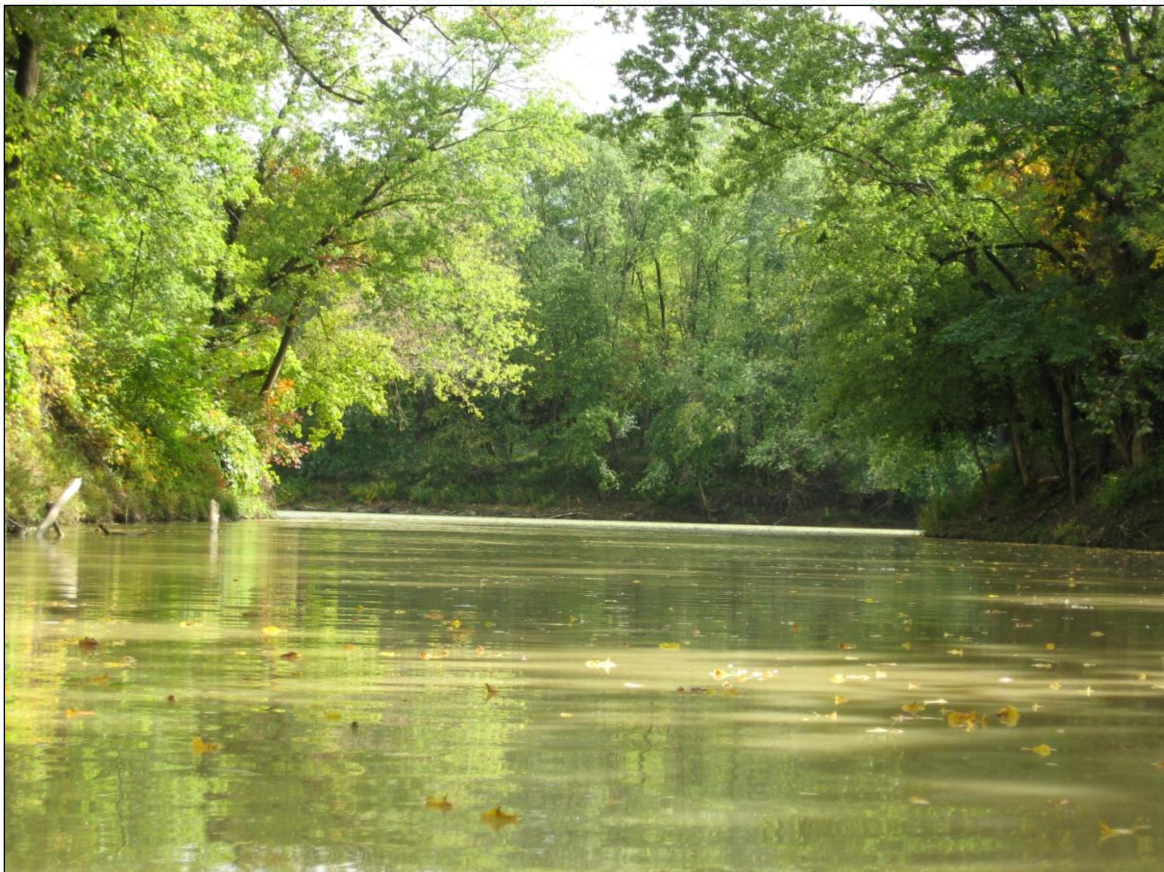
The Banklick Watershed Based Plan

Kenton and Boone Counties

A Holistic Approach to Watershed Improvement

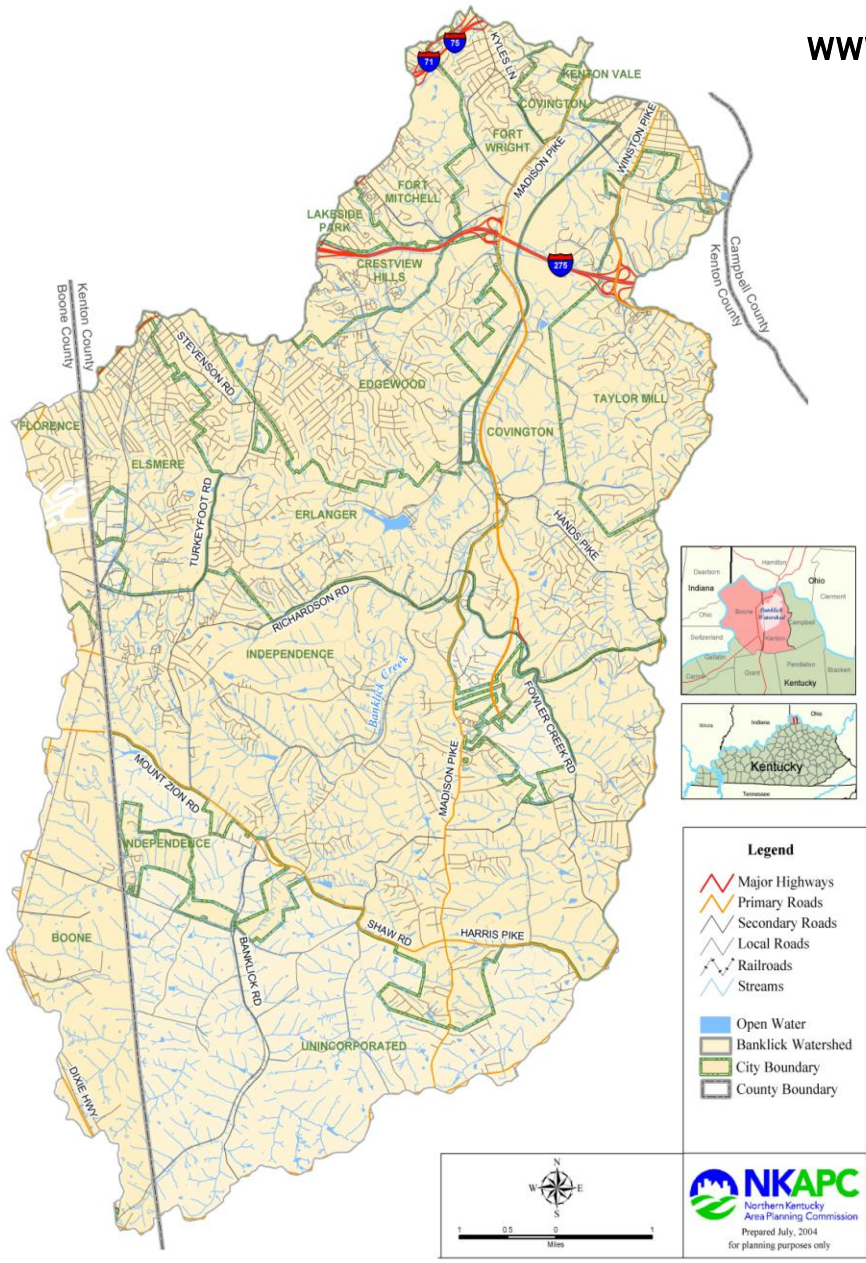


Revised and Updated by Strand Associates, Inc.®
April 2010

BANKLICK WATERSHED COUNCIL 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 5×10^{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.

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The Banklick Watershed Plan

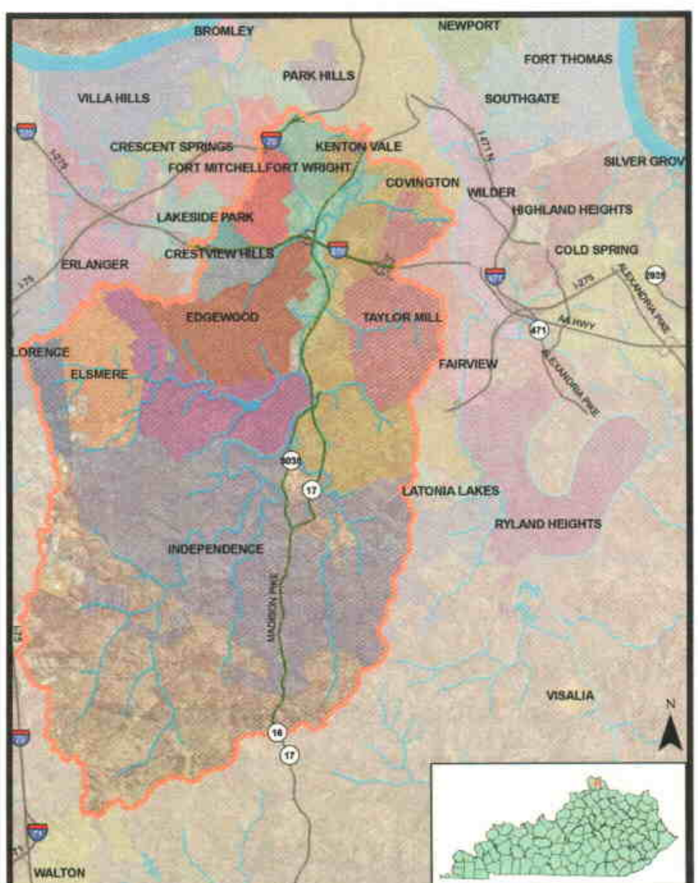
Watershed Plan Summary — November 2009

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.



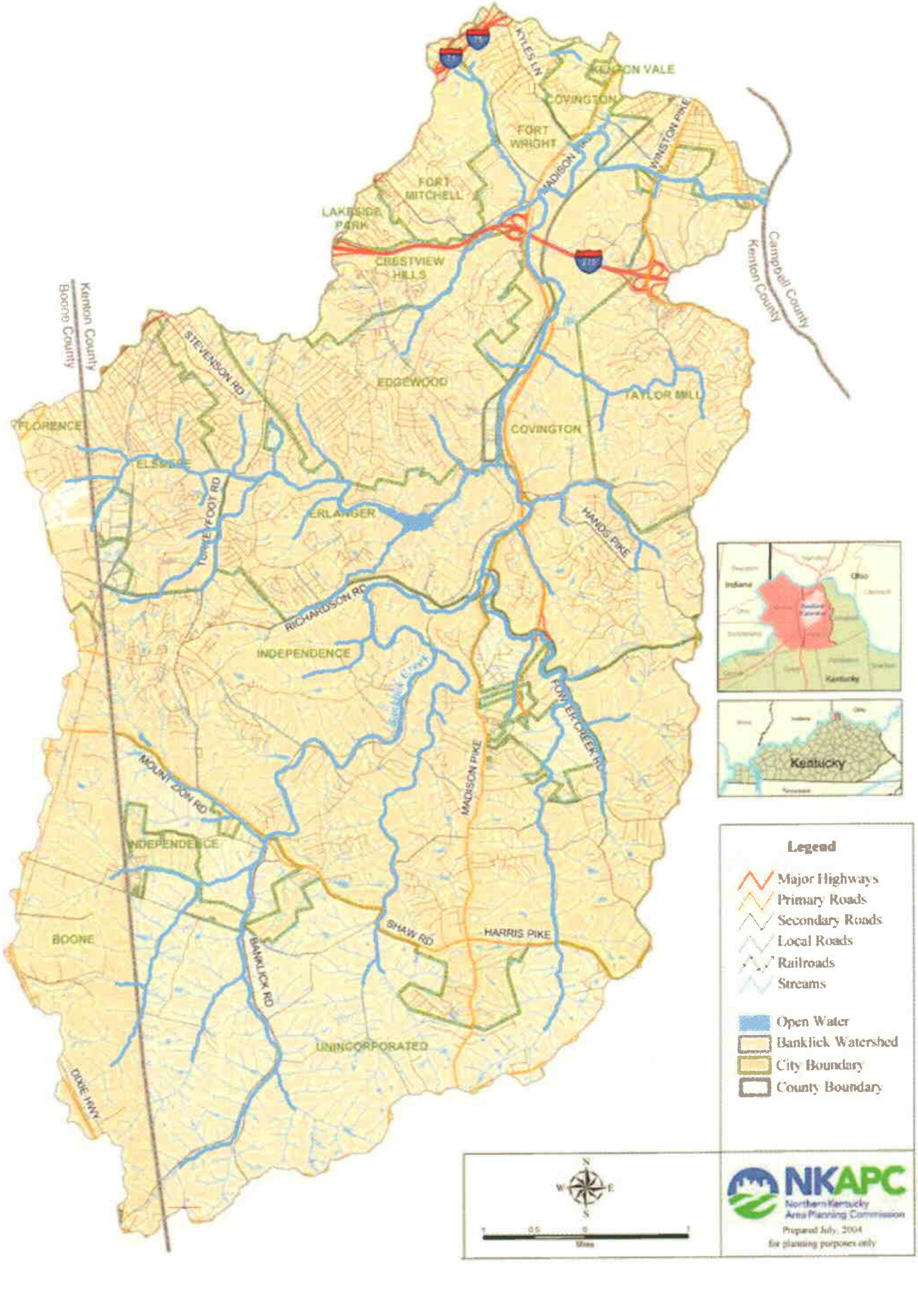
Goals of the Council

CLEAN THE WATER

REDUCE FLOODING

RESTORE THE BANKS

HONOR THE HERITAGE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Boone County
STEVENSON RD
EDGEWOOD
TAYLOR MILL
FLORENCE
COVINGTON
ELSMERE
TURKEYFOOT RD
ERLANGER
HANDS PIKE
RICHARDSON RD
INDEPENDENCE
FOWLER CREEK RD
MOUNT ZION RD
MADISON PIKE
INDEPENDENCE
BOONE
SHAW RD
HARRIS PIKE
BANKLICK RD
UNINCORPORATED
DIXIE HWY
Indiana
Ohio
Kentucky
Kentucky
Legend
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Secondary Roads
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Banklick Watershed
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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.

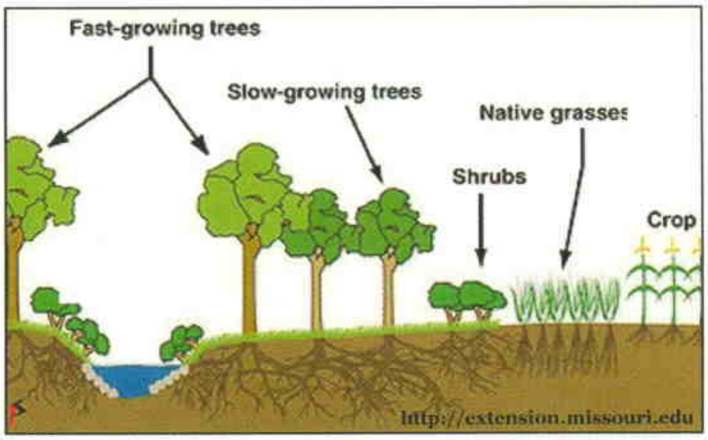
What is the Plan to Improve the Water Quality?

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

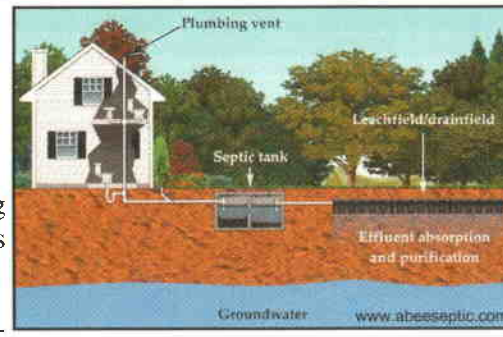
The Problem Livestock farms are often located near small streams allowing the animals to drink directly from the stream. This results in water pollution because manure is deposited directly in or near the stream, the animals trample the banks of the stream which causes the banks to break down and releases 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.

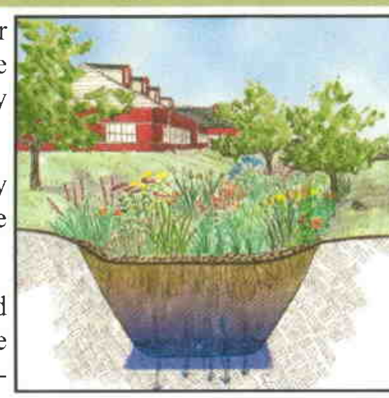


How will fixing septic systems help? Fixing or replacing failing septic systems can prevent residential sewage from entering the streams, this can improve water quality in the Banklick Watershed.

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.

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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.

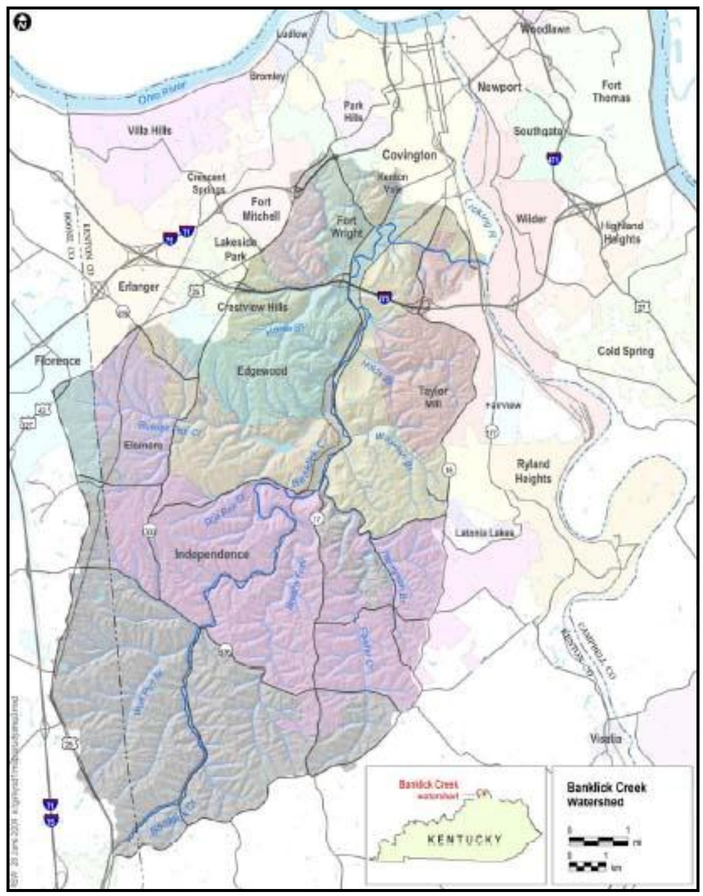

Figure 1.01-2 Municipalities within Banklick Creek

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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

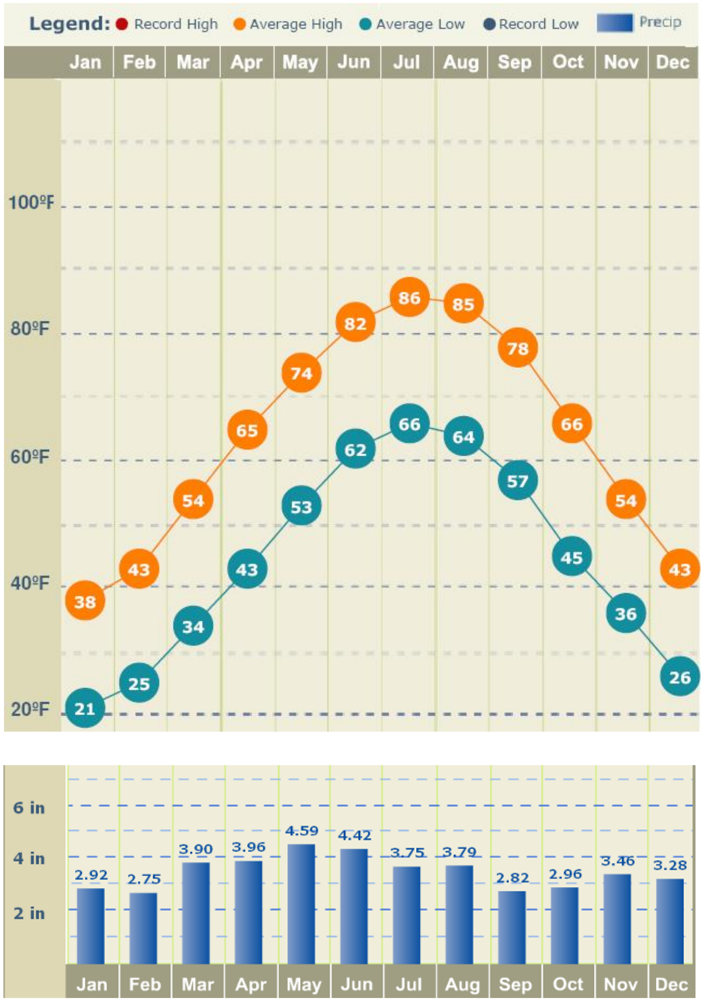
The topography of the watershed ranges from steep to gently sloping. Elevations above mean sea level range from 960 feet along the upper portion of the watershed divide to 450 at the Banklick's confluence with the Licking River [United States Department of Agriculture (USDA) 1973)].

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.

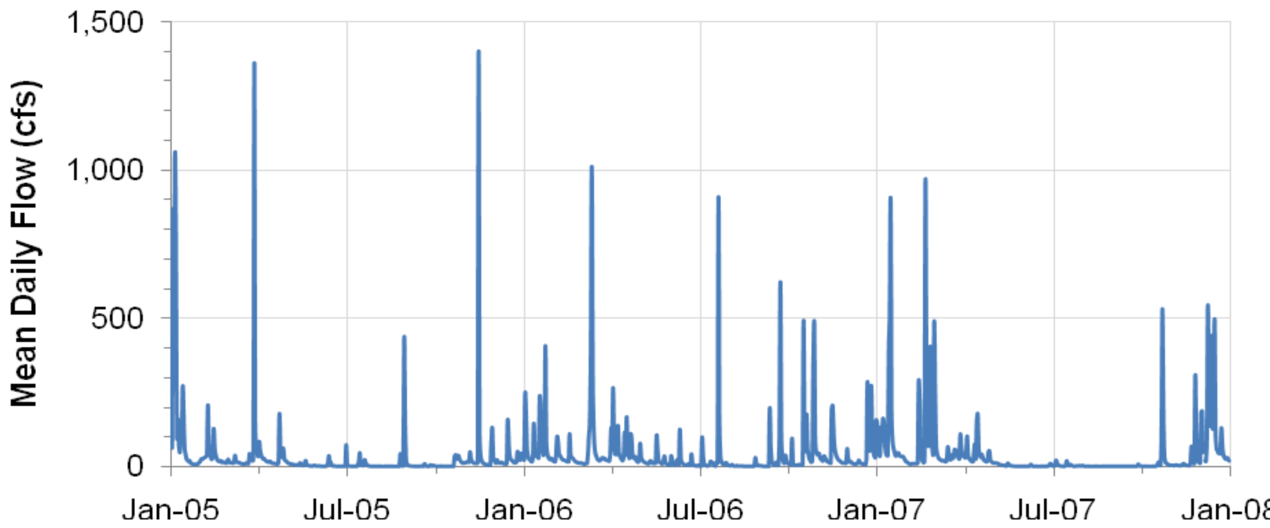


Figure 3.05-1 Three-year Time Series of Mean Daily Flow in Banklick Creek at RM 8.0 (USGS Gauge No. 03254550)

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:

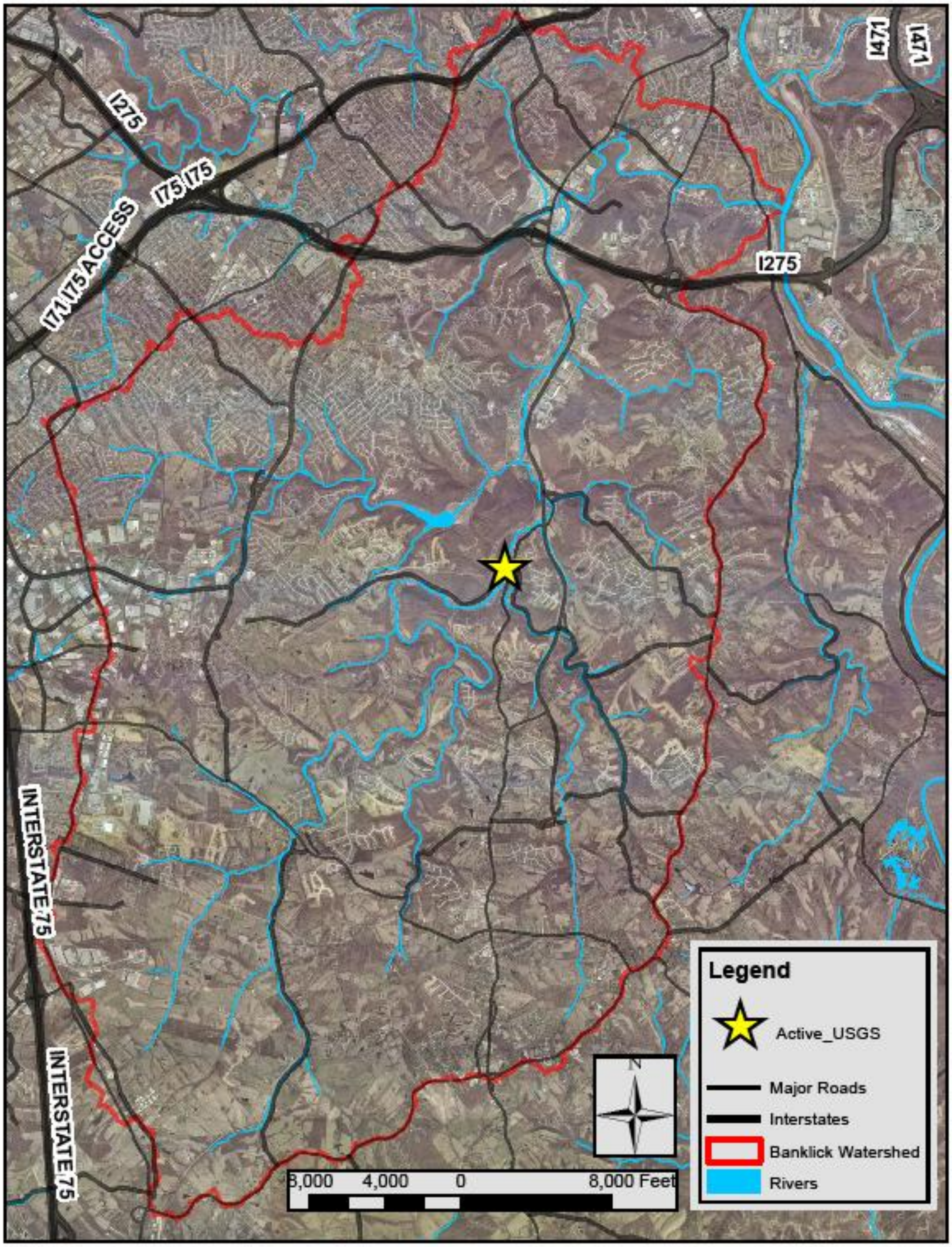
1. The concentration of early development along stream channels.

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

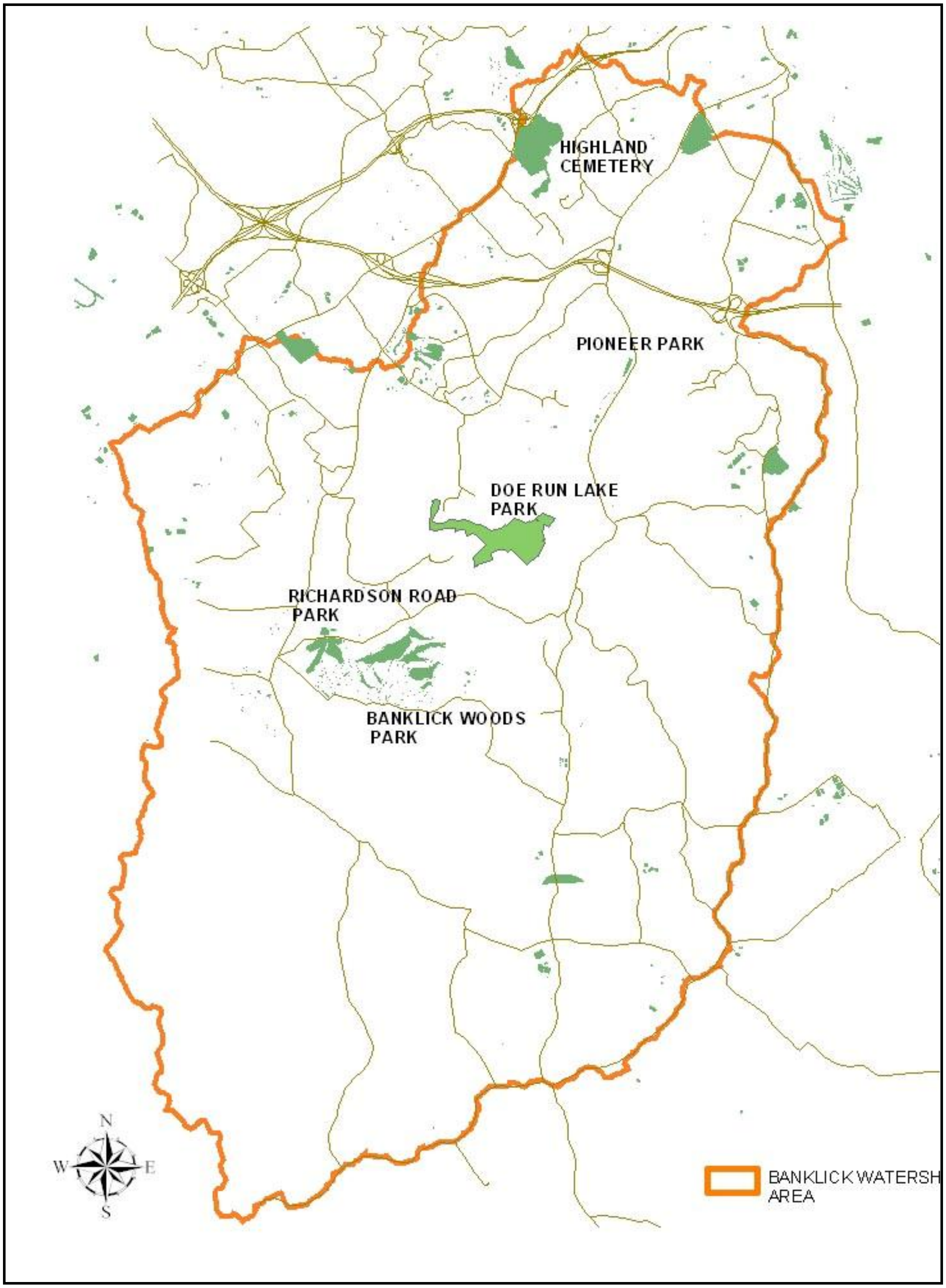
Although many small community parks are located in the watershed, a system of Kenton County parks was not developed until recent decades. In terms of both land availability and affordability, the relatively late start in park development has limited the county's options in acquiring larger tracts of 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.

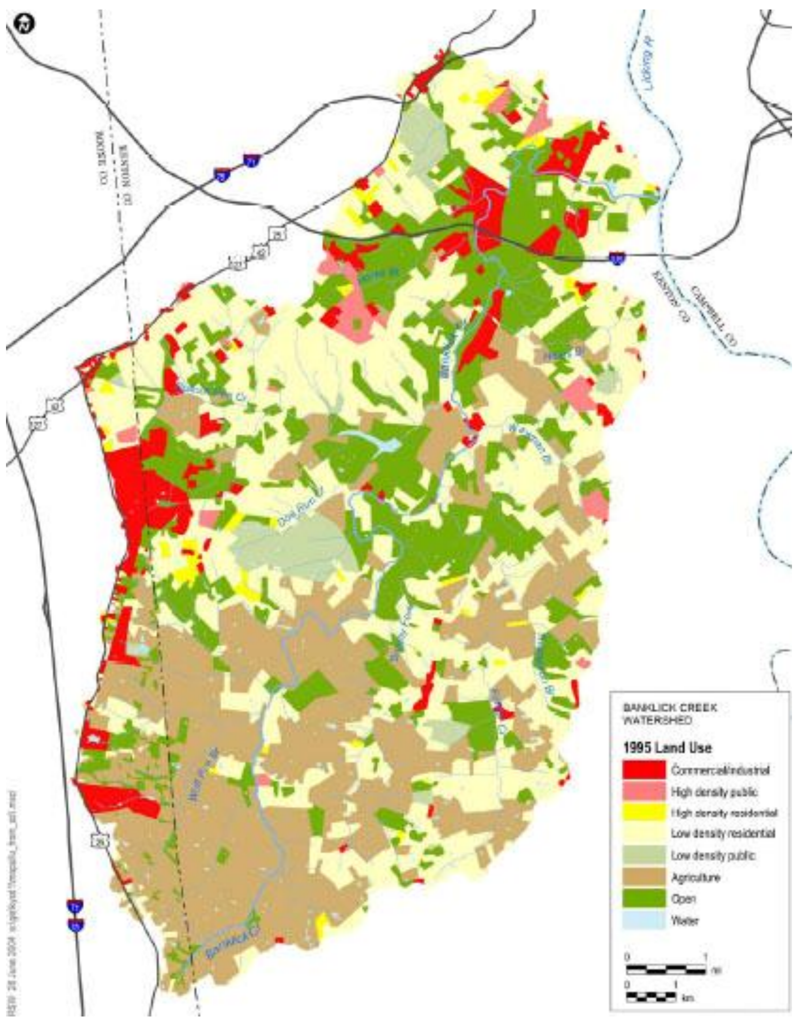
A close link exists between land activities and water quality. For nearly 200 years, agriculture has been the traditional land use in Banklick's headwaters and upland areas. The region's approximately 186-day growing season and 41-inch annual precipitation have been favorable to the growth of tobacco, 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).

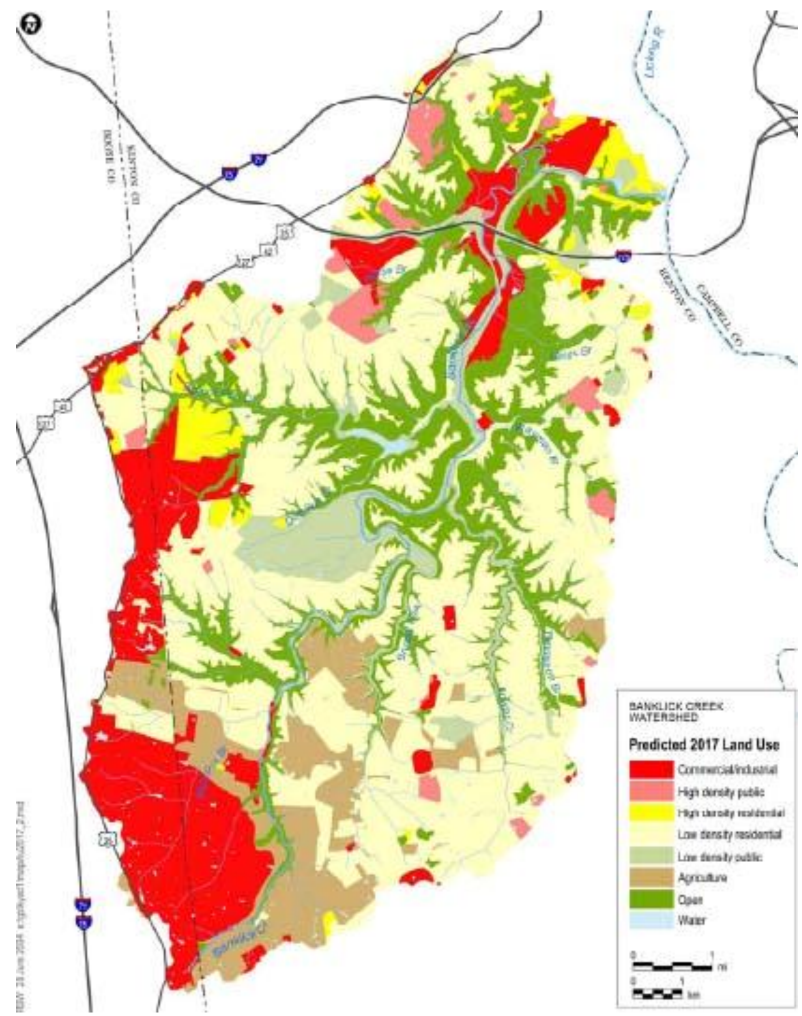
According to the 2008 watershed characterization report by LTI, 47 percent of Banklick Watershed is currently developed. Development is concentrated in the central and northern portions of the watershed. Developed areas include the communities of Independence, Covington, Erlanger, Taylor Mill, Edgewood, 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.



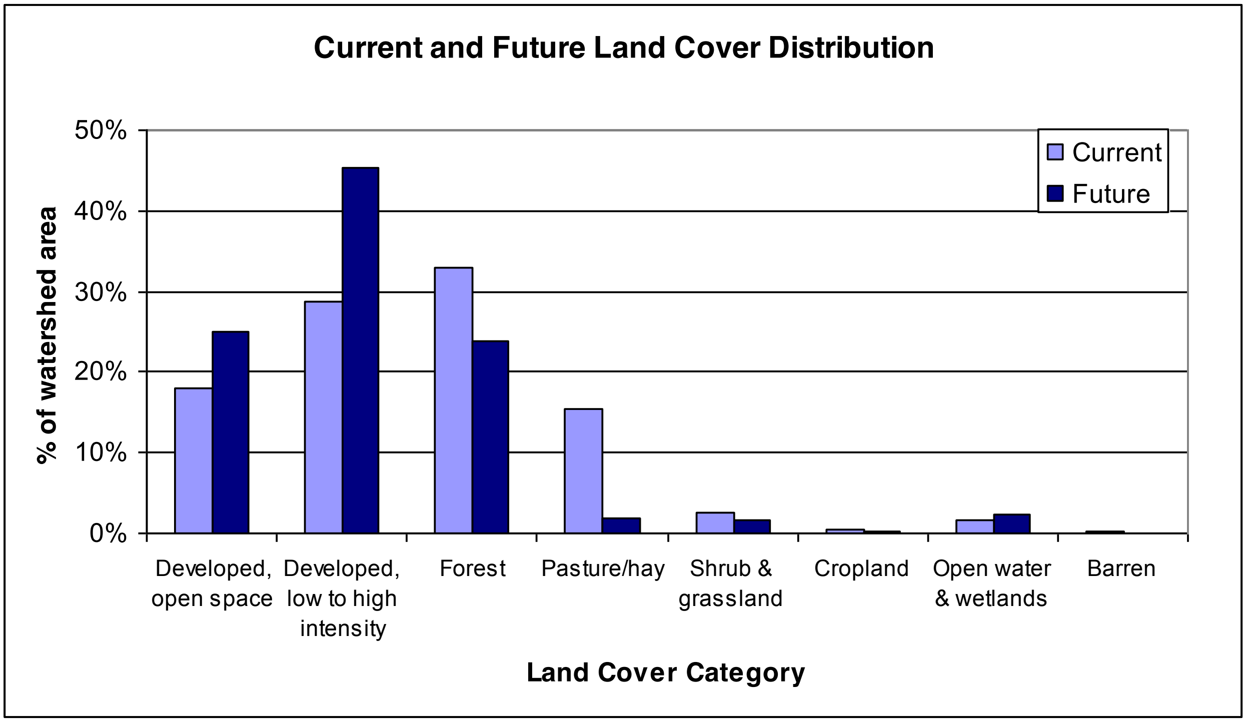
Source: Limnotech, Inc.

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

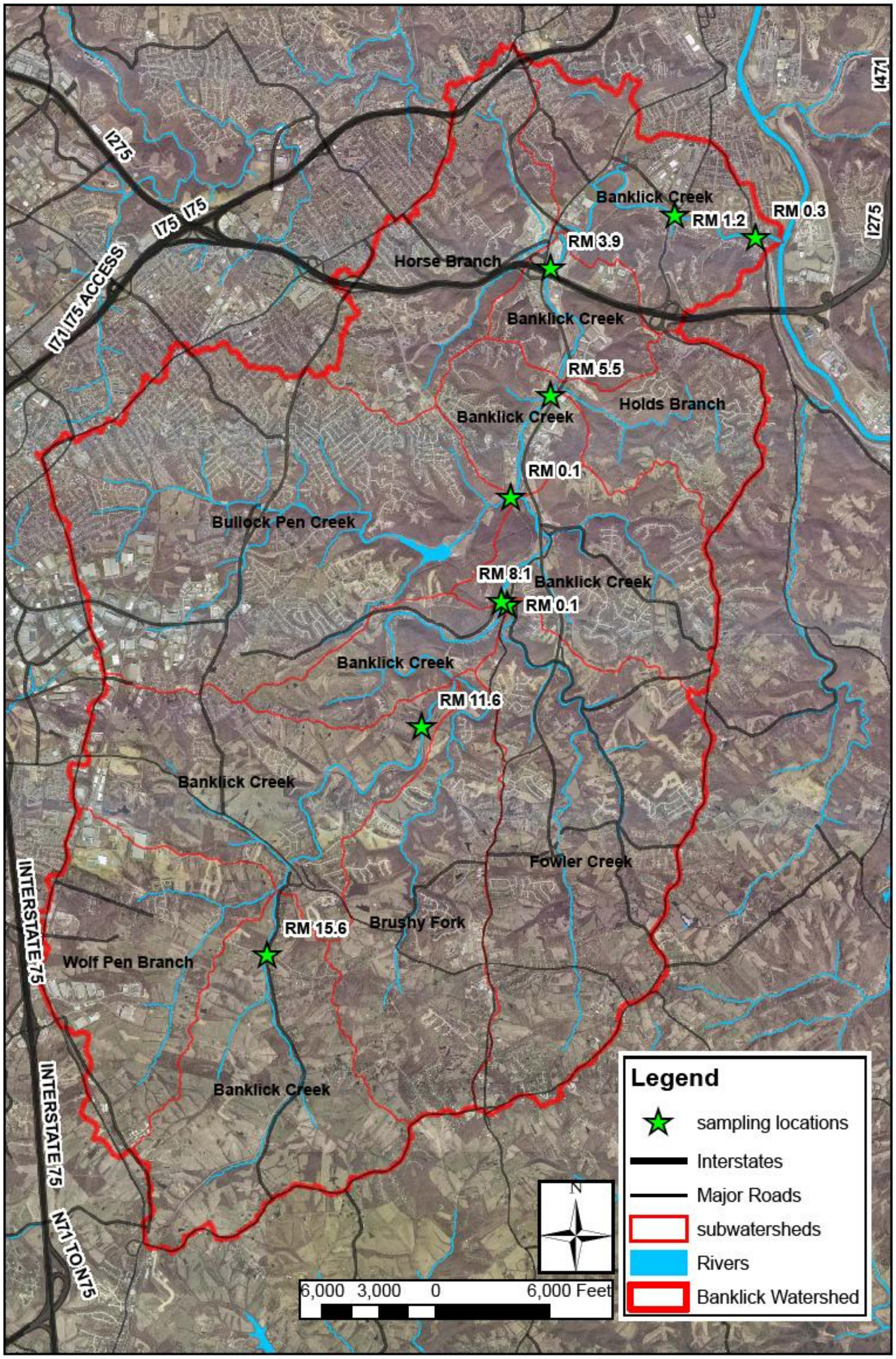
4.01 INTRODUCTION

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

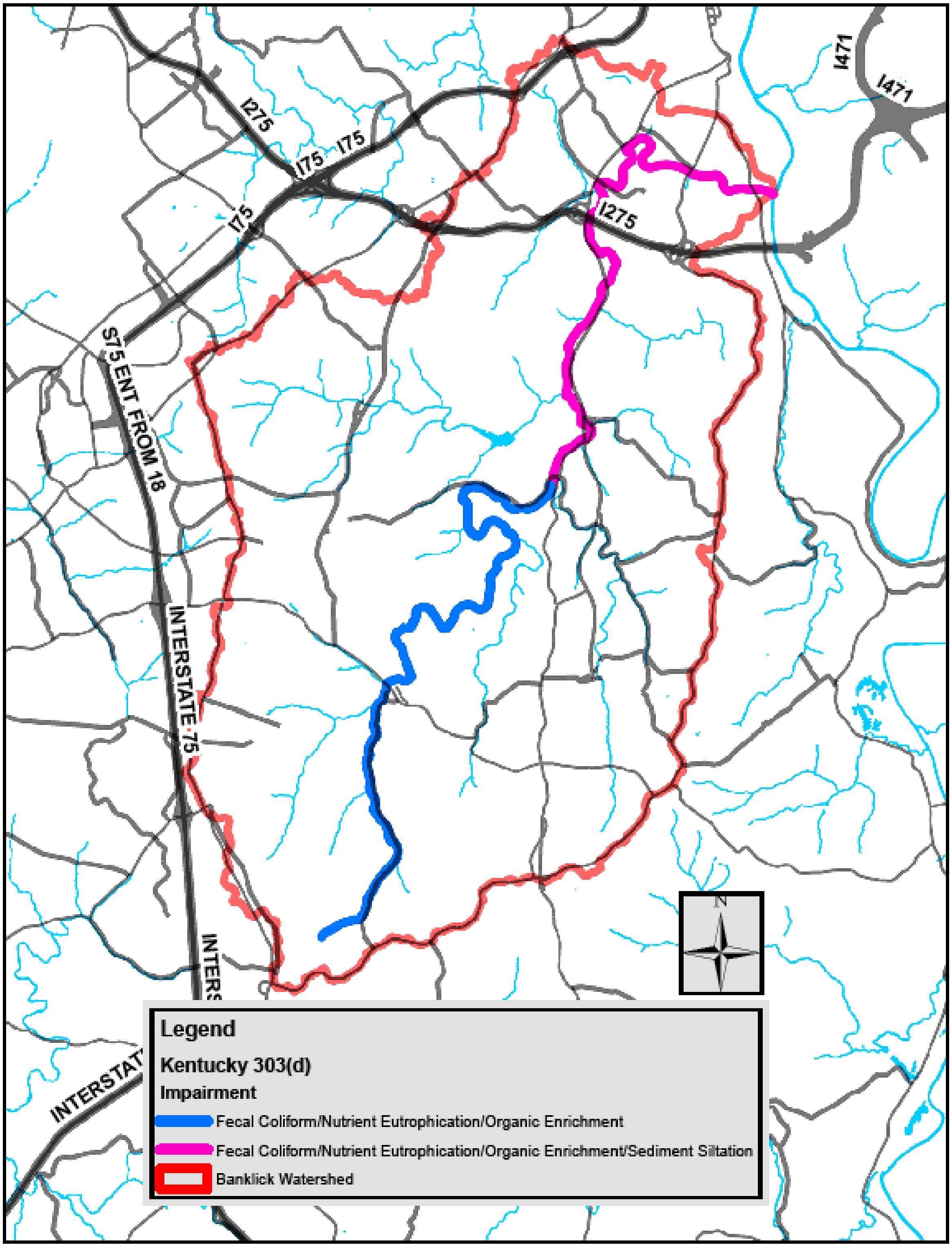


TABLE 4.02-2

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.

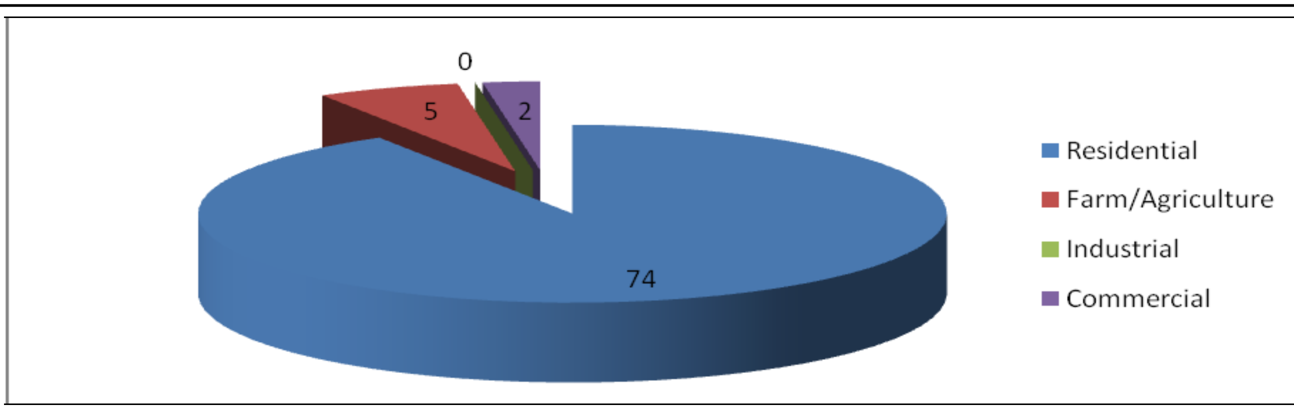


Figure 4.03-1 Survey Question 1 Results

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.

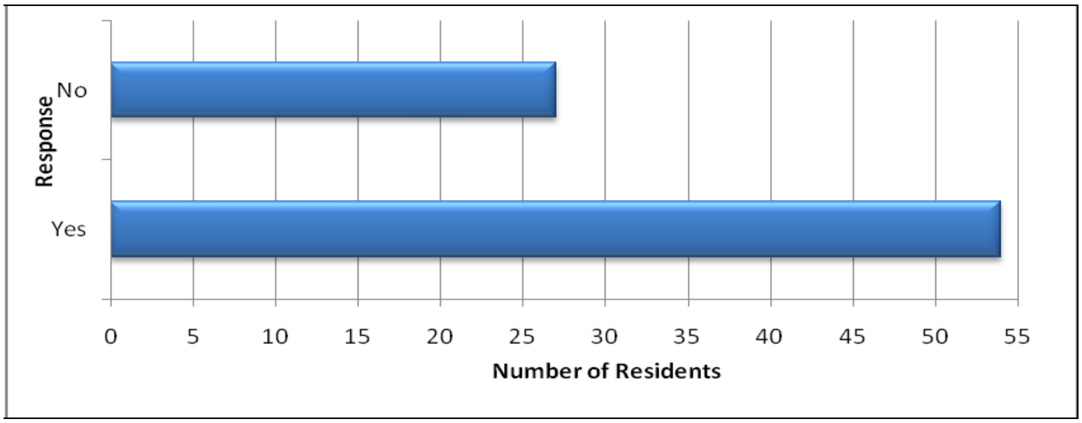


Figure 4.03-2 Survey Question 2 Results

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.

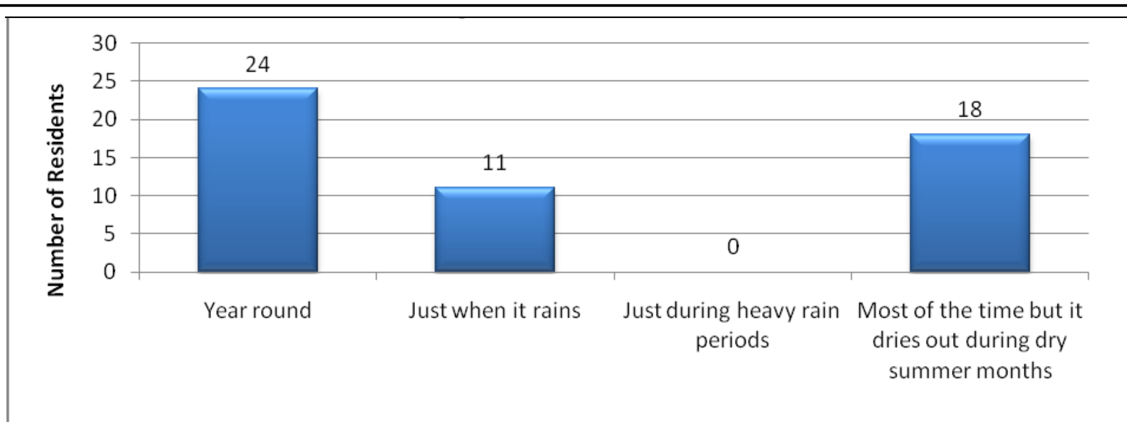


Figure 4.03-3 Survey Question 3 Results

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.

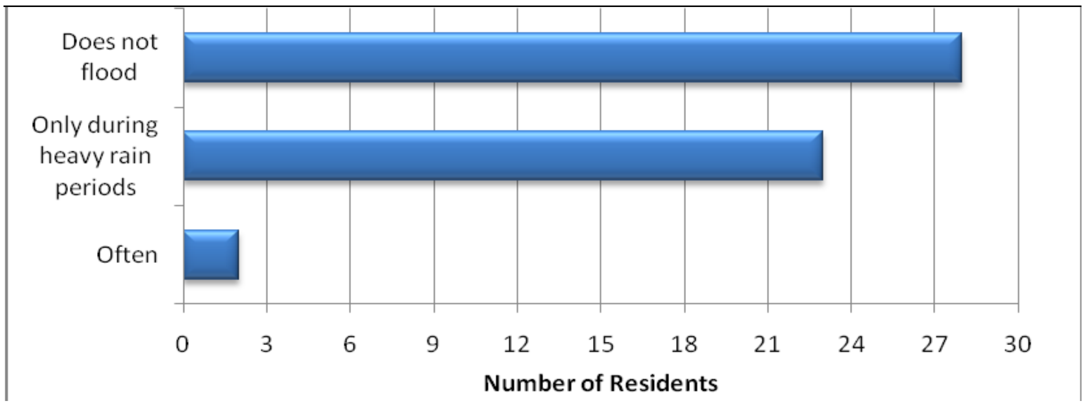


Figure 4.03-4 Survey Question 4 Results

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.

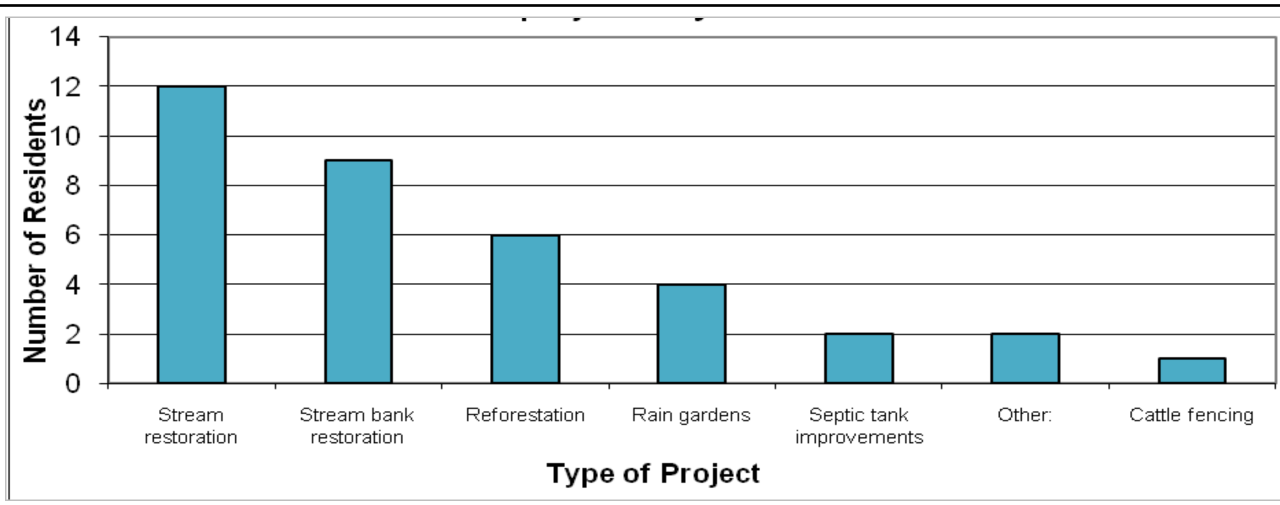


Figure 4.03-5 Survey Question 5 Results

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.

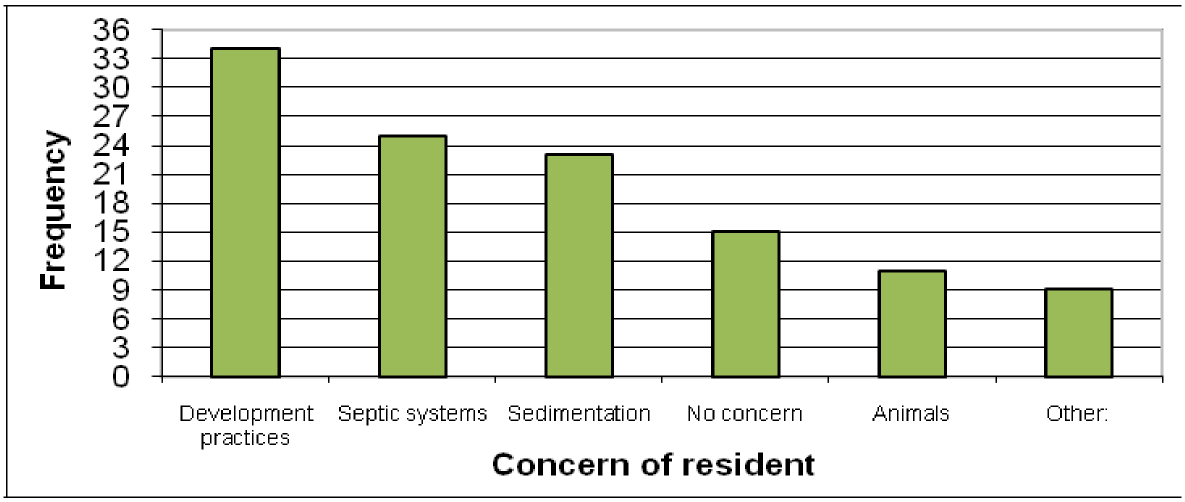


Figure 4.03-6 Survey Question 6 Results

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.

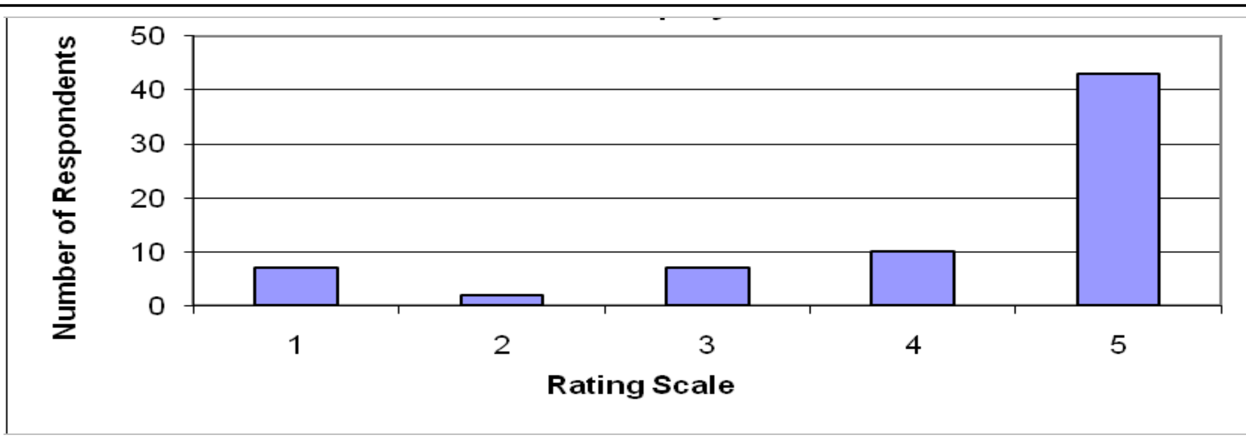


Figure 4.03-7 Survey Question 7A Results

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).

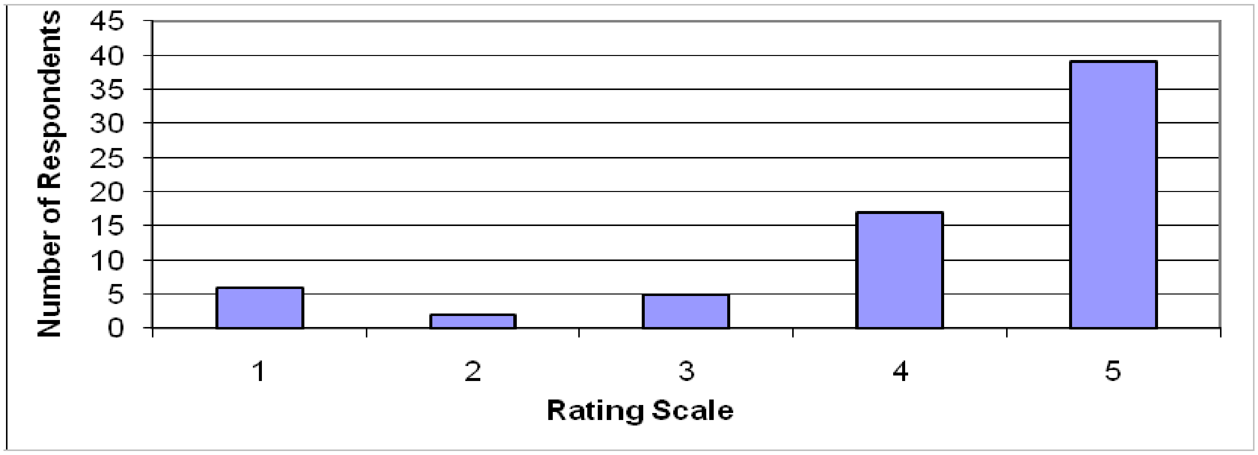


Figure 4.03-8 Survey Question 7B Results

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),

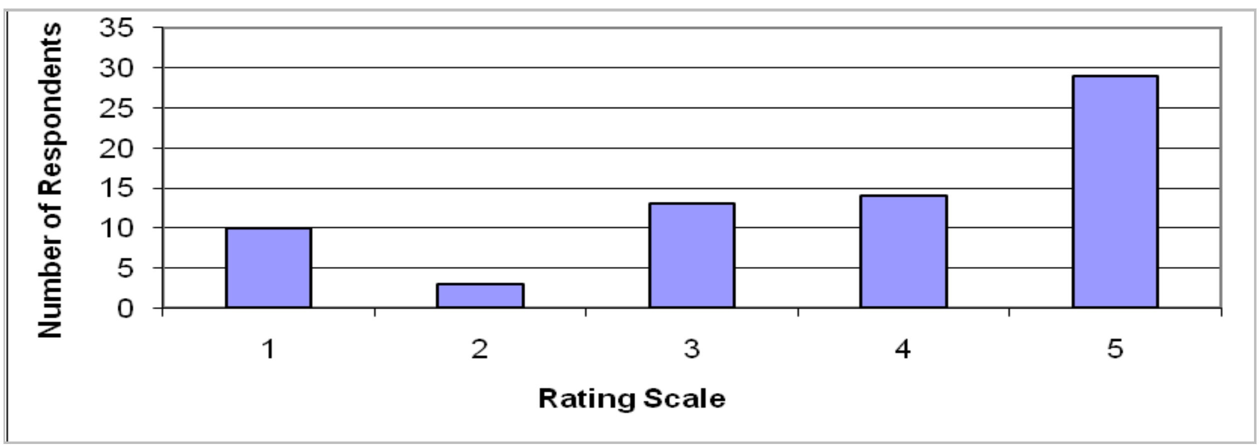


Figure 4.03-9 Survey Question 7C Results

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.

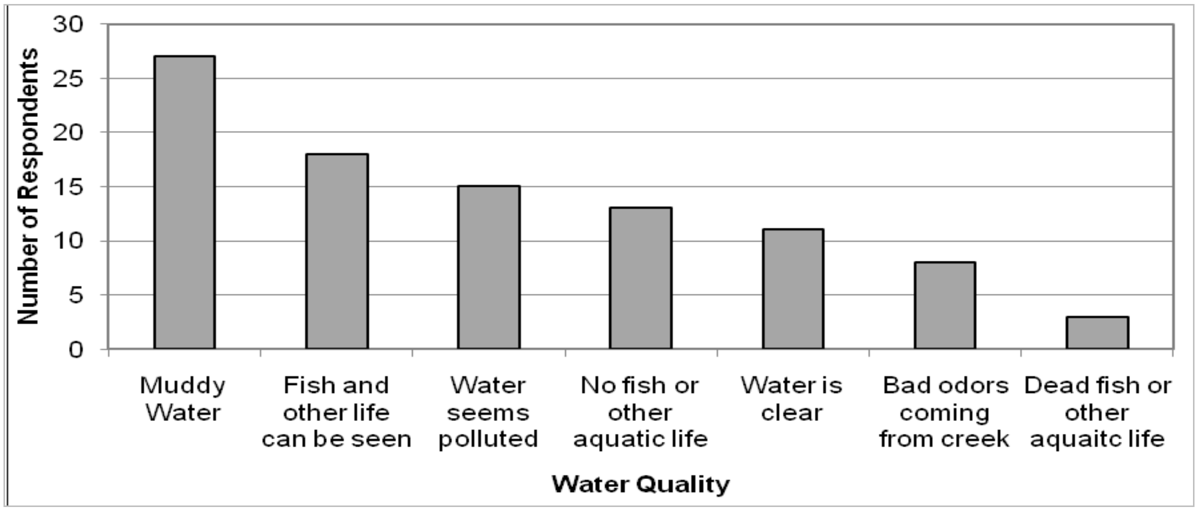


Figure 4.03-10 Survey Question 8 Results

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. Habitat

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:

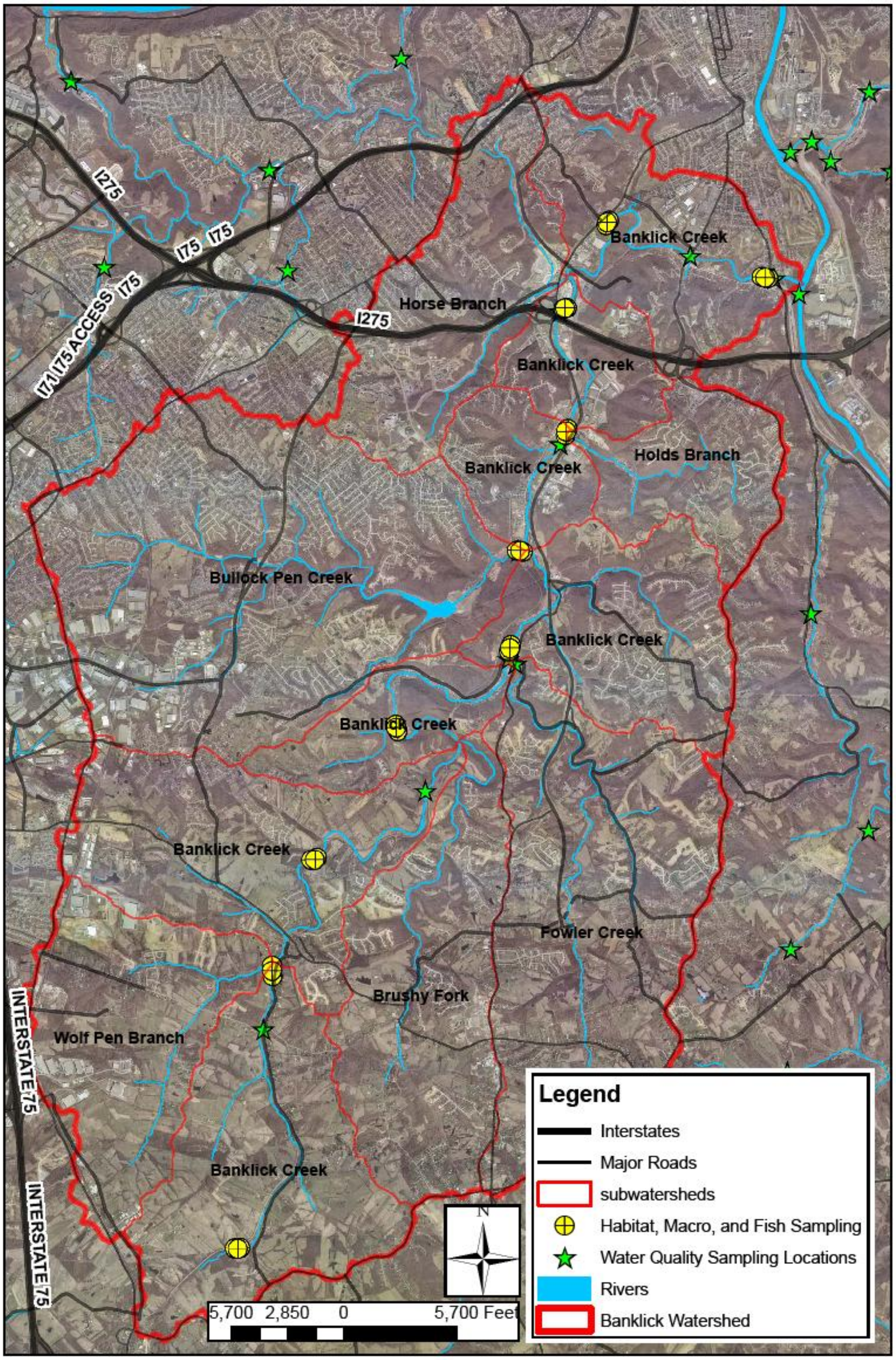
1. *What are the types and sizes of natural materials, such as rocks and sticks, in the stream?*
2. *How much of the rocks on the bottom of the stream are covered with sediment?*
3. *What are the depth and flow speed combinations found in the stream?*
4. *What are the sizes and numbers of islands or 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. Fish

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

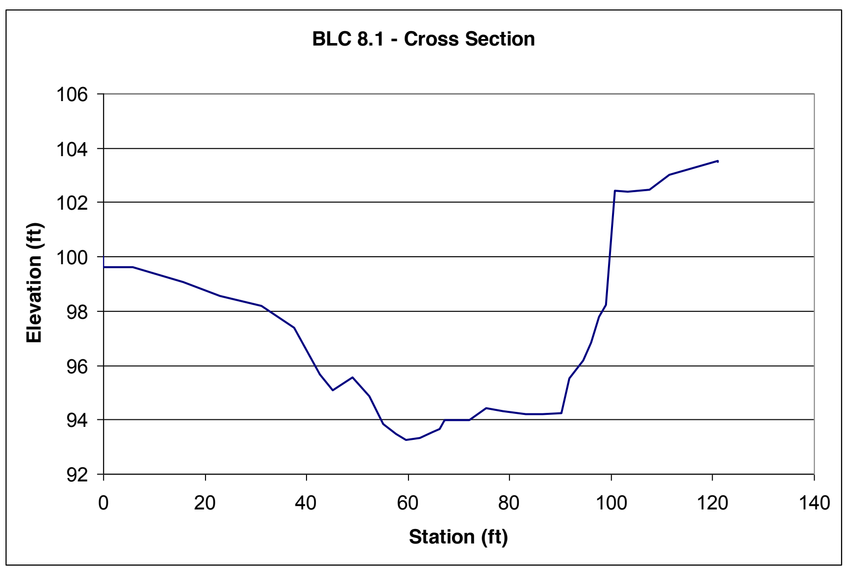


Figure 4.03-13 Sample Cross Section Data from Banklick Creek Mile 8.1

F. <u>Watershed Characterization Report</u>

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

		Parameters exceeding criteria			
		Fecal coliform[a]		*E. coli*[a]	
Stream	River Mile	# 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.

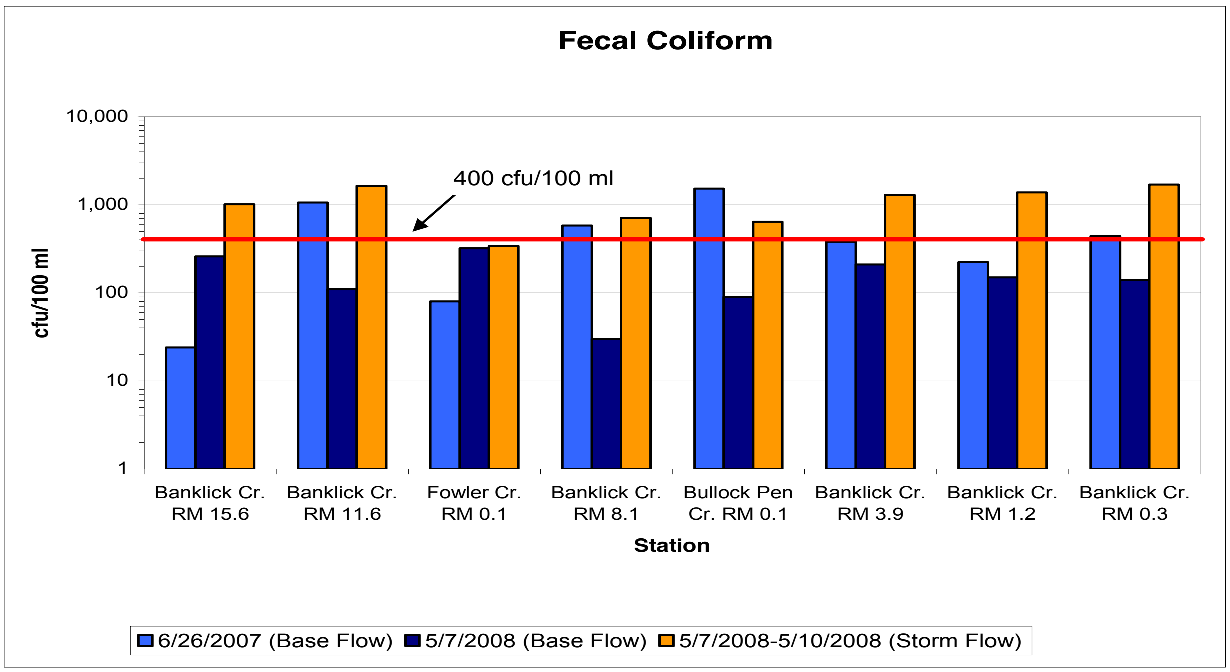


Figure 4.03-14 2006-08 Base Flow and Average Storm Flow Fecal Coliform Concentrations Compared to 400 cfu/100 ml Criterion

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

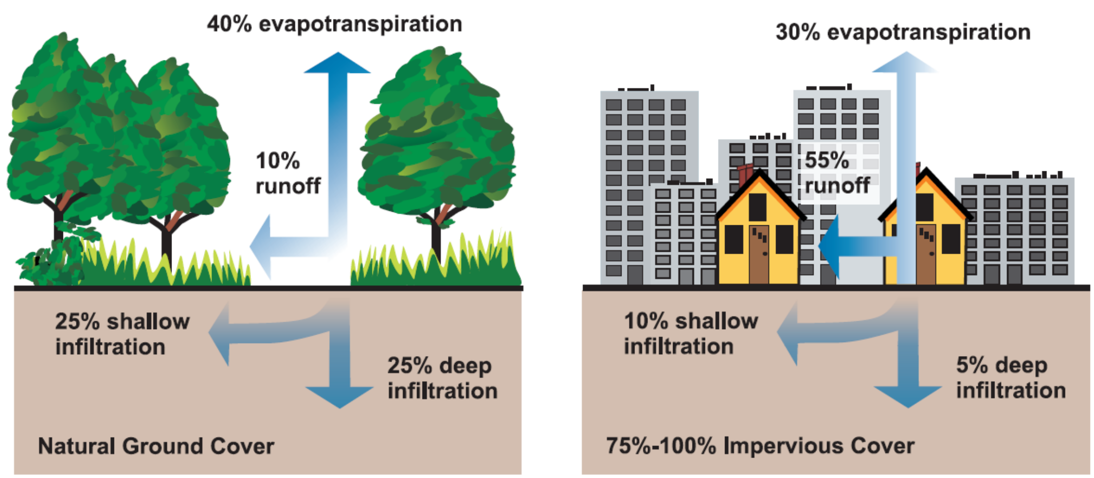
NATURAL SOURCES
RECREATIONAL AND TOURISM ACTIVITIES (Non-boating)
- Golf Courses

UPSTREAM IMPOUNDMENT
SALT STORAGE SITES
GROUNDWATER LOADINGS
GROUNDWATER WITHDRAWAL
OTHER
- Source Unknown

From KDOW (2004a)

A. Urban Runoff

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

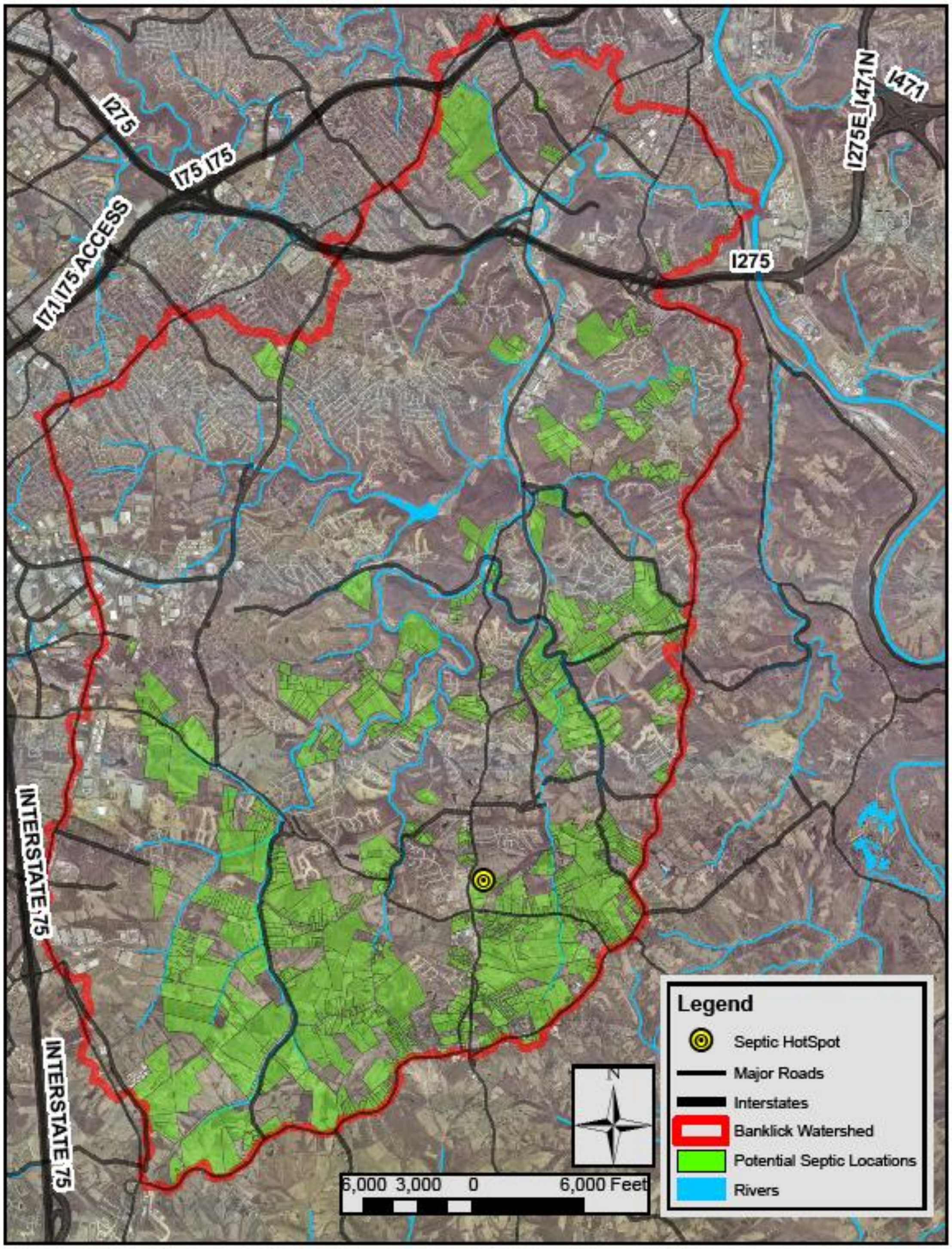
Approximately 5 percent of the lots in the Banklick Creek watershed use septic systems. Properties potentially served by septic systems are more concentrated in the southern portion of the watershed, both inside and outside the District's sanitary sewer service area. Septic systems can be a safe and 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).

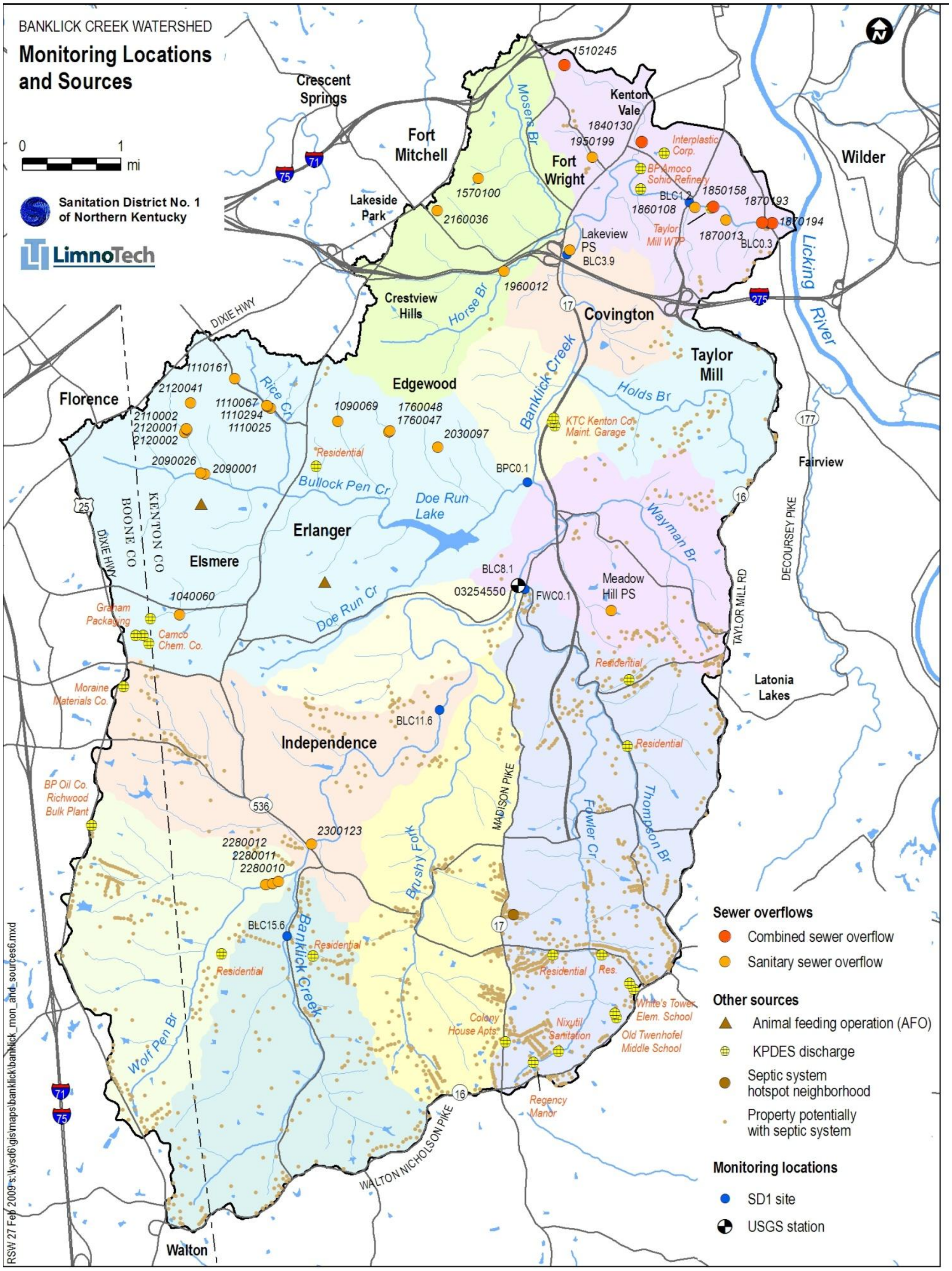
[e] Highways, roads bridges, infrastructure (new construction), municipal point source discharges, unspecified urban storm water runoff, urban runoff/storm sewers, agriculture and on-site treatment systems are identified as potential sources contributing to impairment of the primary contact recreation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

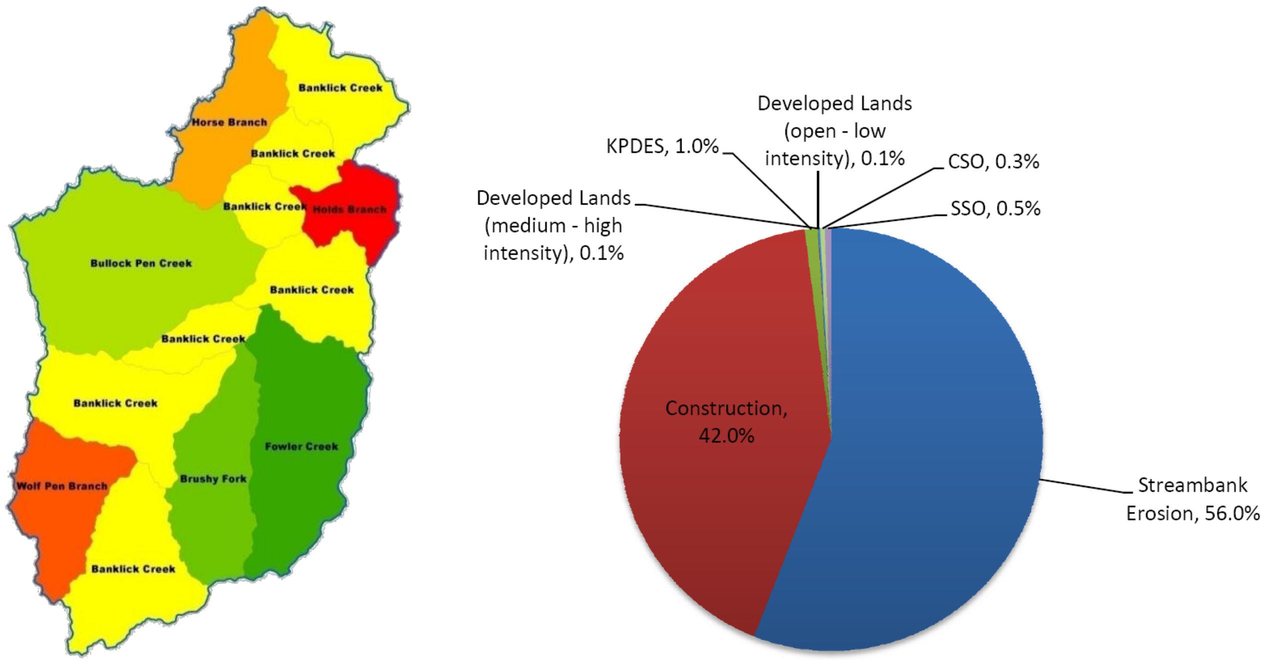


Figure 5.04-2 Total Suspended Solids Loading Allocation in Banklick Watershed

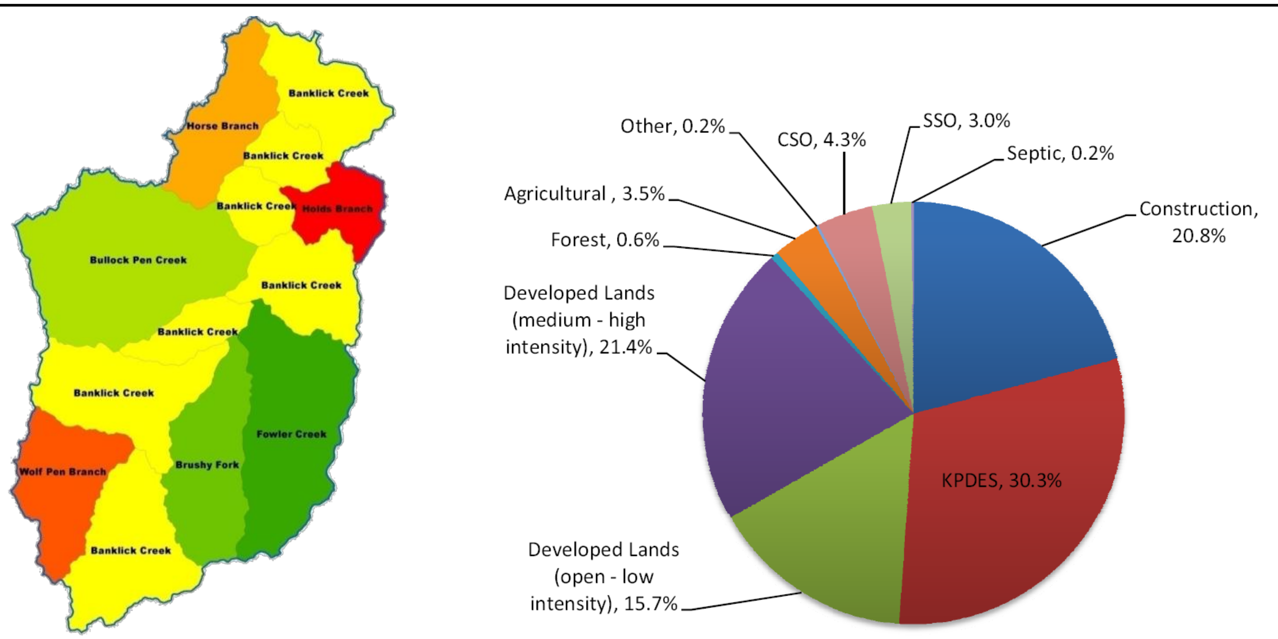


Figure 5.04-3 Total Phosphorous Loading Allocation in Banklick Watershed

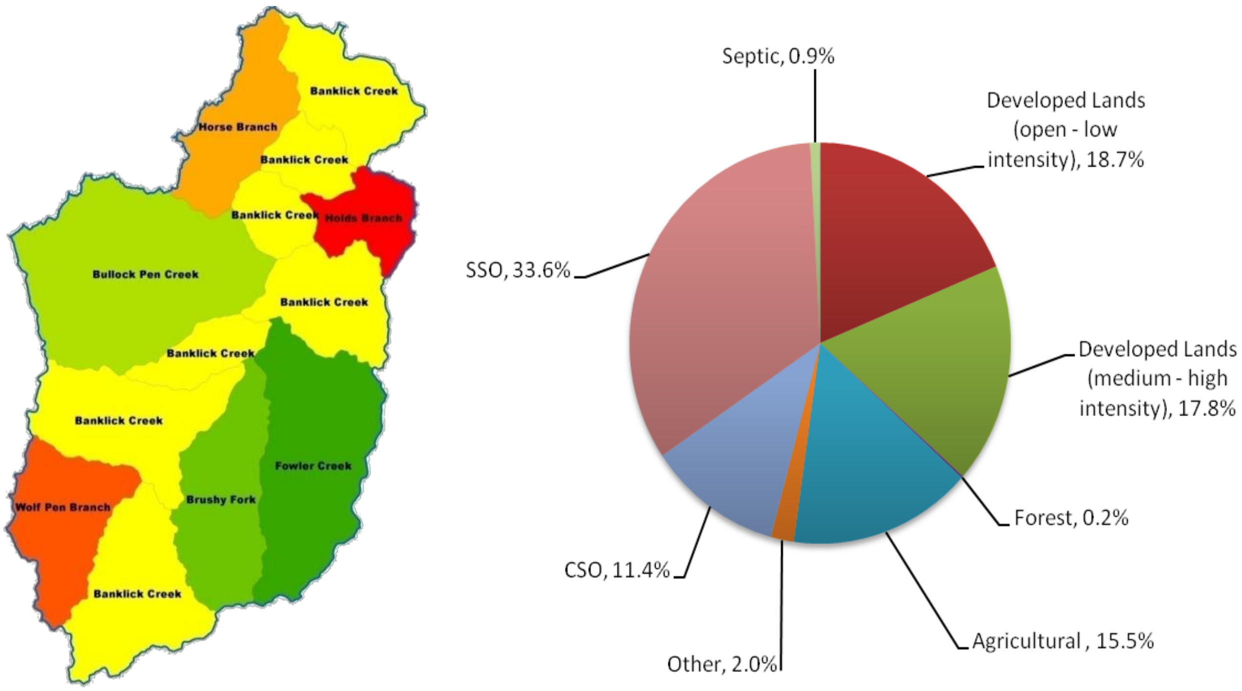


Figure 5.04-4 Fecal Loading Allocation in Banklick Watershed

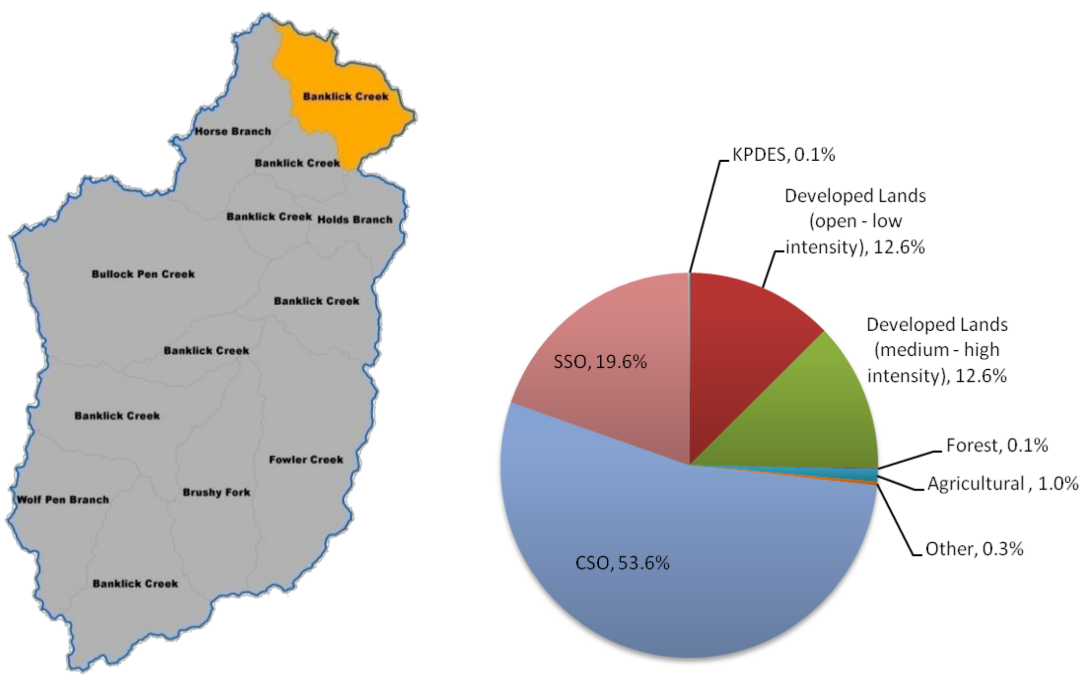


Figure 5.04-5 Fecal Loading Allocation in Banklick Creek Subwatershed 1 (downstream/urban)

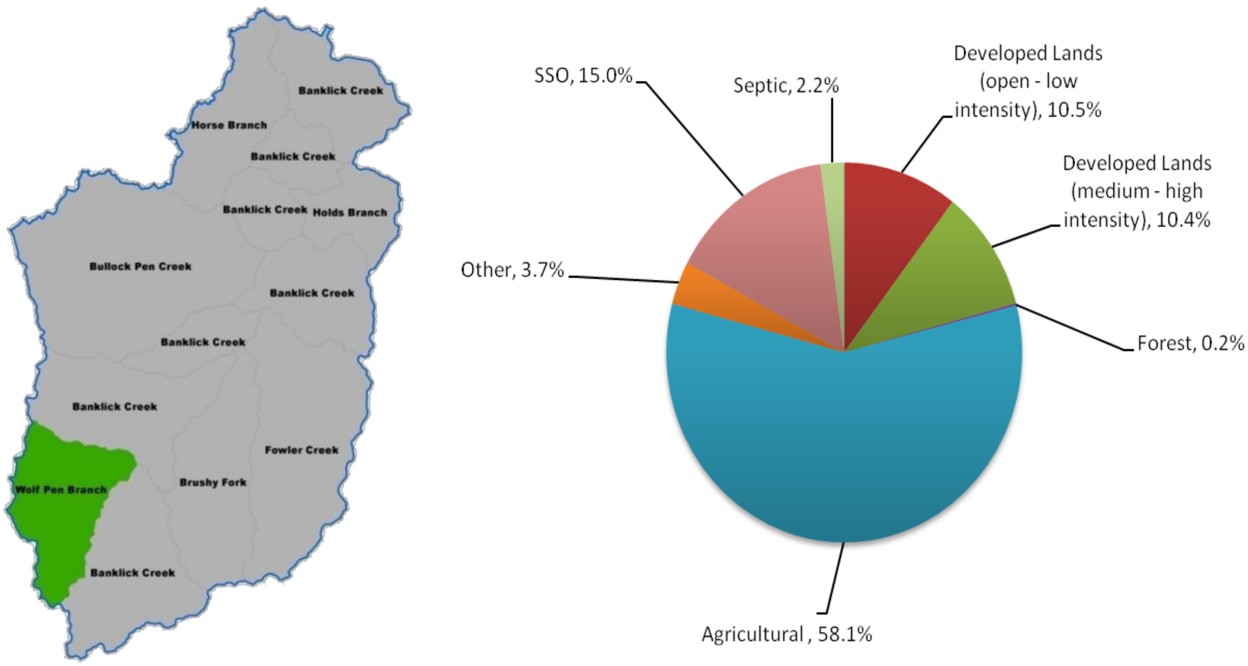


Figure 5.04-6 Fecal Loading Allocation in Wolf Pen Branch Subwatershed (upstream/rural)

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. Reduce Flooding

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

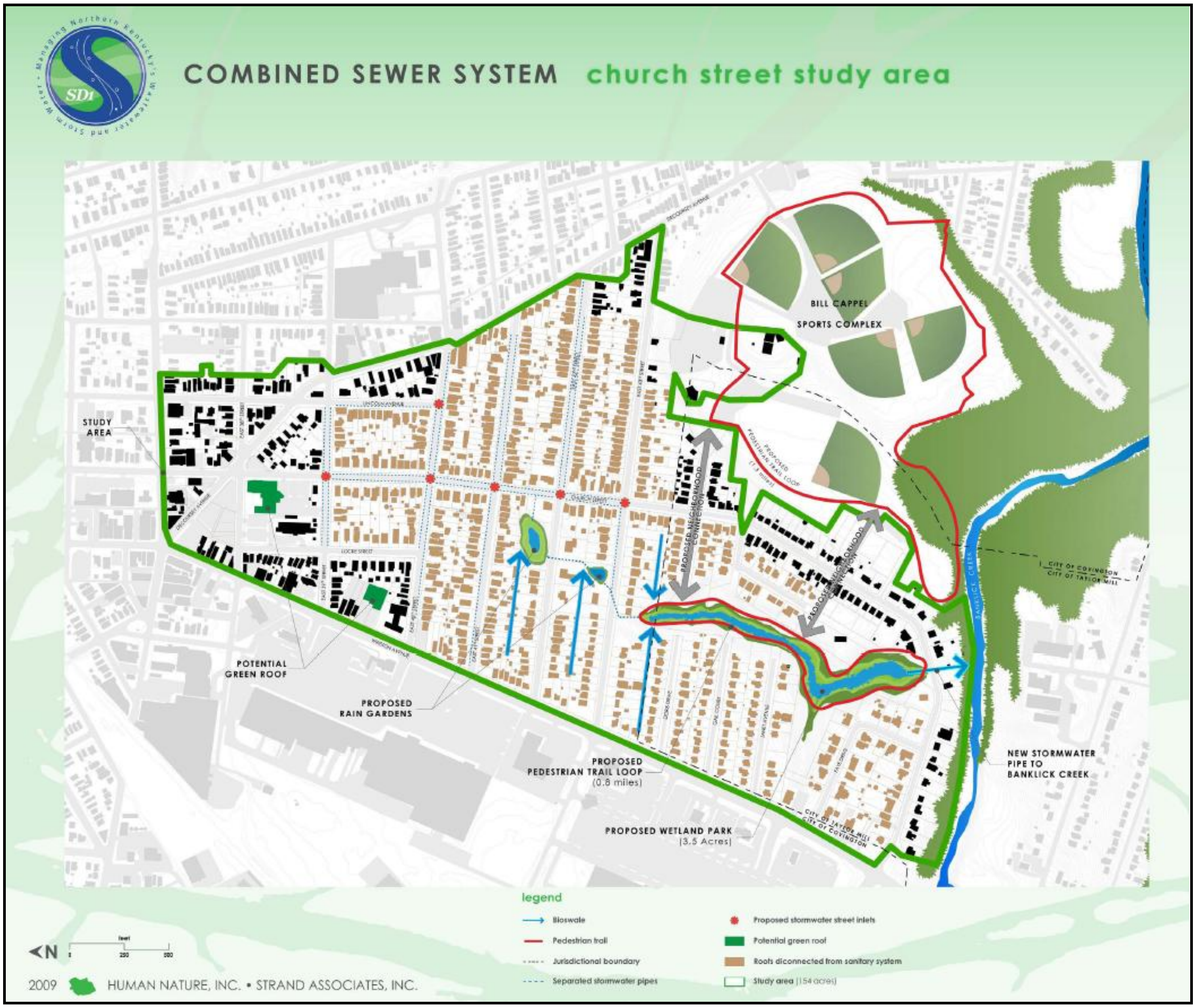
According to the SD1 Draft Watershed Plan, submitted in June 2009, there are several opportunities for the use of green and watershed controls in the Banklick Watershed. SD1 has identified possible locations for the use of green and watershed controls throughout the Banklick Creek as follows.

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).

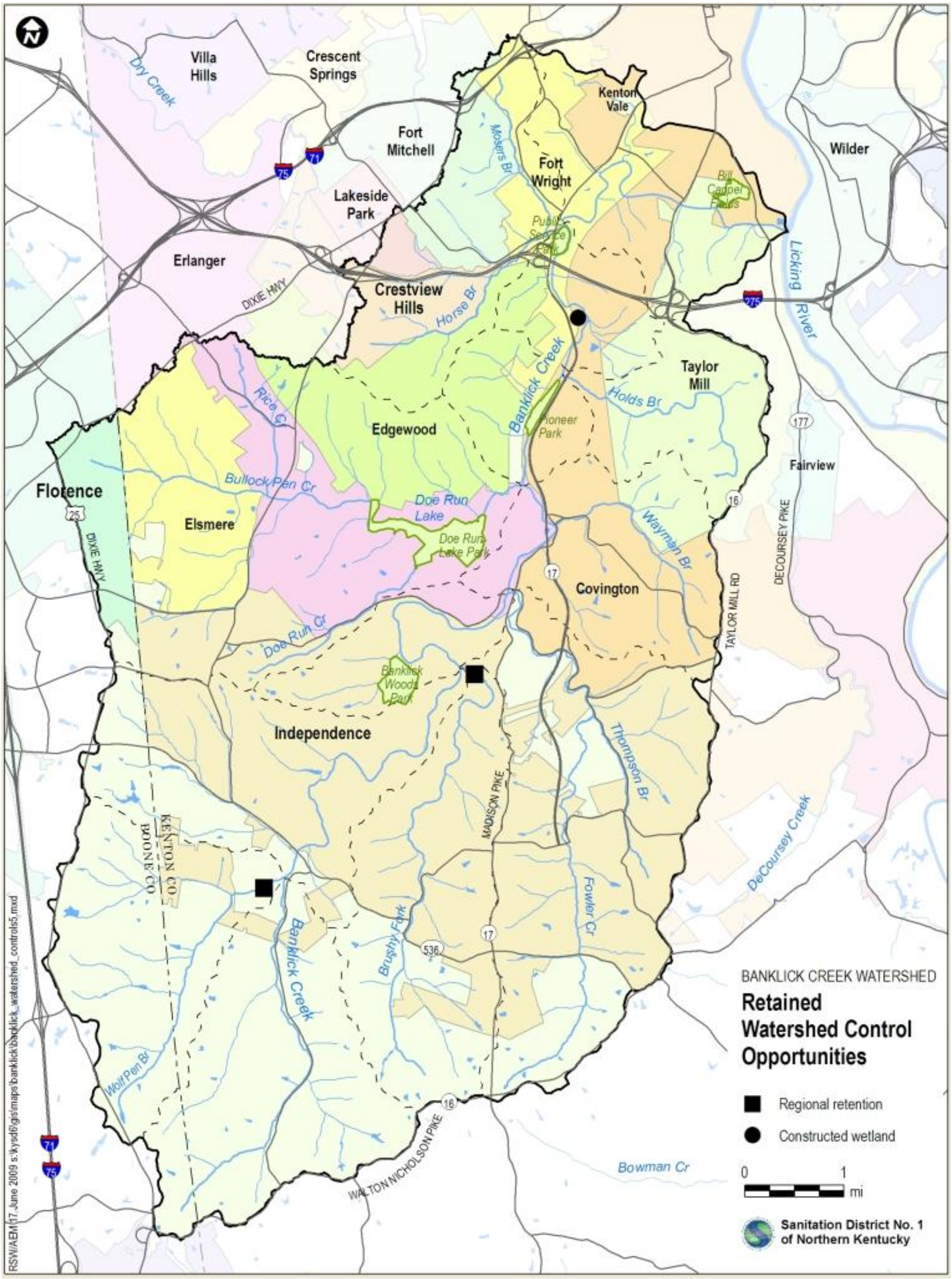
In addition, the model calculates improvement in the geometric mean bacteria density during the recreational season:

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:

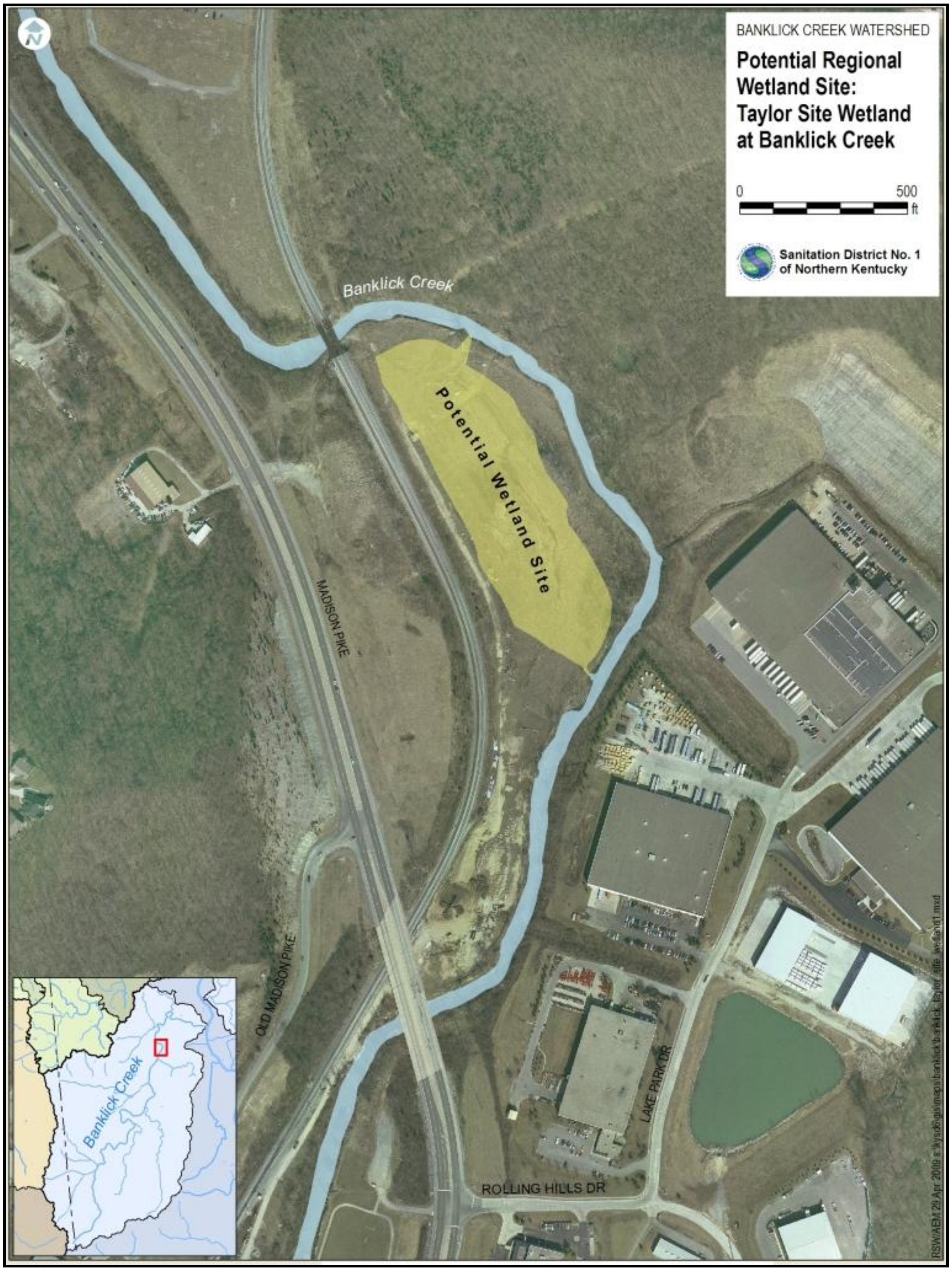
    a. Immediately downstream of the wetland, the geometric mean is calculated to improve from approximately 672 cfu/100ml to approximately 81cfu/100 ml, about an 88 percent reduction.

    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.

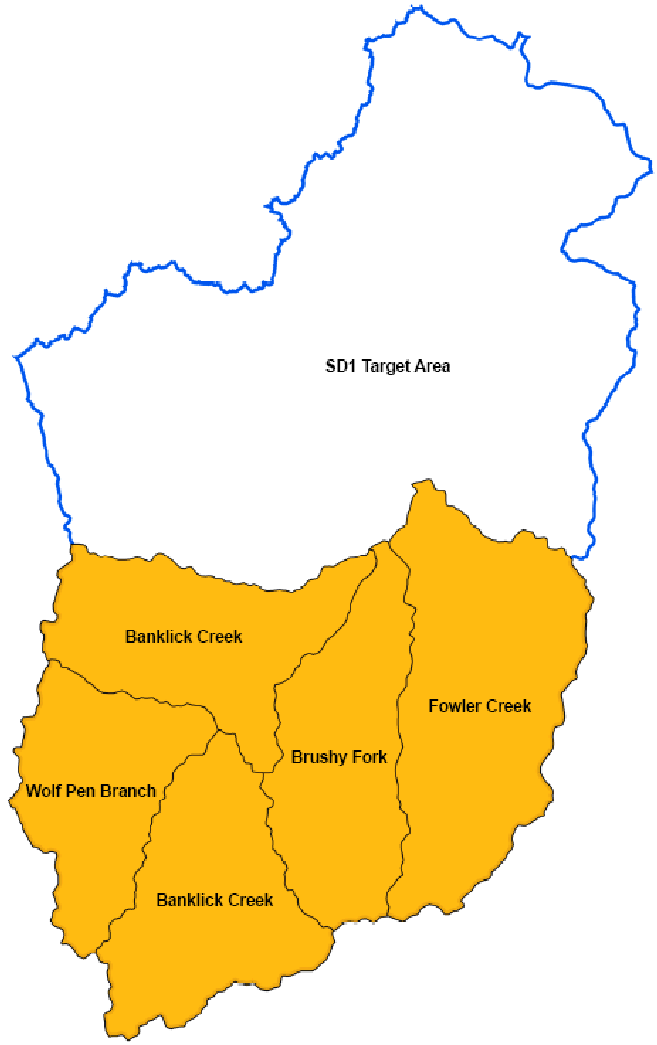


Figure 7.03-1 Focus Area for Future Targeted Management Measures with 319(h) Funding

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

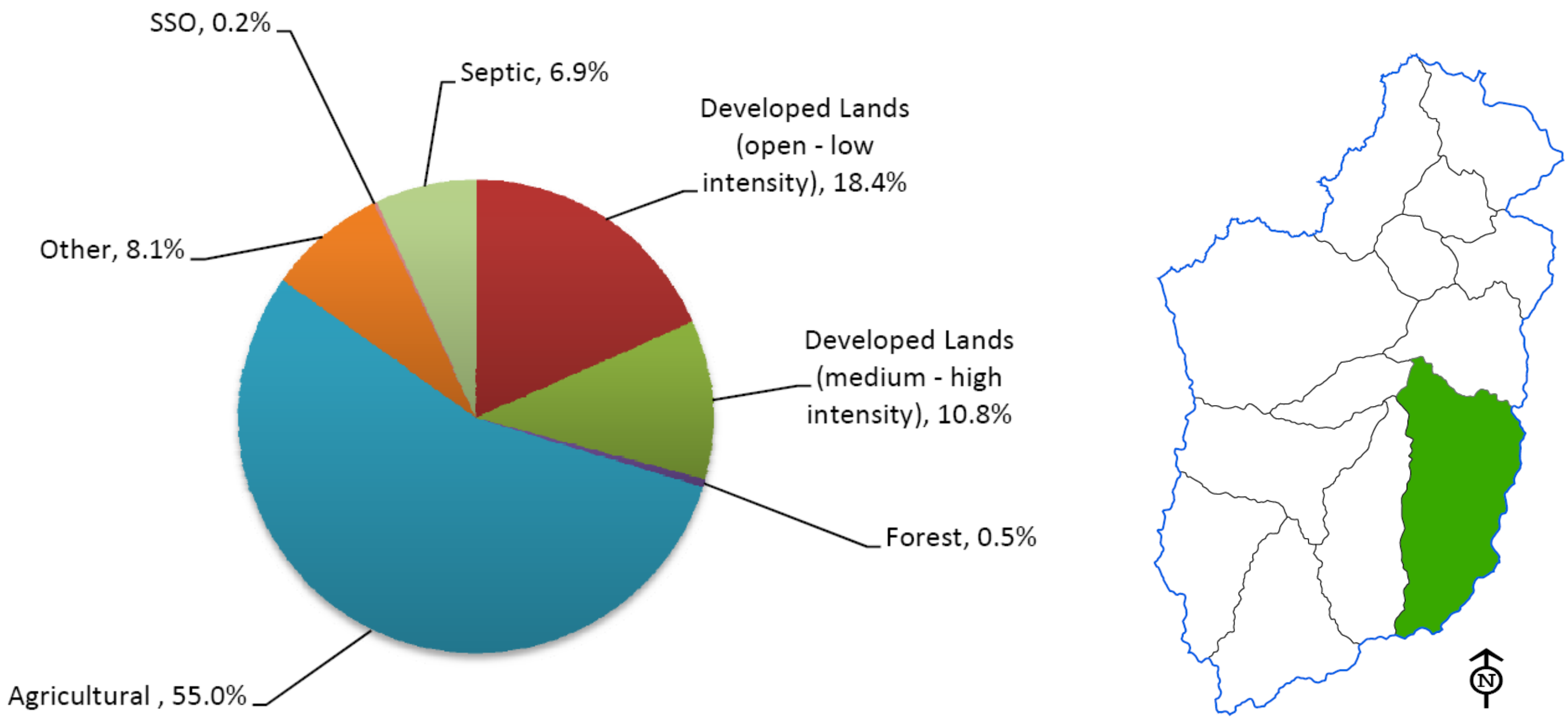


FIGURE 7.03-3

BRUSHY FORK SUBWATERSHED FECAL ALLOCATION–TOTAL LOADING: 652 TRILLION CFUs

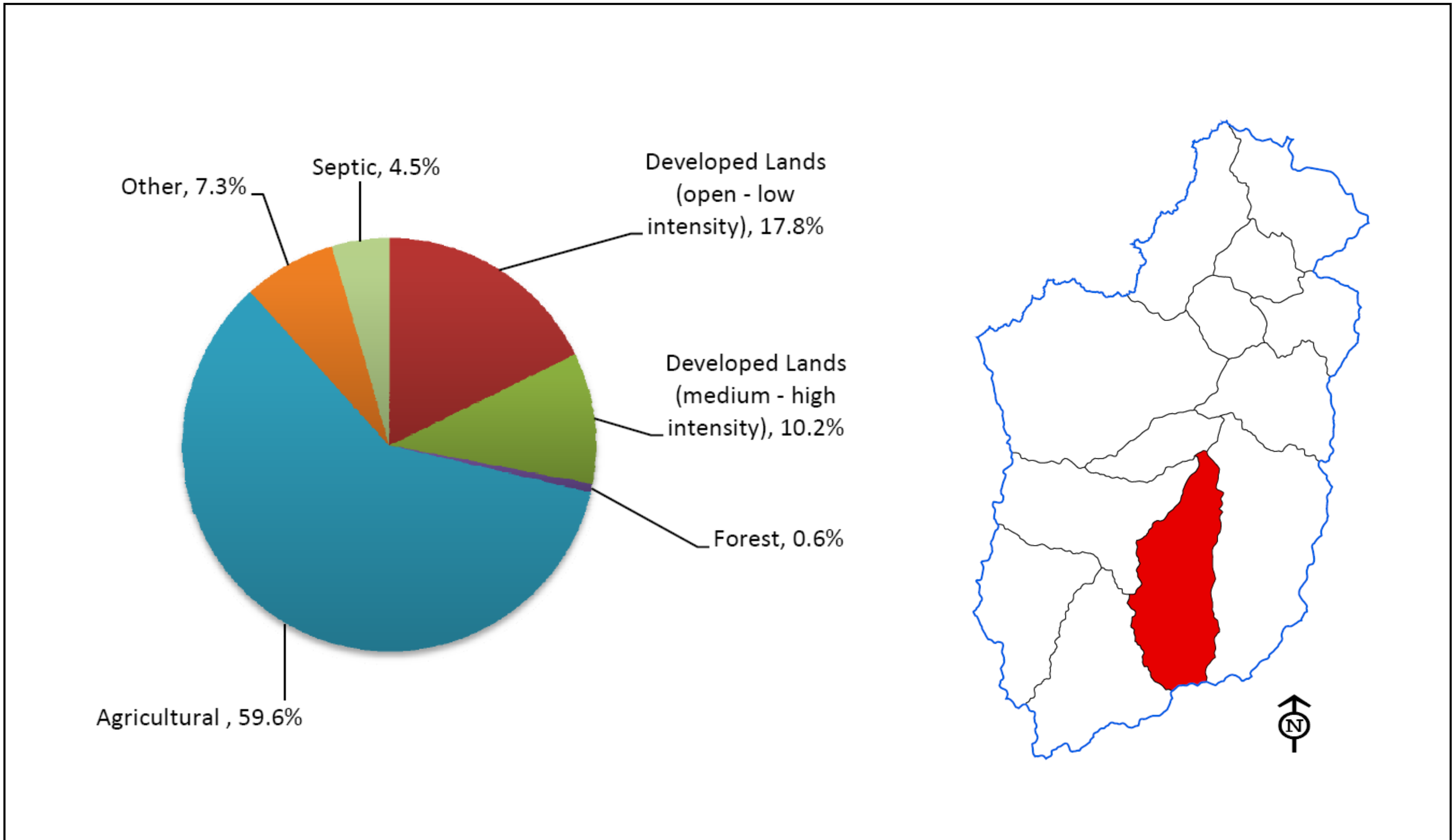


FIGURE 7.03-4

BANKLICK CREEK SUBWATERSHED 11 FECAL ALLOCATION–TOTAL LOADING: 1811 TRILLION CFUs

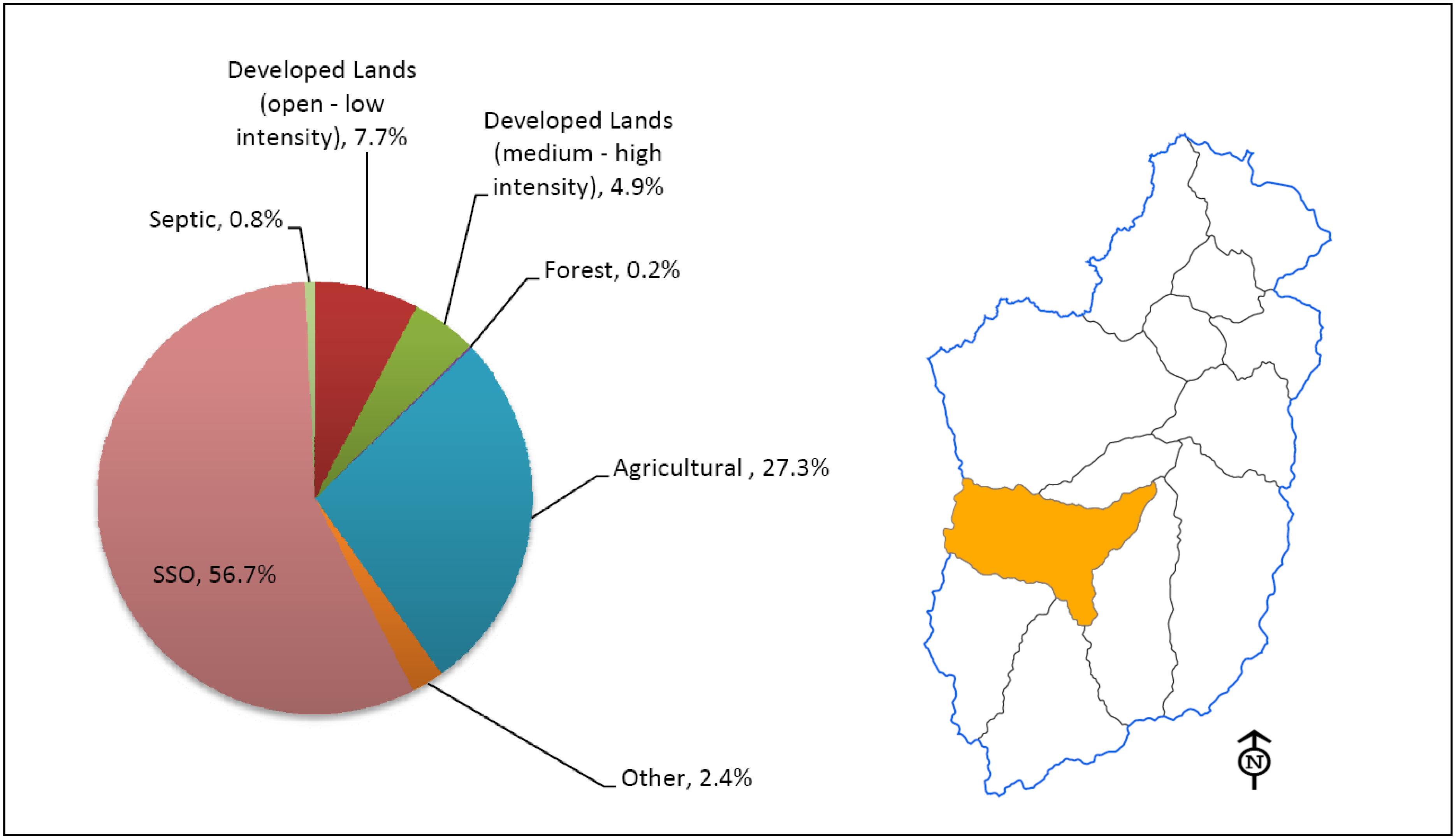


FIGURE 7.03-5

WOLF PEN BRANCH SUBWATERSHED FECAL ALLOCATION–TOTAL LOADING: 972 TRILLION CFUs

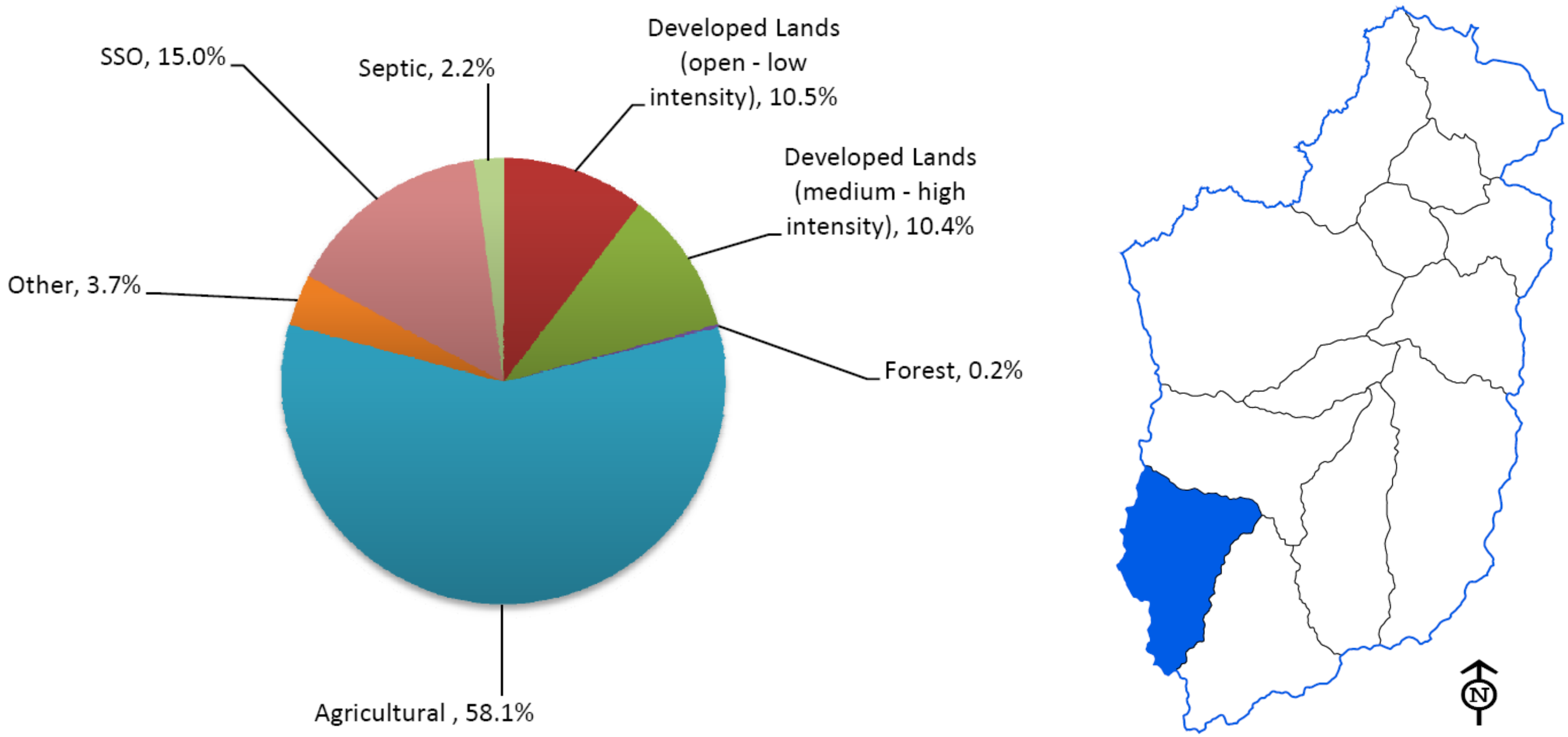
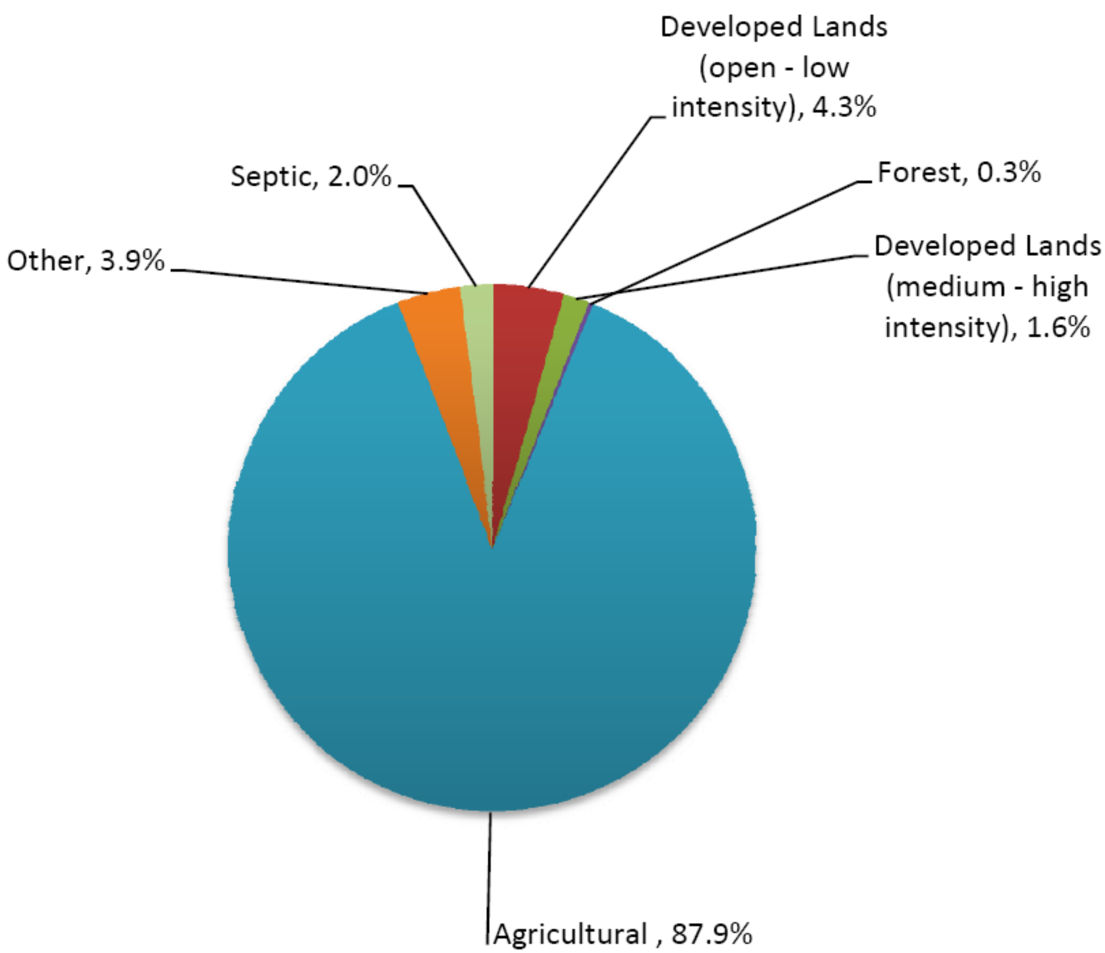


FIGURE 7.03-6

BANKLICK CREEK SUBWATERSHED 13 FECAL ALLOCATION–TOTAL LOADING: 1129 TRILLION CFUs



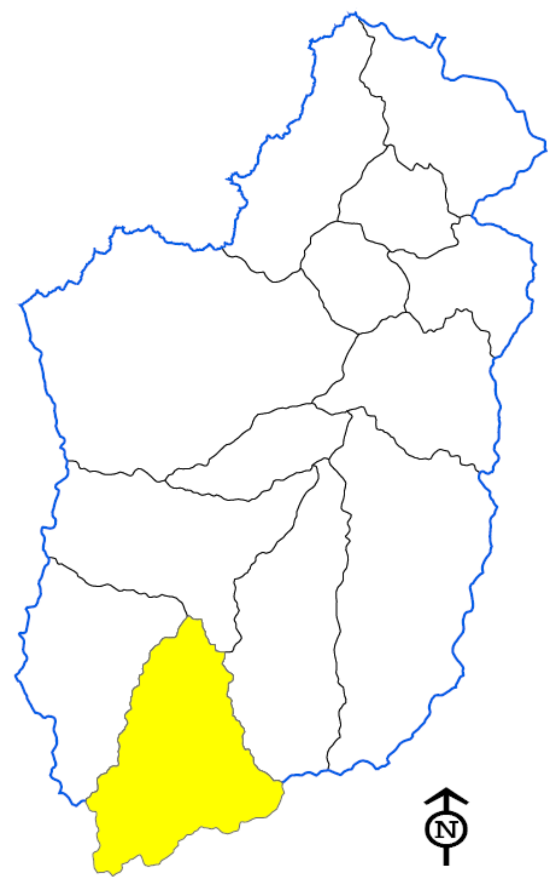
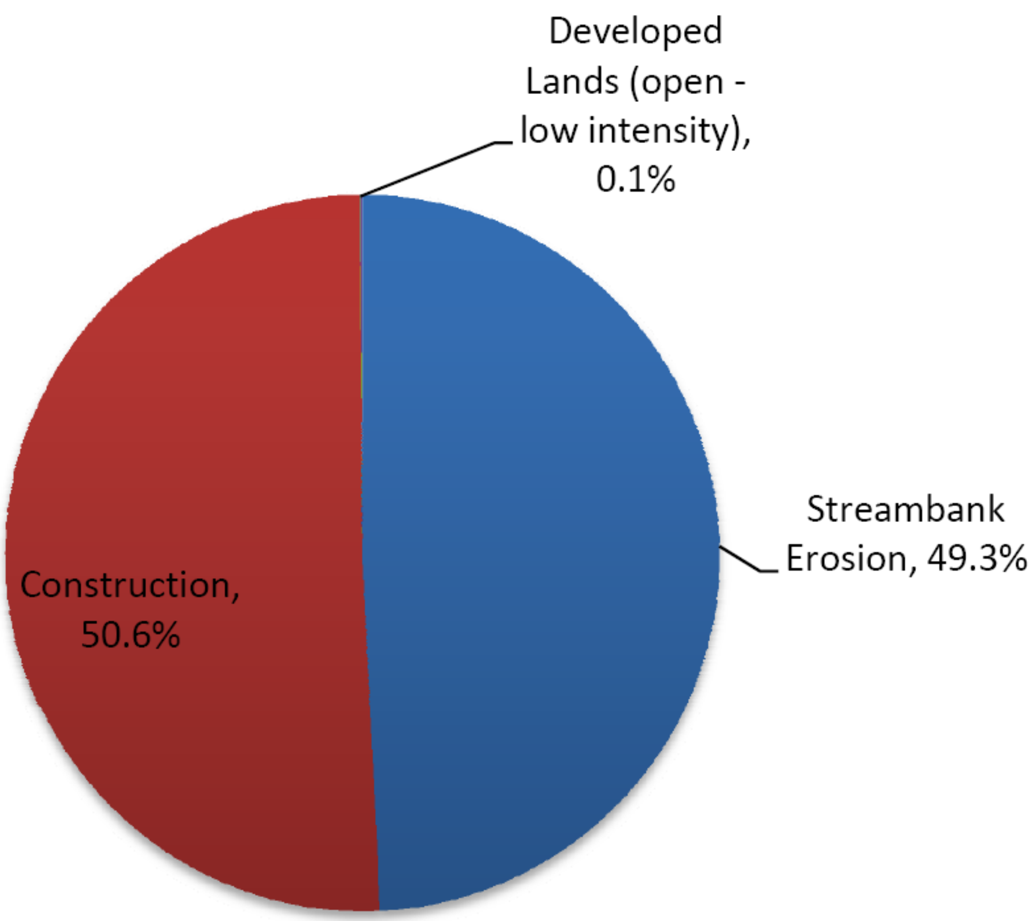


FIGURE 7.03-7

FOWLER CREEK SUBWATERSHED TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 1,276,336 KG



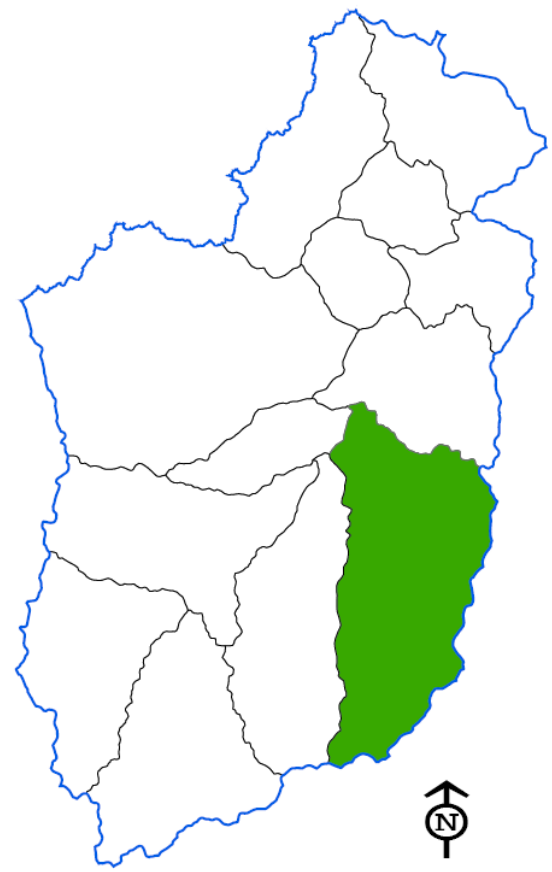


FIGURE 7.03-8

BRUSHY FORK SUBWATERSHED TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 862,399 KG

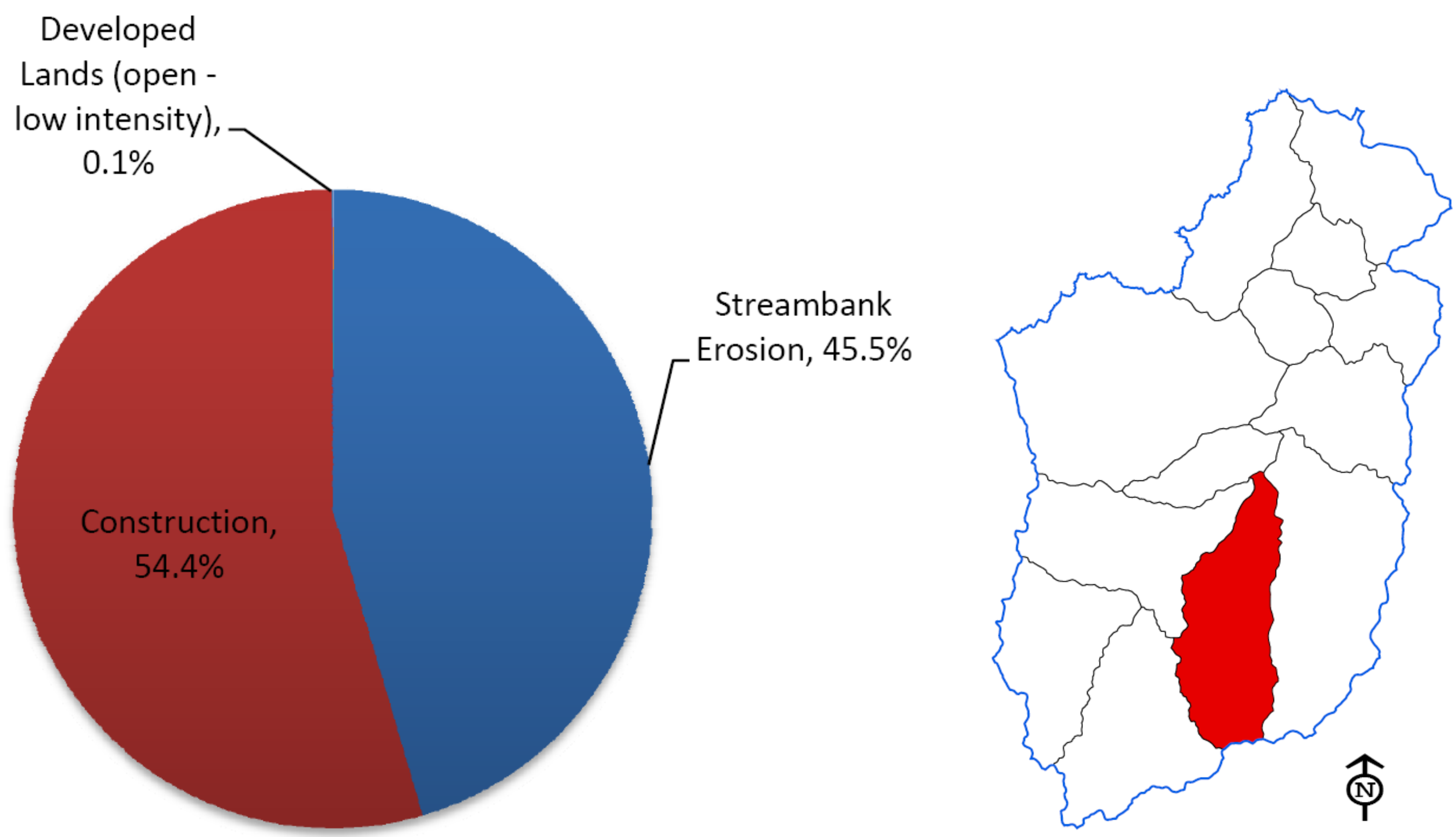


FIGURE 7.03-9

BANKLICK CREEK SUBWATERSHED 11 TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 880,583 KG

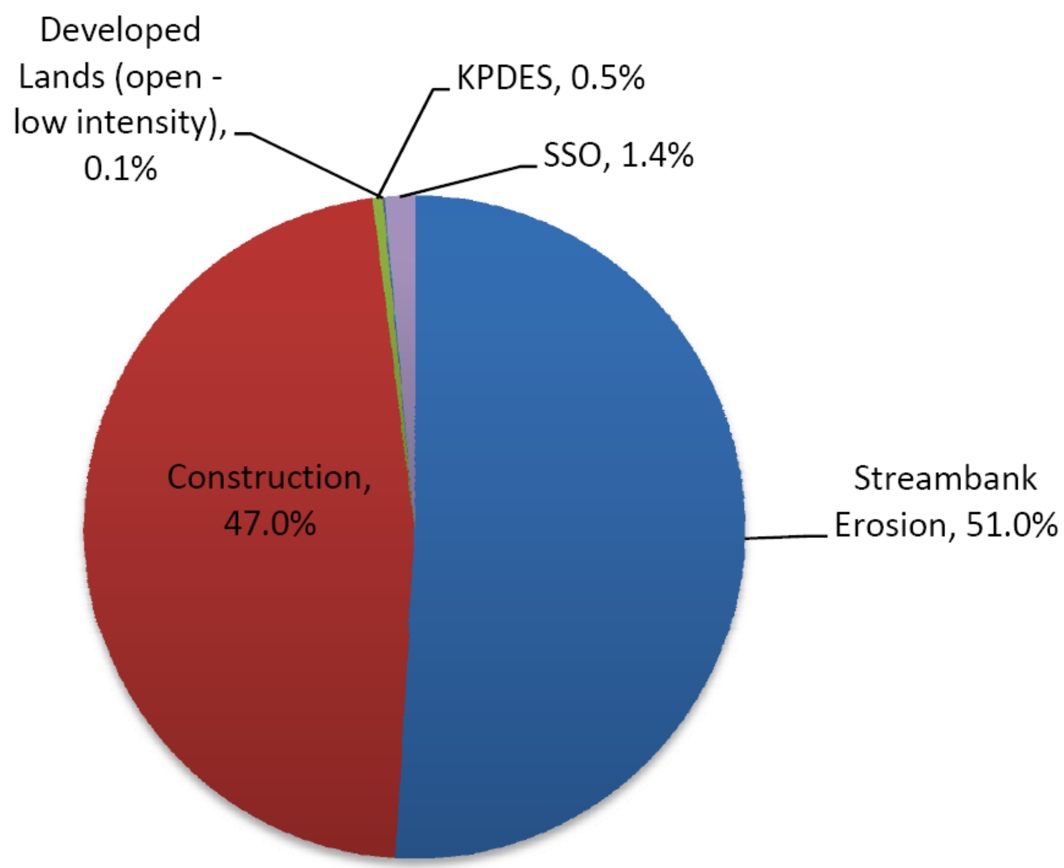


FIGURE 7.03-10

WOLF PEN BRANCH SUBWATERSHED TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 772,198 KG

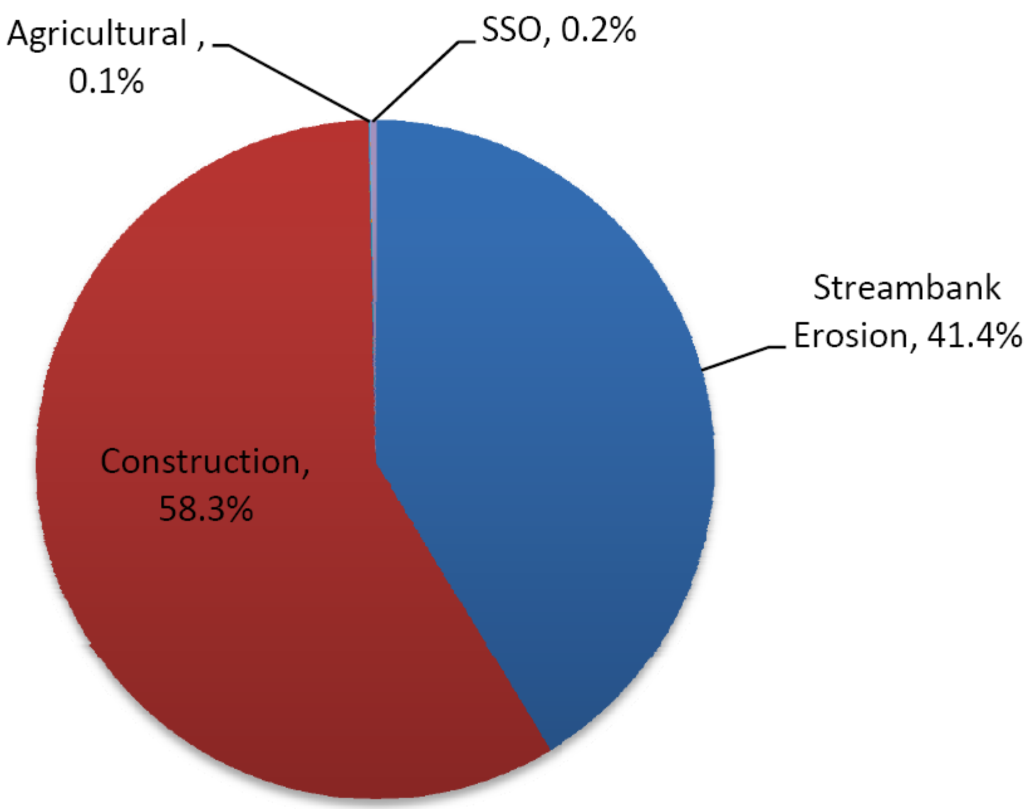
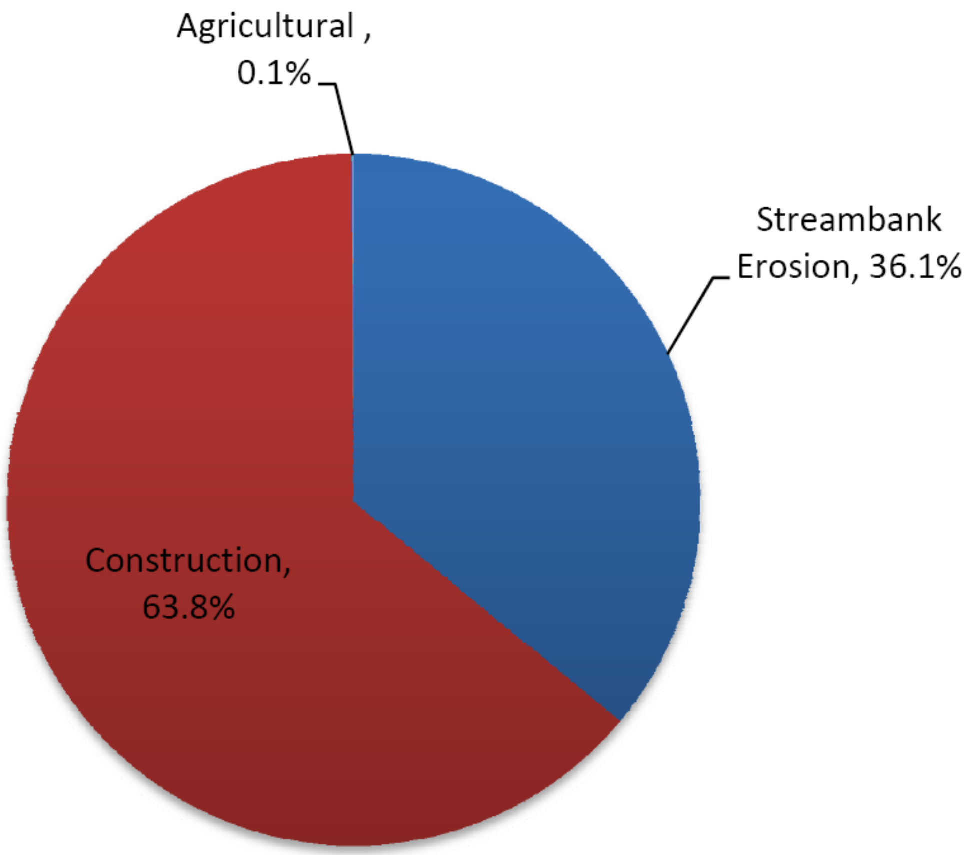


FIGURE 7.03-11

BANKLICK CREEK SUBWATERSHED 13 TOTAL SUSPENDED SOLIDS ALLOCATION–TOTAL LOADING: 950,628 KG



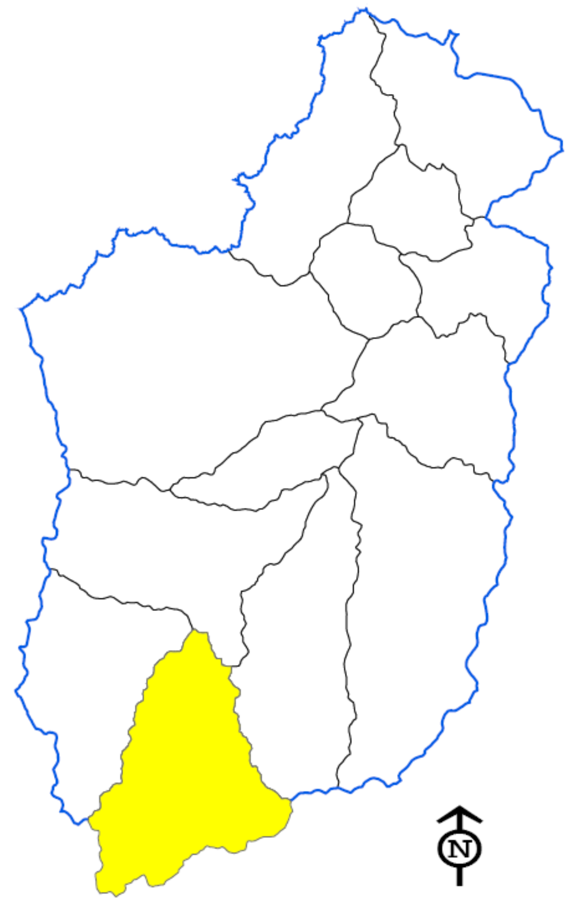
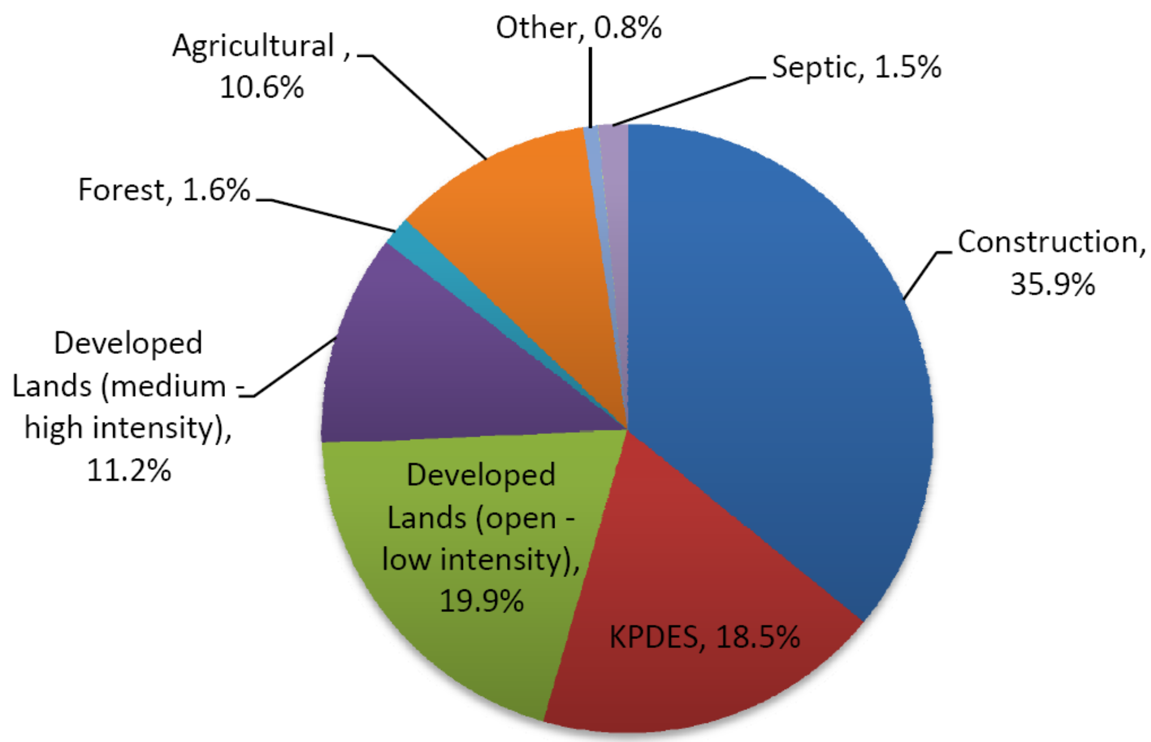


FIGURE 7.03-12

FOWLER CREEK SUBWATERSHED PHOSPHOROUS ALLOCATION–TOTAL LOADING: 3,771 KG



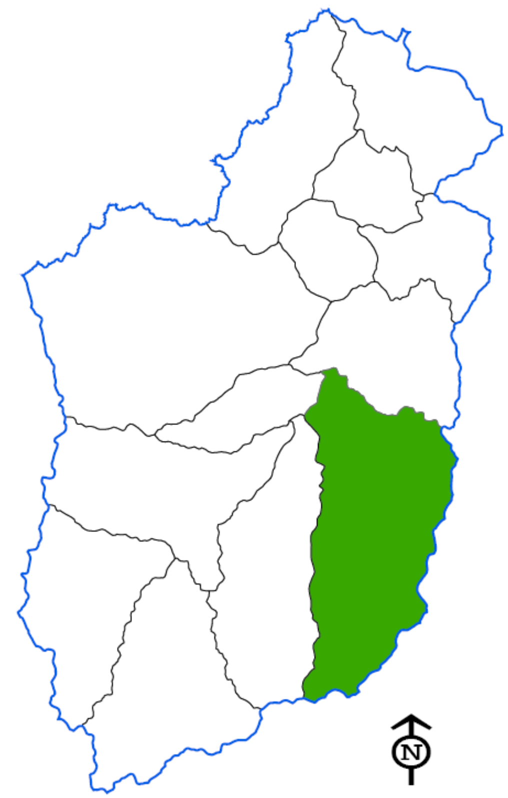
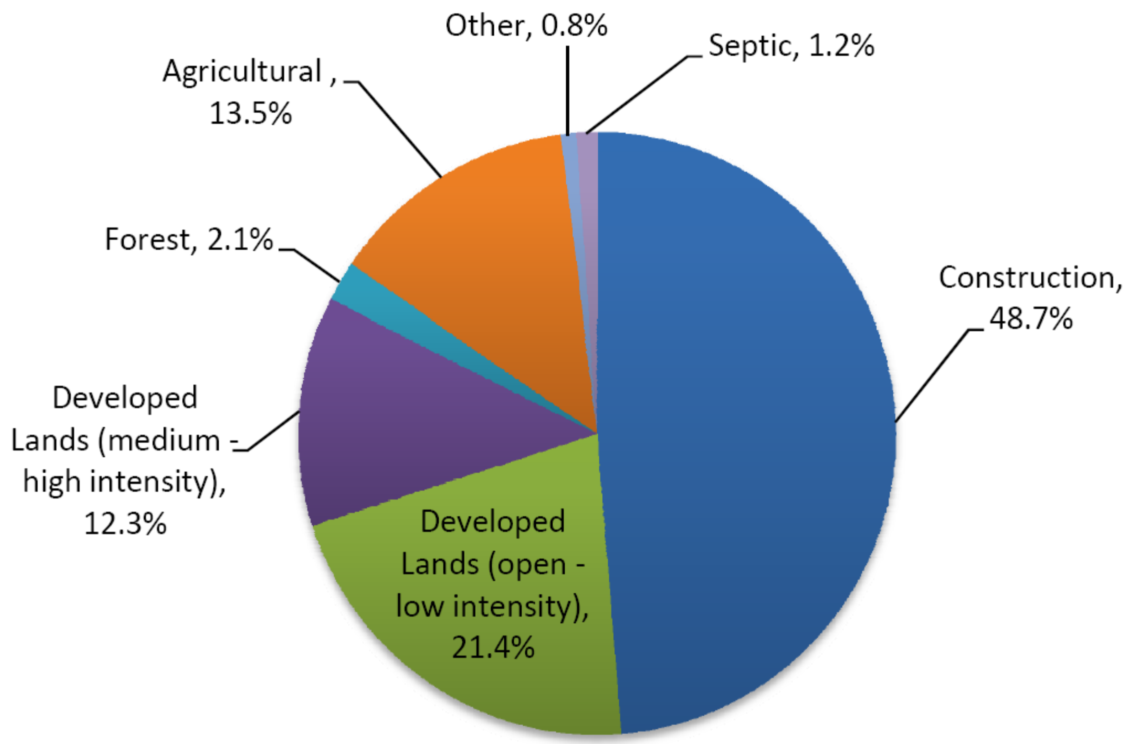


FIGURE 7.03-13

BRUSHY FORK SUBWATERSHED PHOSPHOROUS ALLOCATION–TOTAL LOADING: 2,024 KG



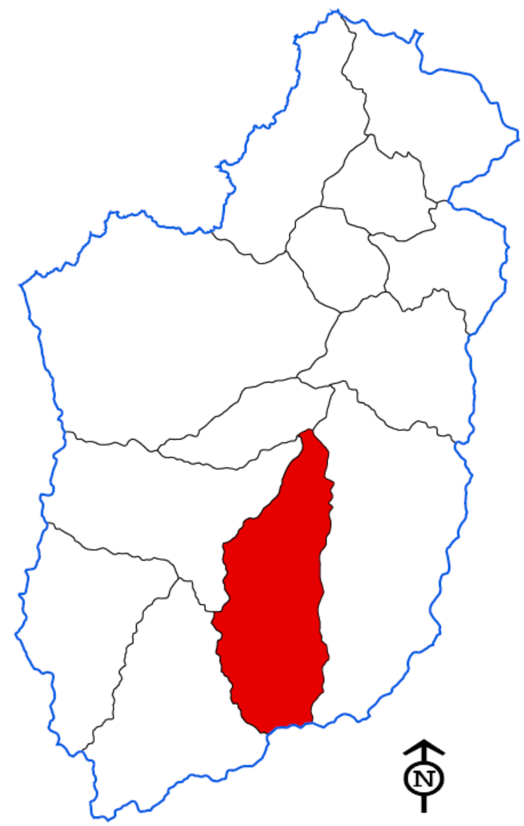


FIGURE 7.03-14

BANKLICK CREEK SUBWATERSHED 11 PHOSPHOROUS ALLOCATION–TOTAL LOADING: 3,724 KG

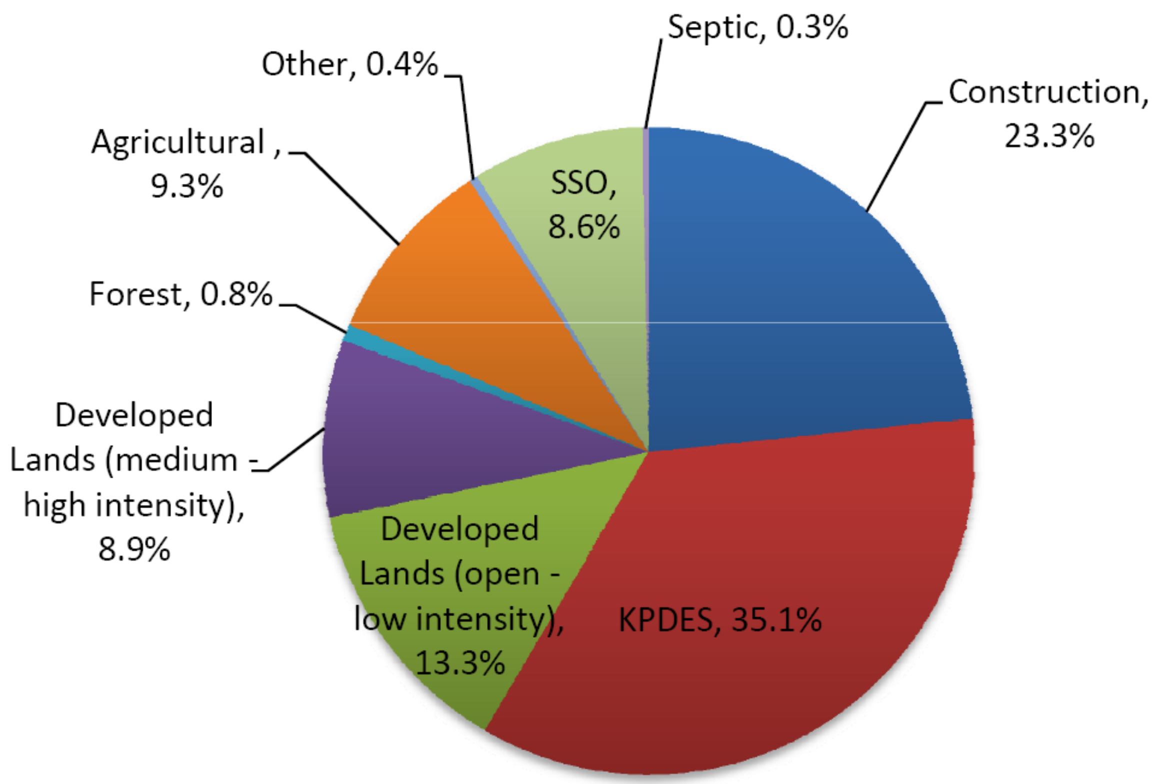


FIGURE 7.03-15

WOLF PEN BRANCH SUBWATERSHED PHOSPHOROUS ALLOCATION–TOTAL LOADING: 2,131 KG

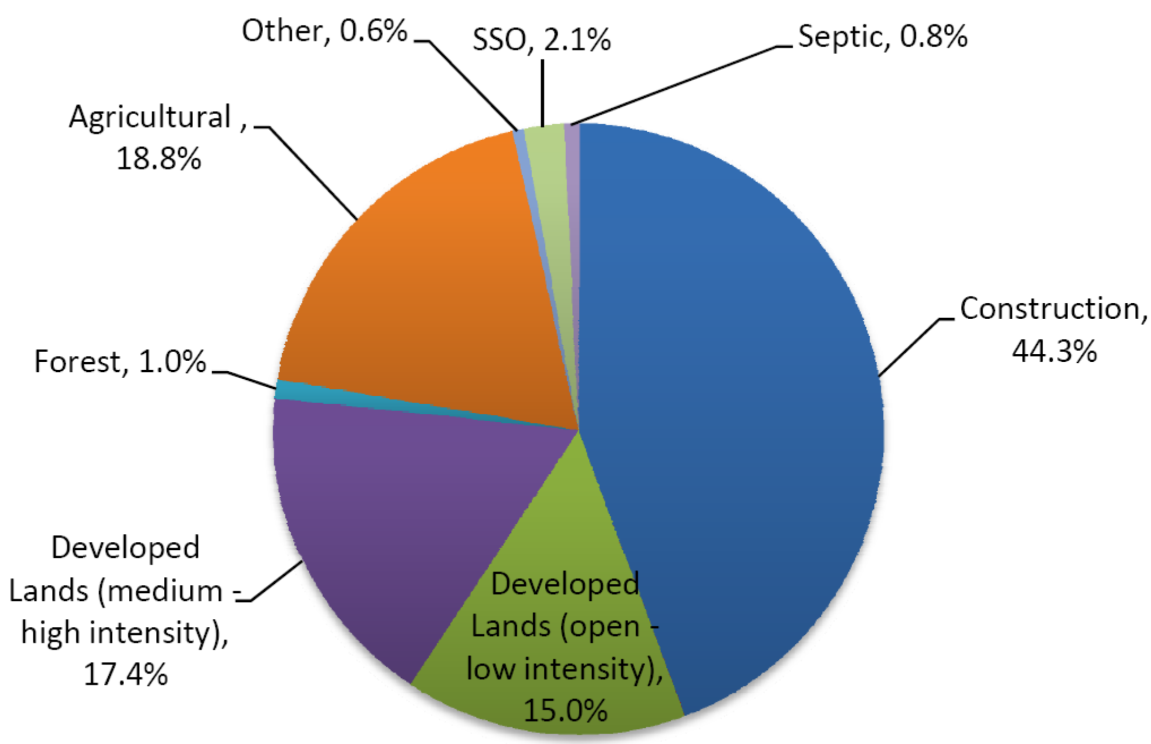


FIGURE 7.03-16

BANKLICK CREEK SUBWATERSHED 13 PHOSPHOROUS ALLOCATION–TOTAL LOADING: 2,349 KG

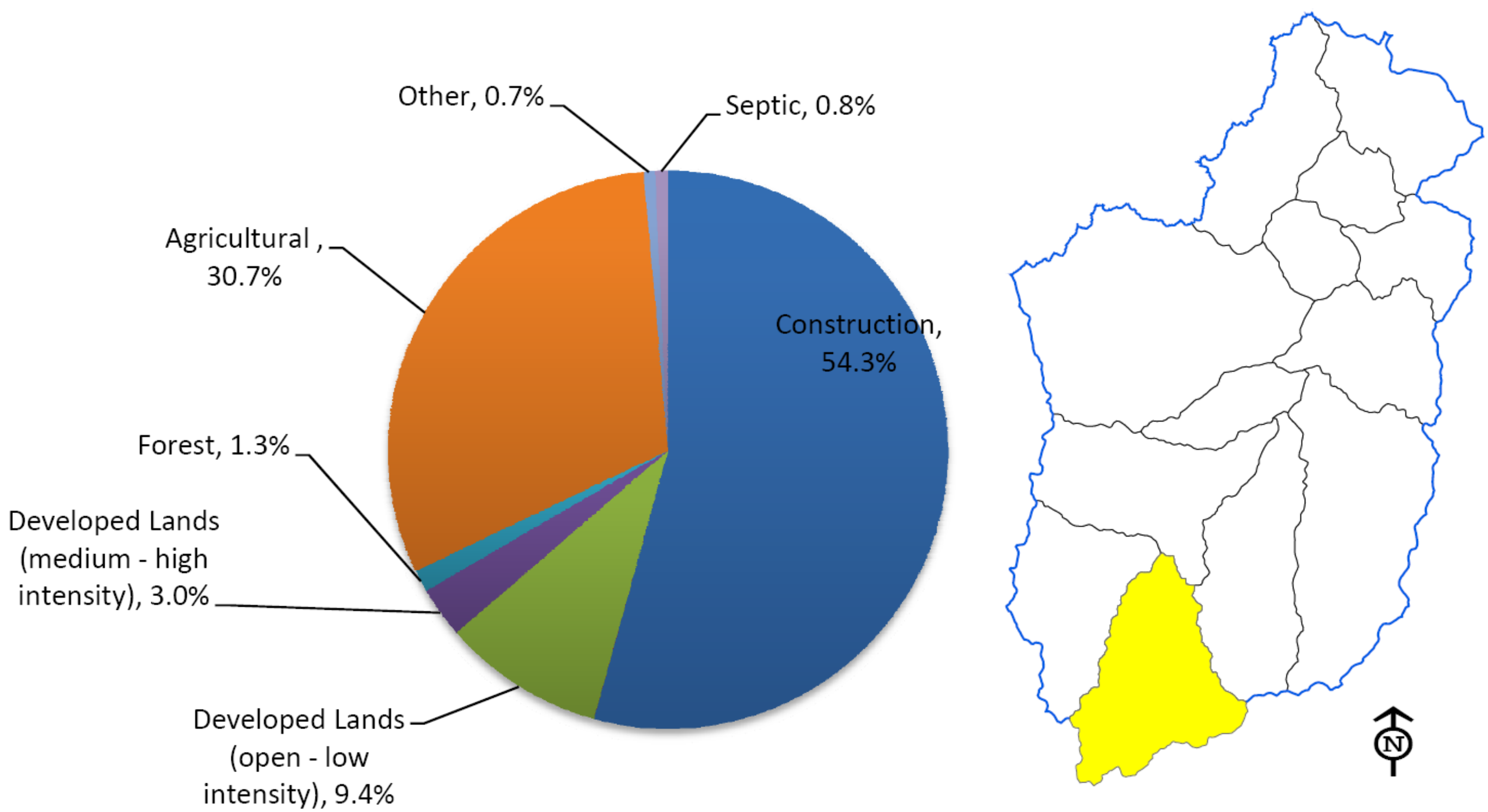


TABLE 7.03-1

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

<table>
<tr><th>Zone</th><th>Zone Location</th><th>Zone Purpose</th><th>Recommended Width</th><th>Recommended Plant Species</th><th>Planting</th><th>Maintenance</th></tr>
<tr><td>Tree</td><td>Next to stream</td><td>Provide stream with shade and additional bank stability</td><td>Minimum 30 feet (four to five rows)</td><td>Oak and Cyprus. Most people prefer mass producing trees in this zone.</td><td rowspan="2">Plant trees and shrubs in early spring. Soak rooted cuttings 2 to 4 hours in water and unrooted cuttings for 24 hours.

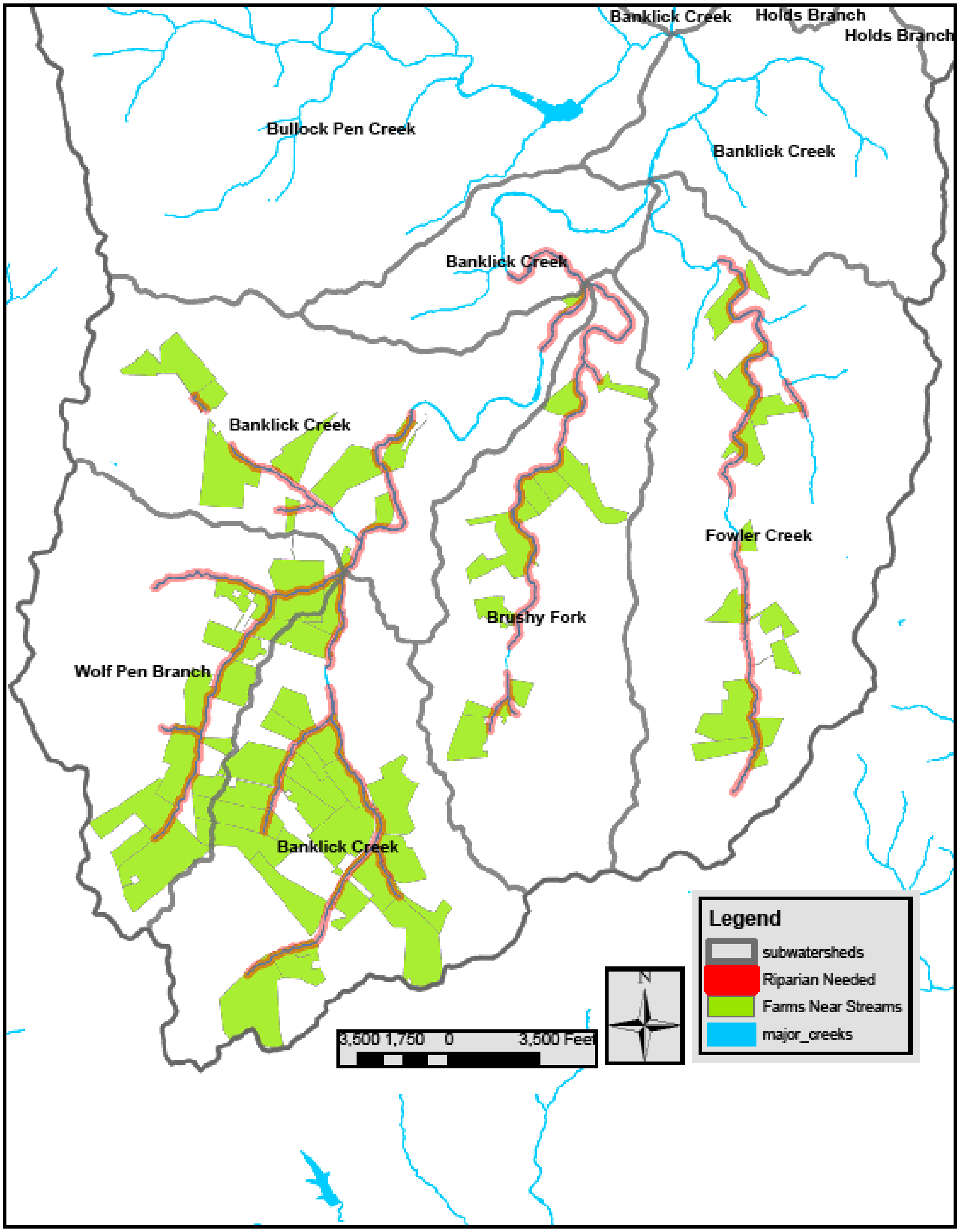
Close planting holes and check for firm soil around the root or cutting. Unrooted cuttings should have 1-2 buds above ground.</td><td rowspan="2">Weed control is essential for tree and shrub zones.

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.</td></tr>
<tr><td>Shrub</td><td>Between the Tree Zone and Grass Zone</td><td>Develop perennial root system, add diversity and wildlife habitats</td><td>Minimum 12 feet (one or two rows)</td><td>Dogwoods, hazelnut, and other native shrubs.</td></tr>
<tr><td>Grass</td><td>Next to cropland</td><td>Primary zone for filtering pollutants</td><td>20 to 24 feet</td><td>Switch grass. If runoff is not a major problem, use Indian grass, big or little bluestem, or eastern gamma.</td><td>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.</td><td>Mow once or twice during growing season to mark rows. Late fall mowing reduces rodent habitats to help minimize damage during winter months.</td></tr>
</table>

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

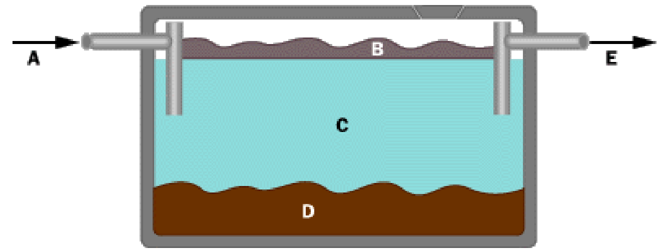
The management measures to be accomplished with the BWC's 319 grant are listed in Table 7.06-2.

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.

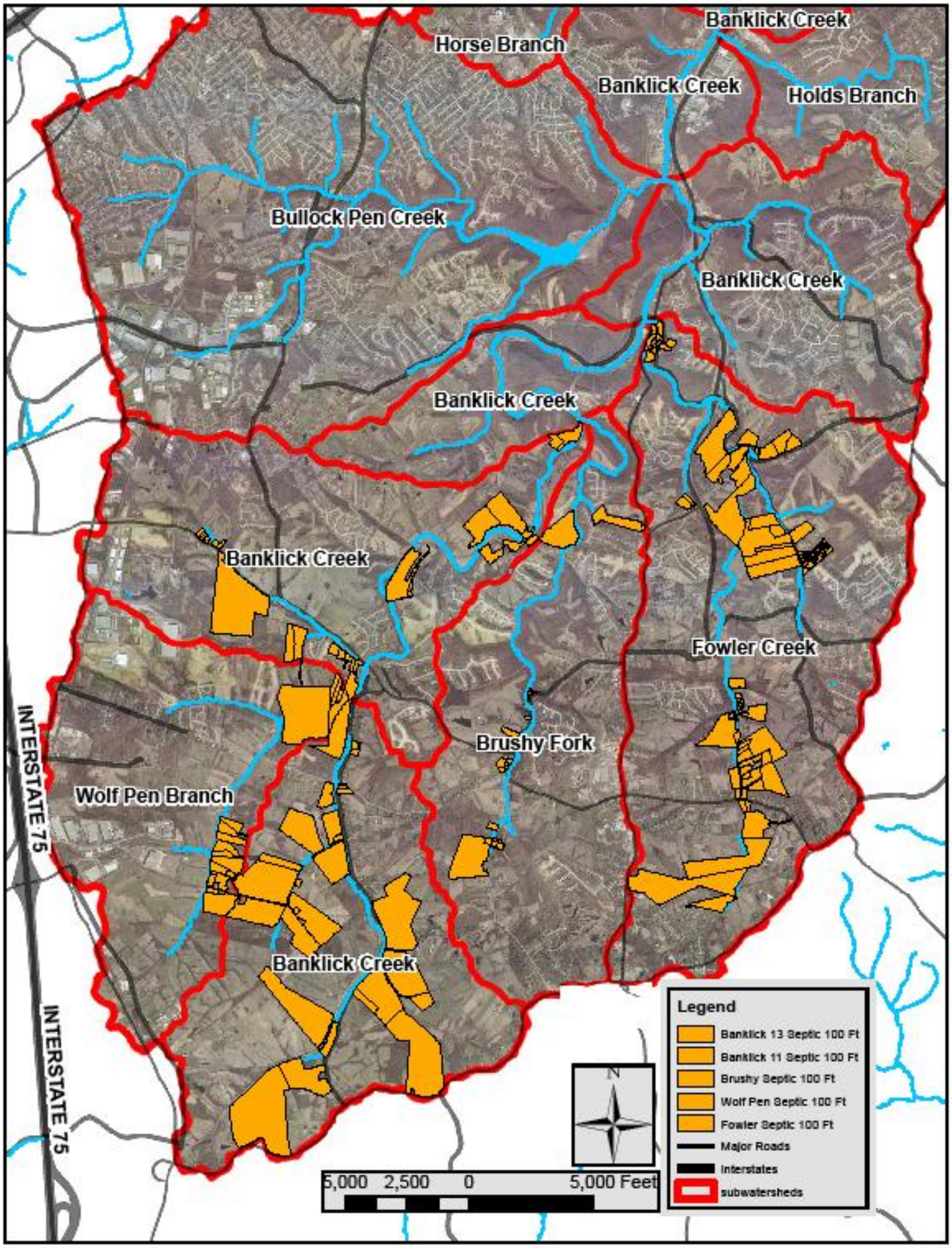
In the focus area, 1,124 parcels are sewered by septic systems, and NKIHD estimates that 10 percent of these systems may be failing. Using the assumption that an average of three people live on each parcel, and the literature value that each person produces 1.95×10^9 cfu/day (Yagow, 2001), it is estimated 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. Gather Information on Interest in a Livestock Fencing Program and Potential Participants

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. Distribute Educational Materials on Dangers of Unfenced Livestock and Resulting Stream Impairments

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. Implement a Pasture Improvement Program for Livestock in the Focus Area.

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. Publish Septic System Informational Articles in a Local Paper for Public Education

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. 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

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. Implement a Cost-Share Program to Encourage Septic System Owners to Improve their Failing Systems

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 workshops 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.