Cane Run Watershed
Watershed-Based Plan

Prepared for:

Kentucky Energy & Environment Cabinet

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I. INTRODUCTION

A. Watershed Background

Cane Run Watershed is in northcentral Lexington, Fayette County, and southwestern Scott County, Kentucky. The headwaters of Cane Run originate in central Fayette County and flow north into Scott County. Once Cane Run crosses into Scott County it flows northwest to its confluence with North Elkhorn Creek just west of the City of Georgetown. The land use of the upper portion of the watershed area is mostly urban within Lexington and has more rural land uses downstream in northern Fayette County and southwestern Scott County. The lower portion of the watershed also drains portions of the City of Georgetown. The watershed has areas of karst, and includes the Royal Spring karst basin, which serves as a water supply for Georgetown.

Cane Run was first listed as impaired for aquatic life in the 1998 303(d) list of Kentucky impaired waters, with river mile 10.0 to 17.4 listed for organic enrichment biological indicators and pathogens (fecal coliform). In subsequent years, additional segments and causes were listed, including impairment to warmwater aquatic habitat (WAH) due to sediment, and recreational uses due to pathogens, nutrients/eutrophication, and organic enrichment (sewage) by 2002. The entire main stem (17.4 miles) of Cane Run was listed for at least one type of impairment by 2002. Additionally, in 2002, 3.5 miles of an unnamed tributary to Cane Run, located at river mile 6.13, was listed for impairment to recreational uses due to pathogens. In 2010, two additional unnamed tributaries to Cane Run were listed for impairment at river miles 10.8 and 12.9. The unnamed tributary at river mile 10.8 was listed for impairment to WAH due to nutrients (nitrogen and phosphorus). The unnamed tributary at river mile 12.9 was also impaired for WAH due to nutrients (phosphorus). Royal Spring was also listed in 2010 for impairment due to nutrients (nitrogen and phosphorus). With these additional listings in 2010, Cane Run (in its entirety) and all major tributaries were listed on the 303(d) list of Kentucky impaired waters. These stream segments were also listed on the draft 2012 303(d) list.

The impairment of Cane Run, in addition to other Lexington streams, led the U.S. Environmental Protection Agency (EPA) and the Kentucky Environmental and Public Protection Cabinet (KY EPPC) to file a lawsuit (United States 2006) against Lexington-Fayette Urban County Government (LFUCG) over violations of the Clean Water Act in 2006. The lawsuit was due to failure of the city to maintain the sanitary and storm sewer systems causing raw sewage discharges into streams. On March 14, 2008, LFUCG lodged a Consent Decree to resolve this lawsuit (United States, 2008). Within the Consent Decree, LFUCG agreed to make extensive improvements to its sewer systems, address sanitary sewer overflows and associated Municipal Separate Storm System (MS4) permit violations, as well as to reduce the discharge of pollutants via stormwater. With the Consent Decree in place, LFUCG is furthering its efforts to improve water quality in Cane Run.

This Watershed-Based Plan (WBP) provides a comprehensive assessment of the health of the watershed, citizen and stakeholder concerns, watershed remediation strategies, and implementation plans for the future. This document is intended to address the nine minimum elements required in the EPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (USEPA 2008). These nine elements are:

1. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this WBP (and to achieve any other

watershed goals identified in the WBP), as discussed in element two. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (*e.g.*, X numbers of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded stream bank needing remediation).

2. An estimate of the load reductions expected for the management measures described under element three (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in element one above (*e.g.*, the total load reduction expected for dairy cattle feedlots, row crops, or eroded stream banks).

3. A description of the nonpoint source management measures that will need to be implemented to achieve the load reductions estimated under element two (as well as to achieve other watershed goals identified in this WBP), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

4. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan. Sources of funding to consider include Section 319(h) Funds, State Revolving Funds, U.S. Department of Agriculture's (USDA) Environmental Quality Incentives program (EQIP) and Conservation Reserve Program (CRP), and other relevant federal, state, local, and private funds that may be available to assist in implementing this plan.

5. An information/education component that will be used to enhance public understanding of the project and encourage early and continued public participation in selecting, designing, and implementing nonpoint source management measures.

6. A schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.

7. A description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this WBP needs to be revised or, if a nonpoint source Total Maximum Daily Load (TMDL) has been established, whether the nonpoint source TMDL needs to be revised.

9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under element eight.

B. Partners and Stakeholders

The Cane Run Watershed Council (CRWC) was formed in December 2007, with the first meeting taking place on December 18, 2007. The watershed council was preceded by the formation of Friends of Cane Run, Inc. (FOCR) which composed bylaws on October 18, 2006. FOCR was organized as a non-profit educational group to protect and improve the water quality of Cane Run and its members are members of the CRWC. The CRWC was formed to identify and include potential stakeholders and partners, help develop a WBP for Cane Run and Royal Spring (UK BAE, 2011) and implement proposed corrective actions. Issues and problems related to the Cane Run Watershed are discussed by the CRWC, and potential solutions are proposed. The CRWC also discusses proposed water quality monitoring plans for Cane Run and helps coordinate funding or other support to programs to improve water quality. Cane Run Watershed partners and stakeholders include the following organizations:

Barton Brothers Farms	Kentucky Horse Park
Bluegrass Greensource	Kentucky River Water Watch Program
Cane Run Watershed Council	Kentucky Water Resources Research Institute
City of Georgetown	Lexington-Fayette Urban County Government
Coldstream Research Campus	Lexmark International
Fayette County Conservation District	Marriott Griffin Gate Resort
Fayette County Public Schools	Natural Resource Conservation Service
Friends of Cane Run	North Limestone Neighborhood Association
Georgetown Municipal Water and Sewer	Scott County Conservation District
Georgetown-Scott County Planning Commission	Scott County Department of Health
Green Acres Neighborhood Association	Scott County Public Schools
Kentucky Department of Fish and Wildlife	Thoroughbred Resource Conservation and Development
Kentucky Department of Transportation	United States Environmental Protection Agency
Kentucky Division of Conservation	University of Kentucky College of Agriculture
Kentucky Division of Forestry	University of Kentucky Cooperative Extension Service
Kentucky Division of Water	University of Kentucky Environmental Research and Training Laboratory
Kentucky Geological Survey	Vulcan Materials

II. WATERSHED INFORMATION

A. Watershed Location

The Cane Run Watershed, Hydrologic Unit Code (HUC-14) number 05100205-280-200, is a 45.4 square mile (mi^2; 29,056 acre) watershed located within Fayette and Scott Counties, Kentucky. The portion of the Cane Run Watershed within Fayette County is 28.4 mi^2 (18,176 acres), while the remaining 17 mi^2 (10,880 acres) lies in Scott County. The only named stream in the watershed is Cane Run. However, large unnamed tributaries flow into Cane Run at river miles 2.8, 4.6, 6.13, 9.6, 10.8, 12.9, 15.7, and 15.8.

The headwaters of Cane Run originate in central Fayette County and flow north into Scott County. Once Cane Run crosses into Scott County, it flows northwest to its confluence with North Elkhorn Creek just west of the City of Georgetown. North Elkhorn Creek flows in a westerly direction until it joins with South Elkhorn Creek to form Elkhorn Creek – just east of the City of Frankfort in Franklin County, Kentucky. Elkhorn Creek continues in a northern direction until it empties into the Kentucky River approximately 7 miles north of the City of Frankfort.

The Cane Run Watershed boundary is shown on **Exhibit 1** (Appendix A). The southern boundary of the Cane Run Watershed originates just north of the intersection of East Loudon Avenue and Winchester Road in northeastern Lexington. From this location, the western boundary parallels East Loudon Avenue to the south in a western direction, until crossing North Broadway and Newtown Pike where it roughly parallels Georgetown Road in a northern direction. This boundary begins to parallel I-64 in a western direction until it crosses the Fayette County border near the intersection of Kearney Road and North Yarnallton Pike. The border continues to the Lancelot Estates and then follows just west of Cane Run Road to the mouth of Cane Run near US-460 (Frankfort Pike). The eastern boundary captures the southern portion of Georgetown following Pocahontas Trail, then across to near Jolomic Lane and I-75. It proceeds to near the intersection of Newtown Pike and Ironworks Pike. Following Ironworks Pike to near Russell Cave Road, it then extends to Paris Pike, just east of the I-75 intersection. The border then bisects the Bryan Station Neighborhood as it continues to near East Loudon Avenue.

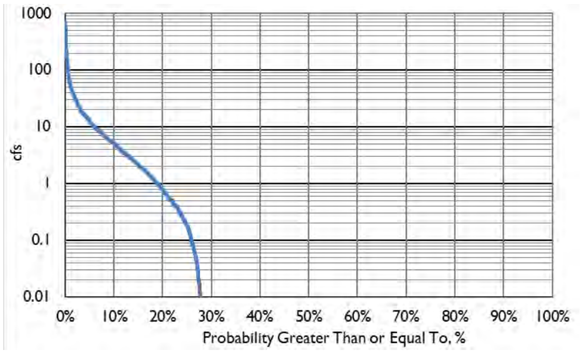
B. Surface Hydrology and Geomorphology

Cane Run lies within the Inner Bluegrass Ecoregion, which contains undulating terrain with moderate rates of both surface runoff and subsurface drainage. Cane Run flows for approximately 17.4 miles from its headwaters to its confluence with North Elkhorn Creek. With numerous small intermittent and perennial streams contributing to its flow, a total of 77.8 miles of stream are in the watershed. Cane Run is predominately a high gradient stream of mixed substrates flowing through a gently rolling topography with slight relief. Several small water bodies (i.e., ponds) are scattered throughout the watershed, some adjacent to Cane Run or its tributaries, and other impoundments of them. A large portion of the headwaters are developed with impervious surfaces (streets, roofs, etc.) that contribute to flashy storm flows due to quick runoff from the impervious surfaces. Outside of this area, land use is more agricultural, promoting greater infiltration.

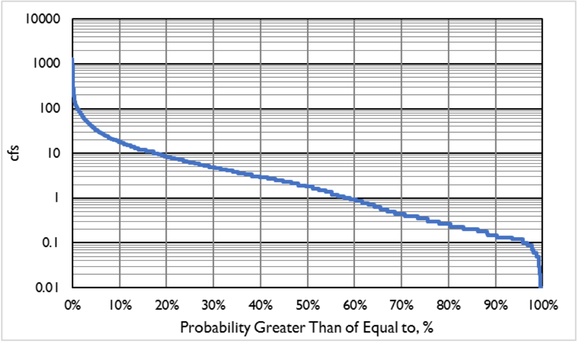
A U.S. Geological Survey (USGS) gaging station was established on Cane Run at Berea Road in Fayette County and was in operation from September 1997 to 2012. Basic statistics on the discharge at this station are provided in **Figure 1**. These statistics indicate that Cane Run, at the Berea Road gage station, discharges approximately 0.003 to 0.17 cubic feet per second (cfs) under low flows and 25.5 to 718 cfs in high flows. This gaging station, representative of most of Cane Run upstream of I-75 in Scott County, was dry during 72% of the period measured due to sinks and karst windows that diverted surface flow into the Royal Spring karst groundwater aquifer. Surface flow only occurred in response to heavy rainfall events at this gage station.

Because of low and inconsistent flows at this location, the gaging station was moved upstream to Citation Boulevard, near the Urban Service Boundary, in June 2012. This station represents one of the few reaches of Cane Run in Fayette County with routine flow due to a perennial spring. Additionally, a gage station was installed on an unnamed tributary to Cane Run at Newtown Pike in June 2012. This tributary, like many other tributaries to Cane Run, maintains flow throughout much of the year. The stage discharge curves for these stations are shown in **Figure 1**.

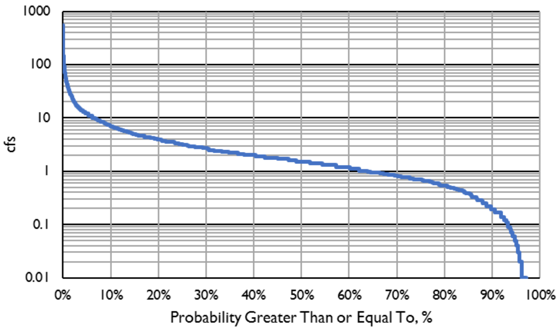
FIGURE 1 – CANE RUN AND TRIBUTARY FLOW DURATION CURVES AT VARIOUS LOCATIONS



USGS 03288200 Cane Run at Berea Road Near Donerail, KY



USGS 03288180 Cane Run at Citation Blvd Near Lexington, KY

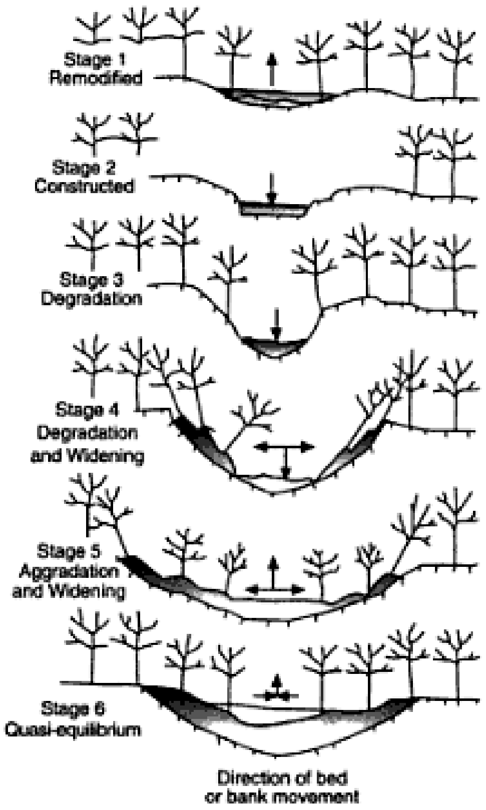


USGS 03288190 Tributary to Cane Run at Newtown Pike Near Lexington, KY

Together, these gaging stations indicate that the interaction between the surface and groundwater systems has important implications on habitat for aquatic organisms.

Geomorphic studies, which describe the average stream dimensions, flow, and bed materials, assess the stream channel conditions and flow. All streams change in response to changes in the drainage area, **Figure 2** shows typical stream channel responses to modifications. In response to changes that occur in the watershed, the original condition (Stage 1) becomes unstable and begins to channelize (Stage 2). Over time it will seek to find a new equilibrium (Stage 6) through a process that involves incision (Stage 3), mass erosion and bank failures (Stage 4), and widening and sedimentation (Stage 5).

FIGURE 2 – CHANNEL EVOLUTION MODEL



When stream channels become channelized (Stage 2) they change over time to re-stabilze through a process that involves incision (Stage 3), mass erosion and bank failures (Stage 4), and widening and sedimentation (Stage 5) before reaching a new equilibrium (Stage 6). (Image from Simon and Hupp, 1986)

Parola *et al.* (2007) performed an evaluation of the geomorphological and bankfull characteristics of streams in the Bluegrass physiographic region where Cane Run is located. Although Cane Run was not assessed during the study, this regional geomorphic study provides general characteristics that apply to Cane Run and its tributaries.

In their analysis of the bed material, they found that “the majority … is comprised of locally broken bedrock and fine-gravel and sand-sized sediments … The bedrock underlying channels in the Bluegrass most frequently consists of thinly bedded and densely jointed limestones and shales. This type of bedrock is susceptible to moderate to rapid rates of erosion by fluvial stresses.” They note that when bedrock erodes, the chemical weathering typically leaves only clay, and not larger grain sizes.

In terms of channel evolution, the study indicates that “many of the larger Bluegrass streams have experienced several cycles of … modifications, which caused them to incise multiple times.” However, the process of re-establishing an equilibrium is relatively slow due to three main reasons. “First, erosion-resistant channel boundaries composed of bedrock and cohesive banks prevent rapid bank erosion or bed degradation. Second, the supply of coarse sediment … is low. Third, the supply of sand-sized sediment that would rapidly reform floodplains is generally low.”

Much of the degradation to the aquatic and riparian ecosystem is attributed to geomorphic processes, including increases in-stream sediment due to bank erosion, limited in-stream habitat due to extensive exposure of bedrock in channels, and channel incision that disconnects streams from a floodplain.

Bank erosion was found to be principally due to freeze-thaw process in winter and extreme drying in summer, contributing large volumes of fine-grained sediment to streams. A lowered water table, common in the region due to stream incision, also contributes to dry streams in the summer, except for isolated pools.

C. Climate and Precipitation

Table 1 shows the monthly climatological normal for temperature and precipitation at the Lexington Bluegrass Airport based on records from 1981 to 2010 compiled by the National Weather Service (NWS, 2011). The temperature in this area ranges from an average monthly minimum of 24.9 degrees Fahrenheit (°F) in January to an average monthly maximum of 86.1°F in July. The average total precipitation is 45.17 inches annually with 13.0 inches of snowfall on average. On average, the driest month is September, with an average of 2.91 inches of precipitation, and May is the wettest, with an average of 5.26 inches. Climate data collected at the Georgetown Water Works (site 153194) includes precipitation and snow (Southeast Regional Climate Center, 2019). Based on records from 1941 to 2012, the average total precipitation is 43.76 inches annually with 10.3 inches of snowfall on average per the Georgetown monitoring location. The Georgetown monitoring data also indicated that the driest month is typically October (with an average of 2.74 inches precipitation) and that May is the wettest month (with an average of 4.47 inches precipitation).

TABLE 1
MONTHLY CLIMATOLOGICAL NORMALS 1981 - 2010

Month	Max Temp (°F)	Min Temp (°F)	Avg Temp (°F)	Precip (in)	Snow (in)
January	40.9	24.9	32.9	3.20	3.9
February	45.6	28.1	36.9	3.20	4.6
March	55.4	35.7	45.5	4.07	1.4
April	65.8	44.7	55.3	3.60	0.3
May	74.4	53.9	64.2	5.26	0
June	82.9	62.5	72.7	4.44	0
July	86.1	66.3	76.2	4.65	0
August	85.6	65.0	75.3	3.25	0
September	78.8	57.5	68.1	2.91	0
October	67.5	46.6	57.0	3.13	0
November	55.4	37.3	46.3	3.53	0.3
December	43.9	28.0	36.0	3.93	2.5
Annual	65.3	46.0	55.6	45.17	13.0

National Weather Service, 2011

D. Groundwater-Surface Water Interaction

When limestone bedrock is near the surface, surface water and precipitation often pass through the soil into the limestone, where it is called groundwater. Over time, horizontal and vertical cracks in the rock can become enlarged by the acids in the water to form a landscape characterized by sinkholes, springs, and caves, called karst topography.

The Cane Run Watershed has numerous karst features throughout the watershed area, and several large karst basins (Currens *et al.* 2003). While numbers change over time, about 50 springs and 100 swallets, karst windows, cave streams, or other injection points have been identified per Kentucky

Geological Survey, University of Kentucky, and LFUCG databases. These features are shown in **Exhibit 2** (Appendix A).

The most significant karst feature within the watershed is the Royal Spring karst basin, a drinking water source for the City of Georgetown. This basin mirrors much of the Cane Run surface watershed, flowing from northcentral Fayette County to the City of Georgetown. Surface flow from Cane Run enters swallets and sinkholes in the upper reaches of the watershed into the Royal Spring karst basin and exits at Royal Spring in Georgetown. Over several decades, 65 swallet holes have been mapped along Cane Run, draining surface flow into the Royal Springs Aquifer (**Exhibit 2**). This is a general indication of swallet and sink presence, as confirmation surveys in recent years have indicated that some have closed by bank collapses and new holes have opened (Husic, 2016). Because of these numerous sinks (except for several short reaches downstream of tributaries or springs) and under normal flow conditions, Cane Run is dry from its headwaters to Lisle Road in Scott County. As exhibited by the historic USGS gage near Donerail (USGS Gage #03288200), surface flow typically only occurs in conjunction with precipitation events (Ormsbee *et al.*, 2013).

Many of the karst basins in the Cane Run Watershed are “misbehaved,” indicating that underground drainage is different from the boundary of the surface water. Royal Springs is an example, discharging outside of the Cane Run Watershed in downtown Georgetown. Slacks Spring, Silver Spring, Vaughans Spring, Russell Spring, and Holland Spring are misbehaved karst basins; all exporting surface waters from Cane Run to surrounding watersheds. The small karst basins for Jenning Springs and Stockyards Spring are located entirely within the Cane Run Watershed. Several karst basins that are immediately adjacent to the Cane Run Watershed, but are not within the watershed, include Nance Spring, Gano Spring, Lindsay Spring, Tevis Spring, and Sharp Spring karst basins.

The upper reaches of Slack Spring karst basin are partially located in the northwest section of the Cane Run Watershed in Fayette County and flows northwest until exiting at North Elkhorn Creek, just west of the confluence with Cane Run. This karst basin captures drainage from the Town Branch watershed as well as Cane Run.

The upper drainage area of Silver Spring karst basin originates in the Cane Run watershed and then flows west until exiting into the Town Branch watershed. Russell Spring karst basin is located within the southeastern section of the Cane Run watershed in Fayette County, and flows north until exiting into the North Elkhorn Creek watershed. Vaughans Spring karst basin originates in the Cane Run watershed within Fayette County and flows north until exiting into North Elkhorn Creek. A very small portion of the Holland Spring karst basin is in the Cane Run watershed in Scott County and flows east into North Elkhorn Creek.

To evaluate the sensitivity of groundwater resources to water pollution, Kentucky Division of Water (KDOW) developed a hydrologic sensitivity index to quantify the regions of Kentucky (Ray *et al.*, 1994). Based on groundwater recharge, flow, and dispersion rates, the index ranges from 1 (low) to 5 (high). With the amount of karst in the Cane Run watershed, the hydrologic sensitivity index is 5 (high), indicating that the area is highly susceptible to groundwater pollution.

E. Flooding

Floodplains are lands adjacent to streams that flood during intense wet weather events. The ability of a stream to access the floodplain is a critical component of a stream's health. When water accesses a floodplain, it spreads out and slows down, facilitating sediment deposition, treatment of nonpoint source pollutants, and recharge of groundwater. A stream that cannot access a floodplain (e.g., by channelization, channel incision, or construction of a flood wall) will carry more energy, causing bank erosion and channel downcutting. It will also carry a higher pollutant load downstream during storm events and may have reduced base flow due to reduced groundwater recharge.

The 100-year floodplain is primarily located in agricultural lands for much of the watershed. However, flooding concerns are notable at multiple locations in the watershed.

The floodplain along Cane Run has been greatly encroached upon by urban development in the headwaters as illustrated on **Exhibit 3** (Appendix A), causing flooding impacts to some residences and infrastructure even in recent years. LFUCG has established greenways and parks along several sections of the floodplain area within the headwater reaches of the Cane Run watershed. Many of these greenways and parks are owned by LFUCG, which should prevent development of these floodplain areas. Parks and greenways located adjacent to the floodplain of Cane Run include Constitution Park adjacent to Bryan Avenue and East Loudon Avenue, Martin Luther King Park at McCullough Drive, and Oakwood Park at Briarwood Drive. The greenway of Coldstream Park also contains portions of the Cane Run floodplain.

Agricultural impacts, such as livestock grazing or row cropping, occurs within the downstream sections of Cane Run in Fayette County. Within Fayette County outside of the Urban Service Boundary, a large portion of the Cane Run floodplain is contained within the Kentucky Horse Park and University of Kentucky Farms. Much of the floodplains occur on private farmland in Scott County. Flooding in these locations can damage planted crops, fences, or other infrastructure, as well as deposit debris and stormwater trash in these locations. Several locations along US 25 have been impacted by flooding, resulting in road closings in recent years near crossings of Cane Run and its tributaries near Maple Grove Mobile Home Park and near Landscape Alternatives and Grace Christian Church.

The frequency and magnitude of flooding is affected by the percent of impervious surface in a watershed. Under natural conditions, most rainwater is infiltrated into the soil or evapotranspired by trees and vegetation. With increased impervious surfaces, such as rooftops or pavement, water cannot infiltrate into the soil and therefore quickly flows into the stream. This can lead to frequent and/or severe flooding events of higher magnitudes. Much of the upper portion of the Cane Run watershed is developed and has a high percentage of impervious surfaces.

F. Geology

The Cane Run watershed lies in the Lexington West (Miller, 1967), Lexington East (MacQuown and Dobrovolny, 1968), Centerville (Kanizay *et al*., 1967), and Georgetown (Cressman, 1967) geologic quadrangles. As shown on **Exhibit 4** (Appendix A), Tanglewood Limestone Member No. 2 (Lower Ordovician – Middle Ordovician) is the dominate formation in the watershed. The remainder of the

Cane Run watershed consists primarily of the Tanglewood Limestone Member No. 1 (Lower Ordovician – Middle Ordovician) and Upper part of Lexington Limestone (Lower Ordovician – Middle Ordovician), with Quaternary Alluvium deposited along stream channels.

The Tanglewood Limestone Member is a bioclastic formation described as medium to coarse grained, thin to thick bedded, phosphatic, and very fossiliferous to sparingly fossiliferous. The member is comprised mostly of limestone (80%), interbedded with shale.

The Upper part of Lexington Limestone member is medium gray, fossiliferous, with a micro-grained calcite matrix. The formation is poorly sorted bioclastic. Shale occurs as a matrix around nodules and lenses and in irregular beds.

Quaternary Alluvium is deposited along the stream channels. Per the geological quadrangles, the alluvium formation is clay, silt, and gravel, and locally may contain abundant chert and dense argillaceous limestone fragments. It is generally less than 5 feet thick along smaller tributaries and 10 feet thick along larger streams, although locally may be as thick as 20 feet.

Fossiliferous shale and limestone occurs primarily west of Cane Run, and is fine to coarse grained, and 0 to 15 feet in thickness. The unit contains numerous bryozoan, shell fragments, and other fossils.

G. Ecoregion and Topography

The Cane Run watershed is in the Inner Bluegrass (71l) Level 4 Ecoregion (Woods *et al*., 2002). This region is described as unglaciated, weakly dissected upland plain that is level to gently rolling, with extensive karst. Upland streams have low to moderate gradients, with cobble and bedrock substrates. Many of these upland streams are intermittent, but some are fed by major springs and have plentiful year-round flow conditions. Sinking streams, underground drainage, springs, numerous sinkholes, and ponds occur throughout the region (Woods *et al*., 2002).

The natural vegetation of upland areas is described as remnants of an open oak-hickory forest with dominants of blue ash, white oak, shumard oak, walnut, chinquapin oak, bur oak, shellbark hickory, and Kentucky coffeetree. Dominant vegetation surrounding sinkholes is described as sycamore, black locust, hackberry, and mulberry, while abandoned agricultural land often has broomsedge and sumac dominants. Poorly drained floodplain forests of the region are dominated by sweet gum, pin oak, box elder, yellow poplar, and hackberry, while along rivers and gorges oak-maple forests dominate. This oak-maple forest is usually comprised of white oak, northern red oak, scarlet oak, black oak, chinquapin oak, white ash, sugar maple, red maple, and eastern red cedar. River cane is a common understory species throughout the inner bluegrass (Woods *et al*., 2002).

Current land use of the ecoregion includes pastureland (horse, cattle), cropland (burley tobacco, corn, and hay), and urban-suburban development. Urban-suburban areas are expanding within the ecoregion. The region is very fertile with alfisol and mollisol soils developed from the underlying phosphatic limestone (Woods *et al*., 2002).

Agricultural activities can contribute sediment, nutrients, pesticides, and pathogens to surface water within the ecoregion. High nutrient levels in the streams contribute to algal blooms and low dissolved oxygen levels, especially in areas with no tree canopy. Runoff from impervious surfaces of urban areas and wastewater discharges can release trace metals, nutrients, and pathogens into surface waters. The Kentucky River has very high concentrations of nutrients (nitrogen and phosphorus) in the state (Woods *et al*., 2002).

Exhibit 5 (Appendix A) shows that the topography of the Cane Run watershed is gently rolling with the most variation located in the southern portion of the watershed in Fayette County. Elevations range from approximately 750 feet above sea level at the confluence with North Elkhorn Creek to approximately 1,000 feet above sea level from the headwaters in Lexington.

H. Soils

Per the soil survey of Fayette County (Sims *et al*., 1987), there are two soil associations within the Cane Run watershed and include the Maury-McAfee and the Lowell-Lordale-Mercer association. The Scott County soil survey (Weisenberger and Isgrig, 1977), shows only the Maury-McAfee association within the Cane Run watershed. The Maury-McAfee soil association is described as undulating, deep and moderately deep soils that are high in phosphates, well drained, and occur on uplands. The Lowell-Lordale-Mercer association is described as gently sloping, well drained to moderately well drained soils that are deep and moderately deep that also occur on uplands. Most of the watershed is within the Maury-McAfee association, while the Lowell-Lordale-Mercer association is restricted to eastern portions of the watershed in the headwater areas, and a small section of the western watershed near Donerail, Kentucky.

Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups (HSG) based on the soil runoff potential (USDA-NRCS, 1986). The four HSGs are A, B, C and D, with HSG A having high infiltration capacity (little runoff) and HSG D having very low infiltration capacity (high runoff). **Table 2** shows the infiltration rates associated with each soil and the relative abundance at which these soils are present in the watershed. The locations of the soils are shown in **Exhibit 6** (Appendix A). The most dominant HSG was B, but C was also common. Group A was not present, and HSG D soils are rare. Based on this information, all soils will generate runoff when the rainfall intensity is more than 0.30 inches per hour.

TABLE 2
RELATIVE ABUNDANCE OF SOILS BY HYDROLOGIC SOIL GROUP

Hydrologic Soil Group	Infiltration Capacity / Permeability	Infiltration Rate (in/hr)	Relative Abundance (%)
A	High	> 0.30	0.0%
B	Moderate	0.15 - 0.30	63.4%
C	Low	0.05 - 0.15	29.2%
D	Very Low	0.00 - 0.05	3.0%
Water / Made Land	None / Very Low	0.00 - 0.05	2.0%
Not Available	Unknown	Unknown	2.4%

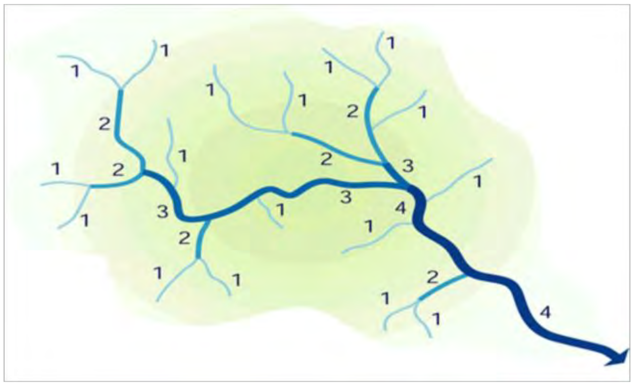
Areas of hydric soil are important since wetland restoration or expansion is more likely to be successful in these areas. Wetlands provide key habitat for aquatic organisms, improve water quality through filtration and biogeochemical processes, and provide flood water retention. Hydric soils comprise about 5% of the watershed land area and are primarily located near streams. Lanton silty clay loam and Melvin silt loam are listed as hydric within Fayette County (http://soils.usda.gov/use/hydric/) and Lawrence silt loam, Loudon silt loam, and Newark silt loam are listed as possibly having inclusions of hydric soils. In Scott County, Dunning silty clay loam is listed as hydric with Newark silt loam having hydric inclusions. Because of karst drainages, few wetlands exist in the watershed.

I. Riparian Ecosystem

Although riparian zones produce many water quality benefits, these benefits are dependent on the width of the riparian area, the size of the stream that it borders, vegetation composition, and vegetation density. Stream ordination is a system applied to designate the size and location of stream systems.

One method of stream ordination, as shown in **Figure 3**, assigns all headwater perennial streams with an order of one, and increases the order at the confluence of streams of equal order. Thus, when two third-order streams combine, a fourth-order stream is produced. The water quality functions provided by the riparian zone vary by stream order. Riparian zones on first and second-order streams provide the maximum nutrient removal, shading, and bank stabilization benefits (Palone and Todd, 1997). Fish habitat and aquatic ecosystem benefits of riparian buffers are typically greatest for third and fourth-order streams, while flood mitigation benefits of riparian zones increase as the stream order increases. Sediment control benefits of riparian buffers remain relatively constant for all stream orders.

FIGURE 3 – STREAM ORDER DIAGRAM



Source: FISRWG 1998

The width of the riparian zone necessary to achieve these benefits varies depending on the function. The U.S. Army Corps of Engineers (USACE; Fischer and Fischenich, 2000), recommends the following riparian buffer widths for various functions: 5 meters to 30 meters (16 feet to 100 feet) for water quality protection, 30 meters to over 500 meters (100 feet to over 1,600 feet) for riparian habitat, 10 meters to 20 meters (30 feet to 65 feet) for stream stabilization, 20 meters to 150 meters (65 feet to 500 feet) for flood attenuation, and 3 meters to 10 meters (10 feet to 30 feet) for detrital input.

Aerial imagery was utilized to analyze the width of the riparian zones throughout the Cane Run watershed. Areas with forested canopy or overgrown vegetation were included in the riparian buffer zone. Reaches of stream were defined as heavily impacted, moderately impacted, or non-impacted based on the width of the riparian zone. Non-impacted reaches were lengths of stream in which the riparian zone averaged 60 feet or wider for both banks. Heavily impacted reaches were defined as reaches where the riparian zone averaged less than 10 feet on both banks. Moderately impacted reaches had riparian zones that averaged between 10 and 60 feet. **Exhibit 7** (Appendix A) shows the results of this analysis, and **Table 3** (page 13) summarizes the results for each sub-watershed area.

Based on the aerial delineations, most of the streams (61%) were found to have little or no riparian zone (less than 10 feet). Ninety-five percent (95%) of the watershed was found to have some riparian zone impact, with only 7% with streams providing full ecological benefits associated with having 60 feet or wider riparian buffer for both banks.

While the quality of the riparian zone cannot be accurately determined via aerial analysis (i.e., mature trees, small shrubs, mowed grass, etc.), such an analysis is useful for identifying areas in need of additional plantings to enhance the riparian zone width. While all impacted reaches could benefit from riparian plantings, planting needs within sub-watersheds were prioritized relative to one another to identify the general areas with the greatest needs for planting. Tributaries along Paynes Depot Road and the tributaries near Etter Lane and Ironworks Pike were identified with some of the greatest needs, while the Lexington headwaters and the reaches near the mouth of Cane Run had some of the largest riparian zones. In recent years, University of Kentucky Farms have made noticeable advances in the expansion of the riparian buffers on their properties.

TABLE 3
RIPARIAN ZONE IMPACT BY SUB-WATERSHED AREA

Sub-watershed ID	Sub-watershed Description	Total Stream Length (mi)	% Length by Riparian Impact			Relative Buffer Planting Need
			Heavily Impacted (<10 ft Width)	Moderately Impacted (10-60 ft Width)	Non-Impacted (>60 ft Width)	
1	Cane Run Mouth	6.28	34%	53%	13%	Low
2	McClelland Circle	6.50	61%	35%	4%	Moderate
3	Paynes Depot Road Tributary	3.10	87%	13%	0%	High
4	Etter Lane Tributary	3.18	86%	9%	5%	High
5	Lisle Road Area	2.59	64%	36%	0%	Moderate
6	US 25 Tributary	8.99	63%	29%	8%	Moderate
7	East I-75	21.77	63%	30%	7%	Moderate
9	UK Farm Tributary	13.03	63%	30%	6%	Moderate
10	Lexington Headwaters	12.35	51%	40%	9%	Low
	Totals	**77.8 mi**	**61%** **47.3 mi**	**32%** **25.3 mi**	**7%** **5.3 mi**	

Expansion of the riparian zone in urban areas is often challenging due to development along the riparian corridor. In these areas, planting efforts should be focused on connectivity. Connecting areas that support riparian habitat to areas with less abundant riparian cover that can be enhanced will increase migration corridors and could benefit wildlife by reducing habitat segmentation in the watershed. Protection of existing riparian zones in urban areas is essential.

Within the rural portion of the Cane Run watershed there is great potential for riparian zone enhancement. Tree plantings and livestock exclusion (*i.e.*, fencing) are relatively inexpensive methods that could greatly improve riparian zone functions in this area. However, leaving riparian zones is often viewed as poor land management by landowners. A large-scale effort to establish no-mow zones along the agricultural areas was initiated on the University of Kentucky Farms during the Cane Run watershed Plan Project in 2012. These areas may be used to help landowners see what good riparian buffer practices looks like and allow them to consider adopting it on their lands.

J. Fauna and Flora

Fauna in the Cane Run watershed is primarily domestic animals, with pets (e.g. dogs, cats) more likely in the southern (Lexington) and northeastern (Georgetown), more urbanized portions of the watershed, and livestock (e.g. horses, cows) more likely in the northern, more rural portions of the watershed. Horses are particularly notable due to the location of the 1,200-acre Kentucky Horse Park within the Cane Run watershed. Other animals inhabiting the watershed are wildlife that are highly adaptable and/or tolerant of disturbance, i.e., raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), squirrel (*Sciurus carolinensis*), northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), robin (*Turdus migratorius*), house sparrow (*Passer domesticus*), starling (*Sturnus vulgaris*), etc. Larger wildlife, such as white-tail deer (*Odocoileus virginianus*), groundhog (*Marmota monax*), beaver (*Castor canadensis*), and coyote (*Canis latrans*), are more likely to be encountered in the rural portions of the watershed. In addition to these wild and domestic animals, a few waterfowl, such as Canada goose (*Branta canadensis*) and mallard (*Anas platyrhynchos*; especially around the Marriott Griffin Gate Resort and Embassy Suites impoundments), are likely species that may contribute fecal inputs to Cane Run.

Per the Kentucky Department of Fish and Wildlife Resources' (KDFWR) website (http://fw.ky.gov/Hunt/Pages/Harvest-Results.aspx), 245 white-tail deer were harvested in Fayette County during the 2015 hunting season, and 1,624 were harvested in Scott County. Deer could be contributing fecal inputs to Cane Run within the rural sections of the watershed.

During the Lexington 2015 Christmas Birding Survey by the Audubon Society of Kentucky, a total of 1,109 waterfowl or birds closely associated with water bodies (i.e., great blue heron (*Ardea herodias*)) were observed and accounted for 6.2% of all birds observed (http://netapp.audubon.org/CBCObservation/CurrentYear/ResultsByCount.aspx). These bird species are likely to have direct fecal inputs to waterbodies, including streams of the Cane Run watershed.

According to the Kentucky State Nature Preserve Commission (KSNPC), U.S. Fish and Wildlife Services (USFWS), and the KDFWR, several state and federally listed threatened, endangered, or special concern species have the potential to occur within the watershed or within Fayette and Scott Counties, **Table 4** (pages 15 and 16).

Habitat for some of these species is present within the watershed, so management activities that create or enhance habitat for these species (i.e., tree plantings, wetland creation) and improve water quality (both within the watershed and in the receiving streams) would have opportunity for additional funding. Habitat creation and/or enhancement would most likely be limited to the greenways and parks within the watershed, and in the rural portions of the watershed.

TABLE 4
THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

Common Name	Scientific Name	Agency*	US Status**	KY Status**
Amphibians				
Northern leopard frog	*Rana pipiens*	KSNPC, KDFWR	-	S
Mussels				
Clubshell	*Pleurobema clava*	USFWS	LE	E
Rayed bean	*Villosa fabalis*	KSNPC	LE	X
Birds				
American coot	*Fulica americana*	KSNPC, KDFWR	-	E
Bald eagle	*Haliaeetus leucocephalus*	KDFWR	-	T
Bank swallow	*Riparia*	KSNPC, KDFWR	-	S
Barn owl	*Tyto alba*	KSNPC, KDFWR	-	S
Bewick’s wren	*Thryomanes bewickii*	KSNPC	SOMC	S
Black-crowned Night-heron	*Nycticorax*	KSNPC, KDFWR	-	T
Blue-winged Teal	*Anas discors*	KSNPC, KDFWR	-	T
Bobolink	*Dolichonyx oryzivorus*	KSNPC, KDFWR	-	S
Brown Creeper	*Certhia americana*	KDFWR	-	E
Canada Warbler	*Cardellina canadensis*	KDFWR	-	S
Dark-eyed Junco	*Junco hyemalis*	KSNPC, KDFWR	-	S
Double-crested Cormorant	*Phalacrocorax auritus*	KSNPC, KDFWR	-	E
Henslow's sparrow	*Ammodramus henslowii*	KSNPC, KDFWR	-	S
Northern shoveler	*Anas clypeata*	KSNPC, KDFWR	-	E
Lark sparrow	*Chondestes grammacus*	KSNPC, KDFWR	-	T
Mississippi kite	*Ictinia mississippiensis*	KDFWR	-	S
Northern shoveler	*Anas clypeata*	KSNPC, KDFWR	-	E
Osprey	*Pandion haliaetus*	KDFWR	-	T
Peregrine falcon	*Falco peregrinus*	KSNPC, KDFWR	PS-LE	E
Red-breasted nuthatch	*Sitta Canadensis*	KDFWR	-	E
Savannah sparrow	*Passerculus sandwichensis*	KSNPC, KDFWR	-	S
Sharp-shinned hawk	*Accipiter striatus*	KDFWR	-	S
Sedge wren	*Cistothorus platensis*	KSNPC, KDFWR	-	S
Vesper sparrow	*Pooecetes gramineus*	KSNPC	-	E
Yellow-crowned Night-heron	*Nyctanassa violacea*	KSNPC, KDFWR	-	T

TABLE 4
THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

Common Name	Scientific Name	Agency*	US Status**	KY Status**
Insects				
Garman's cave beetle	*Pseudanophthalmus horni*	KSNPC, KDFWR	-	S
Northern hairstreak	*Satyrium favonius ontario*	KSNPC, KDFWR	-	S
Sedge sprite	*Nehalennia irene*	KSNPC, KDFWR	-	E
American burying beetle	*Nicrophorus americanus*	KSNPC	LE-X	X
Mammals				
Gray myotis	*Myotis grisescens*	KSNPC, USFWS	LE	T
Northern long-eared bat	*Myotis septentrionalis*	KDFWR, USFWS	LT	E
Indiana bat	*Myotis sodalis*	KSNPC, USFWS, KDFWR	LE	E
Least weasel	*Mustela nivalis*	KSNPC, KDFWR	-	S
Plants				
Marsh marigold	*Caltha palustris*	KSNPC	-	X
Western waterweed	*Elodea nuttallii*	KSNPC	-	T
Svenson’s wildrye	*Elymus svensonii*	KSNPC	SOMC	T
White walnut	*Juglans cinerea*	KSNPC	SOMC	T
Grape honeysuckle	*Lonicera reticulate*	KSNPC	-	T
Hispid falsemallow	*Malvastrum hispidum*	KSNPC	-	T
Stemless evening primrose	*Oenothera triloba*	KSNPC	-	T
Hairy false gromwell	*Onosmodium hispidissimum*	KSNPC	-	E
Mock orange	*Philadelphus inodorus*	KSNPC	-	T
Globe bladderpod	*Physaria globosa*	KSNPC, USFWS	LE	E
Nodding rattlesnake-root	*Prenanthes crepidinea*	KSNPC	-	S
Water stitchwort	*Sagina fontinalis*	KSNPC	-	E
Purple oat	*Schizachne purpurascens*	KSNPC	-	T
Yellow nodding ladies-tresses	*Spiranthes ochroleuca*	KSNPC	-	T
Buffalo clover	*Trifolium reflexum*	KSNPC	-	E
Running buffalo clover	*Trifolium stoloniferum*	KSNPC, USFWS	LE	E
Softleaf arrowwood	*Viburnum molle*	KSNPC	-	S
Walter’s violet	*Viola walteri*	KSNPC	-	T

* USFWS records are from the Cane Run watershed; KDFWR records are from USGS Quadrangles Lexington East, Lexington West, Centerville, and Georgetown; KSNPC records are from Fayette and Scott Counties.

** Abbreviations are as follows: LE = Listed Endangered, PS = Partial Status (status only applies to a portion of the species range), SOMC=Species of Management Concern, E = Endangered, T = Threatened, S = Special Concern, X = Extirpated

Of the nine federally listed species, only four potentially have suitable habitat in the watershed. Globe bladderpod is a federal candidate species for listing that is found in dry to mesic limestone woods (Jones, 2005). This habitat type could occur in the rural portion of the watershed in northern Fayette County and Scott County, but is unlikely to occur in the urbanized areas. Running buffalo clover (*Trifolium stoloniferum*) is known to occur within Fayette County (Ashland – historic home of Henry Clay) and Scott County, and its habitat varies from stream banks and low moist forests to open woods and cemeteries (Slone and Wethington, 2001). It also requires filtered sunlight and moderate periodic disturbance such as grazing. Habitat with this type of disturbance could occur within the agricultural portions of the Cane Run watershed (i.e., Kentucky Horse Park). Projects to improve Cane Run water quality (i.e., stream restoration, riparian buffer creation/enhancement, wetland creation) could impact both plant species during construction activities. Surveys for these species should be conducted prior to any land disturbance.

Indiana bats (*Myotis sodalis*) and northern long-eared bats (*Myotis septentrionalis*) utilize floodplain, riparian, and upland forests for foraging and roosting habitat in the summer. This habitat does exist in the agricultural portions of the watershed. Riparian trees adjacent to Cane Run, wood lots, and fencerow trees in the agricultural portion of the watershed could provide potential summer roosting habitat for these bats. According to aerial mapping, this type of habitat, while present, is uncommon within the Cane Run watershed. Tree plantings along Cane Run could provide potential roosting habitat for both species, and improvements to water quality of Cane Run could improve forage for both bat species. Open pastures, and the riparian area of Cane Run, in the rural areas, could provide foraging, nesting, or other types of habitat to a few of the state-listed species (i.e., barn owl, least weasel).

Of the other federally listed species, habitat does not occur in the watershed, or the species is not federally listed in this region. American burying beetle (*Nicrophorus americanus*) and rayed bean (*Villosa fabalis*) are considered extirpated, and the peregrine falcon (*Falco peregrinus*) is not listed for this part of its range. Gray bats (*Myotis grisescens*) utilize hibernacula caves for year-round roosting. There are no known hibernacula caves within the Cane Run watershed. Additionally, gray bats forage over large bodies of water (i.e., rivers and lakes), which are not present within the watershed. Clubshell mussels (*Pleurobema clava*) are large river species (Slone and Wethington, 2001). There are no large rivers in the watershed.

While consideration of threatened and endangered species is important, consideration of exotic and invasive species in the watershed are also important. Exotic invasive species of plants can wreak havoc with ecological balance, creating trouble for rare and common species alike, and degrade waterways and interfere with water uses. Per Jim Lempke (personal communication, 2010), Curator of Native Plants and Natural Ecosystems for the Arboretum, the following exotic, invasive species have been found in the Arboretum Woods, which is located in central Lexington (in order from highest numbers to lowest): wintercreeper (*Euonymus fortunei*), bush honeysuckle (*Lonicera maackii*), Japanese honeysuckle (*Lonicera japonica*), burning bush (*Euonymus alata*), white mulberry (*Morus alba*), oriental bittersweet (*Celastris orbiculatus*), multiflora rose (*Rosa multiflora*), garlic mustard (*Alliaria petiolata*), privet (*Ligustrum vulgare*), English ivy (*Hedera helix*), Norway maple (*Acer platanoides*), rose of Sharon (*Hibiscus syriacus*), wayfaring tree (*Viburnum lantana*), Japanese knotweed (*Polygonium cuspidatum*), bird cherry (*Prunus avium*), and buckthorn (*Rhamnus davurica*).

Tree of heaven (*Ailanthus altissima*) is not currently in the Arboretum Woods but has been found not far from the woodland and has been removed in large numbers from the Arboretum. These exotic invasive species are also expected to be found elsewhere in Central Kentucky, including the Cane Run watershed, particularly along wooded riparian corridors.

K. Point Sources and Municipal Utilities

1. Drinking Water Service

Drinking water utilities provide water for indoor purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and outdoor purposes such as watering lawns and gardens. Raw water is withdrawn from surface or groundwater sources, treated for public consumption, and then distributed to area residents.

Two drinking water utilities service residents of the Cane Run watershed: Kentucky-American Water Company (KAWC) and Georgetown Municipal Water and Sewer Service (GMWSS). The service area for GMWSS, including most of the Scott County portion of the watershed, is shown on **Exhibit 8** (Appendix A). The KAWC services most of the remaining portion of the watershed.

The Federal Safe Drinking Water Act Amendments of 1996 require states to analyze existing and potential threats to each of its public drinking water systems. Source Water Protection Plans assess the quantity of water used in a public water system and to formulate protection plans for the source waters used by these systems.

Raw water for KAWC is obtained from three sources: Kentucky River, Jacobson Reservoir on East Hickman Creek, and Lake Ellerslie on West Hickman Creek. The Kentucky River is the predominant supply of raw water for the system, providing 80% of the service area's daily consumption. The Kentucky River is utilized at Pool 9 and at Pool 3.

Raw water for the GMWSS is obtained from the Royal Spring Aquifer. To fulfill the requirements of the Safe Drinking Water Act, a wellhead protection plan was developed to identify potential sources of pollution into the water supply (Royal Spring Water Supply Protection Committee, 2003). The supply protection area for Royal Spring Aquifer is shown in **Exhibit 8** (Appendix A). Per the plan, the primary pollution concerns in the Royal Spring recharge area include the potential for leaking storage tanks and spills that allow chemical contaminants or petroleum products to enter the groundwater. Additional concerns were agricultural chemicals and sediment from erosion or construction. The wellhead protection plan is included in Appendix B.

Groundwater Protection Plans (GPPs) are required for anyone engaged in activities that have the potential to pollute groundwater. These activities include anything that could leach into the ground, including septic systems and pesticide storage. Kentucky Administrative Regulation 401 KAR 5:037 does not require GPPs to be submitted to the Cabinet for review and approval unless called in by Department for Environmental Protection inspectors, the

Groundwater Section of the Watershed Management Branch, or Division of Enforcement. Therefore, it is unknown how many GPPs have been developed in the Cane Run watershed.

2. Permitted Dischargers

All dischargers to waters of Kentucky are required to obtain a Kentucky Pollutant Discharge Elimination System (KPDES) permit including concentrated animal feeding operations (CAFOs), combined sewer overflows (CSOs), individual residences, Kentucky Inter-Municipal Operating Permits (KIMOPs), mining, municipal, industrial, oil, and gas. KPDES facilities were researched for the Cane Run watershed utilizing a combination of data available from the KDOW and USEPA. In total, there are 19 facilities with KPDES permits within the Cane Run watershed. Six of these KPDES permits have expired since 2011 or later. The locations of the permit holders are shown in **Exhibit 9** (Appendix A). The facilities and their discharges are summarized in **Table 5** (pages 20 and 21).

Information maintained by the EPA Enforcement and Compliance History Online (ECHO) database was reviewed in May 2016 for permit violations and exceedances that occurred in the previous three years. Five facilities had significant violations from the specified period including: Penske Truck Leasing Company LP (KY0103691); Spindletop Mobile Home Park (MHP; KY0081213); Georgetown Estates (KY0081221); Maple Grove MHP (KY0083321); and H&R Oil Company Inc. (KY0100960).

Penske Truck Leasing Company, LP had significant violations associated with the discharge of chlorine and ammonia for three quarters and had two notices of violation (NOV) in the previous five years. The facility's permit was terminated in 2014, after which they were placed on a "No Discharge" Operating Permit. H&R Oil Company Inc, a petroleum bulk station, has had significant violations in nine quarters for total suspended solids, and continues to have compliance problems for suspended solids.

Three of the permitted dischargers (Spindletop MHP, Maple Grove MHP, and Georgetown Estates) with significant violations are associated with sewage treatment. The reoccurrence of significant violations from 2013 -2016 suggests that the underlying problem has not been addressed at these facilities. Each of these facilities has regularly had significant violations for biological oxygen demand (BOD) and ammonia, as well as elevated *E. coli*. Spindletop MHP has also had significant violations for high chlorine levels.

Spindletop MHP (KY0081213) is a permitted package sewage treatment facility located on Lisle Road near US 25 near Fayette / Scott County border. Per the 2007 KPDES permit application, the facility serviced 265 lots and was zoned for 150 more. The current permit expires in 2019. The design flow capacity of the facility is 0.092 million gallons per day (MGD; 0.14 cfs). According to discharge monitoring reports, flows regularly exceeded this capacity during wet weather, reaching as high as 0.47 MGD (0.72 cfs) in records reviewed since January 2014. Significant violations occur regularly each quarter, even after a state administrative order of consent fined the operators thirty thousand dollars ($30,000) in 2013 due to persistent violations.

TABLE 5
KPDES DISCHARGERS IN THE CANE RUN WATERSHED

Permit No.	Discharger Name	SIC Code / Type of Discharge	Notes*
KY0001317	Lexmark International Inc	3577 / Computer Peripheral Equipment, NEC	Noncompliance for temperature last 5 consecutive quarters.
KY0002739	GE KY Glass LLC	3229 / Pressed and Blown Glass and Glassware, NEC	Permit expired in 2011.
KY0081213	Spindletop MHP	6515 / Operators of Residential Mobile Home Sites	Significant violations in 11 of last 12 quarters for **BOD**, **chlorine**, and **ammonia**. Noncompliance for 1st quarter 2016.
KY0081221	Georgetown Estates MHP	6515 / Operators of Residential Mobile Home Sites	Significant violations in 5 quarters, including last 2 quarters of 2015 for **BOD** and **ammonia.**
KY0083321	Maple Grove MHP	6515 / Operators of Residential Mobile Home Sites	Significant violations for **BOD** and **ammonia** in 5 quarters (2014-2015).
KY0097624	Lexmark International Inc	3579 / Office Machines, NEC	Noncompliance for temperature last 5 consecutive quarters.
KY0110817	Baker Iron & Metal Company Inc	5093 / Scrap and Waste Materials	Noncompliance for **copper** last 9 consecutive quarters.
KY0100960	H&R Oil Company Inc	5171 / Petroleum Bulk Stations and Terminals	Significant violations in 9 of last 12 quarters for **total suspended solids**. Noncompliance 1'st quarter 2016.
KY0103691	Penske Truck Leasing Company LP	7513 / Truck Rental and Leasing, Without Drivers	Significant violations in 3 quarters of 2014 for **chlorine** and **ammonia.** Permit Terminated in 2014. Issued a “No Discharge” Operating Permit.
KYG840002	Vulcan Construction Materials LLC	1422 / Crushed and Broken Limestone	No violations reported within last 3 years.
KYG110028	ATS Construction Plant #16	2951 / Asphalt Paving Mixtures and Blocks	Noncompliance 2nd quarter 2015. Analysis not reported.
KYG110162	Ready Mix Concrete Inc	3273 / Ready-Mixed Concrete	No violations reported within last 3 years.
KYG910077	Speedway SuperAmerica #1102	5541 / Gasoline Service Stations	Permit expired in 2011.
KYR001230	Central Kentucky Processing	3398 / Metal Heat Treating	Permit expired in 2013.
KYR001527	U.S. Postal Service	4311 / United States Postal Service	Permit expired in 2013.

TABLE 5
KPDES DISCHARGERS IN THE CANE RUN WATERSHED

Permit No.	Discharger Name	SIC Code / Type of Discharge	Notes*
KYR003088	LFUCG - Transit Authority	4173 / Terminal and Service Facilities for Motor Vehicle Passenger Transportation	No violations reported within last 3 years.
KYR003586	Bluegrass Auto Parts	5015 / Motor Vehicle Parts, Used	No violations reported within last 3 years.
KYR003823	ATS Construction - Plant #12	2951 / Asphalt Paving Mixtures and Blocks	One quarter noncompliance (4th qtr 2013). Permit terminated in 2015.
KYR003934	R & L Carriers - Lex Service Center	4213 / Trucking, Except Local	No violations reported within last 3 years.
KYR004161	Lextran Headquarters Complex	4173 / Terminal and Service Facilities for Motor Vehicle Passenger Transportation	No violations reported within last 3 years.

* Data was analyzed for 2013 - 2015 with limited data available for 1st quarter 2016.

Georgetown Estates Mobile Home Park (KY0081221) is a permitted package sewage treatment facility located on Lisle Road near US 25 near Fayette / Scott County border, adjacent to the Spindletop Mobile Home Park. Per the 2007 KPDES permit application, the facility services 260 lots and is zoned for 250 more. The current permit expires in 2019. The design flow capacity of the facility is 0.04 MGD (0.06 cfs). Discharge monitoring reports indicate that flows regularly exceeded this capacity during wet weather, reaching as high as 0.25 MGD (0.38 cfs) in records reviewed since January 2014. Significant violations occur regularly each quarter. Per a January 19, 2017 article in the News Graphic (Adkins, 2017), problems with collapsing sanitary sewer infrastructure inside the park led a prospective buyer to withdrawal its bid to buy the park. Georgetown Mayor Prather and former Scott County Judge-Executive George Lusby "have described the situation as Scott County's most critical environmental crisis."

Maple Grove Mobile Home Park (KY0083321) is a permitted package sewage treatment facility located on US 25 in Fayette County. Approximately 100 units are located in the park based on sales advertisements. The current permit expires in 2019. The design flow capacity of the facility is 0.03 MGD (0.05 cfs). Discharge monitoring reports indicate that the flow at this facility is maintained at the capacity flow. Significant violations occur regularly each quarter, including *E. coli* concentrations routinely at 60,000 colonies per100mL (more than 250 times the limit).

3. Stormwater Utilities

Stormwater discharges from municipal sources are permitted under the Clean Water Act. Stormwater runoff is commonly transported through municipal separate storm sewer systems (MS4s), which are defined as:

> *"A conveyance, or series of conveyances, that include roadways with drainage systems, streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains that are owned and/or operated by the government, state, city, town, county, district or other association or public body or utility having jurisdiction over disposal of stormwater that discharges into the waterways of the Commonwealth of Kentucky; is designed or utilized for collecting or conveying stormwater; or is not a combined sewer and is not part of a publicly owned treatment facility."*

MS4 permits (administered by KDOW) are required to discharge stormwater to Kentucky's creeks, streams, and other waterways. MS4s are categorized into Phase I MS4s, which includes medium and large cities or counties with populations over 100,000, and Phase II MS4s, which includes small urbanized areas and some counties. All Phase I MS4s and some Phase II MS4s have individual permits in Kentucky, but most Phase II MS4s are covered under a general permit.

Three MS4 permittees are located within the Cane Run watershed: LFUCG is a Phase I MS4, City of Georgetown (along with Georgetown College and Scott County) is a Phase II community with a general permit, and Kentucky Transportation Cabinet (KYTC) has an individual stormwater MS4 permit. The infrastructure associated with these permits, including pipes, basins / ponds, and other best management practices are shown in **Exhibit 10** (Appendix A).

a. LFUCG Consent Decree

The March 14, 2008 Consent Decree (United States, 2008) was filed by LFUCG to resolve the lawsuit led by the EPA and Commonwealth of Kentucky against violations of the Clean Water Act by LFUCG. The stated objective of the Consent Decree is:

> *"It is the express purpose of the Parties in entering this Consent Decree to further the objectives of the CWA [Clean Water Act]…and to eliminate SSOs, Unpermitted Discharges, Unpermitted Bypasses and Exceedances, to eliminate and prevent CWA permit violations, and, specifically with respect to LFUCG's Stormwater Quality Management Program ("SWQMP"), ensure implementation of a SWQMP that reduces the discharge of pollutants to the maximum extent practicable, and require implementation of measures to ensure compliance with LFUCG's MS4 Permit."*

The Consent Decree contains compliance measures that relate to the storm sewer system as well as the sanitary sewer system and additional environmental projects. For the Storm Sewer System, the Consent Decree implements the following compliance measures:

- SWQMP (Section 11) - Implementation of the SWQMP (LFUCG, 2008a) and enforcement of the "Performance Standards" stated therein.
- Legal Authority (Section 12) - Numerous measures that confer legal authority to LFUCG to adopt and/or maintain ordinances that enforce the stormwater program
- Funding (Section 13) - Establishment of a stormwater management fee to fund stormwater management services
- Personnel, Training, and Equipment (Section 14) - Provide annual education on and obtain equipment necessary for Consent Decree compliance.
- Two Separate Environmental Projects (SEP) requiring 1) a minimum of one million dollars be spent to provide stream bank stabilization, habitat restoration and greenway creation to Cane Run at Coldstream Park, and 2) a minimum of $230,000 be spent on one or more green infrastructure projects for the management of wet weather flows.

All Consent Decree related materials may be accessed on http://www.lexingtonky.gov/.

b. MS4 Permit

The Phase I MS4 Permit for LFUCG (KPDES No. KYS00002 AI No. 74551) went into effect on June 1, 2015 with a five-year duration period. The permit requires a comprehensive wet weather plan and implementation of a program that addresses eight program elements:

- Public Education and Outreach
- Public Participation and Involvement

- Illicit Discharge Detection and Elimination
- Construction Site Stormwater Runoff Control
- Post-Construction Stormwater Management in New Development and Redevelopment
- Pollution Prevention/Good Housekeeping for Municipal Operations
- Industrial Facility Stormwater Pollution Prevention
- Water Quality Monitoring

The permit applies to the entire urban-county government area, but the Illicit Discharge Detection and Elimination (IDDE) Program (except for the Industrial Facilities Program), Pollution Prevention in Residential and Commercial Areas, and Pollution Prevention for Municipal Operations only applies inside the Urban Service Boundary. The Storm Water Quality Management Program (SWQMP) developed by LFUCG must meet the minimum requirements specified in the permit for each of these programs. The content and provisions of the SWQMP are not considered permit conditions but a tool to ensure permit compliance.

LFUCG's MS4 permit may be viewed on-line at the Stormwater Web Page (http://www.lexingtonky.gov/).

The City of Georgetown has been an MS4 permittee since 2005, covered under the general Phase II MS4 permit. Georgetown College became a permittee in 2010, achieving program compliance by co-permitting with Georgetown. Scott County was permitted under the general stormwater permit effective May 1, 2018, when a new five-year MS4 general permit was issued by KDOW. Georgetown, Georgetown College, and Scott County achieve program compliance as co-permitees. The general Phase II MS4 permit contains the six minimum control elements, including same program elements as the LFUCG Phase I permit, except for the industrial facility and water quality monitoring elements. The requirements under these elements differ between the Phase I and Phase II permits. The permit also requires the development of a SWQMP.

KYTC was regulated under the general stormwater permit as a co-permitee with other MS4s starting in 2003. KYTC's individual stormwater permit (KYS000003) became effective October 1, 2012. KYTC is regulated as a Phase II entity; the permit applies to MS4 conveyances and outfalls for KYTC facilities and right-of-ways located within the urbanized boundaries of the MS4s across Kentucky. Thus, they partner with over 40 MS4 communities in Kentucky to implement practices to protect waterways from stormwater pollution. The general Phase II MS4 permit contains the six minimum control elements, including same program elements as the LFUCG Phase I permit, except for the industrial facility and water quality monitoring elements. The permit also requires the development of a SWQMP.

c. Stormwater Quality Management Plan

The SWQMP is a comprehensive, detailed set of procedures and protocols for implementing the stormwater best management programs to manage the quality of stormwater discharged from the storm sewer system. The content of the SWQMP is based on the terms and conditions of the MS4 permit.

The method used to evaluate the program elements of the SWQMP consists of assessing whether the "measurable goals" within each program element have been met. The "measurable goals" consist of clearly defined tasks and schedules.

The LFUCG SWQMP (2016) includes a total of 186 measurable goals among 10 program elements. In addition to the 8 program elements in the MS4 permit, there are also program elements addressing reporting and recordkeeping and total maximum daily loads and impaired waters.

d. Stormwater Pollution Prevention Plans (SWPPP)

Chapter 16, Article 10, Division 3 of the LFUCG Code of Ordinances (LFUCG, 2010) specifically allows LFUCG to regulate industrial and high-risk commercial facilities to develop and implement SWPPPs and monitoring plans. The purpose of this program is to reduce pollutant loadings and improve the quality of stormwater runoff discharged from these areas into the local waterways.

As shown on **Exhibit 9** (Appendix A), LFUCG identified 11 industrial / high-risk commercial facilities in need of a SWPPP within the Cane Run watershed. The pollutants of concern for these facilities are listed in **Table 6**, page 26. Of these 11 facilities, 8 have KDPES permits.

For the most part, these SWPPPs indicate that the largest potential stormwater contaminants from these sites are due to vehicle maintenance fluids (fuel, antifreeze, battery leakage, and oil), parking lot runoff, de-icing chemicals (salt), runoff from scrap metal piles (metals), and soil erosion. Chemical parameters that would reflect pollution from these sites in the watershed include oil and grease, chemical oxygen demand, total residual chlorine, and total suspended solids.

TABLE 6
POLLUTANTS OF CONCERN IN INDUSTRIAL AND HIGH-RISK COMMERCIAL FACILITIES IN THE CANE RUN WATERSHED

Facility	Pollutants of Concern
Baker Iron & Metal Company Inc	Fuels, oils, hydraulic fluids for equipment and operation of facility. Solids, dust, and particulates. Iron, zinc, aluminum, and other heavy metals from scrap metal.
Bluegrass Auto Parts	Fuel, oils, antifreeze, acid (from batteries), transmission fluid, brake fluid, asbestos from brake linings, and acid from batteries.
Central Kentucky Processing (CKP) Heat Treating	Oil, cleaner, trichloroethylene, hardening salt, and quench salt.
H&R Oil Company Inc	Fuel and oil. Parameters sampled for include total suspended solids, oil and grease, benzene, naphthalene, total residual chlorine, and xylene.
*Kentucky Horse Park	Vehicle fuel and oil, horse manure, sand and salt for road maintenance during icy conditions. Runoff from scrap metal.
*Kentucky Utilities	Pesticide, fertilizer, hazardous waste, maintenance chemicals, and fuel and oil.
*Lexel Imaging Systems	Parameters tested for chemical oxygen demand, oil and grease, pH, and total suspended solids.
Lexmark International, Inc.	Petroleum products (fuels, oils, etc.), demolition projects with sediment containment / controls, cooling tower chemicals
LexTran	Fuel, oil, antifreeze from vehicles, and acid from automotive batteries. Also cleaning solvents.
U.S. Postal Services	Fuel and oil from vehicles, and other pollutants associated with vehicle maintenance. Waste handling, and damaged mail.
Vulcan Construction Materials LLC Georgetown Quarry	Fuel, and erosion from mining activities.

*Indicates a facility without a KPDES Permit

e. Stormwater Controls

Stormwater controls describe a wide variety of Best Management Practices (BMPs) used to treat, store, or otherwise manage the quality or quantity of stormwater. Four general types of stormwater controls have been identified within the Cane Run watershed: detention basins, retention basins, underground basins, and other water quality BMPs. The locations of these structures are shown in **Exhibit 10** (Appendix A).

A detention basin is a stormwater control basin designed to hold water when it rains and completely drain afterward. During a rainstorm, a detention basin can store a large quantity of water that will be allowed to discharge slowly. There are 133 detention basins in the Cane Run watershed in Fayette County and 7 in Scott County. The average basin in Fayette County is 0.29 acre in size, with the majority located on commercial lands, as shown in **Table 7**. Sizes of the Scott County basins were not available.

TABLE 7
SUMMARY OF LFUCG STORMWATER CONTROLS
IN THE CANE RUN WATERSHED

Stormwater Control Type	Number of Controls	Total Area (ac)	Average Area (ac)
Detention Basin			
Commercial	110	24.9	0.22
Residential	23	13.9	0.6
Totals	**133**	**38.8**	**0.29**
Retention Pond			
Commercial	6	13.9	2.32
Residential	1	2.3	2.3
Total	**7**	**16.2**	**2.32**
Other Controls			
Underground Basins	5	N/A	N/A
Other BMPs	**24**	**N/A**	**N/A**

A retention pond maintains a permanent pool of water and can provide greater improvements in water quality when used to capture and treat stormwater runoff. These structures also slow incoming runoff and facilitate greater settling of sediment and can filter pollution from runoff through natural bio-chemical activity in the pond. Retention ponds also permanently hold water instead of draining within a few days of a precipitation event. As shown in **Table 7**, there are seven retention ponds in the Cane Run watershed in Fayette County. The average pond is 2.32 acres in size with the ponds on commercial lands averaging slightly larger in size than those on residential lands. One retention pond is in Scott County.

Retention ponds can be retrofitted to add enhanced removal capacities for suspended solids, nutrients, metals, and fecal coliforms. Typically, the retrofit involves the enhancement of the littoral shelf, or area in which wetland vegetation can grow. LFUCG surveyed each retention pond and detention basin larger than 0.4 acres in the Cane Run watershed for its retrofit potential to improve water quality. Thirty-seven (37) ponds and basins were identified for retrofit potential. The opportunities included extending detention to increase settling of pollutants, improving the channel condition to lengthen the travel time through the basin, promoting infiltration through various practices, and other opportunities such as education of residents and businesses near the basin, litter control, and stabilization of eroded areas. A Basin Retrofit Data Sheet for each evaluated basin is included (Appendix C).

Underground basins include underground pipe systems and vaults used to store stormwater. Five underground basins are in the Cane Run watershed, all in Fayette County, with locations at Arlington Elementary, Rite Aid, The Hope Center, Faith Community Housing, and Russell Cave Hope VI Development.

Numerous other stormwater water quality BMPs are located within the Cane Run watershed, including 20 in Fayette County and 47 in Scott County. These BMPs include water quality units, oil-water-debris separators, basin filters, inlet inserts, rain gardens, baffle boxes, permeable pavement, and other BMPs.

f. Applicable Laws and Ordinances

While numerous ordinances apply to watershed management and affect water quality in various manners, some ordinances are particularly applicable to watershed management. The LFUCG Code of Ordinances (LFUCG, 2010) and City of Georgetown Code of Ordinances (2015) were reviewed and briefly summarized. While some areas are addressed with specific ordinances, sinkholes, karst areas, and other special environmental areas are addressed through BMPs and site plans associated with other ordinances. Neighborhood specific ordinances, deed restrictions, and design standards not addressed herein may have applicability to watershed management in specific areas. The following sections of the local code of ordinances are applicable to watershed management with summaries of these ordinances included (Appendix D).

<u>LFUCG Code of Ordinances</u>

Chapter 12: Housing
  Article III: Riparian Areas

Chapter 16: Sewage, Garbage, Refuse and Weeds
  Article IX: Infrastructure and Environmental Hearing Board
  Article X: Stormwater Discharges
  Article XI: Sanitary Sewers Private Infiltration and Inflow
  Article XIII: Sanitary Sewer Capacity Assurance Program (CAP)
  Article XIV: Water Quality Management Fee

Chapter 20: Zoning
  Article XIX: Floodplain Conservation and Protection
  Article XXVI: Tree Protection Standards

<u>City of Georgetown Code of Ordinances</u>

Chapter 8: Flood Prevention
Chapter 18.1 Trees and Shrubbery
Chapter 19 Utilities
  Article V Illicit Connections
Chapter 20 Zoning and Land Use

4. Sanitary Sewer System and Waste Management

In Fayette County, the Cane Run watershed contains over 15 miles of trunk sewer, 110 miles of collection sewer, 10 miles of force main, 3,400 manholes, and 15 pump stations (LFUCG 2008b). In Scott County, there are over 44 miles of sanitary pipe, 1,100 manholes, and 13 pump stations.

A total of 19 sanitary sewer overflow (SSO) locations were identified in this watershed, of which 10 are manhole SSOs, 5 are pump station SSOs, and 4 are basement SSOs. No known SSOs have occurred from the Georgetown sanitary system. The Lexington sanitary sewer lines in the Cane Run watershed flow to the Town Branch Wastewater Treatment Plant (WWTP), which discharges into the Town Branch Watershed. **Exhibit 11** (Appendix A), shows the locations of the sanitary sewer pipes, pump station, and the locations of the SSOs documented in the Lexington Consent Decree. Most of these SSOs are in the headwaters of Cane Run and tributaries and occur during sustained rain events.

The LFUCG Consent Decree (United States, 2006) contains compliance measures that relate to the storm sewer system, sanitary sewer system, and additional environmental projects. Regarding the sanitary sewer system, the Consent Decree is divided into two sections (15 and 16). Section 15 requires capital improvement projects and short-term measures, sewer system assessment (SSA), pumping station evaluation, capacity assessment, a hydraulic model, and a Remedial Measures Plan (RMP). Section 16, Capacity, Management, Operation, and Maintenance (CMOM) Program requires the development of a CMOM self-assessment including an overflow response plan, capacity assurance plan (CAP), fats, oils, and grease (FOG) program, preventative maintenance program, and power outage and backup plans. These various programs and documents have been developed and are available at LFUCG's Consent Decree Web Site (<u>http://www.lexingtonky.gov/epa-consent-degree</u>).

Sanitary sewer assessments (LFUCG, 2011) found 4,970 manhole defects, 1,779 smoke testing defects (1 for every 321 feet inspected; 148 of which were major), 2 stormwater cross-connections, and 10,884 defects of sewer pipes identified by closed-circuit television inspections (1 for every 10.6 feet inspected). The remedial measures plan (LFUCG, 2012) discusses how these problems are to be addressed. The proposed remedial measures for the Cane Run watershed include installing new trunk lines, upsizing existing trunk lines, installing new force main, putting in two wet weather storage tanks, and new pump stations at Expansion Area 3 and Sharon Village. These improvements are scheduled to be completed as summarized in **Table 8**, below. The wet weather storage tank located in Coldstream Research (lower Cane Run) park near I-75 was constructed in 2018 is and operational. This tank collects and stores water from the sanitary sewer system when there are spikes in volume caused by wet weather events (due to inflow and infiltration) until it can be treated by the wastewater treatment plant (WWTP).

Numerous improvements and sewer rehabilitation projects have occurred within the watershed on problems identified through the assessment. These improvements included numerous sump pump redirections, downspout redirections, cleanout installations, manhole replacements or improvements, pipe lining or replacement, and other projects. A notable improvement includes an upgrade to the Griffin Gate pump station from 150 gallons per minute (GPM) to 188 GPM. Locations of improvements and repairs as of 2016 are shown in **Exhibit 11** (Appendix A).

As part of the Consent Decree, LFUCG is obligated to implement a Capacity Assurance Program (CAP) for the sanitary sewer system. This program, established in 2013, only allows for new tap-ons if adequate capacity can be certified for the collection, transmission, and wastewater treatment systems. An alternative to this certification would be the use of a “banked credit system”. Flow removed from qualified activities may be used to offset flow from new connections at an exchange ratio from the Consent Decree. Qualified activities include inflow/infiltration removal, off-line storage, and capacity enhancement projects. Real-time information concerning the available capacity, projects to increase capacity, and new tap-ons in each sewershed bank can be found at http://ctims.lexingtonky.gov/.

TABLE 8
LFUCG CANE RUN REMEDIAL MEASURES PLAN SCHEDULE

RMP Project Name	Construction Year
Lower Cane Run Wet Weather Storage Tank	2018
Expansion Area 3 Pump Station	2018
Expansion Area 3 Force Main	2018
Expansion Area 3 Trunk	2018
Shandon Park Trunk	2018
Winburn Trunk	2018
Thoroughbred Acres Trunk	2018
Sharon Village Pump Statjion and Force Main	2020
Lower Griffin Gate Trunk	2018
Upper Cane Run Wet Weather Storage Tank	2021
Cane Run Trunk	2019
LexMark Trunk A	2020
LexMark Trunk B	2020
New Circle Trunk A	2021
New Circle Trunk B	2022
Griffin Gate Rehabilitation	2020

While LFUCG has a robust program to address SSOs from the public system, private sanitary sewer lateral lines can also be a source of bacteria pollution into the streams. Neighborhoods constructed in the 1970s and prior often have private lateral lines made of Orangeburg or clay pipe. Orangeburg pipe is bituminous fiber paper made from layers of wood pulp and pitch pressed together, and it degrades over time. Clay pipe can separate at the seams and break causing exfiltration into the groundwater or the karst system. Several neighborhoods within the Cane Run watershed were constructed prior to the 1970s, and many houses still have Orangeburg or clay lateral lines. LFUCG has a project underway to identify and rep/ace/repair failing laterals in the Highlands neighborhood, within the headwaters of the Cane Run watershed.

As discussed in "Permitted Dischargers" section, three failing package sewage treatment plants are in the Cane Run watershed servicing mobile home parks. Two of these facilities, Spindletop MHP and Georgetown Estates MHP are in Scott County, while Maple Grove MHP is in Fayette County.

The City of Georgetown has plans to extend sanitary sewers to the southern portion of Scott County from south Georgetown to the Scott County/Fayette County line along the US-25 corridor. The completion of this project would allow the opportunity to eliminate the two package treatment plants located at Georgetown Estates and Spindletop Mobile Home Park. It would also eliminate several older and failing septic systems along the corridor.
A December 2018 article in the News Graphic (Scogin, 2018) announced that Georgetown contracted with an engineering firm to design additional sanitary sewer lines. It is anticipated that project construction will begin in the fall of 2019 and continue through 2021. As proposed, the sanitary sewer expansion project will add to the sanitary sewer collection system from the existing service area near the intersection of US 25 and Bypass US 62 to the intersection of US 25 and KY 1963, including sewer line that could provide service to Georgetown Estates and Spindletop Mobile Home Parks. An agreement still needs to be reached between GMWSS and the mobile home park owners associated with tie-in fees and the collection of sewage bills to help finance the project. Georgetown has applied for section 319(h) grant funding to repair/replace the laterals lines and perform work necessary to connect 500 mobile home units to the new sewer infrastructure. The proposed sanitary sewer line expansion by GMWSS will have capacity to service the Maple Grove Mobile Home Park.

L. Non-Point Sources and Land Management

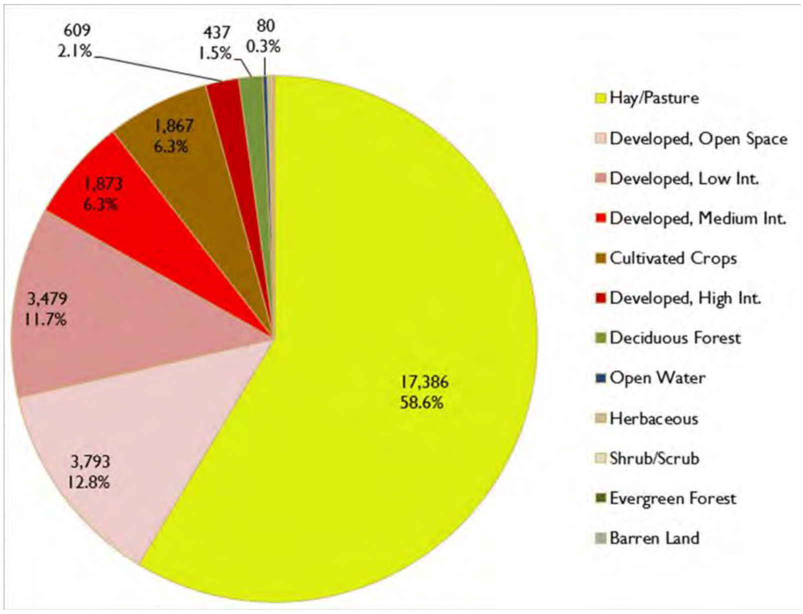
1. Land Use

Because different types of land use contribute different types of pollution and stresses to the creek, identifying these land uses within the Cane Run watershed is important for watershed planning. The landcover of the watershed, according to the USGS 2011 National Landcover Database (NLCD), is shown in **Exhibit 12** (Appendix A) and summarized **Figure 4**, page 32.

Land use is dominated by hay/pasture, which accounts for approximately 59% of the watershed area. Open Space is the most common type of developed space in the watershed accounting for nearly 13% of the land use in the watershed, followed by low intensity developed (nearly 12%), medium intensity developed (6.3%), and cultivated crops (6.3%).

FIGURE 4 – LAND COVER STATISTICS

Note: Top label indicates acres per land use, bottom is the percentage within Cane Run Watershed.



Source: USGS 2011 National Landcover Database (NLCD).

As hay/pasture land accounts for such a large proportion of land use in the watershed, nonpoint sources of pollution commonly associated with such land use may play a large role in the health of Cane Run and its tributaries. Horses, cattle, and other livestock may contribute direct inputs of fecal material or via runoff to Cane Run and its tributaries. This input of fecal material can raise the pathogen and nutrient levels of the streams. Row crops can also contribute nonpoint source pollution due to the addition of fertilizers and pesticides, which may be carried via runoff into the streams. Sediment inputs from both livestock and row crops activities may also occur due to runoff from these land uses. Failing onsite sewage treatment (septic systems) may also be a source of nonpoint source pollution in the rural land use areas since they are located outside of the sanitary sewer coverage. The Scott County Health Department has identified several failing septic systems along the US 25 corridor south of Georgetown's urban boundary.

After hay/pasture, the most abundant land uses include developed spaces of open to medium intensity. The most common feature on this type of land use is single-family housing units. Lawn fertilizers (typically high in nitrogen and phosphorus), herbicides and pesticides are commonly applied in these zones to keep grass green. However, fertilizer may be carried into streams in runoff resulting in nutrient pollution problems and algal blooms in Cane Run and its tributaries. Often, household pets are associated with low-density residential areas and can contribute to fecal and nutrient pollution. Other threats to stream health and water quality exist, including roadway crossings, streamside businesses, sanitary sewer overflows, exfiltration from private sanitary lateral lines, and polluted runoff from impervious surfaces.

2. Zoning

Zoning is addressed in Chapter 20 of the Code of Ordinances for both the LFUCG and City of Georgetown. Zoning districts vary between Scott and Fayette County, so general groups were utilized for the purposes of this plan. The zoning districts for the watershed are shown in **Exhibit 13** (Appendix A) and a summary of the acreage and percentage in each district type are found in **Table 9**.

TABLE 9
GENERAL ZONING DISTRICTS

Zoning District	Acres	Percentage
A - Agricultural	20,148	67.9%
B - Business	1,218	4.1%
C - Conservation	48	0.2%
CC - Community Center	7	0.02%
ED - Economic Development	360	1.2%
I - Industrial	1,188	4.0%
M - Mobile Home	77	0.3%
MU - Mixed Use	0	0.0%
P - Professional	1,431	4.8%
R - Residential	5,192	17.5%
Totals	**29,669***	**100%**

*Total acreage for zoning differs slightly from watershed area due to unknown overlap.

Agricultural zoning is the most prominent zoning area, comprising nearly 68% of the watershed. The agricultural greenbelt between Lexington and Georgetown is actively preserved by both communities to preserve the rural character of the area by promoting agricultural activities, and to discourage all forms of urban development, except for a limited amount of conditional uses such as horse sales establishments, commercial greenhouses, plant nurseries, and sales of agricultural products.

Residential zoned areas are the next most abundant zoned type with nearly 18% of the watershed, mostly in single-family residences. Professional zoning, consisting mostly of research parks, comprises nearly 5% of the watershed area while business (4.1%) and industrial (4%) also have some sizeable areas.

3. Impervious Surface

Impervious surfaces, such as roadways and rooftops, are surfaces which water cannot penetrate. Because these surfaces are unable to infiltrate water, precipitation runs off, subjecting subject streams to high flows during storm events and leading to erosion and further pollution. Impervious surfaces have been found to multiply in-stream discharge rates by two to five times for a given rain event.

In Fayette County, all impervious surfaces have been mapped, while in Scott County only building footprints and parking lots have been mapped. Based on these datasets, impervious surfaces account for 11% of the watershed area, as summarized in **Table 10**, below, and illustrated in **Exhibit 14** (Appendix A). Developed areas account for 87% of the imperviousness in the watershed. BMPs for improving infiltration should be targeted for the developed lands contributing the most to impervious surfaces in the watershed.

On impervious roadways, vehicles introduce numerous pollutants including oils, grease, rubber, and heavy metals (lead, zinc, copper). Some of these pollutants also accumulate when the vehicles are idle on parking lots, driveways, and other parking areas. Most heavy metals tend to accumulate and remain within vegetated ditches adjacent to the surface. Other roadway pollutants tend to be more mobile. Research indicates that the amount of pollutants in surface waters is proportional to the amount of average daily traffic. Also, in winter months, deicing salt transported through runoff can be a pollutant to surface waters. Roof runoff can also be high in certain metals and solids. In residential areas, lawn fertilization and pesticide applications, carried to streams through the storm sewer system, can also contribute to nonpoint source pollution. Additionally, runoff from impervious surfaces often has a higher temperature than receiving streams, which can negatively affect aquatic life.

TABLE 10
SURFACE PERMEABILITY BY LAND USE

Land Use Type	Impervious Acreage*	% Total Impervious in Watershed*	% Impervious by Land Use*
Developed, Low Intensity	1,096	33%	32%
Developed, Medium Intensity	910	28%	49%
Developed, High Intensity	481	15%	79%
Developed, Open Space	365	11%	10%
Hay/Pasture	319	9.7%	2%
Open Water	48	1.5%	60%
Cultivated Crops	37	1.1%	2%
Deciduous Forest	20	0.6%	5%
Barren Land	4	0.1%	26%
Evergreen Forest	2	0.1%	14%
Herbaceous	1	0.0%	1%
Unknown	1	0.0%	100%
Shrub/Scrub	0	0.0%	1%
Totals	**3,284**	**100%**	**11%**

* Impervious data for Scott County only accounts for building footprints and parking lots and is therefore underrepresented.

4. Agricultural Land Use

Agricultural land accounts for approximately 65% (hay/pasture and cultivated crops) of land use in the watershed (**Figure 4**, page 32). Most agricultural zoned areas are in the green belt between the Lexington and Georgetown urban areas. Some smaller sections of agriculture land are also scattered inside the urban areas. Within Lexington, most of the urban agricultural areas are golf courses (Griffin Gate), local parks (Douglass Park, Shadybrook Park), or large public-school grounds (Winburn Middle School). One exception is that portions of the University of Kentucky Agricultural Experiment Station are located inside the LFUCG Urban Service Area.

Numerous thoroughbred horse and cattle farms are in the Cane Run watershed. The Kentucky Horse Park (a world-renowned equine theme park), Fasig-Tipton livestock auction house, Rood and Riddle Equine Hospital, numerous racing and training centers, and numerous prominent horse farms are scattered throughout the area. The Bluegrass Stockyards are located at 4561 Ironworks Pike, near I-75 with several large cattle farms in the watershed. The University of Kentucky Coldstream Dairy Farm Complex, located east of US 25 just south of I-64/I-75, represents one of the few dairies located in Fayette County. Several large row crop production farms are also located in the watershed.

The type of agricultural activity on these lands will affect the type of pollution produced. To estimate the number of livestock in the rural portion of Cane Run watershed, countywide estimates of the number of livestock were obtained from the 2012 Census of Agriculture (USDA, 2012). According to the census, a total of 718 farms with 114,857 acres are found within Fayette County and 838 farms with 127,479 acres in Scott County. Horses, cattle, and sheep are the top livestock inventory items and forage is most abundant row crop, followed by corn and soybeans. These values were used to estimate the agriculture land use in the Cane Run watershed based on the acreage of farms and the quantity of livestock or acreage of crops. The results are shown in **Table 11**(page 36). If the agricultural land use in Fayette and Scott County are typical of Cane Run, then an estimated 1,360 horses/ponies, 3,680 cattle/calves, and 160 sheep/lambs are in the Cane Run watershed. Additionally, croplands are estimated to include 3,430 acres of forage, 640 acres of corn, 540 acres of soybeans, 210 acres of tobacco, 80 acres of wheat, and 20 acres of vegetables.

TABLE 11
AGRICULTURAL STATISTICS ON FAYETTE AND SCOTT COUNTY FARMS, 2012

Livestock or Crop	Fayette County Quantity	Scott County Quantity	Fayette County Estimated Amount / Ag. Acre	Scott County Estimated Amount / Ag. Acre	Cane Run Watershed Estimated Quantity
Number of Farms	718	838			123
Average Size of Farm (acres)	160	152			156
Land in Farms (acres)	114,857	127,479			19,253
Horses and Ponies	11,105	4,501	0.097	0.035	1,360
Cattle and Calves	15,469	33,972	0.135	0.266	3,680
Hogs and Pigs	-	-	-	-	-
Sheep and Lambs	1,044	861	0.009	0.007	160
Forage (acres)	17,605	26,900	0.153	0.211	3,430
Corn (acres)	3,842	4,253	0.033	0.033	640
Soybeans (acres)	4,230	2,049	0.037	0.016	540
Tobacco (acres)	1,283	1,409	0.011	0.011	210
Wheat (acres)	347	790	0.003	0.006	80
Vegetables (acres)	127	157	0.001	0.001	20

5. Demographics and Community

A summary of the United States Census Bureau's 2010 Census statistics with 2014 estimates (U.S. Census Bureau, 2010) for the Fayette and Scott County census transects within the Cane Run watershed are shown in **Table 12** (page 37) to provide an overview of the area demographics. More specific statistics for individual tracts are shown in **Exhibit 15** (Appendix A).

Data was obtained from the American Fact Finder on May 12, 2015 for the 2014 American Community Survey 5-Year Estimates (U.S. Census Bureau, 2014). The population density in Cane Run watershed is higher than all of Scott County, but much lower than for all of Fayette County. Cane Run watershed residents tend to have lower income levels, are more frequently in poverty, and have lesser education levels than either Fayette or Scott County overall. Almost 50% of the population in Cane Run watershed have a high school education or less. Housing in the watershed tends to be older than in the counties. Approximately 40.2% of the housing units in the watershed are occupied by renters.

TABLE 12
CANE RUN CENSUS DATA SUMMARY

Census Statistic	Fayette County	Scott County	Cane Run Watershed
Population			
Total Population	295,803	47,173	83,250
Population Density (people/sq. mi.)	1,036	165	230
Income			
Per Capita Income	$30,031	$28,232	$24,077
% Below Poverty	18.9%	11.0%	21.2%
Education (Adults 25 and older)			
% Education < 12th Grade	7.9%	9.0%	17.7%
% High School Diploma Only	17.1%	24.6%	29.8%
% College Degree or Above	41.2%	27.8%	22.7%
Age			
% Age < 18 Years	24.6%	29.1%	24.1%
Housing			
% Built Pre-1950	10.7%	11.2%	14.8%
% Housing Units Occupied by Renters	45.8%	29.3%	40.2%

Because many of the census tracts cross watershed boundaries and combine some distinct neighborhoods and communities, it is difficult to draw many localized conclusions about the demographics of the Cane Run watershed. Within the Cane Run watershed population densities generally ranged from 24 to over 2,700 people per mi^2 (U.S. Census Bureau, 2014). Per capita income ranges from approximately $12,000 to almost $50,000 by census tract. However, because many owners of larger horse farms do not have their primary residence on the property, these numbers do not include this information. Within the urban headwater section of the Cane Run watershed the percent of the population below poverty level is as high as 47% for some tracts, while the vast majority of the watershed north of the LFUCG Urban Service Area has less than 25% of the population below the poverty limit. Poverty even drops as low as 4% for some tracts (U.S. Census Bureau, 2014). Rental properties are common in both the urban and rural sections of the watershed, with the percentage of residents living in rental properties as high as 67% in some areas (U.S. Census Bureau, 2014).

The Cane Run watershed is somewhat unique in that most of the land is divided between relatively few property owners. Properties larger than 75 acres are shown in **Exhibit 16** (Appendix A). The landowners with the largest acreages in the watershed in public ownership include the Kentucky Horse Park, University of Kentucky Farms and Coldstream Research Campus, and LFUCG greenways/Kearney Hill Golf Links. Numerous large horse farms and equine facilities also comprise much of the area including Cane Run Farm, Castleton Lyons, Cobra Farm, Dan Scott Farm, Don Alberto Farm, Dromoland Farm, Dunford, Dunroven Stud, Eaton Farms, Fasig-Tipton, Hurricane Hall Farms, Marlendale, McLean Holdings, McPeek Racing, Mereworth Properties, Milestone Farm, Old Friends Farm, Peninsula Farm, Shylah

Farm, Spy Coast Farm, Summer Wind Farm, and Walnut Hall. Large cropland farms include Barton Brothers Farms and Ironworks Farm. Numerous other large family farms are in the area. Other large property holdings include Anderson Ramsey LLC, Con Robinson Company, and Sikura Properties. Griffin Gate Marriott's hotel and golf course, LexMark's large urban campus, and Vulcan Materials quarry (Georgetown Road) are also large business properties in the area. With a small number of landowners, efforts to improve the water quality using best management practices can be more easily targeted to key stakeholders.

Outside of large property owners, there are numerous neighborhood associations representing the residents of the area. The locations of these Neighborhood Associations are depicted in **Exhibit 17** (Appendix A). In Fayette County, neighborhoods at least partially within the Cane Run watershed include Spindletop, Glens of Greensdale, Belmont Farms, Highlands, Coldstream Station, Oakwood, Georgetown, Griffin Gate, Winburn, Green Acres-Hollow Creek-Breckinridge, Joyland, Radcliffe-Marlsboro, Elkhorn Park, Old Paris Place, North Pointe Neighbors, Bryan Station, North Limestone, Meadow Park, Meadows-Loudon, Castlewood, Northside, M L King, William Wells Brown. In Scott County, neighborhoods at least partially within the Cane Run watershed include Amerson Farms, Harmony Ridge, Sutton Place, Cassidy Heights, Stonecrest, Southgate, Southpoint, Mount Vernon, McMeekin, Hambrick Place, Indian Acres, Lancaster Heights, Old Armstrong, White Oak Village, The Enclave, Paynes Landing, Canewood, Ward Hall, McClelland View, McClelland Springs, Copperfield, Paynes Crossing, Bradford Place, Parkside, Willowbrook, Lancelot, Clayton Acres, Dream Chase Estates, Etterwood, Kentuckiana Farms, and Crestwood Ironworks. The watershed is within Fayette County Public School Board Districts 1, 2, and 3 and Scott County Elementary School Districts for Garth, Southern, Western, and Lemons Mill.

3. Watershed Management Activities

a. Kentucky River Basin Management Plan

In 2002, the Kentucky Watershed Management Framework completed the "Kentucky River Basin Management Plan" (KWRRI, 2002). This plan included summaries of each of the 97 watersheds in the Kentucky River Basin. Cane Run was analyzed as part of the North Elkhorn Creek Watershed.

The summary indicates that the North Elkhorn Watershed was identified as one of seven watersheds targeted for stakeholder mobilization, in the second cycle, for protection and restoration in the Kentucky River Watershed. Pathogens, sedimentation, and nutrients were the greatest concerns for the watershed. The watershed had "high" rankings for both observed impacts and potential impacts according to the management plan.

b. Greenway Master Plan

Greenways are linear corridors that can provide critical linkage and protection of natural and cultural resources. Issues, such as flooding, transportation, water quality, habitat loss, historic preservation, economic stimulation, recreation and fitness can be addressed and resolved by a multi-objective greenway system. In 2001 as part of the comprehensive plan, LFUCG developed the Lexington-Fayette County Greenway Master Plan (LFUCG, 2001) to communicate the importance and need for greenways and recommends a countywide system of interconnected greenways. Greenways can include trails as well as conservation corridors.

Parks, greenways, and trails in the Cane Run watershed are shown in **Exhibit 18** (Appendix A). Parks in Fayette County include the Kentucky Horse Park, Kearney Hill Golf Links, Coldstream, Highlands, Oakwood, Douglass, Martin Luther King, Mary Todd, Marlboro, Green Acres, Elkhorn, Constitution, Brucetown, Dunbar, and Castlewood. The Legacy Trail is a prominent multi-use trail, which currently runs from Loudon Avenue in Lexington to the Kentucky Horse Park. Other proposed trails include the Cane Run Greenway Trail, the Constitution Greenway Trail, and the Citation Greenway Trail. While not part of the greenway plan, Marshall Park, Suffoletta Family Aquatic Center, and the Lisle Road Soccer Complex are parks located in Scott County.

The Cane Run Greenway Corridor extends along Cane Run and tributaries in the northern section of Fayette County. Within the corridor are the Kentucky Horse Park, Spindletop Research Park, Coldstream Park, and Coldstream Research Park. The Greenway Master Plan recommends the LFUCG focus on preserving the undeveloped floodplain between Newtown Pike and I-75 / I-64. The objectives of the conservation greenway include drinking water protection, water quality improvement, floodplain preservation, green space preservation, and wildlife habitat restoration.

LFUCG constructed a stream restoration project within Coldstream Park and adjacent to the Legacy Trail in 2019 to address many of these objectives. The project created a permanent greenway, reconstructed and stabilized eroded stream banks, installed native plant buffers, restored habitat, and constructed adjacent green infrastructure to treat stormwater runoff before it reaches the creek. The project will be monitored for five years, from 2019 through 2023, to evaluate project success.

c. BAE Cane Run Watershed Based Plan Implementation and Other Management Efforts

Stream restoration, stormwater improvements, conservation efforts, and water quality grants are ongoing in the Cane Run watershed. Numerous projects have been implemented as part of the BAE Cane Run Watershed Based Plan development, LFUCG stormwater program, LFUCG stormwater incentive grants, and other efforts of interested stakeholders. A list and description of known projects is included in Appendix E.

Implemented BMPs have been clustered on LexMark, University of Kentucky farms, and Kentucky Horse Park, but BMPs have been implemented in other areas as well. LexMark has conducted a wide range of practices including stream restoration, impervious surface removal, sanitary sewer repairs, and trash cleanups. The University of Kentucky's implementation efforts include expanding the riparian zones of most streams on their farm properties, horse and cattle exclusions, installation of hardened stream crossings, nutrient management plan development, streams restoration, and other efforts. The Kentucky

Horse Park has repaired sewers, expanded riparian buffers, installed porous asphalt, and constructed a bioretention area among other efforts. LFUCG has completed several stormwater projects, is conducting stream restoration on Cane Run at Coldstream Park, and has awarded numerous grants for green infrastructure in the watershed. Information on the implemented BMPs is primarily compiled from the previous Cane Run Watershed Based Plan (UK BAE, 2011) and records from the LFUCG Stormwater Incentive Grant program.

Other BMP programs (not location specific) ongoing in the Lexington area include LFUCG's Lily Program and the Bluegrass Rain Garden Alliance. Under its Lily Program, the LFUCG, on a supply-limited basis, provides a program that allows residents to save water, prevent stormwater runoff, and improve water quality by installing a Lily Raintainer (or rain barrel). The Bluegrass Rain Garden Alliance is an initiative towards building a better Bluegrass by supporting the construction of rain gardens.

M. Status of Waterways

Kentucky assigns designated uses to each of its waterways, such as primary and secondary contact recreation, aquatic habitat, and drinking water. For each use, certain chemical or descriptive ("narrative") criteria apply to determine if the waters meet their designated uses. The criteria are used to determine whether a stream is listed as "impaired" (KDOW, 2015) and what action needs to be taken to restore water quality. This may include the development of a WBP or a TMDL with load allocations. **Exhibit 19** (Appendix A) shows the regulatory status of waterways in the Cane Run watershed.

1. Designated Uses

The designated uses of Cane Run and its tributaries within Fayette County include warm water aquatic habitat (WAH), primary contact recreation (PCR), and secondary contact recreation (SCR). The WAH criteria are in place to protect in-stream aquatic life. PCR criteria are in-place to protect people recreating in a way that likely will result in full body immersion in the water body, such as swimming. SCR designated use criteria are in place to protect those recreational activities that are likely to result in incidental contact with water, such as boating, fishing and wading.

In Scott County, Royal Spring, which has a karst drainage basin that extends to Fayette County, has been assessed for drinking water use. Fish consumption is not a designated use in Kentucky water quality standards, but the use is implied in 401 KAR 10:031 Section 2 and through human health criteria in Section 6. The fish consumption use is based on water body specific monitoring and comparing the fish tissue body burden results for specific pollutants (e.g., mercury, PCB, chlordane) in applicable water quality standards.

2. Designated Use Impairment Status

Section 305(b) of the Clean Water Act requires Kentucky and other states to assess and report water quality conditions to EPA every two years. Streams are assessed to determine whether they support their designated uses. Based on assessment results, each stream receives one of three classifications to denote relative level of designated use support: fully supporting (good to excellent water quality); partially supporting (fair water quality, does not fully meet designated use); and non-supporting (poor water quality, does not meet designated use).

Kentucky assigns reporting categories to surface waters based on the results of assessments. Category 1 waters are fully supporting all designated uses. Category 2 waters are fully supporting assessed designated uses, but not all uses have been assessed (2), the water is proposed to EPA for delisting but not yet approved (2b), or the waterbody has an EPA approved or established TMDL for the following use(s) now attaining Full Support (2c). Category 3 waters have not yet been assessed. Category 4 waters have been found to be not supporting with an approved TMDL (4a), an approved alternative pollution control plan (4b), or the impairment is not attributable to a pollutant (4c). Category 4a waters are impaired but have an EPA approved TMDL. Categories 4b and 4c streams are impaired but do not have a TMDL developed at this time. Category 5 waters have been found to be not supporting and require a TMDL (5) or insufficient data is available to support a specific listing determination (5b). Although streams in categories 4, 4b, 4c, 5, or 5b are impaired due to either partially supporting or non-supporting their designated uses, only streams in category 5 or 5b are on the 303(d) list of impaired surface waters of Kentucky.

According to the 2014 305(b) and 303(d) lists (KDOW, 2015), Cane Run is impaired from river mile 0.0 to 3.0 in Scott County for WAH (non-support), PCR (non-support), SCR (partial support); impaired from mile 3.0 to 9.6 in Scott and Fayette Counties for WAH (non-support) and PCR (non-support); and impaired from mile 9.6 to 17.6 in Fayette County for WAH (non-support), PCR (non-support), and SCR (non-support).

From river mile 0.0 to 3.0, three pollutants are listed as impairing Cane Run: fecal coliform, nutrient/eutrophication biological indicators, and sedimentation/siltation. Suspected sources are listed as livestock, managed pasture grazing, package plant or other permitted small flow discharges, unspecified urban stormwater, and non-irrigated crop production. From river mile 3.0 to 9.6, three pollutants are listed as impairing Cane Run: fecal coliform, sedimentation/siltation, nutrient/eutrophication biological indicators, and specific conductance. Suspected sources are livestock, managed pasture grazing, package plant or other permitted small flow discharges, highways, roads, bridges, infrastructure, and landfills. From mile 9.6 to 17.4, three pollutants are listed as impairing Cane Run: fecal coliform, nutrient/eutrophication biological indicators, and organic enrichment (sewage) biological indicators. Suspected sources are livestock and unspecified urban stormwater.

Four unnamed tributaries, located at Cane Run river miles 6.13, 10.8, 12.9, and 15.7, have impairments. All are impaired for PCR (non-support), and the tributaries at 6.13, 10.8, and 12.9 are also impaired for WAH (non-support). The tributary at mile 6.13 in Scott County is impaired from mile 0.0 to 3.5. The tributaries at mile 10.8, 12.9, and 15.7 in Fayette County are impaired for 2.4 miles, 2.1 miles, and 0.9 miles respectively. Three pollutants were listed for these tributaries: fecal coliform, nitrogen, and phosphorus. Suspected sources are livestock, managed pasture grazing, non-irrigated crop production, unspecified urban stormwater, and package plant or other permitted small flow discharges.

Royal Spring in Scott County, which has groundwater basin within the Cane Run watershed area, is listed as impaired for WAH (nonsupport) due to nitrogen and phosphorus pollutants from 0.0 to 0.7 miles. Suspected sources of pollution include managed pasture grazing, non-irrigated crop production, and unspecified urban stormwater. Royal Spring also has a drinking water designated use, which it is fully supporting.

3. Total Maximum Daily Load

In a Total Maximum Daily Load (TMDL) report, you will find TMDL calculation(s) establishing the maximum allowable amount of a specific pollutant that an impaired waterbody can receive while still meeting water quality standards for each designated use. A TMDL calculation determines a pollutant reduction target and allocates load reductions necessary to the source(s) of the pollutant. Pollutant sources are characterized as either point sources that receive a wasteload allocation (WLA), or nonpoint sources that receive a load allocation (LA). While a TMDL is not a regulation, the development of a TMDL for every impaired water on that remains on 303(d) list is required under Section 303(d) of the CWA. Currently Cane Run has one approved TMDL for pathogens, approved by the US EPA on August 26, 2013.

a. Nutrients (Phosphorus)

Initial work on the nutrient TMDL for the Cane Run watershed began in May 2002 with additional sampling conducted by KDOW in 2006 and 2007 to support the effort. The proposed in-stream total phosphorus target for WAH was set by KDOW at 0.3 mg/L. However, almost half of the samples collected exceed this limit. A draft nutrient TMDL was submitted by KWRRI to KDOW in 2011 (Albritton *et al.*, 2011) using this proposed target. To meet the proposed TMDL, a load reduction ranging from 10% to 55% of the existing load is proposed.

Because KDOW has not yet approved the draft nutrient TMDL, this target concentration and reductions can be considered only as a non-regulatory reference point, which may be subject to future change.

b. Pathogens

A pathogen TMDL was developed for the Cane Run watershed based on data collected in 2002. The approved “Final Total Maximum Daily Load for Fecal Coliform 7 Stream Segments within the Cane Run watershed, Fayette, and Scott Counties, Kentucky” (Ormsbee et al., 2013), assigns loads to wasteload allocation (WLA; KPDES point sources, MS4 sources from developed lands, and a future growth allocation) and load allocation (LA; MS4 sources from non-developed lands and non-MS4 sources, including both developed and non-developed sources). A margin of safety was applied through the adoption of conservative modeling assumptions. The difference between the allowable load and the initial conditions is the reduction required. The calculated loads are summarized in **Table 13** (page 43).

The document proposes a 50% reduction in the existing Fecal Coliform wasteload in the upper catchments and a 70% reduction in the lower catchments to meet the TMDL.

TABLE 13
CANE RUN FECAL COLIFORM TMDL LOAD ALLOCATIONS

Sub-watershed	TMDL (CFU/day)	Sanitary Wastewater System-WLA (CFU/day)	MS4 Permittee	MS4-WLA (CFU/day)	Future Growth-WLA (CFU/day)	LA (CFU/day)
Cane Run 0.0 to 3.0	2.17E+12	0	Georgetown / KYTC	2.83E+08	4.35E+10	2.12E+12
Cane Run 3.0 to 9.6	4.91E+12	0	Lexington / Georgetown / KYTC	1.98E+09	1.48E+11	4.76E+12
UT to Cane Run at 6.13 RM 0.0 to 3.5	1.36E+12	5.68E+08	None	0.00E+00	4.08E+10	1.32E+12
Cane Run 9.6 to 17.4	2.23E+12	0	Lexington / KYTC	1.29E+10	1.11E+11	2.10E+12
UT to Cane Run at 10.8 RM 0.0 to 2.4	1.19E+12	0	Lexington / KYTC	6.43E+07	2.38E+10	1.17E+12
UT to Cane Run at 12.9 RM 0.0 to 2.1	4.79E+11	0	Lexington / KYTC	1.58E+09	2.40E+10	4.53E+11
UT to Cane Run at 15.7 RM 0.0 to 0.9	1.40E+11	0	Lexington / KYTC	7.01E+09	7.00E+09	1.26E+11

4. Other Analysis

A draft TMDL analysis report for nutrients in Cane Run was started in May 2002 with additional sampling conducted by KDOW in 2006 and 2007 to support the effort. The report proposed in-stream total phosphorus target for WAH at 0.3 mg/L. Almost half of the samples collected exceed this limit. To meet the proposed target, a load reduction ranging from 10% to 55% of the existing load is proposed, though it should be considered a non-regulatory objective.

N. Summary and Conclusions

The streams within the watershed area are impacted for recreation and WAH. The characterization of the watershed has revealed contributing factors to these impairments.

1. Recreation Impairment

Cane Run and its tributaries are impaired for recreational uses due to levels of fecal indicator bacteria, such as fecal coliform or *E. coli* exceeding regulatory limits. The characterization of the watershed indicates that the following factors may be contributing to this impairment:

a. Public Sanitary Sewer System Overflows and Exfiltration: According to the LFUCG Consent Decree, 19 reoccurring SSO locations are in this watershed. Sixteen remedial measure plans have been approved to prevent these SSOs and are scheduled to be completed between 2017 and 2022. Numerous defects in the LFUCG public system have been identified by assessments, many of which have already been repaired through ongoing efforts by LFUCG. However, exfiltration from the sanitary sewer system into the storm system and stream is a contributor to the recreational impairments to the streams.

b. Failing Sanitary Package Plants: Three sanitary package plants are permitted to discharge to the unnamed tributary of Cane Run at RM 6.13, and each plant is routinely out of compliance due to significant exceedances of the permit limits, including high *E. coli* concentrations in discharges. These violations have occurred over an extended period of time, indicating that significant changes to the systems are required to reduce these contributions to the recreational impairment.

c. Aged Private Sanitary Service Lateral Lines: Neighborhoods constructed in the 1970s and prior often have private lateral lines made of Orangeburg or clay pipe. Several neighborhoods within the Cane Run watershed have lateral lines constructed of such material. Neighborhood rehabilitation projects will be necessary to address exfiltration from these sources by repair or replacement of these lines.

d. Septic systems: Numerous septic systems are located throughout the watershed and some are poorly maintained or in need of repair. These septic systems may be nonpoint source contributors to the recreational impairment.

e. Livestock Manure: Horse and cattle operations are abundant in the watershed. Cattle access to streams, runoff from fecal deposits during grazing, and manure spreading can all be sources of fecal input to the streams. Likewise, runoff can be contaminated with horse fecal bacteria, especially in areas where horses and their waste/bedding is concentrated.

f. Pet Waste: Dog ownership is common throughout the watershed and national estimates indicate than many owners do not pick up dog waste. Runoff from neighborhoods with outdoor pets can be a source of fecal bacteria.

g. Waterfowl: Numerous retention ponds are in Cane Run, particularly in the LUFCG Urban Service Area. Many of these ponds have abundant populations of geese or ducks that, in some cases, are present year-round. Waterfowl fecal contributions can be sources of fecal bacteria in the watershed.

2. Warmwater Aquatic Habitat Impairment

Cane Run and its tributaries are impaired for WAH use. The characterization of the watershed indicates several contributors to the impairment of habitat for fishes, aquatic insects, and other aquatic organisms including the following:

a. Karst geology: Upstream of its crossing of I-75 in Scott County, Cane Run typically does not have flowing water during dry weather conditions, except in a few spring or tributary-fed reaches. Numerous sinks or karst windows transport the waters into the groundwater system and the Royal Springs Aquifer. The lack of water during dry weather conditions makes the stream uninhabitable for most aquatic life during much of the year.

b. Geomorphic stream conditions: Much of the degradation to the aquatic and riparian ecosystem of streams in this region are attributed to geomorphic processes of channel evolution (trying to regain a stable stream system in disturbed conditions), including increases in-stream sediment due to bank erosion, limited in-stream habitat due to exposure of bedrock in channels when streams downcut, and disconnection of streams from a floodplain. Stream restoration, including bank stabilization, reducing the impacts of stream downcutting (i.e., restore stream at higher elevation than it is now, which can restore groundwater), and creating in-stream and riparian habitat will be necessary to reverse this degradation

c. Lack of riparian zone: Only 7% of the streams in the Cane Run watershed have wide riparian zones providing water quality benefits. Most streams (61%) have a riparian zone of less than 10 feet on either side of the stream. Riparian zones are notably narrow in agricultural areas. Education of property owners and planting projects will be necessary to help restore these habitat features.

d. Impervious surfaces: Impervious surfaces, which account for 11% of the Cane Run watershed area, can cause streams to have abnormally high flows during storm events, leading to erosion and sedimentation, and impacts to aquatic organisms. A general rule of thumb is that streams become impaired where impervious surfaces covers over 10% of the watershed area. In the headwaters of the Cane Run watershed, where impervious surfaces comprise a larger percentage of the drainage area, impacts are expected to be more pronounced. Best management practices to promote infiltration of stormwater should be used to mitigate larger percentages of impervious surfaces.

e. Nutrient Pollution Sources: All the contributors to impaired recreational use (namely human/animal waste) are also contributors to nutrients, particularly ammonia-nitrogen. Bank erosion can also contribute phosphorus (and nitrogen, to a lesser degree) to streams. Fertilizer, applied to residential yards as well as agricultural areas, is a source of nutrients to streams. Nutrient pollution sources should be evaluated based on the results of the monitoring studies.

3. People

At least two vastly different communities are located in the Cane Run watershed. Large property owners, typically of horse or cattle farms, own the majority of the watershed area and comprise a distinct community. Numerous small residential neighborhoods comprise another large community of citizens with different management needs and issues. Outreach will need to be tailored to these differing audiences during planning and implementation.

III. MONITORING

A. Evaluation Criteria and Benchmarks

To evaluate the nature and extent of impairments in the Cane Run watershed, habitat, biology, and water quality results were compared to applicable criteria and benchmarks. These criteria and benchmarks also allow for comparisons between previous studies and monitoring performed for this WBP. For water quality, both regulatory benchmarks and non-regulatory (scientific) reference levels are used for data evaluation as detailed in sections below.

1. Habitat and Biological Criteria

To analyze habitat, macroinvertebrate, and fish data, the criteria utilized by KDOW to evaluate impairment was utilized. This includes the Rapid Bioassessment Protocol (RBP) for habitat, the Macroinvertebrate Bioassessment Index (MBI) score, and the Kentucky Index of Biotic Integrity (KIBI) for fish. These indices utilize community metrics to evaluate stream health based on biotic indicators and were developed by monitoring reference reach streams of excellent quality in different bioregions of the state and comparing with impacted streams in these regions. Criteria for the Bluegrass Bioregion were utilized for this effort (KDOW, 2011). The criteria are summarized in **Table 14**.

TABLE 14
BIOLOGICAL WARMWATER AQUATIC HABITAT CRITERIA

RATING	HABITAT (RBP)		MACROINVERTEBRATE (MBI)		FISH (KIBI)
	DRAINAGE AREA		DRAINAGE AREA		
	> 5.0 mi^2	< 5.0 mi^2	> 5.0 mi^2	< 5.0 mi^2	
Excellent	N/A	N/A	≥ 70	≥ 58	≥ 52
Good	≥ 130	≥ 156	61-69	51-57	47-51
Fair	114-129	142-155	41-60	39-50	31-46
Poor	≤ 113	≤ 141	21-40	19-38	16-30
Very Poor	N/A	N/A	≤ 20	≤ 18	≤ 15

The Rapid Bioassessment Protocol (RBP) evaluates 10 habitat parameters based on visual assessment. These parameters include 1) epifaunal substrate / available cover, 2) embeddedness, 3) velocity / depth regime, 4) sediment deposition, 5) channel flow status, 6) channel alteration, 7) frequency of riffles or bends, 8) bank stability, 9) vegetative protection, and 10) riparian vegetative zone width.

The Macroinvertebrate Bioassessment Index (MBI) utilizes 7 different benthic macroinvertebrate community metrics to assess stream health. These include 1) the number of different taxa (genus-level), 2) the number of taxa (genus-level) of stoneflies, mayflies, and caddisflies, 3) the percentage of stoneflies, mayflies, and caddisflies, 4) the modified Hilsenhoff Biotic Index (an indicator for organic enrichment), 5) percentage of worms and midges, 6) percentage of clingers, and 7) percentage of mayflies. Each of these metrics are weighted to generate an overall community score and rating.

The Kentucky Index of Biotic Integrity (KIBI) utilizes 7 different fish community metrics to assess stream health. These include 1) total number of native species, 2) the number of pollution sensitive darter, madtom, and sculpin species, 3) the number of pollution intolerant species, 4) the percentage pf simple lithophilic spawners (i.e., species that need clean gravel to lay eggs), 5) the percentage of insect-eating fish, 6) the percentage of pollution tolerant fish, and 7) the percentage of fish that are typically found in headwater streams. Each of these metrics are weighted to generate an overall community score and rating.

2. Regulatory Water Quality Standards

The regulatory statute for surface waters in Kentucky is found in 401 KAR 10:031. The statute provides minimum water quality standards for all surface waters as well as specific standards that apply to particular designated uses. Water quality standards for WAH designated use were utilized for pH, temperature, and dissolved oxygen. Recreational use standards (PCR and SCR) were utilized for *E. coli* and fecal coliform. These benchmarks are summarized in **Table 15** (page 49).

3. Non-Regulatory Water Quality Reference Points

For other parameters, such as nutrients, specific conductance (conductivity), and suspended solids, narrative (as opposed to numeric) water quality reference levels have been established due to the variable relationship between biological integrity and pollutant concentration levels in different streams. KDOW provided these reference levels based on reference reach data and previous watershed plans. It is important to note that exceeding these reference levels does not necessarily result in an impairment listing, nor does reducing to below those levels necessarily result in a delisting. The KDOW uses these reference points in concert with analysis of biology scores and other indicators of impairment to make decisions regarding the water's status.

Because of the difficulty in establishing thresholds for these pollutants independent of other variables impacting aquatic habitat, such as poor riparian and in-stream habitat and poor hydrology/ flow regime, water quality reference levels were set higher than reference conditions since the reference levels may be well below the level necessary to restore support of the use. The goals should be reassessed through the watershed planning process on regular time intervals and lowered if the designated use does not become fully supported through the implementation plan efforts when target levels are achieved. Additional details on the support for these thresholds are included in Appendix F. The water quality reference levels are summarized in **Table 16** (page 50).

In this WBP the term “benchmark” or “thresholds” may be used to refer to both the numerically-based regulatory standards and the water quality reference levels.

TABLE 15
REGULATORY WATER QUALITY STANDARDS

Parameter	Unit	Standard	Source	Description
pH	SU	6.0 - 9.0	WAH	Not be less than 6.0 SU, more than 9.0 SU, nor fluctuate more than 1.0 SU over 24 hours
Temperature	°C (°F)	31.7 (89)	WAH	Instantaneous maximum shall not exeed 31.7 °C
Dissolved Oxygen	mg/L	4.0	WAH	Shall be above 5.0 mg/L as a 24-hour average; above 4.0 mg/L for instantaneous measurements
Fecal coliform	MPN or CFU	200	PCR[1]	Geometric mean based on ≥ 5 samples taken during a 30-day period.
		400		Not to exceed in 20% or more of all samples taken during a 30-day period. If < 5 samples are taken in a month, this standard applies.
		1,000	SCR	Geometric mean based on ≥ 5 samples taken during a 30-day period.
		2,000		Not to exceed in 20% or more of all samples taken during a 30-day period. If < 5 samples are taken in a month, this standard applies.
E. coli	MPN or CFU	130	PCR[1]	Geometric mean based on ≥ 5 samples taken during a 30-day period.
		240		Not to exceed in 20% or more of all samples taken during a 30-day period. If < 5 samples are taken in a month, this standard applies.
		386[2]	SCR	Geometric mean based on ≥ 5 samples taken during a 30-day period.
		676[2]		Not to exceed in 20% or more of all samples taken during a 30-day period. If < 5 samples are taken in a month, this standard applies.

[1] May 1 through October 31

[2] Calculated relationship derived by Ormsbee and Akasapu. 2010. Relationship Between Fecal Coliform and Within the Kentucky River Basin. Kentucky Water Resources Research Institute. University of Kentucky. Lexington, Kentucky. $Ecoli=1.44*FC^{0.8093}$

TABLE 16
NON-REGULATORY REFERENCE POINTS

Parameter	Unit	Reference Point	Description
Specific Conductance	µS/cm	650	50th Percentile in Wolf Run Watershed
Total Suspended Solids	mg/L	80	Rowe, M., D. Essig, and B. Jessup. 2003. *Guide to Selection of Sediment Targets for Use in Idaho TMDLs*. IDEQ
Total Phosphorus	mg/L	0.35	75th to 90th Percentile for reference reaches in the Inner Bluegrass
Total Nitrogen	mg/L	3.0	75th to 90th Percentile for reference reaches in the Inner Bluegrass
Ammonia-Nitrogen	mg/L	0.1	75th Percentile for the Wolf Run Watershed

4. Water Quality Health Grades

To simplify water quality data for public audiences, the percentage of measured pollutant concentrations in exceedance of regulatory benchmark or non-regulatory reference points values was utilized to generate water quality health scores. These health scores, like report cards, assign letter grades to the frequency of exceedance at each site. Each parameter is "graded on a curve" such that letter scores for one parameter are similar to letter scores for other parameters. Letter grades for individual parameters are roughly based on KDOW's method for evaluating data for listing impairments or their TMDL Health Reports. The percent exceedance and the corresponding grade for each parameter are shown in **Table 17,** page 51.

B. Historic Biological and Water Quality Monitoring

To evaluate the water quality within the Cane Run watershed, data was gathered from all available sources including scientific studies, government, and volunteer sources. **Table 18** (page 51) provides an overview of the available data that was gathered by this collection effort. Generators of surface water quality data for the watershed within Cane Run include LFUCG, the City of Georgetown, University of Kentucky Environmental Research and Training Laboratory (UK ERTL), KWRRI, University of Kentucky College of Agriculture's Biosystems and Agricultural Engineering Department (UK BAE), KDOW, and Kentucky River Watershed Watch (KRWW). These studies were conducted at various locations throughout the watershed over multiple years and for different parameters. **Exhibit 20** (Appendix A), shows the locations of the monitoring sites from which the water quality data was collected.

TABLE 17
WATER QUALITY HEALTH GRADES

Parameter	Benchmark	% of Results Exceeding				
		A	B	C	D	F
E. coli – PCR (Swimming)	240	0-10%	11-20%	21-33%	34-66%	67-100%
E. coli – SCR (Wading)	676	0-10%	11-20%	21-33%	34-66%	67-100%
Fecal Coliform – PCR (Swimming)	400	0-10%	11-20%	21-33%	34-66%	67-100%
Fecal Coliform – SCR (Wading)	1,000	0-10%	11-20%	21-33%	34-66%	67-100%
pH	6-9	0-5%	6-10%	11-25%	26-66%	67-100%
Dissolved Oxygen	4	0-5%	6-10%	11-25%	26-66%	67-100%
Specific Conductance	650	0-10%	11-25%	25-50%	51-66%	67-100%
Total Dissolved Solids	373	0-10%	11-25%	25-50%	51-66%	67-100%
Temperature	31.7	0-10%	11-25%	25-50%	51-66%	67-100%
Total Suspended Solids	80	0-10%	11-25%	25-50%	51-66%	67-100%
Total Phosphorus	0.35	0-10%	11-25%	25-50%	51-66%	67-100%
Total Nitrogen	3.0	0-10%	11-25%	25-50%	51-66%	67-100%
Ammonia-Nitrogen	0.1	0-10%	11-25%	25-50%	51-66%	67-100%

TABLE 18
CANE RUN HISTORIC MONITORING SUMMARY

Sampled by	Monitoring Type	No of Stations	Years	Macro / Habitat	Fish	Fecal Coliform / *E. coli*	Physicochemical	Nutrients	Suspended Solids	Metals	Geomorphic
LFUCG	MS4 Stormwater Permit Monitoring	8	1996-2016	X	X	X	X	X	X	X	
GMWSS	Fecal coliform / *E. coli*	2	2002-2005, 2015-2016			X					
KDOW	Habitat and Macroinvertebrates	7	1998, 2000, 2007, 2009, 2014	X			X				
KDOW	Surface Water TMDL Sampling (Nutrients)	12	2006-2007, 2013-2014				X	X	X		
KRWW	Volunteer Sampling	4	2000-2016			X	X	X	X		
KWRRI	Weekly PCR Fecal Coliform Sampling	8	2002			X					
UK BAE	Watershed Based Plan Monitoring	14	2008-2010			X			X		X
UK ERTL	Microbial Source Tracking	8, 7, 4	2005-2006, 2012			X					

Because of the large amount of sampling data collected in the area as well as the numerous sampling locations, a cross reference of the site locations and names is summarized in **Exhibit 20** (Appendix A) and **Table 19** (page 53). Thirty-two sites have been sampled for a variety of parameters over various periods.

The results of these studies have been compiled and compared to the water quality benchmarks presented at the beginning of this chapter (**Tables 15** and **16**, pages 49 and 50, respectively). The frequency of exceedance of recreational use is shown at each location in **Exhibit 21** (Appendix A) for primary contact recreation and **Exhibit 22** (Appendix A) for secondary contact recreation. Exceedances of nutrient benchmarks are shown in **Exhibit 23** (Appendix A) for ammonia-nitrogen, **Exhibit 24** (Appendix A) for total nitrogen, and **Exhibit 25** (Appendix A) for total phosphorus. Habitat and macroinvertebrate scores/ratings are shown in **Exhibit 26** (Appendix A). Composite grades for these parameters, as well as pH, dissolved oxygen, conductivity, and suspended solids are shown in **Table 20** (page 54).

The subsequent sections summarize the comparisons for each specific monitoring source.

TABLE 19
CANE RUN HISTORIC MONITORING SITES CROSS REFERENCE

Site ID	Description	County	Stream / Waterway	River Mile	Lat (NAD 83)	Long (NAD 83)	LFUCG	COG	KDOW	KWRRI	BAE	ERTL	KRWW
1	Royal Springs / Georgetown WTP	Scott	Spring	0.6	38.20833	-84.56222			8013			Georgetown WTP	
2	US 460 (Frankfort Road)	Scott	Cane Run	0.2	38.20976	-84.61083		DC1	8002	C6			744
3	US 62 (Paynes Depot Road)	Scott	Cane Run	3.0	38.18931	-84.58888			8001	C7			
4	US 25 (Lexington / Georgetown Road)	Scott	Cane Run	5.8	38.16887	-84.55493	CR-S3		8003	C5			
5	UT Near US 25 Below Spindletop MHP	Scott	UNT @6.1	0.1	38.16331	-84.54952			8004				
6	UT at Lisle Road near US 25	Scott	UNT @6.1	0.7	38.15630	-84.54520				C4			
7	Coleman Road at Landscape Alternatives	Scott	Cane Run	6.0	38.16783	-84.55409		UC1					1221
8	Grace Christian Church above UT	Scott	Cane Run	6.2	38.16663	-84.55164			8012				
9	Lisle Road	Scott	Cane Run	7.2	38.16712	-84.53897			8005	C3	CR12		
10	UT above Walt Robinson Road	Scott	UNT @ 7.7	0.3	38.16338	-84.52894						Barton Spr.	
11	Pristine Spring	Fayette	Spring	N/A	38.15826	-84.52534						Pristine Spr.	
12	UT Below Rolex Lane	Fayette	UNT @9.1	0.3	38.14998	-84.51770						Retention Pd	
13	Berea Road	Fayette	Cane Run	9.9	38.13880	-84.51703			8006	C2	CR11		
14	UT at Berea Road	Fayette	UNT @9.9	0.05	38.13885	-84.51772			8011				
15	Near Research Park Drive	Fayette	Cane Run	10.4	38.13340	-84.51209						Spindletop	
16	UT at Spindletop Way	Fayette	UNT @10.7	0.2	38.12885	-84.50654			8007		CR09		
17	UT at Agronomy Road	Fayette	UNT @10.7	1.1	38.12345	-84.49727					CR08		
18	UT at Equine Campus Road	Fayette	UNT @10.7	2.1	38.11555	-84.48566					CR07		
19	UK Farm Above UT near Legacy Trail	Fayette	Cane Run	10.9	38.12844	-84.51188					CR10		
20	Downstream of I-75	Fayette	Cane Run	12.9	38.10718	-84.49959	CR-S23						
21	Coldstream Park mouth of UT near I-75	Fayette	UNT @12.9	0.05	38.10579	-84.49858			8010				
22	Coldstream Park mouth of UT near I-75	Fayette	UNT @12.9	0.3	38.10355	-84.49509	CR-S22						
23	Coldstream Park UNT at Legacy Trail	Fayette	UNT @12.9	0.5	38.10150	-84.49182					CR05		3146
24	Upstream of I-75	Fayette	Cane Run	13.0	38.10587	-84.49908				C1	CR06	Newtown Ex.	
25	Citation Boulevard	Fayette	Cane Run	14.0	38.09227	-84.50144	CR-S2						
26	UT at Alice Drive	Fayette	UNT @14.1	0.1	38.09122	-84.50291					CR04	Highland Spr.	
27	Newtown Pike (KY 922)	Fayette	Cane Run	15.1	38.08008	-84.49252	CR-S1		8009	C0	CR03	IBM	
28	LexMark Shadygrove Park	Fayette	Cane Run	15.6	38.07618	-84.48698	CR-S20						
29	UT at LexMark Shadygrove Park Trail - Loudon	Fayette	UNT @15.6	0.1	38.07415	-84.48596					CR01		
30	UT at Loudon Avenue	Fayette	UNT @15.6	0.9	38.06418	-84.48743					CR13		
31	UT at LexMark Shadygrove Park - Green Acres	Fayette	UNT @15.7	0.05	38.07555	-84.48521					CR14		
32	LexMark Shadygrove Park	Fayette	Cane Run	15.8	38.07453	-84.48468					CR02		

TABLE 20
CANE RUN HISTORIC MONITORING RESULTS SUMMARY 1999 - 2016

Site ID	Description	*E. coli* / Fecal – PCR (Swimming)	*E. coli* / Fecal – SCR (Wading)	pH	Dissolved Oxygen	Conductivity	Suspended Solids	Total Phosphorus	Total Nitrogen	Ammonia-Nitrogen	Habitat	Macro
1	Royal Springs / Georgetown WTP	0% (10)	0% (10)	0% (9)	0% (9)	40% (10)	0% (11)	9% (11)	64% (11)	0% (11)		
2	US 460 (Frankfort Road)	64% (54)	33% (54)	3% (38)	16% (37)	0% (49)	0% (34)	22% (27)	36% (33)	15% (27)	123 (2)	49.2 (2)
3	US 62 (Paynes Depot Road)	80% (10)	30% (10)	0% (14)	7% (13)	20% (15)	0% (13)	8% (13)	54% (13)	46% (13)	83 (1)	67.4 (1)
4	US 25 (Lexington / Georgetown Road)	46% (24)	8% (24)	0% (14)			7% (14)	50% (14)	64% (14)	36% (14)	126 (6)	38.9 (9)
5	UT Near US 25 Below Spindletop MHP			0% (14)	0% (11)	21% (14)	0% (15)	87% (15)	73% (15)	80% (15)	84 (1)	23.5 (1)
6	UT at Lisle Road near US 25	90% (10)	40% (10)									
7	Coleman Road at Landscape Alternatives	88% (35)	65% (35)	5% (20)	21% (19)	18% (17)	0% (4)		50% (4)			
8	Grace Christian Church Above UT			0% (12)	0% (11)	0% (12)	0% (11)	27% (11)	18% (11)	18% (11)	89 (1)	
9	Lisle Road	58% (79)	44% (79)				22% (152)					
10	UT Above Walt Robinson Road	18% (11)	9% (11)									
11	Pristine Spring	9% (11)	9% (11)									
12	UT Below Rolex Lane	18% (11)	9% (11)									
13	Berea Road	46% (26)	46% (26)				0% (13)					
14	UT at Berea Road			0% (1)	0% (1)	0% (1)						
15	Near Research Park Drive	9% (11)	0% (11)									
16	UT at Spindletop Way	55% (78)	36% (78)	0% (13)	9% (11)	0% (13)	0% (14)	23% (13)	54% (13)	8% (13)	90 (1)	33.8 (1)
17	UT at Agronomy Road	66% (88)	39% (88)				26% (220)					
18	UT at Equine Campus Road	77% (92)	53% (92)									
19	UK Farm Above UT near Legacy Trail	80% (20)	55% (20)									
20	Downstream of I-75	67% (3)		0% (3)	0% (3)	33% (3)	0% (3)	33% (3)	0% (3)	0% (3)		
21	Coldstream Park Mouth of UT Near I-75			0% (16)	0% (13)	25% (12)	0% (14)	0% (14)	0% (14)	0% (14)	103 (1)	46.7 (1)
22	Coldstream Park mouth of UT Near I-75	36% (11)	0% (11)	11% (9)	0% (9)	56% (9)	0% (9)	22% (9)	0% (9)	0% (9)		
23	Coldstream Park UT at Legacy Trail	56% (93)	38% (93)	0% (4)	50% (4)	25% (4)	5% (340)		0% (6)			
24	Upstream of I-75	70% (46)	59% (46)				15% (348)					
25	Citation Boulevard	73% (126)	62% (126)	0% (66)	0% (65)	65% (66)	7% (70)	46% (70)	51% (70)	23% (70)	123 (7)	24.0 (7)
26	UT at Alice Drive	96% (102)	92% (102)									
27	Newtown Pike (KY 922)	83% (68)	75% (68)	0% (14)	0% (10)	50% (12)	13% (597)	50% (16)	44% (16)	6% (16)	85 (1)	
28	LexMark Shadygrove Park	59% (17)	29% (17)	0% (9)	0% (9)	67% (9)	0% (9)	33% (9)	0% (9)	44% (9)		
29	UT at LexMark Shadygrove Park Trail – Loudon	93% (93)	67% (93)				18% (666)					
30	UT at Loudon Avenue	100% (68)	97% (68)									
31	UT at LexMark Shadygrove Park - Green Acres	79% (34)	65% (34)									
32	LexMark Shadygrove Park	95% (40)	88% (40)				18% (496)					

Note: Count of samples in parentheses. The percentage of results that exceed the benchmark and health grade are provided.
Colors indicate the health grade as defined in **Table 17** (page 50) : blue = A; green = B; yellow = C; orange = D; and red = F.

1. Lexington-Fayette Urban County Government Monitoring

The LFUCG conducts monitoring in conformance with its MS4 stormwater permit for each of the watersheds within the Urban Service Boundary. Three MS4 monitoring sites have been located in the Cane Run watershed since sampling began in 1996. CR-S1, the most upstream site, located just upstream of the Newtown Pike crossing, was briefly monitored in 1996, 2001, and 2002 for chemistry events. CR-S2, the current monitoring site located downstream of the Citation Boulevard overpass, was first monitored in 1996 and 1997 but was not monitored again until 2008. CR-S3, located in Scott County in order to capture all of the drainage of Fayette County, has been the most frequently sampled from 1998 to 2008. All data from 2016 and prior was analyzed for this plan. The count of samples, frequency of exceedance of the water quality benchmarks, and the grades for each parameter are summarized in **Table 21**, page 56.

Prior to 1999, the parameters sampled for chemical parameters varied from year to year. However, solids (total dissolved and suspended), fecal coliform, oil and grease, cadmium, copper, lead, zinc, hardness, phenols, phosphorus (dissolved and total), nitrogen (ammonia, total Kjeldahl, nitrate, nitrite), biochemical oxygen demand, chemical oxygen demand, specific conductance, dissolved oxygen, temperature, pH, and turbidity were routinely sampled from 1999 to 2016. Discharge and *E. coli* were added to this sampling list in the fall of 2008 when the chemical sampling frequency was increased to quarterly dry and wet weather sampling. In 2016, total dissolved solids, fecal coliform, oil and grease, cadmium, copper, lead, zinc, hardness, phenols, biochemical oxygen demand, chemical oxygen demand, and turbidity were dropped from quarterly sampling.

In addition to the MS4-permit-required monitoring, LFUCG conducted routine monitoring of three background water quality sampling sites in the Cane Run watershed from 2011 to 2013. These sites were typically sampled once per quarter under dry weather conditions if flow was present. CR-S20 is in the headwaters of the Cane Run watershed, behind Lexmark; CR-S22 is located on the tributary to Cane Run below Embassy Suites; and CR-23 is located downstream of I-75.

In addition to these monitoring sites, LFUCG Division of Water Quality Compliance and Monitoring conducted visual stream assessments in 2012 (Third Rock, 2012). The streams in the urban area were visually assessed according to the Center for Watershed Protection's *Urban Sub-watershed Restoration Manual 10 – Unified Stream Assessments: A User's Manual Version 2.0* (Kitchell and Schueler, 2005). The assessment identified 174 stormwater outfalls, of which 16 had dry weather flow present. Ten severe erosion areas were identified, as well as 116 stream crossing locations. Forty-three utility crossings were noted. Thirty-five trash and debris locations were estimated to amount to an equivalent of 102 pickup truck loads of trash and debris. These locations are shown in **Exhibit 27** (Appendix A).

TABLE 21
LFUCG HISTORIC MS4-PERMIT MONITORING DATA SUMMARY

ID	**27**	**25**	**4**	**28**	**22**	**20**
Station	**CR-S1**	**CR-S2**	**CR-S3**	**CR-S20**	**CR-S22**	**CR-S23**
Description	**Newtown Pike**	**Citation Blvd**	**US 25**	**LexMark Shadygrove Park**	**Coldstream Park at mouth of UNT Near I-75**	**Downstream of I-75**
Monitoring Years	2001-2002	2008-2016	1999-2008	2011-2013	2011-2013	2011-2013
E. coli PCR (Swimming)		74% (69)		56% (9)	40% (5)	67% (3)
Fecal Coliform PCR (Swimming)	100% (3)	72% (57)	36% (14)	63% (8)	33% (6)	0% (2)
E. coli SCR (Wading)		61% (69)		33% (9)	0% (5)	0% (0)
Fecal Coliform– SCR (Wading)	100% (3)	63% (57)	7% (14)	25% (8)	0% (6)	0% (2)
pH	0% (2)	0% (66)	0% (12)	0% (9)	11% (9)	0% (3)
Dissolved Oxygen		0% (65)		0% (9)	0% (9)	0% (3)
Conductivity		65% (66)		67% (9)	56% (9)	33% (3)
Total Dissolved Solids	67% (3)	60% (57)	25% (12)			
Total Suspended Solids	33% (3)	7% (70)	7% (14)	0% (9)	0% (9)	0% (3)
Total Phosphorus	100% (3)	46% (70)	50% (14)	33% (9)	22% (9)	33% (3)
Total Nitrogen	0% (3)	51% (70)	64% (14)	0% (9)	0% (9)	0% (3)
Ammonia-Nitrogen	0% (3)	23% (70)	36% (14)	44% (9)	0% (9)	0% (3)
Habitat		123 (7)	126 (6)			
Macroinvertebrate		24.0 (7)	38.9 (9)			

Note: Count of samples in parentheses. The percentage of results that exceed the benchmark and health grade are provided. Colors indicate the health grade as defined in **Table 17** (page 50): blue = A; green = B; yellow = C; orange = D; and red = F.

Habitat assessments were also performed at 41 reaches during the 2012 visual stream assessments. All sites were found to have "poor" habitat during this effort with a range of RBP scores from 63 to 138, with results shown in **Exhibit 27** (Appendix A). Riparian zone width was typically narrow contributing to lower habitat scores. Because numerous sites were dry due to karst sub-surface drainage, the velocity depth regime had a "marginal" score on average. Many streams also lacked epifaunal substrate or available cover for aquatic organisms.

The stormwater outfalls were again assessed by LFUCG in 2016 during dry weather conditions. During this assessment, all flowing outfalls were sampled for *E. coli*, total suspended solids, ammonia-nitrogen, detergents, chlorine, pH, conductivity, nitrate-nitrogen, and total phosphorus. Two hundred and ten outfalls were assessed, with 10 requiring follow up. Seventeen outfalls were flowing during the assessment with 8 outfalls with levels that initiated illicit discharge investigations: 3 due to high *E. coli*, 2 due to high conductivity, 2 due to low dissolved oxygen, and 1 due to high ammonia. The greatest pollution levels were measured at an outfall at 201 W. Loudon Ave., most likely due to sanitary sewer exfiltration from pipe scheduled to be addressed by the LexMark Trunk B remedial measures plan project.
Other large pollutant levels were found at outfalls at Walt Robinson Road (retention pond near Alltech Arena), and from industrial uses near upstream of the New Circle Road Eastbound On-Ramp at Newtown Pike.

2. Georgetown

According to results published in the Cane Run and Royal Spring Watershed Based Plan (UK BAE, 2011), the GMWSS has collected fecal coliform results regularly from river mile 6.0 (near site 4 on **Exhibit 20,** Appendix A). The annual fecal coliform geomean for 2002 was 237 CFU/100mls; 2003 was 468 CFU/100mls; and 2005 was 75 CFU/100mls.

City of Georgetown's MS4 program began collecting data for the total maximum daily load (TMDL) for Cane Run within Georgetown's MS4 boundary in 2015. For Cane Run, sampling entails five sample visits within a consecutive 30-day period at two locations for *E. coli*. Monitoring station "DC1" is located at US 460 (Frankfort Road) and station "UC1" is located at Coleman Road near Landscape Alternatives. The count of samples, frequency of exceedance of the water quality benchmarks, and the health grades for each parameter are summarized in **Table 22** (page 58).

TABLE 22
CITY OF GEORGETOWN HISTORIC MONITORING DATA SUMMARY

Site ID	2	7
Station	DC1	UC1
Description	US 460	Coleman Road
Monitoring Years	2015-2016	2015-2016
***E. coli* – PCR (Swimming)**	80% (10)	100% (10)
***E. coli* – SCR (Wading)**	0% (10)	80% (10)
***E. coli* Geomean (MPN/100mLs)**	252 (2015) 438 (2016)	1,626 (2015) 978 (2016)
Fecal Coliform – PCR (Swimming)	10% (10)	100% (10)
Fecal Coliform – SCR (Wading)	0% (10)	80% (10)
Fecal Coliform Geomean (MPN/100mLs)	196 (2015) 291 (2016)	1,374 (2015) 1,196 (2016)

Note: Count of samples in parentheses. The percentage of results that exceed the benchmark and health grade are provided. Colors indicate the health grade as defined in **Table 17** (page 50): blue = A; green = B; yellow = C; orange = D; and red = F.

3. Kentucky Division of Water Nutrient TMDL and Biological Monitoring

KDOW collected surface water samples from November 8, 2006 to October 4, 2007 in 12 events at 12 stations to provide data to support the development of a TMDL for nutrients. The sample parameters included ammonia-nitrogen, 5-day carbonaceous biochemical oxygen demand (CBOD-5), nitrate+nitrite-nitrogen, organic carbon, ortho-phosphorus as phosphorus, total phosphorus, total Kjeldahl nitrogen (TKN), total suspended solids, dissolved oxygen, pH, temperature, specific conductance, and discharge.

Macroinvertebrate surveys were performed at one site in 2007, four sites in 2009, and one site in 2014. Habitat assessments were conducted at one site in 2000, two sites in 2007, four sites in 2009, and one site in 2014.

The count of samples, frequency of exceedance of the water quality benchmarks, and the health grades for each parameter are summarized in **Table 23** (page 59).

4. KWRRI Weekly Fecal Coliform Sampling

KWRRI collected fecal coliform surface water grab samples on a weekly basis from June through September of 2002 to support a pathogen TMDL. The results are summarized in **Table 24** (page 60). No data was collected at site C2 because of the lack of flow at the site during the study. Sites C0 and C1, located in the upper regions of the watershed, had the highest geomean fecal coliform concentrations, but also were only flowing during wet weather conditions. All sites had averages above the regulatory fecal coliform standard for the primary contact recreation period.

TABLE 23
KDOW HISTORIC MONITORING DATA SUMMARY

Site ID	3	2	4	5	9	13	16	27	21	14	8	1
Station	8001	8002	8003	8004	8005	8006	8007	8009	8010	8011	8012	8013
Monitoring Years	2006-2009	2006-2014	2006	2006-2009	2006	2006	2000-2009	2006-2007	2006-2007	2006	2006-2009	2006-2007
Description	Paynes Depot Road	US 460	US 25	UT Along US 25	Lisle Road	Berea Road	Spindletop Way	Newtown Pike	Coldstream Park mouth of UNT near I-75	UT at Berea Road	Grace Christian Church	Royal Springs
pH	0% (14)	0% (14)	0% (2)	0% (14)	0% (2)	0% (1)	0% (13)	0% (12)	0% (16)	0% (1)	0% (12)	0% (9)
Dissolved Oxygen	7% (13)	0% (13)	0% (2)	0% (11)	0% (2)	0% (1)	9% (11)	0% (10)	0% (13)	0% (1)	0% (11)	0% (9)
Conductivity	20% (15)	0% (28)	0% (2)	21% (14)	0% (2)	0% (1)	0% (13)	50% (12)	25% (12)	0% (1)	0% (12)	40% (10)
Suspended Solids	0% (13)	0% (27)		0% (15)			0% (13)	8% (13)	0% (14)		0% (11)	0% (11)
Total Phosphorus	8% (13)	22% (27)		87% (15)			23% (13)	38% (13)	0% (14)		27% (11)	9% (11)
Total Nitrogen	54% (13)	44% (27)		73% (15)			54% (13)	54% (13)	0% (14)		18% (11)	64% (11)
Ammonia-Nitrogen	46% (13)	15% (27)		80% (15)			8% (13)	8% (13)	0% (14)		18% (11)	0% (11)
Habitat	83 (1)	123 (2)		84 (1)			90 (1)	85 (1)	103 (1)		89 (1)	
Macro	67.4 (1)	49.2 (2)		23.5 (1)			33.8 (1)		46.7 (1)			

Note: Count of samples in parentheses. The percentage of results that exceed the benchmark and health grade are provided.
Colors indicate the health grade as defined in **Table 17** (page 50): blue = A; green = B; yellow = C; orange = D; and red = F.

TABLE 24
KWRRI 2002 FECAL COLIFORM DATA SUMMARY

Site ID	27	24	13	9	6	4	2	3
Station	C0	C1	C2	C3	C4	C5	C6	C7
Monitoring Year	2002	2002	2002	2002	2002	2002	2002	2002
Description	Newtown Pike	Upstream of I-75	Berea Road	Lisle Road	Lisle Road	Lexington Road	Frankfort Road	Paynes Depot
Fecal Coliform PCR (Swimming)	100% (5)	100% (3)	0% (0)	60% (10)	90% (10)	60% (10)	80% (10)	80% (10)
Fecal Coliform SCR (Wading)	100% (5)	67% (3)	0% (0)	50% (10)	40% (10)	10% (10)	50% (10)	30% (10)
Geomean (MPN/100mLs)	5,803	1,947	-	877	1923	510	989	724

Note: Count of samples in parentheses. The percentage of results that exceed the benchmark and health grade are provided.
Colors indicate the health grade as defined in **Table 17** (page 50): blue = A; green = B; yellow = C; orange = D; and red = F.

5. UK BAE Watershed Based Plan Monitoring

The UK Department of Biosystems and Agricultural Engineering (BAE) collected fecal coliform and *E. coli* samples at 14 different monitoring sites from 2008 to 2010. Seven sites were also sampled for total suspended solids and turbidity via automated samplers and grab collections. Stage and rainfall data were collected at several sites and geomorphic measurements made on multiple reaches.

Results of the bacterial and suspended solids sampling are summarized in **Table 25** (page 62). Fecal coliform and *E. coli* frequently exceeded regulatory criteria at all locations. The PCR criterion was exceeded in a range of 46% to 100% of samples at different sites, while the SCR criterion was exceeded at frequencies ranging from 28% to 100%. The sites with the highest exceedance frequency include CR04 (26; near Lexington's Highlands neighborhood), CR06 (24) which is downstream, CR13 (30) at Loudon Avenue, CR01 (29), and CR02 (32) at LexMark Park which includes the urban upstream drainage area. Generally, the concentrations are highest in the most upstream locations and decrease moving downstream. Total suspended solids were found not to generally be a problem in the watershed, particularly since they were only sampled during wet weather. The watershed plan notes that concentrations tend to increase in the downstream direction and it is suggested that streambank and overland erosion are linked to agricultural activity which increases moving in the downstream direction.

6. UK ERTL Microbial Source Tracking Monitoring Efforts

Several microbial source tracking studies have been pursued by the UK Environmental Research Training Laboratory (ERTL) in conjunction with the city of Georgetown and research pursuits in an attempt to identify and rank potential sources of fecal contamination into the Royal Springs water supply. As microbial source tracking is still a developing area of research, multiple methods have been utilized in order to evaluate sources in the area.

In 2005, under a contract with the city of Georgetown, UK ERTL utilized pathogen indicator species including total and atypical coliforms, *E. coli* and F+coliphage (Brion, 2005). Eight sites were sampled weekly during the period of March 2 to May 11, 2005 during 11 events. The geometric means of the *E. coli* values for each site are shown in **Table 26** (page 62) as well as the rate of exceedance of benchmarks. The study indicated untreated human sewage sources at Highland Springs and IBM (now LexMark) and an unknown source of human sewage in the spring system.

In May to June 2006, UK ERTL conducted a follow up study at seven sites during six events and analyzed for the same parameters, as well as caffeine, coprostanol, and epicoprostanol, which were used as indicators of human fecal sources (Brion, 2006). The results of this study largely confirmed the results of the 2005 study.

TABLE 25
UK BAE HISTORIC MONITORING SUMMARY

ID	29	32	27	26	23	24	18	17	16	19	13	9	30	31
Station	CR01	CR02	CR03	CR04	CR05	CR06	CR07	CR08	CR09	CR10	CR11	CR12	CR13	CR14
Monitoring Years	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010
***E. coli* PCR (Swimming)**	96% (46)	95% (20)	88% (25)	100% (46)	61% (46)	88% (16)	78% (46)	70% (44)	59% (39)	80% (10)	46% (13)	60% (35)	100% (34)	82% (17)
Fecal Coliform PCR (Swimming)	89% (45)	95% (20)	83% (24)	100% (45)	52% (46)	88% (16)	76% (45)	61% (44)	51% (39)	80% (10)	46% (13)	56% (34)	100% (34)	76% (17)
***E. coli* SCR (Wading)**	76% (46)	90% (20)	76% (25)	100% (46)	43% (46)	81% (16)	57% (46)	48% (44)	44% (39)	70% (10)	46% (13)	51% (35)	97% (34)	71% (17)
Fecal Coliform SCR (Wading)	60% (45)	85% (20)	63% (24)	96% (45)	33% (46)	75% (16)	49% (45)	30% (44)	28% (39)	40% (10)	46% (13)	35% (34)	97% (34)	59% (17)
Total Suspended Solids	18% (666)	18% (496)	13% (581)	0% (1)	5% (333)	15% (348)	0% (1)	26% (220)	0% (1)		0% (13)	22% (152)	0% (1)	

Note: Count of samples in parentheses. The percentage of results that exceed the benchmark and health grade are provided.
Colors indicate the health grade as defined in **Table 17** (page 50): blue = A; green = B; yellow = C; orange = D; and red = F.

TABLE 26
UK ERTL 2005 MICROBIAL SOURCE TRACKING STUDY SUMMARY

ID	1	10	11	12	15	24	26	27
Station	Georgetown WTP	Barton Springs	Pristine Spring	Retention Pond	Spindletop	Newtown Exchange	Highlands	IBM
Monitoring Year	2005	2005	2005	2005	2005	2005	2005	2005
***E. coli* PCR (Swimming)**	0% (10)	18% (11)	9% (11)	18% (11)	9% (11)	9% (11)	64% (11)	55% (11)
***E. coli* SCR (Wading)**	0% (10)	9% (11)	9% (11)	9% (11)	0% (11)	0% (11)	36% (11)	55% (11)
E. coli* Geomean	30	243	13	18	20	20	454	243

Note: Count of samples in parentheses. The percentage of results that exceed the benchmark and health grade are provided.
Colors indicate the health grade as defined in Table 17 (page 50): blue = A; green = B; yellow = C; orange = D; and red = F.
* MPN/100mLs

In 2012, six sampling events were conducted at four sites, three of which were previously sampled: Royal Spring (Georgetown water treatment plant), Highland Springs, and IBM (now Lexmark), and a groundwater site established by the Kentucky Geological Survey in the groundwater conduit for Royal Spring located at the Kentucky Horsepark, in a Master's thesis by Sam Lee conducted through UK ERTL (Lee, 2012). Samples were analyzed for total and atypical coliforms, *E. coli, Bacteroides* quantitative polymerase chain reaction markers for AllBac, HuBac, and HF183, and flow. The study examined some of the divergent results obtained by various indicators and how to interpret these results. The thesis concluded that although a wet-weather, human-sewage source influencing Royal Spring after the Kentucky Horse Park is supported, it cannot be proven. Like previous studies, it concluded that human-sewage sources, likely aging, leaking sanitary infrastructure, were impacting the IBM and Highland Spring sites.

7. Kentucky River Watershed Watch

Kentucky River Watershed Watch (KRWW) is a non-profit organization for citizen monitoring efforts. Volunteers are trained to collect samples and typically three or four sampling events are held each year.

In the Cane Run watershed, four locations have been sampled since 2000. Station 744, located at US 460 near the mouth of Cane Run has been sampled during 33 events from 2000 to 2016. Station 1221, located on Coleman Lane near Landscape Alternatives has been sampled 23 times from 2007 to 2016. Four events have been sampled at Site 3146 at Coldstream Park from 2012 to 2014. Because only one sample has been collected at the KY Horse Park (Site 3147), this site was excluded from the comprehensive analyses.

Sampling parameters include *E. coli*, fecal coliform, pH, conductivity, dissolved oxygen, ammonia-nitrogen, nitrate-nitrogen, total Kjeldahl nitrogen, total suspended solids, ortho-phosphorus-phosphorus, turbidity, temperature, pesticides, metals, alkalinity, and other parameters. The results from Cane Run are summarized in **Table 27** (page 64).

TABLE 27
KRWW HISTORIC MONITORING DATA SUMMARY

ID	2	7	23	-
Station	744	1221	3146	3147
Dates	2000-2016	2007-2016	2012-2014	2014
Description	US 460	Coleman Lane	Coldstream Park	KY Horse Park
***E. coli* – PCR (Swimming)**	89% (19)	73% (15)	0% (1)	
Fecal Coliform – PCR (Swimming)	20% (5)			
***E. coli* – SCR (Wading)**	63% (19)	47% (15)	0% (1)	
Fecal Coliform-SCR (Wading)	20% (5)			
pH	4% (24)	5% (20)	0% (4)	0% (1)
Dissolved Oxygen	25% (24)	21% (19)	50% (4)	0% (1)
Conductivity	0% (21)	18% (17)	25% (4)	0% (1)
Total Suspended Solids	0% (7)	0% (4)	0% (7)	0% (1)
Total Nitrogen	0% (6)	50% (4)	0% (6)	100% (1)

Note: Count of samples in parentheses. The percentage of results that exceed the benchmark and health grade are provided. Colors indicate the health grade as defined in **Table 17** (page 51): blue = A; green = B; yellow = C; orange = D; and red = F. Site 3147 at the Horse Park was not included in comprehensive analysis because only one sample has been collected from the location.

C. Monitoring Needs and Plan

The Cane Run watershed has an abundance of environmental monitoring data collected by various entities. However, much of the data that was collected in 2008-2009 or prior and would benefit from updating due to the amount of BMP implementation that has occurred since that time. Additionally, monitoring gaps in Scott County and the urban headwaters of Lexington need to be fulfilled for this WBP to be comprehensive. To address these needs, two different monitoring plans have been separately sponsored by KDOW and LFUCG. These monitoring plans are summarized below.

1. Kentucky Division of Water WBP Monitoring

KDOW monitoring was performed under an approved quality assurance project plan (QAPP; Third Rock, 2016a) specifically for this WBP and included three major elements: water quality monitoring, biological monitoring, and a severe erosion survey. All monitoring was performed by Third Rock Consultants.

For water quality monitoring, 11 sites, shown in **Table 28**) and **Exhibit 28** (Appendix A) were sampled monthly for 12 events from June 2016 to May 2017. Monitoring included field chemistries, flow, bacteria, nutrients, sediment, and other parameters. A groundwater well at the Kentucky Horse Park was included in these sites. An additional five monitoring events were conducted in May 2017 for *E. coli* and field parameters. Microbial source tracking using quantitative polymerase chain reaction for DNA markers of human and ruminant fecal contributions was performed for select sites and events during the study to try to elucidate bacterial pollution sources.

TABLE 28
KDOW CANE RUN WBP MONITORING LOCATIONS

Site ID	Location	Area (mi^2)	WQ	Macro/ Habitat	Latitude	Longitude
1	Cane Run at US 460 Bridge	45.4	X	X	38.210260	-84.611020
2	Cane Run off SR 62	39.3	X	X	38.189400	-84.589200
3	UT to Cane Run off SR 62	2.02	X	X	38.186472	-84.591300
4	UT to Cane Run on Horse Farm off Etter Lane	3.1	X	X	38.175357	-84.571630
5	Cane Run at Landscape Alternatives Nursery Bridge off US 25	31.8	X	X	38.168000	-84.554250
6	UT to Cane Run in Field off US 25	5.0	X	X	38.163590	-84.549770
7	Cane Run at Lisle Road	24.9	X	X	38.167065	-84.538907
8[1]	Royal Springs Cave System at Horse Park	N/A	X		38.165237	-84.531324
9	UT to Cane Run at UK Ag Research Farm Road Bridge	7.4	X	X	38.128800	-84.507080
10[2]	Cane Run at Citation Boulevard	5.5	X		38.092322	-84.501381
11[3]	UT to Cane Run at Coldstream Farm	1.3	X		38.103658	-84.495021

[1] Site 8 is a groundwater monitoring well site. Together with Site 9, these sites measure all pollutants from Fayette County portion of watershed – surface and groundwater

[2] Site 10 is same location as LFUCG Site CR-5 Site (same record coordinates)

[3] Site 11 is same location as LFUCG Site CR-3 (though slightly different record coordinates)

Biological monitoring consisted of macroinvertebrate collection and identification paired with habitat assessment at eight locations (**Table 28**; Exhibit **28**, Appendix A) in the summer of 2016 (wadeable sites) and spring of 2017 (headwater sites). These results were compared to KDOW metrics for the bioregion (described in the beginning of this chapter).

Severe streambank erosion areas were identified within the watershed in both Scott and Fayette counties (outside of LFUCG's Urban Service Area) by visual assessment (July 2016). Where access was granted, streams were walked, and where not granted, windshield surveys or surveys using aerial mapping were performed to identify high priority areas for implementation of bank stabilization or stream restoration BMPs.

2. LFUCG Watershed-Focused Monitoring

The LFUCG Watershed-Focused Monitoring Program (WFMP) was developed as an MS4 permit requirement to facilitate the identification and remediation of sources of recreational and aquatic habitat impairments to streams in each of the seven major watersheds within the LFUCG Urban Service Area. In the Cane Run watershed, monitoring was performed from fall 2016 through fall 2017 under an approved quality assurance project plan (Third Rock, 2016b) and included five major elements: stream corridor characterization, stream biology, water quality monitoring, discharge prevention investigation, and priority area upland visual assessment.

Stream corridor characterizations were performed at 33 stream reaches by students at Bluegrass Community and Technical College in 2017 and included RBP habitat assessments, general streambed substrate characterizations, and macroinvertebrate screening.

For stream biology, Third Rock Consultants performed macroinvertebrate collection and identification paired with habitat assessments at three locations in the spring of 2017 (**Table 29** (page 67); **Exhibit 28**, Appendix A). These results were compared to KDOW metrics for the bioregion and are compiled within the LFUCG technical report as noted below as well as captured within the Biological and Habitat Monitoring Report (see reference in section D, below) produced for this watershed plan.

Water quality monitoring was performed in two phases. During Phase 1, certified volunteers performed field screening at 12 stream sites and 53 major outfalls in dry weather conditions during 4 events between August 2016 and March 2017. During Phase 2, the 12 stream sites and 15 major outfalls that flowed during at least half of the screening events were sampled biweekly by trained volunteers for 10 events from May to October 2017. The 12 LFUCG-monitored stream sites are shown in **Table 29** (page 67) and **Exhibit 28** (Appendix A). Two of the sites are in overlapping locations with the KDOW-sponsored monitoring performed for this WBP: Site CR-3 is the same location as Site 11 and Site CR-5 is the same location as Site 10.

Discharge prevention / source investigation involved LFUCG Compliance and Monitoring staff tracing pollution levels above certain limits to an upstream source. Additionally, microbial source tracking (using human and bovine genetic markers) and optical brightener surveys (indicative of the presence of wash/wastewater) were performed to determine the source of bacterial pollution.

Neighborhoods and potential pollutant generators upstream of hot spots were also visually assessed during the priority area upland visual assessments to gain additional information on pollution sources.

TABLE 29
LFUCG CANE RUN WFMP MONITORING LOCATIONS

Site ID	Location	Area (mi^2)	WQ	Macro/ Habitat	Latitude	Longitude
CR-1	Cane Run at I-75	7.6	X		38.106192	-84.499152
CR-2	Cane Run upstream of UNT at RM 12.9 near Lower Pump Station	6.1	X		38.104840	-84.498890
CR-3[1]	UT to Cane Run at RM 12.9 at Coldstream Park Trail	1.3	X		38.103439	-84.494748
CR-4	UT to Cane Run at RM 12.9 at Coldstream Park downstream of Pisacano Drive	1.0		X	38.099624	-84.489882
CR-5[2]	Cane Run at Citation Blvd	5.5	X	X	38.092322	-84.501381
CR-6	Highlands Spring near Citation Blvd	0.16	X		38.091330	-84.502946
CR-7	UT to Cane Run behind Eastern State Hospital	4.6	X		38.083768	-84.499531
CR-8	Cane Run at Newtown Pike	4.1	X	X	38.080168	-84.492654
CR-9	UT to Cane Run at 15.7 at LexMark	0.35	X		38.075490	-84.485348
CR-10	Cane Run at LexMark	1.7	X		38.074647	-84.484774
CR-11	UT to Cane Run at 15.6 at LexMark	1.8	X		38.074091	-84.485870
CR-12	UT to Cane Run at 15.6 upstream of RJ Corman Railroad near Loudon	1.2	X		38.064229	-84.487479

[1] LFUCG Site CR-3 is same location as KDOW WBP Site 11(though slightly different record coordinates)

[2] LFUCG Site CR-5 is same location as KDOW WBP Site 10 (same record coordinates)

D. Monitoring Implementation Overview

Details and results of each of the monitoring activities performed for this WBP are provided in the following technical reports:

<u>KDOW WBP Monitoring</u>

- Severe Erosion Survey Report (Third Rock, 2016c; Appendix G)
- Biological and Habitat Monitoring Report (Third Rock, 2017a; Appendix H)
- Combined Water Quality Monitoring and Quality Assurance Project Report (Third Rock, 2017b; Appendix I)

<u>LFUCG WFMP</u>

- Cane Run WFMP Stream Corridor Characterization Technical Memorandum (Third Rock, 2018a; Appendix J)

- Cane Run WFMP Stream Biology Technical Memorandum (Third Rock, 2018b; Appendix K)
- Cane Run WFMP Water Quality Technical Memorandum (Third Rock, 2018e; Appendix L)
- Cane Run WFMP Discharge Prevention / Source Investigation Technical Memorandum (Third Rock, 2018d; Appendix M)
- Cane Run WFMP Priority Area Upland Assessment Technical Memorandum (Third Rock, 2018c; Appendix N)

A summary of the monitoring results and analysis of the designated use impairment sources are detailed in the next chapter.

IV. ANALYSIS

Historic biological monitoring data summarized in **Chapter III** was analyzed to characterize the condition of the aquatic life, habitat, and water quality in the Cane Run watershed. The criteria utilized to analyze habitat, biological, and water quality data (using health grades) is described in **Chapter III**. When available, **Chapter IV** focuses on analysis of the data collected by KDOW and LFUCG specifically to fill gaps in the historic monitoring data.

A. Aquatic Community and Habitat

1. Fish

Historic biological monitoring data (summarized in **Chapter III**) was used to characterize the fish community in the Cane Run watershed. Nineteen species of fish have been collected by LFUCG at two monitoring stations in the Cane Run watershed from 2003 to 2016. The list includes stoneroller (*Campostoma anomalum*), striped shiner (*Luxilus chrysocephalus*), scarletfin shiner (*Lythrurus fasciolaris*), bluntnose minnow (*Pimephales notatus*), fathead minnow (*P. promelas*), white sucker (*Catostomus commersoni*), black bullhead (*Ameiurus melas*), brown bullhead (*A. nebulosus*), yellow bullhead (*A. natalis*), mosquitofish (*Gambusia affinis*), banded sculpin (*Cottus carolinae*), green sunfish (*Lepomis cyanellus*), warmouth (*L. gulosus*), bluegill (*L. macrochirus*), longear sunfish (*L. megalotis*), spotted bass (*Micropterus punctulatus*), largemouth bass (*M. salmoides*), fantail darter (*Etheostoma flabellare*), and orangethroat darter (*E. spectabile*). This community has been scored anywhere from “excellent” to “poor” according to KDOW index criteria narrative scores detailed in **Chapter III**). However, drawing conclusions from the fish community at the upstream station (CR-S2 = Site 11 for water quality data collected for this plan = Site CR-5 where water quality data was collected for this plan as part of LFUCG watershed-focused monitoring) is difficult due to the karst nature of Cane Run and the low number of individuals and species encountered at this station.

At the more downstream station near Berea Road, 14 to 15 species were collected each year, but at the more headwater site, which is more susceptible to drying, only four to six species were identified per year. Of the 19 total species, two (black and brown bullhead) were only collected during one year.

Small fish were collected from the groundwater monitoring well at the Kentucky Horse Park during the monitoring. This indicates that the fish species in the surface streams are being washed into the Royal Springs Karst Conduit and reside there.

2. Macroinvertebrates

Macroinvertebrate sampling was performed in 2016 and 2017 for this WBP. Macroinvertebrate Bioassessment Index (MBI) scores calculated for the 11 sampling stations in the Cane Run watershed (Third Rock, 2017a; Appendix H) resulted in classifications of "poor" at six sites, "fair" at four sites, and "excellent" at one site (per ratings for Bluegrass Bioregion detailed in **Chapter III**). A summary of this data is included in **Table 30**, page 70. All headwater streams (Sites 3, 4, 6, 10/CR-5, CR-4, and CR8) had "poor" ratings. Wadeable locations of Sites 2, 5, 7, and 9 all had "fair" ratings. Wadeable location of Site 1 (most downstream site) had an "excellent" rating. Compared to historic data for Site 1 (KDOW sample in 2009 rated "fair"), this site has improved. Generally, MBI scores increased from upstream site to downstream sites. For the headwater streams in particular, the karst influence causes streams to frequently go dry, thus impacting the diversity and viability of the macroinvertebrate community.

The low MBI scores observed in the Cane Run watershed are the result of several conditions, most of which are re-occurring at each of the sampling stations. All stations were low in the number of pollution intolerant EPT (ephemeroptera, plecoptera, and trichoptera, commonly known as mayflies, stoneflies, and caddisflies) taxa. Decreased EPT abundance is associated with the presence of poor water quality and/or poor habitat conditions. Stations were also relatively low in overall genus taxa richness, also indicative of decreasing water quality, habitat diversity, and habitat suitability. Abundance of generally pollution tolerant midges and oligochaeta was highest at Sites 5, 6, 7 and 10/CR-5, indicating decreasing water quality conditions at these locations. Site 1, with the "excellent" rating had the highest percentage of primary clinger abundance, indicating that more silt free substrates are present in this location.

Site 9 and much of its watershed is located within University of Kentucky farms and has had riparian restoration improvement occur upstream. Compared to historic sampling of this reach, it appears that the improvements in habitat have contributed to improvements to the macroinvertebrate community (historically rated "poor", now rates "fair"). Site CR-4 should see future improvements in macroinvertebrate ratings; a stream restoration project on Cane Run in proximity to this monitoring reach was constructed in 2018; as the riparian vegetation grows and the project stabilizes, the macroinvertebrate community at this site should also improve.

TABLE 30
MACROINVERTEBRATE SAMPLING RESULTS SUMMARY

Metric	**Site ID**										
	1	2	3	4	5	6	7	9	10 / CR-5[1]	CR-4	CR-8
Date Sampled	6/17/16	6/17/16	3/21/17	3/21/17	6/16/16	3/21/17	8/25/16	6/16/16	4/28/17	2/23/17	2/23/17
Taxa Richness-genus level	50	58	8	13	47	23	43	35	23	35	13
EPT Richness-genus level	14	13	3	0	6	0	4	7	3	6	1
mHBI	5.02	5.70	7.84	7.83	5.84	5.42	7.82	5.50	5.72	5.82	7.05
% modified EPT	26.3	15.3	0.34	0	5.9	0	29.4	3.3	5.6	9.3	0.3
% Mayflies[2]	-	-	0	0	-	0	-	-	0.3	1.9	0
% Midges & Worms	7.7	9.3	0.34	0	33.6	40.7	25.6	7.9	51.6	11.1	2.3
% Clingers	76.8	22.1	0.34	0	31.2	24.8	29.4	19.1	7.7	15.1	0.3
MBI Score	**70.5**	**55.8**	**21.7**	**21.4**	**44.6**	**27.2**	**43.9**	**44.1**	**24.2**	**36.5**	**23.2**
MBI Rating[3]	**Excellent**	**Fair**	**Poor**	**Poor**	**Fair**	**Poor**	**Fair**	**Fair**	**Poor**	**Poor**	**Poor**

[1] Site 10 (CR-5) drainage area is slightly greater (5.5. mi^2) than the headwater designation (5 mi^2) but is considered a headwater stream due to its karst nature.

[2] Metric %mayflies only used for headwater stream MBI calculations.

[3] For headwater streams of the Bluegrass Bioregion, an MBI score of 0-18 is "very poor", 19-38 "poor", 39-50 "fair", 51-57 "good", 58 and greater "excellent". For wadeable streams of the Bluegrass Bioregion, an MBI score of 0-20 is "very poor", 21-40 "poor", 41-60 "fair", 61-69 "good", and greater than 69 "excellent".

In 2017, LFUCG used student volunteers to perform screening-level macroinvertebrate assessments using Kentucky Watershed Watch techniques as part of a Stream Corridor Characterization effort performed within the portion of the Cane Run watershed located within LFUCG's Urban Service Area (Third Rock, 2018a; Appendix J). Macroinvertebrates were rapidly assessed at 27 reaches spread across the LFUCG Urban Service Area; 21 reaches had a biotic rating of "poor"; six reaches had a biotic rating of "fair".

The recent results are consistent with historic macroinvertebrate assessments. Restoration efforts towards improving stream and riparian habitat in the watershed through riparian zone widening, stream restoration, streamside wetland creation, and other efforts should be a focus of the BMP implementation plan. BMPs that focus on increasing infiltration, reducing stormwater runoff, and increasing stream base flows could be beneficial for restoring a stream flow regime more conducive to supporting stream biology.

3. Habitat

Habitat assessments were performed in 2016 and 2017 for this WBP. Habitat assessments (RBP) were performed for the 11 sampling stations in the Cane Run watershed (Third Rock, 2017a; Appendix H) at the time of macroinvertebrate sampling. Habitat ratings were "poor" at six sites, "fair" at three sites, and "good" at two sites (per ratings for Bluegrass Bioregion detailed in **Chapter III**). All headwater streams (Sites 3, 4, 6, 10/CR-5, CR-4, and CR8) had "poor" ratings. Wadeable locations of Sites 2, 5, and 7 had "fair" ratings. Wadeable locations of Sites 1 and 9 had "good" ratings. A summary of this data is included in **Table 31**, page 72.

Most of the habitat parameters rated in the suboptimal or marginal categories, with narrow riparian vegetation zone being the most impacted habitat parameter contributing to the poor overall scores (median score in low part of marginal range). Epifaunal substrate/available cover and velocity/depth regime were the next most impacted habitat parameters across all sites.

In 2017, LFUCG used student volunteers to perform stream habitat assessments (RBP) as part of a Stream Corridor Characterization effort performed within the portion of the Cane Run watershed located within LFUCG's Urban Service Area (Third Rock, 2018a; Appendix J). RBP assessments were performed at 32 reaches spread across the Urban Service Area; 26 reaches had a habitat rating of "poor", three had a rating of "fair", and three had a rating of "good". Poor ratings were associated with lack of riparian zone width, indicators of channel instability, presence of features associated with erosion and sediment deposition, and overall lack of in-stream habitat/substrate/cover.

The recent results are consistent with historic habitat assessments. Restoration efforts towards improving stream and riparian habitat in the watershed through riparian zone widening, stream restoration, streamside wetland creation, and other efforts should be a focus of the BMP implementation plan. The aerial assessment of the riparian corridor in **Chapter 11** identified numerous areas in which the riparian corridor is impacted and could be expanded to improve stream habitat.

TABLE 31
HABITAT ASSESSMENT (RBP) RESULTS SUMMARY

Parameter	Site ID											
	1	2	3	4	5	6	7	9	10 / CR-5[1]	CR-4	CR-5	CR-8
Date Sampled	6/17/16	6/17/16	3/21/17	3/21/17	6/16/16	3/21/17	8/25/16	6/16/16	4/28/17	2/23/17	4/28/17	2/23/17
Headwater (H) or Wadeable (W)	W	W	H	H	W	H	W	W	H	H	H	H
Epifaunal Sub/Available Cover	14	11	8	7	10	16	13	12	5	11	5	7
Embeddedness	15	11	12	11	14	8	15	13	10	15	10	12
Velocity Depth Regime	12	11	4	6	12	13	8	10	11	12	11	6
Sediment Deposition	15	13	17	12	13	12	15	14	5	16	5	8
Channel Flow Status	15	16	11	12	14	16	12	16	12	13	12	6
Channel Alteration	15	14	5	12	14	13	16	16	15	15	15	14
Freq. of Riffles (or Bends)	16	5	5	8	8	11	9	16	13	13	13	14
Bank Stability	16	15	20	18	15	13	14	15	2	14	2	8
Vegetative Protection	12	14	8	6	11	16	13	17	2	12	2	4
Riparian Zone Width	6	8	2	2	5	6	6	9	0	16	0	5
RBP Score	**136**	**118**	**92**	**94**	**116**	**124**	**121**	**138**	**75**	**137**	**75**	**84**
RBP Rating[2]	**Good**	**Fair**	**Poor**	**Poor**	**Fair**	**Poor**	**Fair**	**Good**	**Poor**	**Poor**	**Poor**	**Poor**

[1] Site 10 drainage area is slightly greater (5.5. mi^2) than the headwater designation (5 mi^2) but is considered a headwater stream due to its karst nature.

[2] RBP scoring criteria for wadeable streams of the Bluegrass Bioregion: 0-113 Poor, 114-129 Fair, 130-200 Good. For headwater streams of the Bluegrass Bioregion: 0-141 Poor, 142-155 Fair, 156-200 Good.

B. Pollutant Concentrations and Health Grades

Full compilation of pollutant concentration data for the KDOW WBP monitoring sites (Sites 1 through 11) is included in the Combined Water Quality Monitoring and Quality Assurance Project Report (Third Rock, 2017b; Appendix I). Full compilation of pollutant concentration data for the LFUCG watershed-focused monitoring sites (Sites CR-11 through CR-12) is included in the Cane Run Watershed-Focused Monitoring Water Quality Technical Memorandum (Third Rock, 2018e; Appendix L). Within this chapter, some modifications were made to the analyses performed on the LFUCG data in the above-referenced technical memorandum so that the analyses matched those used for the KDOW WBP monitoring data. Specifically, the analyses performed in this chapter for the LFUCG data ensured that the same benchmarks were used for determining health grades in both datasets (LFUCG data was initially analyzed in the technical memorandum using different benchmarks for conductivity, ammonia-nitrogen, nitrate-nitrogen, and total phosphorus).

Relevant data from both efforts is summarized and included in the following sections. **Table 32** (page 74) summarizes average pollutant concentrations and health grades for *E. coli* and nutrients. Health grades for *E. coli* and nutrients are spatially depicted on **Exhibits 29** through **33** (Appendix A) by coloring the incremental drainage area of the site where the grade was assessed. Average concentrations and health grades are included in a subsequent section for *in-situ* water quality parameters.

1. Pathogens

Results indicate that all locations exceeded the PCR use levels for *E. coli* during the study periods, with Sites 2, 10/CR-5, CR-2, CR-6, CR-7, CR-8, CR-9, CR-10, CR-11, and CR-12 exceeding the PCR standard most frequently and receiving "F" health grades for the PCR use **Table 32** (page 74). Several sites also show impairment for the SCR use due to elevated *E. coli* concentrations, though to a lesser degree. The headwater sites closer to Lexington were most impaired for the SCR use, with sites 10/CR-5, CR-6, CR-7, CR-8, CR-9, CR-10, CR-11, and CR-12 receiving "F" health grades. Note, Site 10/CR-5 received "F" grades for both PCR and SCR per either dataset (the Site 10 data collected for this plan or the Site CR-5 data collected by LFUCG). For PCR, Site 11/CR-3 received a "D" grades per both datasets. However, considering the SCR benchmark, the dataset for CR-3 yielded an "A" grade, while the Site 11 dataset yielded a "B" grade. Generally, an "A" or "B" grade indicates that a location is fully supporting the designated use, while "C" grades indicate partially supporting the use, and "D" or "F" grades indicate the use is not supported.

In the samples for Sites 1 through 11, the laboratory did not analyze sample dilutions for most events (budget constraints), thus this *E. coli* dataset is biased low (Third Rock, 2017b; Appendix I). Thus, the average of results for each site was utilized for pollutant load analysis (vs. geomean, which is commonly used to evaluate *E. coli* data). Though dilutions were performed during analysis of the LFUCG data, average *E. coli* concentrations were also evaluated for the LFUCG watershed-focused monitoring data.

TABLE 32
AVERAGE CONCENTRATIONS AND HEALTH GRADES FOR E. COLI AND NUTRIENTS

Site ID	Count[1]	*E. coli* (MPN/ 100mLs)			Ammonia-Nitrogen (mg/L)		Total Nitrogen or Nitrate-Nitrogen[2] (mg/L)		Total Phosphorus (mg/L)	
		PCR (Swimming) Grade	SCR (Wading) Grade	Avg. Conc.	Grade	Avg. Conc.	Grade	Avg. Conc.	Grade	Avg. Conc.
1	12 (17)	D	B	317	A	0.00	C	2.23	B	0.27
2	12 (17)	F	C	753	B	0.03	B	2.12	B	0.30
3	5 (10)	B	A	282	A	0.00	C	4.06	A	0.29
4	10 (15)	D	B	537	A	0.00	A	1.02	A	0.25
5	12 (17)	D	C	678	D	0.22	F	3.25	F	0.51
6	12 (17)	F	D	907	F	1.31	F	4.18	F	0.63
7	9 (14)	B	A	130	A	0.00	B	1.51	B	0.20
8[3]	12 (17)	D	B	475	B	0.12	B	2.45	C	0.39
9	10 (15)	C	A	261	C	0.11	B	1.79	C	0.30
10[4]	10 (15)	F	F	1,327	A	0.03	B	2.47	D	0.46
11[5]	10 (15)	D	B	551	A	0.00	A	0.91	C	0.33
CR-1	6	D	D	682	A	0.03	A	1.62	C	0.36
CR-2	4	F	D	926	A	0.02	C	2.77	C	0.37
CR-3[5]	10	D	A	395	A	0.02	A	1.25	C	0.41
CR-5[4]	10	F	F	1,009	A	0.02	D	3.16	C	0.34
CR-6	10	F	F	2,608	A	0.02	F	3.44	C	0.34
CR-7	10	F	F	3,762	A	0.02	A	1.79	A	0.32
CR-8	4	F	F	1,793	A	0.03	C	3.08	A	0.26
CR-9	1	F	F	1,596	A	0.01	A	2.16	A	0.23
CR-10	2	F	F	1,660	A	0.03	A	2.69	A	0.25
CR-11	10	F	F	1,212	A	0.02	C	2.11	A	0.24
CR-12	10	F	F	24,308	C	0.29	C	2.60	C	0.40

[1] Instances of reduced number of samples due to dry conditions during sampling event (12 max. sampling events plus 5 additional *E. coli* samples for Sites 1 through 11 stations; 10 max. events for Sites CR-1 through CR-12)

[2] Total nitrogen for KDOW sites, but for LFUCG sties data was not sufficient to calculate total nitrogen loads, thus data for nitrate-nitrogen (likely the predominate form of total nitrogen) is presented.

[3] PCR, SCR, and WAH uses are not applicable for groundwater, however grades are presented for Site 8 for comparison with other sites

[4] Site 10 is same location as Site CR-5

[5] Site 11 is same location as Site CR-3

A summary table indicating the range (maximum and minimum) of *E. coli* values measured at each site for this plan, along with a comparison of average and geomean of *E. coli* values is included in **Table 33**.

TABLE 33
E. COLI CONCENTRATION DATA SUMMARY

Site ID	Count	Maximum	Minimum	Average	Geomean
1	17	1,203	41	317	227
2	17	2,420	17	753	390
3	10	1,753	26	282	119
4	15	2,420	11	537	198
5	17	2,420	54	678	402
6	17	2,420	56	907	532
7	14	579	3	130	54
8	17	2,420	10	475	145
9	15	1,643	14	261	133
10[1]	15	2,420	210	1,327	1,071
11[2]	15	2,420	23	551	250
CR-1	6	2,433	100	682	380
CR-2	4	2,133	202	926	660
CR-3[2]	10	1,211	50	395	271
CR-5[1]	10	1,849	202	1,009	810
CR-6	10	14,209	100	2,608	1,171
CR-7	10	12,229	860	3,762	2,633
CR-8	4	3,592	852	1,793	1,489
CR-9	1	1,596	1,596	1,596	1,596
CR-10	2	2,109	1,211	1,660	1,598
CR-11	10	4,103	202	1,212	876
CR-12[3]	10	98,039	413	24,308	5,139

[1] Site 10 is same location as Site CR-5

[2] Site 11 is same location as Site CR-3

[3] Geomean *E. coli* concentration was used in loading calculations for CR-12; average *E. coli* concentration was used in loading calculations for all other sites

For Sites 1 through 11, six *E. coli* samples were collected in May 2017 for specific evaluation of impairment of recreation use; for those six samples, the geomean was evaluated (Third Rock, 2017b; Appendix I). A summary of the results from this effort is included in **Table 34**, page 76. For PCR, when the PCR limit was exceeded, it was exceeded for both the 30-day geomean standard and the percent of exceedances standard. This was true for all sites, except for Site 9. For SCR, both the 30-day geomean and the percent of exceedances standards were over thresholds at Sites 5, 6, and 10. For SCR, the 30-day geomean was not exceeded at Site 4, though the site is indicated as impaired for the SCR based on the percent of exceedances.

TABLE 34
E. COLI GEOMEAN CONCENTRATIONS AND EXCEEDANCES FOR SIX EVENTS MAY 2017

Site ID	Compared to PCR (Swimming) Use Levels			Compared to SCR (Wading) Use Levels		
	Geomean	Count of Exceedances	Percent of Exceedances	Geomean	Count of Exceedances	Percent of Exceedances
1	341	4	67%	341	1	17%
2	277	4	67%	277	0	0%
3	143	2	33%	143	1	17%
4	343	3	50%	343	2	33%
5	668	5	83%	668	3	50%
6	956	5	83%	956	4	67%
7	165	2	33%	165	0	0%
8	520	3	50%	520	3	50%
9	126	1	17%	126	0	0%
10	1,248	6	100%	1,248	5	83%
11	405	4	67%	405	1	17%

Note: Yellow shading indicates exceedance of PCR standard. Blue shading indicates exceedance of SCR standard. Grey shading indicates that PCR and SCR uses are not applicable for groundwater.

Data collected for this watershed-based plan, as well as historic data, indicate that the most significant pollutant causing impairment to Cane Run and its tributaries is pathogens (as indicated by elevated *E. coli* and fecal coliform). Measuring fecal-indicator bacteria concentrations can provide general information on the fecal contamination likely occurring at a given stream site; however, it does not identify the contamination source. Microbial source tracking was conducted at most sites to help determine the source of the fecal-indicator bacteria. Specific genetic markers are used to test for sources of fecal pollution using quantitative polymerase chain reaction. When a marker is detected in a water sample it is indicative of the presence of fecal waste from the given host, but if a marker is not detected the source is not necessarily absent. If enough copies of a marker are detected for a sample, the copies can be quantified and a value for "copies per sample volume", analogous to "marker concentration" can be reported for the sample. It should be noted that these are individual methods of quantification for each marker – quantified values of one marker cannot be compared to quantified values of another marker. But, comparisons of quantified values for a given marker can be made among sites.

For this plan, the laboratories, methods, and genetic markers were different for the KDOW WBP monitoring sites than those applied to the LFUCG watershed-focused monitoring sites. For Sites 2, 4, 5, 6, 8, 9, 10, and 11(locations with recurring high *E. coli* levels during the study period), microbial source tracking analyses were performed by UK ERTL using a human marker and a ruminant marker (includes horses, cattle, and deer; Third Rock, 2017b;

Appendix I). For a stormwater outfall draining to CR-5, a stormwater outfall draining to CR-6, CR-7, a stormwater outfall draining to CR-10, stormwater outfalls draining to CR-11, and a stormwater outfall draining to CR-12 (also locations with recurring high E. coli levels during the study period) microbial source tracking analyses were performed by the laboratory of Dr. Alice Layton at the University of Tennessee (UT) using a human marker and a bovine (cattle) marker (Third Rock, 2017d; Appendix M). The human genetic marker used by UK ERTL was not the same human marker used by UT, though both are indicative of human-sources fecal contamination.

Of the KDOW sites evaluated and yielding satisfactory data, results indicated low levels of human markers were detected at Sites 5, 6, and 10 (no quantifiable difference between these three sites). Microbial source tracking indicated the presence of the ruminant (presumed cattle) marker at Site 2.

Of the LFUCG sites evaluated, the sites deemed to have the greatest human fecal contamination were a stormwater outfall (15506) draining to CR-6, a stormwater outfall (15008) draining to CR-5, a stormwater outfall (15027) draining to CR-12, CR-7, and stormwater outfalls (15019, 15021) draining to CR-11; these locations are listed in order of the quantity of marker copies detected from greatest to least, such that the highest number of human marker copies was quantified for the outfall draining to CR-6 and the lowest number of human marker copies was quantified for outfall 15021, draining to CR-11.

Table 35 (page 78) summarizes the detections of microbial source tracking markers for all sites. Microbial source tracking results confirm human sources of pathogens, likely due to sanitary sewer infrastructure problems. As mentioned previously, LFUCG has a robust program to address SSOs and pollution from the public system; significant improvements to the sanitary sewer infrastructure are ongoing or planned under the LFUCG remedial measures plans. Rehabilitation of the sanitary sewer network in particular neighborhoods, including private lateral lines, beyond what is addressed by the remedial measure plans may be required. Several neighborhoods within the Cane Run watershed were constructed prior to the 1970s, and many houses still have Orangeburg or clay lateral lines which need replacement.

TABLE 35
MICROBIAL SOURCE TRACKING RESULTS SUMMARY

Site ID	Marker Detections	Suspected Fecal Source
1	No MST performed	Unknown
2	Cattle Detections; No Human Detections	Cattle
3	No MST performed	Unknown
4	No Cattle Detections; No Human Detections	Unknown
5	No Cattle Detections; Human Detection	Human
6	No Cattle Detections; Human Detection	Human
7	No MST performed	Unknown
8	No Cattle Detection; No Human Detection	Unknown
9	No Cattle Detection; No Human Detection	Unknown
10[1]	No Cattle Detections; Human Detections	Human
11[2]	No Cattle Detections; No Human Detections	Unknown
CR-1	No MST performed	Unknown
CR-2	No MST performed	Unknown
CR-3[2]	No MST performed	Unknown
CR-5[1]	Human Detections at stormwater outfall draining to this site	Human
CR-6	Human Detections and weak positive detection of optical brightener at stormwater outfall draining to this site; Bovine Detection at stormwater outfall draining to this site	Human; Cattle (low)
CR-7	Human Detection at this site	Human
CR-8	No MST performed	Unknown
CR-9	No MST performed	Unknown
CR-10	MST performed at stormwater outfall draining to this site, but detection was below threshold to indicate Human Detection	Unknown
CR-11	Human Detections at stormwater outfalls draining to this site	Human
CR-12	Human Detections and weak positive detection of optical brightener at stormwater outfall draining to this site	Human

[1] Site 10 is same location as Site CR-5

[2] Site 11 is same location as Site CR-3

2. Nitrogen

Nitrogen is a critical nutrient used by plants but is not characteristically present at high levels in streams, unless received from a leaky or poorly functioning sewer infrastructure or septic systems, discharged by a wastewater treatment plant, or applied to adjacent lands as fertilizer or organic waste in amounts higher than can be incorporated into lawns/crops/pastures or lost to the atmosphere through volatilization or denitrification.

Nitrate is generally the dominant form of nitrogen when in-stream nitrogen is elevated, which was generally true for the data collected for this plan at Sites 1 through 11. Nitrate concentrations ranged from <0.025 mg/L to 5.70 mg/L for Sites 1 through 11. For those sites, sufficient data was produced to calculate total nitrogen (total nitrogen = nitrate-nitrogen + nitrite-nitrogen + TKN. At most sites (with the exception of Site 9 where the average ratio was only 46% and Site 6 where the average ratio was only 55%), the ratio of nitrate-nitrogen concentration to total nitrogen was 70 to 80%, indicating that most of the time, the total nitrogen at each site is in the more reactive, inorganic form. Sites 6 and 9 had larger contributions from organic nitrogen (TKN + ammonia-nitrogen). Total nitrogen concentrations were routinely above the 3.0 mg/L benchmark at Sites 1, 3, 5, and 6, with Sites 5 and 6 receiving a "F" health grade (**Table 32**, page 74).

For LFUCG sites (CR-1 through CR-12) data was not sufficient to calculate total nitrogen loads (only nitrate-nitrogen and ammonia-nitrogen were measured) so for these sites nitrate-nitrogen was compared to the benchmark value (3 mg/L) and was used to define the health grades included in **Table 32** (page 74). Nitrate-nitrogen concentrations ranged from 0.48 mg/L to 4.67 mg/L for Sites CR-1 through CR-12. Nitrate-nitrogen concentrations were routinely above the 3.0 mg/L benchmark at Sites CR-2, CR-5, CR-6, CR-8, CR-11, and CR-12, with Site CR-5 receiving a "D" health grade and Site CR-6 receiving a "F" grade. Considering the nitrogen benchmark, both the dataset for Site 11 and CR-3 yielded an "A" grade, however the dataset for Site 10 yielded an "B" grade, while the CR-5 dataset yielded a "D" grade. Nitrate is commonly associated with runoff from areas where fertilizer has been applied.

For ammonia-nitrogen, most sites received "A" health grades. Note, both Site 10/CR-5 and 11/CR-3 received "A" grades for ammonia-nitrogen per either dataset. Ammonia-nitrogen was not detected at Sites 1, 3, 4, 7, 11 during sampling. However, sites 5, 6, 9, and CR-12 had exceedances of ammonia-nitrogen over the benchmark level that resulted in grades of "D", "F", "C", and "C", respectively. By far the highest concentrations were measured at Site 6, where the average ammonia-nitrogen was 1.31 mg/L. Ammonia-nitrogen was still elevated at site 5 (average was 0.22 mg/L), located on Cane Run downstream of site 6. These sites are located downstream of three failing package wastewater treatment plants, in addition to a large dump, a landscaping business, and multiple horse farms. Site CR-12 is a headwater site draining older Lexington residential and developed areas. Ammonia-nitrogen is typically elevated near sources of human (or animal) waste discharge.

Ammonia-nitrogen represents the total of ammonia in both its ionized (NH_4^+) and un-ionized (NH_3) forms. Ammonia-nitrogen can be converted to nitrate- and nitrite-nitrogen by bacteria and then used by plants. The unionized form of ammonia-nitrogen is more toxic to fish and other aquatic life; the percentage of the unionized form is related to temperature and pH.

Higher temperature and/or pH increases the conversion of ammonia to the unionized form and in-stream toxicity increases. The fraction of total ammonia-nitrogen in the unionized form (mg/L) was calculated for sampling events where ammonia-nitrogen (mg/L), pH (SU), and temperature (°C) were available for a site using the following equations.

Equation 1. $pKa = 0.0902 + \left[\frac{2730}{273.2+Temp}\right]$

and

Equation 2. $Unionized\ Ammonia\ = 1.2\left[\frac{Ammonia\ N\ as\ N}{(1+10^{pKa-pH})}\right]$

The water quality standard for WAH designated uses was also reviewed for the fraction of unionized ammonia-nitrogen present. Unionized ammonia-nitrogen should be less than 0.05 mg/L to protect aquatic life from toxicity. No instances of unionized ammonia-nitrogen in excess of the standard were observed at any of the 22 sites (all were generally very low).

3. Phosphorus

Phosphorus is also a critical nutrient used by plants but should not be present at high levels in streams. Phosphorus can be contributed to streams through runoff, agricultural or sanitary wastes, fertilizers, and soil erosion. In freshwater systems, phosphorus is the limiting nutrient for algal/aquatic plant growth. When it is in excess, it can cause eutrophication, the excessive growth of algae/aquatic plants. This overgrowth ultimately leads to periods of low dissolved oxygen, which can cause the demise of aquatic organisms.

For Sites 1 through 11 total phosphorus and ortho-phosphorus (as phosphorus) were analyzed. Ortho-phosphorus is the dissolved form of phosphorus that is bioavailable for algae and plant growth. Total phosphorus includes particulate-bound phosphorus and other forms of phosphorus. With phosphorus-rich limestone geology in Central Kentucky, phosphorus levels are normally higher here than in surrounding regions. Still, even small increases in in-stream phosphorus can negatively affect water quality and biological conditions. For Sites 1 through 11, most of the measured phosphorus (around 80% on average) is ortho-phosphorus, the more reactive form. However, Sites 8, 9, and 10 did have a lower percentage of phosphorus in the ortho-phosphorus form, compared to the remaining sites. Ortho-phosphorus concentrations ranged from 0.014 to 1.10 mg/L, while total phosphorus ranged from 0.0051 to 1.4 mg/L.

For LFUCG sites (CR-1 through CR-12), samples were only analyzed for total phosphorus, with total phosphorus ranging from 0.19 mg/L to 1.07 mg/L. It is likely that much of this phosphorus is in the more reactive form of ortho-phosphorus as seen in the other samples.

Like for ammonia-nitrogen and total nitrogen, high total phosphorus concentrations and frequent exceedances of the benchmark were observed at Sites 5 and 6, resulting in "F" health grades at those two sites for total phosphorus (**Table 32,** page 74). Site 10 received a "D" health grade and Sites 11, CR-1, CR-2, CR-3, CR-5, and CR-6 received “C” health grades. Considering the phosphorus benchmark, both the dataset for Site 11 and CR-3 yielded an “A” grade, however the dataset for Site 10 yielded an “B” grade, while the CR-5 dataset yielded a “D” grade.

4. *In-Situ* Water Quality Data

Measured pH levels ranged from 6.3 to 8.8 SU during the monitoring period, all within the regulatory criteria (considers all 22 sites). The average of all sites was 7.6 SU, indicating slightly basic stream conditions typical of limestone geology. Average concentration and health grades per sites are not tabulated for pH since it was not found to be negatively impacting the WAH use.

Temperature results were within the desired range during all measurements. Averages and health grades per sites are not tabulated for temperature since it was not found to be negatively impacting the WAH use.

Specific conductance, or conductivity, levels ranged from 88 to 1480 µS/cm during the monitoring period (considers all 22 sites). Sites 1, 3, 4, 7, 9, CR-1, and CR-9 (only 1 measurement obtained at CR-9) never exceeded 650 µS/cm. Sites 2, 5, 6, 8, CR-2, CR-3, and CR-6 each regularly exceeded the benchmark, but average conditions were below the 650 µS/cm level. Conductivity at Sites 10, 11, CR-6, CR-7, CR-8, CR-10, CR-11, and CR-12 averaged conductivity levels in excess of the benchmark for the monitoring period. Sites 10, CR-7, CR-11, CR-12 all had conductivity values more than 1,000 µS/cm during at least one event. Sites 11, CR-2, CR-5, CR-6, CR-7, CR-8, CR-10, CR-11, and CR-12 all received an “F” health grade related to conductivity (as it relates to WAH). Considering the conductivity benchmark, the dataset for Site 10 yielded a “D” grade, while the CR-5 dataset yielded a “F” grade. The dataset for Site 11 yielded a “F” grade, while the CR-3 dataset yielded a “B” grade.

Conductivity measurements are highest for stations draining the developed Lexington area. Conductivity is a measure of the ability an electrical current to flow through a solution (stream water) and is increased in our region by geologic conditions. Conductivity in water is also affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge) that may not be from natural sources. Thus, high conductivity values could be related to runoff from impervious surfaces in the urban environment carrying road salts and other dissolved ions into waterways. However, many high readings occurred during summer months (not during periods when salt is applied to roads) and are potentially related to illicit discharges, urban pollutants, or failing sewer infrastructure. The average conductivity measured for each site and health grade for conductivity are included in **Table 36** (page 83).

Dissolved oxygen measurements were above the WAH instantaneous requirement of 4.0 mg/L for all sampling events at all sites, except for Site 6, located on the tributary along US 25, and Site 9, located on a University of Kentucky research farm, and Site CR-12, the headwater tributary draining downtown Lexington near Louden Avenue. Site 6 had low dissolved oxygen levels on July 18, 2016 (2.5 mg/L) which was also the date of the lowest flow conditions measured at the site. These low flow conditions paired with high ammonia, nitrogen, and phosphorus concentrations and the presence of algae downstream indicate that aquatic life may be negatively impacted based on pollutant concentrations at this site. It is expected that continuous dissolved oxygen monitoring at Site 6 would detect additional impacts. At Site 9, dissolved oxygen levels were less than 4.0 mg/L on July 18 and August 24, 2016 (3.3 and 3.8 mg/L, respectively). The site is located just downstream of an impoundment, a likely cause of the low dissolved oxygen. Site CR-12 had a dissolved oxygen measurement of 3.2 mg/L on July 18, 2017, but other readings at this location during the study were above the benchmark. In generally, low dissolved oxygen was not found to be a problem during most of the study and the majoring of sites; the average dissolved oxygen for all sites was 8.6 mg/L. The average concentration measured for each site and health grade for dissolved oxygen are included in **Table 36**, page 83.

For the KDOW sites (Sites 1 through 11), in-situ turbidity was measured. Turbidity measurements were typically less than 5 NTU at all of these sites. The groundwater well (Site 8) regularly had turbid waters with an average turbidity of 8.7 NTU. This indicates that the groundwater system is regularly transporting low levels of surface sediment through the conduit. During wet weather events, the most turbid waters were found at Site 10 (same location as CR-5) at Citation Boulevard, reaching as high as 150 NTU (average turbidity at this site was 20.4 NTU. Average turbidity at the other KDOW sites ranged from 1.9 to 6.6 NTU during the sampling period.

5. *Suspended Solids*

Most sampling for Sites 1 through 11 was conducted during dry weather, thus total suspended solids were low during most measurements. Site 10 showed a large total suspended solids concentration (199 mg/L) associated with the February 7, 2016 wet weather event. Sampling at LFUCG sites was not targeted to specific antecedent weather/flow conditions, but since sampling was performed with trained volunteers, sampling was never performed in especially high flow conditions. Total suspended solids concentrations were low for all LFUCG sites as well. Except for the one elevated sample at Site 10, all other total suspended solids results were below 50 mg/L. The Severe Erosion Survey Report produced for this WBP provides better focus areas for prioritizing sources of sediment in the Cane Run watershed (Third Rock, 2016c; Appendix G).

C. Pollutant Loads and Target Reductions

Pollutant load is the mass (i.e., pound) of given pollutant moving past a given point (i.e., monitoring site) per unit of time (i.e., year). For this WBP, pollutant loads and target reductions needed for pathogens and nutrients were computed for each of the 22 sites (KDOW and LFUCG). For each pollutant considered, the average pollutant concentration was multiplied by a predicted average annual flow value along with appropriate conversions to compute an annual load at each site.

Equation 3.

$$\text{Annual Load} = \text{Average Measured Concentration X Average Annual Flow X Conversion Factors}$$

TABLE 36
AVERAGE CONCENTRATIONS AND HEALTH GRADES FOR IN-SITU WATER QUALITY PARAMETERS

Site ID	Count[1]	Conductivity (uS/cm)		Dissolved Oxygen (mg/L)	
		Grade	Avg. Concentration	Grade	Avg. Concentration
1	12	A	558	A	10.3
2	12	C	611	A	9.9
3	5	A	427	A	9.0
4	10	A	449	A	9.0
5	12	C	598	A	10.6
6	12	C	577	B	8.1
7	9	A	512	A	10.1
8[1]	12	C	545	A	7.2
9	10	A	371	C	8.5
10[2]	10	D	751	A	8.8
11[3]	10	F	691	A	8.5
CR-1	6	A	574	A	8.1
CR-2	4	F	615	A	8.3
CR-3[3]	10	B	618	A	6.9
CR-5[2]	10	F	665	A	8.2
CR-6	10	F	630	A	7.2
CR-7	10	F	850	A	7.6
CR-8	4	F	760	A	8.0
CR-9	1	A	580	A	10.3
CR-10	2	F	675	A	9.1
CR-11	10	F	939	A	9.3
CR-12	10	F	776	B	6.4

[1] WAH use not applicable for groundwater, however grades are presented for Site 8 for comparison with other sites

[2] Site 10 is same location as Site CR-5

[3] Site 11 is same location as Site CR-3

On exception is that for Site CR-12, the geomean concentration of *E. coli* was used instead of the average concentration (both values are included for comparison in **Table 33**, page 75). As mentioned previously, for the samples from Sites 1 through 11, the laboratory did not analyze sample dilutions for most events (budget constraints), thus *E. coli* values in this dataset are biased low (Third Rock, 2017b; Appendix I). To offset the low bias, the average of results for each site was utilized for pollutant load analysis (vs. geomean, which is commonly used to evaluate *E. coli* data). Though dilutions were performed during analysis of the LFUCG data, average *E. coli* concentrations were also used to compute loads for the LFUCG watershed-focused monitoring data. As seen in **Table 33**, page 75, average and geomean *E. coli* values are similar, however, using the average *E. coli* value does result in higher estimations of pollutant loads. Because the range of *E. coli* values at Site CR-12 was so large and the average value at that site was uncharacteristically high compared to other sites, the geomean was used for the loading calculations at that site.

To calculate the target or benchmark load for each site and pollutant, the same process was utilized, substituting the benchmark pollutant concentration for the average measured concentration.

Equation 4.

$$\text{Benchmark Load} = \text{Benchmark Concentration X Average Annual Flow X Conversion Factors}$$

Pollutant reductions needed to reach benchmark levels were then calculated by subtracting the benchmark loads from the existing annual loads. The percent reduction is the load reduction needed divided by the existing annual load for a given site. These reductions were then further divided into the incremental sub-drainages by subtracting reductions focused in upstream areas from downstream areas.

Available USGS data within the Cane Run watershed was considered when determining a flow estimate for each monitoring site for load calculation. Historic data indicates that because of the heavy interaction between surface and groundwater, strict area-weighted scaling of a USGS gage flow would not produce accurate flow measurements for the individual monitoring stations. Therefore, drainage areas of each monitoring site were adjusted, based on previously mapped sink points, to determine the land area typically contributing to routine stream flows.

Comparing measured flows during sampling events with the USGS gages located in the watershed showed that the sampling events represented all flow levels, but with some bias toward lower flows. Therefore, median flow from a long-term USGS record was chosen to compute annual loads.

The median flow (1.4 cfs) was computed from the long-term flow record at the USGS gage on the tributary to Cane Run at Newtown Pike (site 03288190). This gage is in an area of the watershed where few karst sinks have been mapped, therefore most drainage is through surface flow. This flow was then scaled for each sampling site based on dry weather drainage area (considering karst drainage patterns); this produced a predicted median flow for each site used to compute pollutant loads.

One exception was Site 10/CR-5 at Citation Boulevard. There is a USGS gage on Cane Run at this location (site 03288180), so for Site 10/CR-5 the median flow was computed from the long-term flow record (1.6 cfs) and used directly for this site's load calculations. The flow at this location is primarily fed from a spring-fed tributary downstream of a large neighborhood and is not representative of non-spring fed streams/locations.

Another exception in determining flow for loading calculations was Site 8. For Site 8, the groundwater well at the Kentucky Horse Park, a water depth data logger installed by KGS was utilized to estimate the average flow of groundwater being transported from Fayette County sources to Royal Springs (11 cfs was used for load calculations).

The estimated median flow for each site used in pollutant loading calculations is included in tables of loads for each evaluated pollutant that follow.

1. Pathogens

The annual loads calculated for *E. coli* are summarized in **Table 37**, page 86, along with target loads for both the PCR and SCR benchmarks (per water quality standards) and the reductions required to meet those targets. All sites except Site 7 require *E. coli* reductions to meet the PCR target load, and 13 of the 22 sites require load reductions to meet the SCR target. Considering total load needed to reach the benchmark level (not % or incremental), Sites 2 and CR-12 require the largest *E. coli* reductions to meet safe conditions for swimming and wading (45 and 46.7 trillion/year, respectively). On a percentage basis, the sites draining Lexington (10/CR-5, CR-6, CR-7, CR-8, CR-9, CR-10, CR-11, and CR-12) require the largest *E. coli* reductions. Pollutant yield (existing annual pollutant load per unit dry weather drainage area), was tabulated for each site to see the drainage areas contributing the most pollutant. Reviewing the data based on yield indicates that Sites CR-6, CR-7, and CR-12 are contributing the most *E. coli* on a unit area basis. Considering incremental reductions to meet benchmarks, Sites 2, 6, 10, CR-10, CR-12 need focus.

Exhibits 29 and **30** (Appendix A) illustrate the health grade (based on concentration data) for both PCR and SCR uses, load reduction needed to achieve both uses, and potential sources of fecal-related bacteria based on the microbial source tracking results.

TABLE 37
ANNUAL E. COLI LOADS AND REDUCTIONS NEEDED

Site ID	Dry Weather Drainage Area (mi^2)	Average Concentration (mg/L)	Estimated Median Flow (cfs)	Annual Load (trillion/year)			Existing Annual Pollutant Yield (trillion/yr/mi^2)	Load Reduction Needed to Reach Benchmark (%)		Load Reduction Needed to Reach Benchmark (trillion/year)		Incremental Load Reduction Needed to Reach Benchmark (trillion/year)	
				Existing	PCR Benchmark (240/100 mLs)	SCR Benchmark (676/100 mLs)		PCR Benchmark (240/100 mLs)	SCR Benchmark (676/100 mLs)	PCR Benchmark (240/100 mLs)	SCR Benchmark (676/100 mLs)	PCR Benchmark (240/100 mLs)	SCR Benchmark (676/100 mLs)
1	13.05	317	12.4	35	27	75	2.7	23%	-	8	-	-	-
2	10.31	753	9.9	66	21	59	6.4	68%	11%	45.0	7	18	7
3	0.56	282	0.5	1.3	1.1	3.1	2.3	15%	-	0.2	-	0.2	-
4	0.52	537	0.5	2.3	1	2.9	4.4	57%	-	1.3	-	1.3	-
5	5.77	678	5.6	34	12	34	5.9	65%	-	22	-	-	-
6	4.40	907	4.4	35	9.3	26	8.0	73%	26%	26	9	26	9
7	0.17	130	0.2	0.18	0.34	0.96	1.1	-	-	-	-	-	-
8	19.90	475	11.0	46	23	66	2.3	50%	-	23	-	4	-
9	2.90	261	2.7	6.3	5.8	16	2.2	8%	-	0.5	-	0.5	-
10	1.50	1,327	1.6	19	3.4	9.6	12.7	82%	49%	15.6	9.4	15.6	9.4
11	1.30	551	1.2	6	2.6	7.3	4.6	57%	-	3.4	-	3.4	-
CR-1	1.50	682	1.4	8.4	3.0	8.3	5.6	64%	1%	5.4	0.1	0.8	-
CR-2	0.54	926	0.5	4.1	1.1	3.0	7.6	73%	27%	3.0	1.1	3.0	1.1
CR-3	1.30	395	1.2	4.2	2.6	7.3	3.2	38%	-	1.6	0.0	1.6	-
CR-5	1.50	1,009	1.6	14.0	3.4	9.6	9.3	76%	31%	10.6	4.4	-	-
CR-6	0.16	2,608	0.1	3.4	0.3	0.9	21.5	91%	74%	3.1	2.5	3.1	2.5
CR-7	0.39	3,762	0.4	12.0	0.8	2.2	30.9	94%	82%	11.2	9.8	11.2	9.8
CR-8	0.31	1,793	0.3	4.6	0.6	1.7	14.8	87%	63%	4.0	2.9	-	-
CR-9	0.35	1,596	0.3	4.6	0.7	1.9	13.3	85%	59%	3.9	2.7	3.9	2.7
CR-10	1.67	1,660	1.5	23.0	3.3	9.3	13.8	86%	60%	19.7	13.7	19.7	13.7
CR-11	1.75	1,212	1.6	18.0	3.5	9.8	10.3	81%	46%	14.5	8.2	-	-
CR-12	1.15	5,139	1.1	49.0	2.3	6.4	42.6	99%	97%	46.7	42.6	46.7	42.6

Note: Sites 10 and CR-5 are same location and Sites 11 and CR-3 are same location; For Site 10 incremental load shown here does not consider loads computed for the upstream LFUCG stations; For Site CR-5 incremental load does consider the upstream LFUCG stations; For Site CR-12 Geomean is listed in table instead of Average and Geomean is used to calculate *E. coli* load for this station

2. Nitrogen

The annual loads calculated for total nitrogen (for Sites 1 through 11) and nitrate-nitrogen (Sites CR-1 through CR-12) are summarized in **Table 38**, page 88, along with the target loads for the benchmark to support WAH (same benchmark value of 3.0 mg/L was used for both total nitrogen and nitrate-nitrogen target loads) and the reductions required to meet those targets. Most sites meet the target loads for total (or nitrate) nitrogen. Only Sites 3, 5, 6, CR-5, and CR-6 need nitrogen reductions to meet the target loads aiming to protect in-stream aquatic life conditions, with Sites 3 and 6 requiring the largest reductions. Reviewing the data based on yield indicates that Sites 3 and 6 are contributing the most nitrogen on a unit area basis. **Exhibit 31** (Appendix A) illustrates the health grade (based on concentration data) and the incremental load reductions needed to achieve the benchmark.

For ammonia-nitrogen, the annual loads, target loads to support WAH, and reductions to meet targets are summarized in **Table 39**, page 89. Most sites meet the target loads for ammonia-nitrogen. Only Sites 5, 6, 8, 9, and CR-12 need ammonia-nitrogen reductions to meet the target loads aiming to protect in-stream aquatic life conditions, with Site 6 requiring the largest reduction. Reviewing the data based on yield indicates that Site 6 contributes the most ammonia-nitrogen by far on a unit area basis. **Exhibit 32** (Appendix A) illustrates the health grade (based on concentration data) and the incremental load reductions needed to achieve the ammonia-nitrogen benchmark.

3. Phosphorus

For total phosphorus, the annual loads, target loads to support WAH, and reductions to meet targets are summarized in **Table 40**, page 90. Most sites meet the target loads for total phosphorus, however, Sites 5, 6, 8, 9, CR-1, CR-2, CR-3, and CR-12 need phosphorus reductions to meet the target loads aiming to protect in-stream aquatic life conditions, with Site 6 requiring the largest reduction (same site requiring the largest total and ammonia-nitrogen reductions). Reviewing the data based on yield indicates that Site 6 contributes the most total phosphorus, followed by Site 10 on a unit area basis. **Exhibit 33** (Appendix A) illustrates the health grade (based on concentration data) and the incremental load reductions needed to achieve the total phosphorus benchmark.

TABLE 38
ANNUAL TOTAL NITROGEN OR NITRATE LOADS AND REDUCTIONS NEEDED

Site ID	Dry Weather Drainage Area (mi^2)	Average Concentration (mg/L)	Estimated Median Flow (cfs)	Annual Load (lbs/year)		Existing Annual Pollutant Yield (lbs/yr/mi^2)	Load Reduction Needed to Reach Benchmark (%)	Load Reduction Needed to Reach Benchmark (lbs/year)	Incremental Load Reduction Needed to Reach Benchmark (lbs/year)
				Existing	Benchmark (3.0 mg/L)				
1	13.05	2.23	12.4	54,000	73,000	4,100	-	-	-
2	10.31	2.12	9.9	41,000	58,000	4,000	-	-	-
3	0.56	4.06	0.5	4,200	3,100	7,500	26%	1,100	1,100
4	0.52	1.02	0.5	980	2,900	1,900	-	-	-
5	5.77	3.25	5.6	36,000	33,000	6,200	8%	3,000	
6	4.40	4.18	4.4	36,000	26,000	8,200	28%	10,000	10,000
7	0.17	1.51	0.2	470	940	2,800	-	-	-
8	19.90	2.45	11.0	53,000	65,000	2,700	-	-	-
9	2.90	1.79	2.7	9,500	16,000	3,300	-	-	-
10	1.50	2.47	1.6	7,800	9,400	5,200	-	-	-
11	1.30	0.91	1.2	2,200	7,200	1,700	-	-	-
CR-1	1.50	1.62	1.39	4,400	8,200	2,900	-	-	-
CR-2	0.54	2.77	0.50	2,700	2,900	5,000	-	-	-
CR-3	1.30	1.25	1.20	3,000	7,200	2,300	-	-	-
CR-5	1.50	3.16	1.60	9,900	9,400	6,600	5%	500	370
CR-6	0.16	3.44	0.15	990	860	6,300	13%	130	130
CR-7	0.39	1.79	0.36	1,300	2,100	3,300	-	-	-
CR-8	0.31	3.08	0.29	1,700	1,700	5,500	-	-	-
CR-9	0.35	2.16	0.32	1,400	1,900	4,000	-	-	-
CR-10	1.67	2.69	1.55	8,200	9,100	4,900	-	-	-
CR-11	1.75	2.11	1.62	6,700	9,600	3,800	-	-	-
CR-12	1.15	2.60	1.07	5,400	6,300	4,700	-	-	-

Note: Total nitrogen loads presented for KDOW Sites 1 – 11; for LFUCG sites, data was not sufficient to calculate total nitrogen loads, thus nitrate-nitrogen loads (likely the predominate form of total nitrogen based on KDOW dataset) is presented; Sites 10 and CR-5 are same location and Sites 11 and CR-3 are same location; For Site 10 incremental load shown here does not consider loads computed for the upstream LFUCG stations; For Site CR-5 incremental load does consider the upstream LFUCG stations

TABLE 39
ANNUAL AMMONIA-NITROGEN LOADS AND REDUCTIONS NEEDED

Site ID	Dry Weather Drainage Area (mi^2)	Average Concentration (mg/L)	Estimated Median Flow (cfs)	Annual Load (lbs/year)		Existing Annual Pollutant Yield ($lbs/yr/mi^2$)	Load Reduction Needed to Reach Benchmark (%)	Load Reduction Needed to Reach Benchmark (lbs/year)	Incremental Load Reduction Needed to Reach Benchmark (lbs/year)
				Existing	Benchmark (0.1 mg/L)				
1	13.05	0.00	12.4	-	2,400	-	-	-	-
2	10.31	0.03	9.9	570	1,900	55	-	-	-
3	0.56	0.00	0.5	-	100	-	-	-	-
4	0.52	0.00	0.5	-	95	-	-	-	-
5	5.77	0.22	5.6	2,500	1,100	430	56%	1,400	-
6	4.40	1.31	4.4	11,000	860	2,500	92%	10,140	10,140
7	0.17	0.00	0.2	-	31	-	-	-	-
8	19.90	0.12	11.0	2,600	2,200	130	15%	400	400
9	2.90	0.11	2.7	560	530	190	5%	30	30
10	1.50	0.03	1.6	79	310	53	-	-	-
11	1.30	0.00	1.2	-	240	-	-	-	-
CR-1	1.50	0.03	1.4	77	270	51	-	-	-
CR-2	0.54	0.02	0.5	15	98	28	-	-	-
CR-3	1.30	0.02	1.2	54	240	42	-	-	-
CR-5	1.50	0.02	1.6	51	310	34	-	-	-
CR-6	0.16	0.02	0.1	6	29	41	-	-	-
CR-7	0.39	0.02	0.4	16	71	41	-	-	-
CR-8	0.31	0.03	0.3	15	57	48	-	-	-
CR-9	0.35	0.01	0.3	5	63	14	-	-	-
CR-10	1.67	0.03	1.5	99	300	59	-	-	-
CR-11	1.75	0.02	1.6	58	320	33	-	-	-
CR-12	1.15	0.29	1.1	600	210	520	65%	390	390

Note: Sites 10 and CR-5 are same location and Sites 11 and CR-3 are same location; for sites 10 and 11 incremental loads did not consider loads computed for the upstream LFUCG stations; For Site 10 incremental load shown here does not consider loads computed for the upstream LFUCG stations; For Site CR-5 incremental load does consider the upstream LFUCG stations

TABLE 40
ANNUAL TOTAL PHOSPHORUS LOADS AND REDUCTIONS NEEDED

Site ID	Dry Weather Drainage Area (mi^2)	Average Concentration (mg/L)	Estimated Median Flow (cfs)	Annual Load (lbs/year)		Existing Annual Pollutant Yield (lbs/yr/mi^2)	Load Reduction Needed to Reach Benchmark (%)	Load Reduction Needed to Reach Benchmark (lbs/year)	Incremental Load Reduction Needed to Reach Benchmark (lbs/year)
				Existing	Benchmark (0.35 mg/L)				
1	13.05	0.27	12.4	6,500	8,600	500	-	-	-
2	10.31	0.30	9.9	5,700	6,800	550	-	-	-
3	0.56	0.29	0.5	300	360	540	-	-	-
4	0.52	0.25	0.5	240	330	460	-	-	-
5	5.77	0.51	5.6	5,700	3,900	990	32%	1,800	-
6	4.40	0.63	4.4	5,400	3,000	1,200	44%	2,400	2,400
7	0.17	0.20	0.2	61	110	360	-	-	-
8	19.90	0.39	11.0	8,400	7,600	420	10%	800	400
9	2.90	0.30	2.7	1,600	1,900	550	-	-	-
10	1.50	0.46	1.6	1,500	1,100	1,000	27%	400	400
11	1.30	0.33	1.2	780	840	600	-	-	-
CR-1	1.50	0.36	1.39	980	950	660	3%	30	-
CR-2	0.54	0.37	0.50	360	340	670	6%	20	20
CR-3	1.30	0.41	1.20	980	840	750	14%	140	140
CR-5	1.50	0.34	1.60	1,100	1,100	730	-	-	-
CR-6	0.16	0.34	0.15	98	100	620	-	-	-
CR-7	0.39	0.32	0.36	230	250	590	-	-	-
CR-8	0.31	0.26	0.29	150	200	480	-	-	-
CR-9	0.35	0.23	0.32	150	220	430	-	-	-
CR-10	1.67	0.25	1.55	770	1,100	460	-	-	-
CR-11	1.75	0.24	1.62	770	1,100	440	-	-	-
CR-12	1.15	0.40	1.07	830	730	720	12%	100	100

Note: Sites 10 and CR-5 are same location and Sites 11 and CR-3 are same location; For Site 8, loads for upstream Sites 10 and 11 were deducted; For Site 10 incremental load shown here does not consider loads computed for the upstream LFUCG stations; For Site CR-5 incremental load does consider the upstream LFUCG stations

4. Sub-watershed Prioritization

Table 41, pages 92 and 93, summarizes the water quality load reductions needed and potential sources of pollutants in need of reductions for each sub-watershed. BMPs should be prioritized in sub-watersheds needing incremental pollutant loads.

To achieve pollutant load reductions to meet E. coli water quality goals, significant remediation of sanitary sewer systems, including Lexington's public system and private laterals, private septic systems, and package treatment plants will be necessary. Some BMPs to address contributions from cattle and horses should also be considered. Generally, when BMPs are implemented to address *E. coli*, associated with waste, they will also reduce nutrients. However, in some sub-watersheds, residential and agricultural fertilizer application BMPs should be considered.

Based on MST results, human sources of *E. coli* are likely contributing to the *E. coli* exceedances in the Cane Run watershed, particularly as noted for locations in **Tables 35** (page 78) and **41** (pages 92 and 93). However, wildlife such as deer, racoons, birds and other animals could contribute to the fecal loading in the watershed. And detections of a cattle marker were made at two locations, thought at one location the detection was noted as low.

Quantification of sources of pollutants is refined in **Chapter V**, along with a summary of BMPs to achieve required pollutant reductions.

TABLE 41
INCREMENTAL LOAD REDUCTION PRIORITIES AND SOURCE SUMMARY

Site ID	*E. coli* Incremental Load Reduction Needed to Reach Benchmark (trillion/year)		Ammonia-Nitrogen Incremental Load Reduction Needed to Reach Benchmark (lbs/year)	Nitrogen[1] Incremental Load Reduction Needed to Reach Benchmark (lbs/year)	Total Phosphorus Incremental Load Reduction Needed to Reach Benchmark (lbs/year)	General Comments on Sub-watershed	Potential Sources Where Incremental Reductions Required
	PCR Benchmark (240/100 mLs)	SCR Benchmark (676/100 mLs)					
1	-	-	-	-	-	Generally rural area with some residential development off Ironworks Pike and US-460; agricultural areas, mainly pasture/horses, but some row cropping and cattle	
2	18	7	-	-	-	Large amounts of residential development and businesses (north side of US-62 Bypass); Predominantly still agriculture on the south side of Bypass, including cattle farming; MST detected marker for cattle waste at this site	Cattle upstream of Payne's Depot Road
3	0.2	-	-	1,100	-	Generally rural area with horse farms; sparse residential development on large lots along Grayson Way	Two horse farms
4	1.3	-	-	-	-	Generally rural area with horse farms; sparse residential development on large lots along Etter Lane	Septic systems along Etter Lane; 3 horse farms
5	-	-	-	-	-	Generally rural area with farms/horse farms; small area of residential development at upstream sub-watershed boundary	Incremental reductions not found, but evidence of human fecal contamination found here (possible septic systems)
6	26	9	10,140	10,000	2,400	Generally rural area with farms/horse farms; business/development along US-25; large mobile home parks with package WWTPs; other septic systems; stockyard facility	Failing package WWTPs, septic systems, a large dump, landscaping company, horse farms; evidence of human fecal contamination found here
7	-	-	-	-	-	Kentucky Horse Park, some residential development and businesses, other horse farms.	
8	4	-	400	-	400	Kentucky Horse Park, some residential development and businesses, other horse farms.	Kentucky Horse Park, urban headwaters of Lexington, including some industry (excludes reductions specific to Sites 9 and 10 and LFUCG Sites)
9	0.5	-	30	-	-	Older residential neighborhoods in headwaters of Lexington; horse farms and businesses; other farms; Research farms and facilities	Farms, including a university research farm, and several horse-related farms and businesses
10	15.6	9.4	-	-	400	Developed headwaters of Lexington, including older residential neighborhoods	Primarily private sanitary laterals and sanitary sewer in a large neighborhood; other sources include tributary behind Eastern State Hospital and some from upstream of Newtown Pike; large businesses and factories also present; evidence of human fecal contamination found here
11	3.4	-	-	-	-	Small sub-watershed with mainly residential development and some commercial offices; small amount of undeveloped/farm land	Large neighborhoods, sanitary sewers with LFUCG remedial measures plans.

TABLE 41
INCREMENTAL LOAD REDUCTION PRIORITIES AND SOURCE SUMMARY CONTINUED

Site ID	*E. coli* Incremental Load Reduction Needed to Reach Benchmark (trillion/year)		Ammonia-Nitrogen Incremental Load Reduction Needed to Reach Benchmark (lbs/year)	Nitrogen [1] Incremental Load Reduction Needed to Reach Benchmark (lbs/year)	Total Phosphorus Incremental Load Reduction Needed to Reach Benchmark (lbs/year)	General Comments on Sub-watershed	Potential Sources Where Incremental Reductions Required
	PCR Benchmark (240/100 mLs)	SCR Benchmark (676/100 mLs)					
CR-1	0.8	-	-	-	-	Incrementally, only small area downstream of CR-3 and CR-2 that is predominantly research farm on the north side of I-64	Sanitary sewers with LFUCG remedial measures plans.
CR-2	3.0	1.1	-	-	20	Incrementally, only small area downstream of CR-5 that is predominantly research park and some research cropland	Pump station and sanitary sewers with LFUCG remedial measures plans.
CR-3	1.6	-	-	-	140	Same as Site 11; developed headwaters of Lexington, including older residential neighborhoods	Same as Site 11; sanitary sewers, known SSO locations, areas with LFUCG remedial measures plans and pipe/manhole repairs; golf course
CR-5	-	-	-	370	-	Same as Site 10; incrementally a small area downstream of CR-6, CR-7, and CR-8 that is predominantly research park/farm and older residential neighborhood of Lexington	Incremental *E. coli* reductions not needed here, but evidence of human fecal contamination found here; fertilizer on agricultural land and open space
CR-6	3.1	2.5	-	130	-	Older residential neighborhoods of Lexington; equine hospital facility with pasture	Sanitary sewers (old/failing lateral lines) associated with older residential neighborhoods; equine hospital; lawn fertilizer; evidence of human and cattle (low) fecal contamination found here
CR-7	11.2	9.8	-	-	-	Older residential neighborhood and developed headwaters of Lexington; mobile home park; commercial properties; greenhouse; park	Sanitary sewers (old/failing lateral lines) associated with older residential neighborhoods and mobile home park; evidence of human fecal contamination found here
CR-8	-	-	-	-	-	Incrementally this sub-watershed contains park/recreation facilities, a small amount of residential development, and other commercial development	
CR-9	3.9	2.7	-	-	-	Older residential neighborhoods of Lexington; neighborhood park; farm facility/pasture	Sanitary sewers (old/failing lateral lines) associated with older residential neighborhood
CR-10	19.7	13.7	-	-	-	Older residential neighborhoods of Lexington; neighborhood park; commercial development	Sanitary sewers with historic overflows; have LFUCG remedial measures plans and other repairs ongoing
CR-11	-	-	-	-	-	A large industry campus, other commercial development.	Incremental reductions not required here, but there are sanitary sewers with LFUCG remedial measures plans in this sub-watershed and there was evidence of human fecal contamination found here
CR-12[2]	46.7	42.6	390	-	100	Primarily older residential neighborhoods of Lexington.	Sanitary sewers with historic overflows; have LFUCG remedial measures plans and other repairs ongoing; older residential neighborhoods, including a mobile home park; evidence of human fecal contamination found here

[1] For Sites 1 through 11 this is Total Nitrogen, for Sites CR-1 through CR-12 this is Nitrate-Nitrogen

[2] For Site CR-12 *E. coli* Geomean was used instead of Average to calculate *E. coli* load

V. POLLUTANT SOURCES AND BMP IMPLEMENTATION

Pollutant load reductions needed to achieve the target loads for *E. coli*, total nitrogen, ammonia-nitrogen, and total phosphorus were performed in **Chapter IV** on a sub-watershed basis to lay the groundwork for identifying the sources of pollutants on this spatial scale as well. The sources of pollution in the Cane Run watershed were identified based on the watershed inventory and water quality data presented in previous chapters, along with knowledge of project stakeholders, The predominant sources of bacterial and nutrient pollutants in the Cane Run watershed are considered to be wastewater contributed by failing sewer infrastructure; agriculture hay pasture land that contains cattle and horses, including areas where horse muck is managed; and developed land, including pet waste contributions. The following sections give information on the potential *E. coli*, total nitrogen, ammonia-nitrogen, and total phosphorus reductions that can be achieved by addressing the considered pollution sources.

A. Wastewater-Associated *E. coli* and Nutrient Reductions

Based on MST results, human sources of *E. coli* are likely contributing to the *E. coli* exceedances in the Cane Run watershed, particularly as noted for locations in **Tables 35** (page 78) and **41** (pages 92 and 93). To achieve pollutant load reductions to meet *E. coli* water quality goals, significant remediation of sanitary sewer systems, including Lexington's public system and private laterals, private septic systems, and package treatment plants will be necessary. Likewise, portions of the nitrogen and phosphors loadings are associated with wastewater and will be addressed with the these planned remediations.

The nutrient and *E. coli* load reductions achieved by any particular sanitary sewer project in the upper Cane Run watershed of Lexington (line replacement, wet weather storage tank construction, pump station addition/improvement, or other rehabilitation) is difficult to quantify as the bacterial load reduction depends on numerous factors that can vary over time, including the degree of exfiltration, the amount of flow in a given line, and the concentration of *E. coli* in the wastewater. A list of LFUCG remedial measures plan projects within the Cane Run watershed was provided in **Chapter II, Table 8** (page 30) and mapped along with other repairs on **Exhibit 11** (Appendix A). **Table 42** (page 95) indicates the subcatchment where the remedial measure activity is located, and thus where an *E. coli* and related nutrient load reductions are likely to be achieved.

An iterative approach of implementation of sanitary sewer upgrades followed by post-construction monitoring will be required to determine the reductions achieved for projects. Depending on follow-up monitoring, additional source identification and treatment may be required.

In the middle Cane Run Watershed (sub-watershed to Site 6), decommissioning package sewage treatment plants and providing sanitary sewer infrastructure to mobile home parks is key to meeting *E. coli* and nutrient water quality goals. Based on reviews of historic discharge and permit-required monitoring for the Spindletop, Georgetown Estates, and Maple Grove MHPs (through EPA's ECHO database), as well as literature estimates of pollution from municipal sewage (and partially treated sewage), the following estimates were made for specific allocation of pollutants to these failing facilities (**Table 43**, page 95; EPA, 1999; EPA, 2002).

TABLE 42
LFUCG CANE RUN REMEDIAL MEASURES PLAN SCHEDULE

RMP Project Name	Subcatchment
Lower Cane Run Wet Weather Storage Tank	CR-2
Expansion Area 3 Pump Station	CR-1, CR-3, Site 9
Expansion Area 3 Force Main	CR-1, CR-3, Site 9
Expansion Area 3 Trunk	Site 9
Shandon Park Trunk	Upstream of Site 9, but in karst basin that leaves Cane Run watershed
Winburn Trunk	Upstream of Site 9, but in karst basin that leaves Cane Run watershed
Thoroughbred Acres Trunk	Upstream of Site 9, but in karst basin that leaves Cane Run watershed
Sharon Village Pump Station and Force Main	Upstream of Site 9, but in karst basin that leaves Cane Run watershed
Lower Griffin Gate Trunk	CR-3
Upper Cane Run Wet Weather Storage Tank	CR-8
Cane Run Trunk	CR-8, downstream end of CR-11
LexMark Trunk A	CR-11
LexMark Trunk B	CR-12
New Circle Trunk A	CR-10
New Circle Trunk B	CR-11
Griffin Gate Rehabilitation	CR-3

Georgetown Estates is not listed separately because its wastewater flow has now been routed to the failing Spindletop MHP package treatment plant, so loading related to both Spindletop and Georgetown Estates MHPs is captured by the Spindletop values. **Table 44** (page 96) indicates the annual load reductions in *E. coli*, ammonia-nitrogen, total nitrogen, and total phosphorus to Site 6 that can be achieved when these plants are no longer contributing pollution to the watershed.

TABLE 43
CONCENTRATIONS AND DISCHARGE FOR MHP PACKAGE TREATMENT PLANT POLLUTANT SOURCES

Sources	*E. coli* (MPN/100mLs)	Ammonia-Nitrogen (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Discharge (cfs)
Spindletop MHP	650,000	15.0	30.0	12.0	0.1479
Maple Grove MHP	650,000	15.0	30.0	12.0	0.0294

TABLE 44
MHP PACKAGE TREATMENT PLANT POLLUTANT SOURCE LOADS

Sources	*E. coli* (trillion/year)	Ammonia-Nitrogen (lbs/year)	Total Nitrogen (lbs/year)	Total Phosphorus (lbs/year)
Spindletop MHP	858	4,365	8,730	3,492
Maple Grove MHP	171	868	1,735	694
	1,029	5,233	10,465	4,186

B. *E. coli* Reductions

1. Human Sources

In addition to the potential *E. coli* from the known failing package wastewater treatment plants, other sources of *E. coli* were estimated (spatially for each sub-watershed) to help provide targeted BMP solutions. Since *E. coli* reductions associated with new municipal sanitary sewer infrastructure in the headwaters of the Cane Run watershed are difficult to quantify (as indicated in the above section), an equivalent number of homes with failing septic treatment that would equal the incremental *E. coli* load reduction needed to meet PCR goals was computed per sub-watershed. This was performed across the entire watershed. Some failing onsite septic treatment systems may be present the middle and lower portions of the watershed, but identifying the failing septic systems is difficult. So, to give perspective to the magnitude of the *E. coli* problem, this same approach was used to calculate an equivalent number of homes representing the needed reduction is presented.

To make the computation of the *E. coli* contribution represented by a failing household septic system, the inputs listed below were utilized (Horsley and Whitten, 1996; KDOW 2015) along with appropriate conversion factors.

- 70 gallons/day of effluent produced per person
- 6.5 E+05 CFU/100mL concentration of *E. coli* in septic effluent
- The above values yield the *E. coli* loading rate of 1.72 E+09 CFU/person/day
- 2.5 people per household

Table 45, page 97, tabulates the estimate of total number of homes with failing septic treatment that is equivalent to the incremental annual *E. coli* reduction needed for each sub-watershed where an incremental *E. coli* load reduction is indicated.

TABLE 45
POTENTIAL E. COLI LOAD REDUCTIONS PER POLLUTANT SOURCE

Site ID	Incremental Load Reduction Needed to Reach PCR Benchmark (trillion/year)	Human Sources			Grazing Cattle and Horse Sources							Developed Land Sources	
		Estimated No. of Septic Sources to Remove to Meet Required Reduction	Potential *E. coli* Reduction from Septic Sources (trillion/year)	Potential E. *coli* Reduction from MHP WWTPs (trillion/year)	Hay / Pasture Land Use (ac)	Estimated Total No. of Cattle	Estimated Total No. of Horses	No. of Cattle with Waste Eliminated	Potential *E. coli* Reduction from Cattle Sources (trillion/year)	No. of Horses with Waste Eliminated	Potential *E. coli* Reduction from Horse Sources (trillion/year)	Developed Land Use (ac)	Potential *E. coli* Reduction (trillion/year)
1	-	-	-	-	2,045	-	-	-	-	-	-	174	0.33
2	18	12	19	-	1,384	306	112	22	18	112	10	871	1.64
3	0.2	1	1.6	-	1,200	265	97	1	0.8	2	0.2	5	0.01
4	1.3	1	1.6	-	1,841	406	149	2	1.3	14	1.3	40	0.08
5	-	-	-	-	768	-	-	-	-	-	-	71	0.13
6	26	17	27	1,029	2,415	533	196	32	26	196	18	290	0.55
7	-	-	-	-	3,834	-	-	-	-	-	-	708	1.33
9	0.5	1	1.6	-	3,179	702	258	1	0.8	5	0.5	835	1.57
CR-1	0.8	1	1.6	-	92	-	-	-	-	7	1	19	0.04
CR-2	3.0	2	3.1	-	233	-	-	-	-	-	-	49	0.09
CR-3	1.6	1	1.6	-	191	-	-	-	-	-	-	369	0.70
CR-5	-	-	-	-	85	-	-	-	-	-	-	237	0.45
CR-6	3.1	2	3.1	-	5	1	0	1	0.8	1	0.1	102	0.19
CR-7	11.2	8	12.6	-	-	-	-	-	-	-	-	219	0.41
CR-8	-	3	-	-	58	-	-	-	-	-	-	113	0.21
CR-9	3.9	3	4.7	-	45	-	-	-	-	-	-	101	0.19
CR-10	19.7	13	20.4	-	11	-	-	-	-	-	-	824	1.55
CR-11	-	-	-	-	-	-	-	-	-	-	-	316	0.60
CR-12	46.7	30	47.1	-	-	-	-	-	-	-	-	617	1.16

Note: Site 8 (groundwater well) not shown since sources to be addressed in contributing sub-watersheds; Sites 10 and 11, not shown since CR-5 and CR-3 are in same locations and data for those stations is being used for required incremental load reductions; shading indicates that full required reduction cannot be met by just eliminating cattle or horse waste from the area; Potential reduction due to each potential source not calculated if an incremental load reduction not needed in that sub-watershed; For cattle/horse, potential reduction also not calculated if presence of cattle/horses unlikely even though some hay/pasture land exists.

2. Bovine and Equine Sources

Based on MST results, detections of a cattle marker were made at two locations, thought at one location the detection was noted as low. MST was not performed using a horse marker, however many horse farms and supporting facilities are present in the watershed. Similar to the above effort for household septic sources, estimates for potential load reductions from cattle and horses were evaluated, where an estimate was made for the number of animals whose waste would have to be eliminated to achieve the total incremental *E. coli* reduction needed for a given site (not in excess of the total number of cattle or horses estimated for a given sub-watershed).

The number of cattle and horses was estimated for the entire Cane Run watershed using USDA statistics (**Table 11**, page 36). This estimate of cattle and horses was distributed to each sub-watershed based on the known amount of hay/pasture land use within that sub-watershed (**Exhibit 12**, Appendix A). In Cane Run watershed, cattle and horses do not generally occur within the same farm or pasture, however for this effort they were distributed based on the acreage of hay/pasture land per sub-watershed without knowledge of whether the land is horse farm or cattle farm (this can be a fluctuating situation or hard to identify without additional efforts). Additionally, this does not accurately identify and represent the potential modified distribution of *E. coli* load if a large horse facility collects and centralizes storage/holding of muck from its facilities (for later spreading on pasture or removal from farm). Generally, horses in the Cane Run watershed are not given stream access for watering the way cattle are. Regardless of the limitations associated with this analysis, it does help give guidance on the magnitude of reductions available per potential source.

An *E. coli* rate (see below; Ormsbee *et al*., 2013) for cattle or horses was multiplied by the number of each animal in each sub-watershed to calculate either (1) the number of cattle or horses whose waste would be equivalent to the <u>total</u> incremental annual *E. coli* reduction needed per sub-watershed or (2) the maximum potential *E. coli* load associated with cattle or horses within each sub-watershed (when the maximum potential load reduction does not reach the full load reduction needed).

- Cattle *E. coli* loading rate = 2.25 E+09 CFU/animal/day (Ormsbee *et al*., 2013)
- Horse *E. coli* loading rate = 2.51 E+08 CFU/animal/day (Ormsbee *et al*., 2013)

Table 45, page 97, tabulates the estimates of acreage of hay/pasture, number of cattle and horses, and estimated number of animals whose waste can or needs to be eliminated to meet PCR goals.

3. Developed Land / Pet Sources

Developed land, generally from pet waste, can contribute bacterial loading. The potential for *E. coli* loading from developed areas in the Cane Run watershed was estimated by considering the known amount of developed land within each sub-watershed (**Exhibit 12**, Appendix A) and applying an *E. coli* loading rate estimated for developed lands. The loading rate used represents the average *E. coli* loading rate for commercial, mixed development, residential, and transportation/utility land uses (Ormsbee *et al*., 2013).

- Developed land *E. coli* loading rate = 5.16 E+06 CFU/acre/day (Ormsbee *et al*., 2013)

Table 45, page 97, tabulates the estimated acreage of developed land (sum of low, medium, and high intensity development) and potential *E. coli* load associated with that land per sub-watershed. Unlike for the evaluation of wastewater and cattle/horse sources, this estimate represents the maximum potential *E. coli* load reduction that could be realized if BMPs primarily to address pet waste are implemented.

C. Nutrient Reductions

1. Human Sources

In areas of the Cane Run watershed where wastewater is a source of bacterial pollution, the wastewater is also contributing to the nutrient load. Where the equivalent number of homes with failing septic treatment that would equal the incremental *E. coli* load reduction needed to meet PCR goals was computed, an estimate of potential nutrient load attributable to those sources was also computed (for locations where an incremental nutrient reduction is needed to support WAH). The same nutrient loading rates used to estimate loads from the failing package wastewater treatment plants were used (**Table 43**, page 95) along with the inputs listed below and appropriate conversion factors.

- Number of homes with failing septic systems that would produce annual *E. coli* load equivalent to incremental *E. coli* reduction needed per sub-watershed.
- 70 gallons/day of effluent produced per person
- 2.5 people per household

Tables 46, 47, and 48, pages 100, 101, and 102 tabulate the potential total nitrogen, ammonia-nitrogen, and total phosphorus loads attributed to these septic sources, respectively.

2. Hay / Pasture Agricultural Land

For *E. coli*, potential reductions were tied directly to estimates of cattle and horses within each sub-watershed; however, the nutrient reductions associated with hay/pasture agricultural land were calculated based on the area of that land use in each sub-watershed (**Exhibit 12**, Appendix A) and an estimate of nutrient loading rate from literature (see below). No ammonia-nitrogen load reduction was estimated based on land use.

- Pasture land total nitrogen loading rate = 3.74 lbs/acre/year (EPA, 1999)
- Pasture land total phosphorus loading rate = 0.12 lbs/acre/year (EPA, 1999)

Tables 46, 47, and 48, pages 100, 101, and 102 tabulate the potential total nitrogen and total phosphorus loads contributed by areas of hay/pasture.

TABLE 46
POTENTIAL TOTAL NITROGEN LOAD REDUCTIONS PER POLLUTANT SOURCE

		Human Sources			Cattle and Horse Sources		Developed Land Sources			
Site ID	**Incremental Load Reduction Needed to Reach Benchmark (lbs/year)**	**Estimated No. of Septic Sources to Remove to Meet Required *E. coli* Reductions**	**Potential Total Nitrogen Reduction from Septic Sources (lbs/year)**	**Potential Human Sources of Total Nitrogen Reduction from MHP WWTPs**	**Hay / Pasture Land Use (ac)**	**Potential Total Nitrogen Reduction from Hay / Pasture (lbs/year)**	**Developed Land Use (ac)**	**Potential Total Nitrogen Reduction from Developed Land (lbs/year)**	**Sum of Potential Total Nitrogen Reductions from All Sources Evaluated (lbs/year)**	**Incremental Reduction to Meet Benchmark – Calculated Total Nitrogen Reductions from All Sources (lbs/year)**
1	-	-	-	-	2,045	-	174	712	-	-
2	-	-	-	-	1,384	-	871	3,564	-	-
3	1,100	1	16	-	1,200	4,488	5	22	4,526	(3,426)
4	-	1	16	-	1,841	6,886	40	163	-	-
5	-	-	-	-	768	2,873	71	293	-	-
6	10,000	17	272	10,465	2,415	9,031	290	1,189	20,957	(10,957)
7	-	-	-	-	3,834	14,338	708	2,897	-	-
9	-	1	16	-	3,179	11,888	835	3,420	-	-
CR-1	-	1	-	-	92	343	19	77	-	-
CR-2	-	2	32	-	233	870	49	201	-	-
CR-3	-	1	16	-	191	714	369	1,512	-	-
CR-5	370	-		-	85	319	237	969	1,288	(918)
CR-6	130	2	32	-	5	19	102	416	468	(338)
CR-7	-	8	128	-			219	898	-	-
CR-8	-	-		-	58	217	113	462	-	-
CR-9	-	3	48	-	45	167	101	416	-	-
CR-10	-	13	208	-	11	42	824	3,373	-	-
CR-11	-	-		-			316	1,294	-	-
CR-12	-	30	480	-			617	2,526	-	-

Note: Existing data was not sufficient to calculate total nitrogen load reductions needed for CR-1 through CR-12, thus nitrate-nitrogen load reductions needed (likely the predominate form of total nitrogen based on KDOW dataset) are presented for those sites; Site 8 (groundwater well) not shown since sources to be addressed in contributing sub-watersheds; Sites 10 and 11, not shown since CR-5 and CR-3 are in same locations and data for those stations is being used for required incremental load reductions; negative values in column for "Incremental Reduction to Meet Benchmark - Calculated Total Nitrogen Reductions from All Sources" indicate reductions in excess of what is required to meet benchmark incremental loading may be achieved if all potential sources are addressed.

TABLE 47
POTENTIAL AMMONIA-NITROGEN LOAD REDUCTIONS PER POLLUTANT SOURCE

Site ID	Incremental Load Reduction Needed to Reach Benchmark (lbs/year)	Human Sources Estimated as Homes/Septic Sources		Potential Human Sources of Ammonia- Nitrogen Reduction from MHP WWTPs	Sum of Potential Ammonia-Nitrogen Reductions from All Sources Evaluated (lbs/year)	Incremental Reduction to Meet Benchmark – Calculated Ammonia- Nitrogen Reductions from All Sources (lbs/year)
		Estimated No. of Septic Sources to Remove to Meet Required *E. coli* Reductions	Potential Ammonia-Nitrogen Reduction from Septic Sources (lbs/year)			
1	-	-	-	-	-	-
2	-	12	96	-	-	-
3	-	1	8	-	-	-
4	-	1	8	-	-	-
5	-	-	-	-	-	-
6	10,140	17	136	5,233	5,369	4,771
7	-	-	-	-	-	-
9	30	1	8	-	8	22
CR-1	-	1	8	-	-	-
CR-2	-	2	16	-	-	-
CR-3	-	1	8	-	-	-
CR-5	-	-	-	-	-	-
CR-6	-	2	16	-	-	-
CR-7	-	8	64	-	-	-
CR-8	-	-	-	-	-	-
CR-9	-	3	24	-	-	-
CR-10	-	13	104	-	-	-
CR-11	-	-	-	-	-	-
CR-12	390	30	240	-	240	150

Note: Site 8 (groundwater well) not shown since sources to be addressed in contributing sub-watersheds; Sites 10 and 11, not shown since CR-5 and CR-3 are in same locations and data for those stations is being used for required incremental load reductions; positive values in column for "Incremental Reduction to Meet Benchmark - Calculated Ammonia-Nitrogen Reductions from All Sources" indicate reductions required to meet benchmark incremental loading not achieved by potential sources considered (human only).

TABLE 48
POTENTIAL TOTAL PHOSPHORUS LOAD REDUCTIONS PER POLLUTANT SOURCE

Site ID	Incremental Load Reduction Needed to Reach Benchmark (lbs/year)	Human Sources Estimated as Homes/Septic Sources		Potential Human Sources of Total Phosphorus Reduction from MHP WWTPs	Grazing Cattle and Horse Sources		Sum of Potential Total Phosphorus Reductions from All Sources Evaluated (lbs/year)	Incremental Reduction to Meet Benchmark – Calculated Total Phosphorus Reductions from All Sources (lbs/year)
		Estimated No. of Septic Sources (Homes) to Remove to Meet Required *E. coli* Reductions	Potential Total Phosphorus Reduction from Septic Sources (lbs/year)		Hay / Pasture Land Use (ac)	Potential Total Phosphorus Reduction from Hay / Pasture (lbs/year)		
1	-	-	-	-	2,045	245	-	-
2	-	12.0	77	-	1,384	166	-	-
3	-	1.0	6	-	1,200	144	-	-
4	-	1.0	6	-	1,841	221	-	-
5	-	-	-	-	768	92	-	-
6	2,400	17.0	109	4,186	2,415	290	4,781	(2,381)
7	-	-	-	-	3,834	460	-	-
9	-	1.0	6	-	3,179	381	-	-
CR-1	-	1.0	6	-	92	11	-	-
CR-2	20	2.0	13	-	233	28	74	(54)
CR-3	140	1.0	6	-	191	23	279	(139)
CR-5	-	-	-	-	85	10	-	-
CR-6	-	2.0	13	-	5	1	-	-
CR-7	-	8.0	51	-	-	-	-	-
CR-8	-	-	-	-	58	7	-	-
CR-9	-	3.0	19	-	45	5	-	-
CR-10	-	13.0	83	-	11	1	-	-
CR-11	-	-	-	-	-	-	-	-
CR-12	100	30.0	192	-	-	-	610	(510)

Note: Site 8 (groundwater well) not shown since sources to be addressed in contributing sub-watersheds; Sites 10 and 11, not shown since CR-5 and CR-3 are in same locations and data for those stations is being used for required incremental load reductions; negative values in column for "Incremental Reduction to Meet Benchmark - Calculated Total Phosphorus Reductions from All Sources" indicate reductions in excess of what is required to meet benchmark incremental loading may be achieved if all potential sources are addressed.

3. Developed Land

Like for hay/pasture land, nutrient reductions associated with developed land were calculated based on the area of that land use in each sub-watershed (**Exhibit 12**, Appendix A) and an estimate of nutrient loading rate from literature (see below). No ammonia-nitrogen load reduction was estimated based on land use due to the perception that its predominant source is wastewater-related.

- Average total nitrogen loading rate for commercial, residential, and transportation/utility land uses = 4.09 lbs/acre/year (EPA, 1999)
- Average total phosphorus loading rate for commercial, residential, and transportation/utility land uses = 0.676 lbs/acre/year (EPA, 1999)

D. WBP Goals and Objectives

In addition to extensive data compilation and analysis public meetings, technical advisory meetings, small group meetings, urban outreach activities, and other efforts contributed to development of this WBP. An online survey was performed to give interested citizens and watershed stakeholders the opportunity to provide feedback on their perceived water quality concerns and their interest in becoming involved in the watershed planning and remediation process. Ninety-three surveys were completed and some of results are illustrated on **Figures 5** and **6** (page 104). Results indicated that most respondents were primarily interested in neighborhood/community and environmental issues. Responses indicated that those completing the survey were most concerned about drinking water source pollution, sanitary sewer leaks, bacteria/viruses, and trash/debris. Additional survey responses indicated that there are interested stakeholders willing to do things that can help to improve water quality, such as pick up pet waste, clean up trash/debris, create a rain garden, inspect/maintain their septic system, plant trees, or volunteer for water sampling.

Goals identified as a result of the efforts associated with the development of this WBP, including interactions with stakeholders, are as follows:

1. decrease bacterial levels to allow for safe recreational use;
2. reduce nutrient concentrations (nitrogen and phosphorus) to healthy levels;
3. improve the stream and riparian habitat to support a healthy aquatic ecosystem, including stream restoration/stabilization to reduce bank erosion;
4. decrease velocity and volume of stormwater to Cane Run and tributaries in developed areas;
5. remove trash from waterways and riparian zones;
6. educate the community on the importance of water resources and how they can help improve water quality.

For each goal, the pollutant source or cause, measurable indicator of success, and objectives are identified and summarized in **Table 49**, pages 105 - 106. The reduction in bacteria levels in the watershed was considered the greatest priority due to the risk of human illness during recreation use and water quality data indicated that the majority of sites received a “D” or “F” health grade for not supporting the PCR use. Measurable indicators of success were selected for regulatory standards for comparison (such as *E. coli*) or impairments indicated in the monitoring data. Other parameters may be utilized, as appropriate, to gage overall success in reducing pollutant loading.

FIGURE 5 – STAKEHOLDER INTERESTS

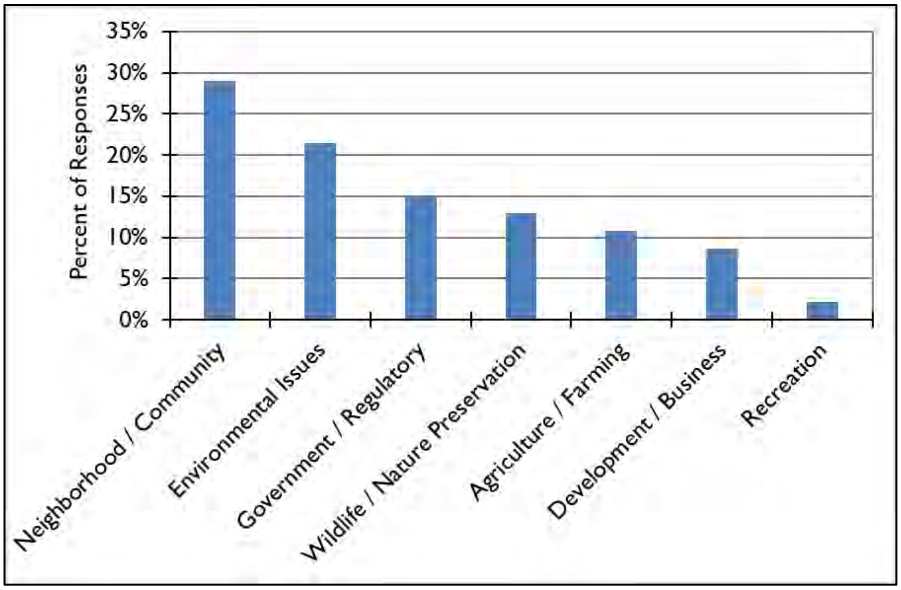


FIGURE 6 – STAKEHOLDER CONCERNS

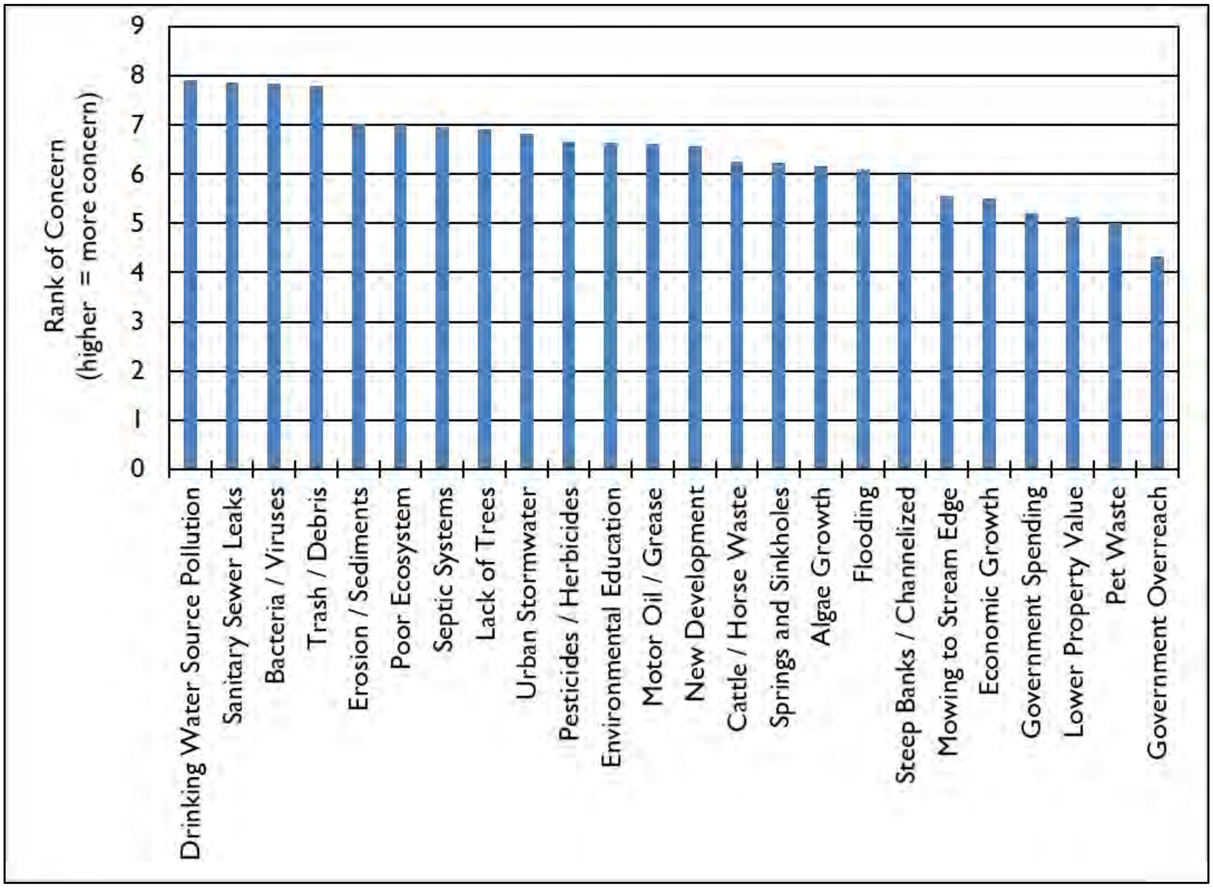


TABLE 49
CANE RUN WBP GOALS AND OBJECTIVES

Goal	Source / Cause Considered for Remediation	Measurable Indicator	Objectives
G1. Decrease in-stream bacteria levels to allow for safe recreational use	• Sanitary sewer system: exfiltration from private lateral lines and public sewer including sewer overflows • Failing MHP package wastewater treatment facilities • Failing home or business septic systems • Grazing horses and/or equine facilities • Residential pet waste	• *E. coli*	• Repair, place, rehabilitate public sanitary sewer infrastructure to prevent exflow and exfiltration • Reduce stormwater inflow to private sanitary sewer system via sump pumps, downspouts, and broken lateral lines. • Implement a septic system evaluation/maintenance/repair program; utilize municipal systems as they become available (i.e. Scott County sewer line extension) • Decommission failing package wastewater treatment facilities as municipal sewer systems become available • Remove cattle and horse waste from streams (may be achieved by providing exclusion fencing/alternative watering sources for cattle, updating/improving agricultural water quality and nutrient management plans, and providing adequate waste storage/handling) • Implement a residential pet waste educational program; consider providing pet waste stations in high-risk locations
G2. Reduce in-stream nutrients (nitrogen and phosphorus) and sediment to healthy levels	• Same as sources for G1 (bacteria) • Stream bank erosion	• Total nitrogen • Ammonia-nitrogen • Total phosphorus • Visual assessment of in-stream sediment deposition	• Same as objectives for G1 (bacteria) • Implement stream restoration/stabilization and buffer establishment/protection
G3. Improve stream habitat to support a healthy aquatic ecosystem	• Narrow riparian width • Unstable banks / Erosion	• Macroinvertebrates • RBP habitat • Visual bank assessment	• Implement stream restoration/stabilization and buffer establishment/protection to remedy eroding stream banks • Improve the quality and width of riparian buffer zones

TABLE 49
CANE RUN WBP GOALS AND OBJECTIVES

Goal	Source / Cause Considered for Remediation	Measurable Indicator	Objectives
G4. Decrease velocity and volume of stormwater runoff to Cane Run and tributaries in developed (or developing) areas	• Increased impervious areas leads to elevated runoff volumes and velocities • Channel alteration, including straightening, channelization, and lining.	• Impervious acreage • Streamflow response to rainfall (flashiness = indicative of reduced infiltration due to increased impervious areas)	• Reduce the amount of impervious surface in the watershed • Increase stormwater infiltration through green infrastructure and other BMPs • Restore altered stream channels to have appropriate dimensions, pattern, and profile
G5. Remove trash and debris from waterways and riparian areas	• Trash and litter	• Estimated trash removed	• Document routine locations of trash accumulation • Organize groups to remove trash from watershed on a routine basis • Implement in-stream trash collection systems, where feasible
G6. Educate the community about the importance of water resources and how they can help to improve water quality	• Lack of education • Continuation of practices that cause or facilitate impairment	• Number of interactions • Educational materials distributed	• Increase public knowledge about water quality impairments • Develop targeted educational materials for each problem area • Reach targeted audience about opportunities for implementation on their property • Reach targeted audience about opportunities to raise expectations on public officials, developers, etc. in order to improve water quality • Perform ongoing monitoring of stream health conditions

E. BMP Implementation Plan

The watershed goals and objectives were used as a framework to develop a list of BMP projects and opportunities necessary to restore the designated sues to the watershed's streams and achieve the plan goals and objectives. The list of BMPs includes projects in various stages of development and execution – some are planned and funded, while others are opportunities at the conceptual stage.

The BMP Implementation plan is intended to guide watershed remediation efforts and represent the type and scope of projects that will be required to meet watershed goals. For each BMP, information for project implementation is summarized, as best as currently possible, including possible stakeholders and funding sources. Alternative approaches may be acceptable. The BMP Implementation Plan for the Cane Run watershed is summarized in **Table 50**, pages 109 through 114.

Each BMP is given a priority ranking of high, medium, or low. High priority BMPs include areas or audiences which are considered necessary to achieve watershed goals, are believed to provide the greatest benefit to the watershed, and which have stakeholder cooperation and support, and may have secured funding as well. Medium priority BMPs typically target areas or audiences where BMPs are needed, but it is unknown if stakeholders are willing to pursue implementation. BMPs may also be of medium priority if implementation is evaluated to be less effective. Low priority BMPs would be beneficial in improving conditions in the watershed but are in areas where pollutant loading reductions are not required or the implementation is less feasible /effective.

Five (5) categories of BMPs have been identified in the implementation plan: Bacterial, Education and Outreach, Stream/Riparian, Green Infrastructure, and General.

1. Bacterial

Bacterial BMPs include proposed sanitary sewer remedial measures plans and other sanitary sewer related projects/programs; replacement of failing package WWTPs (and private septic, where applicable) with municipal sewer access; projects to address cattle and horse waste; and projects to address pet waste to reduce the *E. coli* loading in the watershed. For the proposed remedial measures plan projects, the schedules and milestones are dictated by an agreement between the US EPA, KDOW, and LFUCG. Thus, other BMPS in related areas should be coordinated with the schedules of the remedial measures projects such that projects are implemented in a complementary way that minimizes construction disturbances.

2. Education and Outreach

The Education and Outreach BMPs are intended to educate businesses, homeowners, and other stakeholders to increase awareness of water quality, what's is contributing to stream impairments, and how stakeholders can help improve the watershed.

3. Stream / Riparian

Stream/Riparian BMPs include stream restoration/stabilization and buffer protection/establishment/maintenance with the intention of achieving water quality treatment and reducing streambank instability/erosion (and thus in-stream sediment contribution).

4. Green Infrastructure

Green Infrastructure BMPs are intended to address the pollutant loads from runoff from developed or developing areas. Green infrastructure can be targeted to reduce runoff volume and provide pollutant treatment.

5. General

General BMPs include projects related to in-stream trash collection systems, supporting existing/ongoing environmentally-focused events, and supporting regulatory measures that promote environmental responsibility.

TABLE 50

CANE RUN WBP BMP IMPLEMENTATION PLAN

BMP No.	Type	Target Audience or Area	BMP Description and Action Items	Priority	Impairment / Pollutant Addressed	Responsible Parties	Estimated Cost	Estimated Load Reduction	Funding Source(s) / Program(s)	Technical Assistance Needed	Milestones Short Term (0-5 Years)	Milestones Mid-Term (5-10 Years)	Milestones Long-Term (10+ Years)
1	Bacterial (Sanitary Sewer)	CR-8	Upper Cane Run Wet Weather Storage Tank - Remedial Measures Plan	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	$500,000 Design; $3,980,000 Construction	Unknown	Sanitary Sewer Fees	Design engineers, construction contractors	Planned for 2021 construction	None	None
2	Bacterial (Sanitary Sewer)	CR-9 (but in karst basin that leaves watershed)	Sharon Village Pump Station and Force Main - Remedial Measures Plan	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	$220,000 Design; $1,900,000 Construction	Unknown	Sanitary Sewer Fees	Design engineers, construction contractors	Planned for 2019-2020 construction	None	None
3	Bacterial (Sanitary Sewer)	CR-8, CR-11	Cane Run Trunk - New Circle Rd. to Nandino Blvd. - Remedial Measures Plan	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	$180,000 Design; $1,700,000 Construction	Unknown	Sanitary Sewer Fees	Design engineers, construction contractors	Planned for 2019 construction	None	None
4	Bacterial (Sanitary Sewer)	CR-11	LexMark Trunk A - Between W. Louden Ave. and New Circle Rd. - Remedial Measures Plan	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	$160,000 Design; $1,480,000 Construction	Unknown	Sanitary Sewer Fees	Design engineers, construction contractors	Planned for 2020 construction	None	None
5	Bacterial (Sanitary Sewer)	CR-12	LexMark Trunk B- Between W. Louden Ave. and New Circle Rd. - Remedial Measures Plan	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	$110,000 Design; $960,000 Construction	Unknown	Sanitary Sewer Fees	Design engineers, construction contractors	Planned for 2020 construction	None	None
6	Bacterial (Sanitary Sewer)	CR-10	New Circle Trunk A - New Circle Rd. toward Russell Cave Rd. - Remedial Measures Plan	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	$390,000 Design; $3,920,000 Construction	Unknown	Sanitary Sewer Fees	Design engineers, construction contractors	Planned for 2021 construction	None	None
7	Bacterial (Sanitary Sewer)	CR-11	New Circle Trunk B - Along N. Broadway, East of New Circle Rd. - Remedial Measures Plan	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	$280,000 Design; $2,700,000 Construction	Unknown	Sanitary Sewer Fees	Design engineers, construction contractors	Planned for 2022 construction	None	None
8	Bacterial (Sanitary Sewer)	CR-3	Griffin Gate Rehabilitation - Southwest of I-75 / Newtown Pike Interchange - Remedial Measures Plan	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	Funded through LFUCG's annual rehabiliation program	Unknown	Sanitary Sewer Fees	Design engineers, construction contractors	Planned for 2020 construction	None	None
9	Bacterial (Sanitary Sewer)	CR-5, CR-6, CR-7, CR-8, CR-9, CR-10, CR-11 Aging Residential Neighborhoods	Replacement of deteriorated sewer line laterals which are exfiltrating sewage within LFUCG's MS4 using the "Cane Run Private Lateral Pilot Program in the Highlands Neighborhood" as guidance.	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ	Dependent upon extent of projects	Unknown	319 grant, dedicated municipal funding, private funding	Design engineers, construction contractors	Development of line replacement projects, design, and construction	Ongoing monitoring and maintenance	
10	Bacterial (Sanitary Sewer)	Lexington	Eliminate improper or unauthorized discharges to the sanitary sewer system through the Private Infiltration and Inflow Elimination Program (PIIEP). This program allows for the inspection and enforced removal of discharges sump pumps, downspouts, foundation drains, outside stairwells, and driveway drains to the sanitary sewer system under the new ordinance (Ch 16, Art XI, 16-111-115)	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ, Property Owners	Dependent upon requests	Unknown	Supplemental fee and other fines will be charged upon refusal of inspection or compliance. LFUCG has a cost sharing reimbursement program up to $3,000 for work completed by a licensed plumber and issued a Notice of Compliance.	Inspectors, licensed plumbers	Ongoing inspection, compliance, and enforcement		
11	Bacterial (Sanitary Sewer)	Lexington	Implement the Fats, Oil, and Grease (FOG) Program to reduce the sanitary sewer overflows. The program requires all food service facilities to have a permit or waiver, sets requirements for grease and oil interceptors and maintenance, inspects these facilities and enforces the existing ordinance.	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ, CMOM Program Managers	LFUCG City Program	Unknown	LFUCG budget	Education, inspection, maintenance, enforcement	Ongoing education, inspection, and enforcement		
12	Bacterial (Sanitary Sewer)	Lexington	Utilize the Gravity Line Preventative Maintenance Program (GLPMP) to help maintain the capacity of the sanitary sewer system by hydraulic cleaning, mechanical cleaning, and root control. The program identifies areas needing increased frequency of cleaning, provides consistent maintenance, and identifies repair / rehabilitation locations.	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ, CMOM Program Managers	LFUCG City Program	Unknown	LFUCG budget	Maintenance, repair and rehabilitation	Ongoing cleaning, maintenance, and repair / rehabilitation		
13	Bacterial (Sanitary Sewer)	Lexington	Use the Sanitary Sewer Survey and Rehabilitation (General, Find and Fix Program) to reduce Infiltration / Inflow (I/I), identify exfiltration sources, and correct problems. If stormwater outfalls or illicit discharges are detected and testing indicates the potential sewage sources, Sewer Line Maintenance will evaluate the issue. If Sewer Line Maintenance does not take action, then the issue will be forwarded to I/I Program for repair. Sewer Line Maintenance or I/I will update Stormwater on actions taken to allow for follow up monitoring to confirm the problem was addressed.	High	PCR, SCR / E. coli, Fecal coliform	LFUCG DWQ, Compliance and Monitoring, Sewer Line Maintenance, I/I Program, CMOM Program Managers	$5,000,000 Annually for Repairs Countywide	Unknown	Sanitary sewer fees	Monitoring and repair	Ongoing monitoring, evaluation, and repair		

TABLE 50

CANE RUN WBP BMP IMPLEMENTATION PLAN

BMP No.	Type	Target Audience or Area	BMP Description and Action Items	Priority	Impairment / Pollutant Addressed	Responsible Parties	Estimated Cost	Estimated Load Reduction	Funding Source(s) / Program(s)	Technical Assistance Needed	Milestones		
											Short Term (0-5 Years)	Mid-Term (5-10 Years)	Long-Term (10+ Years)
14	Bacterial (Sanitary Sewer)	CR-6, Package WWTP for Spindletop and Georgetown Estates MHPs	Elimination of package WWTP facilities; replace with access to municipal sewer created by Georgetown/Scott County South Sewer Extension	High	PCR, SCR / E. coli, Fecal coliform	Private WWTP Owner/Operator; Georgetown Municipal Water and Sewer Service	$12.4 M Design and Construction	See load reductions for sources table in plan	Private WWTP Owner/Operator; Georgetown Municipal Water and Sewer Service; Kentucky Infrastructure Authority	Design engineers, construction contractors	Municipal sewer extension planned for 2020 construction; follow-up monitoring	Ongoing monitoring	None
15	Bacterial (Sanitary Sewer)	CR-6, Package WWTP for Spindletop and Georgetown Estates MHPs	Replacement of deteriorated sewer line laterals from MHP units to access municipal sewer created by Georgetown/Scott County South Sewer Extension (including tee conncetion to main line, lateral to a clean out on the easement line, and lateral from the clean out to each MH site)	High	PCR, SCR / E. coli, Fecal coliform, N, and P	319 Grants, Private WWTP Owner/Operator; MHP Site Owners; Georgetown Municipal Water and Sewer Service	>$750,000 Contruction	See load reductions for sources table in plan	319 grants; Private WWTP Owner/Operator; Georgetown Municipal Water and Sewer Service; Kentucky Infrastructure Authority	Design engineers, construction contractors	Planned for 2020 construction; follow-up monitoring	Ongoing monitoring	None
16	Bacterial (Sanitary Sewer)	CR-6, Package WWTP for Maple Grove MHP	Elimination of package WWTP facilities; replace with access to municipal sewer created by Georgetown/Scott County South Sewer Extension	High	PCR, SCR / E. coli, Fecal coliform, N, and P	Private WWTP Owner/Operator; LFUCG, Georgetown Municipal Water and Sewer Service	Some costs associated with BMP # 14 and costs to run additional line to the South Sewer Extension	See load reductions for sources table in plan	Georgetown Municipal Water and Sewer Service; Kentucky Infrastructure Authority; LFUCG	Design engineers, construction contractors	Municipal sewer extension planned for 2020 construction; project needs to be planned/performed to hook to this extension	Ongoing monitoring	None
17	Bacterial (Sanitary Sewer)	CR-6, Package WWTP for Maple Grove MHP	Replacement of deteriorated sewer line laterals from MHP units to access municipal sewer created LFUCG to connect to Georgetown/Scott County South Sewer Extension	High	PCR, SCR / E. coli, Fecal coliform, N, and P	319 Grants, Private WWTP Owner/Operator; MHP Site Owners; LFUCG	Dependent on number of systems	See load reductions for sources table in plan	319 grants; Private WWTP Owner/Operator; LFUCG	Design engineers, construction contractors	Municipal sewer extension planned for 2020 construction; project needs to be planned/performed to hook to this extension	Ongoing monitoring	None
18	Bacterial (Septic)	Watershed; CR-6	Reduce septic system contributions to the fecal load. Work with local health departments to evaluate the number landowners, including business and groups of landowners, on septic systems within the watershed. Develop program to provide assistance for pumpouts, maintenance, replacement, or obtaining services from municipal sanitary sewer provider (especially with future expansion of GMWSS service area). Note potential entitites to convert to future municipal sanitary sewer include 1812- 1840 Lexington Road, 1782 Lexington Road, and 1791 Lexington Road (all in Scott County).	High	PCR, SCR / E. coli, Fecal coliform	WEDCO District/Scott County Health Department, Fayette County Health Department; GMWSS	Dependent on number of systems	Unknown	Discounted rates, landowner system maintenance cost	GIS processing of septic locations, proper septic system care information, technical and construction assistance to convert to municipal sewer	Evaluate in Short Term With Ongoing Maintenance		
19	Bacterial (Agricultural)	Cane Run (Site 2)	Continue to communicate with private property owner to promote and determine feasibility of agricultural BMPs targeting livestock (cattle) at 1530 Paynes Depot Rd. In addition to establishing a riparian buffer along Cane Run within the property, the stream would benefit from livestock exclusion fencing and alternative watering systems. Minimally, the stream would benefit from limiting cattle access to specific, armoured locations. These BMPs would aid in reducing E. coli and nutrient loads and protect/provide stream and riparin habitat. However, the landuse of this parcel is very likely to be converted to residential development in coming years. Thus, the E. coli loading from cattle will be replaced by other stressors (increased runoff, nutrients) and low impact, conservation-minded development that includes green infrastructure and stream buffering should be promoted.	High	PCR, SCR / E. coli, Fecal coliform, WAH / Habitat Improvement, N, P	Private landowners, NRCS, UK Ag. Extension, Consultants, Contractors	Buffer Establishment: $800,000 for buffer design and construction; other BMP costs dependant on those selected as feasible	Stream Buffer: 0.0035 lbs /ft P, 0.02 lbs /ft N annually	319 Grant, designated county or state funding, NRCS agricultural cost share programs, private funding	Consultants, designers, contractors, monitoring	Phase I: 1) Meet with landowner to evaluate support, 2) Secure funding, 3) Project Design	Phase II: 1) Conduct pre- and post construction monitoring, 2) Construction	Ongoing monitoring and maintenance
20	Bacterial (Agricultural)	Watershed; Site 9	Evaluate potential to improve horse muck managment at farms, training centers, and related equine facilities, particulary located in the headwaters of an UT to Cane Run between Newtown Pike and Russell Cave Roads.	Low	PCR, SCR / E. coli, Fecal coliform	Private owners, UK Ag. Extension	Dependent on number existing conditions and needs	Unknown	319 Grant, private funding	Evaluation of existing practices and BMP feasibility, design, and implementation	Development of BMP projects, design, and construction	Ongoing monitoring and maintenance	
21	Bacterial (Developed)	UT to Cane Run (CR-3)	Implement education and outreach for pet waste pick up at Coldstream Park Dog Park (or any other future dog park). Determine appropriateness of implementing pet waste stations; implement if appropriate. Monitor to evaluate effectiveness.	Med	PCR, SCR / E. coli, Fecal coliform	LFUCG and City of Georgetown Parks	$600 - $800 / station	Unknown	319 Grant, designated city or state funding, private funding	LFUCG existing educational materials/programs; Supplier/Installer for waste station; maintenance of waste station	Perform education and outreach; initial implementation of waste station(s)	Ongoing monitoring and maintenance	
	Education & Outreach	Watershed-Wide	Develop and utilize a Cane Run Watershed Coordinator position.	High	Education & Outreach; Plan implementation to address all pollutants	Cane Run Watershed Council	$40,000 / year	Unknown	320 Grant, designated city or county funding, private funding	Job development; organization to oversee the role	Develop job position and hire coordinator; begin watershed plan implementation	Ongoing implemation, seeking of new opportunites, monitoring, and revision of watershed-based plan	

TABLE 50
CANE RUN WBP BMP IMPLEMENTATION PLAN

BMP No.	Type	Target Audience or Area	BMP Description and Action Items	Priority	Impairment / Pollutant Addressed	Responsible Parties	Estimated Cost	Estimated Load Reduction	Funding Source(s) / Program(s)	Technical Assistance Needed	Milestones		
											Short Term (0-5 Years)	**Mid-Term (5-10 Years)**	**Long-Term (10+ Years)**
22	Education & Outreach	General	Develop appropriate watershed signage and place at key locations to increase public awareness. Signs could mark buffer zone areas, watershed boundaries, no-mow areas, and key stream crossings.	Med	Education & Outreach	LFUCG, City of Georgetown, University of Kentucky Research Facilities, Friends of Cane Run, Kentucky Horse Park, Bluegrass Stockyards, other public and private entities	$50 - $1,500 / sign Dependent upon size and quantity.	None	Grants	Sign development and installation	2019 -2029 and ongoing placement of signs as restoration projects are conducted or along key travel paths or public access areas.		
23	Education & Outreach	Neighborhood Associations	Rate the relative strength of neighborhood associations and prioritize the educational presentation and implementation plans in these respective areas.	Med	Education & Outreach	Fayette County Neighborhood Council; Individual neighborhood associations	None	N/A	N/A	Watershed mapping	Rank and prioritize in 2020	None	None
24	Education & Outreach	Neighborhood Associations	Provide "content" (articles / tips / factoids / event information) for Neighborhood newsletters.	Med	Education & Outreach	LFUCG, City of Georgetown, Fayette County Neighborhood Council; Individual neighborhood associations	None	N/A	N/A	LFUCG and Georgetown to provide the content to be distributed by the neighborhood associations	Ongoing: develop content and make available to the FCNC and Scott County neighborhood associations for distribution		
25	Education & Outreach	Neighborhood Associations	General Landowner Educational Package for Neighborhood Association BMP Program: 1. Compile or develop educational materials on what residents can do to reduce water pollution on their property including: the impacts of private contributions to sanitary sewer overflows, non-point sources of pollution, proper lawn care practices, pet waste clean-up, litter, stormwater runoff and impervious surfaces. 2. Compile or develop educational material on installation and benefits of street trees, rain barrels, rain gardens and green infrastructure such as permeable pavers and bioswales. 3. Develop educational material that summarizes the relevant information in the watershed plan for local landowners. 4. Publicize grant programs available to install "green infrastructure" such as the Neighborhood Sustainability Grant and Stormwater Quality Incentive Grant programs. 5. Distribute information through workshops, social media, webpages, and other means to garden clubs and neighborhood associations. 6. Identify or develop a demonstration project and workshop illustrating rain barrel and rain garden installation in each neighborhood area.	Med	Education & Outreach	LFUCG DEP, LFUCG DWQ, City of Georgetown, Bluegrass Greensource, Friends of Cane Run, UK Ag. Extension	Dependent on type of presentation / materials presented and number of workshops and demonstration projects implemented	Unknown	City of Georgetown, LFUCG DEP Budget, 319 Grants, LFUCG Water Quality Incentive Grants,LFUCG Sustainable Environmental Grants,	Development of technical material for problems and BMPs, technical presenters, implementation of BMPs	Educational package development and initial implementation	Ongoing Implementation	
26	Education & Outreach	Streamside Landowners	Streamside Landowner Educational Package for Neighborhood Association BMP Program: 1. Compile or develop educational material on backyard erosion problems, stream stewardship and values / functions of riparian areas 2. Compile or develop educational material on solutions for streamside owners including riparian buffer zones, green engineering for ephemeral streams and stormwater conveyances, and opportunities to fund such projects (i.e., UK Ag. Extension Publication "Living Along a Kentucky Stream"). The material should cover technical information such as the types, sources, costs, and planting techniques for riparian restoration to train participants for implementation. 3. Distribute information through workshops, social media, webpages, and other means to garden clubs and neighborhood associations. 4. Identify or develop a demonstration project and workshop illustrating buffer zone restoration or other green engineering in each neighborhood area.	Med	Education & Outreach	LFUCG DEP, LFUCG DWQ, City of Georgetown, LFUCG Green Check Program, Bluegrass Greensource, Friends of Cane Run, UK Ag. Extension	Dependent on type of presentation / materials presented and number of workshops and demonstration projects implemented	Unknown	City of Georgetown, LFUCG DEP Budget, 319 Grants, LFUCG Water Quality Incentive Grants,LFUCG Sustainable Environmental Grants,	Development of technical material for problems and BMPs, Technical Presenters, implementation of BMPs	Educational Package Development and initial implementation	Ongoing Implementation	

TABLE 50

CANE RUN WBP BMP IMPLEMENTATION PLAN

BMP No.	Type	Target Audience or Area	BMP Description and Action Items	Priority	Impairment / Pollutant Addressed	Responsible Parties	Estimated Cost	Estimated Load Reduction	Funding Source(s) / Program(s)	Technical Assistance Needed	Milestones		
											Short Term (0-5 Years)	Mid-Term (5-10 Years)	Long-Term (10+ Years)
27	Education & Outreach	Businesses, Neighborhood Associations, Development Community	Commercial and Institutional Green Infrastructure Implementation and Outreach Program: 1. Conduct outreach to businesses/residents to increase awareness of the problem associated with increased stormwater runoff and what can be done to reduce it. 2. Publicize grant programs available to neighborhoods / businesses to install "green infrastructure" such as the Neighborhood Sustainability Grant and Stormwater Quality Incentive Grant programs. 3. Develop a demonstration project / workshop for stormwater runoff reduction. 4. Approach businesses and other non-residential organizations identified in the watershed based plan about conducting a green infrastructure feasibility study on their property. 5. Conduct a feasibility study to determine the best locations and types of green infrastructure to install in a given area. 6. Apply for financial assistance to implement these practices.	Med	Education & Outreach	LFUCG DEP, LFUCG DWQ, City of Georgetown, LFUCG Green Check Program, Bluegrass Greensource, Friends of Cane Run, UK Ag. Extension	Dependent on type of presentation / materials presented and number of workshops and demonstration projects implemented	Unknown	City of Georgetown, LFUCG DEP Budget, 319 Grants, LFUCG Water Quality Incentive Grants,LFUCG Sustainable Environmenal Grants,	Development of technical material for problems and BMPs, technical presenters, implementation of BMPs	Educational package development and initial implementation	Ongoing implementation	
28	Education & Outreach	General	Add watershed maps and watershed plan documents to the Friends of Cane Run, LFUCG, and City of Georgetown web sites.	Med	Education & Outreach	Friends of Cane Run, LFUCG, City of Georgetown	None	None	N/A	Webmaster	Post after plan finalization and approval by KDOW	None	None
29	Education & Outreach	General	Establish stream access points within restored buffer zone areas.	Low	Education & Outreach	Riparian buffer restoration teams	None	N/A	N/A	None	Ongoing effort associated with riparian restoration activities and sign installation		
30	Education & Outreach	Septic system homeowners	Educate homeowners on septic system maintenance. Identify septic system owners and distribute "A Kentucky Homeowner's Guide to Septic Systems" available from the Kentucky Onsite Wastewater Association, Inc.	Low	Education & Outreach	Fayette County Health Dept., WEDCO District/Scott County Health Department, Friends of Cane Run	None	Unknown	None	Homeowner's guide	Identify owners and distribute information	None	None
31	Education & Outreach	Upper (CR-12, CR-11, CR-3, Site 9) and Lower Cane Run Watershed (Sites 1, 2, 3)	Neighborhood Association BMP Program. Provide education and funding for implementation of residential BMPs.	Low	WAH / Water Quantity, N, P	LFUCG, City of Georgetown / Scott County, Bluegrass Greensource, UK Extension	$100 - $250 / rain barrel, $500 - $2,500 / rain garden, $20 - $40 / linear ft riparian buffer	Dependent on BMPs implemented	319 Grant, LFUCG Water Quality Incentive Grant, Neighborhood Sustainability Grant, KAWC Grant, Designated city or state funding, private funding	BMP design and installation assistance, planting supplies, education	Educational Package Development and initial implementation	Ongoing implementation	
32	Stream / Riparian	Watershed-Wide	Develop appropriate bank stabilization and riparian buffer projects at sites identified in the Severe Erosion Survey (within this plan).	High	WAH / Habitat Improvement	Friends of Cane Run	Dependent on area implemented	Improved habitat, stream shading, TSS reduction	319 or other grants, discretionary city/county funds, in-kind match	Design expertise, materials, maintenance supplies, volunteer support	Ongoing review and support of increasing stable streambanks and functioning riparian areas.		
33	Stream / Riparian	Cane Run (Site 10/CR-5, CR-2)	Develop appropriate bank stabilization on Cane Run at Citation Blvd. crossing; Develop riparian buffer project where possible; Severe bank erosion has been observed in the vicinity of the bridge crossing; this is located upstream of Coldstream Cane Run Stream Restoration, thus important effort to protect the completed restoration.	High	WAH / Habitat Improvement	KYTC, University of Kentucky Coldstream Research Farm, LFUCG	Design costs; construction costs dependent on solution implemented	Improved habitat, stream shading, in-stream sediment reduction	KYTC, University of Kentucky Coldstream Research Farm, LFUCG	Design expertise, construction	Development of project design and construction	Ongoing maintenance	
34	Stream / Riparian	Cane Run (Site 7)	Kentucky Horse Park Riparian Stream Buffer Stewardship: riparian protection and estabilishment has occurred along Cane Run within the Horse Park, but needs signage and development of education and outreach to promote benefits and improve perceptions of natural buffers.	High	WAH / Habitat Improvement	Kentucky Horse Park, University of Kentucky Agricultural Extension, Friends of Cane Run	Dependent on number and type of signs and selected educational outreach approach	Unknown	Kentucky Horse Park, 319 or other grants	Ecologist/biologist to develop signage and produce/obtain educational materials; Staff and equipment to install/implement	Signage and materials development and initial implementation	Ongoing implementation/maintenance	
35	Stream / Riparian	Cane Run (Site 7)	Kentucky Horse Park Riparian Stream Buffer Stewardship: riparian protection and estabilishment has occurred along Cane Run within the Horse Park, but development and implementation of an operation and maintenance plan is needed such that buffers are maintained appropriately while meeting goals/functions needed by Kentucky Horse Park	High	WAH / Habitat Improvement	Kentucky Horse Park, University of Kentucky Agricultural Extension, Friends of Cane Run	$10,000 for operation and maintenance plan development plus annual cost to implement	Unknown	Kentucky Horse Park, 319 or other grants	Ecologist/biologist to develop plan; Staff and equipment to implement	Development of Buffer Operation and Maintenance Plan and initial implementation	Ongoing implementation/maintenance	

TABLE 50
CANE RUN WBP BMP IMPLEMENTATION PLAN

BMP No.	Type	Target Audience or Area	BMP Description and Action Items	Priority	Impairment / Pollutant Addressed	Responsible Parties	Estimated Cost	Estimated Load Reduction	Funding Source(s) / Program(s)	Technical Assistance Needed	Milestones		
											Short Term (0-5 Years)	Mid-Term (5-10 Years)	Long-Term (10+ Years)
36	Stream / Riparian	UT Cane Run (Site 6)	Stream Restoration: about 2,100 ft of UT to Cane Run stream in need of restoration. Currently in private ownership (1976 Lexington Rd., Georgetown; zoned Commercial), but could be purchased by Georgetown, Scott County, etc. and turned into green space/greenway area. Could be potential to connect to Legacy Trail. The reach is straightened and there is area available for remeandering within the parcel. Erosion is occurring in this area and the downstream end of this tributary is where MHP package wastewater treatment plant discharges. Establishing a riparian buffer would aid in reducing nutrient loads and provide habitat. If stream restoration is unfeasible, riparian buffer restoration would still be very beneficial.	Med	WAH / Habitat Improvement, N, P	Private landowners, Potential public entities to take ownership; Consultants, Contractors	Stream Restoration: $1M for full stream restoration design and construction	Stream Restoration: 0.0035 lbs /ft P, 0.02 lbs /ft N annually	319 Grant, Designated city, county, or state funding, private funding	Consultants, designers, contractors, monitoring	Phase I: 1) Meet with landowners or potential proprty owners to evaluate support, 2) Secure funding, 3) Project Design	Phase II: 1) Conduct pre- and post construction monitoring, 2) Construction	Ongoing monitoring and maintenance
37	Stream / Riparian	UT Cane Run and Cane Run (Site 5)	Stream Restoration: about 1,500 ft of UT to Cane Run and 2,250 ft of Cane Run in need of restoration. Currently in private ownership (Grace Christian Church, 1648 Lexington Rd., Georgetown). Both reaches could be re-meandered within the property. Establishing a riparian buffer would aid in reducing nutrient loads and provide habitat. If stream restoration is unfeasible, riparian buffer restoration would still be very beneficial on both streams.	Med	WAH / Habitat Improvement, N, P	Private landowner, Consultants, Contractors	Stream Restoration: $2M for full stream restoration design and construction	Stream Restoration: 0.0035 lbs /ft P, 0.02 lbs /ft N annually	319 Grant, designated county, or state funding, private funding	Consultants, designers, contractors, monitoring	Phase I: 1) Meet with landowners to evaluate support, 2) Secure funding, 3) Project Design	Phase II: 1) Conduct pre- and post construction monitoring, 2) Construction	Ongoing monitoring and maintenance
38	Stream / Riparian	Cane Run (Site 2)	Riparian Buffer: about 15,000 ft of Cane Run in need of riparian buffer establishment. Currently in private ownership of several large landholders. Establishing a riparian buffer would aid in reducing nutrient loads and provide habitat.	Med	WAH / Habitat Improvement, N, P	Private landowners, NRCS, UK Ag. Extension, Consultants, Contractors	Buffer Establishment: $3M for buffer design and construction	Stream Buffer: 0.0035 lbs /ft P, 0.02 lbs /ft N annually	319 Grant, designated county or state funding, NRCS agricultural cost share programs, private funding	Consultants, designers, contractors, monitoring	Phase I: 1) Meet with landowners to evaluate support, 2) Secure funding, 3) Project Design	Phase II: 1) Conduct pre- and post construction monitoring, 2) Construction	Ongoing monitoring and maintenance
39	Stream / Riparian	Cane Run and Tributaries (CR-8)	Continue to enhance and maintain stream stabilization and riparian buffer: within Lexington's Shadybrook Park. Some grant-funded projects have already been completed there, but may be additional opportunites to increase buffers or buffer effectiveness or provide additional eductaion and outreach opportunites.	Med	WAH / Habitat Improvement, N, P	LFUCG, Consultants, Contractors	Dependent on type and extent of needs	Stream Buffer: 0.0035 lbs /ft P, 0.02 lbs /ft N annually	319 Grant, LFUCG Stormwater Incentive Grant	Consultants, designers, contractors, monitoring	Identification of needs; development and implementation of plans	Ongoing project identification and implementation	
40	Stream / Riparian	Dixie Tributary and UT to Cane Run (Site 6)	Riparian Buffer: potential to establish/enhance riparian buffer on up to approximately 6,000 feet of tributary within a single farm property (4025 Georgetwon Road, Lexington). Establishing a riparian buffer would aid in reducing nutrient loads and provide habitat.	Med	WAH / Habitat Improvement, N, P	Private landowner, NRCS, UK Ag. Extension, Consultants, Contractors	Buffer Establishment: $1M for buffer design and construction	Stream Buffer: 0.0035 lbs /ft P, 0.02 lbs /ft N annually	319 Grant, Designated county or state funding, NRCS agricultural cost share programs, private funding	Consultants, designers, contractors, monitoring	Phase I: 1) Meet with landowners to evaluate support, 2) Secure funding, 3) Project Design	Phase II: 1) Conduct pre- and post construction monitoring, 2) Construction	Ongoing monitoring and maintenance
41	Green Infrastructure	Developed Areas of Watershed (i.e., CR-1 through CR-12 and portions of Site 2)	Runoff-reducing / infiltration-increasing BMPs such as bioretention areas, stormwater wetlands, bioswales, permeable pavements, green roofs, etc. should be promoted and installed in already developed portions of the watershed.	Med	WAH / Water Quantity, N, P	LFUCG , City of Georgetown, Bluegrass Greensource, Friends of Cane Run, UK Ag. Extension	Dependent on number and type of projects implemented	Dependent on action taken	319 grant, LFUCG Stormwater Quality Incentive Grant, private funding	Consultants, designers, contractors, monitoring	Development and installation of BMP projects	Ongoing maintenance/upkeep; additional installations	
42	Green Infrastructure	Developing Areas of Watershed (i.e., portions of Site 2)	Runoff-reducing / infiltration-increasing BMPs such as bioretention areas, stormwater wetlands, bioswales, permeable pavements, green roofs, etc. should be promoted and installed, particularly in Scott County where conversion of large amounts of agricultural lands to residential development is likely to occur in coming years.	High	WAH / Water Quantity, N, P	LFUCG , City of Georgetown, Bluegrass Greensource, Friends of Cane Run, UK Ag. Extension	Dependent on number and type of projects implemented	Dependent on action taken	319 grant, LFUCG Stormwater Quality Incentive Grant, private funding	Consultants, designers, contractors, monitoring	Development and installation of BMP projects	Ongoing maintenance/upkeep; additional installations	
43	Green Infrastructure	BMP Owners, maintainers	As green infrastructure BMPs are promoted, funded, and installed, there is a growing need for the development and implementation of site specific operation and maintenance plans such that BMPS are maintained appropriately to maximize goals/functions	Med	Education & Outreach	LFUCG DWQ, City of Georgetown, LFUCG, Bluegrass Greensource, Friends of Cane Run, UK Ag. Extension	Dependent on type and number of plans	Unknown	City of Georgetown, 319 Grants, LFUCG Water Quality Incentive Grants, LFUCG Sustainable Environmenal Grants,	Development of technical material for plans	Identification of projects / types of projects in need of plans; development and implementation of plans	Ongoing maintenance/upkeep; additional installations	
44	Green Infrastructure	Cane Run (Site 10/CR-3)	Evaluate potential for BMPs to capture runoff within Griffin Gate Golf Club for nutrient treatment. Pockets of bioretention and wetland could be utilized to treat nutrients Capturing and storing stormwater runoff for irrigation should also be evaluated.	Low	N, P	Griffin Gate Golf Club, Consultants	Feasibility study and design: $10,000 - $20,000, Construction Cost Dependent on BMPs developed	Dependent on BMPs developed	319 Grant, LFUCG Water Quality Incentive Grant, private funding	Consultants, designers, contractors	Phase I: 1) Contact property owners to evaluate support, 2) Secure funding, 3) Conduct	Phase II: 1) Choose feasible BMPs to pursue, 2) Secure funding, 3) Conduct pre- and post construction monitoring, 4) Implement BMPs.	Ongoing monitoring and maintenance

TABLE 50

CANE RUN WBP BMP IMPLEMENTATION PLAN

BMP No.	Type	Target Audience or Area	BMP Description and Action Items	Priority	Impairment / Pollutant Addressed	Responsible Parties	Estimated Cost	Estimated Load Reduction	Funding Source(s) / Program(s)	Technical Assistance Needed	Milestones		
											Short Term (0-5 Years)	Mid-Term (5-10 Years)	Long-Term (10+ Years)
45	Green Infrastructure	Cane Run (Sites 6 and 7)	Evaluate potential for BMPs to capture runoff within Kearney Hill Golf Links for nutrient treatment. Pockets of bioretention and wetland could be utilized to treat nutrients Capturing and storing stormwater runoff for irrigation should also be evaluated.	Low	N, P	Kearney Hill Golf Links, Consultants	Feasibility study and design: $10,000 - $20,000, Construction Cost Dependent on BMPs developed	Dependent on BMPs developed	319 Grant, LFUCG Water Quality Incentive Grant, private funding	Consultants, designers, contractors	Phase I: 1) Contact property owners to evaluate support, 2) Secure funding, 3) Conduct feasibility study and design	Phase II: 1) Choose feasible BMPs to pursue, 2) Secure funding, 3) Conduct pre- and post construction monitoring, 4) Implement BMPs.	Ongoing monitoring and maintenance
46	Green Infrastructure	Cane Run (Site 1)	Evaluate potential for BMPs to capture runoff within Canewood Golf Course for nutrient treatment. Pockets of bioretention and wetland could be utilized to treat nutrients Capturing and storing stormwater runoff for irrigation should also be evaluated.	Low	N, P	Kearney Hill Golf Links, Consultants	Feasibility study and design: $10,000 - $20,000, Construction Cost Dependent on BMPs developed	Dependent on BMPs developed	319 Grant, private funding	Consultants, designers, contractors	Phase I: 1) Contact property owners to evaluate support, 2) Secure funding, 3) Conduct feasibility study and design	Phase II: 1) Choose feasible BMPs to pursue, 2) Secure funding, 3) Conduct pre- and post construction monitoring, 4) Implement BMPs.	Ongoing monitoring and maintenance
47	General (Trash)	Cane Run (CR-8)	In-stream floatable Trash and Debris collection system installation targeted to Lexmark and/or adjacent property; Some pilot evaluation has been performed by Lexmark and University of Kentucky BAE students	Med	WAH / Trash and Debris	Lexmark	Varies; requires a maintence/upkeep cost.	Amount of trash removed varies	319 grant, LFUCG Stormwater Incentive Grant, Lexmark, private funding	Technical input on design selected	Installation of system; frequent maintenance/upkeep	Ongoing maintenance/upkeep; additional installations	
48	General (Trash)	Cane Run (CR-2)	In-stream floatable Trash and Debris collection system installation targeted to Coldstream Research Campus and/or adjacent property; Some pilot evaluation has been performed by Lexmark and University of Kentucky BAE students	Med	WAH / Trash and Debris	University of Kentucky Coldstream Research Campus	Varies; requires a maintence/upkeep cost.	Amount of trash removed varies	319 grant, LFUCG Stormwater Incentive Grant, Coldstream Research Campus, private funding	Technical input on design selected	Installation of system; frequent maintenance/upkeep	Ongoing maintenance/upkeep; additional installations	
49	General	General	Support a "Reforest the Bluegrass" or similar event in the Cane Run Watershed to increase the riparian zone width in areas identified in the plan.	Low	WAH / Habitat Improvement	LFUCG DEP Urban Forestry, Reforest the Bluegrass, Scott County / Georgetown, Friends of Cane Run	Dependent on area planted	Dependent on area planted	Local government funding and private sponsors	Planting supplies, organization	Conduct an event along one of the riparian areas identified for improvement		
50	General	General	Support regulatory measures to protect riparian buffers (Fayette and Scott counties) including creation of an ordinance to enhance protection and management of riparian buffers	Low	WAH / Habitat Improvement	Friends of Cane Run	None	Unknown	None	Ordinance drafting, regulatory review	Ongoing review and support of protection / management measures		

F. Funding Sources

Successful implementation of this WBP will require significant financial resources. Where possible, estimates of funding were included in the BMP Implementation Plan (**Table 50**, pages 109 through 114). Known funding sources included designated state or city budgets, sanitary sewer user fees, and various grant programs. Diverse funding sources will need to be sought for BMP implementation and resources leveraged where possible to extend the positive impacts of the acquired implementation funds. Sources of funding that are applicable to this plan will be sought as appropriate; known funding resources are listed below.

1. US EPA 319(h) Grants

The US EPA provides funding through Section 319(h) of the Clean Water Act to the Kentucky Nonpoint Source (NPS) Pollution Control Program. These funds can be used to pay for 60 percent of the total cost for qualifying projects, but require a 40 percent non-federal match. Grants are available for watershed-based implementation, and priority consideration will be given to projects for which implement a WBP, such as this one. Project proposal forms may be submitted to the Kentucky NPS Pollution Control Program at any time; however, deadlines apply to specific federal funding cycles. For more information on this grant program, see Kentucky Division of Water website: http://water.ky.gov.

2. LFUCG Stormwater Quality Projects Incentive Grant Program

The LFUCG Stormwater Quality Projects Incentive Grant Program provides financial assistance for projects in Lexington that improve water quality, address stormwater runoff, and educate the public about these issues. The annual program typically provides over $1 million in funding. The LFUCG Division of Water Quality receives applications and makes recommendations for project selection to the Water Quality Fees Board, who makes the final selection on all grant awards. The grants are divided into three classes: Class A neighborhood grants, Class B infrastructure grants, and Class B education grants. Class A neighborhood grants are open to neighborhood, community, and homeowner associations incorporated with the Commonwealth of Kentucky that represent single family homeowners or farms. Class B infrastructure grants are open to owners and tenants of non-farm, non-single-family residential facilities including businesses, schools, churches, and non-profits located in Fayette County that pay the Water Quality Management Fee. Class B Education Grants are open to owners and tenants of non-farm, non-single-family residential facilities including businesses, schools, churches, and non-profits located in Fayette County that pay the Water Quality Management Fee. Additional information can be found online on the LFUCG website: http://www.lexingtonky.gov.

3. USDA-NRCS EQIP Program

The Environmental Quality Incentive Program (EQIP) provides financial and technical assistance to agricultural producers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation or improved or created wildlife habitat. Eligible program participants that rank well can receive financial and technical assistance to implement conservation practices that address natural resource concerns on their land. Visit your local USDA Service Center for more information or to apply. Additional details may be found at: www.nrcs.usda.gov/getstarted.

4. State Cost Share

The Kentucky Soil Erosion and Water Quality Cost Share Program and the Kentucky Soil Stewardship Program were created to help agricultural operations protect the soil and water resources of Kentucky and to implement their agriculture water quality plans. The program helps landowners address existing soil erosion, water quality and other environmental problems associated with their farming or woodland operation.

The 1994 Kentucky General Assembly established this financial and technical assistance program. Kentucky Revised Statute 146.115 establishes that funds be administered by local conservation districts and the Kentucky Soil and Water Conservation Commission with priority given to animal waste-related problems, agricultural district participants and to producers who have their Agriculture Water Quality plans on file with their local conservation districts. Funding comes from the Kentucky General Assembly through direct appropriations to the program from the Tobacco Settlement Funds and from funds provided by the Kentucky Department of Agriculture.

Practices eligible for cost share are agriculture and animal waste control facilities; streambank stabilization; animal waste utilization; vegetative filter strips; integrated crop management; pesticide containment; sinkhole protection; pasture and hay land forage quality; heavy use area protection; rotational grazing system establishment; water well protection; forest land and cropland erosion control systems; closure of agriculture waste impoundment; on-farm fallen animal composting; soil health management; precision nutrient management; strip intercropping system; livestock stream crossing and riparian area protection.

5. Kentucky American Water Environmental Grant Program

Kentucky American Water supports an annual American Water's Environmental Grant Program to offer funds for innovative, community-based environmental projects that improve, restore, or protect the watersheds, surface water and/or groundwater supplies in our local communities. Since launching the program in 2006, Kentucky American Water has awarded more than $195,000 for environmental projects. Additional details may be found at KAWC's website: www.kentuckyamwater.com.

6. FEMA Hazard Mitigation Grant

FEMA's Hazard Mitigation Assistance grant programs provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages including the Hazard Mitigation Grant Program, Pre-Disaster Mitigation, Flood Mitigation Assistance, Repetitive Flood Claims, and Severe Repetitive Loss. If a project will reduce or eliminate the risk of flood damage to the population or structures insured under the National Flood Insurance Program, it may be eligible for funding under one of these programs. For additional details on eligibility requirements and grant details, visit the FEMA website: http://www.fema.gov.

7. Kentucky Department of Fish and Wildlife's Stream Team Program

The Stream Team offers landowners free repairs to eroding and unstable streams and wetlands. Their task is to identify and undertake stream restoration projects statewide. The Stream Team, which includes stream restoration specialists in the Kentucky Department of Fish and Wildlife Resources (KDFWR), works with private landowners and others to identify stream restoration projects. Projects are funded from the Mitigation Fund held in trust solely for repairing streams and wetlands. No state tax general funds or hunting/fishing license dollars are used.

Landowners must meet certain criteria to qualify including a minimum of 1,000 feet of stream with unstable, eroding banks and agreement to a permanent easement typically at least 50 feet wide on each side of the restored stream. In general, both sides of the stream must be available for work, and often several landowners may be involved to provide access to both banks and appropriate protection. Typical projects are on small streams ranging in size from the smallest that may go dry in late summer downstream to those that have permanent flow. Landowner considerations may be and often are included with the projects to meet the needs of property owners. These often include the construction of fords across the stream, fencing, and access to water for livestock. More information about this program is available at http://fw.ky.gov/Fish/Pages/Stream-Team-Program.aspx.

8. Partners for Fish and Wildlife Program

The Partners for Fish & Wildlife program works with private landowners to improve fish and wildlife habitat on their lands. They are leaders in voluntary, community-based stewardship for fish and wildlife conservation. The future of the nation's fish and wildlife depends on private landowners – more than 90% of land in Kentucky is in private ownership. Providing more high-quality habitat not only helps wildlife - by contributing to a healthy landscape, you create a conservation legacy to pass on to future generations.

To accomplish this work, the Partners for Fish & Wildlife team up with private conservation organizations, state and federal agencies and tribes. Together, with the landowner, this collective share funding, materials, equipment, labor and expertise to meet both the landowner's restoration goals and their conservation mission. More information about this program is available at https://www.fws.gov/frankfort/partners.html.

9. Keep Lexington Beautiful's Great American Cleanup

The Keep Lexington Beautiful's Great American Cleanup™ events are sponsored by local, state, and national sponsors. They provide supplies for litter removal, graffiti removal, recycling, clothing collection, stream cleanups, beautification, or community improvement events. Those who are interested in participating can sign up through registration forms available through the Keep Lexington Beautiful Commission, typically posted annually to LFUCG's website.

10. Keep the Bluegrass Beautiful

Scott county is part of Keep the Bluegrass Beautiful, a regional affiliate of Keep America Beautiful sponsored by Bluegrass Greensource. They are interested in projects to reduce litter, increase recycling, and beautify of the community. As an affiliate, Keep the Bluegrass Beautiful is eligible for grants, such as the Lowe's Community Partner Grant and the Cigarette Litter Prevention Program. They also provide opportunities for participation in Great American Cleanup™ events, cigarette litter prevention programs, and America Recycles day. More information is available at https://bggreensource.org/keep-the-bluegrass-beautiful/

VI. OVERSIGHT AND MONITORING

Upon approval of this WBP, focus will transition from planning to implementation. Oversight of implementation activities and the means and methods used to monitor and evaluate success will be key to ensuring the effective implementation of BMPs as outlined in **Chapter V**. This Chapter defines oversight responsibilities and describes the means and methods selected to evaluate success.

A. Organization

As listed in **Chapter I** (page 3), the Cane Run Watershed Council and many stakeholders will be essential in the implementation of this plan. Implementing this plan will require significant time, resources, and effort. Ideally, a full-time watershed coordinator position would be developed and filled to support the implementation of this plan. A coordinator would provide targeted outreach and program promotion and would be responsible for working with stakeholders to identify funding opportunities, develop funding applications, administer projects, keep stakeholders engaged, and coordinate educational programming.

B. Education and Outreach

The Cane Run Watershed Council will work to present the objectives and recommendations of this plan to the general public and key stakeholders within the watershed. The plan will be published on the Cane Run Watershed Council/Friends of Cane Run website to increase its accessibility to the public.

One of the initial goals of the Cane Run Watershed Council should be to outreach to the watershed stakeholders, evaluate support for implementation, and then establish renewed milestones and priorities based on responses.

Development of a summary of the Cane Run WBP in the form of education and/or promotional pieces would aid in the education and outreach efforts. These pieces should condense the plan's findings and recommendations into a product fitting for local leaders and other important audiences; supplemental pieces that showcase BMP activities once implemented.

C. Schedule and Milestones

Implementing the Cane Run WBP will occur over a 10-year (or greater) period. Additional time may be needed as identified through adaptive management as this plan is implemented and/or it is identified that additional water quality goals need to be achieved in order to restore healthy, functioning, sustainable conditions to streams of the Cane Run watershed. The BMP Implementation Plan (**Chapter V, Table 50**, pages 109 - 114), identifies anticipated implementation milestones and schedule that can be used to track implementation progress. Milestone and schedule adjustments shall be made, if needed, to ensure that goals are met if this strategy becomes infeasible or ineffective or needs to otherwise be refined.

D. Monitoring Success

Success will be monitored and evaluated in terms of implementation progress, load reductions achieved, education and behavior change, and water quality sampling results.

1. Tracking Implementation

If a Watershed Coordinator position is developed and utilized, this person is best suited to track BMP implementation progress over time (otherwise the council will have to designated someone to track the implementation). Both BMP-specific and programmatic data will be recorded and publicized. The identification of a responsible party(ies), funding allocated, geographic location (latitude and longitude), design and / or construction timeline(s), and photo documentation will be recorded and reported/updated for individual BMPs at least quarterly on the Cane Run Watershed Council/Friends of Cane Run web page. In addition, measurable, watershed-wide indicators of success, such as the number of BMPs implemented/installed, length of stream stabilized/buffered, etc. will be tracked for each BMP and publicized on the web page and at Cane Run Watershed Council meetings.

The Watershed Coordinator will track progress toward achieving the needed load reductions to meet water quality goals. In addition to the documentation indicated above for each BMP, load reductions achieved by each implemented BMP will be recorded and maintained and will serve as a tool to determine progress made toward implementing this WBP.

2. Tracking Education and Outreach

The Watershed Coordinator will maintain a record of those in attendance at all Watershed Council meetings, as well as document and publicize meeting minutes. In addition, an on-line survey will be developed and electronically distributed/promoted at the end of the first full year of plan implementation. The goal of the survey will be to solicit input from Watershed Council members and other citizens of the watershed related to perceptions regarding implementation activities and suggestions for future implementation.

3. Water Quality Monitoring

When sufficient implementation has occurred within a given sub-watershed that suggests that enough load reductions have been achieved to show an improvement in water quality, then water quality monitoring will be conducted to evaluate the effectiveness of the implementation efforts. The determination of whether enough implementation has occurred to pursue water quality monitoring shall be made using the database of estimates of overall BMP load reductions cumulated from implemented BMPs relative to the required load reductions to meet water quality goals in a given sub-watershed.

Additional funding will be sought to conduct water quality monitoring, using the parameters listed in **Table 49**, pages 105 - 106, to measure reductions in pathogen and nutrient concentrations. Results will be used to document progress toward meeting water quality goals or lack thereof. The most appropriate approach to monitoring will be selected based on BMPs/efforts that have been implemented. Specific sampling approach, duration, frequency, and objectives will be determined at the time monitoring is warranted.

E. Evaluating and Updating the Plan

Changes in water quality are influenced by many factors and implementation efforts may take considerable time before changes can be observed by monitoring data. Thus, sufficient time should be allowed for implementation to occur before adaptive management of project implementation or plan updates ensue.

The goals, objectives, and BMP implementation strategy included in this WBP were based derived from the best available information and projected needs of the community at the time of plan development. It will be the responsibility of the Watershed Coordinator and Cane Run Watershed Council to revisit and supplement the WBP on or before the 5-year anniversary of plan approval, if it is warranted.

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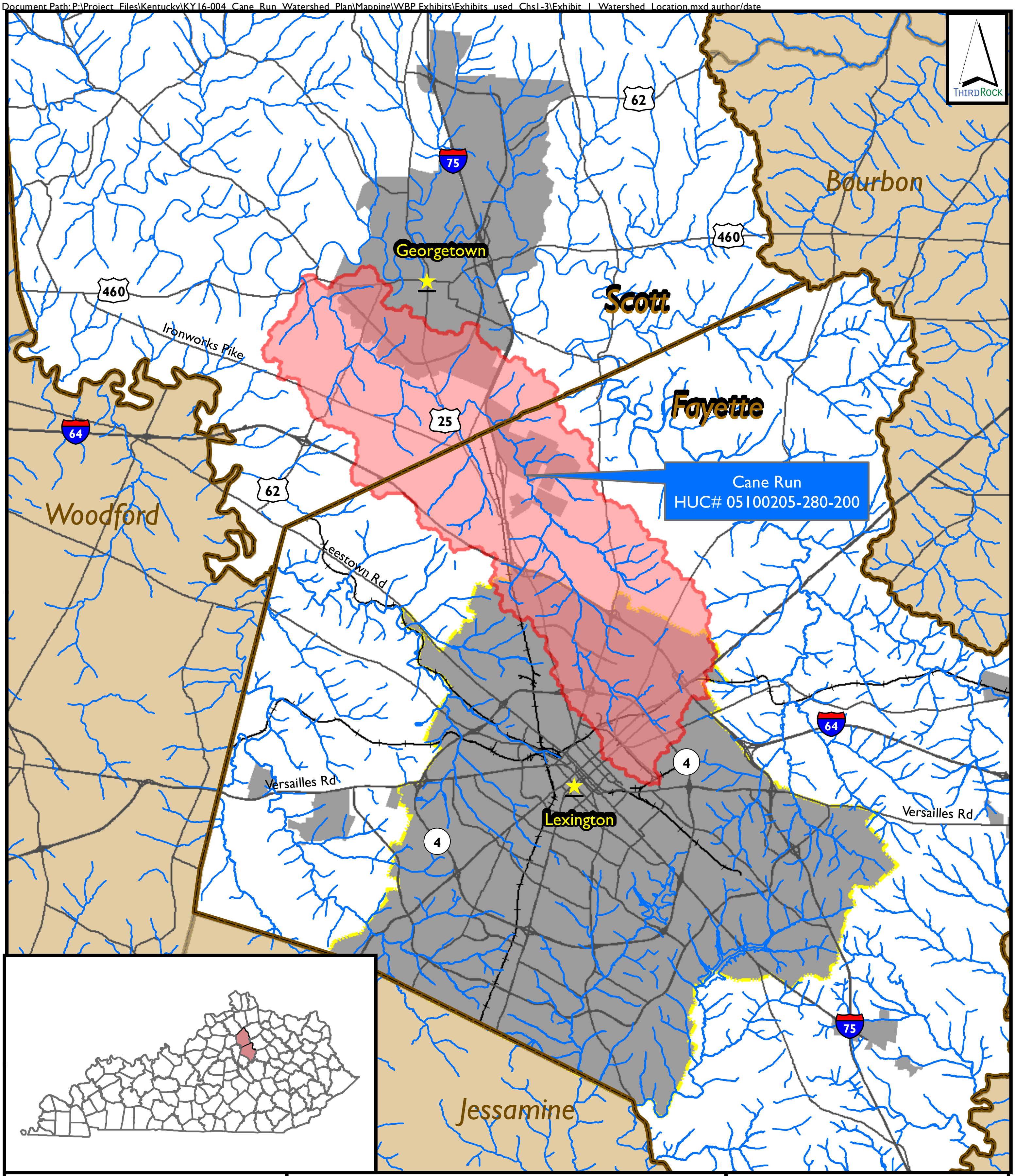
APPENDIX A

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

Document Path: P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\WBP Exhibits\Exhibits_used_Chs1-3\Exhibit_1_Watershed_Location.mxd author/date

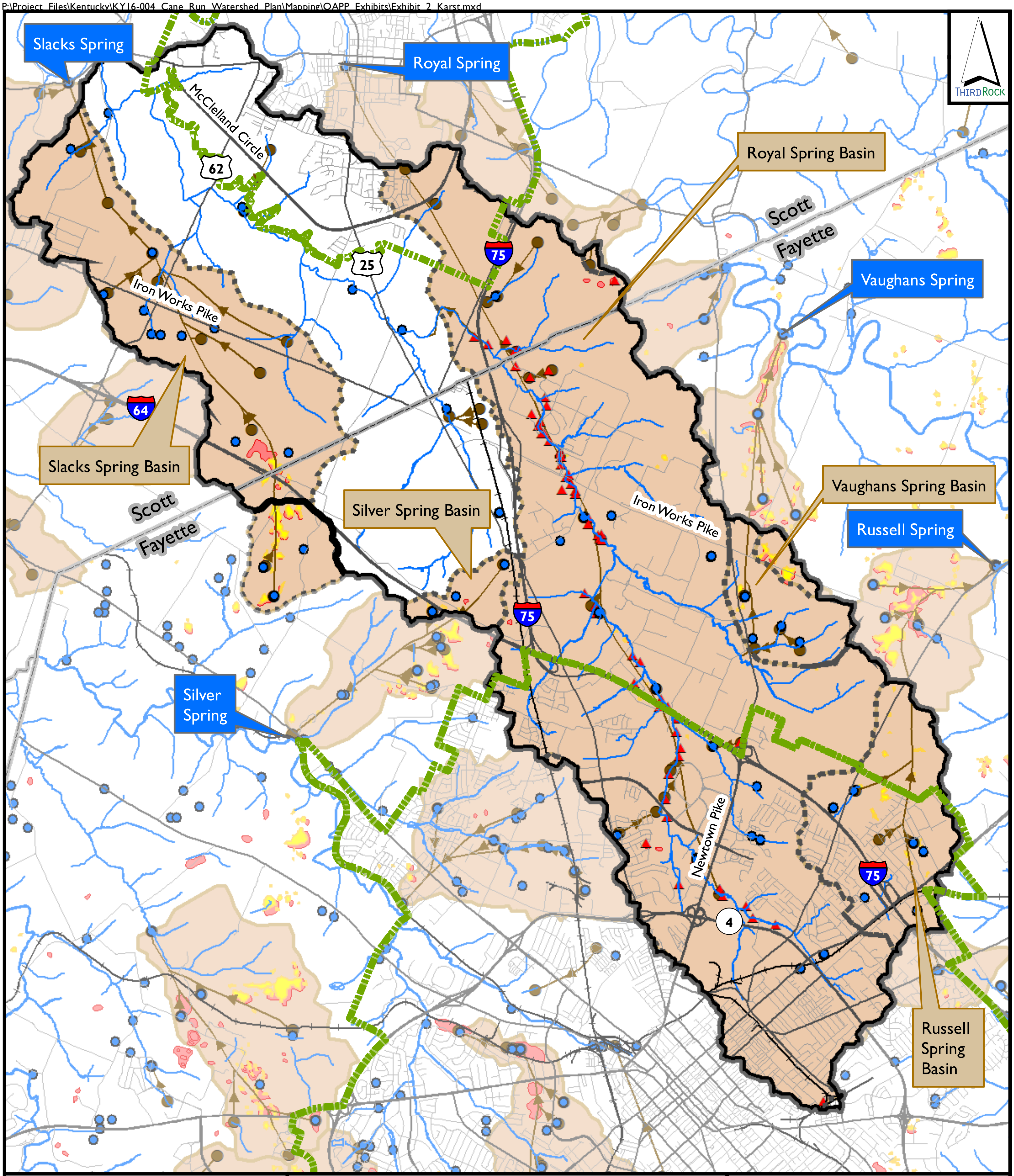


Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

- County Boundary
- Cane Run Watershed
- Incorporated Boundaries
- LFUCG Urban Service Area
- Stream
- Street

Exhibit 1
Watershed Location

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\OAPP_Exhibits\Exhibit_2_Karst.mxd



Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Cane Run Watershed
Karst Basin
Urban Service Boundary
County Boundary
Street
Stream

● Spring
▲ Swallet / Sink
● Karst Flow
→ Karst Flow

🟨 Sinkhole
🟥 Geologic Hazards
▨ Karst Basin

NOTE: Karst shapefiles were obtained from the KGS and UK. Springs, geologic harzards, and sinkholes in Fayette County from LFUCG.

Exhibit 2
Karst

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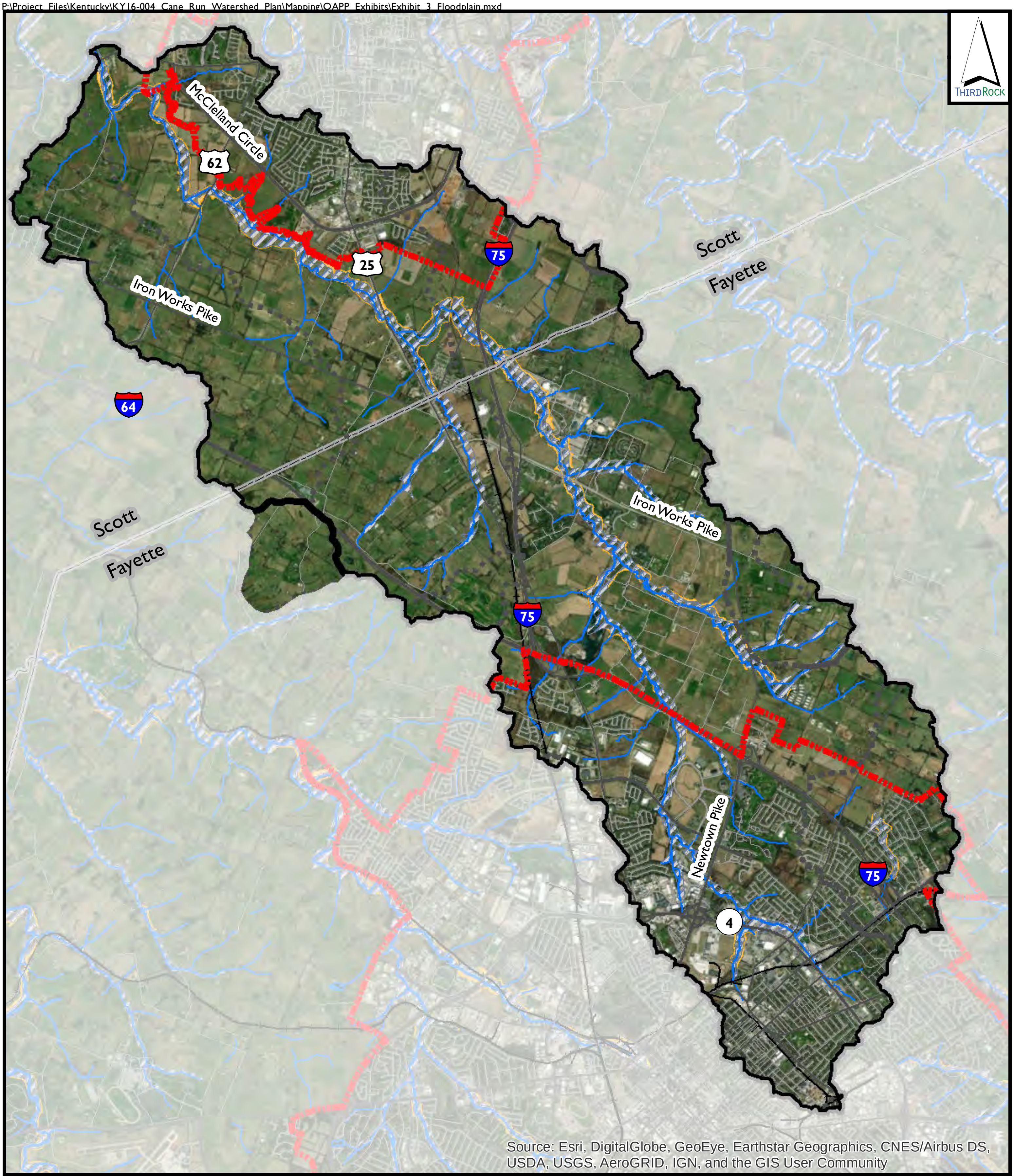

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Cane Run Watershed
Karst Basin
Urban Service Boundary
County Boundary
Street
Stream
▨ 100-Year Floodplain
🟧 500-Year Floodplain

NOTE: Floodplain data was obtained from FEMA.

Exhibit 3
Floodplain

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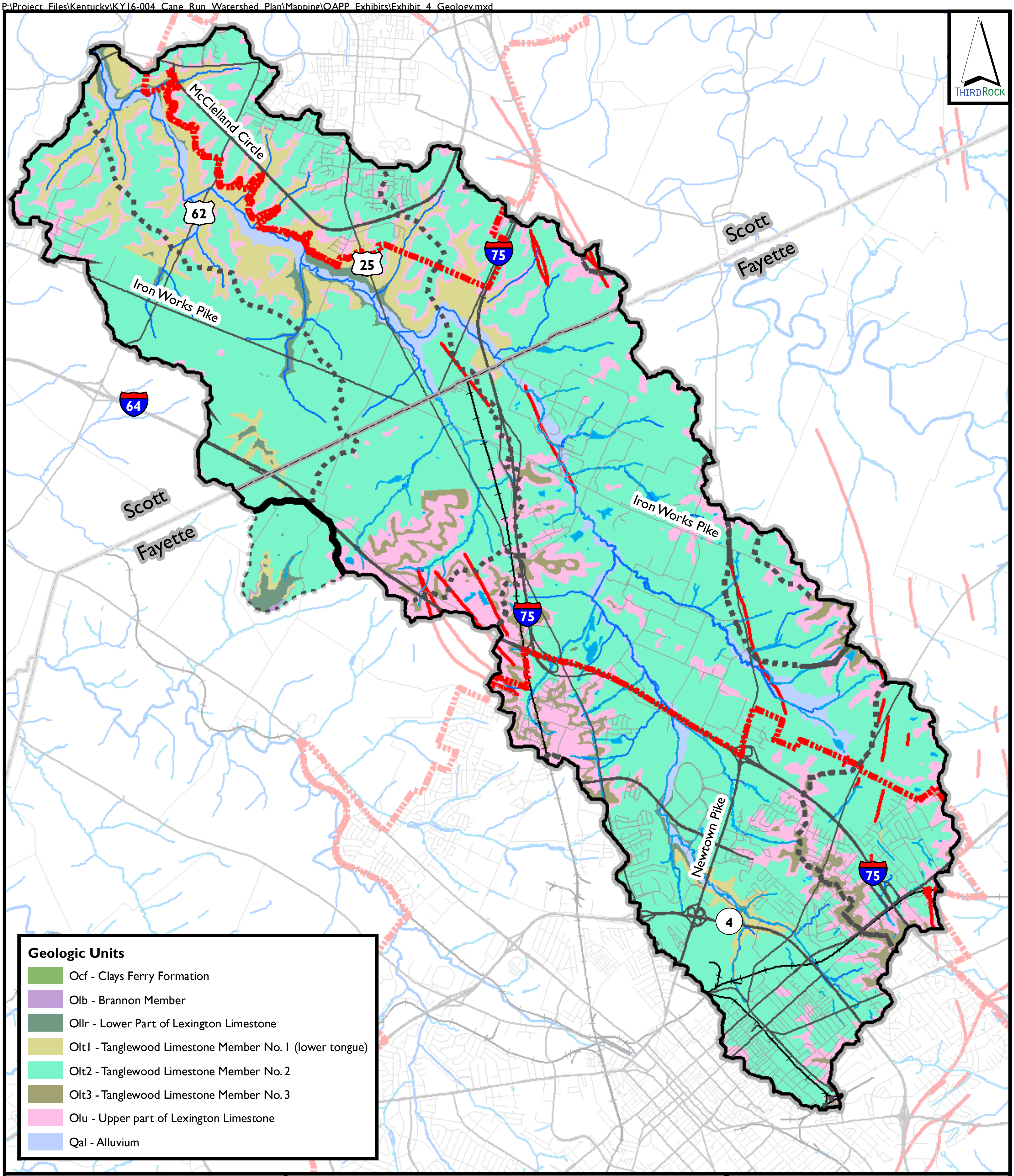

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Cane Run Watershed
Karst Basin
County Boundary
Urban Service Boundary
Intermittent Stream
Stream
Faults
Street

NOTE: Geologic Shapefiles obtained from KGS.

Exhibit 4
Geology

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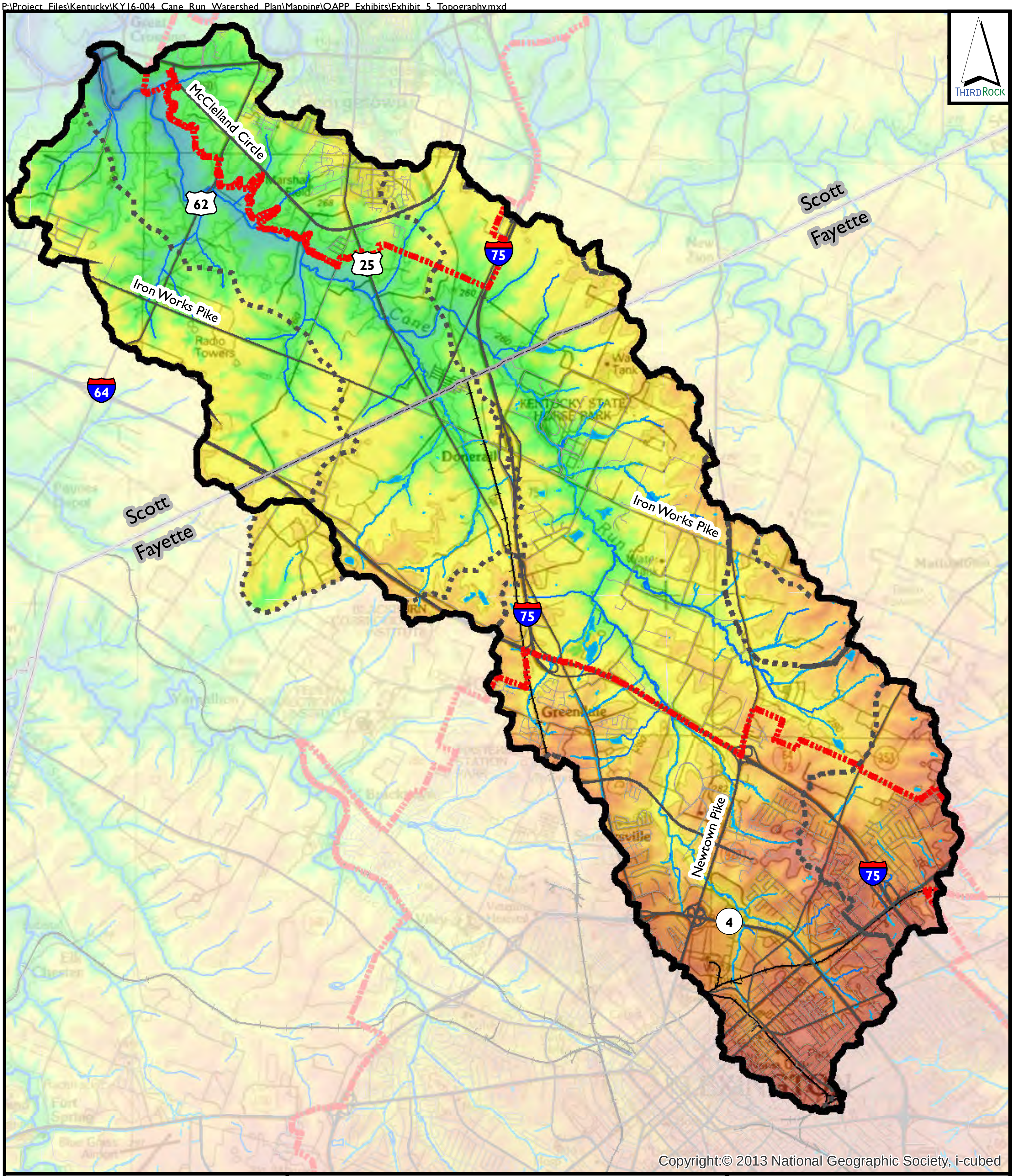

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Cane Run Watershed
Karst Basin
Urban Service Boundary
County Boundary
Intermittent Stream
Stream
Street

Elevation
High : 1000
Low : 750

NOTE: Elevation data was obtained from the KGS

Exhibit 5
Topography

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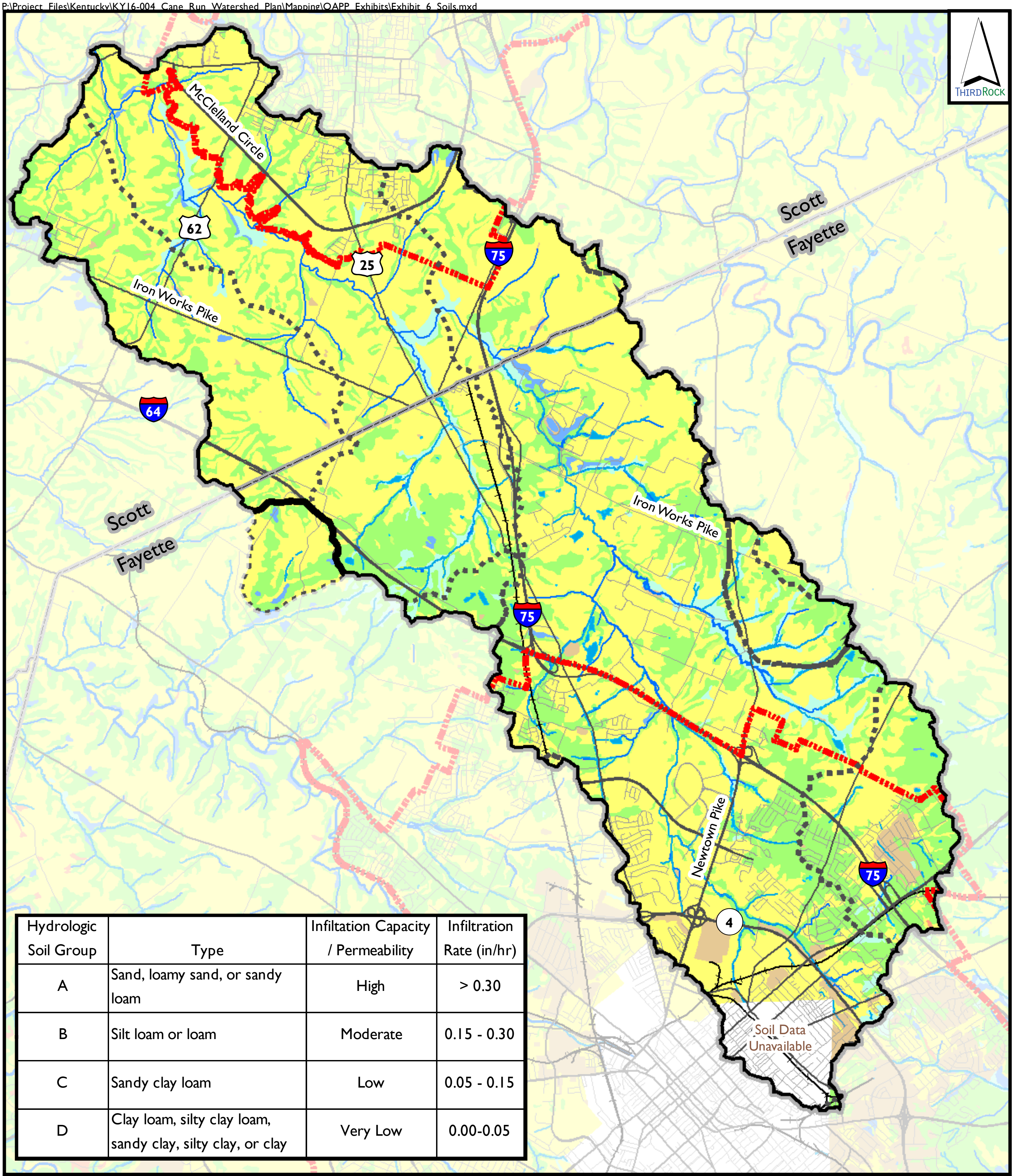

Hydrologic Soil Group	Type	Infiltation Capacity / Permeability	Infiltration Rate (in/hr)
A	Sand, loamy sand, or sandy loam	High	> 0.30
B	Silt loam or loam	Moderate	0.15 - 0.30
C	Sandy clay loam	Low	0.05 - 0.15
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay	Very Low	0.00-0.05

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

Cane Run Watershed
Karst Basin
County Boundary
Urban Service Boundary
Intermittent Stream
Stream

Hydrologic Soil Group
🟧 A
🟪 A/D
🟨 B
🟩 B/D
🟩 C
🟦 C/D
🟦 D
🟫 Not rated
Street

NOTE: Soil data was obtained from the USDA/NRCS.

Exhibit 6
Soils

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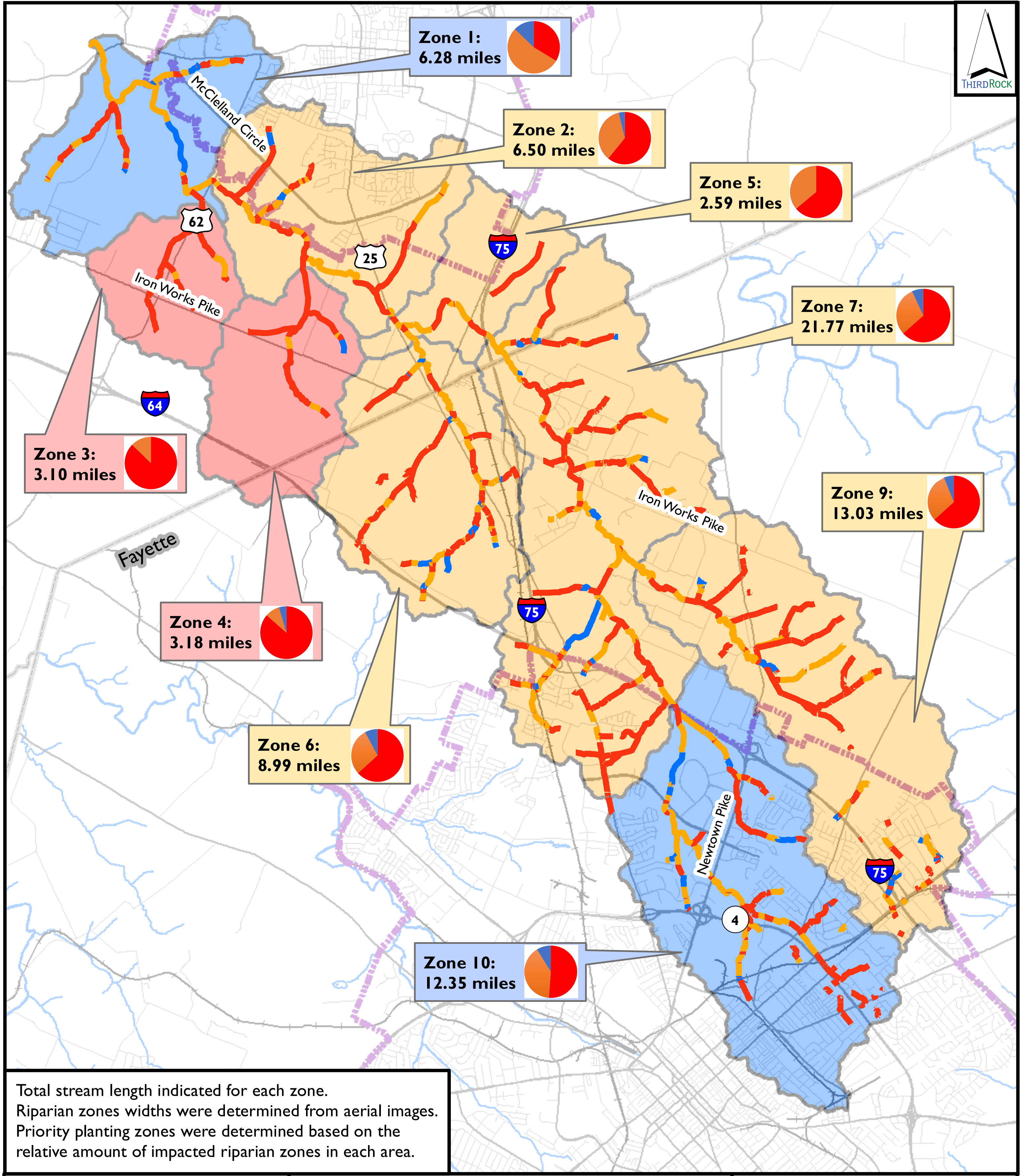

Total stream length indicated for each zone.
Riparian zones widths were determined from aerial images.
Priority planting zones were determined based on the relative amount of impacted riparian zones in each area.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Riparian Zone Width

- 🟥 Heavily Impacted (<10ft)
- 🟧 Moderately Impacted (10-60ft)
- 🟦 Non-impacted (>60 ft)

- 🟦 Low Priority Planting Zone
- 🟨 Moderate Priority Planting Zone
- 🟥 High Priority Planting Zone
- ▭ Urban Service Boundary
- ▭ County Boundary
- — Street

Exhibit 7
Riparian Zone

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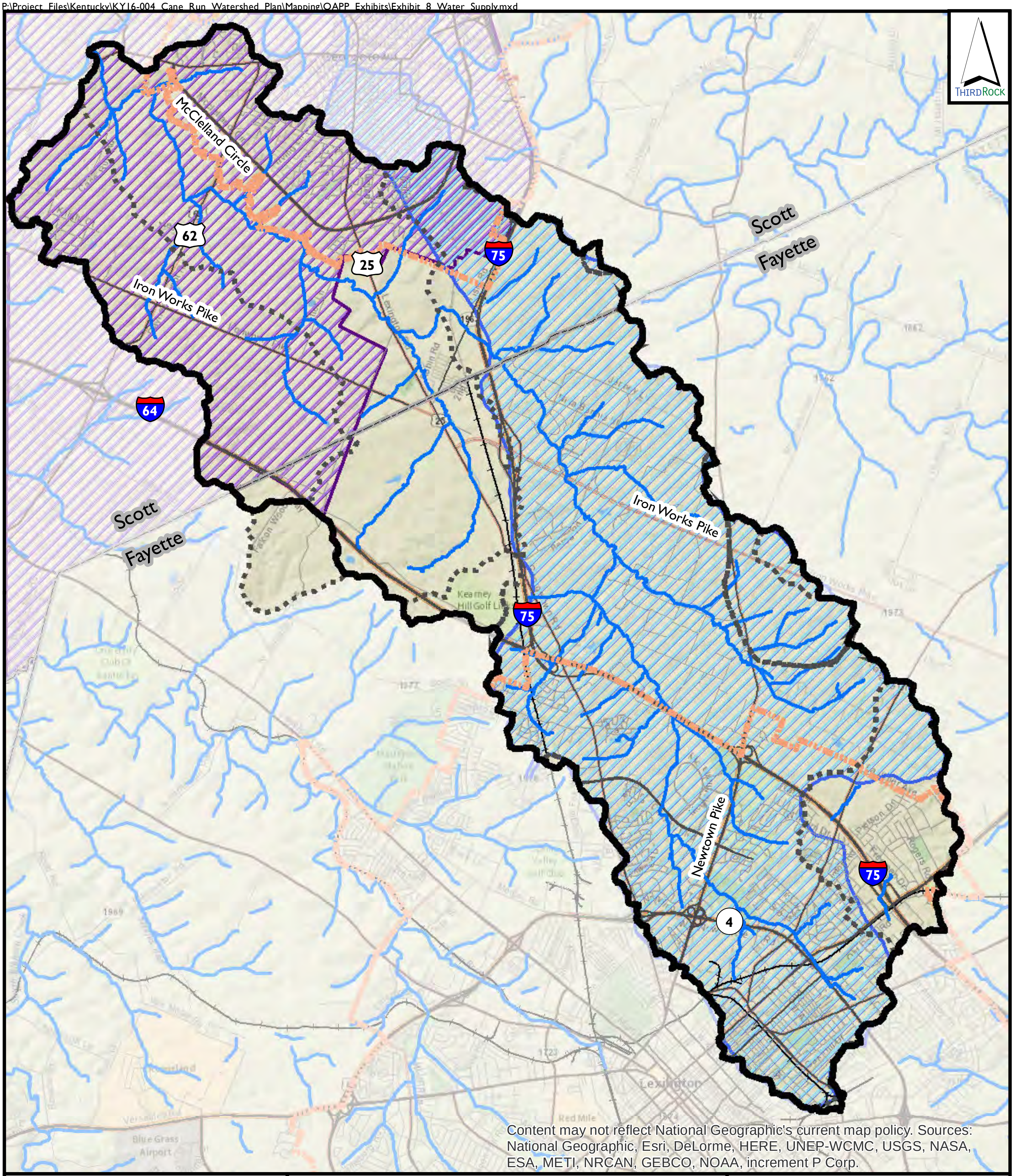

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

▭ Cane Run Watershed	▭ Urban Service Boundary
⬚ Karst Basin	─ Stream
▨ GMW Supply Protection Area	
▨ GMW Service Area	

Exhibit 8
Drinking Water Supply and Service

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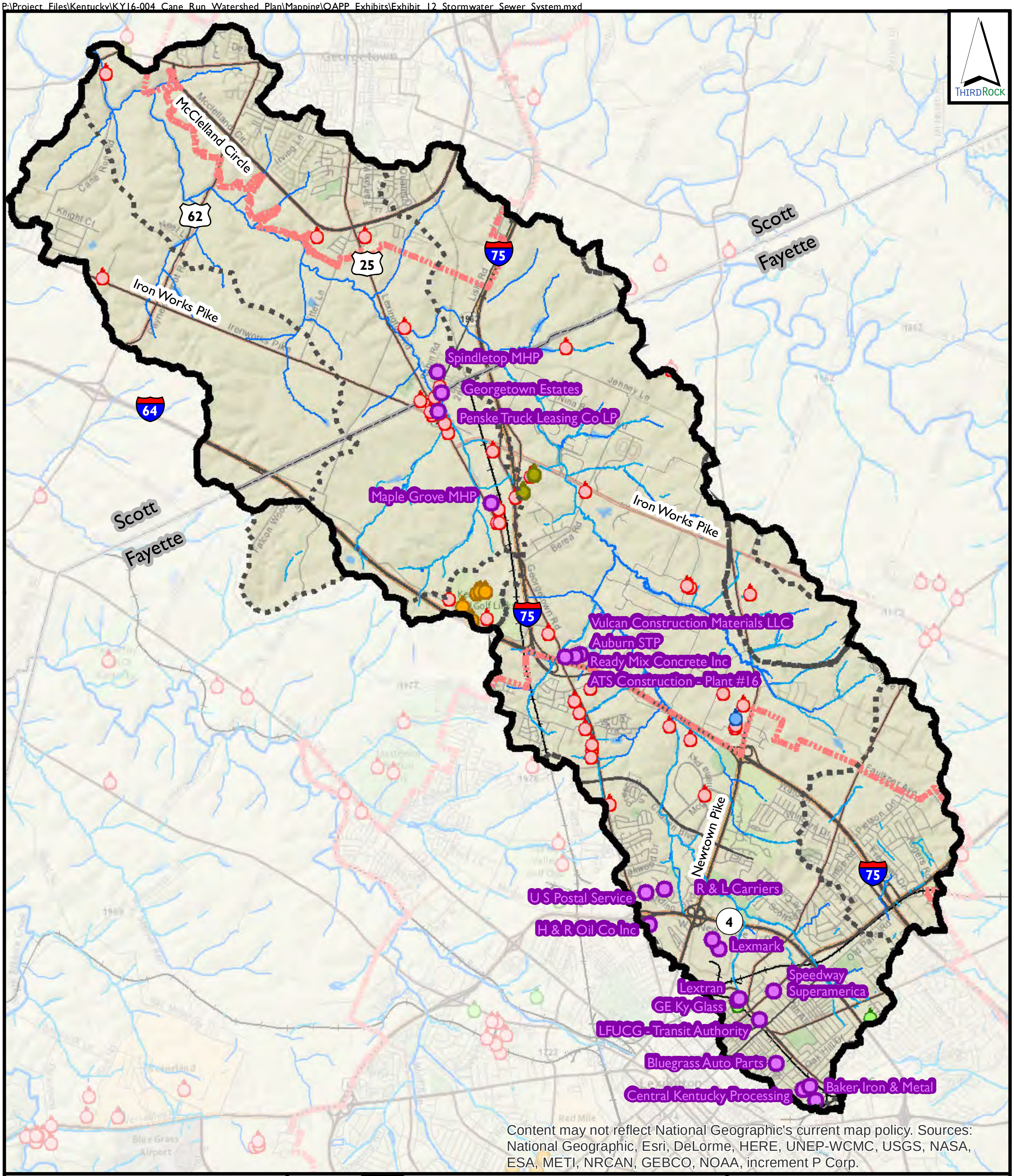

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Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

- Cane Run Watershed
- Karst Basin
- Urban Service Boundary
- Stream
- ● NPDES

Class V Well
- ● Beneficial Use
- ● Carwash
- ● Drainage
- ● Industrial
- ● Septic

Exhibit 9
Permitted Dischargers

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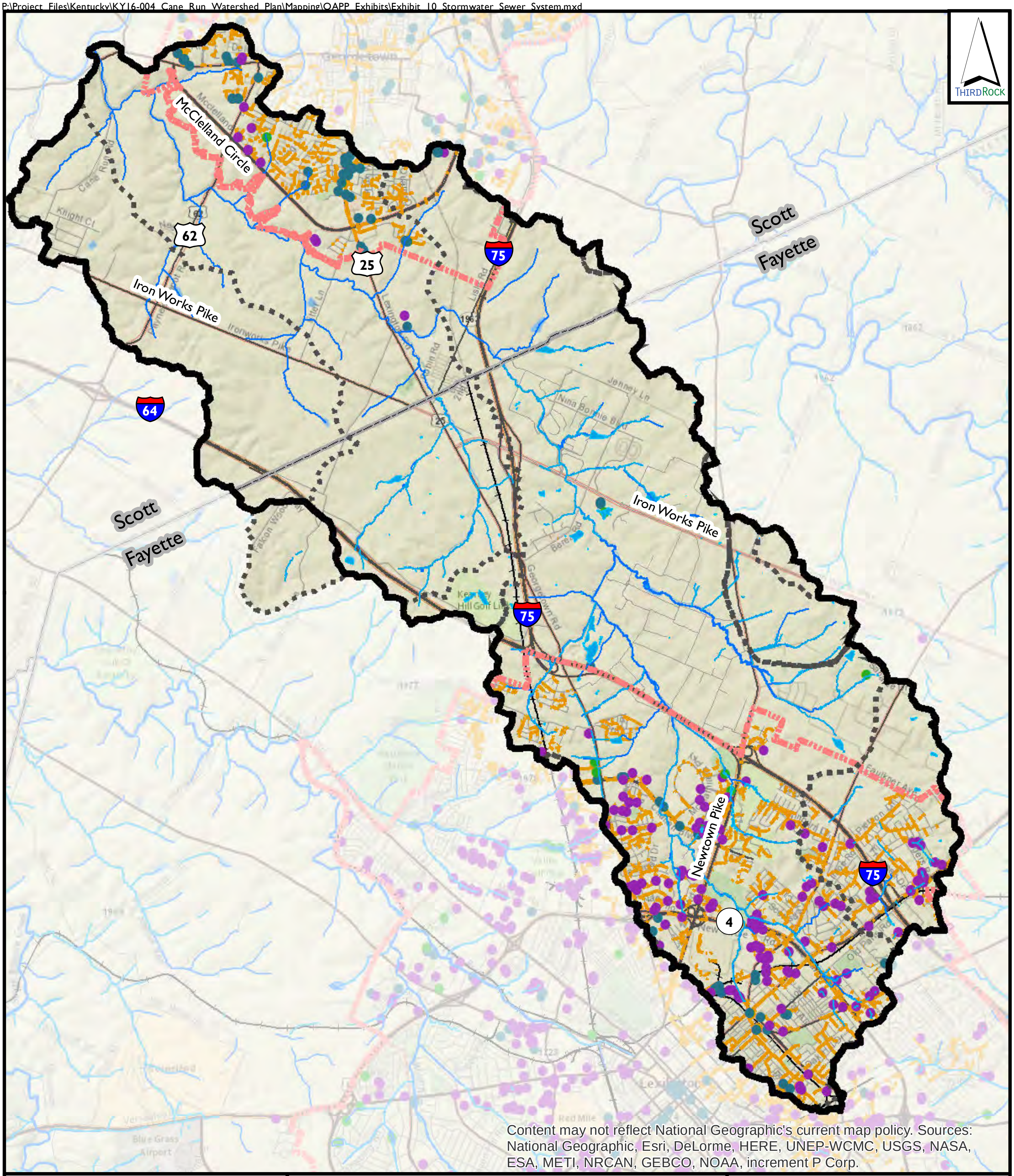

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Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

▭	Cane Run Watershed	●	Detention Pond
⬚	Karst Basin	●	Retention Pond
⬚	Urban Service Boundary	●	Other BMP
—	Stream	—	Stormwater Pipe

Exhibit 10
Stormwater Sewer System

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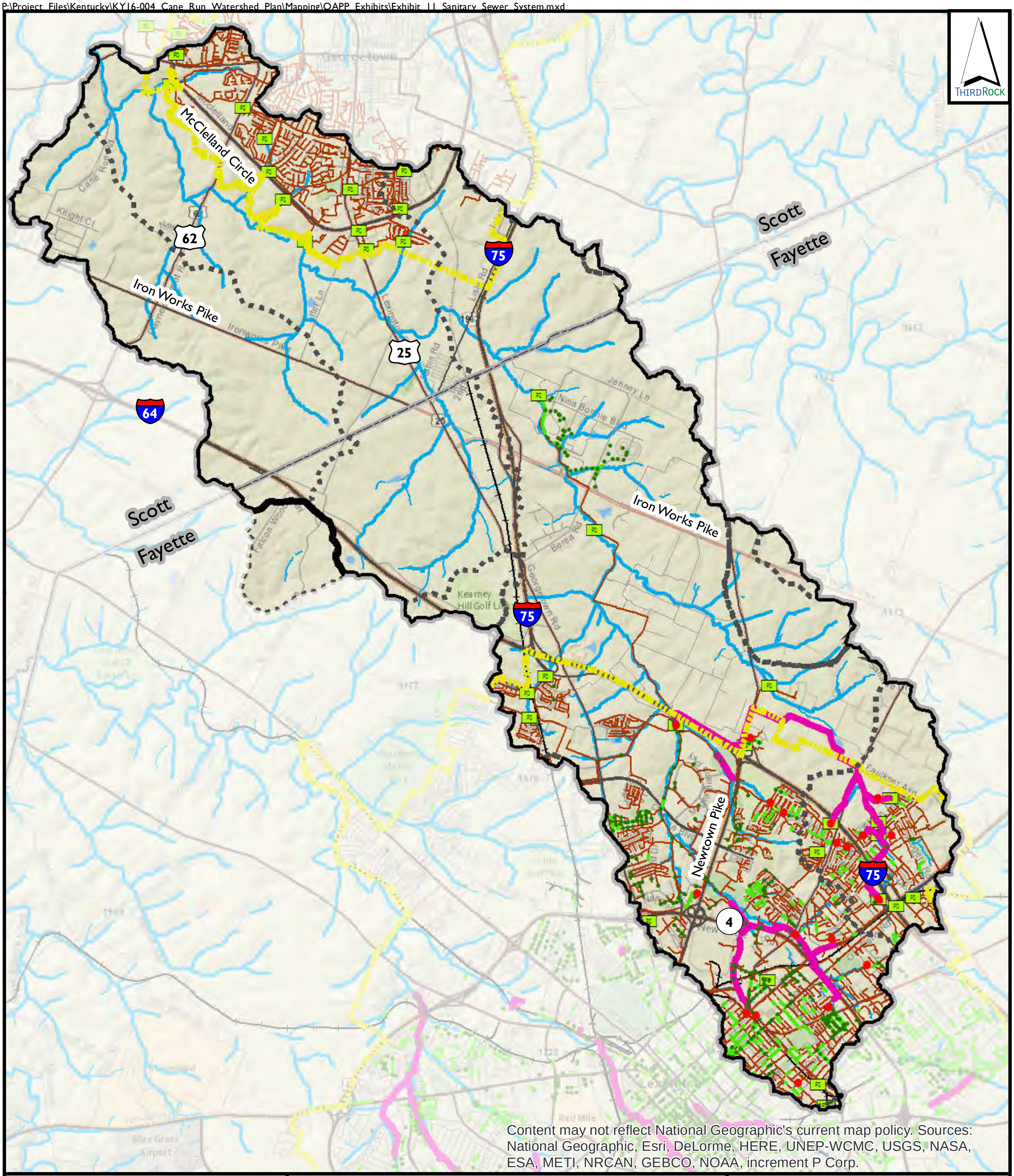

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

- Cane Run Watershed
- Karst Basin
- Urban Service Boundary
- RMP Project
- Pipe Repairs, 2000-2015
- Stream
- Sanitary Sewer Pipe
- PS Pump Station
- ● Manhole Repairs, 2000-2015
- ● Reoccurring SSOs

Sanitary Sewer from LFUCG and GMWSS, 2016

Exhibit 11
Sanitary
Sewer System

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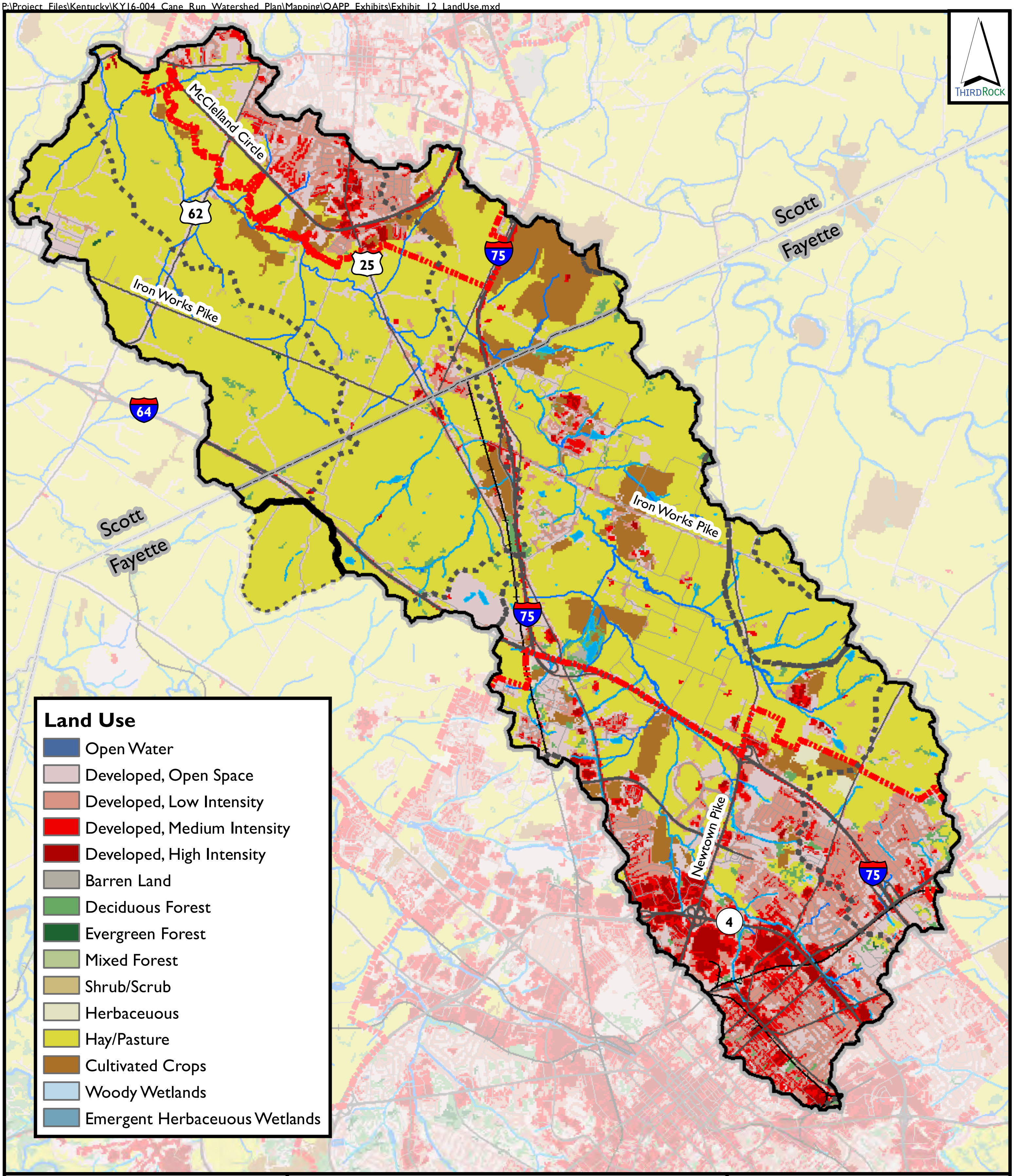

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

NOTE: Land use was obtained from the Multi-Resolution Land Characteristics (MRLC) Consortium's NLCD.

Exhibit 12
Land Use

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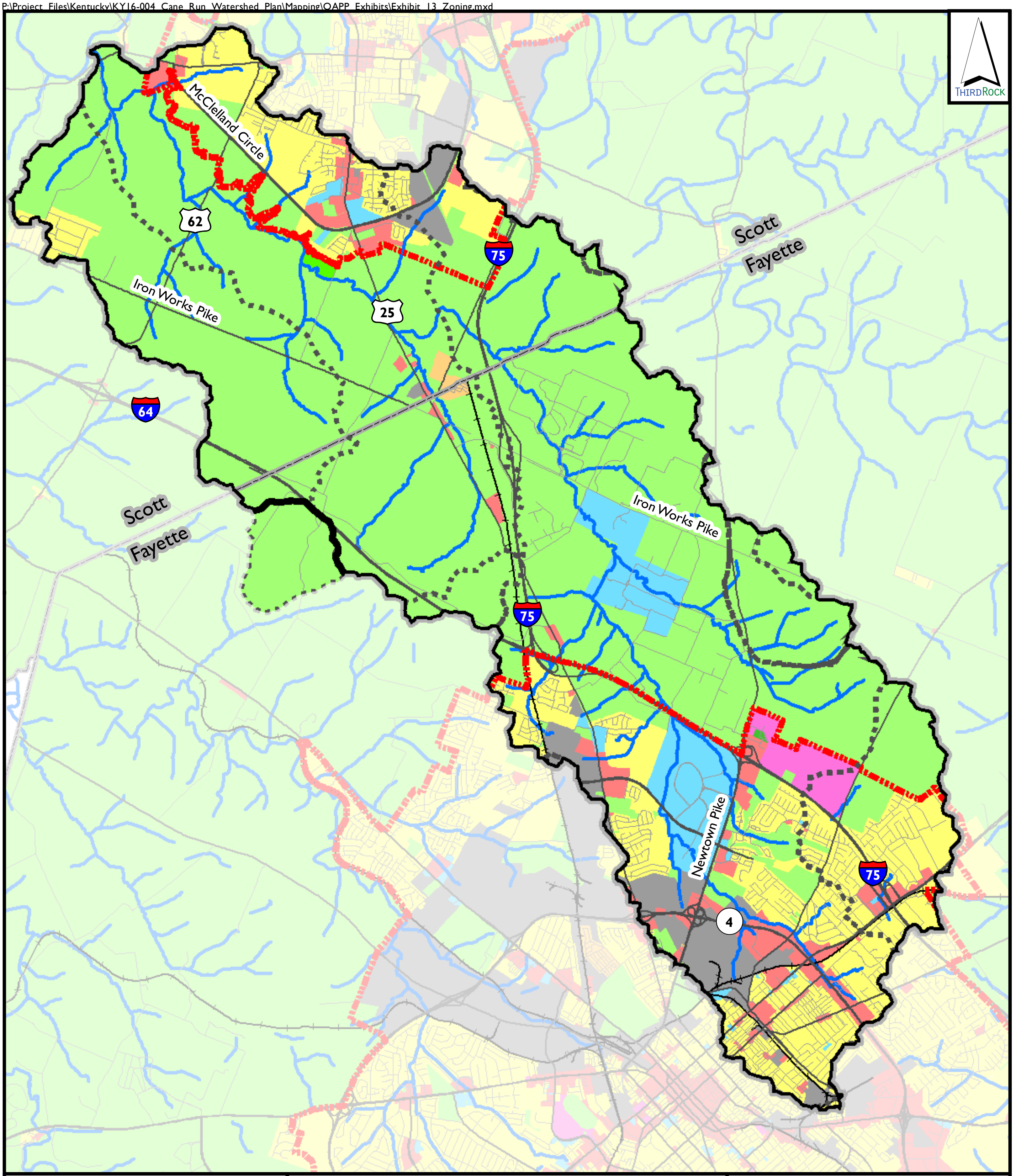

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Cane Run Watershed
Karst Basin
Urban Service Boundary
County Boundary
Street
Stream

Zoning Districts
🟩 A - Agricultural
🟥 B - Business
🟩 C - Conservation
🟩 CC - Comm. Center
🟪 ED - Econ. Dev.
⬛ I - Industrial
🟧 M - Mobile Home
🟪 MU - Mixed Use
🟦 P - Professional
🟨 R - Residential

NOTE: Zoning layers obtained from GSCPC and LFUCG

Exhibit 13
Zoning

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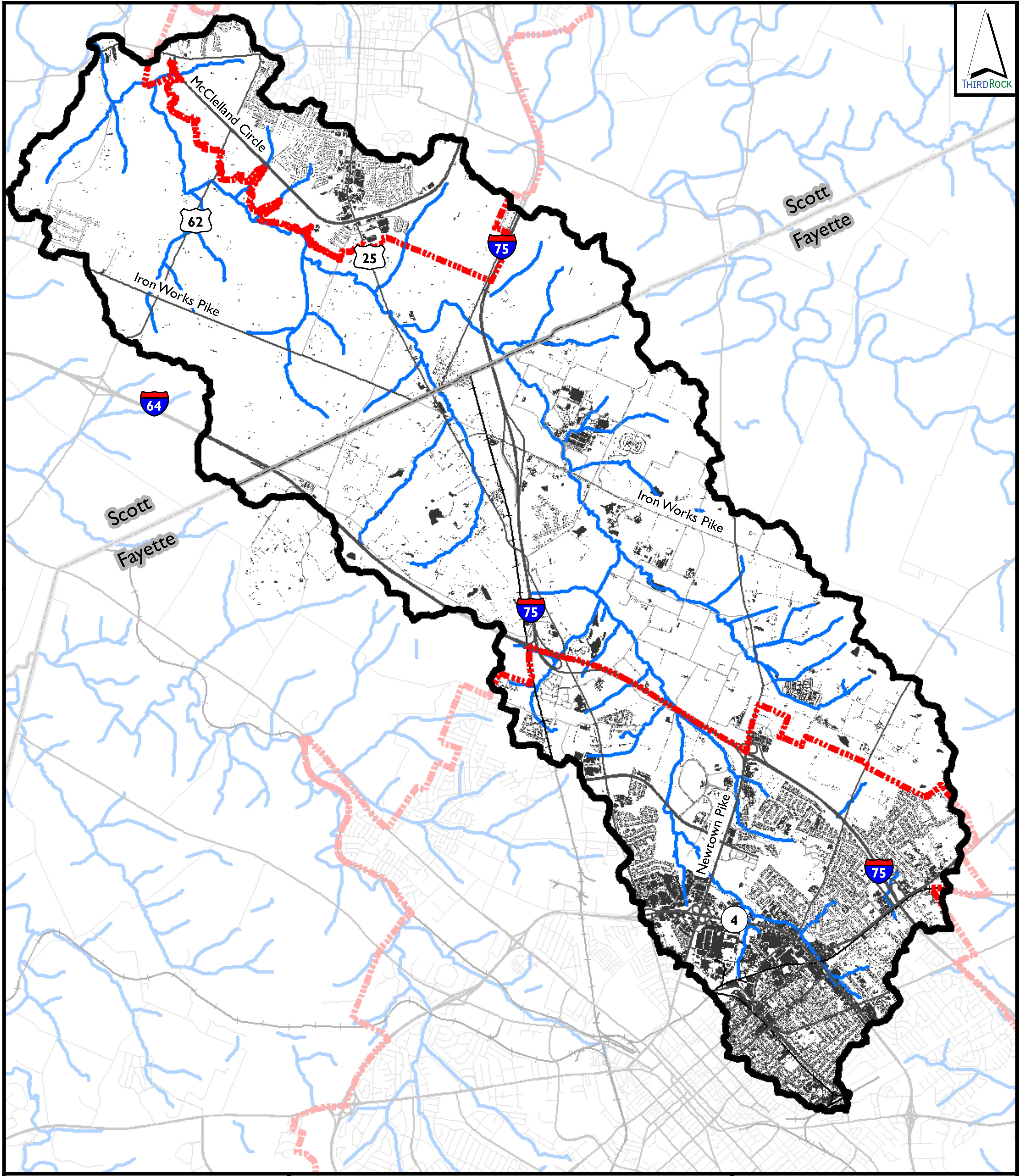

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

- Cane Run Watershed
- Urban Service Boundary
- County Boundary
- Street
- Stream
- ■ Impervious

NOTE: Impervious files were obtained from GSCPC and LFUCG.
*Impervious data for Scott county only accounts for building footprints and parking lots and is therefore likely underrepresented.

Exhibit 14
Impervious Surfaces

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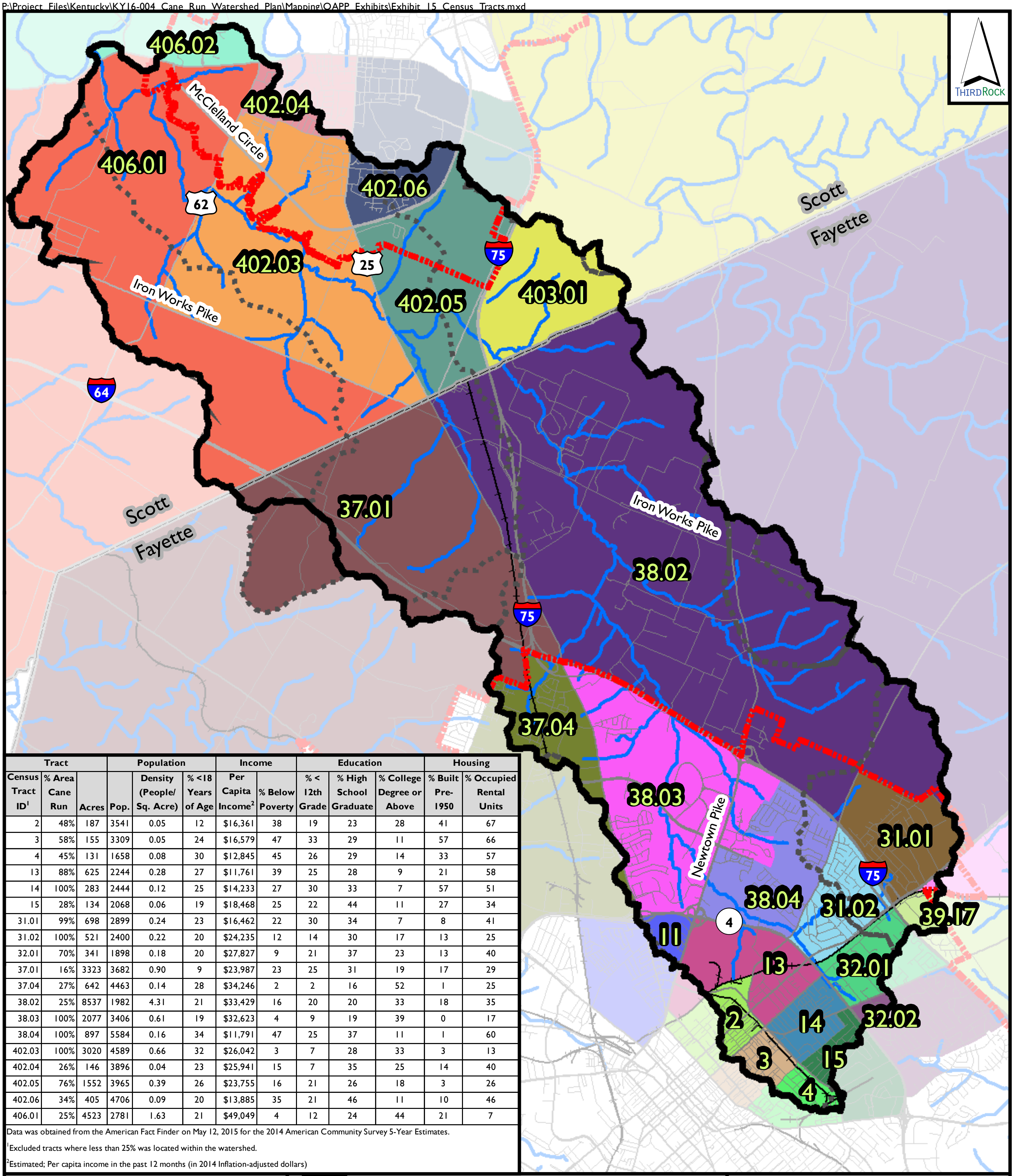
Exhibit 15
Census Tracts



Tract			Population			Income		Education			Housing	
Census Tract ID[1]	% Area Cane Run	Acres	Pop.	Density (People/ Sq. Acre)	% <18 Years of Age	Per Capita Income[2]	% Below Poverty	% < 12th Grade	% High School Graduate	% College Degree or Above	% Built Pre-1950	% Occupied Rental Units
2	48%	187	3541	0.05	12	$16,361	38	19	23	28	41	67
3	58%	155	3309	0.05	24	$16,579	47	33	29	11	57	66
4	45%	131	1658	0.08	30	$12,845	45	26	29	14	33	57
13	88%	625	2244	0.28	27	$11,761	39	25	28	9	21	58
14	100%	283	2444	0.12	25	$14,233	27	30	33	7	57	51
15	28%	134	2068	0.06	19	$18,468	25	22	44	11	27	34
31.01	99%	698	2899	0.24	23	$16,462	22	30	34	7	8	41
31.02	100%	521	2400	0.22	20	$24,235	12	14	30	17	13	25
32.01	70%	341	1898	0.18	20	$27,827	9	21	37	23	13	40
37.01	16%	3323	3682	0.90	9	$23,987	23	25	31	19	17	29
37.04	27%	642	4463	0.14	28	$34,246	2	2	16	52	1	25
38.02	25%	8537	1982	4.31	21	$33,429	16	20	20	33	18	35
38.03	100%	2077	3406	0.61	19	$32,623	4	9	19	39	0	17
38.04	100%	897	5584	0.16	34	$11,791	47	25	37	11	1	60
402.03	100%	3020	4589	0.66	32	$26,042	3	7	28	33	3	13
402.04	26%	146	3896	0.04	23	$25,941	15	7	35	25	14	40
402.05	76%	1552	3965	0.39	26	$23,755	16	21	26	18	3	26
402.06	34%	405	4706	0.09	20	$13,885	35	21	46	11	10	46
406.01	25%	4523	2781	1.63	21	$49,049	4	12	24	44	21	7

Data was obtained from the American Fact Finder on May 12, 2015 for the 2014 American Community Survey 5-Year Estimates.

[1] Excluded tracts where less than 25% was located within the watershed.

[2] Estimated; Per capita income in the past 12 months (in 2014 Inflation-adjusted dollars)

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

▨ Karst Basin
🟥 Urban Service Boundary
☐ County Boundary
— Street
— Stream

NOTE: Census Data obtained from 2014 American Community Survey

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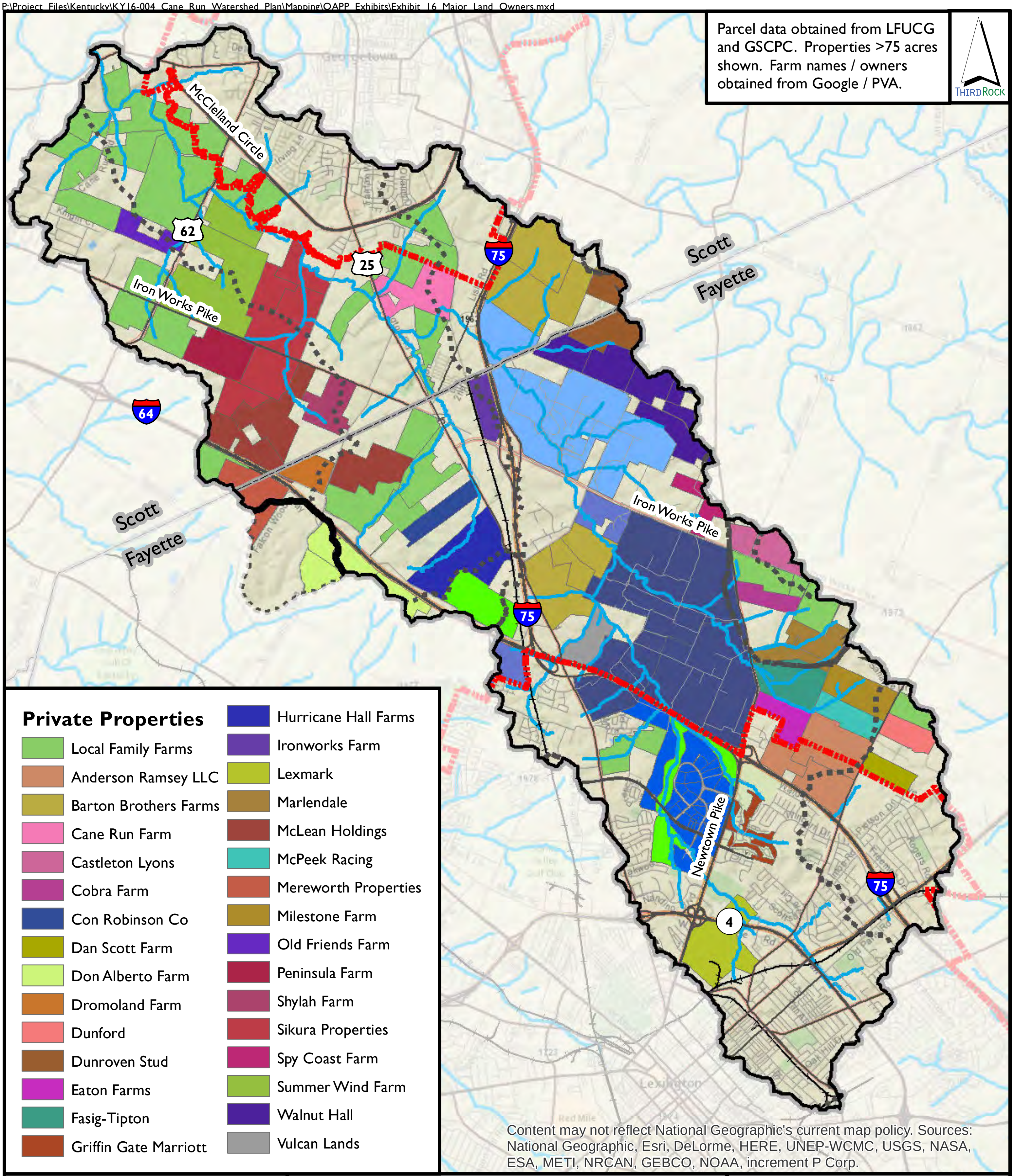

Parcel data obtained from LFUCG and GSCPC. Properties >75 acres shown. Farm names / owners obtained from Google / PVA.

Private Properties

- 🟩 Local Family Farms
- 🟧 Anderson Ramsey LLC
- 🟨 Barton Brothers Farms
- 🟪 Cane Run Farm
- 🟪 Castleton Lyons
- 🟪 Cobra Farm
- 🟦 Con Robinson Co
- 🟨 Dan Scott Farm
- 🟩 Don Alberto Farm
- 🟧 Dromoland Farm
- 🟥 Dunford
- 🟫 Dunroven Stud
- 🟪 Eaton Farms
- 🟩 Fasig-Tipton
- 🟫 Griffin Gate Marriott
- 🟦 Hurricane Hall Farms
- 🟪 Ironworks Farm
- 🟨 Lexmark
- 🟫 Marlendale
- 🟥 McLean Holdings
- 🟦 McPeek Racing
- 🟥 Mereworth Properties
- 🟫 Milestone Farm
- 🟪 Old Friends Farm
- 🟥 Peninsula Farm
- 🟥 Shylah Farm
- 🟥 Sikura Properties
- 🟥 Spy Coast Farm
- 🟩 Summer Wind Farm
- 🟪 Walnut Hall
- ⬜ Vulcan Lands

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Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

- ⬛ Cane Run Watershed
- ▪ Karst Basin
- 🟥 Urban Service Boundary
- ⬜ County Boundary
- — Street
- — Stream

Public Properties

- 🟦 Commonwealth of Kentucky
- 🟦 Kentucky Horse Park
- 🟩 LFUCG
- 🟦 University of Kentucky Coldstream
- 🟦 University of Kentucky Farms

Exhibit 16
Major Land Owners

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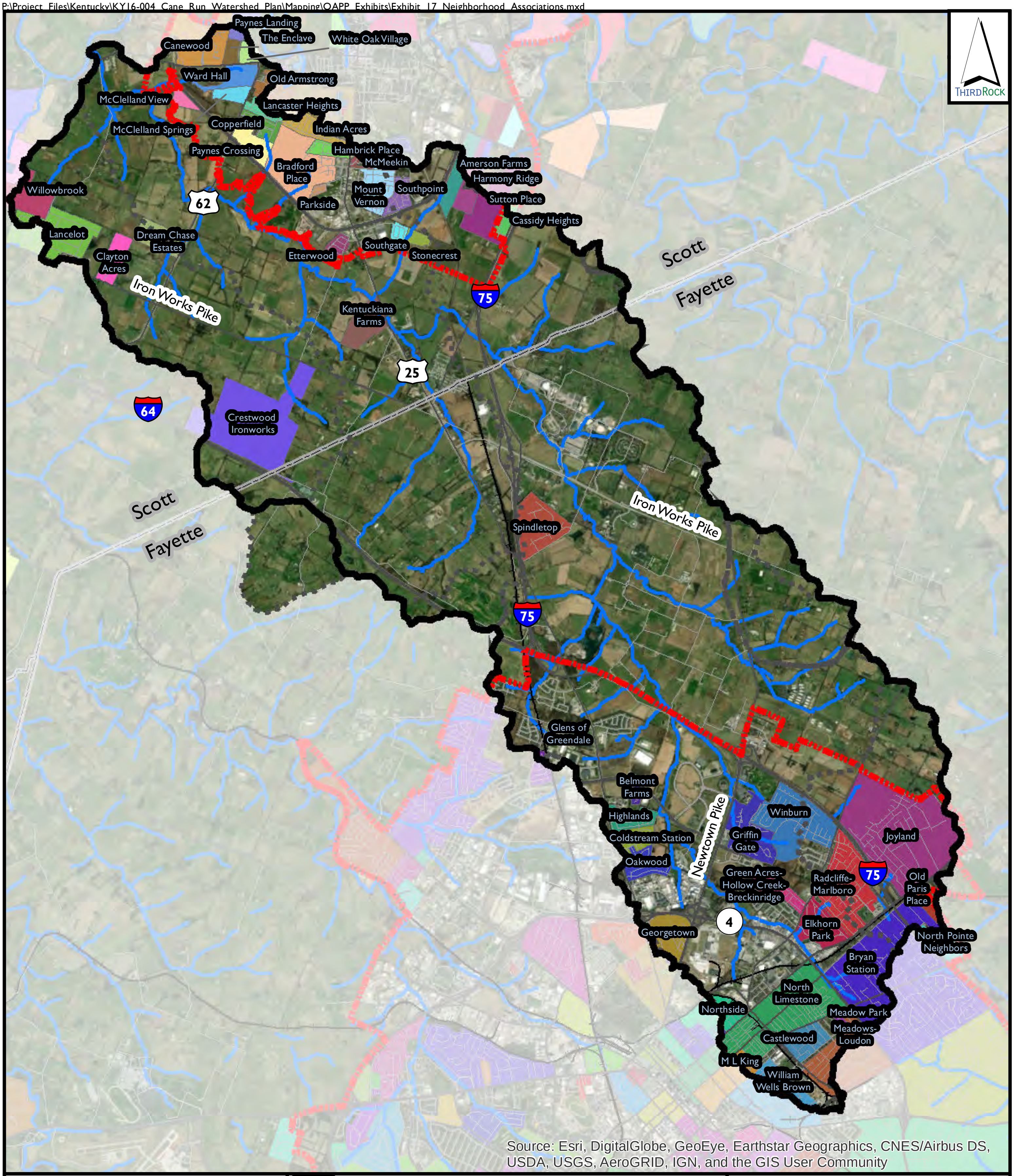


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

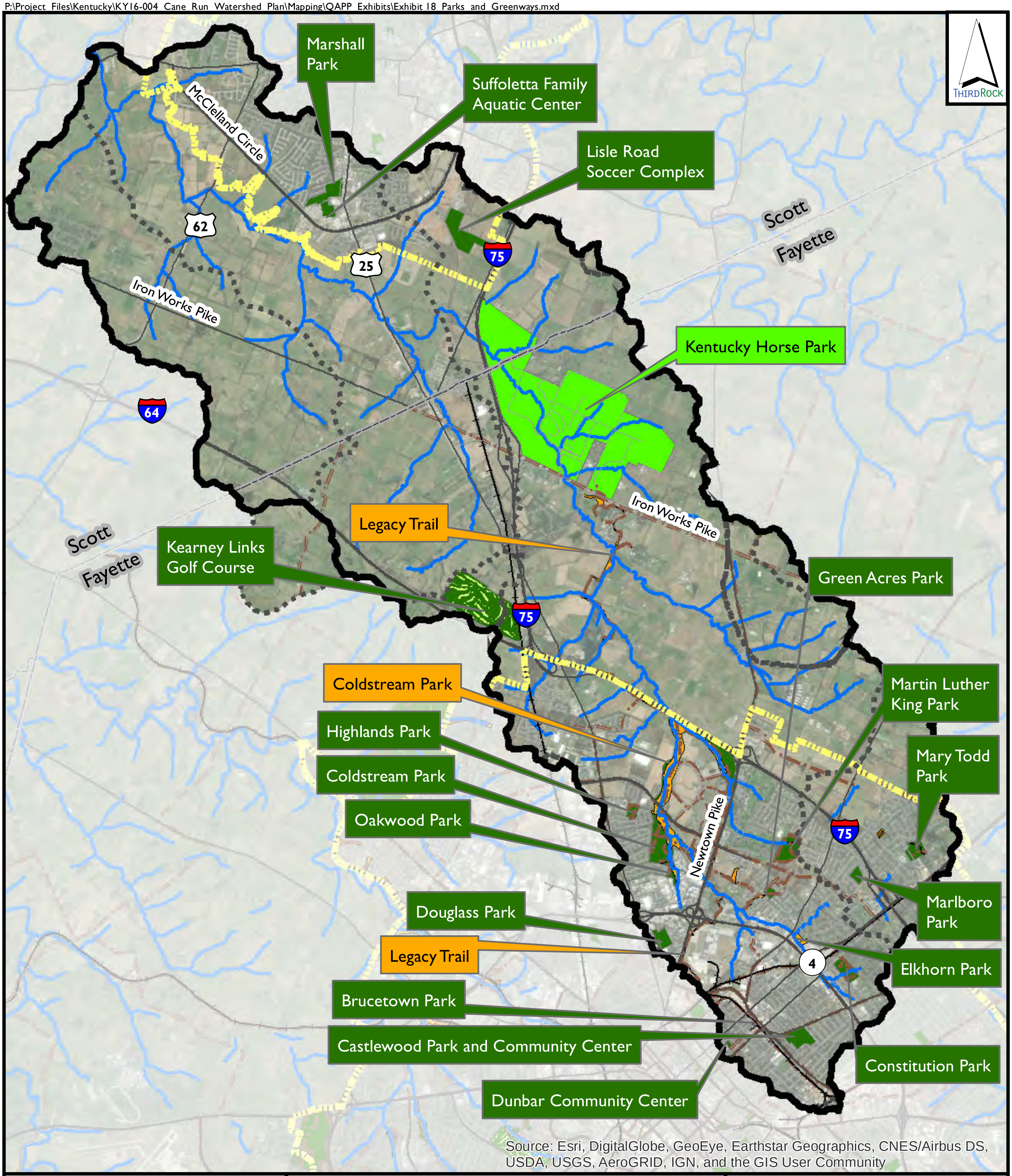
0 0.5 1 2
Miles

Cane Run Watershed
Karst Basin
Urban Service Boundary
County Boundary
Stream
Street

NOTE: Neighborhood Assc files obtained from GSCPC and LFUCG.

Exhibit 17
Neighborhood Associations

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Exhibit 18_Parks_and_Greenways.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

▭	Cane Run Watershed	🟧	Greenway
⬚	Karst Basin	🟩	City/County Park
⬚	Urban Service Boundary	🟩	Other Park
—	Stream	-·-	Bike Trail

NOTE: Parks layers obtained from GSCPC and LFUCG

Exhibit 18
Parks and Greenways

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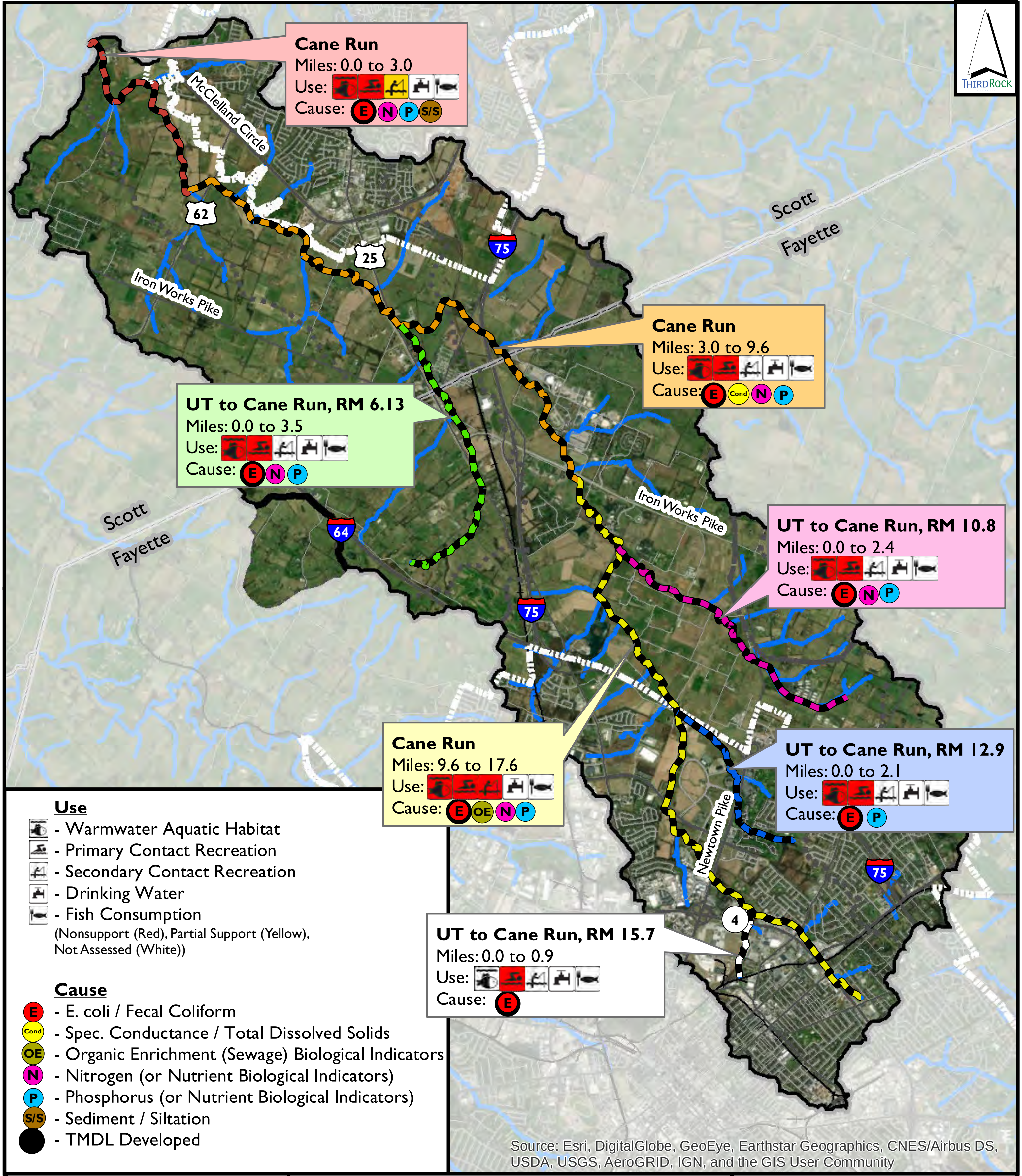

Cane Run
Miles: 0.0 to 3.0
Use: 🟥 🟥 🟨 ⬜ ⬜
Cause: E N P S/S

Cane Run
Miles: 3.0 to 9.6
Use: 🟥 🟥 ⬜ ⬜ ⬜
Cause: E Cond N P

UT to Cane Run, RM 6.13
Miles: 0.0 to 3.5
Use: 🟥 🟥 ⬜ ⬜ ⬜
Cause: E N P

UT to Cane Run, RM 10.8
Miles: 0.0 to 2.4
Use: 🟥 🟥 ⬜ ⬜ ⬜
Cause: E N P

Cane Run
Miles: 9.6 to 17.6
Use: 🟥 🟥 🟥 ⬜ ⬜
Cause: E OE N P

UT to Cane Run, RM 12.9
Miles: 0.0 to 2.1
Use: 🟥 🟥 ⬜ ⬜ ⬜
Cause: E P

UT to Cane Run, RM 15.7
Miles: 0.0 to 0.9
Use: ⬜ 🟥 ⬜ ⬜ ⬜
Cause: E

Use
- Warmwater Aquatic Habitat
- Primary Contact Recreation
- Secondary Contact Recreation
- Drinking Water
- Fish Consumption
(Nonsupport (Red), Partial Support (Yellow), Not Assessed (White))

Cause
E - E. coli / Fecal Coliform
Cond - Spec. Conductance / Total Dissolved Solids
OE - Organic Enrichment (Sewage) Biological Indicators
N - Nitrogen (or Nutrient Biological Indicators)
P - Phosphorus (or Nutrient Biological Indicators)
S/S - Sediment / Siltation
● - TMDL Developed

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Cane Run Watershed
Karst Basin
Urban Service Boundary
County Boundary
Street
Stream
Cane Run 0.0 to 3.0
Cane Run 3.0 to 9.6
Cane Run 9.6 to 17.4
UT to Cane Run 0.0 to 3.5
UT to Cane Run 0.0 to 2.1
UT to Cane Run 0.0 to 2.4
UT to Cane Run 0.0 to 0.09

Exhibit 19
Regulatory Status

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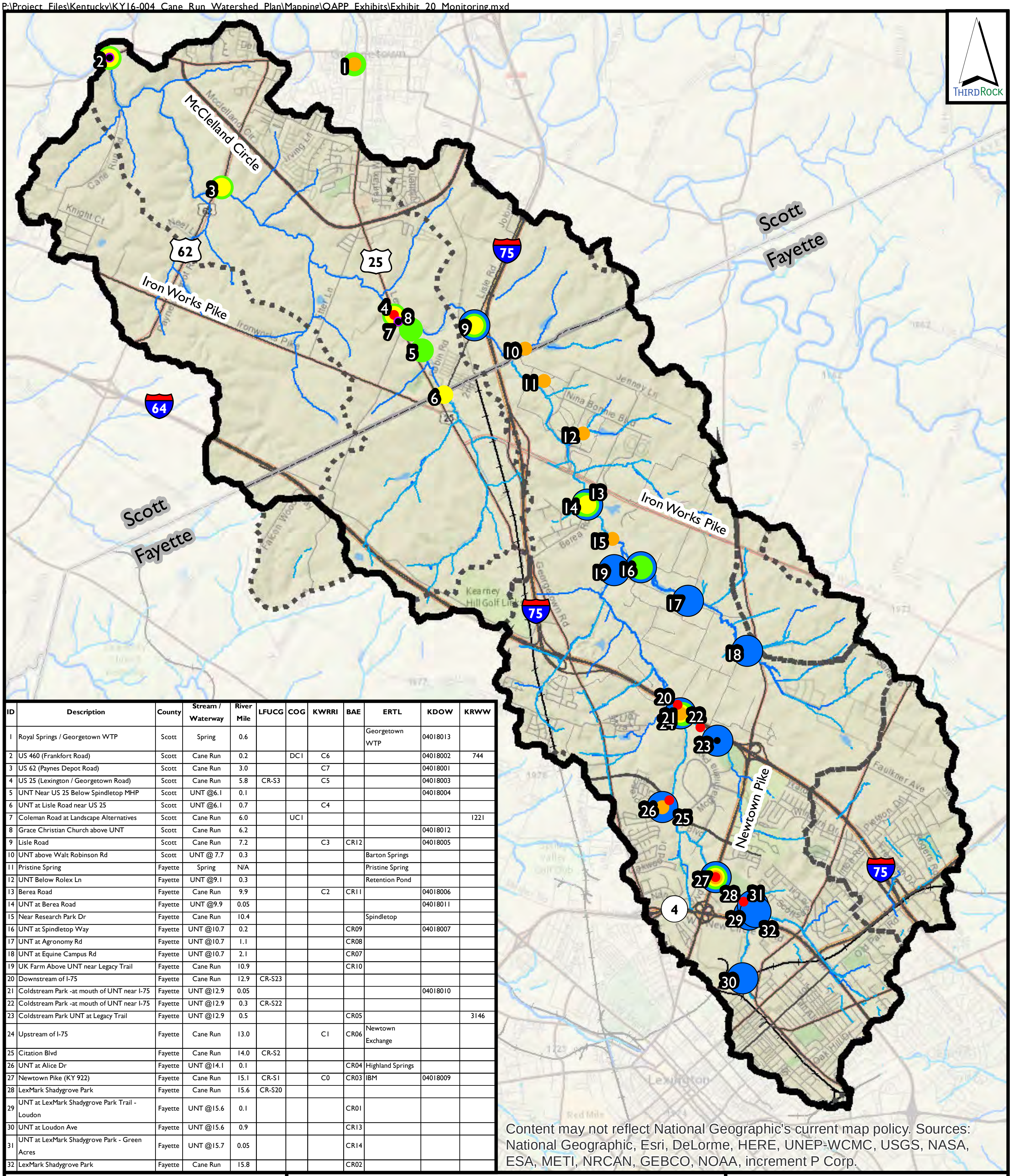

ID	Description	County	Stream / Waterway	River Mile	LFUCG	COG	KWRRI	BAE	ERTL	KDOW	KRWW
1	Royal Springs / Georgetown WTP	Scott	Spring	0.6					Georgetown WTP	04018013	
2	US 460 (Frankfort Road)	Scott	Cane Run	0.2		DC1	C6			04018002	744
3	US 62 (Paynes Depot Road)	Scott	Cane Run	3.0			C7			04018001	
4	US 25 (Lexington / Georgetown Road)	Scott	Cane Run	5.8	CR-S3		C5			04018003	
5	UNT Near US 25 Below Spindletop MHP	Scott	UNT @6.1	0.1						04018004	
6	UNT at Lisle Road near US 25	Scott	UNT @6.1	0.7			C4				
7	Coleman Road at Landscape Alternatives	Scott	Cane Run	6.0		UC1					1221
8	Grace Christian Church above UNT	Scott	Cane Run	6.2						04018012	
9	Lisle Road	Scott	Cane Run	7.2			C3	CR12		04018005	
10	UNT above Walt Robinson Rd	Scott	UNT @ 7.7	0.3					Barton Springs		
11	Pristine Spring	Fayette	Spring	N/A					Pristine Spring		
12	UNT Below Rolex Ln	Fayette	UNT @9.1	0.3					Retention Pond		
13	Berea Road	Fayette	Cane Run	9.9			C2	CR11		04018006	
14	UNT at Berea Road	Fayette	UNT @9.9	0.05						04018011	
15	Near Research Park Dr	Fayette	Cane Run	10.4					Spindletop		
16	UNT at Spindletop Way	Fayette	UNT @10.7	0.2				CR09		04018007	
17	UNT at Agronomy Rd	Fayette	UNT @10.7	1.1				CR08			
18	UNT at Equine Campus Rd	Fayette	UNT @10.7	2.1				CR07			
19	UK Farm Above UNT near Legacy Trail	Fayette	Cane Run	10.9				CR10			
20	Downstream of I-75	Fayette	Cane Run	12.9	CR-S23						
21	Coldstream Park -at mouth of UNT near I-75	Fayette	UNT @12.9	0.05						04018010	
22	Coldstream Park -at mouth of UNT near I-75	Fayette	UNT @12.9	0.3	CR-S22						
23	Coldstream Park UNT at Legacy Trail	Fayette	UNT @12.9	0.5				CR05			3146
24	Upstream of I-75	Fayette	Cane Run	13.0			C1	CR06	Newtown Exchange		
25	Citation Blvd	Fayette	Cane Run	14.0	CR-S2						
26	UNT at Alice Dr	Fayette	UNT @14.1	0.1				CR04	Highland Springs		
27	Newtown Pike (KY 922)	Fayette	Cane Run	15.1	CR-S1		C0	CR03	IBM	04018009	
28	LexMark Shadygrove Park	Fayette	Cane Run	15.6	CR-S20						
29	UNT at LexMark Shadygrove Park Trail - Loudon	Fayette	UNT @15.6	0.1				CR01			
30	UNT at Loudon Ave	Fayette	UNT @15.6	0.9				CR13			
31	UNT at LexMark Shadygrove Park - Green Acres	Fayette	UNT @15.7	0.05				CR14			
32	LexMark Shadygrove Park	Fayette	Cane Run	15.8				CR02			

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Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

Sites by Organization

- ● KRWW
- ● COG
- ● LFUCG
- ● UK ERTL
- ● KWRRI
- ● KDOW
- ● UK BAE
- ▭ Cane Run Watershed
- ▪ ▪ ▪ Karst Basin
- — Stream

Exhibit 20 Monitoring Stations

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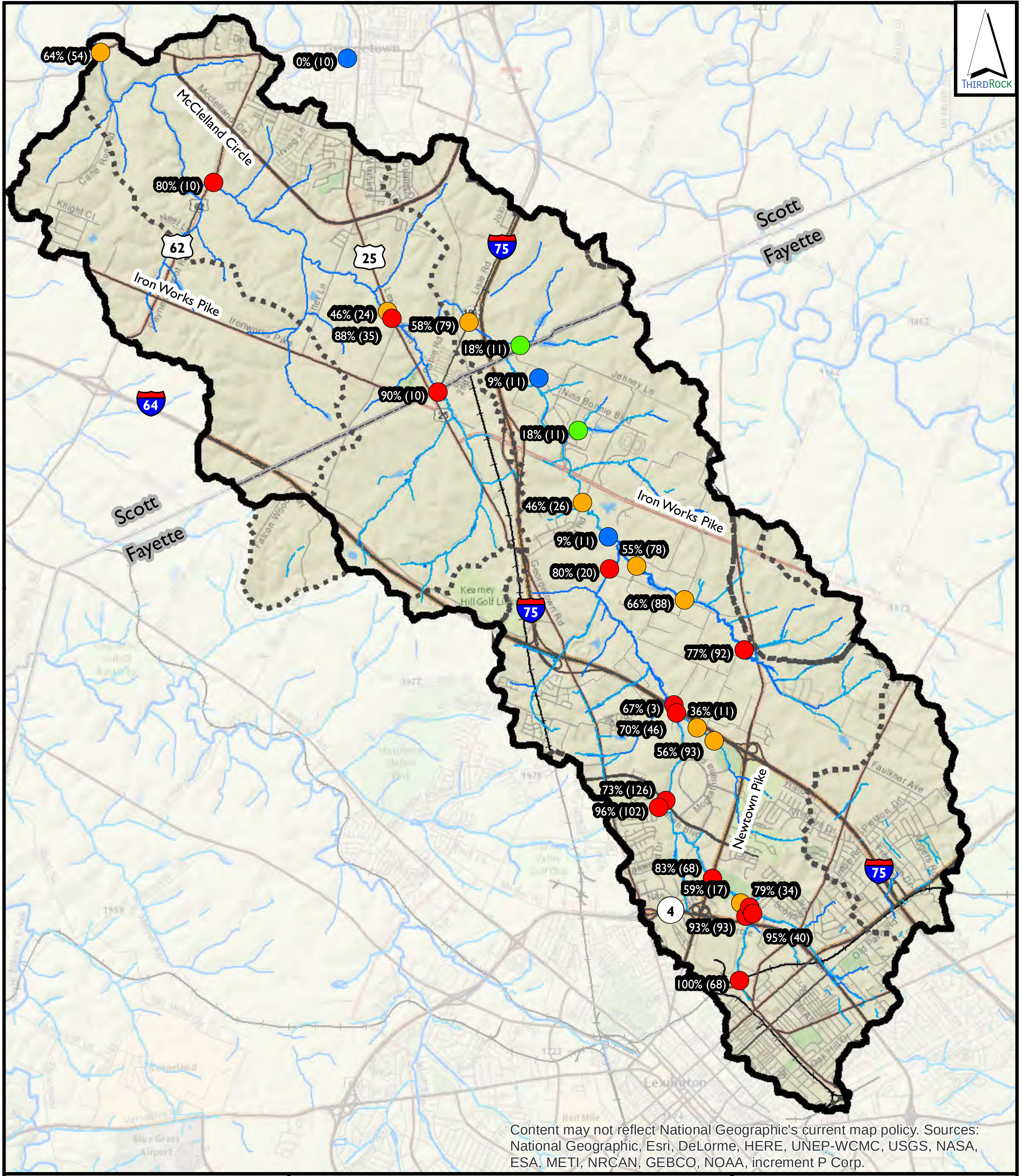

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Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Grade

- 🔵 A
- 🟢 B
- 🟠 D
- 🔴 F

- ▬ Cane Run Watershed
- ┅ Karst Basin
- — Stream

NOTE: Grade is based on the frequency of exceedance of the 401 KAR 10:031 regulatory limit of 240 MPN/100mLs for E. coli or 400 MPN/100 mLs for fecal coliform. Labels indicate the percent of samples exceeding and the number of samples collected (in parentheses).

Exhibit 21
Human Recreation (Primary Contact) Water Quality Grades
1999 - 2016

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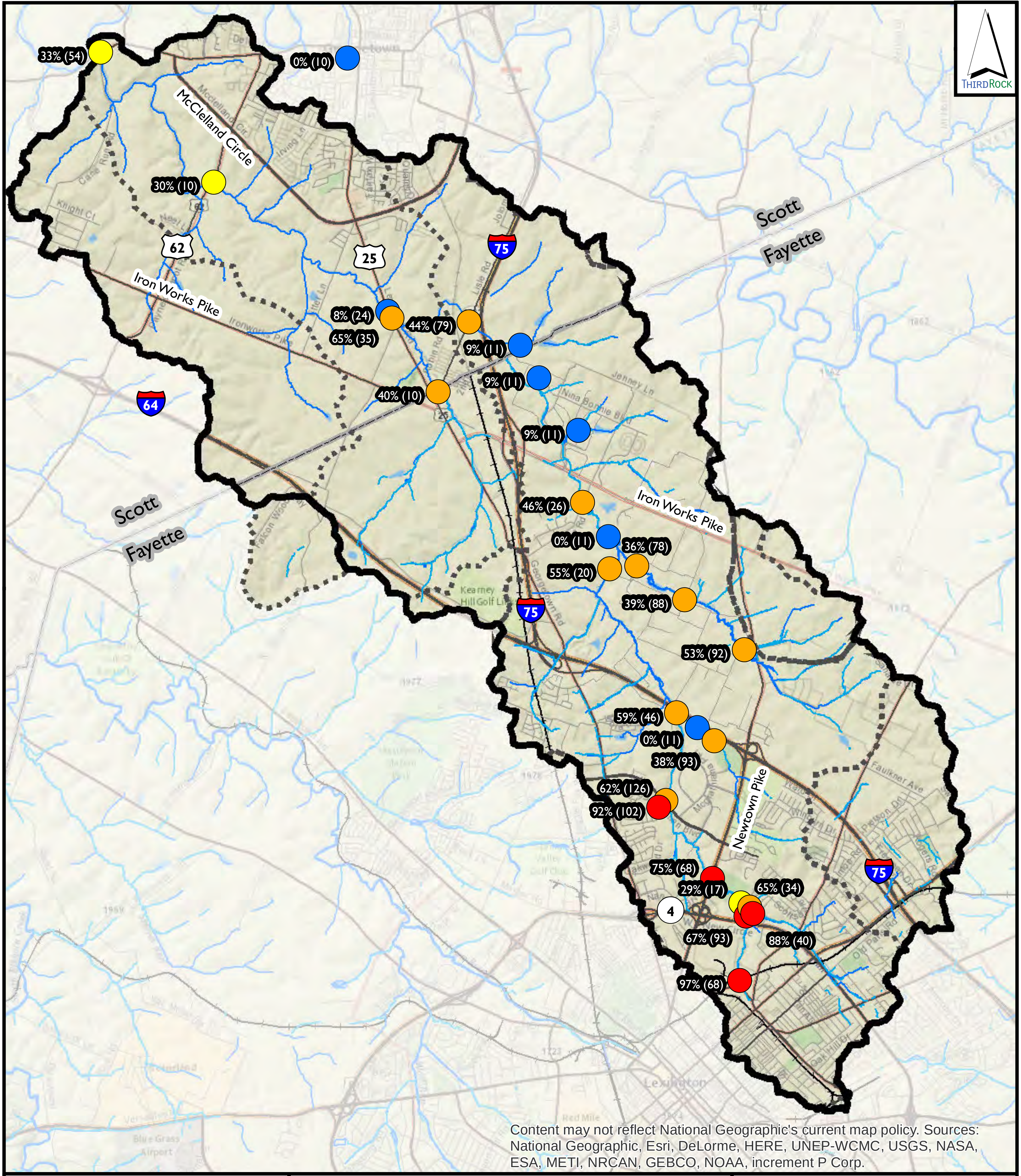

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Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Grade

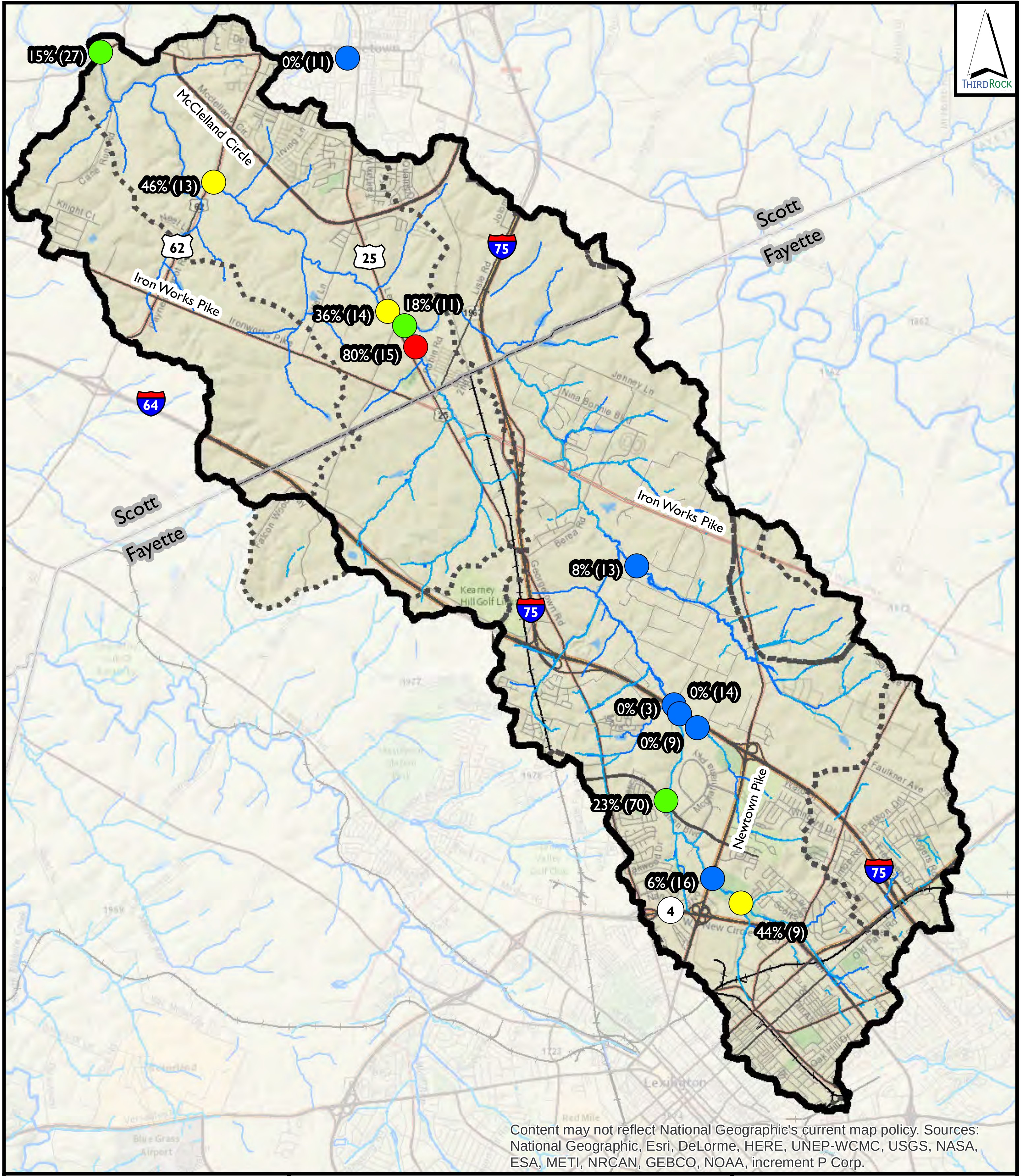
🔵 A
🟡 C
🟠 D
🔴 F

▬ Cane Run Watershed
┅ Karst Basin
— Stream

NOTE: Grade is based on the 401 KAR 10:031 regulatory limit of 1000 MPN/100mLs for fecal coliform and its equivalent in E. coli, 676 MPN/100 mLs. Labels indicate the percent of samples exceeding and the number of samples collected (in parentheses).

Exhibit 22
Human Recreation (Secondary Contact) Water Quality Grades
1999 - 2016

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Exhibit_20_Monitoring.mxd



Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Grade

● A
● B
● C
● F

▭ Cane Run Watershed
▨ Karst Basin
— Stream

NOTE: Grade is based on the frequency of exceedance of ta water quality benchmark of 0.1 mg/L. Labels indicate the percent of samples exceeding and the number of samples collected (in parentheses).

Exhibit 23
Ammonia-Nitrogen Water Quality Grades
1999 - 2016

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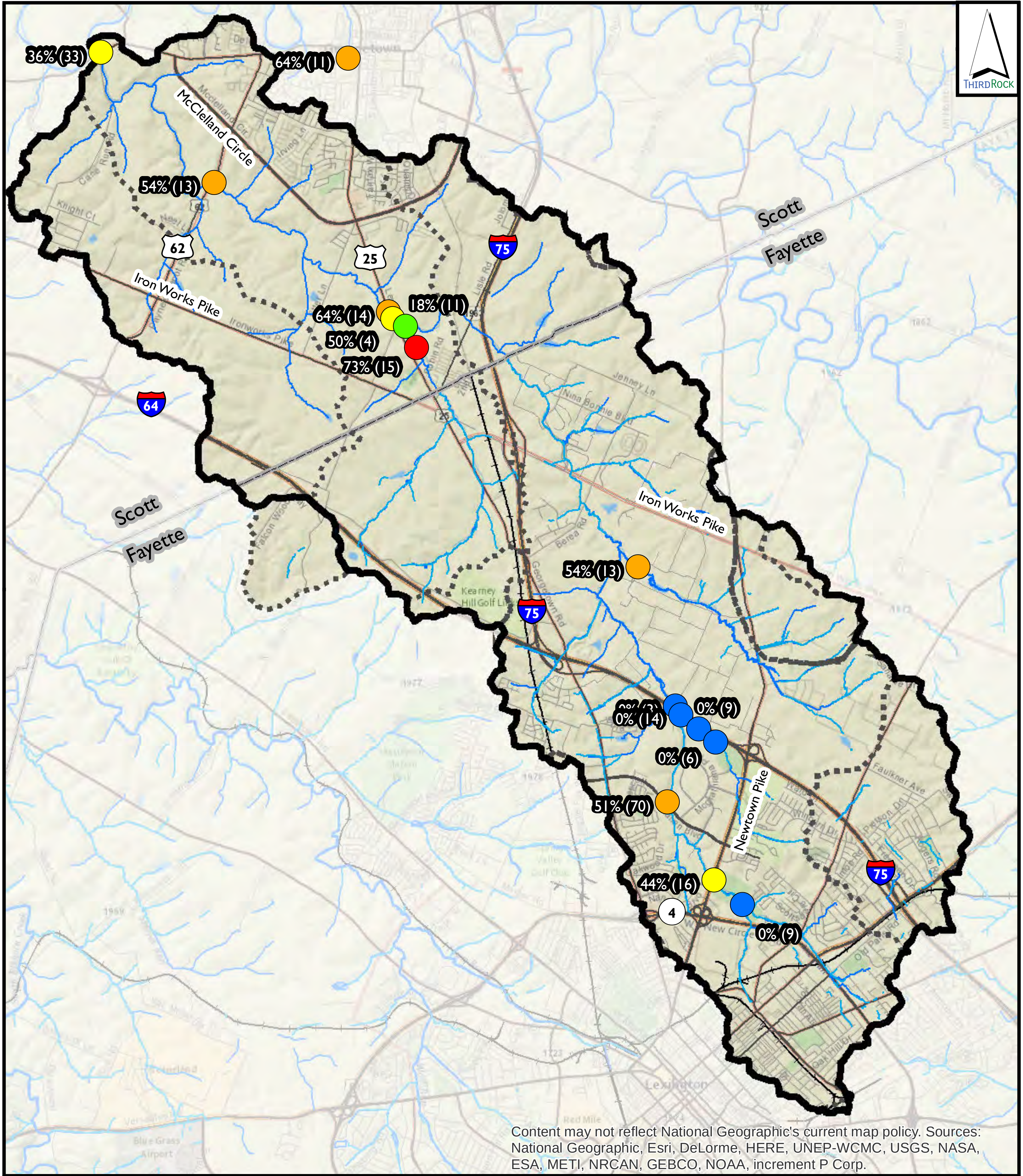


Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Grade

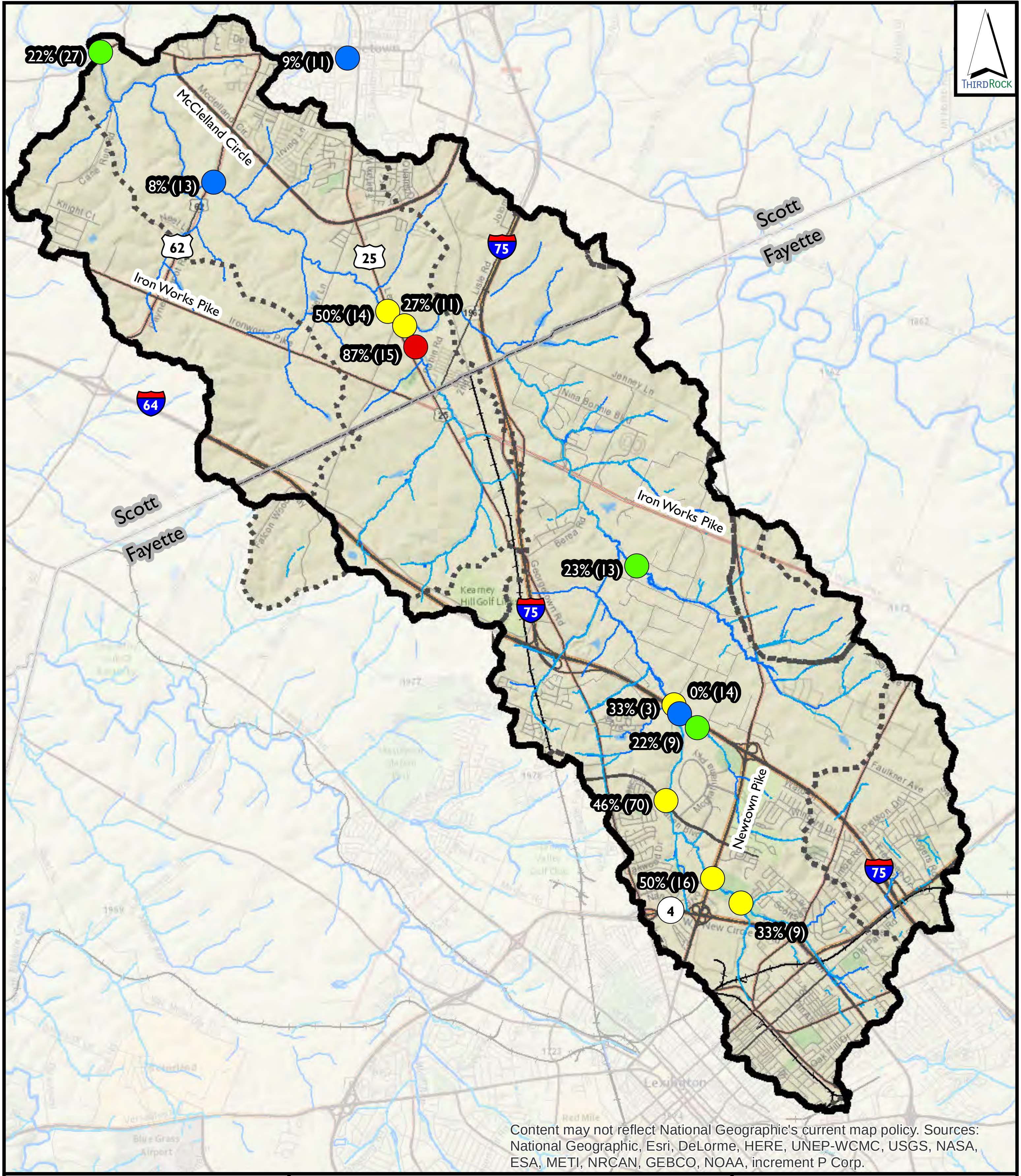
- ● A
- ● B
- ● C
- ● D
- ● F

- ▭ Cane Run Watershed
- ▨ Karst Basin
- — Stream

NOTE: Grade is based on the frequency of exceedance of the water quality benchmark of 3 mg/L for total nitrogen. Labels indicate the percent of samples exceeding and the number of samples collected (in parentheses).

Exhibit 24
Nitrogen
Water Quality Grades
1999 - 2016

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Exhibit_20_Monitoring.mxd



Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

Grade

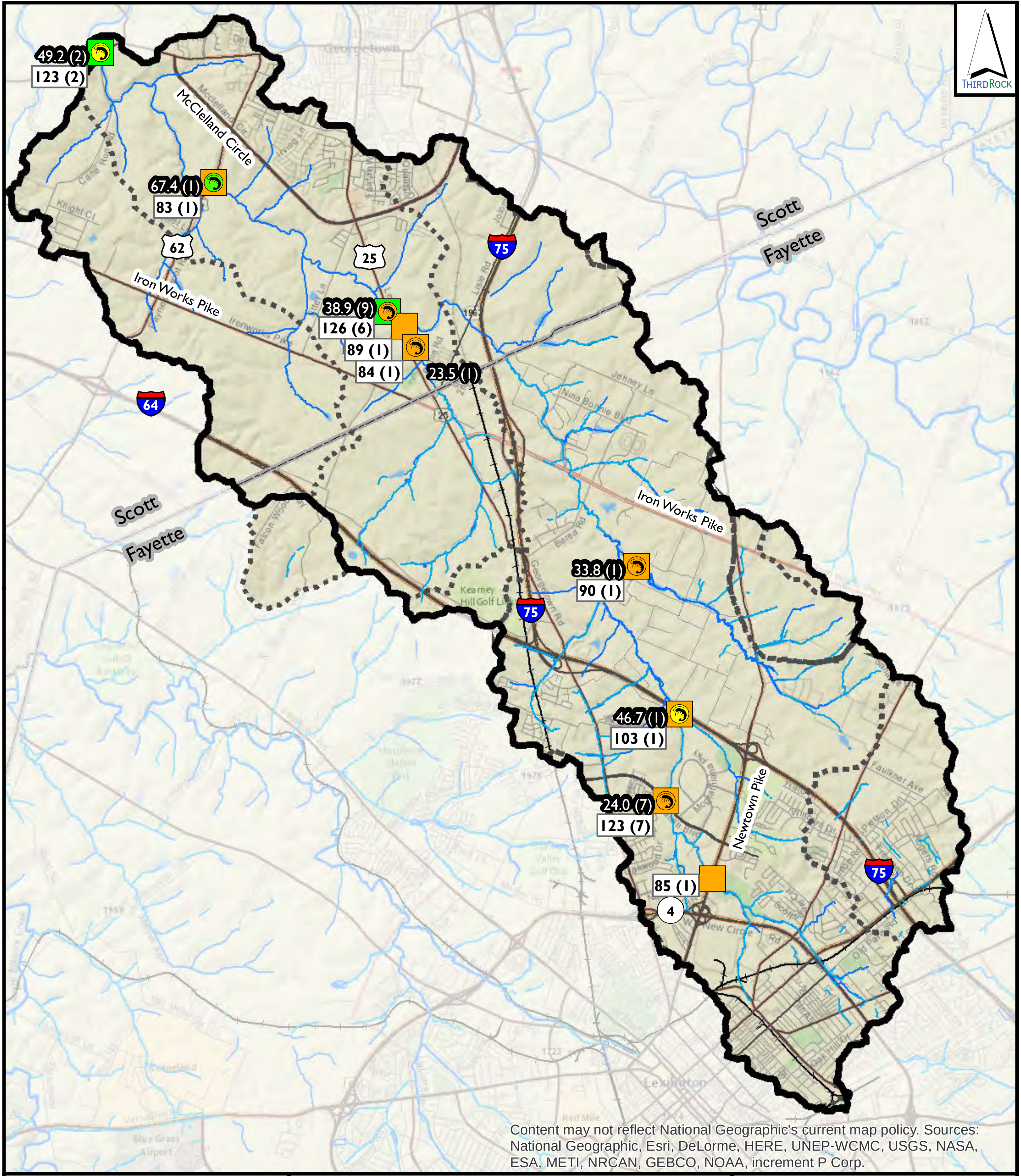
- 🔵 A
- 🟢 B
- 🟡 C
- 🔴 F

- ▭ Cane Run Watershed
- ▨ Karst Basin
- — Stream

NOTE: Grade is based on the frequency of exceedance of ta water quality benchmark of 0.35 mg/L for total phosphorus. Labels indicate the percent of samples exceeding and the number of samples collected (in parentheses).

Exhibit 25
Phosphorus Water Quality Grades 1999 - 2016

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Exhibit_3_7_Biological.mxd



Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

Grade

Macro
- ● Good
- ● Fair
- ● Poor

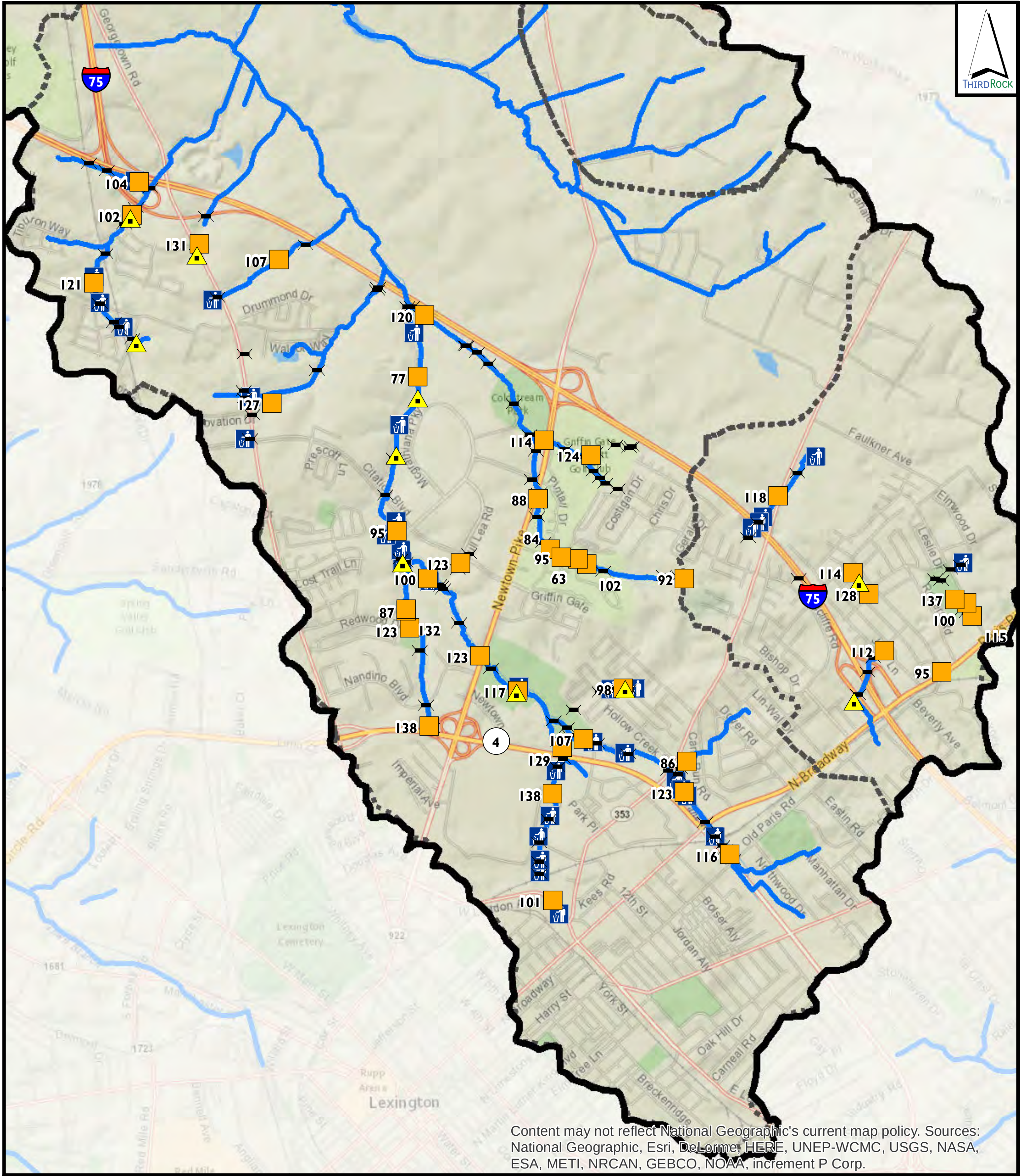
Habitat
- 🟩 Good
- 🟧 Poor

- ▬ Cane Run Watershed
- ▪▪▪ Karst Basin
- — Stream

NOTE: Grade is based on the Bluegrass Bioregion Criteria for the average score. Labels indicate the average and number of samples collected (in parentheses).

Exhibit 26
Habitat and Macroinvertebrate Water Quality Grades
1999 - 2016

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Exhibit_3_8_VSA.mxd



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Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.25 0.5 1 Miles

- ▲ Severe Erosion
- 🟧 Habitat
- ✕ Crossing
- 🗑 Trash
- ▭ Cane Run Watershed
- ⬚ Karst Basin
- ― Stream

NOTE: Habitat assessment scores are by Rapid Bioassessment Protocol (RBP).

Exhibit 27
LFUCG
Visual Stream Assessment Results
2012

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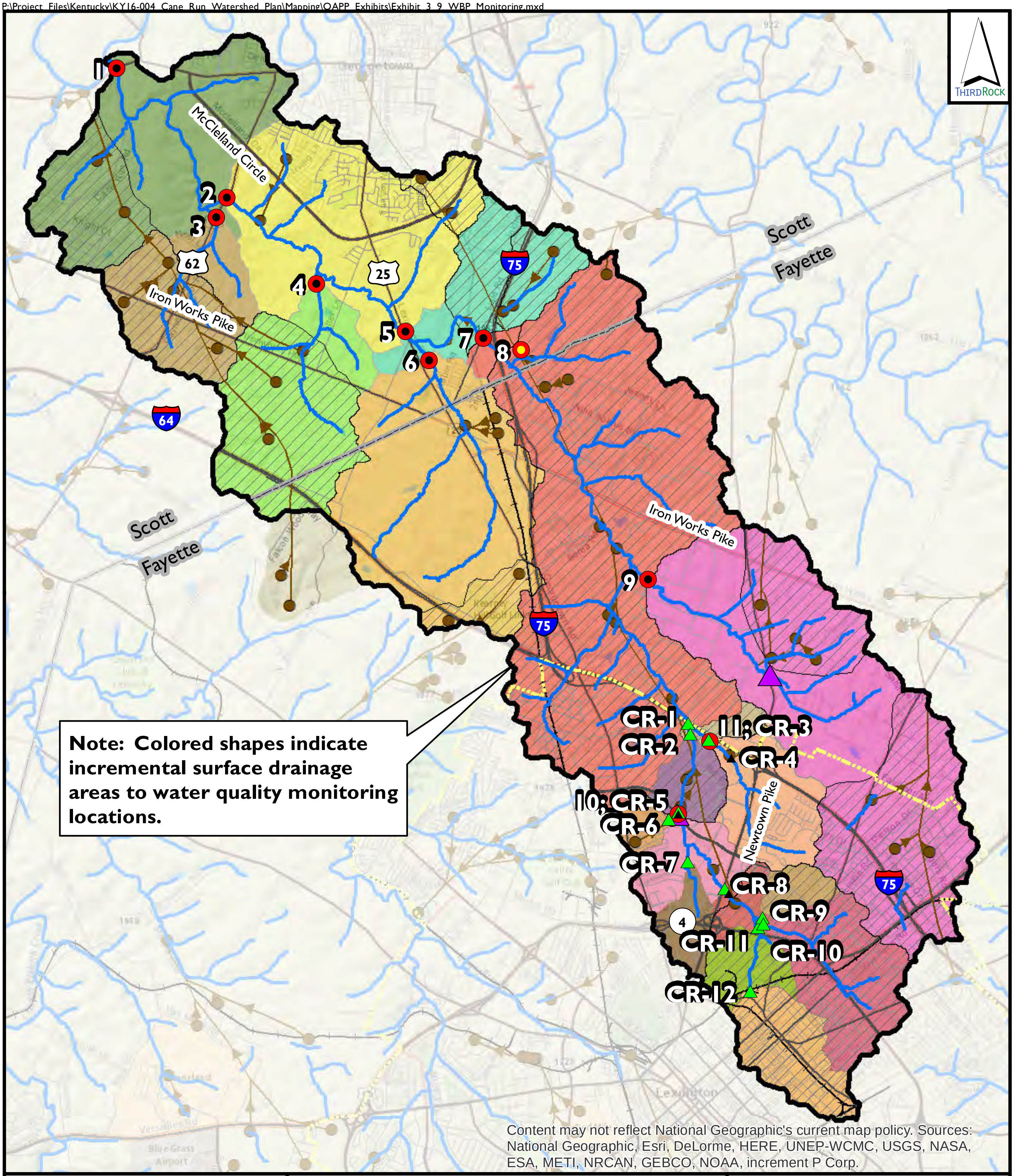

Note: Colored shapes indicate incremental surface drainage areas to water quality monitoring locations.

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

▲ LFUCG Macroinvertebrate Site
● WBP Macroinvertebrate Site
● Groundwater Site
▲ LFUCG Water Quality Site
● WBP Water Quality Site
▲ USGS Station
Stream
▭ Cane Run Watershed
▨ Karst Influenced Area
▭ County Boundary

Exhibit 28
WBP and LFUCG Monitoring Locations, 2016-2017

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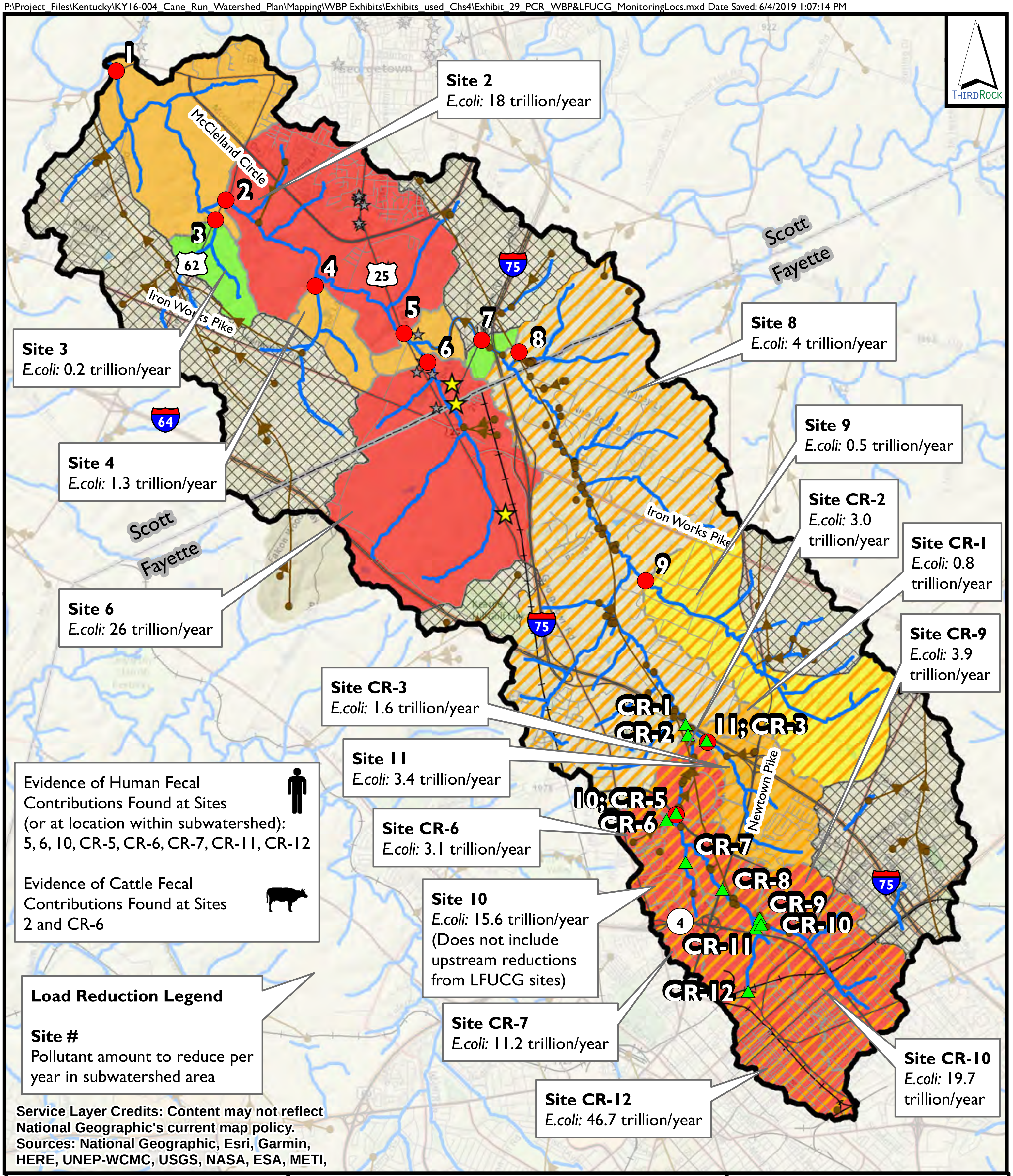

Service Layer Credits: Content may not reflect National Geographic's current map policy.
Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI,

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

- ▲ LFUCG Water Quality Site
- ● WBP Water Quality Site
- ☆ Septic Systems
- ★ Package WWTP
- • Karst Inflow / Outflow
- → Karst Flow

Grade

- 🟦 A
- 🟩 B
- 🟨 C
- 🟧 D
- 🟥 F

- ▨ Site 8 Drainage (Grade D)
- ▭ Cane Run Watershed
- ▩ Other Karst
- — Stream

NOTE: Grades based on frequency of exceedance of regulatory benchmark of 240 MPN/100mLs.

Exhibit 29
Human Recreation (Primary Contact) Grades and Load Reductions by Subwatershed, 2016-2017

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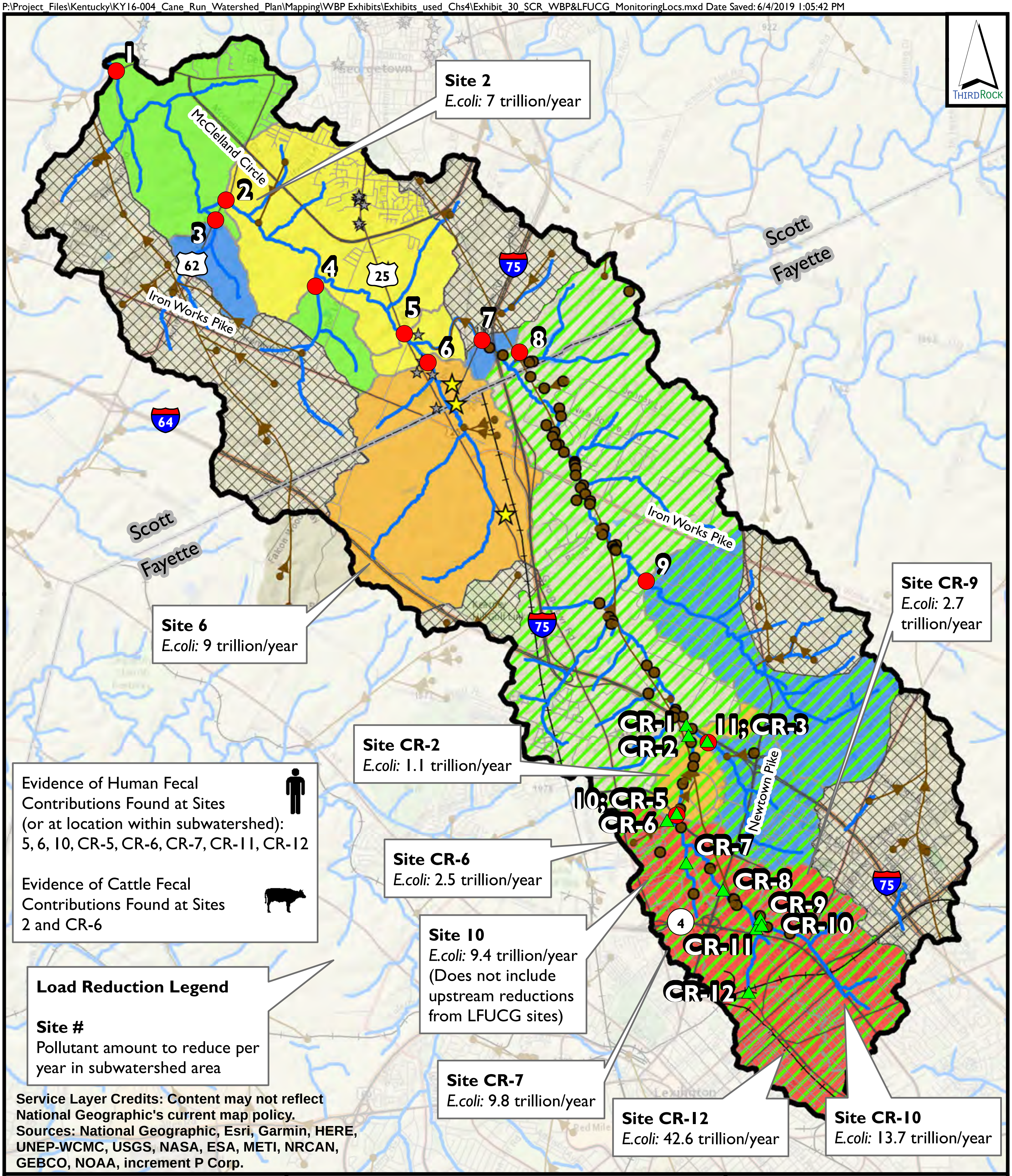

Site 2
E.coli: 7 trillion/year

Site 6
E.coli: 9 trillion/year

Site CR-9
E.coli: 2.7 trillion/year

Site CR-2
E.coli: 1.1 trillion/year

Site CR-6
E.coli: 2.5 trillion/year

Site 10
E.coli: 9.4 trillion/year
(Does not include upstream reductions from LFUCG sites)

Site CR-7
E.coli: 9.8 trillion/year

Site CR-12
E.coli: 42.6 trillion/year

Site CR-10
E.coli: 13.7 trillion/year

Evidence of Human Fecal Contributions Found at Sites (or at location within subwatershed):
5, 6, 10, CR-5, CR-6, CR-7, CR-11, CR-12

Evidence of Cattle Fecal Contributions Found at Sites
2 and CR-6

Load Reduction Legend

Site #
Pollutant amount to reduce per year in subwatershed area

Service Layer Credits: Content may not reflect National Geographic's current map policy.
Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

▲ LFUCG Water Quality Site
● WBP Water Quality Site
☆ Septic Systems
★ Package WWTP
● Karst Inflow / Outflow
→ Karst Flow

Grade
🟦 A
🟩 B
🟨 C
🟧 D
🟥 F

▨ Site 8 Drainage (Grade B)
▭ Cane Run Watershed
▨ Other Karst
— Stream

NOTE: Grades based on frequency of exceedance of regulatory benchmark of 676 MPN/100mLs.

Exhibit 30 Human Recreation (Secondary Contact) Grades and Load Reductions by Subwatershed, 2016-2017

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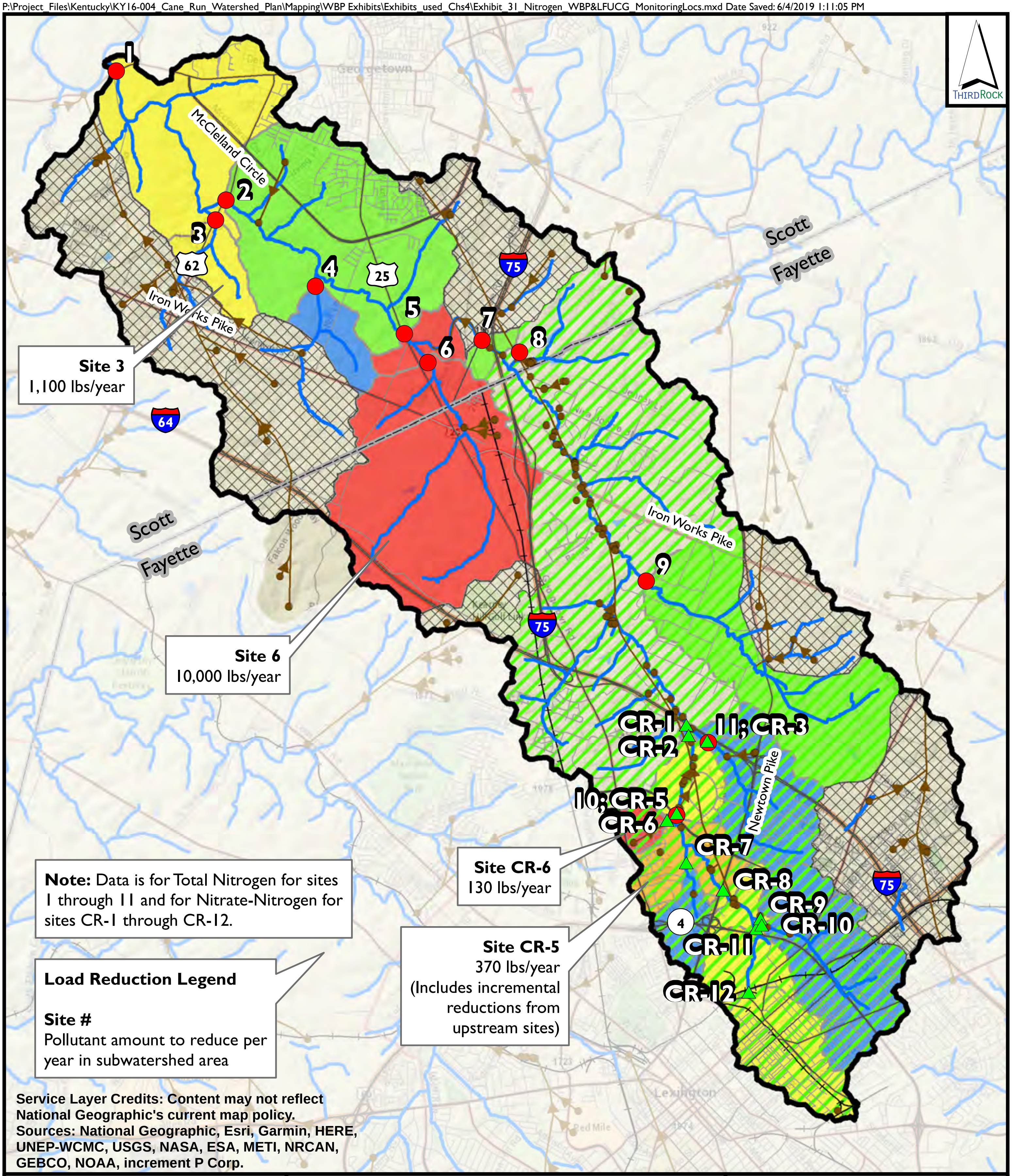

Site 3
1,100 lbs/year

Site 6
10,000 lbs/year

Site CR-6
130 lbs/year

Site CR-5
370 lbs/year
(Includes incremental reductions from upstream sites)

Note: Data is for Total Nitrogen for sites 1 through 11 and for Nitrate-Nitrogen for sites CR-1 through CR-12.

Load Reduction Legend

Site #
Pollutant amount to reduce per year in subwatershed area

Service Layer Credits: Content may not reflect National Geographic's current map policy.
Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

▲ LFUCG Water Quality Site
● WBP Water Quality Site
● Karst Inflow / Outflow
→ Karst Flow

Grade
🟦 A
🟩 B
🟨 C
🟧 D
🟥 F

▨ Site 8 Drainage (Grade B)
▭ Cane Run Watershed
▩ Other Karst
— Stream

NOTE: Grades based on frequency of exceedance of regulatory benchmark of 3.0 mg/L.

Exhibit 31
Total Nitrogen Grades and Load Reductions by Subwatershed, 2016-2017

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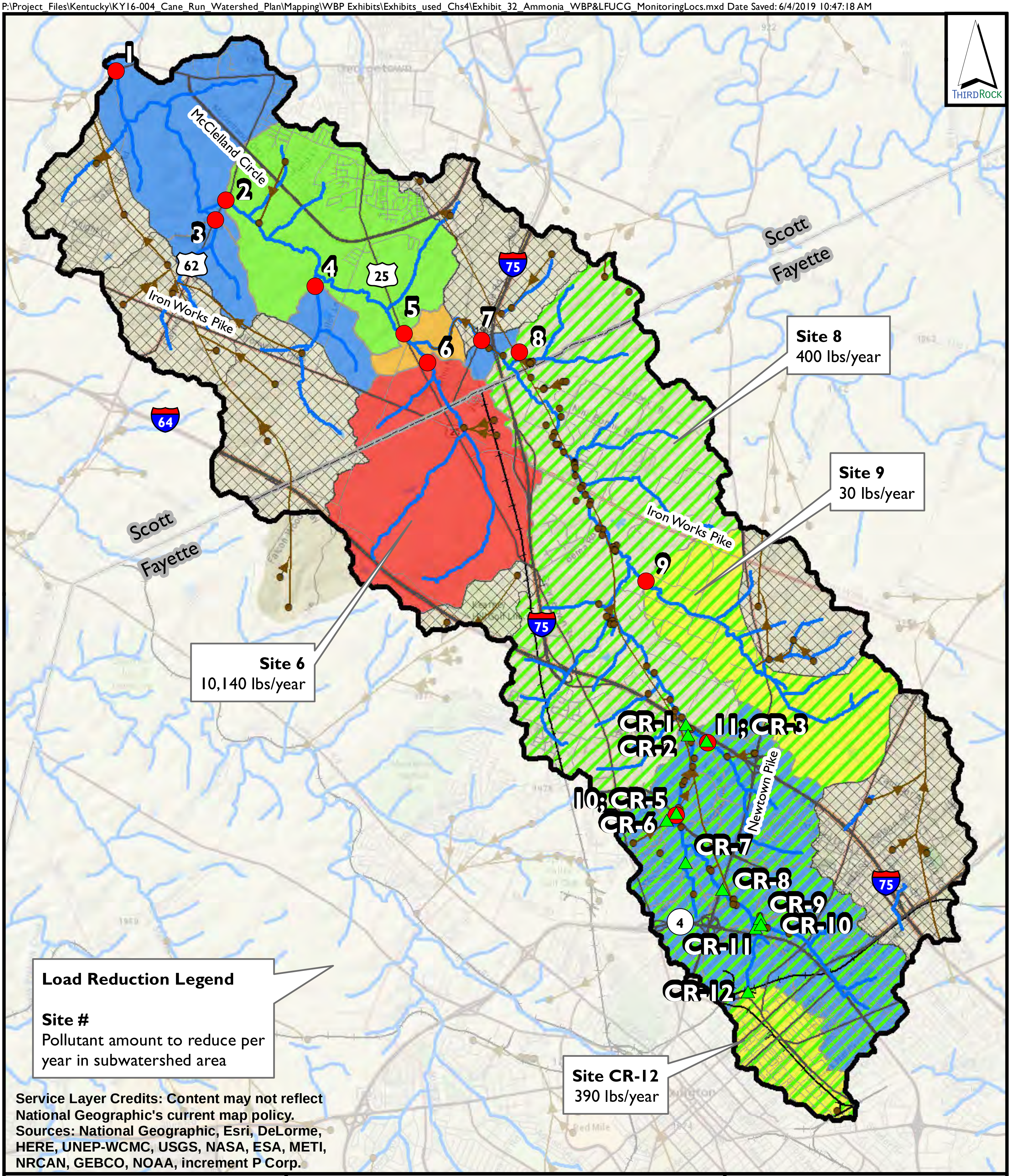


Site 8
400 lbs/year

Site 9
30 lbs/year

Site 6
10,140 lbs/year

Site CR-12
390 lbs/year

Load Reduction Legend

Site #
Pollutant amount to reduce per year in subwatershed area

Service Layer Credits: Content may not reflect National Geographic's current map policy.
Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

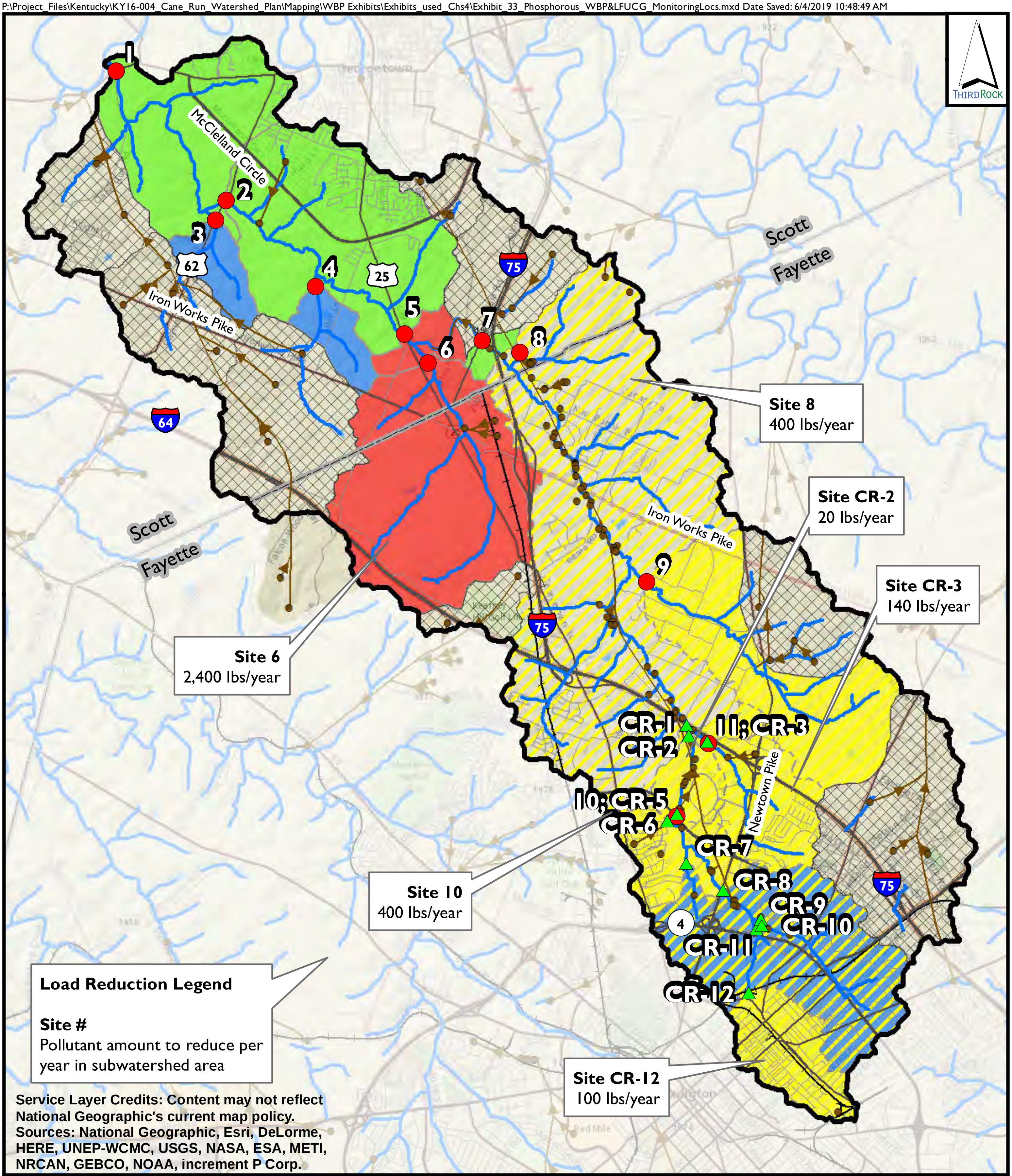
▲ LFUCG Water Quality Site
● WBP Water Quality Site
● Karst Inflow / Outflow
→ Karst Flow

Grade
🟦 A
🟩 B
🟨 C
🟧 D
🟥 F

▨ Site 8 Drainage (Grade B)
▭ Cane Run Watershed
▨ Other Karst
— Stream

NOTE: Grades based on frequency of exceedance of regulatory benchmark of 0.1 mg/L.

Exhibit 32
Ammonia-Nitrogen Grades and Load Reductions by Subwatershed, 2016-2017



Site 8
400 lbs/year

Site CR-2
20 lbs/year

Site CR-3
140 lbs/year

Site 6
2,400 lbs/year

Site 10
400 lbs/year

Site CR-12
100 lbs/year

Load Reduction Legend

Site #
Pollutant amount to reduce per year in subwatershed area

Service Layer Credits: Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run
Watershed Based Plan
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

▲ LFUCG Water Quality Site
● WBP Water Quality Site
• Karst Inflow / Outflow
➤ Karst Flow

Grade

🟦	A
🟩	B
🟨	C
🟧	D
🟥	F

▨ Site 8 Drainage (Grade C)
▭ Cane Run Watershed
▩ Other Karst
— Stream

NOTE: Grades based on frequency of exceedance of regulatory benchmark of 0.35 mg/L.

Exhibit 33
Total Phosphorus Grades and Load Reductions by Subwatershed, 2016-2017

APPENDIX B

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

FAYETTE & SCOTT COUNTY

WELLHEAD PROTECTION PLAN

Prepared by:

Royal Spring Water Supply Protection Committee

June 2003

APPROVED
DIVISION OF WATER
SIGNATURE
Branch Manager 8-28-03
TITLE DATE

GM WSS

Royal Spring Water Supply Protection Committee
P.O. Box 640
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June 25, 2003

Mr. Bruce McKinney
Division of Water
14 Reilly Road
Frankfort, KY 40601

RE: Wellhead Protection Plan

Dear Bruce:

On behalf of the Royal Spring Water Supply Protection Committee, we believe to the best of our knowledge and belief that this plan is complete and accurate. Both the Planning Commissions of Fayette and Scott Counties have adopted the plan.

It has been a challenge and pleasure to have worked on this plan and hopefully the Aquifer of Royal Spring will be protected by its' use.

Respectfully,

Robert L. Riddle, P.E.
Chairperson
Royal Spring Water Supply
Protection Committee

RLR/kma

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Introduction

Groundwater is an important resource, both nationally and locally. It provides over ninety five percent of rural Americans with a source of drinking water. Over fifty percent of Americans living in urban areas derive their water supply from underground water sources. Groundwater is also used for about half of the nation's agricultural needs and about one third of its industrial needs.

In the last twenty years, extremely rapid growth in urban as well as rural areas, has begun to take a toll on our groundwater supplies. Because groundwater is extremely important to this growth, our nation has become sensitive to the contamination of our groundwater resources. Numerous incidents of groundwater contamination reinforce the need for this sensitivity, and protection of our water supplies at the Federal, State and local level has become an imperative. The Royal Spring Aquifer is no exception to the rule. Because of the varied availability of groundwater sources and differing land use complexity, each community is charged with the protection of their groundwater supplies. As a result, many different groundwater protection programs are being implemented throughout the United States that best meet local circumstances and needs. The Georgetown Municipal water system is the largest public water system in the state of Kentucky supplied by a spring. The Kentucky Division of Water has named the Royal Spring Aquifer a priority for watershed protection.

The unique characteristics of the Royal Spring Aquifer make it a system that is highly susceptible to pollution. The Aquifer is located in karst topography, an irregular limestone region with sinkholes, underground streams and caverns from which the spring emerges. The gently undulating topography that typifies our Bluegrass landscape provides a direct access to the groundwater system via sinkholes and cavern passages for both surface water and pollutants. The underground streams and caverns also allow water and pollutants to travel quickly, a matter of hours from Interstate 75 where it crosses Cane Run to Georgetown. Approximately eighty-percent of the recharge area, the geographic area that contributes water to the aquifer, is located in Fayette County.

Prevention of groundwater pollution occurs only when citizens and local government are involved in identifying potential sources, understanding their role in pollution prevention, and taking steps to protect the environment. The plan detailed in the following chapters is designed to protect the waters of Royal Springs for continued enjoyment and use.

Section 1 Wellhead Protection Program – State requirements

1-1 Responsibility for Groundwater Protection

The 1986 amendment to the Safe Drinking Water Act requires states to adopt a Wellhead Protection Program (WHPP) to protect public water supply wells and springs from contamination through the management of potential contaminant sources within a designated land area around a well or spring. The protected areas are called Wellhead Protection Areas (WHPA'S). The U.S. Environmental Protection Agency (EPA) approved Kentucky's WHPP in September 1993. Kentucky was the fourth state in EPA Region IV and the 30th state in the nation to receive EPA approval.

The implementation plan identified in Kentucky's Wellhead Protection Program includes the following steps:

1. Form a community planning team
2. Delineate WHPA'S for public water supply wells & springs
3. Inventory potential sources of contamination within the WHPA'S
4. Develop management strategies to control potential contaminant sources
5. Plan for the future

1-2 State Authority

The Kentucky Wellhead Protection Program is coordinated by the Kentucky Department for Environmental Protection, Division of Water, Groundwater Branch, and is regulated through the Water Supply Planning Regulations (401 KAR 4:220). The regulations require that counties assess the quality of water used by their public water supply systems and formulate protection plans for those systems. The Wellhead Protection Program is designed to assist communities relying on groundwater for their drinking water source to comply with the regulations and develop Wellhead Protection Plans. Communities and counties work together to formulate the plans and submit them to the state by a designated date for review and approval. The Groundwater Branch has identified approximately 295 public water systems in Kentucky that must be covered by a Wellhead Protection Plan. Counties without an approved plan will not receive funding for future water projects.

1-3. Formation of the Planning Unit

Consistent with the State program, the Royal Spring Water Supply Protection Committee was formed and has been meeting since December 1995 to develop a Wellhead Protection Plan for Royal Spring. The Wellhead Protection Committee was created to include decision-makers in a multi-agency cooperative partnership. The Mayors of Georgetown, Lexington-Fayette Urban County Government, and the County Judge Executive of Scott County appointed members. Committee advisors include experienced staff from various State, Local and Federal agencies as well as citizens and interested parties, who are encourage to participate. The committee is unique in that the natural recharge area of the Royal Spring Aquifer crosses three political boundaries --- Fayette County, Scott County and Georgetown --- before emerging at Royal Spring. Eighty percent of the recharge area lies in Fayette County, and though it does not directly benefit from the spring, the intensity of land use in Fayette County contributes to the water quality. Figure 1-1 shows the Royal Spring Aquifer Protection Area within Scott and Fayette Counties.

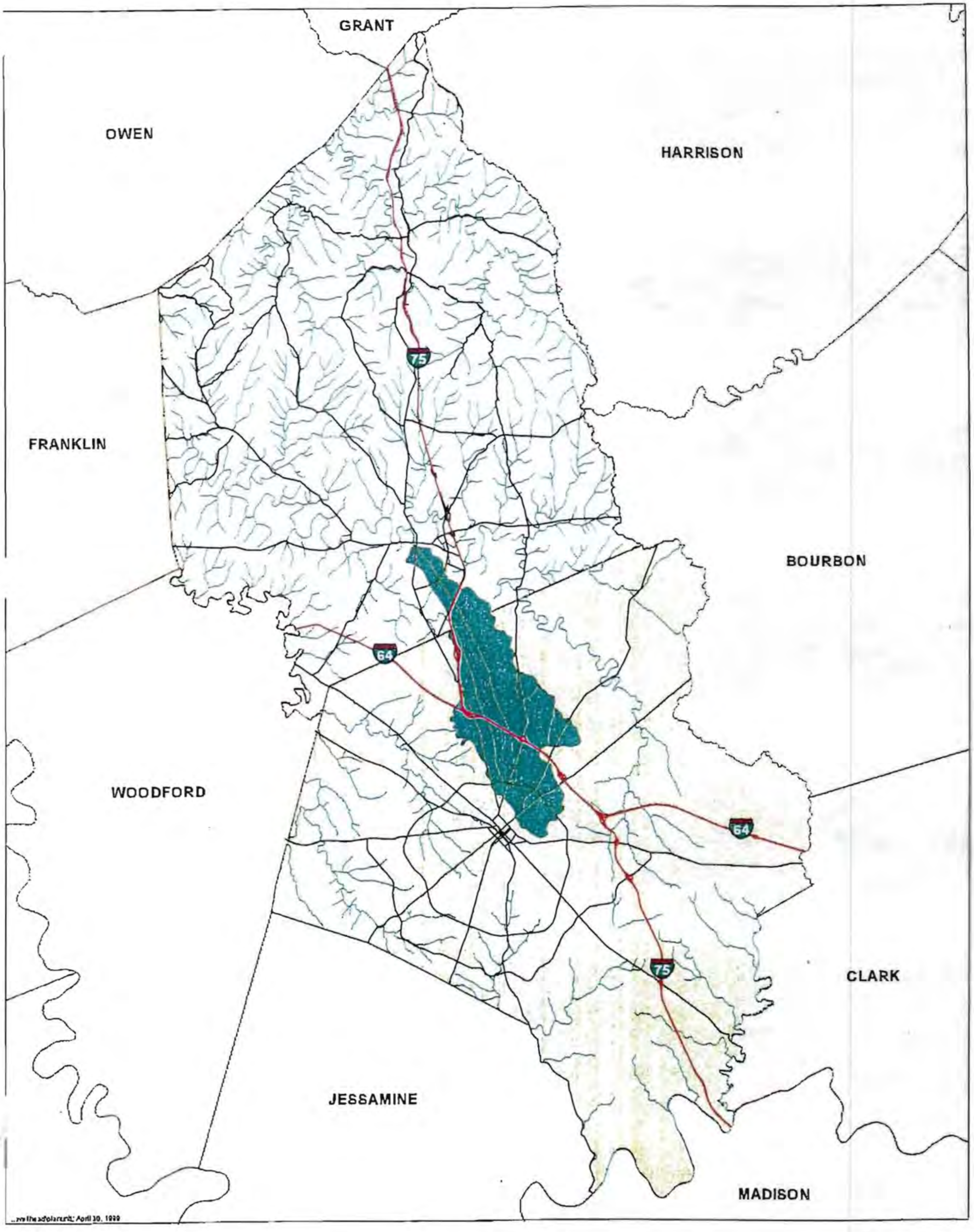
1-4. Background

Both Scott and Fayette Counties have long recognized the importance of Royal Spring and the aquifer protection area. Since the development of the Toyota Manufacturing site over ten years ago, the development pressures on both counties have increased, and development has encroached into the recharge area. Both counties have zoning and land use controls and both counties have recently adopted their respective 1996 Comprehensive Plan Updates for future growth and land development. The development of an effective wellhead protection plan goes one step further in the natural progression of aquifer protection by providing newer updated information to both legislative bodies.

1-5. Program Description

The Royal Spring Aquifer recharge area conforms to the Kentucky Wellhead Protection Program outlined in the October 1996 guidance document titled ***Well Protection: A guide for Kentucky*** published by the Natural Resources and Environmental Protection Cabinet, Division of Water. The Royal Spring Aquifer protection plan is based on the five tenets of the guide:

FIGURE 1-1
Map Delineating the Royal Springs Aquifer Planning Unit



[illegible] April 30, 1999

- The delineation of the aquifer
- Inventory of potential contaminant sources
- Existing management programs
- Developing educational programs
- Developing new management strategies for aquifer protection

Section 2. Goals & Objectives

Goals:

- To provide a continual source of potable groundwater from the Royal Spring water system for Scott and Fayette County residents.
- To preserve the integrity of surface waters for the enjoyment of all.

Objectives:

- Implement effective planning and development processes that recognize significant water uses, protect the groundwater from excessive consumption and minimize erosion into surface waters.
- Encourage the use of best management practices that balance development and resource protection to prevent degradation of water quality.
- Develop regulations complementing but no more imposing than existing federal, state and local regulations to prevent contamination and to continually improve the quality of surface and ground waters.
- Provide opportunities for community education and involvement in groundwater and surface water preservation and protection.

Section 3. Geographic Setting

3.1 Community Relationships

Georgetown/Scott County and Lexington-Fayette Urban County are located in the heart of the Bluegrass Region of Central Kentucky. As the second largest regional center in the state of Kentucky, Scott and Fayette Counties offer a hub of economic, educational, health and cultural activities.

The topography of Scott and Fayette County is gently undulating, highly productive farmland. Farmland comprises about 74% of the rural land in Fayette County and 80% of the land outside the Urban Service Boundary in Scott County. Both counties are located upon a topographic high of an uplift of the Cincinnati Arch. This is an old geologic structure of Ordovician age that has formed our present day physiographic landscape. Fayette County is slightly higher in elevation. This gives Fayette County a unique characteristic in that all streams flow away from the core of downtown Lexington. No major stream flows through Lexington.

The Ordovician Limestone which underlies all of Fayette and Scott Counties has also created a mildly karst condition which permits the rapid movement of water through the rock strata. This has created a number of complex shallow aquifer systems found throughout the county. The many springs and wells present are utilized for agricultural purposes as well as for potable water. The largest and most productive aquifer is the Royal Spring Aquifer, serving the community of Georgetown and Scott County. This aquifer is one of the largest springs in the state of Kentucky serving as a public water supply. Approximately eighty percent of the aquifer recharge area is located in northern Fayette County.

Fayette County has been a leader in recognizing the importance of groundwater assets, and protection of the aquifer recharge area from water pollution has long been a goal in Fayette County planning efforts. One of the first studies, "The Hydrology of the Lexington & Fayette County, Kentucky Area" was published jointly with the U.S. Geological Survey in 1968. This early study helped shape land use planning and the principles of development in a karst area.

Fayette County covers a geographical area of 283 square miles and is the only merged government in the State of Kentucky. Under the charter of the Lexington-Fayette Urban County Government, the functions of the City of Lexington and the County of Fayette were merged in January 1974 into a single government to administer and plan for the total area embraced by the boundaries. The legislative authority of the Lexington-Fayette Urban County Government is vested in the fifteen members of the Urban County Council. Twelve members represent each of the twelve council districts of the county, and three members are elected to represent the county population at large.

The Fayette County Planning and Zoning Commission was created in 1928 by the City Charter. The formation of the Planning Commission set a course of development in Fayette County that has been carried on to the present time. The first guidelines for development, the Subdivision Control Regulations, were adopted in 1929. In 1930, the first Zoning Ordinance was adopted. The first comprehensive planning document was adopted in 1931. In 1958, the City-County Planning & Zoning Commission adopted a comprehensive planning amendment defining and establishing an "Urban Service Area" for development, which represented a dramatic change in the planning process. In the European tradition of compact development, a core urban area was identified for growth and development. The "Rural Service Area" was set-aside for non-urban activities such as in the agricultural and equine industries. Scott County has also adopted the Urban Service Area concept for the community of Georgetown.

Scott and Fayette Counties have a combined area of 567 square miles with approximately half the total area in each county. Fayette County has one major population center, Lexington, with a 1998 population estimate of 250,000 people. Scott County has three population centers, Georgetown, Sadieville and Stamping Ground, with a total 1998 population estimate of 27,000 people. Fayette and Scott counties have each adopted a Comprehensive Plan and in 1996 a Comprehensive Plan Update that guide development in the respective county.

The Royal Spring Aquifer is addressed in Section IV of the Georgetown-Scott County Comprehensive Plan. Goal 3 of the Georgetown-Scott County Comprehensive Plan Update states that the location of the Urban Service Area for Georgetown should not be extended south beyond the greenbelt or further into the Royal Spring Aquifer Recharge Area than the amended 1994 Urban Service Boundary limits. The purpose of the goal is to encourage preservation of prime farmland, the separate identity and small town character of Georgetown, and the rural character of the surrounding area. The plan also includes an *Environmentally-Sensitive* category and a *Water Quality Protection Area.* These areas apply to Industrial Zoning within the Royal Spring Aquifer Recharge Area and to properties that drain directly to Elkhorn Creek within five miles of the Georgetown Municipal Water intake. Also a category called *limited sewer treatment capacity* deals with septic systems for limited light industrial uses.

The Lexington-Fayette Urban County Comprehensive Plan also addresses aquifer recharge areas. More than one aquifer recharge area exists in Fayette County. Land use controls have an *Environmentally Sensitive* category and an element indicating the protection of *aquifers* in the land use regulations. Goal 16 of the Fayette Urban County Comprehensive Plan Update has four objectives pertaining to the protection of aquifer areas:

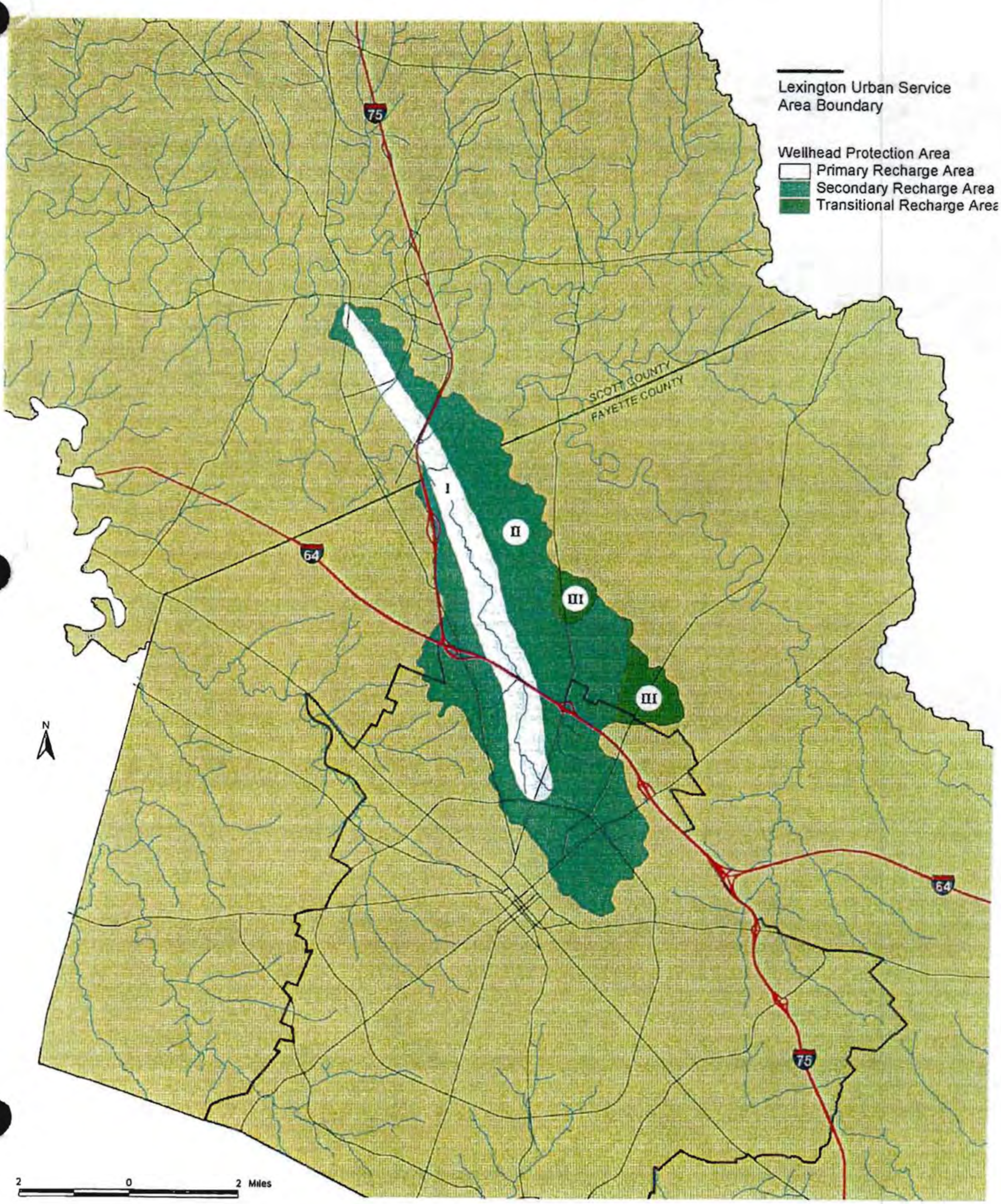
- Objective E " Monitor and minimize air, water, visual, noise, and artificial light pollution"
- Objective G "Preserve and protect natural drainage ways, environmentally sensitive areas and plant life from severe intrusion, alteration, or destruction during urban development"
- Objective J " In cooperation with federal, state, and regional agencies ensure the adequacy and quality of the water supply, encourage conservation of water resources and expedite the abatement of pollution"
- Objective K " Ensure that the proper facilities and structures are employed to accommodate surface drainage in a manner that recognizes their effects on underground drainage and that is consistent with the desire to improve water quality"

Both comprehensive plans stress the need to maintain and keep the unique horse farmlands and agricultural lands as an open space buffer between the two counties.

3-2 Background

The Royal Spring Aquifer and its recharge area are a significant physical presence in the center of two of the fastest growing counties in central Kentucky. Figure 3-1 illustrates what is

FIGURE 3-1
The Royal Spring Aquifer within Fayette and Scott Counties



believed to be the recharge area for the spring. It is estimated to be 25 square miles (Sendline et. al., 1989 p.12 Table 1.). Eighty percent of the recharge area is located in Fayette County with the remainder in Scott County. The main surface stream for the aquifer is Cane Run. The headwaters for this stream and aquifer have been dye traced in the upper reaches to the highly urbanized area located close to downtown Lexington at East Seventh Street. The northern most reach of the aquifer is located at the discharge point of Royal Spring located at Clinton Street in Georgetown. Future hydrologic analysis may yield additional information on the true boundaries of the recharge area.

Royal Springs serves as the principle water supply for the city of Georgetown and Scott County. Nearly 8,000 customers are currently served by the Georgetown water system. Fayette County receives no direct benefit from Royal Springs as a public water supply. However some Fayette County residents have private wells and springs that draw from the shallow aquifer. Agricultural and recreational uses also prevail in the aquifer.

Water quality problems may result when contaminants are introduced in concentrations that either exceed the capacity of the soils to filter them out (poor or no filtering qualities exist in karst areas) or exceed the dilution that occurs as water mixes with the contaminant. In almost all cases, contamination is caused by humans. The potential for contamination is inherent in the creation of communities as a result of urban, suburban, and rural land uses. Use of the land for horse and cattle farms, food or crop production, recreation and even the extraction of limestone through quarrying can affect water quality.

Pollution potentially comes from many sources. On-site septic systems where loadings are not attenuated by the soil or in which toxic inorganic septic tank cleaners are used is one example. In the 1989 report, Groundwater Evaluation, Planning and Policy: An Analysis of Fayette County, Kentucky, a wide range of pollution problems was identified in rural areas. Older studies described in the report found 70 % of the water wells contaminated by fecal coliform, and a review of more recent Health Department records cited in the report indicated thirty-one out of thirty six springs tested unsafe due to total coliform concentrations. The source of the contamination was thought to be animal waste.

Dumping refuse, garbage or horse muck into sinkholes is a direct way for pollution to be introduced into the groundwater system. Commercial, business and industrial discharges to surface streams and sinkholes are a potential source of contamination as are improper storage of raw and hazardous materials or wastes. Incidental leaks of fuel and fluids from vehicles and transportation related accidents where product or automotive fluids drain into storm drains are another source of contamination. Non-essential or inappropriate applications of agricultural and turf chemicals may be detrimental to the groundwater.

Primary concerns in the Royal Spring recharge area include the potential for leaking storage tanks, especially fuel tanks, and intentional or accidental spills that allow chemical contaminants or petroleum products to enter the groundwater. Additional concerns are the extensive use of agricultural chemicals that are leached from the soils and industrial and residential development that can result in stripping the natural vegetation and land cover by total earth movement and re-contouring of the land. Replacing natural or agricultural lands with lawns, landscaping, and impervious surfaces such as roofs and parking lots results in faster runoff rates leading to excessive sediment discharge to the receiving water and increased stream bank erosion. Such erosion is evident on Cane Run Creek.

Growth in Fayette County is important to consider because land use changes in the Royal Springs Aquifer Recharge Area can have an impact upon the water quality of the springs. Locational aspects of business, industry, agriculture, and even recreation could impact the flow of the Royal Spring Aquifer if wells intercept the groundwater flow.

3-3 Population

Population figures and growth trends are factors in determining both the consumptive use of water for drinking and for sewage treatment. Scott and Fayette counties form the center of the Bluegrass Region as a major employment center and the dominant population center. Table 3-1 lists population data supplied by the Bluegrass Area Development District.

Scott County, one of eight Inner Ring counties of the Bluegrass Area Development District, is located on the northwestern boundary of the District. It's 1990 population makes it the seventh-most populated county in the District. The county's growth rate of 9.4% from 1980 to 1990 ranked fifth in the District. This was significantly higher than the 7.9 % growth rate for the District overall.

Table 3-1 POPULATION OF SCOTT & FAYETTE COUNTIES

	FAYETTE	Change	SCOTT	Change
1960 Census	**131,906**		**15,376**	
1970 Census	**174,323**	**32%**	**17,948**	**17%**
1980 Census	**204,165**	**17%**	**21,813**	**22%**
1990 Census	**225,366**	**10%**	**23,867**	**9%**
Moderate Growth Estimate 2000	**244,713**	**9%**	**26,460**	**11%**
Moderate Growth Estimate 2010	**257,621**	**5%**	**28,405**	**7%**
Moderate Growth Estimate 2020	**261,936**	**2%**	**29,662**	**4%**
High Growth Estimate 2000	**260,861**	**16**	**29,558**	**24%**
High Growth Estimate 2010	**290,000**	**11%**	**33,016**	**18%**
High Growth Estimate 2020	**317,032**	**9%**	**35,856**	**9%**

Population in the urban areas of Scott County increased a total of 580 people from 1980 to 1990 while population in the rural areas increased 1,474 people or nearly 72% of the total growth. Rural population is expected to continue growing faster than urban population with the potential to impact land use patterns.

Population density is one indicator of development, and as development and land use patterns change in the Royal Spring recharge area, the potential for groundwater pollution increases. The average population density in the District is 138 people per square mile. Fayette County has a population density of 788 persons per square mile, the highest in the District, and it is one of the most developed.

3-4 Employment

Industrial growth is generally dependent upon the availability of water. Though industrial growth in Fayette County is not dependent upon the availability of water from Royal Spring because it receives its water from the Kentucky River, land use changes can impact the availability of water in Scott County by intercepting groundwater flow.

Fayette and Scott County were ranked number one and two respectively among the 17 counties in the Bluegrass Area Development District in terms of growth from 1985 to 1995 in manufacturing and employment. The change in the number of people engaged in manufacturing activities is shown in Table 3-2.

TABLE 3- 2 MANUFACTURING EMPLOYMENT 1985-1995

County	1985	1995	Change
Fayette	17,891	18,190	1.7 %
Scott	2,457	8,802	245.6 %

The largest employment gains in the District were experienced in the manufacturing of Transportation Equipment (51.3 percent), Rubber & Miscellaneous Plastic Products (43.4 percent), and Fabricated Metal (41.6 percent). The increase in automotive industries over the last ten years has had a major impact on the District's employment base and the economy. This is attributed to Toyota Motor Manufacturing and the associated automotive suppliers locating in the area.

3-5 WATER DEMAND

The Georgetown Municipal Water and Sewer Service (GMWSS) provides water to nearly 8000 people in their service area. Potable water is supplied by two sources, water from the Royal Spring treated by the Georgetown WTP and finished water pumped from the Frankfort water system. Water from the Royal Spring provides for over 85% of the total demand.

The amount of water provided by the GMWSS to its customers is shown in Table 3-3. The amounts shown include residential, commercial, institutional, industrial, water plant and fire protection uses, distribution system losses, and line flushing based on 1995 water records.

TABLE 3-3 CURRENT WATER USE SUPPLIED BY GMWSS

Source	Average Daily Flow MGD	Peak Daily Flow MGD
Georgetown WTP	1.615	2.361
Frankfort	.250	.400
Total	1.865	2.761

The projected water demand from GMWSS based on population forecasts is shown in Table 3-4. Water from the Royal Spring is expected to provide approximately 80% of the total demand.

TABLE 3-4 WATER DEMAND PROJECTIONS GMWSS SERVICE AREA

YEAR	POPULATION	AVERAGE DAILY DEMAND MGD	PEAK DAILY DEMAND MGD
2000	19,761	2.075	3.063
2010	23,466	2.464	3.637
2016	26,014	2.731	4.032
2020	27,875	2.927	4.350

3-6 Land Use Planning

The type of land use has a bearing on the potential source of pollutants. The linkages of transportation systems, location of residential housing, both sewered and non sewered, the location of industrial, business and commercial properties in Fayette County and Scott County are important to understand for their impacts on the Aquifer. Both counties recognize the importance of protecting the Royal Spring Aquifer. Over two and a half years have been spent in increasing aquifer awareness.

Though most of the zoning designations for business and commercial properties in Fayette County existed before the extent of the Royal Spring Aquifer was known, planning efforts continue to refine and protect the aquifer. A number of considerations have been identified and discussed in the planning process to help protect the aquifer, they include.

- Involving the public in the decision making process
- The need for consensus among the City of Georgetown, Scott County and Fayette County for the plan to be successful
- Understanding the impact of different types of development on degradation of water quality

- Identifying portions of the aquifer subject to existing pollution
- Determining whether specific portions of the aquifer should remain in rural / agricultural character
- Determining whether the cost of restrictions in terms of land use be offset by the significant economic, social, ecological, recreational and aesthetic benefits for the aquifer
- Determining if degradation of the aquifer has significant economic, social, ecological, recreational and aesthetic costs for the Royal Spring Water Supply
- Providing for implementation measures that can be utilized by all three political units

In the past three years of discussion, a number of needs have been explored in the development of this plan in regard to land use. These are:

- A determination of the existing aquifer recharge area
- Identification of all known existing and potential point & non-point sources of groundwater contamination
- Development of a mapped area delineating the area of concern
- Development of a resource assessment method to be used for determining the amount and kind of development that can take place in the aquifer area
- Development of a comprehensive statement of land use management policy as it pertains to development in the aquifer recharge area
- Proposal of limits on land uses that might have an inverse impact on the water quality of the aquifer
- Limiting the development of land that might have an impact on the water withdrawal capability for the Royal Spring Aquifer public water supply
- Proposal of limits on land uses that might have an adverse impact on water quality and or recharge capabilities in the aquifer protection area
- Designation of specific areas in the aquifer recharge area that are suitable and appropriate for public acquisition
- Development of a program for local governmental implementation of this comprehensive management plan for the protection of the aquifer.

It is the intention of this plan to develop guidelines for aquifer protection to be incorporated in the planning process of all three political entities – Georgetown, Scott County and the Lexington-Fayette Urban County Government.

3-7 Future Residential Development

Residential development for Fayette County is defined by the 1996 Comprehensive Plan, which designates two major areas: The Urban Service Area (83 square miles) and The Rural Service Area (200 square miles).

New residential development in the Urban Service Area requires sanitary sewers and must meet a number of environmental requirements such as incorporating retention basins and erosion control methods during and after construction. Fayette County is also beginning a more determined program to improve the surface water quality of our county. A number of new water quality sampling points have been established. Though sanitary sewers are predominant in the Urban Service Area, a very small developed area in the Urban Service Area and located within the Royal Spring recharge area is on septic tank systems. These systems are listed in Appendix 3-1.

Residential development in the Rural Service Area has been limited to ten acres or more to allow for the use of septic tanks. In the past three years, pressure has been increasing to develop in the rural areas. A significant number of horse farms and acres of agricultural land have been converted into ten-acre tracts. Today rural preservation efforts for farmland have increased the minimum lot size to forty acres for residential development.

Development in the Fayette County Rural Service Area is being investigated in an ongoing analysis process. Steeper land, thin soil cover, poor soils for septic systems, sinkholes, and more floodplain all pose interesting challenges to not only the aquifer protection plan, but also the entire planning process for rural lands. The concept of rural land planning that is being considered at this time is to create Purchase Development Right (PDR) legislation for the Rural Service Area in Fayette County. Also under consideration is the creation of smaller units of development on either smaller lots in non-prime agricultural lands or allow clustering of residential units to protect larger tracts of land. From a water supply protection perspective, the problem with the former concept is that soils of poor quality that are not of prime agricultural quality are also not of good quality for septic systems. The problem with the later concept is that the cluster of residential units must be on a large enough land area for a septic tank system. For this reason, Fayette County is considering a requirement ***that no clustering of NON-SEWERED residential units be permitted on less than ten acres of land in the Rural Service Area***

For planning in the rural areas a system called land capability strategies have been developed. These concepts have been mapped out in the Rural Service Area and a Land Capability Map has been developed. The importance of this map to water supply protection planning is that a representative sample of the present land use within the aquifer area is illustrated. Seven management units have been created for consideration. These are:

- *Core Agricultural and Rural Landscape Area (CARL)*
- *Rural Landscape and Environmentally Sensitive Area (RLES)*
- *Scenic Resources Protection Areas (SRP)*
- *Transitional Landscape Area (TL)*
- *Rural Development Area (RDA)*
- *Cross-roads Community Area (CRC)*
- *Potential Development Areas (PDA)*

Section six of this report will take a closer look at the existing aquifer, the number of acres of each type of land use that are projected and the relative potential for pollution problems for each type of land use.

3-8 Future Non-Residential Development

3-8.1 Agricultural

Agricultural land use is important to consider in planning the protection of the Royal Spring recharge area because of its extreme importance in the Bluegrass area. Table 3-5 illustrates the trends in agricultural land use. Total agricultural acreage as well as the number of farms has been declining in both Fayette and Scott counties while the average size of a farm has increased. Tobacco continues to be one of the top cash crops in both Fayette and Scott counties. Water usage for agricultural purposes is a concern in the aquifer protection area especially in drought periods, such as experienced in 1988 and 1999, when the demand for water from both streams and wells increased. Water taken from the Royal Spring Aquifer during these periods is not available to meet the community water supply needs. Because farming is expected to continue being one of the principle occupations in the rural area. Agricultural consumption from the Royal Spring Aquifer will need to be considered in water supply protection planning.

TABLE 3-5 AGRICULTURAL TRENDS IN FAYETTE & SCOTT COUNTY

	Total Acreage		Total Number Farms		Average Size of Farms Acres		Harvested Cropland Acres	
County	1987	1992	1987	1992	1987	1992	1987	1992
Fayette	155,594	147,154	912	836	170.6	176.0	29,511	30,047
Scott	164,293	154,082	1,062	971	154.7	158.7	37,322	31,388

3-8.2 Business, Commercial, Industrial

Non residential development patterns are of great concern in the protection of the aquifer. Business, commercial and industrial development provides opportunities for potential contamination from underground and above ground storage tanks, runoff from outside chemical and waste storage areas, parking lots, and roofs. Trucks provide potential for contamination from leaks in cargo they are transporting as well as from fuel tanks and other vehicle fluids. Land use patterns for businesses, commercial and industrial property are influenced by the rail and highway systems in place which provide corridors for this type of non-residential development.

The water supply protection plan needs to take into consideration the potential for contamination from a hazardous spill incident. Landscape features, transportation paths and mitigation parameters such as those listed below determine the best management practice for preventing contamination. Best management practices are outlined in Section 8.

LANDSCAPE FEATURES
- Sinkholes
- Swallow holes
- Fracture zones
- Disappearing streams
- Soils
- High groundwater

TRANSPORTATION PATHS
- Natural surface streams channels
- Man-modified surface channels
- Sinkholes
- Underground channels – natural
- Underground channels –storm sewer
- Detention basins

MITIGATION PARAMETERS
- Spill potential - quantity
- Pollutant potential – type
- Quantity of stormwater runoff
- Potential for changing basin hydrology
- Natural barriers to flow
- Flow capacity
- Time of travel

- Pollutant removal capability
- Proximity to source of concern
- Access for public safety
- Monitoring data

With information on the current land uses and the full development potential of the aquifer, and the landscape features, the potential hazard rating based upon the land use can be applied to the aquifer area. Areas that have a high rating may be analyzed with closer scrutiny, and best management practices identified. This process is the mainstay of the Royal Spring Aquifer Protection Plan.

3-9 Transportation System

Transportation systems are a priority in the planning process because of the potential for intentional and accidental spills as fuels and hazardous materials are transported across and within Fayette and Georgetown/Scott Counties. The rail and interstate systems bisect and run parallel to the aquifer recharge system for almost eight miles (from mile marker 114.4 to mile marker 122). The main stream channel of Cane Run is located at **mile marker 116.2** A hazardous spill at this location into the creek could have immediate consequences to the aquifer. It is estimated that contamination would travel the distance from an interstate hazardous incident to the Royal Spring point of discharge in about nine to twelve hours depending on the flow characteristics of Cane Run and the amount and type of product discharged.

Our society depends on the use of hazardous materials, and as a result, their transportation has become an integral part of daily living. State and federal agencies regulate air, rail, water, pipeline, and highway carriers of hazardous materials. There are no local hazardous material transportation regulations in Fayette and Scott Counties; however, the LFUCG Divisions of Fire, Police, and Environmental and Emergency Management and the Division of Georgetown/Scott County Emergency Management Agency (E.M.A.) are experienced, trained, and prepared to respond and resolve hazardous material incidents.

Following is a more detailed description of the existing transportation systems.

3-9.1 Highway System

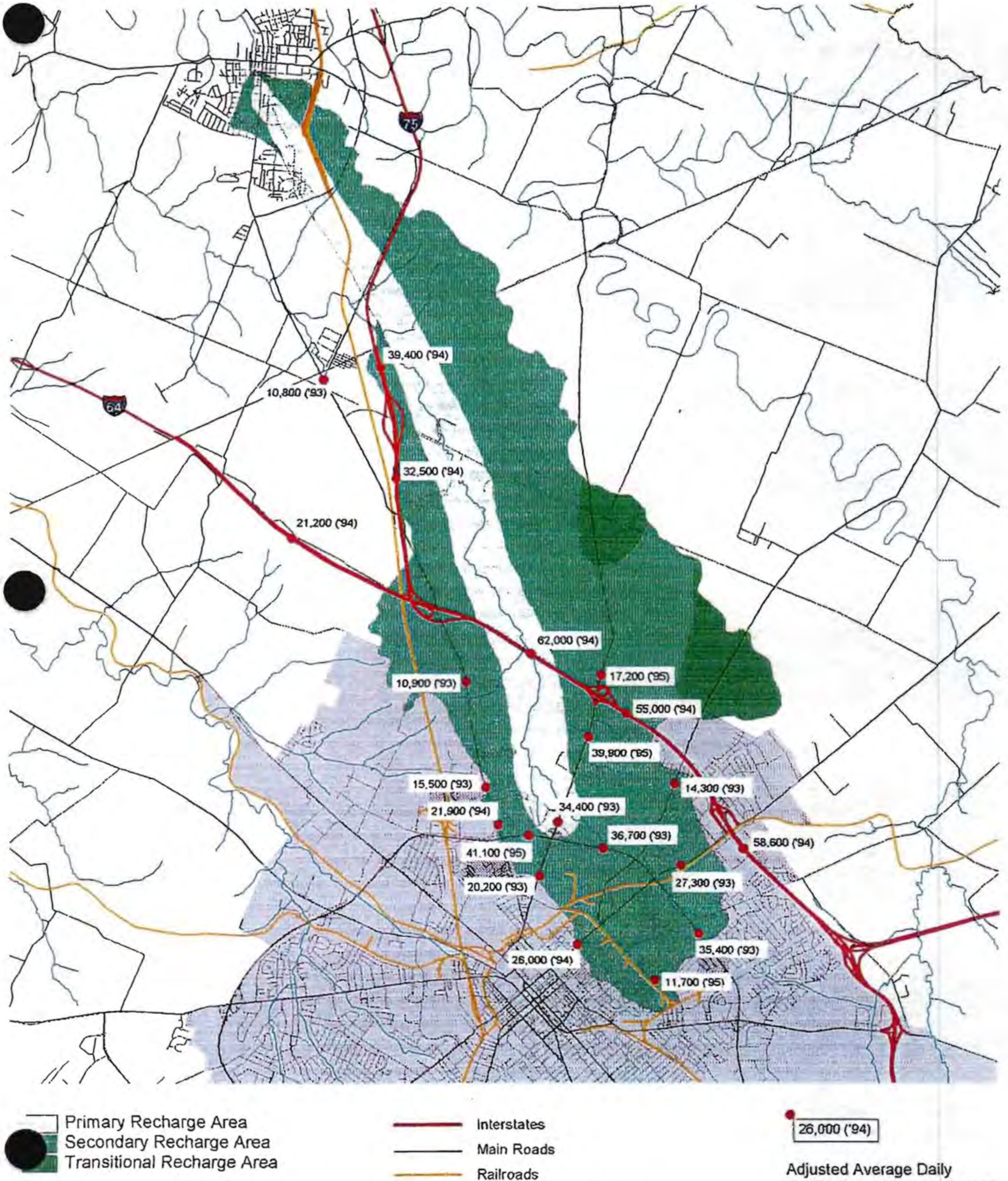
As in most metropolitan areas in the United States, the dominant system of transportation in Fayette & Scott County is the highway system. Fayette County contains Central Kentucky's largest urbanized area and serves as the leading market and trade center for the region. It also provides major employment, education, health-care, and many other opportunities to Central Kentuckians. In Scott County, Toyota is the leading employment center providing jobs for over 7,400 employees. The major transportation routes with average daily traffic counts are shown in Figure 3-2. Table 3-6 shows road mileage by functional class for Fayette County and Scott County.

The Fayette and Scott County area is a junction point for two major interstate routes: east-west I-64 and north-south I-75. In the north of Fayette County, the two interstate routes join and run diagonally together along the northwest border of the urbanized area dividing again southeast of the area. Traffic volumes along the common section of I-64/I-75 have increased over 40% since the mid-1980's. The average daily traffic exceeds 62,000 vehicles at the intersection of I64 & I75 (1994-traffic count). During peak travel periods, volume increases more than 70%. Forty miles of interstate widening is planned in the Central Kentucky area over the next 10 years.

TABLE 3-6 1994 TOTAL ROAD MILES BY CLASSIFICATION

	Fayette Co.	**Scott County**	**Georgetown**
TYPE	**Miles**	**Miles**	**Miles**
Interstate	35.4	23.7	2.7
Expressway	13.8	0	0
Principal Arterial	56.0	3.3	9.3
Minor Arterial	141.8	14.9	11.5
Collector	159.0	57.1	7.2
Local	847.6	191.8	260
Rural Minor Collector	0	60	0
TOTAL	**1,253.6**	**350.8**	**290.7**

FIGURE 3-2
Map of the Major Transportation Systems
With Adjusted Average Daily Traffic Counts



Access to and from the Lexington urbanized area and the city of Georgetown is provided by the interstate system via five interchanges. Three major interchanges of I 75 & I 64 interstates are located in the Royal Springs Recharge Area. These are at mile markers 115, 117, 119.4.

Three major state roads run through the Royal Springs Recharge Area; Georgetown Road, Newtown Road, and Paris Pike. Traffic counts on these major state roads are expected to increase with continued development.

The importance of highways is not to be underestimated. In the analysis of the occurrence of sinkholes, which provide a direct opening into the aquifer, many of the sinkhole locations are immediately adjacent to the state roads. The location of the mainstem of Cane Run also poses a direct connection to the aquifer. Cane Run at Newtown Road had 34,400 vehicles a day crossing the stream. At the interstate crossing with Cane Run, over 62,000 vehicles a day cross the stream. No sinkholes have been found immediately adjacent along the interstate or railway system that would pose an immediate threat to the aquifer in the case of a catastrophic spill. Section 5 covers sinkhole locations in detail.

3-9.2 Aviation

The Blue Grass Airport functions as a principal intermodal transfer point. Though not in the recharge area, the surface transportation system and the aviation transportation system are dependent on one another for the transfer of people and goods within the region.

Air service needs of Central Kentucky and the Blue Grass Airport serves a large portion of Eastern and Southern Kentucky. These needs are met through a mixture of scheduled commercial air service, as well as general aviation service. In addition, Blue Grass Airport interacts with many smaller public and private airports in the region to provide aviation services to private aircraft.

There are various classes of controlled and uncontrolled airspace which make up the operational airspace of the Blue Grass Airport. Flights in the United States are normally channeled along navigational routes that are as well defined as our surface highway systems. The route systems that are in use in the Lexington-Jefferson Metropolitan Planning Organization (MPO) area are the

VOR Airway System, Jet Route System, Area Navigation (RNAV) System, and the Terminal Airspace System, which is composed of the Blue Grass Airport's facilities, equipment, and personnel. Some of these routes traverse the Royal Spring recharge area.

Many military operations involve the movement of freight. Though the number of flights fluctuates somewhat year to year, since 1988, there have been an average of 2,700 military operations each year at Bluegrass Airport.

The Georgetown Airport was opened in 1993 and was designed to be a reliever airport for private planes, corporate jets and cargo functions. The Georgetown Airport is a general aviation facility, providing passengers and pilots with a 5,500 ft. runway with 1,000 foot overruns and parallel taxiway. The airport is served by instrument approaches and lights for 24 hour operations year round. Other features of the airport include a new terminal building, maintenance hanger, fuel farm, and T-hangars in addition to an Automatic Weather Observation System (AWOS III) and weather radar.

3-9.3 Motor Carriers & Trucks

The trucking industry is vital for the transportation of fuel, raw materials and freight into and out of Fayette and Scott Counties.

More than 50 motor carriers service the area. More than 21 of these carriers operate terminals locally. These carriers fall under various classes according to the types of commodity carried. There are also numerous utility trucks, e.g., telephone, water, gas, and electricity; and service trucks, e.g., painters, plumbers, and electricians.

The highest truck volumes on the Lexington highway system are found on the rural and urban interstates and arterials. Listed below are some examples of 1992 truck traffic percentages of total average daily traffic (ADT) at selected locations and facility types.

I-75/I-64 - Urban Interstate between Newtown Road (KY 922) and Paris Road (US 27/68), trucks = 9,312 - 21.9% of 42,519 ADT.

New Circle Road (KY 4) - Urban arterial between Leestown Road (KY 421) and Georgetown Road (US 25), trucks = 6,195 - 11.8% of 52,500 ADT.

Paris Pike (US 27/68) - Rural arterial, near the Bourbon County line, trucks = 952 - 8% of 11,900 ADT.

Nearly all truck companies operating in the area do so from a base in the Lexington urban area. A truck terminal usually consists of a dock (the number of bays varies) at which freight is loaded and unloaded. In the Lexington urban area, truck terminals are concentrated in the industrial and wholesale/warehouse zones located primarily in the north. This puts them in close proximity to the interstates and allows ease of access with other regional population centers. Shippers and receivers of goods are concentrated along major arterials in retail, professional service, and commercial zones (e.g., malls, shopping centers, universities, and office parks).

The majority of pickup and delivery truck trips occur during regular business hours. Local and national studies show that Mondays and Fridays tend to be very heavy days in terms of pickups and deliveries.

Through truck trips (without a local destination) are required by Lexington ordinance to use New Circle Road (avoiding the inner urban area) or the interstates to the north. New Circle Road is the only officially designated truck route in the area as it provides access that penetrates or is near all light and heavy industrial zoning in the Lexington urban area and is less than a mile by major arterial away from three interchanges with I-64/I-75.

3-9.4 Rail Systems

Railroads are a vital part of the American transportation system as the primary long-distance goods transportation mode. In 1991, railroads carried 37% of inter-city freight. In 1990, railroads accounted for 46% of long-haul traffic over 500 miles. The Lexington Metropolitan Planning Organization (MPO) planning area is served primarily by two of the nation's busiest railroads: CSX Transportation and Norfolk Southern Corporation, both of which are Class I. In 1992, Class I railroads were those with annual revenues of at least $251.4 million. The major rail lines are shown in Figure 3-2.

CSX

CSX has an extensive rail system east of the Mississippi River. Major commodities originating in or moved through Kentucky are coal, grains, forest products, automobiles, chemicals, paper, building materials, food, and consumer products.

CSX has approximately 23 miles of double tracked, heavy rail, main-line track running east-west (Winchester to Frankfort, Kentucky) through the Lexington-Fayette County area, not including branch lines or spurs which run off of the main line to serve certain Lexington customers. A portion of the main line as well as some branch lines or spurs are located in the Royal Spring recharge area. CSX has a main switching and freight classification yard in central Lexington on Buchanan Street just south of West Main Street, outside the recharge area.

Norfolk Southern Corporation

Norfolk Southern has approximately 30 miles of double tracked, heavy main-line rail running north-south (Georgetown to Danville Kentucky) through the Lexington-Jessamine Metropolitan Planning Area.

The company has switching yards in Lexington and in Nicholasville where goods may be "transloaded" from railcar to truck and vice versa to serve the Metropolitan Planning Area. In central Lexington, the yard is located off South Broadway between DeRoode Street and Angliana Avenue, out of the Royal Spring Recharge Area.

Norfolk Southern has a rail terminal located in Georgetown that has full "intermodal facilities" to transfer double-stacked truck trailers from railcar to truck tractors and vice versa.

Like CSX Railroad, Norfolk Southern carries a wide variety of goods. Some of the major commodities carried include forest products, chemicals (i.e., plastic and asphalt), automobiles, peanuts, liquor, and

steel. The Toyota automobile manufacturing plant located in Georgetown/Scott County is a major customer of the Norfolk Southern Corporation.

On an average day, Norfolk Southern may have as many as 35 to 40 trains travel in, out, or through the Lexington area.

Passenger Rail

Currently, the closest passenger rail stations operated by Amtrak are located approximately 80 miles from Lexington, in Cincinnati, Ohio, and Jeffersonville Indiana and in Maysville, Kentucky. There are no passenger rail systems that transverse the Royal Spring Recharge area.

Section 4. Geologic / Hydrologic Setting

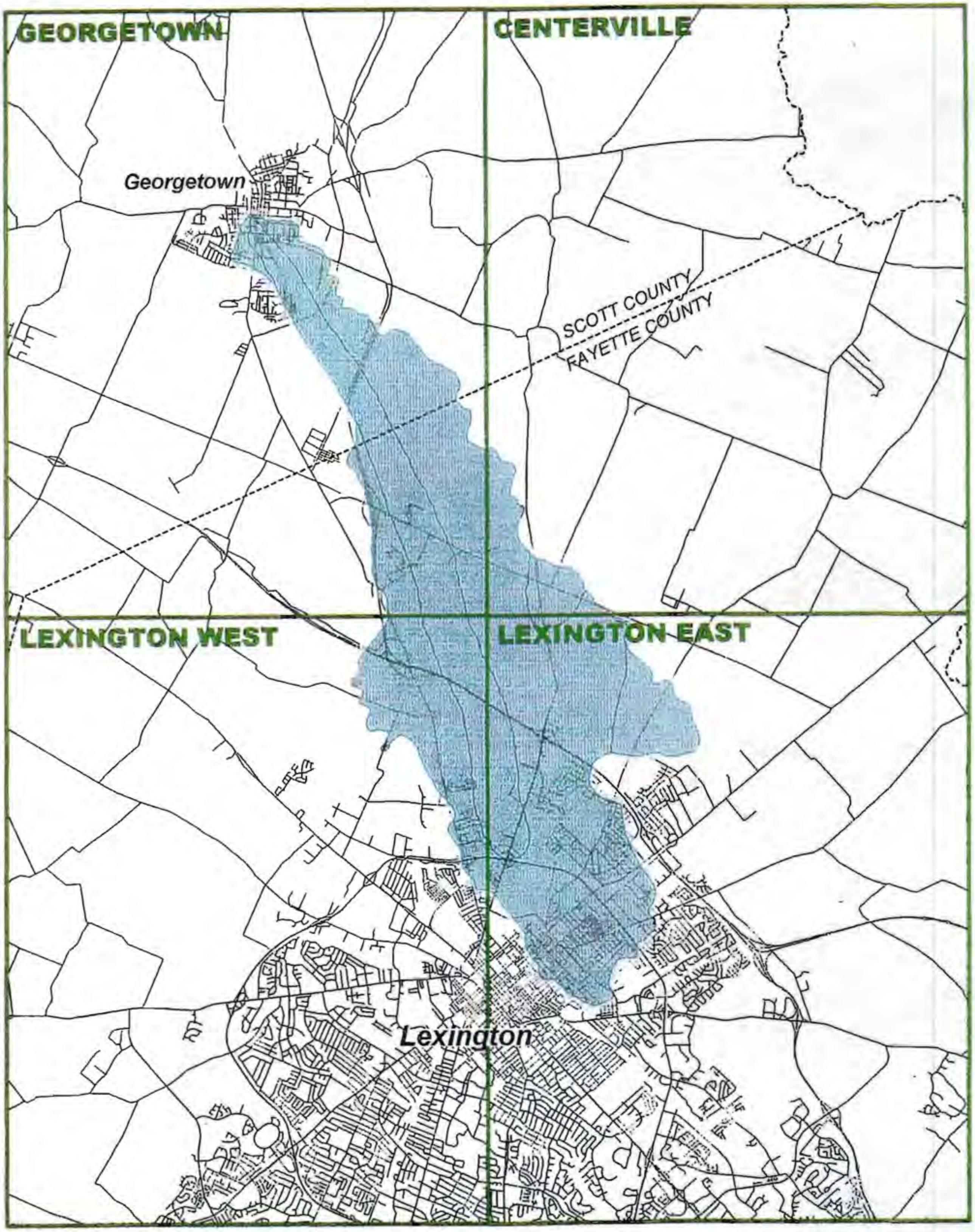
4-1 Location

Georgetown is located in southern Scott County in north central Kentucky, 75 miles east of Louisville and 12 miles north of Lexington in the Inner Bluegrass physiographic region (McFarlan, 1943). The Royal Spring Aquifer Recharge Area is believed to extend from just south of North Elkhorn Creek into the northern part of Fayette County. The entire area is covered by the Lexington East, Lexington West, Georgetown and Centerville 7 ½ minute quadrangles. Figure 4-1 shows the location of the Wellhead Protection Area of the Royal Spring Aquifer within the four quadrangles.

4-2 Previous Studies

There have been numerous hydrogeologic reports written on the Georgetown area. Hamilton (1950) discussed the principles of groundwater occurrence in the Inner Blue Grass region and completed an inventory of wells in Fayette and Scott County. Hendrickson and Krieger (1964) discussed the geochemistry of the groundwater and surface water in the Blue Grass Region. Mull (1986) published a report on the hydrology of Lexington and Fayette County and Faust (1977) discussed the groundwater resources of Lexington, prepared a potentiometric map for the area, and outlined the recharge area of a number of springs and wells, including Royal Spring. Faust believed the yield of wells is related both to topography and stratigraphy. Thrailkill and his students (1982, 1983), defined shallow carbonate aquifer groundwater basins for the Inner Blue Grass Region. Spangler (1982) wrote a thesis on the karst hydrogeology of northern Fayette and southern Scott Counties and Scanlon (1985) determined the chemical characteristics of groundwater in wells and springs in the Inner Bluegrass.

FIGURE 4-1
Map of the U.S.G.S. Quadrangles
that Contain the Wellhead Protection Area



4-3 Geology and Structure

The Inner Bluegrass is underlain by carbonates, siltstone, and shales of middle Ordovician age. The bedrock surface is covered by a thin residual soil and the area has developed mature karst surface features. Within the study area, the Clays Ferry and the Lexington Limestone Formations are exposed at the surface. The Clays Ferry Formation can range up to 100 feet in thickness and is predominately shale, siltstone and interbedded thin limestone. The Lexington Limestone Formation is up to 350 feet in thickness and is dominantly limestone. The study area is covered by four USGS geologic quadrangle maps (Cressman, 1967; Kanizay and Cressman, 1967; MacQuown and Dobrovolney, 1968; and Miller, 1967) and the reader is referred to them for more details on the geology of the region.

Strata in the study area are generally flat lying. The major structural feature in the area is the Cincinnati Arch, which is a broad fold trending north-south from Nashville, Tennessee to Cincinnati, Ohio. The dip of the area bedrock is controlled by the Cincinnati Arch and gently dips 20 to 30 feet/mile to the west and somewhat less northward (Cressman, 1973). There are no major fault systems mapped in the study area but the bedrock in the area has many joints, which appear to decrease with depth. There is a linear trend of sinkholes that exists in the Royal Spring basin that may be related to a joint pattern, but data are not available to verify this.

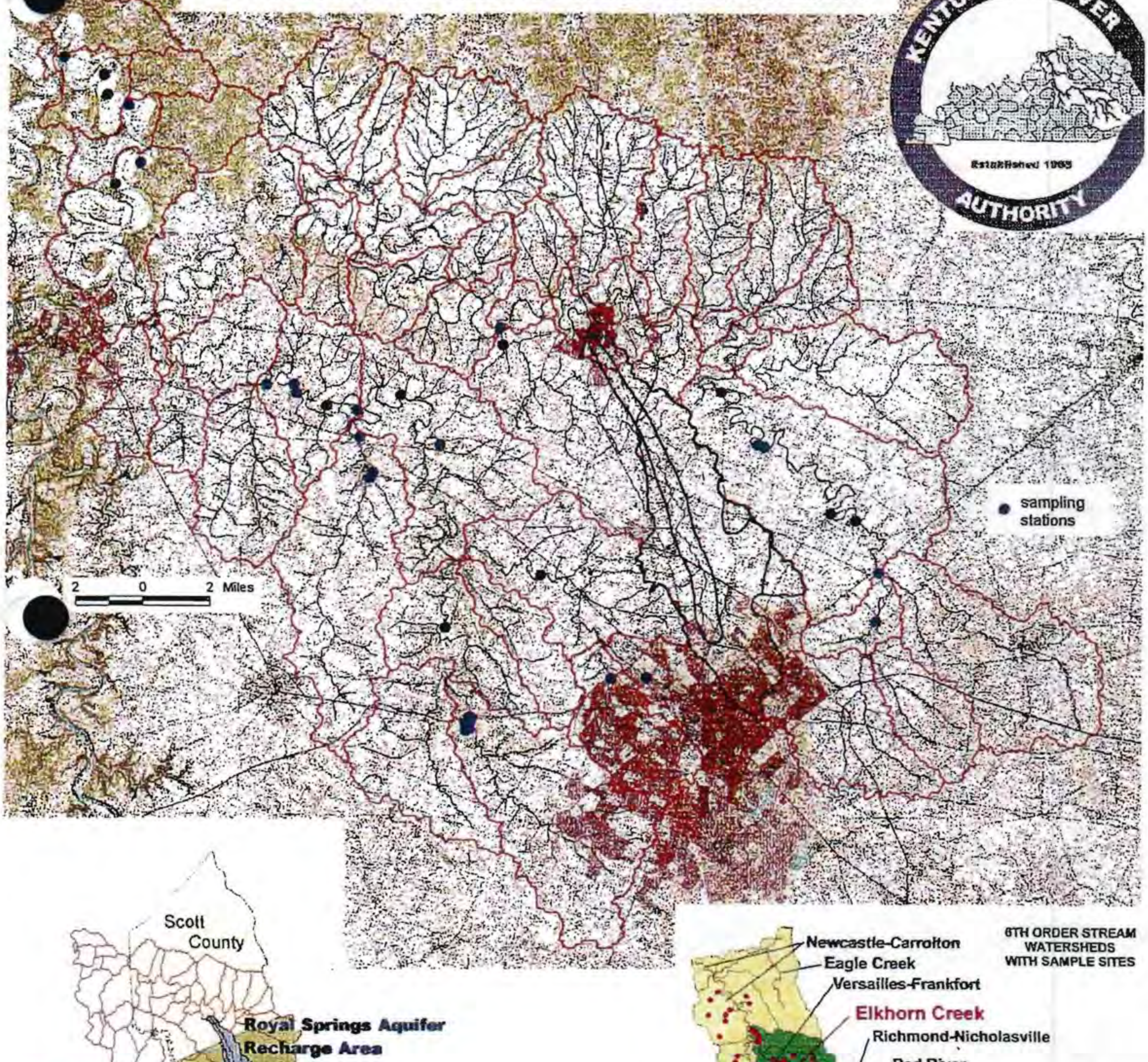
4-4 Topography

The Royal Spring WHPA is dominated by gently rolling karst topography. The maximum relief in the WHPA area is approximately 230 feet. The maximum elevation is in the southern part of the WHPA, in the center of Lexington, at 1030 feet. Royal Spring is located at the northern end of the WHPA at an elevation of approximately 800 feet. The study area is located within the Cane Run watershed illustrated in Figure 4-2 and drains to North Elkhorn Creek. The North Elkhorn flows west to its confluence with the Kentucky River at Frankfort.

Karst topographic features include sinkholes, swallow holes, karst windows, and springs. Surface karst features are numerous within the Royal Spring WHPA. Also found in the WHPA are other

Kentucky River Watershed Watch

FIGURE 4-2
Distribution of Cane Run in the Elkhorn Creek Watershed



Elkhorn Creek Watershed

Sampling Sites - 35
Teams - 17
Stream Distance
Assessed - Approx. 3,300 meters
Mean Total Habitat Assessment - 133
Mean Dissolved Oxygen - 11.1
Mean pH - 8.15

Sources:
B.A. Higgins, 1997, Kentucky River Authority, and
Division of Planning, L.F.U.C.G., 1998

Karst landforms such as blind valleys and pocket valleys, which are a result of deep circulating water and often indicate the presence of groundwater basins as defined by Thrailkill (1982).

4-5 Royal Spring shallow aquifer

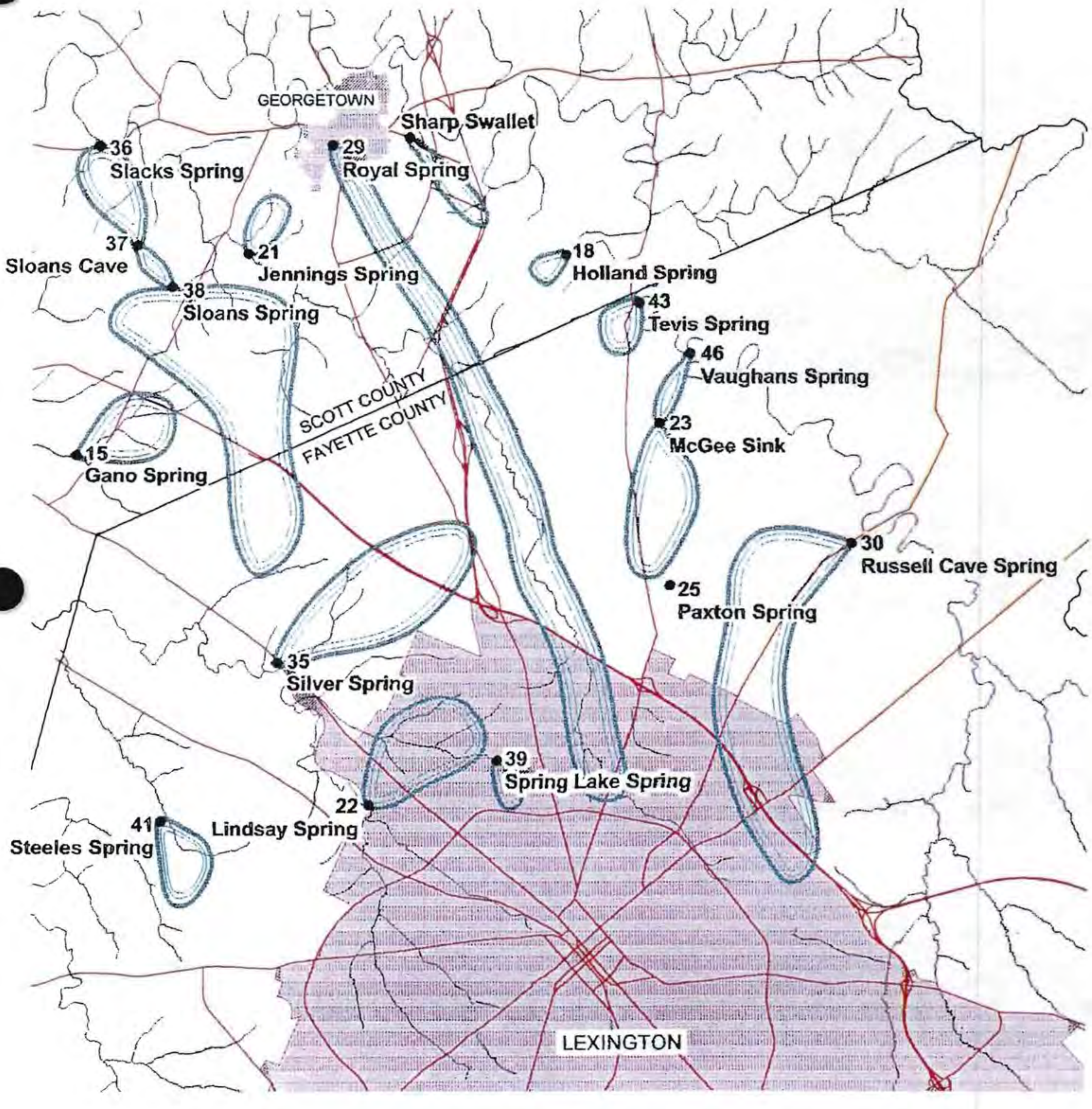
4-5.1 Groundwater Occurrence

Groundwater basins (karst aquifers) in the study area are produced by the dissolution of carbonate rock that forms dendritic conduit systems that discharge at a spring. The most important carbonate unit in the area is the Lexington Limestone, which has developed into a shallow unconfined aquifer, less than 100 feet deep (Matson, 1909; Hamilton, 1948, 1950; Mull, 1968; Thrailkill et al.,1982). The two predominant karst forming rock units within the Lexington Limestone are the Tanglewood and Grier members. Both of these units are relatively soluble and allow water to move through bedding planes and joints in the rock. Solution of the bedrock allows numerous conduits of varying sizes to form in the Lexington Limestone. Royal Spring discharges from the Grier Member of the Lexington Limestone. Both the surface water (the Cane Run Basin) and groundwater (the Royal Spring groundwater basin) contribute recharge to Royal Spring, (Thrailkill, 1982 and Spangler, 1982). Topographic maps have been used to estimate the surface recharge area to Royal Spring (Thrailkill, 1982).

4-5.2 Groundwater Flow

Groundwater flow in the Georgetown area is controlled by the topography and general characteristics of groundwater basins associated with karst (Hamilton, 1948; Thrailkill et al., 1982). Groundwater basins have a dendritic flow pattern and flow within these groundwater basins may cross beneath the surface divides. Mull felt that the regional dip of the area, in the form of the Cincinnati Arch, possibly directs the flow of the groundwater movement. Surface drainage and shallow interbasin drainage seem to flow down-dip away from the city of Lexington in a northwest direction towards Georgetown. The overall direction of the Royal Spring groundwater basin is parallel to the regional dip. Figure 4-3 shows the relationship of the smaller groundwater basins in the aquifer recharge area of Royal Spring. Thrailkill (1982) believes that a linear pattern of sinkholes in the Royal Spring basin is the result of an unmapped fault or joint system. This linear structural feature aids in the movement of the groundwater in the northwest direction. Thrailkill (1989) indicated that not all of the water that enters the

FIGURE 4-3
Relationship of Groundwater Basins in the Royal Spring Aquifer Recharge Area



Adapted from John Thrailkill, "Groundwater in the Inner Bluegrass Karst Region, Kentucky."

conduit system discharges at Royal Spring. He suggested that as much as 65% of the flow could be diverted to another discharge point and not be measured in Royal Spring.

4-5.3 Groundwater Uses

Groundwater provides water for the public water system in Georgetown, Royal Spring, and for private wells and springs in the WHPA as well. Royal Spring pumps about 2 million gallons a day to service approximately 16,000 people (Marvin Hedges, personal communication). A groundwater survey of 1,700 property owners in Fayette County, conducted by the University of Kentucky in 1988, identified approximately 70 wells, with 31 located in the Royal Spring WHPA (Fickel et. al., 1989). The distribution of wells compiled from this survey is shown in Figure 4-4.

The sensitivity to pumping and withdrawal of groundwater in the Royal Spring groundwater basin was demonstrated during the drought of 1988, when a well located in the Royal Spring WHPA in Fayette County significantly impacted the flow at Royal Spring. Flow at Royal Spring was diminished to the point that the spring could not supply the public water supply system.

The Division of Water in Frankfort maintains records of all wells constructed since 1986. Prior to 1986 accurate records of wells drilled were not kept. This was noted by Hamilton (1950) and he concluded at that time that there was no way of obtaining all the information on drilled wells that were either successful in yielding water or dry wells. Local drillers informed Hamilton that the general success of locating producing wells at that time was no more than one out of every five wells drilled.

4-5.4 Ease of pollution

Because there is a direct connection between surface water and groundwater in karst aquifers they are particularly vulnerable to pollution of ground water. Much of the surface water in the study area is diverted through sinkholes, swallets, and drainage wells into the Royal Spring groundwater basin. Figures 4-5 and 4-5-A show the location of identified sinkholes in Fayette and Scott County. These features are the main paths for surface water and possible contamination to enter the groundwater system. The water can rapidly enter these conduits and be discharged within hours or days to the springs. Recharge through infiltration from the soil to

FIGURE 4-4

University of Kentucky Department of Geological Sciences
Generalized Survey of Water Wells in Fayette County (1989)

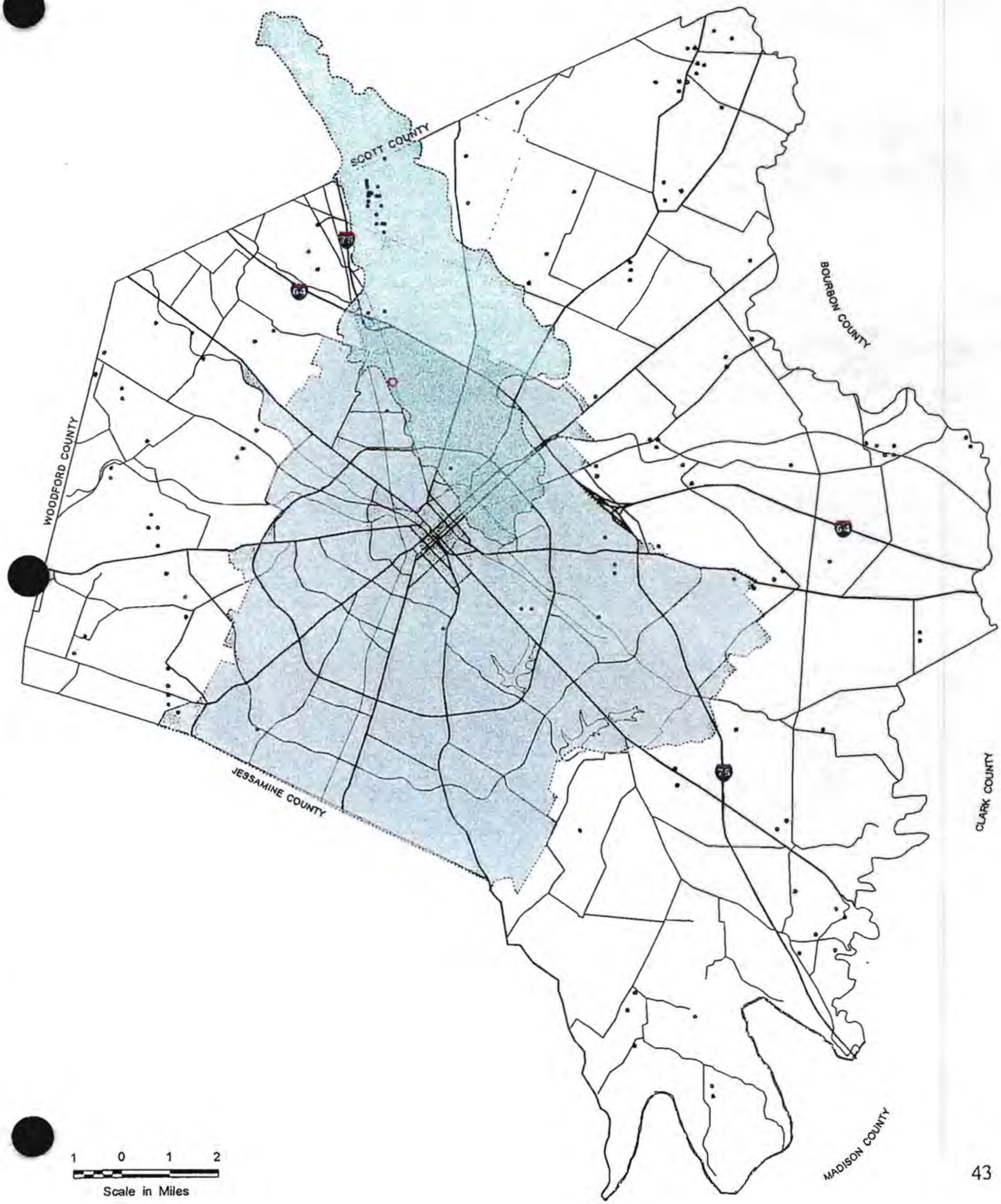
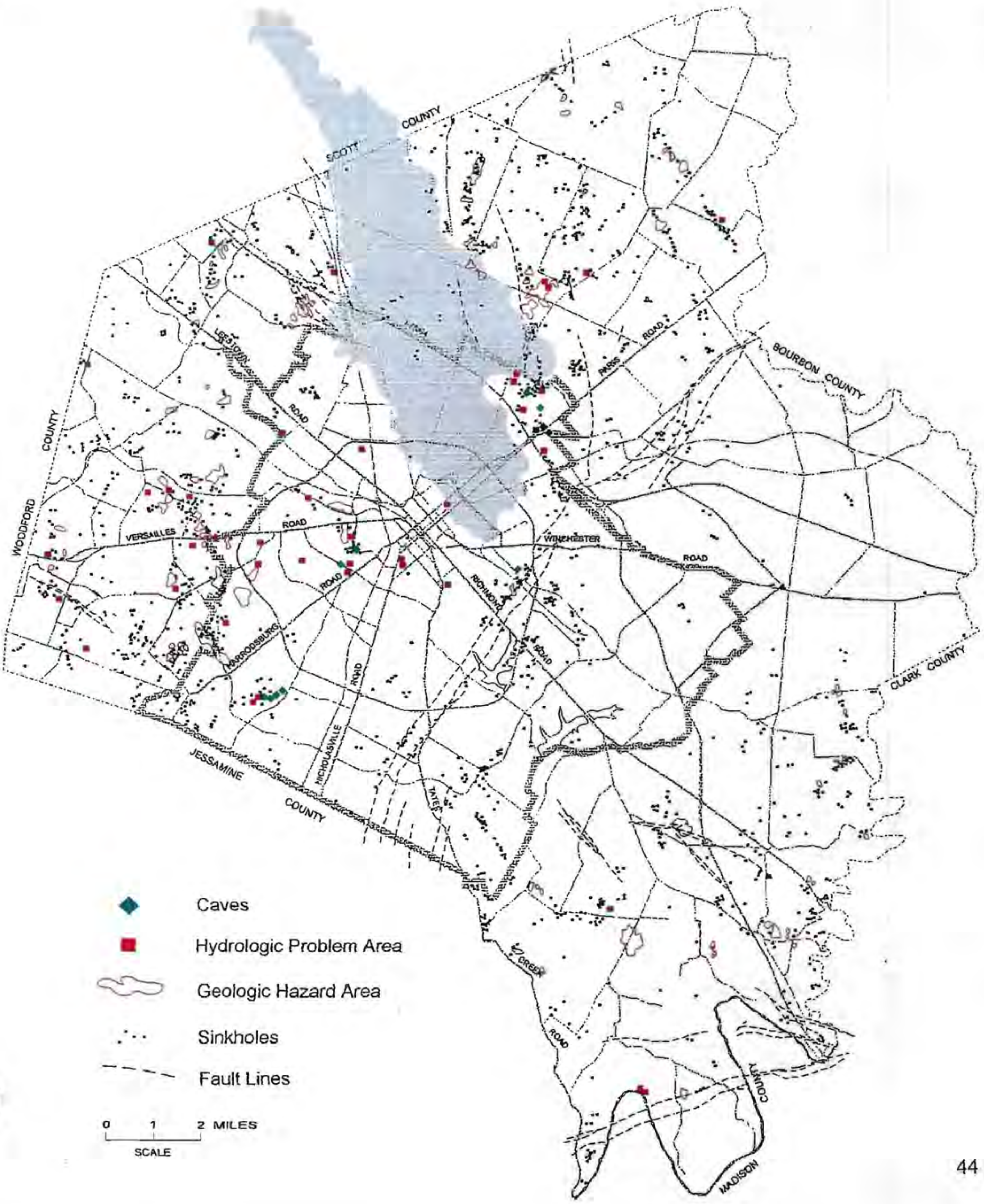


FIGURE 4-5
Generalized Map of Fayette County Sinkholes



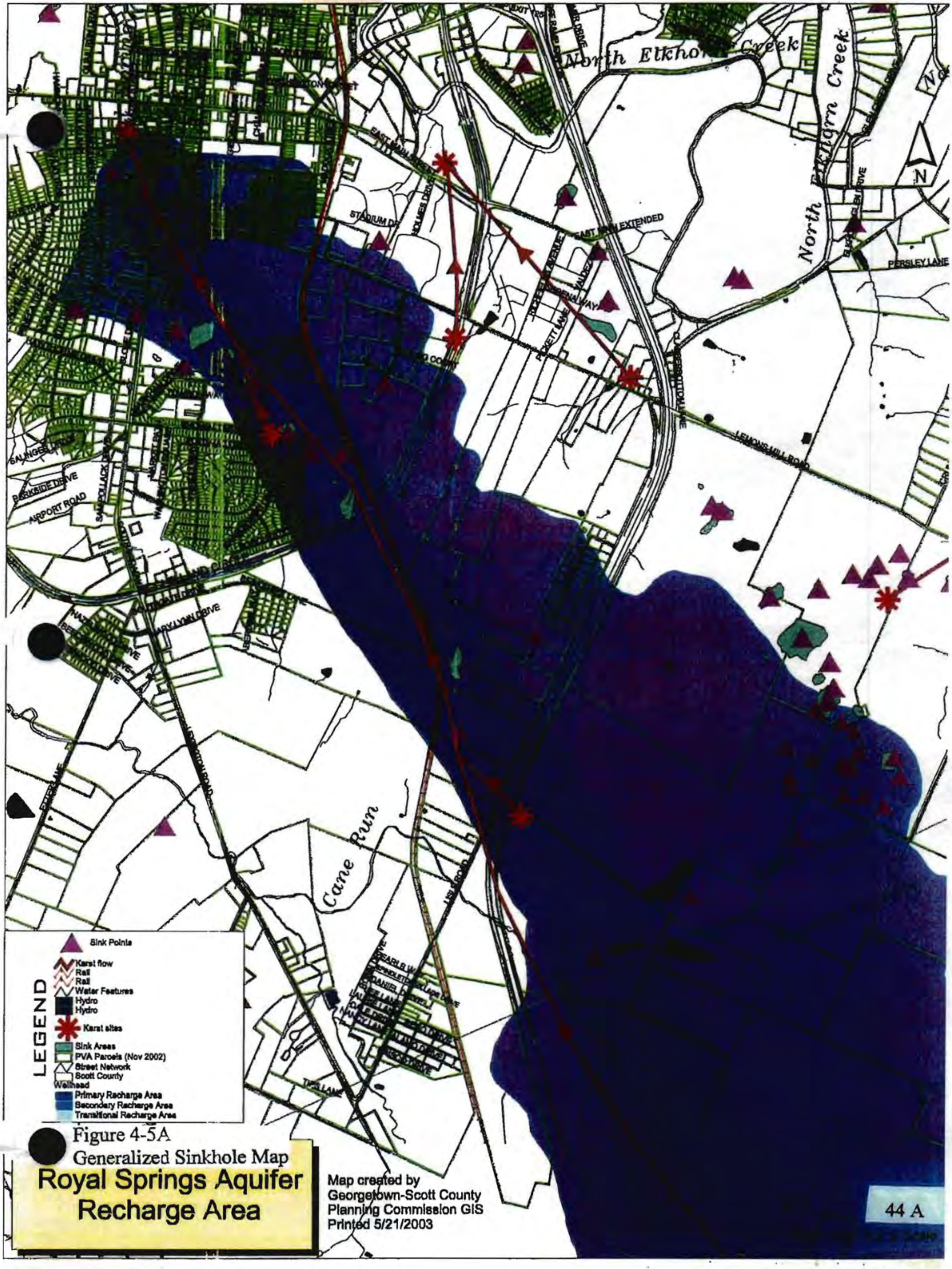


Figure 4-5A

Generalized Sinkhole Map

Royal Springs Aquifer Recharge Area

Map created by
Georgetown-Scott County
Planning Commission GIS
Printed 5/21/2003

conduits also occurs (Thrailkill et al.,1982).

The upper portion of Cane Run drains an urbanized part of Lexington, Kentucky. Urbanization has the two-fold effect of increasing runoff and degrading water quality. Urbanized areas can create excess storm runoff into Cane Run due to the presence of impermeable construction such as pavements and roofs. Storm runoff from the urbanized area collects in the head waters of Cane Run. Some of the water in Cane Run is diverted into a series of swallets that act as recharge points for the shallow aquifer and the remainder of the water flows on the surface out of the WHPA.

A contaminant can rapidly be transported with water through solution channels with limited attenuation processes other than dilution. The dilution mechanism can greatly reduce the concentration of the contaminant under high flow conditions by mixing with large quantities of water. The amount of contaminant that can absorb on clay and organic particles within the conduits is minimal (Thrailkill et al., 1982).

4-5.5 Time of Travel

Time of travel has been determined in the Royal Springs WHPA from dye tests conducted by Thrailkill and his students (Thrailkill et. al., 1982). The time of travel ranged from 0.8 hours to 141 hours. The velocities calculated from these data ranged from 0.14 to 3.6 meters per second. As it can be seen, the travel times for underground water flow is very short. The sinks and swallets identified in the Thrailkill studies are very critical to wellhead protection. Based on the time of travel from dye traces between numerous swallets and Royal Spring, two protection zones have been identified for the Royal Spring WHPA. These areas have been identified as Zone 1 and 2. Zone 1 represents the highest priority protection zone in the WHPA. Zone 2 represents the remaining area that is connected to the conduit system by surface streams or by less fractured rocks within the groundwater and inter-basin areas. The travel times in this area will have variable flow rates but are greater than those from Zone 1. The Zone 1 area has been studied rather extensively, but other sinks or swallets that have not yet been linked to the spring by dye tracing may also exist.

4-6 Wellhead Protection Area Delineation

Hydrogeologic mapping was chosen as the delineation method for Royal Spring. Surface and groundwater are interconnected through the karst features found in the area and Cane Run Creek. The drainage divides of the surface basin of Cane Run Creek was determined from topographic maps and the associated groundwater basins defined by dye tracing conducted by Thrailkill, Spangler and Throester (1982). Because a portion of the Cane Run drainage basin lies outside the Royal Spring groundwater basin, the impact of flooding can cause water to back up into the groundwater basin. For this reason, the 100-year flood plain map was used to check boundaries and determine the impact of a flood of this intensity on Royal Spring and was used to reinforce the selection of the WHPA boundary. The Russell Cave Spring groundwater basin underlies a portion of the Cane Run surface drainage basin. All surface flow to these sinkholes is considered to be a part of that groundwater basin and was therefore removed from the Royal Spring WHPA. This caused the indentation in the WHPA in the southeast end of the WHPA (Area III in Figure 3-1). Even under high flow conditions, up to at least the intensity of the 100-year flood, sinkholes and swallets will drain surface runoff in this area. This surface/groundwater flow will enter directly into the Russell Cave Spring groundwater basin and can cause no recharge or threat to Royal Spring.

A DRASTIC evaluation was completed for the Inner Bluegrass Karst Region, which included the entire Royal Spring WHPA. Couch (1988) concluded from this study that DRASTIC might not be suitable for areas where the aquifer is not well defined. Couch also claims that the aquifer had to be treated as a continuous body, when it has clearly been demonstrated that shallow conduits are discontinuous in many places, and therefore the DRASTIC Index Map most likely overestimated the development of the aquifer.

The delineation of the WHPA boundary for the Royal Spring water supply represents the importance of dye trace information. Without the work of Dr. John Thrailkill and his students at the Department of Geological Sciences, University of Kentucky, the degree of accuracy achieved in locating the boundary would not have been possible.

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Section 5. Potential for Groundwater Contamination

Protection of the present water supply will require planning and control of important swallets and sinkholes that provide direct connection with Royal Spring. A detailed study should be made of the WHPA so that all input points can be located and categorized relative to pollution potential. The fact that the WHPA for Royal Spring occurs in two counties will make the development of protection strategies more difficult. An added problem is that the upper end of the WHPA occurs in an area that will probably experience significant business development because of the location of interstate highway 75.

To effectively protect this aquifer, it is crucial that residents in the recharge area recognize the impacts that their individual actions may have on the quality of water in Royal Spring. An historical problem has been the practice of disposing of agricultural waste and domestic garbage in sinkholes. By local and state laws this is now an illegal practice. Information has and will continue to be dispersed to landowners in the recharge area concerning their impact on water quality. The Scott County Conservation District granted the Royal Spring Water Supply Protection Committee $2,000 for water quality educational material to schools in the area. Other material is scheduled to be distributed concerning the protection of the water supply in Royal Spring.

There are several federal, state, and local programs available to landowners to address natural resource issues and problems in the area. Landowners within the Scott County portion of the recharge area have the opportunity for cost assistance in cleaning up sinkhole dumps. The Scott County Fiscal Court has allocated funds through the Solid Waste Division and the Scott County Conservation District to address this problem (see section 5-12).

5.1 Sinkholes and Streams

Development in any sinkhole area presents a potential for groundwater contamination because the sinkhole serves as a window into the aquifer recharge system. An ordinance that may be used as a model by Scott County for protecting karst aquifers is already in effect in Fayette County Kentucky, which has been a leader in the recognition of the potential for groundwater pollution through sinkhole openings found in the bedrock. In 1985 the Lexington Fayette Urban County

Government developed a comprehensive sinkhole regulation to address the problems of development in sinkhole areas. The regulation deals with two elements. The potential for ground water pollution and the long-term stability of sinkholes filled during development. Any development plan submitted in Fayette County has a review of the geologic conditions specifically looking for sinkholes. The entire county has been mapped at two different scales of mapping. The rural area is mapped at four-hundred foot scale with a ten foot contour interval, while the urban areas have been mapped at two hundred scale with a five foot intervals. Soil maps showing detailed soils also exist at both scales for the entire county. The combination of these two types of maps gives a very detailed picture of sinkhole locations.

In areas of urban development, in Fayette County, all sinkholes are required to be free of debris before development can start. Any filling of sinkholes has to have an approved plan submitted to the LFUCG Division of Engineering and the LFUCG Division of Planning. The LFUCG Division of Environmental and Emergency Management also has developed regulations for any hazardous materials storage areas in close proximity to sinkhole areas.

In Scott County, standard U.S.G.S. topographic maps and soil maps from the U.S. department of Agriculture, Natural Resources Conservation Service are used for sinkhole determination.

In addition to development, a significant potential threat to the groundwater system is found along the major and minor roads including Ironworks Pike, Russell Cave Road and Newtown Pike. Fifty-five of the mapped sinkholes in Figure 4-5 are located in the transportation corridor within the recharge area. Many of the mapped sinkholes are immediate and adjacent to state routes, and in some locations, the roadway bisects some of the sinkholes. A spill in these areas has the potential to result in direct groundwater pollution. Interstate I-64 & I-75 cross the Royal Spring Aquifer from mile marker 114 to mile marker 122. Sinkholes located along the interstate highway system are generally removed from the roadway. It is anticipated that any spill of material being transported on the Interstate would not have enough volume or flow capability to reach a sinkhole unless an accident occurred during a major storm event, or, in the case of a fire large volumes of water were used for fire control.

The interstate highway system also have potential for introducing contamination to the surface waters of Cane Run Creek that flows under the interstate at mile marker 116.2. Cane Run discharges directly into a series of sinkholes in the stream channel and this is the major recharge tributary of the Royal Spring Aquifer. Discharge from streams into sinkholes is not noticeable in times of seasonal high flow, as the water table is high, but in times of low flow during the summer months, the entire stream flow is discharged directly underground. During summer, no surface flow of the stream is evident for a significant portion of the stream. The Cane Run tributary is an example of stream disappearance in low flow conditions.

Four major rural arterials in the recharge area also have potential for direct groundwater access. These are found along Georgetown Road, Iron Works Pike and Russell Cave Road and Paris Pike. The locations of sinkholes and surface streams relative to the transportation routes are shown in Figures 5-1 and 5-1-A. A detailed sinkhole location map and property identification of sinkhole ownership in Fayette County is found in Appendix 5-1.

Hazardous transportation incidents, either rail or vehicular, present a problem that can be minimized with proper planning and emergency response. Both Scott County and Fayette County have emergency response teams that have been active players in the development of this plan. The Cane Run watershed has been delineated and surface features such as storm drainage outfalls and sinkholes have been mapped. A corridor advisory plan has been devised to make persons traveling the corridors aware of the watershed protection area.

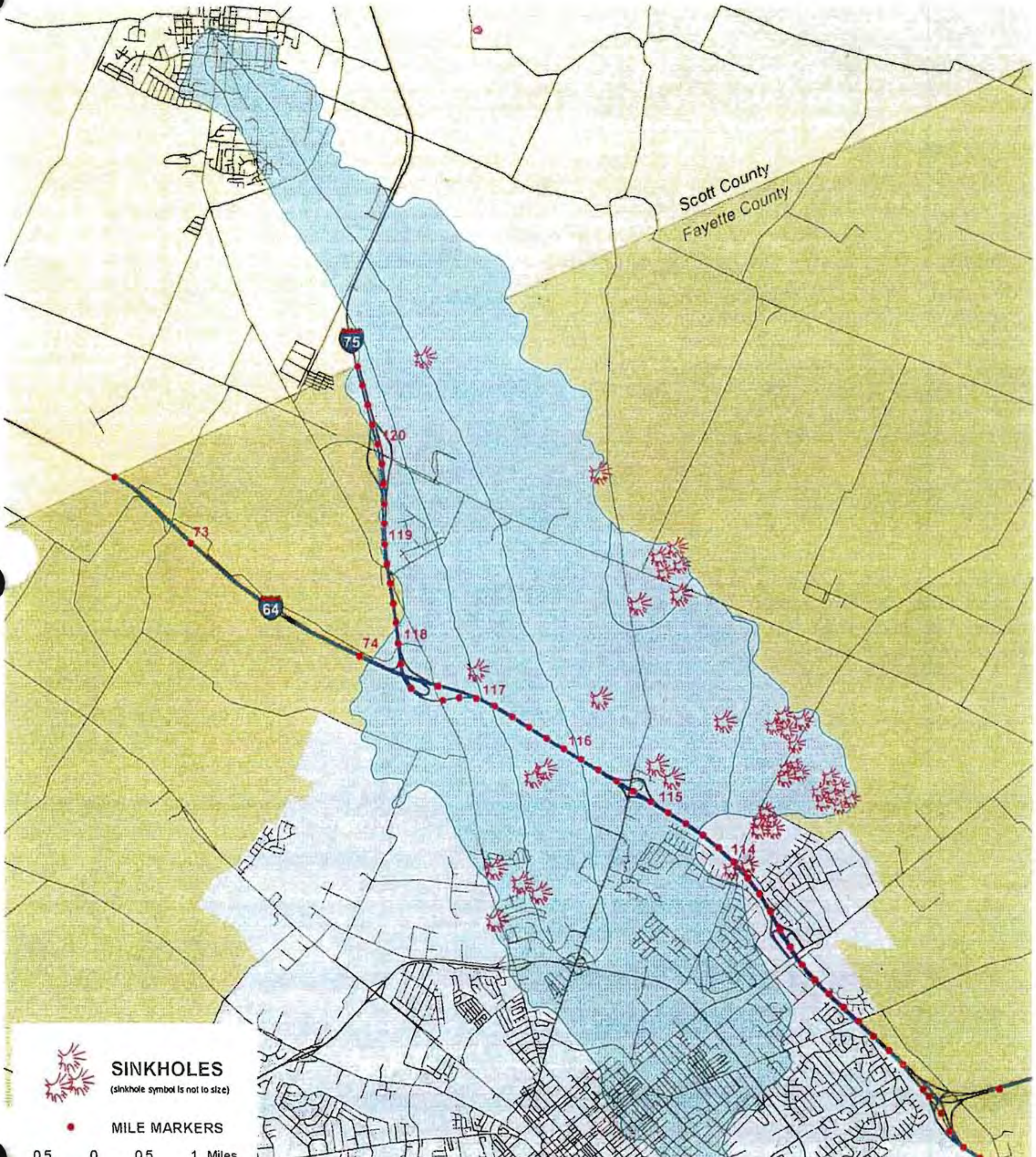
5-2 Land Use & Contamination Potential

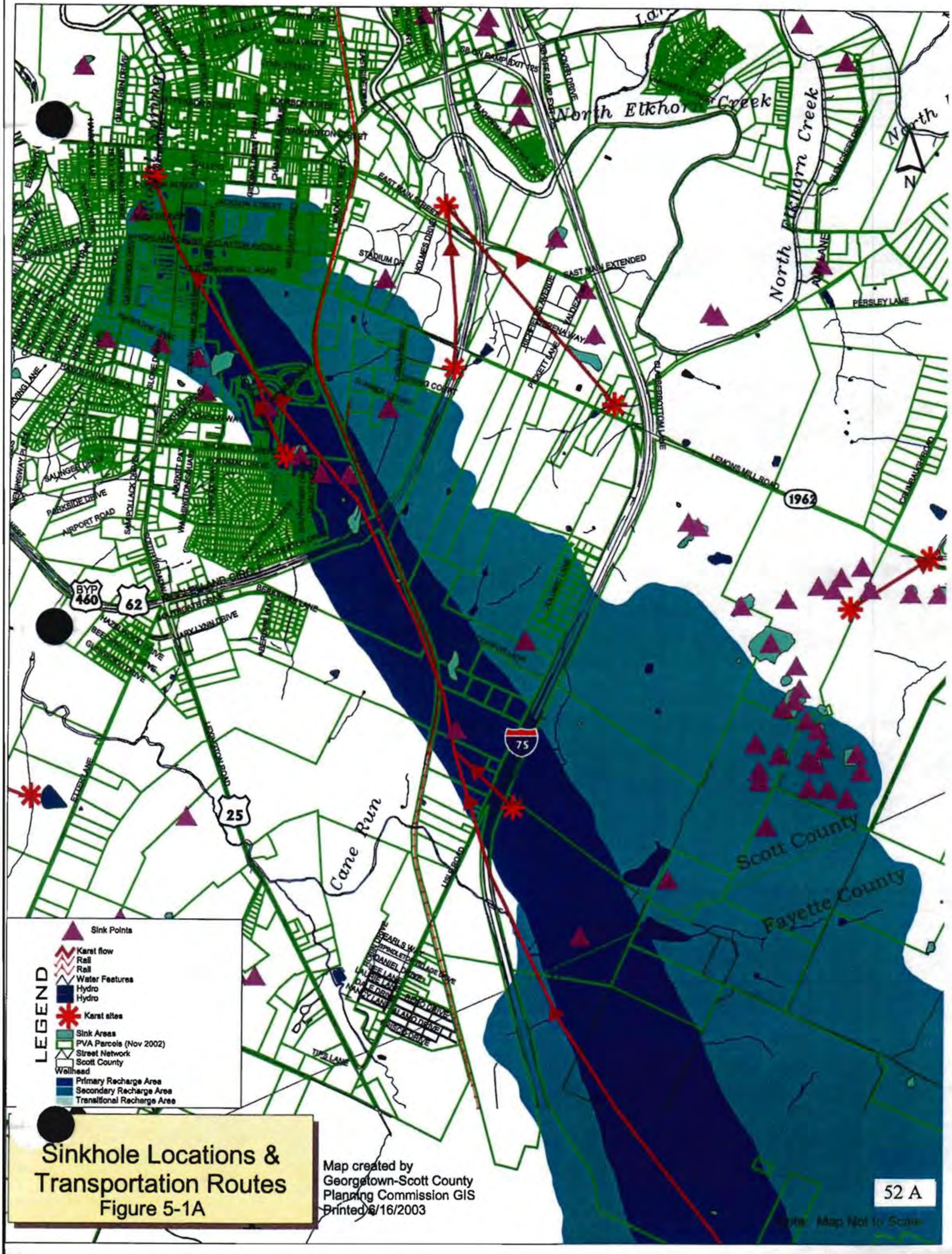
The Royal Spring Water Supply Protection Committee has spent a considerable amount of time delineating the aquifer recharge boundary and identifying land use in the recharge area.

Recognizing the potential for pollution presented by various types of land use provides an opportunity to better plan for watershed protection. Following are major categories of land use and potential sources of contamination.

Agricultural Use
Animal burial areas
Animal feed lots

FIGURE 5-1
Sinkhole Locations and Transportation Routes





Sinkhole Locations & Transportation Routes
Figure 5-1A

Map created by
Georgetown-Scott County
Planning Commission GIS
Printed 6/16/2003

Note: Map Not to Scale

Fertilizer storage/use
Irrigation sites
Manure spreading areas/pits

Pesticide use/storage
Sinkhole refuse dumping
Fuel storage & use

Commercial
Airports
Auto repair shops
Boatyards
Construction areas
Car washes
Cemeteries
Dry cleaners
Gas stations
Golf courses
Jewelry/metal plating
Laundromats
Medical institutions
Nurseries and lawn care
Paint shops
Photography establishments
Railroad tracks and yards
Research laboratories
Scrap and junkyards
Storage tanks

Industrial
Asphalt plants
Chemical manufacturing/storage
Electronics manufacture
Electroplaters
Foundries/metal fabricators
Machine/metalworking shops
Mining and metal drainage
Papermills
Petroleum production/storage
Pipelines
Septic lagoons and sludge
Storage tanks
Toxic and hazardous spills
Wells (operating & abandoned)
Wood preserving facilities

Residential
Fuel oil
Household hazardous products
Lawns care
Septic systems, straight pipes, cesspools
Sewer lines (broken)

Other
Hazardous waste landfill
Municipal incinerators
Municipal landfills
Open burning sites
Recycling/ reduction facilities
Road deicing operations
Road maintenance depots
Storm water drains & basins
Transfer stations.

Contaminants are delivered to the aquifer via either a point source or a non point source. A point source is a direct discharge such as a sewer pipe. Point sources are permitted through the Kentucky Division of Water and are regulated through the KPDES permit system. Unregulated point sources may exist when pipes leak or rupture. A non-point source does not have a direct point of discharge and includes sources such as runoff from a field, a road or golf course especially during and after a storm event. In a karst area, non-point sources are extremely important due to the fact that sinkholes provide direct access to the ground water.

The following are examples of point and non-point sources:

a. Point Source Delivery

- On-site septic or lagoon treatment systems
- Leaky tanks or pipelines containing petroleum products
- Leaks or spills of industrial chemicals at manufacturing facilities
- Underground injection of industrial wastes
- Municipal landfills
- Leaky sewer lines
- Chemicals used at wood preservation or wood reduction facilities
- Mining related activities
- Cemeteries
- Road salt storage areas
- Wells for the disposal of liquid wastes

- Spills related to highway or railway accidents
- Asphalt production and equipment cleaning sites

b. Non-point Source Delivery

- Fertilizer use on agricultural and residential lands and golf courses
- Pesticides use on agricultural and lands, golf courses and woodland areas
- Contaminants in rain runoff, and snow melt from a "first flush effect" on impervious areas
- Sludge disposal (land spreading sludge)
- Runoff of salt and debris from roads and highways

5-3 Royal Spring Aquifer Land Use and Materials Inventory

In the fall of 1996, a large-scale effort was initiated by the Wellhead Protection Committee to inventory the potential contamination sites in the Royal Spring Aquifer. Application for a Federal Government program grant was made through the Kentucky Division of Water to enlist twelve volunteer members of the Americorps National Civilian Community Corps for a month. The inventory was initiated by means of a questionnaire (see Appendix 5-2). Questionnaires were mailed to more than 2,200 residents and property owners located in the aquifer recharge area in both Fayette and Scott counties. The purpose of the questionnaire and letter was twofold. One was to notify and educate each person about the karst nature of the wellhead protection area and the susceptibility of the groundwater to contamination. The second was to solicit information about specific materials and installations on the property that might be a source of potential contaminants. The questionnaires were distributed prior to the arrival of the Americorps volunteers.

The role of the Americorps Volunteers was to follow up on any questionnaires not returned or for which there were questions, and to map out potential contaminant sites. In order to do this a strategic operations center for the processing of information was set up. Detailed maps for the area were prepared using large scale topographic and street maps along with aerial photographs. Questionnaire responses were located on the maps and telephone surveys undertaken to fill in the information. In some cases site visits were made. Completing information for the Primary Recharge Area (Area 1 on Figure 1-1) was the first priority. As Area I was mapped, complete information was mapped for the area at increasing distance from the primary Recharge Area. The area was increased out away from the core area.

The responses below reflect information received form thirty three percent of the landowners or residents in the recharge area.

Respondents to the survey were classified on a percentage basis:

- Residential – 50%
- Commercial – 23%
- Agriculture –10%
- Other – 10%
- Industrial- 5%
- Government – 2%

Survey sites that reported gasoline/fuels fell within these storage categories

- Residential – 0 gallons
- Commercial – 5 or more gallons
- Agricultural – 50 or more gallons
- Industrial – less than 5 gallons
- Other – 500 or more gallons

More than 500 gallons of gasoline were stored on site by 29 out of 727 respondents. Over half of these (16 out of 29 surveyed) indicated that they had groundwater protection plans. The other 13 had no groundwater protection plan. In reviewing the entire range of responses it was found that the following petroleum products were stored at various sites throughout the aquifer:

Petroleum Products

- *Solvents – 6,265 gallons*
- *Gasoline/fuels – 21,500 gallons*
- *Diesel/heating oil – 4,740 gallons*
- *Oil/grease/lubricants – 10,810 gallons.*

Other non-petroleum products were located in the aquifer. The survey found 36 responses out of 727 locations had storage tanks. Of these only 10 had groundwater protection plans. The remaining 26 locations had no plan.

Survey sites reported paints/dyes/stains fell within these storage categories

- Residential – 0 gallons
- Commercial – less than 5
- Agricultural – zero gallons
- Industrial – less than 5 gallons
- Other – over 500 gallons

Other useful information that was ascertained about site locations that will be helpful in the prevention of groundwater contamination are:

Responses of importance

- Sinkholes –2%
- Wells – 4%
- Septic Systems – 26%
- Floor drains – 4%
- Acids – 25%
- Oil/water separators – 3%
- Used antifreeze – 9 %
- Fertilizers – 10%
- Insecticides - <1%
- Solvents- <2%

Property owners indicated that approximately 20 sinkholes existed at various sites in the aquifer area. (the actual mapping of sinkholes in the aquifer recharge area indicated that 55 sinkholes are present if Fayette County). Review of soil maps and topographic maps in Scott County indicates approximately 33 more sinkholes have been mapped. These areas are shown in Figure 4-5-A. One property owner responded that he had a sinkhole and an underground storage tank with over 500 gallons of fuel with no groundwater protection plan. The following breakdown of the 727 properties that responded to the questionnaire about groundwater protection plans are:

Sites with Groundwater Protection Plans

- Commercial – 45 %
- Agricultural –23%
- Residential – 16 %
- Industrial – 11%
- Other - 4%
- Government – 1%

The notification and response of the property owners / business, commercial, and residential residents has been deemed a success in this phase of the protection of the Royal Spring Aquifer. A lot of information was generated about the aquifer and every parcel of land was notified of the importance to have groundwater protection plans and to be careful in everyday habits. Many of the people had no idea that the area was sensitive to pollution accidents.

5-4 Public Meeting on Wellhead Protection

As part of the process for developing a wellhead protection plan, a public meeting was held at the Kentucky Horse Park in May 1998. This meeting provided an opportunity for the public to identify any potential threats to the aquifer perceived by the public and to provide input to the planning process. The location for the meeting was very appropriate in that the Horse Park is located entirely in the aquifer. Extensive notification for this meeting was made to both counties and public officials as well as public notification to both communities, and was well received. Minutes from the meeting are found in Appendix 5-3.

5-5 Existing records

The wealth of information on file with the Fayette County Division of Emergency and Environmental management, the Georgetown/Scott County Emergency Management Agency and the various state agencies combined with the 1996 survey of property owners in the wellhead protection area provides an understanding of current conditions and problems in the aquifer and watershed of Cane Run useful for planning and in reviewing future development in the aquifer. The Wellhead Protection Committee will investigate each project as to location in the aquifer area, the land use and the types of activities planned to identify land management practices to protect the environment and prevent pollution of the groundwater. Significant changes in existing urban and rural land use will be monitored to identify the need for different methods of protection.

Existing records maintained by the Division of Environmental and Emergency Management and the Lexington Fayette Urban County Fire Department for hazardous incident planning and response identified locations of potential contamination sources. These are shown in the following figures:

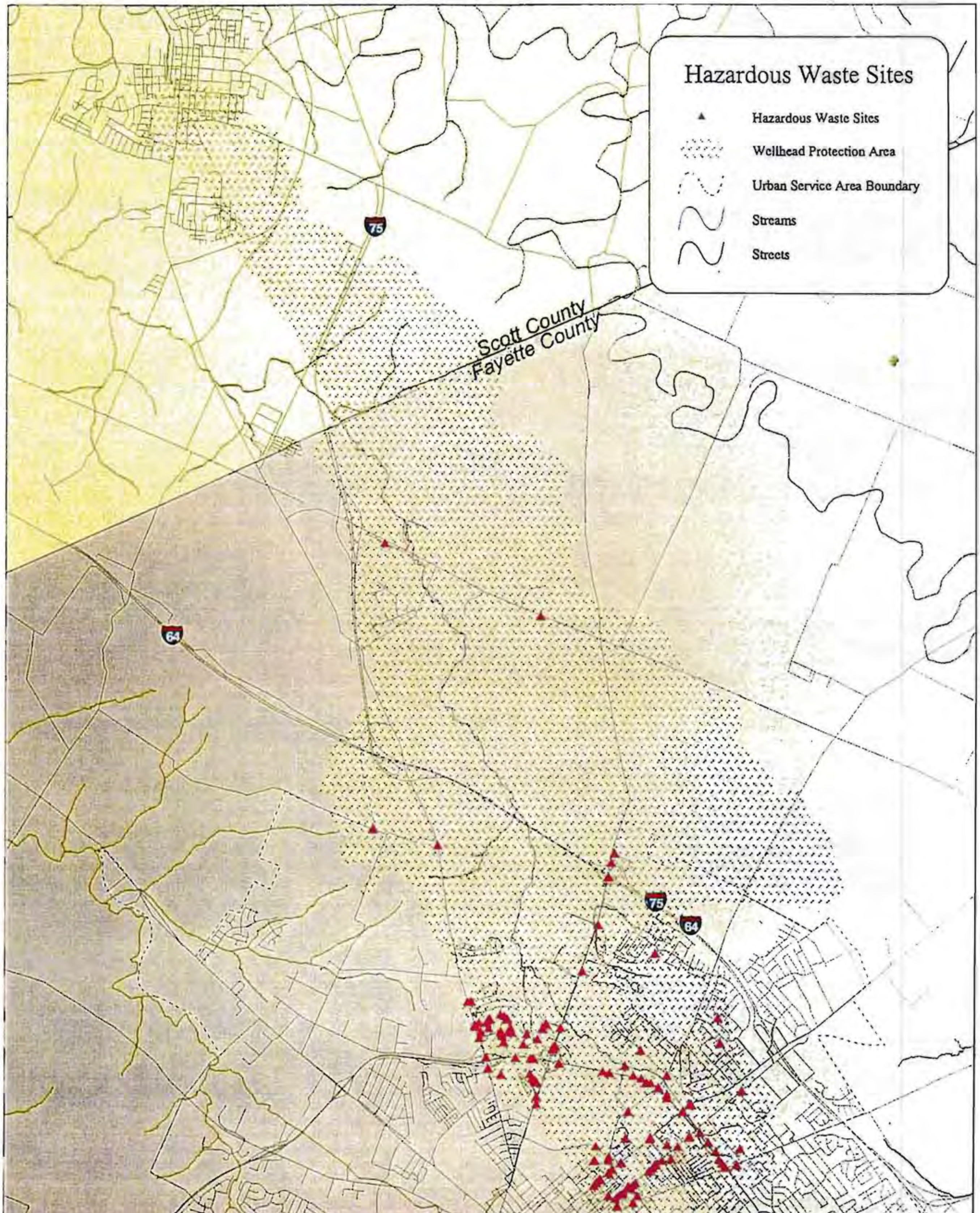
- Figure 5-2 & 5-2-A Hazardous Waste Generator Sites
- Figure 5-3 & 5-3-A Permitted KPDES Sites
- Figure 5-4 & 5-4-A Stormwater Hazards
- Figure 5-5 & 5-5-A Underground Storage Tanks
- Figure 5-6 & 5-6-A Hazardous Materials Storage Facilities

The actual site locations may be found in Appendix 5-4 to 5-5

- **Hazardous waste generators**

Review of records on file with the Cabinet for Natural Resources and Environmental Protection show there are approximately 522 facilities in Fayette County registered on the Resource Conservation and Recovery Act (RCRA) notifier's list. Approximately 299 of these facilities are

FIGURE 5-2 Hazardous Waste Generators



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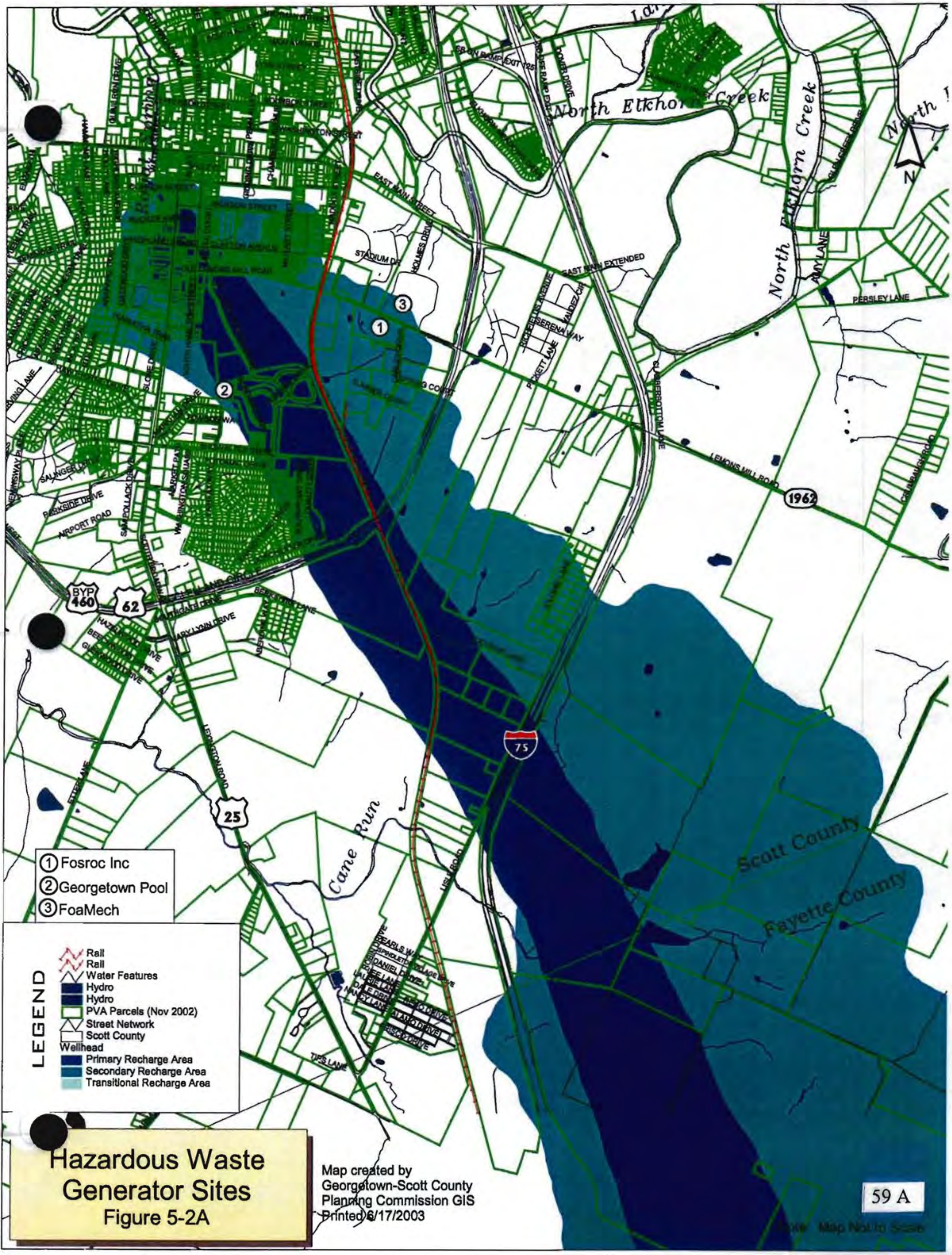

Hazardous Waste Generator Sites

Figure 5-2A

Map created by
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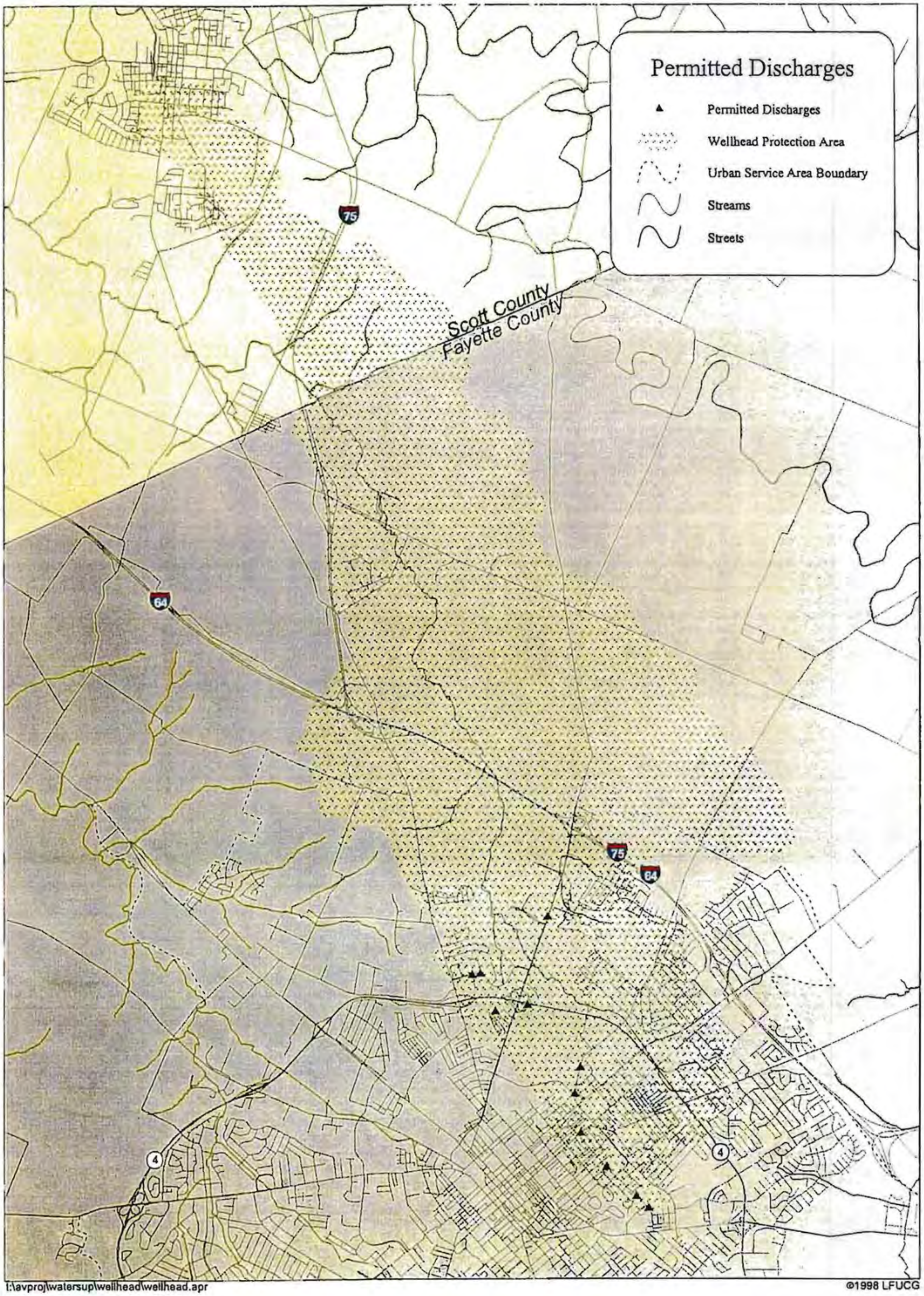
FIGURE 5-3 Permitted KPDES Sites



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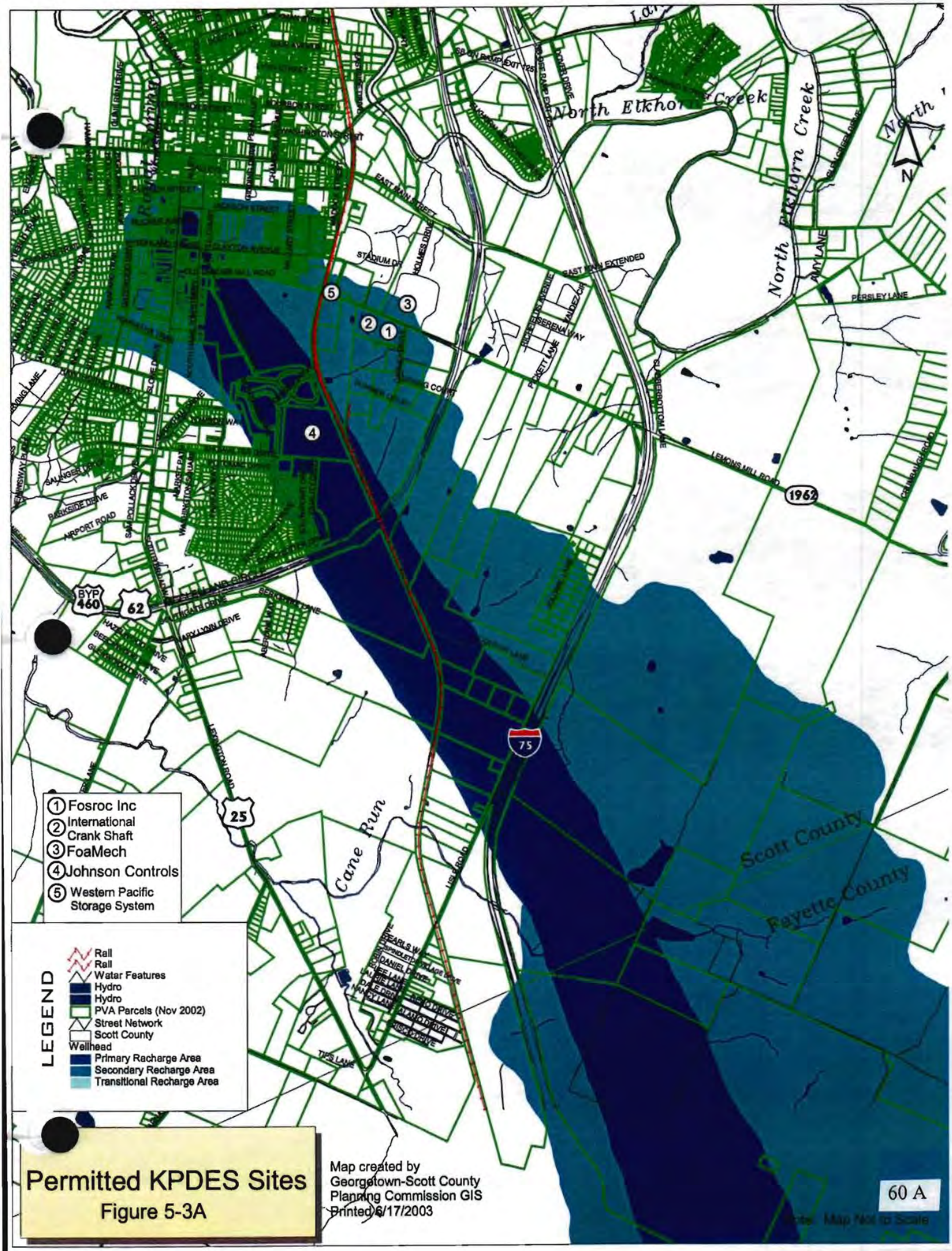

Permitted KPDES Sites

Figure 5-3A

Map created by
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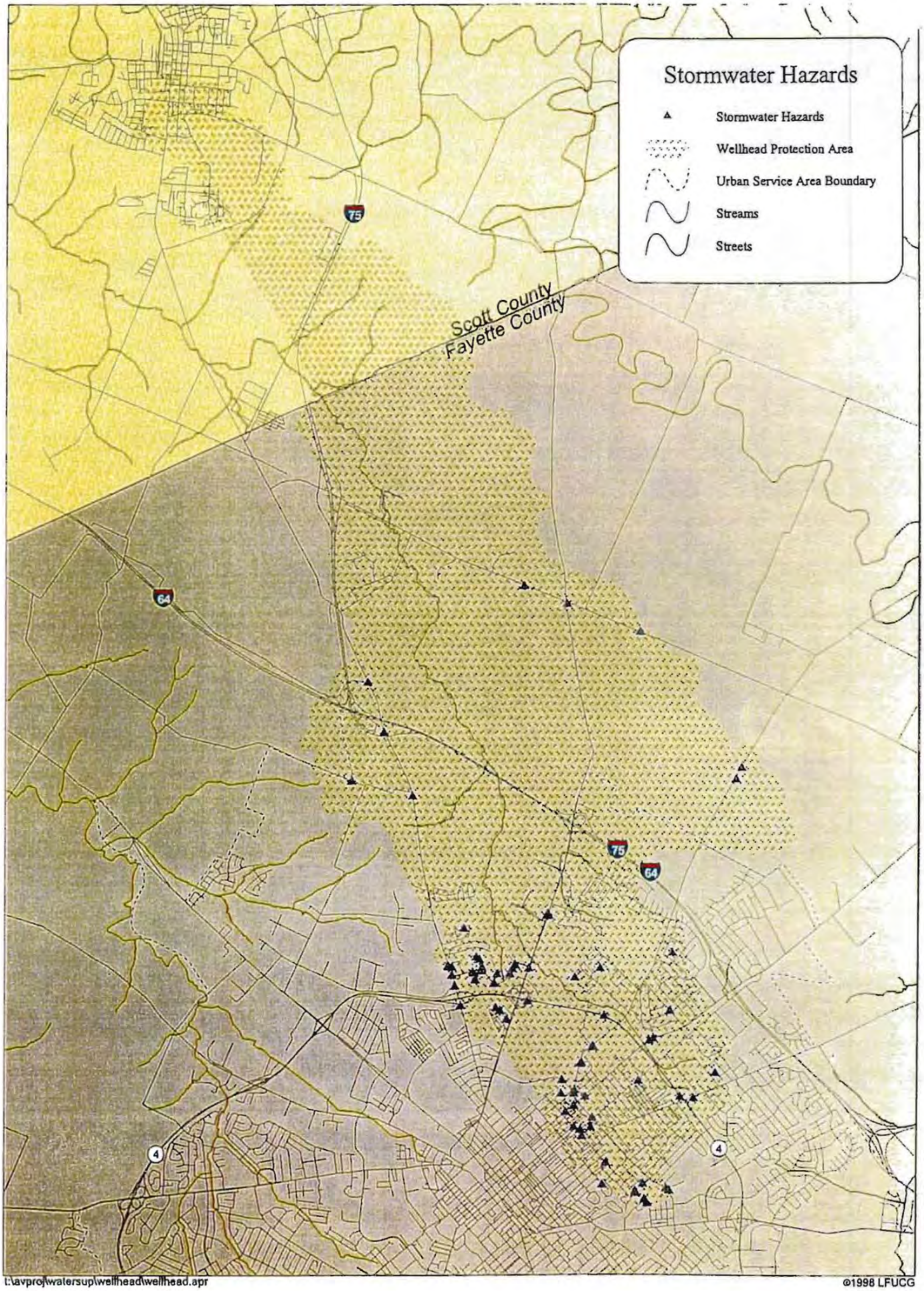
FIGURE 5-4 Stormwater Hazards



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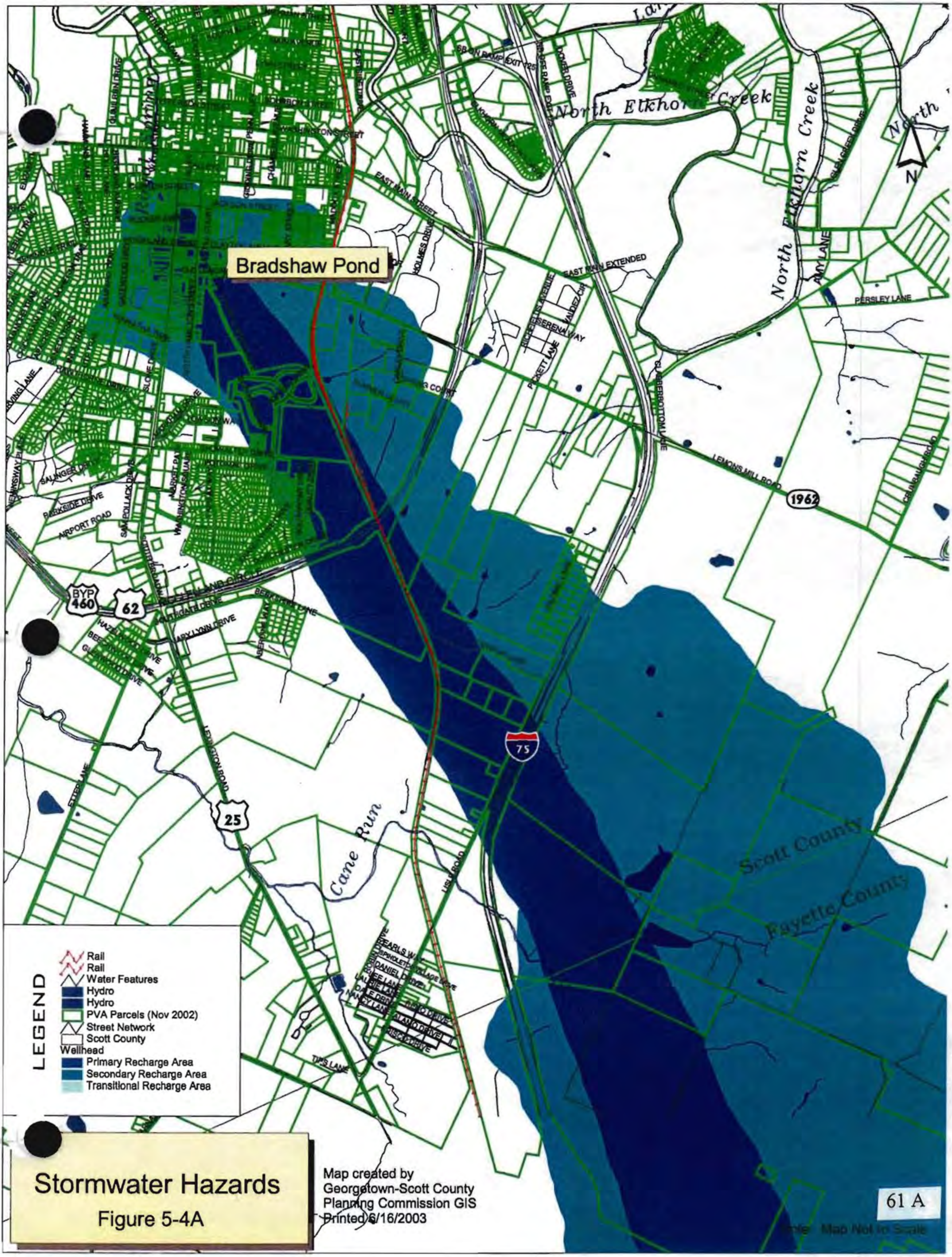

Stormwater Hazards

Figure 5-4A

Map created by
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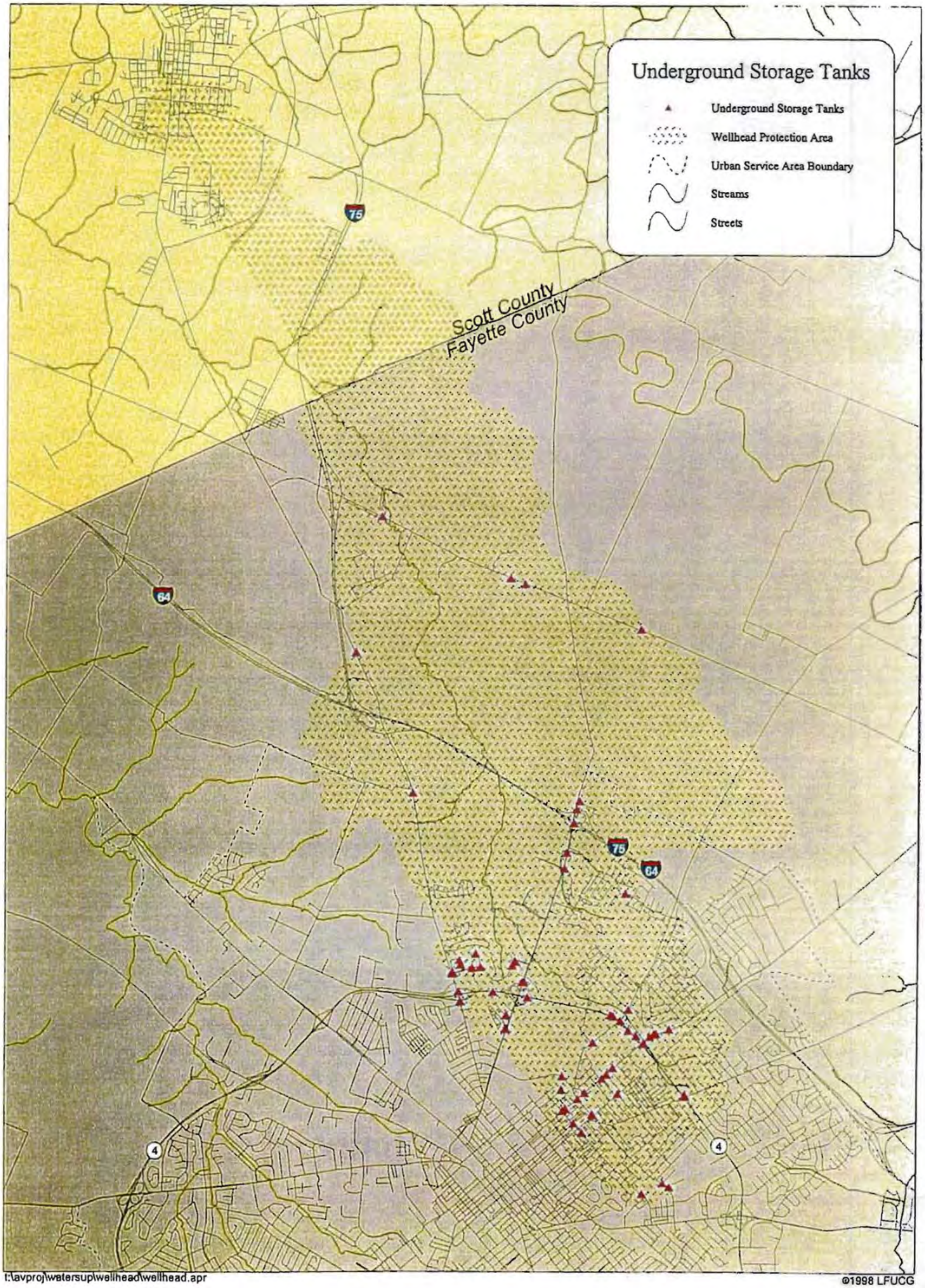
Planning Commission GIS
Printed 6/16/2003

FIGURE 5-5 Underground Storage Tanks



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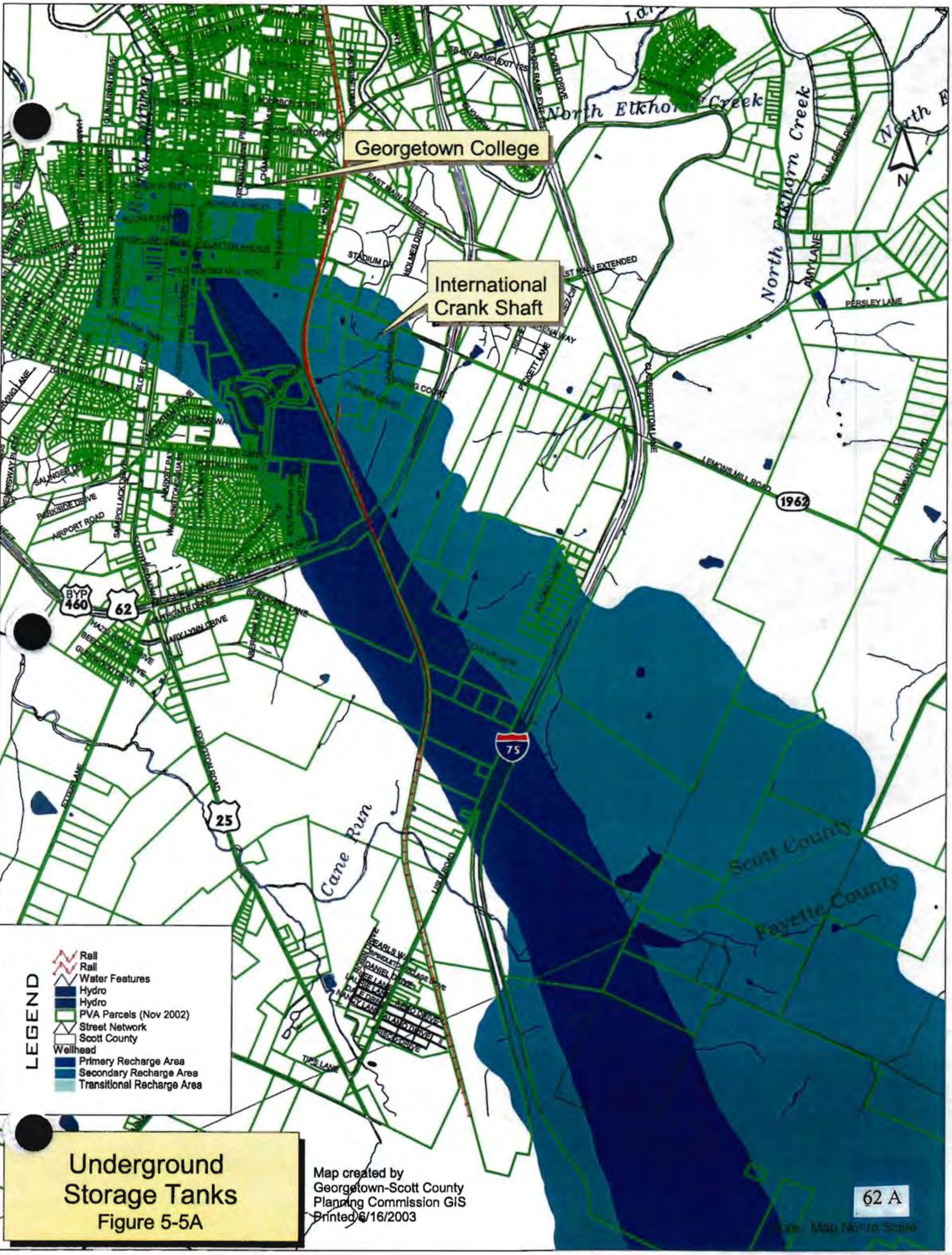
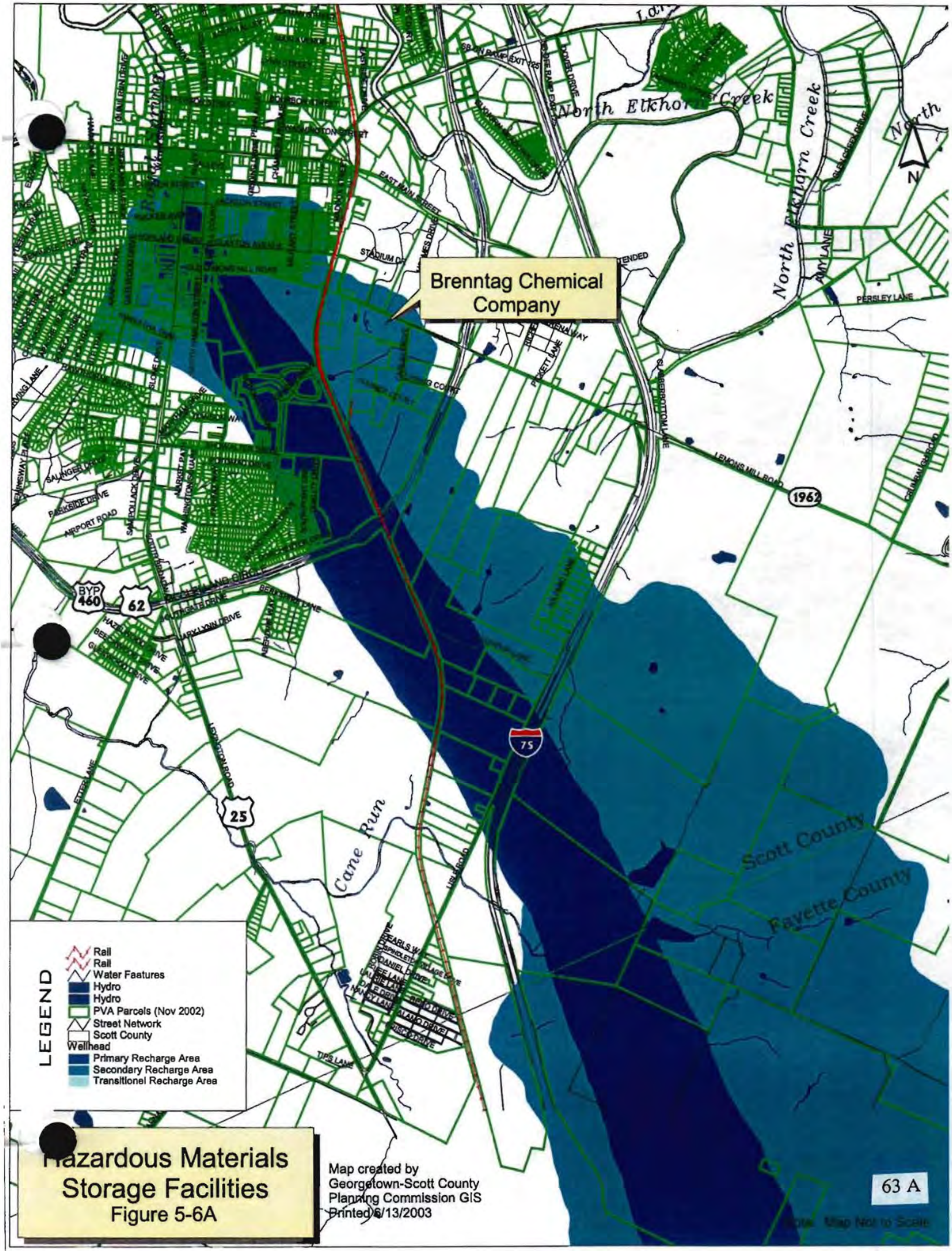


Underground Storage Tanks

Figure 5-5A

Map created by
Georgetown-Scott County
Planning Commission GIS
Printed 6/16/2003

FIGURE 5-6 Hazardous Waste Storage Facilities



Hazardous Materials Storage Facilities

Figure 5-6A

Map created by
Georgetown-Scott County
Planning Commission GIS
Printed 6/13/2003

not currently generating hazardous waste. Of the remaining facilities, 158 are limited quantity generators (generating less than 100 kg per month), 47 are small quantity generators (generating between 100 kg and 1000 kg per month), and 18 are large quantity generators (generating more than 1000 kg per month). Hazardous materials locations in the Royal Spring Aquifer for Fayette and Scott Counties are located in Appendix 5-4 & 5-5.

- **Active or Inactive Underground Storage Tanks**

Records on file with the Kentucky Division of Waste UST Branch indicate there are approximately 622 petroleum underground storage tanks (USTs) in Fayette County registered with the Cabinet. Based on Federal EPA estimates, it is believed 25% of UST systems have experienced some degree of petroleum release. Records on file with the Division of environmental and Emergency Management indicate there are 247 sites within Fayette County with active underground storage tanks registered with DEEM. This differs from the number of USTs registered with the Cabinet since DEEM registers USTs by site (one site may have multiple tanks) while the Cabinet registers each individual UST. Additionally, the universe of USTs required to register with DEEM is larger than those required to register with the Cabinet, since DEEM requires owners/operators of emergency generator STs, heating fuel USTs at business establishments and farm USTs to register.

- **CERCLA Sites**

Review of records on file with the Division of Waste Management Superfund Branch indicate there are three active Comprehensive Emergency Response Compensation and Liability Act (CERCLA) sites in Fayette County. These include the US Federal Correctional Institute (KY0000102475) and the US Veterans Medical Center (KY5360900000) located at 3301 Leestown Road and Cooper Drive, respectively. There was no detailed information available on the third site, listed as Ohio River Flood (KY0001895770).

- **Underground injection wells**

The Safe Drinking Water Act (SDWA) provides for the protection of underground sources of water through regulation of underground injection. The construction and use of any underground injection well requires a permit issued under the underground injection control (UIC) program, which in Kentucky is a federal program administered by Region IV EPA. The regulations for different types of injection wells vary. Injection wells are classified as follows:

Class I	Wells that inject hazardous waste or other industrial and municipal fluids beneath the lowest formation containing, within one quarter mile of the well bore, an underground source of drinking water (USDW).
Class II	Wells that inject fluids for enhanced recovery of oil or natural gas and for storage of hydrocarbons, which are liquid at standard temperature and pressure.
Class III	Wells that inject fluids for the extraction of minerals.
Class IV	Wells used by generators of hazardous or radioactive wastes to dispose of the material, generally above a formation containing, within one quarter mile of the well bore, a USDW, or an aquifer.
Class V	Wells not included in the first four classes.

Elaine Conley of Region IV EPA, stated that EPA does not currently have a listing of UIC wells. There are no permitted underground injection wells in Fayette County according to Region IV EPA, however there are six known major outfalls where stormwater enter sinkholes within the county, which would be classified as Class V injection wells. Due to the availability of sanitary sewers within the Urban Service Area (where most businesses and homes are located) it is believed the number of UIC wells within Fayette County is limited. It is possible that some of these systems may serve more than 20 people per day and therefore would be considered a Class V injection well.

- **Dumps**

Fayette County has several mechanisms in place to discourage illegal dumping. The LFUCG Division of Planning administers an ordinance which forbids the placement of trash, rubbish, fill or other debris within sinkholes. The LFUCG Division of Environmental and Emergency Management and the Lexington-Fayette Urban County Fire Department administer the Hazardous Materials Ordinance, which requires the environment be restored once a hazardous material (including petroleum) is released. The Lexington-Fayette County Health Department and the LFUCG Division of Code Enforcement also administer ordinances that forbid illegal dumping.

Government agency activities as well as citizen involvement in reporting illegal dumping locally, prevent extensive dumping from being a significant problem in Fayette County. Although several sites are currently being monitored, there is only one known area within the county requiring cleanup, and it is not in the Wellhead Protection area.

5-6 Future Contamination Potential

In order to identify the potential for pollution with new land uses, it is necessary to continue an inventory process. It is intended to require that all new development in the aquifer protection area, in Fayette and Scott Counties be identified in the planning and zoning process as to the potential for contamination. In Fayette County, this is accomplished through the use of an *Environmental Review Form for existing site characteristics that is required for major subdivision and development plan applications* and completed for each proposed development at the beginning of the planning process (see Appendix 5-6). This form will aid in determining the potential for pollution for each plan that has to be approved in zone changes, subdivision plans and development plans. The inclusion of this information, up front, will allow timely decisions to be made in the planning process. Scott County would benefit from use of a similar form for planning purposes.

Pertinent to the Royal Spring Aquifer, the following items are required on the Subdivision & Development Plan Existing Site Characteristics Review Form for existing site characteristics:

- Proposed land use
- Location in the aquifer protection area (zone 1&2)
- Sinkholes located on site
- Any sinkholes with debris/rubbish on site
- Any springs on site
- Domestic water wells
- Septic tanks on site
- Underground fuel tanks on site
- Proposed hazardous materials on site
- Existing hazardous materials on site
- Is a sediment control plan required
- Sinkhole development plan required
- Groundwater protection plan required

Depending upon the type and location of any given development certain special development notes may be required for watershed protection. Section 9 covers the long range planning for the protection of the Royal Spring Aquifer.

5-7 Determining the Waste Hazard Potential

The hazard potential of a chemical is determined by a number of variables. These are:

mobility of product - The material must be able to enter the ground-water environment and travel with the ground water. Certain substances are essentially immobile (e.g., asbestos fibers) while others are highly mobile. Most substances fall between these extremes.

persistence - Some substances such as halogenated hydrocarbons decay or degrade very slowly and have a higher hazard potential than other equally toxic materials that decay more rapidly.

volume - Some substances, such as horse muck piles, are only moderately *toxic* but because they are produced in enormous quantities have a somewhat higher hazard potential.

concentration - Substances entering the ground-water environment in concentrations which could potentially endanger human health have a higher hazard potential. Concentration may decrease with dilution and attenuation but the amount of decrease at a given place depends, in part, on mobility and interaction with soils and aquifer material.

5-8 Emergency Planning and Response

Both Fayette County and Scott County have developed an emergency response planning initiative for the protection, health, and safety of county residents. Both organizations work independently in each county and coordinate activity when necessary. Both organizations have been active in the development of the Royal Spring Wellhead Protection Plan.

Georgetown/Scott County Emergency Management Agency (E.M.A.)

Created after the sever weather and in 1974, the Georgetown/Scott Co. Emergency Management Agency currently has a new state of the art Emergency Operations Center, Emergency

Management headquarters, a 38' Command Post vehicle, two response vehicles and a staff of 13 trained in various aspects of emergency response

The Georgetown/Scott County E.M.A. is part of a statewide comprehensive emergency management program for the Commonwealth, and through it an integrated emergency management system, to provide for adequate assessment, mitigation, preparation, response and recovery from the threats to public safety and the effects of destruction resulting from all major hazards. Some of these hazards include tornado, blizzard, ice storms, snowstorms, flooding, earthquakes, hazardous materials, or disaster or emergency occurrences that threaten life, property or the environment.

The Georgetown/Scott County E.M.A. is part of the Local Emergency Planning Committee. This committee helps to improve the quality of our community's chemical emergency response plans and to reduce chemical risks. By planning and ensuring that facilities that store extremely hazardous substances have done their required reporting helps in better preparation for a potential chemical accident.

A Hazardous Materials Ordinance (*ordinance number 96-009 - Appendix 5-7*) is in place for the purpose of protecting public health/safety and the environment in Scott County. This Ordinance provides local agencies and the community the ability to recoup costs from the responsible party of the release.

Fayette County Division of Environmental and Emergency Management (DEEM)

The local Division of Environmental and Emergency Management was initially established in 1985. This Division currently has two primary areas of responsibility. These are Emergency Management, and Environmental Protection. Hazardous materials management is the responsibility of the Lexington–Fayette Urban County Government Fire Department. The two areas relevant to wellhead protection, Hazardous Materials Management and Environmental Protection, are accomplished through several local ordinances and regulations. Chief among these is Section 16A, the Hazardous Materials Ordinance. This ordinance requires facilities which handle hazardous materials (including petroleum) to register with DEEM; establishes the

Technical Advisory Commission (TAC) to advise City Council on environmental issues; requires the environment be restored when a release occurs; requires Spill Prevention and Control Plans be developed by certain facilities; and establishes the local HazMat Response Team and HazMat coordinator. DEEM administers the local Underground Storage Tank regulations for commercial petroleum UST(s), nonpetroleum UST(s) and farm UST(s). These local regulations are considered to be more comprehensive, relative to installations than the existing state UST regulations, in the types of tanks regulated.

5-9 Municipal & Private Sewer Waste Systems

Municipal Sewer Waste Systems

Municipal waste systems have no receiving streams in the Royal Spring Aquifer Protection Zone. Fayette County has a class A sanitary sewer pump station with a 24 inch diameter force main to serve the Coldstream area located in Cane Run. This force main pumps to the Southern Railroad right-of-way, then follows the right-of-way to the Manchester Street Relief Sewer, which flows directly to the Town Branch Treatment Plant. To date, no sewage bypasses have occurred in this new system. This pump station will, in time, eliminate eight old pump stations, some of which are in the aquifer recharge area. Today some problems are encountered with the pump stations, manholes, sewer lines and overflow valves located in the recharge area. When a discharge occurs, the effluent generally discharges into the surface waters of Cane Run. Fortunately these occurrences are usually in a period of intense storm events with a significant amount of rainfall so dilution plays an important role in lessening the problem. At Royal Springs during an intense storm event, degradation in water quality of wastewater is not observed. Problems have been noted in the dry summer months, not related to infiltration but due to the lack of rain.

The Lexington Fayette Urban County Government is in process of developing a Sanitary Sewer Overflow plan to reduce sanitary sewer overflow from inflow and infiltration of water, inadequate sizing of sewer lines, and pump station malfunctions. The locations of the problem areas are shown in Figure 5- 8, with street listings in Table 5-2.

Figure 5-7 Pump Stations and Sewer overflows in the Royal Spring Aquifer

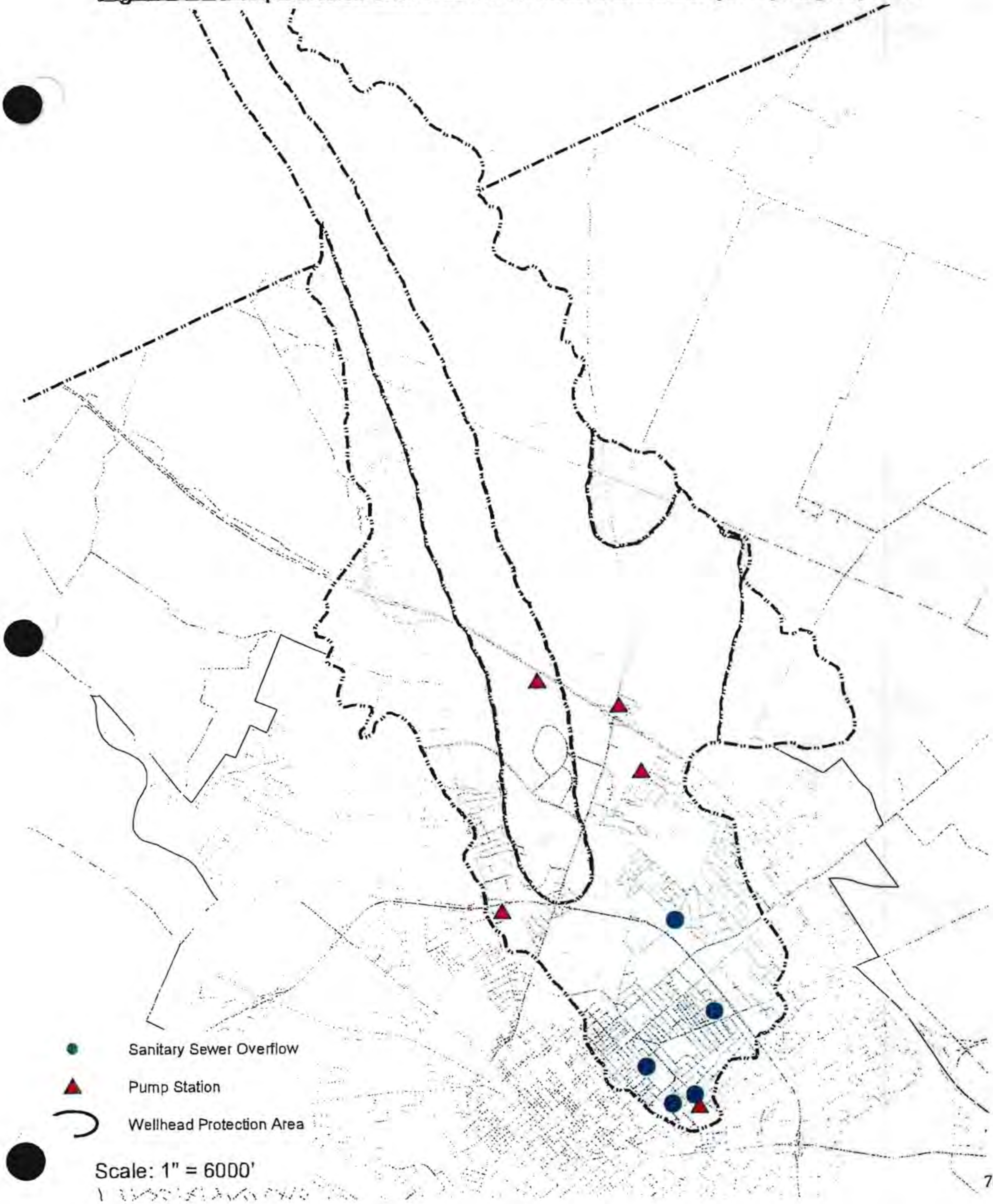


TABLE 5-2 OVERFLOW PROBLEMS – FAYETTE COUNTY

LOCATION		ESTIMATE YEAR / FIX
Pump station problems		
Winburn Estates Pump station		2002
Winburn Pump Station		2004
Throughbred Acres Pump Station		2004
Sharon Village Pump Station		2004
Manhole problems		
1510 Russell Cave Road	4	2004
1434 Edgelawn Ave	5	In progress
7th & Jackson	12	current project
Lancaster Ave	12	current project
801 Marcellus	12	current project

Private Sanitary Waste Systems

Only one package treatment plant exists in the Royal Spring Aquifer Recharge Area. This treatment plant (KPDES permit number KY0048101) is located at the Kentucky Horse Park. The treatment plant serves the Kentucky Horse Park, Spindletop estates and the Council of State Government. The rated capacity for this plant is 150,000 gallons per day. It is currently (based on 1996 figures) having an average daily flow of 191,000 gallons per day, discharging over 40,000 gallons per day in excess of the rated capacity. The treatment plant excess is currently allowed to be spray-irrigated in certain areas of the Horse Park in lieu of discharge to Cane Run.

In the summer of 1998 the Kentucky Horse Park received notice of 7 violations from the Commonwealth of Kentucky Natural Resources and Environmental Protection Cabinet, Department for Environmental Protection with regard to the disposal of wastewater and horse muck. In 1999 an agreed order (Case No. DOW 98153) directed the Kentucky Horse Park to connect to the Lexington-Fayette Urban County Government sewer system by December 31, 2000.

Two other treatment plants, the Spindletop WWTP in Scott County and the Maple Grove Mobil Home Trailer Park WWTP in Fayette County are located near the aquifer zone. These are shown in Figure 5-9. Both of these facilities are small producers. These treatment facilities are adjacent to but outside the aquifer recharge area and probably do not impact the aquifer. The Lexington Fayette County Health Department has indicated that they have not received any complaints in the last several years about these treatment facilities.

Sanitary sewer policy

Fayette County

Fayette County has a sanitary sewer policy that allows for development in the Urban Service Area subject to the availability of sanitary sewers. Section 201 of the Facilities Plan for Waste Water Treatment Works (1978) incorporated the desire of the Lexington Fayette Urban County Government to provide public treatment for persons using package plants to meet the mandated federal water quality standards. The adopted plan stipulates that all areas served by private treatment plants should be incorporated into the public system as private treatment plants are phased out.

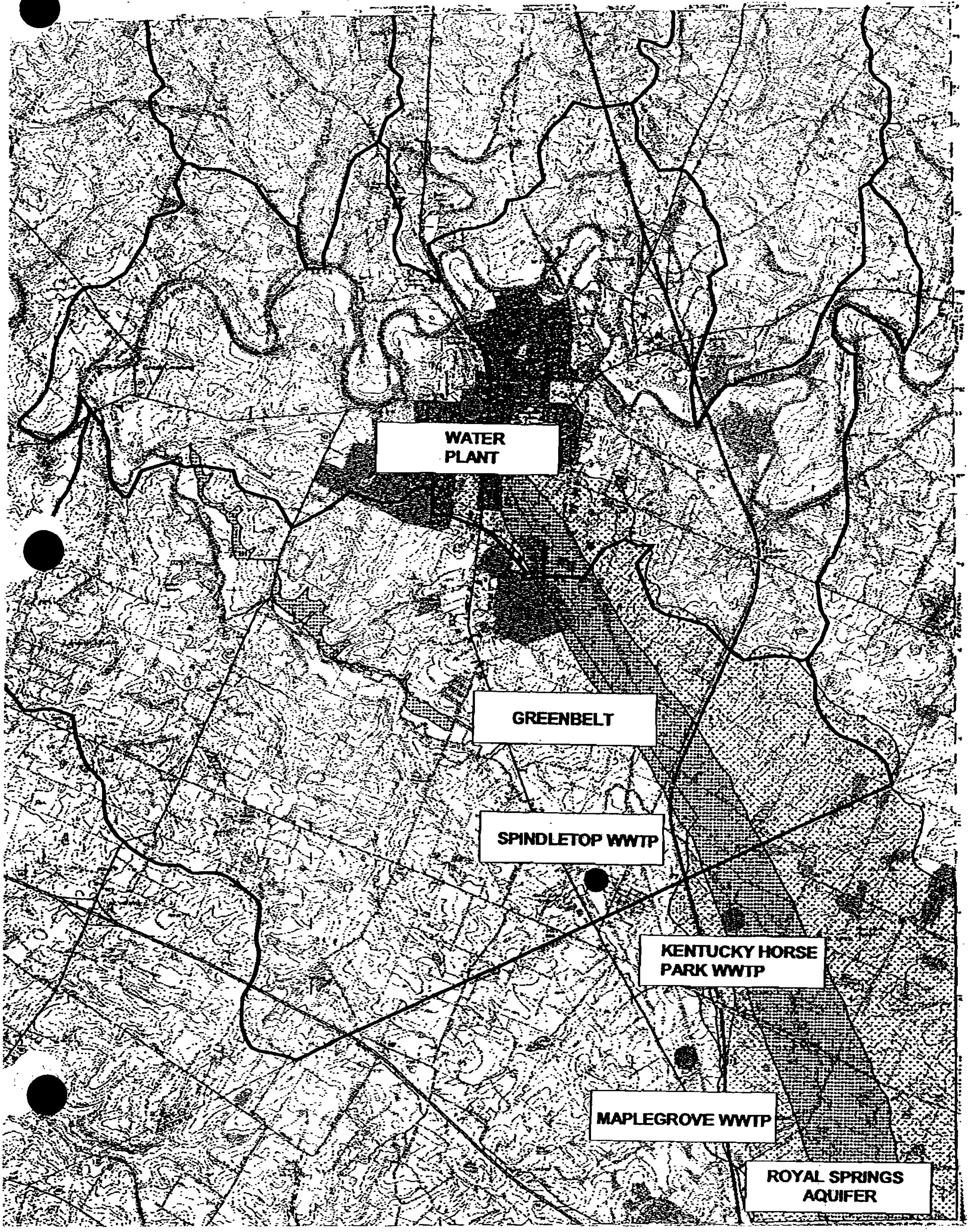
5-10 Septic Systems & Soil Types

Groundwater contamination from failing septic systems and package treatment plant discharge is always a concern. In the Rural Service Area (RSA), past policy was to allow for development of septic systems on lots of ten acres or more. This regulation had been in effect since 1964. Prior to that time, septic systems were allowed on parcels as small as one acre in size in Fayette County. It was intended to maintain a density of 64 septic systems in any given square mile.

More recently, the minimum rural lot size for most of Fayette County's agricultural lands (zoned A-R) has been increased to forty acres. This allows for only 16 septic systems in a given acre. The Rural Land Management Plan, whose implementation is currently underway, has created a recommendation for a 40 acre minimum lot size in most of the Rural Service Area of Fayette County. This 40 acre lot size is to remain a zoning requirement while Fayette County explores the development of Purchase Development Rights (PDR) in the Rural Service Area.

FIGURE 5-8

Royal Spring Aquifer Area Wastewater Treatment Plants



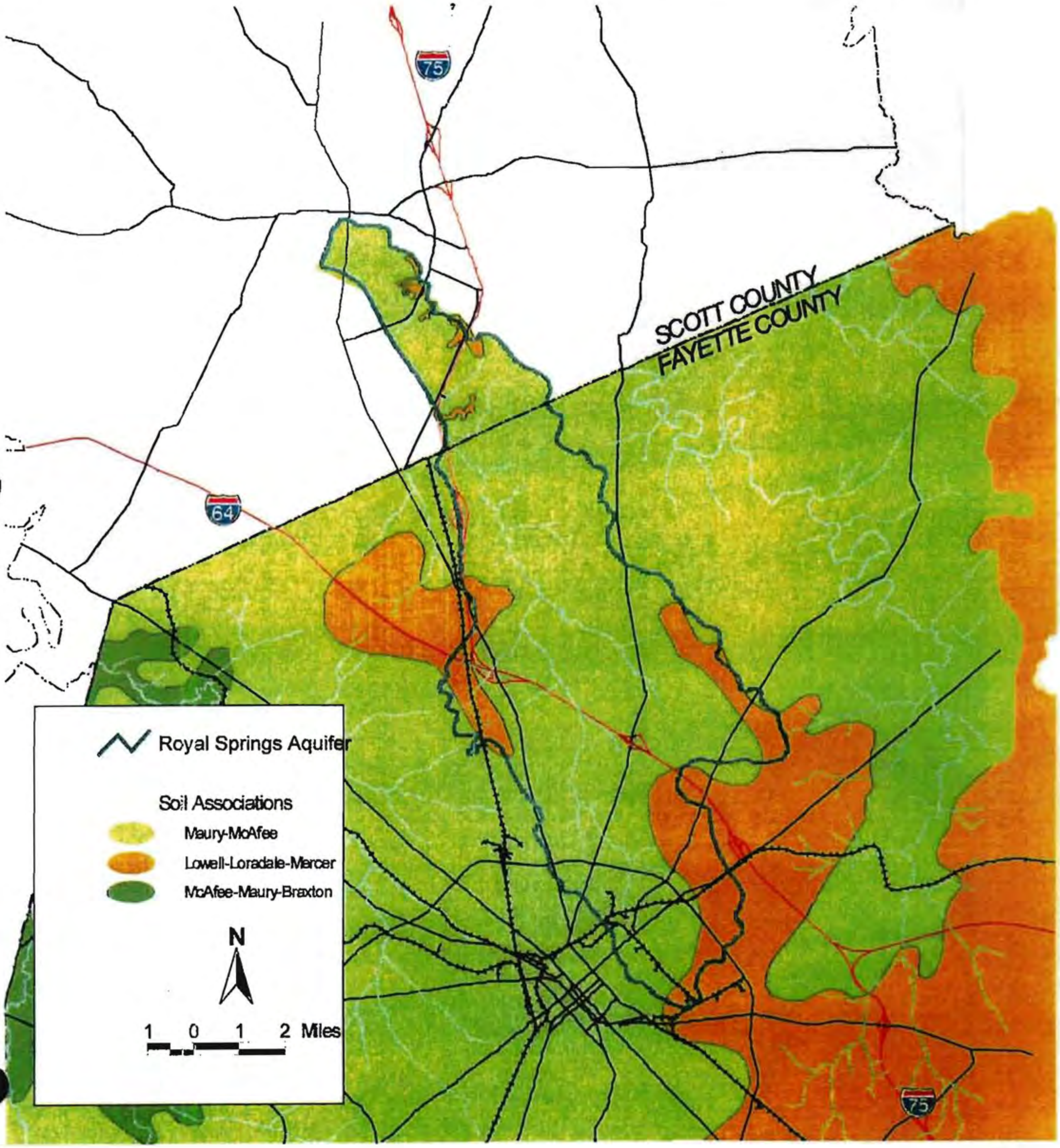
In the Royal Spring Aquifer protection area, two soil associations are found the Maury-McAfee association and the Lowell-Loradale-Mercer association illustrated in Figure 5-9. The predominant soil type for most of the aquifer is that of the Maury-McAfee association. Each soil type in the aquifer has specific properties in terms of the treatment attenuation of effluent. The soil types may also vary in the absorption rate of effluent depending on the slope of the land and the physical properties of the underlying bedrock. A rock that is fractured, or a rock unit that contains sinkholes may have a different suitability for a septic tank drainfield or for land application of wastewater.

Septic systems utilize natural processes to treat and dispose of wastewater. All processes use the soil as a medium to assimilate and attenuate pollutants. Three of the most common systems are The conventional septic system, the vault system and an alternating drainfield system. Each system utilizes the principal of a separator or septic tank, a distribution box to direct the flow of liquid waste, and leachfield line(s) that runs into a drainfield or absorption field. The septic tank, separates solid and liquid waste. The heavier solids settle to the bottom to produce sludge while the liquid and lighter solids float to the surface. When properly working, bacteria in the septic tank break down the effluent and sludge. The liquid waste from the top of the septic system drains into a distribution box to the drainfield. The drainfield provides the final treatment of the wastewater through soil filtration until it reaches the groundwater system.

A number of problems can arise with septic systems. Preventive Maintenance and pumping out of the system to reduce the solid materials are often not done. When the septic tank becomes filled with solids, the system fails when the solids flow into the distribution box and the drainfield becomes clogged. Once the drainfield becomes clogged, septic treatment of the effluent no longer occurs. The effluent then breaks out of the system. In the Royal Spring Aquifer, the soils are thin and sinkholes are abundant. This permits a direct flow of contamination to the aquifer. Routine maintenance is one way to have a properly functioning system. The State of Kentucky does not have a mandatory cleaning schedule for septic tank systems, however it is recommended that septic systems be cleaned out every three to five years.

FIGURE 5-9: FAYETTE & SCOTT COUNTY PREDOMINANT SOIL TYPES

Soil associations adapted from September, 1967 map by
KENTUCKY AGRICULTURAL EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Base data (excluding soil associations) was from digital
information maintained by LFUCG GIS section.
Compiled by the Division of Planning, February, 2001.



Once a system becomes clogged, it is difficult to correct. Some of the new synthetic organic septic tank cleaners are very detrimental to ground water. One specific cleaner contains trichloroethylene (TCE) which is considered to cause cancer in laboratory animals. This product is known to readily leach from septic systems into the groundwater. While these cleaners may open up a septic system, they also can pollute the groundwater.

The State of Kentucky through 401 KAR 5:037 requires a generic groundwater protection plan for residential septic systems. This plan is found in Appendix 5-8. This septic system plan and brochure provides space for the residential owner to record vital information on each individual system and information on what to do and what not to do in the maintenance of a septic tank system. Some communities establish a septic system management service for septic tank inspections, tank pumping, water quality testing and system repair.

According to test results at Royal Spring, septic systems in the aquifer and land treatment of effluent at the State Kentucky Horse Park do not appear to be a problem at this time during high or regular flow of the aquifer. During periods of seasonal low flow, nitrates do increase in concentration at Royal Springs. This may be more problematic to the individual wells and springs in the aquifer system for individual properties utilizing the waters of the Royal Spring Aquifer.

Information has and will continue to be dispersed to landowners in the recharge area concerning their impact on water quality. The Scott County Conservation District granted the Royal Spring Water Supply Protection Committee $2,000 for water quality educational materials to schools in the area. Other material is expected to be distributed concerning the protection of the water supply in Royal Spring including materials to landowners informing them of the proper maintenance of their septic systems.

5-11 Municipal & Private Landfills

There are currently two active (permitted) landfills in Fayette County. These are both operating as construction/demolition debris landfills. The LFUCG landfill is located on Haley Road (permit # 034-00007). The second landfill located at 4400 Haley Pike is operated by Demolition Disposal Services (permit # 034-00040).

In addition to the two active landfills discussed above, there are five inactive landfills within the county. These are the Lexington City Incinerator Landfill (permit # 034-00001), the Avon Lexington Signal Depot (permit # 034-00002), Jacks Creek Pike Landfill (permit # 034-00003), City of Lexington Construction Demolition and Debris Landfill (permit #034-0005) and the City of Lexington Landfill (permit # 034-00006). The Lexington City Incinerator Landfill, the City of Lexington Construction Demolition and Debris Landfill, and the City of Lexington Landfill are all located north of Old Frankfort Pike between Forbes and New Circle Roads. The Lexington Signal Depot Landfill is located at Avon, while the Jacks Creek Pike Landfill is located in the vicinity of Raven Run Nature Sanctuary. **No municipal landfill systems are located in the aquifer recharge area.**

Any new municipal or private landfill would have to conform to a number of state and local regulations. An outline of Fayette County regulations may be found in Appendix 5-11.

There are no known existing hazardous waste sites in the Royal Spring aquifer.

5-12 Sinkhole Dumps

There are very few, if any, sinkholes in the recharge area being used as a dump sites. If any are detected, Scott County has the cost-share program in place to financially help landowners with the cleanup. The Scott County Fiscal Court has allocated funds through the Solid Waste Division and the Scott County Conservation District to address this problem. The district receives $30,000.00 per year to fund projects that improve the quality of water in Scott County. Part of this money is used to clean out sinkholes that have been used as dump sites. All sinkhole cleanup projects are cost-shared at a rate of 50%, not to exceed $2,000 per individual per year. The district has funded the cleaning up of two sinkholes and plans to increase this number as word of the program reaches more landowners.

Fayette County does not have a cost share program to clean out sinkholes. Today no sinkholes have been identified in the aquifer area as being a waste problem. In 1985 Fayette County adopted, as part of the Land Subdivision Regulations, a sinkhole regulation which prohibited the filling of sinkholes with fill or debris (considered fill). Known areas of sinkhole debris have been cleaned up. The knowledge of the importance of the Royal Spring Aquifer over the past twenty-five years has also led to the closer scrutiny of environmental planning in the watershed.

5-13 Rural Non Point Source Pollution

Contamination from herbicides, fertilizers, & pesticides and from animal waste in the form of non point pollution is a factor when any large land area has cropland, pasture, or agricultural activity as the predominate land use. In the Royal Spring Aquifer, the predominant rural land use is that of equine industry and cattle pastures in Fayette County and pasture and row crops in Scott County. Figure 5-11 is an aerial photographic view of the Royal Spring aquifer (a portion of the basin in the northern reaches of the aquifer does not have photographic coverage). In Fayette County, a major portion of rural land use is controlled by the University of Kentucky agricultural experiment station at Coldstream Farm and the State owned Kentucky Horse Park. Together all public lands in the Rural Service Area total over 3,267 acres or 42% of the rural land area. Generally in rural lands, stream bank erosion and erosion from crop tillage constitute a significant problem in terms of sediment migration and nutrient deposition. In-stream livestock watering and manure can contribute to high levels of nutrients and organic loading in runoff from these areas. The organic loading can also contribute to bacterial contamination and dissolved oxygen problems. Improper manure storage practices have been identified in the watershed in the past and remedial measures were initiated. The Kentucky Horse Park has stored a tremendous amount of horse muck on the property and this is a concern that has to be addressed. This was a concern brought up in the public meeting on wellhead in May 1998 (see appendix 5-3). The Lexington Fayette Urban County Government has developed a protection plan for the storage and handling of horse manure in commercial operations (this does not pertain to the Kentucky Horse Park as it is a State operation).

Pesticides used to control weeds and insects may contaminate the aquifer and groundwater wells in the area. At this time it is deemed that pesticide contamination is not a problem. Based on the State Division of Water performing pesticide tests for GMWSS at Royal Springs four times a

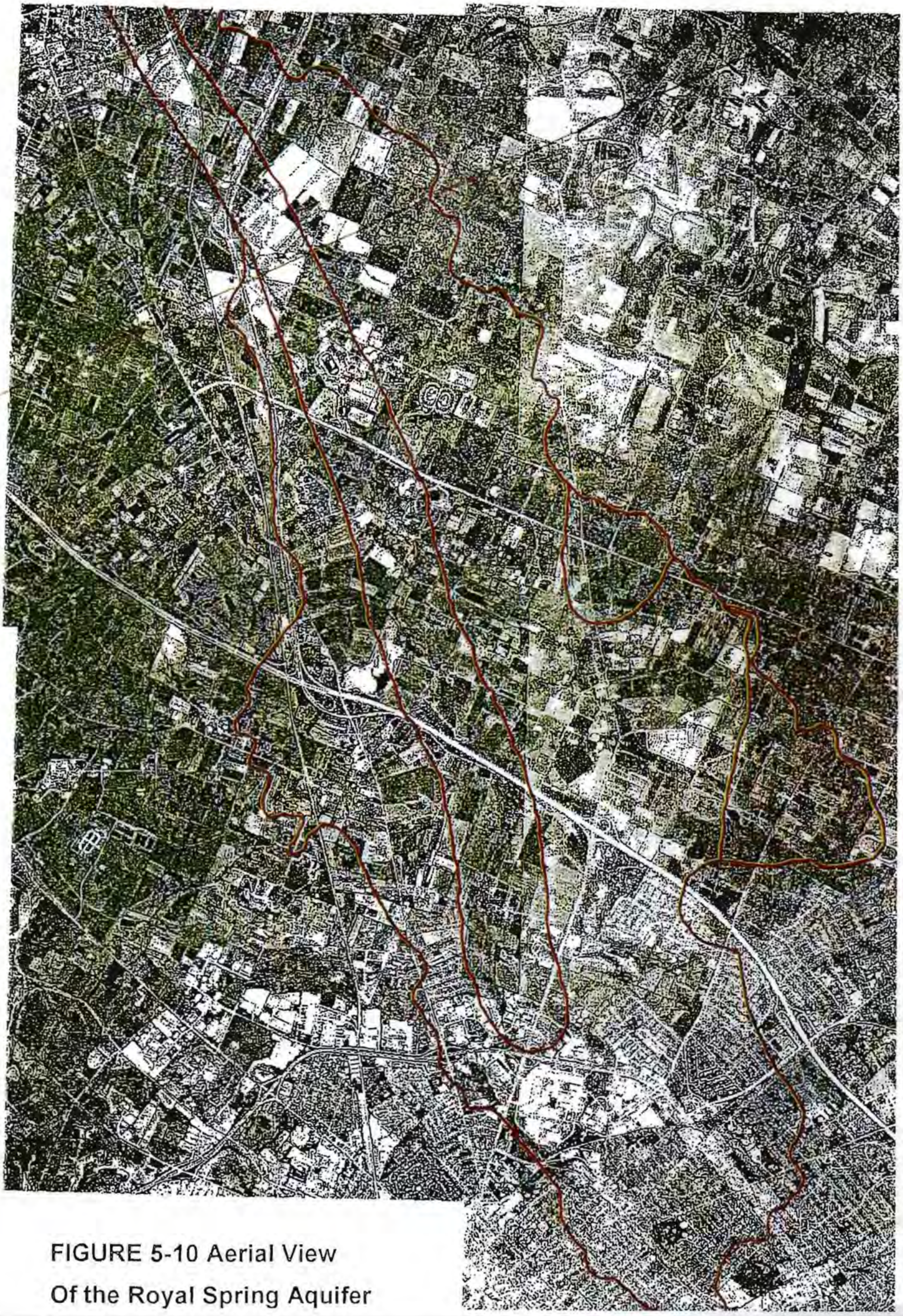


FIGURE 5-10 Aerial View Of the Royal Spring Aquifer

year. Each test has been negative with below detectable levels readings. Historically information on pesticides and groundwater contamination is scarce throughout the United States due to the extremely high cost for monitoring and analysis. Until about 1979 little was known about the movement of pesticides in the soils with regard to the groundwater system. Literature review has indicated that the type of aquifer that we have being a shallow aquifer with thin clay soils is not very good for the breakdown and degradation of pesticides. Once the pesticide reaches groundwater microbial activity decreases due to the low levels of organic material and the half-life greatly increases. Mobility will also greatly increase. Unfortunately in a karst area, such as we have, the potential for pollution is greater than in a non-karst area. Future development though in the aquifer area in terms of residential and business and commercial / industrial development the Coldstream Research Park and adjacent areas will probably see an increase in pesticide use.

Turbidity and stream bank erosion of Cane Run has been a minor problem in the past but potentially could increase with the Coldstream Research Park and adjacent areas. Turbidity, which is the measurement of suspended particles in the water, has not been a significant problem to date. Drinking water leaving the GMWSS water treatment plant is five times less than the required EPA MCL (0.5 NTU's) and has to date not exceeded 0.1 NTU's. Some erosion has taken place on Cane Run, and remedial work was initiated by a joint effort with the University of Kentucky and the Fayette County Natural Resources Conservation Service in the development of a stream bank restoration program. Portions of the stream banks were rebuilt. A major portion of the stream in the new Coldstream Park that will be under the ownership of the Lexington Fayette Urban County Government will be set aside as Greenspace and plans are being implemented for riparian restoration surrounding the stream banks.

A major restoration project of Cane Run using native Kentucky species is shown in Figure 5-12. The Lexington Fayette County Government intends to systematically restore riparian forests to the creek bank of Cane Run. This is a major step to improve the aquatic and wildlife habitat as well as helping to restore water quality to the stream. The reforestation project began in the spring of 1999.

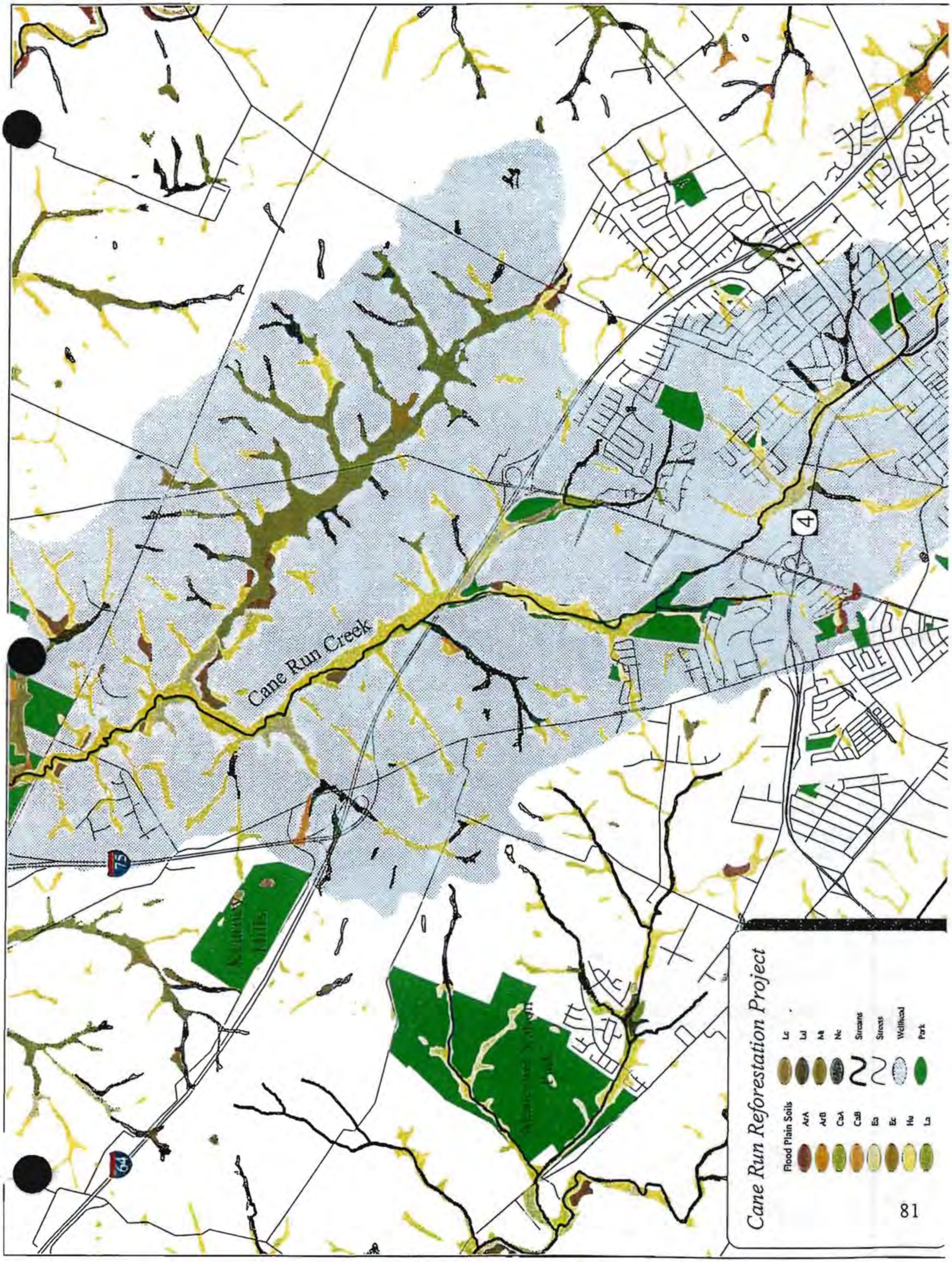


FIGURE **5-11** Cane Run Reforestation Proj

There are several federal, state, and local programs available to landowners to address natural resource issues and problems in the area. Scott County as well as Fayette County offers a number of programs that may be available to landholders for conservation programs through the Natural Resources Conservation Service (NRCS)*. Some of these programs are:

1. Environmental Quality Incentives Program (EQIP) is a federal cost-share program created to help reduce soil erosion and improve water quality. EQIP provides technical assistance, cost-share payments, incentive payments, and education to producers who enter into 5-10 year contracts based on conservation plans.

2. Conservation Reserve Program (CRP) is a federal program created to restore erodible land and protect environmentally sensitive areas. Cost-share and incentive payments are available.

3. Scott County Water Quality Cost-Share Program is a local cost-share program created to improve and protect water quality in Scott County. This program is implemented by the Scott County Conservation District and funded by the Fiscal Court. Cost assistance is provided to landowners to implement Best Management Practices on their land. Cost assistance is also offered for environmental education, research, and other projects that help improve water quality.

4. Kentucky Soil Erosion and Water Quality Cost-Share Program is a state program created to assist landowners in protecting soil and water resources in Kentucky. Priority is given to animal waste related problems. This program is a result of House Bill 377, which was passed by the 1994 General Assembly.

5. Wildlife Habitat Improvement Program is a Federal cost-share program administrated by the NRCS to enhance habitat on eligible land for: upland species, fisheries and other types of wildlife. It provides both technical assistance and cost-share payments to help establish and improve fish and wildlife habitat.

6. Land Acquisition/Easements For Elkhorn Creek is a grant from the Environmental Protection Agency (EPA). The purpose of this grant is to acquire land or easements along streams and sinkholes in the Elkhorn Creek Watershed. The purpose of this grant is to improve water quality by reducing contaminants from non-point source pollution.

* For more information about these programs, contact the Natural Resources Conservation Service or the Scott and Fayette County Conservation Districts.

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Section 6. Land Use Evaluation

Land use, both existing and proposed, will be the key issue in the development of a wellhead protection plan for the Royal Spring Aquifer. A fundamental axiom of a public watershed management program in regard to a public water supply is that the raw water supply sources should be left undeveloped to the maximum extent possible. The Royal Springs Recharge area contradicts this axiom due to the intense development pressures upon the land in both Scott and Fayette County. The inclusion of one of the most traveled interstate highways bisecting the aquifer is a magnet for development. The State mandate for the Royal Springs Aquifer has dictated that a strong watershed management program be adopted.

The effects upon water quality are well known when land use changes are brought about through development. The following events usually occur:

- Increase in impervious area results in an increase in the runoff ratio
- Change in the natural stream channel occurs through an increase in runoff volume
- Change in the natural channel occurs through man made changes
- General channel instability increases
- Increased bank erosion occurs
- Channel movement occurs
- Altered floodplain / downstream flooding occurs
- Potential to transport increased loads of pollutants and contaminants
- New sources of pollutants and contaminants occur
- Loss of trees and stream ecology degradation result in decreased water holding capability

The greatest effect of land use changes with developing communities is the direct relationship between increases in impervious areas and stormwater pollutant concentrations. This generally results in elevated levels of the following:

- Nutrients
- Coliform counts
- Sediment loads
- Metals
- Pesticides

Land use analysis for this plan will look at the existing land use and the proposed land use at full development for the recharge area. The breakdown of each land use type will be an indicator of the potential for pollution. Both Scott and Fayette County have adopted Comprehensive Land

Use Plans. In terms of land use Table 6-1 rates the intensity of land use by type of development. The least intense development is agriculture with a rating of 1. In contrast, heavy industrial land use has the highest intensity rating.

TABLE 6-1 INTENSITY OF LAND USE

1. Agriculture
2. Horse Farms
3. Low density residential
4. Medium density residential
5. High density residential
6. Very high density residential
7. Professional services
8. Office, industry and research parks
9. Retail trade
10. Highway-oriented commercial
11. Warehousing and wholesaling
12. Light industry
13. Heavy industry

6-1 Susceptibility Analysis

Contaminant identification and the potential for groundwater pollution are required to be assessed under the 1986 Amendment to the Safe Drinking Water Act. The process used to determine the potential for pollution is called *"Susceptibility Analysis"*. The state and federal guidelines for this analysis are based upon the premise that the "susceptibility" of the public water system is the potential for a public water system to draw water that is contaminated at concentrations that would pose extraordinary treatment issues or public health concerns. A three-fold analysis of karst areas has been developed for susceptibility analysis. This analysis for the different types of land use in the aquifer area will allow Scott and Fayette County to draw conclusions about the risk posed to the Royal Spring aquifer and provide technical rational for management strategies needed to protect the source of drinking water.

The Environmental Protection Agency (EPA) recommends that in karst areas three factors be utilized for considering the potential for groundwater pollution. These are:

- Contaminant Source Characteristics – threat to public health

- Proximity – the closeness of contaminant to the water source
- Hydrologic Sensitivity – the nature of groundwater flow

Step 1. Determine Contaminant Source Characteristics

Knowledge of the land use and the potential contaminant source, both in existing development and in future development, provide the basis for the type of land use controls necessary to prevent groundwater pollution. Regulatory and non-regulatory measures will be utilized to help prevent the degradation of the Royal Spring Aquifer. This step identifies the land use category and ranks the "use of the land" as to the potential for pollution based upon the general characteristics of a given land use. The Kentucky Division of Water has developed a contaminant value for ranking land use and the potential for groundwater pollution. The contaminant value is based upon the toxicity and mobility characteristics of the contaminants usually associated with a particular land use. Any given site may have a number of various potential contaminants.

Each land use type is given ***a contaminant value of 1 to 3***. A ranking of 1 is considered low potential, while 3 may be considered a high potential for possible hazardous release. Two methods are utilized for ranking. One method is to rank *permitted facilities* based upon the type of permit issued. **Table 6-2** shows the release value assigned according to this method. The likelihood of release value ranges from a 1 to 3. The second method looks at the types of contaminants historically associated with different land uses and assigns a contaminant value. **Table 6-3** illustrates how contaminant values are assigned using this method. Each type of business is ranked based on a potential contaminant value. As with the permitted facilities a rank of 1 is a low risk with 3 being a high risk factor.

Step 2. Determine Proximity to the Water Source

The proximity or distance of a given release to the source of water for a community water supply is of primary importance in estimating its potential impact. Groundwater systems typically have three zones of protection based upon travel time to the point of withdrawal. Wellhead Protection Area 1 or zone 1 is a 180 day time of travel or a 400 foot radius, Zone 2 is a ten year travel time, and Zone 3 is the hydrologic boundary between water or groundwater sheds. Due to the ***KARST*** nature of the Royal Spring Aquifer, the entire recharge area is considered zone 3. The movement of groundwater in a karst area may be as rapid as surface flow. It has been estimated that contaminants may reach Royal Spring in approximately 12 hours depending upon the flow of the aquifer. ***A proximity value of 3 is assigned to Royal Spring.***

Table 6-2 Rating Likelihood of Release from Permit Information

Permitting Terminology	Likelihood of Release Value
Hazardous Waste TSD (Treatment, Storage or Disposal Facility)	
Without "corrective Action"	2
In "Corrective Action" or "Post Closure"	3
Registered Hazardous Waste Generator	
Without "corrective Action"	2
In "Corrective Action"	3
KPDES (discharge)	1
Known wastewater release without a permit	3
Federal Superfund site	2
State Superfund site	
Active	3
Closed	2
Petroleum Release site	
Active	3
Closed	1
Waste lagoon	3
Registered with Local Emergency Planning Committee	
With a contingency plan on file	2
Without a contingency plan on file	3

Step 3 Determine Hydrologic Sensitivity

Hydrologic Sensitivity is the ease of groundwater movement in a given system as it relates to travel time. The physical features of an aquifer or a groundwater system have to be analyzed. The physical characteristics of the system take into consideration the physical, chemical, geological, hydrological, and biological attributes of each given system. Karst geology presents special challenges not found in regular and confined aquifers. It has been found in the Royal Spring Aquifer that vertical and horizontal migration of surface to groundwater is extremely rapid via the sinkholes in Cane Run.

Due to the KARST nature of the Royal Spring Aquifer a hydrologic sensitivity value of 3 is assigned.

TABLE 6-3 POTENTIAL CONTAMINANT SOURCES / LAND-USE ACTIVITIES

Contaminants of Concern	Acids	Bases	Chlorides	Fluoride	Fe/Mn	Other Metals	Nitrate	Pathogens	Pesticides and Herbicides (SOC'S)	Petroleum Products (VOC'S)	Phenols	Radioactivity	Sodium	Solvents	Sulfate	Surfactants(Detergents)	Sediment/Turbidity	Contaminant Value
Land Use Catagories																		
Above Ground Storage Tanks									X	X								3
Airport							X		X	X			X					3
Non Point Sources of Pollution																		
Abandoned Mine Lands	X				X										X		X	2
Agricultural Chemical Business							X		X	X			X					2
Agriculture																		
Hay and Pasture Land							X	X					X					2
CRP Land																	X	1
Row Crops							X	X	X	X			X				X	3
Animal Feeding Operations							X	X					X					2
Golf Course							X		X									2
Lawn Care Chemical Use							X		X	X						X		2
Logging and Timbering										X							X	1
Parks																	X	1
Recreational Space																	X	1
Unmanaged Woodlands																	X	1
Septic Systems (Residential)			X		X	X	X	X					X	X		X		2
Straight Pipe Sewage Discharge			X		X	X	X	X					X	X		X		3
Sewage Lagoon/Sludge			X		X	X	X	X					X	X		X		3
Hazardous Substance Sites																		
Asphalt Plants										X								2
Beauty Parlors		X				X								X		X		1
Boat Repair Facilities						X				X	X			X		X		3
Car Repair Facilities						X				X	X			X		X		3
Car Washes			X			X				X			X	X				2
Cemeteries									X							X		2
Dry Cleaning Facilities														X				3
Farm Machinery Repair Facilities						X				X	X			X		X		3
Furniture Stripping/Painting	X	X				X												2
Gas Stations									X	X								3
Industrial Lagoons	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Jewelry Metal Plating	X	X		X	X	X							X	X		X		2
Junkyards (Salvage Yards)	X				X	X								X	X			3
Laundromats								X						X		X		2
Machine Shops	X	X				X								X		X		2
Medical and Veterinary Clinics								X				X		X		X		2
Photography Labs/Printers	X	X				X								X		X		2
Research Labs	X	X		X	X		X	X	X	X	X	X		X		X		2

1=Low 2= Moderate 3= High

*** General Catagories not differentiated**

Contaminants of Concern	*Acids*	*Bases*	*Chlorides*	*Fluoride*	*Fe/Mn*	*Other Metals*	*Nitrate*	*Pathogens*	*Pesticides and Herbicides (SOC'S)*	*Petroleum Products (VOC'S)*	*Phenols*	*Radioactivity*	*Sodium*	*Solvents*	*Sulfate*	*Surfactants(Detergents)*	*Sediment/Turbidity*	*Contaminant Value*
Schools, Colleges, Universities	X	X		X	X		X	X	X	X	X	X		X		X		2
Salt Domes			X							X			X		X			1
Wood Preserving Facilities						X				X	X			X	X	X		2
Hazardous Material (Haz Mat)																		
Haz/Mat Storage Facilities	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Haz / Mat Transfer Stations	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Haz. Waster Generator and TSD Site	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Imporperly Abandoned Oil & Gas Well			X							X		X	X					2
Improperly Abandoned Water Well					X	X	X	X										2
KPDES (Permitted Discharge) Sites	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Mining and Quarrying	X				X	X									X		X	2
Pipelines																		
Municipal Sewer Lines		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Oil Lines										X								3
Natural Gas										X								2
Stormwater Drains/Detention Basins			X			X		X	X				X	X				2
Solid Waste Sites (Landfills)																		
Landfills (Contained)	X		X		X	X	X	X	X	X	X	X	X	X	X		X	3
Landfills (Non-Contained)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Const., Demolition, Debris Landfills																	X	2
Illegal Dumps	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Special Waste Landfills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Landfarms						X	X	X										3
Superfund Sites	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Transportation Corridors																		
Roads/Highways	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Railroads	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Barge Traffic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
Underground Injection control Well																		
Class I	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	3
Class II			X							X		X	X	X				2
Class III			X										X					2
Class V	X	X	X		X	X	X	X	X	X				X	X	X	X	2
Petroleum Release sites									X	X								3
Underground Storage Tank Sites									X	X								3

1=Low 2= Moderate 3= High

*** General Catagories not differentiated**

Numeric Ranking & Susceptibility Ranking

Land use can be ranked based on potential for groundwater pollution using susceptibility analysis. Susceptibility Determination is calculated from the three factors described above and uses the following scale:

- Low risk 6-9
- Medium risk 10-14
- High risk 15-18

Susceptibility Determination:

The conversion and development of rural lands to a higher intensity land use in the Royal Spring Aquifer in both Fayette and Scott County is going to take place. Both counties are extremely aware of the potential for groundwater pollution. The utilization of the of Hydrologic Sensitivity chart found in Table 6-3 coupled with the 1995 land use for Fayette County has shown that only Greenspace and park uses of the land in the aquifer protection area have a low susceptibility ranking. All other land uses either have a medium or high susceptibility to the potential for groundwater pollution. Table 6-4 illustrates the general risk factor for different land uses in the Royal Spring Watershed Area in Fayette County.

6-2 Fayette County Land Use in the Royal Spring Aquifer

The aquifer protection area in Fayette County may be broken down into four basic land development configurations. The Rural Service Area, and three categories in the Urban Service Area: an area of urban development, a transition area of existing and new development, and a rural area that will be developed in the near future. Section 3 of this report has discussed the planning and land use aspects of Fayette County. The purpose of this section is to discuss the changes of land use that will occur with future development. Generally it may be assumed that a more intense development will occur in the urban areas, consistent with population growth. The Rural Service Area will also see change, but at a much slower pace. Table 6-5 illustrates the increase in the total land area for each type of land use designation. The table compares the developed acres for each land use category that was inventoried in 1995 and compares that to the potential of "full" development. It

TABLE 6-4 NUMERIC RANKING & SUSCEPTIBILITY RANKING FOR FAYETTE COUNTY

CV RATING	Fayette County Land Use	Fayette County Land use Type	Acres	WHPA	Factor Value CV X 3	Factor Proximity X2	Hydro Sens plus	Total Numeric Rating	Susceptibility Ranking
1	CC	Community Center	0	yes	6	4	3	13	med
2	CIR	Auto Circulation / parking	193.4	yes	9	6	3	18	high
3	EAR3	Expansion Area 3	0	yes	6	4	3	13	med
4	ED	Economic Development	0	yes	6	4	3	13	med
5	GS	Greenspace	7	yes	3	2	3	8	low
6	HC	Highway Oriented Commercial	255	yes	9	6	3	18	high
7	HD	High Density Residential	150.7	yes	6	4	3	13	med
8	HF	Horse Farms	256.2	yes	6	4	3	13	med
9	LD	Low Density Residential	980.3	yes	6	4	3	13	med
10	LI	Light Industrial	434.5	yes	9	6	3	18	high
11	MD	Medium Density Residential	723.1	yes	6	4	3	13	med
12	OPU	Other Public Uses	304.7	yes	3	2	3	8	low
13	ORP	Office Research Park	34.9	yes	9	6	3	18	high
14	PE	Schools	63.1	yes	6	4	3	13	med
15	PR	Parks	370.8	yes	3	2	3	8	low
16	PS	Professional Service Office	96.5	yes	6	4	3	13	med
17	RSA	Rural Service Area	10,117.00	yes	6	4	3	13	med
18	RT	Retail Trade & Personal Services	155	yes	6	4	3	13	med
19	RTHD	Retail Trade / High Density	0	yes	6	4	3	13	med
20	SP	Semi-public Facilities	329.9	yes	6	4	3	13	med
21	U	Utilities	14	yes	9	6	3	18	high
22	VAC	Vacant Land	1,560.30	yes	6	4	3	13	med
23	VHD	Very High Density Residential	3.7	yes	6	4	3	13	med
24	WW	Warehouse & Wholesale	189.8	yes	9	6	3	18	high
		TOTAL	**16,239.90**						

CV= contaminant value

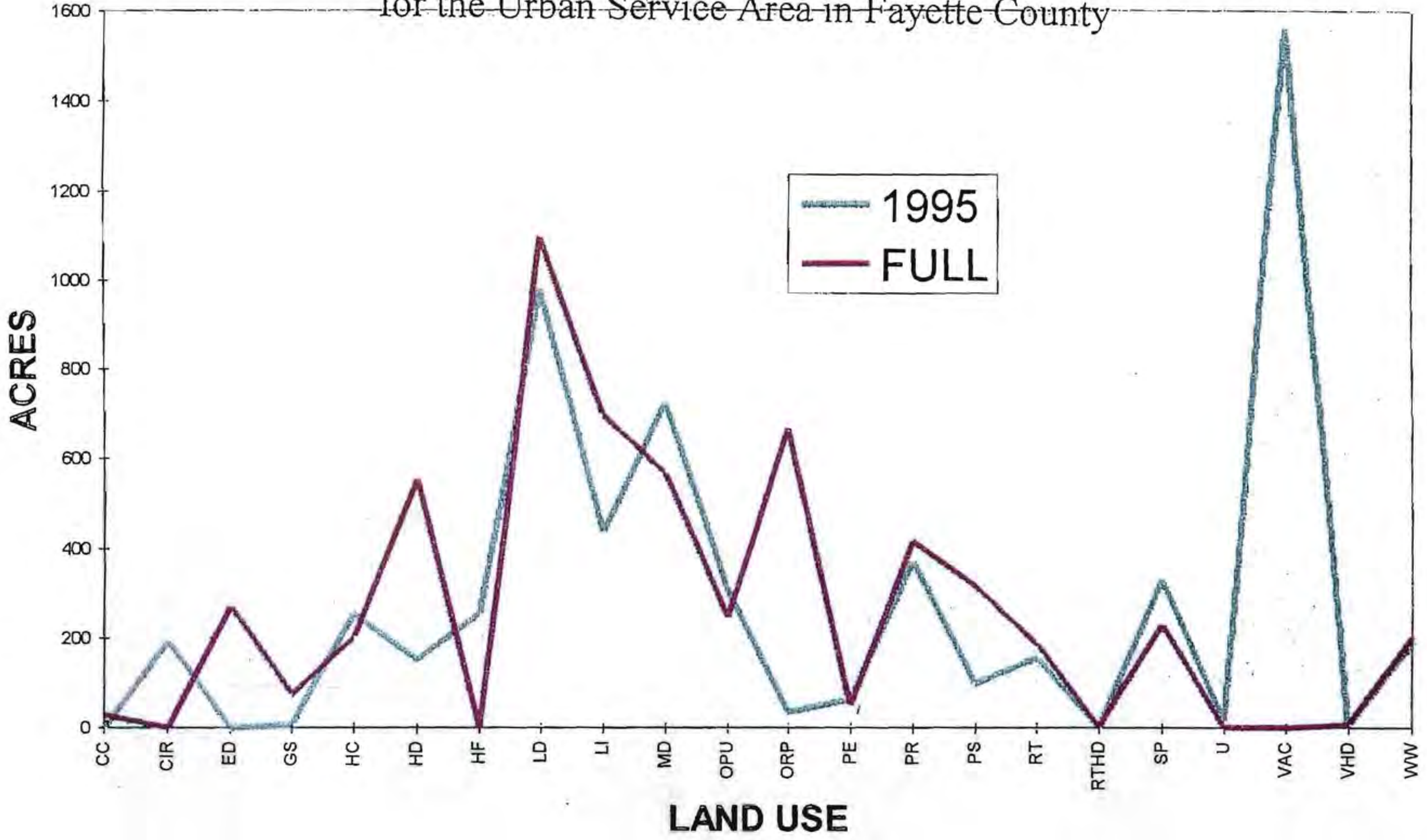
TABLE 6-5 EXISTING AND FUTURE LAND USE IN THE URBAN SERVICE AREA

	LAND USE / ROYAL SPRINGS AQUIFER		
Landuse		**Acres**	**Acres**
Code	**Category**	**1995**	**FULL DEV.**
CC	Community Center	-	28.5
CIR	Auto Circulation / parking	193.4	
EAR3	Expansion Area Residential	-	0
ED	Economic Development	-	271.1
GS	Greenspace	7.0	73.2
HC	Highway Oriented Commercial	255.0	201.9
HD	High Density Residential	150.7	554.1
HF	Horse Farms	256.2	-
LD	Low Density Residential	980.3	1,097.0
LI	Light Industrial	434.5	697.6
MD	Medium Density Residential	723.1	567.9
OPU	Other Public Uses	304.7	245.6
ORP	Office Research Park	34.9	666.8
PE	Schools	63.1	48.6
PR	Parks	370.8	415.5
PS	Professional Service Office	96.5	317.9
RSA	Rural Service Area	10,117.0	10,117.7
RT	Retail Trade & Personal Services	155.0	188.5
RTHD	Retail Trade / High Density	-	2.2
SP	Semi-public Facilities	329.9	231.2
U	Utilities	14.0	-
VAC	Vacant Land	1,560.3	-
VHD	Very High Density Residential	3.7	7.0
WW	Warehouse & Wholesale	189.8	201.7
	TOTAL	16,239.9	15,934.0

will be noted that some discrepancy exists in the total number of acres between the two figures for 1995 and full development. This is due to the calculation method and changes in terminology in some of the land use designation. The differences for purposes of this report are insignificant.

An analysis of these figures is shown in Figure 6-1 graphs the 1995 land use categories for Fayette County and the land use with development as shown in the 1996 Comprehensive Plan.

FIGURE 6-1 Analysis of Land Development in the Royal Spring Aquifer for the Urban Service Area in Fayette County



The full development potential is important to this plan in that the intensity of land use will be an indication of the potential pollution problems that could occur. The higher intensity of land use, the higher the potential for pollution. Density in terms of degree of development usually indicates more impermeable surface area and more business and commercial development.

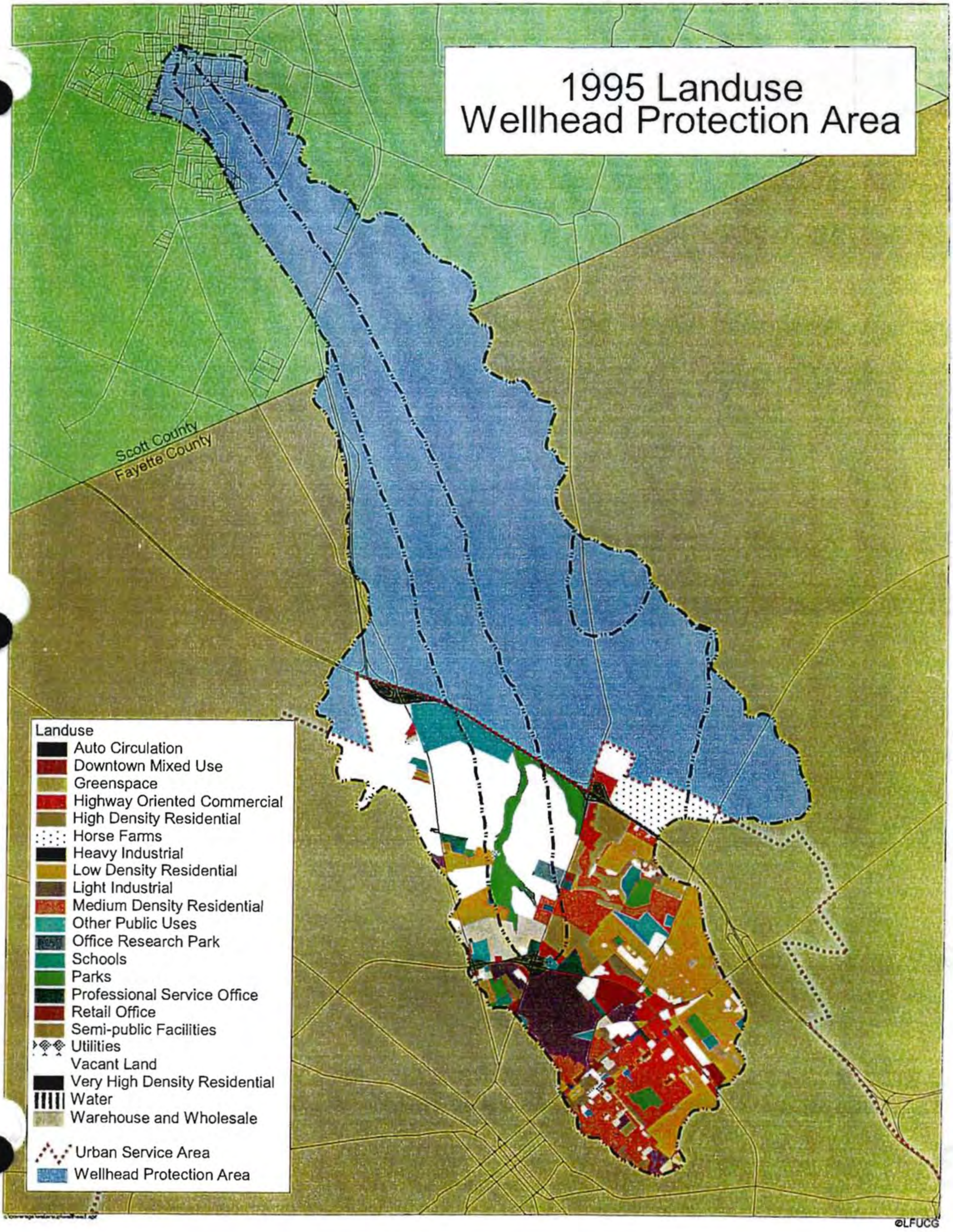
a. Urban Service Area – to be developed

Figure 6-2 and 6-2-A depicts the 1995 Land Use Categories in the Wellhead Protection Area FOR Fayette County. The comparison of Figure 6-2 with Figure 6-3 entitled Full Development Land use Wellhead Protection Area illustrates future development. The area in purple is included in the Rural Service Area. The major increase in the land use types in the Royal Spring Aquifer area in Fayette County will be that of High and Low Density Residential development, Office Research Park development, Professional Service Office, Parks and Semi-public Facilities. Figure 6-2-A illustrates the development potential for Scott County as shown in the draft Zoning Map for the Royal Springs Aquifer Recharge Area. In Fayette County the comparison between the existing 1995 and full development may be easily illustrated in Figure 6-4. In Fayette County, it has been recognized for over twenty years that the recharge area for Royal Spring is important to protect, and special attention has been given to help protect this area. In the development of the Coldstream Research Park over ten years ago, methods were introduced in the form of development plan notes for aquifer protection. The acquisition and development of Cane Run Park that includes the stream of Cane Run, the direct stream for recharge of the aquifer was also in part to protect the aquifer. In Scott County Figure 6-4-A illustrates the comparison of land use types in the aquifer while Figure 6-5-A illustrates the land use character in the aquifer. The rural land use is predominately agricultural with the exception of two rural residential developments, the Cassidy Heights and the Lowell Siders Property.

b. Urban Service Area – developed/residential & business, commercial, & industrial

The developed urban areas in the Urban Service Area include many older urban areas close even to downtown Lexington. The potential problem areas contain many acres of business, commercial and industrial locations. A number of unsewered areas occur in the older residential sections of the aquifer area. Problems have occurred in the older sections of the aquifer area with sewage overflows. One notable problem is located on Grantchester Road. A twelve-inch pipe overflows during intense storm events. The State requires that a twenty-year sewer maintenance

FIGURE 6 – 2


1995 Landuse
Wellhead Protection Area
Scott County
Fayette County
Landuse
Auto Circulation
Downtown Mixed Use
Greenspace
Highway Oriented Commercial
High Density Residential
Horse Farms
Heavy Industrial
Low Density Residential
Light Industrial
Medium Density Residential
Other Public Uses
Office Research Park
Schools
Parks
Professional Service Office
Retail Office
Semi-public Facilities
Utilities
Vacant Land
Very High Density Residential
Water
Warehouse and Wholesale
Urban Service Area
Wellhead Protection Area
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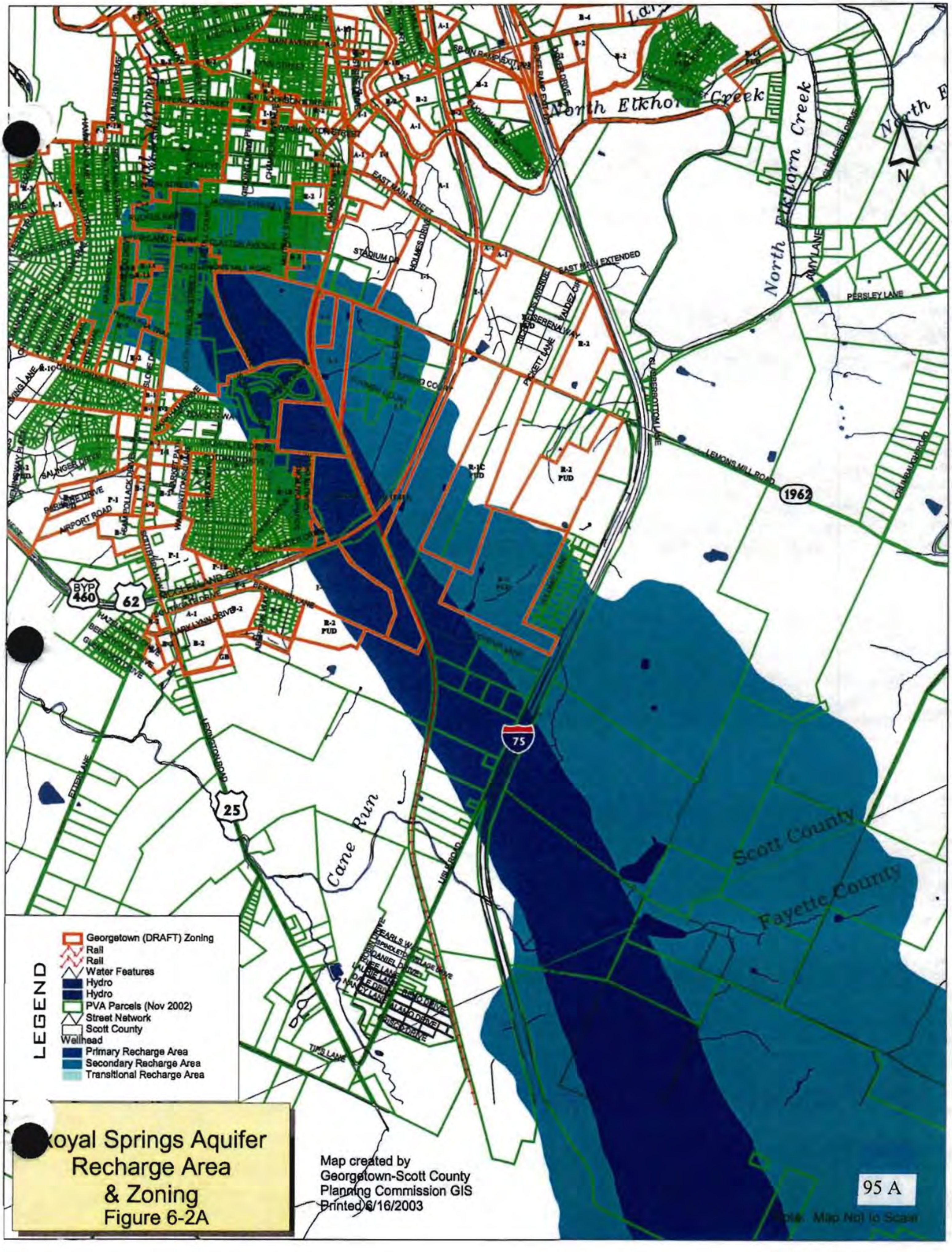
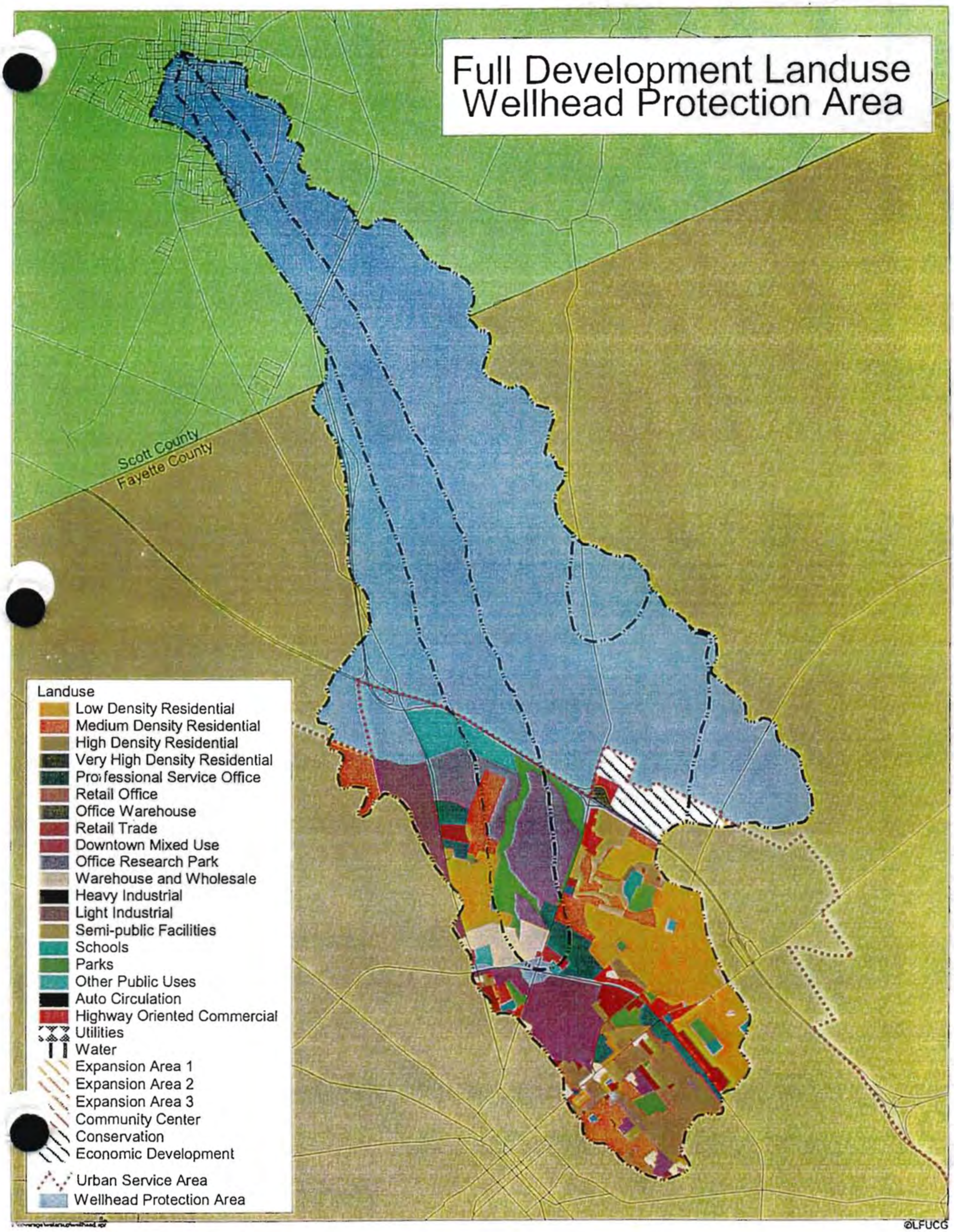


Royal Springs Aquifer
Recharge Area
& Zoning
Figure 6-2A

Map created by
Georgetown-Scott County
Planning Commission GIS
Printed 6/16/2003

FIGURE 6 – 3


Full Development Landuse
Wellhead Protection Area
Scott County
Fayette County
Landuse
Low Density Residential
Medium Density Residential
High Density Residential
Very High Density Residential
Professional Service Office
Retail Office
Office Warehouse
Retail Trade
Downtown Mixed Use
Office Research Park
Warehouse and Wholesale
Heavy Industrial
Light Industrial
Semi-public Facilities
Schools
Parks
Other Public Uses
Auto Circulation
Highway Oriented Commercial
Utilities
Water
Expansion Area 1
Expansion Area 2
Expansion Area 3
Community Center
Conservation
Economic Development
Urban Service Area
Wellhead Protection Area
©LFUCG

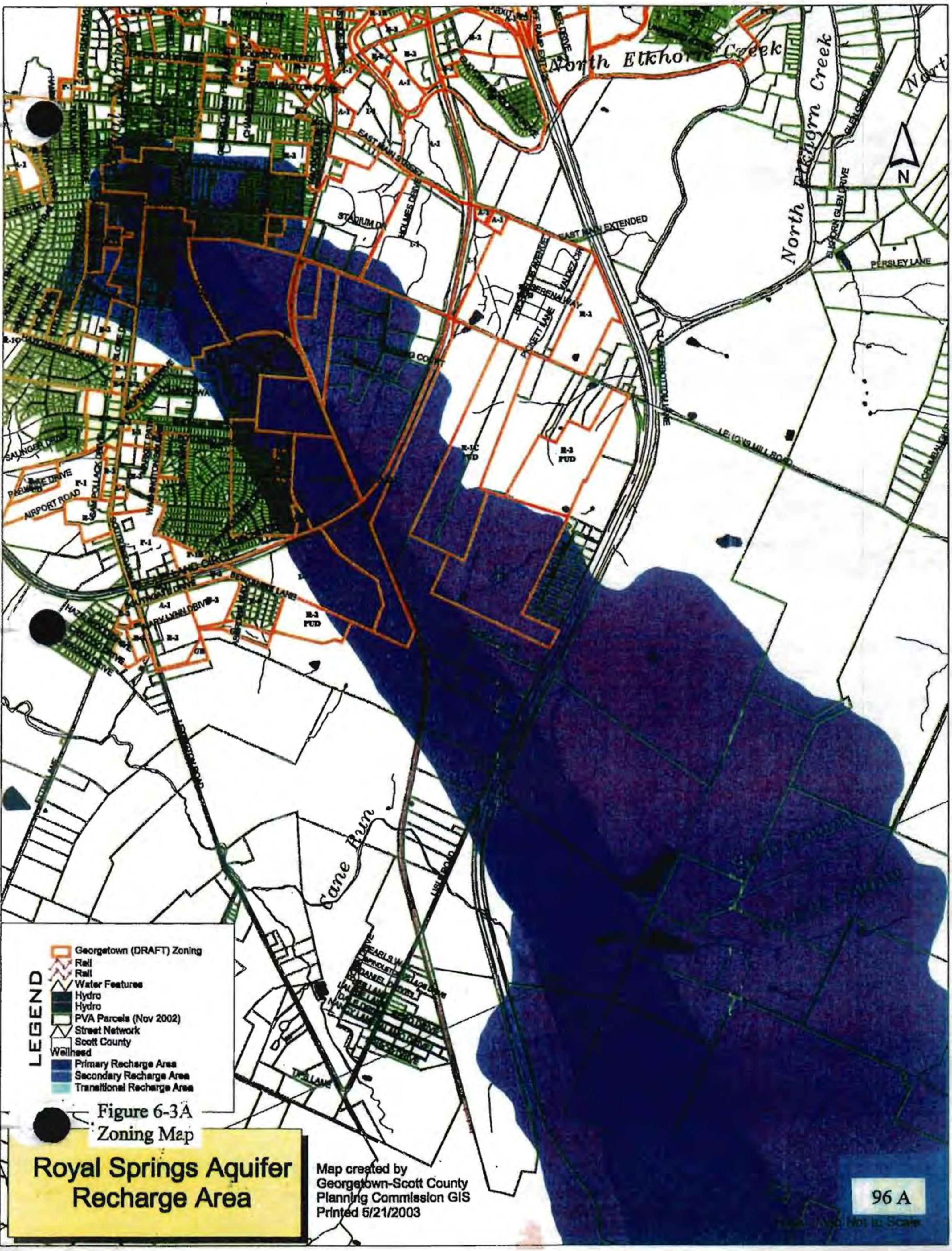


Figure 6-3A
Zoning Map

Royal Springs Aquifer Recharge Area

Map created by
Georgetown-Scott County
Planning Commission GIS
Printed 5/21/2003

FIGURE 6-4. Comparison of Land Use Types

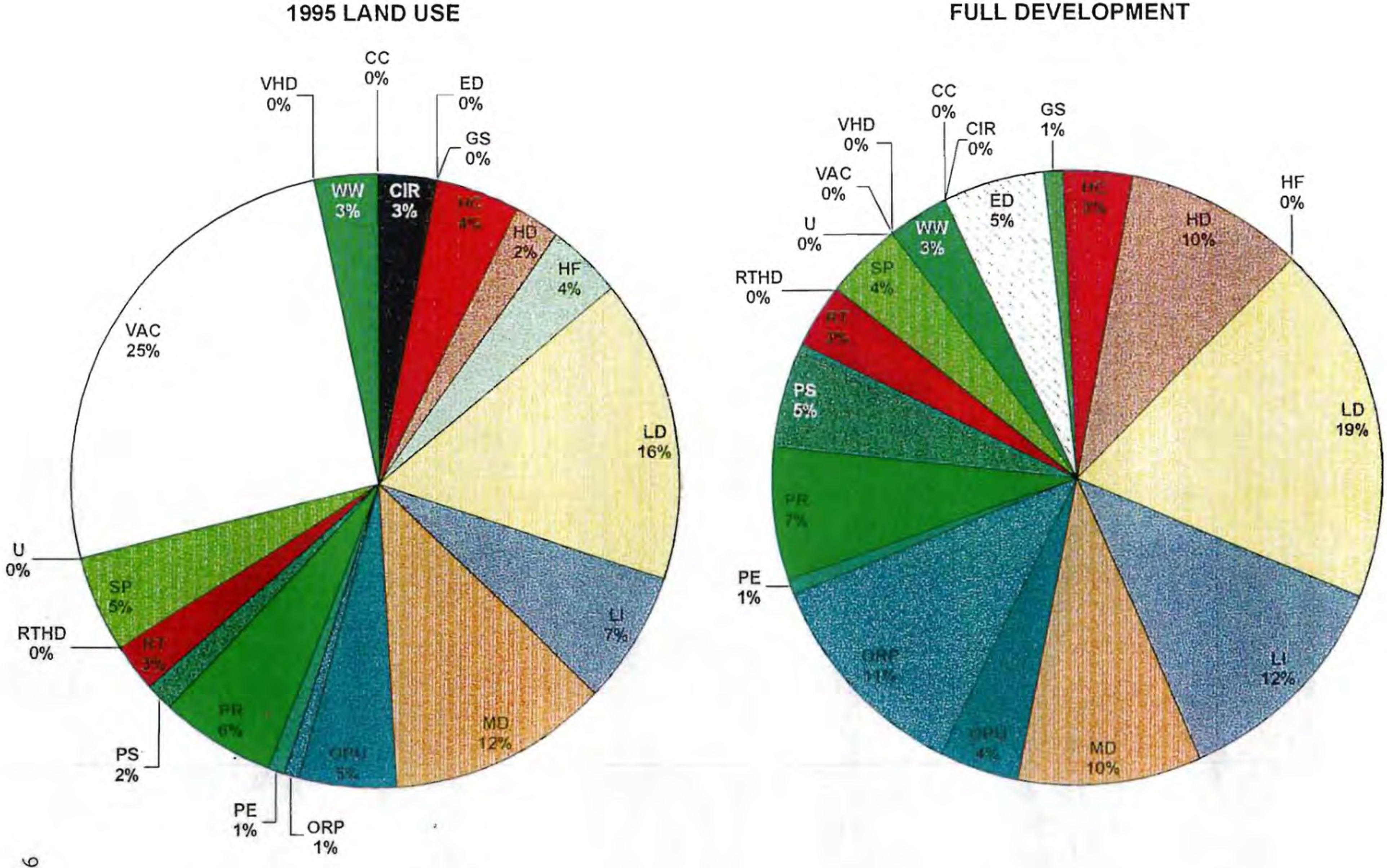
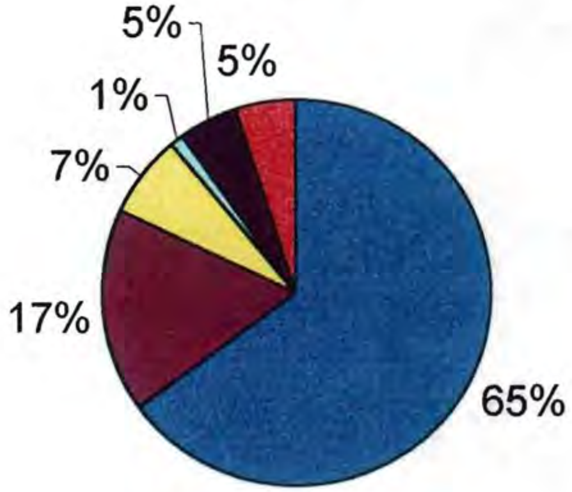


Figure 6-4A Comparison of Land Use Types



Agriculture (A-1)	65 %
Industrial (I-1)	17 %
Residential (R-2)	7 %
Residential (R-1C)	1 %
Residential (R-2 PUD)	5 %
Residential (R-1D)	5 %

plan be developed. Lexington is in the process of locating these problem areas and is developing a remedial plan to address this issue. The problem of sanitary sewer discharge during storm events of high rain and infiltration of sanitary sewer pipes is mitigated in part by the dilution action of the storm event. Stormwater runoff is also an issue that is in the process of being addressed. Both of these critical issues are being studied and analyzed and will be included in updates of this plan.

c. Rural Service Area

Fayette County enacted a Rural Service Area Land Management Plan for the Rural Service Area of Fayette County. The Lexington Fayette Urban County Government has adopted this plan. Section IV pages 5-9 includes guidelines for development in the aquifer recharge area. This Section is found in Appendix 6-1. The LFUCG council has also enacted a special ordinance, Chapter 26 of the code of ordinances, to establish the Fayette County Rural Land Management Board. One of the duties of this board is to establish a program to preserve and manage agricultural, rural and natural lands.

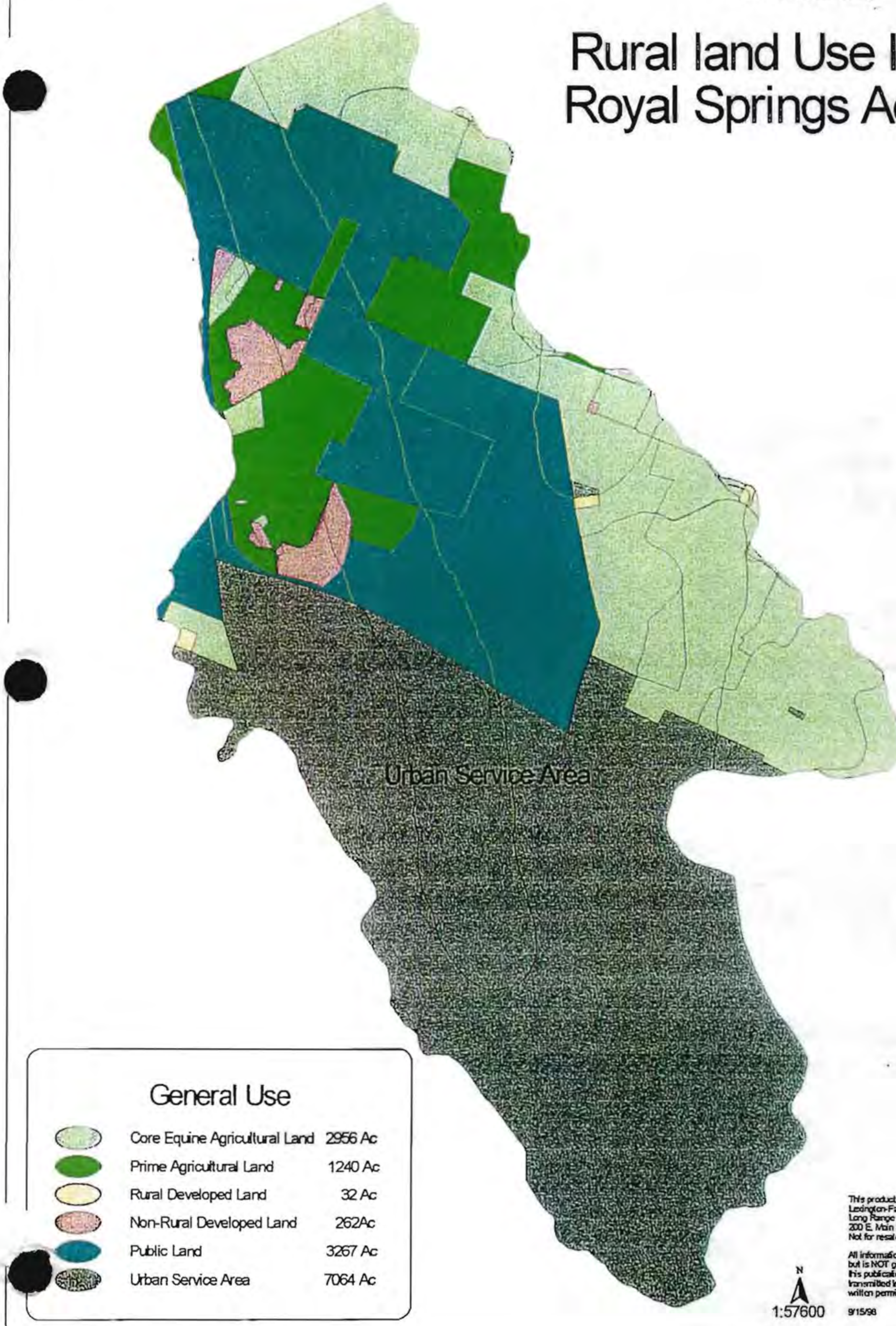
The Wellhead Protection Area is also addressed in this ordinance and may be found in Appendix 6-2. Currently in the Rural Service Area, residential development is generally limited to lots of forty acres or more. Also, a Purchase of Development Right Program (PDR) is to be investigated. If the PDR effort fails and development is once again allowed on rural lots of ten acres in size, it should be the recommendation of this committee that **no septic systems should be allowed on any future lot smaller than ten acres.**

Figure 6-5 entitled Rural Land Use in the Royal Spring Aquifer Area in Fayette County illustrates the rural land. The land use category of Core Equine Agricultural Land and the Prime Agricultural Lands account for 4,196 acres or 54% of the rural area in the aquifer. Rural Development Land accounts for 32 acres, and Non-Rural Developed Land occupies some 262 acres.

Public Land owned either by the University of Kentucky, The Kentucky Horse Park, or other public agencies accounts for 3,267 acres or 42% of the rural area in the aquifer. The public lands and the prime agricultural and horse farms that already exist in Fayette County in the Rural

FIGURE 6-5

Rural land Use In the Royal Springs Aquifer



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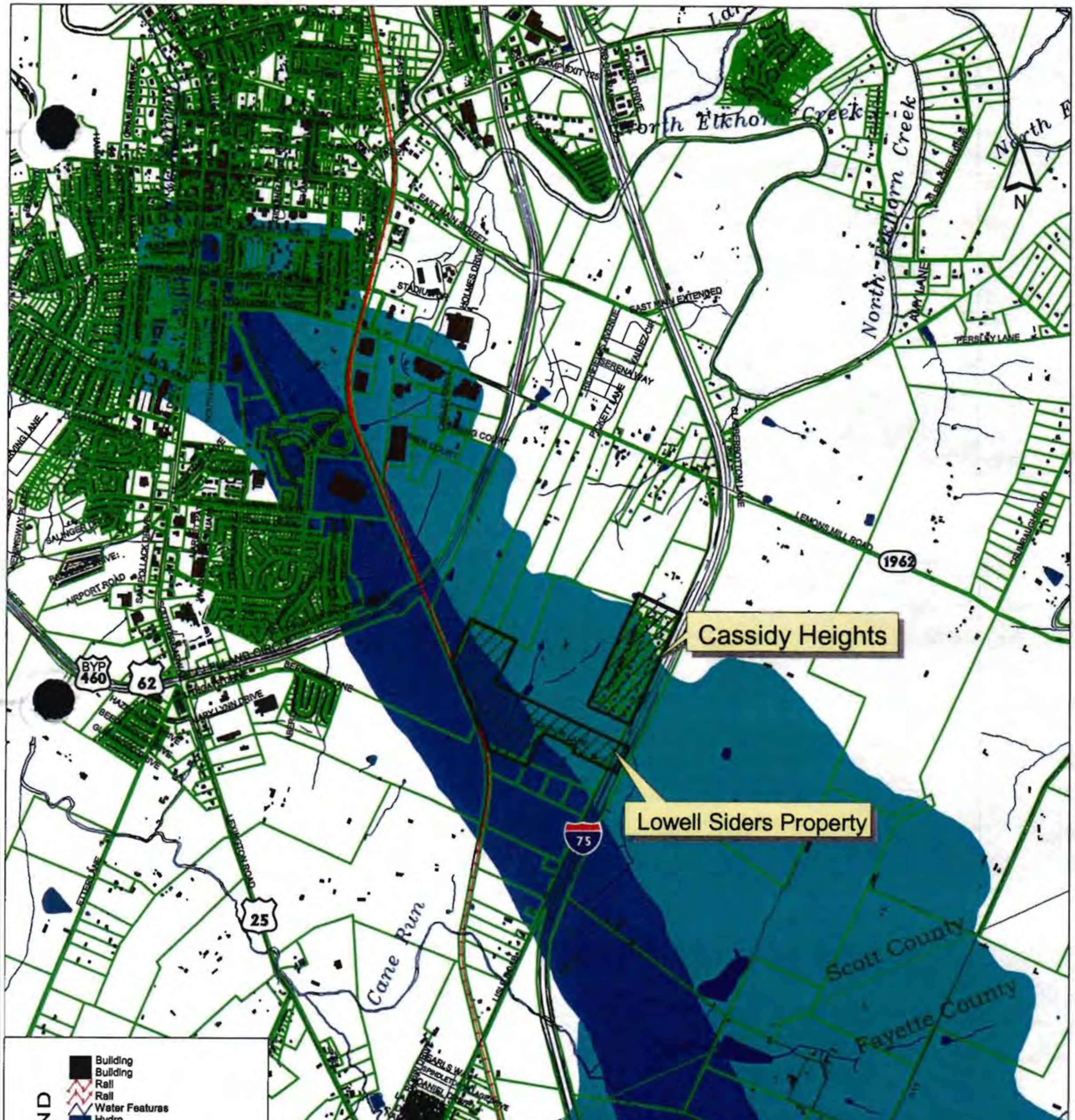

ural Land Use in Royal Springs Aquifer Recharge Area

Figure 6-5A

Map created by
Georgetown-Scott County
Planning Commission GIS
Printed 5/21/2003

Service Area amount to 96% of the area. It is not anticipated that the rural character of the landscape will change that much over the next twenty years except for the possibility of urban development of farm land in large lot holdings.

6- 3 Scott County Land Use in the Royal Spring Aquifer

The 1996 Comprehensive Plan for Scott County was adopted and is currently in effect. Scott County has an Urban Service Boundary (USB) that contains 23.3 square miles. The City of Georgetown contains 16.5 square miles. The Comprehensive Plan also has a Protection Area (PA) for the Royal Spring Aquifer. The following guidelines pertain to development:

- Development within the USB is dependent upon the extension of sanitary sewer.
- The majority of property contained within the USB and Protection Area (PA) is currently developed. The remaining property outside of the USB but within the PA is primarily agricultural. Other Urban uses within the Protection Area:
    1. Lowell Siders property 11 single family residential / 62.6 acres
    2. Cassidy Heights 38 single family residences / 55 acres
- Rural development outside USB – minimum of 5 acres for septic tank
- The Scott County Zoning Ordinance, Zoning & Subdivision Regulations, and the Comprehensive Plan recommends clustering to preserve rural lands / 1.0 acre lot minimum, 4 acres reserved for agricultural / open space. For more information on Scott County cluster development see Appendix 6-3.

6-4 Mutual Systems – Transportation / Rail Interstate / local

In Fayette County it is not anticipated that any new major roads will be developed except for the Viley Road extension that is now called Citation Boulevard. This road extension crosses the main channel of Cane Run at the Coldstream Research Campus, and is expected to be almost extensively utilized by commercial traffic. The design of the road does take into consideration the potential environmental danger of accidental spills and surface runoff into the stream.

Other projects in the area include major existing road improvements. The major planned improvement in the aquifer is a widening of U.S.25 (Georgetown Road) between the Urban

Service Areas of Georgetown and Lexington. Fortunately, one half or more of this corridor lies west of the wellhead protection area.

Section 7. Water Use in the Aquifer

The Royal Spring Aquifer is the predominant water source for the city of Georgetown and Scott County. It is not anticipated that this source of water will be utilized for any other domestic public water supply. Today the Georgetown Municipal Water and Sewer Service Department supplies some 8,000 customers in Georgetown and Scott County. This aquifer has provided water for Scott County for over two hundred years. Fayette County utilizes the Kentucky River as the primary source of water for its municipal area.

Water quality problems with the aquifer have occurred very infrequently in the past. Ten years ago, a significant benzene contamination problem occurred in the aquifer. Royal Spring had to be shut down for about ten months until the quality of the water improved through recharge and the natural flushing of the spring. The contaminant leak was never found and it was suspected that an underground storage tank was creating the problem. In response to this occurrence,an air stripping tower was installed to remove any residue petroleum product left in the water.

The aquifer and any groundwater source is extremely valuable as a water supply. In reviewing the records of groundwater wells in Fayette County,it was noticed that the number of wells as a water source are diminishing. The 1990 census indicates a decline of about half the number of households that utilize water wells from the 1980 census in Fayette County. A groundwater survey of 1,700 property owners in Fayette County, conducted by the University of Kentucky in 1988, identified approximately 70 wells, with 31 located in the Royal Spring WHPA. As the number of wells is diminished, the dependence upon the regional water suppliers goes up.

Agricultural water use in the aquifer may pose a problem with water supply in low flow conditions. In a drought situation where agricultural crops require some irrigation to control loss,the competition for water in the aquifer may present a problem. It is understood that in the drought of 1988 a severe problem occurred with Elkhorn Branch and the withdrawal of water from the stream for irrigation purposes. The State Division of Water had to curtail water withdrawal from the stream. This situation could also occur with golf courses depending upon the location of the course, and the depth and number of water wells. The Kentucky Division of

Water has the opportunity to monitor the number of permits issued and regulate the amount of water to be withdrawn.

Section 8. Management of the Wellhead Protection Area

8-1 Management Approach

The Kentucky Division of Water has adopted the boundaries of the Royal Spring Aquifer as a wellhead protection area to meet the federal requirements for the protection of a sole source aquifer. The designation as a wellhead protection area defines the need for land use planning. The policy of the local government(s) should be to insure that the aquifer will not suffer degradation of the water quality or quantity of the aquifer as suburban and urban development occurs.

The implemented land use plans should strive to meet the intent of the wellhead protection plan. The administration of land use policies should have as an objective the maximum preservation and protection of the undeveloped rural lands overlying the aquifer. Comprehensive watershed rules and regulations regarding land development in the Cane Run Watershed and the Royal Spring Aquifer should be developed and adopted. Existing regulations can and should be rigorously enforced.

The protection of the aquifer will require that new ideas be adopted by the three governmental entities of Fayette County, Scott County and the city of Georgetown. The basic policy should be an antidegradation policy for the aquifer. To do this the public policy objective should be to insure that land use overlying the aquifer will not subject the groundwater to pollution. The local governments should insist on the use of best management practices to preclude the introduction of pollutants into the aquifer regardless of the cost to the community. Land use controls, both urban and rural, can play a large role in the protection of the watershed. It is unrealistic to assume that zero degradation will occur in the aquifer due to the pressures of agricultural production, growth and development. Non degradation though is possible through tradeoffs in total watershed management by not allowing total development of both the urban and rural areas.

8-2 Responsibility for Wellhead Protection

The Georgetown Municipal Water and Sewer System is responsible for coordinating efforts with other state and local agencies and monitoring the status of the programs which protect the groundwater quality of the Royal Spring Wellhead Protection Area. The three local governments are responsible for assuring future urban or suburban development in the ground-water basin does not degrade the quality of the Royal Spring Aquifer. Further, they have the responsibility to enforce their ordinances relative to storm water runoff, storage and handling of hazardous waste, and sinkhole dumping and development. The creation of the Royal Spring Groundwater Protection Committee is one of the first steps to achieve this goal. Each member of that committee is charged with the responsibility of evaluating the hydrology of the aquifer and identifying potential problems that can occur. Whether it is with new development or a response to a hazardous incident, each member is charged with a responsibility to inform, as necessary, the elected officials of potential problems. On going creativity in the design and review of new development and change is the key to accomplishing groundwater protection. The public and property owners also bear some responsibility, thus the importance of education.

8-3 Public Education and Resources

Education is one of the most effective methods of protecting groundwater by encouraging responsible behavior from the general public. Everyone realizes that a water supply is critical to everyday living. Water pollution in a sole source aquifer means community problems and increased water billing for water treatment, or reliance on another source of water.

The following have been developed for countywide (Scott and Fayette County) distribution. Some of the ideas have already been implemented.

Water protection signs

In 1996, Georgetown, Scott, and Fayette Counties participated in the Kentucky Natural Resources and Environmental Protection Cabinet "Water Supply Protection Area" sign project, funded through a federal pollution prevention grant.

The Kentucky Division of Water and the Kentucky Division of Transportation working together with the multi-jurisdictional efforts of Georgetown and Scott and Fayette Counties in the Royal Spring Aquifer project provided the materials and manpower to place signs along the major transportation routes crossing the watershed. Approximately twenty-five signs have been installed and have helped to create an awareness of the sensitivity of this aquifer. By alerting the public to report spills to a designated emergency number. Nationwide, over 270 public water supply systems have posted signs under this federal grant.

Opportunities and Tools for Public Education

Many opportunities arise to increase the public awareness about the necessities of protecting our groundwater and about the various government agencies in Scott and Fayette Counties. Examples of these are:

- Displays for Earth Day or other local environmental day events
- Speakers for open public meetings of groups living in the recharge area such as neighborhood associations
- Letters to landowners about water supply protection
- Articles in newspapers and media press kits
- Wellhead plan fact sheet or brochure on topics such as properly maintained septic tanks, sinkhole cleanup, reporting spills, storage tank requirements and groundwater protection plans

Materials developed by the Kentucky Division of Water:

- Wellhead brochure
- Slide show on Royal Spring
- News release about wellhead protection
- Wellhead protection fact sheet
- Color Slide of Wellhead Protection Area
- 911 & 1-800 number for reporting spills
- List of Wellhead Protection program partners
- Wellhead protection resources available to landowners facts sheet

Wellhead Protection Programs

- Sinkhole cleanup funds
- Cost-share programs
- Reduction of soil erosion (Environmental Quality Incentives Program)
- Restoration of Erodiable Land (Conservation Reserve Program)
- Reduction of Agricultural Non-point Source Pollution (Water Quality Incentive Program)
- Best Management Practices Implementation (Scott County Water Quality Cost-Share Program)
- Soil & Water Protection from Animal-Waste Related Problems (Kentucky Soil Erosion and Water Quality Cost-Share Program)
- Land Acquisition/Easements for Elkhorn Creek (EPA & LFUCG Div. of Parks & Rec.)
- Household Hazardous Waste Program (Fall Haul Program)

Environmental Review Forms

Areas of special concern are those where hazardous materials are stored or areas where there is the potential for sudden discharge, such as a loading dock at an industrial site. New urban and rural development is also a concern. The adoption of an Environmental Review Form in Fayette County (see appendix 5-6) for each new development during the planning process can provide information to the planning agencies for the development of best management practices and guidelines for identification of potential contamination sources and pathways. Areas of agricultural development such as animal feed lots or intense poultry or swine feedlots should not be allowed in the aquifer. Scott County has not adopted a written form, but the elements indicated on the form are reviewed for development in the Royal Spring Aquifer.

CHANGED 5-9 to 5-6

Disposal of hazardous materials

The disposal of hazardous materials is well regulated in both Fayette and Scott County. Part of the education process will be to insure that both communities are vigilant in the awareness that accidents as well as illegal dumping can occur. It is important that detection and remedial cleanup are done in a timely fashion and that all parties are notified immediately as to the problem.

8-4 Wellhead Protection Area: Best Management Strategies

The term best management strategies in regard to the protection of the Royal Spring Aquifer is designed to be flexible when examining the environmental attributes of the land given the type of proposed development and the potential for pollution. Various parameters will be utilized in the review process. The following list contains a sampling of thought provoking land use qualities or potential pollution activities that need to have questions asked concerning the location. If problem areas cannot be relocated, then formulation of best management practices for each type of problematic land use should be developed. This list is not all-inclusive, but points in the direction of the many activities that come into play when trying to make a decision on best management practices.

- Placement of water wells in the aquifer
- Septic systems location and operation, existing and new development
- Class V Underground Injection Wells
- Feedlots & animal waste stockpiling areas
- Illegal dumping sites
- Above and below ground storage tanks
- Municipal sewage lines & disposal treatment facilities
- Chemical storage both farm and industry
- Industrial and auto salvage yards
- Car and commercial truck washes, terminals and service areas
- Funeral homes, morgues and animal hospitals
- Cemeteries, expansion or new facilities
- Sinkholes & other karst areas, as a direct link to the groundwater system
- Potential for accidental spill locations, interstate, bridges, roadway curves etc.
- Drainage structures, existing and proposed rerouting of stream channels
- Stream & channel hydraulic changes through existing and new development
- Water & sediment movement both agricultural and urban

Many potential problems can be alleviated through good long range planning. The location of the aquifer is known and the potential entrances for pollution are generally understood, therefore most problems can be overcome with proper planning. It is inherent in the planning process for plan reviewers to be aware of the potential problems for pollution. The following concepts need to be related to the planning process:

- Develop emergency response plans to accidental & other spills: on site & off site
- Recognize the pollution potential for each type of land use
- Develop site preparation & analysis techniques for each site depending on land use of that site
- Develop equilibrium concepts & stream disturbance minimization guidelines
- Develop streambank erosion control guidelines for both agricultural & urban areas
- Large lot development in rural areas / minimum ten acres or more, no clustering
- Create and develop riparian restoration stream bank restoration projects for streams in the aquifer
- Develop an official overlay zoning district or administrative overlay district for the aquifer

One of the best methods for identification and the environmental controls that might be necessary is the use of the Standard Industrial Codes for determining a potential hazard rating. Is the site in question near Cane Run, a sinkhole, or other drainage way? Does the site have a great potential for pollution, is it an asphalt plant, or a massive poultry or swine operation? Is a rural equine or cattle operation going to change in a drastic way, for instance, a commercial poultry or swine operation that will generate an extensive amount of animal waste. These are questions answered when the Environmental Review Form is submitted with the filing of a subdivision or development plan application or zone change.

Because the Royal Spring aquifer is recharged by direct stream flow, the development of storm-water quantity and quality Best Management Practices (BMPs) should be undertaken.

8-4.1 BMP's for Activities Impacting Ground-water Quality

Impact 1: Loss of Channel Capacity from Stream Bank Erosion

Mitigation should occur through the capture, storage, and release of a volume of water proportional to the impervious area. Infiltration practices should be implemented so that a portion of the additional runoff infiltrates into the ground.

Impact 2: Peak Flow Increases

Detention ponds should be designed and constructed so that peak flows after development are no greater than before development based on 10-year and 100-year storms.

Impact 3: Capacity of the Drainage Network

The development should be designed so that capacities of the newly designed and existing components of the drainage system are not exceeded. Criteria, based on 10-year and 100-year storms, vary with road inlets, storm sewers, culverts, and open channels.

Impact 4: Floodplain Area Increases

Developments should be designed to prevent an increase in the floodplain elevation and associated area. The floodplain area may increase in areas dedicated as a part of a regional stormwater management system.

Impact 5: Protection of Structures from Flooding for the 100-Year Storm

All structures should have the first floor elevations set at least two feet above the 100-year flood water surface elevation.

Impact 6: Destruction of Riparian Vegetation

No disturbances should be allowed in the post-development floodplain. Where disturbances are necessary, BMPs to mitigate the impacts should be designed and constructed.

Impact 7: Decreases in Base Flow

It is important that the base flow of the aquifer does not diminish by having runoff diverted outside of the ground-water aquifer.

Impact 8: Bottom Scour from Culverts

The design velocity at the culvert outlet should be reduced to match the natural stream velocity.

Impact 9: Increased Chemical Toxicity

Propose limits on land uses that might have an adverse impact on the water quality in the aquifer. Limit the development of land that might have an adverse impact on water quality or recharge capabilities in the aquifer protection area.

Impact 10: Nuisance Growth of Aquatic Plants

Riparian areas should be the focus of efforts to create rural greenways. Where possible, without creating interference with agricultural operations, these areas should be left in their natural state, or enhanced with eco-sensitive riparian plantings to improve water quality and create habitat areas.

Impact 11: Increased Bacteriological Content

In the rural lands, there should be a review of infrastructure requirements for potential future growth areas, including a 201-type sewer analysis for lands developing adjacent to sewered areas. In areas still served by septic tanks, analysis should be initiated for remedial action where failing septic systems are identified.

Impact 12: Increased Presence of Petroleum Products

Bioretention and infiltration practices are the preferred BMPs. Other BMPs such as wetland ponds, wet ponds, and dry extended detention ponds may be used but require varying water quality volumes. Runoff from commercial, industrial, and institutional rooftops, storage areas, and parking lots serving more than four dwelling units should be pretreated before discharge.

Impact 13: Sediment Deposition in Aquifer Conduits

Strong inspection guidelines for sediment control during construction in adjacent stream areas should be initiated. Areas of significant stream channel sediment deposition that creates an impact upon the stream corridor or impacts sinkholes in the stream channel should be earmarked for removal.

Impact 14: Increased Suspended Solids Concentration

Buffer zones and building setbacks should be developed to protect riparian areas within the Rural Service Area. Floodplain areas should be left in their natural state except where necessary to alleviate flooding conditions. Riparian buffer areas should be created adjacent to streams to improve water quality and protect stream areas from improper encroachment.

Impact 15: Decreases in Water Reservoir Storage Capacity

Non-structural and structural erosion and sediment control BMPs should be designed and constructed in accordance with an approved erosion and sediment control plan.

8-4.2 Monitoring of Surface and Groundwater

Surface Waters

The Lexington-Fayette Urban County Government (LFUCG) has been monitoring the conditions of the waters of the Commonwealth of Kentucky since it first applied for a stormwater discharge permit in 1992. The permit number is #KY00002. This permit serves the purposes of characterizing and quantifying urban sources of non-point source pollution through stormwater runoff from properties within the urban services boundaries of Fayette County.

The stormwater permit was required as part of the Water Quality Act of 1987. Medium sized cities with populations greater than 100,000 and less than 250,000 which had separate storm sewer systems were required to apply for permits as a phased approach to the management of water quality within the United States. Earlier legislation and programs (1972 Clean Water Act and the National Pollutant Discharge Elimination System (NPDES)), focused on removing point sources of water pollution. The 1987 stormwater permitting requirements were designed to manage non-point source water pollution from various industrial and municipal activities.

The emphasis of the storm-water monitoring program, which has been performed for the LFUCG by Commonwealth Technology, Incorporated (CTI), has evolved over the past six years. Initial sampling involved sampling during rain events and checking for "dry weather" flows from storm sewer out falls. Currently, sampling has been expanded to chemical constituent sampling of outfalls and streams, dry and wet weather, and sampling of the aquatic communities, fish and macroinvertebrates, as well. In the Royal Spring Aquifer the Georgetown Municipal Water & Sewer Service Administration has developed a stream sampling plan for the Royal Spring Aquifer. A summary of both of these plans may be found in Appendix 8-1

Groundwater

Water resources are essential for community growth and development. The water quality of the Royal Spring Aquifer is of high quality and meets or exceeds federal standards in every category. A significant number of tests are performed each year to ensure that the water leaving the GMWSS plant is of the highest quality. Each year approximately 24,000 tests are run on finished water to ensure a quality product. In 1997 and 1998 GMWSS, had no violations of Federal or State standards. The finished water quality standards are presented in Appendix 8-2 Royal Spring Finished Water Quality Analysis.

8-5 Watershed Protection Measures

The Lexington Fayette Urban County Government is in the process of exploring ways to develop better water resource protection measures. The ultimate goal is to provide better protection to existing developed streams and also to provide best management practices and controls to streams in the developing areas of our community. The inter-governmental approach is working to make the community and government agencies more aware of the necessity of water shed protection. This is being accomplished by a number of committees that have been set up to at various environmental concerns. The interaction of these committees together helps to bring together a total package of the environmental needs of our community. An Urban Forester has been hired to provide long range planning, which in part will deal with riparian reforestation. Engineering, Planning, Building Inspection, as well as the Greenspace Commission, Stormwater Commission, Environmental Commission, Tree Board, Royal Spring Water Supply Protection Committee as well as other government and community agencies are working together to create watershed awareness.

8-6 Regulatory Management Strategies

From a review of reports on wellhead protection areas, it is clear that land use restrictions are the best method for the control of groundwater pollution. Groundwater management must begin at the local level in terms of land use decisions and permits. The local management agencies of Fayette and Scott County and the city of Georgetown have to work together to develop a program of land use management for groundwater protection. Strategies have to be developed that incorporate both pollution control for point sources and resource protection for non point sources. Land design and management techniques are recognized as one of the most effective and important approaches to preventing and controlling pollution. The element of resource protection recognizes that land and natural resources perform critical environmental functions. These functions may be groundwater recharge, water quality improvement, erosion control, wildlife habitat, storage of floodwaters, and the scenic beauty of our equine and agricultural lands.

8-6.1 Royal Spring Aquifer Point Source Control Recommendations

Point source criteria for the reduction of groundwater pollution in the Royal Spring Aquifer should address the following:

- All wastewater discharges should be treated to a level sufficient to achieve water quality standards for fish and aquatic life as well as recreation.
- Wastewater facilities planning should be conducted in the non sewered urban areas to provide a timetable for an extension of public sewer service
- New or additional wastewater discharges, public or private, municipal or industrial, will not be permitted unless consistent with 201 facilities planning
- Wastewater facilities planning, both public and private including septic tank fields, shared systems, and clustered housing utilizing wetland systems should address the land use geologic and hydrologic effects of the proposals
- Point source management should address source control including bypasses, correction of excessive infiltration and inflow problems

Non point source runoff from developed urban areas generally contains more organic material. In general these materials usually contain the following:

- Vegetation (leaves, grass clippings, yard & garden debris)
- Traffic and traffic accident related debris
- Deicing and use of salt material in the winter
- Erosion & sediment buildup from construction
- Pet wastes
- Lawn and garden fertilizers and pesticides

Transportation of material is facilitated by the impervious surfaces and storm-water drainage systems carrying the materials to the receiving streams. Impervious surfaces include asphalt roads and driveways as well as compaction of entire subdivisions for building lots in clay based soil. Storm water cannot be absorbed by the compacted soils resulting in increased runoff. Questions have been voiced about the detention of storm water from large developments in the karst areas. One question that remains unanswered is whether natural sinkhole areas that have been a direct link to the aquifer are changed resulting in less water to recharge the aquifer. The thought is that development has not had a significant impact due to the large amount of land left in rural areas. Organic enrichment of the urban storm-water drainage systems and our streams from pollutants such as sediment, nutrients, organic matter, toxic materials, and bacteria can result in an elevated oxygen demand and create depressed levels of dissolved oxygen in stream channels, which affects aquatic life. This is especially true in the hot summer months during low flow conditions. The simple act of creating hydrologic diversions in the stream channel to produce a ripple effect have immense benefits for improvement of the dissolved oxygen content of the receiving stream.

Management practices must be developed and adopted by both Fayette and Scott Counties to better address the degradation of our streams. A significant number of approaches can be used to improve the hydrologic and water quality impacts of urbanization and to control the non-point sources of pollution. Two areas should be investigated: better methods for source control after development and design, management and development of the stormwater drainage system itself before development. Many of these solutions have to start at the source of the problem, the urban and rural waterway and the methods through which we develop our subdivisions. Riparian management of the existing urban and rural streams in both pre and post development stage should be required.

8-6.2 Royal Spring Aquifer non-point source control recommendations:

- Drainage from roofs, driveways, and parking lots should be directed towards grassed or vegetative areas, rather than being directed towards paved areas or stormsewers.
- Street sweeping in the recharge area should be on a regular basis, at least once a week in industrial areas and biweekly to monthly in residential areas.
- Drainage design practices should utilize the natural open channel drainage system utilizing detention and infiltration areas and natural greenways in the new developing areas.
- Sediment and erosion control ordinances should be upgraded to better address stormwater management in the aquifer recharge area.
- Specific watershed stormwater runoff plans for individual industrial areas should be developed for each specific type of new development
- Specific stormwater runoff plans for existing industrial areas should be reviewed for best management practices to upgrade individual facilities.
- Notification of all large-scale development in the aquifer should require notification to the manager of the Georgetown Municipal Water & Sewer Service.
- In areas of development adjacent to Cane Run and area tributaries, the use of infiltration trenches and trash racks on discharge points should be mandatory.
- Storage sites for road salts should not be allowed in the recharge area.
- Land use practices and urban drainage systems should be designed to minimize the potential for toxic or hazardous materials being discharged or washed off the land surface into the surface waters.

Each different type of land use has a different pollution potential. The development of best management practices has to look at the total environmental picture to be effective. The development of the plan for aquifer protection has been very intensive in its efforts to look at the existing land uses and pollution potential in the aquifer. In the development of a long range plan for development the following concerns can be addressed from the gathered data:

- New developing areas in the Wellhead Protection Area
- Determine risk factors based upon different types of land uses: Business, Commercial, Industrial, Residential, Agricultural etc.
- Intense agricultural uses in the rural area
- Proposed urban development - design aquifer friendly development
- Improvement of existing land use controls in the Wellhead Protection Area
- Development of a contaminant source map - what exists
- Development of a potential source of contamination map - problem areas
- Develop sinkhole cleanup & restoration program
- Existing urban development, can drainage patterns be improved

8-6.3 The Development Process - Best Management Practices

The Lexington Fayette Urban County Government has been working with the firm of Commonwealth Technology to address and provide information on better management of stormwater in Fayette County. The following guidelines may be adapted to the Royal Spring Aquifer for the management of stormwater runoff.

Designing Progressive Programs for Urban Watersheds

A stormwater management program encompasses many concepts and requirements. Three items, though, are essential to a good program - stream protection requirements, water quantity requirements, and water quality requirements. These items are essential elements of a progressive and effective program to mitigate the stormwater impacts associated with urban development.

Stream protection requirements should include clearly defined limits on construction in streams. Only the following should be allowed:

- roadways and utilities that cross at angles within 10 degrees of being perpendicular to the stream or flood plain,
- sanitary sewers, constructed outside the horizontal limits of the 10-year storm, with manhole covers set at an elevation one foot higher than calculated for the 100-year storm.

Any excess material from excavation of the sewer should be removed from the post development floodplain,

- storm sewer pipe outlets where the outlet terminates at the edge of the post-development floodplain,
- regional flood control basins,
- other flood control practices that do not disturb below the normal top of bank of the stream, and
- water quality practices that do not disturb below the normal top of bank of the stream.

If no alternatives to construction in the streams or floodplain exist, construction should only be allowed if the area can be enhanced or mitigation work is done in another area.

The disturbance of ground cover poses a problem in the new developing lands. Sediment and erosion control and vegetation clearing are the two major problems. These two factors usually accompany stream channelization. Both counties should adopt a comprehensive watershed management plan for the aquifer that will address the following:

- Natural landform characteristics
- Landform grading & revegetation
- Storm drainage issues
- New or expanded package treatment plants
- Wetland treatment systems & alternative systems unless shown to be compatible in karst areas

8-6.4 Fayette County Rural Service Area Land Management Plan

In April 1999 Fayette County adopted the Fayette County Rural Service Area Land Management Plan. The development of this plan was deemed necessary by the community to better plan for development in the rural areas of Fayette County. A significant portion of the Royal Spring Aquifer is located in the Rural Service Area (RSA) of Fayette County. Up until the adoption of this plan rural subdivisions were allowed in ten-acre lots. This was allowed by the "10-acre rule" adopted in 1964 by the Fayette County Health Department for the treatment of sewage by septic tanks. The development in the rural areas has been rapidly advanced in the past years. The population of Fayette County has risen from 111,500 people in 1958 to an estimated 250,000 persons this year. The development of rural land has also increased significantly in the 1990's. From 1990 to 1998 429 rural residential lots were created in the (RSA) utilizing 4,740 acres of land. This amount of land was equivalent to the total amount of developed land in the Urban Service Area in the same time period. At the present time residential development in the Rural Service Area is limited to forty-acre lot development. In the Royal Spring Aquifer in the Rural Service Area it is estimated that about 4,200 acres of prime agricultural land exist.

In terms of urban development in the rural area the major question is how do we provide for sewer treatment? In a karst area of thin clay soils and poor percolation the systems are prone to failure. Hence the original 1964 requirement for ten acre lots, to allow for dispersion of effluent through dilution and low density.

One method for the preservation of farmlands is through the clustering of residential areas. Some suggestions have been made that the clustering of residential units may be an answer to the utilization and consumption of rural land for residential development. The clustering of homes though provides for a concentrated amount of sewage.

At the present time the requirement of forty acre lots for residential development will probably preclude or slow down rural development. If the requirement of forty acres reverts back to ten acres or allows clustering then the committee should recommend that no lots smaller than ten acres be allowed to be developed in the recharge area unless they are provided with municipal sewers.

8-6.5 Official Overlay Zoning District or Administrative Overlay District for the Aquifer

In many areas of the country communities are developing a planning tool called overlay zoning districts to combat the pollution of groundwater aquifers. The major targets are septic systems and chemical storage facilities. Once the zone of influence or contribution is identified for the aquifer the overlay-zoning district is created. The creation of this district permits special development guidelines or even prohibits certain land uses that could be potentially harmful to a given area in the case of a hazardous event. The development of a comprehensive set of guidelines usually places restrictions upon certain types of land uses such as gas stations, sewage treatment plants, landfills, industry that utilize, store, or dispose of hazardous materials. Large lot zoning in rural areas is also used to decrease the density of septic tanks.

With the zoning amendments that have followed Fayette County's Rural Land Management Plan, large lot rural zoning regulations are largely in place for much of the aquifer. A successful PDR program will augment this approach. However, in Kentucky, local jurisdictions are limited in their use of zoning to regulate agricultural uses, both by provisions of KRS Chapter 100 (the zoning enabling legislature) and by Kentucky's "Right to Farm" law.

8-7 Best Management Practices (BMP's)

- Aquifer wide considerations, from a broad perspective, are important and should be the context from which many resource based land development decisions are made.
- Impacts resulting from stormwater related input to the groundwater aquifer and stream baseflow may have serious and far-reaching consequences for aquifer recharge.
- Post development uncontrolled runoff rapidly increases and peaks out at a runoff rate level which is considerably higher than the peak rate of runoff for predevelopment.
- A conservation or natural approach to site design will be utilized suggesting an array of non-structural conservation techniques
- The use of vegetative swales and buffer strips can provide a significant water quality benefit in addition to reducing the total volume of stormwater runoff.
- Conservation design approaches reflect a totally different philosophy towards site design, which integrates stormwater into the very core of site design, as opposed to being considered an afterthought to site design.

Operation and maintenance of structural stormwater management practices is a significant responsibility if long term performance of the practice is to occur. There is little incentive, under the existing approach to stormwater management, to leave trees in a given location, to establish a riparian restoration, or to maintain low areas as wetlands.

Special Notes: Royal Spring Aquifer Management

Underground storage tanks: No underground storage tanks shall be installed in the aquifer recharge area unless they meet the Lexington-Fayette Urban County Government underground tank installation guidelines. These guidelines require installers to utilize double walled tanks and double walled piping for petroleum storage facilities. Facilities with underground tanks must register with the Lexington-Fayette County Government through the Division of Environmental and Emergency Management (DEEM) prior to operation and development a Spill Prevention Control Plan. DEEM must be notified of tank closures. DEEM acts as the State Fire Marshall's representative in Fayette County and inspects and certifies each phase of the installation process.

Hazardous materials storage: Any development that will include or have the potential to include significant quantities of hazardous materials in Fayette or Scott County shall require the developer of each parcel to provide to the respective Planning Divisions and the GMWSS written identification of and management plans for the storage of hazardous materials. Applicable local, state or federal environmental laws or regulations define these materials. These may also include other substances, which due to its quality or quantity may in the opinion of each Emergency Management Division present a substantial risk of pollution in the event of an accidental spill, which will be created, stored, and/or utilized within its facilities.

Section 8-8 Future Management Plans: The developer shall require the owner or lessee of each parcel to provide to the respective Emergency Management Divisions plans for the control and containment of accidental spills or leakage, especially in loading dock and transfer areas, before the final record plat is approved by the respective Planning Agencies. Each owner shall consult and coordinate the formulation of such plans with the LFUCG Division of Environmental and Emergency Management or the Georgetown/Scott County Emergency Management Agency.

The Planning Divisions of each county shall require the owner or lessee of each parcel to provide detailed design plans and written maintenance / management plans for the retention of the "first flush" storm water runoff. The detailed design plans and written maintenance / management plans will be a condition of final plat approval. "First flush" in this case will be considered the first 1/4" of rainfall. This plan shall provide for a combination of trash racks on surface inlets.

Sedimentation, filtering, and/or other acceptable means of reducing the "first flush" pollutants from impervious surfaces must be shown on the plan.

In addition to the requirements above, the owner or lessees of each parcel shall be required to comply with all applicable local, State, and Federal Hazardous Materials regulations.

Special notes regarding stormwater management will be required for each development. The developer, owner, lessee agrees that they will comply with all ordinances or regulations that are in place. The developer, owner or lessee agrees to provide the Planning Commission, for information purposes, copies of the approved containment facilities design and management plans prior to the issuance of a building permit. Nothing contained in the above notes shall be construed so as to abrogate any additional rights and responsibilities either Planning Commission in Scott or Fayette County.

- There shall be trash/grating racks or other devices on storm sewer inlets to minimize potential for debris to enter the waterways.
- Pond/detention areas shall also have capability of treating "first flush" of storm water from parking areas.
- Any underground storage tanks shall have active monitoring and secondary containment as mandated by all Federal, State and the Lexington-Fayette Urban County Government underground tank installation guidelines.
- The development property is located in the Royal Spring Aquifer Recharge Area. As such the developer will submit detailed design plans and written management plans for the control and containment of accidental spills or leakage, in hazardous materials storage areas and in the loading docks and transfer areas. These plans should be submitted to the respective Division of Environmental and Emergency Management for review and comment.

Section 9 Long Range Planing for Wellhead Protection

9-1 Scott & Fayette County long range planning regulatory & non regulatory management tools

This document is a tool for the planning processes for both Scott and Fayette Counties. It is important because it raises the level of awareness and cooperation for the protection of the aquifer to a new level of understanding. One of the challenges of this plan will be to provide workable mechanisms to ensure aquifer protection.

The study has pointed the way for a concentrated watershed / aquifer management area. Policies related to land use guidance through comprehensive planning is the best method to address water quality issues. In both counties the aquifer extends under three principal areas. These are:

- **The rural agricultural areas**
- **Existing developed urban areas**
- **New developing areas from rural agricultural lands**

To make this wellhead protection program work both Fayette and Scott County must be willing to make a long-term commitment to the protection of the Royal Spring Aquifer. The quality of the Royal Spring Aquifer as a public water supply cannot be understated. The importance of the aquifer as an independent water supply to the numerous farm and residential wells is also of primary concern to both counties. The only available options for protecting the aquifer is to either limit future development in the catchment area of the ground-water basin, or to require best management practices for ground-water pollution control. While the number of water wells has been declining in the aquifer, it still provides water to the individual rural property owner: residential, equine or farm use. The quality of the water in the aquifer to date has been exceptional. However the rate of development of agricultural land to non-agricultural uses is alarming.

A number of land use management techniques are available that are relevant to wellhead protection. Each county must select and adopt methods for management techniques best suited to the individual county and its existing or proposed enforcement regulations to carry out these protection plans. Financial resources as well as staff capability has to be assessed. The committed involvement of both counties is critical in the development of the aquifer protection plan.

9-2 Selecting management strategies

The direction of the community cannot be changed overnight, but it is thought that the process of compiling this document is a great stride towards protecting the aquifer. Sensible new development and design controls along with good emergency response to a hazardous incident will go a long way to the preservation of the aquifer and groundwater quality. Comprehensive planning must take into consideration the urgent need for groundwater protection. As development pressures increase management alternatives may have to require the adoption of more stringent regulations. The following criteria are recommended when evaluating proposed development projects:

- **Public opinion**
- **Financial and social costs**
- **Business and industrial costs**
- **Agricultural interests**
- **Authority to enforce compliance**

The last item, *authority to enforce compliance*, is one of the most important issues in the aquifer protection program. Unless a program is developed for the coordination of efforts for land use and land development with Best Management Practices, by both counties, then the protection of ground-water quality will be difficult. The following criteria must be evaluated for enforcement compliance:

- **Legal authority**
- **What actions are required for groundwater protection?**
- **Who is responsible in the respective communities for groundwater protection?**
- **Development of intergovernmental coordination between communities**
- **Is funding required**
- **Governmental and planning support for regulation**
- **Multi agency cooperation among all agencies concerned with environmental protection**

Management alternatives may be selected based upon the degree of threat for each type of planning area for example rural agricultural areas versus new development on agricultural lands.

9-3 Level of involvement

The level of involvement in the protection of the aquifer may be different depending upon not only the location in the catchment basin, but also the land use classification. Three types of programs have been identified:

- **Low involvement program**
- **Medium involvement program**
- **High involvement program**

The first type of program involves the adoption of policy statements as stated in the plan chapter on goals and objectives. This is a very low key process that is mostly an educational program. The basic response is to let people know that a wellhead protection area exists. An illustration of this is the sign placement program adjacent to the interstate and state roads throughout the aquifer. This type of program has little regulation and bases its strength on notifying the public. This type of program works well with a majority of one type of land use. Such as agrarian production of equine, cattle or row crop production where numerous wells are utilized. The property owners in the aquifer are the beneficiaries of the protection program since they utilize the water from the aquifer.

The second program is the medium involvement program. At this stage water monitoring for quality and greater public participation in a watershed / aquifer management program is initiated. Land use is closely looked at with regard to potential site location problems such as the number of and septic tank locations, private package treatment plants, storage of hazardous materials and other potential high risk generators.

The third stage, or high involvement program, in the development of the aquifer plan is one that regards the total land use setting. Due to the complexity of the area this type of program will focus on voluntary and mandatory regulations depending on the potential for development, existing development, transportation hazards and again the potential for pollution generators. In the Royal Spring Aquifer we are at the medium and high stages of the program. The rapid development of the two communities of Georgetown and Lexington expanding towards each other with a major interstate and rail line in between both communities compounds the protection problem. In the Royal Spring Aquifer many issues come into play. The land use patterns, pressure for development, expanding the transportation system and the anticipated increase flow of traffic, all elements have the potential for future contamination of the aquifer.

9-4 Future Development Programs

In Section 2 of this report two goals and four objectives are outlined to protect the Royal Spring Aquifer. To further theses goal and objectives the following planning practices should be developed:

- Establish standards to be met by both Fayette and Scott County to ensure the protection of the groundwater quality within the Royal Spring Aquifer.
- Define the types of land use activities that are compatible and/or incompatible for areas of protection in the Royal Spring Aquifer.
- Emphasize the importance of non-point pollution controls in the Royal Spring Aquifer.
- Integrate, and support the enforcement of existing statutes, codes and regulations designed to regulate potentially contaminating activities and protect water quality.
- Define zones of land use planning management and protection in the Royal Spring Aquifer to insure adequate protection of the groundwater quality of the Royal Spring Aquifer.

Section 10. GEORGETOWN MUNICIPAL WATER & SEWER SERVICE (GMWSS) DROUGHT MANAGEMENT/ SPRING CONTAMINATION PLAN

SECTION 10-1: Existing Raw Water Sources

1. **Royal Spring** - The primary source of raw water for the Georgetown Water Treatment Plant (WTP) is Royal Spring, which is located adjacent to the WTP. Three vertical turbine pumps at the mouth of Royal Spring are used to pump raw water to the treatment plant. The three pumps have the capacity to supply the WTP at its rated capacity. The water from Royal Spring varies both in quality and quantity. The capacity of Royal Spring is difficult to determine due to lake of historical flow data and the high variability of flow. Estimated flow from the Spring ranges from 0.5 mgd during dry periods to 50 mgd during periods of precipitation. During the drought of 1988, the Spring even stopped flowing for a short period of time. The quality of water is steadily declining and will continue to decline as the recharge basin for the Spring is developed. The recharge basin for the Royal Spring, as identified by Dr. John Thrailkill in Groundwater in the Inner Bluegrass Karst Region, Kentucky, includes the upper watersheds of Cane Run and North Elkhorn Creek. During periods of high precipitation, the Spring reacts like a surface water supply and is very turbid. At the present, the water withdrawal permit for the WTP indicates a withdrawal of 2.0 mgd from Royal Spring.

2. **North Elkhorn Creek** - The pool above Wallace Dam on North Elkhorn Creek is used as an emergency raw water supply. Raw water pumps at the dam are used to pump raw water to the WTP. The pool behind Wallace Dam is estimated to be 33 million gallons. During low precipitation periods water is withdrawn from North Elkhorn Creek for irrigation by farmers, causing the creek to stop flowing. The quality of water from North Elkhorn Creek will also be subject to degradation as the potential for degradation in watershed is developed. Turbidity of the water varies with flow, typical of any surface water supply. The Kentucky Division of Water had stated that the raw water supply from the creek shall be utilized in emergency situations and only with prior approval of the Division of Water. At the present, the water withdrawal permit for the WTP indicates a withdrawal of 2.0 mgd from North Elkhorn Creek.

SECTION 10-2: Existing Supplemental Water Supplies

1. **Frankfort Interconnect** - On April 23, 1990, Georgetown Municipal Water & Sewer Service (GMWSS) and the Frankfort Electric and Water Plant Board entered into an agreement that allowed GMWSS to construct, at its expense, a pump station and 16" water line for the purpose of conveying water purchased from Frankfort to the GMWSS water system. This agreement allowed GMWSS to purchase 1,000,000

gallons of water per day and an additional 1,300,000 gallons per day if it is available. GMWSS purchased an average of 381,802 mgd from Frankfort over the last twelve (12) months.

Frankfort is currently undergoing system improvements that will allow them to supply ever larger amounts of water to GMWSS in the near future. GMWSS is investigating the possibility of adding an additional pump at the Frankfort pump station to allow pumping of larger amounts of treated water through the 16" line.

2. **Kentucky American Interconnect** - On October 18, 1996, GMWSS and the Kentucky American Water Company entered into an agreement that allowed GMWSS to purchase a minimum of 1,350,000 gallons of water per calendar month from a 12" connection located on Burton Road. A total of 660 gallons per minute (gpm) is available from this connection.

SECTION 10-3: Determining Ability to Meet Customer Demand

Raw Water Flow

To assess the impact that precipitation will exert on the recharge area of the Royal Spring, GMWSS will continuously monitor flow from the Royal Spring. This will be accomplished in the following manner:

1. **Internet Sites** - Information on Royal Spring stream flow measurements at the GMWSS WTP is available at this web address:
   a. **<http://wwwdkylsver.er.usgs.gov/>** - This server is maintained by the United States Geological Survey and provides data from the gauging station below the weir at the WTP. Information that is available includes data on stream flow in cubic feet per second and stage elevation above datum **(Figure 1 & 2)**. This server also contains 5-day precipitation data for the Cane Run in Fayette County, which is the prime recharge source for the Royal Spring **(Figure 3)**.
   b. **<http://www.crh.noaa.gov/lmk/>** - This is a web site for the National Weather Service office in Louisville. This location offers detailed precipitation totals for the past 24 hours are regional, state and county levels **(Figure 4)**.

Usable Raw Water Flow - The USGS gauging station is not an accurate reference when calculating customer demand to be met by the Royal Spring. This is the result of Spring flow being diverted to the WTP sedimentation basins **before** measurements at the USGS site. The basins measure 215 feet x 40 feet x 8 feet and contain approximately 6 feet of 386,000 gallons of usable water.

To determine the amount of impounded Spring flow that is obtainable for treatment, the water plant operator measures water depth in the basins and subtracts 2 feet from the whole. Then, the overall dimensions of the basins are multiplied by 7.48 gals/ft_3 to provide the total gallons available.

__Supplementary Flow__ - To maintain customer demand during periods of reduced flow from the Royal Spring, the Frankfort Interconnect Pump Station will be operated at varying flow settings. An additional benefit of operating the interconnects is that the flow from the Spring is not stressed and allows the aquifer to recharge. Pumping from the interconnects will be operated on the following schedule.

1. When the water level in the sedimentation basins is **2 feet** below normal capacity for five consecutive days, then operate the interconnects at **low speed** for every hour the water plant is operational.
2. When the water level in the sedimentation basins is **3 feet** below normal capacity for five consecutive days, then continuous 24-hour operation at **low speed** is necessary. When possible, alternate the operation of the interconnects at low speed.
3. At any time the water level in the sedimentation basins is **4 feet** below normal capacity, operate the interconnect pumps at **high speed** on a continuous basis.

Future Supplemental Water Supplies

1. GMWSS and Kentucky American have signed an agreement to install a dry connection in Georgetown between the two systems in the area of the First National Bank in Georgetown. This agreement will benefit both systems in the event of an unforeseen water shortage and/or drought situation. The connection would be made between two existing 16" lines in close proximity to each other.

2. The Scott County Reservoir is in the planning stages and will benefit GMWSS at such time as it is built.

3. The Louisville/Lexington pipeline is also in the planning stages and will benefit GMWSS at such time as it is built.

SECTION 10-4: Emergency Plans: Water Shortage Response Plan and Supply Contamination Response Plan

Precipitation in Kentucky has an annual average of 45-50 inches. During rainfall and snow melt, the karst aquifer that supplies the Royal Spring is recharged by the Cane Run and associated feeder streams. However, extended droughts can severely affect the water flow into the recharge aquifer and as a consequence, reduce the discharge of the Royal Spring. Although contamination of the recharge area will not diminish the flow from the Spring, the impact of such a catastrophic event would effectively terminate the water supply to Georgetown/ Scott County.

Under the water resources policy of the Commonwealth, as stated in KRS 151.110, the state has the statutory responsibility "to provide for the adequate disposition of water among the people of the Commonwealth entitled to its use during severe droughts or times of emergency..." However, it is the local community that is best able to determine and coordinate an appropriate response to water shortages.

All of the water utilities operating in the Commonwealth of Kentucky are required by regulations promulgated by the Kentucky Division of Water to have a volume of stored water that is equal to the amount of water the utility produces or sells in a 24 hour period. All of the water utilities operating in Scott County meet this requirement. Subsequently, in the event of an occurrence that may contaminate the county's source of water supply, Georgetown could shut-down its water intake until the threat had passed, provided the threat is less than twenty-four hours in duration.

In addition, each county's Emergency Management Agency (EMA) has also written an Emergency Response Plan that discusses how the county will deal with a possible threat to the county's water supply. Scott County not only has an Emergency Response Plan, but also an Emergency Operation Plan for Water Management. Scott County's State-approved Emergency Response Plan addresses the ways that accidental contaminant releases will be handled. Among the topics included in this plan are: identification of the appropriate response agencies, methods of protecting citizens from the contaminants, mitigation measures, and hazard alleviation. The appropriate response depends largely upon the source and type of the hazard. For example, the local fire department may send firefighters trained in handling hazardous materials to clean up gasoline spilled by a tanker truck during an accident. The fact that a spill may or may not be in a water supply protection area does not necessarily affect the way the response is handled, at least in clean-up, mitigation, and alleviation. Thus, a separate component of the local Emergency Response Plan does not exist that specifically discusses how to respond to potential contaminant releases in a water supply protection area.

The local Emergency Management Director will notify Kentucky Division of Emergency Management (formerly DES) officials of any such shutdown that has the potential to last longer than 24-hour reserve water supply. The State DEM has established procedures whereby emergency supplies of water for personal use can be trucked into the community.

If the Georgetown Municipal Water & Sewer Service (GMWSS) makes the decision to quit pumping water from the Royal Spring because of a potential or actual contamination event, the Division of Water will be consulted before any resumption in withdraws. Other affected agencies would also be contacted.

Kentucky Division of Water regulations require water systems to have a volume of stored, potable water which is equal to the amount of water the utility purchases or produces in a 24-hour period. However, should there be a shortage lasting longer than one day, (caused by such factors as a major line break or water treatment plant shutdown) the water system will implement measures in accordance with the 1988 *Kentucky Water Shortage Response Plan.* That plan provides a guide for local officials and water system managers to use in developing their own response plans. As noted in that guide, the Natural resources and Environmental Protection Cabinet has established a two-level Drought Notification System consisting of a Water Shortage Watch and a Water Shortage Warning. When a Watch has been issued, local governments and water utility managers should determine the need for local response and make necessary preparations should a shortage occur. When a warning has been issued by the Cabinet, local officials and water systems should already have adopted water shortage response mechanisms and be in one of four phases of actual response.

Although designed for drought situations, the response plan developed by GMWSS could be implemented in response to other situations which result in limitations on either the supply of raw water or the ability to distribute treated water. The response plan consists of four stages of water shortage severity, with specific response measures for each stage. The stages are based solely on the availability of treated water from both the Frankfort Plant Board and the Kentucky-American Water Company. At the present time and capacity, the maximum amount of treated water that can be purchased by GMWSS form both sources is 3.21 million gallons per day (MGD).

- Advisory phase
- Alert phase
- Emergency phase
- Water rationing phase

A water shortage advisory should be declared by GMWSS when the daily purchase of treated drinking water to meet customer demand is 40% of the 3.21 MGD or 1,284,000 gallons.

An alert phase should be declared by GMWSS when the daily purchase of treated drinking water to meet customer demand is 60% of the 3.21 MGD or 1,926,000 gallons.

An emergency phase will be issued by GMWSS when the daily purchase of treated drinking water to meet customer demand is 70% of the 3.21 MGD or 2,247,000 gallons.

The water rationing phase will be implemented by GMWSS when the daily purchase of treated drinking water exceeds 70% of 3.21 MGD.

Likewise, the responses to each water shortage level become increasingly stringent as the ratio of demand to available water supply increases. In the **advisory phase**, GMWSS and local officials will:

- Issue a water shortage advisory
- Set conservation goals and prepare for a decreasing water supply
- Inform the public about the potential problem
- Request voluntary conservation

GMWSS and local officials will respond to the **alert phase** with the following measures:

- Issue water shortage alert
- Set more stringent voluntary conservation goals for all classes of water use
- Ban all non-essential uses of water, monitor compliance, enforce when necessary
- Inform the public about the problem

In the **emergency phase**, GMWSS and local officials will:

- Issue a water shortage emergency declaration
- Set more stringent conservation goals for all water use classes
- Ban all non-essential uses of water and restrict Class II (socially and economically important) water uses; monitor; enforce as necessary

During the **rationing phase**, GMWSS and local officials will declare:

- Mandatory allocation of water to Class I (essential) and Class II users
- Water pricing to encourage conservation
- monitoring of compliance, enforcement as necessary

Water Conservation Class System: According to water shortage response phase[1]

Essential Water Users (Class I)

The following users of water, listed by site or user type, are essential

Domestic:

- water necessary to sustain human life and the lives of domestic pets, and to maintain minimum standards of hygiene and sanitation

Health Care Facilities:

- patient care and rehabilitation

Water Hauling:

- sales of domestic use where not reasonably available elsewhere

Public Use:

- fire fighting
- health and public protection purposes, as specifically approved by health officials and the local governing body

Socially or Economically Important Uses of Water (Class II)

The following uses of water listed by site or user type, are socially or economically important.

Domestic:

- personal, in-house water use including kitchen, bathroom and laundry

Water Hauling:

- non-domestic, when other sources are not reasonably available elsewhere

Commercial and Civic Use:

- commercial car and truck washes
- Laundromats
- restaurants, clubs and eating places
- schools, churches, motels/hotels and similar commercial establishments

Outdoor Non-Commercial Watering:

- minimal watering of vegetable gardens
- minimal watering of trees where necessary for their survival

Outdoor Commercial or Public Watering (using conservation methods and when other sources of water are not available or feasible to use):

- agriculture irrigation for the protection of food and fiber or the maintenance of livestock,
- water by arboretums and public gardens of national, state, regional or community significance where necessary to preserve specimens,
- watering by commercial nurseries where necessary to maintain stock,
- watering where necessary to establish or maintain revegetation or landscape plantings required pursuant to law or regulation,
- watering of woody plants where necessary to preserve them,
- minimal watering of golf courses

Recreational:

- operation of municipal swimming pools and residential pools that serve more than 25 dwelling units.

Air Conditioning:

- refilling for startup at the beginning of the cooling season,
- makeup of water during the cooling season,
- refilling specifically approved by the health officials and the local governing body, where the system has been drained for health protection or repair services.

<u>Non-Essential (Class III):</u>

Any waste of water, as defined herein, is non-essential. The following uses of water, listed by site or user type, are also non-essential.

Public Use:

- use of fire hydrants (excluding Class I and Class II uses), including use of sprinkler caps, testing fire apparatus and fire department drills,
- flushing of sewers and hydrants except as needed to ensure public health and safety as approved by GMWSS and local officials.

Commercial and Civic Use:

- serving water in restaurants, clubs or eating places, except by customer request, failure to repair a controllable leak,
- increasing water levels in scenic and recreational ponds and lakes, except as necessary to support fish and wildlife.

Ornamental Purposes:

- fountains, reflecting pools and artificial waterfalls.

Outdoor Non-Commercial Watering:

- use of water for dirt control or compaction,
- water of annual or non-woody plants other than vegetable gardens,
- watering of lawns, parks, golf course fairways, playing fields and other recreational areas,
- washing sidewalks, walkways, driveways, parking lots, tennis courts or other hard surfaces,
- washing down buildings or structures for purposes other than immediate fire protection,
- flushing gutters or permitting water to run or accumulate in any gutter or street.

Outdoor Commercial or Public Watering:

- expanding nursery facilities, placing new irrigated agricultural land in production, or planting of landscaping except when required by a site design review process,
- use of water for dirt control or compaction,
- watering of lawns, parks, golf course fairways, playing fields and other recreational areas,
- washing sidewalks, walkways, driveways, parking lots, tennis courts or other hard surfaces,
- washing down buildings or structures for purposes other than immediate fire protection,
- flushing gutters or permitting water to run or accumulate in any gutter or street.

Recreational uses other than those specified as Class II.

Non-commercial washing of motor and other vehicles.

Air-conditioning (see also Class II purposes)

- refilling cooling towers after draining.

[1] *Kentucky Water Shortage Response Plan.* Kentucky Resources and Environmental Protection Cabinet, Department for Environmental Protection, Division of Water. Frankfort, KY. Revised June 1988.Response Phases

GMWSS SOURCE WATER TO MEET CUSTOMER DEMAND

SOURCE	WATER AVAILABLE (MGD)
Frankfort Plant Board Interconnect	3.0[1]
entucky American - Burton Road	0.21[2]
Kentucky American - Champion Way	Undetermined[3]
Royal Spring	+26.0[4]

TRIGGER CONDITIONS FOR RESPONSE PHASE (WATER PURCHASE)

Frankfort Plant Board Interconnect	3.0 mgd
Kentucky-American - Burton Road	0.21 mgd
TOTAL TREATED WATER FOR IMMEDIATE USE	3.21 mgd

PHASE	% OF PURCHASE	GALLONS PER DAY
Advisory	40 of 3.21 mgd	1,284,000
Alert	60 of 3.21 mgd	1,926,000
Emergency	70 of 3.21 mgd	2,247,000
tioning	>70 of 3.21 mgd	+2,247,000

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[1] Should be available with new pumps January 1. 2000.

[2] More available if needed.

[3] Water available at the time of request by GMWSS.

[4] Based on maximum historical amount from Royal Spring.

GMWSS RESPONSE PHASES
Water Conservation and Water Emergency Management

	ADVISORY PHASE	ALERT PHASE	EMERGENCY PHASE	WATER RATIONING PHASE
TRIGGER CONDITIONS	40% of customer demand met by water purchase	60% of customer demand met by water purchase	70% of customers demand met by water purdhase	>70% of customer demand met by water purchase
EMERGENCY MEASURES	Eliminate outside water sprinkler between Noon and 6:00 p.m. Request voluntary reductions in water use Broadcast Public Service Announcements encouraging water conservation	Prohibit car washing except when a bucket is used Allow lawn watering every fifth day No use of fire hydrant except for fire fighting Odd/even schedule for watering trees, shrubs and gardens	Prohibit all outside watering Serve water in restaurant only on request	Enact conservation pricing Begin mandatory allocation of water Immedicately reduce usage by 25 percent Set new conservation goals and monitor all shortage-related activities; enforce as necessary
FORMATION & PUBLIC DUCATION	Announce measures at GMWSS Board Meeting Remind all customers through billing notice Provide conservation awareness information	Announce measures at GMWSS Board Meeting Remind all customers through billing notice Provide conservation awareness information Notify residential customers by radio/ TV/Newspaper	Announce measures at GMWSS Board Meeing Provide conservation awareness information Notify residential customers by radio/ TV/newspaper	Announce measures at GMWSS Board Meeing Provide conservation awareness information Notify residential customers by radio/ TV/newspaper

APPENDIX C

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+11

Address of Basin: 2150 Georgetown Road

Basin Acreage: 1.45 acres

Drainage Acreage: 12.5 acres

FEMA 100-year Floodplain: No

Channel Length: No channel present

Property Owner: Rood & Riddle Partners

Type of Basin: Detention Basin

Drainage Area Land Use: Equine Hospital Grounds

Adjacent Land Use: Residential, Park

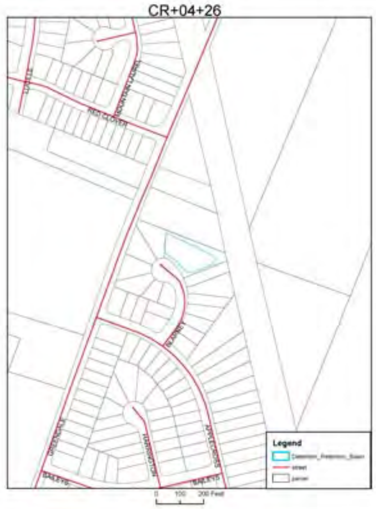
Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet



Basin ID #: CR+04+26

Address of Basin: 1332 Blarney Court

Basin Acreage: 0.43 acres

Drainage Acreage: 6.4 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 90 feet

Property Owner: Cutter Homes, LTD

Type of Basin: Detention Basin

Drainage Area Land Use: Residential

Adjacent Land Use: Residential, Industrial

Utility Issues: Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☒ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☒ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is flat and open, tree planting to enhance and improve water infiltration may be beneficial. Additionally, there is heavy sediment accumulation and growth in northern half of the concrete channel (as seen in picture). Removing the concrete channel would provide additional detention.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+37.18

Address of Basin: 2150 Georgetown Road

Basin Acreage: 1.24 acres

Drainage Acreage: 2.3 acres

FEMA 100-year Floodplain: No

Channel Length: No channel present

Property Owner: Rood & Riddle Partners

Type of Basin: Detention Basin

Drainage Area Land Use: Equine Hospital Grounds

Adjacent Land Use: Residential, Park

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+37.69

Property Owner: Highlands Baptist Church

Address of Basin: 2032 Parallel Road

Type of Basin: Detention Basin

Basin Acreage: 0.40 acres

Drainage Area Land Use: Church

Drainage Acreage: 2.4 acres

Adjacent Land Use: Residential, Equine Hospital

FEMA 100-year Floodplain: No

Utility Issues: Overhead Lines

Channel Length: No Channel Present

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☒ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is flat and open, tree planting to enhance and improve water infiltration may be beneficial. Additionally, because run-off from the parking lot flows directly into the basin via a drainage swale, constructing a rain garden at the end of the drainage swale may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+C2

Address of Basin: 2201 Innovation Drive

Basin Acreage: 0.69 acres

Drainage Acreage: 1.2 acres

FEMA 100-year Floodplain: No

Channel Length: None

Property Owner: Webasto Sunroofs, Inc.

Type of Basin: Retention Pond

Drainage Area Land Use: Industrial

Adjacent Land Use: Industrial, Road

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection. However, there was moderate algal growth around the periphery of the pond. The installation of an aerator/fountain may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+C3

Address of Basin: 2000 Capstone Drive

Basin Acreage: 1.64 acres

Drainage Acreage: 30.9 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 295 feet (Main Channel)

Property Owner: CQ Landlord Multi, LLC

Type of Basin: Detention Basin

Drainage Area Land Use: Industrial

Adjacent Land Use: Industrial, Road

Utility Issues: Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☒ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☒ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☒ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is flat and open, tree planting to enhance and improve water infiltration may be beneficial. For additional water quality improvement, in lieu of removing the concrete channels, a micropool could be constructed to create an area where sediment settling can occur prior to water exiting the basin. Lastly, there is heavy sediment accumulation and growth in the eastern channel (as seen in picture). Removing this concrete channel would provide additional detention.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+C8

Address of Basin: 2150 Georgetown Road

Basin Acreage: 0.80 acres

Drainage Acreage: 7.1 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 275 feet (Grassy Channel)

Property Owner: Rood & Riddle Partners

Type of Basin: Detention Basin

Drainage Area Land Use: Equine Hospital Grounds

Adjacent Land Use: Residential, Park

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+C9

Address of Basin: 2200 Innovation Drive

Basin Acreage: 1.41 acres

Drainage Acreage: 15.3 acres

FEMA 100-year Floodplain: No

Channel Length: None

Property Owner: Webasto Roof Systems, Inc.

Type of Basin: Retention Pond

Drainage Area Land Use: Industrial

Adjacent Land Use: Industrial, Road

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+C10

Address of Basin: 1832 Arbor Station Way

Basin Acreage: 0.51 acres

Drainage Acreage: 2.2 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 205 feet

Property Owner: Robbin Bond

Type of Basin: Detention Basin

Drainage Area Land Use: Residential

Adjacent Land Use: Residential

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☒ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☒ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Abundant sediment and debris has completely filled the lower portion of both concrete channels within the basin causing the water to flow outside the concrete channels and deposit significant sediment along the channels. Additionally, the outlet structure is approximately 90-95% clogged with sediment. Maintenance is recommended to remove the sediment. Once the maintenance is completed, a micropool could be constructed to create an area where sediment settling can occur prior to water exiting the basin.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+04+C11

Address of Basin: 2440 Prescott Lane

Basin Acreage: 0.50 acres

Drainage Acreage: 2.9 acres

FEMA 100-year Floodplain: No

Channel Length: Unknown

Property Owner: Belmont Farm H.O.A., Inc.

Type of Basin: Detention Basin

Drainage Area Land Use: Residential

Adjacent Land Use: Residential, Park

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+05+47.69

Address of Basin: 1765 Gerald Drive

Basin Acreage: 0.40 acres

Drainage Acreage: 5.5 acres

FEMA 100-year Floodplain: No

Channel Length: No Channel Present

Property Owner: James and Monica Tucker

Type of Basin: Detention Basin

Drainage Area Land Use: Residential, Commercial

Adjacent Land Use: Residential, Winburn Middle School

Utility Issues: Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+05+C2

Address of Basin: 1801 Newtown Pike

Basin Acreage: 3.60 acres

Drainage Acreage: 68.9 acres

FEMA 100-year Floodplain: No

Channel Length: None

Property Owner: University of Kentucky

Type of Basin: Retention Pond

Drainage Area Land Use: Hotel, Road

Adjacent Land Use: Commercial, Road, Industrial Park

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection. However, moderate algal growth was present in the northeastern portion of the pond. An aerator (fountain head) is present, but was not operating the day of the inspection. In order to lessen the growth of algae and improve the water quality, it may be beneficial if the aerator is operating.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+05+C3

Address of Basin: 1516 Bull Lea Road

Basin Acreage: 1.69 acres

Drainage Acreage: 19.1 acres

FEMA 100-year Floodplain: No

Channel Length: None

Property Owner: University of Kentucky

Type of Basin: Retention Pond

Drainage Area Land Use: Institutional, Industrial Park

Adjacent Land Use: Industrial (Research) Park

Utility Issues: Electric, Sewer

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

Lexington-Fayette Urban County Government

Basin Retrofit Data Sheet

Basin ID #: CR+05+C6

Property Owner: University of Kentucky

Address of Basin: 1500 Bull Lea Road

Type of Basin: Detention Basin

Basin Acreage: 0.49 acres

Drainage Area Land Use: Institutional, Industrial Park

Drainage Acreage: 2.4 acres

Adjacent Land Use: Institutional, Industrial Park, Road

FEMA 100-year Floodplain: No

Utility Issues: None

Channel Length: Approx. 180 feet

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+05+W5

Address of Basin: 1875 Newtown Pike

Basin Acreage: 0.94 acres

Drainage Acreage: 12.7 acres

FEMA 100-year Floodplain: No

Channel Length: None

Property Owner: LFUCG

Type of Basin: Retention Pond

Drainage Area Land Use: Med. Tech College, Industrial Park

Adjacent Land Use: Road, Industrial Park

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection. However, on the day of the inspection (June 14, 2013), an extremely dense algal matting was covering approximately 90-95% of the pond surface and no aeration system was present. As a result, the pond may be eutrophic. In order to reduce the amount of algae and improve the quality of water within the pond, the installation of aerators could be considered.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+09+X51

Address of Basin: 1040 West New Circle Road

Basin Acreage: 0.46 acres

Drainage Acreage: 20.3 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 190 feet

Property Owner: William R. Clem

Type of Basin: Detention Basin

Drainage Area Land Use: Industrial

Adjacent Land Use: Residential, Industrial, Park

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+10+27.94

Address of Basin: 775 Newtown Court

Basin Acreage: 1.06 acres

Drainage Acreage: 5.0 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 260 feet (Main Channel)

Property Owner: C2 Land L P

Type of Basin: Detention Basin

Drainage Area Land Use: Commercial, Hotel, Parking Lot

Adjacent Land Use: Commercial, Roads

Utility Issues: Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☒ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☒ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: For water quality improvement: In lieu of removing the concrete channels, a micropool could be constructed to create an area where sediment settling can occur prior to water exiting the basin (especially since one inlet drains directly from parking lot). Additionally, there is a rectangular discharge basin behind the dam that is enclosed by Gabion baskets. The discharge basin is currently full of sediment and appears to be preventing a constant flow from the outlet and causing back-up. Conducting periodic maintenance and removing the sediment from the discharge basin to ensure water is draining properly from the outlet may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+10+X28

Address of Basin: 1625 Russell Cave Road

Basin Acreage: 0.83 acres

Drainage Acreage: 6.7 acres

FEMA 100-year Floodplain: No

Channel Length: No Channel Present

Property Owner: Consolidated Baptist Church

Type of Basin: Detention Basin

Drainage Area Land Use: Church Grounds and Parking Lots

Adjacent Land Use: Commercial, Residential

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+10+X29

Address of Basin: 1625 Russell Cave Road

Basin Acreage: 0.98 acres

Drainage Acreage: 2.9 acres

FEMA 100-year Floodplain: No

Channel Length: No Channel Present

Property Owner: Consolidated Baptist Church

Type of Basin: Detention Basin

Drainage Area Land Use: Church Grounds and Parking Lots

Adjacent Land Use: Commercial, Residential

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+11+06.77

Property Owner: LFUCG

Address of Basin: 525 Rogers Road

Type of Basin: Detention Basin

Basin Acreage: 0.81 acres

Drainage Area Land Use: Park, Residential

Drainage Acreage: 9.6 acres

Adjacent Land Use: Residential

FEMA 100-year Floodplain: No

Utility Issues: None

Channel Length: Approximately 170 feet

Retrofit Options:

☐ **Extend Detention**
- ☐ Modify Riser
- ☐ Increase Embankment Height
- ☐ Excavate Bottom
- ☐ Change Geometry

☐ **Channel Condition**
- ☐ Add Meanders/Modify Internal Design
- ☐ Remove Concrete Bottom
- ☐ Add Forebay
- ☐ Add Micropool
- ☐ Repair Bank/Channel Erosion

☐ **Infiltration**
- ☐ Tree Planting
- ☐ Rain Garden
- ☐ Bioretention
- ☐ Other Filtering Practice

☐ **Naturalized Basin**

☐ **OTHER**
- ☐ Public Education
- ☐ Litter Control
- ☐ Bank Stabilization

☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+11+07.71

Address of Basin: 525 Rogers Road

Basin Acreage: 0.79 acres

Drainage Acreage: 75.8 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 360 feet

Property Owner: LFUCG

Type of Basin: Detention Basin

Drainage Area Land Use: Park, Residential

Adjacent Land Use: Residential

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+11+07.93

Address of Basin: 525 Rogers Road

Basin Acreage: 0.72 acres

Drainage Acreage: 47.3 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 460 feet

Property Owner: LFUCG

Type of Basin: Detention Basin

Drainage Area Land Use: Park, Residential

Adjacent Land Use: Residential

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+11+33

Property Owner: LFUCG

Address of Basin: 1701 Silver Lane

Type of Basin: Detention Basin

Basin Acreage: 0.54 acres

Drainage Area Land Use: Residential

Drainage Acreage: 36.1 acres

Adjacent Land Use: Residential

FEMA 100-year Floodplain: No

Utility Issues: None

Channel Length: Approx. 120 feet

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+11+E17

Address of Basin: 100 Strawberry Fields Road

Basin Acreage: 2.32 acres

Drainage Acreage: 51.2 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 360 feet

Property Owner: Old Paris Place Open Space Maintenance Association, Inc.

Type of Basin: Detention Basin

Drainage Area Land Use: Residential

Adjacent Land Use: Residential

Utility Issues: Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial. Additionally, there is moderate to heavy sediment accumulation in the lower portion of the concrete channel. Periodic maintenance to remove the sediment could be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+11+E24

Address of Basin: 450 Radcliffe Road

Basin Acreage: 0.65 acres

Drainage Acreage: 10.4 acres

FEMA 100-year Floodplain: No

Channel Length: No Channel Present

Property Owner: Transylvania University

Type of Basin: Detention Basin

Drainage Area Land Use: Park

Adjacent Land Use: Commercial, Residential

Utility Issues: Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water quality infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+17+E20

Address of Basin: 207 Legends Lane

Basin Acreage: 0.42 acres

Drainage Acreage: 8.6 acres

FEMA 100-year Floodplain: No

Channel Length: No Channel Present

Property Owner: Lexington Properties, LLC

Type of Basin: Detention Basin

Drainage Area Land Use: Legends Stadium and Northland Shopping Center Parking Lots

Adjacent Land Use: Commercial, Residential

Utility Issues: Electric

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☒ **OTHER**
  - ☐ Public Education
  - ☒ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Moderate trash and debris are deposited in basin by the run-off from the surrounding parking lots. Therefore, periodic trash removal may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+17+X5

Address of Basin: 438 Cane Run Road

Basin Acreage: 1.20 acres

Drainage Acreage: 69.5 acres

FEMA 100-year Floodplain: Yes

Channel Length: Approx. 280 feet

Property Owner: LFUCG

Type of Basin: Detention Basin

Drainage Area Land Use: Park, Residential, Commercial

Adjacent Land Use: Residential, Commercial

Utility Issues: Sanitary Sewer

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☒ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☒ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is flat and open, tree planting to enhance and improve water infiltration may be beneficial. Additionally, because the concrete channel discharges stormwater directly into a tributary of Cane Run Creek without any treatment (as seen in photo), a micropool could be constructed to create an area where sediment settling can occur prior to water flowing directly into the creek.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+18+11.92

Address of Basin: 1670 Old Paris Road

Basin Acreage: 1.17 acres

Drainage Acreage: 74 acres

FEMA 100-year Floodplain: No

Channel Length: No Channel Present

Property Owner: LFUCG

Type of Basin: Detention Basin

Drainage Area Land Use: Park

Adjacent Land Use: Residential

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+18+18.33

Address of Basin: 1624 Old Paris Road

Basin Acreage: 0.78 acres

Drainage Acreage: 15.6 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 300 feet

Property Owner: North Limestone, LLC

Type of Basin: Detention Basin

Drainage Area Land Use: Commercial, Residential

Adjacent Land Use: Commercial, Residential

Utility Issues: Sanitary Sewer

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☒ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☒ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: There is heavy sediment accumulation and growth in the eastern portion of the concrete channel. Periodic maintenance and sediment removal may be beneficial. Additionally, because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may also be beneficial. Lastly, in lieu of removing the concrete channel, a micropool could be constructed to create an area where sediment settling can occur for water quality improvement prior to water exiting the basin.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+18+25.16

Address of Basin: 120 Rosemary Avenue

Basin Acreage: 0.50 acres

Drainage Acreage: 2.0 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 320 feet

Property Owner: LFUCG Housing Authority

Type of Basin: Detention Basin

Drainage Area Land Use: Residential

Adjacent Land Use: Commercial, Residential

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☒ **OTHER**
  - ☐ Public Education
  - ☒ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is relatively flat and open, tree planting to enhance and improve water infiltration may be beneficial. Additionally, there is moderate to heavy sediment and trash accumulation in the northern portion of the concrete channel (as seen in picture). Periodic maintenance to remove sediment and trash from the channel may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+18+27.94

Address of Basin: 1610 Bryan Station Road

Basin Acreage: 0.80 acres

Drainage Acreage: 12.8 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 240 feet

Property Owner: Bellerive Development Company

Type of Basin: Detention Basin

Drainage Area Land Use: Commercial, Parking Lots

Adjacent Land Use: Commercial, Road

Utility Issues: Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☒ **OTHER**
  - ☐ Public Education
  - ☒ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: There is significant sediment accumulation immediately around the inlet located on the southeastern portion of the basin preventing flow into the basin (as seen in picture). Maintenance and sediment removal may be beneficial. Additionally, run-off from the adjacent parking lots has deposited a moderate amount of litter into the basin. Periodic trash removal may be beneficial as well.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+18+28.33

Address of Basin: 1725 Bryan Station Road

Basin Acreage: 0.44 acres

Drainage Acreage: 7.5 acres

FEMA 100-year Floodplain: No

Channel Length: No Channel Present

Property Owner: KY District Church of the Nazarene, Inc.

Type of Basin: Detention Basin

Drainage Area Land Use: Church Parking lot, Residential

Adjacent Land Use: Residential

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is flat and open, tree planting to enhance and improve water infiltration may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+18+36.43

Address of Basin: 1660 Bryan Station Road

Basin Acreage: 0.64 acres

Drainage Acreage: 7.4 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 280 feet

Property Owner: ERP Bryan Station, LLC

Type of Basin: Detention Basin

Drainage Area Land Use: Commercial, Parking Lots

Adjacent Land Use: Commercial, Residential

Utility Issues: Water (Fire Hydrants), Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection. However, heavy sediment accumulation around the inlet on the southeastern portion of the basin is preventing continuous flow into the basin (as seen in picture). Maintenance conducted that will enhance the flow from the inlet may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+18+T1

Address of Basin: 1440 Edgelawn Avenue

Basin Acreage: 2.67 acres

Drainage Acreage: 171.1 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 600 feet

Property Owner: LFUCG

Type of Basin: Detention Basin

Drainage Area Land Use: Commercial, Residential

Adjacent Land Use: Commercial, Residential

Utility Issues: Overhead Lines, Sanitary Sewer

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☒ **OTHER**
  - ☐ Public Education
  - ☒ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Significant trash has accumulated within the southern portion of the basin. Periodic trash removal may be beneficial.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+25+Z1

Address of Basin: 816 Magoffin Street

Basin Acreage: 1.07 acres

Drainage Acreage: 38.1 acres

FEMA 100-year Floodplain: No

Channel Length: Approx. 180 feet

Property Owner: LFUCG

Type of Basin: Detention Basin

Drainage Area Land Use: Residential, Road, Train Tracks

Adjacent Land Use: Residential

Utility Issues: Gas, Sewer, Overhead Lines

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☒ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☒ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☒ **Infiltration**
  - ☒ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: Because the basin is flat and open, tree planting to enhance and improve water infiltration may be beneficial. Additionally, in lieu of removing concrete channel, a micropool could be constructed to create an area where sediment settling can occur for water quality improvement prior to water exiting the basin.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+RSA5+E1

Address of Basin: 3572 Iron Works Pike

Basin Acreage: 5.64 acres

Drainage Acreage: 32.6 acres

FEMA 100-year Floodplain: No

Channel Length: None

Property Owner: Commonwealth of Kentucky

Type of Basin: Retention Pond

Drainage Area Land Use: Institutional

Adjacent Land Use: Institutional, Soccer Complex

Utility Issues: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No opportunities for retrofitting observed during inspection.

Lexington-Fayette Urban County Government
Basin Retrofit Data Sheet

Basin ID #: CR+RSA11+E3

Property Owner: Edward T. Saad

Address of Basin: 1800 Sahalee Drive

Type of Basin: Retention Pond

Basin Acreage: 2.30 acres

Drainage Area Land Use: Residential, Horse Farm

Drainage Acreage: 53.2 acres

Adjacent Land Use: Residential, Horse Farms

FEMA 100-year Floodplain: No

Utility Issues: None

Channel Length: None

Retrofit Options:

- ☐ **Extend Detention**
  - ☐ Modify Riser
  - ☐ Increase Embankment Height
  - ☐ Excavate Bottom
  - ☐ Change Geometry
- ☐ **Channel Condition**
  - ☐ Add Meanders/Modify Internal Design
  - ☐ Remove Concrete Bottom
  - ☐ Add Forebay
  - ☐ Add Micropool
  - ☐ Repair Bank/Channel Erosion
- ☐ **Infiltration**
  - ☐ Tree Planting
  - ☐ Rain Garden
  - ☐ Bioretention
  - ☐ Other Filtering Practice
- ☐ **Naturalized Basin**
- ☐ **OTHER**
  - ☐ Public Education
  - ☐ Litter Control
  - ☐ Bank Stabilization
- ☐ **Opportunity to Retrofit Limited Due to Site Issues**

Additional Comments: No retrofitting opportunities observed during inspection.

APPENDIX D

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

The following is an overview of some of the applicable laws and ordinances within the LFUCG Code of Ordinances and City of Georgetown Code of Ordinances that apply to watershed management. This summary is not comprehensive, but is intended to provide an overview of some of the protections in place.

1. Riparian Areas

Per LFUCGs Code (Chapter 12: Housing, Article 3: Riparian Areas), "any person whose property contains a riparian area…[to] create a buffer area bordering the riparian area upon obtaining a permit from the Division of Environmental Services. Such a buffer area shall be exempt from the nuisance provisions of chapter 12 provided that the area is properly maintained as defined herein and acceptable species of vegetation are utilized." In this way, natural riparian areas may be maintained without being cited for a penalty nuisance provisions. The maximum area for such a riparian zone is "twenty-five (25) feet from the edge of the wetland, river, stream or lake, unless a larger area is approved by the urban forester and so designated on the permit."

Per Georgetown Code Section Chapter 8: Flood Prevention, Article 1, Division 5: Provisions for Flood Hazard Reduction, riparian zones are to be maintained within 25 feet of "mean high water level of the channel," and impacts to the riparian zone during construction must be restored upon completion of the construction. Also Chapter 19: Utilities says riparian zone or vegetative buffer strips shall be "preserved within at least 25 feet of the mean high water level of the channel," with native vegetation preferred.

2. Privately-Owned Detention and Retention Basins

The purpose of Division 2 of Article X, Chapter 16 is to set forth ordinances that will ensure compliance with LFUCG's MS4 permit regulations by clarifying the roles of the private property owner and LFUCG in managing stormwater control devices including detention basins and retention ponds. The ordinance requires that these control structures be properly maintained, both through structural repairs and non-structural maintenance. The ordinance also prohibits structures such as fences, gazebos, swimming pools, and sheds from being located in a detention basin or retention pond.

In an area where a public easement exists, the property owner and LFUCG share responsibility for the basin or pond. The property owner is responsible for non-structural maintenance such as mowing, litter removal, algae removal, tree limb removal, and landscaping. LFUCG is responsible for structural maintenance such as repairing severe erosion, removing excess silt, and removing large debris. LFUCG also repairs any structures that are failing, such as concrete flumes or pipes. In an area without a public easement, the property owner is responsible for all non-structural and structural maintenance of the basin or pond. All structural and non-structural maintenance of stormwater control devices on commercial or industrial property is the responsibility of the property owner and manager.

3. Industrial and High-Risk Commercial Stormwater Runoff

Chapter 16, Article X, Division 3 specifically allows LFUCG to regulate industrial and high-risk commercial facilities to develop and implement SWPPPs and monitoring plans, even if they are not otherwise required to have this information. The purpose of this program is to reduce pollutant loadings and improve the quality of stormwater runoff discharged from these areas into the local waterways.

A SWPPP is more detailed than a BMP Plan, Groundwater Protection Plan (GPP), or Spill Prevention Control and Countermeasure (SPCC) Plan. According to LFUCG's website, the four main objectives of a SWPPP are to identify pollutant sources, control the sources, document the control methods, and integrate pollution prevention.

4. Erosion and Sediment Control

Soil erosion from construction sites contributes to the impairment of the floodplain, increased road maintenance costs, clogging of storm sewers, degradation of land surfaces and streams, flooding, and dusty conditions when eroded material on streets dries. Significant erosion results from rainfall and runoff over unprotected soil. Erosion is increased by intense rainfalls, long slopes, steep slopes, and lack of adequate vegetative cover. These conditions are in part caused by or aggravated by improper construction, grading, or excavation, which results in removal of natural ground cover without taking appropriate steps to control erosion problems. The intent of Chapter 16, Article X, Division 5 is to reduce soil erosion in Fayette County and to provide procedures for submission, review, and acceptance of erosion and sediment control plans and applications for land disturbance permits prior to soil disturbance.

The ordinance covers control measures such as installation of silt fences, construction entrances, seeding and mulching, proper disposal of trash, curb and surface inlet protection, inspection of controls, street cleaning, drainage alteration, and snow fences for construction sites of various sizes and disturbance limits. The ordinance also includes enforcement measures and penalties for violations.

5. Water Quality Management Fee

Under Chapter 16, Article XIV, a water quality management fee is imposed on every parcel of land within the water quality management area except undeveloped parcels, railroad tracks, and federal, state, or urban county streets and roads. Single-family homes and duplexes will pay $4.32 per month, while apartment complexes and non-residential properties will pay the fee based on the total amount of impervious surface on their properties. Impervious surfaces are areas such as roofs, parking lots and driveways that do not infiltrate water when it rains. The ordinance establishes a Water Quality Fees Board and a stormwater projects incentive program.

The Stormwater Quality Projects Incentive Grant Program provides financial assistance for projects in the community that improve water quality, address stormwater runoff and educate the public about these issues. LFUCG's Division of Water Quality will receive the applications and make recommendations for project selection. Projects will be ranked based upon project impact, project team and other factors. The Water Quality Fees Board reviews all recommendations and makes the final selection on all grant awards. Because neighborhoods and institutions have different needs, there are two types of grants available.

6. Floodplain Conservation and Protection

Under LFUCG Chapter 20, Article XIX, the designation of flood hazard areas and the regulations imposed on these zones are intended to provide for public awareness of the flooding potential, protect human life and health, minimize public and private property damage, protect individuals from buying lands and structures which are unsuited for intended purposes because of flood hazards, and minimize surface and ground water pollution and erosion of the floodplain soils which will adversely affect human, animal or plant life.

Per Georgetown Code Chapter 19: Utilities, in Special Flood Hazard Areas new construction shall be constructed in such a way as to be resistant to flood damage. Manufactured homes shall be anchored to prevent flotation, collapse, or movement in the event of a flood. The lowest floor of a newly constructed residence in a Special Flood Hazard Area "shall have the lowest floor, including the basement, mechanical equipment, and ductwork elevated two (2) feet above the base flood elevation…"

7. Trees and Shrubs

LFUCG recognizes the importance of trees as a vital component in counterbalancing the effects of an urban setting by providing cooling shade, by reducing noise and glare, by significant contribution to urban aesthetics, by improving air quality through carbon dioxide reduction and replenishing oxygen to the atmosphere, by improving surface drainage and reducing the effects of storm drainage flooding, by filtering non-point source pollution from area streams, by stabilizing soil thereby minimizing erosion, and by providing habitat for wildlife. The purpose of Chapter 20, Article XVI is to establish standards and procedures for countywide tree protection and planting in new developments.

Under Georgetown Code of Ordinances Chapter 18.1: Trees and Shrubbery, a city tree board was established for the city of Georgetown, consisting of eleven members. "It shall be the responsibility of the board to study, investigate, counsel, develop and/or update annually, and administer a written plan for the care, preservation, pruning, planting, replanting, removal or dispositions of trees and shrubs in parks, along streets, and in other public areas." The tree board creates a list of street tree species for the city of Georgetown. No tree species that is not on the list can be planted as street trees without the written approval of the city tree board. The city has the right to plant, prune, maintain and remove trees, plants and shrubs within the lines of all roadways and public grounds to ensure the safety of the public and/or to enhance the beauty of the area.

8. Infrastructure and Environmental Hearing Boards

LFUCG Chapter 16, Article IX establishes two hearing boards: the infrastructure hearing board and the environmental hearing board. The first hears matters pertaining to the "enforcement of ordinances by the divisions of engineering, water quality, planning, traffic engineering and streets, roads, and forestry, and those portions of the zoning ordinance and subdivision regulations subject to enforcement through civil action," while the latter hears matters pertaining to the "enforcement of ordinances by the division of solid waste," as well as matters related to littering. Each board meets monthly and at additional times when necessary. The public must be notified of board meetings seven days in advance.

9. Sanitary Sewers Private Infiltration and Inflow

Under LFUCG Chapter 16, Article XI, discharge of surface water or groundwater into the sanitary sewer system is not permitted. Owners and occupants of premises with a sanitary sewer line that flows into the sanitary sewer system of the urban county government must allow representatives of the urban county government access to all parts of the premises, whether inside or out, to inspect and determine if surface water is discharged into the sanitary sewer system. When it's determined that surface water or groundwater is being discharged into the sanity sewer system, the owner or occupant of the property will receive written notice and will have 60 days to abate the discharge. If the discharge is not abated – or if the homeowner/occupant refuses to allow inspectors onto the property – they will be fined $75.00 per month. After six months, civil penalties and/or criminal prosecution may result.

10. Sanitary Sewer Capacity Assurance Program

LFUCG Chapter 16, Article XIII implements a Capacity Assurance Program (CAP) to assure that the sanitary sewer system will be able to support future connections.

A Sewer Capacity Request may be made new development property. Within 10 days of receiving the request, the division will provide written notice to the applicant of its decision to grant or deny the request. If a decision cannot be made in that time, status updates will be provided at least every 10 days until a determination is made. Remodeling projects do not require a permit and "the Division of Water Quality shall provide written notice of such waiver to the Division of Building Inspection."

11. Flood Prevention

Per Georgetown Code Chapter 8: Flood Prevention, Article 1, Division 5: Provisions for Flood Hazard Reduction, riparian zones are to be maintained within 25 feet of "mean high water level of the channel," and impacts to the riparian zone during construction must be restored upon completion of the construction.

New construction and substantial improvement of a residential structure shall have the lowest floor, including the basement, elevated to no lower than two feet above the base flood elevation.

12. Illicit Discharge and Connection to Stormwater Sewers

Per Georgetown Code Chapter 19 Utilities, Article V Illicit Connections, the city of Georgetown has established methods for controlling the introduction of pollutants into the municipal separate storm system. "No person shall discharge or cause to be discharged into the stormwater system or watercourses any materials, including but not limited to pollutants or waters containing any pollutants that cause or contribute to a violation of applicable water quality standards, other than stormwater." A person is in violation if he connects a line conveying sewage to the MS4. If the city of Georgetown suspects such a connection, it can inspect, require the person to install monitoring equipment, or suspend or terminate the MS4 discharge access of the person.

Watercourse protection: owners/lessees of property through which a watercourse passes must keep that part of the property free of trash, debris, contaminates, and cannot significantly slow the flow of water.

APPENDIX E

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

1) LexMark International, Inc.

Impervious Surface Removal, Tree Planting, & Rain Gardens: In 2008 – 2009, LexMark removed 16.2 acres of impervious surface including buildings and paved surfaces associated with its Ink Ribbon Manufacturing Buildings and reclaimed the area with top soil, grass seeding, planting of 2,000 trees, and constructing a large rain garden.

Cooling Tower Leak Repair: In January 2010, LexMark repaired a 5,400 gallon per day leak from a cooling tower which was contributing to a sewage odor in the stream and high concentrations of ammonia and fecal coliform. The repair resulted in a reduction of instream concentrations for these parameters.

Stream Restoration and Rain Garden: In 2010, LexMark Facilities Engineering restored over 1,500 feet of stream on Cane Run and a tributary in Shady Brook Park, at a cost of over $100,000. The restoration included bank reinforcement and riffle creation as well as wildflower seeding. A rain garden was also constructed as part of this project.

Stream Cleanup and Invasive Removal: Since 2008, LexMark, University of Kentucky, and LFUCG have worked together to host an annual "Cane Run Cleanup Event" during which trash is cleaned from LexMark area streams. In 2010, as part of this effort, bush honeysuckle was removed on 1,650 linear feet of stream bank.

Sanitary Sewer Repairs: In 2010, Black and Veatch was contracted by LexMark to conduct a site-wide inspection of the stormwater and sanitary sewer systems on LexMark property and develop a corrective action plan. LexMark set aside $10 million to repair and replace sewer lines over the next 10 years with over $2 million already spent by 2011.

Stormwater Feasibility Study: According to LFUCG Division of Water Quality, LexMark was awarded a Stormwater Quality Projects Incentive Grant Program grant in FY 2012. Under the grant, LexMark was to evaluate the feasibility of installing stormwater Best Management Practices to improve water quality and reduce stormwater runoff and flooding. The project will include educational component, and evaluation of an in-stream floatable trash collection system.

Trash Collection System: LexMark received CY2018 Stormwater Quality Projects Incentive Grant funding to study and perform preliminary design of an in-stream floatable trash collection system for potential installation in Cane Run within LexMark's property. The project is a collaboration between LexMark and student researchers from the University of Kentucky Biosystems and Agricultural Engineering program.

2) University of Kentucky Properties

In 2006, a dry lot was constructed in a veterinary science paddock to reduce the sediment load in stormwater runoff due to heavy livestock traffic.

Gully Erosion Stabilization Structure: In 2008, a gully erosion stabilization structure installed in a veterinary science paddock to decrease the amount of sediment and nutrient pollution entering waterways due to erosion.

Horse Exclusion, No-Mow Zone: Since 2008, horses on the Experiment Station have been excluded from the stream, and a no-mow riparian buffer of 50 feet width has been installed.

***Hardened Livestock Stream Crossing*:** In 2008, a hardened livestock stream crossing was installed based on NRCS guidelines to reduce the sediment and nutrient pollution into the streams by decreasing erosion. The crossing also includes gates to exclude livestock.

***Spring Fed Watering Tank*:** In 2008 - 2009: a spring near a veterinary science paddock was developed into an alternative water source for livestock. This allowed for exclusion of cattle from the stream thereby decreasing bacteria, sediment, and nutrient loads.

***Riparian Planting and No-Mow Zone*:** In 2010, a 0.087 acre (3,800 ft^2) riparian buffer planting with approximately 1,600 native perennials and grasses along North Farm section. This improved the diversity in the no-mow zone.

***Agricultural Water Quality Plan, Nutrient Management Plan, & Waste Transfer Station*:** In 2011, an Agricultural Water Quality Plan was completed for the University of Kentucky Experiment Station farms as required by law. As part of the Agricultural Water Quality Plan, a nutrient management plan was developed. This plan indicated phosphorus supplementation is unnecessary based on current soil levels. Under the plan, all livestock waste is now collected in a roofed transfer station prior to hauling for compost at a cost of $40,000 / year. Placement under a covered stack pad prevents pollution from runoff.

Pesticide Disposal: From 2010 to 2012, about 6,700 pounds of surplus pesticides and fertilizers were removed and properly disposed of. This disposal comes as part of improved management of these pesticides and fertilizer including inventorying current supplies, proper storage, adjustment of purchase and ordering of pesticides and fertilizers to the minimum, and recycling empty containers using the Rinse and Return System.

***Septic System Removal*:** Removal of septic systems along with 7 residences and apartment buildings, totaling over 6,000 sq feet (0.14 acres). By removing these systems, their contributions to bacterial pollution were removed as well.

Legacy Trail Easement and No-Mow Zones: Easements were granted for the Legacy Trail on UK Farms. A 50 foot width easement was specified, but these areas were expanded under the Cane Run Watershed Plan Project. No-mow zones were established, and 0.8 acres (35,000 ft^2) of wild flowers and native grasses were planted along portions of the trail riparian buffer areas

Cattle Exclusion and No-Mow Zone: In 2010, dairy cows and ponies were excluded from creeks running through their respective paddock areas. The restricted areas include a 30-foot riparian buffer a total of 6,000 feet of now protected stream bank. The restrictions will reduce loading of bacteria and nutrients into Cane Run.

Hardened Livestock Stream Crossing: Installed hardened livestock crossing and permanently closed one crossing. This will reduce erosion and therefore sediment and nutrient pollution.

Clean Water Diversion: Manure and contaminated stormwater is stored in large basins at the dairy on University of Kentucky Farms, however much of the stored liquid is clean water from barn roofs.

Using $41,000 of SB-271 funds, this clean stormwater has been diverted from the manure and contaminated sources. This has reduced bacteria loading to the Cane Run Watershed.

Rain Garden: In 2011, the UK Center for Applied Energy Research, adjacent to UK Farm, constructed a large rain garden to reduce stormwater runoff from two newly constructed buildings.

Waste Management BMP Research Projects: The University of Kentucky Victory Haven Training Center, located off of Russell Cave Road outside of the Urban Service Area, is a facility where large volumes of horse muck are generated from horse boarding and training. Two research projects focused on best management practices dealing with techniques for management and designs of composting areas and muck storage were investigated under a NRCS "earmark" funded project entitled "Development and Implementation of Stream Restoration and Riparian Corridor Techniques for Enhancing Water Quality in the Cane Run Watershed." These two studies were entitled "Evaluating the Effectiveness of Weep Berm Systems for Treating Runoff from the Composting of Horse Muck" and "Control and Treatment of Runoff from a Muck Storage Pad using a Permeable Containment Basin and Phytotechnologies." These projects were completed in 2012.

Horse Exclusion and City Waterer: In 2007, horses were excluded by fencing in this section of stream. Previously, the stream was the only source of water, but a city waterer was installed providing a water source for the horses to be fenced out of the stream.

CRP, Riparian Plantings, Educational Signage: From 2007 to 2010, riparian areas near the Animal and Food Science Horse Area of the University of Kentucky Experiment Station were increasingly improved for water quality protection. In 2007, about 7 acres of riparian buffer enrolled in NRCS Conservation Reserve Program (CRP). In 2009, 1,950 linear feet of buffer were planted with 1,800 saplings. Educational signage was installed in 2010.

Pervious Concrete Horse Wash Bay: A pervious concrete horse washing area was installed at the equine pavilion. This pervious concrete is expected to destroy bacteria upon contact, work as a solid / liquid separation system, and provide storage for holding wash water.

Stream Vehicular Crossing Closed: In 2010, one stream vehicular crossing was closed.

Riparian Buffer Research Project: Under a NRCS "earmark" funded project entitled "Development and Implementation of Stream Restoration and Riparian Corridor Techniques for Enhancing Water Quality in the Cane Run Watershed", a research project on riparian buffers was conducted on an unnamed tributary to Cane Run on UK's Experiment Station. This study, entitled "Management Techniques to Improve the Hydrologic and Structural Properties of Riparian Buffer Soils" was to determine if mowing regime and native grass establishment in the riparian buffer zone influences the vertical and lateral transport of waters from adjacent lands.

No-Mow Zone and Educational Signage: No-mow zones have been established along all streams and water bodies across the entire UK Experiment Station Farms, except several small reaches and Lake Mildred. Cumulatively, these areas add up to about 27 acres of land on the Experiment Station Farms. In 2010, signs and markers have been posted to delineate no-mow zones and educate visitors.

3) Bluegrass Stockyards

Clean Water Basins: Bluegrass Stockyards used funding from a FY2017 Stormwater Quality Projects Incentive Grant to construct two "clean water detention basins" on the site of the new stockyards facility (4561 Iron Works Pike). The basins contain pre-filter settling forebays with drive-in ramps that can be used to remove accumulated solids and sand filter outlets to improve the quality of stormwater runoff leaving the site.

Other BMPS: The entire operation is under one roof to minimize polluted stormwater leaving the site. Manure and bedding are stored under the roofed area and a vendor removes the material for offsite composting. Rainfall from the facility roof is collected and routed via underground pipes to a separate "clean water" pond that holds 1.5 million gallons at the normal pool. The pond is used to supply water to livestock at the facility.

4) Kentucky Horse Park

Riparian Planting, No-Mow Zone, and Educational Signage: In 2010, 500 linear feet of unnamed tributary to Cane Run on Kentucky Horse Park property was planted with native trees, grasses, and wildflowers. Over 9,000 square feet were planted with 39 trees, over 100 willow stakes, 77 shrubs and 4,000 wildflowers, grasses, rushes and sedges. A walking path and educational signs were also installed. Project partners included the Bluegrass Partnership for a Green Community, the Kentucky Horse Park, M2D Design, University of Kentucky, Cane Run Watershed Council, Alpha Phi Omega student service organization, Midway College, KCTCS, KWRRI, Glasgow Garden Club, KY Federation of Garden Clubs, Master Gardeners, UK BAE Interns, and State grounds keepers.

Sanitary Sewer Repairs: In 2009, the Kentucky Horse Park received $5.7 million in funding under the American Recovery and Reinvestment Act (ARRA) and an Energy Savings Performance Contract (ESPC) to pursue cost savings projects addressing energy and maintenance. One of these projects was the repair and replacement of the sanitary sewer manholes and piping at the Kentucky Horse Park to address the large amount of inflow and infiltration in the area. This project was projected to reduce the sewer bill for the Horse Park by approximately $149,000 dollars per year, removing approximately 26 million gallons of wastewater. It also prevents bacteria pollution to surface water in the Cane Run Watershed.

Porous Asphalt and Pavers: In 2010, the Kentucky Horse Park installed 97,000 sq ft of porous asphalt in a parking lot and 7,500 sq ft of porous pavers near a parking area near an unnamed tributary to Cane Run. These measures are intended to reduce the stormwater volume and improve the water quality of runoff entering a sinkhole and tributary.

Manure Bioenergy Management Facility: As part of the Energy Savings Performance Contract (ESPC) funding, the Kentucky Horse Park installed a Manure Bioenergy Management facility to reuse horse muck through biomass gasification to produce electricity.

***Bioretention Basin*:** Using Stormwater Quality Projects Incentive Grant funding, the Kentucky Horse Park installed a 150,000-gallon bioretention basin to treat stormwater, specifically addressing nutrients and bacterial pollution.

5) Other Implemented BMPs

Stream Restoration: Under the Consent Decree, LFUCG was required to implement the Coldstream Park Stream Corridor Restoration and Preservation Supplemental Environmental Project (SEP), as described in Appendix J-1 of the Consent Decree. The Coldstream SEP was constructed in 2018 and the project will be monitored (2019-2023) for success. The project is intended to reduce flooding by removing artificial restrictions, reduce pollutant loadings, enhance recreational and educational opportunities, and promote future water quality initiatives by restoring the 0.8 mile stretch of Cane Run between Citation Boulevard and I-75.

Riparian Planting and Invasive Removal: In 2009, University of Kentucky students removed bush honeysuckle along Cane Run in Coldstream Park. Cane Run, along Coldstream Park, was also one of the first sites of the annual Reforest the Bluegrass (RTB) event in 1999. The Reforest the Bluegrass (RTB) program was started in March of 1999 as a cooperative effort between LFUCG's Water Quality, Urban Forestry, and Parks and Recreation management programs. Its purpose is to recreate pre-settlement streamside forests that were once native to the Inner Bluegrass Region of Kentucky. In addition to this first event, a RTB event was held in April 2012 at the northern part of the Legacy Trail near Spindletop Hall and Ironworks Pike. More than 2 acres adjacent to Cane Run were planted.

***Audubon Cooperative Sanctuary Certification*:** In 2008, the Marriott Griffin Gate Golf Club was certified as Audubon Cooperative Sanctuary which included bat boxes, bird houses, and butterfly garden as well as a wildlife corridor.

Rogers Road Stormwater Project: According to an engineering report prepared by GRW Engineers (2012), seven residents of the Rogers Road project area, located in the Joyland Neighborhood Association outside of New Circle Road between Paris Pike and Russell Cave Road, reported home flooding due to stormwater and twelve reported street flooding. Flooding was found to occur when the detention basins and sinkhole in Mary Todd Park overflow due to inadequate capacity for the 25-year, 24-hour storm. Three alternatives to address this flooding were investigated with a presentation of the alternatives in a public meeting to occur in April 2012. The projected project costs ranged from $1.62 to 1.78 million.

***Green Acres / Hollow Creek Stormwater Project*:** According to a stormwater improvements study, conducted by CDP Engineers (2009), the Green Acres and Hollow Creek neighborhoods, located outside of New Circle, west of Russell Cave Road, have long experienced flooding, trash and debris accumulation problems which increased with infrastructure age and increased development. In 2006, $2.6 million was allocated by the Kentucky Legislature to fix the problems. However, public survey and modeling results indicated that the extent of the problem was greater than originally expected, extending to the Winburn and Brookfield Chase neighborhoods. The stormwater improvements study identified three neighborhood-wide projects and nine specific projects. The neighborhood-wide projects include:

1) flood proofing approximately 44 qualifying residences (grant funded),
2) replacement of about 20 stormwater inlets with limited / restricted openings and relocation of two pipes, and
3) development of a trash and debris cleanup program beginning with a small pilot neighborhood.

Specific projects include construction of detention facilities, stormwater and sanitary sewer infrastructure repair or replacement, stream restoration, home acquisition, trash control, and other solutions for the following areas.

1) Astaire Drive, Grant Place Drive, Grant Court
2) Hollow Creek Drive and LaSalle Road Intersection
3) Green Acres Park
4) 501-517 Asbury Lane
5) 453 and 457 Asbury Lane, Kirk Court
6) Paddock Apartments
7) 1783 and 1787 Barksdale Drive
8) Bowen and Barksdale Courts
9) Feltner Court

The projected cost of all of these projects was between $4.487 and $4.682 million dollars. Because the cost to address all of the identified problems exceeded the available funding, projects were prioritized to address the Green Acres / Hollow Creek subdivisions first. Of the specific projects, Projects 1 and 2 were selected as the top priority projects, and were recommended to be funded under the available funds. With the cost for design and construction of the sanitary trunk sewer to be paid through the LFUCG Sanitary Sewer Fund. Projects 4 and 7 met criteria for inclusion on the LFUCG Stormwater Priority Projects Master List, and have been listed for funding by the LFUCG when money becomes available. Projects 3, 5, 8, and 9 did not meet criteria for inclusion on the LFUCG Stormwater Priority Projects Master List, however Project 3 was recommended for implementation if any funds remained.

Rain Barrel / Rain Garden Program: The Living Arts and Science Center, Inc was awarded a Stormwater Quality Projects Incentive Grant Program grant in FY 2011 according to the LFUCG press release. The grant was used to develop and present educational workshops for the residents of Martin Luther King Neighborhood, and to implement a rain barrel/rain garden program for the neighborhood located in the Town Branch and Cane Run Watersheds.

Improvement Plan, Rain Barrels / Rain Gardens: The North Limestone Neighborhood Association, Inc. was awarded a Stormwater Quality Projects Incentive Grant Program grant in FY 2012 according to the LFUCG press release. Under the grant, an Environmental Improvement Plan for the Limestone / Loudon area was developed to identify stormwater management problems and propose solutions. Educational workshops on the stormwater improvement plan, rain barrels/rain gardens, and water quality were also held.

Pond Aeration, Stream Cleanup, and Invasive Removal: The Spindletop Community Association was awarded a Stormwater Quality Projects Incentive Grant Program grant in FY2012. Under the grant an aeration system was to be installed in the neighborhood pond to improve water quality in the pond and the receiving stream according to the LFUCG press release. Also, the grant funded pond and stream cleaning, storm drain stenciling, and educational seminars.

Environmental Education**:** Bluegrass Pride also obtained a Stormwater Quality Projects Incentive Grant Program grant in FY2011 to produce and develop a 30-minute public broadcast video about Cane Run and its watershed to be broadcast on KET statewide.

APPENDIX F

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

Wolf Run Watershed Plan
Benchmark Recommendations for Nutrient Parameters
Kentucky Division of Water
2/2/12

Nutrient benchmarks given here represent the best information available to the Kentucky Division of Water (KDOW) at this time. The goal is to provide estimates of typical in-stream concentrations below which it is unlikely that nutrients would be a cause of observed impairments. As such, benchmarks are useful in identifying sub-basins with potential nutrient issues when setting priorities for further monitoring or for development of load reduction strategies. In making these recommendations we consider regional and watershed-specific nutrient expectations, regional-scale patterns in biological effects, and the specific indicators of nutrient enrichment observed in the watershed. These benchmarks may be different than targets to be used ultimately as management endpoints; watershed-specific characteristics, practical considerations, and insight gained from early phase monitoring might suggest alternate values for that purpose. The Watershed Group may wish to discuss with KDOW alternative benchmarks and/or targets based on more detailed local information or consultation with experts familiar with the watershed. A summary of candidate benchmarks is given here along with a final set of recommendations to provide more assistance in interpreting nutrient data.

Ecoregional Reference Reach candidate benchmarks:

The Reference Reach network of streams represents the least-impacted conditions for aquatic life in the respective ecoregions. The Wolf Run watershed is entirely within ecoregion 71l (Inner Bluegrass). The significance of the regional placement of the watershed is that the phosphorus content of the formations of the Lexington Limestone found in the Inner Bluegrass is high relative to the geology typical of the Outer Bluegrass and Hills of the Bluegrass (ecoregions 71d and 71k). Nitrate concentrations also may be influenced by this geologic setting. These differences are reflected in the summary table below: total phosphorus and nitrate-nitrite-N are substantially higher in Reference Reaches of 71l than in the Bluegrass as whole (71l plus 71d Outer Bluegrass and 71k Hills of the Bluegrass).

	Ecoregion	Number Samples	MIN	MAX	MED	**75th percentile**	90th percentile
TP(mg/L)	71l	13	0.117	0.46	0.304	0.338	0.396
	BG	114	<0.010	0.46	0.053	0.109	0.244
NN(mg/L)	71l	14	0.108	4.07	1.292	2.628	3.167
	BG	117	<0.010	4.07	0.085	0.372	1.108
TKN(mg/L)	71l	14	<0.200	0.756	<0.200	0.351	0.537
	BG	116	<0.200	1.230	0.216	0.404	0.625
TN(mg/L)	71l	14	0.409	4.170	1.674	2.953	3.272
	BG	116	<0.200	4.170	0.439	0.798	1.520

Watershed reference candidate benchmarks:

When there are segments within the watershed or within closely comparable watersheds where uses are fully supported, then nutrient data from those streams can be summarized as a "watershed reference". These need not be Reference Reaches designated by KDOW, but should have been assessed as being fully supporting of the most sensitive use, in this case aquatic life, and are closely comparable. It is notable that most of the streams in 71l that have been assessed as fully supporting aquatic life use are in the Kentucky River Palisades along the Kentucky River, an area with more rugged terrain where streams have higher gradients and distinctive biological communities relative to other parts of 71l. One exception is Steeles Run, which enters Town Branch 9 miles downstream of Wolf Run. Steeles Run has been assessed as fully supporting aquatic life use; however, the stream does exhibit indicators of excess nutrients such as dense algae growths. There is only one water sample from this stream, with TP 0.382 mg/L and TN 5.58 mg/L.

Effects-based (empirical) candidate benchmarks:

The entire watershed falls within the Bluegrass Bioregion and is not near a boundary. The benchmarks from a KDOW draft bioregional nutrient benchmarks report for the Bluegrass Bioregion are TP 0.1 mg/L, TN 1.2 mg/L; however, it is noted that background nutrient concentrations vary widely within the Bluegrass (as discussed above)and so these bioregional benchmarks must be modified according to local watershed characteristics. As indicated in the report, the relationships between nutrients and biological integrity are difficult to detect from analyses of KDOW's Bluegrass data. It is evident, though, that streams in the Inner Bluegrass with good instream habitat, intact riparian zones, well shaded channels, and normal flow regimes support desirable good quality aquatic communities at levels of TP and TN higher that might produce problems in streams in other regions.

Literature values

TP 0.1 mg/L is often cited as an upper threshold for preventing nuisance algae growth, which is one of the indicators of impairment observed in the Wolf Run watershed. That figure is well below 71l Reference Reach levels and also below levels in streams in the ecoregion observed to be fully supporting aquatic life use. Literature guidelines for the boundary between oligotrophic and mesotrophic conditions are TP 0.025 mg/L and TN 0.700 mg/L. The boundary between mesotrophic and eutrophic conditions are given as TP 0.075 mg/L and 1.5 mg/L. Reference Reaches and watershed reference data summarized above place those streams well into the eutrophic category for both TN and TP.

Summary

In the Inner Bluegrass it is particularly important to take an adaptive approach to setting expectations for nutrients. Background concentrations alone may be high enough that streams without good riparian condition, canopy cover, and in-stream habitat are likely to show signs of nutrient-related problems with little additional enrichment. In addition, stressors other than nutrients are common and may exacerbate nutrient impacts. The benchmark recommendations given here were derived from the median ecoregional Reference Reach data. These benchmarks should be reviewed as more information becomes available on conditions in the Wolf Run watershed, including the specific nutrient-related issues that may be occurring, the feasibility of nutrient reductions, and the importance of nutrients in causing undesirable effects to aquatic life relative to other stressors, such as high specific conductance.

Final benchmark recommendations:

Total P	0.30 mg/L
TKN	0.20 mg/L
Nitrate-Nitrite-N	1.3 mg/L
Total N	1.7 mg/L

Excerpts from Wolf Run Watershed Based Plan, Chapter IV, Pages 14-15

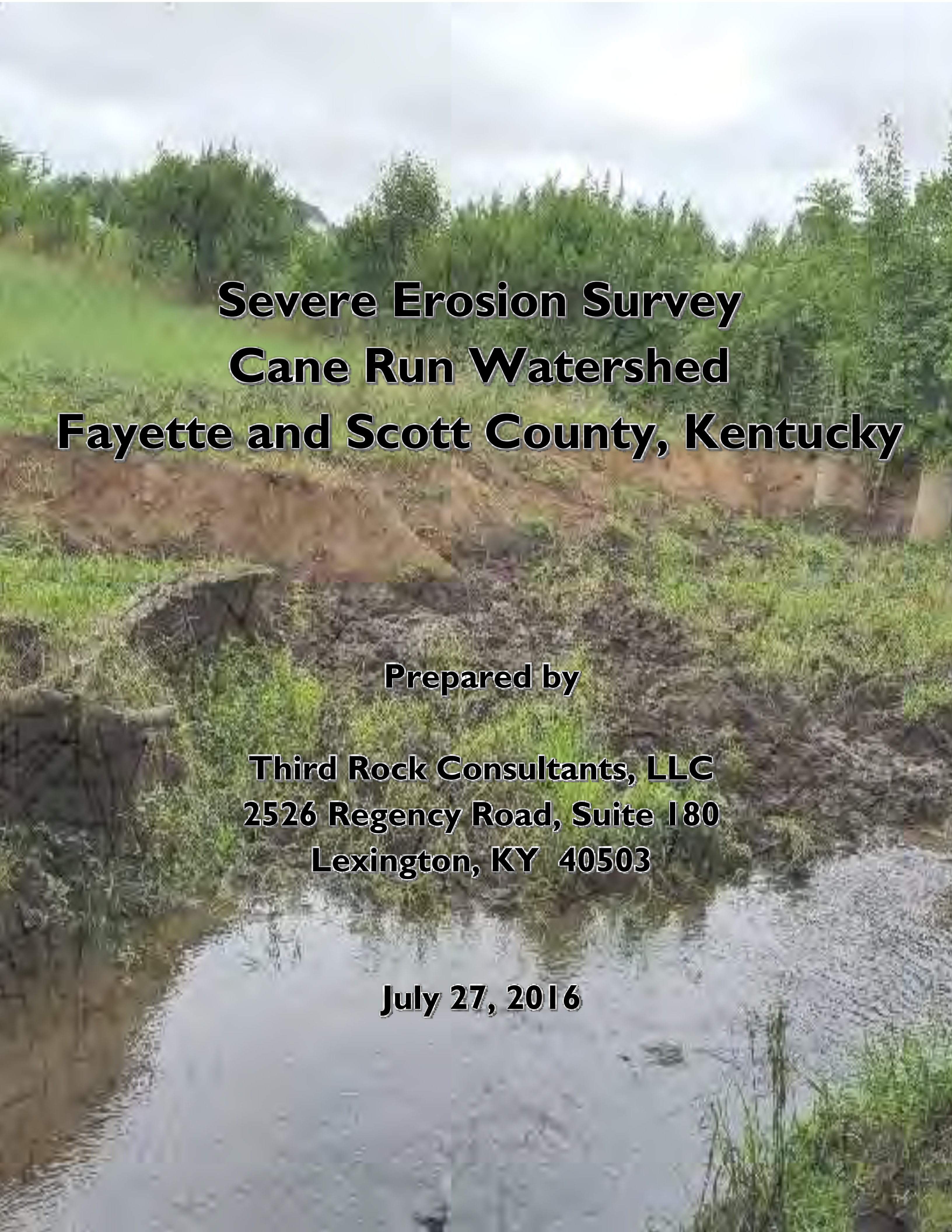
"For other parameters, no regulatory numeric standard has been established due to the variable relationship between biological integrity and concentration levels in different streams. Multiple factors are impacting warmwater aquatic habitat use of the Wolf Run Watershed, including poor riparian and in-stream habitat and poor hydrology/flow regime as well as elevated water quality parameters. Because of the uncertainty in assigning definitive thresholds for these parameters as well as the feasibility and cost-effectiveness of reducing concentrations, a phased approach was utilized in the development of benchmarks for non-regulatory water quality parameters.

Under this phased approach, non-regulatory reference points are initially established higher than reference conditions since the reference levels may be well below the level necessary to restore support of the use. These target levels are established based the extent and magnitude of the problem as well as technological feasibility, cost, and achievability. These goals would be re-assessed through the watershed planning process on regular time intervals and lowered if the designated use does not become fully supported through the implementation plan efforts when target levels are achieved. Table 23, page IV-14, lists the non-regulatory reference points for the Wolf Run Watershed. These levels were developed in consideration of the recommendations made by KDOW, are applicable only for the Wolf Run Watershed, and are not intended to have any regulatory use.

The rationale behind the selection of these non-regulatory reference points is as follows. The nutrient levels (total phosphorus at 0.35 mg/L and total nitrogen at 3.0 mg/L) were each established between the 75th and 90th percentile concentrations for reference reaches in the Inner Bluegrass. The ammonia benchmark of 0.1 mg/L was near the 75th percentile for the Wolf Run data collected. These higher concentrations were utilized based on published literature (Pond *et al.* 2003), which indicates that nutrient concentrations are not well correlated with macroinvertebrate metrics in the Bluegrass Bioregion. The main stem of the Ohio River has a specific conductance limit of 800 µS/cm, which was considered too high for this region. The benchmark of 650 µS/cm was established near the average of the Wolf Run sampling site medians…."

APPENDIX G

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water



Severe Erosion Survey
Cane Run Watershed
Fayette and Scott County, Kentucky

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July 27, 2016

Severe Erosion Survey
Cane Run Watershed
Fayette and Scott County, Kentucky

Prepared for

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INTRODUCTION

Third Rock Consultants, LLC (Third Rock) has been retained by the Kentucky Department for Environmental Protection, Division of Water (DOW) to develop a comprehensive watershed plan for the Cane Run Watershed in Fayette and Scott County, Kentucky (HUC#05100205280200). The watershed plan, funded by Section 319(h) Nonpoint Source Grant PPG BG-00D21415, will identify impairments and potential sources / causes of pollution and an implementation plan to address the impairments. To that end, Third Rock was tasked with conducting a severe erosion survey of perennial and intermittent streams within the watershed in accordance with the approved Cane Run Watershed Quality Assurance Project Plan (QAPP) (Evans 2016). Streams within the Lexington-Fayette Urban County Government (LFUCG) Urban Service Area of the watershed were not assessed under this effort.

METHODS

Streams were surveyed for severe erosion either on foot or by windshield survey from public roads over the course of four (4) days between July 1, 2016 and July 7, 2016. For purposes of this report, severe erosion is defined as erosion that exceeds average reach conditions or threatens property and infrastructure. Sites that could not be accessed by foot or viewed from public roads were analyzed for erosion on aerials following the field effort. In locations where permission could be obtained, surveyors walked stream segments; where permission could not be obtained, survey was accomplished with the aid of binoculars from public roadways.

During the field effort, surveyors recorded data on an Erosion Site Field Datasheet following the *Stream Corridor Assessment Survey- SCA Survey Protocols* (MDDNR 2001). Data collected included GPS coordinates, type of impact, cause of erosion, estimated length of erosion, exposed bank height, left and right bank land use, and potential threat to infrastructure. Additionally, the severity, correctability, and accessibility of each severe erosion site was ranked.

The severity of erosion was ranked from 1 (severe) to 5 (minor) for each site. Severe (1) erosion was considered a long stream (> 1000 ft.) that had incised several feet, with banks on both sides of the stream that are unstable and eroding at a fast rate. Moderate (3) erosion was considered for either a long section of stream (> 1000 ft.) that has a moderate erosion problem, or a shorter stream reach (between 1000 and 300 ft.) with very high banks (> 4 ft.) and evidence that the stream is eroding at a fast rate. Minor erosion (5) was considered a short section of stream (< 300 ft.) where the erosion is limited to one or two meander bends or a site where an erosion problem is being caused by a pipe outfall and the area affected is fairly limited.

Correctability was ranked from 1 (best) to 5 (worst), where the best sites could be corrected by volunteers in one or two days while the worst would require significant funding (i.e., several hundred thousand dollars) and a large amount of earth moving.

Accessibility was ranked from 1 (easy) to 5 (difficult), where easy access was considered by car or foot, moderate access was easy by foot but not car, and difficult would be areas where access by foot or vehicle would be highly restricted (i.e., require an access road to allow construction).

RESULTS

12 severe erosion sites were identified during the survey, with a total approximate length of 9,540 feet (1.81 miles). An additional three (3) sites, with a total approximate length of 1,200 feet (0.23 miles), were identified as potential areas of erosion based upon aerial mapping but could not be field verified. In total, 2.04 miles of erosion were identified during the survey (**Exhibit** 1, page 3). **Table 1**, page 4, describes the erosion features of each site. Erosion Site Field Datasheets are included as **Appendix A**, a photo log as **Appendix B,** and detailed location mapping for each site as **Appendix C**.

Bank heights were between one (1) and five (5) feet high, with severity rankings ranging from moderate (3) to minor (5). The correctability ranking of each site ranged from correctable by volunteers (1) to requiring significant funding and a large amount of earth moving (5). Access to the sites was typically good as the erosion identified was often located near roadways. Most erosion was due to widening of the streambanks, although some downcutting was also observed. While the most common cause of erosion was an adjacent road crossing or infrastructure, erosion due to livestock access to streams, sharp bends in the stream, or pipe outfalls was also observed. Adjacent land use was primarily pasture. Although most erosion sites were not a threat to infrastructure, one reach (ES-7) threatened a parking lot and fencing.

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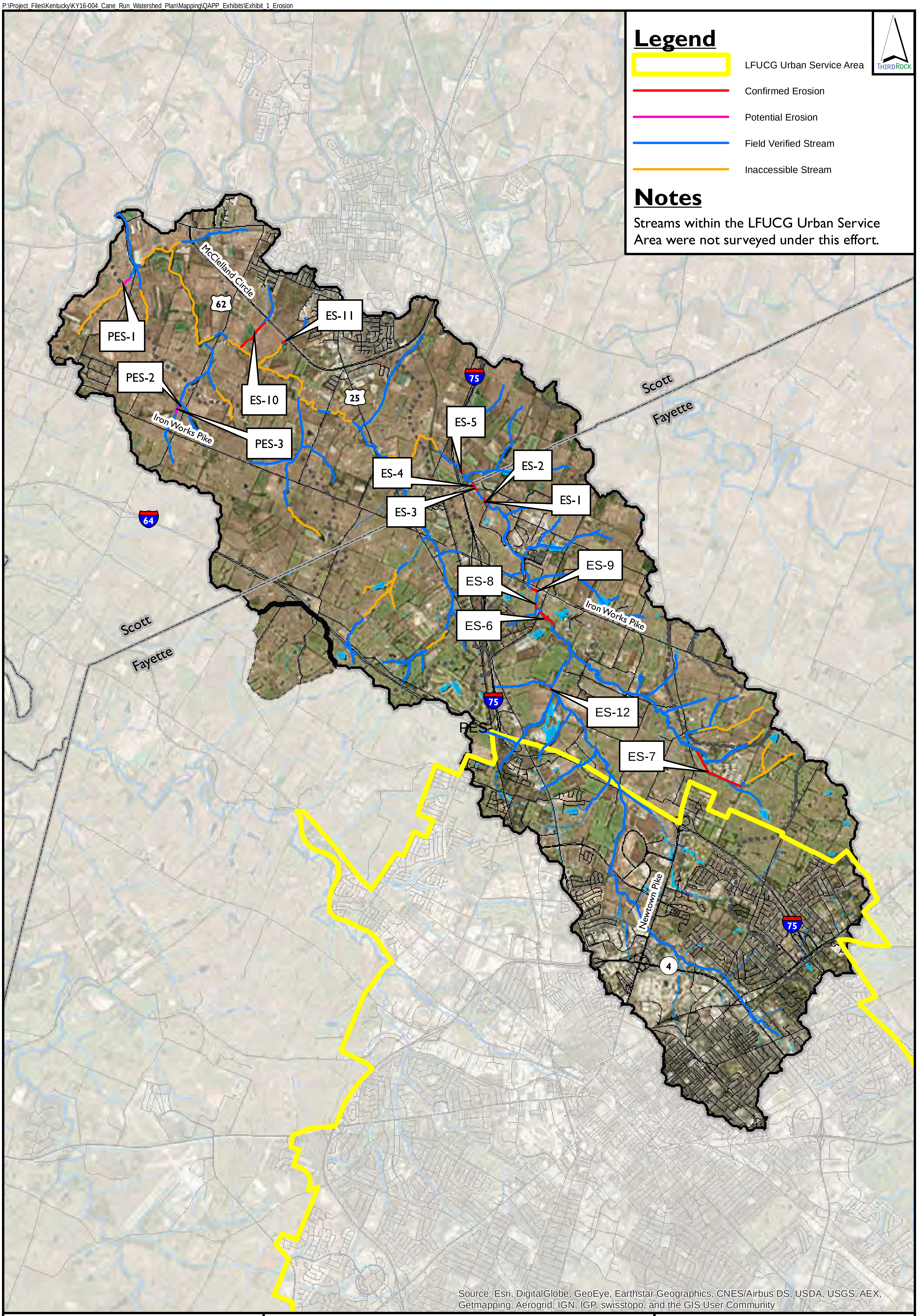
Evans, Steve. 2016. Cane Run Watershed Quality Assurance Project Plan (QAPP). Cane Run Comprehensive Watershed Based Plan. Kentucky Division of Water.

MDDNR. 2001. Stream Corridor Assessment Survey – SCA Survey Protocols. Watershed Restoration Division Chesapeake & Coastal Watershed Services Maryland Dept. of Natural Resources, Annapolis, MD.

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Exhibit_1_Erosion



Notes

Streams within the LFUCG Urban Service Area were not surveyed under this effort.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Exhibit 1 - Severe Erosion Sites
Cane Run Watershed
Fayette and Scott Counties, Kentucky

0 0.5 1 2 3 Miles

Prepared for:
KY Division of Water
300 Sower Boulevard
Frankfort, Kentucky 40601

Erosion Site ID	Approx Length (ft)	Date	Photo #	Type	Probable Cause	Bank Height (ft)	Land Use			Ranking		
							Left Bank	Right Bank	Threat	Severity	Correctability	Access
ES-1	190	7/1/2016	880-882	Widening	Other - Upstream Infrastructure	5	Forest	Pasture	No	5	2	1
ES-2	88	7/1/2016	883-885	Widening	Other - Upstream Infrastructure	6	Forest	Pasture	No	4	3	1
ES-3	165	7/1/2016	886-888	Widening	Road Crossing	5	Pasture	Pasture	No	5	4	1
ES-4	215	7/1/2016	892-894	Widening	Road Crossing	4	Pasture	Pasture	No	5	4	1
ES-5	145	7/1/2016	898-901	Widening	Road Crossing	4	Pasture	Pasture	No	4	4	1
ES-6	1450	7/6/2016	415-715	Widening	Bend at steep slope	4	Pasture	Pasture	No	4	5	2
ES-7	3820	7/5/2016	902-920	Widening	Past Channelization, Road Crossing and Pipe Outfall	4	Pasture	Pasture / Paved	Yes	3	3	2
ES-8	320	7/5/2016	921	Widening	Road Crossing	5	Pasture	Lawn	No	4	2	2
ES-9	440	7/5/2016	922	Downcutting	Bend at steep slope	3	Pasture	Pasture	No	4	2	2
ES-10	2350	7/6/2016	4415	Downcutting	Livestock	1	Pasture	Pasture	No	3	1	1
ES-11	245	7/6/2016	4416-4417	Widening	Livestock	2	Pasture	Pasture	No	5	1	1
ES-12	110	7/7/2016	141022, 141035	Widening	Road Crossing	5	Pasture	Crop Field	No	5	2	2
PES-1	660	7/15/2016	Aerial mapping was reviewed									
PES-2	180	7/16/2016	Aerial mapping was reviewed									
PES-3	360	7/17/2016	Aerial mapping was reviewed									

APPENDIX A

EROSION SITE ES

Map: 55 **Team:** BR/CR **Site:** ES-1

Date: 07 / 01 / 16 **Photo:** 880-882 **Survey:** _______

MM DD YY

Type: **D**owncutting [✓ **W**idening] **H**eadcutting **U**nknown

Cause: **Be**nd at steep slope, **P**ipe **O**utfall, Below **Ch**annelization, Below **R**oad **C**rossing,
Livestock, **L**and **U**se **C**hange Upstream, [✓ **O**ther] Upstream of pier

Length: 150 ft. **Average exposed bank height:** 5 ft.

Present Land Use Left Side (looking downstream): **Cr**op field, **Pa**sture, **La**wn, **Pa**ved, **Sh**rubs & Small Trees,
[✓ **Fo**rest], **M**ultiflora **R**ose, **O**ther _______________

Present Land Use Right Side (looking downstream): **Cr**op field, [✓ **Pa**sture], **La**wn, **Pa**ved, **Sh**rubs & Small Trees,
Forest, **M**ultiflora **R**ose, **O**ther _______________

Threat to Infrastructure?: **Y**es [✓ **N**o] **Describe**: _______________

Severity	Severe	**1**	**2**	**3**	**4**	[✓ 5]	Minor	Unknown (**–1**)
Correctability	Best	**1**	[✓ 2]	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	[✓ 1]	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

EROSION SITE ES

Map: 55 **Team:** BR/CR **Site:** ES-2

Date: 07 / 01 / 16 **Photo:** 883-885 **Survey:** _______

MM DD YY

Type: **D**owncutting [✓ **W**idening] **H**eadcutting **U**nknown

Cause: **Be**nd at steep slope, **P**ipe **O**utfall, Below **Ch**annelization, Below **R**oad **C**rossing,
Livestock, **L**and **U**se **C**hange Upstream, [✓ **O**ther:] _______________

Length: 200 ft. **Average exposed bank height:** 6 ft.

Present Land Use Left Side (looking downstream): **Cr**op field, **Pa**sture, **La**wn, **Pa**ved, **Sh**rubs & Small Trees,
[✓ **Fo**rest], **M**ultiflora **R**ose, **O**ther _______________

Present Land Use Right Side (looking downstream): **Cr**op field, [✓ **Pa**sture], **La**wn, **Pa**ved, **Sh**rubs & Small Trees,
Forest, **M**ultiflora **R**ose, **O**ther _______________

Threat to Infrastructure?: **Y**es [✓ **N**o] **Describe**: _______________

Severity	Severe	**1**	**2**	**3**	[✓ 4]	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	[✓ 3]	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	[✓ 1]	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

EROSION SITE ES

Map: 46 **Team:** BR/CR **Site:** ES-3

Date: 07 / 01 / 16 **Photo:** 886-888 **Survey:** ___

MM DD YY

Type: Downcutting [✓ Widening] Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, [✓ Above ~~Below~~ Road Crossing,] Livestock, Land Use Change Upstream, Other: ___

Length: 150 ft. **Average exposed bank height:** 5 ft.

Present Land Use Left Side (looking downstream): Crop field, [✓ Pasture,] Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other Forest edge then pasture

Present Land Use Right Side (looking downstream): Crop field, [✓ Pasture,] Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other Narrow Forest Edge

Threat to Infrastructure?: Yes [✓ No] **Describe:** ___

Severity	Severe	1	2	3	4	[✓ 5]	Minor	Unknown (–1)
Correctability	Best	1	2	3	[✓ 4]	5	Worst	Unknown (–1)
Access	Best	[✓ 1]	2	3	4	5	Worst	Unknown (–1)

EROSION SITE ES

Map: 46 **Team:** BR/CR **Site:** ES-4

Date: 07 / 01 / 16 **Photo:** ___ **Survey:** ___

MM DD YY

Type: Downcutting [✓ Widening] Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, [✓ Below Road Crossing,] Livestock, Land Use Change Upstream, Other: ___

Length: ___ ft. **Average exposed bank height:** 4 ft.

Present Land Use Left Side (looking downstream): Crop field, Pasture, Lawn, Paved, Shrubs & Small Trees, [✓ Forest,] Multiflora Rose, Other Their Pasture

Present Land Use Right Side (looking downstream): Crop field, [✓ Pasture,] Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other Forest Edge Riparian

Threat to Infrastructure?: Yes [✓ No] **Describe:** ___

Severity	Severe	1	2	3	4	5	Minor	Unknown (–1)
Correctability	Best	1	2	3	4	5	Worst	Unknown (–1)
Access	Best	1	2	3	4	5	Worst	Unknown (–1)

EROSION SITE

ES

Map: 46 **Team:** BR/CR **Site:** ES-5

Date: 07 / 01 / 16 **Photo:** 898-901 **Survey:** ______

MM DD YY

Type: **D**owncutting [✓ **W**idening] **H**eadcutting **U**nknown

Cause: **Be**nd at steep slope, **P**ipe **O**utfall, Below **Ch**annelization, [✓ Above and ~~Below~~ **R**oad **Cr**ossing,] **Li**vestock, **L**and **U**se **C**hange Upstream, **O**ther: ______________________

Length: 150 ft. **Average exposed bank height:** 4 ft.

Present Land Use Left Side (looking downstream): **Cr**op field, [✓ **Pa**sture,] **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees, **F**o**r**est, **M**ultiflora **R**ose, **O**ther Forest Riparian Edge

Present Land Use Right Side (looking downstream): **Cr**op field, [✓ **Pa**sture,] **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees, **F**o**r**est, **M**ultiflora **R**ose, **O**ther Forest Riparian Edge

Threat to Infrastructure?: **Y**es [✓ **N**o] **Describe**: ______________________

Severity	Severe	**1**	**2**	**3**	[✓ **4**]	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	[✓ **4**]	**5**	Worst	Unknown (**–1**)
Access	Best	[✓ **1**]	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

EROSION SITE

ES

Map: 72 **Team:** BR **Site:** ES-6

Date: 07 / 06 / 16 **Photo:** 415-715 **Survey:** ______

MM DD YY

Type: **D**owncutting [✓ **W**idening] **H**eadcutting **U**nknown

Cause: [✓ **Be**nd at steep slope,] **P**ipe **O**utfall, Below **Ch**annelization, Below **R**oad **Cr**ossing, **Li**vestock, **L**and **U**se **C**hange Upstream, **O**ther: ______________________

Length: 1,200 ft. **Average exposed bank height:** 4 ft.

Present Land Use Left Side (looking downstream): **Cr**op field, [✓ **Pa**sture,] **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees, **F**o**r**est, **M**ultiflora **R**ose, **O**ther ______________________

Present Land Use Right Side (looking downstream): **Cr**op field, [✓ **Pa**sture,] **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees, **F**o**r**est, **M**ultiflora **R**ose, **O**ther ______________________

Threat to Infrastructure?: **Y**es [✓ **N**o] **Describe**: ______________________

Severity	Severe	**1**	**2**	**3**	[✓ **4**]	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	[✓ **5**]	Worst	Unknown (**–1**)
Access	Best	**1**	[✓ **2**]	**3**	**4**	**5**	Worst	Unknown (**–1**)

EROSION SITE ES

Map: 98, 104, 105 **Team:** BR **Site:** ES-7

Date: 07 / 05 / 16 (MM DD YY) **Photo:** 902-920 **Survey:** ______

Type: Downcutting [✓ Widening] Headcutting Unknown

Cause: Bend at steep slope, [✓ Pipe Outfall], Below Channelization, [✓ Above ~~Below~~ Road Crossing], Livestock, Land Use Change Upstream, Other: Past Channelization

Length: 3,000 ft. **Average exposed bank height:** 4 ft.

Present Land Use Left Side (looking downstream): Crop field, [✓ Pasture], Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other ______

Present Land Use Right Side (looking downstream): Crop field, [✓ Pasture], Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, [✓ Other] Commercial

Threat to Infrastructure?: [✓ Yes] No **Describe:** Could Threaten Parking Lot and Horse Fences

Severity	Severe	1	2	[✓ 3]	4	5	Minor	Unknown (–1)
Correctability	Best	1	2	[✓ 3]	4	5	Worst	Unknown (–1)
Access	Best	1	[✓ 2]	3	4	5	Worst	Unknown (–1)

EROSION SITE ES

Map: 72 **Team:** BR **Site:** ES-8

Date: 07 / 05 / 16 (MM DD YY) **Photo:** 921 **Survey:** ______

Type: Downcutting [✓ Widening] Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, [✓ Below Road Crossing], Livestock, Land Use Change Upstream, Other: ______

Length: 400 ft. **Average exposed bank height:** 5 ft.

Present Land Use Left Side (looking downstream): Crop field, [✓ Pasture], Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other ______

Present Land Use Right Side (looking downstream): Crop field, Pasture, [✓ Lawn], Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other Riparian Forest Edge

Threat to Infrastructure?: Yes [✓ No] **Describe:** ______

Severity	Severe	1	2	3	[✓ 4]	5	Minor	Unknown (–1)
Correctability	Best	1	[✓ 2]	3	4	5	Worst	Unknown (–1)
Access	Best	1	[✓ 2]	3	4	5	Worst	Unknown (–1)

EROSION SITE ES

Map: 72 **Team:** BR **Site:** ES-9

Date: 07 / 05 / 16 **Photo:** 922 **Survey:** _______

MM DD YY

Type: [✓ **D**owncutting] **W**idening **H**eadcutting **U**nknown

Cause: [✓ **Be**nd at steep slope], **Pi**pe **O**utfall, Below **Ch**annelization, Below **R**oad **Cr**ossing,
Livestock, **L**and **U**se **C**hange Upstream, **O**ther: ____________________

Length: 400 ft. **Average exposed bank height:** 3 ft.

Present Land Use Left Side (looking downstream): **Cr**op field, [✓ **Pa**sture], **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees,
Forest, **M**ultiflora **R**ose, **O**ther ____________________

Present Land Use Right Side (looking downstream): **Cr**op field, [✓ **Pa**sture], **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees,
Forest, **M**ultiflora **R**ose, **O**ther ____________________

Threat to Infrastructure?: **Y**es [✓ **N**o] **Describe**: ____________________

Severity	Severe	**1**	**2**	**3**	[✓ **4**]	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	[✓ **2**]	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	[✓ **2**]	**3**	**4**	**5**	Worst	Unknown (**–1**)

EROSION SITE ES

Map: 16 **Team:** Olson **Site:** ES-10

Date: 07 / 06 / 16 **Photo:** 4415 **Survey:** _______

MM DD YY

Type: [✓ **D**owncutting] **W**idening **H**eadcutting **U**nknown

Cause: **Be**nd at steep slope, **Pi**pe **O**utfall, Below **Ch**annelization, Below **R**oad **Cr**ossing,
[✓ **Li**vestock], **L**and **U**se **C**hange Upstream, **O**ther: ____________________

Length: 2,400 ft. **Average exposed bank height:** 1 ft.

Present Land Use Left Side (looking downstream): **Cr**op field, [✓ **Pa**sture], **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees,
Forest, **M**ultiflora **R**ose, **O**ther ____________________

Present Land Use Right Side (looking downstream): **Cr**op field, [✓ **Pa**sture], **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees,
Forest, **M**ultiflora **R**ose, **O**ther ____________________

Threat to Infrastructure?: **Y**es [✓ **N**o] **Describe**: ____________________

Severity	Severe	**1**	**2**	[✓ **3**]	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	[✓ **1**]	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	[✓ **1**]	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

EROSION SITE

ES

Map: 17 **Team:** Olson **Site:** ES-11

Date: 07 / 06 / 16 **Photo:** 4416-4417 **Survey:** _______
MM DD YY

Type: Downcutting [✓ Widening] Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, Below Road Crossing, [✓ Livestock,] Land Use Change Upstream, Other: _______________

Length: 200 ft. **Average exposed bank height:** 1.5 ft.

Present Land Use Left Side (looking downstream): Crop field, [✓ Pasture,] Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _______________

Present Land Use Right Side (looking downstream): Crop field, [✓ Pasture,] Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other _______________

Threat to Infrastructure?: Yes [✓ No] **Describe:** _______________

Severity	Severe	1	2	3	4	[✓ 5]	Minor	Unknown (-1)
Correctability	Best	[✓ 1]	2	3	4	5	Worst	Unknown (-1)
Access	Best	[✓ 1]	2	3	4	5	Worst	Unknown (-1)

EROSION SITE

ES

Map: 85 **Team:** BR **Site:** ES-12

Date: 07 / 07 / 16 **Photo:** 141022-141035 **Survey:** _______
MM DD YY

Type: Downcutting [✓ Widening] Headcutting Unknown

Cause: Bend at steep slope, Pipe Outfall, Below Channelization, [✓ Above and Below Road Crossing,] Livestock, Land Use Change Upstream, Other: _______________

Length: 100 ft. **Average exposed bank height:** 5 ft.

Present Land Use Left Side (looking downstream): Crop field, [✓ Pasture,] Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other Riparian Forest Edge Partial

Present Land Use Right Side (looking downstream): [✓ Crop field,] Pasture, Lawn, Paved, Shrubs & Small Trees, Forest, Multiflora Rose, Other Riparian Forest Edge

Threat to Infrastructure?: Yes [✓ No] **Describe:** _______________

Severity	Severe	1	2	3	4	[✓ 5]	Minor	Unknown (-1)
Correctability	Best	1	[✓ 2]	3	4	5	Worst	Unknown (-1)
Access	Best	1	[✓ 2]	3	4	5	Worst	Unknown (-1)

APPENDIX B


ES-1, Erosion upstream of infrastructure


ES-2, Tree fall due to erosion


ES-2, Eroded bank about 6 ft tall


ES-3, Erosion along both banks near road crossing


ES-3, Erosion along both banks near road crossing


ES-4, Erosion of soils under roots of riparian trees

ES-4, Erosion and debris piles

ES-5, Large tree fall due to erosion

ES-5, Eroded banks and sedimentation in stream

ES-5, Tree roots without soil

ES-6, Erosion of banks and heavy siltation

ES-6, Erosion of banks and siltation

ES-6, Erosion of banks and heavy siltation

ES-6, Concrete debris dumped in stream

ES-6, Erosion along straightened reach

ES-7, Small erosion along narrow channel

ES-7, Small erosion along narrow channel

ES-7, Small erosion along narrow channel

ES-7, Erosion of bank leaves extended pipe in stream

ES-7, Bank erosion at a bend

ES-7, Slumping banks held together by grass

ES-7, Erosion in a bend

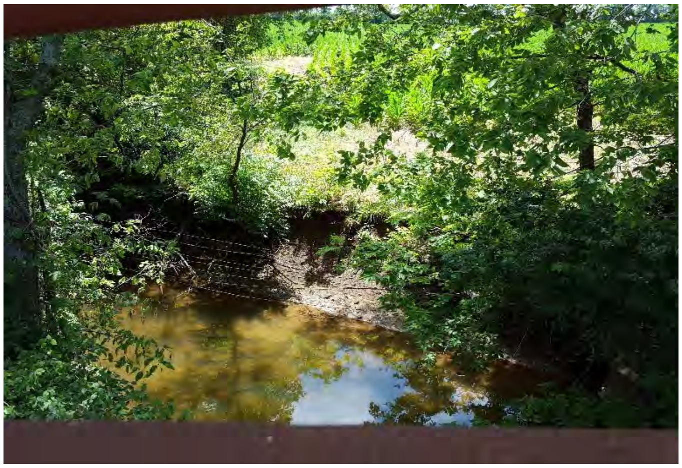
ES-8, Widening due to road crossing

ES-9, Downcuttiing due to bend

ES-10, Erosion due to cattle access along long reach

ES-11, Erosion due to cattle access

ES-11, Erosion due to cattle access



ES-12, Erosion near road crossing

APPENDIX C

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Severe_Erosion_Sites.mxd las 7/27/16

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend

- — Confirmed Erosion
- — Potential Erosion
- — Field Verified Stream
- — Inaccessible Stream

0 200 400
Feet

Severe Erosion Sites 1 and 2
Cane Run Watershed
Fayette and Scott Counties, KY

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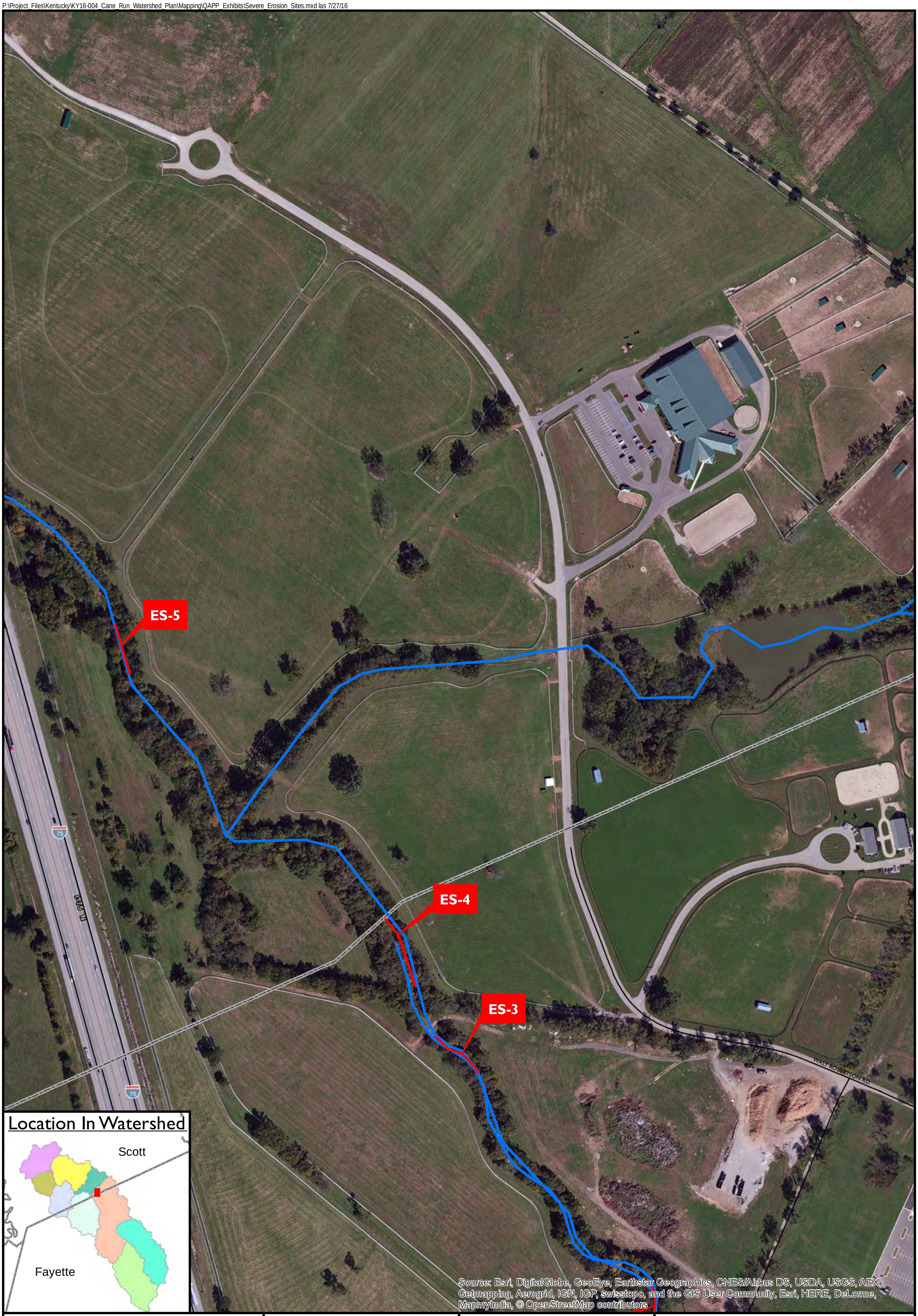

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Lexington, Kentucky 40503

Legend

🟥	Confirmed Erosion
🟪	Potential Erosion
🟦	Field Verified Stream
🟧	Inaccessible Stream

ThirdRock

0 200 400
Feet

Severe Erosion
Sites 3, 4 and 5
Cane Run Watershed
Fayette and Scott Counties, KY

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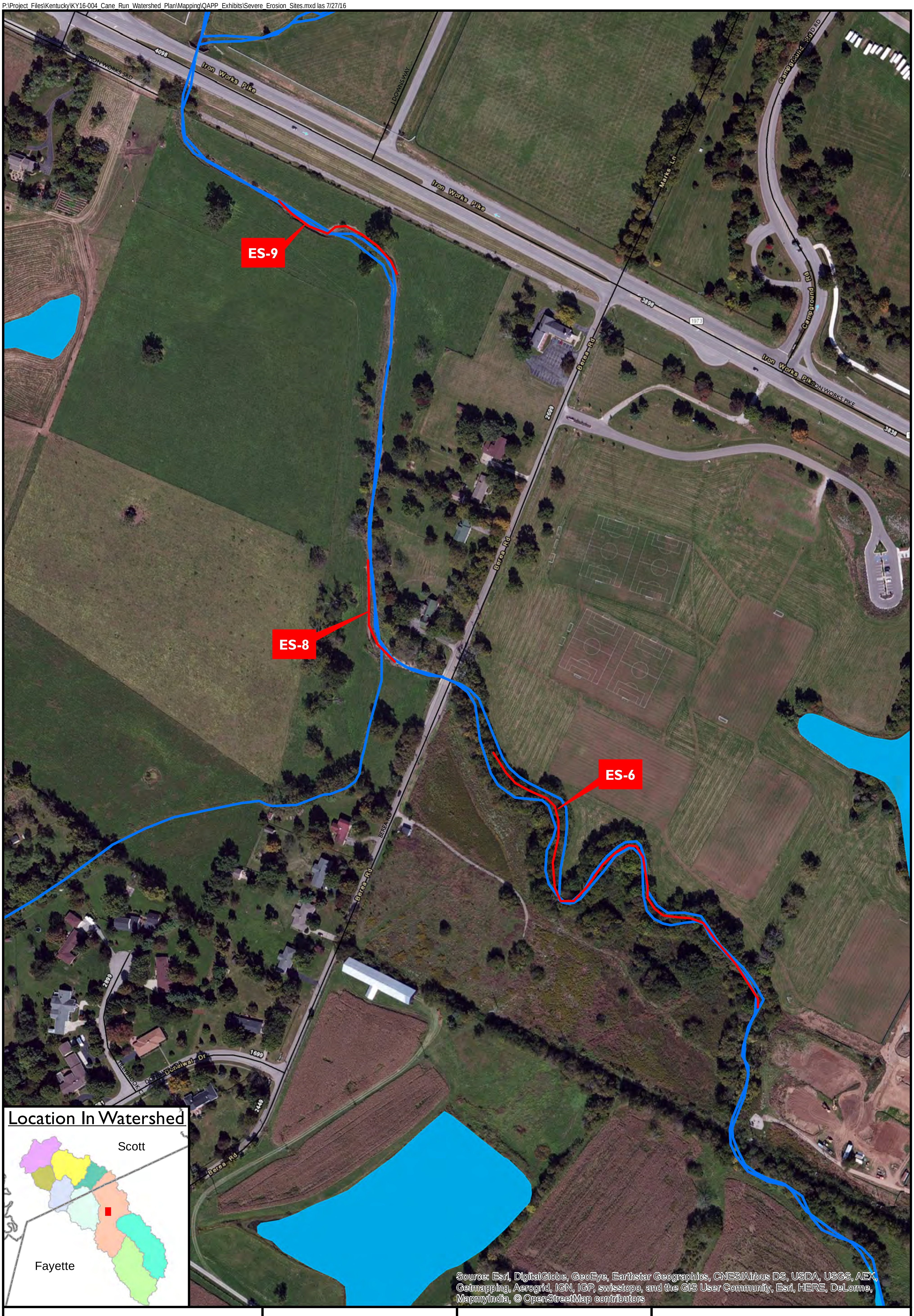

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Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend

- 🟥 Confirmed Erosion
- Potential Erosion
- Field Verified Stream
- Inaccessible Stream

THIRDROCK

0 200 400
Feet

Severe Erosion Sites 6, 8 and 9

Cane Run Watershed
Fayette and Scott Counties, KY

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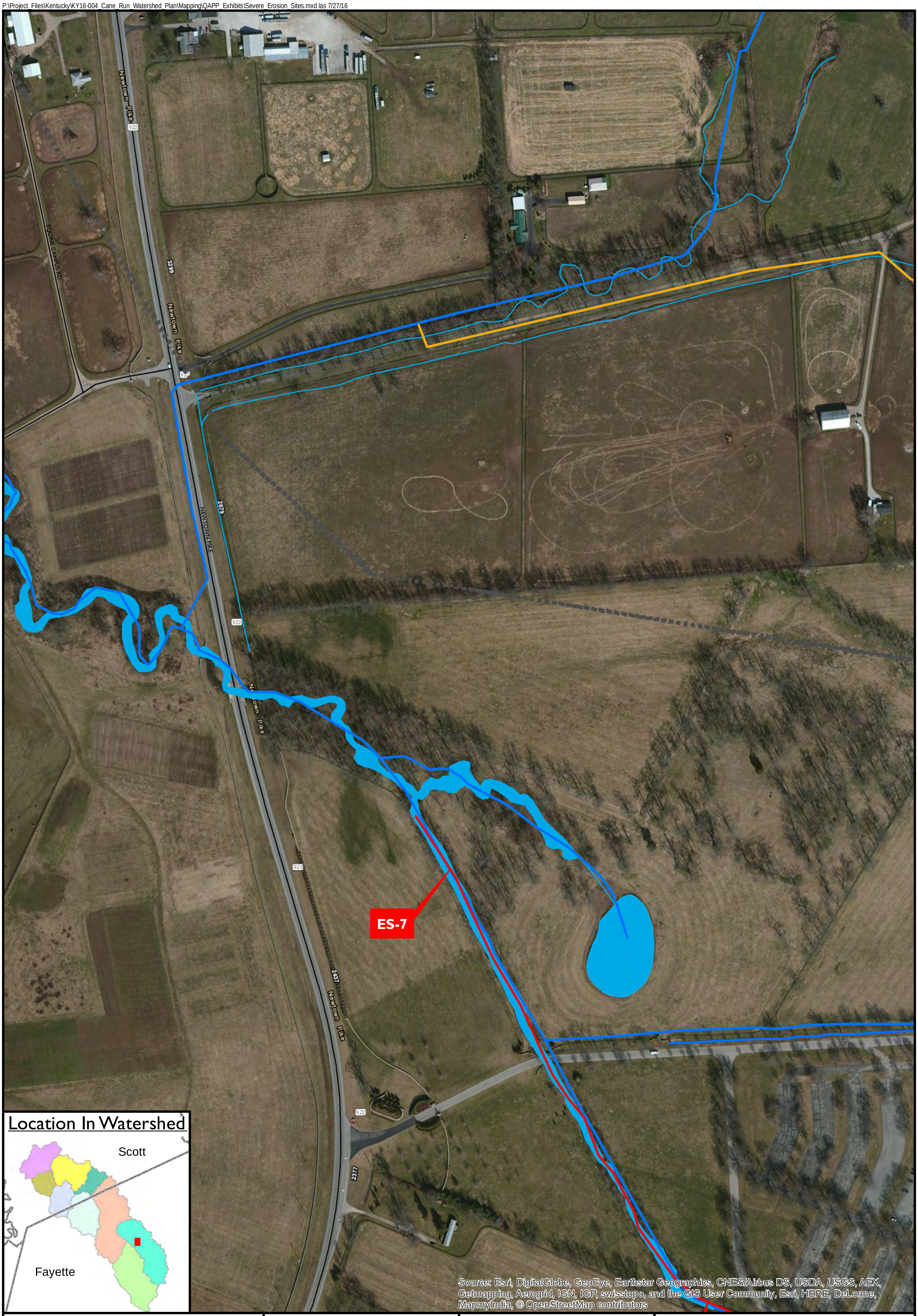

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2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend

- Confirmed Erosion
- Potential Erosion
- Field Verified Stream
- Inaccessible Stream

0 200 400
Feet

Severe Erosion
Site 7
Cane Run Watershed
Fayette and Scott Counties, KY

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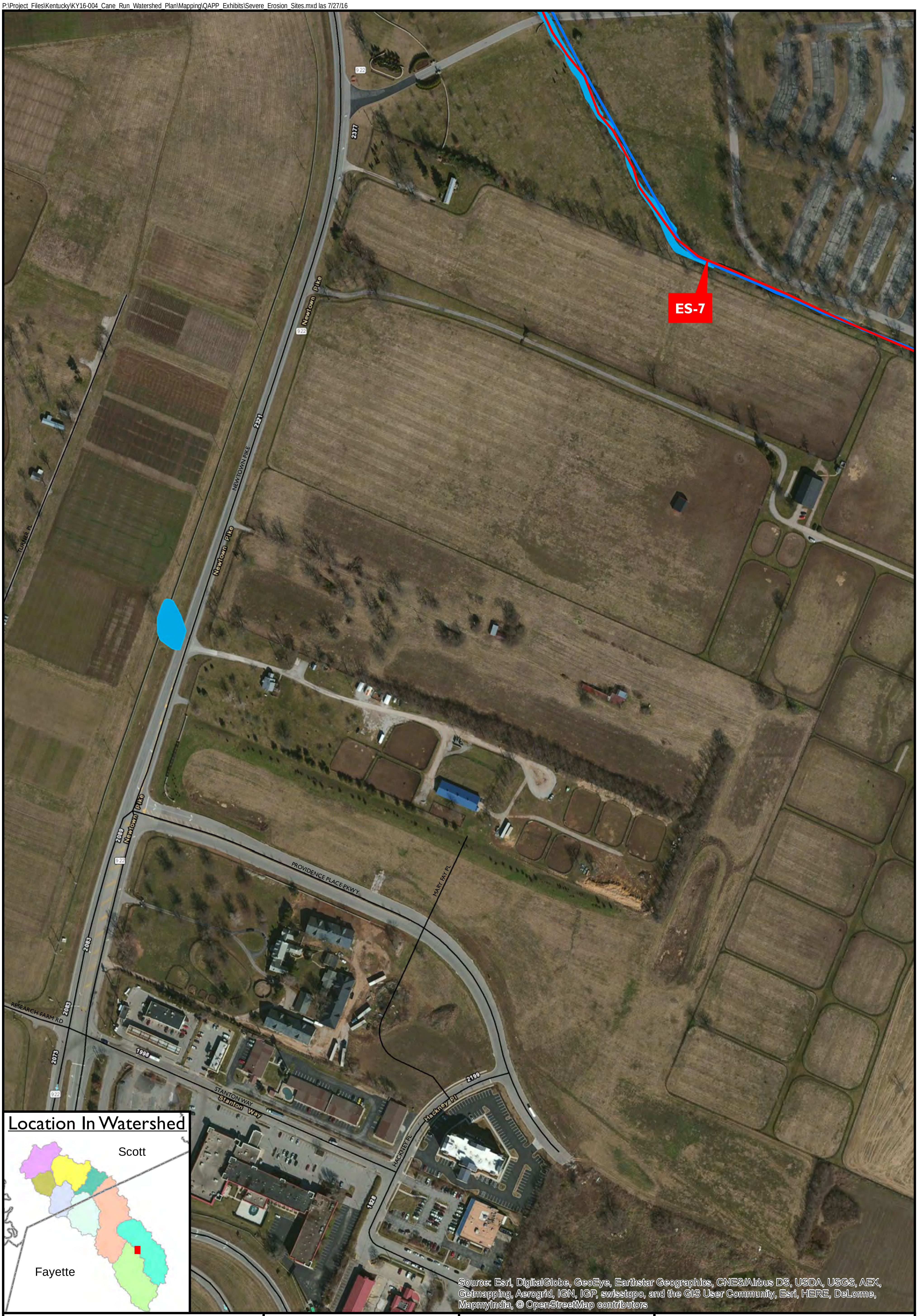

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Lexington, Kentucky 40503

Legend

- Confirmed Erosion
- Potential Erosion
- Field Verified Stream
- Inaccessible Stream

0 200 400 Feet

Severe Erosion
Site 7
Cane Run Watershed
Fayette and Scott Counties, KY

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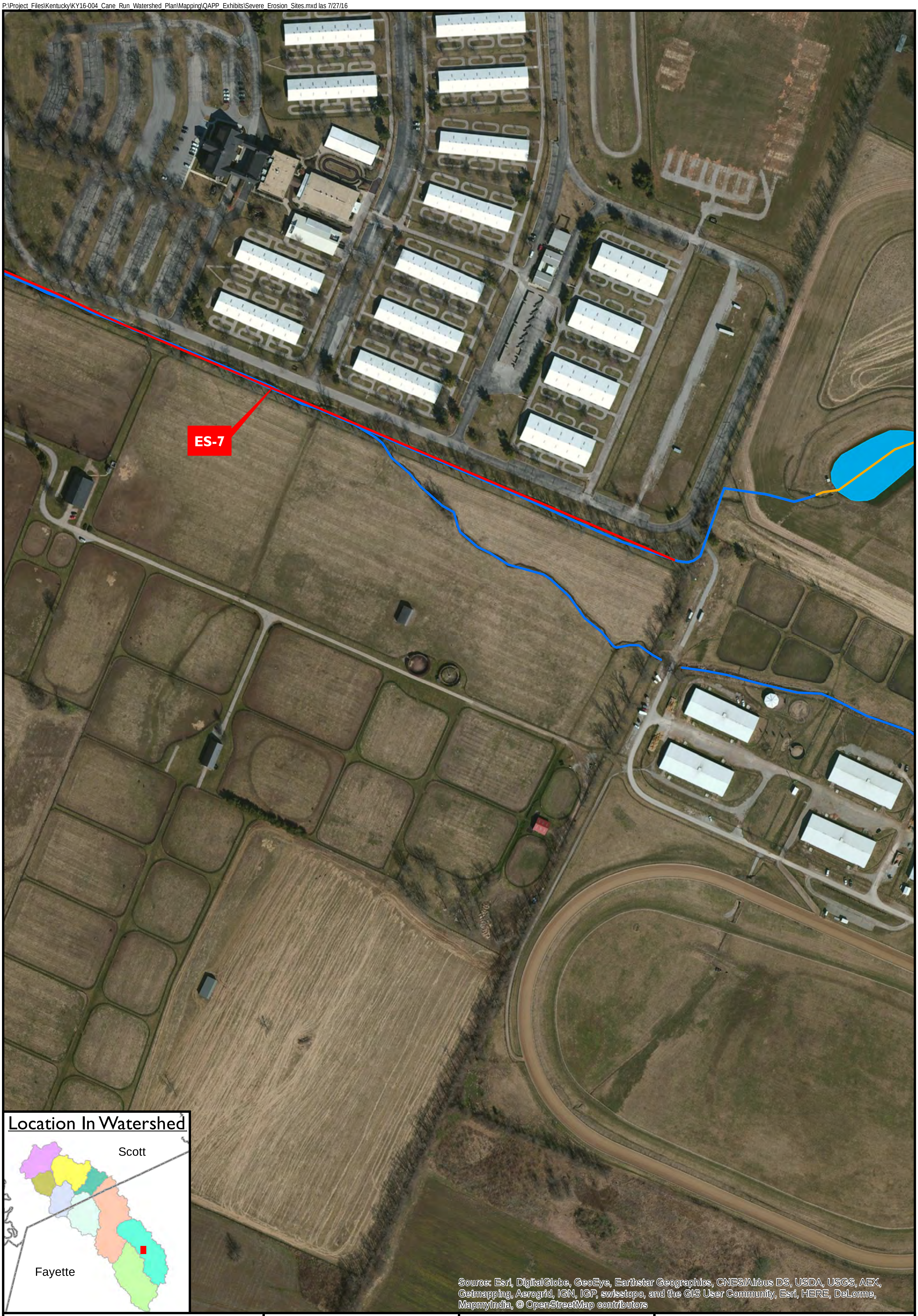

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Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend

- 🟥 Confirmed Erosion
- 🟪 Potential Erosion
- 🟦 Field Verified Stream
- 🟧 Inaccessible Stream

0 200 400 Feet

Severe Erosion
Site 7
Cane Run Watershed
Fayette and Scott Counties, KY

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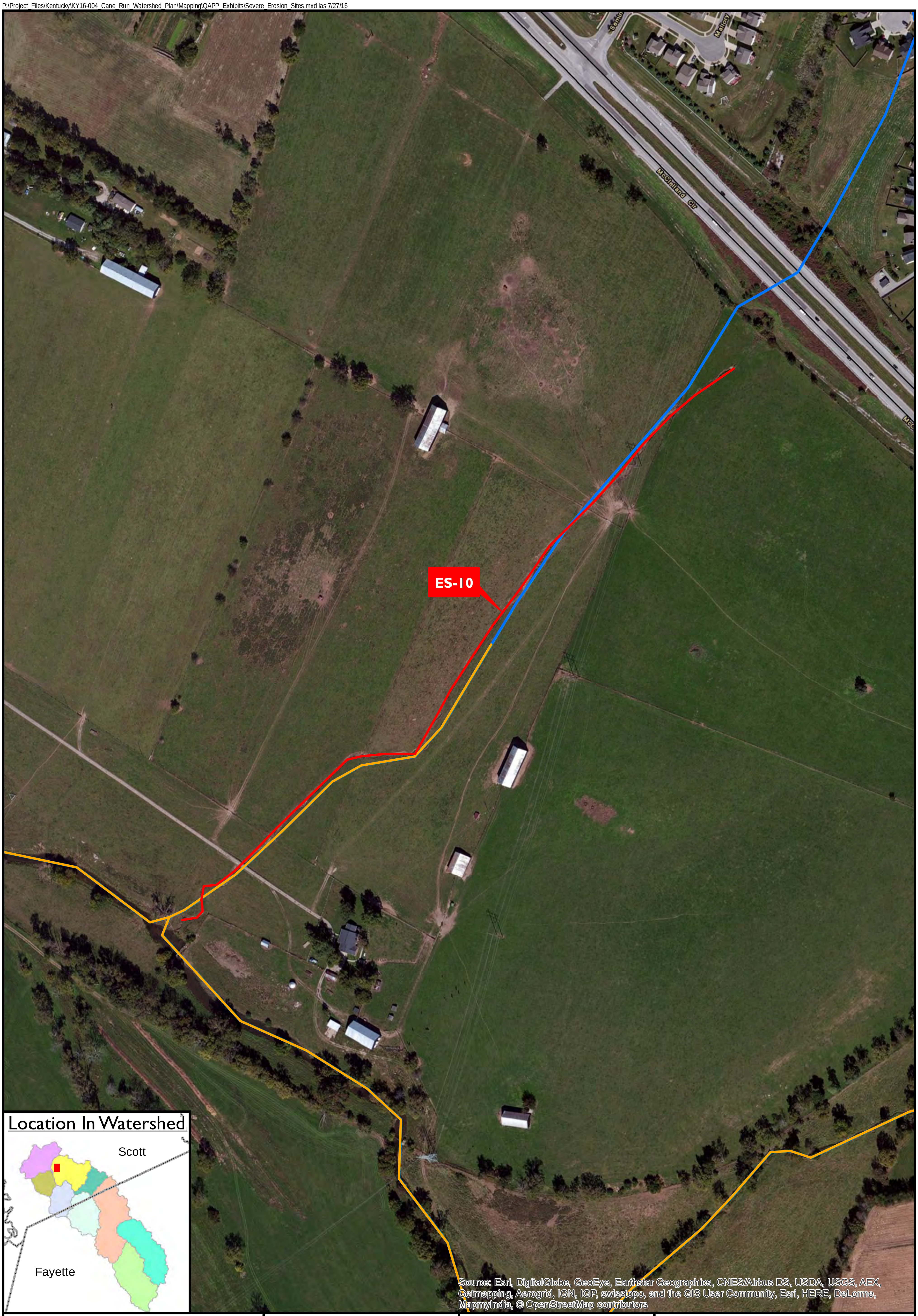

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

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Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend

- 🟥 Confirmed Erosion
- Potential Erosion
- Field Verified Stream
- Inaccessible Stream

ThirdRock

0 200 400
Feet

Severe Erosion
Site 10
Cane Run Watershed
Fayette and Scott Counties, KY

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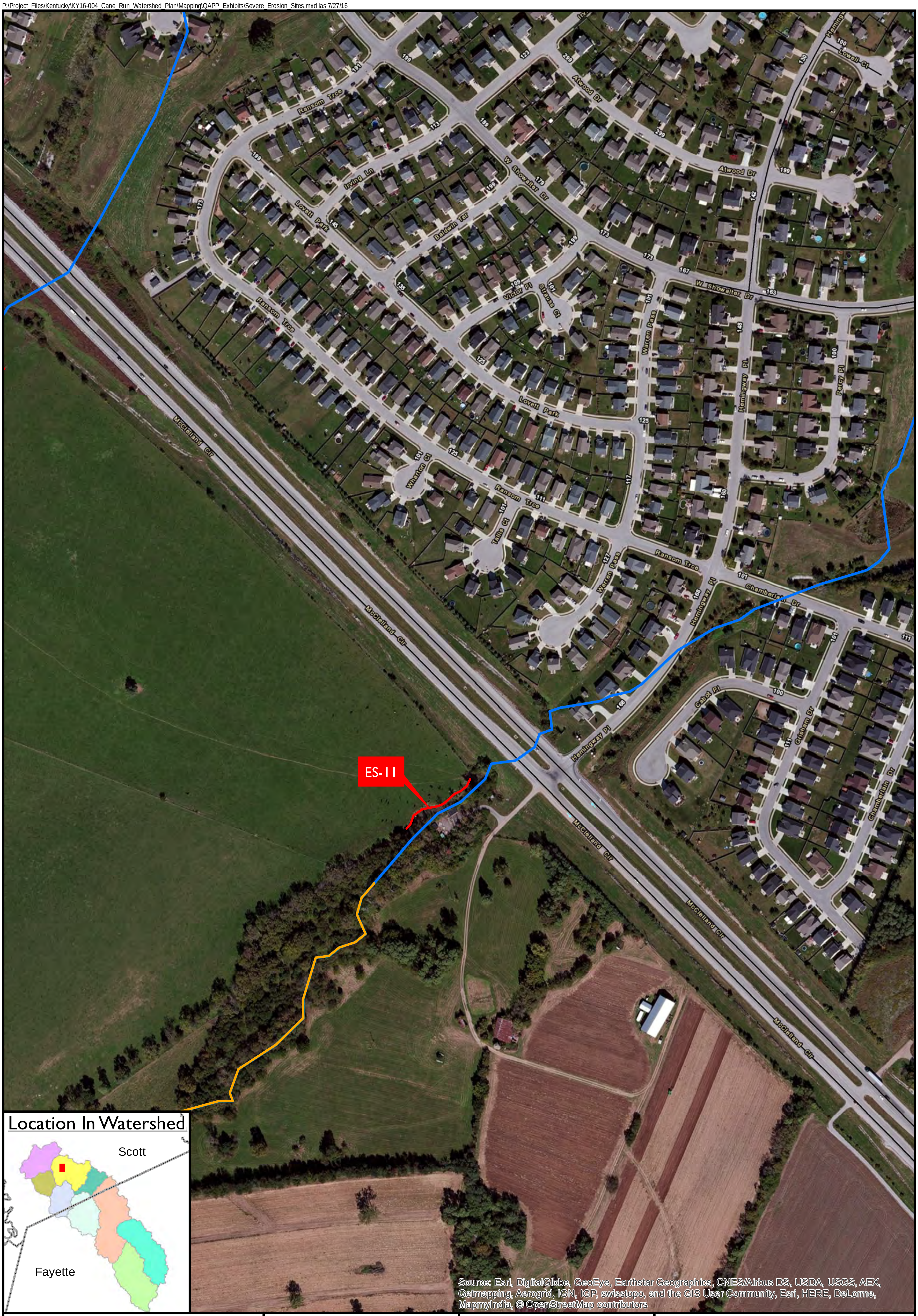


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend

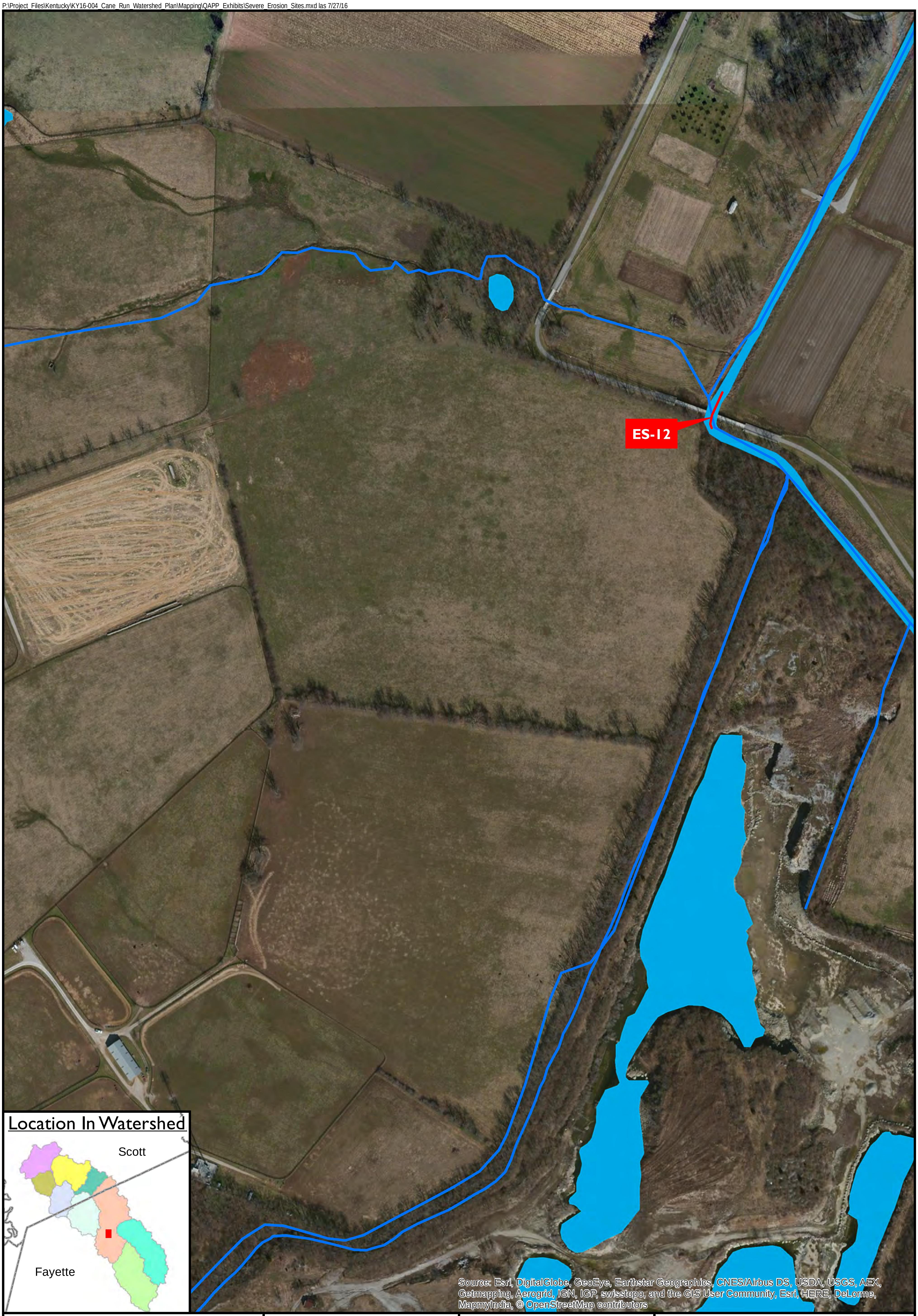
- 🟥 Confirmed Erosion
- 🟪 Potential Erosion
- 🟦 Field Verified Stream
- 🟧 Inaccessible Stream

THIRDROCK

0 200 400 Feet

Severe Erosion
Site 11
Cane Run Watershed
Fayette and Scott Counties, KY

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Severe_Erosion_Sites.mxd las 7/27/16



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend
- Confirmed Erosion
- Potential Erosion
- Field Verified Stream
- Inaccessible Stream

THIRDROCK

0 200 400 Feet

Severe Erosion
Site 12
Cane Run Watershed
Fayette and Scott Counties, KY

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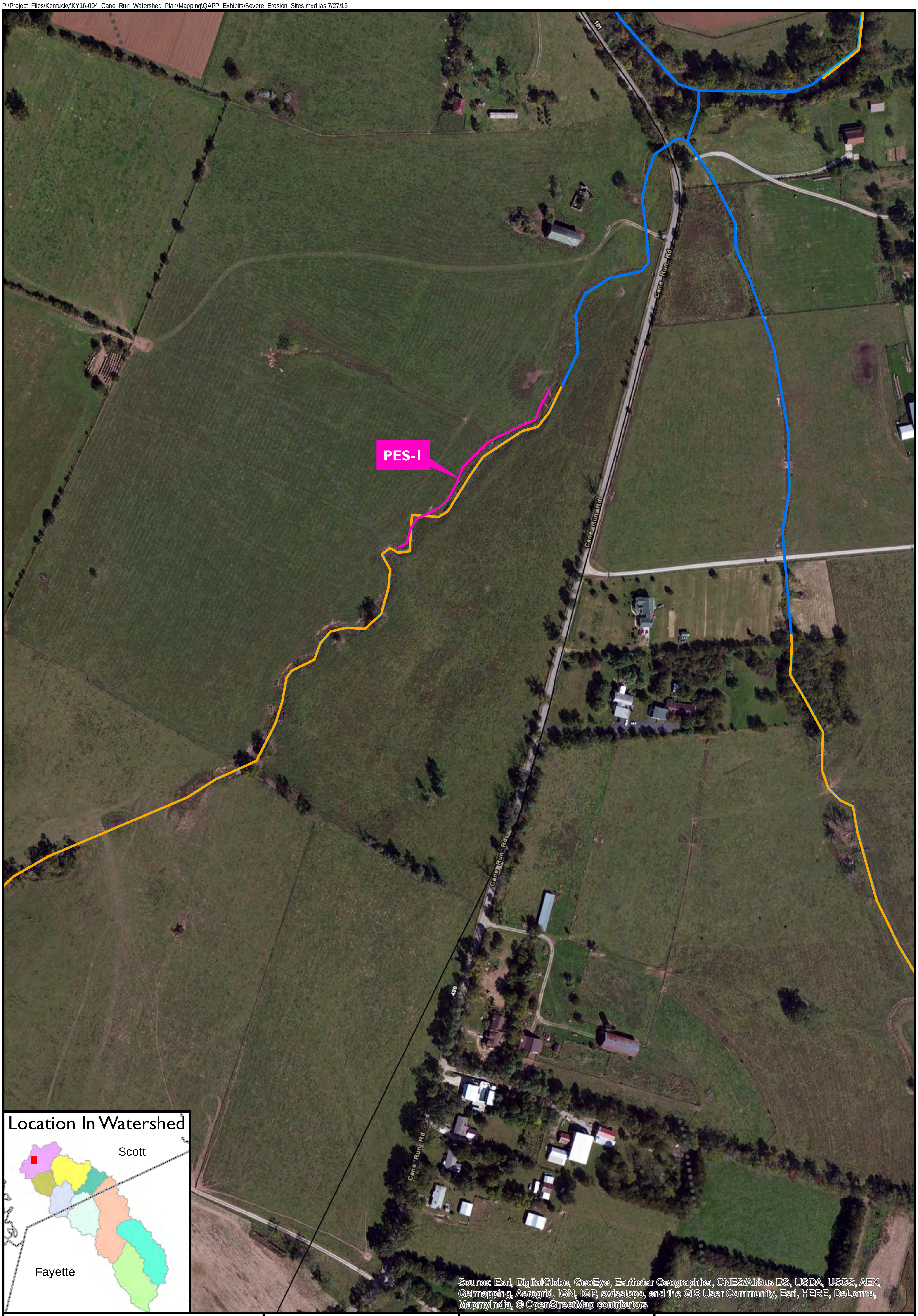

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Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend

- 🟥 Confirmed Erosion
- 🟪 Potential Erosion
- 🟦 Field Verified Stream
- 🟧 Inaccessible Stream

THIRDROCK

0 200 400 Feet

Possible Erosion
Site 1
Cane Run Watershed
Fayette and Scott Counties, KY

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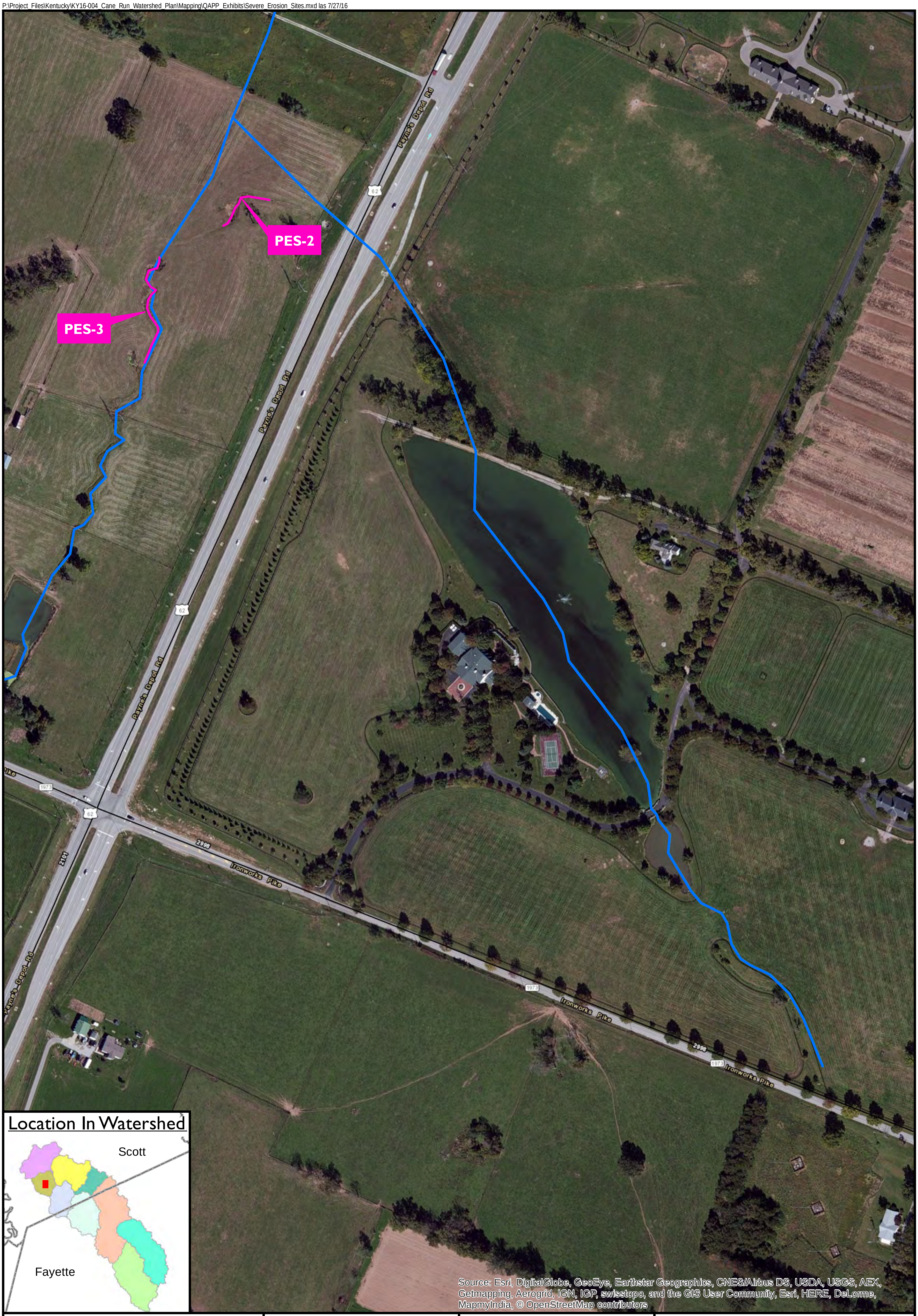

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Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Legend

- Confirmed Erosion
- Potential Erosion
- Field Verified Stream
- Inaccessible Stream

0 200 400
Feet

Possible Erosion Sites 2 and 3
Cane Run Watershed
Fayette and Scott Counties, KY

APPENDIX H

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

Cane Run
Watershed

Comprehensive Watershed-Based Plan
Biological & Habitat
Monitoring Report

Prepared for:

The Kentucky Division of Water
200 Fair Oaks Lane
Frankfort, KY 40601
502-564-3410

Prepared By:

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October 17, 2017

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INTRODUCTION

The Cane Run Watershed (HUC#05100205280200) is a 45.4 square mile (mi^2) watershed located within Fayette and Scott Counties, Kentucky. The stream has been listed as impaired since 1998 for Warmwater Aquatic Habitat and Primary Contact Recreational uses. Since that time, numerous tributaries have also been designated as impaired for causes including pathogens, nutrients / eutrophication, organic enrichment (sewage), and sedimentation/siltation.

In 2011, the University of Kentucky Biosystems and Agricultural Engineering department completed a watershed plan for the Fayette County portion of the watershed. In order to develop a plan that addresses the Scott County sources as well, the Kentucky Division of Water awarded a Section 319 (h) Nonpoint Source Implementation Program Cooperative Agreement to Third Rock Consultants, LLC (Third Rock) in 2016. The overall goal was to generate data sufficient to facilitate the identification and quantification of sources of recreational and aquatic habitat impairments. To that end, water quality monitoring was conducted by Third Rock at 11 sites within the watershed in accordance with a Kentucky Division of Water (KDOW) August 8, 2016 approved quality assurance project plan (QAPP). As part of that effort, Third Rock conducted biological monitoring at 8 of the 11 water quality monitoring sites as well as 3 additional sites monitored in accordance with separately approved KDOW QAPPs. The findings and conclusions of the biological monitoring effort are detailed in this report.

METHODS

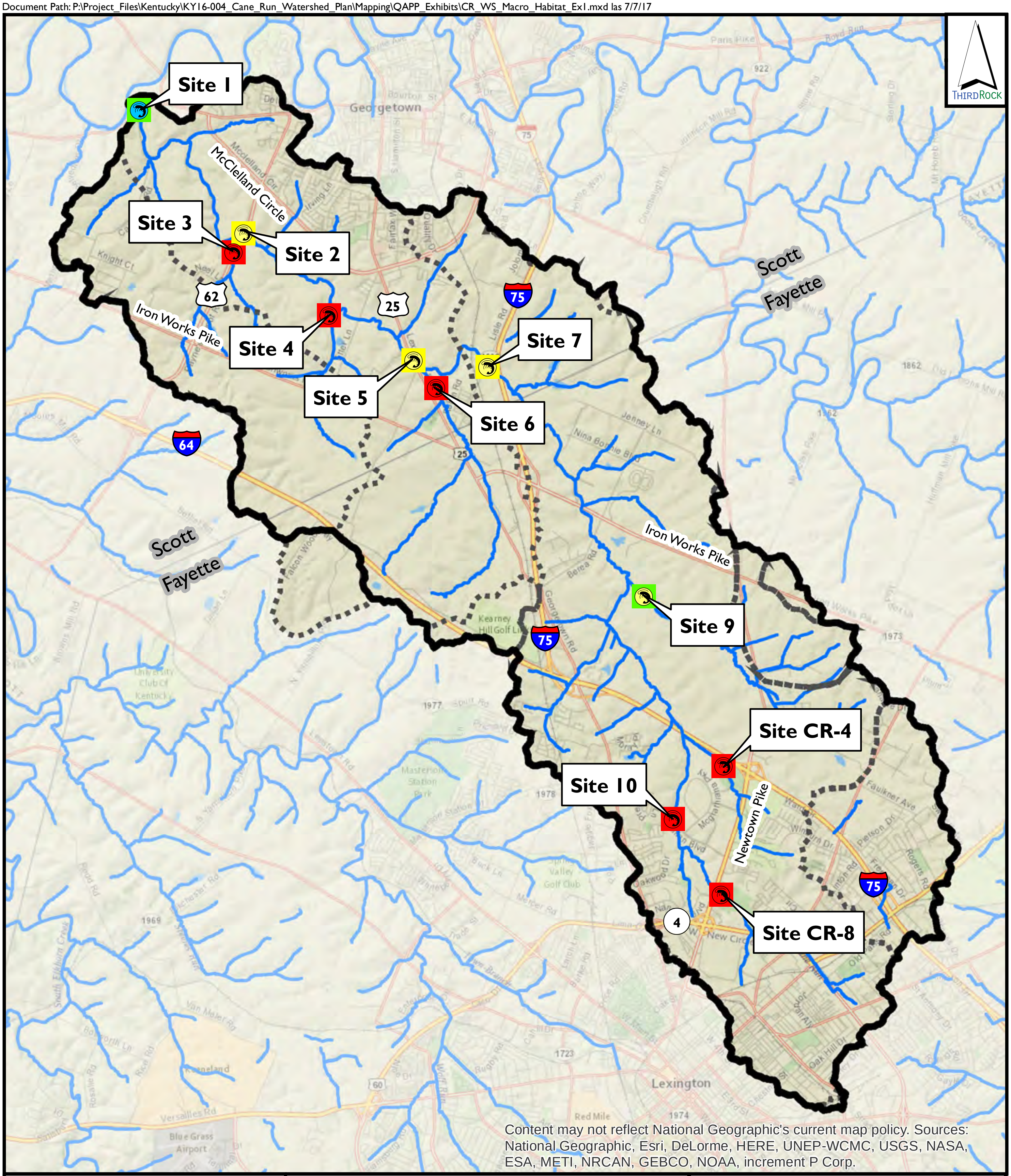
Biological monitoring was conducted at 11 locations within the Cane Run Watershed as shown on **Exhibit 1**, page 2, and identified in **Table 1**.

Table 1 – Biological Monitoring Locations

Site ID	Location	Area (mi^2)	Latitude	Longitude
1	Cane Run at US 460 Bridge	45.4	38.210260	-84.611020
2	Cane Run off SR 62	39.3	38.189400	-84.589200
3	UT to Cane Run off SR 62	2.02	38.186472	-84.591300
4	UT to Cane Run on Horse Farm off Etter Lane	3.1	38.175357	-84.571630
5	Cane Run at Landscape Alternatives bridge off US 25	31.8	38.168000	-84.554250
6	UT to Cane Run in field off of US 25	5	38.163590	-84.549770
7	Cane Run at Lisle Road	24.9	38.167065	-84.538907
9	UT to Cane Run at UK Ag Research Farm road bridge	7.4	38.128800	-84.507080
10[1,2]	Cane Run at Citation Blvd	5.5	38.092322	-84.501381
CR-4[2]	UT Cane at Coldstream Park	1.1	38.100676	-84.490700
CR-8[2]	Cane Run Upstream of Newtown Pike Crossing	4.1	38.079446	-84.491493

[1] Site 10 is also identified as CR-S2

[2] Sites 10 (CR-S2), CR-4, and CR-8 were sampled under other monitoring programs in accordance with QAPP Section 2.7. The results are included in this report for the purpose of data comparison, as the data was collected under similar protocols.



Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Cane Run Watershed Fayette and Scott Counties, Kentucky

0 0.5 1 2 Miles

Macro Rating
- Excellent
- Fair
- Poor

Habitat Rating
- 🟩 Good
- 🟨 Fair
- 🟥 Poor

- Stream
- Watershed Boundary
- Karst Basin Boundary

Exhibit 1 - Monitoring Sites
Cane Run Comprehensive Watershed Plan
Biological Monitoring Report

Page 2 of 10

Water Quality

Dissolved oxygen, pH, water temperature, turbidity, and specific conductance were measured in conjunction with macroinvertebrate sampling by Third Rock staff in the field at each location using a Hydrolab water quality meter calibrated prior each field visit.

Habitat

Habitat was assessed at each location in conjunction with macroinvertebrate sampling. Riffle and pool substrates, stream channelization, riparian conditions and instream cover were assessed and observations recorded on a field data form modified from US EPA 841-B-99-002 (Barbour *et al.* 1999).

Macroinvertebrates

Macroinvertebrates were sampled by Third Rock staff during the months of February, March, and April of 2017 for headwater streams, and June and August of 2016 for wadeable streams. Sampling occurred within their respective sampling index periods (March to May for headwater streams, and May to September for wadeable streams, KDOW 2015a). Macroinvertebrate sampling was not conducted during periods of excessively high or low flows or within two weeks of a known scouring flow event.

The macroinvertebrate community at each site was sampled using methods developed by KDOW (2015a). Semi-quantitative and qualitative samples were collected. Semi-quantitative sampling involved the collection of four 0.25 square meter (m^2) samples collected from at least 2 separate riffles at each station using a $0.25m^2$ quadrat and a kicknet (600µm mesh). Riffle collections at each station were composited to form one semi-quantitative sample.

Qualitative, multi-habitat samples involved the:

- collection of 3 leaf packs (from a riffle, run and pool);
- 3 jabs (with 800 x 900µm D-frame dip net) in sticks/wood;
- 3 jabs into undercut banks/submerged roots, aquatic macrophyte beds;
- collection of 3 bedrock/slabrock dipnet samples;
- hand-picking of 15 rocks (large cobble/small boulder) from riffles, runs, and pools for wadeable streams and 5 small boulders from pools for headwater streams;
- washing 3 replicates of *aufwuchs* material off rocks, sticks, leaves, and filamentous algae into a 300 µm nitrex sampler;
- visual searches of approximately 10 to 20 linear feet of large woody debris for wadeable streams and a minimum of 6 linear feet for headwater streams; and
- 3 sampling replicates in soft sediment using a US #10 sieve.

All samples collected with the dip net and from rock and wood were processed through a 600µm wash bucket. Collections from each microhabitat were composited to form one qualitative sample for each station. Samples were preserved in 95% ethanol and returned to the laboratory for processing and identification.

Random 300-specimen subsamples were removed from the riffle samples using methods described by KDOW (2015b). Each riffle sample was poured into a Canton sorting tray and divided into 30 equally sized grids. Organisms were removed from the sample in randomly selected grids until the 300-specimen total was reached or all specimens had been removed. The number of grids sorted was recorded for each sample to allow estimation of total organism abundance. All organisms were identified to the lowest possible taxonomic level and recorded on laboratory bench sheets. Representative individuals for all distinct taxa were removed from the multi-habitat sample for identification.

DATA EVALUATION

Water quality results were compared against regulatory benchmarks. To evaluate the habitat assessment and macroinvertebrate results, KDOW has developed metrics and narrative classification ratings to indicate whether the designated use of warmwater aquatic habitat is supported or the aquatic community is adversely impacted. These benchmarks and metrics are described below.

Water Quality

All streams within the Cane Run watershed have designated uses of warmwater aquatic habitat (WAH). Warmwater aquatic habitat standards apply to the protection of productive warmwater aquatic communities, fowl, animal wildlife, arboreous growth, agricultural, and industrial uses. The standards that are applicable to the parameters sampled are listed below as follows:

- pH shall not be less than 6.0 SU, more than 9.0 SU, nor fluctuate more than 1.0 SU over 24 hours;
- temperature shall not exceed 31.7°C (89°F);
- dissolved oxygen shall be above 5.0 mg/L as a 24-hour average and above 4.0 mg/L for instantaneous measurements; and
- specific conductance shall not be changed to the extent that the indigenous aquatic community is adversely affected.

Habitat

US EPA Rapid Bioassessment Protocol (RBP) was used for conducting stream habitat assessments, and a Habitat Assessment Field Data Sheet for high gradient streams was completed for each monitoring site. Ten physical habitat parameters that characterize the stream "micro-scale" habitat, the "macro-scale" features, and the riparian and bank structure features, were assessed. Each of the parameters was evaluated on a “Condition Category” scale from 0 to 20 where “optimal” scores from 20 to 16, “suboptimal” scores from 15 to 11, “marginal” scores from 10 to 6, and “poor” scores from 5 to 0.

A score of 0 to 200 was assigned for each location based on the sum of the 10 parameters. For wadeable streams (watersheds greater than 5 mi^2) of the Bluegrass Bioregion, a habitat score below 114 indicates a “poor” warmwater aquatic habitat (WAH) rating, scores between 114 and 129 indicate a “fair” habitat rating, and scores above 130 indicate a “good” habitat rating (KDOW 2011). For headwater streams (watersheds less than 5 mi^2) of the Bluegrass Bioregion, a habitat score below 142 indicates a “poor” habitat rating, scores between 142 and 155 indicate “fair” habitat rating, and scores above 155 indicate “good” rating as summarized in **Table 2**, page 5.

Table 2 – Biological Warmwater Aquatic Habitat Criteria for the Bluegrass Bioregion

	Warmwater Aquatic Habitat Criteria			
	Habitat (RBP Score)		Macroinvertebrates (MBI Score)	
Narrative Rating	Drainage Area > 5.0 mi^2	Drainage Area < 5.0 mi^2	Drainage Area > 5.0 mi^2	Drainage Area < 5.0 mi^2
Excellent	N/A	N/A	≥ 70	≥ 58
Good	≥ 130	≥ 156	61-69	51-57
Fair	114-129	142-155	41-60	39-50
Poor	≤ 113	≤ 141	21-40	19-38
Very Poor	N/A	N/A	≤ 20	≤ 18

Macroinvertebrates

Macroinvertebrate sampling results were evaluated through calculation of several community metrics specified by KDOW. Community metrics include genus taxa richness, genus EPT (mayfly, stonefly and caddisfly) richness, total number of individuals, modified percent EPT individuals, modified Hilsenhoff biotic index (mHBI), percent Ephemeroptera (headwater only), percent primary clingers, and percent Chironomidae plus Oligochaeta (aquatic worms).

Results of community metrics at each location were combined to compute a Macroinvertebrate Bioassessment Index (MBI) score, ranging from 0 (worst) to 100 (best). MBI scores were compared to scoring criteria developed by KDOW to arrive at water quality ratings of "very poor," "poor," "fair," "good," or "excellent." For wadeable streams (watersheds greater than 5 mi^2) of the Bluegrass Bioregion, an MBI score of 20 and below is "very poor," from 21 to 40 is "poor," from 41 to 60 is "fair," from 61 to 69 is "good," and 70 or greater is "excellent." For headwater streams (watersheds less than 5 mi^2) of the Bluegrass Bioregion, an MBI score of 18 and below is "very poor," from 19 to 38 is "poor," from 39 to 50 is "fair," from 51 to 57 is "good," and 58 or greater is "excellent" (Pond *et al.*, 2003).

RESULTS

Water Quality

Field measurements of the specified water quality parameters were taken at all 11 locations prior to conducting macroinvertebrate sampling. All parameters were within regulatory benchmarks for WAH criteria. Dissolved oxygen levels ranged from 5.3 mg/L (Site 7) to 17.1 mg/L (Site 6), all of which are above the acute WAH criteria of 4.0 mg/L. Recorded pH levels were also within the WAH criteria ranging from 7.2 (Site 7) to 8.7 standard units (Site 6). Temperature readings did not exceed 31.7°C (WAH criteria) at any of the stations. While specific conductance does not have a numeric WAH criteria, the sites located in the upper section of the watershed generally had much higher specific conductance levels than stations in the lower section. The exception was Site 9, an unnamed tributary to Cane Run on UK Research Farm, which had the lowest specific conductance level of 247 µS/cm observed during sampling. Streams were not turbid during sampling with turbidity levels all less than 10 NTUs. Results are summarized in **Table 3**.

Table 3 – Summary of Water Quality Results

Metric	Site ID										
	1	2	3	4	5	6	7	9	10	CR-4	CR-8
Date Sampled	6/17/16	6/17/16	3/21/17	3/21/17	6/16/16	3/21/17	8/25/16	6/16/16	4/28/17	2/23/17	2/23/17
Dissolved Oxygen (mg/L)	8.4	6.8	11.7	10.4	16.9	17.1	5.3	9.7	10.7	10.8	11.6
pH (SU)	7.9	7.6	8.3	7.9	8.3	8.7	7.2	7.7	8.1	8.2	8.6
Temperature (°C)	24.7	22.6	11.9	14.8	26.5	14.1	24.4	25.3	16.6	15.2	19.2
Specific Conductance (µS/cm)	537	557	388	380	520	496	660	247	677	701	839
Turbidity (NTUs)	1.5	1.2	6.0	9.2	7.8	3.5	1.9	3.9	1.8	4.0	4.3

Habitat

Habitat assessments were conducted at the 6 headwater locations during the spring of 2017, and at the 5 wadeable locations during the summer of 2016. Sampling dates and a summary of results is provided in **Table 4**. Habitat Assessment Field Data Sheets for high gradient streams was completed for each monitoring site and are included in **Appendix A**. A photo log of sampling locations and specific habitats is included as **Appendix B**.

Table 4 – Summary of Habitat Assessment Results

Parameter	Site ID										
	1	2	3	4	5	6	7	9	10[1]	CR-4	CR-8
Date Sampled	6/17/16	6/17/16	3/21/17	3/21/17	6/16/16	3/21/17	8/25/16	6/16/16	4/28/17	2/23/17	2/23/17
Headwater (H) or Wadeable (W)	W	W	H	H	W	H	W	W	H	H	H
Epifaunal Sub/Available Cover	14	11	8	7	10	16	13	12	5	11	7
Embeddedness	15	11	12	11	14	8	15	13	10	15	12
Velocity Depth Regime	12	11	4	6	12	13	8	10	11	12	6
Sediment Deposition	15	13	17	12	13	12	15	14	5	16	8
Channel Flow Status	15	16	11	12	14	16	12	16	12	13	6
Channel Alteration	15	14	5	12	14	13	16	16	15	15	14
Freq. of Riffles (or Bends)	16	5	5	8	8	11	9	16	13	13	14
Bank Stability	16	15	20	18	15	13	14	15	2	14	8
Vegetative Protection	12	14	8	6	11	16	13	17	2	12	4
Riparian Zone Width	6	8	2	2	5	6	6	9	0	16	5
RBP Score	**136**	**118**	**92**	**94**	**116**	**124**	**121**	**138**	**75**	**137**	**84**
RBP Rating[2]	**Good**	**Fair**	**Poor**	**Poor**	**Fair**	**Poor**	**Fair**	**Good**	**Poor**	**Poor**	**Poor**

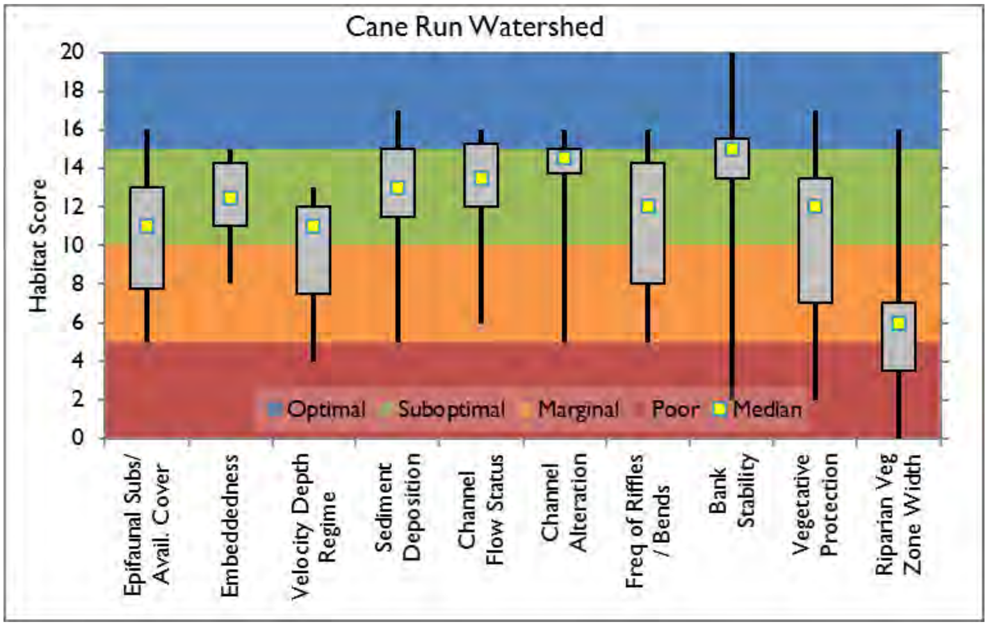
[1] Site 10 drainage area is slightly greater (5.5. mi^2) than the headwater designation (5 mi^2) but is considered a headwater stream due to its karst nature.

[2] RBP scoring criteria for wadeable streams of the Bluegrass Bioregion: 0-113 Poor, 114-129 Fair, 130-200 Good. For headwater streams of the Bluegrass Bioregion: 0-141 Poor, 142-155 Fair, 156-200 Good.

Habitat assessments indicated “poor” habitat for all 6 of the Cane Run Watershed headwater sites (Sites 3, 4, 6, 10, CR-4, and CR-8) when compared to KDOW criteria for streams of the Bluegrass Bioregion. Wadeable sites sampled within the Cane Run Watershed had habitat assessment scores that rated either “fair” (Sites 2, 5, and 7) or “good” (Sites 1 and 9) when compared to KDOW criteria for streams of the Bluegrass Bioregion.

As shown in **Figure 1**, below, the majority of habitat parameters rated within the suboptimal or marginal categories. Riparian vegetation zone width was the most impaired habitat parameter with a median score within the low marginal range. Marginal riparian zone width is 6 to 12 meters (20 to 40 feet) and has been impacted by human activities. Epifaunal substrate/available cover and velocity depth regime were the next most impaired habitat parameters with median scores in the low suboptimal category. Channel alteration and bank stability were the highest rated parameters with high suboptimal median scores (15). However, it should be noted that bank stability had a wide range of scores with a poor score (2) at Site 10 to an optimal score (20) at Site 3.

Figure 1 – Habitat Assessment Scores by Parameter, All Sites



Macroinvertebrates

Macroinvertebrate sampling was conducted at 5 wadeable sites in 2016, and 6 headwater sites in 2017. Wadeable sites were sampled on June 16, June 17, and August 25, 2016. Headwater sites were sampled on February 23, March 21, and April 28, 2017. A summary of macroinvertebrate sampling results is provided in **Table 5**, page 8; supporting documentation including laboratory bench sheets, MBI calculations, collection checklists, chains of custody, and QA/QC forms are included in **Appendix C**.

Table 5 – Summary of Macroinvertebrate Sampling Results

Metric	Site ID										
	1	2	3	4	5	6	7	9	10[1]	CR-4	CR-8
Date Sampled	6/17/16	6/17/16	3/21/17	3/21/17	6/16/16	3/21/17	8/25/16	6/16/16	4/28/17	2/23/17	2/23/17
Taxa Richness-genus level	50	58	8	13	47	23	43	35	23	35	13
EPT Richness-genus level	14	13	3	0	6	0	4	7	3	6	1
mHBI	5.02	5.70	7.84	7.83	5.84	5.42	7.82	5.50	5.72	5.82	7.05
% modified EPT	26.3	15.3	0.34	0	5.9	0	29.4	3.3	5.6	9.3	0.3
% Mayflies[2]	-	-	0	0	-	0	-	-	0.3	1.9	0
% Midges & Worms	7.7	9.3	0.34	0	33.6	40.7	25.6	7.9	51.6	11.1	2.3
% Clingers	76.8	22.1	0.34	0	31.2	24.8	29.4	19.1	7.7	15.1	0.3
MBI Score	**70.5**	**55.8**	**21.7**	**21.4**	**44.6**	**27.2**	**43.9**	**44.1**	**24.2**	**36.5**	**23.2**
MBI Rating[3]	**Excellent**	**Fair**	**Poor**	**Poor**	**Fair**	**Poor**	**Fair**	**Fair**	**Poor**	**Poor**	**Poor**

[1] Site 10 drainage area is slightly greater (5.5. mi^2) than the headwater designation (5 mi^2) but is considered a headwater stream due to its karst nature.

[2] Metric %mayflies only used for headwater stream MBI calculations.

[3] For headwater streams of the Bluegrass Bioregion, an MBI score of 0-18 is "very poor", 19-38 "poor", 39-50 "fair", 51-57 "good", 58 and greater "excellent". For wadeable streams of the Bluegrass Bioregion, an MBI score of 0-20 is "very poor", 21-40 "poor", 41-60 "fair", 61-69 "good", and greater than 69 "excellent".

MBI scores were calculated for all locations and ranged from 21.4 (Site 4) to 70.5 (Site 1). Based on the Bluegrass Bioregion criteria, headwater streams all had "poor" MBI ratings. Wadeable locations all had "fair" MBI ratings except for Site 1 which rated "excellent." MBI scores for wadeable sites generally increased as they progressed from upstream to downstream. Sites 5, 7, and 9 are wadeable sites located in the upper Cane Run watershed and had similar MBI scores (44.6, 43.9, and 44.1, respectively). Sites 1 and 2, located in the lower Cane Run watershed, had MBI scores of 70.5 and 55.8, respectively.

Genus level taxa richness ranged from 8 (Site 3) to 58 (Site 2), and genus EPT richness ranged from 0 (Sites 4 and 6) to 14 (Site 1). Genus taxa richness for wadeable locations ranged from 35 (Site 9) to 58 (Site 2), and genus EPT richness ranged from 4 (Site 7) to 14 (Site 1). Headwater stream sites had genus taxa richness levels from 0 (Sites 4 and 6) to 35 (Site CR-4), and genus EPT richness ranged from 0 (Sites 4 and 6) to 6 (Site CR-4). Increasing taxa and EPT richness is associated with improving water quality, habitat diversity, and/or habitat suitability.

Modified Hilsenhoff Biotic Index (mHBI) scores ranged from a low of 5.02 (Site 1) to 7.84 (Site 3). One location had an mHBI score that rated "excellent" (Site 1), 6 locations rated "good" (Sites 2, 5, 6, 9, 10, and CR-4), 1 location rated "fair" (CR-8), and 3 locations rated "poor" (Sites 3, 4, and 7). An increasing mHBI value indicates decreasing water quality.

Modified EPT abundance, which excludes the ubiquitous caddisfly *Cheumatopsyche*, was relatively low at all locations (<10%) with the exception of Site 1 (26.3%), Site 2 (15.3%), and Site 7 (29.4%). Mayfly abundance, which is a metric for headwater streams only, was zero for all headwater locations with the exception of Site 10 (0.3%) and CR-4 (1.9%). Increased EPT abundance is associated with improving water quality and/or habitat conditions, whereas mayfly abundance generally decreases with the presence of brine and metal contamination.

Abundance of generally pollution tolerant midges and oligochaeta was relatively low (<12%) at all locations except for Site 5 (33.6%), Site 6 (40.7%), Site 7 (25.6%), and Site 10 (51.6%). Increase in midge and oligochaeta abundance suggests decreasing water quality conditions.

Primary clinger abundance ranged from 0 (Site 4) to 76.8 percent (Site 1). Primary clingers require hard, silt free substrates to "cling" to. An increase of primary clingers suggests presence of this habitat type.

SUMMARY

Dissolved oxygen, pH, turbidity, and water temperature measurements were "good" at all locations, while specific conductance levels were generally greater in the upper section of the Cane Run watershed than in the lower section.

On the mainstem of Cane Run, habitat generally improved from upstream to downstream, with upper watershed locations evaluated as "poor," middle sections "fair, and the most downstream location "good." Tributaries to Cane Run all had "poor" habitat ratings, with the exception of Site 9 which evaluated "good."

Macroinvertebrate communities of all headwater locations rated "poor," which may be due to flow problems associated with the karst nature of the Cane Run watershed. Macroinvertebrate community ratings generally improved with increasing surface flow. Sites 1 and 2 had the highest surfaces flows during other monitoring activities, and the best MBI ratings.

Site 9 and the majority of its drainage area is located on University of Kentucky farms and has had riparian restoration improvements occur upstream. Based on scores, these improvements have had a positive impact on habitat within this stream reach. KDOW sampled this stream reach in 2000 resulting in habitat (90) and MBI (33.8) scores lower than evaluated during the current survey (138 and 44.1, respectively). Improvements in habitat ("poor" to "good") appear to have contributed to improvements in the macroinvertebrate community ("poor" to "fair") at Site 9.

Site 10 is another previously sampled location that had a large discrepancy in habitat scores between previous assessments and the current one. The reason for the decline in habitat scores is due to stream restoration construction that is currently underway. The riparian zone was considerably reduced or removed due to construction activities in 2017. As the riparian vegetation recovers, the habitat score at Site 10 should improve.

The MBI rating for Site 2 declined from "good" in 2009 (KDOW sample) to "fair" in 2016. Even though the habitat score for Site 2 increased from 2009 (83) to 2016 (118), it was noted that cattle currently have access to the stream which may be negatively impacting the macroinvertebrate community.

At the most downstream location in the Cane Run watershed, Site 1, the MBI rating improved from “fair” in 2009 (KDOW sample) to “excellent” in 2016.

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APPENDIX A

Prepared for the Kentucky Division of Water
Prepared by Third Rock Consultants, LLC, October 17, 2017

THIRD ROCK CONSULTANTS
RBP HABITAT ASSESSMENT (HIGH GRADIENT)

R2

PROJECT Ky16-004 PROJECT # Ky16.004 STREAM ID Site 1 DATE 6-17-16

WATERSHED Cane Run COUNTY Scott STATE Ky

STATION LAT: 38.20912 LNG: 84.61066 INVESTIGATOR(S): BR/CO

STREAM SIZE: Width (ft) 30' Depth (ft) 1.5' STREAM TYPE: Perennial ☑ Ephemeral ☐ Intermittent ☐

HABITAT PARAMETERS	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate / Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
Score 14	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
Score 15	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / Depth Regime deep is rare	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
Score 12	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score 15	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score 15	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Score 15	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Ky16-OCY
Site 1

THIRD ROCK CONSULTANTS
RBP HABITAT ASSESSMENT (HIGH GRADIENT)

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
7. Frequency of Riffles (or Bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
Score 16	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
LB Score 8	10 9	[✓ 8] 7 6	5 4 3	2 1 0
RB Score 8	10 9	[✓ 8] 7 6	5 4 3	2 1 0
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
LB Score 6	10 9	8 7 [✓ 6]	5 4 3	2 1 0
RB Score 6	10 9	8 7 [✓ 6]	5 4 3	2 1 0
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
LB Score 3	10 9	8 7 6	5 4 [✓ 3]	2 1 0
RB Score 3	10 9	8 7 6	5 4 [✓ 3]	2 1 0

Total Score: 136

Photographs (*List the name and image number of each photo*): GPS Camera

Notes (Diagram on Reverse):

PH 7.9
DO 8.4/104%
Temp 24.7

SPC 537
turb 1.5

THIRD ROCK CONSULTANTS
RBP HABITAT ASSESSMENT (HIGH GRADIENT)

PROJECT Cane Run PROJECT # KY16-024 STREAM ID Site 2 DATE 6-17-16

WATERSHED Cane Run COUNTY Scott STATE KY

STATION LAT: 38.18926 LNG: -84.58899 INVESTIGATOR(S): B.R / C.O

STREAM SIZE: Width (ft) 30' Depth (ft) 2.5' STREAM TYPE: Perennial ☑ Ephemeral ☐ Intermittent ☐

HABITAT PARAMETERS	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate / Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
Score 11	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
Score 11	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / Depth Regime Fast shallow rare	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
Score 11	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score 16	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Score 14	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0

THIRD ROCK CONSULTANTS
RBP HABITAT ASSESSMENT (HIGH GRADIENT)

		OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
7. Frequency of Riffles (or Bends)		Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
Score	5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	[✓ 5] 4 3 2 1 0
8. Bank Stability		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
LB Score	8	10 9	[✓ 8] 7 6	5 4 3	2 1 0
RB Score	7	10 9	8 [✓ 7] 6	5 4 3	2 1 0
9. Vegetative Protection upper sect affected more than middle + lower		More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
LB Score	7	10 9	8 [✓ 7] 6	5 4 3	2 1 0
RB Score	7	10 9	8 [✓ 7] 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width		Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
LB Score	4	10 9	8 7 6	5 [✓ 4] 3	2 1 0
RB Score	4	10 9	8 7 6	5 [✓ 4] 3	2 1 0

Total Score: 118

Photographs (*List the name and image number of each photo*):

Downstream view of reach
upstream view of riffles
upstream view of reach
emergent vegetation
Pool habitat [illegible] view

Pic 34 Bert's phone
Pic 47 [illegible] ''
Pic 838 GPS camera Bert
839 '' ''
840 '' ''

Notes (Diagram on Reverse):

PH 7.6
DO 6.8/82%
Cond 557
Temp 22.6

turb 1.2

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID Site 3 Cane Run Trib **DATE:** 3/21/17 **LAT:** ____ **LONG:** ____

INVESTIGATOR(S) R. Storm, J. Storm **COWARDIN CLASS:** ____ **WATERSHED:** ____

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)		Perennial		IMG	
Depth (Ft)		Ephemeral		IMG	
Reach (Ft)	100	Intermittent	X	IMG	

HABITAT PARAMETER	CONDITION CATEGORY				Score
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR	
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
1. Epifaunal Substrate / Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.	8
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.	12
3. Velocity / Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).	4
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	14
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	11
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	5
7. Frequency of Riffles (or Bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.	5

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 10 RB Score 10	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 4 RB Score 4	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 1 RB Score 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0 92				

REMARKS / NOTES: Rip-rap lined like a rd. ditch - mowed riparian - no pools.

Turbidity 6.0
Temp. 11.93
Cond. 388
DO 11.69
pH 8.32

STREAM ID 0

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID 4
DATE: 3/21/17
LAT:
LONG:

INVESTIGATOR(S) P. Storm, J. Storm
COWARDIN CLASS:
WATERSHED:

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)		Perennial	X	IMG	
Depth (Ft)		Ephemeral		IMG	
Reach (Ft)		Intermittent		IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 7	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 11	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 12	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 12	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 8	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 9 *RB Score* 9	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 3 *RB Score* 3	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 1 *RB Score* 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

94

REMARKS / NOTES: Flat, wide stream on bedrock with mowed riparian and wetland veg. in channel/on sed. deposits

Turbidity 9.2

Temp 14.82

Cond. 380

DO 10.40

pH 7.90

STREAM ID 0

THIRD ROCK CONSULTANTS
RBP HABITAT ASSESSMENT (HIGH GRADIENT)

PROJECT Cane Run PROJECT # KY16-004 STREAM ID Site 5 DATE 6-16-16

WATERSHED Cane Run COUNTY Scott STATE KY

STATION LAT: 38.168014 LNG: -84.554342 INVESTIGATOR(S): B. Ponder / C. Olson

STREAM SIZE: Width (ft) 30 Depth (ft) 2.5' max STREAM TYPE: Perennial ☑ Ephemeral ☐ Intermittent ☐

HABITAT PARAMETERS	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate / Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
Score 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
Score 14	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
Score 12	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score 14	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration Bridges	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Score 14	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0

THIRD ROCK CONSULTANTS
RBP HABITAT ASSESSMENT (HIGH GRADIENT)

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
7. Frequency of Riffles (or Bends) infrequent	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
Score 8	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
8. Bank Stability	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
LB Score 7	10 9	8 [✓ 7] 6	5 4 3	2 1 0
RB Score 8	10 9	[✓ 8] 7 6	5 4 3	2 1 0
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
LB Score 6	10 9	8 7 [✓ 6]	5 4 3	2 1 0
RB Score 5	10 9	8 7 6	[✓ 5] 4 3	2 1 0
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
LB Score 4	10 9	8 7 6	5 [✓ 4] 3	2 1 0
RB Score 1	10 9	8 7 6	5 4 3	2 [✓ 1] 0

Total Score: 116

Photographs (*List the name and image number of each photo*):

Down Stream View @ lower End
Root wads
Pool, undercut root wad
Marginal vegetation
Riffle habitat
upstream @ up End

Notes (Diagram on Reverse):

PH 8.3 Temp 26.5
SPC : 520 Turb 2.8
DO 16.9 / 218%

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID Cane Run 6 **DATE:** 3/21/17 **LAT:** ____ **LONG:** ____

INVESTIGATOR(S) K. Storm, S. Storm **COWARDIN CLASS:** ____ **WATERSHED:** ____

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)		Perennial	✓	IMG	
Depth (Ft)		Ephemeral		IMG	
Reach (Ft)		Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 16	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 8	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 13	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 12	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 16	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 13	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 11	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 10 *RB Score* 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 8 *RB Score* 8	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 3 *RB Score* 3	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

124

REMARKS / NOTES: wide perennial stream – below low-head dam sediment bar + algae. Smells like treated sewage.

turbidity 3.5

temp. 14.12

Cond. 496

DO 17.06

pH 8.71

THIRD ROCK CONSULTANTS
RBP HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM Cave Run DATE 8-25-16 STATION ID CR-7 PROJECT NO. KY16-004

UPSTREAM LAT: 38.167193 LNG: -84.539033 INVESTIGATOR(S): B. Remley / C. Rose

STREAM SIZE: Width (ft) 20 Depth (ft) 2' max STREAM TYPE: Perennial ☑ Ephemeral ☐ Intermittent ☐

WATERSHED (HUC) ______ COWARDIN CLASS ______

HABITAT PARAMETERS	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate / Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
Score 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
Score 15	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
Score 8	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score 15	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score 12	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Score 16	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

THIRD ROCK CONSULTANTS

RBP HABITAT ASSESSMENT (HIGH GRADIENT)

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
7. Frequency of Riffles (or Bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
Score 9	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
8. Bank Stability	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
LB Score 7	10 9	8 [✓ 7] 6	5 4 3	2 1 0
RB Score 7	10 9	8 [✓ 7] 6	5 4 3	2 1 0
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
LB Score 6	10 9	8 7 [✓ 6]	5 4 3	2 1 0
RB Score 7	10 9	8 [✓ 7] 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
LB Score 3	10 9	8 7 6	5 4 [✓ 3]	2 1 0
RB Score 3	10 9	8 7 6	5 4 [✓ 3]	2 1 0

Total Score: 121

REMARKS / NOTES:

Bedrock in places, root wads small & poor quality.

THIRD ROCK CONSULTANTS
RBP HABITAT ASSESSMENT (HIGH GRADIENT)

PROJECT KY 16-004 Cane Run PROJECT # KY16-004 STREAM ID Site 9 DATE 6-16-16

WATERSHED Cane Run (UNT to Cane Run) COUNTY Fayette STATE KY

STATION LAT: 38.129319 LNG: -84.507478 INVESTIGATOR(S): B. Ranky, C. Olsen

STREAM SIZE: Width (ft) 10 Depth (ft) 8"

STREAM TYPE: Perennial ☑ Ephemeral ☐ Intermittent ☐

HABITAT PARAMETERS	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate / Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
Score 12	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
Score 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / Depth Regime no deep	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
Score 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score 14	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score 16	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Score 16	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

THIRD ROCK CONSULTANTS

RBP HABITAT ASSESSMENT (HIGH GRADIENT)

Site 9

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
7. Frequency of Riffles (or Bends) * upstream of reach they are scarce	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
Score 16	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
LB Score 7	10 9	8 [✓ 7] 6	5 4 3	2 1 0
RB Score 8	10 9	[✓ 8] 7 6	5 4 3	2 1 0
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
LB Score 8	10 9	[✓ 8] 7 6	5 4 3	2 1 0
RB Score 9	10 [✓ 9]	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
LB Score 4	10 9	8 7 6	5 [✓ 4] 3	2 1 0
RB Score 5	10 9	8 7 6	[✓ 5] 4 3	2 1 0

Total Score: 138

Photographs (*List the name and image number of each photo*):

upstream view

riffle habitat

pool habitat

downstream view

root wads

Emergent veg

Notes (Diagram on Reverse):

pH 7.7

Cond 247

D.O. 9.7

Temp 23.3

turb 3.9

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR-52 **DATE:** 4-28-17 **LAT:** ______ **LONG:** ______

INVESTIGATOR(S) BR/JS **COWARDIN CLASS:** ______ **WATERSHED:** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	~15'	Perennial	✓	IMG 943/003	Riffle/pool
Depth (Ft)	1.5' avg	Ephemeral		IMG 036	DS view of construction
Reach (Ft)	375	Intermittent		IMG 106	root wad

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 5	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 10	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 11	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 5	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 13	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability See Notes *LB Score* 1 *RB Score* 1	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection See Notes *LB Score* 1 *RB Score* 1	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width See Notes *LB Score* 0 *RB Score* 0	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

75

REMARKS / NOTES: Bottom 3/4 of reach is currently undergoing stream restoration construction is ongoing, all riparian veg has been removed on Both banks in preparation.

STREAM ID 0

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID V,T Cane Run CR-4 **DATE:** 2-23-17 **LAT:** 36.100676 **LONG:** -84.490700

INVESTIGATOR(S) BR/CO **COWARDIN CLASS:** Stream **WATERSHED:** KY

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	10	Perennial	✓	IMG	See photo log
Depth (Ft)	1.5	Ephemeral		IMG	
Reach (~~Ft~~)m	100	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 11	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 15	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 12	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 16	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 13	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) 13 Score	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 7 RB Score 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 6 RB Score 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 8 RB Score 6	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 8

137

REMARKS / NOTES:

Cypress planted, possible constructed riffle, decent riparian zone width for urban stream.

STREAM ID CR-4

Page 2 of 2

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR-4 characterization reach **DATE:** 2-23-17 **LAT:** 38.087232 **LONG:** -84.498639

INVESTIGATOR(S) BR/CO **COWARDIN CLASS:** ______ **WATERSHED:** Cane Run/KY

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	12	Perennial	✓	IMG	See photo log
Depth (Ft)	1.5	Ephemeral		IMG	
Reach (~~Ft~~)m	300	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 10	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 16	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 12	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 8	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 11	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 16	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 16	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 2 *RB Score* 2	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 3 *RB Score* 3	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 8 *RB Score* 4	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 105				

REMARKS / NOTES: Riparian width fluctuates throughout reach

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID Cane Run - CR-8 **DATE:** 2.23-17 **LAT:** 38.079446 **LONG:** -84.491493

INVESTIGATOR(S) B. Remley/C. Olson **COWARDIN CLASS:** Stream **WATERSHED:** KY

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	8	Perennial		IMG	See photo log
Depth (Ft)	6"	Ephemeral		IMG	
Reach (~~Ft~~)m	150	Intermittent	✓	IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 7	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 6	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 8	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 6	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 14	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 14	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 3 *RB Score* 5	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 1 *RB Score* 3	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 1 *RB Score* 4	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0
84

REMARKS / NOTES: Low flow, probably does not flow year round.

Lots of trash n stream.

STREAM ID 8CR-8

APPENDIX B

Prepared for the Kentucky Division of Water
Prepared by Third Rock Consultants, LLC, October 17, 2017

Site 1 downstream view of reach

Site 1 downstream view of riffle habitat and reach

Site 1 root mat habitat

Site 1 upstream view of pool habitat

Site 1 upstream view of reach and riffles

Site 2 downstream view of reach

Site 2 emergent vegetation

Site 2 pool habitat

Site 2 riffle habitat

Site 2 undercut bank and root wads

Site 2 upsteram view of riffles

Site 2 upstream view of reach


Site 3 bedrock


Site 3 channel


Site 3 emergent vegetation


Site 3 leaf pack


Site 3 pool habitat


Site 3 small pool


Site 3 upstream view


Site 4 bedrock


Site 4 cattails


Site 4 channel


Site 4 downstream view


SIte 4 emergent vegetation and roots


Site 4 leaf pack


Site 4 leaf packs


Site 4 pool habitat


Site 4 riffle


Site 4 rock ledge


Site 5 downstream view


SITE 5 EMERGENT VEGETATION


SITE 5 RIFFLE HABITAT


SITE 5 ROOT MAT


SITE 6 DOWNSTREAM VIEW


SITE 6 LEAF PACK


SITE 6 POOL

Site 6 root mat

Site 6 undercut bank

Site 6 undercut ledge

Site 6 wood

Site 7 Bedrock

Site 7 Downstream view of reach

Site 7 Upstream view of riffle habitat

Site 7 Upstream view of road crossing

Site 7 Wetland vegetation upstream of road crossing

Site 9 emergent vegetation

Site 9 riffle habitat

Site 9 root mat


Site 10 end of stream transect


Site 10 pool habitat


Site 10 riffle habitat


Site 10 root wad habitat


Site 10 upstream view from end of transect


Site 10 downstream view of construction area

CR-4 bedrock

CR-4 cypress knees and roots

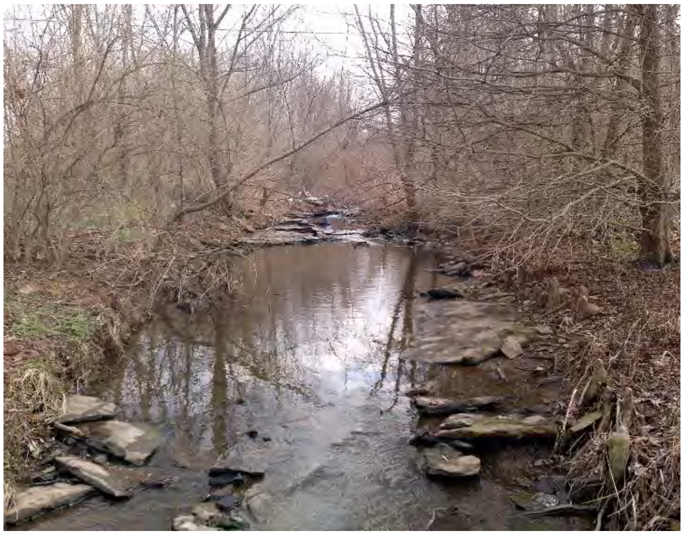
CR-4 downstream view from downstream end

CR-4 downstream view from upstream end

CR-4 leaf pack

CR-4 pool habitat

CR-4 riffle habitat



CR-4 upstream view from downstream end

CR-4 upstream view from upstream end

CR-8 bedrock

CR-8 downstream view from upstream end

CR-8 downstream view of downstream reach

CR-8 eroding bank and pool

CR-8 fine sediment

CR-8 leaf pack

CR-8 left bank

CR-8 riffle habitat

CR-8 right bank

CR-8 root wad

CR-8 under cut bank

CR-8 upstream from upstream end

CR-8 upstream view from downstream end of reach

APPENDIX C

Prepared for the Kentucky Division of Water
Prepared by Third Rock Consultants, LLC, October 17, 2017

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004-01-07
Water Body: Cane Run Watershed
Sample ID: Site 1 QT
Collector: Bert Remley & Chelsey Olson
Sorter: Tammie Fister
Taxonomist: Bert Remley

Client Name: KY Division of Water
State/County: KY / Scott
Collection Date: 6/17/2016
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 298

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
				Cricotopus absurdus	1
				Cryptochironomus sp	1
				Polypedilum flavum	17
				Thienemanniella xena	1
AMPHIPODA				Thienemannimyia gr	3
ISOPODA					
Lirceus fontinalis	17				
DECAPODA					
Cambaridae	1	TRICHOPTERA			
		Cheumatopsyche sp	63		
EPHEMEROPTERA		Chimarra aterrima	4		
Baetis intercalaris	23	Chimarra obscura	4		
Maccaffertium terminatum	2	Helicopsyche borealis	1		
Stenacron interpunctatum	3	Hydropsyche betteni/depravata complex	3		
		Hydropsyche morosa gr	37		
		Hydroptila sp	1	DIPTERA (OTHER)	
				Hemerodromia sp	3
				Simulium sp	8
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Sphaerium sp	1
		COLEOPTERA			
		Psephenus (L) 11	11		
		Stenelmis (A) 6 (L) 84	90		
				OTHER TAXA	
				Hydracarina	1
				Petrophila sp	1
				Number of Individuals	297

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #:	KY16-004-01-07	Client Name:	KY Division of Water
Water Body:	Cane Run Watershed	State/County:	KY / Scott
Sample ID:	Site 1 QL	Collection Date:	6/17/2016
Collector:	Bert Remley & Chelsey Olson	Sampling Method:	Multihabitat
Sorter:	Tammie Fister	Sample Sorting:	Pickall
Taxonomist:	Bert Remley	No. Grids of 30 Picked:	30
		No. Organisms Picked:	NA

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Helobdella stagnalis				Cryptochironomus sp	
Naididae				Microtendipes pedellus gr	
				Nanocladius sp	
				Phaenopsectra flavipes	
AMPHIPODA				Polypedilum illinoense gr	
Hyalella azteca				Polypedilum flavum	
Synurella sp				Polypedilum fallax gr	
				Rheotanytarsus exiguus gr	
ISOPODA				Thienemannimyia gr	
Lirceus fontinalis				Xenochironomus sp	
DECAPODA					
Cambaridae		TRICHOPTERA			
		Cheumatopsyche sp			
EPHEMEROPTERA		Hydropsyche sp			
Acerpenna macdunnoughi		Hydropsyche morosa gr			
Baetis intercalaris		Hydroptila sp			
Caenis diminuta gr		Triaenodes perna			
Hexagenia limbata					
Maccaffertium terminatum				DIPTERA (OTHER)	
Stenacron interpunctatum				Atrichopogon sp	
Stenonema femoratum				Bezzia/Palpomyia gr	
Tricorythodes sp				Hemerodromia sp	
				Simulium sp	
		MEGALOPTERA			
		Sialis sp		MOLLUSCA	
ODONATA				Corbicula fluminea	
Enallagma sp (Damaged)				Elimia sp	
				Ferrissia sp	
		COLEOPTERA		Physella sp	
		Dubiraphia (A) (L)		Pisidium sp	
		Macronychus (A)		Sphaerium sp	
		Psephenus (L)		OTHER TAXA	
		Stenelmis (A) (L)		Sisyra sp	
				Turbellaria	
				Number of Individuals	-

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004-01-07
Water Body: Cane Run Watershed
Sample ID: Site 2 QT
Collector: Bert Remley & Chelsey Olson
Sorter: Tammie Fister
Taxonomist: Chelsey Olson

Client Name: KY Division of Water
State/County: KY / Scott
Collection Date: 6/17/2016
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 296

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
Helobdella stagnalis	1
Naididae	1
AMPHIPODA	
ISOPODA	
Lirceus fontinalis	118
DECAPODA	
Cambaridae	5
EPHEMEROPTERA	
Baetis intercalaris	5
Caenis diminuta gr	22
Diphetor hageni	2
Stenacron interpunctatum	6
ODONATA	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
Cheumatopsyche sp	15
Helicopsyche borealis	5
Hydroptila sp	1
Micrasema sp	1
Ochrotrichia sp	1
MEGALOPTERA	
Sialis sp	1
COLEOPTERA	
Dubiraphia (L) 1	1
Optioservus (A) 1 (L) 1	2
Psephenus (L) 7	7
Stenelmis (A) 5 (L) 15	20

Family or Taxon / Genus	No. Orgs.
DIPTERA (CHIRONOMIDAE)	
Ablabesmyia mallochi	1
Microtendipes pedellus gr	1
Paratanytarsus sp	1
Polypedilum flavum	11
Rheotanytarsus exiguus gr	2
Thienemanniella xena	2
Thienemannimyia gr	7
DIPTERA (OTHER)	
Hemerodromia sp	1
Simulium sp	1
MOLLUSCA	
Elimia sp	25
Pisidium sp	4
Sphaerium sp	11
OTHER TAXA	
Number of Individuals	281

THIRD ROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004-01-07
Water Body: Cane Run Watershed
Sample ID: Site 2 QL
Collector: Bert Remley & Chelsey Olson
Sorter: Tammie Fister
Taxonomist: Bert Remley

Client Name: KY Division of Water
State/County: KY / Scott
Collection Date: 6/17/2016
Sampling Method: Multihabitat
Sample Sorting: Pickall
No. Grids of 30 Picked: 30
No. Organisms Picked: NA

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Helobdella stagnalis				Clinotanypus sp	
				Corynoneura sp	
				Cryptochironomus sp	
				Dicrotendipes neomodestus	
AMPHIPODA				Polypedilum illinoense gr	
				Tanytarsus sp	
				Zavrelimyia sp	
ISOPODA					
Lirceus fontinalis					
DECAPODA					
		TRICHOPTERA			
		Helicopsyche borealis			
EPHEMEROPTERA		Polycentropus sp			
Caenis diminuta gr					
Centroptilum sp					
Hexagenia limbata					
Stenacron interpunctatum					
Stenonema femoratum				DIPTERA (OTHER)	
				Bezzia/Palpomyia gr	
				Dasyhelea sp	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Elimia sp	
Anax sp (Immature)				Ferrissia sp	
Argia sp (Damaged)				Helisoma sp	
Boyeria sp (Immature)		COLEOPTERA		Physella sp	
Enallagma sp		Berosus (L)		Sphaerium sp	
Ischnura sp		Dubiraphia (A) (L)			
Libellula sp		Peltodytes (A)		OTHER TAXA	
		Psephenus (L)		Belostoma sp	
		Scirtes (L)		Pyralidae	
		Tropisternus (A) (L)		Turbellaria	
				Number of Individuals	-

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004
Water Body: Cane Run
Sample ID: Site 3 QT
Collector: Rain Storm
Sorter: Chelsey Olson
Taxonomist: Chelsey Olson

Client Name: KDOW
State/County: KY / Scott
Collection Date: 3/21/2017
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 290

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
		Perlesta sp	1	Larsia sp	1
AMPHIPODA					
Crangonyx sp	20				
ISOPODA					
Lirceus fontinalis	267				
DECAPODA					
Cambaridae	1	TRICHOPTERA			
EPHEMEROPTERA					
				DIPTERA (OTHER)	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA					
		COLEOPTERA			
				OTHER TAXA	
				Number of Individuals	290

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004
Water Body: Cane Run
Sample ID: Site 3 MH
Collector: Rain Storm
Sorter: Chelsey Olson
Taxonomist: Chelsey Olson

Client Name: KDOW
State/County: KY / Scott
Collection Date: 3/21/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: n/a

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
AMPHIPODA					
ISOPODA					
Lirceus fontinalis					
DECAPODA					
		TRICHOPTERA			
		Cheumatopsyche sp			
EPHEMEROPTERA		Rhyacophila ledra/fenestra			
				DIPTERA (OTHER)	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Pisidium sp	
		COLEOPTERA			
				OTHER TAXA	
				Number of Individuals	-

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004
Water Body: Cane Run
Sample ID: Site 4 QT
Collector: Rain Storm
Sorter: Chelsey Olson
Taxonomist: Chelsey Olson

Client Name: KDOW
State/County: KY / Scott
Collection Date: 3/21/2017
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 351

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Naididae	2				
AMPHIPODA					
Crangonyx sp	60				
ISOPODA					
Lirceus fontinalis	281				
DECAPODA					
		TRICHOPTERA			
EPHEMEROPTERA					
				DIPTERA (OTHER)	
				Pseudolimnophila sp	1
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Physella sp	1
Libellulinae (Immature)	1			Pisidium sp	4
		COLEOPTERA			
		Hydrophilidae (L) 1	1		
				OTHER TAXA	
				Number of Individuals	351

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004
Water Body: Cane Run
Sample ID: Site 4 MH
Collector: Rain Storm
Sorter: Chelsey Olson
Taxonomist: Chelsey Olson

Client Name: KDOW
State/County: KY / Scott
Collection Date: 3/21/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: n/a

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
Naididae	
Tubificidae imm w hair setae	
AMPHIPODA	
Crangonyx sp	
ISOPODA	
Lirceus fontinalis	
DECAPODA	
EPHEMEROPTERA	
ODONATA	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
MEGALOPTERA	
COLEOPTERA	
Paracymus (A)	

Family or Taxon / Genus	No. Orgs.
DIPTERA (CHIRONOMIDAE)	
Cricotopus tremulus gr	
DIPTERA (OTHER)	
MOLLUSCA	
Physella sp	
Pisidium sp	
Sphaerium sp	
OTHER TAXA	
Turbellaria	
Number of Individuals	-

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004-01-07
Water Body: Cane Run Watershed
Sample ID: Site 5 QT
Collector: Bert Remely & Chelsey Olson
Sorter: Tammie Fister
Taxonomist: Chelsey Olson

Client Name: KY Division of Water
State/County: KY / Scott
Collection Date: 6/16/2016
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 311

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Erpobdellidae	1			Cricotopus trifascia	22
				Cricotopus bicinctus	22
				Cricotopus/Orthocladius gr	21
				Cryptochironomus sp	3
AMPHIPODA				Dicrotendipes neomodestus	2
				Micropsectra sp	1
				Polypedilum flavum	14
				Polypedilum scalaenum gr	1
ISOPODA				Polypedilum sp	8
Lirceus fontinalis	67			Rheotanytarsus exiguus gr	1
				Stempellinella sp	1
				Tanytarsus sp	4
DECAPODA				Thienemannimyia gr	9
		TRICHOPTERA			
		Cheumatopsyche sp	5		
EPHEMEROPTERA		Hydroptila sp	14		
Baetis intercalaris	4				
Caenis diminuta gr	1				
				DIPTERA (OTHER)	
				Hemerodromia sp	2
				Simulium sp	71
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Elimia sp	12
				Sphaerium sp	5
		COLEOPTERA			
		Peltodytes (L) 1	1		
		Stenelmis (A) 8 (L) 2	10		
				OTHER TAXA	
				Turbellaria	22
				Number of Individuals	324

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #:	KY16-004-01-07	Client Name:	KY Division of Water
Water Body:	Cane Run Watershed	State/County:	KY / Scott
Sample ID:	Site 5 QL	Collection Date:	6/16/2016
Collector:	Bert Remely & Chelsey Olson	Sampling Method:	Multihabitat
Sorter:	Tammie Fister	Sample Sorting:	Pickall
Taxonomist:	Chelsey Olson	No. Grids of 30 Picked:	30
		No. Organisms Picked:	NA

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Glossiphoniidae (Immature)				Ablabesmyia mallochi	
				Chironomus sp	
				Cricotopus bicinctus	
				Cricotopus trifascia	
AMPHIPODA				Cricotopus/Orthocladius gr	
				Dicrotendipes neomodestus	
				Dicrotendipes modestus/tritomus	
				Paratanytarsus sp	
ISOPODA				Paratendipes albimanus	
Lirceus fontinalis				Phaenopsectra sp	
				Polypedilum illinoense gr	
				Polypedilum flavum	
DECAPODA				Procladius sp	
Cambaridae		TRICHOPTERA		Tanytarsus sp	
		Hydroptila sp		Thienemannimyia gr	
EPHEMEROPTERA				Xenochironomus xenolabis	
Caenis diminuta gr					
Stenonema femoratum					
				DIPTERA (OTHER)	
				Atrichopogon sp	
				Bezzia/Palpomyia gr	
				Simulium sp	
				Tipula (Yamatotipula) sp	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Elimia sp	
Argia apicalis				Ferrissia sp	
Boyeria sp (Immature)				Gyraulus sp	
Coenagrionidae (Immature)		COLEOPTERA		Helisoma sp	
		Berosus (A)		Physella sp	
		Dubiraphia (L)		Pisidium sp	
		Dubiraphia (L)		Planorbella sp	
		Peltodytes (A)		Turbellaria	
		Peltodytes (L)			
		Tropisternus (L)			
				Number of Individuals	-

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004
Client Name: KDOW
Water Body: Cane Run
State/County: KY / Scott
Sample ID: Site 6 QT
Collection Date: 3/21/2017
Collector: Rain Storm
Sampling Method: Kick Net
Sorter: Chelsey Olson
Sample Sorting: Subsample
Taxonomist: Chelsey Olson
No. Grids of 30 Picked: 4
No. Organisms Picked: 300

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Lumbriculidae	1			Cricotopus trifascia	2
Naididae	21			Cricotopus tremulus gr	16
				Eukiefferiella sp	73
				Orthocladiinae (Immature)	1
AMPHIPODA				Paratendipes albimanus	2
				Polypedilum scalaenum gr	1
				Polypedilum flavum	2
				Thienemannimyia gr	1
ISOPODA					
DECAPODA					
		TRICHOPTERA			
EPHEMEROPTERA					
				DIPTERA (OTHER)	
				Simulium sp	68
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Corbicula fluminea	1
				Elimia sp	75
				Pisidium sp	13
		COLEOPTERA		Sphaerium sp	12
		Stenelmis (L) 3	3		
				OTHER TAXA	
				Turbellaria	3
				Number of Individuals	295

Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004
Water Body: Cane Run
Sample ID: Site 6
Collector: Rain Storm
Sorter: Chelsey Olson
Taxonomist: Chelsey Olson
Client Name: KDOW
State/County: KY / Scott
Collection Date: 3/21/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: n/a

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Helobdella stagnalis				Cricotopus tremulus gr	
Naididae				Eukiefferiella claripennis gr	
				Micropsectra sp	
				Tanytarsus sp	
AMPHIPODA					
Crangonyx sp					
ISOPODA					
Lirceus fontinalis					
DECAPODA					
Cambaridae		TRICHOPTERA			
EPHEMEROPTERA					
				DIPTERA (OTHER)	
				Simulium sp	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Elimia sp	
				Physella sp	
				Pisidium sp	
		COLEOPTERA			
		Peltodytes (A)			
		Psephenus (L)			
				OTHER TAXA	
				Turbellaria	
				Number of Individuals	-

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004-01-07
Water Body: Cane Run Watershed
Sample ID: CR-7 QT
Collector: Bert Remley, Chad Rose
Sorter: Tammie Fister
Taxonomist: Chelsey Olson

Client Name: KY Division of Water
State/County: KY / Scott
Collection Date: 8/25/2016
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 12
No. Organisms Picked: 298

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Helobdella stagnalis	7			Chironomus sp	4
Naididae	7			Clinotanypus sp	2
				Cryptochironomus sp	1
				Dicrotendipes neomodestus	2
AMPHIPODA				Glyptotendipes sp	9
Crangonyx sp	1			Harnischia complex sp	1
				Larsia sp	6
				Orthocladiinae (Damaged)	1
ISOPODA				Paratanytarsus sp	2
Lirceus fontinalis	54			Paratendipes albimanus	28
				Polypedilum scalaenum gr	1
				Polypedilum illinoense gr	4
DECAPODA				Stenochironomus sp	1
Cambaridae	3	TRICHOPTERA		Tanytarsus sp	1
				Thienemannimyia gr	4
EPHEMEROPTERA				Zavrelimyia sp	1
Caenis diminuta gr	33				
Callibaetis sp	1				
Stenacron interpunctatum	6				
Stenonema femoratum	46				
				DIPTERA (OTHER)	
				Atrichopogon sp	3
				Bezzia/Palpomyia gr	2
				Dasyhelea sp	1
		MEGALOPTERA			
		Sialis sp	1	MOLLUSCA	
ODONATA				Ferrissia sp	8
Coenagrionidae (Immature)	1			Lymnaea sp	4
				Physella sp	6
		COLEOPTERA		Pisidium sp	10
		Cyphon (L) 1	1	Planorbella sp	2
		Dubiraphia (A) 1	1	Sphaerium sp	14
		Dubiraphia (L) 2	2	OTHER TAXA	
		Peltodytes (A) 7	7	Turbellaria	1
		Stenelmis (L) 3	3		
				Number of Individuals	293

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004-01-07a
Water Body: Cane Run Watershed
Sample ID: CR-7 QL
Collector: Bert Remley, Chad Rose
Sorter: Tammie Fister
Taxonomist: Chelsey Olson

Client Name: KY Division of Water
State/County: KY / Scott
Collection Date: 8/25/2016
Sampling Method: Multihabitat
Sample Sorting: Pickall
No. Grids of 30 Picked: 30
No. Organisms Picked: NA

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Helobdella stagnalis				Chironomus sp	
Naididae				Dicrotendipes neomodestus	
				Glyptotendipes sp	
				Harnischia complex sp	
AMPHIPODA				Lopescladius sp	
				Polypedilum illinoense gr	
				Tanytarsus sp	
				Thienemannimyia gr	
ISOPODA					
Lirceus fontinalis					
DECAPODA					
Cambaridae		TRICHOPTERA			
EPHEMEROPTERA					
Callibaetis sp					
Stenacron interpunctatum					
Stenonema femoratum					
				DIPTERA (OTHER)	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Corbicula fluminea	
Ischnura sp				Helisoma sp	
				Physella sp	
		COLEOPTERA		Pisidium sp	
		Dubiraphia (A)		Sphaerium sp	
		Dubiraphia (L)			
		Peltodytes (A)		OTHER TAXA	
				Belostoma flumineum	
				Number of Individuals	-

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004-01-07
Water Body: Cane Run Watershed
Sample ID: Site 9 QT
Collector: Bert Remley & Chelsey Olson
Sorter: Tammie Fister
Taxonomist: Chelsey Olson

Client Name: KY Division of Water
State/County: KY / Fayette
Collection Date: 6/16/2016
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 298

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
AMPHIPODA	
ISOPODA	
Lirceus fontinalis	184
DECAPODA	
Cambaridae (Immature)	1
EPHEMEROPTERA	
ODONATA	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
Cheumatopsyche sp	10
Chimarra obscura	7
Hydroptila sp	3
MEGALOPTERA	
COLEOPTERA	
Optioservus (L) 1	1
Stenelmis (A) 3 (L) 14	17

Family or Taxon / Genus	No. Orgs.
DIPTERA (CHIRONOMIDAE)	
Cricotopus bicinctus	1
Cryptochironomus sp	1
Dicrotendipes neomodestus	1
Polypedilum flavum	15
Rheotanytarsus exiguus gr	2
Tanytarsus sp	4
DIPTERA (OTHER)	
Hemerodromia sp	7
Simulium sp	18
MOLLUSCA	
Elimia sp	22
Sphaerium sp	9
OTHER TAXA	
Turbellaria	1
Number of Individuals	304

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY16-004-01-07
Water Body: Cane Run Watershed
Sample ID: Site 9 QL
Collector: Bert Remley & Chelsey Olson
Sorter: Tammie Fister
Taxonomist: Chelsey Olson

Client Name: KY Division of Water
State/County: KY / Fayette
Collection Date: 6/16/2016
Sampling Method: Multihabitat
Sample Sorting: Pickall
No. Grids of 30 Picked: 30
No. Organisms Picked: NA

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
				Cryptochironomus sp	
				Orthocladius sp	
				Polypedilum fallax gr	
				Polypedilum illinoense gr	
AMPHIPODA				Polypedilum flavum	
Synurella sp				Rheotanytarsus exiguus gr	
				Tanytarsus sp	
				Thienemannimyia gr	
ISOPODA					
Lirceus fontinalis					
DECAPODA					
Cambaridae		TRICHOPTERA			
		Cheumatopsyche sp			
EPHEMEROPTERA		Chimarra obscura			
Diphetor hageni		Helicopsyche borealis			
Stenacron interpunctatum		Hydroptila sp			
		Oxyethira sp			
				DIPTERA (OTHER)	
				Atrichopogon sp	
				Culicidae	
				Hemerodromia sp	
				Simulium sp	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Elimia sp	
Coenagrionidae (Immature)				Lymnaea sp	
Ischnura sp				Sphaerium sp	
		COLEOPTERA			
		Berosus (A)			
		Dubiraphia (L)			
		Hydrophilidae (L)		OTHER TAXA	
		Optioservus (A)		Turbellaria	
		Peltodytes (A)			
		Peltodytes (L)			
		Stenelmis (A) (L)			
		Tropisternus (A) (L)			
				Number of Individuals	-

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15Y3TT3-3B
Water Body: Cane Run
Sample ID: Site 10
Collector: BR
Sorter: Chelsey Olson
Taxonomist: Chelsey Olson

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 4/28/2017
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 347

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Naididae	4			Cricotopus tremulus gr	24
				Cricotopus bicinctus	8
				Cricotopus trifascia	96
				Cricotopus/Orthocladius gr	15
AMPHIPODA				Limnophyes sp	1
Crangonyx sp	2			Micropsectra sp	20
				Paratanytarsus sp	1
				Polypedilum illinoense gr	1
ISOPODA				Thienemanniella xena	5
Lirceus fontinalis	132				
DECAPODA					
		TRICHOPTERA			
		Cheumatopsyche sp	2		
EPHEMEROPTERA		Hydroptila sp	18		
Baetis flavistriga	1				
				DIPTERA (OTHER)	
				Simulium sp	3
		MEGALOPTERA			
				MOLLUSCA	
ODONATA					
		COLEOPTERA			
		Stenelmis (L) 2	2		
				OTHER TAXA	
				Turbellaria	4
				Number of Individuals	339

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15Y3TT3-3B
Water Body: Cane Run
Sample ID: Site 10 QL
Collector: BR
Sorter: Bert Remley
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 4/28/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: 1

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
Helobdella stagnalis	
Naididae	
AMPHIPODA	
Crangonyx sp	
ISOPODA	
Lirceus fontinalis	
DECAPODA	
EPHEMEROPTERA	
ODONATA	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
Hydroptila sp	
MEGALOPTERA	
COLEOPTERA	

Family or Taxon / Genus	No. Orgs.
DIPTERA (CHIRONOMIDAE)	
Chironomus sp	
Cricotopus tremulus gr	
Cricotopus trifascia	
Limnophyes sp	
Paratanytarsus sp	
Stictochironomus sp	
Tanytarsus sp	
DIPTERA (OTHER)	
Anopheles sp	
MOLLUSCA	
Physella sp	
Pisidium sp	
Sphaerium sp	
OTHER TAXA	
Number of Individuals	-

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15-TT-4.3
Water Body: Cane Run
Sample ID: CR-4
Collector: BR/CO
Sorter: Bert Remley
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 2/23/2017
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 321

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Naididae (Immature)	3			Cricotopus trifascia	1
				Cricotopus tremulus gr	7
				Cricotopus/Orthocladius gr	3
				Polypedilum flavum	4
AMPHIPODA				Polypedilum illinoense gr	2
Crangonyx sp	1			Rheotanytarsus exiguus gr	1
				Stempellinella sp	1
				Tanytarsus sp	1
ISOPODA				Thienemanniella xena	3
Lirceus fontinalis	225			Thienemannimyia gr	13
DECAPODA					
Orconectes sp (Damaged)	1	TRICHOPTERA			
		Cheumatopsyche sp	7		
EPHEMEROPTERA		Chimarra obscura	20		
Caenis diminuta gr	3	Chimarra aterrima	1		
Stenacron interpunctatum	2	Hydropsyche betteni/depravata complex	3		
Stenonema femoratum	1				
				DIPTERA (OTHER)	
				Simulium sp	2
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Gyraulus sp	1
				Pisidium sp	1
				Sphaerium sp	1
		COLEOPTERA			
		Psephenus (L) 3	3		
		Stenelmis (A) 1 (L) 8	9		
				OTHER TAXA	
				Turbellaria	4
				Number of Individuals	324

Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15-TT-4.3
Water Body: Cane Run
Sample ID: CR-4
Collector: BR/CO
Sorter: Bert Remley
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 2/23/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: 1

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
Lumbriculidae (Immature)	
AMPHIPODA	
Crangonyx sp	
Synurella sp	
ISOPODA	
Lirceus fontinalis	
DECAPODA	
EPHEMEROPTERA	
Caenis diminuta gr	
Stenacron interpunctatum	
Stenonema femoratum	
ODONATA	
Ischnura sp (Immature)	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
Chimarra obscura	
Hydropsychidae (Immature)	
MEGALOPTERA	
COLEOPTERA	
Dubiraphia (L) 0	

Family or Taxon / Genus	No. Orgs.
DIPTERA (CHIRONOMIDAE)	
Ablabesmyia sp (Damaged)	
Cricotopus tremulus gr	
Cricotopus/Orthocladius gr	
Paratanytarsus sp	
Phaenopsectra flavipes	
Polypedilum fallax gr	
Procladius sp	
Rheotanytarsus exiguus gr	
Stempellinella sp	
Stictochironomus sp	
Tanytarsus sp	
Thienemanniella xena	
Thienemannimyia gr	
DIPTERA (OTHER)	
Simulium sp	
MOLLUSCA	
Pisidium sp	
Sphaerium sp	
OTHER TAXA	
Turbellaria	
Number of Individuals	n/a

Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15-TT-4.3
Water Body: Cane Run
Sample ID: CR-8
Collector: BR/CO
Sorter: Bert Remley
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 2/23/2017
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 10
No. Organisms Picked: 311

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
Erpobdella punctata	1
Lumbriculidae (Immature)	7
Naididae (Immature)	1
AMPHIPODA	
Crangonyx sp	10
ISOPODA	
Lirceus fontinalis	272
DECAPODA	
EPHEMEROPTERA	
ODONATA	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
Chimarra obscura	1
MEGALOPTERA	
COLEOPTERA	
Dubiraphia (A) 1	1

Family or Taxon / Genus	No. Orgs.
DIPTERA (CHIRONOMIDAE)	
DIPTERA (OTHER)	
MOLLUSCA	
Physella sp	1
OTHER TAXA	
Turbellaria	15
Number of Individuals	309

Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15-TT-4.3
Water Body: Cane Run
Sample ID: CR-8
Collector: BR/CO
Sorter: Chelsey Olson
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 2/23/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: 1

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
Helobdella stagnalis	
AMPHIPODA	
Crangonyx sp	
ISOPODA	
Lirceus fontinalis	
DECAPODA	
EPHEMEROPTERA	
ODONATA	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
MEGALOPTERA	
COLEOPTERA	

Family or Taxon / Genus	No. Orgs.
DIPTERA (CHIRONOMIDAE)	
DIPTERA (OTHER)	
Tipula sp (Immature)	
MOLLUSCA	
Lymnaea sp	
Physella sp	
Sphaerium sp	
OTHER TAXA	
Number of Individuals	n/a

Sample ID	Taxa Name	Class	Order	Family	FFG	Count
Site 1 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	6
Site 1 QT	Petrophila sp	Insecta	Lepidoptera	Pyralidae	SH	1
Site 1 QT	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	1
Site 1 QT	Simulium sp	Insecta	Diptera	Simuliidae	CF	8
Site 1 QT	Hemerodromia sp	Insecta	Diptera	Empididae	PR	3
Site 1 QT	Baetis intercalaris	Insecta	Ephemeroptera	Baetidae	CG	23
Site 1 QT	Maccaffertium terminatum	Insecta	Ephemeroptera	Heptageniidae	SC	2
Site 1 QT	Hydracarina	Arachnida	Hydracarina	Hydrachnidae	PR	1
Site 1 QT	Hydropsyche betteni/depravata complex	Insecta	Trichoptera	Hydropsychidae	CF	3
Site 1 QT	Helicopsyche borealis	Insecta	Trichoptera	Helicopsychidae	SC	1
Site 1 QT	Psephenus herricki	Insecta	Coleoptera	Psephenidae	SC	11
Site 1 QT	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	63
Site 1 QT	Hydropsyche morosa gr	Insecta	Trichoptera	Hydropsychidae	CF	37
Site 1 QT	Chimarra aterrima	Insecta	Trichoptera	Philopotamidae	CF	4
Site 1 QT	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	1
Site 1 QT	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	4
Site 1 QT	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	1
Site 1 QT	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	3
Site 1 QT	Cryptochironomus sp	Insecta	Diptera	Chironomidae	PR	1
Site 1 QT	Cricotopus absurdus	Insecta	Diptera	Chironomidae	CG	1
Site 1 QT	Thienemanniella xena	Insecta	Diptera	Chironomidae	CG	1
Site 1 QT	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	17
Site 1 QT	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	3
Site 1 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	84
Site 1 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	17
Site 1 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	NA
Site 1 QL	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	NA
Site 1 QL	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	NA
Site 1 QL	Corbicula fluminea	Mollusca	Pelecypoda	Corbiculidae	CF	NA
Site 1 QL	Ferrissia sp	Mollusca	Lymnophila	Ancylidae	SC	NA
Site 1 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 1 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	NA
Site 1 QL	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	NA
Site 1 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	NA
Site 1 QL	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	NA
Site 1 QL	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	NA
Site 1 QL	Simulium sp	Insecta	Diptera	Simuliidae	CF	NA
Site 1 QL	Turbellaria	Turbellaria			CG	NA
Site 1 QL	Synurella sp	Malacostraca	Amphipoda	Crangonyctidae	CG	NA
Site 1 QL	Macronychus glabratus	Insecta	Coleoptera	Elmidae	CG	NA
Site 1 QL	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	NA
Site 1 QL	Hemerodromia sp	Insecta	Diptera	Empididae	PR	NA
Site 1 QL	Bezzia/Palpomyia gr	Insecta	Diptera	Ceratopogonidae	PR	NA
Site 1 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 1 QL	Xenochironomus sp	Insecta	Diptera	Chironomidae	PR	NA
Site 1 QL	Psephenus herricki	Insecta	Coleoptera	Psephenidae	SC	NA
Site 1 QL	Baetis intercalaris	Insecta	Ephemeroptera	Baetidae	CG	NA
Site 1 QL	Acerpenna macdunnoughi	Insecta	Ephemeroptera	Baetidae	CG	NA
Site 1 QL	Enallagma sp	Insecta	Odonata	Coenagrionidae	PR	NA
Site 1 QL	Tricorythodes sp	Insecta	Ephemeroptera	Tricorythidae	CG	NA
Site 1 QL	Maccaffertium terminatum	Insecta	Ephemeroptera	Heptageniidae	SC	NA
Site 1 QL	Hexagenia limbata	Insecta	Ephemeroptera	Ephemeridae	CG	NA
Site 1 QL	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	NA
Site 1 QL	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 1 QL	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 1 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	NA
Site 1 QL	Phaenopsectra flavipes	Insecta	Diptera	Chironomidae	SC	NA
Site 1 QL	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	NA

Site 1 QL	Hydropsyche morosa gr	Insecta	Trichoptera	Hydropsychidae	CF	NA
Site 1 QL	Hydropsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	NA
Site 1 QL	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	NA
Site 1 QL	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	NA
Site 1 QL	Cryptochironomus sp	Insecta	Diptera	Chironomidae	PR	NA
Site 1 QL	Polypedilum fallax gr	Insecta	Diptera	Chironomidae	SH	NA
Site 1 QL	Microtendipes pedellus gr	Insecta	Diptera	Chironomidae	CF	NA
Site 1 QL	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	NA
Site 1 QL	Atrichopogon sp	Insecta	Diptera	Ceratopogonidae	PR	NA
Site 1 QL	Sialis sp	Insecta	Megaloptera	Sialidae	PR	NA
Site 1 QL	Nanocladius sp	Insecta	Diptera	Chironomidae	CG	NA
Site 1 QL	Hyalella azteca	Malacostraca	Amphipoda	Talitridae	CG	NA
Site 1 QL	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	NA
Site 1 QL	Sisyra sp	Insecta	Neuroptera	Sisyridae	PR	NA
Site 1 QL	Triaenodes perna	Insecta	Trichoptera	Leptoceridae	PR	NA
Site 1 QL	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	NA
Site 2 QT	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	25
Site 2 QT	Micrasema sp	Insecta	Trichoptera	Brachycentridae	SH	1
Site 2 QT	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	4
Site 2 QT	Ochrotrichia sp	Insecta	Trichoptera	Hydroptilidae	CG	1
Site 2 QT	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	1
Site 2 QT	Diphetor hageni	Insecta	Ephemeroptera	Baetidae	CG	2
Site 2 QT	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	22
Site 2 QT	Hemerodromia sp	Insecta	Diptera	Empididae	PR	1
Site 2 QT	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	1
Site 2 QT	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	5
Site 2 QT	Simulium sp	Insecta	Diptera	Simuliidae	CF	1
Site 2 QT	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	11
Site 2 QT	Psephenus herricki	Insecta	Coleoptera	Psephenidae	SC	7
Site 2 QT	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	15
Site 2 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	15
Site 2 QT	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	1
Site 2 QT	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	6
Site 2 QT	Baetis intercalaris	Insecta	Ephemeroptera	Baetidae	CG	5
Site 2 QT	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	1
Site 2 QT	Helicopsyche borealis	Insecta	Trichoptera	Helicopsychidae	SC	5
Site 2 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	5
Site 2 QT	Optioservus sp	Insecta	Coleoptera	Elmidae	SC	1
Site 2 QT	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	1
Site 2 QT	Optioservus sp	Insecta	Coleoptera	Elmidae	SC	1
Site 2 QT	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	2
Site 2 QT	Microtendipes pedellus gr	Insecta	Diptera	Chironomidae	CF	1
Site 2 QT	Ablabesmyia mallochi	Insecta	Diptera	Chironomidae	PR	1
Site 2 QT	Thienemanniella xena	Insecta	Diptera	Chironomidae	CG	2
Site 2 QT	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	11
Site 2 QT	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	7
Site 2 QT	Sialis sp	Insecta	Megaloptera	Sialidae	PR	1
Site 2 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	118
Site 2 QL	Cryptochironomus sp	Insecta	Diptera	Chironomidae	PR	NA
Site 2 QL	Boyeria sp	Insecta	Odonata	Aeshnidae	PR	NA
Site 2 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 2 QL	Centroptilum sp	Insecta	Ephemeroptera	Baetidae	CG	NA
Site 2 QL	Peltodytes sexmaculatus	Insecta	Coleoptera	Haliplidae	PH	NA
Site 2 QL	Scirtes sp	Insecta	Coleoptera	Scirtidae	SH	NA
Site 2 QL	Tropisternus sp	Insecta	Coleoptera	Hydrophilidae	CG	NA
Site 2 QL	Argia sp	Insecta	Odonata	Coenagrionidae	PR	NA
Site 2 QL	Anax sp	Insecta	Odonata	Aeshnidae	PR	NA
Site 2 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 2 QL	Libellula sp	Insecta	Odonata	Libellulidae	PR	NA

Site 2 QL	Pyralidae	Insecta	Lepidoptera	Pyralidae	SH	NA
Site 2 QL	Clinotanypus sp	Insecta	Diptera	Chironomidae	PR	NA
Site 2 QL	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	NA
Site 2 QL	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	NA
Site 2 QL	Helicopsyche borealis	Insecta	Trichoptera	Helicopsychidae	SC	NA
Site 2 QL	Dicrotendipes neomodestus	Insecta	Diptera	Chironomidae	CG	NA
Site 2 QL	Corynoneura sp	Insecta	Diptera	Chironomidae	CG	NA
Site 2 QL	Tropisternus sp	Insecta	Coleoptera	Hydrophilidae	CG	NA
Site 2 QL	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	NA
Site 2 QL	Psephenus herricki	Insecta	Coleoptera	Psephenidae	SC	NA
Site 2 QL	Dasyhelea sp	Insecta	Diptera	Ceratopogonidae	CG	NA
Site 2 QL	Turbellaria	Turbellaria			CG	NA
Site 2 QL	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	NA
Site 2 QL	Hexagenia limbata	Insecta	Ephemeroptera	Ephemeridae	CG	NA
Site 2 QL	Enallagma sp	Insecta	Odonata	Coenagrionidae	PR	NA
Site 2 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	NA
Site 2 QL	Belostoma sp	Insecta	Hemiptera	Belostomatidae	PR	NA
Site 2 QL	Helisoma sp	Mollusca	Lymnophila	Planorbidae	SC	NA
Site 2 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	NA
Site 2 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	NA
Site 2 QL	Berosus sp	Insecta	Coleoptera	Hydrophilidae	PH	NA
Site 2 QL	Polycentropus sp	Insecta	Trichoptera	Polycentropodidae	PR	NA
Site 2 QL	Ferrissia sp	Mollusca	Lymnophila	Ancylidae	SC	NA
Site 2 QL	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	NA
Site 2 QL	Zavrelimyia sp	Insecta	Diptera	Chironomidae	PR	NA
Site 2 QL	Bezzia/Palpomyia gr	Insecta	Diptera	Ceratopogonidae	PR	NA
Site 2 QL	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	NA
Site 2 QL	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	NA
Site 2 QL	Ischnura sp	Insecta	Odonata	Coenagrionidae	PR	NA
Site 5 QT	Polypedilum sp	Insecta	Diptera	Chironomidae	SH	8
Site 5 QT	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	4
Site 5 QT	Cricotopus bicinctus	Insecta	Diptera	Chironomidae	SH	22
Site 5 QT	Dicrotendipes neomodestus	Insecta	Diptera	Chironomidae	CG	2
Site 5 QT	Polypedilum scalaenum gr	Insecta	Diptera	Chironomidae	SH	1
Site 5 QT	Stempellinella sp	Insecta	Diptera	Chironomidae	CG	1
Site 5 QT	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	22
Site 5 QT	Cryptochironomus sp	Insecta	Diptera	Chironomidae	PR	3
Site 5 QT	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	14
Site 5 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	8
Site 5 QT	Cricotopus/Orthocladius gr	Insecta	Diptera	Chironomidae	CG	21
Site 5 QT	Micropsectra sp	Insecta	Diptera	Chironomidae	CG	1
Site 5 QT	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	1
Site 5 QT	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	14
Site 5 QT	Erpobdellidae	Hirudinea	Pharyngobdellida	Erpobdellidae	CG	1
Site 5 QT	Simulium sp	Insecta	Diptera	Simuliidae	CF	71
Site 5 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	2
Site 5 QT	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	9
Site 5 QT	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	5
Site 5 QT	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	12
Site 5 QT	Peltodytes sp	Insecta	Coleoptera	Haliplidae	PH	1
Site 5 QT	Turbellaria	Turbellaria			CG	22
Site 5 QT	Hemerodromia sp	Insecta	Diptera	Empididae	PR	2
Site 5 QT	Baetis intercalaris	Insecta	Ephemeroptera	Baetidae	CG	4
Site 5 QT	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	1
Site 5 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	67
Site 5 QT	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	5
Site 5 QL	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	NA
Site 5 QL	Dicrotendipes modestus/tritomus	Insecta	Diptera	Chironomidae	CG	NA
Site 5 QL	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	NA

Site 5 QL	Dicrotendipes neomodestus	Insecta	Diptera	Chironomidae	CG	NA
Site 5 QL	Cricotopus/Orthocladius gr	Insecta	Diptera	Chironomidae	CG	NA
Site 5 QL	Ablabesmyia mallochi	Insecta	Diptera	Chironomidae	PR	NA
Site 5 QL	Procladius sp	Insecta	Diptera	Chironomidae	PR	NA
Site 5 QL	Coenagrionidae	Insecta	Odonata	Coenagrionidae	PR	NA
Site 5 QL	Tropisternus sp	Insecta	Coleoptera	Hydrophilidae	CG	NA
Site 5 QL	Dubiraphia quadrinotata	Insecta	Coleoptera	Elmidae	SC	NA
Site 5 QL	Bezzia/Palpomyia gr	Insecta	Diptera	Ceratopogonidae	PR	NA
Site 5 QL	Peltodytes lengi	Insecta	Coleoptera	Haliplidae	PH	NA
Site 5 QL	Tipula (Yamatotipula) sp	Insecta	Diptera	Tipulidae	SH	NA
Site 5 QL	Turbellaria	Turbellaria			CG	NA
Site 5 QL	Glossiphoniidae	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	NA
Site 5 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 5 QL	Cricotopus bicinctus	Insecta	Diptera	Chironomidae	SH	NA
Site 5 QL	Argia apicalis	Insecta	Odonata	Coenagrionidae	PR	NA
Site 5 QL	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	NA
Site 5 QL	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	NA
Site 5 QL	Berosus sp	Insecta	Coleoptera	Hydrophilidae	PH	NA
Site 5 QL	Atrichopogon sp	Insecta	Diptera	Ceratopogonidae	PR	NA
Site 5 QL	Chironomus sp	Insecta	Diptera	Chironomidae	CG	NA
Site 5 QL	Xenochironomus xenolabis	Insecta	Diptera	Chironomidae	PR	NA
Site 5 QL	Simulium sp	Insecta	Diptera	Simuliidae	CF	NA
Site 5 QL	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	NA
Site 5 QL	Helisoma sp	Mollusca	Lymnophila	Planorbidae	SC	NA
Site 5 QL	Peltodytes sp	Insecta	Coleoptera	Haliplidae	PH	NA
Site 5 QL	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	NA
Site 5 QL	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	NA
Site 5 QL	Phaenopsectra sp	Insecta	Diptera	Chironomidae	SC	NA
Site 5 QL	Paratendipes albimanus	Insecta	Diptera	Chironomidae	CG	NA
Site 5 QL	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	NA
Site 5 QL	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	NA
Site 5 QL	Boyeria sp	Insecta	Odonata	Aeshnidae	PR	NA
Site 5 QL	Planorbella sp	Mollusca	Lymnophila	Planorbidae	SC	NA
Site 5 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	NA
Site 5 QL	Gyraulus sp	Mollusca	Lymnophila	Planorbidae	SC	NA
Site 5 QL	Ferrissia sp	Mollusca	Lymnophila	Ancylidae	SC	NA
Site 5 QL	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	NA
Site 5 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	NA
Site 5 QL	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	NA
Site 5 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	NA
Site 9 QT	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	3
Site 9 QT	Hemerodromia sp	Insecta	Diptera	Empididae	PR	7
Site 9 QT	Simulium sp	Insecta	Diptera	Simuliidae	CF	18
Site 9 QT	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	10
Site 9 QT	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	7
Site 9 QT	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	9
Site 9 QT	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	1
Site 9 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	14
Site 9 QT	Cryptochironomus sp	Insecta	Diptera	Chironomidae	PR	1
Site 9 QT	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	22
Site 9 QT	Optioservus sp	Insecta	Coleoptera	Elmidae	SC	1
Site 9 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	3
Site 9 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	184
Site 9 QT	Turbellaria	Turbellaria			CG	1
Site 9 QT	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	4
Site 9 QT	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	15
Site 9 QT	Cricotopus bicinctus	Insecta	Diptera	Chironomidae	SH	1
Site 9 QT	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	2
Site 9 QT	Dicrotendipes neomodestus	Insecta	Diptera	Chironomidae	CG	1

Site 9 QL	Lymnaea sp	Mollusca	Lymnophila	Lymnaeidae	SC	NA
Site 9 QL	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	NA
Site 9 QL	Peltodytes lengi	Insecta	Coleoptera	Haliplidae	PH	NA
Site 9 QL	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	NA
Site 9 QL	Berosus sp	Insecta	Coleoptera	Hydrophilidae	PH	NA
Site 9 QL	Culicidae	Insecta	Diptera	Culicidae	CF	NA
Site 9 QL	Ischnura sp	Insecta	Odonata	Coenagrionidae	PR	NA
Site 9 QL	Coenagrionidae	Insecta	Odonata	Coenagrionidae	PR	NA
Site 9 QL	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	NA
Site 9 QL	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	NA
Site 9 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	NA
Site 9 QL	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	NA
Site 9 QL	Cryptochironomus sp	Insecta	Diptera	Chironomidae	PR	NA
Site 9 QL	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	NA
Site 9 QL	Polypedilum fallax gr	Insecta	Diptera	Chironomidae	SH	NA
Site 9 QL	Orthocladius sp	Insecta	Diptera	Chironomidae	CG	NA
Site 9 QL	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	NA
Site 9 QL	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	NA
Site 9 QL	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	NA
Site 9 QL	Tropisternus sp	Insecta	Coleoptera	Hydrophilidae	CG	NA
Site 9 QL	Tropisternus sp	Insecta	Coleoptera	Hydrophilidae	CG	NA
Site 9 QL	Peltodytes sp	Insecta	Coleoptera	Haliplidae	PH	NA
Site 9 QL	Helicopsyche borealis	Insecta	Trichoptera	Helicopsychidae	SC	NA
Site 9 QL	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	NA
Site 9 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 9 QL	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 9 QL	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 9 QL	Atrichopogon sp	Insecta	Diptera	Ceratopogonidae	PR	NA
Site 9 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	NA
Site 9 QL	Hemerodromia sp	Insecta	Diptera	Empididae	PR	NA
Site 9 QL	Hydrophilidae	Insecta	Coleoptera	Hydrophilidae	PR	NA
Site 9 QL	Optioservus sp	Insecta	Coleoptera	Elmidae	SC	NA
Site 9 QL	Simulium sp	Insecta	Diptera	Simuliidae	CF	NA
Site 9 QL	Synurella sp	Malacostraca	Amphipoda	Crangonyctidae	CG	NA
Site 9 QL	Oxyethira sp	Insecta	Trichoptera	Hydroptilidae	CG	NA
Site 9 QL	Turbellaria	Turbellaria			CG	NA
Site 9 QL	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	NA
Site 9 QL	Diphetor hageni	Insecta	Ephemeroptera	Baetidae	CG	NA
CR-7 QT	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	4
CR-7 QT	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	2
CR-7 QT	Atrichopogon sp	Insecta	Diptera	Ceratopogonidae	PR	3
CR-7 QT	Cyphon sp	Insecta	Coleoptera	Scirtidae	SC	1
CR-7 QT	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	7
CR-7 QT	Coenagrionidae	Insecta	Odonata	Coenagrionidae	PR	1
CR-7 QT	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	3
CR-7 QT	Turbellaria	Turbellaria			CG	1
CR-7 QT	Bezzia/Palpomyia gr	Insecta	Diptera	Ceratopogonidae	PR	2
CR-7 QT	Dasyhelea sp	Insecta	Diptera	Ceratopogonidae	CG	1
CR-7 QT	Clinotanypus sp	Insecta	Diptera	Chironomidae	PR	2
CR-7 QT	Cryptochironomus sp	Insecta	Diptera	Chironomidae	PR	1
CR-7 QT	Glyptotendipes sp	Insecta	Diptera	Chironomidae	SH	9
CR-7 QT	Larsia sp	Insecta	Diptera	Chironomidae	PR	6
CR-7 QT	Paratendipes albimanus	Insecta	Diptera	Chironomidae	CG	28
CR-7 QT	Callibaetis sp	Insecta	Ephemeroptera	Baetidae	CG	1
CR-7 QT	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	6
CR-7 QT	Physella sp	Mollusca	Basommatophora	Physidae	SC	6
CR-7 QT	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	14
CR-7 QT	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	10
CR-7 QT	Ferrissia sp	Mollusca	Lymnophila	Ancylidae	SC	8
CR-7 QT	Planorbella sp	Mollusca	Lymnophila	Planorbidae	SC	2

CR-7 QT	Lymnaea sp	Mollusca	Lymnophila	Lymnaeidae	SC	4
CR-7 QT	Sialis sp	Insecta	Megaloptera	Sialidae	PR	1
CR-7 QT	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	46
CR-7 QT	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	1
CR-7 QT	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	33
CR-7 QT	Peltodytes lengi	Insecta	Coleoptera	Haliplidae	PH	7
CR-7 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	3
CR-7 QT	Dubiraphia quadrinotata	Insecta	Coleoptera	Elmidae	SC	1
CR-7 QT	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	7
CR-7 QT	Polypedilum scalaenum gr	Insecta	Diptera	Chironomidae	SH	1
CR-7 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	54
CR-7 QT	Stenochironomus sp	Insecta	Diptera	Chironomidae	CG	1
CR-7 QT	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	2
CR-7 QT	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	1
CR-7 QT	Orthocladiinae	Insecta	Diptera	Chironomidae	CG	1
CR-7 QT	Dicrotendipes neomodestus	Insecta	Diptera	Chironomidae	CG	2
CR-7 QT	Harnischia complex sp	Insecta	Diptera	Chironomidae	CG	1
CR-7 QT	Zavrelimyia sp	Insecta	Diptera	Chironomidae	PR	1
CR-7 QT	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	4
CR-7 QT	Chironomus sp	Insecta	Diptera	Chironomidae	CG	4
CR-7 QL	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	NA
CR-7 QL	Ischnura sp	Insecta	Odonata	Coenagrionidae	PR	NA
CR-7 QL	Callibaetis sp	Insecta	Ephemeroptera	Baetidae	CG	NA
CR-7 QL	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	NA
CR-7 QL	Chironomus sp	Insecta	Diptera	Chironomidae	CG	NA
CR-7 QL	Glyptotendipes sp	Insecta	Diptera	Chironomidae	SH	NA
CR-7 QL	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	NA
CR-7 QL	Dubiraphia quadrinotata	Insecta	Coleoptera	Elmidae	SC	NA
CR-7 QL	Lopescladius sp	Insecta	Diptera	Chironomidae	CG	NA
CR-7 QL	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	NA
CR-7 QL	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	NA
CR-7 QL	Dicrotendipes neomodestus	Insecta	Diptera	Chironomidae	CG	NA
CR-7 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	NA
CR-7 QL	Peltodytes lengi	Insecta	Coleoptera	Haliplidae	PH	NA
CR-7 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	NA
CR-7 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	NA
CR-7 QL	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	NA
CR-7 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	NA
CR-7 QL	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	NA
CR-7 QL	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	NA
CR-7 QL	Corbicula fluminea	Mollusca	Pelecypoda	Corbiculidae	CF	NA
CR-7 QL	Helisoma sp	Mollusca	Lymnophila	Planorbidae	SC	NA
CR-7 QL	Belostoma flumineum	Insecta	Hemiptera	Belostomatidae	PR	NA
CR-7 QL	Harnischia complex sp	Insecta	Diptera	Chironomidae	CG	NA
CR-7 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	NA

Sample ID	Taxa Name	Class	Order	Family	FFG	Count
Site 3 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	N/A
Site 3 QL	Rhyacophila ledra/fenestra	Insecta	Trichoptera	Rhyacophilidae	PR	N/A
Site 3 QL	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	N/A
Site 3 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	N/A
Site 3 QT	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	1
Site 3 QT	Perlesta sp	Insecta	Plecoptera	Perlidae	PR	1
Site 3 QT	Larsia sp	Insecta	Diptera	Chironomidae	PR	1
Site 3 QT	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	20
Site 3 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	267
Site 4 QL	Tubificidae imm w hair setae	Oligochaeta	Haplotaxida	Tubificidae	CG	N/A
Site 4 QL	Turbellaria	Turbellaria			CG	N/A
Site 4 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	N/A
Site 4 QL	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	N/A
Site 4 QL	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	N/A
Site 4 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	N/A
Site 4 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	N/A
Site 4 QL	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	N/A
Site 4 QL	Paracymus sp	Insecta	Coleoptera	Hydrophilidae	PR	N/A
Site 4 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	N/A
Site 4 QT	Pseudolimnophila sp	Insecta	Diptera	Tipulidae	PR	1
Site 4 QT	Hydrophilidae	Insecta	Coleoptera	Hydrophilidae	PR	1
Site 4 QT	Libellulinae	Insecta	Odonata	Libellulidae	PR	1
Site 4 QT	Physella sp	Mollusca	Basommatophora	Physidae	SC	1
Site 4 QT	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	2
Site 4 QT	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	4
Site 4 QT	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	60
Site 4 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	281
Site 6 QL	Cambaridae	Malacostraca	Decapoda	Cambaridae	CG	N/A
Site 6 QL	Psephenus herricki	Insecta	Coleoptera	Psephenidae	SC	N/A
Site 6 QL	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	N/A
Site 6 QL	Eukiefferiella claripennis gr	Insecta	Diptera	Chironomidae	CG	N/A
Site 6 QL	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	N/A
Site 6 QL	Peltodytes lengi	Insecta	Coleoptera	Haliplidae	PH	N/A
Site 6 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	N/A
Site 6 QL	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	N/A
Site 6 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	N/A
Site 6 QL	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	N/A
Site 6 QL	Turbellaria	Turbellaria			CG	N/A
Site 6 QL	Simulium sp	Insecta	Diptera	Simuliidae	CF	N/A
Site 6 QL	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	N/A
Site 6 QL	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	N/A
Site 6 QL	Micropsectra sp	Insecta	Diptera	Chironomidae	CG	N/A
Site 6 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	N/A
Site 6 QT	Orthocladiinae	Insecta	Diptera	Chironomidae	CG	1
Site 6 QT	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	1
Site 6 QT	Corbicula fluminea	Mollusca	Pelecypoda	Corbiculidae	CF	1
Site 6 QT	Lumbriculidae	Oligochaeta	Lumbriculida	Lumbriculidae	CG	1

Site 6 QT	Polypedilum scalaenum gr	Insecta	Diptera	Chironomidae	SH	1
Site 6 QT	Paratendipes albimanus	Insecta	Diptera	Chironomidae	CG	2
Site 6 QT	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	2
Site 6 QT	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	2
Site 6 QT	Turbellaria	Turbellaria			CG	3
Site 6 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	3
Site 6 QT	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	12
Site 6 QT	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	13
Site 6 QT	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	16
Site 6 QT	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	21
Site 6 QT	Simulium sp	Insecta	Diptera	Simuliidae	CF	68
Site 6 QT	Eukiefferiella sp	Insecta	Diptera	Chironomidae	CG	73
Site 6 QT	Elimia sp	Mollusca	Mesogastropoda	Pleuroceridae	SC	75

Sample ID	Taxa Name	Class	Order	Family	FFG	Tolerence	Clinger	Count		
CR-S2 QL	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	0		
CR-S2 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	8.84	FALSE	0		
CR-S2 QL	Chironomus sp	Insecta	Diptera	Chironomidae	CG	9.63	FALSE	0		
CR-S2 QL	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	7	FALSE	0		
CR-S2 QL	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	2.84	FALSE	0		
CR-S2 QL	Limnophyes sp	Insecta	Diptera	Chironomidae	CG	7	FALSE	0		
CR-S2 QL	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	8.45	TRUE	0		
CR-S2 QL	Stictochironomus sp	Insecta	Diptera	Chironomidae	CG	6.52	FALSE	0		
CR-S2 QL	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	6.7	FALSE	0		
CR-S2 QL	Anopheles sp	Insecta	Diptera	Culicidae	CF	8.58	FALSE	0		
CR-S2 QL	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	9.1	FALSE	0		
CR-S2 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	6.48	FALSE	0		
CR-S2 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	7.58	FALSE	0		
CR-S2 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	0		
CR-S2 QL	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	8.63	FALSE	0		
CR-S2 QL	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	6.22	TRUE	0		
CR-S2	Turbellaria	Turbellaria			CG	5	FALSE	4	4	20
CR-S2	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	2	2	16
CR-S2	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	5.1	TRUE	2	2	10.2
CR-S2	Cricotopus bicinctus	Insecta	Diptera	Chironomidae	SH	8.54	FALSE	8	8	68.32
CR-S2	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	7	FALSE	24	24	168
CR-S2	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	2.84	FALSE	96	25	71
CR-S2	Cricotopus/Orthocladius gr	Insecta	Diptera	Chironomidae	CG	7.1	FALSE	15	15	106.5
CR-S2	Limnophyes sp	Insecta	Diptera	Chironomidae	CG	7	FALSE	1	1	7
CR-S2	Micropsectra sp	Insecta	Diptera	Chironomidae	CG	1.52	FALSE	20	20	30.4
CR-S2	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	8.45	TRUE	1	1	8.45
CR-S2	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	9	FALSE	1	1	9
CR-S2	Thienemanniella xena	Insecta	Diptera	Chironomidae	CG	5.9	FALSE	5	5	29.5
CR-S2	Simulium sp	Insecta	Diptera	Simuliidae	CF	4.4	TRUE	3	3	13.2
CR-S2	Baetis flavistriga	Insecta	Ephemeroptera	Baetidae	CG	6.58	FALSE	1	1	6.58
CR-S2	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	9.1	FALSE	4	4	36.4
CR-S2	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	132	25	196.25

CR-S2	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	6.22	TRUE	2	2	12.44
CR-S2	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	6.22	TRUE	18	18	111.96
								339	161	921.2
tr	ept	mhbi	%ept	%E	%C+O	%cling				
23	3	5.72	5.60	0.29	51.62	7.67				

Sample ID	Taxa Name	Class	Order	Family	FFG	Tolerence	Clinger	Count
CR-4 QL	Ischnura sp	Insecta	Odonata	Coenagrionidae	PR	9.52	FALSE	N/A
CR-4 QL	Polypedilum fallax gr	Insecta	Diptera	Chironomidae	SH	6.39	FALSE	N/A
CR-4 QL	Thienemanniella xena	Insecta	Diptera	Chironomidae	CG	5.9	FALSE	N/A
CR-4 QL	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	5.9	FALSE	N/A
CR-4 QL	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	6.7	FALSE	N/A
CR-4 QL	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	6.4	TRUE	N/A
CR-4 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	6.4	FALSE	N/A
CR-4 QL	Lumbriculidae	Oligochaeta	Lumbriculida	Lumbriculidae	CG	7.3	FALSE	N/A
CR-4 QL	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	2.8	TRUE	N/A
CR-4 QL	Procladius sp	Insecta	Diptera	Chironomidae	PR	9.1	FALSE	N/A
CR-4 QL	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	7.18	TRUE	N/A
CR-4 QL	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	7.4	FALSE	N/A
CR-4 QL	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	6.87	TRUE	N/A
CR-4 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	N/A
CR-4 QL	Synurella sp	Malacostraca	Amphipoda	Crangonyctidae	CG	8	FALSE	N/A
CR-4 QL	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	N/A
CR-4 QL	Hydropsychidae	Insecta	Trichoptera	Hydropsychidae	CF	4	FALSE	N/A
CR-4 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	7.58	FALSE	N/A
CR-4 QL	Stempellinella sp	Insecta	Diptera	Chironomidae	CG	4.62	FALSE	N/A
CR-4 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	6.48	FALSE	N/A
CR-4 QL	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	7	FALSE	N/A
CR-4 QL	Simulium sp	Insecta	Diptera	Simuliidae	CF	4.4	TRUE	N/A
CR-4 QL	Ablabesmyia sp	Insecta	Diptera	Chironomidae	PR	7.2	FALSE	N/A
CR-4 QL	Phaenopsectra flavipes	Insecta	Diptera	Chironomidae	SC	7.94	FALSE	N/A
CR-4 QL	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	8.45	TRUE	N/A
CR-4 QL	Cricotopus/Orthocladius gr	Insecta	Diptera	Chironomidae	CG	7.1	FALSE	N/A
CR-4 QL	Stictochironomus sp	Insecta	Diptera	Chironomidae	CG	6.52	FALSE	N/A
CR-4 QL	Turbellaria	Turbellaria			CG	5	FALSE	N/A
CR-4 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	5.1	TRUE	1
CR-4 QT	Stempellinella sp	Insecta	Diptera	Chironomidae	CG	4.62	FALSE	1
CR-4 QT	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	2.84	FALSE	1
CR-4 QT	Chimarra aterrima	Insecta	Trichoptera	Philopotamidae	CF	2	TRUE	1
CR-4 QT	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	7.18	TRUE	1
CR-4 QT	Orconectes sp	Malacostraca	Decapoda	Cambaridae	CG	5.49	FALSE	1
CR-4 QT	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	1
CR-4 QT	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	7.58	FALSE	1
CR-4 QT	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	6.4	TRUE	1
CR-4 QT	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	6.48	FALSE	1
CR-4 QT	Gyraulus sp	Mollusca	Lymnophila	Planorbidae	SC	7.5	FALSE	1
CR-4 QT	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	6.7	FALSE	1
CR-4 QT	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	9	FALSE	2
CR-4 QT	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	6.87	TRUE	2
CR-4 QT	Simulium sp	Insecta	Diptera	Simuliidae	CF	4.4	TRUE	2
CR-4 QT	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	9.1	FALSE	3
CR-4 QT	Psephenus herricki	Insecta	Coleoptera	Psephenidae	SC	2.35	TRUE	3
CR-4 QT	Hydropsyche betteni/depravata complex	Insecta	Trichoptera	Hydropsychidae	CF	4	TRUE	3
CR-4 QT	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	7.4	FALSE	3
CR-4 QT	Thienemanniella xena	Insecta	Diptera	Chironomidae	CG	5.9	FALSE	3
CR-4 QT	Cricotopus/Orthocladius gr	Insecta	Diptera	Chironomidae	CG	7.1	FALSE	3
CR-4 QT	Turbellaria	Turbellaria			CG	5	FALSE	4
CR-4 QT	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	5.3	FALSE	4
CR-4 QT	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	7	FALSE	7
CR-4 QT	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	6.22	TRUE	7
CR-4 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	5.1	TRUE	8
CR-4 QT	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	5.9	FALSE	13
CR-4 QT	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	2.8	TRUE	20
CR-4 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	225
CR-8 QL	Lymnaea sp	Mollusca	Lymnophila	Lymnaeidae	SC	7	FALSE	N/A
CR-8 QL	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	8.63	FALSE	N/A
CR-8 QL	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	N/A

CR-8 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	N/A
CR-8 QL	Tipula sp	Insecta	Diptera	Tipulidae	SH	7.33	FALSE	N/A
CR-8 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	8.84	FALSE	N/A
CR-8 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	7.58	FALSE	N/A
CR-8 QT	Erpobdella punctata	Hirudinea	Pharyngobdellida	Eropolellidae	CG	7.8	FALSE	1
CR-8 QT	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	9.1	FALSE	1
CR-8 QT	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	2.8	TRUE	1
CR-8 QT	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	6.4	FALSE	1
CR-8 QT	Physella sp	Mollusca	Basommatophora	Physidae	SC	8.84	FALSE	1
CR-8 QT	Lumbriculidae	Oligochaeta	Lumbriculida	Lumbriculidae	CG	7.3	FALSE	7
CR-8 QT	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	10
CR-8 QT	Turbellaria	Turbellaria			CG	5	FALSE	15
CR-8 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	272

KY Division of Water/Cane Run Watershed - Wadeable Streams/Macroinvertebrate Results, 2016

StationID	StreamName	CollDate	Bioregion	Basin	CollMeth	G-TR	G-EPT	mHBI	m%EPT	%C+O	%ClngP	G-TR	G-EPT	HBI2	m%EPT	%CO	%ClngP	MBI	Ratings
Site 1	Cane Run	6/17/2016	BG	KY	Riffle Kick + MH	50	14	5.02	26.26	7.74	76.77	73.53	48.28	72.23	35.98	93.19	100.00	70.53	Excellent
Site 2	Cane Run	6/17/2016	BG	KY	Riffle Kick + MH	58	13	5.70	15.30	9.25	22.06	85.29	44.83	62.45	20.96	91.66	29.82	55.84	Fair
Site 5	Cane Run	6/16/2016	BG	KY	Riffle Kick + MH	47	6	5.84	5.86	33.64	31.17	69.12	20.69	60.41	8.03	67.03	42.13	44.57	Fair
Site 7	Cane Run	8/25/2016	BG	KY	Riffle Kick + MH	43	4	7.82	29.35	25.60	29.35	63.24	13.79	31.70	40.21	75.15	39.66	43.96	Fair
Site 9	Cane Run	6/16/2016	BG	KY	Riffle Kick + MH	35	7	5.50	3.29	7.89	19.08	51.47	24.14	65.35	4.51	93.04	25.78	44.05	Fair

KY Division of Water/Cane Run Watershed - Headwater Streams/Macroinvertebrate Results, 2017

StationID	StreamName	CollDate	Bioregion	Basin	CollMeth	G-TR	G-EPT	mHBI	m%EPT	%Ephem	%C+O	%ClngP	G-TR	G-EPT	HBI2	m%EPT	%Ephem	%C+O	%ClngP	MBI	Rating
Site 3	UT Cane Run	3/21/2017	BG	KY	Riffle Kick + MH	8	3	7.84	0.34	0.00	0.34	0.34	13.56	9.68	27.64	0.40	0.00	100.00	0.46	21.68	Poor
Site 4	UT Cane Run	3/21/2017	BG	KY	Riffle Kick + MH	13	0	7.83	0.00	0.00	0.00	0.00	22.03	0.00	27.76	0.00	0.00	100.00	0.00	21.40	Poor
Site 6	UT Cane Run	3/21/2017	BG	KY	Riffle Kick + MH	23	0	5.42	0.00	0.00	40.68	24.75	38.98	0.00	58.58	0.00	0.00	59.73	32.78	27.15	Poor
Site 10 (CR-S2)	Cane Run	4/28/2017	BG	KY	Riffle Kick + MH	23	3	5.72	5.60	0.29	51.62	7.67	38.98	9.68	54.71	6.45	0.44	48.71	10.16	24.16	Poor
CR-4	UNT Cane Run	2/23/2017	BG	KY	Riffle Kick + MH	35	6	5.82	9.26	1.85	11.11	15.12	59.32	19.35	53.47	10.66	2.78	89.50	20.03	36.45	Poor
CR-8	Cane Run	2/23/2017	BG	KY	Riffle Kick + MH	13	1	7.05	0.32	0.00	2.27	0.32	22.03	3.23	37.68	0.37	0.00	98.40	0.43	23.16	Poor

ky 16-004

Wadeable (>5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 6-17-16 Time: 1 pm
Collector(s) Initials: BR/CO Station Number site 1

✓ Collected during the wadeable sampling period (May 1-Sept. 30).

Stream Conditions

✓ Clear with Normal flow
____Turbid or High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 300 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 4 (at least 3)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-habitat Method

Boulder Picks

✓ Boulder Pick (5 boulders from pools, 5 boulders from riffles <u>and</u> 5 boulders from runs within reach totaling 15 rocks)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in pools <u>and</u> 3 sweeps in at least 2 runs within reach; if tree roots are present in riffle at least 1 sweep required)
NO Marginal Emergent Vegetation Sweeps (3 sweeps within reach)
✓ Bedrock/Slab-Rock Sweeps (3 from pools <u>and</u> one from a run within reach)
NO *Justicia* Sweeps (3 sweeps within reach)

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

***Aufwuchs* Picks – habitat associated with attached algae and mosses**

✓ *Aufwuchs* Picks (3 *Aufwuchs* picks from pools, 3 *Aufwuchs* picks from runs and 3 *Aufwuchs* picks from riffles within reach)

Conditioned Submerged Wood Picks – Must pick at least 3 linear meters of conditioned submerged wood, but not more than 6 linear meters of submerged wood; wood pieces should be from 5 to 15 cm in diameter.

____Conditioned Submerged Wood Picks: Linear Meters of Wood Sampled 4 (1 linear meter of wood from pools, 1 linear meter of wood from runs and 1 linear meter of wood from riffles within reach)

Comments: Sampled upstream of Bridge crossing, downstream of bridge is confluence w/ North Elkhorn.

KY16-004

Wadeable (>5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 6-17-16 Time: 1030
Collector(s) Initials: MR/CO Station Number Site 2

✓ Collected during the wadeable sampling period (May 1-Sept. 30).

Stream Conditions

✓ Clear with Normal flow
____Turbid or High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 300 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 4 (at least 3)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-habitat Method

Boulder Picks

✓ Boulder Pick (5 boulders from pools, 5 boulders from riffles <u>and</u> 5 boulders from runs within reach totaling 15 rocks)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in pools <u>and</u> 3 sweeps in at least 2 runs within reach; if tree roots are present in riffle at least 1 sweep required) no riffle
✓ Marginal Emergent Vegetation Sweeps (3 sweeps within reach)
✓ Bedrock/Slab-Rock Sweeps (3 from pools <u>and</u> one from a run within reach)
✓ *Justicia* Sweeps (3 sweeps within reach)

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles) none none

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

KY16-004
Site 2

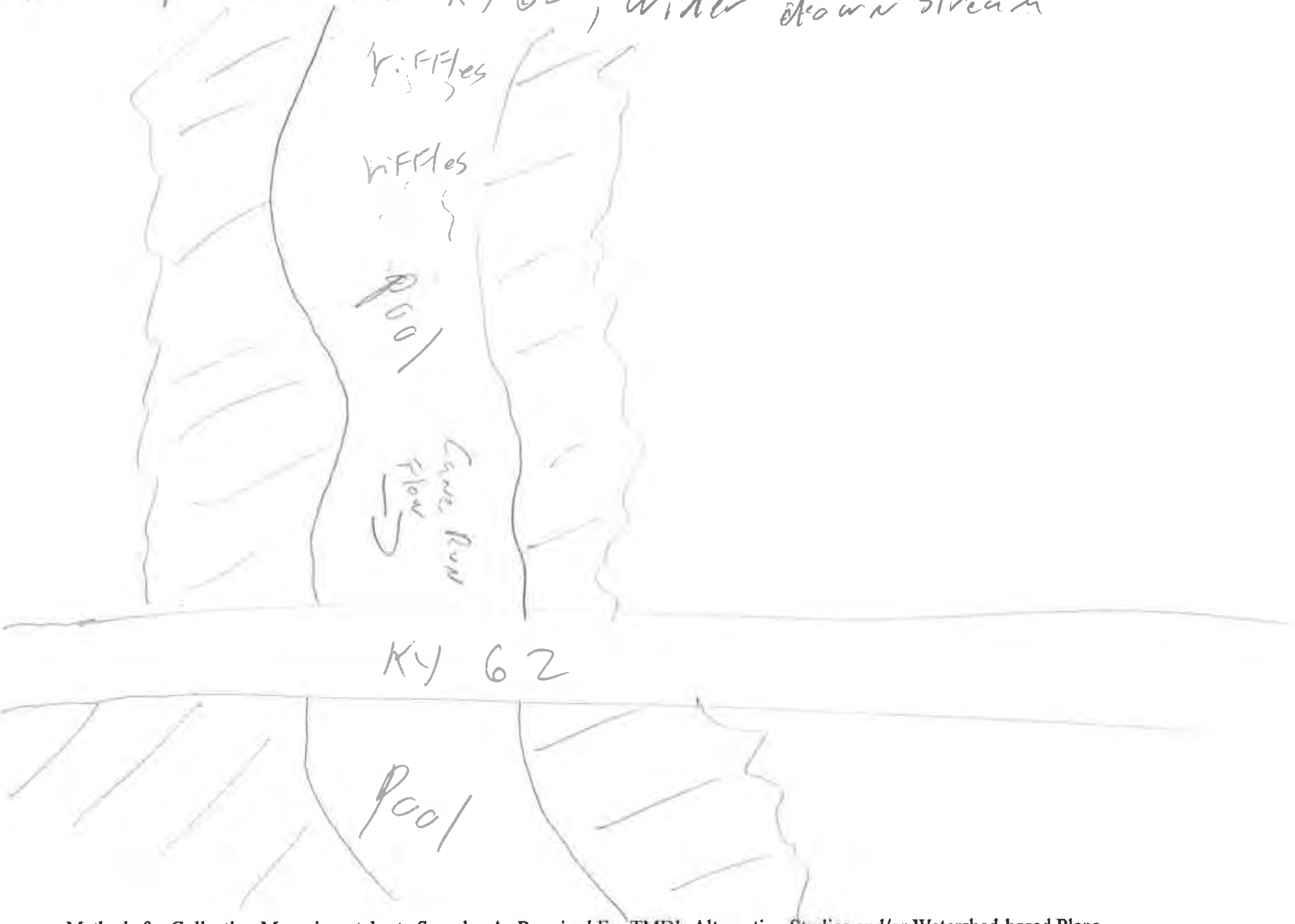
***Aufwuchs* Picks – habitat associated with attached algae and mosses**

✓ *Aufwuchs* Picks (3 *Aufwuchs* picks from pools, 3 *Aufwuchs* picks from runs and 3 *Aufwuchs* picks from riffles within reach)

Conditioned Submerged Wood Picks – Must pick at least 3 linear meters of conditioned submerged wood, but not more than 6 linear meters of submerged wood; wood pieces should be from 5 to 15 cm in diameter.

✓ Conditioned Submerged Wood Picks: Linear Meters of Wood Sampled 4 (1 linear meter of wood from pools, 1 linear meter of wood from runs and 1 linear meter of wood from riffles within reach)

Comments:
riffles confined to upper portion of reach, Long pools above + below. Riparian zone reduced upstream of KY 62, wider downstream



Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 3-21-17 Time: 1:49 pm
Collector(s) Initials: R. Storm, J. Storm Station Number Site 3 UT Cane Run

✓ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 100 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 0 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

N/A Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies <u>and</u> 3 sweeps in 2 runs/riffles within reach)
N/A Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies <u>and</u> 3 sweeps in runs within reach)
✓ Other Sweeps (Ex. Bedrock sweeps) Comments: Bedrock, Emergent Veg

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

N/A Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

N/A Submerged Wood Picks: Linear Meters of Wood Sampled — (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: ________ DO ______ Temperature _____ pH _____ Conductivity

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 3-21-17 Time: 3 pm

Collector(s) Initials: R. Storm, J. Storm Station Number Site 4 Ut Cane Run

✓ Collected during the headwater sampling period (March 1– May 31)

Stream Conditions

✓ Clear /Normal flow

____Turbid/High flow. (If so, do not sample.)

____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 100 meters

Number of riffles in stream reach: 4 (at least 3)

Number of runs in stream reach: 3 (at least 3)

Number of pools in stream reach: 3 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1

✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)

✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach

✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies <u>and</u> 3 sweeps in 2 runs/riffles within reach)

✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies <u>and</u> 3 sweeps in runs within reach)

✓ Other Sweeps (Ex. Bedrock sweeps) Comments: Bedrock, Antweachs

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

N/A Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

N/A Submerged Wood Picks: Linear Meters of Wood Sampled ____________(Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 10.4 DO 14.82 Temperature 7.9 pH 380 Conductivity

Lane Run KY16-004

Wadeable (>5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 6-16-16 Time: 233
Collector(s) Initials: BR/CG Station Number Site 5

✓ Collected during the wadeable sampling period (May 1-Sept. 30).

Stream Conditions

✓ Clear with Normal flow
____Turbid or High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 200 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 4 (at least 3)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-habitat Method

Boulder Picks

✓ Boulder Pick (5 boulders from pools, 5 boulders from riffles and 5 boulders from runs within reach totaling 15 rocks)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in pools and 3 sweeps in at least 2 runs within reach; if ~~tree roots are present~~ in riffle at least 1 sweep required) None in riffle
✓ Marginal Emergent Vegetation Sweeps (3 sweeps within reach)
✓ Bedrock/Slab-Rock Sweeps (3 from pools and one from a run within reach)
____*Justicia* Sweeps (3 sweeps within reach) NO

Conditioned Leaf Pack Picks ✓

✓ Conditioned Leaf ~~Pack~~ Picks (3 conditioned leaf packs from pools, 3 conditioned leaf packs from runs and 3 ~~conditioned leaf~~ packs from riffles) Added additional from pool

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Site 5

***Aufwuchs* Picks – habitat associated with attached algae and mosses**

✓ *Aufwuchs* Picks (3 *Aufwuchs* picks from pools, 3 *Aufwuchs* picks from runs and 3 *Aufwuchs* picks from riffles within reach)

Conditioned Submerged Wood Picks – Must pick at least 3 linear meters of conditioned submerged wood, but not more than 6 linear meters of submerged wood; wood pieces should be from 5 to 15 cm in diameter.

✓ Conditioned Submerged Wood Picks: Linear Meters of Wood Sampled 3.5 (1 linear meter of wood from pools, 1 linear meter of wood from runs and 1 linear meter of wood from riffles within reach)

Comments: Low Flow, hi D.O. levels, suspect Low D.O. @ night.

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 3/21/17 Time: 4pm
Collector(s) Initials: R. Storm / J. Storm Station Number site 6 - ut Cave Run

✓ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 100 meters
Number of riffles in stream reach: 2 (at least 3)
Number of runs in stream reach: 2 (at least 3)
Number of pools in stream reach: 2 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #~~3~~ 2 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 runs/riffles within reach)
- Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
- Other Sweeps (Ex. Bedrock sweeps) Comments: ____

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

✓ Submerged Wood Picks: Linear Meters of Wood Sampled 3m (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 17.06 DO 14.12 Temperature 8.71 pH 496 Conductivity

Wadeable (>5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 8-25-16 Time: 1140
Collector(s) Initials: BR/CR Station Number CR-7

✓ Collected during the wadeable sampling period (May 1-Sept. 30).

Stream Conditions

✓ Clear with Normal flow
___Turbid or High flow. (If so, do not sample.)
___No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 150 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 5 (at least 3)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-habitat Method

Boulder Picks

✓ Boulder Pick (5 boulders from pools, 5 boulders from riffles and 5 boulders from runs within reach totaling 15 rocks)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in pools and 3 sweeps in at least 2 runs within reach; if tree roots are present in riffle at least 1 sweep required)
✓ Marginal Emergent Vegetation Sweeps (3 sweeps within reach)
___Bedrock/Slab-Rock Sweeps (3 from pools and one from a run within reach)
N/A *Justicia* Sweeps (3 sweeps within reach)

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

N/A Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

No Fines

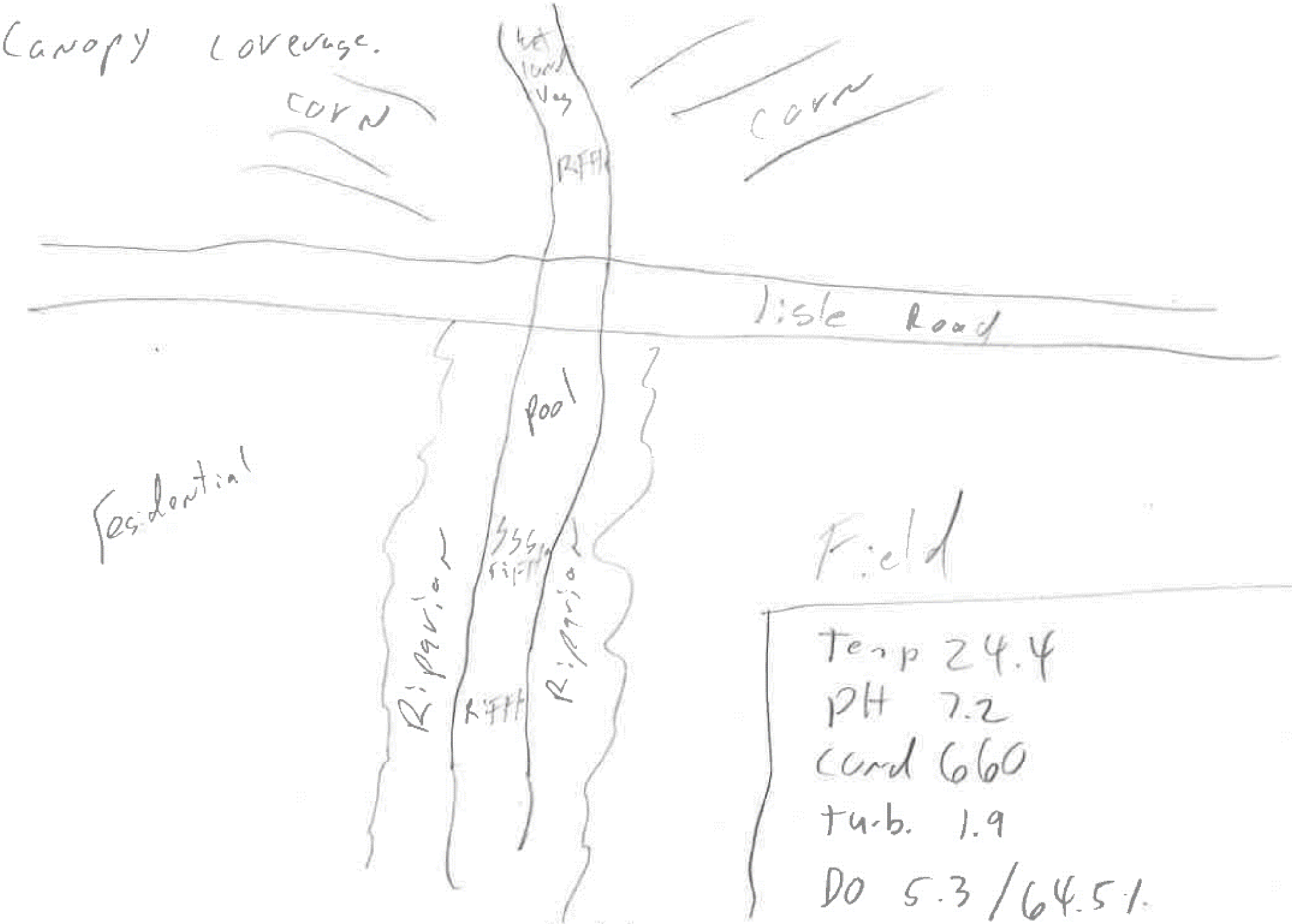
***Aufwuchs* Picks – habitat associated with attached algae and mosses**

✓ *Aufwuchs* Picks (3 *Aufwuchs* picks from pools, 3 *Aufwuchs* picks from runs and 3 *Aufwuchs* picks from riffles within reach)

Conditioned Submerged Wood Picks – Must pick at least 3 linear meters of conditioned submerged wood, but not more than 6 linear meters of submerged wood; wood pieces should be from 5 to 15 cm in diameter.

✓ Conditioned Submerged Wood Picks: Linear Meters of Wood Sampled 4 (1 linear meter of wood from pools, 1 linear meter of wood from runs and 1 linear meter of wood from riffles within reach)

Comments: Stream is Karst upStream of I-75, very low flow, but deep pools, upstream of lisle Road open with corn in Field. channel is chocked with wetland veg. Downstream 80% Canopy coverage.



Temp 24.4
pH 7.2
cond 660
turb. 1.9
DO 5.3/64.5%

KY16-004

Wadeable (>5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 6-16-16 Time: 1230
Collector(s) Initials: BR/CO Station Number Site 9

✓ Collected during the wadeable sampling period (May 1-Sept. 30).

38.129319
-84.507478

Stream Conditions

✓ Clear with Normal flow
____Turbid or High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 120 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 3 (at least 3)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-habitat Method

Boulder Picks

✓ Boulder Pick (5 boulders from pools, 5 boulders from riffles <u>and</u> 5 boulders from runs within reach totaling 15 rocks)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in pools ✓ <u>and</u> 3 sweeps in at ✓ least 2 runs within reach; if tree roots are present in riffle at least 1 sweep required) ✓
✓ Marginal Emergent Vegetation Sweeps (3 sweeps within reach)
NO Bedrock/Slab-Rock Sweeps (3 from pools <u>and</u> one from a run within reach)
NO *Justicia* Sweeps (3 sweeps within reach) None

Conditioned Leaf Pack Picks

X. None in pools

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools, 3 conditioned leaf ✓ packs from runs and 3 conditioned leaf packs from riffles) ✓

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Site 9

***Aufwuchs* Picks – habitat associated with attached algae and mosses**

✓ *Aufwuchs* Picks (3 *Aufwuchs* picks from pools, 3 *Aufwuchs* picks from runs and 3 *Aufwuchs* picks from riffles within reach)

Conditioned Submerged Wood Picks – Must pick at least 3 linear meters of conditioned submerged wood, but not more than 6 linear meters of submerged wood; wood pieces should be from 5 to 15 cm in diameter.

✓ Conditioned Submerged Wood Picks: Linear Meters of Wood Sampled 4 (1 linear meter of wood from pools, 1 linear meter of wood from runs and 1 linear meter of wood from riffles within reach)

Comments: Pools shallow, flow pretty good for Cave run, buffer on each side, Filamentous growth present but not smothering.

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 4-26-17 Time: 3pm - 430pm

Collector(s) Initials: BR/JS Station Number CR-S2

✓ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 125 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 3 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of [✓ Riffle #1] (If Riffle #1 is small, then sample Riffle #4 from the sample reach: Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 runs/riffles within reach)
✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
✓ Other Sweeps (Ex. Bedrock sweeps) Comments: Bedrock embedded

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

✓ Submerged Wood Picks: Linear Meters of Wood Sampled 2 (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 10.7/131 % DO 16.8 Temperature 8.1 pH 677 Conductivity

Turb 1.8

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 2-23-17 Time: 417pm

Collector(s) Initials: BR/CB Station Number CR-4 macro

✓ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 100 meters
Number of riffles in stream reach: 4 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 4 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 runs/riffles within reach)
✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
✓ Other Sweeps (Ex. Bedrock sweeps) Comments: 3 bedrock

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

N/A N/A

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

____Submerged Wood Picks: Linear Meters of Wood Sampled 2.5 (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 10.8/111% DO 15.2 Temperature 8.2 pH 701 Conductivity

turb = 4.0

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 2-23-17 Time: 130 pm

Collector(s) Initials: BR/CO Station Number CR-8

✓ Collected during the headwater sampling period (March 1-- May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 150 meters
Number of riffles in stream reach: 4 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 3 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 ~~runs/riffles within~~ N/A reach)
____Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
✓ Other Sweeps (Ex. Bedrock sweeps) Comments: 3 bedrock

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles) N/A N/A

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

____Submerged Wood Picks: Linear Meters of Wood Sampled 3 (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 11.6/124% DO 19.2 Temperature 8.6* pH 839 Conductivity

*checked twice

turb = 4.3

THIRDROCK
CONSULTANTS

Macroinvertebrate Sample Chain of Custody
Project Information Sheet

Cat 1; Task 7

Client Name: KDOW **Project Administrator:** S. Evans **Project Number:** KY16-004 **Due Date:** 7-18-16

Sampling Site Location: Cane Run watershed **County:** Fayette & Scott **State:** KY

System Type: Wadeable **EcoRegion:** BG **Total Number of Samples:** 8 **Total Number of Containers:** 8

Reporting Requirements: ✓ Laboratory Data Sheet; ✓ Excel Spreadsheet; ✓ MBI Calculations via __ e-Submittal; __ Hardcopy; ✓ Both

Samples Relinquished By: Brent Rumley **Date/Time:** 6-17-16/0400pm **Sample Received By:** Marcia P. Wooton **Date/Time:** 6-17-16/4:00p

Samples Relinquished By: ____ **Date/Time:** ____ **Sample Received By:** ____ **Date/Time:** ____

Comments/Special Instructions: ____

Sample Reference ID	Qualitative or Quantitative	Collected By	Collection Date	Sample Type	Preservative	# of Containers Per Sample	Analysis Required (KDOW Protocol, ID Level; etc.)
Site 1 (Scott Co.)	Quant	BR/CO	6/17/16	KN	Ethanol	1	KDOW TMDL Protocol
Site 1	Qual			MH			See BerT
Site 2 (Scott Co.)	Quant			KN			
Site 2	Qual			MH			
Site 5 (Scott Co.)	Quant		6/16/16	KN			
Site 5	Qual			MH			
Site 9 (Fayette Co.)	Quant			KN			
Site 9	Qual			MH			

- Continue on Reverse for More Samples -

System Type: Headwater Stream; Wadeable Stream; Large River; Lotic; Other ____
EcoRegion: Bluegrass; Mountain; Pennyroyal; Mississippi Valley-Interior River Lowlands; Other ____
Sample Type: **KN** KickNet; **TK** Traveling Kick; **MH** Multihabitat; **S** Surber; **HD** Hester-Dendy Multiplate; **HDD** HD Deep; **HDS** HD Shallow; **OT** Other____; **NA** Not Available

MacLIMS: Client Setup/Login By mlw Date 6-~~17~~ 20-16 mlw; Reported By mlw Date 9-15-16; Invoiced By ✓ SE Date ____ 5/20/10

THIRDROCK
CONSULTANTS

Macroinvertebrate Sample Chain of Custody
Project Information Sheet

MacLIMS KY16-004-01-07a
Cat 1; Task 7

Client Name: KDOW **Project Administrator:** Steve Evans **Project Number:** KY 16-004 **Due Date:** 9-30-16

Sampling Site Location: Cane Run Watershed **County:** Scott **State:** KY

System Type: Wadeable **EcoRegion:** BG **Total Number of Samples:** 2 **Total Number of Containers:** 2

Reporting Requirements: ✓ Laboratory Data Sheet; ✓ Excel Spreadsheet; __ ✓MBI Calculations via __ e-Submittal; __ Hardcopy; ✓ Both

Samples Relinquished By: Matt Remley **Date/Time:** 8-25-16/250pm **Sample Received By:** Marcia P. Wooton **Date/Time:** 8-25-16 250p

Samples Relinquished By: ____________ **Date/Time:** ________ **Sample Received By:** ____________ **Date/Time:** ________

Comments/Special Instructions: ____

Sample Reference ID	Qualitative or Quantitative	Collected By	Collection Date	Sample Type	Preservative	# of Containers Per Sample	Analysis Required (KDOW Protocol, ID Level; etc.)
CR-7	Quant	BR/CR	8-25-16	KN	Ethanol	X 2	KDOW
CR-7	Qual	↓	↓	MH	↓	X 1	↓

- Continue on Reverse for More Samples -

System Type: Headwater Stream; Wadeable Stream; Large River; Lotic; Other ________
EcoRegion: Bluegrass; Mountain; Pennyroyal; Mississippi Valley-Interior River Lowlands; Other ________
Sample Type: **KN** KickNet; **TK** Traveling Kick; **MH** Multihabitat; **S** Surber; **HD** Hester-Dendy Multiplate; **HDD** HD Deep; **HDS** HD Shallow; **OT** Other______; **NA** Not Available

MacLIMS: Client Setup/Login By mlw Date 8/26-16; Reported By mlw Date 9-15-16; Invoiced By ✓SE Date ________ 5/20/10

THIRDROCK
CONSULTANTS

Macroinvertebrate Sample Chain of Custody
Project Information Sheet

Client Name: KDOW Project Administrator: Steve Evans Project Number: KY16-004 Due Date: 6-30-17

Sampling Site Location: Cane Run County: Scott State: KY

System Type: Headwater EcoRegion: BG Total Number of Samples: 6 Total Number of Containers: 6

Reporting Requirements: ✓ Laboratory Data Sheet; ✓ Excel Spreadsheet; ✓ MBI Calculations via __ e-Submittal; __ Hardcopy; ✓ Both

Samples Relinquished By: Date/Time: 3-22-17/0843 Sample Received By: Ammie Foster Date/Time: 3-22-17 8:45

Samples Relinquished By: ____ Date/Time: ____ Sample Received By: ____ Date/Time: ____

Comments/Special Instructions: ____

Sample Reference ID	Qualitative or Quantitative	Collected By	Collection Date	Sample Type	Preservative	# of Containers Per Sample	Analysis Required (KDOW Protocol, ID Level; etc.)
Site 3	Quant	BRS/JS	3-21-17	KN	Ethanol	1	KDOW
Site 3	Qual	RS/JS	↓	MH	↓	↓	↓
Site 4	Quant	↓		KN			
Site 4	Qual			MH			
Site 6	Quant			KN			
Site 6	Qual			MH			

- Continue on Reverse for More Samples -

System Type: Headwater Stream; Wadeable Stream; Large River; Lotic; Other ____
EcoRegion: Bluegrass; Mountain; Pennyroyal; Mississippi Valley-Interior River Lowlands; Other ____
Sample Type: **KN** KickNet; **TK** Traveling Kick; **MH** Multihabitat; **S** Surber; **HD** Hester-Dendy Multiplate; **HDD** HD Deep; **HDS** HD Shallow; **OT** Other____; **NA** Not Available

MacLIMS: Client Setup/Login By ____ Date ____; Reported By ____ Date ____; Invoiced By ____ Date ____ 5/20/10

THIRDROCK
CONSULTANTS

Macroinvertebrate Sample Chain of Custody
Project Information Sheet

Client Name: LFUCG
Project Administrator: Steve Evans
Project Number: ~~KY15TT~~ KY15Y3TT3-3b
Due Date: 7-30-17
Sampling Site Location: Fayette - Lexington
County: Fayette
State: KY
System Type: 2 HW & 5 Wadeable
EcoRegion: Bluegrass
Total Number of Samples: 10
Total Number of Containers: 10
Reporting Requirements: ✓ Laboratory Data Sheet; ✓ Excel Spreadsheet; ✓ MBI Calculations via __ e-Submittal; __ Hardcopy; ✓ Both
Samples Relinquished By: Date/Time: 5-9-17 1700 Sample Received By: Date/Time: 5-9-17 1700
Samples Relinquished By: ______ Date/Time: ______ Sample Received By: ______ Date/Time: ______
Comments/Special Instructions: ______

Sample Reference ID	Qualitative or Quantitative	Collected By	Collection Date	Sample Type	Preservative	# of Containers Per Sample	Analysis Required (KDOW Protocol, ID Level; etc.)
CR-S2	QuanT	BR/CO	4-28-17	KN	Ethanol	1	KDOW
CR-S2	Qual	↓	↓	MH	↓	↓	↓
NE-S3	QuanT			KN			
NE-S3	qual			MH			
EH-S9	Quant		5-8-17	KN	Ethanol		
$ EH-S9	Qual		5-8-17	MH	↓		
SE-S1	Quant		5-9-17	KN			
SE-S1	Qual		5-9-17	MH			
—	—	—	—	—	—	—	—

- Continue on Reverse for More Samples -

1 of 2

System Type: Headwater Stream; Wadeable Stream; Large River; Lotic; Other ______
EcoRegion: Bluegrass; Mountain; Pennyroyal; Mississippi Valley-Interior River Lowlands; Other ______
Sample Type: KN KickNet; TK Traveling Kick; MH Multihabitat; S Surber; HD Hester-Dendy Multiplate; HDD HD Deep; HDS HD Shallow; OT Other______; NA Not Available

MacLIMS: Client Setup/Login By ______ Date ______; Reported By ______ Date ______; Invoiced By ______ Date ______

Continued from Reverse Side

Sample Reference ID	Qualitative or Quantitative	Collected By	Collection Date	Sample Type	Preservative	# of Containers Per Sample	Analysis Required (KDOW Protocol, ID Level; etc.)
TB-S3	QuanT	BR/CO	5-9-17	KN	Ethanol	1	KDow Tmll
TB-S3	Qual	↓	5-9-17	MH	↓	↓	↓
WH-S0	Quant		5-8-17	KN			
WH-S0	Qual		5-8-17	MH			
WR-S1	Quant		5-9-17	KN			
WR-S1	Qual		5-9-17	MH			

2OF2

THIRD ROCK CONSULTANTS

Macroinvertebrate Sample Chain of Custody
Project Information Sheet

Client Name: Tetra Tech / LFUCG Project Administrator: Steve Evans Project Number: KY15TT_W01-5-MS4 storm wq Due Date: 3-31-17

Sampling Site Location: Cane Run County: Fayette State: KY

System Type: Headwater EcoRegion: BG Total Number of Samples: 4 Total Number of Containers: 4

Reporting Requirements: ✓ Laboratory Data Sheet; ✓ Excel Spreadsheet; ✓ MBI Calculations via ✓ e-Submittal; ✓ Hardcopy; ✓ Both

Samples Relinquished By: Date/Time: 2-24-17/0931 Sample Received By: Date/Time: 2-24-17/0931

Samples Relinquished By: ____ Date/Time: ____ Sample Received By: ____ Date/Time: ____

Comments/Special Instructions: ____

Sample Reference ID	Qualitative or Quantitative	Collected By	Collection Date	Sample Type	Preservative	# of Containers Per Sample	Analysis Required (KDOW Protocol, ID Level; etc.)
CR-4	Quant	BR/CO	2-23-17	KN	Ethanol	1	KDOW SS-300
CR-4	Qual	↓	↓	MH	↓	↓	↓
CR-8	Quant	↓	↓	KN	↓	↓	↓
CR-8	Qual	↓	↓	MH	↓	↓	↓

- Continue on Reverse for More Samples -

System Type: Headwater Stream; Wadeable Stream; Large River; Lotic; Other ____
EcoRegion: Bluegrass; Mountain; Pennyroyal; Mississippi Valley-Interior River Lowlands; Other ____
Sample Type: **KN** KickNet; **TK** Traveling Kick; **MH** Multihabitat; **S** Surber; **HD** Hester-Dendy Multiplate; **HDD** HD Deep; **HDS** HD Shallow; **OT** Other ____; **NA** Not Available

MacLIMS: Client Setup/Login By ____ Date ____; Reported By ____ Date ____; Invoiced By ____ Date ____ 5/20/10

Third Rock Consultants, LLC
Macroinvertebrate Sample Taxonomic & Enumeration Efficiency Form

Client Name: KDOW
Sample ID: Site 2 QT
Third Rock Project No.: KY16-004

Original Taxonomist: Chelsey Olson	**Second Taxonomist:** Bert Remley
Original Date Completed: 6/24/16	**Review Date Completed:** 7/28/16
Number Organisms Enumerated (*Taxonomist 1*): 281	**Number Organisms Enumerated (*Taxonomist 2*):** 290

***Percent Difference in Enumeration (PDE)* =** 1.6

$$(281 - 290) \div (281 + 290) \times 100 = \%\ \text{Difference in Enumeration (PDE)}$$

n_1 = *# organisms counted by Taxonomist 1*
n_2 = *# organisms counted by Taxonomist 2*

***Percent Taxonomic Disagreement (PTD)* =** 4.5

$$\text{PTD} = [\ 1 - (277 \div 290)]\ \text{X}\ 100$$

Comp_{pos} = *number of taxonomic agreements (see Taxonomic Comparison Form)*
N = *total number of organisms*

Comments: Passed QA/QC; discussed differences between Acerpenna and Diphetor

Third Rock Consultants, LLC
Macroinvertebrate Sample Taxonomy Precision Form

Client Name: KDOW
Sample ID: Site 2 QT
Third Rock Project No.: KY16-004

Taxon	Taxonomist 1	Taxonomist 2	# Agreements
Dubiraphia sp	1	1	1
Optioservus sp	1	1	1
Optioservus sp	1	1	1
Stenelmis sp	15	15	15
Stenelmis sp	5	6	5
Psephenus herricki	7	7	7
Cambaridae	5	5	5
Ablabesmyia mallochi	1	1	1
Microtendipes pedellus gr	1	1	1
Paratanytarsus sp	1	1	1
Polypedilum flavum	11	11	11
Rheotanytarsus exiguus gr	2	2	2
Thienemanniella xena	2	2	2
Thienemannimyia gr	7	7	7
Hemerodromia sp	1	1	1
Simulium sp	1	1	1
Baetis intercalaris	5	5	5
Diphetor sp	2	0	0
Caenis diminuta gr	22	20	20
Stenacron interpunctatum	6	8	6
Acerpenna pygmaeus	0	2	0
Pisidium sp	4	4	4
Sphaerium sp	11	12	11
Lirceus fontinalis	118	122	118
Sialis sp	1	1	1
Elimia sp	25	25	25
Helobdella stagnalis	1	2	1
Micrasema sp	1	1	1
Helicopsyche borealis	5	5	5
Cheumatopsyche sp	15	17	15
Hydroptila sp	1	1	1
Ochrotrichia sp	1	1	1
Naididae	1	1	1
Totals:	**281**	**290**	**277**

Third Rock Consultants, LLC
Macroinvertebrate Sample Sorting Efficiency Form

Client Name: KDOW
Sample ID: CR-7 QT
Third Rock Project No.: KY16-004

Original Sorter: Tammie Fister	**Resorted By:** Bert Remley
Original Date Sorted: 8/31/16	**Date Resorted:** 9/1/16
Number Grids Sorted: 12	**Number Grids Resorted:** 12
Number Organisms Originally Sorted: 298	**Number Additional Organisms Recovered:** 0

$$s_1 \div (s_2 + s_1) = \%\ \textbf{Sorting Efficiency}$$

$$298 / (0 + 298) = 100\%$$

s_1 = *# organisms originally sorted*
s_2 = *# additional organisms recovered*

Additional Organisms Recovered

Taxon	**Number**
Total:	

Comments: Passed QA/QC

Third Rock Consultants, LLC
Macroinvertebrate Sample Sorting Efficiency Form

Client Name: KDOW
Sample ID: Site 5 QT
Third Rock Project No.: KY16-004

Original Sorter: Tammie Fister	**Resorted By:** Bert Remley
Original Date Sorted: 6/28/16	**Date Resorted:** 6/29/16
Number Grids Sorted: 5 of 4 of 30	**Number Grids Resorted:** 5 of 4 of 30
Number Organisms Originally Sorted: 311	**Number Additional Organisms Recovered:** 0

$$s_1 \div (s_2 + s_1) = \%\ \textbf{Sorting Efficiency}$$

$$311 / (0 + 311) = 100\%$$

s_1 = *# organisms originally sorted*
s_2 = *# additional organisms recovered*

Additional Organisms Recovered

Taxon	**Number**
Total:	

Comments: Passed QA/QC

APPENDIX I

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

Cane Run Watershed

Comprehensive Watershed-Based Plan Combined Water Quality Monitoring and Quality Assurance Project Report

Prepared for:

Kentucky Division of Water
300 Sower Boulevard
Frankfort, KY 40601
502-564-3410

Prepared By:

Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, KY 40503
859-977-2000

December 15, 2017

Water quality monitoring was conducted at 11 sites in the Cane Run watershed monthly from June 2016 to May 2017 as a pollutant load characterization effort. General chemistries were measured *in-situ* at each site. Grab samples were collected for *E. coli*, nitrate/nitrite, ammonia, total Kjeldahl nitrogen, total phosphorus, orthophosphate, 5-day carbonaceous biochemical oxygen demand, and total suspended solids. Flow was measured at the time of collection. For microbial source tracking, 20 samples were chosen for analysis using quantitative polymerase chain reaction (qPCR) for DNA markers of general, human, and ruminant fecal contributions. Additionally, 5 more sampling events were conducted in May 2017 for *E. coli* and flow.

Water quality concentrations were compared to applicable water quality benchmarks to determine the health of the streams based on the frequency of benchmark exceedance. Existing pollutant loads for *E.coli*, ammonia, total nitrogen, and total phosphorous were calculated using the average concentrations and calculated stream flows scaled by drainage area. Load reductions were determined based on comparison to benchmark loads.

Results indicate that streams within the Cane Run Watershed are impaired for primary contact recreational use, secondary contact recreational use, and warmwater aquatic habitat use. In order to meet benchmarks, pollutant load must be reduced by the following amounts: *E.coli* by 69 trillion/year, ammonia by 10,840 lbs/year, total nitrogen by 11,100 lbs/year, and total phosphorus by 3,200 lbs/year. Because surface flow is completely diverted to the groundwater system upstream of some of the sampling sites in the headwaters of the watershed, additional load reductions may be required on streams in these locations.

The greatest pollutant load sources in the watershed were measured at the unnamed tributary to Cane Run along US-25 (Georgetown Road) and Cane Run at Citation Boulevard. Microbial source tracking identified human sources as the most dominant at both locations. The pollutant at the unnamed tributary is primarily due to 3 failing wastewater package plants located upstream, according to discharge monitoring reports. This location accounts for the majority of the *E. coli*, ammonia, nitrogen, and phosphorus reductions required. Poor sanitary sewer infrastructure in a large neighborhood, including failing private lateral lines of orangeburg and clay pipe, are indicated to be the primary source near Citation Boulevard. Significant reductions in *E. coli* due to cattle sources upstream of Cane Run near Paynes Depot Road are also necessary. Minor pollution reductions are also required at other locations in the watershed.

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I. INTRODUCTION

The Cane Run Watershed (HUC#05100205280200) is a 45.4 square mile (mi^2) watershed located within Fayette and Scott Counties, Kentucky. The stream has been listed as impaired since 1998 for Warmwater Aquatic Habitat (WAH) and Primary Contact Recreational (PCR) uses. Since that time, numerous tributaries have also been designated as impaired for causes including pathogens, nutrients / eutrophication, organic enrichment (sewage), and sedimentation/siltation.

In 2011, the University of Kentucky Biosystems and Agricultural Engineering department completed a watershed plan for the Fayette County portion of the watershed. To develop a plan that addresses the Scott County sources as well, the Kentucky Division of Water awarded a Section 319 (h) Nonpoint Source Implementation Program Cooperative Agreement to Third Rock Consultants, LLC (Third Rock) in 2016. The overall goal was to generate data sufficient to facilitate the identification and quantification of sources of recreational and aquatic habitat impairments. To that end, water quality monitoring was conducted by Third Rock in accordance with a Kentucky Division of Water (KDOW) August 8, 2016 approved quality assurance project plan (QAPP) (**Appendix A**). This report details the monitoring results, data quality, and pollutant loading for each site.

II. METHODS

In accordance with the approved QAPP, water quality monitoring was conducted by Third Rock at 11 sites (**Exhibit 1**, page 2) over the course of twelve months between June 2016 to May 2017. Monitoring was conducted with an antecedent dry period of 72 hours: 3 events during wet weather conditions (greater than 0.2 inches of rainfall) and 9 events during dry weather conditions.

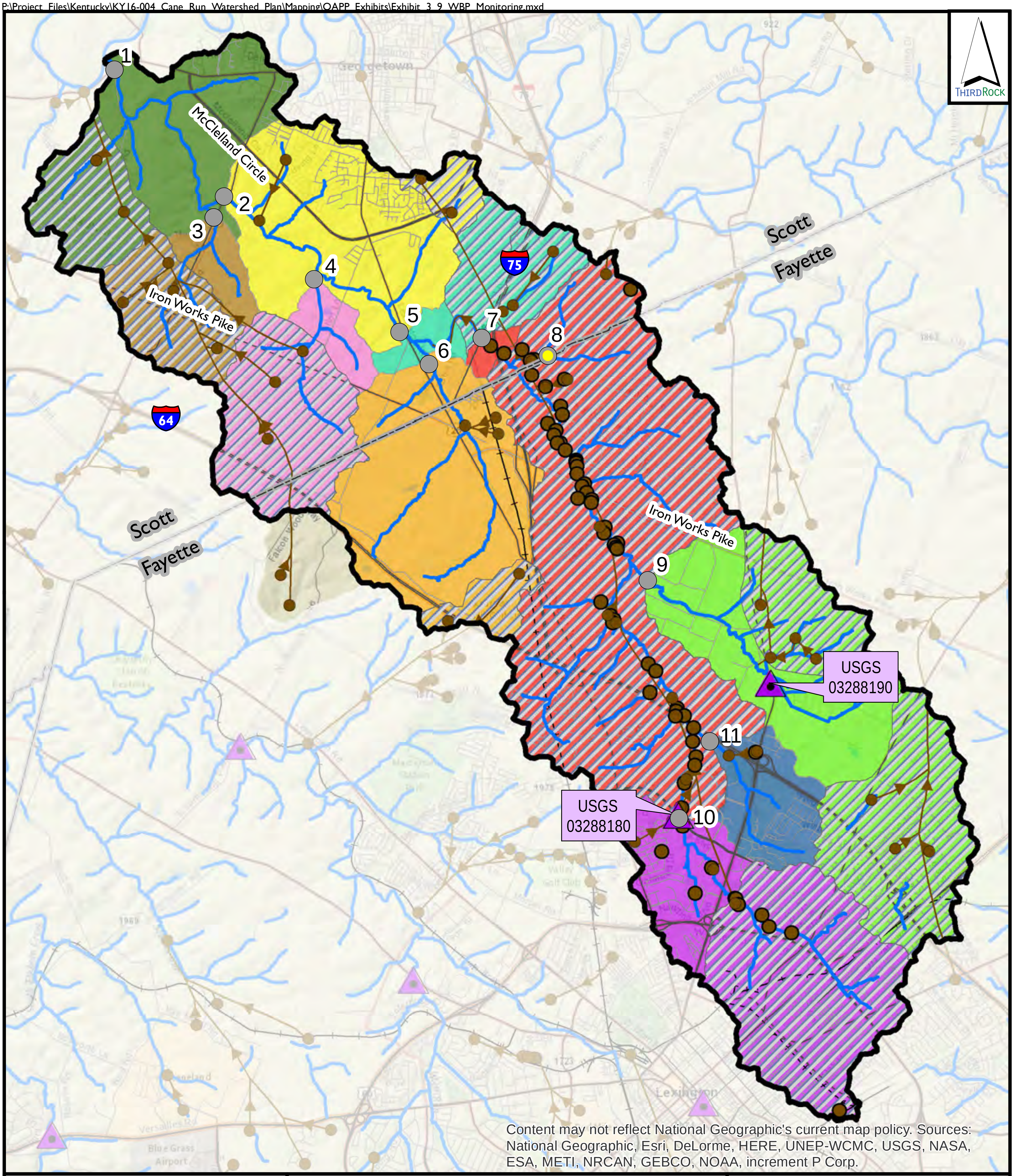
Table 1 – Water Quality Monitoring Sites

Site ID	Location	Area (mi^2)	Latitude	Longitude
1	Cane Run at US 460 Bridge	45.4	38.210260	-84.611020
2	Cane Run off SR 62	39.3	38.189400	-84.589200
3	UT to Cane Run off SR 62	2.02	38.186472	-84.591300
4	UT to Cane Run on Horse Farm off Etter Lane	3.1	38.175357	-84.571630
5	Cane Run at Landscape Alternatives nursery off US 25	31.8	38.168000	-84.554250
6	UT to Cane Run in field off of US 25	5	38.163590	-84.549770
7	Cane Run at Lisle Road	24.9	38.167065	-84.538907
8[1]	Royal Springs Cave System at Horse Park[1]	19.9	38.165237	-84.531324
9	UT to Cane Run at UK Ag Research Farm road bridge	7.4	38.128800	-84.507080
10	Cane Run at Citation Blvd	5.5	38.092322	-84.501381
11	UT to Cane at Coldstream Farm	1.3	38.103658	-84.495021

[1] Site 8 is a groundwater monitoring well site.

Field data, including turbidity, pH, dissolved oxygen (DO), specific conductance (COND), percentage oxygen saturation (DO%), and temperature (TEMP) were measured *in-situ* at each site using a Hydrolab multimeter or the equivalent. Flow was determined using an OTT MF Pro current meter with top set wading rod at intervals across the streams.

P:\Project_Files\Kentucky\KY16-004_Cane_Run_Watershed_Plan\Mapping\QAPP_Exhibits\Exhibit_3_9_WBP_Monitoring.mxd



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Cane Run Watershed
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

● Groundwater Site
● Water Quality Site
▲ USGS Gage Station
● Karst Inflow / Outflow
→ Karst Flow
— Stream
▨ Drainage to Groundwater

Exhibit 1
Monitoring Locations and Drainage Areas
2016-2017

Grab samples were collected for *E. coli*, nitrate/nitrite (NO2+NO3), ammonia (NH3), total Kjeldahl nitrogen (TKN), total phosphorus (TP), orthophosphate (OP), 5-day carbonaceous biochemical oxygen demand (CBOD5), and total suspended solids (TSS). The sample for OP was filtered in the field. Additionally, 5 more sampling events were sampled in May 2017 for *E. coli* and flow. All samples were preserved according to method specifications and transported to the Microbac Laboratories, Inc. (Microbac) for analysis within method holding times and temperature requirements.

In an effort to track microbial sources, twenty samples were chosen for analysis using quantitative polymerase chain reaction (qPCR) for DNA markers associated with general, human, and ruminant fecal contributions. In the process of qPCR, DNA associated with a specific marker is amplified (copied) and fluorescent labeling enables the collection of data to quantify the amplified DNA present as polymerase chain reaction progresses. Thus, qPCR enables the amplified DNA to be quantified in "real time". After each monthly sampling event, an aliquot from each site was filtered, placed into sterile centrifuge tubes, and frozen for storage until selected for DNA analyses.

III. BENCHMARK COMPARISIONS AND DATA QUALITY

To evaluate the nature and extent of impairments in the Cane Run Watershed, water quality results were compared to applicable water quality benchmarks. These benchmarks also allow for comparisons between previous studies and monitoring performed for this watershed based planning project. Both regulatory water quality standards and non-regulatory reference points were used as detailed below.

A. Regulatory Water Quality Standards

The regulatory statute for surface waters in Kentucky is found in 401 KAR 10:031. The statute provides minimum water quality standards for all surface waters as well as specific standards that apply to particular designated uses. Water quality standards for WAH-designated uses were utilized as benchmarks for pH, temperature, and dissolved oxygen. Standards for PCR were utilized for *E. coli* as summarized in **Table 2**. For Secondary Contact Recreation (SCR), the regulatory standard applies to fecal coliform, which was not sampled in this study. Therefore, the relationship developed between *E. coli* and fecal coliform developed by Ormsbee and Akasapu (2010) was utilized to generate an *E. coli* equivalent standard as shown in **Table 2**.

Table 2 – Regulatory Water Quality Standards

Parameter	Unit	Standard	Source	Description
pH	SU	6.0 - 9.0	WAH	Shall not be less than 6.0 SU, more than 9.0 SU, nor fluctuate more than 1.0 SU over 24 hours
Temperature	°C /°F	31.7 / 89	WAH	
Dissolved Oxygen	mg/L	4.0	WAH	Shall be above 5.0 mg/L as a 24-hour average; above 4.0 mg/L for instantaneous measurements
E. coli	MPN or CFU	130	PCR[1]	Geometric mean based on ≥ 5 samples taken 30-day period.
		240		Not to exceed in 20% or more of all samples taken during a 30-day period. If < 5 samples are taken in a month, this standard applies.
		386[2]	SCR	Geometric mean based on ≥ 5 samples taken 30-day period.
		676[2]		Not to exceed in 20% or more of all samples taken during a 30-day period. If < 5 samples are taken in a month, this standard applies.

[1] May 1 through October 31

[2] Calculated relationship derived by Ormsbee and Akasapu. 2010. Relationship Between Fecal Coliform and *E. coli* within the Kentucky River Basin. Kentucky Water Resources Research Institute. University of Kentucky. Lexington, Kentucky. *E. coli* = $1.44*FC^{0.8093}$

B. Non-Regulatory Reference Points

For other parameters, such as nutrients, specific conductance, suspended solids, or dissolved solids, no regulatory numeric standard has been established due to the variable relationship between biological integrity and concentration levels in different streams. KDOW provided recommended water quality benchmarks for the county based on reference reach data. Similar to the Wolf Run Watershed Based Plan, a phased approach is being utilized for these non-regulatory reference points.

Because of the difficulty in establishing thresholds for these pollutants independent of other variables that impact aquatic habitat, such as poor riparian and instream habitat and poor hydrology / flow regime, non-regulatory reference points are initially established higher than reference conditions since the reference levels may be well below the level necessary to restore support of designated uses. The goals should be regularly assessed through the watershed planning process and lowered if the designated use does not become fully supported through the implementation plan efforts when target levels are achieved. Non-regulatory reference points are summarized in **Table 3**, with additional supporting documentation included as **Appendix B**.

Table 3 – Non-Regulatory Reference Points

Parameter	Unit	Reference Point	Description
Specific Conductance	µS/cm	650	50%ile in Wolf Run Watershed
Total Suspended Solids	mg/L	80	Rowe, M., D. Essig, and B. Jessup. 2003. *Guide to Selection of Sediment Targets for Use in Idaho TMDLs*. IDEQ
Total Phosphorus as P	mg/L	0.35	75%ile - 90%ile for reference reaches in the Inner Bluegrass
Total Nitrogen as N	mg/L	3.0	75%ile - 90%ile for reference reaches in the Inner Bluegrass
Ammonia as N	mg/L	0.1	75%ile for the Wolf Run Watershed

For comparative purposes, the nitrogen species (nitrate, nitrite, and TKN) were compared to the total nitrogen reference. Similarly, orthophosphate was compared to the total phosphorus reference.

C. Data Quality

Acceptance criteria for accuracy, precision, bias, and sensitivity were defined in the QAPP and are summarized in **Table 4**, page 5. Field duplicates were collected or measured for *in situ* measurements, field chemistries, and water quality grab samples at 5% of sites. Laboratory duplicates were also performed and internal laboratory QC samples were analyzed. As noted in the table footnote, precision limits were established for laboratory duplicates, but no precision limits were established for field duplicates. In this report, the field duplicate precision is compared to these laboratory precision values but no data was excluded based on an exceedance of these values. **Table 4** "±" values for *in-situ* measurements represent the minimum requirements of field equipment used in this project.

Table 4 – Acceptance Criteria for Field Measurements and Laboratory Chemistry

Parameter	Units	Field / Lab Method	Accuracy (%R or ±)	Precision[1] (% RPD)	Sensitivity (Reporting Limit)
***In situ* Measurements**					
Flow	cfs	Instream	±0.05 ft/sec	N/A	0.01 ft/sec
Dissolved Oxygen	mg/L	*In situ*	±0.2	20	±0.2
% Saturation	%	*In situ*	± 1	20	±1
pH	SU	*In situ*	±0.5	20	±0.5
Specific Conductance	µS/cm	*In situ*	±1	20	±1
Temperature, Water	°F	*In situ*	±0.1	20	±0.1
Turbidity	NTU	*In situ*	±1	20	±1
Laboratory Chemistries					
Escherichia coli	MPN/ 100mL	SM 9223 B	N/A	30	1
Total Suspended Solids	mg/L	USGS 1-3765-85	85-105	10	1.5
Phosphorus, Total as P	mg/L	EPA 365.1 Rev. 2.0	90-110	10	0.05
Orthophosphate as P	mg/L	EPA 365.1 Rev. 2.0	90-110	10	0.05
Ammonia as N	mg/L	SM 4500-NH3-B&G	90-110	10	0.076* (0.25)
Nitrogen, Total Kjeldahl as N	mg/L	SM 4500-NH3-G	90-110	10	0.4
Nitrate as N	mg/L	EPA 300.0	90-110	10	0.08* (0.11)
Nitrite as N	mg/L	EPA 300.0	90-110	10	0.08* (0.15)
Biochemical Oxygen Demand, 5-Day Carbonaceous	mg/L	SM 5210 B	84-116	25	2* (5)
Molecular fecal source tracking	DNA copies	qPCR (Layton *et al,* 2006; Green *et al,* 2014; Reischer *et al*, 2006)	TBD	TBD	1000/mL

[1] Indicates minimum laboratory precision for water quality parameters
* Reporting to method detection limit, values between method detection limit and reporting limit (in parentheses) will be estimates.
TBD = To be determined

IV. QUALITY ASSURANCE

Monitoring was conducted by Third Rock staff 12 times over the course of 12 months, and an additional 5 times over the course of 30 days for *E. coli*. Eleven sites were sampled during these events if flow was present. During the first 2 events (June and July 2016), monitoring was attempted at Cane Run at the surface stream at the Horse Park and at the I-75 crossing near Equine Campus Road, but no or insufficient flow was present. In August 2016, Site 7 was moved to Lisle Road and Site 10 was moved to Citation Boulevard because karst swallets prohibited routine flow at the previous locations. Site 11 was also added at that time.

Monitoring dates and antecedent rainfall conditions are summarized in **Table 5**, page 6. The monthly monitoring events included 8 dry events, 2 wet events, and 2 intermediate events. From June 1, 2016 to May 31, 2017, measurable rain occurred on 33% of the days. On average, a rain event of greater than 0.1 inches with 3 days of dry weather occurred only 1.5 times each month during the work week, making wet weather monitoring extremely difficult to capture. Ensuring that samples could be delivered to the laboratory during business hours such that all hold times could be met further complicated the logistics of obtaining wet weather samples. In some months, waiting for wet weather to occur resulted in antecedent conditions not occurring during the time remaining in the month. However, comparison of the monitoring dates with the USGS flow duration curves indicates that the monitoring is representative of the stream's flow regime, as shown in **Table 5**. Therefore, the monitoring events are representative of the range of conditions that occur on Cane Run and its tributaries.

Table 5 – Antecedent and Concurrent Weather Conditions

Monitoring Event		Previous Rainfall			Event Rainfall	
Date	Type	Date	Amount (in)	Prior Days Dry	Amount (in)	% of Flows that Exceed Flow During Event[1]
6/27/2016	Dry	6/23	0.9	4	0	65% (Moderate Flow)
7/18/2016	Dry	7/16	0.16[2]	2	0	70% (Low Flow)
8/24/2016	Dry	8/21	0.08	3	0	71% (Low Flow)
9/08/2016	Dry	8/31	0.01	8	0	86% (Low Flow)
10/25/2016	Dry	10/21	0.18	4	0	83% (Low Flow)
11/30/2016	Intermediate	11/29	0.09	0	0.11	45% (Moderate Flow)
12/15/2016	Dry	12/12	0.17	3	0	72% (Low Flow)
1/30/2017	Dry	1/29	0.03	1	0[3]	30% (High Flow)
2/07/2017	Wet	1/30	0.01	7	0.91[4]	8% (High Flow)
3/17/2017	Intermediate	3/13	0.04	4	0.09	73% (Low Flow)
4/27/2017	Dry	4/23	0.01	4	0	68% (Low Flow)
5/02/2017	*E. coli* – Intermediate	5/1	0.98	1	0	26% (High Flow)
5/04/2017	Wet	5/1	0.98	3	0.45	28% (High Flow)
5/09/2017	*E. coli* – Dry	5/8	0.02	1	0[3]	50% (Moderate Flow)
5/16/2017	*E. coli* – Dry	5/12	0.86	4	0	49% (Moderate Flow)
5/18/2017	*E. coli* – Dry	5/12	0.86	6	0	69% (Low Flow)
5/24/2017	*E. coli* – Intermediate	5/23	0.06	1	0[3]	21% (High Flow)

Note: Based upon precipitation records at Bluegrass Airport, www.wunderground.com

[1] USGS Gage 03288180 at Citation Blvd

[2] Recorded 0.16 inches on 7/16/16, however no precipitation was measured at the northern portion of Fayette Co according to the USGS gage on Town Branch.

[3] Precipitation began after sampling completed

[4] Recorded 0.02 inches on 2/6/17, however this precipitation was part of the storm sampled on 2/7/17.

Because the events did not capture a sufficient number of representative wet weather events, the decision was made not to separate wet weather loading and dry weather loading during the analysis phase. Rather, all results were considered together to calculate an annual mean loading. The decision to consider the aggregate of all results, rather than wet and dry loads, was also affected by the degree of karst influence upon Cane Run Creek and the lack of flow between I-64 and I-75 for more than 70% of the year.

During the 30-day *E. coli* monitoring, a sanitary sewer force main was broken near Dairy Road according to the LFUCG Division of Water Quality. The sewage from this break entered the groundwater system and resulted in the city of Georgetown having to switch its water source (from Royal Springs to Frankfort water) from May 8, 2017 to May 12, 2017. Some residual flow from this break may also have occurred after this date. Thus, *E. coli* levels at Site 8 are unusually high during samples collected during this time due to this non-routine point source contribution.

A. Sensitivity

The laboratory method blanks analyzed with each parameter were all within the QAPP-established limits as shown in **Table 6**, page 8. Additionally, the equipment utilized for the field measurements met the minimum quality control requirements. Therefore, the sensitivity of the testing was sufficient for data analysis for all parameters.

Samples collected on the rainfall event on Friday, March 17, 2017 were analyzed over the weekend by Microbac personnel in order to meet hold time requirements. Because an analyst was not available to run TP and OP using EPA 365.1, the samples were analyzed using method EPA 300.0. This resulted in reporting an orthophosphate reporting limit of 0.48 mg/L, well above the QAPP requirement of 0.05 mg/L. These results were reported by the laboratory as estimates but were utilized in load calculations.

Additionally, the laboratory analyst for nitrite by EPA 300.0 performed a 5X dilution on all non-drinking water samples from November 2016 to February 2017 in order to prevent clogging of instrumentation. In order to allow for the potential reporting of orthophosphate using this method subsequent to the March 2017 event, the analyst stopped performing dilutions for project samples. The method detection limit (MDL) for samples collected from November 2017 to February 2017 was 0.38, well above the QAPP reporting limit of 0.15 mg/L. Therefore, all results below the laboratory reporting limit during that time are reported by the laboratory as estimates.

Results associated with these elevated reporting limits and MDLs for orthophosphate and nitrite were marked as estimates but used in the load calculations.

B. Precision

The laboratory precision of nutrient parameters was within the QAPP-designated acceptance range of 10% relative percent difference (RPD) for most events and samples, as shown in **Table 7**, page 9. Nitrate, nitrite, ortho-phosphorus, and total phosphorus were within the limits for the entire project. Ammonia and TKN exceeded the QAPP precision limits for 2 events and 4 events, respectively. In each of these cases, the precision was measured from a matrix spike duplicate, so some of the variability may be due to laboratory spike preparation. However, the field duplicates associated with some of these events also showed high RPD. Lab results greater than the reporting limit are qualified as estimated for these parameters for these events. However, the results were used in loading estimates.

Table 6 - Laboratory Sensitivity

Parameter	QAPP Range	6/27	7/18	8/24	9/8	10/25	11/30	12/15	1/30	2/7	3/17	4/27	5/2	5/4	5/9	5/16	5/18	5/24
E. coli	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CBOD	<5 (2 MDL)	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	▨	<2.0	▨	▨	▨	▨
Ammonia	<0.25 (0.076 MDL)	<0.14	<0.14	<0.14	<0.14	<0.14	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	▨	<0.22	▨	▨	▨	▨
Nitrate	<0.11 (0.08 MDL)	<0.027	<0.027	<0.027	<0.025	<0.025	0.035	<0.025	<0.008	0.030	0.030	<0.005	▨	0.027	▨	▨	▨	▨
Nitrite	<0.15 (0.08 MDL)	<0.025	<0.025	0.036	<0.018	<0.025	<0.025	<0.075	<0.075	<0.075	<0.007	0.031	▨	0.034	▨	▨	▨	▨
TKN	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	▨	<0.40	▨	▨	▨	▨
Ortho-phosphorus	<0.05	<0.025	<0.025	<0.035	0.015	<0.011	0.017	0.011	0.013	0.017	<0.010	<0.017	▨	<0.017	▨	▨	▨	▨
Total Phosphorus	<0.05	0.012	0.006	<0.046	0.012	0.0210	0.046	<0.012	<0.012	<0.012	<0.010	<0.010	▨	<0.010	▨	▨	▨	▨
TSS	<1.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	▨	<1	▨	▨	▨	▨

Note: Grayed dates were collected for *E. coli* only.

Table 7 - Laboratory Precision

Parameter	QAPP RPD	6/27	7/18	8/24	9/8	10/25	11/30	12/15	1/30	2/7	3/17	4/27	5/4
Ammonia	10%	1%	15%	9%	11%	6%	8%	N/A	0%	6%	0%	10%	0%
Nitrate	10%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Nitrite	10%	0%	1%	2%	3%	2%	0%	1%	3%	4%	0%	0%	1%
TKN	10%	3%	3%	11%	11%	0%	4%	11%	19%	0%	8%	3%	4%
Ortho-phosphorus	10%	1%	1%	1%	1%	1%	2%	2%	0%	1%	1%	0%	1%
Total Phosphorus	10%	1%	2%	1%	1%	4%	1%	1%	1%	1%	2%	3%	0%

Note: Yellow shading indicates exceedance of QAPP requirement.

Table 8, page 10 shows the RPD of field replicates and field duplicates as compared to the QAPP limits. For *E. coli*, the log difference in the results is shown. All field replicates were within the precision requirements of the QAPP. For field duplicates, precision requirements were not established in the QAPP, but the laboratory precision requirements were used for comparison.

E. coli, nitrite, ammonia, TKN, total phosphorus, and total suspended solids each had 1 or more results where the field duplicate precision exceeded the laboratory precision limit. An average of the field duplicate and sample results was utilized for all loading calculations. For *E. coli* on August 24, the results for the duplicate were 2420 and 240 MPN/100mLs. The laboratory confirmed this was recorded on the data sheet, but it is believed that 1 of the results represents a typographical error (The average was used in analyses). Total phosphorus and total suspended solids were both elevated on June 27 due to field variability in the turbidity at the sampling location. The elevated nitrite result on September 8 was unusual for the event as all nitrite results were less than the detection limit for the site with the exception of the sample where the field duplicate was measured. As was previously mentioned, the field precision results for ammonia and TKN correspond to similar indicators of poor laboratory precision.

C. Accuracy

Percent recovery results for laboratory control samples are summarized in **Table 9**, page 11, along with the corresponding QAPP recovery range. All results were within the acceptable range with the exception of ammonia on September 8 and March 17. On both dates, most samples were below the detection limit for most sites except for Site 6. Results on these dates were qualified due to the low bias indicated by the results.

Table 8 - Field Precision

Parameter	QAPP Requirement	6/27	7/18	8/24	9/8	10/25	11/30	12/15	1/30	2/7	3/17	4/27	5/2	5/4	5/9	5/16	5/18	5/24
Flow	N/A	0%	0%	12%	0%	18%	25%	0%	27%	10%	11%	8%	112%		40%	31%		0%
SpC	20% RPD	0%	0%	1%	0%	0%	1%	1%	0%	0%	N/A	0%						
Dissolved Oxygen	20% RPD	4%	1%	0%	1%	0%	2%	1%	1%	1%	1%	1%						
pH	20% RPD	1%	0%	0%	1%	1%	1%	0%	3%	0%	0%	2%						
Temperature	20% RPD	1%	1%	0%	0%	0%	0%	1%	0%	0%	1%	1%						
Turbidity	20% RPD	0%	10%	N/A	N/A	0%	8%	0%	1%	0%	0%	0%						
E. Coli	Log Difference	0.45	0.02	1.00	0.09	0.04	0.00	0.28	0.10	0.14	0.02	0.00	0.39	0.19	0.21	0.04	0.12	0.00
CBOD	25% RPD Lab	4%	0%	0%	0%	0%	46%	0%	24%	0%	9%	14%		12%				
Ammonia	10% RPD Lab	7%	28%	24%	7%	0%	0%	0%	0%	0%	0%	0%		31%				
Nitrate	10% RPD Lab	12%	4%	0%	0%	0%	3%	10%	0%	0%	0%	2%		5%				
Nitrite	10% RPD Lab	0%	0%	0%	64%	0%	0%	0%	0%	0%	0%	0%		0%				
TKN	10% RPD Lab	29%	7%	32%	2%	0%	12%	0%	48%	0%	0%	0%		17%				
Ortho-phosphorus	10% RPD Lab	0%	0%	5%	2%	3%	0%	0%	0%	0%	0%	4%		3%				
Total Phosphorus	10% RPD Lab	30%	6%	0%	0%	3%	13%	3%	0%	5%	5%	4%		2%				
TSS	10% RPD Lab	67%	17%	29%	0%	100%	0%	15%	0%	0%	67%	40%		0%				

Note: Yellow shading indicates exceedance of QAPP-specified laboratory precision limit.
Blue shading indicates results above the QAPP-specified laboratory precision limit, but the actual differences in the results were minimal due to low concentrations.

Table 9 - Laboratory Accuracy

Parameter	**QAPP Range**	**6/27**	**7/18**	**8/24**	**9/8**	**10/25**	**11/30**	**12/15**	**1/30**	**2/7**	**3/17**	**4/27**	**5/4**
CBOD	84-116%	100%	105%	99%	106%	90%	98%	91%	103%	103%	89%	99%	94%
Ammonia	90-110%	93%	98%	94%	89%	94%	96%	98%	94%	92%	88%	90%	91%
Nitrate	90-110%	104%	99%	98%	92%	96%	92%	92%	105%	102%	97%	100%	97%
Nitrite	90-110%	102%	101%	105%	105%	103%	98%	92%	92%	97%	100%	98%	99%
TKN	90-110%	90%	91%	95%	94%	99%	96%	97%	109%	101%	92%	92%	102%
Ortho-phosphorus	90-110%	108%	109%	103%	104%	102%	100%	100%	98%	100%	103%	100%	100%
Total Phosphorus	90-110%	108%	104%	112%	108%	101%	106%	102%	100%	96%	103%	101%	100%
TSS	85-105%	97%	87%	93%	93%	92%	85%	91%	96%	98%	92%	95%	98%

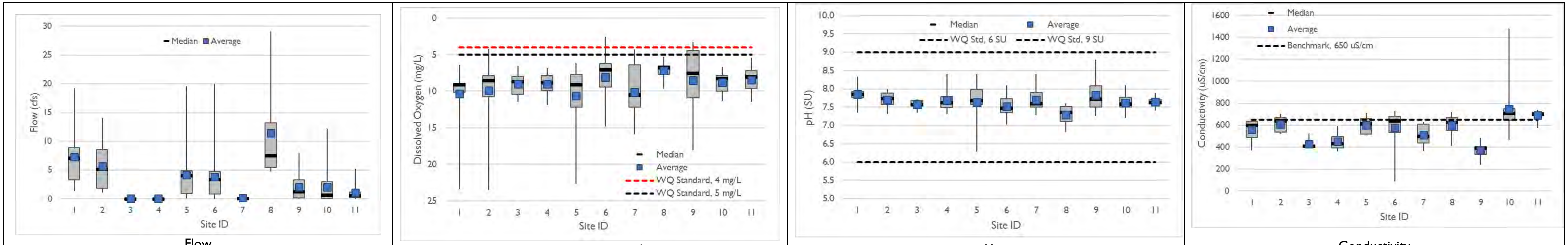
Note: Yellow shading indicates exceedance of QAPP requirement.

V. FINDINGS AND CONCLUSIONS

A. Results by Parameter

Monitoring results are summarized in the box plot charts in **Figure 1**, page 12. Results for each sampling event and site are summarized in **Appendix C,** along with the following supporting documentation for each event and site: laboratory reports, chains of custody, field calibration logs, and field notes.

Figure 1 – Results by Parameter

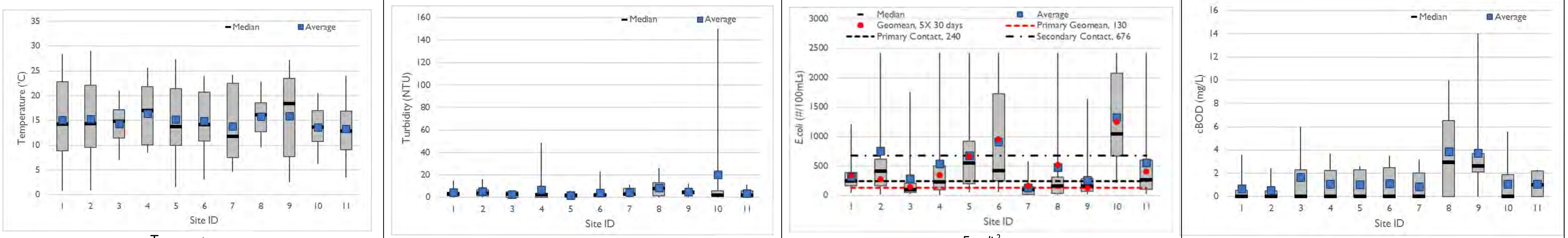


Flow

Dissolved Oxygen[1]

pH

Conductivity

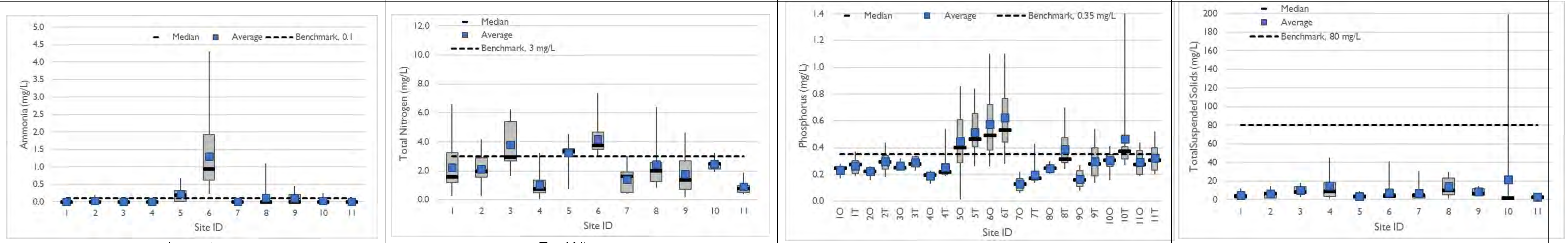


Temperature

Turbidity

E. coli[2]

Biochemical Oxygen Demand



Ammonia

Total Nitrogen

Total (T) and Ortho (O)-Phosphorus

Total Suspended Solids

[1] For dissolved oxygen, the red line represents the instantaneous standard while the black line shows the 24-hour average standard. The vertical axis is flipped since low concentrations are considered exceedances.

[2] For *E. coli*, the red line represents the 30-day geomean standard (130), and the short black dotted line the instantaneous primary contact standard (240). The longer dotted line represents the *E. coli* equivalent of the fecal coliform standard for secondary contact based on Ormsbee and Akasapu. 2010.

1. Flow

All sites had flowing water if sampling occurred at the location. However, flow was at times immeasurable using the current meter and top setting wading rod. When flow could not be measured with monitoring equipment, moving water was confirmed by disturbing sediment downstream of the sampling site and observing the turbid water moving downstream. Flow at these sites was recorded as less than 0.01 cubic feet per second (cfs).

On March 17, the current meter battery died during the sampling event. Therefore, flow was not measured at Sites 4, 5, or 6 during the event. To correct for this omission, flow was estimated at Sites 4, 5, and 6 based on flow ratios to Site 1, located downstream, for other sampling events.

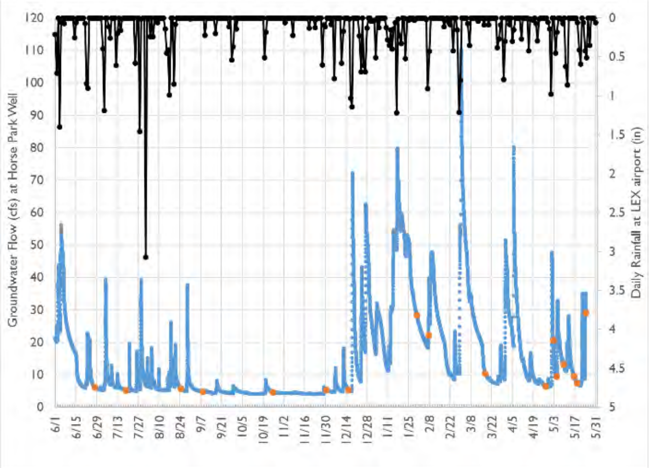
Flow was monitored continuously at 3 sites during the sampling period. Hydrographs and flow duration curves for these sites are shown in Figure 2 alongside rainfall data measured at the Bluegrass Airport. Flow at the groundwater well at Site 8 was calculated using the following equation developed by Kentucky Geological Survey (KGS) and based on previous research by KGS at the well:

$$Q = 0.327 \times (D-0.56), \text{ where } Q = \text{discharge } (m^3/s) \text{ and } D = \text{depth } (m).$$

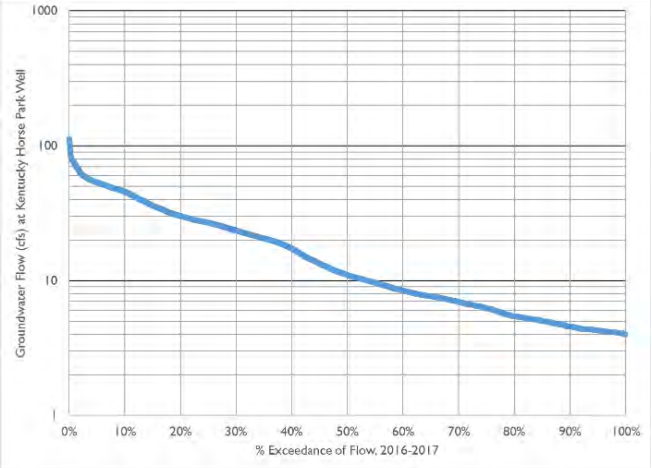
The depth of water in the well at Site 8 ranged from 1.6 feet to 32.4 feet during the monitoring period, with a calculated discharge ranging from 4.0 cfs to 112 cfs, as shown in Figure 2. The groundwater well routinely had the highest flow levels measured in the watershed, particularly under dry weather conditions. Even when surface streams did not have flow, significant flow was found in the groundwater system.

The USGS gage flows for the sampling period are also shown in **Figure 2**, page 14. The dates and times in which flow monitoring was conducted are shown in order to show the representativeness of the sampling events. Comparison of the entire monitoring record for these USGS sites indicates that flows in 2016-2017 were slightly lower than the typical year.

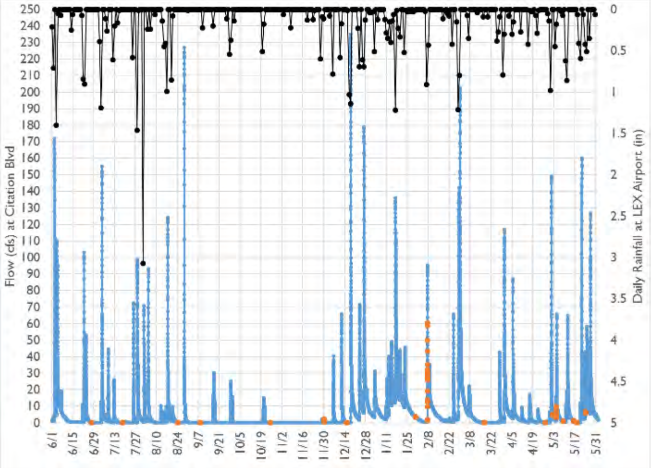
Figure 2 - Flow at Continuous Monitoring Stations During Sampling Period



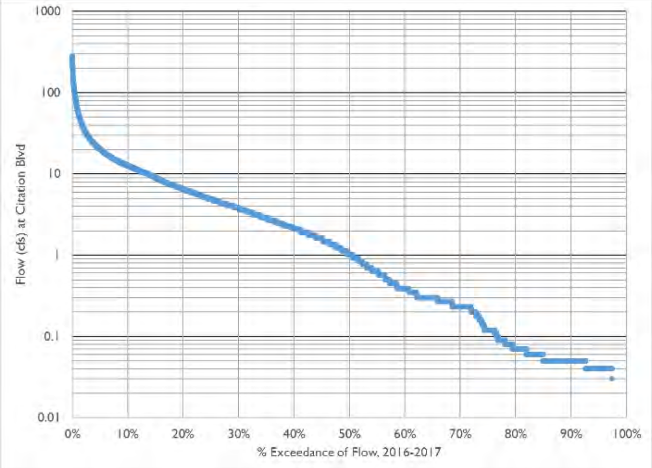
Site 8, Groundwater Well at Horse Park
Hydrograph for Sampling Period



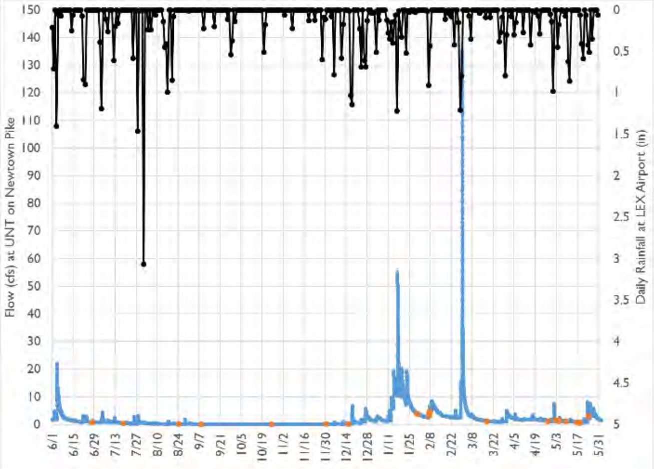
Site 8, Groundwater Well at Horse Park
Flow Duration Curve for Sampling Period



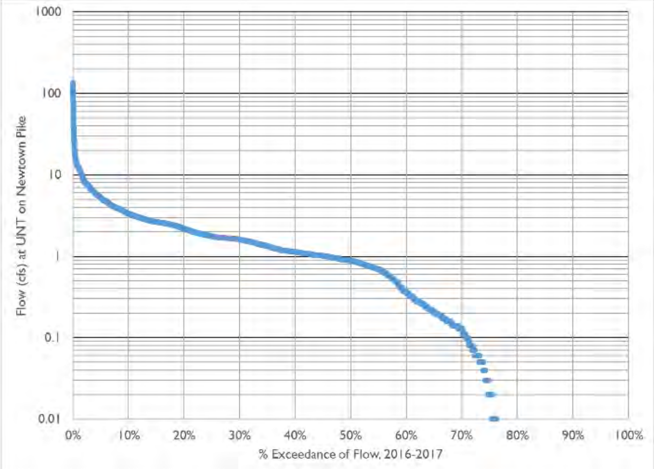
Site 10, Cane Run at Citation Blvd
Hydrograph for Sampling Period



Site 10, Cane Run at Citation Blvd
Flow Duration Curve for Sampling Period



USGS Gage on UNT at Newtown Pike
(Upstream of Site 9)
Hydrograph for Sampling Period



USGS Gage on UNT at Newtown Pike
(Upstream of Site 9)
Flow Duration Curve for Sampling Period

2. *In-Situ Measurements*

Dissolved oxygen measurements were above the WAH instantaneous requirement of 4.0 mg/L for all sampling events at all sites, except for Site 6, located on the tributary along US 25, and Site 9, located on a University of Kentucky research farm. Site 6 had low dissolved oxygen levels on July 18, which was also the date of the lowest flow conditions measured at the site. These low flow conditions paired with high ammonia, nitrogen, and phosphorus concentrations and the presence of algae downstream indicate that aquatic life may be impacted based on pollutant concentrations at this site. It is expected that continuous dissolved oxygen monitoring at Site 6 would detect additional impacts. At Site 9, dissolved oxygen levels were less than 4.0 mg/L on July 18 and August 24, 2016. The site is located just downstream of an impoundment and the low levels are likely due to that reason.

Measured pH levels ranged from 6.3 to 8.8 SU during the monitoring period, all within the regulatory criteria. The average of all sites was 7.6 SU, indicating slightly basic stream conditions typical of limestone geology.

Specific conductance, or conductivity, levels ranged from 88 to 1480 µS/cm. Sites 1, 3, 4, 7, and 9 never exceeded 650 µS/cm. Sites 2, 5, 6, and 8 each regularly exceeded the benchmark, but average conditions were below the 650 µS/cm level. Conductivity at Sites 10 and 11 averaged 751 and 691 µS/cm for the monitoring period, respectively. These higher values could be related to runoff from impervious surfaces in the urban environment carrying road salts and other dissolved ions into waterways. During the wet weather event on February 7, the highest conductivity was measured at Site 10 – almost double the next highest concentration. This rainfall event was the first significant rainfall event after snow accumulation and road salt application from January 27 to January 30.

Temperature results were within the acceptance ranges during all measurements.

Turbidity measurements were typically less than 5 NTU at all sites. The groundwater well regularly had the most turbid waters with a median turbidity of 8 NTU. This indicates that the groundwater system is regularly transporting low levels of surface sediment through the conduit. During wet weather events, the most turbid waters were found at Site 10 at Citation Boulevard, reaching as high as 150 NTU.

3. *E. coli*

E. coli results ranged from 3 to >2,420 MPN/100mLs. Because of budget constraints, the laboratory did not analyze sample dilutions except during the July 18, 2017 event. Because the laboratory maximum is 2,420 MPN/100mLs, some of the results are biased low. One site exceeded 2,420 on July 18, but a value of >2,420 was utilized in calculations for data comparability. Results of >2,420 MPN/100mLs were obtained at the following at the following sites: 2 (2 times), 4 (2 times), 6 (3 times), 8 (1 time), 10 (3 times), and 11 (2 times). To account for this low bias, the average of the results for each site was utilized for loading calculations rather than a geometric mean for all sampling events.

Results indicate that most locations exceeded the PCR use levels, and several sites showed impairment for SCR use, including Sites 2, 3, 4, and 5 due to highly elevated *E. coli* concentrations. **Table 10**, page 16, summarizes the geomean of the 6 samples collected in May 2017 (monthly event + 5 additional events) along with the exceedances of PCR and SCR use levels for those 6 samples. For PCR, when the PCR limit was exceeded, it was exceeded both for the 30-day geomean standard and the percent of exceedances standard. This was the case for all sites except site 9. The PCR levels were exceeded at site 8, but not applicable since this is a groundwater monitoring location. The SCR levels were exceeded to a lesser degree. For SCR, both the 30-day geomean and the percent of exceedances standards were over thresholds at 3 sites (Sites 5, 6, and 10). For SCR, the 30-day geomean was not exceeded at site 4, though the site is indicated as impaired for SCR based on the percent of exceedances. Likewise, the 30-day geomean limit for SCR was exceeded at site 11, though the site is not indicated as impaired for SCR based on the percent of exceedances.

As previously discussed, a sanitary sewer force main broke near Dairy Road, elevating the *E. coli* levels at Site 8 during the geomean sampling in May. Sources of *E. coli* will be discussed in the microbial source tracking section, below.

Table 10 - *E. coli* Geomean Concentrations and Exceedances for 6 Events in May 2017

Site ID	Compared to PCR Use Levels			Compared to SCR Use Levels		
	Geomean	Count of Exceedances	Percent of Exceedances	Geomean	Count of Exceedances	Percent of Exceedances
1	341	4	67%	341	1	17%
2	277	4	67%	277	0	0%
3	143	2	33%	143	1	17%
4	343	3	50%	343	2	33%
5	668	5	83%	668	3	50%
6	956	5	83%	956	4	67%
7	165	2	33%	165	0	0%
8	520	3	50%	520	3	50%
9	126	1	17%	126	0	0%
10	1248	6	100%	1,248	5	83%
11	405	4	67%	405	1	17%

Note: Yellow shading indicates exceedance of PCR use levels. Blue shading indicates exceedance of SCR use levels. Grey shading indicates that PCR and SCR uses are not applicable for groundwater.

4. *Nitrogen*

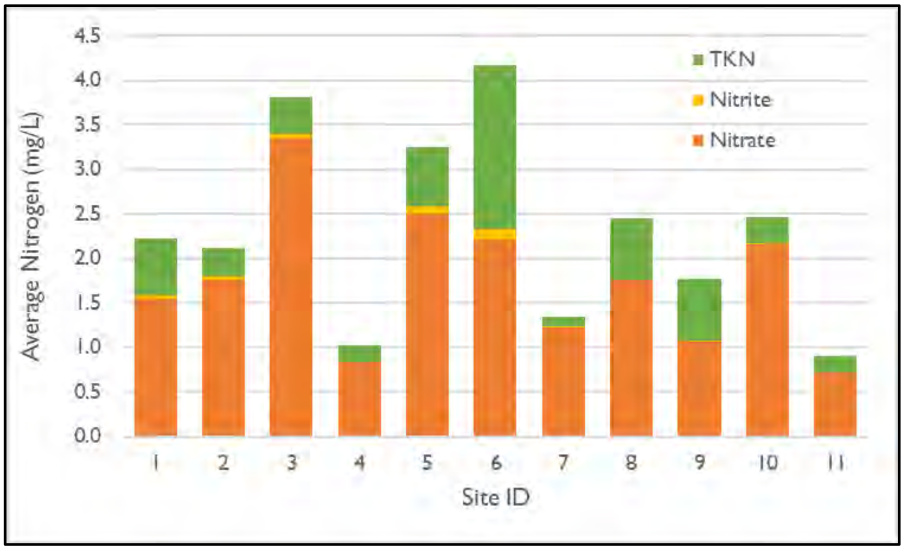
Nitrogen species including ammonia, nitrate, nitrite, and TKN were measured (as N) for this project. Total nitrogen is the sum of nitrate, nitrite, and TKN concentrations. In calculating total nitrogen, "less than" results were assigned a value of 0.

Ammonia, a form of TKN, ranged from <0.14 to 4.30 mg/L. By far the highest concentrations were measured at Site 6, which averaged 1.31 mg/L. No other site averaged concentrations above 0.2 mg/L, except Site 5 (0.22 mg/L) which is located just downstream of Site 6. Ammonia was not detected at Sites 1, 3, 4, 7, and 11 during the sampling.

As shown in **Figure 3**, total nitrogen was typically composed of about 70-80% nitrate, 20-30% TKN, and a miniscule portion of nitrite. Site 6, in particular, but also Site 9, had large contributions from organic nitrogen (TKN and ammonia).

Nitrate concentrations ranged from <0.025 mg/L to 5.70 mg/L. The seasonal contributions of nitrogen were evident in the dataset with higher concentrations at all sites in January to March 2017, with January 30, having the highest concentrations at all sites. Although flow was often not present at Site 3, concentrations of nitrate were highest at this location when flow did occur. Sites 5, 6, and 10 also had routinely high nitrate concentrations. Taken together, total nitrogen concentrations were routinely above the 3.0 mg/L benchmark at Sites 3, 5, and 6. Sites 4, 7, and 11 were regularly below 2.0 mg/L.

Figure 3 - Average Nitrogen Species by Site



5. *Phosphorus*

Total phosphorus and ortho-phosphorus (as P) were analyzed for each sampling location. Ortho-phosphorus is the dissolved form of phosphorus that may be directly uptaken by plants. Total phosphorus includes particulate-bound phosphorus and other forms of phosphorus. With the phosphorus-rich limestone in Central Kentucky, phosphorus levels are normally much higher than surrounding regions. As shown in **Figure 1**, most of the measured phosphorus (around 80% on average) is ortho-phosphorus. Ortho-phosphorus concentrations ranged from 0.014 to 1.10 mg/L, while total phosphorus ranged from 0.0051 to 1.4 mg/L.

Sites 6 and 5 routinely had the highest concentrations of total phosphorus in the watershed, with averages above 0.5 mg/L. Average total phosphorus concentrations at Sites 8 and 10 also exceeded the 0.35 mg/L benchmark. Site 9 had a much lesser percentage of ortho-phosphorus than other sites, and Sites 8 and 10 also showed a large gap between the 2 forms.

6. *Suspended Solids*

Because most sampling was conducted during dry weather, total suspended solids were low at all sites during most measurements. Site 10 showed a large concentration (199 mg/L) associated with the February 7 wet weather event. However, all other total suspended solids results were below 50 mg/L. While this data is helpful in analyzing the sources of some of the other pollutants, this dataset does not provide sufficient information to evaluate sedimentation issues in the watershed. The severe erosion survey provides better focus areas for sediment issues.

B. Water Quality Health Grades

To simplify water quality data for public audiences, the percentage of exceedance (for concentration data) of the benchmarks was utilized to generate water quality health scores. These health scores, like report cards, assign letter grades to the frequency of exceedance at each site. Each parameter is "graded on a curve" such that letter scores for 1 parameter are similar to letter scores for other parameters. Letter grades for individual parameters are roughly based on KDOW's method for evaluating data for listing impairments or their TMDL Health Reports. The percent exceedance and the corresponding grade for each parameter are shown in **Table 11** and graphically depicted on **Exhibits 2** through **7** (included later in this report). The water quality health scores for this project are summarized in **Table 12**, page 19. The pH scores are not shown because all sites were within range (A grade).

Table 11 – Water Quality Health Grades

		% of Results Exceeding				
Parameter	**Benchmark**	**A**	**B**	**C**	**D**	**F**
E. coli – Primary Contact (Swimming)	240	0-10%	11-20%	21-33%	34-66%	67-100%
E. coli – Secondary Contact (Wading)	676	0-10%	11-20%	21-33%	34-66%	67-100%
pH	6-9	0-5%	6-10%	11-25%	26-66%	67-100%
Dissolved Oxygen	4	0-5%	6-10%	11-25%	26-66%	67-100%
Specific Conductance	650	0-10%	11-25%	25-50%	51-66%	67-100%
Total Phosphorus	0.35	0-10%	11-25%	25-50%	51-66%	67-100%
Total Nitrogen	3.0	0-10%	11-25%	25-50%	51-66%	67-100%
Ammonia	0.1	0-10%	11-25%	25-50%	51-66%	67-100%

Table 12 – Water Quality Health Scores

Site ID	Sample Count (*E.coli* Count)	*E. coli* (#/mLs)			Dissolved Oxygen (mg/L)		Conductivity (uS/cm)		Ammonia (mg/L)		Nitrogen (mg/L)		Phosphorus (mg/L)	
		🏊 Grade	🎣 Grade	Avg	🐟 Grade	Avg	🐟 Grade	Avg	🐟 Grade	Avg	🐟 Grade	Avg	🐟 Grade	Avg
1	12 (17)	D	B	317	A	10.3	A	558	A	0.00	C	2.23	B	0.27
2	12 (17)	F	C	753	A	9.9	C	611	B	0.03	B	2.12	B	0.30
3	5 (10)	B	A	282	A	9.0	A	427	A	0.00	C	4.06	A	0.29
4	10 (15)	D	B	537	A	9.0	A	449	A	0.00	A	1.02	A	0.25
5	12 (17)	D	C	678	A	10.6	C	598	D	0.22	F	3.25	F	0.51
6	12 (17)	F	D	907	B	8.1	C	577	F	1.31	F	4.18	F	0.63
7	9 (14)	B	A	130	A	10.1	A	512	A	0.00	B	1.51	B	0.20
8	12 (17)	D	B	475	A	7.2	C	545	B	0.12	B	2.45	C	0.39
9	10 (15)	C	A	261	C	8.5	A	371	C	0.11	B	1.79	C	0.30
10	10 (15)	F	F	1327	A	8.8	D	751	A	0.03	B	2.47	D	0.46
11	10 (15)	D	B	551	A	8.5	F	691	A	0.00	A	0.91	C	0.33

C. Microbial Source Tracking

For microbial source tracking, University of Kentucky Environmental Research Training Laboratories (ERTL) analyzed samples using qPCR for Bacteroides DNA markers of fecal contributions, including general (Allbac), human (qHF183), and ruminant (Bac R), which includes horses, cattle, deer, and other ruminants. The human marker is considered conservative- meaning if detected, human source is present, but if not detected, it is not necessarily absent. The ruminant marker is less conservative – meaning it is a less certain indication of fecal contamination from ruminant animal sources when it is detected (other species can create a false positive signal for this marker). A laboratory control (SKETA) was also analyzed to measure if polymerase chain reaction was inhibited by humic acid or other environmental inhibitors. Inhibitors are any factors which prevent the amplification of DNA through polymerase chain reaction; inhibitors cause amplification failure even when sufficient copies of DNA are present.

Filters from 19 samples with the highest *E. coli* concentrations were selected for analysis as well as control samples. The human control was collected from the Town Branch wastewater treatment plant (TB WWTP) influent, and the ruminant control was a fecal slurry composite from multiple cowpats at the Blue Grass Stockyards South in Stanford, Kentucky.

The results of the analysis are presented in **Table 13**, page 20, alongside the *E. coli* and ammonia concentrations measured at these sites. Overall, low levels of Bacteroides were recovered at the sites, often due to inhibition of the polymerase chain reaction due to environmental conditions, such as the presence of humic acid. Allbac recovery from all field samples was less than 1% of known samples. Two samples, Site 5 from August 24 and Site 8 from November 30, were completely inhibited, indicating polymerase chain reaction could not be performed on the samples (thus qPCR was not possible). With the low recovery of the Allbac marker in the field samples, the detection of markers for human or ruminant sources indicates that these sources are dominant for those sampling locations.

Table 13 - Microbial Source Tracking Results

Site ID	Sample Date	*E. coli* (MPN/ 100mL)	Ammonia (mg/L)	General Allbac (copies/uL)	Human qHF183 (copies/uL)	Ruminant Bac R (copies/uL)	Polymerase Chain Reaction Inhibition? (SKETA control)	Dominant Fecal Source
2	6/27/16	>2420	0.17	165.7	ND	<10	Y	Cattle livestock
	7/18/16	>2420	0.18	517.2	ND	14.6	Y	
	8/24/16	2420	<0.14	<10	ND	<10	Y	
	9/8/16	1553	<0.14	375.3	ND	10.6	N	
4	6/27/16	2420	<0.14	52.5	ND	ND	Y	Unknown
5	8/24/16	2420	0.33	ND	ND	ND	Y - Total	Human sewage
	2/7/17	2420	0.41	157.3	<10	ND	N	
6	6/27/16	>2420	1.9	84.9	ND	ND	N	Human sewage
	10/25/16	>2420	2.00	<10	ND	ND	Y	
	12/15/16	816	0.65	555.4	<10	ND	Y	
8	11/30/16	816	<0.22	ND	ND	ND	Y - Total	Unknown
9	6/27/16	>2420	0.27	91.9	ND	ND	N	Unknown
10	10/25/16	1373	<0.14	26.5	ND	ND	Y	Human sewage
	11/30/16	2420	<0.22	10.3	<10	ND	Y	
	12/15/16	1733	<0.22	234.8	<10	ND	Y	
	1/30/17	1046	<0.22	321	<10	ND	N	
	2/7/17	>2420	0.25	<10	ND	ND	Y	
11	11/30/16	686.7	<0.22	25.4	ND	ND	N	Unknown
	2/7/17	>2420	<0.22	34.9	ND	ND	N	
Human Control: TB WWTP Influent				63,038.70	3,530.00	ND	N	Human sewage
Cattle control: Stockyard Cowpat Slurry				130,444.10	ND	4,505.90	N	Cattle livestock

Note: ND = Not Detected

Because of low recoveries and method inhibition, the source of loading at Sites 4, 8, 9, and 11 is unknown. However, microbial source tracking indicates that cattle sources are the dominant source of fecal pathogen indicators at Site 2 and human sewage are the dominant source at Sites 5, 6, and 10. Because Sites 2, 6, and 10 had the highest *E. coli* concentrations overall, the identification of the sources at these sites will ensure watershed implementation efforts are effective.

D. Pollutant Loads

Pollutant loads are calculated by multiplying the concentration by the flow and a unit conversion factor. However, judgment must be used to determine how to aggregate the concentration data and what flow to utilize to best represent the annual conditions.

For this project, all concentration data was aggregated together as an average for each site because insufficient data was collected to separate loads from wet and dry weather sources with any statistical confidence. Comparison with the USGS gages located in the watershed showed that the sampling events represented all flow levels with some bias toward lower flows. Therefore, the median annual flow was chosen to compute loading.

Because wet weather flow measurements are highly dependent upon when the samplers arrive at the sampling site, comparisons of measured wet weather flows in storm events are not reliable for load calculations. Therefore, the median flows from USGS gauging stations within the watershed were scaled to represent the median annual flow at each site.

For Site 8, the groundwater well at the Kentucky Horse Park, a water depth data logger installed by KGS was utilized to estimate the flow of groundwater being transported from Fayette County sources to Royal Springs. For Site 10 on Cane Run at Citation Boulevard, the USGS gage located at the sampling site (03288180) was utilized. The flow at this location is primarily fed from a spring-fed tributary downstream of a large neighborhood, and is not representative of non-spring fed streams. The median flow at Site 8 is 11.0 cfs and at Site 10 is 1.6 cfs for the entire data record.

For all other sites, the USGS gage (03288190) located on a tributary to Cane Run at Newtown Pike upstream of Site 9 was scaled in order to estimate the median annual flow. Site 9 has a drainage area of 1.5 mi^2 and is located in an area of the watershed in which few karst sinks have been mapped, and therefore most drainage in the watershed is through surface flow. The median flow at this site was 1.4 cfs for the entire data record.

Historic data indicates that because of the heavy interaction between surface and groundwater, strict area-weighted scaling of the USGS gages would not produce accurate flow measurements for other monitoring stations. From 1997 to 2012, a USGS gage located at Berea Road indicated that flow was only present on Cane Run Creek between I-75 in Scott County and I-64 / I-75 in Fayette County during 28% of the year. This indicates that surface flow is completely diverted to the groundwater system during most of the year in areas with well-developed karst windows and sink points. Therefore, drainage areas of each monitoring site were adjusted based on previously mapped sink points to determine the land area typically contributing to routine stream flows. **Exhibit 1** and **Table 14** show the adjusted drainage area of each sampling location.

Table 14 - Karst Adjusted Drainage Areas and Estimated Flows

Site ID	Location	Surface Drainage Area (mi^2)	Karst-Adjusted Drainage Area (mi^2)	Average Measured Flow (cfs)	Estimated Median Flow[1] (cfs)
1	Cane Run at US 460 Bridge	45.4	13.0	7.28	12.4
2	Cane Run off SR 62	39.3	10.3	5.67	9.9
3	UT to Cane Run off SR 62	2.02	0.56	0.07	0.5[2]
4	UT to Cane Run on Horse Farm off Etter Lane	3.1	0.52	0.08	0.5[2]
5	Cane Run at Landscape Alternatives nursery off US 25	31.8	5.8	4.21	5.6

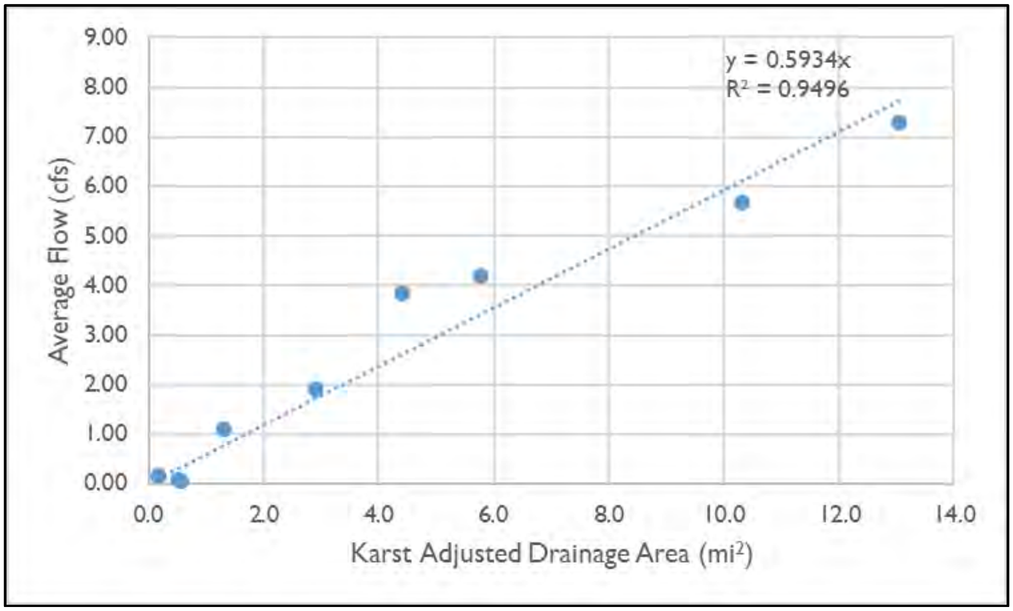
Table 14 - Karst Adjusted Drainage Areas and Estimated Flows *Continued*

Site ID	Location	Surface Drainage Area (mi^2)	Karst-Adjusted Drainage Area (mi^2)	Average Measured Flow (cfs)	Estimated Median Flow[1] (cfs)
6	UT to Cane Run in field off US 25	5	4.4	3.86	4.4
7	Cane Run at Lisle Road	24.9	0.17	0.16	0.2
8	Royal Springs Cave System at Horse Park1	19.9	19.9	11.47	11.0[3]
9	UT to Cane Run at UK Ag Research Farm road bridge	7.4	2.9	1.91	2.7
10	Cane Run at Citation Blvd	5.5	1.5	2.20	1.6[4]
11	UT to Cane at Coldstream Farm	1.3	1.3	1.12	1.2

[1] Flows are estimated based on scaling the median flow of the data record (1.4 cfs) of the USGS gage at Newtown Pike (03288190) based on the karst adjusted drainage area of each site unless otherwise indicated.
[2] Measured flows at Sites 3 and 4 are biased low due to flow being observed but not measurable during several sampling events.
[3] Median calculated flow of at KGS data logger installed at the monitoring location.
[4] Median flow of USGS gage Cane Run at Citation Blvd (03288180), located at the sampling site.

As shown in **Figure 4**, there is a strong relationship (R^2=0.95) between the karst-adjusted drainage area and the average measured flow at each site. This indicates that scaling the flow at the USGS gage at Newtown Pike based on the karst-adjusted drainage area will provide a reasonable median flow estimate for other monitoring locations.

Figure 4 - Relationship Between Average Measured Flow and Karst Adjusted Drainage Area



Therefore, the loading at each site was calculated using the average measured pollutant concentration for the monitoring period and the estimated median flow. Benchmark loads were calculated using the benchmark concentration instead of the average measured concentration. Pollutant reductions needed were then calculated by subtracting the benchmark loads from the existing loads. These reductions were then further divided into the incremental sub-drainages by subtracting reductions focused in upstream areas from downstream areas.

Although groundwater does not have human PCR, SCR or WAH use, loads and reductions were calculated based on those benchmarks. These standards were utilized to represent surface streams which flow into the karst system upstream of this site.

1. *E. coli*

The existing *E.coli* load, benchmark loads, and reductions needed to achieve benchmark loads are summarized in **Table 15**, and shown on **Exhibits 2** and **3**, pages 24 and 25, respectively. Benchmark loads were calculated for the PCR and benchmarks with corresponding percent reductions. Load reductions are required in most subwatershed areas to meet benchmark concentrations, but remediation efforts should be focused in 3 subwatersheds where major reductions are required to meet both PCR and SCR standards.

Table 15 - *E. coli* Loading and Reductions

Site ID	Average Concentration (#/100mLs)	Estimated Median Flow (cfs)	Annual Load (trillions / year)			Load Reduction Needed (%)		Annual Load Reduction Needed[1] (trillions/year)
			Existing	Primary Contact Benchmark (240/100 mLs)	Secondary Contact Benchmark (676/100 mLs)	Primary Contact	Secondary Contact	
1	317	12.4	35	27	75	23%	-	Sites 2,3,4, & 6
2	753	9.9	66	21	59	68%	11%	18
3	282	0.5	1.3	1.1	3.1	15%	-	0.2
4	537	0.5	2.3	1	2.9	57%	-	1.3
5	678	5.6	34	12	34	65%	-	Site 6
6	907	4.4	35	9.3	26	73%	26%	26
7	130	0.2	0.18	0.34	0.96	-	-	-
8	475	11.0	46	23	66	50%	-	4.0
9	261	2.7	6.3	5.8	16	8%	-	0.5
10	1327	1.6	19	3.4	9.6	82%	49%	15.6
11	551	1.2	6	2.6	7.3	57%	-	3.4

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[1] Annual load reduction needed by incremental sub-watershed

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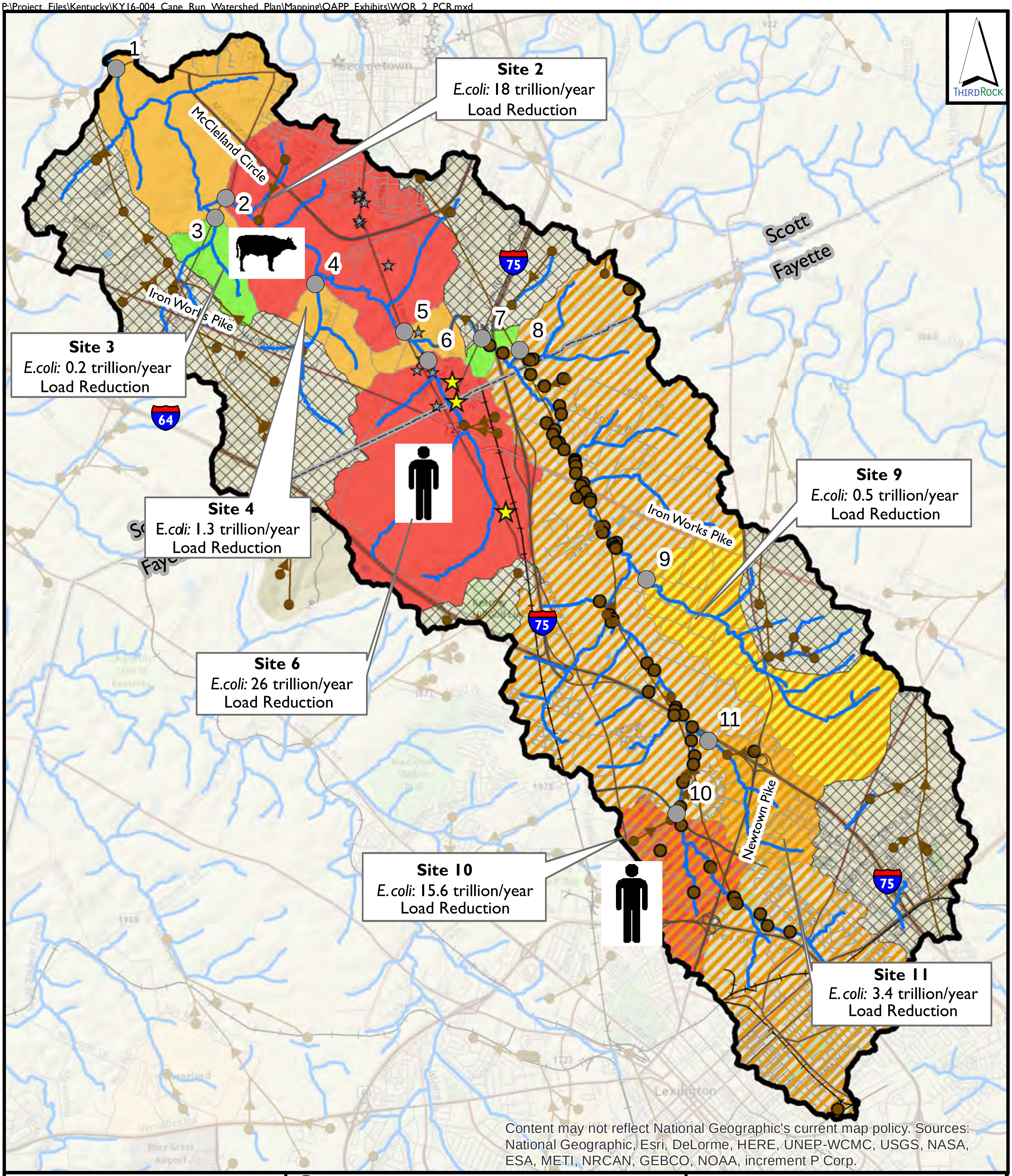

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Cane Run Watershed
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

- ● Water Quality Site
- ☆ Septic Systems
- ★ Package WTP
- ● Karst Inflow / Outflow
- ➤ Karst Flow
- — Stream
- ⊠ Other Karst

Grades

- 🟦 A
- 🟩 B
- 🟨 C
- 🟧 D
- 🟥 F
- ▨ Site 8 Drainage

NOTE: Grades based on frequency of exceedance of regulatory benchmark of 240 MPN/100mLs

Exhibit 2
Human Recreation (Primary Contact) Grades and Load Reductions by Subwatershed 2016-2017

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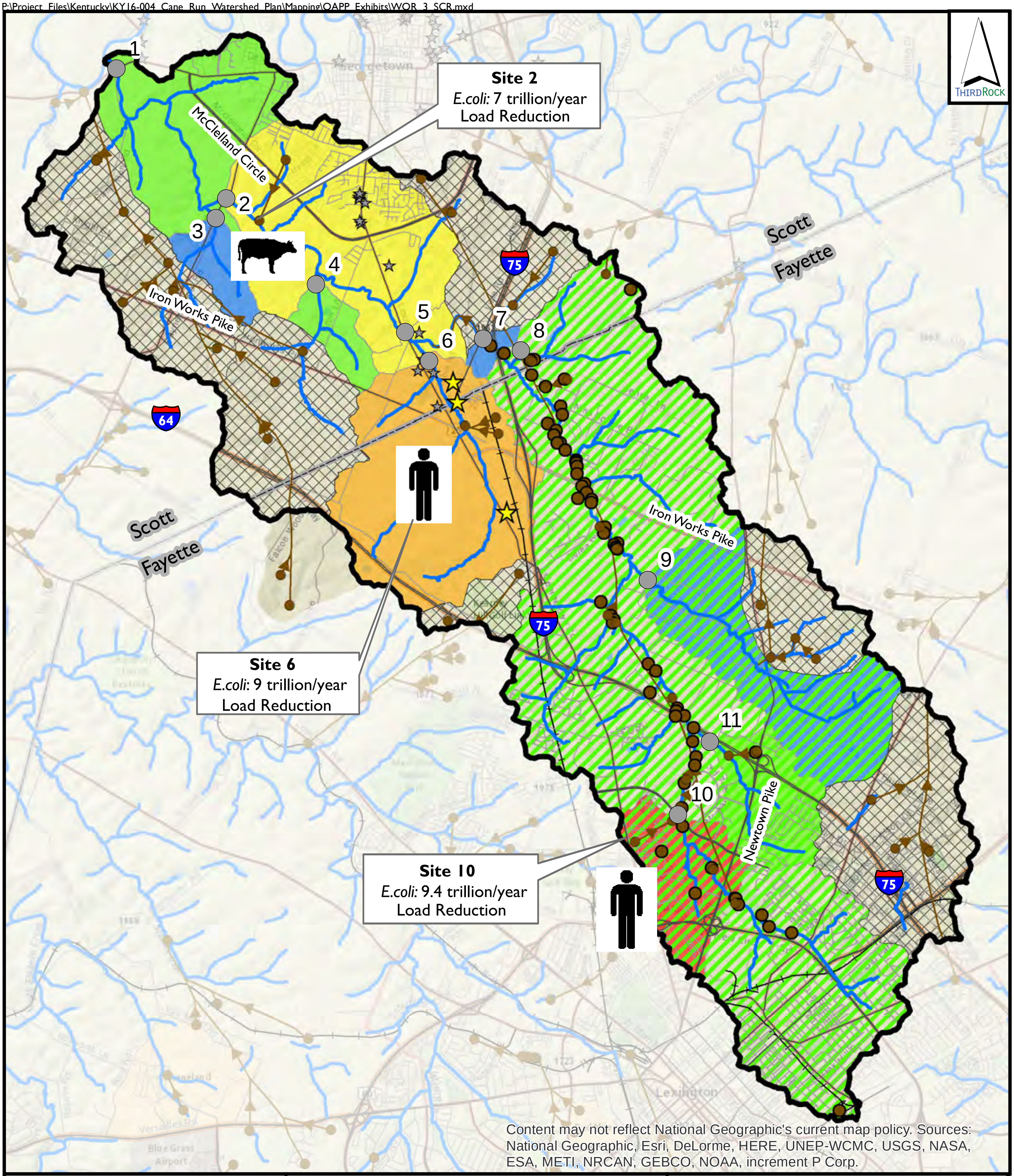

Site 2
E.coli: 7 trillion/year
Load Reduction

Site 6
E.coli: 9 trillion/year
Load Reduction

Site 10
E.coli: 9.4 trillion/year
Load Reduction

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Cane Run Watershed
Scott and Fayette Counties, KY

0 0.5 1 2 Miles

- ● Water Quality Site
- ☆ Septic Systems
- ★ Package WTP
- ● Karst Inflow / Outflow
- ➤ Karst Flow
- — Stream
- ▨ Other Karst

Grades

🟦	A
🟩	B
🟨	C
🟧	D
🟥	F

NOTE: Grades based on frequency of exceedance of regulatory benchmark equivalent of 676 MPN/100mLs

▨ Site 8 Drainage

Exhibit 3
Human Recreation (Secondary Contact) Grades and Load Reductions by Subwatershed 2016-2017

Overall, the highest existing load was calculated at Site 10. Load reductions of 82% are required to meet the Primary Contact benchmark in this area. While flow does reach the site from the sources upstream of Newtown Pike, most of the flow comes from a small tributary near a large neighborhood. Poor sanitary sewer infrastructure, including private lateral lines of orangeburg and clay pipe, are located in this neighborhood. A neighborhood-wide rehabilitation of the sanitary sewer system is recommended to aid achieving the *E.coli* load reductions. Monitoring by LFUCG should further aid in identifying *E.coli* sources upstream of this site, including the tributary near Eastern State Hospital.


Cattle in Stream, Upstream of Site 2

The next highest *E. coli* load was measured at Site 6, which is also responsible for high concentrations at Site 5, downstream. Human sources were indicated to be dominant in this subwatershed area.

Investigation of discharge monitoring reports from the 3 permitted package treatment plants located in the watershed indicate that these facilities are responsible for most of the *E. coli* loading in this area. According to the Scott County Health Department, several poorly functioning septic systems are also located in the area and are contributing to the pollution.

The third major focus area is the subwatershed of Site 2. Cattle sources were shown to be the most dominant source of the *E. coli* load at this location and numerous cattle were observed both in the creek and along the banks. Bank erosion is also being caused due to cattle access to the stream. Livestock restriction from the stream, hardened crossings, and manure management would be effective BMPs to address this fecal source.

2. *Nutrients*

Loads were calculated for ammonia, total nitrogen and total phosphorus. The existing load, benchmark loads, and reductions from ammonia, nitrogen, and phosphorus are summarized in **Tables 16**, **17** (page 27), and **18** (page 27), and shown on **Exhibits 4** through **6**, pages 28-30, respectively.

Table 16 - Ammonia Loading and Reductions

Site ID	Average Concentration (mg/L)	Estimated Median Flow (cfs)	Annual Load (lbs/year)		Load Reduction Needed (%)	Annual Load Reduction Needed[1] (lbs/year)
			Existing	Benchmark (0.1 mg/L)		
1	0.00	12.4	0	2,400	-	-
2	0.03	9.9	570	1900	-	-
3	0.00	0.5	0	100	-	-
4	0.00	0.5	0	95	-	-
5	0.22	5.6	2,500	1,100	56%	Site 6
6	1.31	4.4	11,000	860	92%	10,140

Table 16 - Ammonia Loading and Reductions *Continued*

Site ID	Average Concentration (mg/L)	Estimated Median Flow (cfs)	Annual Load (lbs/year)		Load Reduction Needed (%)	Annual Load Reduction Needed[1] (lbs/year)
			Existing	Benchmark (0.1 mg/L)		
7	0.00	0.2	0	31	-	-
8	0.12	11.0	2,600	2,200	15%	400
9	0.11	2.7	560	530	5%	30
10	0.03	1.6	79	310	-	-
11	0.00	1.2	0	240	-	-

[1] Annual load reduction needed by incremental sub-watershed

Table 17 - Total Nitrogen Loading and Reductions

Site ID	Average Concentration (mg/L)	Estimated Median Flow (cfs)	Annual Load (lbs/year)		Load Reduction Needed (%)	Annual Load Reduction Needed[1] (lbs/year)
			Existing	Benchmark (3 mg/L)		
1	2.23	12.4	54,000	73,000	-	-
2	2.12	9.9	41,000	58,000	-	-
3	4.06	0.5	4,200	3,100	26%	1,100
4	1.02	0.5	980	2,900	-	-
5	3.25	5.6	36,000	33,000	8%	Site 6
6	4.18	4.4	36,000	26,000	28%	10,000
7	1.51	0.2	470	940	-	-
8	2.45	11.0	53,000	65,000	-	-
9	1.79	2.7	9,500	16,000	-	-
10	2.47	1.6	7,800	9,400	-	-
11	0.91	1.2	2,200	7,200	-	-

[1] Annual load reduction needed by incremental sub-watershed

Table 18 - Total Phosphorus Loading and Reductions

Site ID	Average Concentration (mg/L)	Estimated Median Flow (cfs)	Annual Load (lbs/year)		Load Reduction Needed (%)	Annual Load Reduction Needed[1] (lbs/year)
			Existing	Benchmark (0.35 mg/L)		
1	0.27	12.4	6,500	8,600	-	-
2	0.30	9.9	5,700	6,800	-	-
3	0.29	0.5	300	360	-	-
4	0.25	0.5	240	330	-	-
5	0.51	5.6	5,700	3,900	32%	Site 6
6	0.63	4.4	5,400	3,000	44%	2400
7	0.20	0.2	61	110	-	-
8	0.39	11.0	8,400	7,600	10%	400
9	0.30	2.7	1,600	1,900	-	-
10	0.46	1.6	1,500	1,100	27%	400
11	0.33	1.2	780	840	-	-

[1] Annual load reduction needed by incremental sub-watershed

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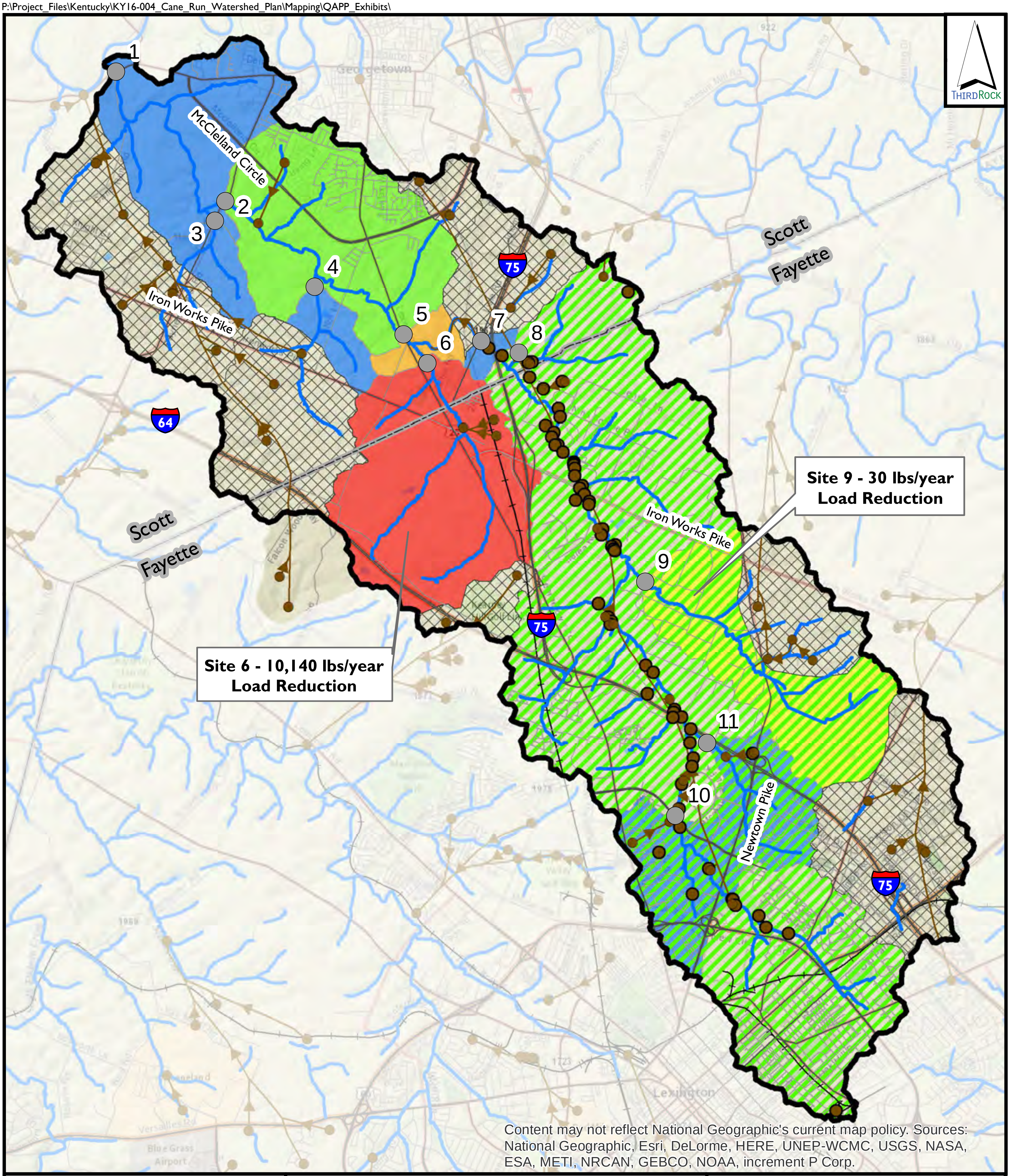

Site 9 - 30 lbs/year Load Reduction

Site 6 - 10,140 lbs/year Load Reduction

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Cane Run Watershed
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

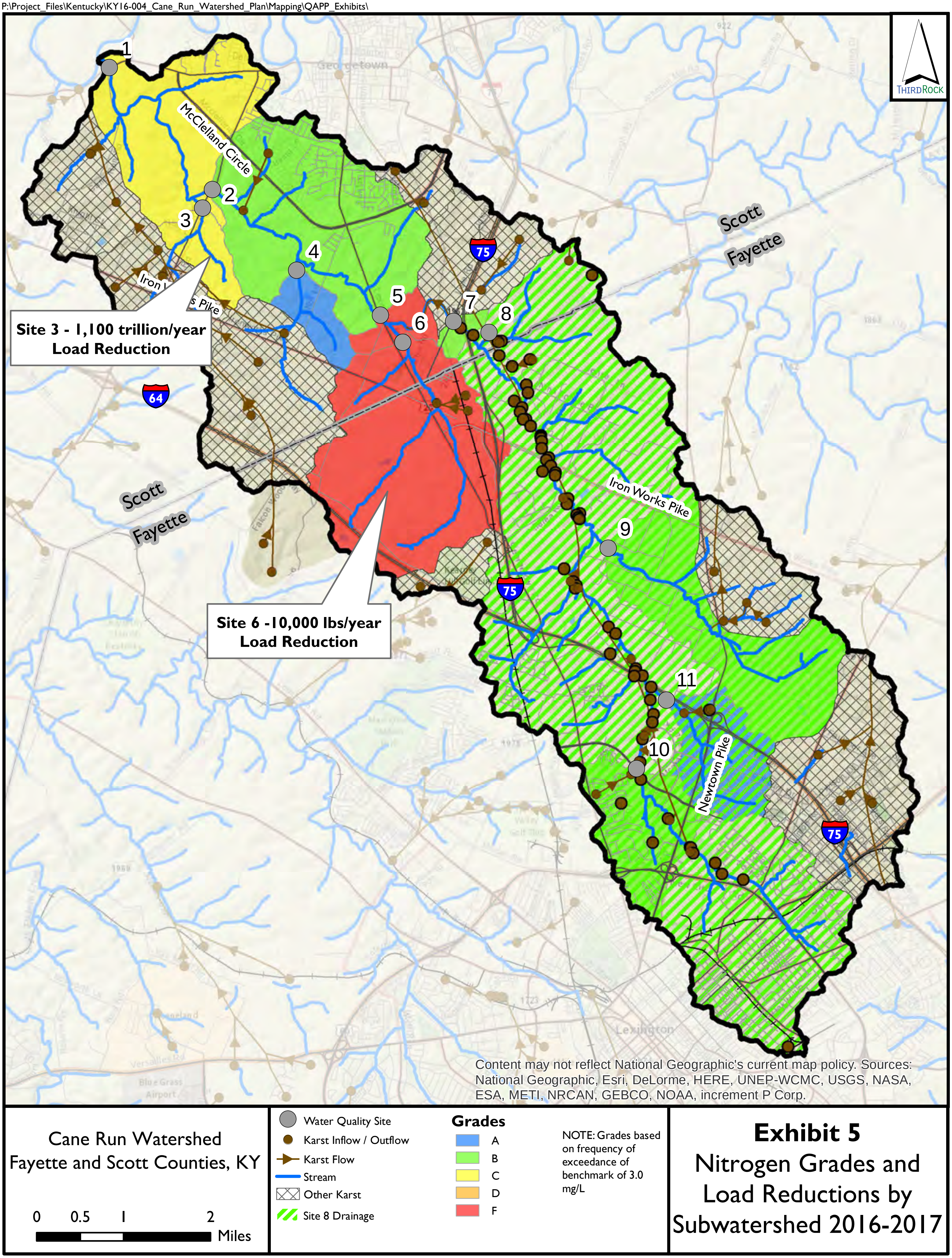
● Water Quality Site
● Karst Inflow / Outflow
➤ Karst Flow
— Stream
▨ Other Karst
▨ Site 8 Drainage

Grades

🟦	A
🟩	B
🟨	C
🟧	D
🟥	F

NOTE: Grades based on frequency of exceedance of benchmark of 0.1 mg/L

Exhibit 4
Ammonia Grades and Load Reductions by Subwatershed 2016-2017



Site 3 - 1,100 trillion/year Load Reduction

Site 6 -10,000 lbs/year Load Reduction

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NOTE: Grades based on frequency of exceedance of benchmark of 3.0 mg/L

Cane Run Watershed
Fayette and Scott Counties, KY

Exhibit 5
Nitrogen Grades and Load Reductions by Subwatershed 2016-2017

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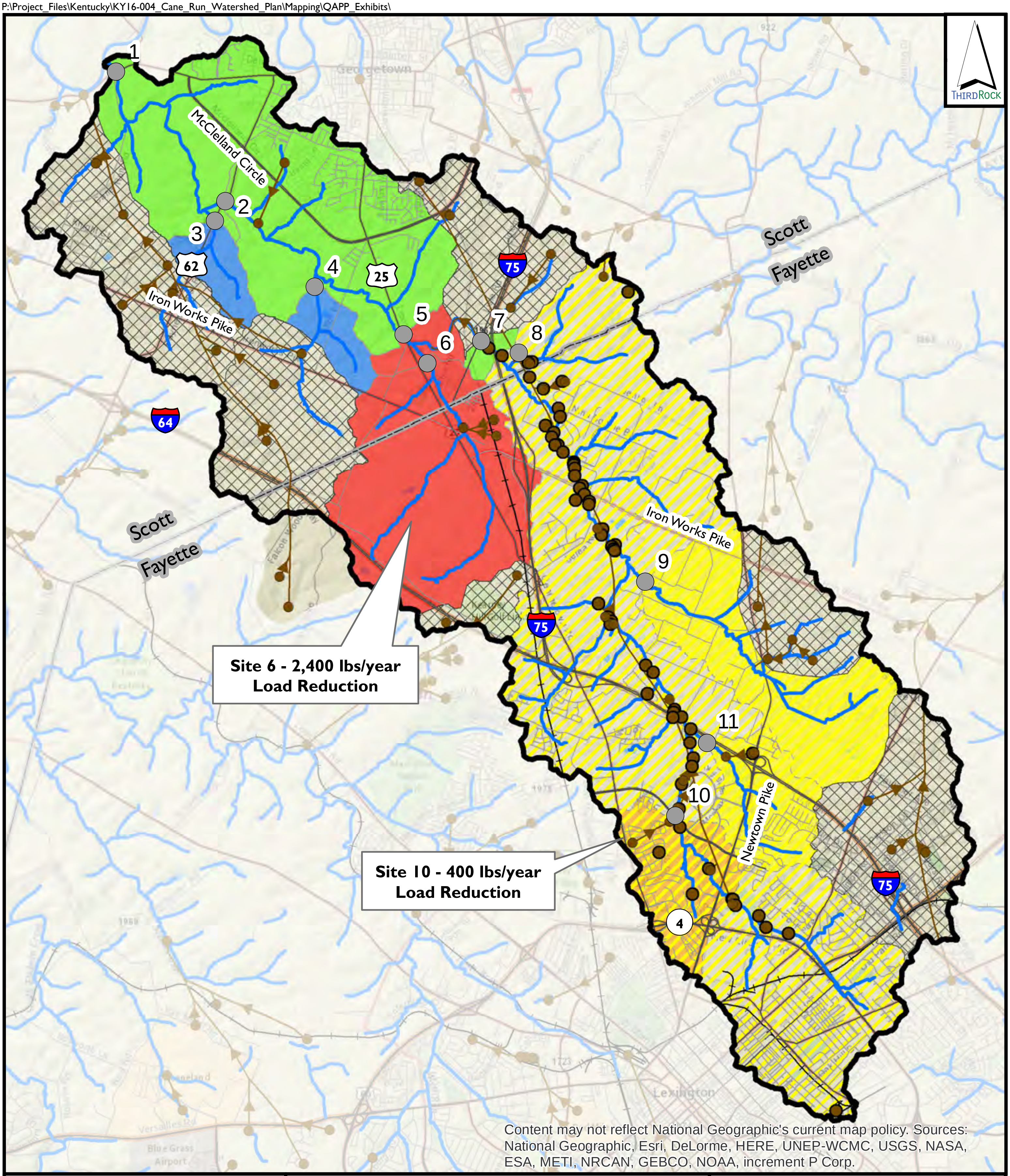

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Cane Run Watershed
Fayette and Scott Counties, KY

0 0.5 1 2 Miles

● Water Quality Site
● Karst Inflow / Outflow
➤ Karst Flow
— Stream
▨ Other Karst
▨ Site 8 Drainage

Grades

🟦 A
🟩 B
🟨 C
🟧 D
🟥 F

NOTE: Grades based on frequency of exceedance of benchmark of 0.35 mg/L

Exhibit 6
Phosphorus Grades and Load Reductions by Subwatershed 2016-2017

The largest load reductions for ammonia, nitrogen, and phosphorus are all from the drainage area of Site 6. The nitrogen reduction needed at Site 6 is due to the high ammonia levels in the area. Based on discharge monitoring reports, most of the ammonia, nitrogen and phosphorus contributions are likely due to the failing package treatment systems associated with 3 mobile home parks located in the watershed, similar to what was observed for high *E.coli* loading. Other potential sources include failing septic systems, manure or fertilizer from horse farms, a landscaping company, and a dump site. Sources upstream of Site 6 are also responsible for the high levels of nutrients at Site 5, downstream.

Site 8 showed elevated levels of ammonia and phosphorus from tributaries located upstream. About 20% of the loading for these parameters is due to agricultural sources upstream of Site 9, located on university research property, which requires slight reductions for ammonia. However, other upstream sources should be targeted to lower nutrient levels in the groundwater system. The LFUCG monitoring study should help to identify additional potential nutrient sources.

Site 3 requires a reduction in nitrogen loads due to contributions from horse farms, which comprise the majority of the drainage area upstream of that site. Additionally, phosphorus reductions should be targeted to the Site 10 drainage area.

Sites 1, 2, 4, 7, and 11 did not show load reductions were needed to meet the benchmark nutrient loads.

3. *Subwatershed Prioritization and Load Reduction Summary*

Table 19 and **Exhibit 7** (page 32) summarize the water quality load reductions needed and implementation effort priority areas for each of the subwatersheds monitored in this project.

Table 19 - Load Reductions and Source Summary

Site ID	*E. coli* (trillions/year)	Ammonia (lbs/year)	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Potential Sources
2	18				Cattle upstream of Payne's Depot Road
3	0.2		1,100		Two horse farms
4	1.3				Septic systems along Etter Lane, horse manure management at 3 horse farms
6	26	10,140	10,000	2,400	Sanitary Package Plants at mobile home parks, along with failing septic systems, a large dump, a landscaping company, and multiple horse farms.
8	4	400		400	Load reductions exclude reductions specific to drainage to Sites 9 or 10, but apply to other streams or karst inputs in the drainage area. Potential sources are Lexington urban headwaters (including some industry), Kentucky Horse Park, and other areas.
9	0.5	30			Farms, including a university research farm, and several horse-related farms and businesses
10	15.6			400	Primarily private sanitary laterals and sanitary sewer in a large neighborhood. Other sources include tributary behind Eastern State Hospital and some from upstream of Newtown Pike.
11	3.4				Large neighborhoods, sanitary sewers with LFUCG remedial measure plans.

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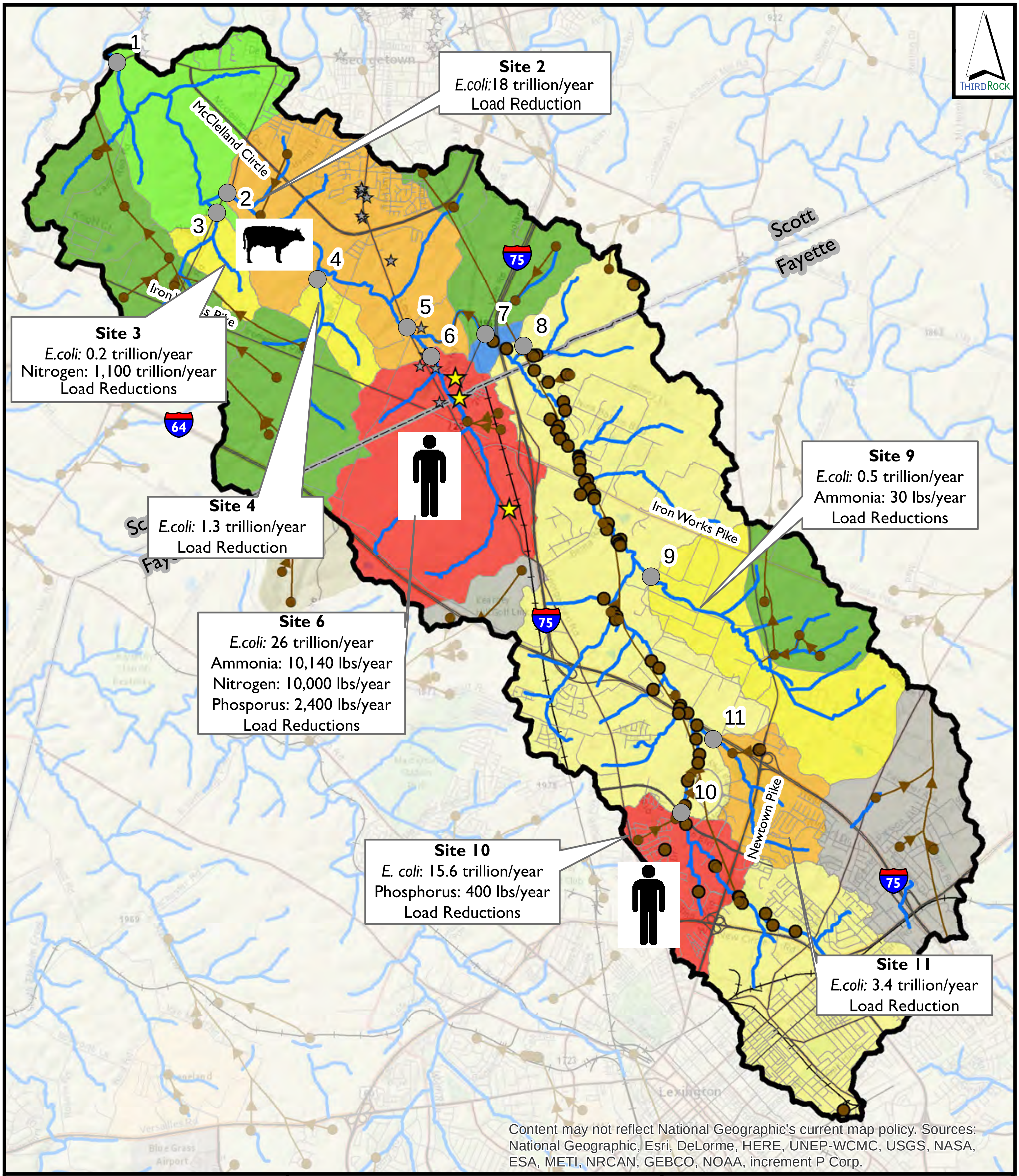

Site 2
E.coli: 18 trillion/year
Load Reduction

Site 3
E.coli: 0.2 trillion/year
Nitrogen: 1,100 trillion/year
Load Reductions

Site 4
E.coli: 1.3 trillion/year
Load Reduction

Site 6
E.coli: 26 trillion/year
Ammonia: 10,140 lbs/year
Nitrogen: 10,000 lbs/year
Phosporus: 2,400 lbs/year
Load Reductions

Site 9
E.coli: 0.5 trillion/year
Ammonia: 30 lbs/year
Load Reductions

Site 10
E. coli: 15.6 trillion/year
Phosphorus: 400 lbs/year
Load Reductions

Site 11
E.coli: 3.4 trillion/year
Load Reduction

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Cane Run Watershed
Fayette and Scott Counties, KY

0 0.5 1 2
Miles

● Water Quality Site
☆ Septic Systems
★ Package WTP
● Karst Inflow / Outflow
➤ Karst Flow
— Stream

Prioritization

🟥 Highest	🟩 Low
🟧 High	🟩 Low (Karst)
🟨 Medium	🟦 Lowest
🟨 Medium (Karst)	⬜ Unknown

Exhibit 7
Prioritization and Load Reductions Summary by Subwatershed 2016-2017

APPENDIX A

Prepared for Kentucky Division of Water
Prepared by Third Rock Consultants, LLC, December 15, 2017

Cane Run
Watershed

Quality Assurance Project Plan
(QAPP)

Cane Run Comprehensive Watershed Based Plan

Prepared By:
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2526 Regency Road, Suite 180
Lexington, KY 40503
859-977-2000

Prepared for:
Kentucky Division of Water
200 Fair Oaks Lane
Frankfort, KY 40601
502-564-3410

Effective Date: May 3, 2016
Revision No. 2, August 8, 2016

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1 PROJECT MANAGEMENT

1.1 Title and Approval Sheet

Action By	Signature	Date
Steven Evans Prepared, QAPP Author		8/8/2016
Bert Remley Reviewed, Chief Biologist	Bert Remley	8/8/2016
Lisa Martin Reviewed, Microbac Laboratories	Lisa Martin	8-10-16
Tricia Coakley Reviewed, UK ERTL	T Coakley	8/10/16
Alyson Jinks Approved, KDOW Nonpoint Source		
Lisa Hicks Approved, KDOW Quality Assurance Officer		
James Roe Supervisor NPS and BT Section KDOW		

1.2 Revision History

Date of Revision	Page(s)/Section(s) Revised	Revision Explanation
May 3, 2016	all	New document
June 7, 2016	General p. 9, 21 p. 10, 1.7.1 Biological Monitoring p. 10-11, 1.7.2 Water Quality Monitoring p. 12-13, Project Schedule Time Line p. 16, Table 5 p. 30 Microbial Source Tracking p. 35, Table 12 p. 36,38, 2.3.3 Site Identification, 2.5 Quality Control p. 39, 2.6 Requirements for Equipment and Supplies p. 44, 4.1 Validation and Verification Methods References	• Included references to HUC 12 throughout • Removed "remediation" from goal statement of QAPP • Revised headwater index period • Change time period of sampling, microbial source tracking to be sampled in office • Change in timelines for tasks and deliverables • Method for nitrate and nitrite revised. Reporting limits lowered • Samples filtered at Third Rock office • Revision to containers and preservatives • Laboratory to assume duplicate sample time as earliest sample. • Calibration to occur day of or day before sampling • KDOW may make final determinations on data acceptability • Removed reference to 2008 KDOW SOP
August 8, 2016	p.10, 1.7.2 Water Quality Monitoring p. 21-22 Table 6 and text Appendix A – Field Forms Appendix D – Maps	• Changed number of sites from ten to eleven • Site 7 moved from Horse Park to Lisle Rd due to lack of flow due to karst swallet. Site 10 moved from Equine Campus Road to Citation Blvd due to karst swallet hole. Site 11 added. Corrected Site 9 description. Changed number of sites to 11. • Chain of Custody includes additional site • New site locations and drainages

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1.4 Distribution List

The following individuals will receive the approved Quality Assurance Project Plan (QAPP) and any subsequent revisions.

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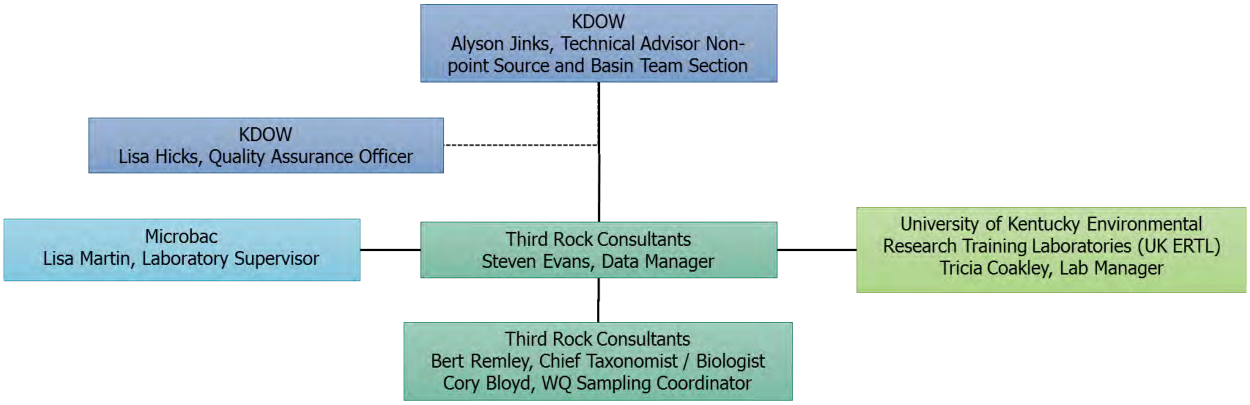
1.5 Project / Task Organization

The key personnel of project team are summarized in Figure 1 as well as the lines of authority with regards to the execution of the project. The roles and responsibilities of specific personnel are summarized below.

FIGURE 1 – ORGANIZATIONAL CHART



Alyson Jinks, Kentucky Division of Water Technical Advisor Nonpoint Source and Basin Team Section, is responsible for ensuring that the monitoring performed under this project is in compliance with the KDOW and EPA requirements.

Lisa Hicks, Kentucky Division of Water QA Officer, will be responsible for reviewing and approving the QA Project Plan. She may provide technical input on proposed sampling design, analytical methodologies, and data review.

Steve Evans, Third Rock Consultants Data Manager, will be responsible for writing and/or coordinating development of the QAPP. He will ensure that monitoring training and sampling events are coordinated as specified in the QAPP. He will review and approve all data generated for the project and prepare QA reports as required by the project. He will also be responsible for managing the data generated.

Bert Remley, Third Rock Consultants Chief Taxonomist / Biologist, will be responsible for biological sampling coordination and identification. He will either identify all biological samples collected or will assign appropriate laboratory staff to perform the identification of biological samples collected. He will be responsible for QA of all biological data generated from both the field and laboratory. He will report to Third Rock Consultants Data Manager and QA Manager.

Cory Bloyd, Third Rock Consultants WQ Sampling Coordinator, will be responsible for coordinating water quality sample collection efforts by Third Rock staff. His responsibilities include assigning to field samplers specific tasks and objectives and ensuring proper chain-of-custody of water samples collected. He has overall responsibility for all field activities associated with water quality samples collected by Third Rock staff. He will report to Third Rock Consultants Data Manager and QA Manager.

Lisa Martin, Microbac Laboratory Supervisor, will be responsible for assigning appropriate laboratory staff to perform the analyses specified in this plan.

Tricia Coakley, University of Kentucky Environmental Research Training Laboratories Lab Manager, will be responsible for performance of microbial source tracking laboratory analysis and reporting.

1.6 Project Background and Overview

This Cane Run Comprehensive Watershed Based Plan Quality Assurance Project Plan (QAPP) has been developed to ensure data generated under this QAPP is of sufficient quality to achieve project goals for the watershed based plan.

The overall goal for this QAPP is to generate data of sufficient quality and resolution to facilitate the identification and quantification of sources of recreational and aquatic habitat impairments to the Cane Run Watershed (HUC#05100205280200).

The study area is the entirety of the Cane Run Watershed that is located in Scott and Fayette Counties. Three key monitoring elements will be performed as briefly outlined below:

1. Biological Monitoring
    - Habitat Assessments by Rapid Bioassessment Protocol (RBP)
    - Macroinvertebrate Collection and Identification

2. Water Quality Monitoring
    - Pollutant Loading Sampling – Monthly
    - *E. coli* Geomean Sampling – 5 events in 30 days
    - Microbial Source Tracking

3. Severe Erosion Survey
    - Visual Assessment or Windshield Survey

1.7 Project / Task Description and Schedule

1.7.1 Biological Monitoring

Habitat assessments will be conducted by visual assessments of riffle and pool substrates, stream channelization, riparian conditions, and in-stream cover. Habitat characteristics are scored on a high gradient habitat assessment field data sheet modified from US EPA 841-B-99-002 (Barbour et al., 1999). Physical habitat assessments will be conducted simultaneously with the macroinvertebrate sampling events, at eight stream locations. *In situ* measures (described below) are also taken at that time. The habitat score is compared to regional criteria for the Bluegrass Bioregion based on stream size (headwater or wadeable) to determine a habitat rating for each site. The assessments will occur during the sampling index periods for each reach (wadeable streams from May 1 to September 30; headwater streams from March 1 to May 31).

Macroinvertebrates will be sampled by approved biologists, during their respective sampling index periods (for wadeable streams the index period is May 1 through September 30; for headwater streams it is March 1 through May 31). Benthic macroinvertebrate samples will not be collected during periods of excessively high or low flow or within two weeks of a known scouring flow event. Macroinvertebrates will be collected at eight locations.

The macroinvertebrate community will be sampled using the high gradient methods developed by KDOW (2015). These sampling methods involve the collection of two separate samples, a semi-quantitative riffle sample and qualitative multi-habitat sample, at each station. Samples will be preserved in 95% ethanol and returned to the laboratory for processing and identification.

Random 300-specimen subsamples are removed from the riffle samples using methods described by KDOW (2015). All organisms are identified to the lowest possible taxonomic level and recorded on laboratory data sheets. Macroinvertebrate results are analyzed to calculate a Macroinvertebrate Biotic Index (MBI) rating for each watershed station using appropriate metrics (KDOW 2015, Pond *et al.*, 2003). The MBI score is then compared to regional criteria for the Bluegrass Bioregion to arrive at a narrative water quality rating based on stream size (headwater or wadeable).

1.7.2 Water Quality Monitoring

Water quality monitoring will be performed at eleven sites on a monthly basis during 12 events from June 2016 to May 2017 as a pollutant load characterization effort. Three of these events will be performed during precipitation events greater than 0.2 inches. The remaining 9 events will take place during dry weather conditions. All events require an antecedent dry period of 72 hours. An effort will be made to sample when streams have flow, however due to the intermittent flow and loss of surface water to the karst system, samples may not be collected at some sites during some events. Sampling at an individual site will not occur if flow is not observed (i.e. pooled).

Field data including turbidity, pH, dissolved oxygen (DO), specific conductance (COND), percentage saturation (DO%), and temperature (TEMP) will be measured *in situ* at each site using a Hydrolab multimeter or the equivalent following methods developed by KDOW (2009a). Flow will be measured using an OTT MF Pro flow meter with top set wading rod following KDOW methods (KDOW 2010). Grab samples will be collected and transported to Microbac for analysis for *E. coli*, nitrate/nitrite (NO_2+NO_3), ammonia (NH_3), total Kjeldahl nitrogen (TKN), total phosphorus (TP), orthophosphate (OP), 5-day carbonaceous biochemical oxygen demand (CBOD5), and total suspended solids (TSS) using methods developed by KDOW (2011b). OP will be filtered in the field. All samples will be preserved according to method specifications and transported to the Microbac Laboratory for analysis within method holding times and temperature requirements.

In addition to the monthly sampling five additional sampling events will be conducted in May 2017 for *E. coli*, and field parameters. Sampling will be conducted during dry weather conditions (72-hour antecedent dry period). *E. coli* will be analyzed by Microbac. Flow and field *in situ* measurements will be conducted using same methods as monthly parameters.

For microbial source tracking, 20 samples will be chosen for analysis using quantitative polymerase chain reaction (qPCR) for DNA markers of general, human, and ruminant fecal contributions. After each monthly sampling event, an aliquot from each site will be filtered, and filters will be rolled and placed into sterile centrifuge tubes, sealed, iced and transported to a deep freezer at the University of Kentucky Environmental Research Training Laboratories (UK ERTL) for storage. In April 2017, Third Rock will work with KDOW to determine the locations and events from this library that should be analyzed by UK ERTL in May 2017 to identify fecal sources.

1.7.3 Severe Erosion Surveys

Perennial and intermittent streams within the Cane Run Watershed (HUC#05100205280200) will be surveyed for areas of severe erosion. Where permission is gained to access property streams will be inspected on foot by Third Rock personnel. In areas where permission cannot be gained, a windshield survey will be conducted from public roadways.

Surveyors will follow the *Stream Corridor Assessment Survey- SCA Survey Protocols (MDDNR 2001)* during the survey, recording length of erosion, bank height, cause, and ranking the severity, correctability, and access. Streams will be walked where permission is granted, but will otherwise perform the survey from roadways. Surveyors will mark locations of severe erosion on a high resolution aerial map as well as areas that could not be accessed. For this survey, severe erosion is defined as areas where erosion greatly exceeds average reach conditions or threatens property and infrastructure. Photographs will be made of each location and the length of the erosion marked with GPS waypoints where access allows. An erosion field datasheet will be completed in the field for areas of severe erosion.

1.7.4 Deliverables

The results of these monitoring activities will be conveyed through multiple deliverable types including reports, maps, and data analysis.

- A Macroinvertebrate and Habitat Assessment Report will be generated after field sampling, and sample identification has been completed. This report will include the following:
  - Habitat scores for each station will be compared to regional KDOW criteria and a habitat score will be assigned for each station.
  - Habitat rating results will be presented in a table and on a summary map.
  - Macroinvertebrate scores will be presented on a map as compared with KDOW Criteria and compared to the total habitat scores. A table of results will also be developed.

- Water quality results will be summarized in a Water Quality Report after sampling is completed. This report will include the following information:
  - Water quality results will be compared to KDOW benchmarks and exceedances will be noted on a summary map.
  - Results for all parameters will be presented in a table.
  - Water quality results will be utilized to generate pollutant loading calculations, sources of pollutants, and required reductions
  - Water quality health grades will be generated according to monitoring results
  - Fecal source contributors of *E. coli* determined through microbial source tracking will be indicated on a summary map.

- Erosional areas in need of bank stabilization or stream restoration will be prioritized and displayed on mapping and summarized in a Severe Erosion Survey Report.

These monitoring results may also be used to develop a comprehensive Watershed Based Plan in the year following the completion of the monitoring.

1.7.7 Project Schedule Time Line

Table 1 (page 13) summarizes the project schedule for the monitoring conducted for Cane Run Watershed (HUC#05100205280200).

It is expected that the laboratory will send results with a turnaround time of 7 days. An initial review of the monitoring water quality data will be conducted within 14 days of receipt and distributed to the watershed working group. Review of other monitoring activities will be conducted within the allotted time period for the sampling activity to allow for re-sampling if necessary. The Macroinvertebrate Survey and Habitat Assessment Report will be generated by August 31, 2017, and the Water Quality Monitoring Report will be submitted by August 31, 2017. The expected reporting dates of other monitoring activities are detailed in Table 1.

TABLE 1 – PROJECT SCHEDULE BY TASK

<table>
<tr><th rowspan="2">Activity</th><th rowspan="2">Frequency / Requirements</th><th colspan="8"></th><th colspan="9">2017</th></tr>
<tr><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th></tr>
<tr><td colspan="19">1. Biological Monitoring</td></tr>
<tr><td rowspan="2">Macroinvertebrate Collection and ID, Habitat Assessment</td><td rowspan="2">> 2 weeks after scour event</td><td colspan="5">Wadeable</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">Headwater</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="19">2. Water Quality Monitoring</td></tr>
<tr><td>Geomean <i>E.coli</i></td><td>5 events in 30 days</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5x</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Monthly Pollutants</td><td>12 events, 72 hrs dry
3 wet weather min.</td><td></td><td colspan="12">12 Events</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Microbial Source Tracking</td><td>20 filters from montly events</td><td></td><td colspan="10">Collect</td><td>Select</td><td>Lab</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="19">3. Severe Erosion Survey</td></tr>
<tr><td>Visual Assessment of Streams</td><td>FayetteOutside of Urban Service Area and Scott</td><td></td><td colspan="3">Visual</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="19">4. Reporting and Data Review</td></tr>
<tr><td>Macroinvertebrate Survey and Habitat Assessment Report</td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">Macro / Habitat Report</td></tr>
<tr><td>WQ QA and Final Reports</td><td>QAER, QA Project Report, and WQ Monitoring Report</td><td></td><td colspan="2">QAER</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">QAPR, WQMR</td></tr>
<tr><td>Severe Erosion Survey Report</td><td>-</td><td></td><td></td><td colspan="5">Erosion Report</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Gather and evaluate existing data</td><td>-</td><td colspan="2"></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Calculate water quality health grades</td><td>Existing and based on WQ data collected</td><td colspan="4">Existing</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">Current Project</td></tr>
<tr><td>Calculate loads and load reductions to meet benchmarks</td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">Loads and Reductions</td></tr>
</table>

1.8 Data Quality Objectives (DQOs) and Criteria for Measurement Data

Data quality is determined primarily based on data quality objectives (DQOs) and data quality indicators (DQIs). DQOs are qualitative and quantitative statements that indicate the objectives or goals for the data. Data Quality Indicators (DQIs) are qualitative and quantitative measures of data that indicate whether the data is of sufficient quality to meet the DQOs. The specific DQOs and DQIs for this project are stated in the following sections.

The overall Quality Assurance / Quality Control (QA/QC) objective for the Cane Run QAPP is to generate data of sufficient quality and resolution to facilitate the identification and quantification of sources of recreational and aquatic habitat impairments to streams within Fayette and Scott Counties.

1.8.1 Data Quality Objectives (DQO)

The data quality objectives in this WFMP QAPP are related primarily to the field sampling. The laboratory DQOs are included, but comprehensive laboratory DQOs, including number of laboratory duplicates, known samples, etc., are stated in individual laboratory Standard Operating Procedures (SOPs) and not in this sampling plan QAPP. This plan is intended to focus on field sampling activities while establishing minimum objectives relating to laboratory quality. The data quality objectives for the respective field sampling activities are listed in Table 2.

TABLE 2 – SUMMARY OF DATA QUALITY OBJECTIVES

Sampling Activity	Objective
Habitat Assessment	Provide a semi-quantified evaluation of the general habitat of the stream
Macroinvertebrate Collection and Identification	Calculation of the Macroinvertebrate Bioassessment Index (MBI). Macroinvertebrates have varying tolerances for water pollution and serve as long-term indicators of water quality
Flow Measurements	Identify stream flow and trends and estimate pollutant loads
In situ Measurements and Field Screening	Indicate general measures of water quality at the time of sample collection during dry weather conditions
Grab Sampling	Compare pollutant concentrations to benchmarks, quantify pollutant loading of streams, tributaries
Microbial Source Tracking	Determine fecal source contributions to high areas of *E. coli* or ammonia
Severe Erosion Survey	Prioritize stream reaches that require bank stabilization or stream restoration

1.8.2 Action Limits / Levels

1. Biological Metrics

In order to evaluate the habitat assessment and macroinvertebrate sampling results, the KDOW has developed metrics and narrative classification ratings to indicate whether the designated use of warmwater aquatic habitat is supported or the aquatic community is adversely impacted. The criteria are summarized in Table 3.

TABLE 3 – BIOLOGICAL WARMWATER AQUATIC HABITAT CRITERIA FOR THE BLUEGRASS BIOREGION

Narrative Rating	Warmwater Aquatic Habitat Criteria			
	Habitat (RBP Score)		Macroinvertebrates (MBI Score)	
	Wadeable > 5.0 mi^2	Headwater < 5.0 mi^2	Wadeable > 5.0 mi^2	Headwater < 5.0 mi^2
Excellent	N/A	N/A	≥ 70	≥ 58
Good	≥ 130	≥ 156	61-69	51-57
Fair	114-129	142-155	41-60	39-50
Poor	≤ 113	≤ 141	21-40	19-38
Very Poor	N/A	N/A	≤ 20	≤ 18

2. Water Quality

The regulatory statute for surface waters in Kentucky is found in 401 KAR 10:031. The statute provides minimum water quality standards for all surface waters as well as specific standards that apply to particular designated uses. For this project, the applicable designated uses include warmwater aquatic habitat (WAH) and primary contact recreation (PCR). Where regulatory criteria exist, such standards are utilized as benchmarks. Where no such criteria exist, KDOW will provide non-regulatory benchmarks specific to this project for load reduction calculations. Because of the sampling frequency of this monitoring program, instantaneous or acute water quality criteria will be used to evaluate results when multiple criteria are present. Table 4 summarizes the criteria used to evaluate water quality data.

TABLE 4 – WATER QUALITY BENCHMARKS

Parameter	Water Quality Benchmark
PCR Regulatory Water Quality Standard	
E. coli[1]	Instantaneous: <240 CFU/100mL; 30-day geometric mean: <130 CFU/100mL
WAH Regulatory Water Quality Standard	
General Aesthetics or Degradation	Not degraded by: objectionable deposits; nuisance floating debris, scum, oil, or other matter; objectionable color, odor, taste, or turbidity; toxic or harmful to humans, animals, or aquatic life; causing dominance of nuisance species; or taints fish flesh
pH	Between 6.0 and 9.0 SU, and not to fluctuate more than 1.0 SU over 24 hours
Temperature	< 31.7°C (89°F)
Flow	Not altered to a degree that will adversely affect the aquatic community
Dissolved oxygen	> 5.0 mg/L as a 24-hour average; or > 4.0 mg/L for instantaneous
Specific Conductance	Indigenous aquatic community is not adversely affected
Total Suspended Solids	Indigenous aquatic community is not adversely affected
Nutrients	Not elevated to a level that results in an eutrophication problem
Un-ionized Ammonia [2]	<0.05 mg/L

NOTE: PCR = primary contact recreation, WAH = warmwater aquatic habitat,

[1] Geometric mean based on not less than five samples taken during a 30-day period. Instantaneous standard is not to be exceeded in 20% or more of all samples taken during a 30-day period. If less than five samples are taken in a month, this standard applies.

[2] Un-ionized ammonia shall be determined from values for total ammonia-N, in mg/L, pH and temperature, by means of the following equations: Un-ionized ammonia (mg/L) = 1.2*{total ammonia (mg/L as N)/[1+10^(pH_a – pH)]}, where pH_a = 0.0902 + [2730/(273.2+T_c)] and where T_c = temperature, °C.

1.8.3 Measurement and Performance Criteria / Acceptance Criteria

Measurement performance criteria are used in new data collection efforts; acceptance criteria are utilized for secondary or existing data use. Measurement criteria are usually stated in quantitative terms, such as limits on method detection limits, bias, or limits of overall variability of study results.

Measurement and performance criteria can be stated as data quality indicators (DQIs); the primary indicators are precision, bias, representativeness, comparability, completeness, and sensitivity. The performance criteria are summarized in Table 5 (page 16).

For benthic macroinvertebrate samples and habitat assessments, field sampling quality is assured through training and audits. Field personnel must document through a signed affidavit that they have read the SOPs and this QAPP annually. Additionally, they must receive an annual field certificate of training from KDOW. KDOW will also perform an annual audit of the sampling procedures. A collection check sheet shall also be used to document the habitats sampled in the field. Field photographs are used to document accuracy for habitat assessment. For macroinvertebrate laboratory identification, sorting and taxonomic quality checks will be utilized to document precision.

TABLE 5 – ACCEPTANCE CRITERIA FOR FIELD MEASUREMENTS AND LABORATORY CHEMISTRIES

Parameter	Units	Field / Lab Method	Accuracy (%R or ±)	Precision[1] (% RPD)	Sensitivity (Reporting Limit)
In situ Measurements					
Flow	cfs	Instream	±0.05 ft/sec	N/A	0.01 ft/sec
Dissolved Oxygen	mg/L	*In situ*	±0.2	20	±0.2
% Saturation	%	*In situ*	± 1	20	±1
pH	SU	*In situ*	±0.5	20	±0.5
Specific Conductance	µS/cm	*In situ*	±1	20	±1
Temperature, Water	˚F	*In situ*	±0.1	20	±0.1
Turbidity	NTU	*In situ*	±1	20	±1
Laboratory Chemistries					
Escherichia coli	MPN/ 100mL	SM 9223 B	N/A	30	1
Total Suspended Solids	mg/L	USGS 1-3765-85	85-105	10	1.5
Phosphorus, Total as P	mg/L	EPA 365.1 Rev. 2.0	90-110	10	0.05
Orthophosphate	mg/L	EPA 365.1 Rev. 2.0	90-110	10	0.05
Ammonia as N	mg/L	SM 4500-NH3-B&G	90-110	10	0.076* (0.25)
Nitrogen, Total Kjeldahl	mg/L	SM 4500-NH3-G	90-110	10	0.4
Nitrate as N	mg/L	EPA 300.0	90-110	10	0.08* (0.11)
Nitrite as N	mg/L	EPA 300.0	90-110	10	0.08* (0.15)
Biochemical Oxygen Demand, 5-Day Carbonaceous	mg/L	SM 5210 B	84-116	25	2* (5)
Molecular fecal source tracking	DNA copies	qPCR (Layton et al, 2006; Green et al, 2014; Reischer et al, 2006)	TBD	TBD	1000/mL

[1] Indicates minimum laboratory precision for water quality parameters

*Reporting to method detection limit, values between the method detection limit and reporting limit (in parentheses) will be estimates.

TBD = To be determined

Field duplicates will be collected or measured for *in situ* measurements, field chemistries, and water quality grab samples at 5% of sites. Laboratory duplicates will also be performed. Internal laboratory QC samples will be analyzed to determine if the project accuracy standards, listed in Table 5 above are met. The "±" values listed in Table 5 for the *in situ* measurements are the minimum requirements of field equipment to be used in this project.

Representativeness is also ensured by collection under the specified sampling conditions and index period. Comparability with other water quality data for the area has been pursued through compliance with the use of Kentucky Division of Water procedures or standardized SOPs. It is assumed that all sites will be sampled for this project unless field conditions are such that prerequisite conditions are not present or interferences prevent representative sample collection. It must be thoroughly documented if a sample cannot be collected.

For grab sampling and *in situ* measurements, the sensitivity levels necessary for this program are specified in Table 5 above. For macroinvertebrate sampling, all organisms are to be identified to the lowest possible taxonomic level (genus or species as the key permits) in order to properly calculate the associated metrics.

1.9 Special Training Requirements

Documentation of training will be maintained by the Data Manager. The minimum training requirements for the project tasks are as follows:

1.9.1 Stream Biology

In order to perform the habitat assessments and macroinvertebrate collection and identification for the stream biology surveys, KDOW specifies the minimum training requirements:

- Graduation from a college or university with a bachelor's degree in a biological, environmental, or natural science, which includes at least thirty credit hours in the biological sciences.
- Three years of professional experience in research, environmental impact assessment, or related environmental program areas. Graduate work in the biological, environmental, or natural sciences can substitute for the required experience on a year-for-year basis.
- Proficiency in the identification of macroinvertebrates to the genus level (for macroinvertebrate identification).
- Annual training certificate and audit for macroinvertebrate collection from the KDOW.
- Annual signed affidavit that the QAPP and SOPs have been reviewed.
- Proper / valid state collecting permits.

1.9.2 Water Quality Monitoring

In order to perform field collection of water quality samples, samplers must meet one of the following qualifications:

- Reading and understanding of the associated protocols and this QAPP.

- Minimum of one year of professional experience in water sample collection, research, environmental impact assessment, or related environmental program areas. Degree in the biological, environmental, or natural sciences can substitute for the required experience.

1.9.3 Severe Erosion Surveys

In order to perform severe erosion surveys, field investigators must read and understand this QAPP and associated protocols.

1.10 Documentation and Records

In order to provide quality data that meets the project objectives, traceability and maintenance of documentation and records is essential. All records relating to the collection, analysis, or reporting data associated with the project shall be made available upon request by the KDOW. A summary of such documentation is included below.

1.10.1 Field Documentation and Records

Proper documentation of all field activities is essential to ensure that data quality objectives are achieved. Field crews are expected to document unusual or anomalous conditions that may later be useful for data interpretation and analysis. The forms described below are those that will be utilized in the sampling effort.

Data collected for this project will be recorded in field notebooks, standardized forms, or directly entered into electronic databases. All data recorded in field notebooks are to be scanned and maintained electronically in project files. The following standardized field forms will be utilized in the sampling effort:

- High-Gradient Habitat Assessment Field Data Sheet
- Aquatic Biology Sample Chain-of-Custody
- Macroinvertebrate Collection Check Sheet
- Water Quality Chain-of-Custody
- Calibration and Maintenance Logs
- Erosion Site Datasheet

These field forms are provided in Appendix A. All field standard operating procedures are provided in Appendix B.

Field documentation may include photography or video to document current field conditions. Photographs will also be used to document habitat assessments. All documentation will be retained electronically until September 2022.

1.10.2 Laboratory Documentation and Records

Draft water quality laboratory results will be submitted in an Excel spreadsheet to KDOW no later than 30 days after receipt of the laboratory results. Full results including a quality control review and data package will be submitted with the Final Water Quality Monitoring

Report. The chemical laboratory data package will include the laboratory results, completed chain(s)-of-custody, lists of qualifiers associated with the data, and a report of the quality control results.

Biological data including macroinvertebrate results, habitat assessments, and metric calculations, will be submitted via a Macroinvertebrate Survey and Habitat Assessment Report. This report will include site photographs, habitat assessment scores, macroinvertebrate sample results, macroinvertebrate benchsheets, metric scores, quality control datasheets, completed chain(s)-of-custody, calibration logs, collection check sheets, and qualifications of the field personnel. All chemical and biological data will be archived electronically until September 2022.

All laboratory forms and standard operating procedures are attached in Appendix C.

1.10.3 QA Reports

This QAPP will be distributed to all individuals on the distribution list, subsequent to updating. A list of changes between revisions will be maintained in the document.

After the first sampling event is completed a quality assurance evaluation report (QAER) will be submitted to KDOW within the sampling index period. The QAER will detail the quality processes and controls used in both field sampling and in the laboratory. The QAER will summarize the status of sampling, and outline any deficiencies and discrepancies in the data collection and analysis process. The QAER will include:

- Raw Data
- Calibration records of field instruments
- Field datasheets
- Laboratory package
    - Cover sheet with signatures
    - Analysis results
    - Qualifiers
    - COCs and sample receipt summary
    - Summary of QC
    - Case narratives, as needed
- Summary of sampling event and QC data results
- Map of final sampling sites, if different from QAPP sites

A final Quality Assurance Project Report (QAPR) will be submitted to KDOW at the conclusion of the project. For chemical laboratory data, the report will document all the quality controls associated with the analysis of the collected samples along with a narrative description of the results and a list of all data qualifiers. Macroinvertebrate laboratory quality assurance documentation will include completion of Macroinvertebrate Sample Sorting Efficiency Form, Macroinvertebrate Sample Taxonomy Precision Form, and Macroinvertebrate Sample Taxonomic and Enumeration Efficiency Form.

Field *in situ* measurements are to be recorded on the datasheet, chain-of-custody, or in a field notebook. Equipment calibration and maintenance logs are to be documented and recorded per procedure specifications. Any field issues and corresponding corrective actions will be discussed in the QAPR. All field data will ultimately be submitted in the Water Quality Report, Macroinvertebrate Survey and Habitat Assessment Report, or the Severe Erosion Report. However, all field notes, including the location and frequency of QC sampling, *in situ* measurements, and calibration and maintenance logbooks will be retained until September 2022.

2 DATA ACQUISITION

2.1 Sampling Experimental Design

A systematic sampling design has been utilized for these activities, wherein the sample locations and parameters have been selected based upon evaluation needs.

This monitoring plan is for the Cane Run Watershed (HUC#05100205280200) in its entirety including portions in both Fayette and Scott Counties.

The three key monitoring elements chosen for this project are intended to identify sources of recreational and aquatic habitat impairments to the Cane Run Watershed, including characterization of pollutants and determine specific locations and land uses generating these pollutants.

A total of 11 sites will be sampled within the Cane Run Watershed, and are shown in Exhibit 1. Water quality monitoring will be conducted at all 11 sites, and macroinvertebrates at eight sites. Types of sampling and sampling site locations are described in Table 6. All water quality parameters sampled are critical to this project. *E. coli* is sampled to determine primary contact recreation impairments; NO_2, NO_3, TKN, NH_3, TP, and OP are sampled for nutrient/eutrophication impairments; CBOD-5 is sampled for organic enrichment (sewage) impairments; and TSS is sampled for sedimentation impairments. *In-situ* measurements (DO, DO%, pH, TEMP, Turbidity, and COND) will be sampled to document general water quality conditions. Flow is field measured and is essential to calculating pollutant loading.

TABLE 6 – CANE RUN WATERSHED SAMPLING SITE LOCATIONS

Site ID	Location	Area (mi^2)	WQ	Macro/ Habitat	Latitude	Longitude
1	Cane Run at US 460 Bridge	45.4	X	X	38.210260	-84.611020
2	Cane Run off SR 62	39.3	X	X	38.189400	-84.589200
3	UT to Cane Run off SR 62	2.02	X	X	38.186472	-84.591300
4	UT to Cane Run on Horse Farm off Etter Lane	3.1	X	X	38.175357	-84.571630
5	Cane Run at Landscape Alternatives nursery bridge off US 25	31.8	X	X	38.168000	-84.554250
6	UT to Cane Run in field off of US 25	5	X	X	38.163590	-84.549770
7	Cane Run at Lisle Road	24.9	X	X	38.167065	-84.538907
8	Royal Springs Cave System at Horse Park[1]	N/A	X		38.165237	-84.531324
9	UT to Cane Run at UK Ag Research Farm road bridge	7.4	X	X	38.128800	-84.507080
10	Cane Run at Citation Blvd	5.5	X		38.092322	-84.501381
11	UT to Cane at Coldstream Farm	1.3	X		38.103658	-84.495021

[1] Site 8 is a groundwater monitoring well site. Together with Site 9, these sites measure all pollutants from Fayette County portion of watershed – surface and groundwater.

Sampling locations were chosen based on historic sampling, county breaks, flow conditions, and major tributaries.

Macroinvertebrate results are utilized to calculate a Macroinvertebrate Biotic Index (MBI) rating which provides a water quality rating when compared to regional criteria. Individual macroinvertebrate sampling site locations are described in Table 6. Sites not sampled include one groundwater site (Site 8), and two sites that will be sampled under another project with an approved QAPP. Habitat assessments are utilized to compare habitat conditions at macroinvertebrate sampling sites to regional criteria.

Severe erosion surveys are intended to provide general locations of erosion such that Best Management Practices can be targeted to areas in need of stabilization.

2.2 Sampling Procedures and Requirements

The following paragraphs provide a summary of the sampling methods and equipment associated with each of the monitoring activities. For a complete discussion of the sampling methods, consult the SOPs listed in Table 7. During all monitoring activities, the sampler personnel are to bring the following materials at a minimum: waterproof field notebook, pencils, ink pens, sampling protocols, appropriate field forms, gloves, waders or boots, and a digital camera. Other equipment or materials specific to each sampling type are recorded in the sections that follow.

TABLE 7 – STANDARD OPERATING PROCEDURES

Sampling Activity	Standard Operating Procedures
Macroinvertebrate Collection and Identification	KDOW. 2015. *Methods for Collecting Macroinvertebrate Samples As Required For TMDL Alternative Studies and/or Watershed-Based Plans*. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03039
Habitat Assessment	KDOW. 2011a. *Methods for Assessing Habitat in Wadeable Waters.* Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03024
In situ Measurements	KDOW. 2009a. *Standard Operating Procedure In situ Water Quality Measurements and Meter Calibration.* Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03014
Grab Sampling	KDOW. 2011b. *Standard Operating Procedure Sampling Surface Water Quality in Lotic Systems.* Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03015
Stream Discharge	KDOW. 2010. *Standard Operating Procedure Measuring Stream Discharge*. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03019
Severe Erosion Surveys	MD DNR. 2001. *Stream Corridor Assessment Survey- SCA Survey Protocols.* Maryland Department of Natural Resources, Annapolis, Maryland.

2.2.1 Habitat Assessments

Equipment

A digital camera and High Gradient Habitat Assessment Data Sheet will be utilized in Habitat Assessments.

Method

Habitat assessments include a visual assessment of ten habitat parameters that characterize the stream "micro scale" habitat, the "macro scale" features, and the riparian and bank structure features that are most often influential in affecting the other parameters. KDOW's *Methods for Assessing Habitat in Wadeable Waters* (KDOW 2011a) follows the USEPA's *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers* (Barbour *et al.* 1999). Each of the parameters is evaluated on a "Condition Category" scale from 0 to 20. The categories within this scale include "Optimal" (scores 20 to 16), "Suboptimal" (scores 15 to 11), "Marginal" (scores 10 to 6), and "Poor" (scores 5 to 0). The score for each parameter is summed to produce a final habitat score (maximum 200).

For parameters 1 to 5, the habitat assessment should evaluate a composite of the entire biological sampling reach. For parameters 6 to 10, an area beginning approximately 100-m upstream of the sampling reach through the sampling reach should be evaluated as a composite. When determining left and right bank, face downstream. For parameters 8 to 10, each bank is scored independently from 10 to 0. At each sampling site, results will be recorded on the High-Gradient Habitat Assessment Field Data Sheet. Photographs will be taken to document the following at each site:

- Sampling zone
- Upstream
- Downstream
- Typical in-stream habitats

The individual scores for each parameter are described on the field data sheet. Table 8, page 24, summarizes each of the ten parameters assessed. Full descriptions can be found in the sampling procedure.

Each photo will be labeled with the stream name, location, station number, sampling date, and the features documented in the photo. This data is to be submitted in a photo log with results of the assessment.

TABLE 8 – SUMMARY OF HABITAT ASSESSMENT PARAMETERS

#	Parameter Name	Description
1	Epifaunal Substrate / Available Cover	Relative quantity and the variety of stable structures, such as cobble, boulders, fallen trees, logs, branches, root mats, undercut banks, aquatic vegetation, etc., that provide refugia, feeding opportunities, and sites for spawning and nursery functions.
2	Embeddedness	The extent to which rocks and snags are covered or sunken into the silt, sand, mud, or biofilms (algal, fungal, or bacterial mats) of the stream bottom.
3	Velocity / Depth Regime	Presence of the following patterns of velocity and depth: 1) slow-deep, 2) slow-shallow, 3) fast-deep, and 4) fast-shallow.
4	Sediment Deposition	The amount of sediment that has accumulated in pools and changes that have occurred to the stream bottom as a result of deposition. This may cause the formation of islands, point bars, or shoals. It could also cause runs and pools to fill.
5	Channel Flow Status	The degree to which the channel is filled with water. The score will change with the seasons. Estimate the percentage of the channel that is wet using the low water mark.
6	Channel Alteration	Channel alteration is present when 1) artificial embankments, rip-rap, and other forms of bank stabilization or structures are present, 2) the stream is very straight for significant distances, 3) dams and bridges are present that obstruct flow, and/or 4) dredging or other substrate mining activities are occurring or have occurred.
7	Frequency of Riffles (or Bends)	Estimate riffle frequency by determining the ratio of distance between riffles divided by the width of the stream. An average of the riffle ratios is determined for biological monitoring stations and the upstream segment.
8	Bank Stability	Whether the stream banks are eroded or have the potential to erode. Each bank is scored independently from 10-0.
9	Bank Vegetative Protection	Each bank is scored independently from 10-0. Determine what vegetative types (trees, understory shrubs, herbs, and non-woody plants) are present on each bank. Native vegetation scores higher than invasive or non-native vegetation.
10	Riparian Vegetative Zone Width	The width of the natural vegetation from the edge of the stream bank through the riparian zone. Each bank is scored independently from 10-0. When determining final scores, the age and density of the riparian vegetation should be evaluated (*e.g.,* A score of 9, instead of 10, should be given to a riparian zone that is over 20 m in width, but is dominated by 5-10 year old hardwood trees).

2.2.2 Macroinvertebrate Sampling

Sampling for benthic macroinvertebrates will be conducted according to the Kentucky Division of Water's *Methods for Collecting Macroinvertebrate Samples as Required for TMDL Alternative Studies and/or Watershed-Based Plans* (KDOW 2015). All streams found in the Cane Run Watershed are high gradient streams. Macroinvertebrates will be sampled at three headwater sites and five wadeable sites throughout the Cane Run Watershed. The equipment and methods specific to these collection efforts are described below.

Equipment

Table 9 (page 25) indicates the sampling equipment to be utilized during benthic macroinvertebrate sampling.

TABLE 9 – BENTHIC MACROINVERTEBRATE SAMPLING EQUIPMENT

600µm mesh, 0.25 meter wide rectangular net or kick seine
800 x 900µm D-frame dip net
U.S. Number 10 sieve
U.S. Number 30 sieve
Two - 600µm mesh wash buckets
Medium-sized bucket
300µm nitrex sampler/mesh
Fine-tipped forceps
95% ethyl alcohol
White picking pans
Sample jars and labels
Water quality multi-meter
Field notebook
Chain-of-Custody
Collection Check Sheet

Method

A collection event consists of a composited semi-quantitative sample and a composited multi-habitat sample. Semi-quantitative samples are collected from a known area in order to indicate the macroinvertebrate community in the most productive habitat in the stream niche (*i.e.,* riffle). Multi-habitat samples are intended to identify other taxa present in the stream that may not be collected in the semi-quantitative sampling. These two sample types must be kept separate for effective diagnosis of impairment. A summary of the collection techniques used for wadeable and headwater streams is shown in Table 10 and further described in the following sections.

TABLE 10 – SUMMARY OF SAMPLING METHODS FOR MACROINVERTEBRATES

Technique	Sampling Device	Habitat	Replicates Composited for Wadeable Sites	Replicates Composited for Headwater Sites
Semi-Quantitative				
1m^2 kicknet / seine	Kicknet / seine and wash bucket	Riffle	4 x 0.25m^2 from thalweg or mid-riffle of at least 2 separated riffles	4 x 0.25m^2 from thalweg of at least 2 separated riffles
Multi-Habitat Sweep				
Undercut banks / roots	D-frame or triangular dip net and wash bucket	All applicable	3 from each riffle, run, and pool	3 from each riffle, run, and pool
Sticks / wood			N/A	3
Emergent vegetation			3	N/A
Bedrock / slabrock			3	N/A
J. americana beds			3	N/A
Leaf packs		Riffle, Run, Pool	3 from each riffle, run, and pool	3 from each riffle, run, and pool
Silt, sand, fine gravel	US #10 Sieve	Margins	3	3
Aufwuchs sample	300 µm nitrex sampler / mesh	Riffle, Run, Pool	3	N/A
Rock pick	Fine-tipped forceps and wash bucket		15 total (5 from each riffle, run, and pool)	5 small boulders from pools only
Wood sample			10 - 20 linear feet, 2 - 6 in diameter	7 linear feet, 2 - 6 in diameter

It is important to keep in-stream habitat intended for benthic macroinvertebrate sampling intact and undisturbed until the single and multi-habitat samples have been collected. Therefore, field personnel will avoid walking through areas designated for collection of benthic macroinvertebrates until sampling has been completed. Failure to use caution could result in sample degradation.

After collections are completed, large sticks and leaves are washed into a 600μm sieve bucket in the field, inspected for organisms and discarded. Rocks will be elutriated and hand washed into a bucket and 600μm sieve. This process is repeated until a manageable amount of debris and organisms (relative to size of sample container) can be preserved for laboratory sorting. Samples may be partially field picked using a white pan and fine-tipped forceps. The sample container is preserved with 95% ethanol. While at the sampling location, all macroinvertebrate samples will receive a label. The label will be placed in the sample jar (labels placed in the jar will be written in No. 2 pencil on waterproof paper) and written directly on some portion of the jar. The label will include the site number, stream name, location, type of sample (*e.g.,* multi-habitat, riffle kick), date sampled, and the collectors' initials.

After sampling has been completed, all sampling gear will be thoroughly cleaned to remove all benthic macroinvertebrates so that specimens are not carried to the next site. The equipment shall be examined prior to sampling at the next site to ensure that no benthic macroinvertebrates are present.

DO, DO%, COND, pH, TEMP, and turbidity will be measured *in situ* with a water quality multi-meter at the time of the survey. Results will be recorded in the field notebook.

Semi-Quantitative

In both headwater and wadeable streams, semi-quantitative sampling consists of taking four (4) 0.25m^2 quadrat kick net samples from mid-riffle or the thalweg. This is accomplished using a 0.25 m^2, 600μm mesh kick net, dislodging benthos by vigorously disturbing the 0.25 m^2 (20 x 20 in.) of substrate in front of the net. Large rocks will be hand washed into the net. The contents of the net are then washed and all four samples are composited to yield a 1m^2 semi-quantitative sample. The composited sample is partially field processed using a U.S. No. 30 sieve (600μm) and wash bucket. Large stones, leaves and sticks are individually rinsed and inspected for organisms and then discarded. Small stones and sediment are removed by elutriation using the wash bucket and U.S. No. 30 sieve. This sample must be kept separate from all other sub-habitat collections.

Multi-Habitat

This method involves sampling a variety of non-riffle habitats with the aid of an 800 x 900µm mesh triangular or D-frame dip net. The habitats sampled and the number or size of replicates differs for headwater and wadeable sites, as shown in Table 10, page 25. Each of these sub-habitat samples are composited into one multi-habitat sample for each site. The sub-habitats are fully described in the procedure and summarized below:

- Undercut Banks / Root Mats - large root wads and undercut banks in riffle, run and pool areas, if present, are each sampled separately with three (3) replicates each.

- Marginal Emergent Vegetation - Three 1-meter sweep replicates are required to be sampled for wadeable sites and may be sampled for headwater if present.

- Bedrock or Slab-Rock Habitats - Disturb approximately 0.1m^2 of area to dislodge attached organisms.

- *Justicia americana* Beds - A 1m section with three replicates is required to be sampled for wadeable sites and may be sampled for headwater if present.

- Leaf Packs - "Conditioned" (*i.e.*, not new-fall material) material when possible. Samples are taken from a diversity of habitats (*i.e.*, riffles, runs and pools). Three replicates from each habitat are to be conducted for both headwater and wadeable sites.

- Silt, Sand, and Fine Gravel - A U.S. No. 10 sieve is used to sort larger invertebrates (*e.g.*, mussels, burrowing mayflies, dragonfly larvae) from silt, sand and fine gravel to an approximate depth of 5 cm. A variety of collection sites are sampled in order to obtain three (3) replicates in each substrate type where available.

- Aufwuchs Sample - Rocks, sticks, leaves, filamentous algae and moss. Three replicates are to be conducted only for wadeable sites.

- Rock Picking - 15 rocks (large cobble/small boulders; 5 each from riffle, run and pool) in wadeable streams and 5 small boulders from pools only in headwater streams.

- Wood Sample - For wadeable streams, pieces of submerged wood, ranging from roughly 3 to 6 meters (10 to 20 linear feet) and ranging from 5–15 cm (2–6 inches) in diameter. For headwater streams only 2 linear meters (7 linear feet) are sampled.

2.2.3 Water Quality Monitoring

During water quality monitoring, three types of sampling will be performed: *in situ* measurements, stream flow measurement, and grab sampling.

In situ measurements will be conducted according to KDOW's *Standard Operating Procedure In situ Water Quality Measurements and Meter Calibration* (KDOW 2009a). Turbidity, pH, TEMP, COND, DO, and DO% are measured *in situ* at each site. Stream flow is typically measured in stream using KDOW's *Standard Operating Procedure Measuring Stream Discharge* (KDOW 2010). Grab sampling will be conducted according to KDOW's *Standard Operating Procedure Sampling Surface Water Quality in Lotic Systems* (KDOW 2011b). *E. coli*, NO_2+NO_3, NH_3, TKN, TP, OP, CBOD5, and TSS samples will be collected by grab sampling at each site.

The equipment and methods specific to these collection efforts are described below. Table 11 describes the sampling equipment and supplies to be utilized during water quality monitoring.

Equipment

TABLE 11 – WATER QUALITY MONITORING EQUIPMENT AND SUPPLIES

General	Stream Flow	*In-Situ* Measurement	Grab Sampling
Camera Sharpie marker Field notebook Pencil Chain-of-Custody Powderless latex or nitrile gloves	Equipment Ott MF Pro Flow Meter, or equivalent Top-setting wading rod Tape measure (100 feet in 1/10ft increments)	Equipment Hydrolab MS5 Multiprobe Water Quality Meter, or the equivalent	Equipment 47mm magnetic filter funnel 1L Nalgene flask Teflon or Tygon tubing Forceps Supplies Sample coolers Ice Plastic food storage bags Sample jars and preservatives 0.45µm sterile membrane filters Deionized water Packing tape

All equipment is maintained and calibrated according to user manuals, procedures, and/or manufacturer specifications at a frequency recommended by or exceeding the manufacturer. Calibration standards are to be poured into a separate container for use and discarded when done, not re-used. All calibration and maintenance data is to be recorded in a logbook associated with each piece of equipment.

Prior to conducting *in situ* measurements, the probe will be rinsed with deionized water to remove contamination. The probe will be rinsed and immersed for storage in clean water between sites.

Routine maintenance of the flowmeter involves cleaning the sensor with mild soap and water and checking battery power on a weekly basis or prior to use if used less frequently.

The filter funnel, tubing, flask, and deionized water storage bottles are cleaned prior to each event using a detergent wash and rinse, acid soak and rinse, and deionized water rinse. After every test conducted, all equipment and supplies shall be properly rinsed with deionized water.

Method

Water quality monitoring is to be conducted by two man teams. One team member is to conduct the *in situ* measurements and grab sampling while the other measures the stream flow. Stream flow measurements are to be conducted downstream of the *in situ* measurements and grab sampling. The samplers will approach the site from downstream, ensuring that no disturbed streambed sediment contaminates the measurements. Replicate measurements and duplicate samples are to be made on one site per sampling event.

In situ Measurements

In situ measurements are to be conducted prior to grab sampling. The instrument should be placed in the centroid of the flow (thalweg) in well-mixed location at mid-depth. When possible, the probe should not be deployed directly in riffles, as this will cause some results (DO and turbidity) to appear higher than they actually are. The instrument will be allowed to equilibrate to environmental conditions for approximately 1-2 minutes. Record results in the field notebook and on the COC.

Grab Sampling

Grab sampling is to be conducted just upstream of the *in situ* measurements to ensure that no disturbed streambed sediment contaminates the samples. Samplers will put on powderless latex or nitrile gloves for protection prior to sampling. As with the *in situ* measurements, grab samples should be collected in the centroid of flow in a section of stream in which indicators of complete mixing are evident. When sampling, point the mouth of sample container upstream/against the flow. Submerge the entire bottle and fill it with water. Care will be taken not to displace the preservative since sample bottles are pre-prepared. If the stream is too shallow to fill the bottle while submerged, fill as much as possible while submerged, ensuring the minimal amount for analysis is obtained. Rinse the caps with sample water prior to capping the bottle. Transport to Microbac Laboratory for analysis.

The collection of the orthophosphate sample requires field filtration using a hand pump. This filtration will be conducted within 15 minutes of sample collection. In order to collect this field filtered sample, collect the stream sample using the grab sample methodology. Triple rinse the funnel, funnel filter base, and flask with DI water; and single rinse the hand pump, the inside of tubing, and tweezers with DI water. Use clean forceps to place 0.45 µm paper filter onto funnel filter base. Attach filter base to flask and connect the tubing from the hand pump. Pour 50 mL of DI water into funnel, filter, rinse, and discard. Pour 50 mL of the stream sample water into funnel, filter, rinse, and discard the sample water. Then pour enough stream sample water into the funnel to provide enough finished sample for rinsing the storage bottle and for analysis. If the stream is particularly turbid, smaller amounts of the sample water should be used. When 0.45 µm paper filter becomes excessively clogged, remove the filter with forceps, discard it, and replace with a fresh filter. Continue to filter until the required sample volume is achieved.

Microbial Source Tracking

For microbial source tracking, 20 samples will be chosen for analysis using quantitative polymerase chain reaction (qPCR) for DNA markers of general, human, and ruminant fecal contributions. After each monthly sampling event, a 100 mL aliquot from each site will be filtered by Third Rock at their office through UV sterilized filters. These filters will be rolled and placed in sterile centrifuge tubes, sealed, labeled with permanent marker, packed in a cooler, iced and transported to the University of Kentucky Environmental Research Training Laboratories (UK ERTL) for storage in a negative twenty degree Celcius freezer on the day after the sampling has occurred. Filters will remain at or below four degrees Celsius until they are placed in the freezer.

DNA extractions from frozen filters and PCR assays will be conducted at the ERTL facility at the University of Kentucky. DNA extractions will be completed by bead beating with an internal standard buffer solution described in USEPA 2010, Method B: Bacteroidales in water by Taqman® quantitative polymerase chain reaction (qPCR) assay. The extracts will be stored at -20°C until DNA analysis by qPCR.

All host specific biomarkers for this study were selected from peer reviewed literature and chosen based on availability and best specificity and sensitivity for each host. The markers are:

General (Allbac marker, Layton et al, 2006)
Human (revised qHF183 marker, Green et al, 2014)
Ruminant (BacR marker, Reischer et al, 2006)

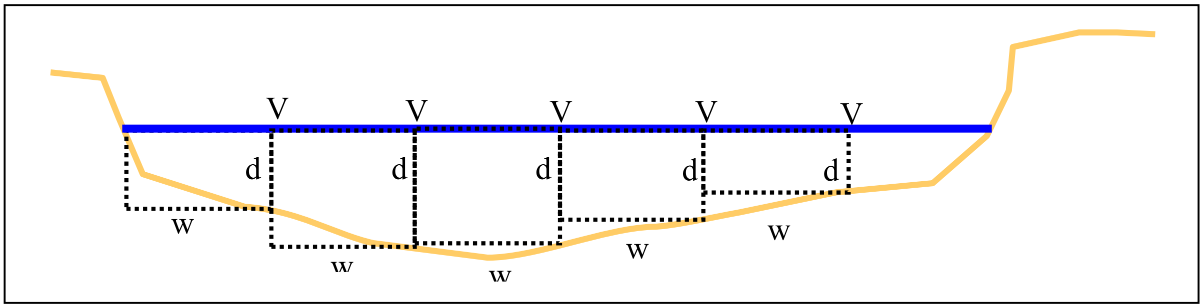
PCR analysis will be performed with LifeTechnologies TaqMan Environmental Mastermix on an Applied Biosystems Step One Plus PCR machine following the thermocyler protocols from each of the associated biomarker publications.

In February – March 2017, Third Rock will work with KDOW to determine the locations and events from this library that should be analyzed to identify fecal sources.

Stream Discharge (Flow)

Stream discharge (Q) is calculated using two variables, flow area (A) and water velocity (V), according to the equation: $Q = AV$. These variables are measured in intervals across the stream and summed as shown in Figure 2. The flow area of each interval is the product of the width (w) and depth (d) for that interval.

FIGURE 2 – MEASUREMENT OF DISCHARGE THROUGH SUBSECTIONAL MEASUREMENTS



Note: Stream cross-section showing intervals where water depth and velocity are measured. Flow will be calculated for each "box" (flow area for each box is $d * w$) and summed to obtain the flow for the entire stream.

To measure stream flow, a tape measure of at least 100 feet is stretched across the stream perpendicular to the stream flow. The tape measure is located directly above the cross-section to be measured and must not touch the water surface. The total width of the stream should be noted to determine a target interval width as follows:

- <20 feet wide, 12-20 intervals
- >20 feet wide, 20-30 intervals

Other considerations for intervals include:

- Average velocity in one interval should not exceed 10% of the total flow.
- Intervals should never be spaced less than 0.2 feet apart.
- Uniform spacing should only be used if the stream is of relative uniform depth and velocity regimes.

A top-setting wading rod will be used to measure water depth and confirm the proper location of the flow meter sensor within the water column at each interval. The wading rod will be held upright and parallel to the stream flow. The sampler will stand beside the flowmeter not to alter the flow. Also rocks, logs, or other obstructions will not be moved during the measurement process as this may cause the stream flow to change in an area of the stream where velocity has already been measured. Once the process of measuring velocity has begun, the stream should not be altered. The wading rod will be adjusted to the appropriate depth at each interval as follows:

- Water depth < 2.5 feet, velocity is measured at 0.6 of the depth, and
- Water depth ≥ 2.5 feet, velocity is measured at 0.2 and 0.8 of the depth.

If the flowmeter calculates the stream flow internally, this value will be record in the field notebook and electronically downloaded after the event is completed.

If the stream cannot be safely waded and a USGS gage is not located at the site, floats can be used to estimate stream discharge. The KDOW (2010) procedure should be consulted in these circumstances.

2.2.4 Severe Erosion Survey

Surveys for severe erosion areas within the Cane Run Watershed will generally follow Maryland Department of Natural Resource's *Stream Corridor Assessment Survey- SCA Survey Protocols* (MDDNR 2001).

Equipment

Equipment for severe erosion surveys include the following: camera, GPS Unit, field maps, pencil, Sharpie marker, field datasheets, clipboard, field notebook, tape measure, and binoculars.

Methods

The Cane Run Watershed will be surveyed for areas of severe erosion either on foot or by a windshield survey from public roads. For the purpose of this project severe erosion is defined as areas where erosion greatly exceeds average reach conditions or threatens property and infrastructure. In locations where permission can be obtained Third Rock staff will walk stream segments in rural Fayette and Scott counties to identify areas of severe erosion. In areas where permission to access streams cannot be obtained surveys will be conducted from public roadways with the aid of binoculars when necessary.

The objective is not to provide quantitative estimates of sediment contribution but to identify high priority areas for implementation of bank stabilization or stream restoration BMPs. During the survey the following will be recorded on an Erosion Site Field Datasheet, to the extent access allows:

- Type of Impact (downcutting, widening, headcutting, unknown)
- Cause (bend at slope, pipe outfall, below channelization, road crossing, livestock, land use change upstream, other)
- Length of Erosion
- Exposed Bank Height (average)
- Left and Right Bank Land Use
- Threat to Infrastructure
- Severity
- Correctability
- Access

Surveyors will mark locations of severe erosion on a high resolution aerial map. Photographs will be made of each location and the length of the erosion marked with GPS waypoints where access allows.

On the datasheet severity, correctability, and access are rated for each severe erosion area. Severity is ranked from 1 (severe) to 5 (minor), correctability ranked from 1 (best) to 5 (worst), and access 1 (best) to 5 (worst).

Factors used to determine erosion severity rating include:

- Length of impact
- Height of stream bank
- Erosion in both bends and run sections
- Erosion rates along stream banks
- Stream channel unstable and readjusting
- Unconsolidated gravel, sands, and silts in the banks
- Stratified soil in the banks
- Stream channel eroded below the root zone of the vegetation along the banks

Examples of severity rating provided by MDDNR (2001) are provided below:

"Severe rating (1): A long section of stream (> 1000 ft.) that had incised several feet, with banks on both sides of the stream that are unstable and eroding at a fast rate. Usually this occurs in areas where there are soft unconsolidated sediments (gravel, sand and/or silts) and the stream has eroded below the root zone of the bank vegetation."

"Moderate rating (3): Either a long section of stream (> 1000 ft.) that has a moderate erosion problem, or a shorter stream reach (between 1000 and 300 ft.) with very high banks (> 4 ft.), and evidence that the stream is eroding at a fast rate."

"Minor rating (5): A short section of stream (< 300 ft.) where the erosion is limited to one or two meander bends or a site where an erosion problem is being caused by a pipe outfall and the area affected is fairly limited."

Factors used to determine correctability rating:

- Length of impact
- Adjacent land use, access and construction staging
- Heavy equipment needed
- How much material (i.e. earth, stone) will be required to be moved
- Funding required

Examples of correctability rating provided by MDDNR (2001) are provided below:

“Best Correctability (1): A short stream reach (< 200 ft.) where the erosion problem can be corrected by simple bioengineering techniques using volunteers in one or two days.”

“Moderate Correctability (3): An erosion problem that could be corrected by a work crew over several weeks, using primarily a backhoe or other small piece of construction equipment. The project may involve using some small rock (< 100 lbs.) to stabilize the toe of a stream bank but most of the work would rely on vegetation and biodegradable material to stabilize the stream banks.”

“Worst Correctability (5): A long reach of stream (i.e., several thousand feet) that had deeply incised several feet and any attempt to actively restore the stream channel would require not only significant funding (i.e., several hundred thousand dollars) but would also involve a large amount of earth moving and disturbance to the riparian corridor.”

Factors determining accessibility rating:

- Land ownership
- Surrounding land use
- Safe access
- Heavy equipment access thru existing roads or trails

Examples of accessibility rating provided by MDDNR (2001) are provided below:

“Rating of 1 is for a site that is easily accessible both by car or on foot. Examples would include a problem in an open area inside a public park where there is sufficient room to park safely near the site. If heavy equipment was needed, it could easily access the site using existing roads or trails.”

“Rating of 3 is for sites that are easily accessible by foot but not easily accessible by a vehicle. Examples would include a stream section that could be reached by crossing a large field or a site that was accessible only by 4-wheel drive vehicles.”

“Rating of 5 is for sites that are difficult to reach both on foot and by a vehicle. Examples would include a site on private land where there are no roads or trails nearby. To reach the site it would be necessary to hike over a mile. If equipment were needed to do the restoration work, an access road would need to be built over a long distance through rough terrain.”

2.3 Sample Handling and Custody Requirements

Sample handling and custody procedures for grab samples are to comply with KDOW’s “Sample Control and Management” (KDOW 2009b). Sample handling and custody for macroinvertebrate samples are to comply with the KDOW procedures corresponding with these sampling methods.

2.3.1 Sample Preservation, Packing, and Transport

The sampler is responsible for sample handling in the field and transporting of samples to the laboratory. The sampler will collect the sample in the appropriately identified collection containers with the correct preservative, as applicable, and ensure that the container lid is secured tightly to prevent leakage and/or outside contamination. Sample containers for chemical analysis shall be placed in plastic food storage bags and then immediately in a cooler on ice to reach and maintain a temperature of 4 ± 2°C for transport to the laboratory. Sample bottles shall be placed in the cooler with lid side up. The containers, preservatives, and hold times for each parameter are to meet the requirements of Table 12. The sampler will ensure that the chain-of-custody (COC) is completely and accurately filled out.

Sample coolers should be of adequate size to allow ice to surround all sample bottles. It is the responsibility of the sampler to ensure that coolers are properly packed in the field and that they have sufficient cooler space on their vehicle for their daily sample load. Coolers shall be secured during transport such that significant disturbance of the samples is avoided.

TABLE 12 – COLLECTION CONTAINERS, PRESERVATIVES, AND HOLD TIMES

Containers	Preservation	Parameters	Maximum Hold Time
Plastic, 4 oz	Cool 4°C, $Na_2S_2O_3$ (No Cl_2)	*E. coli*	6 hours
Plastic, 4 oz	Cool 4°C	qPCR DNA	Filter within 6 hours
Plastic, 32 oz	Cool 4°C	CBOD5	48 hours
		TSS	7 days
Plastic, 8 oz	Cool 4°C, Field filter	OP	48 hours
Plastic, 5 mL	Cool 4°C	NO3, NO2	48 hours
Plastic, 32 oz	Cool 4°C, H_2SO_4 to pH <2	TP, NH3, TKN	28 days

Upon receipt at the laboratory, the sample custodian shall review the COC for completeness and accuracy. Anomalies shall be documented. The laboratory shall measure and record the sample temperature upon receipt, and record any discrepancies with the samples and/or bottle damage on the COC.

2.3.2 Chain-of-Custody

Chain-of-custody forms will be completed for all samples collected in the field and will follow each sample throughout sample processing. A COC is a controlled document used to record sample information, to ensure the traceability of sample handling, and to ensure possession is maintained from the time of collection through analysis and final disposition. A sample is considered in custody if it is:

- In the individual's physical possession,
- In the individual's sight,
- Secured in a tamper-proof way by that individual, or secured in an area restricted to authorized personnel.

The sampling technician shall maintain possession of the sample until custody is transferred to the laboratory or another party. The COC shall accompany the sample from the time of collection until it is relinquished. Field custody is relinquished by signature, with date and time, of the sampling technician in the designated area on the COC.

All information shall be documented on the COC in black or blue waterproof permanent ink including field physical measurements and custody information. The sampling technician shall initiate sample custody at the time the sample is collected. Field custody documentation shall include:

- Verification of Sample Identification
- Number of Sample Bottles Collected
- Collection Date
- Collection Time
- Collector's Signature
- Description of Sampling Location or Site Identifier

Examples of COC forms are included in Appendix A.

2.3.3 Site Identification

A simple unique sample identification system is used to aid in the management of the results. Sites are labeled numerically from the mouth to upstream portions of the Cane Run Watershed. Site 1 is located at the mount of the watershed, and site numbers increase as sites progress upstream terminating in Site 10.

Duplicate samples are to be indicated as such in the unique site identifier ("DD"). The time of collection will not be indicated on the chain-of-custody for duplicate samples so that the laboratory is blind as to the sampling location it corresponds with. This information shall be emailed to the Data Manager. The laboratory shall assume the sampling time is the same as the earliest time on the COC.

2.4 Analytical Methods Requirements

All analytical methods must be United States Environmental Protection Agency (EPA) approved methods.

Detection limits for all parameters must be at a sensitivity level to compare to Kentucky's water quality standards. Each method and reporting limit, by parameter, are found in Table 5, page 16.

All laboratory standard operating procedures are attached in Appendix C. Grab samples collected during water quality monitoring will be analyzed by the Microbac Laboratory except for the microbial source tracking samples which will be analyzed by UK ERTL.

If during the laboratory analysis quality controls fail or contamination occurs, the data is to be reported with qualifiers. Re-sampling might be necessary for certain parameters and could occur as a result of qualified or rejected data.

Third Rock's macroinvertebrate identification laboratory will follow laboratory protocols for benthic macroinvertebrate sample processing, identification, and data reporting per KDOW (2015) with the following exceptions:

- All samples will be logged into Third Rock's Macroinvertebrate Laboratory Information Management System (MacLIMS) upon receipt.
- Sample identification date will be maintained in MacLIMS.
- Taxonomic QA/QC dates (if applicable) will be noted on individual QA/QC forms and maintained electronically in the Project File.
- Initials of the applicable party completing each task associated with sorting, identification, or quality control will be noted electronically in MacLIMS or on associated QA/QC forms.
- QA checks will be documented on applicable forms and maintained in associated project files. These forms include the Macroinvertebrate Sample Sorting Efficiency Form, Macroinvertebrate Sample Taxonomy Precision Form, and Macroinvertebrate Sample Taxonomic and Enumeration Efficiency Form.

2.5 Quality Control Requirements

2.5.1 Field Water Quality Monitoring Quality Control

Field quality control checks for water quality monitoring are collected at a frequency of one duplicate per 20 sites sampled (5%) for each sampling event. Field duplicates must be randomly determined. Based on the number of sites to be sampled on each event, bottles will be distributed to a set number of field teams for collection of a duplicate sample.

At field duplicate sites, two separate samples are to be collected for each parameter. The samples are to be collected at the same time and at the same location. One sample will be labeled as usual, and the other sample will have the site name indicated as a "duplicate". On a form separate from the COC or in an email to the data manager, the site from which the duplicates were collected are to be documented. The laboratory should assume that the duplicate was sampled with the earliest sample for hold time purposes.

Field replicates of *in situ* measurements and field test kits are also to be made at the same site at which field duplicates are collected.

For molecular source tracking quality control, one duplicate sample and one blank will be filtered in field for each sampling event. At least one positive control fecal sample for each host animal species available will be diluted in sterile water, filtered, stored, and transported in the same manner as the samples.

2.5.3 Macroinvertebrate Quality Controls

According to the specifications listed in KDOW 2015, the following quality controls of macroinvertebrate identification will be applied for this project:

> Field personnel must be trained by KDOW in macroinvertebrate collection procedures annually. Additionally field crews will be audited by KDOW personnel once a year.
>
> Ten percent (10%) of all sorting pans will be checked by a second sorter to assure that samples have been picked thoroughly. These samples will be randomly selected. This check is documented on the Taxonomic and Enumeration Efficiency Form.
>
> Five percent (5%) of all identified samples will be re-identified to insure QA/QC by a second taxonomist. These samples will be randomly selected, and documented on the Macroinvertebrate Sample Taxonomy Precision Form and Macroinvertebrate Sample Taxonomic and Enumeration Form. Ninety percent (90%) or greater taxonomic agreement between taxonomists is the target success criteria. If there is less than 90% agreement between the taxonomists, then taxonomy must be reconciled by both taxonomists and a third taxonomist, if necessary.
>
> All macroinvertebrate data entry for all sites will be chosen for data entry QA/QC. Data entry errors will be corrected as they are encountered. Data entry will be 95% correct to pass quality assurance. If patterns of data entry error exist and data entry error rate is less than 95%, all sample sites will be checked for specific errors.

2.5.4 Laboratory Quality Controls

Laboratory quality controls will be analyzed as specified in the SOPs listed in Appendix C. These controls include method blanks, matrix spikes, calibration check samples, laboratory replicates, and other method-specified controls. The frequencies of analysis for these standards are all specified by the individual methods.

2.6 Requirements for Equipment and Supplies

Laboratory instrumentation will be maintained according to the methods listed in Table 5, page 16, and the associated SOPs in Appendix C. Field sampling equipment will be maintained according to the SOPs listed in Table 7, page 23, and summarized in Table 13. The record of inspection, calibration, and maintenance will be recorded in an instrument logbook maintained by the sampler. For sampling nets and bottles, inspection will ensure that the items are free from contamination, in good condition, and adequate for use.

Third Rock personnel will ensure that field multi-meters are calibrated according to manufacturer's instructions the day before or the day of sampling. The multi-meters will be calibrated using a three-point pH calibration, where possible, and a one-point conductivity calibration. Dissolved oxygen is calibrated using saturated air and the barometric pressure of the sampling location. All results are recorded in the instrument logbook.

TABLE 13 – FIELD EQUIPMENT CALIBRATION AND MAINTENANCE

Equipment Name / Type	Purpose	Inspect Before Each Collection Event	Calibration Frequency	Calibration Standard or Type	Person(s) Responsible
Multiprobe Water Quality Meter	pH, Conductivity, Dissolved Oxygen, Temperature Turbidity	Overall condition/ battery power	Within 24 hours of sampling	pH (4, 7, 10) Cond (300 – 1200) DO (Sat. Air) Turb (0, 100)	Sampling Coordinator / Sampler
Macroinvertebrate Sampling Nets	Macroinvertebrate Sampling	Overall condition/ no holes	N/A	N/A	Sampler
Sample Bottles	Sample Collection	Good condition	N/A	N/A	Sampler

Overall condition and battery power will be inspected on all equipment prior to use. Additionally, extra batteries or fuses should be kept in the field vehicle in case of power failure.

All calibration standards and reagents will be reviewed prior to use to ensure that they have not reached the expiration date.

2.7 Data Acquisition Requirements for Non-Direct Measurements

For the purpose of this project, the following sources of non-direct measurements will be utilized:

- USGS Gage Data
- Precipitation Data (Various Sources)
- LFUCG MS4 Permit Compliance Monitoring Data
- TMDL Studies
- 2011 Cane Run and Royal Springs Watershed Based Plan
- Kentucky River Watershed Watch Volunteer Data
- KDOW Monitoring Program Data
- University of Kentucky Research Projects
- Kentucky Geological Survey Groundwater Studies
- DMR Reports from KPDES Permits

Antecedent dry periods will be evaluated using local precipitation data. The UKAg Weather Center (http://wwwagwx.ca.uky.edu/) will be the primary source for precipitation data in evaluating the antecedent dry period. Historic daily precipitation levels will be obtained from stations in Fayette County at either Weather Underground (http://www.wunderground.com/), Kentucky Mesonet (http://www.kymesonet.org/), USGS stream gages (http://waterdata.usgs.gov/KY/nwis/), or NOAA (http://www.noaa.gov/).

Data previously collected under the LFUCG MS4 monitoring program may be used in data comparisons, as these data were collected under similar protocols. Other sources of data that may be utilized for comparisons include TMDL studies, data from Kentucky River Watershed Watch volunteers, data from the Kentucky Division of Water monitoring program, research projects from the University of Kentucky, groundwater studies from KGS, KPDES permit DMR reports, and data collected through the 2011 Cane Run and Royal Spring Watershed-Based Plan (UKBAE 2011).

2.8 Data Management Requirements

For macroinvertebrate, and habitat data, data will be collected in the field and recorded in field notebooks, on field data sheets, or on COCs. The field samplers are responsible to ensure that all hard copies are scanned and saved electronically in Third Rock's project files. Additionally, hard copies are to be stored in the project files. Third Rock's Chief Taxonomist / Biologist will be responsible for reviewing all field results, ensuring that macroinvertebrates are properly sorted and identified, ensuring that all applicable metrics are properly calculated, and submitting the results to the Data Manager.

Data collected during water quality sampling will be recorded on COCs. Microbac Laboratory will send electronic copies of all laboratory reports and COCs used in the collection of water quality samples to the Data Manager. These will be stored in Third Rock's files. The electronic files will be reviewed and information including the field duplicate site, precipitation levels, field measurements, and field flows will be entered by the Data Manager. All results will be reviewed and any outlier results will be investigated by the Data Manager and the laboratory. All results will be reviewed and any outlier results will be investigated by the Data Manager and the laboratory.

For severe erosion data, data will be collected in the field and recorded in field notebooks, and on field data sheets. The field samplers are responsible to ensure that all hard copies are scanned and saved electronically in Third Rock's project files. Additionally, hard copies are to be stored in the project files. Third Rock's Data Manager will be responsible for reviewing all field results, and ensuring field data sheet completeness.

All macroinvertebrate, and habitat data will be published in the Macroinvertebrate and Habitat Assessment Report. Water quality data will be published in the Water Quality Report, and the severe erosion data will be published in the Severe Erosion Summary Report.

3 ASSESSMENTS

Assessment and response actions are necessary to ensure that this QAPP will be implemented as approved. For a general summary of these assessments see Table 14.

TABLE 14 – DATA ASSESSMENT AND MANAGEMENT REPORTS

Type	Frequency	Purpose	Parties Responsible For		Reporting Method
			Performing	Responding	
QAPP Revision	As necessary	Address non-conformances or errors in the QAPP	Project Team Members	Data Manager	Distribution of amended QAPP
KDOW Audit	As requested	Ensure conformance to project objectives	KDOW	Parties of concern	Corrective Action Response
Laboratory Demonstration of Performance	Annually, at minimum	Ensure analyst is capable of performing the method to specifications	Laboratory QA Director	Laboratory Analysts	Internal lab documentation
Laboratory On-Site Audit	Once per five Years	Maintaining Kentucky Wastewater Laboratory Certification	KDOW	Laboratory Analysts	KDOW Audit Report
Laboratory Internal Audits	Annually, at minimum	Ensure conformance to methods, regulations, and procedures	Laboratory QA Director	Laboratory Analysts	Internal lab documentation
Field Biology Training and Audit	Annually	Evaluate quality of habitat assessments and macroinvertebrate collection	KDOW	Third Rock Biologists	Training Certificate and Audit Form
Analytical Results Review	Subsequent to each sampling event	Evaluate the conformance of laboratory data to project DQOs	Data Manager	Laboratory QA Director	Email
Quality Assurance Evaluation	After the first sampling event	Summarize quality controls for both field and laboratory, sampling status, and outline any deficiencies in data collection and analysis.	Data Manager	KDOW	Quality Assurance Evaluation Report
Project Quality Assurance	Conclusion of the project	Document all quality controls and data qualifiers for all field and laboratory results, including calibration and maintenance logs and compare the data produced to project DQIs	Data Manager	KDOW	Quality Assurance Project Report, Macroinvertebrate and Habitat Assessment Report

If at any time a project team member finds an error or non-conformance in the QAPP, the QAPP will be revised and redistributed to those on the distribution list subsequent to approval.

To ensure conformance with this QAPP and the applicable regulations, certifications, and methods by which the laboratories operate, the laboratories will perform several assessment measures. To ensure that analysts are capable of performing the requested analytical methods to specifications, each analyst must acceptably demonstrate this ability prior to conducting sample analyses. The analyst must conduct four replicate analyses of a known standard and achieve precision and accuracy equal to or better than the acceptance ranges for laboratory duplicates and laboratory control samples, respectively. The laboratory QA Director or his appointee on an annual basis will perform internal audits. The findings of the audits, both positive and negative, will be documented, and the corrective response to the cited deviations will be made. Corrective actions will be submitted to the auditing body for review and approval.

Upon receipt of the results, a review of the laboratory and field data shall be performed by the Data Manager or his designee to ensure that the project DQOs have been satisfied. Email shall be utilized to communicate the results found in these evaluations. The quality of the data collected shall be reviewed and summarized in the Quality Assurance Project Report.

4 REVIEW, EVALUATION AND REPORTING REQUIREMENTS

Data verification, data validation, and data usability are each terms used to describe data review and evaluation. Data verification is the review of data sets for completeness, correctness, and conformance/compliance for a specific data set against the method, procedural, or contractual specifications. Data validation is an analyte and sample-specific process that determines the quality of a specific data set relative to its end use. Validation notes any deviations from the QAPP. Data usability is a determination of the adequacy of the data based on verification and validation, to ensure the QAPP criteria are met.

4.1 Validation and Verification Methods

The EPA guidance document *Guidance on Environmental Data Verification and Validation* (EPA QA/G-8) (EPA 2002) guides the overall process by which data will be validated and verified.

The sampler will perform data review for all field data initially before submitting to the laboratory. Upon submission to the laboratory, the laboratory will review the COC for completeness and document any non-conformances on the COC.

For the chemical laboratory data, the laboratory analyst will initially conduct the review, and the data will be peer reviewed by another analyst or capable reviewer. Data will be reviewed according to the laboratory QA Manual and the method specific SOP for data entry, calculations, and transformations as well review of quality control criteria. If deviations are noted, corrective actions will be taken with verification of both the reviewer and the original data collector. If consensus cannot be reached, the data will be rejected. During verification and validation of the data, all data that does not meet the DQIs listed in this QAPP will be qualified or rejected. A list of the type of qualifiers that may be applied to this data is listed in Table 15, page 45. Laboratory codes that correspond to these general types are listed in the laboratory procedures in Appendix D. All qualified data will be evaluated according to the actions listed.

If results are rejected, the laboratory should re-analyze the samples if possible. Re-sampling will not be conducted for the rejected parameters.

The Data Manager will document non-conformances in the data via email and in the Water Quality Monitoring Report, and the QAPR. This review will be submitted to the KDOW in the final reports. The Data Manager will be responsible for making decisions concerning data quality and acceptability. KDOW may also make determinations on data acceptability, depending on data analysis and review during audits, the QAER and other check procedures throughout the project.

TABLE 15 – DATA QUALIFIERS AND RESPONSE

Definition	Action To Be Taken
Analyte detected in associated method blank	Reject results. Indicates all, or a portion of, the amount found in a sample may be due to laboratory sources.
Diluted out	Accept results. Indicates a dilution to overcome matrix effects caused other analytes of interest to be diluted out of range. Normal quantitation is not available.
Holding time exceeded	Reject results. Method-required holding time is exceeded.
Estimated value	Accept results when used to indicate result is below the project reporting limit, but above the Method Detection Limit (MDL).
Matrix spike and/or matrix spike duplicate recovery outside acceptance limits	Accept results if associated Laboratory Control Sample is acceptable (No qualifier). Indicates matrix is adversely affecting the extraction or digestion of the analyte. If the Matrix Spike recovery is below acceptable limits, it may be likely that the reported results for the associated samples may be underestimated. Conversely, if the Matrix Spike results are high, it may be likely that the reported results for the associated samples may be overestimated.
Laboratory control sample outside acceptance limits	Reject or qualify results. Indicates that the laboratory system is out of control. Qualification should indicate the result is estimated.
Sample received exceeding proper temperature or preservation criteria	Reject results. Indicates preservatives or temperature requirements have not been met and the bias on the sample result is unknown.
Analyzed but not detected in sample	Accept results. Indicates that the result is less than the reporting limit.
Analyte exceeded calibration range	Accept results. Only reported in instances in which the calibration curve is exceeded and the sample cannot be reanalyzed.
Laboratory replicate / duplicate precision outside of acceptance limits	Reject or qualify results, unless it occurs on a matrix spike duplicate or due to low recoveries with high relative percent difference. Indicates precision is outside of normal acceptance criteria due to lack of homogeneity or other factors. Qualification should indicate the result is estimated.
Calibration criteria exceeded	Reject results. Indicates that the laboratory system is out of control.

All final reports will receive an internal peer review to evaluate the content, calculations, and data analysis in the report. The reports will also undergo an internal grammatical review to look for grammatical errors and formatting. Lastly, the final report will receive a review from the Data Manager prior to submission to the KDOW to ensure that all project objectives are achieved.

4.2 Reconciliation with Project Requirements

In each report, descriptions of all relevant background information, summary, waterbody details, monitoring results, recommended solutions, and implementation plans will be detailed. Included in these documents will be an overall assessment of the data quality and the uncertainty involved in the results.

5 REFERENCES AND CITATIONS

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EPA. 2002. Guidance on Environmental Data Verification and Validation (EPA QA/G-8). Office of Environmental Information, Washington, DC. EPA/240/R-02/004

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6 APPENDICES

All SOPs and other supporting documentation listed in these appendices to the QAPP may be provided electronically upon request.

A: Field Forms

- High-Gradient Habitat Assessment Field Data Sheet
- Photo Log Data Sheet
- Aquatic Biology Sample Chain-of-Custody
- Headwater Macroinvertebrate Collection Check Sheet for High-Gradient Streams
- Wadeable Macroinvertebrate Collection Check Sheet for High-Gradient Streams
- Water Quality Chain-of-Custodies
- Calibration and Maintenance Logs
- Severe Erosion Datasheet

B: Field Methods

- KDOW. 2015. *Methods for Collecting Macroinvertebrate Samples As Required For TMDL Alternative Studies and/or Watershed-Based Plans*. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03039
- KDOW. 2011. Methods for Assessing Habitat in Wadeable Waters. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03024
- KDOW. 2009. *In situ* Water Quality Measurements and Meter Calibration Standard Operating Procedure. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03014.
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- KDOW. 2010. Measuring Stream Discharge Standard Operating Procedure. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03019

C: Laboratory Forms and Methods

Forms

- Macroinvertebrate Sample Sort Efficiency Form
- Macroinvertebrate Sample Taxonomy Precision Form
- Macroinvertebrate Sample Taxonomic and Enumeration Form

Methods

- KDOW. 2015. *Methods for Collecting Macroinvertebrate Samples As Required For TMDL Alternative Studies and/or Watershed-Based Plans*. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03039
- KDOW. 2009. Sample Control and Management Standard Operating Procedure. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. DOWSOP03001
- Microbac Laboratory SOPs.

D: Maps

Exhibit 1	Cane Run Watershed Sampling Sites
Exhibit 2 & 3	Cane Run Watershed Field Map Grid Layout
Field Maps	Exhibits 1 thru 106

APPENDIX B

Prepared for Kentucky Division of Water
Prepared by Third Rock Consultants, LLC, December 15, 2017

Wolf Run Watershed Plan
Benchmark Recommendations for Nutrient Parameters
Kentucky Division of Water
2/2/12

Nutrient benchmarks given here represent the best information available to the Kentucky Division of Water (KDOW) at this time. The goal is to provide estimates of typical in-stream concentrations below which it is unlikely that nutrients would be a cause of observed impairments. As such, benchmarks are useful in identifying sub-basins with potential nutrient issues when setting priorities for further monitoring or for development of load reduction strategies. In making these recommendations we consider regional and watershed-specific nutrient expectations, regional-scale patterns in biological effects, and the specific indicators of nutrient enrichment observed in the watershed. These benchmarks may be different than targets to be used ultimately as management endpoints; watershed-specific characteristics, practical considerations, and insight gained from early phase monitoring might suggest alternate values for that purpose. The Watershed Group may wish to discuss with KDOW alternative benchmarks and/or targets based on more detailed local information or consultation with experts familiar with the watershed. A summary of candidate benchmarks is given here along with a final set of recommendations to provide more assistance in interpreting nutrient data.

Ecoregional Reference Reach candidate benchmarks:

The Reference Reach network of streams represents the least-impacted conditions for aquatic life in the respective ecoregions. The Wolf Run watershed is entirely within ecoregion 71l (Inner Bluegrass). The significance of the regional placement of the watershed is that the phosphorus content of the formations of the Lexington Limestone found in the Inner Bluegrass is high relative to the geology typical of the Outer Bluegrass and Hills of the Bluegrass (ecoregions 71d and 71k). Nitrate concentrations also may be influenced by this geologic setting. These differences are reflected in the summary table below: total phosphorus and nitrate-nitrite-N are substantially higher in Reference Reaches of 71l than in the Bluegrass as whole (71l plus 71d Outer Bluegrass and 71k Hills of the Bluegrass).

	Ecoregion	Number Samples	MIN	MAX	MED	**75th percentile**	90th percentile
TP(mg/L)	71l	13	0.117	0.46	0.304	0.338	0.396
	BG	114	<0.010	0.46	0.053	0.109	0.244
NN(mg/L)	71l	14	0.108	4.07	1.292	2.628	3.167
	BG	117	<0.010	4.07	0.085	0.372	1.108
TKN(mg/L)	71l	14	<0.200	0.756	<0.200	0.351	0.537
	BG	116	<0.200	1.230	0.216	0.404	0.625
TN(mg/L)	71l	14	0.409	4.170	1.674	2.953	3.272
	BG	116	<0.200	4.170	0.439	0.798	1.520

Watershed reference candidate benchmarks:

When there are segments within the watershed or within closely comparable watersheds where uses are fully supported, then nutrient data from those streams can be summarized as a "watershed reference". These need not be Reference Reaches designated by KDOW, but should have been assessed as being fully supporting of the most sensitive use, in this case aquatic life, and are closely comparable. It is notable that most of the streams in 71l that have been assessed as fully supporting aquatic life use are in the Kentucky River Palisades along the Kentucky River, an area with more rugged terrain where streams have higher gradients and distinctive biological communities relative to other parts of 71l. One exception is Steeles Run, which enters Town Branch 9 miles downstream of Wolf Run. Steeles Run has been assessed as fully supporting aquatic life use; however, the stream does exhibit indicators of excess nutrients such as dense algae growths. There is only one water sample from this stream, with TP 0.382 mg/L and TN 5.58 mg/L.

Effects-based (empirical) candidate benchmarks:

The entire watershed falls within the Bluegrass Bioregion and is not near a boundary. The benchmarks from a KDOW draft bioregional nutrient benchmarks report for the Bluegrass Bioregion are TP 0.1 mg/L, TN 1.2 mg/L; however, it is noted that background nutrient concentrations vary widely within the Bluegrass (as discussed above)and so these bioregional benchmarks must be modified according to local watershed characteristics. As indicated in the report, the relationships between nutrients and biological integrity are difficult to detect from analyses of KDOW's Bluegrass data. It is evident, though, that streams in the Inner Bluegrass with good instream habitat, intact riparian zones, well shaded channels, and normal flow regimes support desirable good quality aquatic communities at levels of TP and TN higher that might produce problems in streams in other regions.

Literature values

TP 0.1 mg/L is often cited as an upper threshold for preventing nuisance algae growth, which is one of the indicators of impairment observed in the Wolf Run watershed. That figure is well below 71l Reference Reach levels and also below levels in streams in the ecoregion observed to be fully supporting aquatic life use. Literature guidelines for the boundary between oligotrophic and mesotrophic conditions are TP 0.025 mg/L and TN 0.700 mg/L. The boundary between mesotrophic and eutrophic conditions are given as TP 0.075 mg/L and 1.5 mg/L. Reference Reaches and watershed reference data summarized above place those streams well into the eutrophic category for both TN and TP.

Summary

In the Inner Bluegrass it is particularly important to take an adaptive approach to setting expectations for nutrients. Background concentrations alone may be high enough that streams without good riparian condition, canopy cover, and in-stream habitat are likely to show signs of nutrient-related problems with little additional enrichment. In addition, stressors other than nutrients are common and may exacerbate nutrient impacts. The benchmark recommendations given here were derived from the median ecoregional Reference Reach data. These benchmarks should be reviewed as more information becomes available on conditions in the Wolf Run watershed, including the specific nutrient-related issues that may be occurring, the feasibility of nutrient reductions, and the importance of nutrients in causing undesirable effects to aquatic life relative to other stressors, such as high specific conductance.

Final benchmark recommendations:

Total P	0.30 mg/L
TKN	0.20 mg/L
Nitrate-Nitrite-N	1.3 mg/L
Total N	1.7 mg/L

Excerpts from Wolf Run Watershed Based Plan, Chapter IV, Pages 14-15

"For other parameters, no regulatory numeric standard has been established due to the variable relationship between biological integrity and concentration levels in different streams. Multiple factors are impacting warmwater aquatic habitat use of the Wolf Run Watershed, including poor riparian and in-stream habitat and poor hydrology/flow regime as well as elevated water quality parameters. Because of the uncertainty in assigning definitive thresholds for these parameters as well as the feasibility and cost-effectiveness of reducing concentrations, a phased approach was utilized in the development of benchmarks for non-regulatory water quality parameters.

Under this phased approach, non-regulatory reference points are initially established higher than reference conditions since the reference levels may be well below the level necessary to restore support of the use. These target levels are established based the extent and magnitude of the problem as well as technological feasibility, cost, and achievability. These goals would be re-assessed through the watershed planning process on regular time intervals and lowered if the designated use does not become fully supported through the implementation plan efforts when target levels are achieved. Table 23, page IV-14, lists the non-regulatory reference points for the Wolf Run Watershed. These levels were developed in consideration of the recommendations made by KDOW, are applicable only for the Wolf Run Watershed, and are not intended to have any regulatory use.

The rationale behind the selection of these non-regulatory reference points is as follows. The nutrient levels (total phosphorus at 0.35 mg/L and total nitrogen at 3.0 mg/L) were each established between the 75th and 90th percentile concentrations for reference reaches in the Inner Bluegrass. The ammonia benchmark of 0.1 mg/L was near the 75th percentile for the Wolf Run data collected. These higher concentrations were utilized based on published literature (Pond *et al.* 2003), which indicates that nutrient concentrations are not well correlated with macroinvertebrate metrics in the Bluegrass Bioregion. The main stem of the Ohio River has a specific conductance limit of 800 µS/cm, which was considered too high for this region. The benchmark of 650 µS/cm was established near the average of the Wolf Run sampling site medians…."

APPENDIX C

Prepared for Kentucky Division of Water
Prepared by Third Rock Consultants, LLC, December 15, 2017

REVISED CERTIFICATE OF ANALYSIS

6061975

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington, KY 40503

Original Date Reported	06/28/2016
Report Reissued	07/05/2016
Date Received	06/27/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 01 **1**									**Sampled** 06/27/2016 @ 12:09	
Sampled By Customer										
Flow by Calculation			3.34	CFS			EPA 600		06/27/2016 12:09	CUS
Oxygen, Dissolved			9.10	mg/L			SM 4500 O G	0.10	06/27/2016 12:09	CUS
Specific Conductance at 25 °C			574	umhos/cm			CLIENT SPECIFIED		06/27/2016 12:09	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1	06/27/2016 12:09	CUS
E. coli			387.3	MPN/100mL			SM9223B (Colilert-18)		06/27/2016 18:05	DZW
pH			7.91	SU			CLIENT SPECIFIED	1.00	06/27/2016 12:09	CUS
Temperature			28.4	deg C			CLIENT SPECIFIED		06/27/2016 12:09	CUS
Sample: 02 **2**									**Sampled** 06/27/2016 @ 12:35	
Sampled By Customer										
Flow by Calculation			1.85	CFS			EPA 600		06/27/2016 12:35	CUS
Oxygen, Dissolved			7.90	mg/L			SM 4500 O G	0.10	06/27/2016 12:35	CUS
Specific Conductance at 25 °C			626	umhos/cm			CLIENT SPECIFIED		06/27/2016 12:35	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1	06/27/2016 12:35	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		06/27/2016 18:05	DZW
pH			7.60	SU			CLIENT SPECIFIED	1.00	06/27/2016 12:35	CUS
Temperature			29.0	deg C			CLIENT SPECIFIED		06/27/2016 12:35	CUS
Sample: 03 **4**									**Sampled** 06/27/2016 @ 13:50	
Sampled By Customer										
Flow by Calculation			0.01	CFS			EPA 600		06/27/2016 13:50	CUS
Oxygen, Dissolved			10.10	mg/L			SM 4500 O G	0.10	06/27/2016 13:50	CUS
Specific Conductance at 25 °C			417	umhos/cm			CLIENT SPECIFIED		06/27/2016 13:50	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1	06/27/2016 13:50	CUS
E. coli			2419.6	MPN/100mL			SM9223B (Colilert-18)		06/27/2016 18:05	DZW
pH			8.40	SU			CLIENT SPECIFIED	1.00	06/27/2016 13:50	CUS
Temperature			25.6	deg C			CLIENT SPECIFIED		06/27/2016 13:50	CUS
Sample: 04 **5**									**Sampled** 06/27/2016 @ 13:25	

The data and other information contained on this, and other accompanying documents, represents only the sample (s) analyzed and is rendered upon the condition that it is not to be reproduced wholly or in part for advertising or other purposes without written approval from the laboratory.

REVISED CERTIFICATE OF ANALYSIS

6061975

Third Rock Consultants
Marcia L. Wooton

Report Reissued 07/05/2016
Date Received 06/27/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 04 **5** Sampled By Customer									**Sampled** 06/27/2016 @ 13:25	
Flow by Calculation			1.43	CFS			EPA 600		06/27/2016 13:25	CUS
Oxygen, Dissolved			15.60	mg/L			SM 4500 O G	0.10	06/27/2016 13:25	CUS
Specific Conductance at 25 °C			596	umhos/cm			CLIENT SPECIFIED		06/27/2016 13:25	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1	06/27/2016 13:25	CUS
E. coli			547.5	MPN/100mL			SM9223B (Colilert-18)		06/27/2016 18:05	DZW
pH			8.40	SU			CLIENT SPECIFIED	1.00	06/27/2016 13:25	CUS
Temperature			27.3	deg C			CLIENT SPECIFIED		06/27/2016 13:25	CUS
Sample: 05 **6** Sampled By Customer									**Sampled** 06/27/2016 @ 14:51	
Flow by Calculation			1.05	CFS			EPA 600		06/27/2016 14:51	CUS
Oxygen, Dissolved			6.80	mg/L			SM 4500 O G	0.10	06/27/2016 14:51	CUS
Specific Conductance at 25 °C			626	umhos/cm			CLIENT SPECIFIED		06/27/2016 14:51	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1	06/27/2016 14:51	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		06/27/2016 18:05	DZW
pH			7.50	SU			CLIENT SPECIFIED	1.00	06/27/2016 14:51	CUS
Temperature			24.0	deg C			CLIENT SPECIFIED		06/27/2016 14:51	CUS
Sample: 06 **8** Sampled By Customer									**Sampled** 06/27/2016 @ 11:05	
E. coli			155.3	MPN/100mL			SM9223B (Colilert-18)		06/27/2016 18:05	DZW
Sample: 07 **9** Sampled By Customer									**Sampled** 06/27/2016 @ 15:33	
Flow by Calculation			0.01	CFS			EPA 600		06/27/2016 15:33	CUS
Oxygen, Dissolved			5.40	mg/L			SM 4500 O G	0.10	06/27/2016 15:33	CUS
Specific Conductance at 25 °C			387	umhos/cm			CLIENT SPECIFIED		06/27/2016 15:33	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1	06/27/2016 15:33	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		06/27/2016 18:05	DZW
pH			7.60	SU			CLIENT SPECIFIED	1.00	06/27/2016 15:33	CUS

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REVISED CERTIFICATE OF ANALYSIS

6061975

Third Rock Consultants
Marcia L. Wooton

Report Reissued 07/05/2016
Date Received 06/27/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 07 **9** Sampled By Customer									**Sampled** 06/27/2016 @ 15:33	
Temperature			27.1	deg C			CLIENT SPECIFIED		06/27/2016 15:33	CUS

Revised to correct report subject line. LLM 7-5-16

Qualifier Definitions

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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COC#:

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P.O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	SA	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix*	Collection Date	Collection Time	Grab/Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P.O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	6-27-16	1209	G	Y*/N	1	1	1	1	1	9.1	120	7.91	573.7	28.4	1.5	3.34
	2	SW	6-27-16	1235	G	Y*/N	1	1	1	1	1	7.4	106.5	7.6	625.5	29.0	3.4	1.85
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	4	SW	6-27-16	1350	G	Y*/N	1	1	1	1	1	10.1	128.2	7.5	416.8	25.6	2.1	0.01
	5	SW	6-27-16	1325	G	Y*/N	1	1	1	1	1	15.6	203.4	8.4	596.4	27.3	0	1.43
	6	SW	6-27-16	1451	G	Y*/N	1	1	1	1	1	6.8	93.2	7.5	626	24	0.5	1.05
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	8	SW	6-27-16	1105	G	Y*/N	1	1	1	1	1							*
	9	SW	6-27-16	1533	G	Y*/N	1	1	1	1	1	5.4	69.9	7.6	387.2	27.1	0	0.01
	~~10~~	SW			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~DD~~	~~SW~~		~~******~~	G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	6-27-16/5:39pm	Lisa Martin	6-27-16 1739

Temp. Upon Receipt (C): 14.0 Measured By: LM
Containers Properly Preserved: [✓ Yes] / No) L10
Bottles Intact: [✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

REVISED CERTIFICATE OF ANALYSIS

6061976

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington, KY 40503

Original Date Reported	06/28/2016
Report Reissued	07/05/2016
Date Received	06/27/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Max	Method	Analysis Date	Tech
Sample: 01 **DD**							**Sampled** 06/27/2016	
Sampled By Customer								
E. coli			866.4	MPN/100mL		SM9223B (Colilert-18)	06/27/2016 19:10	LLM

Revised to correct report subject line. LLM 7-5-16

Qualifier Definitions

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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6061976 LISA MARTIN

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CHAIN OF CUSTODY

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502.962.6411 f

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2701 N. Cullen Ave., Ste. A
Evansville, IN 47715
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812.424.0667 f

5309 Reidland Rd.
Paducah, KY 42003
270.898.3637 p
270.898.3666 f

100 Grand Vue Plaza, Ste. 22
Hazard, KY 41701
606.487.0511 p
606.910.0086 f

Client: Third Rock
Street Address:
City / State / Zip:
Phone: ( ) Fax: ( )
Email:
Attention: PO #:
Sampler: C- Boyd
Site / Project Name:

Due Date: ____

Analyses Requested

	Date / Time	Sample ID / Description	Number of Containers	Type of Container Plastic, clear glass, vial, etc.	Preservative in Container None, HNO_3, H_2SO_4, NaOH, etc.	Sample Matrix Soil, Sludge, Water, Oil, etc.	RUSH* (Fill-in desired TAT)	E. Coli												
	6-27/~~7:30~~	DD	1	P	Sodthio	W												
	LM																			
	6-27-16																			

Relinquished By:	Date: 6/27/16	Time: 7:30pm
Received By:	Date: 6/27/16	Time: 1900
Relinquished By:	Date: / /	Time:
Received By:	Date: / /	Time:
Relinquished By:	Date: / /	Time:
Received By:	Date: / /	Time:

Notes: No times on dups per protocol

To be filled out by Microbac
Temp. Upon Receipt (°C): 13.0 Thermometer ID: L10 No. Bottles Received: 1
Samples Received on Ice? Yes [✓ No] Custody Seals Intact? Yes No [✓ N/A]

Version 05.19.2015

*Standard RUSH TAT Charges: Same Day x3; Next Day x2; Three Day x1.5. **Please contact us for RUSH request arrangements at 502.962.6400**

Page 1 of 1

REVISED CERTIFICATE OF ANALYSIS

6061982

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington, KY 40503

Original Date Reported	07/05/2016
Report Reissued	07/05/2016
Date Received	06/28/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**										**Sampled**	06/27/2016 @ 12:04	
Sampled By Customer												
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		06/28/2016 15:41	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	06/29/2016 15:12	DJR
Nitrogen, Nitrate			0.26	mg/L			EPA 300.0	0.11		0.027	06/28/2016 17:43	JGF
Nitrogen, Nitrite		UJ	<0.025	mg/L			EPA 300.0	0.15		0.025	06/28/2016 17:43	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			07/01/2016 10:33	DJR
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.025	06/28/2016 17:40	DJR
Phosphorus, Total			0.36	mg/L			EPA 365.1	0.046		0.0051	06/30/2016 9:49	DJR
Solids, Total Suspended			12	mg/L			USGS I-3765-85	1	1		06/29/2016 14:48	CJL
Sample: 02 **2**										**Sampled**	06/27/2016 @ 12:35	
Sampled By Customer												
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		06/28/2016 15:41	EGD
Nitrogen, Ammonia		J1	0.17	mg/L			SM 4500 NH3 G	0.25		0.14	06/29/2016 15:14	DJR
Nitrogen, Nitrate			0.25	mg/L			EPA 300.0	0.11		0.027	06/28/2016 18:10	JGF
Nitrogen, Nitrite		J1	0.037	mg/L			EPA 300.0	0.15		0.025	06/28/2016 18:10	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			07/01/2016 10:35	DJR
Phosphorus, Orthophosphate			0.21	mg/L			EPA 365.1	0.050		0.025	06/28/2016 17:42	DJR
Phosphorus, Total			0.34	mg/L			EPA 365.1	0.046		0.0051	06/30/2016 9:50	DJR
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1		06/29/2016 14:48	CJL
Sample: 03 **4**										**Sampled**	06/27/2016 @ 13:50	
Sampled By Customer												
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		06/28/2016 15:41	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	06/29/2016 16:19	DJR
Nitrogen, Nitrate		J1	0.056	mg/L			EPA 300.0	0.11		0.027	06/28/2016 18:37	JGF
Nitrogen, Nitrite		UJ	<0.025	mg/L			EPA 300.0	0.15		0.025	06/28/2016 18:37	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			07/01/2016 10:37	DJR
Phosphorus, Orthophosphate			0.16	mg/L			EPA 365.1	0.050		0.025	06/28/2016 17:43	DJR
Phosphorus, Total			0.23	mg/L			EPA 365.1	0.046		0.0051	06/30/2016 9:51	DJR

The data and other information contained on this, and other accompanying documents, represents only the sample (s) analyzed and is rendered upon the condition that it is not to be reproduced wholly or in part for advertising or other purposes without written approval from the laboratory.

REVISED CERTIFICATE OF ANALYSIS

6061982

Third Rock Consultants
Marcia L. Wooton

Report Reissued 07/05/2016
Date Received 06/28/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 03 **4**										**Sampled**	06/27/2016 @ 13:50	
Sampled By Customer												
Solids, Total Suspended			12	mg/L			USGS I-3765-85	1	1		06/29/2016 14:48	CJL
Sample: 04 **5**										**Sampled**	06/27/2016 @ 13:25	
Sampled By Customer												
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		06/28/2016 15:41	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	06/29/2016 15:17	DJR
Nitrogen, Nitrate			0.71	mg/L			EPA 300.0	0.11		0.027	06/28/2016 19:05	JGF
Nitrogen, Nitrite		J1	0.028	mg/L			EPA 300.0	0.15		0.025	06/28/2016 19:05	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			07/01/2016 10:39	DJR
Phosphorus, Orthophosphate			0.60	mg/L			EPA 365.1	0.050		0.025	06/28/2016 17:44	DJR
Phosphorus, Total			0.65	mg/L			EPA 365.1	0.046		0.0051	06/30/2016 9:53	DJR
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		06/29/2016 14:48	CJL
Sample: 05 **6**										**Sampled**	06/27/2016 @ 14:51	
Sampled By Customer												
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		06/28/2016 15:41	EGD
Nitrogen, Ammonia			1.9	mg/L			SM 4500 NH3 G	0.25		0.14	06/29/2016 15:19	DJR
Nitrogen, Nitrate			0.48	mg/L			EPA 300.0	0.11		0.027	06/28/2016 19:32	JGF
Nitrogen, Nitrite		J1	0.15	mg/L			EPA 300.0	0.15		0.025	06/28/2016 19:32	JGF
Nitrogen, Total Kjeldahl			2.3	mg/L			SM 4500 NH3 G	0.40			07/01/2016 10:41	DJR
Phosphorus, Orthophosphate			0.76	mg/L			EPA 365.1	0.050		0.025	06/28/2016 17:47	DJR
Phosphorus, Total			0.85	mg/L			EPA 365.1	0.046		0.0051	06/30/2016 9:56	DJR
Solids, Total Suspended			10	mg/L			USGS I-3765-85	1	1		06/29/2016 14:48	CJL
Sample: 06 **8**										**Sampled**	06/27/2016 @ 11:05	
Sampled By Customer												
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		06/28/2016 15:41	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	06/30/2016 10:06	DJR
Nitrogen, Nitrate			0.39	mg/L			EPA 300.0	0.11		0.027	06/28/2016 19:59	JGF
Nitrogen, Nitrite		UJ	<0.025	mg/L			EPA 300.0	0.15		0.025	06/28/2016 19:59	JGF
Nitrogen, Total Kjeldahl			0.44	mg/L			SM 4500 NH3 G	0.40			07/01/2016 10:43	DJR

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REVISED CERTIFICATE OF ANALYSIS

6061982

Third Rock Consultants
Marcia L. Wooton

Report Reissued 07/05/2016
Date Received 06/28/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 06 **8**										**Sampled**	06/27/2016 @ 11:05	
Sampled By Customer												
Phosphorus, Orthophosphate			0.25	mg/L			EPA 365.1	0.050		0.025	06/28/2016 17:48	DJR
Phosphorus, Total			0.45	mg/L			EPA 365.1	0.046		0.0051	06/30/2016 9:57	DJR
Solids, Total Suspended			29	mg/L			USGS I-3765-85	1	1		06/29/2016 14:48	CJL
Sample: 07 **9**										**Sampled**	06/27/2016 @ 15:33	
Sampled By Customer												
CBOD, 5 Day			2.8	mg/L			SM 5210 B	2.0	2		06/28/2016 15:41	EGD
Nitrogen, Ammonia			0.27	mg/L			SM 4500 NH3 G	0.25		0.14	06/30/2016 10:08	DJR
Nitrogen, Nitrate		J1	0.040	mg/L			EPA 300.0	0.11		0.027	06/28/2016 20:27	JGF
Nitrogen, Nitrite		UJ	<0.025	mg/L			EPA 300.0	0.15		0.025	06/28/2016 20:27	JGF
Nitrogen, Total Kjeldahl			0.63	mg/L			SM 4500 NH3 G	0.40			07/01/2016 10:49	DJR
Phosphorus, Orthophosphate			0.27	mg/L			EPA 365.1	0.050		0.025	06/28/2016 17:49	DJR
Phosphorus, Total			0.50	mg/L			EPA 365.1	0.046		0.0051	06/30/2016 9:59	DJR
Solids, Total Suspended			16	mg/L			USGS I-3765-85	1	1		06/29/2016 14:48	CJL
Sample: 08 **DD**										**Sampled**	06/27/2016	
Sampled By Customer												
CBOD, 5 Day			2.7	mg/L			SM 5210 B	2.0	2		06/28/2016 15:41	EGD
Nitrogen, Ammonia			0.29	mg/L			SM 4500 NH3 G	0.25		0.14	06/30/2016 10:10	DJR
Nitrogen, Nitrate		J1	0.045	mg/L			EPA 300.0	0.11		0.027	06/28/2016 20:54	JGF
Nitrogen, Nitrite		UJ	<0.025	mg/L			EPA 300.0	0.15		0.025	06/28/2016 20:54	JGF
Nitrogen, Total Kjeldahl			0.47	mg/L			SM 4500 NH3 G	0.40			07/01/2016 10:51	DJR
Phosphorus, Orthophosphate			0.27	mg/L			EPA 365.1	0.050		0.025	06/28/2016 17:50	DJR
Phosphorus, Total			0.37	mg/L			EPA 365.1	0.046		0.0051	06/30/2016 10:00	DJR
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1		06/29/2016 14:48	CJL

Revised to correct report subject line. LLM 7-5-16

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.

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REVISED CERTIFICATE OF ANALYSIS

6061982

Third Rock Consultants
Marcia L. Wooton

Report Reissued	07/05/2016
Date Received	06/28/2016

KDOW Cane Run Watershed Project

UJ Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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6061982 LISA MARTIN

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone #: 859-977-2000
Collected By: Client - C. Bloyd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P^O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	SA	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P^O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	6-27-16	1204	G	Y*/N	1	1	1	1	~~1~~							
	2	SW	6-27-16	1235	G	Y*/N	1	1	1	1	~~1~~							
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	4	SW	6-27-16	1350	G	Y*/N	1	1	1	1	~~1~~							
	5	SW	6-27-16	1325	G	Y*/N	1	1	1	1	~~1~~							
	6	SW	6-27-16	1451	G	Y*/N	1	1	1	1	~~1~~							
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	8	SW	6-27-16	1105	G	Y*/N	1	1	1	1	1							
	9	SW	6-27-16	1533	G	Y*/N	1	1	1	1	~~1~~							
	~~10~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	DD	SW	6-27-16	******	G	Y*/N	1	1	1	1	~~1~~	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	6-28-16/0849	Megan Rothgruber	6-28-16 849

Temp. Upon Receipt (C): 2.2 °C Measured By: L-23
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

6071161

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	07/25/2016
Date Due	07/27/2016
Date Received	07/18/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	MDL	Analysis Date	Tech
Sample: 01 **1**									**Sampled**	07/18/2016 @ 10:00	
Sampled By Customer											
Flow by Calculation			1.4	CFS			EPA 600			07/18/2016 10:00	CUS
Oxygen, Dissolved			6.40	mg/L			SM 4500 O G	0.10		07/18/2016 10:00	CUS
Specific Conductance at 25 °C			623	umhos/cm			CLIENT SPECIFIED			07/18/2016 10:00	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1		07/18/2016 10:00	CUS
E. coli			703.0	MPN/100mL			SM9223B (Colilert-18)			07/18/2016 16:20	DZW
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2	07/19/2016 13:21	DJR
Nitrogen, Ammonia		UJ M2, R1	<0.14	mg/L			SM 4500 NH3 G	0.25	0.14	07/21/2016 15:15	EGD
Nitrogen, Nitrate			0.74	mg/L			EPA 300.0	0.55	0.13	07/19/2016 17:30	LJC
Nitrogen, Nitrite		J1	0.20	mg/L			EPA 300.0	0.75	0.12	07/19/2016 17:30	LJC
Nitrogen, Total Kjeldahl		M2	0.69	mg/L			SM 4500 NH3 G	0.40		07/22/2016 10:06	EGD
pH			7.90	SU			CLIENT SPECIFIED	1.00		07/18/2016 10:00	CUS
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050	0.025	07/19/2016 17:13	EGD
Phosphorus, Total		M2	0.31	mg/L			EPA 365.1	0.046	0.0051	07/22/2016 12:33	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1	07/20/2016 15:43	CJL
Temperature			25.7	deg C			CLIENT SPECIFIED			07/18/2016 10:00	CUS
Sample: 02 **2**									**Sampled**	07/18/2016 @ 10:45	
Sampled By Customer											
Flow by Calculation			1.16	CFS			EPA 600			07/18/2016 10:45	CUS
Oxygen, Dissolved			4.20	mg/L			SM 4500 O G	0.10		07/18/2016 10:45	CUS
Specific Conductance at 25 °C			668	umhos/cm			CLIENT SPECIFIED			07/18/2016 10:45	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1		07/18/2016 10:45	CUS
E. coli			3448.0	MPN/100mL			SM9223B (Colilert-18)			07/18/2016 16:20	DZW
CBOD, 5 Day			2.4	mg/L			SM 5210 B	2.0	2	07/19/2016 13:21	DJR
Nitrogen, Ammonia		J1	0.18	mg/L			SM 4500 NH3 G	0.25	0.14	07/21/2016 15:17	EGD
Nitrogen, Nitrate			0.68	mg/L			EPA 300.0	0.55	0.13	07/19/2016 17:58	LJC
Nitrogen, Nitrite		J1	0.22	mg/L			EPA 300.0	0.75	0.12	07/19/2016 17:58	LJC

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Third Rock Consultants
Marcia L. Wooton

Date Due	07/27/2016
Date Received	07/18/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	MDL	Analysis Date	Tech
Sample: 02 **2**									**Sampled**	07/18/2016 @ 10:45	
Sampled By Customer											
Nitrogen, Total Kjeldahl			1.6	mg/L			SM 4500 NH3 G	0.40		07/22/2016 10:08	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00		07/18/2016 10:45	CUS
Phosphorus, Orthophosphate			0.23	mg/L			EPA 365.1	0.050	0.025	07/19/2016 17:14	EGD
Phosphorus, Total			0.34	mg/L			EPA 365.1	0.046	0.0051	07/22/2016 12:34	EGD
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1	07/20/2016 15:43	CJL
Temperature			24.0	deg C			CLIENT SPECIFIED			07/18/2016 10:45	CUS
Sample: 03 **3**									**Sampled**	07/18/2016 @ 11:10	
Sampled By Customer											
Flow by Calculation			No Flow	CFS			EPA 600			07/18/2016 11:10	CUS
Sample: 04 **4**									**Sampled**	07/18/2016 @ 11:25	
Sampled By Customer											
Flow by Calculation			Observed - Not Detected	CFS			EPA 600			07/18/2016 11:25	CUS
Oxygen, Dissolved			7.70	mg/L			SM 4500 O G	0.10		07/18/2016 11:25	CUS
Specific Conductance at 25 °C			456	umhos/cm			CLIENT SPECIFIED			07/18/2016 11:25	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1		07/18/2016 11:25	CUS
E. coli			573.0	MPN/100mL			SM9223B (Colilert-18)			07/18/2016 16:20	DZW
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2	07/19/2016 13:21	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25	0.14	07/21/2016 15:19	EGD
Nitrogen, Nitrate		J1	0.18	mg/L			EPA 300.0	0.55	0.13	07/19/2016 18:12	LJC
Nitrogen, Nitrite		UJ	<0.12	mg/L			EPA 300.0	0.75	0.12	07/19/2016 18:12	LJC
Nitrogen, Total Kjeldahl			0.54	mg/L			SM 4500 NH3 G	0.40		07/22/2016 10:10	EGD
pH			7.60	SU			CLIENT SPECIFIED	1.00		07/18/2016 11:25	CUS
Phosphorus, Orthophosphate			0.15	mg/L			EPA 365.1	0.050	0.025	07/19/2016 17:15	EGD
Phosphorus, Total			0.22	mg/L			EPA 365.1	0.046	0.0051	07/22/2016 12:35	EGD
Solids, Total Suspended			20	mg/L			USGS I-3765-85	1	1	07/20/2016 15:43	CJL
Temperature			22.5	deg C			CLIENT SPECIFIED			07/18/2016 11:25	CUS
Sample: 05 **5**									**Sampled**	07/18/2016 @ 11:50	
Sampled By Customer											

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CERTIFICATE OF ANALYSIS

6071161

Third Rock Consultants
Marcia L. Wooton

Date Due	07/27/2016
Date Received	07/18/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	MDL	Analysis Date	Tech
Sample: 05 **5**										**Sampled** 07/18/2016 @ 11:50	
Sampled By Customer											
Flow by Calculation			0.35	CFS			EPA 600			07/18/2016 11:50	CUS
Oxygen, Dissolved			8.00	mg/L			SM 4500 O G	0.10		07/18/2016 11:50	CUS
Specific Conductance at 25 °C			657	umhos/cm			CLIENT SPECIFIED			07/18/2016 11:50	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1		07/18/2016 11:50	CUS
E. coli			528.0	MPN/100mL			SM9223B (Colilert-18)			07/18/2016 16:20	DZW
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2	07/19/2016 13:21	DJR
Nitrogen, Ammonia			0.68	mg/L			SM 4500 NH3 G	0.25	0.14	07/21/2016 15:22	EGD
Nitrogen, Nitrate			2.1	mg/L			EPA 300.0	0.55	0.13	07/19/2016 18:26	LJC
Nitrogen, Nitrite		J1	0.36	mg/L			EPA 300.0	0.75	0.12	07/19/2016 18:26	LJC
Nitrogen, Total Kjeldahl			1.2	mg/L			SM 4500 NH3 G	0.40		07/22/2016 10:12	EGD
pH			7.70	SU			CLIENT SPECIFIED	1.00		07/18/2016 11:50	CUS
Phosphorus, Orthophosphate			0.74	mg/L			EPA 365.1	0.050	0.025	07/19/2016 17:17	EGD
Phosphorus, Total			0.76	mg/L			EPA 365.1	0.046	0.0051	07/22/2016 12:39	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1	07/20/2016 15:43	CJL
Temperature			23.9	deg C			CLIENT SPECIFIED			07/18/2016 11:50	CUS

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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MICROBAC

CERTIFICATE OF ANALYSIS

6071161

Third Rock Consultants
Marcia L. Wooton

Date Due	07/27/2016
Date Received	07/18/2016

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	7/18/16	1000	G	Y*/N	1	1	1	1	1	6.4	80.1	7.9	628	25.7	0.0	1.4
	2	SW	7/18/16	1045	G	Y*/N	1	1	1	1	1	4.2	51.1	7.5	668	24.0	0.0	1.16
	3	SW	~~7/18/16~~	~~1110~~	G	Y*/N	1	1	1	1	1	NO FLOW						
	4	SW	7/18/16	1125	G	Y*/N	1	1	1	1	1	7.7	91.4	7.6	456	22.5	0.0	—
	5	SW	7/18/16	1150	G	Y*/N	1	1	1	1	1	8	97.9	7.7	657	23.9	0.0	0.35
	6	SW			G	Y*/N	1	1	1	1	1							
	7	SW			G	Y*/N	1	1	1	1	1							
	8	SW			G	Y*/N	1	1	1	1	1							
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW			G	Y*/N	1	1	1	1	1							
	DD	SW		******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

observed, Not detected

Relinquished By:	Date / Time	Received By:	Date / Time
	7-18-16 1246		
Lisa Martin	7-18-16 1246	LM 7-18-16	

Temp. Upon Receipt (C): 5.2 Measured By: LM
Containers Properly Preserved: (Yes / No) LM
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

6071171

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	07/25/2016
Date Due	07/27/2016
Date Received	07/18/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	MDL	Analysis Date	Tech
Sample: 01 **6**										**Sampled**	07/18/2016 @ 10:00
Sampled By Customer											
Flow by Calculation			0.039	CFS			EPA 600			07/18/2016 10:00	CUS
Oxygen, Dissolved			2.53	mg/L			SM 4500 O G	0.10		07/18/2016 10:00	CUS
Specific Conductance at 25 °C			706	umhos/cm			CLIENT SPECIFIED			07/18/2016 10:00	CUS
Turbidity			5	NTU			CLIENT SPECIFIED	1		07/18/2016 10:00	CUS
E. coli			379.0	MPN/100mL			SM9223B (Colilert-18)			07/18/2016 16:20	DZW
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0	2.0	07/19/2016 13:21	DJR
Nitrogen, Ammonia			4.3	mg/L			SM 4500 NH3 G	0.25	0.14	07/21/2016 15:24	EGD
Nitrogen, Nitrate			1.8	mg/L			EPA 300.0	0.55	0.13	07/19/2016 18:40	LJC
Nitrogen, Nitrite		J1	0.36	mg/L			EPA 300.0	0.75	0.12	07/19/2016 18:40	LJC
Nitrogen, Total Kjeldahl			5.2	mg/L			SM 4500 NH3 G	0.40		07/22/2016 10:18	EGD
pH			7.03	SU			CLIENT SPECIFIED	1.00		07/18/2016 10:00	CUS
Phosphorus, Orthophosphate			1.1	mg/L			EPA 365.1	0.10	0.050	07/19/2016 17:40	EGD
Phosphorus, Total			1.1	mg/L			EPA 365.1	0.091	0.010	07/22/2016 13:38	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1	07/20/2016 15:43	CJL
Temperature			22.5	deg C			CLIENT SPECIFIED			07/18/2016 10:00	CUS
Sample: 02 **8**										**Sampled**	07/18/2016 @ 11:00
Sampled By Customer											
Specific Conductance at 25 °C			626	umhos/cm			CLIENT SPECIFIED			07/18/2016 11:00	CUS
Turbidity			10	NTU			CLIENT SPECIFIED	1		07/18/2016 11:00	CUS
E. coli			20.0	MPN/100mL			SM9223B (Colilert-18)			07/18/2016 16:20	DZW
CBOD, 5 Day			6.2	mg/L			SM 5210 B	5.0	2.0	07/19/2016 13:21	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25	0.14	07/21/2016 15:26	EGD
Nitrogen, Nitrate			1.3	mg/L			EPA 300.0	0.55	0.13	07/19/2016 18:55	LJC
Nitrogen, Nitrite		UJ	<0.12	mg/L			EPA 300.0	0.75	0.12	07/19/2016 18:55	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40		07/22/2016 10:20	EGD
pH			6.89	SU			CLIENT SPECIFIED	1.00		07/18/2016 11:00	CUS

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CERTIFICATE OF ANALYSIS

6071171

Third Rock Consultants
Marcia L. Wooton

Date Due	07/27/2016
Date Received	07/18/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit		MDL	Analysis Date	Tech
Sample: 02 **8**										**Sampled**	07/18/2016 @ 11:00	
Sampled By Customer												
Phosphorus, Orthophosphate			0.24	mg/L			EPA 365.1	0.050		0.025	07/19/2016 17:20	EGD
Phosphorus, Total			0.54	mg/L			EPA 365.1	0.046		0.0051	07/22/2016 12:43	EGD
Solids, Total Suspended			21	mg/L			USGS I-3765-85	1	1		07/20/2016 15:43	CJL
Temperature			17.4	deg C			CLIENT SPECIFIED				07/18/2016 11:00	CUS
Sample: 03 **9**										**Sampled**	07/18/2016 @ 12:00	
Sampled By Customer												
Flow by Calculation			0.01	CFS			EPA 600				07/18/2016 12:00	CUS
Oxygen, Dissolved			3.28	mg/L			SM 4500 O G	0.10			07/18/2016 12:00	CUS
Specific Conductance at 25 °C			406	umhos/cm			CLIENT SPECIFIED				07/18/2016 12:00	CUS
Turbidity			5	NTU			CLIENT SPECIFIED	1			07/18/2016 12:00	CUS
E. coli			246.0	MPN/100mL			SM9223B (Colilert-18)				07/18/2016 16:20	DZW
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0		2.0	07/19/2016 13:21	DJR
Nitrogen, Ammonia			0.37	mg/L			SM 4500 NH3 G	0.25		0.14	07/21/2016 15:28	EGD
Nitrogen, Nitrate		J1	0.26	mg/L			EPA 300.0	0.55		0.13	07/19/2016 19:37	LJC
Nitrogen, Nitrite		J1	0.22	mg/L			EPA 300.0	0.75		0.12	07/19/2016 19:37	LJC
Nitrogen, Total Kjeldahl			0.81	mg/L			SM 4500 NH3 G	0.40			07/22/2016 10:22	EGD
pH			7.27	SU			CLIENT SPECIFIED	1.00			07/18/2016 12:00	CUS
Phosphorus, Orthophosphate			0.24	mg/L			EPA 365.1	0.050		0.025	07/19/2016 17:21	EGD
Phosphorus, Total			0.45	mg/L			EPA 365.1	0.046		0.0051	07/22/2016 12:44	EGD
Solids, Total Suspended			11	mg/L			USGS I-3765-85	1	1		07/20/2016 15:43	CJL
Temperature			23.9	deg C			CLIENT SPECIFIED				07/18/2016 12:00	CUS
Sample: 04 **DD**										**Sampled**	07/18/2016	
Sampled By Customer												
E. coli			256.0	MPN/100mL			SM9223B (Colilert-18)				07/18/2016 16:20	DZW
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0		2.0	07/19/2016 13:21	DJR
Nitrogen, Ammonia			0.28	mg/L			SM 4500 NH3 G	0.25		0.14	07/21/2016 15:30	EGD
Nitrogen, Nitrate		J1	0.25	mg/L			EPA 300.0	0.55		0.13	07/19/2016 19:51	LJC
Nitrogen, Nitrite		J1	0.22	mg/L			EPA 300.0	0.75		0.12	07/19/2016 19:51	LJC

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Third Rock Consultants
Marcia L. Wooton

Date Due 07/27/2016
Date Received 07/18/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	MDL	Analysis Date	Tech
Sample: 04 **DD**									**Sampled**	07/18/2016	
Sampled By Customer											
Nitrogen, Total Kjeldahl			0.87	mg/L			SM 4500 NH3 G	0.40		07/22/2016 10:24	EGD
Phosphorus, Orthophosphate			0.24	mg/L			EPA 365.1	0.050	0.025	07/19/2016 17:22	EGD
Phosphorus, Total			0.48	mg/L			EPA 365.1	0.046	0.0051	07/22/2016 12:45	EGD
Solids, Total Suspended			13	mg/L			USGS I-3765-85	1	1	07/21/2016 17:31	CJL

Qualifier Definitions

J1 The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.

UJ Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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6071171 LISA MARTIN

COC#	CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client - C. Bloyd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

							Requested Lab Analysis					On-Site/Field Measurements						
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	~~1~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~2~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~4~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~5~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	6	SW	7-18-16	1000	G	Y*/N	1	1	1	1	1	2.53	29.3	7.03	706	22.57	5.2	0.039
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	8	SW	7-18-16	1100	G	Y*/N	1	1	1	1	1	—	74.1	6.89	626	17.59	10.20	—
	9	SW	7-18-16	1200	G	Y*/N	1	1	1	1	1	3.28	40.0	7.27	406	23.91	5.57	0.01
	~~10~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	DD	SW	7-18-16	******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	7-18-16 / 1355		7/18/16 1355

Temp. Upon Receipt (C): 14.1 Measured By: 10 SSB
Containers Properly Preserved: (Yes / No) [illegible]
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

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CERTIFICATE OF ANALYSIS

6081841

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	09/02/2016
Date Due	09/02/2016
Date Received	08/24/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max		Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**										**Sampled**	08/24/2016 @ 9:15	
Sampled By Customer												
Flow by Calculation			8.9	CFS			EPA 600				08/24/2016 9:15	CUS
Specific Conductance at 25 °C			632	umhos/cm			CLIENT SPECIFIED				08/24/2016 9:15	CUS
E. coli			325.5	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia		UJ M2	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:02	EGD
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.11		0.025	08/25/2016 16:50	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 16:50	LJC
Nitrogen, Total Kjeldahl			4.7	mg/L			SM 4500 NH3 G	0.40			08/31/2016 11:25	EGD
pH			8.01	SU			CLIENT SPECIFIED	1.00			08/24/2016 9:15	CUS
Phosphorus, Orthophosphate			0.28	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:27	EGD
Phosphorus, Total		L2	0.37	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:36	EGD
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			22.2	deg C			CLIENT SPECIFIED				08/24/2016 9:15	CUS
Sample: 02 **2**										**Sampled**	08/24/2016 @ 10:00	
Sampled By Customer												
Flow by Calculation			12.6	CFS			EPA 600				08/24/2016 10:00	CUS
Oxygen, Dissolved			7.18	mg/L			SM 4500 O G	0.10			08/24/2016 10:00	CUS
Specific Conductance at 25 °C			651	umhos/cm			CLIENT SPECIFIED				08/24/2016 10:00	CUS
E. coli			2419.6	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:04	EGD
Nitrogen, Nitrate			2.1	mg/L			EPA 300.0	0.11		0.025	08/25/2016 17:47	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 17:47	LJC
Nitrogen, Total Kjeldahl		M2, R1	0.73	mg/L			SM 4500 NH3 G	0.40			09/01/2016 15:49	EGD
pH			7.72	SU			CLIENT SPECIFIED	1.00			08/24/2016 10:00	CUS
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:28	EGD

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Third Rock Consultants
Marcia L. Wooton

Date Due	09/02/2016
Date Received	08/24/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max		Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2**										**Sampled**	08/24/2016 @ 10:00	
Sampled By Customer												
Phosphorus, Total		L2	0.44	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:40	EGD
Solids, Total Suspended			15	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			21.5	deg C			CLIENT SPECIFIED				08/24/2016 10:00	CUS
Sample: 03 **4**										**Sampled**	08/24/2016 @ 10:35	
Sampled By Customer												
Flow by Calculation			0.69	CFS			EPA 600				08/24/2016 10:35	CUS
Specific Conductance at 25 °C			508	umhos/cm			CLIENT SPECIFIED				08/24/2016 10:35	CUS
E. coli			224.7	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			3.7	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:06	EGD
Nitrogen, Nitrate			0.45	mg/L			EPA 300.0	0.11		0.025	08/25/2016 18:01	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 18:01	LJC
Nitrogen, Total Kjeldahl			0.91	mg/L			SM 4500 NH3 G	0.40			09/01/2016 15:51	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00			08/24/2016 10:35	CUS
Phosphorus, Orthophosphate			0.22	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:29	EGD
Phosphorus, Total		L2	0.54	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:41	EGD
Solids, Total Suspended			45	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			20.9	deg C			CLIENT SPECIFIED				08/24/2016 10:35	CUS
Sample: 04 **5**										**Sampled**	08/24/2016 @ 11:25	
Sampled By Customer												
Flow by Calculation			4.3	CFS			EPA 600				08/24/2016 11:25	CUS
Oxygen, Dissolved			8.52	mg/L			SM 4500 O G	0.10			08/24/2016 11:25	CUS
Specific Conductance at 25 °C			630	umhos/cm			CLIENT SPECIFIED				08/24/2016 11:25	CUS
E. coli			2419.6	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia			0.33	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:08	EGD
Nitrogen, Nitrate			2.7	mg/L			EPA 300.0	0.11		0.025	08/25/2016 18:16	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 18:16	LJC

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Third Rock Consultants
Marcia L. Wooton

Date Due	09/02/2016
Date Received	08/24/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max		Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **5**										**Sampled**	08/24/2016 @ 11:25	
Sampled By Customer												
Nitrogen, Total Kjeldahl			0.52	mg/L			SM 4500 NH3 G	0.40			09/01/2016 15:53	EGD
pH			7.59	SU			CLIENT SPECIFIED	1.00			08/24/2016 11:25	CUS
Phosphorus, Orthophosphate			0.37	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:30	EGD
Phosphorus, Total		L2	0.46	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:42	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			20.6	deg C			CLIENT SPECIFIED				08/24/2016 11:25	CUS
Sample: 05 **6**										**Sampled**	08/24/2016 @ 11:55	
Sampled By Customer												
Flow by Calculation			3.5	CFS			EPA 600				08/24/2016 11:55	CUS
Oxygen, Dissolved			7.20	mg/L			SM 4500 O G	0.10			08/24/2016 11:55	CUS
Specific Conductance at 25 °C			652	umhos/cm			CLIENT SPECIFIED				08/24/2016 11:55	CUS
E. coli			198.9	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia			0.64	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:10	EGD
Nitrogen, Nitrate			2.6	mg/L			EPA 300.0	0.11		0.025	08/25/2016 18:30	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 18:30	LJC
Nitrogen, Total Kjeldahl			1.1	mg/L			SM 4500 NH3 G	0.40			09/01/2016 15:59	EGD
pH			7.30	SU			CLIENT SPECIFIED	1.00			08/24/2016 11:55	CUS
Phosphorus, Orthophosphate			0.41	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:34	EGD
Phosphorus, Total		L2	0.48	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:44	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			20.2	deg C			CLIENT SPECIFIED				08/24/2016 11:55	CUS
Sample: 06 **DD**										**Sampled**	08/24/2016	
Sampled By Customer												
E. coli			240.0	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia			0.26	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:12	EGD
Nitrogen, Nitrate			2.7	mg/L			EPA 300.0	0.11		0.025	08/25/2016 18:44	LJC

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CERTIFICATE OF ANALYSIS

6081841

Third Rock Consultants
Marcia L. Wooton

Date Due 09/02/2016
Date Received 08/24/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max		Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 06 **DD**											**Sampled** 08/24/2016	
Sampled By Customer												
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 18:44	LJC
Nitrogen, Total Kjeldahl			0.72	mg/L			SM 4500 NH3 G	0.40			09/01/2016 16:01	EGD
Phosphorus, Orthophosphate			0.39	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:35	EGD
Phosphorus, Total		L2	0.46	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:45	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Sample: 07 **7**											**Sampled** 08/24/2016 @ 11:20	
Sampled By Customer												
Flow by Calculation			0.05	CFS			EPA 600				08/24/2016 11:20	CUS
Oxygen, Dissolved			6.40	mg/L			SM 4500 O G	0.10			08/24/2016 11:20	CUS
Specific Conductance at 25 °C			628	umhos/cm			CLIENT SPECIFIED				08/24/2016 11:20	CUS
E. coli			218.7	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:18	EGD
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.11		0.025	08/25/2016 18:58	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 18:58	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			09/01/2016 16:03	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00			08/24/2016 11:20	CUS
Phosphorus, Orthophosphate			0.13	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:36	EGD
Phosphorus, Total		L2	0.17	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:45	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			22.5	deg C			CLIENT SPECIFIED				08/24/2016 11:20	CUS
Sample: 08 **8**											**Sampled** 08/24/2016 @ 12:20	
Sampled By Customer												
Oxygen, Dissolved			6.26	mg/L			SM 4500 O G	0.10			08/24/2016 12:20	CUS
Specific Conductance at 25 °C			634	umhos/cm			CLIENT SPECIFIED				08/24/2016 12:20	CUS
E. coli			151.5	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			2.3	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:20	EGD

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Analysis	OOC	Qualifier	Result	Units	Min	Max		Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 08 **8** Sampled By Customer										**Sampled**	08/24/2016 @ 12:20	
Nitrogen, Nitrate			1.5	mg/L			EPA 300.0	0.11		0.025	08/25/2016 19:12	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 19:12	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			09/01/2016 16:05	EGD
pH			7.35	SU			CLIENT SPECIFIED	1.00			08/24/2016 12:20	CUS
Phosphorus, Orthophosphate			0.25	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:37	EGD
Phosphorus, Total		L2	0.31	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:46	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			19.6	deg C			CLIENT SPECIFIED				08/24/2016 12:20	CUS
Sample: 09 **9** Sampled By Customer										**Sampled**	08/24/2016 @ 10:40	
Flow by Calculation			0.12	CFS			EPA 600				08/24/2016 10:40	CUS
Oxygen, Dissolved			3.80	mg/L			SM 4500 O G	0.10			08/24/2016 10:40	CUS
Specific Conductance at 25 °C			432	umhos/cm			CLIENT SPECIFIED				08/24/2016 10:40	CUS
E. coli			165.8	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:22	EGD
Nitrogen, Nitrate			0.15	mg/L			EPA 300.0	0.11		0.025	08/25/2016 19:26	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 19:26	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			09/01/2016 16:07	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00			08/24/2016 10:40	CUS
Phosphorus, Orthophosphate			0.080	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:37	EGD
Phosphorus, Total		L2	0.14	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:47	EGD
Solids, Total Suspended			6	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			21.7	deg C			CLIENT SPECIFIED				08/24/2016 10:40	CUS
Sample: 10 **10** Sampled By Customer										**Sampled**	08/24/2016 @ 9:15	
Flow by Calculation			0.08	CFS			EPA 600				08/24/2016 9:15	CUS
Oxygen, Dissolved			7.80	mg/L			SM 4500 O G	0.10			08/24/2016 9:15	CUS

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Third Rock Consultants
Marcia L. Wooton

Date Due 09/02/2016
Date Received 08/24/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max		Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 10 **10**											**Sampled** 08/24/2016 @ 9:15	
Sampled By Customer												
Specific Conductance at 25 °C			703	umhos/cm			CLIENT SPECIFIED				08/24/2016 9:15	CUS
E. coli			547.5	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:24	EGD
Nitrogen, Nitrate			2.5	mg/L			EPA 300.0	0.11		0.025	08/25/2016 19:40	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 19:40	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			09/01/2016 16:09	EGD
pH			7.20	SU			CLIENT SPECIFIED	1.00			08/24/2016 9:15	CUS
Phosphorus, Orthophosphate			0.35	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:38	EGD
Phosphorus, Total		L2	0.40	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:48	EGD
Solids, Total Suspended			<1	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			17.9	deg C			CLIENT SPECIFIED				08/24/2016 9:15	CUS
Sample: 11 **11**											**Sampled** 08/24/2016 @ 10:00	
Sampled By Customer												
Flow by Calculation			0.24	CFS			EPA 600				08/24/2016 10:00	CUS
Oxygen, Dissolved			7.30	mg/L			SM 4500 O G	0.10			08/24/2016 10:00	CUS
Specific Conductance at 25 °C			688	umhos/cm			CLIENT SPECIFIED				08/24/2016 10:00	CUS
E. coli			101.7	MPN/100mL			SM9223B (Colilert-18)				08/24/2016 15:37	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		08/25/2016 14:04	DJR
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/01/2016 11:26	EGD
Nitrogen, Nitrate			0.50	mg/L			EPA 300.0	0.11		0.025	08/25/2016 20:23	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	08/25/2016 20:23	LJC
Nitrogen, Total Kjeldahl			0.42	mg/L			SM 4500 NH3 G	0.40			09/01/2016 16:11	EGD
pH			7.60	SU			CLIENT SPECIFIED	1.00			08/24/2016 10:00	CUS
Phosphorus, Orthophosphate			0.44	mg/L			EPA 365.1	0.050		0.035	08/25/2016 15:39	EGD
Phosphorus, Total		L2	0.52	mg/L			EPA 365.1	0.050		0.046	08/29/2016 17:49	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		08/25/2016 17:11	CJL
Temperature			20.9	deg C			CLIENT SPECIFIED				08/24/2016 10:00	CUS

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Third Rock Consultants
Marcia L. Wooton

Date Due 09/02/2016
Date Received 08/24/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 11 **11**										**Sampled** 08/24/2016 @ 10:00	
Sampled By Customer											

Qualifier Definitions

UJ Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

L2 Lab control sample (LCS) recovery above upper Control Limit.

M2 Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.

R1 Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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6081841 LISA MARTIN

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CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days   EDD Required: X Yes _ No

Field Remarks:

Weather Event: X Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							* Preservation Type					On-Site/Field Measurements						
							-	-	SA	-	ST							
							Container Size/Type											
							32oz P	50 mL P	32oz P	8oz P	4oz P							
							Requested Lab Analysis											
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW	8-24	9:15	G	Y*/N	1	1	1	1	1	—	91.8	8.01	632	22.2	—	8.9
	2	SW	8-24	10:00	G	Y*/N	1	1	1	1	1	7.18	83.7	7.72	650.9	21.52	—	12.6
	3	SW	—	—	G	Y*/N	1	1	1	1	1	—	—	—	—	—	—	—
	4	SW	8-24	10:35	G	Y*/N	1	1	1	1	1	—	—	7.5	508.3	20.9	—	0.69
	5	SW	8-24	11:25	G	Y*/N	1	1	1	1	1	8.52	96.7	7.59	629.8	20.61	—	4.3
	6	SW	8-24	11:55	G	Y*/N	1	1	1	1	1	7.2	81.6	7.3	652	20.2	—	3.5
	7	SW			G	Y*/N	1	1	1	1	1							
	8	SW			G	Y*/N	1	1	1	1	1							
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW			G	Y*/N	1	1	1	1	1							
	11	SW			G	Y*/N	1	1	1	1	1							
	DD	SW	8-24	******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
Jon D'tow	8/24/15		8/24/16 13:55

Temp. Upon Receipt (C): 8.4 Measured By:
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report)   COC Copy - TRC Project File   COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days   EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P
Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	1	1	1	1	1							
	2	SW			G	Y*/N	1	1	1	1	1							
	3	SW			G	Y*/N	1	1	1	1	1							
	4	SW			G	Y*/N	1	1	1	1	1							
	5	SW			G	Y*/N	1	1	1	1	1							
	6	SW			G	Y*/N	1	1	1	1	1							
	7	SW	8/24/16	1120	G	Y*/N	1	1	1	1	1	6.4	—	7.5	628	22.5	—	0.05
	8	SW	8/24/16	1220	G	Y*/N	1	1	1	1	1	6.26	69.4	7.35	634	19.49	—	—
	9	SW	8/24/16	1040	G	Y*/N	1	1	1	1	1	3.8	—	7.5	432	21.7	—	0.12
	10	SW	8/24/16	0915	G	Y*/N	1	1	1	1	1	7.8	—	7.2	703	17.9	—	0.08
	11	SW	8/24/16	1000	G	Y*/N	1	1	1	1	1	7.3	—	7.6	688	20.9	—	0.24
	DD	SW		******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
X	8/24/ 13:35		8/24/16 13:35

Temp. Upon Receipt (C): 11.1° Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report)   COC Copy - TRC Project File   COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

6090457

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	09/16/2016
Date Due	09/19/2016
Date Received	09/08/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **7**										**Sampled**	09/08/2016 @ 12:00	
Sampled By Customer												
Flow by Calculation			No Flow	CFS			EPA 600				09/08/2016 12:00	CUS
Oxygen, Dissolved			4.95	mg/L			SM 4500 O G	0.10			09/08/2016 12:00	CUS
Specific Conductance at 25 °C			540	umhos/cm			CLIENT SPECIFIED				09/08/2016 12:00	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			09/08/2016 12:00	CUS
E. coli			98.8	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			3.2	mg/L			SM 5210 B	2.0	2		09/09/2016 6:17	DJR
Nitrogen, Ammonia		UJ L1, M2, R1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 10:48	EGD
Nitrogen, Nitrate		UJ	<0.025	mg/L			EPA 300.0	0.11		0.025	09/09/2016 15:40	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 15:40	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			09/14/2016 13:23	EGD
pH			7.28	SU			CLIENT SPECIFIED	1.00			09/08/2016 12:00	CUS
Phosphorus, Orthophosphate			0.11	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:44	EGD
Phosphorus, Total			0.18	mg/L			EPA 365.1	0.050		0.012	09/15/2016 10:51	EGD
Solids, Total Suspended			6	mg/L			USGS I-3765-85	1	1		09/09/2016 14:46	CJL
Temperature			24.2	deg C			CLIENT SPECIFIED				09/08/2016 12:00	CUS
Sample: 02 **8**										**Sampled**	09/08/2016 @ 10:40	
Sampled By Customer												
Oxygen, Dissolved			6.73	mg/L			SM 4500 O G	0.10			09/08/2016 10:40	CUS
Specific Conductance at 25 °C			702	umhos/cm			CLIENT SPECIFIED				09/08/2016 10:40	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			09/08/2016 10:40	CUS
E. coli			35.0	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			9.2	mg/L			SM 5210 B	2.0	2		09/09/2016 6:17	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 10:50	EGD
Nitrogen, Nitrate			1.4	mg/L			EPA 300.0	0.11		0.025	09/09/2016 15:54	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 15:54	LJC
Nitrogen, Total Kjeldahl			1.1	mg/L			SM 4500 NH3 G	0.40			09/14/2016 13:24	EGD

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Third Rock Consultants
Marcia L. Wooton

Date Due	09/19/2016
Date Received	09/08/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **8** Sampled By Customer											**Sampled** 09/08/2016 @ 10:40	
pH			6.83	SU			CLIENT SPECIFIED	1.00			09/08/2016 10:40	CUS
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:45	EGD
Phosphorus, Total			0.30	mg/L			EPA 365.1	0.050		0.012	09/15/2016 10:55	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		09/09/2016 14:46	CJL
Temperature			22.8	deg C			CLIENT SPECIFIED				09/08/2016 10:40	CUS
Sample: 03 **9** Sampled By Customer											**Sampled** 09/08/2016 @ 12:25	
Flow by Calculation			0.204	CFS			EPA 600				09/08/2016 12:25	CUS
Oxygen, Dissolved			4.40	mg/L			SM 4500 O G	0.10			09/08/2016 12:25	CUS
Specific Conductance at 25 °C			340	umhos/cm			CLIENT SPECIFIED				09/08/2016 12:25	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			09/08/2016 12:25	CUS
E. coli			325.5	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 6:17	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 10:52	EGD
Nitrogen, Nitrate		J1	0.097	mg/L			EPA 300.0	0.11		0.025	09/09/2016 16:08	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 16:08	LJC
Nitrogen, Total Kjeldahl			0.50	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:13	EGD
pH			7.30	SU			CLIENT SPECIFIED	1.00			09/08/2016 12:25	CUS
Phosphorus, Orthophosphate			0.089	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:46	EGD
Phosphorus, Total			0.14	mg/L			EPA 365.1	0.050		0.012	09/15/2016 10:56	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		09/09/2016 14:46	CJL
Temperature			24.1	deg C			CLIENT SPECIFIED				09/08/2016 12:25	CUS
Sample: 04 **10** Sampled By Customer											**Sampled** 09/08/2016 @ 13:00	
Flow by Calculation			0.085	CFS			EPA 600				09/08/2016 13:00	CUS
Oxygen, Dissolved			8.56	mg/L			SM 4500 O G	0.10			09/08/2016 13:00	CUS
Specific Conductance at 25 °C			745	umhos/cm			CLIENT SPECIFIED				09/08/2016 13:00	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			09/08/2016 13:00	CUS

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CERTIFICATE OF ANALYSIS

6090457

Third Rock Consultants
Marcia L. Wooton

Date Due	09/19/2016
Date Received	09/08/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **10**											**Sampled** 09/08/2016 @ 13:00	
Sampled By Customer												
E. coli			648.8	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 6:17	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 10:54	EGD
Nitrogen, Nitrate			2.5	mg/L			EPA 300.0	0.11		0.025	09/09/2016 16:23	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 16:23	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:15	EGD
pH			7.67	SU			CLIENT SPECIFIED	1.00			09/08/2016 13:00	CUS
Phosphorus, Orthophosphate			0.38	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:48	EGD
Phosphorus, Total			0.39	mg/L			EPA 365.1	0.050		0.012	09/15/2016 10:58	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		09/09/2016 14:46	CJL
Temperature			20.5	deg C			CLIENT SPECIFIED				09/08/2016 13:00	CUS
Sample: 05 **11**											**Sampled** 09/08/2016 @ 13:20	
Sampled By Customer												
Flow by Calculation			0.123	CFS			EPA 600				09/08/2016 13:20	CUS
Oxygen, Dissolved			8.03	mg/L			SM 4500 O G	0.10			09/08/2016 13:20	CUS
Specific Conductance at 25 °C			715	umhos/cm			CLIENT SPECIFIED				09/08/2016 13:20	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			09/08/2016 13:20	CUS
E. coli			55.6	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 6:17	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 10:56	EGD
Nitrogen, Nitrate			0.49	mg/L			EPA 300.0	0.11		0.025	09/09/2016 17:05	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 17:05	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:17	EGD
pH			7.64	SU			CLIENT SPECIFIED	1.00			09/08/2016 13:20	CUS
Phosphorus, Orthophosphate			0.44	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:51	EGD
Phosphorus, Total			0.46	mg/L			EPA 365.1	0.050		0.012	09/15/2016 10:59	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		09/09/2016 14:46	CJL
Temperature			24.0	deg C			CLIENT SPECIFIED				09/08/2016 13:20	CUS

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KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
L1	Lab Control Sample (LCS) recovery below lower Control Limit.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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6090457 LISA MARTIN

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days   EDD Required: X Yes _ No

Field Remarks:

Weather Event: X Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
Laboratory #	**Sample I.D.**	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	1	1	1	1	1							
	2	SW			G	Y*/N	1	1	1	1	1							
	3	SW			G	Y*/N	1	1	1	1	1							
	4	SW			G	Y*/N	1	1	1	1	1							
	5	SW			G	Y*/N	1	1	1	1	1							
	6	SW			G	Y*/N	1	1	1	1	1							
	7	SW	9/8	12:00	G	Y*/N	1	1	1	1	1	4.95	61.3	7.28	539.5	24.22	0.0	0.0
	8	SW	9/8	10:40	G	Y*/N	1	1	1	1	1	6.73	80.5	6.83	702.3	22.81	0.0	N/A
	9	SW	9/8	12:25	G	Y*/N	1	1	1	1	1	4.4	53.3	7.3	340	24.1	0.0	0.204
	10	SW	9/8	1:00	G	Y*/N	1	1	1	1	1	8.54	98	7.67	745.1	20.57	0.0	0.085
	11	SW	9/8	1:20	G	Y*/N	1	1	1	1	1	8.03	98.7	7.64	714.8	23.96	0.0	0.123
	DD	SW		******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	9/8/16 1418		9-8-16 1418

Temp. Upon Receipt (C): 5.4 Measured By: JM
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report)   COC Copy - TRC Project File   COC Copy - TRC Laboratory Services Coordinator

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CERTIFICATE OF ANALYSIS

6090459

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	09/20/2016
Date Due	09/19/2016
Date Received	09/08/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**											**Sampled** 09/08/2016 @ 10:20	
Sampled By Customer												
Flow by Calculation			1.9	CFS			EPA 600				09/08/2016 10:20	CUS
Oxygen, Dissolved			6.66	mg/L			SM 4500 O G	0.10			09/08/2016 10:20	CUS
Specific Conductance at 25 °C			640	umhos/cm			CLIENT SPECIFIED				09/08/2016 10:20	CUS
Turbidity			4	NTU			CLIENT SPECIFIED	1			09/08/2016 10:20	CUS
E. coli			193.5	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 11:24	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 10:58	EGD
Nitrogen, Nitrate			0.80	mg/L			EPA 300.0	0.11		0.025	09/09/2016 17:19	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 17:19	LJC
Nitrogen, Total Kjeldahl			0.55	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:23	EGD
pH			7.61	SU			CLIENT SPECIFIED	1.00			09/08/2016 10:20	CUS
Phosphorus, Orthophosphate			0.25	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:53	EGD
Phosphorus, Total			0.29	mg/L			EPA 365.1	0.050		0.012	09/16/2016 9:46	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		09/09/2016 15:55	CJL
Temperature			24.4	deg C			CLIENT SPECIFIED				09/08/2016 10:20	CUS
Sample: 02 **2**											**Sampled** 09/08/2016 @ 11:05	
Sampled By Customer												
Flow by Calculation			1.5	CFS			EPA 600				09/08/2016 11:05	CUS
Oxygen, Dissolved			8.03	mg/L			SM 4500 O G	0.10			09/08/2016 11:05	CUS
Specific Conductance at 25 °C			671	umhos/cm			CLIENT SPECIFIED				09/08/2016 11:05	CUS
Turbidity			5	NTU			CLIENT SPECIFIED	1			09/08/2016 11:05	CUS
E. coli			1553.1	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 11:24	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 11:00	EGD
Nitrogen, Nitrate			1.1	mg/L			EPA 300.0	0.11		0.025	09/09/2016 17:33	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 17:33	LJC

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Third Rock Consultants
Marcia L. Wooton

Date Due	09/19/2016
Date Received	09/08/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2**										**Sampled**	09/08/2016 @ 11:05	
Sampled By Customer												
Nitrogen, Total Kjeldahl			0.68	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:25	EGD
pH			7.33	SU			CLIENT SPECIFIED	1.00			09/08/2016 11:05	CUS
Phosphorus, Orthophosphate			0.24	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:53	EGD
Phosphorus, Total			0.31	mg/L			EPA 365.1	0.050		0.012	09/16/2016 9:47	EGD
Solids, Total Suspended			7	mg/L			USGS I-3765-85	1	1		09/09/2016 15:55	CJL
Temperature			24.5	deg C			CLIENT SPECIFIED				09/08/2016 11:05	CUS
Sample: 03 **3**										**Sampled**	09/08/2016 @ 11:35	
Sampled By Customer												
Flow by Calculation			<0.01	CFS			EPA 600				09/08/2016 11:35	CUS
Oxygen, Dissolved			7.95	mg/L			SM 4500 O G	0.10			09/08/2016 11:35	CUS
Specific Conductance at 25 °C			522	umhos/cm			CLIENT SPECIFIED				09/08/2016 11:35	CUS
Turbidity			6	NTU			CLIENT SPECIFIED	1			09/08/2016 11:35	CUS
E. coli			218.7	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 11:24	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 11:02	EGD
Nitrogen, Nitrate			1.2	mg/L			EPA 300.0	0.11		0.025	09/09/2016 17:47	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 17:47	LJC
Nitrogen, Total Kjeldahl			0.43	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:27	EGD
pH			7.57	SU			CLIENT SPECIFIED	1.00			09/08/2016 11:35	CUS
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:54	EGD
Phosphorus, Total			0.33	mg/L			EPA 365.1	0.050		0.012	09/16/2016 9:48	EGD
Solids, Total Suspended			14	mg/L			USGS I-3765-85	1	1		09/09/2016 15:55	CJL
Temperature			21.0	deg C			CLIENT SPECIFIED				09/08/2016 11:35	CUS
Sample: 04 **4**										**Sampled**	09/08/2016 @ 12:00	
Sampled By Customer												
Flow by Calculation			<0.01	CFS			EPA 600				09/08/2016 12:00	CUS
Oxygen, Dissolved			6.90	mg/L			SM 4500 O G	0.10			09/08/2016 12:00	CUS

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Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **4**											**Sampled** 09/08/2016 @ 12:00	
Sampled By Customer												
Specific Conductance at 25 °C			590	umhos/cm			CLIENT SPECIFIED				09/08/2016 12:00	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			09/08/2016 12:00	CUS
E. coli			27.9	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 11:24	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 11:04	EGD
Nitrogen, Nitrate			0.66	mg/L			EPA 300.0	0.11		0.025	09/09/2016 18:02	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 18:02	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:29	EGD
pH			7.30	SU			CLIENT SPECIFIED	1.00			09/08/2016 12:00	CUS
Phosphorus, Orthophosphate			0.18	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:55	EGD
Phosphorus, Total			0.19	mg/L			EPA 365.1	0.050		0.012	09/16/2016 9:52	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		09/09/2016 15:55	CJL
Temperature			22.1	deg C			CLIENT SPECIFIED				09/08/2016 12:00	CUS
Sample: 05 **5**											**Sampled** 09/08/2016 @ 12:20	
Sampled By Customer												
Flow by Calculation			0.5	CFS			EPA 600				09/08/2016 12:20	CUS
Oxygen, Dissolved			10.31	mg/L			SM 4500 O G	0.10			09/08/2016 12:20	CUS
Specific Conductance at 25 °C			659	umhos/cm			CLIENT SPECIFIED				09/08/2016 12:20	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			09/08/2016 12:20	CUS
E. coli			231.0	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 11:24	DJR
Nitrogen, Ammonia		J1 L1	0.15	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 11:11	EGD
Nitrogen, Nitrate			3.2	mg/L			EPA 300.0	0.11		0.025	09/09/2016 18:16	LJC
Nitrogen, Nitrite		J1	0.035	mg/L			EPA 300.0	0.15		0.018	09/09/2016 18:16	LJC
Nitrogen, Total Kjeldahl			0.46	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:31	EGD
pH			7.63	SU			CLIENT SPECIFIED	1.00			09/08/2016 12:20	CUS
Phosphorus, Orthophosphate			0.51	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:56	EGD
Phosphorus, Total			0.54	mg/L			EPA 365.1	0.050		0.012	09/16/2016 9:53	EGD

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KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 05 **5**										**Sampled**	09/08/2016 @ 12:20	
Sampled By Customer												
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		09/09/2016 15:55	CJL
Temperature			23.9	deg C			CLIENT SPECIFIED				09/08/2016 12:20	CUS
Sample: 06 **6**										**Sampled**	09/08/2016 @ 13:00	
Sampled By Customer												
Flow by Calculation			0.5	CFS			EPA 600				09/08/2016 13:00	CUS
Oxygen, Dissolved			5.33	mg/L			SM 4500 O G	0.10			09/08/2016 13:00	CUS
Specific Conductance at 25 °C			679	umhos/cm			CLIENT SPECIFIED				09/08/2016 13:00	CUS
Turbidity			6	NTU			CLIENT SPECIFIED	1			09/08/2016 13:00	CUS
E. coli			387.3	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 11:24	DJR
Nitrogen, Ammonia		L1	2.0	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 11:12	EGD
Nitrogen, Nitrate			2.9	mg/L			EPA 300.0	0.11		0.025	09/09/2016 18:30	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 18:30	LJC
Nitrogen, Total Kjeldahl			2.3	mg/L			SM 4500 NH3 G	0.40			09/15/2016 15:33	EGD
pH			7.39	SU			CLIENT SPECIFIED	1.00			09/08/2016 13:00	CUS
Phosphorus, Orthophosphate			0.71	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:57	EGD
Phosphorus, Total			0.74	mg/L			EPA 365.1	0.050		0.012	09/16/2016 9:54	EGD
Solids, Total Suspended			41	mg/L			USGS I-3765-85	1	1		09/09/2016 15:55	CJL
Temperature			22.2	deg C			CLIENT SPECIFIED				09/08/2016 13:00	CUS
Sample: 07 **DD**										**Sampled**	09/08/2016	
Sampled By Customer												
E. coli			186.0	MPN/100mL			SM9223B (Colilert-18)				09/08/2016 15:09	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		09/09/2016 11:24	DJR
Nitrogen, Ammonia		UJ L1	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	09/15/2016 11:14	EGD
Nitrogen, Nitrate			3.2	mg/L			EPA 300.0	0.11		0.025	09/09/2016 18:44	LJC
Nitrogen, Nitrite		UJ	<0.018	mg/L			EPA 300.0	0.15		0.018	09/09/2016 18:44	LJC
Nitrogen, Total Kjeldahl			0.47	mg/L			SM 4500 NH3 G	0.40			09/20/2016 13:06	DJR
Phosphorus, Orthophosphate			0.52	mg/L			EPA 365.1	0.050		0.011	09/09/2016 10:58	EGD

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CERTIFICATE OF ANALYSIS

6090459

Third Rock Consultants
Marcia L. Wooton

Date Due	09/19/2016
Date Received	09/08/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 07 **DD**										**Sampled**	09/08/2016	
Sampled By Customer												
Phosphorus, Total			0.54	mg/L			EPA 365.1	0.050		0.012	09/16/2016 9:55	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		09/09/2016 15:55	CJL

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
L1	Lab Control Sample (LCS) recovery below lower Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone #: 859-977-2000
Collected By: Client - C. Olson, S. Evans
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days   EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

							Requested Lab Analysis					On-Site/Field Measurements						
* Preservation Type							-	-	SA	-	ST							
Container Size/Type							32oz P	50 mL P	32oz P	8oz P	4oz P							
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW	9/8/16	1020	G	Y*/N	1	1	1	1	1	6.66	82	7.61	640	24.37	4.3	1.7
	2	SW	9/8/16	1105	G	Y*/N	1	1	1	1	1	8.03	99	7.33	671	24.47	4.9	1.5
	3	SW	9/8/16	1135	G	Y*/N	1	1	1	1	1	7.95	92	7.57	522	20.97	5.7	<0.01
	4	SW	9/8/16	1200	G	Y*/N	1	1	1	1	1	6.9	81	7.3	570	22.1	2.7	<0.01
	5	SW	9/8/16	1220	G	Y*/N	1	1	1	1	1	10.31	126	7.63	659	23.93	2.5	0.5
	6	SW	9/8/16	1300	G	Y*/N	1	1	1	1	1	5.33	63	7.39	679	22.22	16	0.5
	7	SW			G	Y*/N	1	1	1	1	1							
	8	SW			G	Y*/N	1	1	1	1	1							
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW			G	Y*/N	1	1	1	1	1							
	11	SW			G	Y*/N	1	1	1	1	1							
	DD	SW	9/8/16	******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	9/8/2016 1426		9/8/2016 1426

Temp. Upon Receipt (C): 5.1 Measured By: JHL
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report)   COC Copy - TRC Project File   COC Copy - TRC Laboratory Services Coordinator

MICROBAC

CERTIFICATE OF ANALYSIS

6101546

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	11/03/2016
Date Due	11/03/2016
Date Received	10/25/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**										**Sampled**	10/25/2016 @ 9:35	
Sampled By Customer												
Flow by Calculation			1.53	CFS			EPA 600				10/25/2016 9:35	CUS
Oxygen, Dissolved			9.06	mg/L			SM 4500 O G	0.10			10/25/2016 9:35	CUS
Specific Conductance at 25 °C			634	umhos/cm			CLIENT SPECIFIED				10/25/2016 9:35	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			10/25/2016 9:35	CUS
E. coli			166.4	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:24	EGD
Nitrogen, Nitrate			0.17	mg/L			EPA 300.0	0.11		0.025	10/26/2016 13:48	LJC
Nitrogen, Nitrite		UJ	<0.075	mg/L			EPA 300.0	0.15		0.075	10/26/2016 13:48	LJC
Nitrogen, Total Kjeldahl			0.48	mg/L			SM 4500 NH3 G	0.40			11/02/2016 16:53	EGD
pH			7.81	SU			CLIENT SPECIFIED	1.00			10/25/2016 9:35	CUS
Phosphorus, Orthophosphate			0.27	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:29	EGD
Phosphorus, Total			0.30	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:00	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			11.1	deg C			CLIENT SPECIFIED				10/25/2016 9:35	CUS
Sample: 02 **2**										**Sampled**	10/25/2016 @ 10:15	
Sampled By Customer												
Flow by Calculation			1.12	CFS			EPA 600				10/25/2016 10:15	CUS
Oxygen, Dissolved			8.45	mg/L			SM 4500 O G	0.10			10/25/2016 10:15	CUS
Specific Conductance at 25 °C			704	umhos/cm			CLIENT SPECIFIED				10/25/2016 10:15	CUS
Turbidity			8	NTU			CLIENT SPECIFIED	1			10/25/2016 10:15	CUS
E. coli			613.1	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:26	EGD
Nitrogen, Nitrate			0.68	mg/L			EPA 300.0	0.11		0.025	10/26/2016 14:02	LJC
Nitrogen, Nitrite		UJ	<0.075	mg/L			EPA 300.0	0.15		0.075	10/26/2016 14:02	LJC

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CERTIFICATE OF ANALYSIS

6101546

Third Rock Consultants
Steve Evans

Date Due 11/03/2016
Date Received 10/25/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2**										**Sampled**	10/25/2016 @ 10:15	
Sampled By Customer												
Nitrogen, Total Kjeldahl			0.44	mg/L			SM 4500 NH3 G	0.40			11/02/2016 16:55	EGD
pH			7.75	SU			CLIENT SPECIFIED	1.00			10/25/2016 10:15	CUS
Phosphorus, Orthophosphate			0.18	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:30	EGD
Phosphorus, Total			0.24	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:01	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			10.3	deg C			CLIENT SPECIFIED				10/25/2016 10:15	CUS
Sample: 03 **4**										**Sampled**	10/25/2016 @ 10:50	
Sampled By Customer												
Flow by Calculation			Not Measured	CFS			EPA 600				10/25/2016 10:50	CUS
Oxygen, Dissolved			8.70	mg/L			SM 4500 O G	0.10			10/25/2016 10:50	CUS
Specific Conductance at 25 °C			560	umhos/cm			CLIENT SPECIFIED				10/25/2016 10:50	CUS
Turbidity			5	NTU			CLIENT SPECIFIED	1			10/25/2016 10:50	CUS
E. coli			435.2	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			2.7	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:28	EGD
Nitrogen, Nitrate			0.31	mg/L			EPA 300.0	0.11		0.025	10/26/2016 14:16	LJC
Nitrogen, Nitrite		UJ	<0.075	mg/L			EPA 300.0	0.15		0.075	10/26/2016 14:16	LJC
Nitrogen, Total Kjeldahl			0.45	mg/L			SM 4500 NH3 G	0.40			11/02/2016 16:57	EGD
pH			7.65	SU			CLIENT SPECIFIED	1.00			10/25/2016 10:50	CUS
Phosphorus, Orthophosphate			0.13	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:31	EGD
Phosphorus, Total			0.19	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:03	EGD
Solids, Total Suspended			44	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			9.5	deg C			CLIENT SPECIFIED				10/25/2016 10:50	CUS
Sample: 04 **5**										**Sampled**	10/25/2016 @ 11:35	
Sampled By Customer												
Flow by Calculation			0.13	CFS			EPA 600				10/25/2016 11:35	CUS
Oxygen, Dissolved			6.28	mg/L			SM 4500 O G	0.10			10/25/2016 11:35	CUS

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CERTIFICATE OF ANALYSIS

6101546

Third Rock Consultants
Steve Evans

Date Due 11/03/2016
Date Received 10/25/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **5**										**Sampled**	10/25/2016 @ 11:35	
Sampled By Customer												
Specific Conductance at 25 °C			713	umhos/cm			CLIENT SPECIFIED				10/25/2016 11:35	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			10/25/2016 11:35	CUS
E. coli			579.4	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		J1	0.22	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:30	EGD
Nitrogen, Nitrate			2.7	mg/L			EPA 300.0	0.11		0.025	10/26/2016 14:31	LJC
Nitrogen, Nitrite		J1	0.14	mg/L			EPA 300.0	0.15		0.075	10/26/2016 14:31	LJC
Nitrogen, Total Kjeldahl			0.46	mg/L			SM 4500 NH3 G	0.40			11/02/2016 16:59	EGD
pH			6.28	SU			CLIENT SPECIFIED	1.00			10/25/2016 11:35	CUS
Phosphorus, Orthophosphate			0.86	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:32	EGD
Phosphorus, Total			0.84	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:04	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			10.7	deg C			CLIENT SPECIFIED				10/25/2016 11:35	CUS
Sample: 05 **6**										**Sampled**	10/25/2016 @ 11:50	
Sampled By Customer												
Flow by Calculation			0.43	CFS			EPA 600				10/25/2016 11:50	CUS
Oxygen, Dissolved			6.23	mg/L			SM 4500 O G	0.10			10/25/2016 11:50	CUS
Specific Conductance at 25 °C			727	umhos/cm			CLIENT SPECIFIED				10/25/2016 11:50	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			10/25/2016 11:50	CUS
E. coli			>>2419.6	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia			2.0	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:32	EGD
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.11		0.025	10/26/2016 14:45	LJC
Nitrogen, Nitrite			0.43	mg/L			EPA 300.0	0.15		0.075	10/26/2016 14:45	LJC
Nitrogen, Total Kjeldahl			2.7	mg/L			SM 4500 NH3 G	0.40			11/02/2016 17:05	EGD
pH			7.44	SU			CLIENT SPECIFIED	1.00			10/25/2016 11:50	CUS
Phosphorus, Orthophosphate			1.0	mg/L			EPA 365.1	0.10		0.022	10/26/2016 15:56	EGD
Phosphorus, Total			1.1	mg/L			EPA 365.1	0.10		0.023	10/28/2016 14:13	EGD

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MICROBAC®

CERTIFICATE OF ANALYSIS

6101546

Third Rock Consultants
Steve Evans

Date Due 11/03/2016
Date Received 10/25/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 05 **6** Sampled By Customer										**Sampled**	10/25/2016 @ 11:50	
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			12.4	deg C			CLIENT SPECIFIED				10/25/2016 11:50	CUS

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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6101546 LISA MARTIN

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW	10/25/16	9:35	G	Y*/N	1	1	1	1	1	9.06		7.81	634	11.10	2.7	1.53
	2	SW	"	10:15	G	Y*/N	1	1	1	1	1	8.45		7.75	704	10.27	7.5	1.12
	3	SW	—	—	G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	4	SW	10/25/16	10:50	G	Y*/N	1	1	1	1	1	8.7		7.65	560	9.53	4.8	Observed not meas[illegible]
	5	SW	↓	11:35	G	Y*/N	1	1	1	1	1	6.28		7.56	713	10.73	2.8	0.13
	6	SW	↓	11:50	G	Y*/N	1	1	1	1	1	6.23		7.44	727	12.38	2.4	0.43
	7	SW			G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	8	SW			G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	9	SW			G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	10	SW			G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	11	SW			G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	DD	SW		******	G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	10-25-16/12:48	Lisa Martin	10-25-16 124

Temp. Upon Receipt (C): 5.6 Measured By: LM
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No) LID

25 Bottles

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

MICROBAC

CERTIFICATE OF ANALYSIS

6101550

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	11/03/2016
Date Due	11/03/2016
Date Received	10/25/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **7** Sampled By Customer											**Sampled** 10/25/2016 @ 10:30	
Flow by Calculation			<0.01	CFS			EPA 600				10/25/2016 10:30	CUS
Oxygen, Dissolved			4.30	mg/L			SM 4500 O G	0.10			10/25/2016 10:30	CUS
Specific Conductance at 25 °C			610	umhos/cm			CLIENT SPECIFIED				10/25/2016 10:30	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			10/25/2016 10:30	CUS
E. coli			111.9	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:34	EGD
Nitrogen, Nitrate		J1	0.042	mg/L			EPA 300.0	0.11		0.025	10/26/2016 15:00	LJC
Nitrogen, Nitrite		UJ	<0.075	mg/L			EPA 300.0	0.15		0.075	10/26/2016 15:00	LJC
Nitrogen, Total Kjeldahl			0.46	mg/L			SM 4500 NH3 G	0.40			11/02/2016 17:06	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00			10/25/2016 10:30	CUS
Phosphorus, Orthophosphate			0.075	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:37	EGD
Phosphorus, Total			0.14	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:06	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			9.4	deg C			CLIENT SPECIFIED				10/25/2016 10:30	CUS
Sample: 02 **8** Sampled By Customer											**Sampled** 10/25/2016 @ 11:05	
Flow by Calculation			N/A	CFS			EPA 600				10/25/2016 11:05	CUS
Oxygen, Dissolved			7.80	mg/L			SM 4500 O G	0.10			10/25/2016 11:05	CUS
Specific Conductance at 25 °C			705	umhos/cm			CLIENT SPECIFIED				10/25/2016 11:05	CUS
Turbidity			4	NTU			CLIENT SPECIFIED	1			10/25/2016 11:05	CUS
E. coli			275.5	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:40	EGD
Nitrogen, Nitrate			1.5	mg/L			EPA 300.0	0.11		0.025	10/26/2016 15:14	LJC
Nitrogen, Nitrite		UJ	<0.075	mg/L			EPA 300.0	0.15		0.075	10/26/2016 15:14	LJC

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Third Rock Consultants
Steve Evans

Date Due 11/03/2016
Date Received 10/25/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **8** Sampled By Customer											**Sampled** 10/25/2016 @ 11:05	
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			11/02/2016 17:08	EGD
pH			7.40	SU			CLIENT SPECIFIED	1.00			10/25/2016 11:05	CUS
Phosphorus, Orthophosphate			0.27	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:37	EGD
Phosphorus, Total			0.29	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:10	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			16.1	deg C			CLIENT SPECIFIED				10/25/2016 11:05	CUS
Sample: 03 **10** Sampled By Customer											**Sampled** 10/25/2016 @ 8:35	
Flow by Calculation			0.05	CFS			EPA 600				10/25/2016 8:35	CUS
Oxygen, Dissolved			6.90	mg/L			SM 4500 O G	0.10			10/25/2016 8:35	CUS
Specific Conductance at 25 °C			765	umhos/cm			CLIENT SPECIFIED				10/25/2016 8:35	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			10/25/2016 8:35	CUS
E. coli			1373.4	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:42	EGD
Nitrogen, Nitrate			2.5	mg/L			EPA 300.0	0.11		0.025	10/26/2016 15:29	LJC
Nitrogen, Nitrite		UJ	<0.075	mg/L			EPA 300.0	0.15		0.075	10/26/2016 15:29	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			11/02/2016 17:10	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00			10/25/2016 8:35	CUS
Phosphorus, Orthophosphate			0.41	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:38	EGD
Phosphorus, Total			0.41	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:11	EGD
Solids, Total Suspended			<1	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			12.2	deg C			CLIENT SPECIFIED				10/25/2016 8:35	CUS
Sample: 04 **11** Sampled By Customer											**Sampled** 10/25/2016 @ 9:15	
Flow by Calculation			0.11	CFS			EPA 600				10/25/2016 9:15	CUS
Oxygen, Dissolved			6.90	mg/L			SM 4500 O G	0.10			10/25/2016 9:15	CUS

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CERTIFICATE OF ANALYSIS

6101550

Third Rock Consultants
Steve Evans

Date Due	11/03/2016
Date Received	10/25/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **11**										**Sampled**	10/25/2016 @ 9:15	
Sampled By Customer												
Specific Conductance at 25 °C			741	umhos/cm			CLIENT SPECIFIED				10/25/2016 9:15	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			10/25/2016 9:15	CUS
E. coli			248.1	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:43	EGD
Nitrogen, Nitrate			0.36	mg/L			EPA 300.0	0.11		0.025	10/26/2016 15:43	LJC
Nitrogen, Nitrite		UJ	<0.075	mg/L			EPA 300.0	0.15		0.075	10/26/2016 15:43	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			11/02/2016 17:11	EGD
pH			7.60	SU			CLIENT SPECIFIED	1.00			10/25/2016 9:15	CUS
Phosphorus, Orthophosphate			0.39	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:39	EGD
Phosphorus, Total			0.39	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:12	EGD
Solids, Total Suspended			<1	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL
Temperature			11.8	deg C			CLIENT SPECIFIED				10/25/2016 9:15	CUS
Sample: 05 **DD**										**Sampled**	10/25/2016	
Sampled By Customer												
E. coli			272.3	MPN/100mL			SM9223B (Colilert-18)				10/25/2016 13:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		10/26/2016 14:29	EGD
Nitrogen, Ammonia		UJ	<0.14	mg/L			SM 4500 NH3 G	0.25		0.14	11/02/2016 12:45	EGD
Nitrogen, Nitrate			0.36	mg/L			EPA 300.0	0.11		0.025	10/26/2016 15:57	LJC
Nitrogen, Nitrite		UJ	<0.075	mg/L			EPA 300.0	0.15		0.075	10/26/2016 15:57	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			11/02/2016 17:13	EGD
Phosphorus, Orthophosphate			0.40	mg/L			EPA 365.1	0.050		0.011	10/26/2016 15:40	EGD
Phosphorus, Total		P1	0.40	mg/L			EPA 365.1	0.050		0.012	10/28/2016 13:13	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		10/26/2016 17:41	CJL

Qualifier Definitions

J1 The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.

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KDOW Cane Run Watershed Project

UJ Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

P1 Sample as received was improperly preserved for this analyte.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ✓ Dry ___ Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	1	1	1	1	1							
	2	SW			G	Y*/N	1	1	1	1	1							
	3	SW			G	Y*/N	1	1	1	1	1							
	4	SW			G	Y*/N	1	1	1	1	1							
	5	SW			G	Y*/N	1	1	1	1	1							
	6	SW			G	Y*/N	1	1	1	1	1							
	7	SW	10/25	10:30	G	Y*/N	1	1	1	1	1	4.3	38.6	7.5	610	9.4	0.2	<0.01
	8	SW	10/25	11:05	G	Y*/N	1	1	1	1	1	7.8	80.5	7.4	705	16.1	4.5	NA
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW	10/25	8:35	G	Y*/N	1	1	1	1	1	6.9	65.7	7.5	765	12.2	2.6	0.05
	11	SW	10/25	9:15	G	Y*/N	1	1	1	1	1	6.9	65.3	7.6	741	11.8	0	0.cc
	DD	SW	10/25	******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	10/25/16 1:19P	LisaMartin	10/25/16 1319

Temp. Upon Receipt (C): 6.2 Measured By: LM
Containers Properly Preserved: ([✓ Yes] / No) LC
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

6111787

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	12/09/2016
Date Due	12/09/2016
Date Received	11/30/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**											**Sampled** 11/30/2016 @ 9:40	
Sampled By Customer												
Flow by Calculation			3.04	CFS			EPA 600				11/30/2016 9:40	CUS
Oxygen, Dissolved			9.18	mg/L			SM 4500 O G	0.10			11/30/2016 9:40	CUS
Specific Conductance at 25 °C			644	umhos/cm			CLIENT SPECIFIED				11/30/2016 9:40	CUS
Turbidity			4	NTU			CLIENT SPECIFIED	1			11/30/2016 9:40	CUS
E. coli			260.3	MPN/100mL			SM9223B (Colilert-18)				11/30/2016 15:52	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/01/2016 10:26	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/08/2016 16:32	EGD
Nitrogen, Nitrate		J1	0.32	mg/L			EPA 300.0	0.55		0.12	12/01/2016 19:57	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/01/2016 19:57	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/08/2016 13:09	EGD
pH			7.83	SU			CLIENT SPECIFIED	1.00			11/30/2016 9:40	CUS
Phosphorus, Orthophosphate			0.17	mg/L			EPA 365.1	0.050		0.011	12/01/2016 13:12	EGD
Phosphorus, Total			0.21	mg/L			EPA 365.1	0.050		0.012	12/01/2016 14:57	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		12/05/2016 11:36	CJL
Temperature			11.5	deg C			CLIENT SPECIFIED				11/30/2016 9:40	CUS
Sample: 02 **2**											**Sampled** 11/30/2016 @ 10:06	
Sampled By Customer												
Flow by Calculation			1.92	CFS			EPA 600				11/30/2016 10:06	CUS
Oxygen, Dissolved			8.95	mg/L			SM 4500 O G	0.10			11/30/2016 10:06	CUS
Specific Conductance at 25 °C			665	umhos/cm			CLIENT SPECIFIED				11/30/2016 10:06	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			11/30/2016 10:06	CUS
E. coli			601.5	MPN/100mL			SM9223B (Colilert-18)				11/30/2016 15:52	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/01/2016 10:26	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/08/2016 16:34	EGD
Nitrogen, Nitrate			0.79	mg/L			EPA 300.0	0.55		0.12	12/01/2016 20:11	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/01/2016 20:11	LJC

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Steve Evans

Date Due	12/09/2016
Date Received	11/30/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2**											**Sampled** 11/30/2016 @ 10:06	
Sampled By Customer												
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/08/2016 13:14	EGD
pH			7.72	SU			CLIENT SPECIFIED	1.00			11/30/2016 10:06	CUS
Phosphorus, Orthophosphate			0.16	mg/L			EPA 365.1	0.050		0.011	12/01/2016 13:13	EGD
Phosphorus, Total			0.24	mg/L			EPA 365.1	0.050		0.012	12/01/2016 14:59	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		12/05/2016 11:36	CJL
Temperature			12.4	deg C			CLIENT SPECIFIED				11/30/2016 10:06	CUS
Sample: 03 **5**											**Sampled** 11/30/2016 @ 11:00	
Sampled By Customer												
Flow by Calculation			0.55	CFS			EPA 600				11/30/2016 11:00	CUS
Oxygen, Dissolved			6.19	mg/L			SM 4500 O G	0.10			11/30/2016 11:00	CUS
Specific Conductance at 25 °C			662	umhos/cm			CLIENT SPECIFIED				11/30/2016 11:00	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			11/30/2016 11:00	CUS
E. coli			53.7	MPN/100mL			SM9223B (Colilert-18)				11/30/2016 15:52	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/01/2016 10:26	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/08/2016 16:36	EGD
Nitrogen, Nitrate			2.7	mg/L			EPA 300.0	0.55		0.12	12/01/2016 20:25	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/01/2016 20:25	LJC
Nitrogen, Total Kjeldahl			0.46	mg/L			SM 4500 NH3 G	0.40			12/08/2016 13:16	EGD
pH			7.53	SU			CLIENT SPECIFIED	1.00			11/30/2016 11:00	CUS
Phosphorus, Orthophosphate			0.63	mg/L			EPA 365.1	0.050		0.011	12/01/2016 13:14	EGD
Phosphorus, Total			0.67	mg/L			EPA 365.1	0.050		0.012	12/01/2016 15:11	EGD
Solids, Total Suspended			<1	mg/L			USGS I-3765-85	1	1		12/05/2016 11:36	CJL
Temperature			12.5	deg C			CLIENT SPECIFIED				11/30/2016 11:00	CUS
Sample: 04 **6**											**Sampled** 11/30/2016 @ 11:20	
Sampled By Customer												
Flow by Calculation			1.05	CFS			EPA 600				11/30/2016 11:20	CUS
Oxygen, Dissolved			5.94	mg/L			SM 4500 O G	0.10			11/30/2016 11:20	CUS

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Third Rock Consultants
Steve Evans

Date Due 12/09/2016
Date Received 11/30/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **6**											**Sampled** 11/30/2016 @ 11:20	
Sampled By Customer												
Specific Conductance at 25 °C			657	umhos/cm			CLIENT SPECIFIED				11/30/2016 11:20	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			11/30/2016 11:20	CUS
E. coli			122.3	MPN/100mL			SM9223B (Colilert-18)				11/30/2016 15:52	ABK
CBOD, 5 Day			2.1	mg/L			SM 5210 B	2.0	2		12/01/2016 10:26	DJR
Nitrogen, Ammonia			1.0	mg/L			SM 4500 NH3 G	0.25		0.22	12/08/2016 16:38	EGD
Nitrogen, Nitrate			2.0	mg/L			EPA 300.0	0.55		0.12	12/01/2016 20:39	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/01/2016 20:39	LJC
Nitrogen, Total Kjeldahl			1.6	mg/L			SM 4500 NH3 G	0.40			12/08/2016 13:18	EGD
pH			7.36	SU			CLIENT SPECIFIED	1.00			11/30/2016 11:20	CUS
Phosphorus, Orthophosphate			0.66	mg/L			EPA 365.1	0.050		0.011	12/01/2016 13:16	EGD
Phosphorus, Total			0.72	mg/L			EPA 365.1	0.050		0.012	12/01/2016 15:12	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		12/05/2016 11:36	CJL
Temperature			13.2	deg C			CLIENT SPECIFIED				11/30/2016 11:20	CUS
Sample: 05 **8**											**Sampled** 11/30/2016 @ 11:20	
Sampled By Customer												
Oxygen, Dissolved			6.40	mg/L			SM 4500 O G	0.10			11/30/2016 11:20	CUS
Specific Conductance at 25 °C			720	umhos/cm			CLIENT SPECIFIED				11/30/2016 11:20	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			11/30/2016 11:20	CUS
E. coli			816.4	MPN/100mL			SM9223B (Colilert-18)				11/30/2016 15:52	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/01/2016 10:26	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/08/2016 16:39	EGD
Nitrogen, Nitrate			1.1	mg/L			EPA 300.0	0.55		0.12	12/01/2016 20:53	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/01/2016 20:53	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/08/2016 13:19	EGD
pH			7.30	SU			CLIENT SPECIFIED	1.00			11/30/2016 11:20	CUS
Phosphorus, Orthophosphate			0.23	mg/L			EPA 365.1	0.050		0.011	12/01/2016 13:18	EGD
Phosphorus, Total			0.26	mg/L			EPA 365.1	0.050		0.012	12/01/2016 15:13	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		12/05/2016 11:36	CJL

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CERTIFICATE OF ANALYSIS

6111787

Third Rock Consultants
Steve Evans

Date Due 12/09/2016
Date Received 11/30/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 05 **8**										**Sampled**	11/30/2016 @ 11:20	
Sampled By Customer												
Temperature			16.1	deg C			CLIENT SPECIFIED				11/30/2016 11:20	CUS
Sample: 06 **10**										**Sampled**	11/30/2016 @ 9:20	
Sampled By Customer												
Flow by Calculation			1.12	CFS			EPA 600				11/30/2016 9:20	CUS
Oxygen, Dissolved			6.70	mg/L			SM 4500 O G	0.10			11/30/2016 9:20	CUS
Specific Conductance at 25 °C			587	umhos/cm			CLIENT SPECIFIED				11/30/2016 9:20	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			11/30/2016 9:20	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)				11/30/2016 15:52	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/01/2016 10:26	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/08/2016 16:41	EGD
Nitrogen, Nitrate			1.6	mg/L			EPA 300.0	0.55		0.12	12/01/2016 21:07	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/01/2016 21:07	LJC
Nitrogen, Total Kjeldahl			0.47	mg/L			SM 4500 NH3 G	0.40			12/09/2016 12:57	EGD
pH			7.30	SU			CLIENT SPECIFIED	1.00			11/30/2016 9:20	CUS
Phosphorus, Orthophosphate			0.34	mg/L			EPA 365.1	0.050		0.011	12/01/2016 13:19	EGD
Phosphorus, Total			0.36	mg/L			EPA 365.1	0.050		0.012	12/01/2016 15:14	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		12/05/2016 12:05	CJL
Temperature			16.1	deg C			CLIENT SPECIFIED				11/30/2016 9:20	CUS
Sample: 07 **11**										**Sampled**	11/30/2016 @ 10:00	
Sampled By Customer												
Flow by Calculation			0.62	CFS			EPA 600				11/30/2016 10:00	CUS
Oxygen, Dissolved			5.40	mg/L			SM 4500 O G	0.10			11/30/2016 10:00	CUS
Specific Conductance at 25 °C			711	umhos/cm			CLIENT SPECIFIED				11/30/2016 10:00	CUS
Turbidity			10	NTU			CLIENT SPECIFIED	1			11/30/2016 10:00	CUS
E. coli			686.7	MPN/100mL			SM9223B (Colilert-18)				11/30/2016 15:52	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/01/2016 10:26	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/08/2016 16:43	EGD

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Third Rock Consultants
Steve Evans

Date Due	12/09/2016
Date Received	11/30/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 07 **11**										**Sampled**	11/30/2016 @ 10:00	
Sampled By Customer												
Nitrogen, Nitrate		J1	0.30	mg/L			EPA 300.0	0.55		0.12	12/01/2016 21:22	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/01/2016 21:22	LJC
Nitrogen, Total Kjeldahl			0.45	mg/L			SM 4500 NH3 G	0.40			12/09/2016 12:59	EGD
pH			7.40	SU			CLIENT SPECIFIED	1.00			11/30/2016 10:00	CUS
Phosphorus, Orthophosphate			0.34	mg/L			EPA 365.1	0.050		0.011	12/01/2016 13:20	EGD
Phosphorus, Total			0.37	mg/L			EPA 365.1	0.050		0.012	12/01/2016 15:15	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		12/05/2016 12:05	CJL
Temperature			14.0	deg C			CLIENT SPECIFIED				11/30/2016 10:00	CUS
Sample: 08 **DD**										**Sampled**	11/30/2016	
Sampled By Customer												
E. coli			686.7	MPN/100mL			SM9223B (Colilert-18)				11/30/2016 15:52	ABK
CBOD, 5 Day			2.6	mg/L			SM 5210 B	2.0	2		12/01/2016 10:26	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/08/2016 16:45	EGD
Nitrogen, Nitrate		J1	0.29	mg/L			EPA 300.0	0.55		0.12	12/01/2016 21:36	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/01/2016 21:36	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/09/2016 13:01	EGD
Phosphorus, Orthophosphate			0.34	mg/L			EPA 365.1	0.050		0.011	12/01/2016 13:21	EGD
Phosphorus, Total			0.42	mg/L			EPA 365.1	0.050		0.012	12/01/2016 15:17	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		12/05/2016 12:05	CJL

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

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CERTIFICATE OF ANALYSIS

6111787

Third Rock Consultants
Steve Evans

Date Due	12/09/2016
Date Received	11/30/2016

KDOW Cane Run Watershed Project

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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6111787 LISA MARTIN

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - JS, CO
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P^O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P^O	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (^oC)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	11-30-16	9:40	G	Y*/N	2	1	1	1	1	9.18	-	7.83	644	11.52	3.6	3.04
	2	SW	11-30-16	10:06	G	Y*/N	2	1	1	1	1	8.95	-	7.72	665	12.40	2.7	1.92
	3	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	4	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	5	SW	11-30-16	11:00	G	Y*/N	2	1	1	1	1	6.19	-	7.53	662	12.46	1.7	0.55
	6	SW	11-30-16	11:20	G	Y*/N	2	1	1	1	1	5.94	-	7.36	657	13.19	1.9	1.05
	7	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	8	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	9	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	10	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	11	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	DD	SW	—	******	G	Y*/N	2	1	1	1	1	See Field Notebook						

Relinquished By:	Date / Time	Received By:	Date / Time
	11-30-16 / 1313	1313	11-30-16 / 1313
	11-30-16 / 1320	Lisa Martin	11-30-16 1320

Temp. Upon Receipt (C): 4.8 Measured By: LLM
Containers Properly Preserved ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)
L3

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

1 of 2

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - CB, BR
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days
EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
							# of Containers Per Analysis					On-Site/Field Measurements						
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW	11-30-16	1120	G	Y*/N	2	1	1	1	1	6.4	67.8	7.3	720	16.1	0.0	—
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW	11-30-16	0920	G	Y*/N	2	1	1	1	1	6.7	71.5	7.3	587	16.1	2.2	1.12
	11	SW	11-30-16	1030	G	Y*/N	2	1	1	1	1	5.4	54.5	7.4	711	14.0	9.6	0.62
	DD	SW	11-30-16	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	11-30-16/1320		11-30-16/1320

Temp. Upon Receipt (C): 4.8 **Measured By:** LLm
Containers Properly Preserved: ([✓ Yes] / No) L3
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

2 of 2

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CERTIFICATE OF ANALYSIS

6121194

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	12/26/2016
Date Due	12/27/2016
Date Received	12/15/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**										**Sampled**	12/15/2016 @ 9:30	
Sampled By Customer												
Flow by Calculation			3.3	CFS			EPA 600				12/15/2016 9:30	CUS
Oxygen, Dissolved			10.69	mg/L			SM 4500 O G	0.10			12/15/2016 9:30	CUS
Specific Conductance at 25 °C			638	umhos/cm			CLIENT SPECIFIED				12/15/2016 9:30	CUS
Turbidity			15	NTU			CLIENT SPECIFIED	1			12/15/2016 9:30	CUS
E. coli			40.8	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ M2	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 14:43	EGD
Nitrogen, Nitrate			1.1	mg/L			EPA 300.0	0.55		0.12	12/16/2016 20:56	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 20:56	JGF
Nitrogen, Total Kjeldahl			0.43	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:11	EGD
pH			7.35	SU			CLIENT SPECIFIED	1.00			12/15/2016 9:30	CUS
Phosphorus, Orthophosphate			0.19	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:34	EGD
Phosphorus, Total			0.20	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:33	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		12/16/2016 16:17	CJL
Temperature			0.8	deg C			CLIENT SPECIFIED				12/15/2016 9:30	CUS
Sample: 02 **2**										**Sampled**	12/15/2016 @ 10:20	
Sampled By Customer												
Flow by Calculation			2.07	CFS			EPA 600				12/15/2016 10:20	CUS
Oxygen, Dissolved			10.56	mg/L			SM 4500 O G	0.10			12/15/2016 10:20	CUS
Specific Conductance at 25 °C			692	umhos/cm			CLIENT SPECIFIED				12/15/2016 10:20	CUS
Turbidity			15	NTU			CLIENT SPECIFIED	1			12/15/2016 10:20	CUS
E. coli			160.7	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 14:45	EGD
Nitrogen, Nitrate			1.5	mg/L			EPA 300.0	0.55		0.12	12/16/2016 21:10	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 21:10	JGF

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Third Rock Consultants
Steve Evans

Date Due 12/27/2016
Date Received 12/15/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2**											**Sampled** 12/15/2016 @ 10:20	
Sampled By Customer												
Nitrogen, Total Kjeldahl			0.41	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:13	EGD
pH			7.32	SU			CLIENT SPECIFIED	1.00			12/15/2016 10:20	CUS
Phosphorus, Orthophosphate			0.25	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:35	EGD
Phosphorus, Total			0.39	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:34	EGD
Solids, Total Suspended			15	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL
Temperature			0.9	deg C			CLIENT SPECIFIED				12/15/2016 10:20	CUS
Sample: 03 **5**											**Sampled** 12/15/2016 @ 11:00	
Sampled By Customer												
Flow by Calculation			0.91	CFS			EPA 600				12/15/2016 11:00	CUS
Oxygen, Dissolved			9.60	mg/L			SM 4500 O G	0.10			12/15/2016 11:00	CUS
Specific Conductance at 25 °C			687	umhos/cm			CLIENT SPECIFIED				12/15/2016 11:00	CUS
Turbidity			6	NTU			CLIENT SPECIFIED	1			12/15/2016 11:00	CUS
E. coli			613.1	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 14:47	EGD
Nitrogen, Nitrate			2.3	mg/L			EPA 300.0	0.55		0.12	12/16/2016 21:24	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 21:24	JGF
Nitrogen, Total Kjeldahl			0.87	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:15	EGD
pH			6.83	SU			CLIENT SPECIFIED	1.00			12/15/2016 11:00	CUS
Phosphorus, Orthophosphate		J1	0.014	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:36	EGD
Phosphorus, Total			0.47	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:35	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL
Temperature			1.6	deg C			CLIENT SPECIFIED				12/15/2016 11:00	CUS
Sample: 04 **6**											**Sampled** 12/15/2016 @ 11:30	
Sampled By Customer												
Flow by Calculation			0.82	CFS			EPA 600				12/15/2016 11:30	CUS
Oxygen, Dissolved			8.67	mg/L			SM 4500 O G	0.10			12/15/2016 11:30	CUS

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CERTIFICATE OF ANALYSIS

6121194

Third Rock Consultants		**Date Due**	12/27/2016
Steve Evans		**Date Received**	12/15/2016

KDOW Cane Run Watershed Project

Sample: 04 **6** **Sampled** 12/15/2016 @ 11:30

Sampled By Customer

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Specific Conductance at 25 °C			694	umhos/cm			CLIENT SPECIFIED				12/15/2016 11:30	CUS
Turbidity			23	NTU			CLIENT SPECIFIED	1			12/15/2016 11:30	CUS
E. coli			816.4	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia			0.65	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 14:49	EGD
Nitrogen, Nitrate			2.1	mg/L			EPA 300.0	0.55		0.12	12/16/2016 21:38	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 21:38	JGF
Nitrogen, Total Kjeldahl		M2, R1	1.1	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:45	EGD
pH			7.08	SU			CLIENT SPECIFIED	1.00			12/15/2016 11:30	CUS
Phosphorus, Orthophosphate			0.50	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:38	EGD
Phosphorus, Total			0.55	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:36	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL
Temperature			3.1	deg C			CLIENT SPECIFIED				12/15/2016 11:30	CUS

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

The data and other information contained on this, and other accompanying documents, represents only the sample (s) analyzed and is rendered upon the condition that it is not to be reproduced wholly or in part for advertising or other purposes without written approval from the laboratory.

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CERTIFICATE OF ANALYSIS

6121194

Third Rock Consultants
Steve Evans

Date Due	12/27/2016
Date Received	12/15/2016

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							*** Preservation Type**											
							-	-	SA	-	ST							
							Container Size/Type											
							32oz P	50 mL P	32oz P	8oz P	4oz P							
							Requested Lab Analysis					**On-Site/Field Measurements**						
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (o C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	**Sample I.D.**	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	**# of Containers Per Analysis**											
	1	SW	12/15	9:30	G	Y*/N	2	1	1	1	1	10.69	76.1	7.35	638.4	0.8	15.3	3.3
	2	SW	12/15	10:20	G	Y*/N	2	1	1	1	1	10.56	75.4	7.37	691.7	0.86	14.6	2.07
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW	12/15	11:00	G	Y*/N	2	1	1	1	1	9.6	70.2	6.83	687.1	1.65	5.9	0.91
	6	SW	12/15	11:30	G	Y*/N	2	1	1	1	1	8.67	65.7	7.08	683.9	3.07	228	0.82
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	12/15/16 12:45		12/15/16 @ 12:45

Temp. Upon Receipt (C): -0.5 Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

24

Original COC To Laboratory (Accompany Samples & Report)   COC Copy - TRC Project File   COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

6121198

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	12/26/2016
Date Due	12/27/2016
Date Received	12/15/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **7**										**Sampled**	12/15/2016 @ 11:40	
Sampled By Customer												
Flow by Calculation			0.01	CFS			EPA 600				12/15/2016 11:40	CUS
Oxygen, Dissolved			12.19	mg/L			SM 4500 O G	0.10			12/15/2016 11:40	CUS
Specific Conductance at 25 °C			617	umhos/cm			CLIENT SPECIFIED				12/15/2016 11:40	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			12/15/2016 11:40	CUS
E. coli			17.1	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 14:51	EGD
Nitrogen, Nitrate		J1	0.50	mg/L			EPA 300.0	0.55		0.12	12/16/2016 18:34	JGF
Nitrogen, Nitrite		UJ M2	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 18:34	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:47	EGD
pH			7.60	SU			CLIENT SPECIFIED	1.00			12/15/2016 11:40	CUS
Phosphorus, Orthophosphate			0.079	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:41	EGD
Phosphorus, Total			0.14	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:45	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL
Temperature			4.6	deg C			CLIENT SPECIFIED				12/15/2016 11:40	CUS
Sample: 02 **8**										**Sampled**	12/15/2016 @ 12:15	
Sampled By Customer												
Oxygen, Dissolved			6.80	mg/L			SM 4500 O G	0.10			12/15/2016 12:15	CUS
Specific Conductance at 25 °C			413	umhos/cm			CLIENT SPECIFIED				12/15/2016 12:15	CUS
Turbidity			26	NTU			CLIENT SPECIFIED	1			12/15/2016 12:15	CUS
E. coli			410.6	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 14:53	EGD
Nitrogen, Nitrate			1.1	mg/L			EPA 300.0	0.55		0.12	12/16/2016 19:03	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 19:03	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:49	EGD

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CERTIFICATE OF ANALYSIS

6121198

Third Rock Consultants
Steve Evans

Date Due 12/27/2016
Date Received 12/15/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **8**										**Sampled**	12/15/2016 @ 12:15	
Sampled By Customer												
pH			7.60	SU			CLIENT SPECIFIED	1.00			12/15/2016 12:15	CUS
Phosphorus, Orthophosphate			0.24	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:42	EGD
Phosphorus, Total			0.32	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:46	EGD
Solids, Total Suspended			6	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL
Temperature			13.7	deg C			CLIENT SPECIFIED				12/15/2016 12:15	CUS
Sample: 03 **9**										**Sampled**	12/15/2016 @ 10:56	
Sampled By Customer												
Flow by Calculation			0.01	CFS			EPA 600				12/15/2016 10:56	CUS
Oxygen, Dissolved			18.09	mg/L			SM 4500 O G	0.10			12/15/2016 10:56	CUS
Specific Conductance at 25 °C			482	umhos/cm			CLIENT SPECIFIED				12/15/2016 10:56	CUS
Turbidity			8	NTU			CLIENT SPECIFIED	1			12/15/2016 10:56	CUS
E. coli			365.4	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			3.9	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 14:59	EGD
Nitrogen, Nitrate		J1	0.24	mg/L			EPA 300.0	0.55		0.12	12/16/2016 19:17	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 19:17	JGF
Nitrogen, Total Kjeldahl			0.85	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:55	EGD
pH			8.01	SU			CLIENT SPECIFIED	1.00			12/15/2016 10:56	CUS
Phosphorus, Orthophosphate			0.11	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:43	EGD
Phosphorus, Total			0.54	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:47	EGD
Solids, Total Suspended			6	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL
Temperature			2.6	deg C			CLIENT SPECIFIED				12/15/2016 10:56	CUS
Sample: 04 **10**										**Sampled**	12/15/2016 @ 9:30	
Sampled By Customer												
Flow by Calculation			0.087	CFS			EPA 600				12/15/2016 9:30	CUS
Oxygen, Dissolved			10.80	mg/L			SM 4500 O G	0.10			12/15/2016 9:30	CUS
Specific Conductance at 25 °C			713	umhos/cm			CLIENT SPECIFIED				12/15/2016 9:30	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			12/15/2016 9:30	CUS

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6121198

Third Rock Consultants
Steve Evans

Date Due 12/27/2016
Date Received 12/15/2016

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **10**										**Sampled**	12/15/2016 @ 9:30	
Sampled By Customer												
E. coli			1732.9	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 15:00	EGD
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.55		0.12	12/16/2016 19:31	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 19:31	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:57	EGD
pH			7.90	SU			CLIENT SPECIFIED	1.00			12/15/2016 9:30	CUS
Phosphorus, Orthophosphate			0.31	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:44	EGD
Phosphorus, Total			0.47	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:48	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL
Temperature			6.2	deg C			CLIENT SPECIFIED				12/15/2016 9:30	CUS
Sample: 05 **11**										**Sampled**	12/15/2016 @ 10:03	
Sampled By Customer												
Flow by Calculation			0.53	CFS			EPA 600				12/15/2016 10:03	CUS
Oxygen, Dissolved			11.50	mg/L			SM 4500 O G	0.10			12/15/2016 10:03	CUS
Specific Conductance at 25 °C			669	umhos/cm			CLIENT SPECIFIED				12/15/2016 10:03	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			12/15/2016 10:03	CUS
E. coli			65.0	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 15:02	EGD
Nitrogen, Nitrate			0.62	mg/L			EPA 300.0	0.55		0.12	12/16/2016 19:45	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 19:45	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/22/2016 11:59	EGD
pH			7.80	SU			CLIENT SPECIFIED	1.00			12/15/2016 10:03	CUS
Phosphorus, Orthophosphate			0.20	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:45	EGD
Phosphorus, Total			0.23	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:50	EGD
Solids, Total Suspended			<1	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL
Temperature			3.5	deg C			CLIENT SPECIFIED				12/15/2016 10:03	CUS

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CERTIFICATE OF ANALYSIS

6121198

Third Rock Consultants
Steve Evans

Date Due 12/27/2016
Date Received 12/15/2016

KDOW Cane Run Watershed Project

Sample: 06 **DD** **Sampled** 12/15/2016
Sampled By Customer

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
E. coli			217.8	MPN/100mL			SM9223B (Colilert-18)				12/15/2016 15:59	ABK
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		12/16/2016 12:19	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	12/20/2016 15:03	EGD
Nitrogen, Nitrate			1.0	mg/L			EPA 300.0	0.55		0.12	12/16/2016 19:59	JGF
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	12/16/2016 19:59	JGF
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			12/22/2016 12:01	EGD
Phosphorus, Orthophosphate			0.24	mg/L			EPA 365.1	0.050		0.011	12/16/2016 11:45	EGD
Phosphorus, Total			0.33	mg/L			EPA 365.1	0.050		0.012	12/23/2016 11:51	EGD
Solids, Total Suspended			7	mg/L			USGS I-3765-85	1	1		12/16/2016 17:14	CJL

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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MICROBAC®

CERTIFICATE OF ANALYSIS

6121198

Third Rock Consultants
Steve Evans

Date Due	12/27/2016
Date Received	12/15/2016

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

The data and other information contained on this, and other accompanying documents, represents only the sample (s) analyzed and is rendered upon the condition that it is not to be reproduced wholly or in part for advertising or other purposes without written approval from the laboratory.

6121198 LISA MARTIN

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client - CB, BR
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis					Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	~~1~~	~~SW~~			~~G~~	~~Y/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~2~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~4~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~5~~	~~SW~~			~~G~~	~~Y/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~6~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	7	SW	12-15-16	1140	G	Y*/N	2	1	1	1	1	12.19	95.8	7.60	617	4.55	2.5	0.01
	8	SW	12-15-16	1215	G	Y*/N	2	1	1	1	1	6.8	66.9	7.6	413	13.7	26	—
	9	SW	12-15-16	1056	G	Y*/N	2	1	1	1	1	18.09	112.6	8.01	482	2.60	8.0	0.01
	10	SW	12-15-16	0930	G	Y*/N	2	1	1	1	1	10.8	—	7.9	713	6.2	1.6	0.087
	11	SW	12-15-16	1003	G	Y*/N	2	1	1	1	1	11.5	—	7.8	669	3.5	2.4	0.53
	DD	SW	12-15-16	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
Co Br	12-15-16 / 1415	Lisa Martin	12-15-16 1415
~~Lisa Martin~~	~~12-15-16 1415~~ LM 12-15-16		

Temp. Upon Receipt (C): 8.7 Measured By: LB
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

7011915

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	02/06/2017
Date Due	02/08/2017
Date Received	01/30/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **7**										**Sampled**	01/30/2017 @ 11:45	
Sampled By Customer												
Flow by Calculation			0.17	CFS			EPA 600				01/30/2017 11:45	CUS
Oxygen, Dissolved			10.50	mg/L			SM 4500 O G	0.10			01/30/2017 11:45	CUS
Specific Conductance at 25 °C			498	umhos/cm			CLIENT SPECIFIED				01/30/2017 11:45	CUS
Turbidity			8	NTU			CLIENT SPECIFIED	1			01/30/2017 11:45	CUS
E. coli			3.1	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 15:48	EGD
Nitrogen, Nitrate			3.0	mg/L			EPA 300.0	0.55		0.040	01/31/2017 14:22	LJC
Nitrogen, Nitrite		UJ M2	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 14:22	LJC
Nitrogen, Total Kjeldahl		M1, R1	<0.40	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:15	EGD
pH			7.70	SU			CLIENT SPECIFIED	1.00			01/30/2017 11:45	CUS
Phosphorus, Orthophosphate			0.22	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:07	EGD
Phosphorus, Total			0.22	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:08	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			7.0	deg C			CLIENT SPECIFIED				01/30/2017 11:45	CUS
Sample: 02 **8**										**Sampled**	01/30/2017 @ 12:20	
Sampled By Customer												
Oxygen, Dissolved			5.30	mg/L			SM 4500 O G	0.10			01/30/2017 12:20	CUS
Specific Conductance at 25 °C			511	umhos/cm			CLIENT SPECIFIED				01/30/2017 12:20	CUS
Turbidity			11	NTU			CLIENT SPECIFIED	1			01/30/2017 12:20	CUS
E. coli			16.9	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1, BOD3	10	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia			0.32	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 15:54	EGD
Nitrogen, Nitrate		M1	3.6	mg/L			EPA 300.0	0.55		0.040	01/31/2017 14:36	LJC
Nitrogen, Nitrite		UJ M2	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 14:36	LJC
Nitrogen, Total Kjeldahl			2.8	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:17	EGD

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CERTIFICATE OF ANALYSIS

7011915

Third Rock Consultants
Steve Evans

Date Due	02/08/2017
Date Received	01/30/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **8**										**Sampled**	01/30/2017 @ 12:20	
Sampled By Customer												
pH			7.50	SU			CLIENT SPECIFIED	1.00			01/30/2017 12:20	CUS
Phosphorus, Orthophosphate			0.30	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:08	EGD
Phosphorus, Total			0.56	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:09	EGD
Solids, Total Suspended			30	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			9.6	deg C			CLIENT SPECIFIED				01/30/2017 12:20	CUS
Sample: 03 **9**										**Sampled**	01/30/2017 @ 10:55	
Sampled By Customer												
Flow by Calculation			9	CFS			EPA 600				01/30/2017 10:55	CUS
Oxygen, Dissolved			10.00	mg/L			SM 4500 O G	0.10			01/30/2017 10:55	CUS
Specific Conductance at 25 °C			390	umhos/cm			CLIENT SPECIFIED				01/30/2017 10:55	CUS
Turbidity			12	NTU			CLIENT SPECIFIED	1			01/30/2017 10:55	CUS
E. coli			14.8	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1	2.8	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 15:56	EGD
Nitrogen, Nitrate			4.1	mg/L			EPA 300.0	0.55		0.040	01/31/2017 14:51	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 14:51	LJC
Nitrogen, Total Kjeldahl			0.41	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:19	EGD
pH			7.80	SU			CLIENT SPECIFIED	1.00			01/30/2017 10:55	CUS
Phosphorus, Orthophosphate			0.23	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:09	EGD
Phosphorus, Total			0.27	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:10	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			5.4	deg C			CLIENT SPECIFIED				01/30/2017 10:55	CUS
Sample: 04 **10**										**Sampled**	01/30/2017 @ 9:35	
Sampled By Customer												
Flow by Calculation			2.41	CFS			EPA 600				01/30/2017 9:35	CUS
Oxygen, Dissolved			10.20	mg/L			SM 4500 O G	0.10			01/30/2017 9:35	CUS
Specific Conductance at 25 °C			752	umhos/cm			CLIENT SPECIFIED				01/30/2017 9:35	CUS
Turbidity			7	NTU			CLIENT SPECIFIED	1			01/30/2017 9:35	CUS

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KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **10**											**Sampled**	01/30/2017 @ 9:35
Sampled By Customer												
E. coli			1046.2	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 15:58	EGD
Nitrogen, Nitrate			2.8	mg/L			EPA 300.0	0.55		0.040	01/31/2017 15:05	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 15:05	LJC
Nitrogen, Total Kjeldahl			0.44	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:21	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00			01/30/2017 9:35	CUS
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:11	EGD
Phosphorus, Total			0.27	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:14	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			8.6	deg C			CLIENT SPECIFIED				01/30/2017 9:35	CUS
Sample: 05 **11**											**Sampled**	01/30/2017 @ 10:15
Sampled By Customer												
Flow by Calculation			1.09	CFS			EPA 600				01/30/2017 10:15	CUS
Oxygen, Dissolved			9.80	mg/L			SM 4500 O G	0.10			01/30/2017 10:15	CUS
Specific Conductance at 25 °C			693	umhos/cm			CLIENT SPECIFIED				01/30/2017 10:15	CUS
Turbidity			11	NTU			CLIENT SPECIFIED	1			01/30/2017 10:15	CUS
E. coli			23.3	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1	2.0	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 16:00	EGD
Nitrogen, Nitrate			1.8	mg/L			EPA 300.0	0.55		0.040	01/31/2017 15:19	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 15:19	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:23	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00			01/30/2017 10:15	CUS
Phosphorus, Orthophosphate			0.19	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:12	EGD
Phosphorus, Total			0.20	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:15	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			6.1	deg C			CLIENT SPECIFIED				01/30/2017 10:15	CUS

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Third Rock Consultants
Steve Evans

Date Due 02/08/2017
Date Received 01/30/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 06 **DD**										**Sampled**	01/30/2017	
Sampled By Customer												
E. coli			11.9	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1	2.2	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 16:02	EGD
Nitrogen, Nitrate			4.1	mg/L			EPA 300.0	0.55		0.040	01/31/2017 15:33	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 15:33	LJC
Nitrogen, Total Kjeldahl			0.67	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:25	EGD
Phosphorus, Orthophosphate			0.23	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:13	EGD
Phosphorus, Total			0.27	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:16	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL

Qualifier Definitions

UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
B1	The analyte value in the Method Blank is above the Control Limit.
BOD3	BOD result obtained from an average of dilutions that show more than 30% difference.
M1	Matrix Spike recovery outside Control Limits due to sample matrix interference; biased high.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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Third Rock Consultants
Steve Evans

Date Due	02/08/2017
Date Received	01/30/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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7011915 LISA MARTIN

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client - CB, BR
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							* Preservation Type					On-Site/Field Measurements						
							-	-	SA	-	ST							
							Container Size/Type											
							32oz P	50 mL P	32oz P	8oz P	4oz P							
							Requested Lab Analysis											
Laboratory #	Sample I.D.	Matrix*	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
							# of Containers Per Analysis											
	~~1~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~2~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~4~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~5~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~6~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	7	SW	1-30-17	1145	G	Y*/N	2	1	1	1	1	10.5	89.4	7.7	498	7.0	8.0	0.17
	8	SW	1-30-17	1220	G	Y*/N	2	1	1	1	1	5.3	43.6	7.5	511	9.6	10.6	—
	9	SW	1-30-17	1055	G	Y*/N	2	1	1	1	1	10.0	82.1	7.8	390	5.4	11.5	9.00
	10	SW	1-30-17	0935	G	Y*/N	2	1	1	1	1	10.2	90.5	7.5	752	8.6	7.3	2.41
	11	SW	1-30-17	1015	G	Y*/N	2	1	1	1	1	9.8	81.8	7.5	693	6.1	10.8	1.09
	DD	SW	1-30-17	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	1-30-17 / 1337		1-30-17 1337

Temp. Upon Receipt (C): 4.7 Measured By: LB
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

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CERTIFICATE OF ANALYSIS

7011918

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	02/06/2017
Date Due	02/08/2017
Date Received	01/30/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**										**Sampled**	01/30/2017 @ 9:50	
Sampled By Customer												
Flow by Calculation			14.07	CFS			EPA 600				01/30/2017 9:50	CUS
Oxygen, Dissolved			23.38	mg/L			SM 4500 O G	0.10			01/30/2017 9:50	CUS
Specific Conductance at 25 °C			511	umhos/cm			CLIENT SPECIFIED				01/30/2017 9:50	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			01/30/2017 9:50	CUS
E. coli			66.3	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1	2.2	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 16:34	EGD
Nitrogen, Nitrate			4.3	mg/L			EPA 300.0	0.55		0.040	01/31/2017 15:47	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 15:47	LJC
Nitrogen, Total Kjeldahl			0.44	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:27	EGD
pH			8.32	SU			CLIENT SPECIFIED	1.00			01/30/2017 9:50	CUS
Phosphorus, Orthophosphate			0.24	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:14	EGD
Phosphorus, Total			0.26	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:18	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			4.4	deg C			CLIENT SPECIFIED				01/30/2017 9:50	CUS
Sample: 02 **2**										**Sampled**	01/30/2017 @ 10:55	
Sampled By Customer												
Flow by Calculation			12.25	CFS			EPA 600				01/30/2017 10:55	CUS
Oxygen, Dissolved			23.52	mg/L			SM 4500 O G	0.10			01/30/2017 10:55	CUS
Specific Conductance at 25 °C			544	umhos/cm			CLIENT SPECIFIED				01/30/2017 10:55	CUS
Turbidity			6	NTU			CLIENT SPECIFIED	1			01/30/2017 10:55	CUS
E. coli			16.7	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1	2.1	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 16:36	EGD
Nitrogen, Nitrate			4.2	mg/L			EPA 300.0	0.55		0.040	01/31/2017 16:01	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 16:01	LJC

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Steve Evans

Date Due 02/08/2017
Date Received 01/30/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2**										**Sampled**	01/30/2017 @ 10:55	
Sampled By Customer												
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:33	EGD
pH			7.98	SU			CLIENT SPECIFIED	1.00			01/30/2017 10:55	CUS
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:16	EGD
Phosphorus, Total			0.30	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:19	EGD
Solids, Total Suspended			6	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			5.6	deg C			CLIENT SPECIFIED				01/30/2017 10:55	CUS
Sample: 03 **3**										**Sampled**	01/30/2017 @ 10:30	
Sampled By Customer												
Flow by Calculation			0.74	CFS			EPA 600				01/30/2017 10:30	CUS
Oxygen, Dissolved			11.48	mg/L			SM 4500 O G	0.10			01/30/2017 10:30	CUS
Specific Conductance at 25 °C			420	umhos/cm			CLIENT SPECIFIED				01/30/2017 10:30	CUS
Turbidity			5	NTU			CLIENT SPECIFIED	1			01/30/2017 10:30	CUS
E. coli			72.3	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1	2.3	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 16:42	EGD
Nitrogen, Nitrate			5.7	mg/L			EPA 300.0	0.55		0.040	01/31/2017 16:16	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 16:16	LJC
Nitrogen, Total Kjeldahl			0.53	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:35	EGD
pH			7.71	SU			CLIENT SPECIFIED	1.00			01/30/2017 10:30	CUS
Phosphorus, Orthophosphate			0.24	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:17	EGD
Phosphorus, Total			0.28	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:19	EGD
Solids, Total Suspended			7	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			7.0	deg C			CLIENT SPECIFIED				01/30/2017 10:30	CUS
Sample: 04 **4**										**Sampled**	01/30/2017 @ 11:30	
Sampled By Customer												
Flow by Calculation			0.36	CFS			EPA 600				01/30/2017 11:30	CUS
Oxygen, Dissolved			11.40	mg/L			SM 4500 O G	0.10			01/30/2017 11:30	CUS

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CERTIFICATE OF ANALYSIS

7011918

Third Rock Consultants
Steve Evans

Date Due 02/08/2017
Date Received 01/30/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **4**										**Sampled**	01/30/2017 @ 11:30	
Sampled By Customer												
Specific Conductance at 25 °C			445	umhos/cm			CLIENT SPECIFIED				01/30/2017 11:30	CUS
Turbidity			4	NTU			CLIENT SPECIFIED	1			01/30/2017 11:30	CUS
E. coli			10.7	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1	2.1	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 16:44	EGD
Nitrogen, Nitrate			3.2	mg/L			EPA 300.0	0.55		0.040	01/31/2017 16:30	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 16:30	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:37	EGD
pH			7.81	SU			CLIENT SPECIFIED	1.00			01/30/2017 11:30	CUS
Phosphorus, Orthophosphate			0.23	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:17	EGD
Phosphorus, Total			0.26	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:20	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			8.5	deg C			CLIENT SPECIFIED				01/30/2017 11:30	CUS
Sample: 05 **5**										**Sampled**	01/30/2017 @ 12:00	
Sampled By Customer												
Flow by Calculation			19.53	CFS			EPA 600				01/30/2017 12:00	CUS
Oxygen, Dissolved			22.66	mg/L			SM 4500 O G	0.10			01/30/2017 12:00	CUS
Specific Conductance at 25 °C			529	umhos/cm			CLIENT SPECIFIED				01/30/2017 12:00	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			01/30/2017 12:00	CUS
E. coli			61.6	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1	2.6	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 16:46	EGD
Nitrogen, Nitrate			3.8	mg/L			EPA 300.0	0.55		0.040	01/31/2017 17:27	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 17:27	LJC
Nitrogen, Total Kjeldahl			0.72	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:39	EGD
pH			7.95	SU			CLIENT SPECIFIED	1.00			01/30/2017 12:00	CUS
Phosphorus, Orthophosphate			0.28	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:20	EGD
Phosphorus, Total			0.31	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:21	EGD

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Steve Evans

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KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 05 **5** Sampled By Customer										**Sampled**	01/30/2017 @ 12:00	
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			6.9	deg C			CLIENT SPECIFIED				01/30/2017 12:00	CUS
Sample: 06 **6** Sampled By Customer										**Sampled**	01/30/2017 @ 12:15	
Flow by Calculation			19.94	CFS			EPA 600				01/30/2017 12:15	CUS
Oxygen, Dissolved			14.86	mg/L			SM 4500 O G	0.10			01/30/2017 12:15	CUS
Specific Conductance at 25 °C			538	umhos/cm			CLIENT SPECIFIED				01/30/2017 12:15	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			01/30/2017 12:15	CUS
E. coli			55.6	MPN/100mL			SM9223B (Colilert-18)				01/30/2017 15:20	LKE
CBOD, 5 Day		B1, BOD3	3.5	mg/L			SM 5210 B	2.0	2		01/31/2017 10:34	DJR
Nitrogen, Ammonia		J1	0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/03/2017 16:48	EGD
Nitrogen, Nitrate			3.8	mg/L			EPA 300.0	0.55		0.040	01/31/2017 17:41	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	01/31/2017 17:41	LJC
Nitrogen, Total Kjeldahl			0.77	mg/L			SM 4500 NH3 G	0.40			02/03/2017 12:41	EGD
pH			7.85	SU			CLIENT SPECIFIED	1.00			01/30/2017 12:15	CUS
Phosphorus, Orthophosphate			0.28	mg/L			EPA 365.1	0.050		0.011	01/31/2017 11:21	EGD
Phosphorus, Total			0.33	mg/L			EPA 365.1	0.050		0.012	02/03/2017 13:22	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		01/31/2017 17:14	CJL
Temperature			7.5	deg C			CLIENT SPECIFIED				01/30/2017 12:15	CUS

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
B1	The analyte value in the Method Blank is above the Control Limit.
BOD3	BOD result obtained from an average of dilutions that show more than 30% difference.

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Steve Evans

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Date Received	01/30/2017

KDOW Cane Run Watershed Project

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

7011918 LISA MARTIN

COC# **CHAIN OF CUSTODY**

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
* Preservation Type							-	-	SA	-	ST							
Container Size/Type							32oz P	50 mL P	32oz P	8oz P	4oz P							
Laboratory #	**Sample I.D.**	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis					On-Site/Field Measurements						
	1	SW	1/30/17	9:50	G	Y*/N	2	1	1	1	1	23.38	—	8.32	511	4.41	2.4	14.07
	2	SW	1/30/17	10:55	G	Y*/N	2	1	1	1	1	23.52	—	7.98	544	5.62	6.0	12.25
	3	SW	1/30/17	10:30	G	Y*/N	2	1	1	1	1	11.48	—	7.71	420	6.96	4.6	0.74
	4	SW	1/30/17	11:30	G	Y*/N	2	1	1	1	1	11.40	—	7.81	445	8.54	3.5	0.36
	5	SW	1/30/17	12:00	G	Y*/N	2	1	1	1	1	22.66	—	7.95	529	6.94	3.0	19.53
	6	SW	1/30/17	12:15	G	Y*/N	2	1	1	1	1	11.86	—	7.85	538	7.53	3.4	19.94
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~8~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~9~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~10~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~11~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	1/30/17 2:10		1/30/17 14:10

Temp. Upon Receipt (C): 4.4 Measured By:
Containers Properly Preserved: [✓ Yes] / No
Bottles Intact: [✓ Yes] / No

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

7020452

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	02/17/2017
Date Due	02/16/2017
Date Received	02/07/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**										**Sampled**	02/07/2017 @ 8:40	
Sampled By Customer												
Flow by Calculation			7.58	CFS			EPA 600				02/07/2017 8:40	CUS
Oxygen, Dissolved			9.09	mg/L			SM 4500 O G	0.10			02/07/2017 8:40	CUS
Specific Conductance at 25 °C			371	umhos/cm			CLIENT SPECIFIED				02/07/2017 8:40	CUS
E. coli			80.9	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 13:44	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:04	EGD
Nitrogen, Nitrate			3.3	mg/L			EPA 300.0	0.55		0.040	02/08/2017 14:37	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 14:37	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/16/2017 11:51	EGD
pH			7.85	SU			CLIENT SPECIFIED	1.00			02/07/2017 8:40	CUS
Phosphorus, Orthophosphate			0.21	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:39	EGD
Phosphorus, Total			0.19	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:14	EGD
Solids, Total Suspended			7	mg/L			USGS I-3765-85	1	1		02/08/2017 19:27	JAR
Temperature			10.1	deg C			CLIENT SPECIFIED				02/07/2017 8:40	CUS
Sample: 02 **2**										**Sampled**	02/07/2017 @ 9:20	
Sampled By Customer												
Flow by Calculation			5.49	CFS			EPA 600				02/07/2017 9:20	CUS
Oxygen, Dissolved			8.54	mg/L			SM 4500 O G	0.10			02/07/2017 9:20	CUS
Specific Conductance at 25 °C			340	umhos/cm			CLIENT SPECIFIED				02/07/2017 9:20	CUS
E. coli			325.5	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 13:44	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:06	EGD
Nitrogen, Nitrate			3.2	mg/L			EPA 300.0	0.55		0.040	02/08/2017 14:51	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 14:51	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/16/2017 11:53	EGD
pH			7.87	SU			CLIENT SPECIFIED	1.00			02/07/2017 9:20	CUS

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Steve Evans

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Date Received 02/07/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2**											**Sampled** 02/07/2017 @ 9:20	
Sampled By Customer												
Phosphorus, Orthophosphate			0.21	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:41	EGD
Phosphorus, Total			0.18	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:15	EGD
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1		02/08/2017 19:27	JAR
Temperature			11.4	deg C			CLIENT SPECIFIED				02/07/2017 9:20	CUS
Sample: 03 **3**											**Sampled** 02/07/2017 @ 9:00	
Sampled By Customer												
Flow by Calculation			0.3	CFS			EPA 600				02/07/2017 9:00	CUS
Oxygen, Dissolved			8.67	mg/L			SM 4500 O G	0.10			02/07/2017 9:00	CUS
Specific Conductance at 25 °C			410	umhos/cm			CLIENT SPECIFIED				02/07/2017 9:00	CUS
E. coli			107.6	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 13:44	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:08	EGD
Nitrogen, Nitrate			4.9	mg/L			EPA 300.0	0.55		0.040	02/08/2017 15:05	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 15:05	LJC
Nitrogen, Total Kjeldahl			0.52	mg/L			SM 4500 NH3 G	0.40			02/16/2017 11:55	EGD
pH			7.57	SU			CLIENT SPECIFIED	1.00			02/07/2017 9:00	CUS
Phosphorus, Orthophosphate			0.25	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:42	EGD
Phosphorus, Total			0.23	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:24	EGD
Solids, Total Suspended			18	mg/L			USGS I-3765-85	1	1		02/08/2017 19:27	JAR
Temperature			11.4	deg C			CLIENT SPECIFIED				02/07/2017 9:00	CUS
Sample: 04 **4**											**Sampled** 02/07/2017 @ 10:20	
Sampled By Customer												
Flow by Calculation			0.14	CFS			EPA 600				02/07/2017 10:20	CUS
Oxygen, Dissolved			8.37	mg/L			SM 4500 O G	0.10			02/07/2017 10:20	CUS
Specific Conductance at 25 °C			398	umhos/cm			CLIENT SPECIFIED				02/07/2017 10:20	CUS
E. coli			178.2	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 13:44	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:10	EGD

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KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **4**											**Sampled**	02/07/2017 @ 10:20
Sampled By Customer												
Nitrogen, Nitrate			1.4	mg/L			EPA 300.0	0.55		0.040	02/08/2017 15:19	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 15:19	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:01	EGD
pH			7.73	SU			CLIENT SPECIFIED	1.00			02/07/2017 10:20	CUS
Phosphorus, Orthophosphate			0.21	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:43	EGD
Phosphorus, Total			0.20	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:25	EGD
Solids, Total Suspended			10	mg/L			USGS I-3765-85	1	1		02/08/2017 19:27	JAR
Temperature			11.6	deg C			CLIENT SPECIFIED				02/07/2017 10:20	CUS
Sample: 05 **5**											**Sampled**	02/07/2017 @ 10:40
Sampled By Customer												
Flow by Calculation			4.35	CFS			EPA 600				02/07/2017 10:40	CUS
Oxygen, Dissolved			8.55	mg/L			SM 4500 O G	0.10			02/07/2017 10:40	CUS
Specific Conductance at 25 °C			506	umhos/cm			CLIENT SPECIFIED				02/07/2017 10:40	CUS
E. coli			2419.6	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 13:44	LKE
CBOD, 5 Day			2.2	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia			0.41	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:26	EGD
Nitrogen, Nitrate			2.7	mg/L			EPA 300.0	0.55		0.040	02/08/2017 15:34	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 15:34	LJC
Nitrogen, Total Kjeldahl			0.73	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:03	EGD
pH			7.85	SU			CLIENT SPECIFIED	1.00			02/07/2017 10:40	CUS
Phosphorus, Orthophosphate			0.29	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:47	EGD
Phosphorus, Total			0.26	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:26	EGD
Solids, Total Suspended			9	mg/L			USGS I-3765-85	1	1		02/08/2017 19:27	JAR
Temperature			11.8	deg C			CLIENT SPECIFIED				02/07/2017 10:40	CUS
Sample: 06 **6**											**Sampled**	02/07/2017 @ 11:05
Sampled By Customer												
Flow by Calculation			4.87	CFS			EPA 600				02/07/2017 11:05	CUS
Oxygen, Dissolved			8.30	mg/L			SM 4500 O G	0.10			02/07/2017 11:05	CUS

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KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 06 **6**										**Sampled**	02/07/2017 @ 11:05	
Sampled By Customer												
Specific Conductance at 25 °C			487	umhos/cm			CLIENT SPECIFIED				02/07/2017 11:05	CUS
E. coli			416.0	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 13:44	LKE
CBOD, 5 Day			2.4	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia			0.58	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:28	EGD
Nitrogen, Nitrate			2.3	mg/L			EPA 300.0	0.55		0.040	02/08/2017 15:48	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 15:48	LJC
Nitrogen, Total Kjeldahl			0.85	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:05	EGD
pH			7.68	SU			CLIENT SPECIFIED	1.00			02/07/2017 11:05	CUS
Phosphorus, Orthophosphate			0.30	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:48	EGD
Phosphorus, Total			0.28	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:27	EGD
Solids, Total Suspended			10	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			11.8	deg C			CLIENT SPECIFIED				02/07/2017 11:05	CUS
Sample: 07 **DD**										**Sampled**	02/07/2017	
Sampled By Customer												
E. coli			235.9	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 13:44	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:30	EGD
Nitrogen, Nitrate			3.2	mg/L			EPA 300.0	0.55		0.040	02/08/2017 16:02	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 16:02	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:07	EGD
Phosphorus, Orthophosphate			0.21	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:49	EGD
Phosphorus, Total			0.19	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:28	EGD
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR

Qualifier Definitions

UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

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CERTIFICATE OF ANALYSIS

7020452

Third Rock Consultants		**Date Due**	02/16/2017
Steve Evans		**Date Received**	02/07/2017

KDOW Cane Run Watershed Project

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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7020452 LISA MARTIN

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days   EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli
*Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	~~32oz~~ 8 oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix*	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	2/7/17	840	G	Y*/N	2	1	1	1	1	9.09	83.0	7.85	371.1	10.10	-	7.58
	2	SW		920	G	Y*/N	2	1	1	1	1	8.64	81.4	7.87	540.5	11.4	-	5.45
	3	SW		900	G	Y*/N	2	1	1	1	1	8.67	81.0	7.67	410.4	11.35	-	0.3
	4	SW		1020	G	Y*/N	2	1	1	1	1	8.37	79.1	7.73	399.3	11.65	-	0.14
	5	SW		1040	G	Y*/N	2	1	1	1	1	8.55	81.1	7.75	505.5	11.77	-	4.35
	6	SW		1105	G	Y*/N	2	1	1	1	1	8.5	78.7	7.68	487.0	11.78	-	4.87
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW	2/7/17	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	2/7/17 / 11:51		2/7/17 11:51

Temp. Upon Receipt (C): 7.5° Measured By:
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: [✓ Yes] / No)
L3

Original COC To Laboratory (Accompany Samples & Report)   COC Copy - TRC Project File   COC Copy - TRC Laboratory Services Coordinator

MICROBAC

CERTIFICATE OF ANALYSIS

7020456

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	02/17/2017
Date Due	02/16/2017
Date Received	02/07/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **7**										**Sampled**	02/07/2017 @ 11:06	
Sampled By Customer												
Flow by Calculation			0.19	CFS			EPA 600				02/07/2017 11:06	CUS
Oxygen, Dissolved			11.30	mg/L			SM 4500 O G	0.10			02/07/2017 11:06	CUS
Specific Conductance at 25 °C			481	umhos/cm			CLIENT SPECIFIED				02/07/2017 11:06	CUS
Turbidity			11	NTU			CLIENT SPECIFIED	1			02/07/2017 11:06	CUS
E. coli			8.5	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:32	EGD
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.55		0.040	02/08/2017 16:16	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 16:16	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:09	EGD
pH			7.90	SU			CLIENT SPECIFIED	1.00			02/07/2017 11:06	CUS
Phosphorus, Orthophosphate			0.15	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:50	EGD
Phosphorus, Total			0.17	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:30	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			11.8	deg C			CLIENT SPECIFIED				02/07/2017 11:06	CUS
Sample: 02 **8**										**Sampled**	02/07/2017 @ 11:45	
Sampled By Customer												
Flow by Calculation			No Flow	CFS			EPA 600				02/07/2017 11:45	CUS
Oxygen, Dissolved			7.20	mg/L			SM 4500 O G	0.10			02/07/2017 11:45	CUS
Specific Conductance at 25 °C			6	umhos/cm			CLIENT SPECIFIED				02/07/2017 11:45	CUS
Turbidity			8	NTU			CLIENT SPECIFIED	1			02/07/2017 11:45	CUS
E. coli			13.4	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			7.5	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia			1.1	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:34	EGD
Nitrogen, Nitrate			2.6	mg/L			EPA 300.0	0.55		0.040	02/08/2017 16:59	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 16:59	LJC

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CERTIFICATE OF ANALYSIS

7020456

Third Rock Consultants
Steve Evans

Date Due	02/16/2017
Date Received	02/07/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **8**										**Sampled**	02/07/2017 @ 11:45	
Sampled By Customer												
Nitrogen, Total Kjeldahl		M3	3.0	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:11	EGD
pH			7.60	SU			CLIENT SPECIFIED	1.00			02/07/2017 11:45	CUS
Phosphorus, Orthophosphate			0.27	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:51	EGD
Phosphorus, Total			0.70	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:31	EGD
Solids, Total Suspended			22	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			11.7	deg C			CLIENT SPECIFIED				02/07/2017 11:45	CUS
Sample: 03 **9**										**Sampled**	02/07/2017 @ 10:33	
Sampled By Customer												
Flow by Calculation			4.1	CFS			EPA 600				02/07/2017 10:33	CUS
Oxygen, Dissolved			11.20	mg/L			SM 4500 O G	0.10			02/07/2017 10:33	CUS
Specific Conductance at 25 °C			405	umhos/cm			CLIENT SPECIFIED				02/07/2017 10:33	CUS
Turbidity			5	NTU			CLIENT SPECIFIED	1			02/07/2017 10:33	CUS
E. coli			55.4	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			2.5	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:36	EGD
Nitrogen, Nitrate			3.0	mg/L			EPA 300.0	0.55		0.040	02/08/2017 17:13	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 17:13	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:13	EGD
pH			8.10	SU			CLIENT SPECIFIED	1.00			02/07/2017 10:33	CUS
Phosphorus, Orthophosphate			0.16	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:52	EGD
Phosphorus, Total			0.22	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:32	EGD
Solids, Total Suspended			7	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			9.7	deg C			CLIENT SPECIFIED				02/07/2017 10:33	CUS
Sample: 04 **10**										**Sampled**	02/07/2017 @ 9:20	
Sampled By Customer												
Flow by Calculation			12.2	CFS			EPA 600				02/07/2017 9:20	CUS
Oxygen, Dissolved			9.30	mg/L			SM 4500 O G	0.10			02/07/2017 9:20	CUS

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CERTIFICATE OF ANALYSIS

7020456

Third Rock Consultants
Steve Evans

Date Due	02/16/2017
Date Received	02/07/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **10** Sampled By Customer											**Sampled** 02/07/2017 @ 9:20	
Specific Conductance at 25 °C			1480	umhos/cm			CLIENT SPECIFIED				02/07/2017 9:20	CUS
Turbidity			150	NTU			CLIENT SPECIFIED	1			02/07/2017 9:20	CUS
E. coli			2419.6	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			5.6	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		J1	0.25	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:38	EGD
Nitrogen, Nitrate			0.62	mg/L			EPA 300.0	0.55		0.040	02/08/2017 17:27	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 17:27	LJC
Nitrogen, Total Kjeldahl			1.5	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:15	EGD
pH			7.80	SU			CLIENT SPECIFIED	1.00			02/07/2017 9:20	CUS
Phosphorus, Orthophosphate			0.16	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:52	EGD
Phosphorus, Total			1.4	mg/L			EPA 365.1	0.10		0.023	02/15/2017 15:16	EGD
Solids, Total Suspended			199	mg/L			USGS I-3765-85	2	1		02/09/2017 22:27	JAR
Temperature			11.7	deg C			CLIENT SPECIFIED				02/07/2017 9:20	CUS
Sample: 05 **11** Sampled By Customer											**Sampled** 02/07/2017 @ 10:02	
Flow by Calculation			0.73	CFS			EPA 600				02/07/2017 10:02	CUS
Oxygen, Dissolved			9.10	mg/L			SM 4500 O G	0.10			02/07/2017 10:02	CUS
Specific Conductance at 25 °C			721	umhos/cm			CLIENT SPECIFIED				02/07/2017 10:02	CUS
Turbidity			7	NTU			CLIENT SPECIFIED	1			02/07/2017 10:02	CUS
E. coli			2419.6	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:44	EGD
Nitrogen, Nitrate			1.3	mg/L			EPA 300.0	0.55		0.040	02/08/2017 17:42	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 17:42	LJC
Nitrogen, Total Kjeldahl			0.59	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:17	EGD
pH			7.70	SU			CLIENT SPECIFIED	1.00			02/07/2017 10:02	CUS
Phosphorus, Orthophosphate			0.19	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:53	EGD
Phosphorus, Total			0.24	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:34	EGD

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CERTIFICATE OF ANALYSIS

7020456

Third Rock Consultants
Steve Evans

Date Due 02/16/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 05 **11**											**Sampled** 02/07/2017 @ 10:02	
Sampled By Customer												
Solids, Total Suspended			7	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			11.6	deg C			CLIENT SPECIFIED				02/07/2017 10:02	CUS

Qualifier Definitions

J1 The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.

UJ Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

M3 Analyte in the parent sample for the Matrix Spike was >4x the concentration of the spike solution which renders the spike amount insignificant. Matrix spike recoveries do not impact the quality of the parent sample data for this analyte.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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7020456 LISA MARTIN

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
							# of Containers Per Analysis											
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	2-7-17	1106	G	Y*/N	2	1	1	1	1	11.3	91.9	7.9	481	11.8	11.0	0.19
	8	SW	2-7-17	1145	G	Y*/N	2	1	1	1	1	7.2	68.7	7.6	628	11.7	8.0	N/A
	9	SW	2-7-17	1033	G	Y*/N	2	1	1	1	1	11.2	91.5	8.1	405	9.7	5.2	4.1
	10	SW	2-7-17	0920	G	Y*/N	2	1	1	1	1	9.3	86.5	7.8	1480	11.7	150	12.2
	11	SW	2-7-17	1002	G	Y*/N	2	1	1	1	1	9.1	84.1	7.7	721	11.6	6.9	0.73
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	2-7-17 0180 0 LM 2-7-17		2-7-17 1380 0 LM 2-7-17

Temp. Upon Receipt (C): 4.8° Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

7020456 LISA MARTIN

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli							
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
							Requested Lab Analysis					On-Site/Field Measurements						
Laboratory #	**Sample I.D.**	Matrix *	Collection Date	Collection Time	Grab / Comp	Fltrd Y/N	# of Containers Per Analysis					Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	2-7-17	1106	G	Y*/N	2	1	1	1	1	11.3	91.9	7.9	481	11.8	11.0	0.19
	8	SW	2-7-17	1145	G	Y*/N	2	1	1	1	1	7.2	68.7	7.6	628	11.7	8.0	N/A
	9	SW	2-7-17	1033	G	Y*/N	2	1	1	1	1	11.2	91.5	8.1	405	9.7	5.2	4.1
	10	SW	2-7-17	0920	G	Y*/N	2	1	1	1	1	9.3	86.5	7.8	1480	11.7	150	12.2
	11	SW	2-7-17	1002	G	Y*/N	2	1	1	1	1	9.1	84.1	7.7	721	11.6	6.9	0.73
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	2-7-17 0180 0 LM 2-7-17		2-7-17 1380 0 LM 2-7-17

Temp. Upon Receipt (C): 4.8° LJ Measured By:
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: [✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

MICROBAC

REVISED CERTIFICATE OF ANALYSIS

7020456

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Original Date Reported	02/17/2017
Report Reissued	02/23/2017
Date Received	02/07/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **7**										**Sampled**	02/07/2017 @ 11:06	
Sampled By Customer												
Flow by Calculation			0.19	CFS			EPA 600				02/07/2017 11:06	CUS
Oxygen, Dissolved			11.30	mg/L			SM 4500 O G	0.10			02/07/2017 11:06	CUS
Specific Conductance at 25 °C			481	umhos/cm			CLIENT SPECIFIED				02/07/2017 11:06	CUS
Turbidity			11	NTU			CLIENT SPECIFIED	1			02/07/2017 11:06	CUS
E. coli			8.5	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:32	EGD
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.55		0.040	02/08/2017 16:16	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 16:16	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:09	EGD
pH			7.90	SU			CLIENT SPECIFIED	1.00			02/07/2017 11:06	CUS
Phosphorus, Orthophosphate			0.15	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:50	EGD
Phosphorus, Total			0.17	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:30	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			11.8	deg C			CLIENT SPECIFIED				02/07/2017 11:06	CUS
Sample: 02 **8**										**Sampled**	02/07/2017 @ 11:45	
Sampled By Customer												
Flow by Calculation			No Flow	CFS			EPA 600				02/07/2017 11:45	CUS
Oxygen, Dissolved			7.20	mg/L			SM 4500 O G	0.10			02/07/2017 11:45	CUS
Specific Conductance at 25 °C			6	umhos/cm			CLIENT SPECIFIED				02/07/2017 11:45	CUS
Turbidity			8	NTU			CLIENT SPECIFIED	1			02/07/2017 11:45	CUS
E. coli			13.4	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			7.5	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia			1.1	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:34	EGD
Nitrogen, Nitrate			2.6	mg/L			EPA 300.0	0.55		0.040	02/08/2017 16:59	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 16:59	LJC

The data and other information contained on this, and other accompanying documents, represents only the sample (s) analyzed and is rendered upon the condition that it is not to be reproduced wholly or in part for advertising or other purposes without written approval from the laboratory.

REVISED CERTIFICATE OF ANALYSIS

7020456

Third Rock Consultants
Steve Evans

Report Reissued 02/23/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **8**										**Sampled**	02/07/2017 @ 11:45	
Sampled By Customer												
Nitrogen, Total Kjeldahl		M3	3.0	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:11	EGD
pH			7.60	SU			CLIENT SPECIFIED	1.00			02/07/2017 11:45	CUS
Phosphorus, Orthophosphate			0.27	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:51	EGD
Phosphorus, Total			0.70	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:31	EGD
Solids, Total Suspended			22	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			11.7	deg C			CLIENT SPECIFIED				02/07/2017 11:45	CUS
Sample: 03 **9**										**Sampled**	02/07/2017 @ 10:33	
Sampled By Customer												
Flow by Calculation			4.1	CFS			EPA 600				02/07/2017 10:33	CUS
Oxygen, Dissolved			11.20	mg/L			SM 4500 O G	0.10			02/07/2017 10:33	CUS
Specific Conductance at 25 °C			405	umhos/cm			CLIENT SPECIFIED				02/07/2017 10:33	CUS
Turbidity			5	NTU			CLIENT SPECIFIED	1			02/07/2017 10:33	CUS
E. coli			55.4	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			2.5	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:36	EGD
Nitrogen, Nitrate			3.0	mg/L			EPA 300.0	0.55		0.040	02/08/2017 17:13	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 17:13	LJC
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:13	EGD
pH			8.10	SU			CLIENT SPECIFIED	1.00			02/07/2017 10:33	CUS
Phosphorus, Orthophosphate			0.16	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:52	EGD
Phosphorus, Total			0.22	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:32	EGD
Solids, Total Suspended			7	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			9.7	deg C			CLIENT SPECIFIED				02/07/2017 10:33	CUS
Sample: 04 **10**										**Sampled**	02/07/2017 @ 9:20	
Sampled By Customer												
Flow by Calculation			12.2	CFS			EPA 600				02/07/2017 9:20	CUS
Oxygen, Dissolved			9.30	mg/L			SM 4500 O G	0.10			02/07/2017 9:20	CUS

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REVISED CERTIFICATE OF ANALYSIS

7020456

Third Rock Consultants
Steve Evans

Report Reissued 02/23/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **10**										**Sampled**	02/07/2017 @ 9:20	
Sampled By Customer												
Specific Conductance at 25 °C			1480	umhos/cm			CLIENT SPECIFIED				02/07/2017 9:20	CUS
Turbidity			150	NTU			CLIENT SPECIFIED	1			02/07/2017 9:20	CUS
E. coli			> 2419.6	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			5.6	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		J1	0.25	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:38	EGD
Nitrogen, Nitrate			0.62	mg/L			EPA 300.0	0.55		0.040	02/08/2017 17:27	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 17:27	LJC
Nitrogen, Total Kjeldahl			1.5	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:15	EGD
pH			7.80	SU			CLIENT SPECIFIED	1.00			02/07/2017 9:20	CUS
Phosphorus, Orthophosphate			0.16	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:52	EGD
Phosphorus, Total			1.4	mg/L			EPA 365.1	0.10		0.023	02/15/2017 15:16	EGD
Solids, Total Suspended			199	mg/L			USGS I-3765-85	2	1		02/09/2017 22:27	JAR
Temperature			11.7	deg C			CLIENT SPECIFIED				02/07/2017 9:20	CUS
Sample: 05 **11**										**Sampled**	02/07/2017 @ 10:02	
Sampled By Customer												
Flow by Calculation			0.73	CFS			EPA 600				02/07/2017 10:02	CUS
Oxygen, Dissolved			9.10	mg/L			SM 4500 O G	0.10			02/07/2017 10:02	CUS
Specific Conductance at 25 °C			721	umhos/cm			CLIENT SPECIFIED				02/07/2017 10:02	CUS
Turbidity			7	NTU			CLIENT SPECIFIED	1			02/07/2017 10:02	CUS
E. coli			> 2419.6	MPN/100mL			SM9223B (Colilert-18)				02/07/2017 15:24	LKE
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		02/08/2017 9:57	MTA
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	02/10/2017 18:44	EGD
Nitrogen, Nitrate			1.3	mg/L			EPA 300.0	0.55		0.040	02/08/2017 17:42	LJC
Nitrogen, Nitrite		UJ	<0.38	mg/L			EPA 300.0	0.75		0.38	02/08/2017 17:42	LJC
Nitrogen, Total Kjeldahl			0.59	mg/L			SM 4500 NH3 G	0.40			02/16/2017 12:17	EGD
pH			7.70	SU			CLIENT SPECIFIED	1.00			02/07/2017 10:02	CUS
Phosphorus, Orthophosphate			0.19	mg/L			EPA 365.1	0.050		0.017	02/08/2017 17:53	EGD
Phosphorus, Total			0.24	mg/L			EPA 365.1	0.050		0.012	02/15/2017 14:34	EGD

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REVISED CERTIFICATE OF ANALYSIS

7020456

Third Rock Consultants
Steve Evans

Report Reissued 02/23/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 05 **11** Sampled By Customer											**Sampled** 02/07/2017 @ 10:02	
Solids, Total Suspended			7	mg/L			USGS I-3765-85	1	1		02/09/2017 22:27	JAR
Temperature			11.6	deg C			CLIENT SPECIFIED				02/07/2017 10:02	CUS

Revised to correct E coli result on sample -04 & -05. LLM 2-23-17

Qualifier Definitions

J1 The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.

UJ Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

M3 Analyte in the parent sample for the Matrix Spike was >4x the concentration of the spike solution which renders the spike amount insignificant. Matrix spike recoveries do not impact the quality of the parent sample data for this analyte.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

The data and other information contained on this, and other accompanying documents, represents only the sample (s) analyzed and is rendered upon the condition that it is not to be reproduced wholly or in part for advertising or other purposes without written approval from the laboratory.

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	2-7-17	1106	G	Y*/N	2	1	1	1	1	11.3	91.9	7.9	481	11.8	11.0	0.19
	8	SW	2-7-17	1145	G	Y*/N	2	1	1	1	1	7.2	68.7	7.6	628	11.7	8.0	N/A
	9	SW	2-7-17	1033	G	Y*/N	2	1	1	1	1	11.2	91.5	8.1	405	9.7	5.2	4.1
	10	SW	2-7-17	0920	G	Y*/N	2	1	1	1	1	9.3	84.5	7.8	1480	11.7	150	12.2
	11	SW	2-7-17	1002	G	Y*/N	2	1	1	1	1	9.1	84.1	7.7	721	11.6	6.9	0.73
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	2-7-17 0180 0 LM 2-7-17		2-7-17 1380 0 LM 2-7-17

Temp. Upon Receipt (C): 4.8° L3 Measured By:
Containers Properly Preserved: [✓ Yes] / No
Bottles Intact: [✓ Yes] / No

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Flt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli	On-Site/Field Measurements: Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	2-7-17	1106	G	Y*/N	2	1	1	1	1	11.3	91.9	7.9	481	11.8	11.0	0.19
	8	SW	2-7-17	1145	G	Y*/N	2	1	1	1	1	7.2	68.7	7.6	628	11.7	8.0	N/A
	9	SW	2-7-17	1033	G	Y*/N	2	1	1	1	1	11.2	91.5	8.1	405	9.7	5.2	4.1
	10	SW	2-7-17	0920	G	Y*/N	2	1	1	1	1	9.3	86.5	7.8	1480	11.7	150	12.2
	11	SW	2-7-17	1002	G	Y*/N	2	1	1	1	1	9.1	84.1	7.7	721	11.6	6.9	0.73
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	2-7-17 01~~8~~0 0 LM 2-7-17		2-7-17 13~~8~~0 0 LM 2-7-17

Temp. Upon Receipt (C): 4.8° L3 Measured By:
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: [✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

MICROBAC

CERTIFICATE OF ANALYSIS

7031163

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	03/29/2017
Date Due	03/29/2017
Date Received	03/17/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**											**Sampled** 03/17/2017 @ 14:10	
Sampled By Customer												
Flow by Calculation			7.06	CFS			EPA 600				03/17/2017 14:10	CUS
Oxygen, Dissolved - Client Provided			11.65	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 14:10	CUS
Specific Conductance at 25 °C			495	umhos/cm			CLIENT SPECIFIED				03/17/2017 14:10	CUS
E. coli			83.6	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/21/2017 18:28	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			03/23/2017 13:46	EGD
pH			7.51	SU			CLIENT SPECIFIED	1.00			03/17/2017 14:10	CUS
Phosphorus, Total			0.20	mg/L			EPA 365.1	0.050		0.010	03/28/2017 11:57	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			5.4	deg C			CLIENT SPECIFIED				03/17/2017 14:10	CUS
Nitrogen, Nitrate			3.2	mg/L			EPA 300.0	0.33		0.015	03/18/2017 11:18	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 11:18	LJC
Phosphorus, Orthophosphate		J1	0.22	mg/L			EPA 300.0	0.48		0.024	03/18/2017 11:18	LJC
Sample: 02 **3**											**Sampled** 03/17/2017 @ 14:30	
Sampled By Customer												
Flow by Calculation			4.25	CFS			EPA 600				03/17/2017 14:30	CUS
Oxygen, Dissolved - Client Provided			11.33	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 14:30	CUS
Specific Conductance at 25 °C			520	umhos/cm			CLIENT SPECIFIED				03/17/2017 14:30	CUS
E. coli			110.6	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			2.0	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/21/2017 18:30	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			03/23/2017 13:48	EGD
pH			7.98	SU			CLIENT SPECIFIED	1.00			03/17/2017 14:30	CUS
Phosphorus, Total			0.23	mg/L			EPA 365.1	0.050		0.010	03/28/2017 11:58	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL

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Third Rock Consultants
Steve Evans

Date Due 03/29/2017
Date Received 03/17/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **3**											**Sampled** 03/17/2017 @ 14:30	
Sampled By Customer												
Temperature			7.4	deg C			CLIENT SPECIFIED				03/17/2017 14:30	CUS
Nitrogen, Nitrate			3.1	mg/L			EPA 300.0	0.33		0.015	03/18/2017 11:38	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 11:38	LJC
Phosphorus, Orthophosphate		J1	0.22	mg/L			EPA 300.0	0.48		0.024	03/18/2017 11:38	LJC
Sample: 03 **4**											**Sampled** 03/17/2017 @ 15:00	
Sampled By Customer												
Oxygen, Dissolved - Client Provided			9.42	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 15:00	CUS
Specific Conductance at 25 °C			392	umhos/cm			CLIENT SPECIFIED				03/17/2017 15:00	CUS
E. coli			20.3	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 12:54	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			03/23/2017 13:50	EGD
pH			7.39	SU			CLIENT SPECIFIED	1.00			03/17/2017 15:00	CUS
Phosphorus, Total			0.27	mg/L			EPA 365.1	0.10		0.021	03/28/2017 13:09	EGD
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			9.0	deg C			CLIENT SPECIFIED				03/17/2017 15:00	CUS
Nitrogen, Nitrate			1.3	mg/L			EPA 300.0	0.33		0.015	03/18/2017 11:52	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 11:52	LJC
Phosphorus, Orthophosphate		J1	0.22	mg/L			EPA 300.0	0.48		0.024	03/18/2017 11:52	LJC
Sample: 04 **5**											**Sampled** 03/17/2017 @ 15:20	
Sampled By Customer												
Oxygen, Dissolved - Client Provided			11.83	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 15:20	CUS
Specific Conductance at 25 °C			508	umhos/cm			CLIENT SPECIFIED				03/17/2017 15:20	CUS
E. coli			146.7	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			2.6	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 12:56	EGD
Nitrogen, Total Kjeldahl			0.56	mg/L			SM 4500 NH3 G	0.40			03/23/2017 13:52	EGD

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Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **5**											**Sampled** 03/17/2017 @ 15:20	
Sampled By Customer												
pH			8.06	SU			CLIENT SPECIFIED	1.00			03/17/2017 15:20	CUS
Phosphorus, Total			0.30	mg/L			EPA 365.1	0.050		0.010	03/28/2017 12:03	EGD
Solids, Total Suspended		R3	7	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			7.7	deg C			CLIENT SPECIFIED				03/17/2017 15:20	CUS
Nitrogen, Nitrate			2.9	mg/L			EPA 300.0	0.33		0.015	03/18/2017 12:06	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 12:06	LJC
Phosphorus, Orthophosphate		J1	0.24	mg/L			EPA 300.0	0.48		0.024	03/18/2017 12:06	LJC
Sample: 05 **6**											**Sampled** 03/17/2017 @ 15:40	
Sampled By Customer												
Oxygen, Dissolved - Client Provided			11.72	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 15:40	CUS
Specific Conductance at 25 °C			523	umhos/cm			CLIENT SPECIFIED				03/17/2017 15:40	CUS
E. coli			290.9	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			2.7	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		L1	0.30	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 12:58	EGD
Nitrogen, Total Kjeldahl			0.90	mg/L			SM 4500 NH3 G	0.40			03/23/2017 13:54	EGD
pH			7.99	SU			CLIENT SPECIFIED	1.00			03/17/2017 15:40	CUS
Phosphorus, Total			0.33	mg/L			EPA 365.1	0.050		0.010	03/28/2017 12:05	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			7.8	deg C			CLIENT SPECIFIED				03/17/2017 15:40	CUS
Nitrogen, Nitrate			2.8	mg/L			EPA 300.0	0.33		0.015	03/18/2017 12:21	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 12:21	LJC
Phosphorus, Orthophosphate		J1	0.26	mg/L			EPA 300.0	0.48		0.024	03/18/2017 12:21	LJC
Sample: 06 **7**											**Sampled** 03/17/2017 @ 15:45	
Sampled By Customer												
Flow by Calculation			0.43	CFS			EPA 600				03/17/2017 15:45	CUS
Oxygen, Dissolved - Client Provided			15.10	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 15:45	CUS
Specific Conductance at 25 °C			436	umhos/cm			CLIENT SPECIFIED				03/17/2017 15:45	CUS

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Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 06 **7**										**Sampled**	03/17/2017 @ 15:45	
Sampled By Customer												
Turbidity			3	NTU			CLIENT SPECIFIED	1			03/17/2017 15:45	CUS
E. coli			4.1	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			2.2	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 13:00	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			03/23/2017 13:56	EGD
pH			8.10	SU			CLIENT SPECIFIED	1.00			03/17/2017 15:45	CUS
Phosphorus, Total			0.16	mg/L			EPA 365.1	0.050		0.010	03/28/2017 12:06	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			7.5	deg C			CLIENT SPECIFIED				03/17/2017 15:45	CUS
Nitrogen, Nitrate			1.6	mg/L			EPA 300.0	0.33		0.015	03/18/2017 12:35	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 12:35	LJC
Phosphorus, Orthophosphate		J1	0.19	mg/L			EPA 300.0	0.48		0.024	03/18/2017 12:35	LJC
Sample: 07 **8**										**Sampled**	03/17/2017 @ 16:26	
Sampled By Customer												
Oxygen, Dissolved - Client Provided			8.28	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 16:26	CUS
Specific Conductance at 25 °C			578	umhos/cm			CLIENT SPECIFIED				03/17/2017 16:26	CUS
Turbidity			19	NTU			CLIENT SPECIFIED	1			03/17/2017 16:26	CUS
E. coli			9.8	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			3.5	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 13:02	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			03/29/2017 9:58	EGD
pH			7.52	SU			CLIENT SPECIFIED	1.00			03/17/2017 16:26	CUS
Phosphorus, Total			0.38	mg/L			EPA 365.1	0.050		0.010	03/28/2017 12:07	EGD
Solids, Total Suspended			26	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			10.7	deg C			CLIENT SPECIFIED				03/17/2017 16:26	CUS
Nitrogen, Nitrate			2.6	mg/L			EPA 300.0	0.33		0.015	03/18/2017 12:49	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 12:49	LJC
Phosphorus, Orthophosphate		J1	0.20	mg/L			EPA 300.0	0.48		0.024	03/18/2017 12:49	LJC

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Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 07 **8** Sampled By Customer										**Sampled**	03/17/2017 @ 16:26	
Sample: 08 **9** Sampled By Customer										**Sampled**	03/17/2017 @ 15:12	
Flow by Calculation			5.6	CFS			EPA 600				03/17/2017 15:12	CUS
Oxygen, Dissolved - Client Provided			14.90	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 15:12	CUS
Specific Conductance at 25 °C			332	umhos/cm			CLIENT SPECIFIED				03/17/2017 15:12	CUS
Turbidity			6	NTU			CLIENT SPECIFIED	1			03/17/2017 15:12	CUS
E. coli			18.5	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			6.8	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 13:04	EGD
Nitrogen, Total Kjeldahl			0.76	mg/L			SM 4500 NH3 G	0.40			03/29/2017 10:00	EGD
pH			8.80	SU			CLIENT SPECIFIED	1.00			03/17/2017 15:12	CUS
Phosphorus, Total			0.18	mg/L			EPA 365.1	0.050		0.010	03/28/2017 12:09	EGD
Solids, Total Suspended			13	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			7.0	deg C			CLIENT SPECIFIED				03/17/2017 15:12	CUS
Nitrogen, Nitrate			2.2	mg/L			EPA 300.0	0.33		0.015	03/18/2017 13:03	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 13:03	LJC
Phosphorus, Orthophosphate		UJ	<0.024	mg/L			EPA 300.0	0.48		0.024	03/18/2017 13:03	LJC
Sample: 09 **10** Sampled By Customer										**Sampled**	03/17/2017 @ 13:50	
Flow by Calculation			0.196	CFS			EPA 600				03/17/2017 13:50	CUS
Oxygen, Dissolved - Client Provided			11.30	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 13:50	CUS
Specific Conductance at 25 °C			648	umhos/cm			CLIENT SPECIFIED				03/17/2017 13:50	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			03/17/2017 13:50	CUS
E. coli			686.7	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			2.5	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 13:06	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			03/29/2017 10:02	EGD

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Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 09 **10**										**Sampled**	03/17/2017 @ 13:50	
Sampled By Customer												
pH			8.10	SU			CLIENT SPECIFIED	1.00			03/17/2017 13:50	CUS
Phosphorus, Total			0.29	mg/L			EPA 365.1	0.050		0.010	03/28/2017 12:17	EGD
Solids, Total Suspended			<1	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			10.4	deg C			CLIENT SPECIFIED				03/17/2017 13:50	CUS
Nitrogen, Nitrate			3.2	mg/L			EPA 300.0	0.33		0.015	03/18/2017 13:17	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 13:17	LJC
Phosphorus, Orthophosphate		J1	0.26	mg/L			EPA 300.0	0.48		0.024	03/18/2017 13:17	LJC
Sample: 10 **11**										**Sampled**	03/17/2017 @ 14:30	
Sampled By Customer												
Flow by Calculation			0.445	CFS			EPA 600				03/17/2017 14:30	CUS
Oxygen, Dissolved - Client Provided			11.40	mg/L			CLIENT SPECIFIED	0.10			03/17/2017 14:30	CUS
Specific Conductance at 25 °C			683	umhos/cm			CLIENT SPECIFIED				03/17/2017 14:30	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			03/17/2017 14:30	CUS
E. coli			101.9	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			2.4	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 13:08	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			03/29/2017 10:04	EGD
pH			7.89	SU			CLIENT SPECIFIED	1.00			03/17/2017 14:30	CUS
Phosphorus, Total			0.20	mg/L			EPA 365.1	0.050		0.010	03/28/2017 12:19	EGD
Solids, Total Suspended			1	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Temperature			8.2	deg C			CLIENT SPECIFIED				03/17/2017 14:30	CUS
Nitrogen, Nitrate			0.80	mg/L			EPA 300.0	0.33		0.015	03/18/2017 13:31	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 13:31	LJC
Phosphorus, Orthophosphate		J1	0.20	mg/L			EPA 300.0	0.48		0.024	03/18/2017 13:31	LJC
Sample: 11 **DD**										**Sampled**	03/17/2017	
Sampled By Customer												
E. coli			108.1	MPN/100mL			SM9223B (Colilert-18)				03/17/2017 19:20	BAS
CBOD, 5 Day			2.2	mg/L			SM 5210 B	2.0	2		03/18/2017 9:38	DJR

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Sample: 11 **DD**										**Sampled**	03/17/2017	
Sampled By Customer												
Nitrogen, Ammonia		UJ L1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	03/27/2017 13:10	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			03/29/2017 10:06	EGD
Phosphorus, Total			0.19	mg/L			EPA 365.1	0.050		0.010	03/28/2017 12:20	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		03/21/2017 16:47	CJL
Nitrogen, Nitrate			0.80	mg/L			EPA 300.0	0.33		0.015	03/18/2017 14:14	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	03/18/2017 14:14	LJC
Phosphorus, Orthophosphate		J1	0.20	mg/L			EPA 300.0	0.48		0.024	03/18/2017 14:14	LJC

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
L1	Lab Control Sample (LCS) recovery below lower Control Limit.
R3	Relative Percent Difference (RPD) of Sample Duplicates outside of Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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7031163 LISA MARTIN

COC# **CHAIN OF CUSTODY**

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days   EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	~~3~~2oz P 8 CB	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P ° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	3/17	210	G	Y*/N	2	1	1	1	1	11.65	94.5	7.51	495.0	5.43	-	7.06
	2	SW		-	G	Y*/N	2	1	1	1	1							
	3	SW		230	G	Y*/N	2	1	1	1	1	11.33	96.8	7.98	519.8	7.41	-	4.25
	4	SW		300	G	Y*/N	2	1	1	1	1	9.42	83.2	7.39	392.1	8.97	-	
	5	SW		320	G	Y*/N	2	1	1	1	1	11.83	101.4	8.06	507.6	7.67	-	
	6	SW		340	G	Y*/N	2	1	1	1	1	11.72	100.8	7.99	522.9	7.81	-	
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	3/17/17 1710	Lisa Martin	3-17-17 1710

Temp. Upon Receipt (C): 4.6 **Measured By:** LM
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No) LiO

Original COC To Laboratory (Accompany Samples & Report)   **COC Copy - TRC Project File**   **COC Copy - TRC Laboratory Services Coordinator**

1 of 2

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRD ROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
Laboratory #	Sample I.D.	Matrix*	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
							# of Containers Per Analysis											
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW		per client LM 3-17-17	G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	3/17/17	3:45	G	Y*/N	2	1	1	1	1	15.1	126.3	8.1	436	7.46	3.1	0.43
	8	SW	↓	4:26	G	Y*/N	2	1	1	1	1	8.28	68.2	7.52	578	10.7	19	
	9	SW		3:12	G	Y*/N	2	1	1	1	1	14.9	125.6	8.8	332	6.98	5.6	5.6
	10	SW		1:50	G	Y*/N	2	1	1	1	1	11.3	103.6	8.1	648	10.4	1.9	.196
	11	SW		2:30	G	Y*/N	2	1	1	1	1	11.4	99.1	7.89	683	8.2	2.1	.445
	DD	SW		*******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	3-17-17 430		3/17/17 4:30
	3/17/17 1710	Lisa Martin	3-17-17 1710

Temp. Upon Receipt (C): 4.6 Measured By: LM
Containers Properly Preserved: (Yes / No) LIO
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

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CERTIFICATE OF ANALYSIS

7041709

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	05/08/2017
Date Due	05/08/2017
Date Received	04/27/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**										**Sampled**	04/27/2017 @ 10:50	
Sampled By Customer												
Flow by Calculation			5.42	CFS			EPA 600				04/27/2017 10:50	CUS
Oxygen, Dissolved - Client Provided			9.52	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 10:50	CUS
Specific Conductance at 25 °C			465	umhos/cm			CLIENT SPECIFIED				04/27/2017 10:50	CUS
Turbidity			4	NTU			CLIENT SPECIFIED	1			04/27/2017 10:50	CUS
E. coli			517.2	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		J1 BOD3	3.6	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ M2, R1	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:38	EGD
Nitrogen, Total Kjeldahl			0.46	mg/L			SM 4500 NH3 G	0.40			05/03/2017 15:40	EGD
pH			7.84	SU			CLIENT SPECIFIED	1.00			04/27/2017 10:50	CUS
Phosphorus, Orthophosphate			0.17	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:11	EGD
Phosphorus, Total			0.21	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:23	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		04/28/2017 10:19	CJL
Temperature			20.2	deg C			CLIENT SPECIFIED				04/27/2017 10:50	CUS
Nitrogen, Nitrate			1.2	mg/L			EPA 300.0	0.33		0.015	04/28/2017 12:40	LJC
Nitrogen, Nitrite		J1	0.099	mg/L			EPA 300.0	0.45		0.021	04/28/2017 12:40	LJC
Sample: 02 **2**										**Sampled**	04/27/2017 @ 11:55	
Sampled By Customer												
Flow by Calculation			3.04	CFS			EPA 600				04/27/2017 11:55	CUS
Oxygen, Dissolved - Client Provided			12.85	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 11:55	CUS
Specific Conductance at 25 °C			525	umhos/cm			CLIENT SPECIFIED				04/27/2017 11:55	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			04/27/2017 11:55	CUS
E. coli			360.9	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:40	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/03/2017 15:42	EGD

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Third Rock Consultants
Steve Evans

Date Due 05/08/2017
Date Received 04/27/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2**											**Sampled** 04/27/2017 @ 11:55	
Sampled By Customer												
pH			7.75	SU			CLIENT SPECIFIED	1.00			04/27/2017 11:55	CUS
Phosphorus, Orthophosphate			0.20	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:12	EGD
Phosphorus, Total			0.24	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:24	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		04/28/2017 10:19	CJL
Temperature			20.0	deg C			CLIENT SPECIFIED				04/27/2017 11:55	CUS
Nitrogen, Nitrate			1.6	mg/L			EPA 300.0	0.33		0.015	04/28/2017 12:54	LJC
Nitrogen, Nitrite		J1	0.11	mg/L			EPA 300.0	0.45		0.021	04/28/2017 12:54	LJC
Sample: 03 **3**											**Sampled** 04/27/2017 @ 11:45	
Sampled By Customer												
Oxygen, Dissolved - Client Provided			10.40	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 11:45	CUS
Specific Conductance at 25 °C			386	umhos/cm			CLIENT SPECIFIED				04/27/2017 11:45	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			04/27/2017 11:45	CUS
E. coli			37.9	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:42	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/03/2017 15:48	EGD
pH			7.35	SU			CLIENT SPECIFIED	1.00			04/27/2017 11:45	CUS
Phosphorus, Orthophosphate			0.25	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:14	EGD
Phosphorus, Total			0.27	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:25	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		04/28/2017 10:19	CJL
Temperature			17.2	deg C			CLIENT SPECIFIED				04/27/2017 11:45	CUS
Nitrogen, Nitrate			2.6	mg/L			EPA 300.0	0.33		0.015	04/28/2017 13:08	LJC
Nitrogen, Nitrite		J1	0.093	mg/L			EPA 300.0	0.45		0.021	04/28/2017 13:08	LJC
Sample: 04 **4**											**Sampled** 04/27/2017 @ 12:30	
Sampled By Customer												
Oxygen, Dissolved - Client Provided			11.91	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 12:30	CUS
Specific Conductance at 25 °C			368	umhos/cm			CLIENT SPECIFIED				04/27/2017 12:30	CUS

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Third Rock Consultants
Steve Evans

Date Due	05/08/2017
Date Received	04/27/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **4**										**Sampled**	04/27/2017 @ 12:30	
Sampled By Customer												
Turbidity			3	NTU			CLIENT SPECIFIED	1			04/27/2017 12:30	CUS
E. coli			115.3	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:48	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/03/2017 15:50	EGD
pH			7.94	SU			CLIENT SPECIFIED	1.00			04/27/2017 12:30	CUS
Phosphorus, Orthophosphate			0.20	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:15	EGD
Phosphorus, Total			0.22	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:26	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		04/28/2017 10:19	CJL
Temperature			18.4	deg C			CLIENT SPECIFIED				04/27/2017 12:30	CUS
Nitrogen, Nitrate			0.38	mg/L			EPA 300.0	0.33		0.015	04/28/2017 13:22	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	04/28/2017 13:22	LJC
Sample: 05 **5**										**Sampled**	04/27/2017 @ 12:50	
Sampled By Customer												
Flow by Calculation			5.31	CFS			EPA 600				04/27/2017 12:50	CUS
Oxygen, Dissolved - Client Provided			13.16	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 12:50	CUS
Specific Conductance at 25 °C			518	umhos/cm			CLIENT SPECIFIED				04/27/2017 12:50	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			04/27/2017 12:50	CUS
E. coli			62.4	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		J1	2.1	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia			0.25	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:50	EGD
Nitrogen, Total Kjeldahl			0.65	mg/L			SM 4500 NH3 G	0.40			05/03/2017 15:51	EGD
pH			8.13	SU			CLIENT SPECIFIED	1.00			04/27/2017 12:50	CUS
Phosphorus, Orthophosphate			0.42	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:19	EGD
Phosphorus, Total			0.44	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:27	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		04/28/2017 11:14	CJL
Temperature			20.3	deg C			CLIENT SPECIFIED				04/27/2017 12:50	CUS
Nitrogen, Nitrate			2.1	mg/L			EPA 300.0	0.33		0.015	04/28/2017 13:36	LJC

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Third Rock Consultants
Steve Evans

Date Due 05/08/2017
Date Received 04/27/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 05 **5**										**Sampled**	04/27/2017 @ 12:50	
Sampled By Customer												
Nitrogen, Nitrite		J1	0.32	mg/L			EPA 300.0	0.45		0.021	04/28/2017 13:36	LJC
Sample: 06 **6**										**Sampled**	04/27/2017 @ 13:20	
Sampled By Customer												
Flow by Calculation			1.68	CFS			EPA 600				04/27/2017 13:20	CUS
Oxygen, Dissolved - Client Provided			12.83	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 13:20	CUS
Specific Conductance at 25 °C			548	umhos/cm			CLIENT SPECIFIED				04/27/2017 13:20	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			04/27/2017 13:20	CUS
E. coli			248.9	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia			0.87	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:52	EGD
Nitrogen, Total Kjeldahl			1.5	mg/L			SM 4500 NH3 G	0.40			05/03/2017 15:53	EGD
pH			8.10	SU			CLIENT SPECIFIED	1.00			04/27/2017 13:20	CUS
Phosphorus, Orthophosphate			0.48	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:20	EGD
Phosphorus, Total			0.51	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:28	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		04/28/2017 11:14	CJL
Temperature			19.1	deg C			CLIENT SPECIFIED				04/27/2017 13:20	CUS
Nitrogen, Nitrate			2.0	mg/L			EPA 300.0	0.33		0.015	04/28/2017 13:50	LJC
Nitrogen, Nitrite		J1	0.29	mg/L			EPA 300.0	0.45		0.021	04/28/2017 13:50	LJC
Sample: 07 **7**										**Sampled**	04/27/2017 @ 13:20	
Sampled By Customer												
Flow by Calculation			<0.01	CFS			EPA 600				04/27/2017 13:20	CUS
Oxygen, Dissolved - Client Provided			15.91	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 13:20	CUS
Specific Conductance at 25 °C			365	umhos/cm			CLIENT SPECIFIED				04/27/2017 13:20	CUS
Turbidity			11	NTU			CLIENT SPECIFIED	1			04/27/2017 13:20	CUS
E. coli			18.5	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		J1	2.0	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:55	EGD

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Third Rock Consultants
Steve Evans

Date Due 05/08/2017
Date Received 04/27/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 07	**7**									**Sampled**	04/27/2017 @ 13:20	
Sampled By Customer												
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/03/2017 15:55	EGD
pH			8.41	SU			CLIENT SPECIFIED	1.00			04/27/2017 13:20	CUS
Phosphorus, Orthophosphate			0.063	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:21	EGD
Phosphorus, Total			0.16	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:29	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		04/28/2017 11:14	CJL
Temperature			22.5	deg C			CLIENT SPECIFIED				04/27/2017 13:20	CUS
Nitrogen, Nitrate			0.34	mg/L			EPA 300.0	0.33		0.015	04/28/2017 14:05	LJC
Nitrogen, Nitrite		J1	0.090	mg/L			EPA 300.0	0.45		0.021	04/28/2017 14:05	LJC
Sample: 08	**8**									**Sampled**	04/27/2017 @ 12:30	
Sampled By Customer												
Oxygen, Dissolved - Client Provided			6.80	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 12:30	CUS
Specific Conductance at 25 °C			553	umhos/cm			CLIENT SPECIFIED				04/27/2017 12:30	CUS
Turbidity			1	NTU			CLIENT SPECIFIED	1			04/27/2017 12:30	CUS
E. coli			110.6	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day			5.2	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:57	EGD
Nitrogen, Total Kjeldahl			0.51	mg/L			SM 4500 NH3 G	0.40			05/03/2017 15:56	EGD
pH			7.21	SU			CLIENT SPECIFIED	1.00			04/27/2017 12:30	CUS
Phosphorus, Orthophosphate			0.21	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:22	EGD
Phosphorus, Total			0.24	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:30	EGD
Solids, Total Suspended			9	mg/L			USGS I-3765-85	1	1		04/28/2017 11:14	CJL
Temperature			20.1	deg C			CLIENT SPECIFIED				04/27/2017 12:30	CUS
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.33		0.015	04/28/2017 14:19	LJC
Nitrogen, Nitrite		J1	0.093	mg/L			EPA 300.0	0.45		0.021	04/28/2017 14:19	LJC
Sample: 09	**9**									**Sampled**	04/27/2017 @ 11:45	
Sampled By Customer												
Flow by Calculation			1.18	CFS			EPA 600				04/27/2017 11:45	CUS

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CERTIFICATE OF ANALYSIS

7041709

Third Rock Consultants
Steve Evans

Date Due 05/08/2017
Date Received 04/27/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 09 **9**										**Sampled**	04/27/2017 @ 11:45	
Sampled By Customer												
Oxygen, Dissolved - Client Provided			9.66	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 11:45	CUS
Specific Conductance at 25 °C			240	umhos/cm			CLIENT SPECIFIED				04/27/2017 11:45	CUS
Turbidity			4	NTU			CLIENT SPECIFIED	1			04/27/2017 11:45	CUS
E. coli			156.5	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		BOD3	14	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 18:59	EGD
Nitrogen, Total Kjeldahl			1.6	mg/L			SM 4500 NH3 G	0.40			05/05/2017 11:59	EGD
pH			8.38	SU			CLIENT SPECIFIED	1.00			04/27/2017 11:45	CUS
Phosphorus, Orthophosphate			0.11	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:23	EGD
Phosphorus, Total			0.29	mg/L			EPA 365.1	0.050		0.010	05/02/2017 9:31	EGD
Solids, Total Suspended			15	mg/L			USGS I-3765-85	1	1		04/28/2017 11:14	CJL
Temperature			19.6	deg C			CLIENT SPECIFIED				04/27/2017 11:45	CUS
Nitrogen, Nitrate		J1	0.16	mg/L			EPA 300.0	0.33		0.015	04/28/2017 14:33	LJC
Nitrogen, Nitrite		J1	0.099	mg/L			EPA 300.0	0.45		0.021	04/28/2017 14:33	LJC
Sample: 10 **10**										**Sampled**	04/27/2017 @ 10:35	
Sampled By Customer												
Flow by Calculation			<0.01	CFS			EPA 600				04/27/2017 10:35	CUS
Oxygen, Dissolved - Client Provided			8.01	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 10:35	CUS
Specific Conductance at 25 °C			645	umhos/cm			CLIENT SPECIFIED				04/27/2017 10:35	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			04/27/2017 10:35	CUS
E. coli			209.8	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 19:01	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/05/2017 12:01	EGD
pH			7.57	SU			CLIENT SPECIFIED	1.00			04/27/2017 10:35	CUS
Phosphorus, Orthophosphate			0.30	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:24	EGD
Phosphorus, Total			0.31	mg/L			EPA 365.1	0.050		0.010	05/08/2017 13:02	EGD

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CERTIFICATE OF ANALYSIS

7041709

Third Rock Consultants
Steve Evans

Date Due 05/08/2017
Date Received 04/27/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 10 **10**											**Sampled** 04/27/2017 @ 10:35	
Sampled By Customer												
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		04/28/2017 11:14	CJL
Temperature			17.2	deg C			CLIENT SPECIFIED				04/27/2017 10:35	CUS
Nitrogen, Nitrate			2.5	mg/L			EPA 300.0	0.33		0.015	04/28/2017 14:47	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	04/28/2017 14:47	LJC
Sample: 11 **11**											**Sampled** 04/27/2017 @ 11:00	
Sampled By Customer												
Flow by Calculation			0.23	CFS			EPA 600				04/27/2017 11:00	CUS
Oxygen, Dissolved - Client Provided			8.14	mg/L			CLIENT SPECIFIED	0.10			04/27/2017 11:00	CUS
Specific Conductance at 25 °C			711	umhos/cm			CLIENT SPECIFIED				04/27/2017 11:00	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			04/27/2017 11:00	CUS
E. coli			547.5	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		J1	2.3	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 19:03	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/05/2017 12:03	EGD
pH			7.61	SU			CLIENT SPECIFIED	1.00			04/27/2017 11:00	CUS
Phosphorus, Orthophosphate			0.25	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:25	EGD
Phosphorus, Total			0.28	mg/L			EPA 365.1	0.050		0.010	05/08/2017 13:03	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		04/28/2017 11:14	CJL
Temperature			17.2	deg C			CLIENT SPECIFIED				04/27/2017 11:00	CUS
Nitrogen, Nitrate			0.48	mg/L			EPA 300.0	0.33		0.015	04/28/2017 15:44	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	04/28/2017 15:44	LJC
Sample: 12 **DD**											**Sampled** 04/27/2017	
Sampled By Customer												
E. coli			547.5	MPN/100mL			SM9223B (Colilert-18)				04/27/2017 15:15	BAS
CBOD, 5 Day		UJ	<2.0	mg/L			SM 5210 B	5.0		2.0	04/28/2017 9:00	DJR
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/03/2017 19:05	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/05/2017 12:05	EGD
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.017	04/28/2017 16:25	EGD

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CERTIFICATE OF ANALYSIS

7041709

Third Rock Consultants
Steve Evans

Date Due	05/08/2017
Date Received	04/27/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 12 **DD**										**Sampled**	04/27/2017	
Sampled By Customer												
Phosphorus, Total			0.27	mg/L			EPA 365.1	0.050		0.010	05/08/2017 13:05	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		04/28/2017 11:14	CJL
Nitrogen, Nitrate			0.47	mg/L			EPA 300.0	0.33		0.015	04/28/2017 15:58	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	04/28/2017 15:58	LJC

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
BOD3	BOD result obtained from an average of dilutions that show more than 30% difference.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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CERTIFICATE OF ANALYSIS

7041709

Third Rock Consultants
Steve Evans

Date Due	05/08/2017
Date Received	04/27/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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7041709 LISA MARTIN

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days   EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

*Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli
*Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	~~32oz~~ 8 CB P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix*	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	4-27-17	10:50	G	Y*/N	2	1	1	1	1	9.52	111.5	7.84	465.2	20.15	4.2	5.42
	2	SW	4-27-17	11:55	G	Y*/N	2	1	1	1	1	12.85	147.8	7.75	524.9	20.04	2.5	3.04
	3	SW	4-27-17	11:45	G	Y*/N	2	1	1	1	1	10.4	113.0	7.35	385.9	17.2	3.1	—
	4	SW	4-27-17	12:30	G	Y*/N	2	1	1	1	1	11.91	133.5	7.94	368.5	18.44	3.3	—
	5	SW	4-27-17	12:50	G	Y*/N	2	1	1	1	1	13.16	154.7	8.13	518.5	20.34	2.2	5.31
	6	SW	4-27-17	1:20	G	Y*/N	2	1	1	1	1	12.85	145.8	8.10	547.6	19.11	2.3	1.68
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	4/27/17/1:48		4-27-17 1349

Temp. Upon Receipt (C): 4.6 Measured By: JWR
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)
36B

Original COC To Laboratory (Accompany Samples & Report) ~ COC Copy - TRC Project File ~ COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - C. Bloyd, S. Evans
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days
EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix*	Collection Date	Collection Time	Grab / Comp	Fltr'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	2	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	3	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	4	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	5	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	6	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	7	SW	4-27-17	1320	G	Y*/N	2	1	1	1	1	15.91	192.7	8.41	365	22.52	10.8	<0.01
	8	SW	4-27-17	1230	G	Y*/N	2	1	1	1	1	6.80	78.9	7.21	553	20.13	1.1	—
	9	SW	4-27-17	1145	G	Y*/N	2	1	1	1	1	9.66	110.1	8.38	250	19.62	3.5	1.18
	10	SW	4-27-17	1035	G	Y*/N	2	1	1	1	1	8.01	87.3	7.57	655	17.25	0	<0.01
	11	SW	4-27-17	1100	G	Y*/N	2	1	1	1	1	8.14	88.9	7.61	711	17.22	0	0.23
	DD	SW	4-27-17	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	4/27/17 1410		4-27-17 1410

Temp. Upon Receipt (C): 10.6 **Measured By:** JHR
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

7050152

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	05/03/2017
Date Due	05/11/2017
Date Received	05/02/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 01 **1**									**Sampled** 05/02/2017 @ 10:30	
Sampled By Customer										
Flow by Calculation			19.23	CFS			EPA 600		05/02/2017 10:30	CUS
E. coli			1203.3	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 02 **2**									**Sampled** 05/02/2017 @ 11:15	
Sampled By Customer										
Flow by Calculation			14.09	CFS			EPA 600		05/02/2017 11:15	CUS
E. coli			472.1	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 03 **3**									**Sampled** 05/02/2017 @ 11:00	
Sampled By Customer										
Flow by Calculation			0.05	CFS			EPA 600		05/02/2017 11:00	CUS
E. coli			172.5	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 04 **4**									**Sampled** 05/02/2017 @ 11:45	
Sampled By Customer										
Flow by Calculation			70.01	CFS			EPA 600		05/02/2017 11:45	CUS
E. coli			139.6	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 05 **5**									**Sampled** 05/02/2017 @ 12:00	
Sampled By Customer										
Flow by Calculation			9.54	CFS			EPA 600		05/02/2017 12:00	CUS
E. coli			613.1	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 06 **6**									**Sampled** 05/02/2017 @ 12:25	
Sampled By Customer										
Flow by Calculation			9.78	CFS			EPA 600		05/02/2017 12:25	CUS
E. coli			547.5	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 07 **7**									**Sampled** 05/02/2017 @ 11:45	
Sampled By Customer										
Flow by Calculation			0.656	CFS			EPA 600		05/02/2017 11:45	CUS
E. coli			579.4	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS

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CERTIFICATE OF ANALYSIS

7050152

Third Rock Consultants
Steve Evans

Date Due	05/11/2017
Date Received	05/02/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 08 **8**									**Sampled** 05/02/2017 @ 12:24	
Sampled By Customer										
E. coli			816.4	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 09 **9**									**Sampled** 05/02/2017 @ 11:10	
Sampled By Customer										
Flow by Calculation			2.585	CFS			EPA 600		05/02/2017 11:10	CUS
E. coli			344.8	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 10 **10**									**Sampled** 05/02/2017 @ 9:50	
Sampled By Customer										
Flow by Calculation			5.61	CFS			EPA 600		05/02/2017 9:50	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 11 **11**									**Sampled** 05/02/2017 @ 10:20	
Sampled By Customer										
Flow by Calculation			1.724	CFS			EPA 600		05/02/2017 10:20	CUS
E. coli			648.8	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS
Sample: 12 **DD**									**Sampled** 05/02/2017	
Sampled By Customer										
E. coli			980.4	MPN/100mL			SM9223B (Colilert-18)		05/02/2017 15:03	BAS

Qualifier Definitions

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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CERTIFICATE OF ANALYSIS

7050152

Third Rock Consultants
Steve Evans

Date Due	05/11/2017
Date Received	05/02/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

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7050152 LISA MARTIN

1of2

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client - C. Bloyd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ✓ Dry ___Wet

Comments:

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW	5-2-17	1030	G	Y*/N	1	19.23
	2	SW	5-2-17	1115	G	Y*/N	1	14.09
	3	SW	5-2-17	1100	G	Y*/N	1	0.05
	4	SW	5-2-17	1155	G	Y*/N	1	70.01
	5	SW	5-2-17	1200	G	Y*/N	1	9.54
	6	SW	5-2-17	1225	G	Y*/N	1	9.78
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~8~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~9~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~10~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~11~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~DD~~	~~SW~~		~~******~~	~~G~~	~~Y*/N~~	~~1~~	~~- See Field Notebook -~~

Relinquished By:	Date / Time	Received By:	Date / Time
	5-2-17 / 1318		5/2/17 @ 1318

Temp. Upon Receipt (C): 2.3° Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)
LW

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

7050152 LISA MARTIN

2 of 2

CHAIN OF CUSTODY

COC#		
Client: Third Rock Consultants, LLC Project Name: Cane Run Watershed Based Plan Project # : KY16-004 Project Contact (for laboratory): Cory Bloyd Phone # : 859-977-2000 Collected By: Client - Methodology Required: 40CFR Part 136	THIRDROCK CONSULTANTS MICROBAC	**PDF Analytical Report & Invoice To:** cbloyd@thirdrockconsultants.com Cory Bloyd Third Rock Consultants, LLC 2526 Regency Road Suite 180 Lexington, KY 40503 859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

* Preservation Type	ST
Container Size/Type	4oz P
Requested Lab Analysis	E-Coli

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code

ST - Na2S2O3
I - Ice (All)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	On-Site/Field Measurements: Flow (cfs)
	1	SW			G	Y*/N	1	
	2	SW			G	Y*/N	1	
	3	SW			G	Y*/N	1	
	4	SW			G	Y*/N	1	
	5	SW			G	Y*/N	1	
	6	SW			G	Y*/N	1	
	7	SW	5-2-17	1145	G	Y*/N	1	0.656
	8	SW	5-2-17	1224	G	Y*/N	1	N/A
	9	SW	5-2-17	1110	G	Y*/N	1	2.585
	10	SW	5-2-17	0950	G	Y*/N	1	5.61
	11	SW	5-2-17	1030	G	Y*/N	1	~~5.61~~ 1.724
	DD	SW	5-2-17	******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5-2-17 1309	Lisa Martin	5-2-17 1309

Temp. Upon Receipt (C): 4.4 Measured By: LF

Containers Properly Preserved: (Yes / No)

Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

7050408

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	05/13/2017
Date Due	05/16/2017
Date Received	05/04/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 01 **1**										**Sampled**	05/04/2017 @ 18:45	
Sampled By Customer												
Flow by Calculation			8.34	CFS			EPA 600				05/04/2017 18:45	CUS
Oxygen, Dissolved - Client Provided			8.82	mg/L			CLIENT SPECIFIED	0.10			05/04/2017 18:45	CUS
Specific Conductance at 25 °C			471	umhos/cm			CLIENT SPECIFIED				05/04/2017 18:45	CUS
Turbidity			11	NTU			CLIENT SPECIFIED	1			05/04/2017 18:45	CUS
E. coli			224.7	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	2.2	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 9:46	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:04	EGD
pH			8.34	SU			CLIENT SPECIFIED	1.00			05/04/2017 18:45	CUS
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:42	EGD
Phosphorus, Total			0.29	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:15	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			16.9	deg C			CLIENT SPECIFIED				05/04/2017 18:45	CUS
Nitrogen, Nitrate			1.3	mg/L			EPA 300.0	0.33		0.015	05/05/2017 15:17	LJC
Nitrogen, Nitrite		J1	0.096	mg/L			EPA 300.0	0.45		0.021	05/05/2017 15:17	LJC
Sample: 02 **2**										**Sampled**	05/04/2017 @ 20:15	
Sampled By Customer												
Flow by Calculation			8.1	CFS			EPA 600				05/04/2017 20:15	CUS
Oxygen, Dissolved - Client Provided			7.74	mg/L			CLIENT SPECIFIED	0.10			05/04/2017 20:15	CUS
Specific Conductance at 25 °C			521	umhos/cm			CLIENT SPECIFIED				05/04/2017 20:15	CUS
Turbidity			16	NTU			CLIENT SPECIFIED	1			05/04/2017 20:15	CUS
E. coli			160.7	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 9:48	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:06	EGD
pH			7.88	SU			CLIENT SPECIFIED	1.00			05/04/2017 20:15	CUS

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7050408

Third Rock Consultants
Steve Evans

Date Due 05/16/2017
Date Received 05/04/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 02 **2** Sampled By Customer										**Sampled**	05/04/2017 @ 20:15	
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:43	EGD
Phosphorus, Total			0.29	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:16	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			16.3	deg C			CLIENT SPECIFIED				05/04/2017 20:15	CUS
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.33		0.015	05/05/2017 15:31	LJC
Nitrogen, Nitrite		J1	0.12	mg/L			EPA 300.0	0.45		0.021	05/05/2017 15:31	LJC
Sample: 03 **3** Sampled By Customer										**Sampled**	05/04/2017 @ 20:10	
Flow by Calculation			No Flow	CFS			EPA 600				05/04/2017 20:10	CUS
Specific Conductance at 25 °C			399	umhos/cm			CLIENT SPECIFIED				05/04/2017 20:10	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			05/04/2017 20:10	CUS
E. coli			1752.9	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	6.0	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 9:50	EGD
Nitrogen, Total Kjeldahl			0.56	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:22	EGD
pH			7.69	SU			CLIENT SPECIFIED	1.00			05/04/2017 20:10	CUS
Phosphorus, Orthophosphate			0.32	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:45	EGD
Phosphorus, Total			0.34	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:18	EGD
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			14.9	deg C			CLIENT SPECIFIED				05/04/2017 20:10	CUS
Nitrogen, Nitrate			2.3	mg/L			EPA 300.0	0.33		0.015	05/05/2017 16:13	LJC
Nitrogen, Nitrite		J1	0.093	mg/L			EPA 300.0	0.45		0.021	05/05/2017 16:13	LJC
Sample: 04 **4** Sampled By Customer										**Sampled**	05/04/2017 @ 18:20	
Flow by Calculation			No Flow	CFS			EPA 600				05/04/2017 18:20	CUS
Specific Conductance at 25 °C			360	umhos/cm			CLIENT SPECIFIED				05/04/2017 18:20	CUS
Turbidity			<1	NTU			CLIENT SPECIFIED	1			05/04/2017 18:20	CUS

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KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 04 **4**										**Sampled**	05/04/2017 @ 18:20	
Sampled By Customer												
E. coli			866.4	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	2.3	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 9:52	EGD
Nitrogen, Total Kjeldahl			<0.40	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:24	EGD
pH			7.48	SU			CLIENT SPECIFIED	1.00			05/04/2017 18:20	CUS
Phosphorus, Orthophosphate			0.19	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:46	EGD
Phosphorus, Total			0.21	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:19	EGD
Solids, Total Suspended			2	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			15.5	deg C			CLIENT SPECIFIED				05/04/2017 18:20	CUS
Nitrogen, Nitrate			0.40	mg/L			EPA 300.0	0.33		0.015	05/05/2017 16:27	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	05/05/2017 16:27	LJC
Sample: 05 **5**										**Sampled**	05/04/2017 @ 19:40	
Sampled By Customer												
Flow by Calculation			4.62	CFS			EPA 600				05/04/2017 19:40	CUS
Oxygen, Dissolved - Client Provided			6.91	mg/L			CLIENT SPECIFIED	0.10			05/04/2017 19:40	CUS
Specific Conductance at 25 °C			516	umhos/cm			CLIENT SPECIFIED				05/04/2017 19:40	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			05/04/2017 19:40	CUS
E. coli			727.0	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	2.4	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia			0.75	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 9:54	EGD
Nitrogen, Total Kjeldahl			1.3	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:26	EGD
pH			7.64	SU			CLIENT SPECIFIED	1.00			05/04/2017 19:40	CUS
Phosphorus, Orthophosphate			0.38	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:50	EGD
Phosphorus, Total			0.44	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:20	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			15.1	deg C			CLIENT SPECIFIED				05/04/2017 19:40	CUS
Nitrogen, Nitrate			2.1	mg/L			EPA 300.0	0.33		0.015	05/05/2017 16:41	LJC
Nitrogen, Nitrite		J1	0.19	mg/L			EPA 300.0	0.45		0.021	05/05/2017 16:41	LJC

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CERTIFICATE OF ANALYSIS

7050408

Third Rock Consultants	**Date Due**	05/16/2017
Steve Evans	**Date Received**	05/04/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 05 **5**											**Sampled** 05/04/2017 @ 19:40	
Sampled By Customer												
Sample: 06 **6**											**Sampled** 05/04/2017 @ 19:15	
Sampled By Customer												
Flow by Calculation			5.65	CFS			EPA 600				05/04/2017 19:15	CUS
Oxygen, Dissolved - Client Provided			6.93	mg/L			CLIENT SPECIFIED	0.10			05/04/2017 19:15	CUS
Specific Conductance at 25 °C			88	umhos/cm			CLIENT SPECIFIED				05/04/2017 19:15	CUS
Turbidity			2	NTU			CLIENT SPECIFIED	1			05/04/2017 19:15	CUS
E. coli			770.1	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	2.6	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia			1.2	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 9:56	EGD
Nitrogen, Total Kjeldahl			1.8	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:28	EGD
pH			7.52	SU			CLIENT SPECIFIED	1.00			05/04/2017 19:15	CUS
Phosphorus, Orthophosphate			0.45	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:51	EGD
Phosphorus, Total			0.51	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:24	EGD
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			15.1	deg C			CLIENT SPECIFIED				05/04/2017 19:15	CUS
Nitrogen, Nitrate			1.9	mg/L			EPA 300.0	0.33		0.015	05/05/2017 16:56	LJC
Nitrogen, Nitrite		J1	0.17	mg/L			EPA 300.0	0.45		0.021	05/05/2017 16:56	LJC
Sample: 07 **7**											**Sampled** 05/04/2017 @ 19:00	
Sampled By Customer												
Flow by Calculation			0.37	CFS			EPA 600				05/04/2017 19:00	CUS
Oxygen, Dissolved - Client Provided			10.30	mg/L			CLIENT SPECIFIED	0.10			05/04/2017 19:00	CUS
Specific Conductance at 25 °C			429	umhos/cm			CLIENT SPECIFIED				05/04/2017 19:00	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			05/04/2017 19:00	CUS
E. coli			96.0	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day			<2.0	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 9:58	EGD
Nitrogen, Total Kjeldahl			0.47	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:30	EGD

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KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 07 **7** Sampled By Customer										**Sampled**	05/04/2017 @ 19:00	
pH			7.30	SU			CLIENT SPECIFIED	1.00			05/04/2017 19:00	CUS
Phosphorus, Orthophosphate			0.17	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:52	EGD
Phosphorus, Total			0.43	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:25	EGD
Solids, Total Suspended			31	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			15.2	deg C			CLIENT SPECIFIED				05/04/2017 19:00	CUS
Nitrogen, Nitrate			1.7	mg/L			EPA 300.0	0.33		0.015	05/05/2017 17:10	LJC
Nitrogen, Nitrite		J1	0.093	mg/L			EPA 300.0	0.45		0.021	05/05/2017 17:10	LJC
Sample: 08 **8** Sampled By Customer										**Sampled**	05/04/2017 @ 18:30	
Flow by Calculation			No Flow	CFS			EPA 600				05/04/2017 18:30	CUS
Specific Conductance at 25 °C			546	umhos/cm			CLIENT SPECIFIED				05/04/2017 18:30	CUS
Turbidity			15	NTU			CLIENT SPECIFIED	1			05/04/2017 18:30	CUS
E. coli			107.1	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	2.4	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 10:00	EGD
Nitrogen, Total Kjeldahl			0.47	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:32	EGD
pH			7.00	SU			CLIENT SPECIFIED	1.00			05/04/2017 18:30	CUS
Phosphorus, Orthophosphate			0.23	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:53	EGD
Phosphorus, Total			0.29	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:27	EGD
Solids, Total Suspended			11	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			16.0	deg C			CLIENT SPECIFIED				05/04/2017 18:30	CUS
Nitrogen, Nitrate			2.1	mg/L			EPA 300.0	0.33		0.015	05/05/2017 17:24	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	05/05/2017 17:24	LJC
Sample: 09 **9** Sampled By Customer										**Sampled**	05/04/2017 @ 19:40	
Flow by Calculation			1.88	CFS			EPA 600				05/04/2017 19:40	CUS
Oxygen, Dissolved - Client Provided			4.60	mg/L			CLIENT SPECIFIED	0.10			05/04/2017 19:40	CUS

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Third Rock Consultants
Steve Evans

Date Due 05/16/2017
Date Received 05/04/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 09 **9**										**Sampled**	05/04/2017 @ 19:40	
Sampled By Customer												
Specific Conductance at 25 °C			294	umhos/cm			CLIENT SPECIFIED				05/04/2017 19:40	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			05/04/2017 19:40	CUS
E. coli			88.2	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	3.0	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia			0.45	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 10:06	EGD
Nitrogen, Total Kjeldahl			1.2	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:34	EGD
pH			7.50	SU			CLIENT SPECIFIED	1.00			05/04/2017 19:40	CUS
Phosphorus, Orthophosphate			0.20	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:54	EGD
Phosphorus, Total			0.29	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:28	EGD
Solids, Total Suspended			4	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			17.1	deg C			CLIENT SPECIFIED				05/04/2017 19:40	CUS
Nitrogen, Nitrate			0.34	mg/L			EPA 300.0	0.33		0.015	05/05/2017 17:38	LJC
Nitrogen, Nitrite		J1	0.12	mg/L			EPA 300.0	0.45		0.021	05/05/2017 17:38	LJC
Sample: 10 **10**										**Sampled**	05/04/2017 @ 20:20	
Sampled By Customer												
Flow by Calculation			3.8	CFS			EPA 600				05/04/2017 20:20	CUS
Oxygen, Dissolved - Client Provided			8.00	mg/L			CLIENT SPECIFIED	0.10			05/04/2017 20:20	CUS
Specific Conductance at 25 °C			467	umhos/cm			CLIENT SPECIFIED				05/04/2017 20:20	CUS
Turbidity			37	NTU			CLIENT SPECIFIED	1			05/04/2017 20:20	CUS
E. coli			>2419.6 +\- [custom value]	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	2.8	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 10:08	EGD
Nitrogen, Total Kjeldahl			0.55	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:36	EGD
pH			7.60	SU			CLIENT SPECIFIED	1.00			05/04/2017 20:20	CUS
Phosphorus, Orthophosphate			0.26	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:55	EGD
Phosphorus, Total			0.34	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:29	EGD
Solids, Total Suspended			8	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL

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Date Received	05/04/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 10 **10**										**Sampled**	05/04/2017 @ 20:20	
Sampled By Customer												
Temperature			15.2	deg C			CLIENT SPECIFIED				05/04/2017 20:20	CUS
Nitrogen, Nitrate			1.5	mg/L			EPA 300.0	0.33		0.015	05/05/2017 17:52	LJC
Nitrogen, Nitrite		J1	0.093	mg/L			EPA 300.0	0.45		0.021	05/05/2017 17:52	LJC
Sample: 11 **11**										**Sampled**	05/04/2017 @ 20:50	
Sampled By Customer												
Flow by Calculation			3.8	CFS			EPA 600				05/04/2017 20:50	CUS
Oxygen, Dissolved - Client Provided			7.10	mg/L			CLIENT SPECIFIED	0.10			05/04/2017 20:50	CUS
Specific Conductance at 25 °C			571	umhos/cm			CLIENT SPECIFIED				05/04/2017 20:50	CUS
Turbidity			3	NTU			CLIENT SPECIFIED	1			05/04/2017 20:50	CUS
E. coli			218.7	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	2.1	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia		UJ	<0.22	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 10:10	EGD
Nitrogen, Total Kjeldahl			0.44	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:38	EGD
pH			7.60	SU			CLIENT SPECIFIED	1.00			05/04/2017 20:50	CUS
Phosphorus, Orthophosphate			0.29	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:56	EGD
Phosphorus, Total			0.33	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:30	EGD
Solids, Total Suspended			3	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Temperature			15.9	deg C			CLIENT SPECIFIED				05/04/2017 20:50	CUS
Nitrogen, Nitrate			0.54	mg/L			EPA 300.0	0.33		0.015	05/05/2017 18:06	LJC
Nitrogen, Nitrite		UJ	<0.021	mg/L			EPA 300.0	0.45		0.021	05/05/2017 18:06	LJC
Sample: 12 **DD**										**Sampled**	05/04/2017	
Sampled By Customer												
E. coli			1119.9	MPN/100mL			SM9223B (Colilert-18)				05/04/2017 23:02	BAS
CBOD, 5 Day		B1	2.7	mg/L			SM 5210 B	2.0	2		05/05/2017 13:52	CJL
Nitrogen, Ammonia			0.55	mg/L			SM 4500 NH3 G	0.25		0.22	05/12/2017 10:12	EGD
Nitrogen, Total Kjeldahl			1.1	mg/L			SM 4500 NH3 G	0.40			05/11/2017 10:44	EGD
Phosphorus, Orthophosphate			0.37	mg/L			EPA 365.1	0.050		0.017	05/05/2017 14:57	EGD
Phosphorus, Total			0.43	mg/L			EPA 365.1	0.050		0.010	05/08/2017 17:31	EGD

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MICROBAC®

CERTIFICATE OF ANALYSIS

7050408

Third Rock Consultants
Steve Evans

Date Due 05/16/2017
Date Received 05/04/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Cus Limit	MDL	Analysis Date	Tech
Sample: 12 **DD** Sampled By Customer											**Sampled** 05/04/2017	
Solids, Total Suspended			5	mg/L			USGS I-3765-85	1	1		05/06/2017 15:17	CJL
Nitrogen, Nitrate			2.0	mg/L			EPA 300.0	0.33		0.015	05/05/2017 18:20	LJC
Nitrogen, Nitrite		J1	0.19	mg/L			EPA 300.0	0.45		0.021	05/05/2017 18:20	LJC

Qualifier Definitions

J1	The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an estimated value.
UJ	Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.
B1	The analyte value in the Method Blank is above the Control Limit.

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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7050408 LISA MARTIN

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	5-4-17	7:00pm	G	Y*/N	2	1	1	1	1	10.3	107.4	7.3	429	15.2	3.0	0.37
	8	SW	5-4-17	0630pm	G	Y*/N	2	1	1	1	1	7.5	79.5	7.0	546	16.0	15.0	N/A
	9	SW	5-4-17	7:40pm	G	Y*/N	2	1	1	1	1	4.6	49.9	7.5	294	17.1	3.1	1.88
	10	SW	5-4-17	8:20pm	G	Y*/N	2	1	1	1	1	8.0	83.4	7.6	467	15.2	37.0	3.80
	11	SW	5-4-17	8:50pm	G	Y*/N	2	1	1	1	1	7.1	75.2	7.6	571	15.9	3.4	0.57
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	5-4-17 / 9:50		5-4-17 9:50

Temp. Upon Receipt (C): 6.0° 6.0 Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	5/4/17	6:45	G	Y*/N	2	1	1	1	1	94.9	8.82	8.34	471.3	16.92	10.6	8.34
	2	SW	5/4/17	8:15	G	Y*/N	2	1	1	1	1	82.6	7.74	7.88	510.6	16.31	15.9	8.1
	3	SW	5/4/17	8:10	G	Y*/N	2	1	1	1	1	67.7	6.57	7.69	399.0	14.88	0.1	-
	4	SW	5/4/17	6:20	G	Y*/N	2	1	1	1	1	94.0	9.0	7.48	360.5	15.51	0.0	-
	5	SW	5/4/17	7:40	G	Y*/N	2	1	1	1	1	71.5	6.91	7.64	516.1	15.09	1.5	4.62
	6	SW	5/4/17	7:15	G	Y*/N	2	1	1	1	1	71.7	6.93	7.52	88.5	15.11	1.8	5.65
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW	5/4/17	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	5-4-17 / 9:50am		5-4-17 9:50

Temp. Upon Receipt (C): 6.0 2.0 Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

MICROBAC

CERTIFICATE OF ANALYSIS

7050672

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported 05/11/2017
Date Due 05/18/2017
Date Received 05/09/2017
Customer # E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 01 **1**									**Sampled** 05/09/2017 @ 13:50	
Sampled By Customer										
Flow by Calculation			9.84	CFS			EPA 600		05/09/2017 13:50	CUS
E. coli			410.6	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 02 **2**									**Sampled** 05/09/2017 @ 13:10	
Sampled By Customer										
Flow by Calculation			8.52	CFS			EPA 600		05/09/2017 13:10	CUS
E. coli			410.6	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 03 **3**									**Sampled** 05/09/2017 @ 13:35	
Sampled By Customer										
Flow by Calculation			70.01	CFS			EPA 600		05/09/2017 13:35	CUS
E. coli			307.6	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 04 **4**									**Sampled** 05/09/2017 @ 12:45	
Sampled By Customer										
Flow by Calculation			0.06	CFS			EPA 600		05/09/2017 12:45	CUS
E. coli			387.3	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 05 **5**									**Sampled** 05/09/2017 @ 12:00	
Sampled By Customer										
Flow by Calculation			5.71	CFS			EPA 600		05/09/2017 12:00	CUS
E. coli			201.4	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 06 **6**									**Sampled** 05/09/2017 @ 11:45	
Sampled By Customer										
Flow by Calculation			4.78	CFS			EPA 600		05/09/2017 11:45	CUS
E. coli			218.7	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 07 **7**									**Sampled** 05/09/2017 @ 11:20	
Sampled By Customer										
Flow by Calculation			0.12	CFS			EPA 600		05/09/2017 11:20	CUS
E. coli			118.7	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW

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CERTIFICATE OF ANALYSIS

7050672

Third Rock Consultants
Steve Evans

Date Due	05/18/2017
Date Received	05/09/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 08 **8**									**Sampled** 05/09/2017 @ 11:00	
Sampled By Customer										
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 09 **9**									**Sampled** 05/09/2017 @ 10:25	
Sampled By Customer										
Flow by Calculation			1.25	CFS			EPA 600		05/09/2017 10:25	CUS
E. coli			185.0	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 10 **10**									**Sampled** 05/09/2017 @ 9:30	
Sampled By Customer										
Flow by Calculation			0.67	CFS			EPA 600		05/09/2017 9:30	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 11 **11**									**Sampled** 05/09/2017 @ 9:55	
Sampled By Customer										
Flow by Calculation			0.42	CFS			EPA 600		05/09/2017 9:55	CUS
E. coli			261.3	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW
Sample: 12 **DD**									**Sampled** 05/09/2017	
Sampled By Customer										
E. coli			238.2	MPN/100mL			SM9223B (Colilert-18)		05/09/2017 16:45	DZW

Qualifier Definitions

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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CERTIFICATE OF ANALYSIS

7050672

Third Rock Consultants
Steve Evans

Date Due	05/18/2017
Date Received	05/09/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

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For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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COC# CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client - C. Bloyd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW	5-9-17	1350	G	Y*/N	1	9.84
	2	SW	" "	1310	G	Y*/N	1	8.52
	3	SW		1335	G	Y*/N	1	70.01
	4	SW		1245	G	Y*/N	1	0.06
	5	SW		1200	G	Y*/N	1	5.71
	6	SW		1145	G	Y*/N	1	4.78
	7	SW		1120	G	Y*/N	1	0.12
	8	SW		1100	G	Y*/N	1	—
	9	SW		1025	G	Y*/N	1	1.25
	10	SW		0930	G	Y*/N	1	0.67
	11	SW		0955	G	Y*/N	1	0.42
	DD	SW	" "	******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5-9-17/1500		5-9-17 1500

Temp. Upon Receipt (C): 2.6 Measured By: JHR L10
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

7051191

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	05/19/2017
Date Due	05/25/2017
Date Received	05/16/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 01 **1**									**Sampled** 05/16/2017 @ 13:45	
Sampled By Customer										
Flow by Calculation			14.2	CFS			EPA 600		05/16/2017 13:45	CUS
E. coli			248.1	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 02 **2**									**Sampled** 05/16/2017 @ 13:30	
Sampled By Customer										
Flow by Calculation			10.9	CFS			EPA 600		05/16/2017 13:30	CUS
E. coli			135.4	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 03 **3**									**Sampled** 05/16/2017 @ 13:20	
Sampled By Customer										
Flow by Calculation			<0.01	CFS			EPA 600		05/16/2017 13:20	CUS
E. coli			25.9	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 04 **4**									**Sampled** 05/16/2017 @ 13:05	
Sampled By Customer										
Flow by Calculation			<0.01	CFS			EPA 600		05/16/2017 13:05	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 05 **5**									**Sampled** 05/16/2017 @ 12:45	
Sampled By Customer										
Flow by Calculation			4.9	CFS			EPA 600		05/16/2017 12:45	CUS
E. coli			387.3	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 06 **6**									**Sampled** 05/16/2017 @ 12:15	
Sampled By Customer										
Flow by Calculation			3.5	CFS			EPA 600		05/16/2017 12:15	CUS
E. coli			1986.3	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 07 **7**									**Sampled** 05/16/2017 @ 11:50	
Sampled By Customer										
Flow by Calculation			0.27	CFS			EPA 600		05/16/2017 11:50	CUS
E. coli			56.1	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS

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CERTIFICATE OF ANALYSIS

7051191

Third Rock Consultants
Steve Evans

Date Due 05/25/2017
Date Received 05/16/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 08 **8**									**Sampled** 05/16/2017 @ 11:30	
Sampled By Customer										
E. coli			238.2	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 09 **9**									**Sampled** 05/16/2017 @ 11:00	
Sampled By Customer										
Flow by Calculation			1.83	CFS			EPA 600		05/16/2017 11:00	CUS
E. coli			83.6	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 10 **10**									**Sampled** 05/16/2017 @ 10:00	
Sampled By Customer										
Flow by Calculation			1.49	CFS			EPA 600		05/16/2017 10:00	CUS
E. coli			488.6	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 11 **11**									**Sampled** 05/16/2017 @ 10:25	
Sampled By Customer										
Flow by Calculation			1.25	CFS			EPA 600		05/16/2017 10:25	CUS
E. coli			178.9	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS
Sample: 12 **DD**									**Sampled** 05/16/2017	
Sampled By Customer										
E. coli			61.3	MPN/100mL			SM9223B (Colilert-18)		05/16/2017 17:06	BAS

Qualifier Definitions

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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MICROBAC®

CERTIFICATE OF ANALYSIS

7051191

Third Rock Consultants
Steve Evans

Date Due	05/25/2017
Date Received	05/16/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

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For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

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7051191 LISA MARTIN

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis	Flow (cfs)
	1	SW	5/16/17	1345	G	Y*/N	1	14.2
	2	SW		1330	G	Y*/N	1	10.9
	3	SW		1320	G	Y*/N	1	<0.01
	4	SW		1305	G	Y*/N	1	<0.01
	5	SW		1245	G	Y*/N	1	4.9
	6	SW		1215	G	Y*/N	1	3.5
	7	SW		1150	G	Y*/N	1	0.27
	8	SW		11:30	G	Y*/N	1	—
	9	SW		1100	G	Y*/N	1	1.83
	10	SW		1005	G	Y*/N	1	1.49
	11	SW		1025	G	Y*/N	1	1.25
	DD	SW		******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5/16/17 15:10	Paul	5-16-17 15:10

Temp. Upon Receipt (C): 2.0 Measured By: JHR
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

(2A) L24

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

MICROBAC

CERTIFICATE OF ANALYSIS

7051396

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	05/19/2017
Date Due	05/30/2017
Date Received	05/18/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 01 **1**									**Sampled** 05/18/2017 @ 14:40	
Sampled By Customer										
Flow by Calculation			8.68	CFS			EPA 600		05/18/2017 14:40	CUS
E. coli			248.1	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 02 **2**									**Sampled** 05/18/2017 @ 14:15	
Sampled By Customer										
Flow by Calculation			6.03	CFS			EPA 600		05/18/2017 14:15	CUS
E. coli			410.6	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 03 **3**									**Sampled** 05/18/2017 @ 14:00	
Sampled By Customer										
Flow by Calculation			<0.01	CFS			EPA 600		05/18/2017 14:00	CUS
E. coli			42.8	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 04 **4**									**Sampled** 05/18/2017 @ 13:50	
Sampled By Customer										
Flow by Calculation			<0.01	CFS			EPA 600		05/18/2017 13:50	CUS
E. coli			231.0	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 05 **5**									**Sampled** 05/18/2017 @ 13:30	
Sampled By Customer										
Flow by Calculation			3.33	CFS			EPA 600		05/18/2017 13:30	CUS
E. coli			1299.7	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 06 **6**									**Sampled** 05/18/2017 @ 13:05	
Sampled By Customer										
Flow by Calculation			3.34	CFS			EPA 600		05/18/2017 13:05	CUS
E. coli			1723.0	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 07 **7**									**Sampled** 05/18/2017 @ 12:45	
Sampled By Customer										
Flow by Calculation			0.07	CFS			EPA 600		05/18/2017 12:45	CUS
E. coli			156.5	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS

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MICROBAC®

CERTIFICATE OF ANALYSIS

7051396

Third Rock Consultants
Steve Evans

Date Due 05/30/2017
Date Received 05/18/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 08 **8**									**Sampled** 05/18/2017 @ 12:20	
Sampled By Customer										
E. coli			139.6	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 09 **9**									**Sampled** 05/18/2017 @ 11:45	
Sampled By Customer										
Flow by Calculation			0.36	CFS			EPA 600		05/18/2017 11:45	CUS
E. coli			52.1	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 10 **10**									**Sampled** 05/18/2017 @ 10:30	
Sampled By Customer										
Flow by Calculation			0.13	CFS			EPA 600		05/18/2017 10:30	CUS
E. coli			741.0	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 11 **11**									**Sampled** 05/18/2017 @ 11:00	
Sampled By Customer										
Flow by Calculation			0.27	CFS			EPA 600		05/18/2017 11:00	CUS
E. coli			275.5	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS
Sample: 12 **DD**									**Sampled** 05/18/2017	
Sampled By Customer										
E. coli			185.0	MPN/100mL			SM9223B (Colilert-18)		05/18/2017 16:47	BAS

Qualifier Definitions

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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MICROBAC®

CERTIFICATE OF ANALYSIS

7051396

Third Rock Consultants
Steve Evans

Date Due	05/30/2017
Date Received	05/18/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

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7051396 LISA MARTIN

COC# CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client - C. Bloyd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW	5-18-17	1440	G	Y*/N	1	8.68
	2	SW	" "	1416	G	Y*/N	1	6.03
	3	SW		1400	G	Y*/N	1	<0.01
	4	SW		1350	G	Y*/N	1	<0.01
	5	SW		1330	G	Y*/N	1	3.33
	6	SW		1305	G	Y*/N	1	3.34
	7	SW		1245	G	Y*/N	1	0.07
	8	SW		1220	G	Y*/N	1	—
	9	SW		1145	G	Y*/N	1	0.36
	10	SW		1030	G	Y*/N	1	0.13
	11	SW		1100	G	Y*/N	1	0.27
	DD	SW	" "	******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5-18-17 / 1545		5/18/17 1545

Temp. Upon Receipt (C): 3.4°C LIO Measured By:
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: [✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CERTIFICATE OF ANALYSIS

7051758

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington, KY 40503

Date Reported	05/25/2017
Date Due	06/05/2017
Date Received	05/24/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 01 **1**									**Sampled** 05/24/2017 @ 10:15	
Sampled By Customer										
Flow by Calculation			5.92	CFS			EPA 600		05/24/2017 10:15	CUS
E. coli			228.2	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 02 **2**									**Sampled** 05/24/2017 @ 10:45	
Sampled By Customer										
Flow by Calculation			5.1	CFS			EPA 600		05/24/2017 10:45	CUS
E. coli			261.3	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 03 **3**									**Sampled** 05/24/2017 @ 10:40	
Sampled By Customer										
Flow by Calculation			<0.01	CFS			EPA 600		05/24/2017 10:40	CUS
E. coli			83.9	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 04 **4**									**Sampled** 05/24/2017 @ 11:20	
Sampled By Customer										
Flow by Calculation			<0.01	CFS			EPA 600		05/24/2017 11:20	CUS
E. coli			77.1	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 05 **5**									**Sampled** 05/24/2017 @ 11:30	
Sampled By Customer										
Flow by Calculation			2.03	CFS			EPA 600		05/24/2017 11:30	CUS
E. coli			1553.1	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 06 **6**									**Sampled** 05/24/2017 @ 11:50	
Sampled By Customer										
Flow by Calculation			0.85	CFS			EPA 600		05/24/2017 11:50	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 07 **7**									**Sampled** 05/24/2017 @ 12:15	
Sampled By Customer										
Flow by Calculation			<0.01	CFS			EPA 600		05/24/2017 12:15	CUS
E. coli			325.5	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW

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CERTIFICATE OF ANALYSIS

7051758

Third Rock Consultants
Steve Evans

Date Due	06/05/2017
Date Received	05/24/2017

KDOW Cane Run Watershed Project

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 08 **8** Sampled By Customer								**Sampled**	05/24/2017 @ 9:50	
E. coli			2419.6	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 09 **9** Sampled By Customer								**Sampled**	05/24/2017 @ 12:45	
Flow by Calculation			4.29	CFS			EPA 600		05/24/2017 12:45	CUS
E. coli			159.7	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 10 **10** Sampled By Customer								**Sampled**	05/24/2017 @ 13:45	
Flow by Calculation			USGS	CFS			EPA 600		05/24/2017 13:45	CUS
E. coli			1046.2	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 11 **11** Sampled By Customer								**Sampled**	05/24/2017 @ 13:15	
Flow by Calculation			5.24	CFS			EPA 600		05/24/2017 13:15	CUS
E. coli			>2419.6	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW
Sample: 12 **DD** Sampled By Customer								**Sampled**	05/24/2017	
E. coli			259.5	MPN/100mL			SM9223B (Colilert-18)		05/24/2017 16:24	DZW

Qualifier Definitions

The following analyses were not run at the main Louisville lab within the Microbac Kentucky Division, but at a satellite location.

Laboratory	Analysis	Method
Microbac Laboratories, Kentucky Testing Laboratory, Lexington Site	E. coli	SM9223B (Colilert-18)

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MICROBAC®

CERTIFICATE OF ANALYSIS

7051758

Third Rock Consultants
Steve Evans

Date Due	06/05/2017
Date Received	05/24/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin A.M.

David Lester, Managing Director

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7051758 LISA MARTIN

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRD ROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW	5/24	1015	G	Y*/N	1	5.92
	2	SW		10405	G	Y*/N	1	5.10
	3	SW		1040	G	Y*/N	1	<0.01
	4	SW		1120	G	Y*/N	1	<0.01
	5	SW		1130	G	Y*/N	1	2.03
	6	SW		1150	G	Y*/N	1	0.85
	7	SW		1215	G	Y*/N	1	<0.01
	8	SW		950	G	Y*/N	1	—
	9	SW		1245	G	Y*/N	1	4.29
	10	SW		1345	G	Y*/N	1	USGS
	11	SW		1315	G	Y*/N	1	5.24
	DD	SW		******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5/24/17 1403		5/24/17 @ 1403

Temp. Upon Receipt (C): 2.5° Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

MICROBAC®

QUALITY CONTROL DATA REPORT

6061975

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington KY, 40503

Original Date Reported	06/28/2016
Report Reissued	07/05/2016
Date Received	06/27/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B103616						06/27/2016		CUS
Flow by Measurement & Calc.								
	No QC Reported							
		0						
QC Batch: B103616						06/27/2016		CUS
Oxygen, Dissolved								
	No QC Reported							
		0						
QC Batch: B103616						06/27/2016		CUS
Specific Conductance								
	No QC Reported							
		0						
QC Batch: B103616						06/27/2016		CUS
Turbidity								
	No QC Reported							
		0						
QC Batch: B103617						06/27/2016		DZW
E. coli								
	No QC Reported							
		0						
QC Batch: B103616						06/27/2016		CUS
pH								
	No QC Reported							
		0						
QC Batch: B103616						06/27/2016		CUS
Temperature								
	No QC Reported							
		0						

Qualifier Definitions

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QUALITY CONTROL DATA REPORT

6061975

Third Rock Consultants
Marcia L. Wooton

Report Reissued 07/05/2016
Date Received 06/27/2016

KDOW Cane Run Watershed Project

J1 The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an

UJ Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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The data and information on this, and other accompanying documents, represents only the sample(s) analyzed. This report is incomplete unless all pages indicated in the footnote are present and an authorized signature is included. For any feedback concerning our services, please contact your project manager at lisa.martin@microbac.com. You may also contact David Lester, Managing Director at david.lester@microbac.com or Robert Crookston, President at robert.crookston@microbac.com.

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QUALITY CONTROL DATA REPORT

6061976

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington KY, 40503

Original Date Reported	06/28/2016
Report Reissued	07/05/2016
Date Received	06/27/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B103620						06/27/2016		LLM
E. coli								
	No QC Reported							
		0						

Qualifier Definitions

J1 The analyte was positively identified; analyte was detected between the Reporting Limit and Method Detection Limit and the result is an

UJ Analyte was not detected above the Reporting Limit, however, the Reporting Limit is approximate & may or may not represent the actual Limit of Quantitation necessary to accurately & precisely measure the analyte in the sample.

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Lisa Martin, A.M.

David Lester, Managing Director

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MICROBAC®

QUALITY CONTROL DATA REPORT

6061982

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington KY, 40503

Original Date Reported	07/05/2016
Report Reissued	07/05/2016
Date Received	06/28/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B103631						06/28/2016		EGD
BOD, 5 Day								
Blank	mg/L	<2.0	UJ					
QC Batch: B103742						06/29/2016		DJR
Nitrogen, Ammonia								
Blank	mg/L	<0.14	UJ					
LCS	%	93.0		90-110				
QC Batch: B103810						06/30/2016		DJR
Nitrogen, Ammonia								
Blank	mg/L	<0.14	UJ					
LCS	%	95.1		90-110				
MS	%	97.5		90-110				
MSD	%	96.2		90-110				
MS RPD	%	1.34		0-10				
QC Batch: B103638						06/28/2016		JGF
Nitrogen, Nitrate								
Blank	mg/L	<0.027	UJ					
LCS	%	104		90-110				
MS	%	107		90-110				
MSD	%	107		90-110				
MS RPD	%	0.204		0-10				
QC Batch: B103638						06/28/2016		JGF
Nitrogen, Nitrite								
Blank	mg/L	<0.025	UJ					
LCS	%	102		90-110				
MS	%	98.4		90-110				
MSD	%	98.1		90-110				
MS RPD	%	0.294		0-10				
QC Batch: B103872						07/01/2016		DJR
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	90.4		90-110				

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MICROBAC®

QUALITY CONTROL DATA REPORT

6061982

Third Rock Consultants
Marcia L. Wooton

Report Reissued	07/05/2016
Date Received	06/28/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B103704						06/28/2016		DJR
Phosphorus								
Blank	mg/L	<0.025	UJ					
LCS	%	108		90-110				
MS	%	103		90-110				
MSD	%	104		90-110				
MS RPD	%	0.694		0-10				
QC Batch: B103782						06/30/2016		DJR
Phosphorus								
Blank	mg/L	0.0124	J1					
LCS	%	108		90-110				
MS	%	93.8		90-110				
MSD	%	92.2		90-110				
MS RPD	%	0.976		0-10				
QC Batch: B103778						06/29/2016		CJL
Solids, Total Suspended								
Blank	mg/L	<1						
LCS	%	96.9		85-105				

Qualifier Definitions

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QUALITY CONTROL DATA REPORT

6061982

Third Rock Consultants
Marcia L. Wooton

Report Reissued 07/05/2016
Date Received 06/28/2016

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6071161

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	07/25/2016
Date Due	07/27/2016
Date Received	07/18/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B105208						07/18/2016		CUS
Flow by Measurement & Calc.								
	No QC Reported							
		0						
QC Batch: B105208						07/18/2016		CUS
Oxygen, Dissolved								
	No QC Reported							
		0						
QC Batch: B105208						07/18/2016		CUS
Specific Conductance								
	No QC Reported							
		0						
QC Batch: B105208						07/18/2016		CUS
Turbidity								
	No QC Reported							
		0						
QC Batch: B105240						07/18/2016		DZW
E. coli								
	No QC Reported							
		0						
QC Batch: B105298						07/19/2016		DJR
BOD, 5 Day								
Blank	mg/L	<2.0	UJ					
QC Batch: B105525						07/21/2016		EGD
Nitrogen, Ammonia								
Blank	mg/L	<0.14	UJ					
LCS	%	98.4		90-110				
MS	%	89.9	M2, R1	90-110				
MSD	%	104	R1	90-110				
MS RPD	%	14.7	R1	0-10				

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QUALITY CONTROL DATA REPORT

6071161

Third Rock Consultants
Marcia L. Wooton

Date Due 07/27/2016
Date Received 07/18/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B105351						07/19/2016		LJC
Nitrogen, Nitrate								
Blank	mg/L	<0.027	UJ					
LCS	%	98.9		90-110				
MS	%	96.3		90-110				
QC Batch: B105351						07/19/2016		LJC
Nitrogen, Nitrite								
Blank	mg/L	<0.025	UJ					
LCS	%	101		90-110				
MS	%	92.4		90-110				
QC Batch: B105384						07/22/2016		EGD
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	91.0		90-110				
MS	%	89.0		90-110				
MSD	%	85.7		90-110				
MS RPD	%	3.29		0-10				
QC Batch: B105208						07/18/2016		CUS
pH								
	No QC Reported							
		0						
QC Batch: B105353						07/19/2016		EGD
Phosphorus								
Blank	mg/L	<0.025	UJ					
LCS	%	109		90-110				
MS	%	102		90-110				
MSD	%	104		90-110				
MS RPD	%	1.26		0-10				

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Third Rock Consultants
Marcia L. Wooton

Date Due 07/27/2016
Date Received 07/18/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B105562						07/22/2016		EGD
Phosphorus								
Blank	mg/L	0.00550	J1					
LCS	%	104		90-110				
MS	%	92.5		90-110				
MSD	%	89.0	M2	90-110				
MS RPD	%	2.27	M2	0-10				
QC Batch: B105390						07/20/2016		CJL
Solids, Total Suspended								
Blank	mg/L	<1						
LCS	%	87.2		85-105				
QC Batch: B105208						07/18/2016		CUS
Temperature								
	No QC Reported							
		0						

Qualifier Definitions

M2 Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1 Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6071171

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	07/25/2016
Date Due	07/27/2016
Date Received	07/18/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B105215						07/18/2016		CUS
Flow by Measurement & Calc.								
	No QC Reported							
		0						
QC Batch: B105215						07/18/2016		CUS
Oxygen, Dissolved								
	No QC Reported							
		0						
QC Batch: B105215						07/18/2016		CUS
Specific Conductance								
	No QC Reported							
		0						
QC Batch: B105215						07/18/2016		CUS
Turbidity								
	No QC Reported							
		0						
QC Batch: B105240						07/18/2016		DZW
E. coli								
	No QC Reported							
		0						
QC Batch: B105298						07/19/2016		DJR
BOD, 5 Day								
Blank	mg/L	<2.0	UJ					
QC Batch: B105525						07/21/2016		EGD
Nitrogen, Ammonia								
Blank	mg/L	<0.14	UJ					
LCS	%	98.4		90-110				
QC Batch: B105351						07/19/2016		LJC
Nitrogen, Nitrate								
Blank	mg/L	<0.027	UJ					
LCS	%	98.9		90-110				

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Marcia L. Wooton

Date Due	07/27/2016
Date Received	07/18/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B105351						07/19/2016		LJC
Nitrogen, Nitrite								
Blank	mg/L	<0.025	UJ					
LCS	%	101		90-110				
QC Batch: B105384						07/22/2016		EGD
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	91.0		90-110				
QC Batch: B105215						07/18/2016		CUS
pH								
	No QC Reported							
		0						
QC Batch: B105353						07/19/2016		EGD
Phosphorus								
Blank	mg/L	<0.025	UJ					
LCS	%	109		90-110				
QC Batch: B105562						07/22/2016		EGD
Phosphorus								
Blank	mg/L	0.00550	J1					
LCS	%	104		90-110				
QC Batch: B105390						07/20/2016		CJL
Solids, Total Suspended								
Blank	mg/L	<1						
LCS	%	87.2		85-105				
QC Batch: B105391						07/21/2016		CJL
Solids, Total Suspended								
Blank	mg/L	<1						
LCS	%	96.0		85-105				
QC Batch: B105215						07/18/2016		CUS
Temperature								
	No QC Reported							
		0						

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QUALITY CONTROL DATA REPORT

6071171

Third Rock Consultants
Marcia L. Wooton

Date Due	07/27/2016
Date Received	07/18/2016

KDOW Cane Run Watershed Project

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6081841

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	09/02/2016
Date Due	09/02/2016
Date Received	08/24/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B108186						08/24/2016		CUS
Flow by Measurement & Calc.								
	No QC Reported							
		0						
QC Batch: B108186						08/24/2016		CUS
Oxygen, Dissolved								
	No QC Reported							
		0						
QC Batch: B108186						08/24/2016		CUS
Specific Conductance								
	No QC Reported							
		0						
QC Batch: B108204						08/24/2016		LKE
E. coli								
	No QC Reported							
		0						
QC Batch: B108347						08/25/2016		DJR
BOD, 5 Day								
Blank	mg/L	<2.0	UJ					
QC Batch: B108609						09/01/2016		EGD
Nitrogen, Ammonia								
Blank	mg/L	<0.14	UJ					
LCS	%	93.6		90-110				
MS	%	94.4		90-110				
MSD	%	86.5	M2	90-110				
MS RPD	%	8.67	M2	0-10				
QC Batch: B108328						08/25/2016		LJC
Nitrogen, Nitrate								
Blank	mg/L	<0.025	UJ					
LCS	%	97.9		90-110				

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QUALITY CONTROL DATA REPORT

6081841

Third Rock Consultants		**Date Due**	09/02/2016
Marcia L. Wooton		**Date Received**	08/24/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B108328						08/25/2016		LJC
Nitrogen, Nitrite								
Blank	mg/L	0.0360	J1					
LCS	%	105		90-110				
QC Batch: B108585						08/31/2016		EGD
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	90.9		90-110				
QC Batch: B108699						09/01/2016		EGD
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	95.1		90-110				
MS	%	101	R1	90-110				
MSD	%	88.4	M2, R1	90-110				
MS RPD	%	11.2	M2, R1	0-10				
QC Batch: B108186						08/24/2016		CUS
pH								
	No QC Reported							
		0						
QC Batch: B108355						08/25/2016		EGD
Phosphorus								
Blank	mg/L	<0.035	UJ					
LCS	%	103		90-110				
MS	%	95.5		90-110				
MSD	%	97.7		90-110				
MS RPD	%	1.45		0-10				
QC Batch: B108528						08/29/2016		EGD
Phosphorus								
Blank	mg/L	<0.046	UJ L2					
LCS	%	112	L2	90-110				
MS	%	97.4	L2	90-110				
MSD	%	95.3	L2	90-110				
MS RPD	%	1.22	L2	0-10				

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Third Rock Consultants		**Date Due**	09/02/2016
Marcia L. Wooton		**Date Received**	08/24/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B108295						08/25/2016		CJL
Solids, Total Suspended								
Blank	mg/L	<1						
LCS	%	92.9		85-105				
QC Batch: B108186						08/24/2016		CUS
Temperature								
	No QC Reported							
		0						

Qualifier Definitions

L2	Lab control sample (LCS) recovery above upper Control Limit.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6090457

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	09/16/2016
Date Due	09/19/2016
Date Received	09/08/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B109341						09/08/2016		CUS
Flow by Measurement & Calc.								
	No QC Reported							
		0						
QC Batch: B109341						09/08/2016		CUS
Oxygen, Dissolved								
	No QC Reported							
		0						
QC Batch: B109341						09/08/2016		CUS
Specific Conductance								
	No QC Reported							
		0						
QC Batch: B109341						09/08/2016		CUS
Turbidity								
	No QC Reported							
		0						
QC Batch: B109362						09/08/2016		LKE
E. coli								
	No QC Reported							
		0						
QC Batch: B109406						09/09/2016		DJR
BOD, 5 Day								
Blank	mg/L	<2.0	UJ					
QC Batch: B109776						09/15/2016		EGD
Nitrogen, Ammonia								
Blank	mg/L	<0.14	UJ L1					
LCS	%	89.1	L1	90-110				
MS	%	94.0	L1, R1	90-110				
MSD	%	84.5	L1, M2, R1	90-110				
MS RPD	%	10.7	L1, M2, R1	0-10				

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QUALITY CONTROL DATA REPORT

6090457

Third Rock Consultants		**Date Due**	09/19/2016
Marcia L. Wooton		**Date Received**	09/08/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B109417						09/09/2016		LJC
Nitrogen, Nitrate								
Blank	mg/L	<0.025	UJ					
LCS	%	92.3		90-110				
QC Batch: B109417						09/09/2016		LJC
Nitrogen, Nitrite								
Blank	mg/L	<0.018	UJ					
LCS	%	105		90-110				
QC Batch: B109585						09/14/2016		EGD
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	93.7		90-110				
QC Batch: B109684						09/15/2016		EGD
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	98.7		90-110				
MS	%	91.7		90-110				
MSD	%	94.3		90-110				
MS RPD	%	2.53		0-10				
QC Batch: B109341						09/08/2016		CUS
pH								
	No QC Reported							
		0						
QC Batch: B109411						09/09/2016		EGD
Phosphorus								
Blank	mg/L	0.0150	J1					
LCS	%	104		90-110				

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QUALITY CONTROL DATA REPORT

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Third Rock Consultants		**Date Due**	09/19/2016
Marcia L. Wooton		**Date Received**	09/08/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B109712						09/15/2016		EGD
Phosphorus								
Blank	mg/L	0.0123	J1					
LCS	%	108		90-110				
MS	%	104		90-110				
MSD	%	106		90-110				
MS RPD	%	1.35		0-10				
QC Batch: B109437						09/09/2016		CJL
Solids, Total Suspended								
Blank	mg/L	<1						
LCS	%	92.9		85-105				
QC Batch: B109341						09/08/2016		CUS
Temperature								
	No QC Reported							
		0						

Qualifier Definitions

L1	Lab Control Sample (LCS) recovery below lower Control Limit.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

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QUALITY CONTROL DATA REPORT

6090457

Third Rock Consultants		**Date Due**	09/19/2016
Marcia L. Wooton		**Date Received**	09/08/2016

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6090459

Third Rock Consultants
Marcia L. Wooton
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	09/20/2016
Date Due	09/19/2016
Date Received	09/08/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B109342						09/08/2016		CUS
Flow by Measurement & Calc.								
	No QC Reported							
		0						
QC Batch: B109342						09/08/2016		CUS
Oxygen, Dissolved								
	No QC Reported							
		0						
QC Batch: B109342						09/08/2016		CUS
Specific Conductance								
	No QC Reported							
		0						
QC Batch: B109342						09/08/2016		CUS
Turbidity								
	No QC Reported							
		0						
QC Batch: B109362						09/08/2016		LKE
E. coli								
	No QC Reported							
		0						
QC Batch: B109426						09/09/2016		DJR
BOD, 5 Day								
Blank	mg/L	<2.0	UJ					
QC Batch: B109776						09/15/2016		EGD
Nitrogen, Ammonia								
Blank	mg/L	<0.14	UJ L1					
LCS	%	89.1	L1	90-110				
QC Batch: B109417						09/09/2016		LJC
Nitrogen, Nitrate								
Blank	mg/L	<0.025	UJ					
LCS	%	92.3		90-110				

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QUALITY CONTROL DATA REPORT

6090459

Third Rock Consultants
Marcia L. Wooton

Date Due 09/19/2016
Date Received 09/08/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B109417						09/09/2016		LJC
Nitrogen, Nitrite								
Blank	mg/L	<0.018	UJ					
LCS	%	105		90-110				
QC Batch: B109684						09/15/2016		EGD
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	98.7		90-110				
QC Batch: B110028						09/20/2016		DJR
Nitrogen, Total Kjeldahl								
Blank	mg/L	<0.40						
LCS	%	101		90-110				
MS	%	96.6		90-110				
MSD	%	97.1		90-110				
MS RPD	%	0.474		0-10				
QC Batch: B109342						09/08/2016		CUS
pH								
	No QC Reported							
		0						
QC Batch: B109411						09/09/2016		EGD
Phosphorus								
Blank	mg/L	0.0150	J1					
LCS	%	104		90-110				
MS	%	102		90-110				
MSD	%	104		90-110				
MS RPD	%	1.39		0-10				
QC Batch: B109849						09/16/2016		EGD
Phosphorus								
Blank	mg/L	<0.012	UJ					
LCS	%	104		90-110				
MS	%	96.3		90-110				
MSD	%	94.6		90-110				
MS RPD	%	1.11		0-10				

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QUALITY CONTROL DATA REPORT

6090459

Third Rock Consultants
Marcia L. Wooton

Date Due 09/19/2016
Date Received 09/08/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery	Qualifier	Min-Max	Method Reference	Date	Time	Tech
QC Batch: B109438						09/09/2016		CJL
Solids, Total Suspended								
Blank	mg/L	<1						
LCS	%	92.0		85-105				
QC Batch: B109342						09/08/2016		CUS
Temperature								
	No QC Reported							
		0						

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6101546

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	11/03/2016
Date Due	11/03/2016
Date Received	10/25/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B112709										10/25/2016		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B112709										10/25/2016		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B112709										10/25/2016		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B112709										10/25/2016		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B112729										10/25/2016		LKE
E. coli					SM9223B (Colilert-18)							
	No QC Reported											
		0										
QC Batch: B112836										10/26/2016		EGD
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

6101546

Third Rock Consultants
Steve Evans

Date Due 11/03/2016
Date Received 10/25/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B113297										11/02/2016		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.14		UJ								
LCS	%	94.2	90-110									
MS	%	97.8	90-110			6101546-02	ND	2.50	2.45			
MSD	%	104	90-110			6101546-02	ND	2.50	2.60			
MS RPD	%	6.09	0-10									
QC Batch: B112811										10/26/2016		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	<0.025		UJ								
LCS	%	95.6	90-110									
QC Batch: B112811										10/26/2016		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	103	90-110									
QC Batch: B113291										11/02/2016		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	99.1	90-110									
MS	%	96.9	90-110			6101546-01	0.478	2.50	2.90			
MSD	%	97.0	90-110			6101546-01	0.478	2.50	2.91			
MS RPD	%	0.0929	0-10									
QC Batch: B112709										10/25/2016		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										

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QUALITY CONTROL DATA REPORT

6101546

Third Rock Consultants
Steve Evans

Date Due 11/03/2016
Date Received 10/25/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B112840										10/26/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.011		UJ								
LCS	%	102	90-110									
MS	%	102	90-110			6101546-01	0.269	0.50	0.780			
MSD	%	100	90-110			6101546-01	0.269	0.50	0.770			
MS RPD	%	1.32	0-10									
QC Batch: B113020										10/28/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0213		J1								
LCS	%	101	90-110									
MS	%	96.1	90-110			6101546-01	0.304	0.50	0.784			
MSD	%	90.1	90-110			6101546-01	0.304	0.50	0.755			
MS RPD	%	3.87	0-10									
QC Batch: B112808										10/26/2016		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	91.7	85-105									
QC Batch: B112709										10/25/2016		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

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QUALITY CONTROL DATA REPORT

6101546

Third Rock Consultants
Steve Evans

Date Due	11/03/2016
Date Received	10/25/2016

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6101550

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	11/03/2016
Date Due	11/03/2016
Date Received	10/25/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B112715										10/25/2016		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B112715										10/25/2016		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B112715										10/25/2016		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B112715										10/25/2016		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B112729										10/25/2016		LKE
E. coli					SM9223B (Colilert-18)							
	No QC Reported											
		0										
QC Batch: B112836										10/26/2016		EGD
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

6101550

Third Rock Consultants
Steve Evans

Date Due 11/03/2016
Date Received 10/25/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B113297										11/02/2016		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.14		UJ								
LCS	%	94.2	90-110									
QC Batch: B112811										10/26/2016		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	<0.025		UJ								
LCS	%	95.6	90-110									
QC Batch: B112811										10/26/2016		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	103	90-110									
QC Batch: B113291										11/02/2016		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	99.1	90-110									
QC Batch: B112715										10/25/2016		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B112840										10/26/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.011		UJ								
LCS	%	102	90-110									

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QUALITY CONTROL DATA REPORT

6101550

Third Rock Consultants
Steve Evans

Date Due	11/03/2016
Date Received	10/25/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B113020										10/28/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0213		J1								
LCS	%	101	90-110									
QC Batch: B112809										10/26/2016		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	91.9	85-105									
QC Batch: B112715										10/25/2016		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6111787

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	12/09/2016
Date Due	12/09/2016
Date Received	11/30/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B115221										11/30/2016		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B115221										11/30/2016		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B115221										11/30/2016		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B115221										11/30/2016		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B115252										11/30/2016		ABK
E. coli					SM9223B (Colilert-18)							
	No QC Reported											
		0										
QC Batch: B115346										12/01/2016		DJR
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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MICROBAC

QUALITY CONTROL DATA REPORT

6111787

Third Rock Consultants
Steve Evans

Date Due 12/09/2016
Date Received 11/30/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B116001										12/08/2016		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	96.0	90-110									
MS	%	106	90-110			6111787-02	ND	2.50	2.65			
MSD	%	98.3	90-110			6111787-02	ND	2.50	2.46			
MS RPD	%	7.53	0-10									
QC Batch: B115400										12/01/2016		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	0.0350		J1								
LCS	%	91.5	90-110									
QC Batch: B115400										12/01/2016		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	98.4	90-110									
QC Batch: B115832										12/08/2016		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	95.8	90-110									
MS	%	97.9	90-110			6111787-01	0.281	2.50	2.73			
MSD	%	93.2	90-110			6111787-01	0.281	2.50	2.61			
MS RPD	%	4.37	0-10									
QC Batch: B115993										12/09/2016		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	97.5	90-110									
MS	%	91.2	90-110			6111787-06	0.468	2.50	2.75			
MSD	%	92.4	90-110			6111787-06	0.468	2.50	2.78			
MS RPD	%	1.16	0-10									

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QUALITY CONTROL DATA REPORT

6111787

Third Rock Consultants		**Date Due**	12/09/2016
Steve Evans		**Date Received**	11/30/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B115221										11/30/2016		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B115371										12/01/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0165		J1								
LCS	%	100	90-110									
MS	%	101	90-110			6111787-07	0.336	0.50	0.840			
MSD	%	97.7	90-110			6111787-07	0.336	0.50	0.824			
MS RPD	%	1.97	0-10									
QC Batch: B115326										12/01/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0458		J1								
LCS	%	106	90-110									
QC Batch: B115327										12/01/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0180		J1								
LCS	%	99.9	90-110									
QC Batch: B115571										12/05/2016		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	85.0	85-105									
QC Batch: B115572										12/05/2016		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	90.7	85-105									

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MICROBAC®

QUALITY CONTROL DATA REPORT

6111787

Third Rock Consultants
Steve Evans

Date Due 12/09/2016
Date Received 11/30/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B115221										11/30/2016		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6121194

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	12/26/2016
Date Due	12/27/2016
Date Received	12/15/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B116642										12/15/2016		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B116642										12/15/2016		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B116642										12/15/2016		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B116642										12/15/2016		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B116655										12/15/2016		ABK
E. coli					SM9223B (Colilert-18)							
	No QC Reported											
		0										
QC Batch: B116726										12/16/2016		DJR
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

6121194

Third Rock Consultants		**Date Due**	12/27/2016
Steve Evans		**Date Received**	12/15/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B116905										12/20/2016		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	98.2	90-110									
MS	%	95.8	90-110			6121194-01	ND	2.50	2.40			
MSD	mg/L	0	90-110	UJ M2		6121194-01	ND	2.50	ND			
QC Batch: B116766										12/16/2016		JGF
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	<0.025		UJ								
LCS	%	91.5	90-110									
QC Batch: B116766										12/16/2016		JGF
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	91.7	90-110									
QC Batch: B116951										12/22/2016		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	104	90-110									
QC Batch: B117059										12/22/2016		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	97.0	90-110									
MS	%	87.7	90-110	M2, R1		6121194-04	1.07	2.50	3.26			
MSD	%	102	90-110	R1		6121194-04	1.07	2.50	3.63			
MS RPD	%	10.7	0-10	R1								

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QUALITY CONTROL DATA REPORT

6121194

Third Rock Consultants		**Date Due**	12/27/2016
Steve Evans		**Date Received**	12/15/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B116642										12/15/2016		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B116715										12/16/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0111		J1								
LCS	%	99.7	90-110									
MS	%	100	90-110			6121194-01	0.190	0.50	0.692			
MSD	%	98.2	90-110			6121194-01	0.190	0.50	0.681			
MS RPD	%	1.53	0-10									
QC Batch: B117196										12/23/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.012		UJ								
LCS	%	102	90-110									
MS	%	93.9	90-110			6121194-01	0.205	0.50	0.675			
MSD	%	95.7	90-110			6121194-01	0.205	0.50	0.684			
MS RPD	%	1.33	0-10									
QC Batch: B116740										12/16/2016		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	98.0	85-105									
QC Batch: B116741										12/16/2016		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	90.8	85-105									

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QUALITY CONTROL DATA REPORT

6121194

Third Rock Consultants		**Date Due**	12/27/2016
Steve Evans		**Date Received**	12/15/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B116642										12/15/2016		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

6121198

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	12/26/2016
Date Due	12/27/2016
Date Received	12/15/2016
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B116643										12/15/2016		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B116643										12/15/2016		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B116643										12/15/2016		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B116643										12/15/2016		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B116655										12/15/2016		ABK
E. coli					SM9223B (Colilert-18)							
	No QC Reported											
		0										
QC Batch: B116726										12/16/2016		DJR
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

6121198

Third Rock Consultants
Steve Evans

Date Due 12/27/2016
Date Received 12/15/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B116905										12/20/2016		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	98.2	90-110									
QC Batch: B116766										12/16/2016		JGF
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	<0.025		UJ								
LCS	%	91.5	90-110									
MS	%	90.1	90-110			6121198-01	0.505	5.65	5.59			
QC Batch: B116766										12/16/2016		JGF
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	91.7	90-110									
MS	%	89.3	90-110	M2		6121198-01	ND	7.61	6.79			
QC Batch: B117059										12/22/2016		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	97.0	90-110									
QC Batch: B116643										12/15/2016		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B116715										12/16/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0111		J1								
LCS	%	99.7	90-110									

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QUALITY CONTROL DATA REPORT

6121198

Third Rock Consultants
Steve Evans

Date Due 12/27/2016
Date Received 12/15/2016

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B117197										12/23/2016		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.012		UJ								
LCS	%	105	90-110									
MS	%	98.6	90-110			6121198-01	0.140	0.50	0.633			
MSD	%	92.4	90-110			6121198-01	0.140	0.50	0.601			
MS RPD	%	5.07	0-10									
QC Batch: B116741										12/16/2016		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	90.8	85-105									
QC Batch: B116643										12/15/2016		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

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QUALITY CONTROL DATA REPORT

6121198

Third Rock Consultants
Steve Evans

Date Due	12/27/2016
Date Received	12/15/2016

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7011915

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	02/06/2017
Date Due	02/08/2017
Date Received	01/30/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B119830										01/30/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B119830										01/30/2017		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B119830										01/30/2017		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B119830										01/30/2017		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B119842										01/30/2017		LKE
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										
QC Batch: B119878										01/31/2017		DJR
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ B1								

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QUALITY CONTROL DATA REPORT

7011915

Third Rock Consultants
Steve Evans

Date Due 02/08/2017
Date Received 01/30/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120001										02/03/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	94.4	90-110									
QC Batch: B119890										01/31/2017		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	<0.0079		UJ								
LCS	%	105	90-110									
MS	%	110	90-110			7011915-01	3.02	5.65	9.24			
MS	%	117	90-110	M1		7011915-02	3.58	5.65	10.2			
MSD	%	109	90-110			7011915-01	3.02	5.65	9.20			
MS RPD	%	0.488	0-10									
QC Batch: B119890										01/31/2017		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	92.0	90-110									
MS	%	86.1	90-110	M2		7011915-01	ND	7.61	6.55			
MS	%	87.5	90-110	M2		7011915-02	ND	7.61	6.66			
MSD	%	83.5	90-110	M2		7011915-01	ND	7.61	6.35			
MS RPD	%	3.10	0-10	M2								
QC Batch: B119980										02/03/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	109	90-110									
MS	%	109	90-110	R1		7011915-01	ND	2.50	2.73			
MSD	%	132	90-110	M1, R1		7011915-01	ND	2.50	3.30			
MS RPD	%	18.8	0-10	M1, R1								
QC Batch: B119830										01/30/2017		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										

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QUALITY CONTROL DATA REPORT

7011915

Third Rock Consultants		**Date Due**	02/08/2017
Steve Evans		**Date Received**	01/30/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B119877										01/31/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0131		J1								
LCS	%	97.9	90-110									
MS	%	101	90-110			7011915-01	0.220	0.50	0.726			
MSD	%	102	90-110			7011915-01	0.220	0.50	0.730			
MS RPD	%	0.453	0-10									
QC Batch: B120245										02/03/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.012		UJ								
LCS	%	99.8	90-110									
MS	%	101	90-110			7011915-03	0.265	0.50	0.769			
MSD	%	102	90-110			7011915-03	0.265	0.50	0.776			
MS RPD	%	0.816	0-10									
QC Batch: B119884										01/31/2017		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	95.8	85-105									
QC Batch: B119830										01/30/2017		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

B1	The analyte value in the Method Blank is above the Control Limit.
M1	Matrix Spike recovery outside Control Limits due to sample matrix interference; biased high.
M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

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QUALITY CONTROL DATA REPORT

7011915

Third Rock Consultants
Steve Evans

Date Due	02/08/2017
Date Received	01/30/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7011918

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	02/06/2017
Date Due	02/08/2017
Date Received	01/30/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B119833										01/30/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B119833										01/30/2017		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B119833										01/30/2017		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B119833										01/30/2017		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B119842										01/30/2017		LKE
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										
QC Batch: B119878										01/31/2017		DJR
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ B1								

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QUALITY CONTROL DATA REPORT

7011918

Third Rock Consultants
Steve Evans

Date Due 02/08/2017
Date Received 01/30/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120106										02/03/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	91.7	90-110									
MS	%	92.2	90-110			7011918-03	ND	2.50	2.31			
MSD	%	92.4	90-110			7011918-03	ND	2.50	2.31			
MS RPD	%	0.204	0-10									
QC Batch: B119890										01/31/2017		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	<0.0079		UJ								
LCS	%	105	90-110									
QC Batch: B119890										01/31/2017		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	92.0	90-110									
QC Batch: B119980										02/03/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	109	90-110									
QC Batch: B119833										01/30/2017		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B119877										01/31/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0131		J1								
LCS	%	97.9	90-110									

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QUALITY CONTROL DATA REPORT

7011918

Third Rock Consultants
Steve Evans

Date Due 02/08/2017
Date Received 01/30/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120245										02/03/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.012		UJ								
LCS	%	99.8	90-110									
QC Batch: B119884										01/31/2017		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	95.8	85-105									
QC Batch: B119833										01/30/2017		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

B1 The analyte value in the Method Blank is above the Control Limit.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7020452

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	02/17/2017
Date Due	02/16/2017
Date Received	02/07/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120464										02/07/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B120464										02/07/2017		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B120464										02/07/2017		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B120471										02/07/2017		LKE
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										
QC Batch: B120569										02/08/2017		MTA
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

7020452

Third Rock Consultants
Steve Evans

Date Due 02/16/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120704										02/10/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	91.7	90-110									
QC Batch: B120724										02/10/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	98.2	90-110									
MS	%	99.9	90-110			7020452-05	0.413	2.50	2.91			
MSD	%	102	90-110			7020452-05	0.413	2.50	2.96			
MS RPD	%	1.58	0-10									
QC Batch: B120600										02/08/2017		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	0.0300		J1								
LCS	%	102	90-110									
MS	%	111	90-110	M1		7020452-01	3.32	5.65	9.58			
MSD	%	111	90-110	M1		7020452-01	3.32	5.65	9.58			
MS RPD	%	0.104	0-10	M1								
QC Batch: B120600										02/08/2017		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	97.0	90-110									
MS	%	89.8	90-110	M2		7020452-01	ND	7.61	6.84			
MSD	%	93.7	90-110			7020452-01	ND	7.61	7.12			
MS RPD	%	4.15	0-10									
QC Batch: B120883										02/16/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	101	90-110									

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QUALITY CONTROL DATA REPORT

7020452

Third Rock Consultants
Steve Evans

Date Due	02/16/2017
Date Received	02/07/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120464										02/07/2017		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B120651										02/08/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0173		J1								
LCS	%	99.7	90-110									
MS	%	98.4	90-110			7020452-01	0.212	0.50	0.704			
MSD	%	99.8	90-110			7020452-01	0.212	0.50	0.711			
MS RPD	%	1.00	0-10									
QC Batch: B121089										02/15/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.012		UJ								
LCS	%	96.4	90-110									
QC Batch: B121090										02/15/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.012		UJ								
LCS	%	95.6	90-110									
MS	%	95.5	90-110			7020452-03	0.234	0.50	0.712			
MSD	%	94.8	90-110			7020452-03	0.234	0.50	0.708			
MS RPD	%	0.535	0-10									

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MICROBAC®

QUALITY CONTROL DATA REPORT

7020452

Third Rock Consultants
Steve Evans

Date Due 02/16/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120590										02/08/2017		JAR
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	97.0	85-105									
QC Batch: B120756										02/09/2017		JAR
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	98.0	85-105									
QC Batch: B120464										02/07/2017		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

M1 Matrix Spike recovery outside Control Limits due to sample matrix interference; biased high.
M2 Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7020456

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	02/17/2017
Date Due	02/16/2017
Date Received	02/07/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120466										02/07/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B120466										02/07/2017		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B120466										02/07/2017		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B120466										02/07/2017		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B120515										02/07/2017		LKE
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										
QC Batch: B120569										02/08/2017		MTA
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

7020456

Third Rock Consultants		**Date Due**	02/16/2017
Steve Evans		**Date Received**	02/07/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120724										02/10/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	98.2	90-110									
QC Batch: B120600										02/08/2017		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	0.0300		J1								
LCS	%	102	90-110									
QC Batch: B120600										02/08/2017		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	97.0	90-110									
QC Batch: B120883										02/16/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	101	90-110									
MS	%	144	90-110	M3		7020456-02	2.97	2.50	6.58			
MSD	%	138	90-110	M3		7020456-02	2.97	2.50	6.41			
MS RPD	%	2.62	0-10	M3								
QC Batch: B120466										02/07/2017		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B120651										02/08/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0173		J1								
LCS	%	99.7	90-110									

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QUALITY CONTROL DATA REPORT

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Third Rock Consultants
Steve Evans

Date Due 02/16/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B121090										02/15/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.012		UJ								
LCS	%	95.6	90-110									
QC Batch: B120756										02/09/2017		JAR
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	98.0	85-105									
QC Batch: B120466										02/07/2017		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

M3 Analyte in the parent sample for the Matrix Spike was >4x the concentration of the spike solution which renders the spike amount insignificant. Matrix spike recoveries do not impact the quality of the parent sample data for this analyte.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7020456

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Original Date Reported	02/17/2017
Report Reissued	02/23/2017
Date Received	02/07/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120466										02/07/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B120466										02/07/2017		CUS
Oxygen, Dissolved					SM 4500 O G							
	No QC Reported											
		0										
QC Batch: B120466										02/07/2017		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B120466										02/07/2017		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B120515										02/07/2017		LKE
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										
QC Batch: B120569										02/08/2017		MTA
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

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Third Rock Consultants
Steve Evans

Report Reissued 02/23/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B120724										02/10/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	98.2	90-110									
QC Batch: B120600										02/08/2017		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	0.0300		J1								
LCS	%	102	90-110									
QC Batch: B120600										02/08/2017		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.075		UJ								
LCS	%	97.0	90-110									
QC Batch: B120883										02/16/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	101	90-110									
MS	%	144	90-110	M3		7020456-02	2.97	2.50	6.58			
MSD	%	138	90-110	M3		7020456-02	2.97	2.50	6.41			
MS RPD	%	2.62	0-10	M3								
QC Batch: B120466										02/07/2017		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B120651										02/08/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	0.0173		J1								
LCS	%	99.7	90-110									

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Third Rock Consultants
Steve Evans

Report Reissued 02/23/2017
Date Received 02/07/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B121090										02/15/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.012		UJ								
LCS	%	95.6	90-110									
QC Batch: B120756										02/09/2017		JAR
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	98.0	85-105									
QC Batch: B120466										02/07/2017		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										

Qualifier Definitions

M3 Analyte in the parent sample for the Matrix Spike was >4x the concentration of the spike solution which renders the spike amount insignificant. Matrix spike recoveries do not impact the quality of the parent sample data for this analyte.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7031163

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	03/29/2017
Date Due	03/29/2017
Date Received	03/17/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B123439										03/17/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B123439										03/17/2017		CUS
Oxygen, Dissolved					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B123439										03/17/2017		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B123439										03/17/2017		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B123442										03/17/2017		BAS
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										
QC Batch: B123445										03/18/2017		DJR
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

7031163

Third Rock Consultants
Steve Evans

Date Due 03/29/2017
Date Received 03/17/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B123566										03/21/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ L1								
LCS	%	88.4	90-110	L1								
QC Batch: B123816										03/27/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ L1								
LCS	%	83.7	90-110	L1								
QC Batch: B123662										03/23/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	92.4	90-110									
QC Batch: B124108										03/29/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	90.4	90-110									
QC Batch: B123439										03/17/2017		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										

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QUALITY CONTROL DATA REPORT

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Third Rock Consultants
Steve Evans

Date Due 03/29/2017
Date Received 03/17/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B124081										03/28/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.010		UJ								
LCS	%	103	90-110									
QC Batch: B124082										03/28/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.010		UJ								
LCS	%	103	90-110									
MS	%	92.8	90-110			7031163-10	0.199	0.50	0.663			
MSD	%	95.1	90-110			7031163-10	0.199	0.50	0.675			
MS RPD	%	1.72	0-10									
QC Batch: B123583										03/21/2017		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	92.0	85-105									
QC Batch: B123439										03/17/2017		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B123359										03/18/2017		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	0.0300		J1								
LCS	%	97.3	90-110									
QC Batch: B123359										03/18/2017		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	<0.0070		UJ								
LCS	%	99.5	90-110									

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QUALITY CONTROL DATA REPORT

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Third Rock Consultants
Steve Evans

Date Due 03/29/2017
Date Received 03/17/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B123359										03/18/2017		LJC
Phosphate					EPA 300.0							
Blank	mg/L	<0.0080		UJ								
LCS	%	92.8	90-110									

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7041709

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	05/08/2017
Date Due	05/08/2017
Date Received	04/27/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B126503										04/27/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B126503										04/27/2017		CUS
Oxygen, Dissolved					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B126503										04/27/2017		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B126503										04/27/2017		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B126505										04/27/2017		BAS
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										
QC Batch: B126569										04/28/2017		DJR
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ								

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QUALITY CONTROL DATA REPORT

7041709

Third Rock Consultants
Steve Evans

Date Due 05/08/2017
Date Received 04/27/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B126761										05/03/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	90.4	90-110									
MS	%	98.9	90-110	R1		7041709-01	ND	2.50	2.47			
MSD	%	89.2	90-110	M2, R1		7041709-01	ND	2.50	2.23			
MS RPD	%	10.3	0-10	M2, R1								
QC Batch: B126691										05/03/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	92.4	90-110									
MS	%	92.8	90-110			7041709-01	0.455	2.50	2.78			
MSD	%	96.4	90-110			7041709-01	0.455	2.50	2.87			
MS RPD	%	3.23	0-10									
QC Batch: B127037										05/05/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	96.0	90-110									
MS	%	100	90-110			7041709-09	1.60	2.50	4.10			
MSD	%	104	90-110			7041709-09	1.60	2.50	4.19			
MS RPD	%	2.16	0-10									
QC Batch: B126503										04/27/2017		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B126606										04/28/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.017		UJ								
LCS	%	100	90-110									
MS	%	103	90-110			7041709-01	0.167	0.50	0.682			
MSD	%	103	90-110			7041709-01	0.167	0.50	0.683			
MS RPD	%	0.0586	0-10									

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QUALITY CONTROL DATA REPORT

7041709

Third Rock Consultants
Steve Evans

Date Due 05/08/2017
Date Received 04/27/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B126697										05/02/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.010		UJ								
LCS	%	101	90-110									
MS	%	93.9	90-110			7041709-02	0.239	0.50	0.708			
MSD	%	98.3	90-110			7041709-02	0.239	0.50	0.730			
MS RPD	%	3.06	0-10									
QC Batch: B127178										05/08/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.010		UJ								
LCS	%	98.9	90-110									
QC Batch: B126562										04/28/2017		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	95.0	85-105									
QC Batch: B126563										04/28/2017		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	100	85-105									
QC Batch: B126503										04/27/2017		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B126575										04/28/2017		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	<0.0051		UJ								
LCS	%	99.5	90-110									

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QUALITY CONTROL DATA REPORT

7041709

Third Rock Consultants
Steve Evans

Date Due 05/08/2017
Date Received 04/27/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B126575										04/28/2017		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	0.0310		J1								
LCS	%	98.1	90-110									

Qualifier Definitions

M2	Matrix spike recovery outside Control Limits due to sample matrix interference; biased low.
R1	Relative Percent Difference (RPD) of Matrix Spike Duplicates outside of Control Limit.

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7050152

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	05/03/2017
Date Due	05/11/2017
Date Received	05/02/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B126802										05/02/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B126806										05/02/2017		BAS
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7050408

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	05/13/2017
Date Due	05/16/2017
Date Received	05/04/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B127170										05/04/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B127170										05/04/2017		CUS
Oxygen, Dissolved					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B127170										05/04/2017		CUS
Specific Conductance					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B127170										05/04/2017		CUS
Turbidity					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B127169										05/04/2017		BAS
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										
QC Batch: B127212										05/05/2017		CJL
BOD, 5 Day					SM 5210 B							
Blank	mg/L	<2.0		UJ B1								

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QUALITY CONTROL DATA REPORT

7050408

Third Rock Consultants
Steve Evans

Date Due	05/16/2017
Date Received	05/04/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B127437										05/12/2017		EGD
Nitrogen, Ammonia					SM 4500 NH3 G							
Blank	mg/L	<0.22		UJ								
LCS	%	90.8	90-110									
MS	%	98.0	90-110			7050408-03	ND	2.50	2.45			
MSD	%	98.3	90-110			7050408-03	ND	2.50	2.46			
MS RPD	%	0.224	0-10									
QC Batch: B127317										05/11/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	101	90-110									
QC Batch: B127510										05/11/2017		EGD
Nitrogen, Total Kjeldahl					SM 4500 NH3 G							
Blank	mg/L	<0.40										
LCS	%	102	90-110									
MS	%	99.6	90-110			7050408-07	0.471	2.50	2.96			
MSD	%	95.3	90-110			7050408-07	0.471	2.50	2.86			
MS RPD	%	3.66	0-10									
QC Batch: B127170										05/04/2017		CUS
pH					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B127216										05/05/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.017		UJ								
LCS	%	99.9	90-110									
MS	%	104	90-110			7050408-04	0.193	0.50	0.712			
MSD	%	103	90-110			7050408-04	0.193	0.50	0.706			
MS RPD	%	0.945	0-10									

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QUALITY CONTROL DATA REPORT

7050408

Third Rock Consultants
Steve Evans

Date Due 05/16/2017
Date Received 05/04/2017

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B127180										05/08/2017		EGD
Phosphorus					EPA 365.1							
Blank	mg/L	<0.010		UJ								
LCS	%	99.5	90-110									
QC Batch: B127273										05/06/2017		CJL
Solids, Total Suspended					USGS I-3765-85							
Blank	mg/L	<1										
LCS	%	98.0	85-105									
QC Batch: B127170										05/04/2017		CUS
Temperature					CLIENT SPECIFIED							
	No QC Reported											
		0										
QC Batch: B127196										05/05/2017		LJC
Nitrogen, Nitrate					EPA 300.0							
Blank	mg/L	0.0270		J1								
LCS	%	97.4	90-110									
QC Batch: B127196										05/05/2017		LJC
Nitrogen, Nitrite					EPA 300.0							
Blank	mg/L	0.0340		J1								
LCS	%	99.2	90-110									

Qualifier Definitions

B1 The analyte value in the Method Blank is above the Control Limit.

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MICROBAC®

QUALITY CONTROL DATA REPORT

7050408

Third Rock Consultants
Steve Evans

Date Due	05/16/2017
Date Received	05/04/2017

KDOW Cane Run Watershed Project

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7050672

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	05/11/2017
Date Due	05/18/2017
Date Received	05/09/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B127463										05/09/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B127470										05/09/2017		DZW
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7051191

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	05/19/2017
Date Due	05/25/2017
Date Received	05/16/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B127967										05/16/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B127991										05/16/2017		BAS
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										

Qualifier Definitions

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Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7051396

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	05/19/2017
Date Due	05/30/2017
Date Received	05/18/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B128237										05/18/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B128238										05/18/2017		BAS
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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QUALITY CONTROL DATA REPORT

7051758

Third Rock Consultants
Steve Evans
2526 Regency Road, Suite 180
Lexington KY, 40503

Date Reported	05/25/2017
Date Due	06/05/2017
Date Received	05/24/2017
Customer #	E4530

KDOW Cane Run Watershed Project

Batch QC

Analysis	Units	Recovery/ RPD	Min-Max	Qualifier	Method Reference	Sample ID	Raw Sample	Raw Spike	Raw	Date	Time	Tech
QC Batch: B128609										05/24/2017		CUS
Flow by Measurement & Calc.					EPA 600							
	No QC Reported											
		0										
QC Batch: B128660										05/24/2017		DZW
E. coli					SM9223B (Colilert-18)							
Blank	MPN/100mL	<1.0										

Qualifier Definitions

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE: Lisa Martin

Lisa Martin, A.M.

David Lester, Managing Director

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KY16-004

CHAIN OF CUSTODY

COC#

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client - C. Blayd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	SA	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab/ Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	6-27-16	1204	G	Y*/N	1	1	1	1	~~1~~							
	2	SW	6-27-16	1235	G	Y*/N	1	1	1	1	~~1~~							
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	4	SW	6-27-16	1350	G	Y*/N	1	1	1	1	~~1~~							
	5	SW	6-27-16	1325	G	Y*/N	1	1	1	1	~~1~~							
	6	SW	6-27-16	1451	G	Y*/N	1	1	1	1	~~1~~							
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	8	SW	6-27-16	1105	G	Y*/N	1	1	1	1	1							
	9	SW	6-27-16	1533	G	Y*/N	1	1	1	1	~~1~~							
	~~10~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	DD	SW	6-27-16	******	G	Y*/N	1	1	1	1	~~1~~	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	6-28-16/0849	Megan Rothgruber	6-28-16 849

Temp. Upon Receipt (C): 2.2 °C Measured By: L-23
Containers Properly Preserved: ([✓ Yes]/ No)
Bottles Intact: ([✓ Yes]/ No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

KY16-004

MICROBAC®

CHAIN OF CUSTODY

www.microbac.com

3323 Gilmore Industrial Blvd.
Louisville, KY 40213
502.962.6400 p
502.962.6411 f

2520 Regency Rd.
Lexington, KY 40503
859.276.3506 p
859.278.5665 f

2701 N. Cullen Ave., Ste. A
Evansville, IN 47715
812.464.9000 p
812.424.0667 f

5309 Reidland Rd.
Paducah, KY 42003
270.898.3637 p
270.898.3666 f

100 Grand Vue Plaza, Ste. 22
Hazard, KY 41701
606.487.0511 p
606.910.0086 f

Client: Third Rock
Street Address:
City / State / Zip:
Phone: ( ) Fax: ( )
Email:
Attention: PO #:
Sampler: C. Boyd
Site / Project Name:

Due Date:

Analyses Requested

Date / Time	Sample ID / Description	Number of Containers	Type of Container Plastic, clear glass, vial, etc.	Preservative in Container None, HNO3, H2SO4, NaOH, etc.	Sample Matrix Soil, Sludge, Water, Oil, etc.	RUSH* (Fill-in desired TAT)	E. Coli
6-27/~~7:00~~ LM 6-27-16	DD	1	P	Sodthio	W		

Relinquished By:	Date: 6/27/16	Time: 700pm	
Received By:	Date: 6/27/16	Time: 1900	
Relinquished By:	Date: / /	Time:	
Received By:	Date: / /	Time:	
Relinquished By:	Date: / /	Time:	
Received By:	Date: / /	Time:	

Notes: No times on dups per protocol

To be filled out by Microbac
Temp. Upon Receipt (°C): 13.0 Thermometer ID: L10 No. Bottles Received: 1
Samples Received on Ice? Yes [✓ No] Custody Seals Intact? Yes No [✓ N/A]

Version 05.19.2015

*Standard RUSH TAT Charges: Same Day x3; Next Day x2; Three Day x1.5. Please contact us for RUSH request arrangements at 502.962.6400

Page 1 of 1

KY16-004

6061975 LISA MARTIN

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P.O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	SA	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P.O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	6-27-16	1209	G	Y*/N	1	1	1	1	1	9.1	120	7.91	573.7	28.4	1.5	3.34
	2	SW	6-27-16	1235	G	Y*/N	1	1	1	1	1	7.9	106.5	7.6	625.5	29.0	3.4	1.85
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	4	SW	6-27-16	1350	G	Y*/N	1	1	1	1	1	10.1	128.2	7.5	416.8	25.6	2.1	0.01
	5	SW	6-27-16	1325	G	Y*/N	1	1	1	1	1	15.6	203.4	8.4	596.4	27.3	0	1.43
	6	SW	6-27-16	1451	G	Y*/N	1	1	1	1	1	6.8	93.2	7.5	626	24	0.5	1.05
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	8	SW	6-27-16	1105	G	Y*/N	1	1	1	1	1							
	9	SW	6-27-16	1533	G	Y*/N	1	1	1	1	1	5.4	69.9	7.6	387.2	27.1	0	0.01
	~~10~~	SW			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~DD~~	~~SW~~		~~******~~	G	Y*/N	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							

- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	6-27-16/5:39pm	Lisa Martin	6-27-16 1739

Temp. Upon Receipt (C): 14.0 Measured By: LM
Containers Properly Preserved: [✓ Yes] / No) L10
Bottles Intact: [✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK
CONSULTANTS
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PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

Weather Event: ___Dry ___Wet

*** Preservative Code**
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	7/18/16	1000	G	Y*/N	1	1	1	1	1	6.4	80.1	7.9	623	25.7	0.0	1.4
	2	SW	7/18/16	1045	G	Y*/N	1	1	1	1	1	4.2	51.1	7.5	668	24.0	0.0	1.16
	3	SW	~~7/18/16~~	~~1110~~	G	Y*/N	1	1	1	1	1	NO FLOW						
	4	SW	7/18/16	1125	G	Y*/N	1	1	1	1	1	7.7	91.4	7.6	456	22.5	0.0	—
	5	SW	7/18/16	1150	G	Y*/N	1	1	1	1	1	8	97.9	7.7	657	23.9	0.0	0.35
	6	SW			G	Y*/N	1	1	1	1	1							
	7	SW			G	Y*/N	1	1	1	1	1							
	8	SW			G	Y*/N	1	1	1	1	1							
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW			G	Y*/N	1	1	1	1	1							
	DD	SW		******	G	Y*/N	1	1	1	1	1							

observed, Not detected <0.01 Steve 7/18-16

- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	7-18-16 / 1246		
	7-18-16 1246		

Temp. Upon Receipt (C): 5.2 Measured By: LM
Containers Properly Preserved: (Yes / No) LIO
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client - C. Blog
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days
EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

*** Preservative Code**
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

*** Preservation Type**	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Requested Lab Analysis / **# of Containers Per Analysis** / **On-Site/Field Measurements**

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	~~1~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~2~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~4~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~5~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	6	SW	7-18-16	1000	G	Y*/N	1	1	1	1	1	2.53	29.3	7.03	706	22.97	5.2	0.039
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	8	SW	7-18-16	1100	G	Y*/N	1	1	1	1	1	—	74.1	6.59	626	17.59	10.20	—
	9	SW	7-18-16	1200	G	Y*/N	1	1	1	1	1	3.28	40 0	7.27	406	23.91	5.57	0.01
	~~10~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~							
	DD	SW	7-18-16	******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	7-18-16 / 1355		7/18/16 1355

Temp. Upon Receipt (C): 14.1 **Measured By:** 10 SSD
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client - Chelsey Olson & James Storm
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: X Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	8-24	9:15	G	Y*/N	1	1	1	1	1	—	91.8	8.01	632	222	—	8.9
	2	SW	8-24	10:00	G	Y*/N	1	1	1	1	1	7.18	83.7	7.72	650.9	21.52	—	12.16
	3	SW	—	—	G	Y*/N	1	1	1	1	1	—	—	—	—	—	—	—
	4	SW	8-24	10:35	G	Y*/N	1	1	1	1	1	—	—	7.5	508.3	20.9	—	0.69
	5	SW	8-24	11:25	G	Y*/N	1	1	1	1	1	8.52	96.7	7.59	629.8	20.61	—	4.3
	6	SW	8-24	11:55	G	Y*/N	1	1	1	1	1	7.2	81.6	7.3	652	20.2	—	3.5
	7	SW			G	Y*/N	1	1	1	1	1							
	8	SW			G	Y*/N	1	1	1	1	1							
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW			G	Y*/N	1	1	1	1	1							
	11	SW			G	Y*/N	1	1	1	1	1							
	DD	SW	8-24	******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
Jim Storm	8/24/1:15		8/24/16 13:55

Temp. Upon Receipt (C): 8.4C Measured By:
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: [✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client - Bert Remley & Rain Storm
Methodology Required: 40CFR Part 136

THIRDROCK
CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: X Dry ___ Wet

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	On-Site/Field Measurements: Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	1	1	1	1	1							
	2	SW			G	Y*/N	1	1	1	1	1							
	3	SW			G	Y*/N	1	1	1	1	1							
	4	SW			G	Y*/N	1	1	1	1	1							
	5	SW			G	Y*/N	1	1	1	1	1							
	6	SW			G	Y*/N	1	1	1	1	1							
	7	SW	8/24/16	1120	G	Y*/N	1	1	1	1	1	6.4	—	7.5	628	22.5	—	0.05
	8	SW	8/24/16	1220	G	Y*/N	1	1	1	1	1	6.26	64.4	7.35	634	19.59	—	—
	9	SW	8/24/16	1040	G	Y*/N	1	1	1	1	1	3.8	—	7.5	432	21.7	—	0.12
	10	SW	8/24/16	0915	G	Y*/N	1	1	1	1	1	7.8	—	7.2	703	17.9	—	0.08
	11	SW	8/24/16	1000	G	Y*/N	1	1	1	1	1	7.3	—	7.6	688	20.9	—	0.24
	DD	SW		******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	8/24/ 13:35		8/24/16 13:35

Temp. Upon Receipt (C): 11.1 Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report)   COC Copy - TRC Project File   COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client - C. Olson, S. Evans
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: X Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
							# of Containers Per Analysis											
	1	SW	9/8/16	1020	G	Y*/N	1	1	1	1	1	6.66	82	7.61	640	24.34	4.3	1.9
	2	SW	9/8/16	1105	G	Y*/N	1	1	1	1	1	8.03	99	7.33	671	24.47	4.9	1.5
	3	SW	9/8/16	1135	G	Y*/N	1	1	1	1	1	7.95	92	7.57	522	20.97	5.7	<0.01
	4	SW	9/8/16	1200	G	Y*/N	1	1	1	1	1	6.9	81	7.3	590	22.1	2.7	<0.01
	5	SW	9/8/16	1220	G	Y*/N	1	1	1	1	1	10.31	126	7.63	659	23.93	2.5	0.5
	6	SW	9/8/16	1300	G	Y*/N	1	1	1	1	1	5.33	63	7.39	679	22.22	16	0.5
	7	SW			G	Y*/N	1	1	1	1	1							
	8	SW			G	Y*/N	1	1	1	1	1							
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW			G	Y*/N	1	1	1	1	1							
	11	SW			G	Y*/N	1	1	1	1	1							
	DD	SW	9/8/16	******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	9/8/2016 1426		9/8/2016 1426

Temp. Upon Receipt (C): 5.1 Measured By: JHL
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Marcia L. Wooton
Phone # : 859-977-2000
Collected By: Client - J. Storm, B. Remley
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
mwooton@thirdrockconsultants.com
Marcia L. Wooton
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: X Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	1	1	1	1	1							
	2	SW			G	Y*/N	1	1	1	1	1							
	3	SW			G	Y*/N	1	1	1	1	1							
	4	SW			G	Y*/N	1	1	1	1	1							
	5	SW			G	Y*/N	1	1	1	1	1							
	6	SW			G	Y*/N	1	1	1	1	1							
	7	SW	9/8	12:00	G	Y*/N	1	1	1	1	1	4.95	61.3	7.28	539.5	24.22	0.0	0.0
	8	SW	9/8	10:40	G	Y*/N	1	1	1	1	1	6.73	80.5	6.83	702.3	22.81	0.0	N/A
	9	SW	9/8	12:25	G	Y*/N	1	1	1	1	1	4.4	53.3	7.3	340	24.1	0.0	0.204
	10	SW	9/8	1:00	G	Y*/N	1	1	1	1	1	8.56	98	7.67	745.1	20.57	0.0	0.085
	11	SW	9/8	1:20	G	Y*/N	1	1	1	1	1	8.03	98.7	7.64	714.8	23.96	0.0	0.123
	DD	SW		******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	9/8/16 1418		9-8-16 1418

Temp. Upon Receipt (C): 5.4 Measured By: JM
Containers Properly Preserved: [✓ Yes] / No
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days
EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	10/25/16	9:35	G	Y*/N	1	1	1	1	1	9.06		7.81	634	11.10	2.7	1.53
	2	SW	"	10:15	G	Y*/N	1	1	1	1	1	8.45		7.75	704	10.27	7.5	1.12
	3	SW	———	———	G	Y*/N	1	1	1	1	1							
	4	SW	10/25/16	10:50	G	Y*/N	1	1	1	1	1	8.7		7.65	560	9.53	4.8	Observed not measured
	5	SW	↓	11:35	G	Y*/N	1	1	1	1	1	6.28		7.56	713	10.73	2.8	0.13
	6	SW	↓	11:50	G	Y*/N	1	1	1	1	1	6.23		7.44	727	12.38	2.4	0.43
	7	SW			G	Y*/N	1	1	1	1	1							
	8	SW			G	Y*/N	1	1	1	1	1							
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW			G	Y*/N	1	1	1	1	1							
	11	SW			G	Y*/N	1	1	1	1	1							
	DD	SW		******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	10-25-16/12:48		10-25-16 124

Temp. Upon Receipt (C): 5.6 Measured By: LM
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No) LD

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ✓ Dry ___ Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
						# of Containers Per Analysis												
	1	SW			G	Y*/N	1	1	1	1	1							
	2	SW			G	Y*/N	1	1	1	1	1							
	3	SW			G	Y*/N	1	1	1	1	1							
	4	SW			G	Y*/N	1	1	1	1	1							
	5	SW			G	Y*/N	1	1	1	1	1							
	6	SW			G	Y*/N	1	1	1	1	1							
	7	SW	10/25	10:30	G	Y*/N	1	1	1	1	1	4.3	38.6	7.5	610	9.4	0.2	<0.01
	8	SW	10/25	11:05	G	Y*/N	1	1	1	1	1	7.8	80.5	7.4	705	16.1	4.5	NA
	9	SW			G	Y*/N	1	1	1	1	1							
	10	SW	10/25	8:35	G	Y*/N	1	1	1	1	1	6.9	65.7	7.5	765	12.2	2.6	0.05
	11	SW	10/25	9:15	G	Y*/N	1	1	1	1	1	6.9	65.3	7.6	741	11.8	0	0.cc
	DD	SW	10/25	******	G	Y*/N	1	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	10/25/16 1 P		10/25/16 1319

Temp. Upon Receipt (C): 6.2 Measured By: LM
Containers Properly Preserved: ([✓ Yes] / No) LIO
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - CB, BR
Methodology Required: 40CFR Part 136

THIRDROCK
CONSULTANTS
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PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	**Sample I.D.**	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	2	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	3	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	4	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	5	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	6	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	7	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	8	SW	11-30-16	1120	G	Y*/N	2	1	1	1	1	6.4	67.8	7.3	720	16.1	0.0	—
	9	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	10	SW	11-30-16	0920	G	Y*/N	2	1	1	1	1	6.7	71.5	7.3	587	16.1	2.2	1.12
	11	SW	11-30-16	1000	G	Y*/N	2	1	1	1	1	5.4	54.5	7.4	711	14.0	9.6	0.62
	DD	SW	11-30-16	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	11-30-16/1320		11-30-16/1320

Temp. Upon Receipt (C): 4.8 **Measured By:**______
Containers Properly Preserved: ([✓ Yes] / No) L3
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - JS, CO
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P
Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli

On-Site/Field Measurements

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	11-30-16	9:40	G	Y*/N	2	1	1	1	1	9.18	-	7.83	644	11.52	3.6	3.04
	2	SW	11-30-16	10:06	G	Y*/N	2	1	1	1	1	8.95	-	7.72	665	12.40	2.7	1.92
	3	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	4	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	5	SW	11-30-16	11:00	G	Y*/N	2	1	1	1	1	6.19	-	7.53	662	12.46	1.7	0.55
	6	SW	11-30-16	11:20	G	Y*/N	2	1	1	1	1	5.94	-	7.36	657	13.19	1.9	1.05
	7	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	8	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	9	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	10	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	11	SW	—	—	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	DD	SW	—	******	G	Y*/N	2	1	1	1	1	~~See Field Notebook~~						

Relinquished By:	Date / Time	Received By:	Date / Time
	11-30-16 / 1313	~~1313~~	11-30-16 / 1313
	11-30-16/1320		11-30-16 1320

Temp. Upon Receipt (C): 4.8 Measured By: LLM
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: [✓ Yes] / No)
L3

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client - CB, BR
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
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PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P							
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	# of Containers Per Analysis																	
	~~1~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~2~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~4~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~5~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~6~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	7	SW	12-15-16	1140	G	Y*/N	2	1	1	1	1	12.19	95.8	7.60	617	4.55	2.5	0.01
	8	SW	12-15-16	1215	G	Y*/N	2	1	1	1	1	6.8	66.9	7.6	413	13.7	26	—
	9	SW	12-15-16	1056	G	Y*/N	2	1	1	1	1	18.09	112.6	8.01	482	2.60	8.0	0.01
	10	SW	12-15-16	0930	G	Y*/N	2	1	1	1	1	10.8	—	7.9	713	6.2	1.6	0.087
	11	SW	12-15-16	1003	G	Y*/N	2	1	1	1	1	11.5	—	7.8	669	3.5	2.4	0.53
	DD	SW	12-15-16	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
CB	12-15-16 / 1415	Lisa Martin	12-15-16 1415
~~Lisa Martin~~	~~12-15-16 1415~~ LM 12-15-16		

Temp. Upon Receipt (C): 8.7 Measured By: L3
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC# **CHAIN OF CUSTODY**

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
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PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

							* Preservation Type					On-Site/Field Measurements						
							-	-	SA	-	ST							
							Container Size/Type											
							32oz P	50 mL P	32oz P	8oz P	4oz P							
							Requested Lab Analysis											
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	**Sample I.D.**	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW	12/15	9:30	G	Y*/N	2	1	1	1	1	10.69	76.1	7.35	638.4	0.8	15.3	3.3
	2	SW	12/15	10:20	G	Y*/N	2	1	1	1	1	10.56	75.4	7.31	691.7	0.86	14.6	2.07
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW	12/15	11:00	G	Y*/N	2	1	1	1	1	9.6	70.2	6.83	687.1	1.65	5.9	0.91
	6	SW	15/15	11:30	G	Y*/N	2	1	1	1	1	8.67	65.7	7.08	693.9	3.07	22.8	0.82
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	12/15/16 12:45		12/15/16 @ 12:45

Temp. Upon Receipt (C): -0.5 Measured By: RW
Containers Properly Preserved: [✓ Yes] / No) 63
Bottles Intact: [✓ Yes] / No)

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Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - CB, BR
Methodology Required: 40CFR Part 136

THIRDROCK
CONSULTANTS
MICROBAC

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cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
							# of Containers Per Analysis					On-Site/Field Measurements						
	~~1~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~2~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~3~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~4~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~5~~	~~SW~~			G	Y*/N	2	1	~~1~~	~~1~~	~~1~~							
	~~6~~	~~SW~~			~~G~~	Y*/N	2	1	1	1	1							
	7	SW	1-30-17	1145	G	Y*/N	2	1	1	1	1	10.5	89.4	7.7	498	7.0	8.0	0.17
	8	SW	1-30-17	1220	G	Y*/N	2	1	1	1	1	5.3	43.6	7.5	511	9.6	10.6	—
	9	SW	1-30-17	1055	G	Y*/N	2	1	1	1	1	10.0	82.1	7.8	390	5.4	11.5	9.00
	10	SW	1-30-17	0935	G	Y*/N	2	1	1	1	1	10.2	90.5	7.5	752	8.6	7.3	2.41
	11	SW	1-30-17	1015	G	Y*/N	2	1	1	1	1	9.8	81.8	7.5	693	6.1	10.8	1.09
	DD	SW	1-30-17	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	1-30-17/1337		1-30-17 1337

Temp. Upon Receipt (C): 4.7 Measured By: LB
Containers Properly Preserved: [✓ Yes] / No
Bottles Intact: [✓ Yes] / No

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	1/30/17	9:50	G	Y*/N	2	1	1	1	1	23.38	—	8.32	511	4.41	2.4	14.07
	2	SW	1/30/17	10:55	G	Y*/N	2	1	1	1	1	23.52	—	7.98	544	5.62	6.0	12.25
	3	SW	1/30/17	10:30	G	Y*/N	2	1	1	1	1	11.48	—	7.71	420	6.96	4.6	0.74
	4	SW	1/30/17	11:30	G	Y*/N	2	1	1	1	1	11.40	—	7.81	445	8.54	3.5	0.36
	5	SW	1/30/17	12:00	G	Y*/N	2	1	1	1	1	22.66	—	7.95	529	6.94	3.0	19.53
	6	SW	1/30/17	12:15	G	Y*/N	2	1	1	1	1	14.86	—	7.85	538	7.53	3.4	19.94
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~8~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~9~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~10~~	~~SW~~			~~G~~	~~Y*/N~~	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	~~11~~	~~SW~~			G	Y*/N	2	1	1	1	1							
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	1/30/17 2:10		1/30/17 14:10

Temp. Upon Receipt (C): 4.4 Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	2-7-17	1106	G	Y*/N	2	1	1	1	1	11.3	91.9	7.9	481	11.8	11.0	0.19
	8	SW	2-7-17	1145	G	Y*/N	2	1	1	1	1	7.2	68.7	7.6	628	11.7	8.0	N/A
	9	SW	2-7-17	1033	G	Y*/N	2	1	1	1	1	11.2	91.5	8.1	405	9.7	5.2	4.1
	10	SW	2-7-17	0920	G	Y*/N	2	1	1	1	1	9.3	86.5	7.8	1480	11.7	150	12.2
	11	SW	2-7-17	1002	G	Y*/N	2	1	1	1	1	9.1	84.1	7.7	721	11.6	6.9	0.73
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	2-7-17 0150		2-7-17 1350

Temp. Upon Receipt (C): 4.8°C L3 Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -

Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
! - Ice (All)

							Requested Lab Analysis					On-Site/Field Measurements						
						* Preservation Type	-	-	SA	-	ST							
						Container Size/Type	32oz P	50 mL P	~~32oz~~ 8 oz P	8oz P	4oz P							
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
							# of Containers Per Analysis											
	1	SW	2/7/10	840	G	Y*/N	2	1	1	1	1	9.09	83.0	7.85	371.1	10.10	-	7.58
	2	SW		920	G	Y*/N	2	1	1	1	1	8.54	81.4	7.87	540.5	11.4	-	5.45
	3	SW		900	G	Y*/N	2	1	1	1	1	8.67	81.0	7.67	410.4	11.35	-	0.3
	4	SW		1020	G	Y*/N	2	1	1	1	1	8.37	79.1	7.73	399.3	11.65	-	0.14
	5	SW		1040	G	Y*/N	2	1	1	1	1	8.55	81.1	7.85	505.5	11.77	-	4.35
	6	SW		1105	G	Y*/N	2	1	1	1	1	8.3	78.7	7.68	487.0	11.78	-	4.87
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW	2/7/17	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	2/7/17 / 11:51		2/7/17 11:51

Temp. Upon Receipt (C): 2.5° Measured By:
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: [✓ Yes] / No)
L3

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK
CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	~~3~~2oz P 8CB	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	3/17	210	G	Y*/N	2	1	1	1	1	11.65	94.5	7.51	495.0	5.43	-	7.06
	2	SW	↓	-	G	Y*/N	2	1	1	1	1	—	—	—	—	—	—	—
	3	SW	↓	230	G	Y*/N	2	1	1	1	1	11.33	96.8	7.98	519.8	7.41	-	4.25
	4	SW	↓	300	G	Y*/N	2	1	1	1	1	9.42	83.2	7.39	392.1	8.97	-	
	5	SW	↓	320	G	Y*/N	2	1	1	1	1	11.83	101.4	8.06	507.6	7.67	-	
	6	SW	↓	340	G	Y*/N	2	1	1	1	1	11.72	100.8	7.99	522.9	7.81	-	
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	3/17/17 1710	Lisa Martin	3-17-17 1710

Temp. Upon Receipt (C): 4.6 **Measured By:** Lm
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No) Lio

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

							* Preservation Type					On-Site/Field Measurements						
							-	-	SA	-	ST							
							Container Size/Type											
							32oz P	50 mL P	32oz P	8oz P	4oz P							
							Requested Lab Analysis											
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	**Sample I.D.**	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	3/17/17	3:45	G	Y*/N	2	1	1	1	1	15.1	126.3	8.1	436	7.42	3.1	0.43
	8	SW			G	Y*/N	2	1	1	1	1	8.28	68.2	7.52	578	10.7	19	
	9	SW		3:12	G	Y*/N	2	1	1	1	1	14.9	125.6	8.8	332	6.98	5.6	5.6
	10	SW		1:50	G	Y*/N	2	1	1	1	1	11.3	103.6	8.1	648	10.4	1.9	.196
	11	SW	✓	2:30	G	Y*/N	2	1	1	1	1	11.4	99.1	7.89	683	8.2	2.1	.445
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	3-17-17 430		3/17/17 4:30
	3/17/17 1710		3-17-17 1710

Temp. Upon Receipt (C): 4.6 **Measured By:** LM
Containers Properly Preserved: (Yes / No) LIO
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P° (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	~~32oz~~ 8 CB P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P°	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW	4-27-17	10:50	G	Y*/N	2	1	1	1	1	9.52	111.5	7.84	4652	20.15	4.2	5.42
	2	SW	4-27-17	11:55	G	Y*/N	2	1	1	1	1	12.85	147.8	7.75	524.9	20.04	2.5	3.09
	3	SW	4-27-17	11:45	G	Y*/N	2	1	1	1	1	10.4	113.0	7.35	3859	17.2	3.1	—
	4	SW	4-27-17	12:30	G	Y*/N	2	1	1	1	1	11.91	133.5	7.94	368.5	18.44	3.3	—
	5	SW	4-27-17	12:50	G	Y*/N	2	1	1	1	1	13.16	154.7	8.13	518.5	20.34	2.2	5.31
	6	SW	4-27-17	1:20	G	Y*/N	2	1	1	1	1	12.83	145.8	8.10	547.6	19.11	2.3	1.68
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	4/27/17/1:48		4-27-17 1349

Temp. Upon Receipt (C): 4.6 Measured By: JHR
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

30B

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - C. Bloyd , S. Evans
Methodology Required: 40CFR Part 136

THIRDROCK
CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

Weather Event: ___Dry ___Wet

Requested Lab Analysis	CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli
* Preservation Type	-	-	SA	-	ST
Container Size/Type	32oz P	50 mL P	32oz P	8oz P	4oz P

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
	1	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	2	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	3	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	4	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	5	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	6	SW			G	Y*/N	~~2~~	~~1~~	~~1~~	~~1~~	~~1~~							
	7	SW	4-27-17	1320	G	Y*/N	2	1	1	1	1	15.11	192.7	8.41	365	22.52	10.8	<0.01
	8	SW	4-27-17	1230	G	Y*/N	2	1	1	1	1	6.80	73.9	7.21	553	20.13	1.1	—
	9	SW	4-27-17	1145	G	Y*/N	2	1	1	1	1	9.66	110.1	8.38	250	19.62	3.5	1.18
	10	SW	4-27-17	1035	G	Y*/N	2	1	1	1	1	8.01	87.3	7.57	655	17.25	0	<0.01
	11	SW	4-27-17	1100	G	Y*/N	2	1	1	1	1	8.14	88.9	7.61	711	17.22	0	0.23
	DD	SW	4-27-17	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	4/27/17 1410		4-27-17 1410

Temp. Upon Receipt (C): 10.6 Measured By: JHR
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) **COC Copy - TRC Project File** **COC Copy - TRC Laboratory Services Coordinator**

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - C. Bloyd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days
EDD Required: X Yes _ No

* Preservation Type: ST
Container Size/Type: 4oz P

Field Remarks:

Weather Event: ✓ Dry ___Wet

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW	5-2-17	1030	G	Y*/N	1	19.23
	2	SW	5-2-17	1115	G	Y*/N	1	14.09
	3	SW	5-2-17	1100	G	Y*/N	1	0.05
	4	SW	5-2-17	1155	G	Y*/N	1	70.01
	5	SW	5-2-17	1200	G	Y*/N	1	9.54
	6	SW	5-2-17	1225	G	Y*/N	1	9.78
	~~7~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~8~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~9~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~10~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~11~~	~~SW~~			~~G~~	~~Y*/N~~	~~1~~	
	~~DD~~	~~SW~~		~~******~~	~~G~~	~~Y*/N~~	~~1~~	~~See Field Notebook~~

Relinquished By:	Date / Time	Received By:	Date / Time
	5-2-17 / 1318		5/2/17 @ 1318

Temp. Upon Receipt (C): 7.3° Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)
LIO

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

* Preservation Type: ST
Container Size/Type: 4oz P
Requested Lab Analysis: E-Coli

Field Remarks:
Weather Event: ___Dry ___Wet
On-Site/Field Measurements

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW			G	Y*/N	1	
	2	SW			G	Y*/N	1	
	3	SW			G	Y*/N	1	
	4	SW			G	Y*/N	1	
	5	SW			G	Y*/N	1	
	6	SW			G	Y*/N	1	
	7	SW	5-2-17	1145	G	Y*/N	1	0.656
	8	SW	5-2-17	1224	G	Y*/N	1	N/A
	9	SW	5-2-17	1110	G	Y*/N	1	2.585
	10	SW	5-2-17	0950	G	Y*/N	1	5.61
	11	SW	5-2-17	10[illegible]20	G	Y*/N	1	~~5.61~~ 1.724
	DD	SW	5-2-17	******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5-2-17 109	Lisa Martin	5-2-17 1309

Temp. Upon Receipt (C): 4.4 Measured By: L-10
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days   EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							* Preservation Type					On-Site/Field Measurements						
							-	-	SA	-	ST							
							Container Size/Type											
							32oz P	50 mL P	32oz P	8oz P	4oz P							
							Requested Lab Analysis											
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (° C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW	5/4/17	6:45	G	Y*/N	2	1	1	1	1	94.9	8.82	8.34	471.3	16.92	10.6	8.34
	2	SW	5/4/17	8:15	G	Y*/N	2	1	1	1	1	82.6	7.74	7.88	520.6	16.31	15.9	8.1
	3	SW	5/4/17	8:10	G	Y*/N	2	1	1	1	1	67.7	6.57	7.69	399.0	14.88	0.1	–
	4	SW	5/4/17	6:20	G	Y*/N	2	1	1	1	1	94.0	9.0	7.48	360.5	15.51	0.0	–
	5	SW	5/4/17	7:40	G	Y*/N	2	1	1	1	1	71.5	6.91	7.64	516.1	15.09	1.5	4.62
	6	SW	5/4/17	7:15	G	Y*/N	2	1	1	1	1	71.7	6.93	7.52	88.5	15.11	1.8	5.65
	7	SW			G	Y*/N	2	1	1	1	1							
	8	SW			G	Y*/N	2	1	1	1	1							
	9	SW			G	Y*/N	2	1	1	1	1							
	10	SW			G	Y*/N	2	1	1	1	1							
	11	SW			G	Y*/N	2	1	1	1	1							
	DD	SW	5/4/17	******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	5-4-17 / 9:50		5-4-17 9:50

Temp. Upon Receipt (C): 6.0 Measured By:
Containers Properly Preserved: [✓ Yes] / No)
Bottles Intact: [✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report)   COC Copy - TRC Project File   COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:
Report to MDLs for NH3, NO2, NO3, CBOD5.
TSS RL of 1.5,
OP and PT RL of 0.05.
******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
SA - H2SO4
ST - Na2S2O3
I - Ice (All)

							* Preservation Type					On-Site/Field Measurements						
							-	-	SA	-	ST							
							Container Size/Type											
							32oz P	50 mL P	32oz P	8oz P	4oz P							
							Requested Lab Analysis											
							CBOD5, TSS	NO2, NO3	PT, TKN, NH3	P O (* Field Filtered)	E-Coli	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (S.U.)	Specific Conductance (umho/cm)	Temperature (°C)	Turbidity (N.T.U.)	Flow (cfs)
Laboratory #	**Sample I.D.**	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis											
	1	SW			G	Y*/N	2	1	1	1	1							
	2	SW			G	Y*/N	2	1	1	1	1							
	3	SW			G	Y*/N	2	1	1	1	1							
	4	SW			G	Y*/N	2	1	1	1	1							
	5	SW			G	Y*/N	2	1	1	1	1							
	6	SW			G	Y*/N	2	1	1	1	1							
	7	SW	5-4-17	7:00pm	G	Y*/N	2	1	1	1	1	10.3	107.4	7.3	429	15.2	3.0	0.37
	8	SW	5-4-17	6:30pm	G	Y*/N	2	1	1	1	1	7.5	79.5	7.0	546	16.0	15.0	N/A
	9	SW	5-4-17	7:40pm	G	Y*/N	2	1	1	1	1	4.6	49.9	7.5	294	17.1	3.1	1.88
	10	SW	5-4-17	8:20pm	G	Y*/N	2	1	1	1	1	8.0	83.4	7.6	467	15.2	37.0	3.80
	11	SW	5-4-17	8:50pm	G	Y*/N	2	1	1	1	1	7.1	75.2	7.6	571	15.9	3.4	0.57
	DD	SW		******	G	Y*/N	2	1	1	1	1	- See Field Notebook -						

Relinquished By:	Date / Time	Received By:	Date / Time
	5-4-17/9:50		5-4-17 9:50

Temp. Upon Receipt (C): 6.0°C 6.0 Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client - C. Bloyd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis: E-Coli	Flow (cfs)
	1	SW	5-9-17	1350	G	Y*/N	1	9.84
	2	SW	" "	1310	G	Y*/N	1	8.52
	3	SW		1335	G	Y*/N	1	70.01
	4	SW		1245	G	Y*/N	1	0.06
	5	SW		1200	G	Y*/N	1	5.71
	6	SW		1145	G	Y*/N	1	4.78
	7	SW		1120	G	Y*/N	1	0.12
	8	SW		1100	G	Y*/N	1	—
	9	SW		1025	G	Y*/N	1	1.25
	10	SW		0930	G	Y*/N	1	0.67
	11	SW		0955	G	Y*/N	1	0.42
	DD	SW	" "	******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5-9-17/1500		5-9-17 1500

Temp. Upon Receipt (C): 2.6 Measured By: JHR LIO
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

***** **Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW	5/16/17	1345	G	Y* [✓ N]	1	14.2
	2	SW		1330	G	Y* [✓ N]	1	10.9
	3	SW		1320	G	Y* [✓ N]	1	<0.01
	4	SW		1305	G	Y* [✓ N]	1	<0.01
	5	SW		1245	G	Y* [✓ N]	1	4.9
	6	SW		1215	G	Y* [✓ N]	1	3.5
	7	SW		1150	G	Y* [✓ N]	1	0.27
	8	SW		1130	G	Y* [✓ N]	1	—
	9	SW		1100	G	Y* [✓ N]	1	1.83
	10	SW		1000	G	Y* [✓ N]	1	1.49
	11	SW		1025	G	Y* [✓ N]	1	1.25
	DD	SW		******	G	Y* [✓ N]	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5/16/17 15:10		5.16.17 15:10

Temp. Upon Receipt (C): 2.0 Measured By: JhR
Containers Properly Preserved: (Yes / No)
Bottles Intact: (Yes / No)

(24) L24

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project #: KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone #: 859-977-2000
Collected By: Client - C. Bloyd
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

******* Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW	5-18-17	1440	G	Y*/N	1	8.68
	2	SW	" "	1416	G	Y*/N	1	6.03
	3	SW		1400	G	Y*/N	1	<0.01
	4	SW		1350	G	Y*/N	1	<0.01
	5	SW		1330	G	Y*/N	1	3.33
	6	SW		1305	G	Y*/N	1	3.34
	7	SW		1245	G	Y*/N	1	0.07
	8	SW		1220	G	Y*/N	1	—
	9	SW		1145	G	Y*/N	1	0.36
	10	SW		1030	G	Y*/N	1	0.13
	11	SW		1100	G	Y*/N	1	0.27
	DD	SW	" "	******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5-18-17 / 1555		5/18/17 1545

Temp. Upon Receipt (C): 3.4°C Measured By:
LIO
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

COC#

CHAIN OF CUSTODY

Client: Third Rock Consultants, LLC
Project Name: Cane Run Watershed Based Plan
Project # : KY16-004
Project Contact (for laboratory): Cory Bloyd
Phone # : 859-977-2000
Collected By: Client -
Methodology Required: 40CFR Part 136

THIRDROCK CONSULTANTS
MICROBAC

PDF Analytical Report & Invoice To:
cbloyd@thirdrockconsultants.com
Cory Bloyd
Third Rock Consultants, LLC
2526 Regency Road
Suite 180
Lexington, KY 40503
859-977-2000

Turnaround Time Required: 7 Working Days

EDD Required: X Yes _ No

* Preservation Type: ST

Container Size/Type: 4oz P

Field Remarks:

Weather Event: ___Dry ___Wet

Comments:

NOTE:

***** **Assume duplicate sampled at earliest time for hold purposes.**

* Preservative Code
ST - Na2S2O3
I - Ice (All)

Requested Lab Analysis: E-Coli

On-Site/Field Measurements: Flow (cfs)

Laboratory #	Sample I.D.	Matrix *	Collection Date	Collection Time	Grab / Comp	Filt'd Y/N	# of Containers Per Analysis (E-Coli)	Flow (cfs)
	1	SW	5/24	1015	G	Y*/N	1	5.92
	2	SW		1045	G	Y*/N	1	5.10
	3	SW		1040	G	Y*/N	1	<0.01
	4	SW		1120	G	Y*/N	1	<0.01
	5	SW		1130	G	Y*/N	1	2.03
	6	SW		1150	G	Y*/N	1	0.85
	7	SW		1215	G	Y*/N	1	<0.01
	8	SW		950	G	Y*/N	1	—
	9	SW		1245	G	Y*/N	1	4.29
	10	SW		1345	G	Y*/N	1	USGS
	11	SW		1315	G	Y*/N	1	5.24
	DD	SW		******	G	Y*/N	1	- See Field Notebook -

Relinquished By:	Date / Time	Received By:	Date / Time
	5/24/17 1403		5/24/17 @ 1403

Temp. Upon Receipt (C): 2-5°C Measured By:
Containers Properly Preserved: ([✓ Yes] / No)
Bottles Intact: ([✓ Yes] / No)

Original COC To Laboratory (Accompany Samples & Report) COC Copy - TRC Project File COC Copy - TRC Laboratory Services Coordinator

CALIBRATION LOG

Meter Name: Replacement MS 5 w/ turb **Serial #:** 151200066822

Date	Initials	LDO			pH (SU)							Conductivity (uS/cm)		Turbidity (NTU)		Notes
		BP (mmHg)	mg/L Before Calibration	mg/L After Calibration	pH 4 Reading	pH 4 Lot #	pH 7 Reading	pH 7 Lot #	pH 10 Reading	pH 10 Lot #	pH Standard Check	Conductivity Calibration Standard	Conductivity Lot #	1st Pt Calibration Standard	2nd pt Calibration Standard	
18-16	CB	736	—	—	—	—	7.00	144119	10.00	A5197	4.19	447	SP1	0.5		New sonde. ~~Calibrated at Hach~~ ~~Load~~ Charged unit
3-7-16	CR	742	—	—	—	—	7.00(7.42)	A5197	10.00(9.70)	144117	3.85	447(456)	TQ1	0.5(0.0)	100(98.1)	✓ IBU-7.5
4-15-16	CB	742	9.28	9.03	4.00(3.85)	144119	7.00(6.90)	A5197	—	—	9.55	447(443)	SP1	0.5(3.1)	100(101)	✓ IBU-7.4
5-4-16	CB	730	8.78	8.64	—	—	7.00(6.96)	A5197	10.00(9.89)	A6099	3.99	447(453)	TQ1	0.5(2.0)	100(101)	✓ IBU-7.3
6-16-16	BR	734	8.52	8.01	—	—	7.0(7.3)	A5197	10.0(9.9)	A6099	3.71	447(470)	TQ1	0.5(0.0)	100(99)	✓ IBU-7.0
6-17-16	BR	736	8.20	8.12	—	—	7.0(6.9)	A5197	10.0(10.05)	A6099	3.8	447(444)	TQ1	0.5(2.1)	100(101)	✓ IBU 6.9
6-27-16	CB	739	8.26	8.30	—	—	7.0(6.95)	" "	10.00(10.04)	" "	3.88	447(439)	TQ1	0.5(1.3)	100( )	✓-switch Surveyor with New MS5

CALIBRATION LOG

Meter Name: Replacement MS 5 w/ turb **Serial #:** 151200066822

Date	Initials	LDO			pH (SU)							Conductivity (uS/cm)		Turbidity (NTU)		Notes
		BP (mmHg)	mg/L Before Calibration	mg/L After Calibration	pH 4 Reading	pH 4 Lot #	pH 7 Reading	pH 7 Lot #	pH 10 Reading	pH 10 Lot #	pH Standard Check	Conductivity Calibration Standard	Conductivity Lot #	1st Pt Calibration Standard	2nd pt Calibration Standard	
1-8-16	CB	736	—	—	—	—	7.00	144119	10.00	A5197	4.19	447	SP1	0.5		New sonde - ~~Calibrated at Hack~~ ~~Load~~ Charged unit
3-7-16	CR	742	—	—	—	—	7.00(7.42)	A5197	10.00(9.70)	144117	3.85	447(454)	TQ1	0.5(0.0)	100(98.1)	✓ IBU-7.5
4-15-16	CB	742	9.28	9.03	4.00(3.85)	144119	7.00(6.90)	A5197	—	—	4.55	447(443)	SP1	0.5(3.1)	100(101)	✓ IBU-7.4
5-4-16	CB	730	8.78	8.64	—	—	7.00(6.96)	A5197	10.00(9.89)	A6099	3.99	447(453)	TQ1	0.5(0.0)	100(101)	✓ IBU-7.3
6-16-16	BK	734	8.52	8.01	—	—	7.0(7.3)	A5197	10.0(9.9)	A6099	3.71	447(470)	TQ1	0.5(0.0)	100(99)	✓ IBU-7.0
6-17-16	BK	736	8.20	8.12	—	—	7.0(6.9)	A5197	10.0(10.05)	A6099	3.8	447(441)	TQ1	0.5(3.1)	100(101)	✓ IBU 6.9
6-27-16	CB	739	8.26	8.30	—	—	7.0(6.95)	" "	10.00(10.04)	" "	3.88	447(439)	TQ1	0.5(1.3)	100( )	✓-switch Surveyor with New MS5
7-11-16	CB	740	8.22	8.28	—	—	7.00(7.01)	" "	10.00(10.09)	" "	3.90	447(459)	TQ1	0.5(0.5)	100(98.6)	✓ IBU-7.6
7-18-16	CB	743	8.42	8.57	—	—	7.00(7.01)	" "	10.00(10.01)	" "	3.77	447(445)	" "	0.5(0)	100([illegible])	✓ IBU-7.5

CALIBRATION LOG

Meter Name: New MS 5 **Serial #:** New MS5 Unit Serial # 110800062023

		LDO			pH (SU)							Conductivity (uS/cm)		Turbidity (NTU)		
Date	Initials	BP (mmHg)	mg/L Before Calibration	mg/L After Calibration	pH 4 Reading	pH 4 Lot #	pH 7 Reading	pH 7 Lot #	pH 10 Reading	pH 10 Lot #	pH Standard Check	Conductivity Calibration Standard	Conductivity Lot #	~~1st Pt Calibration Standard~~	~~2nd pt Calibration Standard~~	Notes
✓ 9-10-14	CB	737	8.38	8.38	—	—	7.00(7.06)	QT1	10.00(10.10)	QU1	3.97	447(454)	RU1	—	—	IBV-7.0 ✓
9-29-14	CR	734			—	—	7.00 (7.10)	QT1	10.00(10.10)	QU1	3.97	447(455)	RU1	—	—	IBV-6.9-changed sensor, New pH ref solution
11-3-14	CB	744	8.99	8.58	—	—	7.00 (6.99)	13455	10.00(10.01)	QU1	4.00	447(538)	RU1	—	—	IBV-7.5 ✓
1-14-15	CB	766					7.00(6.92)	143679	10.00(9.99)	141957	4.05	447✓	ST2	—	—	IBV-7.2 ✓
3-13-15	CB	744					7.00 (7.32)	143679	10.00(10.01)	141957	3.98	447(440)	SP1	—	—	IBV-7.0 ✓-changed Sensor
4-30-15	CR	733		8.25	—	—	7.00 (7.13)	143679	10.00(10.02)	144117	4.03	447 (448)	SP1	—	—	IBV-7.3 ✓
6-8-15	CR	735	8.48	8.41	—	—	7.00(7.03)	" "	10.00(10.06)	" "	4.04	447 (451)	ST2	—	—	✓IBV-7.1
8-10-15	CR	735	8.52	8.51	—	—	7.00 (7.10)	143679	10.00 (10.10)	144117	4.04	447(449)	SP1	—	—	✓ IBV-7.4
9-9-15	CR	731	8.08	8.07	—	—	7.00(7.19)	143679	10.00(10.02)	144117	4.01	447✓	ST2	—	—	✓ IBV-7.5
10-7-15	CR	741	8.08	8.11	—	—	7.00(7.13)	" "	10.00(10.01)	" "	4.00	447 (448)	ST2	—	—	✓ IBV-7.4
12-14-15	CB	728	8.81	8.75	—	—	7.00(6.95)	143679	10.00 (9.95)	144117	4.04	447 (442)	SP1	—	—	✓ IBV-7.0 new ph solution
1-8-16	CB	736	8.77	8.78			7.00 (6.75)	A5197	10.00(10.[illegible])	" "	4.05	447(450)	SP1	—	—	✓ - changed unit
3-7-16	CR	742	9.45	9.26			7.00(7.0[illegible])	A5197	10.00 (10.14)	144117	4.19	447✓	—	—	—	✓-IBV-7.1 replaced LDO cap off old MS
4-15-16	CB	742	8.96	8.98	4.00 (4.20)	149119	7.00 (7.20)	A5197	—	—	4.17	447(445)	SP1	—	—	✓ -IBV 7.0
5-4-16	CR	730	8.62	8.61	—	—	7.00 (7.21)	A5197	10.00(9.98)	A1009	4.04	447 (451)	TQ1	—	—	✓ - IBV 6.9 - changed Sensor
5-20-16	CR				—	—	~~7.00(7.20)~~	~~5197~~	~~10.00(10.0[illegible])~~	~~[illegible]~~	~~4.0[illegible]~~	~~447([illegible])~~	~~SP1~~	—	—	new internal batteries
7-11-16	CR	740			—	—	7.00(7.12)	A5197	10.00(9.98)	A6069	4.07	447 (451)	TQ1	—	—	✓ IBV-7.3
7-18-16	CR	743	8.63	8.67	—	—	7.00 (7.1[illegible])	" "	10.00(10.06)	" "	4.07	447(451)	" "	—	—	✓ IBV-7.5

Meter Name - Lamotte 2020 Turbidity				
Date	**Initials**	**Blank**	**Calibration pt**	**Note**
4/22/2011	CB	0 (2.1)	100 (92.7)	Meter not used for 1+ year but held calibration relatively well
6/6/2011	CB	0 (0.0)	100 (103.7)	
6-13-11	CB	0 (0.0)	100 (101.9)	✓
6-25-11	CB	0 (0.0)	100 (105.9)	✓
7-13-11	CB	0 (0.0)	100 (97.4)	✓
8-1-11	CB	0 (0.0)	100 (97.2)	✓
9-17-11	CB	0 (0.0)	100 (100)	✓
12-22-11	CB	0 (0.0)	100 (100)	✓
2-17-12	CB	0 (0.0)	100 (105.5)	✓
2-29-12	CB	0.30 ✓	100 ✓	✓
3-5-12	CB	0 ✓	100 ✓	✓
4-30-12	CB	0.33 ✓	100 (105.6)	✓
9-30-13	CB	0.75 ✓	100 (95)	✓
12-13-13	CB	0.15 (0.0)	100 ✓	✓ new cal solution
4-9-14	SJE	0.00 (0.0)	100 (100)	
5-14-14	CB	0.35 ✓	100 ✓	No problems, ~~[illegible]~~ ✓
9-8-14	CB	0.10 ✓	100 (110)	✓
1-14-15	CB	0.55 ✓	100 ✓	✓
7-18-16	CB	0.3 ✓	100 (97.1)	✓ – new cal solution

CALIBRATION LOG

Meter Name: Replacement MS 5 w/ turb **Serial #:** 151200066822

Date	Initials	LDO			pH (SU)							Conductivity (uS/cm)		Turbidity (NTU)		Notes
		BP (mmHg)	mg/L Before Calibration	mg/L After Calibration	pH 4 Reading	pH 4 Lot #	pH 7 Reading	pH 7 Lot #	pH 10 Reading	pH 10 Lot #	pH Standard Check	Conductivity Calibration Standard	Conductivity Lot #	1st Pt Calibration Standard	2nd pt Calibration Standard	
1-8-16	CB	736	—	—	—	—	7.00	144119	10.00	A5197	4.19	447	SP1	0.5		New sonde - ~~Calibrated at Hach~~ Load charged unit
2-7-16	CB	742	—	—	—	—	7.00(7.42)	A5197	10.00(9.70)	144117	3.85	447 (456)	TQ1	0.5(0.0)	100(98.1)	✓ IBU-7.5
4-15-16	CB	752	9.28	9.03	4.00(3.85)	144119	7.00(6.90)	A5197	—		9.55	447(453)	SP1	0.5(3.1)	100(101)	✓ IBU-7.4
5-4-16	CB	730	8.78	8.64	—	—	7.00(6.96)	A5197	10.00(9.89)	A6079	3.99	447(453)	TQ1	0.5(0.0)	100(101)	✓ IBU-7.3
6-16-16	BK	724	8.52	8.01	—	—	7.0(7.2)	A5197	10.0(9.7)	A6094	3.71	447(478)	TQ1	0.5(0.0)	100(96)	✓ IBU-7.0
6-17-16	BK	736	8.20	8.12	—	—	7.0(6.9)	A5197	10.0(10.05)	A6094	3.8	447(440)	TQ1	0.5(2.1)	100(101)	✓ IBU 6.9
6-27-16	CB	739	8.26	8.30	—	—	7.0(6.98)	" "	10.00(10.05)	" "	3.88	447(439)	TQ1	0.5(1.3)	100( )	✓-switch Surveyor with New MS5
7-11-16	CB	740	8.27	8.28	—	—	7.00(7.01)	" "	10.00(10.09)	" "	3.90	447(449)	TQ1	0.5(0.5)	100(98.6)	✓ IBU-7.6
7-18-16	CB	743	8.62	8.57	—	—	7.00(7.11)	" "	10.00(10.01)	" "	3.97	447(445)	" "	0.5(0)	100(97.1)	✓ IBU-7.5
8-24-16	CB	743	8.58	8.47	~~4.00(3.74)~~	~~A6092~~	7.00(6.95)	" "	10.00(9.87)	" "	4.08	447 (455)	UW2	0.5(13.5)	100(108)	✓-IBU-7.5 new ph kit + sonde
8-?-16	CB															~~LDO issue~~ - replaced
																internal batteries - ok
9-2-16	CB	740	8.25	8.11	—	—	7.00(7.05)	" "	10.00(10.0)	" "	4.01	447(?)	UW2	0.5(0)	100(106)	✓-IBU 7.4
9-8-16	BK	739	8.17	8.45	—	—	7.00(7.00)	A6228	10.00(9.96)	" "	3.9	447(461)	UW2	0.5(10.6)	100	IBU 7.3
9-21-16	BK	742	8.52	8.44	—	—	7.00(6.9)	" "	10.00(10.07)	" "	3.9	447(430)	UW2	0.5	100(99.2)	IBU 7.3
9-22-16	CB	741	8.64	9.50	—	—	7.00(6.86)	" "	10.00(10.0)	" "	4.02	447(443)	UW2	0.5(0.0)	100(100.8)	✓-IBU 7.4
9-23-16	BK	740	8.46	8.51	—	—	7.01(6.9)	" "	10.0(9.96)	" "	4.0	447(448)	UW2	0.5(0.4)	100(102)	✓ IBU 7.3
10-6-16	CB	742	8.58	8.57	—	—	7.00(7.06)	A6238	10.00(9.76)	A6099	3.97	447(455)	UW2	0.5(0.03)	100(98.7)	✓ IBU-7.3
10-20-16	CB	735	8.52	8.44	—	—	7.00 (6.91)	" "	10.00(9.94)	" "	3.79	447 (444)	" "	0.5(1.8)	100(105.7)	✓ IBU 7.3-new external batteries
10-25-16	CB	746	8.65	8.88	—		7.00(7.02)	A6238	10.00(10.00)	A6235	4.06	447(449)	UW2	0.5(20)	100(122)	✓ IBU 7.3
11-3-16	CB	742	8.75	8.65	—		7.00 (7.88)	A6238	10.00 (10.04)	A6235	4.09	447 ✓	UW2	0.5(0)	100(95)	✓ IBU-7.3
11-23-16	CB	735	8.61	8.47			7.00(7.09)	" "	10.00(10.0)	" "	4.18	447 ✓	UW2	0.5(0)	100 (95)	✓ IBU-7.3
11-30-16	CB	728	8.74	8.60	—		7.01 ✓				—	447 (447)		0.5(0.2)	100(102)	✓ IBU - 7.3
12-15-16	CB	748	9.03	9.02			7.00 (7.15)	" "	10.00(9.96)	" "	4.07	447(445)	" "	0.5(0.7)	100 (105)	✓ IBU-7.2
1-9-17	CB	752			—		7.00 (6.85)	A6238	10.00(10.09)	A6235	4.10	447 ✓	UW2	0.5 (0.5)	100 (96.6)	✓ IBU-7.2
1-30-17	CB	728	9.03	9.24	—		7.00 ✓	"	10.00 ✓	" "	4.10	447(446)	UW2	0.5(0)	100 (95)	✓ IBU- 7.2
2-3-17	CB	747	9.40	9.52	4.00(4.13)	A6224	7.00(7.05)	" "	—	—	10.15	447 ✓	" "	0.5(1.7)	100 (113)	✓ IBU- 7.2 -new internal batteries
2-3-17	CB	—												0.5(0)	100(97.8)	✓-Turb ok after new battery - ok
2-6-17	CB	741	9.14	9.06	—		7.00 (7.04)	" "	10.00(10.05)	" "	4.17			0.5(10)	100(110)	✓ IBU 7.2
3-17-17	CB	744			—		7.00(7.01)	A6238	10.00 (10.02)	A6235	3.96	447 (457)	UW2	0.5(0)	100(99)	✓ IBU -7.1 -New turb @ Hach
4-26-17	CB	730	8.82	8.58	—		7.00 (7.13)	" "	10.00(9.95)	" "	9.03	447 (450)	" "	0.5(5.0)	100(103)	✓ -Surveyor charged
4-27-17	CB	727	8.52	8.45	—		7.00 (6.96)	" "	10.00 (10.0)	" "	4.03	447(448)	" "	0.5(0)	100(101)	✓ -IBU- 8.2
5-4-17	CB	731	8.26	8.11	—		7.00 (6.97)	" "	10.00 (9.94)	" "	4.10	447 (455)	" "	0.5(0)	100 (101)	✓ -IBU-7.9 -new internal battery 100
6-22-17	CB	757	8.51	8.33	4.00(4.0)	A6224	7.00(6.99)	A6238	—		10.02	447 (452)	UW2	0.5(2.9)	100 (98)	✓ -IBU-7.6
6-29-17	CB	741	8.33	8.45	—	—	7.00(7.00)	A6238	10.00(9.9)	A6235	4.03	447 ✓	UW2	0.5	100(95.0)	✓ -IBU- 7.9 -IBU- 7.4

CALIBRATION LOG

Meter Name: New MS 5 **Serial #:** New MS5 Unit Serial # 110800062023

Date	Initials	LDO			pH (SU)							Conductivity (uS/cm)		Turbidity (NTU)		Notes
		BP (mmHg)	mg/L Before Calibration	mg/L After Calibration	pH 4 Reading	pH 4 Lot #	pH 7 Reading	pH 7 Lot #	pH 10 Reading	pH 10 Lot #	pH Standard Check	Conductivity Calibration Standard	Conductivity Lot #	~~1st Pt Calibration Standard~~	~~2nd pt Calibration Standard~~	
✓ 9-10-14	CB	737	8.38	8.38	—	—	7.00(7.05)	QT1	10.00(10.10)	QU1	3.97	447(459)	RU1	—	—	IBV-7.0 ✓
9-29-14	CK	739			—	—	7.00 (7.10)	QT1	10.00(10.10)	QU1	3.97	447(455)	RU1	—	—	IBII-6.9-changed surveyor, New ph ref solution
11-3-14	CB	744	8.49	8.54	—	—	7.00 (6.89)	145455	10.00(10.01)	QU1	4.00	447(450)	RU1	—	—	IBV-7.5 ✓
1-14-15	CB	744					7.00 (6.92)	143679	10.00(9.99)	141957	4.05	447 ✓	ST2	—	—	IBV-7.2 ✓
3-15-15	CB	744					7.00 (7.32)	143679	10.00(10.01)	141957	3.98	3.28 447(448)	SP1	—	—	IBV-7.0 ✓-charged Surveyor
4-30-15	CB	733		8.25	—	—	7.00 (7.13)	143679	10.00(10.02)	144117	4.03	447 (448)	SP1	—	—	IBV-7.3 ✓
6-8-15	CB	735	8.48	8.41	—	—	7.00 (7.02)	" "	10.00 (10.06)	" "	4.04	447 (451)	ST2	—	—	✓ IBV-7.1
8-10-15	CB	735	8.52	8.51	—	—	7.00 (7.10)	143679	10.00 (10.10)	144117	4.04	447(449)	SP1	—	—	✓ IBV-7.4
9-9-15	CK	736	8.08	8.07	—	—	7.00(7.19)	143679	10.00(10.02)	144117	4.01	447 ✓	ST2	—	—	✓ IBV-7.3
10-7-15	CB	741	8.08	8.11	—	—	7.00(7.15)	" "	10.00(10.01)	" "	4.00	447 (448)	ST2	—	—	✓ TIBII-7.4
12-14-15	CB	728	8.81	8.75	—	—	7.00 (6.95)	143679	10.00 (9.95)	144117	4.04	447 (442)	SP1	—	—	✓ IBV - 7.0 New ph solution
1-8-16	CB	736	8.77	8.78			7.00 (6.95)	A5197	10.00 (10.00)	" "	4.05	447(450)	SP1	—	—	✓ - changed unit
3-7-16	CR	742	9.45	9.26			7.00 (7.02)	A5197	10.00 (10.14)	149117	4.19	447 ✓	—	—	—	✓-IBV-7.1, replaced LDO cap off dates
4-15-16	CB	742	8.96	8.98	4.00 (4.20)	149119	7.00 (7.20)	A5197	—	—	4.07	447(445)	SP1	—	—	✓ - IBV 7.0
5-4-16	CR	730	8.62	8.61	—	—	7.00 (7.21)	A5197	10.00(10.05)	A6000	4.04	447 (451)	TA1	—	—	✓ - IBV 6.9 - changed Surveyor
5-20-16	CR				—	—	~~7.00 (7.30)~~	~~A5197~~	~~10.00 (9.98)~~	~~A6009~~	~~4.07~~	~~447 (451)~~	~~TA1~~	—	—	new internal batteries
7-11-16	CR	740			—	—	7.00 (7.2)	A5197	10.00(9.98)	A6009	4.07	447 (451)	TA1	—	—	✓ IBV-7.3
7-18-16	CK	742	8.63	8.67	—	—	7.0 (7.1)	" "	10.00(10.06)	" "	4.07	447 (449)	" "	—	—	✓ IBV - 7.5
8-8-16	CB	743	8.50	8.51			7.0		10.00 (10.0)	" "	4.10	447 (451)	UW2	—	—	New ref solution
8-25-16	BD	741	7.96	8.07			7.0 (6.8)	A5197	10.00(9.9)	" "	4.05	447(436)	UW2	—	—	✓
8-24-16	CB						7.0 (6.93)	" "	10.00 (9.97)	" "						new ph o-ring + ref solution
9-2-16	CR	740	8.08	8.08			7.00 (6.97)	" "	10.00 (9.96)	" "	4.13	447 ✓	UW2	—	—	✓ IBV-7.0 - changed unit
9-8-16	BH	739	8.46	8.42			7.00 (7.1)	A6234	10.0 (9.9)	" "	4.01	447 (448)	UW2			7.3 IBV
10-20-16	CB	735		8.52	—	—	7.00 (7.08)	" "	10.00 (9.92)	" "	4.02	447 (451)	" "	—	—	✓ IBV 7.0
11-23-16	CB	735	8.76	8.45			7.00 (7.15)	" "	10.00 (10.01)	A6235	4.06	447 (451)	UW2	—	—	✓ changed surveyor, new internal batteries
~~1-18-17~~	CB	741			—	—	7.00 (7.19)	" "	10.00 (10.06)	" "	4.17	447(452)	" "	—	—	Surveyor repaired by Hach
2-6-17							~~7.00 (7.16)~~	~~A6235~~	~~10.00 (9.86)~~	~~A6235~~	~~4.16~~	~~447 (455)~~	~~UW2~~			on 1-18-17. ✓
4-27-17	CB	727	8.55	8.45			7.00 (7.16)	A6235	10.00 (9.86)	A6235	4.16	447 (455)	UW2	—	—	changed surveyor ✓
5-4-17	CB	731	8.35	8.34	4.00 (3.95)	A6224	—	—	10.00 (9.8)	" "	6.93	447 ✓	" "	—	—	✓ IBV-7.9, Inc-7.7
6-22-17	CR	727			—	—	7.00	" "	10.00 (9.06)	" "		447 (448)	" "	—	—	✓

Meter Name - Lamotte 2020 Turbidity				
Date	Initials	Blank	Calibration pt	Note
4/22/2011	CB	0 (2.1)	100 (92.7)	Meter not used for 1+ year but held calibration relatively well
6/6/2011	CB	0 (0.0)	100 (103.7)	
6-13-11	CB	0 (0.0)	100 (101.9)	✓
6-28-11	CB	0 (0.0)	100 (105.9)	✓
7-13-11	CB	0 (0.0)	100 (97.4)	✓
8-1-11	CB	0 (0.0)	100 (97.2)	✓ ✓
9-13-11	CB	0 (0.0)	100 (100)	✓
12-22-11	CB	0 (0.0)	100 (100)	✓
2-17-12	CB	0 (0.0)	100 (105.5)	✓
2-29-12	CB	0.30 ✓	100 ✓	✓
3-5-12	CB	0 ✓	100 ✓	✓
4-30-12	CB	0.33 ✓	100 (105.6)	✓
9-30-13	CB	0.75 ✓	100 (95)	✓
12-13-13	CB	0.15 (0.0)	100 ✓	✓ new cal solution
4-9-14	SJE	0.00 (0.0)	100 (100)	
5-14-14	CB	0.35 ✓	100 ✓	No problems. ~~[illegible]~~ ✓
9-8-14	CB	0.10 ✓	100 (110)	✓
1-14-15	CB	0.55 ✓	100 ✓	✓
7-18-16	CB	0.3 ✓	100 ([illegible])	✓ – new cal solution
8-24-16	CB	0.5 (0.0)	100 (98.7)	✓
9-8-16	BR	0.5 (0.0)	100 (95.8)	✓
10-20-16	CB	0.55 ✓	100 (95)	✓
10-25-16	CB	0.65 ✓	100 ✓	✓
11-3-16	CB	0.50 ✓	100 ✓	✓
11-28-16	CB	0.70 ✓	100 (110)	✓
12-15-16	CB	0.55 ✓	100 (105)	✓
1-9-17	CB	0.50 (1.00)	100 (95)	✓
1-30-17	BR	0.50 (1.00)	100 (100)	✓
2-6-17	CB	0.5 (0.05)	100 ✓	✓
2-23-17	BR	0.45 (1.0)	100 ✓	✓
3-17-17	CB	0.5 (0.6)	100 ✓	✓
3-21-17	AR	0.6 ([illegible])	100 ✓	✓
3-29-17	CB	0.6 ✓	100 (110)	✓ - new cal solution
4-27-17	CB	0.6 ✓	100 (95)	✓
4-28-17	BR	0.5	100 (100)	✓
5-4-17	CB	0.6 ✓	100 (107)	✓
5-8-17	BR	0.5	100 (90)	✓
5-9-17	BR	0.6	100 (92)	✓
6-22-17	CB	0.7 ✓	100 (120)	✓ - new cal solution

CALIBRATION LOG

Meter Name: Quanta **Serial #:** UNIT-02127 Sonde-trc00517

		DO		pH (SU)							Conductivity (uS/cm)		
Date	Initials	Membrane Replaced ?	BP (mmHg)	pH 4 Reading	pH 4 Lot #	pH 7 Reading	pH 7 Lot #	pH 10 Reading	pH 10 Lot #	pH Standard Check	Conductivity Calibration Standard	Conductivity Lot #	Notes
2-23-17	BR	NO	735	4.0(3.95)	A6224	7.0(6.95)	A6238	—	A6235	9.97	447(451)	uw 2	✓
3-17-17	CB	No	744	—	—	7.0(7.08)	A6238	10.00(9.91)	A6235	3.98	447(452)	" "	✓
3-21-17	AC	NO	764	—	—	7.0(6.98)	A6228	10.0(10.08)	A6235	4.07	447(454)	uw 2	✓
4-28-17	[illegible]	NO	737	—	—	7.0(7.15)	A6238	10.0(9.94)	A6235	4.03	447(484)	uw 2	✓
5-8-17	BR	NO	741	4.0(4.07)	A6224	7.0(7.04)	A6238	~~10 (10.05)~~	—	10.05	447(451)	uw-2	✓
5-9-17	KL	NO	727	—	—	7.0(7.03)	A6238	10.0(10.01)	A6235	3.98			

CALIBRATION LOG

Meter Name: Quanta **Serial #:** UNIT-02127 Sonde-trc00517

Date	Initials	DO		pH (SU)							Conductivity (uS/cm)		Notes
		Membrane Replaced ?	BP (mmHg)	pH 4 Reading	pH 4 Lot #	pH 7 Reading	pH 7 Lot #	pH 10 Reading	pH 10 Lot #	pH Standard Check	Conductivity Calibration Standard	Conductivity Lot #	
✓ 12-13-13	CB	No	743	7.00 (7.77)	C165-08	7.00 (6.79)	[illegible]	—	C126-14	9.93	447	RU1	✓
✓ 2-12-14	CB	No	732	—	—	7.00 (7.21)	C155-04	10.00 (10.18)	C126-14	4.06	447 (450)	RU1	✓
✓ 3-11-14	CB	No	730	—	—	7.00 (7.31)	" "	10.00 (9.92)	" "	3.98	447	" "	
✓ 4-9-14	STS	No	738	—	—	7 (6.99)	C155-04	10 (10.02)	00654-08	3.98	448	RU1	
✓ 4-29-14	CB	Yes	730	—	—	7.00 7.03	" "	10.00 (9.89)	C126-14	4.04	447 (477)	" "	New ph ref solution, new DO membrane, prior ph LOT
✓ 6-20-14	CB	No	732	—	—	7.00 7.05	" "	10.00 (9.96)	" "	4.01	447 (445)	" "	✓
✓ ~~8-18-14~~	CB	No	740	—	—	7.00 (7.32)	141955	10.00 (9.91)	02649	3.96	447 ✓	RU1	✓
✓ 9-8-14	CB	No	739	—	—	7.00 (7.28)	" "	10.00 (9.98)	" "	3.70	447 ✓	" "	✓
✓ 9-29-14	CB	Yes	739	—	—	7.00 (7.03)	QT1	10.00 (10.20)	QV1	3.97	447 (445)	RU1	✓ -New DO membrane
✓ 11-3-14	CB	No	744	—	—	7.00 (7.28)	141955	10.08 (9.93)	QU1	3.97	447 (453)	RU1	✓
✓ 1-14-15	CB	No	744	—	—	7.00 (7.61)	143679	10.00 (10.21)	141957	4.06	447 (449)	ST2	✓
✓ 3-18-15	CB	No	744	—	—	7.00	143679	10.00	141957	4.08	447 ✓	SP1	✓ -New ph ref solution
✓ 4-30-15	CB	No	733			7.00 (6.95)	143679	10.00 (9.99)	144117		447 (449)	SP1	✓
✓ 6-23-15	CB	No	739	—	—	7.00 (7.53)	143679	10.00 (9.97)	141957	3.98	447 (445)	SP1	✓
✓ 9-10-15	CB	No	735	—	—	7.00 (7.26)	" "	10.00 (10.01)	144117	4.09	447 ✓	SP1	
✓ 9-?-15	CB	No	736			7.00 (7.31)	143679	10.00 (9.97)	144117	4.01	447 ✓	ST2	
✓ 10-7-15	CB	Yes	741	—	—	7.00 (7.06)	" "	10.00 (9.95)	" "	3.98	447 (449)	" "	✓
✓ 12-14-15	CB	No	726	—	—						447 (480)		Ph fail cal @ 10, new ref junction + solution (port sensor)
✓ 12-30-15	CB	Yes											~~New Ph sensor at Hach, local DO, cal @ Hach~~
✓ 1-8-16	CB	Yes	736										New Ph sensor, calibrated @ Hach, local DO
✓ 3-7-16	CB	No	742	—	—	7.00 (7.14)	A5197	10.00 (10.15)	144117	4.12	447 (417)	TQ1	✓
✓ 4-5-16	BYL	NO	774	—	—	7.00 (7.04)	A5197	10.00 (10.03)	144117	4.14	447 (442)	TQ1	✓
✓ 4-12-16	M	Yes	~~742~~										
✓ 4-15-16	CB	No	742	—	—	7.00 (7.11)	A5197	10.00 (10.03)	144117	3.98	447 (443)	SP1	✓
✓ 5-4-16	CB	No	730	—	—	7.00 (7.31)	A5197	10.00 (9.68)	A6097	3.81	447 (454)	TQ1	✓
✓ 6-8-16	CB	No	738	—	—	7.00 (7.13)	" "	10.00 (10.07)	"	3.94	447 (448)	TQ1	✓
✓ 6-10-16	BYL	NO	765	—	—	7.00 (7.08)	" "	10.00 (10.06)	" "	3.99	447 (441)	TQ1	✓
✓ 6-27-16	BR	NO	740	—	—	7.0 (6.94)	" "	10.00 (10.05)	" "	3.97	447 (443)	TQ1	✓
✓ 7-7-16	BR	NO	736	—	—	7.0 (7.07)	" "	10.0 (9.99)	" "	3.96	447 (450)	TQ1	✓
8-2-16	BR	NO	740	—	—	7.0 (7.01)	" "	10.00 (9.97)	"	3.97	447 (440)	UW2	✓ - checked membrane ok
8-26-16	CB	Yes	743			7.00 (6.54)	" "						ph cal fail - reads 7@ all solutions - changed
													ref solution write no luck
9-20-16	CB	to @ Hach		Before ↓	After								New pH sensor + circulator @ Hach
10-5-16	CB	No	742	DO		7.00 (6.97)	A6238	10.00 (9.90)	A6049	4.05	447 (454)	UW2	✓
10-25-16	CB	No	746	4.75 / 8.86		7.00 (7.10)	A6238	10.00 (10.05)	A6235	4.04	447 ✓	UW2	✓
11-3-16	CB	No	742	8.60 / 7.64		7.00 (6.98)	" "	10.00 (10.04)	" "	4.08	447 ✓	UW2	✓
11-28-16	CB	No	736	8.57 / 9.05		7.00 (7.08)	" "	10.00 ✓	" "	4.03	447 ✓	UW2	✓
11-30-16	CB	No	728	8.07 / 8.77		7.02 ✓		10.00 ✓	—		447 (455)	" "	✓
12-15-16	BR	NO	749			7.0 (7.1)	" "	10.00 (9.99)	" "	4.00	447 (460)	" "	✓
1-9-17	CB	No	752	7.26 / 7.36	~~A6234~~	7.00 (7.02)	A6238	10.00 (9.97)	A6235	4.06	447 (435)	UW2	✓
1-31-17	BR	NO	734		4.03/4.0	7.00 (7.0)	A6238	10.00 (10.01)	A6235	3.97	447 (7??)	UW2	✓
2-6-17	CB	No	741	9.80 (10.13)		7.00 (7.06)	" "	10.00 (10.07)	" "	4.00	447 ✓	" "	✓

K416-004

well 25 CR 8

CB, CO
6-27-16
MSS w/ turb
Flow = 2

✡ - 2.3144 (ft) - Depth of water above 800 ft elevation

- 845.51 - top of casing

- 75' - total depth

- 65.2 - depth to top of cave

- 1.63' - top of casing to ground

Site 1
Q = 3.34
SpC = 573.7
pH = 7.91
DO = 9.1 / 120
T = 28.4
Turb = 1.5

Site 2
Q = 1.85
SpC = 625.5
pH = 7.6
DO = 7.9 / 106.5
T = 29.00
Turb = 3.4

CR 3 - Dry
CR 7 - Pooled
CR 10 - Pooled

CR 4 1350

Temp - 25.62
Ph - 7.56
Cond - 416.8
DO - 10.15 / 128.2
Turb - 2.1
Q - 0.01 - (measured)

Site 5 1325

T = 27.3
pH = 8.4
SpC = 596.4
DO = 15.6 / 203.4
Turb = 0
Q = 1.43

Site 6 14:57

SpC = 626.0
pH = 7.5
DO = 6.8 / 93.2
T = 24.0
Turb = 0.5
Q = 1.05

Dup
Temp - 27.3
Cond - 386.9
Ph - 7.51
DO - 5.56 / 72.1
Turb - 0
Q - 0.01

~~Q~~ - Dup
Site 9 15:33

Q = .01 observed
Not Recordable

SpC = 387.2
pH = 7.6
DO = 5.4 / 67.9
T = 27.1
Turb = 0.0

Rite in the Rain

Griffin sac
1200 6-27-16
Temp 17.9
pH 7.0
Cond 645
DO ~~turb~~ 7.3

Green Acres Park
6-27-16 1241

Tem 17.8
Cond 706
DO 10.1
pH 7.9

COPY
KY16-004

Scale: 1 square = ____

Cane Run
7-18-16 BR/CO
Site 1
1015am (10:00)
pH 7.9
temp 25.7
DO/% 6.4/80.1
Cond 628
turb 0.0
Flow = 1.4

Site 2 1045

pH 7.5
temp 24.0
DO/% 4.2/51.1%
Cond 668
turb 0.0
Flow 1.16

Sta 3
No flow

Sta 4 1123
pH 7.6
temp 22.5
DO/% 7.7/91.4
Cond 456
turb 0.0
Flow - observed but not detected

Scale: 1 square =

Cane Run Sta 5
7-15-16 1150

PH	7.7
temp	23.9
DO %	8.0/97.9
cond	657
Turb	0.0
Flow	0.35

Scale: 1 square = ______

Scale: 1 square = ______

Cane Run

6 1000

Temp - 22.97
Cond - 706
PH - 7.03
DO - 2.53 / 29.3
Turb - 5.2
Q - 0.039

8 1100

Temp 17.44
Cond 626
PH 6.89
DO [illegible] 74.1
Turb - 10.20
Q -

7-18-16
CB, CR
New MSS
Flow 1
LaMotte Turb

9 - 1118

Pooled

10 - 1300

pooled

Rite in the Rain.

~~8~~Dup ~~8~~

9 1200

Temp - 23.91	25.10
Cond - 406	405
Ph - 7.27	7.26
DO - 3.28 ~~3.00~~ / 40.0 ~~40.2~~	3.25 / 39.7
Turb - 5.47	Turb - 5.53
Q - 0.07 (observed)	0.01 (observed)

Ky16-004

8/24/16 Cave Run Dry Sampling

Chelsey Olson
James Storm

1 – SpC - 632 LDo - 91.8
9:15 pH - 8.01 Tem 22.2 Q - 8.9
~~LDO - 91.8~~ ~~Turb~~

2 - SpC - 650.9 LDO - 83.7
10:00 pH - 7.72 Tem - 21.52
LDO - 7.18 ~~Tur -~~
Q - ~~12.6~~ 8.94
CB

3 - No flow

4 - SpC - 363.3 T - 20.9
10:35 pH - 7.5
DO - Not Turb -
Registering Q - 0.69

5 - SpC - 629.8 LDO - 96.7
11:25 pH - 7.59 Tem - 20.61
LDO - 8.52 Tur -
Q - 4.3

Dup SpC 626.1 LDO 96.7
pH 7.59 Temp 20.63
LDO 8.48 Tur -
Q - 3.8

8/24/16 Cave Run Dry Sampling

6 - SpC - 652 LDO - 81.6
11:55 pH - 7.3 Tem - 20.2
LDO - 7.2 Tur - [illegible]
Q - 3.5

KY16-004

8-24-16 · 9/5

Rain
+
Bert

CR-10

pH 7.2
DO 7.8 - 81.6%
temp 17.9
cond 703
Q = 0.08

CR-8 1220

pH 7.35
DO 6.26 - [illegible]
DO% 69.4
Temp 19.59
Cond. 634
Q = N/A
Turb = 2.0

CR-11 10:00

pH 7.61
DO 7.30 - 81%
Temp. 20.92
Cond 688
[illegible] Q = 0.24

CR-9 10:40

pH 7.54
DO 3.75 - 42.9
Temp 21.74
Cond 432
Q = 0.12

CR-7 1120

pH 7.52
DO 6.35 - 73.3
Temp 22.45
Cond 628
Q = 0.05

Chelsea has other turbidity measurements

Rain + Bert
- Millett Shean 8/23/16

Cond. 222

K416-004

y

coored

nwAtely

	T	DO	
1	5.8		
08 2 ~~3~~	4.1		
4	48.7/45.5	6.8/85.9	SpC - 203.8
	Stand		pH - 7.4
	Move		T. - 23.9
	45.9 HL		
5	1.9		
6	2.7		
7	2.2		
	~~20.3, 7.6, 5~~, 3.4, 3.7, 3.9, 3.3		
9	3.7		
10	1.4		
11	1.2		

Marcia L. Wooton

From: Bert W. Remley
Sent: Wednesday, August 24, 2016 4:37 PM
To: Marcia L. Wooton
Subject: FW: DO%

I forgot to copy you on this earlier

From: Bert W. Remley
Sent: Wednesday, August 24, 2016 3:09 PM
To: Jonathan C. Bloyd
Cc: Steve J. Evans; KY16-004_Cane_Run_Watershed_Plan; Rain A. Storm
Subject: DO%

Calculated DO% for our sites are listed below:

CR-7 = 73.3%
CR-8= 69.4% from meter
CR-9=42.8%
CR-10=81.6%
CR-11= 81.0%

Bert Remley, Ecologist
Third Rock Consultants, LLC |2526 Regency Road | Suite 180 | Lexington, KY 40503
Office: (859) 977-2000 | Cell: (859) 619-8009 | www.thirdrockconsultants.com

From: Bert W. Remley
Sent: Wednesday, August 24, 2016 4:37 PM
To: Jonathan C. Bloyd
Cc: Marcia L. Wooton; KY16-004_Cane_Run_Watershed_Plan
Subject: Turbidity Reading

Site 8 = 2.0

Bert Remley, Ecologist
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9/8/16 Cave Run KDOW
KY/C-004 S. Evans / C. Olson

① 10:20 Live Fat mucket
Spc 640 Dead slipper shell
LDO 6.66 82% FISH
Temp 24.37 Some Sediment
pH 7.61
Turb 4.3 Q 1.9

② 1105
SpC 671 pH 7.33
Temp 24.47 FISH PRESENT
LDO 8.03 99.1%
Turb 4.9 Q = 1.5

③ 1135 Move to Fencelow,
SpC 522 Perennial Flow & Fish
pH 7.57 Q = Present but not
LDO 7.95 91.5 Measurable
Temp 20.97 <0.01
Turb 5.7 Snails / Chironomids
seen
Swallet Identified

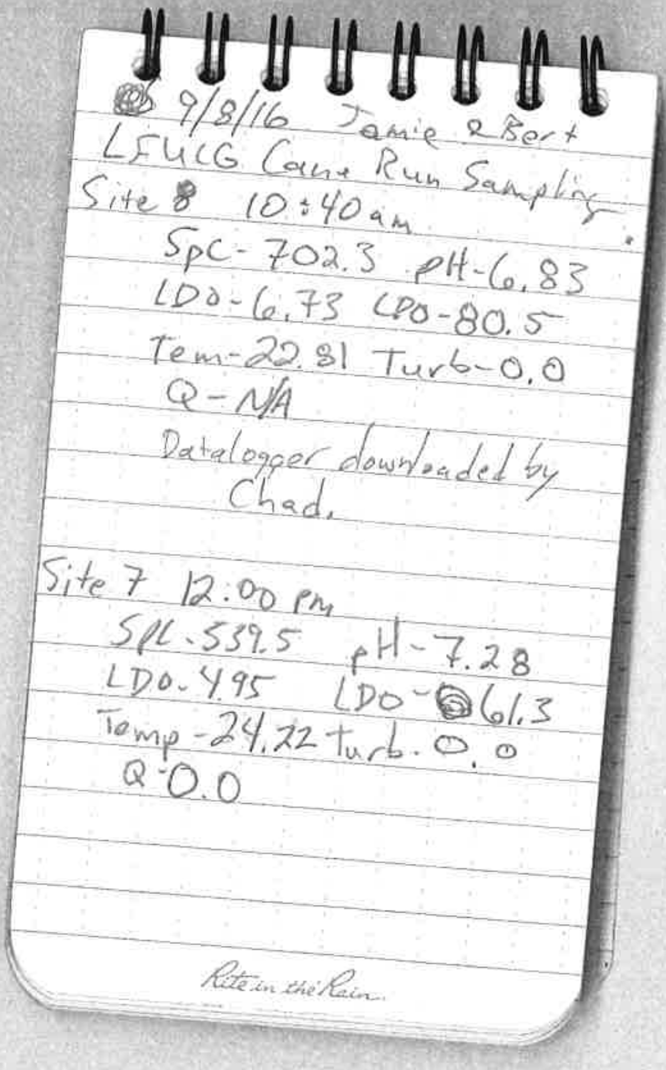
④ 1200

Turb 2.7 Q - Observed
spC 590 but not
DO 6.9 / 80.6 measurable
Temp 22.1
pH 7.3

⑤ 1220 * DUP
SpC 659 662
DO 10.31 126% 10.16 125%
pH 7.63 7.68
Temp 23.93 23.89
Turb 2.5 2.8
Q 0.5 0.5

⑥ 1300
SpC 679
DO 5.33 63.1
pH 7.39
Temp 22.22
Turb 16
Q 0.5

Rite in the Rain.



9/8/16 Jamie & Bert
LFUCG Cane Run Sampling

Site 8 10:40 am
SpC-702.3 pH-6.83
LDO-6.73 LDO-80.5
Tem-22.81 Turb-0.0
Q-N/A
Datalogger downloaded by Chad.

Site 7 12:00 pm
SpC-539.5 pH-7.28
LDO-4.95 LDO-61.3
Temp-24.22 turb-0.0
Q-0.0

Rite in the Rain

9-8-16 Cave Run cont.

CR-9 12:25
SpC - 340 pH - 7.3
LDO - 4.4 LDO - 53.3
Tem - 24.1 Turb - 0.0
Q - 0.204

CR-10 - 1:00
Spc - 745.1 pH - 7.67
LDO - 8.56 LDO - 98.0
Temp - 20.51 Tur - 0.0
Q - 0.085

CR-11 - 1:20

SPC - 714.8 ph - 7.64
LDO - 8.08 LDO - 98.7
Temp 23.96 Turb - 0.0
Q - 0.123

Rite in the Rain

Cane Run Sta 5
7-16-16 1150

PH 7.7
temp 23.9
DO/%. 8.0/97.9
cond 657
Turb 0.0
Flow 0.35

Scale: 1 square = ______

Cane Run 10-25-16

C10 838

pH 7.5
temp 12.2
DO/DO%. 6.9/65.7%.
cond 765
turb 2.6
Q = 0.05 cFS

C 11 9:15 am

pH 7.6
Temp 11.8
DO/DO%. 6.9/65.3%.
Cond 741
turb 0.0
Q = 0.11

Dup
PH = 7.7
temp = 11.8
DO/DO%. 6.9/65.6%.
cond 739
Turb 0.0
Q = 0.25

COPY

Scale: 1 square = ______

C-9 No Flow 10-25-16

C-7 Temp 9.4
pH 7.5
DO/DO% 4.3 / 34.6
Cond 610
turb 0.2

Q = <0.01
- No Flow
- thought I observed
very low Flow

C-6

Temp 16.1
pH 7.4
DO/DO% 7.8 / 80.5
Turb 4.5
Spcc 705

Scale: 1 square = ______

COPY

Scale: 1 square = ______

10/25/16 Cane Run Dry

Site 1 - 9:35 am
Temp - 11.10 LDO -
pH - 7.81 Cond - 634
LDO - 9.06 turb - 2.7
Q = 1.53

Site 2 - 10:15 am
Temp - 10.27 Cond - ~~7.04~~ 704
pH - 7.75 turb - 7.5
LDO - 8.45 Q - 1.12

Site 4 - 10:50
T - 9.53 SpC - 560
pH - 7.65 Turb - 4.8
DO - 8.7 Q - observed / Not measured

Site 5 - 11:35
temp - 10.73 SpC - 713
pH - 7.56 turb - 2.7
DO - 6.28 Q - 0.15
Low flow and thick carpet of filamentous algae may have affected flow

10/25/16 Cane Run Dry Cont.

Site 6 - 11:50
temp - 12.38 Cond - 727
pH - 7.44 turb - 2.4
LDO - 6.23 Q - 0.43

Rite in the Rain.

11/30/16 Cane Run Collection w/Kelsey

Site 1 - 9:40

T - 11.52 Turbidity - 3.6
SpC - 644 Q - 3.04
DO - 9.18
pH - 7.83

Site 2 - 10:06
temp - 12.40 pH - 7.72
SpC - 665 turb - 2.7
DO - 8.95 Q - 1.92

Site 3 - No Flow

Site 4 - No Flow with pools

Site 5 - 11:00

Q - 0.55 DO - 6.19
T - 12.46 Turb - 1.7
pH - 7.53 spC - 662

11/30/16 Cane run cont.
Site 6 - 11:20
temp - 13.19 pH - 7.36
SPC - 657 turb - ~~[illegible]~~ 1.9
DO - 5.94 Q - 1.05

Rite in the Rain

CR-10 11-30-16
0920

Temp 16.1
pH 7.3 Turb: 22
DO 6.7/71.5
Cond 587
Flow 1.12

CR-11 11-30-16 1000

Temp 14.0 turb 9.6
pH 7.4
DO 5.4/54.5 %
cond 711
Flow 0.62

Dup

Temp 14.0
pH 7.5
DO 5.3/53.8%
Cond 716
Flow 0.48
Turb 10.8

C-9
Dry

CR-8 11-30-16 1120

Temp 16.1
pH 7.3
DO/DO% 6.4/67.8%
Cond 720
turb 0.0

CR-7 No Flow

Chelsey

1 12/15 9:30

spC - 638.4
pH - 7.35
DO - 10.69/76.1
T - .8
Turb - 15.3
Q - 3.3

2 12/15 10:28

spC - 691.7
pH - 7.32
DO - 10.56/75.4
T - 0.86
turb - 14.6
Q - 2.07

5 12/15 11:10

spC - 687.1
pH - 6.83
DO - 9.6/70.2
Temp 1.65
turb 5.9
Q - 0.91

6 12/15 1130

spC - 693.9
pH - 7.08
DO - 8.67/68.7
T - 3.07
Turb - 22.8
Q - 0.82

12-15-16 CR-10
0930

Turb = 1.6

Flow unit
= 1
+ Quanty
LaMotte Turb

Temp 6.2
pH 7.9
DO 10.8
Cond 713
Flow = 0.067

12-15-16 C-11
1003am

Turb 2.4
temp 3.5
Cond 669
DO 11.5
pH 7.8
Flow 0.53

CR 9 10:56

- Flow observed but not measureable - assumed @ 0.01

Temp - 2.60
Cond - 482
Ph - 8.01
DO - 18.09 / 112.6
Tub - 8.0
Q - 0.01

CR 7 11:40

Temp - 9.55
Cond - 617
ph - 7.60
DO - 12.19 / 95.8
Tub - 2.5
Q - 0.01 - observed, not measured / lowe [illegible]

CR-8 12-15-16
1215

Temp	13.7
pH	7.6
DO/DO%	6.8 /66.9
cond	413
Turb	26

↑

Dup(8) 12-15-16

Temp	13.9
pH	7.6
DO/DO%	6.7 /63.7 %
turb	26
cond	410

KY16-004

Quanta
LaMotte Turb

1-30-17

Jamie
Chelsey

	9:50 Site 1	10:30 Site 3	10:55 Site 2	11:30 Site 4	12:00 Site 5	12:15 Site 6
temp	4.41	6.96	5.62	8.54	6.94	7.53
SpC	511	420	544	445	529	538
LDO	23.38	11.48	23.52	11.40	22.66	14.86
pH	8.32	7.71	7.98	7.81	7.95	7.85
Q	14.07	0.74	12.25	0.36	1953	19.94
turb	2.4	4.6	6.0	3.5	3.0	~~19.94~~ 3.4

1-30-16

CR-10 935

D.O.	10.2
D.O.%.	90.5
temp	8.6
Cond	752
PH	7.5
turb	7.3
Flow	2.41

CR-11 1015

DO	9.8
DO%.	81.8%
temp	6.1
Cond	693
PH	7.5
turb	10.8
Flow	1.09

1-30-16

CR-9 1055

DO	10.0
DO%.	82.1
temp	5.4
Cond	390
PH	7.8
turb	11.5
Flow	9.00

Dup

DO	10.1
DO%.	82.7
Temp	5.4
Cond	389.5
PH	8.0
turb	12.1
Flow	6.87*

* Noticable drop in water level while @ site

1-30-16

CR-7 1145

PH	7.7
DO	10.5
DO%	89.4
Temp	7.0
cond	498
turb	8.0
Flow	0.19

CR-8 1220

PH	7.5
DO	5.3
DO%	43.6
Temp	9.6
turb	10.6
cond	511
Flow	

2/7/17 Cane Run Wet Weather
w/-chelsey

1 - 8:40
SpC - 371.1 LDO - 83.0
pH - 7.85 Temp - 10.10
LDO - 9.09 Turb - 0.0
Q - 7.58

3 - 9:00
SpC - 410.4 LDO - 81.0
pH - 7.87 Temp - 11.35
LDO - 8.67 Turb - 0.0
Q - 0.3

2 - 9:20
SpC - 540.5 LDO - 81.4
pH - 7.87 Temp - 11.40
LDO - 8.64 Turb - 0.0
Q - 5.45

Dup - 9:30
SpC - 539.6 LDO - 81.2
pH - 7.90 Temp - 11.41
LDO - 8.63 turb - 0.0
Q - 6.09

2/7/17 Can Run Wet Con't.

4 - 10:20
SpC - 398.3 LDO 79.18
pH - 7.73 temp - 11.65
LDO - 8.37 turb - 0.0
Q - 0.14

5 - 10:40
SpC - 505.5 LDO - 81.1
pH - 7.85 temp - 11.77
LDO - 8.55 turb - 0.0
Q - 4.35

6 - 11.05
SpC - 487.0 LDO - 78.7
pH - 7.68 temp - 11.78
LDO - 8.30 turb - 0.0
Q - 4.87

Turb. meter not functional.

1-30-16
CR-7 1145
PH 7.7
DO 10.5
DO% 89.4
Temp 7.0
cond 498
turb 8.0
Flow 0.19

CR-8 12:20

PH 7.5
DO 5.3
DO% 43.6
Temp 9.6
turb 10.6
cond 511
FLOW

TB-2 207

9" wide
1/2" deep
Concave
Concrete

Temp - 12.5
Ph - 8.3
DO - 9.80 / 94.8
Cond - 336
Turb - 95
Quanta
Lamote turb

NH_3 0.07
Cl 0.00
PO 0.35
Detergent 0.25

2-07-17 0920 BA/CB

Flow #1

CR-52/CR-10

Temp 11.7
DO/% 9.3 / 98.5
Cond ~~[illegible]~~ 1480
pH ~~[illegible]~~ 2.8
turb 150
Flow 12.17

CR-11 1002 2-7-17

turb = 6.9
DO/% 9.1 / 84.1%
Cond 721
temp 11.6
pH 7.7
Flow 0.73

1033 ~~hr~~
CR-9 2-7-17

Temp 9.7
pH 8.1
DO/% 11.2 / 91.5
Cond 405
Turb 5.2
Flow 4.13

CR-7 1106

temp 11.8
pH 7.9
DO/% 11.3 / 91.9
Cond 481
turb 11.0
Flow 0.19

CR-8 2-7-17
1145

PH 7.6
temp 11.7
DO/% 7.2/68.7
cond 628
Turb 8.0

WR-52 2.7-17
0140

PH 7.9
temp 12.2
turb 75
DO/DO% 9.4/93.5
cond 357
Flow = gauge

TB-53 2-7-17
0215pm

temp 12.5
pH 7.9
DO/% 9.0/85.6
cond 515
turb = 180
Flow = gauge

2-7-17 0240pm
SE-51
Temp 11.7
DO/% 9.6/89.2
cond 430
PH 7.7
turb = 100
Flow = gauge

CR-10 3-17-13 0150

SpC 648
Temp 10.4
DO/% 11.3 / 103.6 %
pH 8.1
Flow 0.196
Turb 1.9

CR-11 230 pm

Turb 2.1
Temp 8.2
SpC 643
pH 7.89
DO/% 11.4 / 99.1
Flow 0.445

Dup

Turb 2.0
Temp 8.3
pH 7.9
DO/% 11.3/98.3
Flow = 0.498

CR-9

Turb 5.6

Temp 6.98
SpC 332
DO 14.9 / 125.6
pH 8.8

CR-7 345 pm

Temp 7.46
pH 8.1
SpC 436
DO/DO% 15.1 / 126.3
Turb 3.1
Flow 0.43

3/17/17 Cave Run Wet Weather
w/chelsey

Site 1 - 2:10
SPC - 495.0 LDO - 94.5
pH - 7.57 temp - 5.43
LDO - 11.65 turb - 0.0
Q - 7.06

Site 2 - too Low flow

Site 3 - 2:30
SPC - 519.8 LDO - 96.8
pH - 7.98 temp - 7.41
LDO - 11.33 turb - 0.0
Q - 4.25

Site 4 - 3:00
SPC - 392.1 LDO - 83.2
pH - 7.39 temp - 8.97
LDO - 9.42 turb - 0.0
Q - No reading (battery died)

Site 5 - 3:20
SPC - 507.6 T - 7.67
pH - 8.06 Turb - 0.0
LDO - 11.83/
101.4

3/17/17 Cave Run Wet Weather Cont.
w/chelsey

Site 6 - 3:40

SPC - 522.9 T - 7.81
pH - 7.99 Turb - 0
LDO - 11.72/
100.8

4/27/17 Cane Run w/chelsey
Flow meter #1
MS-5 no turb 5.42

1 - LDO - 9.52 spC - 465.2
10:50 pH - 7.84 Temp - 20.15
LDO - 111.5 turb - 4.2
Q - 5.42

2 - 11:55
LDO - 12.85 spC - 524.9
pH - 7.75 temp - 20.04
LDO - 147.8 turb - 2.5
Q - 3.04

3 - DO - 10.4/113.0 T - 17.2
11:45 pH - 7.35 Q - flowing, Not measurable
spC - 385.9
turb - 3.1

4 - 12:30
LDO - 11.91 spC - 368.5
pH - 7.94 temp - 18.44
LDO - 133.5 turb - 3.3
Q - too little flow to measure

4/27/17 Cane Run w/chelsey

5 - 12:50
LDO - 13.16 spC - 578.5
pH - 8.13 temp - 20.34
LDO - 154.7 turb - 2.2
Q - 5.31

6 - 1:20
LDO - 12.83 spC - 547.6
pH - 8.10 temp - 19.11
LDO - 143.8 turb - 2.3
Q - 1.68

Rite in the Rain

Cave Run - Dry Event

4-27-17
CB, SE
65° Overcast

MS5 w/ turb
Flow # 2

10 1035

Temp - 17.24
Cond - 695
ph - 7.57
DO - 8.01 / 87.3
Turb - 0
Q - 0.01 - observed but not recordable

11 1100

Q - 0.23 0.25 Dup
SpC 711.0 709.7
pH 7.61 7.74
DO 8.14 8.09
% 88.9 87.0
Temp 17.22 17.11
Turb 0.0 0.0

9 1145

Spc 240
pH 8.38
DO 9.66
% 110.1
Temp 19.62
Turb 3.5
Q 1.18

8 1230

Spc - 553
pH - 7.21
DO - 6.80
% - 78.9
Temp - 20.13
Turb - 1.1
Q

7 1320

SpC 365
pH 8.41
DO 15.91
% 192.7
Temp 22.52
Turb 10.6

Q - 0.01 - observed but not Record [illegible]

Cane Run E-coli

5-2-17

Flow #2

CB

55°, Clear, windy

#1 1030

Q - 19.23

#3 1100

Q - 0.05

#2 - 1115

Q - 14.09

#4 - 1145

Q - 70.01 - algae + log across culvert obstructing flow but flow was observed

#5 - 1200

Q - 7.54

#6 - 1225

Q - 4.78

Rite in the Rain

5-2-17 950am

CR-10 5.61 Flow

CR-11 1020am

1.724

1.585 dup

CR 9 1110

2.585 Flow

CR-7 1145

0.656

~~CR-8~~

Scale: 1 square = ______

Scale: 1 square = ______

5/4/17 Cane Run Wet Weather
w/ chelsey

4 - 6:20
LDO - 94.0 spC - 3605
LDO - 9.0 temp - 15.51
pH - 7.48 turb - 0.0
Q - too low flow to sample

1 - 6:45
LDO - 94.9 spC - 471.3
LDO - 8.82 temp - 16.92
pH - 8.34 turb - 10.6
Q - 8.34

6 - 7:15
LDO - 71.7 spC - 88.5
LDO - 6.93 temp - 15.11
pH - 7.52 turb - 1.8
Q - 5.65

5 - 7:40
LDO - 71.5 spC - 516.1
LDO - 6.91 temp - 15.09
pH - 7.64 turb - 1.5
Q - 4.62

5/4/17 Cane Run Cont.

3 - 8:10
LDO - 67.7 spC - 399.0
LDO - 6.57 temp - 14.89
pH - 7.69 turb - 0.1
Q - too low flow to sample

2 - 8:15
LDO - 82.6 spC - 520.6
LDO - 7.74 temp - 16.51
pH - 7.88 turb - 15.9
Q - 8.1

5-2-17 950 am
CR-10 5.61 Flow

CR-11 1020am
1.724
1.585 dup

CR 9 1110

2.585 Flow

CR-7 1145
0.656

~~CR-8~~

5-4-17 0630 pm
site 8

Temp 16.0
pH 7.0
DO% 7.5 / 79.5%
cond 546
Turb 15
~~Flow = 0.37~~

Scale: 1 square = ______

Flow #1 New
RSS

site 9 5-4-17
740 pm

Temp 17.1
pH 7.5
DO% 4.6 / 49.9%
cond 294
turb 3.1
Flow = 1.88

5-4-17 0700 pm
Site 7
turb 3.0
Flow = 0.37
temp = 15.2
DO% 10.3 / 107.4%
PH = 7.3
Cond = 429

Scale: 1 square = ______

Site 10 5-4-17 820 pm

Temp 15.2
pH 7.6
DO/% 8.0/83.4%
cond 467
Turb 1[illegible] 37
Flow. 3.80

Site 11 850

0.57 Flow
Turb 3.4
Temp 15.9
pH 7.6
DO/% 7.1/75.2
cond 571

Scale: 1 square = ______

Scale: 1 square = ______

Cane Run E.coli

5-9-17
CB, 70°, partly clouds
Flow # 2

10 - 0930
Q - 0.67

11 - 0955
Q - 0.42

9 - 1025
Q - 1.25

8 - 1100

7 - 1120
Q - 0.12

6 - 1145
Q - 4.78

5 - 1200
Q - 5.71

4 - 1245
Q - 0.06

Dup
Q - 0.04

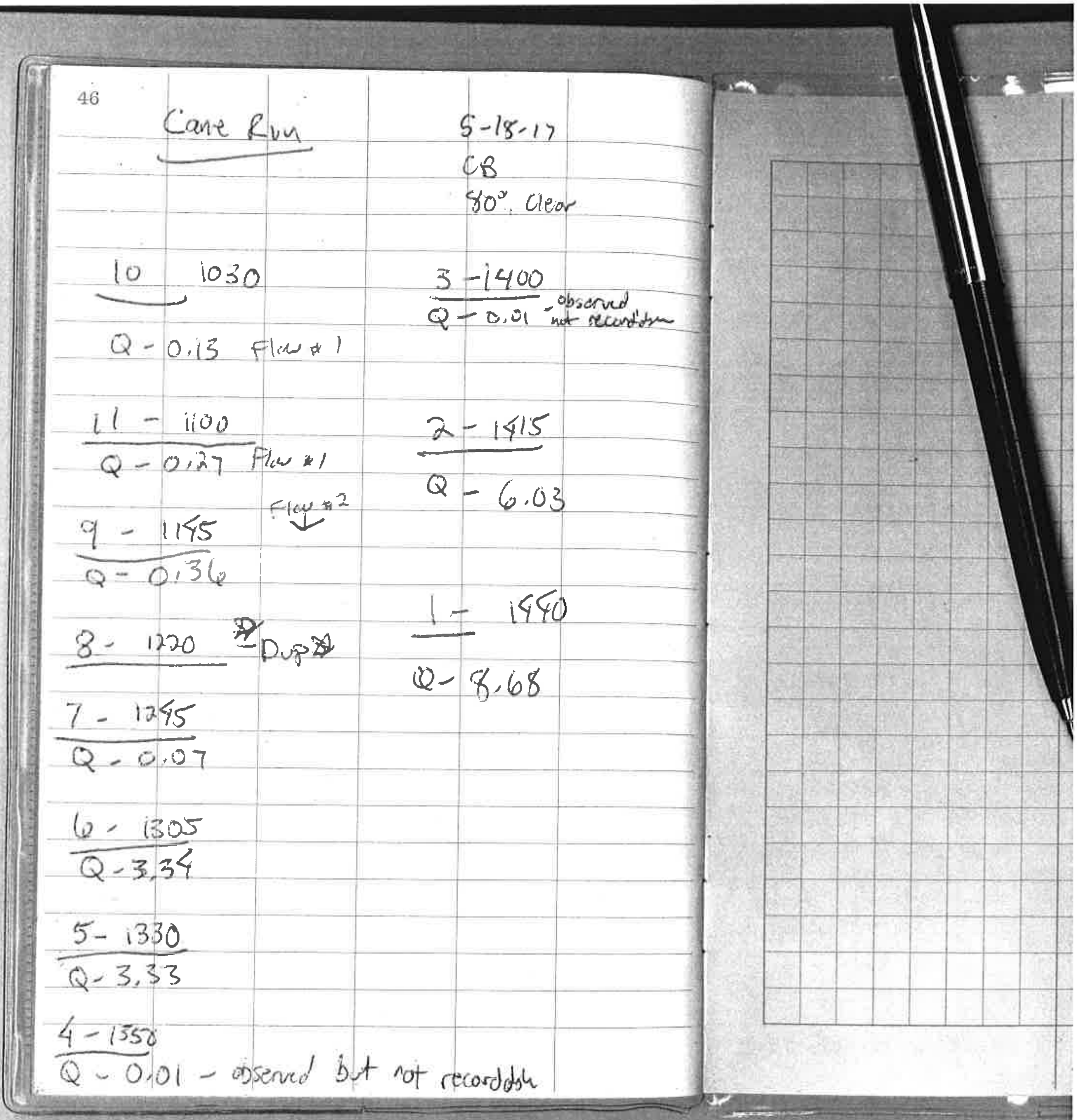
2 - 1310
Q - 8.52

3 - 1335
Q - >0.01
- observed but not recordable

1 - 1350
Q - 9.84

S Evans CAMERON
5/16/2017 9:3 KDOW

CR-10	~~9:30~~ 10:00	
	Q 1,49 cfs	
CR-11	10:25	Q 1,25 cfs
CR-9	11:00	Q 1.83 cfs
CR-8	11:30	Grand well
CR-7	11:50	Q. 0.27 cfs
DUP		Q 0.37 cfs
CR-6	12:15	Q 3,5 cfs
CR-5	12:45	Q 4.9 cfs
CR-4	13:05	Q < 0.01 cfs
		visible flow not measurable
CR-3	1320	Q < 0.01 cfs "
CR-2	1330	Q 10.9 cfs
CR-1	1345	Q 14.2 cfs



Cane Run

5-18-17
CB
80°. Clear

10 1030

Q - 0.13 Flow #1

11 - 1100
Q - 0.27 Flow #1

Flow #2

9 - 1145
Q - 0.136

8 - 1220 ~~#~~ Dup ~~#~~

7 - 1245
Q - 0.07

6 - 1305
Q - 3.34

5 - 1330
Q - 3.33

4 - 1350
Q - 0.01 - observed but not recorded dsh

3 - 1400
Q - 0.01 - observed not recorded dsh

2 - 1415
Q - 6.03

1 - 1440
Q - 8.68

KY16-004 Cane Run
E.coli Event
5/24/2017

S. EVANS

		Q (cfs)
CR-8	9:50	Well
CR-1	1015	Q = 5.92
CR-3	1040	<0.01 (visible)
CR-2	1045	5.10
DUP		5.10
CR-4	1120	<0.01 VISIBLE
CR-5	1130	2.03
CR-6	1150	0.85
CR-7	1215	<0.01 measured some flow
CR-9	1245	4.29
CR-11	1315	5.24
		Stage = 0.55 ft
CR-10	1345	See USGS - 5.85 gage
		5.0

APPENDIX J

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

THIRDROCK
TECHNICAL MEMORANDUM

Submitted to:	Jennifer Carey, PE, MS4 Coordinator Lexington-Fayette Urban County Government (LFUCG) Division of Water Quality
Copied to:	Richard Walker, PE Tetra Tech, Inc.
Prepared by:	Bert Remley
Subject:	Cane Run Watershed-Focused Monitoring Stream Corridor Characterization
Submitted on:	January 16, 2018

BACKGROUND

LFUCG's Phase I MS4 Permit (KPDES No. KYS00002 AI No. 74551) was issued on May 1, 2015, with a five-year duration period effective June 1, 2015. One of the requirements of the permit is that "LFUCG shall begin to change its monitoring program to a watershed-focused monitoring program. In order to facilitate this process, monitoring should be conducted on a watershed basis with additional monitoring stations sampled for water chemistry, macroinvertebrates, microbial source tracking, hydrogeomorphic characterization, and habitat assessment."

The study area for LFUCG's Watershed-Focused Monitoring Program (WFMP) encompasses the seven major watersheds that drain LFUCG's Urban Service Area including Cane Run, South Elkhorn, West Hickman, East Hickman, Town Branch, North Elkhorn, and Wolf Run. Monitoring began in 2016 with the Cane Run Watershed, with monitoring to begin in South Elkhorn in 2017, West Hickman in 2018, and so on until each watershed is monitored and the results reported to the Kentucky Division of Water (KDOW).

The overall objective of the WFMP is to collect and generate data to identify and remediate sources of recreational and aquatic habitat impairments to streams within the Urban Service Boundary. Key monitoring elements include:

1. Stream Corridor Characterization
2. Stream Biology
3. Water Quality Monitoring
4. Discharge Prevention Investigation
5. Priority Area Upland Visual Assessment

Third Rock Consultants, LLC (Third Rock) was retained as a subconsultant to Tetra Tech, Inc. to provide water quality consulting services in support of LFUCG's MS4 program, including conducting key monitoring elements required by LFUCG's WFMP. Results for each watershed will be used to compute and assess pollutant loading and ultimately summarized in a comprehensive, Watershed-Focused Monitoring Program Report for each of the seven watersheds.

As detailed in the WFMP Quality Assurance Project Plan (QAPP), stream corridors were characterized at half mile intervals of each reach of perennial stream in the watershed by Third Rock staff and volunteers. This Technical Memorandum documents the results of Third Rock's Stream Corridor Characterization (SCC) of the Cane Run Watershed.

METHODOLOGY

Thirty-two reaches were characterized within the Cane Run watershed as summarized in **Table 1**, page 3; 26 by volunteers and 6 by Third Rock personnel. Of those, the majority (30) were headwater streams (drainage area < 5.0 mi^2), with only two designated as wadeable (drainage area > 5.0 mi^2). A third wadeable site (CR-2) was not surveyed due to stream restoration construction activities within the reach. Habitat, hydrogeomorphology, and macroinvertebrates were visually assessed along each reach during the respective sampling index period and data was recorded on field datasheets (**Appendix A**). A photo log of typical habitat and conditions for each survey reach is included in **Appendix B**.

Habitat parameters assessed included instream habitat, erosion and deposition, riparian zone condition, and channel stability. Habitat characteristics were scored on a high gradient habitat assessment field data sheet modified from US EPA 841-B-99-002 (Barbour *et al*., 1999). The score was then compared to regional criteria for the Bluegrass Bioregion based upon stream size (headwater or wadeable) to determine a habitat rating for each site (KDOW 2011).

The hydrogeomorphic condition of each reach was assessed by visual estimation of the percentage of substrate (silt, sand, gravel, cobble, boulders, and bedrock) within the reach's riffles, runs, and pools.

Macroinvertebrates were rapidly assessed and identified to order level to evaluate the macroinvertebrate community and identify potential locations of more sensitive taxa (mayflies, caddisflies, and stoneflies). Macroinvertebrates were sampled using methods described in the 2015 Kentucky Watershed Watch Biological Assessment SOP (WWSOP 03000).

As detailed in the WFMP Quality Assurance Project Plan (QAPP), at least 10% of the headwater sites and 10% of the wadeable sites sampled by volunteers were also sampled by Third Rock personnel as a means of quality assurance and are noted accordingly in **Table 1.**

RESULTS

Results of the stream corridor characterization are shown on **Exhibits 1** through **7** (**Appendix C**) and summarized in **Tables 2** (Habitat Condition), **3** (Hydrogeomorphic Condition) and **Table 4** (Macroinvertebrate Abundance) on pages 4, 5, and 6, respectively.

Quality assurance data comparisons are discussed and summarized in **Table 5,** page 7.

Table 1. Cane Run SCC Reaches

Reach ID	Drainage Area[1]	QA[2]	Date	Width	Depth	Lat	Long
CR1	W	X	9/7/2017	20	1.0	38.104337	-84.498901
CR3	W		9/14/2017	15	<1.5	38.091210	-84.501919
CR4	H		3/22/17	14.5	0.3	38.08563	-84.49644
CR5	H		3/27/2017	7	<1.5	38.079680	-84.492730
CR6	H		2/23/2017	8	0.5	38.079446	-84.491493
CR7	H		5/19/2017	8	0.67	38.072416	-84.476463
CR8	H		5/19/2017	4	0.6	38.066776	-84.471221
CR9	H	X	4/29/17	3	0.67	38.06216	-84.46856
A1	H		4/21/2017	1.5	<1.5	38.116070	-84.527190
A2	H		4/18/2017	3	<1.5	38.021800	-84.510350
B1	H	X	3/25/17	3	0.33	38.11024	-84.50893
C1	H		3/28/2017	5.2	1.3	38.104140	-84.505130
C2	H		4/11/2017	6	<1.5	38.099530	-84.510650
D1	H		4/24/2017	9	<1.5	38.102122	-84.492636
D2	H		4/12/17	1.8	1.5	38.09922	-84.48968
D2-1	H		4/25/2017	7	<1.5	38.093400	-84.482100
D3	H		5/31/2017	4	0.33	38.09192	-84.487353
D4	H		5/31/2017	7	0.5	38.087403	-84.484455
D5	H		5/31/2017	2	0.33	38.086382	-84.481455
E1	H		3/7/2017	12	0.6	38.084240	-84.499530
E1-1	H		3/7/2017	8	<1.5	38.083400	-84.500200
E2	H		3/12/2017	7	<1.5	38.078690	-84.498270
F1	H	X	3/21/17	3	0.3	38.08699	-84.49461
G1	H		4/19/2017	21	<1.5	38.071850	-84.486210
G2	H		4/25/2017	5	<1.5	38.065770	-84.487720
H1	H		4/19/2017	6	<1.5	38.077800	-84.481300
I1	H		4/27/2017	4.2	<1	38.074200	-84.471800
J1	H	X	4/9/17	2.5	0.5	38.0663	-84.46212
K1	H		4/1/2017	5	<1.5	38.088470	-84.468060
L1	H		4/7/2017	10	<1.5	38.083900	-84.456500
M1	H		4/18/2017	8	8	38.086900	-84.456400
N1	H		3/28/2017	18	1.5	38.084900	-84.449900

[1] Drainage Area < 5.0 mi^2 = Headwater (H), > 5.0 mi^2 = Wadeable (W)

[2] The WFMP QAPP calls for at least 10% of the headwater sites and 10% of the wadeable sites sampled by volunteers to be sampled by Third Rock personnel as a means of quality assurance. Third Rock personnel sampled that number, as well as one additional site.

Blue shading denotes collected by a volunteer. Green shading denotes QA data collected by Third Rock personnel.

Table 2. Habitat Condition[1]

Reach ID	Habitat		Instream Habitat	Erosion / Deposition	Channel Stability	Riparian Zone
	Score	Rating				
CR1	83	Poor	Marginal	Marginal	Marginal	Marginal
CR3	154	Good	Optimal	Optimal	Suboptimal	Suboptimal
CR4	104	Poor	Suboptimal	Marginal	Suboptimal	Marginal
CR5	107	Poor	Suboptimal	Marginal	Suboptimal	Marginal
CR6	84	Poor	Marginal	Marginal	Marginal	Marginal
CR7	105	Poor	Suboptimal	Suboptimal	Marginal	Poor
CR8	102	Poor	Marginal	Suboptimal	Suboptimal	Poor
CR9	79	Poor	Marginal	Marginal	Suboptimal	Poor
A1	42	Poor	Poor	Poor	Poor	Marginal
A2	70	Poor	Marginal	Marginal	Marginal	Poor
B1	116	Poor	Suboptimal	Suboptimal	Suboptimal	Suboptimal
C1	130	Poor	Suboptimal	Suboptimal	Optimal	Suboptimal
C2	155	Fair	Suboptimal	Optimal	Suboptimal	Optimal
D1	126	Poor	Optimal	Suboptimal	Suboptimal	Marginal
D2	171	Good	Optimal	Optimal	Optimal	Suboptimal
D2-1	47	Poor	Poor	Marginal	Poor	Poor
D3	116	Poor	Marginal	Suboptimal	Optimal	Poor
D4	136	Poor	Suboptimal	Optimal	Optimal	Poor
D5	99	Poor	Marginal	Marginal	Optimal	Marginal
E1	163	Good	Optimal	Optimal	Suboptimal	Suboptimal
E1-1	103	Poor	Suboptimal	Marginal	Suboptimal	Optimal
E2	133	Poor	Suboptimal	Suboptimal	Suboptimal	Optimal
F1	125	Poor	Suboptimal	Optimal	Suboptimal	Poor
G1	82	Poor	Marginal	Marginal	Suboptimal	Suboptimal
G2	123	Poor	Suboptimal	Suboptimal	Optimal	Poor
H1	73	Poor	Poor	Marginal	Suboptimal	Poor
I1	48	Poor	Poor	Poor	Suboptimal	Poor
J1	79	Poor	Marginal	Marginal	Suboptimal	Poor
K1	143	Fair	Suboptimal	Suboptimal	Optimal	Optimal
L1	124	Poor	Suboptimal	Suboptimal	Suboptimal	Poor
M1	121	Poor	Suboptimal	Suboptimal	Suboptimal	Poor
N1	148	Fair	Optimal	Suboptimal	Optimal	Optimal

[1] RBP habitat parameters were grouped into four (4) categories: instream habitat (RBP parameters 1, 3, and 6), erosion/deposition (RBP parameters 2, 4, 5, and 7), channel stability (RBP parameters 8, 9), and riparian zone (RBP parameter 10).

Table 3. Hydrogeomorphic Condition

Reach ID	% Riffle	% Run	% Pool	Substrate Characterization (%)					
				Silt	Sand	Gravel	Cobble	Boulder	Bedrock
CR1	25	35	40	0	18	32	16	24	4
CR3	20	75	5	0	12	10	19	0	59
CR4	N/C			5	10	80	5	0	0
CR5	0	0	100	20	20	15	10	5	30
CR6	0	0	100	10	15	15	40	20	0
CR7	10	20	70	0	11	61	28	0	0
CR8	30	40	30	56	20	7	17	0	0
CR9	25	50	25	88	0	13	0	0	0
A1	0	100	0	70	10	10	5	4	1
A2	20	80	0	59	14	8	10	9	0
B1	20	20	60	86	5	6	0	0	3
C1	20	10	70	59	10	25	7	0	0
C2	65	25	10	7	17	11	23	24	21
D1	20	40	40	26	26	18	30	0	0
D2	15	35	50	7	19	29	44	0	2
D2-1	5	50	45	0	0	50	50	0	0
D3	25	25	50	0	0	5	95	0	0
D4	20	20	60	0	0	10	7	0	83
D5	10	80	10	88	6	7	0	0	0
E1	55	15	30	5	8	19	17	0	53
E1-1	0	0	100	40	40	10	5	5	0
E2	40	60	0	10	8	14	20	32	16
F1	70	15	15	2	14	17	67	0	0
G1	5	25	70	43	37	6	3	2	0
G2	20	80	0	8	42	40	10	0	0
H1	15	15	70	33	33	17	8	0	9
I1	5	25	70	10	10	57	9	0	14
J1	25	50	25	98	0	3	0	0	0
K1	100	0	0	20	30	15	20	15	0
L1	60	25	15	18	30	27	8	1	18
M1	45	25	30	10	20	31	29	8	3
N1	30	25	45	19	32	29	17	2	0

N/C = data not collected.

Table 4. Macroinvertebrate Abundance

Reach ID	Kentucky Watershed Watch	
	Biotic Score	Biotic Rating[1]
CR1	N/C[2]	
CR3	8.1	Poor
CR4	7.5	Poor
CR5	7.8	Poor
CR6	N/C	
CR7	8.4	Poor
CR8	8.03	Poor
CR9	N/C	
A1	7.25	Poor
A2	8.33	Poor
B1	N/C	
C1	6.5	Fair
C2	6.9	Fair
D1	7.08	Poor
D2	7.0	Poor
D2-1	8.8	Poor
D3	7.19	Poor
D4	6.75	Fair
D5	6.86	Fair
E1	8.14	Poor
E1-1	9.0	Poor
E2	8.1	Poor
F1	8.0	Poor
G1	8.25	Poor
G2	6.62	Fair
H1	8.25	Poor
I1	7.25	Poor
J1	N/C	
K1	6.38	Fair
L1	8.0	Poor
M1	7.44	Poor
N1	7.73	Poor

[1] 2015 Kentucky Watershed Watch Biological Assessment SOP (WWSOP 03000)
Rating for the Bluegrass Ecoregion: Good, ≤ 4.6; Fair, 4.7 – 6.9; Poor ≥ 7.0

[2] N/C = Data not collected due to low flow conditions.

Table 5. Quality Assurance Habitat Data Comparisons

Reach ID	QA Date	Habitat		Instream Habitat	Erosion \ Deposition	Channel Stability	Riparian Zone
		Score	Rating				
CR1	9-7-17	83	Poor	Marginal	Poor	Suboptimal	Marginal
CR1	9-27-17	83	Poor	Marginal	Marginal	Marginal	Marginal
CR9	4-29-17	9	Poor	Poor	Poor	Poor	Poor
CR9	5-19-17	79	Poor	Marginal	Marginal	Suboptimal	Poor
B1	3-25-17	45	Poor	Poor	Poor	Marginal	Marginal
B1	5-31-17	116	Poor	Suboptimal	Suboptimal	Suboptimal	Suboptimal
F1	3-21-17	83	Poor	Marginal	Marginal	Suboptimal	Poor
F1	5-31-17	125	Poor	Suboptimal	Optimal	Suboptimal	Poor
J1	4-9-17	34	Poor	Poor	Poor	Marginal	Poor
J1	5-19-17	79	Poor	Marginal	Marginal	Suboptimal	Poor

Blue shading denotes collected by a volunteer. Green shading denotes QA data collected by Third Rock personnel.

Habitat ratings were similar between volunteers and Third Rock personnel for most sites, with the scores varying substantially for a select few. Two of the larger discrepancies involved the same volunteers and dry conditions where the volunteer scored several habitat parameters much lower than Third Rock personnel due to dry conditions during time of survey. Differences in interpretation of how to evaluate parameters in the absence of water contributed to these differences.

LITERATURE CITED

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Kentucky Division of Water. 2011. Methods for assessing habitat in wadeable waters. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky.

APPENDIX A-1
VOLUNTEER
SCC FIELD DATA

Prepared for Lexington-Fayette Urban County Government
Prepared by Third Rock Consultants, LLC January 16, 2018

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR1 **DATE:** 9/7 **LAT:** 38 1048185 **LONG:** -84 4989496

INVESTIGATOR(S) alex Crowe ~~Michelle McHugh~~ **COWARDIN CLASS:** ______ **WATERSHED** ______

STREAM SIZE:	**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft) ~~2.5 in~~ 0	Perennial		IMG	
Depth (Ft) < 1in.	Ephemeral	X	IMG	
Reach (Ft) 100m	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 110	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are *not* new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score ~~10~~ 4	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 3	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 0	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 13	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 10	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL		SUBOPTIMAL			MARGINAL			POOR		
8. Bank Stability	10	9	8	7	6	5	4	3	2	1	0
LB Score 6 *RB Score* 4	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.		Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		
9. Vegetative Protection *LB Score* 9 *RB Score* 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.		70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.		
10. Riparian Vegetative Zone Width *LB Score* 8 *RB Score* 2	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.		Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.		
Total Score 0											

REMARKS / NOTES:

stream reach was dry on 9/7/17.
sediment is moist, some patches of new erosion.
pipe opened up into stream, downstream of that
is ~~[illegible]~~ a~~re~~ pool~~s~~ of water.
gabbion present at drain pipe, also concrete
structure present in stream as well, both documented
~~at~~ in photo log.

STREAM ID 0

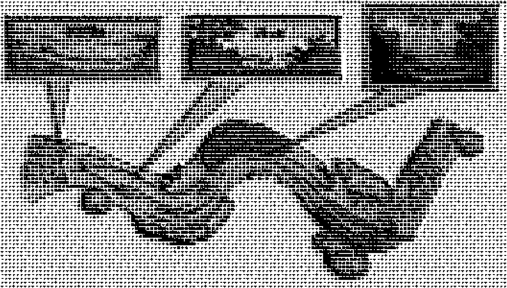
Clear Creek

Sampler: Marian McHugh **Reach:** C2.1 **Date:** 9/7/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns.
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each

No water present in reach



Substrate	Riffle ___ %	Run ___ %	Pool ___ %	Reach total
Silt/Clay (<0.06 mm)				20%
Sand (0.06 – 2 mm)				20%
Gravel (2-64 mm)				30%
Cobble (64-256mm)				20% 20%
Boulders (>256mm)				10%
Bedrock				

* Images from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	
Isopod	
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	
Total	0

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Alex Eberle, Michelle McHugh

Date: ~~4/19/17~~ AE 9-7-2017

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	CR1	Undercut bank / rootmats
2	CR1	Typical Substrate, Riffle
3	CR1	Typical substrate
4	CR1	Emergent vegetation
5	CR1	Effluent Pipe, Stream Alteration (upstream Facing)
6	CR1	Pool downstream of reach stream Alteration
7	CR1	Stream Alteration (Downstream Facing)
8	CR1	Undercut Banks
9	CR1	Undercut Bank / Rootmats
10	CR1	Typical Substrate, Pump station ?, Stream Overview (Upstream Facing)
11	CR1	Undercut Bank / Rootmats
12	CR1	Emergent Vegetation
13	CR1	Stream Overview, (Upstream Facing)

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR3 DATE: 9-14-17 LAT: 38.0912102 LONG: -84.5019188

INVESTIGATOR(S) Alex Eberle Michelle McHugh COWARDIN CLASS: ___ WATERSHED Cane Run

STREAM SIZE: AE

Width ~~(Ft)~~ ~~100 m~~ 5M

Depth (Ft) ___

Reach (Ft) 100M

STREAM TYPE:

Perennial X

Ephemeral ___

Intermittent ___

IMAGE ID:

IMG ___

IMG ___

IMG ___

IMAGE COMMENT:

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 12	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 13	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 20	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 19	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 20	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 13	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 9 *RB Score* 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 8 *RB Score* 8	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 9 *RB Score* 2	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

REMARKS / NOTES:

Effluent pipe coming

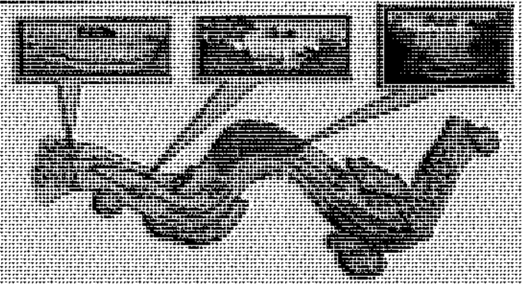
Habitat ~~looks good~~ looks good but not very many benthic invertebrates present, there was a large turtle present.

Stream has potential to be a good habitat.

STREAM ID 0

Sampler: Alex Eberle & Michelle McHugh **Reach:** CR3 **Date:** 09-14-17

Substrate Characterization (Visual Estimate)



1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns.
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each

Substrate	Riffle 20 %	Run 75 %	Pool 5 %	Reach total
Silt/Clay (<0.06 mm)	0	0	0	
Sand (0.06 – 2 mm)	15	10	35%	60%
Gravel (2-64 mm)	10	10	0	60%
Cobble (64-256mm)	75	5	5	85%
Boulders (>256mm)	0	0	0	0
Bedrock	0	75%	60%	135%

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	0
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	5
Isopod	250
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	4
Total	34

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms

Sampler(s): Alex Eberle & Michelle McHugh **Date:** 09-14-17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	CR3	Riffle
2	CR3	Typical in-stream habitat
3	CR3	Riffle
4	CR3	Riffle
5	CR3	undercut bank
6	CR3	undercut bank / rootmat
7	CR3	Bedrock bottom
8	CR3	Bedrock Bottom
9	CR3	Bedrock Bottom
10	CR3	Submergent vegetation
11	CR3	Submergent vegetation
12	CR3	Effluent Pipe (upstream of Reach)
13	CR3	Undercut Bank
14	CR3	Bedrock Bottom
15	CR3	Tributary formation
16	CR3	Channel Alteration

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR4 **DATE:** 3-22-17 **LAT:** 38.08563° **LONG:** 84.49644°

INVESTIGATOR(S) Brandon, Michelle **COWARDIN CLASS:** ___ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	14.5ft	Perennial		IMG	
Depth (Ft)	.25ft	Ephemeral	✓	IMG	
Reach (Ft)	300ft	Intermittent		IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 13	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 19	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 4	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 17	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 1	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 17	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 0	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 7 RB Score 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 7 RB Score 7	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 4 RB Score 3	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

104

REMARKS / NOTES: Stream was Dry with stream bed ~~mostly~~ B.I. exposed completely until the end of the 300ft Reach.

Bush honeysuckle was present.

Stream Width - 3.8m

6.1m

4.7m

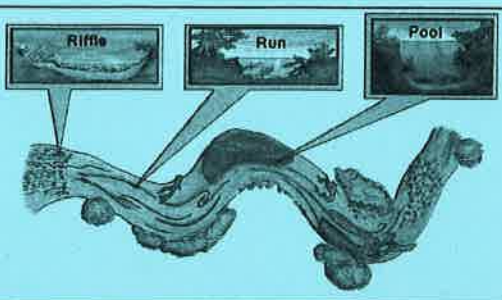
Avg Width 4.86m

STREAM ID 0

Sampler: Brandon Michelle **Reach:** CR4 **Date:** 3-22-17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle ___ %	Run ___ %	Pool 2 %	Reach total
Silt/Clay (<0.06 mm)				5
Sand (0.06 – 2 mm)				10
Gravel (2-64 mm)				~~75~~ 80
Cobble (64-256mm)				5
Boulders (>256mm)				
Bedrock				

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	1
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	1
Isopod	30 + 32 = 64
Non-operculate Snail	2
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Note: Stream was mostly Dry for entire Reach with whole Streambed exposed Unable to perform Riffle, Run, and Pool percentage assessment. Substrate assessment performed for entire Reach.

Sampler(s): Michele McHugh Brandon Thorpe **Date:** 3/22/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
CR4-01	CR4.	Shows stretch of bank with erosion control mats, looking downstream
CR402	CR4.	Shows clear view of erosion control mats
CR4-03	CR4.	Benthic sampling site at end of reach looking downstream,
CR4-04	CR4.	Benthic sampling site at end of reach scoop of leaf pack
CR4-05	CR4.	End of reach looking downstream. pools present in this area
CR4-06	CR4.	Bottom of reach looking upstream, shows beginning of pools ~~and~~ MM
CR4-07	CR4.	Midreach, shows inlet from F1 reach
CR4-08	CR4.	Midreach, shows isolated pools of water. Benthic macroinvertebrates were found in these pools
CR4-09	CR4.	Isolated pools under bridge looking downstream
CR4-10	CR4.	Midreach looking downstream
CR4-11	CR4	Midreach looking upstream
CR4-12	CR4	Shows riparian vegetation at midreach looking upstream
CR4-13	CR4.	Top of reach looking downstream, shows undercut banks on left bank
CR4-14	CR4.	Top of reach looking upstream
CR4-15	CR4	Shows undercut banks looking upstream at top of reach on left bank
CR4-16	CR4	shows undercut banks at top of reach ~~look~~

(2)

THIRD ROCK CONSULTANTS, LLC

STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID Cane Run (CR5) **DATE:** 3/27/17 **LAT:** 38.07968 N **LONG:** 084.49273 W

INVESTIGATOR(S) Corby + Michelle **COWARDIN CLASS:** / **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)		Perennial		IMG	
Depth (Ft)		Ephemeral		IMG	
Reach (Ft)	328	Intermittent		IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 17	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 11	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score [illegible]	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 17	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 20	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration 19 Score 19	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score [illegible]	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 9 RB Score 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 8 RB Score 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 8 RB Score 2 Total Score 0	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

107

REMARKS / NOTES:

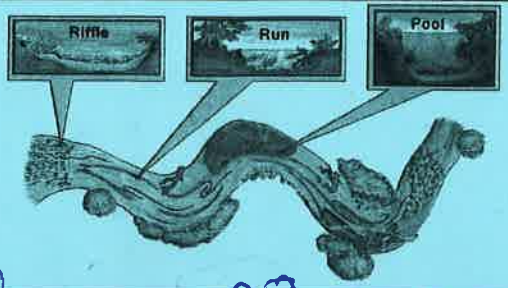
5.6
4.4
9.7
6.2
8.85
7.2

STREAM ID 0

Sampler: Corby Smith & Michelle McWug **Reach:** Cane Run (CRS) **Date:** 3/27/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 0 %	Run 0 %	Pool 20 %	Reach total
Silt/Clay (<0.06 mm)				20
Sand (0.06 – 2 mm)				20
Gravel (2-64 mm)				15
Cobble (64-256mm)				10
Boulders (>256mm)				5
Bedrock				30

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	1
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	
Isopod	24
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	1
Total	26

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Leafpack
→
4 SOWBUGS

Scoop
1 clam

Kick BR
20 sowbugs
1 worm

Sampler(s): Michell McHugh ; Corby **Date:** 3/27/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
CR5-01	CR5	Midpoint of reach, shows undercut banks, deepest pool of reach
CR5-02	CR5	Midpoint of reach looking upstream, shows bedrock and point bar
CR5-03	CR5	Midpoint of reach looking downstream, shows undercut banks, point bar, ~~erosion~~ bank erosion,
CR5-04	CR5	Top of reach looking upstream, shows substrate characteristics
CR5-05	CR5	Top of reach, shows drainpipe, undercut bank, bedrock
CR5-06	CR5	Shows bedrock, sediment deposition,
CR5-07	CR5	Bottom of reach looking downstream, shows substrate characteristics, bedrock bottoms
CR5-08	CR5	Bottom of Reach upstream,
CR5-09	CR5	Bottom of Reach looking upstream, shows bedrock bottom, substrate ~~characterizatio~~ characteristics
CR5-10	CR5	Shows hardening of stream to allow for vehicle crossing,
CR5-11	CR5	Shows undercut banks and substrate characteristics
CR5-12	CR5	Bedrock sampling site, located at bottom of reach
CR5-13	CR5	Bedrock sampling site, located at bottom of reach
CR5-14	CR5	Silt, sand, gravel sampling site
CR5-15	CR5	Drainage holes, this area contained water upon arrival but drained into holes in sediment, shows area of greatest erosion
CR5-16	CR5	Leaf pack sampling site, located at midreach, also shows bedrock and undercut banks
CR5-17	CR5	Shows water draining into holes in stream bed

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR-9 **DATE:** 4/29/17 **LAT:** 38.06216 **LONG:** 084 46 556

INVESTIGATOR(S) Alex Eberle & thomas Ball **COWARDIN CLASS:** ___ **WATERSHED** Cane run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	0	Perennial		IMG	
Depth (Ft)	0	Ephemeral	✓	IMG	
Reach (Ft)	100	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 0	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 0	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 0	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 0	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 0	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 0	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 0	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 1 *RB Score* 2	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 2 *RB Score* 2	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 1 *RB Score* 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0 9				

REMARKS / NOTES:

FLOWS towards GOLden Coral
no water Present at time of Characterization
LOTS of Trash
surrounding area is mowed.

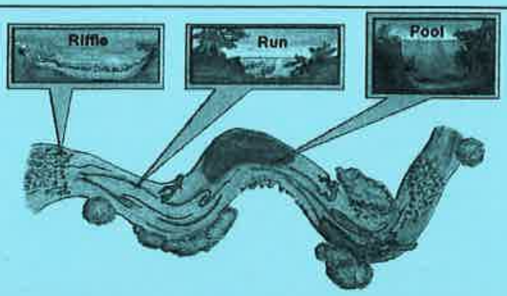
Ground Hog Burrow at end of reach

STREAM ID 0

Sampler: Thomas Boze **Reach:** CR9 **Date:** 4/29/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle____%	Run ____%	Pool____%	Reach total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	no water	present		
Gravel (2-64 mm)	Bottom	was sand/clay		
Cobble (64-256mm)				
Boulders (>256mm)				
Bedrock				

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	0
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	0
Isopod	0
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	0
Total	0

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Alex Eberle & Thomas Bell **Date:** 4/29/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	CR9	Trash Typical Substrate
2	CR9	Trash, Riffle, Typical substrate
3	CR9	overview of Reach
4	CR9	stream dissappears under dirt Road.
5	CR9	culvert downstream of Reach
6	CR9	Sanitary sewer adjacent to stream
7	CR9	overview of Reach
8	CR9	overview of Reach, Facing downstream
9	CR9	Trash, Typical substrate
10	CR9	undercut Bank
11	CR9	small stream south of reach Feeding CR9
12	CR9	undercut Bank/Rootmat
13	CR9	Trash pollution
14	CR9	overview of Reach
15	CR9	Trees in middle of stream.

±19Ft.

THIRD ROCK CONSULTANTS, LLC

STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID A1 **DATE:** 4/21/17 **LAT:** N38.11607 **LONG:** W 84.52719

INVESTIGATOR(S) Alex Eberle & Thomas Ball **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	.5M	Perennial		IMG	
Depth (Ft)	<.5M	Ephemeral		IMG	
Reach (Ft)	100M	Intermittent	X	IMG	

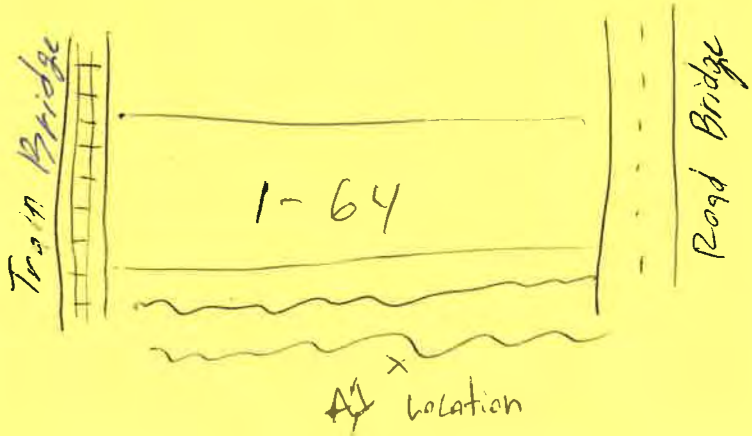
HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 5	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 11	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 9	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 2	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 5	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 6	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 1	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

8. Bank Stability	**OPTIMAL**	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	10 9	8 7 6	5 4 3	2 1 0
LB Score i RB Score 1	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 1 RB Score 2	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 1 RB Score 5	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

42

REMARKS / NOTES:

Right next to I-64, used railroad tracks leading from Kearney Rd. to access location. Very ~~us~~ unstable banks, clear channelization & high flooding likely during rain events. Steeper gradient on the right bank with heavy sediment deposition. Heavy ~~algae~~ algae (blue-green) in stream. Lots of thorns in area.

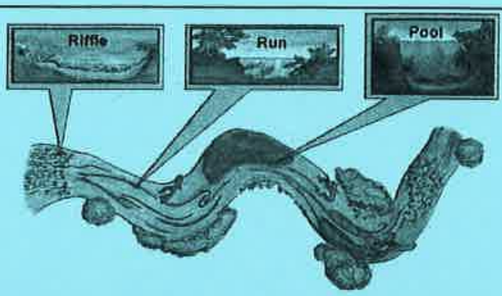


STREAM ID 0

Sampler: Alex Eberle & Thomas Boll **Reach:** A1 **Date:** 4/21/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 0 %	~~Run~~ Glide 100 %	Pool 0 %	Reach total
Silt/Clay (<0.06 mm)	0	70 %	0	
Sand (0.06 – 2 mm)	0	10 %	0	
Gravel (2-64 mm)	0	10 %	0	
Cobble (64-256mm)	0	5 %	0	
Boulders (>256mm)	0	4 %	0	
Bedrock	0	1 %	0	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	>30
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	>30
Isopod	>30
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	>30
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Alexander Eberle, Thomas Ball **Date:** 4/21/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	A1	Bank undercuts (Rb)
2	A1	Bank Undercuts 2(Rb)
3	A1	Center of Reach, Culvert under I-64
4	A1	Facing downstream @ upstream end of Reach, Leaf packs, submerged vegetation
5	A1	Facing upstream of reach
6	A1	High sediment deposition, Trash
7	A1	Train bridge upstream of reach
8	A1	Trash, submerged vegetation, Leaf packs
9	A1	Typical substrate

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID Cane RUN (A2) **DATE:** 4/18/17 **LAT:** N 38.02180 **LONG:** W 84.51035

INVESTIGATOR(S) Coby + Alex **COWARDIN CLASS:** ____ **WATERSHED** Cane RUN

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	1 M	Perennial	X	IMG	
Depth (Ft)	<.5M	Ephemeral		IMG	
Reach (Ft)	100M	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 9	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 5	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 8	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 3	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 7	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 7	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 11	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 2 *RB Score* 2	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 6 *RB Score* 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 2 *RB Score* 2	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

70

REMARKS / NOTES:

culvert ~35 m wide

Lots of undercut banks

high embededness

Broken silt fence

Evidence

Nienwochood adjacent

Upstream of Georgetown RD/US25

Time: 6:18 pm

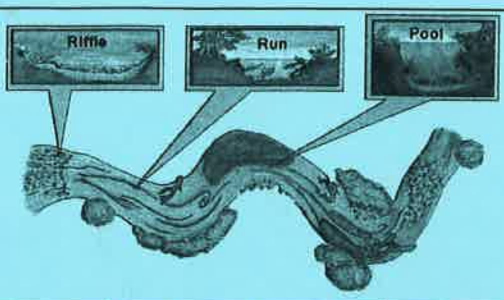
Has been raining recently

STREAM ID 0

Sampler: Corby + Alex **Reach:** Cane Run ([illegible]) **Date:** 4/18/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 20 %	Run 80 %	Pool 0 %	Reach total
Silt/Clay (<0.06 mm)	~~[illegible]~~ 15%	70%	0	
Sand (0.06 – 2 mm)	~~[illegible]~~ 30%	10%	0	
Gravel (2-64 mm)	~~[illegible]~~ 20%	5%	0	
Cobble (64-256mm)	5% 30%	5%	0	
Boulders (>256mm)	~~[illegible]~~ 50%	10%	0	
Bedrock	~~[illegible]~~ 0%	0%	0	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	0
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	30+
Isopod	130+
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	卌|||
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Cody + Alex **Date:** 4/16/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	A2	Aquatic Vegetation in Riffle
2	A2	Bank Undercuts (Rb)
3	A2	Bank Undercuts 2 (Rb)
4	A2	Culvert Filter Facing Downstream, Leaf Packs
5	A2	culvert filter Facing Upstream
6	A2	Erosion Control on Rb of reach
7	A2	Failed silt Fence on Lb near reach
8	A2	Log in stream, leaf packs
9	A2	Riffle 2
10	A2	Riffle, Drainage from adjacent Neighborhood
11	A2	Riparian Zone, Bank Cut
12	A2	Road above Culvert 2
13	A2	Road above Culvert
14	A2	Sewer Pressure Pipe warning 2
15	A2	sewer pressure pipe warning
16	A2	Typical substrate

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID B1 **DATE:** 3/25/17 **LAT:** N 38.11024 **LONG:** W 084.50893

INVESTIGATOR(S) Thomas Boll Alex Eberle **COWARDIN CLASS:** ___ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	0	Perennial		IMG	
Depth (Ft)	0	Ephemeral	✓	IMG	
Reach (Ft)	100 M	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 1	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 2	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 0	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 1	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 0	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 13	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 0	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 3 RB Score 3	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 7 RB Score 7	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width AE 4 LB Score ~~8~~ 4 RB Score ~~7~~	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0 45				

REMARKS / NOTES:

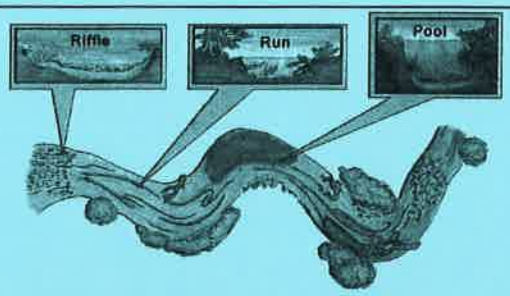
Stream Bed was dry at the time of characterization. More Notes in digital excel copy.

* Stream Bed was Dry at time of sampling *

Sampler: Alex Eberle & Thomas Boll **Reach:** B1 **Date:** 3/25/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 0 %	Run 0 %	Pool 0 %	Reach total
Silt/Clay (<0.06 mm)	0	0	0	0
Sand (0.06 – 2 mm)	0	0	0	0
Gravel (2-64 mm)	0	0	0	0
Cobble (64-256mm)	0	0	0	0
Boulders (>256mm)	0	0	0	0
Bedrock	0	0	0	0

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	0
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	0
Isopod	0
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	0
Total	0

* No Samples taken *

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Alex Eberle & Thomas Ball **Date:** 3/25/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	B1	upstream End of Reach, Facing Downstream
2	B1	Center of Reach, Facing ~~Downstream~~ AE Upstream
3	B1	Center of Reach, Facing Downstream
4	B1	Evidence of drainage from agriculture field. *Flows into reach on left bank.
5	B1	Evidence of vegetative Buffer restoration
6	B2	Downstream End of Reach facing upstream
7	B1	Downstream End of Reach Facing Downstream * Shows Highway & culvert.

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID C1 **DATE:** 3-28-17 **LAT:** 38.10414 **LONG:** 84.50513

INVESTIGATOR(S) Brandon Michell **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	5.16ft	Perennial		IMG	
Depth (Ft)	1.3ft	Ephemeral		IMG	
Reach (Ft)	300ft	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 6	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 7	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 13	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 9	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 20	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) 11.5m 16m 9.3 36.8÷3 12.26 Score 13	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 9 RB Score 9	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 7 RB Score 7	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 7 RB Score 8	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0 130				

REMARKS / NOTES:

Width 2.3
2
1
1
6.3m/4 = 1.575m = 5.16ft

12.26m/1.575m
1.575
= 8:1

[illegible]
14.

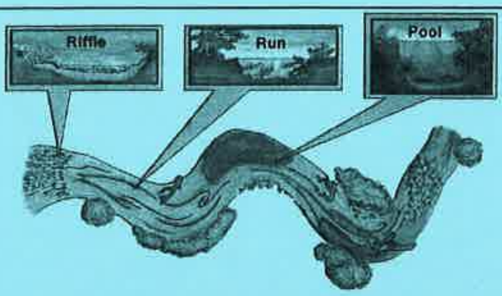
• Lots of Recent (past 5 years) and on going Construction near Reach.

STREAM ID 0

Sampler: Brandon, Michelle **Reach:** C1 **Date:** 3-28-17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 20 %	Run 10 %	Pool 70 %	Reach total
Silt/Clay (<0.06 mm)		25	80	59%
Sand (0.06 – 2 mm)	20	25	5	10%
Gravel (2-64 mm)	80	50	5	25%
Cobble (64-256mm)			10%	7%
Boulders (>256mm)				0%
Bedrock				0%

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	1
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	4
Isopod	
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Michele McHugh & Brandon Thorpe **Date:** 3/28/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
C1-01		Top of reach looking upstream, ~~to shows~~
C1-02		Middle of reach looking upstream, shows riparian vegetation zones
C1-03		Middle of reach looking downstream, shows possible remeandering of stream, ~~ripa~~ common riparian vegetation shown
C1-04		Bottom of reach looking downstream,
C1-05		Shows substrate covered in sediment, this was greatest area of embeddedness, located at top of reach.
C1-06		Shows site for scoop sample
C1-07		Riffle sampling site, width of stream is very narrow through here, mix of ~~cobble and~~ gravel substrate and vegetation
C1-08		Riffle sampling site, substrate here is mostly gravel with some sand
C1-09		Riffle sampling site, substrate here was mostly gravel ~~of t~~
C1-10		Riffle sampling site 4, shows some point bar formation.
C1-11		~~Erosion~~ ent shows erosion entering stream. Picture was taken at grass line at end of Walcer Way overlooking top of reach

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID C2 COVENTRY TRIB 2 **DATE:** 4/11/17 **LAT:** N 38.09953 **LONG:** W 084.51065

INVESTIGATOR(S) Amanda Stephens Corby Smith **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		STREAM TYPE:		IMAGE ID:	IMAGE COMMENT:
Width (Ft)	1.87m	Perennial	X	IMG	
Depth (Ft)	<.5m	Ephemeral		IMG	
Reach (Ft)	100m	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 15	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 18	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 11	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 14	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 14	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 19	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 18	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 6 *RB Score* 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 7 *RB Score* 4	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 9 *RB Score* 9	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

155

REMARKS / NOTES:

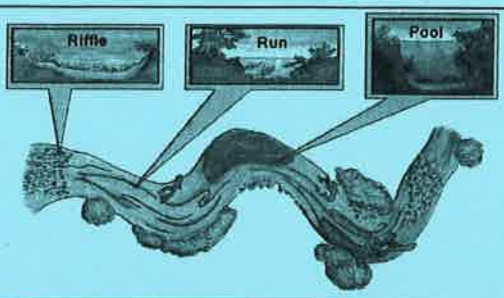
Majority Long Riffles

STREAM ID 0

Sampler: Corby Smith Amanda Stephens **Reach:** C2 (Cane Run) **Date:** 4/11/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 65 %	Run 25 %	Pool 10 %	Reach total
Silt/Clay (<0.06 mm)	5	10	15	
Sand (0.06 – 2 mm)	15	20	25	
Gravel (2-64 mm)	10	15	10	
Cobble (64-256mm)	20	20	15	
Boulders (>256mm)	30	15	10	
Bedrock	20	20	25	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	30+
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	30+
Isopod	30+
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	2
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Amanda Stephens & Corby Smith **Date:** 4/11/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	C2	End of Reach facing Downstream
2	C2	middle of stream facing upstream/ overhang vegetation
3	C2	start of reach facing upstream
4	C2	46m mark/ end of riffle/ 2nd sample spot
~~5~~	~~C2~~	~~51m mark run/pool/ 1st sample spot~~ aes
5	C2	64m mark 3rd sample area/ right bank
10	C2	80m mark + up / long, 25m length riffle facing upstream/ mostly unbedded

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID D1 **DATE:** 4/24/17 **LAT:** ____ **LONG:** ____

INVESTIGATOR(S) Cory : Michelle **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	2.85	Perennial	X	IMG	
Depth (Ft)	~~1~~ <½ m	Ephemeral		IMG	
Reach (Ft)	100 m	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 13	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score ~~12~~ 9	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 15	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 9	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 15	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 20	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) 16.5 24.2 Score 10	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

24
2.7
3.1

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 3 *RB Score* 4	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 10 *RB Score* 10	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 5 *RB Score* 3	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

126

REMARKS / NOTES:

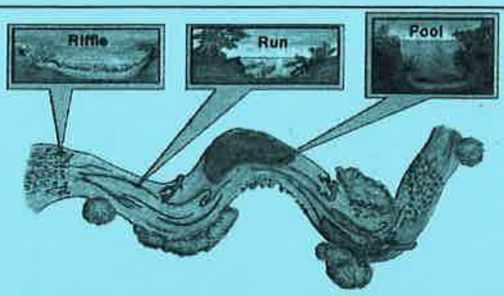
Bush honeysuckle present
algae present throughout reach

STREAM ID 0

Sampler: Corby & Michelle **Reach:** 01 **Date:** 4/24

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 20 %	Run 40 %	Pool 40 %	Reach total
Silt/Clay (<0.06 mm)	10	30	30	
Sand (0.06 – 2 mm)	10	30	30	
Gravel (2-64 mm)	50	10	~~5~~ 10	
Cobble (64-256mm)	30	30	~~25~~ 30	
Boulders (>256mm)	0	0	~~10~~ 0	
Bedrock	0	0	0	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	1
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	1 11
Clams and Mussels (non-native)	14
Alderfly Larva	
True Fly Larva – Midge	2
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	
Isopod	10 10 10
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	14 1
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Michelle & Corby
McHugh Smith

Date: 4/24/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
D1-01	D1/Cordstream Trib	Bottom of reach, stream goes through a floodgate
D1-02	D1/Cordstream Trib	Top of reach
D1-03	D1/Cordstream Trib	Scoop sampling site, shows typical bank erosion; looking upstream
D1-04	D1/Cordstream Trib	Greatest amount of bank erosion, some undercut bank present as well
D1-05	D1/Cordstream Trib	Jab sampling site
D1-06	D1/Cordstream Trib	Typical vegetation cover, bush honey-suckle provided predominant cover
D1-07	D1/Cordstream Trib	Point bar formation, located directly after bank erosion in photo D1-04
D1-08	D1/Cordstream Trib	Midreach upstream, riffle sampling site
D1-09	D1/Cordstream Trib	Midreach downstream, jab site at undercut bank and point bar formation
D1-10	D1 Cordstream Trib	Riffle sampling site

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID DP **DATE:** 4-12-17 **LAT:** 38.09922 **LONG:** 84.48468

INVESTIGATOR(S) Brandon, Corby **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	11.4ft	Perennial	✓	IMG	
Depth (Ft)	1.5 ft	Ephemeral		IMG	
Reach (Ft)	300ft	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 16	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 17	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 19	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 16	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 17	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) 24 7.8 10 13.4/3.4 = 3.5/1 Score 20	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 9 *RB Score* 9	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 8 *RB Score* 8	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 56 *RB Score* 9 *Total Score* 0	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

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REMARKS / NOTES:

Pipe Running across stream

STREAM ID 0

Sampler(s): Brandon, Corby **Date:** 4-12-17

Photo Log

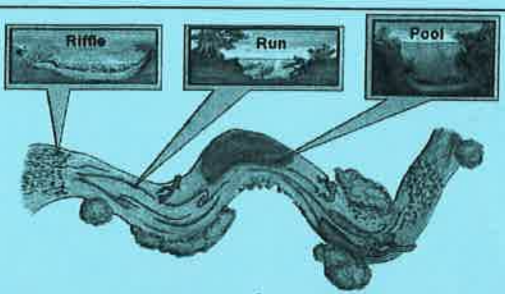
1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
D2-Reach Begining	D2	Start of Reach, upstream
D2-mid Reach, downstream	D2	mid Reach Downstream
D2-End of Reach-Down stream	D2	End of Reach Down stream
D2-pipe crossing	D2	Pipe crossing stream collecting debris
D2-Riffle	D2	only Riffle in Reach, kick taken
D2-undercut bank/Root mat	D2	undercut Banks and Root mats Jab sample taken
D2-scoop sample	D2	gravel and fine sediment grab sample taken

Sampler: Brandon Corby **Reach:** D2 **Date:** 4-12-17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 15 %	Run 35 %	Pool 50 %	Reach total
Silt/Clay (<0.06 mm)		5%	10%	
Sand (0.06 – 2 mm)	5%	10%	30%	
Gravel (2-64 mm)	25%	35	25	
Cobble (64-256mm)	70%	45%	35	
Boulders (>256mm)				
Bedrock		5%		

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	|
Riffle Beetle Larva	
Riffle Beetle Adult	|
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	~~||||~~ |
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	
Isopod	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ +20=40+
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	|||
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID E1-1 (tributary) **DATE:** 3/7/17 **LAT:** N 38.0834 **LONG:** W-84.5002

INVESTIGATOR(S) John Bernardo Anand ~ Stephens **COWARDIN CLASS:** ___ **WATERSHED** Cane Run

STREAM SIZE:
Width (Ft) 2.5m avg
Depth (Ft) <1m
Reach (Ft) 100m

STREAM TYPE:
Perennial ___
Ephemeral ___
Intermittent X

IMAGE ID:
IMG ___
IMG ___
IMG ___

IMAGE COMMENT:

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 [✓ 17] 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 [✓ 3] 2 1 0
1. Epifaunal Substrate / Available Cover Score 14	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 17	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 3	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep). scattered pools
4. Sediment Deposition Score 4	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 0	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 18	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 0	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 5 RB Score 2	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection trash LB Score 10 RB Score 10	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width trash LB Score 10 RB Score 10	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

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REMARKS / NOTES:

Lack of flow

still pools

sporadic

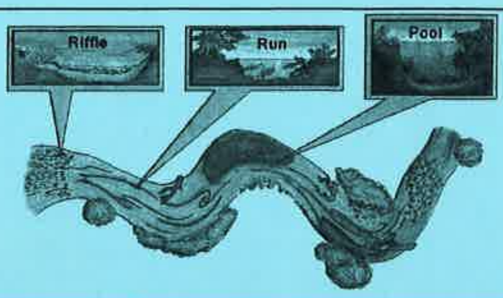
All ~~[illegible]~~ water within reach still, non moving. Broke off into sporadic pools. Never very deep.

STREAM ID 0 E 1-1 CANE RUN

Sampler: Amanda Stephens & John Bernardo **Reach:** Cane Run **Date:** 3/7/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 0 %	Run 0 %	Pool 100 %	Reach total
Silt/Clay (<0.06 mm)			40	
Sand (0.06 – 2 mm)			40	
Gravel (2-64 mm)			10	
Cobble (64-256mm)			5	
Boulders (>256mm)			5	
Bedrock				

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	0
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	0
Isopod	0
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	1
Total	1

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Amanda stephens + John Bernardo **Date:** 3/7/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

CANE RUN

Photo ID	Reach / Site	Description
1	E1-1	middle Downstream
2	E1-1	Middle Upstream
3	E1-1	Begining of Reach ~~Upstream~~ facing downstream 1st sampling area kick/swish
4	E1-1	35 m from start of Reach stream begins to die off downstream
5	E1-1	A End of Reach pointing upstream 2nd sampling jab Deepest water/pool stream picks up slightly

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID D2-1 Winburn trib. **DATE:** 4/25/17 **LAT:** 38.0934 **LONG:** -84.4821

INVESTIGATOR(S) Tony c̄ Michele **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	2m	Perennial		IMG	
Depth (Ft)	<.5m	Ephemeral		IMG	
Reach (Ft)	~~100m~~ 66m	Intermittent	X	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
1. Epifaunal Substrate / Available Cover Score 0	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness 16 Score	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime 1 Score	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition 16 Score	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status 6 Score	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 0	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) 1 Score	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 4 *RB Score* 3	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 0 *RB Score* 0	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 0 *RB Score* 0	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

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REMARKS / NOTES:

- On Golf Course
- Not enough space for 100m reach
- Storm water pipe present in middle of reach (picture enclosed)
- Most of Creek Bottom covered in algae
- Gabion makes up most if not all of the stream
- Evidence of past flooding

STREAM ID 0

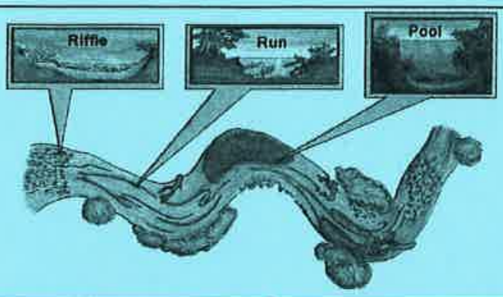
Sampler: Tony &
Michele

Reach: D2-1 Winburn trib.

Date: 4/25/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 5 %	Run 50 %	Pool 45 %	Reach total
Silt/Clay (<0.06 mm)	0	0	0	
Sand (0.06 – 2 mm)	0	0	0	
Gravel (2-64 mm)	50	50	50	
Cobble (64-256mm)	50	50	50	
Boulders (>256mm)	0	0	0	
Bedrock	0	0	0	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	
Isopod	
Non-operculate Snail	1
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	30+ only one leech
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Michele McHugh + John Bernardo **Date:** 4/25/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
D2-1-01	D2-1 / Winburn trib	Midreach upstream, shows entire upstream reach, lack of riparian zone, bank stabilization measures
D2-1-02	D2-1 / Winburn trib	Midreach downstream, lack of riparian zone, bank stabilization measures
D2-1-03	D2-1 / Winburn trib	Typical algae colonization for entire reach. algae surrounded substrate
D2-1-04	D2-1 / Winburn trib	Bottom of reach, down stream
D2-1-05	D2-1 / Winburn trib	storm water inlet
D2-1-06	D2-1 / Winburn trib	upstream of top of reach
D2-1-07	D2-1 Winburn trib	stream bank stabilization
D2-1-08	D2-1 Winburn trib.	Riffle sampling site

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID E1 **DATE:** 3-7-17 **LAT:** 38.08424° **LONG:** 084.49953°

INVESTIGATOR(S) Brandon Thorpe, Corby Smith **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	12.3ft	Perennial	✓	IMG	
Depth (Ft)	.6ft	Ephemeral		IMG	
Reach (Ft)	100ft	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 18	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 17	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 20	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 16	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 15	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 12	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) 5:1 Score 19	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 7 *RB Score* 4	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 9 *RB Score* 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 10 *RB Score* 5	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0 163				

REMARKS / NOTES:

STREAM ID E1

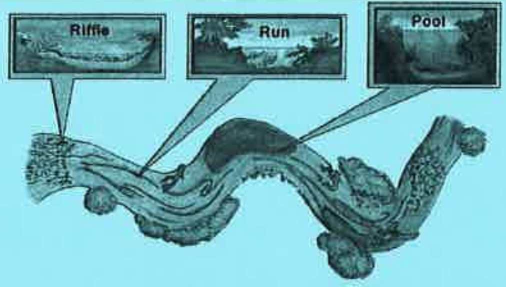
Sampler: Brandon Thorpe
Corby Smith

Reach: E1

Date: 3-7-12

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 55 %	Run 15 %	Pool 30 %	Reach total
Silt/Clay (<0.06 mm)	0	0	15%	
Sand (0.06 – 2 mm)	0	10%	20	—
Gravel (2-64 mm)	10 %	10%	40	
Cobble (64-256mm)	15 %	5%	25	
Boulders (>256mm)	0	0	0	
Bedrock	75 %	75%		

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	13
Isopod	16
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	3
Total	32

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Cody Smith & Brandon Thorpe **Date:** 3/7/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
2	E1	Downstream Reach-Riffle (Kick)
3	E1	Downstream Reach Slabrock/Kick
4	E1	Mid stream (Jab) undercut Bank
5	E1	mid stream (Scoop) Fine sediment
6	E1	Upstream Riffle (Kick)
7	E1	Upstream Riffle (Kick)
8	E1	Upstream Riffle (Kick)
9	E1	Upstream leaves (Scoop)
10.	E1	upstream Reach Boundry
1	G1	Downstream Reach Boundry.

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID E 2 **DATE:** 3-12-2017 **LAT:** N38.07269 **LONG:** W084.49827 ± 20F

INVESTIGATOR(S) Alex & Thomas **COWARDIN CLASS:** ____ **WATERSHED** Cane run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (~~Ft~~) AE	2m	Perennial	✓	IMG	
Depth (~~Ft~~)	>.5m	Ephemeral		IMG	
Reach (~~Ft~~)	100m	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 16	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 17	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 7	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 13	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 7	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 14	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 16	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

		OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
		10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability	*LB Score* 2 *RB Score* 5	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection	*LB Score* 8 *RB Score* 9	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width	*LB Score* 9 *RB Score* 10	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score	0				

133

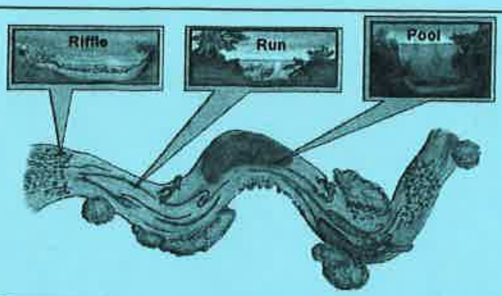
REMARKS / NOTES:

STREAM ID 0 ________________

Sampler: Alex & Thomas **Reach:** E2 **Date:** 3/12/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 40 %	Run 60 %	Pool 0 %	Reach total
Silt/Clay (<0.06 mm)	10%	10%		
Sand (0.06 – 2 mm)	5%	10%	Left	
Gravel (2-64 mm)	20%	10%		
Cobble (64-256mm)	5%	30%		
Boulders (>256mm)	50%	20%	Blank	
Bedrock	10%	20%	AE	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	0
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	12
Isopod	95 ~~93 94~~ AE
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	2
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Thomas Bell, Alex Earle **Date:** 3/12/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	E2	Upstream End of Reach Facing Downstream
2	E2	Center of Reach Facing Upstream
3	E2	Center of Reach Facing Downstream
4	E2	Downstream End of Reach Facing Upstream
		Note: Discussed photos - will
		take additional in future. JW

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID F1 **DATE:** 3-21-17 **LAT:** N 38.08694 **LONG:** W 084.49461

INVESTIGATOR(S) Brandon & Michele **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	4.7ft	Perennial		IMG	
Depth (Ft)	2in.	Ephemeral	X	IMG	
Reach (Ft)	300ft.	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 10	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 19	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 0	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 20	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 0	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 10	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 0	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 8 *RB Score* 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 4 *RB Score* 5	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 1 *RB Score* 2	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

83

REMARKS / NOTES:

Very little water was present in this stream.

Bush honeysuckle was the predominant vegetation.

Half of the reach was a concrete/Steel culvert.

Algae was present at the top of the reach at the culvert outlet.

1.1
1.5
1.7
4.3/3

1.43

1.1
1.5
0.7
3.3/3

avg
1.1

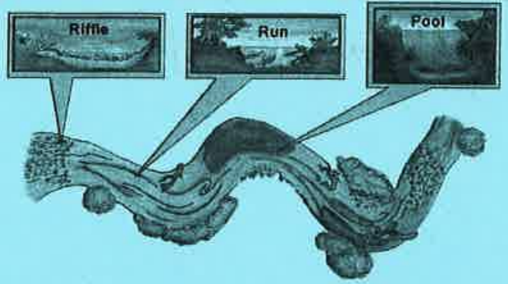
STREAM ID 0

Michele McHugh
Sampler: Brandon Tharpe **Reach:** P1 **Date:** 3-21-17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each

Note on back



Substrate	Riffle 0 %	Run 0 %	Pool 0 %	Reach total
Silt/Clay (<0.06 mm)				5%
Sand (0.06 – 2 mm)				5%
Gravel (2-64 mm)				10
Cobble (64-256mm)				80%
Boulders (>256mm)				0%
Bedrock				

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	
Isopod	6
Non-operculate Snail	3
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	
Total	9

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Note: This reach was dry. The substrate assessment was for entire reach excluding the areas that are culverts.

Sampler(s): Michelle McHugh Brandon Thorpe **Date:** 3/21/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
F101	F1	Bottom of Reach, ends in a culvert, looking downstream
F102	F1	Bottom of Reach upstream, ~~most of r~~ half of reach was culvert
F103	F1	Midpoint of reach, downstream. runs through culvert
F104	F1	Mid point upstream, very little water, mostly cobble substrate
F105	F1	Sampling site, very shallow pool, looking upstream
F106	F1	Sampling site, looking downstream
F107	F1	Sampling site, greatest amount of pooled water in 300 ft-reach shown
F108	F1	~~Top of reach, looking upstream. Presence of algae~~ Top of reach looking upstream, algae presen
F109	F1	Top of reach looking downstream

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID Cgl Loudon Trib 1 **DATE:** 4/19/17 **LAT:** N39.0785 **LONG:** W084.4562

INVESTIGATOR(S) Brandon Thorpe
Amanda Stephens **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	5.8	Perennial	X	IMG	
Depth (Ft)	<.5m	Ephemeral		IMG	
Reach (Ft)	100 m	Intermittent		IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 3	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 3	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 4	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 9	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 17	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 12	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 1	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 2 *RB Score* 4	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 7 *RB Score* 9	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 6 *RB Score* 5	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

82

REMARKS / NOTES:

- Honey suckle present

- Riffles

  1 barely at beginning of reach + 1 right after the end of Reach. 100 m + distance difference between Riffle

- Mostly deep, stagnant pools, very fine sediment

- stream seems dead of life (besides isopods + Geese

STREAM ID 0

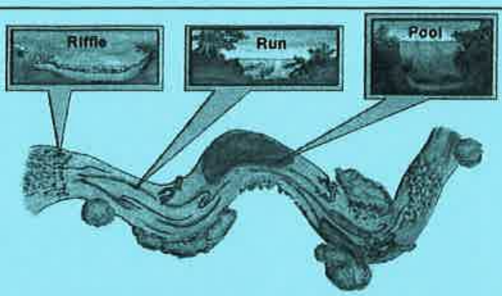
Sampler: Brandon Thorpe
Amanda Stephens

Reach: Gr1

Date: 4/19/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 5 %	Run 25 %	Pool 70 %	Reach total
Silt/Clay (<0.06 mm)	25	40	45	
Sand (0.06 – 2 mm)	25	4	50	
Gravel (2-64 mm)	5	10	5	
Cobble (64-256mm)	40	5	[illegible]	
Boulders (>256mm)	5	5	[illegible]	
Bedrock	0			

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	?
Isopod	30+
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	1
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Amanda Stephens & Brandon Thorpe **Date:** 4/19/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1 A	G1	start of Reach facing upstream
2 B	G1	end of reach facing upstream away from reach
3 A	G1	1st sample Top of only riffle (looks man made)
4 B	G1	2nd sample under cut
5 B	G1	middle of reach facing upstream

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID G2 **DATE:** 4/25/17 **LAT:** N38.06577 **LONG:** W 84.48772

INVESTIGATOR(S) Alex Eberle & thomas Ball **COWARDIN CLASS:** ___ **WATERSHED** ___

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
.8m 2.5m 1M Width (Ft)	1.6M	Perennial	X	IMG	
Depth (Ft)	<.5M	Ephemeral		IMG	
Reach (Ft)	100M	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 12	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 16	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 6	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 15	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 9	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 16	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 6 *RB Score* 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 9 *RB Score* 9	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 1 *RB Score* 2	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

123

REMARKS / NOTES:

Near LEX 18 news station

downstream from train culvert

~~upstream~~ TB upstream from Road/bridge

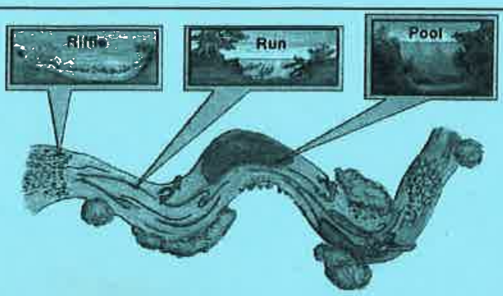
surrounding trees (Ash, silver maple) are 20+ years in age, so stream has been in existant for awhile.

STREAM ID 0

Sampler: Alex Eberle & Thomas Boll **Reach:** G2 **Date:** 4/25/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 20 %	Glide ~~Run~~ 80 %	Pool 0 %	Reach total
Silt/Clay (<0.06 mm)	0	10		
Sand (0.06 – 2 mm)	50	40		
Gravel (2-64 mm)	~~50~~ 40	~~40~~ 40		
Cobble (64-256mm)	~~0~~ 10	10		
Boulders (>256mm)	0	0		
Bedrock	0	0		

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	30 +
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	30 +
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	1
Isopod	9
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	30 +
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Alex Eberle & Thomas Boll **Date:** 4/25/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	G2	undercut bank/rootmat
2	G2	Typical substrate
3	G2	undercut bank/rootmat
4	G2	undercut bank, sediment deposition
5	G2	Typical Riffle
6	G2	Typical Substrate
7	G2	Riparian Zone, Facing downstream of reach
8	G2	Riparian zone, facing upstream
9	G2	Thalweg
10	G2	Riffle

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID H1 Hollow Creek • **DATE:** 4/19/17 **LAT:** 38.0778 **LONG:** -84.4813

INVESTIGATOR(S) John Bernardo, Michele Hikes **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	1.7m	Perennial		IMG	
Depth (Ft)	<1m	Ephemeral		IMG	
Reach (Ft)	100m	Intermittent	X	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover 5 Score	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness 6 Score	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime 2 Score	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition 13 Score	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status 10 Score	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration 6 Score	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) 3 Score	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability 8 LB Score RB Score 9	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection 6 LB Score RB Score 5	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 0 RB Score 0	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

73

REMARKS / NOTES:

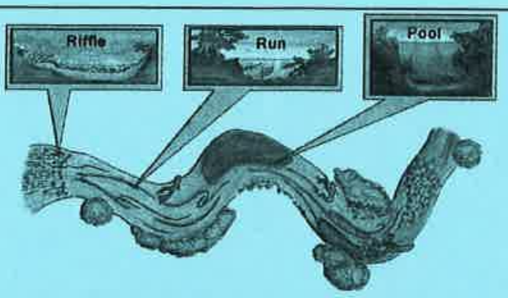
- Overflow tank for Sanitary sewer system at top and bottom of Reach

STREAM ID 0

Sampler: Tony & Michele **Reach:** H1 Hollow Creek **Date:** 4/19/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 15 %	Run 15 %	Pool 70 %	Reach total
Silt/Clay (<0.06 mm)	5	30	40	
Sand (0.06 – 2 mm)	5	30	40	
Gravel (2-64 mm)	40	25	10	
Cobble (64-256mm)	40	10	0	
Boulders (>256mm)	0	0	0	
Bedrock	10	5	10	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	30+
Isopod	30+
Non-operculate Snail	5
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	9
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Michele McHugh & John Bernardo **Date:** 4/19/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
H1-01	H1 / Hollow Creek	downstream of middle of reach
H1-02	H1 / Hollow Creek	upstream of middle of reach
H1-03	H1 / Hollow Creek	upstream of top of reach
H1-04	H1 / Hollow Creek	shows possible channelization at right bank of stream, underwater straight slabs of concrete present
H1-05	H1 / Hollow Creek	Sanitary sewer at top of reach
H1-06	H1 / Hollow Creek	Bank erosion
H1-07	H1 / Hollow Creek	Possible channelization at right bank, sanitary sewer in background at bottom of reach
H1-08	H1 / Hollow Creek	Bottom of reach downstream
H1-09	H1 / Hollow Creek	stabilization / erosion control mats at bottom of reach
H1-10	H1 / Hollow Creek	Riffle sampling site
H1-11	H1 / Hollow Creek	Jab sampling site
H1-12	H1 / Hollow Creek	Riffle sampling site 2
H1-13	H1 / Hollow Creek	Scoop sampling site

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID I1 Dover Trib **DATE:** 4/27/19 **LAT:** N 38.0742 **LONG:** W -84.4718

INVESTIGATOR(S) John Bernardo
Amanda Stephens **COWARDIN CLASS:** ___ **WATERSHED** Cane Run

STREAM SIZE:
Width (Ft) 4ft
Depth (Ft) <.5m
Reach (Ft) 100m

STREAM TYPE:
Perennial ___
Ephemeral ___
Intermittent x

IMAGE ID:
IMG ___
IMG ___
IMG ___

IMAGE COMMENT:

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 8	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 5	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 2	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 4	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 3	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 2	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 3	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 2 *RB Score* 3	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection 8/8 *LB Score* [illegible] *RB Score* [illegible]	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 0 *RB Score* 0	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

46

REMARKS / NOTES:

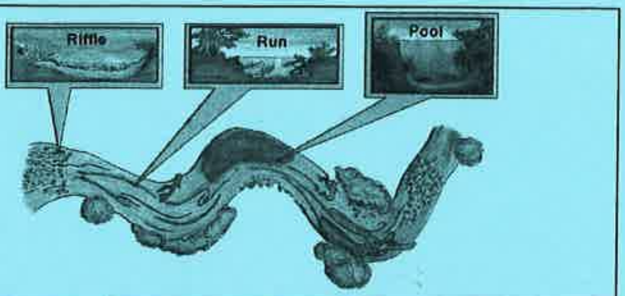
- Stream very unhealthy, summertime smells terrible mosquito happy
- 2 maybe 3 very shallow riffles
- water stagnant + shallow
- many invasive honeysuckle

STREAM ID 0

John Bernardo
Sampler: Amanda Stephens **Reach:** I1 Clare Run **Date:** 4/27/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 5 %	Run 25 %	Pool 70 %	Reach total
Silt/Clay (<0.06 mm)	10	10	10	
Sand (0.06 – 2 mm)	10	10	10	
Gravel (2-64 mm)	50	50	60	
Cobble (64-256mm)	30	30	0	
Boulders (>256mm)	0	0	0	
Bedrock	0	0	20	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	1
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	1
Isopod	3
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	4
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Amanda Stephens John Bernardo **Date:** 4/27/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1 A	I1	Start of Reach facing Downstream
2 A	I1	37m mark Appears to be small riffle facing Down stream/1st SAMple Area
3 A	I1	middle of reach stream narrows significantly
4 J	I1	Bottom of reach ~~[illegible]~~ facing upstream
5 J	I1	~~Storm Drain~~ across stream 91m mark point source
6	I1	61m mark / 2nd Sample area / deepest point of reach

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

1 17Ft

STREAM ID J1 **DATE:** 4-9-17 **LAT:** N38.0663° **LONG:** W084.46212'

INVESTIGATOR(S) Alex + Thomas **COWARDIN CLASS:** ____ **WATERSHED** Cane run

STREAM SIZE:		STREAM TYPE:		IMAGE ID:	IMAGE COMMENT:
Width (Ft)	.6m	Perennial		IMG	
Depth (Ft)	.5m	Ephemeral		IMG	
Reach (Ft)	100m	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 3	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are *not* new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 2	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 1	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 3	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 2	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 7	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 6	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB5 RB5 LB Score RB Score	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB2 RB2 LB Score RB Score	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB1 RB1 LB Score RB Score	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

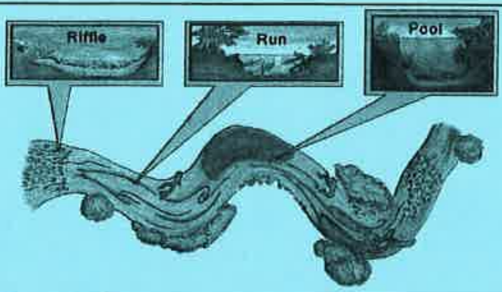
34

REMARKS / NOTES:

Sampler: Alex + Thomas **Reach:** J1 **Date:** 49

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 0 %	Run 100 %	Pool 0 %	Reach total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)				
Gravel (2-64 mm)				
Cobble (64-256mm)				
Boulders (>256mm)				
Bedrock				

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	0
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	0
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	0
Isopod	0
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	0
Total	0

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Alexander Eberle & Thomas Ball **Date:** 4/9/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	J1	Center of Reach
2	J1	Unknown Drainage Pipe (source)
3	J1	Typical Riffle habitat
4	J1	emergent vegetation
5	J1	upstream substrate
6	J1	upstream, facing downstream, Emergent vegetation
7	J1	stream cutting through yard
8	J1	Stream ~~dissap~~ disappears downstream
9	J1	typical substrate
10	J1	Sanitary sewer manhole downstream (near culvert)
11	J1	Emergent vegetation
12	J1	Culvert downstream

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID K1

DATE: 4-2-17 ~~4-1-17~~ AE

LAT: N38.08847

LONG: W084.46806 ±15 ft.

INVESTIGATOR(S) Alex Eberle, Thomas Ball

COWARDIN CLASS:

WATERSHED Cane Run

STREAM SIZE:

.7m
1.2m
2.5m

Width (Ft) $\bar{X}$= 1.5M

Depth (Ft) <.5m ~~0-.5m~~ AE

Reach (Ft) 100M

STREAM TYPE:

Perennial X

Ephemeral

Intermittent

IMAGE ID:

IMG

IMG

IMG

IMAGE COMMENT:

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 15	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 14	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 8	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 11	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 17	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 16	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 8	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

8. Bank Stability	**OPTIMAL**	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	10 9	8 7 6	5 4 3	2 1 0
LB Score 7 *RB Score* 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 10 *RB Score* 10	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 10 *RB Score* 10	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

143

REMARKS / NOTES:

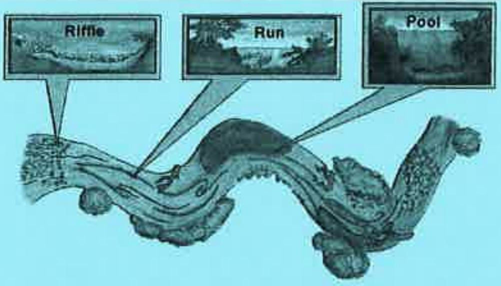
The reach was fed by a large stormwater drain at the upstream end of our reach. We were located in an area that looks like it becomes a floodplain during heavy rainfall events. there were large amounts of trash pollution seen throughout the reach thats likely brought there from the drain during flooding. At the end of our reach there was a sewer overflow station, with a warning sign. there seemed to be ample vegetation, however

STREAM ID 0 K1

Sampler: Alex Eberle & Thomas Boll **Reach:** K1 **Date:** 4-1-17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 100 %	Run 0 %	Pool 0 %	Reach total
Silt/Clay (<0.06 mm)	20%	0	0	20%
Sand (0.06 – 2 mm)	30%	0	0	30%
Gravel (2-64 mm)	15%	0	0	15%
Cobble (64-256mm)	20%	0	0	20%
Boulders (>256mm)	15%	0	0	15%
Bedrock	0	0	0	0

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	0
Mussel (Native)	0
True Fly Larva – Watersnipe Fly	0
Caddisfly Larva (case-building)	0
Mayfly Nymph	0
Water Penny Larva	0
Caddisfly Larva (net-spinner)	0
Riffle Beetle Larva	0
Riffle Beetle Adult	0
Operculate Snail	AE ~~[illegible]~~ 18
Hellgrammite (Dobsonfly Larva)	0
True Fly Larva – Crane Fly	0
True Fly Larva – Black Fly	0
Dragonfly Nymph	0
Crayfish	2
Clams and Mussels (non-native)	0
Alderfly Larva	0
True Fly Larva – Midge	0
Flatworm	0
Damselfly Nymph	0
True Fly Larva – Other	0
Scud	7100
Isopod	0
Non-operculate Snail	0
Adult Beetles (non-riffle beetles)	0
Beetle Larva (other than riffle beetles and water pennies)	0
Aquatic Worm/Leech	2
Total	120

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Alex Eberle + Thomas Boll **Date:** 4-1-17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	K1	Upstream end of reach facing upstream, (Stormdrain)
2	K1	Evidence of trash 1
3	K1	Evidence of trash 2
4	K1	Evidence of trash 3
5	K1	Evidence of trash 4
6	K1	center of Reach facing upstream
7	K1	center of reach facing downstream
8	K1	Culvert flowing underneath paved road
9	K1	Downstream End of reach facing upstream on top of culvert
10	K1	Evidence of sewer overflow. Drain into downstream End of reach.
11	K1	sewer overflow warning sign.

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID L1 Freeman tributary **DATE:** 4/7/17 **LAT:** N 38.0839 **LONG:** W -84.4565

INVESTIGATOR(S) John Bernardo Amanda Stephens **COWARDIN CLASS:** ___ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	3.2m	Perennial	✓	IMG	
Depth (Ft)	<.5m	Ephemeral		IMG	
Reach (Ft)	100m	Intermittent		IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 17	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 9	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 13	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 10	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 15	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 14	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 18	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 6 *RB Score* 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 8 *RB Score* 7	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 0 *RB Score* 0	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

124

REMARKS / NOTES:

Water very clear

Active discharge pipe + storm drain (NOTE: PICTURES)

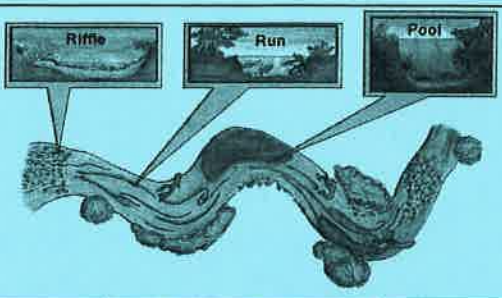
STREAM ID 0

John Bernardo

Sampler: Amanda Stephens **Reach:** Cave Run (M1) **Date:** 4/7/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 60 %	Run 25 %	Pool 15 %	Reach total
Silt/Clay (<0.06 mm)	10	40	10	
Sand (0.06 – 2 mm)	30	35	20	
Gravel (2-64 mm)	35	10	20	
Cobble (64-256mm)	5	5	25	
Boulders (>256mm)			5	
Bedrock	20	10	20	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	30 +++
Isopod	30 + ++
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Amanda Stephens & John Bernardo **Date:** 4/7/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1 A	L1	Start of Reach facing Downstream Note discharge pipe (active) on left
2 J	L1	~~Downstream~~ end of Reach facing upstream
3 J	L1	middle of Reach facing upstream
4 A	L1	middle of Reach | Deepest point 45m mark 1st sample area
5 A	L1	9m mark | second sample area / under bank
6 A	L1	60 m mark overhang vegetation facing Downstream
7 A	L1	54 m mark storm drain on right Bank

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID M-1 Laclede Trib

DATE: 4/18/17

LAT: N 38.0801

LONG: W-84.4564

INVESTIGATOR(S) John Bernardo
Amanda Stephens

COWARDIN CLASS: ____

WATERSHED Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	2.34m	Perennial	X	IMG	
Depth (Ft)	<.5m	Ephemeral		IMG	
Reach (Ft)	100 m	Intermittent		IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 10	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 11	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime b/c shallow Score 15	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 13	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 17	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 10	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 6 *RB Score* 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 7 *RB Score* 9	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 0 *RB Score* 3	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

121

REMARKS / NOTES:

Plenty of water skaters again

Shallow

OUT of Reach :- After concrete underpass, stream really picks up

- storm drain before underpass
- there was 1 fish in the underpass!

STREAM ID 0

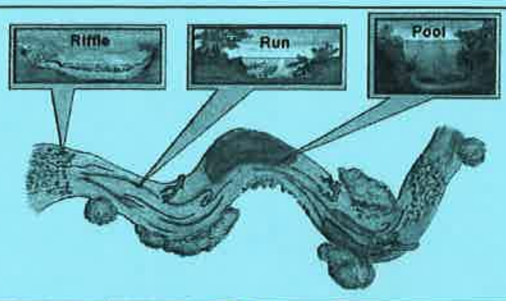
Sampler: John Bernardo
Amanda Stephens

Reach: M| CANE RUN

Date: 4/18/17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 45 %	Run 25 %	Pool 30 %	Reach total
Silt/Clay (<0.06 mm)	10	10	10	
Sand (0.06 – 2 mm)	10	25	30	
Gravel (2-64 mm)	35	30	25	
Cobble (64-256mm)	40	20	20	
Boulders (>256mm)	5	10	10	
Bedrock	0	5	5	

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	3
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	1
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	30 + +
Isopod	30 + +
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	1 + 2
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Amanda Stephens & John Bernardo **Date:** 4/18/17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1 A	M1	start of reach Facing upstream
2 J	M1	End of reach facing downstream
3 J	M1	middle of reach facing upstream
4	M1	94m mark | 1st sample spot | Kick End of riffle
5	M1	50 m mark 2 sample spot | pond deepest point
6	M1	24 m mark right bank 3rd sample spot undercut

THIRD ROCK CONSULTANTS, LLC

STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID N1 Mary Todd tributary

DATE: 3-28-17

LAT: N 38.0849

LONG: W-84.4499

INVESTIGATOR(S) John Bernardo Amanda Stephens

COWARDIN CLASS: ____

WATERSHED Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	3m	Perennial	X	IMG	
Depth (Ft)	<.5m	Ephemeral		IMG	
Reach (Ft)	100 m	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 15	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 17	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 12	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 11	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 10	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 19	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 13	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 8 RB Score 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 8 RB Score 9	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 10 RB Score 6	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

148

REMARKS / NOTES:

Flowing stream

Banks show definite signs of becoming inundated.

Rain yesterday and stream is surrounded by very muddy, wet terrain.

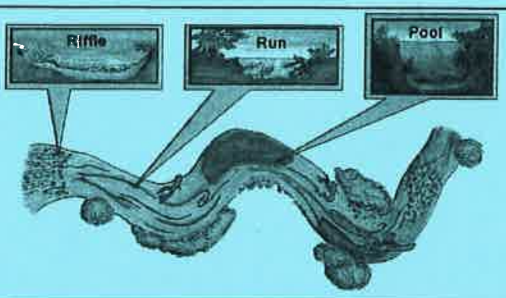
STREAM ID 0

John Bernardo

Sampler: Amanda Stephens **Reach:** N1 Cane Run **Date:** 3-28-17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 30 %	Run 25 %	Pool 45% %	Reach total
Silt/Clay (<0.06 mm)	~~35~~ 20	25	15	
Sand (0.06 – 2 mm)	20	50	30	
Gravel (2-64 mm)	45	15	25	
Cobble (64-256mm)	10	10	25	
Boulders (>256mm)			5	
Bedrock				

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	4
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	1 (baby)
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	30+
Isopod	30+
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	10
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

Sampler(s): Amanda Stephens & John Bernardo **Date:** 3-28-17

Photo Log

1. Sampling zone - *In middle of reach – either direction*
2. Upstream - *Stand at upstream point of reach and photograph upstream of the sampling zone*
3. Downstream - *Stand at downstream end of reach and photograph downstream of the sampling zone*
4. One each of any "Typical in-stream habitats": (a) riffles, (b) undercut banks/rootmats, (c) submerged and emergent vegetation, (d) bedrock bottoms, (e) leaf packs & (f) large submerged wood.

Photo ID	Reach / Site	Description
1	N1	starting point / Downstream Around partial Island
2	N1	ending of reach / up strem
3	N1	middle of stream / facing Downstream
4	N1	25 m mark / upstream Riffle/Vegetation zone
5	N1	upstream Island Vegetation
6	N1	water skaters
7	N1	sample site (Riffle + pool) 70 m downstream
[illegible]	[illegible]	

APPENDIX A-2
THIRD ROCK
SCC FIELD DATA

Prepared for Lexington-Fayette Urban County Government
Prepared by Third Rock Consultants, LLC January 16, 2018

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID Cane Run - SCC CR-B **DATE:** 2 23-17 **LAT:** 38.079446 **LONG:** -84.491493

INVESTIGATOR(S) B Ramley / C Olsen **COWARDIN CLASS:** Stream **WATERSHED:** KY

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	8	Perennial		IMG	See photo log
Depth (Ft)	6"	Ephemeral		IMG	
Reach (~~Ft~~) m	150	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 7	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 6	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 8	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 6	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 14	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 17	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

SCC CR-6

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 3 RB Score 2	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 1 RB Score 3	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 1 RB Score 4	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

84

REMARKS / NOTES: Low flow, probably does not flow year round

Lots of trash in stream

STREAM ID /, SC CR-6

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR 7 **DATE:** 5-19-17 **LAT:** 38.072416 **LONG:** -84.476463

INVESTIGATOR(S) C. Blayd **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	8-10	Perennial	✓	IMG	
Depth (Ft)	10"	Ephemeral		IMG	
Reach (Ft)	300	Intermittent		IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 10	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 13	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 13	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 11	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 19	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 11	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 7	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

CR-7

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 7 RB Score 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 3 RB Score 3	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 1 RB Score 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

105

REMARKS / NOTES:

Evidence of recent Mowing-grass clippings in creek

STREAM ID 0

General

Site ID	**Stream Name**	
CR 7	Cane Run	
Date	**Sampler(s)**	
5-19-17	C. Boyd	

Substrate Characterization

NOTE: Enter percentages as whole numbers

Substrate	Riffle %	Run %	Pool %	Reach total	Notes
% of Stream	10	20	70	0%	NOTE: Row must total 100%
Silt/Clay (<0.06 mm)				0%	NOTE: Each column must total to 100.
Sand (0.06 – 2 mm)	20	10	10	0%	
Gravel (2-64 mm)	70	60	60	0%	
Cobble (64-256mm)	10	30	30	0%	
Boulders (>256mm)				0%	
Bedrock				0%	

Macro Screening

1. Record Abundance Count, or number of organisms, from your field data sheet. Do not use ">" symbol.
2. Spreadsheet will assign an Abundance Value of 6, 3, or 1 based on the Abundance Count: >30 orgs = 6; 5-30 orgs = 3; and 1-4 orgs = 1
3. Spreadsheet multiplies each Abundance Value by the Tolerance Value to get the Tolerance Score for that type of Benthic Macroinvertebrate
4. Spreadsheet adds the entire Tolerance Score column to get Total Tolerance
5. Spreadsheet adds the entire Abundance Value column to get Total Abundance
6. Spreadsheet divides the Total Tolerance by the Total Abundance to calculate the Biotic Index
6. Spreadsheet calculates the Integrity Rating for the Bluegrass Region

Benthic Macroinvertebrates	Abundance Count	Abundance Value	Tolerance Value	Tolerance Score
Stoneflies		0	2	0
Mayflies		0	3	0
Caddisflies (case-building)		0	3	0
Caddisflies (net-spinning)		0	4	0
Dragonflies		0	6	0
Damselflies		0	8	0
Riffle beetles (adults & larvae)		0	4	0
Water pennies		0	3	0
Other beetles		0	9	0
Hellgrammites		0	5	0
Alderflies		0	7	0
True Flies - Other		0	8	0

CR-7

True Flies - Midges		0	7	0
True Flies - Blackflies		0	5	0
True Flies - Craneflies		0	5	0
True Flies - Watersnipe flies		0	2	0
Crayfishes		0	6	0
Clams & mussels (non-native)		0	6	0
Mussels (native)		0	2	0
Scuds/sideswimmers		0	8	0
Operculate snails		0	4	0
Non-operculate snails		0	8	0
Aquatic sowbugs	30	0	8	0
Aquatic worms	1	0	9	0
Leeches	1	0	9	0
Flatworms		0	7	0
TOTALS	**Abundance**	0	**Tolerance**	0
Biotic Index:	**#DIV/0!**			
Integrity Rating:	**#DIV/0!**			

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR-8

DATE: 5-19-17

LAT: 38.066776

LONG: -84.471221

INVESTIGATOR(S) C. Boyd

COWARDIN CLASS:

WATERSHED Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	2-4'	Perennial		IMG	
Depth (Ft)	6"	Ephemeral		IMG	
Reach (Ft)	300	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 8	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 7	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 13	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 13	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 10	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.

CR-8

7. Frequency of Riffles (or Bends) Score 14	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

8. Bank Stability	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
LB Score 7 RB Score 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 4 RB Score 4	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 1 RB Score 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities
Total Score				

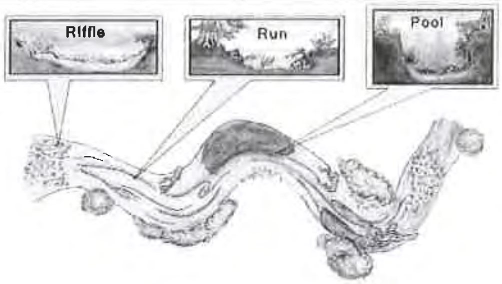
102

REMARKS / NOTES:

Sampler: C Bloyd* **Reach:** CR-8 **Date:** 5-19-17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 30 %	Run 40 %	Pool 30 %	Reach total
Silt/Clay (<0.06 mm)	50	50	70	
Sand (0.06 – 2 mm)	20	20	20	
Gravel (2-64 mm)	10	10		
Cobble (64-256mm)	20	20	10	
Boulders (>256mm)				
Bedrock				

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	2
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	
Isopod	>30
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	3
Total	35

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

* transferred to new sheet by BR

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID D3 **DATE:** 5-31-17 **LAT:** 38.09192 **LONG:** -84.487353

INVESTIGATOR(S) C. Bland, H. Hall **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	4	Perennial	✓	IMG D3 [illegible]	
Depth (Ft)	4"	Ephemeral		IMG D3 habitat D3 habitat	
Reach (Ft)	300	Intermittent		IMG [illegible]	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 9	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 16	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 16	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 11	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 3	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 14	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

D3

	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 9 *RB Score* 10	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 8 *RB Score* 8	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 1 *RB Score* 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

116

REMARKS / NOTES:

Channelized adjacent to golf course

STREAM ID 0

General

Site ID	Stream Name	
D3	Cane Run	
Date	**Sampler(s)**	
5-31-17	C. Boyd, M. Hall	

Substrate Characterization

NOTE: Enter percentages as whole numbers

Substrate	Riffle %	Run %	Pool %	Reach total	Notes
% of Stream	25	25	50	0%	NOTE: Row must total 100%
Silt/Clay (<0.06 mm)				0%	NOTE: Each column must total to 100.
Sand (0.06 – 2 mm)				0%	
Gravel (2-64 mm)			10	0%	
Cobble (64-256mm)	100	100	90	0%	
Boulders (>256mm)				0%	
Bedrock				0%	

Macro Screening

1. Record Abundance Count, or number of organisms, from your field data sheet. Do not use ">" symbol.
2. Spreadsheet will assign an Abundance Value of 6, 3, or 1 based on the Abundance Count: >30 orgs = 6; 5-30 orgs = 3; and 1-4 orgs = 1
3. Spreadsheet multiplies each Abundance Value by the Tolerance Value to get the Tolerance Score for that type of Benthic Macroinvertebrate
4. Spreadsheet adds the entire Tolerance Score column to get Total Tolerance
5. Spreadsheet adds the entire Abundance Value column to get Total Abundance
6. Spreadsheet divides the Total Tolerance by the Total Abundance to calculate the Biotic Index
6. Spreadsheet calculates the Integrity Rating for the Bluegrass Region

Benthic Macroinvertebrates	Abundance Count	Abundance Value	Tolerance Value	Tolerance Score
Stoneflies		0	2	0
Mayflies		0	3	0
Caddisflies (case-building)		0	3	0
Caddisflies (net-spinning)		0	4	0
Dragonflies	12	0	6	0
Damselflies		0	8	0
Riffle beetles (adults & larvae)	2	0	4	0
Water pennies		0	3	0
Other beetles		0	9	0
Hellgrammites		0	5	0
Alderflies		0	7	0
True Flies - Other		0	8	0

D3

True Flies - Midges		0	7	0
True Flies - Blackflies	10	0	5	0
True Flies - Craneflies		0	5	0
True Flies - Watersnipe flies		0	2	0
Crayfishes		0	6	0
Clams & mussels (non-native)		0	6	0
Mussels (native)		0	2	0
Scuds/sideswimmers		0	8	0
Operculate snails		0	4	0
Non-operculate snails		0	8	0
Aquatic sowbugs	30+	0	8	0
Aquatic worms	5	0	9	0
Leeches	20	0	9	0
Flatworms		0	7	0
TOTALS	**Abundance**	0	**Tolerance**	0
Biotic Index:	**#DIV/0!**			
Integrity Rating:	**#DIV/0!**			

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID D4 **DATE:** 5-31-17 **LAT:** 38,087403 **LONG:** -84.484455

INVESTIGATOR(S) C. Blayd, M. Hall **COWARDIN CLASS:** ____ **WATERSHED:** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	7	Perennial	✓	IMG D4 ds [illegible]	
Depth (Ft)	6"	Ephemeral		IMG [illegible]	
Reach (Ft)	300	Intermittent		IMG [illegible] habitat	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 14	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 16	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 13	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 15	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 16	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 10	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 16	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

D4

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 9 RB Score 9	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 7 RB Score 9	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 1 RB Score 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

136

REMARKS / NOTES:

golf course [illegible]

STREAM ID 0

Page 2 of 2

General

Site ID	**Stream Name**	
D4	Cane Run	
Date	**Sampler(s)**	
5-31-17	C.Blayd, M. Hall	

Substrate Characterization

NOTE: Enter percentages as whole numbers

Substrate	Riffle %	Run %	Pool %	Reach total	Notes
% of Stream	20	20	60	0%	NOTE: Row must total 100%
Silt/Clay (<0.06 mm)				0%	NOTE: Each column must total to 100.
Sand (0.06 – 2 mm)				0%	
Gravel (2-64 mm)	20	15	5	0%	
Cobble (64-256mm)	10	10	5	0%	
Boulders (>256mm)				0%	
Bedrock	70	75	90	0%	

Macro Screening

1. Record Abundance Count, or number of organisms, from your field data sheet. Do not use ">" symbol.

2. Spreadsheet will assign an Abundance Value of 6, 3, or 1 based on the Abundance Count: >30 orgs = 6; 5-30 orgs = 3; and 1-4 orgs = 1

3. Spreadsheet multiplies each Abundance Value by the Tolerance Value to get the Tolerance Score for that type of Benthic Macroinvertebrate

4. Spreadsheet adds the entire Tolerance Score column to get Total Tolerance

5. Spreadsheet adds the entire Abundance Value column to get Total Abundance

6. Spreadsheet divides the Total Tolerance by the Total Abundance to calculate the Biotic Index

6. Spreadsheet calculates the Integrity Rating for the Bluegrass Region

Benthic Macroinvertebrates	Abundance Count	Abundance Value	Tolerance Value	Tolerance Score
Stoneflies		0	2	0
Mayflies		0	3	0
Caddisflies (case-building)		0	3	0
Caddisflies (net-spinning)		0	4	0
Dragonflies	7	0	6	0
Damselflies		0	8	0
Riffle beetles (adults & larvae)	5	0	4	0
Water pennies		0	3	0
Other beetles	2	0	9	0
Hellgrammites		0	5	0
Alderflies		0	7	0
True Flies - Other		0	8	0

D4

True Flies - Midges		0	7	0
True Flies - Blackflies	30+	0	5	0
True Flies - Craneflies		0	5	0
True Flies - Watersnipe flies		0	2	0
Crayfishes		0	6	0
Clams & mussels (non-native)		0	6	0
Mussels (native)		0	2	0
Scuds/sideswimmers		0	8	0
Operculate snails		0	4	0
Non-operculate snails		0	8	0
Aquatic sowbugs		0	8	0
Aquatic worms	10	0	9	0
Leeches	30+	0	9	0
Flatworms		0	7	0
TOTALS	**Abundance**	0	**Tolerance**	0
Biotic Index:	**#DIV/0!**			
Integrity Rating:	**#DIV/0!**			

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID D5

DATE: 5-31-17

LAT: 36.086382 **LONG:** -84.481455

INVESTIGATOR(S) C. Boyd, M. [illegible]

COWARDIN CLASS: ____

WATERSHED: [illegible]

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	2	Perennial		IMG 05 ds [illegible]	
Depth (Ft)	4"	Ephemeral		IMG [illegible]	
Reach (Ft)	300	Intermittent	✓	IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 9	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 8	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 14	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 1	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 9	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 8	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

D5

	OPTIMAL 10 9	SUBOPTIMAL 8 7 6	MARGINAL 5 4 3	POOR 2 1 0
8. Bank Stability *LB Score* 8 *RB Score* 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 8 *RB Score* 8	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 3 *RB Score* 3	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

99

REMARKS / NOTES:

Karst [illegible] dry [illegible] Only water [illegible]

[illegible]

STREAM ID 0

General

Site ID	**Stream Name**	
DS	Cane Run	
Date	**Sampler(s)**	
5-31-17	C. Bloyd, M. Hall	

Substrate Characterization

NOTE: Enter percentages as whole numbers

Substrate	Riffle %	Run %	Pool %	Reach total	Notes
% of Stream	10	80	10	0%	NOTE: Row must total 100%
Silt/Clay (<0.06 mm)	90	90	70	0%	NOTE: Each column must total to 100.
Sand (0.06 – 2 mm)	5	5	10	0%	
Gravel (2-64 mm)	5	5	20	0%	
Cobble (64-256mm)				0%	
Boulders (>256mm)				0%	
Bedrock				0%	

Macro Screening

1. Record Abundance Count, or number of organisms, from your field data sheet. Do not use ">" symbol.
2. Spreadsheet will assign an Abundance Value of 6, 3, or 1 based on the Abundance Count: >30 orgs = 6; 5-30 orgs = 3; and 1-4 orgs = 1
3. Spreadsheet multiplies each Abundance Value by the Tolerance Value to get the Tolerance Score for that type of Benthic Macroinvertebrate
4. Spreadsheet adds the entire Tolerance Score column to get Total Tolerance
5. Spreadsheet adds the entire Abundance Value column to get Total Abundance
6. Spreadsheet divides the Total Tolerance by the Total Abundance to calculate the Biotic Index
6. Spreadsheet calculates the Integrity Rating for the Bluegrass Region

Benthic Macroinvertebrates	Abundance Count	Abundance Value	Tolerance Value	Tolerance Score
Stoneflies		0	2	0
Mayflies		0	3	0
Caddisflies (case-building)		0	3	0
Caddisflies (net-spinning)		0	4	0
Dragonflies		0	6	0
Damselflies		0	8	0
Riffle beetles (adults & larvae)		0	4	0
Water pennies		0	3	0
Other beetles		0	9	0
Hellgrammites		0	5	0
Alderflies		0	7	0
True Flies - Other		0	8	0

D5

True Flies - Midges		0	7	0
True Flies - Blackflies	5	0	5	0
True Flies - Craneflies		0	5	0
True Flies - Watersnipe flies		0	2	0
Crayfishes		0	6	0
Clams & mussels (non-native)		0	6	0
Mussels (native)		0	2	0
Scuds/sideswimmers		0	8	0
Operculate snails		0	4	0
Non-operculate snails		0	8	0
Aquatic sowbugs	20	0	8	0
Aquatic worms	1	0	9	0
Leeches		0	9	0
Flatworms		0	7	0
TOTALS	**Abundance**	0	**Tolerance**	0
Biotic Index:	**#DIV/0!**			
Integrity Rating:	**#DIV/0!**			

APPENDIX A-3
THIRD ROCK
SCC QA FIELD DATA

Prepared for Lexington-Fayette Urban County Government
Prepared by Third Rock Consultants, LLC January 16, 2018

QA

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR-1 (SCC) **DATE:** 9-27-17 **LAT:** 38.104337 **LONG:** -84.498901

INVESTIGATOR(S) BR/ER **COWARDIN CLASS:** ____ **WATERSHED** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	20'	Perennial		IMG	See photo log
Depth (Ft)	1'	Ephemeral		IMG	
Reach (~~Ft~~)	300M	Intermittent	✓	IMG	

QA

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 11	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Dry (karst) Score 0	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 7	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status NO FLOW Score 0	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 13	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.

Evaluated From I-75 To start of Restoration

7. Frequency of Riffles (or Bends) Score 12	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 5 RB Score 5	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 5 RB Score 5	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 7 RB Score 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

83

Dry No Flow

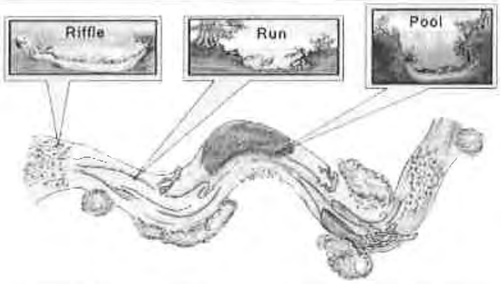
REMARKS / NOTES:

QA

Sampler: B. Remley **Reach:** CR-1 **Date:** 9-27-17

Substrate Characterization (Visual Estimate)

1) Estimate the percentage of riffle, run, and pool in the assessment reach and record at the top of the columns
2) Visually assess the percentage of each of these areas that has each of the particle sizes. Use the Gravelometer to help gage particle sizes.
3) IN OFFICE: Calculate the reach totals by multiplying the % of each



Substrate	Riffle 25 %	Run 35 %	Pool 40 %	Reach total
Silt/Clay (<0.06 mm)				
Sand (0.06 – 2 mm)	10 (2.5)	10 (3.5)	30 (12)	18
Gravel (2-64 mm)	10 (2.5)	55 (19.25)	40 (16)	37.75
Cobble (64-256mm)	20 (5)	20 (7)	10 (4)	16
Boulders (>256mm)	60 (15)	15 (5.25)	10 (4)	24.25
Bedrock			10 (4)	4

* Image from Missouri Department of Conservation, Texas Parks and Wildlife Department, The Meadows Center for Water and the Environment, Rudolph Rosen

Macroinvertebrate Screening

No water

Benthic Macroinvertebrates	Abundance Counts
Stonefly Nymph	
Mussel (Native)	
True Fly Larva – Watersnipe Fly	
Caddisfly Larva (case-building)	
Mayfly Nymph	
Water Penny Larva	
Caddisfly Larva (net-spinner)	
Riffle Beetle Larva	
Riffle Beetle Adult	None
Operculate Snail	
Hellgrammite (Dobsonfly Larva)	
True Fly Larva – Crane Fly	
True Fly Larva – Black Fly	
Dragonfly Nymph	
Crayfish	
Clams and Mussels (non-native)	
Alderfly Larva	
True Fly Larva – Midge	
Flatworm	
Damselfly Nymph	
True Fly Larva – Other	
Scud	
Isopod	
Non-operculate Snail	
Adult Beetles (non-riffle beetles)	
Beetle Larva (other than riffle beetles and water pennies)	
Aquatic Worm/Leech	
Total	

See Kentucky Aquatic Macroinvertebrate Checklist of pictures of these organisms.

QA

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CF 9 **DATE:** 5-19-17 **LAT:** 35.06216 **LONG:** -84.46856

INVESTIGATOR(S) C. Blayd **COWARDIN CLASS:** ____ **WATERSHED:** Conc Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	3	Perennial		IMG	
Depth (Ft)	8"	Ephemeral		IMG	
Reach (Ft)	300	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 5	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are _not_ new fall and _not_ transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 6	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 8	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 11	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 0	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 5	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 14	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

CR-9

8. Bank Stability	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
LB Score 6 RB Score 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 7 RB Score 7	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 2 RB Score 2	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

79

REMARKS / NOTES:

Lots of trash. Dry. Thick vegetation along stream
limited access for quality pics.

QA

STREAM ID 0

General

Site ID	**Stream Name**	
CR 9	Cane Run	
Date	**Sampler(s)**	
5-19-17	C. Bloyd	

Substrate Characterization

NOTE: Enter percentages as whole numbers

Substrate	Riffle %	Run %	Pool %	Reach total	Notes
% of Stream	25	50	25	0%	NOTE: Row must total 100%
Silt/Clay (<0.06 mm)	70	90	100	0%	NOTE: Each column must total to 100.
Sand (0.06 – 2 mm)				0%	
Gravel (2-64 mm)	30	10		0%	
Cobble (64-256mm)				0%	
Boulders (>256mm)				0%	
Bedrock				0%	

Macro Screening

1. Record Abundance Count, or number of organisms, from your field data sheet. Do not use ">" symbol.

2. Spreadsheet will assign an Abundance Value of 6, 3, or 1 based on the Abundance Count: >30 orgs = 6; 5-30 orgs = 3; and 1-4 orgs = 1

3. Spreadsheet multiplies each Abundance Value by the Tolerance Value to get the Tolerance Score for that type of Benthic Macroinvertebrate

4. Spreadsheet adds the entire Tolerance Score column to get Total Tolerance

5. Spreadsheet adds the entire Abundance Value column to get Total Abundance

6. Spreadsheet divides the Total Tolerance by the Total Abundance to calculate the Biotic Index

6. Spreadsheet calculates the Integrity Rating for the Bluegrass Region

Benthic Macroinvertebrates	Abundance Count	Abundance Value	Tolerance Value	Tolerance Score
Stoneflies		0	2	0
Mayflies		0	3	0
Caddisflies (case-building)		0	3	0
Caddisflies (net-spinning)		0	4	0
Dragonflies	N/A	0	6	0
Damselflies		0	8	0
Riffle beetles (adults & larvae)		0	4	0
Water pennies		0	3	0
Other beetles		0	9	0
Hellgrammites		0	5	0
Alderflies		0	7	0
True Flies - Other		0	8	0

QA

CR-9

True Flies - Midges		0	7	0
True Flies - Blackflies		0	5	0
True Flies - Craneflies		0	5	0
True Flies - Watersnipe flies		0	2	0
Crayfishes		0	6	0
Clams & mussels (non-native)		0	6	0
Mussels (native)		0	2	0
Scuds/sideswimmers		0	8	0
Operculate snails		0	4	0
Non-operculate snails		0	8	0
Aquatic sowbugs		0	8	0
Aquatic worms		0	9	0
Leeches		0	9	0
Flatworms		0	7	0
TOTALS	**Abundance**	0	**Tolerance**	0
Biotic Index:	**#DIV/0!**			
Integrity Rating:	**#DIV/0!**			

QA

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID B-1 -QA

DATE: 5-31-17

LAT: 38.11024

LONG: -84.50893

INVESTIGATOR(S) C. Bland . H. Hall

COWARDIN CLASS:

WATERSHED: Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	3	Perennial		IMG	
Depth (Ft)	4"	Ephemeral		IMG	
Reach (Ft)	300	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 10	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 10	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 11	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 15	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 11	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

QA

B1 QA

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 5 *RB Score* 5	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 6 *RB Score* 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 7 *RB Score* 5	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

116

REMARKS / NOTES:

QA

STREAM ID 0

General

Site ID	**Stream Name**
B-1 -QA	Cane Run trib
Date	**Sampler(s)**
5-31-17	C. Bloyd, M. Hall

Substrate Characterization

NOTE: Enter percentages as whole numbers

Substrate	Riffle %	Run %	Pool %	Reach total	Notes
% of Stream	20	20	60	0%	NOTE: Row must total 100%
Silt/Clay (<0.06 mm)	80	80	90	0%	NOTE: Each column must total to 100.
Sand (0.06 – 2 mm)	5	5	5	0%	
Gravel (2-64 mm)	15	15		0%	
Cobble (64-256mm)				0%	
Boulders (>256mm)				0%	
Bedrock			5	0%	

Macro Screening

1. Record Abundance Count, or number of organisms, from your field data sheet. Do not use ">" symbol.

2. Spreadsheet will assign an Abundance Value of 6, 3, or 1 based on the Abundance Count: >30 orgs = 6; 5-30 orgs = 3; and 1-4 orgs = 1

3. Spreadsheet multiplies each Abundance Value by the Tolerance Value to get the Tolerance Score for that type of Benthic Macroinvertebrate

4. Spreadsheet adds the entire Tolerance Score column to get Total Tolerance

5. Spreadsheet adds the entire Abundance Value column to get Total Abundance

6. Spreadsheet divides the Total Tolerance by the Total Abundance to calculate the Biotic Index

6. Spreadsheet calculates the Integrity Rating for the Bluegrass Region

Benthic Macroinvertebrates	Abundance Count	Abundance Value	Tolerance Value	Tolerance Score
Stoneflies		0	2	0
Mayflies		0	3	0
Caddisflies (case-building)		0	3	0
Caddisflies (net-spinning)		0	4	0
Dragonflies		0	6	0
Damselflies		0	8	0
Riffle beetles (adults & larvae)		0	4	0
Water pennies		0	3	0
Other beetles		0	9	0
Hellgrammites		0	5	0
Alderflies		0	7	0
True Flies - Other		0	8	0

QA

BI QA

True Flies - Midges		0	7	0
True Flies - Blackflies		0	5	0
True Flies - Craneflies		0	5	0
True Flies - Watersnipe flies		0	2	0
Crayfishes		0	6	0
Clams & mussels (non-native)		0	6	0
Mussels (native)		0	2	0
Scuds/sideswimmers		0	8	0
Operculate snails		0	4	0
Non-operculate snails		0	8	0
Aquatic sowbugs		0	8	0
Aquatic worms		0	9	0
Leeches		0	9	0
Flatworms		0	7	0
TOTALS	**Abundance**	0	**Tolerance**	0
Biotic Index:	**#DIV/0!**			
Integrity Rating:	**#DIV/0!**			

QA

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID F1 -QA **DATE:** 5-31-17 **LAT:** 38.08699 **LONG:** -84.49461

INVESTIGATOR(S) C. Boyd, M. Hall **COWARDIN CLASS:** ____ **WATERSHED:** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	3	Perennial		IMG	
Depth (Ft)	4"	Ephemeral		IMG	
Reach (Ft)	300	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 12	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 15	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 10	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 15	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 14	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 11	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 18	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

QA

F1 QA

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability LB Score 8 RB Score 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection LB Score 6 RB Score 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width LB Score 1 RB Score 1	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

125

REMARKS / NOTES:

QA

General

Site ID	**Stream Name**
F1	Cane Run trib
Date	**Sampler(s)**
5-31-17	C.Boyd, M. Hall

Substrate Characterization

NOTE: Enter percentages as whole numbers

Substrate	Riffle %	Run %	Pool %	Reach total	Notes
% of Stream	70	15	15	0%	NOTE: Row must total 100%
Silt/Clay (<0.06 mm)			10	0%	NOTE: Each column must total to 100.
Sand (0.06 – 2 mm)	15	15	10	0%	
Gravel (2-64 mm)	15	15	30	0%	
Cobble (64-256mm)	70	70	50	0%	
Boulders (>256mm)				0%	
Bedrock				0%	

Macro Screening

1. Record Abundance Count, or number of organisms, from your field data sheet. Do not use ">" symbol.
2. Spreadsheet will assign an Abundance Value of 6, 3, or 1 based on the Abundance Count: >30 orgs = 6; 5-30 orgs = 3; and 1-4 orgs = 1
3. Spreadsheet multiplies each Abundance Value by the Tolerance Value to get the Tolerance Score for that type of Benthic Macroinvertebrate
4. Spreadsheet adds the entire Tolerance Score column to get Total Tolerance
5. Spreadsheet adds the entire Abundance Value column to get Total Abundance
6. Spreadsheet divides the Total Tolerance by the Total Abundance to calculate the Biotic Index
6. Spreadsheet calculates the Integrity Rating for the Bluegrass Region

Benthic Macroinvertebrates	Abundance Count	Abundance Value	Tolerance Value	Tolerance Score
Stoneflies		0	2	0
Mayflies		0	3	0
Caddisflies (case-building)		0	3	0
Caddisflies (net-spinning)		0	4	0
Dragonflies		0	6	0
Damselflies		0	8	0
Riffle beetles (adults & larvae)		0	4	0
Water pennies		0	3	0
Other beetles		0	9	0
Hellgrammites		0	5	0
Alderflies		0	7	0
True Flies - Other		0	8	0

QA

F1

True Flies - Midges		0	7	0
True Flies - Blackflies		0	5	0
True Flies - Craneflies		0	5	0
True Flies - Watersnipe flies		0	2	0
Crayfishes		0	6	0
Clams & mussels (non-native)		0	6	0
Mussels (native)		0	2	0
Scuds/sideswimmers		0	8	0
Operculate snails		0	4	0
Non-operculate snails		0	8	0
Aquatic sowbugs		0	8	0
Aquatic worms		0	9	0
Leeches		0	9	0
Flatworms		0	7	0
TOTALS	**Abundance**	0	**Tolerance**	0
Biotic Index:	**#DIV/0!**			
Integrity Rating:	**#DIV/0!**			

QA

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID J1 (QA) **DATE:** 5-19-17 **LAT:** 38.0663 **LONG:** -64.46212

INVESTIGATOR(S) C. Blayd **COWARDIN CLASS:** ____ **WATERSHED:** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	2.5	Perennial		IMG	
Depth (Ft)	6"	Ephemeral		IMG	
Reach (Ft)	300	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 4	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 6	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 8	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 11	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 10	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 5	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 5	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

QA

31 QA

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 6 *RB Score* 6	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 7 *RB Score* 7	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 2 *RB Score* 2	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0

79

REMARKS / NOTES:

QA

STREAM ID 0

General

Site ID	**Stream Name**	
J1 (QA)	Cane Run	
Date	**Sampler(s)**	
5-19-17	C. Bloyd	

Substrate Characterization

NOTE: Enter percentages as whole numbers

Substrate	Riffle %	Run %	Pool %	Reach total	Notes
% of Stream	25	50	25	0%	NOTE: Row must total 100%
Silt/Clay (<0.06 mm)	90	100	100	0%	NOTE: Each column must total to 100.
Sand (0.06 – 2 mm)				0%	
Gravel (2-64 mm)	10			0%	
Cobble (64-256mm)				0%	
Boulders (>256mm)				0%	
Bedrock				0%	

Macro Screening

1. Record Abundance Count, or number of organisms, from your field data sheet. Do not use ">" symbol.

2. Spreadsheet will assign an Abundance Value of 6, 3, or 1 based on the Abundance Count: >30 orgs = 6; 5-30 orgs = 3; and 1-4 orgs = 1

3. Spreadsheet multiplies each Abundance Value by the Tolerance Value to get the Tolerance Score for that type of Benthic Macroinvertebrate

4. Spreadsheet adds the entire Tolerance Score column to get Total Tolerance

5. Spreadsheet adds the entire Abundance Value column to get Total Abundance

6. Spreadsheet divides the Total Tolerance by the Total Abundance to calculate the Biotic Index

6. Spreadsheet calculates the Integrity Rating for the Bluegrass Region

Benthic Macroinvertebrates	Abundance Count	Abundance Value	Tolerance Value	Tolerance Score
Stoneflies		0	2	0
Mayflies		0	3	0
Caddisflies (case-building)		0	3	0
Caddisflies (net-spinning)		0	4	0
Dragonflies		0	6	0
Damselflies	N/A	0	8	0
Riffle beetles (adults & larvae)		0	4	0
Water pennies		0	3	0
Other beetles		0	9	0
Hellgrammites		0	5	0
Alderflies		0	7	0
True Flies - Other		0	8	0

QA

J1 QA

True Flies - Midges		0	7	0
True Flies - Blackflies		0	5	0
True Flies - Craneflies		0	5	0
True Flies - Watersnipe flies		0	2	0
Crayfishes		0	6	0
Clams & mussels (non-native)		0	6	0
Mussels (native)		0	2	0
Scuds/sideswimmers		0	8	0
Operculate snails		0	4	0
Non-operculate snails		0	8	0
Aquatic sowbugs		0	8	0
Aquatic worms		0	9	0
Leeches		0	9	0
Flatworms		0	7	0
TOTALS	**Abundance**	0	**Tolerance**	0
Biotic Index:	**#DIV/0!**			
Integrity Rating:	**#DIV/0!**			

QA

APPENDIX B
PHOTO LOG

A1- Bank Undercuts (Rb)

A1- Bank Undercuts 2 (Rb)

A1- Center of Reach, Culvert under I-64

A1- Facing Downstream from Upstream End of Reach, Submerged Vegetation, Leaf Packs

A1- Facing Upstream of Reach

A1- Train Bridge Upstream


A1- Trash, Submergent Vegetation, Leaf Packs


A1- Typical Substrate


A2- Aquatic Vegitation in Riffle


A2- Bank Undercuts (Rb) (a)


A2- Bank Undercuts (Rb) (b)


A2- Culvert Filter Facing Downstream, Leaf Packs

A2- Culvert Filter Facing Upstream

A2- Erosion Control on Rb of Reach

A2- Failed Silt Fence on Lb near Reach

A2- Log in Stream, Leaf Packs

A2- Riffle 2

A2- Riffle, Drainage from adjacent Neighborhood

A2- Riparian Zone, Bank Cut

A2- Road above Culvert (a)

A2- Road above Culvert (b)

A2- Sewer Pressure Pipe Warning (a)

A2- Sewer Pressure Pipe Warning (b)

A2- Typical Substrate

B1- Center of Reach Facing Upstream

B1- Center of Reach Facing Downstream

B1- Downstream End of Reach Facing Downstream

B1- Downstream End of Reach Facing Upstream

B1- Evidence of Buffer Restoration

B1- Evidence of Drainage from Agriculture Field

B1- Upstream End of Reach Facing Downstream

C1- Embeddedness Top of reach

C1- Riffle Sampling Site 4

C1- Top of Reach, Upstream

CR1- Banks

CR1- Downstream View of Stream Alteration


CR1- Effluent Pipe Stream Alteration


CR1- Emergent Vegetation (a)


CR1- Emergent Vegetation (b)


CR1- Pool Downstream of Reach


CR1- Pump Station Stream Reach


CR1- Root Mats and Undercut Banks


CR1- Typical Substrate Riffle


CR1- Typical Substrate


CR1- Undercut Bank Root Mat


CR1- Undercut Banks


CR1- Upstream View of Reach


CR3- Bedrock Bottom (a)


CR3- bedrock Bottom (b)


CR3- Bedrock Bottom (d)


CR3- Channel Alteration


CR3 Effluent Pipe Upstream of Reach


CR3- Riffle Habitat


CR3- Riffle


CR3- Submergent Vegetation (b)


CR3- Tributary Formation


CR3- Typical Instream Habitat


CR3- Undercut Bank (a)


CR3- Undercut Bank (b)


CR3- Undercut Bank and Root Mat

CR4- Bank Stabilization (a)

CR4- Bank Stabilization (b)

CR4- Bottom of Reach Looking Downstream

CR4- Looking Downstream Isolated Pools under Bridge

CR4- Midreach Looking Downstream

CR4- Midreach Looking Upstream


CR4- Riparian Vegetation Looking Upstream


CR4- Undercut Banks Top of Reach (a)


CR4- Undercut Banks Top of Reach (b)


CR5- Bedrock Sampling Site (a)


CR5- Bedrock-Drainpipe-Undercut Banks


CR5- Bedrock-Undercut Banks


CR5- Bottom of Reach Bedrock


CR5- Bottom of Reach Downstream


CR5- Drain Holes Bank Erosion


CR5- Drainage Holes


CR5- Hardening


CR5- Leaf Pack Sampling Site

CR5- Midpoint of Reach looking Downstream

CR5- Undercut Banks-Substrate

CR6- Bedrock

CR6- Downstream View from Upstream End

CR6- Downstream View of Downstream Reach

CR6- Eroding Bank and Pool

CR6- Fine Sediment

CR6- Leaf Pack

CR6- Left Bank

CR6- Riffle Habitat

CR6- Right Bank

CR6- Root Wad

Photographed by Third Rock Consultants, LLC

CR6- Under Cut Bank

CR6- Upstream from Upstream End

CR6- Upstream View from Downstream End of Reach

CR7- Downstream View Downstream End of CR-7

CR7- Downstream View from Upstream End of CR-7

CR7- Habitat (a)

CR7- Habitat Photo (b)

CR7- Habitat Photo (c)

CR7- Upstream View from Upstream End

CR7- Upstream View from Downstream End of CR-7

CR9- Another Overviw of Reach

CR9- Culvert Downstream of Reach

CR9- Overview Facing Downstream

CR9- Overview of Reach (a)

CR9- Overview of Reach (b)

CR9- Riffle

CR9- Sanitary Sewer Adjacent to Stream

CR9- Small Trib to CR-9

CR9- Stream Disppears Under Dirt Road

CR9- Trash

CR9- Trees in Middle of Stream

CR9- Typical Substrate (a)

CR9- Typical Substrate (b)

CR9- Undercut Bank Root Mat


CR9- Undercut Bank


D1- Erosion and Undercut Banks


D1- Jab Sampling Site


D1- Point Bar Formation


D1- Riffle Sample Site


D1- Scoop Sampling Site

D1- Typical Vegetative Cover

D2- Riffle

D2- Scoop Sample

D2- Undercut Bankroot Mat

D2-1- Algae

D2-1- Bottom of Reach Downstream

Photographed by Third Rock Consultants, LLC


D2-1- Midreach Downstream


D2-1- Midreach Upstream


D2-1- Storm Drain


D2-1- Stream Bank Stabilization


D2-Pipe Crossing Creek


D2-Reach Begining, Upstream

D3- Downstream View

D3- Emergent Vegetation

D3- Instream habitat

D3- Upstream view

D4- Downstream View From Downstream End

D4- Downstream View From Upstream End

D4- Emergent Vegetation

D4- Habitat

D4- Upstream View from Downstream End

D4- Upstream View from Upstream End

D5- Upstream View from Upstream End

D5- Downstream View from Downstream End


D5- Downstream View from Upstream End


D5- Habitat


D5- Upstream View from Downstream End


E2- Center of Reach Facing Downstream


E2- Center of Reach Facing Upstream


E2- Downstream End of Reach Facing Upstream

Photographed by Third Rock Consultants, LLC


E2- Upstream End of Reach Facing Downstream


F1- Downstream


F1- Mid-Downstream


F1- Mid-Upstream


F1- Upstream (a)


G2- Riffle


G2- Riparian Zone Facing Downstream


G2- Root Mat Undercut Bank


G2- Sediment Deposition


G2- Thawleg


G2- Typical Riffle


G2- Typical Substrate (a)


G2- Undercut Bank Root Mat


G2- Upstream Riparian Zone


H1- Jab Sampling Site


H1- Sanitary Sewer


H1- Scoop Sampling Site


A1- High Sediment Deposition


C1- Bottom of Reach Looking Downstream


C1- Erosion Entering Top of Reach


C1- Midreach Looking Downstream

Photographed by Third Rock Consultants, LLC

C1- Midreach Looking Upstream

C1- Riffle Sampling Site 1

C1- Riffle Sampling Site 2

C1- Riffle Sampling Site 3

C1- Scoop Sampling Site

C2- Downstream

C2- Riffle (Kick)

C2- Riffle (Sample Site)

C2- Undercut Bank (Jab)

C2- Upstream

C2- Vegatation

CR3 Bedrock Bottom (c)

CR3 Submergent Vegetation (a)

CR4- Benthic Sampling Site (a)

PCR4- Benthic Sampling Site (b)

PCR4- Bottom of Reach Looking Upstream

CR4- Inlet at Midreach

CR4- Isolated Pools Midreach

CR4- Top of Reach Looking Downstream

CR4- Top of Reach Looking Upstream

CR5- Bedrock Sampling Site (b)

CR5- Bottom of Reach Upstream

CR5- Midpoint of Reach Upstream

CR5- Midpoint of Reach

CR5- Silt-Sand-Gravel Sampling Site

CR5- Top of Reach Upstream

D1- Midreach Downstream

D1- Midreach Upstream Riffle Sample Site


D1- Top of Reach


D1-Bottom of Reach


D2- Mid Reach, Downstream


D2-1- Riffle Sample Site

Photographed by Third Rock Consultants, LLC


D2-1- Top of Reach Upstream


D2-End of Reach, Downstream


E1- Downstream (a)


E1- Downstream (b)

E1- Fine Sediment

E1- Leaves

PE1- Riffle (a)

PE1- Riffle (b)

E1- Riffle (c)

E1- Riffle (d)

E1- Slabrock

E1- Undercut Bank


E1-1- At End of Reach Facing Upstream


E1-1- Beginning of Reach


E1-1- Middle Downstream


E1-1- Middle Upstream


E1-1- Start of Reach Facing Downstream


F1- Benthic Sampling Site-Downstream


F1- Benthic Sampling Site-Upstream


F1- Benthic Sampling Site

F1- Top of Reach

F1- Upstream (b)

G1- 1st Sample Spot_Toop of Only Riffle_At Beginning of Reach Site G1 Cane Run

G1- 42m mark2nd Sample Spot (Undercut) Site G1 Cane Run

G1- End of Reach Facing Upstream Away From Reach Site G1 Cane Run

G1- Middle of Reach Facing Upstream Site G1 Cane Run

G1- Start of Reach Facing Upstream Site G1 Cane Run

G2- Typical substrate (b)

H1- Bank erosion

H1- Bottom of Reach Downstream

H1- Channelization Top of Reach

H1- Erosion Control Blankets


H1- Middle of Reach Downstream


H1- Middle of Reach Upstream


H1- Possible Channelization-Sanitary Sewer


H1- Riffle Sampling Site (a)


H1- Riffle Sampling Site (b)


H1- Top of Reach Upstream


I1- 2nd Sample Area Deepest Point of Reach Site I1 Cane Run


I1- End of Reach Facing Upstream Site I1 Cane Run

11- Middle of Reach SIte 11 Cane Run

11- Pipe Running Across Stream 91m mark Site 11 Cane Run

11- Small Riffle Facing Downstream 1st Sample Area Site 11 Cane Run

11- Start of Reach Facing Downstream Site 11 Cane Run


M1- 24m Mark- Right Bank 3rd Sample Spot-Undercut


M1- 50m Mark- 2nd Sampling Spot-Pool- Deepest Point of Reach


M1- 94m Mark- 1st Sampling Spot -Kick-End of Riffle


M1- End of Reach Facing Downstream

M1- Middle of Reach Facing Upstream

M1- Start of Reach Facing Upstream

N1- 25m Mark Facing Upstream Riffle-Vegetation

N1- 2nd and 3rd Sampling Site

N1- At End of Reach Facing Upstream

N1- At Start of Reach Facing Downstream

N1- Middle of Reach Facing Downstream

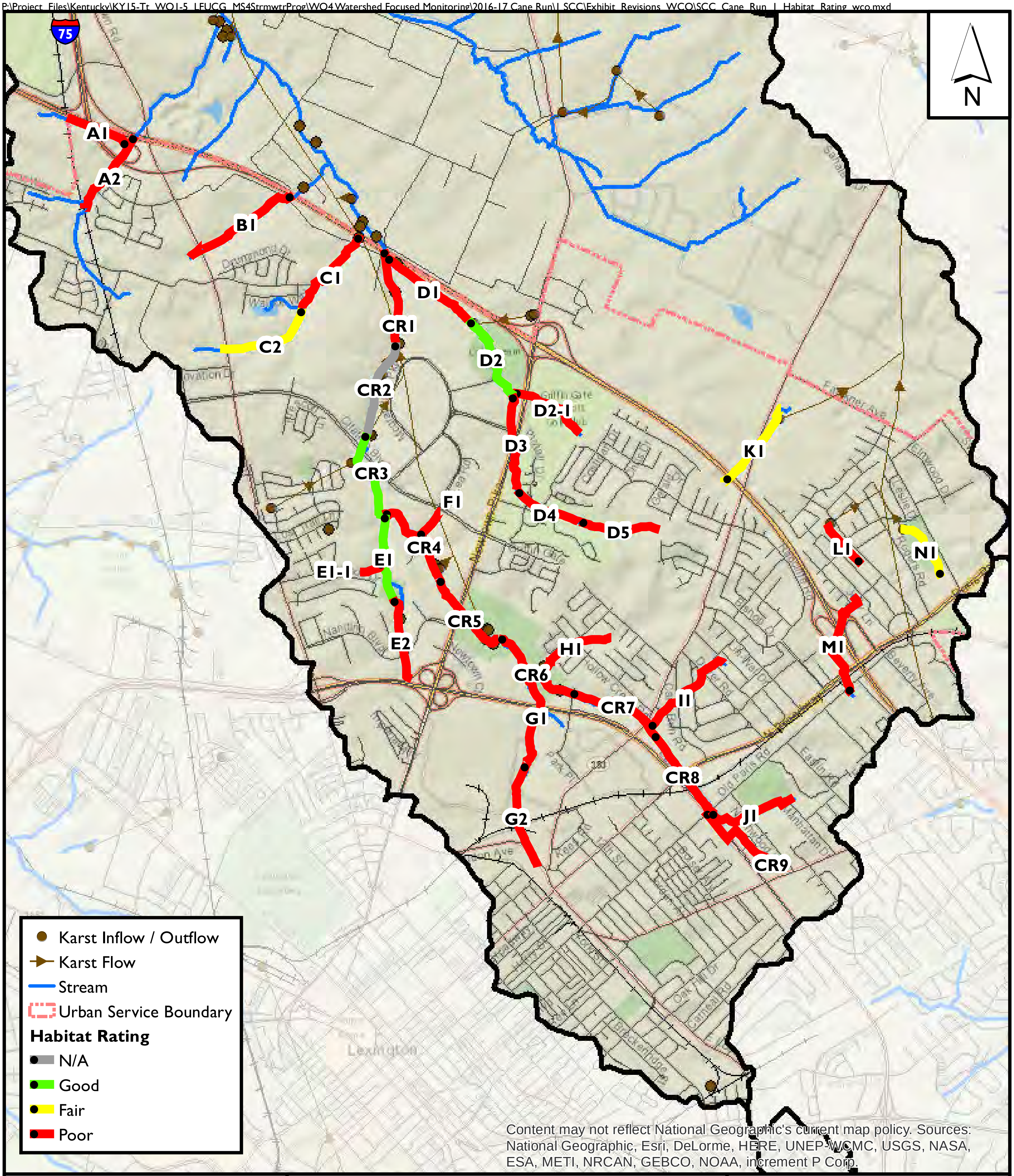
N1- Pond Skaters

N1- Upstream Island Vegetation

APPENDIX C
EXHIBITS

Prepared for Lexington-Fayette Urban County Government
Prepared by Third Rock Consultants, LLC January 16, 2018

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\LSCC\Exhibit_Revisions_WCO\SCC_Cane_Run_1_Habitat_Rating_wco.mxd



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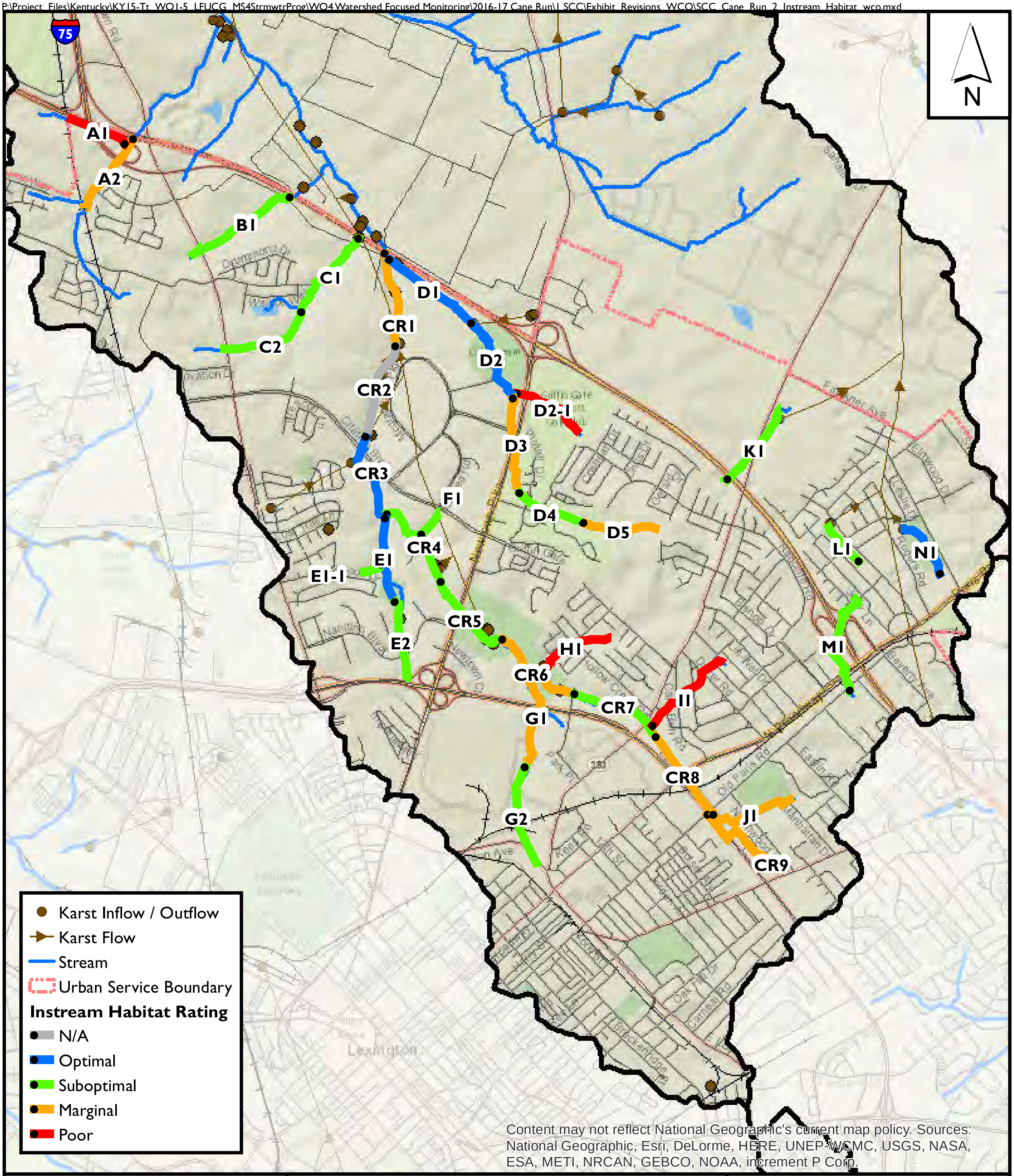
Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 1
Habitat
Stream Corridor Characterization
Cane Run Watershed, Fayette County, KY

0 0.25 0.5 1
Miles

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\LSCC\Exhibit_Revisions_WCO\SCC_Cane_Run_2_Instream_Habitat_wco.mxd



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Prepared by:
Third Rock Consultants, LLC
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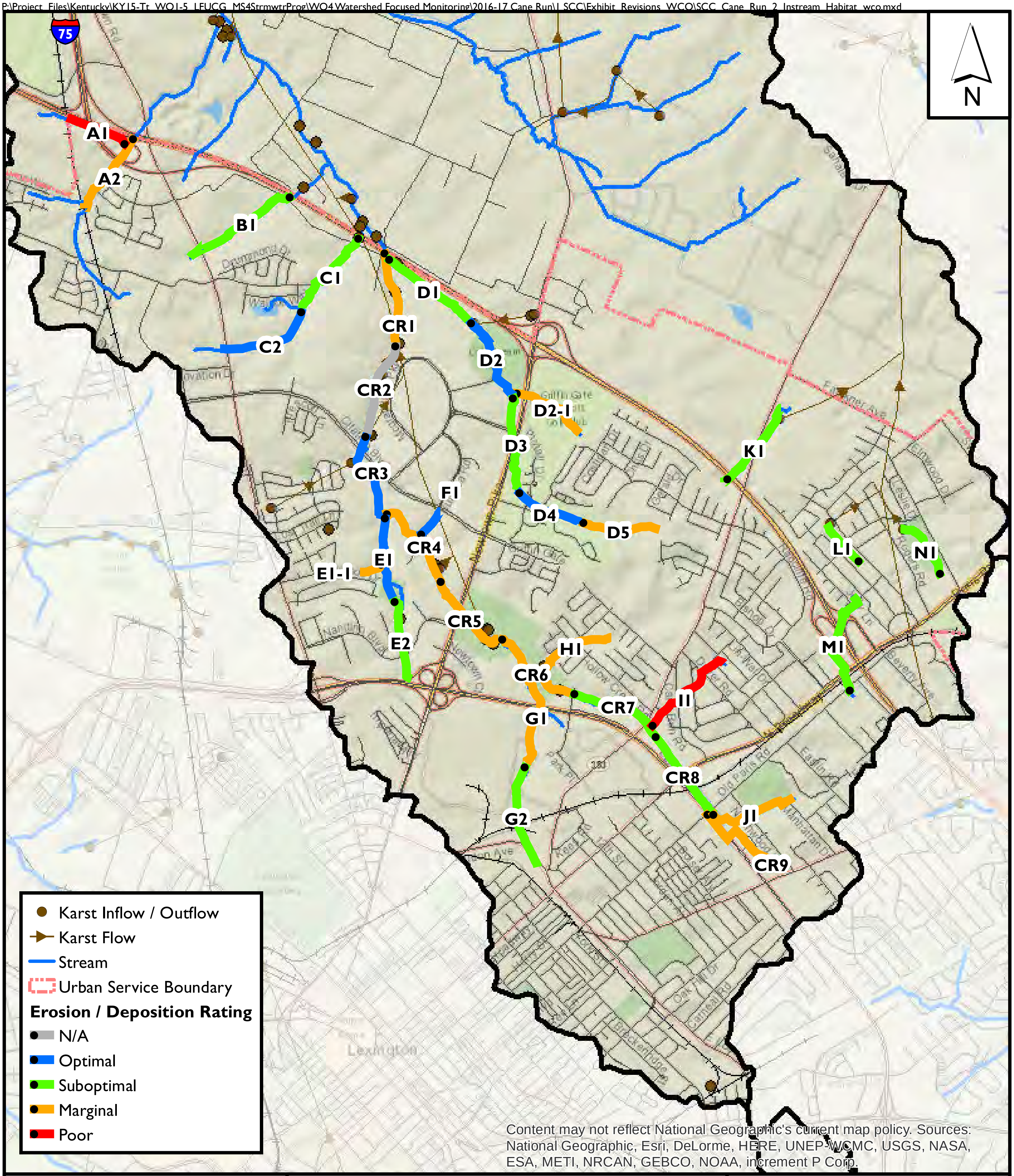
Exhibit 2
Instream Habitat
Stream Corridor Characterization
Cane Run Watershed, Fayette County, KY

0 0.25 0.5 1
Miles

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\LSCC\Exhibit_Revisions_WCO\SCC_Cane_Run_2_Instream_Habitat_wco.mxd



Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 3
Erosion/Deposition
Stream Corridor Characterization
Cane Run Watershed, Fayette County, KY

0 0.25 0.5 1
Miles

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

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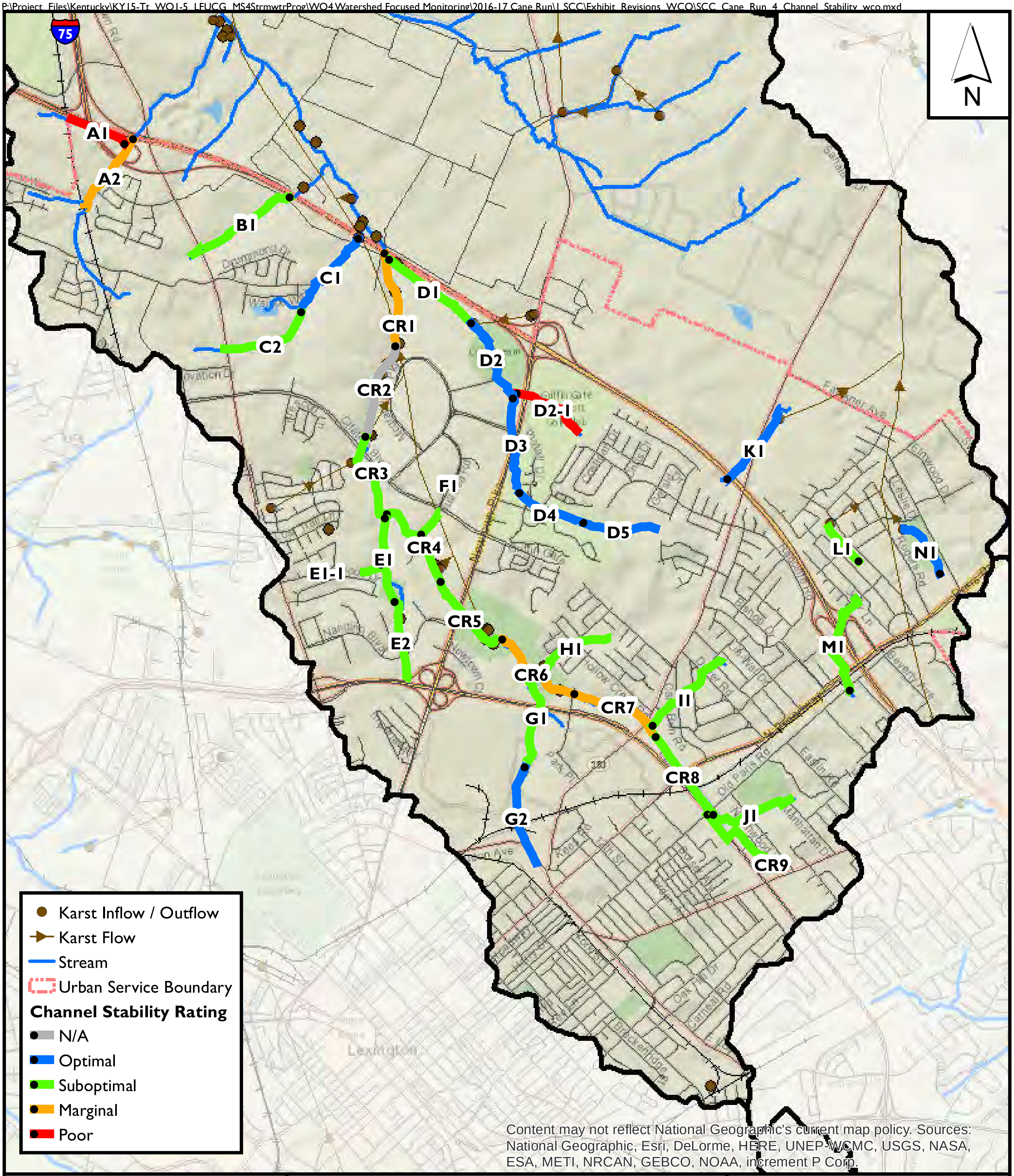

● Karst Inflow / Outflow
➤ Karst Flow
Stream
Urban Service Boundary

Channel Stability Rating
● N/A
● Optimal
● Suboptimal
● Marginal
● Poor

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Prepared by:
Third Rock Consultants, LLC
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Exhibit 4
Channel Stability
Stream Corridor Characterization
Cane Run Watershed, Fayette County, KY

0 0.25 0.5 1
Miles

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

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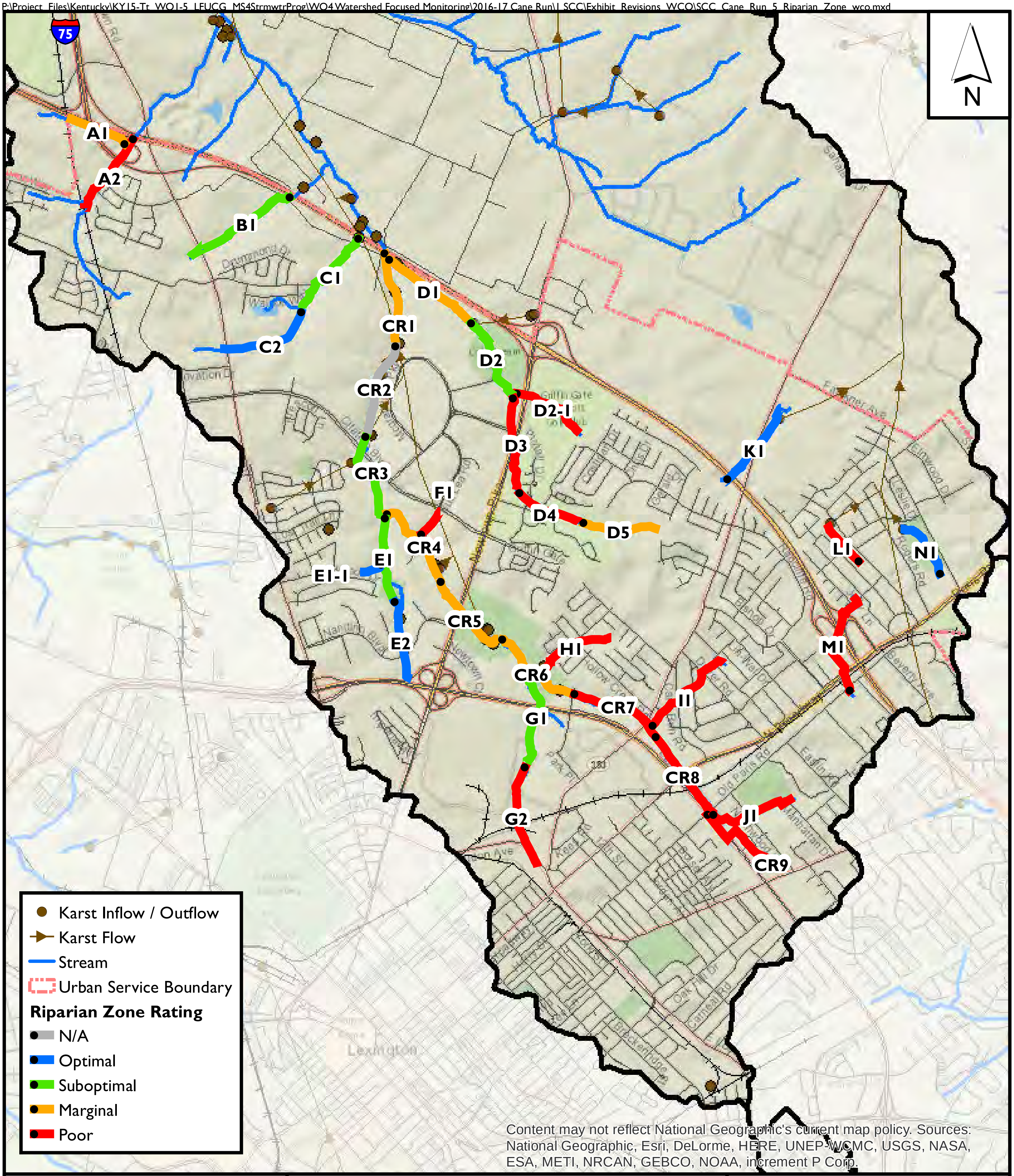

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Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 5
Riparian Zone
Stream Corridor Characterization
Cane Run Watershed, Fayette County, KY

0 0.25 0.5 1
Miles

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

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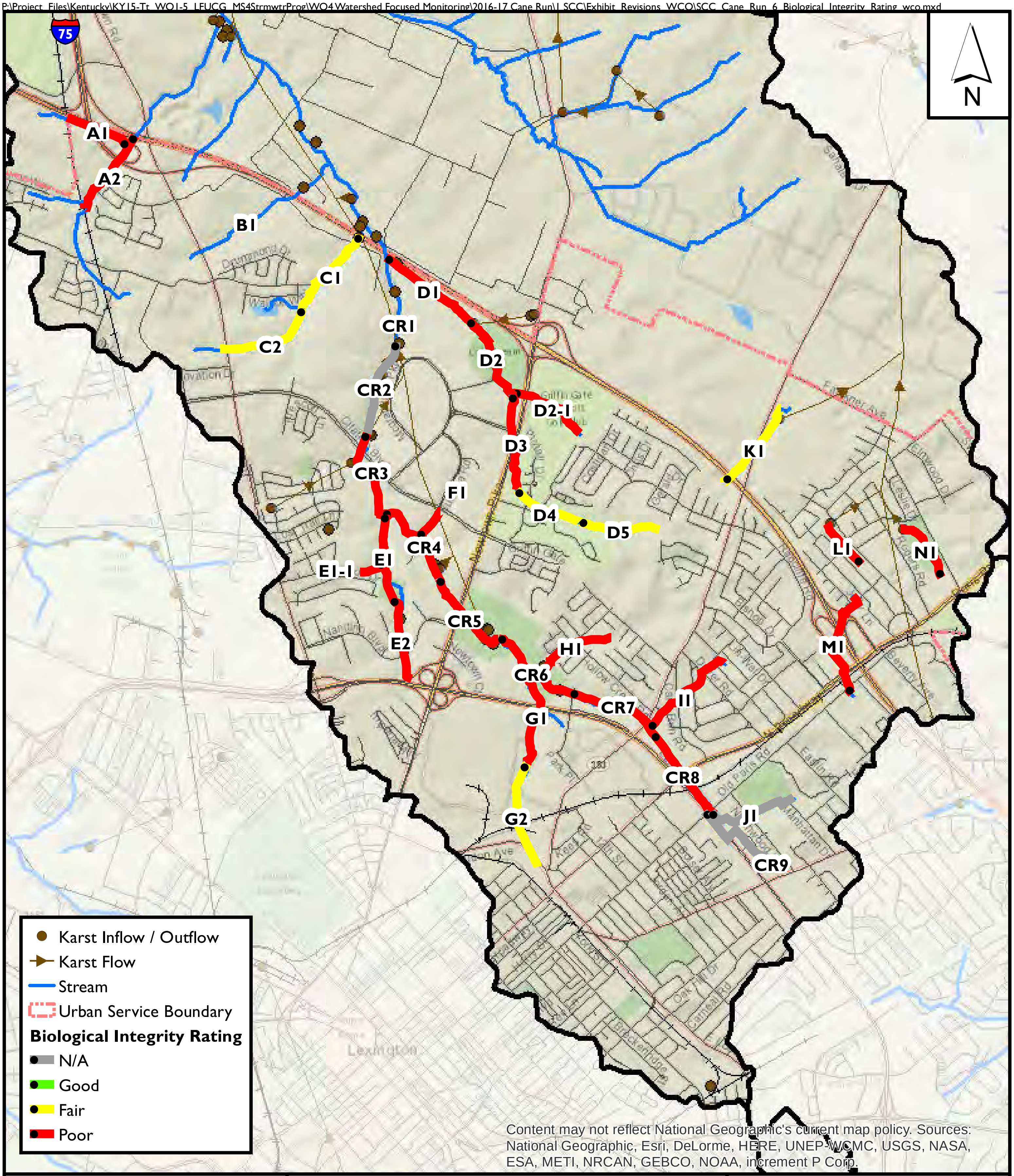

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Prepared by:
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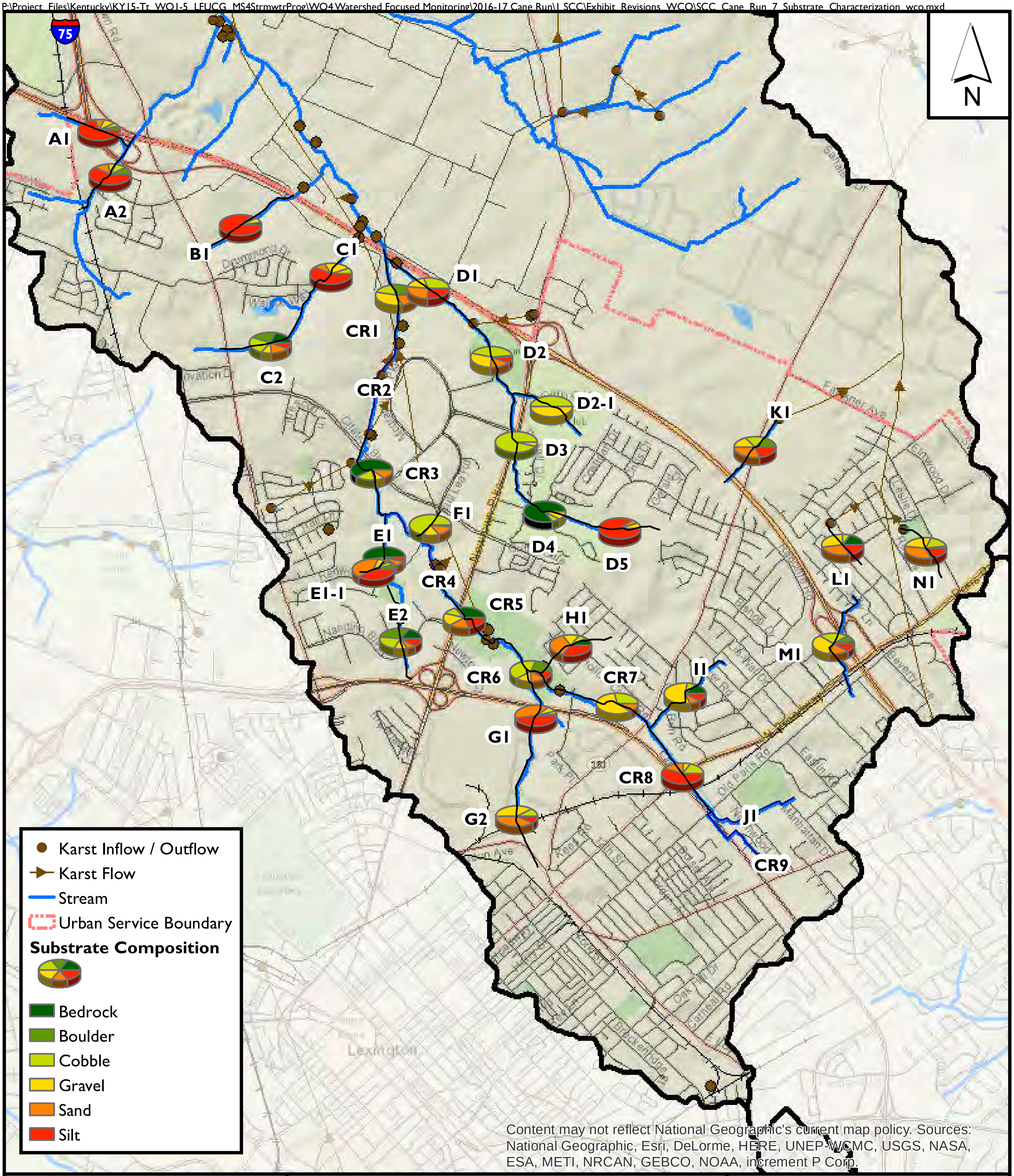
Exhibit 6
Biological Integrity
Stream Corridor Characterization
Cane Run Watershed, Fayette County, KY

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\LSCC\Exhibit_Revisions_WCO\SCC_Cane_Run_7_Substrate_Characterization_wco.mxd



Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
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Exhibit 7
Substrate
Stream Corridor Characterization
Cane Run Watershed, Fayette County, KY

0 0.25 0.5 1
Miles

Prepared for:
LFUCG Division of Water Quality
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Lexington, Kentucky 40511

APPENDIX K

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

THIRD ROCK
TECHNICAL MEMORANDUM

Submitted to: Jennifer Carey, PE, MS4 Coordinator
Lexington-Fayette Urban County Government (LFUCG)
Division of Water Quality

Copied to: Richard Walker, PE
Tetra Tech, Inc.

Prepared by: Bert Remley

Subject: Cane Run Watershed-Focused Monitoring
Stream Biology

Submitted on: January 16, 2018

BACKGROUND

LFUCG's Phase I MS4 Permit (KPDES No. KYS00002 AI No. 74551) was issued on May 1, 2015, with a five-year duration period effective June 1, 2015. One of the requirements of the permit is that "LFUCG shall begin to change its monitoring program to a watershed-focused monitoring program. In order to facilitate this process, monitoring should be conducted on a watershed basis with additional monitoring stations sampled for water chemistry, macroinvertebrates, microbial source tracking, hydrogeomorphic characterization, and habitat assessment."

The study area for LFUCG's Watershed-Focused Monitoring Program (WFMP) encompasses the seven major watersheds that drain LFUCG's Urban Service Area including Cane Run, South Elkhorn, West Hickman, East Hickman, Town Branch, North Elkhorn, and Wolf Run. Monitoring began in 2016 with the Cane Run Watershed, with monitoring to begin in in South Elkhorn in 2017, West Hickman in 2018, and so on until each watershed is monitored and the results reported to the Kentucky Division of Water (KDOW).

The overall objective of the WFMP is to collect and generate data to identify and remediate sources of recreational and aquatic habitat impairments to streams within the Urban Service Boundary. Key monitoring elements include:

1. Stream Corridor Characterization
2. Stream Biology
3. Water Quality Monitoring
4. Discharge Prevention Investigation
5. Priority Area Upland Visual Assessment

Third Rock Consultants, LLC (Third Rock) was retained as a subconsultant to Tetra Tech, Inc. to provide water quality consulting services in support of LFUCG's MS4 program, including conducting key monitoring elements required by LFUCG's WFMP. Results for each watershed will be used to compute and assess pollutant loading and ultimately summarized in a comprehensive, Watershed-Focused Monitoring Program Report for each of the seven watersheds.

As detailed in the WFMP Quality Assurance Project Plan (QAPP), macroinvertebrates were sampled by Third Rock's KDOW-certified biologists at three sites within the watershed. This Technical Memorandum documents the results of Third Rock's stream biology monitoring in the Cane Run Watershed.

METHODOLOGY

Semi-quantitative and qualitative macroinvertebrate samples were collected at sites CR-4 and CR-8 on February 23, 2017 and site CR-5 on April 25, 2017 (*see* **Exhibit 1**, **Appendix A**). All sites were sampled using methods developed by KDOW (KDOW 2015a).

Physical parameters (dissolved oxygen, pH, water temperature, turbidity, and specific conductance) were measured using a Hydrolab water quality meter, and US EPA Rapid Bioassessment Protocol (RBP) was used to assess stream habitat, in conjunction with the sampling effort. Ten physical habitat parameters that characterize the stream "micro-scale" habitat, the "macro-scale" features, and the riparian and bank structure features were assessed, photographed (**Appendix B**, Photo Log) and recorded on a field data sheets modified from US EPA 841-B-99-002 (Barbour *et al.* 1999) (**Appendix C**).

Semi-quantitative sampling involved the collection of four 0.25 square meter (m^2) samples collected from at least two separate riffles at each station using a $0.25m^2$ quadrat and a kicknet (600µm mesh). Riffle collections at each station were composited to form one semi-quantitative sample.

Since all sites were evaluated as headwater streams, qualitative, multi-habitat sampling involved the following:

- collection of three leaf packs; one each from a riffle, run and pool
- three jabs (with an 800 x 900µm D-frame dip net) in sticks/wood
- three jabs into undercut banks/submerged roots, edge habitat, and depositional areas (soft sediment) using a US #10 sieve
- hand-picking of five small boulders from pools
- visual searches of approximately six linear feet of large woody debris

All samples collected with the dip net and from rock and wood were processed through a 600µm wash bucket. Collections from each microhabitat were composited to form one qualitative sample for each station.

Samples were preserved in 95% ethanol and returned to Third Rock's laboratory for processing and identification. Random 300-specimen subsamples were removed from the semi-quantitative (riffle) samples using methods described by KDOW (2015b). Each riffle sample was poured into a Canton sorting tray and divided into 30 equally sized grids. Organisms were removed from the sample in randomly selected grids until the 300-specimen total was reached or all specimens had been removed. The number of grids sorted was recorded for each sample to allow estimation of total organism abundance. Representative individuals for all distinct taxa were removed from the qualitative (multi-habitat) sample for identification. All organisms were identified to the lowest possible taxonomic level and recorded on laboratory bench sheets.

Deviation from the WFMP QAPP is summarized below:

The QAPP identifies sampling sites CR-1, CR-4, CR-8. Cane Run, downstream of site CR-5, has karst features that limit surface flow in this section of the stream, and as a result, dry conditions in CR-1 prevented sampling during the index period; therefore, site CR-5, just upstream of site CR-1, was selected as an alternate sampling site. While CR-5 has a watershed greater than five (5) square miles, it was evaluated as a headwater stream because of the karst influence in the drainage area.

Sites CR-4 and CR-8 were sampled February 23, seven days in advance of the March 1 start of the index period. Third Rock Senior Taxonomist made the decision to sample in advance of a large a large precipitation event (> 1 inch) forecast for February 28 that would have scoured the macroinvertebrate communities and delaying sampling into March. Sampling results were not affected as a result of this schedule deviation.

RESULTS

Physical Water Quality Parameters

All streams within the Cane Run watershed have designated uses of Warmwater Aquatic Habitat (WAH). WAH standards apply to the protection of productive warmwater aquatic communities, fowl, animal wildlife, arboreous growth, agricultural, and industrial uses. The standards applicable to the physical parameters measured are as follows:

- pH shall not be less than 6.0 SU, more than 9.0 SU, nor fluctuate more than 1.0 SU over 24 hours;
- temperature shall not exceed 31.7°C (89°F);
- dissolved oxygen shall be above 5.0 mg/L as a 24-hour average and above 4.0 mg/L for instantaneous measurements; and
- specific conductance shall not be changed to the extent that the indigenous aquatic community is adversely affected.

All parameters were within regulatory benchmarks for WAH criteria. Dissolved oxygen, pH, turbidity, and water temperature measurements were "good" at all locations, while specific conductance levels were generally higher than would be expected. Dissolved oxygen levels ranged from 10.7 mg/L (CR-5) to 11.6 mg/L (CR-8), all of which are above the acute WAH criteria of 4.0 mg/L. Recorded pH levels were also within the WAH criteria, ranging from 8.1 (CR-5) to 8.6 standard units (CR-8). Temperature readings did not exceed 31.7°C (WAH criteria) at any of the stations. Specific conductance does not have a numeric WAH criteria, but results ranged from 677 to 839 µS/cm. Streams were not turbid during sampling with turbidity levels all less than 5 NTUs. Results are summarized in **Table 1**, page 4.

Table 1. Physical Water Quality Parameter Results

Parameter	Site ID		
	CR-4	CR-5	CR-8
Date Sampled	2/23/17	4/28/17	2/23/17
Dissolved Oxygen (mg/L)	10.8	10.7	11.6
pH (SU)	8.2	8.1	8.6
Temperature (°C)	15.2	16.6	19.2
Specific Conductance (μS/cm)	701	677	839
Turbidity (NTUs)	4.0	1.8	4.3

Habitat

Each of the ten parameters was evaluated on a "Condition Category" scale from 0 to 20 where "optimal" scores from 20 to 16, "suboptimal" scores from 15 to 11, "marginal" scores from 10 to 6, and "poor" scores from 5 to 0. A score of 0 to 200 was assigned for each location based on the sum of the ten parameters. For headwater streams (watersheds less than 5 mi^2) of the Bluegrass Bioregion, a habitat score below 142 indicates a "poor" habitat rating; scores between 142 and 155 indicate "fair" habitat rating; and scores above 155 indicate "good" rating (KDOW 2011) as summarized in **Table 2.**

Table 2. WAH Habitat Criteria

Rating	Habitat (RBP Score)	
	Drainage Area > 5.0 mi^2	Drainage Area < 5.0 mi^2
Excellent	N/A	N/A
Good	≥ 130	≥ 156
Fair	114-129	142-155
Poor	≤ 113	≤ 141
Very Poor	N/A	N/A

Habitat assessment indicated "poor" habitat for all three sites when compared to KDOW criteria for streams of the Bluegrass Bioregion. Results are summarized in **Table 3**, page 5.

Table 3. Habitat Results

Parameter	Site ID		
	CR-4	CR-5	CR-8
Date Sampled	2/23/17	4/28/17	2/23/17
Headwater (H) or Wadeable (W)	H	H	H
Epifaunal Sub/Available Cover	11	5	7
Embeddedness	15	10	12
Velocity Depth Regime	12	11	6
Sediment Deposition	16	5	8
Channel Flow Status	13	12	6
Channel Alteration	15	15	14
Freq. of Riffles (or Bends)	13	13	14
Bank Stability	14	2	8
Vegetative Protection	12	2	4
Riparian Zone Width	16	0	5
RBP Score	137	75	84
RBP Rating	Poor	Poor	Poor

The majority of habitat parameters rated within the suboptimal or marginal categories. Vegetation protection and riparian vegetation zone width were the most impaired habitat parameters with a median score in the poor to low marginal range. Marginal riparian zone width is 6 to 12 meters (20' to 40') and has been impacted by human activities. Epifaunal substrate/available cover, sediment deposition, and bank stability were the next most impaired habitat parameters all with median scores falling in the mid-marginal category. Channel alteration and frequency of riffles/bends were the highest rated parameters with medium/high suboptimal median scores (15/13).

Bank stability and riparian vegetation zone width were the most variable parameters evaluated during the assessment with scores ranging from 2 to 14 and 0 to 16, respectively. It should be noted that stream restoration work at CR-5 had begun prior to assessment, lowering the scores at this location. Riparian vegetation had been removed from both banks of CR-5 resulting in a considerable reduction of the riparian zone. As the riparian vegetation recovers, the habitat score at CR-5 will improve.

Macroinvertebrates

Macroinvertebrate sampling results were evaluated through calculation of several community metrics specified by KDOW. Community metrics include genus taxa richness, genus EPT (mayfly, stonefly, and caddisfly) richness, total number of individuals, modified percent EPT individuals, modified Hilsenhoff biotic index (mHBI), percent Ephemeroptera (headwater only), percent primary clingers, and percent Chironomidae plus Oligochaeta (aquatic worms).

Results of community metrics at each site were combined to compute a Macroinvertebrate Bioassessment Index (MBI) score, ranging from 0 (worst) to 100 (best). MBI scores were compared to scoring criteria developed by KDOW to arrive at water quality ratings of "very poor," "poor," "fair," "good," or "excellent." For headwater streams (watersheds less than 5 mi^2) of the Bluegrass Bioregion, an MBI score of 18 and below is "very poor," from 19 to 38 is "poor," from 39 to 50 is "fair," from 51 to 57 is "good," and 58 or greater is "excellent" (Pond *et al.*, 2003) as summarized in **Table 4**.

Table 4. WAH Macroinvertebrate Criteria

Rating	Macroinvertebrates (MBI Score)	
	Drainage Area > 5.0 mi^2	Drainage Area < 5.0 mi^2
Excellent	≥ 70	≥ 58
Good	61-69	51-57
Fair	41-60	39-50
Poor	21-40	19-38
Very Poor	≤ 20	≤ 18

Macroinvertebrate results are summarized in **Table 5**; sampling checklists, laboratory chains of custody/bench sheets, taxa lists, and MBI calculations are included in **Appendix C.**

Table 5. Macroinvertebrate Results

Metric	Site ID		
	CR-4	CR-5	CR-8
Date Sampled	2/23/17	4/28/17	2/23/17
Taxa Richness-genus level	35	23	13
EPT Richness-genus level	6	3	1
mHBI	5.82	5.72	7.05
% modified EPT	9.3	5.6	0.3
% Mayflies	1.9	0.3	0
% Midges & Worms	11.1	51.6	2.3
% Clingers	15.1	7.7	0.3
MBI Score	36.5	24.2	23.2
MBI Rating	Poor	Poor	Poor

MBI scores calculated for all sites ranged from 23.2 (CR-8) to 36.5 (CR-4). Based on the Bluegrass Bioregion criteria, all stations had "poor" MBI ratings for headwater reaches. However, it should be noted that site CR-4 had the highest habitat and macroinvertebrate scores of the three sites and would rate "fair" for macroinvertebrates with only a slight increase in MBI score. It appears that site

CR-4 has undergone previous stream restoration activity (riparian plantings), which may have contributed to higher scores compared to the other sites.

Genus level taxa richness ranged from 13 (CR-8) to 35 (CR-4), and genus EPT richness ranged from 1 (CR-8) to 6 (CR-4). Genus taxa richness and genus EPT richness was highest at site CR-4, scoring 35 for genus taxa richness and 6 for genus EPT richness. Genus taxa richness and genus EPT richness were much lower at headwater sites CR-5 and CR-8. Increasing taxa and EPT richness is associated with improving water quality, habitat diversity, and/or habitat suitability.

Modified Hilsenhoff Biotic Index (mHBI) scores ranged from a low of 5.72 (CS-5) to 7.05 (CR-8). Stations CR-5 and CR-4 rated “good” and CR-8 rated “fair”. An increasing mHBI value indicates decreasing water quality.

Percent modified EPT abundance, which excludes the ubiquitous caddisfly *Cheumatopsyche*, was relatively low at all locations (<10%). Mayfly abundance, which is a metric for headwater streams only, was zero for CR-8, 0.3% for CR-5 and 1.9% CR-4. Increased EPT abundance is associated with improving water quality and/or habitat conditions, whereas mayfly abundance generally decreases with the presence of brine and metal contamination.

Abundance of generally pollution tolerant midges and oligochaeta (worms) was relatively low (<12%) at all locations except for CR-5 (51.6%). Increase in midge and oligochaeta abundance suggests decreasing water quality conditions.

Primary clingers ranged from 0.3 (CR-8) to 15.1 percent (CR-4). Primary clingers require hard, silt free substrates on which to “cling.”

LITERATURE CITED

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish.* Second Edition. EPA 841-B-99-002. USEPA, Office of Water, Washington, D.C.

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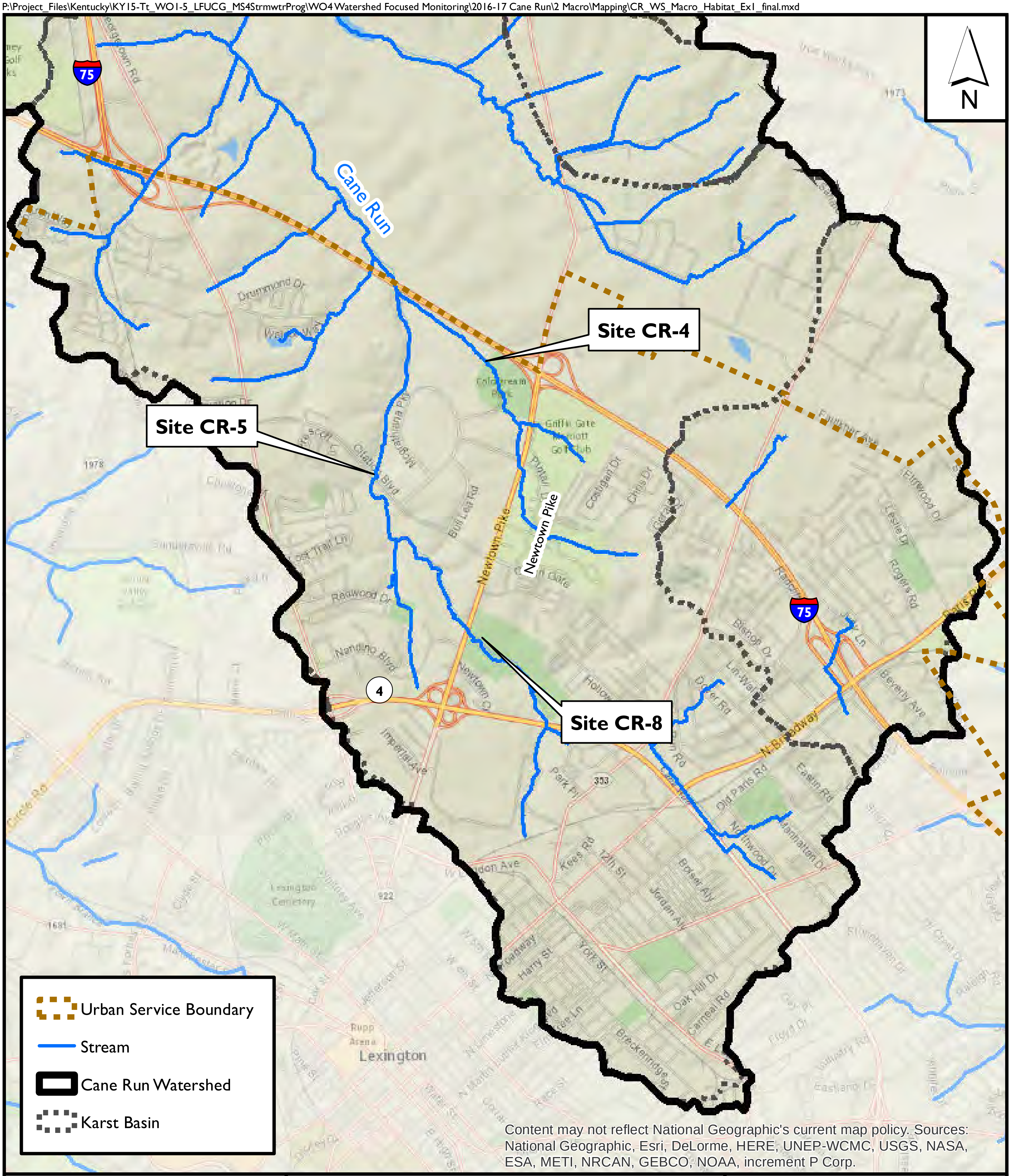
Pond, G.J., S.M. Call, J.F. Brumley and M.C. Compton. 2003. The Kentucky macroinvertebrate bioassessment index: derivation of regional narrative ratings for wadeable and headwater streams. Kentucky Department for Environmental Protection, Division of Water, Frankfort, KY.

APPENDIX A
EXHIBIT 1

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC; January 16, 2018

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\2 Macro\Mapping\CR_WS_Macro_Habitat_Ex1_final.mxd



Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 1
Stream Biology Monitoring Results
Cane Run Watershed Fayette County, Kentucky

0 0.25 0.5 1 Miles

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

APPENDIX B
PHOTO LOG

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC; January 16, 2018


CR-4 Bedrock


CR-4 Cypress Knees and Roots

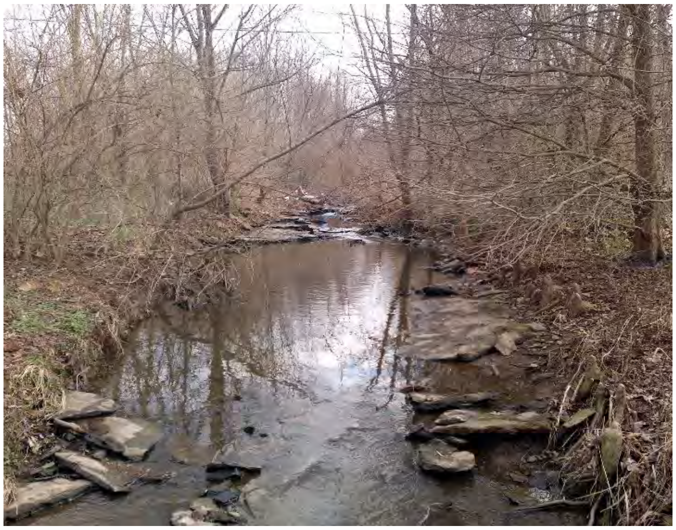

CR-4 Downstream View from Downstream End


CR-4 Downstream View from Upstream End


CR-4 Leaf Pack


CR-4 Pool Habitat


CR-4 Riffle Habitat


CR-4 Upstream View from Downstream End


CR-4 Upstream View from Upstream End


CR-5 Downstream View of Construction Area


CR-5 End of Stream Transect


CR-5 Pool Habitat

CR-5 Root Wad Habitat

CR-5 Upstream View from End of Transect

CR-8 Bedrock

CR-8 Downstream View from Upstream End

CR-8 Downstream View of Downstream Reach

CR-8 Eroding Bank and Pool

CR-8 Fine Sediment

CR-8 Lleaf Pack

CR-8 Left Bank

CR-8 Riffle Habitat

CR-8 Right Bank

CR-8 Root Wad

CR-8 Under Cut Bank

CR-8 Upstream from Upstream End

CR-8 upstream view from downstream end of reach

APPENDIX C
HABITAT ASSESSMENT FIELD DATA

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC; January 16, 2018

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID UT Cane Run CR-4 **DATE:** 2-23-17 **LAT:** 36.100676 **LONG:** -84.490700

INVESTIGATOR(S) BR/CO **COWARDIN CLASS:** Stream **WATERSHED:** KY

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	10	Perennial	✓	IMG	see photo log
Depth (Ft)	1.5	Ephemeral		IMG	
Reach (F~~t~~)m	100	Intermittent		IMG	

HABITAT PARAMETER	**CONDITION CATEGORY**			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 11	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 15	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 12	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 16	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 13	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) 13 Score	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

8. Bank Stability	**OPTIMAL**	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	10 9	8 7 6	5 4 3	2 1 0
LB Score 7 *RB Score* 7	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 6 *RB Score* 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 8 *RB Score* 6	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Total Score 0				

137

REMARKS / NOTES:

Cypress planted, possible constructed riffle, decent riparian zone width for urban stream.

STREAM ID 0 CR-4

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID Cane Run - CR-8 **DATE:** 2.23-17 **LAT:** 38.07946 **LONG:** -84.491493

INVESTIGATOR(S) B. Remley/C. Olson **COWARDIN CLASS:** Stream **WATERSHED:** KY

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	8	Perennial		IMG	See photo log
Depth (Ft)	6"	Ephemeral		IMG	
Reach (~~Ft~~)m	150	Intermittent	✓	IMG	

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 7	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 12	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 6	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 8	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 6	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 14	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 14	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
	10 9	8 7 6	5 4 3	2 1 0
8. Bank Stability *LB Score* 3 *RB Score* 5	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
9. Vegetative Protection *LB Score* 1 *RB Score* 3	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
10. Riparian Vegetative Zone Width *LB Score* 1 *RB Score* 4	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

Total Score 0
84

REMARKS / NOTES: Low flow, probably does not flow year round. Lots of trash in stream.

STREAM ID 8 CR-8

Page 2 of 2

THIRD ROCK CONSULTANTS, LLC
STREAM HABITAT ASSESSMENT (HIGH GRADIENT)

STREAM ID CR-52/AKA CR-5 DATE: 4-25-17 **LAT:** ______ **LONG:** ______

INVESTIGATOR(S) BR/JS **COWARDIN CLASS:** ______ **WATERSHED:** Cane Run

STREAM SIZE:		**STREAM TYPE:**		**IMAGE ID:**	**IMAGE COMMENT:**
Width (Ft)	✓15'	Perennial	✓	IMG 943/003	Riffle/pool
Depth (Ft)	1,5' avg	Ephemeral		IMG 036	DS view of construction
Reach (Ft)	375	Intermittent		IMG 106	root wad

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
1. Epifaunal Substrate / Available Cover Score 5	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.)	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
2. Embeddedness Score 10	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
3. Velocity / Depth Regime Score 11	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
4. Sediment Deposition Score 5	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
5. Channel Flow Status Score 12	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
6. Channel Alteration Score 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
7. Frequency of Riffles (or Bends) Score 13	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.

	OPTIMAL		**SUBOPTIMAL**			**MARGINAL**			**POOR**		
	10	9	8	7	6	5	4	3	2	1	0
8. Bank Stability see notes *LB Score* 1 *RB Score* 1	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.		Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		
9. Vegetative Protection see notes *LB Score* 1 *RB Score* 1	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.		70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.		
10. Riparian Vegetative Zone Width see notes 50 *LB Score* 0 *RB Score* 0	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.		Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.		
Total Score 0 75											

REMARKS / NOTES: Bottom 3/4 of reach is currently undergoing stream restoration construction is ongoing, all riparian veg has been removed on both banks in preparation.

STREAM ID 0

APPENDIX D
LABORATORY DATA

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC; January 16, 2018

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 2-23-17 Time: 417pm

Collector(s) Initials: BR/CG Station Number CR-4 macro

✓ Collected during the headwater sampling period (March 1– May 31).

Stream Conditions

✓ Clear /Normal flow

____Turbid/High flow. (If so, do not sample.)

____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 100 meters

Number of riffles in stream reach: 4 (at least 3)

Number of runs in stream reach: 3 (at least 3)

Number of pools in stream reach: 4 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalweg of Riffle #1

✓ 0.25 m^2 quadrat from the thalweg of a different area of [✓ Riffle #1] (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)

✓ 0.25 m^2 quadrat from the thalweg of Riffle #2 which is located at the most upstream portion of the stream reach

✓ 0.25 m^2 quadrat from the thalweg of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 runs/riffles within reach)

✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)

✓ Other Sweeps (Ex. Bedrock sweeps) Comments: 3 bedrock

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from [✓ pools/side channels]/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

N/A N/A

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

____Submerged Wood Picks: Linear Meters of Wood Sampled 2.5 (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 10.8/111% DO 15.2 Temperature 8.2 pH 701 Conductivity

turb = 4.0

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 2-23-17 Time: 130 pm
Collector(s) Initials: BR/CO Station Number CR-8

✓ Collected during the headwater sampling period (March 1-- May 31).

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 150 meters
Number of riffles in stream reach: 4 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 3 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalwag of Riffle #1
✓ 0.25 m^2 quadrat from the thalwag of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalwag of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalwag of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies and 3 sweeps in 2 ~~runs/riffles within~~ reach) N/A
____Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies and 3 sweeps in runs within reach)
✓ Other Sweeps (Ex. Bedrock sweeps) Comments: 3 bedrock

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and [✓ 3 conditioned leaf packs from riffles]) N/A N/A

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

____Submerged Wood Picks: Linear Meters of Wood Sampled 3 (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 11.6/124% DO 19.2 Temperature 8.6* pH 839 Conductivity

* checked twice

turb = 4.3

Headwater (<5 mi^2) Macroinvertebrate Collection Check Sheet for High-Gradient Streams

Date: 4-28-17 Time: 3-430pm

Collector(s) Initials: BR/JS Station Number CR-5

✓ Collected during the headwater sampling period (March 1– May 31)

Stream Conditions

✓ Clear /Normal flow
____Turbid/High flow. (If so, do not sample.)
____No flow in riffles. (If so, do not sample.)

Stream Reach

✓ 100 meters – 300 meters. How long? 125 meters
Number of riffles in stream reach: 3 (at least 3)
Number of runs in stream reach: 3 (at least 3)
Number of pools in stream reach: 3 (at least 3; for headwaters with no pools, then at least 4 runs and riffles)

1 m^2 Kick-net Method

✓ 0.25 m^2 quadrat from the thalweg of Riffle #1
✓ 0.25 m^2 quadrat from the thalweg of a different area of Riffle #1 (If Riffle #1 is small, then sample Riffle #4 from the sample reach; Riffle #4 can be anywhere within the stream reach)
✓ 0.25 m^2 quadrat from the thalweg of Riffle #2 which is located at the most upstream portion of the stream reach
✓ 0.25 m^2 quadrat from the thalweg of Riffle #3 which is located at the most downstream portion of the stream reach

Multi-Habitat Method

Boulder Picks

✓ Boulder Pick (5 rocks from pools/side channels/eddies within reach)

Sweeps (If any of these habitats are missing, then add one more sweep to each habitat that is present.)

✓ Undercut Banks/Roots Sweeps (3 sweeps in 2 pools/side channels/eddies <u>and</u> 3 sweeps in 2 runs/riffles within reach)
✓ Sticks/Wood Sweeps (3 sweeps in pools/side channels/eddies <u>and</u> 3 sweeps in runs within reach)
– Other Sweeps (Ex. Bedrock sweeps) Comments: Bedrock embedded

Conditioned Leaf Pack Picks

✓ Conditioned Leaf Pack Picks (3 conditioned leaf packs from pools/side channels/eddies, 3 conditioned leaf packs from runs and 3 conditioned leaf packs from riffles)

Fine Material (Silt/Sand/Fine Gravel) Scoops

✓ Fine Material Scoops (Using a US#10 sieve, scoop fine material and sieve. 6 depositional areas within reach)

Conditioned Submerged Wood Picks – Total between 2 and 4 linear meters of conditioned submerged wood.

✓ Submerged Wood Picks: Linear Meters of Wood Sampled 2 (Wood from riffles, runs and pools/side channels/eddies within reach shall be represented.)

Field Measurements: 10.7/113% DO 16.6 Temperature 8.1 pH 677 Conductivity

turb 1.8

Sample ID	Taxa Name	Class	Order	Family	FFG	Tolerence	Clinger	Count
CR-4 QL	Ischnura sp	Insecta	Odonata	Coenagrionidae	PR	9.52	FALSE	N/A
CR-4 QL	Polypedilum fallax gr	Insecta	Diptera	Chironomidae	SH	6.39	FALSE	N/A
CR-4 QL	Thienemanniella xena	Insecta	Diptera	Chironomidae	CG	5.9	FALSE	N/A
CR-4 QL	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	5.9	FALSE	N/A
CR-4 QL	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	6.7	FALSE	N/A
CR-4 QL	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	6.4	TRUE	N/A
CR-4 QL	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	6.4	FALSE	N/A
CR-4 QL	Lumbriculidae	Oligochaeta	Lumbriculida	Lumbriculidae	CG	7.3	FALSE	N/A
CR-4 QL	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	2.8	TRUE	N/A
CR-4 QL	Procladius sp	Insecta	Diptera	Chironomidae	PR	9.1	FALSE	N/A
CR-4 QL	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	7.18	TRUE	N/A
CR-4 QL	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	7.4	FALSE	N/A
CR-4 QL	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	6.87	TRUE	N/A
CR-4 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	N/A
CR-4 QL	Synurella sp	Malacostraca	Amphipoda	Crangonyctidae	CG	8	FALSE	N/A
CR-4 QL	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	N/A
CR-4 QL	Hydropsychidae	Insecta	Trichoptera	Hydropsychidae	CF	4	FALSE	N/A
CR-4 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	7.58	FALSE	N/A
CR-4 QL	Stempellinella sp	Insecta	Diptera	Chironomidae	CG	4.62	FALSE	N/A
CR-4 QL	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	6.48	FALSE	N/A
CR-4 QL	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	7	FALSE	N/A
CR-4 QL	Simulium sp	Insecta	Diptera	Simuliidae	CF	4.4	TRUE	N/A
CR-4 QL	Ablabesmyia sp	Insecta	Diptera	Chironomidae	PR	7.2	FALSE	N/A
CR-4 QL	Phaenopsectra flavipes	Insecta	Diptera	Chironomidae	SC	7.94	FALSE	N/A
CR-4 QL	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	8.45	TRUE	N/A
CR-4 QL	Cricotopus/Orthocladius gr	Insecta	Diptera	Chironomidae	CG	7.1	FALSE	N/A
CR-4 QL	Stictochironomus sp	Insecta	Diptera	Chironomidae	CG	6.52	FALSE	N/A
CR-4 QL	Turbellaria	Turbellaria			CG	5	FALSE	N/A
CR-4 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	5.1	TRUE	1
CR-4 QT	Stempellinella sp	Insecta	Diptera	Chironomidae	CG	4.62	FALSE	1
CR-4 QT	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	2.84	FALSE	1
CR-4 QT	Chimarra aterrima	Insecta	Trichoptera	Philopotamidae	CF	2	TRUE	1
CR-4 QT	Stenonema femoratum	Insecta	Ephemeroptera	Heptageniidae	SC	7.18	TRUE	1
CR-4 QT	Orconectes sp	Malacostraca	Decapoda	Cambaridae	CG	5.49	FALSE	1
CR-4 QT	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	1
CR-4 QT	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	7.58	FALSE	1
CR-4 QT	Rheotanytarsus exiguus gr	Insecta	Diptera	Chironomidae	CF	6.4	TRUE	1
CR-4 QT	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	6.48	FALSE	1
CR-4 QT	Gyraulus sp	Mollusca	Lymnophila	Planorbidae	SC	7.5	FALSE	1
CR-4 QT	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	6.7	FALSE	1
CR-4 QT	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	9	FALSE	2
CR-4 QT	Stenacron interpunctatum	Insecta	Ephemeroptera	Heptageniidae	CG	6.87	TRUE	2
CR-4 QT	Simulium sp	Insecta	Diptera	Simuliidae	CF	4.4	TRUE	2
CR-4 QT	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	9.1	FALSE	3
CR-4 QT	Psephenus herricki	Insecta	Coleoptera	Psephenidae	SC	2.35	TRUE	3
CR-4 QT	Hydropsyche betteni/depravata complex	Insecta	Trichoptera	Hydropsychidae	CF	4	TRUE	3
CR-4 QT	Caenis diminuta gr	Insecta	Ephemeroptera	Caenidae	CG	7.4	FALSE	3
CR-4 QT	Thienemanniella xena	Insecta	Diptera	Chironomidae	CG	5.9	FALSE	3
CR-4 QT	Cricotopus/Orthocladius gr	Insecta	Diptera	Chironomidae	CG	7.1	FALSE	3
CR-4 QT	Turbellaria	Turbellaria			CG	5	FALSE	4
CR-4 QT	Polypedilum flavum	Insecta	Diptera	Chironomidae	SH	5.3	FALSE	4
CR-4 QT	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	7	FALSE	7
CR-4 QT	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	6.22	TRUE	7
CR-4 QT	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	5.1	TRUE	8
CR-4 QT	Thienemannimyia gr	Insecta	Diptera	Chironomidae	PR	5.9	FALSE	13
CR-4 QT	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	2.8	TRUE	20
CR-4 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	225
CR-8 QL	Lymnaea sp	Mollusca	Lymnophila	Lymnaeidae	SC	7	FALSE	N/A
CR-8 QL	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	8.63	FALSE	N/A
CR-8 QL	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	N/A

CR-8 QL	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	N/A
CR-8 QL	Tipula sp	Insecta	Diptera	Tipulidae	SH	7.33	FALSE	N/A
CR-8 QL	Physella sp	Mollusca	Basommatophora	Physidae	SC	8.84	FALSE	N/A
CR-8 QL	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	7.58	FALSE	N/A
CR-8 QT	Erpobdella punctata	Hirudinea	Pharyngobdellida	Eropolellidae	CG	7.8	FALSE	1
CR-8 QT	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	9.1	FALSE	1
CR-8 QT	Chimarra obscura	Insecta	Trichoptera	Philopotamidae	CF	2.8	TRUE	1
CR-8 QT	Dubiraphia sp	Insecta	Coleoptera	Elmidae	SC	6.4	FALSE	1
CR-8 QT	Physella sp	Mollusca	Basommatophora	Physidae	SC	8.84	FALSE	1
CR-8 QT	Lumbriculidae	Oligochaeta	Lumbriculida	Lumbriculidae	CG	7.3	FALSE	7
CR-8 QT	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	10
CR-8 QT	Turbellaria	Turbellaria			CG	5	FALSE	15
CR-8 QT	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	272

Sample ID	Taxa Name	Class	Order	Family	FFG	Tolerence	Clinger	Count
CR-5	Turbellaria	Turbellaria			CG	5	FALSE	4
CR-5	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	2
CR-5	Stenelmis sp	Insecta	Coleoptera	Elmidae	SC	5.1	TRUE	2
CR-5	Limnophyes sp	Insecta	Diptera	Chironomidae	CG	7	FALSE	1
CR-5	Polypedilum illinoense gr	Insecta	Diptera	Chironomidae	SH	9	FALSE	1
CR-5	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	8.45	TRUE	1
CR-5	Thienemanniella xena	Insecta	Diptera	Chironomidae	CG	5.9	FALSE	5
CR-5	Cricotopus bicinctus	Insecta	Diptera	Chironomidae	SH	8.54	FALSE	8
CR-5	Cricotopus/Orthocladius gr	Insecta	Diptera	Chironomidae	CG	7.1	FALSE	15
CR-5	Micropsectra sp	Insecta	Diptera	Chironomidae	CG	1.52	FALSE	20
CR-5	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	7	FALSE	24
CR-5	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	2.84	FALSE	96
CR-5	Simulium sp	Insecta	Diptera	Simuliidae	CF	4.4	TRUE	3
CR-5	Baetis flavistriga	Insecta	Ephemeroptera	Baetidae	CG	6.58	FALSE	1
CR-5	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	9.1	FALSE	4
CR-5	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	132
CR-5	Cheumatopsyche sp	Insecta	Trichoptera	Hydropsychidae	CF	6.22	TRUE	2
CR-5	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	6.22	TRUE	18
CR-5	Crangonyx sp	Malacostraca	Amphipoda	Crangonyctidae	SH	8	FALSE	N/A
CR-5	Physella sp	Mollusca	Basommatophora	Physidae	SC	8.84	FALSE	N/A
CR-5	Chironomus sp	Insecta	Diptera	Chironomidae	CG	9.63	FALSE	N/A
CR-5	Stictochironomus sp	Insecta	Diptera	Chironomidae	CG	6.52	FALSE	N/A
CR-5	Paratanytarsus sp	Insecta	Diptera	Chironomidae	CG	8.45	TRUE	N/A
CR-5	Limnophyes sp	Insecta	Diptera	Chironomidae	CG	7	FALSE	N/A
CR-5	Tanytarsus sp	Insecta	Diptera	Chironomidae	CF	6.7	FALSE	N/A
CR-5	Cricotopus tremulus gr	Insecta	Diptera	Chironomidae	SH	7	FALSE	N/A
CR-5	Cricotopus trifascia	Insecta	Diptera	Chironomidae	SH	2.84	FALSE	N/A
CR-5	Anopheles sp	Insecta	Diptera	Culicidae	CF	8.58	FALSE	N/A
CR-5	Naididae	Oligochaeta	Haplotaxida	Naididae	CG	9.1	FALSE	N/A
CR-5	Pisidium sp	Mollusca	Heterodonta	Pisidiidae	CF	6.48	FALSE	N/A
CR-5	Sphaerium sp	Mollusca	Heterodonta	Pisidiidae	CF	7.58	FALSE	N/A
CR-5	Lirceus fontinalis	Malacostraca	Isopoda	Asellidae	CG	7.85	FALSE	N/A
CR-5	Helobdella stagnalis	Hirudinea	Rhynchobdellida	Glossiphoniidae	PC	8.63	FALSE	N/A
CR-5	Hydroptila sp	Insecta	Trichoptera	Hydroptilidae	PH	6.22	TRUE	N/A

MBI Calculations

2017 Cane Run Headwater MBI Results									Raw Results							Metric Score								
StationID	StreamName	CollDate	Bioregion	Sub-Ecoregion	Basin	Order	Catchment Area	CollMeth	G-TR	G-EPT	mHBI	m%EPT	%Ephem	%C+O	%ClngP	G-TR	G-EPT	HBI2	m%EPT	%Ephem	%C+O	%ClngP	MBI Score	MBI Rating
CR-4	UNT Cane Run	2/23/2017	BG	71I	KY	2	1.02	1 M2 KICKNET/Multihabitat	35	6	5.82	9.26	1.85	11.11	15.12	59.32	19.35	53.47	10.66	2.78	89.50	20.03	36.5	Poor
CR-5	Cane Run	4/28/2017	BG	71I	KY	2	5.5	1 M2 KICKNET/Multihabitat	23	3	5.72	5.60	0.29	51.62	7.67	38.98	9.68	54.73	6.44	0.44	48.71	10.16	24.2	Poor
CR-8	Cane Run	2/23/2017	BG	71I	KY	2	4.08	1 M2 KICKNET/Multihabitat	13	1	7.05	0.32	0.00	2.27	0.32	22.03	3.23	37.68	0.37	0.00	98.40	0.43	23.2	Poor

THIRDROCK CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #:	KY15-TT-4.3	Client Name:	TRC In-House Tetra Tech-LFUCG
Water Body:	Cane Run	State/County:	KY / Fayette
Sample ID:	CR-4	Collection Date:	2/23/2017
Collector:	BR/CO	Sampling Method:	Kick Net
Sorter:	Bert Remley	Sample Sorting:	Subsample
Taxonomist:	Bert Remley	No. Grids of 30 Picked:	4
		No. Organisms Picked:	321

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Naididae (Immature)	3			Cricotopus trifascia	1
				Cricotopus tremulus gr	7
				Cricotopus/Orthocladius gr	3
				Polypedilum flavum	4
AMPHIPODA				Polypedilum illinoense gr	2
Crangonyx sp	1			Rheotanytarsus exiguus gr	1
				Stempellinella sp	1
				Tanytarsus sp	1
ISOPODA				Thienemanniella xena	3
Lirceus fontinalis	225			Thienemannimyia gr	13
DECAPODA					
Orconectes sp (Damaged)	1	TRICHOPTERA			
		Cheumatopsyche sp	7		
EPHEMEROPTERA		Chimarra obscura	20		
Caenis diminuta gr	3	Chimarra aterrima	1		
Stenacron interpunctatum	2	Hydropsyche betteni/depravata complex	3		
Stenonema femoratum	1				
				DIPTERA (OTHER)	
				Simulium sp	2
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Gyraulus sp	1
				Pisidium sp	1
				Sphaerium sp	1
		COLEOPTERA			
		Psephenus (L) 3	3		
		Stenelmis (A) 1 (L) 8	9		
				OTHER TAXA	
				Turbellaria	4
				Number of Individuals	324

Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15-TT-4.3
Water Body: Cane Run
Sample ID: CR-4
Collector: BR/CO
Sorter: Bert Remley
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 2/23/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: 1

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Lumbriculidae (Immature)				Ablabesmyia sp (Damaged)	
				Cricotopus tremulus gr	
				Cricotopus/Orthocladius gr	
				Paratanytarsus sp	
AMPHIPODA				Phaenopsectra flavipes	
Crangonyx sp				Polypedilum fallax gr	
Synurella sp				Procladius sp	
				Rheotanytarsus exiguus gr	
ISOPODA				Stempellinella sp	
Lirceus fontinalis				Stictochironomus sp	
				Tanytarsus sp	
				Thienemanniella xena	
DECAPODA				Thienemannimyia gr	
		TRICHOPTERA			
		Chimarra obscura			
EPHEMEROPTERA		Hydropsychidae (Immature)			
Caenis diminuta gr					
Stenacron interpunctatum					
Stenonema femoratum					
				DIPTERA (OTHER)	
				Simulium sp	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Pisidium sp	
Ischnura sp (Immature)				Sphaerium sp	
		COLEOPTERA			
		Dubiraphia (L) 0			
				OTHER TAXA	
				Turbellaria	
				Number of Individuals	n/a

ThirdRock Consultants
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15-TT-4.3
Water Body: Cane Run
Sample ID: CR-8
Collector: BR/CO
Sorter: Bert Remley
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 2/23/2017
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 10
No. Organisms Picked: 311

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
Erpobdella punctata	1
Lumbriculidae (Immature)	7
Naididae (Immature)	1
AMPHIPODA	
Crangonyx sp	10
ISOPODA	
Lirceus fontinalis	272
DECAPODA	
EPHEMEROPTERA	
ODONATA	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
Chimarra obscura	1
MEGALOPTERA	
COLEOPTERA	
Dubiraphia (A) 1	1

Family or Taxon / Genus	No. Orgs.
DIPTERA (CHIRONOMIDAE)	
DIPTERA (OTHER)	
MOLLUSCA	
Physella sp	1
OTHER TAXA	
Turbellaria	15
Number of Individuals	309

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15-TT-4.3
Water Body: Cane Run
Sample ID: CR-8
Collector: BR/CO
Sorter: Chelsey Olson
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 2/23/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: 1

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Helobdella stagnalis					
AMPHIPODA					
Crangonyx sp					
ISOPODA					
Lirceus fontinalis					
DECAPODA					
		TRICHOPTERA			
EPHEMEROPTERA					
				DIPTERA (OTHER)	
				Tipula sp (Immature)	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Lymnaea sp	
				Physella sp	
				Sphaerium sp	
		COLEOPTERA			
				OTHER TAXA	
				Number of Individuals	n/a

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15Y3TT3-3B
Water Body: Cane Run
Sample ID: CR-5
Collector: BR
Sorter: Chelsey Olson
Taxonomist: Chelsey Olson

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 4/28/2017
Sampling Method: Kick Net
Sample Sorting: Subsample
No. Grids of 30 Picked: 4
No. Organisms Picked: 347

Family or Taxon / Genus	No. Orgs.
ANNELIDA	
Naididae	4
AMPHIPODA	
Crangonyx sp	2
ISOPODA	
Lirceus fontinalis	132
DECAPODA	
EPHEMEROPTERA	
Baetis flavistriga	1
ODONATA	

Family or Taxon / Genus	No. Orgs.
PLECOPTERA	
TRICHOPTERA	
Cheumatopsyche sp	2
Hydroptila sp	18
MEGALOPTERA	
COLEOPTERA	
Stenelmis (L) 2	2

Family or Taxon / Genus	No.Orgs.
DIPTERA (CHIRONOMIDAE)	
Cricotopus tremulus gr	24
Cricotopus bicinctus	8
Cricotopus trifascia	96
Cricotopus/Orthocladius gr	15
Limnophyes sp	1
Micropsectra sp	20
Paratanytarsus sp	1
Polypedilum illinoense gr	1
Thienemanniella xena	5
DIPTERA (OTHER)	
Simulium sp	3
MOLLUSCA	
OTHER TAXA	
Turbellaria	4
Number of Individuals	339

[1] Sampling Method: Surber (SU); Traveling-Kick (TK); Multihabitat (MH); Hester-Dendy (HD); or Other (O).
[2] Sorting: Entire Sample (E); 100-Specimen Subsample (SS-100); or Other (O).

Reviewed By:___________
Date:___________

THIRDROCK
CONSULTANTS
Lexington, Kentucky

MACROINVERTEBRATE LABORATORY DATA SHEET

Third Rock Pjt #: KY15Y3TT3-3B
Water Body: Cane Run
Sample ID: CR-5 QL
Collector: BR
Sorter: Bert Remley
Taxonomist: Bert Remley

Client Name: TRC In-House Tetra Tech-LFUCG
State/County: KY / Fayette
Collection Date: 4/28/2017
Sampling Method: Multihabitat
Sample Sorting: Subsample
No. Grids of 30 Picked: 30
No. Organisms Picked: 1

Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.	Family or Taxon / Genus	No. Orgs.
ANNELIDA		PLECOPTERA		DIPTERA (CHIRONOMIDAE)	
Helobdella stagnalis				Chironomus sp	
Naididae				Cricotopus tremulus gr	
				Cricotopus trifascia	
				Limnophyes sp	
AMPHIPODA				Paratanytarsus sp	
Crangonyx sp				Stictochironomus sp	
				Tanytarsus sp	
ISOPODA					
Lirceus fontinalis					
DECAPODA					
		TRICHOPTERA			
		Hydroptila sp			
EPHEMEROPTERA					
				DIPTERA (OTHER)	
				Anopheles sp	
		MEGALOPTERA			
				MOLLUSCA	
ODONATA				Physella sp	
				Pisidium sp	
				Sphaerium sp	
		COLEOPTERA			
				OTHER TAXA	
				Number of Individuals	NA

[1] Sampling Method: Surber (SU); Traveling-Kick (TK); Multihabitat (MH); Hester-Dendy (HD); or Other (O).
[2] Sorting: Entire Sample (E); 100-Specimen Subsample (SS-100); or Other (O).

Reviewed By:___________
Date:___________

THIRD ROCK
CONSULTANTS

Macroinvertebrate Sample Chain of Custody
Project Information Sheet

Client Name: Tetra Tech / LFUCG Project Administrator: Steve Evans Project Number: KY15TT_W01-5-MS4 storm way Due Date: 3-31-17

Sampling Site Location: Cane Run County: Fayette State: KY

System Type: Headwater EcoRegion: BG Total Number of Samples: 4 Total Number of Containers: 4

Reporting Requirements: ✓ Laboratory Data Sheet; ✓ Excel Spreadsheet; ✓ MBI Calculations via ✓ e-Submittal; ✓ Hardcopy; ✓ Both

Samples Relinquished By: Date/Time: 2-24-17/0931 Sample Received By: Date/Time: 2-24-17/0931

Samples Relinquished By: ______ Date/Time: ______ Sample Received By: ______ Date/Time: ______

Comments/Special Instructions: ______

Sample Reference ID	Qualitative or Quantitative	Collected By	Collection Date	Sample Type	Preservative	# of Containers Per Sample	Analysis Required (KDOW Protocol, ID Level; etc.)
CR-4	Quant	BR/CO	2-23-17	KN	Ethanol	1	KDOW SS-300
CR-4	Qual	↓	↓	MH	↓	↓	↓
CR-8	Quant			KN			
CR-8	Qual			MH			

- Continue on Reverse for More Samples -

System Type: Headwater Stream; Wadeable Stream; Large River; Lotic; Other ______
EcoRegion: Bluegrass; Mountain; Pennyroyal; Mississippi Valley-Interior River Lowlands; Other ______
Sample Type: **KN** KickNet; **TK** Traveling Kick; **MH** Multihabitat; **S** Surber; **HD** Hester-Dendy Multiplate; **HDD** HD Deep; **HDS** HD Shallow; **OT** Other______; **NA** Not Available

MacLIMS: Client Setup/Login By ______ Date ______; Reported By ______ Date ______; Invoiced By ______ Date ______ 5/20/10

THIRDROCK
CONSULTANTS

Macroinvertebrate Sample Chain of Custody
Project Information Sheet

Client Name: LFUCG **Project Administrator:** Steve Evans **Project Number:** Ky15tt **Due Date:** 7-30-17

Sampling Site Location: Cane Run **County:** Fayette **State:** Ky

System Type: Headwater **EcoRegion:** Bluegrass **Total Number of Samples:** 2 **Total Number of Containers:** 2

Reporting Requirements: ✓ Laboratory Data Sheet; ✓ Excel Spreadsheet; ✓ MBI Calculations via __ e-Submittal; __ Hardcopy; ✓ Both

Samples Relinquished By: ______ **Date/Time:** 5-9-17/1700 **Sample Received By:** Erin M Remley **Date/Time:** 5-9-17/1700

Samples Relinquished By: ______ **Date/Time:** ______ **Sample Received By:** ______ **Date/Time:** ______

Comments/Special Instructions: ______

Sample Reference ID	Qualitative or Quantitative	Collected By	Collection Date	Sample Type	Preservative	# of Containers Per Sample	Analysis Required (KDOW Protocol, ID Level; etc.)
CR-5	Quant	BR/CO	4-26-17	KN	Ethanol	1	KDOW
CR-5	Qual	↓	↓	MH	↓	↓	↓

- Continue on Reverse for More Samples -

System Type: Headwater Stream; Wadeable Stream; Large River; Lotic; Other ______
EcoRegion: Bluegrass; Mountain; Pennyroyal; Mississippi Valley-Interior River Lowlands; Other ______
Sample Type: **KN** KickNet; **TK** Traveling Kick; **MH** Multihabitat; **S** Surber; **HD** Hester-Dendy Multiplate; **HDD** HD Deep; **HDS** HD Shallow; **OT** Other______; **NA** Not Available

MacLIMS: Client Setup/Login By ______ Date ______; Reported By ______ Date ______; Invoiced By ______ Date ______ 5/20/10

APPENDIX L

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

THIRD ROCK
TECHNICAL MEMORANDUM

Submitted to: Jennifer Carey, PE
Lexington-Fayette Urban County Government (LFUCG)
Division of Water Quality

Copied to: Richard Walker, PE
Tetra Tech, Inc.

Prepared by: Jennifer Shelby, PE

Subject: Cane Run Watershed-Focused Monitoring
Water Quality Monitoring

Submitted on: April 10, 2018; *Revised* May 22, 2019

BACKGROUND

LFUCG's Phase I MS4 Permit (KPDES No. KYS00002 AI No. 74551) was issued on May 1, 2015, with a five-year duration period effective June 1, 2015. One of the requirements of the permit is that "LFUCG shall begin to change its monitoring program to a watershed-focused monitoring program. In order to facilitate this process, monitoring should be conducted on a watershed basis with additional monitoring stations sampled for water chemistry, macroinvertebrates, microbial source tracking, hydrogeomorphic characterization, and habitat assessment."

The study area for LFUCG's Watershed-Focused Monitoring Program (WFMP) encompasses the 7 major watersheds that drain LFUCG's Urban Service Area including Cane Run, South Elkhorn, West Hickman, East Hickman, Town Branch, North Elkhorn, and Wolf Run. Monitoring began in 2016 with the Cane Run Watershed, with monitoring to begin in South Elkhorn in 2017, West Hickman in 2018, and so on until each watershed is monitored and the results reported to the Kentucky Division of Water (KDOW).

The overall objective of the WFMP is to collect and generate data to identify and remediate sources of recreational and aquatic habitat impairments to streams within the Urban Service Boundary. Key monitoring elements include:

1. Stream Corridor Characterization
2. Stream Biology
3. Water Quality Monitoring
4. Discharge Prevention / Source Investigation
5. Priority Area Upland Visual Assessment

Third Rock Consultants, LLC (Third Rock) was retained as a subconsultant to Tetra Tech, Inc. to provide water quality consulting services in support of LFUCG's MS4 program, including conducting key monitoring elements required by LFUCG's WFMP. Results for each watershed will be used to compute and assess pollutant loading and ultimately summarized in a comprehensive, Watershed-Focused Monitoring Program Report for each of the seven watersheds.

The Cane Run watershed (HUC#05100205280200) is a 45.4 square mile (mi^2) watershed located within Fayette and Scott Counties, Kentucky. The stream has been listed as impaired since 1998 for Warmwater Aquatic Habitat (WAH) and Primary Contact Recreational (PCR) uses. Since that time, tributaries have also been designated as impaired for causes including pathogens and nutrients.

As detailed in the WFMP Quality Assurance Project Plan (QAPP; Third Rock 2017), water quality was monitored by trained volunteers, LFUCG staff, and consultants at major outfalls and stream sites throughout the headwater portion of the Cane Run watershed (11.6 mi^2) that lies within the LFUCG Urban Service Area (USA). This Technical Memorandum documents the results of that effort.

METHODOLOGY

Monitoring

In accordance with the approved QAPP (Third Rock 2017), water quality monitoring was conducted in 2 phases. Phase 1 was a screening effort during which dry weather sampling (at least 72 consecutive hours of dry weather prior to sampling) was attempted at 11 in-stream sites and 73 major outfalls shown on **Exhibit 1**, **Appendix A**, respectively. Phase 2 monitoring was attempted at the 11 in-stream sites and 17 of the Phase I major outfalls found to be routinely flowing during Phase 1 as shown on **Exhibit 2**, **Appendix A**.

Prior to sampling, physical characteristics (*i.e.* cross-section, slope, roughness) of each in-stream site and outfall location were measured such that stream or pipe flow could be calculated using water depth values measured during sampling events. The United States Geological Survey (USGS) gage within the watershed at Newtown Pike (Station 03288190, Tributary to Cane Run) was used to validate flow estimates when needed.

Phase 1 Sampling

Phase 1 sampling was conducted in September and October of 2016 and February through May 2017. Each site was visited 4 times, but samples were only collected when there was water flowing. Ammonia-Nitrogen and Chlorine were measured in the field using Hanna Checkers, handheld colorimeter units and detergents were measured in the field using a CHEMets kit (also a colorimetric method). Dissolved oxygen, pH, temperature, and specific conductance were measured *in-situ* using a multimeter water quality probe. Grab samples were collected and transported to the LFUCG Town Branch Waste Water Treatment Plant (WWTP) Laboratory for analysis of *E. coli*, Total Suspended Solids, Total Phosphorus, Nitrate-Nitrogen. All samples were preserved according to method specifications and transported to the laboratory within method holding times and temperature requirements.

Phase 2 Sampling

Phase 2 monitoring consisted of 10 sampling events during the PCR period (May through September 2017) on a set day of the week, regardless of weather conditions. Chlorine was measured in the field using Hanna Checkers, handheld colorimeter units. Dissolved oxygen, pH, temperature, and specific conductance were measured *in-situ* using a multimeter water quality probe. Grab samples were collected and transported to the Town Branch WWTP Laboratory for analysis of *E. coli*, Total Suspended Solids, Total Phosphorus, Nitrate-Nitrogen, Ammonia-Nitrogen, and Detergents. All samples were preserved according to method specifications and transported to the laboratory within method holding times and temperature requirements.

LFUCG staff collected duplicate grab samples and associated field replicates of *in situ* measurements and field test kits at 1 of 28 sites during 5 of the 10 Phase 2 sampling events. The QAPP (Third Rock 2017) requires field duplicates and associated field replicates of *in situ* measurements and field test kits be collected by LFUCG staff at 5% (or 1 for every 20 sites sampled) during each of the Phase 2 monitoring events.

Internal laboratory quality control samples were analyzed to determine if the project accuracy standards, listed in Table 7 of the QAPP (Third Rock 2017) were met.

Action Levels and Discharge Prevention Investigation

When field or laboratory water quality sampling results were found to be above established action levels summarized in **Table 1**, illicit discharge prevention investigations were performed by LFUCG staff to attempt to locate pollution sources.

Table 1. Parameter Action Levels

Parameter	Limit	Parameter	Limit
E. coli	>1,000 MPN/100 mL	Fluoride	>0.5 mg/L
Total Suspended Solids	>80 mg/L	Ammonia	>0.5 mg/L
Conductivity	>1000 µS/cm	Detergents	>0.5 mg/L
Chlorine	>0.5 mg/L	pH	<6 SU or >9 SU
Temperature	>90°F or >32.2°C	Dissolved Oxygen	< 4 mg/L

Data Analysis

To evaluate the nature and extent of impairments in the Cane Run Watershed, water quality results were compared to applicable water quality benchmarks summarized in **Table 2**, page 4. Both regulatory water quality standards and non-regulatory benchmarks were used (as detailed below). Regulatory water quality standards provided in 401 KAR 10:031 apply to specific designated uses. For this project, the applicable designated uses included Warmwater Aquatic Habitat (WAH), Primary Contact Recreation (PCR), and Secondary Contact Recreation (SCR). Where regulatory criteria exist, those standards were used as benchmarks. Where such criteria do not exist, non-regulatory benchmarks were utilized for data evaluation purposes. Because of the sampling frequency of this monitoring effort, instantaneous or acute water quality criteria were used to evaluate results when multiple criteria existed.

Table 2. Water Quality Benchmarks

PCR Regulatory Water Quality Standard	
E. coli[1]	Instantaneous: <240 CFU/100mL; 30-day geometric mean: <130 CFU/100mL (MPN treated as equivalent to CFU)
SCR Regulatory Water Quality Standard	
E. coli[1]	Instantaneous: <676 CFU/100mL; 30-day geometric mean: <386 CFU/100mL (MPN treated as equivalent to CFU)[2]
WAH Regulatory Water Quality Standard	
pH	Between 6.0 and 9.0 SU, and not to fluctuate more than 1.0 SU over 24 hours
Temperature	< 31.7°C (89°F)
Flow	Not altered to a degree that will adversely affect the aquatic community
Dissolved Oxygen	> 5.0 mg/L as a 24-hour average; or > 4.0 mg/L for instantaneous
Specific Conductance	Indigenous aquatic community is not adversely affected
Total Suspended Solids	Indigenous aquatic community is not adversely affected
Nutrients	Not elevated to a level that results in a eutrophication problem
WAH Non-Regulatory Benchmark	
Specific Conductance	<300 µS/cm
Total Phosphorus as P	<0.5 mg/L
Nitrate as N	<2.0 mg/L
Ammonia as N	<0.5 mg/L
Detergents	>0.5 mg/L
Chlorine	<0.5 mg/L
Fluoride	<0.5 mg/L
Total Suspended Solids	<80 mg/L

1 Geometric mean based on not less than five samples taken during a 30-day period. Instantaneous standard is not to be exceeded in 20% or more of all samples taken during a 30-day period. If less than five samples are taken in a month, this standard applies. This study compared values to the instantaneous standard.

2 SCR standard for Fecal Coliform converted to *E. coli* using relationship derived by Ormsbee and Akasapu. 2010. Relationship Between Fecal Coliform and Within the Kentucky River Basin. Kentucky Water Resources Research Institute. University of Kentucky. Lexington, Kentucky. Ecoli=1.44*FC$^{0.8093}$

Acceptance criteria for accuracy, precision, and sensitivity were defined in the QAPP (Third Rock 2017). While these criteria were generally met, the reporting limit specified in the QAPP for *E. coli* was 1 MPN/100mL but the laboratory reported values of <100 MPN/100mL for results below the reporting limit. In the analysis of the Phase 2 data, when values for *E. coli* were below the reporting limit, a value of 50 MPN/100mL (half of the reporting limit) was used; when results for *E. coli* were above the reporting limit (>241,960 MPN/100mL), a value of 241,960 MPN/100mL was used. For laboratory measurements of Ammonia-Nitrogen, when values were below the reporting limit (<0.015 mg/L), a value of 0.0075 mg/L, or half of the reporting limit, was used in analyses.

Pollutant Loads

Pollutant loads are calculated for a given parameter by multiplying the pollutant concentration by the flow and unit conversion factors. However, professional judgment must be used to determine how best to aggregate the concentration data and what flow to utilize to represent annual loading conditions. In this case, Phase 2 concentration data was aggregated together as an average for each site per parameter. The median annual flow (1.4 cfs) was computed from the long-term flow record at the USGS gage on the Tributary to Cane Run at Newtown Pike (site 3288190), scaled for each Phase 2 sampling site based on dry weather drainage area (considering karst drainage patterns), and then used to compute pollutant loadings. One exception was site CR-5 at Citation Boulevard; where another USGS gage is located (site 3288180). For this site the median annual flow computed from the long-term flow record was 1.6 cfs.

Historic data indicates that because of the heavy interaction between surface and groundwater, strict area-weighted scaling of the USGS gage flow would not produce accurate flow measurements for the individual monitoring stations. Therefore, drainage areas of each monitoring site were adjusted, based on previously mapped sink points, to determine the land area typically contributing to routine stream flows. The adjusted drainage area of each sampling location (except for CR-5) was used to scale the median flow from USGS site 3288190, within the watershed to develop a median annual flow at each site.

Therefore, the loading at each site was calculated using the average measured Phase 2 pollutant concentration (for Ammonia-Nitrogen, Nitrate-Nitrogen, Total Phosphorus, and *E. coli*; these are the parameters that required load reductions at some stations) and the predicted median flow. Likewise, benchmark loads were calculated using the benchmark concentration instead of the average measured concentration. Pollutant reductions needed to reach benchmark levels were then calculated by subtracting the benchmark loads from the existing loads. These reductions were then further divided into the incremental sub-drainages by subtracting reductions focused in upstream areas from downstream areas. This includes subtracting reductions at outfalls from the downstream stream sites that they drain to.

RESULTS

Concentration Data

Phase 1 samples were collected at 9 in-stream sites and 18 of the major outfalls over the course of the monitoring effort for a total of 86 samples collected. Samples were only collected when there was water flowing. Phase 1 results are included in **Appendix B** by monitoring site. Exceedances of the action level for 1 or more parameter occurred at the majority of sites (17 of the outfalls and 6 of the in-stream locations), many of which were due to measured *E. coli* above the 1,000 MPN/100mL action level.

Sampling was conducted at least once at each of the Phase 2 major outfall and in-stream sites for a total of 221 samples collected. Phase 2 results are included in **Appendix C.1** by monitoring site, along with summary statistics, including the percent of time the measured values exceeded the benchmark for a given parameter. Exceedances of the action level for 1 or more parameters occurred at all sites over the course of the monitoring effort. As in Phase 1, many were due to measured *E. coli* above the 1,000 MPN/100mL action level. Results can be summarized as follows:

- *pH* was always within the desired range set by water quality standards at all sites during the study.

- *Dissolved oxygen (DO)* dropped below the desired threshold (water quality standard) very infrequently. However, repeated low DO was observed at outfall 15519.

- *Conductivity* measurements exceeded the benchmark during most events at most stations; outfall 15019 was higher than other stations.

- *Water temperature* did not exceed the water quality standard for any site during the study.
- Some measured values for *Detergents* did exceed the benchmark value; however, on average it was within desired limits at all sites. Likewise, some measured values for *Chlorine* did exceed the benchmark value; however, on average it was well below the benchmark at all stations.

- Some measured values for *Ammonia-Nitrogen* did exceed the benchmark value; however, on average it only exceeded the benchmark at outfall 15506.

- For *Nitrate-Nitrogen*, the benchmark was frequently exceeded and, on average, it was exceeded at most stations; the highest Nitrate-Nitrogen average was observed at outfall 15506 (same for Ammonia-Nitrogen).

- For *Total Phosphorus*, some measured values did exceed the benchmark value; however, on average it only exceeded the benchmark at outfall 15506 (same as for Ammonia- and Nitrate-Nitrogen).

- *Total Suspended Solids* was always within the threshold set by water quality standards at all sites during the study.

- All sites generally had *E. coli* values above the water quality standards for PCR and SCR.

Phase 2 quality control field duplicate results are summarized in **Appendix C.2**. Exceedances of precision values were evaluated based upon those established in the QAPP (Third Rock 2017), but no data was excluded from analyses based upon and identified exceedance.

To better compare the data to benchmarks and make comparisons between sites, “box and whisker” plots of the summary statistics were produced for each water quality parameter and are included in **Appendix D**. Statistics for the Phase 2 data set presented in the plots are the median (thick black dash), average (blue square), minimum (end of bottom whisker except for dissolved oxygen, which is reversed), maximum (end of top whisker except for dissolved oxygen, which is reversed), 25th percentile (bottom of box except for dissolved oxygen, which is reversed), and 75th percentile (top of box except for dissolved oxygen, which is reversed). The specific benchmark(s) for each parameter are plotted as thick dashed lines (black).

Health Grades

To highlight trends in the Phase 2 water quality data, the percentage exceedance (for concentration data) of a benchmark was utilized to generate water quality health grades as illustrated in **Table 3**. This approach assigns letter grades, like in report cards, to the frequency of exceedances at each site. Each parameter is "graded on a curve" such that letter scores for 1 parameter are similar to letter scores for other parameters. Letter grades for individual parameters are roughly based on Kentucky Division of Water (KDOW) methods for evaluating data for listing impairments or TMDL Health Reports.

Table 3. Water Quality Health Grades

Parameter	Benchmark	% of Results Exceeding Benchmark				
		A	B	C	D	F
pH (SU)	6 - 9	0-5%	6-10%	11-25%	26-66%	67-100%
DO (mg/L)	4	0-5%	6-10%	11-25%	26-66%	67-100%
COND (uS/cm)	300	0-10%	11-25%	25-50%	51-66%	67-100%
DTRG (mg/L)	0.5	0-10%	11-25%	25-50%	51-66%	67-100%
Cl (mg/L)	0.5	0-10%	11-25%	25-50%	51-66%	67-100%
NH_3 - N (mg/L)	0.5	0-10%	11-25%	25-50%	51-66%	67-100%
NO_3 - N (mg/L)	2	0-10%	11-25%	25-50%	51-66%	67-100%
TP (mg/L)	0.5	0-10%	11-25%	25-50%	51-66%	67-100%
TSS (mg/L)	80	0-10%	11-25%	25-50%	51-66%	67-100%
E. coli, PCR (MPN/ 100mLs)	240	0-10%	11-20%	21-33%	34-66%	67-100%
E. coli, SCR (MPN/ 100mLs)	676	0-10%	11-20%	21-33%	34-66%	67-100%

Table 4, pages 9 and 10, summarizes the percent exceedance for each parameter at each site and illustrates the corresponding "health grade" using the shading assigned in **Table 3**.

USGS DATA

LFUCG works in cooperation with the USGS to collect continuous water quality data at its stream flow gauging stations within Fayette County on a rotation basis. Specific conductance (conductivity), pH, water temperature, and dissolved oxygen were collected at the USGS gaging station at Cane Run and Citation Boulevard (site 03288180) during the watershed-focused monitoring effort between June 23, 2016 and July 6, 2017. Thus, the USGS record ends before the last 6 samples of the Phase 2 effort were collected. Plots of available USGS water quality data (along with benchmarks used to analyze Phase 1 and 2 concentration data) are included in **Appendix E**. To compare the response of these parameters to stream flow, a plot of the flow at this location is also included in **Appendix E**.

The pH data collected by the USGS was within the desired water quality standard range for the entire record. Dissolved oxygen was observed to seasonally fall below the desired water quality standard in the USGS record. Specific conductance was above the benchmark for this study the majority of the time; however, it seldom exceeded the action level. Seasonal fluctuations of water temperature were observed, but the water temperature was well below the water quality standard during the entire USGS monitoring period.

POLLUTANT LOADS

Predicted flows used for loading calculations are tabulated in **Appendix F**. Existing annual loads, annual benchmark loads, and annual load reductions required to reach the benchmark loads (both as an absolute value and as a percentage of the existing annual load) at each station, along with the incremental load reductions needed, are identified in **Appendix G**. Required load reductions for Nitrate-Nitrogen and *E. coli* were common. Load reductions are required at all outfall stations except outfall CR8_502 and at stream sites CR-7, CR-9, CR-10, and CR-12 to meet the *E. coli* standards for PCR and SCR. The only station to require Ammonia-Nitrogen and Total Phosphorus load reductions to meet benchmark levels is outfall 15506.

LITERATURE CITED

Third Rock Consultants, LLC. 2017. *Quality Assurance Project Plan (QAPP) for Lexington-Fayette Urban County Government Watershed-Focused Monitoring Plan.* Revision No. 2, August 1, 2017.

Table 4. Phase 2 Water Quality Health Grades (Outfalls)

Benchmark:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**	**676**
Site ID	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Cl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	**PCR *E. coli* (MPN/ 100mLs)**	**SCR *E. coli* (MPN/ 100mLs)**
15003	0%	10%	80%	0%	10%	0%	20%	80%	10%	0%	90%	80%
15008	0%	0%	86%	0%	43%	0%	29%	71%	29%	0%	86%	86%
15013	0%	0%	100%	0%	10%	0%	0%	90%	0%	0%	100%	50%
15015	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	100%	100%
15016	0%	0%	100%	0%	0%	0%	0%	10%	0%	0%	50%	40%
15018	0%	0%	100%	0%	10%	0%	0%	50%	0%	0%	100%	100%
15019	0%	0%	90%	0%	30%	0%	0%	10%	20%	10%	100%	100%
15021	0%	10%	100%	0%	10%	0%	10%	60%	10%	0%	100%	70%
15023	0%	0%	100%	0%	0%	0%	0%	80%	0%	0%	80%	60%
15027	0%	10%	100%	0%	0%	0%	10%	90%	20%	0%	90%	90%
15040	0%	0%	100%	0%	25%	0%	0%	100%	13%	0%	100%	75%
15503	0%	0%	100%	0%	14%	0%	0%	86%	0%	0%	43%	43%
15506	0%	0%	100%	0%	50%	0%	38%	88%	38%	0%	100%	100%
15519	0%	33%	100%	0%	0%	0%	0%	89%	11%	11%	44%	33%
15523	0%	0%	100%	0%	10%	0%	0%	70%	0%	0%	100%	60%
15524	0%	0%	100%	0%	0%	0%	10%	70%	0%	0%	50%	20%
CR8_502HW	0%	0%	100%	0%	0%	14%	0%	71%	0%	0%	29%	0%

Table 4. Phase 2 Water Quality Health Grades (Instream Sites) *Cont.*

Benchmark:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**	**676**
Site ID	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Cl (mg/L)**	**NH$_3$ - N (mg/L)**	**NO$_3$ - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**	**SCR *E. coli* (MPN/ 100mLs)**
CR-1	0%	0%	100%	0%	0%	0%	0%	33%	0%	0%	50%	33%
CR-2	0%	0%	100%	0%	0%	0%	0%	100%	25%	0%	75%	50%
CR-3	0%	0%	100%	0%	0%	0%	0%	10%	10%	0%	60%	10%
CR-5	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	90%	70%
CR-6	0%	0%	100%	0%	0%	0%	0%	90%	0%	0%	90%	70%
CR-7	0%	0%	100%	0%	0%	10%	0%	30%	0%	0%	100%	100%
CR-8	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	100%	100%
CR-9	0%	0%	100%	0%	100%	0%	0%	100%	0%	0%	100%	100%
CR-10	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	100%	100%
CR-11	0%	0%	100%	0%	10%	10%	0%	50%	0%	0%	90%	70%
CR-12	0%	10%	100%	0%	10%	0%	10%	60%	20%	0%	100%	90%

APPENDIX A
EXHIBITS 1 AND 2

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC April 10, 2018

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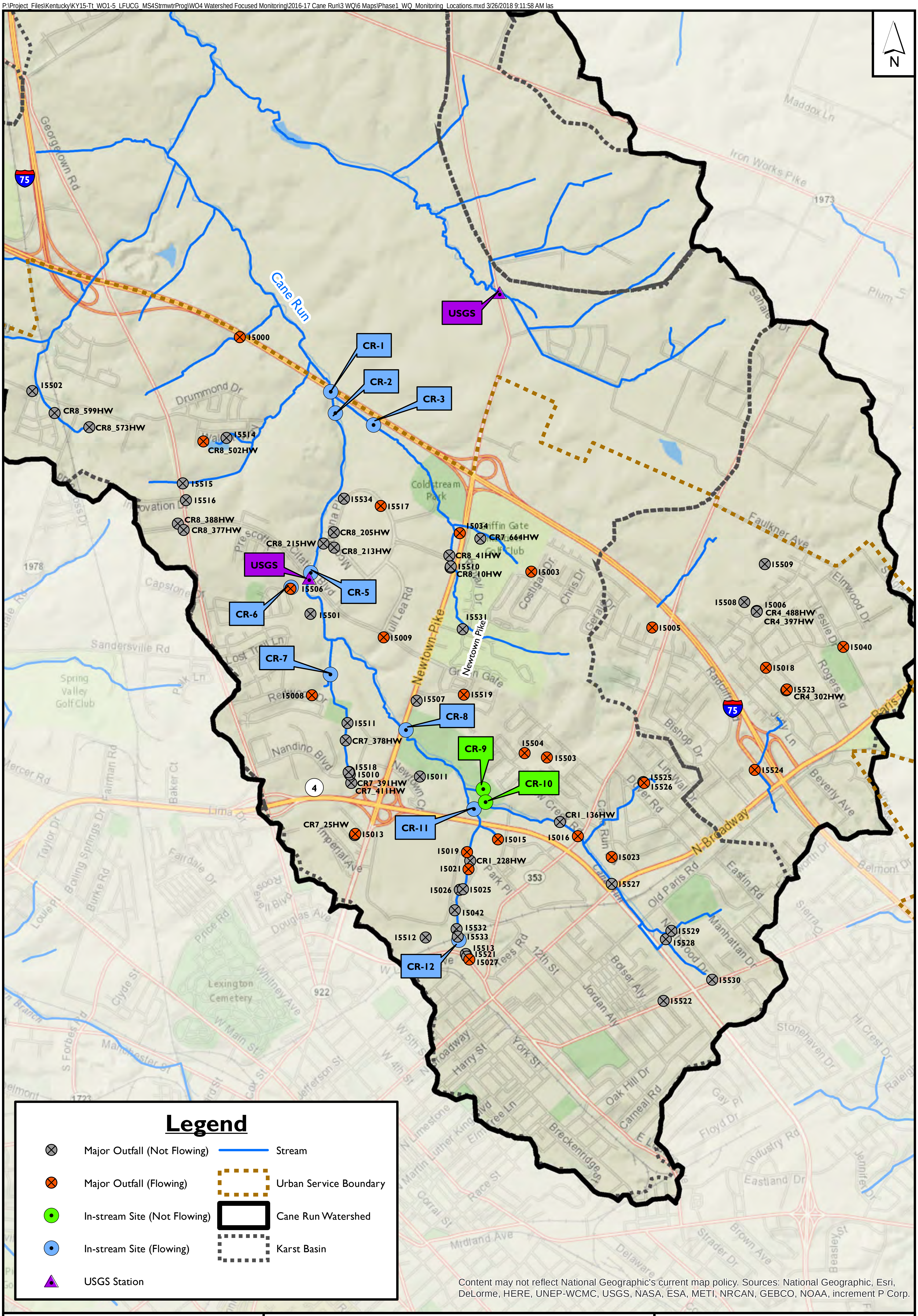

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Prepared by:
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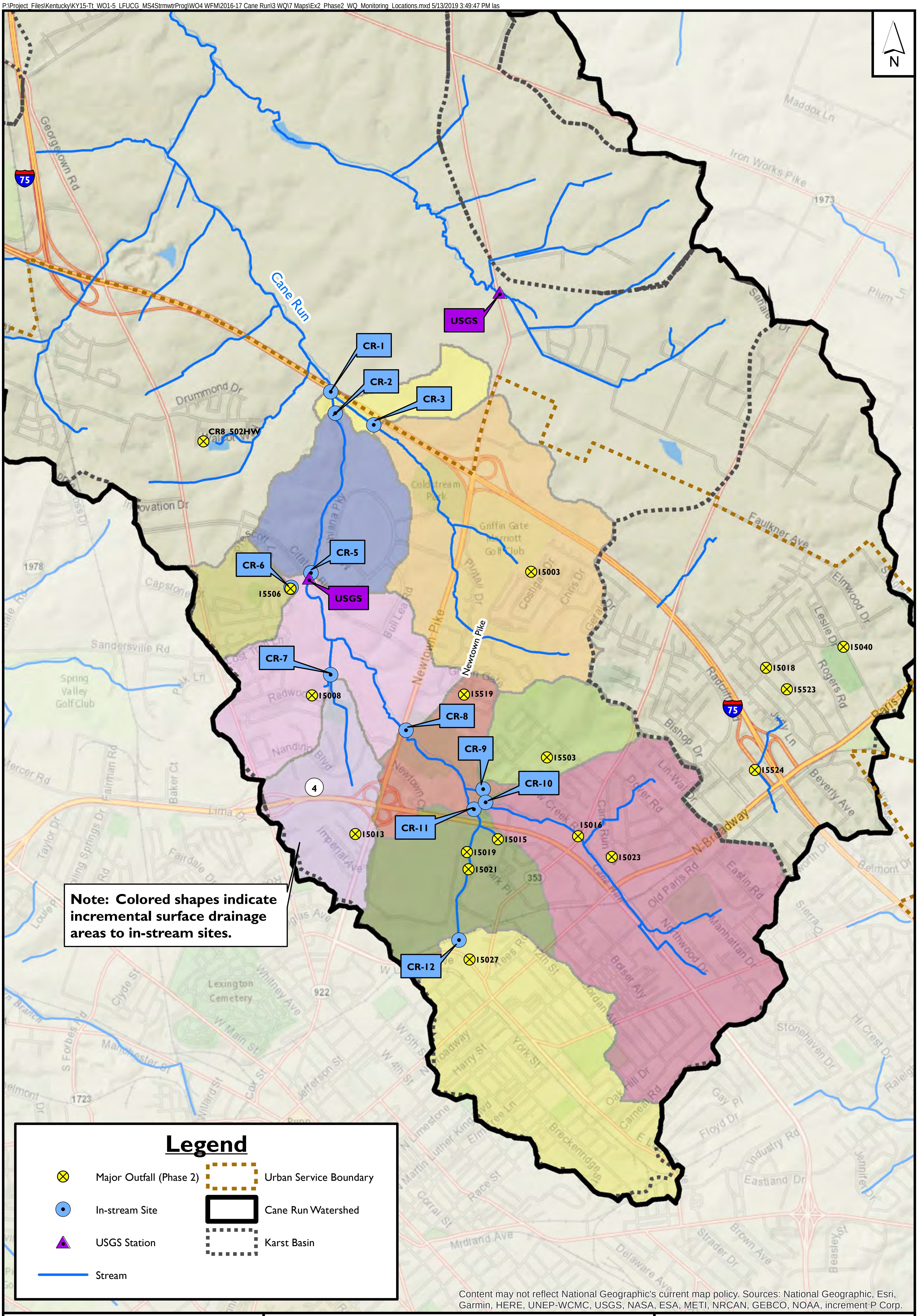
Exhibit 1
Phase 1 Water Quality Monitoring Locations Cane Run Watershed Fayette County, Kentucky

1 0.5 0 Miles

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 WFM\2016-17 Cane Run\3 WQ\7 Maps\Ex2_Phase2_WQ_Monitoring_Locations.mxd 5/13/2019 3:49:47 PM las



Note: Colored shapes indicate incremental surface drainage areas to in-stream sites.

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

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Exhibit 2
Phase 2 Water Quality Monitoring Locations
Cane Run Watershed Fayette County, Kentucky

1 0.5 0 Miles

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APPENDIX B
PHASE 1 RESULTS

Appendix B
Cane Run Watershed-Focused Monitoring
Phase I Results Summary Page 1 of 5

	Benchmark Value:		6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240	"Hit" above Action Level
Site ID	Date	Est. Flow (cfs)	pH (SU)	DO (mg/L)	COND (uS/cm)	TEMP (°C)	DTRG (mg/L)	Chl (mg/L)	NH_3 - N (mg/L)	NO_3 - N (mg/L)	TP (mg/L)	TSS (mg/L)	*E. coli* (MPN/ 100mLs)	
15000	2/14/2017	2.3	7.7	10.4	688	12.1	0.3	0.00	0.05	10.70	0.90	8	100	
15003	9/6/2016	2.8	7.9	9.1	818	20.2	0.1	0.02	0.00	2.48	0.37	8	1,989	1
	10/4/2016	2.43	8.1	6.9	844	17.8	0.1	0.02	0.00	2.35	0.46	11	38,732	1
	2/14/2017	0.33	8.1	6.5	756	11.2	0.2	0.05	0.09	2.96	0.23	1	100	
	3/16/2017	2.3	8.4	9.4	769	7.6	0.2	0.02	0.03	2.98	2.50	2	100	
15005	2/6/2017	0.33	8.2	11.3	722	9.3	0.0	0.02	0.00	0.34	2.50	7	9,322	1
	3/16/2017	0.004	8.3	10.8	764	4.1	0.2	0.00	0.26	0.33	2.16	4	3,405	1
15008	9/7/2016	0.004	8.5	5.0	915	22.0	0.5	0.05	0.14	1.98	0.85	4	5,284	2
	10/4/2016	0.004	8.3	6.8	928	19.1	0.5	0.06	0.05	1.80	0.42	8	1,223	2
15009	2/14/2017	0.07	8.4	7.1	916	9.8	0.2	0.00	0.00	1.13	0.05	0	400	
15013	9/7/2016	6.0	7.8	6.8	611	19.5	0.8	0.02	0.00	2.07	0.91	5	413	1
	10/4/2016	5.7	7.8	7.8	602	19.1	0.1	0.00	0.00	1.98	2.50	3	738	
	2/14/2017	5.8	7.6	5.9	300	13.2	0.2	0.00	0.01	2.43	0.91	1	1,350	1
	3/16/2017	1.8	7.8	8.1	532	11.9	0.2	0.00	0.07	2.32	1.56	1	969	
15015	9/6/2016	0.07	7.5	7.0	211	25.3	-	0.04	0.00	1.16	1.20	14	1,613	1
	10/4/2016	0.04	8.4	7.9	400	23.2	0.0	0.02	0.04	1.13	0.68	5	1,596	1
15016	9/6/2016	1.79	7.8	6.4	926	24.5	0.1	0.28	0.06	0.90	1.23	15	<100	
	2/6/2017	0.29	7.6	9.8	610	13.4	0.2	0.00	0.00	2.61	0.86	1	413	
	3/16/2017	2	8.2	8.5	1,276	11.4	0.2	0.04	0.00	1.10	0.80	2	7,665	2

Note: CR-9 and CR-10 were not flowing during Phase I

Red text indicates value >= benchmark value

Yellow shading indicates exceedance of action level

Appendix B
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Phase I Results Summary Page 2 of 5

		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240	
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**	**"Hit" above Action Level**
15018	9/6/2016	0.20	8.4	7.0	743	20.5	0.1	0.03	0.00	1.59	0.80	6	3,839	1
	10/4/2016	0.32	8.2	7.5	527	16.2	0.1	0.00	0.00	1.38	0.84	5	738	
	2/3/2017	0.83	8.3	9.4	602	8.1	0.2	0.06	0.04	2.36	0.82	3	2,917	1
	3/16/2017	0.68	8.3	12.2	700	4.2	0.2	0.00	0.06	2.08	0.51	5	979	
15019	9/6/2016	0.003	7.9	6.6	2,229	21.8	0.2	0.16	0.00	2.08	0.40	87	27,551	3
	2/3/2017	0.01	8.2	6.9	2,459	8.5	0.3	0.00	0.00	1.67	0.65	11	111,987	2
	3/15/2017	0.003	8.3	6.9	2,193	5.0	0.3	0.18	1.17	2.00	0.03	29	12,356	3
15021	10/4/2016	0.003	8.7	8.2	1,235	18.3	0.0	0.02	0.01	1.25	0.63	16	24,809	2
	2/3/2017	0.04	7.8	8.9	1,471	10.7	0.3	0.01	0.12	2.78	1.54	7	844	1
	3/15/2017	0.07	7.8	6.0	1,281	9.8	0.3	0.00	0.07	2.12	1.22	3	745	1
15023	2/14/2017	0.79	7.4	9.3	623	13.2	0.2	0.02	0.00	3.26	1.09	1	1,100	1
	3/15/2017	0.33	7.7	4.7	590	10.2	0.2	0.00	0.73	3.07	2.50	1	1,869	2
15027	9/7/2016	0.14	7.6	3.8	761	23.2	0.0	0.00	0.00	1.95	1.23	3	1,211	2
	10/5/2016	0.19	7.8	5.6	694	19.8	0.2	0.00	0.07	<0.23	1.12	2	2,307	1
	2/3/2017	4.6	7.7	8.4	713	8.8	0.2	0.00	0.13	4.20	1.11	2	<100	
	3/15/2017	9	7.6	6.3	666	8.5	0.5	0.00	0.13	3.96	0.00	1	20,142	2
15034	10/4/2016	0.51	7.0	2.3	634	21.7	0.1	0.00	0.06	0.68	1.15	10	<100	1
15040	2/6/2017	0.03	8.0	10.7	294	9.5	0.2	0.04	0.01	3.97	0.72	5	1,989	1
	3/16/2017	0.06	8.0	12.7	488	2.4	0.2	0.00	0.00	3.72	0.00	9	2,334	1

Note: CR-9 and CR-10 were not flowing during Phase I

Red text indicates value >= benchmark value

Yellow shading indicates exceedance of action level

Appendix B
Cane Run Watershed-Focused Monitoring
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Benchmark Value:			6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240	"Hit" above Action Level
Site ID	Date	Est. Flow (cfs)	pH (SU)	DO (mg/L)	COND (uS/cm)	TEMP (°C)	DTRG (mg/L)	Chl (mg/L)	NH_3 - N (mg/L)	NO_3 - N (mg/L)	TP (mg/L)	TSS (mg/L)	*E. coli* (MPN/ 100mLs)	
15503	9/6/2016	0.68	8.1	6.8	844	20.6	0.1	0.00	0.05	3.25	1.31	7	852	
	10/4/2016	0.73	8.0	6.2	777	19.1	0.1	0.01	0.00	2.85	1.00	4	<100	
	2/15/2017	2.15	7.6	6.8	318	8.3	0.1	0.03	0.01	0.56	0.58	5	969	
	3/15/2017	1	8.1	4.8	635	11.7	0.2	0.00	0.00	3.29	0.13	2	632	
15504	2/14/2017	1.6	7.8	7.0	670	13.7	0.2	0.05	0.01	3.20	2.50	1	<100	
15506	2/14/2017	3.15	7.1	5.8	673	14.8	0.2	0.00	0.21	4.18	1.77	3	1,211	1
	3/16/2017	4.3	7.6	6.3	652	10.3	0.3	0.04	0.46	3.91	1.40	6	7,712	1
15517	2/14/2017	0.26	7.7	6.5	584	11.2	0.2	0.09	0.00	2.93	1.45	1	<100	
15519	10/4/2016	3.07	7.5	3.9	866	16.9	0.3	0.00	0.27	0.68	0.65	8	1,731	2
	2/6/2017	0.08	7.5	6.8	844	11.0	0.2	0.03	0.03	4.03	0.57	4	306	
	3/15/2017	2.6	7.7	6.1	791	9.8	0.2	0.00	0.06	4.32	2.50	10	<100	
15523	9/6/2016	0.16	7.6	6.9	218	19.2	0.2	0.13	0.02	1.68	0.84	6	100	
	2/3/2017	0.3	8.0	8.1	731	9.0	0.2	0.07	0.00	2.35	2.20	3	4,257	1
	3/16/2017	0.67	8.0	12.8	638	5.7	0.3	0.03	0.00	2.11	2.50	2	202	
15524	9/6/2016	0.003	7.9	6.8	555	22.7	0.3	0.12	0.02	1.89	0.73	6	201	
	10/4/2016	0.001	7.7	5.1	692	20.6	0.0	0.07	0.01	1.40	0.64	2	1,464	1
	2/6/2017	0.003	7.4	8.2	637	12.6	0.2	0.00	0.02	2.34	0.40	2	100	
	3/16/2017	0.01	8.0	9.1	590	10.9	0.3	0.02	0.00	2.40	0.05	5	306	
15526	2/14/2017	1.82	7.6	9.1	351	9.5	0.2	2.49	0.44	1.20	1.10	0	<100	1

Note: CR-9 and CR-10 were not flowing during Phase I

Red text indicates value >= benchmark value

Yellow shading indicates exceedance of action level

Appendix B
Cane Run Watershed-Focused Monitoring
Phase I Results Summary Page 4 of 5

		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240	"Hit" above Action Level
Site ID	Date	Est. Flow (cfs)	pH (SU)	DO (mg/L)	COND (uS/cm)	TEMP (°C)	DTRG (mg/L)	Chl (mg/L)	NH_3 - N (mg/L)	NO_3 - N (mg/L)	TP (mg/L)	TSS (mg/L)	*E. coli* (MPN/ 100mLs)	
CR8_502HW	4/26/2017	0.001	7.9	6.7	864	21.1	0.2	0.05	0.08	1.45	0.09	13	<100	
	4/27/2017	0.001	7.6	5.5	656	18.6	0.2	0.00	0.03	2.06	0.69	32	<100	
	5/9/2017	0.02	7.5	6.2	655	17.8	0.3	0.05	0.00	2.35	2.40	0	<100	
	5/10/2017	0.003	7.8	-	491	24.0	0.2	0.14	0.00	1.65	0.66	10	306	
CR-1	2/15/2017	0.58	8.2	9.0	703	10.2	0.1	0.07	0.00	2.22	0.90	3	<100	
	3/15/2017	20	7.8	8.0	623	4.9	0.2	0.00	0.09	1.48	0.84	2	400	
CR-2	10/4/2016	3.64	7.7	8.3	703	17.3	0.1	0.13	0.41	0.45	0.41	15	4,737	1
CR-3	10/4/2016	0.03	7.6	6.2	764	17.2	0.1	0.15	0.01	0.62	1.03	7	202	
	2/15/2017	0.52	7.9	11.0	735	10.3	0.1	0.13	0.07	1.82	1.42	3	<100	
	3/15/2017	0.52	8.0	9.3	645	6.8	0.2	0.02	0.05	1.11	1.65	2	<100	
CR-5	9/6/2016	0.22	8.0	7.3	703	19.3	0.2	0.00	0.00	2.92	1.09	8	1,078	1
	10/4/2016	0.05	7.2	6.7	724	18.1	0.2	0.01	0.05	3.16	1.19	5	1,613	1
	2/3/2017	1.02	8.2	9.9	729	8.9	0.2	0.00	0.44	3.39	0.13	5	1,579	1
	3/15/2017	0.7	8.0	9.0	654	8.0	0.2	0.12	0.04	3.61	1.12	3	2,157	1
CR-6	9/6/2016	0.45	7.2	6.7	689	18.3	0.2	0.00	0.04	3.10	1.32	7	2,785	1
	10/4/2016	0.69	7.8	7.4	746	17.5	0.2	0.00	0.01	2.94	1.15	6	731	
	2/3/2017	0.69	7.3	6.7	679	13.5	0.2	0.08	0.15	3.96	2.20	5	4,135	1
	3/15/2017	0.69	7.4	6.6	629	12.8	0.2	0.07	0.06	3.97	1.33	3	4,223	1

Note: CR-9 and CR-10 were not flowing during Phase I

Red text indicates value >= benchmark value

Yellow shading indicates exceedance of action level

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Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240	"Hit" above Action Level
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**	
CR-7	9/7/2016	0.4	8.1	5.8	1,010	21.3	0.3	0.16	0.00	1.36	1.36	12	1,336	2
	10/4/2016	2.61	7.9	8.9	474	17.2	0.5	0.03	0.00	1.29	1.00	33	2,785	2
	2/15/2017	6.79	8.1	10.5	877	8.7	0.2	0.00	0.11	2.27	1.86	5	1,199	1
	3/15/2017	6.8	8.2	7.8	834	5.0	0.2	0.00	0.02	2.22	2.50	2	306	
CR-8	2/15/2017	87.06	8.3	8.2	888	6.8	0.2	0.02	0.03	3.38	0.56	3	<100	
CR-11	9/6/2016	0.61	8.0	12.6	1,218	21.9	0.1	0.02	0.00	0.32	0.73	8	100	1
	10/4/2016	0.61	7.7	7.6	782	16.5	0.3	0.03	0.00	0.31	0.36	9	960	
	2/15/2017	3.21	7.7	7.2	870	9.3	0.2	0.07	1.01	3.34	0.65	1	969	1
	3/15/2017	1.6	8.0	11.6	945	3.8	0.3	0.03	0.10	2.38	0.87	5	<100	
CR-12	2/15/2017	0.68	8.5	14.2	656	10.1	0.2	0.05	0.03	4.40	1.01	1	969	
	3/15/2017	0.15	7.8	5.8	511	2.6	0.3	0.00	0.27	3.98	0.00	3	86,644	1

Note: CR-9 and CR-10 were not flowing during Phase I

Red text indicates value >= benchmark value

Yellow shading indicates exceedance of action level

APPENDIX C.1
PHASE 2 RESULTS

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC April 10, 2018

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Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15003	5/16/2017	2.3	8.2	9.0	753	15.8	0.00	0.11	0.02	2.71	0.10	3	202
	5/30/2017	3.4	7.5	9.5	645	16.9	0.00	0.05	0.04	2.88	0.15	23	2,882
	6/13/2017	2.30	7.3	9.1	709	17.7	0.00	0.07	0.0075	2.55	0.30	3	860
	6/27/2017	2.81	7.7	9.6	643	17.9	0.13	0.06	0.03	2.89	0.13	2	745
	7/18/2017	2.3	8.1	8.8	676	19.3	0.15	0.12	0.02	2.39	0.28	15	979
	7/25/2017	1.4	8.4	8.1	721	20.2	0.15	0.02	0.02	2.59	0.10	4	1,596
	8/8/2017	2.3	8.2	7.5	616	19.5	0.15	0.06	0.02	2.80	0.13	2	306
	8/22/2017	0.78	8.0	3.7	826	20.9	0.15	0.12	3.17	0.81	0.21	6	241,960
	9/5/2017	2.3	7.9	7.1	233	21.5	0.15	0.00	0.54	1.89	0.41	20	46,111
	9/19/2017	3.37	7.6	5.8	249	21.3	1.00	0.06	0.26	2.10	0.58	30	241,960

% BM Exceedances	0%	10%	80%	0%	10%	0%	20%	80%	10%	0%	90%
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.9	7.8	607	19.1	0.19	0.07	0.41	2.36	0.24	11	53,760
Median	7.9	8.5	661	19.4	0.15	0.06	0.03	2.57	0.18	5	1,288
Q1	7.6	7.2	623	17.7	0.03	0.05	0.02	2.17	0.13	3	774
Q3	8.2	9.1	718	20.7	0.15	0.10	0.20	2.78	0.30	19	35,304
Min	7.3	3.7	233	15.8	0.00	0.00	0.01	0.81	0.10	2	202
Max	8.4	9.6	826	21.5	1.00	0.12	3.17	2.89	0.58	30	241,960

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1

Cane Run Watershed-Focused Monitoring

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15008	5/16/2017	1.44	8.2	7.5	963	17.1	1.50	0.03	0.0075	2.66	0.26	3	100
	7/25/2017	1.4	8.3	7.6	839	22.4	0.15	0.08	0.04	2.80	0.56	55	969
	6/27/2017	6.13	8.1	5.7	860	19.3	0.50	0.00	0.0075	2.47	0.33	17	15,756
	7/18/2017	0.78	6.3	5.7	981	21.3	0.15	0.01	0.02	2.32	0.31	35	7,976
	8/22/2017	3.99	6.0	8.4	886	23.0	0.15	0.00	0.0075	2.56	0.32	3	34,480
	9/5/2017	1.14	8.0	5.8	660	21.8	0.15	0.00	0.74	1.78	0.48	29	64,882
	9/19/2017	7.4	8.0	5.1	268	22.6	0.50	0.00	0.67	1.42	0.89	60	32,554

% BM Exceedaces	**0%**	**0%**	**86%**	**0%**	**43%**	**0%**	**29%**	**71%**	**29%**	**0%**	**86%**
Count	7	7	7	7	7	7	7	7	7	7	7
Average	7.6	6.5	780	21.1	0.44	0.02	0.21	2.29	0.45	29	22,388
Median	8.0	5.8	860	21.8	0.15	0.00	0.02	2.47	0.33	29	15,756
Q1	7.2	5.7	750	20.3	0.15	0.00	0.01	2.05	0.32	10	4,473
Q3	8.1	7.5	925	22.5	0.50	0.02	0.35	2.61	0.52	45	33,517
Min	6.0	5.1	268	17.1	0.15	0.00	0.01	1.42	0.26	3	100
Max	8.3	8.4	981	23.0	1.50	0.08	0.74	2.80	0.89	60	64,882

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1

Cane Run Watershed-Focused Monitoring

Phase 2 Results Summary Page 3 of 28

		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15013	5/16/2017	3.63	7.7	7.5	558	15.3	0.00	0.06	0.02	2.15	0.29	3	304
	5/30/2017	4.8	7.8	9.6	539	16.0	0.00	0.06	0.02	2.12	0.29	1	2,109
	6/13/2017	4.76	7.9	9.1	536	17.5	0.00	0.02	0.03	2.20	0.29	2	304
	7/18/2017	7.4	7.7	7.8	609	18.3	0.15	0.00	0.05	2.77	0.30	2	413
	7/25/2017	0.06	7.8	7.6	534	19.1	0.15	0.01	0.02	2.49	0.30	2	409
	8/8/2017	9.71	7.6	7.6	501	18.9	0.15	0.00	0.02	2.25	0.32	4	745
	6/27/2017	10.53	7.3	5.5	536	19.2	0.00	0.00	0.02	2.58	0.31	3	9,331
	8/22/2017	7.4	8.0	7.1	591	19.7	0.15	0.00	0.02	2.58	0.31	2	979
	9/5/2017	6.02	7.4	6.2	561	19.0	0.15	0.00	0.02	2.53	0.33	4	632
	9/19/2017	10.53	7.5	6.3	629	20.7	0.50	0.00	0.12	1.66	0.34	46	77,010

% BM Exceedances	0%	0%	100%	0%	10%	0%	0%	90%	0%	0%	100%
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.6	7.4	559	18.4	0.13	0.02	0.03	2.33	0.31	7	9,224
Median	7.7	7.5	549	18.9	0.15	0.00	0.02	2.37	0.30	3	689
Q1	7.5	6.5	536	17.7	0.00	0.00	0.02	2.16	0.29	2	410
Q3	7.8	7.8	584	19.2	0.15	0.02	0.03	2.57	0.31	4	1,827
Min	7.3	5.5	501	15.3	0.00	0.00	0.02	1.66	0.29	1	304
Max	8.0	9.6	629	20.7	0.50	0.06	0.12	2.77	0.34	46	77,010

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1

Cane Run Watershed-Focused Monitoring

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15015	5/30/2017	0.003	8.4	9.0	1,093	18.3	0.00	0.00	0.0075	1.81	0.16	3	9,322
	6/27/2017	0.02	7.4	8.6	268	17.9	0.13	0.00	0.05	1.79	0.15	4	3,545

% BM Exceedaces	**0%**	**0%**	**50%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Count	2	2	2	2	2	2	2	2	2	2	2
Average	7.9	8.8	681	18.1	0.06	0.00	0.03	1.80	0.16	4	6,434
Median	7.9	8.8	681	18.1	0.06	0.00	0.03	1.80	0.16	4	6,434
Q1	7.7	8.7	474	18.0	0.03	0.00	0.02	1.80	0.15	3	4,989
Q3	8.2	8.9	887	18.2	0.09	0.00	0.04	1.81	0.16	4	7,878
Min	7.4	8.6	268	17.9	0.00	0.00	0.01	1.79	0.15	3	3,545
Max	8.4	9.0	1,093	18.3	0.13	0.00	0.05	1.81	0.16	4	9,322

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15016	5/16/2017	0.86	7.5	4.6	1,114	17.5	0.00	0.03	0.0075	0.92	0.21	4	50
	5/30/2017	1.5	7.9	10.0	1,055	18.6	0.00	0.00	0.0075	1.07	0.21	3	1,596
	6/13/2017	0.74	7.8	6.9	1,256	19.7	0.00	0.02	0.02	0.94	0.25	5	202
	7/18/2017	4.8	7.4	4.7	1,146	21.6	0.00	0.00	0.02	1.54	0.40	16	100
	7/25/2017	2.7	8.1	7.5	1,172	21.9	0.15	0.02	0.03	1.29	0.26	9	516
	6/27/2017	4.76	7.6	7.6	877	20.3	0.25	0.00	0.0075	1.42	0.18	3	4,195
	8/8/2017	2.88	7.9		1,029	29.2	0.15	0.03	0.05	3.32	0.36	2	2,917
	8/22/2017	2.65	7.2	6.1	1,097	22.9	0.25	0.00	0.0075	1.01	0.30	2	50
	9/5/2017	4	7.7	5.7	622	22.4	0.15	0.00	0.02	1.10	0.43	12	202
	9/19/2017	2.91	7.1	7.0	1,053	21.8	0.15	0.00	0.02	0.93	0.28	5	979

% BM Exceedances	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**10%**	**0%**	**0%**	**50%**
Count	10	9	10	10	10	10	10	10	10	10	10
Average	7.6	6.7	1,042	21.6	0.11	0.01	0.02	1.35	0.29	6	1,081
Median	7.6	6.9	1,076	21.7	0.15	0.00	0.02	1.09	0.27	5	359
Q1	7.4	5.7	1,035	19.8	0.00	0.00	0.01	0.96	0.22	3	126
Q3	7.9	7.5	1,138	22.3	0.15	0.02	0.02	1.39	0.35	8	1,442
Min	7.1	4.6	622	17.5	0.00	0.00	0.01	0.92	0.18	2	50
Max	8.1	10.0	1,256	29.2	0.25	0.03	0.05	3.32	0.43	16	4,195

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15018	5/16/2017	1.19	8.0	9.7	627	16.9	0.00	0.12	0.04	1.93	0.24	5	1,890
	5/30/2017	2.2	7.8	9.8	702	16.9	0.00	0.03	0.02	2.42	0.23	7	1,869
	6/27/2017	0.64	7.7	10.2	652	17.0	0.13	0.11	0.03	2.49	0.21	4	1,749
	7/18/2017	0.59	7.9	8.8	736	20.9	0.25	0.11	0.01	1.98	0.25	1	979
	7/25/2017	0.29	8.1	8.6	742	19.8	0.15	0.00	0.03	2.06	0.25	3	1,464
	6/13/2017	1.03	8.0	8.1	759	20.5	0.00	0.00	0.04	0.90	0.25	5	5,833
	8/8/2017	0.53	8.1	8.1	429	18.8	0.15	0.06	0.0075	2.15	0.26	2	2,917
	8/22/2017	1.59	8.1	7.9	749	21.5	0.15	0.00	0.02	1.92	0.28	2	11,874
	9/5/2017	0.32	7.8	7.9	683	19.3	0.50	0.00	0.02	2.12	0.26	3	2,621
	9/19/2017	0.5	7.7	7.3	741	19.2	0.15	0.00	0.02	1.56	0.35	6	8,803

% BM Exceedances	0%	0%	100%	0%	10%	0%	0%	50%	0%	0%	100%
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.9	8.7	682	19.1	0.15	0.04	0.02	1.95	0.26	4	4,000
Median	8.0	8.3	719	19.3	0.15	0.02	0.02	2.02	0.25	4	2,256
Q1	7.8	8.0	660	17.4	0.03	0.00	0.02	1.92	0.24	2	1,779
Q3	8.0	9.5	742	20.3	0.15	0.10	0.03	2.14	0.26	5	5,104
Min	7.7	7.3	429	16.9	0.00	0.00	0.01	0.90	0.21	1	979
Max	8.1	10.2	759	21.5	0.50	0.12	0.04	2.49	0.35	7	11,874

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15019	7/18/2017	0.003	8.1	5.4	2,116	20.8	0.00	0.00	0.03	0.84	0.21	62	27,551
	6/13/2017	0.003	7.9	6.1	2,411	19.6	0.00	0.02	0.04	0.99	0.38	103	23,822
	5/16/2017	0.01	7.9	5.7	2,670	15.8	0.25	0.00	0.02	1.78	0.22	15	38,732
	5/30/2017	0.01	7.8	9.9	1,959	17.1	0.00	0.00	0.06	1.63	0.38	15	6,437
	7/25/2017	0	8.2	7.1	2,040	20.9	0.15	0.15	0.02	1.80	0.28	20	979
	8/8/2017	0.003	8.2		1,975	20.1	1.00	0.18	0.23	3.20	0.63	25	745
	6/27/2017	0	7.7	8.0	1,811	18.4	0.13	0.02	0.04	1.89	0.19	5	8,823
	8/22/2017	0.001	6.9	6.7	2,196	22.2	0.15	0.00	0.03	1.37	1.01	48	9,108
	9/5/2017	0.01	7.6	7.6	1,216	20.3	1.00	0.02	0.33	1.89	0.29	18	129,965
	9/19/2017	0.42	7.5	8.2	173	22.0	0.75	0.07	0.14	1.25	0.14	23	12,112

% BM Exceedances	**0%**	**0%**	**90%**	**0%**	**30%**	**0%**	**0%**	**10%**	**20%**	**10%**	**100%**
Count	10	9	10	10	10	10	10	10	10	10	10
Average	7.8	7.2	1,857	19.7	0.34	0.05	0.09	1.66	0.37	33	25,827
Median	7.8	7.1	2,008	20.2	0.15	0.02	0.04	1.71	0.28	22	10,610
Q1	7.7	6.1	1,848	18.7	0.03	0.00	0.03	1.28	0.21	16	7,034
Q3	8.1	8.0	2,176	20.9	0.63	0.06	0.12	1.87	0.38	42	26,619
Min	6.9	5.4	173	15.8	0.00	0.00	0.02	0.84	0.14	5	745
Max	8.2	9.9	2,670	22.2	1.00	0.18	0.33	3.20	1.01	103	129,965

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15021	5/16/2017	0.02	7.6	8.1	1,293	16.8	0.00	0.07	0.03	2.56	0.27	7	5,731
	5/30/2017	0.07	7.7	11.5	1,317	15.4	0.00	0.00	0.02	2.49	0.19	4	2,655
	6/13/2017	0.74	8.0	2.0	1,109	20.1	0.00	0.12	0.10	1.64	0.73	11	13,540
	6/27/2017	0.5	7.5	7.0	1,341	16.7	0.25	0.00	0.09	2.72	0.31	4	306
	7/25/2017	1.9	7.9	7.9	1,269	18.1	0.15	0.00	0.03	2.11	0.20	3	516
	8/8/2017	0.31	7.8	10.1	1,199	18.0	1.00	0.00	0.0075	2.33	0.19	3	413
	7/18/2017	0.5	7.6	8.3	1,265	18.0	0.00	0.00	0.02	1.88	0.20	3	6,198
	8/22/2017	0.31	8.1	7.3	1,266	18.9	0.15	0.00	0.0075	1.86	0.22	2	16,743
	9/5/2017	0.73	7.4	7.6	626	19.8	0.15	0.00	0.67	2.21	0.25	8	120,333
	9/19/2017	0.17	7.8	7.0	1,010	19.6	0.15	0.00	0.02	1.40	0.32	7	1,749

% BM Exceedances	**0%**	**10%**	**100%**	**0%**	**10%**	**0%**	**10%**	**60%**	**10%**	**0%**	**100%**
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.7	7.7	1,170	18.1	0.19	0.02	0.10	2.12	0.29	5	16,818
Median	7.7	7.7	1,266	18.0	0.15	0.00	0.02	2.16	0.23	4	4,193
Q1	7.6	7.1	1,132	17.1	0.00	0.00	0.02	1.87	0.20	3	824
Q3	7.9	8.3	1,287	19.4	0.15	0.00	0.08	2.45	0.30	7	11,705
Min	7.4	2.0	626	15.4	0.00	0.00	0.01	1.40	0.19	2	306
Max	8.1	11.5	1,341	20.1	1.00	0.12	0.67	2.72	0.73	11	120,333

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15023	5/16/2017	0.78	7.3	7.5	618	14.7	0.00		0.0075	2.82	0.33	8	306
	5/30/2017	1.4	7.5	10.8	622	15.1	0.00	0.00	0.0075	2.81	0.32	2	202
	6/27/2017	1.25	7.1	8.7	644	16.0	0.13	0.10	0.0075	3.26	0.34	3	1,223
	8/8/2017	0.47	7.9		674	19.6	0.15	0.00	0.03	1.27	0.30	8	3,498
	9/5/2017	0.78	7.2	7.1	1,034	18.3	0.15	0.00	0.12	3.01	0.39	23	2,776

% BM Exceedaces	0%	0%	100%	0%	0%	0%	0%	80%	0%	0%	80%
Count	5	4	5	5	5	4	5	5	5	5	5
Average	7.4	8.5	718	16.7	0.09	0.03	0.03	2.63	0.33	9	1,601
Median	7.3	8.1	644	16.0	0.13	0.00	0.01	2.82	0.33	8	1,223
Q1	7.2	7.4	622	15.1	0.00	0.00	0.01	2.81	0.32	3	306
Q3	7.5	9.2	674	18.3	0.15	0.03	0.03	3.01	0.34	8	2,776
Min	7.1	7.1	618	14.7	0.00	0.00	0.01	1.27	0.30	2	202
Max	7.9	10.8	1,034	19.6	0.15	0.10	0.12	3.26	0.39	23	3,498

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15027	7/18/2017	14	7.5	4.2	1,008	22.1	0.25	0.00	0.18	3.08	0.50	3	57,943
	7/25/2017	1.5	7.6	4.0	900	22.4	0.25	0.00	0.64	2.77	0.56	4	20,142
	5/16/2017	8.97	7.8	8.3	647	17.0	0.00	0.00	0.15	3.90	0.40	5	2,378
	5/30/2017	14	7.8	9.4	672	18.0	0.00	0.00	0.13	3.38	0.31	2	3,839
	6/13/2017	8.97	7.8	6.4	991	19.9	0.00	0.12	0.07	1.99	0.41	5	100
	8/8/2017	13.96	8.0	8.1	760	21.6	0.15	0.00	0.09	3.35	0.37	33	7,328
	6/27/2017	14.36	7.7	5.8	617	19.6	0.13	0.03	0.23	4.41	0.34	3	3,310
	8/22/2017	9.46	7.8	4.2	695	23.6	0.15	0.06	0.15	2.73	0.47	2	3,786
	9/5/2017	13.96	7.8	6.1	670	21.7	0.15	0.29	0.12	3.40	0.41	3	6,631
	9/19/2017	12.92	7.8	3.6	720	21.5	0.15	0.00	0.05	2.15	0.37	5	1,449

% BM Exceedances	**0%**	**10%**	**100%**	**0%**	**0%**	**0%**	**10%**	**90%**	**20%**	**0%**	**90%**
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.8	6.0	768	20.7	0.12	0.05	0.18	3.12	0.41	7	10,691
Median	7.8	6.0	708	21.6	0.15	0.00	0.14	3.22	0.40	4	3,813
Q1	7.7	4.2	671	19.7	0.03	0.00	0.10	2.74	0.37	3	2,611
Q3	7.8	7.6	865	22.0	0.15	0.05	0.17	3.40	0.45	5	7,154
Min	7.5	3.6	617	17.0	0.00	0.00	0.05	1.99	0.31	2	100
Max	8.0	9.4	1,008	23.6	0.25	0.29	0.64	4.41	0.56	33	57,943

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15040	6/13/2017	0.07	7.6	6.8	610	20.6	0.00	0.00	0.07	2.82	0.28	16	15,756
	8/8/2017	0.01	8.2	7.5	543	19.4	0.15	0.03	0.04	3.31	0.36	30	12,740
	5/16/2017	0.63	7.8	9.4	609	15.7	0.00	0.10	0.10	2.96	0.30	32	304
	5/30/2017	0.32	7.6	9.9	512	15.3	0.00	0.09	0.04	3.48	0.21	20	306
	6/27/2017	0.26	7.7	8.1	547	16.0	0.50	0.00	0.04	3.42	0.21	19	1,199
	7/18/2017	0.07	7.7	7.3	629	21.4	0.15	0.09	0.04	2.85	0.26	10	1,100
	9/5/2017	0.004	7.7	7.7	579	20.0	0.15	0.00	0.08	3.41	0.32	9	3,498
	9/19/2017	0.001	7.3	5.4	506	19.7	0.75	0.19	0.29	2.44	0.99	51	12,457

% BM Exceedaces	**0%**	**0%**	**100%**	**0%**	**25%**	**0%**	**0%**	**100%**	**13%**	**0%**	**100%**
Count	8	8	8	8	8	8	8	8	8	8	8
Average	7.7	7.8	567	18.5	0.21	0.06	0.09	3.09	0.36	23	5,920
Median	7.7	7.6	563	19.6	0.15	0.06	0.06	3.14	0.29	20	2,349
Q1	7.6	7.2	535	15.9	0.00	0.00	0.04	2.84	0.25	15	902
Q3	7.8	8.4	609	20.2	0.24	0.09	0.09	3.41	0.33	31	12,528
Min	7.3	5.4	506	15.3	0.00	0.00	0.04	2.44	0.21	9	304
Max	8.2	9.9	629	21.4	0.75	0.19	0.29	3.48	0.99	51	15,756

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1

Cane Run Watershed-Focused Monitoring

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15503	5/16/2017	1.35	8.6	7.7	624	15.6	0.00	0.10	0.03	3.22	0.26	3	202
	5/30/2017	1.7	7.5	8.3	588	15.4	0.00	0.01	0.0075	1.70	0.27	1	202
	6/13/2017	0.73	8.2	8.0	665	18.3	0.00	0.11	0.02	3.18	0.26	4	100
	6/27/2017	1.72	7.8	8.3	610	16.5	0.00	0.01	0.0075	2.96	0.29	3	202
	8/8/2017	1.34	7.8	7.3	641	18.2	0.15	0.07	0.03	3.37	0.29	2	860
	9/5/2017	1.14	7.4	7.4		19.0	0.15	0.02	0.07	3.09	0.27	7	3,089
	9/19/2017	0.68	7.7	6.4		19.8	0.50	0.00	0.03	2.53	0.30	6	1,869

% BM Exceedances	**0%**	**0%**	**100%**	**0%**	**14%**	**0%**	**0%**	**86%**	**0%**	**0%**	**43%**
Count	7	7	5	7	7	7	7	7	7	7	7
Average	7.9	7.6	626	17.5	0.11	0.05	0.03	2.86	0.28	4	932
Median	7.8	7.7	624	18.2	0.00	0.02	0.03	3.09	0.27	3	202
Q1	7.6	7.3	610	16.1	0.00	0.01	0.01	2.75	0.26	3	202
Q3	8.0	8.1	641	18.6	0.15	0.09	0.03	3.20	0.29	5	1,365
Min	7.4	6.4	588	15.4	0.00	0.00	0.01	1.70	0.26	1	100
Max	8.6	8.3	665	19.8	0.50	0.11	0.07	3.37	0.30	7	3,089

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1

Cane Run Watershed-Focused Monitoring

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		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15506	7/25/2017	4.6	7.5	8.2	612	18.6	1.00	0.00	1.33	3.01	0.63	15	173,289
	7/18/2017		7.1	10.6	781	18.4	0.15	0.00	0.61	3.86	0.47	4	10,193
	5/16/2017	3.15	7.2	8.0	628	15.1	0.00	0.02	0.28	3.47	0.38	3	9,881
	5/30/2017	9	6.0	8.4	584	15.3	0.00	0.02	0.03	4.06	0.34	3	5,284
	6/27/2017	8.99	6.0	8.9	579	16.1	0.50	0.00	0.0075	4.69	0.29	3	1,869
	8/8/2017	7.26	7.0	7.4	627	17.3	0.15	0.00	0.03	3.39	0.38	3	3,145
	9/5/2017	6.47	7.0	7.4		17.8	0.75	0.00	0.08	3.70	0.59	7	15,286
	9/19/2017	1.35	7.2			18.0	1.00	0.14	3.17	0.23	1.15	16	241,960

% BM Exceedaces	0%	0%	100%	0%	50%	0%	38%	88%	38%	0%	100%
Count	8	7	6	8	8	8	8	8	8	8	8
Average	6.9	8.4	635	17.1	0.44	0.02	0.69	3.30	0.53	7	57,613
Median	7.0	8.2	620	17.5	0.33	0.00	0.18	3.59	0.42	4	10,037
Q1	6.7	7.7	591	15.9	0.11	0.00	0.03	3.30	0.37	3	4,749
Q3	7.2	8.7	628	18.1	0.81	0.02	0.79	3.91	0.60	9	54,786.75
Min	6.0	7.4	579	15.1	0.00	0.00	0.01	0.23	0.29	3	1,869
Max	7.5	10.6	781	18.6	1.00	0.14	3.17	4.69	1.15	16	241,960

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15519	5/16/2017	3.12	7.2	4.5	801	15.7	0.00	0.00	0.03	3.21	0.19	4	50
	5/30/2017	2.7	6.7	6.5	746	15.4	0.00	0.00	0.0075	2.15	0.19	1	50
	6/13/2017	1.82	7.0	1.9	815	17.3	0.00	0.12	0.03	2.75	0.20	6	860
	6/27/2017	4.76	7.2	7.4	726	16.1	0.13	0.00	0.02	3.29	0.23	3	100
	7/18/2017		7.8	2.8	655	18.3	0.15	0.12	0.02	2.88	0.22	4	100
	8/8/2017	4.76	6.8	4.5	776	18.1	0.15	0.10	0.0075	3.95	0.18	1	620
	7/25/2017	3.9	7.2	8.5	673	19.8	0.15	0.08	0.12	1.82	0.25	8	2,751
	8/22/2017	3.63	7.1	1.6	815	19.9	0.15		0.22	2.27	0.91	111	202
	9/5/2017	5.69	7.0	7.0		18.3	0.25	0.03	0.02	3.67	0.18	3	16,695

% BM Exceedaces	**0%**	**33%**	**100%**	**0%**	**0%**	**0%**	**0%**	**89%**	**11%**	**11%**	**44%**
Count	9	9	8	9	9	8	9	9	9	9	9
Average	7.1	5.0	751	17.6	0.11	0.06	0.05	2.89	0.29	16	2,381
Median	7.1	4.5	761	18.1	0.15	0.06	0.02	2.88	0.20	4	202
Q1	7.0	2.8	713	16.1	0.00	0.00	0.02	2.27	0.19	3	100
Q3	7.2	7.0	805	18.3	0.15	0.11	0.03	3.29	0.23	6	860
Min	6.7	1.6	655	15.4	0.00	0.00	0.01	1.82	0.18	1	50
Max	7.8	8.5	815	19.9	0.25	0.12	0.22	3.95	0.91	111	16,695

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15523	5/16/2017	0.31	7.6	6.9	804	16.0	0.00		0.02	2.01	0.23	5	1,078
	5/30/2017	2.1	7.6	9.8	712	16.4	0.00	0.04	0.02	2.38	0.22	3	521
	6/27/2017	0.58	7.4	7.8	669	16.8	0.13	0.02	0.04	2.52	0.23	5	512
	7/18/2017	0.21	7.3	9.2	732	19.5	0.00	0.17	0.02	1.98	0.24	1	516
	7/25/2017	2.2	7.0	7.6	729	19.9	0.15	0.21	0.02	2.20	0.30	6	306
	8/8/2017	0.91	7.7	8.7	682	18.1	0.15	0.00	0.0075	2.26	0.26	2	1,849
	6/13/2017	0.24	7.6	8.1	782	18.3	0.00	0.00	0.0075	1.98	0.24	5	3,184
	8/22/2017	1.32	7.5	9.0	763	18.3	1.00	0.00	0.0075	2.18	0.28	10	46,111
	9/5/2017	2.89	7.6	8.0	688	19.2	0.15	0.02	0.02	2.08	0.32	13	2,621
	9/19/2017	0.93	7.4	7.7	775	18.8	0.15	0.29	0.02	1.68	0.50	33	979

% BM Exceedances	**0%**	**0%**	**100%**	**0%**	**10%**	**0%**	**0%**	**70%**	**0%**	**0%**	**100%**
Count	10	10	10	10	10	9	10	10	10	10	10
Average	7.5	8.3	734	18.1	0.17	0.08	0.02	2.13	0.28	8	5,768
Median	7.5	8.0	731	18.3	0.14	0.02	0.02	2.13	0.25	5	1,029
Q1	7.4	7.7	694	17.1	0.00	0.00	0.01	1.99	0.23	4	517
Q3	7.6	8.9	772	19.1	0.15	0.17	0.02	2.25	0.29	9	2,428
Min	7.0	6.9	669	16.0	0.00	0.00	0.01	1.68	0.22	1	306
Max	7.7	9.8	804	19.9	1.00	0.29	0.04	2.52	0.50	33	46,111

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
15524	5/16/2017	0.04	7.4	6.8	609	15.6	0.00	0.03	0.04	1.90	0.19	4	306
	5/30/2017	0.07	7.7	9.8	523	16.5	0.00	0.13	0.03	2.32	0.17	5	50
	6/13/2017	0.15	7.9	8.6	595	17.6	0.00	0.00	0.07	1.15	0.17	2	202
	6/27/2017	0.29	7.6	8.1	557	18.0	0.00	0.00	0.0075	2.57	0.18	3	100
	7/18/2017	0.003	7.9	8.4	604	19.6	0.15	0.17	0.07	2.25	0.19	2	50
	7/25/2017	0.15	7.9	7.4	570	19.9	0.15	0.02	0.04	2.46	0.18	2	202
	8/8/2017	0.15	7.4	8.0	578	19.8	0.15	0.00	0.04	2.37	0.28	6	413
	8/22/2017	0.003	7.6	6.5	667	21.1	0.15	0.11	0.08	2.24	0.20	2	620
	9/5/2017	0.03	7.3	7.2	339	21.3	0.15	0.00	0.67	2.23	0.29	17	1,849
	9/19/2017	0.01	7.7	5.6	538	20.4	0.25	0.03	0.22	1.68	0.47	14	11,446

% BM Exceedances	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**10%**	**70%**	**0%**	**0%**	**50%**
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.6	7.6	558	19.0	0.10	0.05	0.13	2.12	0.23	6	1,524
Median	7.6	7.7	574	19.7	0.15	0.03	0.05	2.25	0.19	4	254
Q1	7.4	6.9	543	17.7	0.00	0.00	0.04	1.98	0.18	2	126
Q3	7.9	8.4	602	20.3	0.15	0.09	0.08	2.36	0.26	6	568
Min	7.3	5.6	339	15.6	0.00	0.00	0.01	1.15	0.17	2	50
Max	7.9	9.8	667	21.3	0.25	0.17	0.67	2.57	0.47	17	11,446

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
CR8_502HW	5/16/2017	0.001	7.3	6.5	696	18.6	0.00	0.10	0.0075	2.26	0.21	15	50
	5/30/2017	0.003	7.5	8.2	698	20.4	0.00	0.00	0.02	1.99	0.18	4	516
	6/27/2017	0.07	7.3	8.0	596	19.1	0.13	0.10	0.05	2.48	0.35	6	50
	7/25/2017	0.0001	7.2	5.9	630	21.7	0.15	0.00	0.02	2.31	0.21	4	400
	8/8/2017	0.07	7.4	5.9	489	22.3	0.15	0.06	0.02	1.33	0.26	7	50
	9/5/2017		7.1	5.8		19.8	0.15	0.07	0.02	2.32	0.22	8	99
	9/19/2017	0.004	6.9	6.0		20.6	0.15	1.05	0.02	2.12	0.25	19	50

% BM Exceedaces	**0%**	**0%**	**100%**	**0%**	**0%**	**14%**	**0%**	**71%**	**0%**	**0%**	**29%**
Count	7	7	5	7	7	7	7	7	7	7	7
Average	7.2	6.6	622	20.4	0.10	0.20	0.02	2.12	0.24	9	174
Median	7.3	6.0	630	20.4	0.15	0.07	0.02	2.26	0.22	7	50
Q1	7.1	5.9	596	19.4	0.06	0.03	0.02	2.06	0.21	5	50
Q3	7.4	7.2	696	21.2	0.15	0.10	0.02	2.32	0.25	12	250
Min	6.9	5.8	489	18.6	0.00	0.00	0.01	1.33	0.18	4	50
Max	7.5	8.2	698	22.3	0.15	1.05	0.05	2.48	0.35	19	516

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1

Cane Run Watershed-Focused Monitoring

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
CR-1	5/16/2017	20.3	7.7	7.9	602	18.6	0.00	0.05	0.04	1.05	0.40	27	2,433
	5/30/2017	62.2	7.5	9.6	617	17.6	0.00	0.12	0.02	2.36	0.33	6	202
	6/27/2017	73.6	7.8	8.2	645	17.2	0.00	0.07	0.04	2.94	0.33	8	409
	7/18/2017	32.34	8.1	8.1	591	21.6	0.15	0.04	0.02	1.14	0.31	6	100
	8/8/2017	32.34	7.2	7.0	490	19.5	0.15	0.04	0.02	0.90	0.36	5	745
	9/5/2017	41.2	7.8	7.8	500	20.5	0.25	0.13	0.04	1.36	0.42	13	202

	pH	DO	COND	TEMP	DTRG	Chl	NH_3 - N	NO_3 - N	TP	TSS	E. coli
% BM Exceedaces	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**33%**	**0%**	**0%**	**50%**
Count	6	6	6	6	6	6	6	6	6	6	6
Average	7.7	8.1	574	19.2	0.09	0.08	0.03	1.62	0.36	11	682
Median	7.7	8.0	597	19.0	0.08	0.06	0.03	1.25	0.35	7	306
Q1	7.5	7.8	523	17.8	0.00	0.04	0.02	1.07	0.33	6	202
Q3	7.8	8.2	613	20.3	0.15	0.11	0.04	2.11	0.39	12	661
Min	7.2	7.0	490	17.2	0.00	0.04	0.02	0.90	0.31	5	100
Max	8.1	9.6	645	21.6	0.25	0.13	0.04	2.94	0.42	27	2,433

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
CR-2	5/30/2017	151	8.0	9.8	668	17.1	0.00	0.13	0.0075	2.75	0.26	2	516
	6/27/2017	167.26	7.8	8.7	684	17.0	0.13	0.10	0.02	3.59	0.56	38	852
	8/8/2017	59.1	7.6	6.3	495	18.4	0.25	0.00	0.02	2.29	0.32	4	2,133
	9/5/2017	112.94	7.8	8.5	613	21.6	0.15	0.10	0.02	2.43	0.32	6	202

% BM Exceedances	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**100%**	**25%**	**0%**	**75%**
Count	4	4	4	4	4	4	4	4	4	4	4
Average	7.8	8.3	615	18.5	0.13	0.08	0.02	2.77	0.37	13	925.75
Median	7.8	8.6	641	17.7	0.14	0.10	0.02	2.59	0.32	5	684
Q1	7.7	7.9	584	17.1	0.09	0.08	0.01	2.40	0.30	4	438
Q3	7.9	9.0	672	19.2	0.18	0.11	0.02	2.96	0.38	14	1,172
Min	7.6	6.3	495	17.0	0.00	0.00	0.01	2.29	0.26	2	202
Max	8.0	9.8	684	21.6	0.25	0.13	0.02	3.59	0.56	38	2,133

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
CR-3	5/16/2017	0.52	8.1	7.9	610	19.1	0.00	0.04	0.03	0.88	0.33	5	50
	5/30/2017	1.22	7.6	7.8	501	19.9	0.00	0.14	0.03	1.68	0.36	6	413
	6/13/2017	0.12	7.7	6.5	639	21.1	0.00	0.17	0.03	3.43	0.37	6	632
	6/27/2017	0.52	7.1	7.8	536	19.8	0.00	0.07	0.02	1.67	0.34	4	306
	7/18/2017	0.03	7.6	6.5	602	21.2	0.15	0.00	0.02	0.82	0.32	3	413
	7/25/2017	0.03	7.2	6.4	637	20.9	0.15	0.04	0.02	0.82	0.32	5	1,211
	8/8/2017	0.12	7.6	6.7	501	20.5	0.15	0.07	0.02	0.68	0.35	4	521
	8/22/2017	0.01	7.8	5.7	924	23.0	0.15	0.01	0.03	0.57	1.07		202
	9/5/2017	0.52	7.5	8.7	494	20.5	0.25	0.06	0.02	1.23	0.32	2	100
	9/19/2017	0.01	7.2	5.2	732	20.7	0.15	0.03	0.02	0.70	0.33	5	100

% BM Exceedances	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**10%**	**10%**	**0%**	**60%**
Count	10	10	10	10	10	10	10	10	10	9	10
Average	7.5	6.9	618	20.7	0.10	0.06	0.02	1.25	0.41	4	395
Median	7.6	6.6	606	20.6	0.15	0.05	0.02	0.85	0.34	5	360
Q1	7.3	6.4	510	20.1	0.00	0.03	0.02	0.73	0.33	4	126
Q3	7.7	7.8	639	21.1	0.15	0.07	0.03	1.56	0.36	5	494
Min	7.1	5.2	494	19.1	0.00	0.00	0.02	0.57	0.32	2	50
Max	8.1	8.7	924	23.0	0.25	0.17	0.03	3.43	1.07	6	1,211

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
CR-5	5/16/2017	0.93	8.8	7.8	702	16.5	0.00	0.00	0.03	2.79	0.28	5	860
	5/30/2017	5.21	7.6	8.7	676	16.8	0.00	0.01	0.0075	2.84	0.27	3	409
	6/13/2017	0.23	7.4	7.7	678	17.3	0.00	0.10	0.03	3.61	0.37	14	413
	6/27/2017	5.85	7.6	8.5	704	16.9	0.13	0.03	0.0075	3.64	0.34	3	1,829
	7/18/2017	0.18	7.8	8.1	651	17.9	0.25	0.05	0.02	3.77	0.35	11	1,829
	7/25/2017	0.13	7.7	8.2	651	17.7	0.15	0.06	0.02	3.61	0.34	5	1,211
	8/8/2017	1.92	7.5	7.8	559	18.0	0.25	0.01	0.02	2.46	0.30	2	1,849
	8/22/2017	0.06	8.0	8.3	665	19.2	0.15	0.01	0.0075	3.10	0.39	9	745
	9/5/2017	3.4	7.4	9.5	636	18.6	0.15	0.05	0.02	2.69	0.33	1	738
	9/19/2017	0.2	7.7	7.6	732	18.3	0.15	0.00	0.02	3.06	0.49	18	202

% BM Exceedances	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**0%**	**90%**
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.7	8.2	665	17.7	0.12	0.03	0.02	3.16	0.34	7	1,009
Median	7.6	8.2	671	17.8	0.15	0.02	0.02	3.08	0.34	5	803
Q1	7.5	7.8	651	17.0	0.03	0.01	0.01	2.80	0.31	3	494
Q3	7.8	8.4	696	18.2	0.15	0.05	0.02	3.61	0.36	11	1,675
Min	7.4	7.6	559	16.5	0.00	0.00	0.01	2.46	0.27	1	202
Max	8.8	9.5	732	19.2	0.25	0.10	0.03	3.77	0.49	18	1,849

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
CR-6	7/18/2017	0.69	7.1	6.7	658	16.9	0.15	0.00	0.05	3.89	0.39	7	14,209
	7/25/2017	0.31	7.2	7.1	655	17.0	0.15	0.04	0.02	3.78	0.40	19	3,405
	5/16/2017	0.69	7.6	7.1	631	15.5	0.00	0.02	0.0075	3.36	0.34	11	1,829
	5/30/2017	0.69	7.3	7.8	580	15.5	0.00	0.09	0.0075	3.85	0.23	2	304
	6/13/2017	0.69	6.6	8.0	682	15.9	0.00	0.09	0.0075	1.56	0.31	4	860
	6/27/2017	0.69	7.1	8.1	589	16.3	0.00	0.07	0.07	4.67	0.32	3	1,480
	8/8/2017	0.31	7.1	6.1	558	17.6	0.15	0.01	0.02	3.22	0.37	3	100
	8/22/2017	0.09	7.1	6.5	676	19.5	0.15	0.00	0.0075	3.27	0.36	3	2,034
	9/5/2017	0.69	6.4	8.5	566	18.0	0.25	0.04	0.02	3.65	0.39	2	521
	9/19/2017	0.31	6.8	5.6	703	19.7	0.18	0.00	0.02	3.13	0.31	3	1,336

% BM Exceedances	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**90%**	**0%**	**0%**	**90%**
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.0	7.2	630	17.2	0.10	0.04	0.02	3.44	0.34	6	2,608
Median	7.1	7.1	643	16.9	0.15	0.03	0.02	3.51	0.35	3	1,408
Q1	6.9	6.5	582	16.0	0.00	0.00	0.01	3.23	0.31	3	606
Q3	7.1	7.9	672	17.9	0.15	0.06	0.02	3.83	0.38	6	1,983
Min	6.4	5.6	558	15.5	0.00	0.00	0.01	1.56	0.23	2	100
Max	7.6	8.5	703	19.7	0.25	0.09	0.07	4.67	0.40	19	14,209

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

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		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli*** **(MPN/ 100mLs)**
CR-7	6/13/2017	2.61	7.8	7.1	962	21.0	0.00	0.00	0.03	0.80	0.29	5	5,208
	8/8/2017	4.38	7.8	7.8	743	18.6	0.15	0.00	0.0075	1.96	0.32	3	3,592
	5/16/2017	6.79	7.7	8.0	888	19.0	0.00	2.15	0.03	2.07	0.33	4	1,336
	5/30/2017	6.79	7.6	7.7	822	18.0	0.00	0.06	0.02	1.98	0.31	4	3,319
	6/27/2017	4.38	7.7	9.8	712	16.8	0.13	0.00	0.03	2.30	0.27	5	2,882
	7/18/2017	1.3	7.9	7.9	890	20.5	0.00	0.00	0.02	1.80	0.33	2	860
	7/25/2017	1.3	7.8	6.0	841	20.7	0.15	0.09	0.03	1.55	0.34	18	1,211
	8/22/2017	1.3	8.1	5.4	1,024	22.2	0.15	0.06	0.02	1.55	0.36	3	6,127
	9/5/2017	6.79	7.6	8.1	844	19.6	0.15	0.00	0.02	2.22	0.35	4	860
	9/19/2017	2.61	7.9	8.1	770	19.7	0.15	0.00	0.02	1.62	0.33	6	12,229

% BM Exceedances	0%	0%	100%	0%	0%	10%	0%	30%	0%	0%	100%
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.8	7.6	850	19.6	0.09	0.24	0.02	1.79	0.32	5	3,762
Median	7.8	7.8	843	19.7	0.14	0.00	0.02	1.88	0.33	4	3,101
Q1	7.7	7.3	783	18.7	0.00	0.00	0.02	1.57	0.32	3	1,242
Q3	7.9	8.0	890	20.6	0.15	0.06	0.03	2.05	0.34	5	4,804
Min	7.6	5.4	712	16.8	0.00	0.00	0.01	0.80	0.27	2	860
Max	8.1	9.8	1,024	22.2	0.15	2.15	0.03	2.30	0.36	18	12,229

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH$_3$ - N (mg/L)**	**NO$_3$ - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli*** **(MPN/ 100mLs)**
CR-8	8/8/2017	124.17	7.7	8.1	589	18.2	0.15	0.00	0.0075	2.77	0.23	3	3,592
	5/30/2017	144	7.2	6.3	808	18.5	0.00	0.00	0.03	3.06	0.26	5	1,869
	6/27/2017	9.11	7.1	10.2	801	16.8	0.13	0.04	0.06	4.27	0.28	3	860
	9/5/2017	124.17	7.9	7.5	842	20.3	0.15	0.05	0.02	2.23	0.26	4	852

% BM Exceedaces	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**0%**	**100%**
Count	4	4	4	4	4	4	4	4	4	4	4
Average	7.4	8.0	760	18.4	0.11	0.02	0.03	3.08	0.26	4	1,793
Median	7.4	7.8	805	18.3	0.14	0.02	0.02	2.92	0.26	4	1,365
Q1	7.1	7.2	748	17.8	0.09	0.00	0.01	2.64	0.25	3	858
Q3	7.7	8.6	817	18.9	0.15	0.04	0.03	3.36	0.27	4	2,300
Min	7.1	6.3	589	16.8	0.00	0.00	0.01	2.23	0.23	3	852
Max	7.9	10.2	842	20.3	0.15	0.05	0.06	4.27	0.28	5	3,592

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
CR-9	5/30/2017	0.01	8.1	10.3	580	18.0	0.50	0.05	0.0075	2.16	0.23	1	1,596

% BM Exceendaces	**0%**	**0%**	**100%**	**0%**	**100%**	**0%**	**0%**	**100%**	**0%**	**0%**	**100%**
Count	1	1	1	1	1	1	1	1	1	1	1
Average	8.1	10.3	580	18.0	0.50	0.05	0.01	2.16	0.23	1	1,596
Median	8.1	10.3	580	18.0	0.50	0.05	0.01	2.16	0.23	1	1,596
Q1	8.1	10.3	580	18.0	0.50	0.05	0.01	2.16	0.23	1	1,596
Q3	8.1	10.3	580	18.0	0.50	0.05	0.01	2.16	0.23	1	1,596
Min	8.1	10.3	580	18.0	0.50	0.05	0.01	2.16	0.23	1	1,596
Max	8.1	10.3	580	18.0	0.50	0.05	0.01	2.16	0.23	1	1,596

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	**6 - 9**	**4**	**300**	**31.7**	**0.5**	**0.5**	**0.5**	**2**	**0.5**	**80**	**240**
Site ID	**Date**	**Est. Flow (cfs)**	**pH (SU)**	**DO (mg/L)**	**COND (uS/cm)**	**TEMP (°C)**	**DTRG (mg/L)**	**Chl (mg/L)**	**NH_3 - N (mg/L)**	**NO_3 - N (mg/L)**	**TP (mg/L)**	**TSS (mg/L)**	***E. coli* (MPN/ 100mLs)**
CR-10	5/30/2017	12.1	7.8	8.8	682	18.3	0.00	0.00	0.03	2.41	0.25	1	1,211
	6/27/2017	15.55	7.5	9.3	667	18.3	0.25	0.01	0.04	2.97	0.26	4	2,109

% BM Exceedances	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	100%
Count	2	2	2	2	2	2	2	2	2	2	2
Average	7.7	9.1	675	18.3	0.13	0.01	0.03	2.69	0.25	3	1,660
Median	7.7	9.1	675	18.3	0.13	0.01	0.03	2.69	0.25	3	1,660
Q1	7.6	8.9	671	18.3	0.06	0.00	0.03	2.55	0.25	2	1,436
Q3	7.8	9.2	678	18.3	0.19	0.01	0.04	2.83	0.26	3	1,885
Min	7.5	8.8	667	18.3	0.00	0.00	0.03	2.41	0.25	1	1,211
Max	7.8	9.3	682	18.3	0.25	0.01	0.04	2.97	0.26	4	2,109

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
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		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240
Site ID	Date	Est. Flow (cfs)	pH (SU)	DO (mg/L)	COND (uS/cm)	TEMP (°C)	DTRG (mg/L)	Chl (mg/L)	NH_3 - N (mg/L)	NO_3 - N (mg/L)	TP (mg/L)	TSS (mg/L)	*E. coli* (MPN/ 100mLs)
CR-11	8/8/2017	3.21	7.2	8.1	687	19.1	0.15	0.00	0.0075	3.17	0.26	4	4,103
	5/16/2017	0.61	8.5	7.5	904	21.3	0.00	0.24	0.02	3.24	0.26	6	202
	5/30/2017	5.24	7.4	9.4	834	17.4	0.00	0.80	0.03	3.36	0.26	12	626
	6/13/2017	0.61	8.3	12.8	1,331	25.9	0.00	0.05	0.02	0.77	0.23	8	738
	6/27/2017	5.24	7.0	9.5	724	17.7	0.25	0.05	0.0075	4.42	0.19	5	2,281
	7/18/2017	0.61	7.9	9.2	1,083	24.3	0.25	0.05	0.03	1.04	0.26	4	413
	7/25/2017	0.61	7.8	9.4	906	21.7	0.15	0.00	0.03	0.72	0.23	5	1,089
	8/22/2017	0.61	8.0	7.1	1,105	24.0	0.15	0.12	0.02	0.48	0.23	4	844
	9/5/2017	3.21	7.2	7.7	871	18.6	3.00	0.02	0.02	3.15	0.25	6	1,089
	9/19/2017	0.61	7.8	12.3	941	20.4	0.15	0.07	0.02	0.71	0.24	7	738

% BM Exceedances	0%	0%	100%	0%	10%	10%	0%	50%	0%	0%	90%
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.7	9.3	939	21.0	0.41	0.14	0.02	2.11	0.24	6	1,212
Median	7.8	9.3	905	20.8	0.15	0.05	0.02	2.10	0.25	6	791
Q1	7.3	7.8	843	18.7	0.04	0.03	0.02	0.73	0.23	4	654
Q3	8.0	9.5	1,048	23.5	0.23	0.11	0.02	3.22	0.26	7	1,089
Min	7.0	7.1	687	17.4	0.00	0.00	0.01	0.48	0.19	4	202
Max	8.5	12.8	1,331	25.9	3.00	0.80	0.03	4.42	0.26	12	4,103

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

Appendix C.1
Cane Run Watershed-Focused Monitoring
Phase 2 Results Summary Page 28 of 28

Site ID	Date	Est. Flow (cfs)	pH (SU)	DO (mg/L)	COND (uS/cm)	TEMP (°C)	DTRG (mg/L)	Chl (mg/L)	NH_3 - N (mg/L)	NO_3 - N (mg/L)	TP (mg/L)	TSS (mg/L)	*E. coli* (MPN/ 100mLs)
		Benchmark Value:	6 - 9	4	300	31.7	0.5	0.5	0.5	2	0.5	80	240
CR-12	7/25/2017	0.15	7.6	5.1	994	21.2	0.50	0.00	2.02	1.40	0.60	8	98,039
	7/18/2017	0.68	7.6	3.2	1,158	21.8	0.25	0.09	0.19	2.94	0.39	2	72,699
	8/8/2017	0.68	8.0	7.2	750	20.8	0.15	0.00	0.0075	2.18	0.27	2	15,648
	5/16/2017	0.15	8.3	8.3	679	24.8	0.00	0.12	0.04	3.58	0.36	3	1,336
	5/30/2017	0.15	7.7	8.2	668	21.6	0.00	0.10	0.06	3.45	0.33	0	1,078
	6/13/2017	0.07	7.9	5.8	995	21.7	0.00	0.05	0.03	1.77	0.32	5	1,100
	6/27/2017	0.15	7.8	6.8	745	19.1	0.13	0.16	0.05	4.22	0.30	3	2,462
	8/22/2017	0.15	8.2	5.2	629	24.1	0.15	0.01	0.06	1.93	0.33	1	413
	9/5/2017	11.57	7.7	7.5	475	21.9	0.15	0.26	0.39	3.14	0.68	49	48,844
	9/19/2017	0.68	7.9	6.5	669	21.8	0.15	0.08	0.03	1.35	0.39	9	1,464

% BM Exceedaces	0%	10%	100%	0%	10%	0%	10%	60%	20%	0%	100%
Count	10	10	10	10	10	10	10	10	10	10	10
Average	7.9	6.4	776	21.9	0.15	0.09	0.29	2.60	0.40	8	24,308
Median	7.9	6.7	712	21.8	0.15	0.09	0.05	2.56	0.34	3	1,963
Q1	7.7	5.4	668	21.3	0.03	0.02	0.04	1.81	0.32	2	1,159
Q3	8.0	7.4	933	21.8	0.15	0.12	0.15	3.37	0.39	7	40,545
Min	7.6	3.2	475	19.1	0.00	0.00	0.01	1.35	0.27	0	413
Max	8.3	8.3	1,158	24.8	0.50	0.26	2.02	4.22	0.68	49	98,039

Note: %BM Exceedance shading indicates "health grade"

Red text indicates >= benchmark value

Blue text indicates at reporting limit changed for calculation

Yellow shading indicates exceedance of action level

APPENDIX C.2
PHASE 2 QUALITY CONTROL RESULTS

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC April 10, 2018

Appendix C.2
Cane Run Watershed-Focused Monitoring
Phase 2 WQ Monitoring Quality Control Results Page 1 of 1

		7/25/2017 - 15003			8/8/2017 - 15018			8/22/2017 - CR-7			9/5/2017 - 15524			9/19/2017 - 15040		
Parameter	**QAPP Precision (Relative % Difference)[1]**	**15003**	**DUP**	**Relative % Difference**	**15018**	**DUP**	**Relative % Difference**	**CR-7**	**DUP**	**Relative % Difference**	**15524**	**DUP**	**Relative % Difference**	**15040**	**DUP**	**Relative % Difference**
pH (SU)	20	8.44	8.45	0%	8.09	8.09	0%	8.07	8.09	0%	7.3	7.61	4%	7.25	7.26	0%
DO (mg/L)	20	8.14	7.57	7%	8.1	7.2	12%	5.41	4.91	10%	7.21	6.97	3%	5.35	5.85	9%
COND (uS/cm)	20	721	719	0%	429	662	43%	1,024	920	11%	339	352	4%	506	578	13%
TEMP (°C)	20	20.15	19.77	2%	18.83	18.65	1%	22.24	22.1	1%	21.33	21.27	0%	19.73	19.67	0%
DTRG (mg/L)	20[2]	0.15	0.15	0%	0.15	0.15	0%	0.15	0.15	0%	0.15	0.15	0%	0.75	0.5	40%
Chl (mg/L)	20	0.02	0.06	100%	0.06	0.09	40%	0.06	0.06	0%	0	0	0%	0.19	0.15	24%
NH_3 - N (mg/L)	20	0.02	0.019	5%	0.015[3]	0.02	29%	0.024	0.02	4%	0.668	0.695	4%	0.287	0.26	10%
NO_3 - N (mg/L)	20	0.097	0.1	3%	0.262	0.394	40%	0.355	0.42	16%	0.285	0.281	1%	0.988	1.04	5%
TP (mg/L)	20	2.59	2.62	1%	2.15	1.91	12%	1.55	1.55	0%	2.23	2.22	0%	2.44	2.03	18%
TSS (mg/L)	20	4	3	29%	2	5	86%	3	13	125%	17	16	6%	51	89	54%
E. coli (MPN/ 100mLs)	20	1,596	1,350	17%	2,917	3,225	10%	6,127	9,599	44%	1,849	2,917	45%	12,457	15,001	19%

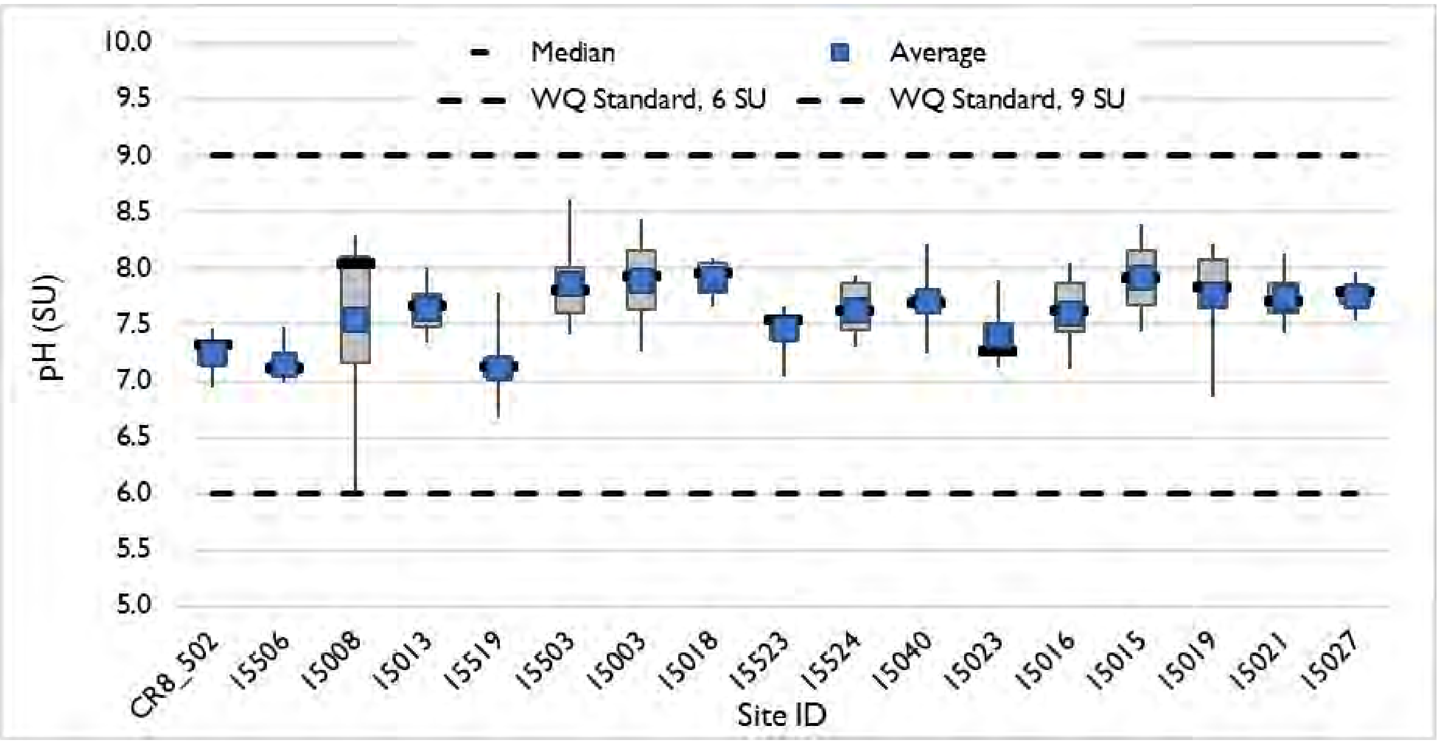
[1] Precision was compared to the laboratory precision values established in Table 7 of the QAPP (Third Rock 2017). Values shaded in yellow indicate exceedances of the established precision values; however, no data was excluded from analyses based on these values.

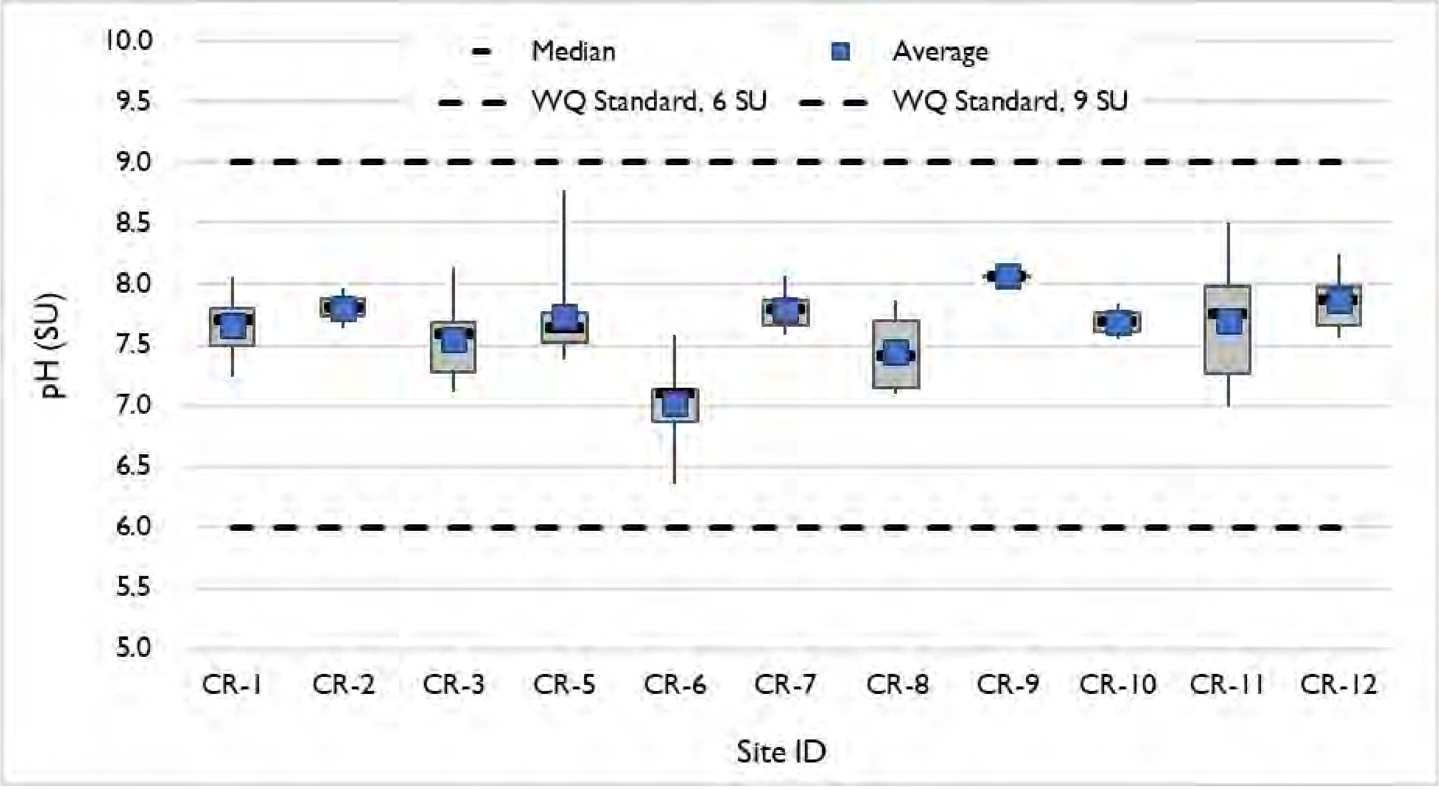
[2] Precision limit for Detergent was "Variable" per the QAPP for the field method; substituted limit of 20% Relative % Difference RPD since performed laboratory analysis of this parameter in Phase 2 monitoring.

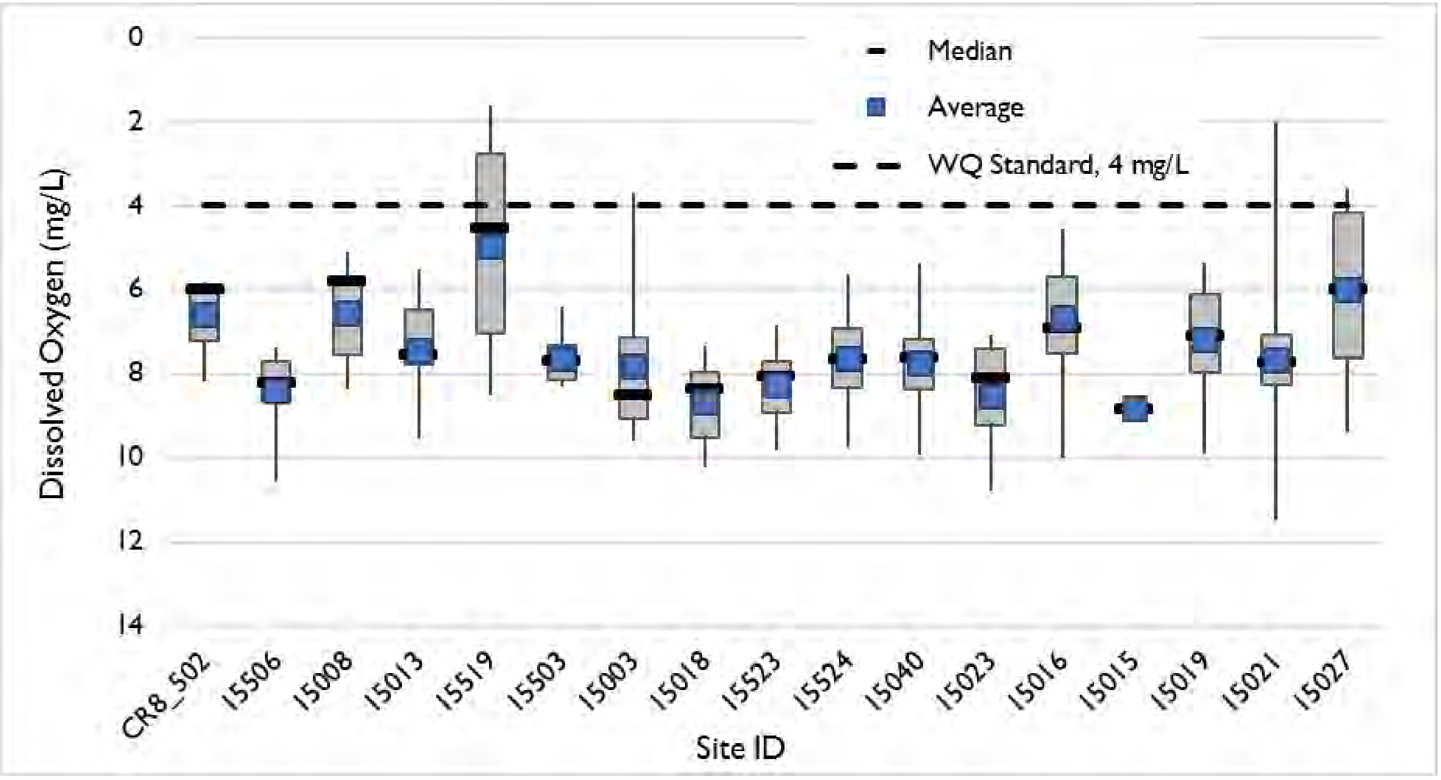
[3] This value was reported as <0.015 mg/L.

APPENDIX D
SUMMARY STATISTIC PLOTS

Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 1 of 11



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Average
WQ Standard, 4 mg/L
Dissolved Oxygen (mg/L)
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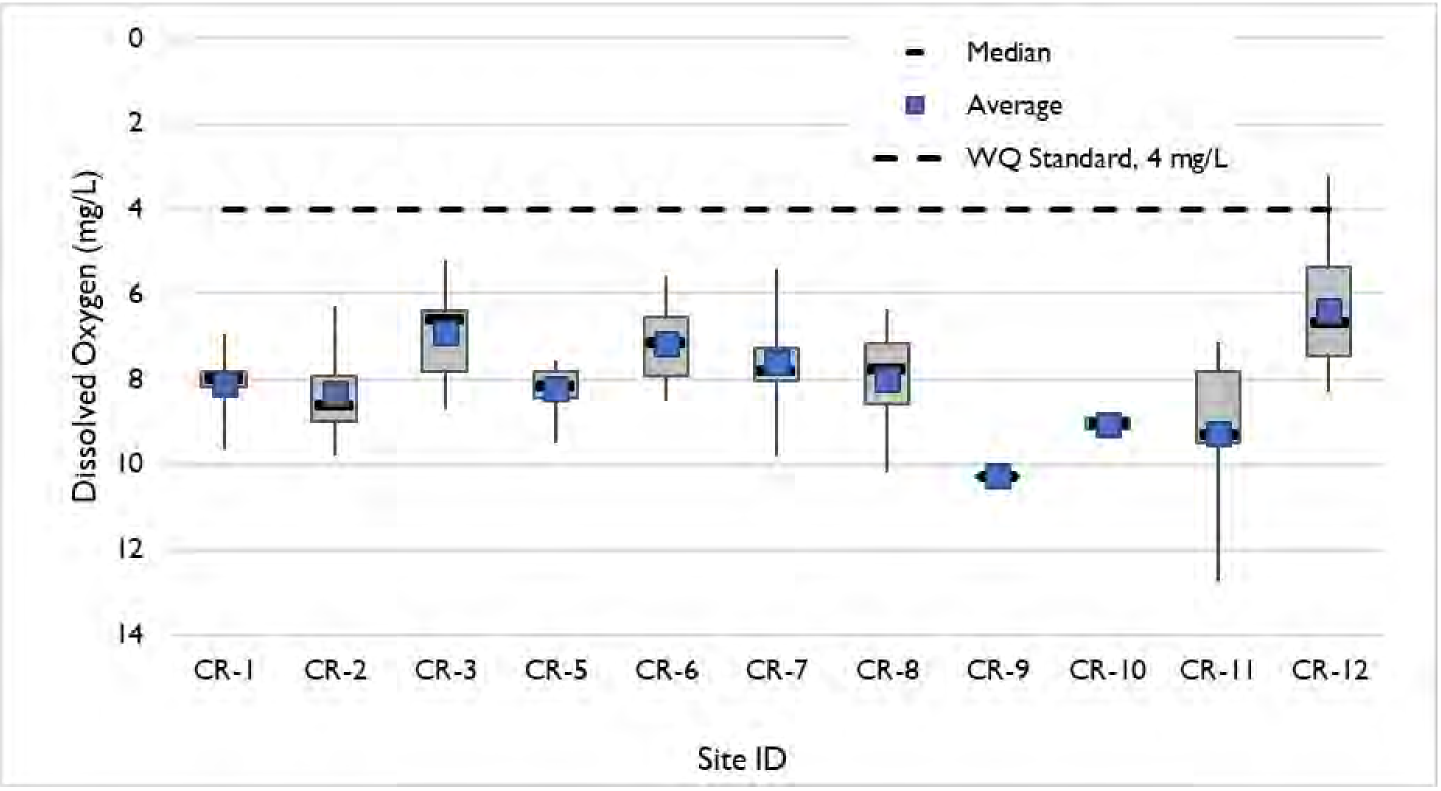
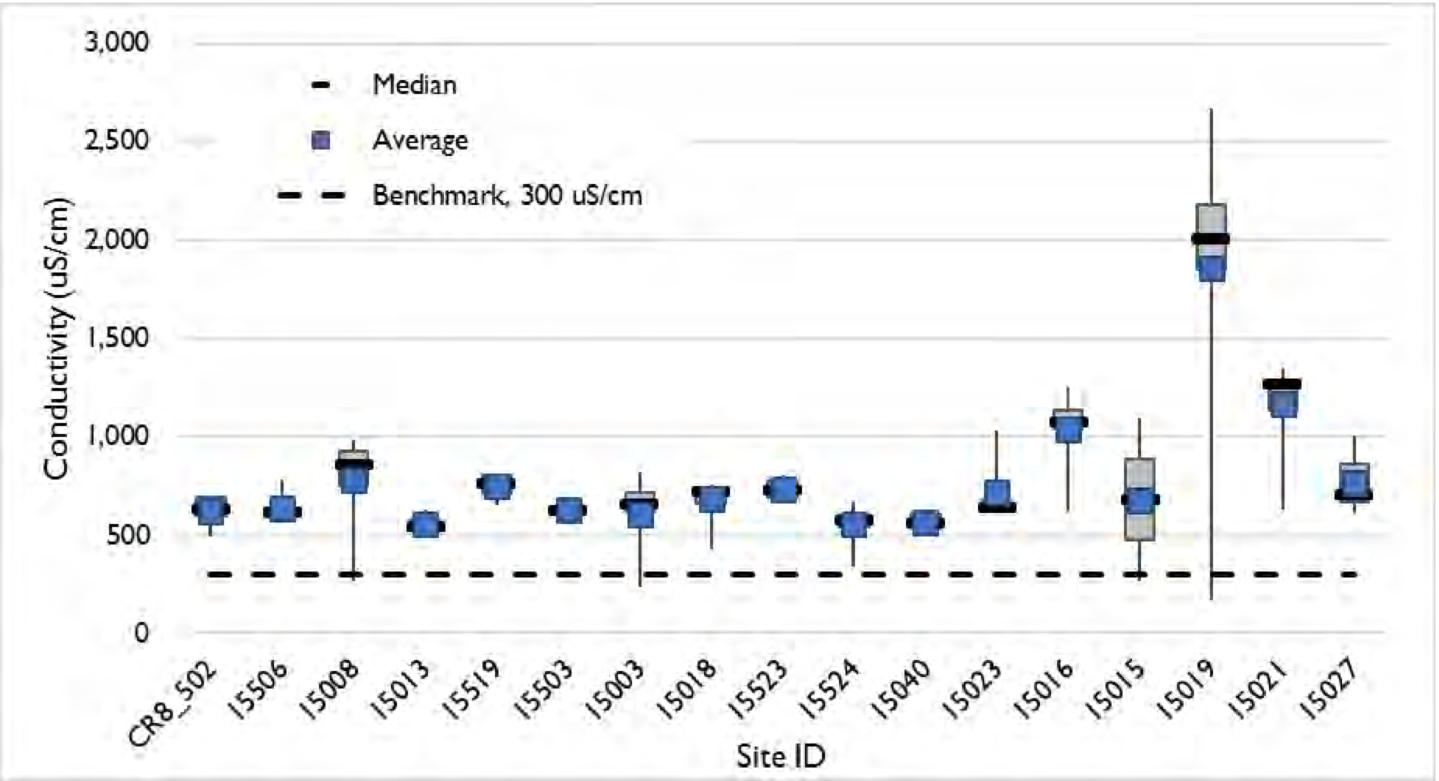
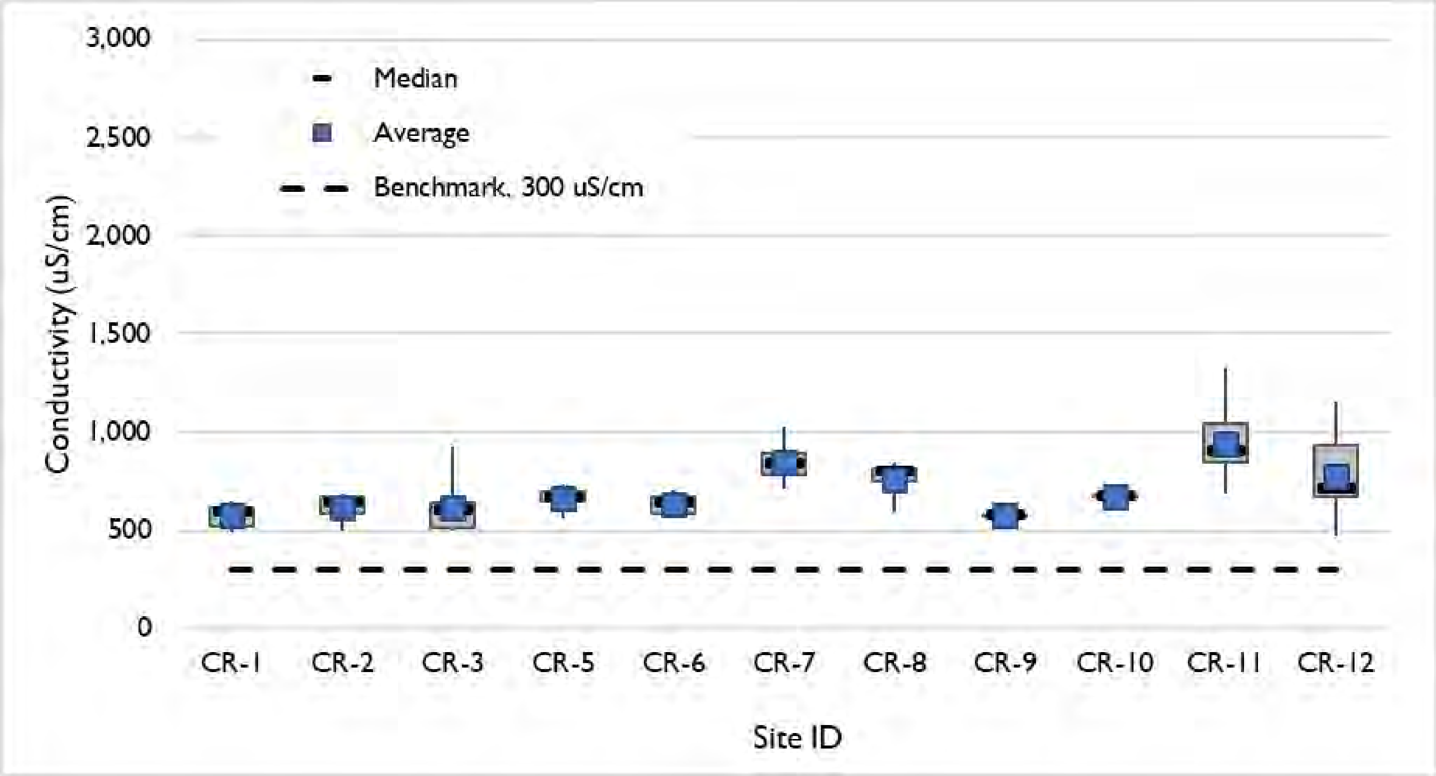
2
4
6
8
10
12
14
CR8_502
15506
15008
15013
15519
15503
15003
15018
15523
15524
15040
15023
15016
15015
15019
15021
15027
Site ID

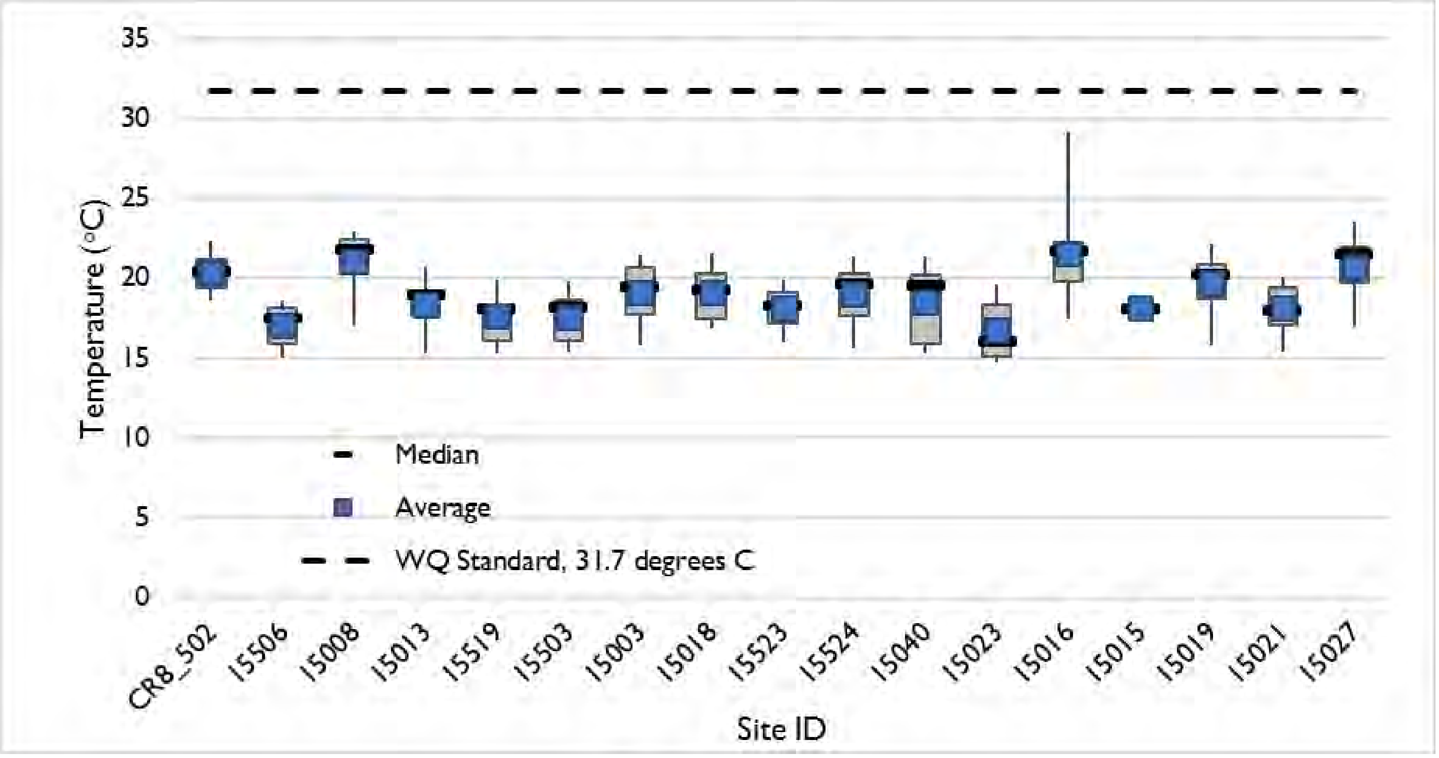

Median
Average
WQ Standard, 4 mg/L
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
14
CR-1
CR-2
CR-3
CR-5
CR-6
CR-7
CR-8
CR-9
CR-10
CR-11
CR-12
Site ID

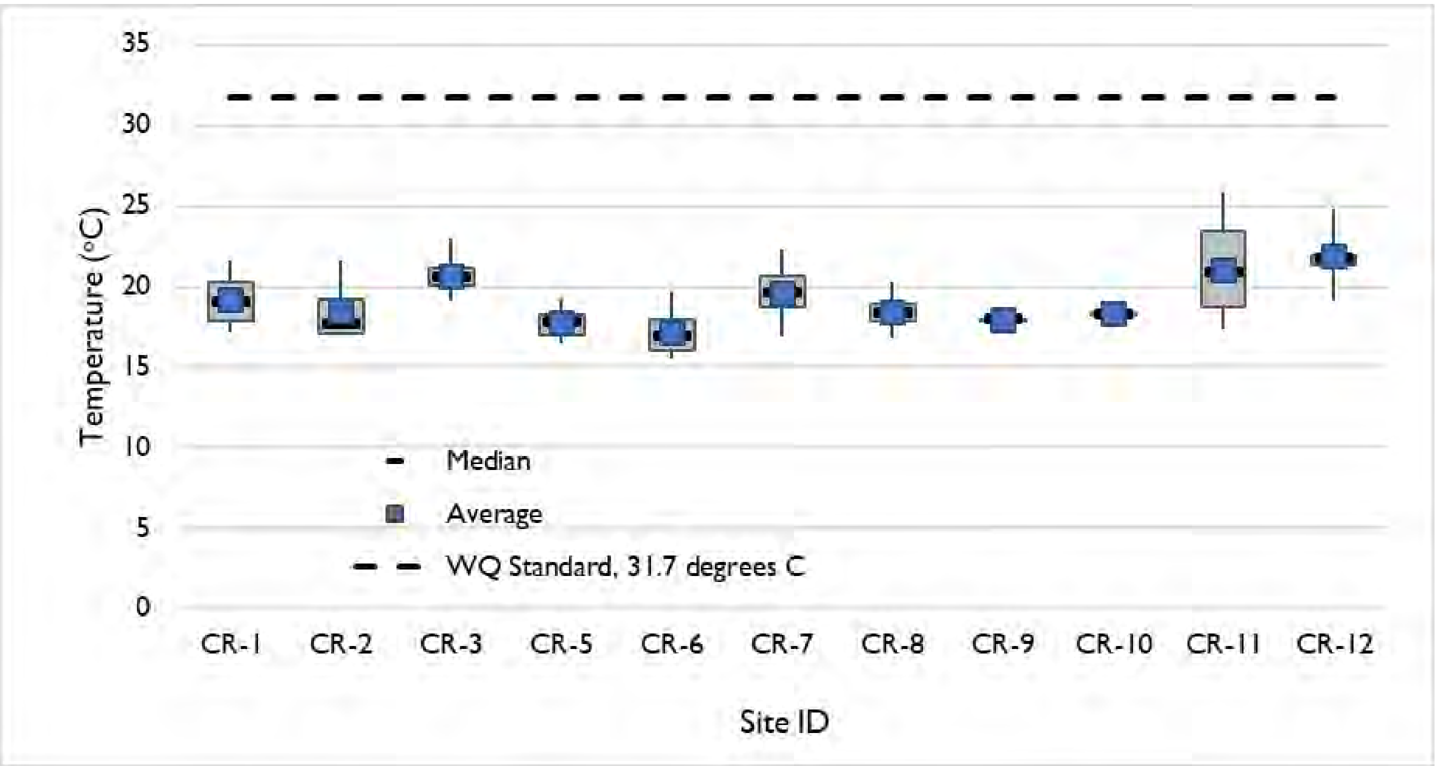
Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 3 of 11



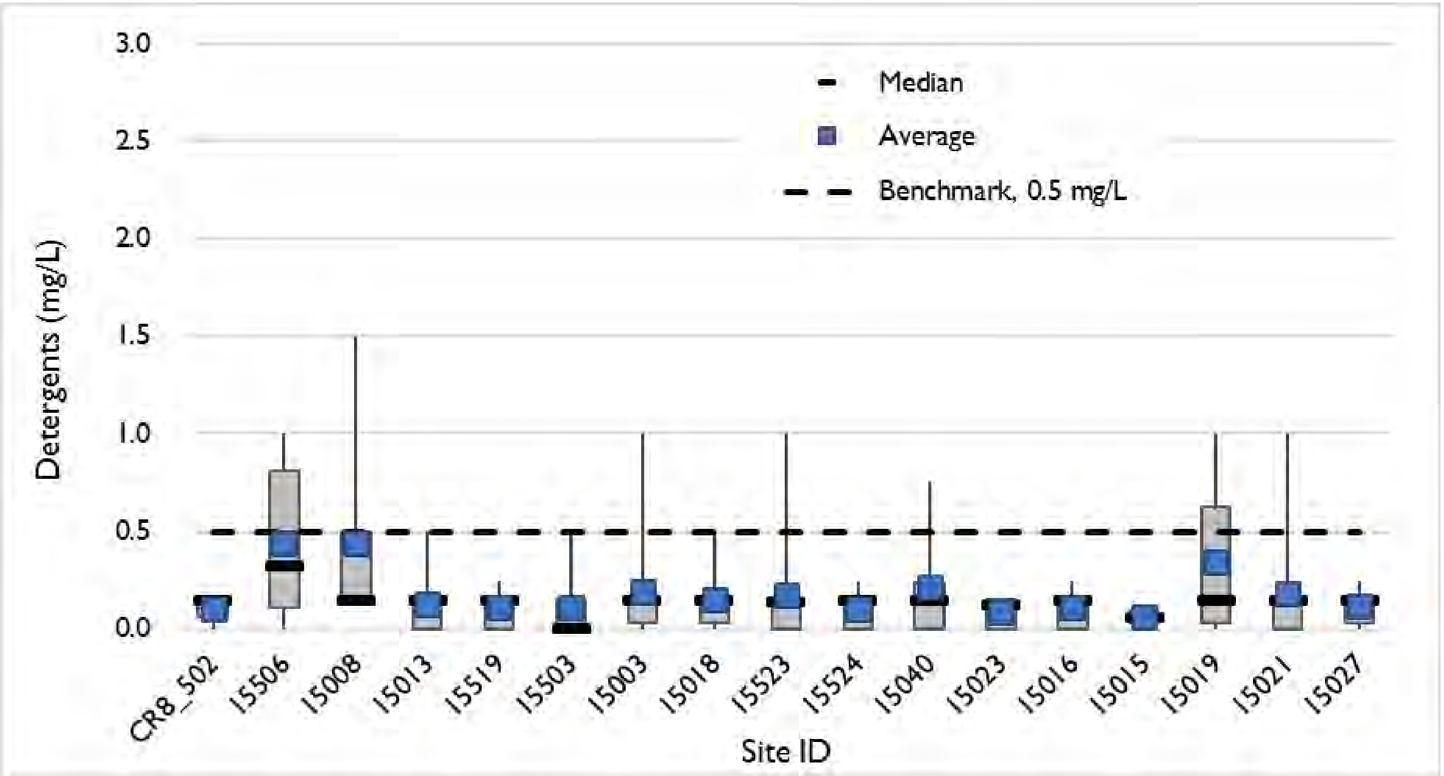


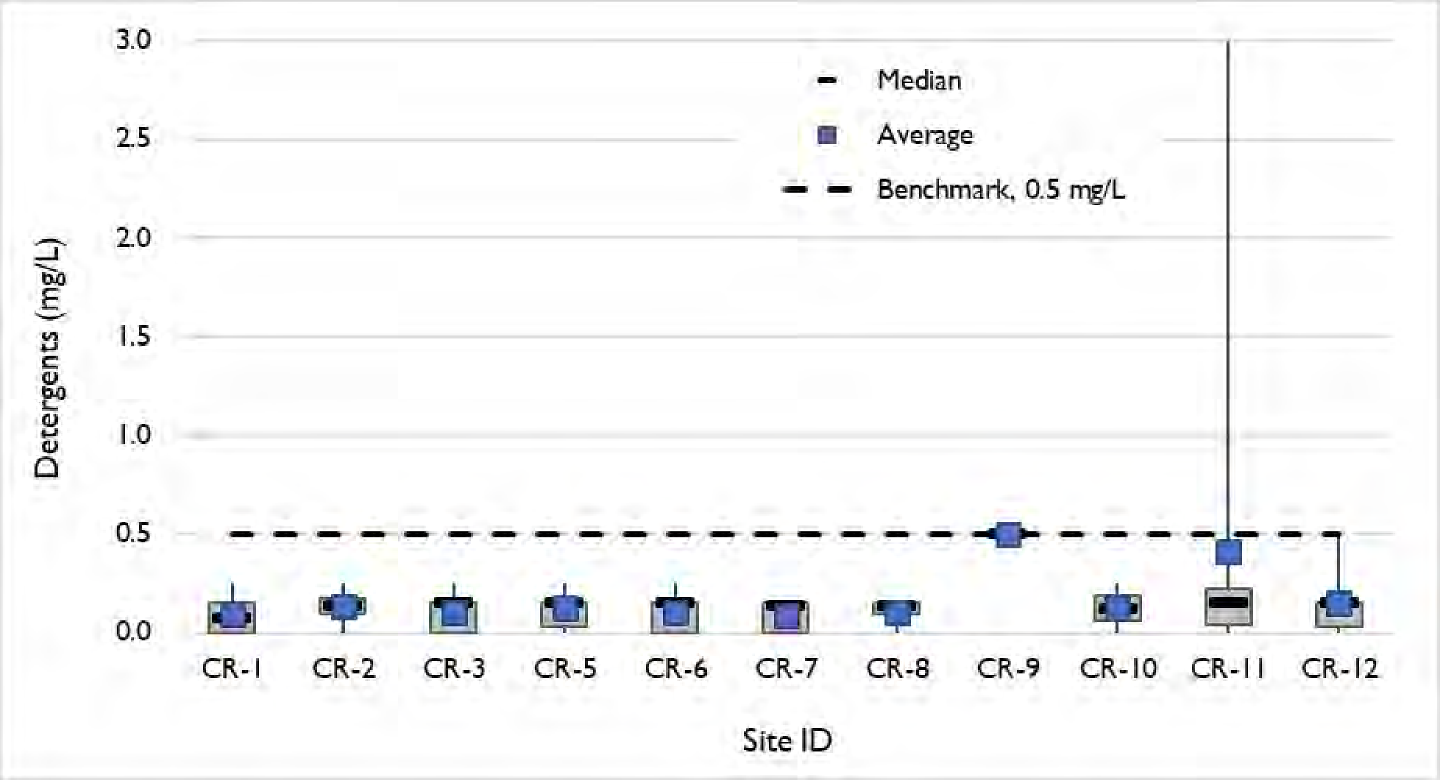
Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 4 of 11



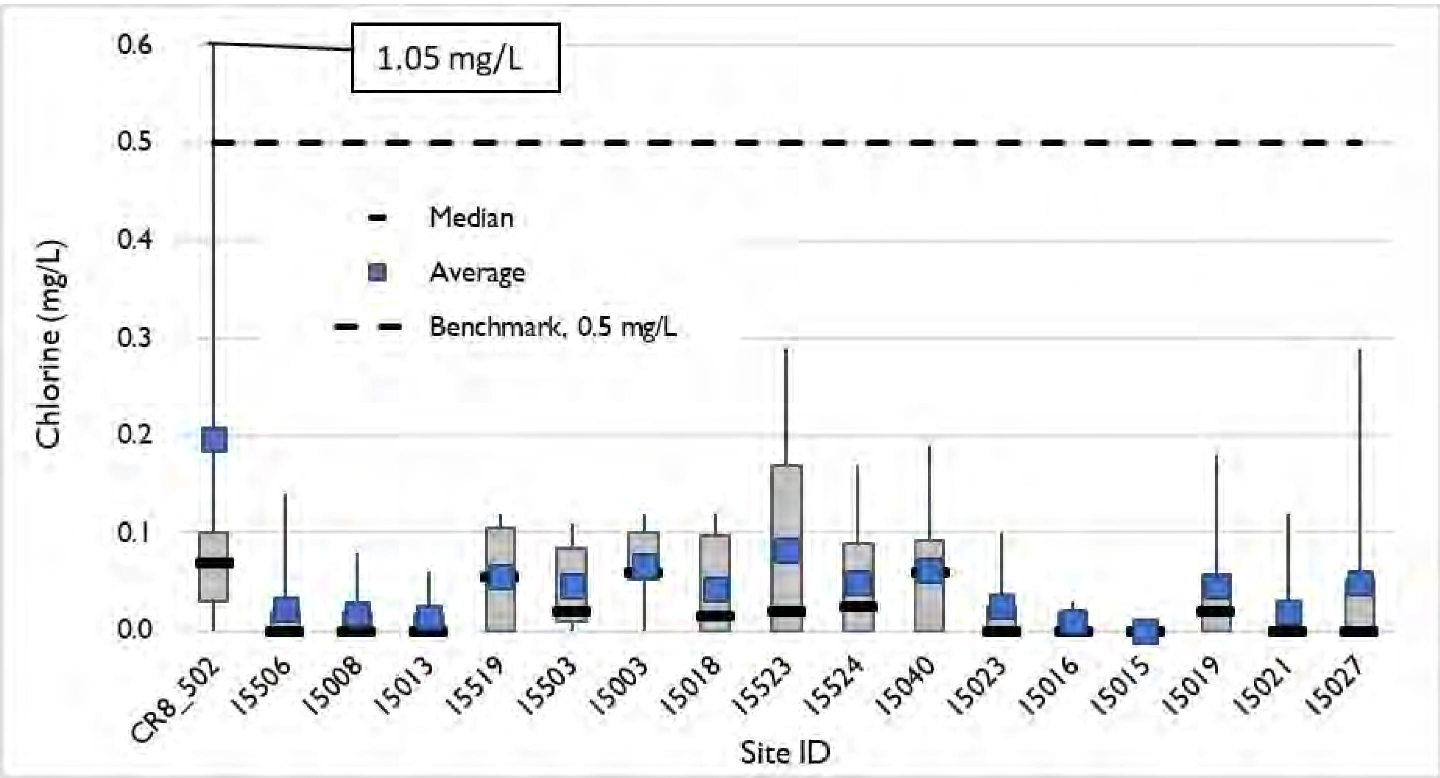


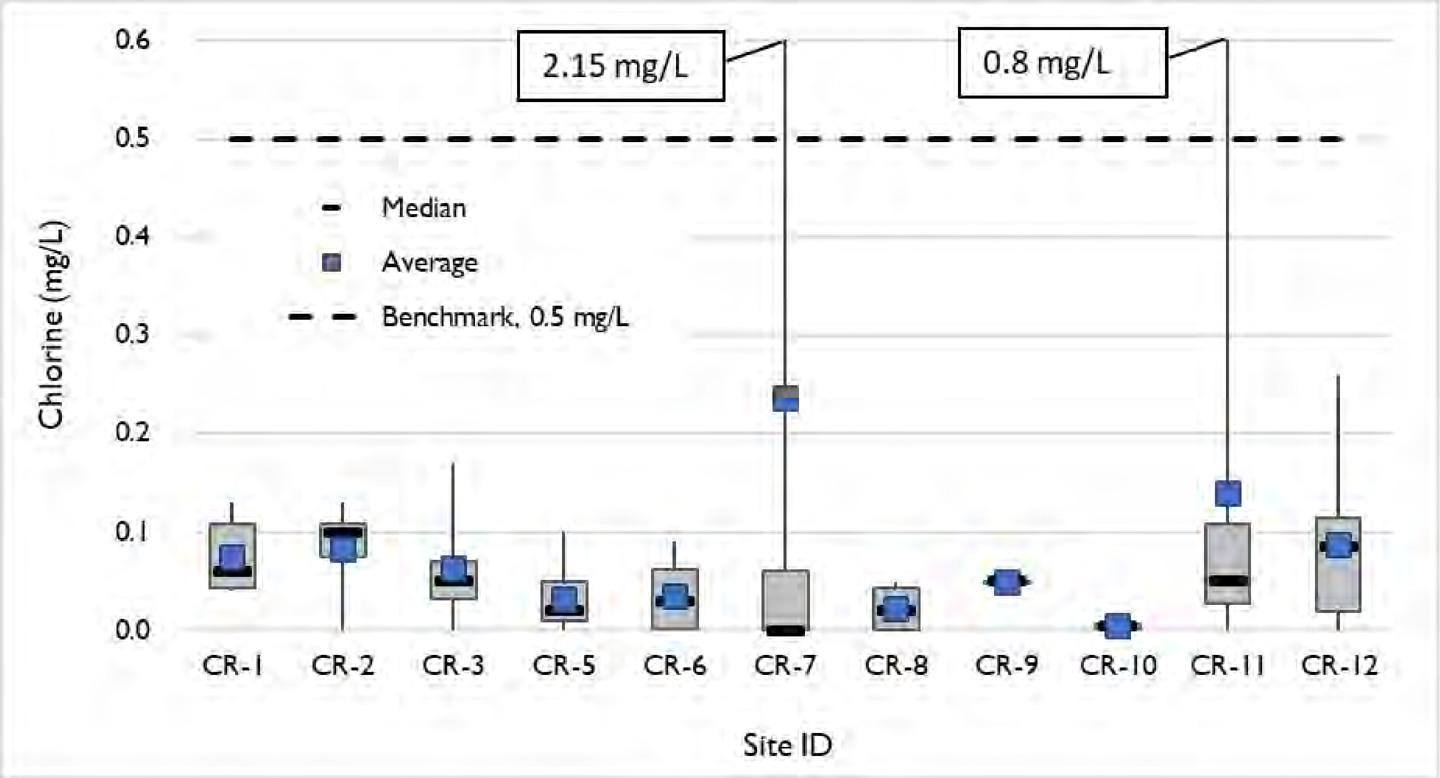
Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 5 of 11



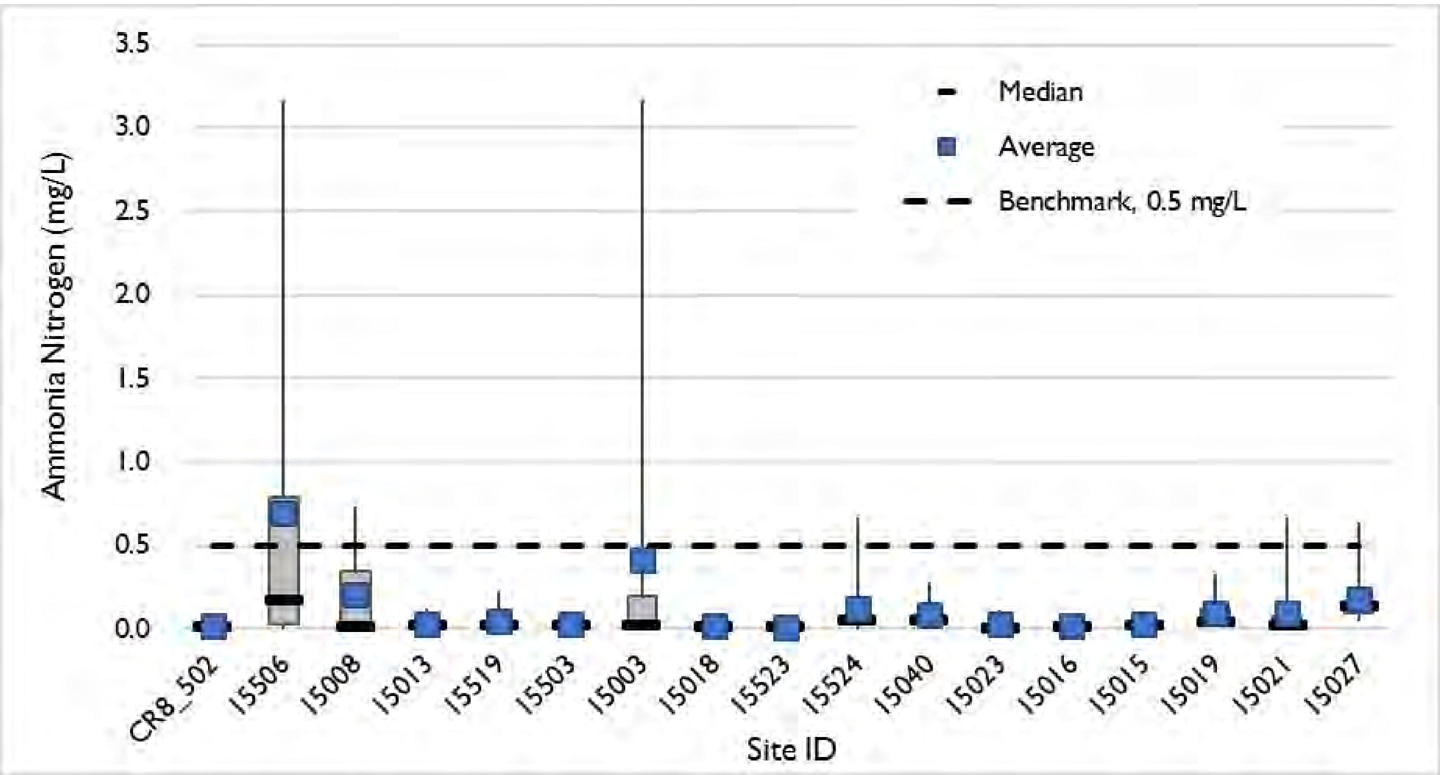


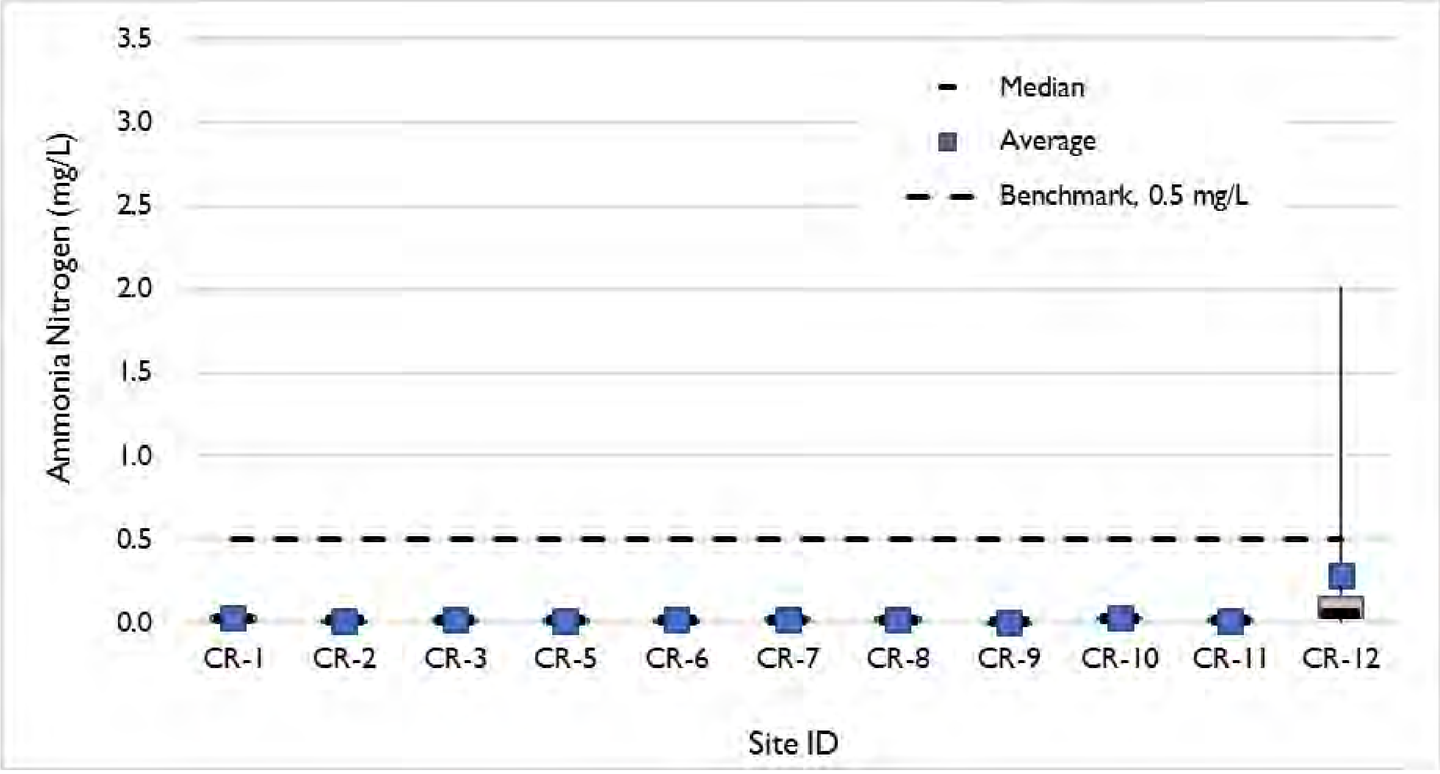
Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 6 of 11



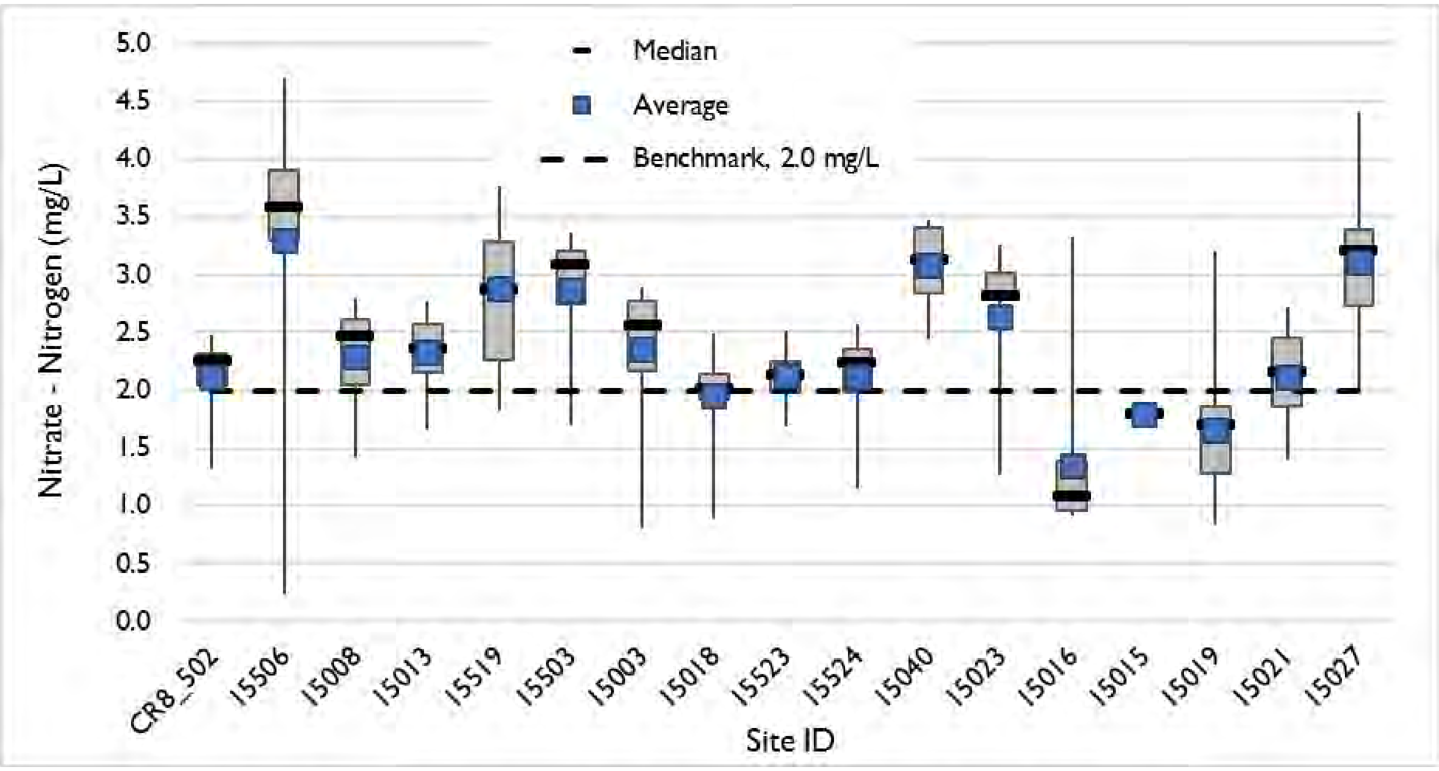


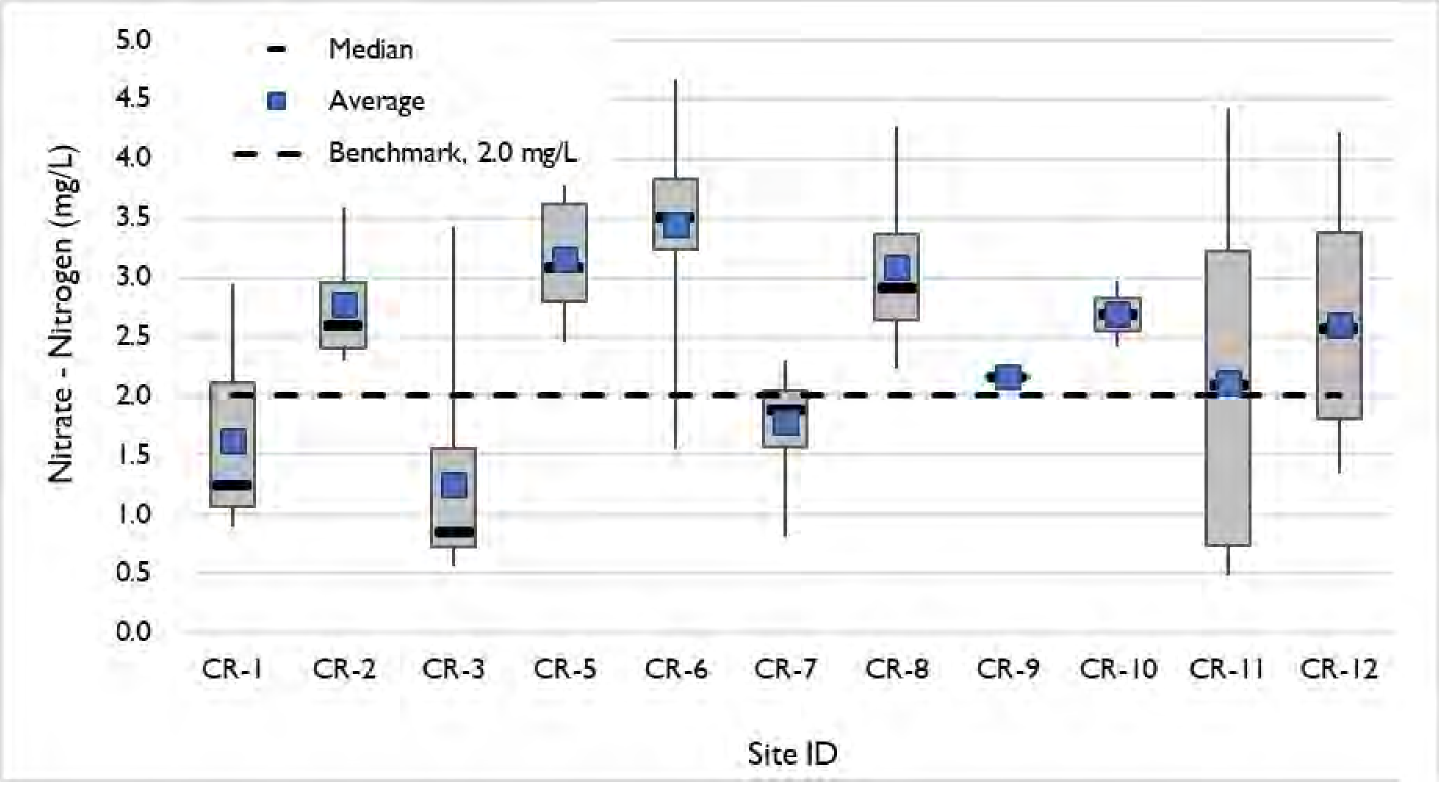
Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 7 of 11

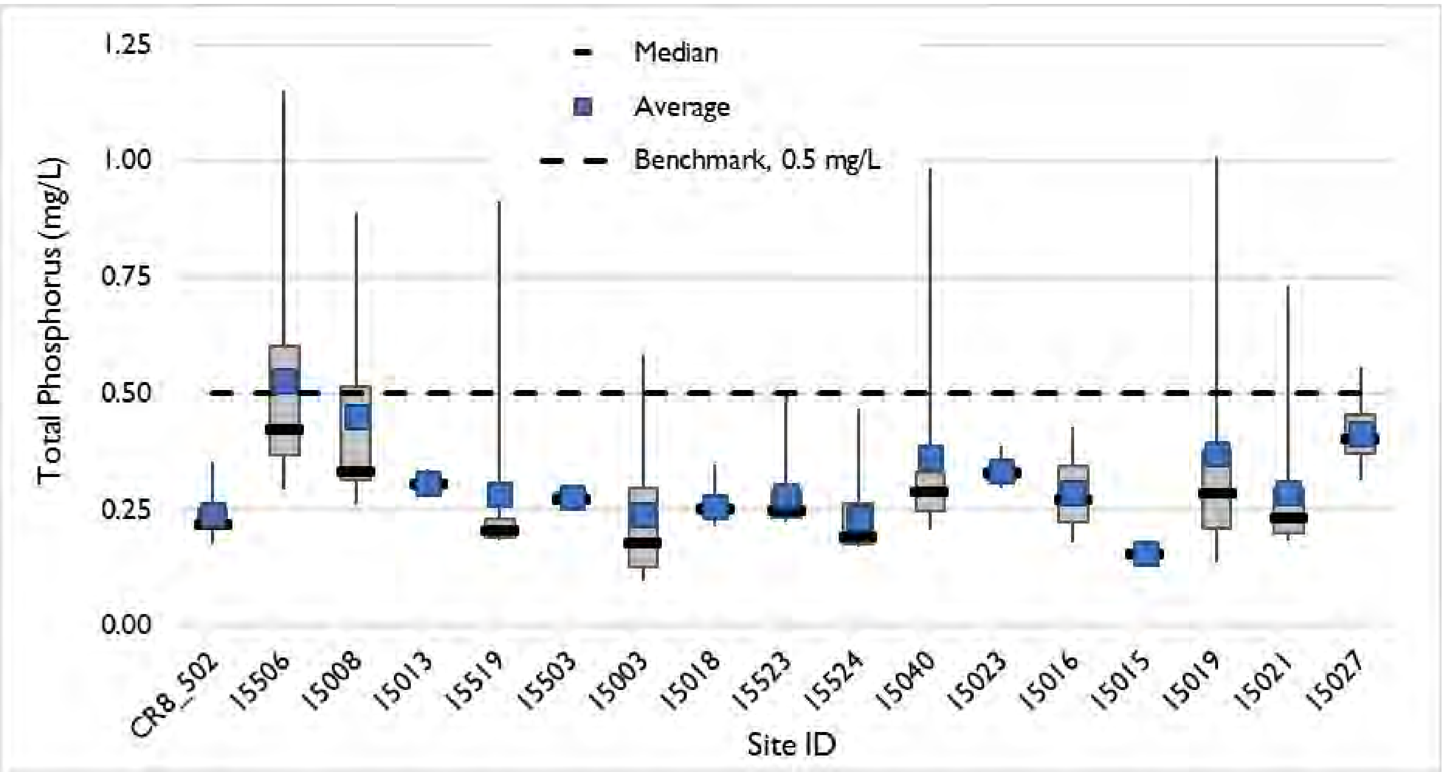


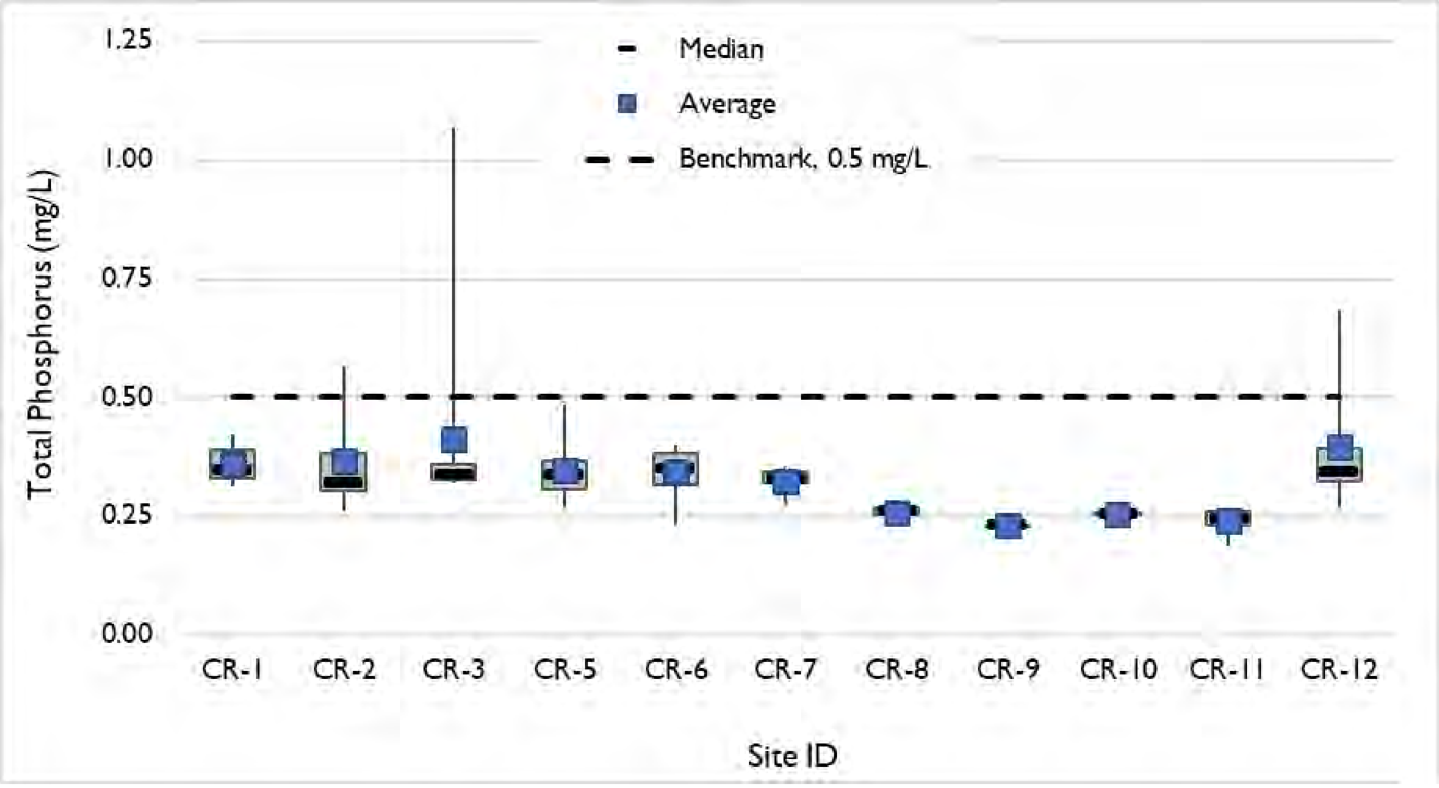


Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 8 of 11

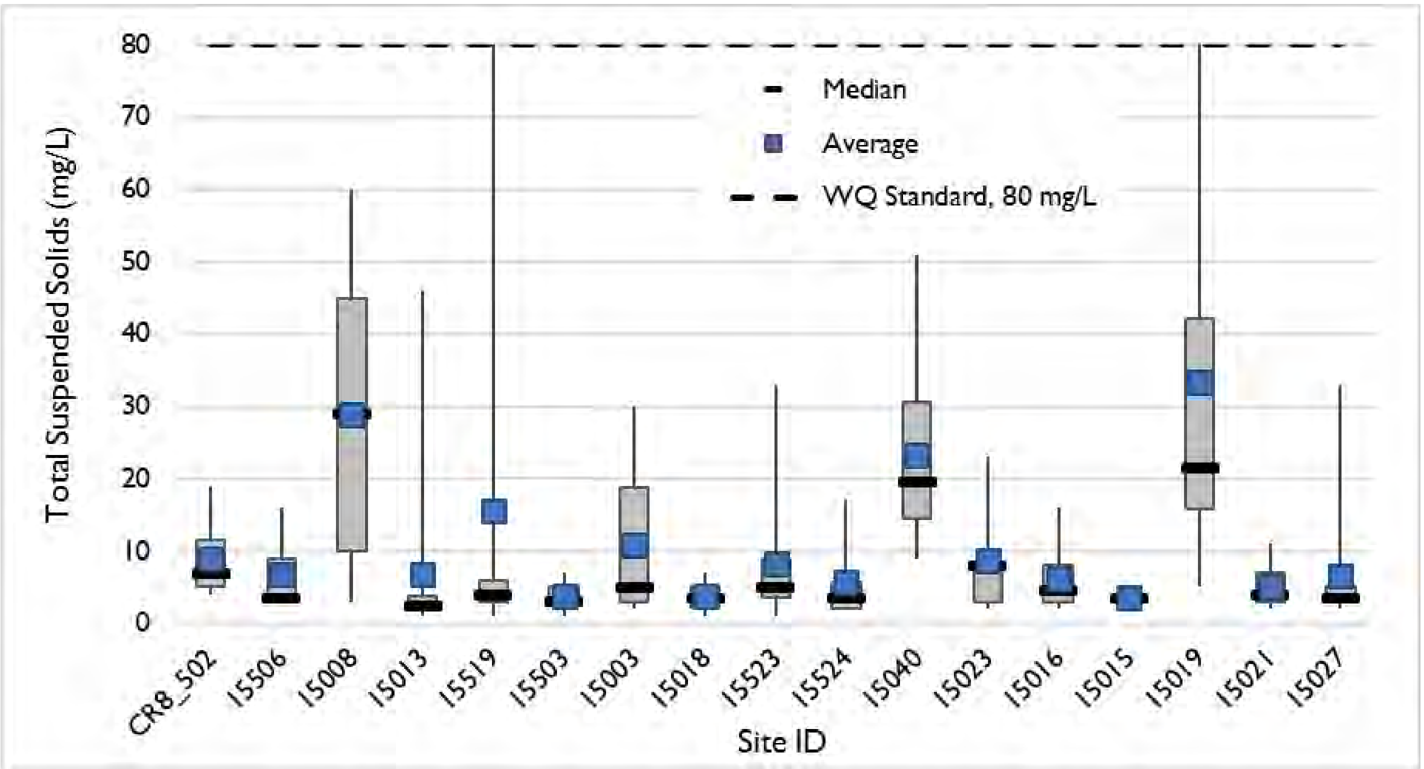


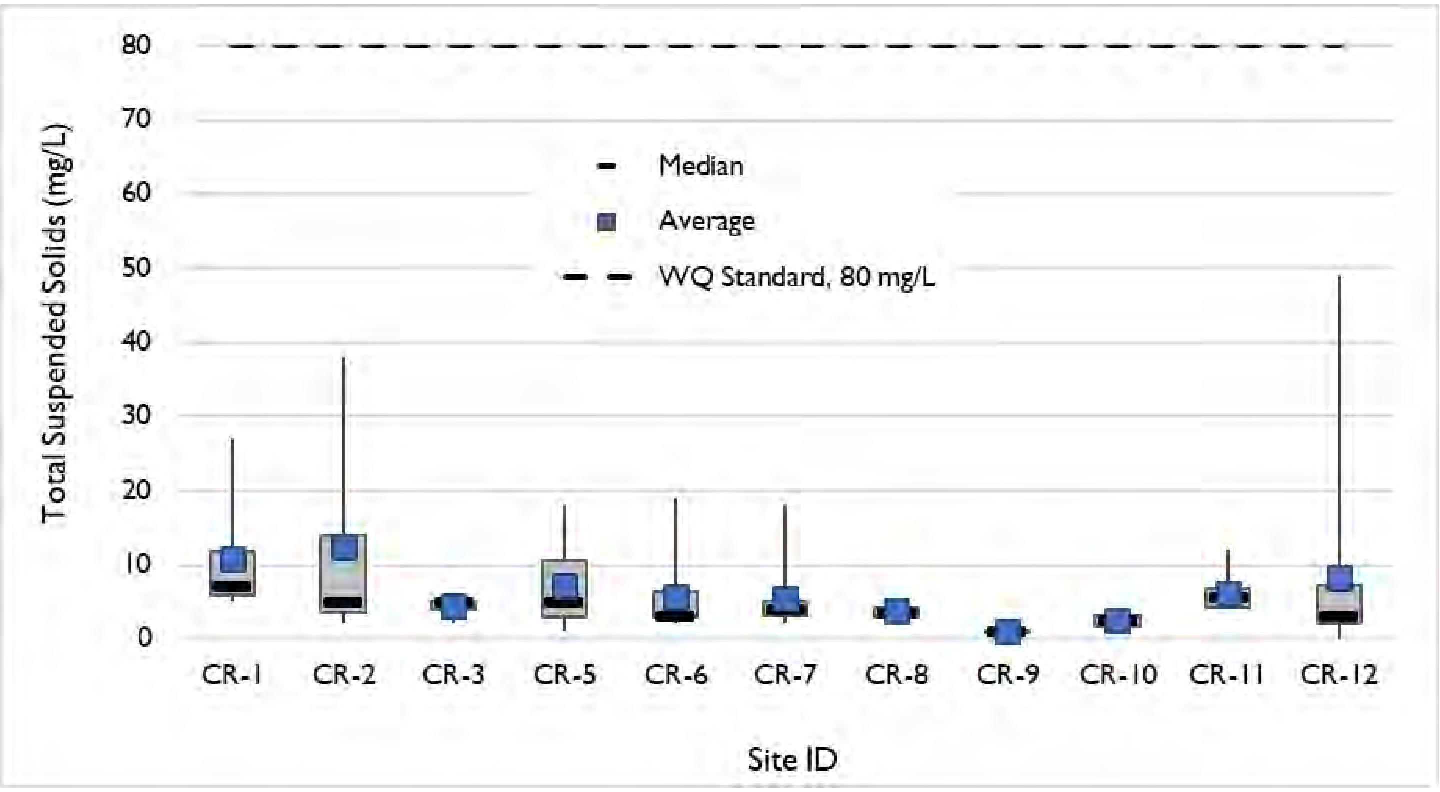



1.25
1.00
0.75
0.50
0.25
0.00
Total Phosphorus (mg/L)
Median
Average
Benchmark, 0.5 mg/L
CR8_502
15506
15008
15013
15519
15503
15003
15018
15523
15524
15040
15023
15016
15015
15019
15021
15027
Site ID

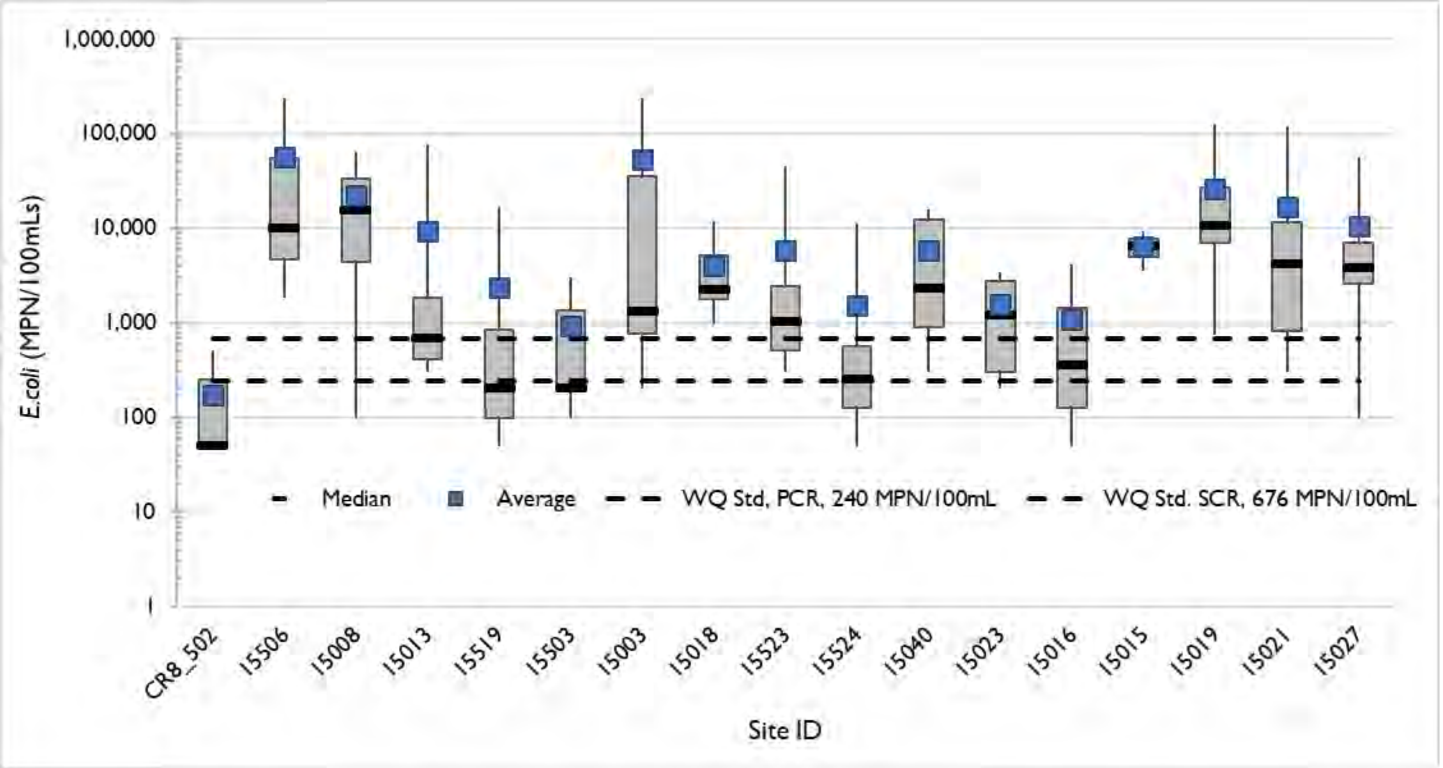

1.25
1.00
0.75
0.50
0.25
0.00
Total Phosphorus (mg/L)
Median
Average
Benchmark, 0.5 mg/L
CR-1
CR-2
CR-3
CR-5
CR-6
CR-7
CR-8
CR-9
CR-10
CR-11
CR-12
Site ID

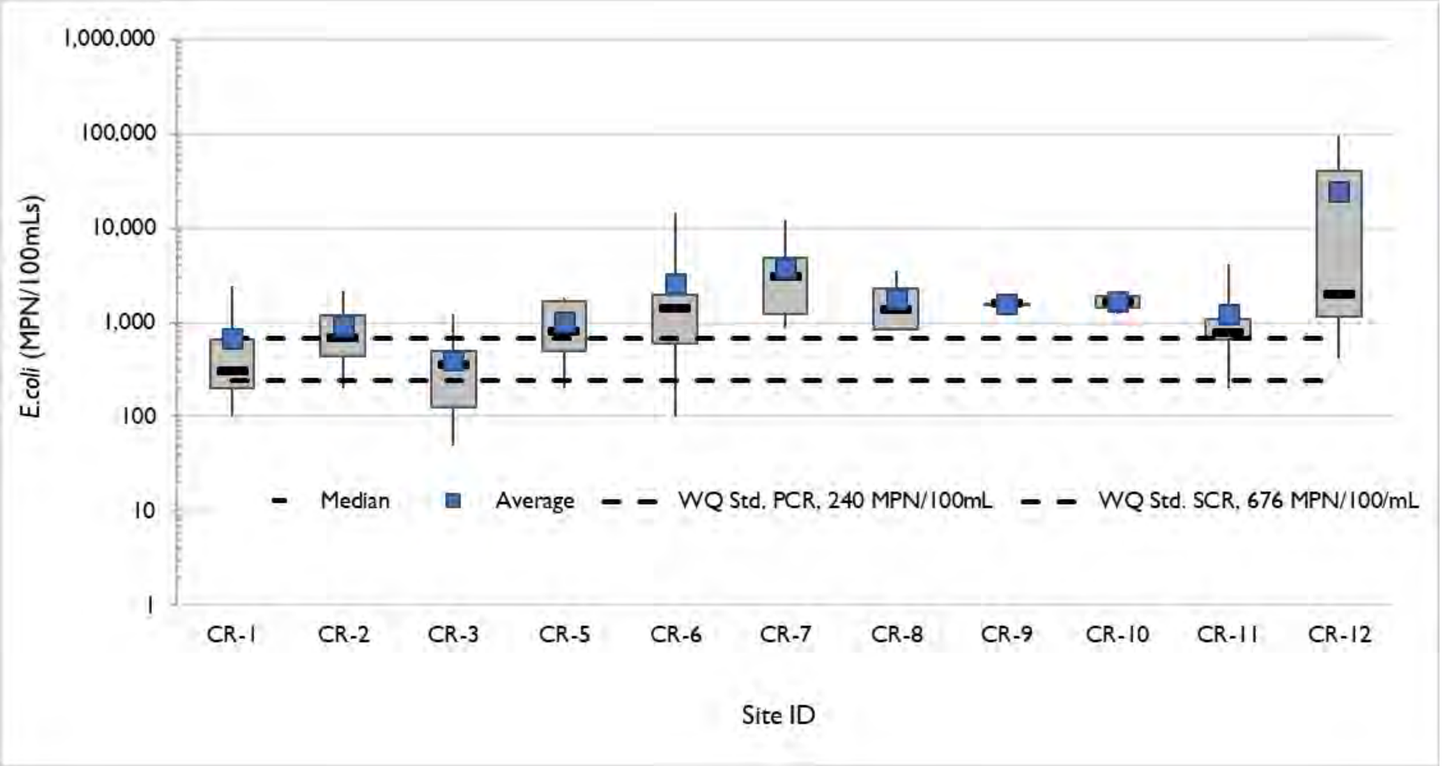
Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 10 of 11





Appendix D
Cane Run Watershed Focused Monitoring
Phase 2 Plots of Statistics per Parameter Page 11 of 11

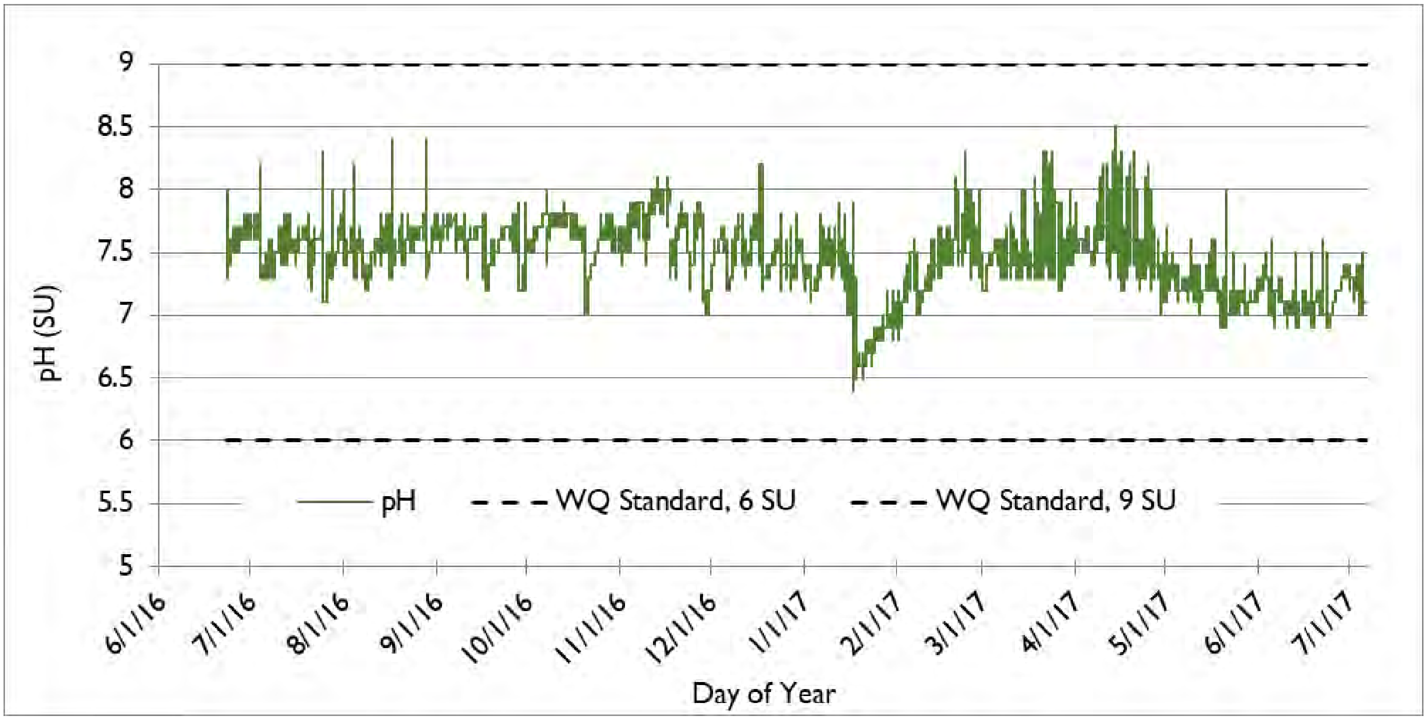


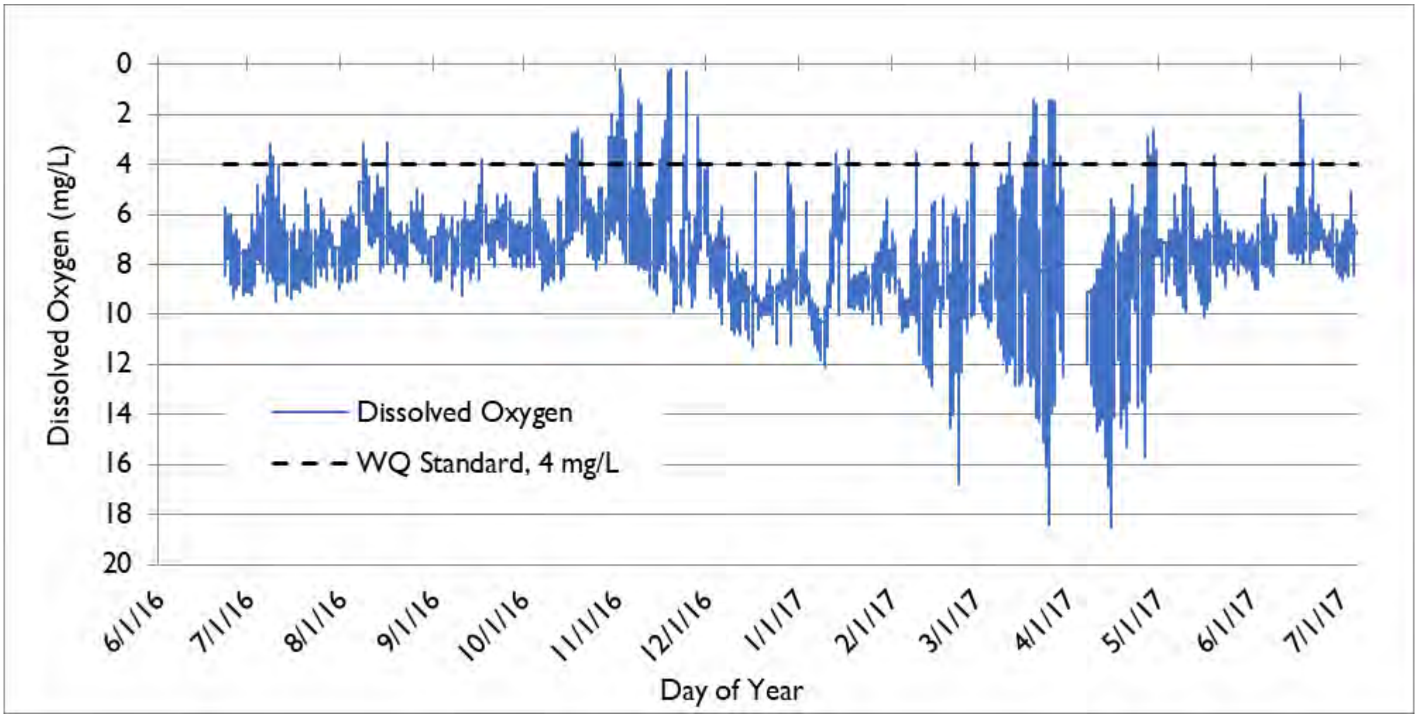


APPENDIX E
USGS DATA PLOTS

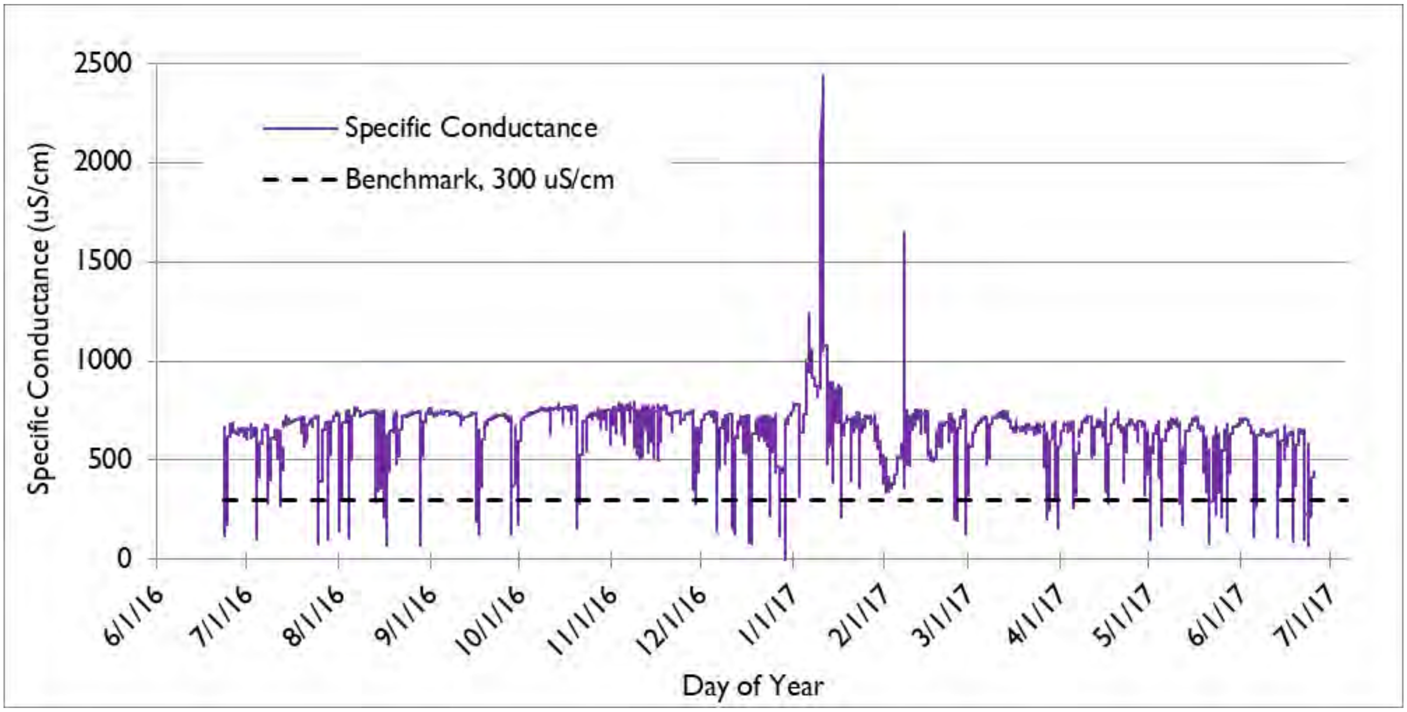
Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC April 10, 2018

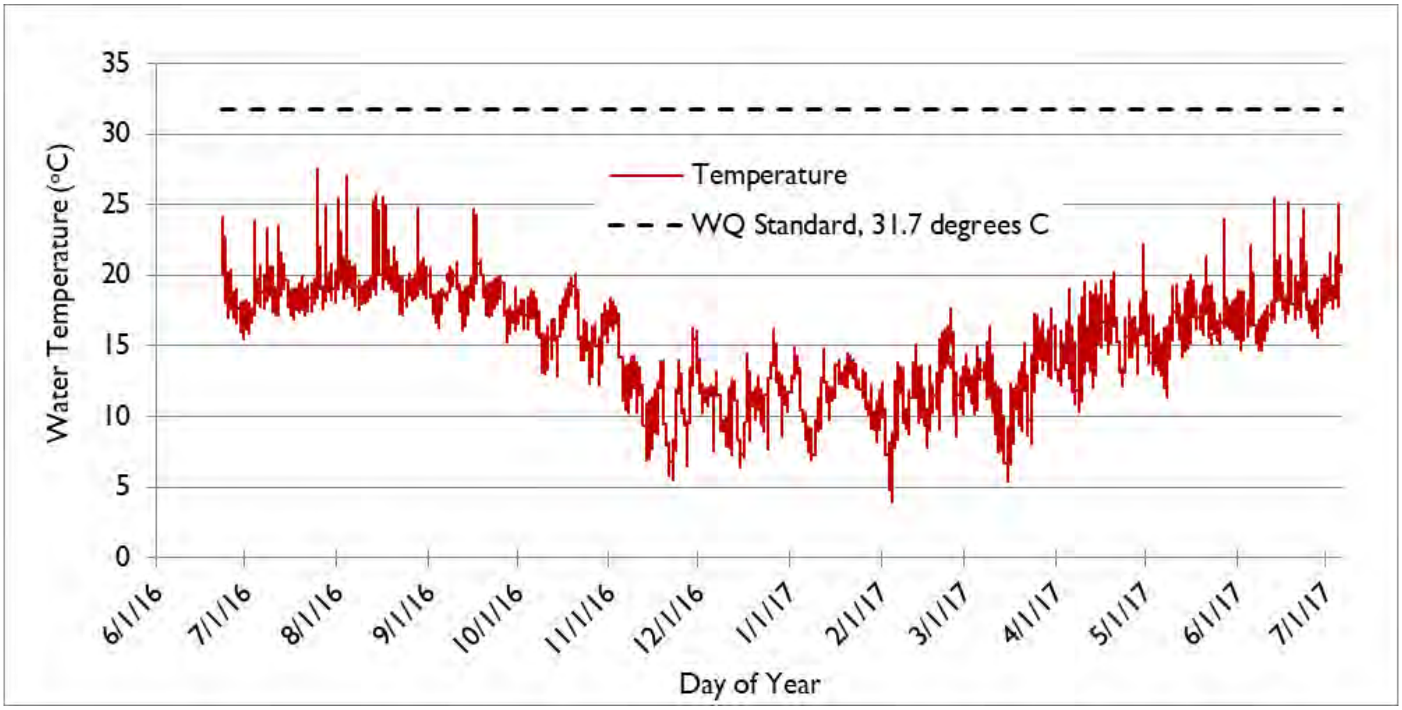
Appendix E
Cane Run Watershed Focused Monitoring
Phase 2 Plots of USGS Data Page 1 of 3



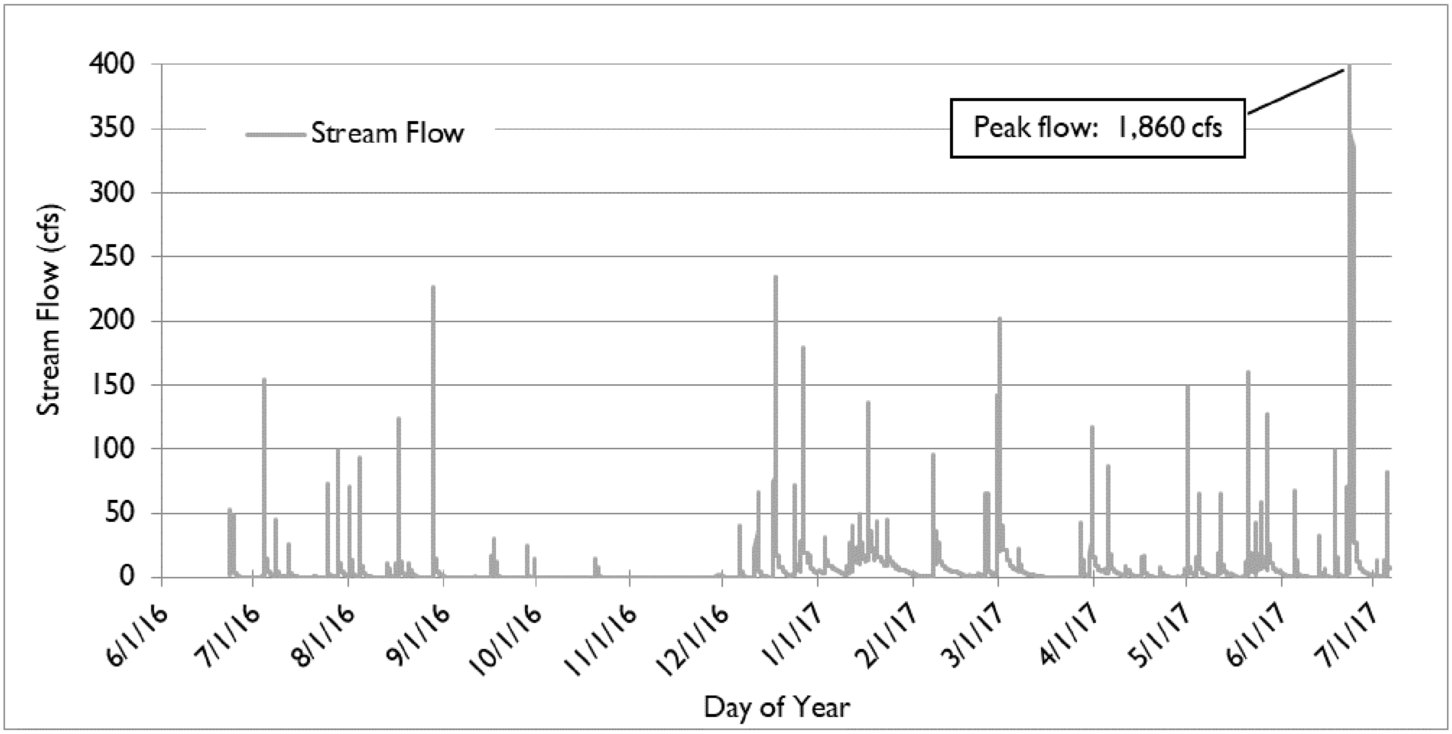


Appendix E
Cane Run Watershed Focused Monitoring
Phase 2 Plots of USGS Data Page 2 of 3





Appendix E
Cane Run Watershed Focused Monitoring
Phase 2 Plots of USGS Data Page 3 of 3



APPENDIX F
PREDICTED MEDIAN FLOWS

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC April 10, 2018

Appendix F

Cane Run Watershed Focused Monitoring

Predicted Median Flows for Loading Calculations

Site ID	Downstream Site	Surface Drainage Area (mi^2)	Dry Weather (Karst-Adjusted) Drainage Area (mi^2)	Predicted Median Flow (cfs)
15506	CR6	0.16	0.16	0.14
15008	CR5	0.18	0.18	0.16
15013	CR7	0.08	0.08	0.08
15519	CR8	0.01	0.01	0.01
15503	CR9	0.12	0.12	0.11
15003	CR3	0.16	0.16	0.15
15018	-	0.10	0.10	0.09
15523	-	0.24	0.24	0.23
15524	-	0.09	0.09	0.08
15040	-	0.11	0.11	0.10
15023	CR10	0.04	0.04	0.04
15016	CR10	0.04	0.04	0.04
15015	CR11	0.12	0.12	0.11
15019	CR11	0.07	0.07	0.06
15021	CR11	0.11	0.11	0.10
15027	CR12	1.03	1.03	0.95
CR8_502HW	-	-	-	0.02[1]
CR-1	-	7.58	1.50	1.39
CR-2	CR1	6.08	0.54	0.50
CR-3	CR1	1.30	1.30	1.20
CR-5	CR2	5.54	1.50	1.60 [2]
CR-6	CR5	0.16	0.16	0.15
CR-7	CR5	4.56	0.39	0.36
CR-8	CR7	4.09	0.31	0.29
CR-9	CR8	0.35	0.35	0.32
CR-10	CR8	1.67	1.67	1.55
CR-11	CR8	1.75	1.75	1.62
CR-12	CR11	1.15	1.15	1.07

[1] Median flow for this station estimated as average flow measured during monitoring events.

[2] Median flow for this station estimated as long-term median flow from USGS gage 3288180 (at this location, Citation Blvd); flow at remaining stations was computed by scaling the long-term median annual flow from USGS gage 3288190 (at Newtown Pike) for each sampling site's dry weather drainage area.

APPENDIX G
LOADS AND REQUIRED LOAD REDUCTIONS

Appendix G

Cane Run Watershed-Focused Monitoring

Loads and Load Reductions to Reach Benchmark Loads Page 1 of 2

									Benchmark Concentration Value:	0.5 mg/L	2 mg/L	0.5 mg/L	240 MPN/100mLs	676 MPN/100mLs
	Predicted	Average Concentration				Existing Annual Load				Annual Benchmark Load				
Site ID	Median Flow (cfs)	NH_3 - N (mg/L)	NO_3 - N (mg/L)	TP (mg/L)	*E. coli* (MPN/100mLs)	NH_3 - N (lbs/year)	NO_3 - N (lbs/year)	TP (lbs/year)	*E. coli* (trillion/year)	NH_3 - N (lbs/year)	NO_3 - N (lbs/year)	TP (lbs/year)	*E. coli* PCR (trillion/year)	*E. coli* SCR (trillion/year)
CR8_502	0.019	0.02	2.12	0.24	174	0.7	77	9	0.0	18.2	72.8	18.2	0.0	0.1
15018	0.09	0.02	1.95	0.26	4,000	4.0	352	46	3.3	90.1	360.4	90.1	0.2	0.6
15523	0.23	0.02	2.13	0.28	5,768	7.5	942	124	11.6	221.4	885.8	221.4	0.5	1.4
15524	0.08	0.13	2.12	0.23	1,524	20.6	345	38	1.1	81.5	326.1	81.5	0.2	0.5
15040	0.10	0.09	3.09	0.36	5,920	18.0	637	75	5.5	103.2	413.0	103.2	0.2	0.6
CR-1	1.39	0.03	1.62	0.36	682	77.3	4431	978	8.4	1,363.6	5,454.6	1,363.6	3.0	8.3
CR-2	0.50	0.02	2.77	0.37	926	14.8	2707	359	4.1	489.6	1,958.3	489.6	1.1	3.0
CR-3	1.20	0.02	1.25	0.41	395	54.0	2956	978	4.2	1,184.8	4,739.2	1,184.8	2.6	7.3
15003	0.15	0.41	2.36	0.24	53,760	121.0	694	70	71.8	147.0	588.1	147.0	0.3	0.9
CR-5	1.60	0.02	3.16	0.34	1,009	51.2	9937	1085	14.4	1,573.9	6,295.5	1,573.9	3.4	9.6
15008	0.16	0.21	2.29	0.45	22,388	68.3	738	145	32.8	161.2	645.0	161.2	0.4	1.0
CR-6	0.15	0.02	3.44	0.34	2,608	6.4	990	98	3.4	143.9	575.7	143.9	0.3	0.9
15506	0.14	0.69	3.30	0.53	57,613	196.8	939	150	74.4	142.2	568.7	142.2	0.3	0.9
CR-7	0.36	0.02	1.79	0.32	3,762	15.9	1266	229	12.1	354.7	1,418.7	354.7	0.8	2.2
15013	0.08	0.03	2.33	0.31	9,224	4.9	345	45	6.2	73.9	295.5	73.9	0.2	0.5
CR-8	0.29	0.03	3.08	0.26	1,793	14.9	1747	146	4.6	283.4	1,133.5	283.4	0.6	1.7
15519	0.01	0.05	2.89	0.29	2,381	1.4	78	8	0.3	13.6	54.4	13.6	0.03	0.1
CR-9	0.32	0.01	2.16	0.23	1,596	4.7	1362	146	4.6	315.4	1,261.5	315.4	0.7	1.9
15503	0.11	0.03	2.86	0.28	932	5.9	618	59	0.9	107.9	431.6	107.9	0.2	0.7
CR-10	1.55	0.03	2.69	0.25	1,660	98.9	8189	775	22.9	1,522.2	6,088.6	1,522.2	3.3	9.3
15023	0.04	0.03	2.63	0.33	1,601	2.4	186	24	0.5	35.3	141.2	35.3	0.1	0.2
15016	0.04	0.02	1.35	0.29	1,081	1.5	110	23	0.4	40.6	162.3	40.6	0.1	0.2
CR-11	1.62	0.02	2.11	0.24	1,212	57.7	6719	766	17.6	1,594.8	6,379.4	1,594.8	3.5	9.8
15015	0.11	0.03	1.80	0.16	6,434	6.7	394	34	6.4	109.5	438.1	109.5	0.2	0.7
15019	0.06	0.09	1.66	0.37	25,827	11.9	209	47	14.8	62.9	251.7	62.9	0.1	0.4
15021	0.10	0.10	2.12	0.29	16,818	19.0	415	56	14.9	97.8	391.1	97.8	0.2	0.6
CR-12	1.07	0.29	2.60	0.40	24,308	602.3	5445	830	231.4	1,048.8	4,195.3	1,048.8	2.3	6.4
15027	0.95	0.18	3.12	0.41	10,691	338.1	5849	777	91.1	938.6	3,754.2	938.6	2.0	5.7

Note: Sites are ordered such that outfalls are listed below the stream site that they drain to (considers karst drainage, when applicable)

Appendix G

Cane Run Watershed-Focused Monitoring

Loads and Load Reductions to Reach Benchmark Loads Page 2 of 2

Benchmark Concentration Value:		**0.5 mg/L**	**2 mg/L**	**0.5 mg/L**	**240 MPN/100mLs**	**676 MPN/100mLs**										
		Annual Load Reductions Required to Reach Benchmark Load					**Annual Load Reductions to Reach Benchmark Load as %**					**Incremental Load Reductions to Reach Benchmark Load**				
Site ID	**Predicted Median Flow (cfs)**	**NH_3 - N (lbs/year)**	**NO_3 - N (lbs/year)**	**TP (lbs/year)**	***E. coli* PCR (trillion/year)**	***E. coli* SCR (trillion/year)**	**NH_3 - N (lbs/year)**	**NO_3 - N (lbs/year)**	**TP (lbs/year)**	***E. coli* PCR (trillion/year)**	***E. coli* SCR (trillion/year)**	**NH_3 - N (lbs/year)**	**NO_3 - N (lbs/year)**	**TP (lbs/year)**	***E. coli* PCR (trillion/year)**	***E. coli* SCR (trillion/year)**
CR8_502	0.019	-	4.2	-	-	-	-	5%	-	-	-	-	4.2	-	-	-
15018	0.09	-	-	-	3.1	2.7	-	-	-	94%	83%	-	-	-	3.1	2.7
15523	0.23	-	56.2	-	11.1	10.2	-	6%	-	96%	88%	-	56.2	-	11.1	10.2
15524	0.08	-	19.1	-	1.0	0.6	-	6%	-	84%	56%	-	19.1	-	1.0	0.6
15040	0.10	-	224.3	-	5.3	4.9	-	35%	-	96%	89%	-	224.3	-	5.3	4.9
CR-1	1.39	-	-	-	5.5	0.1	-	-	-	65%	1%	-	-	-	2.4	-
CR-2	0.50	-	749.0	-	3.0	1.1	-	28%	-	74%	27%	-	-	-	3.0	1.1
CR-3	1.20	-	-	-	1.7	-	-	-	-	39%	-	-	-	-	-	-
15003	0.15	-	106.1	-	71.4	70.9	-	15%	-	100%	99%	-	106.1	-	71.4	70.9
CR-5	1.60	-	3,642.0	-	11.0	4.8	-	37%	-	76%	33%	-	3,505.5	-	-	-
15008	0.16	-	92.6	-	32.4	31.8	-	13%	-	99%	97%	-	92.6	-	32.4	31.8
CR-6	0.15	-	413.9	-	3.1	2.5	-	42%	-	91%	74%	-	43.9	-	-	-
15506	0.14	54.6	370.0	8.1	74.1	73.5	28%	39%	5%	100%	99%	54.6	370.0	8.1	5.3	4.2
CR-7	0.36	-	-	-	11.3	9.9	-	-	-	94%	82%	-	-	-	1.3	1.3
15013	0.08	-	49.2	-	6.0	5.7	-	14%	-	97%	93%	-	49.2	-	6.0	5.7
CR-8	0.29	-	613.5	-	4.0	2.9	-	35%	-	87%	62%	-	-	-	-	-
15519	0.01	-	24.1	-	0.3	0.2	-	31%	-	90%	72%	-	24.1	-	0.3	0.2
CR-9	0.32	-	100.9	-	3.9	2.6	-	7%	-	85%	58%	-	-	-	3.2	2.4
15503	0.11	-	186.5	-	0.7	0.3	-	30%	-	74%	28%	-	186.5	-	0.7	0.3
CR-10	1.55	-	2,100.6	-	19.6	13.6	-	26%	-	86%	59%	-	2,055.8	-	18.9	13.2
15023	0.04	-	44.8	-	0.4	0.3	-	24%	-	85%	58%	-	44.8	-	0.4	0.3
15016	0.04	-	-	-	0.3	0.1	-	-	-	78%	38%	-	-	-	0.3	0.1
CR-11	1.62	-	339.4	-	14.1	7.8	-	5%	-	80%	44%	-	-	-	-	-
15015	0.11	-	-	-	6.2	5.7	-	-	-	96%	90%	-	-	-	6.2	5.7
15019	0.06	-	-	-	14.6	14.4	-	-	-	99%	97%	-	-	-	14.6	14.4
15021	0.10	-	23.5	-	14.7	14.3	-	6%	-	99%	96%	-	23.5	-	14.7	14.3
CR-12	1.07	-	1,250.2	-	229.2	225.0	-	23%	-	99%	97%	-	-	-	140.1	139.7
15027	0.95	-	2,094.9	-	89.0	85.3	-	36%	-	98%	94%	-	2,094.9	-	89.0	85.3

Note: (1) Negative load reductions are indicted by " - "; (2) Sites are ordered such that outfalls are listed below the stream site that they drain to (considers karst drainage, when applicable); (3) Incremental loads calculated for stream sites include deductions of outfall loads contributing to those sites (considers karst drainage, where applicable)

APPENDIX M

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

THIRDROCK
TECHNICAL MEMORANDUM

Submitted to:	Jennifer Carey, PE Lexington-Fayette Urban County Government (LFUCG) Division of Water Quality
Copied to:	Richard Walker, PE Tetra Tech, Inc.
Prepared by:	Jennifer Shelby, PE Cory Bloyd
Subject:	Cane Run Watershed-Focused Monitoring Discharge Prevention / Source Investigation
Submitted on:	April 13, 2018

BACKGROUND

LFUCG's Phase I MS4 Permit (KPDES No. KYS00002 AI No. 74551) was issued on May 1, 2015, with a five-year duration period effective June 1, 2015. One of the requirements of the permit is that "LFUCG shall begin to change its monitoring program to a watershed-focused monitoring program. In order to facilitate this process, monitoring should be conducted on a watershed basis with additional monitoring stations sampled for water chemistry, macroinvertebrates, microbial source tracking, hydrogeomorphic characterization, and habitat assessment."

The study area for LFUCG's Watershed-Focused Monitoring Program (WFMP) encompasses the seven major watersheds that drain LFUCG's Urban Service Area including Cane Run, South Elkhorn, West Hickman, East Hickman, Town Branch, North Elkhorn, and Wolf Run. Monitoring began in 2016 with the Cane Run Watershed, with monitoring to begin in in South Elkhorn in 2017, West Hickman in 2018, and so on until each watershed is monitored and the results reported to the Kentucky Division of Water (KDOW).

The overall objective of the WFMP is to collect and generate data to identify and remediate sources of recreational and aquatic habitat impairments to streams within the Urban Service Boundary. Key monitoring elements include:

1. Stream Corridor Characterization
2. Stream Biology
3. Water Quality Monitoring
4. Discharge Prevention / Source Investigation
5. Priority Area Upland Visual Assessment

Third Rock Consultants, LLC (Third Rock) was retained as a subconsultant to Tetra Tech, Inc. to provide water quality consulting services in support of LFUCG's MS4 program, including conducting key monitoring elements required by LFUCG's WFMP. Results will be used to compute and assess pollutant loading and ultimately summarized in a comprehensive, Watershed-Focused Monitoring Program Report for each of the seven watersheds.

To that end, Third Rock conducted a discharge prevention investigation of the Cane Run Watershed to inform LFUCG Compliance and Monitoring section staff and aid in the tracing and identification of unknown sources of pollution contributing to water quality measurements above established action limits. The investigation involved the compilation and review of LFUCG Division of Water Quality (DWQ) Illicit Discharge Detection and Elimination (IDDE) investigation data, an optical brightener survey (to investigate locations of elevated *E. coli* and ammonia concentrations not clearly attributable to any specific source), and microbial source tracking (used to trace sources of fecal contamination at sites with consistently high *E. coli* and ammonia concentrations).

This Technical Memorandum documents the methodology and results of the discharge prevention investigation.

METHODOLOGY

IDDE Investigation Data Compilation and Review

When Cane Run WFMP water quality monitoring results indicated an exceedance of action limits, LFUCG DWQ Environmental Inspectors were notified and investigated the source of the discharge. The Inspectors began at the monitoring site with the actionable result(s) to confirm the previously measured result(s) and then traced high results through the stream and stormwater network in accordance with LFUCG's IDDE-01: *Illicit Discharge Detection and Elimination Protocol*. Various methods were employed working bridge-to-bridge or manhole-to-manhole to identify and isolate sources. In some cases, dye testing was also utilized to aid in the identification of potential discharges. Ultimately, best professional judgement was used by LFUCG's Environmental Inspectors to determine if additional tracing efforts were justified or if the source was adequately identified and / or verified to not be present.

LFUCG IDDE investigation data for Cane Run was compiled, reviewed and summarized by Third Rock and is included in **Table 1**, page 3.

Table 1. Cane Run IDDE Investigation Data

Table 1. Cane Run IDDE Investigation Results Summary

Site ID	IDDE Investigation	WFM E. coli Hits (MPN/100mLs)	IDDE E. coli Hits (MPN/100mLs)	Comments
CR 1	Closed	2,433	N/A	1 of 10 WFM samples above E. coli action limit; not an IDDE issue
CR 3	Closed	1,211	N/A	1 of 10 WFM samples above E. coli action limit; not an IDDE issue
CR 6	Closed	N/A	N/A	See 15506
CR 8	Closed	3,592; 1,869	N/A	2 of 10 WFM samples above E. coli action limit; not an IDDE issue
CR 9	Closed	1,596	N/A	1 of 10 WFM samples above E. coli action limit; not an IDDE issue
CR 10	Closed	1,211; 2,109	N/A	2 of 10 WFM samples above E. coli action limit; predominately dry; thought to be attributed to animal sources; not an IDDE issue
CR 11	Closed	N/A	N/A	Conductivity hit attributed to Lexmark OT #002; See 15019 and 15021
15003	Closed	2,882; 1,696; 241,960; 46,111; 241,960	61,314; 68,667; 241,960; 2,820	E.coli attributed to manhole surcharge
15005	Closed	N/A	4,434; 2,182; 3,225; 2,433; 3,498; 1,596; 2,621; 1,596; 9,590; 1,089	Numerous E.coli results above action limits; attributed to birds in flume
15013	Closed	2,109; 9,331; 77,010	3,089; 1,596; 27,230; 10,460	Isolated E.coli hits during wet event, lower in dry; raccoons observed in storm system; high E. coli attributed to raccoons and excessive sediment in system
15015	Closed	9,322; 3,545	11,446; 43,517	2 of 10 WFM samples above E. coli action limit (rain within 3 days of each event); follow up sampling produced E.coli hits above action limit; checked 3 additional times and no flow; not an IDDE issue due to no apparent dry weather discharge.
15016	Closed	1,596; 4,195; 2,917	N/A	2 of 10 WFM samples above E. coli action limit; slightly elevated conductivity reported (1,000 µms/cm range) over multiple sampling events; thought to be groundwater or cooling tower drain; not an IDDE issue.
15023	Closed	1,223; 3,498; 2,776	5,448	Isolated E. coli hits with numerous follow ups with low result or no flow; no dry weather flow; not an IDDE issue.
15526	Closed	N/A	N/A	Chlorine hit (2.49 mg/L) confirmed to be KY American water leak; not an IDDE issue
15522	Closed	N/A	N/A	Initial hit on chlorine; rechecked at 0.0; not an IDDE issue
CR 5	Open	N/A	N/A	See 15506
CR 12	Open	N/A	N/A	See 15027
15008	Closed	15,756; 7,976; 34,480; 64,882; 32,554	N/A	5 of 10 WFM samples above E. coli action limit; MST hit; dye testing results indicate no LFUCG sanitary influence; follow up effort below action limit; suspected stagnant water sampled during previous WFM events; not an IDDE issue.
15018	Open	1,890; 1,869; 1,749; 1,464; 5,833; 2,917; 11,874; 2,621; 8,803	2,462; 2,882; 1,869	9 of 10 WFM samples above E. coli action limit; dye testing results indicate no LFUCG sanitary influence.
15524	Closed	1,849; 11,446	N/A	Investigation initiated on 1-18-17 with subsequent results below action limit; not an IDDE issue.
15027	Open	57,943; 20,142; 2,378; 3,839; 7,328; 3,310; 3,786; 6,631; 1,449	30,759; 8,162; 9,867; 36,540; 4,020	9 of 10 WFM samples above E. coli action limit; MST and Optical Brightener hit; dye tracing positive hits at 733 N upper, CR3_192MH, CRS_197MH, CR3_198MH; investigation still underway
15040	Open	15,756; 12,740; 1,199; 1,100; 3,498; 12,457	2,182; 2,917; 11,619; 11,874; 3,786; 2,133; 2,255	6 of 10 WFM samples above E. coli action limit; additional IDDE hits; MST and Optical Brightener hit; known septic tank influence.
15506	Open	173,289; 10,193; 9,881; 5,284; 1,869; 3,145; 15,286; 241,960	98,039; 48,844; 5,686; 13,735; 141,361; 1,449	8 of 10 WFM samples above E. coli action limit; IDDE hits; dye testing confirmed sewage leak; MST and Optical Brightener hit; investigation ceased, awaiting repairs.
15523	Open	1,078; 1,849; 3,184; 46,111; 2,621	1,199; 1,100	5 of 10 WFM samples above E. coli action limit; dye testing results indicate no LFUCG sanitary influence.
CR 7	Open	5,208; 3,592; 1,336; 3,319; 2,882; 1,211; 6,127; 9,599; 12,229	4,798; 1,323; 2,917; 4,479; 2,433	Consistently high E.coli; MST hit; still tracing upstream.
15019	TBD	27,551; 23,822; 38,732; 6,437; 8,823; 9,108; 129,965; 12,112	19,890; 4,725; 77,010	8 of 10 WFM samples above E. coli action limit; thought to be partially attributed to animal sources; MST hit.
15021	TBD	5,730; 2,655; 13,540; 6,198; 16,743; 120,333; 1,749	2,255	7 of 10 WFM samples above E. coli action limit; thought to be attributed to animal sources; MST hit.

Shading indicates an elevated concentration of *E. coli*.

Optical Brightener Survey

Optical brighteners are dyes added to many laundry detergents. The brighteners adhere to natural fibers and increase the "brightness" of fabrics. Laundry effluent is predominantly associated with sanitary wastewater, thus the presence of optical brighteners in storm drains can indicate an illicit discharge or suggest that untreated wastewater is entering the stormwater system via exfiltration from the sanitary system. Based on Cane Run WFMP water quality results, 13 locations were sampled as part of the optical brightener survey as illustrated on **Exhibit 1** (**Appendix A**). Each was identified as a potential illicit discharge with *E. coli* results above the 1,000 MPN/mL action limit.

The cotton absorption method was utilized in accordance with *LFUCG Standard Operating Procedure for Optical Brightener* (SOP-ID: DWQ-MON-03). The method involves the deployment of cotton pads into the stormwater system during dry weather for a period of at least three days.

Two types of pads were used, sterile 3" x 3" medical gauze and 2" x 2" unbleached cosmetic pads to ensure no optical brighteners were present within the pad. Each pad type was checked for negative fluorescence before deployment. Pads were placed within plastic mesh bags and anchored in the stormwater system at each of the 13 locations using bricks as shown in **Figure 1.** In an attempt to sample each location twice, pads were deployed during three separate dry weather periods during the following dates: 8/25/2017 to 8/28/2017, 9/8/2017 to 9/11/17, and 9/22/2017 to 9/26/2017 as documented on field data sheets included in **Appendix B**.

Figure 1. Cotton Pad Deployed within the Stormwater System.

Each set of pads was positioned securely and out of direct sunlight where they remained for a period of three days until they were retrieved, rinsed in the field with source water, and transported to Third Rock's office in brown envelopes to protect them from exposure to sunlight. The pads were subsequently placed in a designated dark room where they were left to dry overnight before being viewed and photographed under a UV light. In the presence of UV light, optical brightener dyes fluoresce. The cotton pads from each sampling location were compared against a known positive control and a negative control (clean pad) as shown in **Figure 2**. The positive control was a pad dipped in a solution of one teaspoon laundry detergent to one gallon of water, a typical concentration for household laundry effluent.

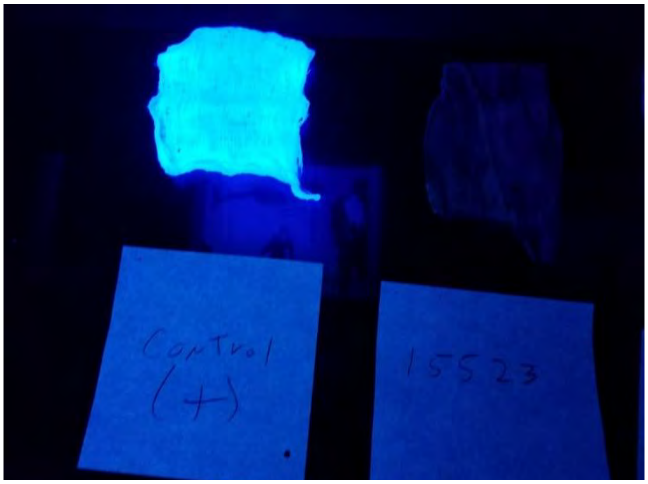


Figure 2. Visual Fluorescence of Control Sample Treated with Optical Brightener Compared to Sample Where Optical Brightener Not Detected.

MST Assessment

MST analysis was used to detect the presence (with quantification) of general, human and bovine DNA biomarkers associated with host-specific *Bacteroides* species. *Bacteroides* are a species of bacteria commonly found in the feces of humans and other animals, with subpopulations of microorganisms that harbor gene sequences associated the fecal material of their animal host; these unique gene sequences are those sampled by the biomarkers. Based upon Cane Run WFMP water quality results, MST samples were collected for analysis from 11 locations with consistently high *E. coli* and ammonia concentrations. The locations where MST samples were collected are illustrated on **Exhibit 2, Appendix C.** Generally, samples from two different dates were analyzed from each location (except for outfall 15013 and CR-7, which only had one sample each). Thus, 19 samples were collected.

Samples selected for MST analysis were first evaluated for *E. coli* to ensure a high value of bacteria present. The samples were filtered and the filters containing the sample DNA were frozen at the Town Branch WWTP Laboratory. Third Rock took possession of the DNA samples and shipped them to the laboratory of Dr. Alice Layton at the University of Tennessee (UT) on August 31, 2017. Dr. Layton analyzed the samples using qPCR for ABac (all *Bacteroides* species), Hubac (human-associated *Bacteroides* species), and BoBac (bovine-associated *Bacteroides* species).

RESULTS

Optical Brighteners

A photo log documenting positive survey results is included in **Appendix D.** Results, as summarized in **Table 2**, suggest wastewater may be present at outfalls 15027, 15040, and 15506. While florescence was observed from pads collected at these locations, the fluorescence was weak and not suggestive of a substantial influence. Both samples collected from outfall 15506, however, had a positive response, indicating that the problem is likely ongoing at this location.

Table 2. Cane Run Optical Brightener Survey Results

Site ID	Date of Retrieval	Fluorescence Result	*E. coli*[1] (MPN/100mL)	Potential Sources
15003	8/28/2017	Negative	53,770	Winburn Neighborhood
15003	9/11/2017	Negative		
15008	8/28/2017	Negative	22,388	Oakwood Estates Neighborhood; Commercial off of Nandino / Whipple Court
15008	9/11/2017	Negative		
15013	8/28/2017	Negative	9,224	Businesses; Imperial Mobile Home Estates
15013	9/11/2017	Negative		
15015	9/11/2017	Negative	6,434	Park Place / Russell Cave Industries
15015	9/26/2017	Negative		
15016	9/11/2017	Negative	1,081	Fayette Housing Authority (300 New Circle)
15016	9/26/2017	Negative		

Table 2. Optical Brightener Survey Results *Cont.*

Site ID	Date of Retrieval	Fluorescence Result	*E. coli*[1] (MPN/100mL)	Potential Sources
15018	9/11/2017	Negative	4,000	Joyland Neighborhood
15018	9/26/2017	Not Retrieved		
15019	9/11/2017	Negative	25,827	Lexmark; Inspectors discovered data to help rule out sanitary leak; Saw evidence of groundhogs / scat around inlets
15019	9/26/2017	Negative		
15021	9/11/2017	Negative	16,818	Lexmark; Inspectors discovered data to help rule out sanitary leak; Saw evidence of groundhogs / scat around inlets
15021	9/26/2017	Negative		
15027	9/11/2017	Positive, Weak	10,691	Downtown / Loudon area; E. Louden west of Idlewild Court; Elm Tree Lane.; Possibly Florida Street area
15027	9/26/2017	Not Retrieved		
15040	9/11/2017	Negative	5,920	Septic systems near Kingston Rd; Some chickens upstream
15040	9/26/2017	Positive, Weak		
15506	8/28/2017	Positive, Weak	57,613	Highlands Neighborhood
15506	9/11/2017	Positive, Weak		
15519	8/28/2017	Negative	2,392	Townhome Neighborhood
15519	9/11/2017	Negative		
15523	9/11/2017	Negative	5,768	Joyland Neighborhood
15523	9/26/2017	Negative		

[1] Average from Cane Run WFMP Water Quality Monitoring

Two samples were not retrieved from 9/26/2017 event, likely as a result of animal activity. The cotton pads were missing from the mesh bags at two locations (15018, 15027) with animal influence evident (torn bag, bricks relocated, animal scat). Though not confirmed, it is believed that racoons were attracted to the cotton pads and subsequently disturbed the monitoring devices. Therefore, results associated with 15018 and 15027 for the 9/26/2017 event were not generated.

In summary:

- Surveying for optical brighteners during dry weather may be a simple and inexpensive way to determine if wastewater is being discharged into the stormwater network without being physically present during the "event."
- Pads need to be deployed during a period of no rainfall; if rainfall/runoff occurs once the pad is deployed, the sample will likely wash away and if not will be considered "contaminated.
- "Weak" positives observed indicate that the technique may only pick up the most contaminated discharges.

- Average *E. coli* levels at sites where a positive result was observed range from nearly 6,000 to over 57,000 MPN/100mL.

- This technique is likely best suited as a simple indicator of the presence or absence of intermittent wastewater flow or to detect the most concentrated flows.

Microbial Source Tracking

The absolute copy numbers of each marker were compared across sites to determine the sites with the most human or bovine contamination. As expected for this generally developed watershed, copies of BoBac markers were much lower than copies of HuBac markers for each event. As such, samples were ranked from high to low based on the abundance of HuBac copies.

Results generated from the qPCR analysis suggest that the highest of human fecal contamination was most likely present at sites 15506, 15008, 15040, 15027, CR-7, 15019 and 15021, compared to the remaining four sites. The HuBac copies detected at 15506 on 7/25/17 were especially high – over 7 times greater than the next largest HuBac value. This is suggestive that a relatively large and fresh input of human waste was captured by that sample. For reference, sites 15027, 15506 and 15040 also had positive detections of optical brighteners.

Results for each marker are and summarized in **Table 3**, page 8 (also presented in rank of HuBac copies) and plotted in **Figure 3**, page 9.

Table 3. Cane Run MST Results

		Lab-Reported Values:			Calculated Ratios:			Reference Data:		
Sample ID	Collection Date	ABac Avg. 3 reps copies/40µl DNA	HuBac Avg. 3 reps copies/40µl DNA	BoBac Avg. 3 reps copies/40µl DNA	HuBac/ABac	BoBac/ABac	Remainder	E. coli (MPN/ 100mLs)	Rainfall / Moisture Conditions	Potential Bacteria Sources
15506	7/25/2017	24,572,549	6,912,551	153,850	28.1%	0.6%	71.2%	173,289	dry	Highlands Neighborhood
15008	7/18/2017	1,664,126	924,747	0	55.6%	0.00	44.4%	7,976	dry	Oakwood Estates Neighborhood; Commercial off of Nandino / Whipple Court
15040	6/13/2017	2,119,765	600,085	0	28.3%	0.00	71.7%	15,756	0.21"	Septic systems near Kingston Rd; Some chickens upstream
15506	7/18/2017	917,119	197,509	6,459	21.5%	0.7%	77.8%	10,193	dry	Highlands Neighborhood
15008	6/27/2017	657,130	114,186	38	17.4%	0.0%	82.6%	15,756	dry	Oakwood Estates Neighborhood; Commercial off of Nandino / Whipple Court
15027	7/18/2017	452,608	95,457	2,557	21.1%	0.6%	78.3%	57,943	dry	Downtown / Loudon area; E. Louden west of Idlewild Ct; Elm Tree Ln.; Florida Street area?
CR-7	6/13/2017	369,223	33,596	32	9.1%	0.0%	90.9%	5,208	0.21"	In-stream site; Outfall 15013 drains to this location
15040	8/8/2017	68,562	22,063	0	32.2%	0.00	67.8%	12,740	0.41" on day before	Septic systems near Kingston Rd; Some chickens upstream
15019	6/13/2017	125,935	17,266	890	13.7%	0.7%	85.6%	23,822	0.21"	Lexmark; Inspectors discovered data to help rule out sanitary leak; Saw evidence of groundhogs / scat around inlets
15021	6/13/2017	88,152	7,133	118	8.1%	0.1%	91.8%	13,540	0.21"	Lexmark; Inspectors discovered data to help rule out sanitary leak; Saw evidence of groundhogs/scat around inlets
15027	7/25/2017	8,902	5,224	93	58.7%	1.0%	40.3%	20,142	dry	Downtown / Loudon area; E. Louden west of Idlewild Ct; Elm Tree Ln.; Possibly Florida Street area
15018	8/8/2017	7,606	4,625	130	60.8%	1.7%	37.5%	2,917	0.41" on day before	Joyland Neighborhood
15019	7/18/2017	13,824	3,178	117	23.0%	0.8%	76.2%	27,551	dry	Lexmark; Inspectors discovered data to help rule out sanitary leak; Saw evidence of groundhogs / scat around inlets
15013	6/27/2017	4,954	1,952	264	39.4%	5.3%	55.3%	9,331	dry	Businesses; Imperial Mobile Home Estates
15018	6/13/2017	4,591	781	571	17.0%	12.4%	70.5%	5,833	0.21"	Joyland Neighborhood
15016	6/27/2017	12,338	573	0	4.6%	0.00	95.4%	4,195	dry	Fayette Housing Authority (300 New Circle)
15015	6/27/2017	3,484	536	0	15.4%	0.00	84.6%	3,545	dry	Park Place / Russell Cave Industries
15021	7/18/2017	890	381	0	42.8%	0.00	57.2%	6,198	dry	Lexmark; Inspectors discovered data to help rule out sanitary leak; Saw evidence of groundhogs/scat around inlets
15016	8/8/2017	1,361	250	0	18.3%	0.00	81.7%	2,917	0.41" on day before	Fayette Housing Authority (300 New Circle)

Calculated Statistics:			
Average	1,636,480.0	470,636.4	8,690.6
Median	68,562.3	7,132.7	92.9

Figure 3. Cane Run MST Results, Copies of Each Biomarker Quantified (Sorted by Abundance of HBac Copies Detected)

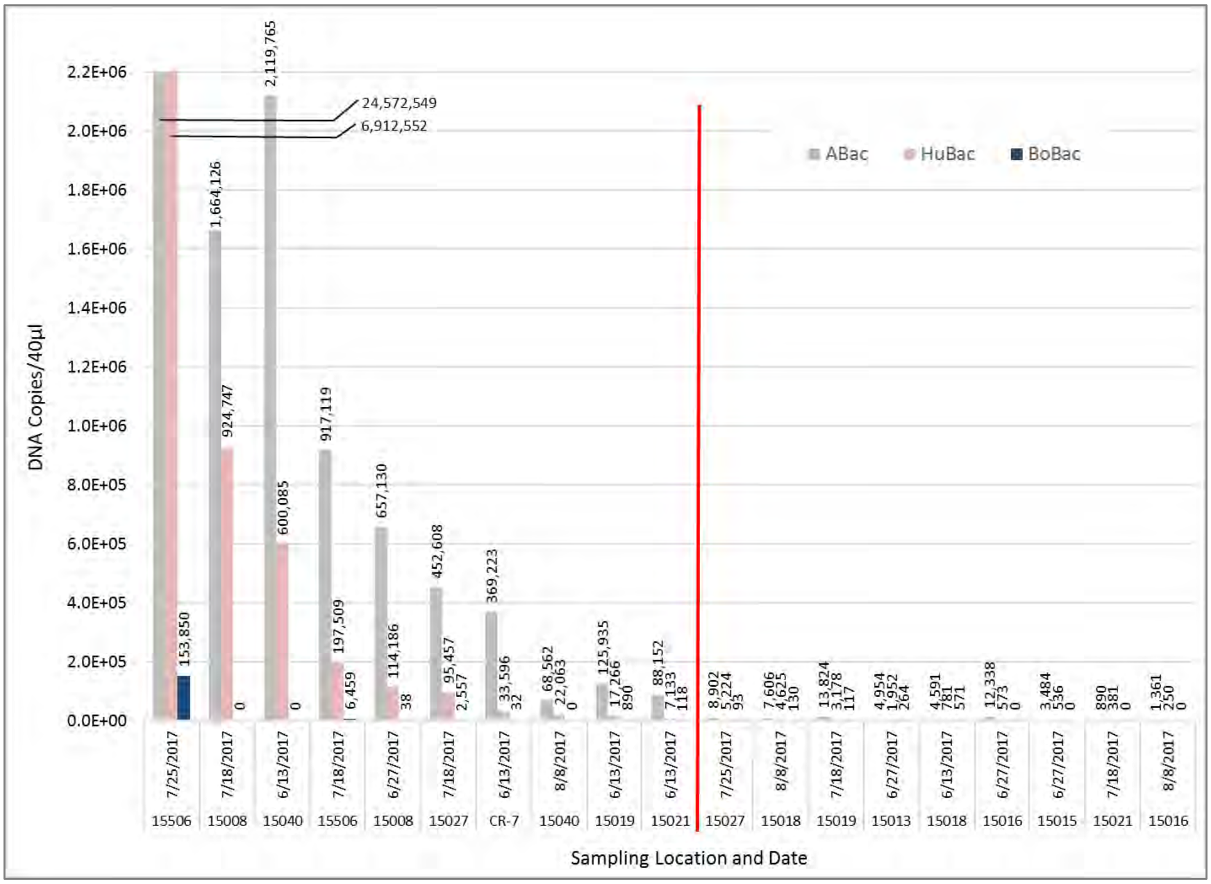
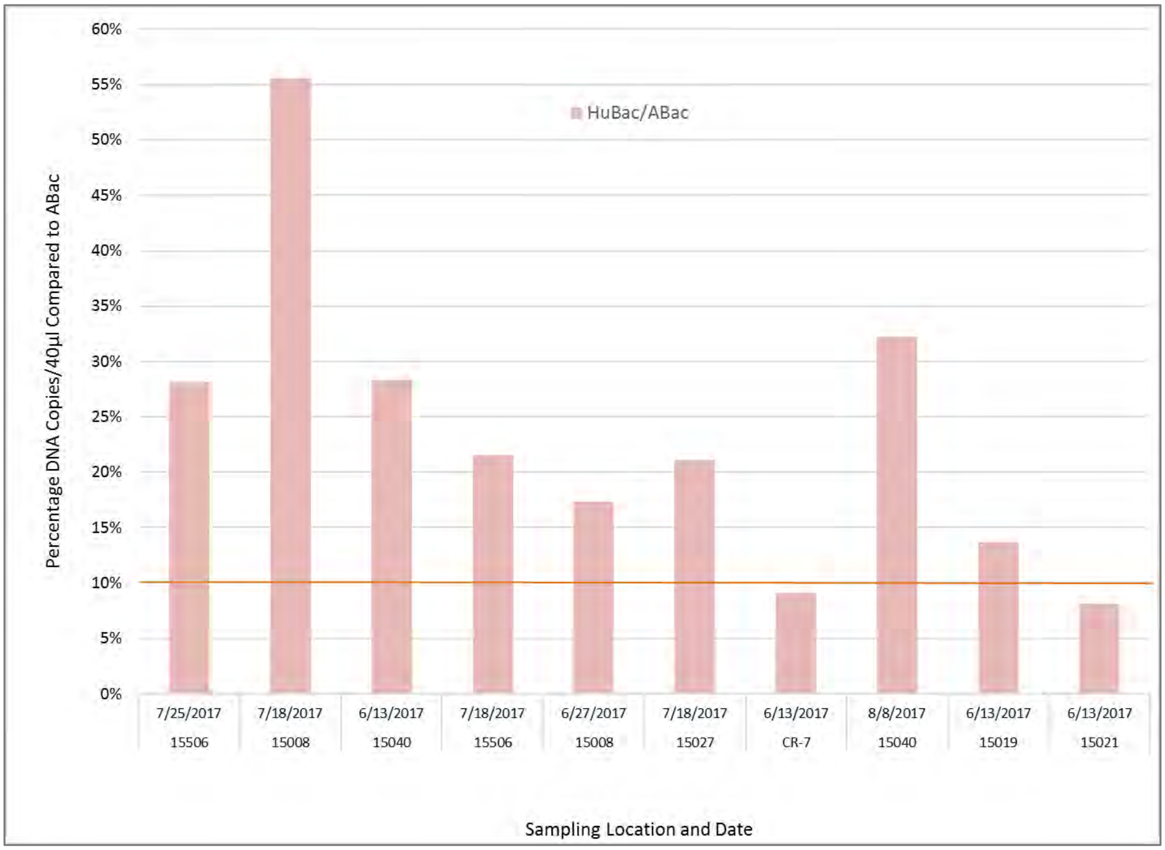


Figure 3 plots the sites with the highest human fecal contamination (15506, 15008, 15040, 15027, CR-7, 15019 and 15021) on the left side of the vertical red line. The red line is a threshold selected to differentiate between sites with a larger human waste problem and sites where the concentration of human waste is likely lower. The sites to the left of the red line are those with HuBac results greater than or equal to the median HuBac copies value. The samples to the right of the red line in **Figure 3** can be considered to have low HuBac levels compared to the other sites for these sampling dates. These low results could be considered a "background" level of contamination for this watershed, though it is only based on a limited number of sampling dates. The levels are low for these samples; however, it is worth noting that the *Bacteriodes* HuBac marker is still being detected at all sites above the laboratory's negative control values.

For sites 15506, 15008, and 15040, both sampling events resulted in HuBac copies above the median value, indicating a higher need for investigating and eliminating sources of human waste at these locations. Site CR-7 is downstream of site 15506, thus it is reasonable that if HuBac was detected at 15506 it would be detected to a lesser degree at CR-7 (in-stream site), with no additional human waste inputs between the two sites (Hubac diluted as flow increases and *Bacteroides* signal decays with time/distance from source). However, the sample at CR-7 was taken on a different day from the two samples at 15506, so this cannot be confirmed with this dataset.

Relative copy numbers between ABac and the two source markers (BoBac and HuBac) is also considered important after the sites with the highest levels of contamination are identified (Layton 2017). A site with greater than10% HuBac relative to ABac is considered likely to have human fecal contamination and a site with less than 1% HuBac relative to ABac is unlikely to have human fecal contamination. **Figure 4** plots the HuBac/ABac ratios for samples with HuBac total copies greater than or equal to the median HuBac copies value.

Figure 4. MST Results, Relative Copies Between ABac and HuBac Marker (Sorted by Abundance of HBac Copies Detected)



These are the samples plotted to the left of the red vertical line in **Figure 3** and are presented in the same order as in **Figure 3**, ranked from greatest HuBac copies to least HuBac copies. Thus, of the ten samples (representing 7 sites) considered to have the most human fecal contamination for the events analyzed, all but two (CR-7 and 15021) also have HuBac/ABac ratios greater than 10%, confirming the likelihood of human fecal contamination. However, while the ratios for sites CR-7 and 15021 may not be above the 10% threshold cited by the UT researchers (Layton 2017), they are approximately 9% and 8%, respectively, which does support the likelihood of human fecal contamination.

Generally, the HuBac marker is associated with fresh human waste and sewage influent and tends to degrade quickly. However, the HuBac marker has been reported to cross-react to some degree with swine and canine waste. There should not be any swine present in these sampling locations, though canines are likely present and could amplify the HuBac marker in this watershed. Nevertheless, even with the potential amplification due to canines, this data is highly suggestive of the presence of human fecal contamination that should be addressed. Priority should be given to sites 15506, 15008, 15040, 15027, CR-7, 15019 and 15021, those with the highest magnitude of contamination.

None of the sites with the highest total copies of ABac (same sites as those with total HuBac copies, plotted in **Figure 3**) had a BoBac/ABac ratio indicative of bovine fecal contamination. The BoBac/ABac ratios for all samples plotted to the left of the red vertical line in **Figure 3** were less than 1%, thus those sites are unlikely to have bovine fecal contamination. This was expected since there are not known cattle within the developed watersheds of these sites.

In summary:

- Using microbial source tracking is a highly technical way to assess whether the source of bacterial contamination is likely human or non-human. The MST testing is rather expensive compared to other analytical testing; however, if the human-associated *Bacteroides* DNA marker is detected, there is a high level of certainty that fresh human waste is contaminating the sample. Performing quantification of the DNA results gives the ability to rank and prioritize sites based on the relative magnitude of each detected marker.

- For this investigation, samples were only analyzed where chronically high *E. coli* and ammonia concentrations were observed. MST can be performed in locations where *E. coli* is not always elevated.

- Sometimes *E. coli* levels correlate with copies of biomarkers, other times it does not. Generally, in this investigation, samples with the highest magnitude of HuBac marker detected also had high *E. coli* concentrations (measured before MST analyses occurred). When the linear relationship between measured sample *E. coli* and HuBac copies was plotted, the values correlated with an R^2 of 0.88. This high correlation between *E. coli* and HuBac for the high priority sites suggests that the fecal contamination was fresh and provides additional evidence that it was from human sources. This is in contrast to the linear relationship between measured sample *E. coli* and HuBac copies for the samples where HuBac copies were below the median Hubac value. Those values only correlated with an R^2 of 0.31, which indicates less fresh bacterial inputs and/or that the bacterial inputs are from more than one environmental source.

- Samples were evaluated for two biomarkers, human and bovine. Though bovine waste was not expected in the developed part of the Cane Run watershed covered by this assessment, it could be present in the more rural portions of the watershed and its use would be more applicable there. When this marker is used in a more applicable setting it is considered more conservative than the HuBac marker – meaning if detected there is less chance of a false-positive interpretation for the BoBac marker, though low cross-amplification of the BoBac marker with deer could occur.

- This technique is likely best suited when enough background information is present such that suspected sources of bacteria are known – this enables the selection of the most relevant biomarkers for analysis.

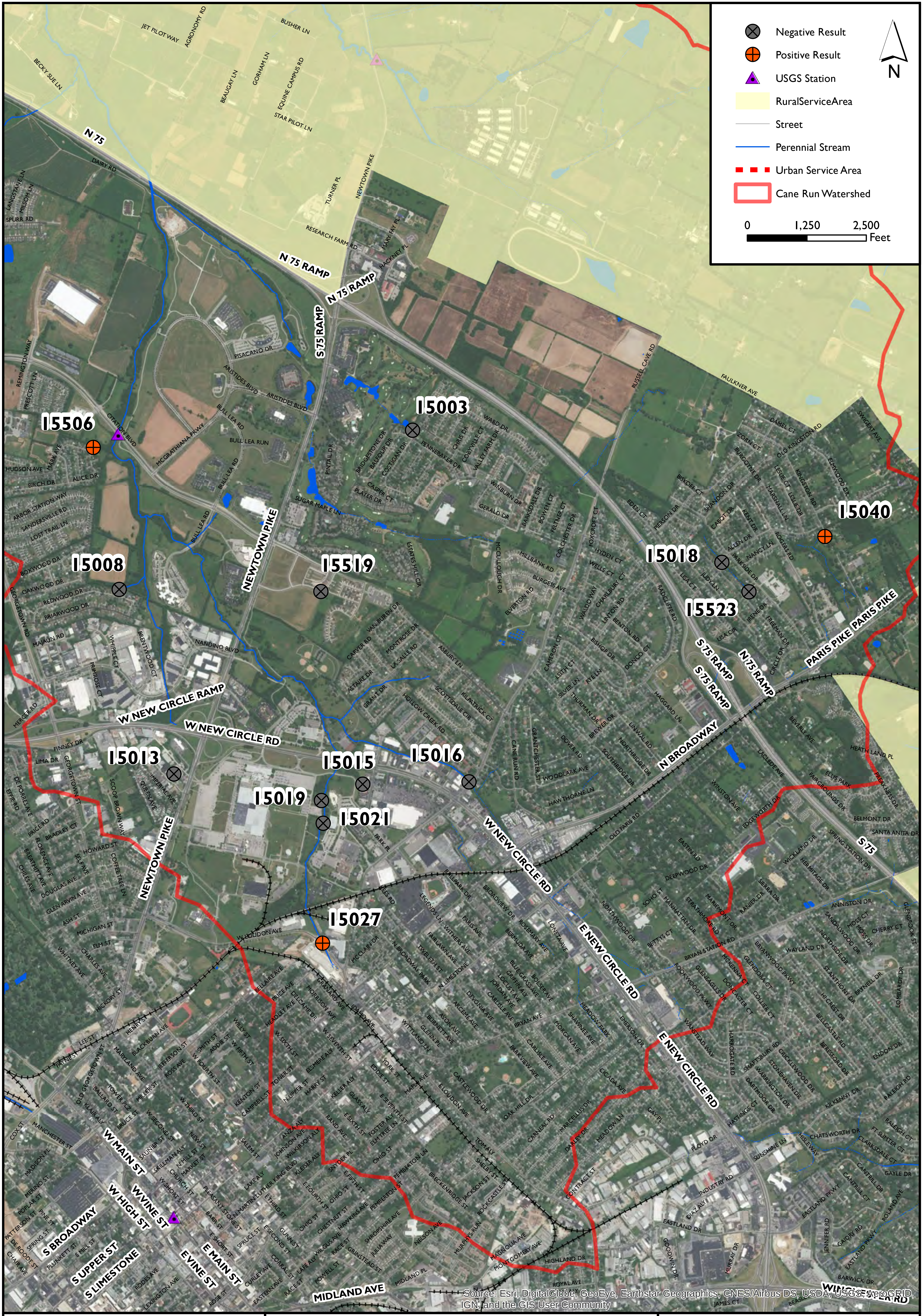
References

Layton, A. and Williams, D.E. 2017. Numerous email conversations related to their MST methods, data analyses, and results interpretation.

APPENDIX A
EXHIBIT 1 - OPTICAL BRIGHTENER SURVEY SAMPLING LOCATIONS

Prepared for Jennifer Carey, Lexington-Fayette Urban County Government
Prepared by Third Rock Consultants, LLC April 13, 2018

Document Path: P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\Mapping\GIS\Watershed_Exhibits\CR Optical Brightener.mxd CB 1-2-18



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 1 - Sampling Locations
Optical Brightener Survey
Cane Run Watershed - Focused Monitoring
Discharge Prevention Investigation

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

APPENDIX B
OPTICAL BRIGHTENER SURVEY FIELD DATA SHEETS

Prepared for Jennifer Carey, Lexington-Fayette Urban County Government
Prepared by Third Rock Consultants, LLC April 13, 2018

Optical Brightener Data Sheet

Field Deployment and Retrieval				
	Deployment		Retrieval	
Date:	8-25-17		8-28-17	
Sampler(s):	C. Blayd, B. Remley			
Rainfall Prior to Deployment:	Date: 8-22-17		Amount (in):	1.36"
Rainfall During Deployment? [✓ Y] N	If Y, Date: 8-28-17		Amount (in):	0.06"
Analysis				
Analyst 1:	C. Blayd			
Analyst 2:	B. Remley			

	Deployment			Retrieval			CB Analysis Results*	BR	
Site ID	Time	Flow (Describe)	Photo #	Time	Flow (Describe)	Days Deployed	Analyst 1	Analyst 2	Final Result
15003	1003	Moderate Flow	15003	1000	Moderate flow	3	-	-	-
15519	1039	dry	15519	1130	dry	3	-	-	-
15506	0930	strong flow	15506	1040	Moderate flow	3	+, weak	+, weak	+, weak
15008	0945	pooled	15008	1056	pooled	3	-	-	-
15013	1028	strong flow	15013	1105	strong flow	3	-	-	-

*Indicate Results as "+ Strong", "+ Weak", "+", "-", or "Inconclusive".

Optical Brightener Data Sheet

Field Deployment and Retrieval		
	Deployment	Retrieval
Date:	9-8-17	9-11-17
Sampler(s):	B. Remley	B. Remley

Rainfall Prior to Deployment: Date: 9-5-17 Amount (in): 0.09"

Rainfall During Deployment? Y [✓ N] If Y, Date: Amount (in):

Analysis	
Analyst 1:	C. Bloyd
Analyst 2:	C. Olson

	Deployment			Retrieval			Analysis Results*		
Site ID	Time	Flow (Describe)	Photo #	Time	Flow (Describe)	Days Deployed	Analyst 1	Analyst 2	Final Result
15015	1227	no flow	15015	1350	no flow	3	-	-	-
15519	1055	no flow	15519	1440	no flow	3	-	-	-
15040	1150	low	15040	1324	no flow	3	-	-	-
15027	1215	moderate	15027	1423	moderate	3	+, weak	+, weak	+, weak
15018	1110	low	15018	1306	low	3	-	-	-
15506	1012	low	15506	1513	pooled	3	+, weak	+, weak	+, weak
15008	1028	low	15008	1502	low	3	-	-	-
15523	1125	moderate	15523	1316	low	3	-	-	-
15016	1207	low	15016	1400	low	3	-	-	-
15003	10:00	low	15003	1247	low	3	-	-	-
15013	1039	low	15013	1450	low	3	-	-	-
15019	1235	low	15019	1408	low	3	-	-	-
15021	1353	moderate	15021	1415	moderate	3	-	-	-

*Indicate Results as "+ Strong", "+ Weak", "+", "-", or "Inconclusive".

Optical Brightener Data Sheet

Field Deployment and Retrieval

	Deployment	Retrieval
Date:	9-22-17	9-26-17
Sampler(s):	C. Bloyd	C. Bloyd

Rainfall Prior to Deployment: Date: 9-20-17 Amount (in): 0.00

Rainfall During Deployment? Y / [✓ N] If Y, Date: Amount (in):

Analysis

Analyst 1: B. Remley

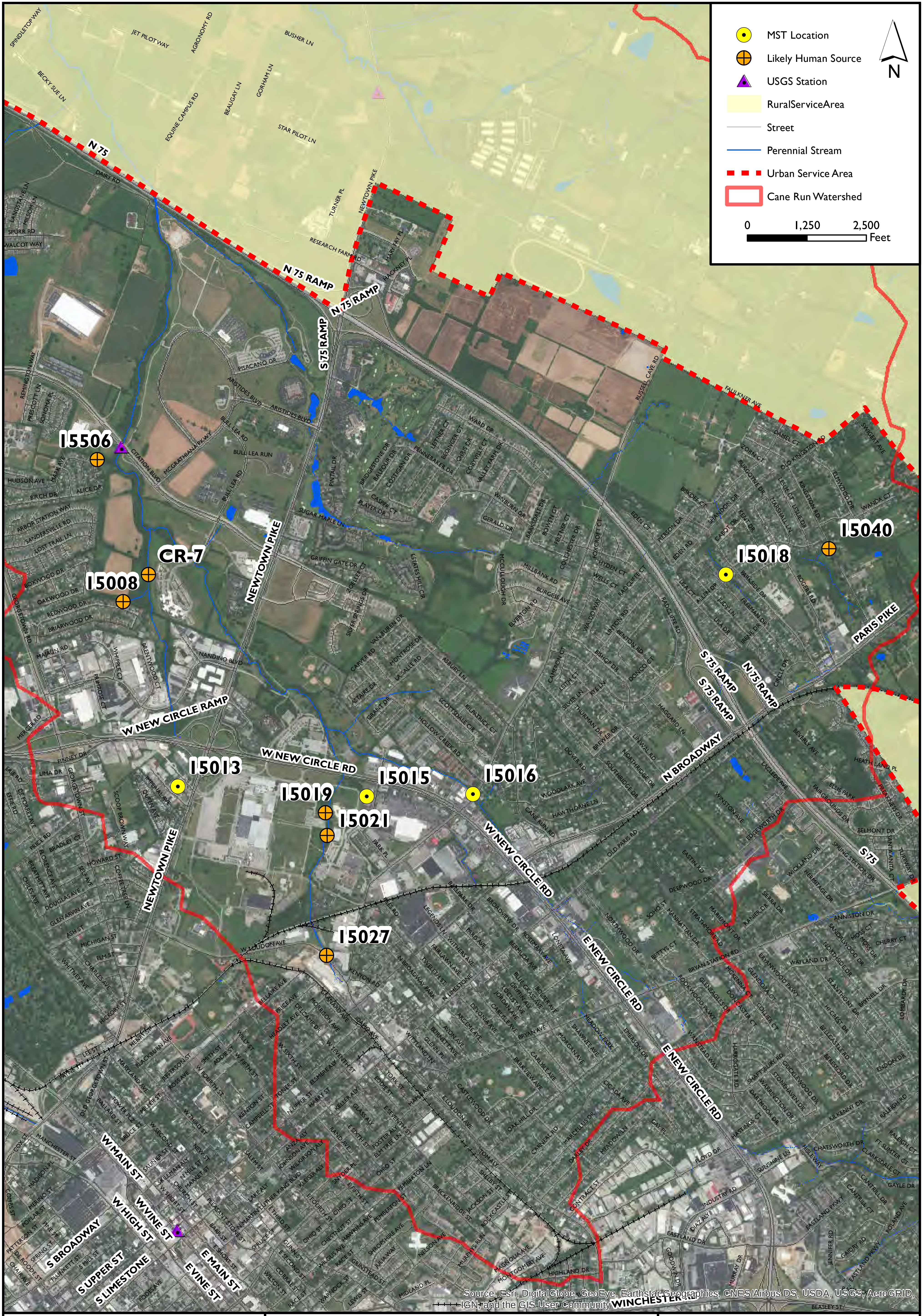
Analyst 2: C. Bloyd

	Deployment			Retrieval			Analysis Results*		
Site ID	Time	Flow (Describe)	Photo #	Time	Flow (Describe)	Days Deployed	Analyst 1	Analyst 2	Final Result
15018	0925	Low	1058	1000	Low Poor Pad recovery	4	NA	NA	NA
15523	0935	Low	1059	1005	Low	4	-	-	-
15040	0945	Trickle	1060	1020	dry	4	+ Weak	+ Weak	+ Weak
15016	0955	moderate	1061	1030	Low	4	-	-	-
15015	1005	dry	1062	1045	dry	4	-	-	-
15019	1015	Low	1063	1050	Trickle	4	-	-	-
15021	1030	Low	1064	1055	Low	4	-	-	-
15027	1040	moderate	1065	1110	-no Pad-recovered Low	4	NA	NA	NA

*Indicate Results as "+ Strong", "+ Weak", "+", "-", or "Inconclusive".

APPENDIX C
EXHIBIT 2
MST SAMPLING LOCATIONS

Document Path: P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\Mapping\GIS\Watershed_Exhibits\CR MST_rev.mxd CB 12-21-17



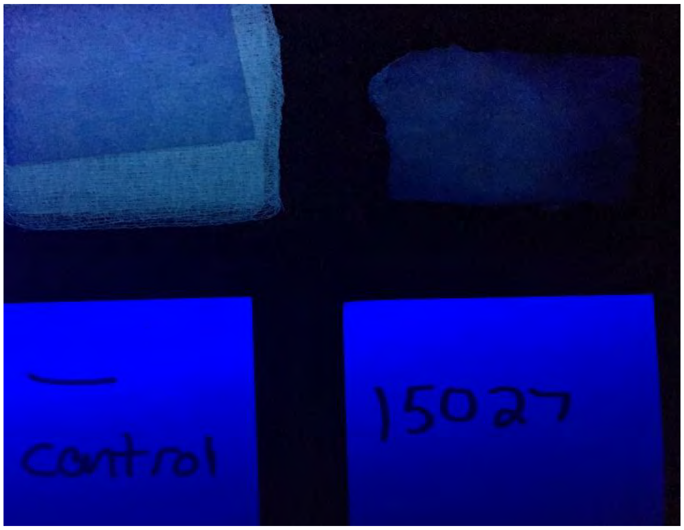
Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 2 - Sampling Locations
Microbial Source Tracking Analysis
Cane Run Watershed - Focused Monitoring
Discharge Prevention Investigation

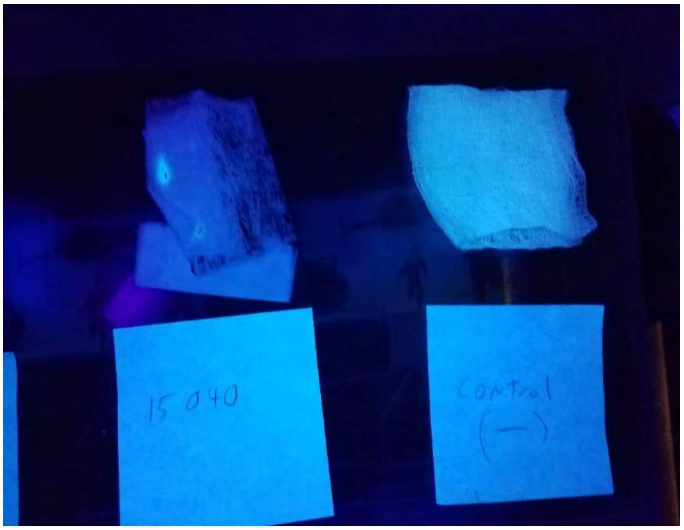
Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

APPENDIX D
OPTICAL BRIGHTENER RESULTS
PHOTOLOG

Prepared for Jennifer Carey, Lexington-Fayette Urban County Government
Prepared by Third Rock Consultants, LLC April 13, 2018

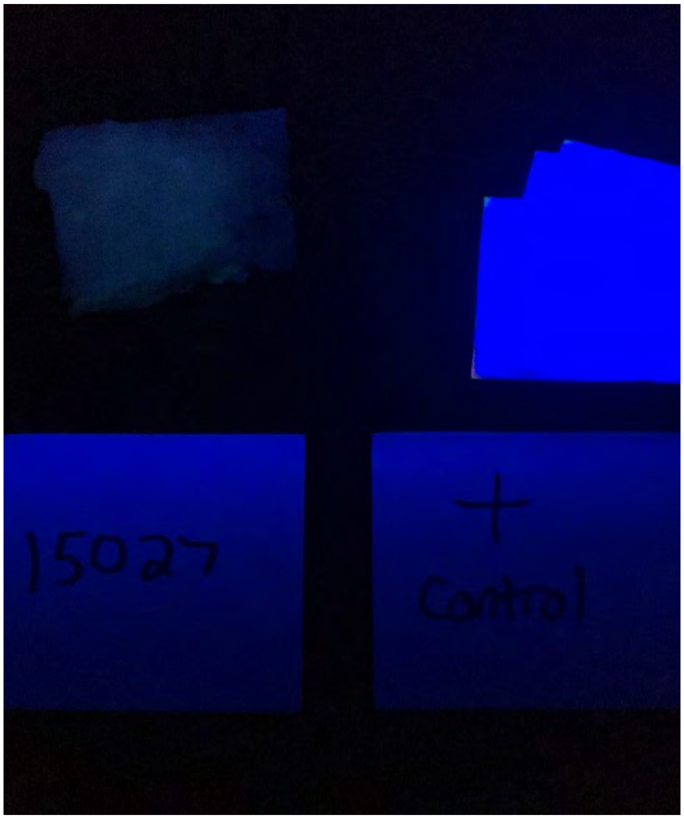


15027 Negative Control 09-11-17.JPG



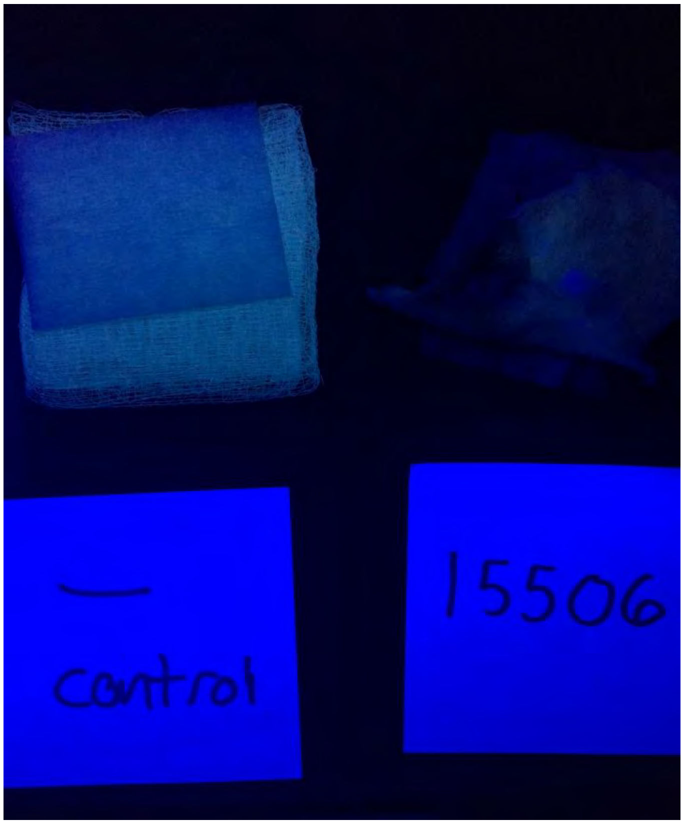
15040 Negative Control 09-26-17.jpg

15040 Positive Control 09-26-17.jpg

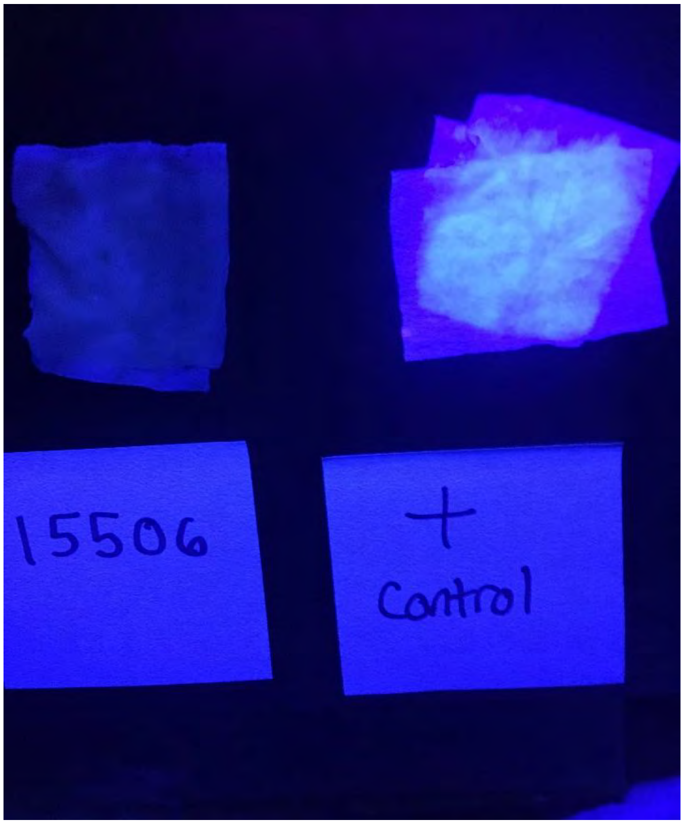


15027 Positive Control 09-11-17.JPG

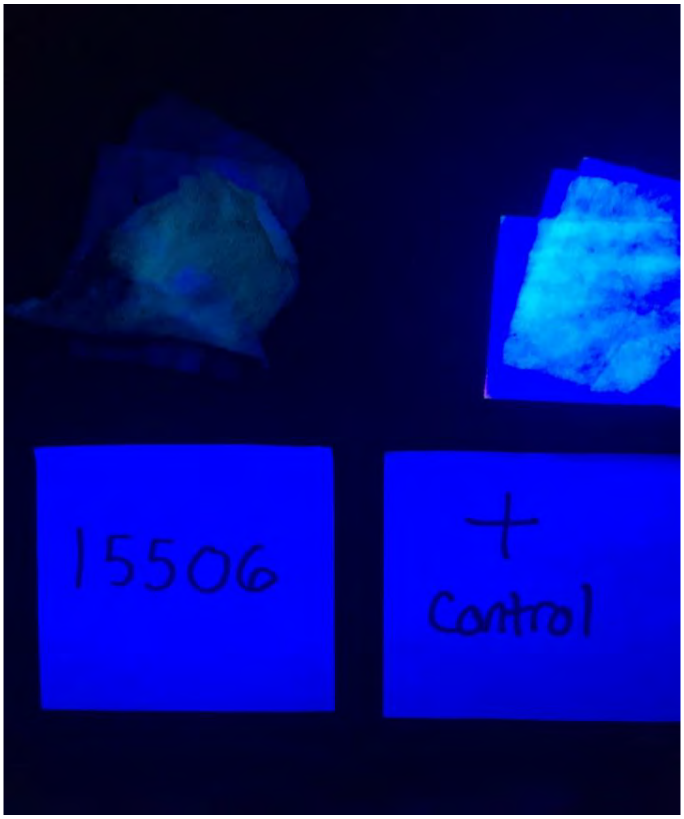
15506 Negative Control 08-28-17.JPG



15506 Negative Control 09-11-17.JPG



15506 Positive Control 08-28-17.JPG



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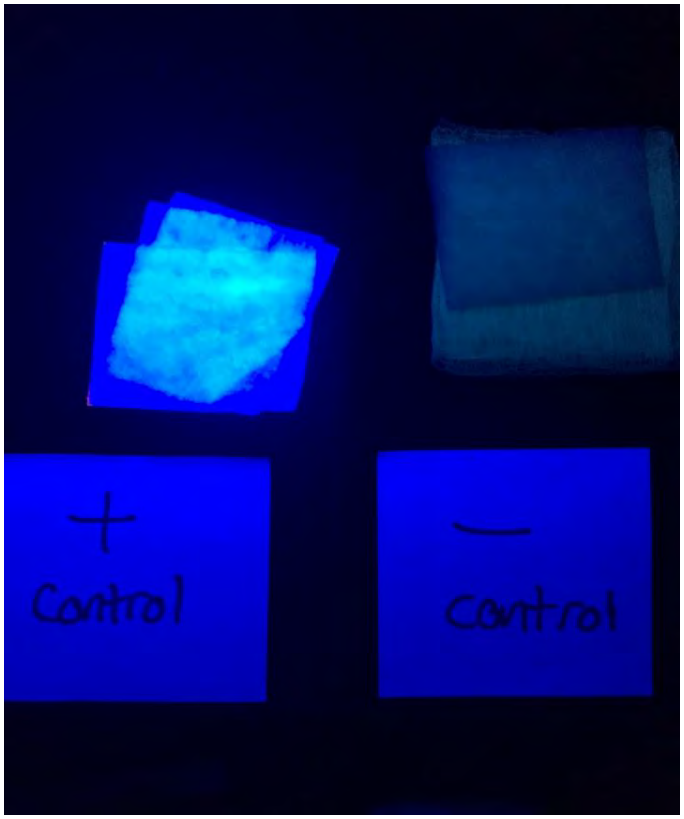


Positive and Negative Control Samples.JPG

APPENDIX N

Prepared by Third Rock Consultants, LLC
Prepared for the Kentucky Division of Water

THIRDROCK
TECHNICAL MEMORANDUM

Submitted to:	Jennifer Carey, PE, MS4 Coordinator Lexington-Fayette Urban County Government (LFUCG) Division of Water Quality
Copied to:	Richard Walker, PE Tetra Tech, Inc.
Prepared by:	Jennifer Shelby, PE William Hall
Subject:	Cane Run Watershed-Focused Monitoring Priority Area Upland Visual Assessment
Submitted on:	February 26, 2018

BACKGROUND

LFUCG's Phase I MS4 Permit (KPDES No. KYS00002 AI No. 74551) was issued on May 1, 2015, with a five-year duration period effective June 1, 2015. One of the requirements of the permit is that "LFUCG shall begin to change its monitoring program to a watershed-focused monitoring program. In order to facilitate this process, monitoring should be conducted on a watershed basis with additional monitoring stations sampled for water chemistry, macroinvertebrates, microbial source tracking, hydrogeomorphic characterization, and habitat assessment."

The study area for LFUCG's Watershed-Focused Monitoring Program (WFMP) encompasses the seven major watersheds that drain LFUCG's Urban Service Area including Cane Run, South Elkhorn, West Hickman, East Hickman, Town Branch, North Elkhorn, and Wolf Run. Monitoring began in 2016 with the Cane Run Watershed, with monitoring to begin in in South Elkhorn in 2017, West Hickman in 2018, and so on until each watershed is monitored and the results reported to the Kentucky Division of Water (KDOW).

The overall objective of the WFMP is to collect and generate data to identify and remediate sources of recreational and aquatic habitat impairments to streams within the Urban Service Area. Key monitoring elements include:

1. Stream Corridor Characterization
2. Stream Biology
3. Water Quality Monitoring
4. Discharge Prevention / Source Investigation
5. Priority Area Upland Visual Assessment

Third Rock Consultants, LLC (Third Rock) was retained as a subconsultant to Tetra Tech, Inc. to provide water quality consulting services in support of LFUCG's MS4 program, including conducting key monitoring elements required by LFUCG's WFMP. Results for each watershed will be used to compute and assess pollutant loadings and ultimately summarized in a comprehensive, Watershed-Focused Monitoring Program Report for each of the seven watersheds.

As detailed in the WFMP Quality Assurance Project Plan (QAPP), a priority area upland visual assessment was conducted to identify potential sources of contaminants previously detected at LFUCG water quality monitoring sites within the watershed. Visual assessment using methods from the Center for Watershed Protection's "*Unified Subwatershed and Site Reconnaissance: A User's Manual*" (2004) was conducted to evaluate potential sources of pollution within neighborhoods and to investigate areas of potential pollutant generators.

This Technical Memorandum documents the results of Third Rock's priority area upland visual assessment of the Cane Run Watershed.

NEIGHBORHOOD SOURCES

Methodology

Five neighborhoods were visually assessed for indicators of nutrients, oil and grease, trash / litter, bacteria, and sediment based upon their locations upstream of LFUCG water quality monitoring sites found to have routinely high pollutant levels as follows:

- Joyland
- Winburn
- North Limestone / Castlewood
- Oakwood
- Highlands

The boundaries of each neighborhood are illustrated on **Exhibit 1**, **Appendix A.** Because neighborhood associations independently define their extents when registering with the LFUCG Division of Planning, the North Limestone and Castlewood neighborhood boundaries overlap. As a result, the two neighborhoods were evaluated as one for purposes of this assessment with distinctions made when appropriate.

Field reconnaissance was conducted during dry weather between August 25, 2017 and September 15, 2017. A driving survey of all neighborhood streets was conducted initially, followed by detailed assessment of three representative properties within each neighborhood (six, total, for the combined North Limestone / Castlewood area). Each representative property was assigned a unique identifier, located with GPS (**Exhibit 2**, **Appendix A**), photographed (**Appendix B**), and assessed based upon the following: neighborhood characterization; yard and lawn condition; driveway, sidewalk, and curb; rooftop; and common area ("Neighborhood Source Assessment" (NSA) forms, **Appendix C**). Subsequent to field reconnaissance, satellite imagery of each representative property was analyzed using ArcView GIS to confirm lot dimensions and calculate percent ground cover.

Following data compilation and analysis, Pollution Severity Index (PSI) and Neighborhood Restoration Opportunity Index (NROI) scores were calculated for each neighborhood. Possible PSI scores range from 0 to 15, with 0 being the least severe and 15 being the most severe. Possible NROI scores range from 0 to 8, with 0 being the least likely to improve neighborhood pollution control and 8 being the most likely to improve neighborhood pollution control.

Results

PSI and NROI results are shown on **Exhibits 3** and **4** (**Appendix A**), respectively, and summarized in **Table 1**, page 4.

POTENTIAL POLLUTANT GENERATORS

Methodology

Sixteen potential pollutant generators, including unpermitted and lower risk commercial and industrial operations, were visually assessed for indicators of sediment, organic material, and litter. Like the neighborhood assessment, sites were selected on the basis of their location upstream of LFUCG water quality monitoring sites found to have routinely high pollutant levels. Each site was assigned a unique identifier, located with GPS (**Exhibit 5**, **Appendix A**), photographed (**Appendix B**), and assessed based upon the following criteria: vehicle operations; outdoor materials; waste management; physical plant; turf and landscaping; and stormwater infrastructure ("Potential Generator Investigation" (PGI) forms, **Appendix C**).

Following data compilation and analysis, Hotspot Status Index (HSI) scores were calculated for each site. Possible HSI scores range from 0 to 28, with 0 indicative of a site that is not a hot spot and 15 or greater indicative of a severe hotspot.

Results

HSI results are shown on **Exhibit 6** (**Appendix A**) and summarized in **Table 2**, page 5.

Table 1. Neighborhood Source Assessment Results

NSA Criteria	**Neighborhood**				
	Joyland	**Winburn**	**North Limestone / Castlewood**	**Oakwood**	**Highlands**
Neighborhood Characterization					
Housing Style	Single Family Detached	Single Family Attached, Single Family Detached, and Multifamily	Single Family Detached and Mobile Home Park	Single Family Detached	Single Family Detached
Acres	300	150	445	30	50
Garage (%)	70	20	60	50	75
Basement (%)	10	20	60	50	50
Index of Infill, Etc. (%)	<5	>10	5 - 10	0	0
Yard and Lawn Conditions					
Average % of Impervious Cover	36.7	41.7	44.2	38.3	40.6
Average % of Grass Cover	58.3	55	52.2	61.7	5.6
Average % of Landscaping	5	0	3.7	0	1.7
Average % of Bare Soil	0	3.3	0	0	1.7
Average % of Forest Canopy	13.3	20	16	9.43	55
Average % of Evidence of Non-Target Irrigation	0	0	0	0	0
Proportion of High Lawn Management (%)	10	5	15	5	0
Proportion of Medium Lawn Management (%)	80	55	55	85	80
Proportion of Low Lawn Management (%)	10	40	30	10	20
Estimated # of Swimming Pools	20	5	5	0	5
Junk/Trash in Yards (%)	5	60	20	0	0
Driveways, Sidewalks, and Curbs					
% of Driveways that Are Impervious	90	90	70	95	95
Driveway Conditions	Breaking Up	Dirty, Breaking Up, and Stained	Clean, Dirty and Breaking Up	Clean, Dirty, Breaking Up, Stained	Clean, Dirty, and Breaking Up
Distance Between Sidewalk and Streets (ft)	4	4	3	5	3
Curb and Gutter Conditions	Sediment, Trash, Litter, and Debris	Lawn Clippings, Trash, Litter, Debris	Lawn Clippings, Trash, and Litter	Lawn Clippings	Long-Term Parking, Lawn Clippings
Pet Waste Present?	No	Yes	Yes	No	No
Rooftops					
Downspouts Connected Directly to Sewer (%)	0	0	0	0	0
Downspouts Directed to Impervious Areas (%)	20	20	40	30	25
Downspouts Discharge to Pervious Areas (%)	80	80	55	70	75
Downspouts Discharge to a Cistern/Rainbarrel (%)	0	0	0	0	0
Common Areas					
Storm Drain Inlets?	Yes	Yes	Yes	Yes	Yes
Storm Drains Stenciled?	No	No	North Limestone No; Castlewood Yes	No	No
Storm Drain Conditions	Dirty	Dirty	Dirty	Dirty	Clean
Open Space Conditions	No Concern	Pet Waste	Pet Waste	No Concern	No Concern
Buffers/Floodplain	Present, No Encroachment	Present, No Encroachment	North Limestone No; Castlewood Yes, No Encroachment	Not Present	Present, No Encroachment
NSA Pollution Severity Index (PSI)	3 (Moderate)	7 (High)	North Limestone 7 (High) Castlewood 3 (Moderate)	2 (Moderate)	1 (Moderate)
Neighborhood Restoration Opportunity Index (NROI)	3 (Low)	4 (Moderate)	North Limestone 4 (Moderate) Castlewood 3 (Low)	3 (Low)	2 (Low)

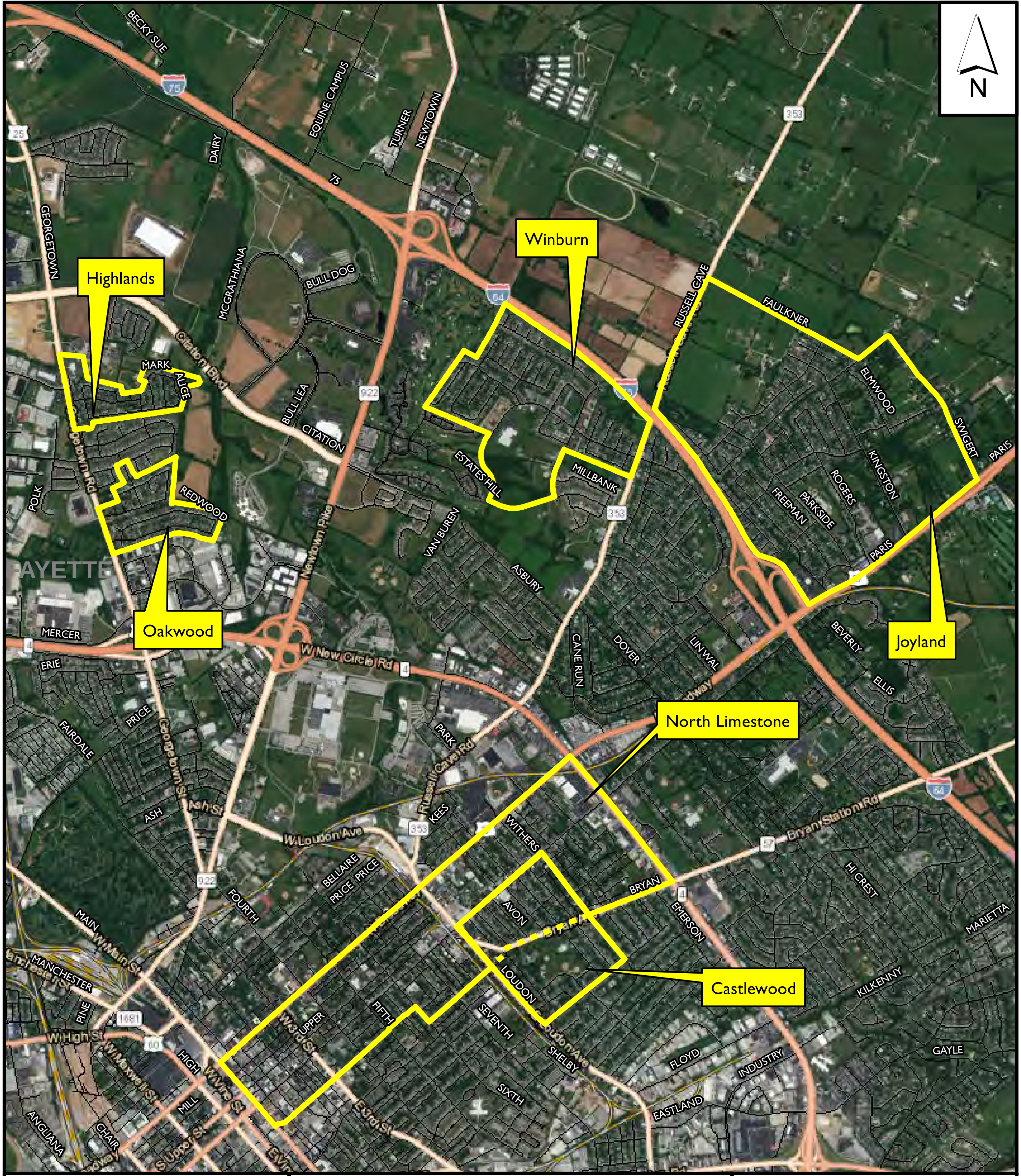
Table 2. Potential Generator Investigation Results

PGI Criteria	Sharps Lawn and Landscape	Affordable Restaurant Equipment Inc.	N&H Auto Sales	Val's Auto Sales and Repair	Kentucky Utilities	Coit	Site One Landscape Supply	Estes Truck Line	National Lease Trucks	Bluegrass Contracting	Duffs / Royal Auto	Ziegler Tire	Legends' Field	Broadway Auto Mall	Star Manufacturing
Site Data and Characteristics															
Date Assessed	9/12/2017	9/12/2017	9/12/2017	9/12/2017	9/12/2017	9/13/2017	9/13/2017	9/13/2017	9/13/2017	9/13/2017	9/14/2017	9/14/2017	9/14/2017	9/14/2017	9/14/2017
Category	Commercial	Commercial	Commercial	Commercial	Industrial	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	Industrial
NPDES Status	Unregulated	Unregulated	Unregulated	Unregulated	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Vehicle Type	Fleet Vehicles		Vehicles For Sale	Sales/Repair	Fleet Vehicles			Fleet Vehicles	Fleet Vehicles		Sales			Sales	
Vehicle Operations															
Approximate Number of Vehicles	10		30	100	50			50	30		50			>100	
Vehicle Activities	Maintained, Washed, Stored		Maintained, Repaired, Washed, Stored	Maintained, Repaired, Washed, Stored	Stored			Maintained, Repaired, Washed, Fueled, Stored	Maintained, Repaired, Washed, Fueled, Stored		Maintained, Repaired, Washed, Stored			Maintained, Repaired, Washed, and Stored	
Stored/Repaired Outside	Yes		No	No	Yes			Cannot Tell	No		Yes			Yes	
Runoff Diversion Methods	No		No	No	Cannot Tell			Cannot Tell	Cannot Tell		No			No	
Spills or Leaks?	Cannot Tell		No	Yes	No			No	No		Yes			No	
Uncovered Outdoor Fueling Areas?	No		No	Yes	Cannot Tell			Yes	Yes		No			No	
Fueling Areas Connected to Storm Drains?	No		No	No	Cannot Tell			No	No		No			No	
Vehicles Washed Outdoors?	Yes		Yes	Cannot Tell	Cannot Tell			Cannot Tell	Cannot Tell		Cannot Tell			Yes	
Washing Area Connected to Storm Drain?	Cannot Tell		Cannot Tell	Cannot Tell	Cannot Tell			Cannot Tell	Cannot Tell		Cannot Tell			Yes	
Outdoor Materials															
Loading/Unloading Operations	Present				Present		Not Present			Present		Present	Present		Present
Materials Stored Outside	Soil, Mulch, Covered Salt				Yes		Rock, Soil, and Mulch			Yes		Yes	Yes		Industrial Parts
Storage Area Connected to Storm Drain?	Cannot Tell				Cannot Tell		Cannot Tell			Cannot Tell		No	Yes		No
Staining or Discoloration Present?	No, Unpaved				Cannot Tell	Yes, Staining in Inlet	Cannot Tell			Cannot Tell		Yes	No		Yes
Covered Storage Area?	No				No		No			No		No	No		No
Secondary Liquid Containment Storage	Cannot Tell				Yes, Oil Drums		No	Yes, Containers for Fuel		No		No	No		No
Labeling Condition	Cannot Tell				Cannot Tell		Labels Present			Labels Present		Cannot Tell	Labels Present		Missing Labels, Poor Conditions
Waste Management															
Type of Waste	Vegetation											Garbage			
Dumpster Condition												Cannot Tell			
Dumpster Near Storm Drain Inlet?	Yes, Lacks Runoff Diversion											Yes, Lacks Runoff Diversion			
Physical Plant															
Building Condition															
Evidence of Discharge from Maintenance															
Parking Lot Condition		Dirty													
Downspout Direction															
Turf / Landscaping															
% Forest Canopy	0														
% Turf	20														
% Landscaping	0														
% Bare Soil	80														
Turf Management Status	High														
Evidence of Non-Target Irrigation	None														
Landscaping Drain to Storm Drain Inlet?	Yes														
Accumulation of Organic Matter?	Yes														
Storm Water Infrastructure															
Storm Water Treatment Present?	No	No													
Private Stormdrains in the Area?	Yes	No													
Index Rating for Gutter Accumulation															
Sediment	4	1	2	2	1										
Organic Material	4	1	2	2	1										
Litter	4	3	2	2	1										
Hot Spot Index (HSI)	8 (Potential Hotspot)	2 (Not a Hotspot)	2 (Not a Hotspot)	4 (Not a Hotspot)	0 (Not a Hotspot)	0 (Not a Hotspot)	1 (Not a Hotspot)	1 (Not a Hotspot)	1 (Not a Hotspot)	3 (Not a Hotspot)	4 (Not a Hotspot)	6 (Potential Hotspot)	5 (Potential Hotspot)	5 (Potential Hotspot)	5 (Potential Hotspot)

APPENDIX A
EXHIBITS 1 - 6

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC February 26, 2018

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\5 Upland\Mapping\Exhibit_1_Neighborhoods.mxd



Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

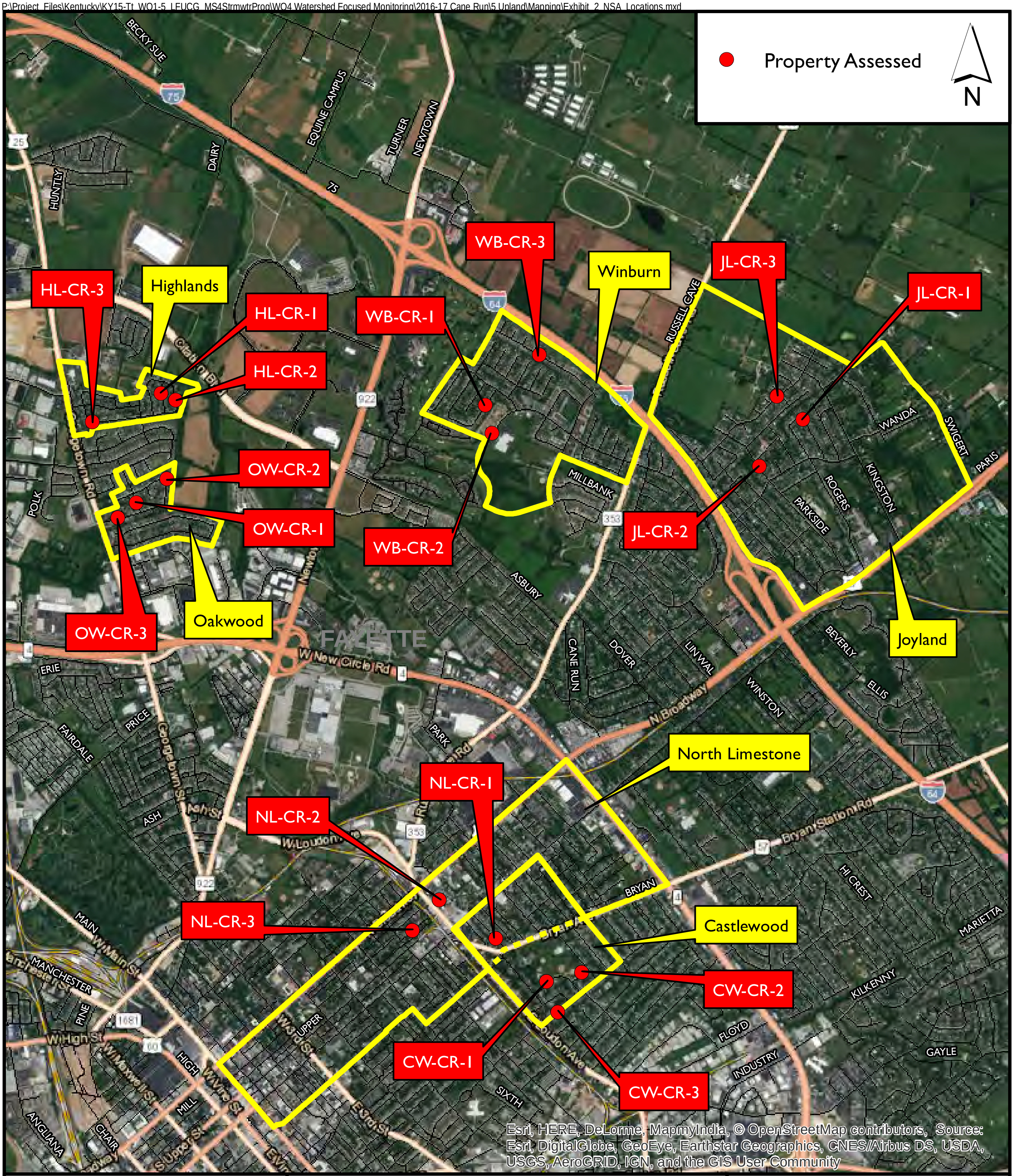
Exhibit 1

Neighborhoods Assessed
Priority Area Upland Visual Assessment
Cane Run Watershed, Fayette County, KY

0 3,200 6,400 Feet

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\5 Upland\Mapping\Exhibit_2_NSA_Locations.mxd



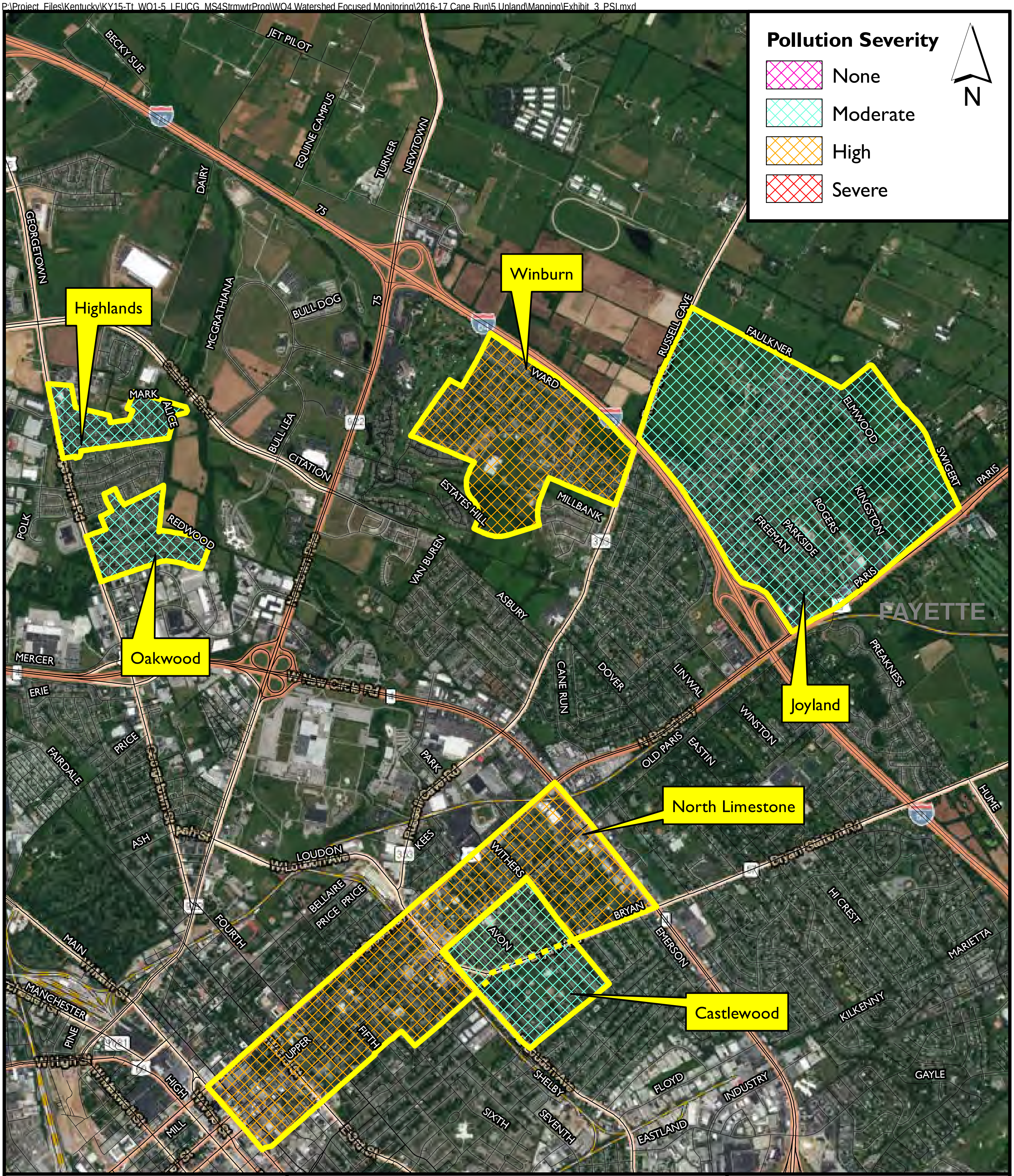
Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 2
Properties Assessed
Priority Area Upland Visual Assessment
Cane Run Watershed, Fayette County, KY

0 3,200 6,400 Feet

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\5 Upland\Mapping\Exhibit_3_PSI.mxd

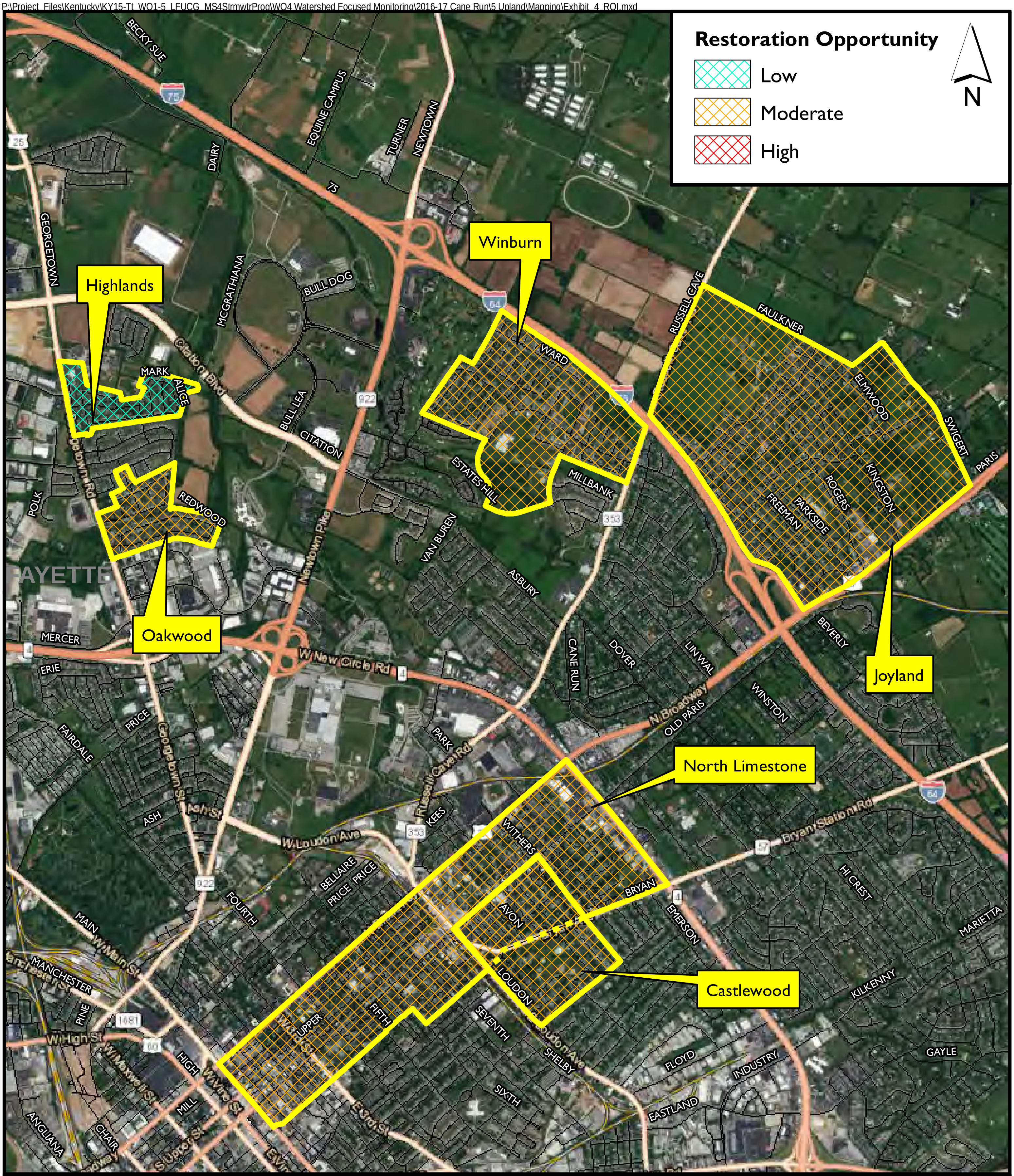


Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 3
Neighborhood Pollution Severity
Priority Area Upland Visual Assessment
Cane Run Watershed, Fayette County, KY

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste. 180
Lexington, Kentucky 40511

P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\5 Upland\Mapping\Exhibit_4_ROI.mxd



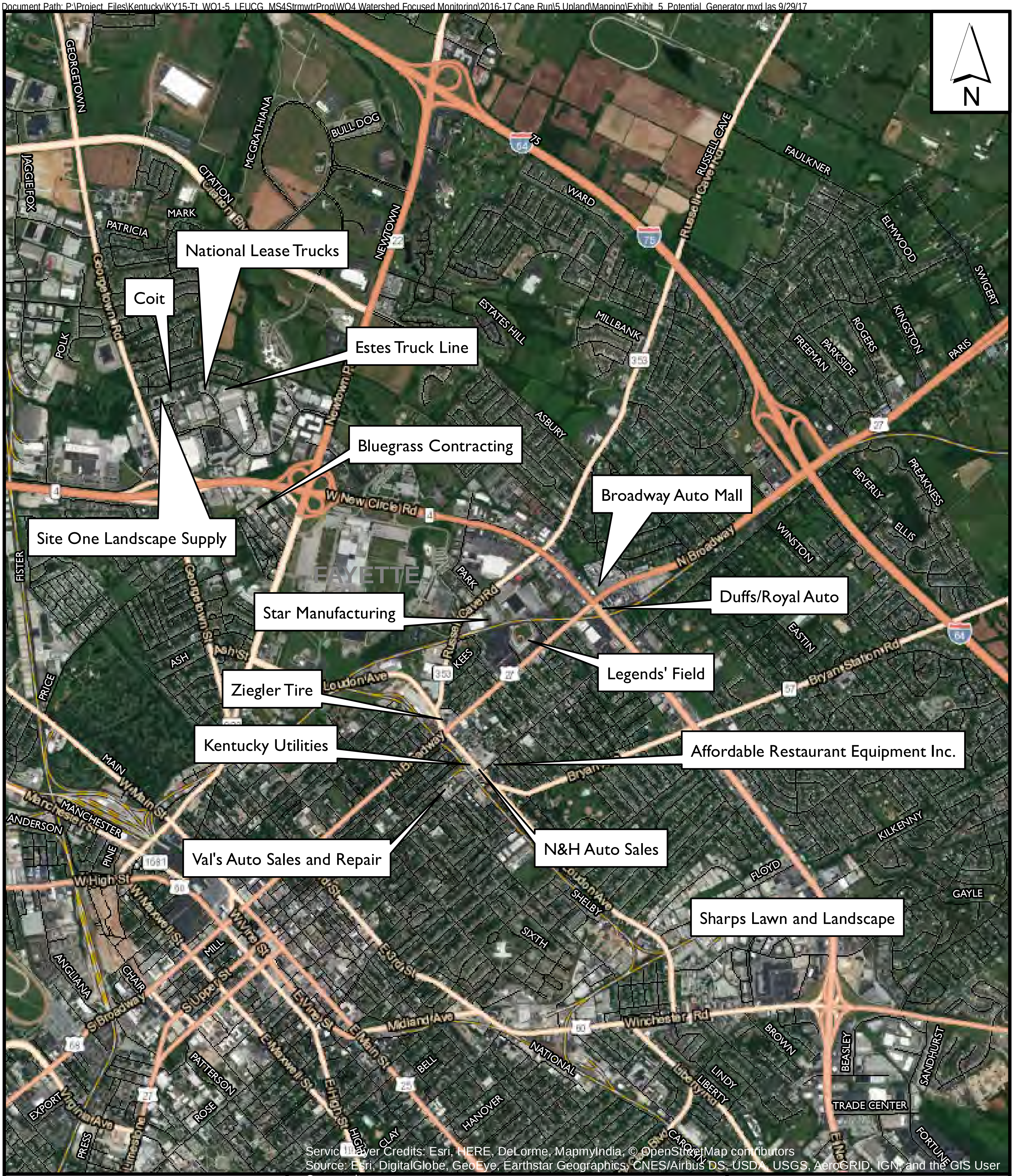
Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 4
Neighborhood Restoration Opportunity Priority Area Upland Visual Assessment Cane Run Watershed, Fayette County, KY

0 3,200 6,400 Feet

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

Document Path: P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\5 Upland\Mapping\Exhibit_5_Potential_Generator.mxd las 9/29/17



Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

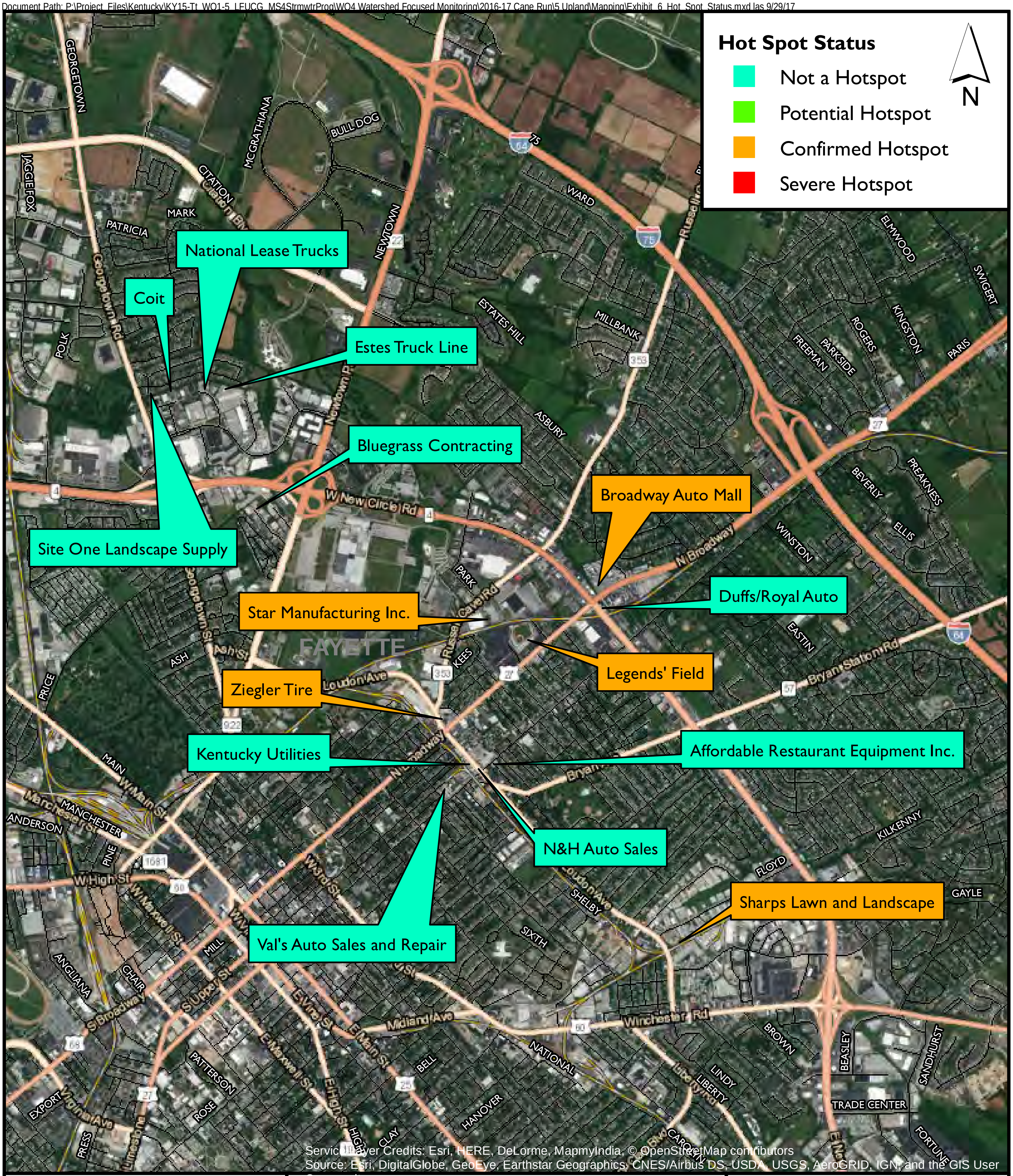
Exhibit 5

Potential Generators
Priority Area Upland Visual Assessment
Cane Run Watershed, Fayette County, KY

0 3,200 6,400 Feet

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

Document Path: P:\Project_Files\Kentucky\KY15-Tt_WO1-5_LFUCG_MS4StrmwtrProg\WO4 Watershed Focused Monitoring\2016-17 Cane Run\5 Upland\Mapping\Exhibit_6_Hot_Spot_Status.mxd las 9/29/17



Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Prepared by:
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503

Exhibit 6

Hot Spot Status
Priority Area Upland Visual Assessment
Cane Run Watershed, Fayette County, KY

0 3,200 6,400
Feet

Prepared for:
LFUCG Division of Water Quality
125 Lisle Industrial Ave, Ste 180
Lexington, Kentucky 40511

APPENDIX B
PHOTO LOGS

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC February 26, 2018


CW-CR-1


CW-CR-2


CW-CR-3


HL-CR-1


HL-CR-2


HL-CR-3

JL-CR-1

JL-CR-2

JL-CR-3

NL-CR-1

NL-CR-2

NL-CR-3

OW-CR-1

OW-CR-2

OW-CR-3

WB-CR-1

WB-CR-2

WB-CR-3

Sharps Lawn and Landscape

Affordable Restaurant Equipment Inc.

N&H Auto Sales

Val's Auto Sales and Repair

Kentucky Utilities

Coit

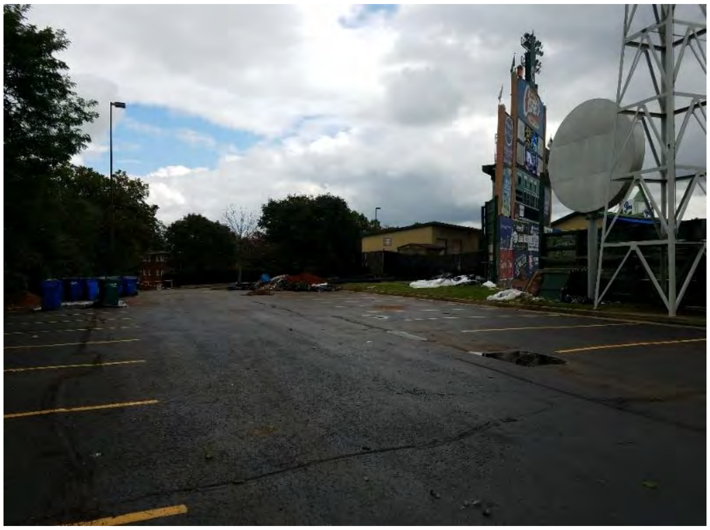

Site One Landscape Supply

Estes Truck Line


National Lease Trucks

Duffs-Royal Auto


Ziegler Tire


Legends' Field

Broadway Auto Mall

Star Manufacturing

APPENDIX C
NSA AND PGI FORMS

Prepared for Jennifer Carey, PE, LFUCG Division of Water Quality
Prepared by Third Rock Consultants, LLC February 26, 2018

Neighborhood Source Assessment **NSA**

WATERSHED: Cave Run	**SUBWATERSHED:**	**UNIQUE SITE ID:** JL-CR-1,2,3
DATE: 8/25/17	**ASSESSED BY:** M. Hall	**CAMERA ID:** Shelby **PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: Joyland Neighborhood Area (acres) 300

If unknown, address (or streets) surveyed:

Homeowners Association? ☐ Y ☑ N ☐ Unknown If yes, name and contact information:

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☑ Single Family Detached [✓ <¼] ¼ ½ 1 >1 acre ☐ Mobile Home Park

	INDEX*
Estimated Age of Neighborhood: _____ years Percent of Homes with Garages: 70 % With Basements 10 %	
Sewer Service? ☑ Y ☐ N	○
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☑ <5% of units ☐ 5-10% ☐ >10%	○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage			Comments/Notes	INDEX*
B. YARD AND LAWN CONDITIONS					
B1. % of lot with impervious cover	35	35	40	36.7%	
B2. % of lot with grass cover	60	60	55	58.3%	○ ✓
B3. % of lot with landscaping (e.g., mulched bed areas)	5	5	5	5%	◇ ✓
B4. % of lot with bare soil	0	0	0	0%	○
**Note: B1 through B4 must total 100%*	100	100	100	100%	
B5. % of lot with forest canopy	5	25	10	13.3%	◇ ✓
B6. Evidence of permanent irrigation or "non-target" irrigation	0	0	0	0%	○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 10				○
	Med: 80				
	Low: 10				
B8. Outdoor swimming pools? ☑ Y ☐ N ☐ Can't Tell Estimated # 20	10				○ ✓
B9. Junk or trash in yards? ☑ Y ☐ N ☐ Can't Tell	5				○
C. DRIVEWAYS, SIDEWALKS, AND CURBS					
C1. % of driveways that are impervious ☐ N/A	90				
C2. Driveway Condition ☐ Clean ☐ Stained ☐ Dirty ☑ Breaking up					○
C3. Are sidewalks present? ☑ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☑					
☐ Spotless ☐ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation					○
What is the distance between the sidewalk and street? 3-4 ft.					◇
Is pet waste present in this area? ☐ Y ☑ N ☐ N/A					○
C4. Is curb and gutter present? ☑ Y ☐ N If yes, check all that apply:					
☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☑ Sediment					○ ✓
☐ Organic matter, leaves, lawn clippings ☑ Trash, litter, or debris ☐ Overhead tree canopy					◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer	0		◇ ○
D2. Downspouts are directed to impervious surface	20		
D3. Downspouts discharge to pervious area	80		
D4. Downspouts discharge to a cistern, rain barrel, etc.	0		
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☐ Y ☑ N			◇

E. COMMON AREAS Marked w/ a "no dumping"

E1. Storm drain inlets? ☑ Y ☐ N If yes, are they stenciled? ☐ Y ☑ N Condition: ☐ Clean ☑ Dirty ◇ ✓

Catch basins inspected? ☐ Y ☑ N If yes, include Unique Site ID from SSD sheet: ________ ○

E2. Storm water pond? ☐ Y ☑ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N ◇

What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre

E3. Open Space? ☑ Y ☐ N If yes, is pet waste present? ☐ Y ☑ N dumping? ☐ Y ☑ N ○

Buffers/floodplain present: ☑ Y ☐ N If yes, is encroachment evident? ☐ Y ☐ N

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS

Based on field observations, this neighborhood has significant indicators for the following: *(check all that apply)* ○ ✓

☐ Nutrients ☐ Oil and Grease ☑ Trash/Litter ☐ Bacteria ☑ Sediment ☐ Other ________

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☑ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☑ Other action(s) ________

Describe Recommended Actions:

- "No littering" Signs
- Sed. Control

Initial Assessment

NSA Pollution Severity Index

☐ Severe (More than 10 circles checked)
☐ High (5 to 10 circles checked)
☑ Moderate (Fewer than 5 circles checked)
☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

☐ High (More than 5 diamonds checked)
☐ Moderate (3-5 diamonds checked)
☑ Low (Fewer than 3 diamonds checked)

NOTES:

Neighborhood Source Assessment **NSA**

WATERSHED: Cane Run	**SUBWATERSHED:**	**UNIQUE SITE ID:** W-CR-1,2,3
DATE: 8/25/17	**ASSESSED BY:** M. Hall	**CAMERA ID:** Shelby **PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: Winburn Neighborhood Area (acres) ______

If unknown, address (or streets) surveyed:

Homeowners Association? ☐ Y ☑ N ☐ Unknown If yes, name and contact information: ______

Residential *(circle average single family lot size):*

☑ Single Family Attached (Duplexes, Row Homes) [✓ <⅛] ⅛ ¼ ⅓ ⅓ acre ☑ Multifamily (Apts, Townhomes, Condos)

☑ Single Family Detached [✓ <¼] ¼ ½ 1 >1 acre ☐ Mobile Home Park

		INDEX*
Estimated Age of Neighborhood: _____ years	Percent of Homes with Garages: 20 % With Basements 20%	
Sewer Service? ☑ Y ☐ N		○
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☐ 5-10% ☑ >10% Park Construction		[✓ ○]

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage 1	2	3	Comments/Notes	
B. YARD AND LAWN CONDITIONS	1	2	3		
B1. % of lot with impervious cover	30	60	35	41.7%	
B2. % of lot with grass cover	70	30	65	55%	[✓ ○]
B3. % of lot with landscaping (e.g., mulched bed areas)	0	0	0	0%	[✓ ◇]
B4. % of lot with bare soil	0	10	0	3.3%	○
**Note: B1 through B4 must total 100%*	100	100	100	100%	
B5. % of lot with forest canopy	40	15	5	20%	[✓ ◇]
B6. Evidence of permanent irrigation or "non-target" irrigation	0	0	0	0%	○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 5				○
	Med: 55				
	Low: 40				
B8. Outdoor swimming pools? ☑ Y ☐ N ☐ Can't Tell Estimated # 5	<10				○
B9. Junk or trash in yards? ☑ Y ☐ N ☐ Can't Tell	60				[✓ ○]

C. DRIVEWAYS, SIDEWALKS, AND CURBS

C1. % of driveways that are impervious ☐ N/A	90		
C2. Driveway Condition ☐ Clean ☑ Stained ☑ Dirty ☑ Breaking up			[✓ ○]
C3. Are sidewalks present? ☑ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☐			
☑ Spotless ☑ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation			○
What is the distance between the sidewalk and street? 4 ft.			◇
Is pet waste present in this area? ☑ Y ☐ N ☐ N/A			○
C4. Is curb and gutter present? ☑ Y ☐ N If yes, check all that apply:			
☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment			[✓ ○]
☑ Organic matter, leaves, lawn clippings ☑ Trash, litter, or debris ☐ Overhead tree canopy			[✓ ◇]

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer	0		◇ ○
D2. Downspouts are directed to impervious surface	20		
D3. Downspouts discharge to pervious area	80		
D4. Downspouts discharge to a cistern, rain barrel, etc.	0		
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☐ Y ☑ N			◇

E. COMMON AREAS Marked w/ "no dumping"

E1. Storm drain inlets? ☑ Y ☐ N If yes, are they [✓ stenciled?] ☐ Y ☑ N Condition: ☑ Clean ☐ Dirty ☑◇

Catch basins inspected? ☐ Y ☑ N If yes, include Unique Site ID from SSD sheet: ____________ ○

E2. Storm water pond? ☐ Y ☑ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N ◇
What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre

E3. Open Space? ☑ Y ☐ N If yes, is pet waste present? ☑ Y ☐ N dumping? ☐ Y ☑ N ☑○

Buffers/floodplain present: ☑ Y ☐ N If yes, is encroachment evident? ☐ Y ☑ N

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS

Based on field observations, this neighborhood has significant indicators for the following: *(check all that apply)* ☑○
☑ Nutrients ☐ Oil and Grease ☑ Trash/Litter ☑ Bacteria ☑ Sediment ☐ Other ____________

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☑ Better lawn/landscaping practice?
- ☑ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☑ Other action(s) ____________

Describe Recommended Actions:

- Lawn Clippings
- Pet Waste Stations
- Sediment + Erosion Inspection at Park construction.

Initial Assessment

NSA Pollution Severity Index
☐ Severe (More than 10 circles checked)
☑ High (5 to 10 circles checked)
☐ Moderate (Fewer than 5 circles checked)
☐ None (No circles checked)

Neighborhood Restoration Opportunity Index
☐ High (More than 5 diamonds checked)
☑ Moderate (3-5 diamonds checked)
☐ Low (Fewer than 3 diamonds checked)

NOTES:

Neighborhood Source Assessment **NSA**

WATERSHED: Cane Run	**SUBWATERSHED:**	**UNIQUE SITE ID:** NL-CR-1,2,3	
DATE: 9/6/17	**ASSESSED BY:** M. Hall	**CAMERA ID:**	**PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: North Limestone Neighborhood Area (acres) 385

If unknown, address (or streets) surveyed:

Homeowners Association? ☐ Y ☑ N ☐ Unknown If yes, name and contact information:

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☑ Single Family Detached [✓ <¼] ¼ ½ 1 >1 acre ☑ Mobile Home Park

Estimated Age of Neighborhood: _____ years	Percent of Homes with Garages: 60 % With Basements 60 %				**INDEX***
Sewer Service? ☑ Y ☐ N					○
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☑ 5-10% ☐ >10%					○ ✓
Record percent observed for each of the following indicators, depending on applicability and/or site complexity	**Percentage**			**Comments/Notes**	
B. YARD AND LAWN CONDITIONS					
B1. % of lot with impervious cover	20	40	35	31.6%	
B2. % of lot with grass cover	68	60	65	64.4%	○ ✓
B3. % of lot with landscaping (e.g., mulched bed areas)	12	0	0	4%	◇ ✓
B4. % of lot with bare soil	0	0	0	0%	○
**Note: B1 through B4 must total 100%*	100	100	100	100%	
B5. % of lot with forest canopy	36	28	11	25%	◇ ✓
B6. Evidence of permanent irrigation or "non-target" irrigation	0	0	0	0%	○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 10				○
	Med: 40				
	Low: 50				
B8. Outdoor swimming pools? ☐ Y ☑ N ☐ Can't Tell Estimated # ____	0				○
B9. Junk or trash in yards? ☑ Y ☐ N ☐ Can't Tell	25				○ ✓
C. DRIVEWAYS, SIDEWALKS, AND CURBS					
C1. % of driveways that are impervious ☐ N/A	70				
C2. Driveway Condition ☐ Clean ☐ Stained ☑ Dirty ☑ Breaking up					○
C3. Are sidewalks present? ☑ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☑					
☐ Spotless ☑ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation					○
What is the distance between the sidewalk and street? 0-3 ft.					◇
Is pet waste present in this area? ☑ Y ☐ N ☐ N/A					○ ✓
C4. Is curb and gutter present? ☑ Y ☐ N If yes, check all that apply:					
☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment					○ ✓
☑ Organic matter, leaves, lawn clippings ☑ Trash, litter, or debris ☐ Overhead tree canopy					◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer	10		◇ ✓ ○
D2. Downspouts are directed to impervious surface	40		
D3. Downspouts discharge to pervious area	50		
D4. Downspouts discharge to a cistern, rain barrel, etc.			
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☑ Y ☐ N	15		◇

E. COMMON AREAS Marked w/ a "no dumping"

E1. Storm drain inlets? ☑ Y ☐ N If yes, are they stenciled? ☐ Y ☑ N Condition: ☐ Clean ☑ Dirty ◇ ✓

Catch basins inspected? ☐ Y ☑ N If yes, include Unique Site ID from SSD sheet: ______ ○

E2. Storm water pond? ☐ Y ☑ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N ◇
What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre

E3. Open Space? ☑ Y ☐ N If yes, is pet waste present? ☑ Y ☐ N dumping? ☐ Y ☑ N ○ ✓

Buffers/floodplain present: ☐ Y ☑ N If yes, is encroachment evident? ☐ Y ☐ N

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS

Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply*) ○ ✓
☑ Nutrients ☐ Oil and Grease ☑ Trash/Litter ☑ Bacteria ☐ Sediment ☐ Other ______

Recommended Actions

Specific Action

☐ Onsite retrofit potential?
☑ Better lawn/landscaping practice?
☑ Better management of common space?
☐ Pond retrofit?
☐ Multi-family Parking Lot Retrofit?
☐ Other action(s) ______

Describe Recommended Actions:

- Install Pet Waste Stations
- Litter + Pet Waste Signs

Initial Assessment

NSA Pollution Severity Index

☐ Severe (More than 10 circles checked)
☑ High (5 to 10 circles checked)
☐ Moderate (Fewer than 5 circles checked)
☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

☐ High (More than 5 diamonds checked)
☑ Moderate (3-5 diamonds checked)
☐ Low (Fewer than 3 diamonds checked)

NOTES:

Neighborhood Source Assessment **NSA**

WATERSHED: Cane Run	**SUBWATERSHED:**	**UNIQUE SITE ID:** CW-CR-1,2,3	
DATE: 9/6/17	**ASSESSED BY:** M. Hall	**CAMERA ID:**	**PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: Castlewood Neighborhood Area (acres) 60

If unknown, address (or streets) surveyed:

Homeowners Association? ☐ Y ☑ N ☐ Unknown If yes, name and contact information:

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☑ Single Family Detached [✓ <¼] ¼ ½ 1 >1 acre ☐ Mobile Home Park

Estimated Age of Neighborhood: _____ years	Percent of Homes with Garages: 60 % With Basements 60 %	**INDEX***
Sewer Service? ☑ Y ☐ N		○
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☑ <5% of units ☐ 5-10% ☐ >10%		○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	**Percentage**			**Comments/Notes**	
B. YARD AND LAWN CONDITIONS					
B1. % of lot with impervious cover	65	40	65	56.7%	
B2. % of lot with grass cover	35	55	30	40%	○
B3. % of lot with landscaping (e.g., mulched bed areas)	0	5	5	3.3%	◇ ✓
B4. % of lot with bare soil	0	0	0	0%	○
**Note: B1 through B4 must total 100%*	100	100	100	100%	
B5. % of lot with forest canopy	6	7	8	7%	◇ ✓
B6. Evidence of permanent irrigation or "non-target" irrigation	0	0	0	0%	○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 20				○ ✓
	Med: 70				
	Low: 10				
B8. Outdoor swimming pools? ☑ Y ☐ N ☐ Can't Tell Estimated # 5	<10				○
B9. Junk or trash in yards? ☑ Y ☐ N ☐ Can't Tell	<10				○
C. DRIVEWAYS, SIDEWALKS, AND CURBS					
C1. % of driveways that are impervious ☐ N/A	90				
C2. Driveway Condition ☑ Clean ☐ Stained ☐ Dirty ☑ Breaking up	(Recent Repairs Made)				○
C3. Are sidewalks present? ☑ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☑					
☐ Spotless ☑ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation					○
What is the distance between the sidewalk and street? 2-4 ft.					◇
Is pet waste present in this area? ☐ Y ☑ N ☐ N/A					○
C4. Is curb and gutter present? ☑ Y ☐ N If yes, check all that apply:					
☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment					○
☑ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy					◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer	0		◇ ○
D2. Downspouts are directed to impervious surface	40		
D3. Downspouts discharge to pervious area	60		
D4. Downspouts discharge to a cistern, rain barrel, etc.	0		
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☑ Y ☐ N	5		◇

E. COMMON AREAS Marked w/ Grill no dumping	
E1. Storm drain inlets? ☑ Y ☐ N If yes, are they stenciled? ☑ Y ☐ N Condition: ☐ Clean ☑ Dirty	◇
Catch basins inspected? ☐ Y ☑ N If yes, include Unique Site ID from SSD sheet: ______	○
E2. Storm water pond? ☑ Y ☐ N Is it a ☐ wet pond or ☑ dry pond? Is it overgrown? ☑ Y ☐ N What is the estimated pond area? ☑ <1 acre ☐ about 1 acre ☐ > 1 acre	◇ ✓
E3. Open Space? ☑ Y ☐ N If yes, is pet waste present? ☑ Y ☐ N dumping? ☐ Y ☐ N	○ ✓
Buffers/floodplain present: ☑ Y ☐ N If yes, is encroachment evident? ☐ Y ☑ N	
F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS	
Based on field observations, this neighborhood has significant indicators for the following: *(check all that apply)* ☑ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☑ Sediment ☐ Other ______	○ ✓

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☑ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) ______

Describe Recommended Actions:

- Lawn Clippings
- Residential Sed. Control

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☑ Moderate (Fewer than 5 circles checked)
- ☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☑ Moderate (3-5 diamonds checked)
- ☐ Low (Fewer than 3 diamonds checked)

NOTES:

Neighborhood Source Assessment **NSA**

WATERSHED: Cane Run	**SUBWATERSHED:**	**UNIQUE SITE ID:** OW-CR-1,2,3
DATE: 9/15/17	**ASSESSED BY:** M. Hall	**CAMERA ID:** CORY **PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: Oakwood Neighborhood Area (acres) 30

If unknown, address (or streets) surveyed:

Homeowners Association? ☐ Y ☑ N ☐ Unknown If yes, name and contact information:

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☑ Single Family Detached [✓ <¼] ¼ ½ 1 >1 acre ☐ Mobile Home Park

		INDEX*
Estimated Age of Neighborhood: ____ years	Percent of Homes with Garages: 50 % With Basements 50%	
Sewer Service? ☑ Y ☐ N		○
Index of Infill, Redevelopment, and Remodeling ☑ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10%		○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage 1	2	3	Comments/Notes	INDEX
B. YARD AND LAWN CONDITIONS					
B1. % of lot with impervious cover	37	38	40	38.3%	
B2. % of lot with grass cover	63	62	60	61.7%	○ ✓
B3. % of lot with landscaping (e.g., mulched bed areas)	0	0	0	0 %	◇ ✓
B4. % of lot with bare soil	0	0	0	0 %	○
**Note: B1 through B4 must total 100%*	100	100	100	100 %	
B5. % of lot with forest canopy	25	2	1.3	9.43%	◇ ✓
B6. Evidence of permanent irrigation or "non-target" irrigation	0	0	0	0 %	○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 5				○
	Med: 85				
	Low: 10				
B8. Outdoor swimming pools? ☐ Y ☑ N ☐ Can't Tell Estimated # ____					○
B9. Junk or trash in yards? ☐ Y ☑ N ☐ Can't Tell					○
C. DRIVEWAYS, SIDEWALKS, AND CURBS					
C1. % of driveways that are impervious ☐ N/A					
C2. Driveway Condition ☑ Clean ☑ Stained ☑ Dirty ☑ Breaking up					○ ✓
C3. Are sidewalks present? ☑ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☑					
☐ Spotless ☑ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation					○
What is the distance between the sidewalk and street? 4-5 ft.					◇
Is pet waste present in this area? ☐ Y ☑ N ☐ N/A					○
C4. Is curb and gutter present? ☑ Y ☐ N If yes, check all that apply:					
☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment					○
☑ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy					◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer	0		◇ ○
D2. Downspouts are directed to impervious surface	30		
D3. Downspouts discharge to pervious area	70		
D4. Downspouts discharge to a cistern, rain barrel, etc.	0		
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☑ Y ☐ N	15		◇

E. COMMON AREAS Marked w/ "no dumping"

E1. Storm drain inlets? ☑ Y ☐ N If yes, are they [✓ stenciled?] ☐ Y ☑ N Condition: ☐ Clean ☑ Dirty ◇ ✓

Catch basins inspected? ☐ Y ☑ N If yes, include Unique Site ID from SSD sheet: ______ ○

E2. Storm water pond? ☐ Y ☑ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N ◇

What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre

E3. Open Space? ☐ Y ☑ N If yes, is pet waste present? ☐ Y ☐ N dumping? ☐ Y ☐ N ○

Buffers/floodplain present: ☐ Y ☑ N If yes, is encroachment evident? ☐ Y ☐ N

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS

Based on field observations, this neighborhood has significant indicators for the following: *(check all that apply)* ○ ✓

☑ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☐ Other ______

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☑ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) ______

Describe Recommended Actions:

- Lawn Clipping Control

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☑ Moderate (Fewer than 5 circles checked)
- ☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☑ Moderate (3-5 diamonds checked)
- ☐ Low (Fewer than 3 diamonds checked)

NOTES:

Neighborhood Source Assessment **NSA**

WATERSHED: Cane Run	**SUBWATERSHED:**	**UNIQUE SITE ID:** HL-CR-1,2,3
DATE: 9/15/17	**ASSESSED BY:** M. Hall	**CAMERA ID:** CORY **PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: Highlands Neighborhood Area (acres) 50

If unknown, address (or streets) surveyed:

Homeowners Association? ☐ Y ☑ N ☐ Unknown If yes, name and contact information:

Residential *(circle average single family lot size)*:

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☑ Single Family Detached [✓ <¼] ¼ ½ 1 >1 acre ☐ Mobile Home Park

Estimated Age of Neighborhood: _____ years	Percent of Homes with Garages: 75% With Basements 50%	**INDEX***
Sewer Service? ☑ Y ☐ N		○
Index of Infill, Redevelopment, and Remodeling ☑ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10%		○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	**Percentage**			**Comments/Notes**	
B. YARD AND LAWN CONDITIONS	1	2	3		
B1. % of lot with impervious cover	38	38	46	40.6%	
B2. % of lot with grass cover	57	62	49	56%	○ ✓
B3. % of lot with landscaping (e.g., mulched bed areas)	0	0	5	1.7%	◇ ✓
B4. % of lot with bare soil	5	0	0	1.7%	○
**Note: B1 through B4 must total 100%*	100	100	100	100%	
B5. % of lot with forest canopy	29	78	0	55%	◇
B6. Evidence of permanent irrigation or "non-target" irrigation	0	0	0	0%	○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 0				○
	Med: 80				
	Low: 20				
B8. Outdoor swimming pools? ☑ Y ☐ N ☐ Can't Tell Estimated # 5	LIC				○
B9. Junk or trash in yards? ☐ Y ☑ N ☐ Can't Tell					○
C. DRIVEWAYS, SIDEWALKS, AND CURBS					
C1. % of driveways that are impervious ☐ N/A	95				
C2. Driveway Condition ☑ Clean ☐ Stained ☑ Dirty ☑ Breaking up					○
C3. Are sidewalks present? ☑ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☑					
☐ Spotless ☑ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation					○
What is the distance between the sidewalk and street? 3 ft.					◇
Is pet waste present in this area? ☐ Y ☑ N ☐ N/A					○
C4. Is curb and gutter present? ☑ Y ☐ N If yes, check all that apply:					
☐ Clean and Dry ☐ Flowing or standing water ☑ Long-term car parking ☐ Sediment					○
☑ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy					◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer	0		◇ ○
D2. Downspouts are directed to impervious surface	25		
D3. Downspouts discharge to pervious area	75		
D4. Downspouts discharge to a cistern, rain barrel, etc.	0		
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☑ Y ☐ N	20		◇

E. COMMON AREAS Marked w/ a "no dumping"

E1. Storm drain inlets? ☑ Y ☐ N If yes, are they [✓ stenciled?] ☐ Y ☑ N Condition: ☑ Clean ☐ Dirty ◇

Catch basins inspected? ☐ Y ☑ N If yes, include Unique Site ID from SSD sheet: ______ ○

E2. Storm water pond? ☑ Y ☐ N Is it a ☐ wet pond or ☑ dry pond? Is it overgrown? ☐ Y ☑ N ◇ ✓

What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre

E3. Open Space? ☑ Y ☐ N If yes, is pet waste present? ☐ Y ☑ N dumping? ☐ Y ☑ N ○

Buffers/floodplain present: ☑ Y ☐ N If yes, is encroachment evident? ☐ Y ☑ N

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS

Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply*) ○ ✓

☑ Nutrients ☑ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☐ Other ______

Recommended Actions

Specific Action

☐ Onsite retrofit potential?
☑ Better lawn/landscaping practice?
☐ Better management of common space?
☐ Pond retrofit?
☐ Multi-family Parking Lot Retrofit?
☐ Other action(s) ______

Describe Recommended Actions:

- No longterm Parking
- Pick up lawn Clippings

Initial Assessment

NSA Pollution Severity Index

☐ Severe (More than 10 circles checked)
☐ High (5 to 10 circles checked)
☑ Moderate (Fewer than 5 circles checked)
☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

☐ High (More than 5 diamonds checked)
☐ Moderate (3-5 diamonds checked)
☑ Low (Fewer than 3 diamonds checked)

NOTES:

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** 15027		**UNIQUE SITE ID:**
DATE: 9/21/17	**ASSESSED BY:** GF	**CAMERA ID:** Per	**PIC#:** 948
MAP GRID:	**LAT** __° __' __" **LONG** __° __' __"		**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

38.046853 -94.66472

Name and Address: Sharps Lawn
800 Floyd

Category: ☒ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ______

NPDES Status: ☐ Regulated ☒ Unregulated ☐ Unknown

Basic Description of Operation: Lawn Care & Landscaping

	INDEX*
B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)*	**Observed Pollution Source?** Y
B1. Types of vehicles: ☒ Fleet vehicles ☐ School buses ☐ Other: ______	
B2. Approximate number of vehicles: 10	
B3. Vehicle activities *(circle all that apply)*: [✓ Maintained] Repaired Recycled Fueled [✓ Washed] [✓ Stored]	●
B4. Are vehicles stored and/or repaired outside? ☒ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☒ Y ☐ N ☐ Can't Tell	●
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☒ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☒ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☒ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☒ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☒ Can't Tell	○
C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)*	**Observed Pollution Source?** ✓
C1. Are loading/unloading operations present? ☒ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☒ Can't Tell	○
C2. Are materials stored outside? ☒ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☒ Solid Description: ____ Where are they stored? ☒ grass/dirt area ☐ concrete/asphalt ☐ bermed area mulch/Covered Salt	○✓
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☒ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☒ N ☐ Can't Tell Un-paved	○
C5. Does outdoor storage area lack a cover? ☒ Y ☐ N ☐ Can't Tell	○✓
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☒ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☒ Can't Tell	○
D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)*	**Observed Pollution Source?** Y
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials Vegetation	○✓
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☒ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☒ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☒ N/A *(Skip to part F)*	**Observed Pollution Source?** ☐
E1. Building: Approximate age: ____ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○ ✓
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☒ Don't know	○
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)* **Observed Pollution Source?**	Y
F1. % of site with: Forest canopy 0 % Turf grass 20 % Landscaping 0 % Bare Soil 80 %	○ ✓
F2. Rate the turf management status: ☒ High ☐ Medium ☐ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☒ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☒ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☒ Y ☐ N ☐ Can't Tell	○ ✓
G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)* **Observed Pollution Source?**	☐
G1. Are storm water treatment practices present? ☐ Y ☒ N ☐ Unknown If yes, please describe: ____________	○
G2. Are private storm drains located at the facility? ☒ Y ☐ N ☐ Unknown Ditch/Inlet Is trash present in gutters leading to storm drains? If so, complete the index below.	○ ✓

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☒ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☒ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☒ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☒ Potential hotspot (5 to 10 circles but no boxes checked)

☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** 15027	**UNIQUE SITE ID:**
DATE: 9/21/17	**ASSESSED BY:** GF **CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** ___°_____'_____" **LONG** ___°_____'____"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION 38.057641 -84.480584

Name and Address: Affordable Restaurant Equipment, Inc. 814 N. Limestone

Category: ☒ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): __________

NPDES Status: ☐ Regulated ☒ Unregulated ☐ Unknown

Basic Description of Operation: Buy/Sell Equipment - outside Storage

	INDEX*
B. VEHICLE OPERATIONS ☒ **N/A** *(Skip to part C)*	**Observed Pollution Source?** N
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: __________	
B2. Approximate number of vehicles: _______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☑ **N/A** *(Skip to part D)*	**Observed Pollution Source?** Y
C1. Are loading/unloading operations present? ☒ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☒ N ☐ Can't Tell	○
C2. Are materials stored outside? ☑ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☑ Solid Description: equipment Where are they stored? ☐ grass/dirt area ☒ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☒ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☒ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☒ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☒ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☒ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☒ **N/A** *(Skip to part E)*	**Observed Pollution Source?** N
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☒ **N/A** *(Skip to part F)*	**Observed Pollution Source?** N
E1. Building: Approximate age: ________ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○ ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☒ Dirty ☐ Breaking up Surface material ☒ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☒ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☒ Don't know	○
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☒ N ☐ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☑ N/A *(skip to part G)* **Observed Pollution Source?**	N
F1. % of site with: Forest canopy [illegible] % Turf grass [illegible] % Landscaping [illegible] % Bare Soil ____%	○
F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell	○
G. STORM WATER INFRASTRUCTURE ☑ N/A *(skip to part H)* **Observed Pollution Source?**	N
G1. Are storm water treatment practices present? ☐ Y ☒ N ☐ Unknown If yes, please describe: ______________	○
G2. Are private storm drains located at the facility? ☐ Y ☒ N ☐ Unknown Is trash present in gutters leading to storm drains? If so, complete the index below.	○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☒ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☒ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)

☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ______________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** 15027		**UNIQUE SITE ID:**
DATE: __/__/____	**ASSESSED BY:** GF	**CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** __° ___' ___" **LONG** __° ___' ___"		**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

38.057292 -84.481778

Name and Address: NEH Auto Sales
791 N. Limestone

Category: ☒ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ______

NPDES Status: ☐ Regulated ☒ Unregulated ☐ Unknown

Basic Description of Operation: Auto Sales & Repair

	INDEX*
B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)*	**Observed Pollution Source?** Y
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☒ Other: Vehicles for sale	
B2. Approximate number of vehicles: 30	
B3. Vehicle activities *(circle all that apply)*: [✓ Maintained] [✓ Repaired] Recycled Fueled [✓ Washed] [✓ Stored]	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☒ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☒ Y ☐ N ☐ Can't Tell	○ ✓
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☒ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☒ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☒ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☒ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○ ✓
C. OUTDOOR MATERIALS ☒ N/A *(Skip to part D)*	**Observed Pollution Source?** N
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☒ N/A *(Skip to part E)*	**Observed Pollution Source?** N
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply*): ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☒ N/A *(Skip to part F)*	**Observed Pollution Source?** N
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○ ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ N/A *(skip to part G)* **Observed Pollution Source?** N

F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☐ N/A *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☑ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☑ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☑ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☒ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:
☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** 15A27	**UNIQUE SITE ID:**
DATE: 9/21/17	**ASSESSED BY:** GF **CAMERA ID:** Per	**PIC#:**
MAP GRID:	**LAT** __° __' __" **LONG** __° __' __"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION 38.055798 -84.484198

Name and Address: Vals Auto
717 N. Limestone

Category: ☒ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ________

NPDES Status: ☐ Regulated ☒ Unregulated ☐ Unknown

Basic Description of Operation: Sales Service Auto (Paint)

	INDEX*
B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)*	**Observed Pollution Source?** Y
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: Sales/Repair	
B2. Approximate number of vehicles: 100	
B3. Vehicle activities *(circle all that apply)*: [✓ Maintained] [✓ Repaired] Recycled Fueled [✓ Washed] [✓ Stored]	✓
B4. Are vehicles stored and/or repaired outside? ☐ Y ☑ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☑ Y ☐ N ☐ Can't Tell	✓
B5. Is there evidence of spills/leakage from vehicles? ☑ Y ☐ N ☐ Can't Tell	✓
B6. Are uncovered outdoor fueling areas present? ☑ Y ☐ N ☐ Can't Tell	✓
B7. Are fueling areas directly connected to storm drains? ☐ Y ☑ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☑ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☑ N/A *(Skip to part D)*	**Observed Pollution Source?** ☐
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☑ N/A *(Skip to part E)*	**Observed Pollution Source?** ☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☑ N/A *(Skip to part F)*	**Observed Pollution Source?** ☐
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ **N/A** *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ____________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☒ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☑ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☒ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☒ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** 15027	**UNIQUE SITE ID:**
DATE: 9/21/17	**ASSESSED BY:** GF **CAMERA ID:** Per	**PIC#:**
MAP GRID:	**LAT** __° __' __" **LONG** __° __' __"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

38.057480 -84.482468

Name and Address: KU
104 W Loudon Ave

Category: ☐ Commercial ☒ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ______

NPDES Status: ☐ Regulated ☐ Unregulated ☒ Unknown

Basic Description of Operation: Vehicle, transformers, Substation, Meters

	INDEX*
B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)* — **Observed Pollution Source?**	☑
B1. Types of vehicles: ☑ Fleet vehicles ☐ School buses ☐ Other: ______	
B2. Approximate number of vehicles: 50	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed [✓ Stored]	○
B4. Are vehicles stored and/or repaired outside? ☑ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☑ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☑ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☑ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☑ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — **Observed Pollution Source?**	☑
C1. Are loading/unloading operations present? ☑ Y ☐ N ☑ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☑ Can't Tell	○
C2. Are materials stored outside? ☑ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☑ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☑ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☑ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☑ Y ☐ N ☐ Can't Tell oil Drums	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☑ Can't Tell	○
D. WASTE MANAGEMENT ☑ N/A *(Skip to part E)* — **Observed Pollution Source?**	☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☑ N/A *(Skip to part F)* — **Observed Pollution Source?**	☐
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ N/A *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____% Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☐ N/A *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☑ Unknown If yes, please describe: ____________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☑ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☒ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Bath 1x15

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** 15008	**UNIQUE SITE ID:**
DATE: 9/13/17	**ASSESSED BY:** GF **CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** __°__'__" **LONG** __°__'__"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION 38.080357, -84.505585

Name and Address: Coit
1078 Majuren Rd

Category: ☒ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related
Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ______

NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

Basic Description of Operation: Cleaning & Restoration Services

	INDEX*
B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)* — **Observed Pollution Source?**	☐
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ______	
B2. Approximate number of vehicles: ______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☑ N/A *(Skip to part D)* — **Observed Pollution Source?**	✓
C1. Are loading/unloading operations present? ☐ Y ☑ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☑ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☑ Y ☐ N ☐ Can't Tell	✓
C4. Is staining or discoloration around the area visible? ☑ Y ☐ N ☐ Can't Tell	✓
C5. Does outdoor storage area lack a cover? ☐ Y ☑ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☑ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☑ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☑ N/A *(Skip to part E)* — **Observed Pollution Source?**	☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply*): ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☑ N/A *(Skip to part F)* — **Observed Pollution Source?**	☐
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○ ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ N/A *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____% Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☐ N/A *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ______________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☒ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:
☐ Refer for immediate enforcement
☑ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:
staining in inlet at rear of
Bld. Carpet Cleaning truck
parked next to it.

Potential Generator Investigation **PGI**

WATERSHED: Cone Run	**SUBWATERSHED:** 15008	**UNIQUE SITE ID:**
DATE: 9/13/17	**ASSESSED BY:** GP **CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** ___° ___' ___" **LONG** ___° ___' ___"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: Site One
1063 Magaur Rd.

SIC code (if available): ________

NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

Category: ☑ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous: ☐ Golf Course ☐ Marina ☐ Animal Facility

Basic Description of Operation: Landscape Supply

	INDEX*
B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)* — **Observed Pollution Source?**	☐
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ________	
B2. Approximate number of vehicles: ______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — **Observed Pollution Source?**	☑
C1. Are loading/unloading operations present? ☐ Y ☑ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☑ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☑ Solid Description: ______ Where are they stored? ☑ grass/dirt area ☑ concrete/asphalt ☐ bermed area	○ ✓
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☑ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☑ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☑ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☑ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☑ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☑ N/A *(Skip to part E)* — **Observed Pollution Source?**	☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☑ N/A *(Skip to part F)* — **Observed Pollution Source?**	☐
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ N/A *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____% Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☐ [✓ N/A] *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☑ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** 15008	**UNIQUE SITE ID:**
DATE: 9/13/17	**ASSESSED BY:** GF / **CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** ___°_____'_____" **LONG** ___°_____'____"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION 38.080783, -84.501610

Name and Address: Estes
1020 Whipple Dr.

Category: ☑ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related
Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): __________

NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

Basic Description of Operation: Truck line

	INDEX*
B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)* — **Observed Pollution Source?** ☑	
B1. Types of vehicles: ☑ Fleet vehicles ☐ School buses ☐ Other: ________	
B2. Approximate number of vehicles: 50	
B3. Vehicle activities *(circle all that apply)*: [✓ Maintained] [✓ Repaired] Recycled [✓ Fueled] [✓ Washed] [✓ Stored]	○ ✓
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☑ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☑ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☑ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☑ Y ☐ N ☐ Can't Tell	○ ✓
B7. Are fueling areas directly connected to storm drains? ☐ Y ☑ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☑ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☑ Can't Tell	○
C. OUTDOOR MATERIALS ☑ N/A *(Skip to part D)* — **Observed Pollution Source?** ☐	
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☑ N/A *(Skip to part E)* — **Observed Pollution Source?** ☐	
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☑ N/A *(Skip to part F)* — **Observed Pollution Source?** ☐	
E1. Building: Approximate age: ________ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ N/A *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____% Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☑ N/A *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ____________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☑ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:
Secondary Containment for fuel, Maint/repair Under roof.

Potential Generator Investigation **PGI**

WATERSHED: Cane Run
SUBWATERSHED: 15008
UNIQUE SITE ID:
DATE: __/__/____
ASSESSED BY: GF
CAMERA ID:
PIC#:
MAP GRID:
LAT __°___'___" **LONG** __°___'___" 38.081039 -84.503073
LMK #

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: AIM
National lease
1068 Whipple Ct

SIC code (if available): ________
NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

Category: ☑ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related
Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

Basic Description of Operation: Truck leasing

INDEX*

B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)*

Observed Pollution Source? ☑

B1. Types of vehicles: ☑ Fleet vehicles ☐ School buses ☐ Other: ________

B2. Approximate number of vehicles: 30

B3. Vehicle activities *(circle all that apply)*: [✓ Maintained] [✓ Repaired] Recycled [✓ Fueled] [✓ Washed] [✓ Stored] ✓

B4. Are vehicles stored and/or repaired outside? ☐ Y ☑ N ☐ Can't Tell
Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell ○

B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☑ N ☐ Can't Tell ○

B6. Are uncovered outdoor fueling areas present? ☑ Y ☐ N ☐ Can't Tell Secondary Cont. Present ✓

B7. Are fueling areas directly connected to storm drains? ☐ Y ☑ N ☐ Can't Tell ○

B8. Are vehicles washed outdoors? ☐ Y ☐ N ☑ Can't Tell
Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell ○

C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)*

Observed Pollution Source? ☐

C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell
If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell ○

C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______
Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area ○

C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell ○

C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell ○

C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell ○

C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell ○

C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell ○

D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)*

Observed Pollution Source? ☐

D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials ○

D2. Dumpster condition (*check all that apply*): ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing ○

D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell
If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell ○

E. PHYSICAL PLANT ☐ N/A *(Skip to part F)*

Observed Pollution Source? ☐

E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged ○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ___% Turf grass _____% Landscaping ___% Bare Soil ___% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☑ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** CR7	**UNIQUE SITE ID:**	
DATE: 9/13/17	**ASSESSED BY:** GF	**CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** __° __' __" **LONG** __° __' __"		**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION 38.073617, -84.499221

Name and Address: Blugrass Contracting
698 Kennedy Rd

SIC code (if available): ______

NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

Category: ☑ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

Basic Description of Operation: Construction Yard

	INDEX*
B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)* — **Observed Pollution Source?**	☑
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ______	
B2. Approximate number of vehicles: ______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☒ Y ☐ N ☐ Can't Tell	○ ✓
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☑ N/A *(Skip to part D)* — **Observed Pollution Source?**	☑
C1. Are loading/unloading operations present? ☑ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☑ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☑ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○ ✓
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☒ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☑ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☑ Y ☐ N ☐ Can't Tell	○ ✓
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☑ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☑ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☒ N/A *(Skip to part E)* — **Observed Pollution Source?**	☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☑ N/A *(Skip to part F)* — **Observed Pollution Source?**	☐
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○ ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ N/A *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____% Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☑ N/A *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:
☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes: Two lots

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** CR-10		**UNIQUE SITE ID:**
DATE: 9/14/17	**ASSESSED BY:**	**CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** __° ___' ___" **LONG** __° ___' ___"		**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

38.067543, -84.472168

Name and Address: Duffs/Royal
177/175 New Circle R

Category: ☑ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related
Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ________

Basic Description of Operation: Sales/Repair Auto

NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

INDEX*

B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)*

Observed Pollution Source? ☑

B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☑ Other: ______	
B2. Approximate number of vehicles: 50	
B3. Vehicle activities *(circle all that apply)*: [✓ Maintained] [✓ Repaired] Recycled Fueled [✓ Washed] [✓ Stored]	○✓
B4. Are vehicles stored and/or repaired outside? ☑ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☑ Y ☐ N ☐ Can't Tell	○✓
B5. Is there evidence of spills/leakage from vehicles? ☑ Y ☐ N ☐ Can't Tell	○✓
B6. Are uncovered outdoor fueling areas present? ☐ Y ☑ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☑ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☑ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○✓

C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)*

Observed Pollution Source? ☐

C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○

D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)*

Observed Pollution Source? ☐

D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply*): ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○

E. PHYSICAL PLANT ☐ N/A *(Skip to part F)*

Observed Pollution Source? ☐

E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

Potential Generator Investigation **PGI**

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know	○
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)*	**Observed Pollution Source?** ☐
F1. % of site with: Forest canopy ____% Turf grass _____% Landscaping ____% Bare Soil ____%	○
F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell	○
G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)*	**Observed Pollution Source?** ☐
G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________	○
G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown Is trash present in gutters leading to storm drains? If so, complete the index below.	○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)

☒ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:
Surface oil Staining Common

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** CR-12		**UNIQUE SITE ID:**
DATE: 9/14/17	**ASSESSED BY:** GF	**CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** ___° ___' ___" **LONG** ___° ___' ___"		**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION 38.060641, -84.484485

Name and Address: Zeigler Tire
851 N. Broadway

Category: ☑ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related
Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ________

NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

Basic Description of Operation: Retail tire

	INDEX*
B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)* — **Observed Pollution Source?** ☐	
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ________	
B2. Approximate number of vehicles: ______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — **Observed Pollution Source?** ☑	
C1. Are loading/unloading operations present? ☑ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☑ N ☐ Can't Tell	○✓
C2. Are materials stored outside? ☑ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○✓
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☑ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☑ Y ☐ N ☐ Can't Tell	○✓
C5. Does outdoor storage area lack a cover? ☑ Y ☐ N ☐ Can't Tell	○✓
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☑ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☑ Can't Tell	○
D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)* — **Observed Pollution Source?** ☑	
D1. Type of waste *(check all that apply)*: ☑ Garbage ☐ Construction materials ☐ Hazardous materials	○✓
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☑ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☑ N ☐ Can't Tell	○✓
E. PHYSICAL PLANT ☑ N/A *(Skip to part F)* — **Observed Pollution Source?** ☐	
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○ ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know ○

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know ○

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ **N/A** *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____% Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☑ **N/A** *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown
Is trash present in gutters leading to storm drains? If so, complete the index below. ○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ____________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☒ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes: arly Soil Core tires stored on Loudon Ave side of property. Similar condition on Keyon RD. Side

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** CR 10	**UNIQUE SITE ID:**
DATE: ___/___/_____	**ASSESSED BY:** / **CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** ___° _____' _____" **LONG** ___° _____' _____"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

38.065407, -84.477834

Name and Address: Legends BB Field
207 Legends Ln

Category: ☑ Commercial ☐ Industrial Miscellaneous
☐ Institutional ☐ Municipal ☐ Golf Course
☐ Transport-Related ☐ Marina
☐ Animal Facility

SIC code (if available): __________

NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

Basic Description of Operation: Minor league Baseball

	INDEX*
B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)* — **Observed Pollution Source?** ☐	
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: __________	
B2. Approximate number of vehicles: ________	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — **Observed Pollution Source?** ☑	
C1. Are loading/unloading operations present? ☑ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☑ Y ☐ N ☐ Can't Tell	○ ✓
C2. Are materials stored outside? ☑ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _______ Where are they stored? ☐ grass/dirt area ☑ concrete/asphalt ☐ bermed area	○ ✓
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☑ Y ~~☒ N~~ ☐ Can't Tell	○ ✓
C4. Is staining or discoloration around the area visible? ☐ Y ☑ N ☐ Can't Tell	○ ✓
C5. Does outdoor storage area lack a cover? ☑ Y ☐ N ☐ Can't Tell	○ ✓
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☑ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☑ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☑ N/A *(Skip to part E)* — **Observed Pollution Source?** ☐	
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☑ N/A *(Skip to part F)* — **Observed Pollution Source?** ☐	
E1. Building: Approximate age: ________ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

Potential Generator Investigation **PGI**

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know ○

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know ○

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☑ N/A *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☑ N/A *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown
Is trash present in gutters leading to storm drains? If so, complete the index below. ○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☑ 3	☐ 4	☐ 5
Organic material	☑ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☑ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☑ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes: Field maint. materials exposed on Lot

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** 15023(?)	**UNIQUE SITE ID:**
DATE: 9/14/17	**ASSESSED BY:** GF	**CAMERA ID:** / **PIC#:**
MAP GRID:	**LAT** ___°_____'____" **LONG** ___°_____'____"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION 38.068762, -84.472363

Name and Address: Broadway Auto Mall
1651 N. Broadway

SIC code (if available): __________

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

Category: ☑ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

Basic Description of Operation: Used Auto Sales

	INDEX*
B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)* — **Observed Pollution Source?**	☑
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: sales	
B2. Approximate number of vehicles: >100	
B3. Vehicle activities *(circle all that apply)*: [✓ Maintained] [✓ Repaired] Recycled Fueled [✓ Washed] [✓ Stored]	○ ✓
B4. Are vehicles stored and/or repaired outside? ☑ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☑ Y ☐ N ☐ Can't Tell	○ ✓
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☑ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☑ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☑ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☑ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☑ Y ☐ N ☐ Can't Tell	○ ✓
C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — **Observed Pollution Source?**	☐
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)* — **Observed Pollution Source?**	☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☐ N/A *(Skip to part F)* — **Observed Pollution Source?**	☐
E1. Building: Approximate age: ________ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know	○
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)*	**Observed Pollution Source?** ☐
F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____%	○
F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell	○
G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)*	**Observed Pollution Source?** ☐
G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________	○
G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown Is trash present in gutters leading to storm drains? If so, complete the index below.	○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)

☑ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Potential Generator Investigation **PGI**

WATERSHED: Cane Run	**SUBWATERSHED:** CR-11 (?)	**UNIQUE SITE ID:**
DATE: 9/14/17	**ASSESSED BY:** GF **CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** __°__'__" **LONG** __°__'__"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION 38.066611, -84.480879

Name and Address: Star Mfg.
1200 Russell Cave Rd

Category: ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related
Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ______

NPDES Status: ☐ Regulated ☐ Unregulated ☑ Unknown

Basic Description of Operation: Industrial Parts (?)

	INDEX*
B. VEHICLE OPERATIONS ☑ N/A *(Skip to part C)* — **Observed Pollution Source?** ☐	
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ______	
B2. Approximate number of vehicles: ______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — **Observed Pollution Source?** ☑	
C1. Are loading/unloading operations present? ☑ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☑ Y ☐ N ☐ Can't Tell	○✓
C2. Are materials stored outside? ☑ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☑ concrete/asphalt ☐ bermed area	○✓
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☑ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☑ Y ☐ N ☐ Can't Tell	○✓
C5. Does outdoor storage area lack a cover? ☑ Y ☐ N ☐ Can't Tell	○✓
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☑ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☑ Y ☐ N ☐ Can't Tell	○✓
D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)* — **Observed Pollution Source?** ☐	
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☐ N/A *(Skip to part F)* — **Observed Pollution Source?** ☐	
E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○ ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know ○

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know ○

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____% ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown
Is trash present in gutters leading to storm drains? If so, complete the index below. ○

Index Rating for Accumulation in Gutters

	Clean				Filthy
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Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: __________ Condition: ☐ Dirty ☐ Clean

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☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes: See Storage in Rear of facility