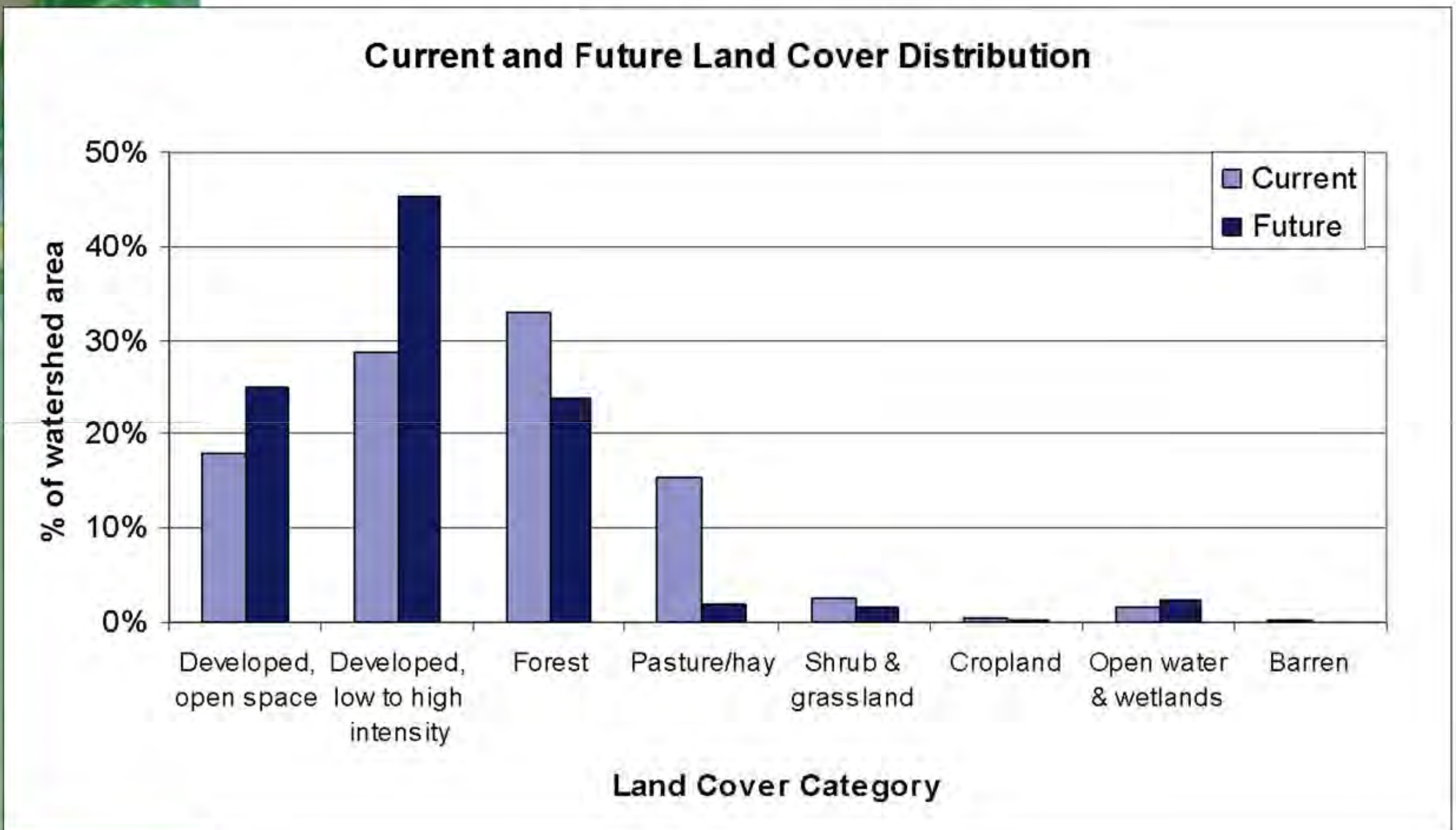


Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

WOLF PEN BRANCH SUBWATERSHED FECAL LOADINGS

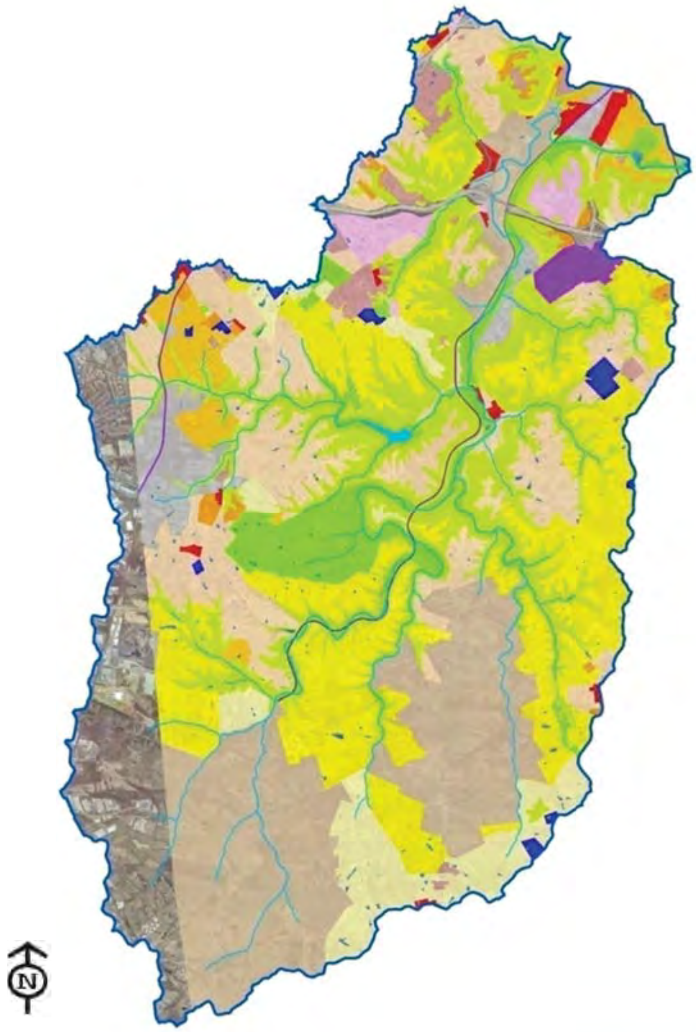


Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report



Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

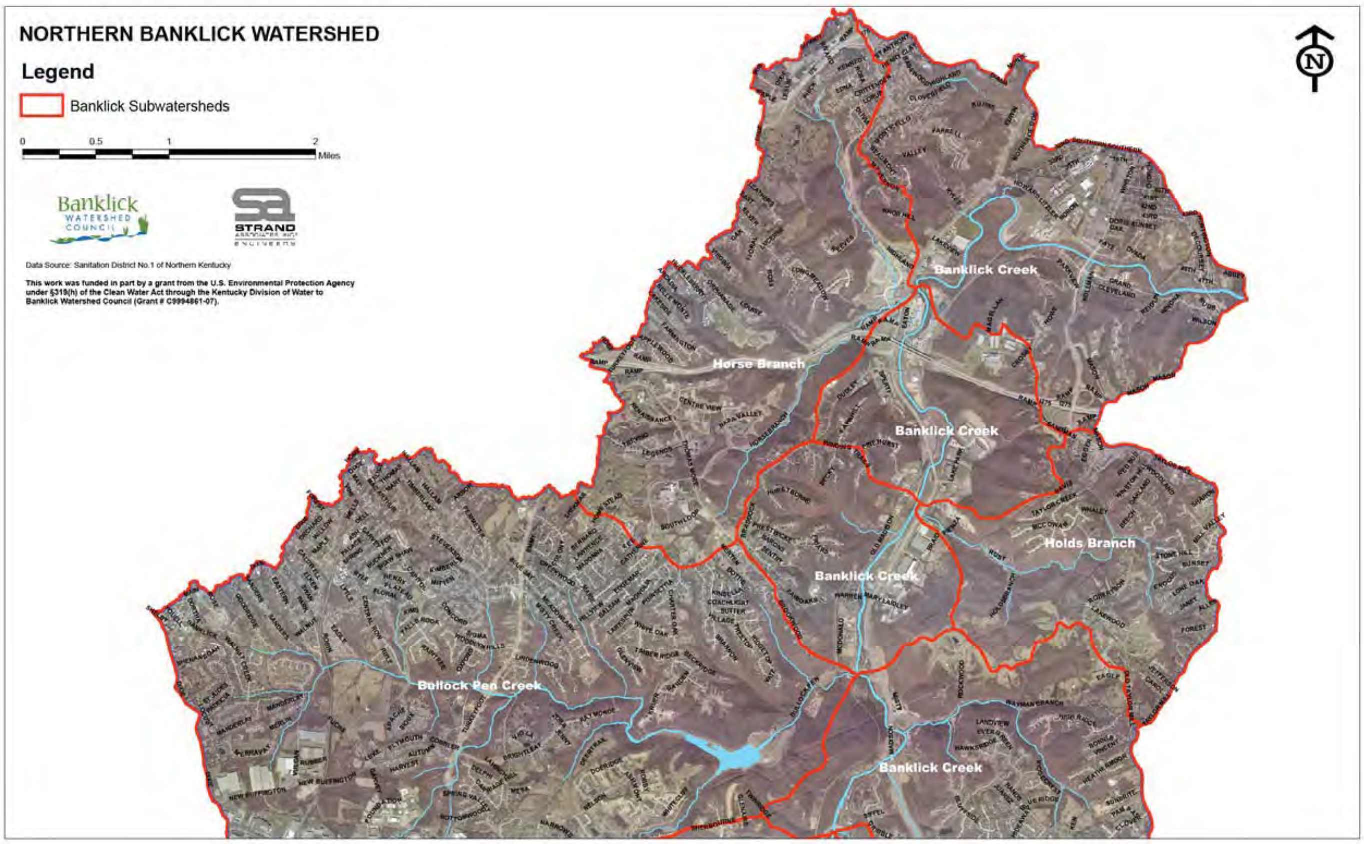
BANKLICK WATERSHED FUTURE LAND USE



Legend

- Residential Under 2.0
- Residential 2.1 TO 4.0
- Residential 4.1 TO 7.0
- Residential 7.1 TO 14.0
- Residential 14.1 TO 30.0
- Residential Over 30.0
- Commercial Retail/Service
- Commercial Office
- Commercial Rural
- Special Development Area
- Industrial
- Rail Road
- Agricultural and Rural Uses
- Physically Restrictive Development Area:
- Water
- School Parks
- Recreation and Open Space
- Other Community Facilities
- Small Study Area
- Right of Way

Data Source:
Kenton County 2006 Comprehensive Plan, NKAPC
Sanitation District No. 1


NORTHERN BANKLICK WATERSHED
Legend
Banklick Subwatersheds
0
0.5
1
2
Miles
Banklick Watershed Council
STRAND
ENGINEERS
Data Source: Sanitation District No.1 of Northern Kentucky
This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to Banklick Watershed Council (Grant # C9994861-07).
N
Banklick Creek
Horse Branch
Banklick Creek
Holds Branch
Banklick Creek
Bullock Pen Creek
Banklick Creek

Banklick Watershed Council Public Input Meeting

Name (Optional): ________________________________

Contact Information (Optional):

Check all that apply:

☐ I would like to stay informed about what is happening in the Banklick Watershed

☐ I would like to become more involved with the Banklick Watershed Council by: attending future meetings, volunteering at events, or ____.

☐ I would be interested in working with the council to implement a project on my land such as: stream restoration, reforestation, cattle fencing, septic tank improvements, stream bank restoration, rain gardens, or ____.

☐ I believe that the following are major concerns in this watershed that must be addressed to improve the streams: ____

____

____

____

____

☐ Other Information I would like to share: ____

____

____

____

____

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act.

Banklick Watershed Council

927 Forest Ave
Covington, KY 41016

PUBLIC INPUT SURVEY

Thank you for participating in the survey! As you are probably aware, Banklick Creek has been listed as a polluted waterway for various uses by the Kentucky Division of Water (KDOW). Your input is valuable as we move forward in addressing some of the associated issues.

1. How would you describe your property?

☐ Residential ☐ Farm/ Agriculture ☐ Industrial

☐ Commercial ☐ Other ______________________________

2. Is there a creek that flows on, adjacent to your property or that you are very familiar with? (Skip to question 6 if your answer is No)

☐ Yes ☐ No ☐ Unsure

3. When do you see water in the creek?

☐ Year round ☐ Just when in rains ☐ Just during heavy rain periods

☐ Most of the time but it dries out during dry summer months

4. Does the creek that flows on or adjacent to your property flood?

☐ Often ☐ Only during heavy rain periods ☐ Does not flood

5. Would you be interested in working with the council to implement a project on your land for any of the following?

☐ Stream restoration ☐ Reforestation ☐ Cattle fencing,

☐ Septic tank improvements ☐ Stream bank restoration ☐ Rain gardens

☐ Other ____.

6. Which of the following are major concerns that must be addressed to improve Banklick Creek?

☐ No concern ☐ Animals ☐ Sedimentation

☐ Development practices ☐ Septic systems

☐ Other _____________________________________

7. On a scale of 1 to 5, with 1 being not important and 5 being very important, how important is it that Banklick Creek is safe for:

1. Children to play	1	2	3	4	5
2. Habitat	1	2	3	4	5
3. Fishing	1	2	3	4	5

8. What is the quality of the water in the creek?

- ☐ Fish and other aquatic life can be seen
- ☐ No aquatic life can be seen
- ☐ Dead fish or other aquatic life can be seen
- ☐ Bad odors are coming from the creek
- ☐ The water is usually muddy
- ☐ The water seems to be polluted
- ☐ I feel it is safe for people to be in contact with the creek water because the water is clear

9. Other Information I would like to share:

Name (Optional): ____

Contact Information (Optional):

Check all that apply:

☐ I would like to stay informed about what is happening in the Banklick Watershed

☐ I would like to become more involved with the Banklick Watershed Council by attending future meetings, volunteering at events, or ____.

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act.

Banklick
WATERSHED
COUNCIL

Public Meeting

April 16 , 2009

INFORM

IDENTIFY & INVOLVE

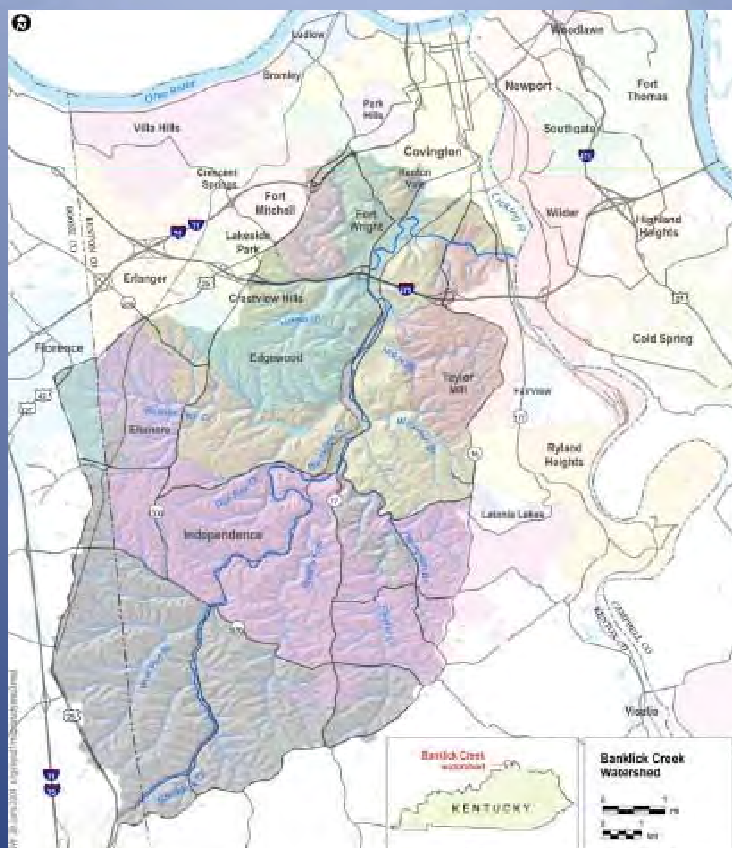
INFORM

Data has been gathered and studies conducted in the Banklick Watershed

WHY?

The Kentucky Division of Water designated the Banklick Watershed as one of the three highest priority watersheds in the Licking River basin because of the severity of flooding and water quality problems, expected growth of development, and the large number of water quality violations.

BANKLICK WATERSHED



Municipalities within Banklick Watershed **Limno-Tech 2004**

BANKLICK CREEK

- Drainage Area - 58.3 square miles
- Enters the Licking River approx. 4.6 miles upstream of the Ohio River in the Latonia area
- Extends 18.9 miles southwestwardly to its headwaters near Walton

U.S. Department of Agriculture Soil Conservation Service 1971 Banklick Creek Watershed Work Plan

Four floodwater retarding structures proposed to have controlled runoff from 40 percent of the watershed

Estimated cost of the retarding structures and land treatment measures was $4,930,200

DOE RUN DAM

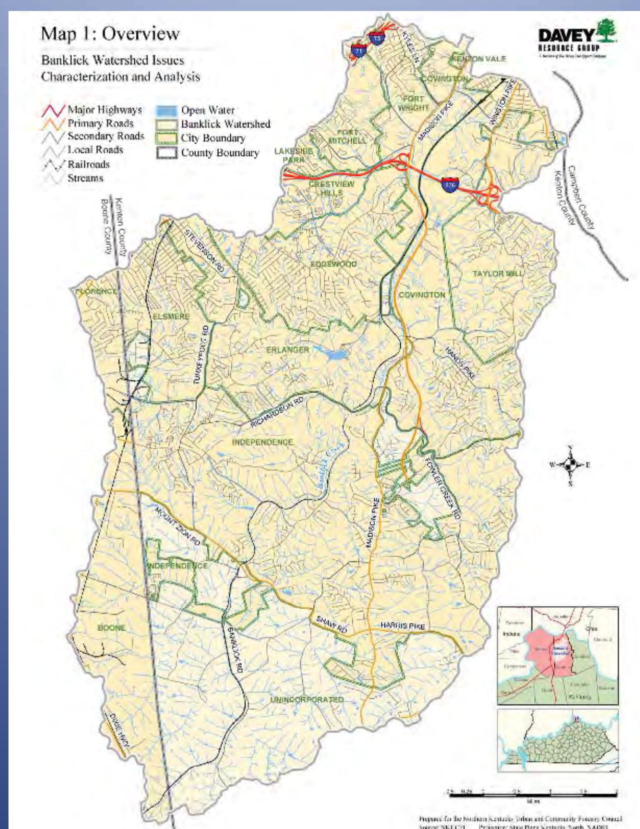
ONLY FLOOD CONTROL STRUCTURE BUILT

Ground was broken on February 1976, with the structure being complete in April 1981 and dedicated in October 1981

The actual cost totaled $5,982,186

Public Law 566
The Watershed Protection and Flood Prevention Act funded $5,172,006

BANKLICK WATERSHED



STUDIES RELATING TO BANKLICK FLOODING

- 1982 Study – flood damages estimated to be $2,939,000 for the 100 year flood.
- 1993 Study – predicted significantly higher estimated flows than prior reports.
- 1995 Study – noted major headwater flooding along Banklick Creek in 1962, 1967 and 1979.

1998 /1999 Flood Reduction Proposals

…75 foot dam upstream from Wayman Branch and KY 17 – cost $20,000,000

50% reduction in peak flows downstream
for 100 year flood

Note: to provide real flood damage reduction would also require an additional regional basin on Fowler Creek.

or

…29 small detention structures in Banklick and Fowler Creek – cost $300,000 per structure $8,700,000 total

STRUCTURAL ALTERNATIVES ARE VERY COSTLY AND IN TIME CAN LOSE THEIR EFFECTIVENESS

- Doe Run Dam was designed for a 100 year storm event
- About 9 years after being completed, March of 1990, it was less than 1 foot from overflowing the spillway
- A recent report by Fish & Wildlife is suggesting that the spillway needs to be raised 15 feet
- The amount of stormwater entering the Lake has increased because of how the land has been developed surrounding the lake and its tributaries

U. S. Army Corps of Engineers

2000 Banklick Creek Watershed Analysis

THREE PRIMARY FACTORS HAVE CONTRIBUTED TO FLOOD DAMAGES IN THE WATERSHED:

- The early development, which occurred along the stream channels.
- The extremely steep slopes of Banklick Creek and its tributaries.
- Extraordinary recent development along the watershed’s ridgelines and hillsides.

WITHOUT A PLAN

Current problems of flooding,
ecosystem damage and increased erosion
along with corresponding sediment
deposition can be expected
to worsen in the watershed.

U S Army Corps of Engineers

WATER QUALITY

Water quality data, provided by the Kentucky Division of Water, indicates that the stream is impaired and does not meet aquatic life and swimmable criteria.

Causes of the impairments include nutrients, organic enrichment, low dissolved oxygen, and habitat alteration.

IDENTIFY

RECOMMENDATIONS

ECOSYSTEM RESTORATION WORK

Estimated Cost

$2,000,000

(DOES NOT INCLUDE PURCHASE OF LAND)

Will Still Need to Change Ways in How Our Land is Developed

10.5 Stream Miles of Grade Control Structures in Banklick

Benefits

- Reduced Upstream Bedcutting
- Reduced Downstream Sedimentation
- Reduced Bank Erosion
- Increased Dissolved Oxygen Levels
- Increased Aquatic Habitat

10.5 miles of Expanded Riparian Corridor in Banklick Creek

Benefits

- Increased Terrestrial and Aquatic Habitat
- Lower Water Temperatures
- Filtering/Trapping of Non-Point Source Pollution

CONSTRUCT WETLANDS

Benefits

- Biological Treatment of Water
- Reduction of Suspended Solids
- Terrestrial and Aquatic Habitat

WETLANDS

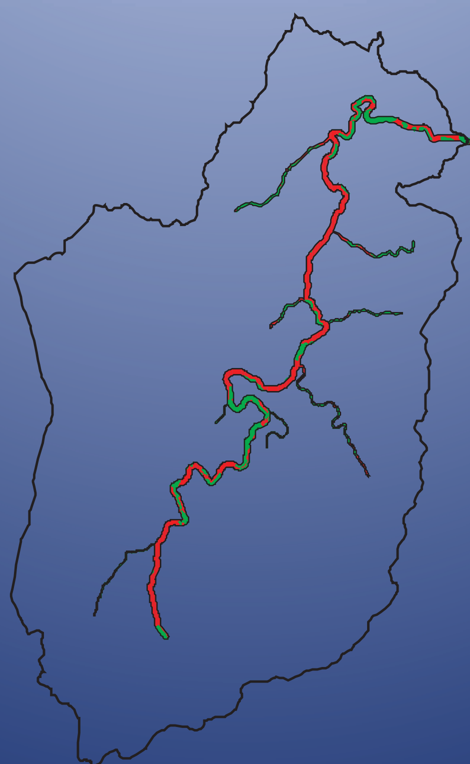
While constructed wetlands are not intended to reproduce or mimic natural wetland wildlife diversity, they do provide areas for water quality improvements due to biological treatment, and additional habitat for aquatic species.

Preliminary estimates indicate the potential for 11 acres of wetlands to be created.

Natural wetland along Brushy Fork

Existing riparian corridor (green) and areas
where riparian enhancements are needed in (red)

ESTIMATED RIPARIAN ZONE DEFICIT – 857 ACRES

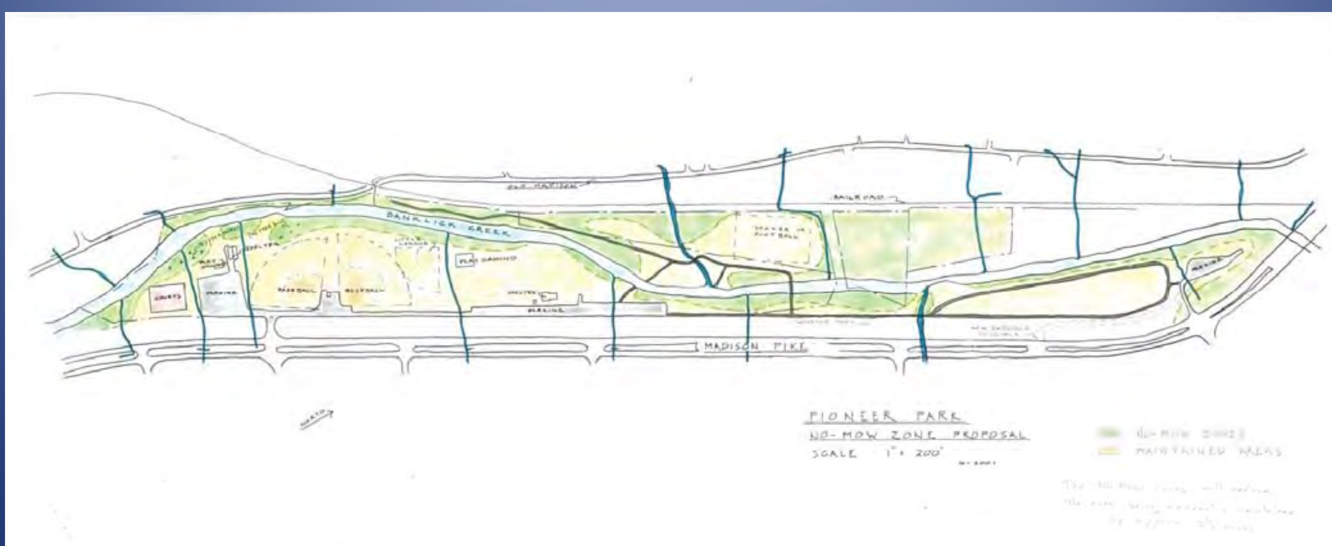


NO-MOW ZONES AND RIPARIAN AREAS

Establishment of “no-mow” zones and/or floodplain and riparian plantings to create a streamside buffer would enhance the water quality and wildlife diversity along Banklick Creek by reducing water temperatures, filtering nonpoint source runoff pollution, and providing wildlife corridors with additional foraging opportunities.

BANKLICK CREEK ALONG PIONEER PARK

Proposed NO-MOW Zone for Pioneer Park 2001



2004 - BACE STUDY

Banklick Creek Watershed **A**nalysis and Issue **C**haracterisation for **E**ducation and Outreach focused on forest resources and estimated that **30% of the Banklick watershed has natural areas needing protection and 50% is in need of restoration.**

The BACE Study was funded with a National Urban Forestry Grant.
Northern KY Area Planning Commission was the lead agency, with the Northern KY Urban & Community Forestry Council, BWC and SD#1 as partners.

LESS IMPERVIOUS SURFACES AND LESS LAND COMPACTION

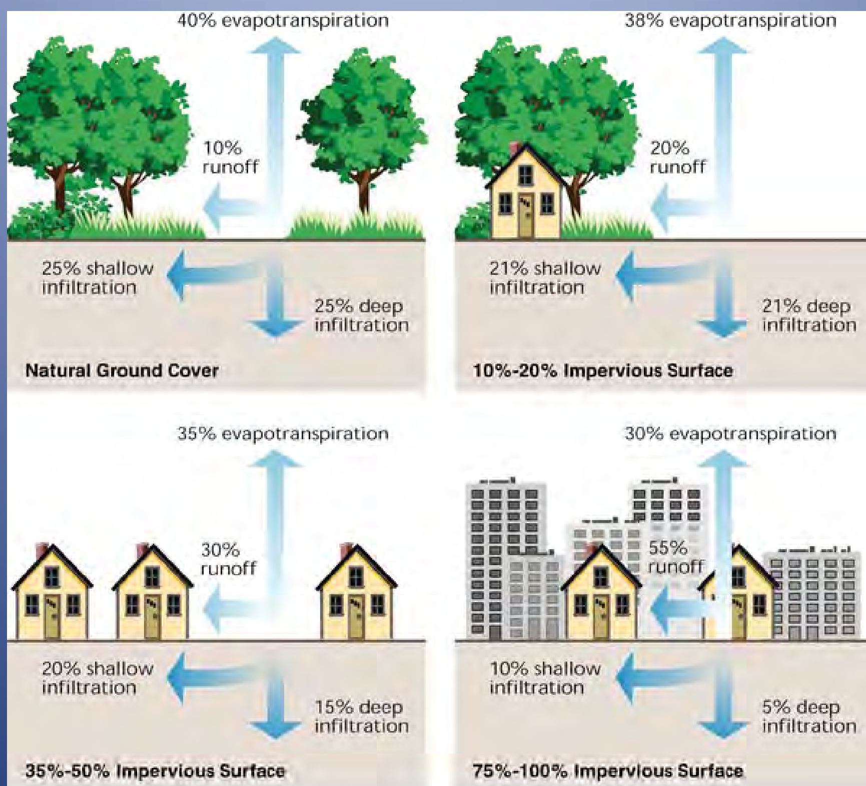


Fig. 3.21 – Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.
In Stream Corridor Restoration: Principles, Processes, and Practices (10/98).
By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the U.S.)

2005 - CONSENT DECREE

SD#1 reached an agreement with EPA on their Consent Decree which is a

20 year plan to address

combined sewer overflows (CSO),

sanitary sewer overflows (SSO),

and SD#1 will continue with their

stormwater management program.

Stormwater Management Plan for Kyles Lane I-75 Interchange

Banklick Creek at Bullock Pen

2005 - BWC ACTION PLAN

BWC completed an Action Plan for the Banklick Watershed that stated four main goals:

1. Clean the Water
2. Reduce Flooding
3. Restore the Banks
4. Honor the Heritage

2006 - South Banklick Small Area Study

- NKAPC studied the headwater area of Banklick Creek and had major input from property owners in the area.
- The study recommended riparian buffers along with recommendations for conservation subdivision and eco commerce park areas.
- For the first time, recommended riparian buffers were adopted into the Kenton County Comprehensive Plan and Zoning which makes them required but only for the study area.

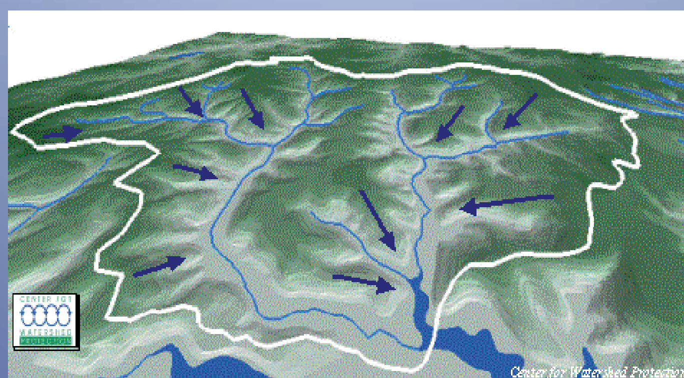
2008 - BWC BEGINS EPA 319 GRANT

An important and exciting effort for the Banklick Watershed is BWC has started work on a major $1,000,000 EPA Grant Project.

$600,000 is funding from EPA and $400,000 is coming from in-kind of volunteers and technical support from partners in the project.

•

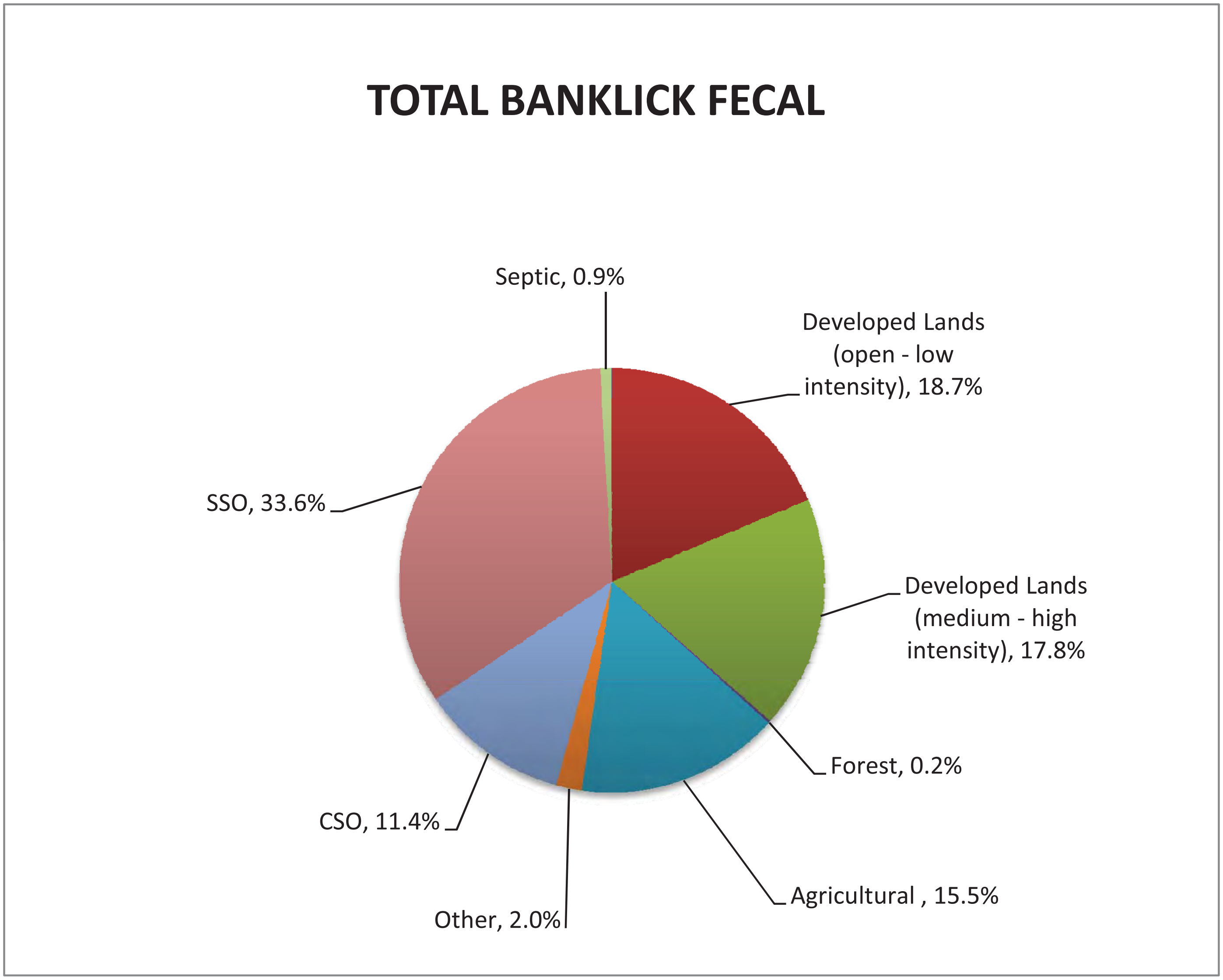
INVOLVE

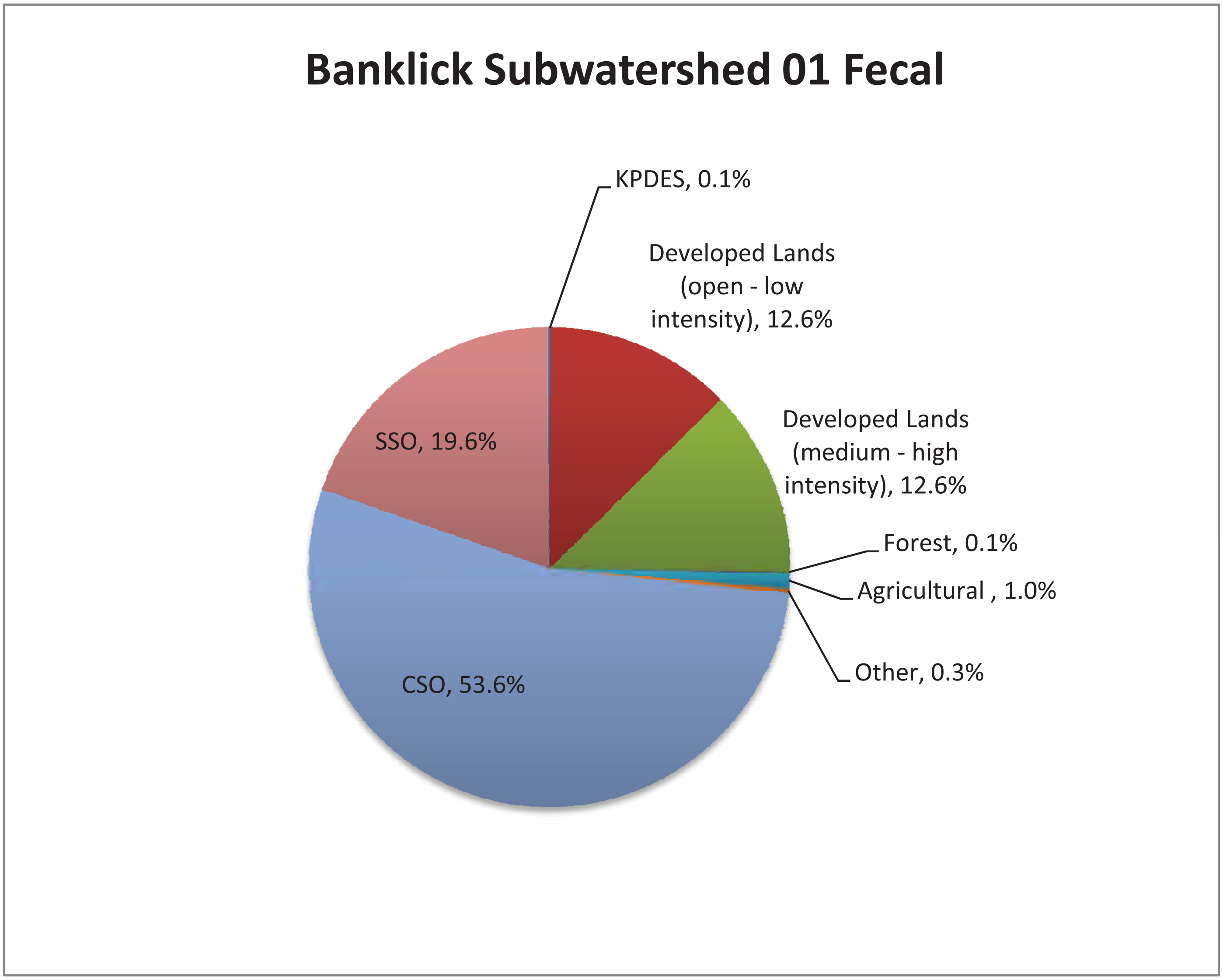


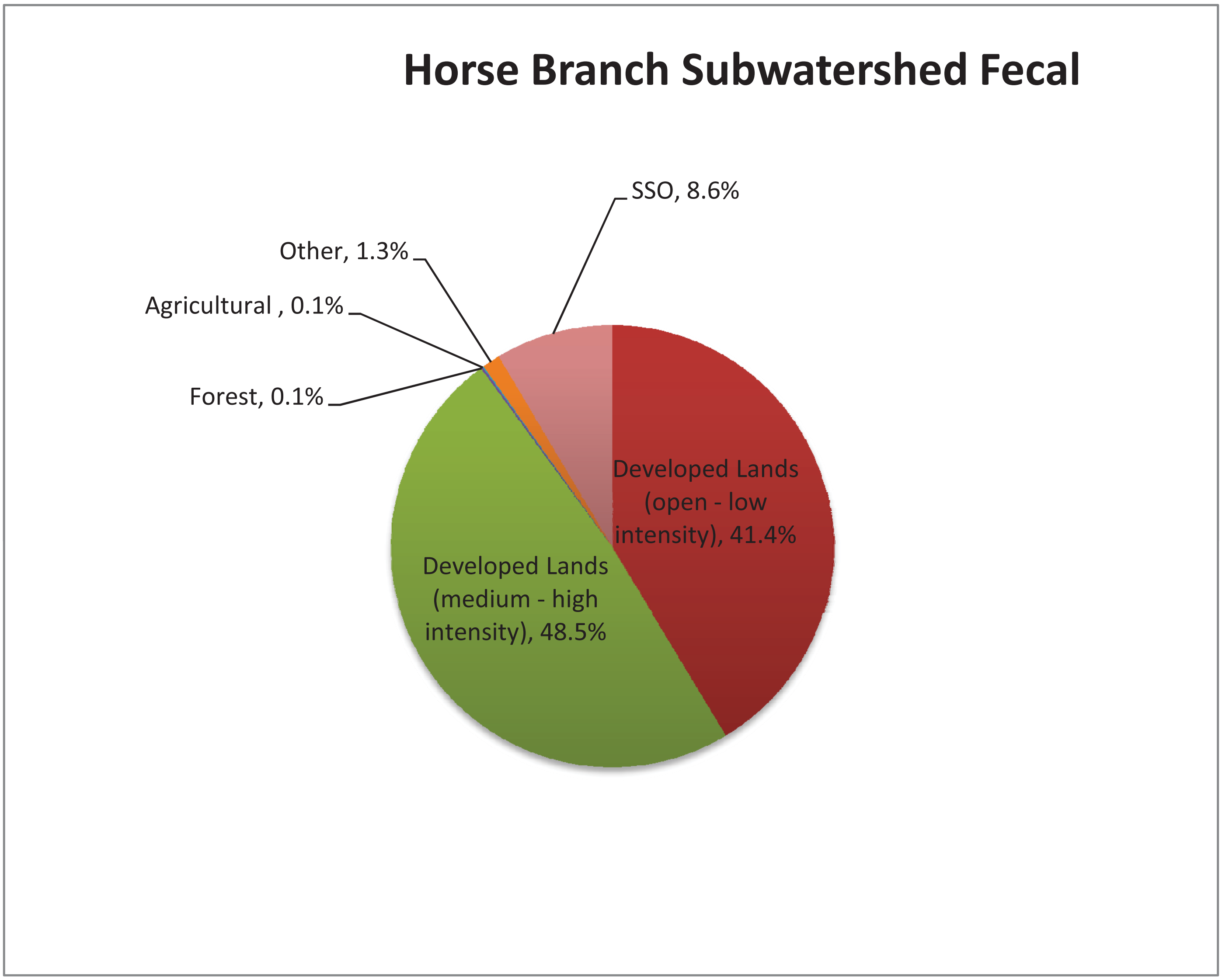
Solutions to watershed problems often involve changing the way we live on the land; so citizen involvement, awareness and support are essential for success. It will take city officials, government agencies, industries, educators and citizens working together to solve these water problems.

Banklick Creek Watershed Based Planning, Implementation, and Results

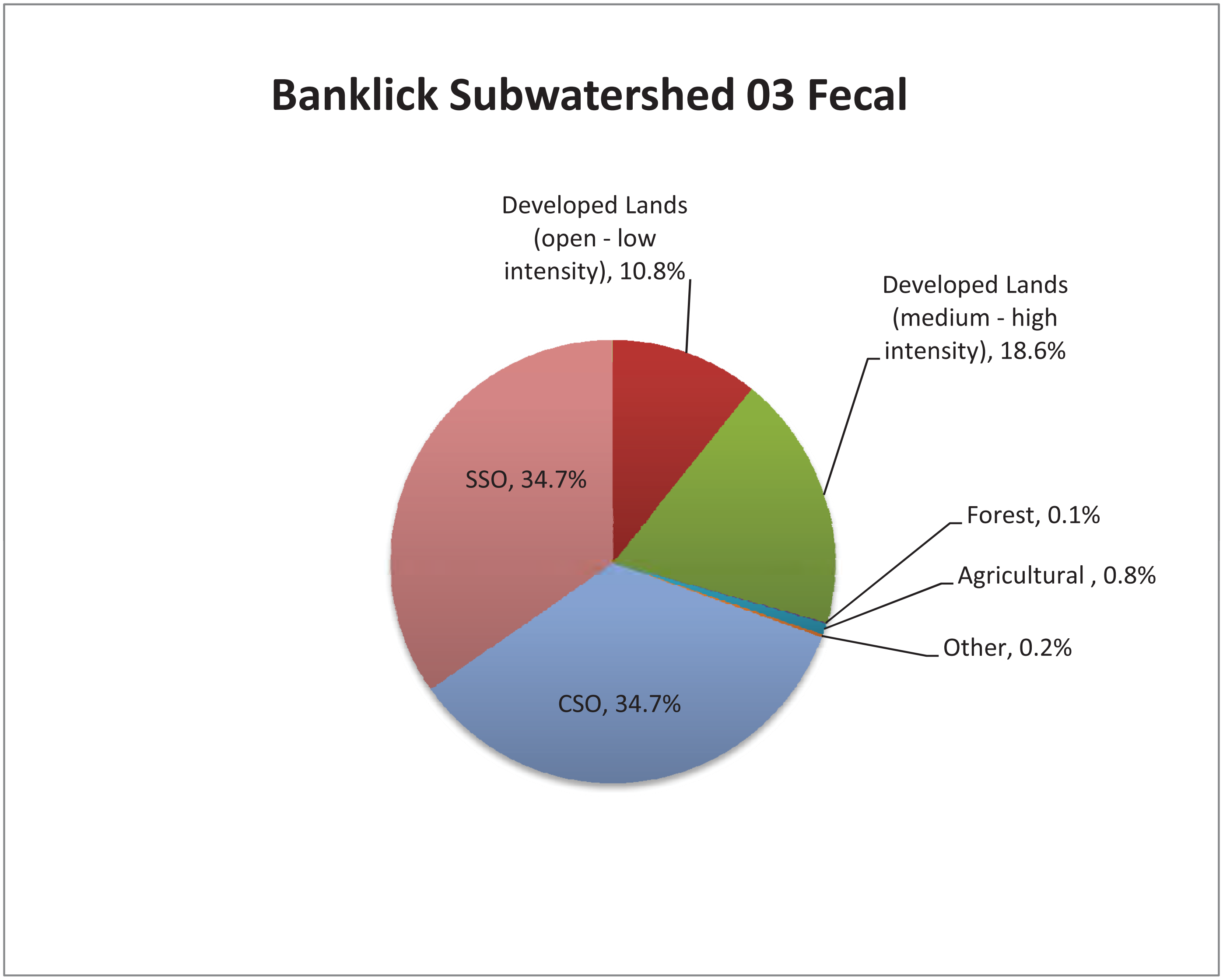
"This work was funded in part by a grant
from the U.S. Environmental Protection Agency
under §319(h) of the Clean Water Act
through the Kentucky Division of Water to
Banklick Watershed Council
Grant # C9994861-07."


TOTAL BANKLICK FECAL
Septic, 0.9%
Developed Lands (open - low intensity), 18.7%
SSO, 33.6%
Developed Lands (medium - high intensity), 17.8%
Forest, 0.2%
CSO, 11.4%
Agricultural , 15.5%
Other, 2.0%

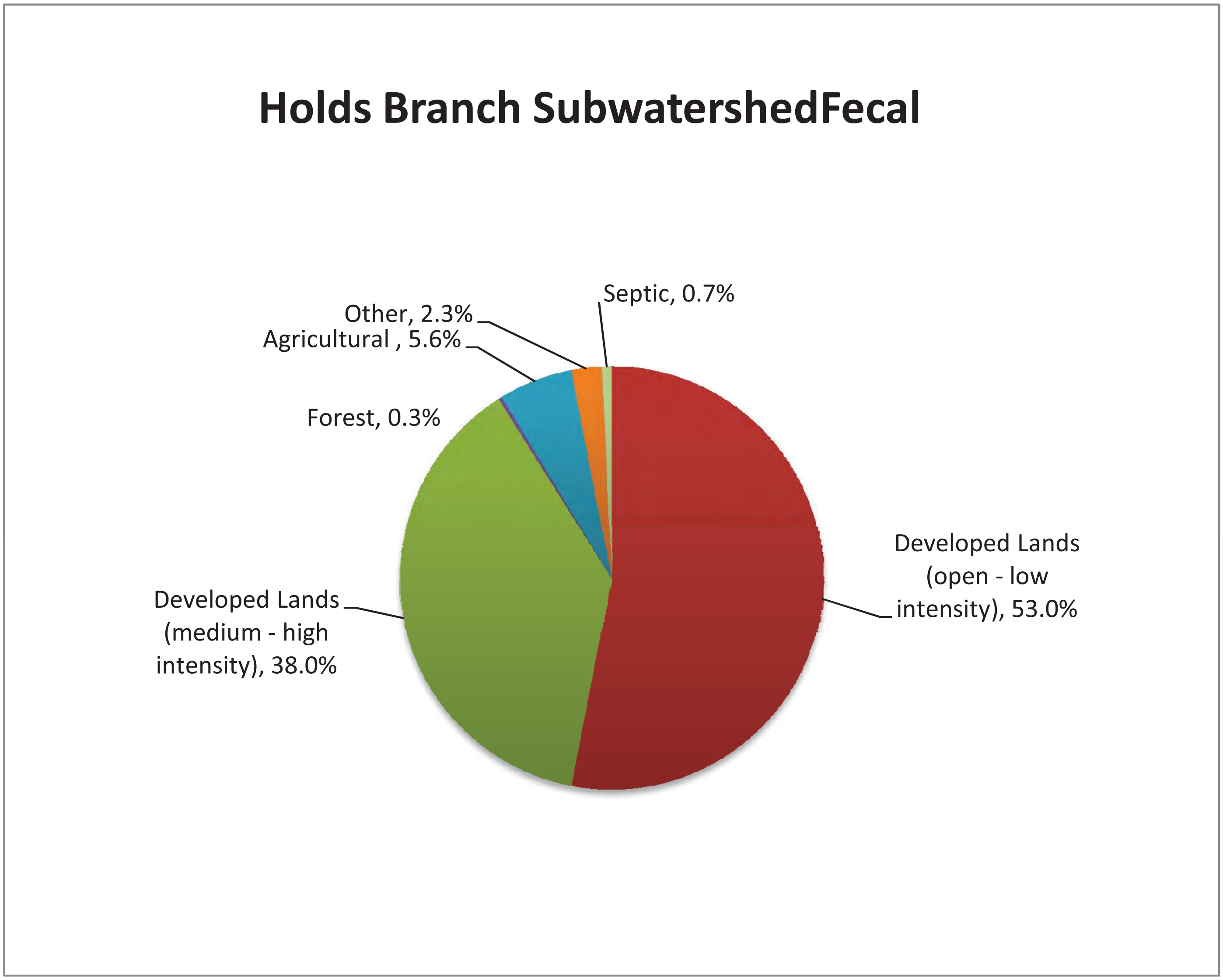

Banklick Subwatershed 01 Fecal
KPDES, 0.1%
Developed Lands (open - low intensity), 12.6%
Developed Lands (medium - high intensity), 12.6%
Forest, 0.1%
Agricultural , 1.0%
Other, 0.3%
CSO, 53.6%
SSO, 19.6%

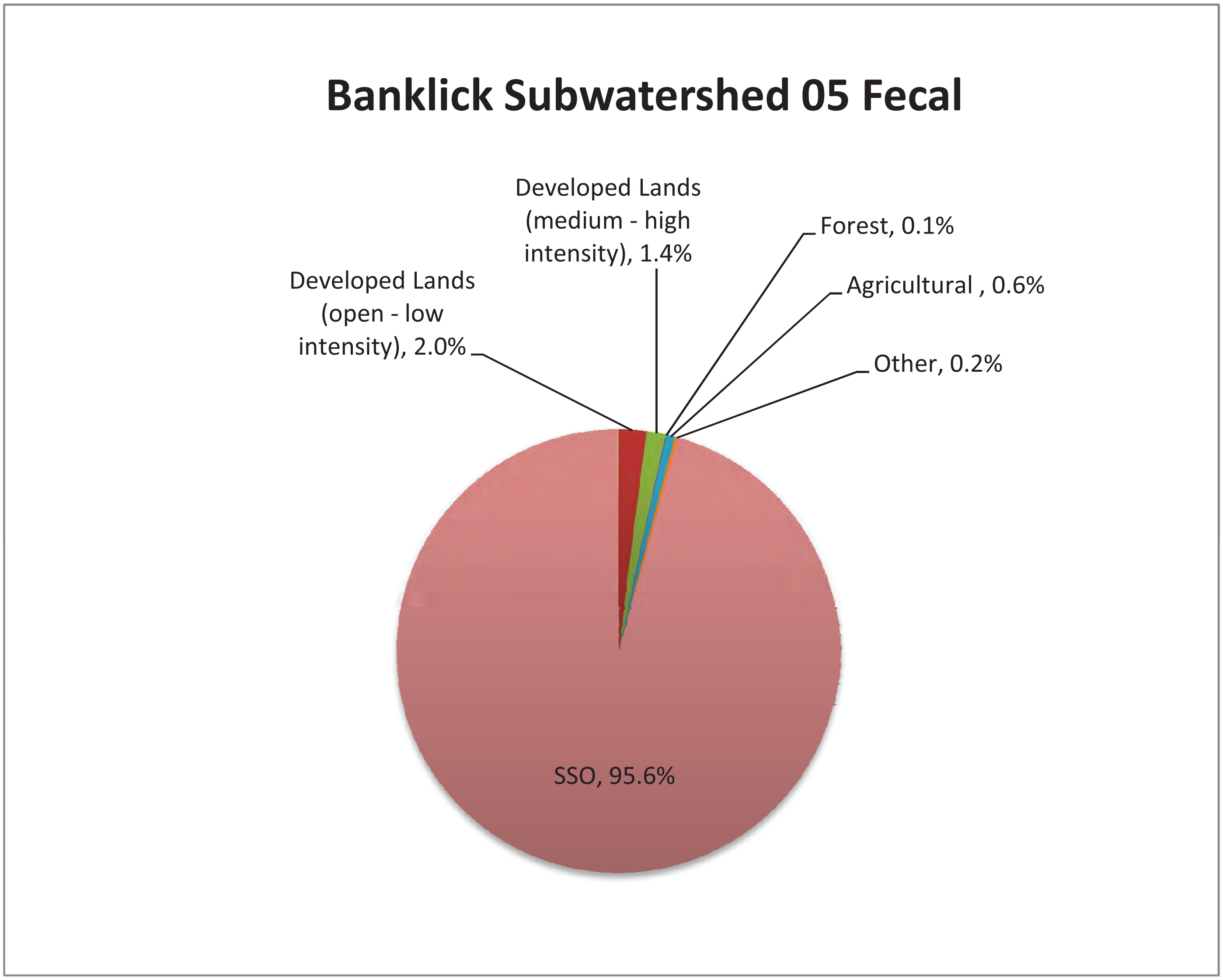


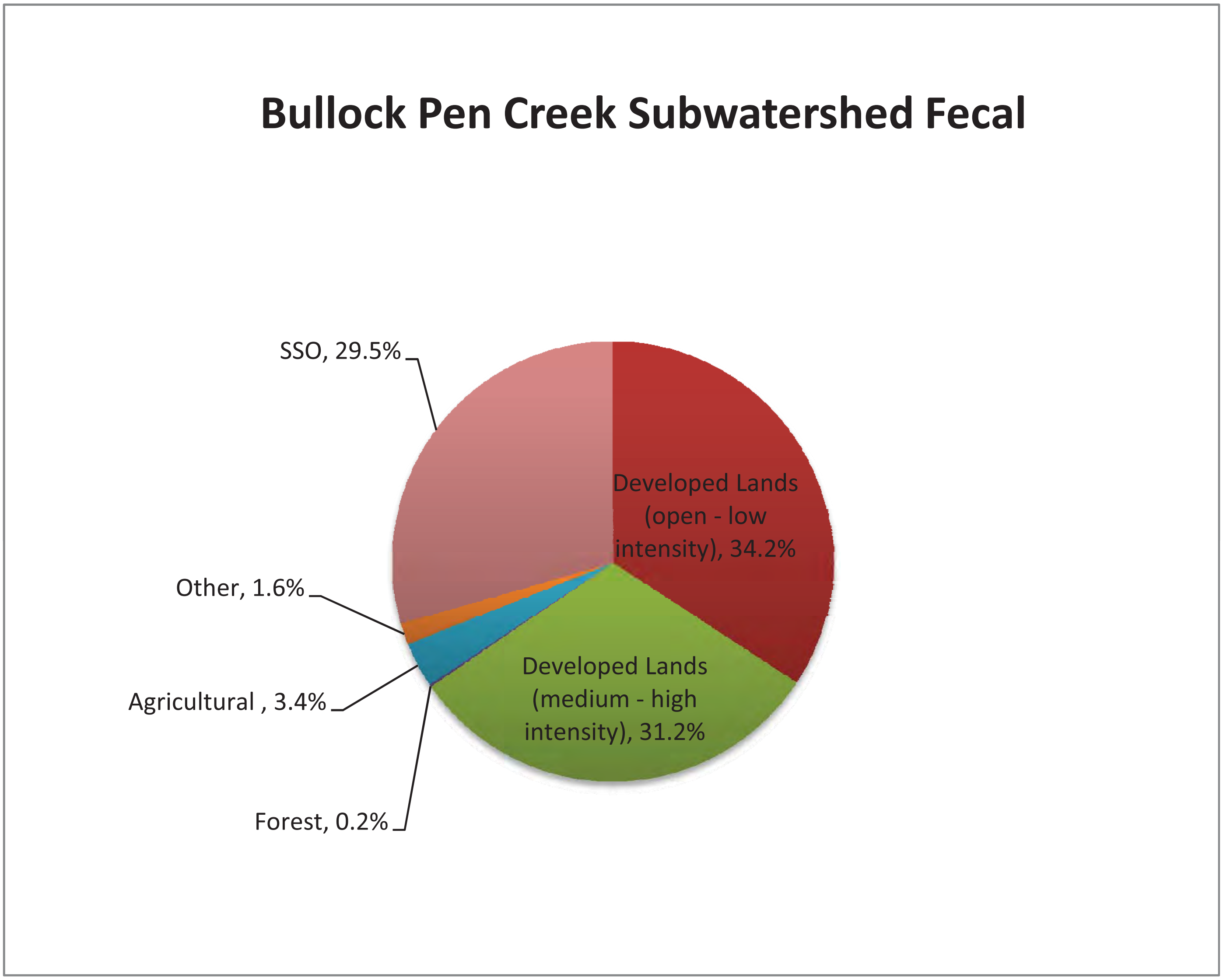
Horse Branch Subwatershed Fecal
SSO, 8.6%
Other, 1.3%
Agricultural , 0.1%
Forest, 0.1%
Developed Lands (open - low intensity), 41.4%
Developed Lands (medium - high intensity), 48.5%

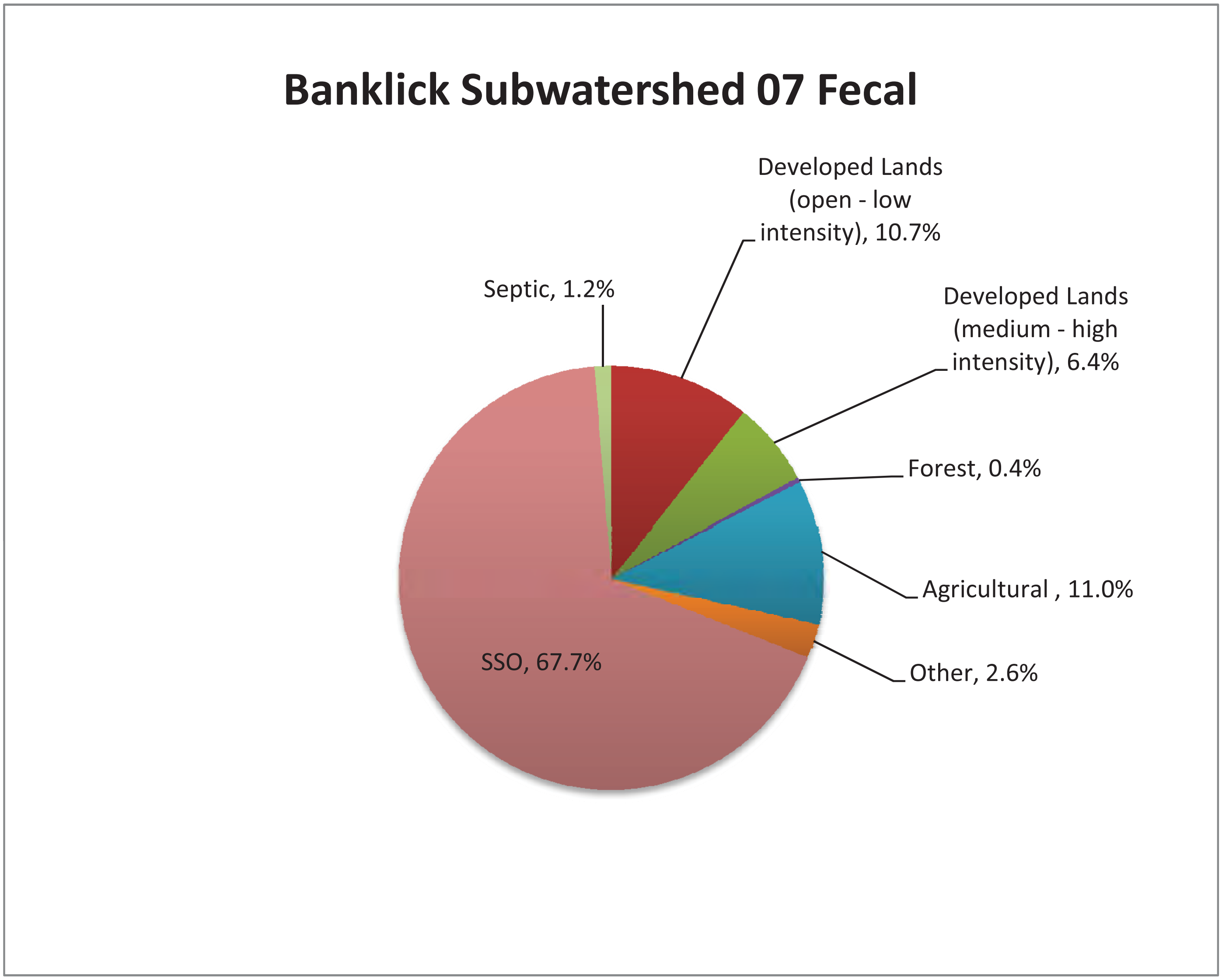


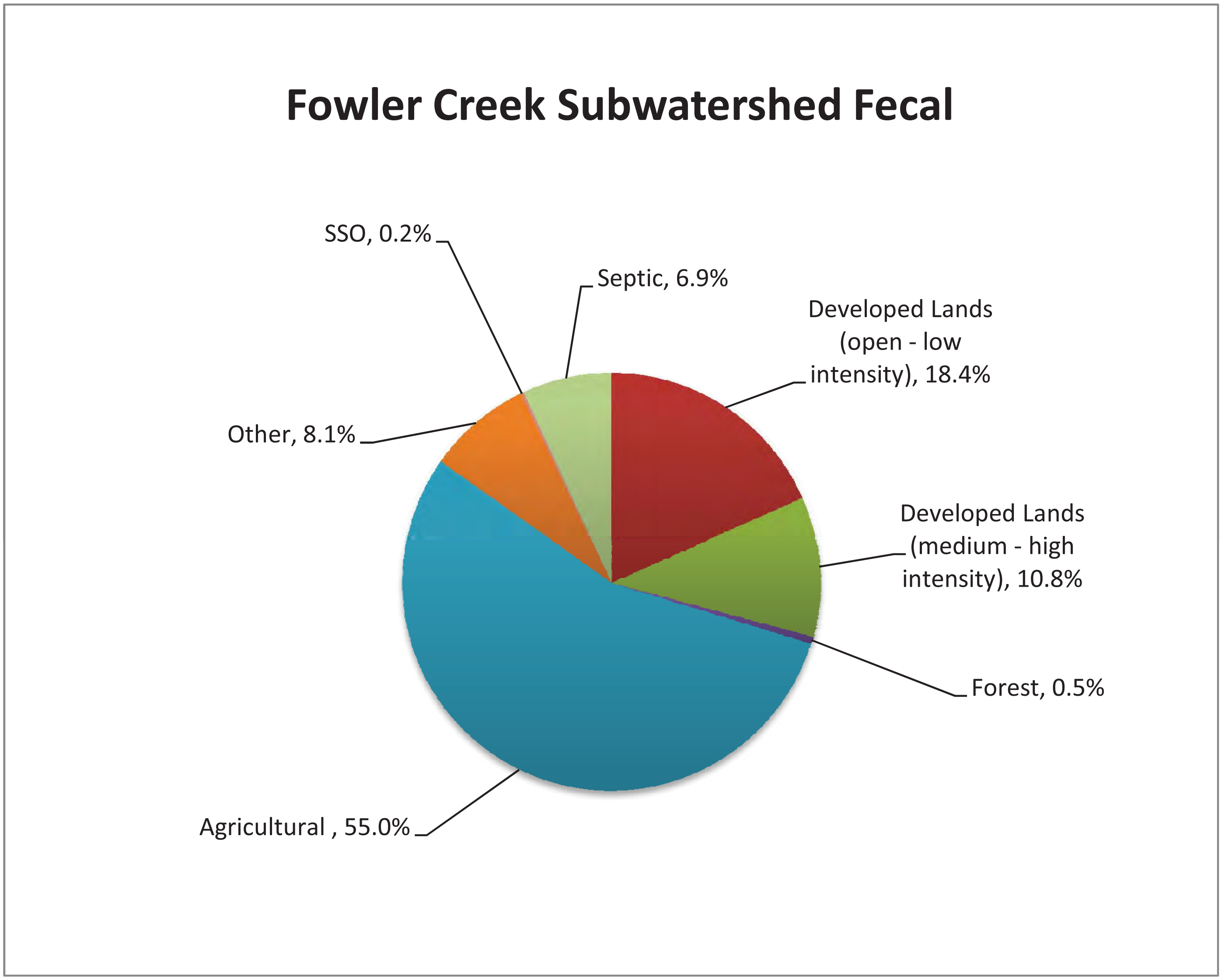
Banklick Subwatershed 03 Fecal
Developed Lands (open - low intensity), 10.8%
Developed Lands (medium - high intensity), 18.6%
Forest, 0.1%
Agricultural , 0.8%
Other, 0.2%
CSO, 34.7%
SSO, 34.7%

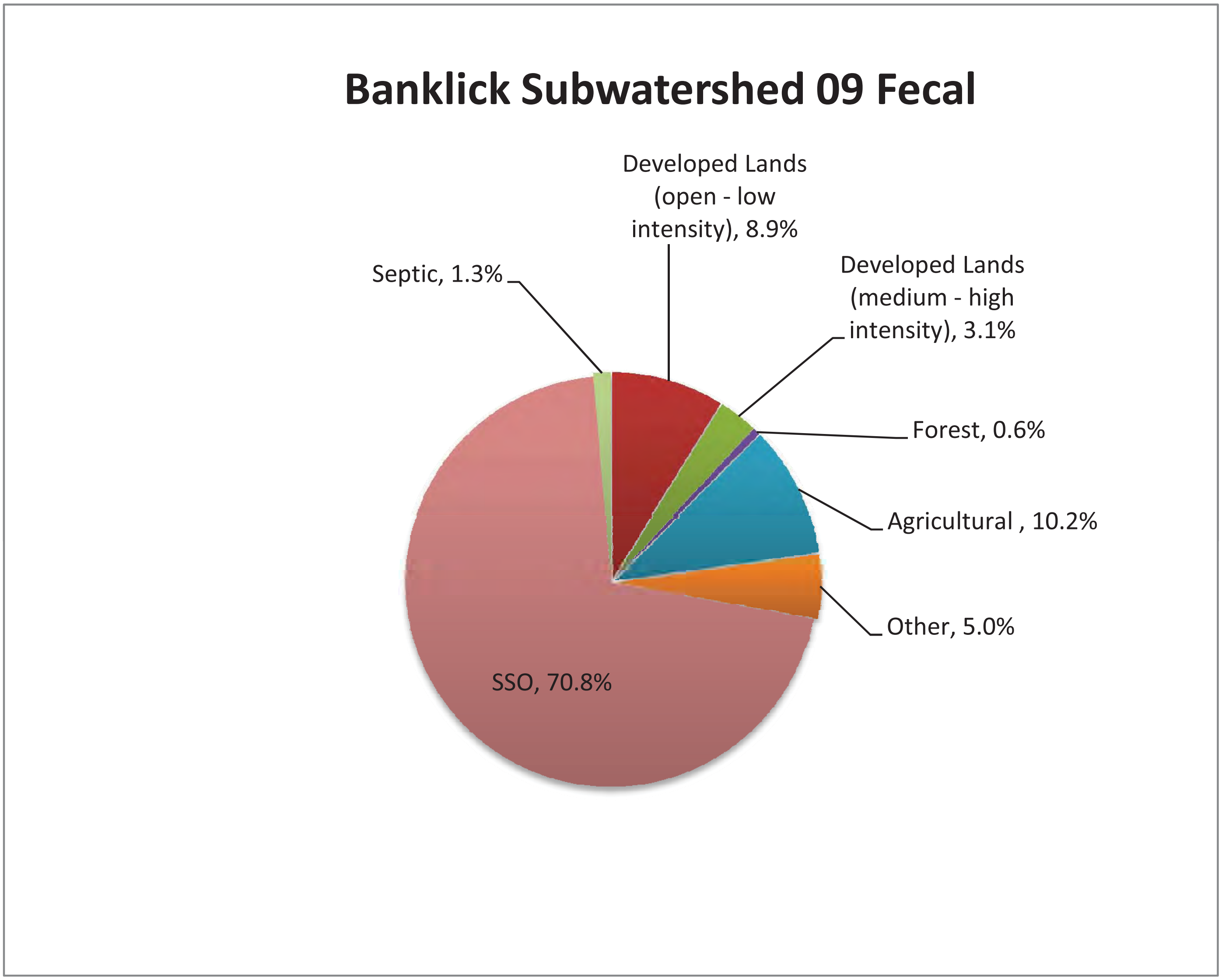

Holds Branch SubwatershedFecal
Septic, 0.7%
Other, 2.3%
Agricultural , 5.6%
Forest, 0.3%
Developed Lands (open - low intensity), 53.0%
Developed Lands (medium - high intensity), 38.0%


Banklick Subwatershed 05 Fecal
Developed Lands (medium - high intensity), 1.4%
Forest, 0.1%
Agricultural , 0.6%
Developed Lands (open - low intensity), 2.0%
Other, 0.2%
SSO, 95.6%

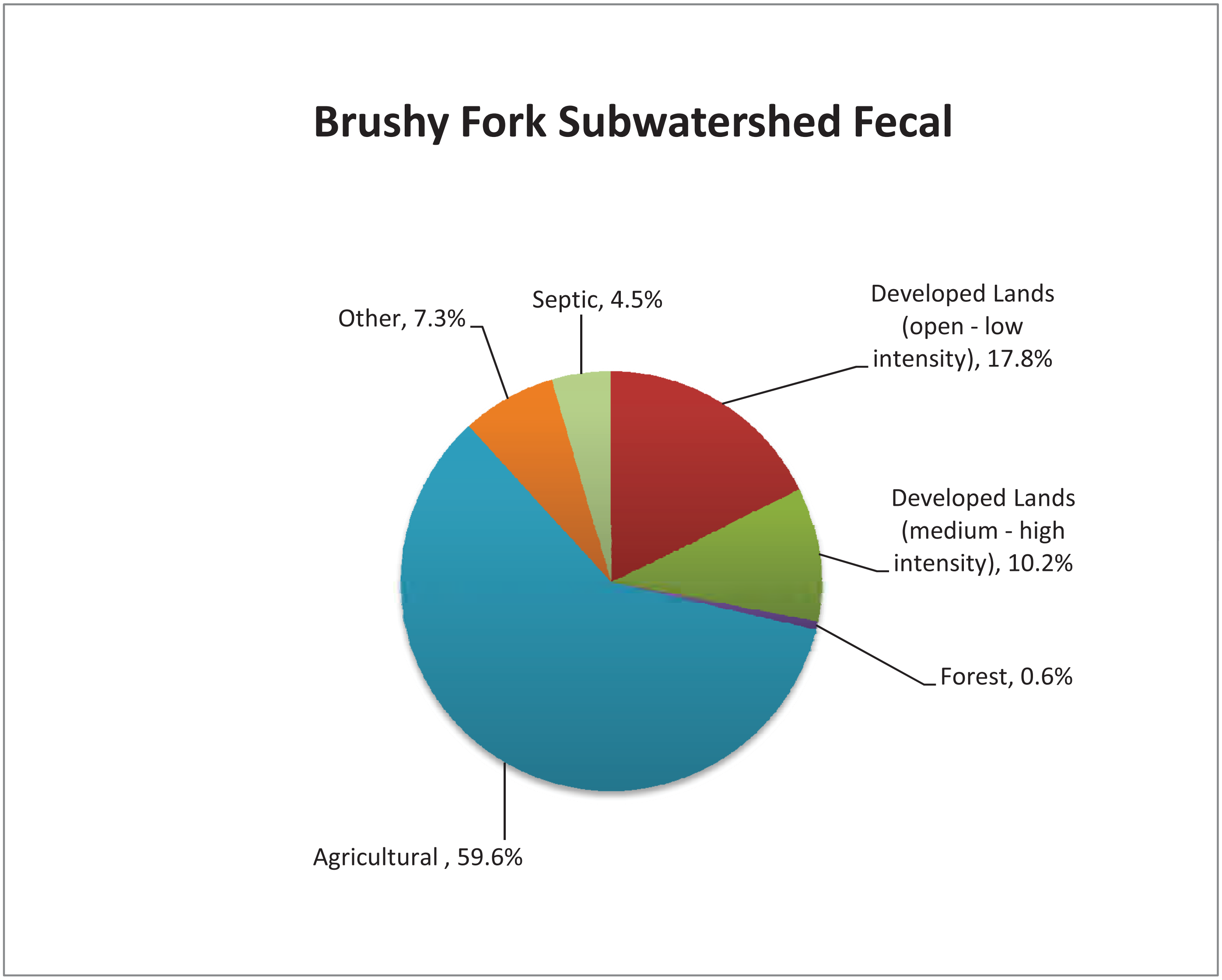

Bullock Pen Creek Subwatershed Fecal
SSO, 29.5%
Developed Lands (open - low intensity), 34.2%
Other, 1.6%
Agricultural , 3.4%
Developed Lands (medium - high intensity), 31.2%
Forest, 0.2%


Banklick Subwatershed 07 Fecal
Developed Lands (open - low intensity), 10.7%
Septic, 1.2%
Developed Lands (medium - high intensity), 6.4%
Forest, 0.4%
Agricultural , 11.0%
Other, 2.6%
SSO, 67.7%

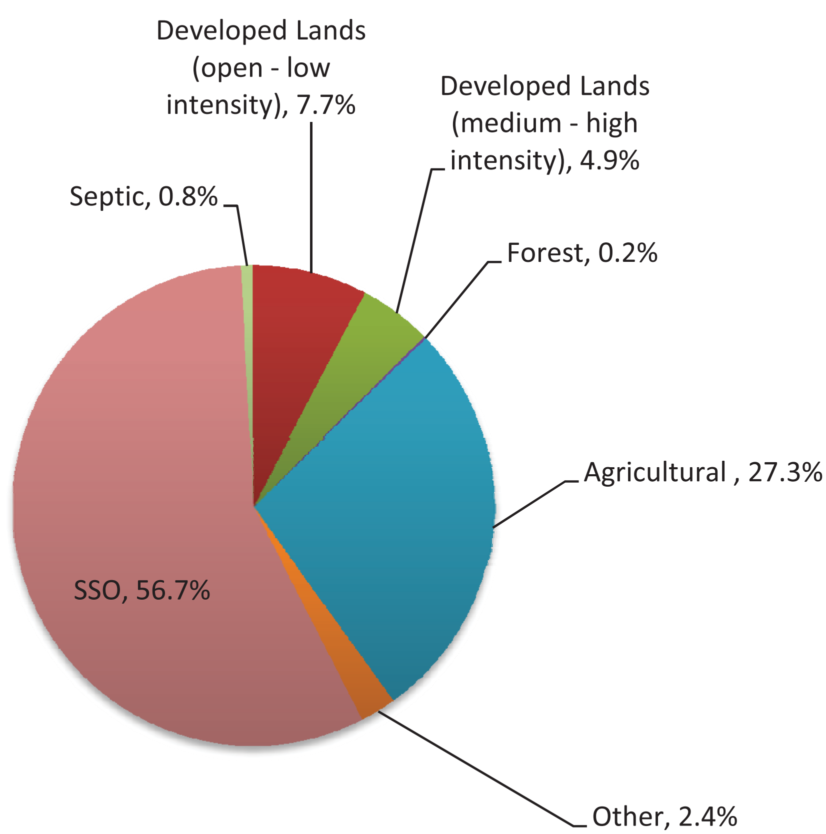

Fowler Creek Subwatershed Fecal
SSO, 0.2%
Septic, 6.9%
Developed Lands (open - low intensity), 18.4%
Other, 8.1%
Developed Lands (medium - high intensity), 10.8%
Forest, 0.5%
Agricultural , 55.0%

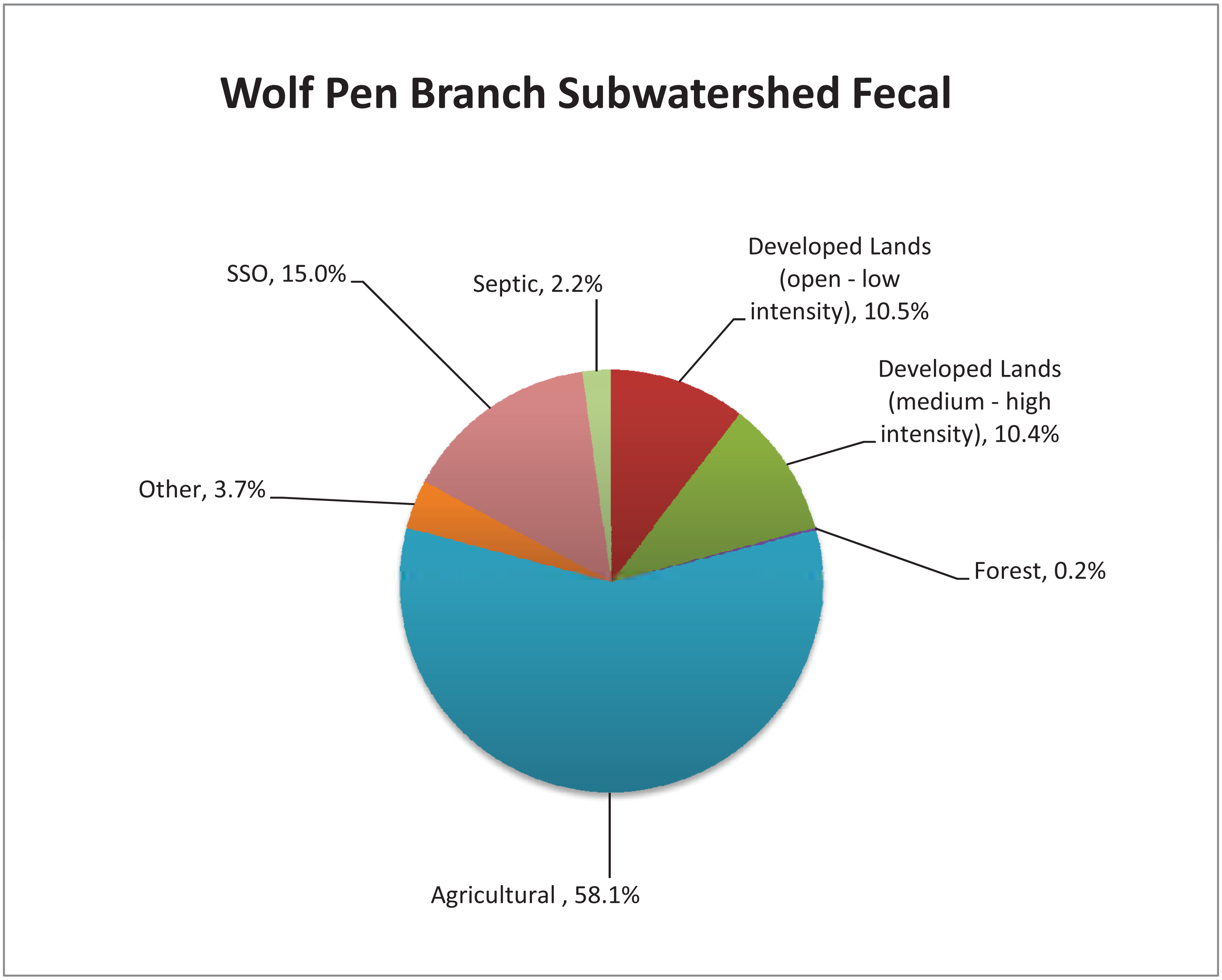


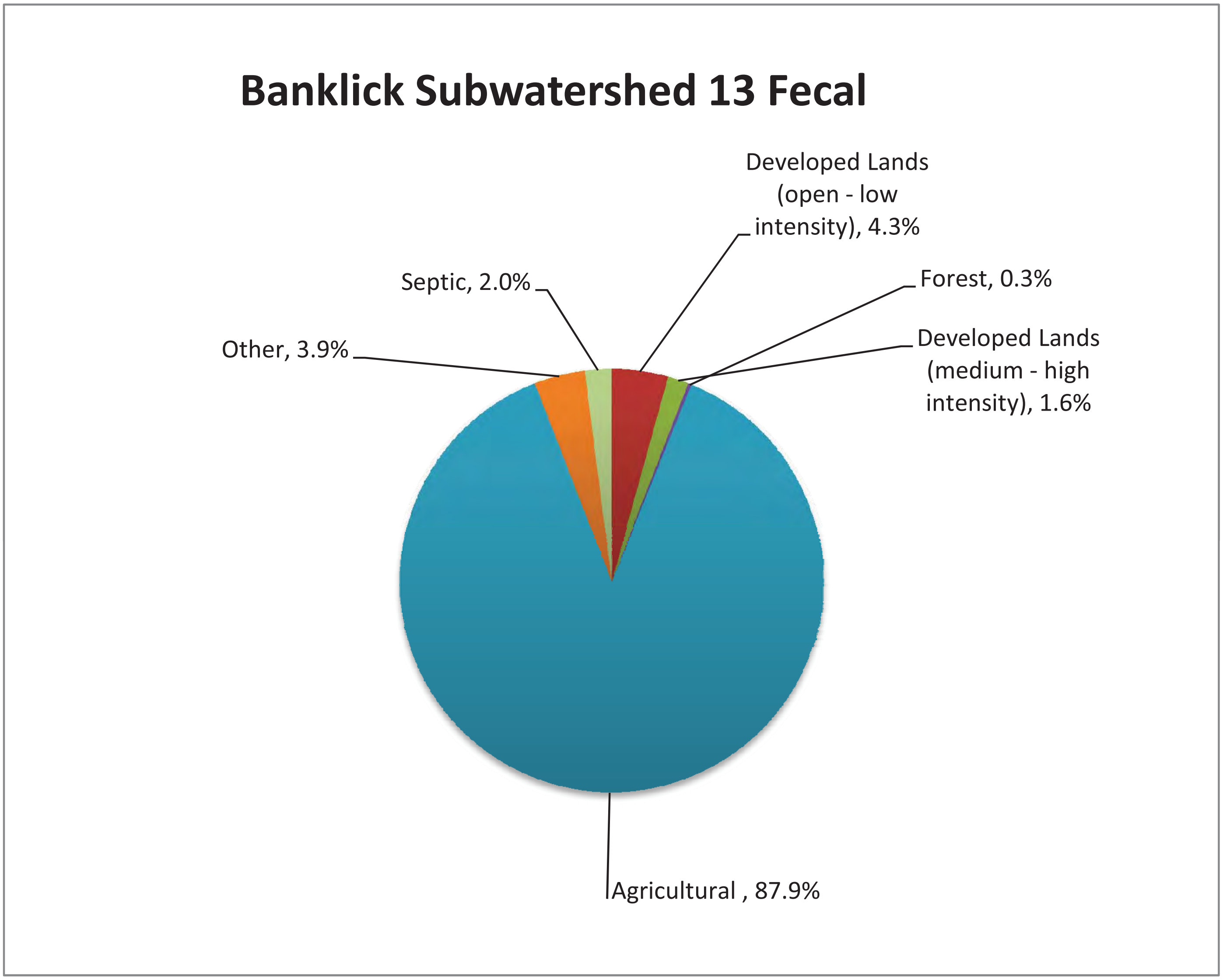
Banklick Subwatershed 09 Fecal
Developed Lands (open - low intensity), 8.9%
Septic, 1.3%
Developed Lands (medium - high intensity), 3.1%
Forest, 0.6%
Agricultural , 10.2%
Other, 5.0%
SSO, 70.8%

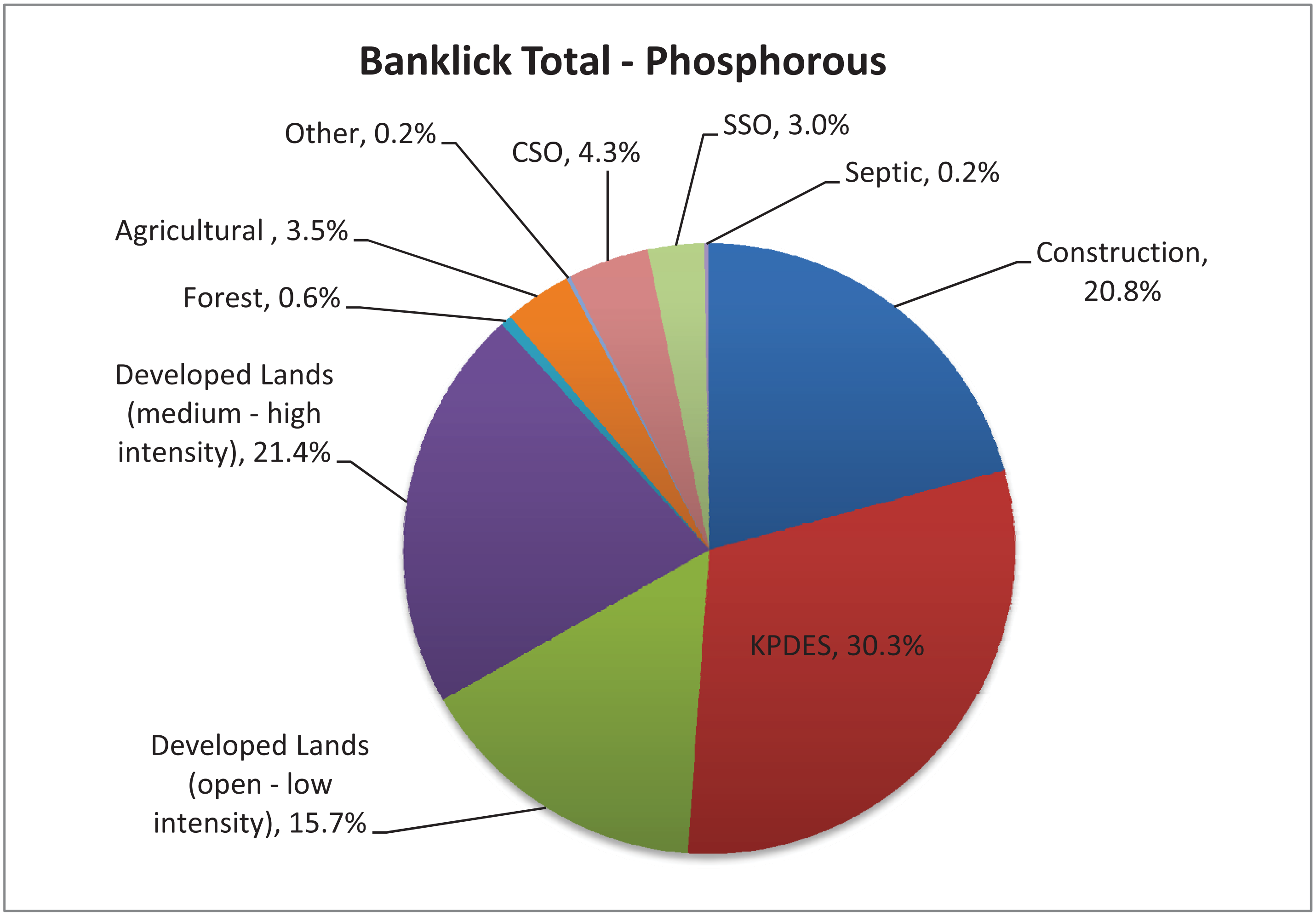

Brushy Fork Subwatershed Fecal
Septic, 4.5%
Other, 7.3%
Developed Lands (open - low intensity), 17.8%
Developed Lands (medium - high intensity), 10.2%
Forest, 0.6%
Agricultural , 59.6%

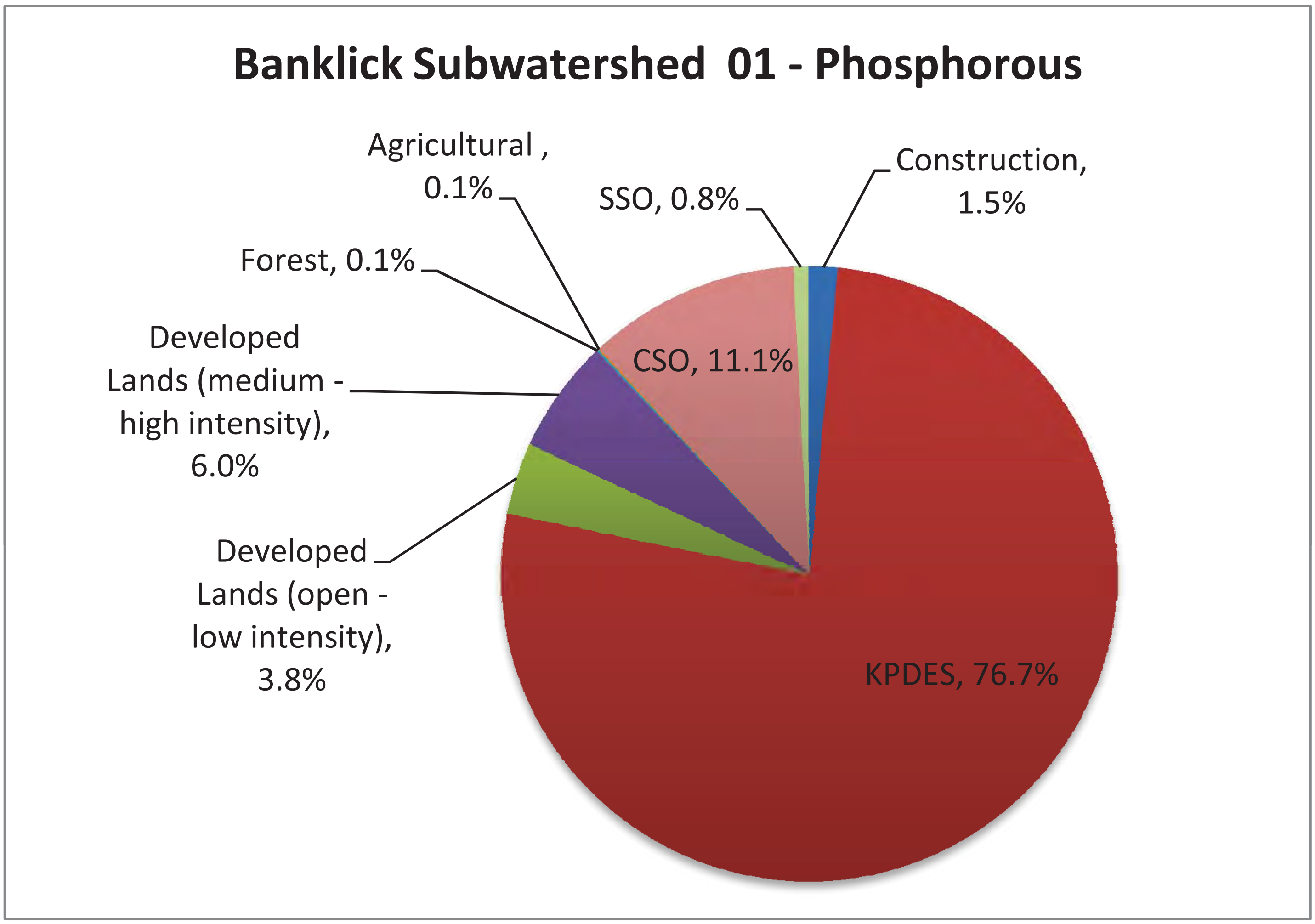
Banklick Subwatershed 11 Fecal

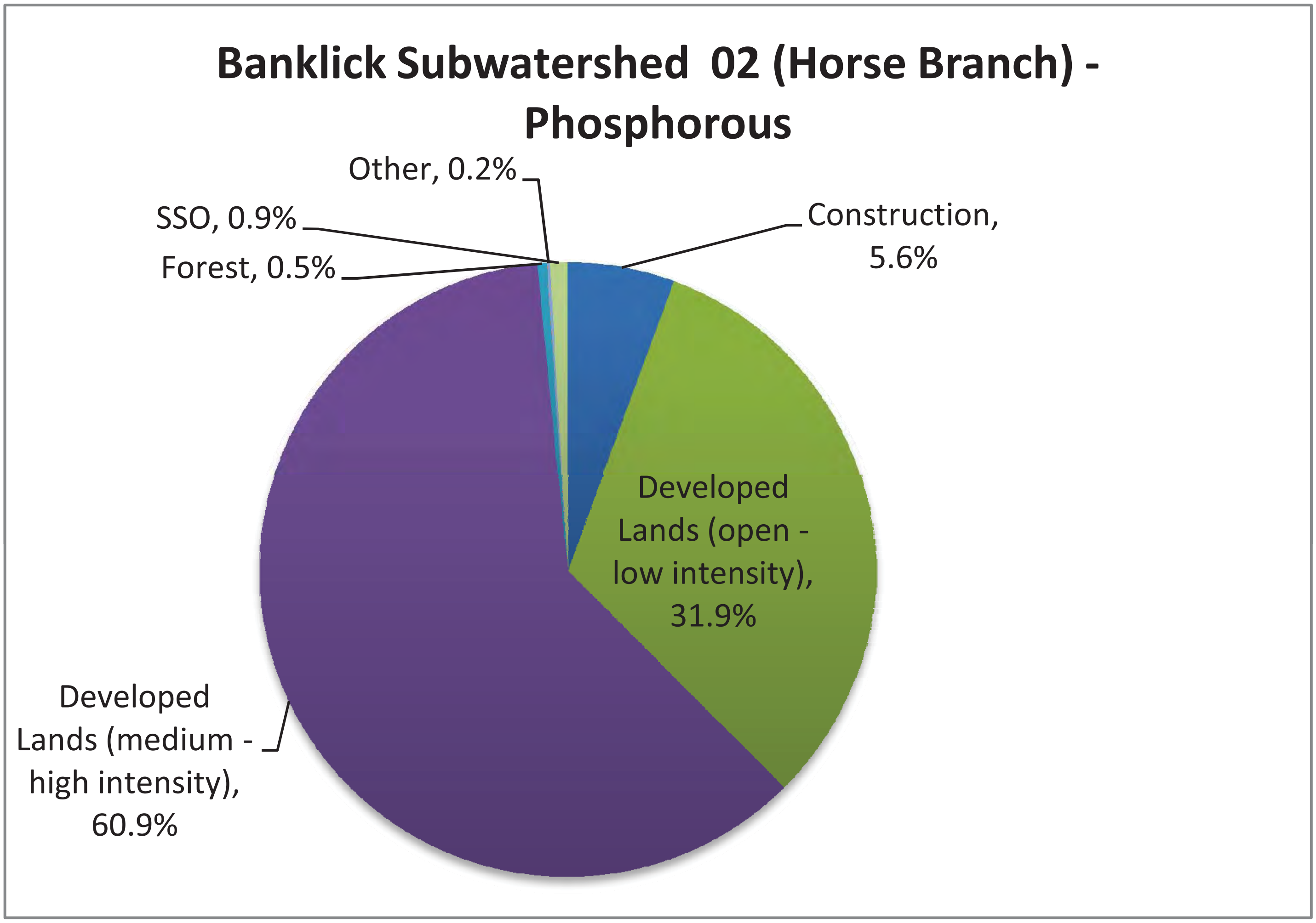


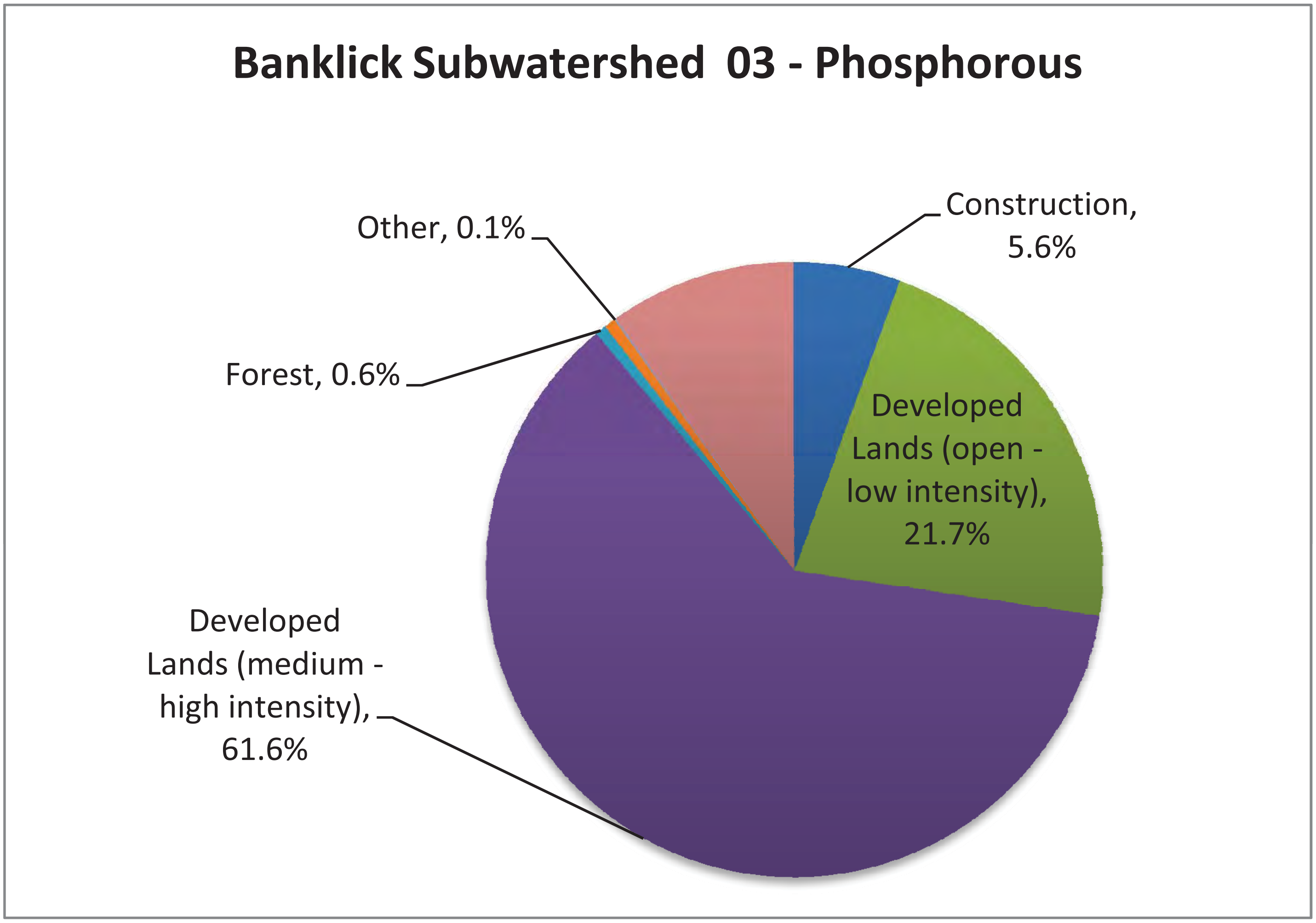

Wolf Pen Branch Subwatershed Fecal
SSO, 15.0%
Septic, 2.2%
Developed Lands (open - low intensity), 10.5%
Developed Lands (medium - high intensity), 10.4%
Other, 3.7%
Forest, 0.2%
Agricultural , 58.1%

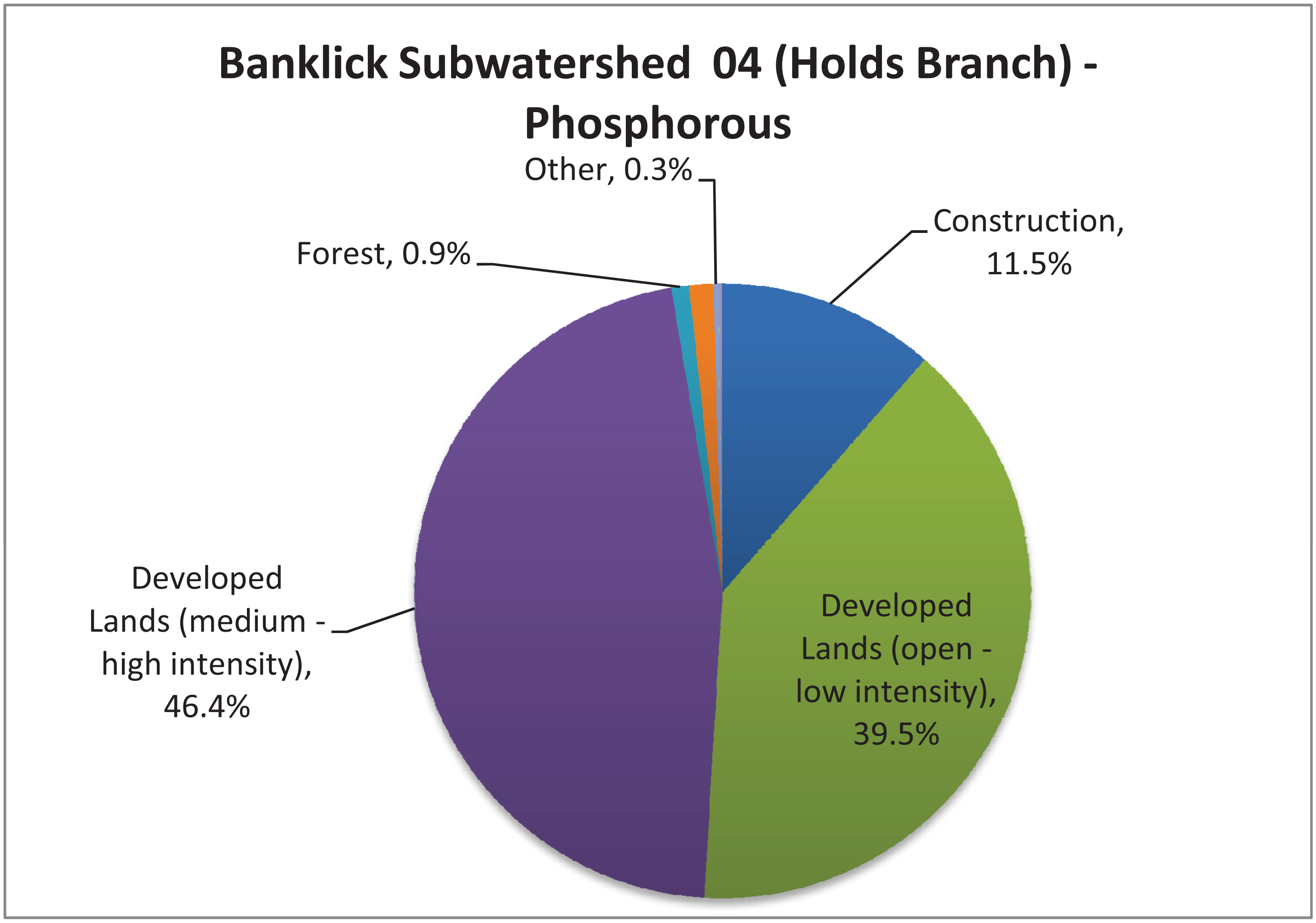

Banklick Subwatershed 13 Fecal
Developed Lands (open - low intensity), 4.3%
Forest, 0.3%
Developed Lands (medium - high intensity), 1.6%
Septic, 2.0%
Other, 3.9%
Agricultural , 87.9%

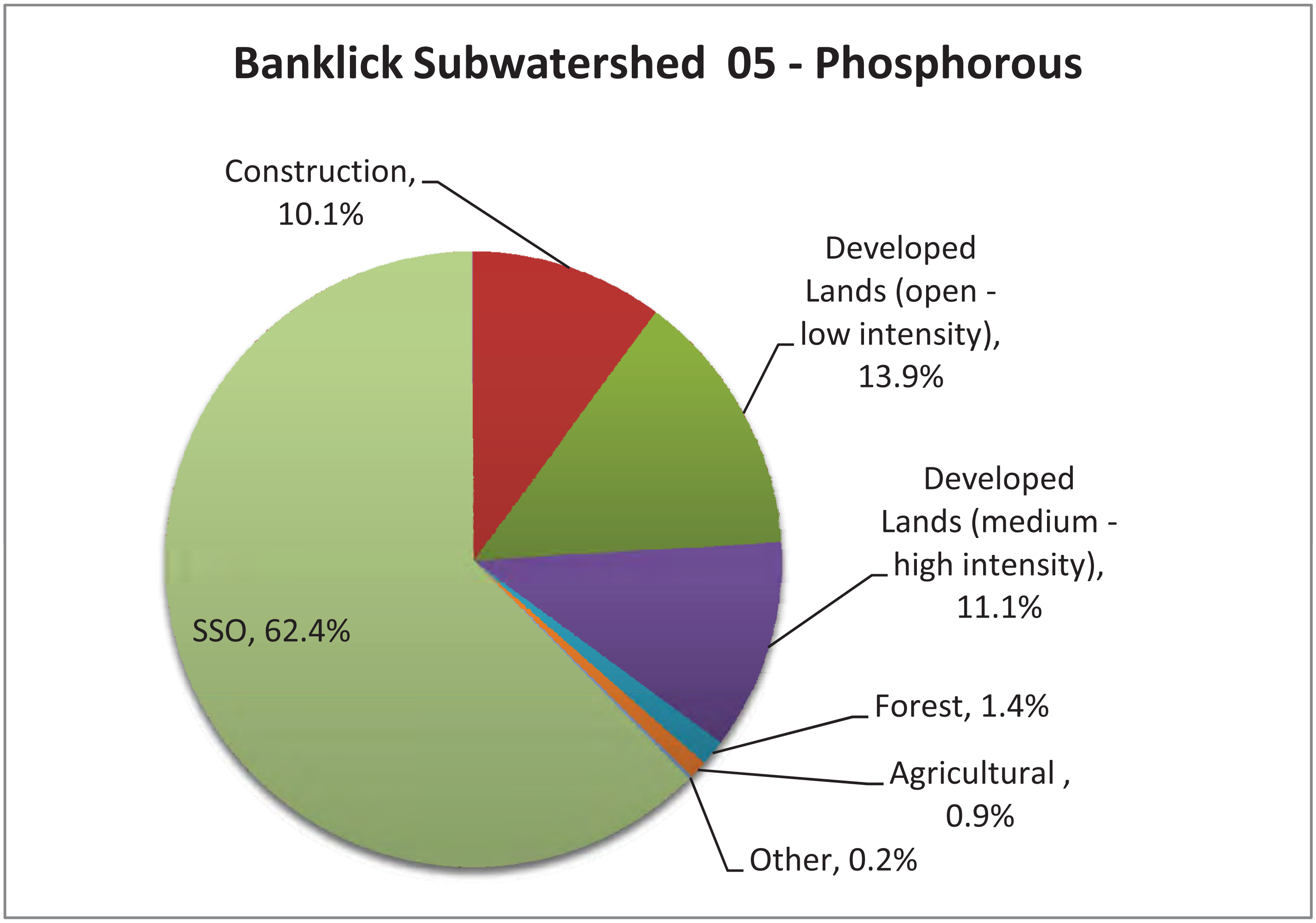

Banklick Total - Phosphorous
Other, 0.2%
CSO, 4.3%
SSO, 3.0%
Septic, 0.2%
Agricultural , 3.5%
Construction, 20.8%
Forest, 0.6%
Developed Lands (medium - high intensity), 21.4%
KPDES, 30.3%
Developed Lands (open - low intensity), 15.7%


Banklick Subwatershed 01 - Phosphorous
Agricultural , 0.1%
SSO, 0.8%
Construction, 1.5%
Forest, 0.1%
Developed Lands (medium - high intensity), 6.0%
CSO, 11.1%
Developed Lands (open - low intensity), 3.8%
KPDES, 76.7%

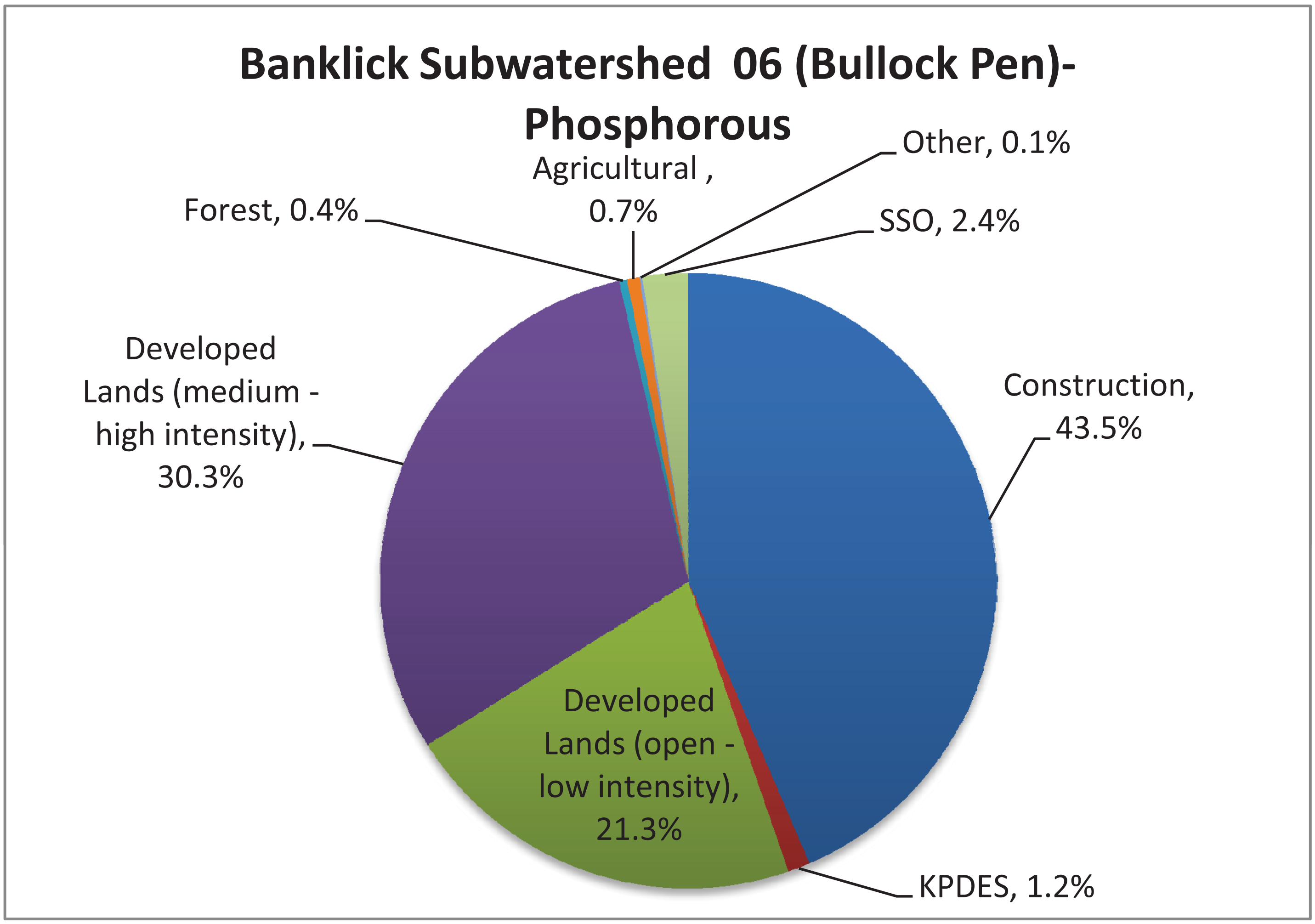

Banklick Subwatershed 02 (Horse Branch) - Phosphorous
Other, 0.2%
SSO, 0.9%
Forest, 0.5%
Construction, 5.6%
Developed Lands (open - low intensity), 31.9%
Developed Lands (medium - high intensity), 60.9%


Banklick Subwatershed 03 - Phosphorous
Construction, 5.6%
Other, 0.1%
Forest, 0.6%
Developed Lands (open - low intensity), 21.7%
Developed Lands (medium - high intensity), 61.6%

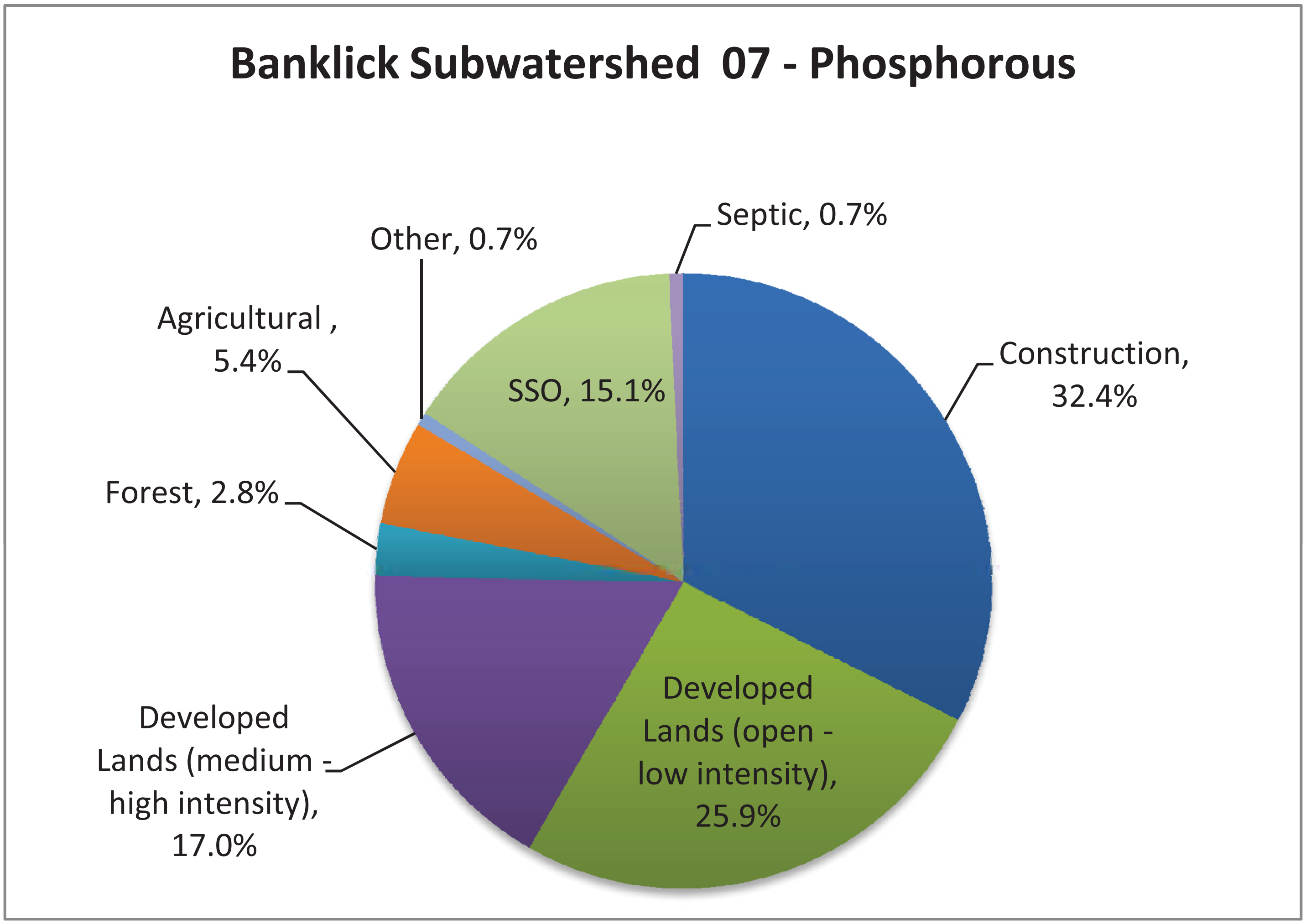

Banklick Subwatershed 04 (Holds Branch) - Phosphorous
Other, 0.3%
Construction, 11.5%
Forest, 0.9%
Developed Lands (medium - high intensity), 46.4%
Developed Lands (open - low intensity), 39.5%

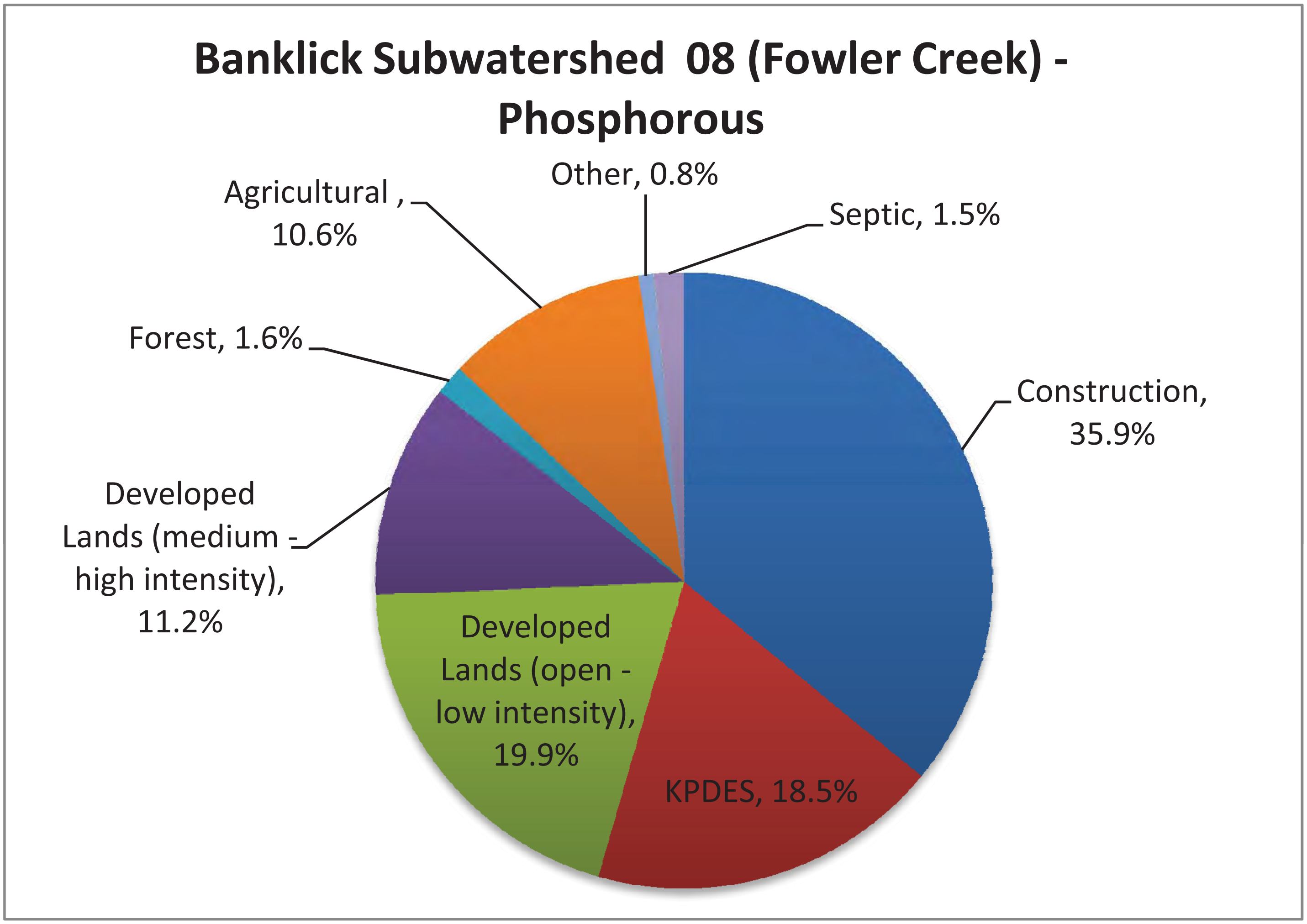


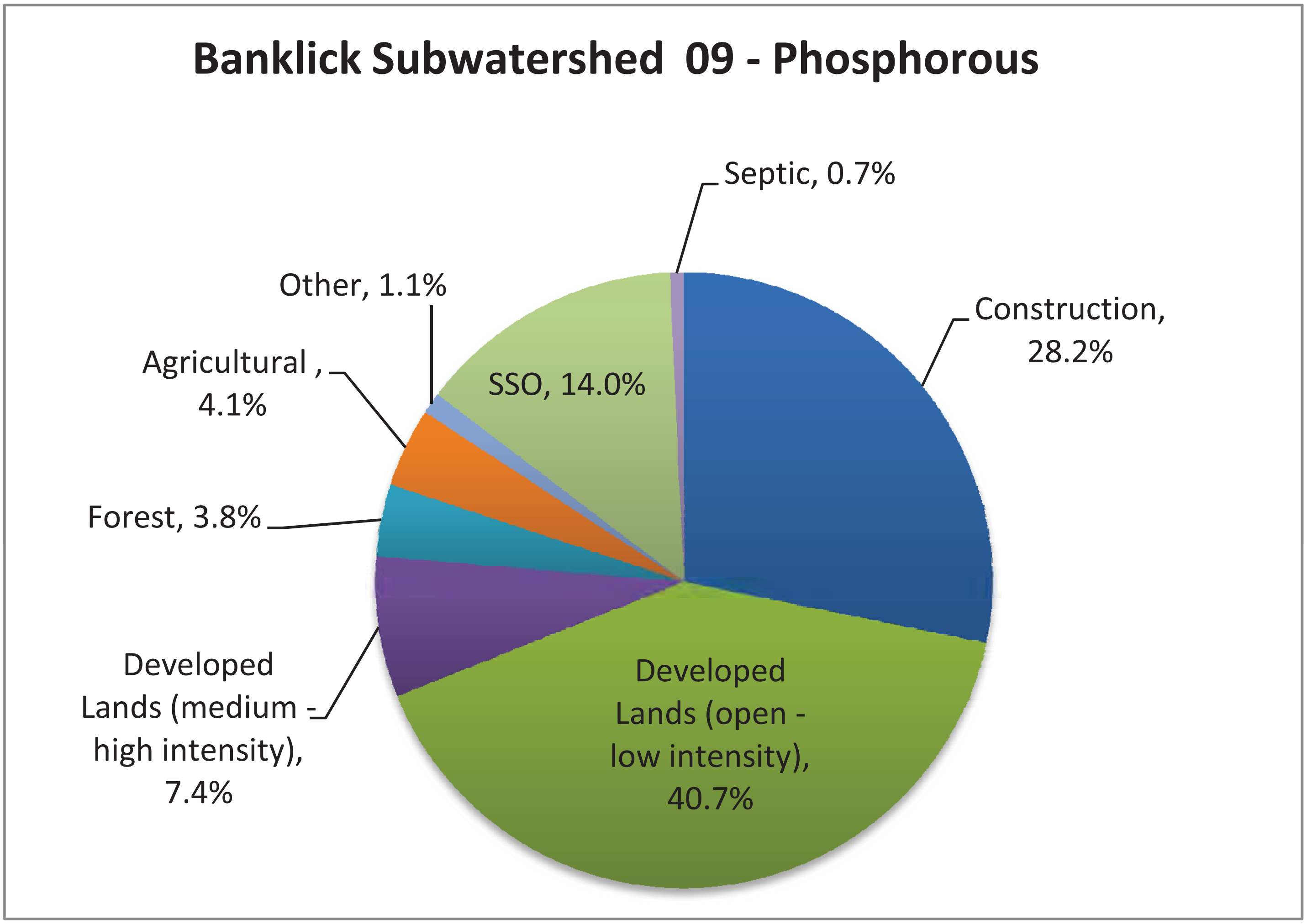
Banklick Subwatershed 05 - Phosphorous
Construction, 10.1%
Developed Lands (open - low intensity), 13.9%
Developed Lands (medium - high intensity), 11.1%
Forest, 1.4%
Agricultural , 0.9%
Other, 0.2%
SSO, 62.4%

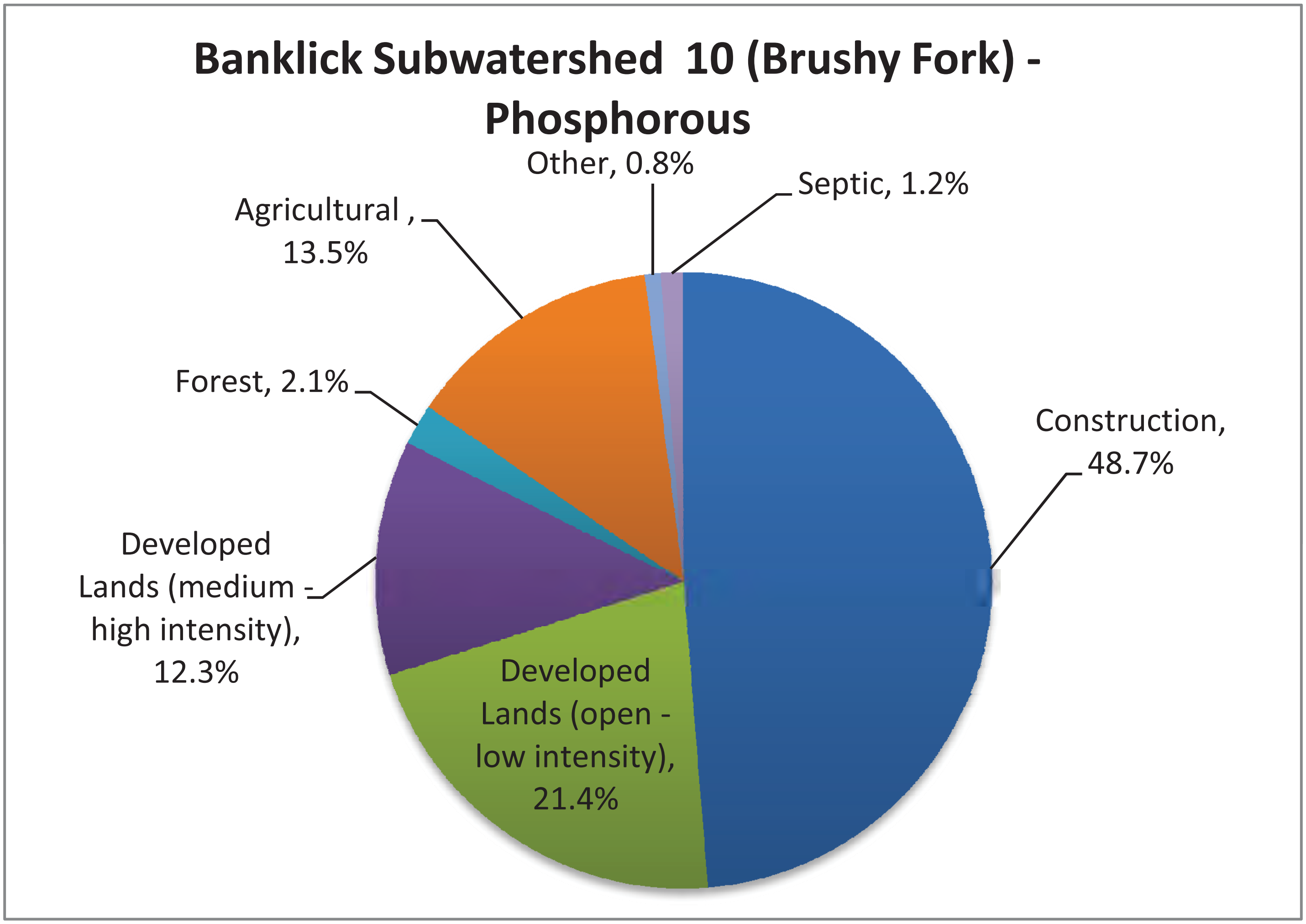


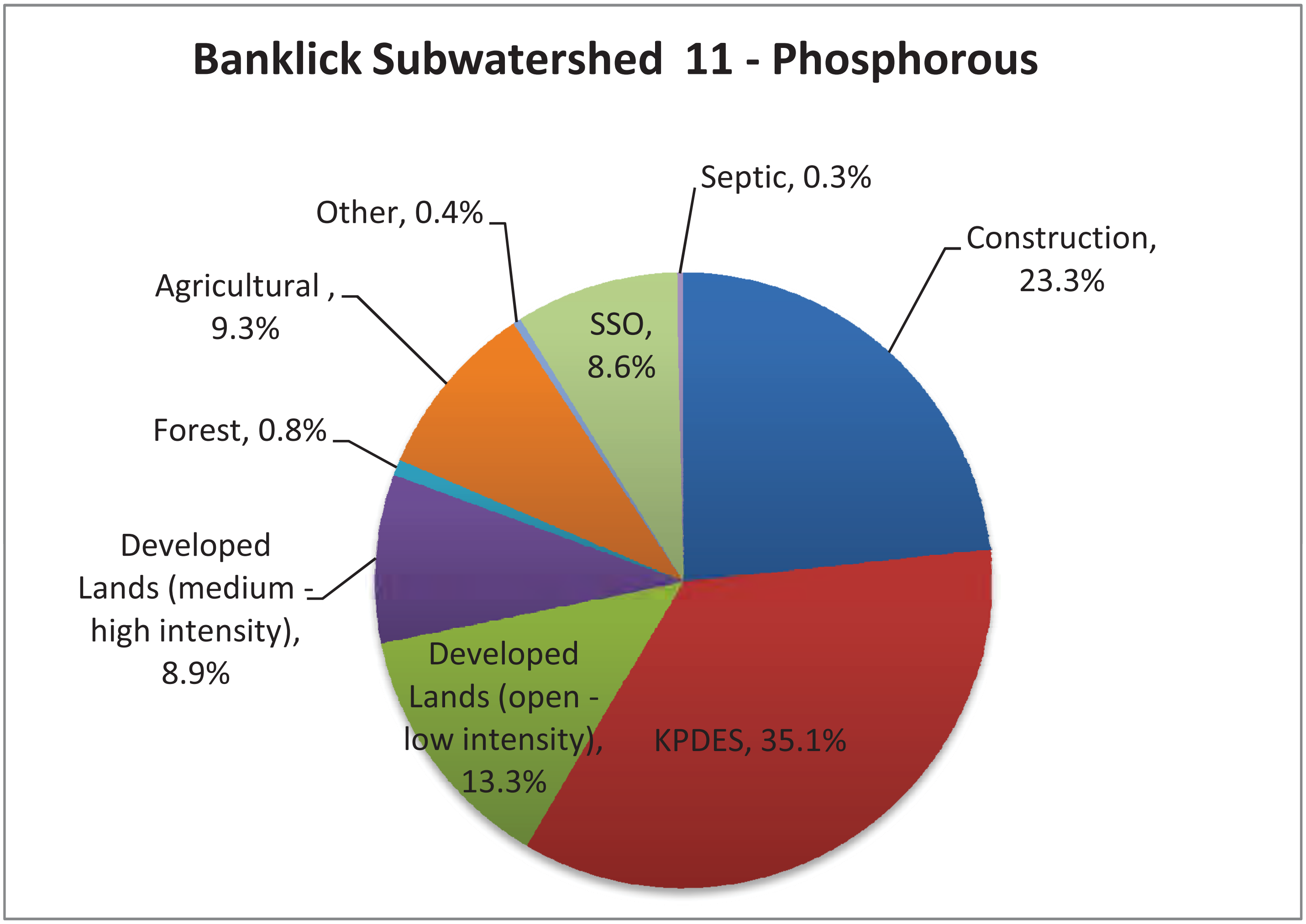
Banklick Subwatershed 06 (Bullock Pen)-
Phosphorous
Other, 0.1%
Agricultural ,
0.7%
Forest, 0.4%
SSO, 2.4%
Developed
Lands (medium -
high intensity),
30.3%
Construction,
43.5%
Developed
Lands (open -
low intensity),
21.3%
KPDES, 1.2%

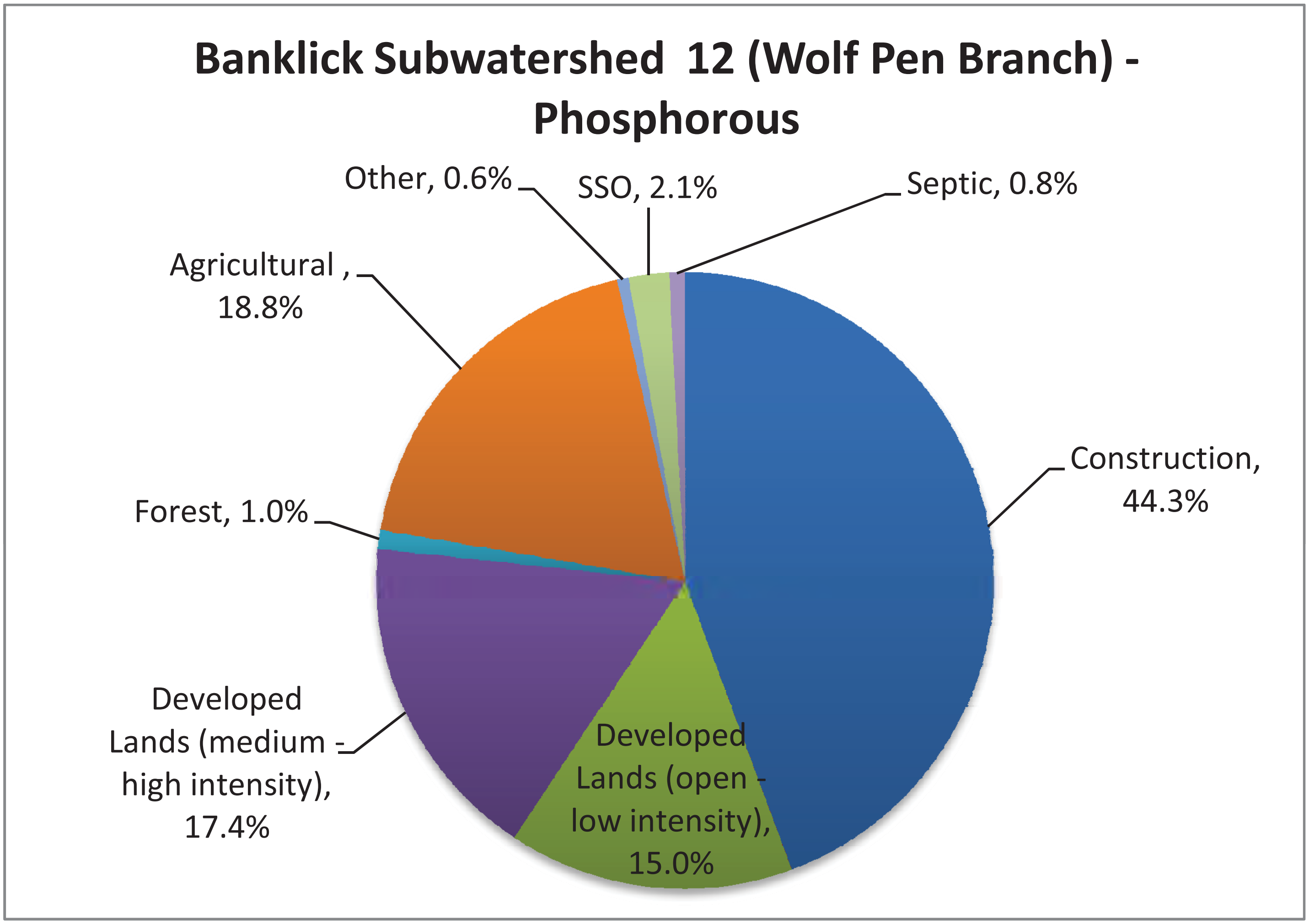

Banklick Subwatershed 07 - Phosphorous
Septic, 0.7%
Other, 0.7%
Agricultural , 5.4%
SSO, 15.1%
Construction, 32.4%
Forest, 2.8%
Developed Lands (open - low intensity), 25.9%
Developed Lands (medium - high intensity), 17.0%

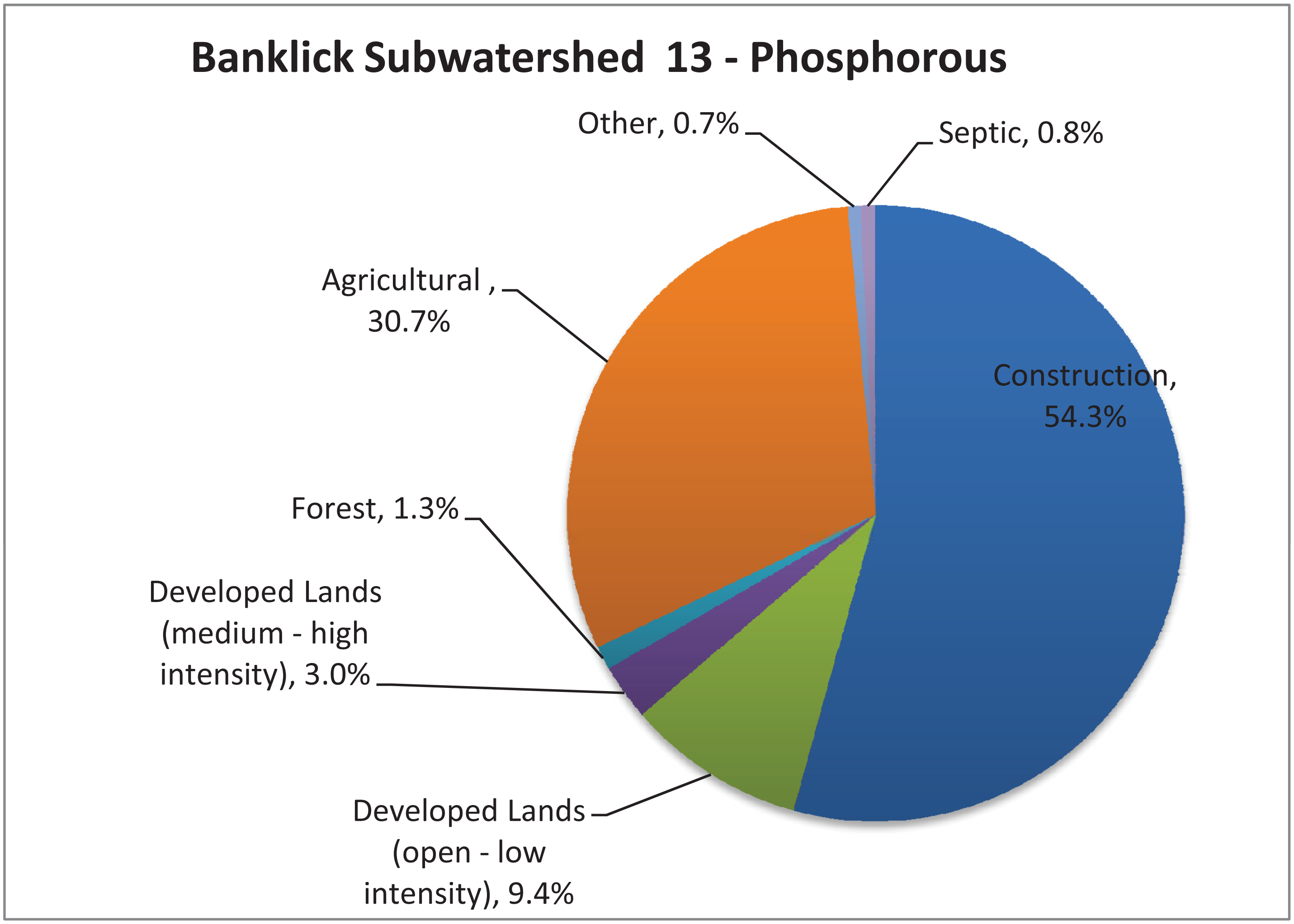

Banklick Subwatershed 08 (Fowler Creek) - Phosphorous
Other, 0.8%
Septic, 1.5%
Agricultural , 10.6%
Forest, 1.6%
Construction, 35.9%
Developed Lands (medium - high intensity), 11.2%
Developed Lands (open - low intensity), 19.9%
KPDES, 18.5%

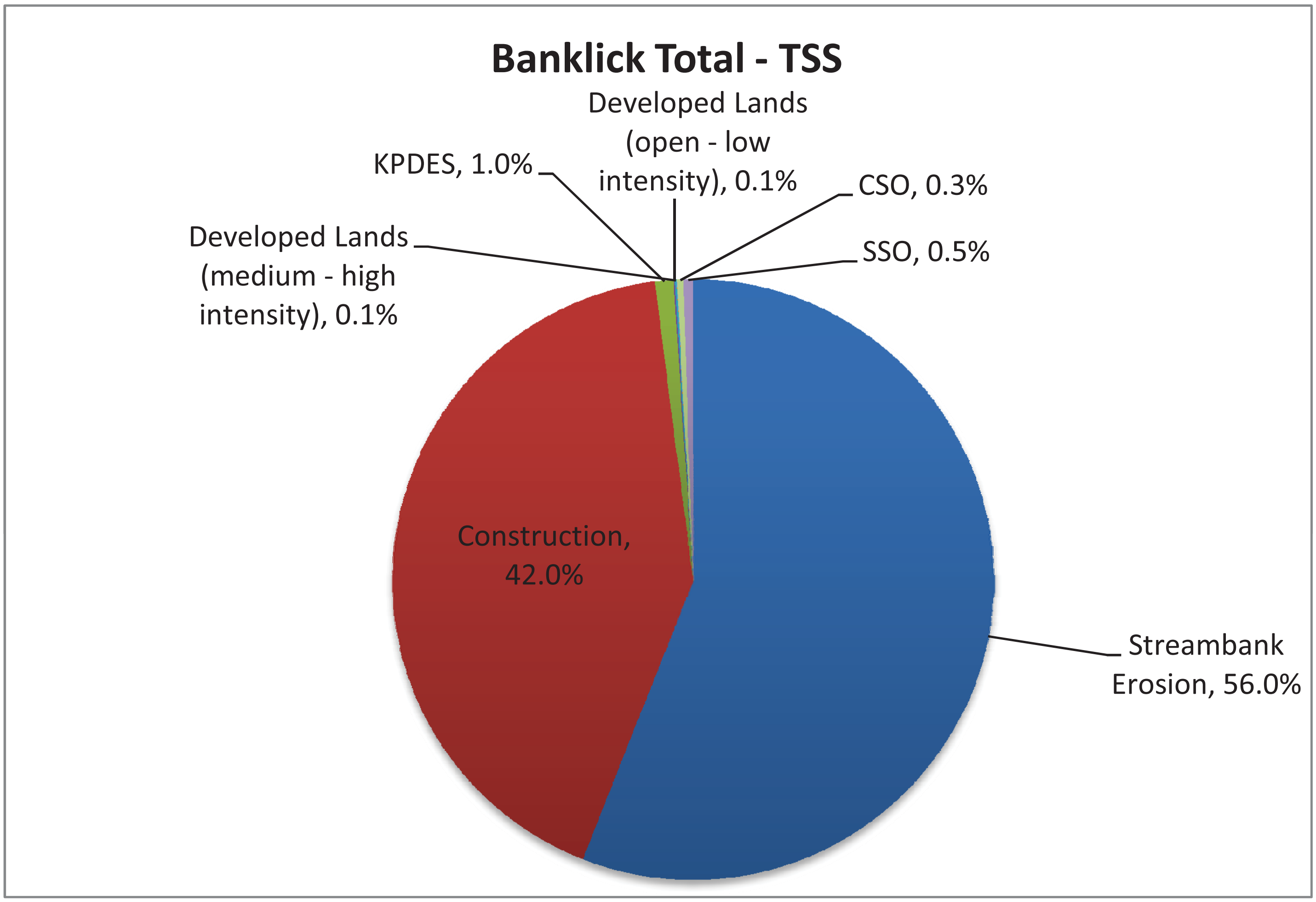

Banklick Subwatershed 09 - Phosphorous
Septic, 0.7%
Other, 1.1%
Construction, 28.2%
Agricultural , 4.1%
SSO, 14.0%
Forest, 3.8%
Developed Lands (medium - high intensity), 7.4%
Developed Lands (open - low intensity), 40.7%

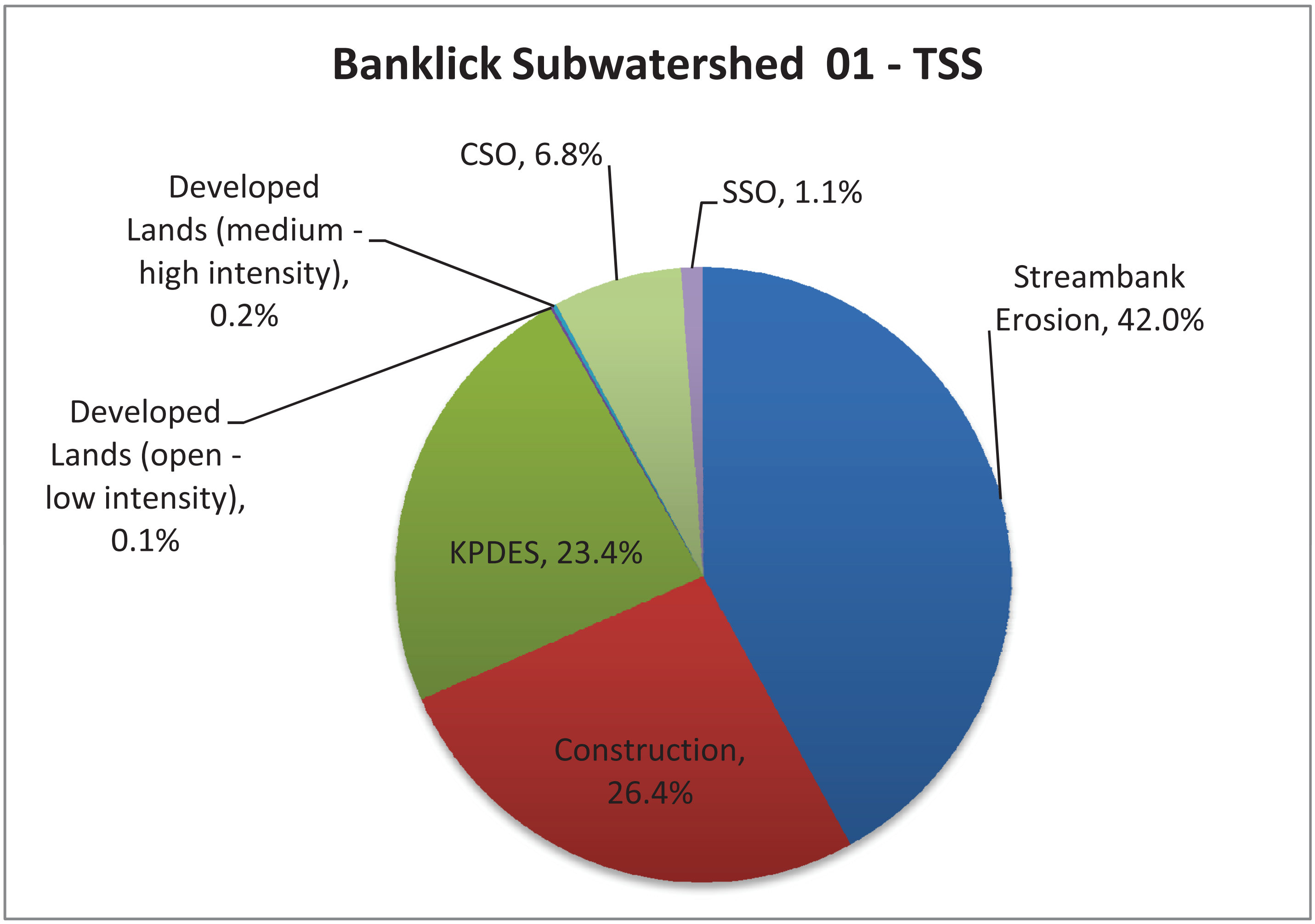

Banklick Subwatershed 10 (Brushy Fork) - Phosphorous
Other, 0.8%
Septic, 1.2%
Agricultural , 13.5%
Forest, 2.1%
Construction, 48.7%
Developed Lands (medium - high intensity), 12.3%
Developed Lands (open - low intensity), 21.4%

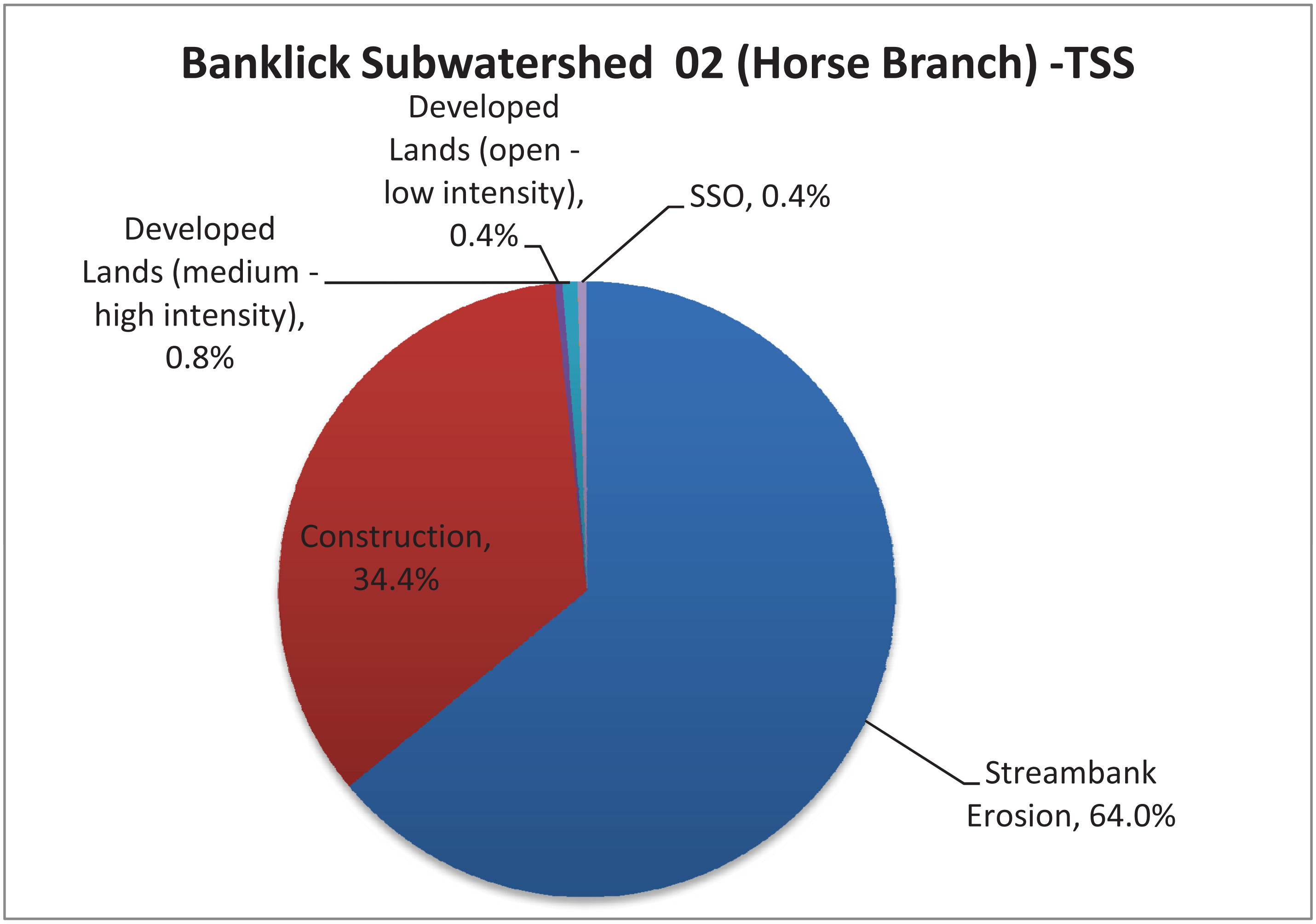

Banklick Subwatershed 11 - Phosphorous
Septic, 0.3%
Other, 0.4%
Construction, 23.3%
Agricultural , 9.3%
SSO, 8.6%
Forest, 0.8%
Developed Lands (medium - high intensity), 8.9%
Developed Lands (open - low intensity), 13.3%
KPDES, 35.1%

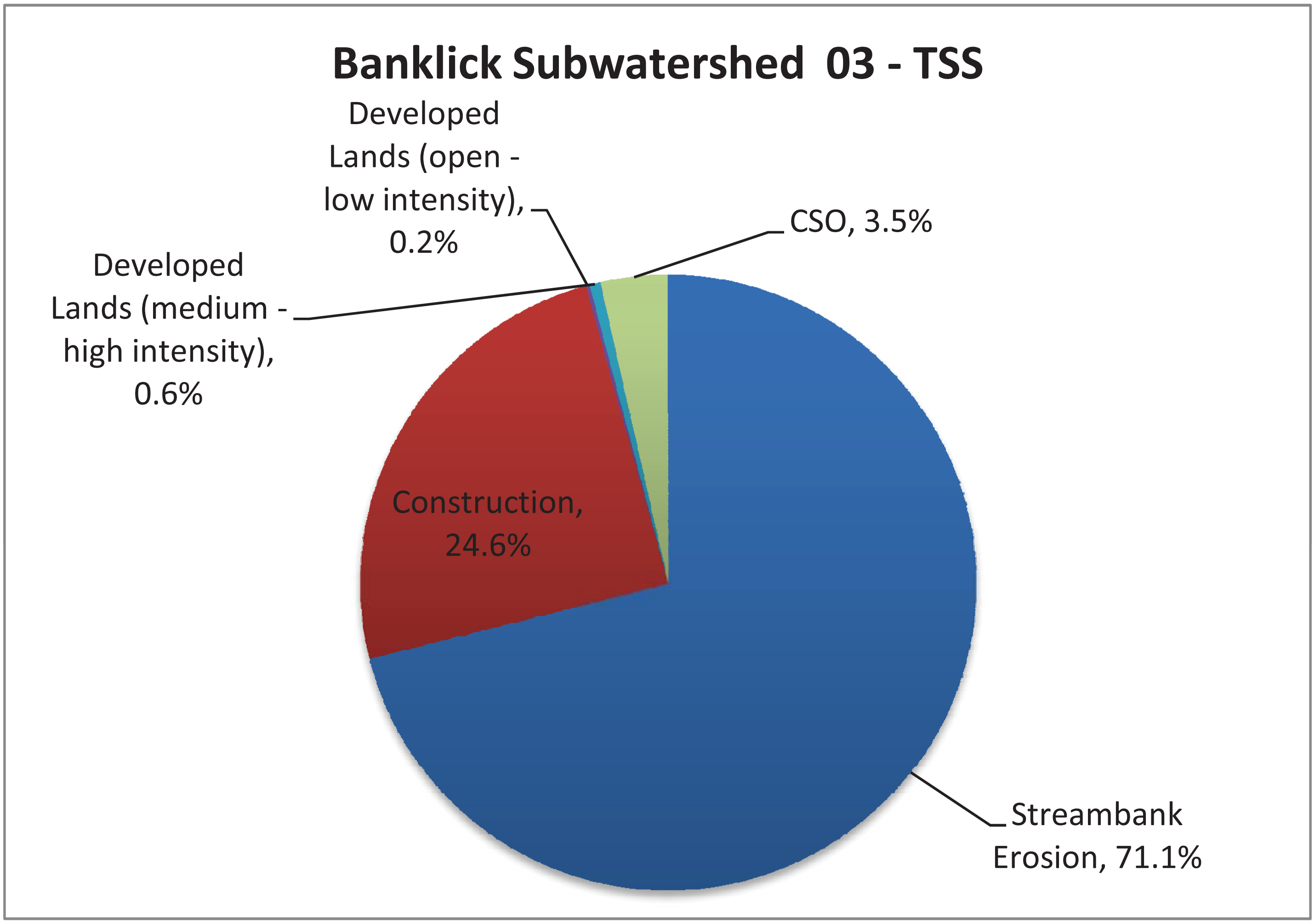

Banklick Subwatershed 12 (Wolf Pen Branch) - Phosphorous
Other, 0.6%
SSO, 2.1%
Septic, 0.8%
Agricultural , 18.8%
Construction, 44.3%
Forest, 1.0%
Developed Lands (medium - high intensity), 17.4%
Developed Lands (open - low intensity), 15.0%

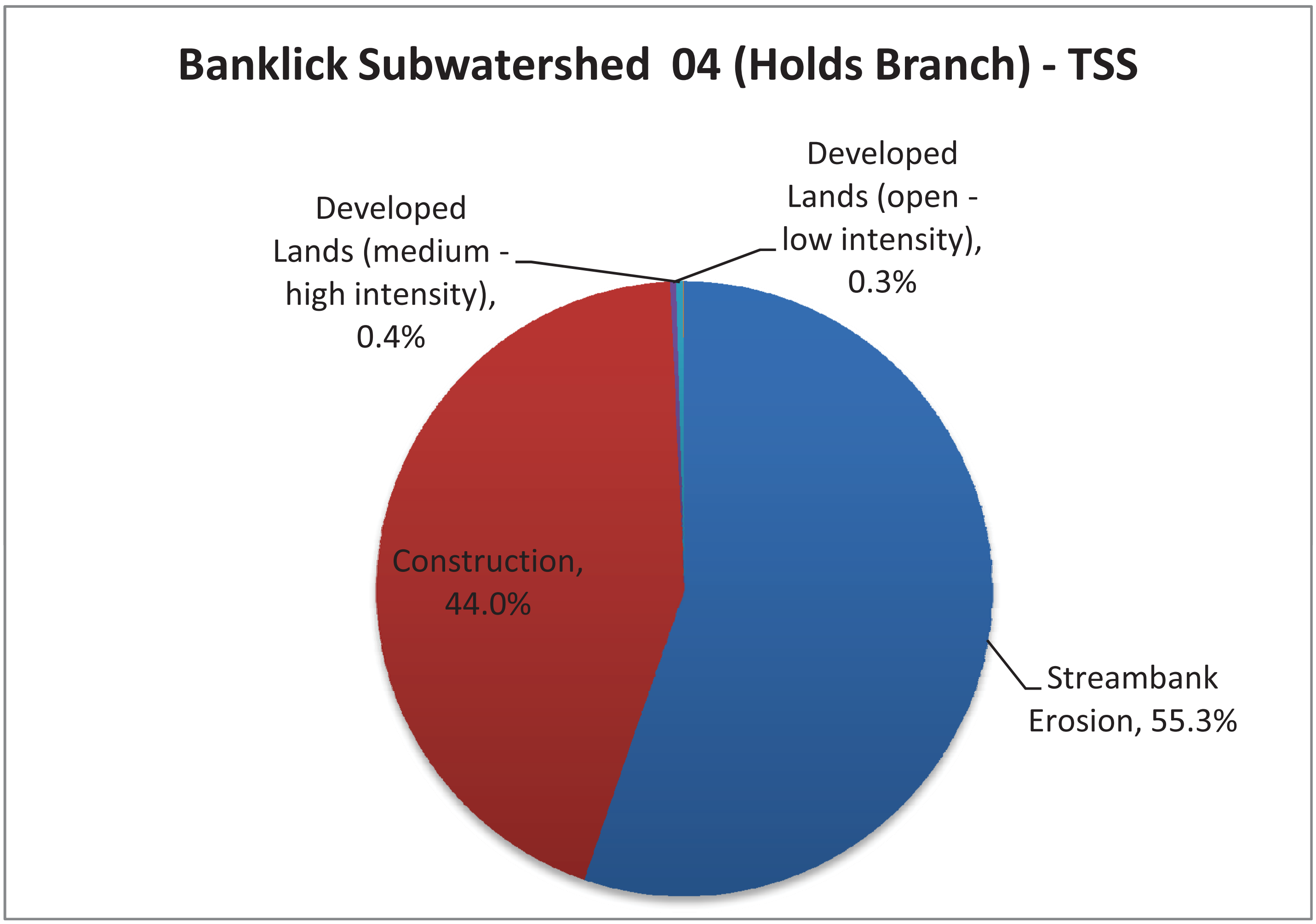

Banklick Subwatershed 13 - Phosphorous
Other, 0.7%
Septic, 0.8%
Agricultural , 30.7%
Construction, 54.3%
Forest, 1.3%
Developed Lands (medium - high intensity), 3.0%
Developed Lands (open - low intensity), 9.4%

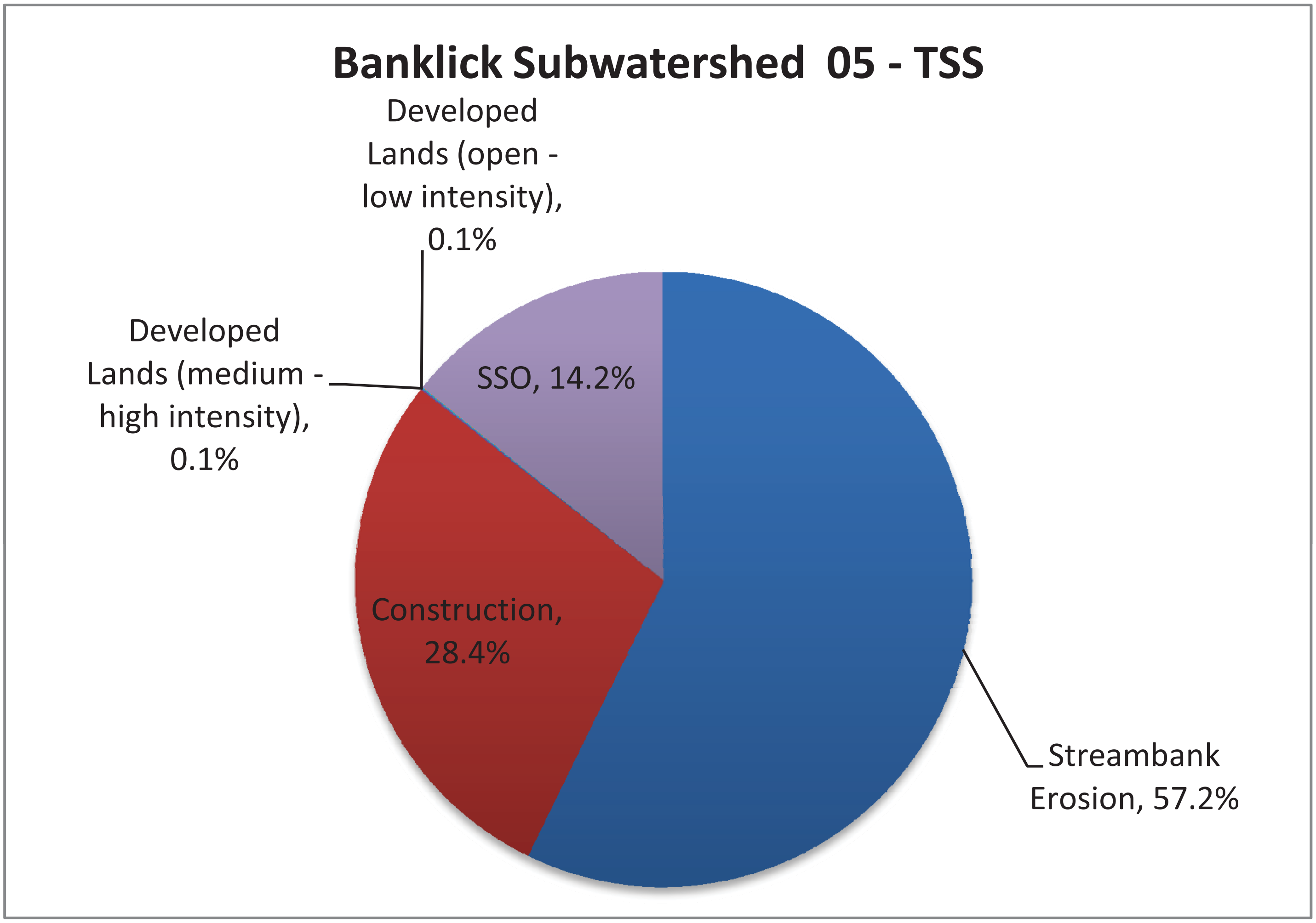

Banklick Total - TSS
Developed Lands (open - low intensity), 0.1%
KPDES, 1.0%
CSO, 0.3%
Developed Lands (medium - high intensity), 0.1%
SSO, 0.5%
Construction, 42.0%
Streambank Erosion, 56.0%

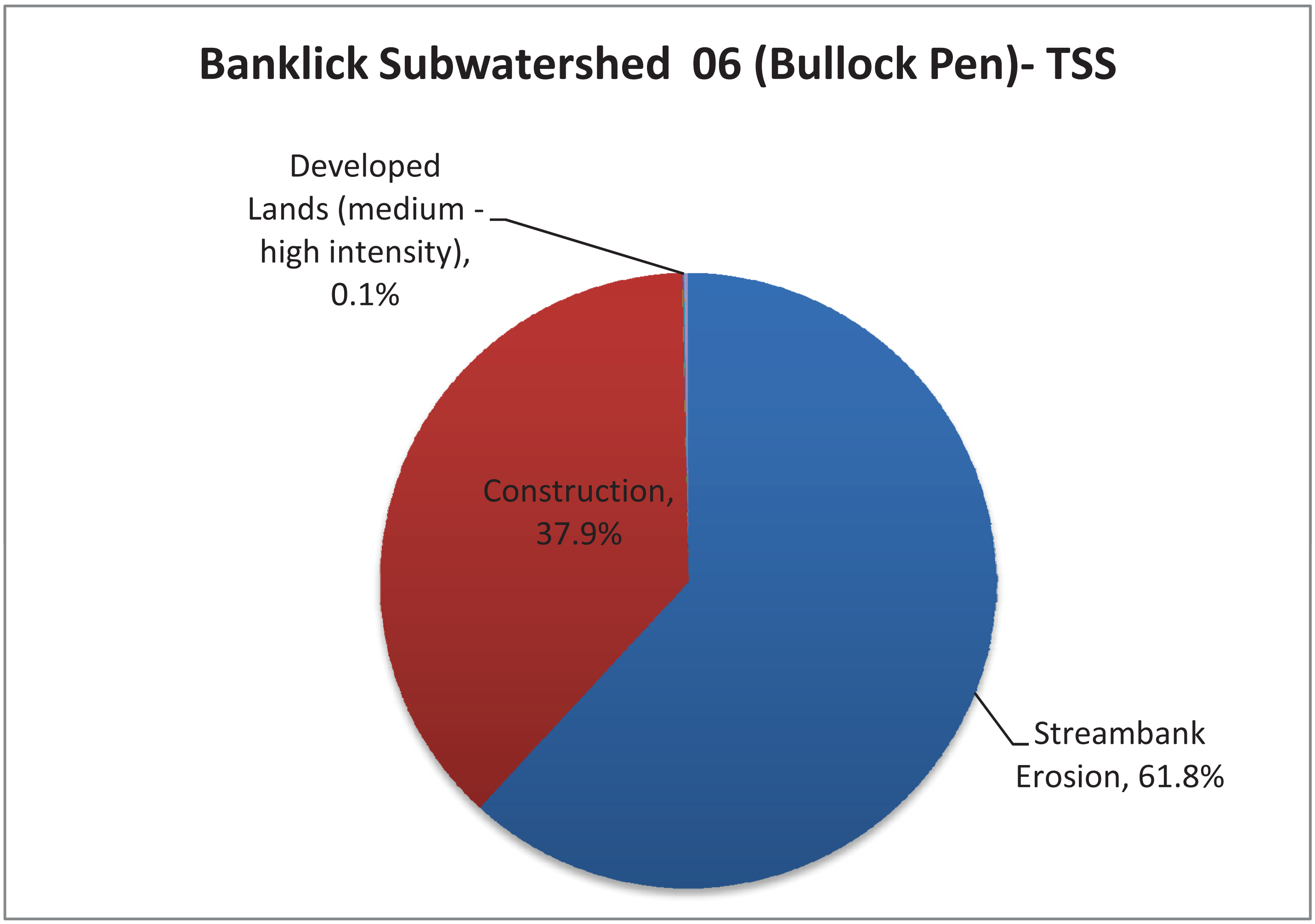

Banklick Subwatershed 01 - TSS
CSO, 6.8%
SSO, 1.1%
Developed Lands (medium - high intensity), 0.2%
Streambank Erosion, 42.0%
Developed Lands (open - low intensity), 0.1%
KPDES, 23.4%
Construction, 26.4%

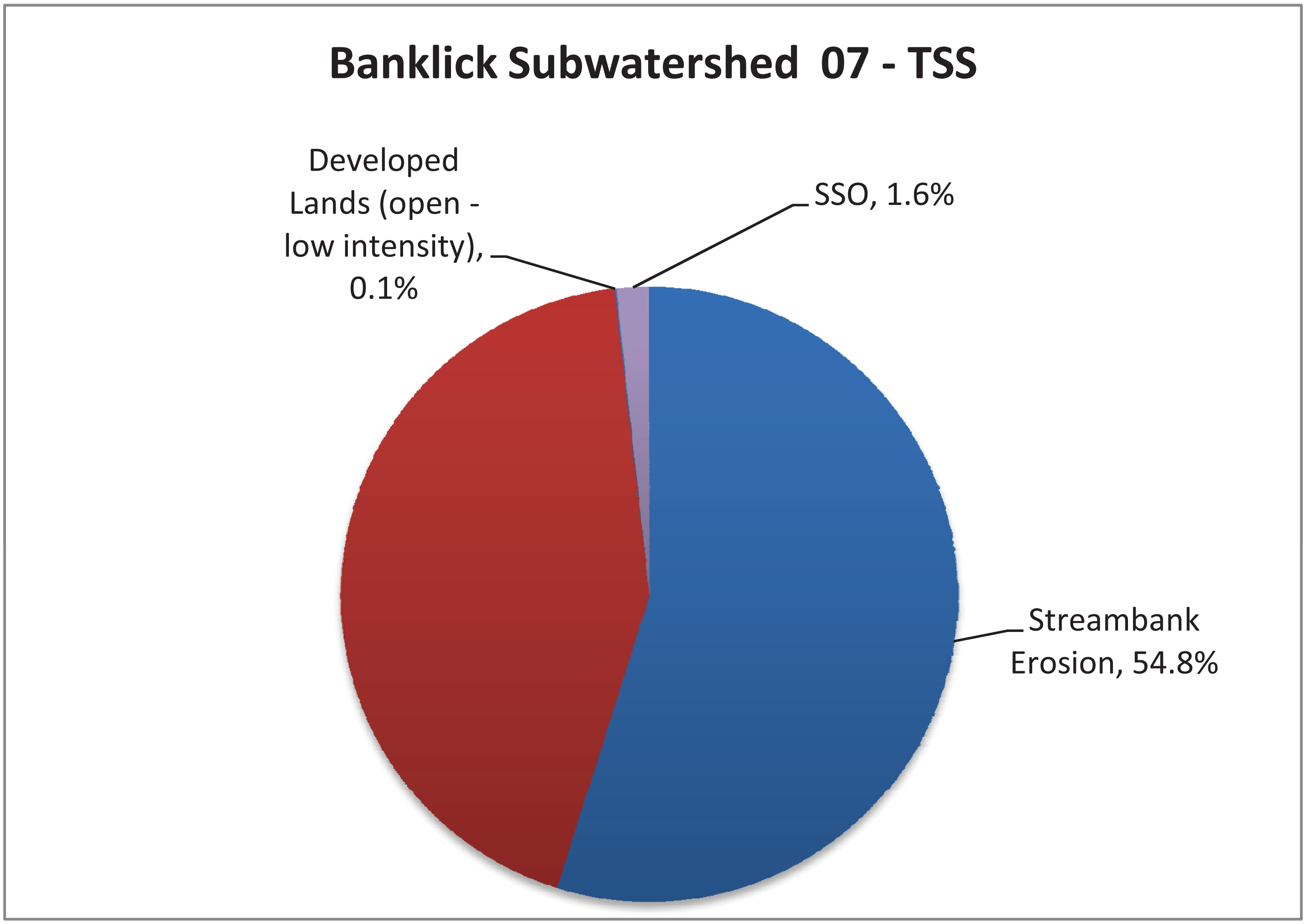

Banklick Subwatershed 02 (Horse Branch) -TSS
Developed Lands (open - low intensity), 0.4%
SSO, 0.4%
Developed Lands (medium - high intensity), 0.8%
Construction, 34.4%
Streambank Erosion, 64.0%

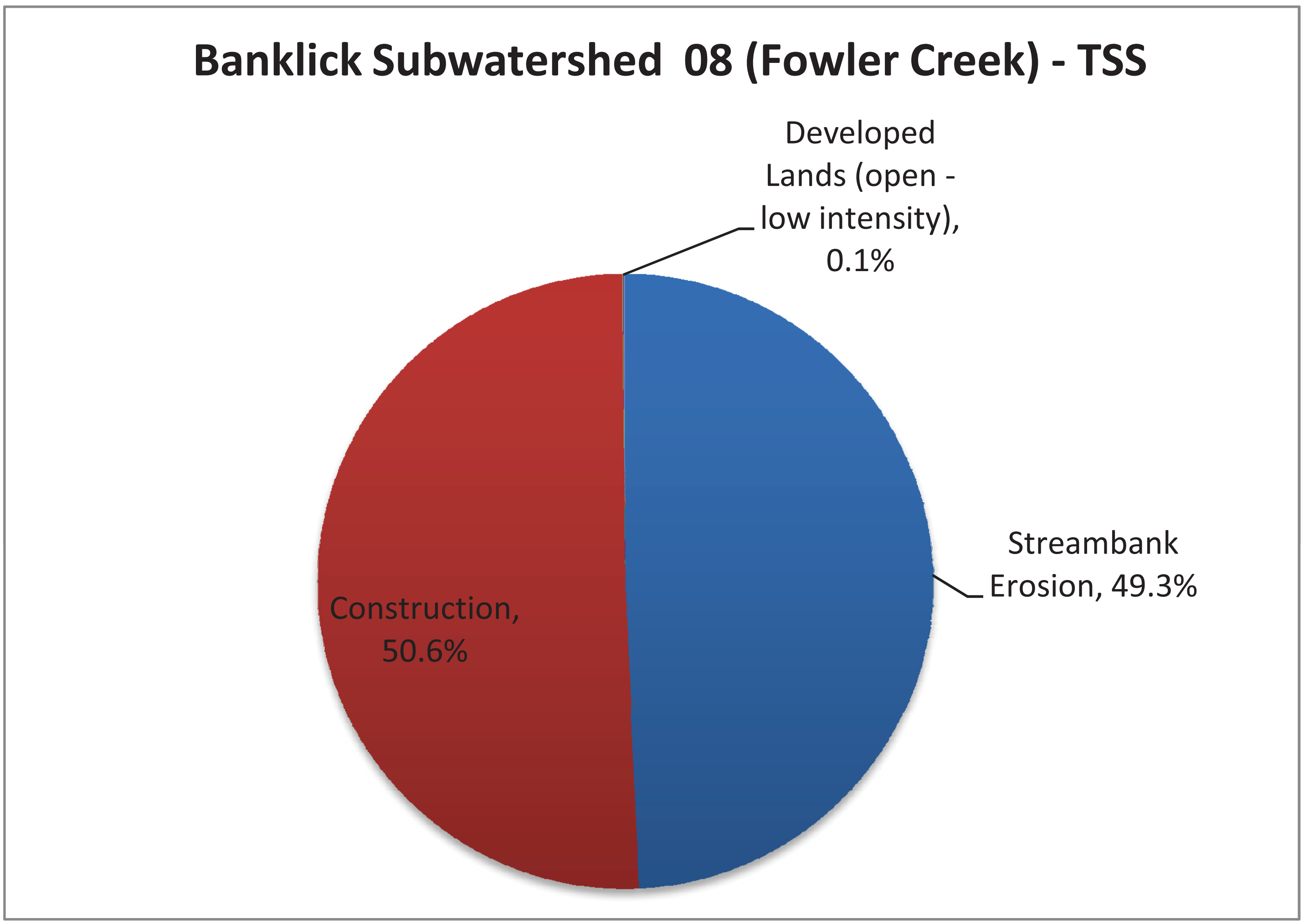

Banklick Subwatershed 03 - TSS
Developed Lands (open - low intensity), 0.2%
CSO, 3.5%
Developed Lands (medium - high intensity), 0.6%
Construction, 24.6%
Streambank Erosion, 71.1%

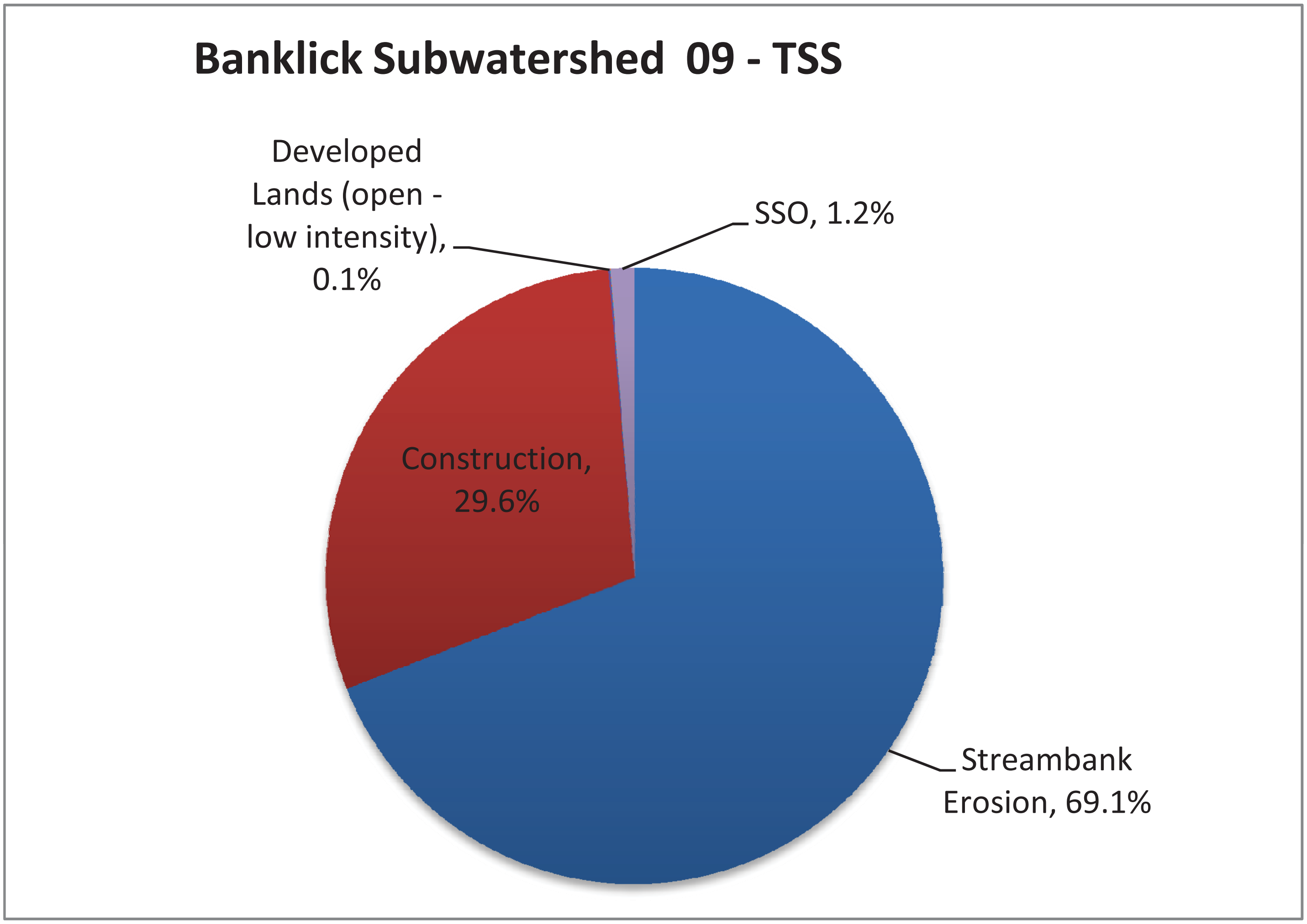

Banklick Subwatershed 04 (Holds Branch) - TSS
Developed Lands (medium - high intensity), 0.4%
Developed Lands (open - low intensity), 0.3%
Construction, 44.0%
Streambank Erosion, 55.3%


Banklick Subwatershed 05 - TSS
Developed Lands (open - low intensity), 0.1%
Developed Lands (medium - high intensity), 0.1%
SSO, 14.2%
Construction, 28.4%
Streambank Erosion, 57.2%

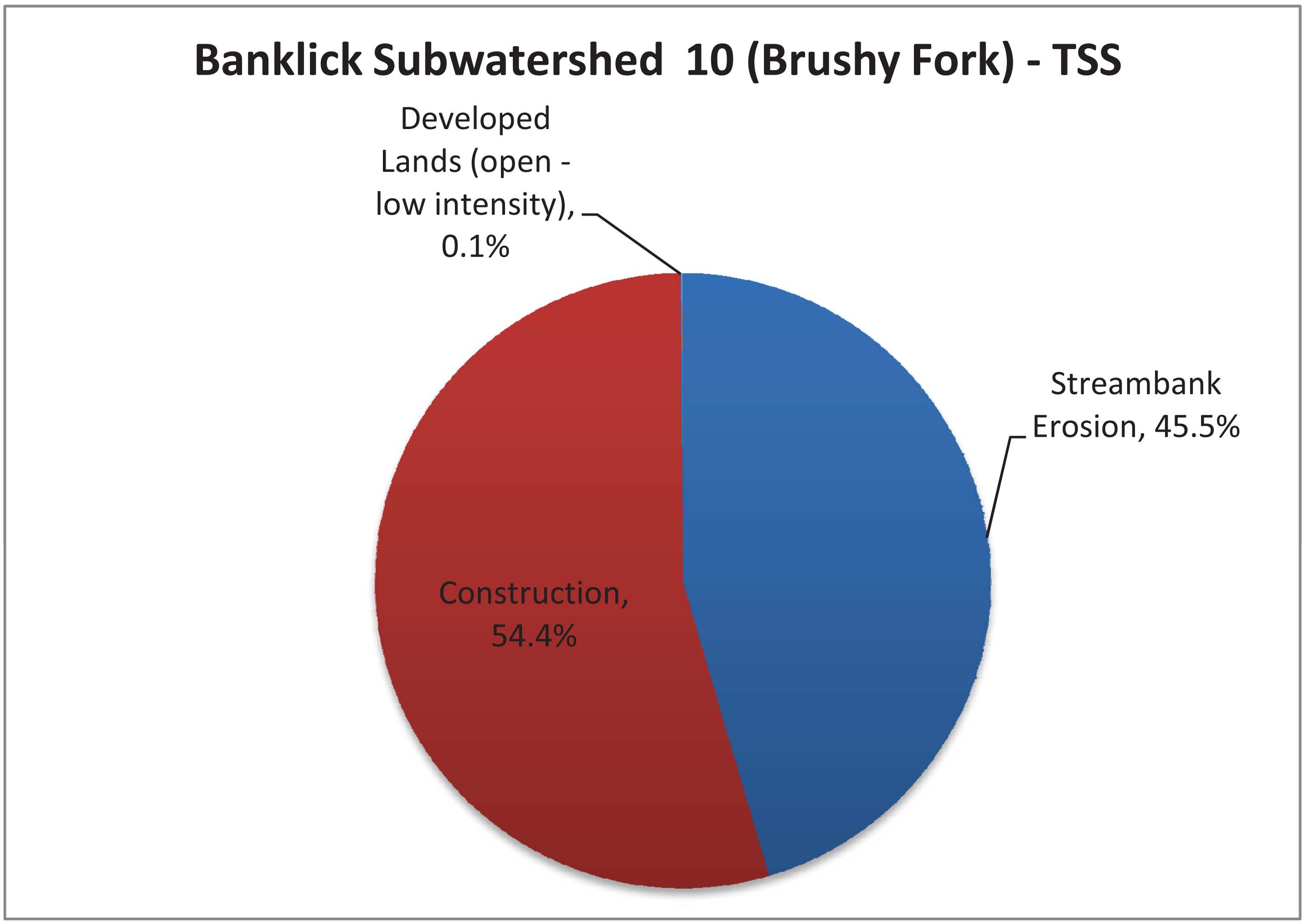

Banklick Subwatershed 06 (Bullock Pen)- TSS
Developed Lands (medium - high intensity), 0.1%
Construction, 37.9%
Streambank Erosion, 61.8%

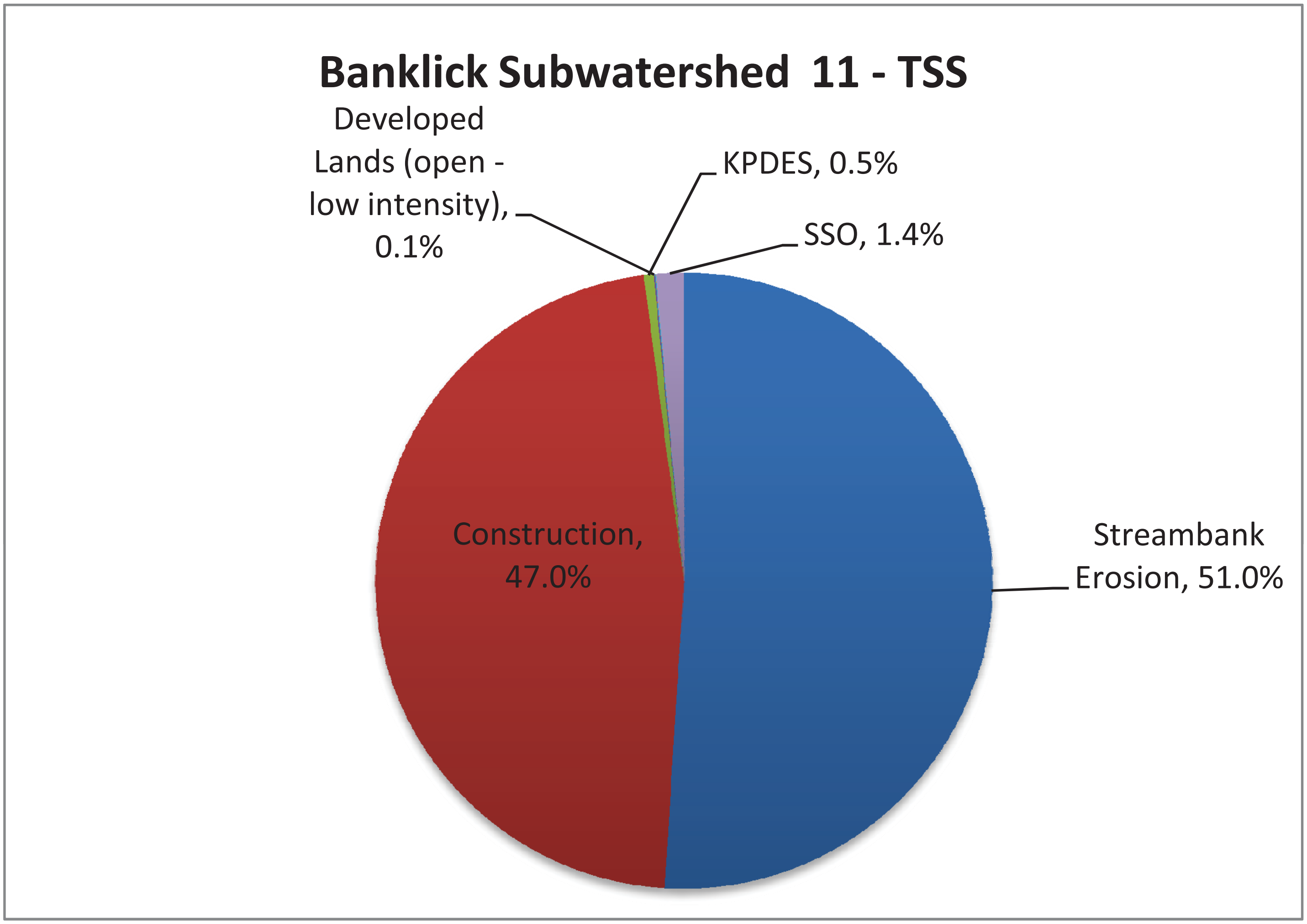

Banklick Subwatershed 07 - TSS
Developed Lands (open - low intensity), 0.1%
SSO, 1.6%
Streambank Erosion, 54.8%

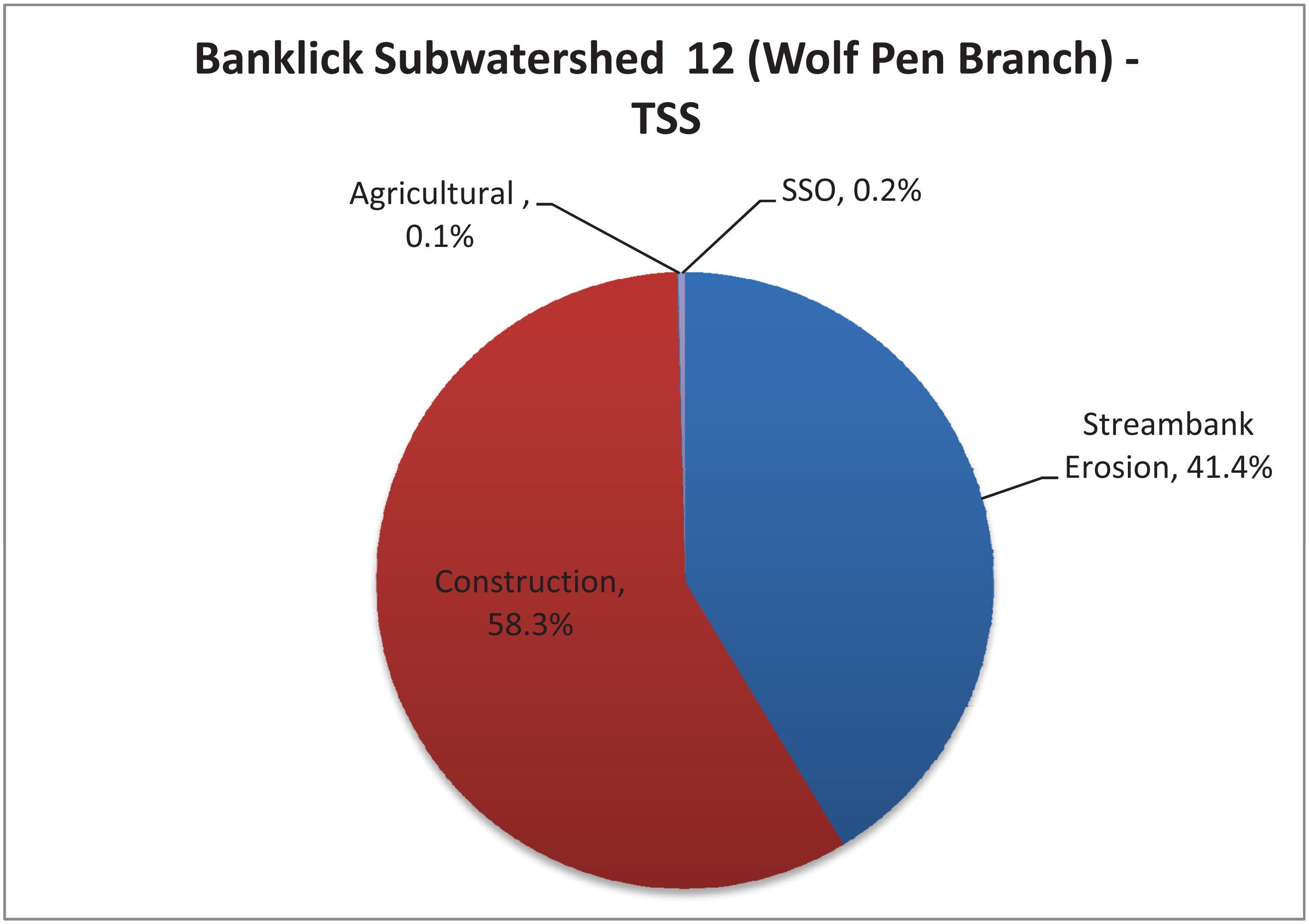

Banklick Subwatershed 08 (Fowler Creek) - TSS
Developed Lands (open - low intensity), 0.1%
Streambank Erosion, 49.3%
Construction, 50.6%

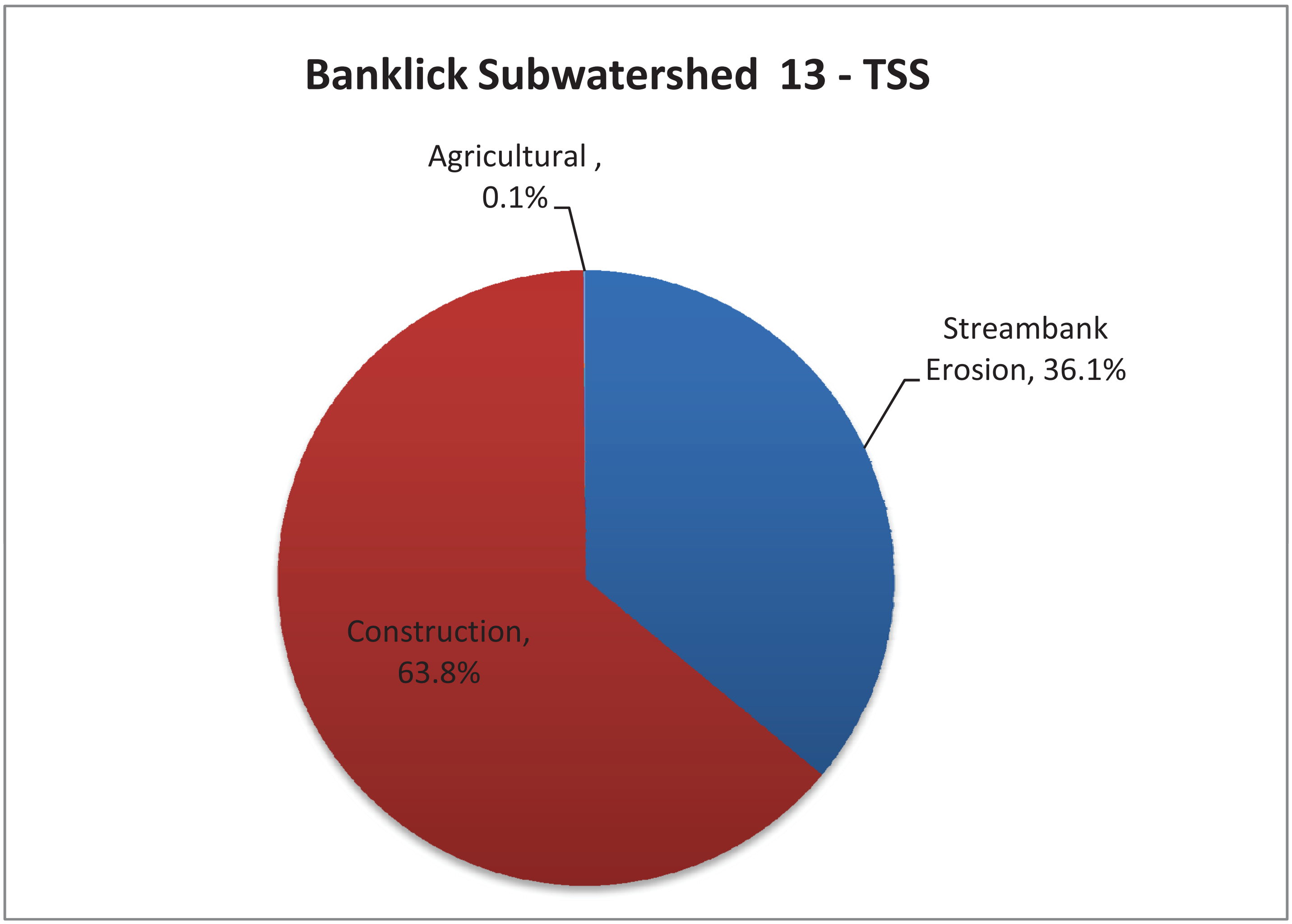


Banklick Subwatershed 09 - TSS
Developed Lands (open - low intensity), 0.1%
SSO, 1.2%
Construction, 29.6%
Streambank Erosion, 69.1%


Banklick Subwatershed 10 (Brushy Fork) - TSS
Developed Lands (open - low intensity), 0.1%
Streambank Erosion, 45.5%
Construction, 54.4%


Banklick Subwatershed 11 - TSS
Developed Lands (open - low intensity), 0.1%
KPDES, 0.5%
SSO, 1.4%
Construction, 47.0%
Streambank Erosion, 51.0%


Banklick Subwatershed 12 (Wolf Pen Branch) - TSS
Agricultural , 0.1%
SSO, 0.2%
Streambank Erosion, 41.4%
Construction, 58.3%


Banklick Subwatershed 13 - TSS
Agricultural , 0.1%
Streambank Erosion, 36.1%
Construction, 63.8%

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MEMORANDUM

DATE: November 24, 2008

FROM: Tim Towey

TO: Jim Gibson (SD1), Mindy Scott (SD1)

CC: Carrie Turner (LimnoTech)

SUBJECT: Banklick Creek HSPF Model Hydrology and Water Quality Calibration Update

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Overview

The Sanitation District No. 1 (SD1) is investing in the development of detailed water quality models in several watersheds. These models are an important contribution for watershed and water quality characterization, which is a required element of a combined sewer overflow (CSO) long-term control plan. The models are also necessary to establish appropriate goals for CSO and sanitary sewer overflow (SSO) control using the watershed approach. This is done by applying the models to look at the relative effectiveness of these controls when compared to controls of other pollutant sources, such as dry weather sources and runoff from agricultural and urban areas.

A model of the Banklick Creek watershed using the Hydrologic Simulation Program in Fortran was originally developed in 2004 as part of a federal grant to develop and apply a Watershed Assessment Protocol (WAP) in order to understand water quality problems on a watershed basis (LimnoTech, 2004). The calibration of that model was updated to incorporate a more detailed land cover analysis; to evaluate dry-weather fecal coliform loads using a larger set of monitoring results; and to calibrate wet-weather loads incorporating recent literature values of storm water fecal coliform densities, output from an updated collection system model, SD1 outfall monitoring data, and a new set of wet-weather monitoring data collected in May 2008. This memorandum describes the updates to the Banklick model and presents a comparison of modeled versus measured values for flow, dry-weather fecal coliform density, and wet-weather fecal coliform density.

Calibration Approach

The following is a summary of the approach to calibrating the Banklick HSPF model:

- Step 1: Watershed characteristics and stream configuration
    - Land use updated using analysis completed in 2007, stream configuration maintained from original WAP configuration.
- Step 2: Hydrology
    - Hydrologic characteristics largely maintained from WAP configuration. Slight changes made due to land use update and a calibration with more emphasis on reproducing measured hourly, in addition to daily and monthly, flows.
    - Observed and predicted values were compared at both USGS/SD1 gage and using level sensor data from River Mile (RM 1.2).

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- Step 3: Dry weather fecal coliform loading
    - Constrained with existing info on dry weather sources, being cognizant of lack of specific information on these sources.
    - Evaluated long term (2002-2007) dry weather densities and compliance with water quality standards (WQS) at eight sites (six in Banklick, two in major tributaries (Bullock Pen and Fowler)).
    - Update resulted in lower dry weather loads than used in recent Banklick Pilot analysis.
- Step 4: Wet weather fecal coliform loading
    - Reproduced wet weather instream densities for multiple events spanning a range of conditions (three 2003 wet weather events, 2008 May wet weather event)
        - Used CSO and SSO volumes from calibrated IC model and applied densities based on SD1 monitoring data (note: model-predicted overflow locations (e.g. model-calculated overflows at manholes that have not been field verified) will be treated as SSOs).
        - Used SD1 monitoring data to constrain fecal coliform densities
        - Used storm water literature to constrain runoff site mean densities for land covers in watershed.
    - Conducted analysis to understand model sensitivity to CSO and SSO densities and presence of unverified SD1 infrastructure overflows.
- Step 5: *E. coli* simulation
    - Tested the models ability to reproduce instream E. coli densities, by using SD1 monitoring data for CSO and SSO E. coli densities

Watershed Characteristics and Stream Configuration

The land cover from the original Banklick model was refined using a number of newly available datasets:

- Aerial photography from 2006 from the National Resource Conservation Service;
- Open space land delineation obtained in 2007 from the Ohio-Kentucky-Indiana Council of Governments;
- Building footprints provided by SD1 in 2007;
- Pavement provided by SD1 in 2007; and
- Surface waters provided by SD1 in September 2006.

Although these datasets are more recent than the primary Banklick hydrology and wet-weather calibration period (2002-2003), LimnoTech felt that the improved quality and completeness of the land cover created with this data made it preferable to the previously used land cover information. A more complete description of the development of the land cover dataset will be part of the WAT! report materials.

The channel geometry was maintained from the model version used in the WAP Application report. The geometry was based on a US Army Corps of Engineers HEC-2 model of Banklick Creek and refined using field information gathered by XCG in 2003 (LimnoTech, 2004).

Hydrology Calibration

The hydrologic calibration of the model was re-evaluated using the new land cover classifications. Also, this calibration effort placed more emphasis on reproducing the distribution of hourly flow results than the original calibration presented in the WAP application report. In addition to the hourly results, the calibration was evaluated in terms of daily and monthly flow because there is guidance available for model performance in terms of these parameters (Donigian, 2002).

The model parameter that was adjusted as part of the calibration update was the slope (SLSUR in HSPF) of both pervious and the impervious lands. Increasing the slope improves the ability of the model to reproduce peak hourly flows, reduces the "trickle" of fecal coliform loading after storm events that impacts instream dry-weather densities, and is a better reflection of conditions in the Banklick watershed. A GIS evaluation of slopes in the Banklick Creek watershed showed the average slope in pervious areas is 0.16 and the average impervious slope is 0.08. These values were incorporated into the HSPF model.

Hydrologic model performance was evaluated by comparing flows predicted by the HSPF model to the measured flows at two locations: the jointly operated USGS/SD1 gage located at Highway 1829 (RM 8.0) and at Kentucky Hwy 16 (KY16 - RM 1.2), where a level sensor was installed as part of the SD1 Watershed Assessment (XCG, 2003). The predicted flows were compared to the USGS/SD1 gage for the period from January 1, 2001 to September 30, 2003. At RM 1.2, the predicted flows were compared to level sensor data for August 2003, a month of nearly complete data.

The USGS/SD1 gage is located just downstream of the confluence of Banklick and Fowler Creeks, therefore the modeled Banklick flow from just upstream of the confluence was summed with the modeled flow in Fowler Creek in order to make the comparison to measured flow. Figure 1 and Table 1 show the distribution of modeled and measured hourly flow values at the USGS/SD1 gage for the comparison period. Table 1 also shows the distribution of values when the comparison is limited to the May 1 – October 31 recreation season. These comparisons demonstrate that the model is reproducing the overall distribution of measured values at this location.

Figure 1. Distribution of Measured and Modeled Hourly Flows at USGS/SD1 Gage.

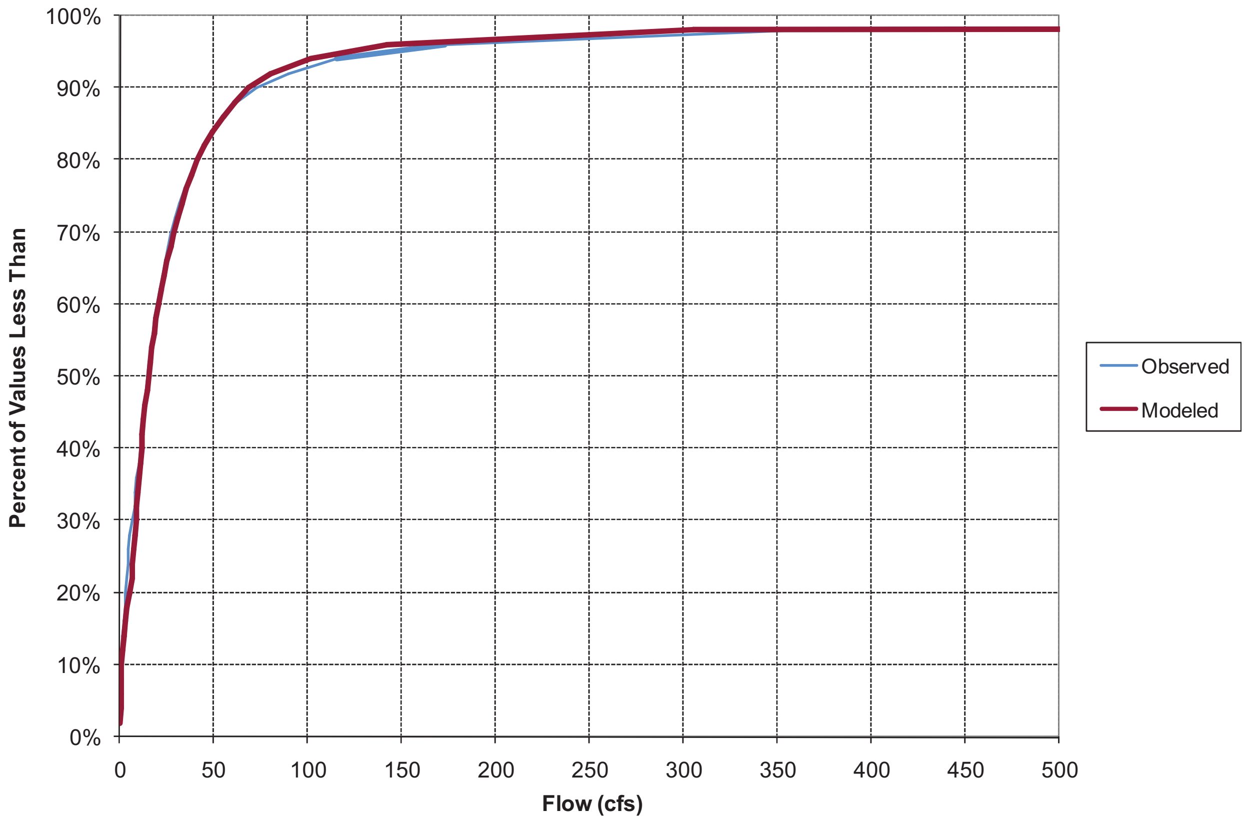


Table 1. Distribution of Measured and Modeled Hourly Flows at USGS/SD1 Gage.

	Full comparison period		Recreation season	
	Measured (cfs)	Modeled (cfs)	Measured (cfs)	Modeled (cfs)
Mean	48.2	47.2	37.3	42.2
Geometric Mean	10.9	12.5	5.1	6.8
5th %ile	0.2	0.4	0.1	0.3
25th %ile	4.4	7.1	1.7	1.7
50th %ile	14.7	15.2	6.2	8.9
75th %ile	32.9	34.3	20.3	24.6
95th %ile	137.6	117.3	106.6	100.9

In addition to hourly flows, the hydrologic calibration was also evaluated using HSPF-specific criteria suggested by Donigian (2002). He suggests using monthly or annual relative percent differences (RPDs) to evaluate how well the model is reproducing the central tendency of the data. He characterizes an RPD of <10% as "Very good." The RPD for the Banklick HSPF flow for the entire January 2002-September 2003 period is 2% and for the recreation season it is 13%.

To characterize the ability of the model to reproduce the timing of observed flow conditions, Donigian provides a range of R and R^2 values for monthly and daily flows. Figure 2 shows the criteria for model performance suggested by Donigian . Table 2 shows the performance of the Banklick HSPF model for both the full model period and using just the recreation season. For both daily and monthly flows, the Banklick model performance is "Good" for the full model period. The model performs slightly better during the recreation season when comparing monthly flow values and slightly worse when comparing daily values.

Figure 2. R and R^2 Values for the Evaluation of Model Performance from Donigian, 2002.

Table 2. R And R^2 Values for Banklick HSPF Model and Evaluation of Performance Using Donigian Criteria.

	R	R^2	Model Performance
Daily – Full model period	0.86	0.74	Good
Monthly – Full model period	0.91	0.82	Good
Daily – Recreation season	0.81	0.66	Fair
Monthly – Recreation season	0.95	0.90	Very Good

A similar evaluation was performed using the level sensor data obtained at River Mile 1.2. SD1 deployed level sensors in lower Banklick Creek at river mile 1.2 (KY16) and river mile 0.3 (KY177) during portions of 2002 and 2003 to characterize backwater influences from the Ohio River and Licking River. The primary purpose of this model-to data comparison was to evaluate the performance of the lower Banklick Creek portion of SD1's EFDC model. The dataset from August 2003 was used because this period was characterized by low flow in the Ohio River so backwater effects were limited to the meter at KY177, a wide range of flows from the upper portion of the Banklick Creek watershed, and a relatively complete dataset because both meters were operational through the first 25 days of the month. This dataset provides the best contrast between the level meters: the meter at KY16 (RM 1.2) reflects upstream flows while the meter at KY177 (RM 0.3) reflects Ohio River stage conditions. Figure 3 and Table 3 show the distribution of modeled and measured flows.

Figure 3. Distribution of Measured and Modeled Hourly Flows At KY16.

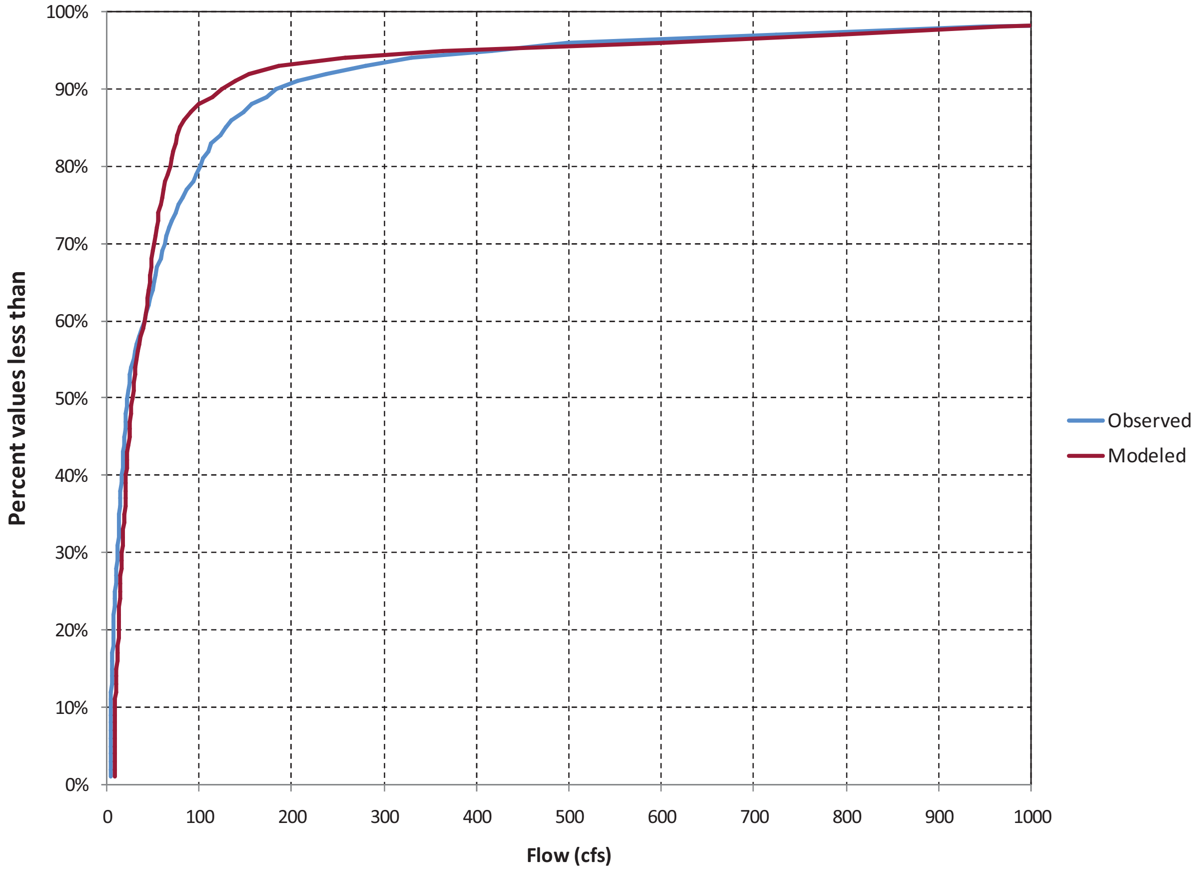


Table 3. R and R^2 Values for Banklick HSPF Model and Evaluation of Performance Using Donigian Criteria at KY16.

	Measured (cfs)	Modeled (cfs)
Mean	99.6	89.9
Geometric Mean	28.4	33.1
5th %ile	8.7	13.8
25th %ile	21.5	27.3
50th %ile	76.6	58.1
75th %ile	416.0	363.2
95th %ile	99.6	89.9

The RPD for the for the August 2003 period at RM 1.2 is -10%, and the daily R and R^2 values are 0.89 and 0.80 respectively, putting the model performance in the “Very Good” category using the Donigian criteria. The model reasonably reproduces measured values at Banklick Creek RM 1.2, downstream of its major tributaries.

Dry Weather Fecal Coliform Load Calibration

The dry-weather fecal coliform loading was determined to have a large impact on meeting water quality standards in the Banklick Pilot project. In that version of the Banklick model, dry weather loads were input as failing septic systems, KPDES permitted dischargers, and cattle in stream. Estimates were made about the location and magnitude of each of the sources, using information about land use, age of homes, and KPDES records. In an evaluation of modeled and measured instream fecal coliform densities using data from 2002-2007, it was determined that the dry-weather loads should be relocated and scaled back.

For the current version of the model, all dry-weather sources were input as a single load for any given subwatershed. A model to data comparison was used to determine the appropriate magnitude and location of the loads. An assessment of the sources contributing to the loads (e.g., septics, KPDES dischargers, cattle, wildlife) will be made outside of the model framework.

The loads were calibrated using recreation season (May 1 – October 31) geometric mean densities, percent of days complying with the single sample max criteria of 400 cfu/100 mL, and peak densities. In order to meet all of the criteria, the loads were input as oscillating loads. The oscillations varied smoothly over a period of approximately 5 days. Because small amounts of rainfall can impact instream fecal coliform densities in the model, the model to data comparison was restricted to days with only base flow (i.e., no storm flow) and having 0.01 inch or less of rainfall on that day or the day prior. Table 3 shows the numbers of measured fecal coliform densities available at eight locations (six along Banklick Creek, two in tributaries) in the 2002-2007 period that meet the dry-weather criteria.

Table 4. Location and Number of Instream Measurements used to Calibrate Dry-Weather Loads.

Stream	River Mile	Number of dry-weather samples
Banklick Creek	15.6	5
Banklick Creek	11.6	4
Banklick Creek	8.1	16
Banklick Creek	3.9	17
Banklick Creek[1]	1.2	14
Banklick Creek	0.5	17
Bullock Pen Creek	0.1	7
Fowler Creek	0.1	5

[1]One dry weather sample from River Mile 1.2 was identified as an outlier (26,000 cfu/100 mL) because of an isolated incident and was not included in the analysis.

Figures 4 through 6 show the measured and modeled recreation season geometric mean densities, single sample maximum compliance rates, and peak densities, respectively. Peak densities are compared using the maximum measured value and the 95th percentile modeled value. The maximum measured value at Banklick Creek RM 1.2 was 26,000 cfu/100 mL, and was considered an outlier; the value is not included in the analysis. Additionally, because only four measurements were available at RM 11.6, less consideration was given to meeting the seasonal geomean and WQS compliance values at that location.

Figure 4. Modeled and Measured Dry-Weather Recreation Season Geometric Mean Fecal Coliform Densities.

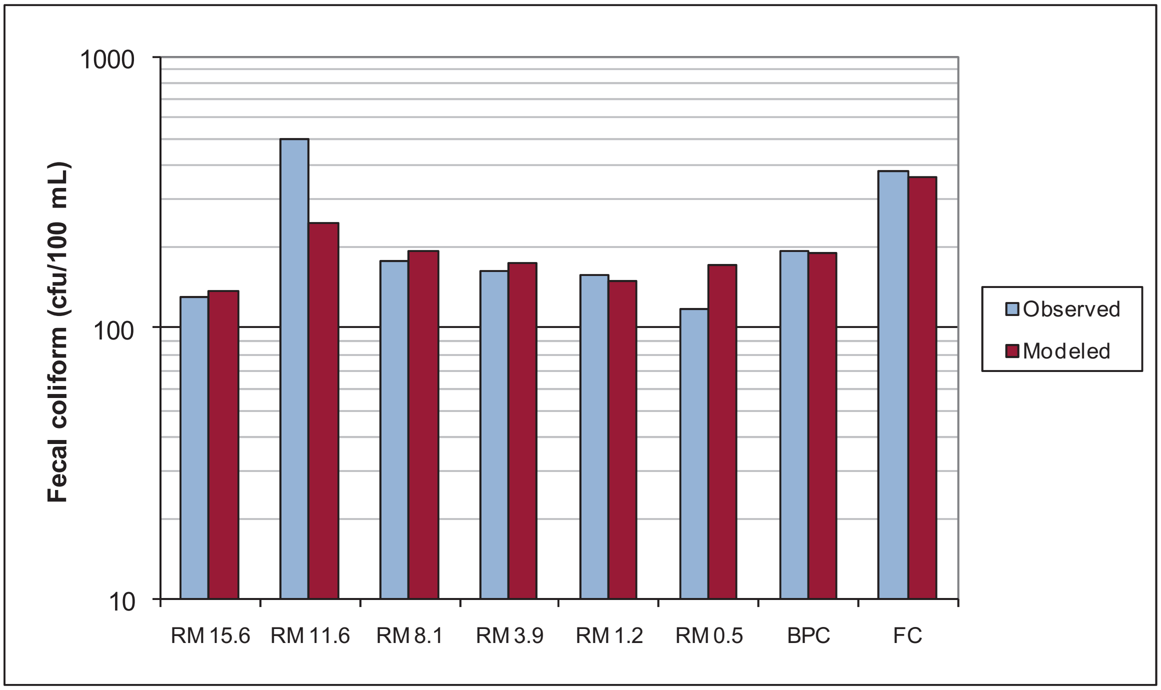


Figure 5. Modeled and Measured Dry-Weather Compliance with Single-Sample Maximum Criterion (400 cfu/100 ml).

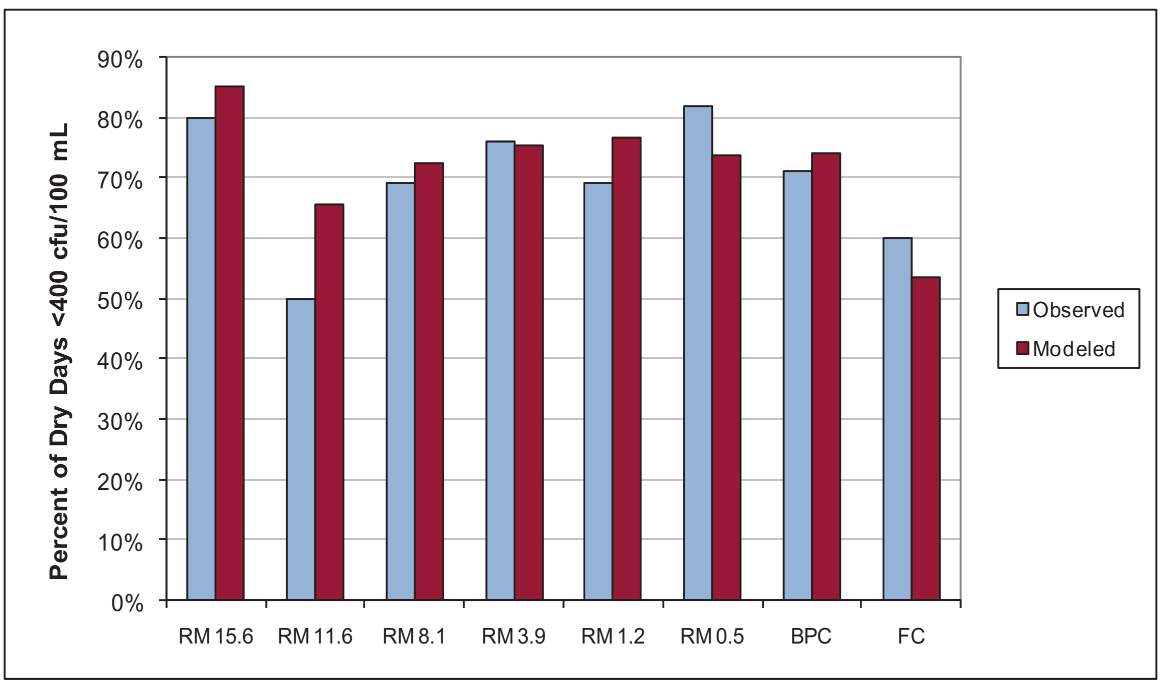
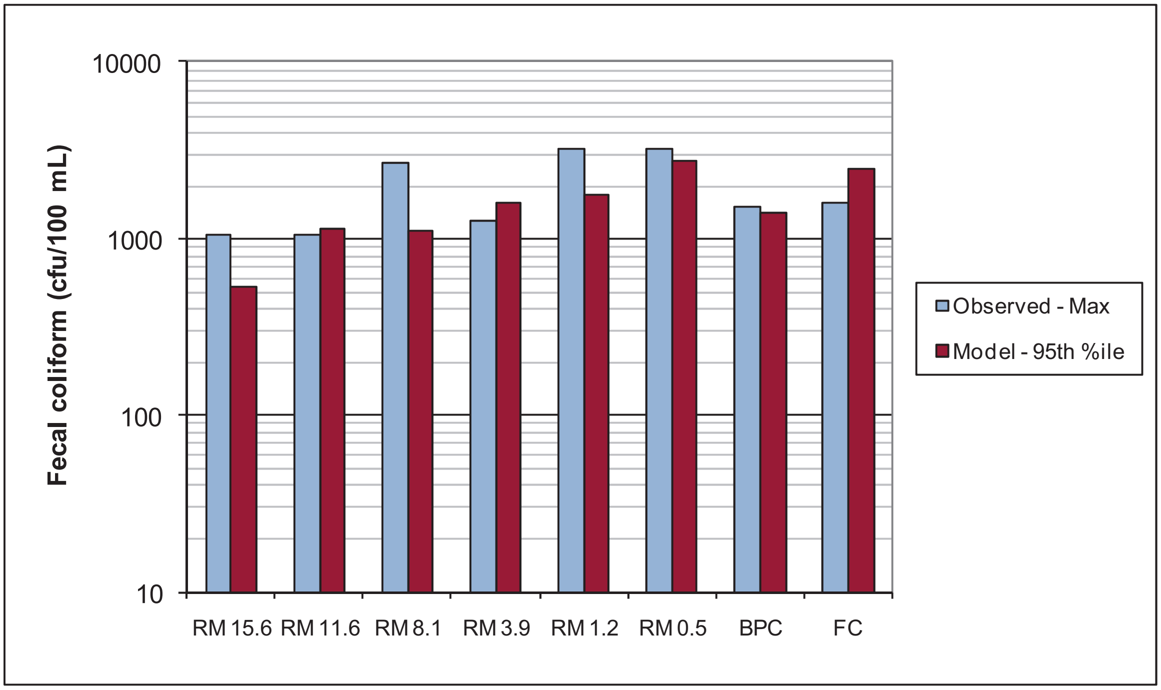


Figure 6. Modeled and Measured Peak Dry-Weather Fecal Coliform Densities.



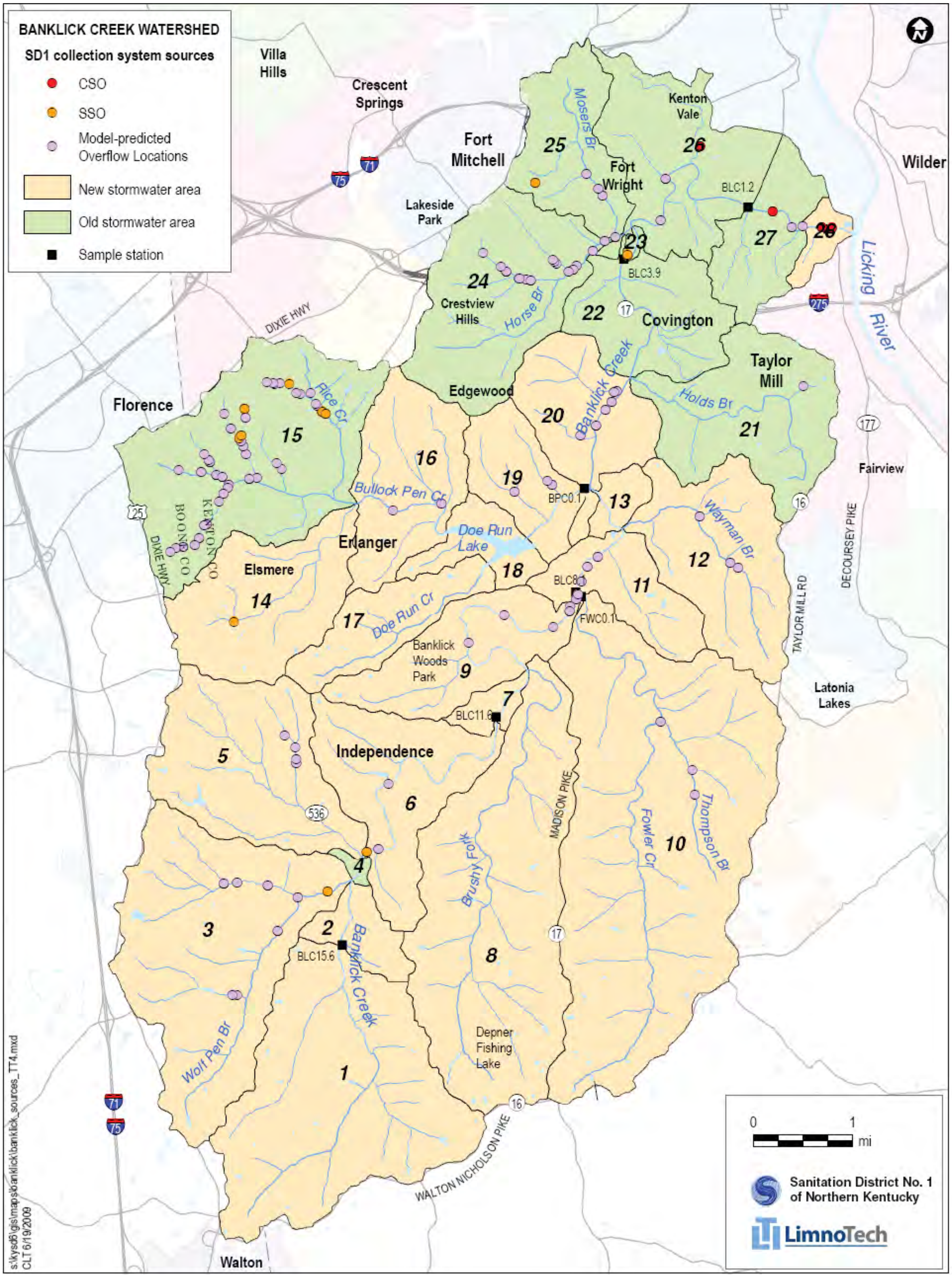
The charts show that the model reasonably reproduces both the central tendency and the elevated densities of instream dry-weather bacteria levels.

Wet Weather Fecal Coliform Calibration

Wet weather sources of fecal coliform bacteria include both runoff sources and sources from the SD1 collection system. In HSPF, the runoff source load is calculated based on a build-up and wash-off routine for each land use/land cover (LULC) type specified in the model. The SD1 infrastructure sources are input to the watershed model based on output from the collection system models. These sources include CSOs, SSOs, and model-predicted overflow locations. The loads from these sources are calculated by assigning a fecal coliform density to modeled overflows. SD1 outfall monitoring data was used to determine the appropriate density for these sources. For the model calibration, the geomean densities of measured fecal coliform density in CSOs (682,000 cfu/100 mL) and SSOs (1,870,000 cfu/100 mL) were used. Because the model-predicted overflow locations occur in the sanitary sewer areas, they were assigned the SSO density. Figure 7 shows the locations of the SD1 infrastructure sources in the Banklick Creek watershed.

Monitoring data was also used to constrain the modeled fecal coliform runoff density from developed areas. Monitoring of SD1 storm water outfalls suggested that fecal coliform densities vary based on the age of the developed area. Monitored storm water outfalls were roughly divided into two categories: those in older developments and those in newer developments. The geomean fecal coliform density from outfalls in older areas was 86,500 cfu/100 mL, while in the newer areas, the geomean density was 14,200 cfu/100 mL. This division in the storm water data was consistent with the instream data for Banklick Creek. An increase in fecal coliform densities was observed in downstream Banklick Creek in the vicinity of the older developed areas that other watershed and infrastructure sources did not fully account for. Therefore, the HSPF RCHRES (subwatersheds) were divided into old and new categories and the build-up wash off parameters for developed areas were adjusted to approximate the monitored densities.

Figure 7. Map of the Banklick Creek Watershed, Including SD1 Infrastructure Sources, Old and New Developed Areas, and Sampling Stations.



Data from the 2000 US Census was used to designate each HSPF RCHRES as "old" or "new." The census provides household construction data for individual block-groups. There are a total of 175 block groups that intersect the Banklick model domain. For each block-group, the number of households built in each decade is available. An area weighted average of households built before 1980 and after 1980 was calculated for each HSPF RCHRES. The RCHRES with a minimum of 25% developed area and at least 50% of dwellings built before 1980 were classified as old. The remaining RCHRES were classified as new. The 25% developed area and 50% pre-1980 figures correspond closely with the median values for Banklick Creek. Figure 7 shows a map of the HSPF RCHRES and their storm water age classification.

The geomean fecal coliform densities for both the old and new storm water areas are significantly higher than the medians found in the National Stormwater Quality Database (NSQD, 2005) for developed areas. In order to achieve flow-weighted averages that reasonably matched the SD1 monitoring data, the build-up parameters for each developed LULC were scaled up from parameters that produce the median densities found in the NSQD. The parameters were scaled by approximately a factor of five to match the new development storm water densities and a factor of about 30 to meet the old development storm water densities. Having constrained the infrastructure loads and the storm water loads, the build-up and wash-off parameters for the remaining LULC categories were then adjusted to reasonably reproduce the instream fecal coliform densities while staying within density ranges seen in the literature for the various LULCs.

Table 5 presents the flow-weighted site mean densities from each HSPF LULC category. It should be noted that the majority of the flow from developed areas comes from impervious lands which have relatively lower fecal coliform densities. This is why the pervious developed land categories have site mean densities substantially higher than the targeted densities described above.

Table 5. Site Mean Fecal Coliform Densities from Calibrated Banklick HSPF Model.

HSPF LULC category	Description	Flow-weighted site mean density (cfu/100 mL)	Literature density (cfu/100 mL)	Source
PER-1	New Storm: HDD - Comm/Indus	21,773	4,300	NSQD, 2005
PER-2	New Storm: HDD - Res	53,725	11,000	NSQD, 2005
PER-3	New Storm: MDD - Comm/Indus	25,213	5,000	NSQD, 2005
PER-4	New Storm: MDD - Res	42,489	8,300	NSQD, 2005
PER-5	New Storm: LDD - Comm/Indus	25,213	5,000	NSQD, 2005
PER-6	New Storm: LDD - Res	42,489	8,300	NSQD, 2005
PER-7	Developed Open Space	2,747	2,600	NSQD, 2005
PER-8	Cropland	65,040	67,000	CWP, 1999
PER-9	Forest	769	100-1,000	CWP, 1999
PER-10	Pasture/Grassland	91,628	120-1.3e6	CWP, 1999
PER-11	Barren	1,116		
PER-12	Failing septic	1.1E+06	10,000-1e8	CWP, 1999
PER-13	Old storm: HDD - Comm/Indus	133,928	4,300	NSQD, 2005
PER-14	Old storm: HDD - Res	341,805	11,000	NSQD, 2005
PER-15	Old storm: MDD - Comm/Indus	153,229	5,000	NSQD, 2005
PER-16	Old storm: MDD - Res	257,329	8,300	NSQD, 2005
PER-17	Old storm: LDD - Comm/Indus	153,229	5,000	NSQD, 2005
PER-18	Old storm: LDD - Res	257,329	8,300	NSQD, 2005
IMP-1	New storm: Impervious	5,199	1,100 (730 - 4,300)	NSQD, 2005
IMP-2	Old storm: Impervious	34,495	1,100 (730 - 4,300)	NSQD, 2005

PER – pervious land category; IMP – impervious land category; HDD- high density development; MDD – medium density development; LDD- low density development; Comm/Ind – Commercial/Industrial; Res – residential

The model was calibrated by comparing predicted and measured instream fecal coliform densities at six locations on Banklick Creek during four separate storm events – three events in the summer of 2003 and one event in May 2008. A seventh location, BLC 0.5, was also sampled during all of the wet-weather events. However this location can be impacted by backwaters from the Licking and Ohio Rivers, which are not included in the HSPF model. This location was included in the EFDC model domain. Additionally, BLC 1.2 was sampled in the May 2008 event; however, it is not broken out in the model to data comparisons, because it includes relatively few samples. However, figures and statistics that include all Banklick Locations do include this location. Additionally, a WinModel snapshot comparison of model to data at this location for the May 2008 event is available in Attachment A.

During each event, multiple samples were collected at each location. During the 2003 events, sample were approximately collected at event initiation, hour 3, hour 6, hour 9, hour 12, and hour 24. During the May 2008 event, sample collection distributed over a longer period. Samples were collected at approximately event initiation, hour 8, hour 16, hour 24, hour 36, hour 48, and hour 72.

Table 6 presents a statistical summary of the model to data comparison for the calibrated Banklick model for samples collected during wet-weather events at each location.. The table shows the observed and modeled geomeans, the observed and modeled compliance with the single sample maximum criteria of

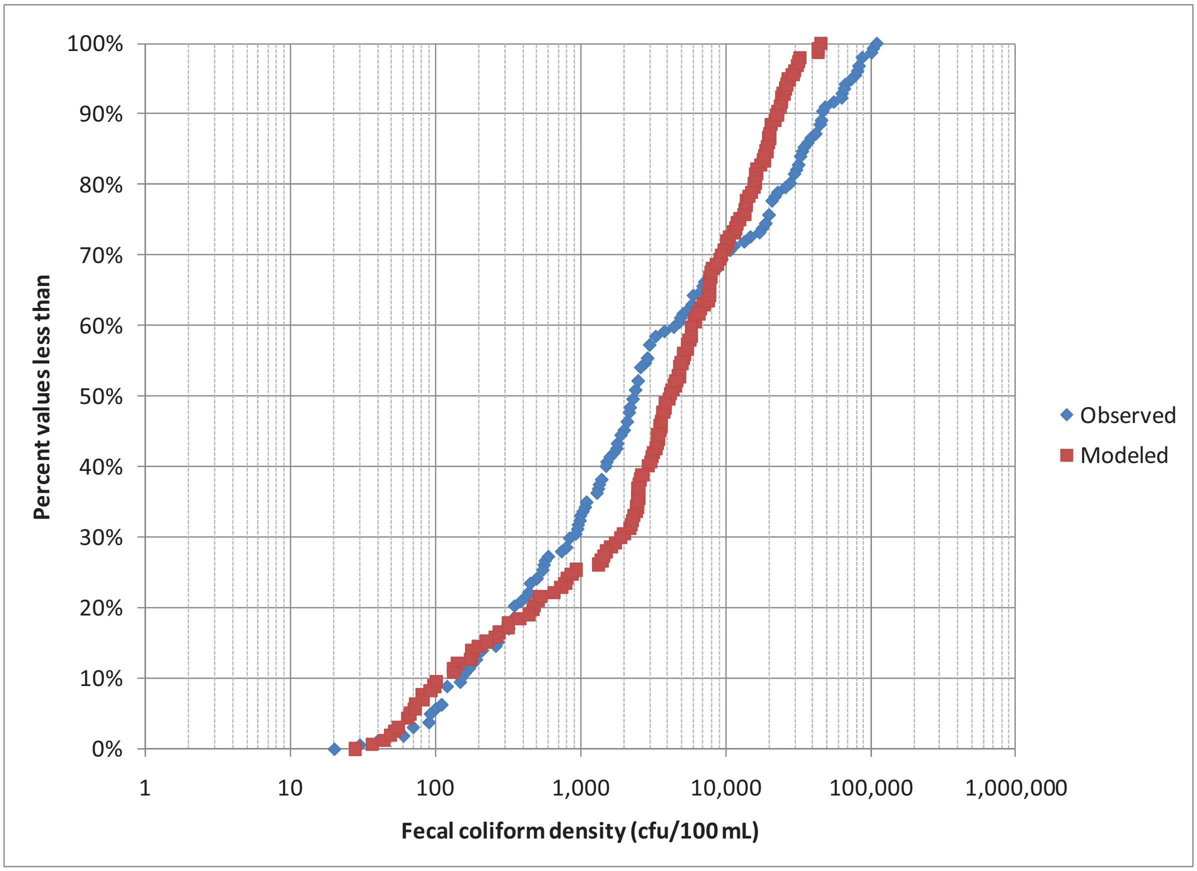
400 cfu/100 mL, and the mean relative and absolute percent differences of the natural-logarithm transformed modeled and observed values. Comparing observed and modeled geomeans allows for an evaluation of how well the model is reproducing the central tendency of the measured values. The observed and modeled geomeans are good matches in the main stem of Banklick Creek, however the model under-predicts densities in Fowler Creek and over-predicts densities in Bullock Pen Creek. Across all locations, the model reasonably reproduces the central tendency of the data. Additionally, the model produces compliance rates with the single-sample maximum similar to observed values. The mean RPD of the natural log transformed values is less than 10% at all locations except Bullock Pen Creek and the mean absolute percent difference is less than 30% at all locations.

Table 6. Summary Statistics Comparing Predicted and Instream Fecal Coliform Measurements for the Calibrated Model.

HSPF RCHRES outlet	Location	n	Observed geomean (cfu/100 mL)	Model geomean (cfu/100 mL)	% Observed compliance with SS Max	% Modeled compliance with SS Max	Mean relative % difference of ln values	Mean absolute % difference of ln values
1	BLC 15.6	25	2689	1945	20%	32%	0.6%	24.4%
6	BLC 11.6	25	2852	3089	24%	16%	5.9%	22.9%
9	BLC 8.1	25	2767	2472	24%	16%	5.0%	21.9%
22	BLC 3.9	25	4499	4501	15%	15%	5.1%	20.4%
10	Fowler Creek	25	3004	2151	19%	19%	0.4%	19.0%
19	Bullock Pen	24	1730	3395	25%	17%	14.4%	29.4%
All Locations		183	3314	3207	20%	18%	4.8%	23.1%

Figure 8 is the cumulative frequency distribution plot of the observed data at all sampling locations and the corresponding model outputs from the hour closest to when the samples were collected. Cumulative frequency distribution plots show the percent of values within the dataset that are less than each observed or simulated density. They are useful for comparing the range of observed and simulated densities and the relative frequencies at which the densities occur.

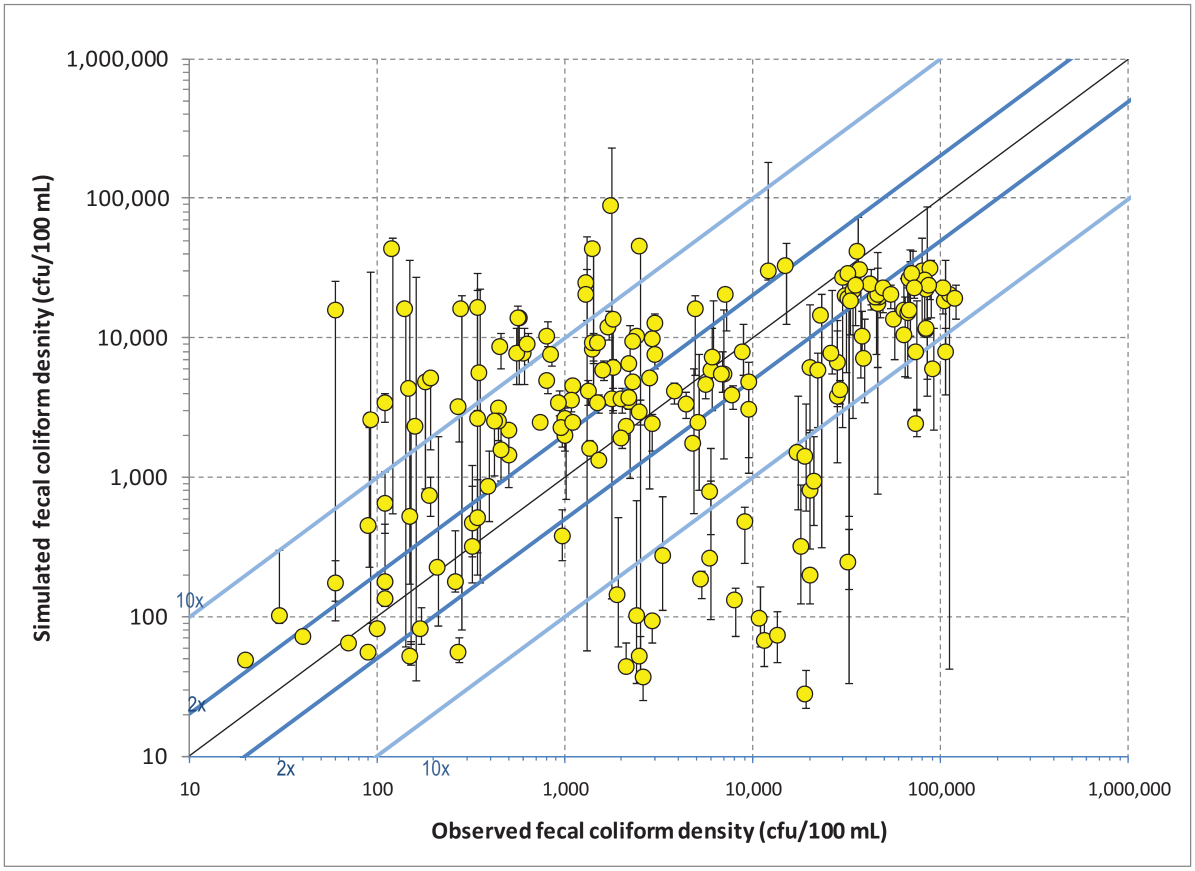
Figure 8. Cumulative Frequency Distribution of Modeled and Measured Wet-Weather Fecal Coliform Densities.



The cumulative frequency distribution plots of the model and the data match fairly well, indicating that the model is successfully reproducing the range of observed densities at the appropriate frequency. Cumulative frequency distribution plots at each location where a minimum of 20 samples were analyzed are included in Attachment A. These plots show the model is successfully reproducing the range of observed data at each location.

Figure 9 is a scatter plot or (one-to-one plot) of modeled and measured fecal coliform densities. Scatter Plots of model predictions versus data predictions show how well the model is reproducing the data for each measured value. Two sets of lines on the one-to-one plots form limits for acceptable model-to-date comparisons. Points on the scatter plot that fall within the lines labeled '2x' are considered excellent predictions because they roughly correspond to the sampling and analytical accuracy limits of the bacteria count. The wider band between the '10x' lines is a more liberal criteria for the model predictions; predictions that fall within these bands are accurate to one order of magnitude of the measured bacteria densities. The error bars around each point indicate the minimum and maximum modeled values for the three hours before and three hours after each sample collection time, showing the variability of fecal coliform densities over a short time period during wet-weather events.

Figure 9. Scatter Plot of Modeled and Measured Wet-Weather Fecal Coliform Densities.



The scatter plot shows that the majority of the modeled values are within an order of magnitude of observed values. In the cases in which the model over-predicts the observed values by more than an order of magnitude, the error bars show that the model produces values that better match the observed values within a few hour time-window. The cases where the model under-predicts the observed the observed values by more than an order of magnitude almost all occur 24-hours after the event initiation for two storm event. This could be related to the timing of the rainfall at different locations in the watershed.

Scatter plots for each location with at least 10 measured values, as well as snapshots of model-to-data comparisons from the WinModel framework for the May 2008 event, are available in Attachment A.

Model Wet Weather Sensitivity Analysis

Selection of model inputs can have a significant influence on water quality model predictions. Each of the model inputs has a degree of uncertainty associated with it. Two model features of particular interest are the densities associated with the infrastructure sources, and the impact of the overflows that have not been verified (model-predicted overflows).

Sensitivity to CSO and SSO Densities

To assess the sensitivity of the model results to the CSO and SSO densities, the model was run using the arithmetic means from the SD1 outfall monitoring program: 1,110,000 cfu/100 mL and 3,263,000 cfu/100 mL for CSOs and SSOs respectively. These values are over 50% greater than the geometric mean values used for the calibration. The same set of summary statistics and charts as were presented for the model calibration are shown for this simulation in Table 7 and Figures 10 and 11 below.

Table 7. Summary Statistics Comparing Predicted and Instream Fecal Coliform Measurements for Model with the Collection System Source Densities Set to the Arithmetic Averages.

HSPF RCHRES	Location	n	Observed geomean (cfu/100 mL)	Model geomean (cfu/100 mL)	% Observed compliance with SS Max	% Modeled compliance with SS Max	Mean relative % difference of ln values	Mean absolute % difference of ln values
1	BLC 15.6	25	2689	1945	20%	32%	0.6%	24.4%
6	BLC 11.6	25	2852	3430	24%	16%	7.2%	23.5%
9	BLC 8.1	25	2767	2700	24%	16%	6.2%	22.6%
22	BLC 3.9	25	4499	4853	15%	15%	6.2%	21.0%
10	Fowler Creek	25	3004	2151	19%	19%	0.4%	19.0%
19	Bullock Pen	24	1730	3541	25%	17%	14.9%	29.5%
All RCHs		158	2668	2942	22%	19%	6.4%	23.4%

Figure 10. Cumulative Frequency Distribution of Modeled and Measured Wet-Weather Fecal Coliform Densities for Model with the Collection System Source Densities Set to the Arithmetic Averages.

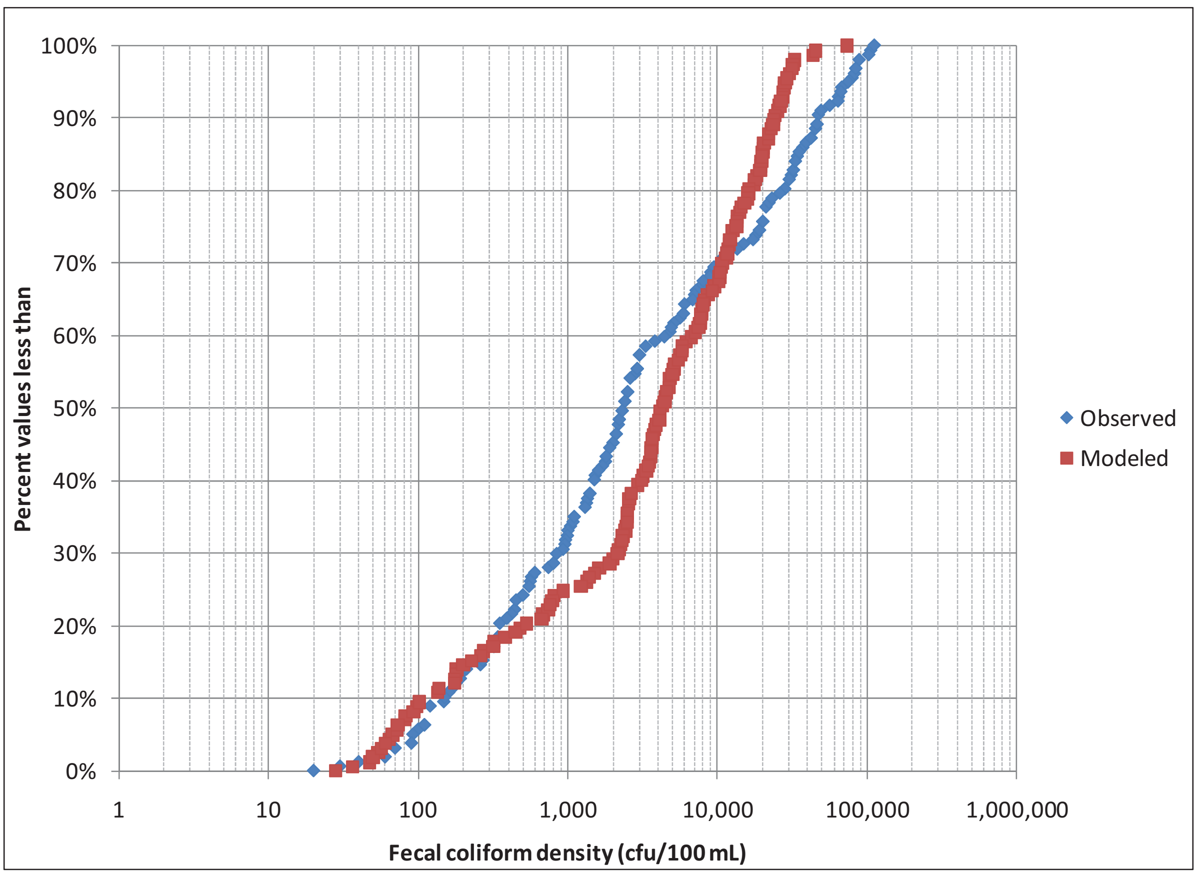
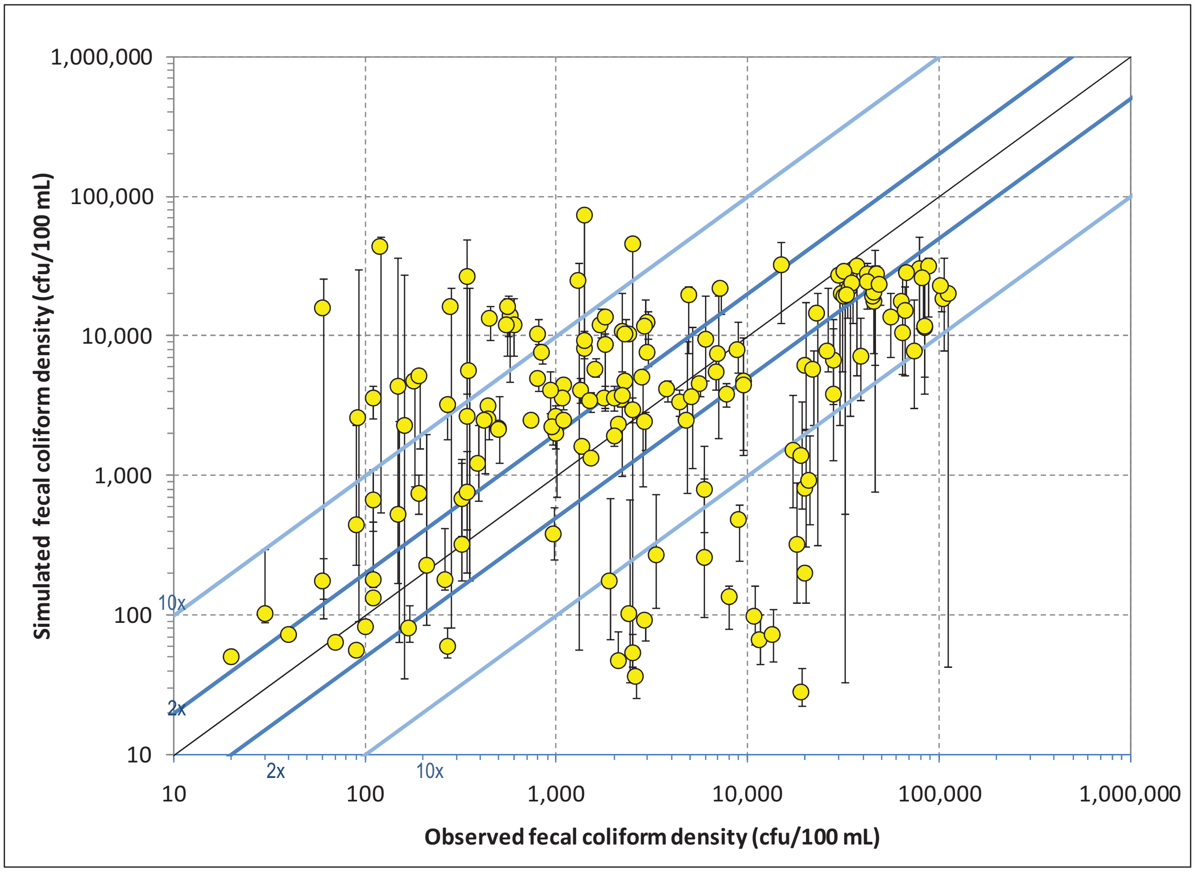


Figure 11. Scatter Plot of Modeled and Measured Wet-Weather Fecal Coliform Densities for Model with Collection System Densities Set to Arithmetic Averages.



The results show that the model still reasonably reproduces the measured data using higher CSO and SSO densities. While the modeled geomean is higher for the locations impacted by infrastructure sources (all but BLC 15.6), the use of the higher value does not dramatically affect the quality of the calibration. In fact, the model better reproduces the peak instream densities using these values. Notably, the simulated percent compliance with the single sample maximum criterion does not change using the higher densities for these sources.

Sensitivity to Model-Predicted Overflow Locations

Overflows occurring at model-predicted overflow locations have not been field verified, so it is important to understand how they are impacting the simulations of the Banklick system. The model sensitivity to the presence of these sources was evaluated by running the model without those components. The same set of summary statistics and charts as were presented for the model calibration are shown for this simulation in Table 8 and Figures 12 and 13 below.

Table 8. Summary Statistics Comparing Predicted and Instream Fecal Coliform Measurements for Model without Model-Predicted Overflow Locations.

HSPF RCHRES	Location	n	Observed geomean (cfu/100 mL)	Model geomean (cfu/100 mL)	% Observed compliance with SS Max	% Modeled compliance with SS Max	Mean relative % difference of ln values	Mean absolute % difference of ln values
1	BLC 15.6	25	2689	1945	20%	32%	0.6%	24.4%
6	BLC 11.6	25	2852	2369	24%	20%	2.5%	23.1%
9	BLC 8.1	25	2767	1999	24%	20%	1.9%	21.2%
22	BLC 3.9	25	4499	3766	15%	15%	2.5%	18.8%
10	Fowler Creek	25	3004	2151	19%	19%	0.4%	19.0%
19	Bullock Pen	24	1730	3142	25%	17%	13.4%	29.4%
All RCHs		158	2668	2440	22%	20%	3.8%	22.4%

Figure 12. Cumulative Frequency Distribution of Modeled and Measured Wet-Weather Fecal Coliform Densities for Model with no Model-Predicted Overflow Locations.

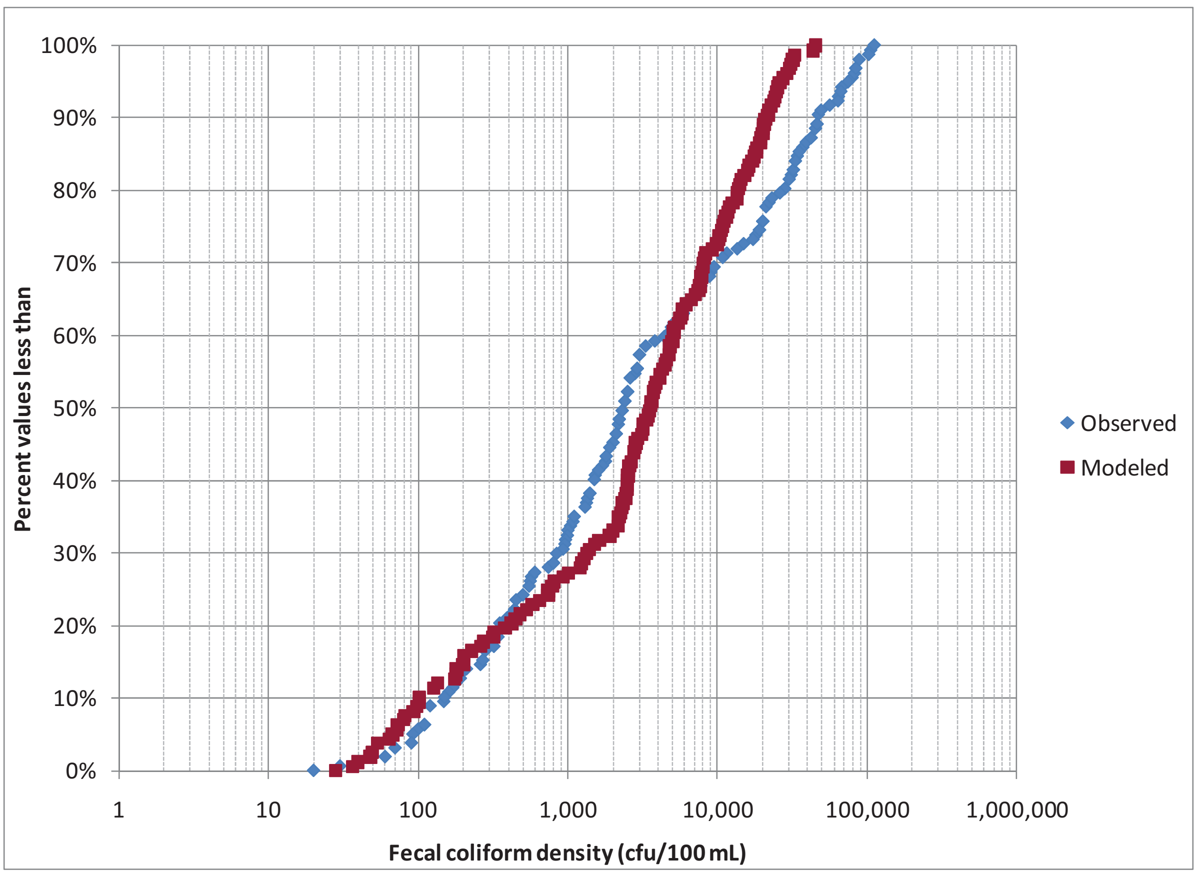
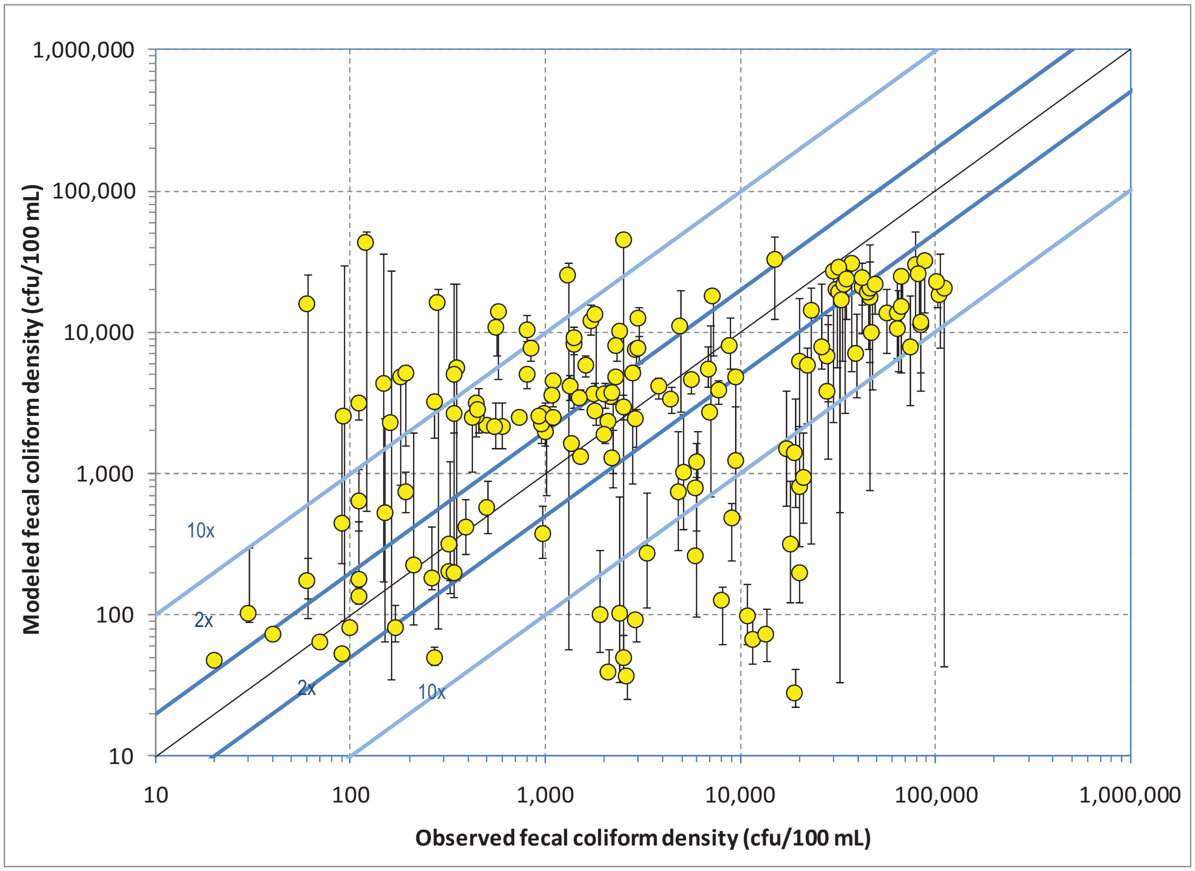


Figure 13. Scatter Plot of Modeled and Measured Wet-Weather Fecal Coliform Densities for Model with no Model-Predicted Overflow Locations.



The results suggest that the model reasonably reproduces the central tendency without these sources. However, the highest observed densities are under-predicted to a greater degree than they are in the calibrated model.

E. coli Simulation

The Banklick HSPF model was also run using the *E. coli* geometric mean densities from the SD1 infrastructure modeling (210,000 cfu/100 mL for CSOs and 705,000 cfu/100 mL for SSOs) to gage the models ability to reproduce instream *E. coli* densities. For this simulation, the build-up, wash-off parameters calibrated for fecal coliform densities were used. Table 9 and Figures 14 and 15 present the results of this simulation. It should be noted that the single-sample maximum for *E. coli* is 240 cfu/100 mL as opposed to 400 cfu/100 mL for fecal coliform.

Table 9. Summary Statistics Comparing Predicted and Instream *E. coli* Measurements for Model.

HSPF RCHRES	Location	n	Observed geomean (#/100 mL)	Model geomean (#/100 mL)	% Observed compliance with SS Max (240 #/100 mL)	% Modeled compliance with SS Max (240 #/100 mL)	Mean relative % difference of ln values	Mean absolute % difference of ln values
1	BLC 15.6	25	2138	1594	12%	20%	0.4%	26.2%
6	BLC 11.6	25	2177	2042	20%	16%	4.0%	22.5%
9	BLC 8.1	25	2130	1629	16%	16%	1.1%	19.8%
22	BLC 3.9	26	2991	1940	8%	15%	-1.6%	17.6%
10	Fowler Creek	26	2560	1439	12%	15%	-4.4%	16.8%
19	Bullock Pen	24	1214	1175	21%	25%	4.3%	25.9%
All RCHs		158	2038	1564	15%	18%	0.6%	20.9%

Figure 14. Distribution of Modeled and Measured Wet-Weather *E. coli* Densities.

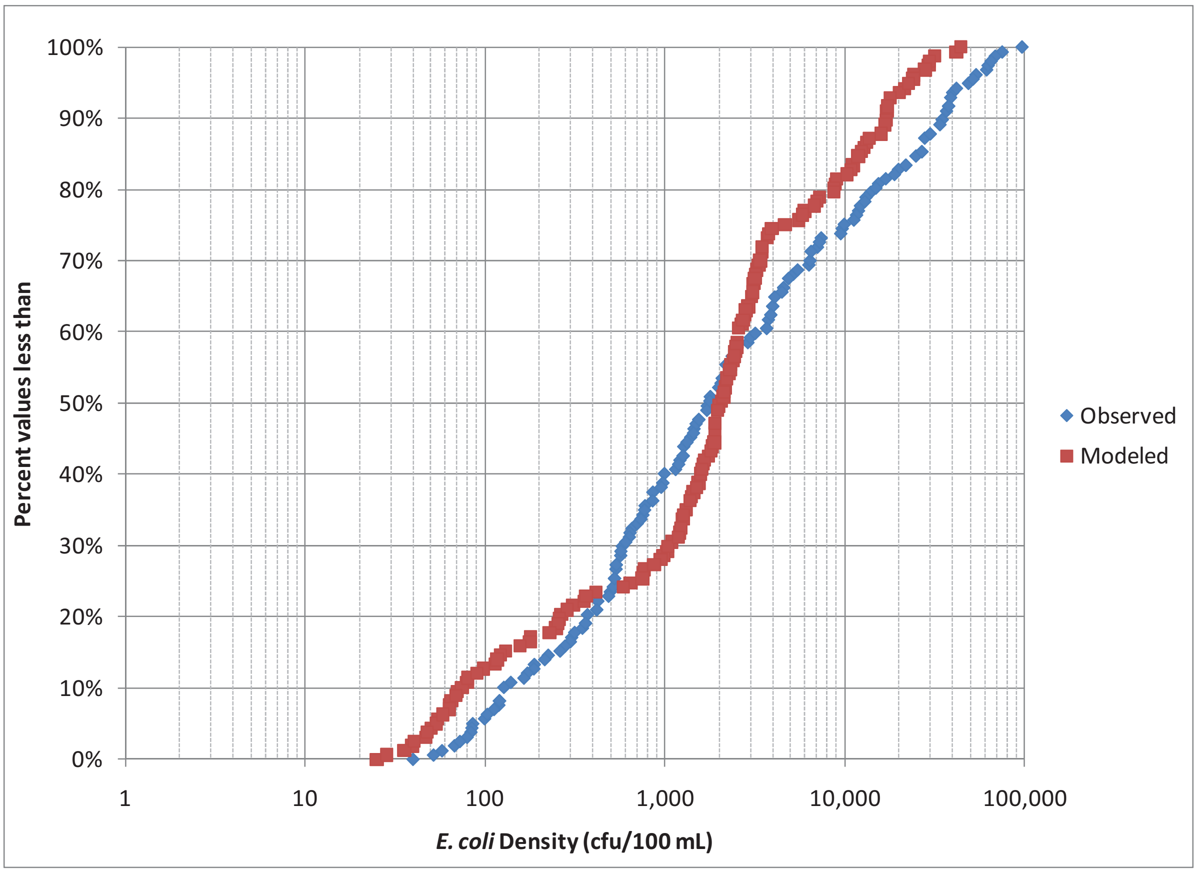
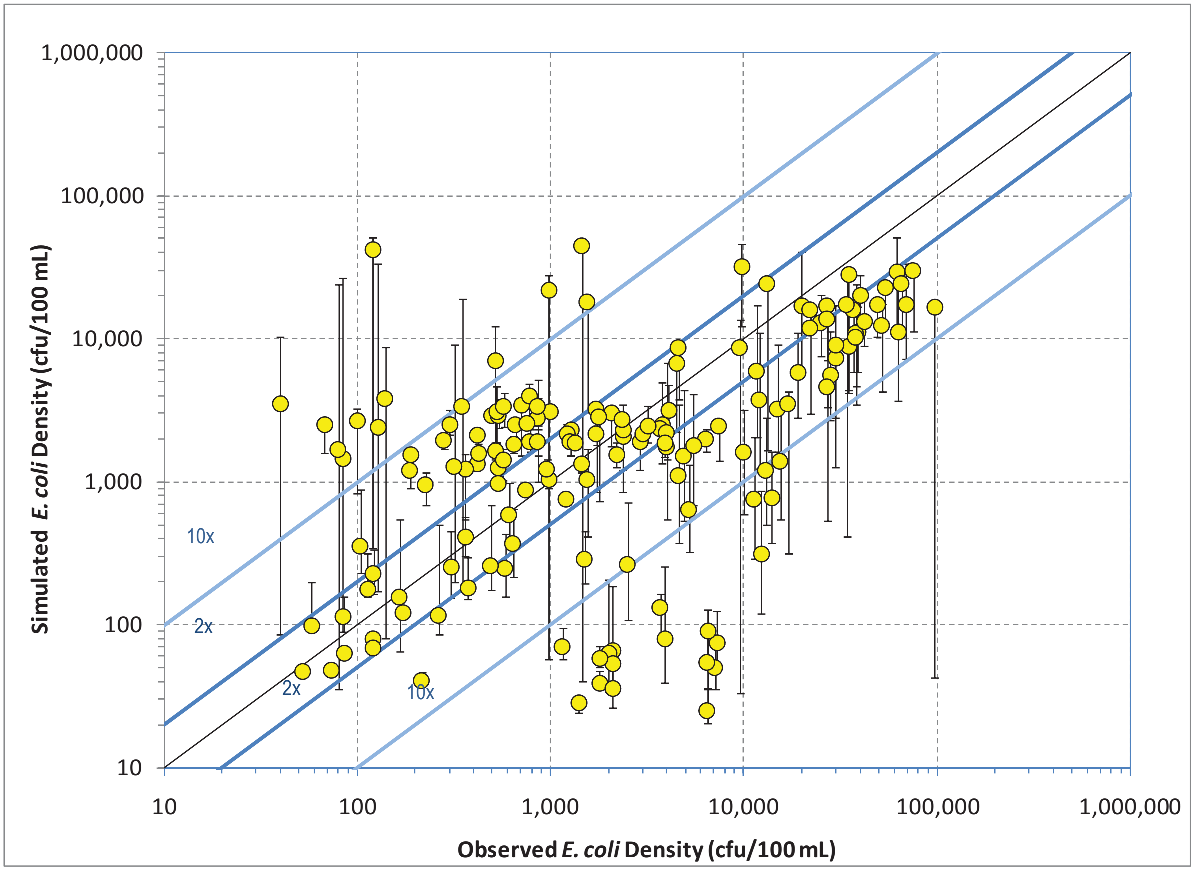


Figure 15. Modeled and Measured Wet-Weather *E. coli* Densities.



The model under-predicts measured *E. coli* densities using this configuration. This suggests that *E. coli* runoff loads would need to be greater than the calibrated fecal coliform loads to better match instream data.

Conclusions

The information from the Banklick Creek watershed modeling effort can be summarized as follows:

- The HSPF model provides a reasonable reproduction of flow and fecal coliform densities in Banklick Creek for a range of environmental conditions;
- The calibration suggests that the methods used for quantifying fecal coliform loading are providing reasonable estimates of point and nonpoint source bacteria loads;
- The water quality model will be a useful tool for quantifying potential benefits of various control scenarios considered for the LTCP.

The calibration to instream values indicates that it is capable of reproducing the timing and magnitude of most of the observed data. It is the best tool available for evaluating instream impacts from fecal coliform sources, including CSOs and SSOs, under a range of environmental conditions and control scenarios. The model is suitable for evaluating the water quality benefits of traditional infrastructure, green infrastructure, and watershed control alternatives in the Banklick Creek watershed.

References

Center for Watershed Protection (CWP). 1999. Watershed Protection Techniques, Special Issue Bacteria. Vol. 3, No. 1. April 1999.

Donigian, A.S. Jr. 2002. Watershed Model Calibration and Validation: The HSPF Experience. WEF National TMDL Science and Policy 2002, November 13-16, 2002. Phoenix, AZ. WEF Specialty Conference Proceedings on CD-ROM.

LimnoTech. 2004. Watershed Assessment Protocol. Application to Banklick Creek. Prepared for Sanitation District Number 1 of Northern Kentucky. June 2004.

National Stormwater Quality Database (NSQD). 2005. *NPDES Phase I Data – Municipal Separate Storm Sewer System. Version 1.1*. University of Alabama and Center for Watershed Protection. Updated March 4, 2005.

XCG Consults, Inc. 2003. Banklick Creek. Watershed Assessment. Summary of results for countinuous flow/level meters and continuous water quality datasonde. Prepared for Sanitation District Number 1 of Northern Kentucky. December, 2003.

Survey	Station_Desc	Date	Result	Meas_Unit
	Banklick Creek at RM 5.7 (Pioneer Park Off Sr 17)	9/5/2003	0.08	mg/L-P
	Banklick Creek at RM 5.7 (Pioneer Park Off Sr 17)	9/5/2003	0.22	mg/L-P
	Mosers Branch at RM 0.7 (Teepee To Creek)	9/6/2003	0	mg/L-P
	Mosers Branch at RM 0.7 (Teepee To Creek)	9/6/2003	0.04	mg/L-P
	Banklick Creek at RM 0.2 (Mouth)	9/6/2003	0.14	mg/L-P
	Banklick Creek at RM 15 (Station 2)	5/3/2003	0.069	mg/L-P
	Banklick Creek at RM 18.2 (Station 1)	5/2/2003	0.125	mg/L-P
	Banklick Creek at RM 13.5 (Station 3 - Under Railroad Tressel)	5/2/2003	0.169	mg/L-P
	Banklick Creek at RM 10.1 (Station 4 - Banklick Woods)	5/2/2003	0.083	mg/L-P
	Banklick Creek at RM 8.1 (Station 5 - USGS Station)	5/1/2003		mg/L-P
	Bullock Pen Creek at RM 0.1 (Station 6 - White Church)	5/1/2003	0.037	mg/L-P
	Banklick Creek at RM 5.4 (Station 7 - Prairie Park)	5/1/2003		mg/L-P
	Banklick Creek at RM 3.9 (Station 8 - Sanitation District)	4/30/2003	0.041	mg/L-P
	Banklick Creek at RM 0.4 (Station 10)	4/30/2003	0.043	mg/L-P
	Banklick Creek at RM 2.5 (Station 9 - Driving Range)	4/30/2003	0.039	mg/L-P
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	10/17/2002	0.099	mg/L-P
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	10/17/2002	0.105	mg/L-P
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	10/17/2002	0.131	mg/L-P
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	10/17/2002	0.047	mg/L-P
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	10/17/2002	0.063	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	10/17/2002	0.093	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	10/17/2002	0.071	mg/L-P
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	10/17/2002	0.119	mg/L-P
Dry	Banklick Creek at RM 0.4 (Station 10)	10/17/2002	0.149	mg/L-P
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/25/2003	0.138	mg/L-P
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/25/2003	0.132	mg/L-P
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/25/2003	0.066	mg/L-P
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/25/2003	0.088	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/25/2003	0.122	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/25/2003	0.064	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/25/2003	0.138	mg/L-P
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	6/25/2003	0.122	mg/L-P
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	8/20/2003	0.142	mg/L-P
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	8/20/2003	0.612	mg/L-P
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8/20/2003	0.158	mg/L-P
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	8/20/2003	0.116	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	8/20/2003	0.132	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	8/20/2003	0.138	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	8/20/2003	0.118	mg/L-P
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	8/20/2003	0.238	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/26/2003	0.116	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/26/2003	0.084	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/26/2003	0.104	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/27/2003	0.146	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/27/2003	0.148	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/27/2003	0.124	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/26/2003	0.19	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/26/2003	0.353	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/27/2003	0.132	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/27/2003	0.204	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/27/2003	0.22	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/27/2003	0.124	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/26/2003	1.02	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/26/2003	0.337	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/27/2003	0.198	mg/L-P

Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/27/2003	0.196	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/27/2003	0.168	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/27/2003	0.132	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/26/2003	0.353	mg/L-P
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Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.142	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.341	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.196	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.128	mg/L-P
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Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.138	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.132	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.168	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.116	mg/L-P
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Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/22/2003	0.21	mg/L-P
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Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/22/2003	0.206	mg/L-P

Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/22/2003	2.22	mg/L-P
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Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/22/2003	0.604	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/23/2003	0.589	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/22/2003	0.124	mg/L-P
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Wet	Banklick Creek at RM 0.4 (Station 10)	9/24/2003	0.313	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	0.532	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	3.22	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	1.42	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	0.632	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	0.461	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/28/2003	0.27	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	0.234	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	3.22	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	3.52	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	3.52	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	2.42	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	0.424	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/28/2003	0.296	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	8.12	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	8.12	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	3.42	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	2.02	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	1.92	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	0.612	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/28/2003	0.292	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	5.32	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	8.42	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	3.22	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	1.42	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	0.441	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/28/2003	0.278	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.17	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.349	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.672	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.692	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.289	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/28/2003	0.232	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	6.92	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	1.72	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	2.92	mg/L-P

Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	2.12	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	0.572	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/28/2003	0.509	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	2.32	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	2.42	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	3.12	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	2.62	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	9.02	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	3.82	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	0.764	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/28/2003	0.405	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/29/2003	0.216	mg/L-P
Wet	Banklick Creek at RM 0.4 (Station 10)	9/29/2003	0.186	mg/L-P
Dry	Banklick Creek at RM 15.6 (Maher Rd. bridge)	6/26/2007	0.168	mg/L-P
Dry	Banklick Creek at RM 11.6 (Independence Station Rd.)	6/26/2007	0.151	mg/L-P
Dry	Fowler Creek at RM 0.1 (Rt. 17 bridge)	6/26/2007	0.085	mg/L-P
Dry	Fowler Creek at RM 0.1 (Rt. 17 bridge)	6/26/2007	0.155	mg/L-P
Dry	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	6/26/2007	0.112	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	6/26/2007	0.169	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Dr bridge)	6/26/2007	0.1	mg/L-P
Dry	Banklick Creek at RM 0.3 (Rt. 177)	6/26/2007	0.2	mg/L-P
Dry	Banklick Creek at RM 1.2 (Rt. 16 bridge)	6/26/2007	0.106	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/7/2008	0.091	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/7/2008	0.083	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008	0.098	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008	0.102	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008	0.11	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/9/2008	0.115	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/9/2008	0.125	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/10/2008	0.078	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008		mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008		mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/7/2008	0.096	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/7/2008	0.08	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/8/2008	0.163	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/8/2008	0.278	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/9/2008	0.214	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/9/2008	0.179	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/10/2008	0.115	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/7/2008	0.014	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/7/2008	0.063	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/7/2008	0.058	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/8/2008	0.095	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/8/2008	0.119	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/9/2008	0.092	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/9/2008	0.05	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/10/2008	0.054	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/7/2008	0.046	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/8/2008	0.036	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/8/2008	0.114	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/8/2008	0.115	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/9/2008	0.164	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/9/2008	0.129	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/10/2008	0.067	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/7/2008		mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/8/2008		mg/L-P

Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/7/2008	0.047	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/7/2008	0.058	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/8/2008	0.13	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/8/2008	0.134	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/9/2008	0.081	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/9/2008	0.05	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/10/2008	0.06	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/7/2008	0.066	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/7/2008	0.119	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/8/2008	0.127	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/8/2008	0.126	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/8/2008	0.152	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/9/2008	0.108	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/9/2008	0.083	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/10/2008	0.077	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/7/2008	0.066	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/7/2008	0.176	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/8/2008	0.166	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/8/2008	0.163	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/9/2008	0.16	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/9/2008	0.13	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/9/2008	0.125	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/10/2008	0.062	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/8/2008		mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/8/2008		mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/7/2008		mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/9/2008		mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/7/2008	0.05	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/7/2008	0.152	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/8/2008	0.151	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/8/2008	0.205	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/9/2008	0.112	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/9/2008	0.107	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/10/2008	0.108	mg/L-P

Survey_Type	Station_Desc	RiverMile	Result	Meas_Units
	Banklick Creek at RM 5.7 (Pioneer Park Off Sr 17)	5.7	58	mg/L
	Mosers Branch at RM 0.7 (Teepee To Creek)	0.7	13	mg/L
	Banklick Creek at RM 0.2 (Mouth)	0.2	26	mg/L
	Banklick Creek at RM 15 (Station 2)	15	9	mg/L
	Banklick Creek at RM 18.2 (Station 1)	18.2	19	mg/L
	Banklick Creek at RM 13.5 (Station 3 - Under Railroad Tressel)	13.5	27	mg/L
	Banklick Creek at RM 10.1 (Station 4 - Banklick Woods)	10.1	9	mg/L
	Banklick Creek at RM 8.1 (Station 5 - USGS Station)	8.1	11	mg/L
	Bullock Pen Creek at RM 0.1 (Station 6 - White Church)	0.1		mg/L
	Banklick Creek at RM 5.4 (Station 7 - Prairie Park)	5.4	12	mg/L
	Banklick Creek at RM 3.9 (Station 8 - Sanitation District)	3.9	17	mg/L
	Banklick Creek at RM 0.4 (Station 10)	0.4	26.7	mg/L
	Banklick Creek at RM 2.5 (Station 9 - Driving Range)	2.5	22	mg/L
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	2	mg/L
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	2.3	mg/L
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	3.8	mg/L
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	4.8	mg/L
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	1.2	mg/L
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	1.6	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	7.4	mg/L
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	14.2	mg/L
Dry	Banklick Creek at RM 0.4 (Station 10)	0.4	18.2	mg/L
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	9.12	mg/L
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	13.2	mg/L
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	14.5	mg/L
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	17.3	mg/L
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	4.33	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	18.6	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	22	mg/L
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	8.09	mg/L
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	10	mg/L
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	126	mg/L
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	19	mg/L
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	13	mg/L
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	9	mg/L
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	10	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	25	mg/L
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	43	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	10.6	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	13.3	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	14.5	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	14.2	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	14.3	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	8.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	11.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	13.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	15.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	13	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	30.1	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	18.8	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	15.1	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	37.5	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	42.3	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	40	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	29.3	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	22.9	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	125	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	60.7	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	40.3	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	41.2	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	137	mg/L

Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	33.2	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	24	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	932	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	61.7	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	33.3	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	25.8	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	31.3	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	28.9	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	11.2	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	664	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	106	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	160	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	91	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	46	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	43.1	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	128	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	369	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	189	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	119	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	155	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	68.7	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	27	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	670	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	170	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	88	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	78	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	54	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	32	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	6.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	2800	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	540	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	200	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	94	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	55	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	29	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	2550	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	2500	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	1100	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	320	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	130	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	53	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	30	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	3700	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	610	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	210	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	48	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	39	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	6.2	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	530	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	230	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	71	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	55	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	37	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	13	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	1600	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	1400	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	1400	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	350	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	100	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	51	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	120	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	1300	mg/L

Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	2000	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	450	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	410	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	120	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	58	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	24	mg/L
Wet	Banklick Creek at RM 0.4 (Station 10)	0.4	26	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	79	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	570	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	190	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	91	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	38	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	28	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	31	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	1300	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	1300	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	630	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	220	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	73	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	110	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	17	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	1500	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	950	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	310	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	310	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	73	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	44	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	1200	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	3300	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	560	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	180	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	76	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	21	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	12	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	73	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	110	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	97	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	32	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	23	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	1500	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	520	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	710	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	420	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	83	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	37	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	660	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	1000	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	720	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	790	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	640	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	600	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	110	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	43	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	19	mg/L
Wet	Banklick Creek at RM 0.4 (Station 10)	0.4	20	mg/L
Dry	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	35.5	mg/L
Dry	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	19.7	mg/L
Dry	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	11	mg/L
Dry	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	10	mg/L
Dry	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	24	mg/L
Dry	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	8.75	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	38	mg/L

Dry	Banklick Creek at RM 0.3 (Rt. 177)	0.3	44.3	mg/L
Dry	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	27.7	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	6.36	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	7.27	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	7.27	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	7.82	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	8.4	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	9.09	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	5.82	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	4.4	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6		mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6		mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	7.27	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	10.7	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	26.2	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	88.3	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	88.7	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	42.9	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	42.9	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	17.6	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	10.8	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	3.45	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	22.2	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	24.4	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	18	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	32.6	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	12.9	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	8.36	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	6.4	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	3.64	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	9.09	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	15.1	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	19.6	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	26.4	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	7.82	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	5.8	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1		mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1		mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	10	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	18.5	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	12.4	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	19.6	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	3.64	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	4.18	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	15.6	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	11.3	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	48	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	41.3	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	39.4	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	58.6	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	58.3	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	22.8	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	14	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	12.4	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	20.7	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	60.2	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	74	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	83.6	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	65.2	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	39.7	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	40.4	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	9.8	mg/L

Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3		mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3		mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3		mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3		mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	14.4	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	74	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	75.3	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	45.4	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	75	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	32.8	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	27	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	26.5	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	32.6	mg/L

Survey_Desc	Survey	Par_Name	Result	Meas_Units
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	620	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	120	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	60	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	260	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	400	CFU/100mL
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Ecoli_(cfu)	100	CFU/100ml
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Fecal_(cfu)	240	CFU/100mL
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Ecoli_(cfu)	224	CFU/100ml
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Fecal_(cfu)	600	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	192	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	68	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	660	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	800	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1220	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1330	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	780	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1080	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1450	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2100	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	540	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1350	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	128	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	148	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	75500	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	88000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	69100	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	105000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	30000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	74000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	11300	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	20000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	7090	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	11500	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	980	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	1300	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	35000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	37000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	17000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	25000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	40000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	42000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	25000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	47000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	4600	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	4800	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	1800	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2500	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	1060	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	1178	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	110	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	112.8	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	270	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	189	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1800	CFU/100mL

Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	2064	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1400	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1553	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	6000	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	3784	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	320	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	583	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	70	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	121	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	97	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	130	CFU/100mL
1998-2003 LRWW (NKU) Fecal Only Surveys		Ecoli_(cfu)	90	CFU/100ml
1998-2003 LRWW (NKU) Fecal Only Surveys		Fecal_(cfu)	150	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	56	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	88	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	52	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	88	CFU/100mL
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Ecoli_(cfu)	128	CFU/100ml
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Fecal_(cfu)	192	CFU/100mL
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Ecoli_(cfu)	640	CFU/100ml
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Fecal_(cfu)	1040	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	100	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	180	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1730	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2800	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1000	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2300	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	500	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1100	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1280	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2170	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	520	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1040	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	120	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	120	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	61800	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	79000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	63000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	83600	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	12000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	28000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	12300	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	18000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	6450	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	19000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	1460	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2500	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	9730	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	14900	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	20000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	46000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	11700	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	20000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	2500	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	3300	CFU/100mL

Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	1400	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2600	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	24	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	52	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	260	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	373.2	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1000	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1553	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	2900	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	2909	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	982	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	2382	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1000	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1529	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	964	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1500	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	170	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1153	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	70	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	86	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)		CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)		CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	790	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	580	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	884	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	30	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	58	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	86.4	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	420	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	364	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	927	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	644	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	340	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	520	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	2200	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	862	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	340	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	305	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	20	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	52	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)		CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	10	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	10	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	440	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	885	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	400	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	10	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	110	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	410	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	150	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	530	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	180	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	900	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	350	CFU/100mL

Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	450	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	740	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	1020	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	820	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	690	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	1323	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	2400	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	440	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)		CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	1210	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	8200	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	650	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	260	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	10	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	5900	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	90	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	450	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	170	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	2670	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	29732	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	310	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	420	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	16	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	350	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	271	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	963	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	40	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	8800	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	620	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	235	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	90	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	30	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	390	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	860	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	4100	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	10	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	33000	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	24	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	32	CFU/100mL
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Ecoli_(cfu)	263	CFU/100ml
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Fecal_(cfu)	520	CFU/100mL
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Ecoli_(cfu)	84	CFU/100ml
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Fecal_(cfu)	160	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2200	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	860	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	5600	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	3700	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	7730	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	6360	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	4400	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	4000	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2000	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	980	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1520	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1200	CFU/100ml

Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	84	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	92	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	34000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	46000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	30000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	33000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	65500	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	81800	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	38000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	83600	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	15500	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	17200	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	6450	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	13500	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	80	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	160	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	13200	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	30000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	54000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	67300	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	42000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	63600	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	4900	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	5100	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	2100	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2100	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	2000	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	14300	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	68000	CFU/100mL
1998-2004 LRWW Surveys		Fecal_(cfu)	500	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	52	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	1600	CFU/100mL
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Ecoli_(cfu)	100	CFU/100ml
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Fecal_(cfu)	180	CFU/100mL
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Ecoli_(cfu)	92	CFU/100ml
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Fecal_(cfu)	240	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	9450	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	7440	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	3800	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	3000	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1780	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1270	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2000	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1200	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2500	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	2200	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	740	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	420	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	500	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	188	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	350	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	350	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	27000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	31000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	35000	CFU/100ml

Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	64000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	28000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	28000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	14000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	21000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	7270	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	10800	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	97300	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	111000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	37000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	45000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	39000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	56000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	19000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	39000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	5200	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	5900	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	2100	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2900	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	80	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	98	MPN/100ml
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	1470	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	1565	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	320	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	489.2	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	380	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	426	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	500	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	624	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	954	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	538	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	440	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	571	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	191	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	364	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	40	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	85	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	80	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	40	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	121	MPN/100ml
1998-2004 LRWW Surveys		Fecal_(cfu)	250	CFU/100mL
1998-2003 LRWW (NKU) Fecal Only Surveys		Ecoli_(cfu)	90	CFU/100ml
1998-2003 LRWW (NKU) Fecal Only Surveys		Fecal_(cfu)	400	CFU/100mL

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1
Banklick Creek
Kenton County, Kentucky

Collection Date: May and June, 2008
TRC Project Number: 8161-08

			BLC 2.6		BLC 3.9		BLC 5.5		BLC 8.1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
ANNELIDA										
Erpobdellidae gen. sp.	CG	8.2				X				
Lumbriculidae gen. sp.	CG	7.3								X
Naididae gen. sp.	CG	9.1						X		X
AMPHIPODA										
Crangonyx sp.	SH-d	8						X		
Synurella dentata Hubricht	SH-d	7.7	4					X	10	
ISOPODA										
Lirceus fontinalis Rafinesque	CG	7.9	20	X	24	X	116	X	475	
DECAPODA										
Orconectes sp.	CG	5.5		X	8	X	4	X	20	X
EPHEMEROPTERA										
Acentrella ampla Traver	CG	3.6							10	
Acerpenna pygmaeus (Hagen)	CG	3.9						X		
Acerpenna sp.	CG	5				X				
Baetis flavistriga McDunnough	CG	6.6	28	X	80	X			5	
Baetis intercalaris McDunnough	CG	5.8	28	X	80	X	4	X		
Caenis diminuta group sp.	CG	7.4					4			X
Procloeon sp.	CG	5.4		X						
Stenonema femoratum (Say)	SC	7.2	12	X	8	X	8	X	5	X
ODONATA										
Argia apicalis (Say)	P	8.7				X				
Argia sp. (imm.)	P	8.7		X						
Calopteryx maculata (Beauvois)	P	7.8						X		
Enallagma sp. (imm.)	P	9		X		X		X		
PLECOPTERA										
Neoperla sp.	P	1.6							5	
Perlesta sp.	P	4.9							50	X
TRICHOPTERA										
Cheumatopsyche sp.	CF	6.2	28	X	56	X	40	X	110	X
Chimarra sp.	CF	2.7		X						
Hydroptila sp.	P	6.2			24	X				
COLEOPTERA										
Berosus sp.	P	8.6		X						

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1 | Collection Date: May and June, 2008
Banklick Creek | TRC Project Number: 8161-08
Kenton County, Kentucky

			BLC 2.6		BLC 3.9		BLC 5.5		BLC 8.1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
Ectopria sp.	SC	4.2	4	X		X				
Hydrophilidae gen. sp. (imm.)	P	6.3					4			
Peltodytes sp.	P	8.5		X						
Psephenus herricki (DeKay)	SC	2.4	4	X	4	X	8		35	X
Stenelmis sp.	SC	5.1	100	X	384	X	388	X	340	X
DIPTERA (Chironomidae)										
Ablabesmyia mallochi (Walley)	P	7.2	12	X		X		X		
Chaetocladius sp.	CG	6						X		
Chironomus sp.	CG	9.8				X		X		
Corynoneura sp.	CG	6	4							
Cricotopus (C.) trifascia Edwards	SH-d	7		X	4			X		
Cricotopus (I.) absurdus	CG	5			16		100			
Cricotopus / Orthocladius sp.	CG	7.1	88		4	X	516	X	485	X
Cricotpus (I.) "Ozarks"	SH-d	7						X	140	X
Cryptochironomus sp.	P	6.4	4		4					
Dicrotendipes neomodestus (M.)	CG	8.1		X	12	X			10	
Eukeifferiella brevicalcar grp. sp.	CG	2.2	20			X			15	
Eukiefferiella sp.	CG	3.4					4			
Labrundinia sp.	PR	6				X				
Parametriocnemus sp.	CG	3.7	48	X	8					
Polypedilum flavum (Joh.)	SH-d	5.3	384	X	44		8	X	45	X
Polypedilum illinoense group sp.	SH-d	9	132	X		X	12	X		
Polypedilum scalaenum group sp.	SH-d	8.4	4							
Rheotanytarsus exiguus group sp.	CF	6.4		X		X				
Stictochironomus sp.	CG	6.5					12	X		X
Tanytarsus sp.	CF	6.7		X	8					
Thienemanniella xena (Roback)	CG	5.9	4		4					
Thienemannimyia group sp.	P	5.9	60	X	84	X		X	15	X
DIPTERA (Other)										
Anopheles sp.	CF	9.1				X				
Simulium sp. (imm.)	CF	4	196	X	24	X	4		15	X
MOLLUSCA										
Physella sp.	SC	8.8		X						
Pisidium	CF	6.1						X		

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1
Banklick Creek
Kenton County, Kentucky

Collection Date: May and June, 2008
TRC Project Number: 8161-08

			BLC 2.6		BLC 3.9		BLC 5.5		BLC 8.1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
Sphaerium sp.	CF	7.6	8							
OTHER TAXA										
Turbellaria gen. sp.	NA	7.2	8	X	12	X		X		

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1

Collection Date: May and June, 2008

Banklick Creek Watershed Set 2

TRC Project Number: 8161-08

Kenton County, Kentucky

			BLC 13.5		BLC 15.6		BLC 17.8	
			Station 1		Station 2		Station 3	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL
ANNELIDA								
Lumbriculidae gen. sp.	CG	7.3			4			
Naididae gen. sp.	CG	9.1		X		X		X
AMPHIPODA								
Crangonyx sp.	SH-d	8		X				
Synurella dentata Hubricht	SH-d	7.7	5	X	24	X	84	X
ISOPODA								
Lirceus fontinalis Rafinesque	CG	7.9	57	X	200	X	380	X
DECAPODA								
Cambarus sp.	CG	4.9			4		2	X
Orconectes sp.	CG	5.5		X	16	X	8	X
EPHEMEROPTERA								
Baetis flavistriga McDunnough	CG	6.6	1	X	8	X		
Baetis intercalaris McDunnough	CG	5.8	3		8		2	
Centroptilum sp.	CG	6.6		X				
Leptophlebiidae gen. sp. (imm.)	CG	3.3			4	X		
Leucrocuta sp.	SC	0						X
Paraleptophlebia sp.	CG	0.9						X
Plauditus sp.	CG	5.4			4			
Procloeon sp.	CG	5.4				X		
Stenonema femoratum (Say)	SC	7.2	13	X	16	X		X
PLECOPTERA								
Amphinemura sp.	SH-d	3.4					2	
Neoperla sp.	P	1.6	1	X		X		
Perlesta sp.	P	4.9	4		8		20	X
TRICHOPTERA								
Cheumatopsyche sp.	CF	6.2	14	X	36		6	X
Hydroptila sp.	P	6.2			4			
Polycentropus sp.	P	3.5		X				
COLEOPTERA								
Ectopria sp.	SC	4.2	1					
Psephenus herricki (DeKay)	SC	2.4	15	X				
Stenelmis sp.	SC	5.1	128	X	124	X	4	X

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1

Collection Date: May and June, 2008

Banklick Creek Watershed Set 2

TRC Project Number: 8161-08

Kenton County, Kentucky

			BLC 13.5		BLC 15.6		BLC 17.8	
			Station 1		Station 2		Station 3	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL
DIPTERA (Chironomidae)								
Ablabesmyia mallochi (Walley)	P	7.2	1	X	4	X		
Chironomus sp.	CG	9.8				X		
Cricotopus (C.) trifascia group sp.	SH-d	2.8			12			
Cricotopus (I.) absurdus	CG	5		X			12	
Cricotopus / Orthocladius sp.	CG	7.1	32		156	X	130	X
Cricotpus (I.) "Ozarks"	SH-d	7			208			
Microtendipes pedellus group sp.	CF	6.2	86					
Parametriocnemus sp.	CG	3.7			4		24	X
Paratendipes albimanus (Meigen)	CG	9.2					4	
Polypedilum flavum (Joh.)	SH-d	5.3	47	X	212	X	6	
Polypedilum illinoense group sp.	SH-d	9	8	X			4	X
Rheocricotpus sp.	CG	6.8			4			
Rheotanytarsus exiguus group sp.	CF	6.4					2	
Stempellinella sp.	CG	4.6	1					
Stictochironomus sp.	CG	6.5	1	X		X		
Tanytarsus sp.	CF	6.7	1	X	4	X	2	X
Thienemanniella sp.	CG	5.9	3					
Thienemanniella xena (Roback)	CG	5.9			4			
Thienemannimyia group sp.	P	5.9	19	X	44	X	8	
Tventia paucunca (Saether)	CG	3.7					2	
DIPTERA (Other)								
Atrichopogon sp.	P	6.8				X		
Bezzia / Palpomyia grp. sp.	P	6.9				X		
Hemerodromia sp.	P	8.1				X		
Hexatoma sp.	P	4.3	1					
Simulium sp. (imm.)	CF	4	4	X	320	X	2	
MOLLUSCA								
Ferrissia sp.	SC	6.9	1					
Helisoma sp.	SC	6.5		X				
Physella sp.	SC	8.8	1	X		X	6	
Pisidium	CF	6.1	1			X		
Sphaerium sp.	CF	7.6		X		X		

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1

Collection Date: May and June, 2008

Banklick Creek Watershed Set 2
Kenton County, Kentucky

TRC Project Number: 8161-08

			BLC 13.5		BLC 15.6		BLC 17.8	
			Station 1		Station 2		Station 3	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL
OTHER TAXA								
Turbellaria gen. sp.	NA	7.2	3				2	X

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

APPENDIX C
BMP Implementation Plans

STRAND
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June 29, 2010

Mr. Daniel Bishop
Energy and Environment Cabinet–DEP DOW
200 Fair Oaks, 4th Floor
Frankfort, KY 40601

Re: Banklick Creek Watershed 319(h)
Best Management Practices Implementation Plan

Dear Daniel,

Enclosed is the Best Management Practices Implementation Plan for the Banklick Creek Watershed 319(h) Grant–Septic Repair Component. Please let me know if you have any questions.

Sincerely,

STRAND ASSOCIATES, INC.®

Kelly Kuhbander

Kelly M. Kuhbander

Enclosure: Implementation Plan Brief Report

c/enc: Sherry Carran, Banklick Watershed Council

KMK:clw\R:\CIN\Documents\Reports\Archive\2010\Banklick Watershed Council, KY\BMP IP for the BCW Septic Repair.3522001.kmk.june\Report\Brief Report.062910 .docx

This report describes the Green Infrastructure Best Management Practices (BMPs) to be implemented on the Banklick Creek Watershed under the 319(h) grant.

TECHNOLOGIES TO BE INSTALLED

This project consists of repairing or replacing failing septic systems in the Banklick Creek Watershed. Types of BMP technologies to be installed are as follows:

1. New septic tank and conventional leach lines to be installed in original or approved fill soil areas.

2. New septic tank and leaching chambers to be installed in original or approved fill soil areas.

3. Existing septic tank and new conventional leach lines to be installed in original or approved fill soil areas.

4. Existing septic tank and new leaching chambers to be installed in original or approved fill soil areas.

5. Addition of conventional leach lines or leaching chamber to existing systems that are surfacing sewage.

6. Experimental systems as submitted and approved; mandatory operation and maintenance contracts.

7. Any of the above systems with a pump tank and a pump to transfer the effluent from a lower tank to a higher lateral field if necessary.

DESCRIPTION OF SELECTION PROCESS

BMPs will be chosen once the applicant submits an application, which has been designed to collect information on the existing system as well as any information necessary to properly size any corrective actions that may be taken. If the minimum criteria have been met by the applicant, the application will be scored based on the impact on the waterway. It is important to note the applicant must be within the Banklick Creek Watershed and have an active sewage problem. Those applicants chosen will have a similar BMP to the current septic configuration implemented on their respective site.

The highest priority will be given to those installations that have the highest water pollution impact. The ranking will be determined based on the probable existing system components, amount of discharge, location of discharge, watershed and health impact, available repair area, and installation feasibility. Household income is optional, and may be supplied at the homeowner's discretion. A Health Department inspector will visit each property to evaluate the septic situation, repairs, and soil. This inspector will also rank the system for pollution impact to Banklick Creek. The Watershed Council is requiring each landowner to pay an evaluation fee and, if chosen, a permit fee.

Based on previous septic system projects, an average cost to repair/replace septic systems is nearly $6,000. The cost per system will vary depending on the extent of the repairs/replacement needed.

Relative treatment efficiency for a straight pipe system once repaired with an updated system that meets current on-site sewage regulations and is maintained accordingly should be 90 to 100 percent. Systems that have failing leach field systems and or leaking septic tanks which are repaired and maintained to meet current regulations should also show 90 to 100 percent efficiency. The relative treatment efficiencies and estimated load reductions for all installed BMPs will be submitted to KDOW in the 319(h) annual report.

HOW BEST MANAGEMENT PRACTICES ARE TARGETED TO SPECIFIC LOCATIONS

BMPs for this grant have been targeted using geographical information system (GIS) parcel data. In an effort to make a measurable water quality impact, the uppermost subwatershed was selected for the first round of septic repairs. Septic repair BMPs in this area of the watershed are identified as a need in the Banklick Watershed Plan. All septic parcels in this subwatershed within 200 feet of a stream were selected as target parcels. These property owners will be sent a direct mailing about the grant program, application information, and contact numbers. As outlined above, the selection process is designed to select for repair or replacement those failing septic systems or straightpipes that can be shown to have the highest impact on the streams.

FINANCIAL PLAN OF ACTION

The 319(h) grant is a 60/40 match-style grant. Forty percent of the total value of the grant comes from in-kind contributions and 60 percent comes from federal funds. The homewoner’s contribution of evaluation fee and permit fees will be utilized as in-kind match, and the remaining cost of the repairs will be paid from the federal funds. Financial assistance shall be provided as follows. A Health Department On-site Inspector shall evaluate and rank the project, the site, and the proposed repair/installation area. See attached ranking worksheet. The inspector shall perform any necessary soil and site evaluations at this time as well. A report shall be sent to the applicant with any necessary project modifications. A minimum of two bids must be submitted, and the potential award recipient shall be encouraged to accept the best and lowest bid. After a permit has been obtained and when weather and soil conditions are conducive, the septic system will be installed and then inspected by the On-site Inspector. Only when all inspections are completed and approved shall the funds be authorized to be disbursed directly to the Certified Septic Installer. All information pertaining to the application will be recorded and tracked on a database that will include information about the components of this grant, such as grant application number, significant dates, type of work done, overall cost of project, and amount disbursed.

MAINTENANCE AGREEMENT WITH LANDOWNER

If the system installed is an approved alternative system that requires an Operation and Maintenance contract, one will be required to be signed before the permit will be issued. Otherwise grant recipients will be expected to follow maintenance guidelines explained in person, in the “Homeowner’s Guide to Septic Systems”, and the “Groundwater Protection Plan” – these documents are included in the appendices. This agreement shall include provisions allowing United States Environmental Protection Agency (USEPA) and the state "to periodically inspect the practice during the life span of the project to ensure that operation and maintenance are occurring, and if it is determined that participants are not operating and maintaining practices in an appropriate manner, the USEPA or the state respectively, shall request a refund for that practice supported by the grant.

NOTIFICATION PROCESS TO KENTUCKY DIVISION OF WATER

Communication with Kentucky Division of Water (KDOW) has been open from the start of this project, and KDOW representatives are kept informed throughout the process. As applications are received and selected for high priority for funding, notification shall be sent to KDOW in batches, which shall be quarterly unless we are requested by KDOW to send them more often. As this plan is implemented KDOW NPS Section shall be updated and have ability to approve the number and specific types of system repairs made prior to their installation. When possible, pictures of the systems scheduled for repair shall be included with the submitted notification.

ADDITIONAL INFORMATION

The Appendix to this BMP Implementation Plan includes the following.

1. Letter to homeowners explaining the program.
2. Application to be completed by homeowners.
3. Ranking Scale to score application.
4. Map of parcels within 200 feet of streams in uppermost subwatershed.

APPENDIX

Banklick WATERSHED COUNCIL

How to apply for the Septic System Repair Grant

Thank you for your interest in this grant program, which is designed to improve water quality in Banklick Creek by assisting with septic system repairs. If you own and live in a home with a septic problem, and your home is within the Banklick Watershed, you may qualify for this grant.

Here are the guidelines to follow if you would like to apply.

Step 1: Submit the Enclosed Application Form by July 23, 2010

- Mail completed Septic System Repair Grant application to Sherry Carran at 927 Forest Ave. Covington, KY 41016
- The initial Septic System Repair Grant application is **Free**. The Banklick Watershed Council will contact you to assist you with completing the next steps in the process.

Step 2: Site Evaluation by Northern Kentucky Health Department

- The Banklick Watershed Council will provide you with a Site Evaluation Application and ranking form. This application is necessary to have the Northern Kentucky Health Department evaluate your septic system. The non-refundable fee for the site evaluation is **$125**. You will receive the results of the site evaluation.
- The Health Department Inspector will visit your home to evaluate your septic situation and available repair area and soil. Then he will send you a **Site Evaluation Report** that lists what needs to be done for the repair.
- The Inspector will also rank your existing system for water pollution impact on nearby streams and return the form to the Banlick Watershed Council. The highest ranking Septic System Repair Grant applications will be selected for repair first.

Step 3: Get Bids from At Least Two Certified Septic Installers

- Contact several Certified Septic System Installers, give them copies of the Site Evaluation Report, have them visit your house and prepare bids that show what they will do and how much it will cost. The best, lowest bid will be awarded the work.
- Send the following documents to Sherry Carran at 927 Forest Ave. Covington, KY 41016
  - ☐ Completed Site Evaluation Report
  - ☐ Copy of AT LEAST TWO Certified Septic System Installer Bids

Step 4: Installer Obtains Permit and Repairs Your Septic System

- You will be contacted if your system is selected. Your installer will have to obtain a permit at a cost of **$250** (which you are responsible to pay for) before beginning repairs to your system. When the repair work has been completed and all inspections are completed and approved, the Banklick Watershed Council will pay all installation costs directly to the Certified Installer.

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the Banklick Watershed Council (Grant # C9994861-07).

Banklick Septic System Repair Grant Application
RETURN BY JULY 23, 2010

Owner's Name (if different)____

Occupant's Name ____

Location of Property ____

City ______________ State _________ Zip Code_________ Phone No. _____________

The following is optional information you may include to further qualify for this grant.

Number of people residing in home __________ Annual household income___________

- -

Number of bedrooms in home _________ Number of people living in home _____________

Existing System: Type of Tank ________________ Size of Tank______________ gallons

Type of Leach Field ____________________________ Amount of leach line ________ feet

Is there an overflow line on your present system? Yes _____ No ______ Unknown ______

Is existing system discharging into creek, road ditch, or drainage? Yes ___ No ___Unknown ___

Mail completed application to Sherry Carran at 927 Forest Ave. Covington, KY 41016

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the Banklick Watershed Council (Grant # C9994861-07).

Banklick WATERSHED COUNCIL

Dear Banklick Creek Watershed Resident,

The Banklick Creek Watershed Council would like to announce a new program in target areas of the Banklick Creek Watershed for residents with septic systems. Banklick Creek is polluted with significant amounts of silt, agricultural waste (manure run-off), and sewage. To help reduce water pollution, the Banklick Creek Watershed Council has grant funds available to repair failing septic systems in your area. You are receiving this invitation to apply for funding because your property is located near a stream in the target area. If your system has problems, repairing your septic system could make the streams much cleaner.

The purpose of this grant is to help Banklick Creek Watershed residents (like you) replace straight pipes and/or repair failing septic systems, especially those that have a strong impact on Banklick Creek and its tributaries.

This project is voluntary and if you wish to participate; your property will be evaluated according to criteria below. If your property qualifies for funding, this grant will cover all costs for the repair except a $125 evaluation fee, and a $250 permit fee (if your system is selected for repair). Please see the enclosed application instructions for clarification on how and when these fees are collected.

The criteria for selection are as follows:

- Must be an existing home within the Banklick Creek Watershed
- Must have an active sewage problem
- Must have impact on a waterway within the Banklick Creek Watershed; highest priority will be given to those that have the highest water pollution impact.

Highest priority installations will be awarded in the summer of 2010. If funds are still available in 2011, lower impact installations may be addressed.

If you would like to participate in this program, please review the attached instructions and return the application form.

If you have any questions concerning this program, please contact Sherry Carran at carranbs@fuse.net or by phone at 859-491-0722.

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the Banklick Watershed Council (Grant # C9994861-07).

Onsite Wastewater Incentive Grant

Application #____________________________

Name:_________________________________ Address:____

CRITERIA	RATING SCALE				SCORE
	8 7	6 5	4 3	2 1 0	
Probable existing system components	No tank or lateral field	Tank only Type:_______________	Tank field with overflow pipe	Tank field with no overflow pipe Feet:__________________	___________
Amount of discharge	Major surface discharge evidence	Significant surface discharge evidence	Minor surface discharge evidence	No discharge evidence	___________
Location of discharge	Discharging directly to stream or body of water	Discharge directly onto other lots and/or into drainages, ditches,gullies, etc…	Discharge crosses property lines	Discharge contained within lot	___________
Watershed/Health Impact	Major risk by direct exposure	Significant risk by direct or indirect exposure	Moderate risk	Minor or no impact	___________
Available repair area	Ample usable space for system repair	Moderate usable space for system repair	Very limited usable repair space but some repair possible	No usable repair space available	___________
Installation Feasibility	Excellent site conditions favorable with minimum enhancement	Good site conditions favorable with moderate enhancement	Fair site conditions can be upgraded by major enhancement	Poor site conditions not conducive to repair	___________
Household Income (if supplied on application)	<$25,000 annual	$25,000 - $40,000 annual	$40,000 - $75,000 annual	>$75,000 annual	___________
				TOTAL	___________

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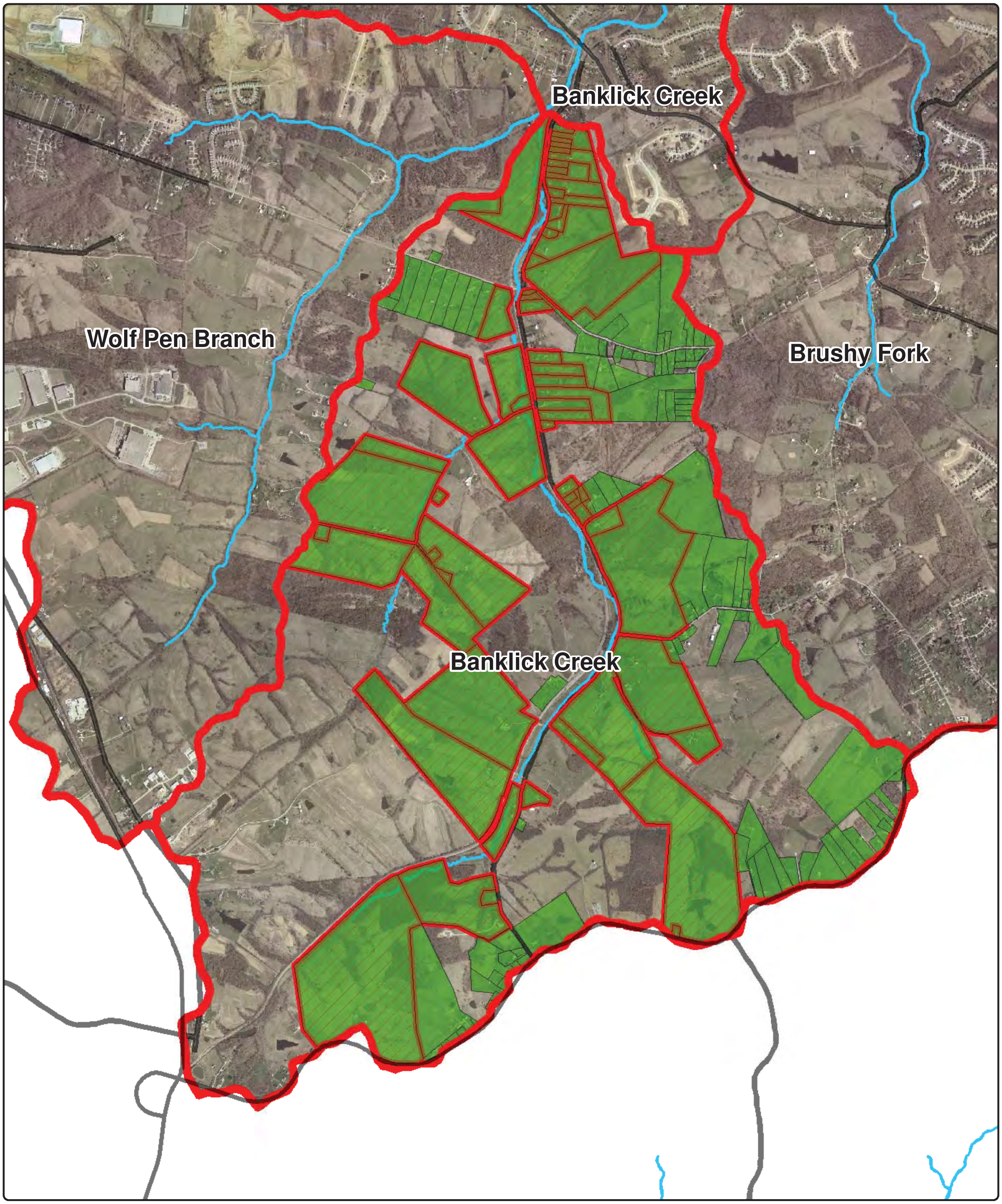


BANKLICK CREEK WATERSHED
SEPTIC BMP TARGET AREAS

BANKLICK CREEK WATERSHED
BANKLICK WATERSHED COUNCIL
NORTHERN KENTUCKY

STRAND ASSOCIATES, INC. ENGINEERS

1901.001

March 5, 2012

Mr. Daniel Bishop
Kentucky Division of Water
Frankfort, KY

Re: Banklick Creek Watershed 319(h)
Best Management Practices Implementation Plan

Dear Daniel,

Enclosed is one copy of the Best Management Practices Implementation Plan for the Banklick Creek Watershed 319(h) Grant - Infiltration Techniques report. Please call with any questions.

Sincerely,

STRAND ASSOCIATES, INC.®

Kelly M. Kuhbander

Enclosure: Implementation Plan Report

c/enc: Sherry Carran, Banklick Watershed Council

Report for

Kentucky Division of Water

Best Management Practices Implementation Plan for the Banklick Creek Watershed 319(h) Grant - Infiltration Techniques

Prepared by:

STRAND ASSOCIATES, INC.®
910 West Wingra Drive
Madison, WI 53715
www.strand.com

March 2012

STRAND ASSOCIATES®

This report describes the Infiltration Best Management Practices (BMPs) to be implemented in the Banklick Creek Watershed under the 319(h) grant.

TECHNOLOGIES TO BE INSTALLED

This project consists of designing and installing green infrastructure BMPs in the Banklick Creek Watershed that promote shallow infiltration. Types of BMP technologies that may be installed include, but are not limited to the following:

1. Rain gardens
2. Bioswales
3. Extended detention basin with native plantings
4. Reforestation
5. Green Streets
6. Similar green infrastructure practices that provide water quality benefits and infiltration

DESCRIPTION OF SELECTION PROCESS

Infiltration was chosen as an implementation measure for the Watershed Based Plan (WBP) as it has been shown to reduce bacteria loadings by 35 to 90 percent. Only infiltration techniques will be employed to promote groundwater recharge while providing water quality benefits. Soil type will mandate the locations and types of infiltration techniques that can be implemented within the watershed. BMP locations will be identified based on willing partners, available land, watershed drainage, soil types, and visibility.

HOW BEST MANAGEMENTS PRACTICES ARE TARGETED TO SPECIFIC LOCATIONS

BMPs for this grant have been targeted using geographical information system (GIS) data. GIS soil data was used to identify areas with the best infiltration rates. The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) has classified the soil with hydrologic soil groups, an indication of the infiltration rate of that soil. The majority of the focus area is hydrologic soil group C, which has an infiltration rate of 0.17 to 0.27 in/hr. As shown in the map in Appendix A, soil group B tends to be found along the creek bank; these will be the priority areas for infiltration implementation.

On-going education is an important aspect of implementation of the WBP for Banklick Creek. Locations may be given priority if there are ample opportunities to educate and/or inform members of the community through infiltration implementation. Identifying willing partners for these programs will also play a role in the locations of the features.

FINANCIAL PLAN OF ACTION

The 319(h) grant is a 60/40 match-style grant. Forty percent of the total value of the grant comes from in-kind contributions and 60 percent comes from federal funds. The infiltration implementation will receive a portion of the $567,000 of federal money that is currently budgeted for BMP Implementation. In addition, $458,083 of non-federal match has been identified for BMP Implementation. According to the WBP, at least $20,000 is planned to be spent in designing and implementing infiltration techniques.

MAINTENANCE AGREEMENT WITH LANDOWNER

It is the expectation of Banklick Watershed Council (BWC) that all feature maintenance of the features will be performed by the landowner or SD1. An Operation and Maintenance contract will be required between BWC and the landowner or SD1 and will be signed before construction commences. This agreement shall include provisions allowing the USEPA and the state "to periodically inspect the practice during the life span of the project to ensure that operation and maintenance are occurring, and if it is determined that participants are not operating and maintaining practices in an appropriate manner, EPA or the State respectively, will request a refund for that practice supported by the grant."

NOTIFICATION PROCESS TO KENTUCKY DIVISION OF WATER

Communication with Kentucky Division of Water (KDOW) has been open from the start of this project, and KDOW representatives are kept informed throughout the process. As sites are identified for shallow infiltration implementation, notification shall be sent to KDOW. KDOW will also have the opportunity to comment on the plan set prior to construction of features. If desired, KDOW will also be kept apprised of the construction progress, and when possible, pictures of the construction progress will be submitted to KDOW in a summary memorandum at the completion of construction.

APPENDIX
ADDITIONAL INFORMATION

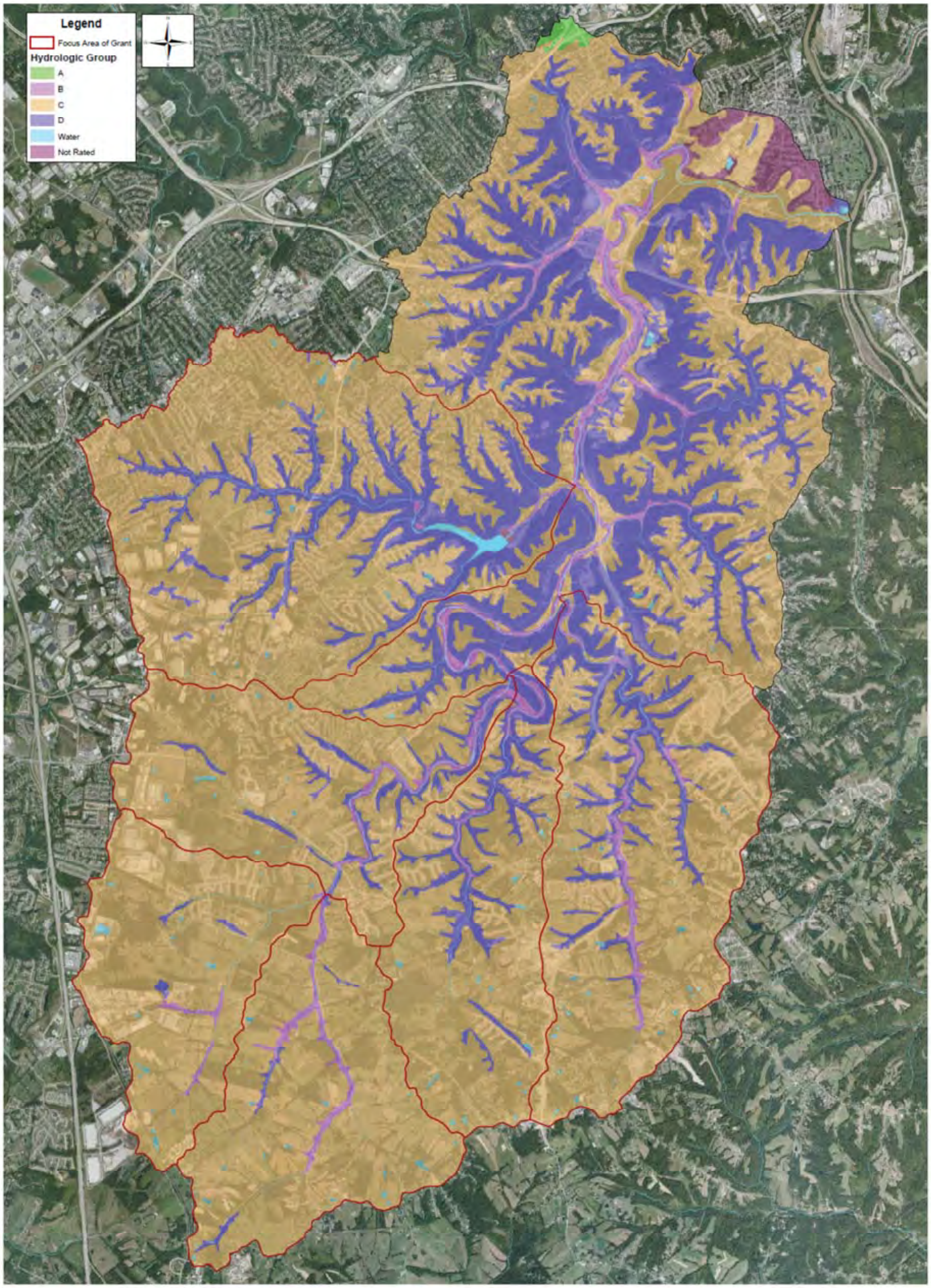


Figure A.01-1 Soils Map

March 5, 2012

Mr. Daniel Bishop
Kentucky Division of Water
Frankfort, KY

Re: Banklick Creek Watershed 319(h)
Best Management Practices Implementation Plan

Dear Daniel,

Enclosed is one copy of the Best Management Practices Implementation Plan for the Banklick Creek Watershed 319(h) Grant - Pasture Management Techniques report. Please call with any questions.

Sincerely,

STRAND ASSOCIATES, INC.®

Kelly M. Kuhbander

Enclosure: Implementation Plan Report

c/enc: Sherry Carran, Banklick Watershed Council

Report for

Kentucky Division of Water

Best Management Practices Implementation Plan for the Banklick Creek Watershed 319(h) Grant - Pasture Management Techniques

Prepared by:

STRAND ASSOCIATES, INC.®
910 West Wingra Drive
Madison, WI 53715
www.strand.com

March 2012

This report describes the Best Management Practices (BMPs) for pasture management to be implemented in the Banklick Creek Watershed under the 319(h) grant.

TECHNOLOGIES TO BE INSTALLED

This project consists of implementing pasture management BMPs in the Banklick Creek Watershed that will reduce livestock interaction with the creek, and improve water quality. Types of BMP technologies that may be applied include, but are not limited to, the following:

1. Livestock exclusion fencing or hedgerows
2. Rotational grazing or other improved grazing methods
3. Establishment of alternative drinking water source(s)
4. Limited access practices
5. Installation of hardened access points for drinking water consumption
6. Similar practices that provide water quality benefits

DESCRIPTION OF SELECTION PROCESS

Agricultural animals are a source of fecal coliform loading in streams through direct and indirect activities. Animals with access to the streams can directly deposit feces into streams or onto their banks; animal feces can also be deposited in fields and be transported via overland flow during rain events. It is estimated that the average fecal loading from raw livestock manure contains over 2,500,000 cfu per gram of manure.

There are roughly 3,000 livestock animals within the Banklick watershed, and these livestock should be kept out of Banklick Creek in order to reduce fecal loading. The goal established in the Watershed Based Plan (WBP) is to reduce the fecal loading of Banklick Watershed by 21 percent. Through a prioritization of numerous management measures, the technologies stated above encompass the efforts that will assist in the attainment of this goal.

HOW BEST MANAGEMENTS PRACTICES ARE TARGETED TO SPECIFIC LOCATIONS

BMPs for this grant have been targeted using geographical information system (GIS) data. GIS data layers for Kenton County were evaluated to determine the approximate area of agricultural lands within the watershed. Based upon data from the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS), over 9,000 livestock are present within Kenton County. Using a rough percentage of the total agricultural land in the county versus the watershed, the estimated number of livestock within the watershed, about 3,000, was developed.

On-going education is an important aspect of implementation of the WBP for Banklick Creek. Specific locations may be given priority if there are farmers who would willfully participate in the program. These farmers may be identified as educational information is distributed to farmers throughout the watershed.

FINANCIAL PLAN OF ACTION

The 319(h) grant is a 60/40 match-style grant. Forty percent of the total value of the grant comes from in-kind contributions and 60 percent comes from federal funds. A total of $1,025,083 has been set aside for all BMP implementation efforts, which is comprised of $567,000 of federal money and $458,083 of non-federal match. The pasture management implementation will receive a portion of this, but no set dollar amount was identified in the WBP to be for the purpose of pasture management, this will allow greater flexibility to respond to qualified projects as needed.

As a reference point, livestock fencing costs range from $0.70 to $2.00 per linear foot. Livestock stream crossings cost $2,500 to $5,000 each and a watering system for livestock can range anywhere from $500 to over $8,000.

MAINTENANCE AGREEMENT WITH LANDOWNER

It is the expectation of Banklick Watershed Council (BWC) that minimal maintenance efforts will be needed for the pasture management techniques that are employed. However, all maintenance is expected to be performed by the landowner. An Operation and Maintenance contract will be required between BWC and the landowner and will be signed before construction commences. This agreement shall include provisions allowing the USEPA and the state "to periodically inspect the practice during the life span of the project to ensure that operation and maintenance are occurring, and if it is determined that participants are not operating and maintaining practices in an appropriate manner, EPA or the State respectively, will request a refund for that practice supported by the grant."

NOTIFICATION PROCESS TO KENTUCKY DIVISION OF WATER

Communication with Kentucky Division of Water (KDOW) has been open from the start of this project, and KDOW representatives are kept informed throughout the process. As properties are identified for pasture management implementation, notification shall be sent to KDOW. As this plan is implemented, KDOW NPS staff shall be updated and have ability to approve the number and specific types of pasture improvements made prior to their installation. When possible, pre- and post-improvement pictures shall be included with the submitted information.

APPENDIX D
Public Input Documentation

Our Water

Lajuanda Haight-Maybriar

Licking River Basin Coordinator
Kentucky Division of Water
Kentucky Department for Environmental Protection

Anything we do to the land will affect our water.

We pave over it

We build houses on it

We farm it

We mine it

We log it

We treat our poop on it or in it,
or

—— not

Our animals poop on it

We dump trash, used oil, gasoline, paint, etc on it

Ponds and their watersheds

What is a watershed?

A watershed is the land in an area where all of the water running off that land and soaking into that land drains to a specific point in a stream

Watersheds are "nested" - each smaller watershed is also part of a larger watershed

Very large watersheds are often called basins. Here is a map of the major river basins in Eastern Kentucky. Which basin do you live in?

The spring in Magoffin County that is the beginning of the Licking River – the headwaters

The mouth of the Licking River on the Ohio River across from Cincinnati

Anything <u>we</u> do to the land will affect <u>our</u> water.

Sign Up Sheet

Banklick Watershed Council Public Meeting – March 23, 2009

Name	Address	Phone no.	email
Wilhelm Kossenjans	3870 Richardson Rd Independence	283-1282	Wilhelm.Kossenjans@uc.edu
Brooke Shireman	200 Fair Oaks Frankfort, KY	502-564-3410	brooke.shireman@ky.gov
Lajuanda Haight-Maybriar	525 Hecks Plaza Dr. Morehead KY 40351	606 783 8655	lajuanda.haight-maybriar@ky.gov
Kelly Kaufman	615 Elsinore Pl Cincinnati OH	513 861 5600	kelly.kaufman@strand.com
MaryPat Behler	806 Stablewatch Dr. Independence, KY 41051	(859) 356-0297	behler55@zoomtown.com
Lorna Harrell	686 Ridge Rd Taylor Mill, Ky 41015	859.581.8052	harrellky@fuse.net
Casey Mattingly	437 Ripple Creek Dr Elsmere, Ky 41018	859.445.1682	clmattingly@mactec.com
Charlotte Thompson	11015 Banklick Rd	356-9713	
John Wood	PO Box 11 Indep Ky	356-1360	

Sign Up Sheet

Banklick Watershed Council Public Meeting – March 23, 2009

Name	Address	Phone no.	email
Matt Wooten	SD1	859-578-6887	mwooten@sd1.org
Lennie Collins	1518 Walton Nich	859-356-5751	
John Lyons	Strand	513-861-5600	john.lyons@strand.com
Donna Horine	524 E. Southern Ave. Covington Ky 41015	859-261-3525	dmhorine@zoom.com
Kevin Bramlage	11209 Banklick Road Walton, Ky 41094	859-653-2550	

Banklick Watershed 319(h) Non-Point Source Grant Public Input Meeting

Strand Associates, Inc.

John Lyons, P.E.

April 16, 2009

BANKLICK WATERSHED CHARACTERISTICS

Legend

Banklick Watershed

Data Source:
Sanitation District No. 1

BANKLICK WATERSHED CHARACTERISTICS

Legend

★ Strand Sampling Points

Kentucky 303(d) List

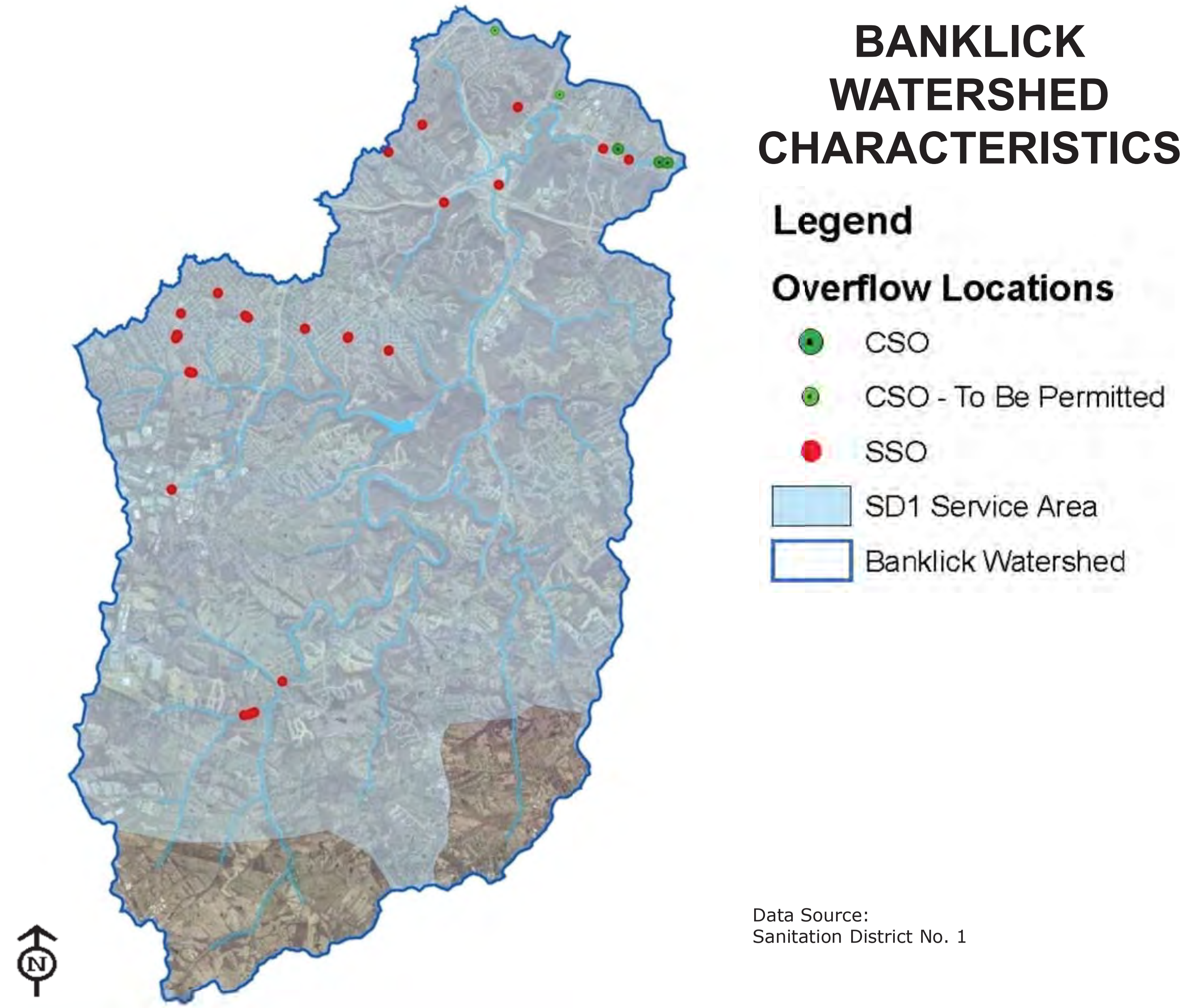
FC/NE/OE

FC/NE/OE/SS

Banklick Watershed

Data Source:
Sanitation District No. 1
Strand Associates, Inc.
2008 303(d) List

BANKLICK WATERSHED CHARACTERISTICS



Data Source:
Sanitation District No. 1

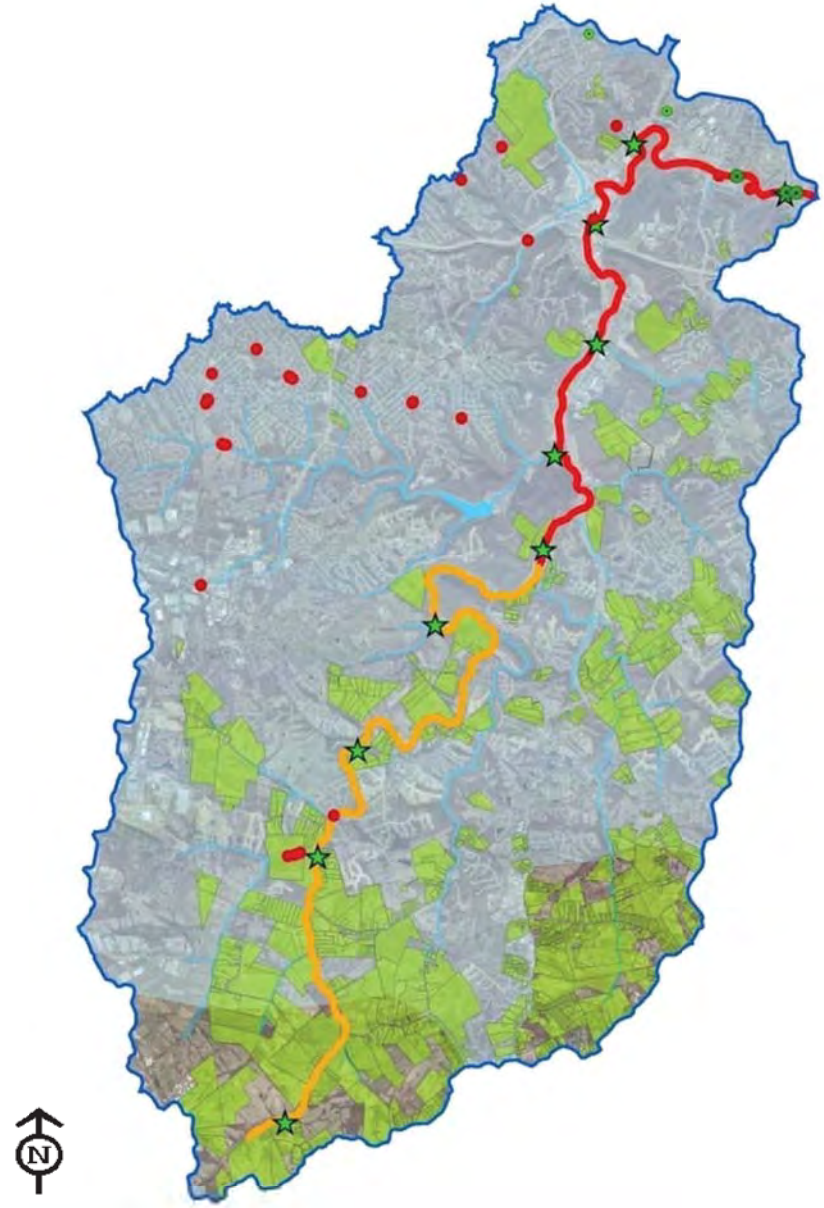
BANKLICK WATERSHED CHARACTERISTICS

Legend

- Potential Septic Systems
- Banklick Watershed

Data Source:
Sanitation District No. 1

BANKLICK WATERSHED CHARACTERISTICS



Legend

Overflow Locations

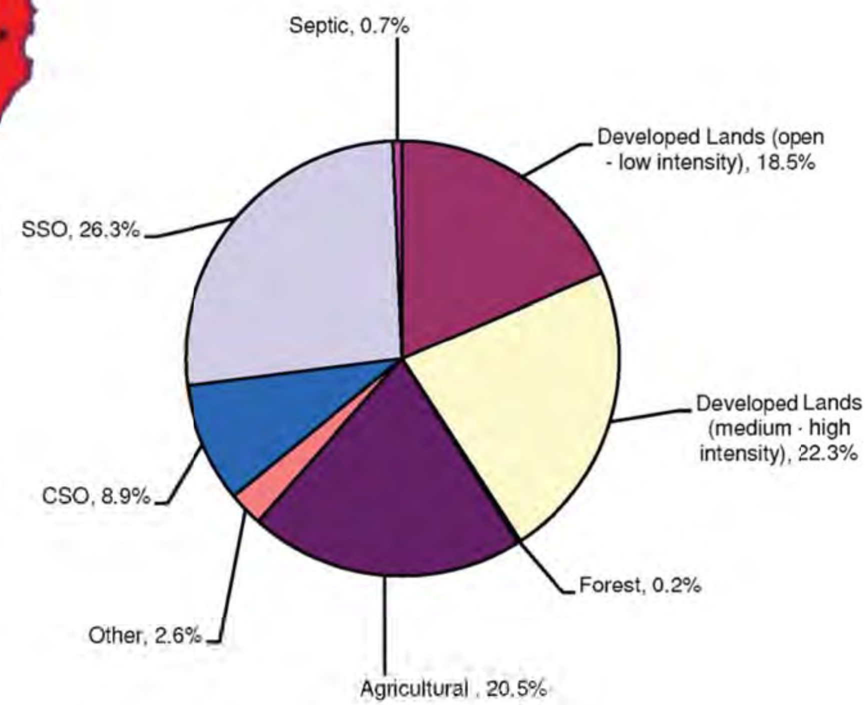
- CSO
- CSO - To Be Permitted
- SSO
- Strand Sampling Points

Kentucky 303(d) List

- FC/NE/OE
- FC/NE/OE/SS
- Potential Septic Systems
- SD1 Service Area
- Banklick Watershed

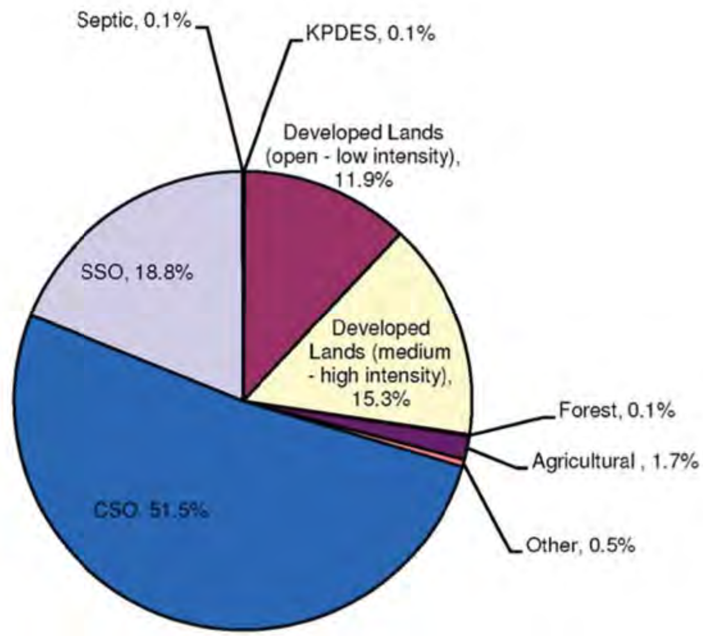
Data Source:
Sanitation District No. 1
Strand Associates, Inc.
2008 303(d) List

BANKLICK WATERSHED FECAL LOADINGS



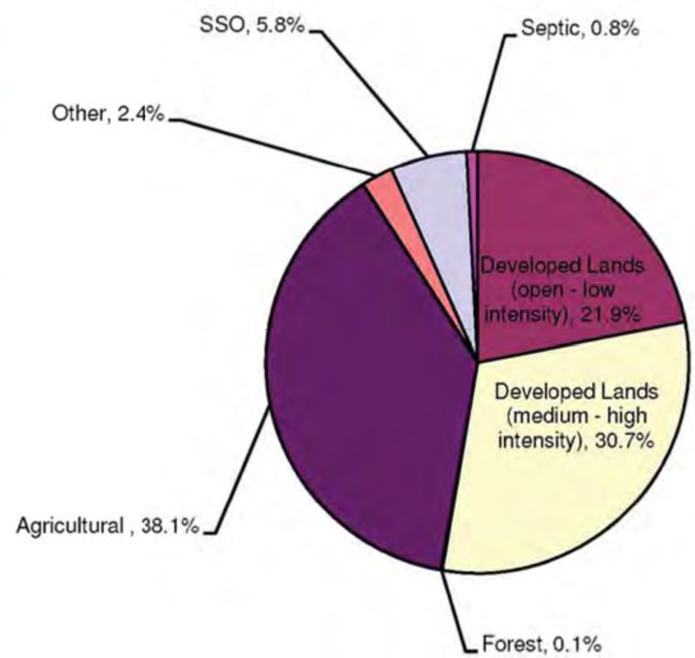
Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

BANKLICK CREEK SUBWATERSHED-01 FECAL LOADINGS

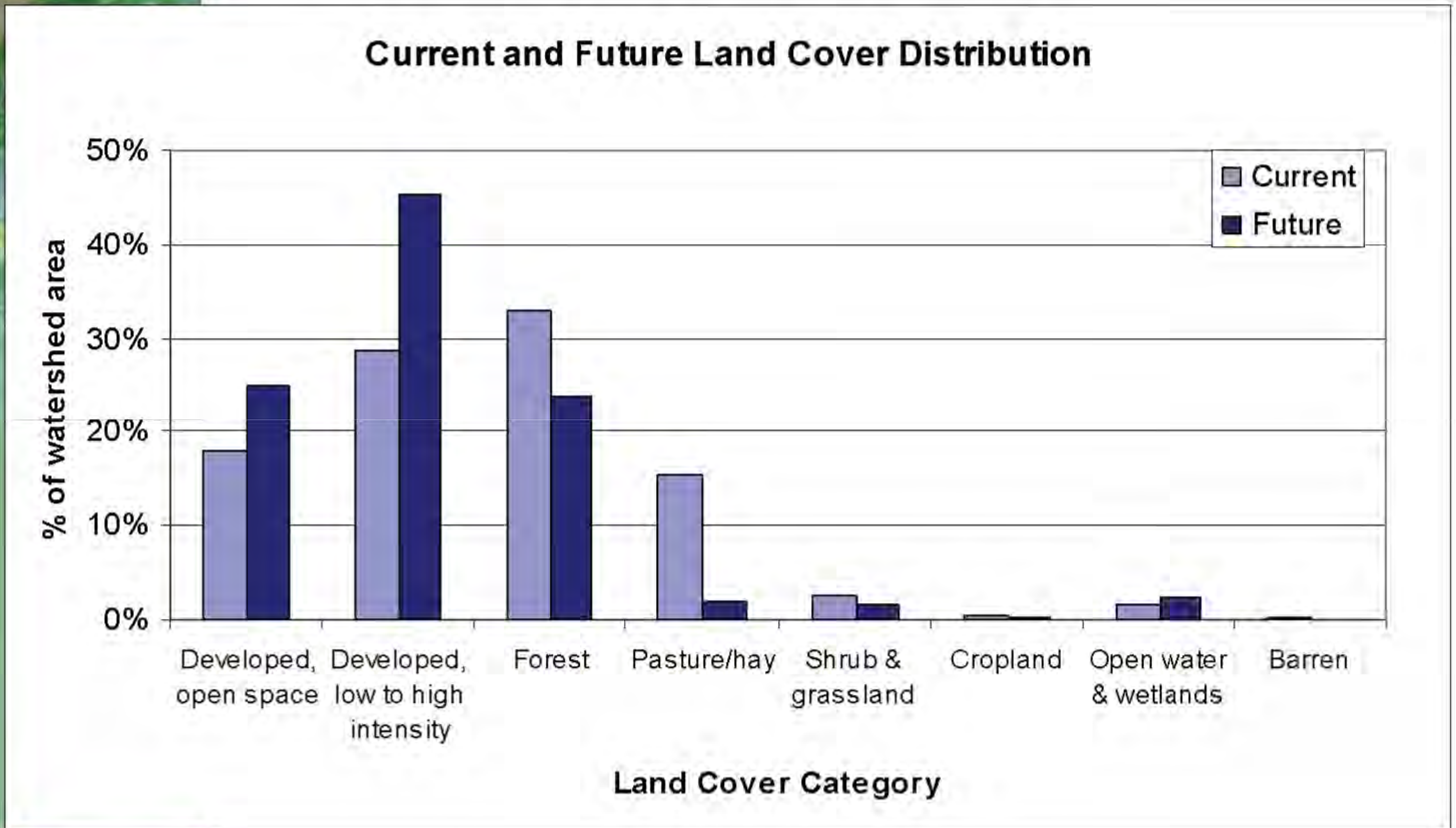


Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

WOLF PEN BRANCH SUBWATERSHED FECAL LOADINGS

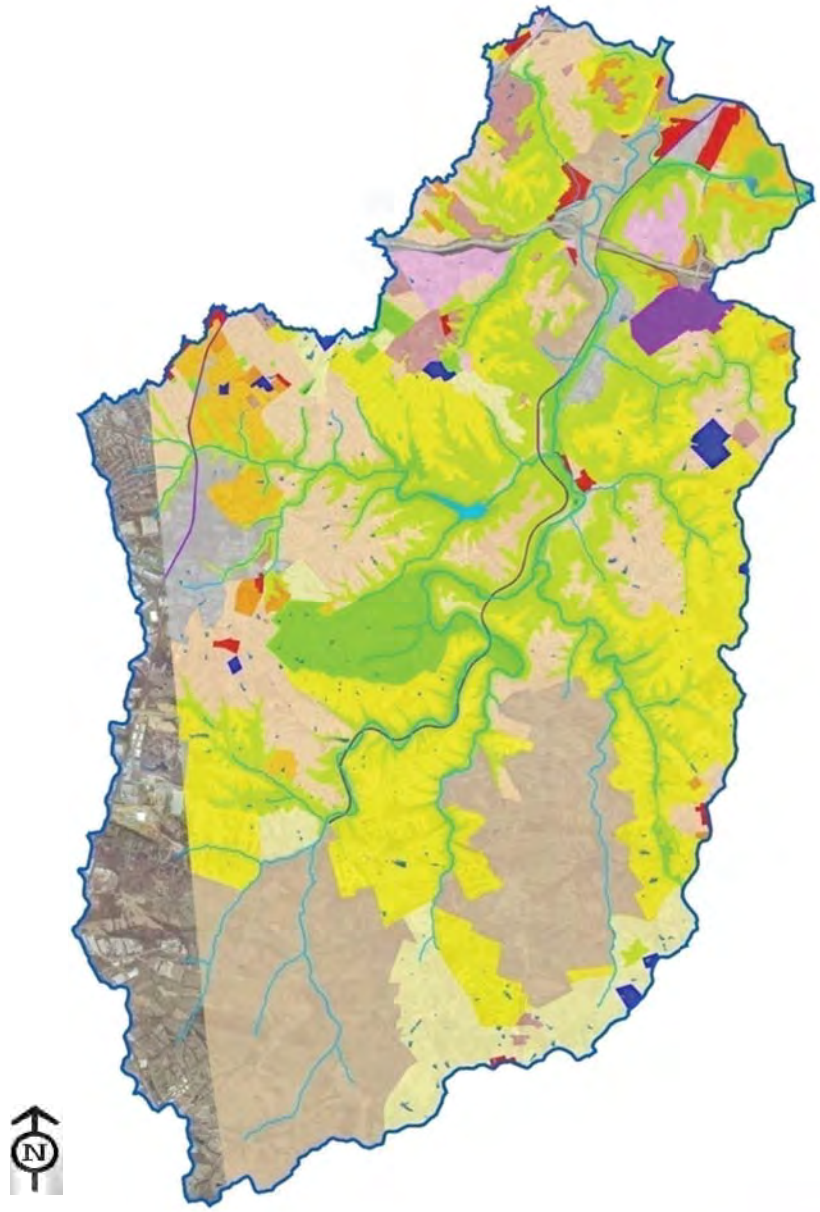


Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report



Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

BANKLICK WATERSHED FUTURE LAND USE



Legend

- Residential Under 2.0
- Residential 2.1 TO 4.0
- Residential 4.1 TO 7.0
- Residential 7.1 TO 14.0
- Residential 14.1 TO 30.0
- Residential Over 30.0
- Commercial Retail/Service
- Commercial Office
- Commercial Rural
- Special Development Area
- Industrial
- Rail Road
- Agricultural and Rural Uses
- Physically Restrictive Development Area
- Water
- School Parks
- Recreation and Open Space
- Other Community Facilities
- Small Study Area
- Right of Way

Data Source:
Kenton County 2006 Comprehensive Plan, NKAPC
Sanitation District No. 1

NORTHERN BANKLICK WATERSHED

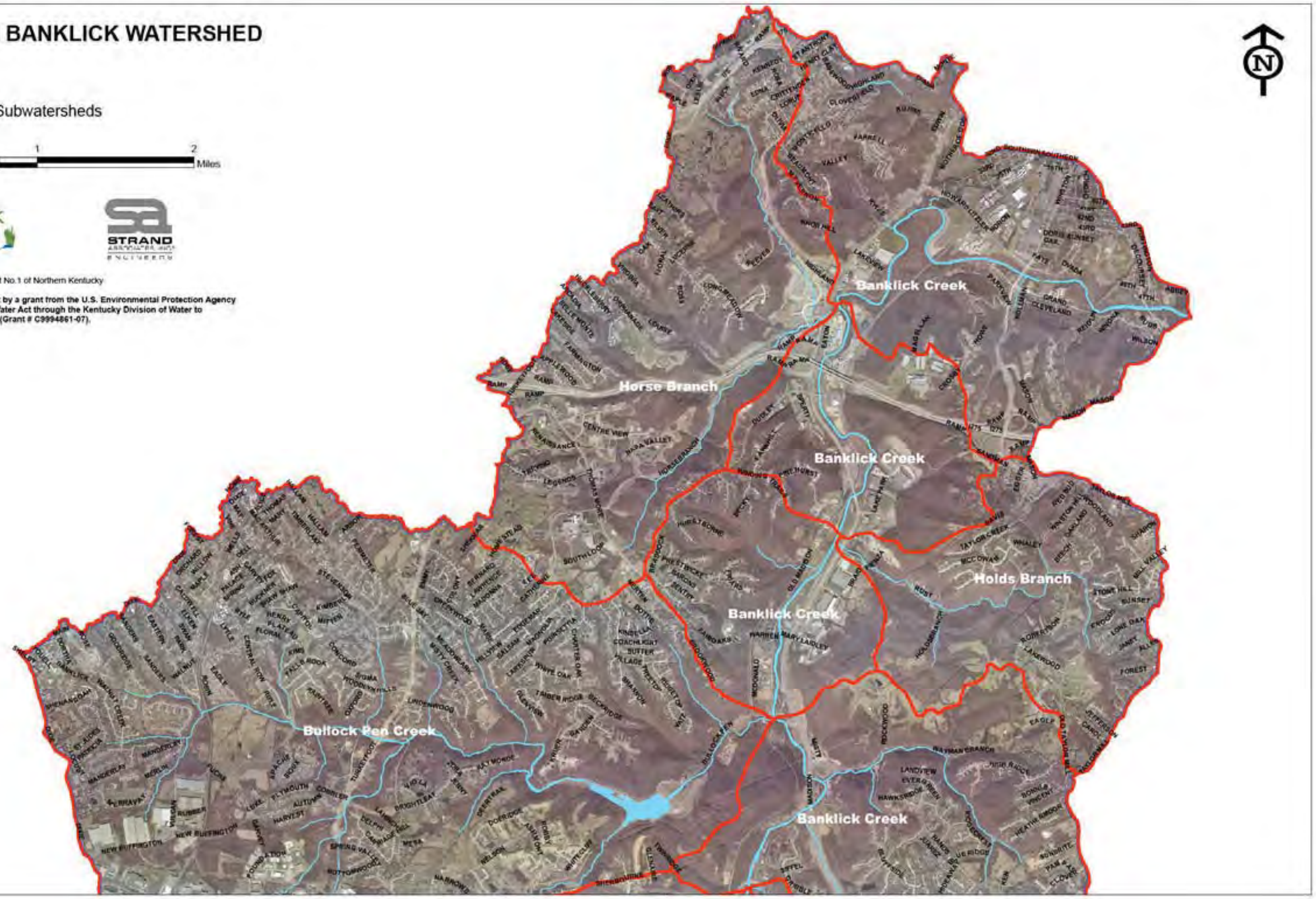
Legend

Banklick Subwatersheds

0 0.5 1 2 Miles

Data Source: Sanitation District No.1 of Northern Kentucky

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to Banklick Watershed Council (Grant # C9994861-07).



Banklick Watershed Council Public Input Meeting

Name (Optional): ______________________________

Contact Information (Optional):

Check all that apply:

☐ I would like to stay informed about what is happening in the Banklick Watershed

☐ I would like to become more involved with the Banklick Watershed Council by: attending future meetings, volunteering at events, or ____________________________________.

☐ I would be interested in working with the council to implement a project on my land such as: stream restoration, reforestation, cattle fencing, septic tank improvements, stream bank restoration, rain gardens, or ____.

☐ I believe that the following are major concerns in this watershed that must be addressed to improve the streams: ____

____

____

____

____

☐ Other Information I would like to share: ______________________________________

____

____

____

____

Banklick WATERSHED COUNCIL

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act.

STRAND ASSOCIATES, INC.® ENGINEERS

Banklick WATERSHED COUNCIL

PUBLIC INPUT SURVEY

927 Forest Ave
Covington, KY 41016

Thank you for participating in the survey! As you are probably aware, Banklick Creek has been listed as a polluted waterway for various uses by the Kentucky Division of Water (KDOW). Your input is valuable as we move forward in addressing some of the associated issues.

1. How would you describe your property?

☐ Residential ☐ Farm/ Agriculture ☐ Industrial

☐ Commercial ☐ Other ______________________________

2. Is there a creek that flows on, adjacent to your property or that you are very familiar with? (Skip to question 6 if your answer is No)

☐ Yes ☐ No ☐ Unsure

3. When do you see water in the creek?

☐ Year round ☐ Just when in rains ☐ Just during heavy rain periods

☐ Most of the time but it dries out during dry summer months

4. Does the creek that flows on or adjacent to your property flood?

☐ Often ☐ Only during heavy rain periods ☐ Does not flood

5. Would you be interested in working with the council to implement a project on your land for any of the following?

☐ Stream restoration ☐ Reforestation ☐ Cattle fencing,

☐ Septic tank improvements ☐ Stream bank restoration ☐ Rain gardens

☐ Other ____.

6. Which of the following are major concerns that must be addressed to improve Banklick Creek?

☐ No concern ☐ Animals ☐ Sedimentation

☐ Development practices ☐ Septic systems

☐ Other ____________________________________

7. On a scale of 1 to 5, with 1 being not important and 5 being very important, how important is it that Banklick Creek is safe for:

1. Children to play	1	2	3	4	5
2. Habitat	1	2	3	4	5
3. Fishing	1	2	3	4	5

8. What is the quality of the water in the creek?

- ☐ Fish and other aquatic life can be seen
- ☐ No aquatic life can be seen
- ☐ Dead fish or other aquatic life can be seen
- ☐ Bad odors are coming from the creek
- ☐ The water is usually muddy
- ☐ The water seems to be polluted
- ☐ I feel it is safe for people to be in contact with the creek water because the water is clear

9. Other Information I would like to share:

Name (Optional): ____

Contact Information (Optional):

Check all that apply:

☐ I would like to stay informed about what is happening in the Banklick Watershed

☐ I would like to become more involved with the Banklick Watershed Council by attending future meetings, volunteering at events, or ____.

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act.

Public Survey Results

Question 1: How would you describe your property?

More than 91 percent of the respondents described their property as residential, 6 percent were described as Farm/Agriculture, and 2 percent described their property as commercial. Figure C.01-1 represents the number of residents who live in each property category.

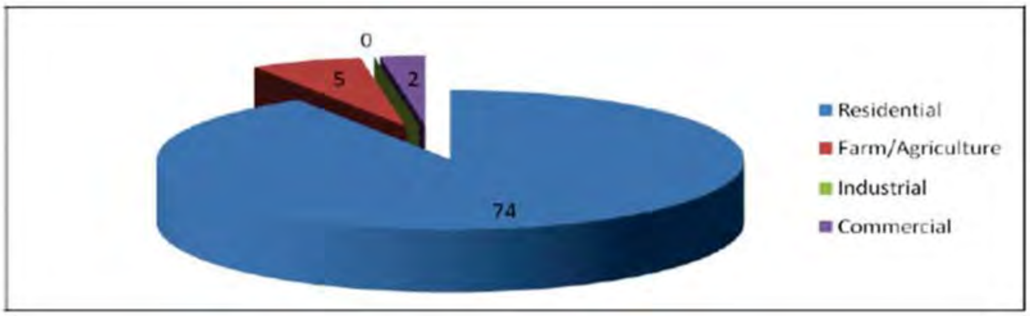


Figure C.01-1 Survey Question 1 Results

Question 2: Is there a creek that flows on, adjacent to your property or that you are very familiar with?

Two-thirds of the respondents know of a creek that flows on, adjacent to their property, or are very familiar with a creek while the other one-third do not. Figure C.01-2 provides the number of residents who answered Yes and No.

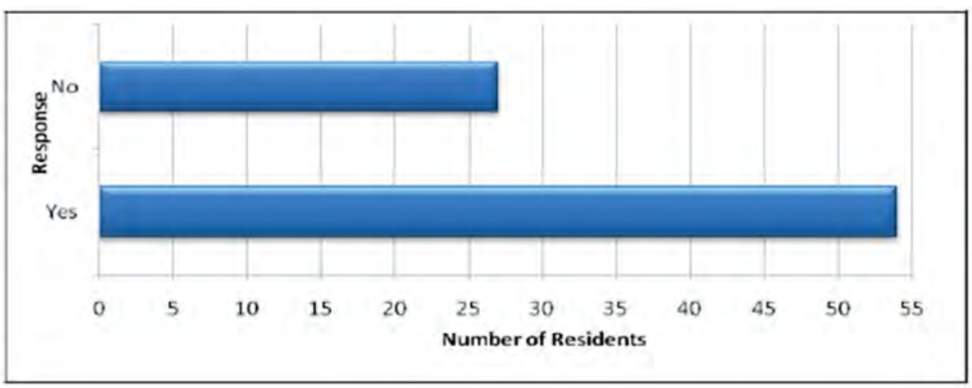


Figure C.01-2 Survey Question 2 Results

Question 3: When do you see water in the creek?

Out of the 54 residents who answered question 2, only 53 answered question 3. Nearly 45 percent of the 53 people said they see water in the creek year-round. None of the respondents claim that there is water in the creek only after heavy rain storms. See Figure C.01-3.

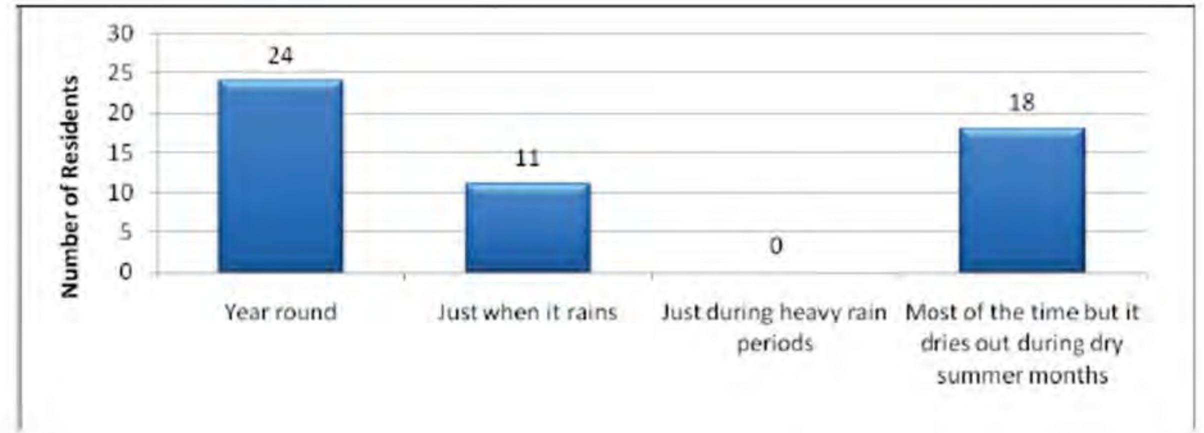


Figure C.01-3 Survey Question 3 Results

Question 4: Does the creek that flows on or adjacent to your property flood?

Approximately half of the 53 residents who responded to this question believe that the creek does not flood. Although, there were 4 percent, two residents, who believe that it floods often. See Figure C.01-4.

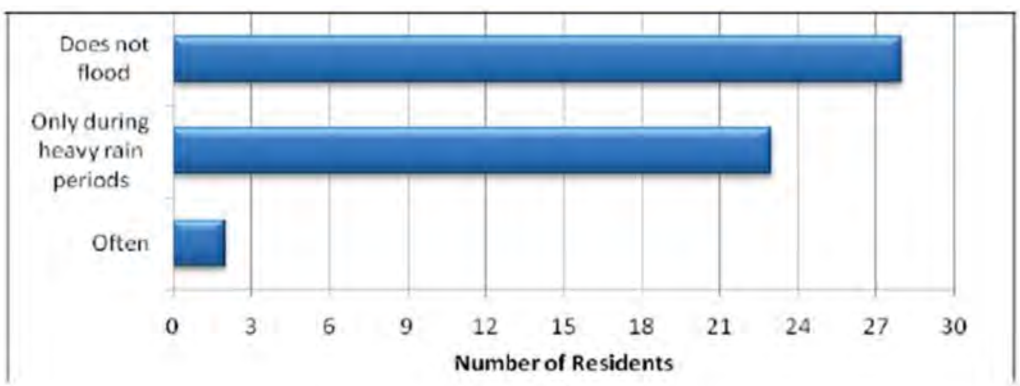


Figure C.01-4 Survey Question 4 Results

Question 5: Would you be interested in working with the council to implement a project on your land for any of the following?

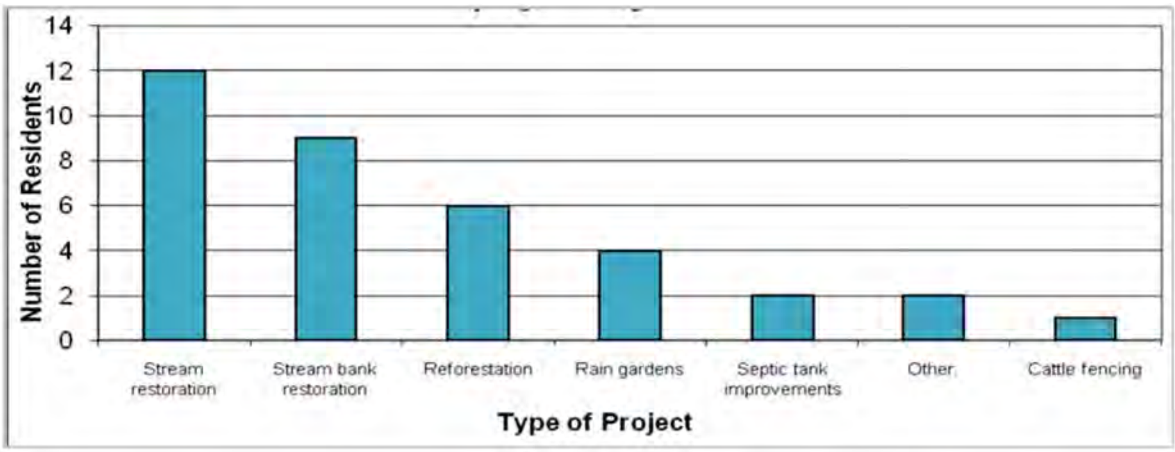


Figure C.01-5 Survey Question 5 Results

As shown in Figure C.01-5, of the 14 residents who responded to this question, 12 of them are interested in working with the council to implement stream restoration on their property. Another nine residents would be in favor of stream bank restoration.

<u>Question 6: Which of the following are major concerns that must be addressed to improve Banklick Creek?</u>

Based on the surveys, development practices, sedimentation, and septic systems seem to be what most residents believe are major concerns that must be addressed to improve the creek. Six of the 66 residents put all three as concerns in their surveys as shown in Figure C.01-6.

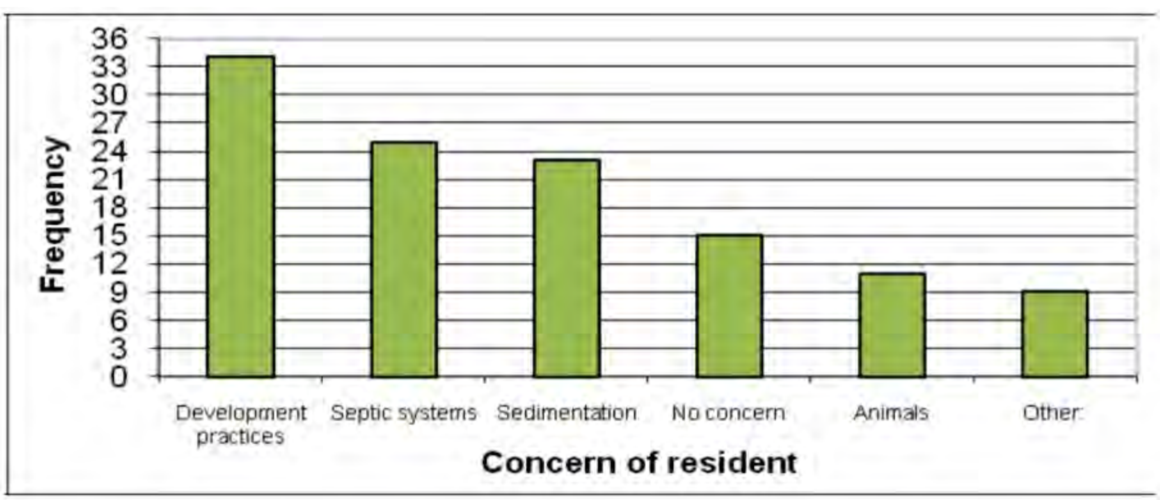


Figure C.01-6 Survey Question 6 Results

Question 7: On a scale of 1 to 5, with 1 being not important and 5 being very important, how important is it that Banklick Creek is safe for: A. Children to play? B. Habitat? C. Fishing?

More than 62 percent of 69 people who responded to this question believed that having Banklick Creek safe for children to play in or around is very important based on them responding with a 5 to this question as shown in Figure C.01-7.

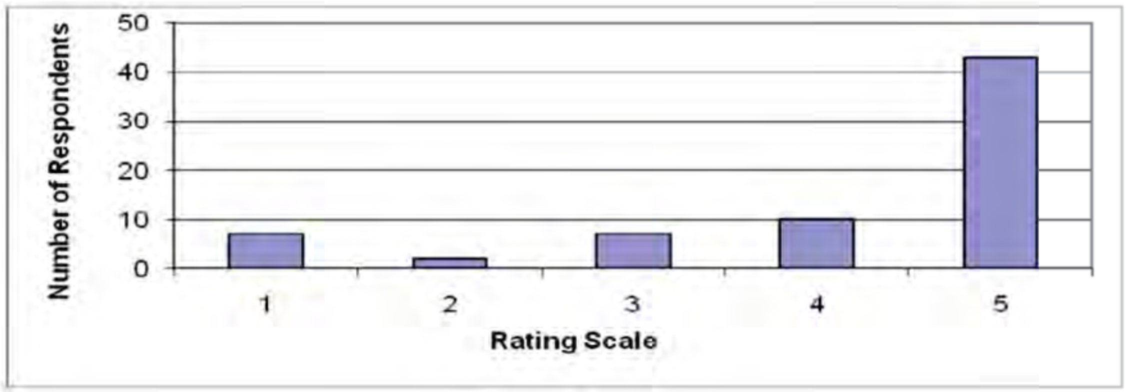


Figure C.01-7 Survey Question 7A Results

Approximately 57 percent of the respondents believe that habitat safety is very important in the Banklick Creek area and gave this the highest rating of 5 (see Figure C.01-8).

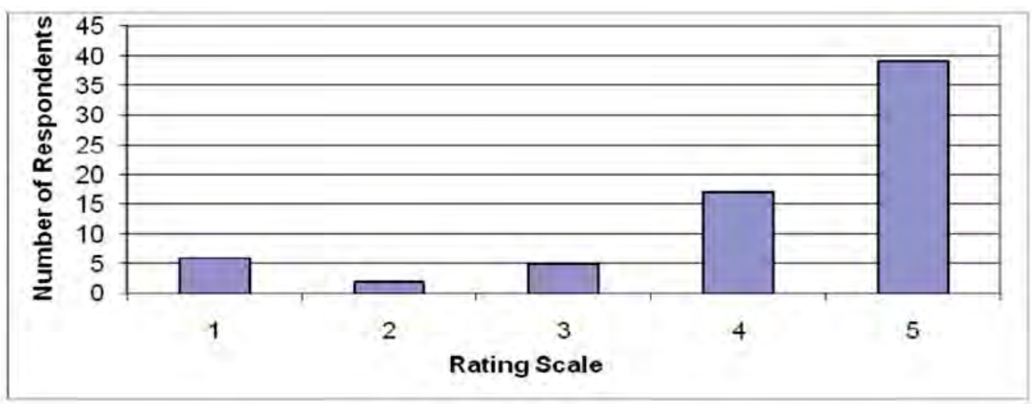


Figure C.01-8 Survey Question 7B Results

Less than half, 42 percent, believe that the fishing is very important in Banklick Creek based on the quantity of 5s received. The rating of a 5 still received the highest number of votes but there were also a larger number of residents who responded with a rating of 3 or 4 (see Figure C.01-9).

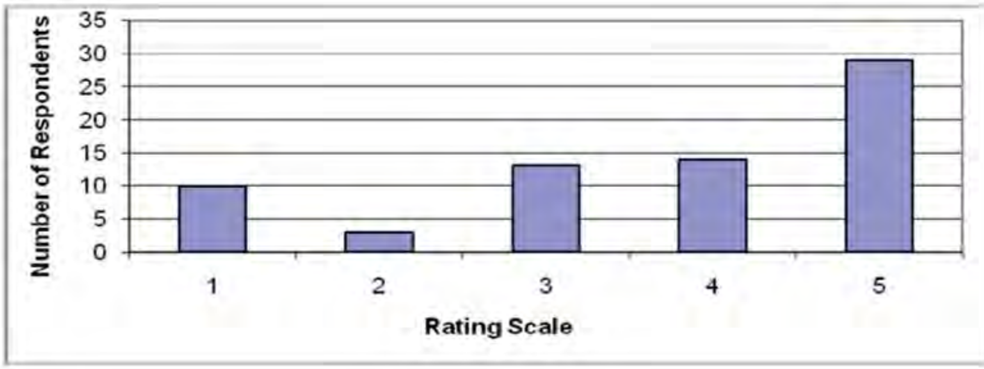


Figure C.01-9 Survey Question 7C Results

<u>*Question 8: What is the quality of the water in the creek?*</u>

Based on the survey, most respondent residents thought the creek was muddy, but several still said that fish and other aquatic life could be seen. Figure C.01-10 represents the range of answers that were received.

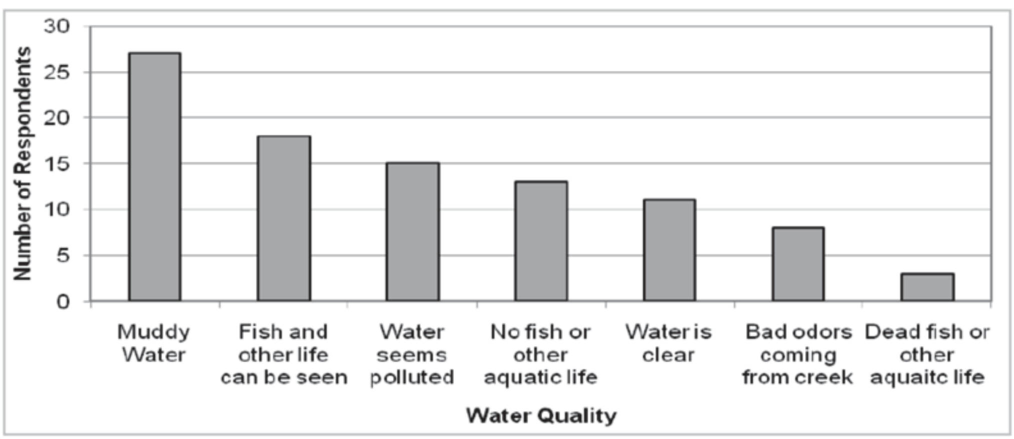


Figure C.01-10 Survey Question 8 Results

Banklick
WATERSHED
COUNCIL

Public Meeting

April 16 , 2009

INFORM

IDENTIFY & INVOLVE

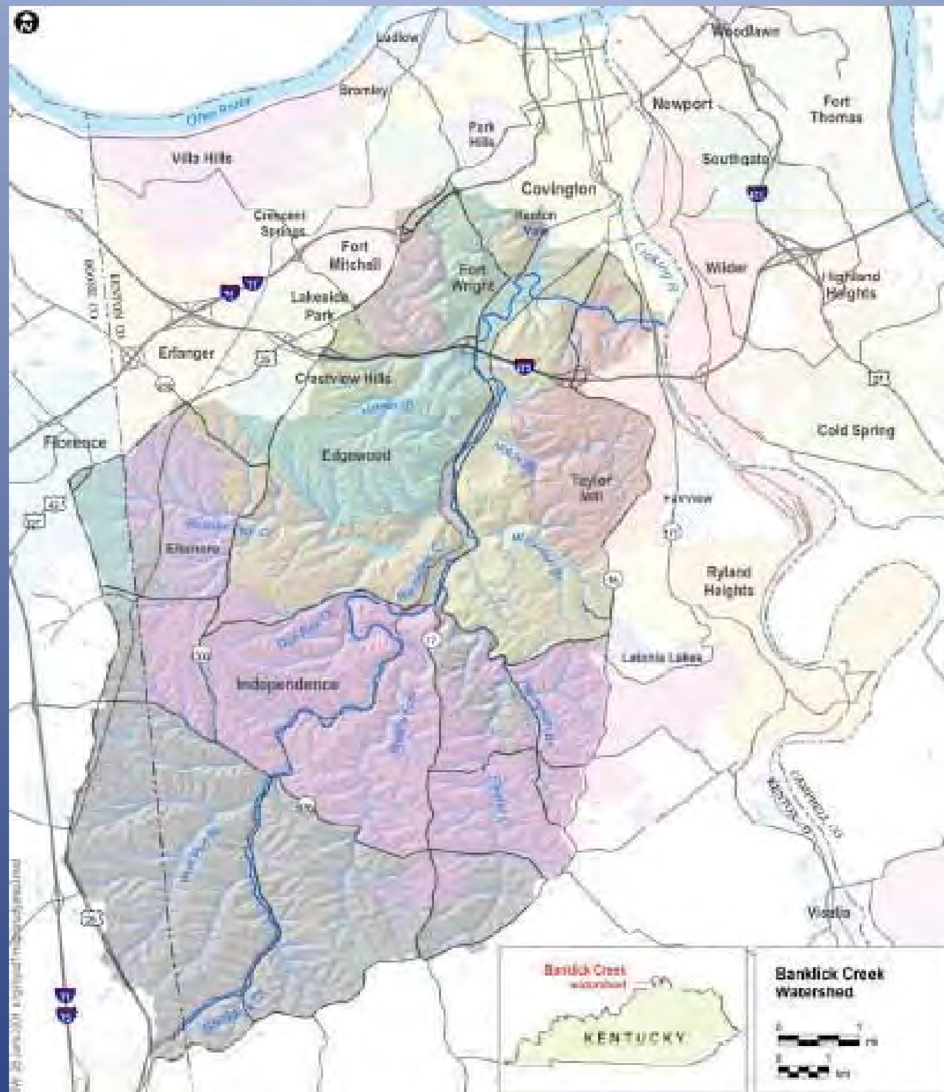
INFORM

Data has been gathered and studies conducted in the Banklick Watershed

WHY?

The Kentucky Division of Water designated the
Banklick Watershed as one of the
three highest priority watersheds in the
Licking River basin because of the
severity of flooding and water quality problems,
expected growth of development,
and the large number of water quality violations.

BANKLICK WATERSHED



Municipalities within Banklick Watershed Limno-Tech 2004

BANKLICK CREEK

- Drainage Area - 58.3 square miles
- Enters the Licking River approx. 4.6 miles upstream of the Ohio River in the Latonia area
- Extends 18.9 miles southwestwardly to its headwaters near Walton

U.S. Department of
Agriculture Soil Conservation Service
1971 Banklick Creek Watershed Work Plan

Four floodwater retarding structures proposed to have controlled runoff from 40 percent of the watershed

Estimated cost of the retarding structures and land treatment measures was $4,930,200

DOE RUN DAM

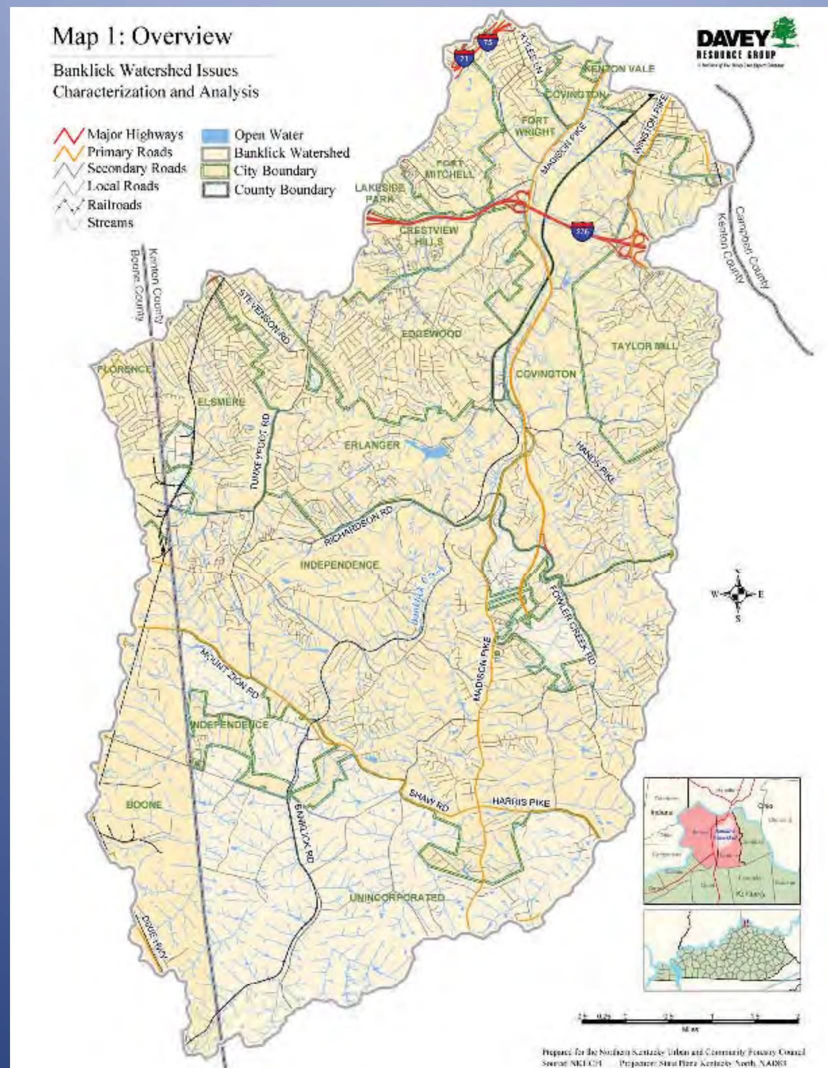
ONLY FLOOD CONTROL STRUCTURE BUILT

Ground was broken on February 1976, with the structure being complete in April 1981 and dedicated in October 1981

The actual cost totaled $5,982,186

Public Law 566
The Watershed Protection and Flood Prevention Act funded $5,172,006

BANKLICK WATERSHED



STUDIES RELATING TO BANKLICK FLOODING

- 1982 Study – flood damages estimated to be $2,939,000 for the 100 year flood.
- 1993 Study – predicted significantly higher estimated flows than prior reports.
- 1995 Study – noted major headwater flooding along Banklick Creek in 1962, 1967 and 1979.

1998 /1999 Flood Reduction Proposals

…75 foot dam upstream from Wayman Branch and KY 17 – cost $20,000,000

50% reduction in peak flows downstream for 100 year flood

Note: to provide real flood damage reduction would also require an additional regional basin on Fowler Creek.

or

…29 small detention structures in Banklick and Fowler Creek – cost $300,000 per structure $8,700,000 total

STRUCTURAL ALTERNATIVES ARE VERY COSTLY AND IN TIME CAN LOSE THEIR EFFECTIVENESS

- Doe Run Dam was designed for a 100 year storm event
- About 9 years after being completed, March of 1990, it was less than 1 foot from overflowing the spillway
- A recent report by Fish & Wildlife is suggesting that the spillway needs to be raised 15 feet
- The amount of stormwater entering the Lake has increased because of how the land has been developed surrounding the lake and its tributaries

U. S. Army Corps of Engineers
2000 Banklick Creek Watershed Analysis

THREE PRIMARY FACTORS HAVE CONTRIBUTED TO FLOOD DAMAGES IN THE WATERSHED:

- The early development, which occurred along the stream channels.
- The extremely steep slopes of Banklick Creek and its tributaries.
- Extraordinary recent development along the watershed’s ridgelines and hillsides.

WITHOUT A PLAN

Current problems of flooding, ecosystem damage and increased erosion along with corresponding sediment deposition can be expected to worsen in the watershed.

U S Army Corps of Engineers

WATER QUALITY

Water quality data, provided by the Kentucky Division of Water, indicates that the stream is impaired and does not meet aquatic life and swimmable criteria.

Causes of the impairments include nutrients, organic enrichment, low dissolved oxygen, and habitat alteration.

IDENTIFY

RECOMMENDATIONS

ECOSYSTEM RESTORATION WORK

Estimated Cost

$2,000,000

(DOES NOT INCLUDE PURCHASE OF LAND)

Will Still Need to Change Ways in How Our Land is Developed

10.5 Stream Miles of Grade Control Structures in Banklick

Benefits

- Reduced Upstream Bedcutting
- Reduced Downstream Sedimentation
- Reduced Bank Erosion
- Increased Dissolved Oxygen Levels
- Increased Aquatic Habitat

10.5 miles of Expanded Riparian Corridor in Banklick Creek

Benefits

- Increased Terrestrial and Aquatic Habitat
- Lower Water Temperatures
- Filtering/Trapping of Non-Point Source Pollution

CONSTRUCT WETLANDS

Benefits

- Biological Treatment of Water
- Reduction of Suspended Solids
- Terrestrial and Aquatic Habitat

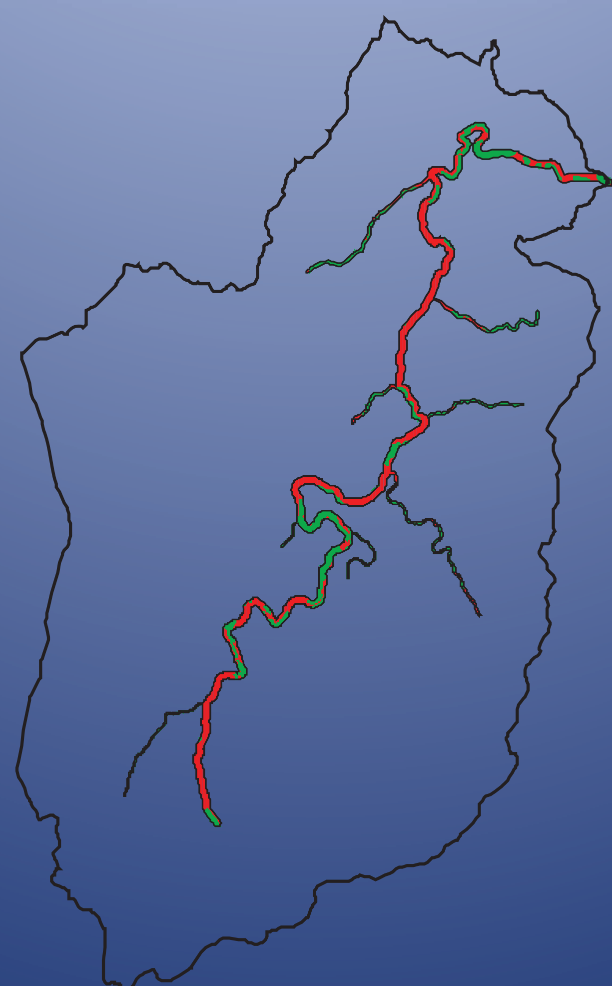
WETLANDS

While constructed wetlands are not intended to reproduce or mimic natural wetland wildlife diversity, they do provide areas for water quality improvements due to biological treatment, and additional habitat for aquatic species.

Preliminary estimates indicate the potential for 11 acres of wetlands to be created.

Natural wetland along Brushy Fork

Existing riparian corridor (green) and areas
where riparian enhancements are needed in (red)
ESTIMATED RIPARIAN ZONE DEFICIT – 857 ACRES

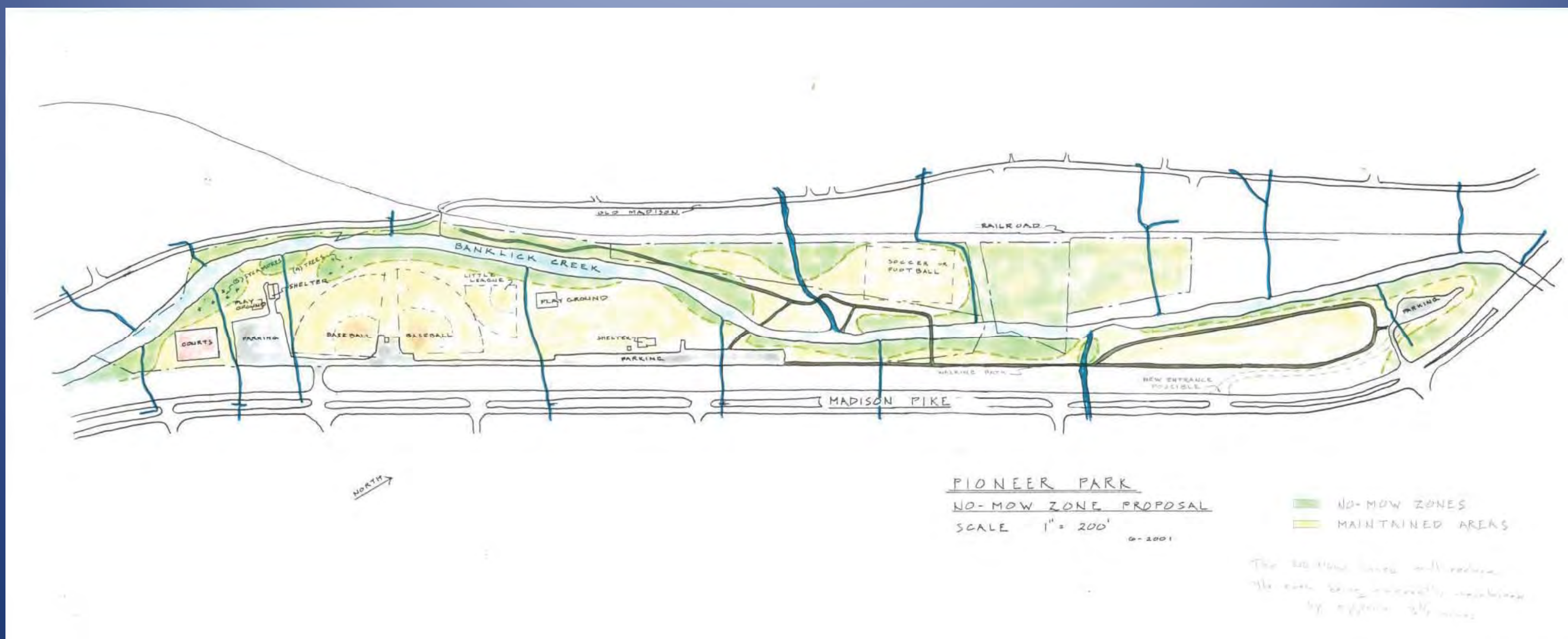


NO-MOW ZONES AND RIPARIAN AREAS

Establishment of “no-mow” zones and/or floodplain and riparian plantings to create a streamside buffer would enhance the water quality and wildlife diversity along Banklick Creek by reducing water temperatures, filtering nonpoint source runoff pollution, and providing wildlife corridors with additional foraging opportunities.

BANKLICK CREEK ALONG PIONEER PARK

Proposed NO-MOW Zone for Pioneer Park 2001



2004 - BACE STUDY

Banklick Creek Watershed **A**nalysis and Issue **C**haracterisation for **E**ducation and Outreach focused on forest resources and estimated that **30% of the Banklick watershed has natural areas needing protection and 50% is in need of restoration.**

The BACE Study was funded with a National Urban Forestry Grant. Northern KY Area Planning Commission was the lead agency, with the Northern KY Urban & Community Forestry Council, BWC and SD#1 as partners.

LESS IMPERVIOUS SURFACES AND LESS LAND COMPACTION

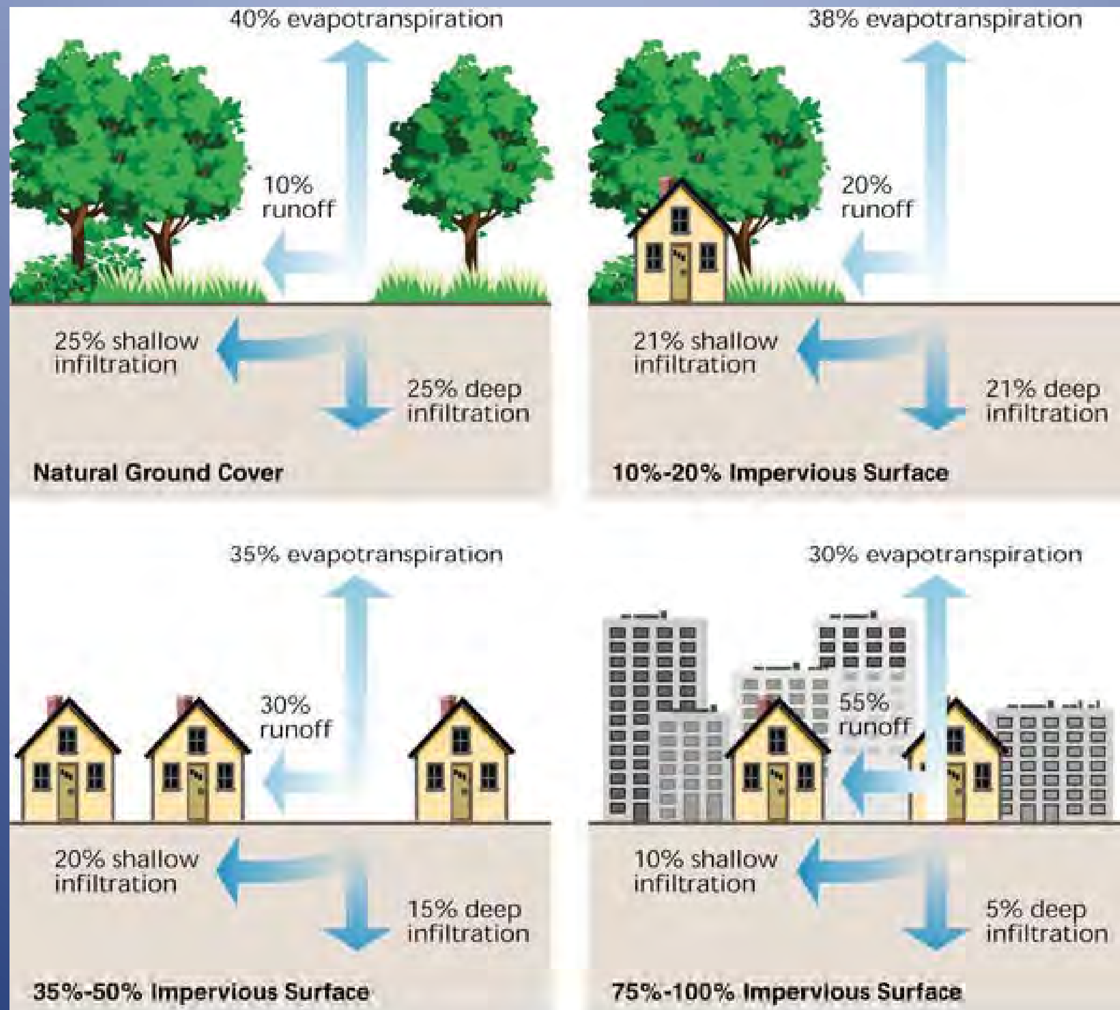


Fig. 3.21 – Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.
In Stream Corridor Restoration: Principles, Processes, and Practices (10/98).
By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the U.S.)

2005 - CONSENT DECREE

SD#1 reached an agreement with EPA on their Consent Decree which is a 20 year plan to address combined sewer overflows (CSO), sanitary sewer overflows (SSO), and SD#1 will continue with their stormwater management program.

Stormwater Management Plan for Kyles Lane I-75 Interchange

Banklick Creek at Bullock Pen

2005 - BWC ACTION PLAN

BWC completed an Action Plan for the Banklick Watershed that stated four main goals:

1. Clean the Water
2. Reduce Flooding
3. Restore the Banks
4. Honor the Heritage

2006 - South Banklick Small Area Study

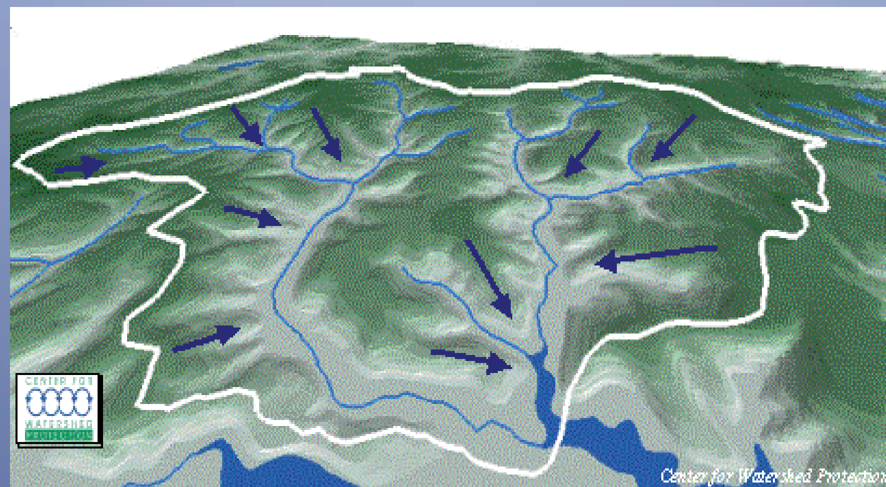
- NKAPC studied the headwater area of Banklick Creek and had major input from property owners in the area.
- The study recommended riparian buffers along with recommendations for conservation subdivision and eco commerce park areas.
- For the first time, recommended riparian buffers were adopted into the Kenton County Comprehensive Plan and Zoning which makes them required but only for the study area.

2008 - BWC BEGINS EPA 319 GRANT

An important and exciting effort for the Banklick Watershed is BWC has started work on a major $1,000,000 EPA Grant Project.

$600,000 is funding from EPA and $400,000 is coming from in-kind of volunteers and technical support from partners in the project.

INVOLVE



Solutions to watershed problems often involve changing the way we live on the land; so citizen involvement, awareness and support are essential for success.

It will take city officials, government agencies, industries, educators and citizens working together to solve these water problems.

Banklick Creek Watershed Based Planning, Implementation, and Results

“This work was funded in part by a grant
from the U.S. Environmental Protection Agency
under §319(h) of the Clean Water Act
through the Kentucky Division of Water to
Banklick Watershed Council
Grant # C9994861-07.”

MIDDLE BANKLICK WATERSHED

Legend

Banklick Subwatersheds

0 0.5 1 Miles

Banklick WATERSHED COUNCIL

STRAND

Data Source: Sanitation District No.1 of Northern Kentucky

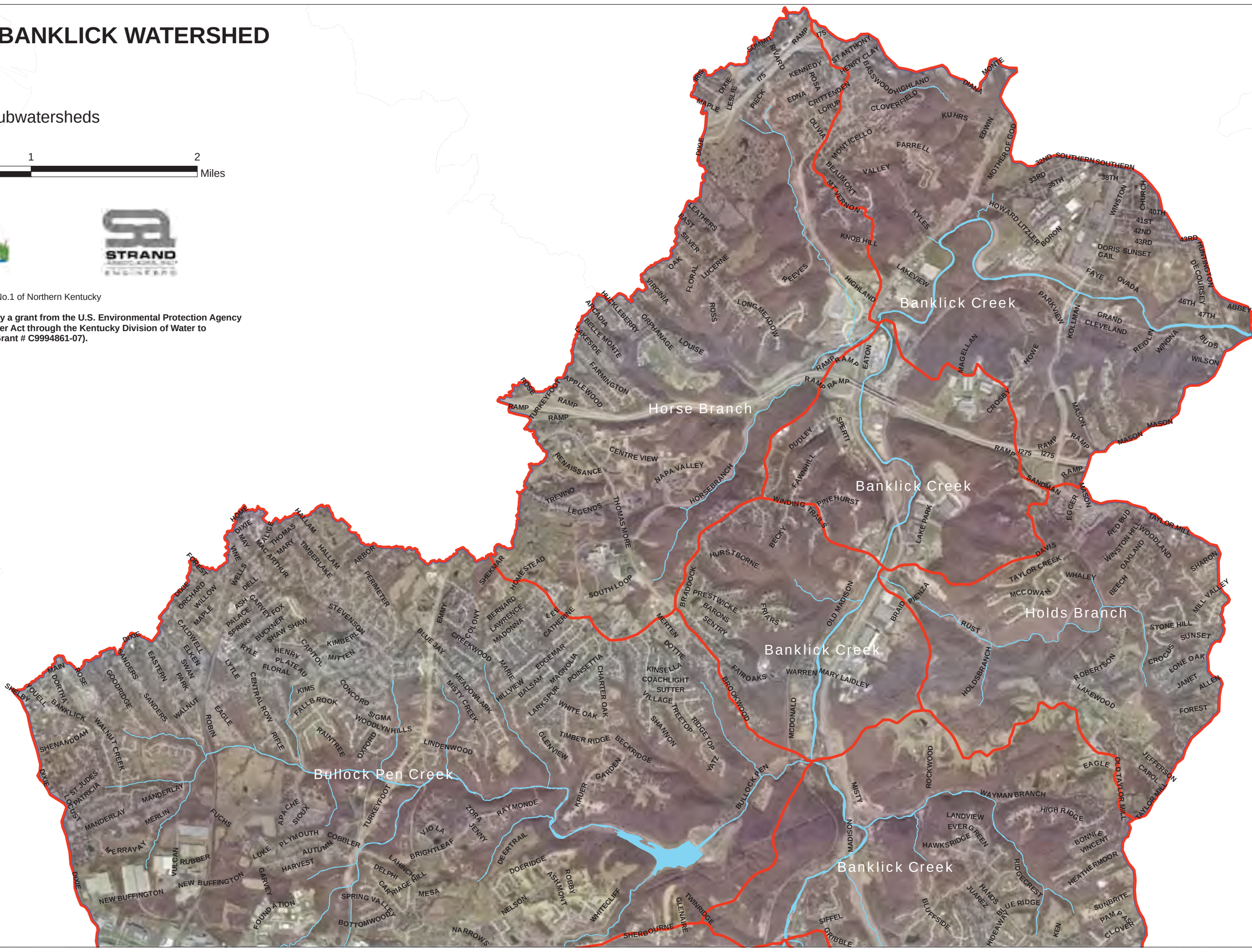
This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to Banklick Watershed Council (Grant # C9994861-07).

NORTHERN BANKLICK WATERSHED

Legend

Banklick Subwatersheds

0 0.5 1 2 Miles

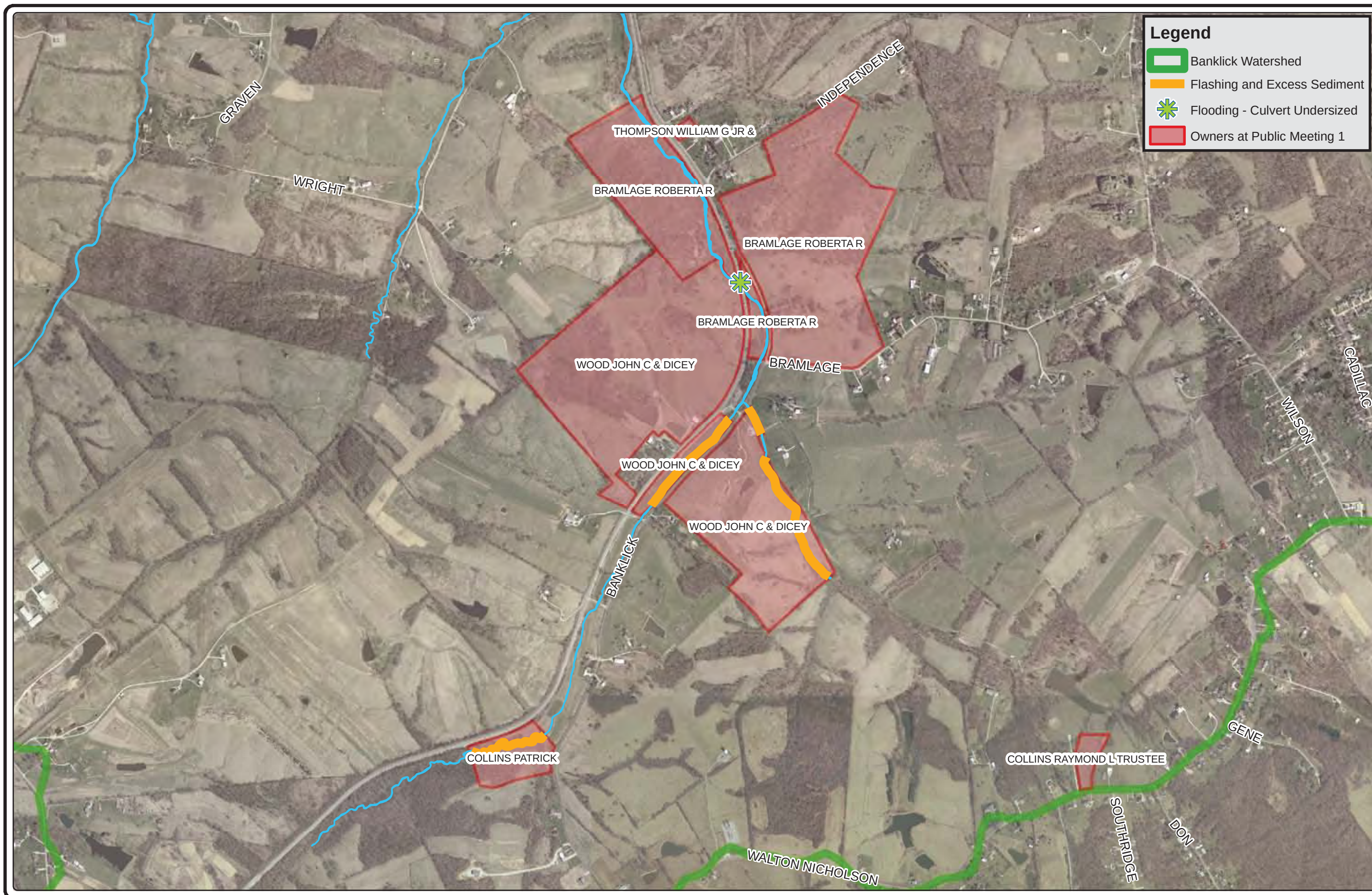


Banklick WATERSHED COUNCIL

STRAND

Data Source: Sanitation District No.1 of Northern Kentucky

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to Banklick Watershed Council (Grant # C9994861-07).



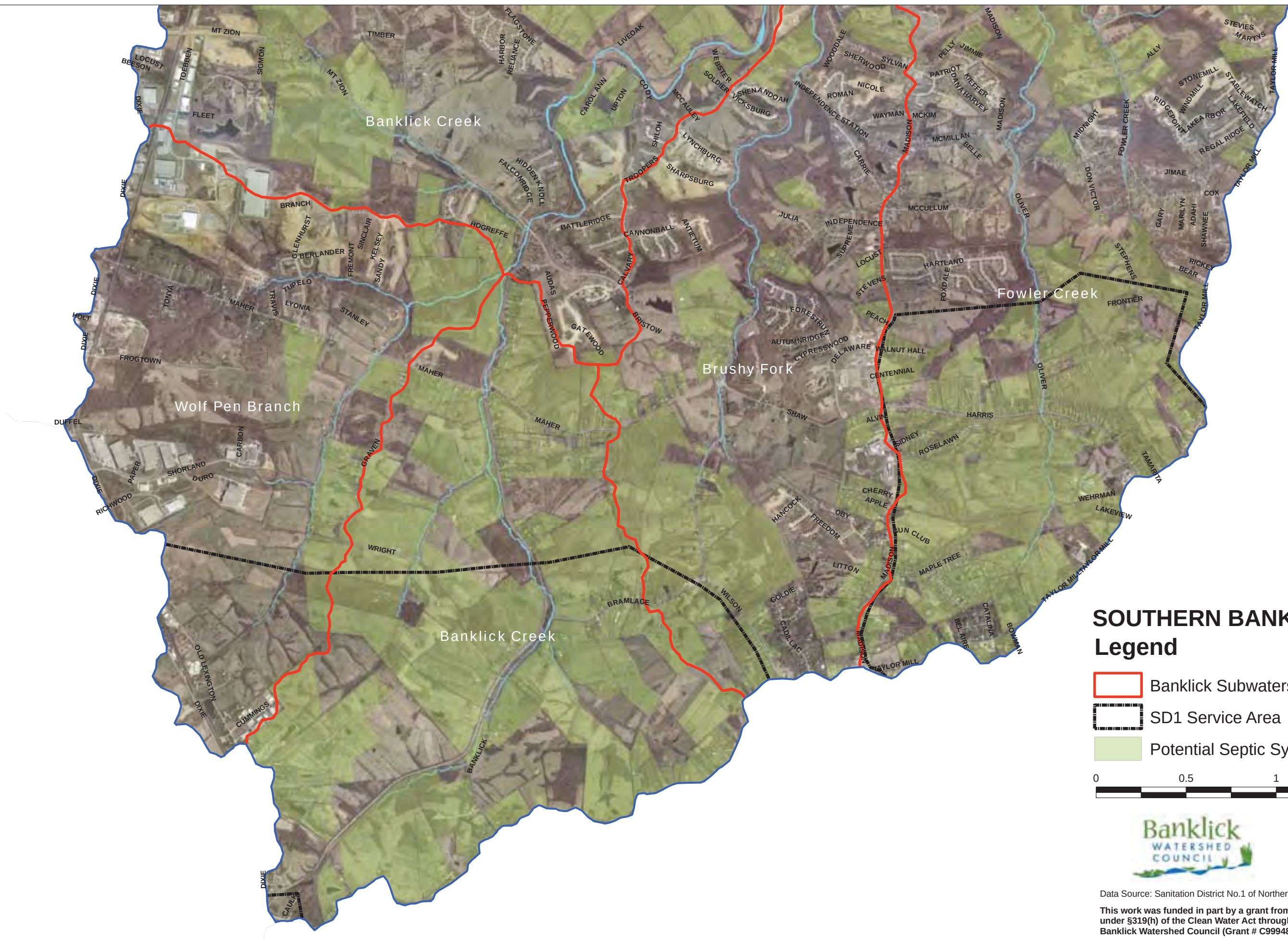
Banklick Public Meeting Comments at Public Meeting No. 1 on 3-23-09

BANKLICK WATERSHED 319(H) GRANT
BANKLICK WATERSHED COUNCIL

STRAND ASSOCIATES, INC. ENGINEERS

FIGURE X.XX-X
1901-001

T:\GIS\Arcgis\templates\SAI_11x17_LS.mxt



SOUTHERN BANKLICK WATERSHED

Legend

- Banklick Subwatersheds
- SD1 Service Area
- Potential Septic Systems

0 0.5 1 2 Miles

Banklick WATERSHED COUNCIL

STRAND

Data Source: Sanitation District No.1 of Northern Kentucky

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to Banklick Watershed Council (Grant # C9994861-07).

APPENDIX E
Septic Program Information

How to apply for the Septic System Repair Grant

Thank you for your interest in this grant program, which is designed to improve water quality in Banklick Creek by assisting with septic system repairs. If you own and live in a home with a septic problem, and your home is within the Banklick Watershed, you may qualify for this grant.

Here are the guidelines to follow if you would like to apply.

Step 1: Submit the Enclosed Application Form by July 23, 2010

- Mail completed Septic System Repair Grant application to Sherry Carran at 927 Forest Ave. Covington, KY 41016
- The initial Septic System Repair Grant application is **Free**. The Banklick Watershed Council will contact you to assist you with completing the next steps in the process.

Step 2: Site Evaluation by Northern Kentucky Health Department

- The Banklick Watershed Council will provide you with a Site Evaluation Application and ranking form. This application is necessary to have the Northern Kentucky Health Department evaluate your septic system. The non-refundable fee for the site evaluation is **$125**. You will receive the results of the site evaluation.
- The Health Department Inspector will visit your home to evaluate your septic situation and available repair area and soil. Then he will send you a **Site Evaluation Report** that lists what needs to be done for the repair.
- The Inspector will also rank your existing system for water pollution impact on nearby streams and return the form to the Banlick Watershed Council. The highest ranking Septic System Repair Grant applications will be selected for repair first.

Step 3: Get Bids from At Least Two Certified Septic Installers

- Contact several Certified Septic System Installers, give them copies of the Site Evaluation Report, have them visit your house and prepare bids that show what they will do and how much it will cost. The best, lowest bid will be awarded the work.
- Send the following documents to Sherry Carran at 927 Forest Ave. Covington, KY 41016
  - ☐ Completed Site Evaluation Report
  - ☐ Copy of AT LEAST TWO Certified Septic System Installer Bids

Step 4: Installer Obtains Permit and Repairs Your Septic System

- You will be contacted if your system is selected. Your installer will have to obtain a permit at a cost of **$250** (which you are responsible to pay for) before beginning repairs to your system. When the repair work has been completed and all inspections are completed and approved, the Banklick Watershed Council will pay all installation costs directly to the Certified Installer.

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the Banklick Watershed Council (Grant # C9994861-07).

Banklick Septic System Repair Grant Application
RETURN BY JULY 23, 2010

Owner's Name (if different)____

Occupant's Name ____

Location of Property ____

City ______________ State _________ Zip Code_________ Phone No. _____________

The following is optional information you may include to further qualify for this grant.

Number of people residing in home __________ Annual household income___________

Number of bedrooms in home _________ Number of people living in home _____________

Existing System: Type of Tank ________________ Size of Tank______________ gallons

Type of Leach Field ___________________________ Amount of leach line ________ feet

Is there an overflow line on your present system? Yes ____ No ______ Unknown _____

Is existing system discharging into creek, road ditch, or drainage? Yes ___ No ___Unknown ___

Mail completed application to Sherry Carran at 927 Forest Ave. Covington, KY 41016

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the Banklick Watershed Council (Grant # C9994861-07).

Dear Banklick Creek Watershed Resident,

The Banklick Creek Watershed Council would like to announce a new program in target areas of the Banklick Creek Watershed for residents with septic systems. Banklick Creek is polluted with significant amounts of silt, agricultural waste (manure run-off), and sewage. To help reduce water pollution, the Banklick Creek Watershed Council has grant funds available to repair failing septic systems in your area. You are receiving this invitation to apply for funding because your property is located near a stream in the target area. If your system has problems, repairing your septic system could make the streams much cleaner.

The purpose of this grant is to help Banklick Creek Watershed residents (like you) replace straight pipes and/or repair failing septic systems, especially those that have a strong impact on Banklick Creek and its tributaries.

This project is voluntary and if you wish to participate; your property will be evaluated according to criteria below. If your property qualifies for funding, this grant will cover all costs for the repair except a $125 evaluation fee, and a $250 permit fee (if your system is selected for repair). Please see the enclosed application instructions for clarification on how and when these fees are collected.

The criteria for selection are as follows:

- Must be an existing home within the Banklick Creek Watershed
- Must have an active sewage problem
- Must have impact on a waterway within the Banklick Creek Watershed; highest priority will be given to those that have the highest water pollution impact.

Highest priority installations will be awarded in the summer of 2010. If funds are still available in 2011, lower impact installations may be addressed.

If you would like to participate in this program, please review the attached instructions and return the application form.

If you have any questions concerning this program, please contact Sherry Carran at carranbs@fuse.net or by phone at 859-491-0722.

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the Banklick Watershed Council (Grant # C9994861-07).

Banklick
WATERSHED
COUNCIL

Onsite Wastewater Incentive Grant

Application #____________________________

Name:__________________________________ Address:____

CRITERIA	RATING SCALE				SCORE
	8 |-------7-------|	6 |-------5-------|	4 |-------3-------|	2 |-------1-------| 0	
Probable existing system components	No tank or lateral field	Tank only Type:________________	Tank field with overflow pipe	Tank field with no overflow pipe Feet:___________________	____________
Amount of discharge	Major surface discharge evidence	Significant surface discharge evidence	Minor surface discharge evidence	No discharge evidence	____________
Location of discharge	Discharging directly to stream or body of water	Discharge directly onto other lots and/or into drainages, ditches,gullies, etc…	Discharge crosses property lines	Discharge contained within lot	____________
Watershed/Health Impact	Major risk by direct exposure	Significant risk by direct or indirect exposure	Moderate risk	Minor or no impact	____________
Available repair area	Ample usable space for system repair	Moderate usable space for system repair	Very limited usable repair space but some repair possible	No usable repair space available	____________
Installation Feasibility	Excellent site conditions favorable with minimum enhancement	Good site conditions favorable with moderate enhancement	Fair site conditions can be upgraded by major enhancement	Poor site conditions not conducive to repair	____________
Household Income (if supplied on application)	<$25,000 annual	$25,000 - $40,000 annual	$40,000 - $75,000 annual	>$75,000 annual	____________
				TOTAL	____________

Banklick
WATERSHED
COUNCIL

927 Forest Ave.
Covington, KY 41016

November 8, 2011

Robert and Karen Kirby
39 Walnut Hall Drive
Independence, KY 41051

Dear Robert and Karen,

The Banklick Watershed Council is pleased to inform you that have been selected to receive funding to help repair your septic system based on the evaluation by the N KY Health Department. You are now in Step 4 of the process, see the enclosed 'How to apply for the Septic System Repair Grant'.

After review of the bids from S & E Construction/Septic Service and from H & M Construction to repair your septic system, the **Banklick Watershed Council has selected the proposal from H & M Construction**. This proposal for the amount of $4,275 includes cost of the permit from the Health Department. The permit cost of $200 is your responsibility, which brings the cost of the repair to $4,075. The Banklick Watershed Council can pay 90% of this cost, meaning **we will pay $3,667.50** to help with the repair. When the work on septic system is completed, including inspection by the Health Department, we will pay H & M Construction directly.

Note the proposal mentions if the tank needs to be pumped there will be an additional cost of $300. If this work is performed, we can pay 90% of this, which will add an additional $270 to what we will cover.

Also note that the proposal does not cover seed or straw. Most home owners have a personal preference for the kind of seed they want planted so this part of the project is left to the home owner.

Also enclosed are several informational documents regarding septic systems, about the Banklick Watershed Plan, and 'Life at the Water's Edge' (last page mentions septic systems).

If you have any concerns or questions please feel free to call me.

Yours truly,

Sherry Carran
Chair – Banklick Watershed Council
859-491-0722 home
859-380-2528 cell

cc: H & M Construction

927 Forest Ave.
Covington, KY 41016

November 5, 2011

Sharon & Mark Ferrell
57 Walnut Hall Drive
Independence, KY 41051

Dear Sharon and Mark,

The Banklick Watershed Council is pleased to inform you that have been selected to receive funding to repair your septic system based on the evaluation by the N KY Health Department.

You now need to follow Step 2 and Step 3 of the process. See the attached **How to apply for the Septic System Repair Grant.** The Site Evaluation Application and Ranking Form is also attached and this needs to be given to the Health Department along with the application fee of $125. When you call the Health Department they will let you know if you should mail it in or if it be given to the inspector at the time of inspection.

The evaluation and ranking needs to be completed so you can share the information with the Certified Septic System Installers when they come to visit your home to prepare bids for the needed work to your septic system.

If you have any questions please feel free to call me.

Yours truly,

Sherry Carran
Chair – Banklick Watershed Council
859-491-0722 home
859-380-2528 cell

Banklick
WATERSHED
COUNCIL

927 Forest Ave.
Covington, KY 41016

November 8, 2011

Donald & Brenda McMillen
33 Walnut Hall Drive
Independence, KY 41051

Dear Donald and Brenda,

The Banklick Watershed Council is pleased to inform you that have been selected to receive funding to help repair your septic system based on the evaluation by the N KY Health Department. You are now in Step 4 of the process, see the enclosed 'How to apply for the Septic System Repair Grant'.

After review of the bids from S & E Construction/Septic Service and from H & M Construction to repair your septic system, the **Banklick Watershed Council has selected the proposal from H & M Construction**. This proposal for the amount of $5,100 includes cost of the permit from the Health Department. The permit cost of $200 is your responsibility, which brings the cost of the repair to $4,900. The Banklick Watershed Council can pay 90% of this cost, meaning **we will pay $4,410.00** to help with the repair. When the work on septic system is completed, including inspection by the Health Department, we will pay H & M Construction directly.

Note that the proposal does not cover seed or straw. Most home owners have a personal preference for the kind of seed they want planted so this part of the project is left to the home owner.

Also enclosed are several informational documents regarding septic systems, about the Banklick Watershed Plan, and 'Life at the Water's Edge' (last page mentions septic systems).

If you have any concerns or questions please feel free to call me.

Yours truly,

Sherry Carran
Chair – Banklick Watershed Council
859-491-0722 home
859-380-2528 cell

cc: H & M Construction

Banklick
WATERSHED
COUNCIL

927 Forest Ave.
Covington, KY 41016

November 8, 2011

Linda Netherly and Travis Caudill
23 Walnut Hall Drive
Independence, KY 41051

Dear Linda and Travis,

The Banklick Watershed Council is pleased to inform you that have been selected to receive funding to repair your septic system based on the evaluation by the N KY Health Department. You are now in Step 3 of the process. See the enclosed "How to apply for the Septic Repair Grant'.

Once you have received bids from at least two Certified Septic Installers, you will need to send those to me for review before we can move forward.

Also enclosed are several informational documents regarding septic systems, about the Banklick Watershed Plan, and 'Life at the Water's Edge' (last page mentions septic systems).

If you have any concerns or questions please feel free to call me.

Yours truly,

Sherry Carran
Chair – Banklick Watershed Council
859-491-0722 home
859-380-2528 cell

Banklick
WATERSHED
COUNCIL

927 Forest Ave.
Covington, KY 41016

November 8, 2011

Tim and Rebekah Waters
35 Walnut Hall Drive
Independence, KY 41051

Dear Tim and Rebekah,

The Banklick Watershed Council is pleased to inform you that have been selected to receive funding to help repair your septic system based on the evaluation by the N KY Health Department. You are now in Step 4 of the process, see the enclosed 'How to apply for the Septic System Repair Grant'.

After review of the bids from S & E Construction/Septic Service and from H & M Construction to repair your septic system, the **Banklick Watershed Council has selected the proposal from H & M Construction**. This proposal for the amount of $5,500 includes cost of the permit from the Health Department. The permit cost of $200 is your responsibility, which brings the cost of the repair to $5,300. The Banklick Watershed Council can pay 90% of this cost, meaning **we will pay $4,770.00** to help with the repair. When the work on septic system is completed, including inspection by the Health Department, we will pay H & M Construction directly.

Note that the proposal does not cover seed or straw. Most home owners have a personal preference for the kind of seed they want planted so this part of the project is left to the home owner.

Also enclosed are several informational documents regarding septic systems, about the Banklick Watershed Plan, and 'Life at the Water's Edge' (last page mentions septic systems).

If you have any concerns or questions please feel free to call me.

Yours truly,

Sherry Carran
Chair – Banklick Watershed Council
859-491-0722 home
859-380-2528 cell

cc: H & M Construction

APPENDIX F
Detention Basin Retrofit Documentation

DETENTION BASIN RETROFITS

FOR THE

BANKLICK WATERSHED COUNCIL
KENTON COUNTY, KENTUCKY

SCHEPER
COURT BASIN

NICOLE COURT
BASIN

INDEX OF SHEETS

615 Elsinore Place, Suite 320
Cincinnati, Ohio 45202
513-861-5600
513-861-5601 Fax
www.strand.com

Contract 1 - 2013

USEPA 319(h) Grant Funded

UNDERGROUND UTILITIES
2 WORKING DAYS BEFORE YOU DIG

CALL 800-752-6007 (TOLL FREE)
KENTUCKY 811

NON-MEMBERS
MUST BE CALLED DIRECTLY

Kentucky 811

Banklick WATERSHED COUNCIL

STRAND ASSOCIATES®

SUBMITTAL, 8-30-13

SHEET
1

PROJECT CONSTRUCTION NOTES:

GENERAL:

1. PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL SUBMIT TO SD1:
   - 1.1. CONSTRUCTION SEQUENCING DOCUMENTATION FOR THE SCHEPER COURT BASIN.
   - 1.2. MINIMUM OF THREE PROJECT DESCRIPTIONS FOR SIMILAR PROJECTS PREFORMED BY THE CONTRACTOR.

2. THE CONTRACTOR SHALL CONTACT ANDY AMAN, AT SD1, AT (859) 578-6880, AT LEAST 72 HOURS BEFORE THE START OF CONSTRUCTION.

3. CONTRACTOR SHALL PROVIDE POST CONSTRUCTION CERTIFICATION WITH SD1.

4. THE CONTRACTOR SHALL VERIFY THE LOCATIONS AND ELEVATIONS OF ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. THE LOCATIONS AND ELEVATIONS OF EXISTING UTILITIES, AS INDICATED ON THE DRAWINGS, ARE FOR INFORMATIONAL PURPOSES ONLY. NO RESPONSIBILITY IS ASSUMED FOR THE ACCURACY OR COMPLETENESS OF THIS INFORMATION. ALL UTILITIES MUST BE MARKED AND THEIR HORIZONTAL AND VERTICAL LOCATION FIELD VERIFIED BY THE CONTRACTOR PRIOR TO STARTING CONSTRUCTION. THE CONTRACTOR SHALL NOT CUT OR DISCONNECT ANY UTILITIES WITHOUT PRIOR APPROVAL FROM THE APPROPRIATE AGENCY.

5. WHERE PLANS PROVIDE FOR A PROPOSED CONDUIT TO BE CONNECTED TO, OR CROSS OVER OR UNDER AN EXISTING SEWER OR UNDERGROUND UTILITY, THE CONTRACTOR SHALL LOCATE THE EXISTING PIPES OR UTILITIES BOTH AS TO LINE AND GRADE BEFORE STARTING TO LAY THE PROPOSED CONDUIT.

   IF IT IS DETERMINED THAT THE ELEVATION OF THE EXISTING CONDUIT, OR EXISTING APPURTENANCE TO BE CONNECTED, DIFFERS FROM THE PLAN ELEVATION OR RESULTS IN A CHANGE IN THE PLAN CONDUIT SLOPE, THE ENGINEER SHALL BE NOTIFIED BEFORE STARTING CONSTRUCTION OF ANY PORTION OF THE PROPOSED CONDUIT WHICH WILL BE AFFECTED BY THE VARIANCE IN THE EXISTING ELEVATIONS.

   IF IT IS DETERMINED THAT THE PROPOSED CONDUIT WILL INTERSECT AN EXISTING SEWER OR UNDERGROUND UTILITY IF CONSTRUCTED AS SHOWN ON THE PLAN, THE ENGINEER SHALL BE NOTIFIED BEFORE STARTING CONSTRUCTION OF ANY PORTION OF THE PROPOSED CONDUIT WHICH WOULD BE AFFECTED BY THE INTERFERENCE WITH AN EXISTING FACILITY.

6. BEFORE ANY WORK IS STARTED ON THE PROJECT AND AGAIN BEFORE FINAL APPROVAL OF THE SITE, REPRESENTATIVES OF THE CONTRACTOR, ALONG WITH THE OWNER OF THE SITE, SHALL MAKE AN INSPECTION OF ALL EXISTING SEWERS WHICH ARE TO REMAIN IN SERVICE AND WHICH MAY BE AFFECTED BY THE WORK. THE CONDITION OF THE EXISTING CONDUITS AND THEIR APPURTENANCES SHALL BE DETERMINED FROM FIELD OBSERVATIONS. RECORDS OF THE INSPECTION SHALL BE KEPT IN WRITING BY THE CITY.

   ALL NEW CONDUITS, INLETS, CATCH BASINS, AND MANHOLES CONSTRUCTED AS A PART OF THE PROJECT SHALL BE FREE OF ALL FOREIGN MATTER AND IN A CLEAN CONDITION BEFORE THE PROJECT WILL BE APPROVED.

   ALL EXISTING SEWERS INSPECTED INITIALLY BY THE ABOVE MENTIONED PARTIES SHALL BE MAINTAINED AND LEFT IN A CONDITION REASONABLY COMPARABLE TO THAT DETERMINED BY THE ORIGINAL INSPECTION. ANY CHANGE IN THE CONDITION RESULTING FROM THE CONTRACTOR'S OPERATIONS SHALL BE CORRECTED BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.

7. CONSTRUCTION SITE RUNOFF FROM DISTURBED AREAS SHALL NOT BE ALLOWED TO ENTER THE BIORETENTION BASIN. USE STRAW WATTLE AND OTHER SEDIMENT CONTROL MEASURES AS NECESSARY, TO PREVENT CONSTRUCTION SITE RUNOFF FROM ENTERING THE BIORETENTION BASIN.

8. CONSTRUCTION OF THE BIORETENTION BASIN SHALL BE SUSPENDED DURING PERIODS OF RAINFALL. CONSTRUCTION SHALL REMAIN SUSPENDED IF PONDED WATER IS PRESENT OR IF RESIDUAL SOIL MOISTURE CONTRIBUTES SIGNIFICANTLY TO THE POTENTIAL FOR CLUMPING OR OTHER FORMS OF COMPACTION.

9. DURING CONSTRUCTION OF THE SCHEPER COURT BIORETENTION BASIN THE OUTLET CONTROL STRUCTURE SHALL BE PROTECTED TO PREVENT SEDIMENT EROSION FROM CONSTRUCTION ACTIVITIES.

10. COMPACTION OF THE SOILS BENEATH THE FLOOR OF THE BIORETENTION BASIN AND THE BIORETENTION SOIL MIXTURE WITHIN THE BIORETENTION BASIN SHALL BE MINIMIZED. DURING SITE DEVELOPMENT, THE AREA DEDICATED TO THE BIORETENTION BASIN SHALL BE CORDONED OFF TO PREVENT ACCESS FROM HEAVY EQUIPMENT. IF COMPACTION OCCURS BENEATH THE FLOOR OF THE BIORETENTION BASIN, THE SOIL SHALL BE REFRACTURED TO A DEPTH OF 12 INCHES.

11. EXCESS EXCAVATED OR UNDESIRABLE MATERIAL FOR BACKFILLING SHALL BE REMOVED FROM THE SITE AND PROPERLY DISPOSED OF BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER. POINTS OF DISPOSAL ARE SUBJECT TO APPROVAL OF OWNER.

12. CONTRACTOR SHALL COORDINATE WITH HOMEOWNER, BRANDON ROWLAND, 2199 SCHEPER COURT, INDEPENDENCE, KENTUCKY 41051, (513) 349-5101, REGARDING THE PLACEMENT OF EXCESS BACKFILL MATERIAL PRIOR TO HAULING OFF SITE.

CONTRACTOR'S RESPONSIBILITIES:

SUPERVISION AND SUPERINTENDENCE:

1. AT ALL TIMES DURING THE PROGRESS OF THE WORK, CONTRACTOR SHALL ASSIGN A COMPETENT RESIDENT SUPERINTENDENT WHO SHALL NOT BE REPLACED WITHOUT WRITTEN NOTICE TO OWNER AND ENGINEER EXCEPT UNDER EXTRAORDINARY CIRCUMSTANCES.

LABOR; WORKING HOURS:

2. CONTRACTOR SHALL PROVIDE COMPETENT, SUITABLY QUALIFIED PERSONNEL TO SURVEY AND LAY OUT THE WORK AND PERFORM CONSTRUCTION AS REQUIRED BY THE CONTRACT DOCUMENTS. CONTRACTOR SHALL AT ALL TIMES MAINTAIN GOOD DISCIPLINE AND ORDER AT THE SITE.

3. EXCEPT AS OTHERWISE REQUIRED FOR THE SAFETY OR PROTECTION OF PERSONS OR THE WORK OR PROPERTY AT THE SITE OR ADJACENT THERETO, ALL WORK AT THE SITE SHALL BE PERFORMED DURING REGULAR WORKING HOURS. CONTRACTOR WILL NOT PERMIT THE PERFORMANCE OF WORK ON A SATURDAY, SUNDAY, OR ANY LEGAL HOLIDAY WITHOUT OWNER'S WRITTEN CONSENT (WHICH WILL NOT BE UNREASONABLY WITHHELD) GIVEN AFTER PRIOR WRITTEN NOTICE TO ENGINEER.

SERVICES, MATERIALS, AND EQUIPMENT:

4. CONTRACTOR SHALL PROVIDE AND ASSUME FULL RESPONSIBILITY FOR ALL SERVICES, MATERIALS, EQUIPMENT, LABOR, TRANSPORTATION, CONSTRUCTION EQUIPMENT AND MACHINERY, TOOLS, APPLIANCES, FUEL, POWER, LIGHT, HEAT, TELEPHONE, WATER, SANITARY FACILITIES, TEMPORARY FACILITIES, AND ALL OTHER FACILITIES AND INCIDENTALS NECESSARY FOR THE PERFORMANCE, TESTING, START-UP, AND COMPLETION OF THE WORK.

5. ALL MATERIALS AND EQUIPMENT INCORPORATED INTO THE WORK SHALL BE AS SPECIFIED OR, IF NOT SPECIFIED, SHALL BE OF GOOD QUALITY AND NEW. IF REQUIRED BY ENGINEER, CONTRACTOR SHALL FURNISH SATISFACTORY EVIDENCE (INCLUDING REPORTS OF REQUIRED TESTS) AS TO THE SOURCE, KIND, AND QUALITY OF MATERIALS AND EQUIPMENT.

6. ALL MATERIALS AND EQUIPMENT SHALL BE STORED, APPLIED, INSTALLED, CONNECTED, ERECTED, PROTECTED, USED, CLEANED, AND CONDITIONED IN ACCORDANCE WITH INSTRUCTIONS OF THE APPLICABLE SUPPLIER.

7. CONTRACTOR SHALL AVOID COMPACTING BIORETENTION BASIN WITH CONSTRUCTION TRAFFIC.

STABILIZED CONSTRUCTION ENTRANCE:

8. THE CONTRACTOR SHALL PROTECT ALL POINTS OF CONSTRUCTION INGRESS AND EGRESS TO PREVENT THE DEPOSITION OF MATERIALS ONTO PUBLIC ROADS. ALL MATERIALS DEPOSITED ONTO PUBLIC ROADS SHALL BE REMOVED IMMEDIATELY USING A STREET SWEEPER OR SCRAPER. DEBRIS SHALL NOT BE WASHED OFF PAVED SURFACES OR INTO STORM DRAINS.

OTHER:

9. NO SOLID OR LIQUID WASTE, INCLUDING BUILDING MATERIALS, SHALL BE DISCHARGED IN STORM WATER RUNOFF. THE CONTRACTOR MUST IMPLEMENT ALL NECESSARY CONTROL MEASURES TO PREVENT THE DISCHARGE OF POLLUTANTS TO THE DRAINAGE SYSTEM OF THE SITE OR SURFACE WATERS. UNDER NO CIRCUMSTANCE SHALL CONCRETE TRUCKS WASH OUT DIRECTLY INTO A DRAINAGE CHANNEL, STORM SEWER OR SURFACE WATER.

10. THE CONTRACTOR SHALL CONTROL WASTES, GARBAGE, DEBRIS, WASTEWATER, AND OTHER SUBSTANCES ON THE SITE IN SUCH A WAY THAT THEY SHALL NOT BE TRANSPORTED FROM THE SITE BY THE ACTION OF WINDS, STORM WATER RUNOFF, OR OTHER FORCES. PROPER DISPOSAL OR MANAGEMENT OF ALL WASTES AND UNUSED BUILDING MATERIAL, APPROPRIATE TO THE NATURE OF THE WASTE OR MATERIAL, IS REQUIRED. COMPLIANCE IS REQUIRED WITH ALL STATE OR LOCAL REGULATIONS REGARDING WASTE DISPOSAL, SANITARY SEWER, OR SEPTIC SYSTEMS.

NO.	REVISIONS	DATE

GENERAL CONSTRUCTION NOTES

DETENTION BASIN RETROFITS

BANKLICK WATERSHED COUNCIL
KENTON COUNTY, KY

JOB NO.
1901.001

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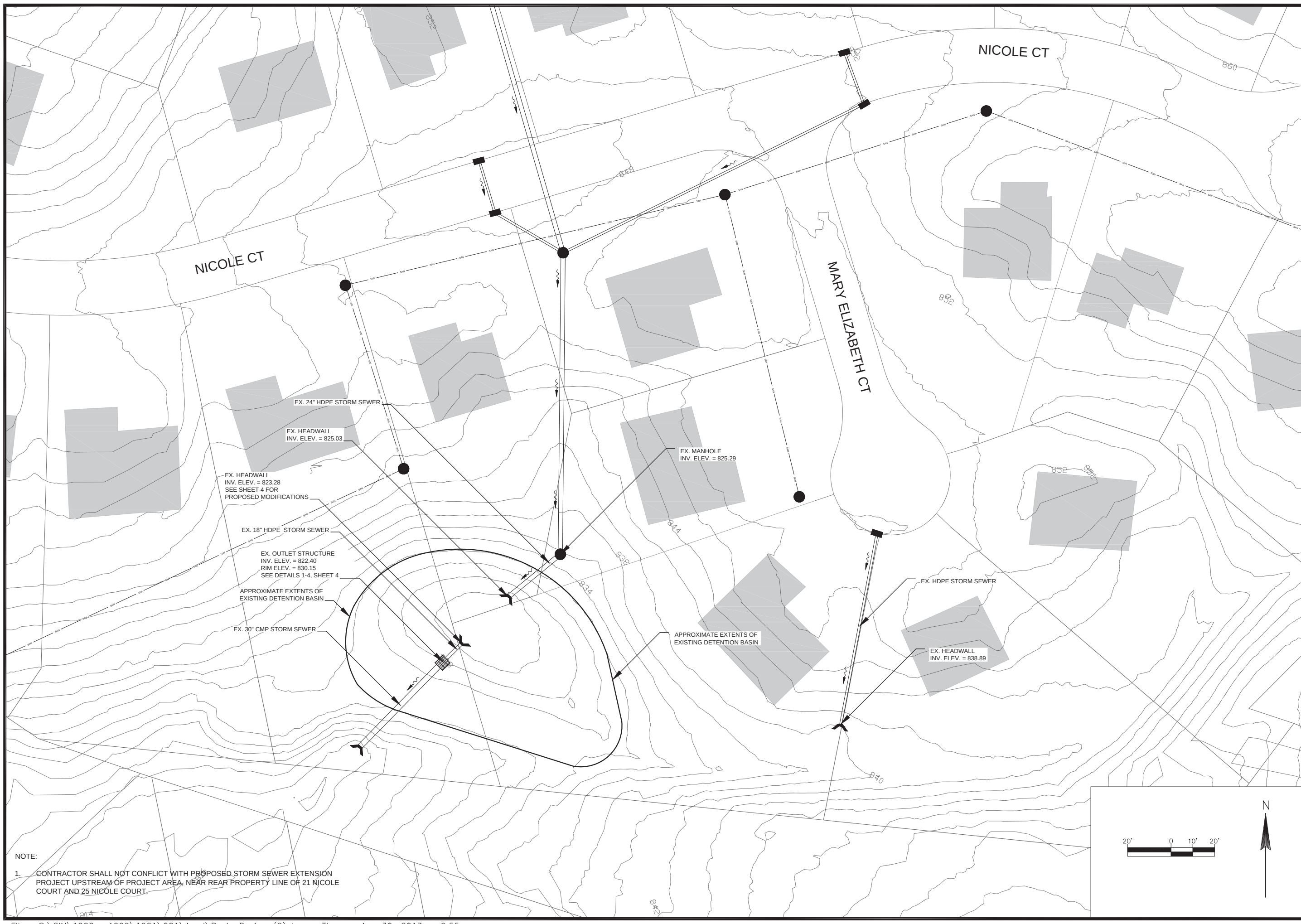

NOTE:

1. CONTRACTOR SHALL NOT CONFLICT WITH PROPOSED STORM SEWER EXTENSION PROJECT UPSTREAM OF PROJECT AREA, NEAR REAR PROPERTY LINE OF 21 NICOLE COURT AND 25 NICOLE COURT.

NO.	REVISIONS	DATE:

NICOLE CT.
EXISTING CONDITIONS

DETENTION BASIN RETROFITS

BANKLICK WATERSHED COUNCIL
KENTON COUNTY, KY

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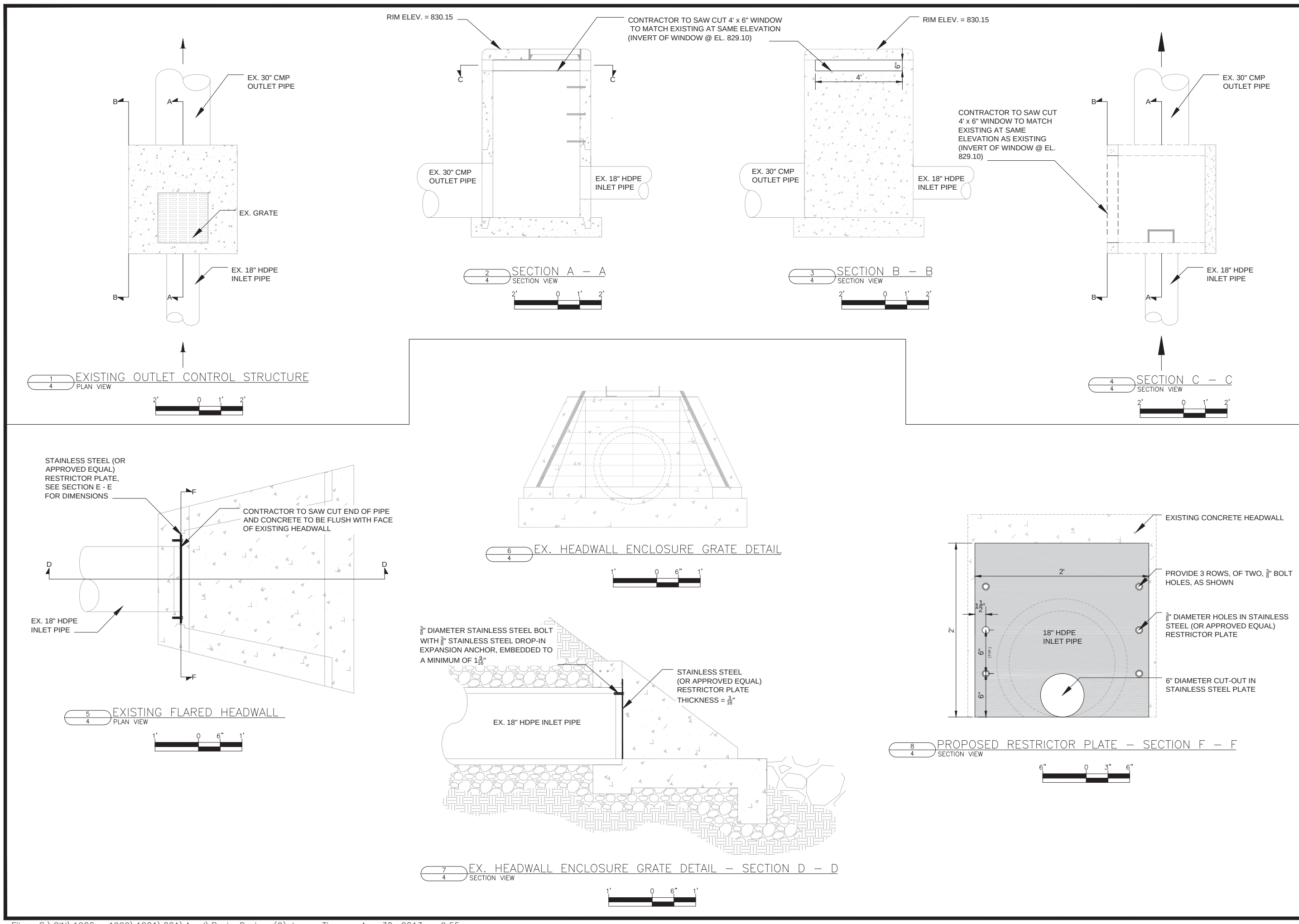

DATE.
REVISIONS
NO.

NICOLE CT.
TYPICAL SECTIONS & DETAILS
DETENTION BASIN RETROFITS
BANKLICK WATERSHED COUNCIL
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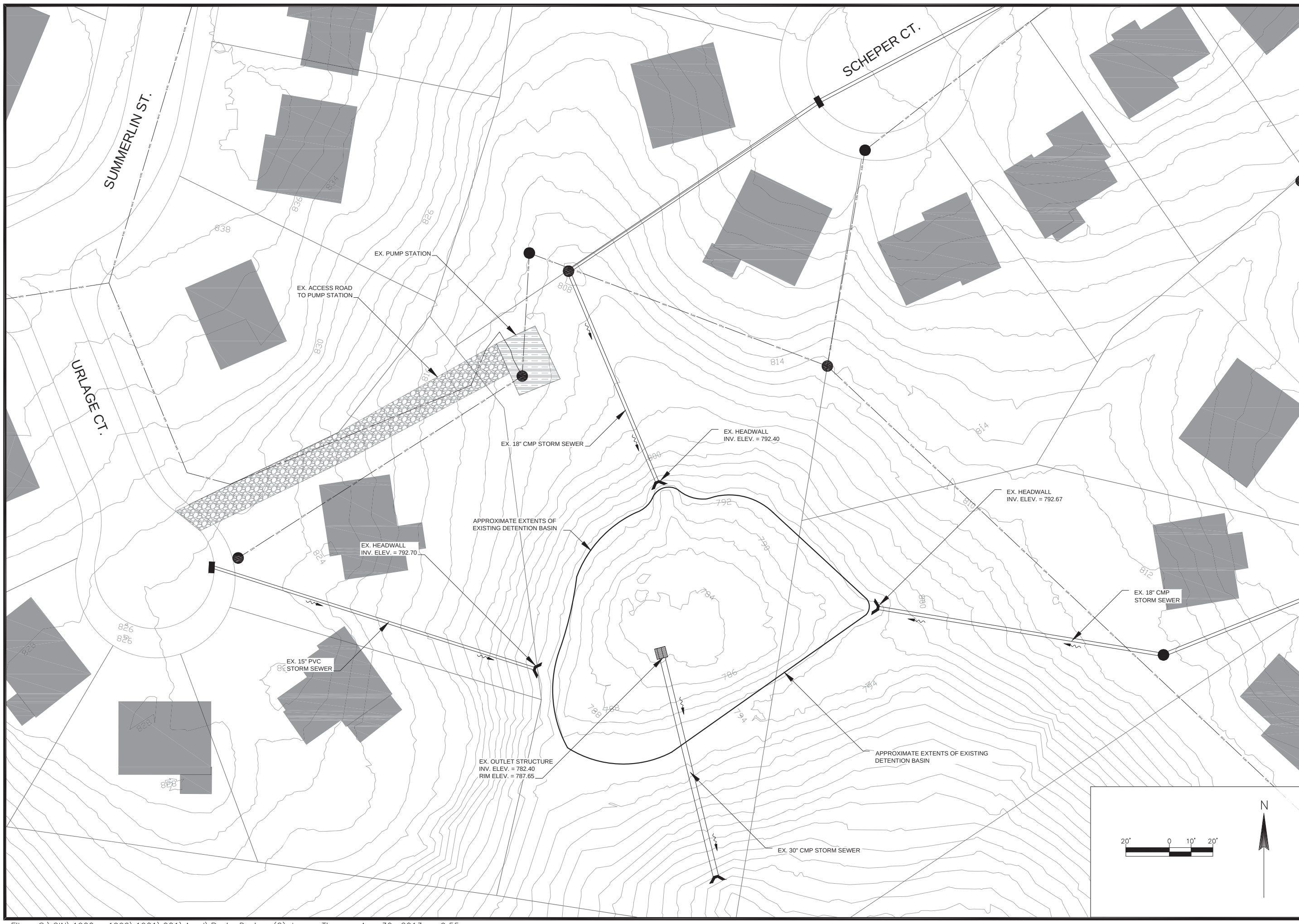

NO. | REVISIONS | DATE:

SCHEPER CT.
EXISTING CONDITIONS

DETENTION BASIN RETROFITS

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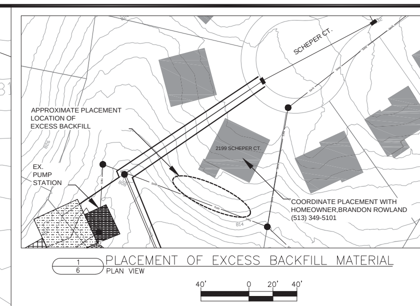
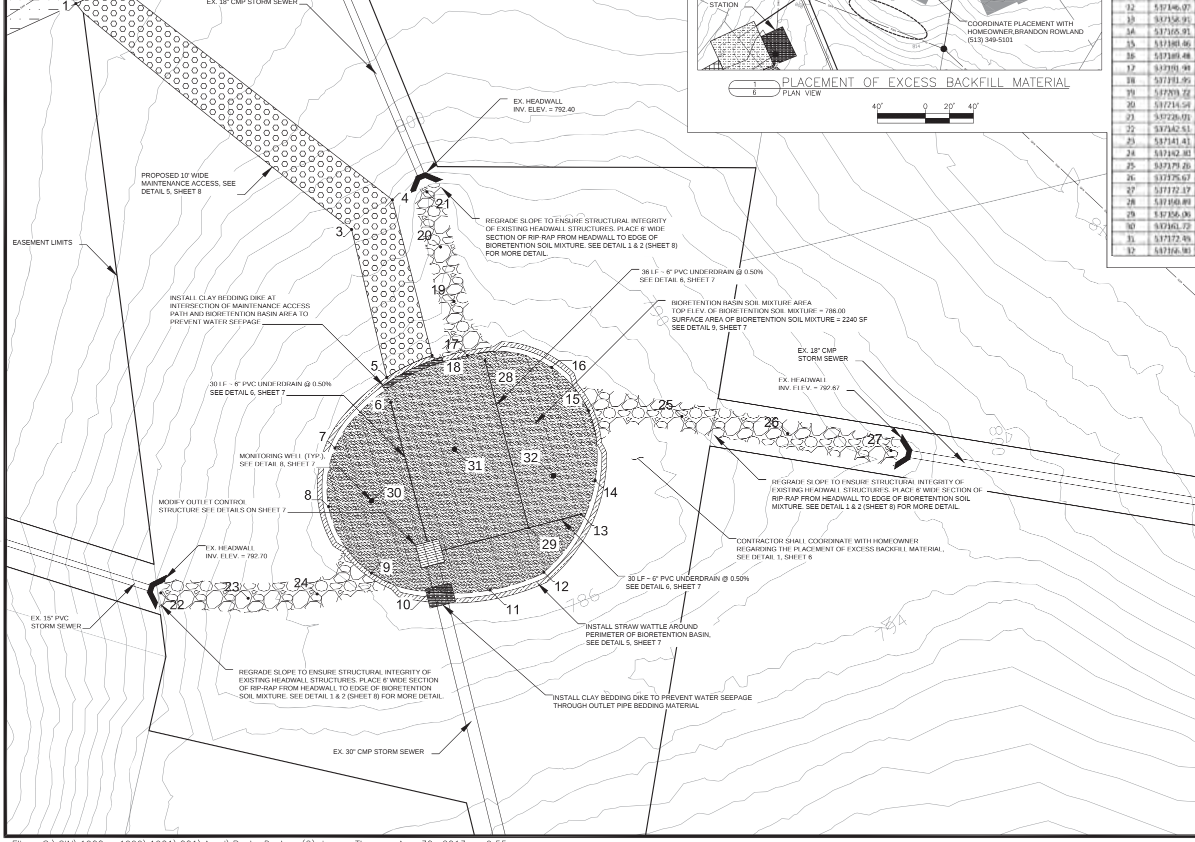


STAKING PLAN TABLE

NUMBER	NORTHING	EASTING	DESCRIPTION
1	537265.24	1559301.39	PROPOSED MAINTENANCE ACCESS PATH
2	537260.15	1559309.99	PROPOSED MAINTENANCE ACCESS PATH
3	537218.18	1559358.84	PROPOSED MAINTENANCE ACCESS PATH
4	537224.36	1559367.43	PROPOSED MAINTENANCE ACCESS PATH
5	537187.38	1559366.16	PROPOSED MAINTENANCE ACCESS PATH
6	537182.15	1559366.97	UNDERDRAIN CLEANOUT
7	537172.09	1559355.37	BIORETENTION SOIL MIXTURE PERIMETER
8	537160.49	1559354.04	BIORETENTION SOIL MIXTURE PERIMETER
9	537146.66	1559362.97	BIORETENTION SOIL MIXTURE PERIMETER
10	537142.65	1559375.05	BIORETENTION SOIL MIXTURE PERIMETER
11	537143.11	1559387.67	BIORETENTION SOIL MIXTURE PERIMETER
12	537146.07	1559399.54	BIORETENTION SOIL MIXTURE PERIMETER
13	537158.91	1559406.64	UNDERDRAIN CLEANOUT
14	537165.91	1559409.59	BIORETENTION SOIL MIXTURE PERIMETER
15	537180.46	1559408.19	BIORETENTION SOIL MIXTURE PERIMETER
16	537189.48	1559400.53	BIORETENTION SOIL MIXTURE PERIMETER
17	537191.94	1559382.97	BIORETENTION SOIL MIXTURE PERIMETER
18	537191.95	1559375.60	PROPOSED MAINTENANCE ACCESS PATH
19	537209.22	1559380.18	RIP-RAP CHANNEL CENTER-LINE
20	537214.58	1559377.37	RIP-RAP CHANNEL CENTER-LINE
21	537226.01	1559374.53	RIP-RAP CHANNEL CENTER-LINE
22	537142.51	1559319.08	RIP-RAP CHANNEL CENTER-LINE
23	537141.41	1559337.78	RIP-RAP CHANNEL CENTER-LINE
24	537142.30	1559351.66	RIP-RAP CHANNEL CENTER-LINE
25	537179.26	1559427.64	RIP-RAP CHANNEL CENTER-LINE
26	537175.67	1559449.68	RIP-RAP CHANNEL CENTER-LINE
27	537172.17	1559471.27	RIP-RAP CHANNEL CENTER-LINE
28	537160.89	1559386.63	UNDERDRAIN CLEANOUT
29	537156.06	1559395.72	UNDERDRAIN TEE FITTING
30	537161.72	1559363.08	MONITORING WELL
31	537172.49	1559380.28	MONITORING WELL
32	537166.90	1559380.91	MONITORING WELL



LEGEND

- EX. PUMP STATION
- PROPOSED CONTRACTOR STAGING AREA
- PROPOSED 10' MAINTENANCE ACCESS
- PROPOSED RIP-RAP CHANNEL
- PROPOSED BIORETENTION BASIN AREA
- STRAW WATTLE

10' 0 5' 10'

N

DATE:

REVISIONS

NO.

SCHEPER CT.
SITE & STAKING PLAN

DETENTION BASIN RETROFITS

BANKLICK WATERSHED COUNCIL
KENTON COUNTY, KY

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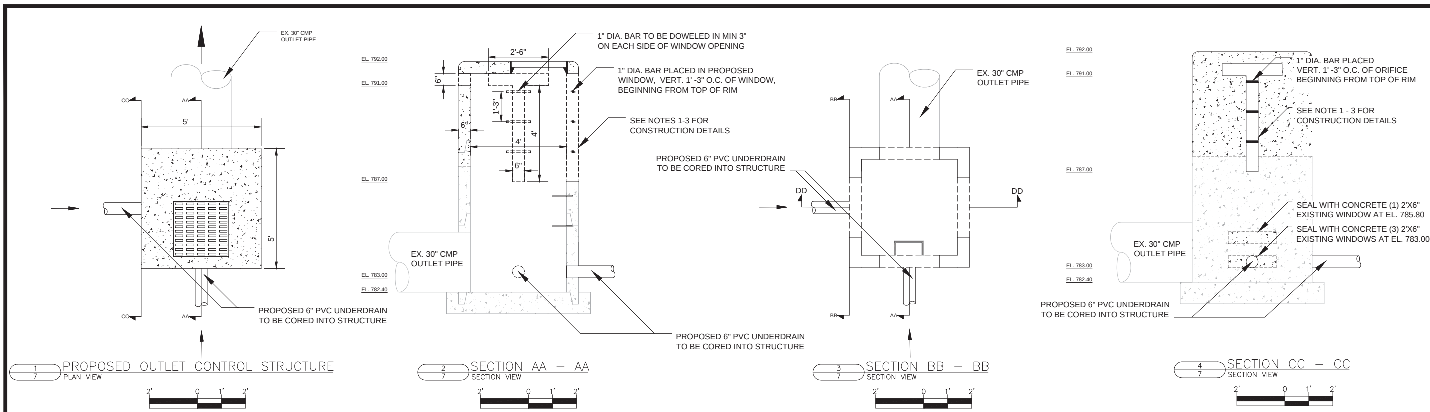
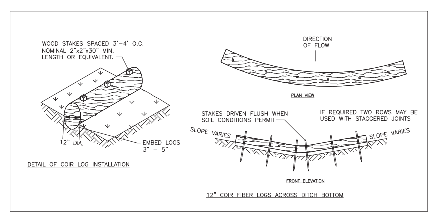
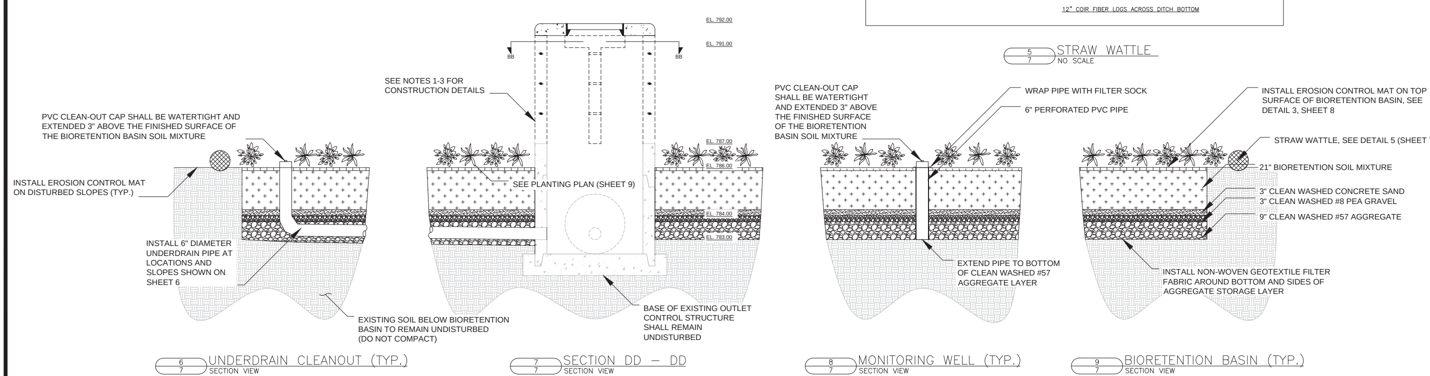


CONSTRUCTION NOTES:

1. THE PROPOSED MODIFICATIONS TO THE OUTLET CONTROL STRUCTURE SHALL NOT DISTURB THE EXISTING BASE OF THE STRUCTURE OR OUTLET PIPE.
2. WALLS - CAST-IN-PLACE (CIP) WALLS SHALL HAVE A NOMINAL THICKNESS OF 8". PRECAST WALLS SHALL HAVE A MINIMUM THICKNESS OF 6" AND BE REINFORCED SUFFICIENTLY TO PERMIT SHIPPING AND HANDLING WITHOUT DAMAGE. CONCRETE SHALL MEET REQUIREMENTS OF SD1'S SPECIFICATIONS, SECTION 02630, PARAGRAPH 3.1.1.
3. PRECAST BASE - IF A PRECAST BASE IS USED, IT SHALL BE SET DEEP ENOUGH SO THAT THE TOP CAN BE PLACED ON THE BASE TO PROVIDE THE GRATE ELEVATION SPECIFIED IN THE PLANS. GRADE ADJUSTMENTS SHALL BE MADE PER SD1'S SPECIFICATION SECTION 02630, SECTION 3.2.4 AND 3.2.5. CONCRETE SHALL MEET REQUIREMENTS OF SD1'S SPECIFICATIONS, SECTION 02630, PARAGRAPH 3.1.1.



5 / 7 STRAW WATTLE
NO SCALE



SCHEPER CT.
TYPICAL SECTIONS & DETAILS

DETENTION BASIN RETROFITS
BANKLICK WATERSHED COUNCIL
KENTON COUNTY, KY

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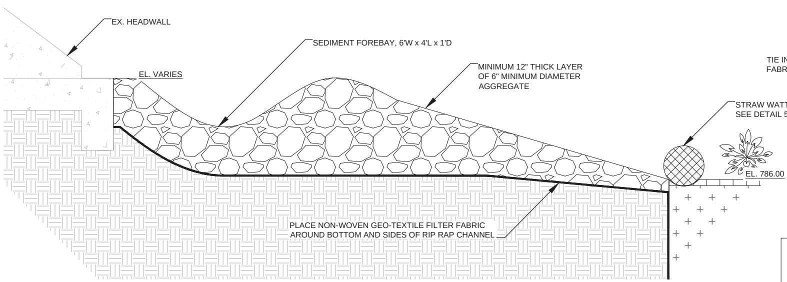
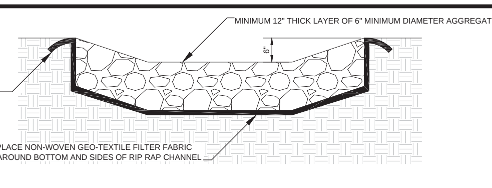
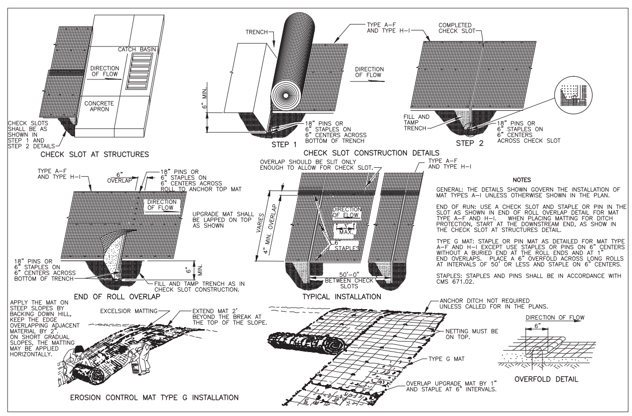


1/8 PROPOSED RIP RAP CHANNEL (TYP.)
PROFILE VIEW – NTS



2/8 PROPOSED RIP RAP CHANNEL (TYP.)
SECTION VIEW – NTS



NOTES

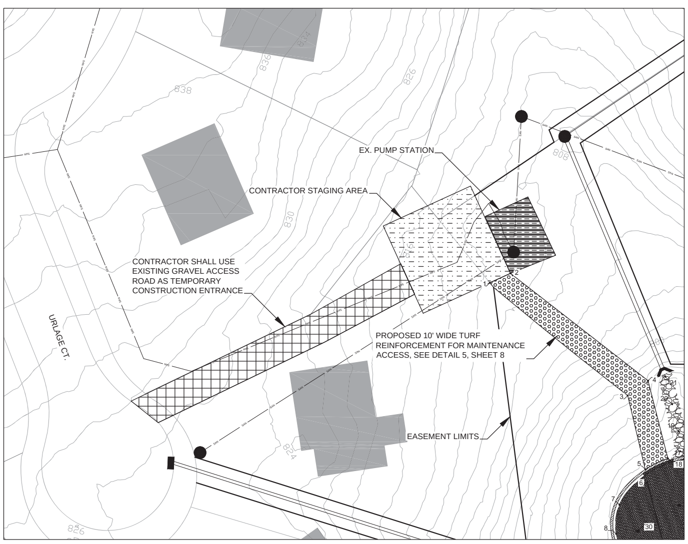
GENERAL: THE DETAILS SHOWN GOVERN THE INSTALLATION OF MAT TYPES A–I UNLESS OTHERWISE SHOWN IN THE PLAN.

END OF RUN: USE A CHECK SLOT AND STAPLE OR PIN IN THE SLOT AS SHOWN IN END OF ROLL OVERLAP DETAIL FOR MAT TYPE A–F AND H–I. WHEN PLACING MATTING FOR DITCH PROTECTION, START AT THE DOWNSTREAM END, AS SHOW IN THE CHECK SLOT AT STRUCTURES DETAIL.

TYPE G MAT: STAPLE OR PIN MAT AS DETAILED FOR MAT TYPE A–F AND H–I EXCEPT USE STAPLES OR PINS ON 6" CENTERS WITHOUT A BURIED END AT THE ROLL ENDS AND AT 1" END OVERLAPS. PLACE A 6" OVERFOLD ACROSS LONG ROLLS AT INTERVALS OF 50' OR LESS AND STAPLE ON 6" CENTERS.

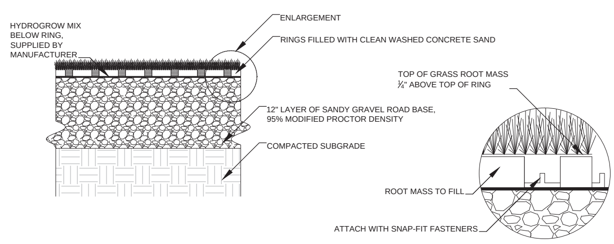
STAPLES: STAPLES AND PINS SHALL BE IN ACCORDANCE WITH CMS 671.02.

4/8 EROSION CONTROL MAT DETAIL TYPE A – I
NO SCALE



3/8 CONSTRUCTION ENTRANCE & STAGING AREA
PLAN VIEW

20' 0 10' 20'



5/8 TURF REINFORCEMENT FOR MAINTENANCE ACCESS (TYP.)
NO SCALE

NO.	REVISIONS	DATE

SCHEPER CT.
TYPICAL SECTIONS & DETAILS

DETENTION BASIN RETROFITS

BANKLICK WATERSHED COUNCIL
KENTON COUNTY, KY

JOB NO. 1901.001

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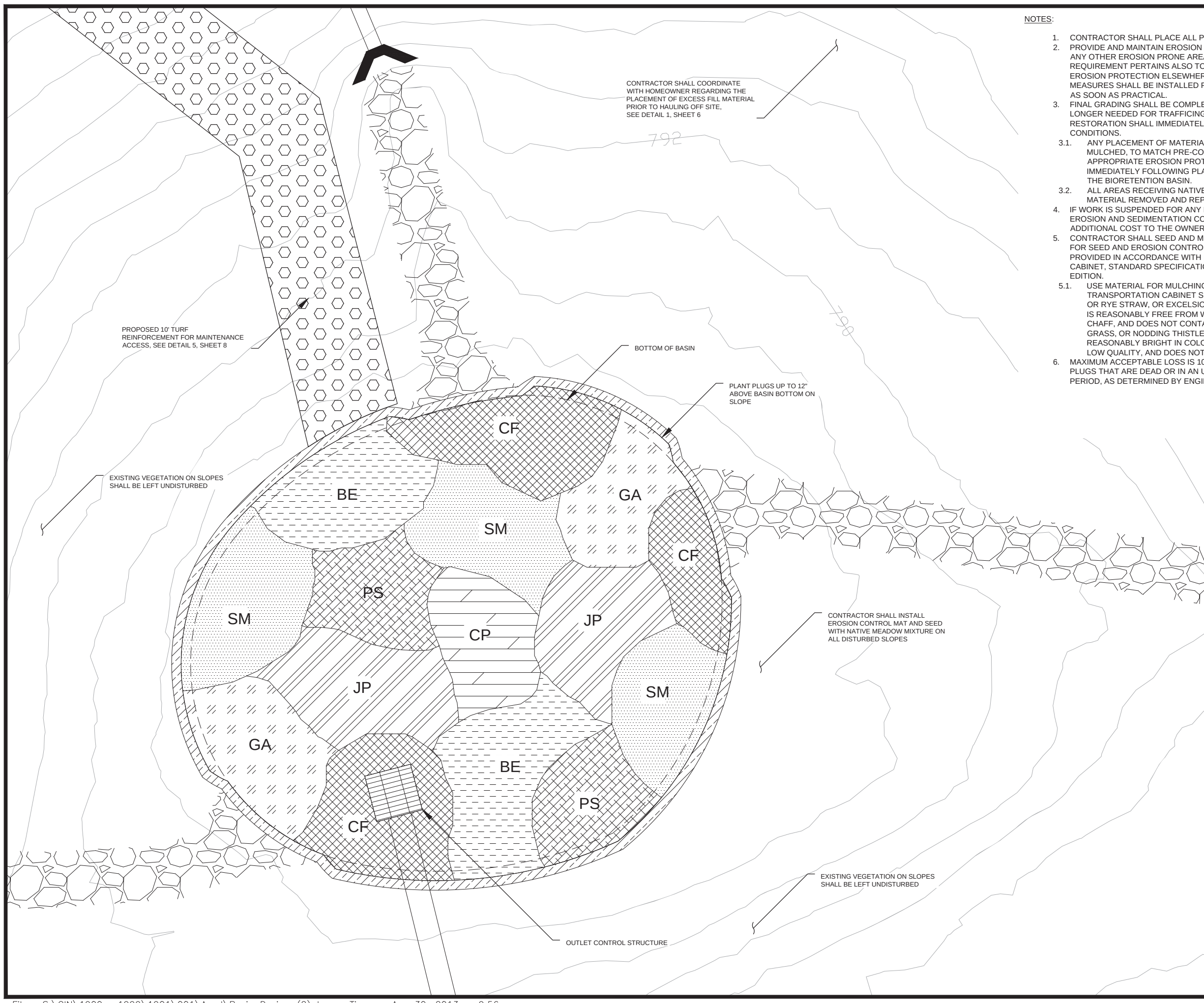
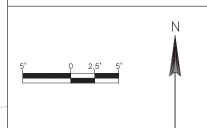


NOTES:

1. CONTRACTOR SHALL PLACE ALL PLANT PLUGS AT 16" O.C.
2. PROVIDE AND MAINTAIN EROSION PROTECTION ALONG CLEARED SLOPED AREA AND ANY OTHER EROSION PRONE AREAS AS DIRECTED BY OWNER OR ENGINEER. THIS REQUIREMENT PERTAINS ALSO TO HAUL AND ACCESS ROADS. NOTE DETAILS FOR EROSION PROTECTION ELSEWHERE WITHIN THE DRAWINGS. EROSION CONTROL MEASURES SHALL BE INSTALLED PRIOR TO INITIAL LAND DISTURBANCE ACTIVITIES OR AS SOON AS PRACTICAL.
3. FINAL GRADING SHALL BE COMPLETED IN ANY GIVEN AREA AS SOON AS IT IS NO LONGER NEEDED FOR TRAFFICING OF EQUIPMENT AND MATERIALS. FINAL RESTORATION SHALL IMMEDIATELY FOLLOW FINAL GRADING TO PRE-CONSTRUCTION CONDITIONS.
   - 3.1. ANY PLACEMENT OF MATERIAL ON HOMEOWNERS PROPERTY SHALL BE SEEDED, MULCHED, TO MATCH PRE-CONSTRUCTION CONDITIONS, AND PROTECTED APPROPRIATE EROSION PROTECTION AND SEDIMENT CONTROL MEASURES IMMEDIATELY FOLLOWING PLACEMENT TO PREVENT SEDIMENT EROSION INTO THE BIORETENTION BASIN.
   - 3.2. ALL AREAS RECEIVING NATIVE MEADOW MIXTURE SHALL HAVE THE TOP 6" OF MATERIAL REMOVED AND REPLACED WITH TOPSOIL.
4. IF WORK IS SUSPENDED FOR ANY REASON. THE CONTRACTOR SHALL MAINTAIN THE EROSION AND SEDIMENTATION CONTROLS DURING THE SUSPENSION AT NO ADDITIONAL COST TO THE OWNER.
5. CONTRACTOR SHALL SEED AND MULCH ALL DISTURBED AREAS THAT DO NOT CALL FOR SEED AND EROSION CONTROL MAT. CLASS I SEEDING AND MULCHING SHALL BE PROVIDED IN ACCORDANCE WITH ITEM 724 OF THE KENTUCKY TRANSPORTATION CABINET, STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, 2012 EDITION.
   - 5.1. USE MATERIAL FOR MULCHING, IN ACCORDANCE WITH KENTUCKY TRANSPORTATION CABINET SECTION 724, THAT IS BALED WHEAT, OAT, BARLEY, OR RYE STRAW, OR EXCELSIOR WOOD FIBERS. ENSURE THAT MULCH MATERIAL IS REASONABLY FREE FROM WEED SEEDS, STOLONS, FOREIGN MATTER, OR CHAFF, AND DOES NOT CONTAIN ANY JOHNSON GRASS, CANADA THISTLE, QUACK GRASS, OR NODDING THISTLE. ENSURE THAT THE MULCH MATERIAL IS REASONABLY BRIGHT IN COLOR AND NOT MUSTY, MOLDY, OR OTHERWISE OF LOW QUALITY, AND DOES NOT CONTAIN CHEMICALS TOXIC TO PLANT GROWTH.
6. MAXIMUM ACCEPTABLE LOSS IS 10% OF TOTAL # OF INSTALLED PLUGS. REPLACE PLUGS THAT ARE DEAD OR IN AN UNHEALTHY CONDITION AT END OF WARRANTY PERIOD, AS DETERMINED BY ENGINEER.

LEGEND

- STRAW WATTLE
- PROPOSED MAINTENANCE ACCESS
- RIP RAP CHANNEL
- CP - CUP PLANT
- BE - BROWN-EYED SUSAN
- SM - SWAMP MILKWEED
- JP - JOE-PYE WEED
- GA - GOLDEN ALEXANDERS
- CF - COMMON FOX SEDGE
- PS - PORCUPINE SEDGE



NO. | REVISIONS | DATE:

SCHEPER CT.
PLANTING & EPSC PLAN

DETENTION BASIN RETROFITS

BANKLICK WATERSHED COUNCIL
KENTON COUNTY, KY

JOB NO.
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PROJECT MGR.
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Banklick Watershed Council

Detention Basin Retrofit

Bid Tabulation Summary

Bidder & Address	Bid Bond or Guarantee	Addenda Acknowledged	Computed Total Bid	Alternative Bid No. 1	Alternative Bid No. 2	Alternative Bid No. 3
Brass Eagle, Inc. 7601 Highway 42, Apt. 5 Florence, KY 41042	Auto-Owners Insurance	N/A	$66,580.00	$5,500.00	$4,250.00	$9,750.00
Cardno JFNew 11121 Canal road Cincinnati, OH 45241	Travelers Insurance	N/A	$79,817.18	$13,000.00	$10,965.00	$23,965.00
Allison Landscaping 889 Anderson Ferry Road Cincinnati, OH 45238	Huntington - Check	N/A	$84,433.39	$6,773.99	$8,670.00	$15,443.99

Stormwater Detention Basin Retrofit Project at Nicole Court

Project Overview

The existing stormwater detention basin in your neighborhood, located near Nicole Court and Mary Elizabeth Court, will be modified by construction activities this fall. The detention basin currently provides stormwater storage and control of stormwater runoff peak flow rates during rainfall events. The purpose of this detention basin retrofit project is to reduce the stormwater runoff peak flow rates, providing water quality benefits in the Banklick Creek. You may see light construction equipment in your neighborhood, and contractors working in the area.

The construction activities will occur entirely within the existing detention basin, and are not anticipated to impact private property. The activities will include a simple modification to the existing outlet control structure within the basin. Upon completion of this project, the detention basin will still capture and store the stormwater runoff from the drainage area within the neighborhood. However, the modifications to the outlet control structure are intended to utilize more of the detention basin area for stormwater storage during rainfall events.

Project Participants

The Banklick Watershed Council was awarded a stormwater grant from the Kentucky Division of Water that included the implementation of this detention basin retrofit project. The Banklick Watershed Council retained the services of Strand Associates, Inc. for the design of the project, and has recently contracted with Brass Eagle, Inc. for the construction of the project.

The Sanitation District No. 1 of Northern Kentucky will be providing re-occurring maintenance of the project site after construction. Maintenance of the basin is required to provide proper function of the system both in the short-term and long-term.

Questions

You are receiving this letter as a notification of the construction activity planned in your neighborhood. However, the construction activity will not impact private property.

If you have any questions or concerns during or after construction of this project, please contact Chris Rust of Strand Associates, Inc. at (513) 861-5600.

Project location, shown above, will be near Nicole Court and Mary Elizabeth Court

Construction Schedule:

Start: October 8, 2013
End: December 15, 2013

Project Participants:

Administration: Banklick Watershed Council
Sherry Carran, Chair

Designer: Strand Associates, Inc.
Chris Rust, P.E.

Contractor: Brass Eagle, Inc.
Art Reed, Owner

Maintenance: Sanitation District No. 1
Craig Frye

Stormwater Detention Basin Retrofit Project at Scheper Court

Project Overview

The existing stormwater detention basin in your neighborhood, located in between the cul-de-sacs of Urlage Court, Scheper Court and Custer Lane, will be modified by construction activities this fall. The purpose of this detention basin retrofit project is to convert the existing detention basin into a bioretention basin to provide water quality benefits in the Banklick Creek. A bioretention basin provides control of stormwater runoff peak flow rates during rainfall events, while improving stormwater quality through infiltration, soil absorption, and evapotranspiration from plants. You may see construction equipment in your neighborhood, and contractors working in the area.

The construction activities will primarily occur within the existing low-lying area of the detention basin, as well as around the side slopes. Modifications to the existing outlet control structure are also included with the project. Upon completion of this project, the bioretention basin will still capture and store the stormwater runoff from the drainage area within the neighborhood. However, the detention basin will appear different than current conditions by incorporating a variety of native plants on the surface of the basin.

Project Participants

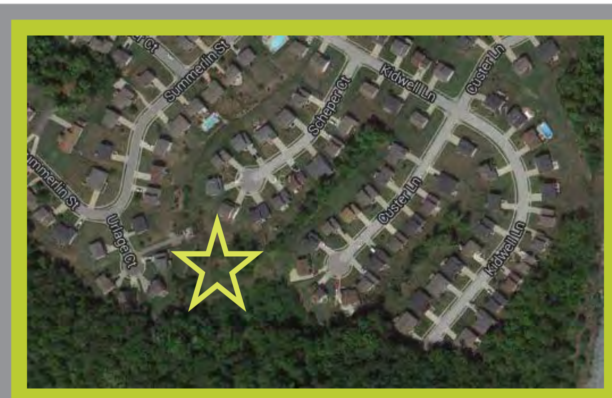
The Banklick Watershed Council was awarded a stormwater grant from the Kentucky Division of Water that included the implementation of this detention basin retrofit project. The Banklick Watershed Council retained the services of Strand Associates, Inc. for the design of the project, and has recently contracted with Brass Eagle, Inc. for the construction of the project.

The Sanitation District No. 1 of Northern Kentucky will be providing re-occurring maintenance of the project site after construction and establishment of plants. Maintenance of the bioretention basin is required to provide proper function of the system both in the short-term and long-term.

Questions

You are receiving this letter as a notification of the construction activity planned in your neighborhood. However, the construction activity will only occur on one property where the existing detention basin is located.

If you have any questions or concerns during or after construction of this project, please contact Chris Rust of Strand Associates, Inc. at (513) 861-5600.



Project location, shown above, will be in between the cul-de-sacs of Custer Lane, Scheper Court, and Urlage Court

Construction Schedule:

Start: October 8, 2013
End: December 15, 2013

Project Participants:

Administration: Banklick Watershed Council
Sherry Carran, Chair

Designer: Strand Associates, Inc.
Chris Rust, P.E.

Contractor: Brass Eagle, Inc.
Art Reed, Owner

Maintenance: Sanitation District No. 1
Craig Frye

November 14, 2014

Mr. Matt Wooten
Sanitation District No. 1 of Northern Kentucky
1045 Eaton Drive
Fort Wright, Kentucky 41017

Re: Scheper Court Bioretention Basin Maintenance Plan

Dear Matt,

Enclosed is one copy of the draft Scheper Court Bioretention Basin Maintenance Plan. This plan is intended to provide an overview of typical long-term maintenance activities needed for the Scheper Court detention basin retrofit project.

Please call with questions.

Sincerely,

STRAND ASSOCIATES, INC.®

Christopher J. Rust, P.E.

Enclosure: Report

c/enc: Sherry Carran, Banklick Watershed Council

DRAFT

Report for

Sanitation District No. 1 of Northern Kentucky

Scheper Court Bioretention Basin Maintenance Plan

Prepared by:

STRAND ASSOCIATES, INC.®
615 Elsinore Place, Suite 320
Cincinnati, OH 45202
www.strand.com

November 2014

STRAND ASSOCIATES®

PURPOSE OF MAINTENANCE PLAN

The Banklick Watershed Council (BWC) in Kentucky was the recipient of a 319(h) grant from the United States Environmental Protection Agency (USEPA) and the Kentucky Division of Water (KDOW) to implement stormwater management controls in the Banklick Creek watershed to improve water quality. One of the stormwater management controls that has been implemented through the grant includes retrofitting of existing detention basins. Traditional dry detention basins have been constructed in recent decades to provide storage and attenuation of stormwater runoff from new development sites to minimize downstream flooding during large rainfall events. However, these detention basins generally provide very minimal stormwater benefits during smaller, more frequent rainfall events.

As part of the grant, the BWC has implemented a detention basin retrofit project near Scheper Court in Covington, Kentucky. The project involves the conversion of an existing detention basin in the Fowler Ridge subdivision to a bioretention basin, which consists primarily of an amended soil mixture, aggregate storage layer, and a variety of plants. The bioretention basin is intended to capture and store stormwater runoff from approximately 16 acres of land within the subdivision, while providing water quality improvements and water quantity reductions through infiltration, soil absorption, and evapotranspiration. The Sanitation District No. 1 of Northern Kentucky (SD1) is a project partner and will be monitoring the water quality and water quantity changes as a result of the implementation of the detention basin retrofit.

Because the project is intended to provide long-term water quality benefits in the Banklick Creek watershed, maintenance activities are critical for the performance of the detention basin retrofit over a long period of time. The long-term success and sustainability of the project is dependent upon adequate maintenance activities. SD1 will be providing maintenance activities at the Scheper Court detention basin retrofit project following construction. The purpose of this maintenance plan is to provide a recommendation of future maintenance activities for the project site which extend beyond the contractual timeframe as indicated by the initial implementation and establishment period required by the contractor.

PLANTING MAINTENANCE

The bioretention basin was planted with seven different types of perennial plugs. The plugs were generally planted in approximately 15 different zones, as displayed in Figure 1, the planting plan for the basin. The plugs have different growth heights and bloom times to provide an aesthetic variety across the footprint of the basin and at different times of the year.

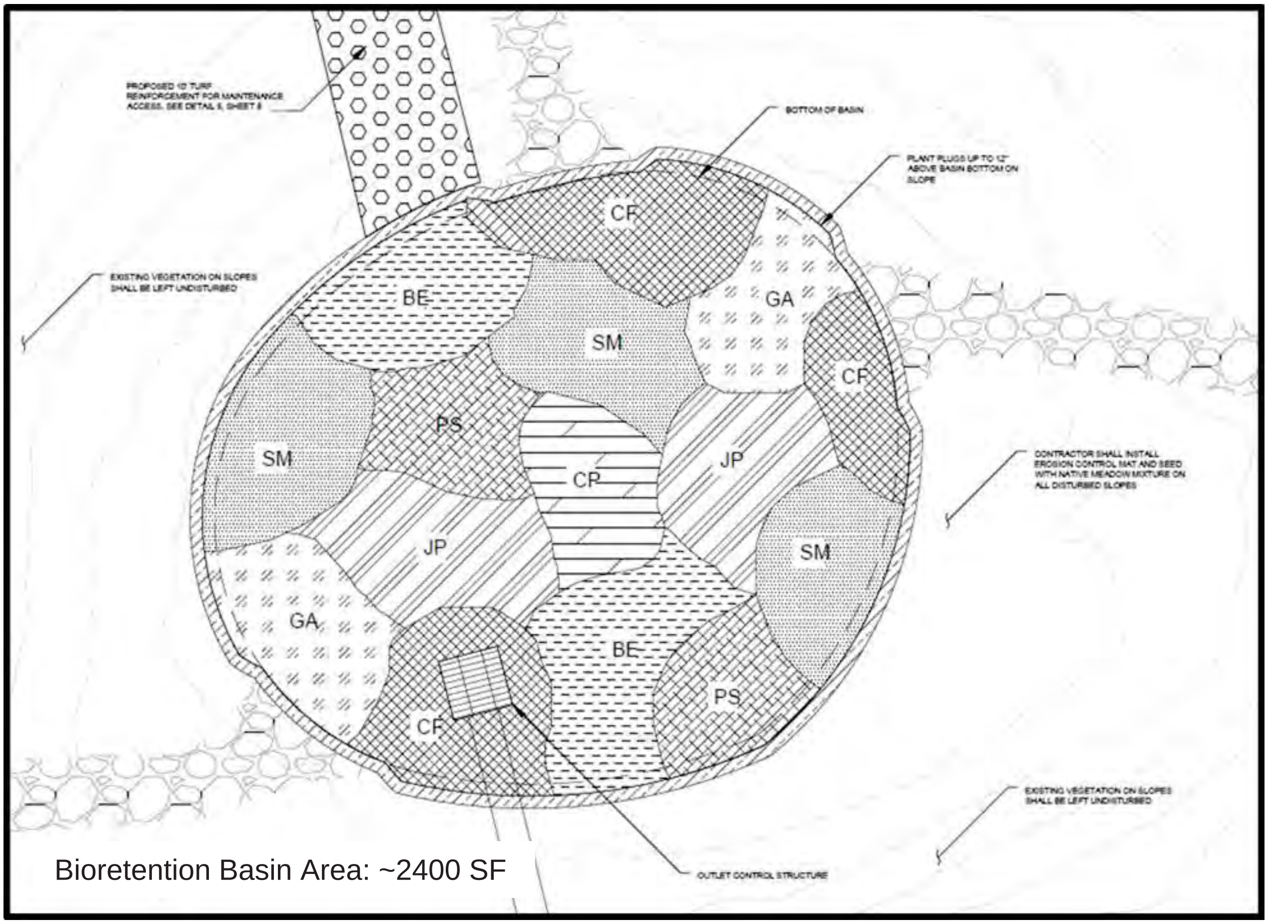


Figure 1 Bioretention Basin Planting Plan (See Table 2 for Planting Plan Table)

A. <u>Maintenance Schedule</u>

Table 1 provides a general maintenance activity schedule for the bioretention basin, while Table 2 provides the planting plan table.

Maintenance Activities	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Plant Replacement												
Weed Control												
Watering												
Pruning Perennials												

Table 1 Typical Maintenance Activities

B. Plant Replacement

Occasionally, plants may need to be replaced or added to fill in gaps that appear in the planting bed. Below are some recommendations for plant replacement and infill:

1. If perennials fail to reappear in the spring and the plantings are still under the contractor warranty period, contact the contractor with a list of plants that need to be replaced at the contractor's cost.
2. After the initial implementation and maintenance period by the contractor, the native plants should have reached a sufficient level of establishment. By year three, the native plug areas should have proper coverage over the entire site with little invasive species.

If new or replacement perennials are to be planted in the bioretention basin, they should meet the following criteria:

1. Be a native species that can withstand both wet and dry conditions. Ideally, the plant should be one of the species originally installed in the bioretention basin.
2. Plants should be healthy and have a good form with no broken stems and a properly maintained root ball.

C. Weed Control

Weeding removes unwanted plants that prevent desired plants from growing.

1. Weeding should correspond to weed seed development. Preferably, weeding should be performed before the weed has come to seed to reduce future potential of weed growth. If weeding occurs while the weed has come to seed care should be taken to prevent the dispersal of any potential weed seeds within the basin.
2. The preferred method for weed control is hand weeding. It eliminates the need for herbicides and protects desirable plants from accidental spraying. Use a spade, shovel or garden knife to remove the above ground portion of the weed and the roots.
3. In the event that invasive weed populations persist within the native planting areas, unwanted species should be controlled aggressively by spot spraying with the appropriate selective herbicides.
4. Depending on the level of infestation, it may be necessary to perform herbicide applications more than once throughout the growing season in order to best target the desired weeds.
5. All herbicide applications should be performed by a crew of state-licensed herbicide applicators.

D. Watering

1. Water plants in the morning to avoid loss of water through evaporation.

2. Watering and rainfall should supply a minimum of one inch of water per week. The rain gauge installed on site will show how much water the plants receive. Warmer temperatures (spring and summer) and sandy soils will require more water. The soil should remain lightly moist to prevent it from drying out.
3. Young or new plants require more moisture at the soil surface to help establish the roots. Watering more frequently is important.
4. Mature plants with large root systems can be watered heavily and less often than younger plants.
5. During the active growing season, monitor rainfall to determine plant watering frequency. If less than one inch of rainfall occurs per week, watering should continue until regular rainfall begins again or until the end of September, whichever comes first.
6. An assessment of the overall planting establishment and corresponding watering need should be conducted annually. The plantings within the bioretention basin do not require manual watering after they have become fully established. Watering should only be required in the event of substantial loss of vegetation or if the site is substantially disturbed.

E. Pruning Perennials

A perennial is a plant that grows and blooms over the spring and summer, dies back every autumn and winter, and then returns the following year.

1. Maintain the native planting beds by cutting back all stems and shoots to a height of four to six inches in late fall or early winter after the plants have become dormant.
2. Cut vegetation using a string trimmer or shears. Do not use a mower of any kind.
3. The cut vegetated material should be left on site as mulch during the winter months and also as a source of seeds for wildlife and natural re-seeding potential for the following year.
4. Deadhead (remove flowers as they fade) to extend the flowering and promote a second flush of flower. After the frost, when perennials have died, cut down for next year’s growth.

OTHER SITE MAINTENANCE

A. GrassPave2

The following maintenance activities should be followed for the GrassPave2 system:

1. Water as needed (refer to watering procedures described above).
2. Fertilize once a year, up until two years following full establishment, with an NPK (Nitrogen-Phosphorus-Potassium) slow-release fertilizer that contains trace elements. Apply fertilizer at a rate of 17 pounds per 1,000 square feet.
3. Do not aerate. This will cause damage to the ring structure.
4. If area needs to be re-seeded, drive on it only in emergency.

B. Stormwater Outfalls

1. The outfalls, stone channels, and sediment forebays should all be in working order without signs of damage or malfunction, and the site in general should be free of erosion upon the soil surface.
2. An inspection of all outfalls, stone channels, and sediment traps should be performed at least twice per year. The inspection should assure that these items are in proper functioning order and that drainage is being appropriately managed.
3. Any sign of damage or malfunction of these items should be properly resolved as needed.

C. Sediment/Debris Removal

1. All trash and debris should be removed by hand from the bioretention basin area. Remove any trash or debris that may be causing blockage in the outlet control structure.
2. All sediment deposited in the sediment forebays at the outfall from each headwall should be removed with a spade/shovel as needed. These areas should be monitored on a routine basis to determine frequency of sediment removal.
3. All sediment deposited on the surface of the bioretention basin area should be removed with a spade/shovel as needed. Removal of the sediment should occur in a timely manner to prevent continued spreading of sediment deposit over the surface of the basin. No heavy equipment should be used in the bioretention basin area.

D. Erosion Control

The side slopes and areas upstream from the bioretention basin should be occasionally monitored for any disturbance that could lead to sedimentation issues in the bioretention basin. Upon completion of construction, the areas tributary to the basin should be established with vegetation and erosion controls, including erosion control blankets and straw wattles. Any potential sources of sedimentation should be addressed immediately with erosion protection and sediment control measures.

STRAND ASSOCIATES®

Sign-In Sheet
Preconstruction Conference
Detention Basin Retrofits
Contract 1-2013
Banklick Watershed Council
October 7, 2013, 2:00 P.M.

Name	Organization	Telephone Number	E-Mail Address

Minutes
Preconstruction Conference
{Project Name}
Contract {_-____}
{Client Name}
Date {________________}, _____ {A.M.} {P.M.}

NTS: USE THE F11 KEY TO GO FROM FIELD TO FIELD. RUN "NOTES OUT" MACRO TO DELETE ALL NTS:

NTS: SUBMIT ALL DOCUMENTS TO THE OFFICE PRODUCTION STAFF FOR PROOFREADING AND FINAL FORMATTING.

NTS: CHECK ALL REFERENCES IN THIS DOCUMENT. THE GENERAL CONDITIONS AND SUPPLEMENTARY CONDITIONS REFERENCES ARE FOR THE 2007 VERSION OF ENGINEER'S JOINT CONTRACT DOCUMENT COMMITTEE (EJCDC).

NTS: USE THE PRECONSTRUCTION CONFERENCE MEETING MINUTES TEMPLATE FOR PROJECTS WITH EJCDC GENERAL CONDITIONS. SECTIONS THAT ARE NOT APPLICABLE TO YOUR PROJECT MAY BE DELETED.

NTS: ONCE SUBMITTED TO OP FOR PROCESSING, THESE MINUTES WILL BE RELOCATED TO THE R:\ DRIVE. AN ACTIVE "WORD" FILE OF THE WORK-IN-PROGRESS DOCUMENT AND SECURE .PDF COPIES OF ALL PREVIOUS FINALIZED MINUTES WILL BE PLACED IN THE JOB NUMBER FOR YOUR USE.

1. Introduction of those Present–The following people were in attendance at the conference:

Present	Representing	Contact
{Representative Name}	{City,Village,Town} of {Name} (Owner)	Tel: {AC}-{xxx-xxxx} Fax: {AC}-{xxx-xxxx} E-mail: {name@_____.com or .net}
{Representative Name}	{City,Village,Town} of {Name}	Tel: {AC}-{xxx-xxxx} Fax: {AC}-{xxx-xxxx} E-mail: {name@_____.com or .net}
{Representative Name}	{Contractor Name} (Contractor)	Tel: {AC}-{xxx-xxxx} Fax: {AC}-{xxx-xxxx} E-mail: {name@_____.com or .net}
{Representative Name}	{Contractor Name}	Tel: {AC}-{xxx-xxxx} Fax: {AC}-{xxx-xxxx} E-mail: {name@_____.com or .net}
{Representative Name}	{Subcontractor Name}	Tel: {AC}-{xxx-xxxx} Fax: {AC}-{xxx-xxxx} E-mail: {name@_____.com or .net}
{Representative Name}, Resident Project Representative (RPR)	Strand Associates, Inc.® (Engineer)	Tel: PHONE ext. {No.} Fax: FAX E-mail: {name}@strand.com
{Project Manager Name}, Project Manager	Strand Associates, Inc.®	Tel: PHONE ext. {No.} Fax: FAX E-mail: {name}@strand.com
{Representative Name}	Strand Associates, Inc.®	Tel: PHONE ext. {No.} Fax: FAX E-mail: {name}@strand.com

The following issues were discussed at the preconstruction conference.

{Mr.} {Ms.} {Contractor Superintendent Name} will be the Superintendent for {Contractor Name}. The Superintendent was identified as the Safety Representative according to GC-6.14.

Emergency (after hours) contact information:

Fire/Ambulance: 911

{City,Village,Town} of {Name}: {AC}-{xxx-xxxx} (Police Department Nonemergency)

{Contractor Name}: {AC}-{xxx-xxxx}
{Contractor}: {name@_____.com or .net}

Strand Associates, Inc.®: PHONE ext. {No.}
{name}@strand.com

2. Consulting Engineer's Role

a. Personnel

Chris Rust	Project Manager
Adam Athmer	RPR

Resident Project Representative's (RPR) role is defined in Section SC-9.03. RPR is not full-time on this project.

b. Communication Procedures–All correspondence should be addressed to {Project Manager Name}. Phone calls should go from {Contractor Representative Name} to {Project Manager Name}. {Contractor Representative Name} can call Engineer listed above directly regarding specific questions if Project Manager or RPR is not available, and it is urgent. These calls should be followed up in writing depending on the nature of the discussion. Engineer will normally communicate through Contractor's Project Manager. It was agreed that if Engineer needs to contact suppliers or subcontractors directly for clarifications on shop drawings, Contractor will be notified only if major changes are contemplated and if cost is an issue. It was also agreed Engineer will communicate with Owner directly and will communicate with Contractor directly to minimize miscommunication or breakdown in communications.

3. Owner–Engineer–Contractor Relations

Refer to General Conditions Article 6–Contractor's Responsibilities (managing subcontractors and suppliers, safety, and materials and equipment), Article 8–Owner's Responsibilities, and Article 9–Engineer's Status During Construction (Owner's representative, part-time RPR).

4. Project Funding

{Text} Project is funded by 319 grant.

5. Contract Document Status

a. Agreement–Signed by Owner and Contractor.

b. Bonds–Provided.
c. Insurance–In effect.
d. Notice to Proceed–Signed by Owner on Date Signed {_______________}.

6. Subcontractor, Material, and Equipment Requirements

a. Shop Drawing Submittals–Shop drawing requirements are outlined in GC-6.05, GC-6.17, and SC-6.17. Shop drawings must be submitted prior to 25 percent completion. Contractor shall provide a schedule for all submittals that meets this requirement. Payment will not be recommended beyond 25 percent until all shop drawings are submitted or a revised schedule for any remaining submittals has been agreed to.

Section 01300–Submittals indicates that shop drawings and product data shall be transmitted to Engineer in electronic (PDF) format using Submittal Exchange or a similar web site service. Once a shop drawing has been "approved" or "approved as noted," Contractor shall provide three color hard copies to Engineer.

Contractor shall review and stamp all shop drawings before submitting them to Engineer. Contractor should prioritize shop drawings if many are submitted at once.

SC-6.17 states that Contractor shall produce submittals with sufficient information and accuracy to obtain required approval with no more than three submittals. Contractor shall be responsible for all costs associated with all subsequent submittals, including Engineer's review costs.

b. Requests for Substitutions or Deviations–Refer to GC-6.05.A. Contractor is required to certify proposed substitutes according to GC-6.05.A.2.d. Drawing revisions to accommodate equipment supplied (Section 01600–Materials and Equipment)–Contractor is responsible for costs associated with revising drawings, if necessary, to accommodate a substitute piece of equipment.

c. Delivery and Storage of Material–See Section 01600–Materials and Equipment.

NTS: DISCUSS LOCATION OF STORAGE HERE.

d. Site Security–Contractor was referred to Division 1, Section 01560–3.03 Site Security. All materials should be properly stored in accordance with manufacturer's or supplier's instructions and according to weather conditions. Damaged materials may not be used in the construction.

e. Material Testing–Refer to Section SC-13.03.A–Tests and Inspections; Buried Piping and Water Main pressure testing in Sections 02600 and 03300, 3.14–Cast-In-Place Concrete, Testing and Sampling, and 3.19–Reservoir Testing and Disinfection; Section 15040–Piping and Accessories, 3.02 Field Quality Control and 3.03 Cleaning and Disinfection. There may be other testing requirements in the Contract not listed here.

7. Payments and Completion Issues

a. Schedule of Values–Specifications Section GC-2.05.A.3 requires that Contractor provides a preliminary schedule of values at the meeting which is enclosed with these minutes. Engineer will provide comments so that a final version can be formulated by Contractor.

b. Progress Payments–Form(s) {AP1} {AP 5} was/were distributed to Contractor. Engineer noted that Contractor can put the forms on its own computer software, but the payment request form must have the same language as the form that was distributed. The following procedure was agreed upon:

c. Lien Waivers–Specifications Section SC-14.02.A. requires Contractor to submit partial lien waivers with each pay request, beginning with the second application. Included with these lien waivers shall be a signed lien waiver log as required in SC-14.02.A.

d. Contract Retainage–See Agreement Article 6.02 on page 00520-3. Retainage is 10 percent through 50 percent completion. Retainage is reduced to 0 percent upon substantial completion of the whole project.

e. Change Orders–See Articles 10, 11, and 12 in the General Conditions for procedures.

f. Contract Completion Dates: Refer to Agreement.

Substantial Completion Date	November 15, 2013
Final Completion Date	December 1, 2013

g. Liquidated Damages–See Agreement. Liquidated damages are $500 a day for substantial and final completion.

h. Partial Utilization–Refer to Section GC-14.05.

i. Substantial Completion–Refer to Section GC-14.04. Substantial completion will mean when the project is ready for its intended use. When Contractor believes the work is substantially complete, it must make written notification and request a certificate of substantial completion from Engineer.

j. Guarantee and Warranty

The following special warranty is included in the specifications (this list may not be all-inclusive):

(1) According to Section 02950-Trees, Plants, Stone Mulch, and Edging-all plant material is to be fully guaranteed for a period of two years from the date of final completion. Only those plants that are alive and normally healthy for the first two years will be accepted. Also refer to Note 6 on Sheet 9 regarding maximum acceptable losses.

This is in addition to the general warranty and guarantee required by GC-13.07.

k. Final Payment/Lien Waivers–Refer to GC-14.07 and 14.09.

8. <u>Documents and Procedures</u>

a. Copies of Bidding Documents–GC-2.02 and SC-2.02 indicate(s) Contractor will be receiving up to two copies of the Bidding Documents. Additional copies of the drawings will be available at the cost of reproduction plus binding and shipping and handling.

b. Addenda–There were no addenda.

c. Request for Information–The RFI form was distributed to Contractor. If Contractor requests clarification, interpretation, or additional information pertaining to the Contract Document, Contractor shall submit this request on the form provided.

d. Record Drawings–Record drawings are required to be kept by Contractor and should be reviewed by RPR approximately monthly.

e. Construction Progress Meetings–See Section 01039. It was decided the meetings will usually be held on {Date}.

f. Construction Schedule–Contractor distributed a preliminary schedule for the project. The project shall be updated monthly and shall be reviewed at each progress meeting. See Section 01039 for submittal requirements at each progress meeting.

g. Permits–Refer to Section 01060. No permits were obtained by Owner.

9. Use of Site

a. Property Limits–Approximately identified as the “Area of the Site” on the drawings. Confine activities to within this area.

b. Easements–See Sheet 6 of design drawings for easement limits.

c. Storage and Yard Areas–Refer to Section 01600. Damaged material will not be accepted and shall be immediately removed from the site. All stored material must be clearly labeled and tagged. See Section 01560 regarding daily cleanup.

d. Temporary Facilities–Refer to Section 01500. Contractor should determine with Owner the location of temporary toilet, electrical, telephone, and water service.

e. Staking and Layout–Contractor is responsible to lay out work.

f. Operation of Existing Facilities–Refer to Section 01010, 1.04 Construction Requirements.

g. Special Requirements (Hours, Sign-In, Smoking)–Work hours are Time {___} {A.M.} {P.M.} to Time {___} {A.M.} {P.M.}, Monday through Friday, Time {___} {A.M.} {P.M.} to Time {___} {A.M.} {P.M.}on Saturday (Section 01010).

10. Other Construction Issues

{Text} or {There were no comments.} or {There was no discussion.}

11. Owner’s Comments

{Text} or {There were no comments.} or {There was no discussion.}

12. Sanitation District No. 1 Comments

{Text} or {There were no comments.} or {There was no discussion.} or {No agency representative attended the meeting.}

13. Contractor's Comments

{Text} or {There were no comments.} or {There was no discussion.}

14. Presentation of Construction Schedule by Contractor

{Text} or {There were no comments.} or {There was no discussion.}

15. Open Discussion Questions and Answers

{Text} or {There were no comments.} or {There was no discussion.}

16. Next Meeting

Construction Progress Meeting No. {No.} will be held on Date {_______________}, at Time {___} {A.M.} {P.M.} at {Location}.

If there are any additions or comments, please call me at PHONE ext. {No.}.

NTS: MINUTES DISTRIBUTED BY REGULAR MAIL USE THE STANDARD CLOSURE. JERRY HUTZLER **MUST** RECEIVE A COPY OF **ALL** MINUTES DISTRIBUTED. DO NOT DELETE HIS NAME FROM THE COPY LIST.

Respectfully Submitted,

STRAND ASSOCIATES, INC.®

{Name}

FOR DOUBLE SIGNATURES

{Name} {Name}

NTS: MINUTES DISTRIBUTED BY E-MAIL USE THE FOLLOWING CLOSURE. JERRY HUTZLER **MUST** RECEIVE A COPY OF **ALL** MINUTES DISTRIBUTED. DO NOT DELETE HIS NAME FROM THE COPY LIST.

Prepared and respectfully submitted by {Name}.

NTS: FOR ONE OR MORE ENCLOSURES, KEEP THE APPROPRIATE NOTATION AS INDICATED BELOW. UNLESS SPECIFIED OTHERWISE BY THE AUTHOR, COURTESY COPIES ARE SENT WITHOUT ENCLOSURES; CHOOSE THE APPROPRIATE FORMAT.

Enclosure(s)

c: All Participants — Jerry Hutzler, Strand Associates, Inc.®
{Individual's Name/Company} — {Individual's Name/Company}

OR

c/enc: All Participants — Jerry Hutzler, Strand Associates, Inc.®
{Individual's Name/Company} — {Individual's Name/Company}

« REMEMBER CORRESPONDENCE FILE COPY »

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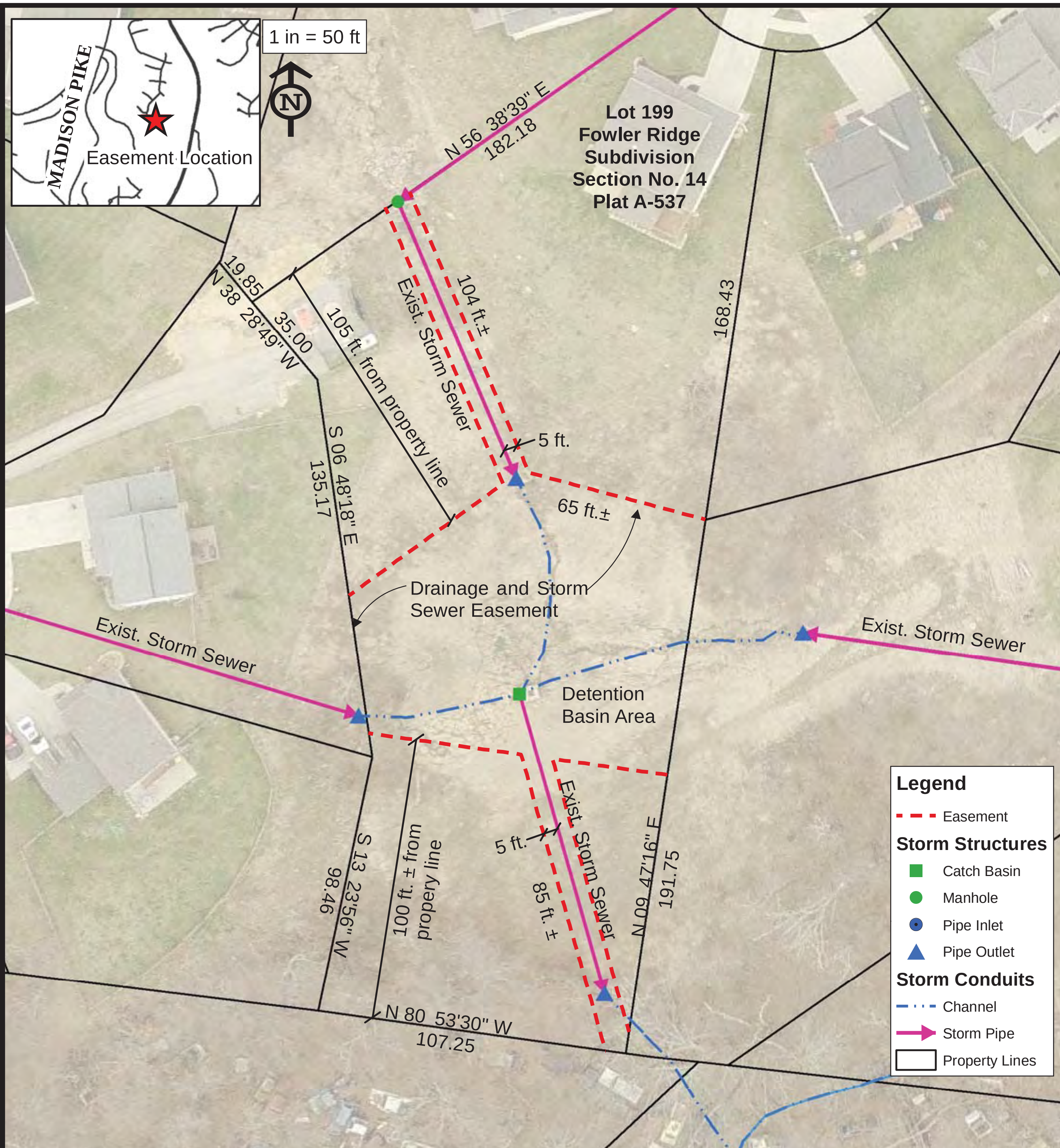

Notes:
1) The purpose of this exhibit is to show the approximate location and dimensions for a proposed drainage and storm sewer easement.
2) Metes and bounds information based on existing plat of record for Fowler Ridge Subdivision Section No. 14 in the Kenton County Clerks office.
3) Proposed easement limits are approximate based on feature locations delineated using current availble GIS information.
Contact: Strand Associates, Inc. 615 Elsinore Pl Suite 320 Cincinnati OH 45202 (513) 861-5600

EASEMENT EXHIBIT
FOR SANITATION DISTRICT NO. 1 OF NKY
2199 SCHEPER CT. COVINGTON, KY
KENTON COUNTY PVA PARCEL ID: 045-10-01-199

Note: This is not a boundary survey and is not intended for land transfer.

STRAND ASSOCIATES®

APPENDIX G
Conservation Deeds

Tax Exempt KRS 142.050 7(b)

PIDN: 017-30-08-157.02
GROUP: IND.

CORRECTED DEED OF CONSERVATION

WHEREAS, by deed recorded on April 15, 2008 in OR Book I-2305, Page 199 of the Kenton County Clerk's records at Independence, Kentucky, Doe Run Estates II, LLC, a Kentucky limited liability company, conveyed 26.457 acres located in the City of Erlanger, County of Kenton, State of Kentucky and more particularly described in Exhibit A, attached hereto and incorporated herein by reference ("Property") to The Kenton Conservancy, Inc. ("Deed"); and

WHEREAS The Kenton Conservancy, Inc. ("The Kenton Conservancy") is a community based non-profit, 501(c)(3) land trust with a stated purpose of land conservation in Kenton County, Kentucky for the benefit of people and nature; and

WHEREAS, the Deed inadvertently failed to include the purpose and provisions to maintain the Property, in its present state, which has significant natural, ecological, habitat, scenic, educational, forestry, open space and watershed values, including value relating to abatement of non-point source pollution, (collectively, "Conservation Values") of importance to The Kenton Conservancy, the Banklick Watershed Council, KDOW, the EPA, and the people of Kenton County; and

WHEREAS, the Deed further failed to meet the requirements of the U.S. Environmental Protection Agency Region IV (EPA) as the appraised value of the Property will be used as in-kind match for Grant #C9994861-07 from the EPA under §319(h) of the Clean Water Act through the Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water (the "Cabinet"), to the Banklick Watershed Council. The Kenton Conservancy is a stated partner on this Grant; and

WHEREAS, the purpose of this correcting deed is to include the omitted provisions from the Deed including, but without limitation the purpose and maintaining the Property in its present state.

NOW, THEREFORE, the Grantor, DOE RUN ESTATES II, LLC, a Kentucky limited liability company, by its duly authorized member, whose address is 81 Sweetbriar, Fort Thomas, Kentucky 41075, for and in consideration of One ($1.00) Dollar and other valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, does hereby BARGAIN, SELL and CONVEY to the Grantee, THE KENTON CONSERVANCY, INC., whose address is 303 Court Street, Room 307, Covington, Kentucky 41011 its successors and assigns forever, the Property, more particularly described in Exhibit A, attached hereto and incorporated herein.

The Property conveyed herein shall be subject to the following provisions:

ARTICLE I DURATION OF CONSERVATION DEED

This Conservation Deed shall be perpetual and shall run with the Property. The Kenton Conservancy may assign its rights and obligations under this Conservation Deed to a like non-profit, 501 (c)(3) organization deemed qualified to hold such interest by the EPA.

ARTICLE II PERMITTED ACTIVITIES

A. Permitted activities include: inspection of the property for violations of this conservation deed; the construction and use of trails for foot travel, provided that they do not diminish the Conservation Values of the Property, are located and constructed to prevent erosion, avoid habitat fragmentation, protect sensitive areas and water quality, and that all trails shall have a pervious surface of natural materials; passive environmental assessment; education; environmental stewardship, including restoration and protection activities, and the installation of water quality best management practices (BMPs) such as modification of hydrology, aquatic and riparian habitat improvement, native vegetation planting, invasive species removal, removal of diseased trees and other practices towards a healthy forest, and maintenance and monitoring of streams and riparian zones.

B. Appropriate trails as described above in Article II A and educational signs will be permitted. See Article III C for signage restrictions.

ARTICLE III PROHIBITED AND RESTRICTED ACTIVITIES

A. All residential and active recreational uses shall be prohibited on the Property. Active recreation activities include, but are not limited to, hunting, use of all terrain and other motorized vehicles, biking, horseback riding, or other activities that may negatively impact the Conservation Values of the Property. No motorized vehicles shall be permitted on the Property. All commercial activities within the Property area shall be prohibited.

B. All agriculture shall be prohibited within the Property. This includes all methods of production and management of livestock, including the feeding, housing, training and maintaining of animals such as cows, sheep, goats, hogs, horses and poultry, and all methods of production and management of crops, trees and other vegetation, including related activities of tillage, fertilization, pest control, harvesting and logging.

C. Display of billboards, signs or advertisements is prohibited on or over the Property, except: (1) to state solely the name and/or address of the Kenton Conservancy ; (2) to commemorate the history of the Property, its recognition under state or federal historical registers, or its protection under this Conservation Deed or state and local environmental or game laws; or (3) to prohibit trespassing, and hunting and/or other active recreation; provided that no sign on the Property shall exceed two/2 feet by three/3 feet. Multiple signs shall be limited to a reasonable number, shall be placed at least five hundred/500 feet apart, shall not damage living trees, and shall be placed in accordance with applicable local regulations, except that signs permitted under exception (3) may be placed the lesser of one hundred/100 feet apart or the distance required by law.

D. Dumping or storage on or under the Property of any trash, ashes, garbage, waste, sewage, manure, hazardous materials, discarded materials such as abandoned vehicles, appliances, machinery and other unsightly or offensive materials shall be prohibited. There shall also be no dumping or stockpiling of any soil, sawdust, gravel, and/or sand. This is not intended to prohibit composting excess brush or other plant materials generated on the Property by activities permitted in this Deed, provided that composting shall not be located within one hundred/100 feet of any creek, stream, intermittent stream, drainage way, surface or subsurface spring, wetland or of the high water mark of Doe Run Lake. Soil, rock, other earth materials, vegetative matter may be placed as may be necessary for water quality BMPs or stream bank restoration.

E. Excavation, dredging, drilling, mining or removal of any loam, gravel, soil, rock, sand, minerals, coal, petroleum and other materials on or from this Property shall be prohibited.

F. Surface alterations of the Property, including, without limitation, ditching, draining, diking, tiling, filling, leveling, channelizing, impounding, dredging or removal of wetlands or streams shall be prohibited, except as may be required for activities or uses expressly permitted in this Deed or for water quality BMPs or stream and/or wetland restoration.

G. No new permanent structures shall be constructed within the Property.

H. All existing easements that may include underground utility easements, overhead utility easements, or ingress/egress easements, including the pedestrian access easement from between Lots 111 and 112 as shown on the plat of Doe Run Estates II, may be maintained with permission and review of the Kenton Conservancy. Future granting of easements may be permitted through a review process by the Kenton Conservancy Board. Provided such easements are in keeping with all other articles of this deed. Such reviews will include review by EPA to ensure the intent of the Banklick Watershed Council's EPA 319 (h) Grant #C9994861-07 are being met.

I. Spraying with biocides or use of herbicides or pollutants that violate water quality standards.

ARTICLE IV REQUIRED ACTIVITIES

A. The Kenton Conservancy shall perform a property inspection a minimum of once a year for the purpose of assessing the quality and condition of the land, ensuring that no prohibited activities are occurring on the Property, and that the requirements of this Conservation Deed are being upheld.

ARTICLE V ENFORCEMENT AND REMEDIES

A. Upon any breach of a Term of this Conservation Deed the Kenton Conservancy may exercise any or all of the following remedies:

1. institute suits to enjoin any breach or enforce any Term by temporary, and/or permanent injunction either prohibitive or mandatory, including a temporary restraining order; and

2. require that the Property be restored promptly to the condition required by this Conservation Deed.

These remedies shall be cumulative and shall be in addition to all appropriate legal proceedings and any other rights and remedies available at law or equity.

B. No failure to enforce any Term hereof shall discharge or invalidate such Term or any other Term hereof or affect the right to enforce the same in the event of a subsequent breach or default.

ARTICLE VI EXHIBITS

The following exhibits are hereby made a part of this Conservation Deed:

A. Exhibit A: Boundary Reference and Property Description is attached hereto and made a part hereof. Exhibit A consists of two (2) pages.

B. Exhibit B: Aerial Map of the Deeded Property is attached hereto and made a part hereof. Exhibit B consists of one (1) page.

C. Exhibit C: Map Showing Approximate Location of Existing (utility or ingress/egress) Easements on the Deeded Property. This is to be used only for referencing the easements. Exhibit C consists of one (1) page.

D. Exhibit D: Statement of the Appraised Property Value is attached hereto and made a part hereof. Exhibit D consists of _____ page.

ARTICLE VII MISCELLANEOUS

A. The appraised value of this Property has been used as an in-kind match for Grant #C9994861-07 from the EPA under §319(h) of the Clean Water Act through KDOW to the Banklick Watershed Council. The Kenton Conservancy is a stated partner on this Grant.

B. The Kenton Conservancy agrees to hold this Conservation Deed into perpetuity exclusively for conservation purposes, as defined in Section 170(h) of the Internal Revenue Code or to deed to a like non-profit, 501 (c)(3) organization that will carry out the intent of this Conservation Deed and that is deemed qualified to hold such interest by the EPA .

C. No Property transfer shall occur by inverse condemnation proceedings. If all or any part of the Property is taken under the power of eminent domain by public, corporate or other authority the Kenton Conservancy shall move forward with appropriate proceedings at the time of such taking to recover the full value of the interests in the property subject to the taking and all incidental or direct damages resulting from the taking. The EPA and the Cabinet will be notified of these actions and given opportunity to have their interest represented in the proceedings.

D. This Conservation Deed may be amended, provided that no amendment shall be allowed that will affect the qualification of this Conservation Deed or the status of the property owner under any applicable state or federal law, including Section 170(h) of the Internal Revenue Code. Amendments shall be subject to approval of the Cabinet and shall be recorded in the Kenton County, Kentucky Records.

E. The Terms of this Conservation Deed do not replace, abrogate or otherwise set aside any local, state or federal laws, requirements or restrictions imposing limitations on the use of the Property.

F. Severability: If a court of law or other legally binding authority holds that any provision of this Conservation Deed is invalid or otherwise enforceable the Court or other authority shall have the authority to modify said provision to best effectuate the intent of the Property Owner and render the provision valid and unenforceable. If, for any reason, such modification does not or cannot take place, the offending provision shall be treated as if it were never a part of this Conservation Deed and the remainder of the Conservation Deed shall remain valid and enforceable.

TO HAVE AND TO HOLD unto The Kenton Conservancy, Inc., Kenton County, Kentucky, its successors and assigns forever, with covenants of general warranty except real estate taxes for the year 2007 pro-rated to the closing date, easements and legal highways of record.

This deed is effective as of the 8^{th} day of March, 2008 and the Grantor has hereunto subscribed its hand by its duly authorized member this ___ day of December 2009.

GRANTOR:

DOE RUN ESTATES II, LLC, a Kentucky limited liability company

By ____
Authorized Member

____
Name (Printed)

STATE OF KENTUCKY

COUNTY OF _______________

The foregoing instrument was acknowledged before me this ____ day of December, 2009 by __________________________, (Print Name) duly authorized member of Doe Run Estates II, LLC, a Kentucky limited liability company, on behalf of the limited liability company.

____
Notary Public
Kentucky State at Large

My commission expires: _______________________

CERTIFICATE OF CONSIDERATION

Grantor and Grantee both certify, under oath, that the consideration reflected in this deed is the full consideration paid for the property and Grantee joins in this deed for the sole purpose of making this certificate about the consideration.

(Fair Market Value: _______________).

GRANTOR:

DOE RUN ESTATES II, LLC, a Kentucky limited liability company

By:_________________________________
Authorized Member

____
Name (Printed)

GRANTEE:

THE KENTON CONSERVANCY, INC.,

By:_________________________________

____
Name (Printed)

____
Title

STATE OF KENTUCKY

COUNTY OF __________

The foregoing instrument was acknowledged, subscribed and sworn to before me this ____ day of December, 2009 by ________________________ (Print Name), duly authorized member of Doe Run Estates II., LLC, a Kentucky limited liability company, on behalf of the limited liability company.

____
Notary Public
Kentucky State at Large

My commission expires: ______________

STATE OF KENTUCKY
COUNTY OF KENTON

The foregoing instrument was subscribed, sworn and acknowledged before me this ____ day of __________ 2009, by _________________________ , ___________________________
Name Title
of The Kenton Conservancy, Inc., on its behalf .

____
NOTARY PUBLIC
Kentucky, State at Large

My commission expires: _______________

This Instrument Prepared By:

____
Linda H. Schaffer
Keating Muething & Klekamp PLL
One East Fourth Street, Suite 1400
Cincinnati, Ohio 45202
(513) 579-6400

3250154.1

CONSERVATION DEED

WHEREAS, Banklick Watershed Council, Inc., a Kentucky nonprofit corporation, is the owner of certain real estate known as Parcels A and B of the Banklick Watershed Council Sub. located in the City of Independence, County of Kenton, State of Kentucky, and more particularly described in Exhibit A, attached hereto and incorporated by reference ("Property") by deed from Independence Station Road, LLC and recorded on September 12, 2014, in OR Book I-3488, page 80, in the Kenton County Clerk's records at Independence, Kentucky ("Deed"); and

WHERAS, The Kenton Conservancy, Inc. ("The Kenton Conservancy") is a community based nonprofit, 501(c)(3) land trust with a stated purpose of land conservation in Kenton County, Kentucky, for the benefit of people and nature; and

WHEREAS, it is necessary to meet the requirements of the U.S. Environmental Protection Agency Region IV (EPA) since the Property has been purchased at its appraised value with funds provided to Banklick Watershed Council, Inc. by virtue of Grant #C9994861-07 from the EPA under §319(h) of the Clean Water Act through the Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water (the "Cabinet"). The Kenton Conservancy is a stated partner on this Grant; and

WHEREAS, the purpose of this Deed of Conservation is to maintain the Property in its present state, as it has significant natural, ecological, habitat, scenic, educational, forestry, open space, and watershed values, including value relating to abatement of non-point source pollution (collectively, "Conservation Values"), of importance to The Kenton Conservancy, the Banklick Watershed Council, KDOW, the EPA, and the people of Kenton County;

NOW, THEREFORE, the Grantor, **BANKLICK WATERSHED COUNCIL, INC.**, a Kentucky nonprofit corporation, by its duly authorized officer, whose address is c/o Sherry Carran, Chair, 927 Forest Avenue, Covington, Kentucky 41016,

for and in consideration of One ($1.00) Dollar and other valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, does hereby BARGAIN, SELL, and CONVEY to the Grantee, **THE KENTON CONSERVANCY, INC.**, whose address is c/o Mackey McNeill, Chair, 2332 Royal Drive, Ft. Mitchell, Kentucky 41017, its successors and assigns forever, the Property, more particularly described in Exhibit A, attached hereto and incorporated herein by reference, subject to easements, restrictions, covenants and matters of record and TOGETHER WITH AN INGRESS AND EGRESS EASEMENT set forth in deed from Independence Station Road, LLC to Banklick Watershed Council, Inc. recorded in OR Book I-3488, Page 80 and further subject to the Vendor's Lien from Banklick in the amount of $78,935.59 to Independence Station Road, LLC recorded in OR Book I-3488, Page 109.

The Property conveyed herein shall be subject to the following provisions:

ARTICLE I DURATION OF CONSERVATION DEED

This Conservation Deed shall be perpetual and shall run with the Property. The Kenton Conservancy may assign its rights and obligations under this Conservation Deed to a like nonprofit, 501(c)(3) organization deemed qualified to hold such interest by the EPA.

ARTICLE II PERMITTED ACTIVITIES

A. Permitted activities include: inspection of the property for violations of this Conservation Deed; the construction and use of trails for foot travel, provided that they do not diminish the Conservation Values of the Property, are located and constructed to prevent erosion, avoid habitat fragmentation, protect sensitive areas and water quality, and that all trails shall have a pervious surface of natural materials; passive environmental assessment; education; environmental stewardship, including restoration and protection activities, and the installation of water quality best management practices (BMPs) such as modification of hydrology, aquatic, and riparian habitat improvement, native vegetation planting, invasive species removal, removal of diseased trees and other practices toward a healthy forest, and maintenance and monitoring of streams and riparian zones.

B. Appropriate trails as described above in Article II A and educational signs will be permitted. See Article III C for signage restrictions.

ARTICLE III PROHIBITED AND RESTRICTED ACTIVITIES

A. All residential and active recreational uses shall be prohibited on the Property. Active recreation activities include, but are not limited to, hunting, use of all terrain and other motorized vehicles, biking, horseback riding, or other activities that may negatively impact the Conservation Values of the Property. No motorized vehicles shall be permitted on the Property. All commercial activities within the Property area shall be prohibited.

B. All agriculture shall be prohibited within the Property. This includes all methods of production and management of livestock, including the feeding, housing, training, and maintaining of animals such as cows, sheep, goats, hogs, horses, and poultry, and all methods of production and management of crops, trees, and other vegetation, including related activities of tillage, fertilization, pest control, harvesting, and logging.

C. Display of billboards, signs, or advertisements is prohibited on or over the Property, except: (1) to state solely the name and/or address of The Kenton Conservancy; (2) to commemorate the history of the Property, its recognition under state or federal historical registers, or its protection under this Conservation Deed or state and local environmental or game laws; or (3) to prohibit trespassing, and hunting and/or other active recreation; provided that no sign on the Property shall exceed two/2 feet by three/3 feet. Multiple signs shall be limited to a reasonable number, shall be placed at least five hundred/500 feet apart, shall not damage living trees, and shall be placed in accordance with applicable local regulations, except that signs permitted under exception (3) may be placed the lesser of one hundred/100 feet apart or the distance required by law.

D. Dumping or storage on or under the Property of any trash, ashes, garbage, waste, sewage, manure, hazardous materials, discarded materials such as abandoned vehicles, appliances, machinery, and other unsightly or offensive materials shall be prohibited. There shall be no dumping or stockpiling of any soil, sawdust, gravel, and/or sand. This is not intended to prohibit composting excess brush or other plant materials generated on the Property by activities permitted in this Deed, provided that composting shall not be located within one hundred/100 feet of any creek, stream, intermittent stream, drainage way, surface or subsurface spring, or wetland. Soil, rock, other earth materials, and vegetative matter may be placed as may be necessary for water quality BMPs or stream bank restoration.

E. Excavation, dredging, drilling, mining, or removal of any loam, gravel, soil, rock, sand, minerals, coal, petroleum, and other materials on or from this Property shall be prohibited.

F. Surface alterations of the Property, including, without limitation, ditching, draining, diking, tilling, filling, leveling, channelizing, impounding, dredging, or removal of wetlands or streams shall be prohibited, except as may be required for activities or uses expressly permitted in this Deed or for water quality BMPs or stream and/or wetland restoration.

G. No new permanent structures shall be constructed within the Property.

H. All existing easements, including a certain ingress/egress easement of record, may be maintained with permission and review of The Kenton Conservancy. Future granting of easements may be permitted through a review process by The Kenton Conservancy Board, provided such easements are in keeping with all other articles of this Deed. Such reviews will include review by the EPA to ensure the intent of the Banklick Watershed Council's EPA 319(h) Grant #C9994861-07 is being met.

I. Spraying of biocides or use of herbicides are permitted, provided they do not violate water quality standards and the spraying is done by individuals with the appropriate State Certification. The Kenton Conservancy will review the plan and product to be used prior to commencement of work.

ARTICLE IV REQUIRED ACTIVITIES

A. The Kenton Conservancy shall perform a property inspection a minimum of once a year for the purpose of assessing the quality and condition of the land, ensuring that no prohibited activities are occurring on the Property, and that the requirements of this Conservation Deed are being upheld.

ARTICLE V ENFORCEMENT AND REMEDIES

A. Upon any breach of a Term of this Conservation Deed The Kenton Conservancy may exercise any or all of the following remedies:

1. institute suits to enjoin any breach or enforce any Term by temporary, and/or permanent injunction either prohibitive or mandatory, including a temporary restraining order; and

2. require that the Property be restored promptly to the condition required by this Conservation Deed.

These remedies shall be cumulative and shall be in addition to all appropriate legal proceedings and any other rights and remedies available at law or equity.

B. No failure to enforce any Term hereof shall discharge or invalidate such Term or any other Term hereof or affect the right to enforce the same in the event of a subsequent breach or default.

ARTICLE VI EXHIBITS

The following exhibits are hereby made a part of this Conservation Deed:

A. Exhibit A: Boundary Reference and Property Description is attached hereto and made a part hereof. Exhibit A consists of nine pages.

B. Exhibit B: Aerial Map of the Deeded Property is attached hereto, and made a part hereof. Exhibit B consists of one pages.

C. Exhibit C: Attached to the map affixed hereto as Exhibit C is a list of the easements noted in Attorney Fred Summe's report on the title to the Deeded Property. This is to be used only for referencing the easements on the Deeded Property as noted in the report on the title to the Deeded Property. Exhibit C consists of three pages.

D. Exhibit D: Statement of the Appraised Property Value is attached hereto and made a part hereon. Exhibit D consists of nine pages.

ARTICLE VII MISCELLANEOUS

A. The Property has been purchased at its appraised value with funds provided to Banklick Watershed Council, Inc. by virtue of grant #C9994861-07 from the EPA under Section 319 (h) of the Clean Water Act through KDOW. The Kenton Conservancy is a stated partner on this Grant.

B. The Kenton Conservancy agrees to hold this Conservation Deed into perpetuity exclusively for conservation purposes, as defined in Section 170(h) of the Internal Revenue Code or to deed to a like nonprofit, 501(c)(3) organization that will carry out the intent of this Conservation Deed and that is deemed qualified to hold such interest by the EPA.

C. No Property transfer shall occur by inverse condemnation proceedings. If all or any part of the Property is taken under the power of eminent domain by public, corporate, or other authority, The Kenton Conservancy shall move forward with appropriate proceedings at the time of such taking to recover the full value of the interests in the Property subject to the taking and all incidental or direct damages resulting from the taking. The EPA and the Cabinet will be notified of these actions and given opportunity to have their interest represented in the proceedings.

D. This Conservation Deed may be amended, provided that no amendment shall be allowed that will affect the qualification of this Conservation Deed or the status of the property owner under any applicable state or federal law, including Section 170(h) of the Internal Revenue Code. Amendments shall be subject to approval of the Cabinet and shall be recorded in the Kenton County, Kentucky, Records.

E. The Terms of this Conservation Deed do not replace, abrogate, or otherwise set aside any local, state, or federal laws, or requirements or restrictions imposing limitation on the use of the Property.

F. Severability: If a court of law or other legally binding authority holds that any provision of this Conservation Deed is invalid or otherwise enforceable, the Court or other authority shall have the authority to modify said provision to best effectuate the intent of the Property Owner and render the provision valid and unenforceable. If, for any reason, such modification does not or cannot take place, the offending provision shall be treated as if it were never a part of this Conservation Deed, and the remainder of the Conservation Deed shall remain valid and enforceable.

ARTICLE VIII NOTICES

A. NOTICE: This Property is subject to a Declaration of Restrictive Covenants for Conservation dated 1/17/13 recorded in the Kenton County Clerk's Office on 1/22/13 in Official Record Book I-3202, Page 237 and enforceable by the U.S. Army Corps of Engineers and Kentucky Energy and Environment Cabinet, Department of Environmental Protection, Division of Water.

B. NOTICE: This Property is subject to a Declaration of Restrictive Covenants for Conservation dated 3/8/13 recorded in the Kenton County Clerk's Office on 3/14/13 in Official Record Book I-3235, Page1 and enforceable by the U.S. Army Corps of Engineers and Kentucky Energy and Environment Cabinet, Department of Environmental Protection, Division of Waters.

C. NOTICE: The purchase of this Property by the Banklick Watershed Council is made possible by Grant #C9994861-07, a federal grant from the Environmental Protection through a subgrant from the Kentucky Energy and Environment Cabinet. Therefore, the United States has an interest in 60% of the fair market value of the property, and a right to 60% of the proceeds from any subsequent sale thereof. Prior to selling the property or changing the intended use from non-point source water pollution, the owner (or named subgrantee) must first seek disposition instructions from the Kentucky Environmental Cabinet and the Environmental Protection Agency Region 4 pursuant to 40 CFR Section 31.31 (2009) or 40 CFR Section 30.32 (2009) as appropriate.

TO HAVE AND TO HOLD unto **THE KENTON CONSERVANCY, INC.**, its successors and assigns forever, with covenants of general warranty except easements, restrictions, covenants and legal highways of record.

CERTIFICATE OF CONSIDERATION

Grantor and Grantee both certify, under oath, that the consideration reflected in this Deed is the full consideration paid for the property, and the Grantee joins in this Deed for the sole purpose of making this certificate about the consideration.

(Fair Market Value: $178,935.59)

IN WITNESS WHEREOF, the Grantor has hereunto subscribed its hand by its duly authorized officer this 11th day of September, 2014.

GRANTOR:

BANKLICK WATERSHED COUNCIL, INC.

By: Sherry Carran
Sherry Carran, Chair

GRANTEE:

THE KENTON CONSERVANCY, INC.

By: G. R. Wolnitzek
Gary R. Wolnitzek, Vice Chair

STATE OF KENTUCKY
COUNTY OF KENTON

The foregoing instrument was acknowledged, subscribed, and sworn to before me this 11th day of September, 2014, by Sherry Carran, Chair of the Banklick Watershed Council, Inc., a Kentucky nonprofit corporation, on behalf of the corporation.

My Commission Expires: 12/08/17

Notary Public – State of Kentucky
Notary ID No. 500673

STATE OF KENTUCKY
COUNTY OF KENTON

The foregoing instrument was acknowledged, subscribed, and sworn to before me this 11th day of September, 2014, by Gary R. Wolnitzek, Vice Chair of The Kenton Conservancy, Inc., a Kentucky nonprofit corporation, on behalf of the corporation.

My Commission Expires: 12/08/17

Notary Public -- State of Kentucky
Notary ID No. 500673

This Instrument Prepared By:

F. Edward Worland, Jr., Attorney
P.O. Box 2420
Covington, KY 41012-2420
(859) 581-8787

Civil Engineers
Land Surveyors
Planners

Erpenbeck
Consulting
Engineers, Inc.

Exhibit A

September 5, 2014

Group No. IND.
PIDN:032-00-05-001.00

PARCEL A

BANKLICK WATERSHED COUNCIL SUBDIVISION

0.3048 ACRES

Being located in the City of Independence, Kenton County, Kentucky and being all of Parcel A, Banklick Watershed Council Subdivision as recorded in Plat A1050 of the Kenton County Clerk's Office at Independence, Kentucky and being described by metes and bounds as follows:

Beginning at a set rebar and cap on northwest corner of lot 74, Canberra Ridge Subdivision, Section 5, Plat 734; thence with the projection of the east right of way line of Canberra Drive N 20°25'43" E, 50.00 feet to a set rebar and cap; thence S 69°34'17" E, 110.00 feet to a set rebar and cap; thence N 20°25'43" E, 65.00 feet to a set rebar and cap; thence S 69°34'17" E, 91.63 feet to a set rebar and cap on the west line of Parcel B, Banklick Watershed Council Subdivision; thence with said line for two calls, along curve to the left an arc length of 35.04 feet, radius 376.62 feet, Chord S 23° 05' 40" W, 35.03 feet to a set rebar and cap on the PT of said curve; thence S 20°25'43" W, 14.99 feet to a set rebar and cap on the north line of lot 73, Canberra Ridge Subdivision, Section 6, Plat A735; thence with said line N 69°34'17" W, 40.00 feet to a set rebar and cap; thence with the west line of lot 73, S 20°25'43" W, 65.00 feet to a set rebar and cap on the northeast corner of lot 74; thence with said lot N 69°34'17" W, 160.00 feet to the point of beginning and containing 0.3048 acres.

4205 Dixie Hwy.
Elsmere, KY 41018
859.727.4200
fax 859.342.5852
www.ece-inc.net

Exhibit A continued

Being part of the same property conveyed to Independence Station Road, LLC and recorded in O.R. I-954, pg. 127 and recorded in the Kenton County Clerk's Office at Independence, Kentucky.

The bearings are based on plats of record for Canberra Ridge Subdivision. Set rebar are 5/8" rebar, 18 inches long with a plastic cap stamped "LPS 2931", Set December 2014.

Civil Engineers
Land Surveyors
Planners

ECE Erpenbeck Consulting Engineers, Inc.

Exhibit A continued

Group No. IND.
PIDN: 032-00-05-002.00

September 5, 2014
Revised September 9, 2014

PARCEL B
BANKLICK WATERSHED COUNCIL SUBDIVISION
47.6965 ACRES

Being located in the City of Independence, Kenton County, Kentucky and being all of Parcel B, Banklick Watershed Council Subdivision as recorded in Plat A1050 of the Kenton County Clerk's Office at Independence, Kentucky and being described by metes and bounds as follows:

Beginning at a set rebar and cap at the most northerly corner of lot 34, Wood Dale Subdivision, Section XI, as recorded in Plat B413; thence with the northwest line of said subdivision S 52°12'42" W, 648.73 feet to a set rebar and cap at the east line of Canberra Ridge Subdivision; thence with said line for four calls thence N 35°02'48" E, 385.66 feet to a set rebar and cap; thence N 10°06'01" W, 271.68 feet to a set rebar and cap; thence N 39°10'25" W, 124.07 feet to a set rebar and cap; thence N 65°44'19" W, 16.38 feet to a set rebar and cap at the southeast corner of Parcel C, Banklick Watershed Council Subdivision; thence with said parcel for two calls N 11°52'21" E, 100.00 feet to a set rebar and cap; thence N 61°41'23" W, 206.16 feet to a set rebar and cap at a point on the rear line of lot 67, Canberra Ridge Subdivision; thence with the north line of Canberra Ridge Subdivision for ten calls, N 70°45'59" E, 152.20 feet to a set rebar and cap; thence N 70°45'59" E, 78.72 feet to a set rebar and cap; thence N 11°52'21" E, 152.21 feet to a set rebar and cap; thence N 19°33'06" W, 112.95 feet to a set rebar and cap; thence N

4205 Dixie Hwy.
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fax 859.342.5852
www.ece-inc.net

46°12'19" W, 80.00 feet to a set rebar and cap; thence N 46°12'19" W, 32.95 feet to a set rebar and cap; thence S 87°21'04" W, 117.99 feet to a set rebar and cap; thence N 76°41'47" W, 80.62 feet to a set rebar and cap; thence N 69°34'17" W, 80.00 feet to a set rebar and cap; thence N 69°34'17" W, 40.00 feet to a set rebar and cap a corner of Parcel A, Banklick Watershed Council Subdivision; thence with the west line of Parcel B, N 20°25'43" E, 14.99 feet to a set rebar and cap; thence with a curve to the right with an arc length of 184.07 feet, with a radius of 376.62 feet, with a chord bearing of N 34°25'43" E, with a chord length of 182.24 feet, passing the northeast corner of said parcel at 35.04 feet, to a set rebar and cap; thence continuing with the northerly line of Parcel B for twenty-two calls, N 48°25'43" E, 478.35 feet to a set rebar and cap; thence N 50°58'03" E, 154.73 feet to a set rebar and cap; thence N 58°19'13" E, 334.48 feet to a set rebar and cap; thence S 55°40'49" E, 573.52 feet to a set rebar and cap; thence S 59°10'57" E, 203.74 feet to a set rebar and cap; thence S 53°45'30" E, 242.47 feet to a set rebar and cap; thence S 86°30'11" E, 196.90 feet to a set rebar and cap; thence N 45°53'11" E, 281.19 feet to a set rebar and cap; thence N 37°23'16" E, 78.61 feet to a set rebar and cap; thence N 38°48'00" E, 177.13 feet to a set rebar and cap; thence N 09°36'43" E, 176.29 feet to a set rebar and cap; thence N 22°41'44" W, 232.67 feet to a set rebar and cap; thence N 44°01'38" W, 186.31 feet to a set rebar and cap; thence N 27°39'31" W, 136.33 feet to a set rebar and cap; thence N 56°12'31" W, 96.19 feet to a set rebar and cap; thence N 28°53'48" W, 185.60 feet to a set rebar and cap; thence N 58°19'44" W, 184.07 feet to a set rebar and cap; thence N 59°11'15" W, 245.89 feet to a set rebar and cap; thence N 49°59'40" W, 278.92 feet to a set rebar and cap; thence N 44°03'43" W, 249.35 feet to a set rebar and cap; thence N 52°28'34" W, 168.03 feet; thence N 76°34'26" W, 262.54 feet to a set rebar and cap to on the east line of CSX

Railroad; thence said railroad along a with a curve to the left with an arc length of 176.72 feet, with a radius of 900.00 feet, with a chord bearing of N 16°54'32" W, with a chord length of 176.44 feet to a set rebar and cap on the north line of Independence Station Road, LLC, O.R. I-954, pg. 127; thence with said line for eighteen calls, and along the common line of Ridgeway Farm, Section1, 2 and 5, Plats A236, A238 and A379; Hellman, PIDN 031-0000038.00, OR I-2313, pg. 071 and Weber, PIDN 046-10-00-002.01, OR I-I2869, pg. 003, N 67°27'56" E, 46.35 feet to a set rebar and cap; thence S 61°17'47" E, 221.23 feet to a set rebar and cap; thence S 66°45'22" E, 204.33 feet to a set rebar and cap; thence S 66°45'24" E, 125.68 feet to a set rebar and cap; thence S 55°00'22" E, 93.50 feet to a set rebar and cap; thence S 43°15'22" E, 142.00 feet to a set rebar and cap; thence S 52°15'22" E, 122.26 feet to a set rebar and cap; thence S 52°15'22" E, 116.74 feet to a set rebar and cap; thence S 71°15'22" E, 294.00 feet to a set rebar and cap; thence S 52°23'22" E, 9.00 feet to a set rebar and cap; thence S 46°58'47" E, 234.33 feet to a set rebar and cap; thence S 32°08'31" E, 285.00 feet to a set rebar and cap; thence S 44°50'31" E, 138.00 feet to a set rebar and cap; thence S 18°45'31" E, 100.00 feet;
thence S 19°30'31" E, 392.00 feet; thence S 01°05'31" E, 128.00 feet; thence S 16°44'29" W, 248.00 feet to a set rebar and cap; thence S 33°19'29" W, 285.00 feet to a set rebar and cap, a common corner of Independence Station Road, LLC, O.R. I-3303, pg. 001; thence with said original line for three calls S 44°04'01" E, 394.00 feet to a set rebar and cap; thence S 80°58'01" E, 88.00 feet to a set rebar and cap; thence S 07°15'01" E, 55.63 feet to a set rebar and cap on the north line of Hillcrest Acres, Plat B273; thence with said line for two calls S 82°44'59" W, 491.70 feet to a set rebar and cap; thence S 87°19'59" W, 404.60 feet to a set rebar and cap on the east line of Hillcrest Subdivision; thence

with the north line of said subdivision for fourteen calls N 02°40'01" W, 40.00 feet to a set rebar and cap; thence N 02°40'01" W, 105.18 feet to a set rebar and cap; thence N 15°26'03" W, 60.35 feet to a set rebar and cap; thence N 60°24'58" W, 118.92 feet to a set rebar and cap; thence S 75°34'05" W, 157.34 feet to a set rebar and cap; thence N 02°31'01" W, 59.93 feet to a set rebar and cap; thence N 86°07'00" W, 135.00 feet to a set rebar and cap on the east right of way of Pritchard Lane; thence with said right of way with a curve to the left with an arc length of 20.00 feet, with a radius of 143.94 feet, with a chord bearing of N 00°05'50" W, with a chord length of 19.98 feet to a set rebar and cap; thence leaving said right of way and continuing with the perimeter of Hillcrest Subdivision N 85°55'19" E, 140.00 feet to a set rebar and cap; thence N 15°27'19" W, 112.02 feet to a set rebar and cap; thence N 33°17'42" W, 114.42 feet to a set rebar and cap; thence N 70°53'33" W, 113.73 feet to a set rebar and cap; thence N 79°15'07" W, 85.90 feet to a set rebar and cap; thence N 81°40'01" W, 70.00 feet to a set rebar and cap on the northeast corner of lot 23, Hillcrest Subdivision, Section 5, Plat A502; thence with the north line of said lot N 81°40'01" W, 70.00 feet to a set rebar and cap on the northwest corner of lot 23; thence continuing with the perimeter of Hillcrest Subdivision for seven calls N 70°50'03" W, 118.76 feet to a set rebar and cap; thence S 48°44'45" W, 164.93 feet to a set rebar and cap; thence S 01°17'45" E, 164.93 feet to a set rebar and cap; thence S 55°08'26" E, 111.60 feet to a set rebar and cap; thence S 19°29'02" W, 112.72 feet; thence S 27°01'21" W, 69.67 feet; thence S 16°55'17" E, 177.42 feet to a set rebar and cap at the common corner of lot 45, Hillcrest Subdivision and Parcel F, Banklick Watershed Council Subdivision; thence with Parcel F for two calls, N 86°58'10" W, 20.00 feet to a set rebar and cap; thence S 20°55'47" W, 138.32 feet to a set rebar and cap to the common corner with Parcel E, Banklick Watershed

Council Subdivision; thence with Parcel E for two calls S 14°23'08" E, 184.78 feet to a set rebar and cap; thence N 52°59'59" E, 30.00 feet to a set rebar and cap on the most westerly corner of lot 47, Hillcrest Subdivision; thence continuing with the perimeter of Hillcrest Subdivision for six calls, S 61°20'01" E, 148.34 feet to a set rebar and cap; thence S 39°15'15" W, 124.68 feet to a set rebar and cap; thence S 19°35'12" E, 175.47 feet to a set rebar and cap; thence S 67°54'01" E, 126.44 feet to a set rebar and cap; thence S 33°51'51" W, 84.91 feet to a set rebar and cap; thence S 06°35'01" E, 143.58 feet to a set rebar and cap to the most northerly corner of Parcel D; thence with said parcel for two calls S 20°12'37" E, 117.58 feet to a set rebar and cap; thence N 79°43'10" E, 98.95 feet to a set rebar and cap on the southwest corner of lot 75, Hillcrest Subdivision; thence continuing with the perimeter of Hillcrest Subdivision for four calls, N 79°44'17" E, 110.99 feet to a set rebar and cap; thence N 62°44'45" E, 76.97 feet to a set rebar and cap; thence N 62°45'33" E, 90.22 feet to a set rebar and cap; thence N 62°43'57" E, 89.28 feet to a set rebar and cap on the original line of Independence Station Road, LLC, O.R. I-3303, pg. 001; thence with said line S 44°52'19" W, 669.19 feet to a set rebar and cap to the east line of Wood Dale Subdivision, Section XI, Plat B413; thence N 19°54'24" W, 726.18 feet to the point of beginning and containing 47.6965 acres.

Being part of the same property conveyed to Independence Station Road, LLC and recorded in O.R. I-954, pg. 127 and O.R. I-3303, pg. 001 and recorded in the Kenton County Clerk's Office at Independence, Kentucky.

The bearings are based on plats of record for Canberra Ridge Subdivision. Set rebar are 5/8" rebar, 18 inches long with a plastic cap stamped "LPS 2931", Set December 2014.

Canberra Ridge

Property to be purchas

Exhibit B

Legend

N

Building
- Building
- Pool
- Tank
- Concrete Pad

Roads
- Paved Road
- Upaved Road
- Bridges
- Paved Parking
- Unpaved Parking
- Railroad

Recreation
- Ball Fields
- Tennis Courts
- Playground/ General Rec
- Tee/Green
- Trail

Boundaries
- Parcel
- City
- Zoning

Topography
- Index Contour
- Intermediate Contour
- Drainage
- Creek/ Lake

Utilities
- Sewer
- Sewer Structure
- Water Pipe
- Water Hydrant

0 390 780

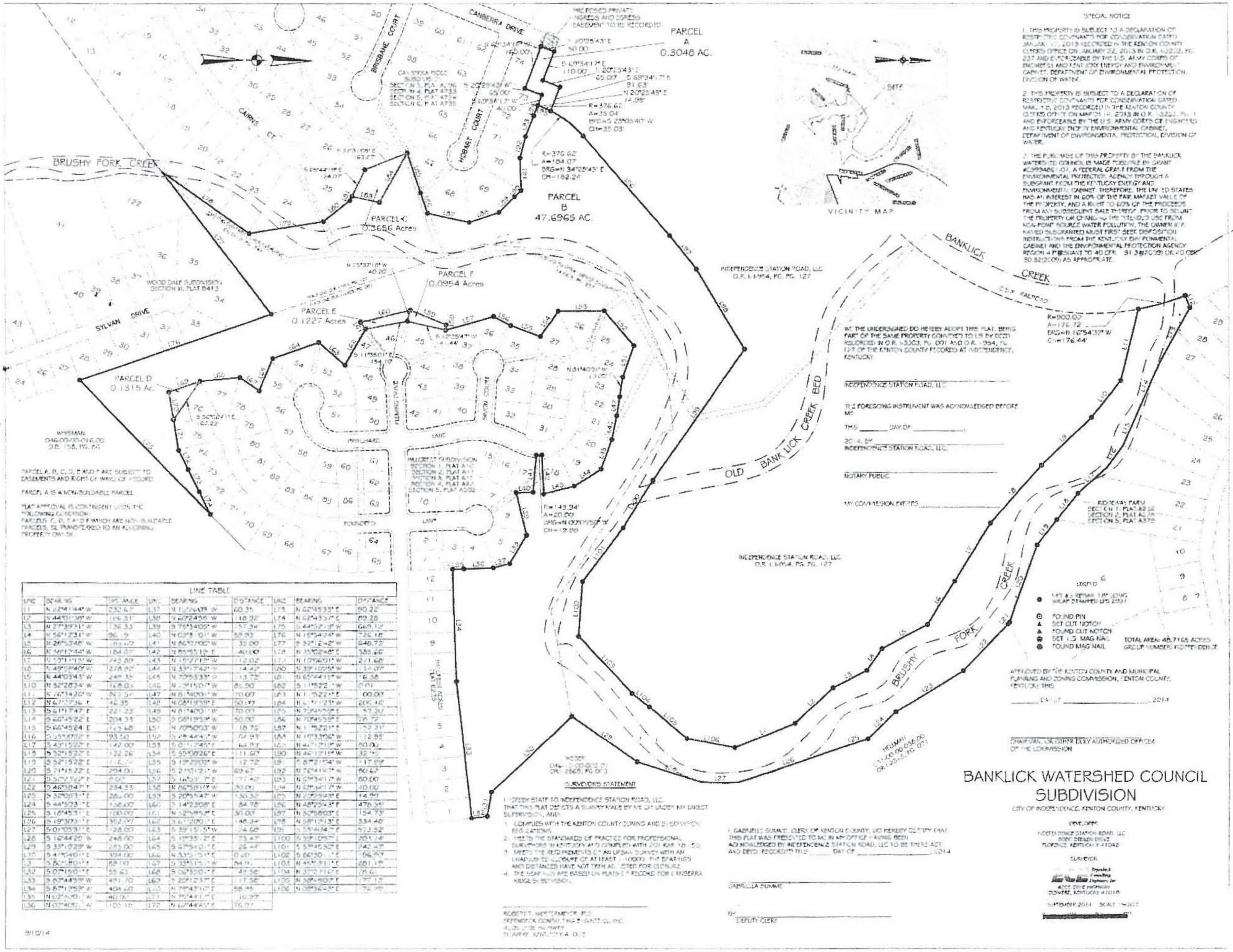
Feet

LINK·GIS

NKAPC

Parcel data provided by
CCPVA, PCPVA and LINK-GIS
For planning purposes only.
2332 Royal Drive
Ft. Mitchell, KY 41017
859-331-8980
Office hours M-F 8-5
www.linkgis.org
Date: 9/9/2014

Exhibit C



LINE TABLE								
LINE	BEARING	DISTANCE	LINE	BEARING	DISTANCE	LINE	BEARING	DISTANCE
L1	N 22°41'44" W	232.67'	L37	N 15°26'03" W	60.35	L73	N 62°45'33" E	90.22'
L2	N 44°01'30" W	106.31'	L38	N 60°24'55" W	118.92'	L74	N 62°43'37" E	89.28
L3	N 27°39'31" W	136.33'	L39	S 75°34'05" W	157.34'	L75	S 44°52'19" W	669.12'
L4	N 56°12'31" W	96.19'	L40	N 03°31'01" W	59.93	L76	N 15°54'24" W	726.18'
L5	N 28°53'48" W	183.47'	L41	N 86°27'00" W	35.00'	L77	S 52°12'42" W	648.73'
L6	N 38°12'44" W	184.07'	L42	N 85°55'19" E	40.00'	L78	N 35°02'48" E	385.66'
L7	N 59°11'15" W	243.89'	L43	N 15°27'19" W	112.02'	L79	N 10°06'01" W	271.68'
L8	N 49°59'40" W	278.92'	L44	N 33°17'42" W	14.42'	L80	N 39°10'25" W	134.07'
L9	N 44°03'43" W	249.35'	L45	N 70°53'33" W	113.72'	L81	N 65°44'15" W	16.38
L10	N 52°28'34" W	168.03'	L46	N 72°15'07" W	85.90	L82	S 11°52'21" W	0.01
L11	N 76°34'20" W	262.54'	L47	N 81°40'01" W	70.07	L83	N 11°52'21" E	100.00
L12	N 67°27'36" E	46.35	L48	N 08°19'59" E	50.00	L84	N 41°51'23" W	205.16
L13	S 61°17'47" E	221.23'	L49	N 81°40'01" W	70.00	L85	N 70°45'59" E	57.20'
L14	S 66°45'22" E	204.33'	L50	S 08°19'59" W	50.00	L86	N 70°45'59" E	26.72
L15	S 66°45'24" E	125.68'	L51	N 70°50'03" W	18.74'	L87	N 11°52'21" E	152.21'
L16	S 55°30'12" E	93.50	L52	S 28°44'41" W	64.93'	L88	N 19°33'06" W	112.95'
L17	S 43°15'22" E	142.00'	L53	S 01°17'45" E	64.93'	L89	N 44°12'19" W	60.00
L18	S 52°15'22" E	122.26'	L54	S 55°08'26" E	111.60'	L90	N 46°12'18" W	32.45'
L19	S 52°15'22" E	[illegible]	L55	S 19°29'02" W	12.72'	L91	S 87°21'54" W	117.59'
L20	S 71°15'22" E	294.07'	L56	S 21°51'21" W	69.67'	L92	N 76°41'47" W	80.67
L21	S 52°23'22" E	8.00'	L57	S 16°53'17" E	177.42'	L93	N 69°34'17" W	60.00
L22	S 46°38'47" E	234.33'	L58	N 86°58'17" W	30.00	L94	N 53°34'17" W	40.00
L23	S 32°08'31" E	265.00	L59	S 20°55'47" W	130.32'	L95	N 20°25'43" E	14.99'
L24	S 44°52'31" E	138.00'	L60	S 14°23'08" E	84.78'	L96	N 48°25'43" E	478.35'
L25	S 16°45'31" E	100.00'	L61	N 52°59'52" E	30.00'	L97	N 50°58'03" E	154.73'
L26	S 19°30'31" E	352.00'	L62	S 61°20'01" E	146.34'	L98	N 58°12'13" E	334.46'
L27	S 01°05'31" E	128.00'	L63	S 39°15'15" W	124.68'	L99	S 55°40'47" E	573.52'
L28	S 16°44'29" W	248.00'	L64	S 19°35'12" E	75.47'	L100	S 39°10'57" E	205.24'
L29	S 33°10'29" W	265.00'	L65	S 67°54'01" E	126.44'	L101	S 53°45'30" E	242.47'
L30	S 47°04'01" E	304.00'	L66	N 33°51'51" E	0.20'	L102	S 84°30'[illegible]" E	196.97'
L31	S 80°20'01" E	88.00	L67	S 33°51'51" W	[illegible]	L103	N 45°53'11" E	281.19'
L32	S 07°15'01" E	55.63'	L68	S 06°35'01" E	43.58'	L104	N 37°21'16" E	78.61'
L33	S 87°44'59" W	481.70'	L69	S 20°12'37" E	17.58'	L105	N 38°45'07" E	177.15'
L34	S 87°12'59" W	404.60'	L70	N 79°42'10" E	88.95	L106	N 08°36'43" E	176.79'
L35	N 02°40'01" W	40.00'	L71	N 75°44'17" E	10.97'			
L36	N 02°40'52" W	105.16'	L72	N 62°44'45" E	76.21'			

Exhibit C continued

These items appear in Fred Summe's title reports certified to Banklick Watershed Council, Inc. for the property as of 09/03/14.

Restrictive Covenants for Conservation

A Declaration of Restrictive Covenants for Conservation, executed by Charles Berling Land Corporation, on January 17, 2013, was recorded in Official Record Book I-3202, page 237. Attached thereto is a legal description of the property that is the subject matter of this Declaration, along with plats showing its location.

Brushy Fork Creek

Brushy Fork Creek flows through Parcel B (47.6965 acres).

Easements

This property is, or may be, subject to the 20' sanitary sewer easement granted Sanitation District No. 1 of Campbell and Kenton Counties, Kentucky, on May 26, 1988, and recorded in Easement Book 3, page 337.

This property is, or may be, subject to the sanitary sewer easement granted the City of Independence on April 19, 1994, and recorded in Easement Book 14, page 32.

Ingress and Egress Easement

The ingress and egress easement to be conveyed with Parcel A (0.3048 acre) and with Parcel B (47.6965 acres) is at the end of Canberra Drive, as Canberra Drive is dedicated on the plat of Canberra Ridge Subdivision, Section 5, recorded in Plat Cabinet A, Slide 734.

Restrictive Covenants for Conservation

A Declaration of Restrictive Covenants for Conservation, executed by Independence Station Road, LLC, a Kentucky limited liability company, on March 8, 2013, was recorded in Official Record Book I-3235, page 1. Attached thereto is a legal description of the property that is the subject matter of this Declaration, along with plats showing its location.

Exhibit C continued

More items which appear in Fred Summe's title reports certified to Banklick Watershed Council Inc for the property as of 09/03/14.

CSX

Parcel B (47.6965 acres) adjoins CSX Railroad. Assuming that that part of Parcel B is subdivided from the 47 acres, then the CSX Railroad right-of-way would be 50' from the center line of the main line track.

Brushy Fork Creek

Brushy Fork Creek flows through Parcel B (47.6965 acres).

Easements

This property is, or may be, subject to the 20' sanitary sewer easement granted Sanitation District No. 1 of Campbell and Kenton Counties, Kentucky, on December 3, 1986, and recorded in Easement Book 3, page 11.

This property is, or may be, subject to the 20' sanitary sewer easement granted Sanitation District No. 1 of Campbell and Kenton Counties, Kentucky, on October 28, 1987, and recorded in Easement Book 3, page 199.

This property is, or may be, subject to the 20' sanitary sewer easement granted Sanitation District No. 1 of Campbell and Kenton Counties, Kentucky, on June 2, 1988, and recorded in Easement Book 3, page 344.

This property is, or may be, subject to the 20' sanitary sewer easement granted Sanitation District No. 1 of Campbell and Kenton Counties, Kentucky, on November 8, 1988, and recorded in Easement Book 4, page 145.

Land Use Restrictions

A Certificate of Land Use Restriction, issued by the Kenton County Planning Commission, was recorded on June 9, 2003, in Official Record Book I-987, page 161.

A Certificate of Land Use Restriction, issued by the Kenton County Planning Commission, was recorded on June 13, 2014, in Official Record Book I-3448, page 234.

Exhibit D

SUMMARY APPRAISAL REPORT
OF

PIDN 032-00-00-039.00
82.4904+/- ACRES OF UNDEVELOPED LAND
246 INDEPENDENCE STATION RD, INDEPENDENCE
KENTON COUNTY, KENTUCKY
41051

DATE OF VALUATION:
FEBRUARY 12, 2013

PREPARED FOR:
SHERRY CARRAN
THE BANKLICK WATERSHED COUNCIL
927 FOREST AVE
COVINGTON, KY 41016

PREPARED BY:
LISA A. KEATON
CERTIFIED GENERAL APPRAISER
12115 MADISON PIKE
INDEPENDENCE, KENTUCKY 41051

Lisa A. Keaton, Certified General Appraiser
12115 Madison Pike
Independence, Kentucky 41051
Telephone 859-991-1470

February 22, 2013

The Banklick Watershed Council
c/o Sherry Carran
927 Forest Avenue
Covington, KY 41016

RE: 82.4904 Acres located at
246 Independence Station Rd
Independence, KY 41051
PIDN 032-00-00-039.00

Dear Ms. Carran,

As requested, I have inspected the above referenced property for the purpose of estimating the fee simple interest or "fair market value" of the subject property. Market value is defined in the following attached report. I have analyzed information pertinent to the formulation of the value estimate and am reporting the conclusions in this report.

No personal property is included in this report. The value opinion report is qualified by certain definitions, limiting conditions and certifications which are set forth in this report.

This report was prepared for Sherry Carran, attorney for the The Banklick Watershed Council and the professional fee was billed to The Banklick Watershed Council. This report is intended to assist Ms. Carran in determining the "fair market value" of 82.4904 acres of property located at 246 Independence Station Rd and known as PIDN 032-00-00-039.00. All emphasis in this report is on the sales comparison approach.

The subject consists of 82.4904 acres located on the East side of Independence Station Road, Independence, Kenton County, Kentucky. Should a new survey reveal the subject's acreage to be different, the appraiser reserves the right to alter the total value estimate accordingly.

This report may not be distributed to or relied upon by other persons or entities without permission. To the best of my knowledge and belief, the facts and conclusions herein are true and correct and that neither the employment to make this appraisal nor the fee involved is contingent upon the value reported. The appraisal assignment was not based on a requested minimum valuation, or a specific valuation.

This letter is not an appraisal report and therefore must not be removed from the attached report. If this letter is removed from the attached summary appraisal report, the value opinions set forth in this letter are invalid because the analyses, opinions, and conclusions cannot be properly understood. The estimated value is based on a personal site visit. The accompanying **summary appraisal report,** containing the market data together with my analysis, reasonings, and judgment, forms the basis for the value estimate. The market value estimate is subject to the limiting conditions contained herein. After careful consideration of the factors pertaining to and influencing the subject's fair market value, the data and analysis supports the following final market value opinion for the subject property as of February 12, 2013:

$950,000 "As Is"

I am pleased to provide you with my professional appraisal services. If you have any questions please do not hesitate to call.

Sincerely,

Lisa Keaton

Lisa A. Keaton
Certified General Real Property Appraiser, License #004013

Summary Appraisal Report:

Purpose of the Appraisal:
To estimate market value as defined by the Office of the Comptroller of the Currency under 12 CFR, part 34, Subpart C

Intended use of Report:
The intended use of this report is to estimate the most probable price the subject property would bring on the open market. Inherent in the "fair market value" is a reasonable time period for marketing and finding a buyer whom could purchase the property with all the knowledge to which the property can be used.

Summary of Important Facts and Conclusions:

Subject:	The property being appraised is a 82.4904+/- Acre tract, under one deed, owned by Independence Station Road LLC.
Property Location:	The subject property is located at 246 Independence Station Rd, Independence, KY 41051
Land Area:	82.4904 Acres
Deed Reference:	Deed Book I-954 Page 127 (Parent Tract).
Property Rights Appraised:	Fee Simple
Effective Date of Value:	February 12, 2013
Utilities:	Public water, public sewer, natural gas, electric
Zoning:	The subject is zoned R-1C (Residential-one C).
Marketing Period:	Estimated marketing period twelve months.
Exposure Time:	Estimated exposure time twelve months.
Highest and Best Use:	Single Family Residential Development
Final Estimate of Market Value:	**$950,000**

THE APPRAISAL COMPANY
3037 DIXIE HWY. #209
EDGEWOOD, KY 41017

September 5, 2014

Banklick Watershed Council
927 Forest Avenue
Covington, KY 41016
Attn: Mrs. Sherry Carran, Chair

RE: Independence Station Road, LLC Property
Independence, KY 41051

Dear Mrs. Carran,

Pursuant to your request, I the undersigned, have made an investigation and appraisal of the Independence Station Road, LLC Property located in Independence, KY.

In my opinion the market value of the Subject Property assuming it to be free and clear of all encumbrances, as of September 1, 2014 is:

NINETY EIGHT THOUSAND TWO HUNDRED DOLLARS - ($98,200)

($2,400 per Acre)

All analysis of the data contained within this report and conclusions reached from examination of this data have been made by the undersigned. The assumptions and limiting conditions upon which this value estimate has been based may be found within the text of this report.

Market value as used in this report is defined as the most probable price in cash, terms equivalent to cash, or in other precisely revealed terms, for which the appraised property will sell in a competitive market under all conditions requisite to fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress.

Presumed in this definition is:

1. Buyer and seller are motivated by self-interest.
2. Buyer and seller are well informed and acting prudently.
3. The property is exposed for a reasonable time on the open market.
4. Payment is made in terms of cash in U. S. dollars or in financial arrangements comparable thereto.
5. The price represents the normal consideration for the property sold, unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.

Banklick Watershed Council
09/05/2014

The accompanying report describes in detail the method of appraisal and contains pertinent data covered in the appraisal of the unencumbered fee simple title.

Respectfully submitted,

Tony Walsburger

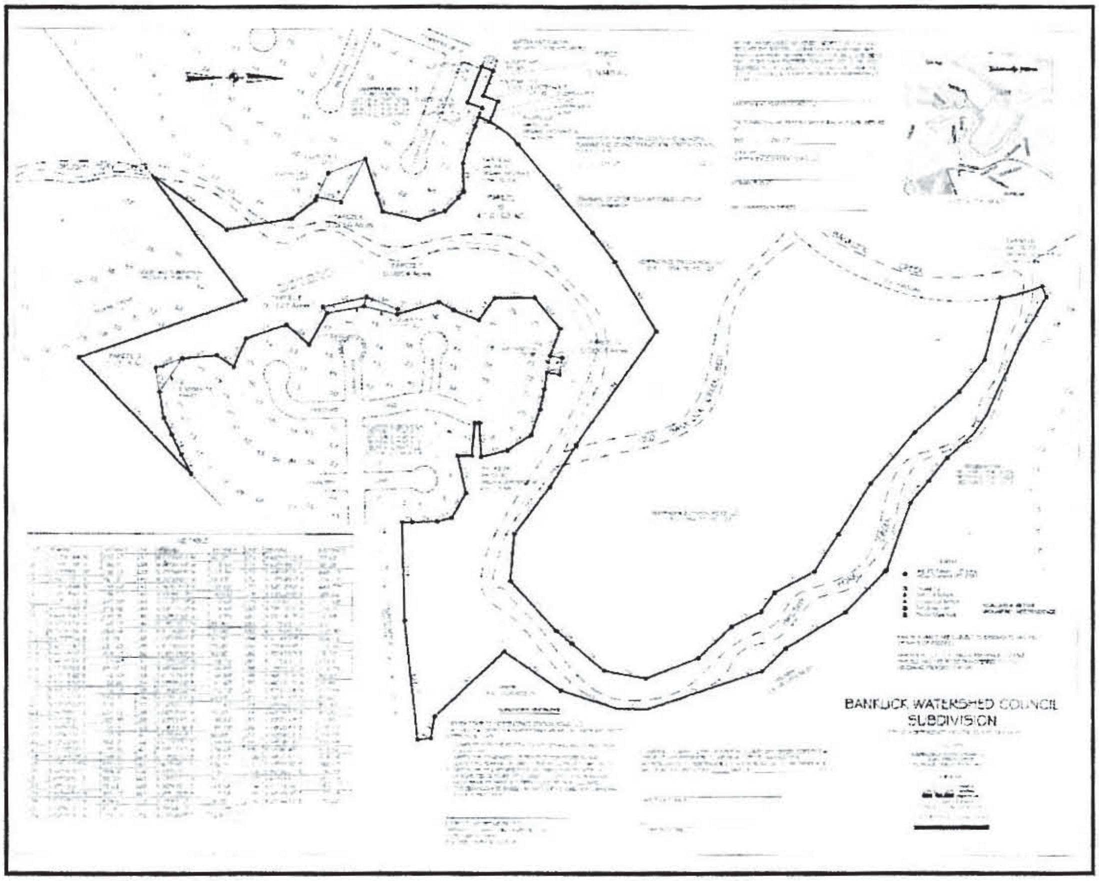
Anthony J. Walsburger
KCGRPA #774

Mitigation Site Plan

Borrower						
Property Address	246 Independence Station Rd					
City	Independence	County		State KY	Zip Code	41051
Client						

Subject Property Plat

Borrower					
Property Address	246 Independence Station Rd				
City	Independence	County		State KY	Zip Code 41051
Client					



Recorded INDEPENDENCE
GABRIELLE SUMME
KENTON COUNTY CLERK
Doc type: DEED
Book / Page : I - 3488 / 119 26pgs
Doc#: 14 09 12 059 00083
Dt/tm Recorded: 09/12/2014 10:52:50am
Total fees: 269.00 Tax: 179.00
Clerk name: C RUST

Kentucky Real Estate Appraisers Board

2014-15

Hereby grants a

Certified General Real Property Appraiser
Certificate

License № 000774

To

Anthony J. Walsburger
The Appraisal Company
3037 Dixie Highway, Ste. 209
Edgewood, KY 41017

who has complied with the provisions of Chapter 324A of the Kentucky Revised Statutes IN WITNESS WHEREOF, we have caused the official seal to be affixed and attested for the year shown above.

Harold G. Brantley, Chair
Sam E. Blackburn, Vice Chair
G. Herbert Pritchett
Kathy J. Mayfield
Thomas W. Oliver

Harold Brantley

Control № 40525

THIS CERTIFICATE EXPIRES June 30, 2015

PIDN: 061-10-00-254.00
GROUP: IND.

CONSERVATION DEED

WHEREAS, Banklick Watershed Council, Inc., a Kentucky nonprofit corporation, is the owner of a certain tract of land located in the City of Independence, County of Kenton, State of Kentucky, and more particularly described in Exhibit A, attached hereto and incorporated by reference ("Property") by deed from Gary C. Petty and Lyn Whitehouse Petty, and recorded on 10/21, 2013, in OR Book I-3358, page 6, of the Kenton County Clerk's records at Independence, Kentucky ("Deed"); and

WHERAS, The Kenton Conservancy, Inc. ("The Kenton Conservancy") is a community based nonprofit, 501(c)(3) land trust with a stated purpose of land conservation in Kenton County, Kentucky, for the benefit of people and nature; and

WHEREAS, it is necessary to meet the requirements of the U.S. Environmental Protection Agency Region IV (EPA) since the Property has been purchased at its appraised value with funds provided to Banklick Watershed Council, Inc. by virtue of Grant #C9994861-07 from the EPA under §319(h) of the Clean Water Act through the Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water (the "Cabinet"). The Kenton Conservancy is a stated partner on this Grant; and

WHEREAS, the purpose of this Deed of Conservation is to maintain the Property in its present state, as it has significant natural, ecological, habitat, scenic, educational, forestry, open space, and watershed values, including value relating to abatement of non-point source pollution (collectively, "Conservation Values"), of importance to The Kenton Conservancy, the Banklick Watershed Council, KDOW, the EPA, and the people of Kenton County;

NOW, THEREFORE, the Grantor, **BANKLICK WATERSHED COUNCIL, INC.**, a Kentucky nonprofit corporation, by its duly authorized officer, whose address is c/o Sherry Carran, Chair, 927 Forest Avenue, Covington, Kentucky 41016,

for and in consideration of One ($1.00) Dollar and other valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, does hereby BARGAIN, SELL, and CONVEY to

the Grantee, **THE KENTON CONSERVANCY, INC.**, whose address is c/o Mackey McNeill, Chair, 2332 Royal Drive, Ft. Mitchell, Kentucky 41017, its successors and assigns forever, the Property, more particularly described in Exhibit A, attached hereto and incorporated herein by reference.

Recorded INDEPENDENCE — GABRIELLE SUMME KENTON COUNTY CLERK
Doc type: DEED
Book / Page : I - 3358 / 11 16pgs
Doc#: 13 10 21 059 00204
Dt/tm Recorded: 10/21/2013 01:22:30pm
Total fees: 221.00 Tax: 165.00
Clerk name: TARA K BLESSING

The Property conveyed herein shall be subject to the following provisions:

ARTICLE I DURATION OF CONSERVATION DEED

This Conservation Deed shall be perpetual and shall run with the Property. The Kenton Conservancy may assign its rights and obligations under this Conservation Deed to a like nonprofit, 501(c)(3) organization deemed qualified to hold such interest by the EPA.

ARTICLE II PERMITTED ACTIVITIES

A. Permitted activities include: inspection of the property for violations of this Conservation Deed; the construction and use of trails for foot travel, provided that they do not diminish the Conservation Values of the Property, are located and constructed to prevent erosion, avoid habitat fragmentation, protect sensitive areas and water quality, and that all trails shall have a pervious surface of natural materials; passive environmental assessment; education; environmental stewardship, including restoration and protection activities, and the installation of water quality best management practices (BMPs) such as modification of hydrology, aquatic, and riparian habitat improvement, native vegetation planting, invasive species removal, removal of diseased trees and other practices toward a healthy forest, and maintenance and monitoring of streams and riparian zones.

B. Appropriate trails as described above in Article II A and educational signs will be permitted. See Article III C for signage restrictions.

ARTICLE III PROHIBITED AND RESTRICTED ACTIVITIES

A. All residential and active recreational uses shall be prohibited on the Property. Active recreation activities include, but are not limited to, hunting, use of all terrain and other motorized vehicles, biking, horseback riding, or other activities that may negatively impact the Conservation Values of the Property. No motorized vehicles shall be permitted on the Property. All commercial activities within the Property area shall be prohibited.

B. All agriculture shall be prohibited within the Property. This includes all methods of production and management of livestock, including the feeding, housing, training, and maintaining of animals such as cows, sheep, goats, hogs, horses, and poultry, and all methods of production and management of crops, trees, and other vegetation, including related activities of tillage, fertilization, pest control, harvesting, and logging.

C. Display of billboards, signs, or advertisements is prohibited on or over the Property, except: (1) to state solely the name and/or address of The Kenton Conservancy; (2) to commemorate the history of the Property, its recognition under state or federal historical registers, or its protection under this Conservation Deed or state and local environmental or game laws; or (3) to prohibit trespassing, and hunting and/or other active recreation; provided that no sign on the Property shall exceed two/2 feet by three/3 feet. Multiple signs shall be limited to a reasonable number, shall be placed at least five hundred/500 feet apart, shall not damage living trees, and shall be placed in accordance with applicable local regulations, except that signs permitted under exception (3) may be placed the lesser of one hundred/100 feet apart or the distance required by law.

D. Dumping or storage on or under the Property of any trash, ashes, garbage, waste, sewage, manure, hazardous materials, discarded materials such as abandoned vehicles, appliances, machinery, and other unsightly or offensive materials shall be prohibited. There shall be no dumping or stockpiling of any soil, sawdust, gravel, and/or sand. This is not intended to prohibit composting excess brush or other plant materials generated on the Property by activities permitted in this Deed, provided that composting shall not be located within one hundred/100 feet of any creek, stream, intermittent stream, drainage way, surface or subsurface spring, or wetland. Soil, rock, other earth materials, and vegetative matter may be placed as may be necessary for water quality BMPs or stream bank restoration.

E. Excavation, dredging, drilling, mining, or removal of any loam, gravel, soil, rock, sand, minerals, coal, petroleum, and other materials on or from this Property shall be prohibited.

F. Surface alterations of the Property, including, without limitation, ditching, draining, diking, tilling, filling, leveling, channelizing, impounding, dredging, or removal of wetlands or streams shall be prohibited, except as may be required for activities or uses expressly permitted in this Deed or for water quality BMPs or stream and/or wetland restoration.

G. No new permanent structures shall be constructed within the Property.

H. All existing easements, including a certain ingress/egress easement of record, may be maintained with permission and review of The Kenton Conservancy. Future granting of easements may be permitted through a review process by The Kenton Conservancy Board, provided such easements are in keeping with all other articles of this Deed. Such reviews will include review by the EPA to ensure the intent of the Banklick Watershed Council's EPA 319(h) Grant #C9994861-07 is being met.

I. Spraying of biocides or use of herbicides are permitted, provided they do not violate water quality standards. The Kenton Conservancy will review the plan and product to be used prior to commencement of work.

ARTICLE IV REQUIRED ACTIVITIES

A. The Kenton Conservancy shall perform a property inspection a minimum of once a year for the purpose of assessing the quality and condition of the land, ensuring that no prohibited activities are occurring on the Property, and that the requirements of this Conservation Deed are being upheld.

ARTICLE V ENFORCEMENT AND REMEDIES

A. Upon any breach of a Term of this Conservation Deed The Kenton Conservancy may exercise any or all of the following remedies:

1. institute suits to enjoin any breach or enforce any Term by temporary, and/or permanent injunction either prohibitive or mandatory, including a temporary restraining order; and

2. require that the Property be restored promptly to the condition required by this Conservation Deed.

These remedies shall be cumulative and shall be in addition to all appropriate legal proceedings and any other rights and remedies available at law or equity.

B. No failure to enforce any Term hereof shall discharge or invalidate such Term or any other Term hereof or affect the right to enforce the same in the event of a subsequent breach or default.

ARTICLE VI EXHIBITS

The following exhibits are hereby made a part of this Conservation Deed:

A. Exhibit A: Boundary Reference and Property Description is attached hereto and made a part hereof. Exhibit A consists of two pages.

B. Exhibit B: Aerial Map of the Deeded Property is attached hereto, and made a part hereof. Exhibit B consists of one page.

C. Exhibit C: Map making reference to easements noted in the report on the title to the Deeded Property. This is to be used only for referencing the easements on the Deeded Property as noted in the report on the title to the Deeded Property. Exhibit C consists of one page.

D. Exhibit D: Statement of the Appraised Property Value is attached hereto and made a part hereon. Exhibit C consists of six pages.

ARTICLE VII MISCELLANEOUS

A. The Property has been purchased at its appraised value with funds provided to Banklick Watershed Council, Inc. by virtue of Grant #C9994861-07 from the EPA under §319(h) of the Clean Water Act through KDOW. The Kenton Conservancy is a stated partner on this Grant.

B. The Kenton Conservancy agrees to hold this Conservation Deed into perpetuity exclusively for conservation purposes, as defined in Section 170(h) of the Internal Revenue Code or to deed to a like nonprofit, 501(c)(3) organization that will carry out the intent of this Conservation Deed and that is deemed qualified to hold such interest by the EPA.

C. No Property transfer shall occur by inverse condemnation proceedings. If all or any part of the Property is taken under the power of eminent domain by public, corporate, or other authority, The Kenton Conservancy shall move forward with appropriate proceedings at the time of such taking to recover the full value of the interests in the Property subject to the taking and all incidental or direct damages resulting from the taking. The EPA and the Cabinet will be notified of these actions and given opportunity to have their interest represented in the proceedings.

D. This Conservation Deed may be amended, provided that no amendment shall be allowed that will affect the qualification of this Conservation Deed or the status of the property owner under any applicable state or federal law, including Section 170(h) of the Internal Revenue Code. Amendments shall be subject to approval of the Cabinet and shall be recorded in the Kenton County, Kentucky, Records.

E. The Terms of this Conservation Deed do not replace, abrogate, or otherwise set aside any local, state, or federal laws, or requirements or restrictions imposing limitation on the use of the Property.

F. Severability: If a court of law or other legally binding authority holds that any provision of this Conservation Deed is invalid or otherwise enforceable, the Court or other authority shall have the authority to modify said provision to best effectuate the intent of the Property Owner and render the provision valid and unenforceable. If, for any reason, such modification does not or cannot take place, the offending provision shall be treated as if it were never a part of this Conservation Deed, and the remainder of the Conservation Deed shall remain valid and enforceable.

TO HAVE AND TO HOLD unto **THE KENTON CONSERVANCY, INC.**, its successors and assigns forever, with covenants of general warranty except easements, restrictions, and legal highways of record.

CERTIFICATE OF CONSIDERATION

Grantor and Grantee both certify, under oath, that the consideration reflected in this Deed is the full consideration paid for the property, and Grantee joins in this Deed for the sole purpose of making this certificate about the consideration.

(Fair Market Value: $165,000.00)

IN WITNESS WHEREOF, the Grantor has hereunto subscribed its hand by its duly authorized officer this 18 day of October, 2013.

GRANTOR:	GRANTEE:
BANKLICK WATERSHED COUNCIL, INC.	THE KENTON CONSERVANCY, INC.
By: Sherry Carran	By: Mackey McNeill
Sherry Carran, Chair	Mackey McNeill, Chair

STATE OF KENTUCKY
COUNTY OF KENTON

The foregoing instrument was acknowledged, subscribed, and sworn to before me this 18th day of October, 2013, by Sherry Carran, Chair of the Banklick Watershed Council, Inc., a Kentucky nonprofit corporation, on behalf of the corporation.

My Commission Expires: 12/08/13

Notary Public – State of Kentucky
Notary ID No. 408453

STATE OF KENTUCKY
COUNTY OF KENTON

The foregoing instrument was acknowledged, subscribed, and sworn to before me this 18th day of October, 2013, by Mackey McNeill, Chair of The Kenton Conservancy, Inc., a Kentucky nonprofit corporation, on behalf of the corporation.

My Commission Expires: 12/08/13

Notary Public – State of Kentucky
Notary ID No. 408453

This Instrument Prepared By:

F. Edward Worland, Jr., Esq.
Attorney at Law
P.O. Box 2420
Covington, KY 41012-2420
(859) 581-8787

EXHIBIT
A

DESCRIPTION

14.30 Remainder

Remainder Parcel

Situated in the City of Independence, Kenton County, Kentucky.

Being located on the north side of Stephens Road, Kenton County, Kentucky and lying west of Taylor Mill Road and being more particularly described as follows:

Beginning at an iron pin at the intersection of the southeast line of a parcel conveyed to Bentley as recorded in D.B. 322, pg. 85 and the north right of way line of Stephens Road; thence with Bentley N 81° 03' 14" W, 421.47 feet to an iron pin on the grantors' original north line; thence leaving said line and with said original line S 55° 07' 17" E, 377.37 feet to an iron pin; thence S 56° 29' 24" E, 308.71 feet to an iron pin, said pin being the common corner with a 13.47 acre parcel previously conveyed by the grantors; thence with the west line of said parcel S 33° 13' 17" W, 394.69 feet to an iron pin; thence S 39° 01' 29" E, 227.46 feet to an iron pin, said pin being the common corner to Ross, as recorded in D.B. 272, pg. 71; thence with Ross S 42° 03' 51" W, 90.48 feet to an iron pin; thence S 48° 14' W, 146.14 feet to an iron pin; thence S 34° 54' 39" W, 96.64 feet to an iron pin on the north right of way line of Stephens Road; thence with said right of way N 65° 56' 35" W, 164.11 feet ; thence N 66° 01' 14" W, 233.87 feet to the PC of a curve; thence along said curve to the right 168.61 feet (R=296.46 feet, Chord N 49° 43' 39" W, 166.34 feet) to the PT of said curve; thence N 33° 26' 04" W, 67.37 feet to the PC of a curve; thence along said curve to the right 283.16 feet (R=617.11 feet, Chord N 20° 17' 22" W, 280.68 feet) to the PT of said curve; thence N 7° 08' 40" W, 486.15 feet to the point of beginning, containing 16.69 acres.

Exception I

Beginning at an iron pin found in the east right of way line at the southwest corner of James Bentley, N 81° 03' 14" E, 421.45 feet to an iron pin found in the southwesterly line of lot 9, Schell Country Estates (PB 17, pg. 6); thence with a new made line partitioning the Grantor's property, S 81° 03' 14" W, 588.78 feet to an iron pin set;

thence with the right of way line N 7° 19' 49" W, 125.00 feet to the place of beginning and containing 1.4920 acres more or less exclusive of all right of way of record.

There is included in this conveyance a partial consisting of 0.0895 acres and measuring approximately 30.01 feet by 125 feet and identified as the "30 foot right of way parcel" on the attached plat.

See O.R. I-1121, pg. 264 for the description and the approved Survey for Division, approved August 7, 2003.

Exception II

Beginning at a found #4 rebar on the most northerly corner of Ross, D.B. 272, pg. 71 on a southwest line of Harrell, D.B. 398, pg. 264; thence with the northwesterly line of Ross for three calls S 42°03'51" W, 90.48 feet to a found #4 rebar; thence S 48°14'00" W, 146.14 feet to a found #4 rebar; thence S 34°54'39" W, 96.64 feet to a found #4 rebar on the east right of way line of Stephens Road; thence with said right of way, 30 feet from the center line N 65°56'35" W, 110.00 feet to a set #5 rebar; thence leaving said right of way and with a new division of the grantor's property N 37°19'31" E, 389.01 feet to a set #5 rebar on the southwest line of Harrell; thence with said line S 39°01'29" E, 142.14 feet to the point of beginning and containing 0.980 acres.

See O.R. I-3340, pg. 237 for the description and the approved Identification Plat, approved August 16 2013.

The remainder parcel contains 14.30 acres.

Being all of the remainder of the property convey to Gary C. Petty and Lyn W. Petty and recorded in D.B. 398, pg. 268 of the Kenton County Clerk's Office at Independence, Kentucky.

TOGETHER WITH the right of ingress and egress to the 14.30 acre remainder parcel described herein to and from Stephens Road over the 0.980 acre tract described above (Exception II above) as set forth in Declaration of Easement recorded in Official Record Book I-3325, Page 180 in the aforesaid Office.

EXHIBIT B

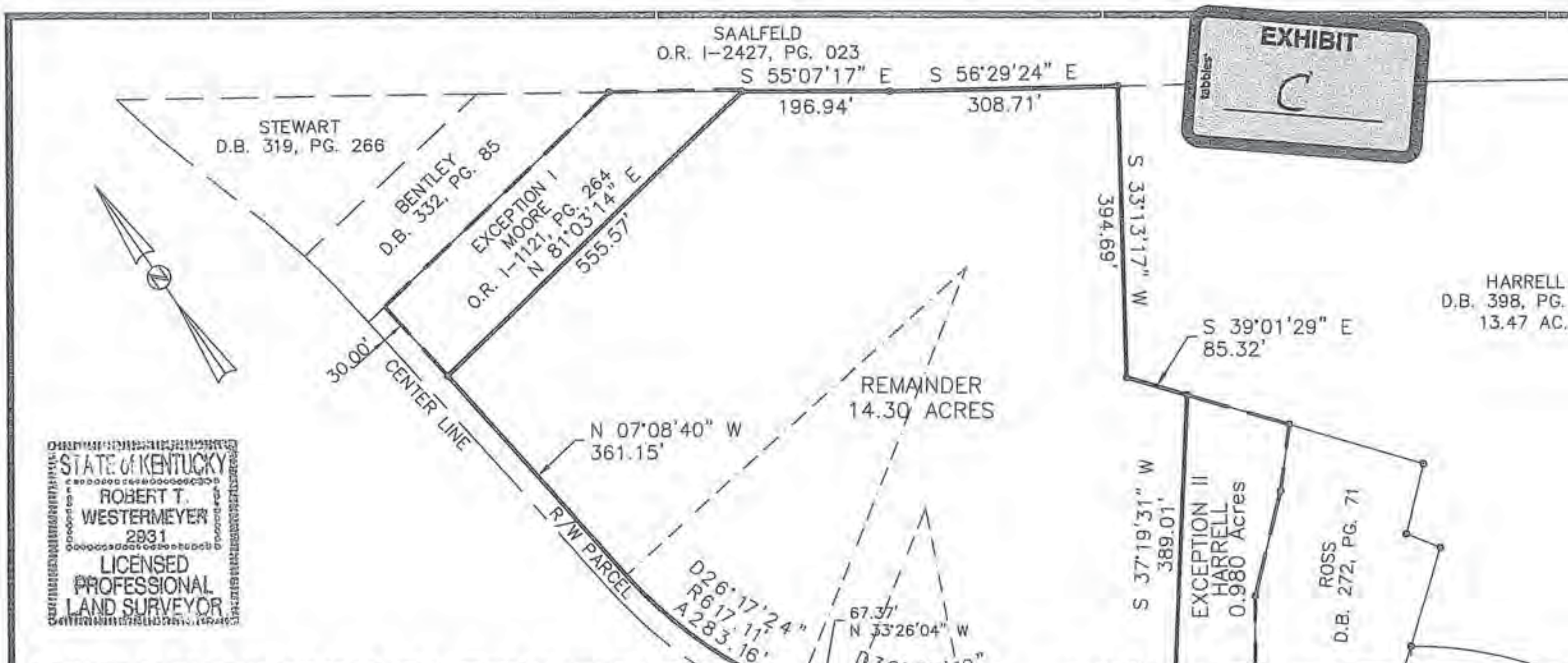
EXHIBIT
B

0 80 160
Feet

LINK-GIS

NKAPC

Parcel data provided by
CCPVA, PCPVA and LINK-GIS
For planning purposes only.
2332 Royal Drive
Ft. Mitchell, KY 41017
859-331-8980
Office hours M-F 8-5
www.linkgis.org
Date: 10/8/2013



THIS DRAWING REFLECTS THE REMAINDER OF THE GARY C. PETTYAND LYN WHITEHOUSE PETTY PROPERTY RECORDED IN D.B. 398, PG. 268 LESS EXCEPTION I CONVEYED TO LEWIS WAYNE MOORE AND BARBARA MOORE, RECORDED IN O.R. 1121, PG. 264 AND EXCEPTION II CONVEYED TO LORNA PETTY HARRELL AND DENNIS O. HARRELL AND RECORDED IN O.R. I–3340, PG. 237.

BASE PARCEL

THE 16.69 ACRE PARCEL WAS SURVEYED BY RAYMOND ERPENBECK CONSULTING ENGINEERS, INC DECEMBER 1994. THIS SURVEY COMPLIED WITH THE STANDARDS OF PRACTICE AT THAT TIME IN 201 KAR 18:150.

EXCEPTION 1

THE 1.4059 ACRE PARCEL WAS SURVEYED BY JERRY CANNON JUNE 23, 2003 AND APPROVED BY KENTON COUNTY MUNICIPAL PLANNING COMMISSION AUGUST 7, 2003.

EXCEPTION II

THE 0.98 ACRE PARCEL WAS SURVEYED BY ECE, INC., MAY 5, 2013. THIS SURVEY COMPLIED WITH THE STANDARDS OF PRACTICE AT THAT TIME IN 201 KAR 18:150 AND WAS APPROVED BY THE KENTON COUNTY AND MUNICIPAL PLANNING COMMISSION AUGUST 16, 2013.

THE CURRENT REMAINDER IS 14.30 ACRES.

THE BEARINGS AND DISTANCES SHOWN ON THIS PLAT ARE BASED ON THE DEEDS OF RECORD DESCRIBED ABOVE. THEY ARE NOT BASED ON A NEW SURVEY...

Robert T Westermeyer

ROBERT T WESTERMEYER, P.L.S.

Easements listed in the Title Examination Report by Fred H. Summe, dated September 21, 2013:

1) A utility easement granted to Citizens Telephone Company December 18, 1953 and recorded in D.B. 106, pg. 13.

The location of this easement cannot be determined from the recorded description.

2) A drainage easement granted to the Commonwealth of Kentucky, Department of Highways, April 30, 1953 and recorded in D.B. 106, 13.

This appears to be a grant over this parcel.

3) A utility easement granted to the Union Light, Heat and Power Company April 9, 1074, and recorded in D.B. 174, pg. 22

The location of this easement cannot be determined from the recorded description.

DECLARATION OF EASEMENT

A Declaration of Easement, executed by Gary C. Petty and Lyn Whitehouse Petty on August 7, 2013, was recorded in O.R. I–3325, pg. 180. The Declaration of Easement creates an easement allowing the Kenton Conservancy, Inc., ingress and egress over the 0.980 acre tract to and from Stephens Road.

The Declaration of Easement is over the exception parcel shown as Exception II on this drawing.

REMA
KENT
14.30
STEPHENS ROA
KENTO
2332
FT. MITCH
Civil Engineers
Land Surveyors
Planners
SEPTEMBER 2013

EXHIBIT
D
tabbies

APPRAISAL OF REAL PROPERTY

LOCATED AT

724 Stephens Rd
Independence, KY 41051
14.30 acres

FOR

Banklick Watershed Council
927 Forest Avenue
Covington, KY 41016

OPINION OF VALUE

165,000

AS OF

10/03/2013

BY

R. Bryan Meade
Meade & Associates
15 Harvard Drive
Ft Mitchell, KY 41017
(859) 331-6463
appraisals@fuse.net

Meade & Associates
15 Harvard Drive
Ft Mitchell, KY 41017
(859) 331-6463

October 08, 2013

Sharmili Reddy
Banklick Watershed Council
927 Forest Avenue
Covington, KY 41016

Re: Property:	724 Stephens Rd Independence, KY 41051
Borrower:	N/A
File No.:	1310petty

Opinion of Value: $	165,000
Effective Date:	10/03/2012

In accordance with your request, we have appraised the above referenced property. The report of that appraisal is attached.

The purpose of the appraisal is to develop an opinion of market value for the property described in this appraisal report, as improved, in unencumbered fee simple title of ownership.

This report is based on a physical analysis of the site and improvements, a locational analysis of the neighborhood and city, and an economic analysis of the market for properties such as the subject. The appraisal was developed and the report was prepared in accordance with the Uniform Standards of Professional Appraisal Practice.

The opinion of value reported above is as of the stated effective date and is contingent upon the certification and limiting conditions attached.

It has been a pleasure to assist you. Please do not hesitate to contact me or any of my staff if we can be of additional service to you.

Cordially,

R. Bryan Meade
Certified Real Property Appraiser
License or Certification #: 512
State: KY Expires: 06/30/2014
appraisals@fuse.net

Assumptions, Limiting Conditions & Scope of Work

File No.: 1310petty

Property Address: 724 Stephens Rd	City: Independence	State: KY	Zip Code: 41051
Client: Banklick Watershed Council	Address: 927 Forest Avenue, Covington, KY 41016		
Appraiser: R. Bryan Meade	Address: 15 Harvard Drive, Ft Mitchell, KY 41017		

APPRAISAL AND REPORT IDENTIFICATION

This appraisal report is a written Summary Appraisal Report prepared under Standards Rule 2-2(b) of the Uniform Standards of Professional Appraisal Practice, pursuant to the Scope of Work, as disclosed elsewhere in this report.

STATEMENT OF ASSUMPTIONS & LIMITING CONDITIONS— The appraiser will not be responsible for matters of a legal nature that affect either the property being appraised or the title to it. The appraiser assumes that the title is good and marketable and, therefore, will not render any opinions about the title. The property is appraised on the basis of it being under responsible ownership.

— The appraiser may have provided a sketch in the appraisal report to show approximate dimensions of the improvements, and any such sketch is included only to assist the reader of the report in visualizing the property and understanding the appraiser's determination of its size. The appraiser has made no survey of the property.

— If so indicated, the appraiser has examined the available flood maps that are provided by the Federal Emergency Management Agency (or other data sources) and has noted in the appraisal report whether the subject site is located in an identified Special Flood Hazard Area. Because the appraiser is not a surveyor, he or she makes no guarantees, express or implied, regarding this determination.

— The appraiser will not give testimony or appear in court because he or she made an appraisal of the property in question, unless specific arrangements to do so have been made beforehand.

— If the cost approach is not applicable and thus not included in this appraisal

— The appraiser has noted in the original appraisal report any adverse conditions (including, but not limited to, needed repairs, depreciation, the presence of hazardous wastes, toxic substances, etc.) observed during the inspection of the subject property, or that he or she became aware of during the normal research involved in performing the appraisal. Unless otherwise stated in the appraisal report, the appraiser has no knowledge of any hidden or unapparent conditions of the property, or adverse environmental conditions (including, but not limited to, the presence of hazardous wastes, toxic substances, etc.) that would make the property more or less valuable, and has assumed that there are no such conditions and
makes no guarantees or warranties, express or implied, regarding the condition of the property. The appraiser will not be responsible for any such conditions that do exist or for any engineering or testing that might be required to discover whether such conditions exist. Because the appraiser is not an expert in the field of environmental hazards, the appraisal report must not be considered as an environmental assessment of the property.

— The appraiser obtained the information, estimates, and opinions that were expressed in the appraisal report from sources that he or she considers to be reliable and believes them to be true and correct. The appraiser does not assume responsibility for the accuracy of such items that were furnished by other parties.

— The appraiser will not disclose the contents of the appraisal report except as provided for in the Uniform Standards of Professional Appraisal Practice, and any applicable federal, state or local laws.

— If this appraisal is indicated as subject to satisfactory completion, repairs, or alterations, the appraiser has based his or her appraisal report and valuation conclusion on the assumption that completion of the improvements will be performed in a workmanlike manner.

— An appraiser's client is the party (or parties) who engage an appraiser in a specific assignment. Any other party acquiring this report from the client does not become a party to the appraiser-client relationship. Any persons receiving this appraisal report because of disclosure requirements applicable to the appraiser's client do not become intended users of this report unless specifically identified by the client at the time of the assignment.

— The appraiser's written consent and approval must be obtained before this appraisal report can be conveyed by anyone to the public, through advertising, public relations, news, sales, or by means of any other media, or by its inclusion in a private or public database.

— The appraiser specializes in the valuation of real property and is not a home inspector, building contractor, structural engineer, or similar expert. The appraiser did not conduct the intensive type of field observations of the kind intended to seek and discover property defects. The viewing of the property and any improvements is for purposes of developing an opinion of the defined value of the property, given the intended use of this assignment. Statements regarding condition are based on surface observations only. The appraiser claims,no special expertise regarding issues including, but not limited to: foundation settlement, basement moisture problems, wood destroying (or other) insects, pest infestation, radon gas, lead based paint, mor or environmental issues. Unless otherwise indicated, mechanical systems were not activated or tested. Clients with concerns about such potential negative factors
are encouraged to engage the appropriate type of expert to investigate.

The Scope of Work is the type and extent of research and analyses performed in an appraisal assignment that is required to produce credible assignment results, given the nature of the appraisal problem, the specific requirements of the intended user(s) and the intended use of the appraisal report. Reliance upon this report, regardless of how acquired, by any party or for any use, other than those specified in this report by the appraiser, is prohibited. The opinion of value that is the conclusion of this report is credible only within the context of the Scope of Work, effective date, the date of report, the intended user(s), the intended use, the stated Assumptions and Limiting Conditions, any hypothetical conditions and/or extraordinary assumptions, and the type of value, as defined herein. The appraiser, appraisal firm, and related parties assume no obligation, liability, or accountability, and will not be responsible for any unauthorized use of this report or its conclusions.

Additional Comments (Scope of Work, Extraordinary Assumptions, Hypothetical Conditions, etc.):

Information was obtained from an on-site observation of the subject property, the Northern Kentucky Multiple Listing Services, Realist on-line tax data and/or public records of the appropriate county courthouse, the appropriate satellite geographic system (if available), other real estate professionals, and/or industry mapping systems. Unless otherwise noted this appraisal was not completed with extraordinary assumptions and/or hypothetical conditions.

Certifications

File No.: 1310petty

Property Address: 724 Stephens Rd	City: Independence	State: KY	Zip Code: 41051
Client: Banklick Watershed Council	Address: 927 Forest Avenue, Covington, KY 41016		
Appraiser: R. Bryan Meade	Address: 15 Harvard Drive, Ft Mitchell, KY 41017		

APPRAISER'S CERTIFICATION

I certify that, to the best of my knowledge and belief:

— The statements of fact contained in this report are true and correct.

— The credibility of this report, for the stated use by the stated user(s), of the reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, impartial, and unbiased professional analyses, opinions, and conclusions.

— I have no present or prospective interest in the property that is the subject of this report and no personal interest with respect to the parties involved.

— Unless otherwise indicated, I have performed no services, as an appraiser or in any other capacity, regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment.

— I have no bias with respect to the property that is the subject of this report or to the parties involved with this assignment.

— My engagement in this assignment was not contingent upon developing or reporting predetermined results.

— My compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal.

— My analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Professional Appraisal Practice that were in effect at the time this report was prepared.

— I did not base, either partially or completely, my analysis and/or the opinion of value in the appraisal report on the race, color, religion, sex, handicap, familial status, or national origin of either the prospective owners or occupants of the subject property, or of the present owners or occupants of the properties in the vicinity of the subject property.

— Unless otherwise indicated, I have made a personal inspection of the property that is the subject of this report.

— Unless otherwise indicated, no one provided significant real property appraisal assistance to the person(s) signing this certification.

Additional Certifications:

No additional certifications are made.

DEFINITION OF MARKET VALUE *:

Market value means the most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:

1. Buyer and seller are typically motivated;
2. Both parties are well informed or well advised and acting in what they consider their own best interests;
3. A reasonable time is allowed for exposure in the open market;
4. Payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and
5. The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.

* This definition is from regulations published by federal regulatory agencies pursuant to Title XI of the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) of 1989 between July 5, 1990, and August 24, 1990, by the Federal Reserve System (FRS), National Credit Union Administration (NCUA), Federal Deposit Insurance Corporation (FDIC), the Office of Thrift Supervision (OTS), and the Office of Comptroller of the Currency (OCC). This definition is also referenced in regulations jointly published by the OCC, OTS, FRS, and FDIC on June 7, 1994, and in the Interagency Appraisal and Evaluation Guidelines, dated October 27, 1994.

Client Contact: Sharmili Reddy	Client Name: Banklick Watershed Council
E-Mail: sreddy@nkapc.org	Address: 927 Forest Avenue, Covington, KY 41016
APPRAISER	**SUPERVISORY APPRAISER (if required) or CO-APPRAISER (if applicable)**

RECERTIFICATION OF VALUE

File No.: 1310petty

Client: Banklick Watershed Council

Borrower: N/A

On March 20, 2013 , the property situated at 724 Stephens Rd, Independence, KY 41051

was appraised by R. Bryan Meade
and valued at $ 196,000

The original appraisal assumed 16.69 acres. I have reviewed the appraisal, acknowledged that the total remainder of the subject site is 14.3 acres, and reviewed recent sales.

It is my opinion that the value of the subject property:

- ☐ has INCREASED since the effective date of the original appraisal.
- ☐ has remained STABLE since the effective date of the original appraisal.
- ☒ has DECREASED since the effective date of the original appraisal.

It is my opinion that the market would a value difference between the orignal acreage appraised and the actual remaining acreage. In addition to the originally emphasized sales within the report dated March 20, 2013, a newer comparable sale was identified.

5025 Oliver Rd, Independence, KY transferred 08/05/2013 for $80,000. It offered 6.18 acres which averages at $12,945 per acre. However, it is superior in that is offers a creek.

Using the newest sale in the consideration of the reduction of 2.39 acres (16.69 - 14.3), a new estimate of the fair market value has been established. Internal file notes contain supporting documents.

As of 10/03/2013 I estimate the fair market value of the remaining 14.3 acres to be $165,000 (One Hundred and Sixty-five thousand dollars). This value is subject to the ingress and egress easement being located on the adjoining 0.98 acre parcel (061-10-00-254.01). With the full burden of maintenance being placed on the same parcel (061-10-00-254.01).

Certification

Kentucky Real Estate Appraisers Board

2013 - 14

Hereby grants a Certified Residential Real Property Appraiser Certificate License № 000512

To R. Bryan Meade
Meade & Associates
1645 Elder Ct.
Ft. Wright, KY 41011

who has complied with the provisions of Chapter 324A of the Kentucky Revised Statutes IN WITNESS WHEREOF, we have caused the official seal to be affixed and attested for the year shown above.

REAL ESTATE APPRAISERS BOARD Commonwealth of Kentucky

Harold G. Brantley, Chair
Sam E. Blackburn, Vice Chair
G. Herbert Pritchett
Dorsey Hall
Kathy J. Mayfield

Harold Brantley

Control № 37174

THIS CERTIFICATE EXPIRES June 30, 2014

APPENDIX H
Approved Watershed Based Plan

The Banklick Watershed Based Plan

Kenton and Boone Counties

A Holistic Approach to Watershed Improvement

Revised and Updated by Strand Associates, Inc.®
April 2010

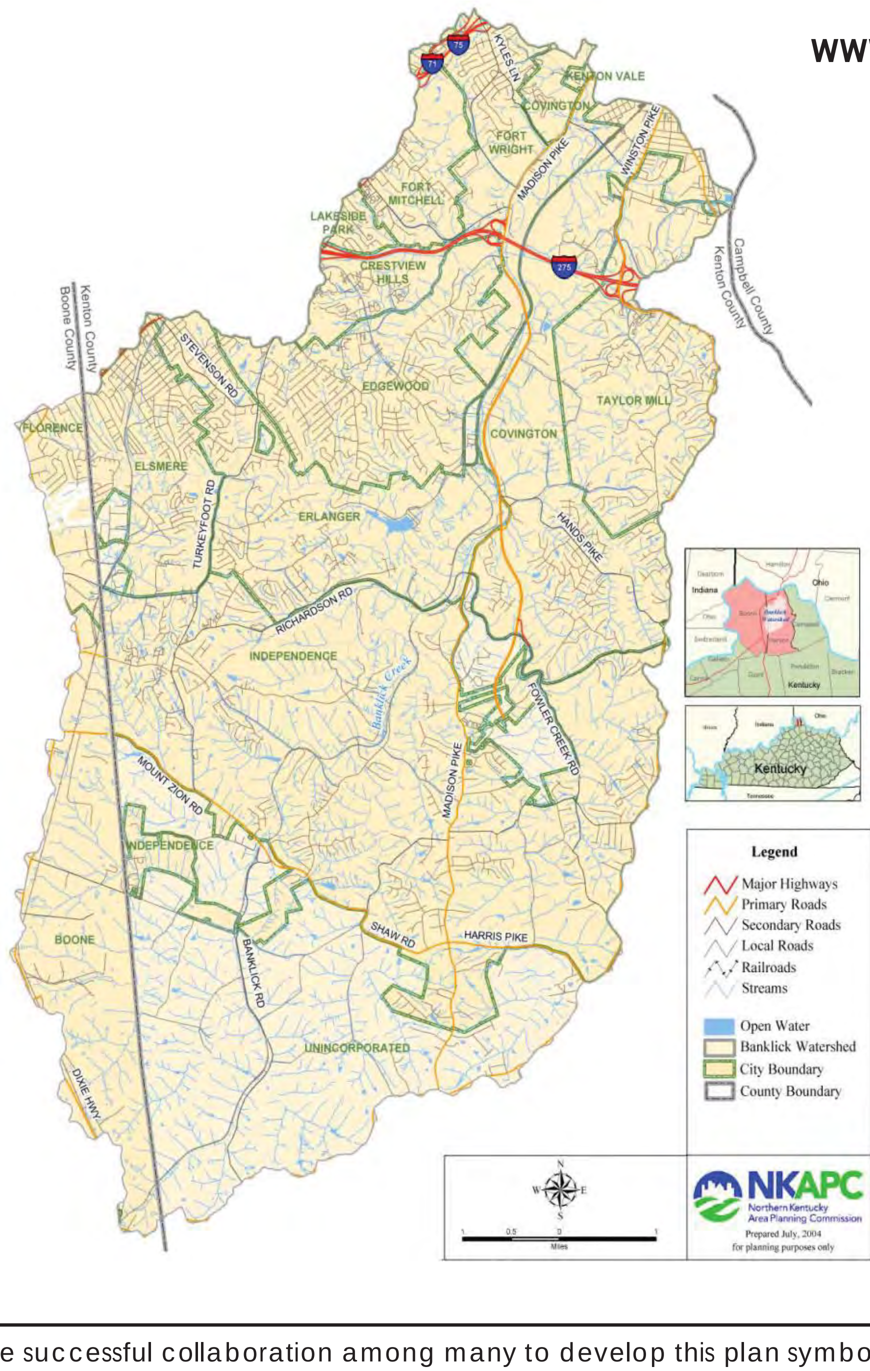
Banklick WATERSHED COUNCIL

STRAND ASSOCIATES, INC.® ENGINEERS

BANKLICK WATERSHED COUNCIL MISSION STATEMENT –

" protecting, promoting and restoring the biological, chemical and physical integrity of Banklick Creek, its tributaries and watershed."

WWW.BANKLICK.ORG



The successful collaboration among many to develop this plan symbolizes the spirit of partnership that can reclaim Banklick Creek for the people who live and work in its watershed.

This report was prepared to address the plan for the EPA 319(h) grant. The initial Banklick Watershed Action Plan was created in 2005, and served as a starting point for this version of the Watershed Based Plan. It is important to note that watershed plans are dynamic and should be seen as evolving documentation of the status of a watershed.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

In November of 2005, the Banklick Watershed Council (BWC) produced a general watershed plan for Banklick Creek. As a product of countless volunteer hours, the plan has raised awareness of the major issues of concern in the Banklick watershed. The 2005 Watershed Plan outlined four major goals for the watershed as determined by the BWC and discussed initial action plans toward achieving those goals.

The four main goals are:

1. Clean the Water.
2. Reduce Flooding.
3. Restore the Banks.
4. Honor the Heritage.

The focus of this, the 2009 revised and updated Banklick Watershed Plan, is to track the progress in the watershed, and to establish a plan to remediate both the point source and nonpoint source pollution that is reaching Banklick Creek. This document was guided by the United States Environmental Protection Agency's *Handbook for Developing Watershed Plans to Restore and Protect our Waters*, which indicates that nine minimum elements should be included in a watershed plan. To ensure that these nine elements have been clearly addressed for the Banklick Watershed Plan, the section headings of this document indicate which of the nine elements (A to I) are discussed in each section.

Though watershed plans are dynamic and evolving documents, the intent of this effort is to establish a plan of action to restore and protect the water quality in the Banklick Watershed. Although this document provides a comprehensive assessment of the entire watershed, the ongoing commitments of Sanitation District No. 1 (SD1) in the lower portions of the watershed allow this project to target areas that have traditionally seen less resource allocation. By calling out a "focus area" comprised of the upper five subwatersheds, the recommendations proposed within this plan outline management measures for the portions of the stream network where SD1 is not already investing large amounts of management controls. The anticipated outcome of implementing the management measures is to achieve the following goals:

1. Reduce and cleanse agricultural and urban stormwater runoff.

2. Ensure cattle, horses, and other agricultural livestock are fenced and kept out of the streams.

3. Reduce pollution from potentially failing septic systems.

4. Increase infiltration to cleanse runoff and increase base flows in streams.

These management measures were determined through a detailed watershed characterization process, analysis of pollutant source assessment data, and literature reviews of control measures. Estimates of current bacteria loads in the focus area indicate greater than 5 x 10^{15} colony forming units (cfu) of fecal coliform per year, corresponding to average in-stream concentrations that would require greater than 95 percent reductions in order to attain water quality standards. Although such reductions may seem daunting, the financial support of the Environmental Protection Agency's 319(h) grant will allow the BWC to make real and significant gains toward achieving those goals. The management measures recommended herein will be implemented to the fullest extent possible with corresponding reductions in bacteria estimated at up to 20 to 40 percent. With the support of partnering agencies, through a combination of riparian buffers, livestock fencing, education, septic improvements, and infiltration BMPs, these efforts will bring the Banklick Watershed substantially closer to more fully realizing the vision of a safe and healthy stream network and an invaluable community resource.

As an alternative to this necessarily detailed and technical Watershed Based Plan, the BWC prepared a four-page summary to ensure that its message could more broadly appeal to all stakeholders. The concise and illustrated format is appropriate for all audiences; this public summary is included following this section.

Strand Associates, Inc.® is not responsible for the content of the material prepared by others contained in the Appendices.

The Banklick Watershed Plan

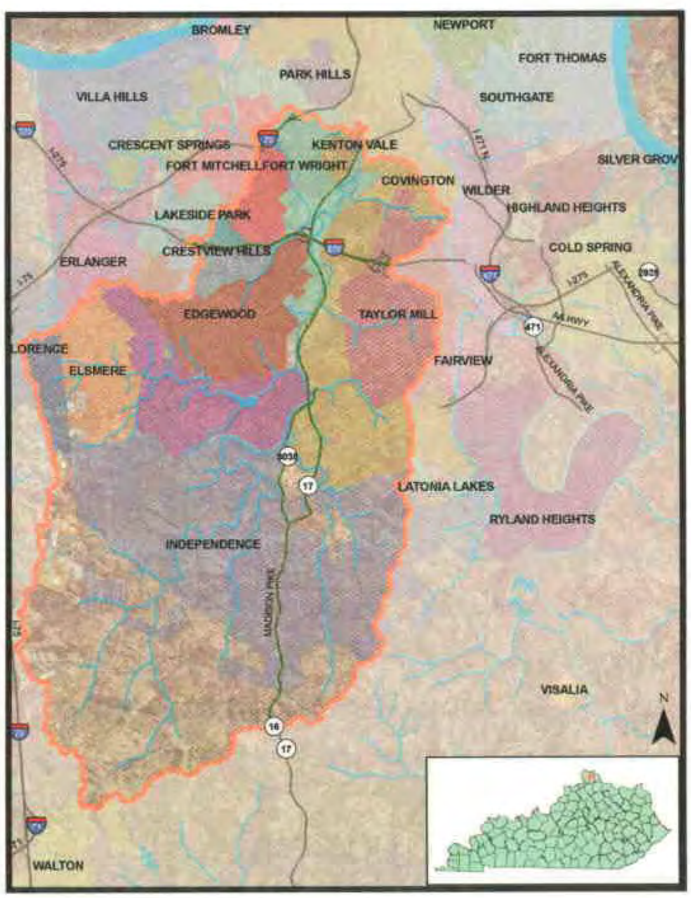
Watershed Plan Summary — November 2009

The Banklick Watershed is defined as all the of the land area that drains to the Banklick Creek (see map below). This includes the land drained by tributary streams such as Fowler Creek, Bullock Pen, Horse Branch, Holds Branch, Brushy Fork, Wolf Pen Branch, etc. that eventually flow into the Banklick Creek. The Banklick Watershed area includes parts of Fort Wright, Taylor Mill, Lakeside Park, Crestview Hills, Edgewood, Elsmere, Florence, Covington, Independence, and even parts of Boone County. All of the water from the Banklick Creek Watershed eventually empties into the Licking River.

Many of the streams in the Banklick Watershed have been negatively impacted by high levels of bacteria, sediments, and other pollutants. This pollution makes our streams unsafe for swimming and other recreational enjoyment. Additionally, much of the critical habitat for the animals that live in and around the streams is being destroyed. In fact, the water in the Banklick Creek is so polluted that the creek is in violation of a federal water quality regulation known as the Clean Water Act. Currently, the entire Banklick Creek is listed as an "impaired (polluted) stream" by the Kentucky Division of Water. In addition to the water quality problems, the Banklick Creek also experiences flooding problems and significant stream bank erosion. These problems may affect you! Look at the map below, and the map on page 2—do you live in the Banklick Watershed? If you do, there may be things that you can do to help solve these problems!

In an effort to protect and improve the streams in the Banklick Watershed, a citizen group called the Banklick Watershed Council was created in 2002. This group has established four goals to guide their efforts: Clean the Water, Reduce Flooding, Restore the Banks, and Honor the Heritage.

Recently, the Banklick Watershed Council received a grant from the U.S. Environmental Protection Agency (EPA) through the Kentucky Division of Water (KDOW) to develop and begin implementing a watershed plan. The goal of the Council is to use part of the federal grant to identify and prioritize pollutant sources within the watershed and to use the remainder of the funds to implement projects to improve the overall health of the stream. Details of the probable sources of pollution, and the proposed solutions to these problems can be found in the remainder of this summary. You will also find examples of how you can help improve the water quality and protect the Banklick Watershed.



Banklick WATERSHED COUNCIL

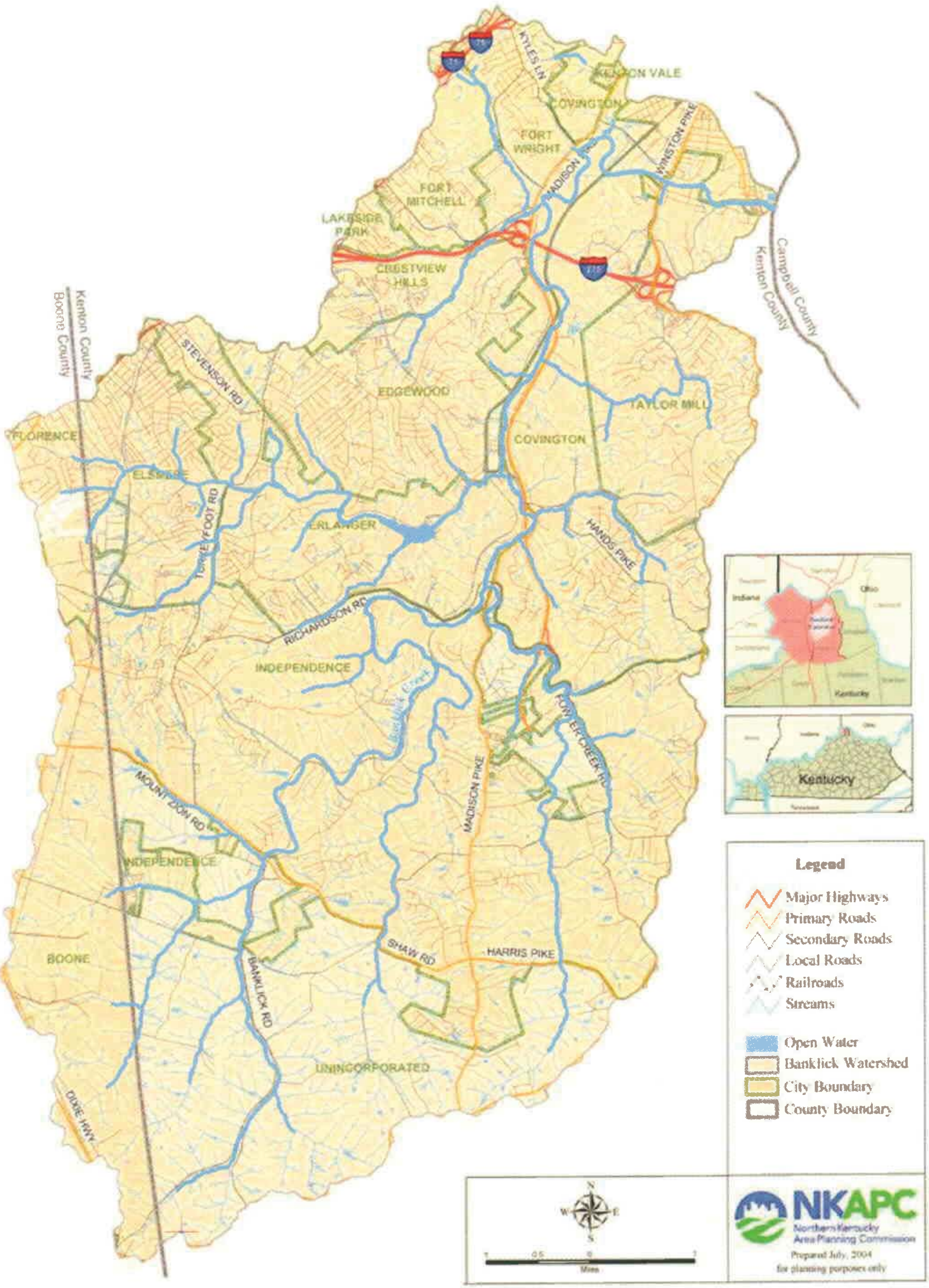
Goals of the Council

CLEAN THE WATER

REDUCE FLOODING

RESTORE THE BANKS

HONOR THE HERITAGE


KENTON VALE
COVINGTON
FORT WRIGHT
FORT MITCHELL
LAKESIDE PARK
CRESTVIEW HILLS
EDGEWOOD
TAYLOR MILL
COVINGTON
FLORENCE
ELSMERE
ERLANGER
INDEPENDENCE
INDEPENDENCE
BOONE
UNINCORPORATED
KYLES LN
MADISON PIKE
WINSTON PIKE
STEVENSON RD
TURKEYFOOT RD
HANDS PIKE
RICHARDSON RD
FOWLER CREEK RD
MOUNT ZION RD
MADISON PIKE
SHAW RD
HARRIS PIKE
BANKLICK RD
DIXIE HWY
Banklick Creek
Kenton County
Boone County
Campbell County
Kenton County
Indiana
Ohio
Kentucky
Legend
Major Highways
Primary Roads
Secondary Roads
Local Roads
Railroads
Streams
Open Water
Banklick Watershed
City Boundary
County Boundary
N
S
E
W
Miles
NKAPC
Northern Kentucky Area Planning Commission
Prepared July, 2004
for planning purposes only

Where Is All The Pollution Coming From?

The pollution in the Banklick Watershed comes from many different places. When it rains the stormwater washes across the land carrying soil from farmland, oil from roadways, chemicals from lawns, pet waste from parks, and many other pollutants into the streams. Pollution can also get to the streams from broken septic systems, construction sites, livestock walking through streams, etc. All of these things are called *nonpoint source pollution,* or runoff pollution. One common form of stream pollution occurs when sewers carrying wastewater get filled with rainwater causing them to overflow into streams before the sewage is treated at a Wastewater Treatment Plant. This is called *point source pollution.* In the Banklick Watershed, Sanitation District No. 1 is working to improve the sewer systems, and reduce stream pollution from sewer overflows. Since the Sanitation District is focused on fixing the sewers, the Banklick Watershed Council is focusing their efforts on improving water quality by reducing the nonpoint source pollution. To make the council's efforts more effective, they will focus on the southern half of the watershed where nonpoint source pollution is more predominant, as shaded in the map below.

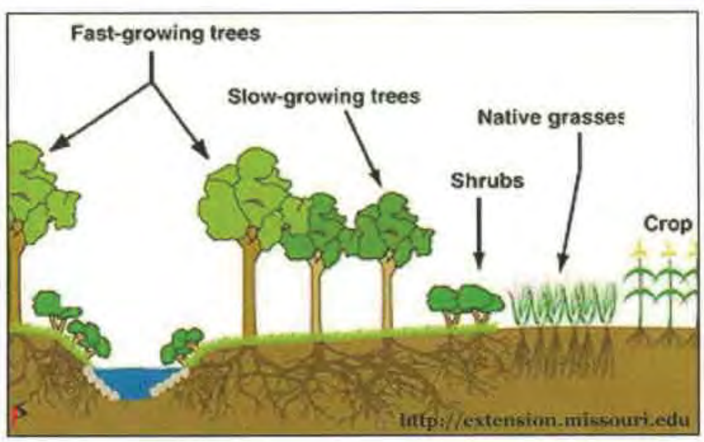
What is the Plan to Improve the Water Quality?

The Banklick Watershed Plan was developed through a detailed analysis of water quality data and the sources suspected of causing the most pollution. This assessment resulted in the following four control measures that will be implemented throughout the Banklick Watershed to improve water quality:

- **Establishing Streamside Vegetated Buffers**
- **Fencing Livestock to Prevent Stream Access**
- **Improving Failing Septic Systems**
- **Increasing Infiltration**

Establishing Streamside Vegetated Buffers

The Problem When land is used for farming and development, the trees and vegetation along the stream banks are often removed. This exposes the stream to polluted stormwater and can make stream banks more easily eroded. Also, the stream which was once shaded by trees now gets very hot in the sunlight and the water cannot hold enough oxygen for fish to survive.



How will buffers help? Streamside vegetated buffers as shown in the figure at right, will help protect the stream by filtering the pollution from the runoff before it reaches the stream. This vegetation also shades the stream to create a cool environment for aquatic life, and stabilizes the stream bank soil with its roots to prevent erosion.

Our Plan for Banklick Ultimately, the goal is to have vegetated buffers, protecting all streamside land in the Banklick Watershed. Buffers are one of the most critical improvements that will improve water quality. The Council has established a goal of protecting or restoring 10,000 linear feet of streamside vegetated buffers in the southern half of the watershed. If you own streamside land in this area, this federal grant money could be used to create or restore vegetated buffers on your land! This includes removing invasive species of plants, planting native trees, shrubs, and grasses, and ensuring that the stream is protected.

Fencing Livestock to Prevent Stream Access

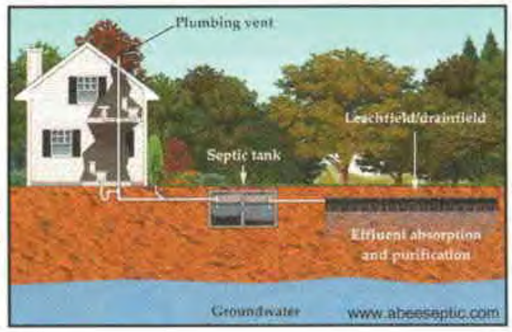
The Problem Livestock farms are often located near small streams allowing the animals to drink directly from the stream. This results in water pollution because manure is deposited directly in or near the stream, the animals trample the banks of the stream which causes the banks to break down and releases soil into the water. Also, animals can become sick if they drink water that is polluted.

How will fencing livestock help? Fencing livestock keeps them out of the streams which saves the banks from being trampled, and keeps the manure out of the water. This helps improve the water quality and it keeps the animals healthy by not drinking dirty water.

Our Plan for Banklick The council will use the grant money to help farmers fund fencing and related pasture improvements, as well as educate farmers on pasture management and resources available to them.

Improving Failing Septic Systems

The Problem Houses that are not connected to public sewer have septic systems on their land that treat their wastes. If these systems are old, not properly maintained, or installed in inappropriate soils they can fail and human waste can pollute surrounding land and the streams. Failing septic systems can also cause sewage to back up into these houses.



How will fixing septic systems help? Fixing or replacing failing septic systems can prevent residential sewage from entering the streams, this can improve water quality in the Banklick Watershed.

Our Plan for Banklick The 319 funds will be used to assist with replacement or repair of several failing systems in the watershed and educate septic system owners on proper system care.

Increasing Infiltration (Water Soaking into the Ground)

The Problem As the land in the Banklick Watershed is developed, less rain water is able to soak deep into the soil (which is called infiltration). This causes more pollution to runoff with the stormwater into the streams, and it causes the streams to dry up when it is not raining rather than having a constant water level to support fish life.

Drawing provided by Emmons & Olivier Resources, Inc.

How will infiltration help? Increasing infiltration will help to naturally remove pollution from water before making its way into streams. It will also recharge groundwater levels giving streams year-round water supplies, even during dry months.

Our Plan for Banklick To increase infiltration in the Banklick Watershed, land owners need to install controls that allow the water to collect and infiltrate deep into the soil before it can runoff to the stream, such as the rain garden shown at right. The council plans to use 319 grant money to fund infiltration controls in the watershed.

Will this Plan Really Improve the Water Quality in the Banklick Watershed?

Yes! Studies have been completed to show that these proposed changes in the watershed can make a very big difference in the water quality and stream condition. Water pollution is a big problem, but every improvement is one step closer to the goal of clean safe streams in the Banklick Watershed. The 319 grant is a good start, and the funding from this grant can be used to pay for the installation of these controls on your land! For more information on how you can help, contact Sherry Carran, president of the Banklick Watershed Council at carranbs@fuse.net or (859) 491-0722.

A more detailed and technical version of this watershed plan is available. To obtain a copy of the extended version, please contact the Banklick Watershed Council at www.banklick.org.

"This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the Banklick Watershed Council (Grant # C9994861-07)."

STRAND ASSOCIATES, INC.® ENGINEERS

1.01 INTRODUCTION

Expanding populations and rapidly changing landscapes are affecting the way we think about our natural resources. There is a growing recognition that our waterways, soils, forests, and other resources do not exist in isolation but are part of a much larger system of natural functions and human activities. The watershed approach recognizes the intricacy of these connections and encourages holistic and coordinated ways to address environmental concerns. As in many other parts of our country, the watershed approach offers a blueprint for success in the approximately 58-square mile drainage basin of Northern Kentucky's Banklick Creek. The United States Environmental Protection Agency (USEPA) and Kentucky Division of Water (KDOW) are among the public agencies that recognize the value of the watershed approach in improving streams and the lands within watersheds. Like many other states, Kentucky has organized its water quality and assessment programs by major watersheds.

Figure 1.01-1 Banklick Creek from the Decoursey Pike Bridge

Banklick Watershed is a located within the larger Licking River Basin. Through an interagency prioritization process led by the KDOW, Banklick Creek has been designated as one of the three highest priority streams in the Licking River basin. Among the factors contributing to the watershed's priority designation are the severity of Banklick's flooding and water quality problems, its diversity of stakeholders, the high projected growth rate, and the large number of water quality violations. Figure 1.01-1 is an aerial view of Banklick Creek.

Watershed monitoring, assessment, and other collaborative activities conducted in the Licking River Basin have helped support the formation of the Banklick Watershed Council (BWC), the primary citizens' group involved in the protection and improvement of the Banklick Watershed. The BWC recognizes the critical connections between the region's rolling topography, forest cover, agricultural lands, and cityscapes through which the creek flows for 19 miles toward its confluence with the Licking River. Like all streams, Banklick Creek is a reflection of its watershed, mirroring the natural landscape and decades of human activity and intense development. At the beginning of the twenty-first century, the creek reflected a highly developed, ecologically compromised watershed.

Since 2002, the BWC has worked with many agencies and individuals to develop a new vision for Banklick Creek that includes the improvement and reclamation of the stream and its riparian corridor. A strategy for the watershed's long-term management is emerging, but its transformation to reality will require adherence to the well-defined comprehensive effort as presented in this plan. Successful watershed projects elsewhere have illustrated the need for a clear plan of action to garner public support and to leverage the funding for implementation of plan components.

Several other key factors must be considered to create a blueprint for success in the Banklick watershed. The effort must encompass the entire watershed, transcending political boundaries for the collective good. The watershed as shown on Figure 1.01-2 is a jurisdictional patchwork of more than ten municipalities and unincorporated portions of Boone and Kenton counties. Although each of these cities and areas has its own identity, they are all part of the same watershed. From a watershed perspective, cities and counties working together have the advantages of combined resources and greater influence in dealing with state and federal agencies. Communities working together to improve the Banklick Watershed can realize economies of scale in implementing sound, cost-effective strategies. Moreover, better ideas and implementation strategies frequently emerge from group interaction than can be developed individually.

The success of the Banklick effort also depends upon:

1. Providing well-structured opportunities for meaningful participation by all the project stakeholders.

2. Identifying the most significant threats to water quality and targeting resources accordingly.

3. Establishing well-defined goals and objectives related to water quality, habitat improvement, and biodiversity.

4. Recognizing at the outset the long-term nature of watershed improvement and the diversity of financial and technical resources required to accomplish the goals.

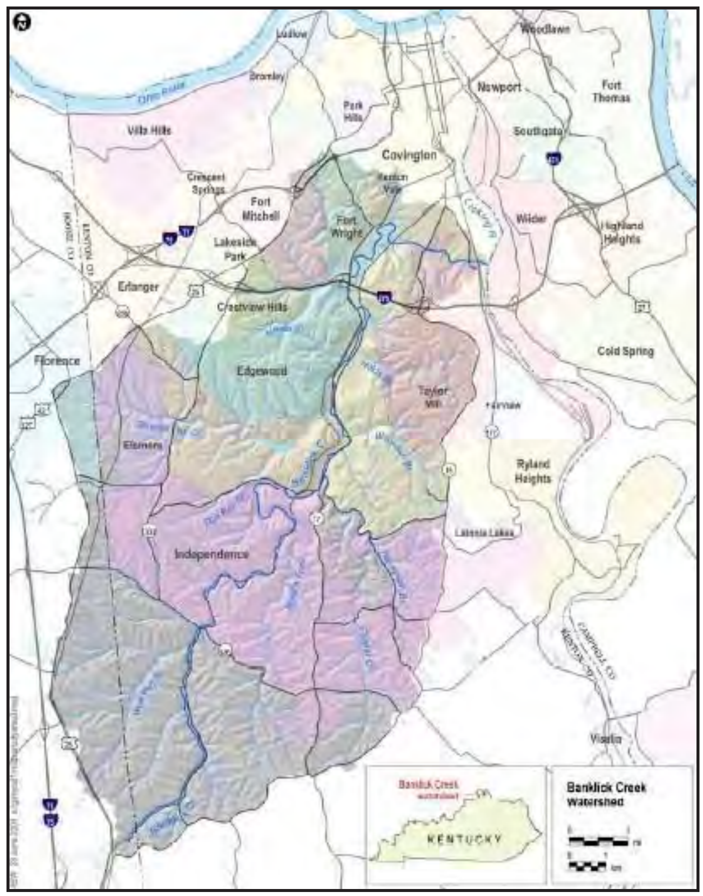


Figure 1.01-2 Municipalities within Banklick Creek

1.02 REFERENCES

This section provides a compilation of all the reference materials utilized throughout the Watershed Plan.

Baumgartner, F. & Reichel, E. 1975. *The World Water Balance: Mean Annual Global, Continental and Maritime Precipitation, Evaporation and Runoff.* Ordenbourg, Miinchen.

Boone County Planning Commission. 2005 Comprehensive Plan.

Budyko, M.I. 1970.The water balance of the ocean. *World Water Balance*, pp.24-34: IAHS Publ. No. 92.

Budyko, M.I. 1974.*Climate and Life*, International Geophysical Series, vol. 18, Academic Press, 508 pp.

Building a Nationally Recognized Program Through Innovation and Research. Portland, Oregon. Water Environment Research Foundation. http://www.werf.org/livablecommunities/studies_port_or.htm

Davey Resource Group. 2004. What's in <u>your</u> watershed? A case study and guide to the Banklick Creek Watershed Analysis and Issue Characterization for Education and Outreach (BACE).

Draft Watershed Planning Guidebook for Kentucky Communities. Kentucky Waterways Alliance, Kentucky Division of Water.

FFY 2007 Project Application: Kentucky Nonpoint Source Pollution Control Program. Submitted by Banklick Creek Watershed Council. Prepared by Strand Associates, Inc., Project Manager John Lyons.

Francis J. Larney[*], L. Jay Yanke, James J. Miller and Tim A. McAllister. Fate of Coliform Bacteria in Composted Beef Cattle Feedlot Manure. Agriculture and Agri-Food Canada, Research Centre, 5403 1st Ave. S., Lethbridge, Alberta, Canada T1J 4B1.

Handbook for Developing Watershed Plans to Restore and Protect Our Waters. U.S. Environmental Protection Agency, Office of Water Nonpoint Source Control Branch. March 2008. Washington, D.C.

Kentucky Division of Water. 2004. Licking and Salt River Basin Strategic Monitoring Plan.

Kentucky Division of Water. 1998. The Licking River region in Kentucky: Status and trends.

Korzun, V. I. (ed.) 1978. *World Water Balance and Water Resources of the Earth.* No. 25 of Studies and Reports in Hydrology, UNESCO, Paris.

Limno-Tech, Inc. 2008 Banklick Creek Watershed Characterization Report. Preliminary Working Draft Watershed Conscent Decree. Prepared for Sanitation District No. 1 of Northern Kentucky.

Limno-Tech, Inc. 2004. Watershed Assessment Protocol–Application to Banklick Creek. Prepared for Sanitation District No.1 of Northern Kentucky.

Limno-Tech, Inc. 1998. Water quality assessment of Banklick Creek and the Lower Licking River. Prepared for Sanitation District No.1 in association with Woolpert LLP.

Lvovitch, M I. 1973 The global water balance. *EOS Trans. AGU* 54, 28-42.

Northern Kentucky Area Planning Commission. 2001 Areawide Comprehensive Plan.

Ormsbee, L., A. Jain, S. Gruzesky, S. Reddy and D. McPherson. 1995. CSO impact assessment for the Licking River. University of Kentucky, Department of Civil Engineering, Lexington, KY.

Pille, Gayle. Personal communication. Phone conversation on October 17, 2005, with Gayle Pille, Wildlife Enhancement Coordinator, Highland Cemetery, Fort Mitchell, KY.

Strand Associates, Inc. 2003. Habitat and biological community assessment. Prepared for Sanitation District No.1

The Weather Channel. Monthly Averages for Northern Kentucky Int'l Airport. http://www.weather.com/outlook/travel/businesstraveler/wxclimatology/monthly/graph/CVG:9?from=tenDay_bottomnav_business

U.S. Army Corps of Engineers, Louisville District. Banklick Creek Watershed Kenton County, Kentucky Flood Danage Reduction/ Ecosystem Restoration Section 905(b) (WRDA 1986) Analysis. September 2000.

U.S. Department of Agriculture, Soil Conservation Service. 1973. Final environmental statement–Banklick Creek Watershed, Kenton and Boone Counties, Kentucky. USDA-SCS-ES-WS-(ADM)-72-25-(F).

U.S. Department of Agriculture. Farm Service Agency. Conservation Reserve Enhancement Program website. June2008.http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep

United States Environmental Protection Agency. 2006. "Guidance Specifying Management Measuresf or Nonpoint Pollution in Coastal Waters. *Chapter 6: Management Measures for Hydromodification*." Web address: http://www.epa.gov/owow/nps/MMGI/Chapter6/index.html

Watershed Framework Pilot Project: Banklick Creek. Limno Tech Powerpoint presentation Sanitation District No. 1 of Northern Kentucky *Watershed Community Council Meeting* May 20, 2008.

Strand Associates, Inc.® is not responsible for the content of the material prepared by others contained in the Appendices.

1.03 GLOSSARY OF TERMS

The following table defines terms used within this report (see Table 1.03-1).

TABLE 1.03-1

GLOSSARY OF TERMS

Aquatic habitat, warmwater	A water use designation that means the waterbody provides suitable warmwater habitat for the survival and reproduction of fish, shellfish and other aquatic organisms.
Best management practices (BMPs)	Methods or techniques designed to prevent pollution. Often used in combination, BMPs include but are not limited to structural and nonstructural measures and operation and maintenance procedures.
Consent decree	A legally binding document with environmental regulators outlining an accelerated program of actions to further improve water quality and ensure compliance with the Clean Water Act.
Designated uses	Specified goals for surface waterbodies that include uses for public water supply, protection and propagation of fish and wildlife, recreation in and on the water, and agricultural, industrial and other uses as established by Kentucky state law, in accordance with the federal Clean Water Act.
Fecal coliforms	Bacteria that indicate the presence of animal or human waste contamination of a waterway and the possible presence of other pathogenic organisms.
Geographical Information System (GIS)	A computerized data management method that allows for collection, retrieval, analysis and spatial display of geographically-based information. GIS combines maps of an area with database tables related to map features.
Macroinvertebrates	Animals without backbones (invertebrates) that are visible to the naked eye.
Nonpoint source	Any source of pollution which is diffuse and does not have a single point of origin (e.g. fertilizers on residential lawns). Such pollutants are generally carried off the land by stormwater runoff.
point source	Any discernible, confined or discrete conveyance from which a pollutant is or may be discharged into a waterbody (e.g. industrial discharge pipe).
Primary Contact Recreation designation	Refers to a water quality use designation indicating that people can swim in a waterbody without risk of adverse human health effects (such as catching waterborne diseases from raw sewage contamination).
Riparian corridor	A vegetated stream-side corridor that provides an important transition from the terrestrial to the aquatic environment.
Secondary Contact Recreation Designation	Refers to a water quality use designation indicating that people can perform activities on the water (such as boating or fishing) without risk of adverse human health effects from ingestion or contact with the water.
Total maximum daily load (TMDL)	A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.
Watershed	A watershed, or basin, includes all the area that drains to a particular stream, river or lake. Each watershed is unique, with its characteristics dependent on its natural systems and the people who live there. Like other watersheds, the Banklick watershed and its resources mirror the natural events and economic activities within its boundaries.

1.04 DEFINITIONS

BACE	Banklick Creek Watershed Analysis and Issue Characterization for Education and Outreach
BMP	best management practice
BWC	Banklick Watershed Council
BWP	Banklick Watershed Plan
USACE	United States Army Corps of Engineers
cfs	cubic feet per second
CREP	Conservation Reserve Enhancement Program
CSO	combined sewer overflow
CWA	Clean Water Act
CWEP	Commonwealth Water Education Program
DFW	Department of Fish and Wildlife
FSA	Farm Service Agency
GIS	geographical information system
HSEM	Homeland Security and Emergency Management
I/I	inflow and infiltration
KCCD	Kenton County Conservation District
KCHSEM	Kenton County Homeland Security and Emergency Management
KDFW	Kentucky Department of Fish and Wildlife
KDOW	Kentucky Division of Water
KET	Kentucky Educational Television
KG	kilograms
KIBI	Kentucky Index of Biotic Integrity
KSNPC	Kentucky State Nature Preserve Commission
LAND	Local Alliance for Nature and Development
LRWW	Licking River Watershed Watch
LTI	LimnoTech, Inc.
MBI	Macroinvertebrate Biotic Index
mm	millimeters
NASS	National Agricultural Statistics Service
NKAPC	Northern Kentucky Area Planning Commission
NKIHD	Northern Kentucky Independent Health District
KPDES	Kentucky Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service of the USDA
ORSANCO	Ohio River Sanitary Commission
P	production
PSA	public service announcement
QAPP	Quality Assurance Project Plan
R	respiration
RM	river mile
SIA	suspected illicit activity
SD1	Sanitation District No.1 of Northern Kentucky
SSO	sanitary sewer overflow
Strand	Strand Associates, Inc.®

TMDL	total maximum daily load
TSS	total suspended solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
WBP	Watershed Based Plan
WQS	Water Quality Standards

2.01 PROJECT TEAM

This Watershed Based Plan (WBP) was developed in a collaborative manner. The Banklick Watershed includes a spectrum of public agencies and groups that play important roles in protection, management, and public education related to watershed activities and resources. The list is extensive (see Section 8.02), but of the many players in the Banklick Watershed, the only group with a primary focus on the watershed is the BWC. Since its formation in 2002, the BWC has worked in various ways to fulfill its mission of "protecting, promoting and restoring the biological, chemical, and physical integrity of Banklick Creek, its tributaries, and watershed." WBP has been developed to provide guidance in fulfilling that mission.

Like similar groups in other watersheds, the BWC understands that success in attaining its mission depends on its ability to communicate to the larger watershed community. To that end, the BWC simplified its goals so communications are very clear.

BWC has four goals:

1. Clean the water.
2. Reduce flooding.
3. Restore the banks.
4. Honor the heritage.

To develop this watershed plan, the BWC has collaborated closely with Sanitation District No. 1 of Northern Kentucky (SD1). SD1 is the regional sewer district serving 97 percent of properties in the Banklick Watershed as shown in the map of Figure 2.01-1. As the regional sewer district, SD1 manages the stormwater infrastructure for the service area. On April 18, 2007, SD1 entered into a consent decree with the USEPA to address combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs). As a result of the consent decree, SD1 invested millions of dollars throughout its service area on water quality monitoring and watershed characterization. SD1 allowed the BWP Project Team to utilize the Banklick Watershed characterization data and monitoring data for the development of the BWP. SD1 representatives also remained engaged in the Plan development to provide further assistance when possible.

Finally, the BWC hired Strand Associates, Inc.® (Strand) to assist with the development and implementation of this watershed plan. The collaboration of these groups has resulted in the creation of this WBP.

FIGURE 2.01-1

SANITATION DISTRICT NO. 1 SERVICE AREA IN BANKLICK WATERSHED

3.01 INTRODUCTION

The purpose of the watershed characterization section is to present all of the general information about the Banklick Watershed and its attributes. All of these characteristics have some affect on the water quality in the streams. The information in this section provides an important introduction to the physical features of the watershed that will then lead into the much more detailed water quality assessment in Section 4.

3.02 WATERSHED BOUNDARIES

Banklick Watershed is one of the largest watersheds in Northern Kentucky. Of the watershed's more than 58 square miles, approximately 90 percent are in Kenton County and about 10 percent are in Boone County. The stream rises in rural areas near the Boone-Kenton County line and then flows northeasterly joining the Licking River in a highly urbanized area of Covington, about 4.7 miles from the Licking's confluence with the Ohio River.

3.03 TOPOGRAPHY AND GEOMORPHOLOGY

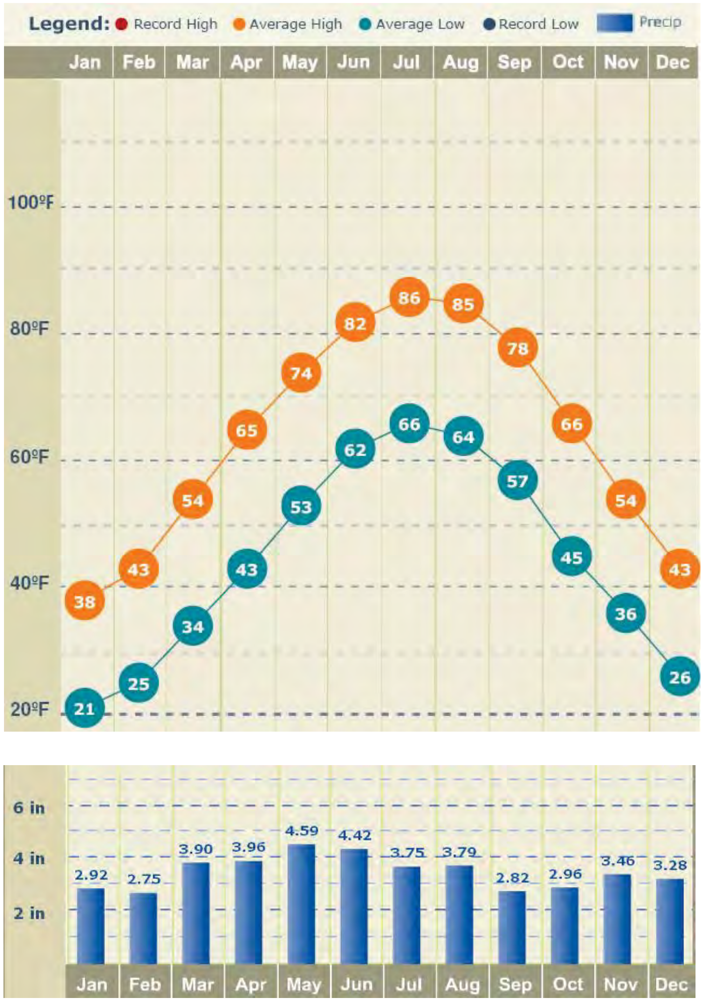
The topography of the watershed ranges from steep to gently sloping. Elevations above mean sea level range from 960 feet along the upper portion of the watershed divide to 450 at the Banklick's confluence with the Licking River [United States Department of Agriculture (USDA) 1973)].

Over its 19-mile length, LimnoTech, Inc. (LTI) (2008) found the average slope of the stream bed to be 0.4 percent. In a separate study, Strand and SD1 found the bed slope as measured at five locations (River Mile (RM) 5.5, 8.1, 17.6, 17.8, and 18.0) to range 0.4 to 0.8 percent. Adjoining tributaries are generally steeper with slopes ranging up to approximately 2 percent (100 ft/mi) (USACE), 2000)).

Median grain size of the bed material from riffle transects at the five RM locations mentioned above ranged 18 to 60 millimeter (mm), with clasts largely composed of broken limestone bedrock. A low-flow channel ranging from 7 to 10-feet wide and 0.5 to 1-foot deep is set within a much larger entrenched cross section that varies from 15 to 60-feet wide and from 2.5 to over 4-feet deep. Incision and bank instability typically worsen as one moves downstream. Backwater from the Licking River and corresponding effects on channel geometry have been reported for up to three-fourths mile upstream from the confluence (LTI, 2008).

3.04 CLIMATE

The region exhibits a humid-temperate climate with seasonal trends in temperature and precipitation (Figure 3.04-1). On average, July is the warmest month and January is the coldest. The maximum average precipitation occurs in the month of May, and the minimum average precipitation occurs in the month of February with 2.75 inches; the mean annual rainfall is 41 inches (weather.com).



Source: weather.com

Figure 3.04-1 Monthly Average Temperature and Precipitation in Northern Kentucky

3.05 HYDROLOGY

Banklick Creek is a perennial stream and is hydraulically influenced by the Licking River at its mouth. At times, the Licking River flows upstream into Banklick Creek for 30 to 40 feet and has an influence on its temperature, dissolved oxygen, and other stream parameters (LTI, 1998). Groundwater supplies baseflow to streams and is the primary contributor to stream flow during dry weather. Most small upstream tributaries of Banklick Creek are bounded by relatively intact limestone bedrock. Bed material of lower reaches and downstream tributaries is composed of broken limestone clasts in the gravel/cobble range but is still underlain by bedrock layers of limestone and shale. Banklick Creek's major tributaries from upstream to downstream are Wolf Pen Branch, Brushy Fork, Fowler Creek, Wayman Branch, Bullock Pen Creek, Holds Branch, and Horse Branch. There also are several small, unnamed tributaries. Also located in the watershed is Doe Run Lake, a 51-acre flood control reservoir that was constructed on Bullock Pen Creek between 1978 and 1982 (USDA 1973, LTI, 2004).

Flow is measured in Banklick Creek at RM 8.0 at the intersection with Kentucky Highway 1829 by the US Geological Survey (USGS). Gauge No. 03254550 has been active since April 1999. The regime is flashy, which basically means it has large increases in flows during rain events and instantaneous peak flows that are generally much larger than the corresponding mean daily flow. As seen in Figure 3.05-1, base flows dominate the hydrograph and tend to be less than 50 cfs.

Since 1999, the USGS has recorded flows at mile 8.2 of Banklick Creek, which is located at approximately the midpoint of the stream. See Figure 3.05-2 for map showing gauge location. Instantaneous flows are recorded once every 15 minutes, which are then averaged every 24 hours to determine the mean daily flow (i.e. 'daily flow') of each day. Analysis of daily flow data from April 1, 1999, through March 31, 2008 (9 years) indicate the following.

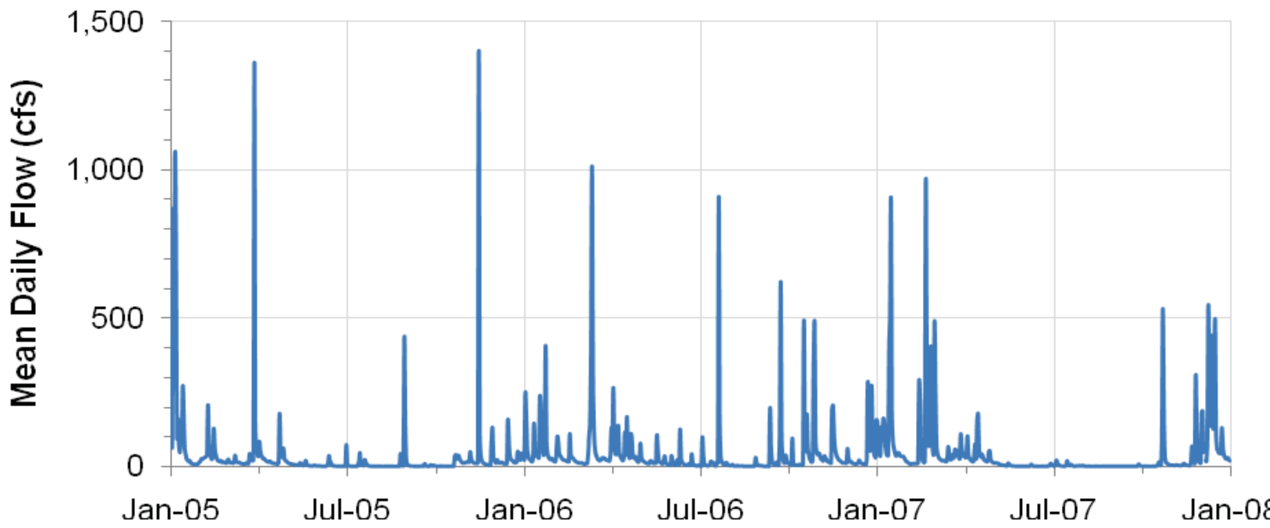


Figure 3.05-1 Three-year Time Series of Mean Daily Flow in Banklick Creek at RM 8.0 (USGS Gauge No. 03254550)

1. The average of all mean daily flows, (i.e. the average daily flow) is approximately 42 cubic feet per second (cfs).

2. Seventy percent of mean daily flows are less than approximately 25 cfs, 85 percent are less than approximately 50 cfs, and 95 percent are less than approximately 150 cfs.

3. Base flows have been less than 0.5 cfs.

4. Flows have increased by three orders of magnitude during storm events.

5. The maximum of all mean daily flows, (i.e. the maximum daily flow) is 2,130 cfs (February 18, 2000), while the maximum of all instantaneous flows on record (i.e. the maximum peak flow) is 9,570 cfs (April 21, 2002).

The periods of high flow typically last one to two days while flow becomes intermittent during dry weather (although pools generally retain water). Flooding is a serious problem in the Banklick Watershed, particularly in the Pioneer Park area. (LTI, 2008) The United States Army Corps of Engineer (USACE) study, USACE (2000), identifies three primary factors that have contributed to flood damages in the watershed. These are:

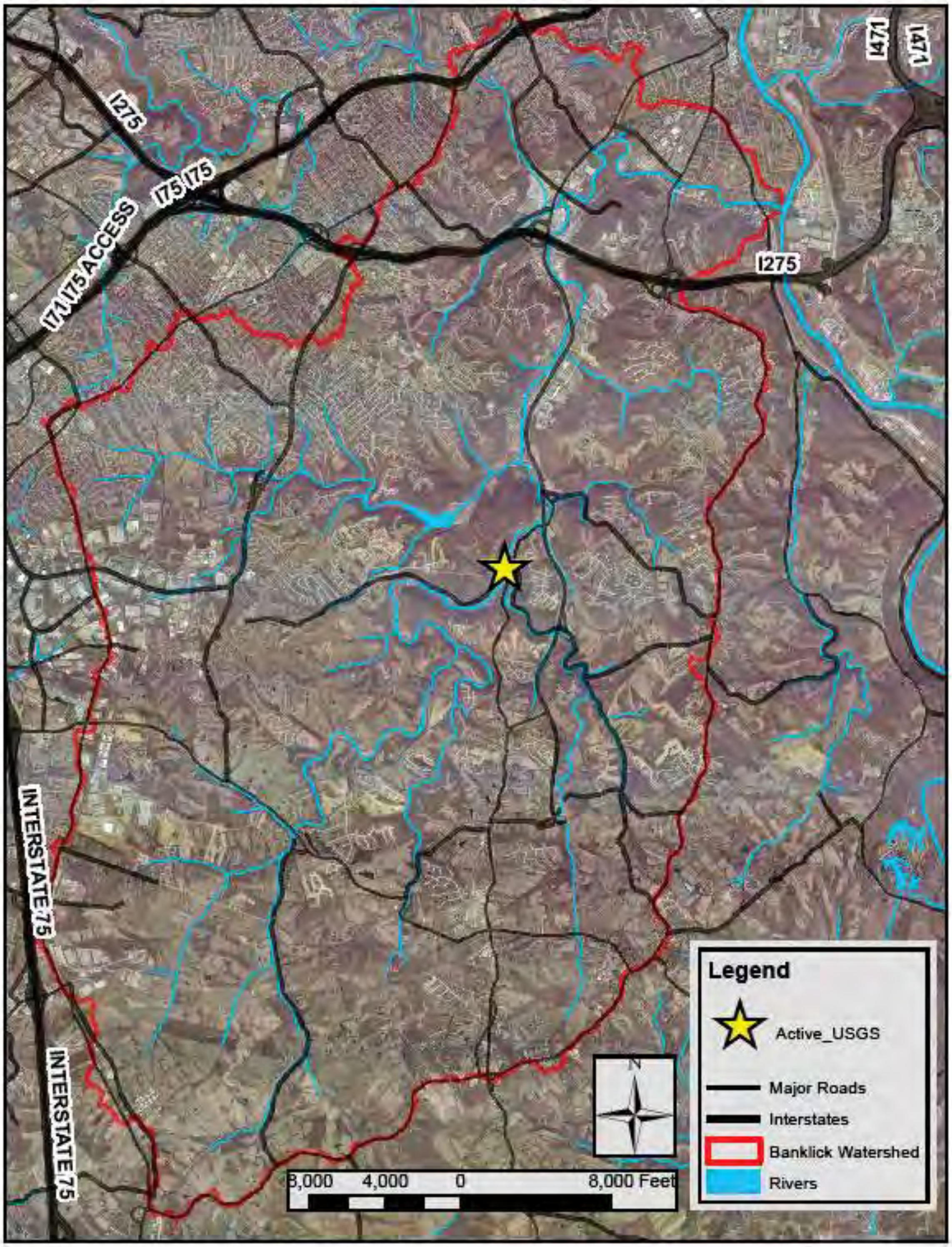
1. The concentration of early development along stream channels.

2. The extremely steep slopes of Banklick Creek and its tributaries.

3. Extraordinary recent development in the watershed along ridgelines and hillsides.

FIGURE 3.05-2

BANKLICK USGS GAUGE



3.06 SOILS

Most soils in the watershed were formed from shale, limestone, and sandstone. Principal upland soils, which are relatively well-drained, include Eden, Cynthiana, Faywood and Nicholson. Major bottomland and terrace soils include Newark, Nolin, Captina, and Licking. Ninety-three percent of the soils in the watershed are classified by the USGS as hydrologic group C, which indicates slow infiltration rates. Sixty percent of the soils in the watershed are classified as highly erodible, and the remaining soils are considered fairly erodible (LTI, 2008). Soil layers in the watershed are relatively shallow (less than 10 feet deep).

3.07 GEOLOGY

The Banklick Watershed is located in the Bull Fork formation in the Bluegrass Region and is underlain by interbedded limestone and shale. Because of the presence of shale within the limestone, the conduits formed from dissolved limestone do not extend very far both horizontally and vertically. Most of the area is moderately dissected by surface streams and contains local karst drainage (LTI, 2008). Karst can dampen the potential attenuation of pollutant loads in the subsurface by providing direct conduits between surface water and shallow and/or deep aquifers

How does geography affect stream health?

The lay of the land, soil types, and vegetation in an area can directly affect water quality–especially when the land is tilled. Vegetation can reduce flooding by slowing down runoff from rainstorms and can even filter out silt and other contaminants before they reach streams [Licking River Region in Kentucky (LRRK)].

Another important consideration in this area is the presence of steep topography throughout Banklick Watershed. The steep slopes in the area encourage stormwater to runoff of the land very quickly. This can have a big impact on water quality, as stormwater runoff is not given time to infiltrate into the soil, and be cleansed naturally.

3.08 GREEN SPACE

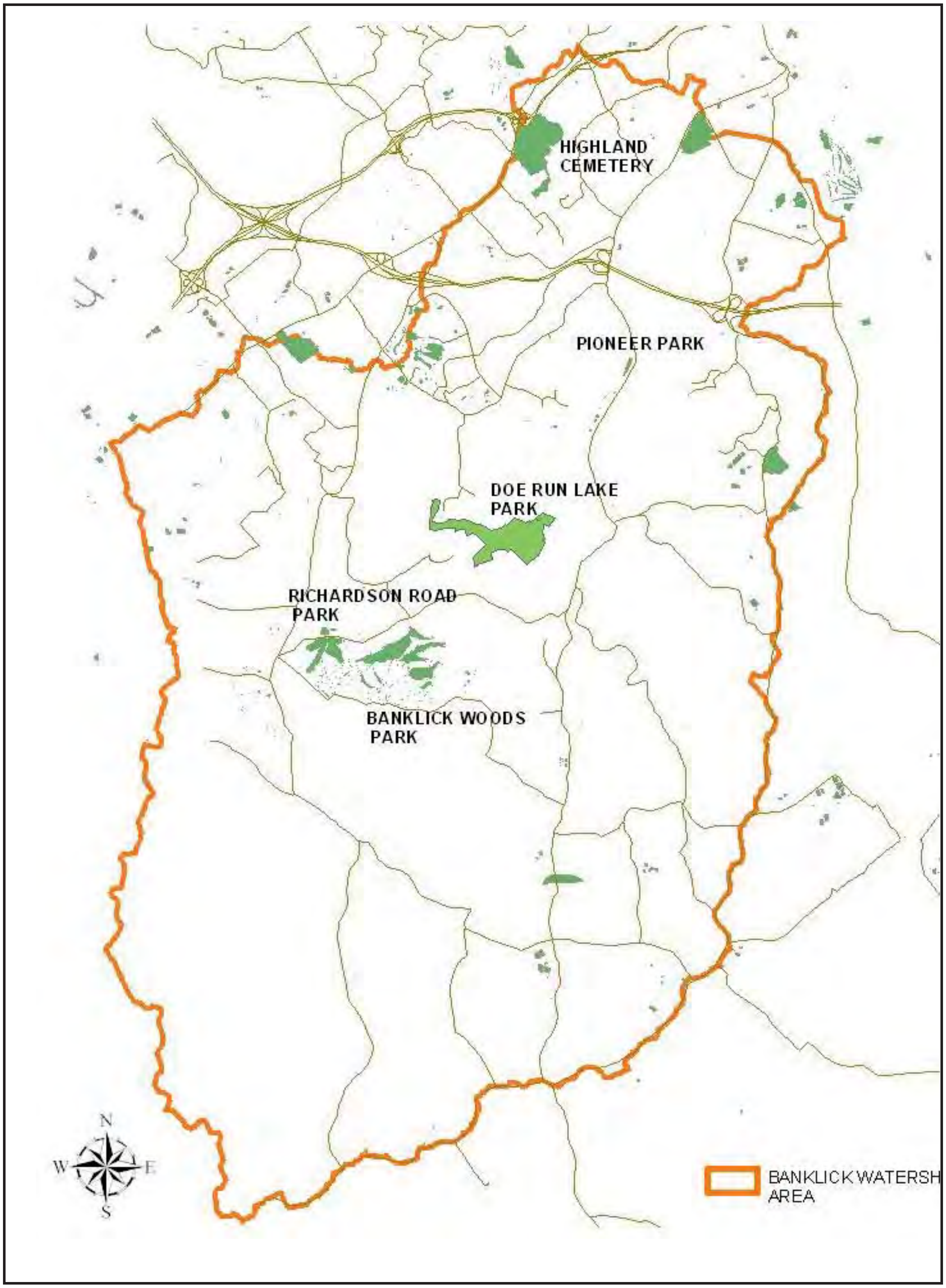
Although many small community parks are located in the watershed, a system of Kenton County parks was not developed until recent decades. In terms of both land availability and affordability, the relatively late start in park development has limited the county's options in acquiring larger tracts of land. Kenton County parks in the watershed include:

1. Doe Run Lake Park–183 acres
2. Middleton-Mills Park–100 acres
3. Lincoln Ridge Park–78 acres
4. Pioneer Park–43 acres
5. Locust Pike Park–35 acres
6. Richardson Road Park–21 acres
7. Bowman Field Park–4 acres
8. President's Park–20 acres

Another notable green space available to the public is Highland Cemetery, which includes a 150-acre natural area with extensive trails. The cemetery trail system connects with the 13-acre Fort Wright Nature Center. Figure 3.08-1 depicts the green space throughout the watershed.

FIGURE 3.08-1

GREEN SPACE IN BANKLICK WATERSHED



3.09 VEGETATION AND WILDLIFE

Plant species that are typical in the Banklick Watershed include dogwood and redbud trees, blue phlox, bloodroot, Solomon's seal, wild ginger, trout lily, May apple, sessile trillium, Queen Anne's lace, chicory, evening primrose, late summer aster, black-eyed Susan, butterfly weed, goldenrod, snakeroot, thistle, and ironweed. Wildlife observed in the Highland-Fort Wright area and typical of the watershed includes at least 106 species of birds and 19 species of mammals (Gayle Pille, personal communication). Common trees associated with this ecoregion include white oak, northern red oak, black oak, scarlet oak, bur oak, chinquapin oak, sugar maple, red maple, black maple, Virginia pine, yellow-poplar, hickory, yellow buckeye, white ash, blue ash, eastern red cedar, black walnut, beech, basswood, black cherry, and black locust. See Section 3.11 for threatened and endangered species. The Banklick Watershed also has a variety of invasive plant species that are very common. Invasive vegetation out-competes native plants and can deplete the diversity of an ecosystem. Invasive species within the Banklick Watershed include: Bush Honeysuckle, Japanese Honeysuckle, Multifloral Rose, Garlic Mustard, Tree of Heaven, Winter Creeper, Autumn Olive, Burning Bush, Privet, Japanese Stiltgrass, and Japanese knotweed.

Biotic data concerning Banklick Watershed are scattered, although the watershed's natural resources have received more attention. In recent years the 2004 Banklick Creek Watershed Analysis and Issue Characterization for Education and Outreach (BACE) study focused on forest resources and determined that nearly 30 percent of the Banklick Watershed is comprised of natural areas needing protection while nearly 50 percent of the watershed is in need of restoration measures.

3.10 AQUATIC RESOURCES

Aquatic resources of the watershed have not been extensively studied in the past, but there is a 1969 fish survey of Banklick Creek near present-day Pioneer Park and a Bankllick tributary, Bullock Pen (Jones, 1970). A total of 16 fish species representing five families were collected, among which were three darter species (Figure 3.10-1.) Darters are small fish adapted for life in swift-flowing sections of clear rocky streams and are indicative of relatively high water quality. At the time of the survey, Jones noted a moderate amount of bank fishing along Banklick Creek and that fishing was considered good. Accompanying notes on fish food organisms (macroinvertebrates) indicated the presence of Ephemeroptera (mayflies) and Coleoptera (aquatic beetles); both groups of organisms are considered to be pollution sensitive. Although Jones' report includes little interpretation, data for Banklick indicates a relatively healthy small stream ecosystem for much

Carp and Minnow Family
- central stoneroller
- common carp
- silverjaw minnow
- rosefin shiner
- common shiner
- bluntnose minnow
- creek chub

Sucker Family
- white sucker

Catfish Family
- channel catfish

Sunfish Family
- green sunfish
- longear sunfish
- hybrid sunfish
- largemouth bass
- black crappie

Perch Family
- rainbow darter
- fantail darter
- johnny darter

Species reported by Jones, A.R. 1970. Inventory and Classification of Streams in the Licking River Drainage. KY Dept. of Fish and Wildlife Resources.

Figure 3.10-1 Fishes of the Banklick Watershed

of its length in 1969. SD1 began collecting biological data in the Banklick Watershed in 2008 (see Section 4 of this report for information on habitat, macroinvertebrates, and fish).

3.11 THREATENED AND ENDANGERED SPECIES

According to the Kentucky State Nature Preserve Commission (KSNPC), several species in the Banklick Watershed are of significant concern. Table 3.11-1, prepared by LTI in 2008, summarizes these species.

Taxonomic Group	Scientific Name	Common Name	Status[a]	Last Observed	Habitat(s)	Identified Threats
Vascular Plants	Trifolium stoloniferum	Running buffalo clover	Federal - Endangered State - Threatened	2003	Riparian areas, upland areas	Habitat loss, non-native species, bison decline,
Breeding Birds	Ammodramus henslowii	Henslow's sparrow	Federal - SOMC State-Special Concern	1950	Grasslands, savannahs	Habitat loss
Breeding Birds	Tyto alba	Barn owl	State - Special Concern	1987	Farms and farm structures	Habitat loss
Amphibians	Plethodon cinereus	Redback salamander	State - Special Concern	1998	Woodlands	Habitat loss, habitat degradation
Amphibians	Rana pipiens	Northern leopard frog	State - Special Concern	1934	Ponds, wetlands, grasslands	Habitat loss, non-native species, commercial overexploitation

Table 3.11-1 Species of Concern in Banklick Creek Watershed

Running buffalo clover is a small plant that inhabits streambanks and upland areas; erosion is noted as the biggest threat to this species (KSNPC, 2006). Other factors contributing to population declines are

loss of bison populations, nonnative plants, and overall habitat loss (United States Fish and Wildlife Service (USFWS), 2003). The northern leopard frog is an aquatic species that inhabits various habitats including slow flowing areas in creeks and rivers, springs, the nearshore area of lakes, bogs, fens, herbaceous wetlands, riparian areas and grasslands (NatureServe, 2007). Threats to the northern leopard frog include habitat loss, environmental pollution, and competition with introduced species. Three of the species identified by KSNPC are neither aquatic nor dependent on aquatic habitats. These are Henslow's sparrow, the barn owl, and the redback salamander. Although some of these threatened and endangered species are not aquatic, it is still very important to understand the impacts to their populations. The land use changes causing threats to these species has a major effect on water quality.

3.12 STREAM HABITAT

Since 1969, many changes have occurred including the impoundment of Bullock Pen and its tributary Doe Run to form Doe Run Lake. The development of Doe Run Lake has been followed by major subdivision development in that subbasin. Also, near the Pioneer Park sampling site and throughout the watershed major highway development has occurred. It is important to understand the impacts that development has on the water quality and stream health. As more development occurs, the land that was once forests and open fields becomes pavement, buildings, and concrete. The impact of this is the land that was once soaking up the water is now impervious and the water cannot soak in but rather has a runoff over the land surface (or through storm sewers) and into streams. When this stormwater runs off, it carries many pollutants into the streams. Also, the volume of water that enters the streams is now much larger, and is reaching the streams much faster; this results in damage to the streams much faster; this results in damage to the streams as well as potential flooding. These problems will negatively affect the stream habitat. A 2003 habitat and biological community assessment found high algal biomass in the Bullock pen/Doe Run subbasin, possibly indicative of high nutrient loads from suburban lawns. Assessment of this data has indicated that Bullock Pen Creek has high nutrient loads. (Strand, 2003). The assessment also found lower numbers of common invertebrates in the more urbanized portions of the creek, typical of habitat changes, reduced riparian corridors, and siltation impacts from runoff.

Natural stream habitats in Banklick Watershed have been altered from their natural conditions by development, agriculture, deforestation, mill dams, beaver removal, and channelization. Using USEPA methods, the Kentucky Department of Fish and Wildlife (KDFW) sampled instream habitat at one site in 1998, and from 2001 to 2003 Strand assessed several sites using the same method. The USEPA method creates a habitat score based on embeddedness, water velocity and depth, channel alteration, riffle frequency, bank stability, and vegetative protection. Score ranges from 0 to 200 indicate whether the area is poor (0-60), marginal (61-109), suboptimum (110-159), or optimum (160-200). The stream habitat scores for Banklick Creek in 2003 ranged from poor to suboptimal (Strand, 2003). The lower part of the watershed received the poor scores, possibly as a result of flow from the Licking and Ohio Rivers causing sedimentation of existing habitat and covering natural creek formations. Additionally, the watershed is heavily urbanized and the creek channel is modified at this location. The middle watershed sites were considered suboptimum habitat and showed a presence of riffle habitat, low urbanization, and channel modification. The upper portion of the watershed had a marginal habitat, likely because of the high gradient and few riffles in these stream reaches as well as impacts from land use activities. The site assessed by the KDFW was at the KY Highway 491 bridge and was considered marginal. Additional habitat information was collected by SD1 in 2008. This information is presented in Section 4.

Wetlands are areas of permanently or seasonally saturated soils. Welands play an important role in water quality of streams because wetlands store and cleanse water before it has a chance to runoff into the streams.

3.13 LAND USE CHANGES

The Banklick Watershed has long-standing problems resulting from two centuries of human settlement and related activities and a general lack of civic awareness of the values of stream and watershed resources. The cumulative impacts of such broad, landscape-scale alterations have changed much of Banklick Creek and its network of tributaries into an unhealthy, ecologically impoverished stream system that has become notorious in Northern Kentucky. Major concerns in the watershed include water quality, water quantity and flooding, land use, and lack of community involvement.

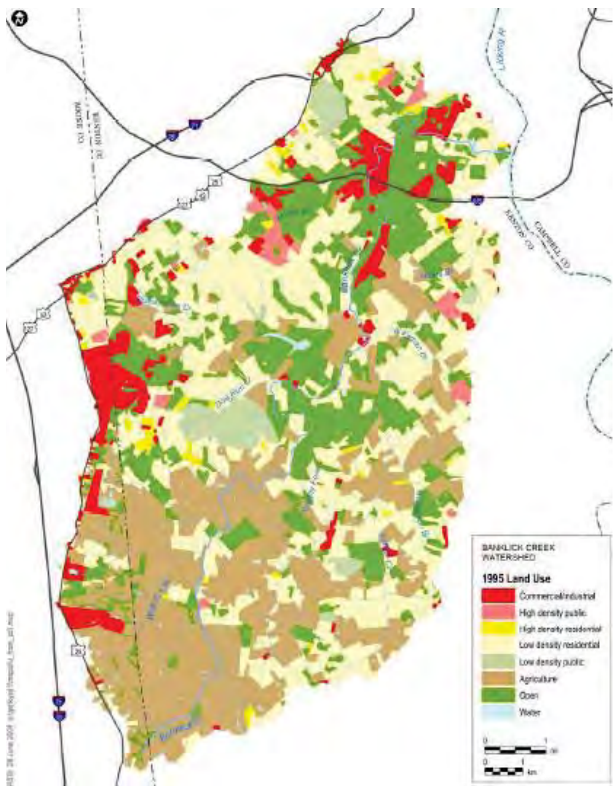
A close link exists between land activities and water quality. For nearly 200 years, agriculture has been the traditional land use in Banklick's headwaters and upland areas. The region's approximately 186-day growing season and 41-inch annual precipitation have been favorable to the growth of tobacco, other row crops, and fruits and vegetables. Livestock operations also are numerous in the watershed and have contributed waterborne sediments and manure to streams. Many of these traditional farmlands are in transition, however, and are rapidly being converted into residential subdivisions, adding to impervious surfaces in the watershed. As the Banklick flows downstream, its watershed becomes increasingly urbanized flowing through dense residential, commercial, and light industrial development in the Latonia neighborhood of Covington. Appendix C contains a summary of Kentucky Agriculture Water Quality Plan Certification information in the Banklick Creek Watershed based on information gathered in 2002.

Figure 3.13-1 reflects 1995 land use in the Banklick Watershed and illustrates that a large portion of the watershed is highly developed. Long-standing patterns show that developed parts of the watershed are clustered near the northernmost parts of the drainage while the southern part of the watershed is more agricultural and contains large amounts of open space.

Figure 3.13-2, however, projects growth through 2017 and illustrates marked changes in land use in the watershed, especially a decrease in the amount of agricultural land. Most of Fowler Creek is expected to change from agricultural to low density residential, while a large strip of land along the western edge of the watershed in proximity to Interstate 75 is expected to change from primarily agricultural to industrial uses (LTI, 2004).

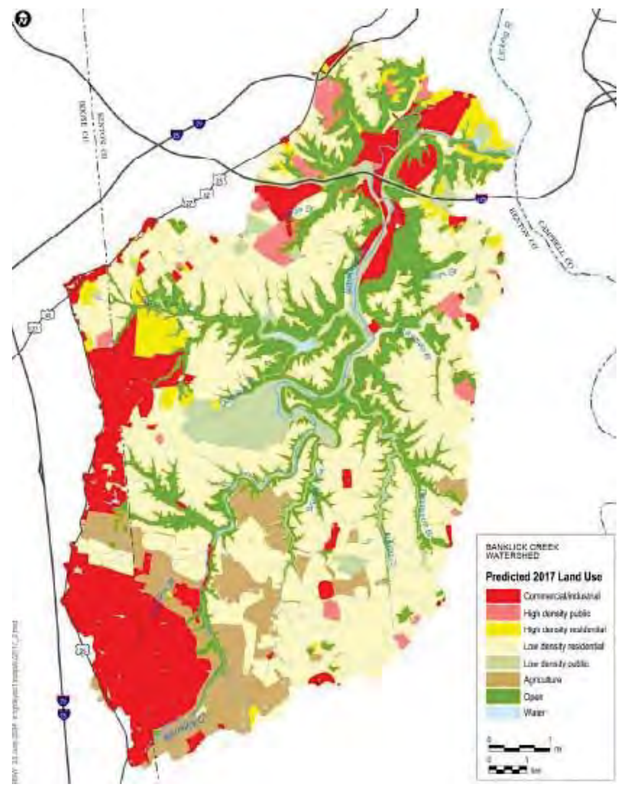
According to the 2008 watershed characterization report by LTI, 47 percent of Banklick Watershed is currently developed. Development is concentrated in the central and northern portions of the watershed. Developed areas include the communities of Independence, Covington, Erlanger, Taylor Mill, Edgewood, Elsmere, Fort Wright, Fort Mitchell, Florence, Crestview Hills, and very small portions of Lakeside Park, Kenton Vale, Latonia Lakes, Walton and Wilder. Approximately 11 percent of the watershed is impervious.

The characterization report also indicated the headwaters of Banklick Creek are still primarily undeveloped and agricultural in nature. Forest and pasture/hay comprise the majority of the undeveloped land in the watershed. The larger parks in this watershed include Doe Run Lake Park and several community parks such as Banklick Woods Park, Pioneer Park, and Bill Cappel Fields. There are also many smaller neighborhood parks and ball fields associated with schools. Figure 3.13-3 provides a land cover distribution chart for the current conditions and the 2030 predicted conditions.



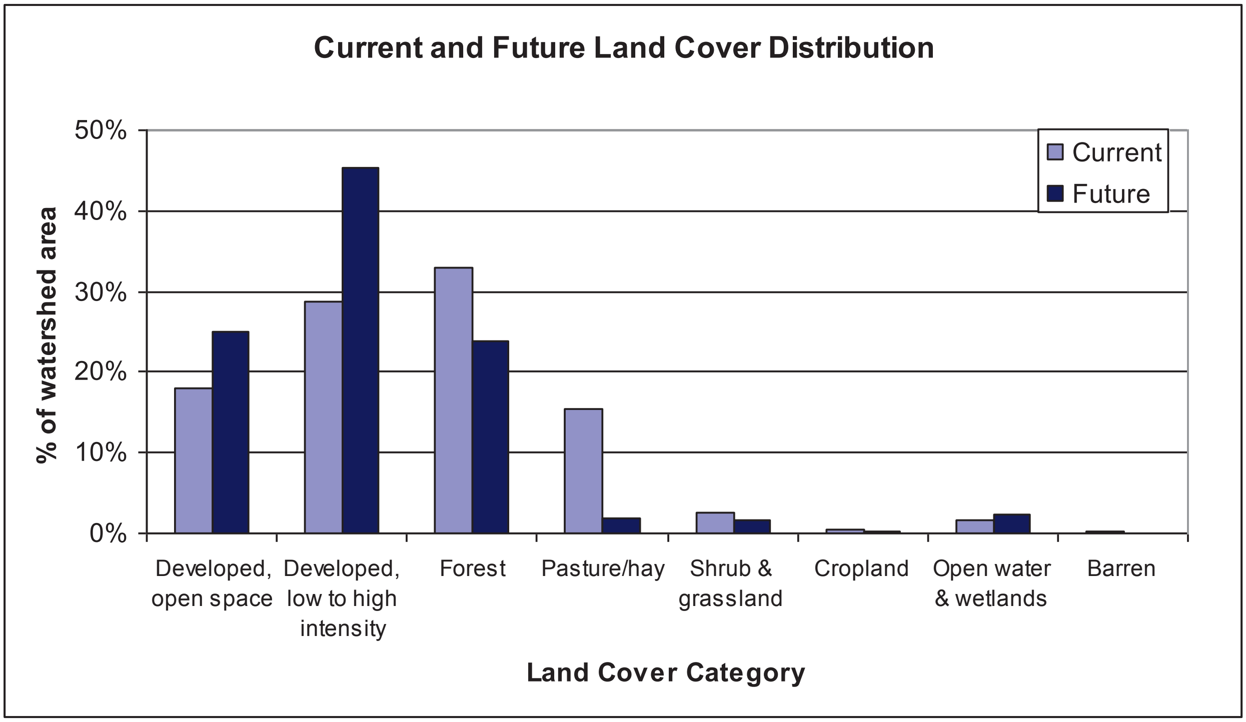
Source: Limnotech, Inc.

Figure 3.13-1 1995 Land Use



Source: Limnotech, Inc.

Figure 3.13-2 2017 Land Use



Source: LimnoTech Inc. 2008

Figure 3.13-3 Land Cover Distribution

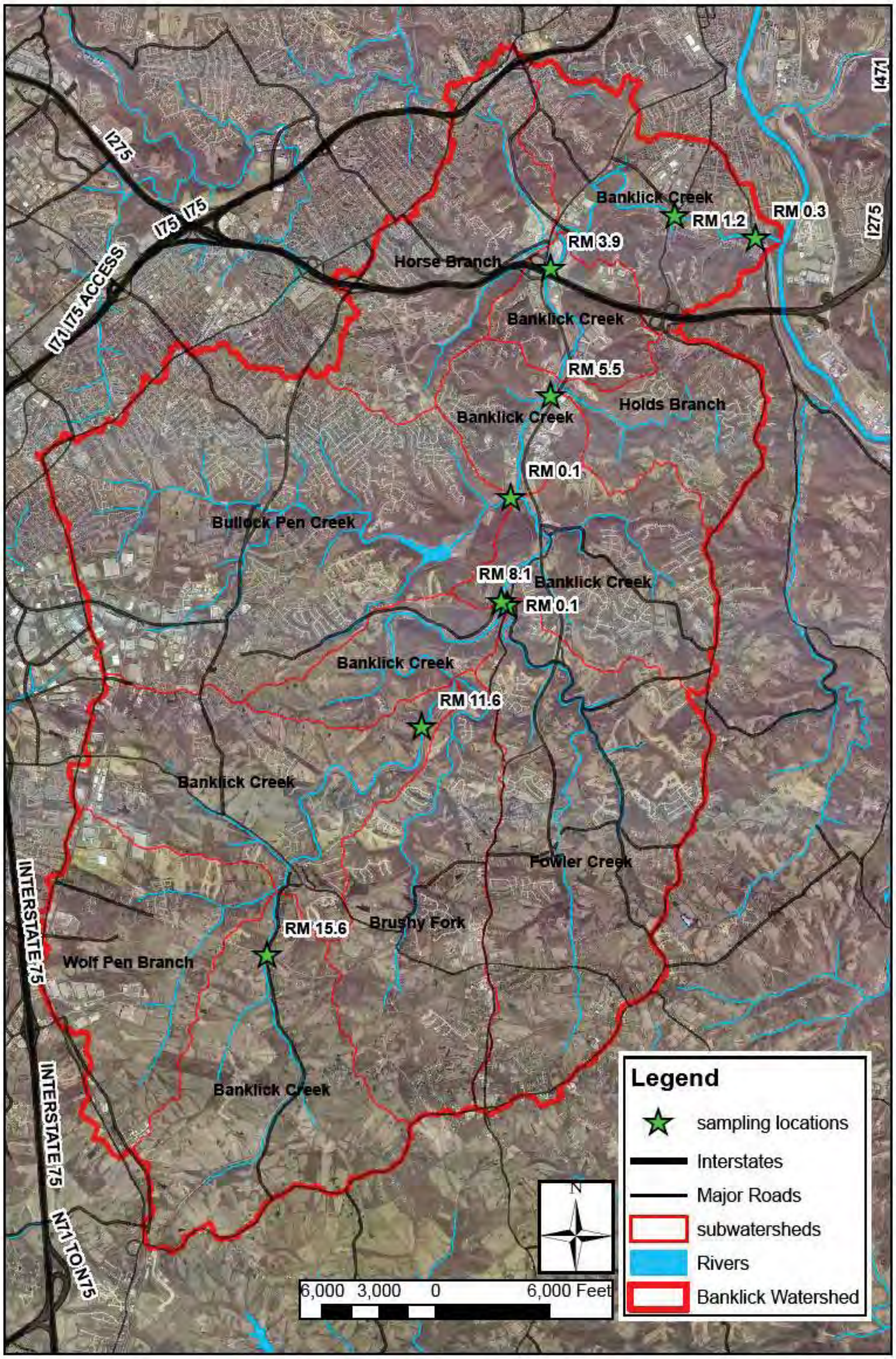
4.01 INTRODUCTION

The purpose of this section is to review the water quality standards and regulations that govern the waters of the Banklick Watershed, and to present the recent data that has been collected in the Watershed. The data presented in this section ties into the source assessments in Section 5, the load calculations in Section 6, and ultimately is used to determine the management measures and desired outcomes presented in Section 7.

A watershed map depicting subwatersheds, tributaries, roads, and river miles of the Banklick mainstem sampling locations has been included as Figure 4.01-1 as a reference for the remainder of this section.

FIGURE 4.01-1

BANKLICK MAINSTEM SAMPLING LOCATIONS



4.02 WATER QUALITY STANDARDS, REGULATIONS, AND KENTUCKY DIVISION OF WATER ASSESSMENTS

The ultimate objective of this WBP is to bring the surface waters of the Banklick Watershed into compliance with the Federal Water Pollution Control Amendments of 1972 and the subsequent amendments of 1977 and 1987, which in totality are commonly referred to as the Clean Water Act (CWA). The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly-owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands (epa.gov.)"

There are also State of Kentucky regulations that affect Banklick Creek. As stated in Section 1 of the Antidegradation Policy, the purpose of 401 Kentucky Administrative Regulation (KAR) 10:026 through 401 KAR 10:031 is to safeguard the surface waters of the commonwealth for their designated uses, to prevent the creation of new pollution of these waters, and to abate existing pollution. These regulations can be found at the Legislative Research Commission's Web site: www.lrc.ky.gov/kar/title401.htm

Agricultural operations must comply with the standards found in the Kentucky Agricultural Water Quality Act. The Kentucky General Assembly passed the Kentucky Agriculture Water Quality Act in 1994 (KRS 224.71-100 through 224.71-140.) The goal of the act is to protect surface and groundwater resources from pollution resulting from agriculture and silviculture operations.

An Agricultural Operation is defined as any farm operation on a tract of land, including all income producing improvements and farm dwellings, together with other farm buildings and structures incident to the operation and maintenance of the farm, situated on 10 contiguous acres or more of land used for the production of livestock, livestock products, poultry, poultry products, milk, milk products, or silviculture products or for the growing of crops such as, but not limited to, tobacco, corn, soybeans, small grains, fruits and vegetables, or devoted to and meeting the requirements and qualifications for payments to agriculture programs under an agreement with the state or federal government.

The Agricultural Water Quality Act requires that landowners with 10 acres of land or more used for agricultural or silviculture operation develop and implement a water quality plan based on guidance from the Kentucky Agricultural Water Quality Plan. The regulations for the Kentucky Agricultural Water Quality Act can be found at the Legislative Research Commission's Web site:
http://www.lrc.ky.gov/KRS/224-71/CHAPTER.HTM.

In March of 2008, KDOW prepared a draft of its biannual Report to Congress on the Condition of Water Resources in Kentucky. The designated uses are split into the following categories:

1. Warm Water Aquatic Habitat (WAH)
2. Cold Water Aquatic Habitat (CAH)
3. Primary Contact Recreation (PCR)
4. Secondary Contact Recreation (SCR)
5. Fish Consumption (FC)
6. Domestic Water Supply (DWS)
7. Outstanding Natural Resource Water (ONRW)

KDOW monitors Kentucky's water and collects data to determine designated use support as defined by the state's water quality standards (WQS) regulations. KDOW monitoring programs include:

1. Biological, water quality, and bacteriological sampling at 70 long-term sites statewide, called ambient stations.

2. Water quality and bacteriological monitoring at rotating watershed locations.

3. A reference reach biological program to determine least-impaired conditions.

4. Nutrient and trophic status determination of publicly owned reservoirs (lakes monitoring).

5. Fish tissue sampling.

6. A random, statistically-based biological survey of wadeable streams, called probabilistic monitoring.

7. Monitoring of nonpoint pollution sources and results of BMP implementation.

8. Monitoring for total maximum daily load (TMDL) development.

Much of the baseline biological data is collected through the probability biosurvey and targeted ambient biological monitoring programs. The probability biosurvey program provides a broad understanding of the overall biological and water quality conditions on both a basin and state level. Targeted ambient biological monitoring allows KDOW to focus intensified data collection efforts on a particular event and/or locale, such as in the case of a toxic spill and its impact on a particular watershed.

When considering waters for assessment, KDOW solicited data from a variety of entities including other government agencies, state agencies (e.g., KDFW and federal agencies such as USACE, USFWS, USGS, and Tennessee Valley Authority. Generally, data older than five years were not considered for assessment; however, assessment decisions were made on a case-by-case basis.

The 2008 Integrated Report to Congress on Water Quality in Kentucky defines the designated uses of surface waters throughout the state. The 2008 integrated report to congress indicates that the following designated uses apply to Banklick Creek by RM as shown in Table 4.02-1.

Banklick Segment by River Mile	Designated Uses
0 to 3.5	Warm Water Aquatic Habitat, Fish Consumption, Primary Contact Recreation, Secondary Contact Recreation, Domestic Water Supply
3.5 to 8.2	Warm Water Aquatic Habitat, Fish Consumption, Primary Contact Recreation, Secondary Contact Recreation
8.2 to 19.2	Warm Water Aquatic Habitat, Fish Consumption, Primary Contact Recreation, Secondary Contact Recreation, Domestic Water Supply

Table 4.02-1 Banklick Creek Designated Uses 305(b)

The 2008 303(d) list further breaks down the Banklick Creek by Impairments and Suspected Sources. The impairments by RM are shown in Figure 4.02-1, with suspected sources listed in Table 4.02-2. The entire length of Banklick Creek is listed as Impaired for fecal coliform (bacteria), organic enrichment (excess nutrients), and corresponding nutrient eutrification (low dissolved oxygen levels). In addition, the lower half of the creek is listed for sediment siltation, which may be described as a combination of channel erosion, high suspended solids (muddy water), and deposition of those fine sediments in important aquatic habitat. Although there are multiple suspected sources, municipal point source discharges and on-site treatment systems (septic systems and similar decentralized systems) dominate the list along with agriculture. Such sources are commonly associated with bacteria, nutrients, and eutrophication.

FIGURE 4.02-1

2008 BANKLICK CREEK 303(D) LIST IMPAIRMENTS

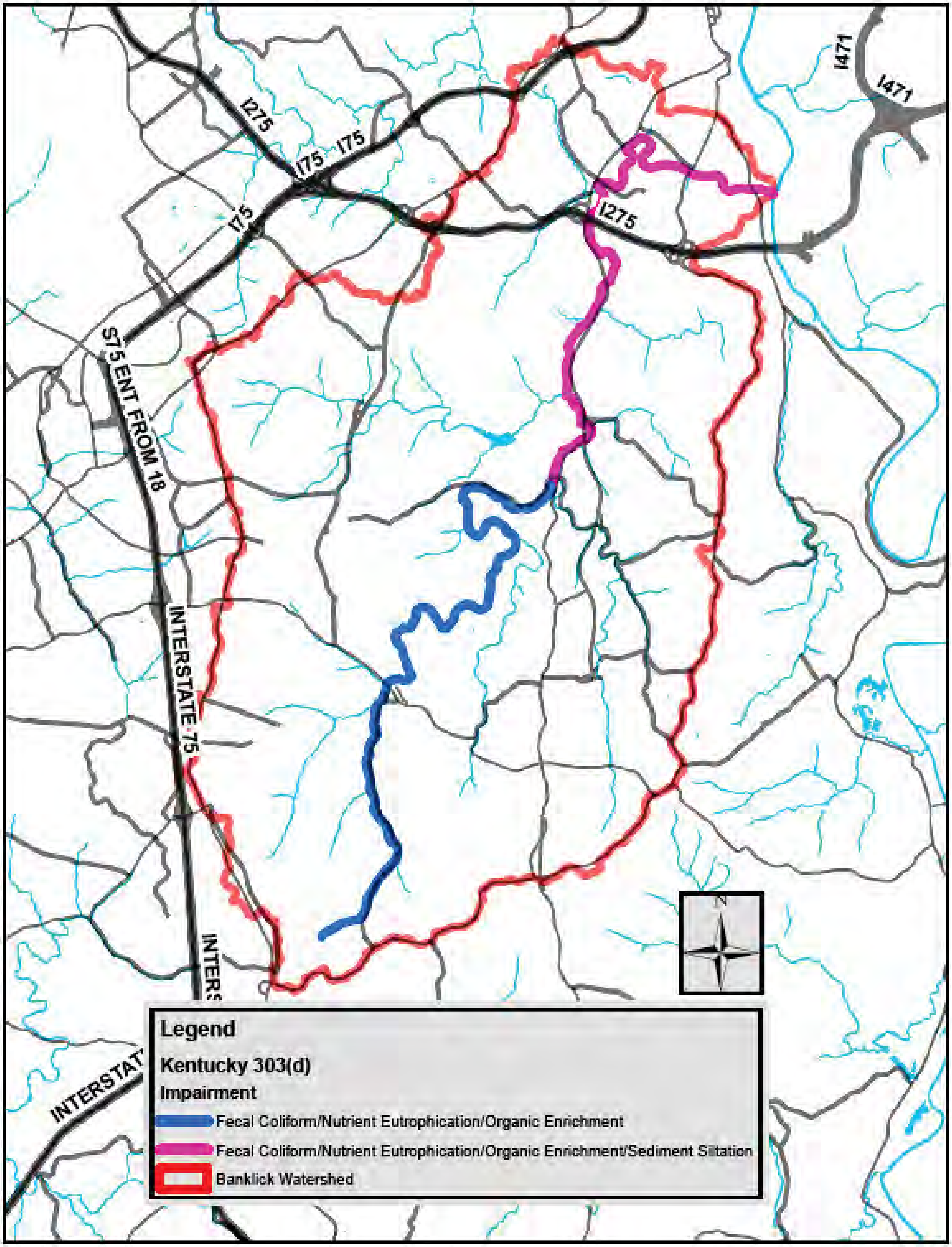


TABLE 4.02-2

2008 BANKLICK CREEK 303(D)

Banklick Segment by River Mile	Use	Impairment	Suspected Source
0 to 3.5	PCR	Fecal Coliform	Municipal Point Source Discharges, Unspecified Urban Stormwater
0 to 3.5	WAH	Nutrient/Eutrophication Biological Indicators	Municipal Point Source Discharges
0 to 3.5	WAH	Organic Enrichment (Sewage) Biological Indicators	Municipal Point Source Discharges
0 to 3.5	WAH	Sedimentation/Siltation	Highways, Roads, Bridges, Infrastructure (New Construction), Urban Runoff/Storm Sewers
3.5 to 8.2	PCR	Fecal Coliform	Agriculture, On-site Treatment systems (septic systems and similar decentralized systems)
3.5 to 8.2	WAH	Nutrient/Eutrophication Biological Indicators	Agriculture
3.5 to 8.2	WAH	Organic Enrichment (Sewage) Biological Indicators	On-site Treatment systems (septic systems and similar decentralized systems)
3.5 to 8.2	WAH	Sedimentation/Siltation	Agriculture
8.2 to 19.2	PCR	Fecal Coliform	Agriculture, On-site Treatment systems (septic systems and similar decentralized systems)
8.2 to 19.2	WAH	Nutrient/Eutrophication Biological Indicators	Agriculture
8.2 to 19.2	WAH	Organic Enrichment (Sewage) Biological Indicators	On-site Treatment systems (septic systems and similar decentralized systems)

A comparison of the 305(b) list to the 303(d) list indicates that each segment of the Banklick Creek is impaired for two of its designated uses: primary contact recreation and warm water aquatic habitat.

For primary contact recreation, Kentucky law states:

> "Fecal coliform content or *Escherichia* coli content shall not exceed 200 colonies per 100 mL or 130 colonies per 100 mL respectively as a geometric mean based on not less than 5 samples taken during a 30-day period. Content also shall not exceed 400 colonies per 100 mL in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies per 100 mL for *Escherichia coli*. [These limits shall be applicable during the recreation season of May 1 through October 31.]"

For warm water aquatic habitat, Kentucky law states:

1. Natural alkalinity as $CaCO_3$ shall not be reduced by more than 25 percent. If natural alkalinity is below 20 mg/l CaCO3, there shall not be a reduction below the natural level. Alkalinity shall not be reduced or increased to a degree which may adversely affect the aquatic community.

2. pH shall not be less than 6.0 nor more than 9.0 and shall not fluctuate more than 1.0 pH unit over a period of 24 hours.

3. Flow shall not be altered to a degree which will adversely affect the aquatic community.

4. Temperature shall not exceed 31.7 degrees Celsius 89 degrees Fahrenheit.

5. Dissolved oxygen shall be maintained at a minimum concentration of 5.0 mg/l daily average; the instantaneous minimum shall not be less than 4.0 mg/l.

6. Total dissolved solids or specific conductance shall not be changes to the extent that the indigenous aquatic community is adversely affected.

7. Total suspended solids (TSS) shall not be changed to the extent that the indigenous aquatic community is adversely affected.

8. The addition of settleable solids that may alter the stream bottom so as to adversely affect productive aquatic communities is prohibited.

9. The concentration of the un-ionized form of ammonia shall not be greater than 0.05 mg/l at any time instream after mixing. Un-ionized ammonia shall be determined from values for total ammonia-N, in mg/l, pH and temperature, by means of an equation.

10. Toxics.

a. The allowable instream concentration of toxic substances, or whole effluents containing toxic substances, which are noncumulative or nonpersistent with a half-life of less than 96 hours, shall not exceed: a. 0.1 of the 96-hour median lethal concentration (LC_{50}) of representative indigenous or indicator aquatic organisms; or b. a chronic toxicity unit of 1.00 utilizing the 25 percent inhibition concentration, or LC_{25}.

b. The allowable instream concentration of toxic substances, or whole effluents containing toxic substances, which are bioaccumulative or persistent, including pesticides, if not specified elsewhere in this section, shall not exceed: a. 0.01 of the 96-hour median lethal concentration (LC_{50}) of representative indigenous or indicator aquatic organisms; or b. A chronic toxicity unit of 1.00 utilizing the LIC_{25}.

c. In the absence of acute criteria for pollutants […] the allowable instream concentration shall not exceed the LC1 or 1/3 LC50 concentration derived from toxicity tests on representative indigenous or indicator aquatic organisms or exceed 0.3 acute toxicity units.

d. If specified application factors have been determined for a toxic substance or whole effluent such as an acute to chronic ratio or water effect ratio, they may be used instead of the 0.1 and 0.01 factors listed in this subsection upon approval by the cabinet.
   (1) Allowable instream concentrations for specific pollutants for the protection of warm water aquatic habitat are listed in Table 1 of Section 6 of KAR 5:031. These concentrations are based on protecting the aquatic life from acute and chronic toxicity and shall not be exceeded.

In order to achieve WQS, the criteria for primary contact recreation and the criteria for warm aquatic habitat need to be met for the entire length of the Banklick Creek.

4.03 RECENT DATA COLLECTION

Data has been collected in Banklick Watershed for many years, for purposes of this Watershed Plan, the more recent data was utilized for analyses. For reference only, older information can be found in Appendix. It is important to note that the data collected previously differs from the data collected recently, so it would be difficult to compare these values. The changes in these values over the last several years are a result of additional information and added sampling points, more refined models using more accurate data, and other natural changes.

The remainder of this section presents the recent data that was utilized for analysis and decision making in this watershed plan. This information includes public input surveys and public meetings conducted by BWC to gather additional data and perform "ground-truthing" SD1's data collection which includes biologic indexing of the streams, data collection for hydromodification in Northern

Kentucky, and watershed characterization based on extensive monitoring and modeling. SD1's data collection efforts are directly related to their consent decree efforts. This information has been shared with the Banklick Watershed Council for development of this plan.

A. Public Input

As part of the BWP, three public meetings were held to engage and inform the residents of the watershed and collect valuable information from the public. The meetings were held on March 23, April 16, and April 30, 2009. The meetings were planned at three locations throughout the watershed to encourage residents from all portions of the watershed to attend. See Appendix F for the flyer that was sent to the residents. The first meeting focused on the upper third of the watershed and was held at the Durr Branch Library in Independence. The second meeting was held at the SD1 headquarters in Fort Wright and focused on residents in the middle third of the watershed. The last public meeting was held at the Independence City Building, and the residents from the lower third of the watershed were invited. The format and information presented at all three meetings was the same. Sherry Carran, BWC President, gave a presentation to introduce the BWC and the 319 grant project. Lajuanda Haight-Maybriar, KDOW, gave a brief presentation on what a watershed is and how residents affect watersheds. John Lyons, Strand, gave the final presentation to explain the water quality data that has been collected in the watershed. All presentations can be found in Appendix F. At the conclusion of the presentations, residents were encouraged to share their thoughts about the problems and issues in the watershed. Large maps of the watershed were available for residents to mark on to highlight their areas of concern and make notes about specific issues.

To gain additional feedback, BWC sent out 500 surveys to residents throughout the watershed. The Public Input Survey that was sent to the residents can be reviewed in Appendix F. Eighty-one responses were received. A summary of the resident responses is presented in this section.

Question 1: How would you describe your property?

More than 91 percent of the respondents described their property as residential, 6 percent were described as Farm/Agriculture, and 2 percent described their property as commercial. Figure 4.03-1 represents the number of residents who live in each property category.

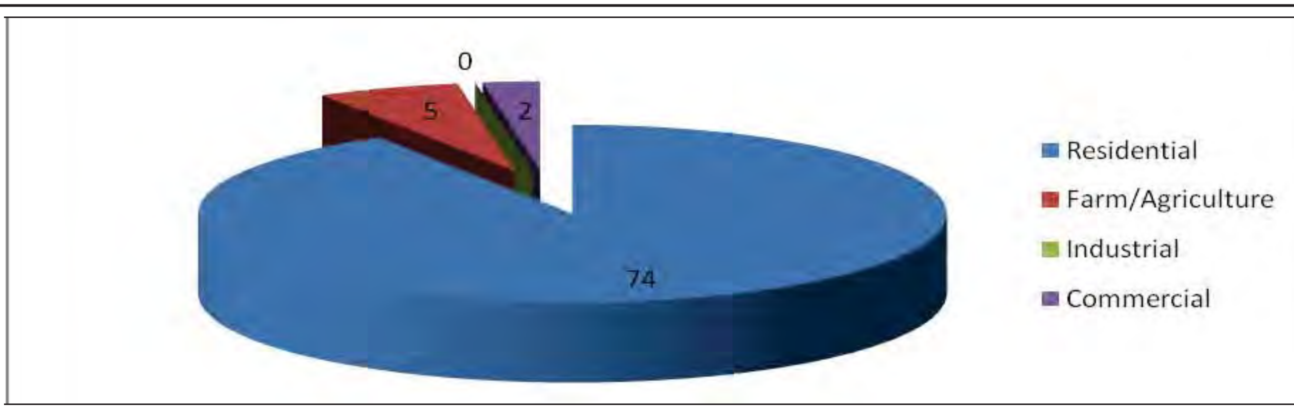


Figure 4.03-1 Survey Question 1 Results

Question 2: Is there a creek that flows on, adjacent to your property or that you are very familiar with?

Two-thirds of the respondents know of a creek that flows on, adjacent to their property, or are very familiar with a creek while the other one-third do not. Figure 4.03-2 provides the number of residents who answered Yes and No.

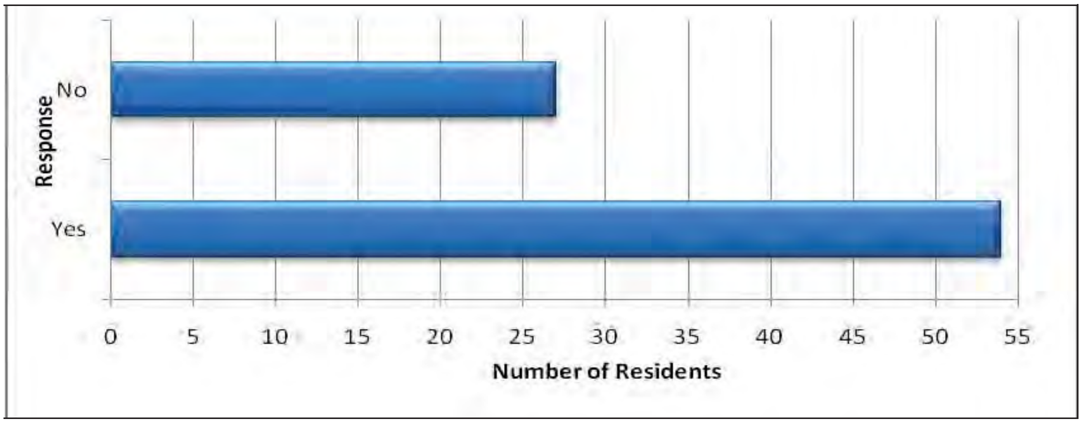


Figure 4.03-2 Survey Question 2 Results

Question 3: When do you see water in the creek?

Out of the 54 residents who answered question 2, only 53 answered question 3. Nearly 45 percent of the 53 people said they see water in the creek year-round. None of the respondents claim that there is water in the creek only after heavy rain storms. See Figure 4.03-3.

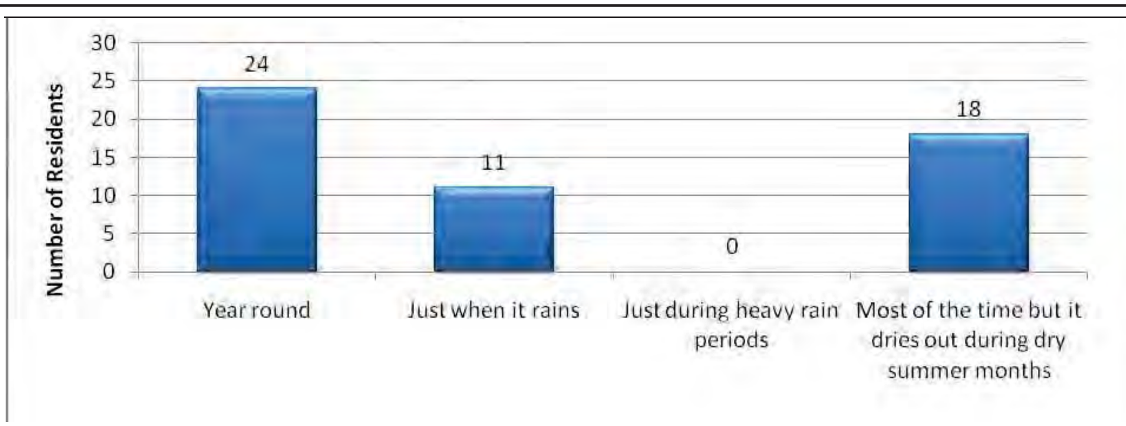


Figure 4.03-3 Survey Question 3 Results

Question 4: Does the creek that flows on or adjacent to your property flood?

Approximately half of the 53 residents who responded to this question believe that the creek does not flood. Although, there were 4 percent, two residents, who believe that it floods often. See Figure 4.03-4.

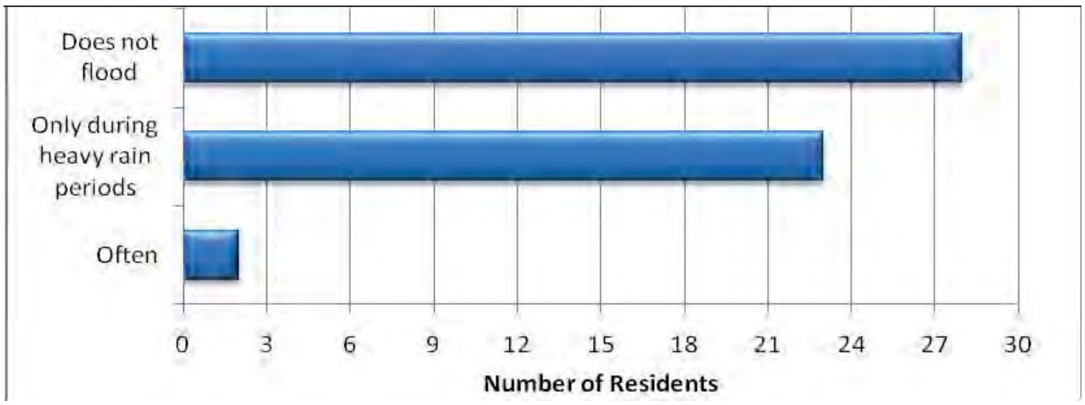


Figure 4.03-4 Survey Question 4 Results

Question 5: Would you be interested in working with the council to implement a project on your land for any of the following?

As shown in Figure 4.03-5, of the 14 residents who responded to this question, 12 of them are interested in working with the council to implement stream restoration on their property. Another nine residents would be in favor of stream bank restoration.

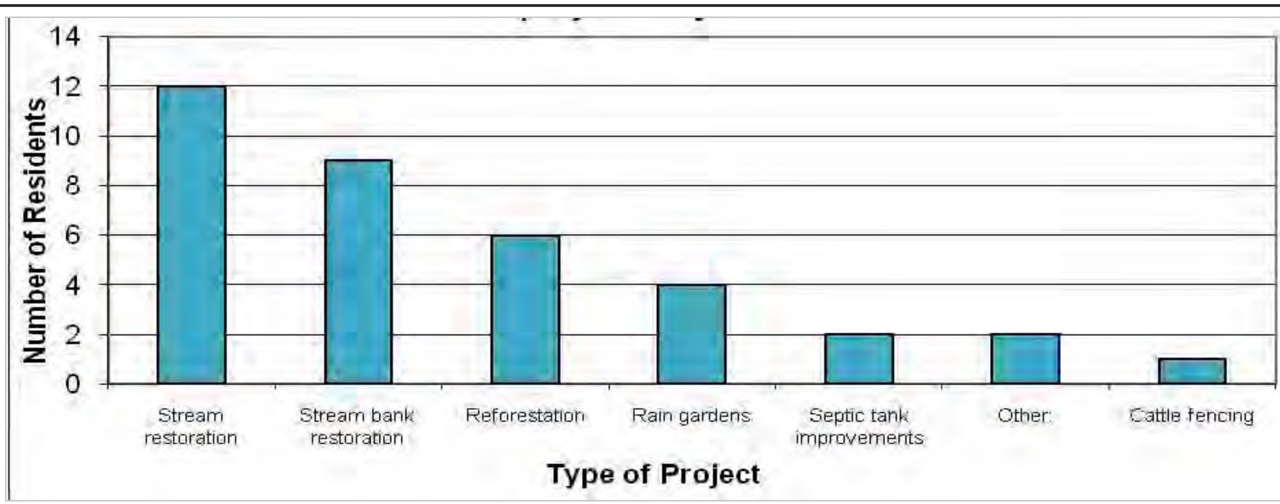


Figure 4.03-5 Survey Question 5 Results

Question 6: Which of the following are major concerns that must be addressed to improve Banklick Creek?

Based on the surveys, development practices, sedimentation, and septic systems seem to be what most residents believe are major concerns that must be addressed to improve the creek. Six of the 66 residents put all three as concerns in their surveys as shown in Figure 4.03-6.

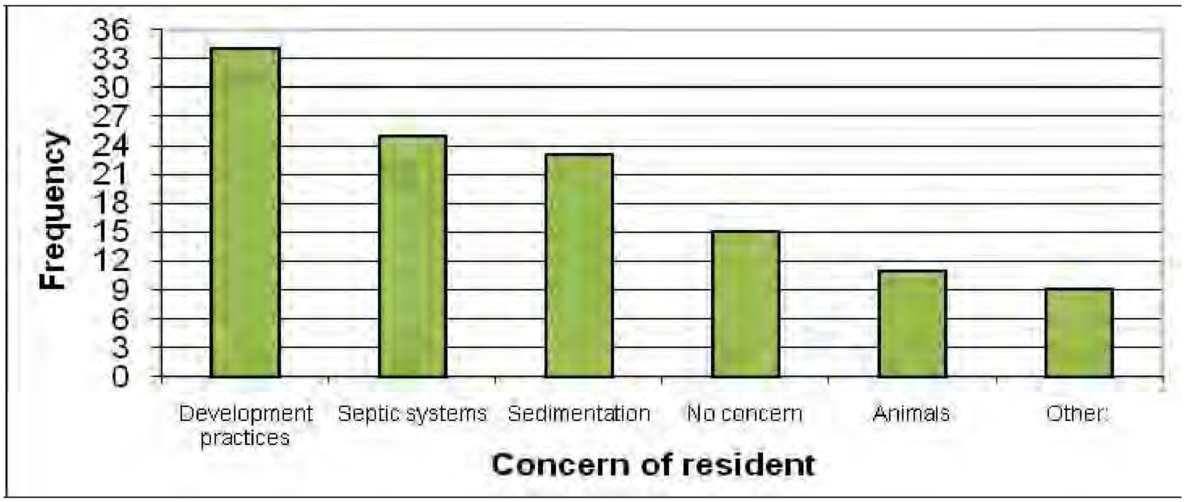


Figure 4.03-6 Survey Question 6 Results

Question 7: On a scale of 1 to 5, with 1 being not important and 5 being very important, how important is it that Banklick Creek is safe for: A. Children to play? B. Habitat? C. Fishing?

More than 62 percent of 69 people who responded to this question believed that having Banklick Creek safe for children to play in or around is very important based on them responding with a 5 to this question as shown in Figure 4.03-7.

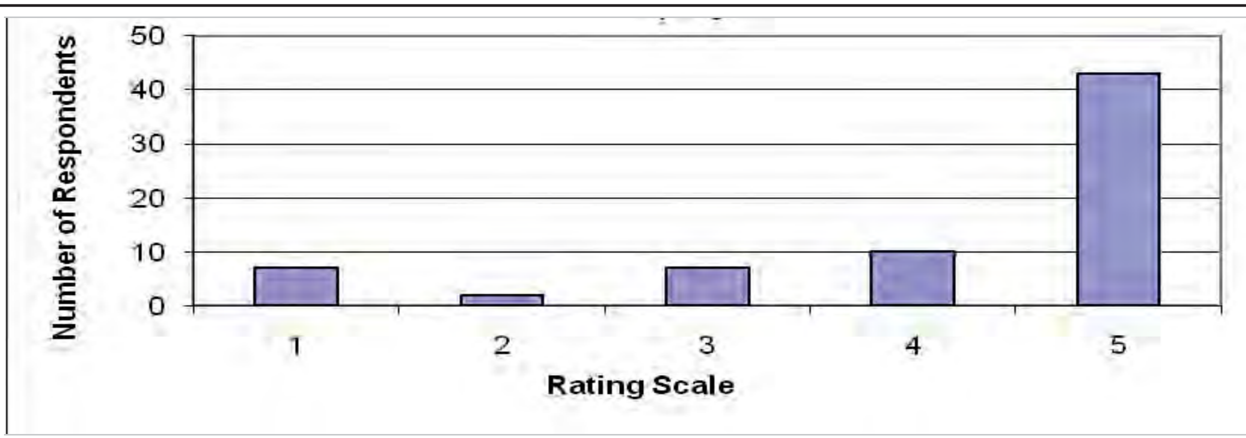


Figure 4.03-7 Survey Question 7A Results

Approximately 57 percent of the respondents believe that habitat safety is very important in the Banklick Creek area and gave this the highest rating of 5 (see Figure 4.03-8).

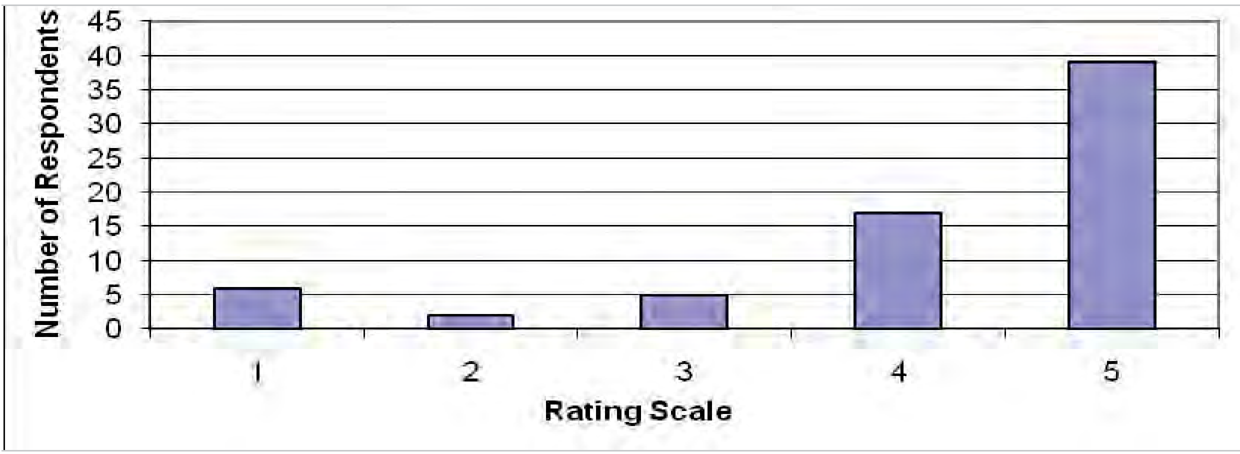


Figure 4.03-8 Survey Question 7B Results

Less than half, 42 percent, believe that the fishing is very important in Banklick Creek based on the quantity of 5s received. The rating of a 5 still received the highest number of votes but there were also a larger number of residents who responded with a rating of 3 or 4 (see Figure 4.03-9),

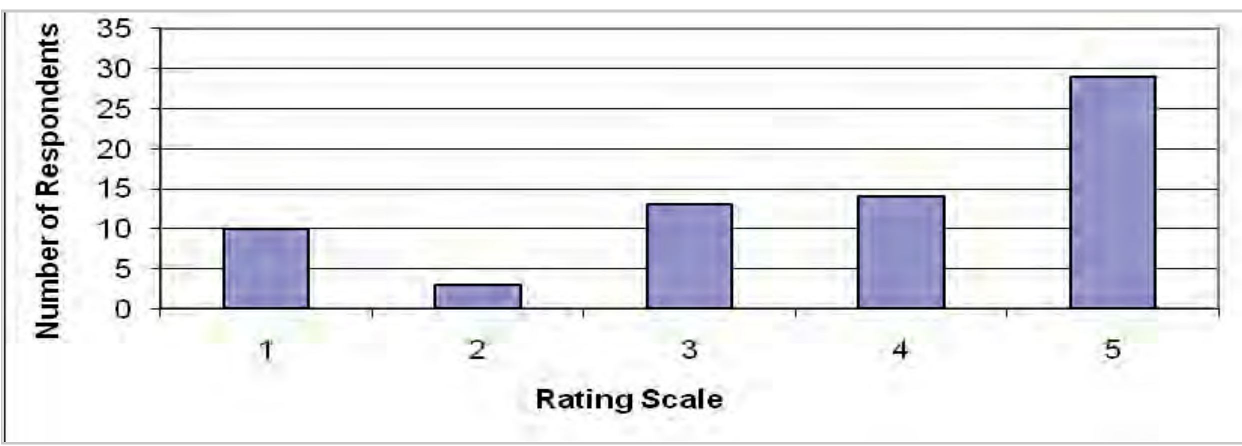


Figure 4.03-9 Survey Question 7C Results

Question 8: What is the quality of the water in the creek?

Based on the survey, most respondent residents thought the creek was muddy, but several still said that fish and other aquatic life could be seen. Figure 4.03-10 represents the range of answers that were received.

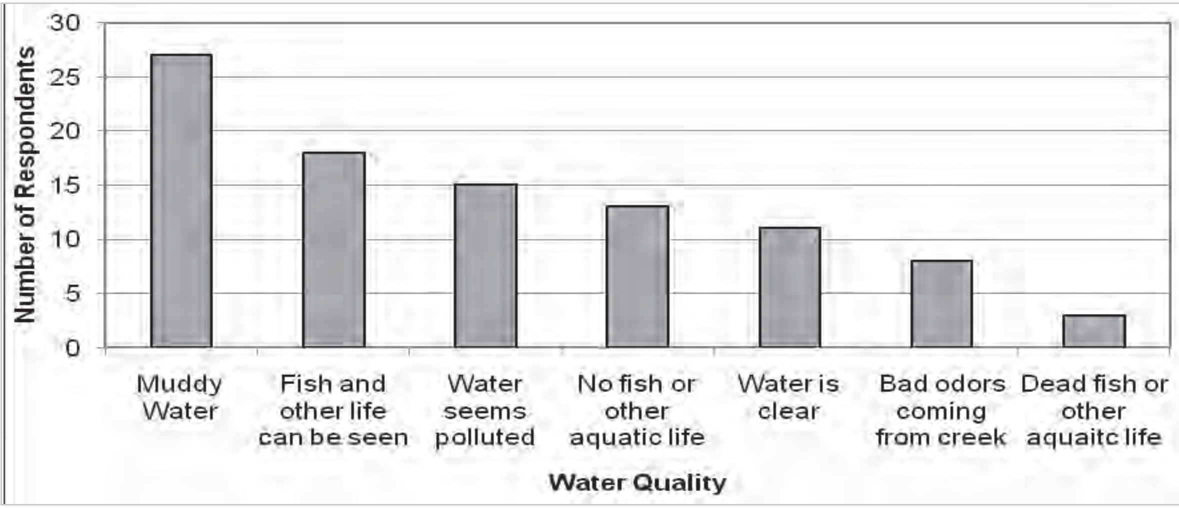


Figure 4.03-10 Survey Question 8 Results

Getting the resident's input was the first step but keeping them informed is an ongoing step. The last portion of the survey related to staying informed and/or staying involved in the process of creating a BWP. Of the 81 residents responding to the survey, 35 wanted to stay informed and nine wanted to be more involved by attending future meetings and volunteering at events.

Throughout the entire survey, residents had designated locations to leave responses. Some of the residents seem eager to do something about fixing the creek while some are not concerned about it. One resident recommends cleaning the creek after spring rains. This same resident said "the creek by me has a lot of old wood/trees blocking the drain under Richardson Road which if left will end up on the road." Another resident said that "many years ago there was a plan to flood the Richardson Road Valley and make a man-made lake for recreation purposes. This would be ideal at this time." On the other hand one resident of the area "was not aware that Banklick Creek had been listed as an impaired waterway." Although there were some negative responses, most of the respondents wanted to see the Creek protected. "I'm never around Banklick Creek, but it is very important to me" was the response from another resident. There were several respondents who had this same mindset about the Creek and Watershed. The surveys proved there are many people in the watershed that feel strongly about the Creek and gave strong input in the surveys.

The following is a summary from SD1 of its 2008 ecological data collection in the Banklick Watershed consisting of three categories: habitat, macroinvertebrates, and fish. SD1 has conducted this data collection as part of their Adaptive Watershed Management Strategy for Consent Decree compliance.

B. <u>Habitat</u>

A habitat is generally defined as the area in which a plant or animal lives and grows. That being said, the quality of the in-stream and riparian (area along the banks adjacent to the stream) habitat has considerable influence on the structure and function of the aquatic community in a stream. Habitat and biological diversity (i.e. the number of different species) are closely linked, to the extent that a biological community is limited by the quality of the habitat. A habitat assessment evaluates physical and chemical components of the stream by examing several different aspects of the stream. Altered habitat can be a major stressor to aquatic systems, and these assessments will help determine if chemical or nonchemical stressors are present. Additionally, habitat assessments can be used to document physical changes that may occur over time. The measurement of physical characteristics and parameters will provide insight to the condition of the biological community. Habitat assessment procedures follow those outlined in Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (Barbour et al, 1999**)**. Sampling locations for Habitat, Macroinvertebrates, and Fish are on the map shown in Figure 4.03-11.

The habitat assessment assigns scores from 0 to 20 in ten different categories of habitat health. The combination of these scores is the overall habitat score with a maximum possible score of 200. Based on the habitat score, the following stream classifications are assigned (note there are two different scales for headwater streams and wadeable streams): non supporting (headwater, =<141, wadeable, =<113), partially supporting (headwater, 142 to 155, wadeable, 114 to 129), fully supporting (headwater, =>156, wadeable =>130). The following ten questions are answered when performing a habitat assessment:

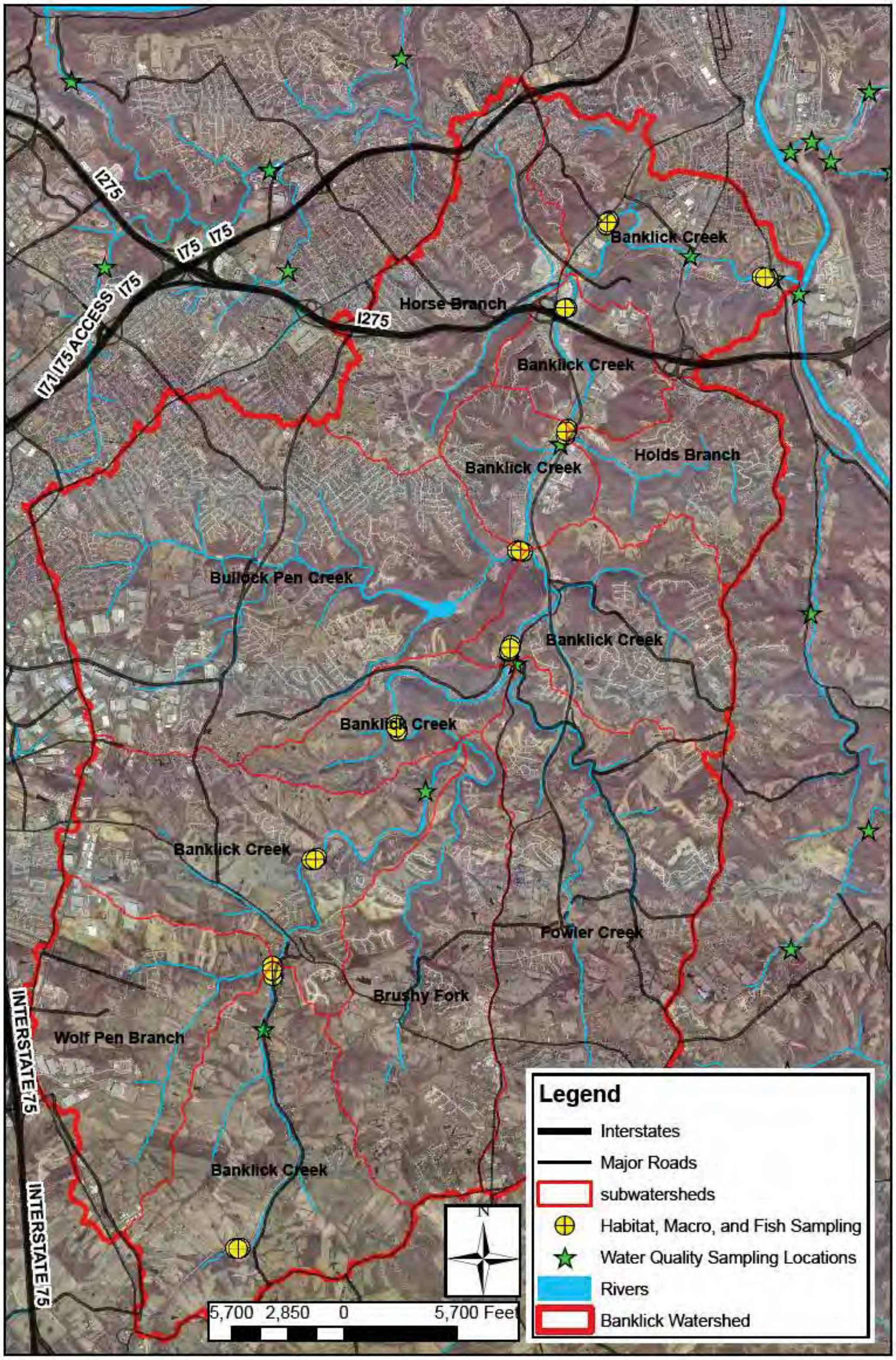
1. *What are the types and sizes of natural materials, such as rocks and sticks, in the stream?*
2. *How much of the rocks on the bottom of the stream are covered with sediment?*
3. *What are the depth and flow speed combinations found in the stream?*
4. *What are the sizes and numbers of islands or point bars formed by sediment?*
5. *How much of the stream bottom is covered by water?*
6. *How much of the stream has been straightened?*
7. *How many riffles are in the stream?*
8. *How stable are the banks of the stream?*
9. *How much of the streambanks are covered with native plants?*
10. *How wide is the riparian area (the land adjacent to the streambanks)?*

Station ID	Habitat Score	Classification
BPC0.1	118	Partial Support
BLC2.6	110	Nonsupporting
BLC3.9	88	Nonsupporting
BLC5.5	111	Nonsupporting
BLC8.1	116	Partial Support
BLC13.5	103	Nonsupporting
BLC15.6	116	Partial Support
BLC17.8	115	Partial Support

Table 4.03-1 Habitat Scores

Table 4.03-1 displays the results of habitat surveys completed at each site within the Banklick Creek watershed. Streams within the Bluegrass portion of the Interior Plateau ecoregion, according to KDOW guidance, are divided into two groups, headwater streams (drainage area <5 mi ^{2}) and wadeable streams (drainage area >5 mi ^{2}). This separation was employed based on the bias toward several metrics observed in many headwater streams of the Bluegrass region. Among the eight sites surveyed, all were considered wadeable (although BLC17.3 is under consideration as “headwater”).. Among these sites, four were classified as “partially supporting” in the KDOW habitat criteria, with four classified as “not supporting.” Low habitat scores were primarily because of lack/condition of riparian area, lack of bank stability, and lack of vegetated protection. Stream substrates varied throughout the watershed but were dominated by bedrock, boulder, and cobble. A comparison of these habitat scores to those collected in 2003 (see Section 3.12) similar results from both data sets and no notable discrepancies.

FIGURE 4.03-11 SAMPLING LOCATIONS FOR HABITAT, MACROINVERTEBRATES, AND FISH



C. Macroinvertebrates

Macroinvertebrates are aquatic organisms, large enough to be seen by the naked eye, living at least part of their life cycle within or upon the available substrates (i.e. rock, leaves, and logs) of a waterbody. Macroinvertebrate communities have been used extensively over the past several decades for water quality assessments and have proven to be very useful in detecting even the most subtle changes in habitat and/or water quality. The macroinvertebrate community was sampled at all sites using the Multihabitat Rapid Bioassessment approach (Barbour *et al.* 1999) and modified to reflect KDOW protocol requirements (KDOW 2001). At each site, a riffle sample is collected using a one meter wide net (600 micron mesh) in moderate to fast water with gravel/cobble substrate. Four 0.25m2 samples are taken from mid-points within the riffle, throughout the length of the sampling reach, combining to comprise one-square meter of sampling area. Additionally, a multihabitat sweep sample is collected in a variety of nonriffle habitats using a d-frame dip net. Each sampling type is kept separate in the field, and processed (species identified and counted) separately in the laboratory. Upon processing, the results of the samples are combined and used determine the Kentucky Macroinvertebrate Index (MBI).

The MBI was developed by KDOW as a means of assessing the quality of the macroinvertebrate community. The MBI is a “multi-metric” approach examining many attributes of the macroinvertebrate (species richness, tolerance values, and feeding guilds) and has been calibrated based on watershed size and location within the state. Specifics regarding the MBI can be found in *Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky* (KDOW 2008) and *The Kentucky Macroinvertebrate Bioassessment Index* (KDOW 2003), but generally, the index uses the various

Stream Name	Station ID	G-TR	G-EPT	mHBI	m%EPT	%C+O	%ClngP	MBI	Rating
Bullock Pen	BPC 0.1	18	0	7.18	0.0	59.0	13.5	20.82	Poor
Banklick Creek	BLC 2.6	31	5	5.9	6	63	28.7	33.74	Poor
	BLC 3.9	29	5	5.83	21.5	21	56.1	50.24	Fair
	BLC 5.5	27	5	6.48	1.3	53	36.4	33.78	Poor
	BLC 8.1	21	7	6.74	4	40	31.3	34.57	Poor
	BLC 13.5	32	7	6.18	4.8	44	39.8	39.82	Poor
	BLC 15.6	33	9	6.1	3.6	46	35.5	39.77	Poor
	BLC 17.8	23	7	7.51	3.3	27	5.34	29.34	Poor

G-TR= Genus level Taxa Richess
G-EPT= Genus level Taxa Richness of Ephemeroptera(mayflies), Plecoptera(stoneflies), and Trichoptera(caddisflies)
mHBI=modified Hilsenhoff Biotic Index
m%EPT=modified Percentage of abundance of Epheroptera, Plectoptera and Trichoptera (modification excludes the genus Chematopsyche)
%C+O=Percentage of Abundance of Chironomids and Oligochaetes %Cling
P=Percentage of Primary Clingers, or the abundance of the bugs that need clean rocks in order to "cling" to them.

Table 4.03-2 Macroinvertebrate Scores

metrics to attain a numeric value, to which a rating of "very good," "good," "fair," "poor," or "very poor" is assigned. Table 4.03-2 displays the results of macroinvertebrate surveys collected from eight sites in the Banklick Watershed.. All sites but one in Banklick Creek were rated as "poor," with the remaining site rated as "fair." Low MBI scores are primarily due to the dominance of chirinomids and oligochaetes (%C+O) throughout the samples (these organisms are typically tolerant of pollution). Low values of the pollution sensitive groups of mayflies, stoneflies, and caddisflies (m%EPT) also contributed to low overall MBI scores. Raw macroinvertebrate sampling data can be found in Appendix I.

D. <u>Fish</u>

Measurements of the structure and function of the fish community also provide insight to stream health and water quality. For all wadeable sites, fish community structure was sampled with a backpack-type shocking device utilizing the rapid bioassessment multihabitat electrofishing approach (Barbour *et al.* 1999) and modified to reflect KDOW protocol requirements (KDOW 2008). The segment of stream identified in the habitat assessment was the focus of the fish collection. Fish samples were taken outside of the habitat assessment area if portions were not accessible with the backpack electrofishing unit, i.e. a stream segment may be too deep to safely sample.

Table 4.03-3 displays the results of fish surveys that were collected from six sites in the Banklick Watershed. Two sites (BLC15.6 and BLC17.8) were not samples due low water conditions. KDOW has developed a multimetric index known as the Kentucky Index of Biotic Integrity (KIBI) to assess stream health by examining fish community structure. Similar to the MBI, the KIBI is also scaled for ecoregion and watershed size. Sites in the Banklick Watershed ranged from "fair" to "excellent" based on KIBI criteria. The "excellent" rating at BPC0.1 appears to be a response to a low percent insectivores (%insct), which typically increases with disturbance. Given that these same sites scored much lower on the MBI, caution should be taken when using the fish population data to rate this stream. It is the opinion of local biologists that the macroinvertebrate surveys provide a more accurate depiction of stream condition, as the KIBI still needs refinement to better evaluate Bluegrass ecoregion streams, especially in watersheds less than 10 mi^2.

Site ID	TNI	NAT	DMS	INT	SL	% FHW	%INSCT	%TOL	KIBI	Classification
BLC2.6	134	134	4	0	5	58.2	46.3	10.4	42	Fair
BLC3.9	123	123	4	0	5	88.6	64.2	26.0	46	Fair
BLC5.5	115	115	4	0	5	62.6	61.7	13.9	48	Good
BLC8.1	108	13	2	0	4	74.1	46.3	28.7	39	Fair
BLC13.5	108	108	3	0	2	52.8	63.0	52.8	48	Good
BPC0.1	103	103	3	0	4	72.8	35.9	21.4	54	Excellent

TNI=Total Number of Individuals
NAT=Number of Native Species
DMS=Number of Darter, Madtom and Sculpin Species SL= Simple Lithophils %FHW=Percent Facultative Headwater Species %INSCT=Percent Insectivores
%TOL=Percent Tolerant KIBI=Kentucky Index of Biotic Integrity Score

Table 4.03-3 Fish Scores

E. Hydromodification

The USEPA defines hydromodification as the “alteration of the hydrologic characteristics of coastal and noncoastal waters, which in turn could cause degradation of water resources” (EPA 2006). Simply stated, hydromodification is a change in a waterbody's physical structure as well as its natural function. These changes can cause many problems such as changes in flow, increased sedimentation, higher water temperature, lower dissolved oxygen, degradation of aquatic habitat structure, loss of fish and other aquatic populations, and decreased water quality. The term is most often used in reference to the hydrologic changes caused by the conversion of land from undeveloped to urban. If left unmitigated, the increases in impervious surfaces, such as roofs, parking lots, and roads, result in increased surface runoff and higher flow magnitudes and durations for equivalent rainfalls relative to the undeveloped setting. Some of the effects of hydromodification include an altered sediment delivery from the watershed, increased sediment transport within channels, and changes in channel forms. SD1 took a proactive approach to managing hydromodification and began collecting data from the Northern Kentucky streams in the summer of 2008. Stream survey data and pebble count data are being collected for five cross sections along Banklick Creek at RMs 5.5, 8.1, 17.6, 17.8, and 18.0. This information is being used to determine the critical flow rates within the stream channel that cause sediment transport and degrade the stream quality. SD1 plans to continue to collect hydromodification data in the hopes of developing channel stability assessment tools calibrated to the Northern Kentucky streams. Figure 4.03-12 and 4.03-13 show a photo of the survey and sample cross section data. Cross section data basically shows the location and measurements of stream channel and banks at one specific stream segment, or cross section.

Figure 4.03-12 Hydromodification Survey in Banklick Creek Mile 8.1

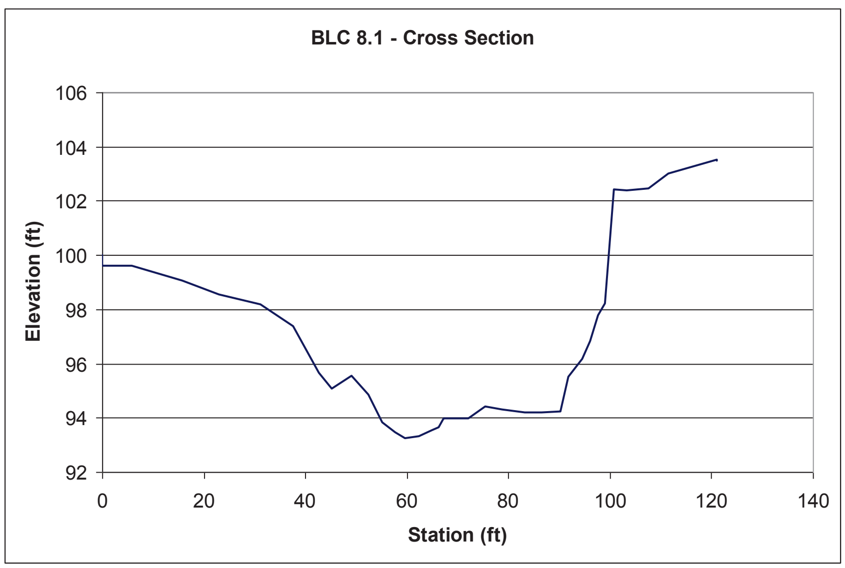


Figure 4.03-13 Sample Cross Section Data from Banklick Creek Mile 8.1

F. Watershed Characterization Report

In 2008 LTI reviewed all historical monitoring data, collected new data, and completed an in-depth analysis of the water quality of Banklick Watershed. This analysis consisted of evaluation of water quality monitoring results, computer modeling, and the creation of a Watershed Assessment Tool (WAT!). These processes are described in more detail in Appendix D. The following is text taken directly from the 2008 Banklick Watershed Characterization Report that was prepared for SD1 by LTI. The full text of the Characterization Report can be found in Appendix D.

Recent water quality data was available for six locations along the mainstem of Banklick Creek (RM 0.3, 1.2, 3.9, 8.1, 11.6, and 15.6) and one location on Bullock Pen Creek (RM 0.1) and one location on Fowler Creek (RM 0.1). Eight fecal coliform samples and eight *E. coli* samples were available for each location. See Table 4.03-4.

Recent bacteria exceedances were observed. Measurements for parameters not shown met water quality criteria. Recent data collected at the USGS station are being reviewed and will be included in the next update of this report.

TABLE 4.03-4

RECENT (2006 TO 2008) BACTERIA EXCEEDANCES

Stream	River Mile	Parameters exceeding criteria			
		Fecal coliform[a]		*E. coli*[a]	
		# samples	% of samples exceeding criteria	# samples	% of samples exceeding criteria
Banklick Creek	0.3	8	75%	8	75%
	1.2	8	63%	8	75%
	3.9	8	50%	8	88%
	8.1	8	50%	8	75%
	11.6	8	50%	8	63%
	15.6	8	50%	8	75%
Bullock Pen Creek	0.1	8	50%	8	50%
Fowler Creek	0.1	8	25%	8	63%

[a] There are no instances where 5 samples were collected from a single location within a 30-day period. Therefore the comparison to the geometric mean portion of the fecal coliform and E. coli criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, "Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for E. coli." Even this comparison is conservative as the criterion is meant to be applied to a dataset of 5 or more samples collected over a 30-day period.

1. Bacteria

Fecal coliform and *E. coli* data were available for both base flow and storm conditions. Storm flow results for bacteria are presented as an average over the storm event. As shown in Figure 4.03-14, fecal coliform concentrations exceeded the applicable criterion in Banklick Creek and Bullock Pen Creek. Four of the 16 base flow samples exceeded the fecal coliform criterion, and storm flow samples exceeded the criterion at every location except Fowler Creek at RM 0.1. The maximum base flow fecal coliform concentration, 1,530 cfu/100ml, was observed at Bullock Pen Creek RM 0.1, while the maximum storm event concentration, 1,697 cfu/100 ml, was observed at Banklick Creek RM 0.3.

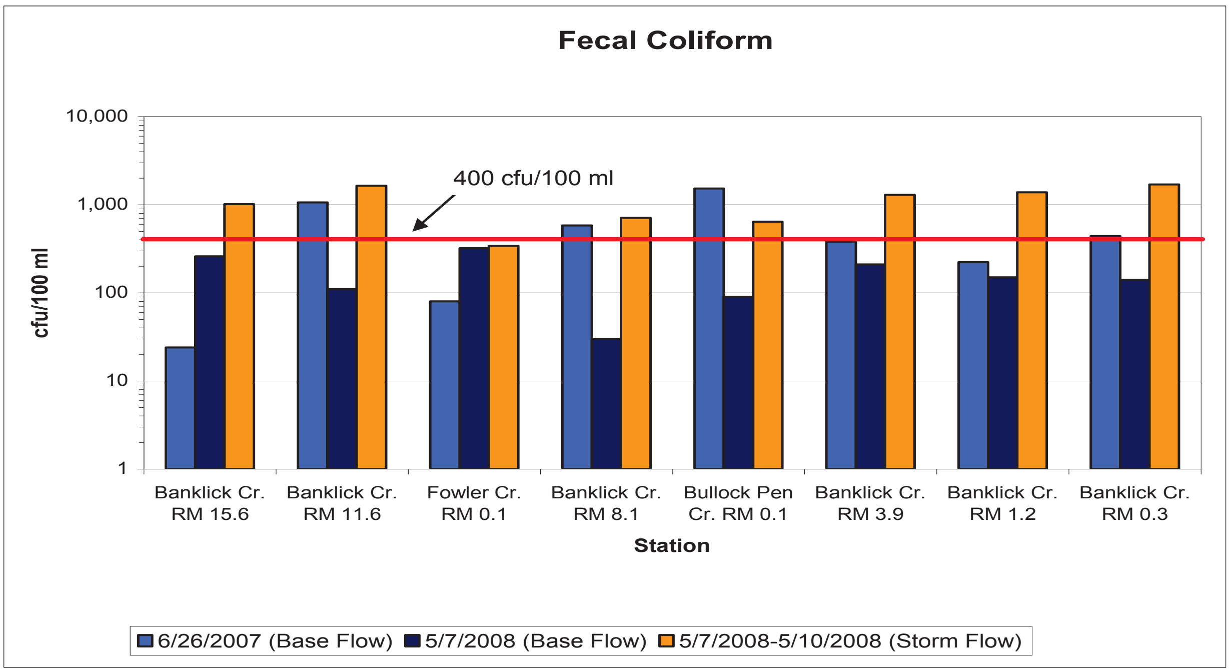


Figure 4.03-14 2006-08 Base Flow and Average Storm Flow Fecal Coliform Concentrations Compared to 400 cfu/100 ml Criterion

E. coli concentrations exhibited a similar pattern. Eight of the 16 base flow measurements exceeded the applicable criterion, with exceedances observed at all sampling locations. The maximum base flow *E. coli* concentration, 1,333 cfu/100 ml, was observed at Bullock Pen Creek RM 0.1. Storm flow measurements exceeded the criterion at all locations, with a maximum concentration of 1,972 cfu/100 ml observed at Banklick Creek RM 0.3.

2. Biological Conditions

Macroinvertebrate communities are susceptible to water quality and habitat degradation, and data from these communities are used as a tool to detect changes in habitat and water quality and assessing stream health (KDOW, 2008b).

KDOW sampled macroinvertebrates in 1999 at Banklick Creek RM 1.2, which yielded a MBI[1] rank of poor. KDOW and Strand also collected macroinvertebrate samples in 1996 and 2001 to 2003, respectively, but these data are not compatible with calculating the MBI. The 2001 to 2003 data indicate, with a few exceptions in locations where the creek is ephemeral, that areas upstream in the watershed had higher percentages of desirable macroinvertebrate individuals (Strand, 2003). This is likely due to the lower level of land use disturbance in the primarily agricultural area compared to the high level of disturbance farther down the watershed where urban development exists. The urbanized areas have altered aquatic habitats, reduced riparian zones, and increased siltation. Desirable macroinvertebrates were also low at the Bullock Pen Creek site and at sites closest to the mouth of Banklick Creek. The downstream sites in Banklick Creek are also subject to backwater flows from the Licking and Ohio Rivers that cause siltation and further reduce desirable macroinvertebrates.

Benthic algae are useful biological indicators of water quality because they are sensitive to changes in water quality and are primary producers within aquatic ecosystems. Diatoms are benthic algae that are useful indicators of biological integrity because at least a few can be found under almost any condition and they are identifiable to species (KDOW, 2008b). In 1993, an unnamed tributary to Bullock Pen Creek received a poor rating based on diatom measurements. Benthic algae were also measured in total biomass by Strand between 2001 and 2003 (Strand, 2003). The results of this sampling showed that eutrophication is a problem in some sections of the creek during some seasons. The Bullock Pen Creek site often had *chlorophylla* measurements exceeding 300 mg/m^2. High algal levels were also observed in the uppermost portion of the creek, which is surrounded by agricultural lands and subject to low flows, especially during the fall. In the most downstream portions of Banklick Creek, periphyton levels were high only during extended periods of low flow.

3. Stream Metabolism

Stream metabolism can be used as a measure of ecosystem health because it responds to the complex interactions between instream conditions (physical, biological and chemical) and watershed conditions. It can be assessed by looking at the ratio of primary production (P), which is influenced by instream conditions (light and nutrient inputs), to respiration (R), which is influenced by watershed conditions (other nutrient and detritus inputs). This ratio can be calculated using continuous instream dissolved oxygen measurements, because dissolved oxygen responds to both instream and watershed inputs. Smaller ratios (e.g., P:R less

[1] The macroinvertebrate data collected by KDOW were used to calculate the macroinvertebrate biotic index (MBI). The MBI compiles attributes of the macroinvertebrate community such as taxa richness, pollution tolerant species, and pollution intolerant species. Additional metrics are added depending on the stream size and/or ecoregion.

than 1) suggest that stream system health is more strongly affected by watershed inputs than by instream and near stream processes.

Stream metabolism has been analyzed at eight USGS continuous monitoring stations that deploy multiparameter sondes. These stations are located in watersheds that have varying levels of watershed impacts; however, none are located in an unimpacted or reference watershed. For the 2000 to 2005 period, all eight sites have ratios that indicate the health of these streams is more strongly affected by watershed inputs than instream and near stream inputs.

Instream and watershed inputs appear to be relatively well-balanced in Banklick Creek at RM 8.1, because this site has a P:R ratio close to 1. Because there are no reference sites in this region that can be used for comparison, it is not known how this ratio compares to that for an unimpacted watershed. Longer-term monitoring of dissolved oxygen at the Banklick Creek site may prove useful in understanding how stream and watershed level changes affect the stream metabolism balance at this site.

5.01 INTRODUCTION

This section is intended to evaluate the water quality data presented in Section 4 to determine the potential sources of water quality impairment that are present in the Banklick Creek. The assessment is comprehensive in that it evaluates both potential point sources and nonpoint sources in the Banklick Creek. Figure 5.04-1 at the end of this section summarizes some of the information from this section in a convenient mapped format. Additionally, Table 5.04-2 summarizes LTI's source assessment results. Please reference this figure as you read through Section 5.

5.02 POINT SOURCE POLLUTION

Point source pollution is a single identifiable localized source of pollution, such as the direct discharge of effluent from an industrial facility through a pipe to a stream. Point source discharges are regulated by National Pollutant Discharge Elimination System and Kentucky Pullutant Discharge Elimination System (KPDES) permits. The permits are site-specific and regulate a variety of pollutants such as fecal coliform, biological oxygen demand, toxic pollutants, metals, oil, grease, and more.

There are 17 KPDES permitted dischargers and 22 permitted outfalls in the watershed. Fifteen of these outfalls are for sanitary wastewater, seven of which are covered under general permits for residences. The remaining outfalls are for stormwater runoff, cooling water, a sedimentation basin drain, and concrete mixer truck washout water. Permitted CSOs are not included in this tally and are discussed separately. These permitted discharges and their locations are shown in Table 5.02-1 (KDOW, 2010). According to LTI's review of effluent monitoring data (January 2007 to June 2008), it was observed that 18 of the permitted dischargers in the Banklick Watershed have violated their permit limits at least once.

TABLE 5.02-1

KPDES PERMITTED DISCHARGES IN BANKLICK WATERSHED

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted? [a]	Permit Violations
Wolf Pen Branch	KY0101591	Bp Oil Co Richwood Bulk Plant	0011	Minor	Storm water runoff	Y	NA
Wolf Pen Branch	KYG400896	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Fowler Creek	KY0034207	Colony House Apts	0012	Minor	Sanitary wastewater	Y	Total chlorine, total ammonia
Fowler Creek	KY0075833	Nixutil Sanitation Assoc Inc	0012	Minor	Sanitary wastewater	Y	Fecal coliform, total ammonia
Fowler Creek	KY0080802	Regency Manor Inc	0012	Minor	Sanitary wastewater	Y	Total ammonia
			0022	Minor	Simon Kenton High School	N	Total ammonia
			0062	Minor	Twenhofel Jr High School	Y	$CBOD_5$, fecal coliform, total ammonia, TSS
Fowler Creek	KYG400090	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Fowler Creek	KYG400482	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Fowler Creek	KYG400719	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Bullock Pen Creek	KY0075485	Graham Packaging Plastic Prods	0011	Minor	Cooling water and sanitary	Y	Fecal coliform
Bullock Pen Creek	KY0090191	Camco Chemical Co Inc	0011	Minor	Storm water runoff	Y	pH
			0021	Minor	Storm water runoff	Y	pH
			0031	Minor	Storm water runoff	Y	pH
Bullock Pen Creek	KYG400111	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Thompson Branch	KYG400625	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA

TABLE 5.02-1 (CONTINUED)

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?[a]	Permit Violations
Banklick Creek	KY0089524	Interplastic Corp Thermoset	0011	Minor	Storm water runoff - plant grds	Y	Oil and grease, total zinc, TSS
			0012	Minor	Storm water runoff - plant grds	Y	None
			0041	Minor	Storm water runoff - east side	Y	Total zinc, TSS
			0042	Minor	Storm water runoff - east side	Y	None
Banklick Creek	KY0101052	Moraine Materials Co Plt #29	0011	Minor	Concrete mixer trk washout wtr	Y	Oil and grease, TSS
Banklick Creek	KY0101222	BP Amoco Sohio Refinery	0022	Minor	Stormwater runoff	Y	Naphthalene
			0021	Minor	Groundwater remediation	N	Total iron
			0031	Minor	Storm water runoff	Y	NA
			0032	Minor	Storm water runoff	Y	NA
			0041	Minor	Storm water runoff	Y	Total phenolics
			0042	Minor	Storm water runoff	Y	NA
Banklick Creek	KYG400514	Residence	0011	Minor	Sanitary wastewater Type B	Y	Total ammonia
Banklick Creek	KYG640158	Taylor Mill WTP	0011	Minor	Sedimentation basin drain	Y	TSS

[a] Discharge is permitted as of June 2008.

NA – Monitoring data was not available.

There are five current CSOs (both permitted and to be permitted) in the Banklick Watershed. These overflows are listed in Table 5.02-2. These CSOs are located in the watershed draining the lower 2.3 miles of Banklick Creek. There are twenty-seven sanitary sewer overflows (SSOs) in this watershed (see Table 5.02-3). Two of these are located at pump stations that have historically been shown to have a lack of wet weather capacity. The Lakeview pump station is located along the Banklick Creek mainstem within the City of Fort Wright, and the Meadow Hill pump station is located in the southern portion of the City of Covington. (LTI, 2008).

Manhole ID	Common Name	Direct Discharge to Waterbody	Typical Year Spill Frequency (# spills)[a]	Typical Year Volume (Million gallons)[a]
1870194 (outfall 79)	47th Street	Banklick Cr.	4	0.13
1850158 (outfall 76)	Church Street	Banklick Cr.	74	56.26
1870193 (outfall 78)	Decoursey Ave.	Banklick Cr.	24	1.29
1840130[b]	Latonia	Banklick Cr. trib.	25	1.12
1510245[b]	Henry Clay	Banklick Cr. trib.	0	0

a The results presented were generated by models based on SD1's current (2008) understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual field conditions. These models are subject to change based on improved knowledge of the system improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.
b These are "to be permitted" CSOs, i.e., SD1 has (or will) identified these locations for KPDES

Table 5.02-2 Combined Sewer Overflow Points

Point source pollution is a major contributor to water quality impairment. As discussed above, a number of initiatives are in place or being developed to address the point source issues. The 319(h) grant, however, only targets implementation for nonpoint sources of pollution.

TABLE 5.02-3

SANITARY SEWER OVERFLOW POINTS

Manhole ID	Direct Discharge to Waterbody	Typical Year Spill Frequency (# spills)[a,b]	Typical Year Volume (Million Gallons)[a,b]
1040060	Tributary to Bullock Pen Creek	3	0.1
1090069	Tributary to Bullock Pen Creek	0	0.0
1110025	Tributary to Bullock Pen Creek	4	0.2
1110067	Tributary to Bullock Pen Creek	5	0.4
1110161	Tributary to Bullock Pen Creek	2	0.1
1110294	Tributary to Bullock Pen Creek	5	0.1
1570100	Tributary to Horse Branch	7	0.2
1760047	Tributary to Bullock Pen Creek	0	0.0
1760048	Tributary to Bullock Pen Creek	0	0.0
1860108	Banklick Creek	0	0.0
1870013	Banklick Creek	0	0.0
1950199	Tributary to Banklick Creek	0	0.0
1960012	Horse Branch	0	0.0
2030097	Tributary to Bullock Pen Creek	0	0.0
2090001	Bullock Pen Creek	0	0.0
2090026	Bullock Pen Creek	0	0.0
2110002	Tributary to Bullock Pen Creek	10	1.0
2120001	Tributary to Bullock Pen Creek	5	0.2
2120002	Tributary to Bullock Pen Creek	0	0.0
2120041	Tributary to Bullock Pen Creek	4	0.1
2160036	Tributary to Horse Branch	NA	NA
2280010	Wolf Pen Branch	0	0
2280011	Wolf Pen Branch	10	0.4
2280012	Wolf Pen Branch	0	0.0
2300123	Banklick Creek	27	6.1
1950PS1 (Lakeview PS)	Banklick Creek	17	10.6
2020PS2 (Meadow Hill PS)	Tributary to Banklick Creek	NA	NA

[a] The results presented were generated by models based on SD1's current (2008) understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

[b] NA means no model data is available.

5.03 NONPOINT SOURCE POLLUTION

Unlike point source pollution, nonpoint source pollution does not discharge from a pipe, it comes primarily from stormwater runoff from farms, roofs, streets, and parking lots. As the rainwater falls on widespread areas and turns into runoff, it picks up and carries natural and human-made pollutants. The runoff then deposits all the pollutants it has picked up in streams, lakes, rivers, and other surface waters. Primary nonpoint pollutants include fertilizers, oil, grease, and chemicals from urban runoff, sediment from cropland, forests, and eroding stream banks, salt from irrigation practices, and bacteria and nutrients from livestock, pet wastes, and faulty septic systems. See Figure 5.03-1 for a listing of nonpoint sources of pollution. Concerned citizens can help control pollution from construction sites by contacting the plan review department at SD1 to report any construction site that appears to have inadequate sediment and erosion control practices in place.

FIGURE 5.03-1

NONPOINT SOURCES OF POLLUTION AS DEFINED BY KENTUCKY DIVISION OF WATER

Nonpoint Pollution Sources

AGRICULTURE
- Non-irrigated Crop Production
- Irrigated Crop Production
- Specialty Crop Production
- Pasture Grazing-Riparian and/ or Upland Pasture Grazing-Riparian
- Pasture Grazing-Upland
- Range Grazing-Riparian and/ or Upland Range Grazing-Riparian
- Range Grazing-Upland
- Animal Feeding Operations (NPS)
- Aquaculture
- Animal Holding/Management Areas

SILVICULTURE
- Harvesting, Restoration, Residue Management
- Forest Management (pumped drainage, fertilization, and pesticide application)
- Logging Road Construction/Maintenance
- Silvicultural Point Sources

CONSTRUCTION
- Highway/Road/Bridge Construction
- Land Development

URBAN RUNOFF/STORM SEWERS
- Other Urban Runoff
- Illicit Connections/Illegal Hook-ups/Dry Weather Flows
- Highway/Road/Bridge Runoff
- Erosion and Sedimentation

RESOURCE EXTRACTION
- Surface Mining
- Subsurface Mining
- Placer Mining
- Dredge Mining
- Petroleum Activities
- Mill Tailings
- Mine Tailings
- Acid Mine Drainage
- Abandoned Mining
- Inactive Mining

IMPROPER WASTE DISPOSAL
- Sludge
- Wastewater
- Landfills
- Inappropriate Waste Disposal/Wildcat Dumping
- Industrial Land Treatment
- Onsite Wastewater Systems (Septic Tanks)
- Hazardous Waste
- Septage Disposal

HYDROMODIFICATION
- Channelization
- Dredging
- Dam Construction
- Upstream Impoundment
- Flow Regulation/Modification

HABITAT MODIFICATION (other than hydro-modification)
- Removal of Riparian Vegetation
- Streambank Modification/Destabilization
- Drainage/Filling of Wetlands

MARINAS AND RECREATIONAL BOATING
- In-water Releases
- On-land Releases

EROSION FROM DERELICT LAND

ATMOSPHERIC DEPOSITION

HIGHWAY MAINTENANCE AND RUNOFF SPILLS

CONTAMINATED SEDIMENTS

DEBRIS AND BOTTOM DEPOSITS

INTERNAL NUTRIENT CYCLING
(primarily lakes)

SEDIMENT RESUSPENSION

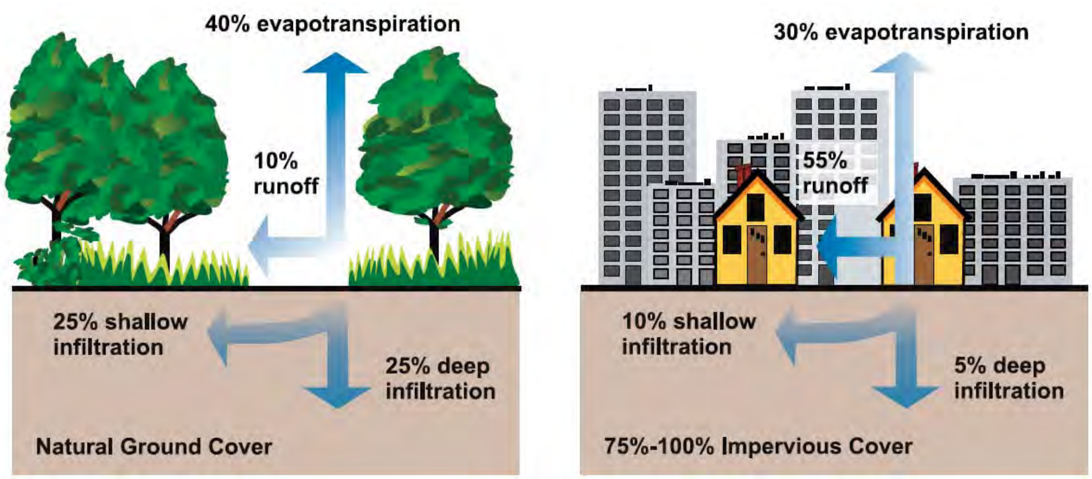
NATURAL SOURCES
RECREATIONAL AND TOURISM ACTIVITIES (Non-boating)
- Golf Courses

UPSTREAM IMPOUNDMENT
SALT STORAGE SITES
GROUNDWATER LOADINGS
GROUNDWATER WITHDRAWAL
OTHER
- Source Unknown

From KDOW (2004a)

A. <u>Urban Runoff</u>

Urban runoff is a significant source of pollution in any developed area. USEPA publications state that a city block generates five times more runoff than a woodland area (see Figure 5.03-2). The USEPA documentation also explains that urban runoff increases pollutant loadings to water bodies. These pollutant loadings can include sediment, oil, grease, toxic chemicals, lawn pesticides, viruses and bacteria from pet wastes, road salts, heavy metals, and thermal pollution. Urban activities can cause elevated concentrations of ammonia and phosphorus in water bodies downstream.



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

Figure 5.03-2 Urban Runoff (Source http://www.epa.gov/owow/nps/toolbox/other/epa_nps_urban_facts.pdf)

1. Pet Waste

Pet waste is no different than human wastes in that it can introduce fecal coliform into surface waters. Recent studies have shown that pet waste is the third or fourth most common source of bacteria in contaminated waters (Watson, 2002). Pet wastes can be controlled through ordinances requiring collection and removal of the waste from curbsides, yards, parks, roadways, and other areas where the waste can be washed directly into receiving waters.

2. Improper Disposal

Homeowners introduce toxins such as pesticides, solvents, and petroleum products into the water supply through improper disposal. Proper use, storage, and disposal of used motor oil, paints, furniture stains, and mercury thermostats are important to prevent contamination of ground and surface water.

3. Lawn Care

Professional lawn and garden chemical applicators receive training and maintain application records but individual homeowners do not, and they often over apply chemicals. Over application of lawn and garden chemicals contributes to significant nutrient loads to urban waterbodies (USGS, 1995). Yard waste such as grass clippings, leaves, and dead plants are high in organic matter; yard waste that is piled or dumped on nearby streambank results in smothered vegetation, increased erosion, and depleted dissolved oxygen levels.

As stated earlier, 47 percent of the Banklick Watershed is developed, and roughly 11 percent of the watershed is impervious. LTI estimated the land use changes through 2030 using information from the Northern Kentucky Area Planning Commission (NKAPC) and predicts that the land will be 70 percent developed with 17 percent impervious area. This increase is significant for urban runoff because the increase in both development and imperviousness correlates to increased urban runoff and increased pollutant loadings to streams.

B. Animal Operations

Agricultural animals act as a direct and indirect source of fecal coliform loadings in surface water streams. Animals with direct access to water can especially impact water quality; feces can be deposited directly into streams or on stream banks. Feces deposited in fields do not always decay completely before a rain event occurs, and coliform from the feces can be transported to the streams from the runoff.

There are two large dairy operations with 40 to 45 animals located in the Bullock Pen Creek watershed. According to the extension agent from Kenton County, the waste from the dairy cows is primarily spread on row crops. Based on information from the United Stated Department of Agriculture (USDA) National Agricultural Statistics Service (NASS), over 9000 livestock animals are reported in Kenton County. Using geographical information system (GIS) data layers for the County, the livestock lands located within Banklick Watershed were estimated to be nearly 30 percent. This translates to approximately 3000 livestock animals in Banklick Watershed. Based on data from USDA National Conservation Resources Service (NCRS), it is estimated that these animals produce approximately 4,160 tons of manure per year. Most manure spreading in the Banklick Watershed occurs on hayfields.

It is unknown at this time whether these hayfields have implemented BMPs in accordance with the Kentucky Agricultural Water Quality Act plan to minimize the potential for manure to runoff into receiving streams. See Table 5.03-1 for number of livestock in Banklick Watershed and estimated manure production annually.

In several locations, cows and other animals have direct access to Banklick Creek and its tributaries. Animals with direct access to the surface water pose the largest threat of pollution. Many horse hobbyists are located in Banklick Watershed.

Livestock	Estimated Number in Banklick (2002)	Tons of Manure per year
Number of Cattle and Calves	2403	16,522.23
Number of Hogs and Pigs	68	110.43
Number of Sheep and Lambs	30	17.57
Number of Layers	499	22.84
	TOTAL	16,673.07

Table 5.03-1 Watershed Livestock Manure Production

C. Septic Systems

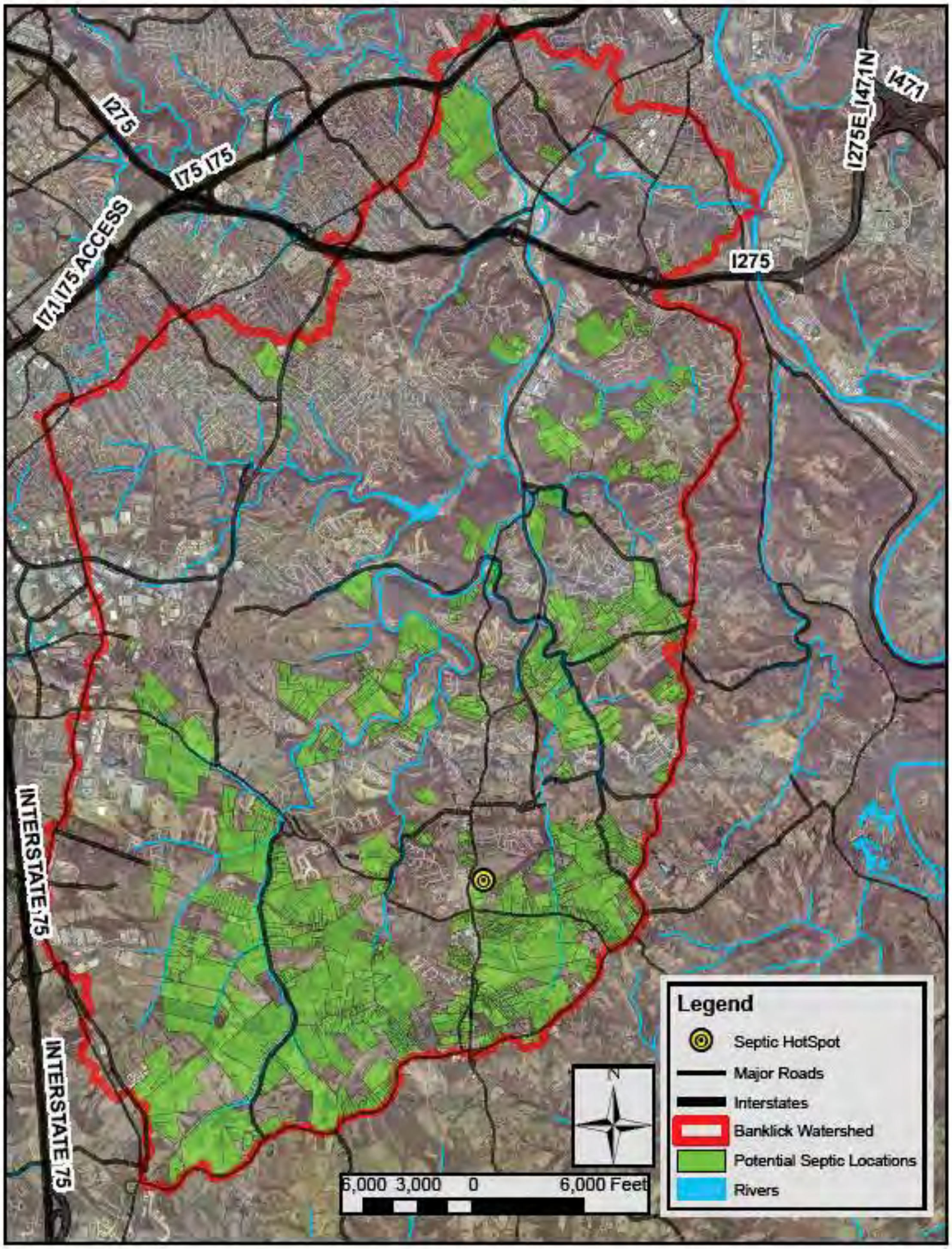
Approximately 5 percent of the lots in the Banklick Creek watershed use septic systems. Properties potentially served by septic systems are more concentrated in the southern portion of the watershed, both inside and outside the District's sanitary sewer service area. Septic systems can be a safe and effective method for treating wastewater if they are sized, sited, and maintained properly. However, if the tank or absorption field malfunctions or if they are improperly sited, constructed, or maintained, nearby wells and surface waters may become contaminated. Some of the potential problems from malfunctioning septic systems include polluted groundwater, bacteria, nutrients, toxic substances, and oxygen consuming wastes. The primary contaminant of a failing septic system would be human fecal coliform, or *E.coli* being dispersed to local water supply wells or receiving streams. Reports from Health Department inspectors suggest that 10 percent of the septic systems may be operating improperly because of incorrect installation, lack of maintenance, or age of the system (NKIHD, 2008). Although no empirical data were collected to support this suspicion, the anecdotal evidence may point to the need of more detailed investigations. Because of the expected increase in developed areas mentioned earlier, more septic systems can be expected in the watershed as time goes on, which could proliferate this potential problem.

One septic "hot spot" was identified in the Fowler Creek subwatershed; this is defined as an area that either has very small lots that have unrepairable failing systems or has systems that have been repaired to the extent practicable on the site but that are not fully functional (NKIHD, 2008). The septic hot spots identified are assumed to be causing more water impairments than other systems and should be given a higher priority and be remediated first.

See Figure 5.03-3 for septic system mapping information. The areas shown as potential septic systems in green are the properties that we know SD1 has not sewered, so we have assumed these as potential septic system properties.

FIGURE 5.03-3

SEPTIC SYSTEM PARCELS IN BANKLICK WATERSHED



D. Cropland

The National Water Quality Inventory reports that agricultural nonpoint source pollution is the leading source of water quality impacts to surveyed rivers and lakes, the third largest source of impairments to surveyed estuaries, and a major contributor to groundwater contamination and wetlands degradation. Agriculture is listed as a source of impairment for over 35 percent of the surveyed streams and rivers in the United States. Lands used for agricultural purposes may be applied with pesticides, fertilizers, or have active livestock. Rainwater runoff can pick up and carry a considerable amount of pollutants from the pesticides, fertilizers, and livestock into surface water bodies or the pollutants can work their way into nearby groundwater supplies. Runoff from fertilizers, animal waste, and pesticides can carry high concentrations of nitrogen, phosphorous, pathogens, chlorides, and potassium salts. Runoff can also transport large amounts of topsoil from cultivated land into surface water bodies, drastically increasing sediment loads.

Nutrients such as phosphorus and nitrogen and potash are applied to farmland to enhance crop production. In overabundance, these nutrients can stimulate algal blooms and excessive plant growth in streams that will reduce the dissolved oxygen content of surface waters through plant respiration and decomposition of dead algae and other plants. The problem can be accelerated in hot weather and low flow conditions because of the reduced capacity of the water to retain dissolved oxygen.
Sedimentation occurs when wind or water runoff carries soil particles from nearby land and transports them to a water body, such as a stream or lake. Sedimentation is very common near farmland because farmers are frequently tilling and cultivating the land which creates loose particles for transport. Excessive sedimentation clouds the water, reduces the amount of sunlight reaching aquatic plants, covers fish spawning areas and food supplies, and clogs the gills of fish. In addition, other pollutants like phosphorus and pathogens are often attached to the soil particles and are transported into the water bodies with the sediment.

	Kenton Co.	Banklick Watershed (est.)
Total Acres of Farm Land	46,479	15,493
Total Acres of Crop Land	26,577	8,859
Acres of Corn for Grain	94	31
Acres of Corn for Silage	231	77
Acres of Wheat	60	20
Acres of Tobacco	399	133
Acres for Forage (hay greenchop)	12,202	4,067
Acres for Vegetables	16	5
Acres for Orchards	17	6

Table 5.03-2 Farmland in Banklick Watershed

Data from the USDA NASS system shows over 26,000 acres of cropland in Kenton County with an estimated 8,800 acres located in Banklick Watershed. Nearly half of the cropland is used for forage, with corn, wheat, tobacco, vegetables, and orchards also in production. See Table 5.03-2 for a breakdown of acreages by crop type. Using fertilization data from the USDA Economic Research Service, fertilizer loadings in

Banklick Watershed are estimated to be more than 140,000 pounds per year, excluding manure spreading.

E. Stream Bank Erosion

Channelization includes any change to a stream that moves, straightens, shortens, or alters the current flow conditions of a stream. Most streams are channelized by shortening the stream or armoring the bottom and stream banks with concrete in order to increase the amount and speed of water leaving an area.

By moving the water out of an area faster, there will be less pooling and more of the area can be developed. Although channelization increases the amount of land for development, it has adverse effects on stream stability and water quality. Shortening the length of a stream increases the overall slope, increases the velocity of the water, boosts the stream's erosive power, and changes flood patterns, levels, and frequencies. Streams immediately upstream and downstream from channelized sections can be significantly altered because of the change in flow conditions. Channelization can also decrease water quality by decreasing the water's contact time with naturally occurring intermittent and ephemeral streams, which can act as pollutant filters.

Most farmers want to get the most usable farm land on their property, often channelizing the stream and removing riparian vegetation to increase the farmable area of their property. Removing riparian vegetation decreases bank stability, making the stream more susceptible to erosion. Riparian vegetation also acts as a natural filter for fertilizer, pesticides, and other chemicals in the runoff from an agricultural area. If there is insufficient riparian vegetation, pollutants will more easily reach the stream from agricultural nonpoint source runoff.

Riparian vegetation also shades the stream from the sun during the day, maintaining proper stream temperature. The removal of riparian vegetation allows the stream to be in direct sunlight at all times during the day, increasing the stream temperature and reducing the dissolved oxygen capacity of the water.

F. Construction

Construction is a significant contributor to nonpoint source pollution. Soil erosion from construction activities can contribute to filling of nearby waterways affecting water quality and aquatic habitats. In most areas, a number of best management practices (BMP) including silt fencing, straw bales, and turf seeding are required to control sediment during construction activities. As long as these practices are in place and followed, construction activities should not cause significant water quality impairment.

In the Banklick Watershed, SD1 has rules and regulations in place for managing stormwater runoff from construction sites. Outside of the SD1 service area in Banklick Watershed, the county stormwater regulations for construction sites apply.

Concerned citizens can help control pollution from construction sites by contacting the plan review department at SD1 to report any construction site that appears to have inadequate sediment and erosion control practices in place.

G. Wildlife

Wildlife contributes significantly to the number of bacteria and organic matter in stormwater runoff. Habitually, ducks and geese nest in colonies located in trees and bushes around rivers, streams, and lakes. The presence of waterfowl has been shown to result in elevated levels of ammonia, organic nitrogen, and *E.coli* bacteria (USGS 1997). Waterfowl activity can also increase sediment loadings by pulling up grasses and sprouts and trampling emergent vegetation along streambanks and shorelines, significantly impacting erosion and sediment. However, it should be noted that sediment loadings and erosion caused by waterfowl and other wildlife are suspected to be relatively small in comparison to loadings from anthropogenic activities and erosion induced by alterations of the natural flow regime in developed areas by stormwater systems.

H. Suspected Illicit Activity

Stormwater outlets are dispersed through much of the Banklick Watershed. Their density generally increases with development such that they are concentrated the highest in the northern and western portions of the watershed LTI. During SD1's stormwater mapping project (2001-2002), approximately 162 suspected illicit activity (SIA) points were identified. SIA's are locations where there is potential evidence of illicit discharges. Their concentration was also roughly commensurate with development density, with the highest occurrences in the north and west. The locations are being further investigated by SD1 to determine if they are recurrent.

5.04 SOURCE ASSESSMENT RESULTS

As part of the watershed characterization information presented in section 4.04, LTI performed source assessment of bacteria in Banklick Creek. LTI summarized these sources of bacteria in tabular (see Table 5.04-1) and geographical (see Figure 5.04-1) form. LTI clearly identifies suspected sources of fecal impairment in Banklick Creek as CSOs, SSOs, septic, KPDES outfalls, stormwater runoff, livestock, and Licking River backwater.

In addition, LTI produced a tool that assesses the potential for point and nonpoint sources to generate fecal coliform, phosphorus, and TSS pollutant loads. More details on the development of this tool can be found in Section 6.01.

TABLE 5.04-1

LIMNO TECH SOURCE ASSESSMENT

	Banklick Creek Headwaters to RM 8.2 (excluding Fowler Ck)	Fowler Creek	Bullock Pen	Banklick Creek RM 8.2 - mouth (excluding Bullock Pen)
Recent observed Impairments=>	Bacteria 303(d): Nutrients, organic enrichment [c] Flooding reported upstream to RM 10.3	Bacteria Flooding reported	Bacteria 303(d): Doe Run Lake DO, nutrients, dissolved gas supersaturation [d]	Bacteria[b] 303(d): Nutrients, organic enrichment, sedimentation/siltation[e] Flooding reported
CSO[a]				5
SSO[a]	4		15	6
SSO-pump station[a]				2
Septic	Numerous	Numerous 1 septic "hot spot"	Few	Few
KPDES-sanitary outfalls[f]	2	11	2	
KPDES-storm water/other outfalls[g]	2		4	12
Stormwater runoff	Urban and rural	Urban and rural	Urban; Small portion in Florence	Urban
Livestock	Cattle, horses		2 AFOs (cattle)	
Licking River backwater				Affects lower reaches of Banklick Creek
Watershed improvements	*Planned stream and wetland restoration along Banklick Creek in Wolsing preserve.* *3 projects planned on mainstem of Banklick Creek near RM 10.5, to address streambank erosion.*		*Doe Run Lake Master Plan developed to protect and enhance the lake and link the lake to adjacent areas using greenways, trails or stream corridors.*	*Several projects completed to increase capacity at, and divert flows from Lakeview PS to reduce overflows at PS and upstream.* *Latonia sewer separation project to reduce overflow from downstream CSOs.* *Bluegrass Swim Club sewer separation to reduce wet weather flows into sanitary system.* *Several improvement projects planned to divert flow from Lakeview PS to reduce overflows* *Madison Pike Corridor Study to maximize Banklick Creek as an asset.*

[a] SD1 is undertaking a characterization and assessment of the sewer system, and sources are subject to change.

[b] DO, pH and temperature violations have historically been observed at the USGS station, but recent data have not been reviewed.

[c] Agriculture and on-site treatment systems are identified as potential sources contributing to the impaired primary contact recreation and warm water aquatic habitat uses (KDOW, 2008).

[d] An upstream source and unknown source are identified as potential sources contributing to the impairment of the warm water aquatic habitat use (KDOW, 2008).

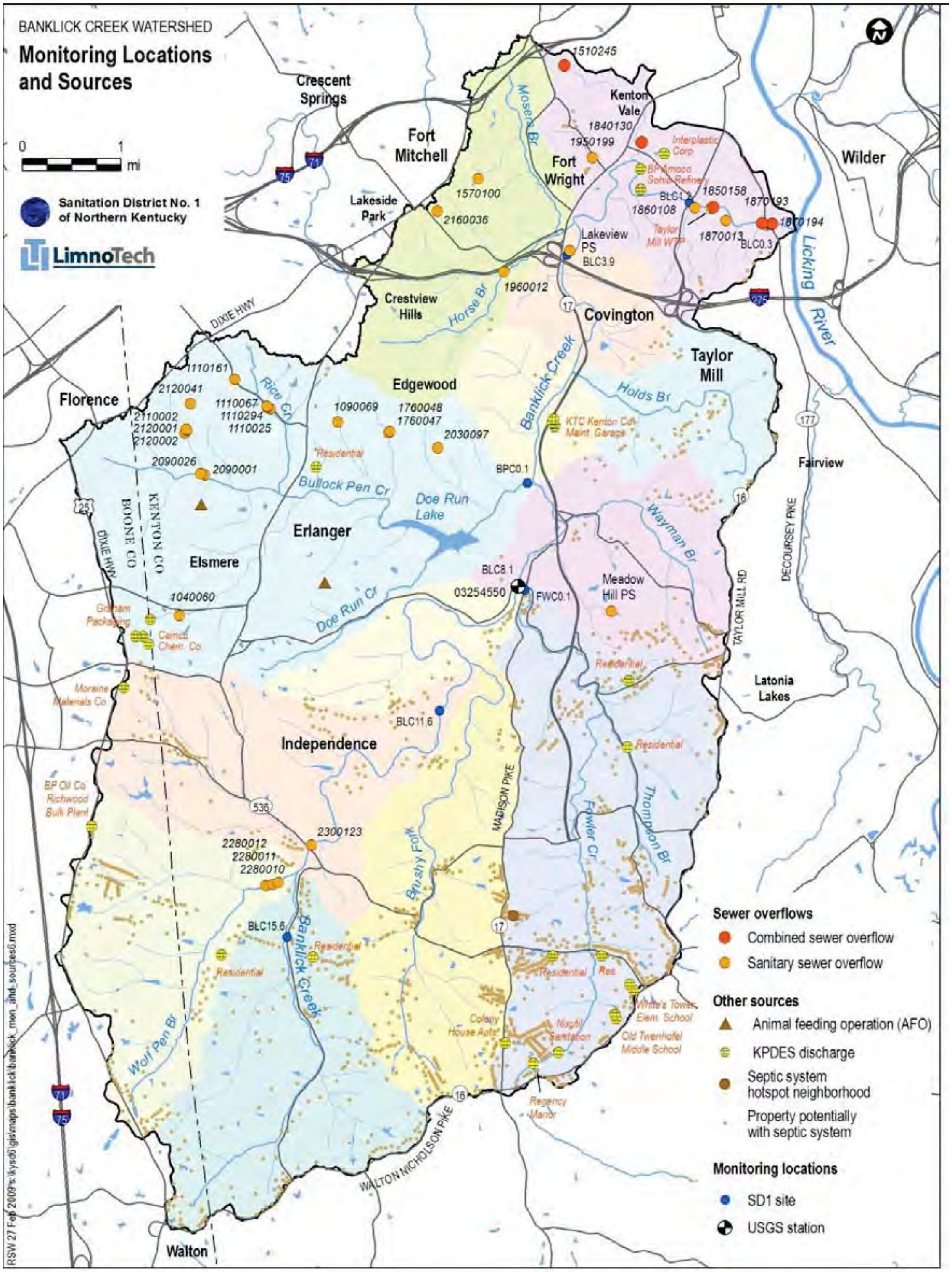
[e] Highways, roads bridges, infrastructure (new construction), municipal point source discharges, unspecified urban storm water runoff, urban runoff/storm sewers, agriculture and on-site treatment systems are identified as potential sources contributing to impairment of the primary contact recreation and warm water aquatic habitat uses (KDOW, 2008).

[f] Excludes CSOs. Includes currently permitted facilities only.

[g] One outfall is included twice because it covers sanitary and cooling water. Includes currently permitted facilities only.

FIGURE 5.04-1

CSO AND SSO LOCATIONS IN BANKLICK WATERSHED-LIMNO TECH



Based on the source-loading results modeled by LTI in this tool, pie charts were developed that graphically allocate loadings to the modeled sources. Figure 5.04-2 represents the total TSS loading allocation for the Banklick Watershed. This indicates that the major sources of TSS in the watershed are construction practices and streambank erosion. Figure 5.04-3 represents the total phosphorous loading allocation for the Banklick Watershed. In this case, the main sources of phosphorous include SSOs, developed lands, CSOs, and agriculture. Figure 5.04-4 represents the fecal loading allocation for the Banklick Watershed as a whole. As indicated on this chart, CSOs and SSOs represent approximately 45 percent of the total fecal loading in the Banklick Watershed, runoff from developed lands represents 36.5 percent of the fecal loading, and agricultural runoff represents 15.5 percent.

To more adequately define the sources of the impairments, pie charts were developed on a subwatershed basis. Figures 5.04-5 and 5.04-6 demonstrate the fecal loading allocation for a northern (downstream/urban) and southern (upstream/rural) subwatershed as a comparison of how the relative proportions of source-types change as one moves from upstream/rural to downstream/urban. In the downstream portion of the watershed (Banklick Creek Subwatershed 1), the fecal loading from CSOs and SSOs is 73.2 percent compared to 15 percent in Wolf Pen Branch, which is located in the uppermost section of the watershed (rural). Conversely the fecal loadings from developed lands and agriculture are 26.2 percent in the northern subwatershed and 79 percent in the southern subwatershed.

These critical differences in source-loadings between the more developed (northern) and less developed (southern) parts of the Banklick Watershed exemplify the rationale for calling out a "focus area" for the 319(h) grant project. Management strategies in the northern portion of the watershed fall more broadly under the jurisdiction of SD1 and often involve point source controls that are explicitly prohibited from using 319(h) funds. Conversely, the less developed upper portion of the watershed is dominated by nonpoint loadings where 319(h) approved management solutions will be both more effective and appropriate.

The subwatershed load allocation charts are extremely meaningful in the source assessment throughout Banklick Watershed. All pie charts can be found in Appendix G while the charts for the five subwatersheds within the focus area are presented in Section 7.

Section 7 describes how the source allocation results from this section were utilized to determine the appropriate management measures for the Banklick Watershed. First, section 6 will discuss necessary load reductions, as well as some of the previous progress that has been made in the watershed already.

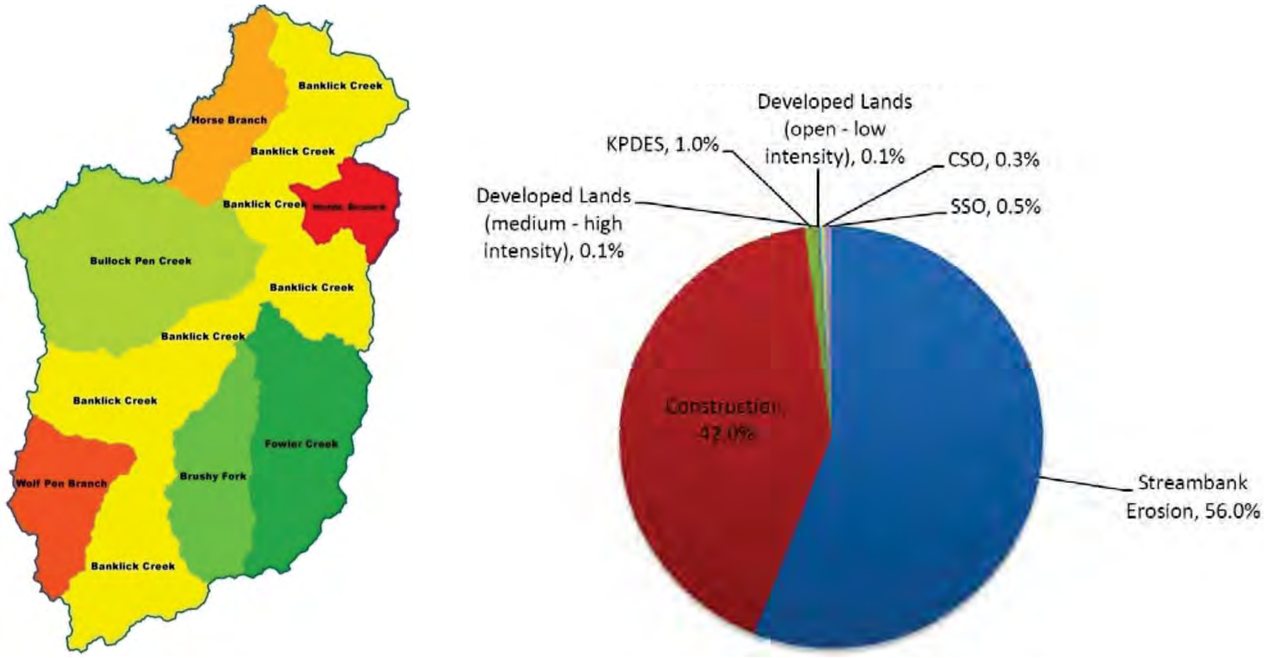


Figure 5.04-2 Total Suspended Solids Loading Allocation in Banklick Watershed

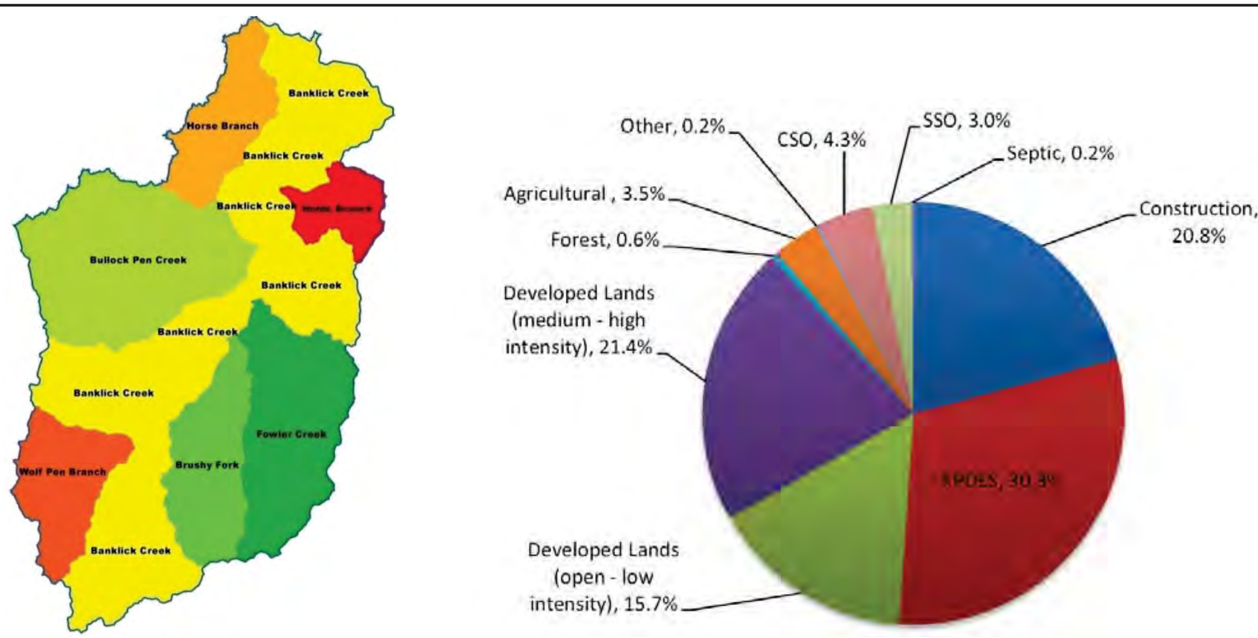


Figure 5.04-3 Total Phosphorous Loading Allocation in Banklick Watershed

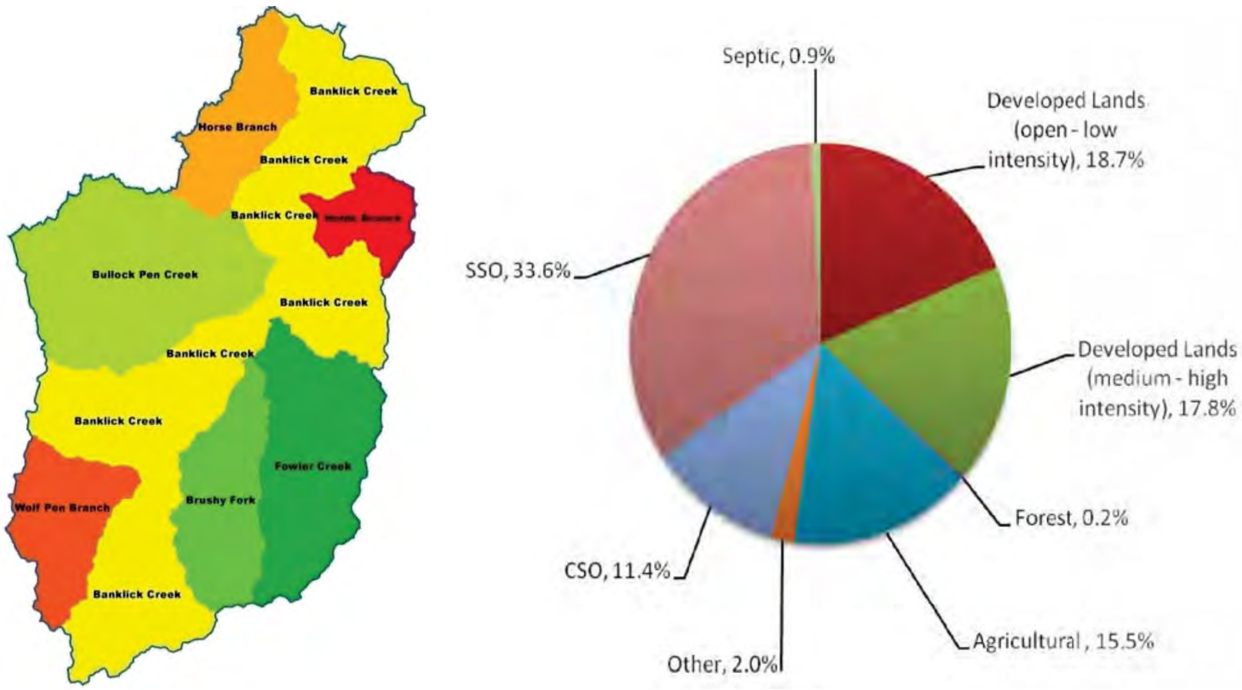


Figure 5.04-4 Fecal Loading Allocation in Banklick Watershed

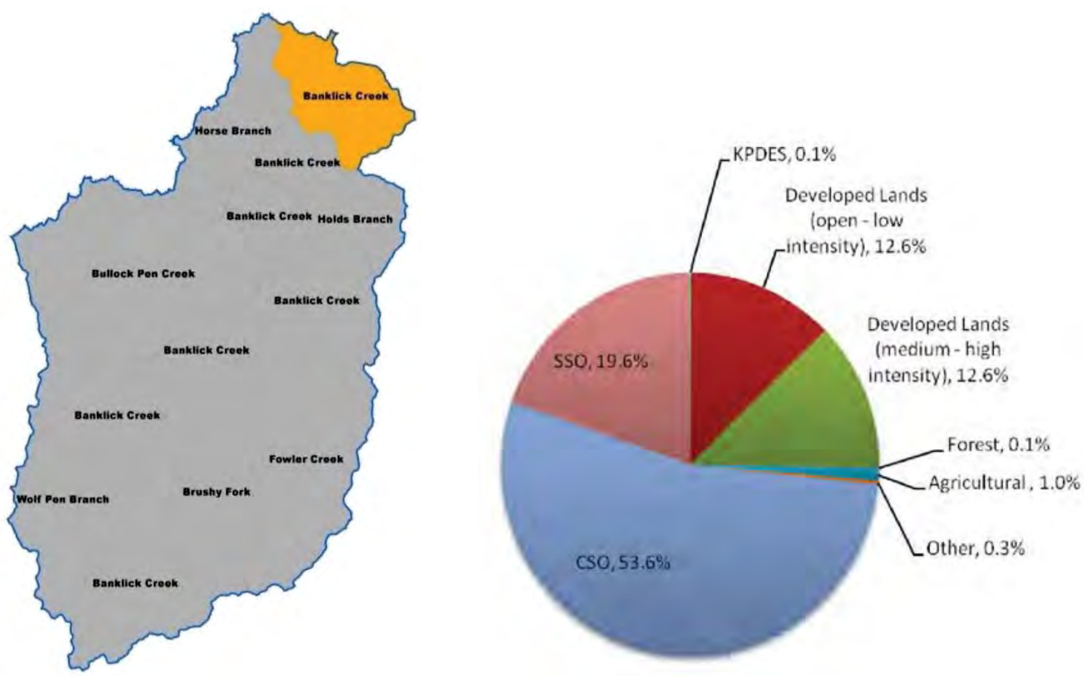


Figure 5.04-5 Fecal Loading Allocation in Banklick Creek Subwatershed 1 (downstream/urban)

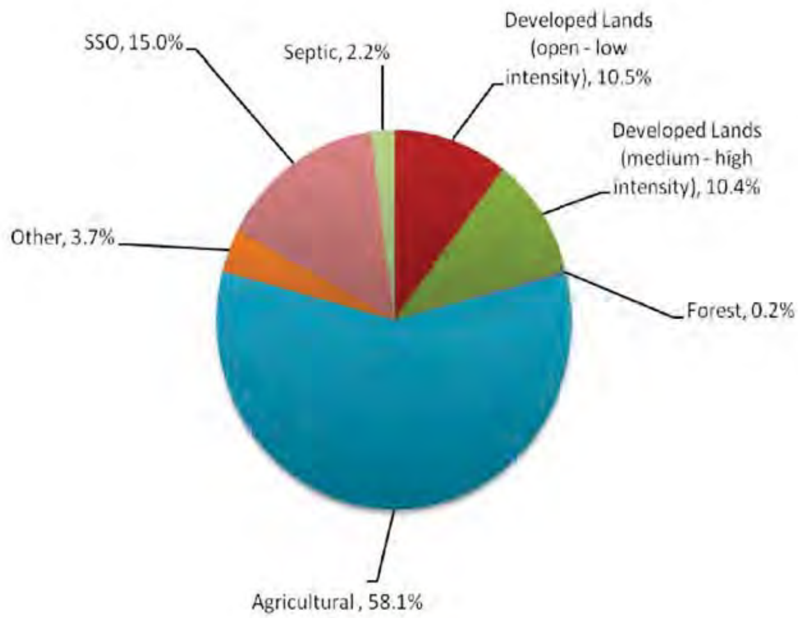


Figure 5.04-6 Fecal Loading Allocation in Wolf Pen Branch Subwatershed (upstream/rural)

6.01 INTRODUCTION

Many organizations have contributed a significant amount of work to be able to have such a detailed characterization of the Banklick watershed and its challenges. The water quality data and source assessment has been presented in the previous two sections. This section presents an estimate of load reductions that are necessary to bring the Banklick into compliance with water quality standards and also discusses some progress that has already been made toward achieving those goals.

6.02 LOAD REDUCTIONS

The BWC and this watershed based plan have benefited from an invaluable partnership with SD1 who has made the results of a substantial water quality modeling effort available for this report. Rather than performing a separate round of modeling that would have necessarily been at a much coarser scale, the BWC elected to use the results of the SD1 modeling. To realize efficiencies in its detailed modeling, SD1 selected three specific parameters to represent the major water quality impairments: fecal coliform for bacteria, TSS for sediment, and phosphorus for nutrients. The fecal coliform loadings are the most refined, while TSS and phosphorus data are yet to be calibrated and are considered preliminary. Yet, it could be assumed that even the preliminary results were generated from a level of effort that would not be attainable within the confines of this project budget were the BWC to elect to calibrate its own models from field data. If SD1 further refines the TSS and Phosphorous data in the future, the information in this watershed plan could be updated to reflect the most recent data available.

According to the SD1 Watershed Plan, the Banklick Watershed model was developed using Hydrologic Simulation Program in Fortran, a USEPA supported watershed model. The model was originally developed in 2004 as part of a federal grant to develop to apply a Watershed Assessment Protocol to understand water quality problems on a watershed basis (LTI, 2004). The model was recently updated to incorporate a more detailed land cover analysis and to link dry weather and wet weather loads to in-stream densities of fecal coliform. The model was calibrated in a step-wise fashion. First, the hydrology was calibrated to two years of data (2002 and 2003), then a dry weather load was calibrated to five years of fecal coliform data (2002 to 2007), and finally, the wet weather calibration and validation were conducted using wet weather data from four storms (one in 2008 and three in 2002 and 2003). Runoff characteristics from each primary land use/cover were constrained to values within the ranges of runoff concentrations found in the literature or measured by SD1. This data used for the Banklick Watershed plan is a simplified evaluation based on these planning level abstractions from more detailed models.

The watershed and water quality models were developed in conjunction with infrastructure models. The models were applied for a typical period of rainfall to:

1. Define the impact of current stressors on in stream water quality.
2. Identify important sources under different environmental conditions.
3. Forecast the impacts and benefits of different land development and pollutant scenarios.
4. Control scenarios.
5. Identify data gaps.

The models integrate watershed and water quality data and define the link between sources of bacteria and water quality impacts. The models calculate in-stream bacteria densities for each hour of the simulation along the length of tributaries and mainstem streams. The models were developed (or updated) using:

1. In-stream dry weather and wet weather monitoring.
2. Infrastructure model calculations of sewer overflows.
3. CSO, SSO, and stormwater outfall sampling data.
4. Updated land use/land cover data.
5. Other information such as soils, topography/elevation, meteorological, and stream.
6. Bathymetric and hydraulic and KPDES-permitted facilities' data.

A detailed memorandum on the model calibration methodology in Banklick Watershed can be found in Appendix H.

As stated in Section 4 of this document, water quality standard require that the fecal coliform or *Escherichia coli* in the Banklick Creek must "…not exceed 200 colonies per 100 mL or 130 colonies per 100 ml respectively as a geometric mean based on not less than five samples taken during a 30-day period. Content also shall not exceed 400 colonies per 100 mL in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies per 100 mL for *Escherichia coli*. [These limits shall be applicable during the recreation season of May 1 through October 31.]"

The current estimated annual loading of fecal coliform is broken down by subwatershed as shown in Table 6.02-1. The concentrations in Table 6.02-1 were calculated from the modeled annual fecal loadings by LTI distributed over the total annual river flow volume and can be best thought of as the arithmetic means. These annual mean fecal concentration values may seem high; however, they are a reflection of many years of data collection and rigorous modeling by SD1 and their consultants. It should be noted that although the level of water quality analysis by SD1 far exceeded the capacity of a typical 319(h)-funded project, the load allocations did come with constraints that could have resulted in a potential overestimation of mean annual fecal concentrations presented in this report. First, although fecal concentrations are typically summarized by their geometric mean, there is no mathematical way to express total annual loadings on a geometric scale without rigorous modeling, and as such these calculations are necessarily expressed on an arithmetic scale. Arithmetic means are typically higher than geometric means; however, they generally tend to be on the same order of magnitude, especially for large data sets. Further, these calculations do not account for losses such as fecal coliform broken down by vegetation, or in stream fate. To validate the methodology used in this report, Strand summarized all available raw data from SD1 on both geometric and arithmetic scales, which confirmed that the concentrations presented herein were on the same order of magnitude as actual in-stream samples. All data and methodologies point to a consistent conclusion that bacteria loadings and resulting concentrations are considerably high throughout the Banklick watershed, generally on the order of 100,000 cfu/ 100 mL, which is two to three orders of magnitude higher than water quality standards (i.e. 100 - 1,000 cfu/ 100 mL).

	Modeled Annual Fecal Loading (Trillions of cfu)	Estimated Mean Annual Concentration* (cfus/100mL)
Banklick Creek 1	3,119	67,556
Horse Branch	2,069	39,487
Banklick Creek 3	1,553	75,068
Holds Branch	779	26,778
Banklick Creek 5	2,582	130,615
Bullock Pen Creek	4,127	30,304
Banklick Creek 7	1,026	21,799
Fowler Creek	1,043	10,608
Banklick Creek 9	320	14,173
Brushy Fork	652	10,092
Banklick Creek 11	1,811	27,708
Wolf Pen Branch	972	17,652
Banklick Creek 13	1,129	16,883

*arithmetic mean based on modeled annual loadings and average annual flow volume

Table 6.02-1 Estimated Annual Fecal Loading by Subwatershed

Average annual river flow volumes were estimated through a variety of techniques, including the Soil Conservation Service (SCS) curve number method and rainfall runoff models. The surface runoff methods provided reasonable estimates of overland flow, but neglected baseflows from groundwater. A detailed analysis of the USGS gauge on Banklick Creek at RM 8.0 showed that dry weather base flows account for nearly half of the total volume of average annual flow. Accordingly, we calibrated a simple mass balance model based on precipitation inputs and outputs of both riverflow and evapotranspiration. The model assumes that the system over annual/decadal scales is in relative equilibrium such that there are no long-term changes in total groundwater storage. Based on average annual rainfall and 9 years of gauge data (April 1, 1999 to March 31, 2008), approximately 46 percent of annual precipitation is converted into streamflow through either direct runoff or subsurface pathways in the upper portion of the Banklick Creek Watershed. This ratio is roughly consistent with coarse estimates of average rates for North America, e.g. 43 percent (Lvovitch, 1973), 37 percent (Baumgartner and Recichel, 1975), and 45 percent (Korzoun et al., 1977), as well as the global average of 42 percent (Budyko 1970, 1974). As such, the simple mass balance ratio method was considered appropriate for average annual volumes for all of the subwatersheds.

To meet the WQS, the necessary reduction in fecal coliform in each subwatershed is shown in Table 6.02-2. The overall objective of the management measures recommended in Section 7 of this plan is to reduce the annual fecal loadings by the extent demonstrated in Table 6.02-2 in an effort to attain water quality standards. No numeric WQS's are available for phosphorous and TSS at this time. Rather than try to determine an appropriate load reduction target without WQS or guidance, this watershed plan utilizes the WQS for fecal coliform as a surrogate target value to determine the necessary management measures for the watershed. Based on these management measures, the resulting reductions in phosphorous and TSS will be calculated for documentation of progress (see Section 7.09). If future WQS are developed for phosphorous and TSS and funding becomes available, this plan will be updated to reflect these values as the targets for load reductions.

The estimated annual loading of TSS by subwatershed is shown in Table 6.02-3. The TSS loading ranges from 91mg/L to 638.94 mg/L.

Estimates of annual loading of phosphorous by subwatershed is provided in Table 6.02-4., ranging 0.30 mg/L to 5.23 mg/L.

TABLE 6.02-2 NECESSARY FECAL LOAD REDUCTIONS TO ACHIEVE COMPLIANCE WITH WATER QUALITY STANDARDS BASED ON ESTIMATED MEAN ANNUAL CONCENTRATION

	Estimated Annual River Flow Volume** (MG)	Modeled Annual Fecal Loading (Trillions of cfu)	Estimated Mean Annual Concentration* (cfus/100mL)	Water Quality Standards (cfu/100mL)	Necessary Load Reduction to Achieve WQS
Banklick Creek 1	1,220	3,119	67,556	400	99.4%
Horse Branch	1,384	2,069	39,487	400	99.0%
Banklick Creek 3	546	1,553	75,068	400	99.5%
Holds Branch	768	779	26,778	400	98.5%
Banklick Creek 5	522	2,582	130,615	400	99.7%
Bullock Pen Creek	3,598	4,127	30,304	400	98.7%
Banklick Creek 7	1,243	1,026	21,799	400	98.2%
Fowler Creek	2,596	1,043	10,608	400	96.2%
Banklick Creek 9	596	320	14,173	400	97.2%
Brushy Fork	1,708	652	10,092	400	96.0%
Banklick Creek 11	1,727	1,811	27,708	400	98.6%
Wolf Pen Branch	1,455	972	17,652	400	97.7%
Banklick Creek 13	1,766	1,129	16,883	400	97.6%

*arithmetic mean based on modeled annual loadings and average annual flow volume
** calibrated to gauge data based on approximately 46 percent of mean annual precipitation converted into river flow via surface or groundwater

TABLE 6.02-3

ESTIMATED TOTAL LOADING OF TOTAL SUSPENDED SOLIDS IN BANKLICK BY SUBWATERSHED

	Annual Surface and Ground water Volume (MG)	Estimated Annual TSS Loading (Kg)	Annual Loading Concentration (mg/L)
Banklick Creek 1	1,220	662,268	143
Horse Branch	1,384	481,415	92
Banklick Creek 3	546	283,404	137
Holds Branch	768	296,350	102
Banklick Creek 5	522	208,964	106
Bullock Pen Creek	3,598	8,701,784	639
Banklick Creek 7	1,243	507,367	108
Fowler Creek	2,596	1,276,336	130
Banklick Creek 9	596	227,849	101
Brushy Fork	1,708	862,399	133
Banklick Creek 11	1,727	880,583	135
Wolf Pen Branch	1,455	772,198	140
Banklick Creek 13	1,766	950,628	142

TABLE 6.02-4

ESTIMATED TOTAL LOAD OF PHOSPHOROUS IN BANKLICK BY SUBWATERSHED

	Annual Surface and Ground water Volume (MG)	Estimated Annual Phosphorus Loading (Kg)	Annual Loading Concentration (mg/L)
Banklick Creek 1	1,220	24,136	5.23
Horse Branch	1,384	6,164	1.18
Banklick Creek 3	546	2,614	1.26
Holds Branch	768	2,393	0.82
Banklick Creek 5	522	1,228	0.62
Bullock Pen Creek	3,598	15,918	1.17
Banklick Creek 7	1,243	1,426	0.30
Fowler Creek	2,596	3,771	0.38
Banklick Creek 9	596	502	0.22
Brushy Fork	1,708	2,024	0.31
Banklick Creek 11	1,727	3,724	0.57
Wolf Pen Branch	1,455	2,131	0.39
Banklick Creek 13	1,766	2,349	0.35

6.03 PREVIOUS PROGRESS

As listed in the following, substantial efforts have been and continue to be undertaken to reduce water quality impairments and improve the health of Banklick Creek. These efforts are included in this watershed plan to tell the story of the watershed and demonstrate the dedication and investment that has been made in the Banklick Watershed over time. These efforts have not been evaluated with respect to the water quality data presented in Section 6.02 because that data was being collected as these efforts were ongoing. Section 7 will begin to link the water quality data to the proposed management measures. The following projects that have occurred in the Banklick Watershed are categorized in the BWC's four main goals, Clean the Water, Reduce Flooding, Restore the Banks, and Honor the Heritage.

A. Clean The Water

1. The KDOW has designed a planning document entitled *Basin Monitoring Plan 2004-2005–Strategic Monitoring Salt and Licking Rivers* to guide water quality monitoring and assessment in relation to landuse/cover types to attain the best characterization of water quality resources.

2. The 2004 *Watershed Assessment Protocol–Application to Banklick*, prepared for SD1, outlines a standardized approach for assessing water quality, identifying water quality impairments and sources of impairment, linking sources to the impairments, and ranking those sources. Another document prepared for SD1, *Habitat and Biological Community Assessment of Banklick Creek*, presents data and analyses of present stream conditions.

3. The NKIHD has designated surface water quality as a priority health concern in its *2005 Master Health Plan*. The Health District took the lead in collaborating with other organizations to prepare a Section 319 grant application for septic system repair to USEPA to address pathogens and other pollutants in Banklick Creek and other Northern Kentucky watersheds. Although the project was not funded, the grant application may be revised and resubmitted in the future.

4. Kenton Paw Park, a dog park in Kenton County, now has signage and pet waste disposal items to encourage dog owners to clean up after their pets. Some areas in Banklick Watershed have an ordinance on pet waste. Other park signage warns patrons of unsafe waters. See Figure 6.03-1.

5. Banklick Watershed Council printed 12-page informational booklets called *Life at the Waters Edge–Living in Harmony with Your Backyard Stream*. The brochures provide contact information and additional resources for riparian landowners.

Figure 6.03-1 No Wading Sign and Playground Equipment at Pioneer Park

6. SD1 has developed and is implementing a long-term program for stormwater management, in accordance with requirements of the federal Stormwater Phase II requirements of the CWA. The plan encompasses management of stormwater to mitigate flooding, erosion and sedimentation from all land uses, and extensive public outreach programs. In response to the requirement to provide public outreach, SD1 has opened an award-winning regional stormwater park designed to illustrate Best Management Practices (BMPs) and educate all age groups about water quality and quantity, see Figure 6.03-2. Aside from SD1's development regulations, no other local regulations or ordinances are currently in place to improve or protect water quality in the Banklick Watershed.

Figure 6.03-2 SD1 Public Service Park

7. The Kenton County Fiscal Court, through a collaborative effort with NKAPC, has established a 50-foot required riparian buffer in the headwaters of Banklick. Forty acres in the headwaters are currently in conservation through the efforts of the Kenton Conservancy.

8. The KCCD, a governmental subdivision of the state organized under Kentucky Revised Statute 262, is responsible for local administration of the Kentucky Agriculture Water Quality Act (KAWQA). The KAWQA requires landowners with 10 or more acres to develop and implement a plan to protect surface and ground water from pollution because of agricultural or forestry activities. Landowners are not required to file their water quality plan with any governmental agency, but a self-certification form should be filed with the local Conservation District office. By signing this form, landowners certify they understand the requirements of the KAWQA and that they have developed a water quality plan for their operation. Working with the KCCD, the USDA Natural Resources Conservation Service provides technical and financial assistance for remediation of agricultural pollution. These agencies administer funds that are available to landowners through the Federal Farm Bill, the Kentucky Soil Erosion and Water Quality Cost Share Program, and other related federal and state programs.

   The following table shows the principal conservation programs that can be accessed through the Kenton County Conservation District.

Kentucky Division of Conservation		Soil Erosion and Water Quality Cost Share Program
		Farm-dump cleanup assistance
		Dead animal (livestock) removal program
Federal Emergency Management Agency	FEMA-HMGP	FEMA-KY Emergency Management Hazard Mitigation Grant Program
US Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS)	EQIP	Environmental Quality Incentives
	WHIP	Wildlife Habitat Incentives Program
	WRP	Wetland Reserve Program
	CRP	Conservation Reserve Program
	EWPP	Emergency Watershed Protection Program

Table 6.03-1 Principal Conservation Programs through Kenton County Conservation District

9. Water quality monitoring of Banklick Creek is periodically conducted by volunteers for the LRWW. Doe Run Lake also has been monitored since 1991 by staff and supervisors of the KCCD.

According to the 2008 Banklick Creek Watershed Characterization Report, SD1 has completed numerous projects and studies, including the following:

1. The first study was conducted to understand the impacts of CSOs on Banklick Creek and the lower Licking River (LTI, 1998).

2. SD1 then participated in the Ohio River Valley Water Sanitation Commission's (ORSANCO) wet weather demonstration program to evaluate CSO impacts on the Ohio River (ORSANCO, 2002).

3. Both studies determined that CSOs were contributing to exceedances of recreational use criteria but were not impacting aquatic life.

4. In 2004, SD1 obtained a federal grant to assess the feasibility of a watershed approach for reducing impacts of pollutants on Banklick Creek. The study identified that sources such as runoff, failing septic tanks, straight pipe discharges, streambank erosion, and livestock were contributing to water quality problems (LTI, 2004). This study justified SD1's incorporation of watershed monitoring and modeling into its budget so that resources could be used to gather information and develop tools to better evaluate sources of pollutants.

5. In 2006, SD1 increased its data collection efforts to further characterize the sewer systems and the area's streams and rivers to better understand the relationship between the two systems in preparation for the Watershed Plans. Watershed characterization included dry and wet weather-related stream monitoring and watershed model development and analysis.

6. Lakeview Pump Station Capacity Upgrade, completed in 2005, involved the repair and rehabilitation of the existing pump station and increased the capacity of the Lakeview Pump Station to approximately 22 mgd, reducing overflows at the pump station bypass and upstream as well.

7. Banklick Pump Station Screening Facility project, completed in 2006, installed a new bar screen to remove solids and floatables that were clogging the pumps and preventing the pump station from running properly during wet weather. The pump station can now run continuously without clogging, reducing the frequency and volume of CSOs upstream.

8. The Wilson Road Sewer Assessment project was completed in 2005 and involved extending sewer lines, allowing six properties the opportunity to connect to sewer service.

9. The Taylor Mill Sewer Assessment project was completed in 2005 and involved extending sewer lines, allowing 15 properties the opportunity to connect to sewer service.

10. The Pleasure Isle Sewer Assessment project was completed in 2005 and involved extending sewer lines, allowing 10 properties the opportunity to connect to sewer service.

11. The Cadillac Drive Sewer Assessment project was completed in 1999 and involved extending sewer lines, allowing 73 properties the opportunity to connect to sewer service.

12. Brookwood Subdivision SSES Study, completed in 2006, evaluated the sanitary sewer and storm sewers in the Brookwood subdivision to identify locations of stormwater inflow and infiltration (I/I) into the separate sanitary sewer system to identify projects that will mitigate identified I/I. Flows from this area contribute to the Lakeview pump station service area.

13. Stevenson Road Relief Sewer Project Phase II project, completed in 2006, was constructed to increase the wet weather capacity in the Lakeview pump station service area collection system to reduce the frequency and volume of known SSOs.

14. McMillan Pump Station Removal project, completed in 2006, provided increased dry and wet weather sewer capacity by constructing a new sewer to eliminate an existing maintenance intensive pump station.

15. Apple Drive Sewer Outfall project, completed in 2006, extended sanitary sewer service to remove a package treatment plant.

16. Kentucky Transportation Cabinet–KY17/Pelly to Nicholson project, completed in 2006, relocated and upsized existing sewers to provide additional dry and wet weather capacity in an area upstream of Lakeview pump station.

17. Fort Wright Sanitary Sewer Rehabilitation project, completed in 2006, was a result of the Fort Wright Illicit Discharge Removal Project and installed new sanitary and storm sewers to separate sanitary and storm flows in this area. This project resulted in eliminating sewage from getting into existing storm sewers and the local creeks and reduced wet weather flow tributary to the Lakeview pump station service area, thereby reducing overflows downstream.

18. Fort Wright Outfall Sewer Phase II, completed in 2006, constructed a new sanitary sewer to remove the existing sanitary sewer from the creek, thereby reducing inflow and infiltration from storm and creek water into the sanitary sewer.

19. South Hills Outfall, completed in 2007, included the construction of a new 24-inch sewer via horizontal directional drilling on grade (first in the country of this size and slope) to eliminate a CSO at a street intersection. This new sewer has been successful in diverting combined sewer flows from the Lakeview pump station service area and into the Bromley pump station combined sewer service area, thereby consolidating flows within the combined system and reducing overflow volume at the Lakeview pump station. This project also eliminated a failing sewer located within a landslide area that has resulted in past sanitary sewer overflows.

20. Latonia Combined Sewer Separation project, first phase completed in 2007, provided sewer separation through the construction of a new storm sewer to separate and intercept stormwater flow to keep it out of the combined sewers in Latonia. This project

has helped to reduce basement backups in this area and reduce the overflow volume from downstream CSOs. Additional phases of this work could be completed in the future if monitoring proves that it would be beneficial.

Figure 6.03-3 Flooding in Banklick Watershed

21. Bluegrass Swim Club Sewer Separation, completed in 2007, removed existing stormwater connections to the sanitary sewers in Fort Wright, thereby reducing wet weather flows in SD1's sanitary sewer system.

B. <u>Reduce Flooding</u>

1. The USACE–Louisville District completed a flood damage reduction feasibility study advocating measures to control flooding. Possible measures included purchase of properties in the floodway and restoration of wetlands and other natural habitats in the floodplain. The recommendations made by the USACE should be taken into account in future action plans. See Figure 6.03-3 for an image of flooding in Banklick.

2. Measures outlined in SD1's Stormwater Management Plan are being implemented to mitigate stormwater impacts. An interactive stormwater model developed by SD1 helps to assess the effectiveness of various BMPs.

3. In the City of Fort Wright, a stormwater disconnect program is underway to direct rooftop drainage into local soils and away from the sewer system. Such disconnections decrease water volumes entering sewers and, ultimately, streams during wet weather. In additon, such actions can recharge groundwater levels and potentially augment base-level flows in streams during dry weather, which can be an added biological benefit to the flood control measure.

4. The Kenton County *2001 Areawide Comprehensive Plan* calls for special zoning and building restrictions in flood-prone areas. Both Kenton and Boone counties consider watersheds and watershed issues in planning for growth.

5. The USGS installed a stream flow gauge at Banklick Creek mile 8.0 near Richardson Road in 1999 that provides data to understand and manage flooding. Data collected by the gauge also is helping discern long-term flow patterns.

6. The KCCD has distributed publications and sponsored numerous workshops and other educational events on erosion and sediment control aimed at public officials, developers, and contractors. Effective controls are aimed at reducing the amount of sediment and associated pollutants in our streams.

7. Kenton County's Homeland Security and Emergency Management Agency (HSEM) coordinates government emergency services to ensure that needs of the public are met during disasters, including floods. HSEM coordinates Project Impact, a federal program to encourage building disaster-resistant communities. Further, the HSEM works with communities to develop predisaster action plans to minimize loss of life and property when emergencies occur.

8. A group of developers, planners, public officials, and environmental leaders has created the Local Alliance for Nature and Development (LAND). LAND is planning to implement a development project that would showcase and promote BMPs aimed at minimizing stormwater runoff during project development and maintenance. Aspects of LAND's efforts are also related to the goal of restoring the banks.

C. Restore the Banks

Several project partners and cooperating agencies worked together on the Banklick Creek Watershed Analysis and Issue Characterization for Education and Outreach (BACE), which focused on forest resources. The resulting GIS analysis has been used to identify critical areas for protection and restoration. Data generated by the study has increased understanding of the watershed's resources and will also help establish watershed priorities.

1. Groups in the watershed are in various stages of developing and planning greenways that will optimally promote reforestation and recreational use as well as raise community awareness of the importance of green corridors to protect streams and link wildlife habitat. Among the watershed entities involved in greenway development are the cities of Erlanger and Fort Wright, the Doe Run Lake advisory group, and the NKAPC.

2. The KCCD, Boone County Conservation District, and USDA Natural Resources Conservation Service continue to promote riparian buffers as a first line of defense to prevent erosion of streambanks and sedimentation of streambeds. State and federal cost share programs are available for the implementation of related BMPs.

3. The Kenton and Boone County Conservancies have been formed in the last few years as local land trusts. Both seek to protect green space though a variety of mechanisms, including conservation easements. In the past years, Conservancy members, developers, and landowners have worked together to place more than 40 acres along Banklick Creek into conservation.

Figure 6.03-4 Stream Signs Raise Awareness of the Banklick Creek

D. Honor the Heritage

The Banklick watershed not only has rich and varied natural resources but also rich and varied cultural resources. Small cemeteries still carry the names of pioneer farmers who settled the area two centuries ago, while artifacts collected near industrial sites along KY 17 have revealed a Native American encampment. Small bands of both Union and Confederate soldiers came though the area during the Civil War. The site of the present day Latonia Shopping Plaza, from 1883 to 1939, was the location of Latonia Racetrack, one of the foremost racetracks in the world at that time. Many aspects of the cultural history of the watershed have been documented by the Behringer-Crawford Museum in Covington and in *Northern Kentucky Heritage* magazine.

1. Signage placed at several locations in the watershed within recent years has made citizens aware of the location of Banklick Creek. See Figure 6.03-4.

2. Critical natural areas for protection and restoration have been identified through the BACE study.

3. Neighborhood organizations such as garden clubs and groups such as the East Ritte's Corner group in Latonia form a base for other possible activities that could honor or preserve aspects of the natural and cultural heritage of the watershed.

7.01 INTRODUCTION

The load reduction goals stated in Section 6 of this document are not easily achievable goals. The previous efforts to improve water quality are a start, but there is a long way to go to achieve WQS. This section will begin to tie all of the information presented so far together to form the recommended management measures for the Banklick Watershed. It is so important to bring together the background and characterization of the watershed, the water quality data, the source allocation results, and the necessary load reductions, to determine the most meaningful management measures.

The Banklick Watershed is in a unique position because of the commitment that SD1 is making to remediate the point sources of pollution. The SD1 Consent Decree is unique in that it incorporates a watershed-based approach into traditional wet weather improvement programs. This Consent Decree was specifically crafted by the USEPA, the Cabinet, and SD1 to allow for a program that evaluates water pollution control needs using a holistic, watershed management approach. SD1 is required to develop, submit, and implement Watershed Plans, with subsequent 5-year updates, to accomplish specific goals by no later than December 31, 2025.

The resulting efforts by SD1 will be substantial, as evident by the list of ongoing and planned projects presented below (Section 7.02). This allows BWC and other community groups to more appropriately and effectively target subwatersheds where nonpoint source controls are the primary management strategy as presented in detail in Section 7.03.

7.02 ONGOING/PLANNED PROJECTS BY SANITATION DISTRICT NO. 1

According to SD1's Draft Watershed Plan, submitted in June 2009, the goal of the 5-year improvement program is to achieve the greatest water quality and public health improvement, through a cost-effective, integrated approach that considers both dry and wet weather-related sources of pollution. This approach utilizes SD1's extensive characterization to identify the most effective ways to maximize improvements to water quality, and unlike traditional approaches, considers pollution sources other than just CSOs and SSOs. According to the 2008 Banklick Watershed Characterization Report, SD1 has several ongoing and planned projects for the Banklick Watershed including:

1. Western Regional: Narrows Road Diversion Pump Station and Industrial Road Force Main. This project will divert flow from the Lakeview pump station service area, which experiences overflows at the pump station and from manholes upstream. This project will (1) free up capacity at the Dry Creek Treatment Plant and (2) increase capacity in the conveyance system tributary to Lakeview, decreasing overflows in this system.

2. Western Regional: Kentucky Transportation Cabinet–Turkeyfoot Road Force Main, partially completed, is the first construction piece of the new Diversion Pump Station system that will eventually divert flow from the Lakeview Pump Station service area.

3. Three locations where the sewerline crosses Banklick Creek are being fixed using stream stabilization techniques such as J hooks and riffles to stop headcutting. These are located along the mainstem of Banklick Creek, just upstream of Banklick Woods

Park. Another manhole and exposed pipe are being surveyed to determine the best solution for that site, which is also along the mainstem of Banklick Creek, near RM 9.5.

Project information is presented in Table 7.02-1.

Capital Improvement Project Title	Goals	Anticipated Start Date	Anticipated Completion Date	Project Total
Western Regional - Narrows Road Diversion Pump Station	Decrease overflows in the Lakeview service area	2010	2013	$11,565,000
Western Regional - Turkeyfoot Industrial Road Force Main	Decrease overflows in the Lakeview service area	2010	2013	$3,045,000
Stream crossing projects and problem manhole	Decrease potential for stream inflow into District sanitary sewers	To be determined	To be determined	To be determined

Table 7.02-1 Ongoing or Planned Infrastructure Improvement Projects

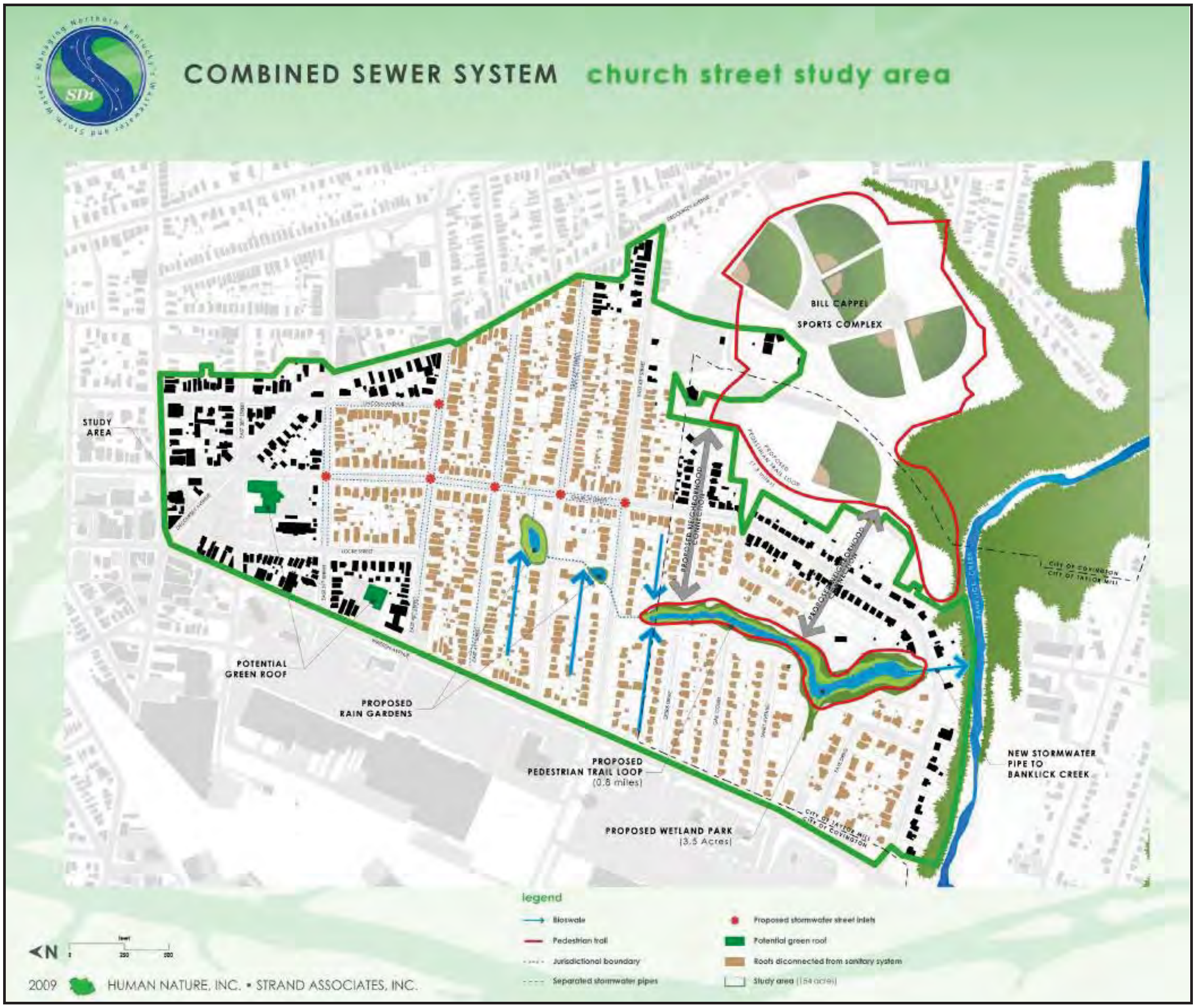
According to the SD1 Draft Watershed Plan, submitted in June 2009, there are several opportunities for the use of green and watershed controls in the Banklick Watershed. SD1 has identified possible locations for the use of green and watershed controls throughout the Banklick Creek as follows.

1. The Church Street Priority Area includes three CSOs along Banklick Creek, near its confluence with the Licking River. Key components of the solution included strategic separation of street inlets and disconnection of downspouts from residential properties. The heart of the green infrastructure solution for the Church Street Priority Area is a 3.5-acre stormwater wetland park. The proposed wetland is located in an existing low-lying area behind residential properties near Church Street. This area would be bordered by a 0.8-mile pedestrian trail loop through restored habitat. Native wetland plants and amended soils provide a valuable, natural filter for stormwater before it flows directly into the Banklick Creek. Figure 7.02-1 shows the Church Street Green Infrastructure Concept Plan.

2. Components of the green infrastructure components will be phased over several years. Once all phases of this concept plan are complete, the constructed stormwater wetland will have the ability to intercept runoff from the upstream drainage area that currently enters the combined system. A total of 103 acres (of both pervious and impervious acreage) is being targeted for removal from the combined system. In addition, stormwater inlets to the combined sewers under the Church Street swale can be eliminated, and several locations along the combined sewers can be repaired to reduce infiltration.

FIGURE 7.02-1

CHURCH STREET GREEN INFRASTRUCTURE CONCEPT PLAN



Source: SD1 Draft Watershed Plan, June 2009

3. These improvements in the Church Street system drainage basin would decrease the number of Church Street CSO activations during the typical year storm from 74 to 55, and the overflow volume from 56 to 24 MG (for current conditions). With the reduction in overflow volume, the storage tank size for the pure gray solution would also become smaller. According to the Draft Watershed Plan, the initial phase of this project will be completed as part of the first set of Watershed Plan projects.

Several opportunities for regional retention were identified in the Banklick Watershed. Two possible sites, shown in Figure 7.02-2, were identified as good locations for retention. Both potential regional retention basins are located on tributaries to Banklick Creek; one is located on Brushy Fork, the other is located on Wolf Pen Branch. In addition to reduction of bacteria in both dry and wet weather flows, other water quality constituents such as suspended solids and nutrients can be removed with the use of retention. According to the SD1's Draft Watershed Plan, modeling of these control measures indicates they could have significant water quality benefits. Model results suggest the retention basins could increase the number of days with bacteria densities below 400 cfu/100ml:

1. In upstream reaches (e.g. Wolf Pen Branch), the model calculates that, in a typical year, bacteria densities in Banklick Creek will be 400 cfu/100ml or less for 91 days out of 184 (49 percent). The model calculates that the regional retention basin could improve the number of days below 400 cfu/100 ml from 91 to 138 days out of 184 (an increase of 30 percent to a total of 75 percent compliance).

2. In downstream reaches (near the mouth of Banklick), the model calculates only 76 days of the recreational season will be below 400 cfu/100 ml (41 percent). With the regional retention measures, the number is improved to 81 days per season (44 percent).

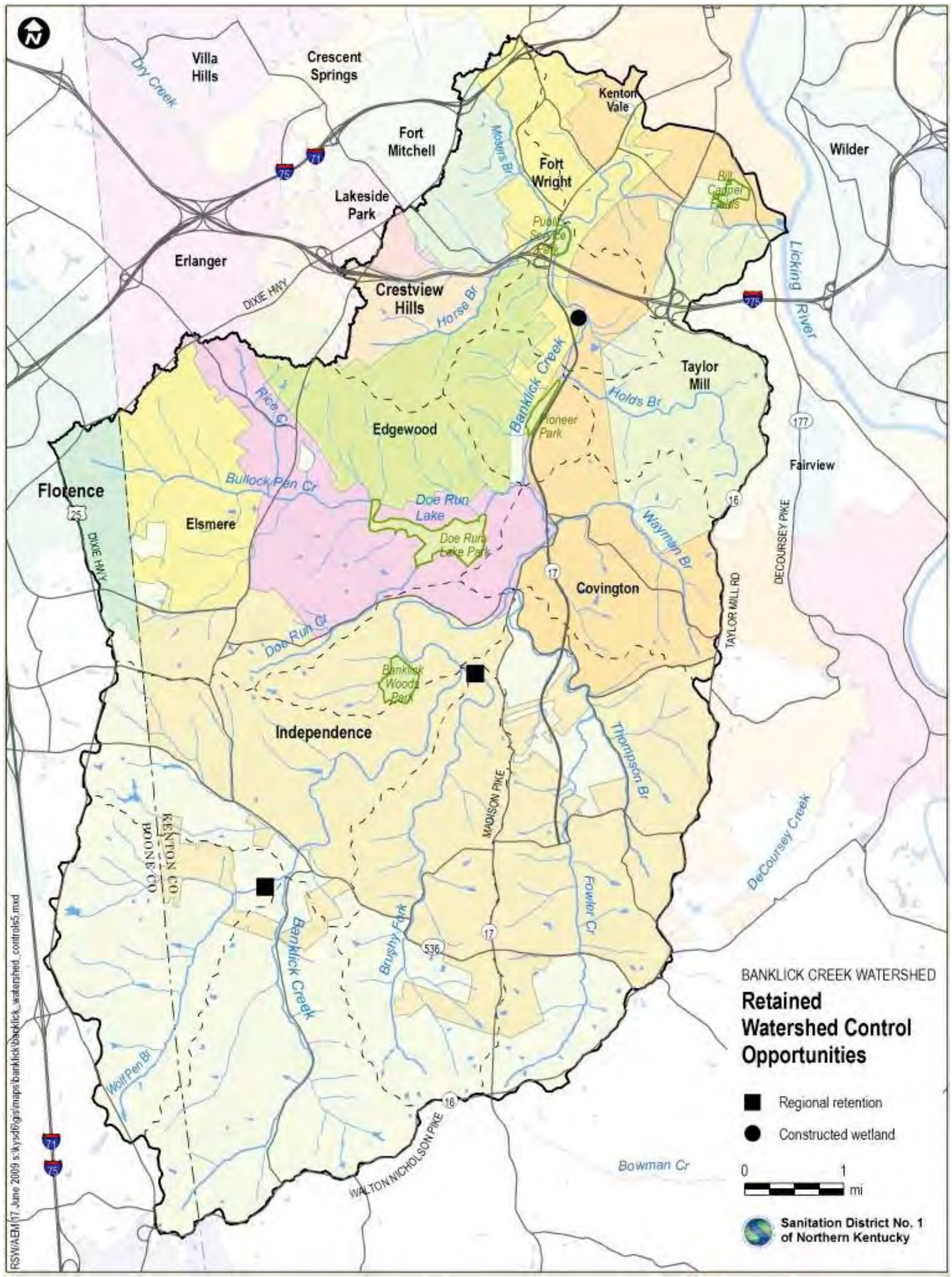
In addition, the model calculates improvement in the geometric mean bacteria density during the recreational season:

1. In upstream reaches (e.g., Wolf Pen Branch), the geometric mean is calculated to improve from 376 cfu/100ml to 98 cfu/100 ml (74 percent reduction).

2. At the downstream end of Banklick Creek (near the mouth), the recreational season geometric mean is calculated to decrease from 782 cfu/100ml to 737 cfu/100 ml (6 percent reduction).

FIGURE 7.02-2

REGIONAL WATERSHED CONTROL OPPORTUNITIES



Source: SD1 Draft Watershed Plan, June 2009

3. A conceptual design was developed for a wetland that would involve diverting a portion of dry weather flow from Banklick Creek into a constructed wetland and then reintroducing the treated flow back into the creek. Figure 7.02-3 shows the location of the wetland, just upstream of two local parks. Flows above the wetland's treatment capacity would be routed around the wetland untreated. If SD1 chooses to implement this concept it will be executed as a pilot wetland to test the effectiveness of the approach. If successful, the constructed wetland concept can be applied to other locations in Banklick and, potentially, to other watersheds. The wetland will have the additional benefits of restoring connectivity between Banklick Creek and its floodplain and providing habitat and public education opportunities.

A potential regional constructed wetland was modeled using the Banklick Watershed model, assuming a 6-acre constructed wetland located downstream of Holds Branch. The results indicate that the wetland could have significant benefits for water quality and public health protection during the recreational season. Because some flow from the creek is treated every day, in both dry weather and wet weather, the benefits to water quality and public health protection are projected to be significant.

1. Immediately downstream of the wetland, the model calculates that the treatment wetland will provide about 53 more days in a typical recreation season below the 400 cfu/100ml bacteria threshold. This represents an increase from 40 percent to 68 percent of the recreational season.

2. In downstream reaches (near the mouth of Banklick), the model calculates that with the wetland, about 104 days of the recreational season will be below 400 cfu/100 ml (a total of 56 percent), compared to about 76 days without it.

3. In addition, the model calculates improvement in the geometric mean bacteria density during the recreational season:

    a. Immediately downstream of the wetland, the geometric mean is calculated to improve from approximately 672 cfu/100ml to approximately 81cfu/100 ml, about an 88 percent reduction.

    b. At the downstream end of Banklick Creek, the recreational season geometric mean is calculated to decrease from 782 cfu/100ml to approximately 206 cfu/100 ml, an approximate reduction of 74 percent.

Much of the modeled improvements from the wetland are attributable to the treatment of nonwet weather flows on a daily basis.

FIGURE 7.02-3

POTENTIAL WETLAND IN BANKLICK CREEK

Source: SD1 Draft Watershed Plan, June 2009

7.03 BANKLICK WATERSHED COUNCIL DEFINED FOCUS AREA

As indicated in the pie chart in Figure 5.04-6, much of the water quality impairments in the lower portions of the watershed are a result of the CSOs and SSOs. As shown above, SD1 has extensive plans through their consent decree to remediate and reduce these major point sources of pollution. Until SD1 completes its consent decree efforts in the lower portions of the watershed, it will be difficult to quantify and track the progress of reducing nonpoint sources of pollution.

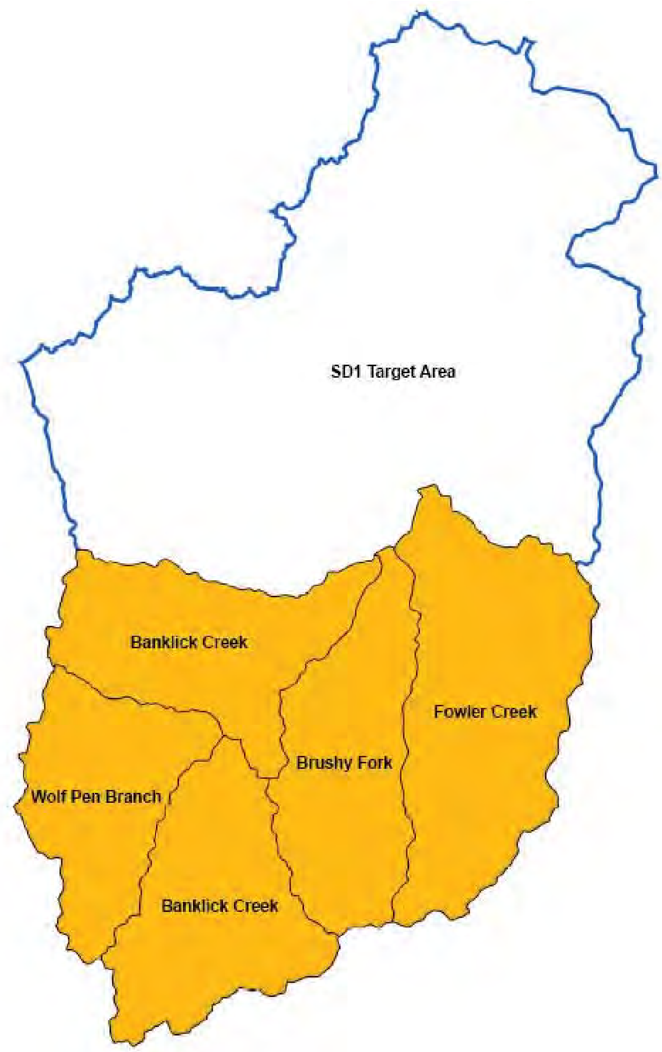


Figure 7.03-1 Focus Area for Future Targeted Management Measures with 319(h) Funding

Therefore, this watershed plan proposes that future management measures completed by the BWC and other community groups with 319(h) grant funds, along with other non-SD1 entities, should focus on projects in the upper (Southern most) reaches of the Banklick Watershed. The proposed delineation is shown in Figure 7.03-1; this area will be referred to as the Focus Area. Focusing nonpoint source management measures in the upper portions of the Banklick Watershed is a logical decision and will allow for a targeted effort with meaningful and measureable results. The pie charts showing fecal allocation for these five targeted subwatersheds are shown in Figures 7.03-2 to 7.03-6. A coarse assessment of these loading allocations reveals that the largest sources of water impairment are agricultural runoff and runoff from developed lands (or urban runoff). The pie charts showing total suspended solids for these five targeted subwatersheds are shown in Figures 7.03-7 to 7.03-11. The pie charts showing total phosphorus for these five targeted subwatersheds are shown in Figures 7.03-12 to 7.03-16. Table 7.03-1 provides a summary of pollutant loading by subwatershed in tabular format. Table 7.03-2 provides a summary of loadings in each subwatershed normalized by area. This table will demonstrate the loading compared to the watershed size.

FIGURE 7.03-2

FOWLER CREEK SUBWATERSHED FECAL ALLOCATION–TOTAL LOADING: 1043 TRILLION CFUs

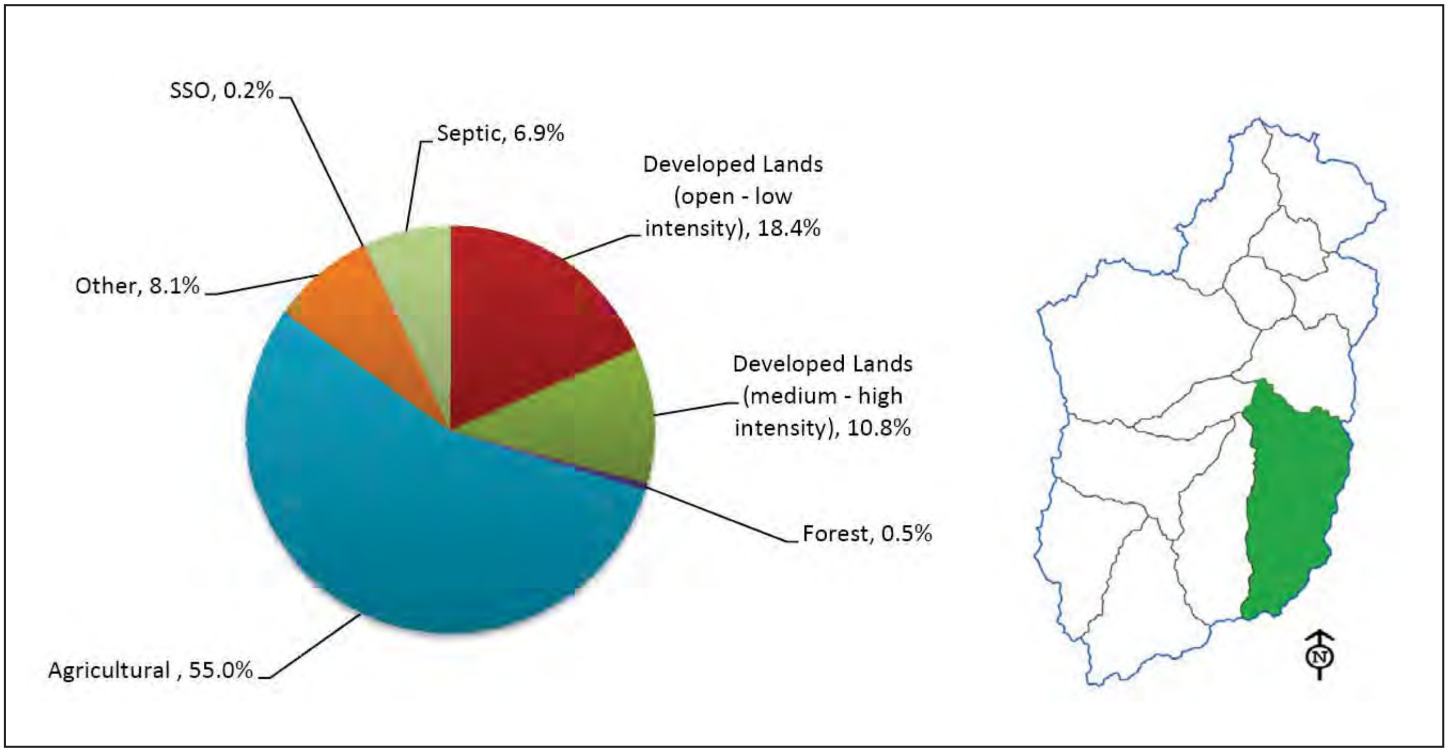
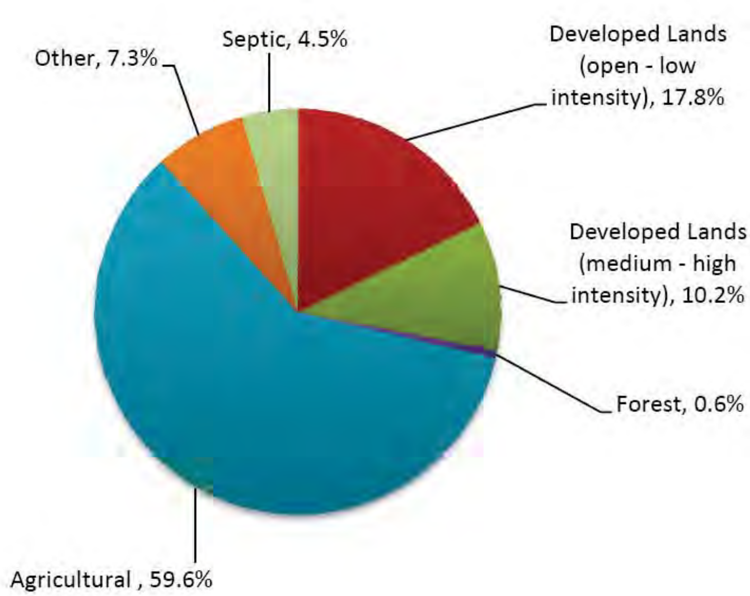


FIGURE 7.03-3

BRUSHY FORK SUBWATERSHED FECAL ALLOCATION–TOTAL LOADING: 652 TRILLION CFUs



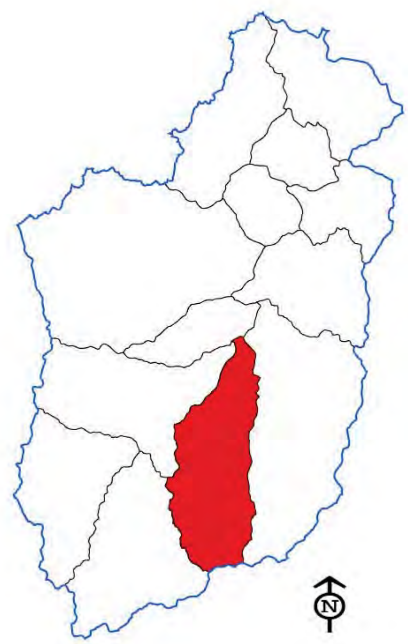


FIGURE 7.03-4

BANKLICK CREEK SUBWATERSHED 11 FECAL ALLOCATION–TOTAL LOADING: 1811 TRILLION CFUs

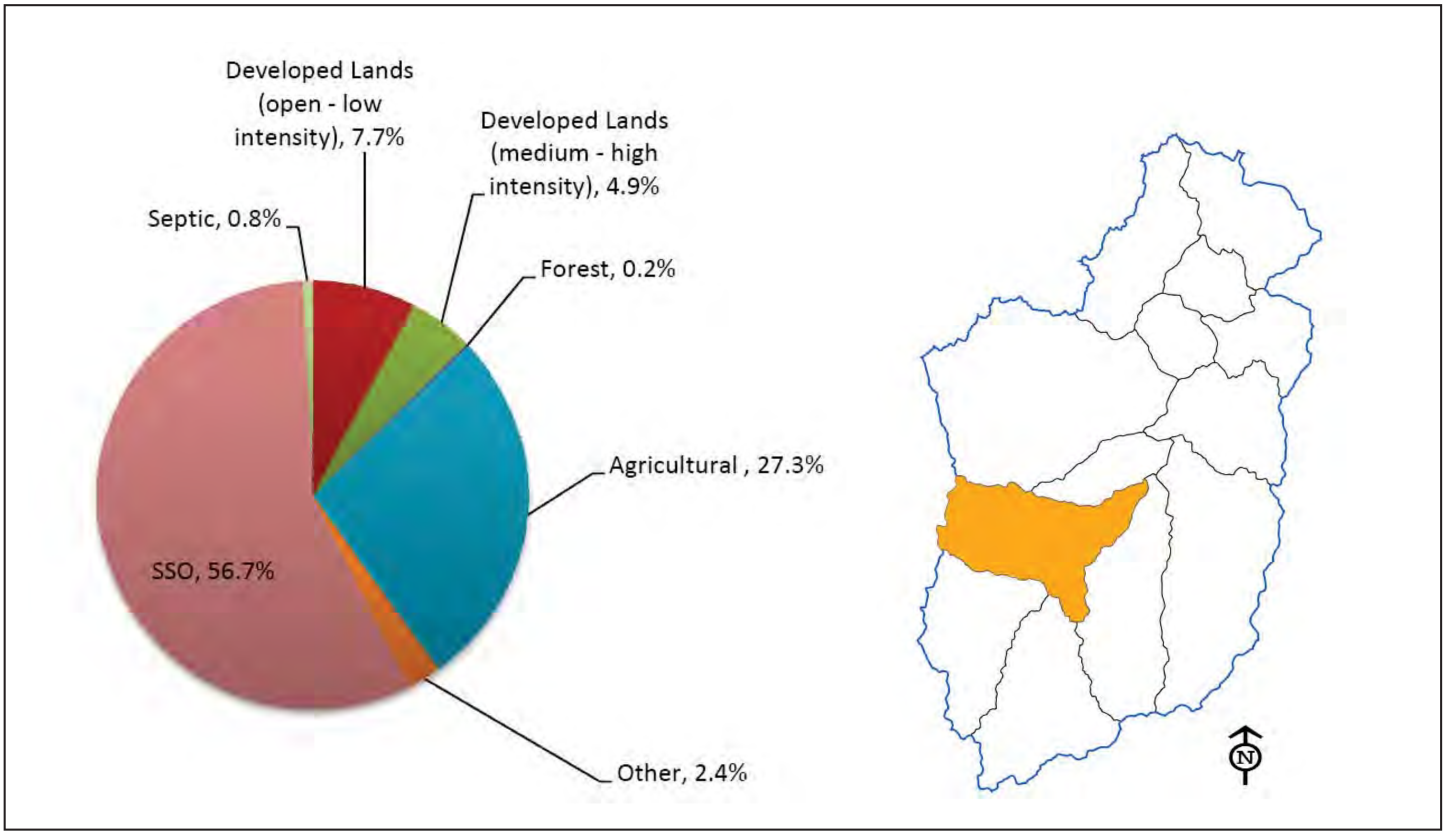


FIGURE 7.03-5

WOLF PEN BRANCH SUBWATERSHED FECAL ALLOCATION–TOTAL LOADING: 972 TRILLION CFUs

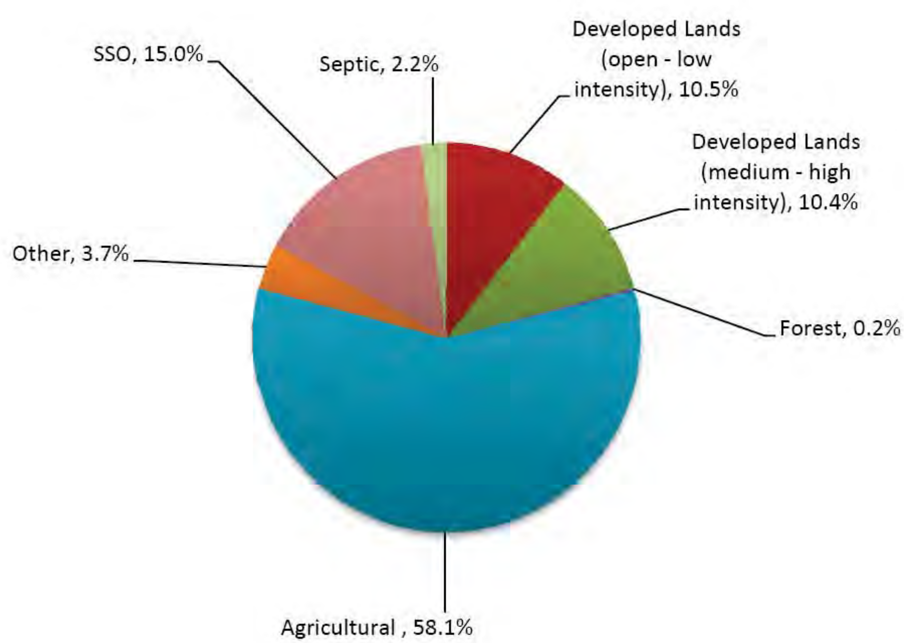


FIGURE 7.03-6

BANKLICK CREEK SUBWATERSHED 13 FECAL ALLOCATION–TOTAL LOADING: 1129 TRILLION CFUs

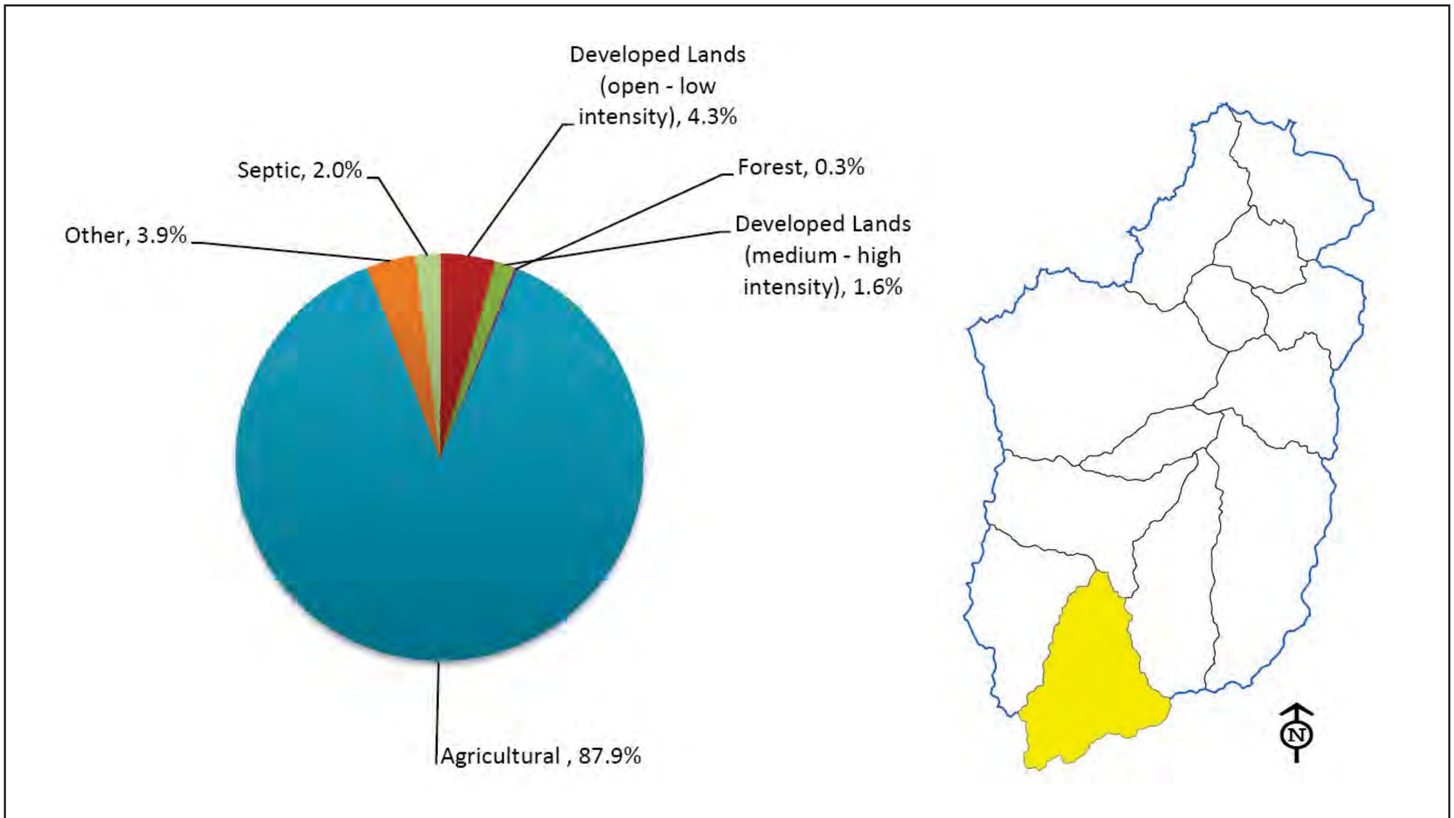


FIGURE 7.03-7

FOWLER CREEK SUBWATERSHED TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 1,276,336 KG

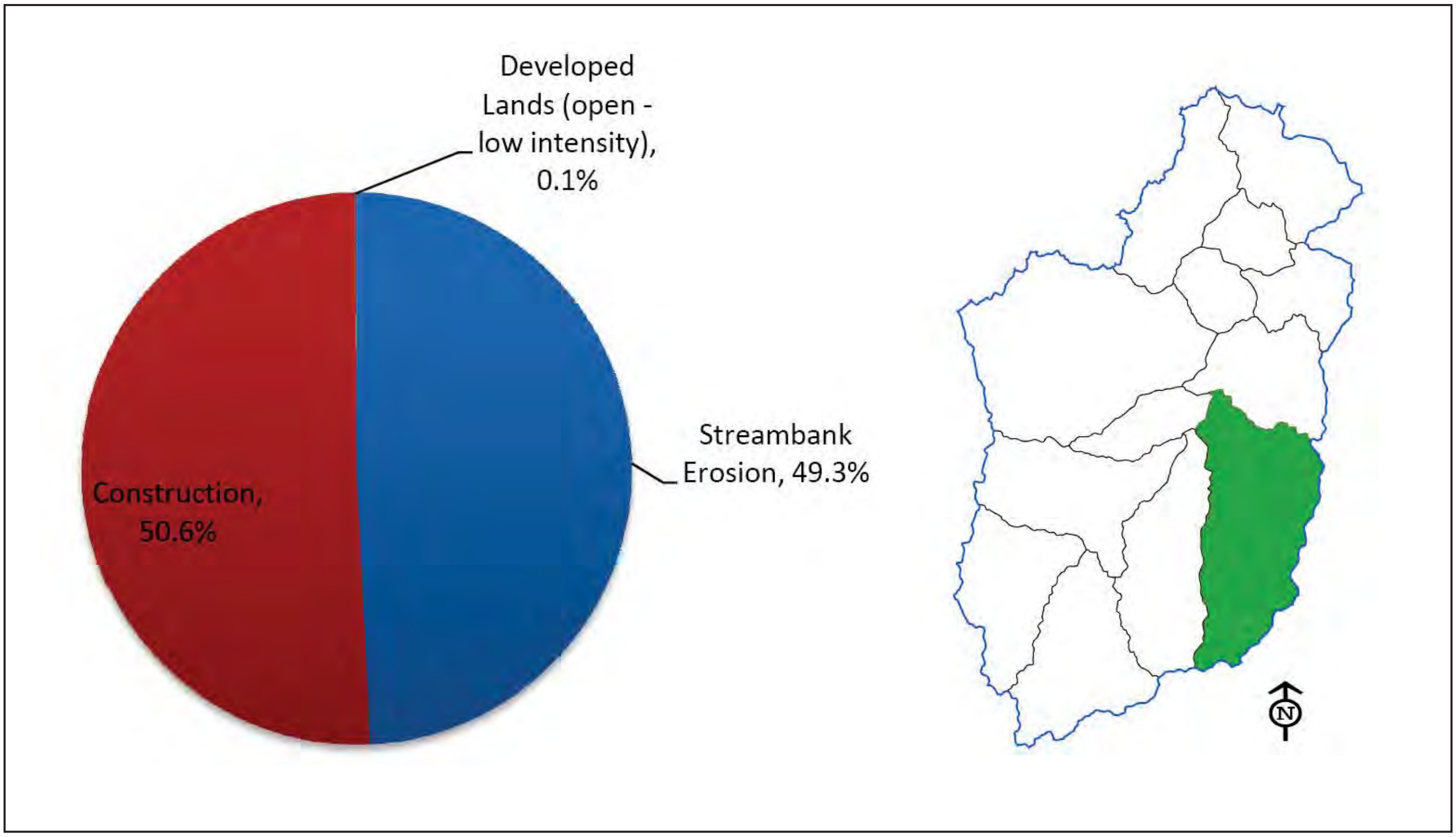


FIGURE 7.03-8

BRUSHY FORK SUBWATERSHED TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 862,399 KG

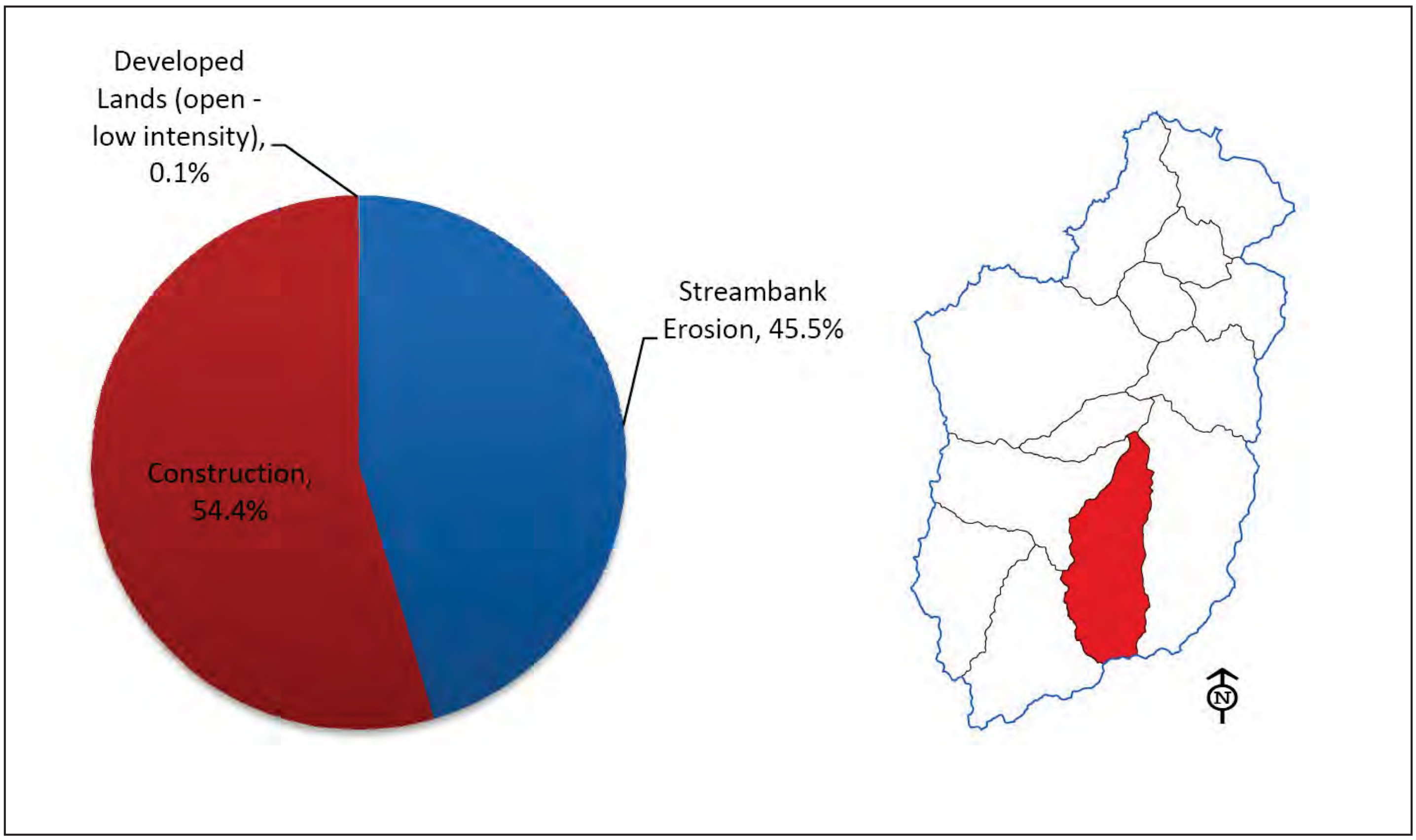


FIGURE 7.03-9

BANKLICK CREEK SUBWATERSHED 11 TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 880,583 KG

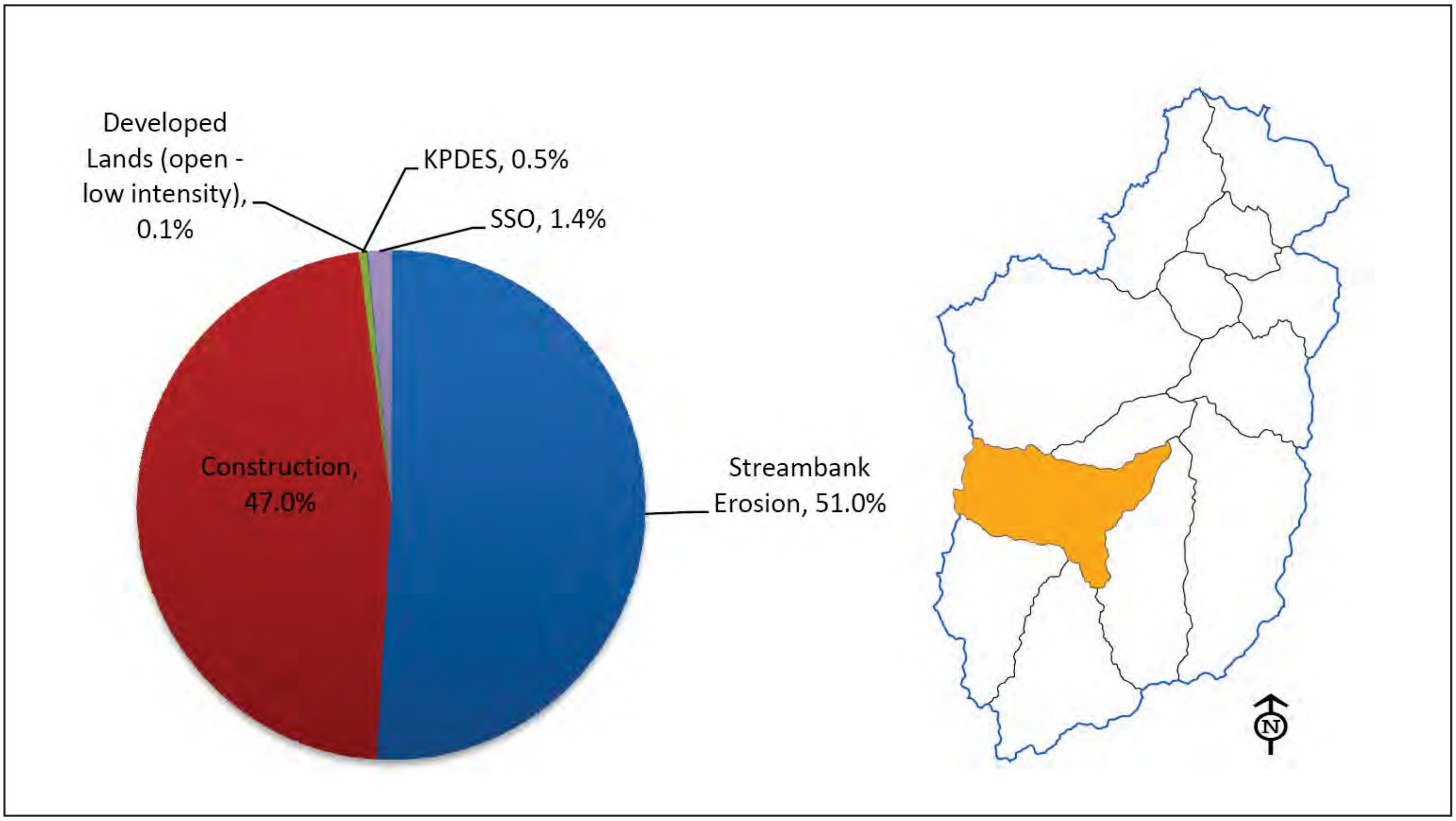


FIGURE 7.03-10

WOLF PEN BRANCH SUBWATERSHED TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 772,198 KG

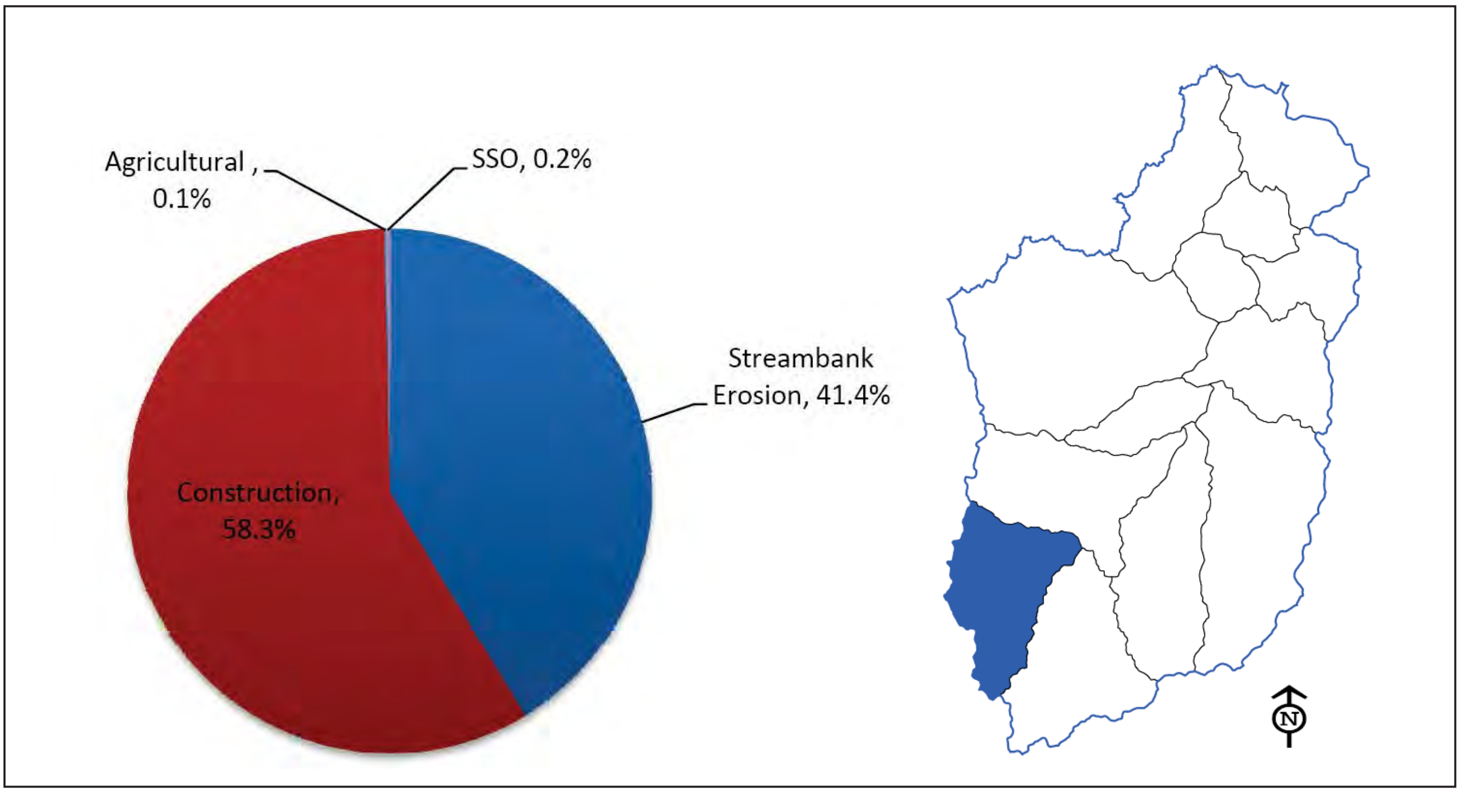


FIGURE 7.03-11

BANKLICK CREEK SUBWATERSHED 13 TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 950,628 KG

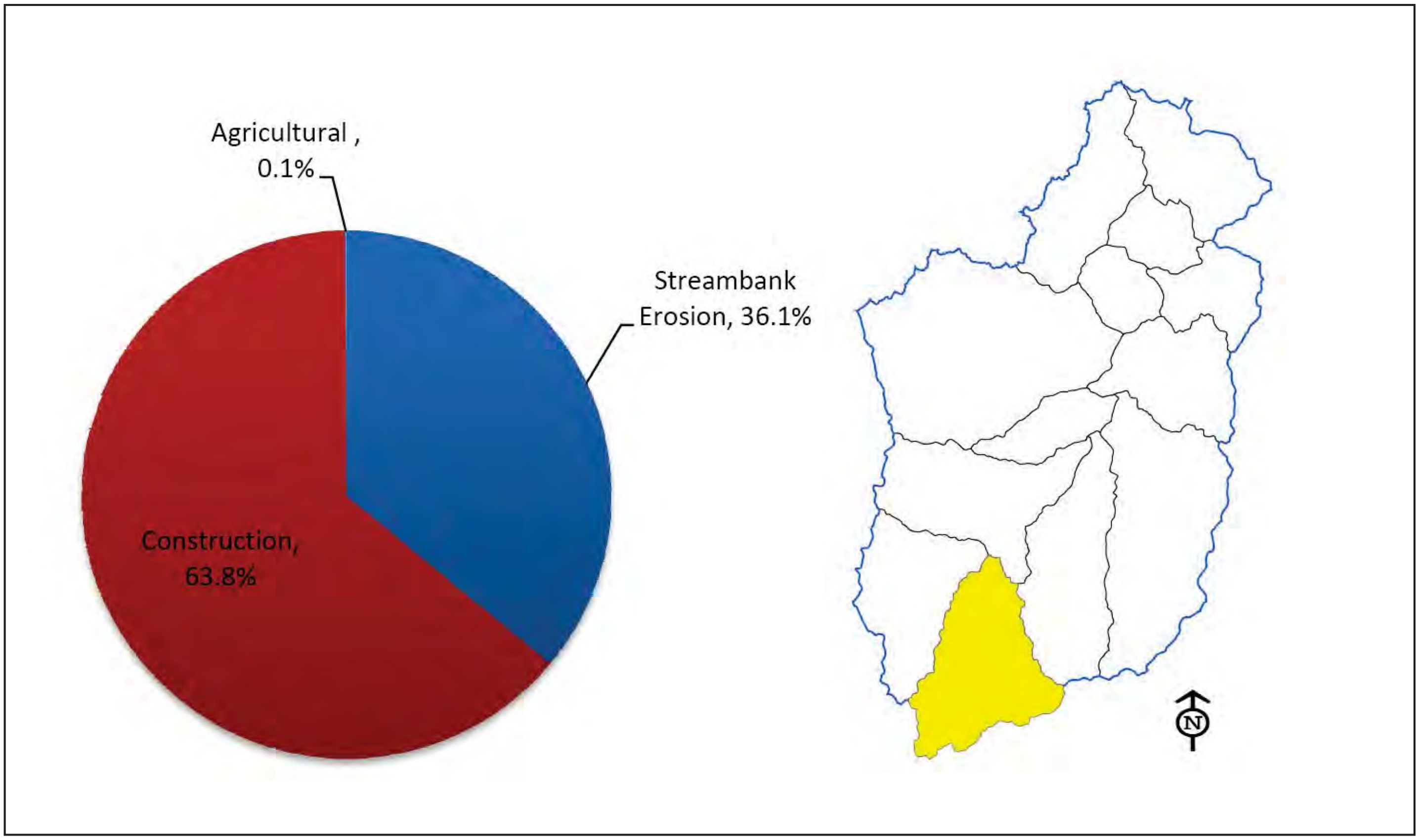


FIGURE 7.03-12

FOWLER CREEK SUBWATERSHED PHOSPHOROUS ALLOCATION–TOTAL LOADING: 3,771 KG

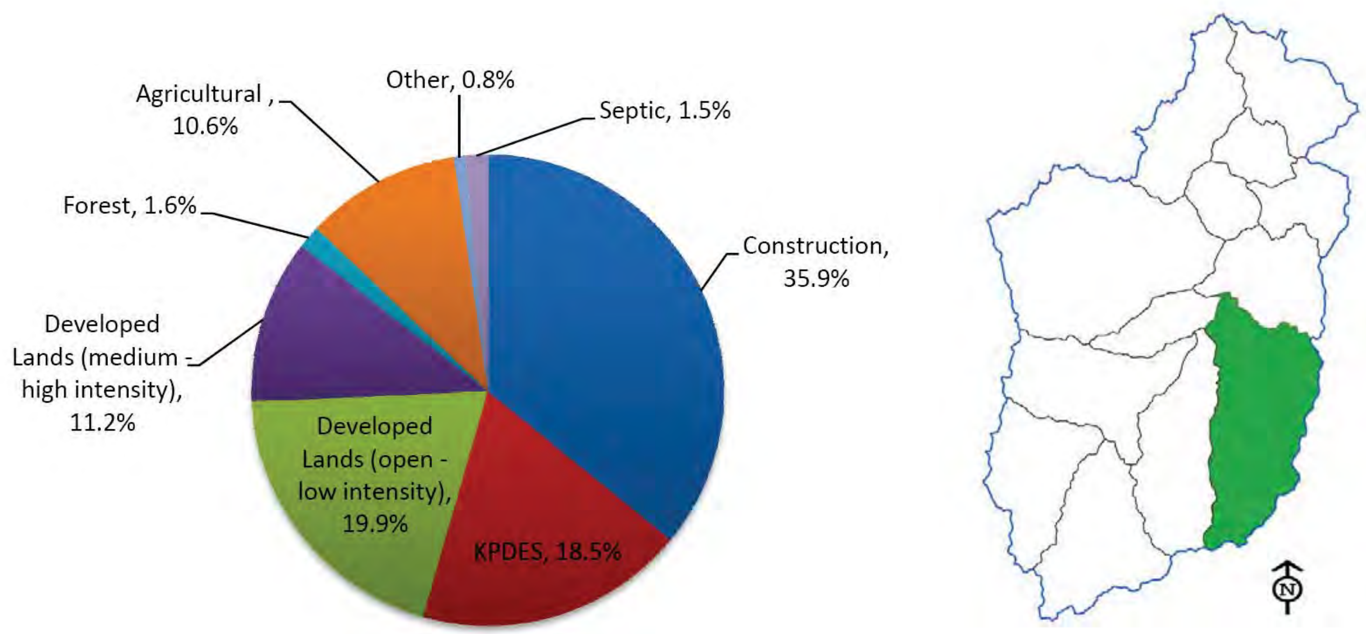


FIGURE 7.03-13

BRUSHY FORK SUBWATERSHED PHOSPHOROUS ALLOCATION–TOTAL LOADING: 2,024 KG

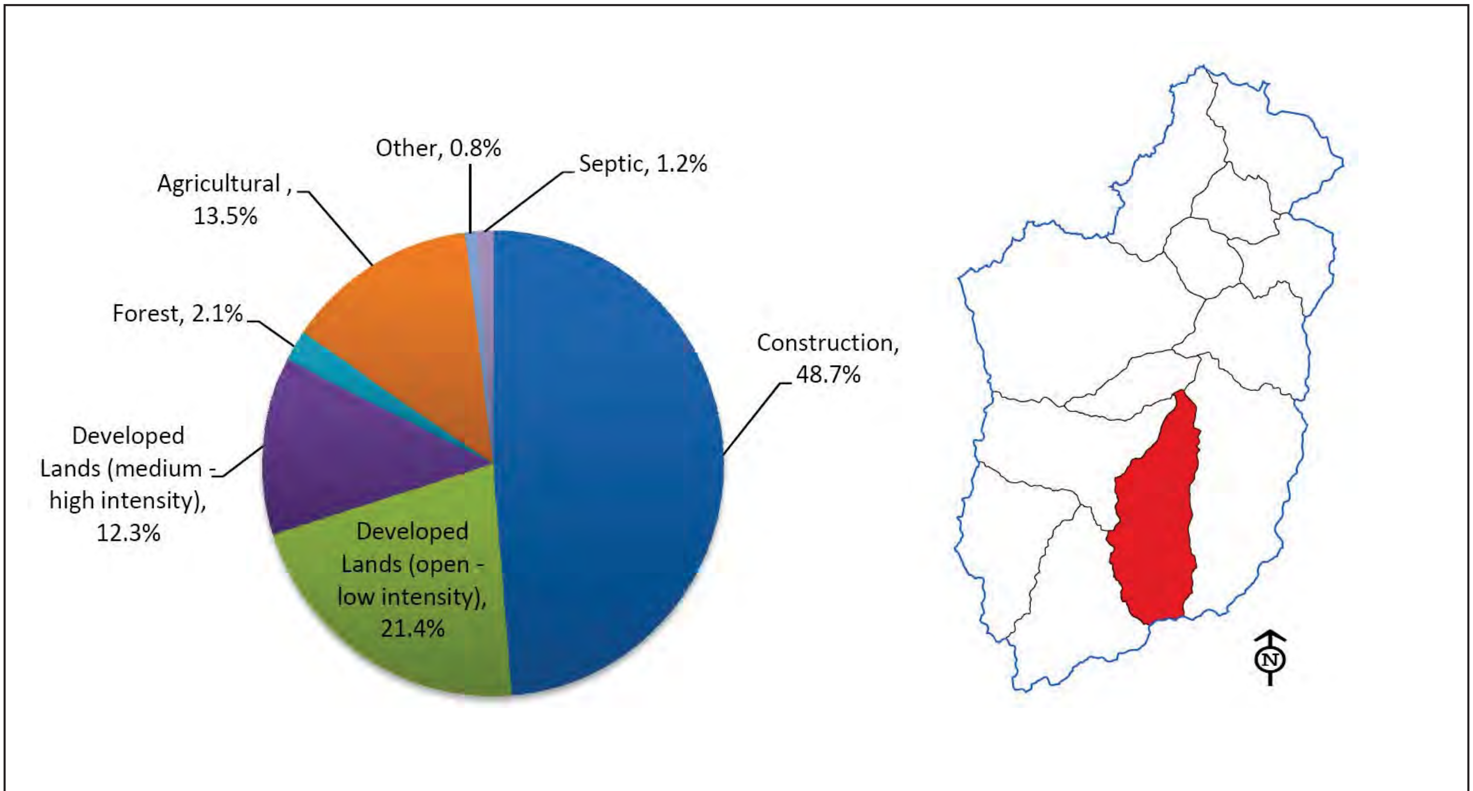


FIGURE 7.03-14

BANKLICK CREEK SUBWATERSHED 11 PHOSPHOROUS ALLOCATION–TOTAL LOADING: 3,724 KG

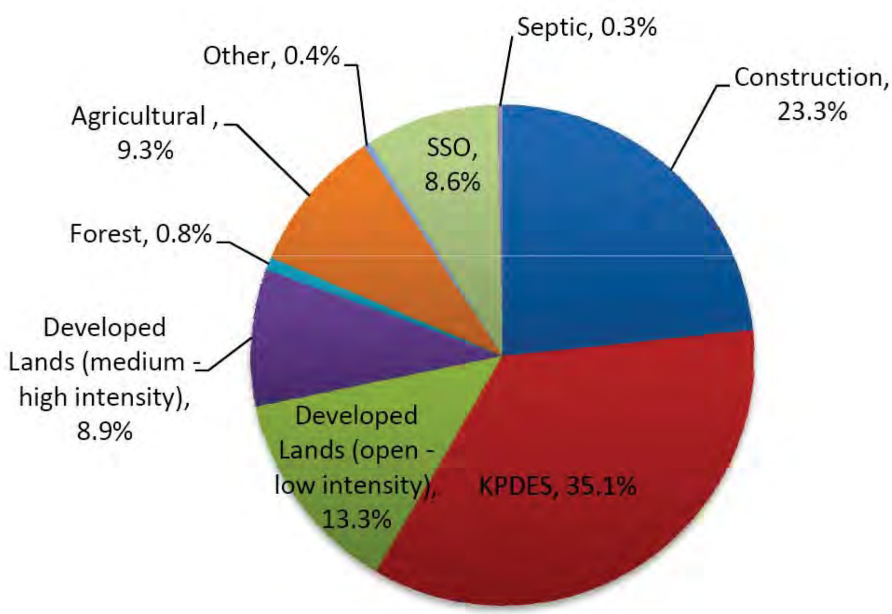


FIGURE 7.03-15

WOLF PEN BRANCH SUBWATERSHED PHOSPHOROUS ALLOCATION–TOTAL LOADING: 2,131 KG

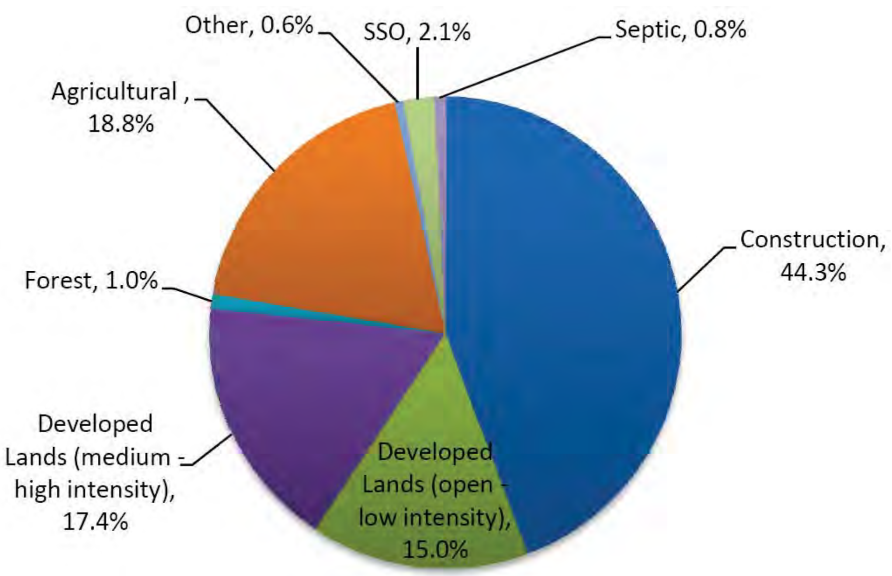


FIGURE 7.03-16

BANKLICK CREEK SUBWATERSHED 13 PHOSPHOROUS ALLOCATION–TOTAL LOADING: 2,349 KG

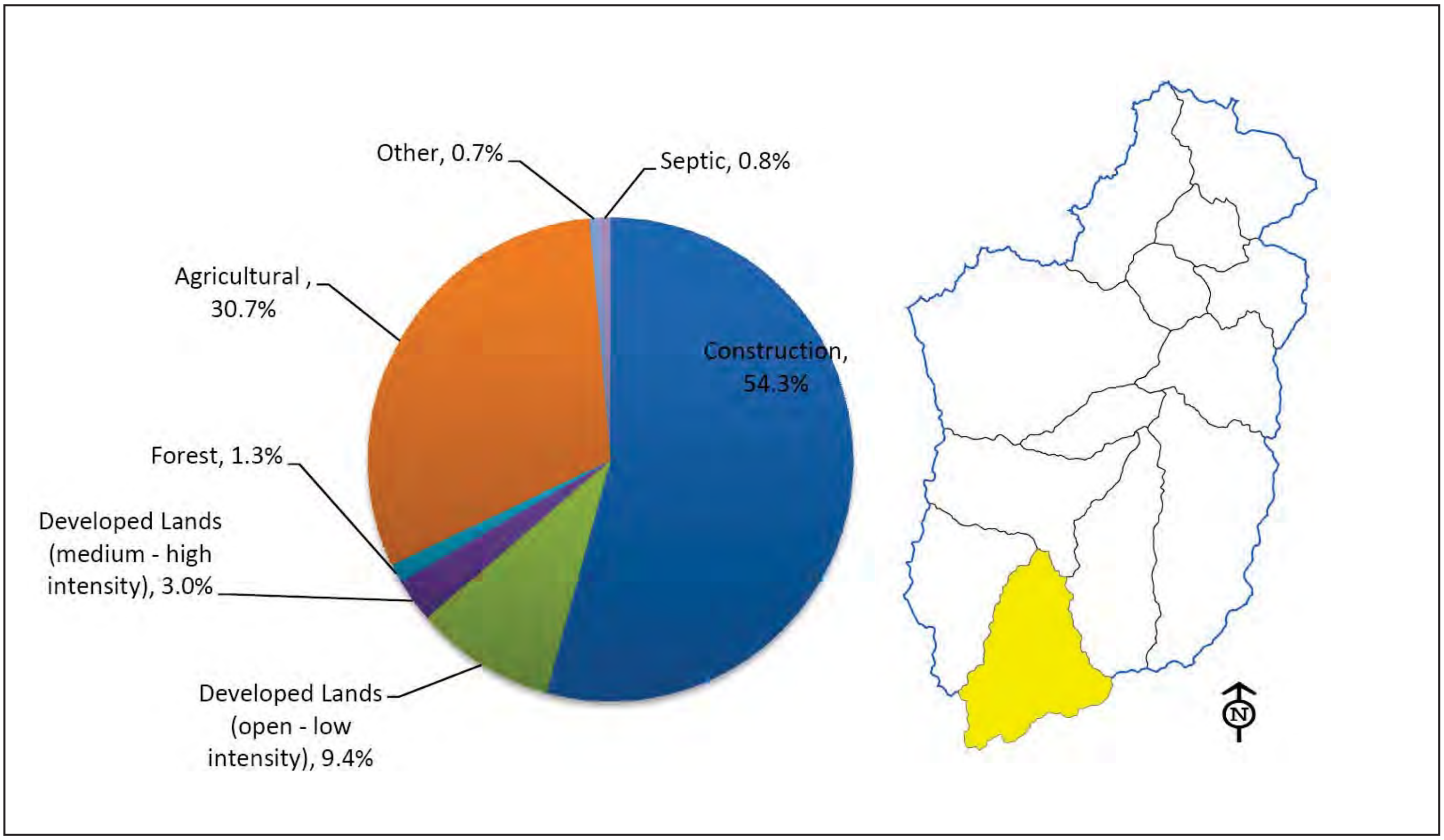


TABLE 7.03-1

BANKLICK LOADINGS BY SUBWATERSHEDS

	Fowler Creek	Brushy Fork	Banklick Creek 11	Wolf Pen Branch	Banklick Creek 13
Annual Fecal Loading (Trillion cfu)	1,042.58	652.50	1,811.40	972.48	1,128.62
KPDES	0.11	-	0.24	0.00	0.00
Developed Lands (open - low intensity)	191.86	116.08	139.61	101.65	48.67
Developed Lands (medium - high intensity)	112.337261	66.63	88.44	100.94	18.04
Forest	5.716628557	4.22	2.99	2.07	2.88
Agricultural	573.9298343	388.63	494.81	564.85	992.38
Other	84.12586596	47.41	43.81	35.97	43.76
CSO	0	-	-	-	-
SSO	2.347404311	-	1,026.94	146.02	-
Septic	72.14833518	29.52	14.55	20.99	22.88
Annual Phosphorous Loading (Kg)	3771	2024	3724	2131	2349
Construction	1,355.46	985.69	868.86	944.81	1,274.32
KPDES	697.56	-	1,307.98	0.14	0.14
Developed Lands (open - low intensity)	749.05	432.79	495.55	318.95	220.50
Developed Lands (medium - high intensity)	422.15	248.87	329.83	370.34	69.64
Forest	58.73	43.35	30.72	21.22	29.59
Agricultural	399.84	272.85	345.41	400.61	720.76
Other	29.50	16.73	15.57	12.76	15.32
CSO	-	-	-	-	-
SSO	0.73	-	318.51	45.29	-
Septic	57.72	23.62	11.64	16.79	18.30

	Fowler Creek	**Brushy Fork**	**Banklick Creek 11**	**Wolf Pen Branch**	**Banklick Creek 13**
Annual TSS Loading (Kg)	1,276,336	862399	880583	772198	950628
SSO	628,705.69	392,007.03	448,758.62	319,401.57	342,751.50
Construction	645,456.37	469,376.96	413,743.74	449,907.85	606,820.78
KPDES	486.18	-	4,491.26	5.60	0.24
Developed Lands (open - low intensity)	749.05	432.79	495.55	318.95	220.50
Developed Lands (medium - high intensity)	422.15	248.87	329.83	370.34	69.64
Forest	58.73	43.35	30.72	21.22	29.59
Agricultural	399.84	272.85	345.41	400.61	720.76
Other	29.50	16.73	15.57	12.76	15.32
CSO	-	-	-	-	-
SSO	28.28	-	12,372.65	1,759.20	-
Septic	-	-	-	-	-

TABLE 7.03-2

NORMALIZED LOADING BY SUBWATERSHED

	Fowler Creek	Brushy Fork	Banklick Creek 11	Wolf Pen Branch	Banklick Creek 13
Annual Normalized Fecal Loading (Trillion cfu/Acre)	0.21	0.20	0.54	0.34	0.33
KPDES	0.00	-	0.00	0.00	0.00
Developed Lands (open - low intensity)	0.04	0.03	0.04	0.04	0.01
Developed Lands (medium - high intensity)	0.02	0.02	0.03	0.04	0.01
Forest	0.00	0.00	0.00	0.00	0.00
Agricultural	0.11	0.12	0.15	0.20	0.29
Other	0.02	0.01	0.01	0.01	0.01
CSO	-	-	-	-	-
SSO	0.00	-	0.31	0.05	-
Septic	0.01	0.01	0.00	0.01	0.01
	0.21	0.20	0.54	0.34	0.33
Annual Phosphorous Loading (Kg/Acre)	0.75	0.61	1.11	0.75	0.68
Construction	0.27	0.30	0.26	0.33	0.37
KPDES	0.14	-	0.39	0.00	0.00
Developed Lands (open - low intensity)	0.15	0.13	0.15	0.11	0.06
Developed Lands (medium - high intensity)	0.08	0.07	0.10	0.13	0.02
Forest	0.01	0.01	0.01	0.01	0.01
Agricultural	0.08	0.08	0.10	0.14	0.21
Other	0.01	0.01	0.00	0.00	0.00
CSO	-	-	-	-	-
SSO	0.00	-	0.09	0.02	-
Septic	0.01	0.01	0.00	0.01	0.01
Annual TSS Loading (Kg/Acre)	252.44	259.29	261.84	272.48	276.43
SSO	124.35	117.86	133.44	112.70	99.67
Construction	127.66	141.12	123.03	158.75	176.45
KPDES	0.10	-	1.34	0.00	0.00
Developed Lands (open - low intensity)	0.15	0.13	0.15	0.11	0.06
Developed Lands (medium - high intensity)	0.08	0.07	0.10	0.13	0.02
Forest	0.01	0.01	0.01	0.01	0.01
Agricultural	0.08	0.08	0.10	0.14	0.21
Other	0.01	0.01	0.00	0.00	0.00
CSO	-	-	-	-	-
SSO	0.01	-	3.68	0.62	-
Septic	-	-	-	-	-

7.04 MANAGEMENT STRATEGIES: IDENTIFIED ALTERNATIVES AND SELECTION PROCESS

Upon completion of all data collection and source allocation as described in the previous sections, an assessment was conducted to determine the appropriate management measures within the focus area based on the available information. The first step was to rank the sources for each pollutant to determine the critical sources based on the WAT assessment. These rankings are shown in Tables 7.04-1 through 7.04-3. Looking at the rankings, the first decision was to eliminate the sources already under the jurisdiction of another entity. SD1 is responsible for controlling discharge from CSO's and SSO's under their consent decree; since SD1 is already working on this source, these were removed from the ranking for purposes of this watershed plan. SD1 is also responsible for enforcement of their erosion protection and sediment control regulations for construction sites. Similarly, enforcement of KPDES permits is under the jurisdiction of KDOW, so this will not be a targeted source of this watershed plan. By removing these sources already being targeted by other entities, the remaining target sources are agriculture, developed land, other, septic, and streambank erosion, as shown in Tables 7.04-4 through 7.04-6. These are the key sources of pollution that this watershed plan will focus on reducing.

Rank	Source	Percent of Total Load
1	Agricultural	53.8%
2	SSO	21.0%
3	Developed Land (open - low intensity)	10.7%
4	Developed Land (med - high intensity)	6.9%
5	Other	4.5%
6	Septic	2.9%

Table 7.04-1 Fecal Source Ranking in Focus Area

Rank	Source	Percent of Total Load
1	KPDES	38.8%
2	Developed Land (open - low intensity)	15.8%
3	Agricultural	15.3%
4	KPDES	14.3%
5	Developed Land (med - high intensity)	10.3%
6	SSO	2.6%

Table 7.04-2 Phosphorous Source Ranking in Focus Area

1	Construction	54.5%
2	Streambank Erosion	45.0%
3	KPDES	0.1%

Table 7.04-3 TSS Source Ranking in Focus Area

New Rank	Source	Percent of Total Load
1	Agricultural	53.8%
2	Developed Land (open - low intensity)	10.7%
3	Developed Land (med - high intensity)	6.9%
4	Other	4.5%
5	Septic	2.9%

Table 7.04-4 Fecal Source Ranking in Focus Area–Not Already Regulated

New Rank	Source	Percent of Total Load
1	Developed Lands (open - low intensity)	15.8%
2	Agricultural	15.3%
3	Developed Lands (med - high intensity)	10.3%

Table 7.04-5 Phosphorous Source Ranking in Focus Area–Not Already Regulated

New Rank	Source	Percent of Total Load
1	Streambank Erosion	45.0%

Table 7.04-6 TSS Source Ranking in Focus Area–Not Already Regulated

The next step in this process was an engaged and iterative selection process to identify appropriate and feasible management measures to include in this WBP. To start, a range of structural and nonstructural management practices were considered, specifically to determine which of these controls were appropriate for the targeted sources. The list of possible management measures was exhaustive. A concise resource for many of the considered alternatives was USEPA's Watershed Plan Handbook. Although not comprehensive, the table broken down by land use served as a valuable template in the decision making process. First, the knowledge of the area, and the results of the source assessment were utilized to eliminate management measures that didn't make sense for this watershed. For example, it was easy to determine that the management measure of establishing no wake zones would not be applicable to Banklick, since there is almost no motorized water travel in the streams. Additional considerations in this process included public input, technical guidance, meetings with SD1, and BWC group meetings.

Once the applicable management practices were identified, they were then segmented into three groups:

1. Controls recommended for implementation under the 319 grant.

2. Controls recommended for implementation by SD1.

3. Controls recommended for implementation by others within the watershed, such as the Soil and Water Conservation District, Natural Resourced Conservation Service, and the Forestry Council.

The criteria used to separate these practices into these three groups was essentially knowledge of the organizations goals, objectives, and capabilities. For example, SD1 already has jurisdiction over many areas such as stormwater ordinances, erosion and sediment control, and even encouraging “green” development practices such as green roofs, sediment basins, sand filters, and water quality swales. These recommendations are by no means the only appropriate management measures to be implemented by each group, but they are meant only to provide a starting point for which measures are best suited for implementation by each organization. These recommendations resulting from this exercise are summarized in Table 7.04-7. The assessment is very meaningful, and it opens the door for implementation of all of the indicated practices by the respective organizations.

TABLE 7.04-7

EXAMPLES OF STRUCTURAL AND NONSTRUCTURAL MANAGEMENT PRACTICES

	Structural Practices	Nonstructural Practices
Agriculture	▪ Contour buffer strips*✓¥ ▪ Grassed waterway ✓ ▪ Herbaceous wind barriers ▪ Mulching ▪ Live fascines ▪ Live staking ▪ Livestock exclusion fence (prevents livestock from wading into streams) ✓¥ ▪ Revetments ▪ Riprap ▪ Sediment basins* ▪ Terraces ▪ Waste treatment lagoons	▪ Brush management ▪ Conservation coverage ¥ ▪ Conservation tillage ¥ ▪ Educational Materials*✓ ▪ Erosion and sediment control plan ¥ ▪ Nutrient management plan ¥ ▪ Pesticide management ¥ ▪ Prescribed grazing ▪ Residue management ▪ Requirement for minimum riparian buffer ¥ ▪ Rotational grazing ¥ ▪ Workshops/training for developing nutrient management plans ¥
Forestry	▪ Broad-based dips ▪ Culverts ▪ Establishment of riparian buffer*✓ ▪ Mulch ▪ Revegetation of firelines with adapted herbaceous species ▪ Temporary cover crops ▪ Windrows	▪ Education campaign on forestry related nonpoint source controls ¥ ▪ Erosion and sediment control plans ¥ ▪ Forest chemical management ▪ Fire management ▪ Operation of planting machines along the contour to avoid ditch formation ▪ Planning and proper road layout and design ▪ Preharvest planning ▪ Training loggers and landowners about forest management practices, forest ecology, and silviculture
Urban	▪ Bioretention cells*✓ ▪ Breakwaters ▪ Brush layering ▪ Infiltration basins*✓ ▪ Green roofs* ▪ Live fascines ▪ Marsh creation/restoration ▪ Establishment of riparian buffers*✓¥ ▪ Riprap* ▪ Stormwater ponds* ▪ Sand filters* ▪ Sediment basins* ▪ Tree revetments*¥ ▪ Vegetated gabions ▪ Water quality swales*✓ ▪ Clustered wastewater treatment systems*	▪ Planning for reduction of impervious surfaces (e.g. eliminating or reducing curb and gutter) * ▪ Management programs for on-site and clustered (decentralized) wastewater treatment systems* ▪ Educational materials*✓¥ ▪ Erosion and sediment control plan*¥ ▪ Fertilizer management ✓¥ ▪ Ordinances* ▪ Pet waste programs✓¥ ▪ Pollution prevention plans* ▪ No-wake zones ▪ Setbacks ▪ Stormdrain stenciling* ▪ Workshops on proper installation of structural practices*✓ ▪ Zoning overlay districts ▪ Perservation of open space✓ ▪ Development of greenways in critical areas✓

* To be considered for implementation by SD1.
✓ Recommended for implementation under the 319(h) grant
¥ Recommended for implementation through partnering organizations (Soil and Water Conservation District, Natural Resourced Conservation Service, Forestry Council etc.)

Next, the range of recommended management measures that came out of the initial assessment were evaluated more extensively relative to the following criteria:

1. Potential for load reductions relative to modeled loads and sources.

2. Cost.

3. Feasibility.

4. Public benefits (such as project perception in the community and educational opportunities).

These criteria were ranked using a linear ranking methodology, by assigning a number 1 to 3 to each category where 3 = high, 2 = moderate, and 1 = low for load reduction, feasibility, and public benefits, and the rankings are reversed for cost (such that 1 = high cost and 3 = low cost). This method does have some subjectivity associated with it, but various quality control checks were performed to ensure the most consistent results. The results of this ranking process were combined linearly such that a high score would represent the most beneficial management measures. The results of this prioritization process can be seen in Table 7.04-8.

Overall, this process resulted in identifying which management measures are appropriate for respective entities to target, and then further prioritized those management measures with regard to load reduction, cost, feasibility, and public benefit.

The priority rankings show that the following management measures should be the focus of management measures within the Banklick Watershed, because they achieved a “high” ranking.

1. Livestock Exclusion
2. Educational Materials
3. Requirement for Minimum Riparian Buffer
4. Establishment of Riparian Buffer
5. Improving Septic Wastewater Treatment Systems
6. Preservation of Open Space

Again, it is important to note these are not the only possible solutions for the watershed as other management measures scoring “moderate” or even “low” in the priority rankings could also be considered depending on specific opportunities for water quality improvement. However, broadly speaking, the “high” priority rankings will be those BMPs targeted most frequently with 319(h) funding.

TABLE 7.04-8

PRIORITIZATION OF MANAGEMENT MEASURES RANKING RESULTS

Applicable Management Measures	Potential for load reductions	Cost (more $ = 1, less $ = 3)	Feasibility	Public Benefits	Linear Rankings	Priority Ranking
Contour buffer strips	3	2	1	2	8	Moderate
Grassed waterway	2	3	3	1	9	Moderate
Livestock exclusion fence (prevents livestock from wading into streams)	3	2	3	3	11	High
Sediment basins	2	1	2	2	7	Low
Conservation coverage	2	3	2	2	9	Moderate
Educational Materials	1	3	3	3	10	High
Nutrient management plan	2	3	2	1	8	Moderate
Pesticide management	2	3	1	1	7	Low
Requirement for minimum riparian buffer	3	3	2	2	10	High
Rotational grazing	2	2	2	2	8	Moderate
Workshops/training for developing nutrient management plans	2	3	2	2	9	Moderate
Education campaign on forestry related nonpoint source controls	1	3	3	2	9	Moderate
Bioretention cells	2	1	2	2	7	Low
Infiltration basins	2	1	2	2	7	Low
Green roofs	2	1	2	2	7	Low
Establishment of riparian buffers	3	2	3	3	11	High
Riprap	1	1	1	1	4	Low
Stormwater ponds	2	1	1	2	6	Low
Sand filters	2	1	1	1	5	Low
Sediment basins	2	1	1	1	5	Low
Tree revetments	2	2	1	2	7	Low
Water quality swales	2	3	2	2	9	Moderate
Improving septic wastewater treatment systems	2	2	3	3	10	High
Planning for reduction of impervious surfaces (e.g. eliminating or reducing curb and gutter)	2	3	2	2	9	Moderate
Management programs for septic syetms	2	2	2	3	9	Moderate
Erosion and sediment control plan	2	3	3	1	9	Moderate
Fertilizer management	2	3	2	2	9	Moderate
Ordinances	3	3	2	1	9	Moderate
Pet waste programs	2	3	2	2	9	Moderate
Pollution prevention plans	1	3	2	1	7	Low
Stormdrain stenciling	1	3	3	2	9	Moderate
Workshops on proper installation of structural practices	1	3	2	3	9	Moderate
Perservation of open space (conservation easements)	3	3	2	3	11	High
Development of greenways in critical areas	2	2	1	3	8	Moderate

Specific examples of management measures receiving a "moderate" priority ranking, but may make good candidates for improvement projects under the BWC grant include "water quality swales", and "grassed waterways". Information collected from the public meetings, the hydrology of the watershed, and the documented flooding problems all indicate development has substantially altered the natural flow regime in the watershed. As a result, the streams in the headwaters of the Banklick watershed are showing increased flash flooding as well as lower base stream flow. To address this concern, the management measures in the Banklick watershed should also aim to increase base flows in the stream through promotion of infiltration to restore the natural hydrology where opportunities exist.

Although many projects would have worthy water quality benefits, BWC concluded its evaluations by selecting the following measures as optimally meeting the four criteria from feasibility to load reductions regarding how nonprofit agencies in the watershed could best affect water quality. These four areas cover the management measures that scored well in the priority ranking, and they take into account all data that has been gathered and analyzed to date. The recommended management measures for the focus area shall fall into the following four areas:

1. Reestablishment/restoration of riparian buffers.
2. Livestock and pasture management.
3. Septic system programs.
4. Shallow infiltration promotion.

7.05 AGRICULTURE/URBAN RUNOFF

Stormwater and agricultural runoff were identified as critical sources of water quality impairment in the Banklick Watershed. To alleviate the impacts of this runoff on streams, land should be acquired and remediated along Banklick Creek and its tributaries to create riparian buffers along the banks.

The USDA Natural Resources Conservation Services describes a riparian buffer as "…land adjacent to streams where vegetation is strongly influenced by the presence of water […] containing native grasses, flowers, shrubs, and trees". Riparian buffer zones are proven to help prevent sediment, nitrogen, phosphorous, pesticides and other pollutants from reaching the water. Riparian buffers also provide an enhanced habitat for wildlife. Such buffers even reduce some of the effects of flooding through interception storage, transpiration, and by promoting infiltration/groundwater recharge. Riparian areas also serve to regulate the water temperature by providing shade. The September 2000 USACE report on the Banklick Creek indicated the rising water temperatures were a major concern for the water quality as it is causing decreased levels of dissolved oxygen.

One major goal of this watershed plan is to attain land along stream banks that will become inhabited with native grasses, shrubs, and trees. This vegetation plays a very important role in the preservation of the banks by developing extensive root systems that stabilize the soils and thereby reduce the occurrence of bank erosion.

A three-zone buffer strip system is considered to be the most effective riparian buffer available. The three-zone buffer strip consists of three zones of vegetation planted parallel to the stream. The zone closest to the stream is the tree zone. The tree zone should be at least 30-feet wide and consist of four to five rows of trees. The trees used in this zone are selected for their ability to quickly develop deep roots to stabilize the stream bank, their tolerance of wet conditions to survive in the area closest to the stream, and their ability to shade the stream to maintain water temperature.

Temperature control is especially important due to the higher than normal temperatures occurring during field testing. Loss of riparian vegetation along with collapses in stream banks increase stream width and decrease stream depth, which has the potential to alter the stream temperature. Streams with no riparian vegetation cover are exposed to direct solar radiation during the day, increasing stream temperature. The opposite occurs at night, there is no vegetation acting as insulation and the stream temperature drops.

The next zone is the shrub zone, which is a minimum 12-foot-wide zone of one or two rows of shrubs. Shrubs develop a perennial root system, add diversity and wildlife habitat to the ecosystem, and slow floodwater when the stream leaves its channel. A mixture of shrub species adapted to the soil conditions in the area should be used for this zone. Another alternative is to extend the tree zone with mass producing trees and eliminate the shrub zone.

The grass zone is the final zone located nearest the field crop, a 20- to 24-foot-wide strip preferably consisting of switch grass. Switch grass is preferred because it has dense, stiff stems to slow overland flow, and it allows water to infiltrate and sediment to be deposited in the buffer area. Switch grass also has an extensive and deep root system, providing organic matter to the soil that improves soil quality by increasing infiltration rates and microbial activity. Table 7.05-1 is a summary of the three-zone riparian buffer strips.

A spatial analysis was conducted to determine which segments of creek in the focus area are located within 100 feet of agricultural lands. The intention of focusing on agricultural lands is to get a bigger impact from large parcels, and to reduce the significant pollution that can be carried in agricultural runoff. The result of this analysis indicated that 127,574 linear feet of Banklick Watershed streams and tributaries are located in the focus area within 100 feet of an agricultural parcel of land. See Figure 7.05-1. These nearby agricultural lands are owned by approximately 57 people. Establishing and protecting riparian buffers on these streamside lands in the focus area is an important goal of this watershed plan. One action that could have a major impact on the watershed is the implementation of riparian buffer regulations and guidelines throughout the Banklick Watershed as part of a zoning ordinance.

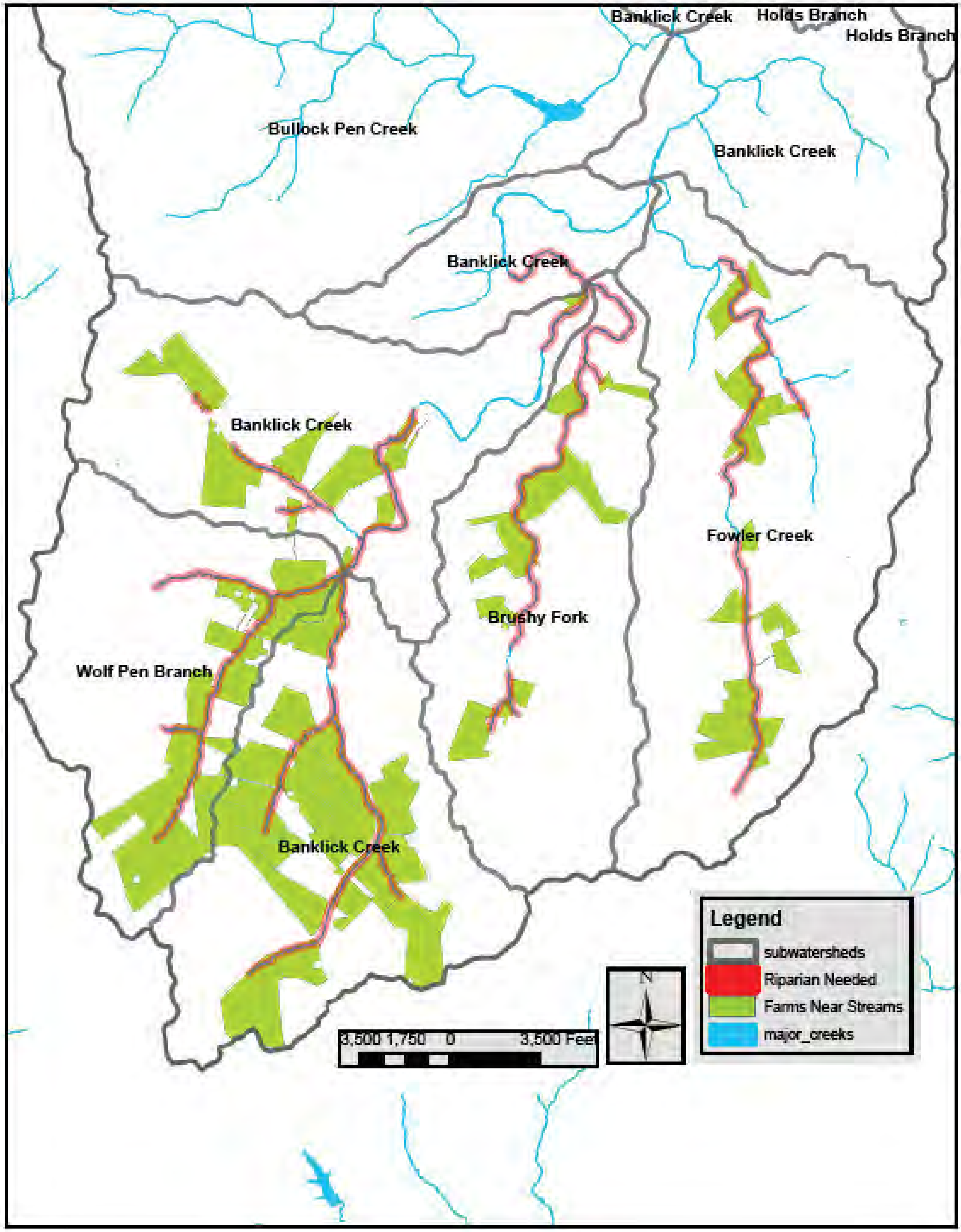
Once the key buffer lands are acquired, remediation plans should be implemented. All invasive species should be removed, and the areas should be restored to the maximum extent practicable with plantings, signage, and a long-term maintenance plan. Many variables make it difficult to estimate costs for riparian buffer restoration given that the land could be purchased or donated and may or may not require extensive restoration.

TABLE 7.05-1 THREE-ZONE RIPARIAN BUFFER STRIP SUMMARY

Zone	Zone Location	Zone Purpose	Recommended Width	Recommended Plant Species	Planting	Maintenance
Tree	Next to stream	Provide stream with shade and additional bank stability	Minimum 30 feet (four to five rows)	Oak and Cyprus. Most people prefer mass producing trees in this zone.	Plant trees and shrubs in early spring. Soak rooted cuttings 2 to 4 hours in water and unrooted cuttings for 24 hours. Close planting holes and check for firm soil around the root or cutting. Unrooted cuttings should have 1-2 buds above ground.	Weed control is essential for tree and shrub zones. Use 46 inches of organic mulch, weed control fabrics, shallow cultivation, or pre-emergent herbicides. Nonchemical weed control is preferred because of the close proximity to streams.
Shrub	Between the Tree Zone and Grass Zone	Develop perennial root system, add diversity and wildlife habitats	Minimum 12 feet (one or two rows)	Dogwoods, hazelnut, and other native shrubs.		
Grass	Next to cropland	Primary zone for filtering pollutants	20 to 24 feet	Switch grass. If runoff is not a major problem, use Indian grass, big or little bluestem, or eastern gamma.	Plant by late July. Use a prairie seed drill to plant warm season grass and forbes. Use 8 to 10 lbs. switch grass seed per acre. Seed can be drilled into killed sod, or into disked and packed soil.	Mow once or twice during growing season to mark rows. Late fall mowing reduces rodent habitats to help minimize damage during winter months.

FIGURE 7.05-1

CRITICAL AREAS FOR RIPARIAN BUFFER IN FOCUS AREA AND AGRICULTURAL PARCELS WITHIN 100 FEET OF STREAMS.



Research has shown that well maintained filter strips and vegetated buffers can reduce nutrient, pathogen, and sediment runoff loads in streams by over 50 percent, especially when preceded by a settling or detention basin. Widespread installation and maintenance of buffer strips in the watershed could significantly reduce TSS, *E. coli*, and nutrient loads, as well as moderate temperatures in the streams and rivers. Coyne *et al.* (1995) applied poultry manure to two test plots and measured fecal coliform reduction across 9 m (30 feet) wide grass filter strips. After artificial rain was applied, researchers found that fecal coliform concentrations were reduced by 74 percent and 34 percent in the two strips.

A 1973 study by Young *et al.* found that a 60-meter (197-foot)-long grass filter strip reduced fecal coliform by 87 percent, total coliform by 84 percent and BOD by 62 percent (Karr and Schlosser 1977). Based on this and similar literature, a 50 percent reduction in fecal loading for water that passes through a vegetated buffer seems to be a reasonable estimate. As an example, applying this value to the volume of water that could pass over 100 acres of buffer in the Focus Area of the Banklick Watershed indicates a removal of 380 trillion cfus of fecal coliform annually, which equates to a 6.78 percent reduction in overall fecal loadings in the focus area.

In addition to implementing riparian buffers, some areas in this watershed could also benefit from stream bank restoration. A major source of water quality impairment in the Banklick Watershed is sedimentation from erosive processes. While the proposed infiltration and riparian buffer establishment will help reduce the amount of further erosion, some restoration or stabilization of the bank and stream may be necessary to address bank instability resulting from past erosion. These restoration practices can be used to augment the use of riparian buffers and protect the investment of these water quality control measures. These restoration techniques could include bioengineered banks, stable channel morphology, in stream structures, or a combination thereof. When a stream adequately conveys flow of the receiving watershed, it improves water quality by reducing degradation and erosion due to excess stresses. The stream can begin to heal itself and accommodate more nutrients without affecting the aquatic habitat and biodiversity of the stream. Some stream restoration practices can be costly, but the Banklick Watershed Council does not want to eliminate this control as a meaningful and viable management measure for the Banklick Watershed in the Future.

To effectively reduce pollution from urban runoff, educational programming can be used to teach homeowners about the hazardous runoff that they may be producing, and inform them of what they can do to reduce their pollution on a household level. Such actions suggested by the USEPA include installation of porous pavements for driveways and sidewalks, replacing grass areas with native vegetation and mulch, decreased use of fertilizers, sweeping with a broom rather than spraying with a hose, composting, integrated pest management, picking up after pets, proper chemical disposal, and septic system inspections. Similar pollution reduction measures can be implemented for new and existing developments. Research conducted by the Connecticut Department of Natural Resources Management and Engineering determined that homeowner education programs (specifically targeting nonpoint source pollution) were able to reduce fecal coliform loadings to streams by 26 percent. Although this may be overly optimistic depending on watershed conditions, applying this load reduction rate, as an example, to the residential parcels in the focus area in Banklick Watershed indicates an overall fecal coliform load reduction of 10.6 percent.

The management measures necessary to achieve the target load reductions are listed in Table 7.05-2.

Management Measures	Desired Outcomes	Timeline
Obtain conservation easements or land donated for conservationin the watershed.	Continually aquire land for conservation, or conservation easements.	Ongoing
Protect or enhance riparian buffers.	Protect or enhance 315 acres of riparian buffers.	Ongoing
Educate homeowners about urban runoff.	Educate all homeowners.	Ongoing

Table 7.05-2 Management Measures for Agricultural and Urban Runoff to Meet WQS

The management measures to be accomplished with the BWC's 319 grant are listed in Table 7.05-3.

Management Measures	Desired Outcomes	Timeline
Obtain conservation easements or land donated for conservation in the watershed.	Conserve at least 60 acres.	2008 – 2013 Ongoing
Protect or enhance riparian buffers.	Protect or enhance 10,000 linear feet of streamside.	2010 – 2013 Ongoing
Allocate Funding for Urban Runoff controls in the focus area.	Allocate at least $20,000 for on the ground projects that improve runoff quality.	2010-develop program strategy 2011-2013-Implement program, allocate funds.

Table 7.05-3 Management Measures for Agricultural and Urban Runoff (319 Grant)

7.06 LIVESTOCK AND PASTURE MANAGEMENT

A goal of this watershed plan is to improve livestock pastures in ways that benefit water quality. One of the most meaningful ways to accomplish this is through livestock fencing. In addition to runoff from cattle and horse farms, in various locations throughout Banklick Watershed, animals have direct access to the streams and tributaries that may contribute to water pollution. As stated in Section 5, the livestock in the Banklick Watershed are estimated to produce over 16,000 tons of manure annually. Increasing the amount of fencing throughout the watershed will keep animals out of the streams and improve overall water quality. Additionally, providing a clean, reliable alternative water source is essential to encouraging landowners to fence livestock out of streams. Practices such as development of rotational grazing systems, provision of alternative water sources, fencing of livestock out of streams, and limited access practices would contribute to improved water quality. State and federal cost share programs may be available to assist landowners with implementation of these practices. Also, many farmers might prefer to have their animals well-fenced to prevent livestock from wandering off. This results in a mutually beneficial arrangement for both the farmers and the health of the watershed. Making funding available to farmers to reduce the cost of fence installation could be an easy solution to the livestock polluting the waters. There are 308 parcels of agricultural lands located in the focus area. Though many of these parcels are row crops, some contain livestock that have access to streams. Figure 7.06-1 shows a photo of cows in the focus area of Banklick Creek with stream access.

Figure 7.06-1 Cows in Banklick Watershed with Stream Access

Fencing cattle out of streams has many benefits, including stabilizing streambanks, preventing erosion and controlling runoff. It also improves downstream water quality and wildlife habitat, and reduces the risk of injury to cattle from waterborne bacteria and hoof-rot. The EPA recommends excluding or controlling livestock access to sensitive areas, such as streambanks, riparian zones, and soils prone to erosion. EPA also lists several practices by which this objective can be achieved, including using exclusionary practices such as fencing and hedgerows; providing stream crossings in areas selected to minimize the impacts of crossings on water quality; installation of alternative drinking water sources; use of improved grazing methods, to reduce physical disturbance to soil and vegetation and to minimize the direct loading of sediment and animal waste into sensitive areas; placement of salt and additional shade, including artificial shelters, at locations adequate to protect sensitive areas; and installation of hardened access points for drinking water consumption where alternatives are infeasible.

Estimating the water quality benefit of cattle fencing is challenging based on the uncertainty of the number of cattle that are currently unfenced in the watershed. Published research showed that raw livestock manure contains an average fecal loading of over 2,500,000 cfu per gram of manure. Using some conservative assumptions on the number of cattle that could be kept out of streams in the Banklick focus area, it is estimated that a successful fencing program in Banklick watershed could reduce the fecal loading in the focus area by 21 percent. It is important to understand that these values are approximations and may vary based on additional data within the focus area. However, the fact is that management measures to keep livestock out of streams will, with great certainty, reduce the fecal coliform levels in the streams.

The management measures necessary to achieve the target load reductions are listed in Table 7.06-1.

Management Measures	Desired Outcomes	Timeline
Distribute educational materials on dangers of unfenced livestock and resulting stream impairments.	Keep all farmers informed via educational materials about water quality and known impairments.	Ongoing
Implement a pasture improvement programs for livestock in watershed.	Minimize negative impacts of livestock on water quality through continued pasture improvement programs.	Ongoing

Table 7.06-1 Management Measures for Livestock and Pasture Management to Meet WQS

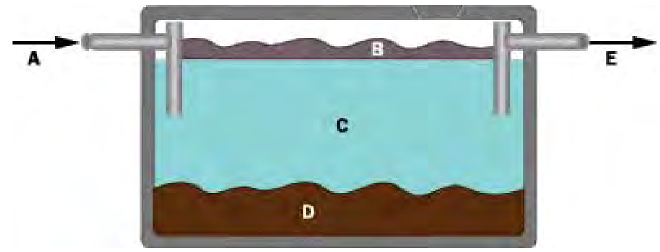
The management measures to be accomplished with the BWC's 319 grant are listed in Table 7.06-2.

Management Measures	Desired Outcomes	Timeline
Gather information on interest in a livestock fencing program and potential participants.	Determine if a cost share fencing program would be well received by livestock owners.	2010–Generate information.
Distribute educational materials on dangers of unfenced livestock and resulting stream impairments.	Distribute educational information to 75 percent of all farmers in focus area.	2010–Distribute educational materials to farmers in focus area.
Implement a pasture improvement program for livestock in watershed.	Improve at least 8 pastures in the watershed.	2010–Develop rules and qualifications of program. 2011–2013 implement program and improve pastures.

Table 7.06-2 Management Measures for Livestock and Pasture Management (319 Grant)

7.07 FAILING SEPTIC SYSTEMS

NKIHD suspected that approximately 10 percent of the septic systems in Banklick Watershed could be failing. Targeting these failing systems is one of the objectives of this watershed plan. Although the calibrated models from LTI do not identify septic systems as a significant source of fecal coliform, the 303(d) list calls out septic systems as a suspected source of fecal coliform and organic enrichment for Banklick RM 3.5 to 19.2. Therefore, improving failing septic systems is a goal for the Banklick Watershed.



A – Wastewater In **B** – Floatable Layer
C – Liquid Layer **D** – Sludge Layer **E** – To Drain Field

Figure 7.07-1 Septic Tank Separation

Private septic systems consist of a large underground tank that accepts all wastewater from a residence or commercial location. A typical tank holds approximately 1,000 gallons. Its purpose is to separate the wastewater into floatables, sludge, and liquid layers. See Figure 7.07-1. After separation, the liquid layer is dispensed to a drain field consisting of perforated pipes buried in gravel filled trenches. The drain field allows the separated liquid to slowly filter through the ground and recharge the groundwater table.

Septic systems are designed to last 20 to 30 years under the best conditions. Eventually all septic systems will fail and have to be repaired. Septic systems can fail as a result of clogged soils, blocked pipes, root damage to pipes, improper location of field drain, and lack of maintenance by the owner. If the owner fails to have the tank sludge pumped out on a regular basis, it will back up into the drain field and be permanently ruined. When septic systems fail, the pollutants that would have been removed are able to reach the streams and water supply. According to USEPA, costs for installation and maintenance of septic systems vary according to geographical region, system size and type, and the specific soil and geological characteristics of the selected site. Installation of a new septic system ranges from as low as $1,500 to more than $8,000. An average installation cost of $4,000 is assumed for a traditional septic tank/soil absorption system in a geologically favorable area. USEPA also estimates the costs associated with repairing failing septic systems to be $1,200 to $2,500 for revitalization or repair of an exhausted drainfield.

Faulty septic systems are particularly hazardous when they have the potential to affect nearby streams. Nutrients such as phosphorous can cause excessive algae growth in streams which affects fish habitats and often causes fish kills. Additionally, the *E. coli* from the septic system can cause health hazards for people who come in contact with the waters.

The most effective method to prevent faulty septic systems is to ensure proper maintenance. The following is a small list of septic system maintenance strategies and tips that should be followed by owners to keep septic systems working properly.

1. Do not overload the system by using too much water. Overloading the system is one of the leading causes of septic system failure.

2. Do not add any other materials besides domestic wastewater.

3. Do not pour grease, cooking oils, or any other similar material down the sink.

4. Maintain adequate vegetative cover over the drain field.

5. Keep surface water away from the tank and drain field.

6. Keep cars and heavy equipment off the system.

7. Have the septic system professionally inspected on an annual basis.

8. Maintain frequent pumping to remove the sludge in the tank.

Tank Size (gal)	Household Size (number of people)									
	1	2	3	4	5	6	7	8	9	10
	Recommended Pumping Frequency (Years)									
500*	5.8	2.6	1.5	1	0.7	0.4	0.3	0.2	0.1	-
750*	9.1	4.2	2.6	1.8	1.3	1	0.7	0.6	0.4	0.3
900*	11	5.2	3.3	2.3	1.7	1.3	1	0.8	0.7	0.5
1,000*	12.4	5.9	3.7	2.6	2	1.5	1.2	1	0.8	0.7
1,250	15.6	7.5	4.8	3.4	2.6	2	1.7	1.4	1.2	1
1,500	18.9	9.1	5.9	4.2	3.3	2.6	2.1	1.8	1.5	1.3
1,750	22.1	10.7	6.9	5	3.9	3.1	2.6	2.2	1.9	1.6
2,000	25.4	12.4	8	5.9	4.5	3.7	3.1	2.6	2.2	2
2,250	28.6	14	9.1	6.7	5.2	4.2	3.5	3	2.6	2.3
2,500	34.9	15.6	10.2	7.5	5.9	4.8	4	3.5	3	2.6

*Kentucky requires a minimum septic system capacity of 1,000 gallons without garbage disposal and 1,250 gallons with garbage disposal.

Table 7.07-1 Septic System Pumping Frequency

Table 7.07-1 shows a pumping frequency that should be maintained for proper system operation. To reduce the contamination from poorly maintained septic systems in Banklick watershed, efforts could be focused on education of septic system owners and a cost-share program to assist septic system owners with the financial burden of repairing or replacing their system. Education is an important component of the watershed plan because making residents of the watershed more aware of the impacts they have on the waters is critical to reaching a successful solution. Educating septic system owners on how to properly maintain their septic systems, and potentially providing a cost share program could significantly reduce the water quality pollution from septic systems in Banklick Watershed.

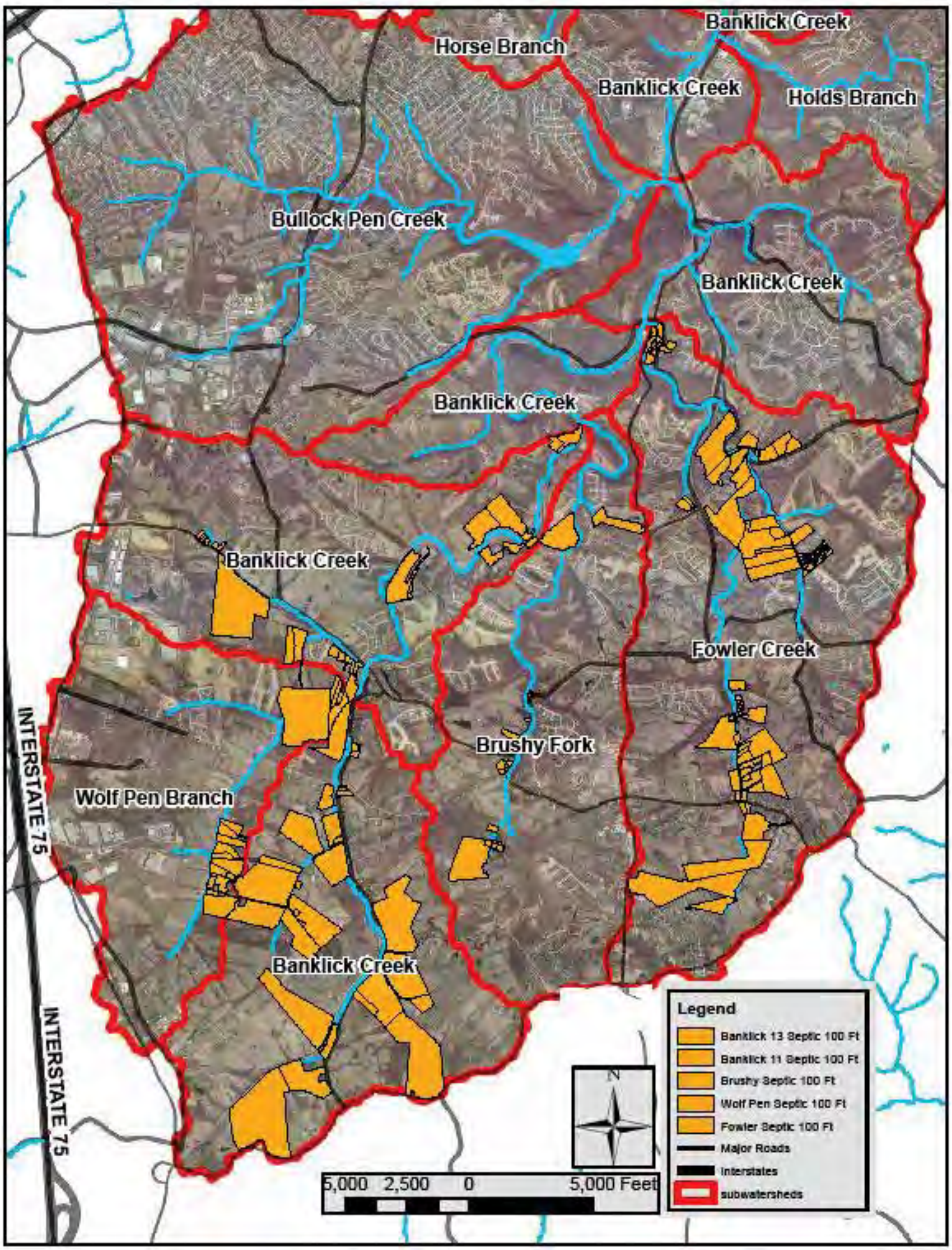
In the focus area, 1,124 parcels are sewered by septic systems, and NKIHD estimates that 10 percent of these systems may be failing. Using the assumption that an average of three people live on each parcel, and the literature value that each person produces 1.95×10^9 cfu/day (Yagow, 2001), it is estimated that failing septic systems in the focus area could contribute 4.3 percent of the fecal loading in the streams. As an example, assuming that half of failing systems were repaired, the load reduction from this management measure could be reduced by 2.14 percent.

One potential fix to faulty septic systems is to have them tied into the sewer system and removed from septic entirely. This is an option that is feasible when public sewers are located nearby, and the cost to run the new sewer line to pick up additional homes can be justified. Many homes do not have the opportunity to be on public sewer, and for those homes maintaining and repairing their septic systems regularly is very important.

An analysis was conducted to determine the critical septic parcels in the focus area. It was determined all parcels located within 100 feet of a main creek were critical parcels because a failing septic in this area has the highest probability of polluting the stream. These parcels are shown on the map in Figure 7.07-2. In the focus area, 162 unique properties were identified as having a septic system, and being located within 100 feet of a stream. The BWC will target these properties for fixing failing septic. To further determine which of these properties will have the most meaningful impact if its septic system is repaired, the systems will be individually assessed and ranked. Those systems with willing homeowners ranking the highest will be selected for repairs first.

FIGURE 7.07-2

SEPTIC SYSTEMS IN FOCUS AREA WITHIN 100 FEET OF STREAMS



The management measures necessary to achieve the target load reductions are listed in Table 7.07-2.

Management Measures	Desired Outcomes	Timeline
Educate Homeowners on the water quality implications of failing septic systems.	Educate all homeowners in the watershed.	Ongoing
Improve failing septic systems.	Improve 130 failing septic systems.	Ongoing

Table 7.07-2 Management Measures for Failing Septic to Meet WQS

The management measures to be accomplished with the BWC's 319 grant are listed in Table 7.07-3.

Management Measures	Desired Outcomes	Timeline
Publish septic system informational articles in a local paper for public education.	Publish 6 articles in the local paper.	2010-2011-publish 3 articles 2012–2013-publish 3 articles
Distribute educational materials - on proper septic system maintenance and what to do in the case of a septic system failure - to 80% of known septic system owners.	Increase the problem awareness, and improve septic system maintenance over time.	2010–Distribute educational materials.
Implement a cost share program to encourage septic system owners to improve failing septic systems.	Improve at least 12 septic systems in the focus area.	2010–Create the program. 2010–Advertise program to septic system owners. 2010-2012–Award cost share funding to up to 20 septic system owners.

Table 7.07-3 Management Measures for Failing Septic Systems (319 Grant)

7.08 INCREASE INFILTRATION

Increasing infiltration in target areas throughout the Banklick Watershed will help cleanse water before it reaches the streams and also potentially increase base flows in the streams throughout the year. This is an overall goal of the Banklick Watershed Plan. Stormwater infiltration can be accomplished in a number of ways. Shallow infiltration consists of creating structures to hold the water and allow it to slowly discharge through the soil over a period of time. Shallow infiltration techniques include extended detention basins, rain gardens, and bioswales. Shallow infiltration is typically more effective in areas with highly permeable soils that will allow the water to flow from the surface down into the water table easily. Deep infiltration is a method of recharging water to the ground where impermeable soils, such as clay, will not allow shallow infiltration. Deep infiltration can be accomplished through a dry well, an injection well, or some other device.

Nearly the entire focus area is comprised of soils in hydrologic soil group C. The hydrologic soil groups are classified by the USDA NRCS, formerly the Soil Conservation Service. There are four hydrologic soil groups: A, B, C, and D. Soils in group C have a typical infiltration rate of 0.17 to 0.27 in/hr. The different soil types can have a big impact on the success of green infrastructure projects in this area. Soils with very low infiltration rates will not readily "soak up" the stormwater, and much of the water will runoff overland, carrying pollutants into the stream. Soils with high infiltration rates are best for green infrastructure practices.

Increasing infiltration through implementation of bioswales and rain gardens can reduce fecal loadings significantly. Studies have shown that biofiltration techniques can reduce bacteria loadings by 35 to 90 percent. Based on the range of removal efficiencies, it seems reasonable to estimate that biofiltration in the Banklick Focus area could reduce fecal loadings by approximately 40 to 50 percent for each BMP.

The management measures necessary to achieve the target load reductions are listed in Table 7.08-1. The management measures to be implemented by the BWC under the 319 grant are listed in Table 7.08-2.

Management Measures	Desired Outcomes	Timeline
Increase infiltration to encourage restoration of the natural flow regime.	Install 20 acres of biofiltration BMP's.	Ongoing

Table 7.08-1 Management Measures for Increasing Infiltration to Meet WQS

Management Measures	Desired Outcomes	Timeline
Conduct four infiltration BMP demonstration workshops.	Educate watershed residents on the benefits of BMPs.	2010–Conduct BMP workshops.
Explore opportunities to direct flows from to low flow streams.	An analysis of opportunities within Banklick Creek.	2011–2012 Conduct analysis to determine if and where flow redirection may be beneficial.
Allocate funding for visible demonstration BMPs in the watershed.	Allocate at least $20,000 for visible BMP demonstrations projects in the watershed.	2010–2013 Allocate $20,000 for BMP installation.

Table 7.08-2 Management Measures for Increasing Infiltration (319 Grant)

7.09 SUMMARY OF RECOMMENDED MANAGEMENT MEASURES

It is important to understand that many types of nonpoint source control can make a meaningful impact on this watershed. The assessment shown in Table 7.04-1 identifies the potential controls that could be implemented by SD1, the BWC, and other partners. The four main controls that were prioritized as being the most important were the following:

1. Reestablishment/restoration of riparian buffers.
2. Livestock fencing.
3. Septic system programs.
4. Shallow infiltration promotion.

All of these controls can be implemented in different combinations, by different organizations, and at different costs. It will require the collaboration of many efforts to help the Banklick Watershed get closer to the goal of achieving water quality standards. The BWC's 319 grant is a start (see Tables 7.09-1 through 7.09-3) but it is not the final solution. An example of one possible combination of the efforts required to achieve water quality standards for fecal coliform in the Banklick Watershed focus area is over 312 acres of riparian buffer, fencing nearly all of the livestock with access to streams, educating all residents about water quality, improving over 130 failing septic systems, and installing 20 acres of bioretention facilities. Again, this is just one example based on the best available data of how controls could be implemented in order to illustrate the challenge of achieving water quality standards, and the importance of collaborating with other organizations and other programs to achieve this goal. The Estimated Load Reductions that could be achieved with this combination of management measures in the focus area is demonstrated in Table 7.09-1. These load reductions were calculated by considering the percentage of pollutant loading attributed to sources that are under the jurisdiction of other entities, SSOs, KPDES discharges, and construction sites and it was assumed that these sources would be reduced by the same percentage needed to meet WQS. Then, the necessary management measures were quantified by subwatershed to reduce the remaining loading to meet water quality standards. The management measures needed to achieve WQS for fecal coliform result in modeled complete load reduction for both phosphorous and TSS.

The BWC plans to make a big impact on this objective with the 319 grant that was awarded to them. Tables 7.09-2 through 7.09-4 summarize the expected results of the 319 management measures outlined in Sections 7.05 to 7.08. These results are based on the best available information and may be modified as future data is generated.

The costs associated with implementing controls is widely variable. For example, having land donated for conservation is certainly much more cost effective than purchasing land for conservation. However, it is important to have some guideline of the potential costs of control measures. Table 7.09-5 shows approximate unit costs associated with the management measures that the BWC proposes to accomplish with the 319 grant. Additional budgetary information can be found in section 8 of this watershed plan.

	Annual Fecal Loading (Trillion cfu)	Estimated Load Reduction						Total Estimated Load Reduction
		From Other Jurisdictions	Riparian Buffers	Livestock Fencing	Homeowner Education	Improved Septic	Infiltration	
Fowler Creek	1,042.58	2.36	521.29	121.66	172.31	181.50	4.12	96.2%
Brushy Fork	652.50	0.00	326.25	121.66	98.85	76.87	3.92	96.2%
Banklick Creek 11	1,811.40	1012.80	517.05	121.66	137.21	-	5.78	99.1%
Wolf Pen Branch	972.48	142.66	435.85	243.31	121.81	-	12.78	98.3%
Banklick Creek 13	1,128.62	0.00	405.80	608.29	62.55	25.62	6.56	98.2%
Total	5,607.57	1,157.82	2,206.24	1,216.57	592.73	283.99	33.18	97.9%

Table 7.09-1 Estimated Fecal Coliform Load Reductions from Management Measures Needed to Achieve WQS

	Annual Fecal Loading (Trillion cfu)	Estimated Load Reductions (Trillion cfu)					Total Estimated Load Reduction
		Riparian Buffers	Livestock Fencing	Homeowner Education	Improved Septic	Infiltration	
Fowler Creek	1,042.58	84.80	121.66	172.31	12.83	0.21	37.6%
Brushy Fork	652.50	53.07	121.66	98.85	5.63	0.20	42.8%
Banklick Creek 11	1,811.40	147.33	121.66	137.21	2.10	0.29	22.6%
Wolf Pen Branch	972.48	79.10	121.66	121.81	0.87	0.64	33.3%
Banklick Creek 13	1,128.62	91.80	121.66	62.55	4.19	0.33	24.9%
Total	**5,607.57**	**456.09**	**608.29**	**592.73**	**25.62**	**1.66**	**30.0%**

Table 7.09–2 Estimated Fecal Coliform Load Reductions from 319 Management Measures

	Annual Phosphorous Loading (kg)	Estimated Load Reductions (kg)					Total Estimated Load Reduction
		Riparian Buffers	Livestock Fencing	Homeowner Education	Improved Septic	Infiltration	
Fowler Creek	3771	4.29E+02	1.38E+02	0.00E+00	1.05E+01	7.46E-01	15.3%
Brushy Fork	2024	2.30E+02	1.38E+02	0.00E+00	4.62E+00	6.09E-01	18.4%
Banklick Creek 11	3724	4.24E+02	1.38E+02	0.00E+00	1.72E+00	1.11E+00	15.2%
Wolf Pen Branch	2131	2.43E+02	1.38E+02	0.00E+00	7.11E-01	7.52E-01	17.9%
Banklick Creek 13	2349	2.67E+02	1.38E+02	0.00E+00	3.44E+00	6.83E-01	17.4%
TOTAL	**13,998.24**	**1,593.96**	**687.63**	**0.00E+00**	**21.02**	**3.90**	**16.5%**

Table 7.09–3 Estimated Phosphorous Load Reductions from 319 Management Measures

	Annual TSS Loading (kg)	Estimated Load Reductions (kg)					Total Estimated Load Reduction
		Riparian Buffers	Livestock Fencing	Homeowner Education	Improved Septic	Infiltration	
Fowler Creek	1276336	1.66E+05	3.63E+03	0.00E+00	1.25E+03	4.80E+02	13.4%
Brushy Fork	862399	1.12E+05	3.63E+03	0.00E+00	5.47E+02	4.93E+02	13.6%
Banklick Creek 11	880583	1.15E+05	3.63E+03	0.00E+00	2.04E+02	4.98E+02	13.5%
Wolf Pen Branch	772198	1.00E+05	3.63E+03	0.00E+00	8.41E+01	5.18E+02	13.6%
Banklick Creek 13	950628	1.24E+05	3.63E+03	0.00E+00	4.07E+02	5.25E+02	13.5%
TOTAL	**4,742,144.20**	**617,123.06**	**18,150.67**	**0.00E+00**	**2,487.02**	**2,512.71**	**13.5%**

Table 7.09–4 Estimated TSS Load Reductions from 319 Management Measures

Practice	Units	Cost Range per Unit*
Land Donation	Acre of Land	$ -
Conservation Easement	Acre of land	$ -
Riparian Buffer Enhancement	Per Square Foot	$0.30 - $0.70
Livestock Fencing	Per Linear Foot	$0.70 - $2.00
Livestock Stream Crossing	Each	$2500 - $5000
Livestock Watering Systems	Each	$500 - $8000+
Education Programs	People Reached	Varies
Septic Tank Repair	Per System	$1200 - $2500+
Septic Tank Replacement	Per System	$1500 - $8000+
Infiltration BMPs	Per Square Foot	$0.20 - $15

* These costs are approximate

Table 7.09–5 Approximate Unit Costs of Management Measures

8.01 BUDGET OVERVIEW

The proposed budget for this project includes cost estimates based on the best available information.

The largest source of funding currently available for the implementation of the management measures described in Section 7 is the 319(h) nonpoint source pollution grant that the BWC received from KDOW. This funding will be used to implement the management measures to improve water quality in Banklick Watershed. The BWC will not use any of the funds from the 319(h) grant for KPDES permit-related activities such as municipal separate storm sewer system or CSO compliance. Considerable investments will be made in the Banklick watershed by SD1 as they work towards compliance with their consent decree requirements.

The monies from the 319 grant will help make a meaningful impact on the quality of water in the focus area of the watershed, but future additional funding will be needed to reduce the loadings to a level meeting WQS. Other groups and stakeholders throughout the watershed may invest funds towards improving the watershed in the future. For example, NKIHD may invest in improving failing septic systems, KCCD may invest in pasture improvement measures, and municipalities may install BMP technologies; all of these investments help towards achieving the goals of this watershed plan.

The remainder of this section is a detailed breakdown of how the 319(h) grant money will be applied. $762,100 is budgeted for project implementation efforts, of which $380,200 represent local matching funds allotted for conservation easements and stream restoration projects associated with the Northern Kentucky “in-lieu” program. Approximately $381,900 is budgeted for other BMP projects.

Technical expertise will be utilized as needed for the implementation of specific project components, such as stream or wetland restoration. Design and planning assistance will likely come from the Center for Applied Ecology at Northern Kentucky University, Strand, and other qualified resources. To stretch the implementation dollars even further, volunteers will be utilized where appropriate, such as for riparian zone creation, stream bank restoration, and so forth. Based on the success of Lexington’s “Reforest the Bluegrass,” utilizing volunteers for activities such as seedling planting not only maximizes a project’s budget but also conveys the message of water quality protection through forestry practices and provides “earned media” opportunities. Rather than paying for advertisements, community volunteer events such as riparian zone creation attract media as worthy news coverage, which is free, often allotted more time, and is more effective than 30-second advertisements.

The remaining $237,900 is budgeted for the development of this WBP, project management and reporting, and marketing of the plan to the public and various agencies to promote future implementation efforts.

$77,400 is budgeted for pre- and postconstruction monitoring (as needed). Postconstruction monitoring will target specific pollutants of concern identified in the existing data sets, as well as measures of overall stream health such as habitat and biological integrity. It is anticipated that monitoring will be conducted through contractual agreements with the Center for Applied Ecology at Northern Kentucky University and Strand. Local partners may assist with this effort where appropriate. Should less money be required for monitoring, any excess funds would likely be applied to implementation.

An additional $50,000 is allocated for technical assistance to develop the WBP. Identified technical assistance will be contracted through qualified engineers and scientists, including but not limited to the Center for Applied Ecology and Strand. $56,100 is budgeted for project management throughout the duration of the project. This includes quarterly billings, annual reporting, project coordination, and the development of the final project report. Should either the WBP development or project management be completed with less money than budgeted, the remaining budget will likely be applied to implementation activities.

Additionally, $52,400 is allocated for educational, training, and outreach activities. Most of these funds will be used to present the WBP to the public, government officials, resource agencies, and various stakeholders. This includes $15,000 for any materials that the BWC determines necessary for successful marketing. This budget includes $1,000 for project managers to attend WBP development training, if such training is available. It should be noted that no dollars from this project will be used to implement any educational or outreach activities that have the potential to overlap with required Phase II stormwater permitting activities. Further, the project will maximize the outreach and education budget where possible/appropriate by utilizing existing educational materials, such as the Commonwealth Water Education Program (CWEP), Public Service Announcements (PSA) and Kentucky Educational Television's (KET) virtual tour of a watershed.

In addition to the $380,200 local matching funds discussed above, $19,800 in personnel time is budgeted for efforts from the staff of BWC and other project partners to be donated to the project to bring the total local matching contribution to $400,000. For example, this will include time from stakeholder group members and other citizens who are involved in the project. Also, $2,000 has been budgeted for personnel time for tasks not listed in other categories, for example, activities such as reviewing and developing the WBP outside the scope of management, outreach, or monitoring. It could also include time spent on implementation activities that address nonpoint source pollution that do not directly fall under the classification of implementing BMPs.

Aside from the $380,200 in project implementation efforts and the $19,800 in personnel time, it is anticipated that all other project-related activities will be funded through 319(h) funds.

It should also be noted that dollars budgeted for supplies, equipment, and travel are subject to change. Supplies and equipment may include tree seedlings and shovels for riparian zone establishment, live willow stakes for natural bank stabilization, and other similar materials.

8.02 TECHNICAL ASSISTANCE

A large number of organizations and individuals are actively involved with the restoration of the Banklick Watershed. The key project partners within the watershed and their contact information is as follows:

Agency Name: Northern Kentucky Health Department
Agency Address: 610 Medical Village Drive
Role/Contribution to Project: Monitoring, education, Project Steering Committee
Contact Person: Tony Powell
Phone No. 859-363-2049
E-mail address: tony.powell@ky.gov

Agency Name: Sanitation District No. 1
Agency Address: 1045 Eaton Drive
Role/Contribution to Project: Monitoring, data, education, Project Steering Committee
Contact Person: Jim Gibson
Phone No. 859-578-6882
E-mail address: jgibson@sd1.org

Agency Name: Northern Kentucky Urban & Community Forestry Council
Agency Address: P.O. Box 876, Burlington, Kentucky 41005
Role/Contribution to Project: Public outreach, Project Steering Committee
Contact Person: Kris Stone
Phone No. 859-384-4999
E-mail address: Kstone@boonecountyky.org

Agency Name: City of Fort Wright
Agency Address: 409 Kyles Lane, Fort Wright, Kentucky 41011
Role/Contribution to Project: Education, Project Steering Committee
Phone No. 859-331-1700

Agency Name: City of Erlanger
Agency Address: 505 Commonwealth Avenue, Erlanger, Kentucky 41018
Role/Contribution to Project: Public outreach, Project Steering Committee
Phone No. 859-727-2525

Agency Name: Northern Kentucky University–Center for Applied Ecology
Agency Address: Northern Kentucky University,
510 Johns Hill Road, Highland Heights, Kentucky 41076
Role/Contribution to Project: Education, Project Steering Committee
Contact Person: Jessica Metzger
Phone No. 859-572-1999
E-mail address: metzgerj2@nku.edu

Agency Name: Northern Kentucky Area Planning Commission
Agency Address: 2332 Royal Drive, Fort Mitchell, Kentucky 41017
Role/Contribution to Project: Public Outreach, GIS Information, Project Steering Committee
Contact Person: Sharmili Sampath
Phone No. 859-331-8980
E-mail address: ssampath@nkapc.org

Agency Name: Kenton County Conservation District
Agency Address: 6028 Camp Ernst Road, Burlington, Kentucky 41005
Role/Contribution to Project: Project Steering Committee
Contact Person: Mary Katherine Dickerson
Phone No. 859-586-7903
E-mail address: mary.dickerson@ky.nacdnet.net

Agency Name: City of Covington, Kentucky
Agency Address: City of Covington, Mayor and Commissioners' Office,
638 Madison Avenue Covington, Kentucky 41011
Role/Contribution to Project: Project Steering Committee
Contact Person: Mayor Butch Callery
Phone No. 859-292-2127
E-mail address: mayor@covingtonky.gov

Agency Name: Kenton County Fiscal Court
Agency Address: 303 Fourth Street, Covington, Kentucky 41011
Role/Contribution to Project: Project Steering Committee, potential Implementation Coordination, and potential Outreach Coordination
Contact Person: Scott Kimmich
Phone No. 859-392-1400
E-mail address: scott.kimmich@kentoncounty.org

Agency Name: United States Geological Survey
Agency Address: Kentucky Water Science Center,
9818 Bluegrass Parkway, Louisville, Kentucky 40299
Role/Contribution to Project: Flow Data
Contact Person: Michael Griffin
Phone No. 502-493-1913
E-mail address: mgriffin@usgs.gov

Agency Name: Kentucky Transportation Cabinet
Agency Address: 421 Buttermilk Pike, PO Box 17130, Covington, Kentucky 41017
Role/Contribution to Project: Project Steering Committee and potential project coordination
Contact Person: Mike Bezold
Phone No. 859-341-2700
E-mail address: mike.bezold@ky.gov

Agency Name: Boone County Planning Commission
Agency Address: 950 Washington St. P.O. Box 958 Burlington, KY 41005
Role/Contribution to Project: Project Steering Committee & potential project coordination
Contact Person: Kevin Costello, Executive Director
Phone No. 859-334-2196
E-mail address: kcostello@boonecountyky.org

Agency Name: Kenton Conservancy
Agency Address: 2332 Royal Drive, Fort Mitchell, KY 41017
Role/Contribution to Project: Land Conservation and Buffer Acquisition
Contact Person: Kathy Donohoue
Phone No. (859) 331-8980

8.03 WORK BREAKDOWN

Although a large number of project partners are involved with this watershed plan effort, the key organizations implementing the controls in the focus area will be the BWC and Strand. Other organizations and entities will be contacted for collaboration and assistance when appropriate.

The work breakdown for the 319 management measures is shown in Table 8.03-1. The work breakdown for the overall management measures is shown in Table 8.03-2. To achieve the goals outlined in this plan, the BWC will hold regular monthly meetings to assign tasks and discuss progress. The BWC will keep project partners informed and engaged as appropriate throughout the implementation of the watershed plan.

TABLE 8.03-1

TECHNICAL ASSISTANCE BREAKDOWN BY TASK FOR THE 319 GRANT

	BWC	Strand	Other
Management Measures for Reducing Agricultural and Urban Runoff			
Obtain conservation easements or land donated for conservation in the watershed.	X	X	X
Protect or enhance riparian buffers.	X		X
Allocate Funding for Urban Runoff controls in the focus area.	X	X	X
Management Measures for Controlling Unfenced Animals			
Gather information on interest in a livestock fencing program and potential participants.	X	X	X
Distribute educational materials on dangers of unfenced livestock and resulting stream impairments.	X		
Implement a pasture improvement program for livestock in watershed.	X	X	X
Management Measures for Failing Septic Systems			
Publish septic system informational articles in a local paper for public education.			
Distribute educational materials - on proper septic system maintenance and what to do in the case of a septic system failure - to 80% of known septic system owners.	X	X	
Implement a cost share program to encourage septic system owners to improve failing septic systems.	X		
Management Measures for Increasing Infiltration			
Conduct infiltration BMP demonstration workshops.			X
Explore opportunities to direct flows to low flow streams.	X	X	
Allocate funding for visible demonstration BMPs in the watershed.	X	X	X

TABLE 8.03-2

WORK BREAKDOWN BY TASK FOR OVERALL WATERSHED PLAN

	BWC	NKHD	SD1	Forestry Council	City of Ft. Wright	City of Erlanger	NKU CAE	NKAPC	KCCD	City of Covington	KC Fiscal Court	USGS	KyTC	Boone Co. Planning	KDOW	Kenton County Conservancy
Management Measures for Reducing Agricultural and Urban Runoff																
Obtain conservation easements or land donated for conservation in the watershed.	X							X						X		X
Protect or enhance riparian buffers.	X		X	X	X	X	X	X	X	X	X		X	X		
Educate homeowners about urban runoff.	X		X	X				X	X					X		
Management Measures for Controlling Unfenced Animals																
Distribute educational materials on dangers of unfenced livestock and resulting stream impairments.	X	X	X						X							
Implement a pasture improvement programs for livestock in watershed.	X								X							
Management Measures for Failing Septic Systems																
Educate Homeowners on the water quality implications of failing septic systems.	X	X	X					X	X					X		
Improve failing septic systems.	X	X														
Management Measures for Increasing Infiltration																
Increase infiltration to encourage restoration of the natural flow regime.	X		X	X	X	X	X	X	X	X	X	X	X	X		
Management Measures Enforced Under Specific Jurisdictions																
CSO and SSO controls associated with consent decree compliance.			X													
Enforcement of KPDES Permits															X	
Enforcement of sediment and erosion control plans for construction sites.			X					X								

Note: This work breakdown is for planning purposes only and is subject to change.

9.01 PUBLIC INVOLVEMENT AND EDUCATION

Public Outreach has always been an integral part of the BWC's efforts. The first organized venture of the BWC was a stakeholder meeting in July 2002. Almost forty people attended this meeting; they were civic leaders, representatives of organizations and citizens, their input helped BWC prioritize its efforts. The National Urban Forestry Grant, that BACE was completed in December 2004, used social marketing to guide proposed public outreach endeavors. In addition, social marketing was a major component in the South Banklick Study that was completed this year by Northern Kentucky Area Planning.

The knowledge gained from past public outreach and social marketing along with continued collaboration among stakeholders and public outreach are considered be critical to the success of the project. BWC intends to involve interested parties throughout the development and implementation of the plan and will evaluate the potential to utilize social marketing techniques to more effectively achieve local support for the proposed activities. One potential avenue to achieve this objective is through the formation of a Stakeholder Group. Such a group may provide review and feedback on the WBP as it is being developed and implemented by meeting once per quarter during the project. The BWC values existing and new relationships with individuals and entities, and recognizes their valuable perspective to this process.

Resources are allocated to market this WBP to the general public, property owners, government officials, and others. Beyond the marketing of the watershed plan for Banklick Creek, outreach and education efforts targeted at creating an awareness of the water quality impacts of nonpoint source pollution will be developed. Recommended activities will make use of material and programs already available through KDOW, such as the PSAs developed by the CWEP, KET's virtual tour of a watershed, and others. An informed public will be critical to maintaining water quality in Banklick Creek. It should be noted that any outreach/educational efforts that could possibly overlap with Phase II stormwater permit requirements will not be implemented under this grant.

Three public meetings were held during the development of this WBP to gain input and "ground truthing" about the problems in the watershed and the suspected sources of those problems. The public meetings serve dual purposes, to help inform the community and gain their input as stakeholders. The details of the public meetings held in the spring of 2009 and the results of a public input survey can be found in Section 4.03 of this report.

The public involvement goal for this project will be to create an informed community, including stakeholders, government officials, and the general public. If people at every level are informed of the importance of the WBP, its implementation has a greater chance of continuing beyond the cycle of the 319(h) grant. Creating a supportive and motivated public will reinforce the level of commitment the many agencies have already expressed in this project.

Additionally, many of the management measures include an education component. The BWC realizes the necessity of educating the residents of the watershed and inspiring many people to become actively involved and engaged in protecting and restoring the watershed.

10.01 IMPLEMENTATION SCHEDULE

The implementation schedule for the 319 grant is shown as Figure 10.01-1. This schedule takes each of the main management measures, and their sub task breakdown, and assigns a timeline to each action item. The schedule is broken down by year and then by month, and it provides an outlook for the duration of the project. The schedule should provide general guidance for accomplishing tasks, but a project of this nature does not have specific deadline dates, so the schedule does have some flexibility. It is important to note that this schedule is meant for guidance and support, but it is not a perfected plan–it may need revisions as the project progresses. Some tasks may be started sooner than scheduled, and some may not get completed on time, but the schedule should be followed as much as possible to ensure that progress is being made in the right direction. In general, this schedule will provide guidance for the project and will be helpful in keeping the variety of tasks associated with the project on track and on time.

The schedule coincides with the measureable milestones, project benchmarks, and the evaluation plan. A schedule has not been prepared for the watershed overall, due to the difficulty predicting the activities of the various project partners over time. The first step overall is to successfully complete the implementation of the 319 grant management measures as described. Upon completion of the 319 implementation the BWC will prepare a schedule to focus on ongoing implementation of the overall watershed plan based on the progress made.

10.02 DESCRIPTION OF MILESTONES

Project Milestones are meant to provide a measure of progress for the implementation of each project phase. The following milestone descriptions explain the milestones from the implementation schedule.

A. Obtain Conservation Easements or Donated Land for Conservation in the Watershed

Meetings with landowners will be conducted to encourage the donation of buffer lands. Land may be purchased if landowners are unwilling to donate their lands for conservation. This task will be monitored by the total acres of streamside land acquired. The milestones are to acquire 25 acres within the first two years, 50 acres by the fourth year, and 60 acres in the long term.

B. Protect or Enhance Riparian Buffers

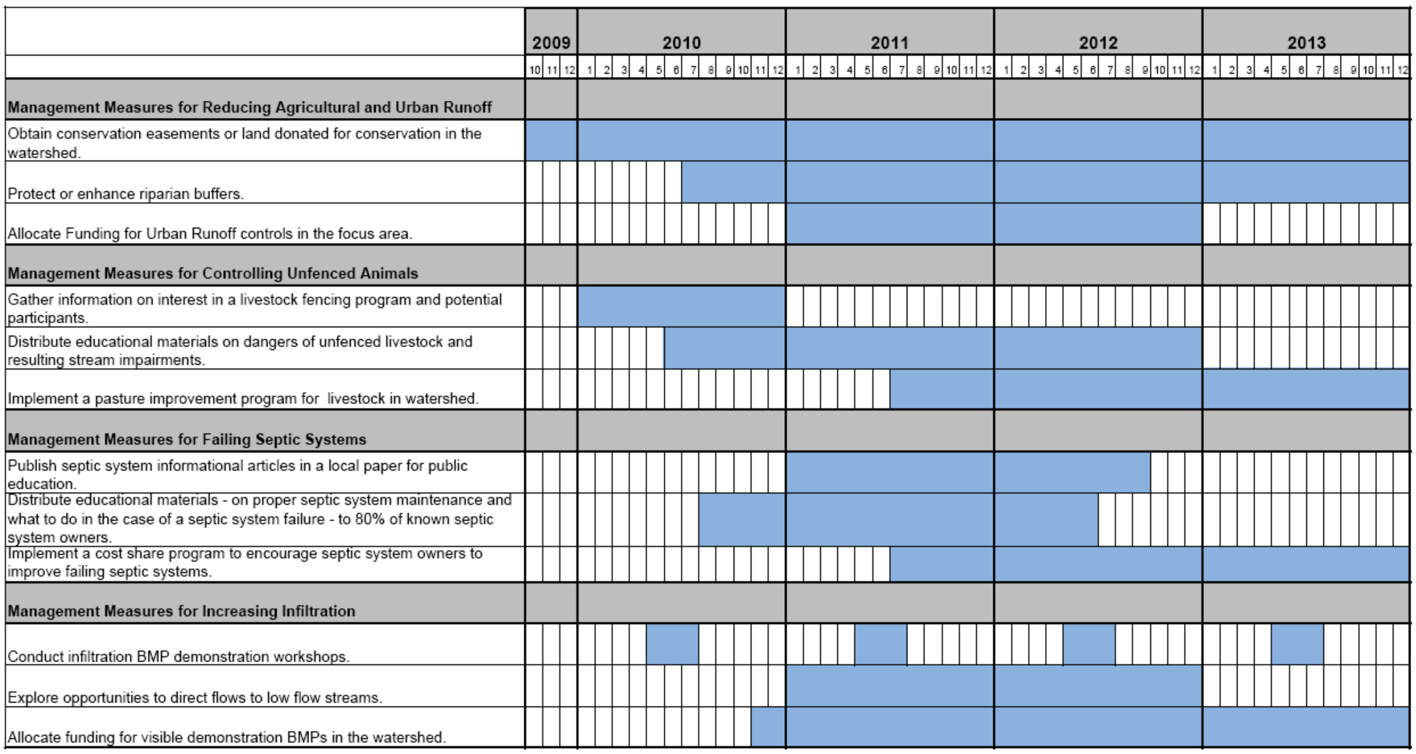
This task goes along with the acquisition of buffer land. This task refers specifically to the vegetative recovery and revival of that buffer land, and this task will be monitored by tracking the linear feet of land that has been restored. The milestones are to restore 5,000 linear feet by the end of the fourth year, and 10,000 linear feet by the end of the fifth year.

C. Allocate Funding for Urban Runoff Controls in the Focus Area

This task is intentionally broad in nature to allow the council to allocate up to $20,000 of the 319 funding to appropriate urban runoff controls. These controls could include any urban runoff controls that improve the water quality problems outlines in this plan. The $20,000 figure is a minimum goal, and more could be allocated if deemed appropriate.

FIGURE 10.01-1

PROJECT SCHEDULE



D. <u>Gather Information on Interest in a Livestock Fencing Program and Potential Participants</u>

This task is simply necessary to gather more specific information on the number of unfenced livestock in the focus area and the proportion of these livestock owners who might be interested in a fence cost-share program.

E. <u>Distribute Educational Materials on Dangers of Unfenced Livestock and Resulting Stream Impairments</u>

This is an educational program to make farmers aware of the harm and dangers of unfenced cattle as well as encourage them to participate in the fence cost-share program. The objective is to distribute educational materials to 50 percent of all farmers by the fourth year, and 75 percent of all farmers by the fifth year. The list of farmers in the focus area will be determined from available PVA and GIS information.

F. <u>Implement a Pasture Improvement Program for Livestock in the Focus Area.</u>

This milestone is meant to implement a program for pasture improvement that will allow 319 funds to be distributed to farmers in the focus area for appropriate pasture improvements. The objective is to improve six pastures by the fourth year, and eight pastures by the fifth year.

G. <u>Publish Septic System Informational Articles in a Local Paper for Public Education</u>

This milestone is focused on public education. The objective is to publish three septic system articles by the fourth year and six articles by the fifth year in local papers. The articles intended for this effort have already been written, and approved for use in another 319 program in Grant County.

H. <u>Distribute Educational Materials–on Proper Septic System Maintenance and What To Do in the Case of a Septic System Failure–to 80 Percent of Known Septic System Owners</u>

This educational program will be focused on educating known septic system owners, and may also be use to notify owners of available funds where appropriate. The goal is to distribute materials to 40 percent of system owners by the fourth year, and 80 percent of system owners by the fifth year.

I. <u>Implement a Cost-Share Program to Encourage Septic System Owners to Improve their Failing Systems</u>

This milestone is targeted at improving failing septic systems through a cost-share program. The medium milestone for this task is improving six septic systems. The long-term milestone of this task is to improve 12 septic systems. Utilizing a partnership with NKIHD, and their experience with a similar program in Grant County may allow the BWC to realize some efficiencies in the development and implementation of this effort.

J. Conduct Infiltration Best Management Practice Demonstration Workshops

To increase infiltration, workshops will be organized to educate residents on the benefits of infiltration. The milestone is to have three workshops by the fourth year and four by the fifth year.

K. Explore Opportunities to Direct Flows to Low Flow Streams

Promoting infiltration throughout the watershed will allow opportunities to increase base flows in low flow streams. This milestone will be on an as-needed basis due to the unknown opportunities that may arise throughout the life of the grant.

L. Allocate Funding for Visible Demonstration BMPs in the Watershed

This task allows the council to allocate up to $20,000 of the 319 funding for visible demonstration BMPs. $20,000 is a minimum goal, and more could be allocated if deemed appropriate.

Each of these milestones will be completed through the accomplishment of smaller subtasks. The milestones are set up in three levels, short-term milestones are set within the first two years (by October 2010), medium milestones are set within the first four years (by October 2012) and long-term milestones are set before the end of five years or by the target project completion date of December 2013. All milestones can be found in Table 10.02-1.

TABLE 10.02-1

SHORT-, MEDIUM-, AND LONG-TERM MILESTONES

			Milestones		
	Task	**Measure of Success**	**Short < 2 yr**	**Med < 4 yr**	**Long < 5 yr**
Agricultural and Urban Runoff Reduction	Obtain conservation easements or land donated for conservation in the watershed.	Acres conserved	25	50	60
	Protect or enhance riparian buffers.	Linear Feet Protected or Restored	-	5,000	10,000
	Allocate Funding for Urban Runoff controls in the focus area.	Funding Dollars Spent	-	$ 10,000	$ 20,000
Livestock Fencing	Gather information on interest in a livestock fencing program and potential participants.	N/A	-	-	-
	Distribute educational materials on dangers of unfenced livestock and resulting stream impairments.	Percent of farmers receiving information.	-	50%	75%
	Implement a pasture improvement program for livestock in watershed.	Number of pastures improved.	-	6	8
Improve Failing Septic Systems	Publish septic system informational articles in a local paper for public education.	Number of articles published	-	3	6
	Distribute educational materials - on proper septic system maintenance and what to do in the case of a septic system failure - to 80% of known septic system owners.	% of system owners receiving information	-	40%	80%
	Implement a cost share program to encourage septic system owners to improve failing septic systems.	Number of systems improved	-	6	12
Increase Infiltration	Conduct infiltration BMP demonstration workshops.	Number of workships conducted.	-	3	4
	Explore opportunities to direct flows to low flow streams.	As Needed	-	-	-
	Allocate funding for visible demonstration BMPs in the watershed.	Funding dollars allocated.	-	$10,000	$20,000

10.03 PROPOSED BENCHMARKS

The following benchmarks are meant to evaluate the effectiveness of the management measures that are to be implemented in the focus area in the upper portion of the watershed through this watershed plan. These benchmarks will be evaluated through the collection of water quality data as well as through calculations and estimations based on the progress of the milestones.

A. Short Term (< 2 years) – October 2010

3 percent reduction in total fecal coliform concentration (cfus/100ml)
5.5 percent reduction in total solids
5 percent reduction in phosphorous

B. Medium Term (< 4 years) – October 2012

25 percent reduction in total fecal coliform concentration (cfus/100ml)
11 percent reduction in total solids
11 percent reduction in phosphorous

C. Long Term (< 5 years) – October 2013

30 percent reduction in total fecal coliform concentration (cfus/100ml)
13.5 percent reduction in total suspended solids
21 percent reduction in phosphorous

10.04 EVALUATION PLAN

This plan to improve the Banklick Watershed is both comprehensive and long term, making it essential to frequently measure progress in attaining goals and specific objectives. Further, incorporating regular evaluations into the initiative will help to maintain direction and momentum. Monitoring components are critical to ensure the progress toward the established goals is being made. The monitoring components of the BWP are fully integrated with the project schedule and the project benchmarks. The primary reasons to monitor the watershed program are to demonstrate progress toward the goal, and to continually improve the effectiveness of the program.

Ongoing water quality monitoring is to be conducted as part of SD1's efforts to reduce pollution from point sources. This monitoring will be conducted in accordance with the Quality Assurance Project Plan (QAPP) found in Appendix A. This water quality data is instrumental in the success of this project because shared information will reduce the need for additional water quality testing for the evaluation of the nonpoint source controls. This water quality data will be collected over the course of the six-year life of this project. The water quality data will be analyzed to determine the total pollutant load reductions that will be useful to determine the overall effectiveness of the management measures.

Should the evaluations indicate that the benchmarks are not being achieved, or that progress is not being made as anticipated, the management measures should be reevaluated to determine if they were properly implemented, and if they need to be revised. It is critical to perform this evaluation and reassessment to ensure that the money and time being invested in this problem are successfully helping work toward the solution.

APPENDIX A
CITY INCENTIVE DATABASE

Report for

Banklick Watershed Council

QA Project Plan for the Data Collection Program of the Banklick Creek Watershed Based Plan

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On Behalf of:

Banklick Creek Watershed Council

May 2005

Submitted for Approval to:

The Kentucky Natural Resources and
Environmental Protection Cabinet Department
for Environmental Protection Division of Water,
Nonpoint Source Section

Signature of Approving Official:

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1.01 PROJECT MANAGEMENT

A. Problem Background

Northern Kentucky continues to grow at one of the fastest rates in the State of Kentucky, becoming one of the State's premier economic engines. Much of the development connected to the region's economic success has occurred in the Banklick Creek Watershed in North and Central Kenton County. Banklick Creek is the principal watershed in Kenton County, Kentucky, located directly across the Ohio River from downtown Cincinnati. Of the 58 square mile watershed, approximately 75% lies within urbanized areas such as Covington, Ft. Wright and Independence. The watershed includes aging communities, rapidly expanding suburbs, and agricultural areas.

Banklick Creek has been designated as one of the three "highest priority" watersheds in the Licking River basin. Its entire length is designated as a 1st-priority 303(d) listed stream (KDOW 1999). Impaired uses include aquatic life and primary contact recreation resulting from nutrients, organic enrichment/low dissolved oxygen, habitat alteration (non-flow), and pathogens. Pollution sources within the watershed include CSOs, SSOs, stormwater runoff, failing septic systems and NPS runoff. Additionally, the problem of habitat alteration is suspected to be from human modifications rather than by natural flow.

Yet, despite what appears to be a desperate picture, several plans are in place that suggest a possible recovery for the Banklick Creek Watershed. Beginning with the progressive leadership of Sanitation District Number 1 (SD1), the region's sanitary, combined, and storm sewers are now under the well-planned direction of one organization. With oversight from KDOW and USEPA, SD1 has entered into an agreement which lays out a process to mitigate the sanitary and combined sewer overflows. SD1 is also implementing a comprehensive urban stormwater program. Local municipalities are also discussing water quality in the planning process by considering conservation and greenspace opportunities.

As SD1 establishes programs to address CSOs, SSOs and stormwater issues, considerable improvement in the Banklick's water quality are anticipated. However, despite the efforts of SD1, the problem of Habitat Alteration falls outside the traditional purview of sanitary and storm water agencies. Moreover, data suggests that no matter the gains in water quality, the problems of habitat loss, reduced riparian corridors, and stream channelization will prevent the stream from being able to fully support aquatic life and meet its designated uses.

The goal of this project is to establish a comprehensive watershed based plan (WBP) that identifies the activities and the responsible parties necessary to reduce point and nonpoint sources of pollution negatively impacting the Banklick Creek. The WBP will be the avenue to achieve the ultimate goal of improved water quality and restored habitat of the Banklick Creek.

B. Project Description

Significant resources have been invested in the generation of physical, chemical and biological data throughout the length of the Banklick Creek in both wet and dry weather. This effort has resulted in a thorough understanding of the existing conditions of the stream and the environmental stressors and their relative significance throughout the watershed.

These studies have revealed the following impairments:

Parameter	Location
Fecal Coliform	Entire Length
Phosphorous	Entire Length
Sediment	Between RM 0-12
Copper	In vicinity of RM 0.5 and 8
Lead	Between RM 0.5 and 12
Dissolved Oxygen	Lower 3.5 miles
HABITAT ALTERATIONS	Entire Length

Additionally, a biological community assessment was conducted by the Sanitation District between 2001 and 2003. This project was designed to initiate a record of the creek's biological diversity and habitat quality that was used to establish baseline conditions to measure the efficiency of future water quality enhancement activities.

The Report titled *Habitat and Biological Community Assessment of Banklick Creek, Kentucky*, July 2003 states "Based on the discriminant analysis, additional data collected from Banklick Creek in the future can be classified using the linear functions developed. As more data are collected for different years or different seasons, the relationships could also be recalculated to strengthen the analysis.

Key points from this exercise are:

- A linear combination of five variables (Habitat Assessment Score, Composite Periphyton Biomass, Total Macroinvertebrate Individuals, % EPT and Total Fish Taxa) are sufficient to explain most of the site variation observed. Future analytical results should focus on these parameters."
- The ranking of the five variables in terms of explaining the observed variation are Habitat Assessment Score, fish IBI or fish taxa, macroinvertebrate – total individuals, composite chlorophyll a, and percent EPT. If economic reasons limit sampling efforts, this information can be used to decide which variables should be analyzed."

These extensive data sets have been generated over the past few years and therefore are still considered relevant in defining existing conditions. However, the over $1,000,000 investment by SD1 in this data will quickly diminish over time as result of the rapidly changing conditions within the watershed. In order to capitalize on this baseline information and to minimize the need for additional data, it is imperative to begin this project as soon as possible.

Based on the available data, it is not anticipated that additional water chemistry, geomorphic, or biological data will be needed at the beginning of the project. The existing data, valued at over $1,000,000, will be used as the project baseline. Focused post-construction monitoring will occur for any BMPs that are implemented during the 6.5-year project to serve as a measure of success. A post-construction monitoring plan will be developed as a part of the WBP.

Should any additional data (pre or post-construction) be required during the project, it will be collected in accordance with the Quality Assurance Project Plan (QAPP) as presented herein.

C. Quality Objectives and Criteria

C1. Water Chemistry Data

Should water chemistry data be collected, Table 1.01-1 summarizes the quality objectives and criteria for the water quality monitoring.

Type of QA/QC Check	Frequency Required	Total Number of Analyses	Acceptance Criteria
Matrix Spike (MS)	One sample per stream per year	One per year	Percent recovery should be greater than or equal to 20%
Matrix Spike Duplicate (MSD)	One sample per stream per year	One per year	Relative Percent Difference should less than or equal to 71%
Laboratory Blank	One per twenty samples analyzed or one at the beginning of the week	Subject to change, absolute minimum of three	No false positive
Laboratory Ongoing precision and recovery (OPR)	One per twenty samples analyzed or one at the beginning of the week	Subject to change, absolute minimum of three	Percent recovery should be greater than or equal to 20%

Table 1.01-1 Summary of Quality Objectives and Criteria

The percent recovery will be computed by the following formula:

$R = 100 \times ([Nsp - Ns] / T)$

Where:

- R is the percent recovery;
- Nsp is the number of colonies detected in the spiked sample;

- Ns is the number of colonies detected in the unspiked sample;
- T is the number of colonies added to the spiked sample (during the spiking process).

The relative percent difference (RPD), which is a quantitative measure of the laboratory's precision and difference in interference between the MS and the MSD sample matrix, will be calculated by the following formula:

RPD = 100 x ([=RMS - RMSD=] / $X_{(mean)}$)

Where:

- RPD is the relative percent difference
- RMS is the number of colonies detected in the matrix spike sample
- RMSD is the number of colonies detected in the matrix spike duplicate sample
- $X_{(mean)}$ is the mean of the MS and MSD recoveries

C2. <u>Geomorphic Data</u>

Should geomorphic data be required, the objective of the geomorphic assessment is to determine the primary causes of sediment and habitat impairment. An evaluation of in-channel sediment sources will be obtained from estimates of bank erosion rates and estimated rates of sediment production from other sources such as roadway ditches, construction sites and agricultural lands. Assessment of habitat will be evaluated based on EPA rapid bioassessment procedures conducted in a separate part of this project. Three basic groups of data will be collected: sediment samples, streambank samples, and stream geometric characteristics.

Surveying techniques that provide accuracy of about 1 cm in all directions will be used with the total station equipment that will be employed for stream geometric data collection. Also standard sieve analysis procedures employed by the geomechanics laboratory using standard ASTM techniques for fine and coarse aggregates will provide data for sediment size gradation to high precision. Large variations in geometric characteristics (typically on the order of 0.3 m) are associated with the subjective selection of bankfull elevations based on field indicators; therefore all bankfull indicators will be measured and flow levels associated with each indicator will be reported. These indicators include tops of coarse bar deposits, tops of fine bar deposits, low vegetation lines, tops of banks and floodplain elevations.

Sediment sampling in coarse bed channels is limited by the ability to only sample a very small portion of the streambed. Four techniques will be used to assess sediment in gravel and cobble bed streams:

1) pebble counts on each riffle studied

2) riffle subsurface bulk samples
3) bar bulk samples
4) 30 largest particles on the bar

Amounts of gravel required to characterize the active streambed will be determined according to Bunte and Abt (2001), Rosgen (1996) and Kappesser (2002).

To ensure consistency in the selection of sampling locations for bankfull indicators, for collection of geometric stream characteristics and for sampling of bar materials, the QA manager will conduct on-site quality checks.

C3. Biological Data

Should it be required, assessments of habitat will be evaluated based on EPA rapid bioassessment procedures. There will be quality objectives and controls on all biological sample types (algal, macroinvertebrate, and fish). To ensure quality on the smaller specimen, samples of algae and macroinvertebrates will be randomly selected from each sampling event and sent to outside authorities for independent taxononmic confirmation. An average of 10% of the total samples will be selected for independent verification.

The laboratory that performs the identification for the bulk of the samples (approximately 90% of the algal and macroinvertebrate samples) will adhere to its internal QA/QC program. Voucher species along with reference details and authorities consulted will be maintained in the laboratory.

D. Special Training/Certification

D1. Water Chemistry Data

Sampling technicians will be given training and instruction on the proper collection of environmental samples according to the procedure outlined in Section 2.2. An experienced sampling technician will direct the training. Laboratories conducting analytical work must be certified by US EPA and pass annual Kentucky Performance Evaluations.

D2. Geomorphic Data

The QA manager and project team have academic as well as professional training in applied morphology and the techniques necessary to collect and analyze the required geomorphic data. This training includes extensive academic and professional training in surveying, sediment sampling, hydraulic and hydrologic modeling, and geomorphic assessment.

D3. Biological Data

Sampling and Lab personnel must have proper training for both collection and identification techniques for biological sampling. Equipment operators and the QA manager must have documentation of having received all necessary training for operation of the manufacturers equipment used in this project.

E. Documents and Records

The identified QA/QC officer at Strand Associates will be responsible for ensuring appropriate project personnel have the most current approved version of the QA Project Plan. After the QA Project Plan has been approved by KDOW, it will be sent electronically to all appropriate personnel who will acknowledge their receipt and concurrence of the plan by e-mail reply. Should any revisions be necessary to the plan, the recipients will be sent the revised plan, and will be required to discard the old plan. Recipients will acknowledge their receipt and concurrence with the revised version by e-mail reply. The electronic circulation will save paper, time, and energy, while still ensuring the highest quality.

Analytical data from the laboratory(s) will be reported to Strand Associates. At a minimum, the data report will include the following:

- Date and time samples were collected,
- Date and time samples were received,
- Date and time samples were analyzed,
- Sample name and location,
- Analysis name and method,
- Results of analysis,
- Units of results,
- Reporting limit of analysis,
- Initials of technician(s) performing analysis,
- Results of laboratory blanks and other QA/QC.

At a minimum, field sampling notes will include:

- Location of sample source,
- Names of sampling technicians,
- Narrative summary of field conditions, including general weather conditions, stream flow, and any other noteworthy observations,
- Results of stream temperature, pH conductivity and dissolved oxygen levels,
- Date and time samples were collected.

Data and reports sent to Strand Associates will be reduced into a technical report deliverable once all samples due that year have been collected. This technical report will serve as a chapter of the Watershed Based Plan. The report will include the following information:

- Data summary and interpretation,
- Baseline conditions of waters in the Banklick Creek Watershed,
- Effects of Watershed Based Plan,
- Summaries of any problems and observations during sample collection and analysis,
- Complete listings of all collected data and chains of custody.

Technical reports, data, and the final Watershed Based Plan will be submitted to the Banklick Creek Watershed Council, Kentucky Division of Water, and stored at the Cinicinnati, OH office of Strand Associates for a period of not less than ten years.

SECTION 2
DATA GENERATIION AND ACQUISITION

2.01 DATA GENERATION AND ACQUISITION

A. Sampling Design

In order to develop a Watershed Based Plan that will protect and enhance the water quality of the Banklick Creek Watershed, a comprehensive understanding of the baseline health of the watershed must be established. Based on data from previous efforts and the current plans of Sanitation District Number 1, it is anticipated that minimal to no additional data collection will be required under the umbrella of this project. BWC will solicit technical assistance from experienced experts where needed, for example, the Center for Applied Ecology at Northern Kentucky University.

If it is determined that additional data needs to be collected, the sampling methods listed below are to be used.

B. Sampling Methods

B1. Water Chemistry Data

Should water quality data be required for this project, it will be generated by using any of the following methods: grab samples from stream banks or bridges, with auto-samplers connected to stream flow-meters,

1. Sampling from Stream Banks or Bridges/Overpasses

Samples will be collected from stream banks or bridges to minimize safety concerns. The procedures described below assume that a two-person sampling team with some basic knowledge of the accepted procedures used to collect environmental samples will take the samples. The two-person team will have decided before beginning work who will be the “Clean hands” and who will be the “Dirty hands”. The designation will determine the division of labor between them. In general, “Clean Hands” will be in charge of any activities that might involve direct contact with the sample, while “Dirty Hands” will handle equipment, take notes, and any other activities that do not involve direct contact with the sample. The specific duties of each individual are described below.

a. Before arriving on site both team members should have thoroughly washed and dried their hands and forearms. Soap and water should be kept on hand at all times in case a team member’s hands become excessively dirty.

b. Immediately upon arriving on site both team members should set-up any necessary safety equipment such as lights or cones. In cases where the bank slope is steep or slippery, or whenever there is a risk of a team member falling, especially if falling could results in being swept away in a fast moving stream, it may be necessary to 'tie-off' to a static object. It is highly recommended that a self-retracting lifeline, with a built in winch, be used to decrease the risk of falling and, if necessary, pull a team member out of the stream and/or up the bank without exposing other team members to the same hazards. It may be necessary to have a third team member available to act as a safety supervisor and lifeline operator.

c. Once all of the necessary equipment is set-up and it is safe to begin work, "Clean Hands" should put on a fresh pair of non-talc latex gloves and begin triple rinsing the pre-cleaned sampling bucket. If metals are among the analtyes to be tested, then the bucket should be made from a non-reactive plastic such as Nalgene; otherwise the bucket should be made from stainless steel.

d. While "Clean Hands" rinses the sampling bucket, "Dirty Hands" should be filling out the necessary field paper work, including preparing the label for the sample bottle(s), and begin taking any environmental readings (temperature, DO, pH, etc.)

e. After the bucket has been properly rinsed and the paperwork completed, "Dirty Hands" should put on a pair of non-talc latex gloves to assist "Clean Hands" in the sample collection.

f. "Dirty Hands" should throw the bucket into the water body, while only holding onto the rope and being careful to not touch the bank, tree branches, or anything else. Once the bucket is filled, "Dirty Hands" may pull in the bucket, being extremely careful not to let the bucket touch the bank, to "Clean Hands" who will empty the bucket back into the water body. This process needs to be repeated twice more to "river rinse" the bucket. This can be a tedious and time-consuming task, so in cases where it is possible to fill and empty the bucket without pulling it back to the bank or having the bucket touch anything, it is recommended to do so.

g. Now that the bucket has been 'river rinsed', the sample can be collected. "Dirty Hands" should follow the same procedure to lower and raise the bucket in Step 6, so that "Clean Hands" can submerge the sample bottle into the bucket to collect the sample while minimizing, to the greatest extent possible, the amount of exposure the sample has to the open air. Whenever possible, it is preferable that the bucket be submerged and the sample pulled up from beneath the surface.

h. Now that the sample has been collected, “Dirty Hands” should label and store the sample on ice in a clean cooler while “Clean Hands” changes gloves.

i. For analyses that require more than one bottle for sampling to be completed Steps 7 and 8 should be repeated (including the replacement of gloves) until enough volume has been collected.

j. When the sample needs to be composited over time, or if the sample site is not in a good mixing zone and the sample needs to be composited across the stream, it will be necessary to use a churn splitter. In that case, “Clean Hands” will need to have triple washed the churn splitter using deionized water and, if possible, a river rinse from the water body, making sure that all surfaces (including the lid) that may come in contact with the sample are rinsed and purged. The spigot should be purged with each washing.

k. The general process will remain the same when collecting time composited samples except that when “Clean Hands” has control of the sampling bucket, he will pour the sample into the churn splitter and immediately close the lid. This process will repeat until enough samples have been collected over the specified period of time.

l. In cases where the samples must be composited from aliquots from the left bank, right bank, and middle of the stream, the bucket should be thrown to one section of the stream by “Dirty Hands”, pulled across to “Clean Hands”, who will pour it directly into the churn splitter and immediately close the lid. This will need to be repeated at the next section until a cross-section of the stream has been collected into the churn splitter.

m. Now that the sample is ready to be collected, “Dirty Hands” should ‘churn’ the sample using at least ten slow strokes of the churn. It is very important that the churn never breaks the surface of the sample as this can introduce additional oxygen into the sample.

n. “Clean Hands” should purge excess samples before filling the sample bottles.

The following guidelines will help reduce the opportunity for contamination to enter the sample:

i. Be sure to position the churn splitter so that it is fairly level and the spigot is not touching anything.

ii. Avoid resting the churn splitter under trees, wires, poles etc.

iii. Minimize the amount of time the lid of the churn splitter is not secured over the churn splitter.

iv. When rinsing the churn splitter, use copious amounts of de-ionized water.

v. Before arriving on site, the churn splitter should have been thoroughly washed and dried. The churn splitter still needs to be triple rinsed once the team has arrived on site. If a bucket will be used to transport sample from the water body, it should also be washed and dried before arriving on site, in addition to being triple rinsed before sampling.

vi. If multiple sites are going to be sampled using the same equipment, sample in the order of the site with the lowest expected concentrations to the one with the highest. For example, if samples are going to be taken near a discharge point, the upstream sample should be taken first, then the downstream sample, and finally the sample nearest the discharge point.

vii. The churn splitter must be triple rinsed between every sample. It is preferred that it be cleaned as close in time as possible to the collection of the sample.

2. Collecting Samples Using a Flow Triggered Automatic Sampler

The procedures described below assume that a two-person sampling team with some basic knowledge of the accepted procedures used to collect environmental samples will take the samples. The two-person team will have decided before beginning work who will be the “Clean hands” and who will be the “Dirty hands”. The designation will determine the division of labor between them. In general, “Clean Hands” will be in charge of any activities that might involve direct contact with the sample, while “Dirty Hands” will handle equipment, take notes, and any other activities that do not involve direct contact with the sample. The specific duties of each individual are described below. The procedure described in this protocol assumes that the automatic sampler will be left in place at the sampling site and that a sampling team will collect the samples some time after an event is completed. Please refer to the user manual for information on setting-up and programming specific pieces of equipment.

a. Before arriving on site both team members should have thoroughly washed and dried their hands and forearms. Soap and water should be kept on hand at all times in case a team member’s hands become excessively dirty.

b. Immediately upon arriving on site both team members should set-up any necessary safety equipment such as lights, cones, or traffic barricades.

c. Once all of the necessary equipment is set-up and it is safe to begin work, “Clean Hands” should put on a fresh pair of non-talc latex gloves.

d. “Dirty Hands” should fill out the necessary field paper work, including preparing the label for the sample bottle(s), and begin taking any environmental readings (temperature, DO, pH, etc.) Once that is completed, “Dirty Hands” should put on a fresh pair of non-talc latex gloves to assist in the sample collection.

e. “Dirty Hands” should unlock the sample bottle compartment and open up the automatic sampler so that “Clean Hands” has free and easy access to the sample bottles.

f. “Dirty Hands” should then open the bags containing the automatic sampler bottle caps but should not actually touch the caps. “Clean Hands” should reach into the bags and bring out each cap for the bottles.

g. After all of the sample bottles have been sealed, they can be removed from the automatic sampler, labeled, and stored on ice in a clean cooler.

h. In cases where the sample must be transferred to a “traditional” sample bottle, the sample should be carefully poured from the automatic sampler bottle into the “traditional” sample bottle. At no time should the automatic sampler bottle touch the “traditional” bottle. The use of a funnel is strongly discouraged however if it is necessary the funnel should be pre-cleaned thoroughly and stored in at least two airtight bags made of non-reactive plastic.

i. If several bottles are going to be composited for analysis the use of a churn splitter will be necessary. In that case, “Clean Hands” will need to have triple washed the churn splitter using deionized water, paying close attention to be sure that all surfaces, including the lid, that may come in contact with the sample are rinsed and purged the spigot with each washing.

j. The appropriate automatic sampler bottles should be poured into the churn splitter and the lid closed immediately.

k. Now that the sample is ready to be collected, “Dirty Hands” should ‘churn’ the sample using at least ten slow strokes of the churn. It is very important that the churn never breaks the surface of the sample as this can introduce additional oxygen into the sample.

l. “Clean Hands” should purge with excess sample before filling the sample bottles.

The following guidelines will help reduce the opportunity for contamination to enter the sample:

i. Be sure to position the churn splitter so that it is fairly level and the spigot is not touching anything.

ii. Avoid resting the churn splitter under trees, wires, poles etc.

iii. Minimize the amount of time the lid of the churn splitter is not secured over the churn splitter.

iv. When rinsing the churn splitter, use copious amounts of de-ionized water.

v. Before arriving on site, the churn splitter should have been thoroughly washed and dried. The churn splitter still needs to be triple rinsed once the team has arrived on site. If a bucket will be used to transport sample from the water body, it should also be washed and dried before arriving on site, in addition to being triple rinsed before sampling.

vi. If multiple sites are going to be sampled using the same equipment, sample in the order of the site with the lowest expected concentrations to the one with the highest. For example, if samples are going to be taken near a discharge point, the upstream sample should be taken first, then the downstream sample, and finally the sample nearest the discharge point.

vii. The churn splitter must be triple rinsed between every sample. It is preferred that it be cleaned as close in time as possible to the collection of the sample.

The following general guidelines should be followed to insure the highest quality results are achieved when using automatic samplers:

i. Automatic samplers should be cleaned and maintained regularly according to their manufacturer’s recommendation. Careful attention should be paid to the tubing running to and from the sampler and the pump when being cleaned as they come in direct contact with the sample. In cases where ultra-low detection levels are called for it may be necessary to install pre-cleaned tubing and pump right before sampling is set to begin.

ii. The bottles in the automatic sampler should be pre-cleaned before being set-up.

iii. The bottle storage compartment should be closed tight enough so that no possible contaminant such as rain, leaves, or other debris could enter the sample bottle.

iv. Automatic samplers should be placed to the greatest extent possible in a flat, dry location with the smallest chance of the sampler being submerged.

v. Caps to the automatic sampler bottles can be left in the automatic sampler, or carried with the sampling team. In either case they should be pre-cleaned and stored in at least two airtight bags made from a non-reactive plastic.

vi. When opening and closing the sample bottle compartment, be careful not to accidentally knock any dirt or debris that may be attached to the automatic sampler into a sample bottle. Additionally, the top of the automatic sampler should not be placed down so that the bottom rim is in the dirt or mud.

The automatic samplers will be triggered by flow meters that will simultaneously collect flow date from the streams during sample collection. Flow data will be collected by connected to the flow meter via a laptop computer or other device and downloaded using the appropriate software. Flow data should be reviewed in the field to verify that the flow meter is working correctly. Field crews should attempt to correct any malfunctions in the field as soon as possible to return the meter to a calibrated state before leaving the site. If time does not allow for adjustments to be made then the field team should return as soon as possible to address the flow meter.

B2. Geomorphic Assessment

Should geomorphic assessment(s) be required, the effort can be grouped into two categories: (1) surveying for channel geometric characteristics and (2) sediment sampling. Table 2.01-1 describes the types of data to be sampled and the methods used to sample.

Table 2.01-1 Geomorphic Sampling Methods

Type of Data	Method	Reference
Channel cross section	Total station survey	Rosgen (1996)
Channel profile	Total station survey	Rosgen (1996)
Channel planform	Total station survey	Rosgen (1996)
Riffle surface sediment grain size distribution	Wolman pebble counting	Bunte and Abt (2001)

Subsurface sediment grain size distribution	Fine and coarse sieve analysis	Bunte and Abt (2001)
Bar sediment grain size distribution	Fine and coarse sieve analysis	Rosgen (1996) and Bunte and Abt (2001)

Survey data will be checked during the surveying process by intermittently checking elevations at monumented locations. Any error in survey information will be apparent by following standard professional surveying procedures. A resurvey will be initiated when errors occur.

Total sediment weight before and after sieve analysis will be used to determine the error in sieve analysis procedures. Samples with an error greater than 8% will not be used, and the reasons for the errors will be determined and corrective action will be taken. The QA manager will be responsible for reviewing the sediment grain size distribution error analysis to determine the need to repeat the analysis.

Survey errors are most often apparent in the field when control points are recorded. Maximum errors at control points will be recorded. Surveys will be repeated where the errors at monuments are greater than 2 cm. The QA manager will review survey error measures at each site to ensure that inaccurate surveys are repeated.

B3. Biological Sampling

Should biological data collection be necessary, sampling methods will adhere to industry standard procedures and protocol to ensure high quality samples with no cross contamination. Personnel will thoroughly wash their hands and forearms prior to arriving on site, along with their equipment including all nets, sieves, and so forth.

Additional equipment rinsing will take place between samples to prevent cross-sample contamination. This includes thoroughly rinsing all nets and sieves with filtered water between each biological sample. As a rule, all biological sampling (fish, macroinvertebrates, algae) will follow the protocols outlined in Methods for Assessing Biological Integrity of Surface Waters (Kentucky, 2002).

COC# | CHAIN OF CUSTODY | PAGE 1 OF 1

Client:
Project Name:
Project # : Acct # :
Quote # : P.O. # :
Project Contact:
Phone # :
Collected By :
Landfill License # : / PWS ID # :

EnviroData Group
2520 Regency Road, Lexington KY 40503-2421
Phone: 859-276-3506
Toll Free: 1-800-489-3506
Fax: 859-278-5665

Mail Report To:
Company:
Address:
City/State/Zip:
Invoice To:
Company:
Address:
City/State/Zip:

Shipped Via: Fed-Ex / UPS / Courier / *HES*
Airbill # :
COC Seal # :
Turnaround Time:
10-Day / 5-Day / 3-Day / 24-Hours / Other
Date / Time Needed
QC Level :

* Matrix
A - Air
DW - Drinking Water
GW - Ground Water
L - Liquid
SE - Sediment
S - Soil
LS - Liquid Sludge
ST - Stormwater
SS - Solid Sludge
SU - Surface Water
WW - Wastewater
W - Water
O - Other

* * Preservation Type

Requested Analysis

Field Measurements: Temp. (C) | pH | Cond. (umhos/cm) | DO (mg/L)

* * Preservation Code
AA - Ascorbic Acid
AC - NH4Cl
E - EnCore
HA - HCl
M - Methanol
NA - HNO3
SA - H2SO4
SH - NaOH
SS - Na2SO3
ST - Na2S2O3
ZA - Zinc Acetate
O - Other ______

Sample I.D.	Location	Collection Date	Collection Time	Matrix	Grab / Comp	Filt'd Y/N							Temp. (C)	pH	Cond. (umhos/cm)	DO (mg/L)	EDG Lab #	Comments

Relinquished By:	Date / Time	Received By:	Date / Time

Notes:

Properly Preserved: (Yes / No) Headspace: (Yes / No)
COC Seals Intact: (Yes / No / NA) Bottles Intact: (Yes / No)
Temp. Upon Receipt (C) ______ By: ______
Field Document Attached: (Yes / No)

Figure 2.01-2 Example Chain of Custody Form

C. Sampling Handling and Custody

C1. Water Chemistry Data

Once samples are collected, a member of the sampling team will drop off the samples to a representative of the Laboratory to be transported for analysis. Samples will be kept in coolers on ice before and during transport. Table 2.01.2 summarizes the potential analytical testing that may be required for this project. Copies of all paperwork, including field sheets and chains of custody, will be signed and exchanged. Figure 2.01-1 shows an example of a sample label and Figure 2.01-2 shows an example of a chain of custody that will be used.

Client:____
Sample ID:____
Location:____
Collection Time:_____________________________________
Collection Date:_____________________________________
Analysis:____
Preservation:____

Figure 2.01-1 Example Sample Label

Parameter	Method	Reporting Limit	Preservation	Holding Time
BOD_5	EPA 405.1	1 mg/L	Unpreserved	48 Hours
Total Suspended Solids	EPA 160.2	3 mg/L	Unpreserved	Seven Days
Nutrients	EPA 300.0 and 350	Varies	H_2SO_4 (as necessary)	28 Days
Metals	EPA 200.7	Varies	HNO_3	Six Months
Fecal Coliform	SM 9222D	1 colonies/100 mL	$Na_2S_2O_3$	Six Hours

Table 2.01-2 Summary of Analytical Testing

C2. Geomorphic Data

Total station survey data will be collected in electronic format on data loggers and downloaded each day to a laptop computer.

Pebble count and other sediment data will be recorded on data forms and typed into a database.

Sediment samples will be labeled in the field and transported directly to the geomechanics laboratory. Grain size analysis will be conducted in the laboratory within one month of sample collection. Grain size analysis will be completed and data will be directly entered into a computer database.

The data will be archived by the project QA manager.

C3. Biological Data

For biological samples, chain of custody procedures will be adapted from those of the Kentucky Natural Resources and Environmental Protection Cabinet. Forms include entries, to be filled by the sampler, of sample number, date and time, station description, method, type, size, type of preservation, and analysis requested. The sampler will carry the samples and records to either the lab, or a courier, who must also sign the form. The lab staff member designated to receive the samples, either the shift supervisor or assistant, will then sign the form. At all transactions, both the relinquishing and receiving parties will sign the chain of custody form. Sample labels and chain of custody forms are included in the packet.

D. Instrument/Equipment QA/QC

Before any test is run, laboratory technicians will run an initial test to demonstrate that the capabilities to run the test per method is there. Equipment is checked and maintained according to manufacturers' standards, or testing standards, whichever is more stringent.

E. Inspection/Acceptance of Supplies and Consumable

All sample containers will be inspected for defects and will only be accepted with a certification of proper cleaning.

F. Data Management

Data results from analytical testing will be entered into the laboratory's LIMS system after an initial review of the data against method criteria. A secondary reviewer then reviews the data before it is released to Strand Associates. Should errors arise in the laboratory, a non-conformance report/corrective action report is generated. This report identifies the problem or error, gives planned corrective action and corrective action follow-up procedures. This form is reviewed and agreed to by the laboratory section manager, project manager, QA manager, and analyst. All completed forms are kept in the QA Manager's possession.

Upon receipt of the data, Strand Associates will perform a review of the quality assurance checks and report any variances back to the laboratory for rectification. Should no variances arise, the data will be accepted and used.

SECTION 3
ASSESSMENT AND OVERSIGHT

3.01 ASSESSMENT AND OVERSIGHT

A. Reports to Management

Should data collection be required, Strand Associates, on behalf of the Banklick Creek Watershed Council, will prepare a technical report for each sample collection year to be submitted to the Kentucky Division of Water (KDOW). The report will discuss the results of the monitoring, the quality of the data, any quality assurance problems and the steps taken to solve them. KDOW will then be able to comment on the report and make recommendations. The report will also suffice as a chapter of the Watershed Based Plan. The Watershed Based Plan and general summary of the project will be included in a final project report for KDOW upon project completion.

SECTION 4
DATA VALIDATION AND USABILITY

4.01 DATA VALIDATION AND USABILITY

A. Data Review, Verification and Validation

Quantitative and qualitative descriptions of the validity will be included in the technical reports. Data will be validated using principle data quality indicator's precision, bias, accuracy, and completeness. These will be reported as the relative standards deviation, relative percent difference (RPD), percent recovery, and percent complete. Data validity descriptions will also include the results of laboratory blanks.

APPENDIX A
DISTRIBUTION LIST/PROJECT TEAM

DISTRIBUTION LIST/PROJECT TEAM

1. Sherry Carran
   Banklick Creek Watershed Council
   927 Forest Avenue; Covington, KY 41016

2. John Lyons, P.E.
   Project Manager – Strand Associates
   990 St. Paul Place; Cincinnati, OH 45206

3. Paul Maron, P.E.
   Quality Assurance Manager – Strand Associates
   325 West Main Street, Suite 710; Louisville, KY 40202

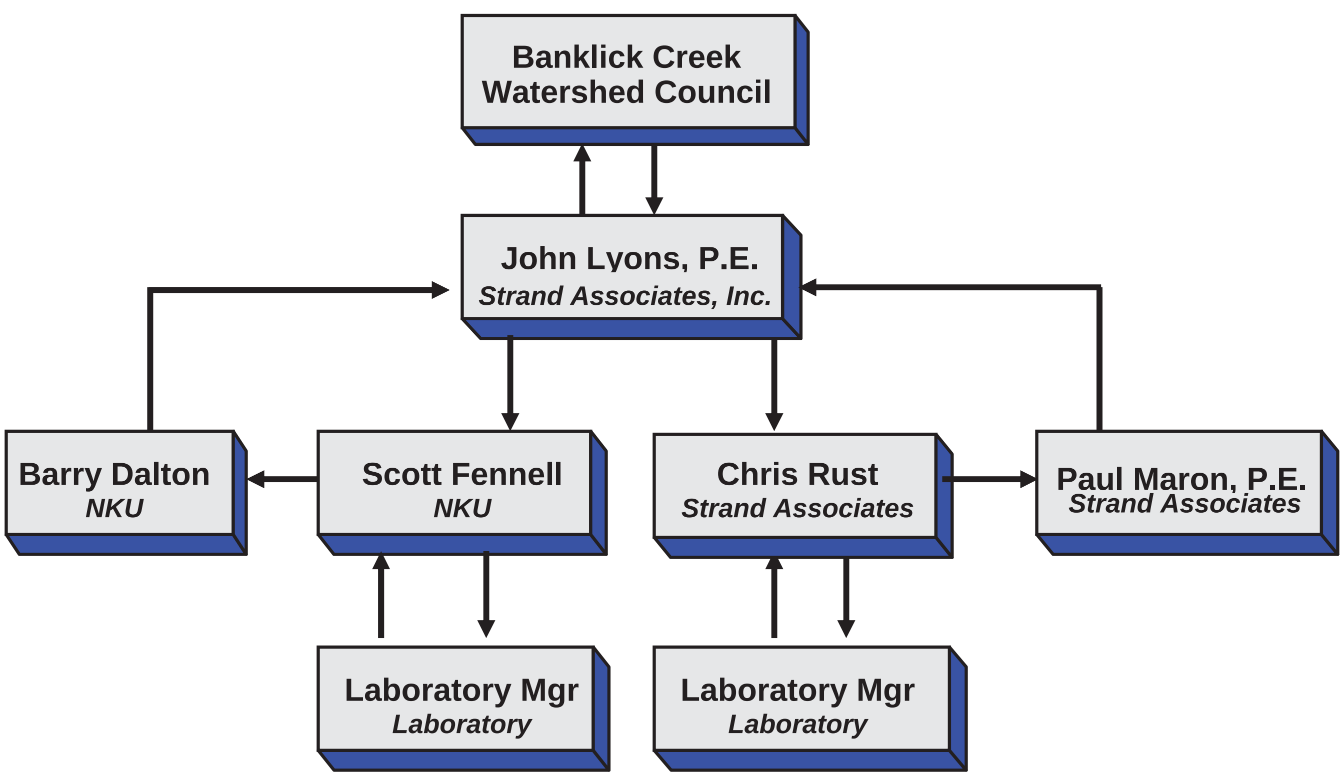
4. Chris Rust
   Environmental Data Collection Manager – Strand Associates
   990 St. Paul Place; Cincinnati, OH 45206

5. Laboratory Analysis Project Manager
   Laboratory yet to be determined

6. Barry Dalton
   Geomorphic & Biological Quality Assurance Manager –
   Northern Kentucky University, Center for Applied Ecology
   510 Johns Hill Road; Highland Heights, KY 41076

7. Scott Fennell
   Geomorphic & Biological Data Collection Manager –
   Northern Kentucky University, Center for Applied Ecology
   510 Johns Hill Road; Highland Heights, KY 41076

The following organizational chart shows the relationships and lines of communication among all project participants:



July 18, 2002 – Thomas More College, Holbrook Center

Those in attendance: See attached list of participants

Meeting convened at 11:30 with lunch
Introductions were made by all participants, led by Marc Hult, Chairman. Agenda was reviewed.

Marc Hult gave an introduction on the status and purpose of the Banklick Watershed Council. He discussed the prioritization process coordinated by the Division of Water that identified problem watersheds and where an action plan could be of help. Of the sixty-nine subwatersheds in the Licking River the Banklick rated 3. The Kentucky Waterways Alliance was introduced as a group that fosters local watershed action by looking for local energy. This group made available a$5000 grant for the Banklick Watershed Council's nonprofit incorporation. A grant proposal was written for the EPA 104b grant which was a multi state competition. The Banklick Watershed Council received approximately $117,000 of that money.

Banklick Watershed Council objectives include:

- Improve and protect the physical, chemical and biological integrity of Banklick Creek, its tributaries, and watersheds. Research, design, obtain funding for, and conduct projects to improve the watershed.
- Build a reputation for excellence as the primary, community-based organization concerned with the Banklick Watershed: an organization that is respected by citizens, public officials, and the corporate community. Become an organization that the citizens can identify with and to which citizens feel comfortable in voicing their concerns and in reporting problems.
- Build a broad sense of partnership among stakeholders: those who live in or those who have an interest in the Banklick watershed. Facilitate collaboration between the many parties that are investigating, planning, and implementing projects related to the physical, chemical, and biological integrity of the Banklick watershed. Cooperate with all agencies, governmental or private, which have an interest in water resources management, water quality, water quantity and the well-being of the streams, wetlands, and reservoirs in the Banklick watershed.
- Foster public enjoyment, health and pride in the Banklick Creek, its tributaries, and watersheds.
- Collect and assemble scientific studies and literature pertaining to the Banklick Creek Watershed. Scientifically investigate and characterize the hydrologic, human, botanic and ecological resources and conditions and health of the streams and the land in the watershed of the Banklick watershed.
- Scientifically explore the social and economic resources and conditions in the Banklick watershed, including options for managing and conserving the ecological and environmental resources and health of the Banklick watershed.
- Educate the public within and around the watershed in all aspects related to the physical, chemical and biological health of the Banklick watershed. Prepare, disseminate, copyright and register periodicals, pamphlets, books, and materials pertaining to the water resources and related subjects.
- Sponsor and conduct meetings for the study and discussion of water resources and matters pertaining thereto.
- Promote sound water resource management practices and conservation.

Initial Project Objectives Include:

- Raise community concern about impairments and increase support for remedies.
- Establish programs to disconnect household storm water drains from sanitary sewers.

- Identify and seek funding for a pilot project for decentralized wastewater options
- Assess geomorphologic stream health and facilitate restoration projects
- Convene and coordinate stakeholders to develop a comprehensive Watershed Action Plan
- Build capacity of the Banklick Watershed Council for long term action
- Foster public enjoyment, health and pride in the Banklick Creek

Floor was opened for questions and comments:

Q: How bad is the Banklick?
A: Several issues are currently being addressed by the Sanitation District and through the Phase II Regulations, and through the Corps of Engineers. Banklick is a priority because of the bacterial count and the continuing pressure of people and growth that it is constantly trying to keep up with.

Q: How far has the Mill Creek Watershed Council come since start up?
A: They are currently working for a tunnel to deal with CSO's. First goal is to make the Mill Creek safe to come in contact with. Often industrial water is cleaner than the creek water because of NPDES requirements. The Mill Creek Greenway Master Plan has been completed. This is a multi-objective and community based effort dealing with watersheds, tributaries and riparian corridor studies and projects.

Q: Where and when are we testing water quality and who has the information?
A: The Sanitation District and the Watershed Watch are some of the organizations testing at various times and in various places. One of the Banklick Watershed Council's goals is to find out the specific answer to that question and where the holes are that we can address and to make information easily available to the public.

12:15 – Ms. Wood introduced the issues and questions that were to be discussed in a roundtable format. See the following outlines.

ISSUES and active parties as listed by meeting participants

Aquatic life habitat:
- Sanitation District
- Fish & Wildlife
- Watershed Watch (Licking & Doe Run)
- KYTC Environmental Assessments
- Division of Water

Bacteriological conditions: human & other animal waste:
- Sanitation District
- Health Department (Enforcement)
- Division of Water
- Natural Resource Conservation Service
- Watershed Watch
- Conservation District (animal waste)

Biological diversity:

- Sanitation District
- Fish & Wildlife
- NKU/ERMC
- Urban Forestry

<u>Botanical resources:</u>

- Urban Forestry
- Fish & Wildlife (habitat improvements)
- Northern Kentucky University

<u>Chemical Conditions:</u>

- Sanitation District
- Water District
- DOW
- EM. Management
- EPA

<u>Recreational Resources:</u>

- KC Parks, Rec, & Cities (Independence, Ft. Wright, Edgewood, Erlanger, Covington (RGI))
- Forward Quest
- OKI

<u>Adequacy of Riparian Corridor (physical encroachments):</u>

- ERMC
- NRCS
- Fish & Wildlife
- Urban Forestry

<u>Regulations Impacting Water Resources:</u>

- Government

<u>Brownfields:</u>

- City of Covington

<u>Community Growth & Planning:</u>

- Northern Kentucky Area Planning Commission
- Home Builders Association
- Ft. Wright (and other cities)
- Conservation District
- Park's Master Plan
- KYTC
- Smart Growth Coalition

<u>Cultural attitudes towards the watershed's natural resources:</u>

- Sierra Club
- OKI
- Conservation District

- NFFC

Flooding:

- NFFC
- Kenton County Fiscal Court
- Emergency Management
- Northern Kentucky Area Planning Commission
- Urban Forestry
- NKADD
- Corps.
- Division of Water

Hydrologic balance (flow regimes):

- Sanitation District
- Corps.
- Urban Forestry
- Northern Kentucky Area Planning Commission

Impacts of impermeable surfaces/soils:

- Conservation District
- Northern Kentucky Area Planning Commission
- NKU/ERMS
- NRCS

Management of toxins in the watershed:

- EM Management WK ADD
- DOW
- Health Department
- Sierra Club
- Northern Kentucky Water District
- Division of Water

Public awareness of the facts related to the issues:

- Conservation District
- Residents
- HBA
- Health Department
- NFFC
- Kenton Co.

Storm management:

- Sierra Club
- HBA
- Northern Kentucky Area Planning Commission
- DOW

Trash, litter:

- ADD
- Kenton County Parks
- Conservation District
- Sierra Club
- CRIK
- Ft. Wright

Dams:

- Corps.
- DOW
- Conservation District/NRCS

Combined sewer overflows:

- Sanitation District
- Division of Water

Stream Banks/Erosion

What Issues Might the Council Best Address, and How?
How Could the Council Enhance Activities Already Underway?

1. Consensus building from stakeholders
2. Watershed tours
3. PRIDE – legislation
4. Slow development in growth areas
5. Get with business communities as stakeholders
6. Be a representative for the watershed
7. Resource information compilation & identify voids to develop action plan (what do we have/need) to make a decision
8. Get historical information – how vegetation/land use changed/oral history
9. Coordination of efforts – esp. **Education**
10. Being a central source (clearing house) of information
11. Enforcement/be a watchdog/voice/follow up
12. Existing subdivisions – BMPs/tools for storm water runoff minimization
    - Demonstrations
13. Develop plan identifying positive aspects of Banklick
14. Outreach/media
15. Find funding for home owners to fix problems related
16. Demonstration project – **NOW**! (something people can "see" and relate too)
17. Validate information – help people understand citizens & organizations
    - Credibility
18. Develop better – more greenways/space
    - Increase Awareness
    - Advocate
19. Support/enhance buyout program
20. Support better storm water quantity (reduction)/quality programs/BMP's during development & after
21. Find the good spots in watershed
22. Take the lead in developing interest in creek as a resource & not a liability

23. Put resources ($) into making a media team
24. Involve universities/students – fund leadership for the future
25. Inventory Banklick
26. Involve youth
27. Engage the arts

APPENDIX B
LITERATURE REVIEW

Banklick WATERSHED COUNCIL

Meeting Minutes
January 21, 2009
3:00 – 4:30 PM

The first meeting of 2009 was called to order by Chair – Sherry Carran at NKAPC. In attendance were Donna Horine, Sharmili (Sampath) Reddy, Lajuanda Haight-Maybriar, Lorna Harrell, Matt Wooten, Marc Hult and Kelly Kaufman.

The purpose of the meeting was to discuss plans for the public input meetings on the revised draft of the Council's Watershed Plan. These meetings will be educational not only for the general public but also for the Council. The meetings are an important step to completing the revised Watershed Plan, which is the key component to the Council's EPA 319 Grant.

Lajuanda noted that public meetings are a way of 'ground-truthing', identifying and calculating water source problems. She also noted that the desired outcome of the meetings is to get a list of the public's concerns and questions; the Council should then follow up.

There was discussion on where, when and what materials will be used.

The thought was to have the first public meeting in the southern part of the watershed because of NKAPC's work in 2006 on the South Banklick Study. Sharmili supplied a list of property owners in the area, along with a map.

Marc wondered about the approach and how would the rest of the watershed be addressed. Sherry thought the public meetings could be sectioned into the rural, the suburban and the urban parts of the watershed. Other thoughts were to section by south, east, west and north.

Discussion then went to when the meetings would be held. It was decided that meetings should be completed before May as it is hard to get people attending once school lets out. With that kind of time line it was decided to keep it to three meetings: southern, middle and northern sections of the watershed. It was also decided that all the meeting dates should be set before the first meeting so they can be announced at the first meeting. It was recommended that it would be best to alternate the days and times of the meetings. Lorna recommended a 'catch statement' in meeting announcements to get people's attention.

Sherry said she would contact the new library in Independence to see if the first meeting could be held there as this would be convenient for the people living in the southern part.

There was then discussion about materials that would be used. All materials will have to be approved by KY Div. of Water (KDOW). Lajuanda advised that the materials could be sent by email if possible for approval and that it could take 2-4 weeks. Most thought that past materials that have been developed from past projects, whether parts or all, should be forwarded to KDOW and that way once approved they can be used when needed.

It was decided to meet Thursday Feb. 5th at 3PM to go over the materials. Sharmili said we could meet at NKAPC. Matt noted that the materials should not be too technical but also advised “don’t dumb it down”.

It was discussed that a brief overview of watershed issues and planning should start the public meetings then break out into smaller groups. The groups could be based on the four goals of the watershed: Clean the waters; Reduce flooding; Restore the banks; and Honor the Heritage.

The next item of discussion was the language that needed be included in deeds to land or easements given for conservation purpose that the Council would be using as in-kind match. Sharmili and Sherry had a conference call with KDOW as to what they would require. KDOW did send a sample deed to help. The language needs to be worked out so it can be included in the property (26.5 acres) that the Kenton Conservancy has received around Doe Run Lake as the hope is to use this as match. This property was recorded to the Kenton Conservancy on April 15th, 2008 with the value set at $449,700. Sherry had contacted the original owner, Mr. List, a number of years ago about giving the land to the Kenton Conservancy. When Mr. List sold the property to a developer he requested the forested hillside portion of the property be given to the Conservancy.

Sherry is going to work on the language. Kelly said she could help as Strand was involved with the sample deed project.

Sherry reported that she has transferred the Council’s banking to Donna. Donna reported that she did not have exact figure but there is around $5,000 in the account. Sherry explained that this is the money from the Council’s first grant through Kentucky Waterways Alliance 319 Grant back in 2002. Donna also reported that the Council did receive the first payment from KDOW and that money was then used to pay Strand. Note, exact figures are: bank balance - $5,070.49; 319 payment from KDOW - $10,364.26; payment to Strand - $10,364.26.

Sherry asked everyone to keep track of the hours they contribute to the Council’s 319 Project, this includes attending meetings. These hours are needed to report in-kind. She explained that she has been keeping track for the invoicing so far but it is best that each person keep track of their own hours for now on.

Meeting was adjourned.

Respectfully submitted,
Sherry Carran

Meeting Minutes
February 5, 2009
3:00 – 4:30 PM

The first meeting was called to order by Chair – Sherry Carran at NKAPC. In attendance were Donna Horine, Sharmili (Sampath) Reddy, Lorna Harrell, Matt Wooten, Marc Hult and Kelly Kaufman. Sherry noted that Lajuanda Haight-Maybriar had called earlier to apologize that she could not make the meeting.

The purpose of the meeting was to plan for the upcoming public meetings, including the materials that would be used.

Discussion started around the materials. Examples of power points, brochures and reports were shared. It was decided to send everything to KDOW to get approval for it all if possible.

Kelly turned the discussion towards developing an outline for how the public meetings would be conducted. After much discussion this is the outline:

1. Sign in - include if possible that the attendee can get their watershed address. Sharmili explained how something on this order is done when NKAPC participates in the Kenton County Fair. A handout will be put together to have at the sign-in table that will list the Council's contact info and list upcoming events in the watershed such as clean-ups and the next public input meetings.
2. Power point introduction (15 minutes) – explaining what is a watershed and a few principles of watershed management; background on the Council and their past projects; and explanation on the current 319 Project and why the public meetings are important.
3. Break out into 4 stations based on the goals of Clean the waters; Reduce flooding; Restore the banks; and Honor the Heritage. People will have the option of participating in all of the stations or only what they choose, especially if they are limited on time. At the stations, people's concerns or info they can contribute will be listed on flip charts. Watershed maps will be at each station. It was discussed about having an extra (parking) station where things could be listed that did not fit the 4 goals. Note: Approach people by how can they get involved to meet goals. (10 minutes per station X 4 = 40 minutes)
4. Wrap up with THANK YOU (5 minutes)

Objective is to have everything completed in an hour.

There was discussion about having hand-out materials available, either all at one table or pertinent hand-outs at each station. It was noted that there would not be much available on 'Honoring the Heritage'.

Kelly suggested having a small survey available as another way to list people's concerns and to get their contact info.

It was decided that invitations to the meeting would go out by letter to property owners in the area, by press release and by sending to email list serves of Council's 319 Project partners. Sharmili volunteered to work on the letter. Sherry will work with Sharmili on developing the mailing list.

The first meeting will be held at the Durr Branch of the Kenton County Library (1992 Walton-Nicholson Rd, Independence, KY 41051, 859-962-4030) on Monday, March 23rd. The meeting has been reserved from 6:00 – 8:00 PM, with meeting from 6:30 - 7:30.

Sherry asked who would be able to attend and assist with the public meeting. Marc, Matt, Kelly, Sharmili, Donna and Lorna all said they would be able to. Sherry thought that Lajuanda and Wilhelm may also be able to.

Lorna suggested that possible meeting dates be discussed for the following public meetings. Thursday, April 16th and Monday, May 4th were dates that seemed to work. We will try to have one of the meetings at SD#1 to cover the northern part of the watershed and the other one at Summit View Middle School to cover the middle part.

Matt shared with the Council some of his work on stream monitoring. His work showed documentation of how stream health was directly related to having stream banks in good condition. Steams with good riparian areas had higher macroinvertebrate counts indicating better water quality. Most of us knew this kind of relationship existed but to have it actually documented is very important.

Sherry turned over the second payment from KDOW of $6,477.61 to Donna. She noted that the invoicing from Strand did not show the Council's last payment of $10,364.26 and that a payment that was showing was one not made by the Council. Kelly said she would check on it.

Donna said she would keep track of in-kind time for meeting attendance.

Meeting was adjourned.

Respectfully submitted,
Sherry Carran

APPENDIX C
SUMMARY OF KY
AGRICULTURE WATER QUALITY PLAN CERTIFICATION
INFORMATION IN THE BANKLICK CREEK WATERSHED

17 July 2002

The following information was compiled from Kenton County Conservation District records of Agriculture Water Quality Plan Certification forms on file in our office as of 8 July 2002.

This list is not a complete survey of the watershed, as we do not have the statistics on how much land in the watershed is in farms. Not all of the farms have Ag Water Quality Plans on file, and we do not have some of them classified yet by watershed. I can give you more information as it becomes available.

Banklick Creek 11- digit Watershed – Hydrologic Unit # 05100101290

Total Acres:	37,259.63
Total Acres with Ag Water Quality Plan Certification on file:	2,527.60
Total Farms with Ag Water Quality Plan Certification on file:	52

Total operations by class: (most farms have more than one production class)

Beef	22
Dairy	5
Equine	3
Hay/Forage	28
Row Crops	19
Swine	0
Poultry	0

14 Digit Watersheds Breakdown (These are the only 14 digit watersheds we have plans for right now.)

Banklick Creek – 14 digit Watershed - Hydrologic Unit # 05100101290010 (3,439.65 acres)

Acres with Ag Water Quality Plan Certification on file: 1,601.56

Farms with Ag Water Quality Plan Certification on file: 42

Operations by class: (most farms have more than one production class)

Beef	18
Dairy	0
Equine	3
Hay/Forage	25
Row Crops	13
Swine	0
Poultry	0

Wolf Pen – 14 digit Watershed - Hydrologic Unit # 05100101290020 (2,835.08 acres)

Acres with Ag Water Quality Plan Certification on file: 511.55

Farms with Ag Water Quality Plan Certification on file: 7

Operations by class: (most farms have more than one production class)

Beef	2
Dairy	3
Equine	0
Hay/Forage	1
Row Crops	4
Swine	0
Poultry	0

Banklick – 14 digit Watershed - Hydrologic Unit # 05100101290040 (3,327.48 acres)
Acres with Ag Water Quality Plan Certification on file: 133.31
Farms with Ag Water Quality Plan Certification on file: 1
Operations by class: (most farms have more than one production class)

Beef	0
Dairy	0
Equine	0
Hay/Forage	1
Row Crops	0
Swine	0
Poultry	0

Bullock Pen – 14 digit Watershed - Hydrologic Unit # 05100101290080 (7,017.96 acres)
Acres with Ag Water Quality Plan Certification on file: 280.80
Farms with Ag Water Quality Plan Certification on file: 2
Operations by class: (most farms have more than one production class)

Beef	2
Dairy	2
Equine	0
Hay/Forage	2
Row Crops	2
Swine	0
Poultry	0

END

APPENDIX D
RETURNED CITY OF COLUMBUS DOSD SURVEYS

2008 Banklick Creek Watershed Characterization Report

Confidential Preliminary Working Draft

Watershed Consent Decree

Prepared for: Sanitation District No. 1 of Northern Kentucky

January 2009

LimnoTech
Water | Environment | Scientists | Engineers

Ann Arbor, Michigan
www.limno.com

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Table of Contents

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1. WATERSHED SUMMARY

Watershed characterization reports are being developed for sixteen watersheds located in Northern Kentucky that lie within Sanitation District No. 1's (SD1's) service area. The purpose of the watershed characterization reports is to describe the physical and natural features, land cover, infrastructure, waterbody conditions, potential pollutant sources and other features in each watershed. This information will allow SD1 and other interested parties to develop an understanding of important features, pollutant sources and water quality in the watersheds. This information will also assist SD1 and others in goal-setting, prioritization of improvement projects, and assessment of the effectiveness of these projects. The watershed characterization reports meet the system characterization element for the receiving water that is required for a combined sewer overflow (CSO) Long-Term Control Plan (LTCP). Additionally, the Consent Decree requires that the Watershed Plans include elements of a LTCP.

The 58.2-square mile Banklick Creek watershed is located in Kenton and Boone Counties, in the Central Study Basin (Figure 1). Development is found throughout most of this watershed, although the headwaters are currently much less developed. The topography is fairly steep and flooding has been a recurring issue in this watershed. Doe Run Lake, a 51-acre reservoir (normal pool), is located on Bullock Pen Creek. This reservoir was constructed between 1978 and 1982 to help control flooding, but flooding problems persist.

Banklick Creek and its tributaries are designated for warm water aquatic habitat, primary contact recreation, secondary contact recreation and domestic water supply, at applicable points of withdrawal. Doe Run Lake and the entire length of Banklick Creek appear on the 303(d) list of impaired waterbodies (KDOW, 2008). A comparison of recent water quality data to applicable water quality criteria revealed elevated levels of bacteria. Violations of dissolved oxygen, temperature and pH have historically been observed at the USGS continuous monitoring station between 2001 and 2005, but the more recent data from this location are still being reviewed and are not yet included in this assessment.

Potential pollutant sources in this watershed include combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), septic systems, KPDES-permitted discharges, livestock, storm water and streambank erosion. Backwater from the Licking River is a potential source in the downstream end of the creek. The potential for these sources (except backwater) to generate fecal coliform loads has been assessed using a Watershed Assessment Tool (WAT!)[1]. The WAT! identifies the potential sources within a watershed and estimates their possible impact. It also allows SD1 to compare and rank the 16 different Northern Kentucky watersheds.

The WAT! calculated an approximately average fecal coliform loading potential for the Banklick Creek watershed for year-round conditions. Overland runoff is predicted to be the dominant source under year-round conditions. Under base flow conditions, septic

[1] The WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

systems and non-CSO KPDES-permitted discharges are predicted to be the primary sources of bacteria.

The WAT! ranking is one of several factors that should be considered when prioritizing watersheds for improvement projects. Other factors include high public interest, the presence of one aquatic-dependent threatened and endangered species, the location of a drinking water intake just upstream of the Banklick confluence with the Licking River, and the location of portions of this watershed in a source water assessment and protection zone (SWAPP zone 1) for this intake.

Since improvement projects are planned to reduce collection system overflows in this watershed, next steps might include the application of the Banklick Creek model, the Ohio River model and WAT!, to better understand the appropriate level of control for the watershed. No additional monitoring, beyond what is currently planned, is recommended for this watershed.

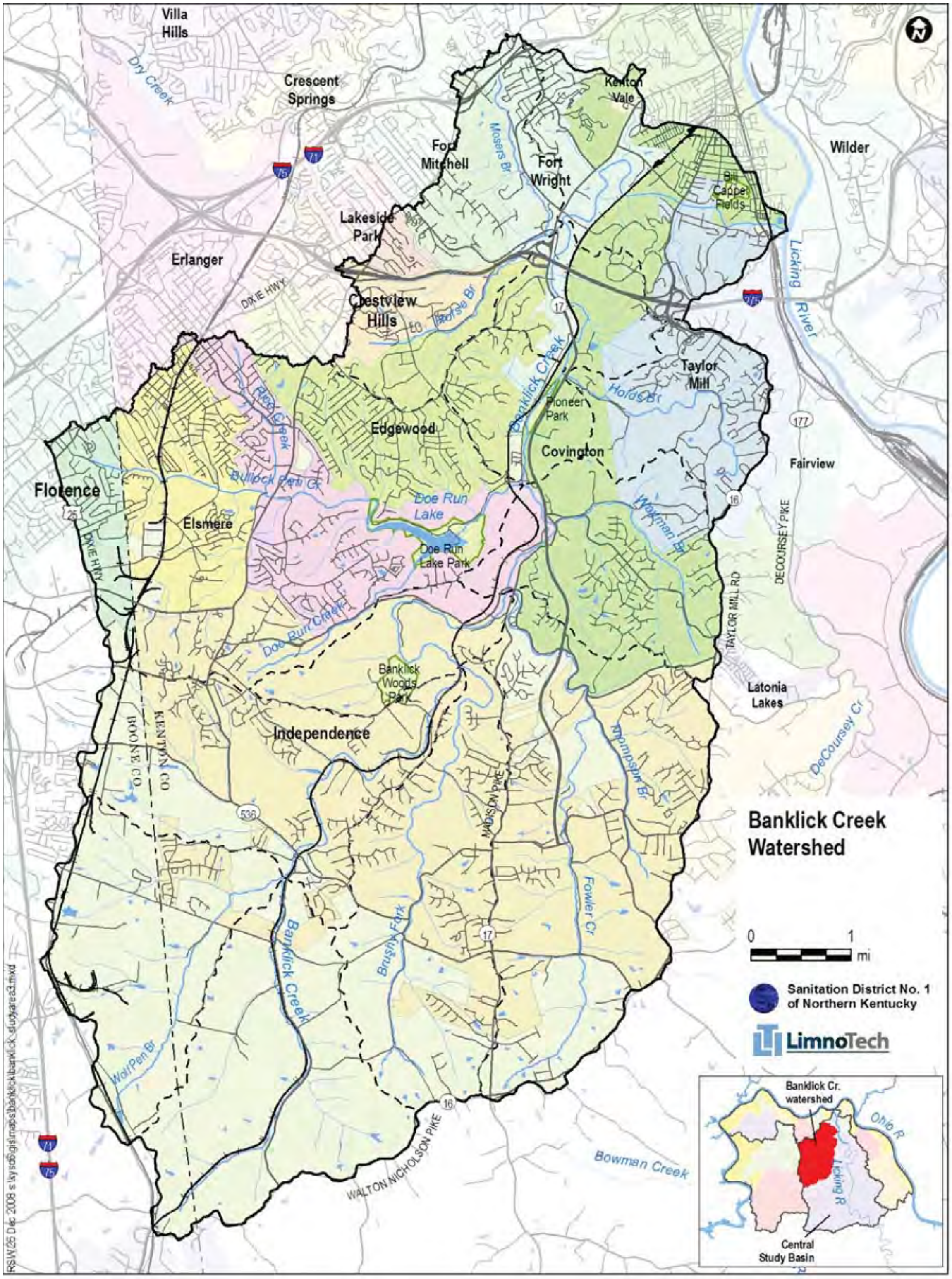

Figure 1. Banklick Creek Watershed

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2. WATERSHED FEATURES

Banklick Creek originates in Boone County and flows northward through Kenton County to the Licking River. The watershed area for this creek is 58.2 square miles.

2.1 PHYSICAL AND NATURAL FEATURES

The following sections describe key features of the watershed and creek, including hydrology, geology, topography, soils, climate, and habitat. These features are important because they affect land uses, and shape the chemical, biological, and hydrological characteristics of Banklick Creek.

2.1.1 Hydrology

Banklick Creek is a 19.2-mile long perennial stream and has six major tributaries. These tributaries are, in order from downstream to upstream: Horse Branch, Holds Branch, Bullock Pen Creek, Fowler Creek, Brushy Fork, and Wolf Pen Branch. The creek is shallow through most of its length and has been observed to go dry upstream of river mile (RM) 8.1. The stream gradient is highest near the upstream and middle reaches of the creek. Near the confluence with the Licking River (approximately 0.75 miles upstream from the mouth), the gradient is much lower and the channel widens. Near the mouth, flow is hydraulically influenced by the Licking River and backwater effects are thought to extend upstream to approximately RM 3.8. The spatial extent of backwater effects depends on Ohio River stage levels.

Banklick Creek flows are measured at an active USGS continuous monitoring station (03254550) located on Banklick Creek at Richardson Road near Erlanger, KY, which is at approximately RM 8.1 (see Figure 1). The watershed area draining to the station is 30 square miles, comprising approximately 58% of the Banklick Creek watershed. Daily discharge measurements are available at the station from April 1999 to the present[2]. The average flow is 38 cfs (4/1/1999 - 9/30/2007), and 95% of flows are less than 138 cfs. Base flows at this location have been measured at less than 2 cfs, with flows increasing by up to three orders of magnitude during a storm event. The maximum flow recorded at the USGS station is 2,130 cfs. The periods of high flow tend to be very brief and only last one to two days. In contrast, during extended periods of dry weather, flows at the station become intermittent. Between April 1999 and September 2007 there were 49 days with zero flow.

Flooding has been a recurring problem in the Banklick Creek watershed, particularly in the Pioneer Park area. The United States Army Corps of Engineers (USACE) – Louisville District, has identified five primary flood damage areas along Banklick Creek that are located between RM 0.0 and RM 10.3. Previous major floods have been documented (USACE, 2000) as occurring in 1937, 1962, 1967, 1979, 1991, 1992, 1995 and 1996 with flooding occurring not only on Banklick Creek, but also Fowler Creek. The USACE (2000) study identifies three primary factors that have contributed to flood damages in the watershed. These are: 1) the concentration of early development along

[2] This analysis only uses approved data from USGS, and at the time of the analysis data was approved through 9/30/2007.

stream channels; 2) the extremely steep slopes of Banklick Creek and its tributaries; and 3) extraordinary recent development in the watershed along ridgelines and hillsides.

Agencies investigating flooding in this watershed have included the United States Department of Agriculture (USDA), Federal Emergency Management Agency (FEMA), and the Louisville District of the Corps of Engineers. Several reports have also been developed by residents. As a result of these studies, several projects have been implemented to reduce flooding impacts. These are:

- 1982 – completion of a 51-acre reservoir (normal pool), Doe Run Lake, on Bullock Pen Creek to help control flooding.
- 1980s - Removal of 36 trailer homes from the floodplain near I-275
- 1980s – Some channel realignment
- Elevation of mobile homes above most major flood levels (USACE, 2000).

Additional detail on other more recent ongoing projects is found in Sections 2.3 and 2.5.

2.1.2 Geology

The Banklick Creek watershed is located in the Outer Bluegrass Physiographic[3] Region which is underlain primarily by Ordovician-age interbedded limestone and shale (Ray et. al., 1994). Although most of this watershed is underlain by bedrock with a moderate potential for karst development (Paylor and Currens, 2002), rocks in this region generally contain higher percentages of shale layers and do not develop extensive karst features (Ray et al., 1994)[4].

The headwaters of this creek traverse the rolling hills of the Grant Lake Limestone/ Fairview formation, which produces broad stream valleys. The middle portion of the creek, as well as some tributaries (Fowler Creek, Bullock Pen Creek) cut through the erodible shale found in the Kope formation. Downstream of Bullock Pen Creek, Banklick Creek traverses alluvium comprised of unconsolidated sediments.

Groundwater yield varies depending on geological formation. Except near the headwaters, groundwater is generally unavailable on ridgetops and hillsides. In contrast, wells in the valley bottoms may yield 100-500 gallons per day. This water is hard and may contain salt and hydrogen sulfide. Water obtained from the alluvium may also be high in iron (Carey and Stickney, 2004, Carey and Stickney, 2005).

2.1.3 Topography

The Banklick Creek watershed is characterized by rolling hills with more gentle slopes in the headwaters. In the downstream half of the watershed, the ground tends to slope steeply toward the creek. The adjoining hillsides and tributaries also have steep slopes;

[3] Physiographic regions are based on differences in geology, topography and hydrologic regime. The State of Kentucky is divided into five physiographic regions.
[4] In areas with karst, an almost immediate connection between groundwater and surface water can exist, short-circuiting any attenuation of pollutant loads that might otherwise occur.

slopes in excess of 100 feet per mile are not uncommon for many of these tributaries (USACE, 2000).

The highest elevations in the watershed (966 feet) are found near the intersection of Walton-Nicholson Pike and Dixie Highway at the southernmost part of the watershed, and near the intersection of Mt. Zion Road and Dixie Highway on the western edge of the watershed. The lowest elevation in the watershed (453.6 feet at normal Ohio River pool) occurs at the confluence of Banklick Creek with the Licking River.

2.1.4 Soils

The nature of soils and topography in a watershed play an important role in both the amount of runoff generated and the amount of soil erosion that can occur. Most (93%) of the soils in the Banklick Creek watershed are classified as hydrologic soil group C (NRCS, 2006), meaning they have slow infiltration rates when thoroughly wetted. Roughly 60% of the soils in the watershed are ranked “highly erodible”, and the remaining 40% of the watershed soils are ranked “fairly erodible” as indicated by an index for erodibility (NRCS, 2006). The erodibility of soils is important when soils are disturbed through activities such as land clearing for new development. Portions of the watershed, especially within the City of Independence and near the Banklick Creek headwaters, are undergoing significant development, as discussed in Section 2.2.2, and areas of severe erosion have been observed in this watershed (Figure 2).

Source: SD1

Figure 2. Banklick Creek at RM 5.5

2.1.5 Climate

The temperatures in this area are generally lowest in January and highest in July. Precipitation averages 41.2 inches annually, with the wettest months observed between March and July. Minimum precipitation is recorded in the fall and late winter as shown in Figure 3 (NCDC, 2008).

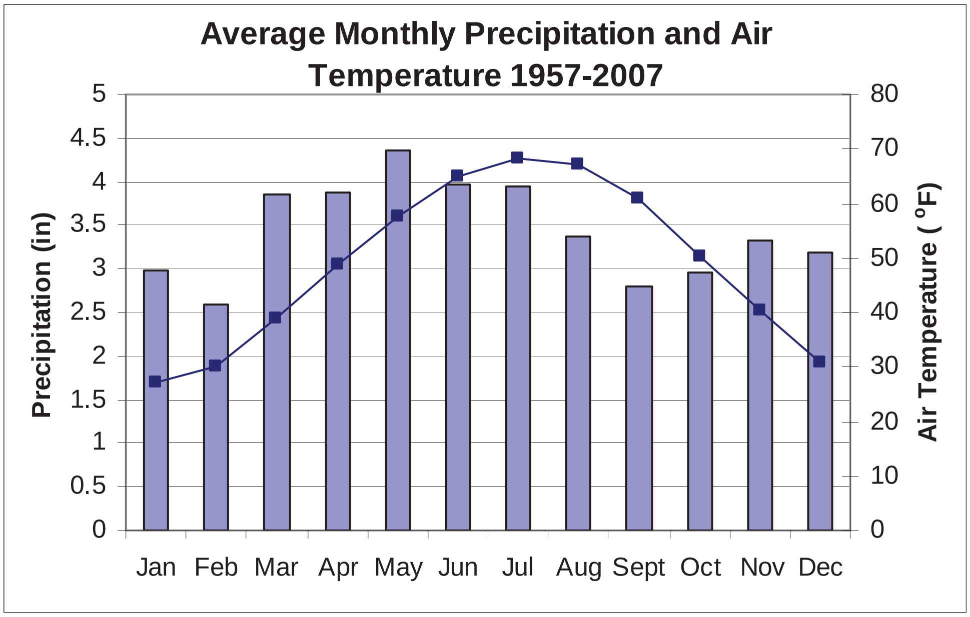

Figure 3. Average Monthly Precipitation and Air Temperature at the Cincinnati Northern Kentucky Airport (1957-2007)

2.1.6 Habitat

The Banklick Creek watershed lies within the Outer Bluegrass ecoregion[5], which is characterized by sinkholes, springs, entrenched rivers and intermittent and perennial streams (Woods et al., 2002). Wetlands are not common in this ecoregion and comprise less than 1% of this watershed. Streams typically have relatively high levels of suspended sediment and nutrients. Glacial outwash, which tends to be highly erodible, exists in a few areas.

Pre-settlement conditions in this ecoregion consisted of open woodlands with barren openings, and vegetation was mostly oak-hickory, with some white oak, maple-oak-ash and American beech-sugar maple forests (Woods et al., 2002). As described in Section 2.2.1, natural habitats have been altered from pre-settlement conditions.

Habitat assessments have been conducted at many sites within the watershed. Habitat rankings reflect variable conditions (Table 1) and range from not supporting to partially supporting as calculated using EPA-established protocols, and from fair to good using the QHEI[6]. A habitat assessment of ten sites in 2001 found the site at RM 0.4 consistently

[5] Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources (Woods et al., 2002).

[6] These assessments were generally conducted using EPA-established protocols. KDOW rated several components of physical habitat within the stream such as epifaunal substrate, embeddedness, sediment deposition, channel flow status, bank stability and riparian vegetation zone width, among others. In 1996, some sites were assessed using a different protocol, Qualitative Habitat Evaluation Index (QHEI).

had the poorest habitat, followed by the site at RM 3.9, due to the lower stream gradient, sedimentation, stream modifications and backwater flows. The lower habitat scores at RM 15 and 18.2 were directly related to the fact that they are low order streams (Strand and Associates, 2003).

Table 1. Aquatic Habitat and Biological Sampling

		Monitoring[a]							
		Habitat		Macroinvertebrates		Diatoms		Fish	
Stream	River Mile	Year	Ranking	Year(s)	Ranking[b]	Year	Result	Year	Result[b]
Banklick Creek	0.3	1996	Fair[c]	1996	N/A[d]				
Banklick Creek	0.4	2001	Not supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001 2002, 2002, 2003	Very poor Fair, Fair, Poor
Banklick Creek	1.2	1996, 1999	Good[c], Not supporting	1996, 1999	N/A[d] Poor	1999	Poor	1999	Fair
Banklick Creek	2.5	2001	Partially supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair, Poor, Excellent, Fair
Banklick Creek	3.9	1996, 2001	Good[c], Not supporting	1996, 2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair, Poor, Fair, Fair
Banklick Creek	5.4	2001	Partially supporting	2001, 2002, 2002 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair, Fair, Excellent, Fair
Banklick Creek	8.1	2001	Partially supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair
Banklick Creek	10.1	2001	Partially supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Fair
Banklick Creek	13.5	2001	Not supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2002, 2003	Good, Fair, Good, Fair
Banklick Creek	15	2001	Not supporting	2001, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2003	Good, Excellent, Excellent

Table 1. Aquatic Habitat and Biological Sampling - Continued

		Monitoring[a]							
		Habitat		Macroinvertebrates		Diatoms		Fish	
Stream	River Mile	Year	Ranking	Year(s)	Ranking[b]	Year	Result	Year	Result[b]
Banklick Creek	18.2	2001	Not supporting	2001, 2002, 2003	N/A[d]	2001	N/A[e]	2001, 2002, 2003	Excellent
Bullock Pen Creek	0.1	2001	Partially supporting	2001, 2002, 2002, 2003	N/A[d]	2001	N/A\[e]	2001, 2002, 2002, 2003	Excellent, Fair, Excellent, Good
Unnamed tributary to Bullock Pen Ck. at RM 3.2	0.8					1993	Poor		
Unnamed tributary to Bullock Pen Ck. at RM 3.2	2.1					1993	Poor		
Unnamed tributary to Bullock Pen Ck. at RM 3.2	2.2					1993	Poor		

[a] SD1 completed sampling in 2008. These data were not available at the time of this report, but will be included in future updates.

[b] When results for all sampling periods were the same, the value is only shown once.

[c] At these sites, habitat was assessed using the Qualitative Habitat Evaluation Index (QHEI) and have a slightly different scale.

[d] Results are not available because some parameters needed to calculate the MBI were not measured.

[e] Results are not available because some parameters needed to calculate the DBI were not measured.

2.2 LAND COVER CHARACTERISTICS

Land cover and land use play an important role in the quantity and quality of runoff into receiving waters. Current and future land cover is described below.

2.2.1 Current Land Cover

The Kentucky Division of Geographic Information, Commonwealth Office of Technology provided a GIS dataset showing 2005 Kentucky land cover. This dataset was updated and improved to approximate 2007 land cover conditions (Figure 4) using a variety of other datasets that represent current impervious conditions (roads, parking lots, buildings), open space lands (including parks), and surface waters.

47% of this watershed is developed, with development concentrated in the central and northern (downstream) portions of the watershed. Developed areas include the communities of Independence, Covington, Erlanger, Taylor Mill, Edgewood, Elsmere, Fort Wright, Fort Mitchell, Florence, Crestview Hills, and very small portions of Lakeside Park, Kenton Vale, Latonia Lakes, Walton and Wilder. Roughly 11% of the watershed is impervious.

The headwaters of Banklick Creek are still primarily undeveloped and agricultural in nature. Forest and pasture/hay comprise the majority of the undeveloped land in the watershed. The larger parks in this watershed are shown in Figure 1 and include Doe Run Lake Park, and several community parks such as Banklick Woods Park, Pioneer Park and Bill Cappel Fields. There are also many smaller neighborhood parks and ball fields associated with schools.

2.2.1.a Animal operations

There are no concentrated animal feeding operations (CAFOs) in this watershed (Kentucky Geographic Network, 2008). There are two animal feeding operations (AFOs) in the watershed (Kentucky Geographic Network, 2008a). These are dairy operations with 40-45 animals and are located in the Bullock Pen Creek watershed.

Other livestock present, but not prevalent in the watershed include cattle and horses (Kenton County Conservation District, 2007), which are primarily found in the upstream portions of the watershed. Most manure spreading occurs on hayfields on average every few months and some cows are thought to have access to Banklick Creek and its tributaries.

2.2.1.b Septic Systems

SD1 estimates that approximately 5% of all parcels in the Banklick Creek watershed are potentially serviced by septic systems. Properties potentially served by septic systems are found throughout the watershed, but are more concentrated in the southern (headwater) portion, both inside and outside SD1's sanitary sewer service area.

Estimates of septic system failure rates are not available for Kenton and Boone Counties; however anecdotal reports from Health Department inspectors suggest that 10% of the septic systems may be operating improperly due to incorrect installation, lack of maintenance or age of the system (NKHD, 2008).

In addition, one septic area (hot spot area) was identified as having problems in the Fowler Creek subwatershed. This is an area in an older subdivision that either has very small lots that have unrepairable failing systems, or has systems that have been repaired to the extent practicable on the site, but are not fully functional (NKHD, 2008a).

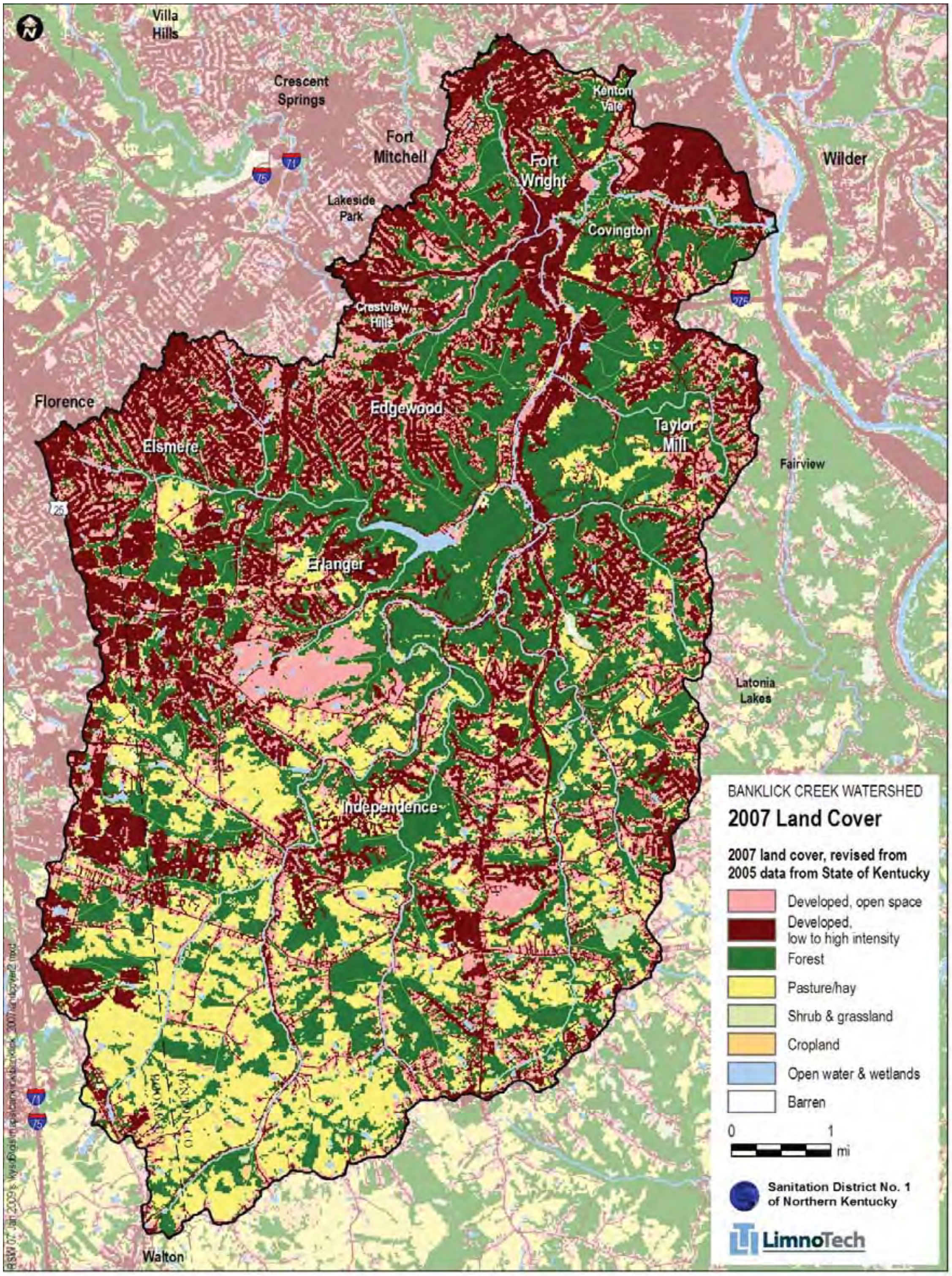

Figure 4. 2007 Land Cover

2.2.2 Future Conditions

Portions of the Banklick Creek watershed are developing at a fairly rapid pace, with urban-suburban developments replacing rural areas. In recent years (2000-2005), population growth in the watershed has been focused in the City of Independence (NKAPC, 2006), although Erlanger, Taylor Mill and Crestview Hills have also seen growth due to new home construction. In the unincorporated portions of the watershed, growth has expanded towards Walton. Between 2005 and 2010, it is anticipated that most of the new residential development will continue to occur in the City of Independence and in areas north of Walton, since urban areas will be nearing saturation. These areas correspond to the less developed headwater areas (NKAPC, 2006).

Several road construction, relocation or improvement projects are planned within the watershed. In the vicinity of Independence, KY 17 is being widened and relocated to the east of the city, essentially bypassing the downtown area, and additional road reconstruction is planned for route 536. Other planned road projects in the watershed includes portions of Turkeyfoot Road, KY 16, and I-275 (KYTC, 2006).

2.2.2.a Future land cover

Future land cover was developed by modifying 2007 land cover to reflect potential future conditions (roughly 2030) obtained from SD1 and the Northern Kentucky Area Planning Commission (NKAPC). It is predicted that development will comprise 70% of this watershed, with most development replacing forest and pasture/hay (Figure 5). Imperviousness is predicted to increase from 11% to 17%. Because flat land is becoming scarce, this development is expected to occur more frequently in areas with steep slopes (NKAPC, 2006).

The Kenton County Comprehensive Plan (NKAPC, 2006) outlines measures to reduce the impact of development. These include, but are not limited to, land use recommendations (e.g., conservation subdivisions, concentration of new developments in areas where urban services can be extended in a timely fashion, encouragement of mixed land use development) and protection of sensitive areas (e.g., greenways, riparian areas and hillsides).

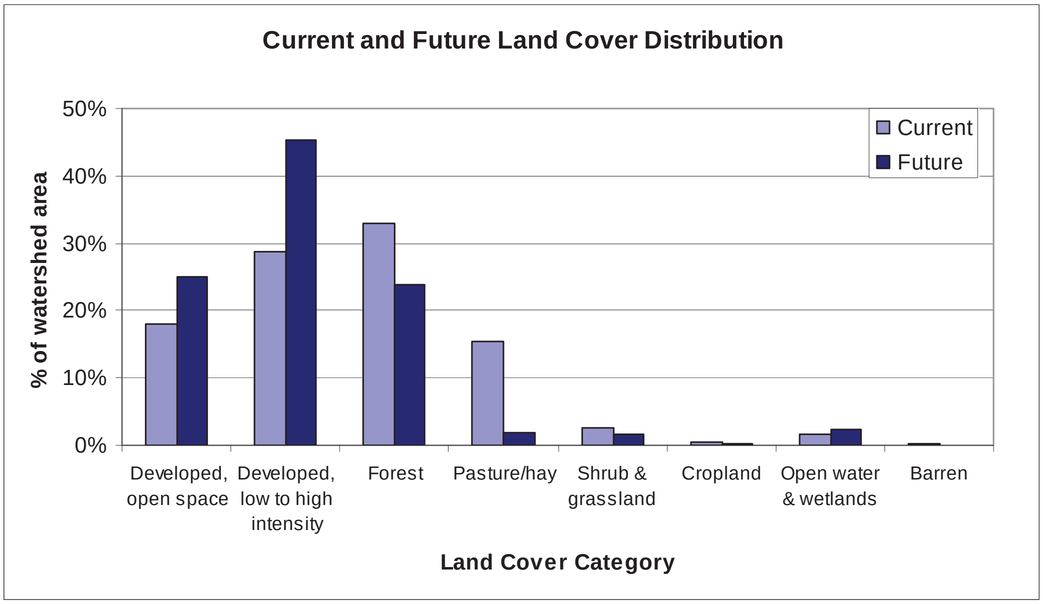

Figure 5. Current and Predicted Future Land Cover

2.3 INFRASTRUCTURE FEATURES

This section summarizes infrastructure features for the Banklick Creek watershed[7].

Approximately 2% of the Banklick Creek watershed is serviced by SD1's combined sanitary sewer area. In addition, approximately 83% of the watershed is serviced by SD1's 48.05 square mile separate sanitary sewer (Figure 6). Of that area, the City of Walton owns approximately 0.03 square miles of the separate sanitary sewer area in this watershed, but contracts with SD1 for operation and maintenance. In total, there are approximately 386.2 miles of separate sanitary sewer lines and approximately 19.2 miles of combined sanitary sewer lines that are operated and maintained by SD1.

Approximately 2% of the Banklick Creek watershed is located within the City of Florence's sanitary sewer service area, which contains approximately 13.4 miles of separate sanitary sewer lines.

Approximately 98% of the Banklick Creek watershed lies within SD1's storm water service area. Within the service area, the storm water system is comprised of approximately 607 miles of streams and channels and approximately 188.9 miles of pipes. Approximately 2% of the Banklick Creek watershed is located within the City of Florence's storm water service area. The Florence storm water system is comprised of approximately 9.7 miles of streams and channels; the extent of the piped storm water system has not been mapped.

The extent of the sanitary sewer, combined sewer and storm water service areas in this watershed is shown in Figure 6.

---

[7] SD1 is undertaking a characterization and assessment of the sewer system, and overflows identified herein are subject to change. Information on the sanitary and storm water system in Section 2.3 was queried from SD1's geodatabase accessed on November 21, 2008.

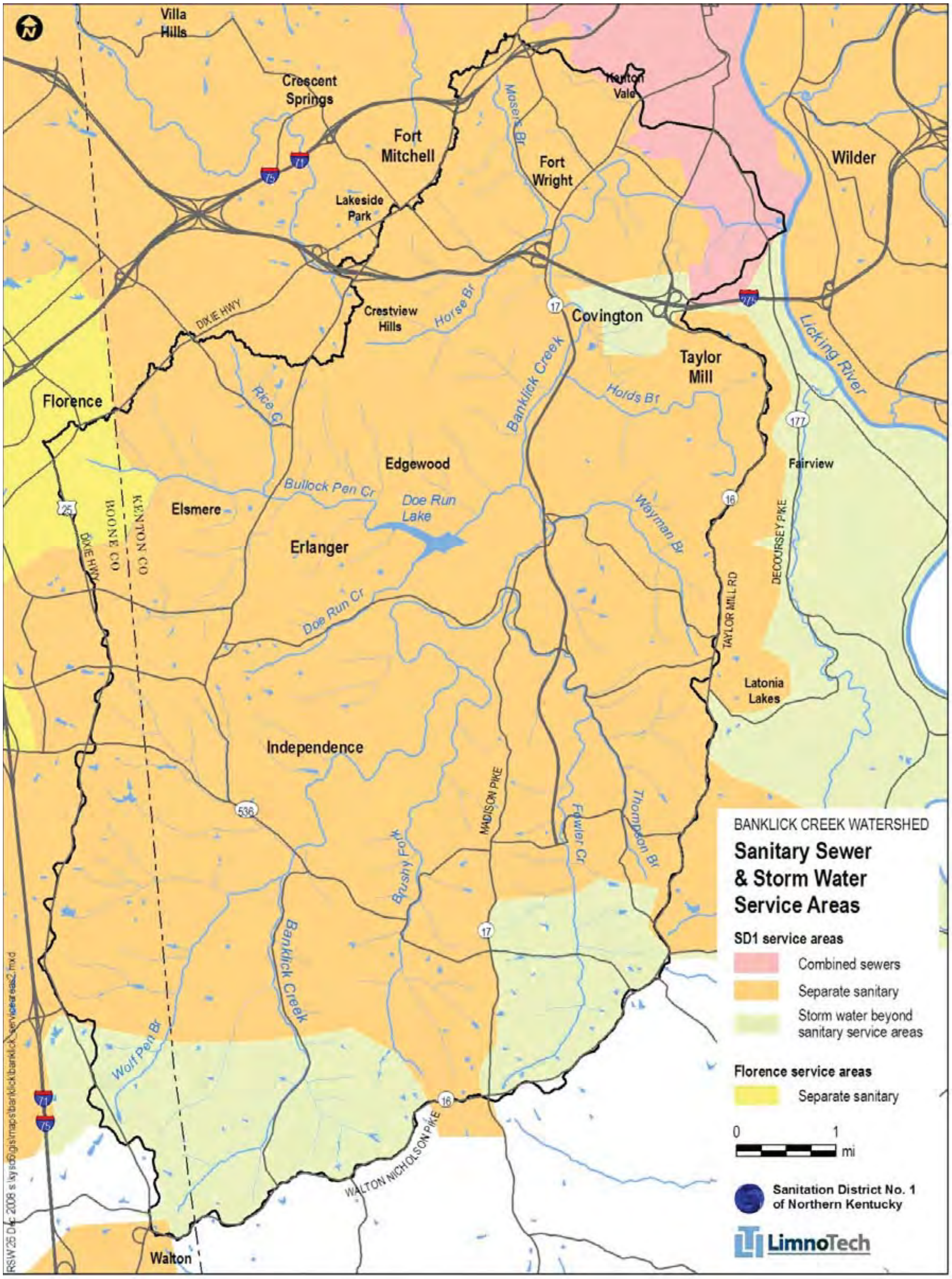

Figure 6. Sanitary Sewer, Combined Sewer and Storm Water Service Areas

2.3.1 Point Sources and Infrastructure

The occurrence of KPDES dischargers, sewer overflows and storm water discharges are described below.

2.3.1.a KPDES dischargers

There are 21 KPDES-permitted dischargers in the Banklick Creek watershed with a total of 32 currently-permitted outfalls. Fifteen of these outfalls are for sanitary wastewater, seven of which are covered under general permits for residences. The remaining outfalls are for storm water runoff, cooling water, a sedimentation basin drain, and concrete mixer truck washout water. Permitted CSOs are not included in this tally and are discussed separately. Permitted dischargers, excluding CSOs, are presented in Table 2.

Based on a review of recent effluent monitoring data (January 2007 to June 2008), it was observed that 18 of the permitted dischargers in the Banklick Creek watershed have violated their permit limits for at least one of the following parameters: total chlorine, total ammonia, fecal coliform, oil and grease, total zinc, total suspended solids (TSS), pH, total phenolics, and 5-day carbonaceous biochemical oxygen demand ($CBOD_5$). KDOW requires effluent monitoring for residential general permits (monitoring is required twice per year); however, data were not available for four of these facilities in this watershed. KDOW estimates that residential dischargers fail at a rate that is believed to be higher than 10% (KDOW, 2007).

Table 2. Permitted Dischargers

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?[a]	Permit Violations
Wolf Pen Branch	KY0033057	Eaton Asphalt Frogtown Plant	0011	Minor	New sanitary wastewater plant	N	NA
Wolf Pen Branch	KY0101591	Bp Oil Co Richwood Bulk Plant	0012	Minor	Storm water runoff	Y	NA
Wolf Pen Branch	KYG400896	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Fowler Creek	KY0034207	Colony House Apts	0012	Minor	Sanitary wastewater	Y	Total chlorine, total ammonia
Fowler Creek	KY0040631	Whites Tower Elem School	0011	Minor	Sanitary wastewater	Y	NA
Fowler Creek	KY0040690	Old Twenhofel Middle School	0011	Minor	Sanitary wastewater	Y	Total chlorine
Fowler Creek	KY0075833	Nixutil Sanitation Assoc Inc	0012	Minor	Sanitary wastewater	Y	Fecal coliform, total ammonia
Fowler Creek	KY0080802	Regency Manor Inc	0012	Minor	Sanitary wastewater	Y	Total ammonia
Fowler Creek	KY0101672	Kenton Co Bd of Ed	0012	Minor	Whites Tower Elem School	Y	Total ammonia
			0022	Minor	Simon Kenton High School	N	Total ammonia
			0062	Minor	Twenhofel Jr High School	Y	$CBOD_5$, fecal coliform, total ammonia, TSS
Fowler Creek	KYG400090	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Fowler Creek	KYG400482	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Fowler Creek	KYG400719	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Bullock Pen Creek	KY0075485	Graham Packaging Plastic Prods	0011	Minor	Cooling water and sanitary	Y	Fecal coliform
Bullock Pen Creek	KY0090191	Camco Chemical Co Inc	0011	Minor	Storm water runoff	Y	pH
			0021	Minor	Storm water runoff	Y	pH
			0031	Minor	Storm water runoff	Y	pH
Bullock Pen Creek	KYG400111	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Thompson Branch	KYG400625	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA

Table 2. Permitted Dischargers - Continued

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?[a]	Permit Violations
Banklick Creek	KY0089524	Interplastic Corp Thermoset	0011	Minor	Storm water runoff - plant grds	Y	Oil and grease, total zinc, TSS
			0012	Minor	Storm water runoff - plant grds	Y	None
			0021	Minor	Storm water runoff - west side	N	Total zinc, TSS
			0022	Minor	Storm water runoff - west side	N	NA
			0041	Minor	Storm water runoff - east side	Y	Total zinc, TSS
			0042	Minor	Storm water runoff - east side	Y	None
Banklick Creek	KY0101052	Moraine Materials Co Plt #29	0011	Minor	Concrete mixer trk washout wtr	Y	Oil and grease, TSS
Banklick Creek	KY0101222	BP Amoco Sohio Refinery	0011	Minor	Groundwater remediation	N	Naphthalene
			0021	Minor	Groundwater remediation	N	Total iron
			0031	Minor	Storm water runoff	Y	NA
			0032	Minor	Storm water runoff	Y	NA
			0041	Minor	Storm water runoff	Y	Total phenolics
			0042	Minor	Storm water runoff	Y	NA
Banklick Creek	KYG400514	Residence	0011	Minor	Sanitary wastewater Type B	Y	Total ammonia
Banklick Creek	KYG500131	KTC Kenton Co Maint Garage	SW10	Minor	Storm water runoff	Y	None
			SW20	Minor	Storm water runoff	Y	Oil and grease
			SW30	Minor	Storm water runoff	Y	NA
Banklick Creek	KYG640158	Taylor Mill WTP	0011	Minor	Sedimentation basin drain	Y	TSS

[a] Discharge is permitted as of June 2008.

NA – Monitoring data were not available.

2.3.1.b Sewer overflows

There are five current combined sewer overflows (both permitted and "to be permitted") in the Banklick Creek watershed. These overflows are listed in Table 3. All of these CSOs are located in the watershed draining the lower 2.3 miles of Banklick Creek.

There are twenty-seven sanitary sewer overflows (SSOs) in this watershed (Table 4). Two of these are located at pump stations that have historically been shown to have a lack of wet weather capacity. The Lakeview pump station is located along the Banklick Creek mainstem within the City of Fort Wright, and the Meadow Hill pump station is located in the southern portion of the City of Covington.

Table 3. Combined Sewer Overflow Points

Manhole ID	Common Name	Direct Discharge to Waterbody	Typical Year Spill Frequency (# spills)[a]	Typical Year Volume (Million gallons)[a]
1870194 (outfall 79)	47th Street	Banklick Cr.	4	0.13
1850158 (outfall 76)	Church Street	Banklick Cr.	74	56.26
1870193 (outfall 78)	Decoursey Ave.	Banklick Cr.	24	1.29
1840130[b]	Latonia	Banklick Cr. trib.	25	1.12
1510245[b]	Henry Clay	Banklick Cr. trib.	0	0

[a] The results presented were generated by models based on SD1's current (2008) understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

[b] These are "to be permitted" CSOs, i.e., SD1 has (or will) identified these locations for KPDES permitting.

Table 4. Sanitary Sewer Overflow Points

Manhole ID	Direct Discharge to Waterbody	Typical Year Spill Frequency (# spills)[a,b]	Typical Year Volume (Million Gallons)[a,b]
1040060	Tributary to Bullock Pen Creek	3	0.1
1090069	Tributary to Bullock Pen Creek	0	0.0
1110025	Tributary to Bullock Pen Creek	4	0.2
1110067	Tributary to Bullock Pen Creek	5	0.4
1110161	Tributary to Bullock Pen Creek	2	0.1
1110294	Tributary to Bullock Pen Creek	5	0.1
1570100	Tributary to Horse Branch	7	0.2
1760047	Tributary to Bullock Pen Creek	0	0.0
1760048	Tributary to Bullock Pen Creek	0	0.0
1860108	Banklick Creek	0	0.0
1870013	Banklick Creek	0	0.0
1950199	Tributary to Banklick Creek	0	0.0
1960012	Horse Branch	0	0.0
2030097	Tributary to Bullock Pen Creek	0	0.0
2090001	Bullock Pen Creek	0	0.0
2090026	Bullock Pen Creek	0	0.0
2110002	Tributary to Bullock Pen Creek	10	1.0
2120001	Tributary to Bullock Pen Creek	5	0.2
2120002	Tributary to Bullock Pen Creek	0	0.0
2120041	Tributary to Bullock Pen Creek	4	0.1
2160036	Tributary to Horse Branch	NA	NA
2280010	Wolf Pen Branch	0	0
2280011	Wolf Pen Branch	10	0.4
2280012	Wolf Pen Branch	0	0.0
2300123	Banklick Creek	27	6.1
1950PS1 (Lakeview PS)	Banklick Creek	17	10.6
2020PS2 (Meadow Hill PS)	Tributary to Banklick Creek	NA	NA

[a] The results presented were generated by models based on SD1's current (2008) understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

[b] NA means no model data are available.

2.3.1.c Storm water discharges

Storm water pipe outlets are located throughout most of the Banklick Creek watershed with the highest concentration in north and west portions of the watershed where development is denser. In addition to storm water outfalls, there are approximately 162 suspected illicit activity (SIA) points which are located throughout the Banklick Creek watershed, with the greatest concentrations to the north and west. SIAs are locations where there was possible evidence of illicit discharges during SD1's storm water mapping project (2001-2002). These locations are being further investigated to determine if they are recurring.

A small portion of this watershed is located outside of SD1's storm water service area, so outfalls and other illicit discharges may be located in these areas, but were not inventoried by SD1. Storm water outfalls covered by individual KPDES permits are discussed in Section 2.3.1.a.

2.3.2 Recently Completed Infrastructure Projects

SD1 has completed numerous projects, including the following:

- Lakeview Pump Station Capacity Upgrade, completed in 2005, involved the repair and rehabilitation of the existing pump station and increased the capacity of the Lakeview Pump Station to approximately 22 MGD, reducing overflows at the pump station bypass and upstream as well.
- Banklick Pump Station Screening Facility project, completed in 2006, installed a new bar screen to remove solids and floatables that were clogging the pumps and preventing the pump station from running properly during wet weather. The pump station can now run continuously without clogging reducing the frequency and volume of CSOs upstream.
- The Wilson Road Sewer Assessment project was completed in 2005 and involved extending sewer lines, giving 6 properties the opportunity to connect to sewer service.
- The Taylor Mill Sewer Assessment project was completed in 2005 and involved extending sewer lines, giving 15 properties the opportunity to connect to sewer service.
- The Pleasure Isle Sewer Assessment project was completed in 2005 and involved extending sewer lines, giving 10 properties the opportunity to connect to sewer service.
- The Cadillac Drive Sewer Assessment project was completed in 1999 and involved extending sewer lines, giving 73 properties the opportunity to connect to sewer service.
- Brookwood Subdivision SSES Study, completed in 2006, evaluated the sanitary sewer and storm sewers in the Brookwood subdivision to identify locations of storm water inflow and infiltration (I/I) into the separate sanitary sewer system in

order to identify projects to be performed to remove this identified I/I. Flows from this area are tributary to the Lakeview pump station service area.

- Stevenson Road Relief Sewer Project Phase II project, completed in 2006, was constructed to increase the wet weather capacity in the Lakeview pump station service area collection system to reduce the frequency and volume of known SSOs.
- McMillan Pump Station Removal project, completed in 2006, provided increased dry and wet weather sewer capacity by constructing a new sewer to eliminate an existing maintenance intensive pump station.
- Apple Drive Sewer Outfall project, completed in 2006, extended sanitary sewer service to remove a package treatment plant.
- KY Transportation Cabinet - KY17 / Pelly to Nicholson project, completed in 2006, relocated and upsized existing sewers to provide additional dry and wet weather capacity in an area upstream of Lakeview pump station.
- Fort Wright Sanitary Sewer Rehabilitation project, completed in 2006, was a result of the Fort Wright Illicit Discharge Removal Project and installed new sanitary and storm sewers to separate sanitary and storm flows in this area. This project resulted in eliminating sewage from getting into existing storm sewers and the local creeks and reduced wet weather flow tributary to the Lakeview pump station service area, thereby reducing overflows downstream.
- Fort Wright Outfall Sewer Phase II, completed in 2006, constructed a new sanitary sewer to remove the existing sanitary sewer from the creek, thereby reducing inflow and infiltration from storm and creek water into the sanitary sewer.
- South Hills Outfall, completed in 2007, included the construction of a new 24-inch sewer via horizontal directional drilling on grade (first in the country of this size and slope) to eliminate a CSO at a street intersection. This new sewer has been successful in diverting combined sewer flows from the Lakeview pump station service area, and into the Bromley pump station combined sewer service area, thereby consolidating flows within the combined system and reducing overflow volume at the Lakeview pump station. This project also eliminated a failing sewer located within a landslide area that has resulted in past sanitary sewer overflows.
- Latonia Combined Sewer Separation project, first phase completed in 2007, provided sewer separation through the construction of a new storm sewer to separate and intercept storm water flow to keep it out of the combined sewers in Latonia. This project has helped to reduce basement backups in this area and reduce the overflow volume from downstream CSOs. Additional phases of this work could be completed in the future if monitoring proves that it would be beneficial.

- Bluegrass Swim Club Sewer Separation, completed in 2007, removed existing storm water connections to the sanitary sewers in Fort Wright, thereby reducing wet weather flows in SD1's sanitary sewer system.

2.3.3 Ongoing or Planned Infrastructure Improvement Projects

SD1 has several ongoing and planned projects for the Banklick Creek watershed including:

- Western Regional - Narrows Road Diversion Pump Station and Industrial Road Force Main. This project will divert flow from the Lakeview pump station service area, which experiences overflows at the pump station and from manholes upstream. This project will: (1) free up capacity at the Dry Creek Treatment Plant; and (2) increase capacity in the conveyance system tributary to Lakeview, decreasing overflows in this system.
- Western Regional – KY Transportation Cabinet - Turkeyfoot Road Force Main, partially completed, is the first construction piece of the new Diversion Pump Station system that will eventually divert flow from the Lakeview Pump Station service area.
- Three locations where the sewerline crosses Banklick Creek are being fixed using stream stabilization techniques such as J hooks and riffles, to stop headcutting. These are located along the mainstem of Banklick Creek, just upstream of Banklick Woods Park. Another manhole and exposed pipe are being surveyed to determine the best solution for that site, which is also along the mainstem of Banklick Creek, near River mile 9.5.

Project information is presented in Table 5.

Table 5. Ongoing or Planned Infrastructure Improvement Projects

Capital Improvement Project Title	Goals	Anticipated Start Date	Anticipated Completion Date	Project Total
Western Regional - Narrows Road Diversion Pump Station	Decrease overflows in the Lakeview service area	2010	2013	$11,565,000
Western Regional - Turkeyfoot Industrial Road Force Main	Decrease overflows in the Lakeview service area	2010	2013	$3,045,000
Stream crossing projects and problem manhole	Decrease potential for stream inflow into District sanitary sewers	To be determined	To be determined	To be determined

2.4 SENSITIVE AREAS

The federal CSO Control Policy (USEPA, 1994) states EPA's expectation that a permittee's Long-Term Control Plan (LTCP) give the highest priority to controlling CSOs in sensitive areas. The CSO Control Policy indicates that sensitive areas include:

- Waters designated as Outstanding National Resource Waters (ONRW);
- Waters with threatened or endangered species and their habitat;

- Waters with primary contact recreation, such as bathing beaches;
- Public drinking water intakes and their designated protected areas;
- National Marine Sanctuaries; and
- Shellfish beds.

These six criteria were evaluated individually. None of the waters in the Banklick Creek watershed have been designated by the State of Kentucky as ONRW (401 KAR 10:030) and no National Marine Sanctuaries have been designated (NOAA, 2008). There are no known commercial shellfish beds within the Banklick Creek watershed, nor is shellfish harvest for consumption by private individuals known to occur. The remaining three criteria are discussed below.

2.4.1 Threatened and Endangered Species or Their Designated Critical Habitat

Threatened and endangered species, species of concern and their designated critical habitat within the Banklick Creek watershed were identified by contacting the Kentucky State Nature Preserves Commission (KSNPC). KSNPC identified five species (Table 6), one of which (Running buffalo clover) is an threatened and endangered species. There is no critical habitat designated for any of the five species.

Table 6. Endangered Species, Threatened Species and Species of Concern

Taxonomic Group	Scientific name	Common name	Status[a]	Last Observed	Habitat(s)	Identified Threats
Vascular Plants	*Trifolium stoloniferum*	Running buffalo clover	Federal - Endangered State - Threatened	2003	Riparian areas, upland areas	Habitat loss, non-native species, bison decline,
Breeding Birds	*Ammodramus henslowii*	Henslow's sparrow	Federal – SOMC State-Special Concern	1950	Grasslands, savannahs	Habitat loss
Breeding Birds	*Tyto alba*	Barn owl	State – Special Concern	1987	Farms and farm structures	Habitat loss
Amphibians	*Plethodon cinereus*	Redback salamander	State – Special Concern	1998	Woodlands	Habitat loss, habitat degradation
Amphibians	*Rana pipiens*	Northern leopard frog	State - Special Concern	1934	Ponds, wetlands, grasslands	Habitat loss, non-native species, commercial overexploitation

Source: KSNPC, 2006; KSNPC, 2007

[a] Species of Management Concern (SOMC) is a Federal/ESA Designation

Running buffalo clover is a small herbaceous plant (Figure 7) that inhabits streambanks and upland areas, and erosion is noted as the biggest threat (KSNPC, 2006). Other factors contributing to population declines are loss of bison populations, non-native plants, and overall habitat loss (USFWS, 2003).

Figure 7. Running Buffalo Clover, *Trifolium stoloniferum*

The northern leopard frog is an aquatic-dependent species, which is a state species of special concern. The northern leopard frog inhabits various habitats including slowly flowing areas in creeks and rivers, springs, the nearshore area of lakes, bogs, fens, herbaceous wetlands, riparian areas and grasslands (NatureServe, 2007). Threats to the northern leopard frog include habitat loss, commercial overexploitation, and competition with introduced species (NatureServe, 2007).

Three of the species identified by KSNPC are neither aquatic nor dependent on riparian habitats. These are Henslow's sparrow, the barn owl and the redback salamander. Henslow's sparrow inhabits grassland and savannah habitats and the greatest threat to the species is loss of habitat (Reinking, 2002). The barn owl inhabits farms and farm structures, and loss of farmland to commercial development, changes in farming practices (e.g., reduction in dairy and sheep farming) and a general decline in the number of farms have been cited as contributing to population declines (NatureServe, 2007). The redback salamander, a woodland species, is sensitive to localized habitat loss, mainly due timber removal and habitat degradation (NatureServe, 2007).

2.4.2 Primary contact recreation waters

Kentucky does not have a tiered approach for primary contact recreation (PCR). This means that the State has designated that all PCR waters should be suitable for full body contact recreation during the recreation season of May 1 through October 31 (401 KAR 10:001E). The State water quality standards do not define full body contact recreation, so the bacteria criteria developed are based on the presumption that people will ingest water and could become ill if the water was sufficiently contaminated with bacteria.

Banklick Creek and its tributaries are designated for PCR. It is not clear whether or not swimming occurs in the creek, as public surveys regarding that information are unavailable. No public swimming beaches were identified in the watershed. Wading has been observed in Banklick Creek. Additional data will be gathered about uses of the creek.

2.4.3 Public drinking water intakes or their designated protection areas

There are no public drinking water intakes from surface waters or public groundwater wells in this watershed. The nearest intake is located on the Licking River just upstream of the Banklick Creek confluence. Northern Kentucky Water District (NKWD) is responsible for the drinking water intake on the Licking River.

Source Water Assessment and Protection Areas (SWAPPs) for the water intake on the Licking River have been delineated to identify potential contaminants upstream of the water intake. The SWAPP zones are not used in a regulatory sense but are used to support identification of sources potentially impacting the intakes. Due to the location of the NKWD intake, portions of this watershed lie within SWAPP Zone 1, which extends 5 miles upstream on Banklick Creek from the mouth. The remainder of the watershed lies within SWAPP Zones 2 and 3, because they are farther from the intake.

Drinking water supply features are shown in Figure 8.

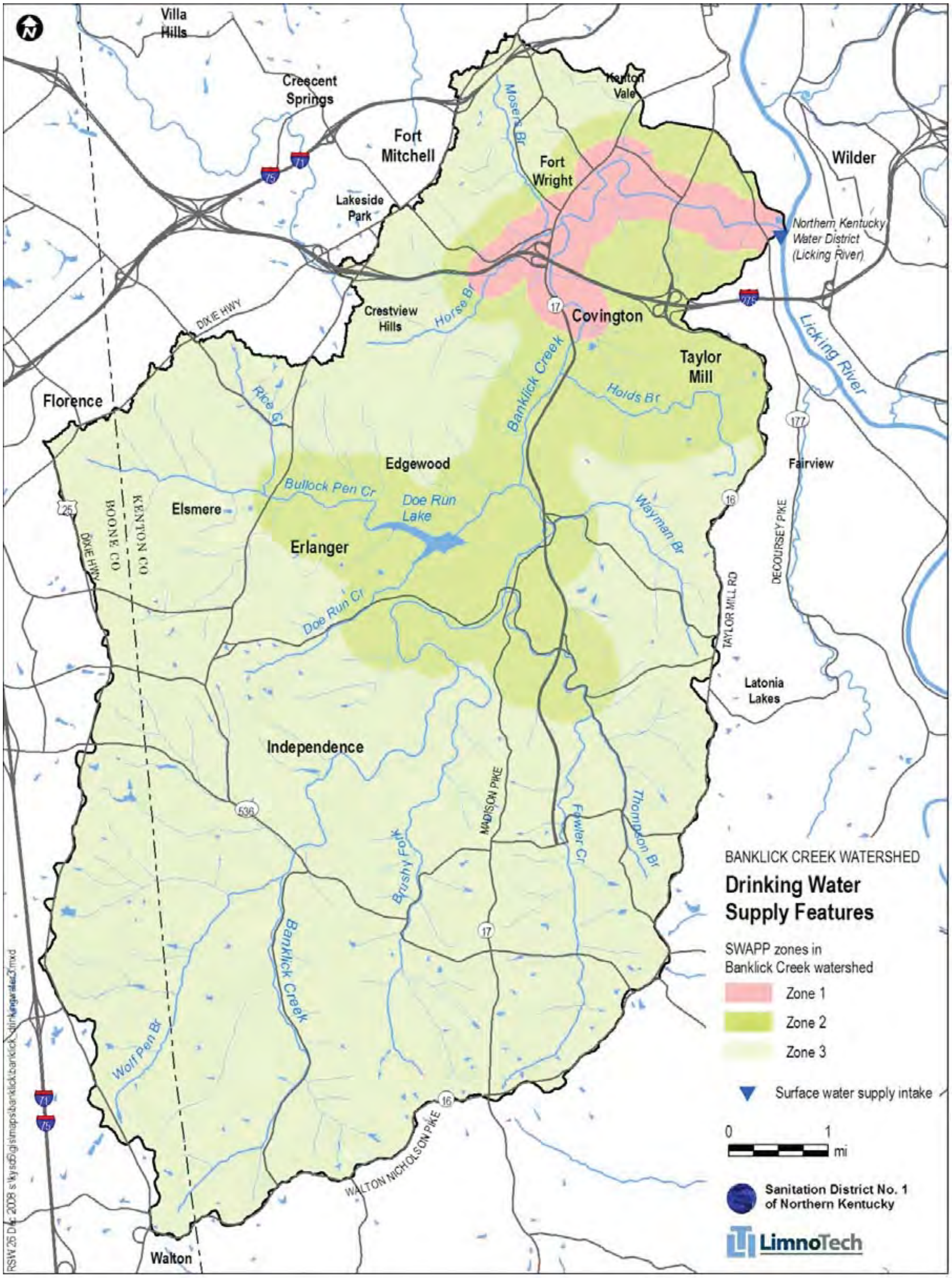

Figure 8. Drinking Water Supply Features

2.5 PUBLIC INTEREST/WATERSHED GROUP ACTIVITIES

Interest in this watershed is considered high, and is gauged through an active watershed council, past studies and improvement projects, and past sampling.

The Banklick Watershed Council was formed in 2002 "to make Banklick Creek once again "swimmable and fishable" and a safe, public amenity without dangerous flooding and pollution" (http://www.banklick.org/index.htm). A watershed action plan was developed in 2005 using 104(b)(3) funds (Banklick Watershed Council, 2005), and more recently, the watershed council was awarded 319(h) grant funding to revise the existing watershed plan and continue restoration activities.

Many organizations have been active in this watershed, including SD1, the Banklick Creek Watershed Council, the U.S. Army Corps of Engineers, the Northern Kentucky Health Department, the Local Alliance for Nature and Development, Kenton County Conservation District, Licking River Watershed Watch, the Area Development District and the Licking Region Basin Team. Some studies and projects in this watershed are briefly described below. Projects more directly related to infrastructure improvements are discussed in Sections 2.3.2 and 2.3.3.

- SD1 has been conducting monitoring and modeling studies in this watershed since 1995 and has been responsible for funding or conducting numerous investigations, reports and projects aimed at improving the health of the watershed.
- The USDA, FEMA and the USACE have been involved in projects to investigate and reduce flooding in the watershed (See Section 2.1.1).
- A 2006 small area study (NKAPC, 2006a) examined potential future land uses in the headwaters of Banklick Creek, and identified key natural features for preservation. The study provides recommendations for greenways, riparian buffers along perennial and intermittent streams, hillside protection, stream restoration.
- A $1 million 319(h) project is underway to modify the existing watershed plan and conduct restoration activities in this watershed over the next 6.5 years (Kentucky Energy and Environment Cabinet, 2008).
- A preliminary scope has been developed to conduct stream and wetland restoration along Banklick Creek, in the 38-acre Wolsing Preserve. This work will involve removal of a low water bridge, sewer crossing restoration, Cody Road crossing removal, restoration of a 100 foot riparian buffer, and wetlands enhancement. This project is proposed by the Northern Kentucky University Center for Applied Ecology through the Northern Kentucky Stream and Wetland Restoration Fund, with some funding also being provided by Kenton County Conservation District. The Kenton and Boone County Conservation Districts, and the USDA Natural Resources Conservation Service also continue to promote riparian buffers (Banklick Watershed Council, 2005).

- A master plan has been developed for Doe Run Lake to protect and enhance the lake, link adjacent areas using trails, greenways, stream or wildlife corridors, and provide opportunities for education and increasing awareness of this resource (Human Nature, 2003).
- The Madison Pike (KY 17) Corridor Study was developed to guide development of the area adjacent to Banklick Creek. Among other things, this plan includes objectives to maximize Banklick Creek as an asset to the surrounding area and provide recreational opportunities in the corridor. Riparian protection/buffers and hillside protection areas are discussed (City of Fort Wright, Kentucky, 2004).

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3. WATERBODY USES

This section describes designated and current uses for Banklick Creek and its tributaries.

3.1 DESIGNATED USES

Banklick Creek and its tributaries are designated for warm water aquatic habitat, primary contact recreation, secondary contact recreation and domestic water supply, applicable at existing points of public water supply withdrawal (401 KAR 10:026). These are defined below.

- **Warm water aquatic habitat** means any surface water and associated substrate capable of supporting indigenous warm water aquatic life.
- **Primary contact recreation** waters means those waters suitable for full body contact recreation during the recreation season of May 1 through October 31.
- **Secondary contact recreation** waters means those waters that are suitable for partial body contact recreation, with minimal threat to public health due to water quality.
- **Domestic water supply** means surface waters that with conventional domestic water supply treatment are suitable for human consumption through a public water system as defined in 401 KAR 8:010, culinary purposes, or for use in any food or beverage processing industry; and meet state and federal regulations under the Safe Drinking Water Act, as amended, 42 U.S.C. 300f - 300j.

3.2 CURRENT USES

An assessment of available information found the following:

- Fish IBI scores for Banklick Creek ranged from poor to excellent. Benthic algal surveys revealed high levels of eutrophication throughout the creek. The most diverse aquatic macroinvertebrate communities were found in the upper watershed and outside of urban areas (Strand Associates, 2003).
- There is a swimming advisory for the entire length of Banklick Creek, based on bacteria measurements in the creek (KDOW, 2007b).
- Wading in the creek has been observed along the mainstem of the Banklick Creek in the Pioneer Park area.
- There are no boat launches or marinas on the creek, however recreational boating may occur on Banklick Creek. Banklick Creek is listed on the American Whitewater website and a description of the creek between Independence Station Road and the Doe Run confluence is provided, which provides the class of the creek, the gradient and the length of this reach (http://www.americanwhitewater.org/rivers/id/3132).
- A boat launch ramp for Doe Run Lake is located within Doe Run Lake Park.
- A statewide fish consumption advisory was issued on April 11, 2000 due to low levels of organic mercury found in fish taken from Kentucky waters (KDOW, 2007a).

- Fishing is permitted at Doe Run Lake Park and Banklick Woods Park. Fishing has also been observed along the mainstem of the Banklick in the areas of Pioneer Park and SD1's Public Service Park.
- There are no water supply intakes from surface waters in the Banklick Creek watershed.
- There are no active public water supply groundwater wells in this watershed (KDOW, 2008a; KDOW, 2007c).

4. WATERBODY CONDITIONS

This section describes monitoring programs and observed water quality and biological conditions in this watershed.

4.1 303(d) STATUS AND POLLUTANTS OF CONCERN

The entire length of Banklick Creek and one lake appear on Kentucky's 2008 303(d) list of impaired waters (Table 7; KDOW, 2008).

Table 7. 303(d)-listed Waterbodies

Waterbody Segment	Designated Uses (use support)	Pollutants	Suspected Sources
Banklick Creek RM 0.0 – 3.5	Primary contact recreation (Not supporting) Warm water aquatic habitat (Partially supporting)	Fecal coliform Nutrient/eutrophication biological indicators; Organic enrichment (sewage) biological indicators; Sedimentation/siltation	Highways, Roads, Bridges, Infrastructure (New construction), municipal point source discharges, unspecified urban storm water, urban runoff/storm sewers
Banklick Creek RM 3.5 – 8.2	Primary contact recreation (Not supporting) Warm water aquatic habitat (Not supporting)	Fecal coliform Nutrient/eutrophication biological indicators; Organic enrichment (sewage) biological indicators; Sedimentation/siltation	Agriculture, on-site treatment systems (septic systems and similar decentralized systems)
Banklick Creek RM 8.2 – 19.2	Primary contact recreation (Partially supporting) Warm water aquatic habitat (Partially supporting)	Fecal coliform Nutrient/eutrophication biological indicators; Organic enrichment (sewage) biological indicators	Agriculture, on-site treatment systems (septic systems and similar decentralized systems)
Doe Run Lake 51 acres	Warm water aquatic habitat (Partially supporting)	Dissolved oxygen; Nutrient/eutrophication biological indicators; Dissolved gas supersaturation	Source unknown, upstream source

TMDL development is planned for Banklick Creek. KDOW may collect additional sediment data if needed and once data collection is complete, KDOW will develop the sediment TMDLs. KDOW will pursue development of nutrient and organic enrichment TMDLs when nutrient targets are available (KDOW, 2008).

4.2 MONITORING PROGRAMS

Water quality data have been collected in this watershed by KDOW, Northern Kentucky University (NKU), Licking River Watershed Watch (LRWW), USGS and SD1. Data currently compiled by SD1 from known monitoring programs are presented in Table 8, however, only data which have been fully analyzed are discussed in Section 4.3 Water Quality Data Analysis. Available data exists for the main stem of Banklick Creek, Bullock Pen Creek, Fowler Creek, Mosers Branch as well as Doe Run Lake.

Data not included in this report will be reviewed and included in subsequent updates.

Table 8. Summary of Water Quality Monitoring Data

Entity	Dates	Parameters Sampled	Sampling Locations[b]	Number of Samples
KDOW	1985	Fecal coliform, Fecal strep	Banklick Cr. RM 5.9, 0.3, 1.2	1/month March & July
KDOW	1989, 1994, 1995,	Alkalinity, chloride, chlorophyll-a, DO, DO % Sat, 1% light compensation point, pH, conductivity, TSS, VSS, TOC, DOC, transparency (secchi disc), temperature, nutrients	Doe Run Lake (Bullock Pen Cr. RM 0.9)	3/yr May-October
KDOW	1991-2005	Fecal coliform, Fecal strep or entero, E. coli, alkalinity, chloride, chlorophyll-a, DO, DO % Sat, 1% light compensation point, pH, conductivity, TSS, transparency (secchi disc), temperature, nutrients	Banklick Cr. RM 0.2, 0.3, 1.2, 2.4, 3.3, 3.6, 4.0, 8.1	Numerous sampling dates between Apr & Nov
KDOW	1996	DO, pH, conductivity, transparency (secchi disc), turbidity, temperature	Banklick Cr. RM 0.3	13 days in June, July, Aug, & Sept.
KDOW	1999	Fecal coliform	Bullock Pen Cr. RM 0.1	2/month May, Aug, Sept
KDOW	1999	DO, DO % Sat, pH, conductivity, temperature	Banklick Cr. RM 1.2	1 sample (8/19/1999)
KDOW	1999-2000	Fecal coliform, biochemical oxygen demand (5 Day), TSS, nutrients	Banklick Cr. RM 0.3, 1.2, 3.9, 8.2, 8.1, 11.6, 17.7; Fowler Cr. RM 0.1	10 samples from Apr 1999 to Mar 2000 (no sample in June, Oct, & Jan, but two samples for Feb)
LRWW	1999	Fecal coliform	Banklick Cr. RM 0.2, 5.7	1 sample (7/16/1999)
LRWW	2002	Fecal coliform	Banklick Cr. RM 0.1, 0.2, 5.7; Fowler Cr. RM 0.1, 1.7; Mosers Br. RM 0.7	1 sample (7/12/2002)
LRWW	2003	Fecal coliform	Banklick Cr. RM 7.7	2 samples (5/14/2003 & 7/10/2003)
LRWW	2004	Fecal coliform, *E. coli*	Banklick Cr. RM 0.1, 0.2, 0.8, 5.7; ; Bullock Pen Cr. RM 0.1, 1.8; Mosers Br. RM 0.7	3 samples (May, July, Sept)
NKU	1998	Alkalinity, bromide, chloride, fluoride, hardness, conductivity, sulfate, TOC, TSS, nutrients, metals	Banklick Cr. RM 0.2, 5.7	1 sample (10/11/1998)
NKU	1998	Fecal coliform	Banklick Cr. RM 0.2, 5.7	1 sample (7/14/1998)
NKU	1998	Alachlor, atrazine, chlorpyrifos-methyl, metolachlor, 2,4-D, Dichlorophenoxyacetic acid	Banklick Cr. RM 0.2, 5.7	1 sample (5/17/1998)
NKU	1999	Atrazine, chlorpyrifos-methyl, 2,4-D, Dichlorophenoxyacetic acid	Banklick Cr. RM 0.2, 5.7	1 sample (5/23/1999)
NKU	1999	Alkalinity, chloride, hardness, conductivity, sulfate, TOC, TSS, nutrients	Banklick Cr. RM 0.2, 5.7	1 sample (9/13/1999)
NKU	2000	Alkalinity, chloride, hardness, conductivity, DO, pH, sulfate, TOC, TSS, temperature, nutrients	Banklick Cr. RM 0.2, 5.7	1 sample (Sept.)
NKU	2000	Fecal coliform, Fecal Streptococci	Banklick Cr. RM 0.2, 5.7	1 sample (7/15/2000)
NKU	2000	Atrazine, metolachlor	Banklick Cr. RM 0.2, 5.7	1 sample (5/21/2000)
NKU	2001	Atrazine, metolachlor	Banklick Cr. RM 0.1, 0.2, 5.7	1 sample (June)

Table 8. Summary of Water Quality Monitoring Data - Continued

Entity	Dates	Parameters Sampled	Sampling Locations[b]	Number of Samples
NKU	2001	Fecal coliform, Fecal Streptococci	Banklick Cr. RM 0.1, 0.2, 5.7	1 sample (7/14/2000)
NKU	2001	Fecal coliform, E. coli, DO, pH, temperature	Banklick Cr. RM 15.6; Bullock Pen Cr. RM 0.4, 2.7; Fowler Cr. RM 1.7; Mosers Br. RM 0.7	1 sample (8/25/2001)
NKU	2002	Atrazine, DO, pH, temperature	Banklick Cr. RM 15.6; Bullock Pen Cr. RM 0.4, 2.7; Fowler Cr. RM 0.1, 1.7; Mosers Br. RM 0.7	1 sample (May)
NKU	2003	Fecal coliform, DO, pH, conductivity, temperature	Banklick Cr. RM 0.1, 0.2, 0.8, 5.7; Mosers Br. RM 0.7	1 sample (5/17/2003)
NKU	2003	Fecal coliform, alkalinity, boron, chloride, DO, hardness, pH, conductivity, silicon, sulfur, sulfate, TSS, temperature, nutrients, metals	Banklick Cr. RM 0.2, 5.7; Mosers Br. RM 0.7	1 sample (Sept.)
NKU	2003	Fecal coliform	Banklick Cr. RM 0.1, 0.2, 5.7; Mosers Br. RM 0.7	1 sample (7/10/2003)
SD1	1995-1996	Fecal coliform, E. coli, biochemical oxygen demand (5 Day), carbonaceous biochemical oxygen demand (5-day), chlorophyll a, cyanide, DO, hardness, oil and grease, pH, settleable solids, conductivity, TOC, total solids, TSS, transparency (secchi disc), turbidity, VSS, temperature, nutrients, metals	Banklick Cr. RM 0.3, 1.2, 3.9	12 wet/dry weather events (33 samples from each station for all of the events)
SD1	1996	DO, pH, conductivity, transparency (secchi disc), temperature	Banklick Cr. RM 0.3, 1.2, 3.9	1/month June, Aug, & Sept
SD1	1996	WQ: DO, pH, conductivity, turbidity, temperature, transparency (secchi disc) Sediment: chemical oxygen demand, oil and grease, total solids, total volatile solids, toluene, nutrients, metals	Banklick Cr. RM 0.3	1 sample (8/8/1996)
SD1	2001-2003	DO, pH, conductivity, transparency (secchi disc), turbidity, TSS, temperature, nutrients	Banklick Cr. RM 0.4, 2.5, 3.8, 5.4, 8, 10.1, 13.5, 15, 18.2; Bullock Pen Cr. RM 0.1	Four sampling events (Sept & Oct of 2001, May & June of 2002, Sept of 2002, & April & May of 2003) -- parameters and sampled stations vary from each event
SD1	2002-2003	Fecal coliform, E. coli, carbonaceous biochemical oxygen demand (5-day), DO, hardness, pH, conductivity, TSS, VSS, temperature, nutrients, metals	Banklick Cr. RM 0.3, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; Fowler Cr. RM 0.1	3 wet and 3 dry weather events (21samples from each station for all of the events)

Table 8. Summary of Water Quality Monitoring Data - Continued

Entity	Dates	Parameters Sampled	Sampling Locations[b]	Number of Samples
SD1	2002-2003	Gage height, discharge, DO, pH, conductivity, temperature	Banklick Cr. RM 0.3, 1.2	5- & 15-minute intervals
SD1	2007	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Banklick Cr. RM 0.3, 1.2, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; Fowler Cr. RM 0.1	1 sample (6/26/2007)
SD1	2008	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Banklick Cr. RM 0.3, 1.2, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; Fowler Cr. RM 0.1	1 Wet Weather Event in May (Eight samples from each station for the event)
SD1	2008[a]	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Banklick Cr. RM 0.3, 1.2, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; Fowler Cr. RM 0.1	1 sample (6/25/2008)
University of Kentucky	1993	Fecal coliform, Fecal strep, biochemical oxygen demand (5 Day), DO, TSS	Banklick Cr. RM 1.2, 2.4, 3.6, 4.0	10 samples for Aug, 5 samples for Sept, & 2 samples for Nov
USGS	1999-present[a]	Gage height, discharge, precipitation, DO, DO % sat, DO equilibrium, pH, conductivity, turbidity, temperature	USGS Station No. 03254550; Banklick Cr. RM 8.1	15-minute intervals

[a]Data not analyzed in Section 4.3, including USGS data collected after WY 2005

[b] RM = River mile

4.2.1 Future Sampling

Both instream and outfall sampling are currently planned.

SD1 plans to continue monitoring this watershed during base flow conditions with at least one survey per year. The eight sampling locations are: Banklick Cr. RM 0.3, 1.2, 3.9, 8.1, 11.6, 15.6; Bullock Pen Cr. RM 0.1; and Fowler Cr. RM 0.1. Typical analyses will include bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters.

SD1 is planning to collect wet weather data at four locations in this watershed in 2009. The four locations are: Banklick Creek RM 0.3, 1.2, 3.9 and 8.1. Attempts will be made to sample three events of varying characteristics (total rainfall, maximum intensity). Samples may be analyzed for bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters. Within each event, samples will be collected near hour 0, 2, 4, 6, 12, 24, 36, and 48 hours of the start of the storm, though these intervals are dependent on the storm characteristics and may be changed if necessary. Additionally, surveys to assess the degree of stream hydromodification are currently underway by SD1.

The USGS will continue to operate the stage gage, measure flow, and water quality (physical parameters) at RM 8.1 (station 03254550). This station is operated and funded via a cooperative agreement between USGS and SD1.

Outfall sampling was initiated in 2007 to better characterize water quality and loadings from CSOs, SSOs and storm water runoff. Six outfalls are being sampled in the Banklick Creek watershed and analyzed for bacteria, nutrients, solids, metals and oxygen-demanding constituents. The outfalls being sampled include the Lakeview pump station, the Church Street CSO and four storm water outfall locations. This sampling program plan is anticipated to continue until ten events are monitored.

4.3 WATER QUALITY DATA ANALYSIS

Water quality data have been collected in the Banklick Creek watershed since 1985. Historical water quality data (1985-2005) have been analyzed to identify past water quality problems in this watershed. Historical exceedances of bacteria, dissolved oxygen, metals, temperature, pH and alkalinity (Doe Run Lake only) have been observed. Temperature and pH violations were only observed at the USGS continuous monitoring station.

Recent data (2006-present) have been analyzed in more detail to describe current stream conditions, because these data better reflect the effect of existing sources on instream water quality. Analysis of recent data collections indicate elevated bacteria levels. It should be noted that the data collected at the USGS station are not included in this assessment of recent data. These data are being reviewed and will be included in the next update of this report.

4.3.1 Historical Data

Both discrete measurements and the continuous water quality data were analyzed to identify historical water quality problems. The 15-minute data collected at the USGS continuous monitoring station through water year 2005 have been previously analyzed and documented in report by Cumberland Environmental Group (2007). This report is used to as the basis for the continuous data analysis.

Historical sampling data, as well as the 15-minute USGS data, reveal numerous exceedances of water quality criteria (Tables 9-12). Locations and parameters not discussed met their applicable water quality standards.

Table 9. Historical Bacteria Exceedances

Stream	River Mile	Parameters exceeding criteria				
		Fecal coliform			*E. coli*	
		Season	# samples	% of samples exceeding criteria[a]	# samples	% of samples exceeding criteria[a]
Banklick Creek	0.1	May-Oct	6	83%	1	100%
Banklick Creek	0.2	May-Oct Nov-Apr	101 6	61% 17%	3 ---	67% n/a
Banklick Creek	0.3	May-Oct Nov-Apr	58 7	86% 100%	50 ---	90% n/a
Banklick Creek	0.4	May-Oct	3	67%	3	67%
Banklick Creek	0.8	May-Oct	2	100%	---	n/a
Banklick Creek	1.2	May-Oct Nov-Apr	125 13	75% 23%	27 ---	93% n/a
Banklick Creek	2.4	May-Oct Nov-Apr	68 8	54% 38%	---	n/a
Banklick Creek	3.3	May-Oct	12	58%	---	n/a
Banklick Creek	3.6	May-Oct Nov-Apr	93 8	68% 38%	---	n/a
Banklick Creek	3.9	May-Oct Nov-Apr	51 5	82% 40%	47 ---	85% n/a
Banklick Creek	4.0	May-Oct Nov-Apr	112 8	72% 13%	---	n/a
Banklick Creek	5.7	May-Oct	10	80%	---	n/a
Banklick Creek	7.7	May-Oct	2	100%	---	n/a
Banklick Creek	8.1	May-Oct Nov-Apr	60 7	68% 14%	21 ---	81% n/a
Banklick Creek	11.6	May-Oct	24	75%	21	81%
Banklick Creek	15.6	May-Oct	22	77%	21	81%
Banklick Creek	17.7	May-Oct	1	100%	---	n/a
Bullock Pen Creek	0.1	May-Oct	26	65%	23	78%
Fowler Creek	0.1	May-Oct Nov-Apr	24 1	88% 100%	21 ---	81% n/a
Mosers Branch	0.7	May-Oct	8	50%	3	67%

[a] There are no instances where 5 samples were collected from a single location within a 30-day period. Therefore the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, "Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for *E. coli*." Even this comparison is conservative as the criterion is meant to be applied to a dataset of 5 or more samples collected over a 30-day period.

--- is used to indicate no data; n/a indicated not applicable

Table 10. Historical Dissolved Oxygen Violations

Stream	River Mile	Parameters violating criteria — Dissolved oxygen[a] — # measurements	% of measurements in violation
Banklick Creek	0.2	67	7%
Banklick Creek	0.3	76	7%
Banklick Creek	1.2	114	11%
Banklick Creek	2.4	70	9%
Banklick Creek	3.6	81	20%
Banklick Creek	4.0	82	1%
Banklick Creek	8.1	60	2%
Bullock Pen Creek	0.9	186	66%

[a] The dissolved oxygen criterion is 4 mg/l.

Table 11. Historical Metals Violations

		Parameters violating criteria							
		Cadmium[a]		Copper[a]		Iron[b]		Zinc[a]	
Stream	River Mile	# samples	% of samples in violation	# samples	% of samples in violation	# samples	% of samples in violation	# samples	% of samples in violation
Banklick Creek	0.3	44	7%	54	2%	---	n/a	---	n/a
Banklick Creek	1.2	30	23%	---	n/a	---	n/a	---	n/a
Banklick Creek	3.9	29	17%	---	n/a	---	n/a	---	n/a
Banklick Creek	5.7	---	n/a	---	n/a	5	50%	---	n/a
Banklick Creek	8.1	---	n/a	20	5%	---	n/a	---	n/a
Banklick Creek	11.6	---	n/a	20	5%	---	n/a	---	n/a
Fowler Creek	0.1	---	n/a	20	10%	---	n/a	20	5%

[a] Acute criteria to protect aquatic life are hardness-dependent. Individual criteria were calculated for each sampling event based on hardness at the time of sampling. Acute cadmium criteria ranged from 1.9 ug/l to 8.5 ug/l. Acute copper criteria ranged from 12.7 ug/l to 50.5 ug/l. Acute zinc criteria ranged from 110 ug/l to 380 ug/..

[b] The acute water quality criterion for iron is 4,000 ug/l

--- is used to indicate no data; n/a indicated not applicable

Table 12. Historical Alkalinity Violations

Stream	River Mile	Parameters violating criteria: Alkalinity[a] # samples	% of samples in violation
Bullock Pen Creek	0.9	3	100%

[a] The alkalinity criterion is 20 mg/l $CaCO_3$

The dissolved oxygen, temperature and pH violations discussed below were all observed at the USGS station on Banklick Creek at RM 8.1.

Violations of the 4.0 mg/l dissolved oxygen criteria have been reported in 2001 (May and September), 2002 (June), and 2003 (July). In general, flows were very low on days where dissolved oxygen was less than 4 mg/l.

Infrequent violations of the temperature criteria (31.7^{o}C) were observed in 2001, 2002 and 2005. These violations occurred during the summer months when flows were low.

Infrequent pH violations at the USGS gage were observed in 2002 and 2005, where the pH at RM 8.1 was observed to change more than 1 su in a 24-hour period. These violations occurred over a range of flow conditions. There were no observations of pH greater than 9.0 su or less than 6.0 su. The Synthesis Report suggests that the cause of most pH violations is algal growth and photosynthesis (CEG, 2007).

4.3.2 Recent Data

Recent water quality data were available for six locations along the mainstem of Banklick Creek (RM 0.3, 1.2, 3.9, 8.1, 11.6, and 15.6), as well as one location on Bullock Pen Creek (RM 0.1) and one location on Fowler Creek (RM 0.1). Eight fecal coliform samples and eight *E. coli* samples were available for each location.

Recent bacteria exceedances were observed (Table 13). Measurements for parameters not shown met water quality criteria. Recent data collected at the USGS station are being reviewed and will be included in the next update of this report.

Table 13. Recent (2006-2008) Bacteria Exceedances

Stream	River Mile	Parameters exceeding criteria			
		Fecal coliform[a]		*E. coli*[a]	
		# samples	% of samples exceeding criteria	# samples	% of samples exceeding criteria
Banklick Creek	0.3	8	75%	8	75%
Banklick Creek	1.2	8	63%	8	75%
Banklick Creek	3.9	8	50%	8	88%
Banklick Creek	8.1	8	50%	8	75%
Banklick Creek	11.6	8	50%	8	63%
Banklick Creek	15.6	8	50%	8	75%
Bullock Pen Creek	0.1	8	50%	8	50%
Fowler Creek	0.1	8	25%	8	63%

[a] There are no instances where 5 samples were collected from a single location within a 30-day period. Therefore the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, "Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for *E. coli*." Even this comparison is conservative as the criterion is meant to be applied to a dataset of 5 or more samples collected over a 30-day period.

4.3.2.a Bacteria

Fecal coliform and *E. coli* data were available for both base flow and storm conditions. Storm flow results for bacteria are presented as an average over the storm event. As shown in Figure 9, fecal coliform concentrations exceeded the applicable criterion in Banklick Creek and Bullock Pen Creek. Four of the 16 base flow samples exceeded the fecal coliform criterion, and storm flow samples exceeded the criterion at every location except Fowler Creek at RM 0.1. The maximum base flow fecal coliform concentration, 1,530 cfu/100 ml, was observed at Bullock Pen Creek RM 0.1, while the maximum storm event concentration, 1,697 cfu/100 ml, was observed at Banklick Creek RM 0.3.

E. coli concentrations exhibited a similar pattern, as shown in Figure 10. Eight of the 16 base flow measurements exceeded the applicable criterion, with exceedances observed at all sampling locations. The maximum base flow *E. coli* concentration, 1,333 cfu/100 ml, was observed at Bullock Pen Creek RM 0.1. Storm flow measurements exceeded the criterion at all locations, with a maximum concentration of 1,972 cfu/100 ml observed at Banklick Creek RM 0.3.

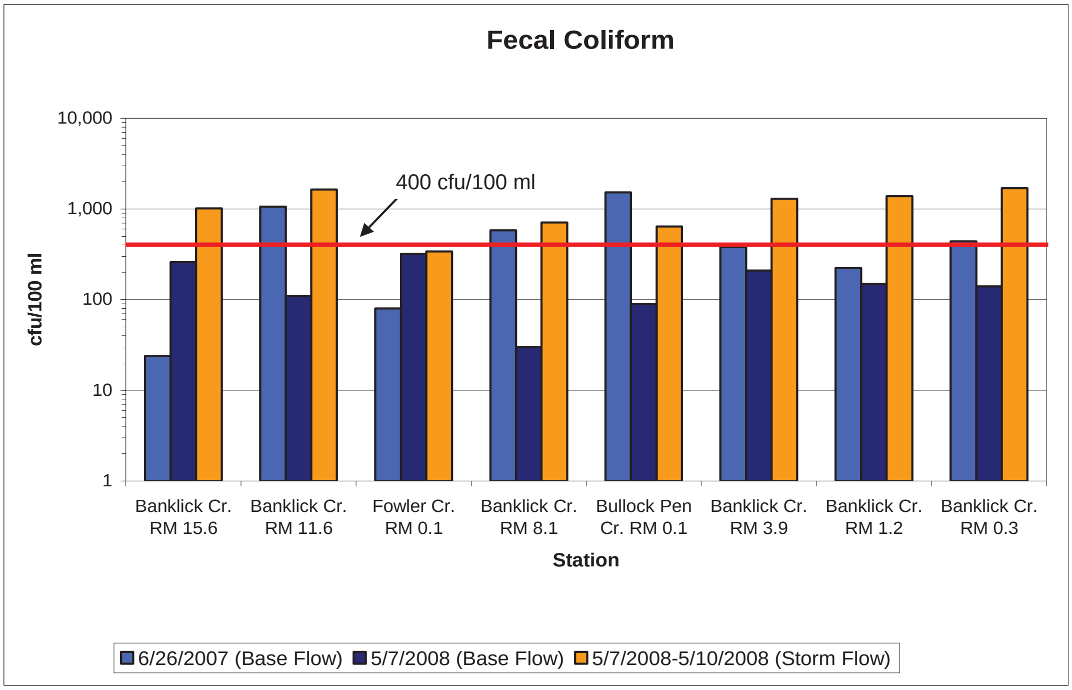

Figure 9. 2006-08 Base Flow and Average Storm Flow Fecal Coliform Concentrations Compared to 400 cfu/100 ml Criterion

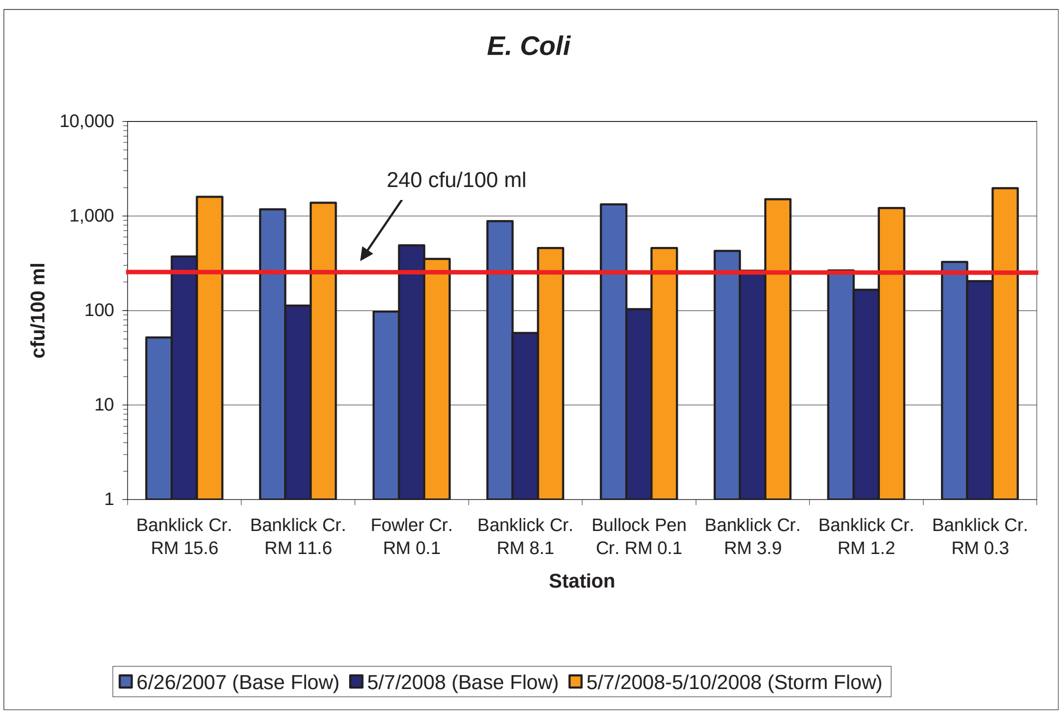

Figure 10. 2006-08 Base Flow and Average Storm Flow *E. Coli* Concentrations Compared to 240 cfu/100 ml Criterion

4.4 BIOLOGICAL CONDITIONS

Macroinvertebrate communities are susceptible to water quality and habitat degradation, and data from these communities are used as a tool to detect changes in habitat and water quality and assessing stream health (KDOW, 2008b).

KDOW sampled macroinvertebrates in 1999 at Banklick Creek RM 1.2, which yielded a MBI[8] rank of "poor" (Table 1). KDOW and Strand Associates also collected macroinvertebrate samples in 1996 and 2001-2003, respectively, but these data are not compatible with calculating the MBI. The 2001-2003 data indicate, with a few exceptions in locations where the creek is ephemeral, that areas upstream in the watershed had higher percentages of desirable macroinvertebrate individuals (Strand Associates, 2003). This is likely due to the lower level of land use disturbance in the primarily agricultural area compared to the high level of disturbance farther down the watershed where urban development exists. The urbanized areas have altered aquatic habitats, reduced riparian zones and increased siltation. Desirable macroinvertebrates were also low at the Bullock Pen Creek site and at sites closest to the mouth of Banklick Creek (Strand Associates, 2003). The downstream sites in Banklick Creek are also subject to backwater flows from the Licking and Ohio Rivers that cause siltation and further reduce desirable macroinvertebrates.

Benthic algae are useful biological indicators of water quality because they are sensitive to changes in water quality and are primary producers within aquatic ecosystems. Diatoms are benthic algae that are useful indicators of biological integrity because at least a few can be found under almost any condition and they are identifiable to species (KDOW, 2008b). In 1993, an unnamed tributary to Bullock Pen Creek received a poor rating based on diatom measurements (Table 1). Benthic algae were also measured in total biomass by Strand Associates between 2001 and 2003 (Strand Associates, 2003). The results of this sampling showed that eutrophication is a problem in some sections of the creek during some seasons (Strand Associates, 2003). The Bullock Pen Creek site often had chlorophyll-a measurements exceeding 300 mg/m^2. High algal levels were also observed in the uppermost portion of the creek, which is surrounded by agricultural lands and subject to low flows, especially during the fall. In the most downstream portions of Banklick Creek, periphyton levels were high only during extended periods of low flow (Strand Associates, 2003).

KDOW and Strand Associates sampled several sites within the Banklick Creek watershed for fish. The calculated KIBI scores[9] varied in ratings (Table 1).

[8] The macroinvertebrate data collected by KDOW were used to calculate the macroinvertebrate biotic index (MBI). The MBI compiles attributes of the macroinvertebrate community such as taxa richness, pollution tolerant species and pollution intolerant species. Additional metrics are added depending on the stream size and/or ecoregion.
[9] The data from this survey were used to calculate the Kentucky Index of Biotic Integrity (IBI), a multimetric index using fish as an indicator of stream health. The IBI compiles attributes of the fish community such as taxa richness and abundance, pollution tolerance/ intolerance, feeding and reproductive needs, and presence or absence of native species in order to provide a numerical value and corresponding narrative classification for streams.

4.5 STREAM METABOLISM

Stream metabolism can be used as a measure of ecosystem health because it responds to the complex interactions between instream conditions (physical, biological and chemical) and watershed conditions. It can be assessed by looking at the ratio of primary production (P), which is influenced by instream conditions (light and nutrient inputs), to respiration (R), which is influenced by watershed conditions (other nutrient and detritus inputs). This ratio can be calculated using continuous instream dissolved oxygen measurements, because dissolved oxygen responds to both instream and watershed inputs. Smaller ratios (e.g., P:R less than 1) suggest that stream system health is more strongly affected by watershed inputs than by instream and near stream processes.

Stream metabolism has been analyzed at eight USGS continuous monitoring stations which deploy multi-parameter sondes. These stations are located in watersheds that have varying levels of watershed impacts; however, none are located in an unimpacted or reference watershed. For the 2000-2005 period, all eight sites have ratios that indicate the health of these streams is more strongly affected by watershed inputs than instream and near stream inputs.

Instream and watershed inputs appear to be relatively well balanced in Banklick Creek at RM 8.1, because this site has a P:R ratio close to 1. Because there are no reference sites in this region that can be used for comparison, it is not known how this ratio compares to that for an unimpacted watershed. Longer-term monitoring of dissolved oxygen at the Banklick Creek site may prove useful in understanding how stream and watershed level changes affect the stream metabolism balance at this site.

5. SOURCE ANALYSIS

This section summarizes potential pollutant sources in the Banklick Creek watershed and some of its tributaries. Conclusions are based on the watershed characterization and recent water quality data.

5.1 WATERSHED SOURCES ANALYSIS

Potential sources of bacteria were identified within the Banklick Creek watershed, based on the watershed characterization information discussed previously. Bacteria exceedances have been observed during both base flow and storm flow conditions at all locations recently monitored. These sources are summarized in Table 14 and their location is shown in Figure 11.

Table 14. Summary of Potential Sources

	Banklick Creek Headwaters to RM 8.2 (excluding Fowler Ck)	Fowler Creek	Bullock Pen	Banklick Creek RM 8.2 - mouth (excluding Bullock Pen)
Recent observed Impairments=>	Bacteria 303(d): Nutrients, organic enrichment [c] Flooding reported upstream to RM 10.3	Bacteria Flooding reported	Bacteria 303(d): Doe Run Lake DO, nutrients, dissolved gas supersaturation [d]	Bacteria[b] 303(d): Nutrients, organic enrichment, sedimentation/siltation[e] Flooding reported
CSO[a]				5
SSO[a]	4		15	6
SSO-pump station[a]				2
Septic	Numerous	Numerous 1 septic "hot spot"	Few	Few
KPDES-sanitary outfalls[f]	2	11	2	
KPDES-storm water/other outfalls[g]	2		4	12
Storm water runoff	Urban and rural	Urban and rural	Urban; Small portion in Florence	Urban
Livestock	Cattle, horses		2 AFOs (cattle)	
Licking River backwater				Affects lower reaches of Banklick Creek
Watershed improvements	*Planned stream and wetland restoration along Banklick Creek in Wolsing preserve.* *3 projects planned on mainstem of Banklick Creek near RM 10.5, to address streambank erosion.*		*Doe Run Lake Master Plan developed to protect and enhance the lake and link the lake to adjacent areas using greenways, trails or stream corridors.*	*Several projects completed to increase capacity at, and divert flows from Lakeview PS to reduce overflows at PS and upstream.* *Latonia sewer separation project to reduce overflow from downstream CSOs.* *Bluegrass Swim Club sewer separation to reduce wet weather flows into sanitary system.* *Several improvement projects planned to divert flow from Lakeview PS to reduce overflows* *Madison Pike Corridor Study to maximize Banklick Creek as an asset.*

[a] SD1 is undertaking a characterization and assessment of the sewer system, and sources are subject to change.

[b] DO, pH and temperature violations have historically been observed at the USGS station, but recent data have not been reviewed.

[c] Agriculture and on-site treatment systems are identified as potential sources contributing to the impaired primary contact recreation and warm water aquatic habitat uses (KDOW, 2008).

[d] An upstream source and unknown source are identified as potential sources contributing to the impairment of the warm water aquatic habitat use (KDOW, 2008).

[e] Highways, roads bridges, infrastructure (new construction), municipal point source discharges, unspecified urban storm water runoff, urban runoff/storm sewers, agriculture and on-site treatment systems are identified as potential sources contributing to impairment of the primary contact recreation and warm water aquatic habitat uses (KDOW, 2008).

[f] Excludes CSOs. Includes currently permitted facilities only.

[g] One outfall is included twice because it covers sanitary and cooling water. Includes currently permitted facilities only.

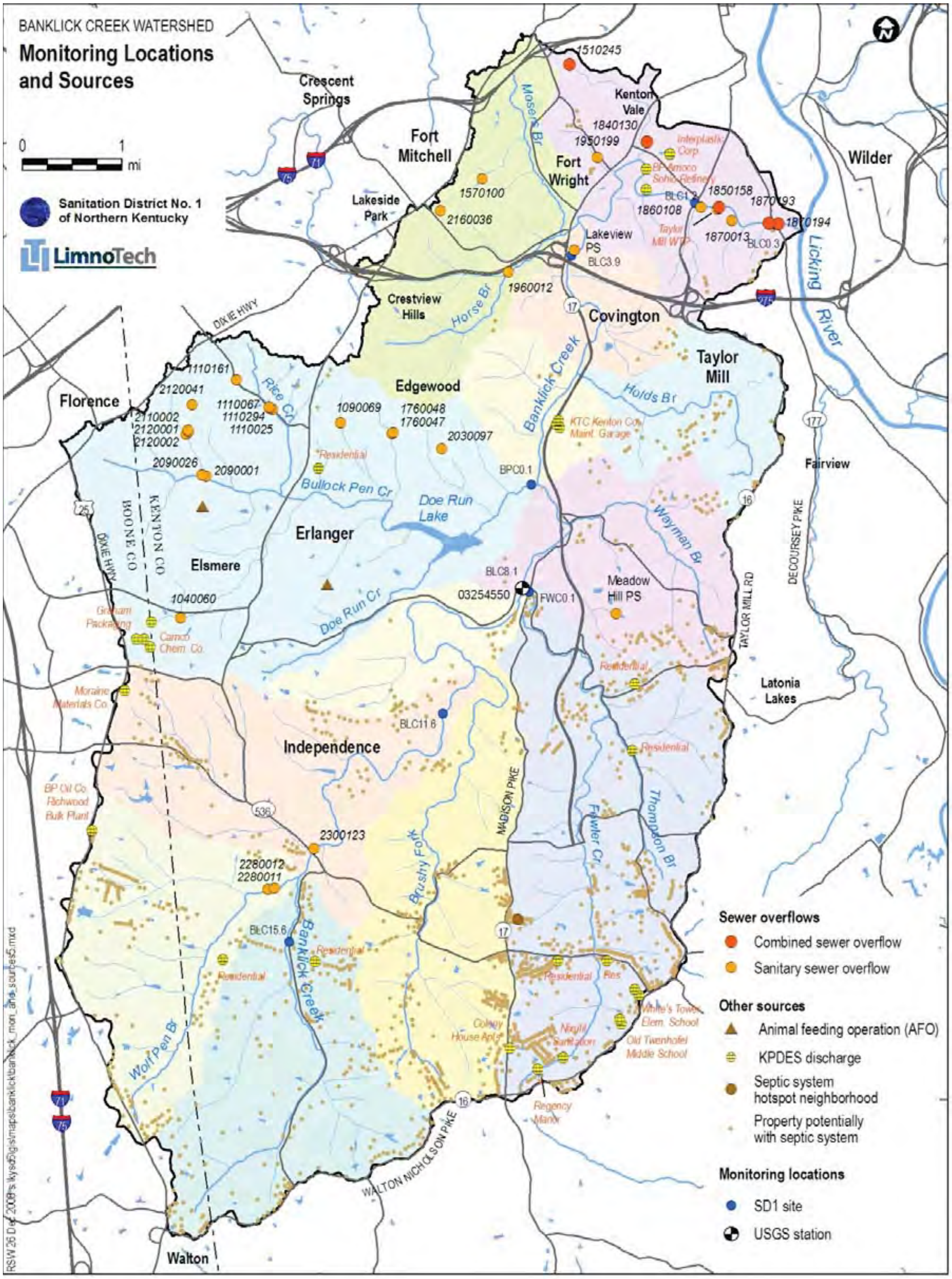

Figure 11. Monitoring Locations and Sources

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6. RANKING

6.1 SUMMARY OF RESULTS

The WAT! is a tool that assesses the potential for point and nonpoint sources to generate fecal coliform, total solids and total phosphorus pollutant loads. WAT! was developed for these three pollutants because data to support modeling were readily available and they are representative indicators of potential water quality conditions. Calibration of the WAT! tool for total solids and total phosphorus is planned, and results should be available in future reports. Results for fecal coliform are discussed below.

This analysis was conducted for each of the sixteen watersheds located within SD1's study area. In addition to assessing pollutant loading potential by source, the WAT! also assesses pollutant loading potential by watershed, which allows for ranking and comparisons among the 16 watersheds.

WAT! results[10] indicate that the Banklick Creek watershed has a roughly average ranking (analogous to load) for bacteria under year-round conditions, relative to the sixteen identified watersheds in SD1's service area.

In addition to watershed rank, other factors such as public interest and the presence of a SWAPP zone, may affect watershed prioritization. These and other ranking considerations are summarized in Table 15.

Table 15. Watershed Ranking Considerations

CSO (#)	SSO (#)	SWAPP Zone	Aquatic-dependent T&E Species[a] (#)	Special Designations	Public Interest	WAT! Rank, year-round conditions[b]
						Bacteria
5	27	Zone 1, 2 and 3 (due to Licking River intake)	1	None	High	7 of 16

[a] There is also one aquatic-dependent and three terrestrial species of State special concern. One terrestrial species is also a federal species of management concern.

[b] The WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

T&E = Threatened and endangered species

6.2 SCREENING TO DETERMINE IF ADDITIONAL DATA ARE NEEDED

Sufficient data and information are currently available or planned for collection to support a good understanding of current conditions in the Banklick Creek watershed. Additionally, watershed and water quality models have been developed which could be applied to examine the effects that future activities (e.g., development or improvement projects) will have on the creek.

[10] WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

Elevated bacteria concentrations have been observed in the watershed during base flow conditions. Preliminary WAT! results indicate septic systems are the primary bacteria source during base flow conditions, but other potential sources, such as: livestock, KPDES-permitted facilities, pets, and wildlife may also be contributing.

6.2.1 Data Gap Analysis

A site visit to the watershed to investigate dry weather bacteria sources is recommended. Additionally, coordination with the health department and KPDES-permitting agency is may also be useful for identifying and addressing improperly operating systems and facilities.

No additional water quality or biological data collection is recommended beyond that already planned, to characterize current conditions in this watershed.

6.3 SOURCE PRIORITIZATION

The sources identified through the process of watershed characterization have been quantified using the WAT!. WAT! has been applied for a five-year period (1992-1996 climatological conditions), to quantify fecal coliform contributions by source. Together the characterization and WAT! results help inform source prioritization for improvement or elimination.

6.3.1 WAT! Results

The relative fecal coliform load generated by source is shown in Figure 12. These WAT! results incorporate predicted sewer overflow volumes from infrastructure model simulations for 1992-1996 climatological conditions[11]. Flow estimates are available for four of the CSOs and thirteen of the SSOs in this watershed.

Under year-round conditions, the largest source of fecal coliform is overland storm water runoff. Septic systems are not a significant contributor to the total annual bacteria load; however, during base flow conditions they are estimated to contribute the majority of the fecal coliform load.

[11] The results presented were generated by models based on SD1's current understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual measured field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

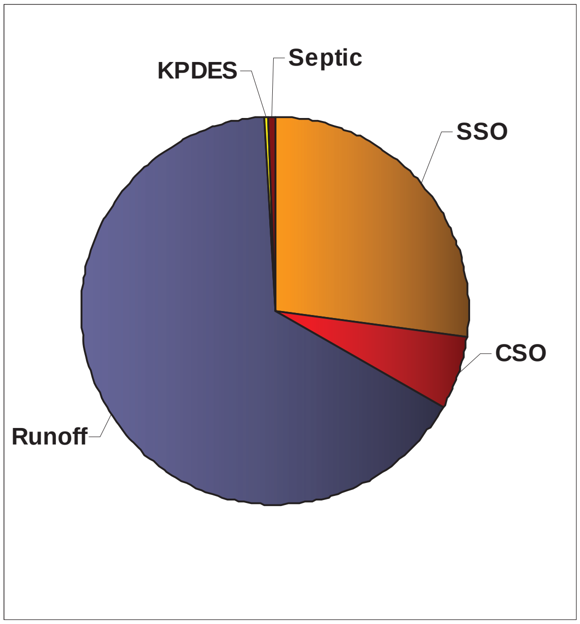

Figure 12. Initial Year-Round WAT! Results for Fecal Coliform

WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive .

WAT! results should be considered preliminary as ongoing work may affect the WAT! source analysis and rankings. Work is currently ongoing to refine the bacteria contribution from septic systems.

6.4 WATERSHED RANKING

The WAT! produced a ranking, by watershed for sixteen watersheds, based on their potential to generate fecal coliform loads over a 1-year period. The water quality impact score (analogous to load) for each of the sixteen watersheds was used as a ranking metric. Additional detail on the ranking is available in the WAT! documentation.

The WAT! produces rankings of the watersheds for both base flow and year-round conditions. By separating base flow conditions, the impacts of dry weather sources on stream conditions can be differentiated from the combined impact of dry and wet weather sources. The ranking of the Banklick Creek watershed during year-round and base flow conditions is provided in Table 16.

Table 16. WAT! Watershed Rankings

	Rank for Year-Round Conditions[a,b]	Rank for Base flow Conditions[a,b]
Fecal coliform	7	9

[a]Rank ranges from 1 to 16. A rank of 1 indicates a high water quality impact score which is analogous to load. The lowest possible rank is 16.

[b]WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

The WAT! analysis for both total solids and total phosphorus will be presented in future reports upon completion of the WAT! calibration. Future monitoring will further populate and refine modeling results, aiding in identification and characterization of potential sources.

7. REFERENCES

Banklick Watershed Council. 2005. The Banklick Watershed Action Plan; A Comprehensive Approach to Watershed Management. URL: http://www.banklick.org/Banklick_Watershed_Plan_Nov_2005.pdf

Carey, D. I. and J.F. Stickney, 2004. Groundwater Resources of Boone County, Kentucky. Kentucky Geological Survey County Report 8, Series XII, ISSN 0075-5567.

Carey, D.I. and J.F. Stickney, 2005. Groundwater Resources of Kenton Co. Kentucky. Kentucky Geological Survey County Report 59, Series XII. ISSN 0075-5567.

City of Fort Wright, Kentucky, 2004. Madison Pike Corridor land Use and Economic Development Plan. October 2004.

Cumberland Environmental Group, LLC (CEG), 2007. Continuous Monitoring Network Synthesis Report Water Years 2001 – 2005. Prepared for Sanitation District No. 1 of Northern Kentucky. Draft.

Grace, M. and S. Imberger 2006. Stream Metabolism: Performing & Interpreting Measurements. New South Wales Department of Environmental Conservation stream metabolism workshop. May 2004, Sydney Australia. Workshop developed technical manual. Accessed at http://www.sci.monash.edu.au/wsc/docs/tech-manual-v3.pdf

Human Nature, 2003. Doe Run Lake Master Plan-Inventory/Analysis.

Kenton County Conservation District, 2007. Agricultural Water Quality Self Certification Tracking Sheet.

Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 001E. Statement of Emergency Regulation. Definitions for 401 KAR Chapter 10.

Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 026. Designation of Uses of Surface Waters. Administrative Register of Kentucky. Technical Amendment August 9, 2007.

Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 030. Antidegradation Policy Implementation Methodology.

Kentucky Commonwealth Office of Technology, 2005. 2005 Kentucky Land Cover. Obtained in November, 2007.

Kentucky Division of Water (KDOW), 2007. Personal communication, Florence Regional Office. April 9, 2007.

Kentucky Division of Water (KDOW), 2007a. Fish Consumption Advisories in Kentucky. www.water.ky.gov/sw/advisories/fish.htm Last modified 7/25/2007. Accessed 7/25/2007.

Kentucky Division of Water (KDOW). 2007b. Swimming Advisories in Kentucky. URL: http://www.water.ky.gov/sw/advisories/swim.htm. Last modified 1/3/07.

Kentucky Division of Water (KDOW), 2007c. Personal communication on status of domestic and public water wells. December 2007.

Kentucky Division of Water (KDOW), Kentucky Environmental and Public Protection Cabinet. 2008. 2008 Integrated Report to Congress on the Condition of Water Resources in Kentucky. Volume II. 303(d) List of Surface Waters. Final. May, 2008.

Kentucky Division of Water (KDOW), 2008a. Kentucky Drinking Water Watch Database Version 1.2. Accessed March 2008.

Kentucky Division of Water (KDOW), Natural Resources and Environmental Protection Cabinet. 2008b. Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky. February.

Kentucky Energy and Environment Cabinet, Office of Communications and Public Outreach, 2008. Governor Beshear Presents $1 Million Grant to Protect Banklick Creek. URL: http://www.eppc.ky.gov/press/press2008/april/4-23banklick.htm. July 3, 2008.

Kentucky Geographic Network, 2008. April 9, 2008. http://kygeonet.ky.gov/geographicexplorer/explorer.jsf

Kentucky Geographic Network, 2008a. August 11, 2008. http://kygeonet.ky.gov/geographicexplorer/explorer.jsf

Kentucky State Nature Preserves Commission (KSNPC). 2006. Boone County Report of Endangered, Threatened, and Special Concern Plants, Animals, and Natural Communities of Kentucky. Frankfort, KY. February.

Kentucky State Nature Preserves Commission (KSNPC). 2007. Natural Heritage Program Database Review. Data Request 07-097. February 14.

Kentucky Transportation Cabinet. 2006. Kenton County Six-Year Plan Projects. FY-2006 thru FY-2012.

McTammany, M.E., E.F. Benefeld and J.R. Webster. 2007. Recovery of stream ecosystem metabolism from historical agriculture. Journal of the North American Benthological Society 26(3):532-545.

National Climatic Data Center (NCDC), NOAA Satellite and Information Service. 2008. Data obtained for Cincinnati Northern KY Airport, Covington/Cincinnati, KY, United States. WBAN 93814.

National Oceanic and Atmospheric Administration (NOAA). 2008. National Marine Sanctuaries. http://sanctuaries.noaa.gov/welcome.html. Revised February 7, 2008. Accessed February 11, 2008.

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 5, 2007).

Northern Kentucky Area Planning Commission (NKAPC). 2006. Comprehensive Plan Update. 2006 – 2026. An Area-wide Vision for Kenton County.

Northern Kentucky Area Planning Commission (NKAPC). 2006a. South Banklick Small Area Study. September.

Northern Kentucky Health Department (NKHD). 2008. Personal communication February 2008.

Northern Kentucky Health Department (NKHD). 2008a. Personal communication August 2008.

Northern Kentucky Water District (NKWD). 2003. Source Water Assessment and Protection Plan, Susceptibility Analysis and Protection Recommendations for Campbell County.

Natural Resources Conservation Service (NRCS), 2006. SSURGO/GIS format. [online] http://datagateway.nrcs.usda.gov/

Odum, E.P. 1956. Primary production in flowing waters. Limnology and Oceanography. 1:102-117.

Paylor, R.L. and J.C. Currens. *Karst Occurrence in Kentucky*. University of Kentucky, Kentucky Geological Survey. 2002. http://kgsweb.uky.edu/olops/pub/kgs/mc33_12.pdf. Accessed on May 21, 2007.

Ray, J.A., Webb, J.S., O'Dell, P.W. (Kentucky Department of Environmental Protection, Division of Water, Groundwater Branch), 1994. Groundwater Sensitivity Regions of Kentucky.

Reinking, D. L. 2002. Rare, local, little-known, and declining North American breeders a closer look: Henslow's sparrow. American Birding. April. 146-153.

Strand Associates. 2003. Final Report for Northern Kentucky Sanitation District No. 1, Part 1 of 2: Final Report Habitat and Biological Community Assessment of Banklick Creek, Kentucky. Madison, WI. July.

United States Army Corps of Engineers (USACE), 2000. Banklick Creek Watershed Kenton County, Kentucky. Flood Damage Reduction/Ecosystem Restoration Section 905(b) (WRDA 1986) Analysis. September 2000.

United States Environmental Protection Agency (USEPA). April 19, 1994. Combined Sewer Overflow (CSO) Policy. *Fed. Regist*. Vol. 59 pg. 18688.

United States Fish and Wildlife Service (USFWS), 2003. Running Buffalo Clover *Trifolium stoloniferum*. Fort Snelling, Minnesota. July.

Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor. 2002. Ecoregions of Kentucky. Color poster with map, descriptive text, summary tables, and photographs, U.S. Geological Survey (map scale 1:1,000,000), Reston, VA.

APPENDIX E
POSTCONSTRUCTION STORMWATER REGULATION REVIEW TECHNICAL MEMORANDUM

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Kentucky County Data - Livestock

Commodity ↑	Year	State	County	District	Cattle All	Beef Cows
Cattle & Calves	2005	Kentucky	Boone	40	8,900 head	5,600 head
Cattle & Calves	2005	Kentucky	Campbell	40	7,800 head	4,000 head
Cattle & Calves	2005	Kentucky	Kenton	40	6,200 head	3,100 head
Cattle & Calves	2006	Kentucky	Boone	40	10,300 head	5,300 head
Cattle & Calves	2006	Kentucky	Campbell	40	7,700 head	4,400 head
Cattle & Calves	2006	Kentucky	Kenton	40	6,900 head	3,700 head
Cattle & Calves	2007	Kentucky	Boone	40	10,700 head	5,900 head
Cattle & Calves	2007	Kentucky	Campbell	40	8,500 head	4,600 head
Cattle & Calves	2007	Kentucky	Kenton	40	7,000 head	4,000 head
Cattle & Calves	2008	Kentucky	Boone	40	10,500 head	6,200 head
Cattle & Calves	2008	Kentucky	Campbell	40	8,400 head	4,300 head
Cattle & Calves	2008	Kentucky	Kenton	40	7,200 head	3,800 head

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Kentucky County Data - Livestock

Commodity ↑	Year	State	County	District	Hogs All
Hogs & Pigs	1987	Kentucky	Kenton	40	700 head
Hogs & Pigs	1988	Kentucky	Kenton	40	700 head
Hogs & Pigs	1989	Kentucky	Kenton	40	400 head
Hogs & Pigs	1991	Kentucky	Kenton	40	600 head
Hogs & Pigs	1992	Kentucky	Kenton	40	600 head

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Kentucky County Data - Livestock

Commodity ↑	Year	State	County	District	Hogs All
Hogs & Pigs	1993	Kentucky	Boone	40	1,400 head
Hogs & Pigs	1993	Kentucky	Campbell	40	700 head
Hogs & Pigs	1994	Kentucky	Boone	40	1,300 head
Hogs & Pigs	1994	Kentucky	Campbell	40	700 head
Hogs & Pigs	1995	Kentucky	Boone	40	1,200 head
Hogs & Pigs	1995	Kentucky	Campbell	40	800 head
Hogs & Pigs	1996	Kentucky	Boone	40	700 head
Hogs & Pigs	1996	Kentucky	Campbell	40	800 head
Hogs & Pigs	1997	Kentucky	Boone	40	600 head
Hogs & Pigs	1997	Kentucky	Campbell	40	800 head
Hogs & Pigs	1998	Kentucky	Boone	40	500 head
Hogs & Pigs	1998	Kentucky	Campbell	40	700 head

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Census, State - County Data
Table 1. County Summary Highlights: 2002

Geographic area ↑	Item	Data
Kentucky\Kenton	Farms (number)	495
Kentucky\Kenton	Land in farms (acres)	46,479
Kentucky\Kenton	Land in farms - Average size of farm (acres)	94
Kentucky\Kenton	Land in farms - Median size of farm (acres)	68
Kentucky\Kenton	Estimated market value of land and buildings 1/ - Average per farm (dollars)	310,436
Kentucky\Kenton	Estimated market value of land and buildings 1/ - Average per acre (dollars)	3,775
Kentucky\Kenton	Estimated market value of all machinery and equipment 1/ - Average per farm (dollars)	32,786
Kentucky\Kenton	Farms by size - 1 to 9 acres	33
Kentucky\Kenton	Farms by size - 10 to 49 acres	157
Kentucky\Kenton	Farms by size - 50 to 179 acres	241
Kentucky\Kenton	Farms by size - 180 to 499 acres	55
Kentucky\Kenton	Farms by size - 500 to 999 acres	9
Kentucky\Kenton	Farms by size - 1,000 acres or more	-
Kentucky\Kenton	Total cropland (farms)	463
Kentucky\Kenton	Total cropland (acres)	26,577
Kentucky\Kenton	Total cropland - Harvested cropland (farms)	409
Kentucky\Kenton	Total cropland - Harvested cropland (acres)	13,042
Kentucky\Kenton	Irrigated land (farms)	20
Kentucky\Kenton	Irrigated land (acres)	32
Kentucky\Kenton	Market value of agricultural products sold (See Text) ($1,000)	5,311
Kentucky\Kenton	Market value of agricultural products sold (See Text) - Average per farm (dollars)	10,730
Kentucky\Kenton	Market value of agricultural products sold (See Text) - Crops ($1,000)	2,825
Kentucky\Kenton	Market value of agricultural products sold (See Text) - Livestock, poultry, and their products ($1,000)	2,486
Kentucky\Kenton	Farms by value of sales - Less than $2,500	224
Kentucky\Kenton	Farms by value of sales - $2,500 to $4,999	79
Kentucky\Kenton	Farms by value of sales - $5,000 to $9,999	77
Kentucky\Kenton	Farms by value of sales - $10,000 to $24,999	69
Kentucky\Kenton	Farms by value of sales - $25,000 to $49,999	25
Kentucky\Kenton	Farms by value of sales - $50,000 to $99,999	9
Kentucky\Kenton	Farms by value of sales - $100,000 or more	12
Kentucky\Kenton	Government payments (farms)	63
Kentucky\Kenton	Government payments ($1,000)	106
Kentucky\Kenton	Total income from farm-related sources, gross before taxes and expenses (See Text) (farms)	182
Kentucky\Kenton	Total income from farm-related sources, gross before taxes and expenses (See Text) ($1,000)	914
Kentucky\Kenton	Total farm production expenses 1/ ($1,000)	3,713
Kentucky\Kenton	Total farm production expenses 1/ - Average per farm (dollars)	7,500
Kentucky\Kenton	Net cash farm income of operation (See Text) 1/ (farms)	495

Kentucky\Kenton	Net cash farm income of operation (See Text) 1/ ($1,000)	-316
Kentucky\Kenton	Net cash farm income of operation (See Text) 1/ - Average per farm (dollars)	-639
Kentucky\Kenton	Principal operator by primary occupation - Farming (number)	235
Kentucky\Kenton	Principal operator by primary occupation - Other (number)	260
Kentucky\Kenton	Principal operator by days worked off farm - Any (number)	290
Kentucky\Kenton	Principal operator by days worked off farm - Any - 200 days or more (number)	229
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory (farms)	274
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory (number)	7,208
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory - Beef cows (farms)	255
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory - Beef cows (number)	(D)
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory - Milk cows (farms)	6
Kentucky\Kenton	Livestock and poultry - Cattle and calves inventory - Milk cows (number)	(D)
Kentucky\Kenton	Livestock and poultry - Cattle and calves sold (farms)	229
Kentucky\Kenton	Livestock and poultry - Cattle and calves sold (number)	3,366
Kentucky\Kenton	Livestock and poultry - Hogs and pigs inventory (farms)	10
Kentucky\Kenton	Livestock and poultry - Hogs and pigs inventory (number)	205
Kentucky\Kenton	Livestock and poultry - Hogs and pigs sold (farms)	8
Kentucky\Kenton	Livestock and poultry - Hogs and pigs sold (number)	178
Kentucky\Kenton	Livestock and poultry - Sheep and lambs inventory (farms)	13
Kentucky\Kenton	Livestock and poultry - Sheep and lambs inventory (number)	91
Kentucky\Kenton	Livestock and poultry - Layers 20 weeks old and older inventory (farms)	21
Kentucky\Kenton	Livestock and poultry - Layers 20 weeks old and older inventory (number)	1,496
Kentucky\Kenton	Livestock and poultry - Broilers and other meat-type chickens sold (farms)	1
Kentucky\Kenton	Livestock and poultry - Broilers and other meat-type chickens sold (number)	(D)
Kentucky\Kenton	Selected crops harvested - Corn for grain (farms)	14
Kentucky\Kenton	Selected crops harvested - Corn for grain (acres)	94
Kentucky\Kenton	Selected crops harvested - Corn for grain (bushels)	7,932
Kentucky\Kenton	Selected crops harvested - Corn for silage or greenchop (farms)	18
Kentucky\Kenton	Selected crops harvested - Corn for silage or greenchop (acres)	231
Kentucky\Kenton	Selected crops harvested - Corn for silage or greenchop (tons)	3,687
Kentucky\Kenton	Selected crops harvested - Wheat for grain, All (farms)	8
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all (acres)	60
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all (bushels)	2,256
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all - Winter wheat for grain (farms)	8
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all - Winter wheat for grain (acres)	60
Kentucky\Kenton	Selected crops harvested - Wheat for grain, all - Winter wheat for grain (bushels)	2,256
Kentucky\Kenton	Selected crops harvested - Oats for grain (farms)	-
Kentucky\Kenton	Selected crops harvested - Oats for grain (acres)	-
Kentucky\Kenton	Selected crops harvested - Oats for grain (bushels)	-
Kentucky\Kenton	Selected crops harvested - Barley for grain (farms)	-
Kentucky\Kenton	Selected crops harvested - Barley for grain (acres)	-
Kentucky\Kenton	Selected crops harvested - Barley for grain (bushels)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for grain (farms)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for grain (acres)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for grain (bushels)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for silage or greenchop (farms)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for silage or greenchop (acres)	-
Kentucky\Kenton	Selected crops harvested - Sorghum for silage or greenchop (tons)	-
Kentucky\Kenton	Selected crops harvested - Soybeans for beans (farms)	2

Kentucky\Kenton	Selected crops harvested - Soybeans for beans (acres)	(D)
Kentucky\Kenton	Selected crops harvested - Soybeans for beans (bushels)	(D)
Kentucky\Kenton	Selected crops harvested - Dry edible beans, excluding limas (farms)	-
Kentucky\Kenton	Selected crops harvested - Dry edible beans, excluding limas (acres)	-
Kentucky\Kenton	Selected crops harvested - Dry edible beans, excluding limas (cwt)	-
Kentucky\Kenton	Selected crops harvested - Tobacco (farms)	194
Kentucky\Kenton	Selected crops harvested - Tobacco (acres)	399
Kentucky\Kenton	Selected crops harvested - Tobacco (pounds)	691,805
Kentucky\Kenton	Selected crops harvested - Potatoes (farms)	1
Kentucky\Kenton	Selected crops harvested - Potatoes (acres)	(D)
Kentucky\Kenton	Selected crops harvested - Potatoes (cwt)	(D)
Kentucky\Kenton	Selected crops harvested - Sweet potatoes (farms)	-
Kentucky\Kenton	Selected crops harvested - Sweet potatoes (acres)	-
Kentucky\Kenton	Selected crops harvested - Sweet potatoes (cwt)	-
Kentucky\Kenton	Selected crops harvested - Forage - land used for all hay and all haylage, grass silage, and greenchop (See Text) (farms)	353
Kentucky\Kenton	Selected crops harvested - Forage - land used for all hay and all haylage, grass silage, and greenchop (See Text) (acres)	12,202
Kentucky\Kenton	Selected crops harvested - Forage - land used for all hay and all haylage, grass silage, and greenchop (See Text) (tons, dry)	25,187
Kentucky\Kenton	Selected crops harvested - Sunflower seed, All (farms)	-
Kentucky\Kenton	Selected crops harvested - Sunflower seed, all (acres)	-
Kentucky\Kenton	Selected crops harvested - Sunflower seed, all (pounds)	-
Kentucky\Kenton	Selected crops harvested - Vegetables harvested for sale (See Text) (farms)	4
Kentucky\Kenton	Selected crops harvested - Vegetables harvested for sale (See Text) (acres)	16
Kentucky\Kenton	Selected crops harvested - Land in orchards (farms)	10
Kentucky\Kenton	Selected crops harvested - Land in orchards (acres)	17

The following footnotes, headnotes, abbreviations and symbols are used throughout this table:

(D) Withheld to avoid disclosing data for individual farms.
- Represents zero.

1/ Data are based on a sample of farms.

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APPENDIX F
PUBLIC INPUT MEETING PRESENTATIONS

Our Water

Lajuanda Haight-Maybriar

Licking River Basin Coordinator
Kentucky Division of Water
Kentucky Department for Environmental Protection

Anything we do to the land will affect our water.

We pave over it

We build houses on it

We farm it

We mine it

F-2

We log it

We treat our poop on it or in it,
or

— not

Our animals poop on it

We dump trash, used oil, gasoline, paint, etc on it

Ponds and their watersheds

What is a watershed?

A watershed is the land in an area where all of the water running off that land and soaking into that land drains to a specific point in a stream

Watersheds are "nested" - each smaller watershed is also part of a larger watershed

Very large watersheds are often called **basins**. Here is a map of the major river basins in Eastern Kentucky. Which basin do you live in?

The spring in Magoffin County that is the beginning of the Licking River – the headwaters

The mouth of the Licking River on the Ohio River across from Cincinnati

Anything <u>we</u> do to the land will affect <u>our</u> water.

Sign Up Sheet

Banklick Watershed Council Public Meeting – March 23, 2009

Name	Address	Phone no.	email
Wilhelm Kossenjans	3870 Richardson Rd Independence	283-1282	Wilhelm.Kossenjans@uc.edu
Brooke Shireman	200 Fair Oaks Frankfort, KY	502-564-3410	brooke.shireman@ky.gov
Lajuanda Haight-Maybriar	525 Hecks Plaza Dr. Morehead KY 40351	606 783 8655	lajuanda.haight-maybriar@ky.gov
Kelly Kaufman	615 Elsinore Pl Cincinnati OH	513 861 5600	kelly.kaufman@strand.com
Mary Pat Behler	806 Stablewatch Dr. Independence, KY 41051	(859) 356-0297	behlers5@zoomtown.com
Norma Harrell	686 Ridge Rd Taylor Mill, Ky 41015	859.581.8052	harrellky@fuse.net
Casey Mattingly	437 Ripple Creek Dr Elsmere, Ky 41018	859.445.1682	clmattingly@mactec.com
Charlotte Thompson	11015 Banklick Rd	356-9713	
John Wood	PO Box 11 Indep Ky	356-1360	

Sign Up Sheet

Banklick Watershed Council Public Meeting – March 23, 2009

Name	Address	Phone no.	email
Matt Wooten	SD1	859-578-6887	mWOOTEN@SD1.ORG
LENNIE Collins	1518 WAlton Nich	859-356-5751	
John Lyons	Strand	513-861-5600	john.lyons@strand.com
Donna Horine	524 E. Southern Ave. Covington Ky 41015	859-261-3525	dmhorine@zoom.com
Kevin Bramlage	11209 Banklick Road Walton, Ky 41094	859-653-2550	

Banklick Watershed 319(h) Non-Point Source Grant Public Input Meeting

Strand Associates, Inc.

John Lyons, P.E.

April 16, 2009

BANKLICK WATERSHED CHARACTERISTICS

Legend

Banklick Watershed

Data Source:
Sanitation District No. 1

BANKLICK WATERSHED CHARACTERISTICS

Legend

Strand Sampling Points

Kentucky 303(d) List

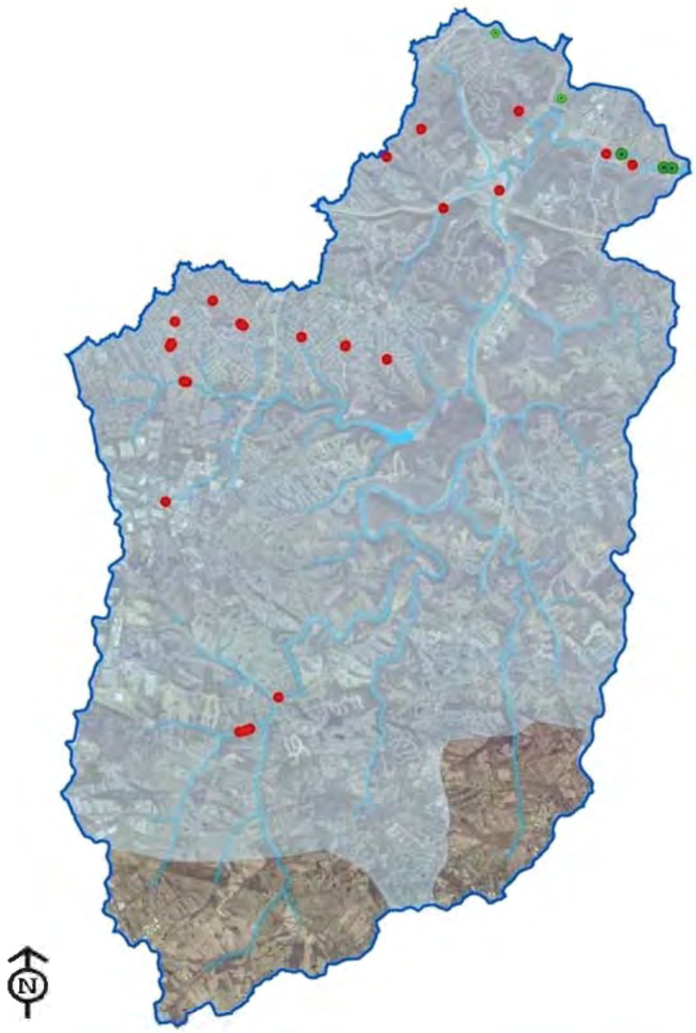
FC/NE/OE

FC/NE/OE/SS

Banklick Watershed

Data Source:
Sanitation District No. 1
Strand Associates, Inc.
2008 303(d) List

BANKLICK WATERSHED CHARACTERISTICS



Legend

Overflow Locations

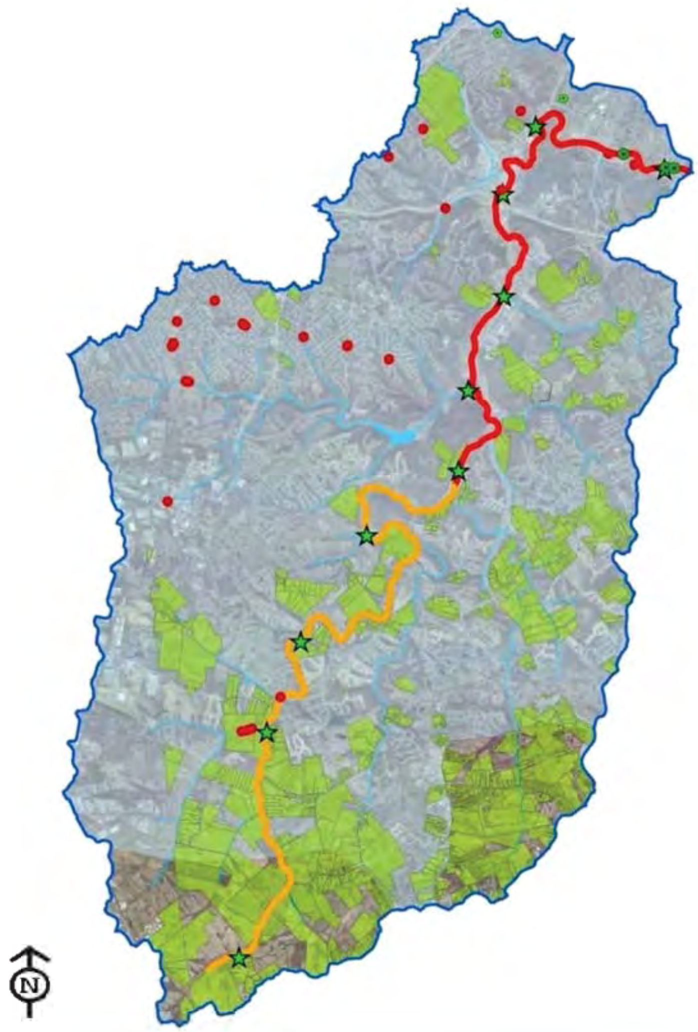
- CSO
- CSO - To Be Permitted
- SSO
- SD1 Service Area
- Banklick Watershed

Data Source:
Sanitation District No. 1

BANKLICK WATERSHED CHARACTERISTICS

Data Source:
Sanitation District No. 1

BANKLICK WATERSHED CHARACTERISTICS



Legend

Overflow Locations

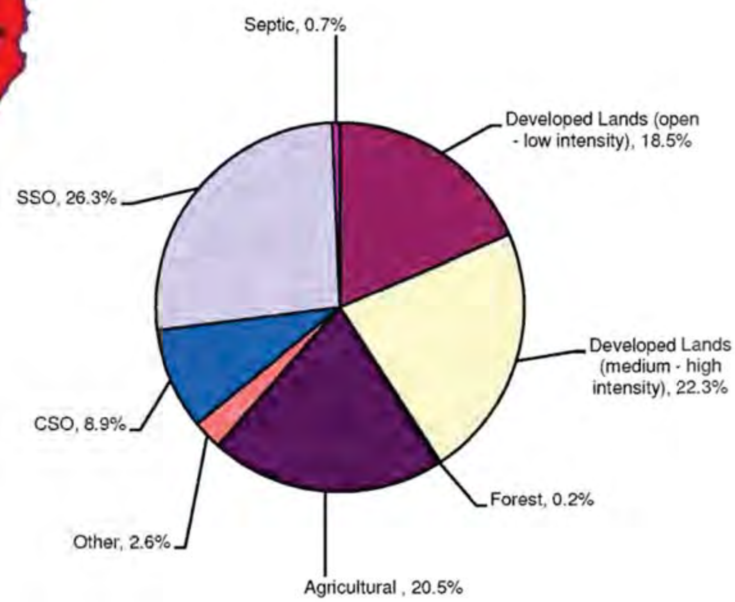
- CSO
- CSO - To Be Permitted
- SSO
- Strand Sampling Points

Kentucky 303(d) List

- FC/NE/OE
- FC/NE/OE/SS
- Potential Septic Systems
- SD1 Service Area
- Banklick Watershed

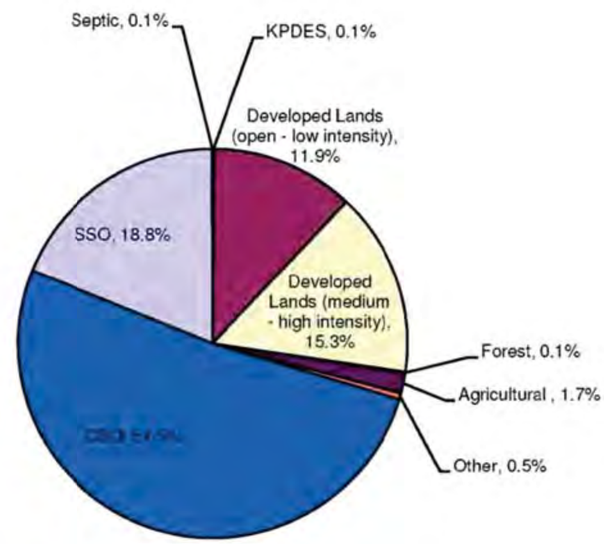
Data Source:
Sanitation District No. 1
Strand Associates, Inc.
2008 303(d) List

BANKLICK WATERSHED FECAL LOADINGS



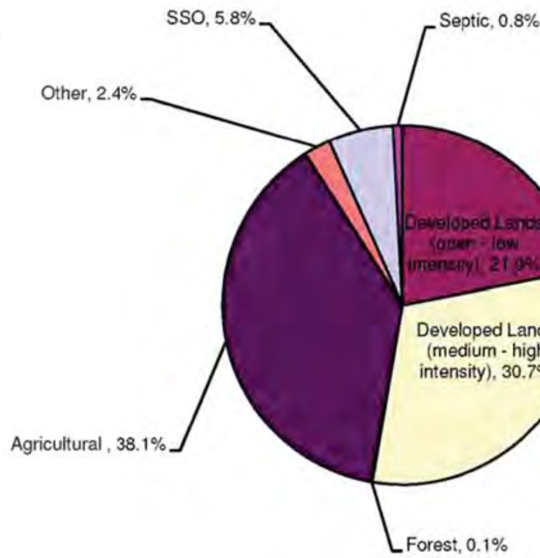
Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

BANKLICK CREEK SUBWATERSHED-01 FECAL LOADINGS

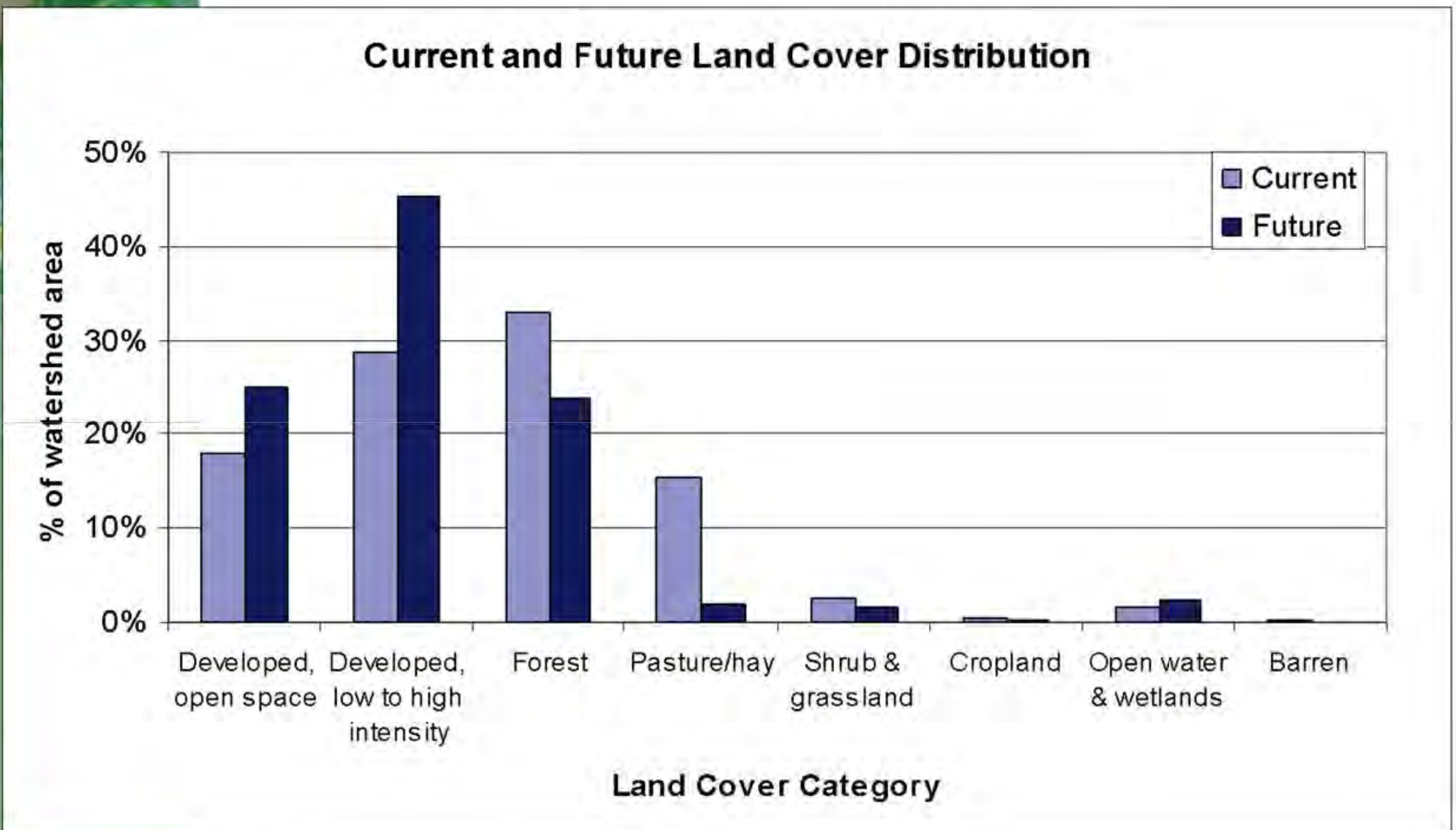


Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

WOLF PEN BRANCH SUBWATERSHED FECAL LOADINGS

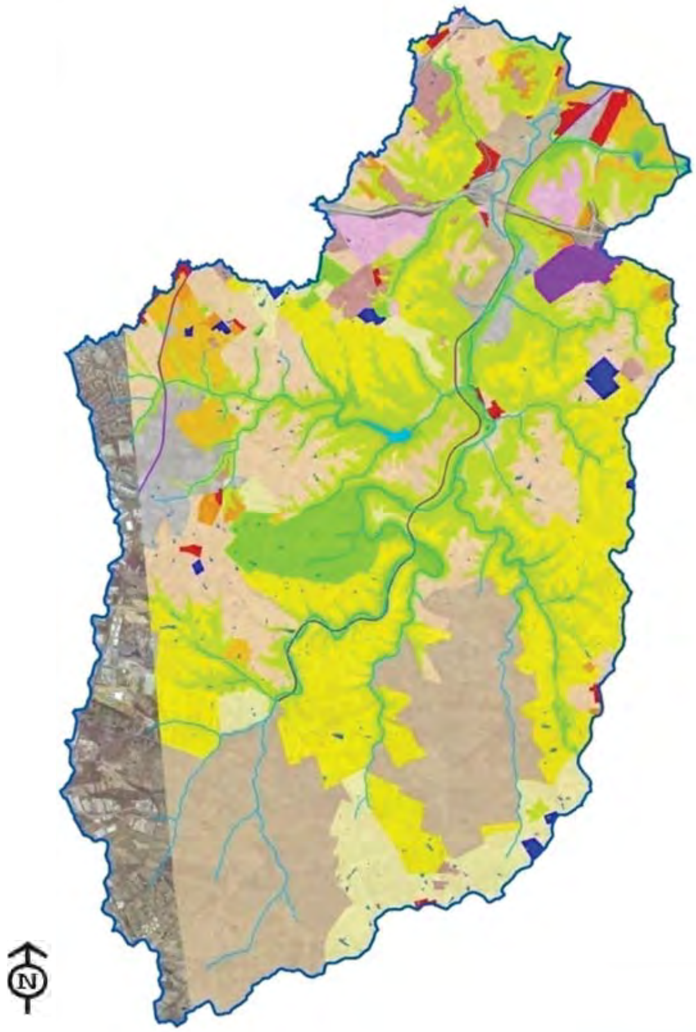


Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report



Data Source:
Sanitation District No. 1 – 2009 Banklick Creek Watershed Characterization Report

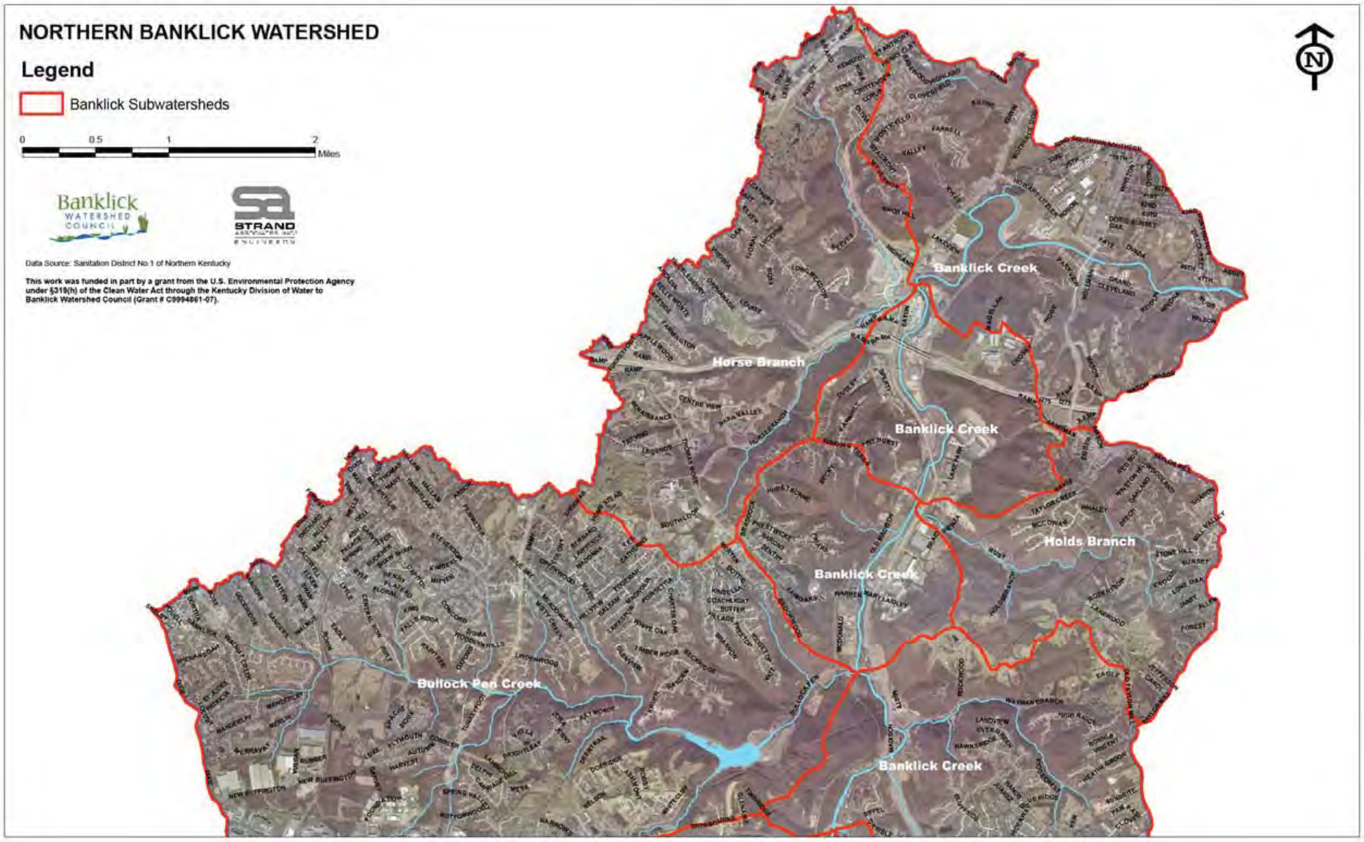
BANKLICK WATERSHED FUTURE LAND USE



Legend

- Residential Under 2.0
- Residential 2.1 TO 4.0
- Residential 4.1 TO 7.0
- Residential 7.1 TO 14.0
- Residential 14.1 TO 30.0
- Residential Over 30.0
- Commercial Retail/Service
- Commercial Office
- Commercial Rural
- Special Development Area
- Industrial
- Rail Road
- Agricultural and Rural Uses
- Physically Restrictive Development Area:
- Water
- School Parks
- Recreation and Open Space
- Other Community Facilities
- Small Study Area
- Right of Way

Data Source:
Kenton County 2006 Comprehensive Plan, NKAPC
Sanitation District No. 1



NORTHERN BANKLICK WATERSHED
Legend
Banklick Subwatersheds
0
0.5
1
2
Miles
Banklick Watershed Council
STRAND
Data Source: Sanitation District No.1 of Northern Kentucky
This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to Banklick Watershed Council (Grant # C9994861-07).
N
Banklick Creek
Horse Branch
Banklick Creek
Holds Branch
Banklick Creek
Bullock Pen Creek
Banklick Creek

Banklick Watershed Council Public Input Meeting

Name (Optional): ___________________________________

Contact Information (Optional):

Check all that apply:

☐ I would like to stay informed about what is happening in the Banklick Watershed

☐ I would like to become more involved with the Banklick Watershed Council by: attending future meetings, volunteering at events, or ____.

☐ I would be interested in working with the council to implement a project on my land such as: stream restoration, reforestation, cattle fencing, septic tank improvements, stream bank restoration, rain gardens, or ____.

☐ I believe that the following are major concerns in this watershed that must be addressed to improve the streams: ____

____

____

____

____

☐ Other Information I would like to share:____

____

____

____

____

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act.

PUBLIC INPUT SURVEY

927 Forest Ave
Covington, KY 41016

Thank you for participating in the survey! As you are probably aware, Banklick Creek has been listed as a polluted waterway for various uses by the Kentucky Division of Water (KDOW). Your input is valuable as we move forward in addressing some of the associated issues.

1. How would you describe your property?

☐ Residential ☐ Farm/ Agriculture ☐ Industrial

☐ Commercial ☐ Other ______________________________

2. Is there a creek that flows on, adjacent to your property or that you are very familiar with? (Skip to question 6 if your answer is No)

☐ Yes ☐ No ☐ Unsure

3. When do you see water in the creek?

☐ Year round ☐ Just when in rains ☐ Just during heavy rain periods

☐ Most of the time but it dries out during dry summer months

4. Does the creek that flows on or adjacent to your property flood?

☐ Often ☐ Only during heavy rain periods ☐ Does not flood

5. Would you be interested in working with the council to implement a project on your land for any of the following?

☐ Stream restoration ☐ Reforestation ☐ Cattle fencing,

☐ Septic tank improvements ☐ Stream bank restoration ☐ Rain gardens

☐ Other ____.

6. Which of the following are major concerns that must be addressed to improve Banklick Creek?

☐ No concern ☐ Animals ☐ Sedimentation

☐ Development practices ☐ Septic systems

☐ Other ____________________________________

7. On a scale of 1 to 5, with 1 being not important and 5 being very important, how important is it that Banklick Creek is safe for:

1. Children to play	1	2	3	4	5
2. Habitat	1	2	3	4	5
3. Fishing	1	2	3	4	5

8. What is the quality of the water in the creek?

- ☐ Fish and other aquatic life can be seen
- ☐ No aquatic life can be seen
- ☐ Dead fish or other aquatic life can be seen
- ☐ Bad odors are coming from the creek
- ☐ The water is usually muddy
- ☐ The water seems to be polluted
- ☐ I feel it is safe for people to be in contact with the creek water because the water is clear

9. Other Information I would like to share:

Name (Optional): ____

Contact Information (Optional):

Check all that apply:

☐ I would like to stay informed about what is happening in the Banklick Watershed

☐ I would like to become more involved with the Banklick Watershed Council by attending future meetings, volunteering at events, or ________________________________.

This work was funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act.

Banklick Watershed Council

Public Meeting

April 16 , 2009

INFORM

IDENTIFY & INVOLVE

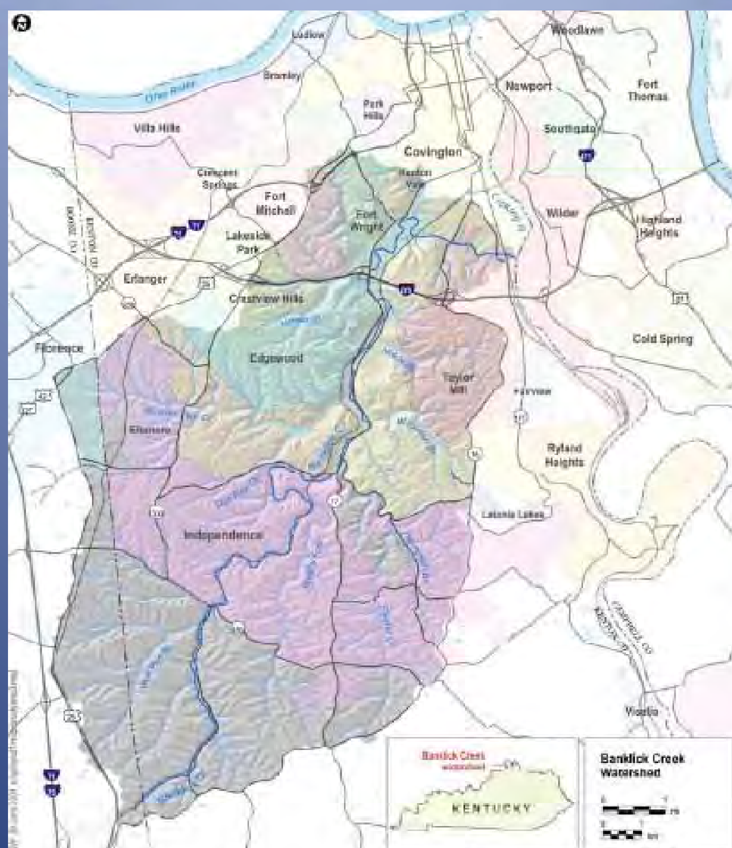
INFORM

Data has been gathered and studies conducted in the Banklick Watershed

WHY?

The Kentucky Division of Water designated the Banklick Watershed as one of the three highest priority watersheds in the Licking River basin because of the severity of flooding and water quality problems, expected growth of development, and the large number of water quality violations.

BANKLICK WATERSHED



Municipalities within Banklick Watershed   Limno-Tech 2004

BANKLICK CREEK

- Drainage Area - 58.3 square miles
- Enters the Licking River approx. 4.6 miles upstream of the Ohio River in the Latonia area
- Extends 18.9 miles southwestwardly to its headwaters near Walton

U.S. Department of
Agriculture Soil Conservation Service
1971 Banklick Creek Watershed Work Plan

Four floodwater retarding structures proposed to have controlled runoff from 40 percent of the watershed

Estimated cost of the retarding structures and land treatment measures was $4,930,200

DOE RUN DAM

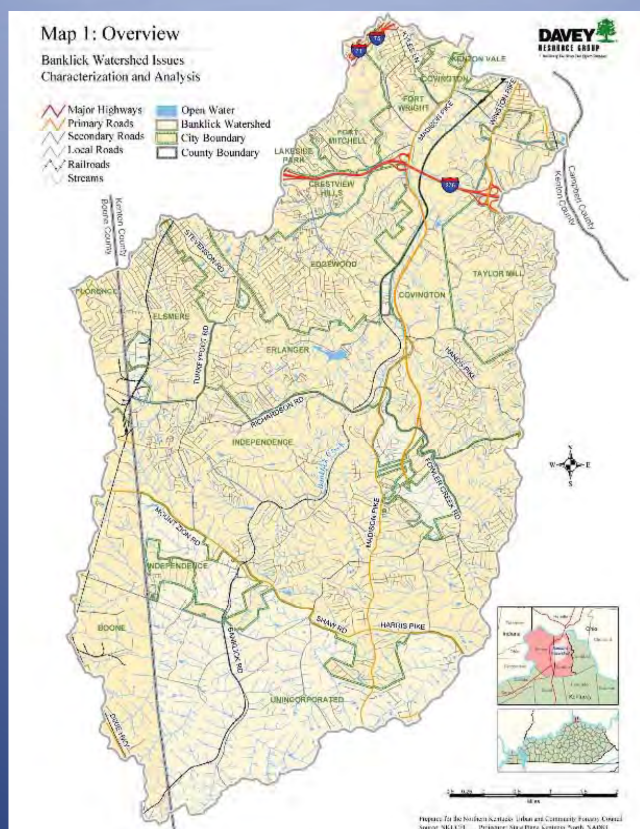
ONLY FLOOD CONTROL STRUCTURE BUILT

Ground was broken on February 1976, with the structure being complete in April 1981 and dedicated in October 1981

The actual cost totaled $5,982,186

Public Law 566
The Watershed Protection and Flood Prevention Act funded $5,172,006

BANKLICK WATERSHED



STUDIES RELATING TO BANKLICK FLOODING

- 1982 Study – flood damages estimated to be $2,939,000 for the 100 year flood.
- 1993 Study – predicted significantly higher estimated flows than prior reports.
- 1995 Study – noted major headwater flooding along Banklick Creek in 1962, 1967 and 1979.

1998 /1999 Flood Reduction Proposals

…75 foot dam upstream from Wayman Branch and KY 17 – cost $20,000,000

50% reduction in peak flows downstream
for 100 year flood

Note: to provide real flood damage reduction would also require an additional regional basin on Fowler Creek.

or

…29 small detention structures in Banklick and Fowler Creek – cost $300,000 per structure $8,700,000 total

STRUCTURAL ALTERNATIVES ARE VERY COSTLY AND IN TIME CAN LOSE THEIR EFFECTIVENESS

- Doe Run Dam was designed for a 100 year storm event
- About 9 years after being completed, March of 1990, it was less than 1 foot from overflowing the spillway
- A recent report by Fish & Wildlife is suggesting that the spillway needs to be raised 15 feet
- The amount of stormwater entering the Lake has increased because of how the land has been developed surrounding the lake and its tributaries

U. S. Army Corps of Engineers
2000 Banklick Creek Watershed Analysis

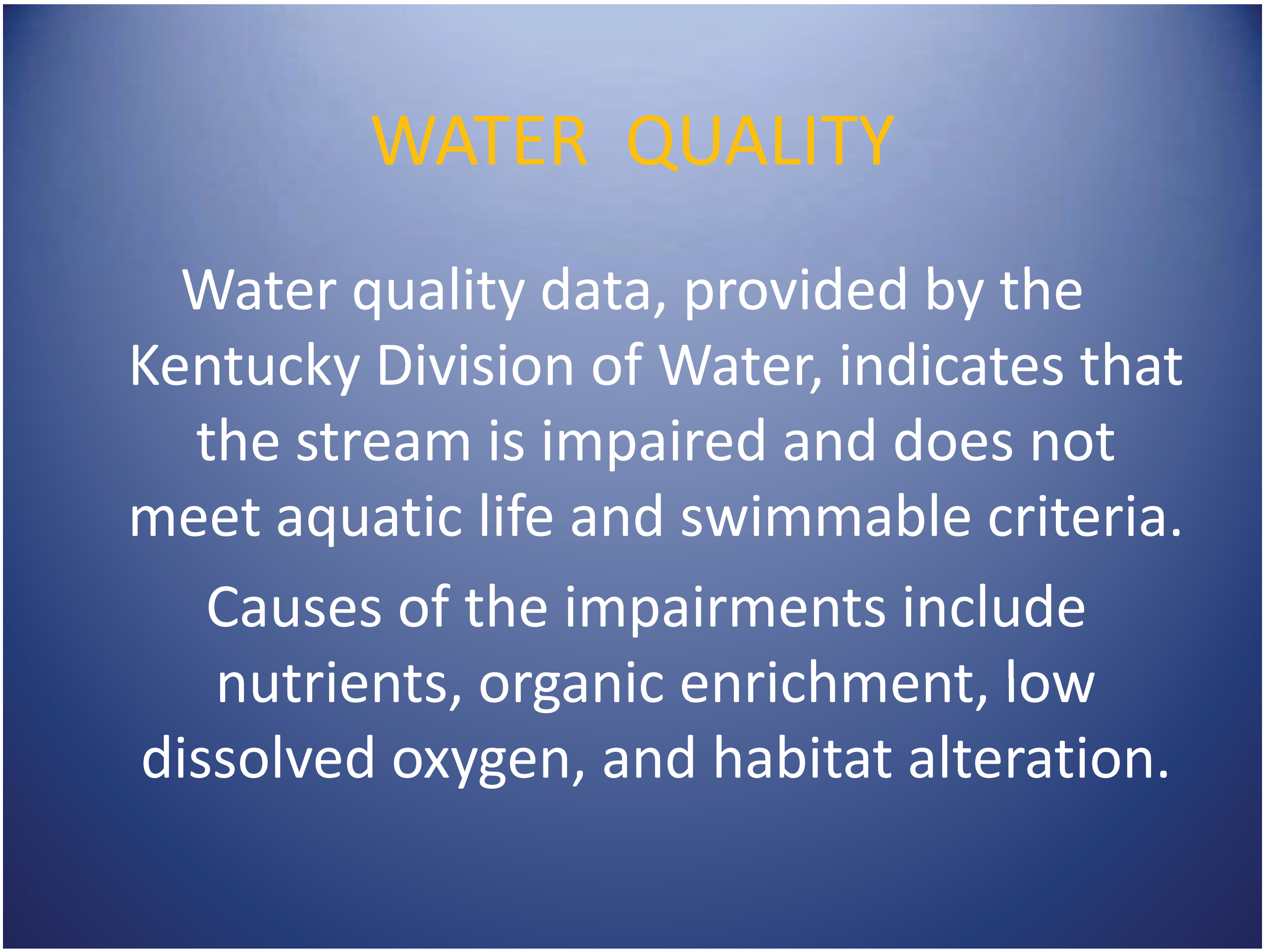
THREE PRIMARY FACTORS HAVE CONTRIBUTED TO FLOOD DAMAGES IN THE WATERSHED:

- The early development, which occurred along the stream channels.
- The extremely steep slopes of Banklick Creek and its tributaries.
- Extraordinary recent development along the watershed's ridgelines and hillsides.

WITHOUT A PLAN

Current problems of flooding, ecosystem damage and increased erosion along with corresponding sediment deposition can be expected to worsen in the watershed.

U S Army Corps of Engineers


WATER QUALITY
Water quality data, provided by the Kentucky Division of Water, indicates that the stream is impaired and does not meet aquatic life and swimmable criteria.
Causes of the impairments include nutrients, organic enrichment, low dissolved oxygen, and habitat alteration.

IDENTIFY

RECOMMENDATIONS

ECOSYSTEM RESTORATION WORK

Estimated Cost

$2,000,000

(DOES NOT INCLUDE PURCHASE OF LAND)

Will Still Need to Change Ways in How Our Land is Developed

10.5 Stream Miles of Grade Control Structures in Banklick

Benefits

- Reduced Upstream Bedcutting
- Reduced Downstream Sedimentation
- Reduced Bank Erosion
- Increased Dissolved Oxygen Levels
- Increased Aquatic Habitat

10.5 miles of Expanded Riparian Corridor in Banklick Creek

Benefits

- Increased Terrestrial and Aquatic Habitat
- Lower Water Temperatures
- Filtering/Trapping of Non-Point Source Pollution

CONSTRUCT WETLANDS

Benefits

- Biological Treatment of Water
- Reduction of Suspended Solids
- Terrestrial and Aquatic Habitat

WETLANDS

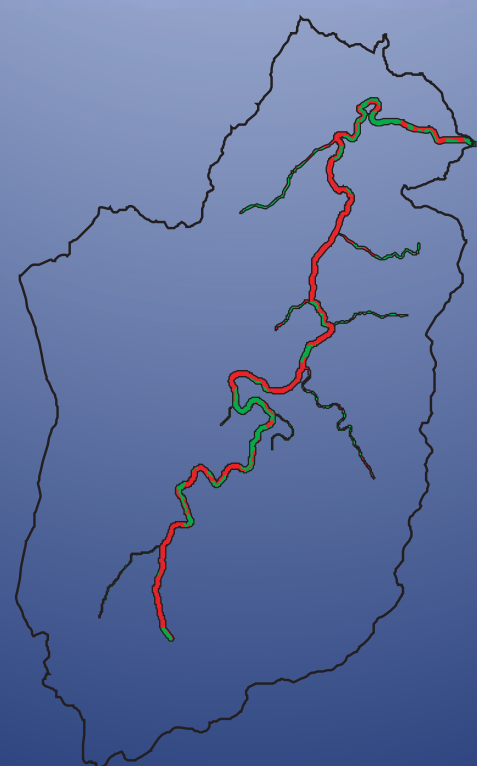
While constructed wetlands are not intended to reproduce or mimic natural wetland wildlife diversity, they do provide areas for water quality improvements due to biological treatment, and additional habitat for aquatic species.

Preliminary estimates indicate the potential for 11 acres of wetlands to be created.

Natural wetland along Brushy Fork

Existing riparian corridor (green) and areas where riparian enhancements are needed in (red)

ESTIMATED RIPARIAN ZONE DEFICIT – 857 ACRES

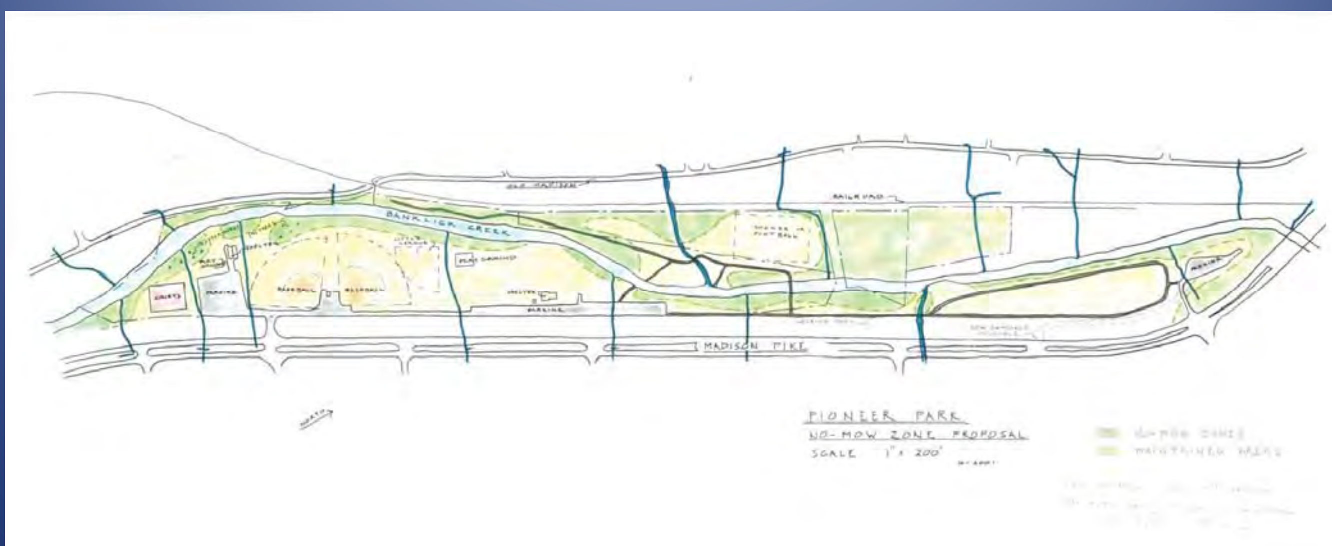


NO-MOW ZONES AND RIPARIAN AREAS

Establishment of "no-mow" zones and/or floodplain and riparian plantings to create a streamside buffer would enhance the water quality and wildlife diversity along Banklick Creek by reducing water temperatures, filtering nonpoint source runoff pollution, and providing wildlife corridors with additional foraging opportunities.

BANKLICK CREEK ALONG PIONEER PARK

Proposed NO-MOW Zone for Pioneer Park 2001



2004 - BACE STUDY

Banklick Creek Watershed Analysis and Issue Characterisation for Education and Outreach focused on forest resources and estimated that **30% of the Banklick watershed has natural areas needing protection and 50% is in need of restoration.**

The BACE Study was funded with a National Urban Forestry Grant.
Northern KY Area Planning Commission was the lead agency, with the Northern KY Urban & Community Forestry Council, BWC and SD#1 as partners.

LESS IMPERVIOUS SURFACES AND LESS LAND COMPACTION

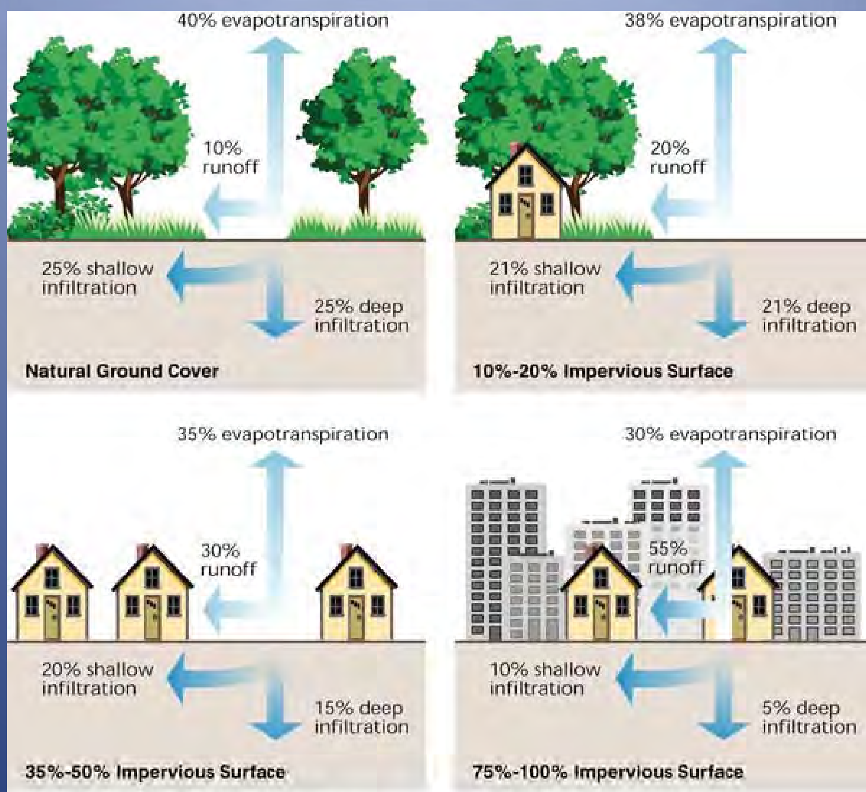


Fig. 3.21 – Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.
In Stream Corridor Restoration: Principles, Processes, and Practices (10/98).
By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the U.S.)

2005 - CONSENT DECREE

SD#1 reached an agreement with EPA on their Consent Decree which is a 20 year plan to address combined sewer overflows (CSO), sanitary sewer overflows (SSO), and SD#1 will continue with their stormwater management program.

Stormwater Management Plan for Kyles Lane I-75 Interchange

Banklick Creek at Bullock Pen

2005 - BWC ACTION PLAN

BWC completed an Action Plan for the Banklick Watershed that stated four main goals:

1. Clean the Water
2. Reduce Flooding
3. Restore the Banks
4. Honor the Heritage

2006 - South Banklick Small Area Study

- NKAPC studied the headwater area of Banklick Creek and had major input from property owners in the area.
- The study recommended riparian buffers along with recommendations for conservation subdivision and eco commerce park areas.
- For the first time, recommended riparian buffers were adopted into the Kenton County Comprehensive Plan and Zoning which makes them required but only for the study area.

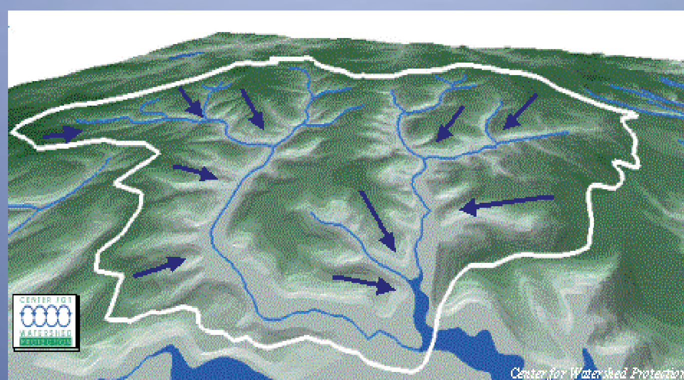
2008 - BWC BEGINS EPA 319 GRANT

An important and exciting effort for the Banklick Watershed is BWC has started work on a major $1,000,000 EPA Grant Project.

$600,000 is funding from EPA
and $400,000 is coming from in-kind of volunteers and technical support
from partners in the project.

•

INVOLVE

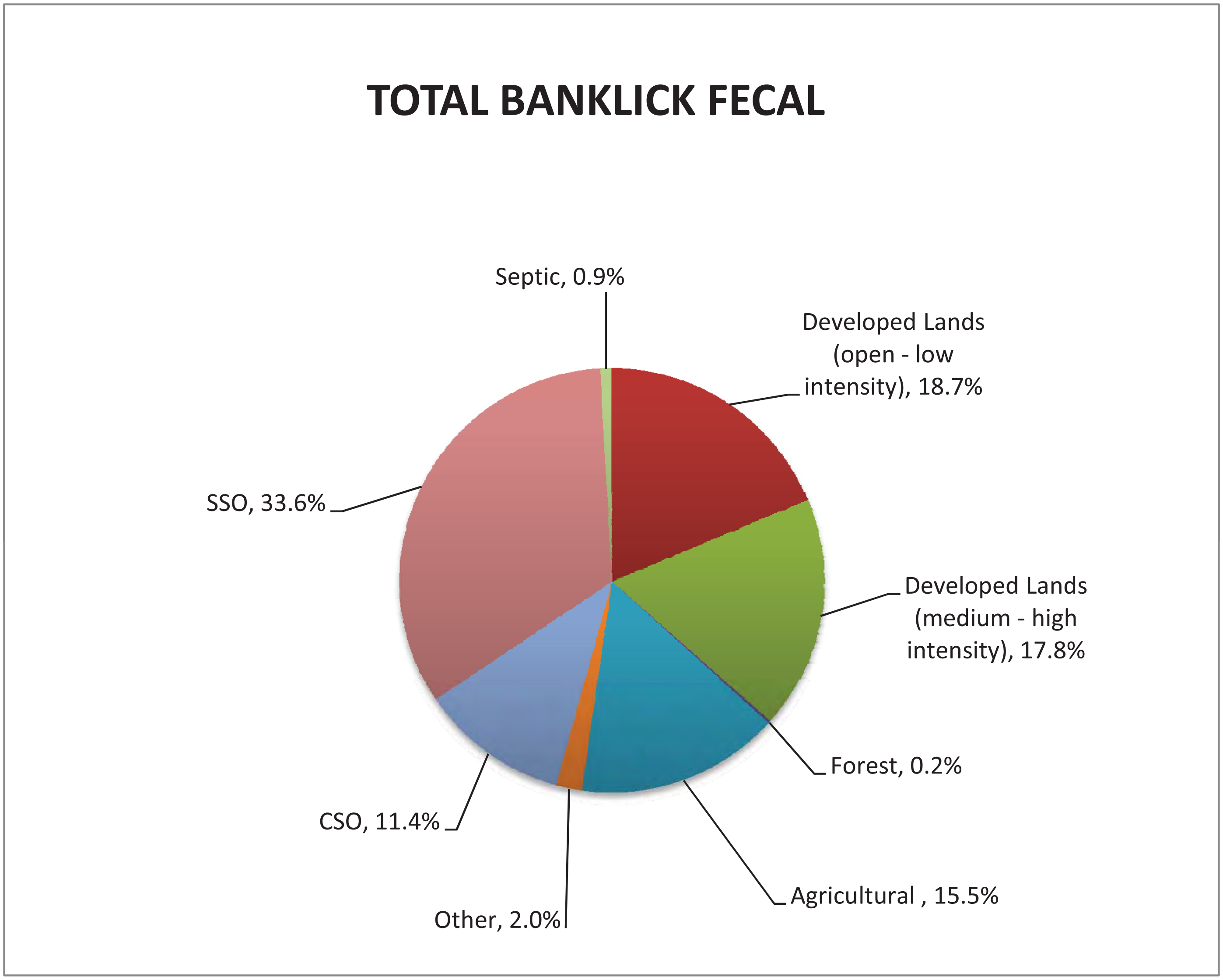


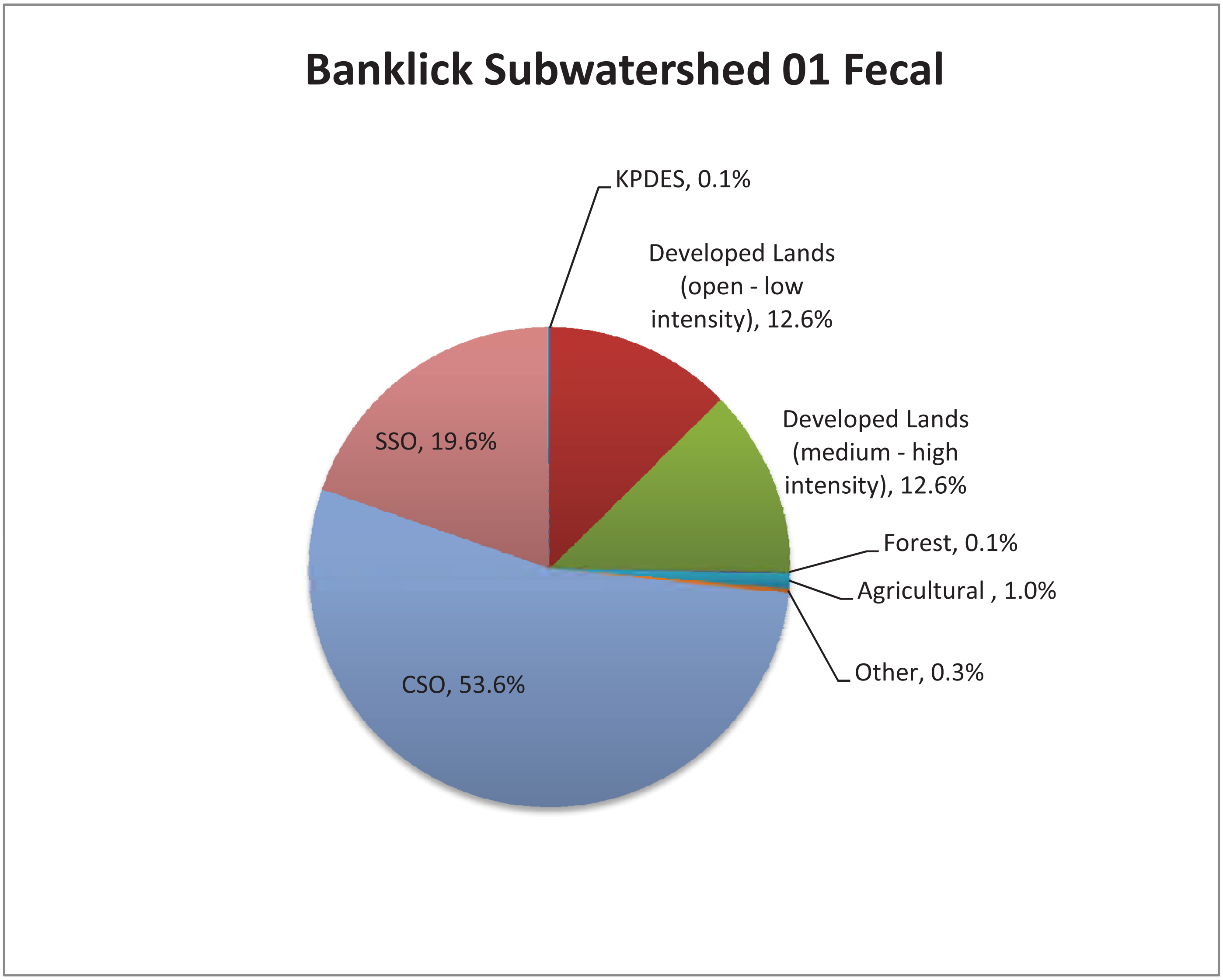
Solutions to watershed problems often involve changing the way we live on the land; so citizen involvement, awareness and support are essential for success. It will take city officials, government agencies, industries, educators and citizens working together to solve these water problems.

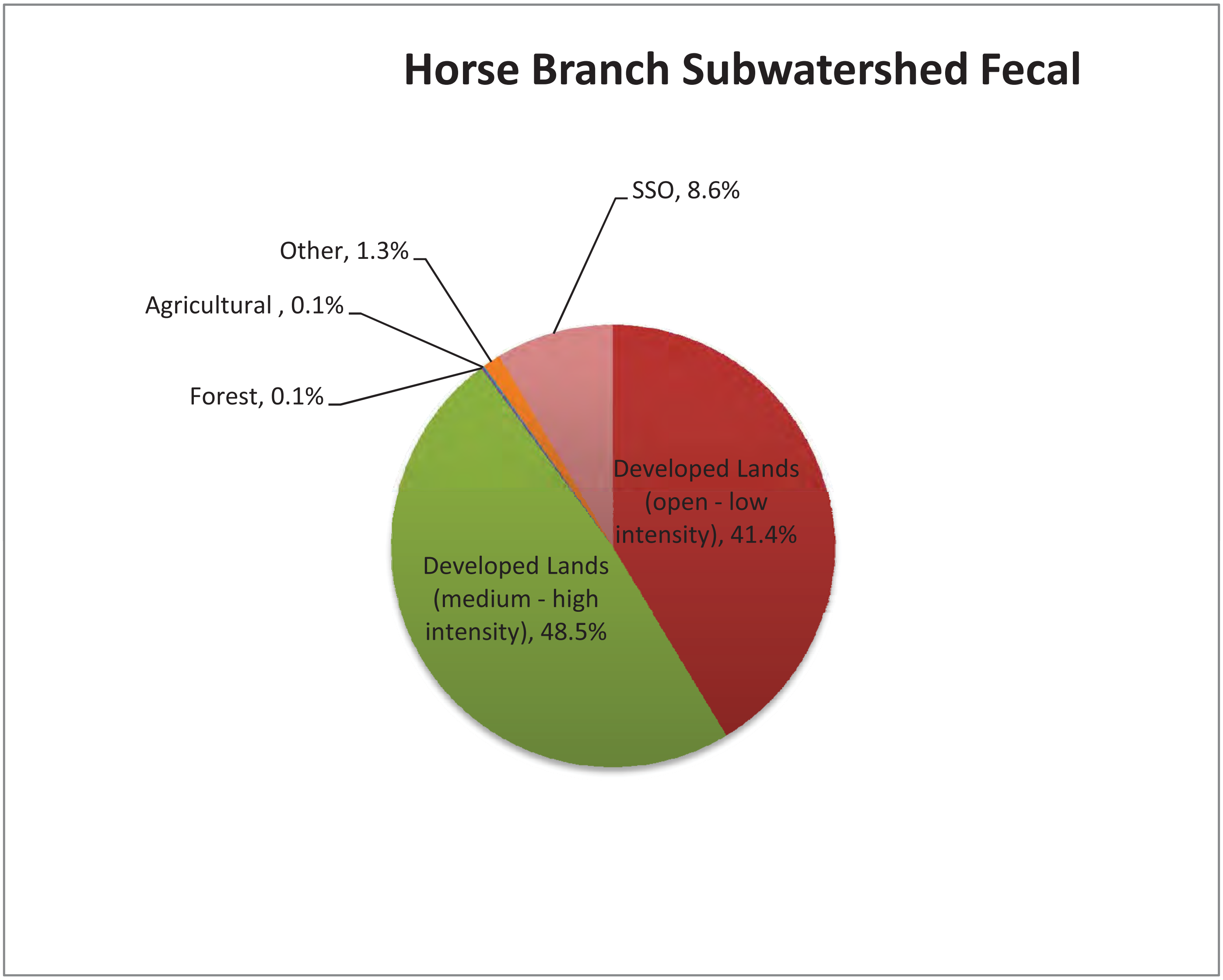
Banklick Creek Watershed Based Planning, Implementation, and Results

"This work was funded in part by a grant
from the U.S. Environmental Protection Agency
under §319(h) of the Clean Water Act
through the Kentucky Division of Water to
Banklick Watershed Council
Grant # C9994861-07."

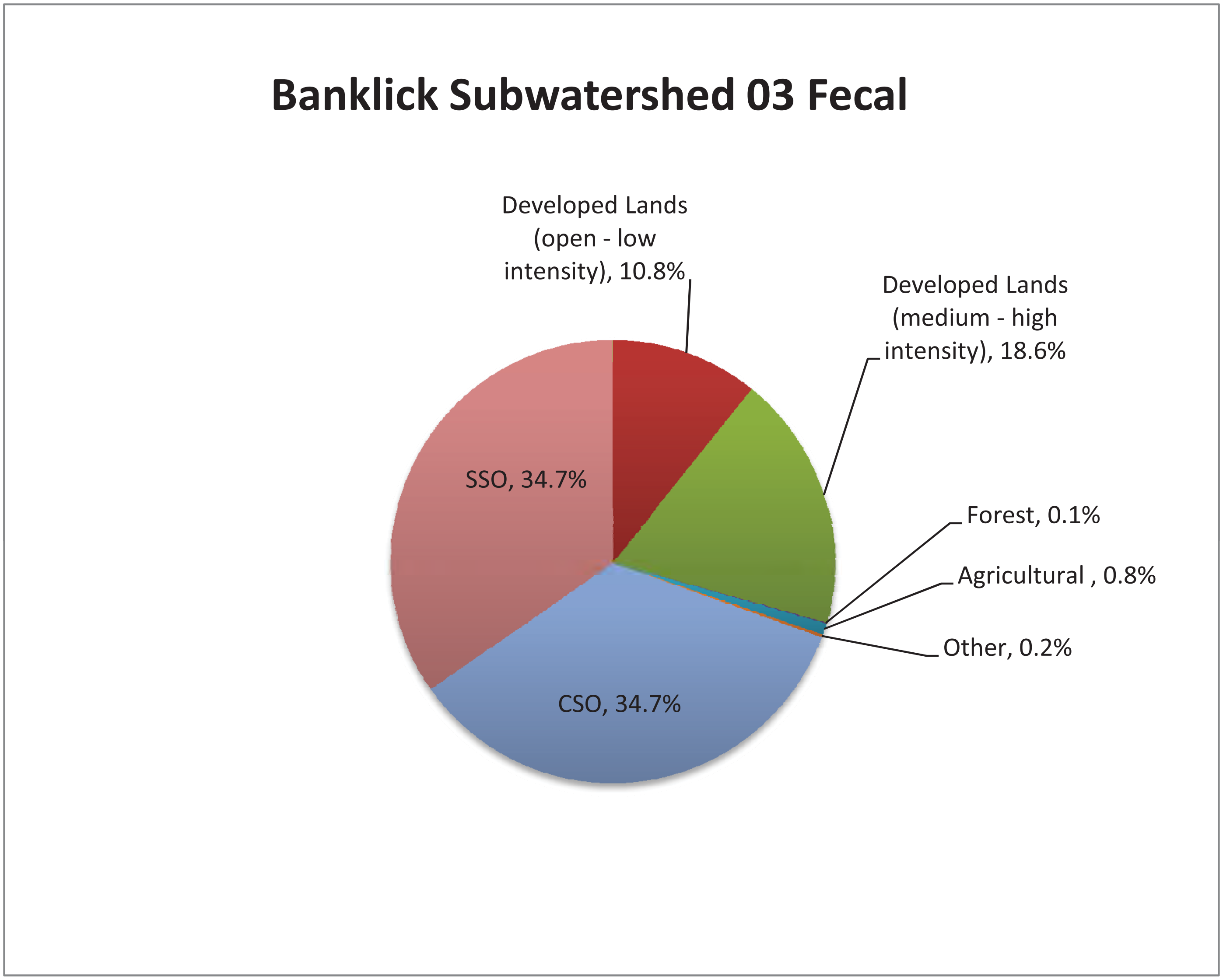
APPENDIX G
SOURCE ALLOCATION PIE CHARTS


TOTAL BANKLICK FECAL
Septic, 0.9%
Developed Lands (open - low intensity), 18.7%
SSO, 33.6%
Developed Lands (medium - high intensity), 17.8%
Forest, 0.2%
CSO, 11.4%
Agricultural , 15.5%
Other, 2.0%

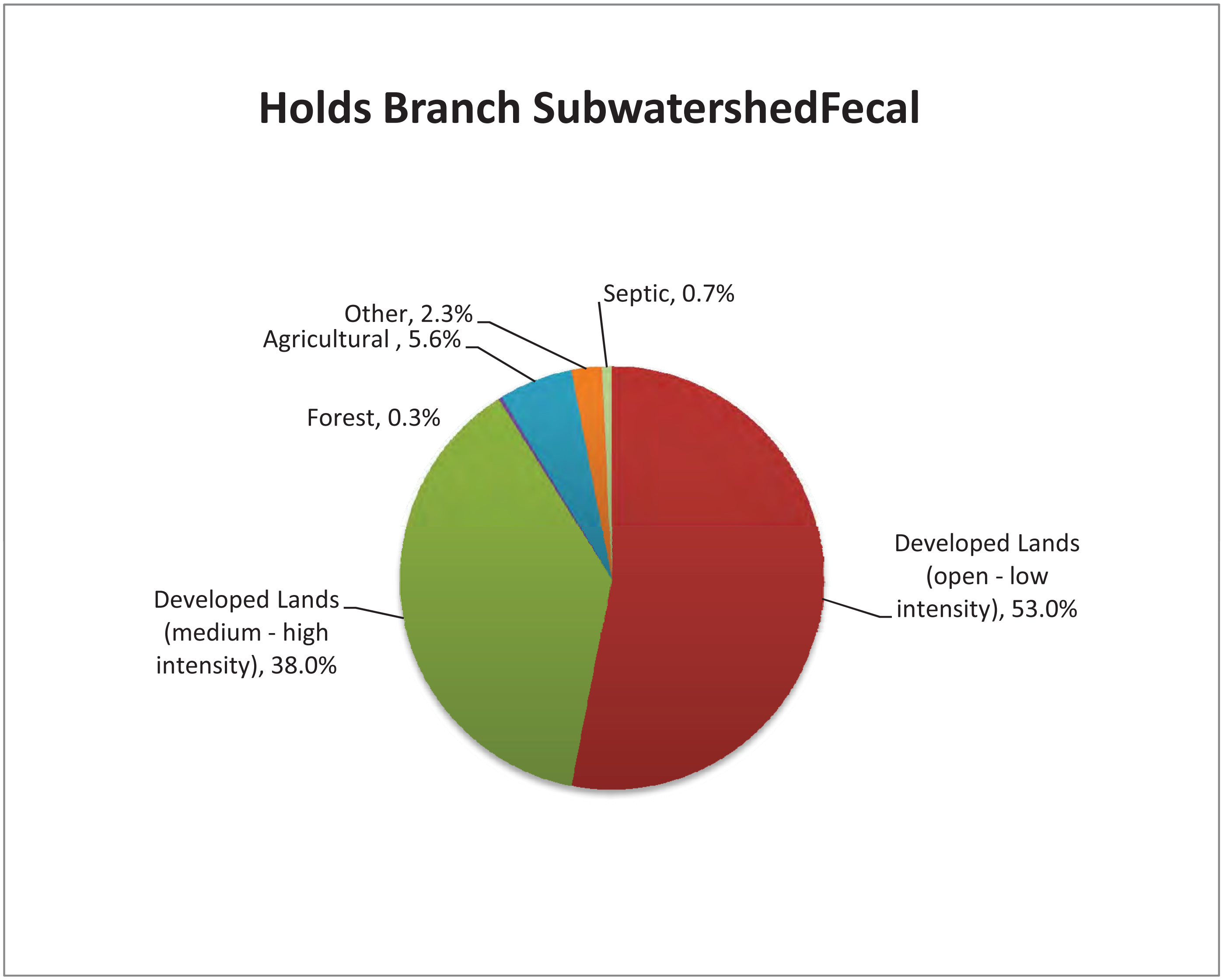

Banklick Subwatershed 01 Fecal
KPDES, 0.1%
Developed Lands (open - low intensity), 12.6%
Developed Lands (medium - high intensity), 12.6%
Forest, 0.1%
Agricultural , 1.0%
Other, 0.3%
CSO, 53.6%
SSO, 19.6%

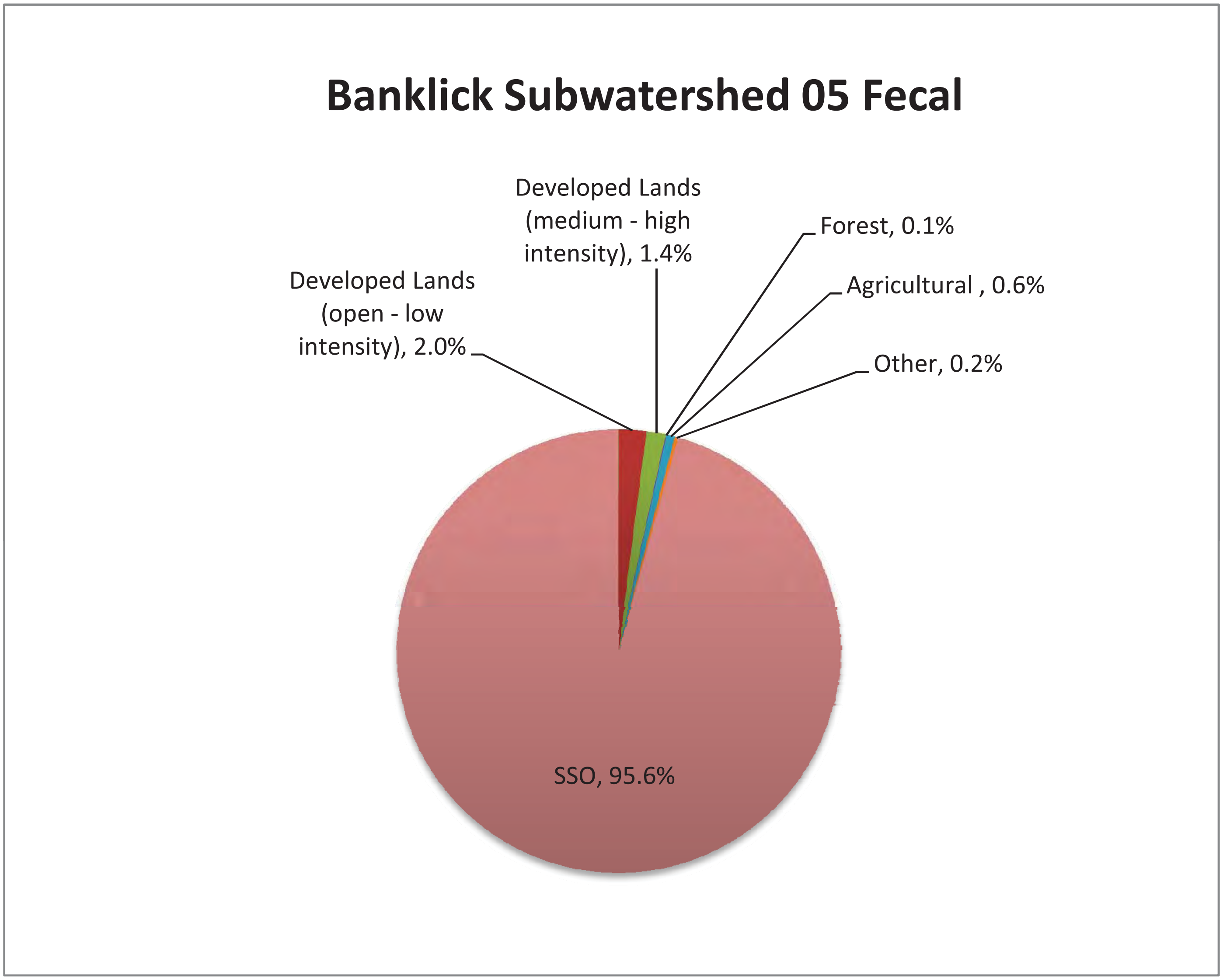


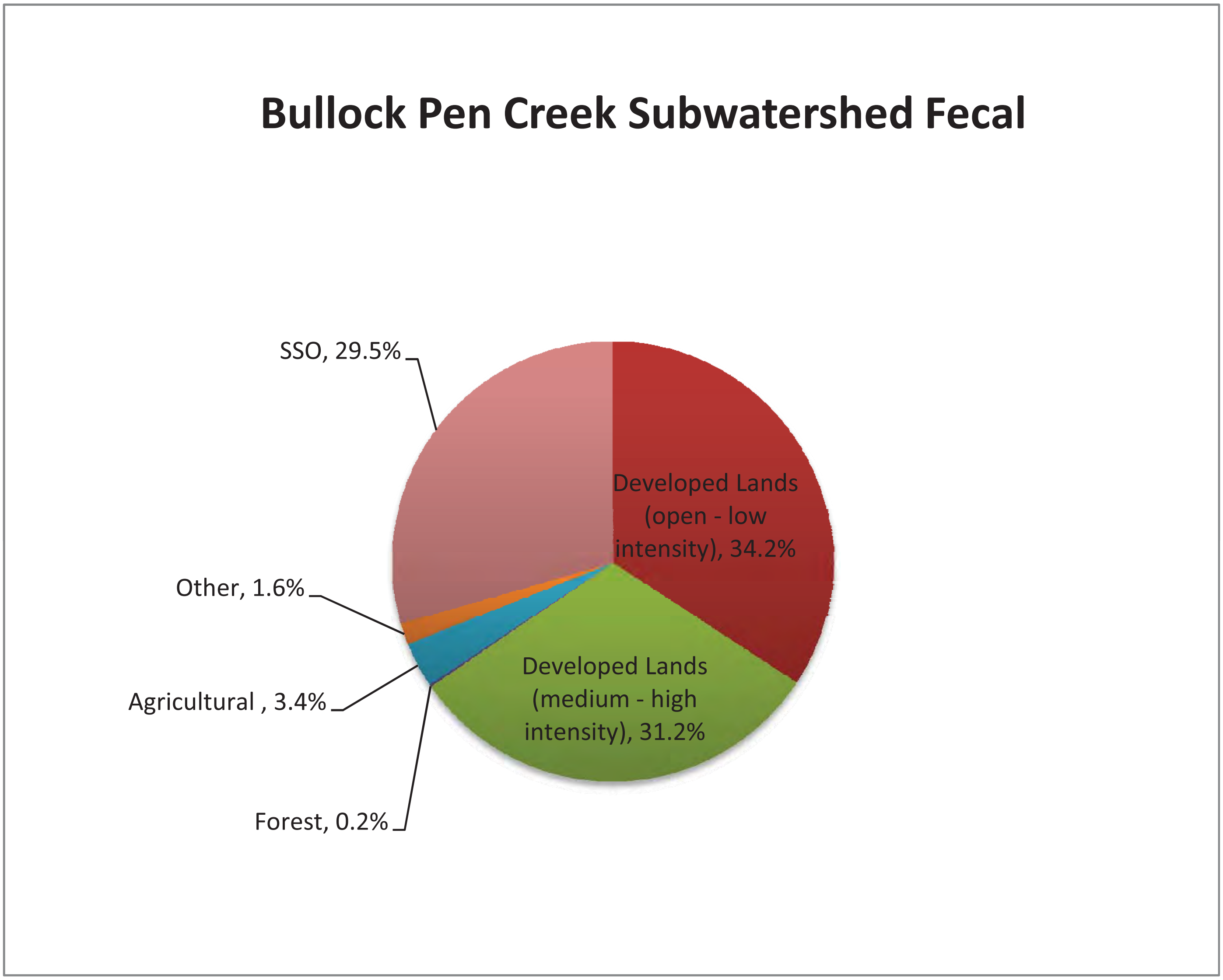
Horse Branch Subwatershed Fecal
SSO, 8.6%
Other, 1.3%
Agricultural , 0.1%
Forest, 0.1%
Developed Lands (open - low intensity), 41.4%
Developed Lands (medium - high intensity), 48.5%

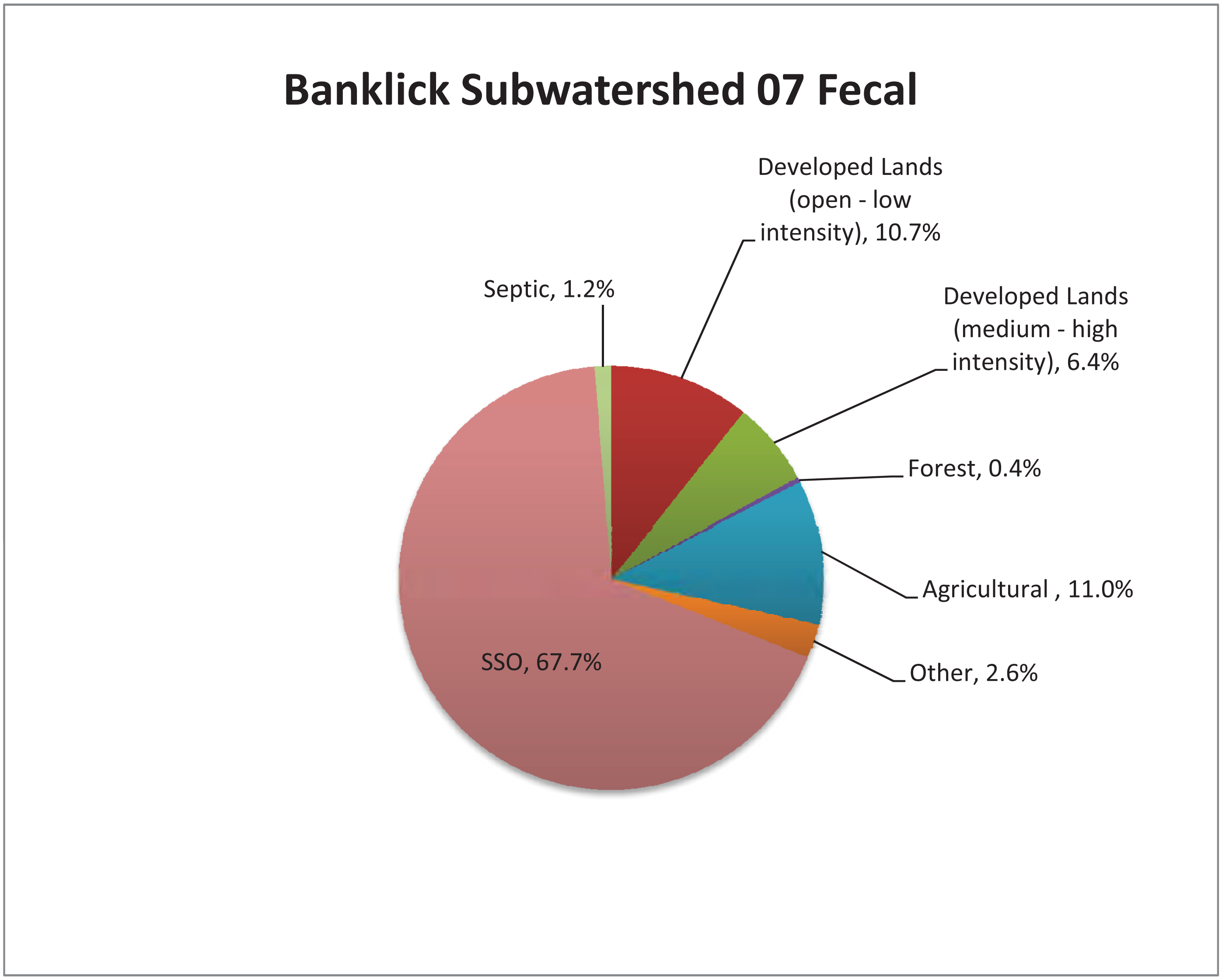


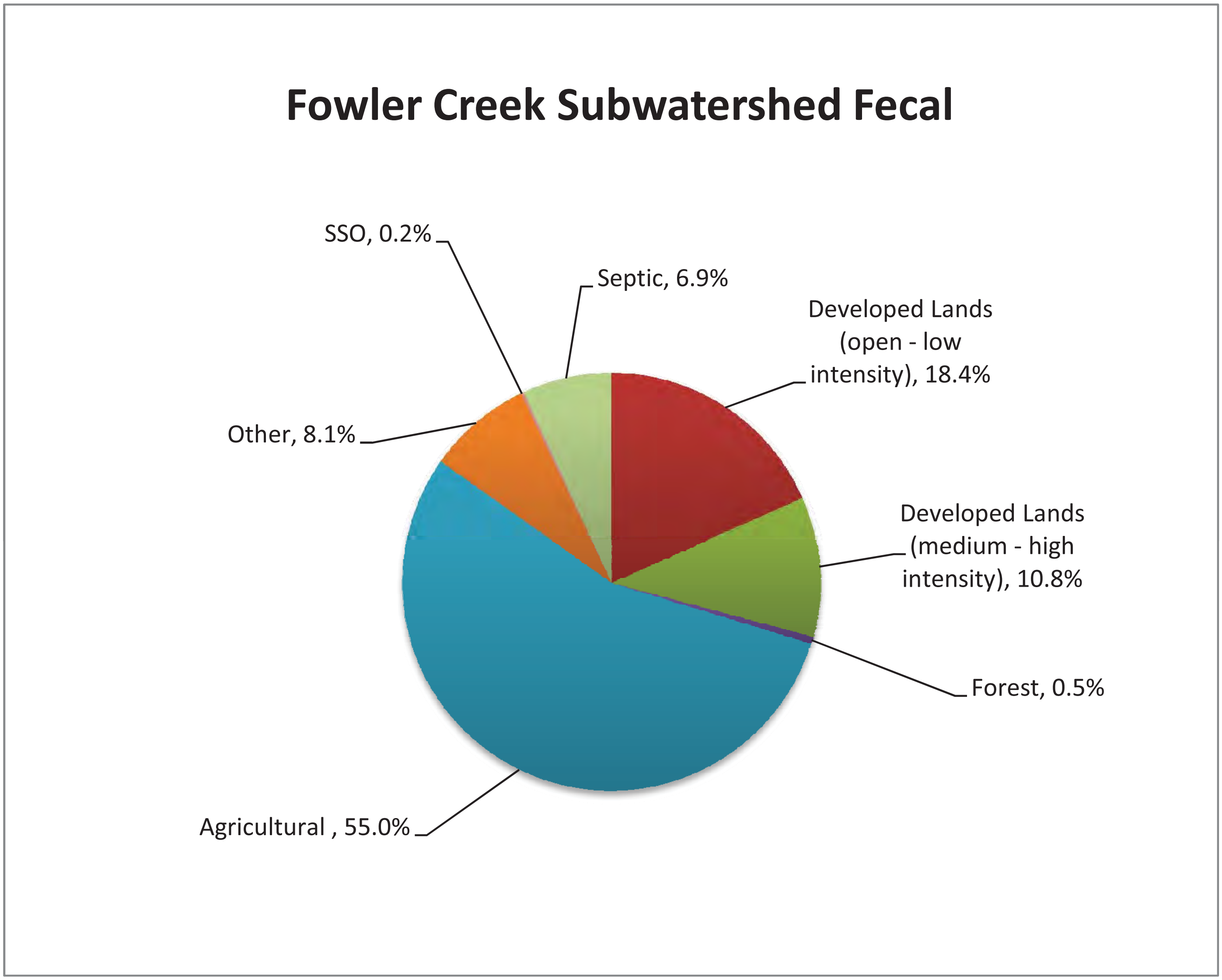
Banklick Subwatershed 03 Fecal
Developed Lands (open - low intensity), 10.8%
Developed Lands (medium - high intensity), 18.6%
Forest, 0.1%
Agricultural , 0.8%
Other, 0.2%
CSO, 34.7%
SSO, 34.7%


Holds Branch SubwatershedFecal
Septic, 0.7%
Other, 2.3%
Agricultural , 5.6%
Forest, 0.3%
Developed Lands (open - low intensity), 53.0%
Developed Lands (medium - high intensity), 38.0%

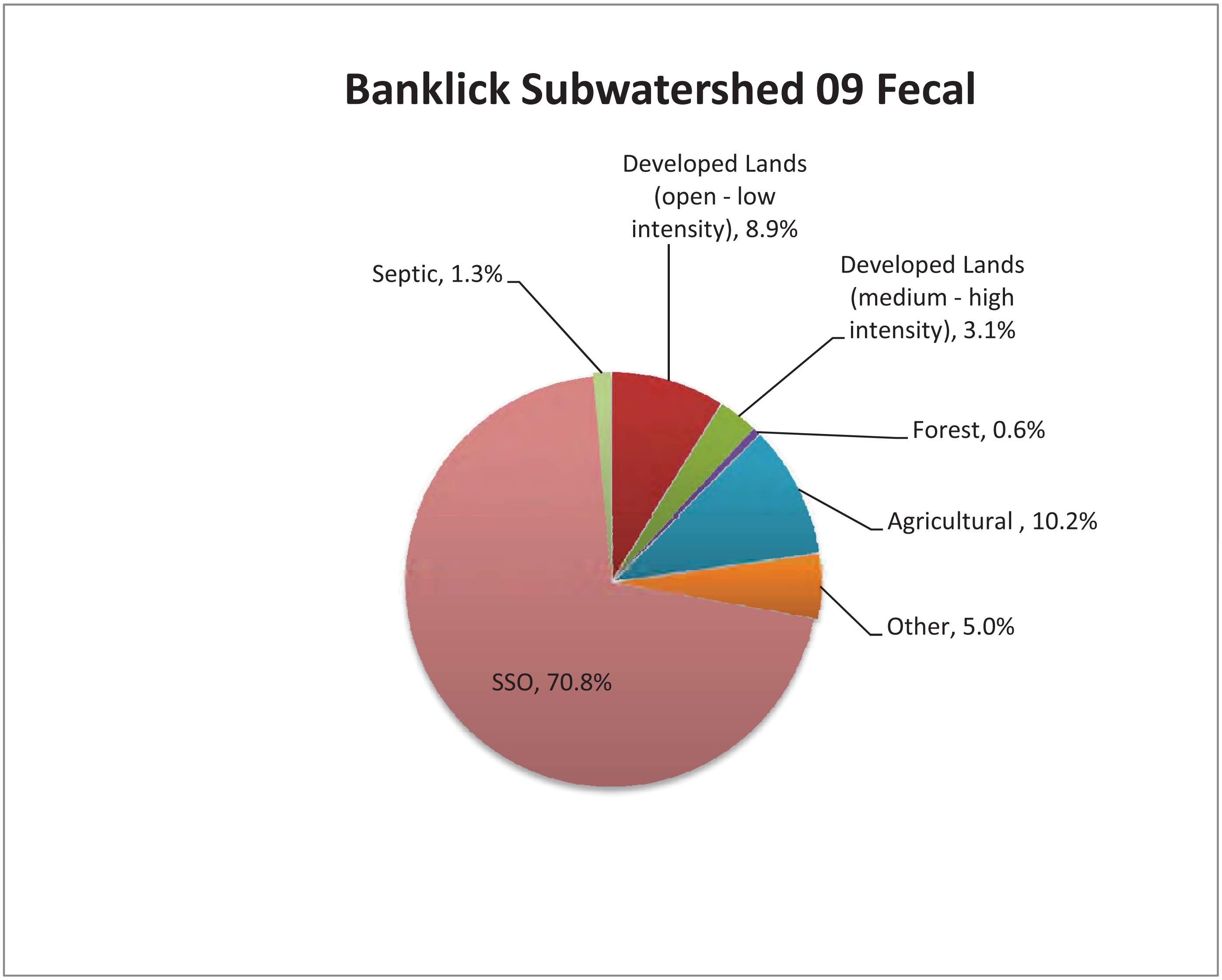

Banklick Subwatershed 05 Fecal
Developed Lands (medium - high intensity), 1.4%
Forest, 0.1%
Agricultural , 0.6%
Developed Lands (open - low intensity), 2.0%
Other, 0.2%
SSO, 95.6%


Bullock Pen Creek Subwatershed Fecal
SSO, 29.5%
Developed Lands (open - low intensity), 34.2%
Other, 1.6%
Agricultural , 3.4%
Developed Lands (medium - high intensity), 31.2%
Forest, 0.2%

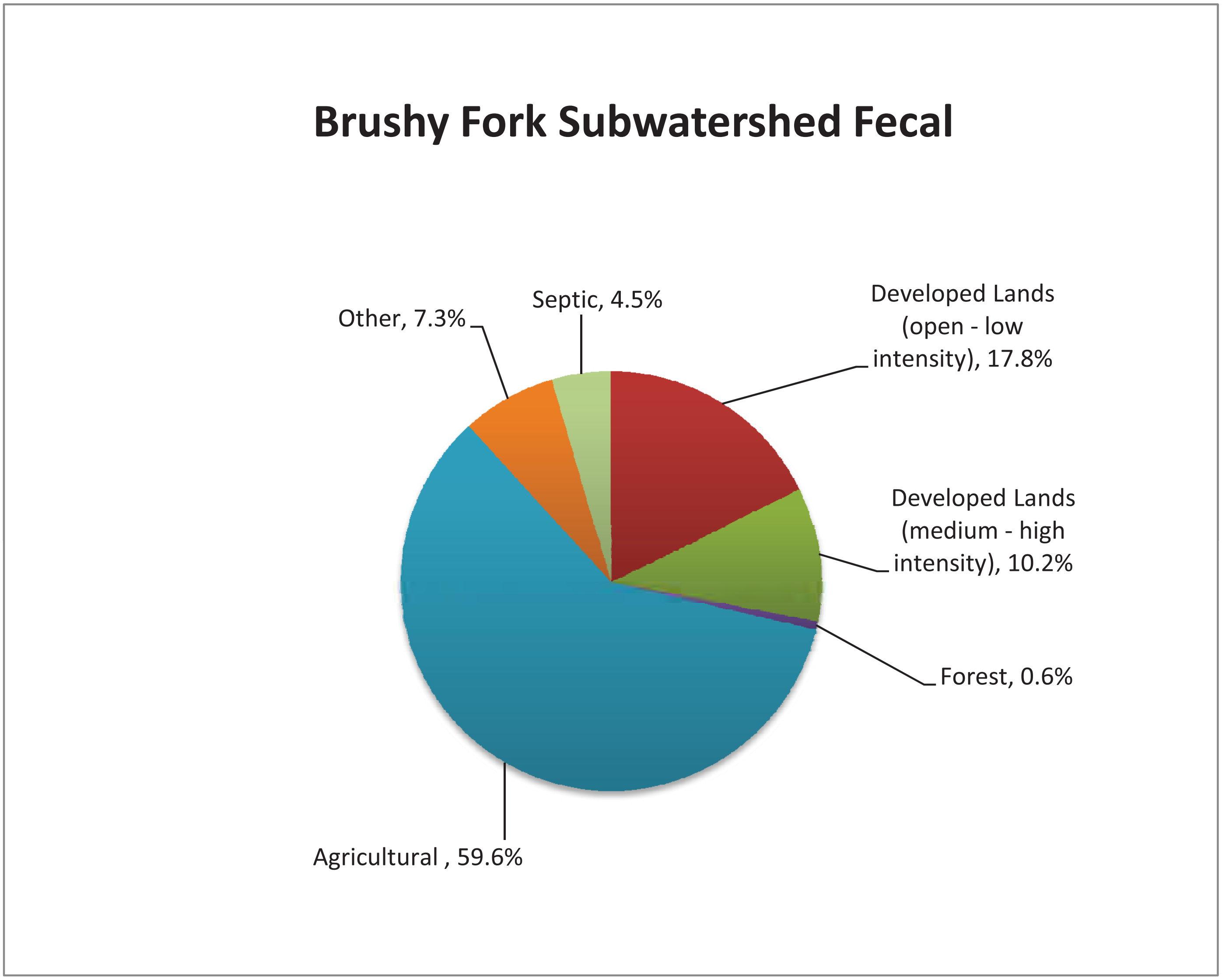

Banklick Subwatershed 07 Fecal
Developed Lands (open - low intensity), 10.7%
Developed Lands (medium - high intensity), 6.4%
Forest, 0.4%
Agricultural , 11.0%
Other, 2.6%
SSO, 67.7%
Septic, 1.2%

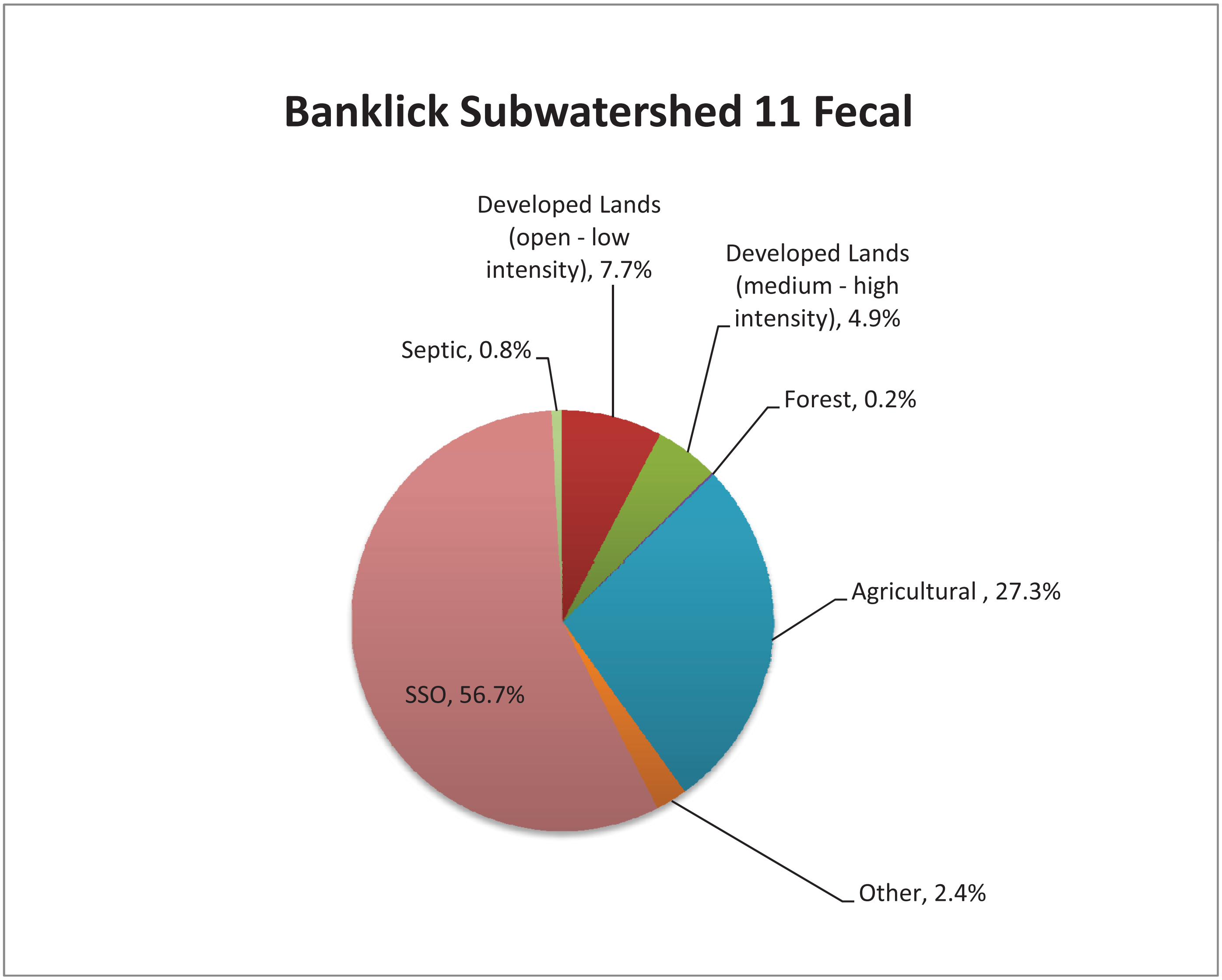


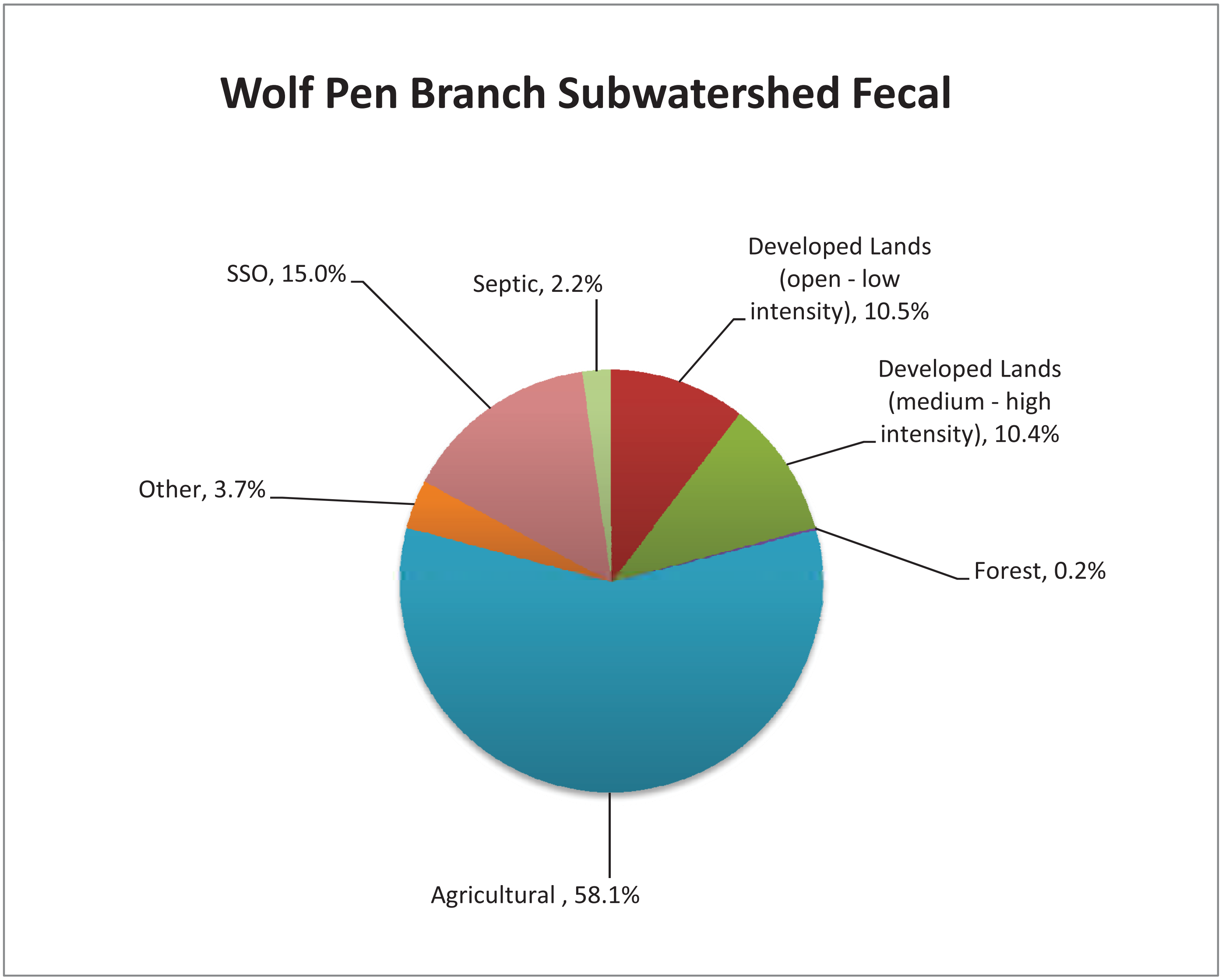
Fowler Creek Subwatershed Fecal
SSO, 0.2%
Septic, 6.9%
Developed Lands (open - low intensity), 18.4%
Other, 8.1%
Developed Lands (medium - high intensity), 10.8%
Forest, 0.5%
Agricultural , 55.0%

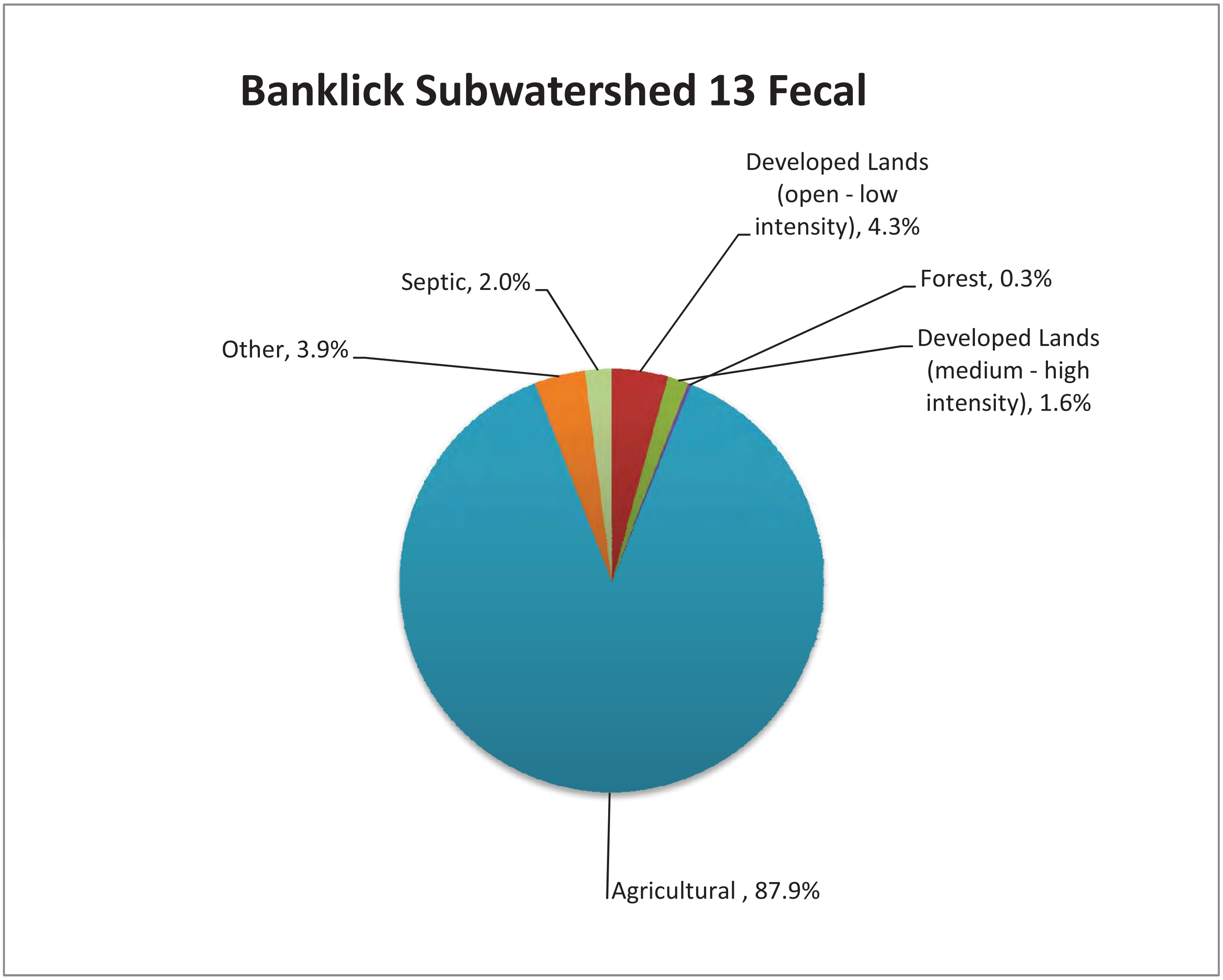


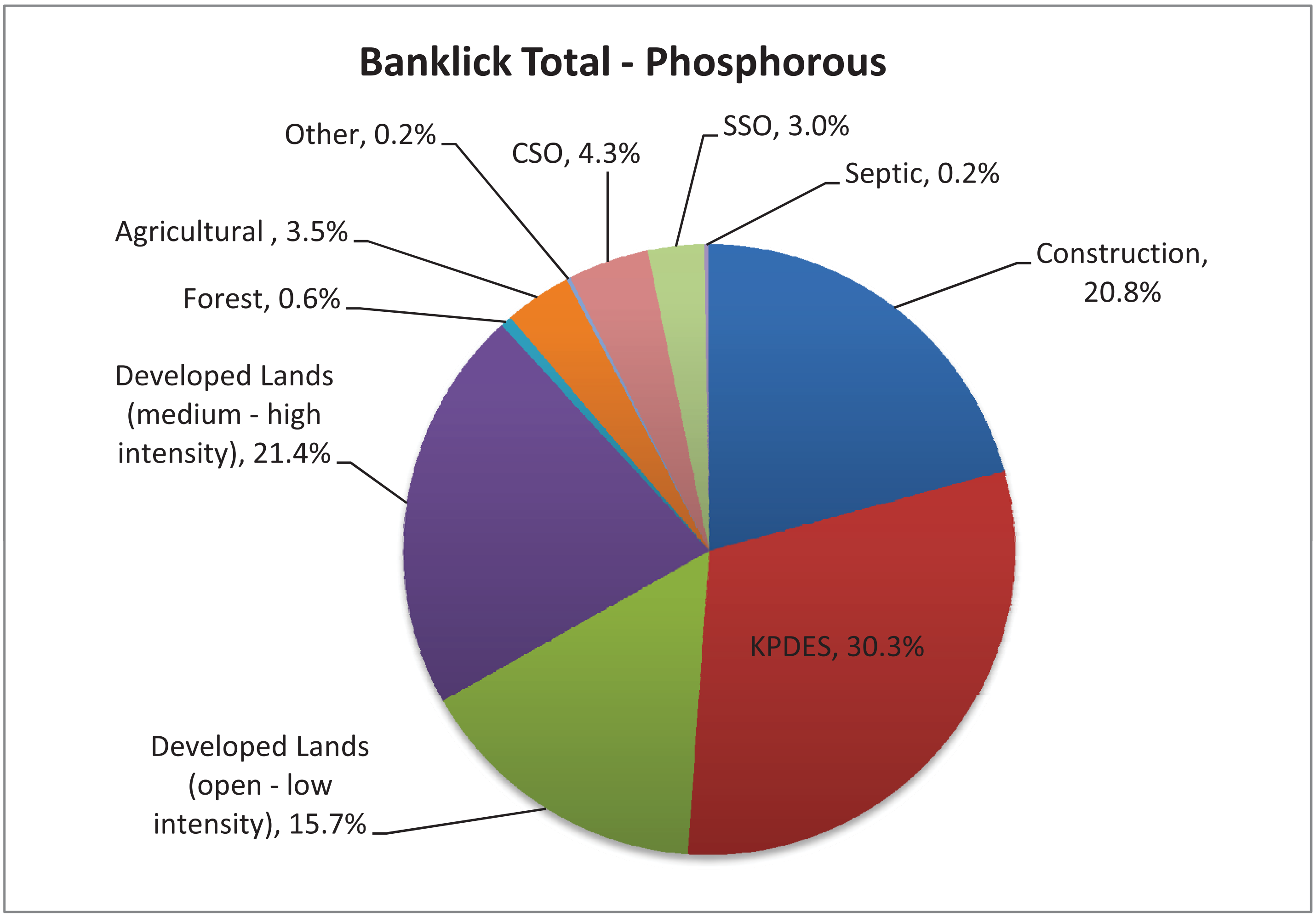
Banklick Subwatershed 09 Fecal
Developed Lands (open - low intensity), 8.9%
Septic, 1.3%
Developed Lands (medium - high intensity), 3.1%
Forest, 0.6%
Agricultural , 10.2%
Other, 5.0%
SSO, 70.8%

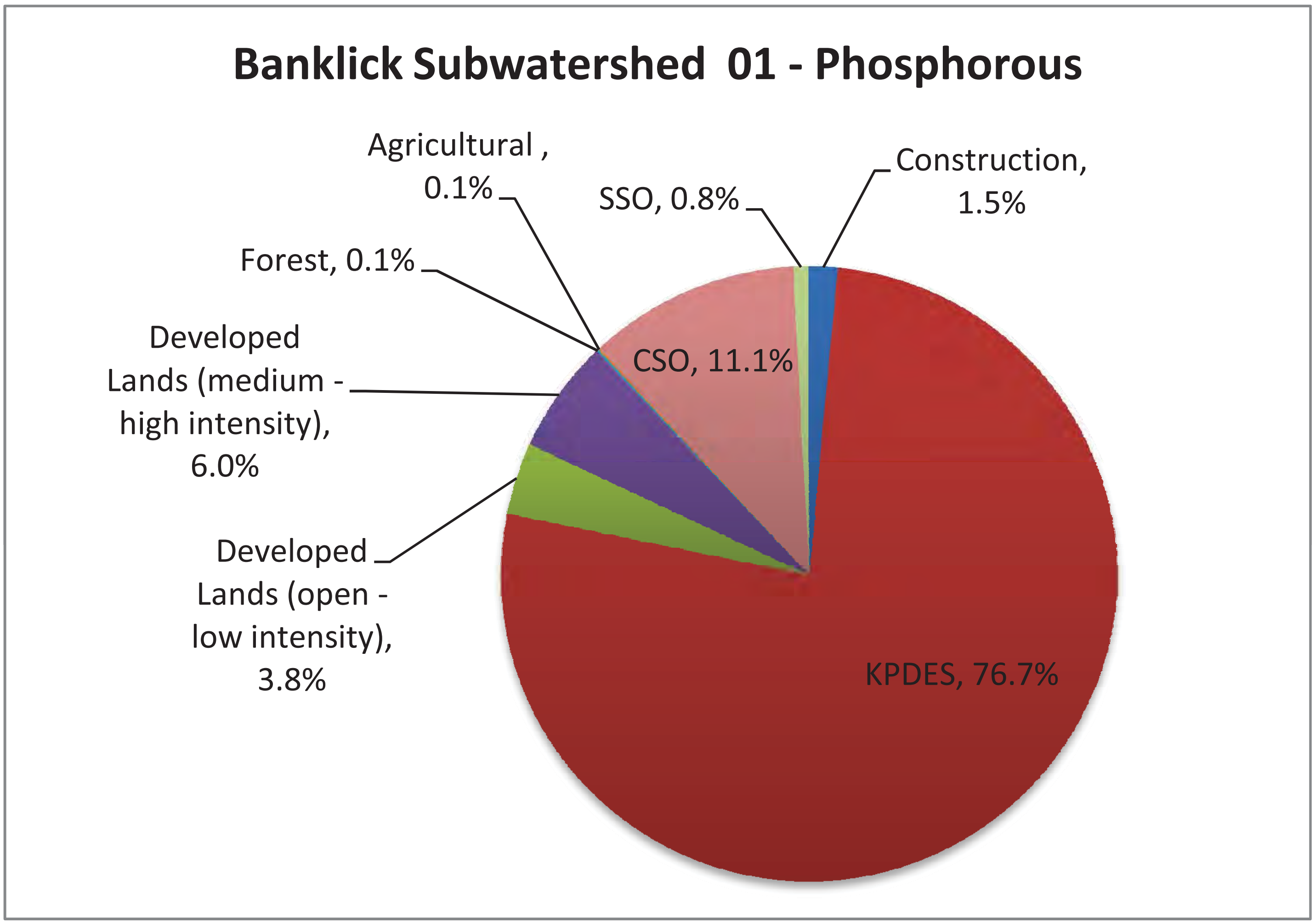

Brushy Fork Subwatershed Fecal
Septic, 4.5%
Other, 7.3%
Developed Lands (open - low intensity), 17.8%
Developed Lands (medium - high intensity), 10.2%
Forest, 0.6%
Agricultural , 59.6%

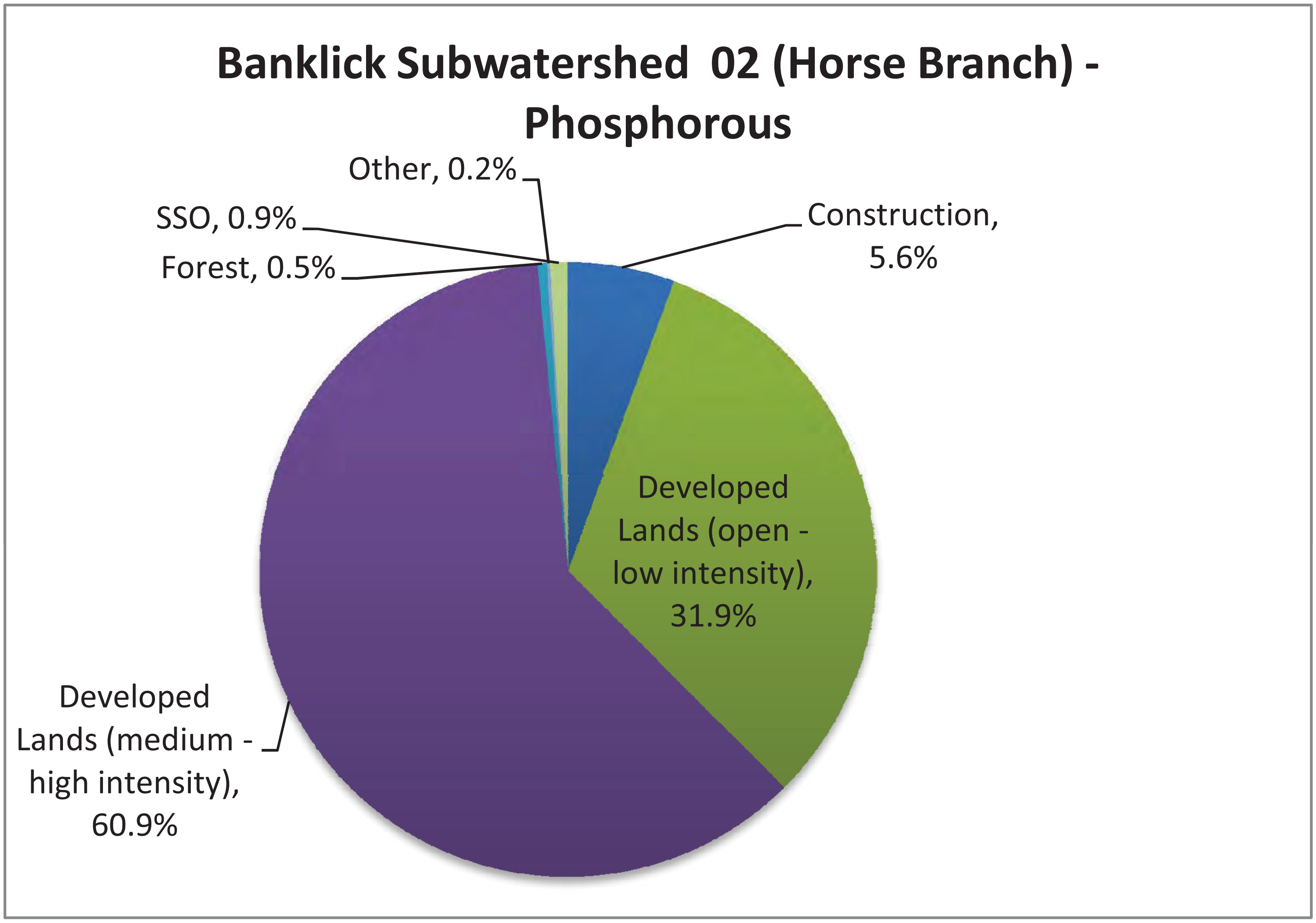

Banklick Subwatershed 11 Fecal
Developed Lands (open - low intensity), 7.7%
Developed Lands (medium - high intensity), 4.9%
Septic, 0.8%
Forest, 0.2%
Agricultural , 27.3%
SSO, 56.7%
Other, 2.4%

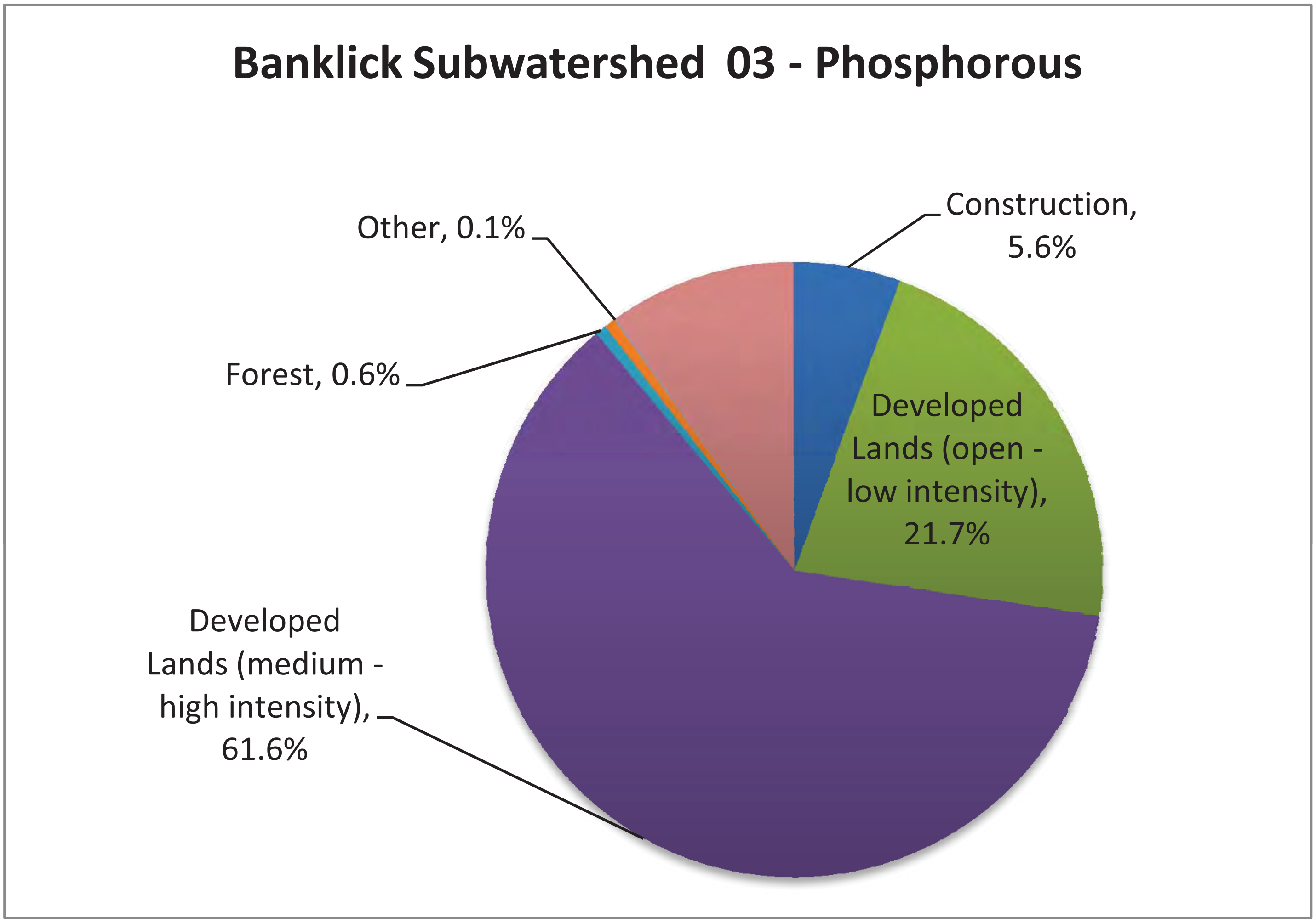

Wolf Pen Branch Subwatershed Fecal
SSO, 15.0%
Septic, 2.2%
Developed Lands (open - low intensity), 10.5%
Developed Lands (medium - high intensity), 10.4%
Other, 3.7%
Forest, 0.2%
Agricultural , 58.1%

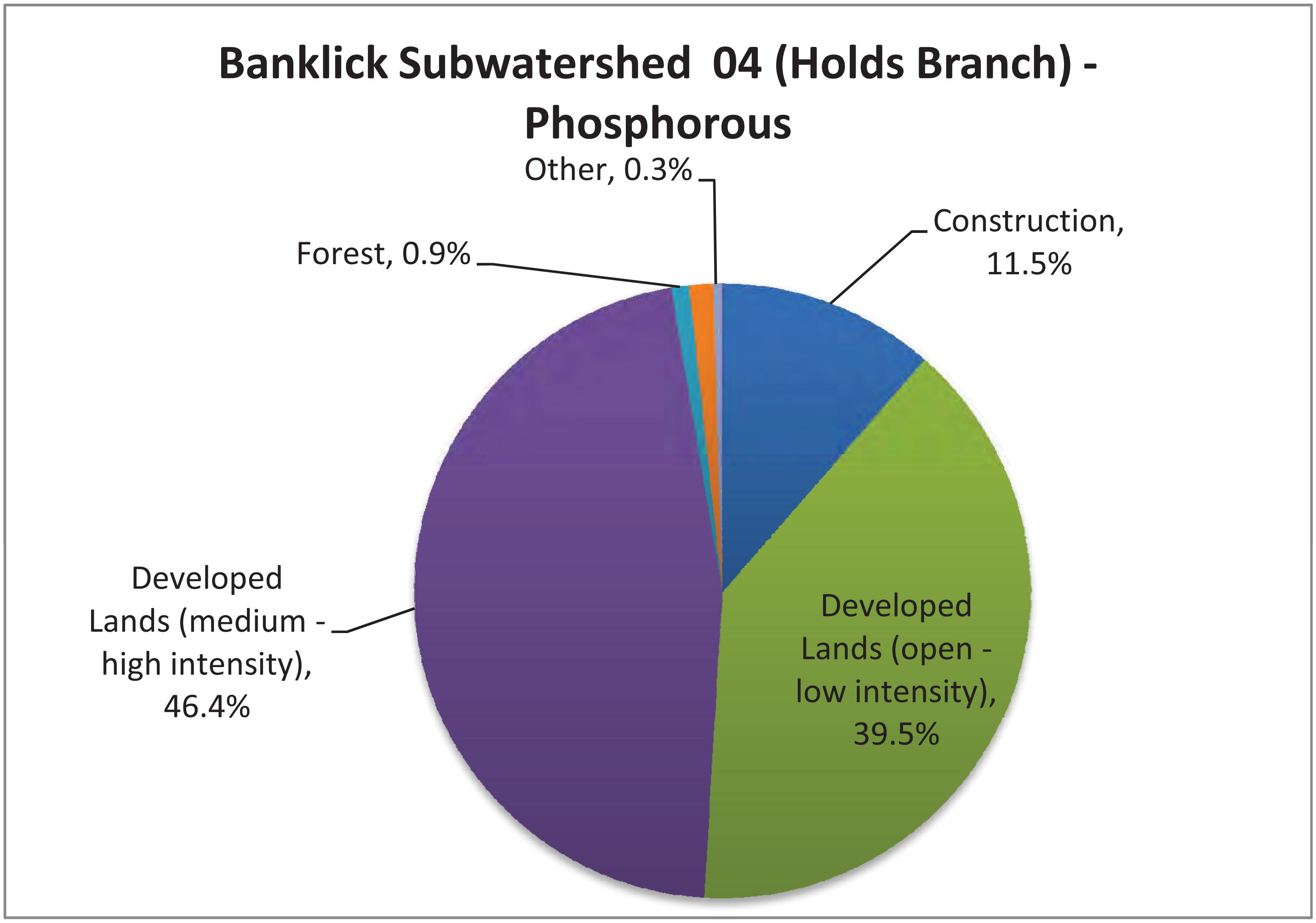

Banklick Subwatershed 13 Fecal
Developed Lands (open - low intensity), 4.3%
Forest, 0.3%
Developed Lands (medium - high intensity), 1.6%
Septic, 2.0%
Other, 3.9%
Agricultural , 87.9%

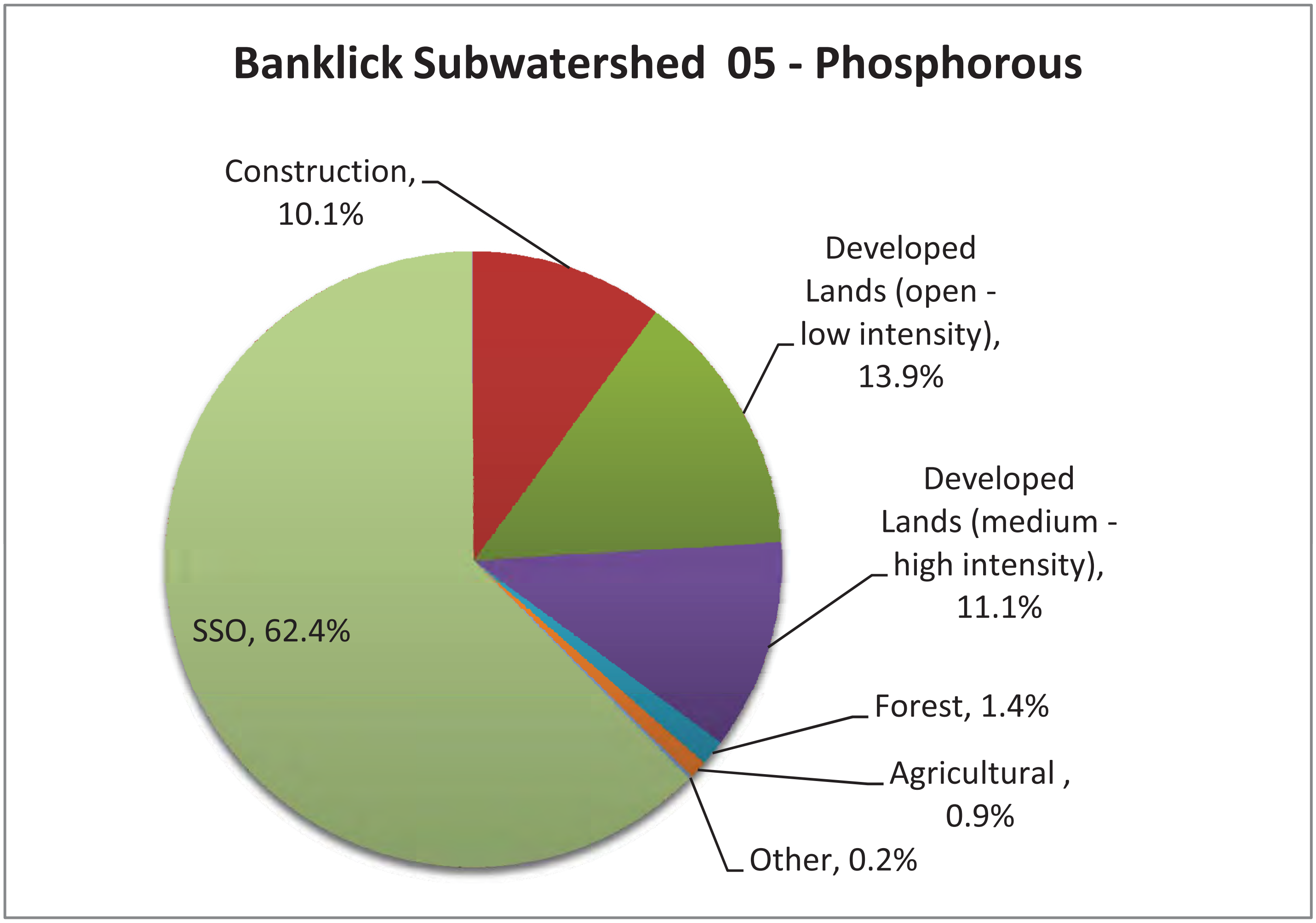

Banklick Total - Phosphorous
Other, 0.2%
CSO, 4.3%
SSO, 3.0%
Septic, 0.2%
Agricultural , 3.5%
Construction, 20.8%
Forest, 0.6%
Developed Lands (medium - high intensity), 21.4%
KPDES, 30.3%
Developed Lands (open - low intensity), 15.7%

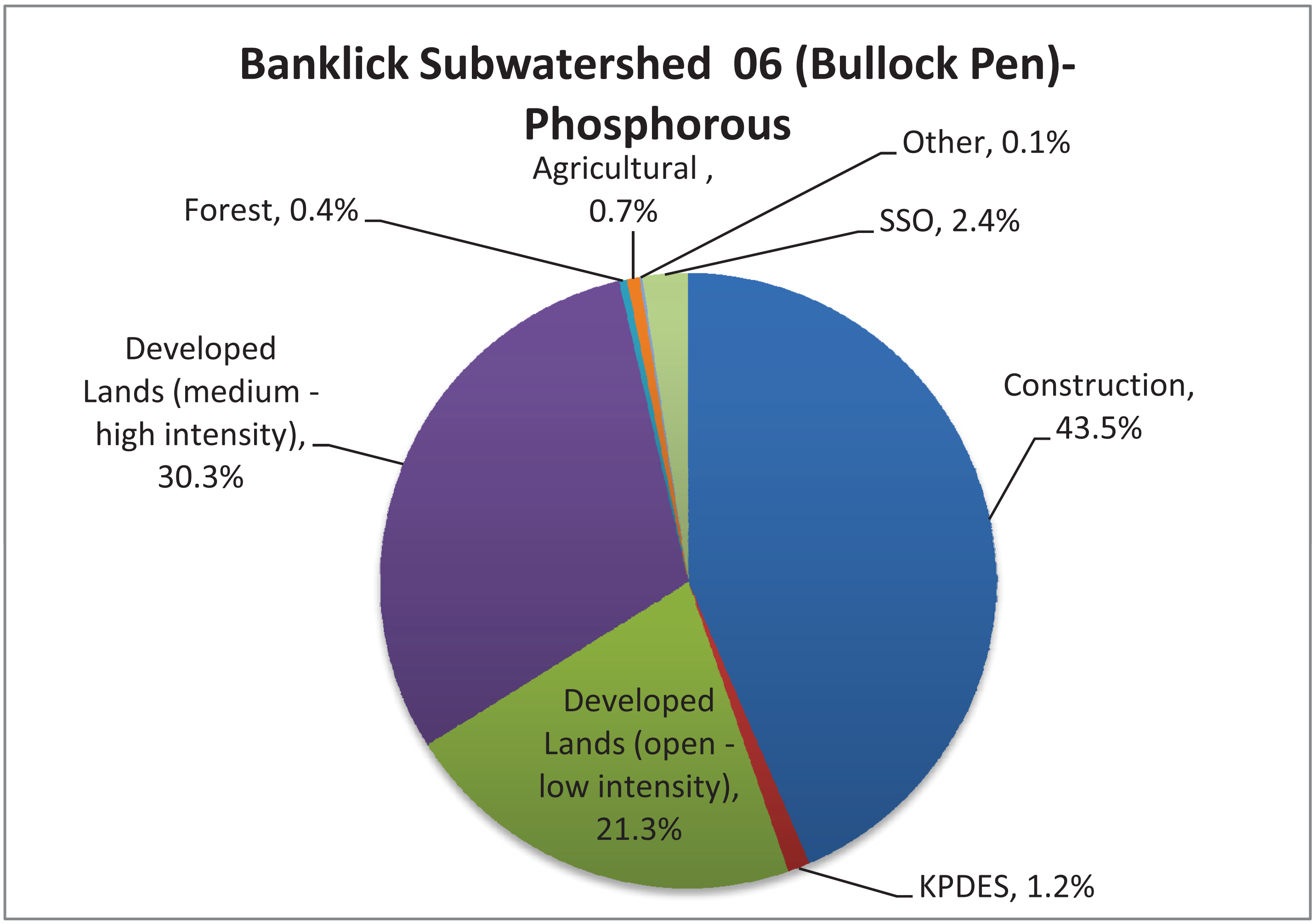

Banklick Subwatershed 01 - Phosphorous
Agricultural , 0.1%
SSO, 0.8%
Construction, 1.5%
Forest, 0.1%
Developed Lands (medium - high intensity), 6.0%
CSO, 11.1%
Developed Lands (open - low intensity), 3.8%
KPDES, 76.7%

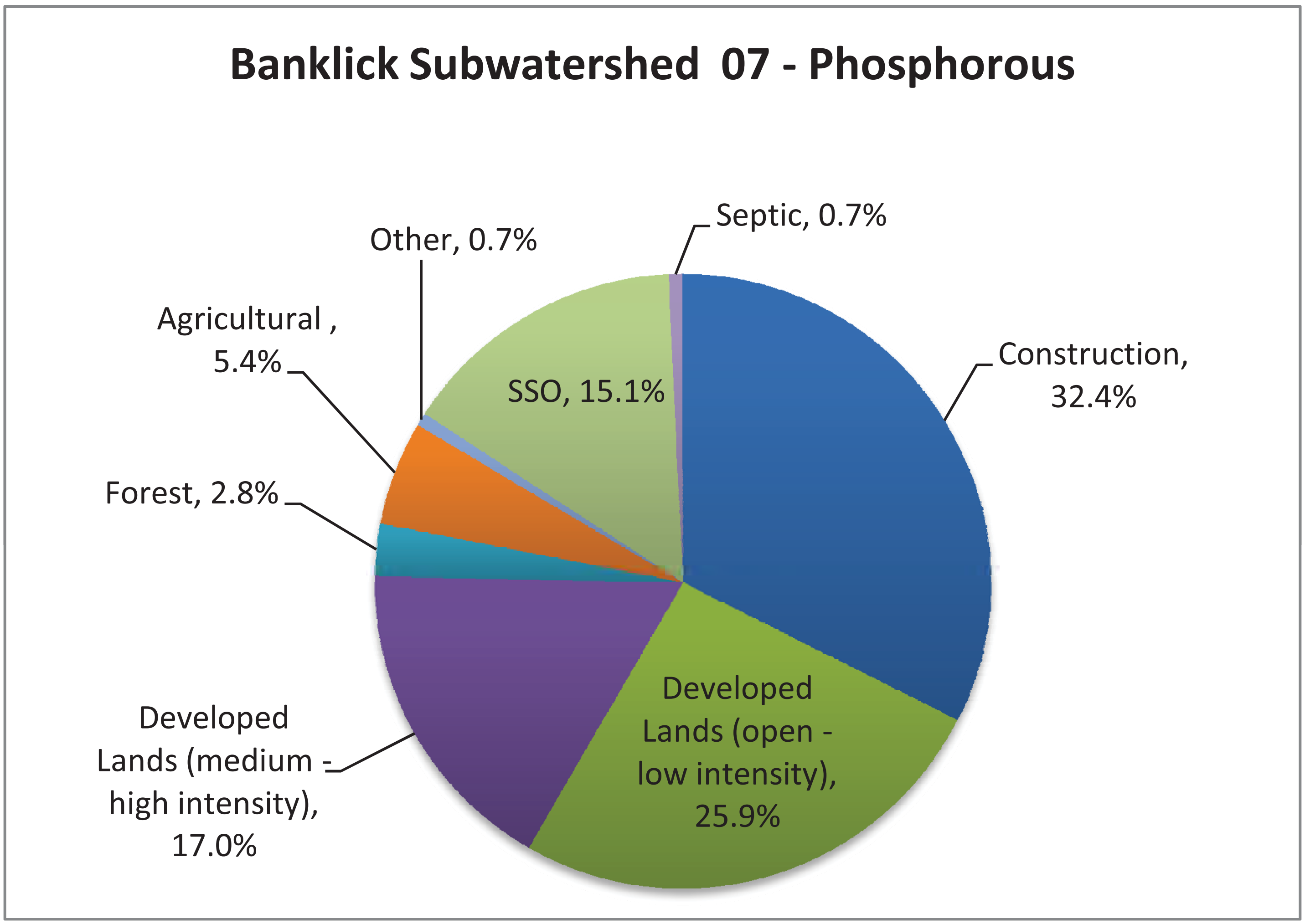

Banklick Subwatershed 02 (Horse Branch) - Phosphorous
Other, 0.2%
SSO, 0.9%
Forest, 0.5%
Construction, 5.6%
Developed Lands (open - low intensity), 31.9%
Developed Lands (medium - high intensity), 60.9%

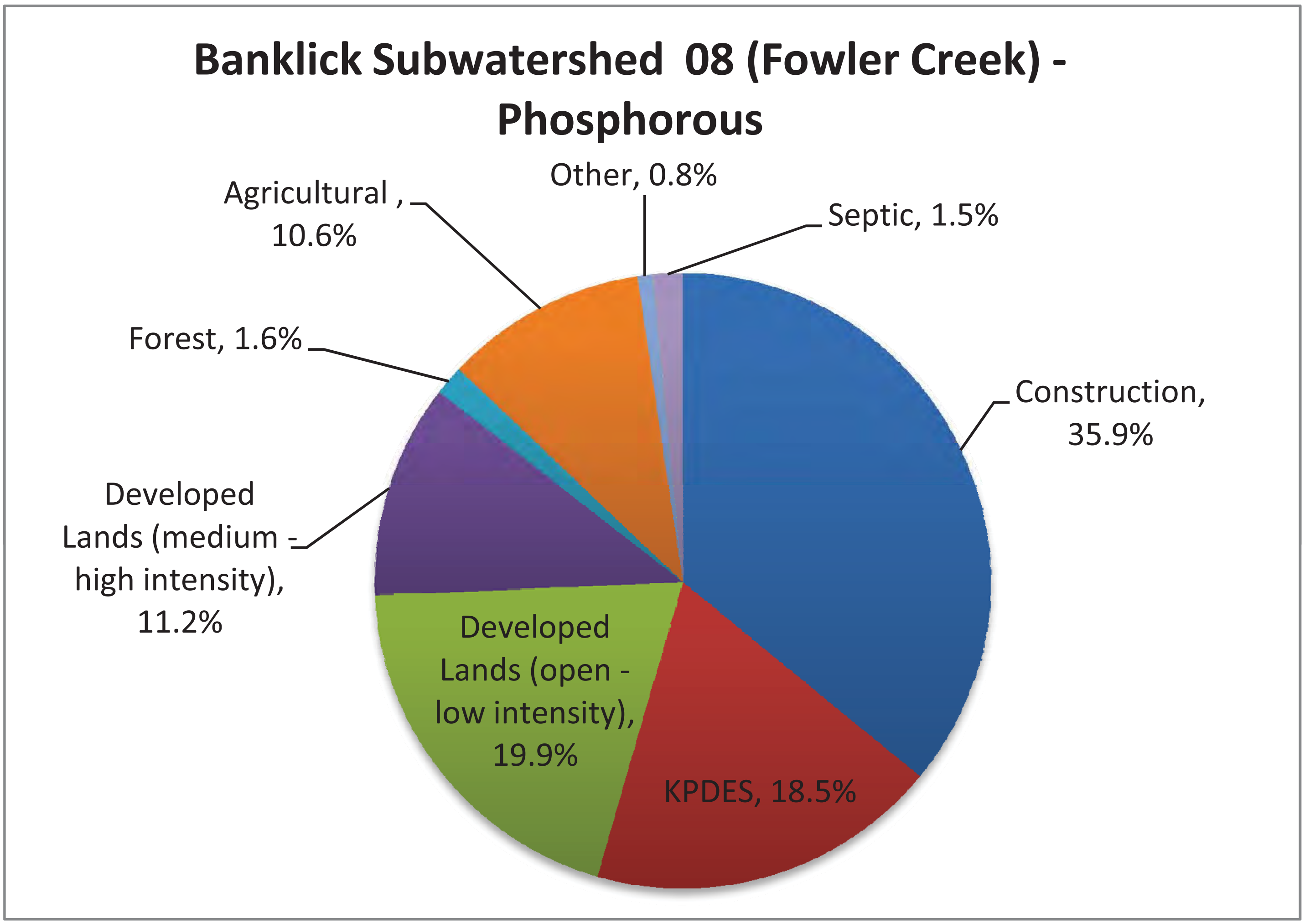

Banklick Subwatershed 03 - Phosphorous
Construction, 5.6%
Other, 0.1%
Forest, 0.6%
Developed Lands (open - low intensity), 21.7%
Developed Lands (medium - high intensity), 61.6%

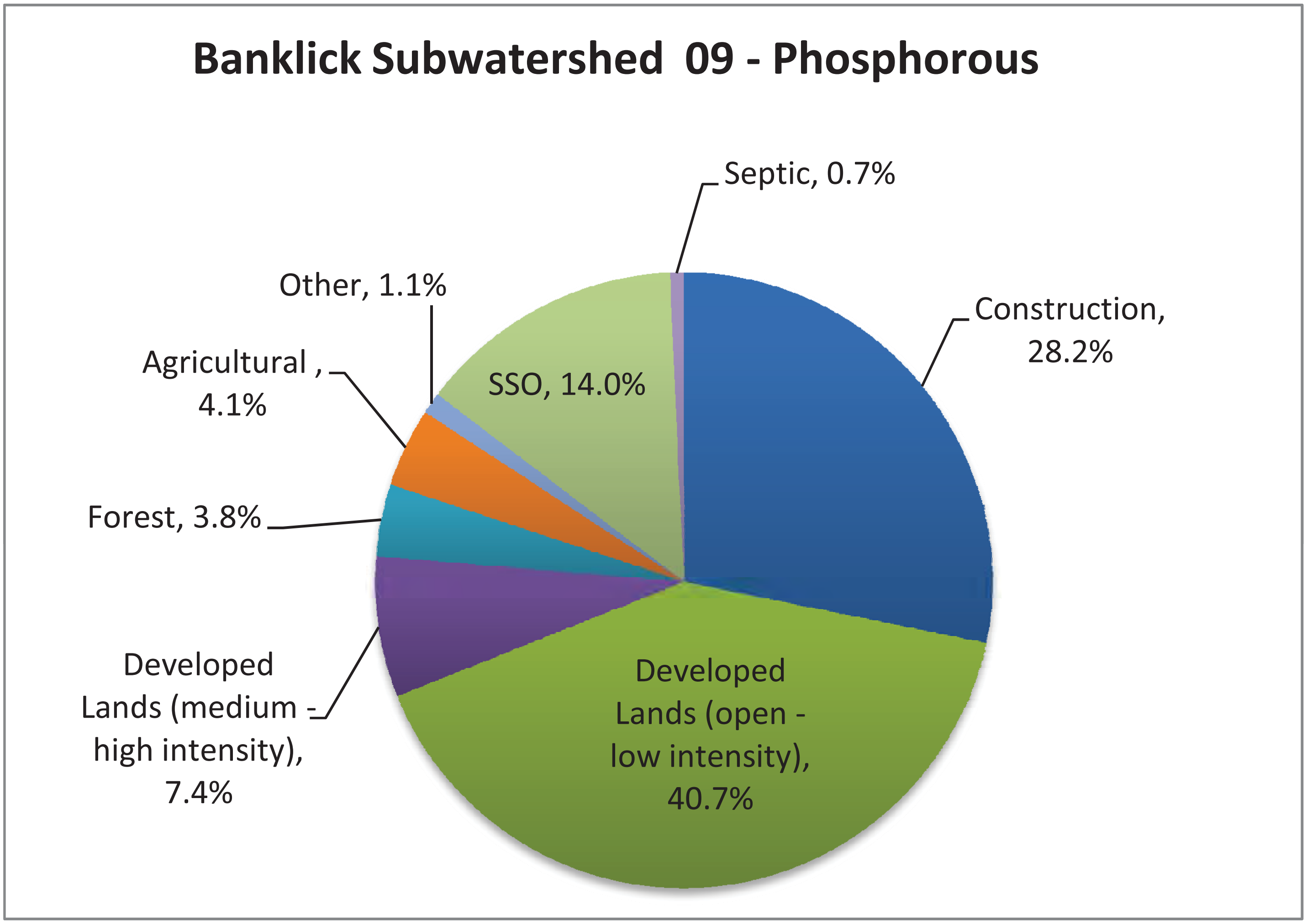

Banklick Subwatershed 04 (Holds Branch) - Phosphorous
Other, 0.3%
Construction, 11.5%
Forest, 0.9%
Developed Lands (medium - high intensity), 46.4%
Developed Lands (open - low intensity), 39.5%

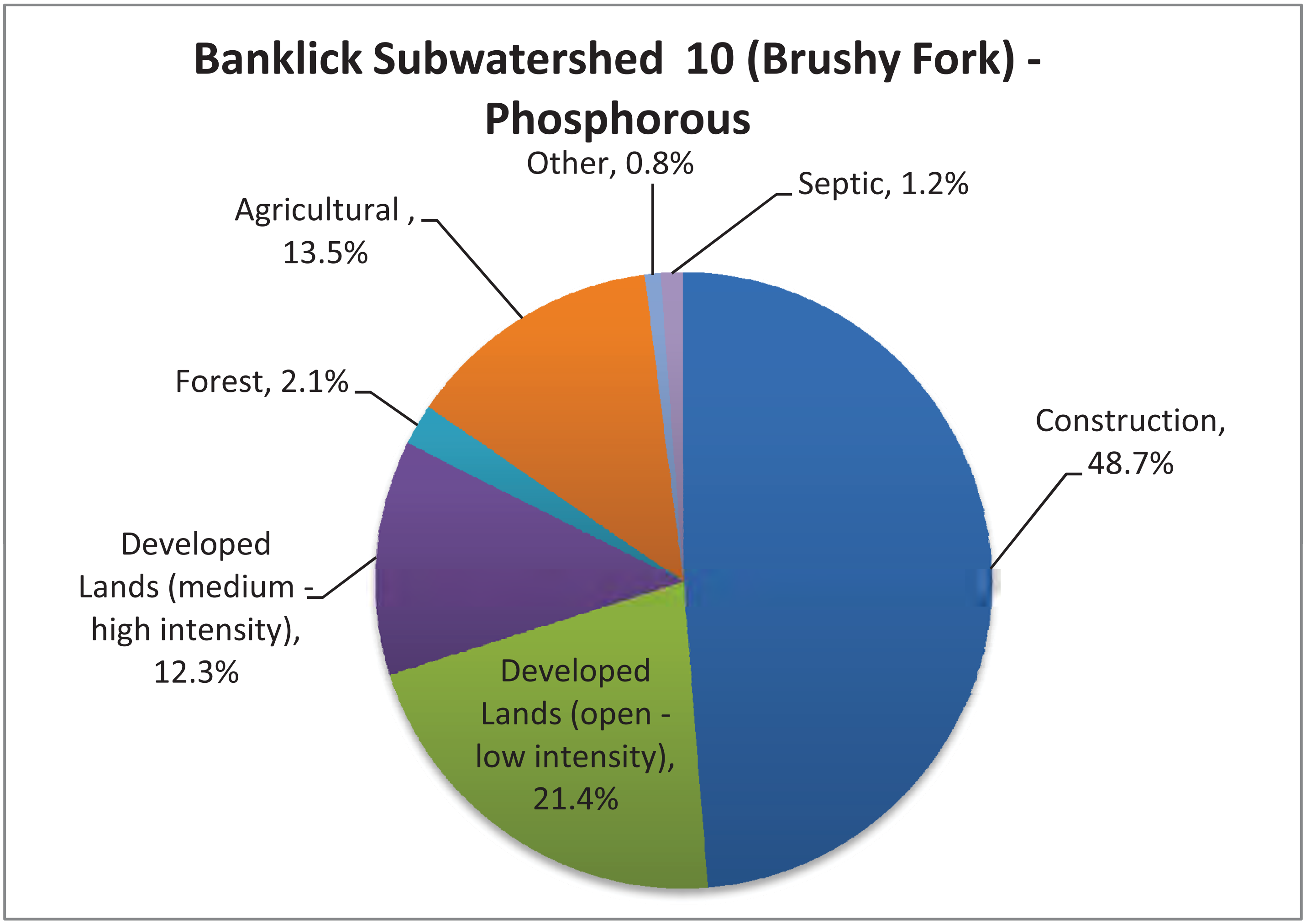

Banklick Subwatershed 05 - Phosphorous
Construction, 10.1%
Developed Lands (open - low intensity), 13.9%
Developed Lands (medium - high intensity), 11.1%
Forest, 1.4%
Agricultural , 0.9%
Other, 0.2%
SSO, 62.4%

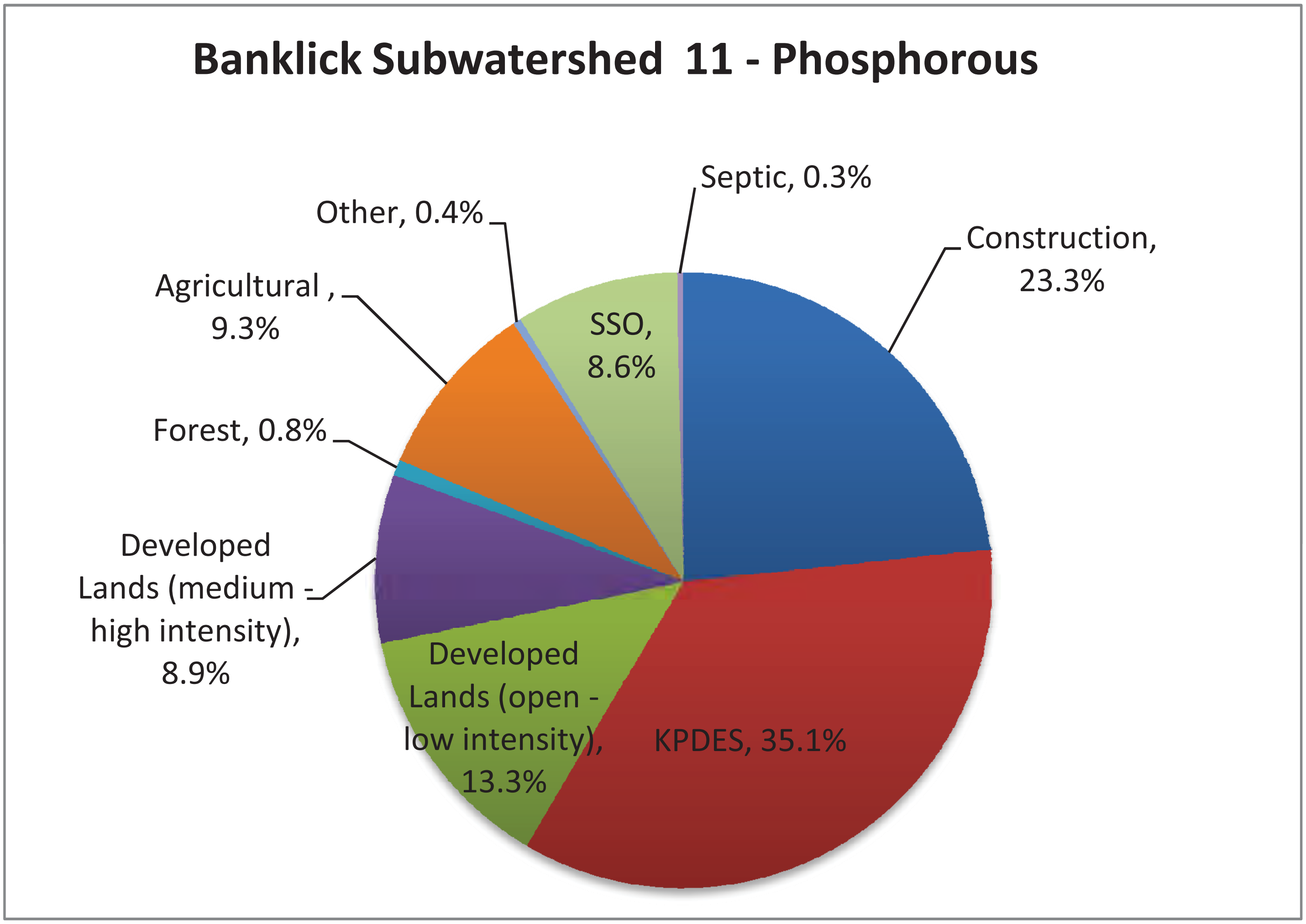

Banklick Subwatershed 06 (Bullock Pen)-
Phosphorous
Other, 0.1%
Agricultural , 0.7%
SSO, 2.4%
Forest, 0.4%
Developed Lands (medium - high intensity), 30.3%
Construction, 43.5%
Developed Lands (open - low intensity), 21.3%
KPDES, 1.2%

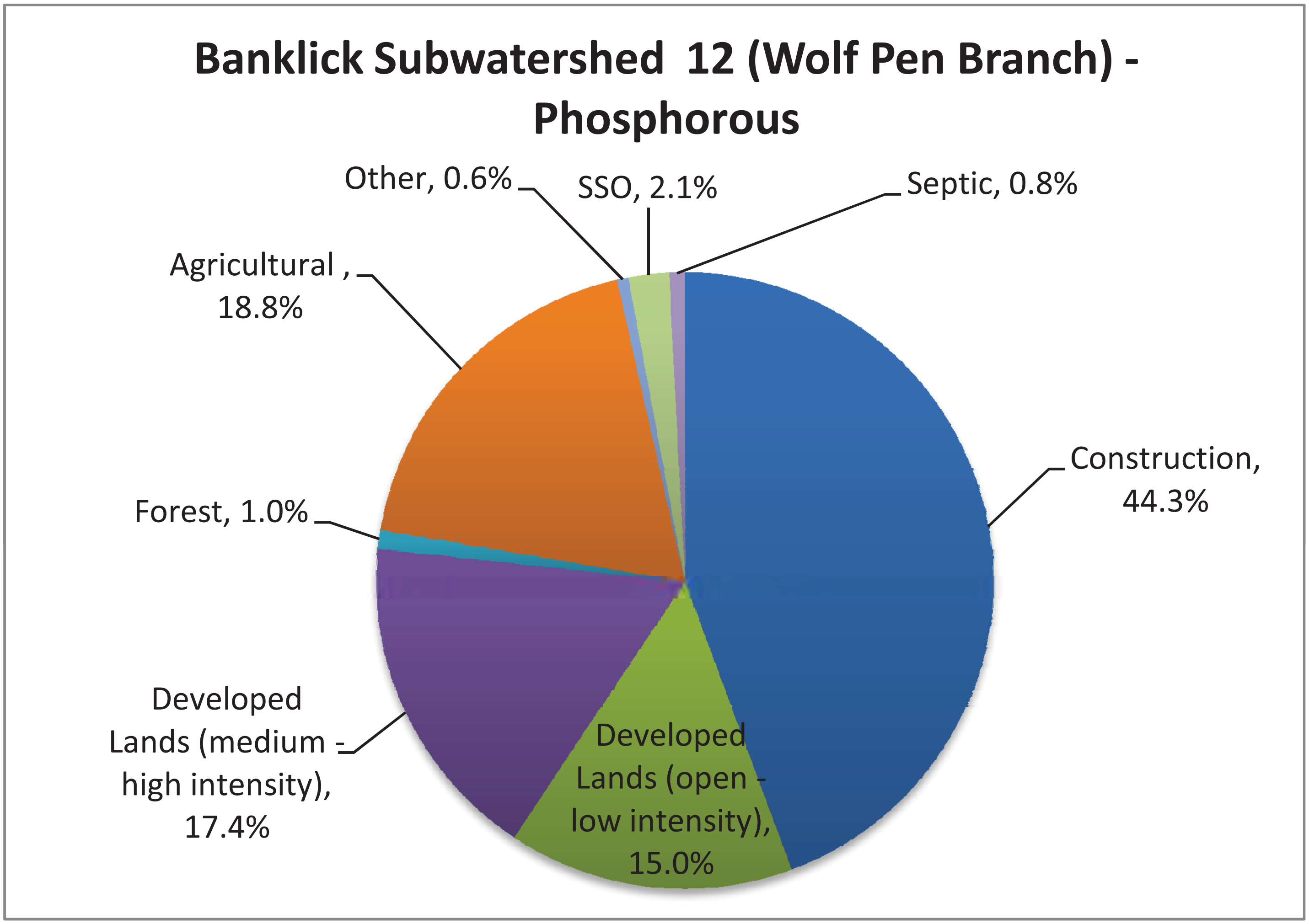

Banklick Subwatershed 07 - Phosphorous
Septic, 0.7%
Other, 0.7%
Agricultural , 5.4%
Construction, 32.4%
SSO, 15.1%
Forest, 2.8%
Developed Lands (open - low intensity), 25.9%
Developed Lands (medium - high intensity), 17.0%


Banklick Subwatershed 08 (Fowler Creek) - Phosphorous
Other, 0.8%
Septic, 1.5%
Agricultural , 10.6%
Forest, 1.6%
Construction, 35.9%
Developed Lands (medium - high intensity), 11.2%
Developed Lands (open - low intensity), 19.9%
KPDES, 18.5%

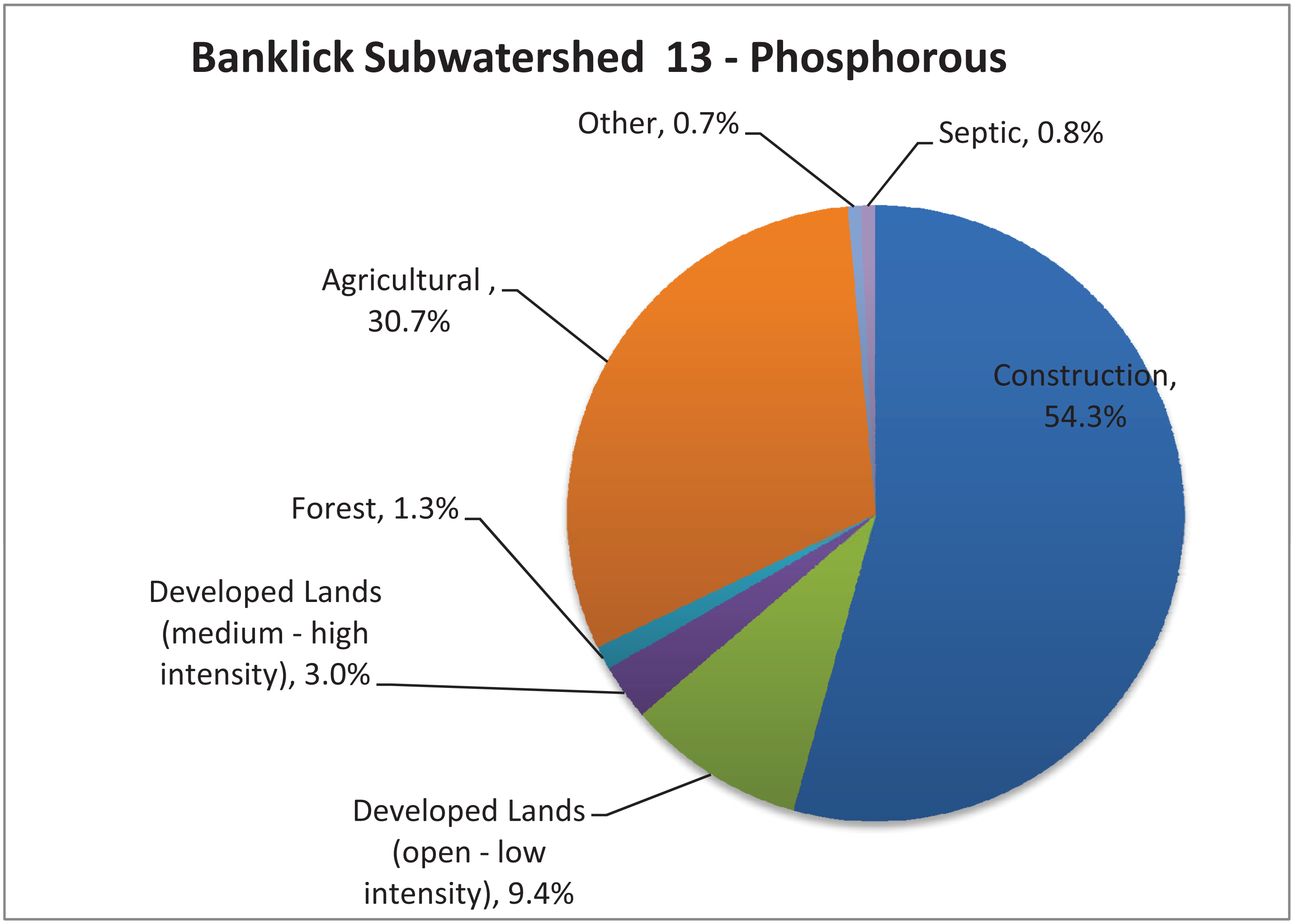

Banklick Subwatershed 09 - Phosphorous
Septic, 0.7%
Other, 1.1%
Construction, 28.2%
Agricultural , 4.1%
SSO, 14.0%
Forest, 3.8%
Developed Lands (medium - high intensity), 7.4%
Developed Lands (open - low intensity), 40.7%

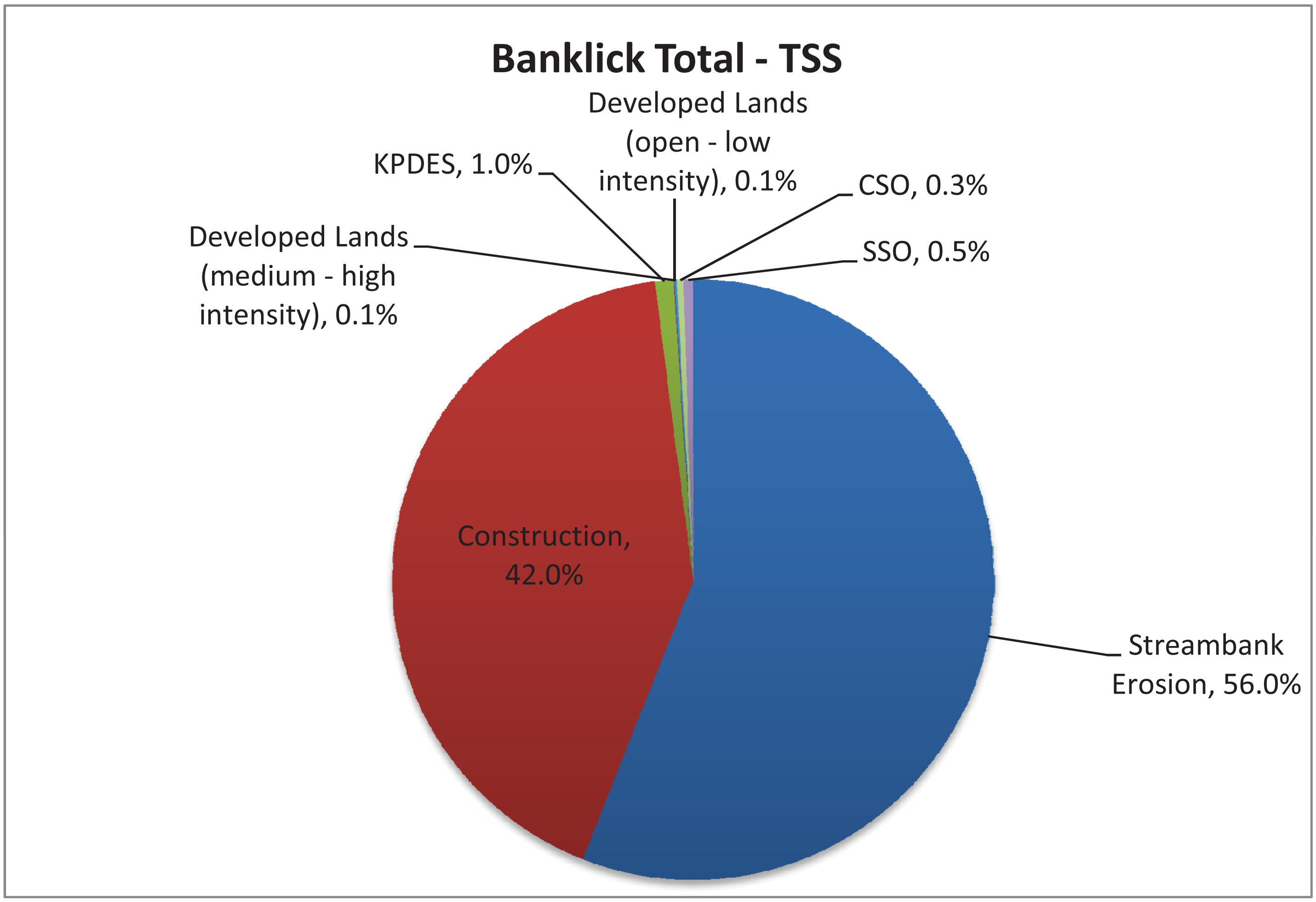

Banklick Subwatershed 10 (Brushy Fork) - Phosphorous
Other, 0.8%
Septic, 1.2%
Agricultural , 13.5%
Forest, 2.1%
Construction, 48.7%
Developed Lands (medium - high intensity), 12.3%
Developed Lands (open - low intensity), 21.4%

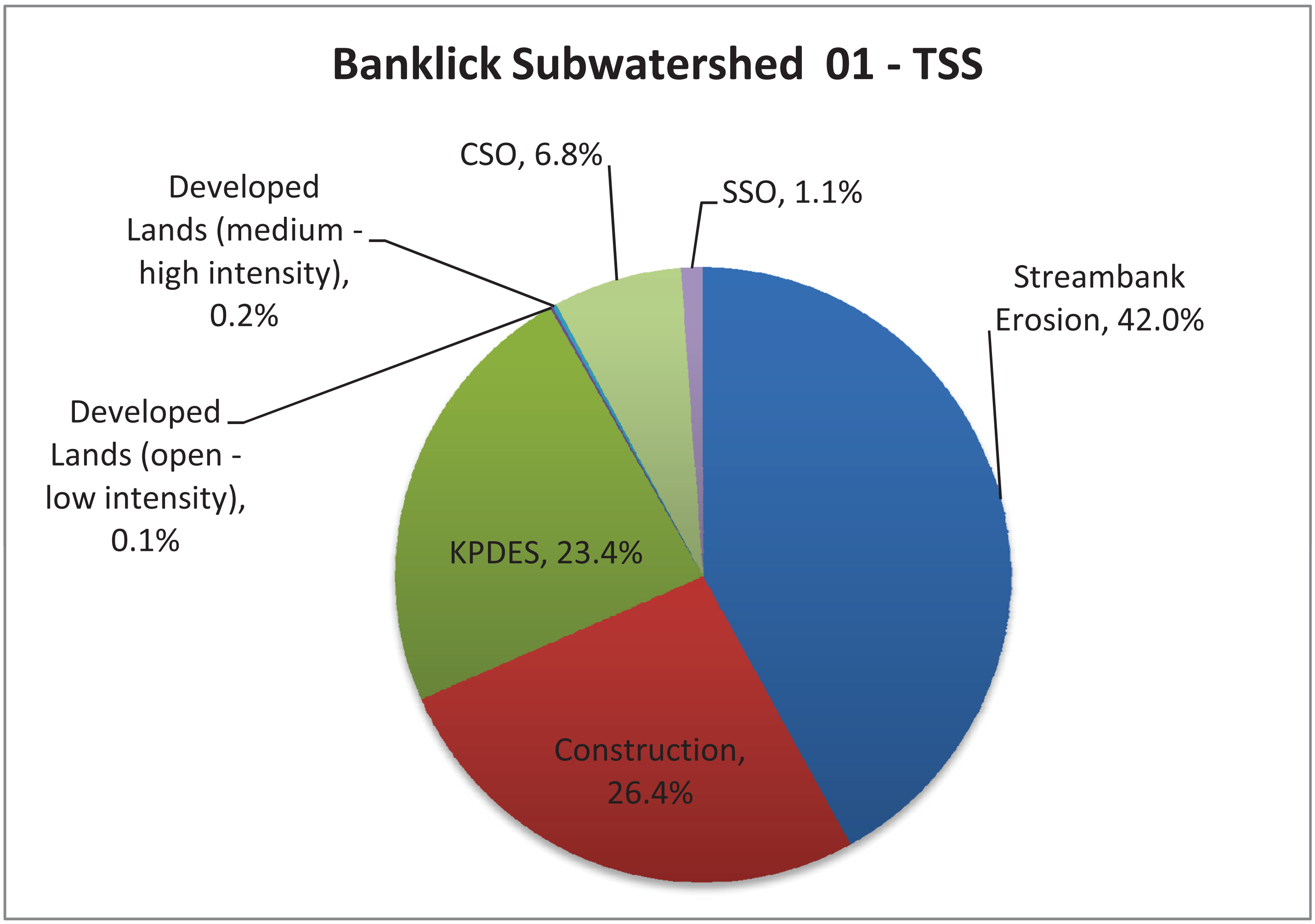

Banklick Subwatershed 11 - Phosphorous
Septic, 0.3%
Other, 0.4%
Construction, 23.3%
Agricultural , 9.3%
SSO, 8.6%
Forest, 0.8%
Developed Lands (medium - high intensity), 8.9%
Developed Lands (open - low intensity), 13.3%
KPDES, 35.1%

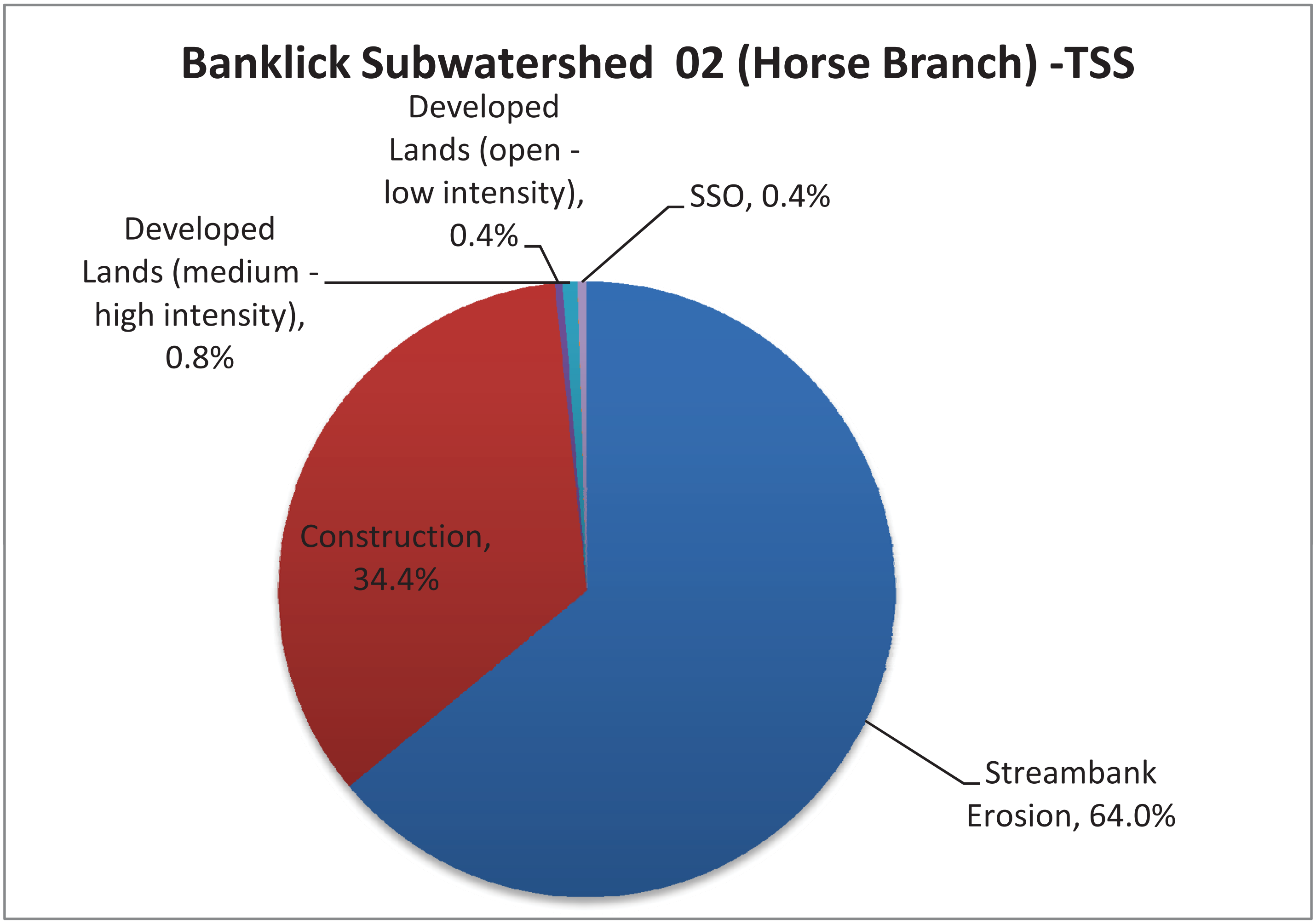


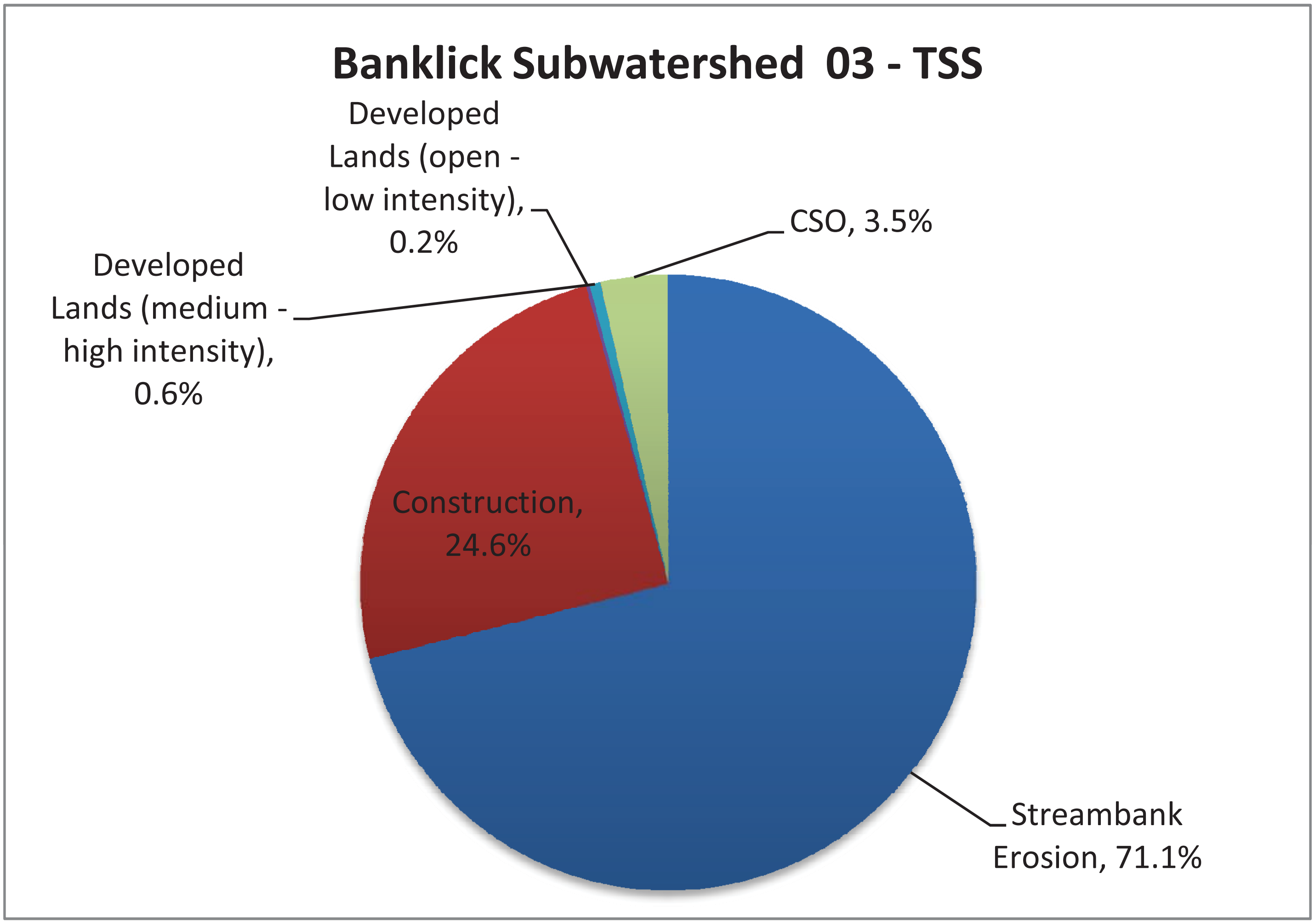
Banklick Subwatershed 12 (Wolf Pen Branch) - Phosphorous
Other, 0.6%
SSO, 2.1%
Septic, 0.8%
Agricultural , 18.8%
Construction, 44.3%
Forest, 1.0%
Developed Lands (medium - high intensity), 17.4%
Developed Lands (open - low intensity), 15.0%


Banklick Subwatershed 13 - Phosphorous
Other, 0.7%
Septic, 0.8%
Agricultural , 30.7%
Construction, 54.3%
Forest, 1.3%
Developed Lands (medium - high intensity), 3.0%
Developed Lands (open - low intensity), 9.4%

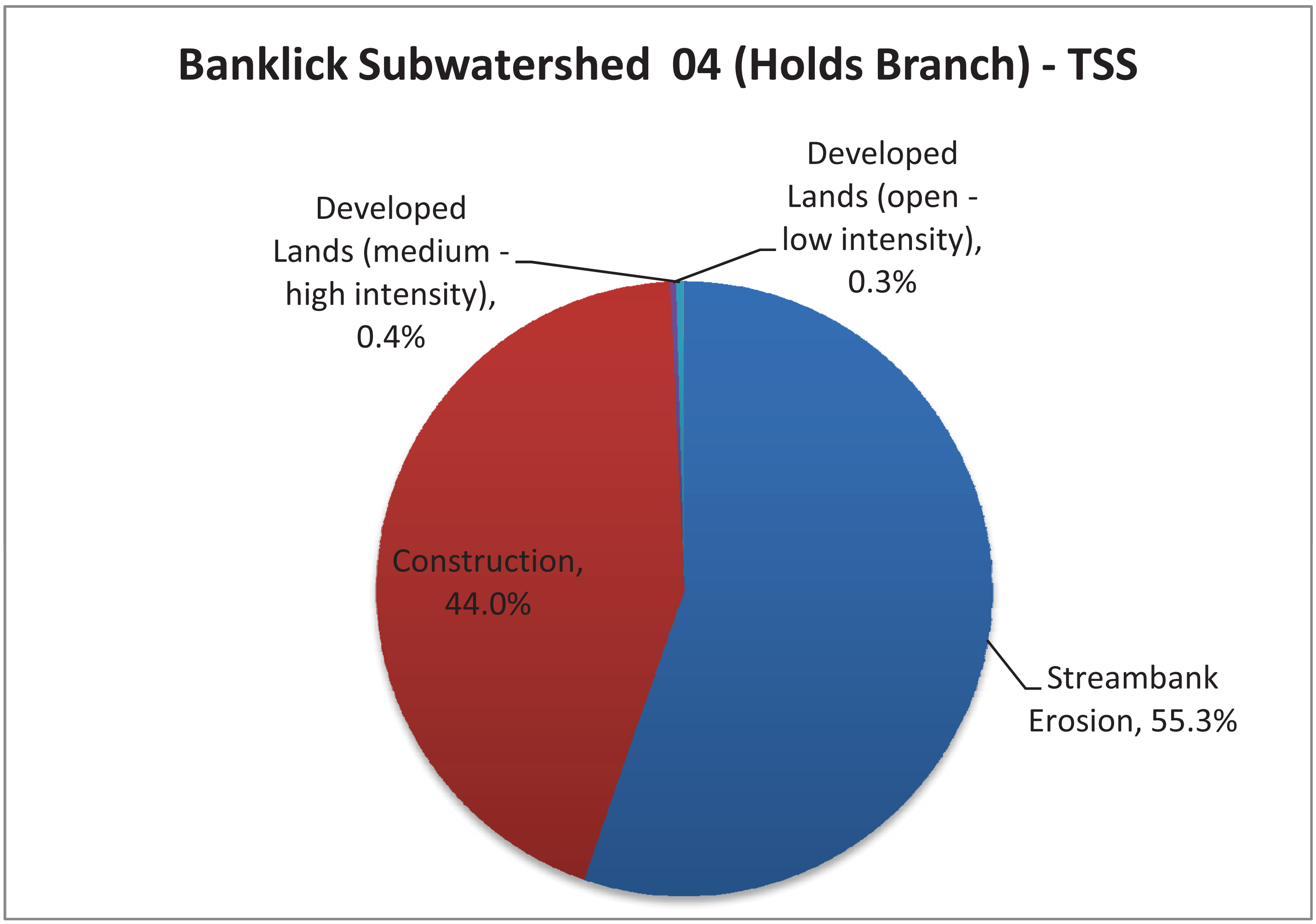

Banklick Total - TSS
Developed Lands (open - low intensity), 0.1%
KPDES, 1.0%
CSO, 0.3%
Developed Lands (medium - high intensity), 0.1%
SSO, 0.5%
Construction, 42.0%
Streambank Erosion, 56.0%

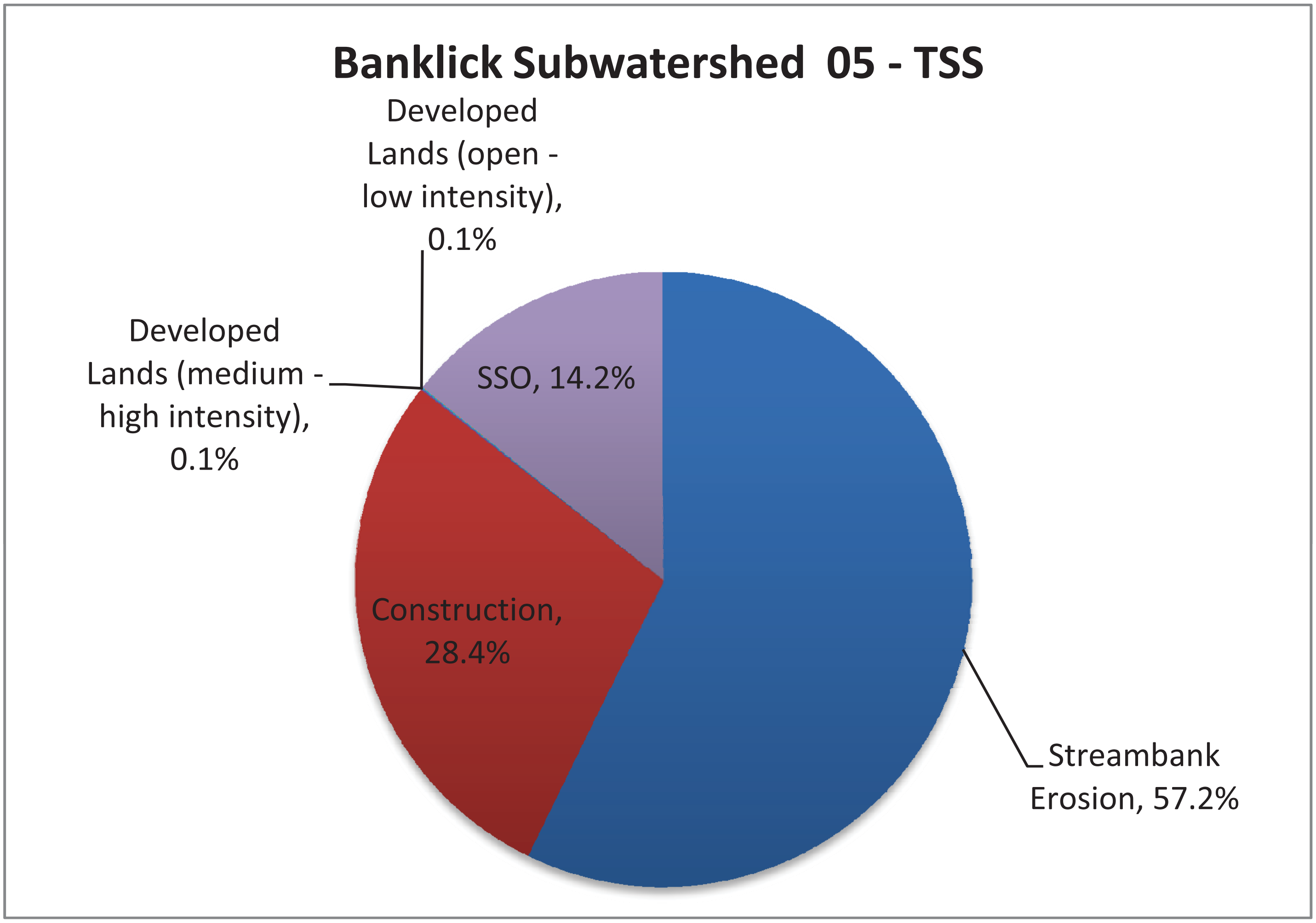

Banklick Subwatershed 01 - TSS
CSO, 6.8%
SSO, 1.1%
Developed Lands (medium - high intensity), 0.2%
Streambank Erosion, 42.0%
Developed Lands (open - low intensity), 0.1%
KPDES, 23.4%
Construction, 26.4%

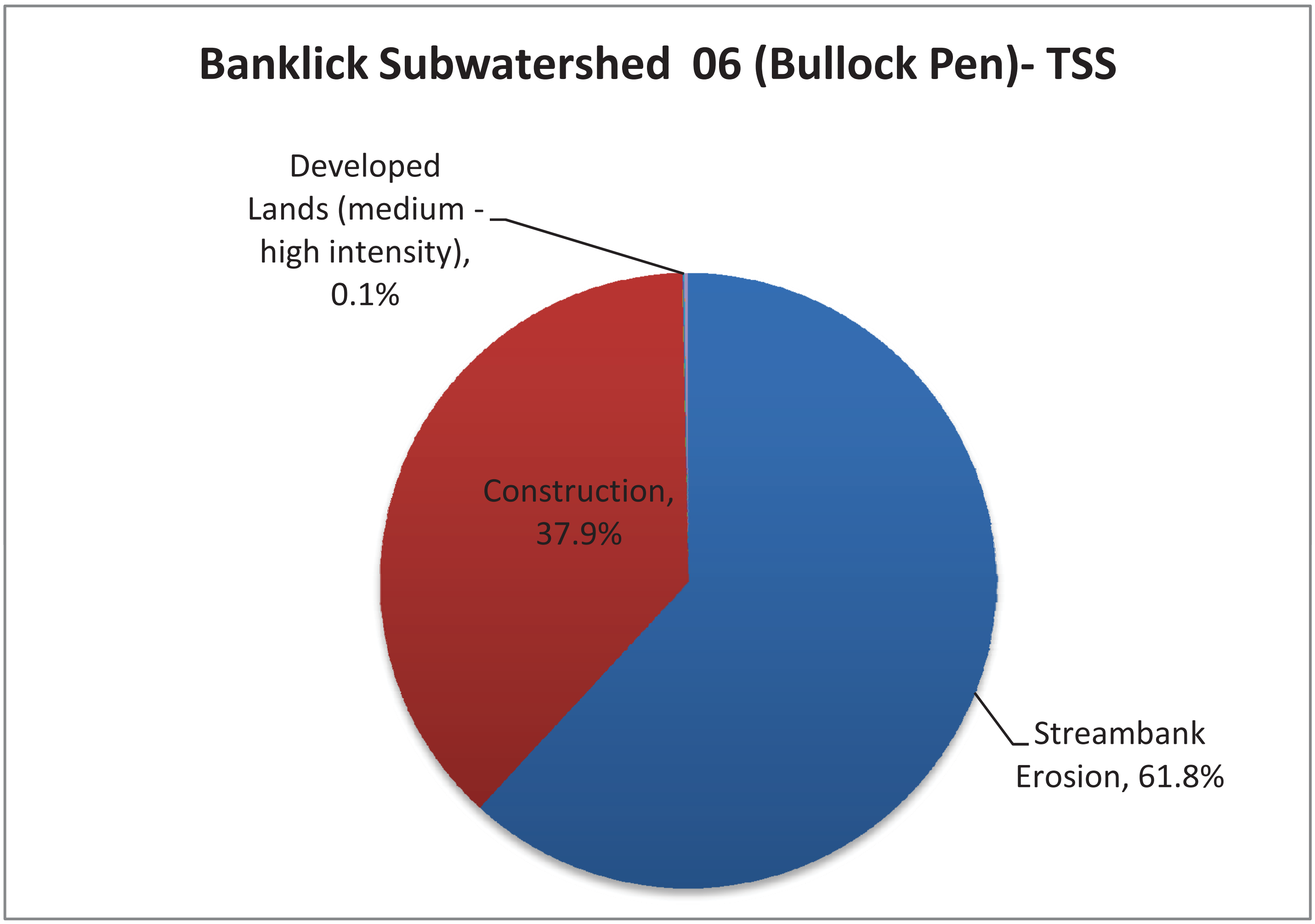

Banklick Subwatershed 02 (Horse Branch) -TSS
Developed Lands (open - low intensity), 0.4%
SSO, 0.4%
Developed Lands (medium - high intensity), 0.8%
Construction, 34.4%
Streambank Erosion, 64.0%



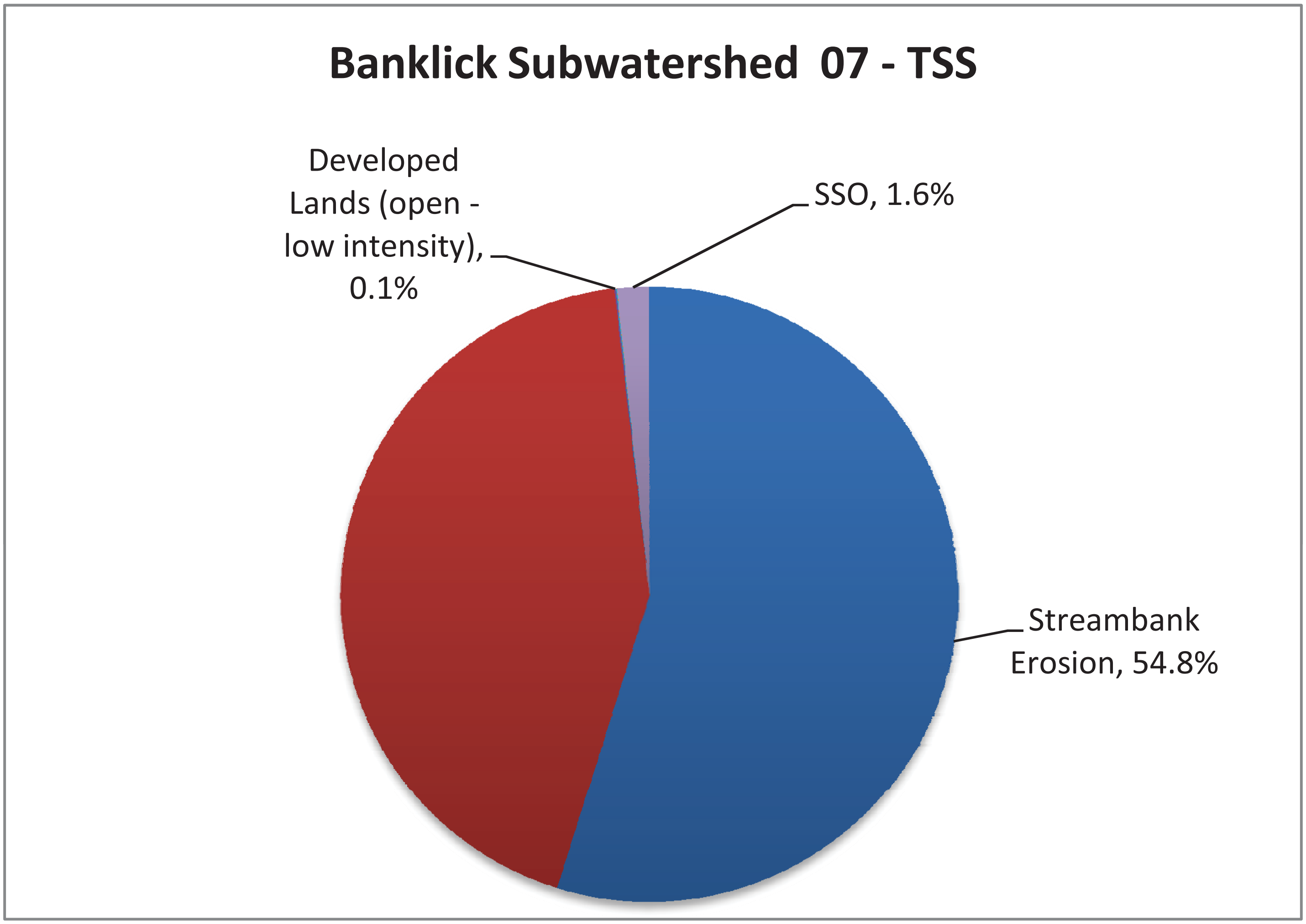
Banklick Subwatershed 03 - TSS
Developed Lands (open - low intensity), 0.2%
CSO, 3.5%
Developed Lands (medium - high intensity), 0.6%
Construction, 24.6%
Streambank Erosion, 71.1%

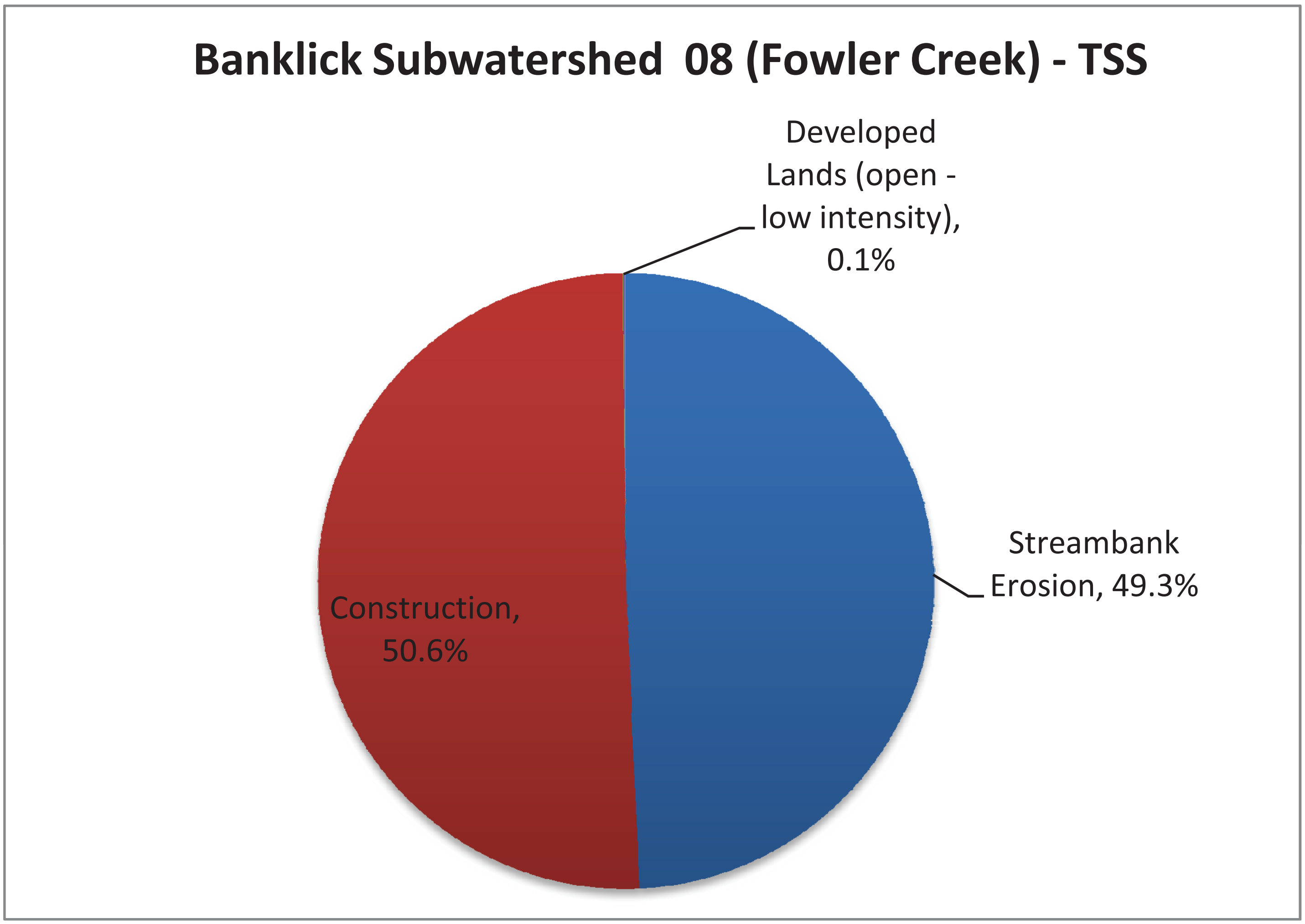

Banklick Subwatershed 04 (Holds Branch) - TSS
Developed Lands (medium - high intensity), 0.4%
Developed Lands (open - low intensity), 0.3%
Construction, 44.0%
Streambank Erosion, 55.3%

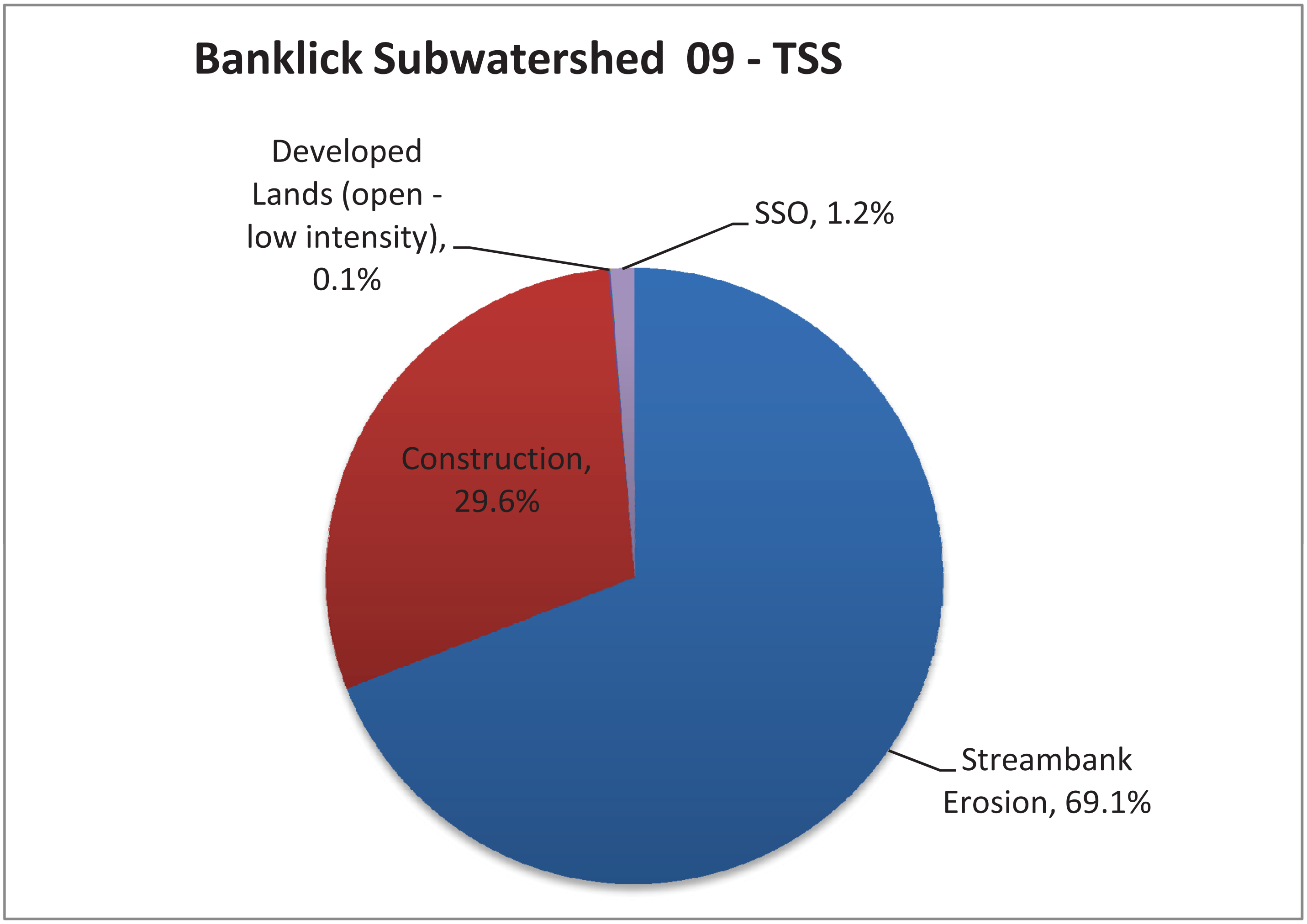

Banklick Subwatershed 05 - TSS
Developed Lands (open - low intensity), 0.1%
Developed Lands (medium - high intensity), 0.1%
SSO, 14.2%
Construction, 28.4%
Streambank Erosion, 57.2%

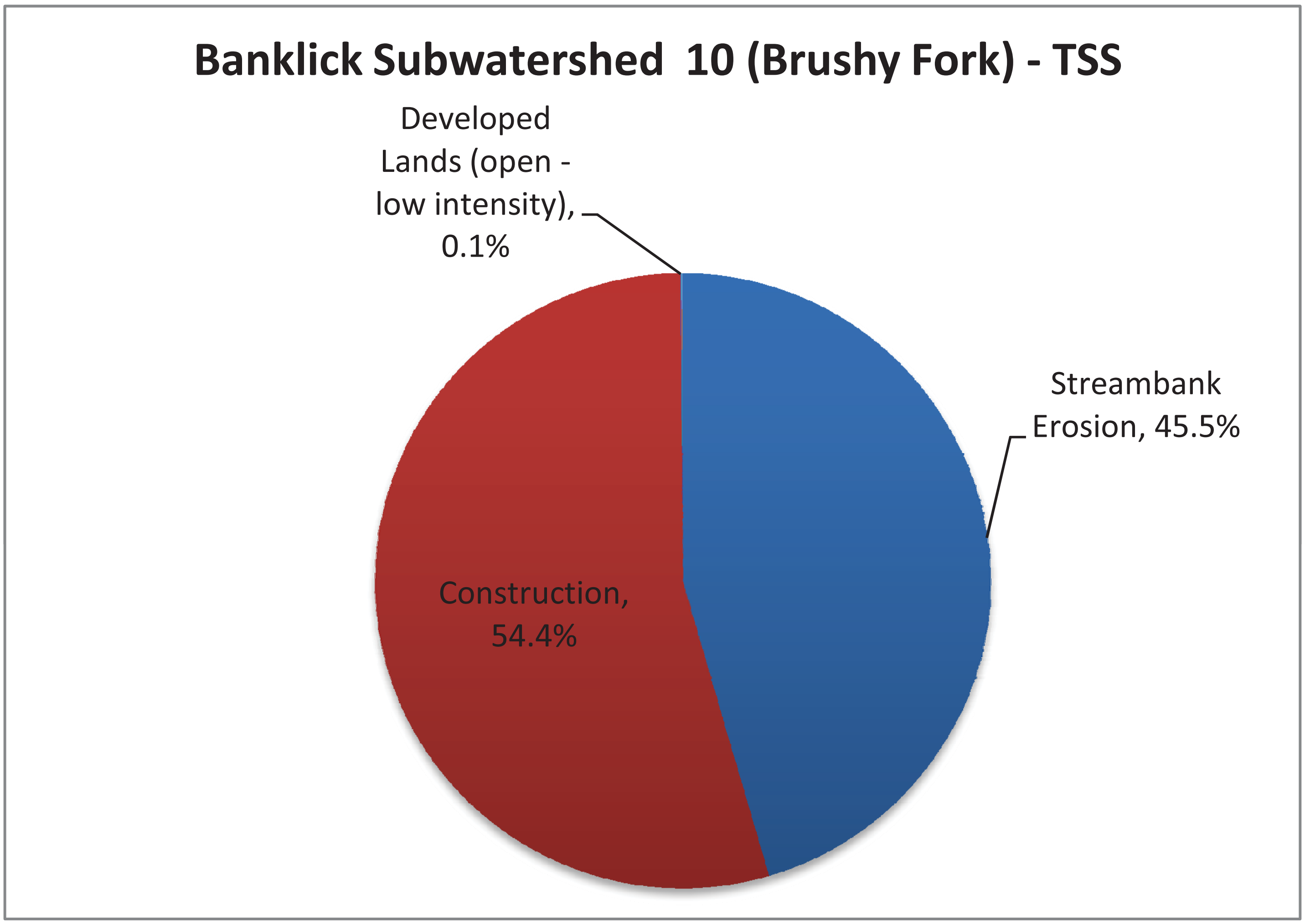


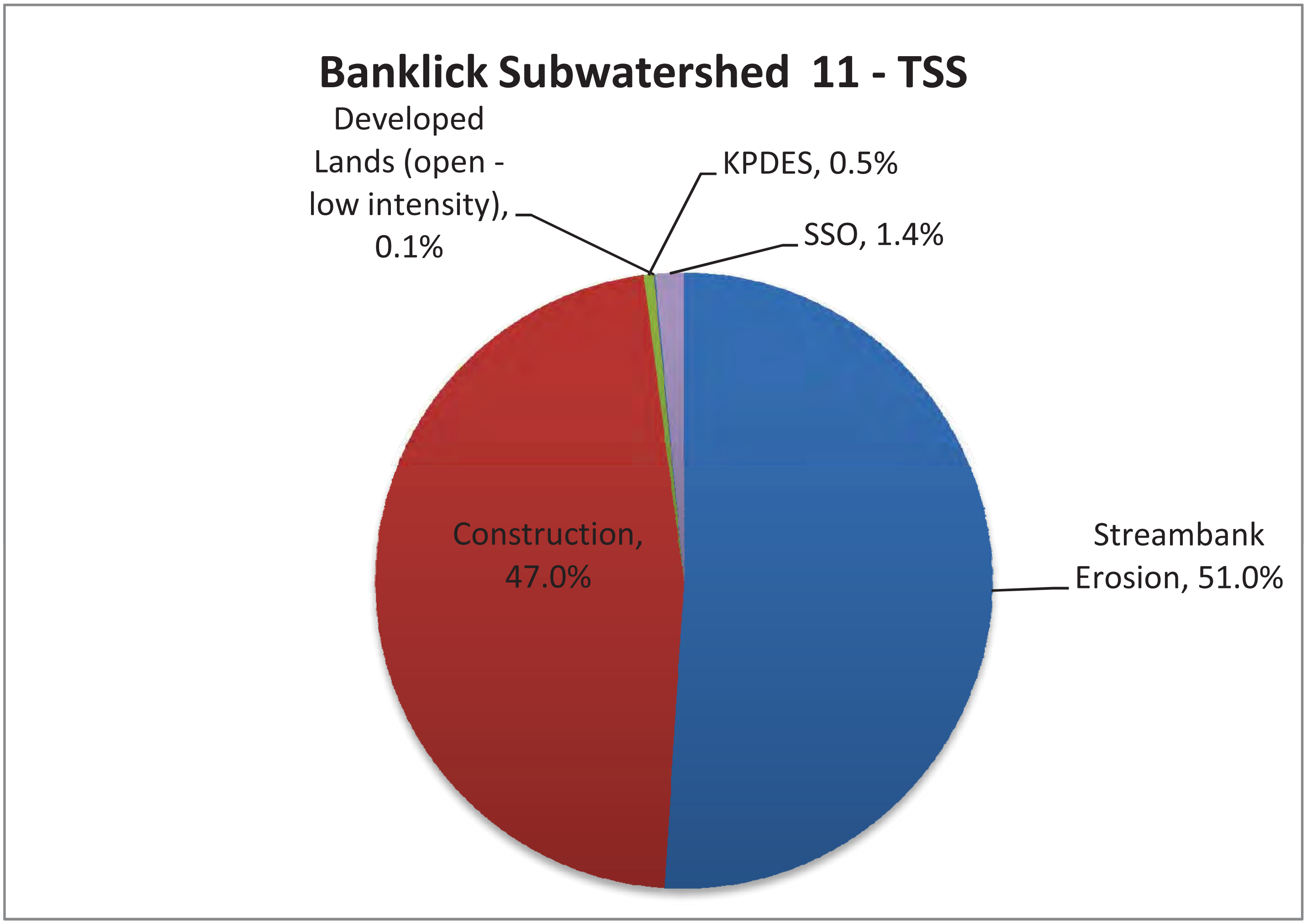
Banklick Subwatershed 06 (Bullock Pen)- TSS
Developed Lands (medium - high intensity), 0.1%
Construction, 37.9%
Streambank Erosion, 61.8%

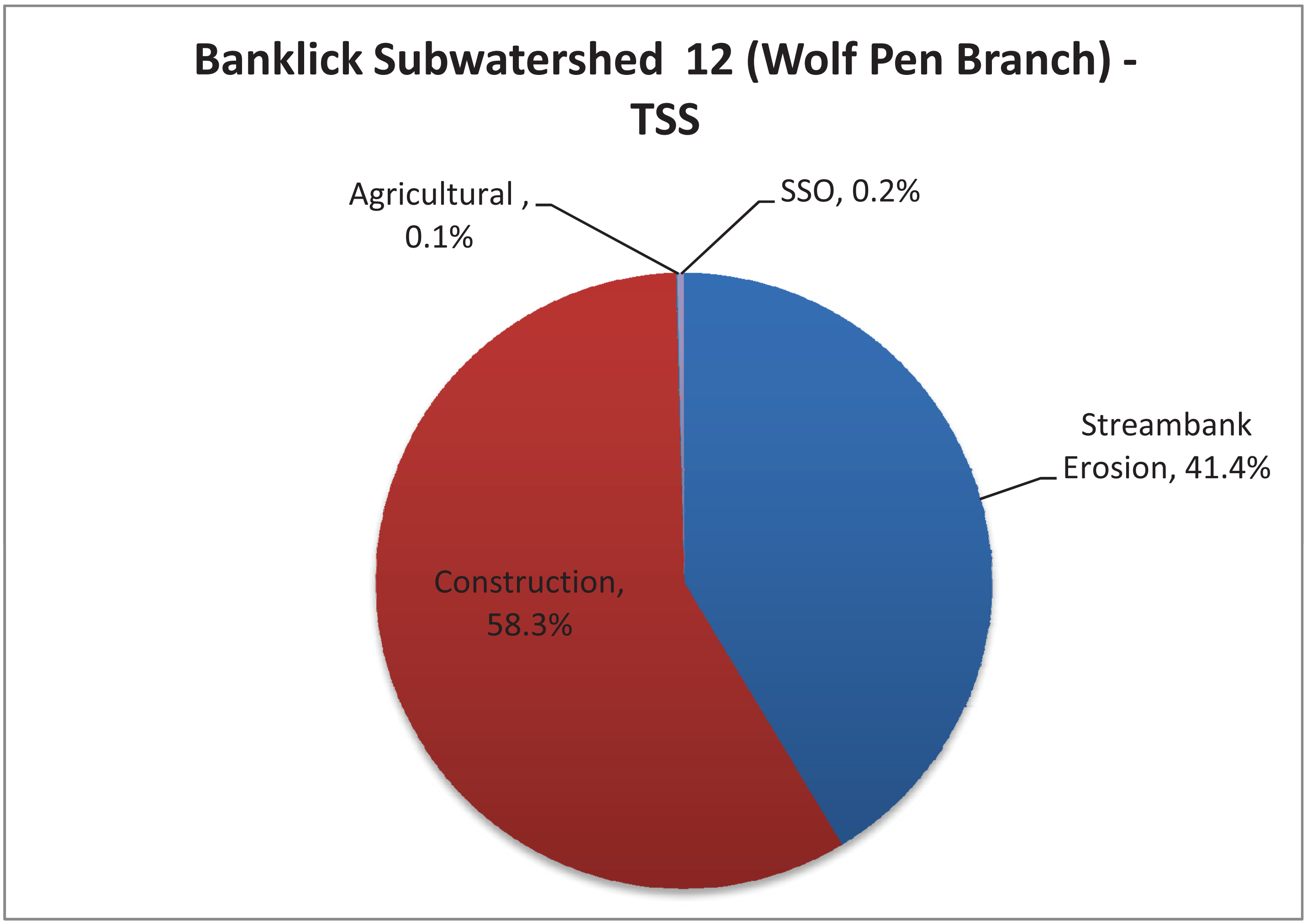

Banklick Subwatershed 07 - TSS
Developed Lands (open - low intensity), 0.1%
SSO, 1.6%
Streambank Erosion, 54.8%


Banklick Subwatershed 08 (Fowler Creek) - TSS
Developed Lands (open - low intensity), 0.1%
Streambank Erosion, 49.3%
Construction, 50.6%

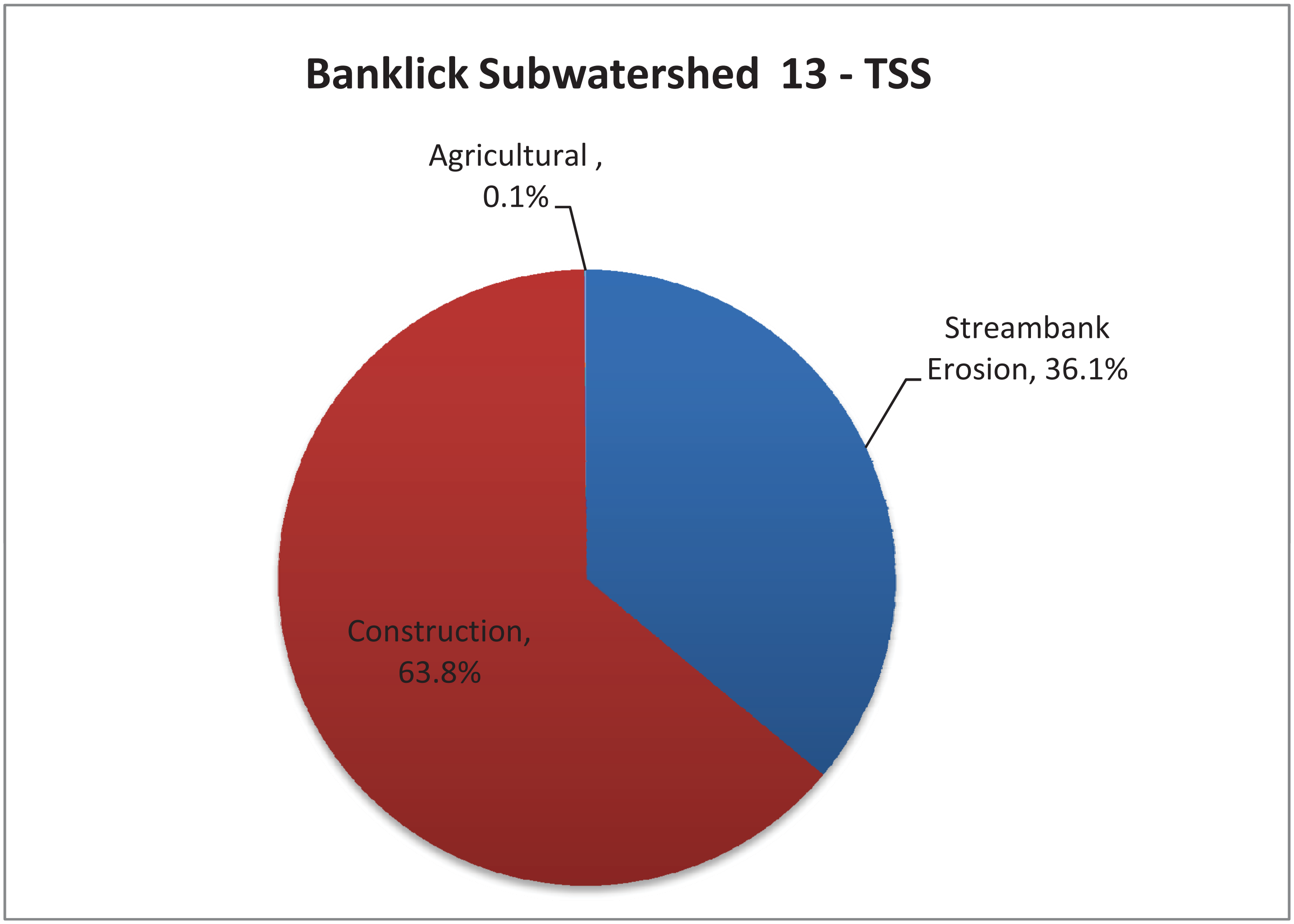

Banklick Subwatershed 09 - TSS
Developed Lands (open - low intensity), 0.1%
SSO, 1.2%
Construction, 29.6%
Streambank Erosion, 69.1%


Banklick Subwatershed 10 (Brushy Fork) - TSS
Developed Lands (open - low intensity), 0.1%
Streambank Erosion, 45.5%
Construction, 54.4%


Banklick Subwatershed 11 - TSS
Developed Lands (open - low intensity), 0.1%
KPDES, 0.5%
SSO, 1.4%
Construction, 47.0%
Streambank Erosion, 51.0%



Banklick Subwatershed 12 (Wolf Pen Branch) - TSS
Agricultural , 0.1%
SSO, 0.2%
Streambank Erosion, 41.4%
Construction, 58.3%


Banklick Subwatershed 13 - TSS
Agricultural , 0.1%
Streambank Erosion, 36.1%
Construction, 63.8%

APPENDIX H
BANKLICK MODEL CALLIBRATION MEMO

LimnoTech
Water | Environment | Scientists | Engineers

MEMORANDUM

DATE: November 24, 2008

FROM: Tim Towey

TO: Jim Gibson (SD1), Mindy Scott (SD1)

CC: Carrie Turner (LimnoTech)

SUBJECT: Banklick Creek HSPF Model Hydrology and Water Quality Calibration Update

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Overview

The Sanitation District No. 1 (SD1) is investing in the development of detailed water quality models in several watersheds. These models are an important contribution for watershed and water quality characterization, which is a required element of a combined sewer overflow (CSO) long-term control plan. The models are also necessary to establish appropriate goals for CSO and sanitary sewer overflow (SSO) control using the watershed approach. This is done by applying the models to look at the relative effectiveness of these controls when compared to controls of other pollutant sources, such as dry weather sources and runoff from agricultural and urban areas.

A model of the Banklick Creek watershed using the Hydrologic Simulation Program in Fortran was originally developed in 2004 as part of a federal grant to develop and apply a Watershed Assessment Protocol (WAP) in order to understand water quality problems on a watershed basis (LimnoTech, 2004). The calibration of that model was updated to incorporate a more detailed land cover analysis; to evaluate dry-weather fecal coliform loads using a larger set of monitoring results; and to calibrate wet-weather loads incorporating recent literature values of storm water fecal coliform densities, output from an updated collection system model, SD1 outfall monitoring data, and a new set of wet-weather monitoring data collected in May 2008. This memorandum describes the updates to the Banklick model and presents a comparison of modeled versus measured values for flow, dry-weather fecal coliform density, and wet-weather fecal coliform density.

Calibration Approach

The following is a summary of the approach to calibrating the Banklick HSPF model:

- Step 1: Watershed characteristics and stream configuration
    - Land use updated using analysis completed in 2007, stream configuration maintained from original WAP configuration.
- Step 2: Hydrology
    - Hydrologic characteristics largely maintained from WAP configuration. Slight changes made due to land use update and a calibration with more emphasis on reproducing measured hourly, in addition to daily and monthly, flows.
    - Observed and predicted values were compared at both USGS/SD1 gage and using level sensor data from River Mile (RM 1.2).

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- Step 3: Dry weather fecal coliform loading
    - Constrained with existing info on dry weather sources, being cognizant of lack of specific information on these sources.
    - Evaluated long term (2002-2007) dry weather densities and compliance with water quality standards (WQS) at eight sites (six in Banklick, two in major tributaries (Bullock Pen and Fowler)).
    - Update resulted in lower dry weather loads than used in recent Banklick Pilot analysis.
- Step 4: Wet weather fecal coliform loading
    - Reproduced wet weather instream densities for multiple events spanning a range of conditions (three 2003 wet weather events, 2008 May wet weather event)
        - Used CSO and SSO volumes from calibrated IC model and applied densities based on SD1 monitoring data (note: model-predicted overflow locations (e.g. model-calculated overflows at manholes that have not been field verified) will be treated as SSOs).
        - Used SD1 monitoring data to constrain fecal coliform densities
        - Used storm water literature to constrain runoff site mean densities for land covers in watershed.
    - Conducted analysis to understand model sensitivity to CSO and SSO densities and presence of unverified SD1 infrastructure overflows.
- Step 5: *E. coli* simulation
    - Tested the models ability to reproduce instream E. coli densities, by using SD1 monitoring data for CSO and SSO E. coli densities

Watershed Characteristics and Stream Configuration

The land cover from the original Banklick model was refined using a number of newly available datasets:

- Aerial photography from 2006 from the National Resource Conservation Service;
- Open space land delineation obtained in 2007 from the Ohio-Kentucky-Indiana Council of Governments;
- Building footprints provided by SD1 in 2007;
- Pavement provided by SD1 in 2007; and
- Surface waters provided by SD1 in September 2006.

Although these datasets are more recent than the primary Banklick hydrology and wet-weather calibration period (2002-2003), LimnoTech felt that the improved quality and completeness of the land cover created with this data made it preferable to the previously used land cover information. A more complete description of the development of the land cover dataset will be part of the WAT! report materials.

The channel geometry was maintained from the model version used in the WAP Application report. The geometry was based on a US Army Corps of Engineers HEC-2 model of Banklick Creek and refined using field information gathered by XCG in 2003 (LimnoTech, 2004).

Hydrology Calibration

The hydrologic calibration of the model was re-evaluated using the new land cover classifications. Also, this calibration effort placed more emphasis on reproducing the distribution of hourly flow results than the original calibration presented in the WAP application report. In addition to the hourly results, the calibration was evaluated in terms of daily and monthly flow because there is guidance available for model performance in terms of these parameters (Donigian, 2002).

The model parameter that was adjusted as part of the calibration update was the slope (SLSUR in HSPF) of both pervious and the impervious lands. Increasing the slope improves the ability of the model to reproduce peak hourly flows, reduces the "trickle" of fecal coliform loading after storm events that impacts instream dry-weather densities, and is a better reflection of conditions in the Banklick watershed. A GIS evaluation of slopes in the Banklick Creek watershed showed the average slope in pervious areas is 0.16 and the average impervious slope is 0.08. These values were incorporated into the HSPF model.

Hydrologic model performance was evaluated by comparing flows predicted by the HSPF model to the measured flows at two locations: the jointly operated USGS/SD1 gage located at Highway 1829 (RM 8.0) and at Kentucky Hwy 16 (KY16 - RM 1.2), where a level sensor was installed as part of the SD1 Watershed Assessment (XCG, 2003). The predicted flows were compared to the USGS/SD1 gage for the period from January 1, 2001 to September 30, 2003. At RM 1.2, the predicted flows were compared to level sensor data for August 2003, a month of nearly complete data.

The USGS/SD1 gage is located just downstream of the confluence of Banklick and Fowler Creeks, therefore the modeled Banklick flow from just upstream of the confluence was summed with the modeled flow in Fowler Creek in order to make the comparison to measured flow. Figure 1 and Table 1 show the distribution of modeled and measured hourly flow values at the USGS/SD1 gage for the comparison period. Table 1 also shows the distribution of values when the comparison is limited to the May 1 – October 31 recreation season. These comparisons demonstrate that the model is reproducing the overall distribution of measured values at this location.

Figure 1. Distribution of Measured and Modeled Hourly Flows at USGS/SD1 Gage.

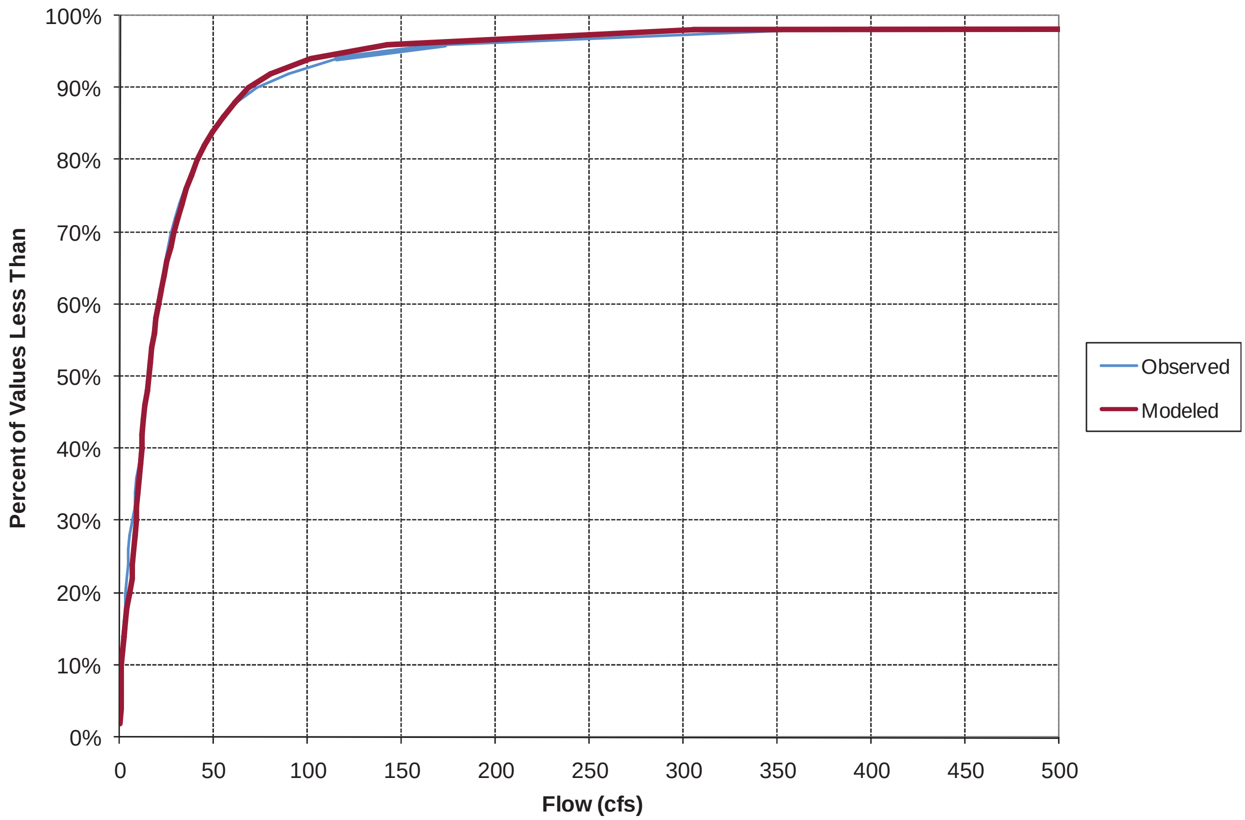


Table 1. Distribution of Measured and Modeled Hourly Flows at USGS/SD1 Gage.

	Full comparison period		Recreation season	
	Measured (cfs)	**Modeled (cfs)**	**Measured (cfs)**	**Modeled (cfs)**
Mean	48.2	47.2	37.3	42.2
Geometric Mean	10.9	12.5	5.1	6.8
5th %ile	0.2	0.4	0.1	0.3
25th %ile	4.4	7.1	1.7	1.7
50th %ile	14.7	15.2	6.2	8.9
75th %ile	32.9	34.3	20.3	24.6
95th %ile	137.6	117.3	106.6	100.9

In addition to hourly flows, the hydrologic calibration was also evaluated using HSPF-specific criteria suggested by Donigian (2002). He suggests using monthly or annual relative percent differences (RPDs) to evaluate how well the model is reproducing the central tendency of the data. He characterizes an RPD of <10% as “Very good.” The RPD for the Banklick HSPF flow for the entire January 2002-September 2003 period is 2% and for the recreation season it is 13%.

To characterize the ability of the model to reproduce the timing of observed flow conditions, Donigian provides a range of R and R^2 values for monthly and daily flows. Figure 2 shows the criteria for model performance suggested by Donigian . Table 2 shows the performance of the Banklick HSPF model for both the full model period and using just the recreation season. For both daily and monthly flows, the Banklick model performance is “Good” for the full model period. The model performs slightly better during the recreation season when comparing monthly flow values and slightly worse when comparing daily values.

Figure 2. R and R^2 Values for the Evaluation of Model Performance from Donigian, 2002.

R	← 0.75 — 0.80 — 0.85 — 0.90 — 0.95 →
R^2	← 0.6 — 0.7 — 0.8 — 0.9 →
Daily Flows	Poor Fair Good Very Good
Monthly Flows	Poor | Fair | Good | Very Good

Table 2. R And R^2 Values for Banklick HSPF Model and Evaluation of Performance Using Donigian Criteria.

	R	R^2	Model Performance
Daily – Full model period	0.86	0.74	Good
Monthly – Full model period	0.91	0.82	Good
Daily – Recreation season	0.81	0.66	Fair
Monthly – Recreation season	0.95	0.90	Very Good

A similar evaluation was performed using the level sensor data obtained at River Mile 1.2. SD1 deployed level sensors in lower Banklick Creek at river mile 1.2 (KY16) and river mile 0.3 (KY177) during portions of 2002 and 2003 to characterize backwater influences from the Ohio River and Licking River. The primary purpose of this model-to data comparison was to evaluate the performance of the lower Banklick Creek portion of SD1’s EFDC model. The dataset from August 2003 was used because this period was characterized by low flow in the Ohio River so backwater effects were limited to the meter at KY177, a wide range of flows from the upper portion of the Banklick Creek watershed, and a relatively complete dataset because both meters were operational through the first 25 days of the month. This dataset provides the best contrast between the level meters: the meter at KY16 (RM 1.2) reflects upstream flows while the meter at KY177 (RM 0.3) reflects Ohio River stage conditions. Figure 3 and Table 3 show the distribution of modeled and measured flows.

Figure 3. Distribution of Measured and Modeled Hourly Flows At KY16.

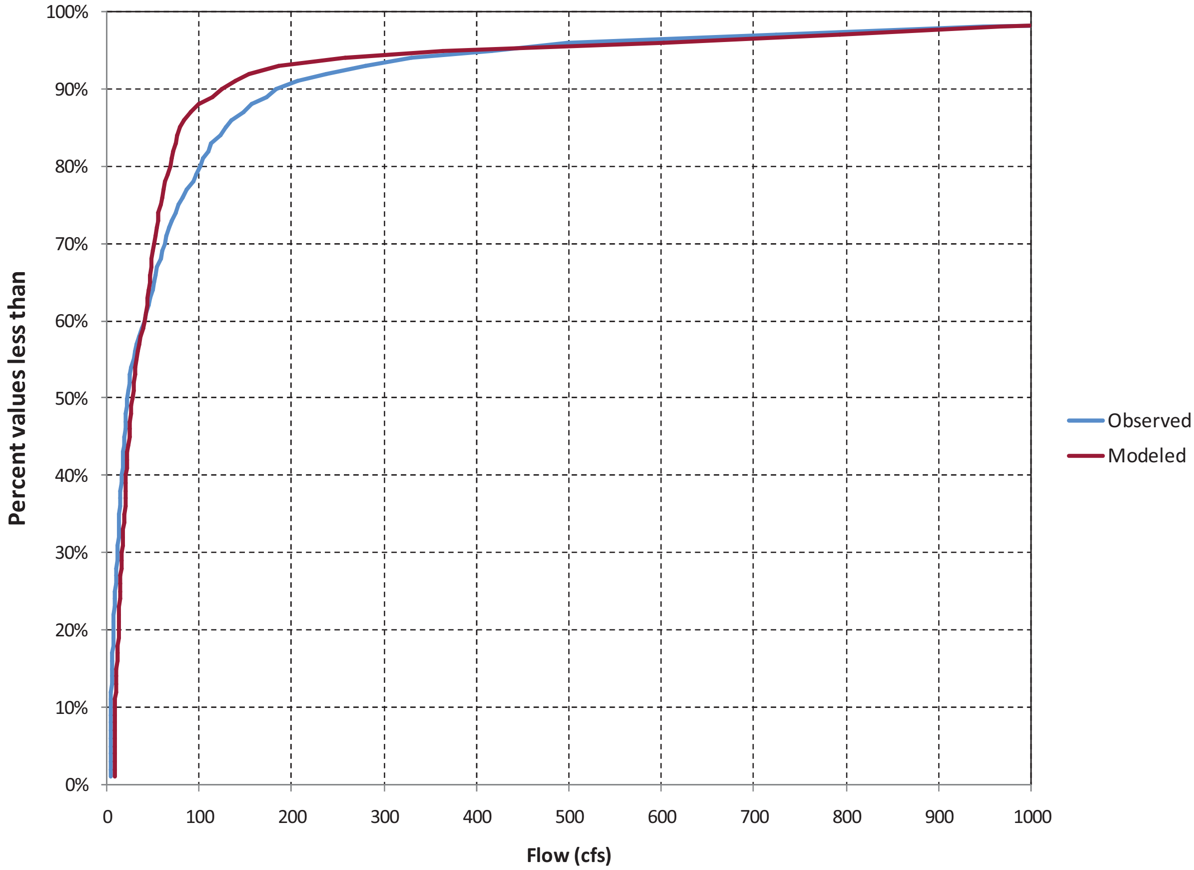


Table 3. R and R^2 Values for Banklick HSPF Model and Evaluation of Performance Using Donigian Criteria at KY16.

	Measured (cfs)	Modeled (cfs)
Mean	99.6	89.9
Geometric Mean	28.4	33.1
5th %ile	8.7	13.8
25th %ile	21.5	27.3
50th %ile	76.6	58.1
75th %ile	416.0	363.2
95th %ile	99.6	89.9

The RPD for the for the August 2003 period at RM 1.2 is -10%, and the daily R and R^2 values are 0.89 and 0.80 respectively, putting the model performance in the "Very Good" category using the Donigian criteria. The model reasonably reproduces measured values at Banklick Creek RM 1.2, downstream of its major tributaries.

Dry Weather Fecal Coliform Load Calibration

The dry-weather fecal coliform loading was determined to have a large impact on meeting water quality standards in the Banklick Pilot project. In that version of the Banklick model, dry weather loads were input as failing septic systems, KPDES permitted dischargers, and cattle in stream. Estimates were made about the location and magnitude of each of the sources, using information about land use, age of homes, and KPDES records. In an evaluation of modeled and measured instream fecal coliform densities using data from 2002-2007, it was determined that the dry-weather loads should be relocated and scaled back.

For the current version of the model, all dry-weather sources were input as a single load for any given subwatershed. A model to data comparison was used to determine the appropriate magnitude and location of the loads. An assessment of the sources contributing to the loads (e.g., septics, KPDES dischargers, cattle, wildlife) will be made outside of the model framework.

The loads were calibrated using recreation season (May 1 – October 31) geometric mean densities, percent of days complying with the single sample max criteria of 400 cfu/100 mL, and peak densities. In order to meet all of the criteria, the loads were input as oscillating loads. The oscillations varied smoothly over a period of approximately 5 days. Because small amounts of rainfall can impact instream fecal coliform densities in the model, the model to data comparison was restricted to days with only base flow (i.e., no storm flow) and having 0.01 inch or less of rainfall on that day or the day prior. Table 3 shows the numbers of measured fecal coliform densities available at eight locations (six along Banklick Creek, two in tributaries) in the 2002-2007 period that meet the dry-weather criteria.

Table 4. Location and Number of Instream Measurements used to Calibrate Dry-Weather Loads.

Stream	River Mile	Number of dry-weather samples
Banklick Creek	15.6	5
Banklick Creek	11.6	4
Banklick Creek	8.1	16
Banklick Creek	3.9	17
Banklick Creek[1]	1.2	14
Banklick Creek	0.5	17
Bullock Pen Creek	0.1	7
Fowler Creek	0.1	5

[1]One dry weather sample from River Mile 1.2 was identified as an outlier (26,000 cfu/100 mL) because of an isolated incident and was not included in the analysis.

Figures 4 through 6 show the measured and modeled recreation season geometric mean densities, single sample maximum compliance rates, and peak densities, respectively. Peak densities are compared using the maximum measured value and the 95th percentile modeled value. The maximum measured value at Banklick Creek RM 1.2 was 26,000 cfu/100 mL, and was considered an outlier; the value is not included in the analysis. Additionally, because only four measurements were available at RM 11.6, less consideration was given to meeting the seasonal geomean and WQS compliance values at that location.

Figure 4. Modeled and Measured Dry-Weather Recreation Season Geometric Mean Fecal Coliform Densities.

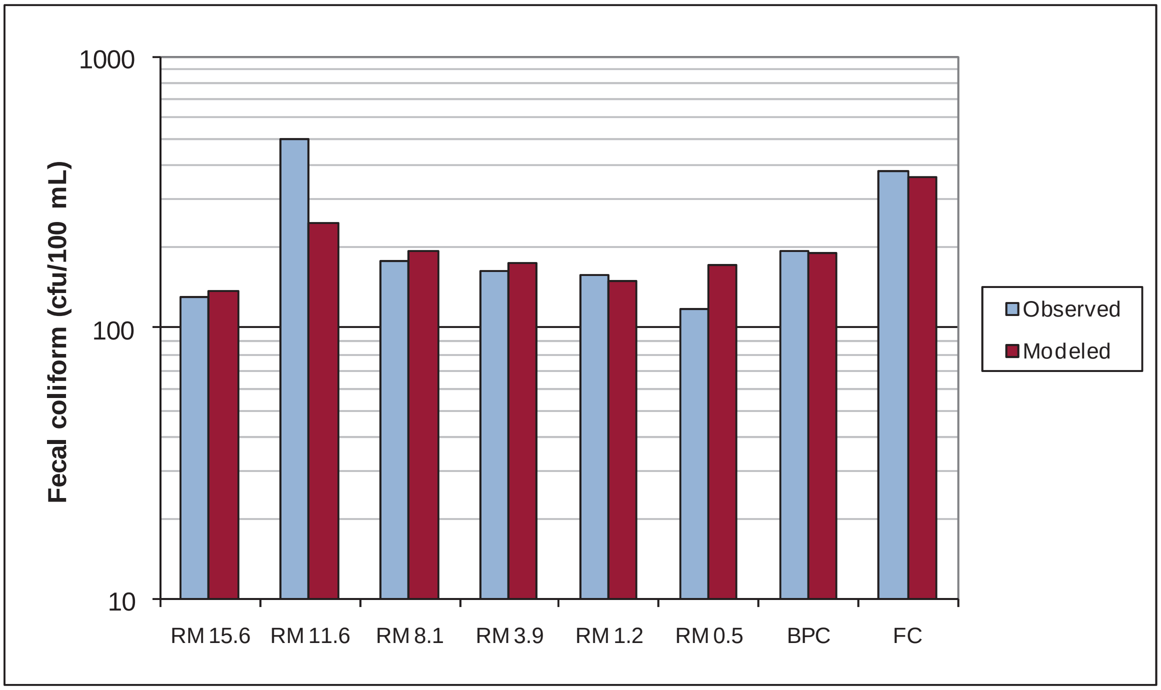


Figure 5. Modeled and Measured Dry-Weather Compliance with Single-Sample Maximum Criterion (400 cfu/100 ml).

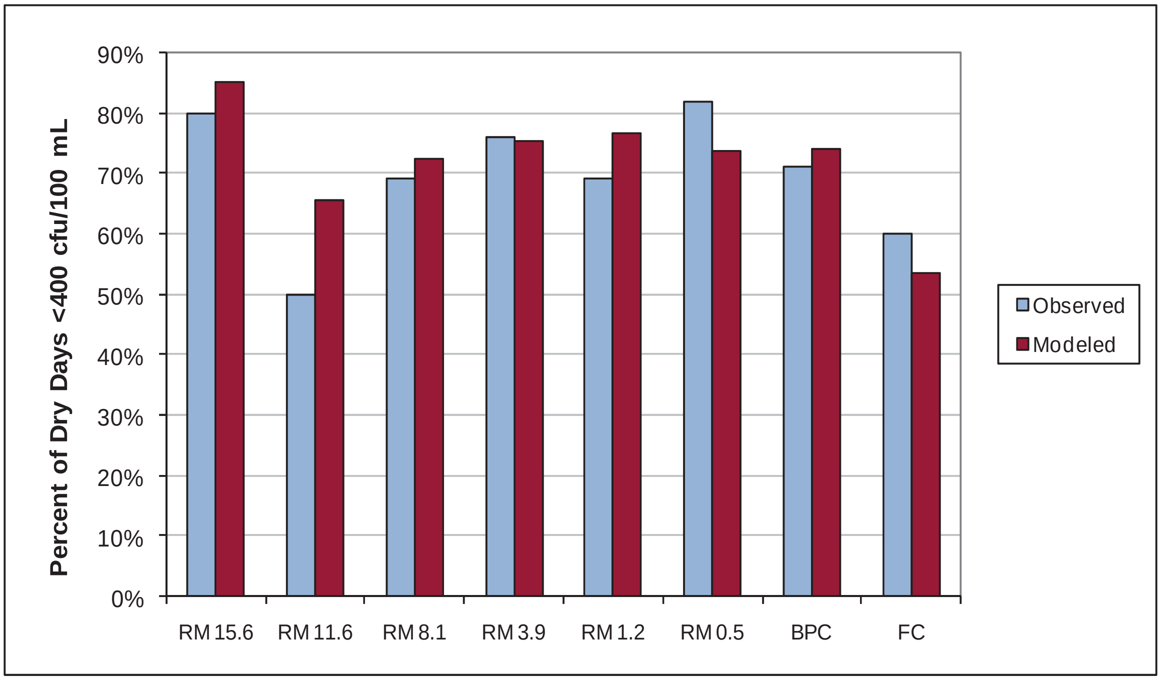
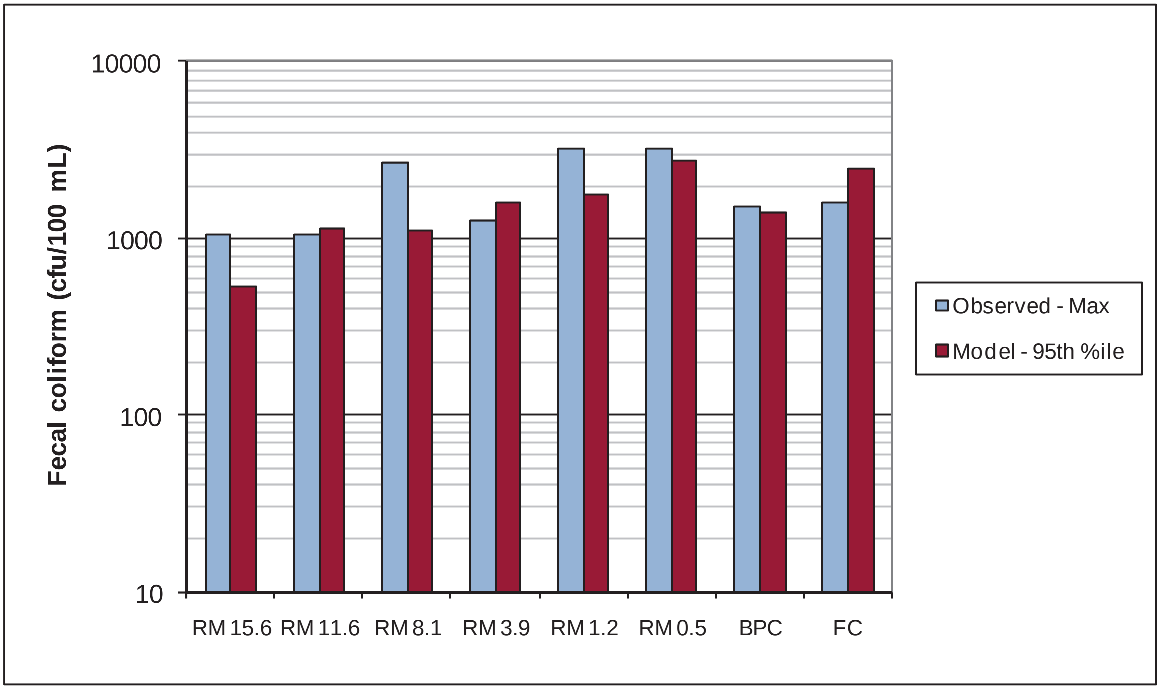


Figure 6. Modeled and Measured Peak Dry-Weather Fecal Coliform Densities.



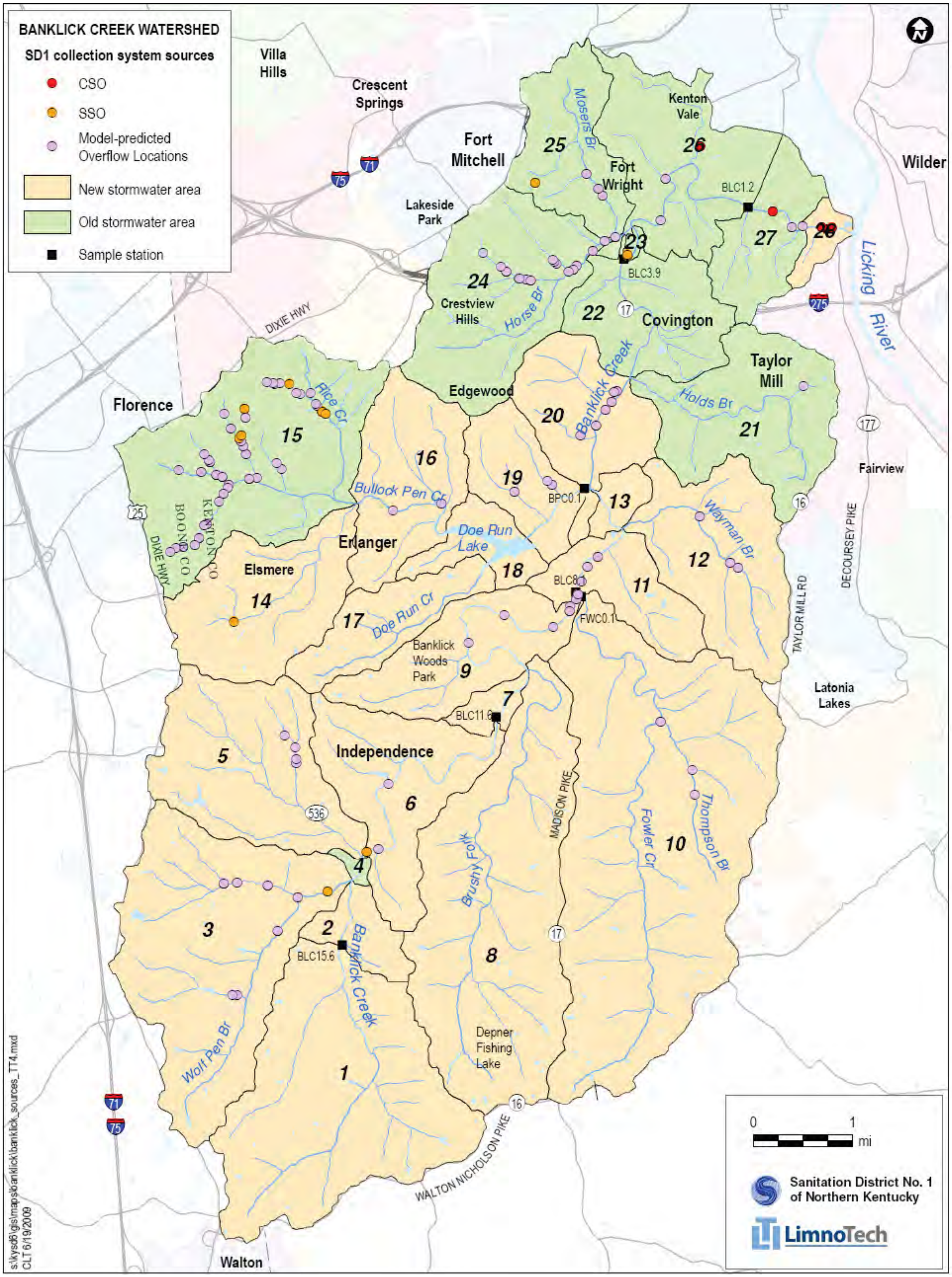
The charts show that the model reasonably reproduces both the central tendency and the elevated densities of instream dry-weather bacteria levels.

Wet Weather Fecal Coliform Calibration

Wet weather sources of fecal coliform bacteria include both runoff sources and sources from the SD1 collection system. In HSPF, the runoff source load is calculated based on a build-up and wash-off routine for each land use/land cover (LULC) type specified in the model. The SD1 infrastructure sources are input to the watershed model based on output from the collection system models. These sources include CSOs, SSOs, and model-predicted overflow locations. The loads from these sources are calculated by assigning a fecal coliform density to modeled overflows. SD1 outfall monitoring data was used to determine the appropriate density for these sources. For the model calibration, the geomean densities of measured fecal coliform density in CSOs (682,000 cfu/100 mL) and SSOs (1,870,000 cfu/100 mL) were used. Because the model-predicted overflow locations occur in the sanitary sewer areas, they were assigned the SSO density. Figure 7 shows the locations of the SD1 infrastructure sources in the Banklick Creek watershed.

Monitoring data was also used to constrain the modeled fecal coliform runoff density from developed areas. Monitoring of SD1 storm water outfalls suggested that fecal coliform densities vary based on the age of the developed area. Monitored storm water outfalls were roughly divided into two categories: those in older developments and those in newer developments. The geomean fecal coliform density from outfalls in older areas was 86,500 cfu/100 mL, while in the newer areas, the geomean density was 14,200 cfu/100 mL. This division in the storm water data was consistent with the instream data for Banklick Creek. An increase in fecal coliform densities was observed in downstream Banklick Creek in the vicinity of the older developed areas that other watershed and infrastructure sources did not fully account for. Therefore, the HSPF RCHRES (subwatersheds) were divided into old and new categories and the build-up wash off parameters for developed areas were adjusted to approximate the monitored densities.

Figure 7. Map of the Banklick Creek Watershed, Including SD1 Infrastructure Sources, Old and New Developed Areas, and Sampling Stations.



Data from the 2000 US Census was used to designate each HSPF RCHRES as “old” or “new.” The census provides household construction data for individual block-groups. There are a total of 175 block groups that intersect the Banklick model domain. For each block-group, the number of households built in each decade is available. An area weighted average of households built before 1980 and after 1980 was calculated for each HSPF RCHRES. The RCHRES with a minimum of 25% developed area and at least 50% of dwellings built before 1980 were classified as old. The remaining RCHRES were classified as new. The 25% developed area and 50% pre-1980 figures correspond closely with the median values for Banklick Creek. Figure 7 shows a map of the HSPF RCHRES and their storm water age classification.

The geomean fecal coliform densities for both the old and new storm water areas are significantly higher than the medians found in the National Stormwater Quality Database (NSQD, 2005) for developed areas. In order to achieve flow-weighted averages that reasonably matched the SD1 monitoring data, the build-up parameters for each developed LULC were scaled up from parameters that produce the median densities found in the NSQD. The parameters were scaled by approximately a factor of five to match the new development storm water densities and a factor of about 30 to meet the old development storm water densities. Having constrained the infrastructure loads and the storm water loads, the build-up and wash-off parameters for the remaining LULC categories were then adjusted to reasonably reproduce the instream fecal coliform densities while staying within density ranges seen in the literature for the various LULCs.

Table 5 presents the flow-weighted site mean densities from each HSPF LULC category. It should be noted that the majority of the flow from developed areas comes from impervious lands which have relatively lower fecal coliform densities. This is why the pervious developed land categories have site mean densities substantially higher than the targeted densities described above.

Table 5. Site Mean Fecal Coliform Densities from Calibrated Banklick HSPF Model.

HSPF LULC category	Description	Flow-weighted site mean density (cfu/100 mL)	Literature density (cfu/100 mL)	Source
PER-1	New Storm: HDD - Comm/Indus	21,773	4,300	NSQD, 2005
PER-2	New Storm: HDD - Res	53,725	11,000	NSQD, 2005
PER-3	New Storm: MDD - Comm/Indus	25,213	5,000	NSQD, 2005
PER-4	New Storm: MDD - Res	42,489	8,300	NSQD, 2005
PER-5	New Storm: LDD - Comm/Indus	25,213	5,000	NSQD, 2005
PER-6	New Storm: LDD - Res	42,489	8,300	NSQD, 2005
PER-7	Developed Open Space	2,747	2,600	NSQD, 2005
PER-8	Cropland	65,040	67,000	CWP, 1999
PER-9	Forest	769	100-1,000	CWP, 1999
PER-10	Pasture/Grassland	91,628	120-1.3e6	CWP, 1999
PER-11	Barren	1,116		
PER-12	Failing septic	1.1E+06	10,000-1e8	CWP, 1999
PER-13	Old storm: HDD - Comm/Indus	133,928	4,300	NSQD, 2005
PER-14	Old storm: HDD - Res	341,805	11,000	NSQD, 2005
PER-15	Old storm: MDD - Comm/Indus	153,229	5,000	NSQD, 2005
PER-16	Old storm: MDD - Res	257,329	8,300	NSQD, 2005
PER-17	Old storm: LDD - Comm/Indus	153,229	5,000	NSQD, 2005
PER-18	Old storm: LDD - Res	257,329	8,300	NSQD, 2005
IMP-1	New storm: Impervious	5,199	1,100 (730 - 4,300)	NSQD, 2005
IMP-2	Old storm: Impervious	34,495	1,100 (730 - 4,300)	NSQD, 2005

PER – pervious land category; IMP – impervious land category; HDD- high density development; MDD – medium density development; LDD- low density development; Comm/Ind – Commercial/Industrial; Res – residential

The model was calibrated by comparing predicted and measured instream fecal coliform densities at six locations on Banklick Creek during four separate storm events – three events in the summer of 2003 and one event in May 2008. A seventh location, BLC 0.5, was also sampled during all of the wet-weather events. However this location can be impacted by backwaters from the Licking and Ohio Rivers, which are not included in the HSPF model. This location was included in the EFDC model domain. Additionally, BLC 1.2 was sampled in the May 2008 event; however, it is not broken out in the model to data comparisons, because it includes relatively few samples. However, figures and statistics that include all Banklick Locations do include this location. Additionally, a WinModel snapshot comparison of model to data at this location for the May 2008 event is available in Attachment A.

During each event, multiple samples were collected at each location. During the 2003 events, sample were approximately collected at event initiation, hour 3, hour 6, hour 9, hour 12, and hour 24. During the May 2008 event, sample collection distributed over a longer period. Samples were collected at approximately event initiation, hour 8, hour 16, hour 24, hour 36, hour 48, and hour 72.

Table 6 presents a statistical summary of the model to data comparison for the calibrated Banklick model for samples collected during wet-weather events at each location.. The table shows the observed and modeled geomeans, the observed and modeled compliance with the single sample maximum criteria of

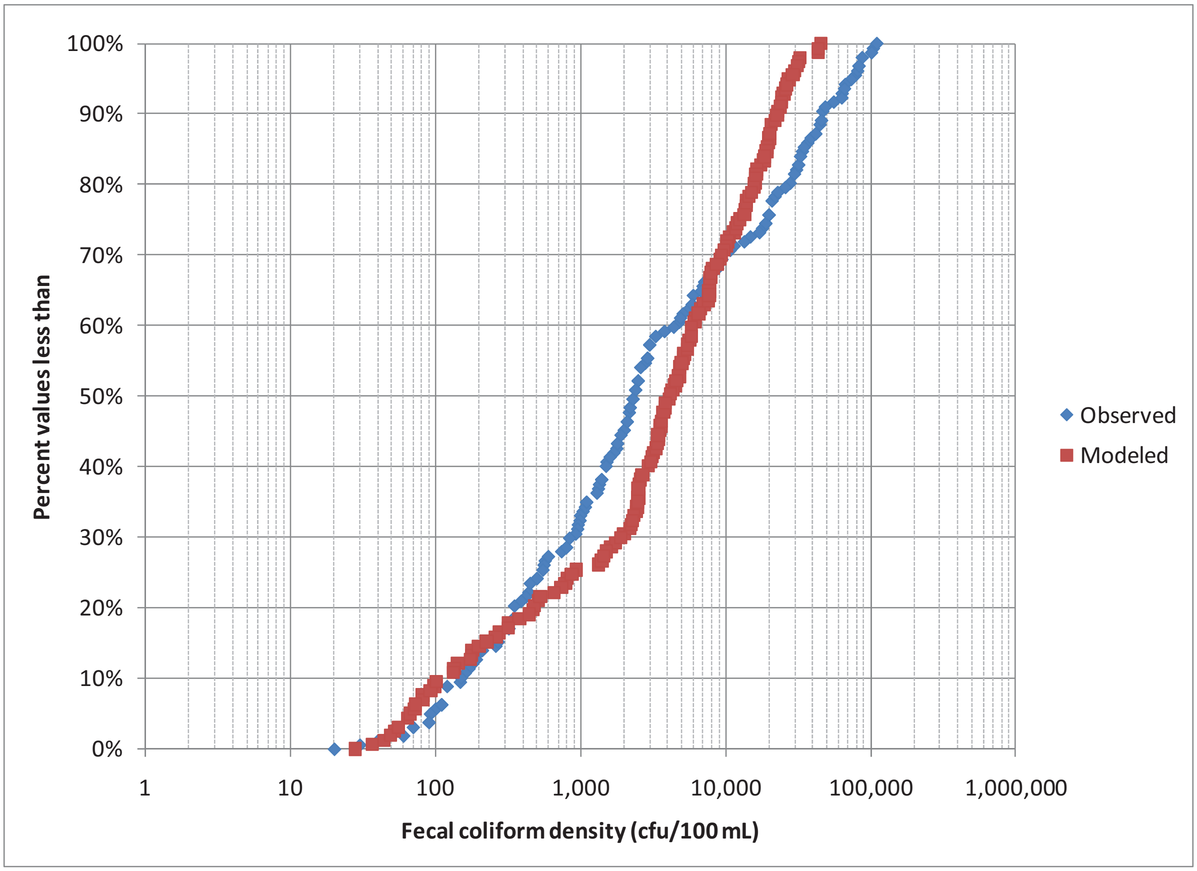
400 cfu/100 mL, and the mean relative and absolute percent differences of the natural-logarithm transformed modeled and observed values. Comparing observed and modeled geomeans allows for an evaluation of how well the model is reproducing the central tendency of the measured values. The observed and modeled geomeans are good matches in the main stem of Banklick Creek, however the model under-predicts densities in Fowler Creek and over-predicts densities in Bullock Pen Creek. Across all locations, the model reasonably reproduces the central tendency of the data. Additionally, the model produces compliance rates with the single-sample maximum similar to observed values. The mean RPD of the natural log transformed values is less than 10% at all locations except Bullock Pen Creek and the mean absolute percent difference is less than 30% at all locations.

Table 6. Summary Statistics Comparing Predicted and Instream Fecal Coliform Measurements for the Calibrated Model.

HSPF RCHRES outlet	Location	n	Observed geomean (cfu/100 mL)	Model geomean (cfu/100 mL)	% Observed compliance with SS Max	% Modeled compliance with SS Max	Mean relative % difference of ln values	Mean absolute % difference of ln values
1	BLC 15.6	25	2689	1945	20%	32%	0.6%	24.4%
6	BLC 11.6	25	2852	3089	24%	16%	5.9%	22.9%
9	BLC 8.1	25	2767	2472	24%	16%	5.0%	21.9%
22	BLC 3.9	25	4499	4501	15%	15%	5.1%	20.4%
10	Fowler Creek	25	3004	2151	19%	19%	0.4%	19.0%
19	Bullock Pen	24	1730	3395	25%	17%	14.4%	29.4%
All Locations		183	3314	3207	20%	18%	4.8%	23.1%

Figure 8 is the cumulative frequency distribution plot of the observed data at all sampling locations and the corresponding model outputs from the hour closest to when the samples were collected. Cumulative frequency distribution plots show the percent of values within the dataset that are less than each observed or simulated density. They are useful for comparing the range of observed and simulated densities and the relative frequencies at which the densities occur.

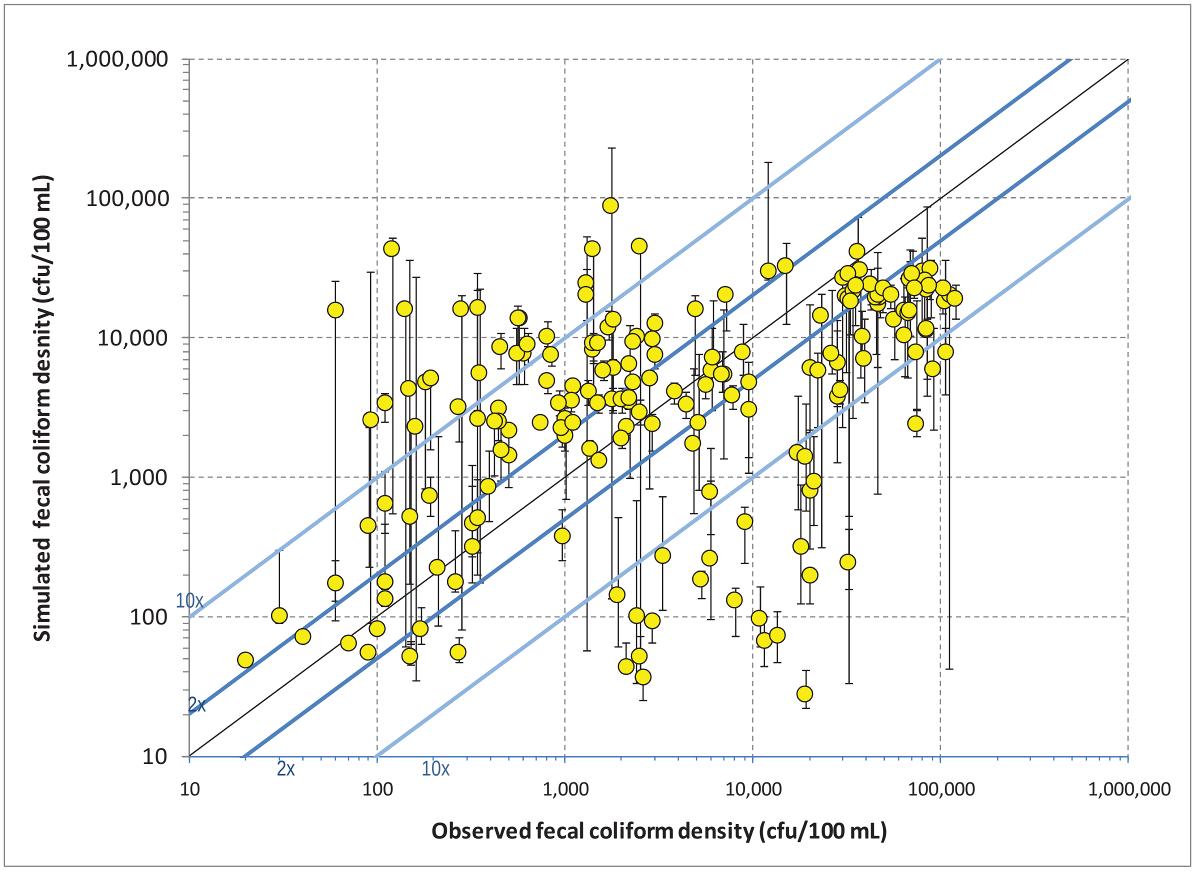
Figure 8. Cumulative Frequency Distribution of Modeled and Measured Wet-Weather Fecal Coliform Densities.



The cumulative frequency distribution plots of the model and the data match fairly well, indicating that the model is successfully reproducing the range of observed densities at the appropriate frequency. Cumulative frequency distribution plots at each location where a minimum of 20 samples were analyzed are included in Attachment A. These plots show the model is successfully reproducing the range of observed data at each location.

Figure 9 is a scatter plot or (one-to-one plot) of modeled and measured fecal coliform densities. Scatter Plots of model predictions versus data predictions show how well the model is reproducing the data for each measured value. Two sets of lines on the one-to-one plots form limits for acceptable model-to-date comparisons. Points on the scatter plot that fall within the lines labeled ‘2x’ are considered excellent predictions because they roughly correspond to the sampling and analytical accuracy limits of the bacteria count. The wider band between the ‘10x’ lines is a more liberal criteria for the model predictions; predictions that fall within these bands are accurate to one order of magnitude of the measured bacteria densities. The error bars around each point indicate the minimum and maximum modeled values for the three hours before and three hours after each sample collection time, showing the variability of fecal coliform densities over a short time period during wet-weather events.

Figure 9. Scatter Plot of Modeled and Measured Wet-Weather Fecal Coliform Densities.



The scatter plot shows that the majority of the modeled values are within an order of magnitude of observed values. In the cases in which the model over-predicts the observed values by more than an order of magnitude, the error bars show that the model produces values that better match the observed values within a few hour time-window. The cases where the model under-predicts the observed the observed values by more than an order of magnitude almost all occur 24-hours after the event initiation for two storm event. This could be related to the timing of the rainfall at different locations in the watershed.

Scatter plots for each location with at least 10 measured values, as well as snapshots of model-to-data comparisons from the WinModel framework for the May 2008 event, are available in Attachment A.

Model Wet Weather Sensitivity Analysis

Selection of model inputs can have a significant influence on water quality model predictions. Each of the model inputs has a degree of uncertainty associated with it. Two model features of particular interest are the densities associated with the infrastructure sources, and the impact of the overflows that have not been verified (model-predicted overflows).

Sensitivity to CSO and SSO Densities

To assess the sensitivity of the model results to the CSO and SSO densities, the model was run using the arithmetic means from the SD1 outfall monitoring program: 1,110,000 cfu/100 mL and 3,263,000 cfu/100 mL for CSOs and SSOs respectively. These values are over 50% greater than the geometric mean values used for the calibration. The same set of summary statistics and charts as were presented for the model calibration are shown for this simulation in Table 7 and Figures 10 and 11 below.

Table 7. Summary Statistics Comparing Predicted and Instream Fecal Coliform Measurements for Model with the Collection System Source Densities Set to the Arithmetic Averages.

HSPF RCHRES	Location	n	Observed geomean (cfu/100 mL)	Model geomean (cfu/100 mL)	% Observed compliance with SS Max	% Modeled compliance with SS Max	Mean relative % difference of ln values	Mean absolute % difference of ln values
1	BLC 15.6	25	2689	1945	20%	32%	0.6%	24.4%
6	BLC 11.6	25	2852	3430	24%	16%	7.2%	23.5%
9	BLC 8.1	25	2767	2700	24%	16%	6.2%	22.6%
22	BLC 3.9	25	4499	4853	15%	15%	6.2%	21.0%
10	Fowler Creek	25	3004	2151	19%	19%	0.4%	19.0%
19	Bullock Pen	24	1730	3541	25%	17%	14.9%	29.5%
All RCHs		158	2668	2942	22%	19%	6.4%	23.4%

Figure 10. Cumulative Frequency Distribution of Modeled and Measured Wet-Weather Fecal Coliform Densities for Model with the Collection System Source Densities Set to the Arithmetic Averages.

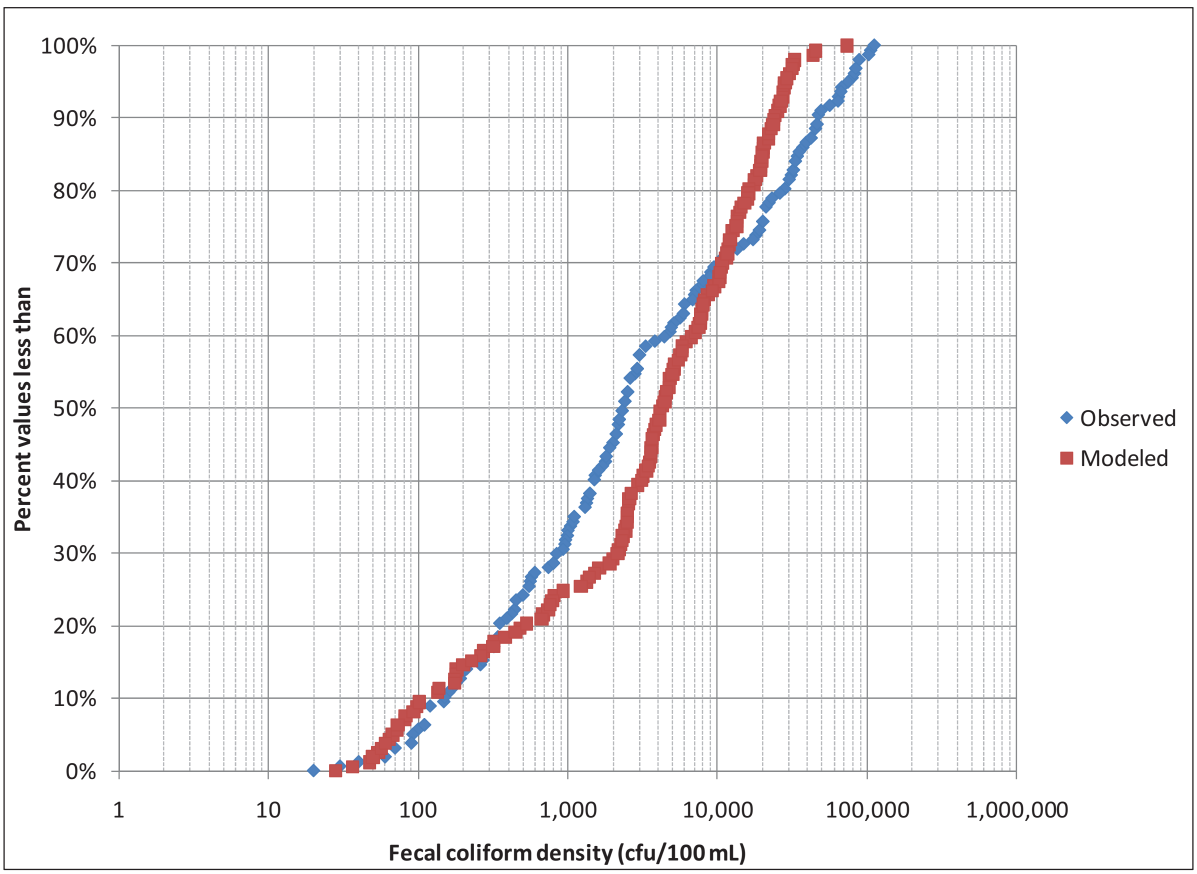
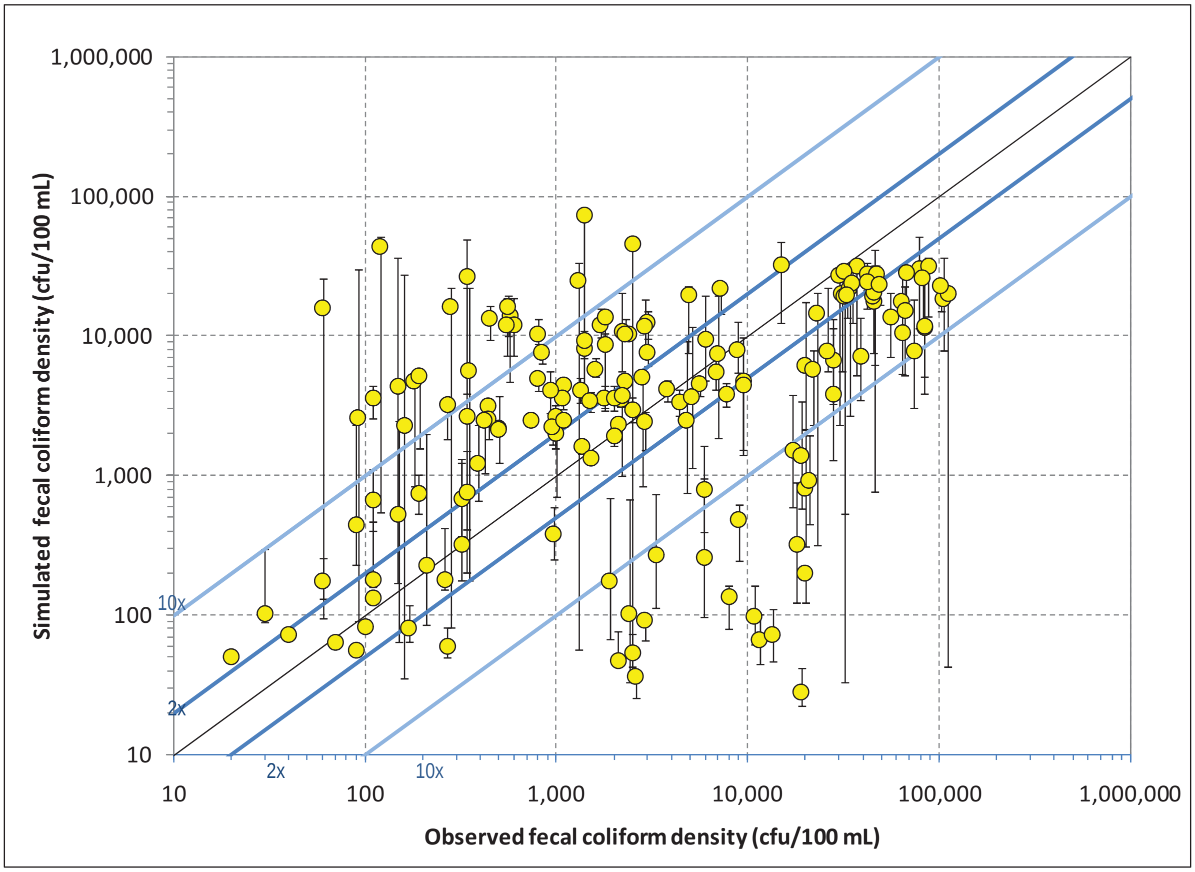


Figure 11. Scatter Plot of Modeled and Measured Wet-Weather Fecal Coliform Densities for Model with Collection System Densities Set to Arithmetic Averages.



The results show that the model still reasonably reproduces the measured data using higher CSO and SSO densities. While the modeled geomean is higher for the locations impacted by infrastructure sources (all but BLC 15.6), the use of the higher value does not dramatically affect the quality of the calibration. In fact, the model better reproduces the peak instream densities using these values. Notably, the simulated percent compliance with the single sample maximum criterion does not change using the higher densities for these sources.

Sensitivity to Model-Predicted Overflow Locations

Overflows occurring at model-predicted overflow locations have not been field verified, so it is important to understand how they are impacting the simulations of the Banklick system. The model sensitivity to the presence of these sources was evaluated by running the model without those components. The same set of summary statistics and charts as were presented for the model calibration are shown for this simulation in Table 8 and Figures 12 and 13 below.

Table 8. Summary Statistics Comparing Predicted and Instream Fecal Coliform Measurements for Model without Model-Predicted Overflow Locations.

HSPF RCHRES	Location	n	Observed geomean (cfu/100 mL)	Model geomean (cfu/100 mL)	% Observed compliance with SS Max	% Modeled compliance with SS Max	Mean relative % difference of ln values	Mean absolute % difference of ln values
1	BLC 15.6	25	2689	1945	20%	32%	0.6%	24.4%
6	BLC 11.6	25	2852	2369	24%	20%	2.5%	23.1%
9	BLC 8.1	25	2767	1999	24%	20%	1.9%	21.2%
22	BLC 3.9	25	4499	3766	15%	15%	2.5%	18.8%
10	Fowler Creek	25	3004	2151	19%	19%	0.4%	19.0%
19	Bullock Pen	24	1730	3142	25%	17%	13.4%	29.4%
All RCHs		158	2668	2440	22%	20%	3.8%	22.4%

Figure 12. Cumulative Frequency Distribution of Modeled and Measured Wet-Weather Fecal Coliform Densities for Model with no Model-Predicted Overflow Locations.

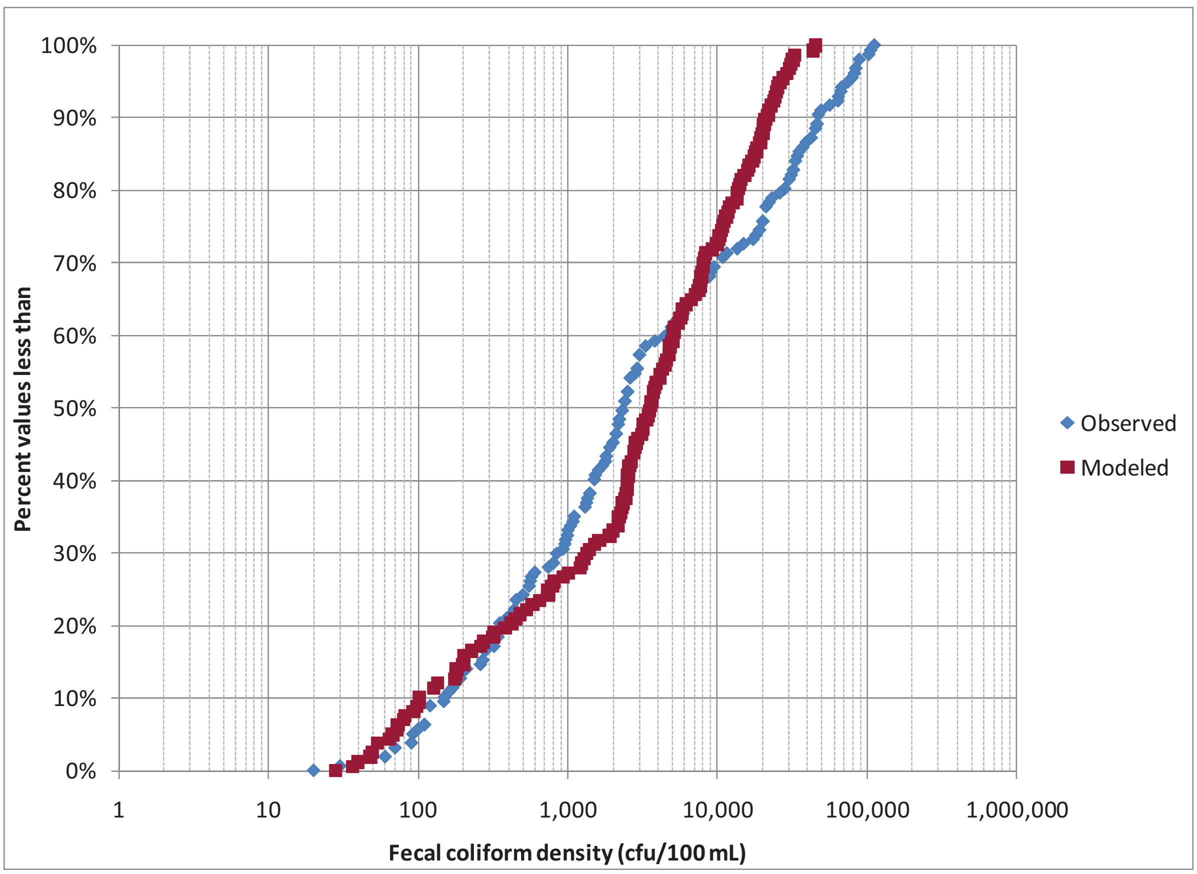
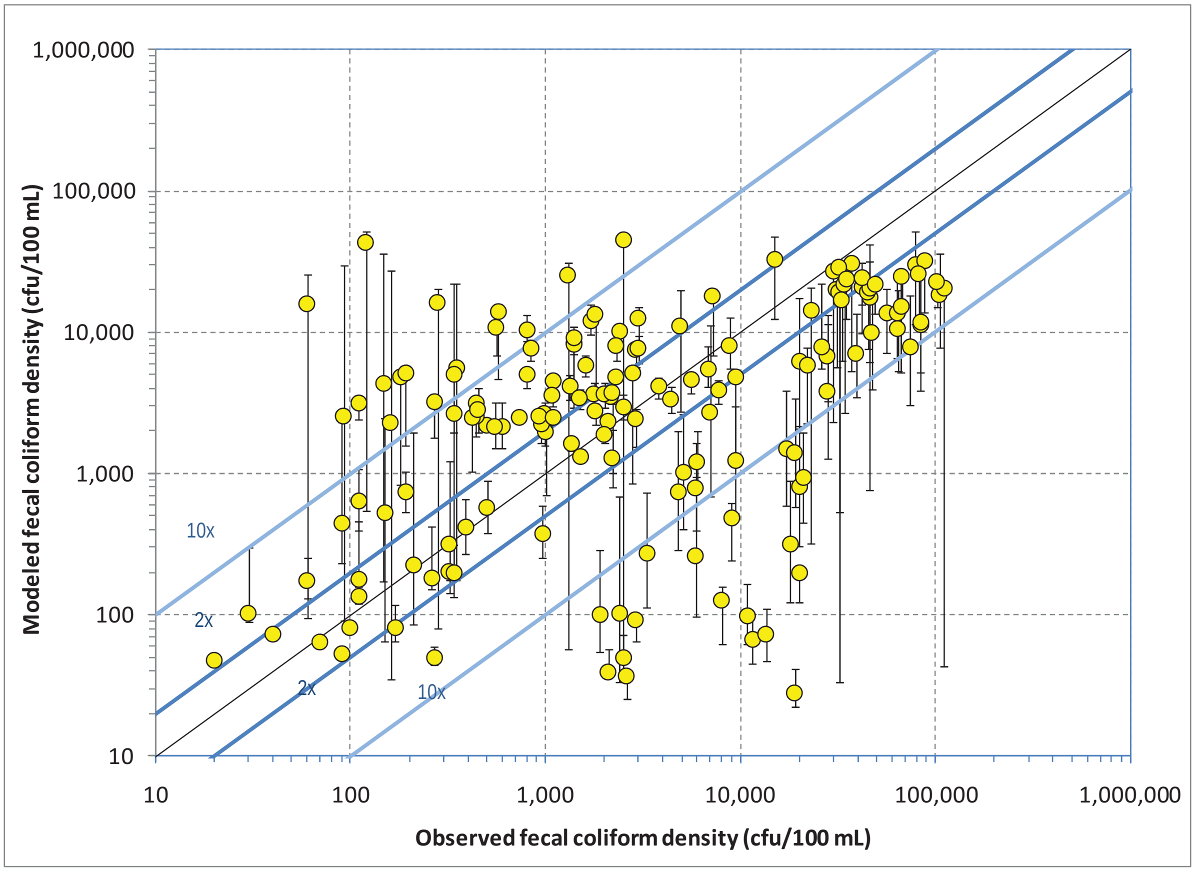


Figure 13. Scatter Plot of Modeled and Measured Wet-Weather Fecal Coliform Densities for Model with no Model-Predicted Overflow Locations.



The results suggest that the model reasonably reproduces the central tendency without these sources. However, the highest observed densities are under-predicted to a greater degree than they are in the calibrated model.

E. coli Simulation

The Banklick HSPF model was also run using the *E. coli* geometric mean densities from the SD1 infrastructure modeling (210,000 cfu/100 mL for CSOs and 705,000 cfu/100 mL for SSOs) to gage the models ability to reproduce instream *E. coli* densities. For this simulation, the build-up, wash-off parameters calibrated for fecal coliform densities were used. Table 9 and Figures 14 and 15 present the results of this simulation. It should be noted that the single-sample maximum for *E. coli* is 240 cfu/100 mL as opposed to 400 cfu/100 mL for fecal coliform.

Table 9. Summary Statistics Comparing Predicted and Instream *E. coli* Measurements for Model.

HSPF RCHRES	Location	n	Observed geomean (#/100 mL)	Model geomean (#/100 mL)	% Observed compliance with SS Max (240 #/100 mL)	% Modeled compliance with SS Max (240 #/100 mL)	Mean relative % difference of ln values	Mean absolute % difference of ln values
1	BLC 15.6	25	2138	1594	12%	20%	0.4%	26.2%
6	BLC 11.6	25	2177	2042	20%	16%	4.0%	22.5%
9	BLC 8.1	25	2130	1629	16%	16%	1.1%	19.8%
22	BLC 3.9	26	2991	1940	8%	15%	-1.6%	17.6%
10	Fowler Creek	26	2560	1439	12%	15%	-4.4%	16.8%
19	Bullock Pen	24	1214	1175	21%	25%	4.3%	25.9%
All RCHs		158	2038	1564	15%	18%	0.6%	20.9%

Figure 14. Distribution of Modeled and Measured Wet-Weather *E. coli* Densities.

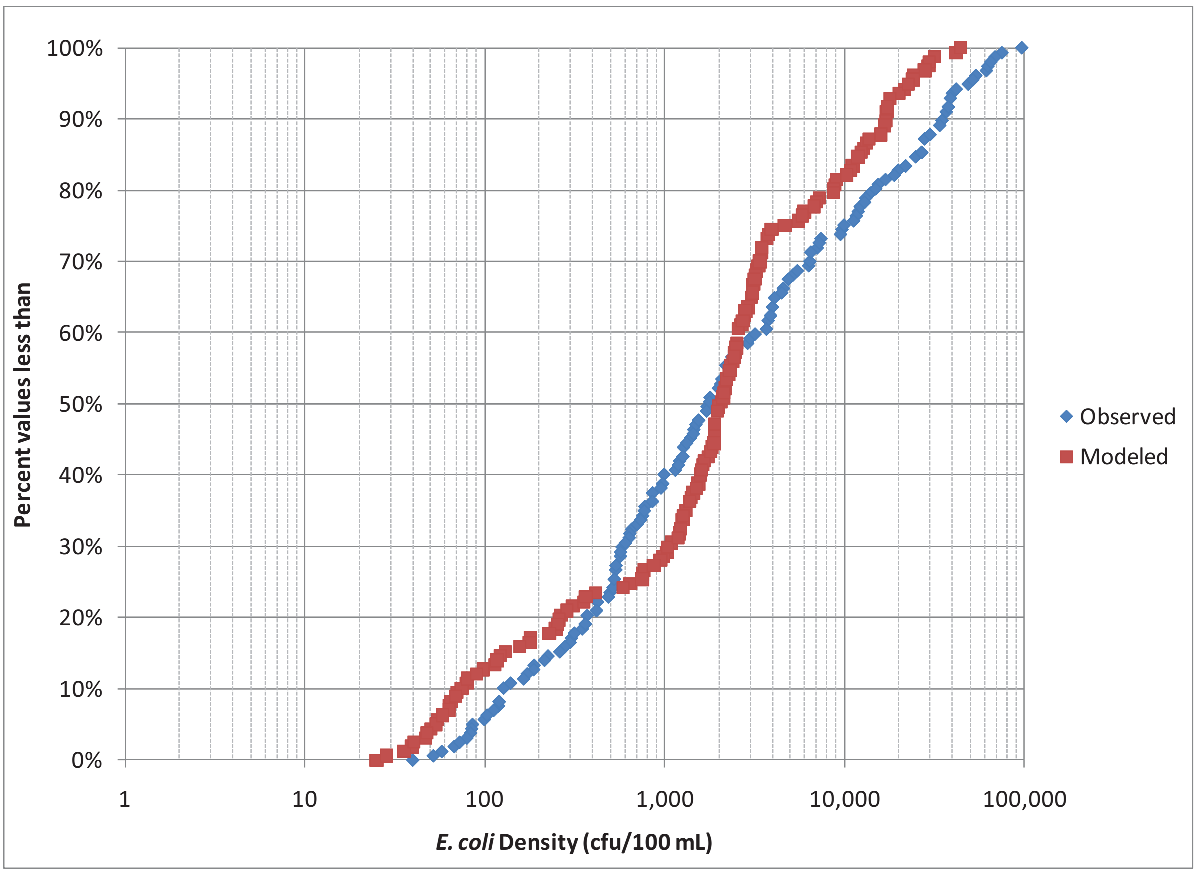
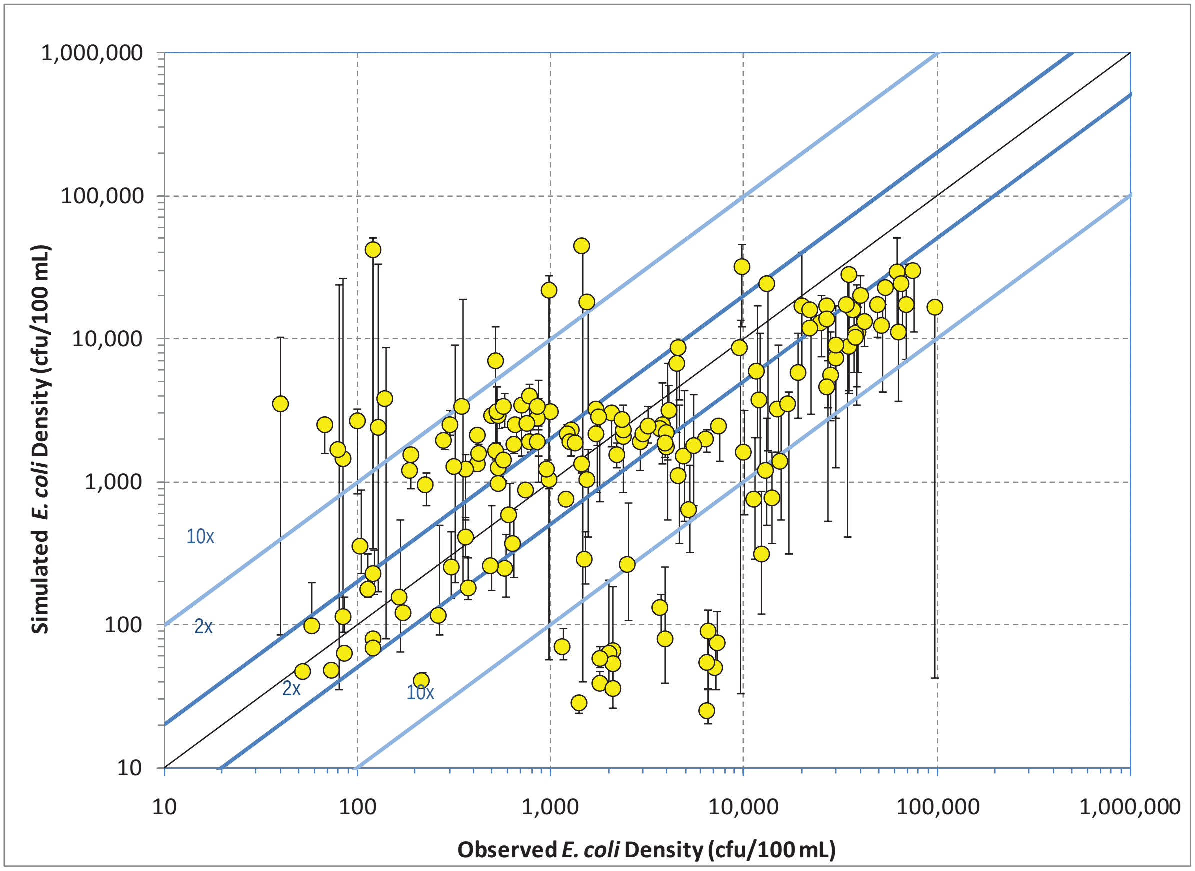


Figure 15. Modeled and Measured Wet-Weather *E. coli* Densities.



The model under-predicts measured *E. coli* densities using this configuration. This suggests that *E. coli* runoff loads would need to be greater than the calibrated fecal coliform loads to better match instream data.

Conclusions

The information from the Banklick Creek watershed modeling effort can be summarized as follows:

- The HSPF model provides a reasonable reproduction of flow and fecal coliform densities in Banklick Creek for a range of environmental conditions;
- The calibration suggests that the methods used for quantifying fecal coliform loading are providing reasonable estimates of point and nonpoint source bacteria loads;
- The water quality model will be a useful tool for quantifying potential benefits of various control scenarios considered for the LTCP.

The calibration to instream values indicates that it is capable of reproducing the timing and magnitude of most of the observed data. It is the best tool available for evaluating instream impacts from fecal coliform sources, including CSOs and SSOs, under a range of environmental conditions and control scenarios. The model is suitable for evaluating the water quality benefits of traditional infrastructure, green infrastructure, and watershed control alternatives in the Banklick Creek watershed.

References

Center for Watershed Protection (CWP). 1999. Watershed Protection Techniques, Special Issue Bacteria. Vol. 3, No. 1. April 1999.

Donigian, A.S. Jr. 2002. Watershed Model Calibration and Validation: The HSPF Experience. WEF National TMDL Science and Policy 2002, November 13-16, 2002. Phoenix, AZ. WEF Specialty Conference Proceedings on CD-ROM.

LimnoTech. 2004. Watershed Assessment Protocol. Application to Banklick Creek. Prepared for Sanitation District Number 1 of Northern Kentucky. June 2004.

National Stormwater Quality Database (NSQD). 2005. *NPDES Phase I Data – Municipal Separate Storm Sewer System. Version 1.1*. University of Alabama and Center for Watershed Protection. Updated March 4, 2005.

XCG Consults, Inc. 2003. Banklick Creek. Watershed Assessment. Summary of results for countinuous flow/level meters and continuous water quality datasonde. Prepared for Sanitation District Number 1 of Northern Kentucky. December, 2003.

APPENDIX I
BANKLICK RAW SAMPLING DATA

Survey	Station_Desc	Date	Result	Meas_Unit
	Banklick Creek at RM 5.7 (Pioneer Park Off Sr 17)	9/5/2003	0.08	mg/L-P
	Banklick Creek at RM 5.7 (Pioneer Park Off Sr 17)	9/5/2003	0.22	mg/L-P
	Mosers Branch at RM 0.7 (Teepee To Creek)	9/6/2003	0	mg/L-P
	Mosers Branch at RM 0.7 (Teepee To Creek)	9/6/2003	0.04	mg/L-P
	Banklick Creek at RM 0.2 (Mouth)	9/6/2003	0.14	mg/L-P
	Banklick Creek at RM 15 (Station 2)	5/3/2003	0.069	mg/L-P
	Banklick Creek at RM 18.2 (Station 1)	5/2/2003	0.125	mg/L-P
	Banklick Creek at RM 13.5 (Station 3 - Under Railroad Tressel)	5/2/2003	0.169	mg/L-P
	Banklick Creek at RM 10.1 (Station 4 - Banklick Woods)	5/2/2003	0.083	mg/L-P
	Banklick Creek at RM 8.1 (Station 5 - USGS Station)	5/1/2003		mg/L-P
	Bullock Pen Creek at RM 0.1 (Station 6 - White Church)	5/1/2003	0.037	mg/L-P
	Banklick Creek at RM 5.4 (Station 7 - Prairie Park)	5/1/2003		mg/L-P
	Banklick Creek at RM 3.9 (Station 8 - Sanitation District)	4/30/2003	0.041	mg/L-P
	Banklick Creek at RM 0.4 (Station 10)	4/30/2003	0.043	mg/L-P
	Banklick Creek at RM 2.5 (Station 9 - Driving Range)	4/30/2003	0.039	mg/L-P
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	10/17/2002	0.099	mg/L-P
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	10/17/2002	0.105	mg/L-P
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	10/17/2002	0.131	mg/L-P
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	10/17/2002	0.047	mg/L-P
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	10/17/2002	0.063	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	10/17/2002	0.093	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	10/17/2002	0.071	mg/L-P
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	10/17/2002	0.119	mg/L-P
Dry	Banklick Creek at RM 0.4 (Station 10)	10/17/2002	0.149	mg/L-P
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/25/2003	0.138	mg/L-P
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/25/2003	0.132	mg/L-P
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/25/2003	0.066	mg/L-P
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/25/2003	0.088	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/25/2003	0.122	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/25/2003	0.064	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/25/2003	0.138	mg/L-P
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	6/25/2003	0.122	mg/L-P
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	8/20/2003	0.142	mg/L-P
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	8/20/2003	0.612	mg/L-P
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8/20/2003	0.158	mg/L-P
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	8/20/2003	0.116	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	8/20/2003	0.132	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	8/20/2003	0.138	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	8/20/2003	0.118	mg/L-P
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	8/20/2003	0.238	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/26/2003	0.116	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/26/2003	0.084	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/26/2003	0.104	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/27/2003	0.146	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/27/2003	0.148	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	6/27/2003	0.124	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/26/2003	0.19	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/26/2003	0.353	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/27/2003	0.132	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/27/2003	0.204	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/27/2003	0.22	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	6/27/2003	0.124	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/26/2003	1.02	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/26/2003	0.337	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/27/2003	0.198	mg/L-P

Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/27/2003	0.196	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/27/2003	0.168	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	6/27/2003	0.132	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/26/2003	0.353	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/26/2003	0.381	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.162	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.142	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.341	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.196	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	6/27/2003	0.128	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/26/2003	0.702	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/26/2003	0.256	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.822	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.138	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.132	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.168	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	6/27/2003	0.116	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/26/2003	0.322	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/26/2003	0.169	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/27/2003	0.922	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/27/2003	0.505	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/27/2003	0.184	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	6/27/2003	0.11	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	6/26/2003	0.062	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	6/26/2003	0.512	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	6/27/2003	0.313	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	6/27/2003	0.952	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	6/27/2003	0.782	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	6/27/2003	0.292	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/22/2003	0.164	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/22/2003	2.62	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/22/2003	1.11	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/22/2003	0.704	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/22/2003	0.784	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/22/2003	0.557	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/23/2003	0.292	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/22/2003	0.14	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/22/2003	13.52	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/22/2003	1.52	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/22/2003	1.47	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/22/2003	0.644	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/23/2003	0.332	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/22/2003	0.088	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/22/2003	7.52	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/22/2003	8.02	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/22/2003	6.12	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/22/2003	1.31	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/22/2003	0.824	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/23/2003	0.302	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/22/2003	0.21	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/22/2003	15.02	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/22/2003	3.22	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/22/2003	1.22	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/22/2003	0.473	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/23/2003	0.234	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/22/2003	0.206	mg/L-P

Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/22/2003	2.22	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/22/2003	1.22	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/22/2003	0.812	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/22/2003	0.345	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/23/2003	0.344	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/22/2003	0.166	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/22/2003	3.32	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/22/2003	7.32	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/22/2003	7.92	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/22/2003	0.86	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/22/2003	0.604	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/23/2003	0.589	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/22/2003	0.124	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/22/2003	5.12	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/22/2003	9.12	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/22/2003	3.02	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/22/2003	2.92	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/22/2003	1.18	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/23/2003	0.162	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/24/2003	0.224	mg/L-P
Wet	Banklick Creek at RM 0.4 (Station 10)	9/24/2003	0.313	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	0.532	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	3.22	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	1.42	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	0.632	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/27/2003	0.461	mg/L-P
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	9/28/2003	0.27	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	0.234	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	3.22	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	3.52	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	3.52	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	2.42	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/27/2003	0.424	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	9/28/2003	0.296	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	8.12	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	8.12	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	3.42	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	2.02	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	1.92	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/27/2003	0.612	mg/L-P
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	9/28/2003	0.292	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	5.32	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	8.42	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	3.22	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	1.42	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/27/2003	0.441	mg/L-P
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	9/28/2003	0.278	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.17	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.349	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.672	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.692	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/27/2003	0.289	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	9/28/2003	0.232	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	6.92	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	1.72	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	2.92	mg/L-P

Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	2.12	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/27/2003	0.572	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	9/28/2003	0.509	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	2.32	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	2.42	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	3.12	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	2.62	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	9.02	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	3.82	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/27/2003	0.764	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/28/2003	0.405	mg/L-P
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	9/29/2003	0.216	mg/L-P
Wet	Banklick Creek at RM 0.4 (Station 10)	9/29/2003	0.186	mg/L-P
Dry	Banklick Creek at RM 15.6 (Maher Rd. bridge)	6/26/2007	0.168	mg/L-P
Dry	Banklick Creek at RM 11.6 (Independence Station Rd.)	6/26/2007	0.151	mg/L-P
Dry	Fowler Creek at RM 0.1 (Rt. 17 bridge)	6/26/2007	0.085	mg/L-P
Dry	Fowler Creek at RM 0.1 (Rt. 17 bridge)	6/26/2007	0.155	mg/L-P
Dry	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	6/26/2007	0.112	mg/L-P
Dry	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	6/26/2007	0.169	mg/L-P
Dry	Banklick Creek at RM 3.9 (Eaton Dr bridge)	6/26/2007	0.1	mg/L-P
Dry	Banklick Creek at RM 0.3 (Rt. 177)	6/26/2007	0.2	mg/L-P
Dry	Banklick Creek at RM 1.2 (Rt. 16 bridge)	6/26/2007	0.106	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/7/2008	0.091	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/7/2008	0.083	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008	0.098	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008	0.102	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008	0.11	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/9/2008	0.115	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/9/2008	0.125	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/10/2008	0.078	mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008		mg/L-P
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	5/8/2008		mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/7/2008	0.096	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/7/2008	0.08	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/8/2008	0.163	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/8/2008	0.278	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/9/2008	0.214	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/9/2008	0.179	mg/L-P
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	5/10/2008	0.115	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/7/2008	0.014	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/7/2008	0.063	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/7/2008	0.058	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/8/2008	0.095	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/8/2008	0.119	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/9/2008	0.092	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/9/2008	0.05	mg/L-P
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	5/10/2008	0.054	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/7/2008	0.046	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/8/2008	0.036	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/8/2008	0.114	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/8/2008	0.115	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/9/2008	0.164	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/9/2008	0.129	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/10/2008	0.067	mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/7/2008		mg/L-P
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	5/8/2008		mg/L-P

Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/7/2008	0.047	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/7/2008	0.058	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/8/2008	0.13	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/8/2008	0.134	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/9/2008	0.081	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/9/2008	0.05	mg/L-P
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	5/10/2008	0.06	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/7/2008	0.066	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/7/2008	0.119	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/8/2008	0.127	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/8/2008	0.126	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/8/2008	0.152	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/9/2008	0.108	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/9/2008	0.083	mg/L-P
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	5/10/2008	0.077	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/7/2008	0.066	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/7/2008	0.176	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/8/2008	0.166	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/8/2008	0.163	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/9/2008	0.16	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/9/2008	0.13	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/9/2008	0.125	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/10/2008	0.062	mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/8/2008		mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/8/2008		mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/7/2008		mg/L-P
Wet	Banklick Creek at RM 0.3 (Rt. 177)	5/9/2008		mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/7/2008	0.05	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/7/2008	0.152	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/8/2008	0.151	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/8/2008	0.205	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/9/2008	0.112	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/9/2008	0.107	mg/L-P
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	5/10/2008	0.108	mg/L-P

Survey_Type	Station_Desc	RiverMile	Result	Meas_Units
	Banklick Creek at RM 5.7 (Pioneer Park Off Sr 17)	5.7	58	mg/L
	Mosers Branch at RM 0.7 (Teepee To Creek)	0.7	13	mg/L
	Banklick Creek at RM 0.2 (Mouth)	0.2	26	mg/L
	Banklick Creek at RM 15 (Station 2)	15	9	mg/L
	Banklick Creek at RM 18.2 (Station 1)	18.2	19	mg/L
	Banklick Creek at RM 13.5 (Station 3 - Under Railroad Tressel)	13.5	27	mg/L
	Banklick Creek at RM 10.1 (Station 4 - Banklick Woods)	10.1	9	mg/L
	Banklick Creek at RM 8.1 (Station 5 - USGS Station)	8.1	11	mg/L
	Bullock Pen Creek at RM 0.1 (Station 6 - White Church)	0.1		mg/L
	Banklick Creek at RM 5.4 (Station 7 - Prairie Park)	5.4	12	mg/L
	Banklick Creek at RM 3.9 (Station 8 - Sanitation District)	3.9	17	mg/L
	Banklick Creek at RM 0.4 (Station 10)	0.4	26.7	mg/L
	Banklick Creek at RM 2.5 (Station 9 - Driving Range)	2.5	22	mg/L
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	2	mg/L
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	2.3	mg/L
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	3.8	mg/L
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	4.8	mg/L
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	1.2	mg/L
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	1.6	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	7.4	mg/L
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	14.2	mg/L
Dry	Banklick Creek at RM 0.4 (Station 10)	0.4	18.2	mg/L
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	9.12	mg/L
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	13.2	mg/L
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	14.5	mg/L
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	17.3	mg/L
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	4.33	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	18.6	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	22	mg/L
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	8.09	mg/L
Dry	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	10	mg/L
Dry	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	126	mg/L
Dry	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	19	mg/L
Dry	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	13	mg/L
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	9	mg/L
Dry	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	10	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	25	mg/L
Dry	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	43	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	10.6	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	13.3	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	14.5	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	14.2	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	14.3	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	8.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	11.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	13.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	15.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	13	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	30.1	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	18.8	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	15.1	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	37.5	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	42.3	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	40	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	29.3	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	22.9	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	125	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	60.7	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	40.3	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	41.2	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	137	mg/L

Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	33.2	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	24	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	932	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	61.7	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	33.3	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	25.8	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	31.3	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	28.9	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	11.2	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	664	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	106	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	160	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	91	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	46	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	43.1	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	128	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	369	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	189	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	119	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	155	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	68.7	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	27	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	670	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	170	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	88	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	78	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	54	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	32	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	6.8	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	2800	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	540	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	200	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	94	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	55	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	29	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	2550	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	2500	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	1100	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	320	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	130	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	53	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	30	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	3700	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	610	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	210	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	48	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	39	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	6.2	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	530	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	230	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	71	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	55	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	37	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	13	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	1600	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	1400	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	1400	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	350	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	100	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	51	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	120	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	1300	mg/L

Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	2000	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	450	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	410	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	120	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	58	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	24	mg/L
Wet	Banklick Creek at RM 0.4 (Station 10)	0.4	26	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	79	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	570	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	190	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	91	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	38	mg/L
Wet	Banklick Creek at RM 15.6 (S7-Maher Road Bridge (Rm 15.6))	15.6	28	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	31	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	1300	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	1300	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	630	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	220	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	73	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Road Bridge)	11.6	110	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	17	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	1500	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	950	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	310	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	310	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	73	mg/L
Wet	Banklick Creek at RM 8.5 (Richardson Road Bridge (Ky 1829))	8.5	44	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	1200	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	3300	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	560	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	180	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	76	mg/L
Wet	Fowler Creek at RM 0.1 (Madison Pike (Ky 17) Near Confluence With Banklick Creek)	0.1	21	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	12	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	73	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	110	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	97	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	32	mg/L
Wet	Bullock Pen Creek at RM 0.1 (Bullock Pen Road Downstream Of Doe Run Lake)	0.1	23	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	1500	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	520	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	710	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	420	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	83	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Drive Bridge)	3.9	37	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	660	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	1000	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	720	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	790	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	640	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	600	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	110	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	43	mg/L
Wet	Banklick Creek at RM 0.3 (Decoursey Pike Bridge (Ky 177))	0.3	19	mg/L
Wet	Banklick Creek at RM 0.4 (Station 10)	0.4	20	mg/L
Dry	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	35.5	mg/L
Dry	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	19.7	mg/L
Dry	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	11	mg/L
Dry	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	10	mg/L
Dry	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	24	mg/L
Dry	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	8.75	mg/L
Dry	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	38	mg/L

Dry	Banklick Creek at RM 0.3 (Rt. 177)	0.3	44.3	mg/L
Dry	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	27.7	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	6.36	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	7.27	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	7.27	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	7.82	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	8.4	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	9.09	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	5.82	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6	4.4	mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6		mg/L
Wet	Banklick Creek at RM 15.6 (Maher Rd. bridge)	15.6		mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	7.27	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	10.7	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	26.2	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	88.3	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	88.7	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	42.9	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	42.9	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	17.6	mg/L
Wet	Banklick Creek at RM 11.6 (Independence Station Rd.)	11.6	10.8	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	3.45	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	22.2	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	24.4	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	18	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	32.6	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	12.9	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	8.36	mg/L
Wet	Fowler Creek at RM 0.1 (Rt. 17 bridge)	0.1	6.4	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	3.64	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	9.09	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	15.1	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	19.6	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	26.4	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	7.82	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1	5.8	mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1		mg/L
Wet	Banklick Creek at RM 8.1 (Richardson Rd. bridge)	8.1		mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	10	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	18.5	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	12.4	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	19.6	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	3.64	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	4.18	mg/L
Wet	Bullock Pen Creek at RM 0.1 (bridge off Bullock Pen Rd.)	0.1	15.6	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	11.3	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	48	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	41.3	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	39.4	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	58.6	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	58.3	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	22.8	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	14	mg/L
Wet	Banklick Creek at RM 3.9 (Eaton Dr bridge)	3.9	12.4	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	20.7	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	60.2	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	74	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	83.6	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	65.2	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	39.7	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	40.4	mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3	9.8	mg/L

Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3		mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3		mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3		mg/L
Wet	Banklick Creek at RM 0.3 (Rt. 177)	0.3		mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	14.4	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	74	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	75.3	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	45.4	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	75	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	32.8	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	27	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	26.5	mg/L
Wet	Banklick Creek at RM 1.2 (Rt. 16 bridge)	1.2	32.6	mg/L

Survey_Desc	Survey	Par_Name	Result	Meas_Units
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	620	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	120	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	60	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	260	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	400	CFU/100mL
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Ecoli_(cfu)	100	CFU/100ml
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Fecal_(cfu)	240	CFU/100mL
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Ecoli_(cfu)	224	CFU/100ml
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Fecal_(cfu)	600	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	192	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	68	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	660	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	800	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1220	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1330	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	780	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1080	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1450	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2100	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	540	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1350	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	128	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	148	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	75500	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	88000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	69100	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	105000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	30000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	74000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	11300	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	20000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	7090	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	11500	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	980	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	1300	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	35000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	37000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	17000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	25000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	40000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	42000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	25000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	47000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	4600	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	4800	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	1800	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2500	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	1060	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	1178	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	110	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	112.8	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	270	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	189	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1800	CFU/100mL

Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	2064	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1400	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1553	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	6000	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	3784	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	320	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	583	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	70	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	121	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	97	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	130	CFU/100mL
1998-2003 LRWW (NKU) Fecal Only Surveys		Ecoli_(cfu)	90	CFU/100ml
1998-2003 LRWW (NKU) Fecal Only Surveys		Fecal_(cfu)	150	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	56	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	88	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	52	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	88	CFU/100mL
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Ecoli_(cfu)	128	CFU/100ml
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Fecal_(cfu)	192	CFU/100mL
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Ecoli_(cfu)	640	CFU/100ml
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Fecal_(cfu)	1040	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	100	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	180	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1730	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2800	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1000	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2300	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	500	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1100	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1280	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2170	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	520	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1040	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	120	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	120	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	61800	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	79000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	63000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	83600	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	12000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	28000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	12300	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	18000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	6450	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	19000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	1460	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2500	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	9730	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	14900	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	20000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	46000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	11700	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	20000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	2500	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	3300	CFU/100mL

Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	1400	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2600	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	24	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	52	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	260	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	373.2	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1000	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1553	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	2900	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	2909	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	982	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	2382	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1000	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1529	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	964	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1500	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	170	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	1153	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	70	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	86	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)		CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)		CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	790	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	580	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	884	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	30	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	58	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	86.4	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	420	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	364	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	927	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	644	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	340	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	520	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	2200	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	862	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	340	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	305	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	20	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	52	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)		CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	1	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	10	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	10	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	440	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	885	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	400	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	10	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	110	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	410	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	150	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	530	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	180	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	900	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	350	CFU/100mL

Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	450	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	740	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	1020	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	820	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	690	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	1323	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	2400	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	440	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)		CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	1210	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	8200	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	650	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	260	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	10	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	5900	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	90	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	450	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	170	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	2670	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	29732	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	310	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	420	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	16	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	350	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	271	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	963	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	40	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	8800	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	620	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	235	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	90	CFU/100mL
Routine Licking River Basin monitoring (1990-2007)		Fecal_(cfu)	30	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	390	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	860	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	4100	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	10	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	33000	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	24	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	32	CFU/100mL
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Ecoli_(cfu)	263	CFU/100ml
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Fecal_(cfu)	520	CFU/100mL
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Ecoli_(cfu)	84	CFU/100ml
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Fecal_(cfu)	160	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2200	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	860	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	5600	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	3700	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	7730	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	6360	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	4400	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	4000	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2000	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	980	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1520	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1200	CFU/100ml

Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	84	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	92	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	34000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	46000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	30000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	33000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	65500	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	81800	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	38000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	83600	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	15500	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	17200	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	6450	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	13500	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	80	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	160	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	13200	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	30000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	54000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	67300	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	42000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	63600	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	4900	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	5100	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	2100	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2100	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	2000	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	14300	CFU/100mL
1999-2000 Banklick 303(d) Survey		Fecal_(cfu)	68000	CFU/100mL
1998-2004 LRWW Surveys		Fecal_(cfu)	500	CFU/100mL
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Ecoli_(cfu)	52	CFU/100ml
Banklick Cr. Dry weather survey 1 (10/17/02)	Dry	Fecal_(cfu)	1600	CFU/100mL
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Ecoli_(cfu)	100	CFU/100ml
Banklick Cr. Dry weather survey 2 (6/25/03)	Dry	Fecal_(cfu)	180	CFU/100mL
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Ecoli_(cfu)	92	CFU/100ml
Banklick Cr. Dry weather survey 3 (8/20/03)	Dry	Fecal_(cfu)	240	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	9450	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	7440	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	3800	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	3000	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	1780	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1270	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2000	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	1200	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	2500	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	2200	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	740	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	420	CFU/100ml
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Fecal_(cfu)	500	CFU/100mL
Banklick Cr. Wet weather survey 1 (6/26/03-6/27/03)	Wet	Ecoli_(cfu)	188	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	350	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	350	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	27000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	31000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	35000	CFU/100ml

Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	64000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	28000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	28000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	14000	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	21000	CFU/100mL
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Ecoli_(cfu)	7270	CFU/100ml
Banklick Cr. Wet weather survey 2 (9/22/03-9/24/03)	Wet	Fecal_(cfu)	10800	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	97300	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	111000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	37000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	45000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	39000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	56000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	19000	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	39000	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	5200	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	5900	CFU/100mL
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Ecoli_(cfu)	2100	CFU/100ml
Banklick Cr. Wet weather survey 3 (9/27/03-9/29/03)	Wet	Fecal_(cfu)	2900	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	80	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	98	MPN/100ml
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Fecal_(cfu)	1470	CFU/100mL
Phase 2 (2007) Baseline survey-Central Basin (6/26/07-7/3/07)	Dry	Ecoli_(mpn)	1565	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	320	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	489.2	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	380	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	426	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	500	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	624	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	954	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	538	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	440	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	571	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	191	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	364	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	40	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	85	MPN/100ml
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	80	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Fecal_(cfu)	40	CFU/100mL
Banklick Creek/Licking River Wet Weather Survey 1 (5/7-10/08)	Wet	Ecoli_(mpn)	121	MPN/100ml
1998-2004 LRWW Surveys		Fecal_(cfu)	250	CFU/100mL
1998-2003 LRWW (NKU) Fecal Only Surveys		Ecoli_(cfu)	90	CFU/100ml
1998-2003 LRWW (NKU) Fecal Only Surveys		Fecal_(cfu)	400	CFU/100mL

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1 — Collection Date: May and June, 2008

Banklick Creek — TRC Project Number: 8161-08

Kenton County, Kentucky

			BLC 2.6		BLC 3.9		BLC 5.5		BLC 8.1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
ANNELIDA										
Erpobdellidae gen. sp.	CG	8.2				X				
Lumbriculidae gen. sp.	CG	7.3								X
Naididae gen. sp.	CG	9.1						X		X
AMPHIPODA										
Crangonyx sp.	SH-d	8						X		
Synurella dentata Hubricht	SH-d	7.7	4					X	10	
ISOPODA										
Lirceus fontinalis Rafinesque	CG	7.9	20	X	24	X	116	X	475	
DECAPODA										
Orconectes sp.	CG	5.5		X	8	X	4	X	20	X
EPHEMEROPTERA										
Acentrella ampla Traver	CG	3.6							10	
Acerpenna pygmaeus (Hagen)	CG	3.9						X		
Acerpenna sp.	CG	5				X				
Baetis flavistriga McDunnough	CG	6.6	28	X	80	X			5	
Baetis intercalaris McDunnough	CG	5.8	28	X	80	X	4	X		
Caenis diminuta group sp.	CG	7.4					4			X
Procloeon sp.	CG	5.4		X						
Stenonema femoratum (Say)	SC	7.2	12	X	8	X	8	X	5	X
ODONATA										
Argia apicalis (Say)	P	8.7				X				
Argia sp. (imm.)	P	8.7		X						
Calopteryx maculata (Beauvois)	P	7.8						X		
Enallagma sp. (imm.)	P	9		X		X		X		
PLECOPTERA										
Neoperla sp.	P	1.6							5	
Perlesta sp.	P	4.9							50	X
TRICHOPTERA										
Cheumatopsyche sp.	CF	6.2	28	X	56	X	40	X	110	X
Chimarra sp.	CF	2.7		X						
Hydroptila sp.	P	6.2			24	X				
COLEOPTERA										
Berosus sp.	P	8.6		X						

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1
Banklick Creek
Kenton County, Kentucky

Collection Date: May and June, 2008
TRC Project Number: 8161-08

			BLC 2.6		BLC 3.9		BLC 5.5		BLC 8.1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
Ectopria sp.	SC	4.2	4	X		X				
Hydrophilidae gen. sp. (imm.)	P	6.3					4			
Peltodytes sp.	P	8.5		X						
Psephenus herricki (DeKay)	SC	2.4	4	X	4	X	8		35	X
Stenelmis sp.	SC	5.1	100	X	384	X	388	X	340	X
DIPTERA (Chironomidae)										
Ablabesmyia mallochi (Walley)	P	7.2	12	X		X		X		
Chaetocladius sp.	CG	6						X		
Chironomus sp.	CG	9.8				X		X		
Corynoneura sp.	CG	6	4							
Cricotopus (C.) trifascia Edwards	SH-d	7		X	4			X		
Cricotopus (I.) absurdus	CG	5			16		100			
Cricotopus / Orthocladius sp.	CG	7.1	88		4	X	516	X	485	X
Cricotpus (I.) "Ozarks"	SH-d	7						X	140	X
Cryptochironomus sp.	P	6.4	4		4					
Dicrotendipes neomodestus (M.)	CG	8.1		X	12	X			10	
Eukeifferiella brevicalcar grp. sp.	CG	2.2	20			X			15	
Eukiefferiella sp.	CG	3.4					4			
Labrundinia sp.	PR	6				X				
Parametriocnemus sp.	CG	3.7	48	X	8					
Polypedilum flavum (Joh.)	SH-d	5.3	384	X	44		8	X	45	X
Polypedilum illinoense group sp.	SH-d	9	132	X		X	12	X		
Polypedilum scalaenum group sp.	SH-d	8.4	4							
Rheotanytarsus exiguus group sp.	CF	6.4		X		X				
Stictochironomus sp.	CG	6.5					12	X		X
Tanytarsus sp.	CF	6.7		X	8					
Thienemanniella xena (Roback)	CG	5.9	4		4					
Thienemannimyia group sp.	P	5.9	60	X	84	X		X	15	X
DIPTERA (Other)										
Anopheles sp.	CF	9.1				X				
Simulium sp. (imm.)	CF	4	196	X	24	X	4		15	X
MOLLUSCA										
Physella sp.	SC	8.8		X						
Pisidium	CF	6.1						X		

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1
Banklick Creek
Kenton County, Kentucky

Collection Date: May and June, 2008
TRC Project Number: 8161-08

			BLC 2.6		BLC 3.9		BLC 5.5		BLC 8.1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
Sphaerium sp.	CF	7.6	8							
OTHER TAXA										
Turbellaria gen. sp.	NA	7.2	8	X	12	X		X		

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1

Collection Date: May and June, 2008

Banklick Creek Watershed Set 2

TRC Project Number: 8161-08

Kenton County, Kentucky

			BLC 13.5		BLC 15.6		BLC 17.8	
			Station 1		Station 2		Station 3	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL
ANNELIDA								
Lumbriculidae gen. sp.	CG	7.3			4			
Naididae gen. sp.	CG	9.1		X		X		X
AMPHIPODA								
Crangonyx sp.	SH-d	8		X				
Synurella dentata Hubricht	SH-d	7.7	5	X	24	X	84	X
ISOPODA								
Lirceus fontinalis Rafinesque	CG	7.9	57	X	200	X	380	X
DECAPODA								
Cambarus sp.	CG	4.9			4		2	X
Orconectes sp.	CG	5.5		X	16	X	8	X
EPHEMEROPTERA								
Baetis flavistriga McDunnough	CG	6.6	1	X	8	X		
Baetis intercalaris McDunnough	CG	5.8	3		8		2	
Centroptilum sp.	CG	6.6		X				
Leptophlebiidae gen. sp. (imm.)	CG	3.3			4	X		
Leucrocuta sp.	SC	0						X
Paraleptophlebia sp.	CG	0.9						X
Plauditus sp.	CG	5.4			4			
Procloeon sp.	CG	5.4				X		
Stenonema femoratum (Say)	SC	7.2	13	X	16	X		X
PLECOPTERA								
Amphinemura sp.	SH-d	3.4					2	
Neoperla sp.	P	1.6	1	X		X		
Perlesta sp.	P	4.9	4		8		20	X
TRICHOPTERA								
Cheumatopsyche sp.	CF	6.2	14	X	36		6	X
Hydroptila sp.	P	6.2			4			
Polycentropus sp.	P	3.5		X				
COLEOPTERA								
Ectopria sp.	SC	4.2	1					
Psephenus herricki (DeKay)	SC	2.4	15	X				
Stenelmis sp.	SC	5.1	128	X	124	X	4	X

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1

Collection Date: May and June, 2008

Banklick Creek Watershed Set 2
Kenton County, Kentucky

TRC Project Number: 8161-08

			BLC 13.5		BLC 15.6		BLC 17.8	
			Station 1		Station 2		Station 3	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL
DIPTERA (Chironomidae)								
Ablabesmyia mallochi (Walley)	P	7.2	1	X	4	X		
Chironomus sp.	CG	9.8				X		
Cricotopus (C.) trifascia group sp.	SH-d	2.8			12			
Cricotopus (I.) absurdus	CG	5		X			12	
Cricotopus / Orthocladius sp.	CG	7.1	32		156	X	130	X
Cricotpus (I.) "Ozarks"	SH-d	7			208			
Microtendipes pedellus group sp.	CF	6.2	86					
Parametriocnemus sp.	CG	3.7			4		24	X
Paratendipes albimanus (Meigen)	CG	9.2					4	
Polypedilum flavum (Joh.)	SH-d	5.3	47	X	212	X	6	
Polypedilum illinoense group sp.	SH-d	9	8	X			4	X
Rheocricotpus sp.	CG	6.8			4			
Rheotanytarsus exiguus group sp.	CF	6.4					2	
Stempellinella sp.	CG	4.6	1					
Stictochironomus sp.	CG	6.5	1	X		X		
Tanytarsus sp.	CF	6.7	1	X	4	X	2	X
Thienemanniella sp.	CG	5.9	3					
Thienemanniella xena (Roback)	CG	5.9			4			
Thienemannimyia group sp.	P	5.9	19	X	44	X	8	
Tventia paucunca (Saether)	CG	3.7					2	
DIPTERA (Other)								
Atrichopogon sp.	P	6.8				X		
Bezzia / Palpomyia grp. sp.	P	6.9				X		
Hemerodromia sp.	P	8.1				X		
Hexatoma sp.	P	4.3	1					
Simulium sp. (imm.)	CF	4	4	X	320	X	2	
MOLLUSCA								
Ferrissia sp.	SC	6.9	1					
Helisoma sp.	SC	6.5		X				
Physella sp.	SC	8.8	1	X		X	6	
Pisidium	CF	6.1	1			X		
Sphaerium sp.	CF	7.6		X		X		

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

NKSD #1

Collection Date: May and June, 2008

Banklick Creek Watershed Set 2

TRC Project Number: 8161-08

Kenton County, Kentucky

			BLC 13.5		BLC 15.6		BLC 17.8	
			Station 1		Station 2		Station 3	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL
OTHER TAXA								
Turbellaria gen. sp.	NA	7.2	3				2	X

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

APPENDIX J
PREVIOUS DATA COLLECTION EFFORTS

PREVIOUS DATA COLLECTION EFFORTS
(BEYOND KENTUCKY DIVISION OF WATER)

Many data collection efforts have been undertaken on Banklick Creek. In general, these efforts have identified sources and impairments that are relatively consistent with the KDOW assessment discussed above. As early as the 1950s, residents along Banklick Creek described the stream as smelly and complained about debris left by receding waters (Ormsbee et al. 1994). A 1952 attempt to lessen the creek's odors by building up the bank and containing the creek failed to alleviate the problem. Banklick Creek's water quality concerns have continued to the present day, but unlike past efforts to treat the symptoms of pollution, today's public agencies and citizens are trying to understand the sources of problems and remediate them for the long-term benefit of the stream and those who live and work in the watershed.

Over the years, data documenting water quality in the Banklick Watershed have been collected by the Northern Kentucky Independent Health District (NKIHD), SD1, Kenton County Conservation District (KCCD) and Licking River Watershed Watch (LRWW).

A study conducted by the USACE in 2000 describes the quality of the Banklick Creek in the following manner:

> "Bank erosion has resulted in little bank vegetation and lack of canopy, which in effect has increased water temperatures; thereby, lowering the amount of dissolved oxygen. Bank erosion has also increased bed degradation, turbidity, and sedimentation. Habitat alteration has fragmented the riparian buffer that provides wildlife corridors with foraging opportunities and provides protected access to water. Degradation of the stream banks has reduced the opportunity for natural filtration of nonpoint source runoff."

In 2001, SD1 was awarded a federal grant to develop and demonstrate a method for understanding water quality problems on a watershed basis. The objective of the study was to develop a standard protocol for determining the quality of a watershed that could be applied to any impaired watershed in SD1's jurisdictional region. The first phase of the project led to the development of the protocol which consisted of four steps:

1. Problem identification--Compare current conditions to desired conditions to determine whether or not there is an existing problem.

2. Source Assessment--Identify potential and actual sources contributing to the problems identified.

3. Modeling--Select and apply a model to link the sources to the problems.

4. Source Ranking--Rank sources based on contribution to impairments and other site-specific factors.

In the second phase of the project, the protocol was applied to the Banklick Watershed. Banklick Watershed was selected as an appropriate site to test the protocol because it is located entirely within the SD1's jurisdictional area. Additionally, the sources of impairments are diverse, and a comprehensive database describing flow and water quality in this creek was available.

To supplement existing data on Banklick Creek, LTI sampled water quality during three dry and three wet weather events from October 2002 through September 2003 at five stations along the Banklick mainstem (located at RMs 0.5, 3.9, 8.1, 11.6, and 15.6). Additional stations were established at RM 0.08 on Fowler Creek (near its confluence with the Banklick at RM 8.1) and at RM 0.08 on Bullock Pen Creek (downstream from Doe Run Lake and near its confluence with Banklick Creek at RM 6.7).

Data collected by LTI during 2002 to 2003 were added to data collected by other organizations during the previous five years and all data were analyzed and compared to water quality criteria.

Steps 2 through 4 of the watershed assessment protocol were used to identify significant sources for each pollutant based on their relative contribution to in stream impairment, as presented in Table 4.03-1:

Pollutant Source	FC	TSS	TP	Am	CBOD	SOD
Commercial/Industrial	1%	20%	19%	8%	8%	19%
High Density Residential	0%	2%	2%	1%	1%	2%
Low Density Residential	34%	51%	67%	44%	41%	50%
Construction activity	0%	8%	0%	0%	0%	7%
Cropland	2%	2%	6%	6%	3%	2%
Forest	0%	13%	4%	5%	9%	13%
Pasture	4%	4%	1%	3%	2%	4%
Septic Systems	29%	0%	1%	27%	2%	0%
Point Sources	0%	0%	0%	0%	0%	1%
Sewer Overflows	30%	0%	1%	6%	33%	2%

Table 4.03-1 Percent of Pollutant Contributed by Source in the Banklick Watershed

Shading is used to represent pollutant-specific sources identified as being significant.

FC=fecal coliforms
TSS=total suspended solids
TP=total phosphorus
Am=ammonia
CBOD and SOD are measures of organic materials, including sediment.

In 2004, LTI produced a document titled *Watershed Assessment Protocol–Application to Banklick Creek*.

In addition to water quality parameters listed as impaired by the KDOW, the watershed protocol assessment application to Banklick Creek revealed high levels of lead and copper exceeding state standards, as follows:

1. The standard for copper was exceeded at Banklick Creek in the vicinity of RM 0.5 and 8.0 and at Fowler Creek at the mouth.

2. The standard for lead was exceeded at Banklick Creek RM 0.5 to 12, Bullock Pen Creek at the mouth, and Fowler Creek at the mouth.

3. Low density residential development and commercial/industrial development appeared to be the major sources contributing these heavy metals to the watershed (LTI, 2004).

4. The application of the watershed assessment protocol to Banklick Creek illustrated the complexities of water quality issues in larger urbanizing watersheds where many potential sources of pollution occur.