2014

A Summary of the Kentucky River Watershed Watch 2014 Water Sampling Results

Kentucky Water Resources Research Institute

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Watershed Watch is a non-profit organization that was formed in 1997 to support a citizen monitoring effort, improve and protect water quality by raising community awareness, and promote the goals of the Clean Water Act and other water quality initiatives.

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TABLE OF CONTENTS

APPENDIX A: FIGURES

APPENDIX B: TABLES

CHAPTER 1: INTRODUCTION

Background

This report documents the results of the 2014 Kentucky River Watershed Watch sampling effort, which was supported through funding and other contributions from the Kentucky River Authority, the Kentucky Division of Water, Bluegrass PRIDE, Bluegrass Community Foundation, the Kentucky Waterways Alliance, the Lexington-Fayette Urban County Government, and the Virginia Environmental Endowment. Kentucky River Watershed Watch is a volunteer organization with the following goals:

- To provide current data on general water quality conditions to local stream based organizations working to protect their watershed.
- To provide widespread screening for potential water quality problems to resource management agencies.
- To provide auxiliary information to assist resource management agencies in meeting specific operational and management objectives.
- To identify specific impacts to water quality through targeted observations and measurements.

The 2014 sampling effort was conducted according to KRWW's Annual Workplan. (See "About," then "Work Plan" on organization's website at www.krww.org.) Detailed sampling results for 2014 and past years are also posted on the KRWW web site at http://www.krww.org.

2014 Sampling Site Overview

During 2014, Kentucky River Watershed Watch volunteers collected water samples from streams, rivers and lakes throughout the Kentucky River Basin. A total of 166 sites were sampled during the spring, summer and fall sampling events.

The Kentucky River Basin extends over much of the central and eastern portions of the state and is home to approximately 710,000 Kentuckians. The watershed includes all or part of 42 counties and drains over 7,000 square miles with a tributary network of more than 15,000 miles. A map of the watershed with the associated counties is shown in Figure 1 (see Appendix A for all figures). For the purpose of watershed management, the river basin has been subdivided into smaller sub-basins and watersheds using the USGS Hydrologic Unit Code (HUC) classification system. A map showing the 8-digit sub basins is shown in Figure 2. A more detailed description of the smaller 11-digit HUC watersheds is provided in Figures 3-5.

An index of the 2014 KRWW sampling sites is provided in Table 1 (see Appendix B for all tables with the exception of Table 2), and the locations of the 166 sites sampled in 2014 are shown in Figure 6. The 2014 sampling sites were highly concentrated in the central and southeastern regions of the Kentucky River Basin.

Water quality data were collected at four different times between May and September of 2014. A listing of the sample dates and types of data collected during each sample period is provided in the table below.

Table 2: Summary of 2014 Kentucky River Watershed Watch Sampling Events

Sampling Event	Dates	# of Sites Sampled
Spring Herbicide Event	May 14-18, 2014	16 (NEW sites)
Synoptic Pathogen Event	July 11-15, 2014	115
Follow-Up Pathogen Event	August 7-9 2014	46
Fall Nutrients/Chemistry Event	September 11-18, 2014	110
Metals Event	September 11-18, 2014	50

2014 Flow Conditions

In order to provide a basis for interpreting the sampling results, it is important to understand the associated stream flow conditions. For example, data collected during low flow or dry conditions may be more indicative of the impact of "point source" discharges, mainly from pipes. Data collected following a storm may be more reflective of the impacts of "non-point" pollutant discharges, or pollution that is picked up from stormwater runoff.

An indication of the stream flow conditions during the sampling period may be obtained by examination of USGS (United States Geological Survey) stream flow records. For the purposes of this study, five separate USGS gaging stations were selected to provide an indication of the stream flow conditions during the sampling period. Stream flow plots for each station showing the flow rates during each of the different sampling efforts are shown in Figures 7-11. (Daily stream flow values for these tables can be found on the USGS website at http://ky.water.usgs.gov).

The flow graphs illustrate the varying flow conditions present during the 2014 KRWW sampling season. Typically, lower flows indicate that a concurrent sampling event is more likely to capture point sources, such as sewage from leaking sanitary sewer infrastructure or straight pipes. Higher flows can indicate a recent precipitation event, and sampling may capture more nonpoint source contributions, such as septic system runoff, livestock waste from pastureland or fertilizer runoff from lawns or crops.

Generalizations about flow levels relative to pollutant concentrations are complicated by a variety of factors, and as with most scientific investigations will require more data to fine tune the meaning of the sampling results. Complicating factors include:

- Higher flows can mobilize pollutants that have accumulated in the stream, raising their concentrations.
- Higher flows can cause sanitary sewer overflows that add to levels of certain pollutants (i.e., pathogens, nutrients).
- Without long-term sampling results, it is difficult to make connections between elevated pollutant levels and higher water volumes. Is it lower due to dilution from high water volumes? Or, it higher due to stormwater runoff carrying these pollutants into the stream?

Regardless, it is important to consider flow levels, as well as flow rates and precipitation records, when evaluating the meaning of water sampling results.

Spring Sampling Event: Moderately high flows were observed at the time of the Spring Sampling Event in May 2014.

Synoptic Pathogen Sampling Event: The flows during the first (synoptic) pathogen sampling in July were the lowest of all sampling events. Since flows had been consistently low leading up this sampling event, it is likely that any observation of high E coli levels would be due to point source contributions, such as leaking sewer lines.

Follow-Up Pathogen Sampling Event: The second (follow-up) pathogen sampling event also occurred during lower flow conditions, but appears to have taken place shortly after higher flow peaks. This flow condition could indicate pathogen contributions from runoff sources, such as livestock pasture or septic systems.

Fall Sampling Event: Higher, declining flows were observed across the basin during the fall nutrient/chemical/metals sampling event in September. This observation may indicate a higher concentration of pollutants associated with runoff sources from pasture (nutrient and conductivity), residential septic systems (nutrients and conductivity), urbanized areas (metals, nutrients, conductivity), among other land use sources. Or, it could indicate that a "flush" of pollutants has occurred, producing lower readings of assessed water quality indicators.

CHAPTER 2: DATA COLLECTION AND ANALYSIS

Physical/Chemical Field Data

General physical/chemical field data (dissolved oxygen, pH, water temperature, and observed flow level) were collected at each sample site during the four separate basin wide sampling periods. A summary of the physical/chemical data collected during this period is provided in Table 3. The table also includes conductivity and turbidity results for some of the sampling sites.

Dissolved Oxygen

A dissolved oxygen value less than 5.0 mg/L is problematic for aquatic organisms, causing increased susceptibility to environmental stresses, reduced growth rates, mortality and an alteration in the distribution of aquatic life. The normal range for dissolved oxygen in freshwater streams is between 6.5 mg/L and 8.5 mg/L.

Dissolved oxygen is inversely proportional to water temperature, with higher levels of dissolved oxygen corresponding to lower temperatures. According to temperature, there are maximum dissolved oxygen concentrations, with 14.6 mg/L being the absolute maximum. Thus, dissolved oxygen results greater than 14.6 mg/L are not possible. Additionally, samplers can check the likelihood of their findings by checking a dissolved oxygen vs temperature table (see http://water.epa.gov/type/rsl/monitoring/vms52.cfm).

Eighteen percent of the sites (43 of 243 sites) displayed a dissolved oxygen value less than 5.0 mg/L. The 43 sampling sites with 2014 readings less than 5.0 mg/L are noted in Table 3.

pH

A pH value less than 6 signifies acidic conditions in which toxic heavy metals are more soluble, and therefore more available for uptake by aquatic life. At pH values greater than 9, toxic ammonia concentrations increase. Thus, a pH between 6 and 9 indicates that the waterbody is within a safe pH range for the survival of aquatic life. **Three of the reported pH readings for 2014 were less than 6, and two readings were greater than 9.**

Temperature

In addition to having its own toxic effect, water temperature affects the solubility and the toxicity of many other water quality parameters. Generally, the solubility of solids increases with increasing temperature, while gases tend to be more soluble in cold water. An important physical relationship exists between the amount of dissolved oxygen in a body of water and its temperature. The warmer the water, the less dissolved oxygen. Colder water can maintain greater dissolved oxygen concentrations.

One site (#2924 at Tates Creek, Madison Co.) had a temperature reading that exceeded 31.7° Celsius, the water quality standard for protection of aquatic life in warm water streams.

Flow

Based on visual observations, the flow rate in the streams was assessed using the following numerical equivalents:

0 – Dry

1 – Ponded

2 – Low

3 – Normal

4 – Bank Full

5 – Flood

The visual flow assessments during the 2014 KRWW sampling season were mainly low (2) to normal (3), with very few ponded (1) or flood level (5) observations.

Spring Sampling Event: Flows were mainly normal (3) for the spring herbicide event, with reports of up to 0.5 to 1.5 inches of recent rainfall.

Synoptic Pathogen Sampling Event: The first pathogen sampling event in July was also conducted during mainly low to normal conditions, with some of the higher flows reported in parts of the upper (southeastern) parts of the basin. Very little recent rainfall was reported.

Follow-Up Pathogen Sampling Event: Flows were about the same during the second pathogen sampling event, mainly reported as low to normal. There were more reports of recent rainfall. especially in the southeastern portion of the basin. Recent rainfall conditions could result in E coli findings from runoff sources, such as septic systems and livestock pastures.

Fall Sampling Event: Higher flows and greater recent rainfall amounts were reported during the September sampling event, which is unusual in the fall. High pollutant levels occurring during higher flow levels and following recent rainfall can indicate runoff contributions from area sources. On the other hand, lower levels can result from the dilution effects of larger water volumes in the stream.

Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. Conductivity measurements are used to determine levels of total inorganic dissolved solid ions, such as nutrients, metals, or other compounds. Indirect effects of high conductivity levels are primarily the elimination of plants needed for food or habitat and the decline of sensitive aquatic species, such as mayflies and fish.

Some volunteers have field equipment to measure conductivity onsite. **Sixty-one percent (or 161/263) of the field conductivity readings during the 2014 sampling season were at 500 microSiemens/cm (**mS/cm) **or greater**. This conductivity level is the EPA's newly established criterion for streams in Central Appalachia. In central Appalachia, the conductivity of headwater streams is naturally between 100 and 200 mS/cm. This is important because the plants, insects and animals in local streams have adapted to living in this level of conductivity. Recent studies conducted by the EPA show that when the conductivity in central Appalachian streams rises to about 300 mS/cm, the plants, insects and animals begin to be affected. When the conductivity of these streams goes above 500 mS/cm, the plants, insects and animals are drastically affected. And when the conductivity measures above 1,000 mS/cm, everything in the stream is effectively dead. [NOTE: KDOW sampling has shown that some pollutant-tolerant aquatic life is present at conductivity levels greater than 1,000 mS/cm.] In other regions of the country the natural conductivity may be higher or lower than in central Appalachia, and the plants, insects and animals there will have adapted over thousands of years to live within those natural conductivity levels.

Turbidity

Turbidity is a measure of water clarity and how much the material suspended in the water decreases the passage of light through the water. Suspended materials include soil particles (clay, silt and sand), algae, plankton, microbes, and other substances. Higher turbidity increases water temperatures, because suspended particles absorb more heat. This, in turn, reduces the concentration of dissolved oxygen because warm water holds less dissolved oxygen than cold water. Higher turbidity also reduces the amount of light penetrating the water, which reduces photosynthesis and the production of oxygen. Suspended materials can clog fish gills, reducing resistance to disease in fish, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Sources of turbidity include soil erosion, waste discharge, urban runoff, eroding streambanks, large numbers of bottom feeders which stir up bottom sediments and excessive algal growth (USEPA, www.epa.gov/owow/monitoring/volunteer/stream/vms55.html). The state of Kentucky has not issued water quality standards for turbidity.

Turbidity results were based on subjective observations at the time of sampling. Volunteers rated the turbidity of the waterbody on a scale of 0 (clear) to 3 (turbid). Most 2014 observations indicated clear (0) to slightly turbid conditions (1).

Herbicide Indicators

During the spring sampling event of May 2014, 16 sampling sites were tested for Triazines to evaluate the possibility of potential pollution from rural and/or urban herbicide applications.

followed by biodegradation. Atrazine is highly persistent in soil. Chemical hydrolysis followed by microbial breakdown accounts for most of its degradation in soil. Although hydrolysis is rapid in acidic or basic soil environments, it is slower at neutral pHs.

The EPA's drinking water standard maximum contaminant level for Atrazine is 3 micrograms/L (http://www.epa.gov/safewater/mcl.html). EPA's Office of Water has published a draft ambient water quality criteria document for atrazine containing acute and chronic criteria recommendations for the protection of aquatic life in both freshwater and saltwater. The procedures described in the "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" indicate that, except possibly where a locally important species is very sensitive, freshwater aquatic life and their uses should not be affected unacceptably if the one-hour average concentration does not exceed 350 ug/L more than once every three years on the average (acute criterion). If the four-day average concentration of atrazine does not exceed 12 ug/L more than once every three years on the average (chronic criterion).

Herbicide Sampling Results

Herbicide data were collected at 16 new sampling sites during May of 2014. **Five of the 16 sites had detectable levels of Triazine. The detections were observed at stream sites in Franklin and Estill Counties. None of the triazine detections exceeded recommended water quality standards.**

The locations of the five sites with herbicide detections are shown in Figure 12. A summary of the results for the herbicide data collection effort is provided in Table 4.

Bacteriological Indicator

A number of pathogenic (disease causing) viruses, bacteria, and protozoans can enter a water body via fecal contamination. Human illness can result from drinking water or swimming in water that contains pathogens. Eating shellfish harvested from such waters may also result in human illness.

Unfortunately, direct testing for pathogens is impractical. Pathogens are rarely present in large numbers, and many are difficult to cultivate in the lab. Instead, microbiologists look for "indicator" species – so called because their presence indicates that fecal contamination may have occurred. The indicators most commonly used today include: total coliforms, fecal coliforms, Escherichia coli, fecal streptococci, and enterococci. Each of these bacteria are normally prevalent in the intestines and feces of warm-blooded animals, including humans. The indicator bacteria themselves are not usually pathogenic. All but E. coli are composed of a number of species of bacteria that share common characteristics such as shape, habitat, or behavior. E. coli is a single species in the fecal coliform group. It should be pointed out that when a water sample is determined to contain E. coli, that does not necessarily mean that the dangerous strain (i.e. E. coil O157:H7) is actually present, it is probably not, however this would indicate recent fecal contamination.

Escherichia coli (E. coli)

The bacteria, E. coli, is commonly found in intestines of healthy humans and animals and produces the K and B– complex vitamins that are then absorbed for nutritional benefit. The presence of E. coli in water indicates fecal contamination and the potential for waterborne disease. EPA recommends E. coli as the best indicator of health risk from water contact in recreational waters. Kentucky has transitioned from a fecal coliform standard to an E. coli standard. Recently, Akasapu and Ormsbee (2014) developed a mathematical approximation between fecal coliform values (FC) and E. Coli values for samples in the Kentucky River Basin which can be used to relate past fecal coliform values to "equivalent" E. coli values. The relationship is: $E.coli = 1.435*FC^{0.8093}$

The state criteria for E. coli are based on the designated use of the particular stream and may be summarized as follows: *Primary Contact Recreation* (swimming from May 1 thru Oct 31): E. coli shall not exceed 130 colonies per 100 ml as a monthly geometric mean based on not less than 5 samples per month; nor exceed 240 colonies per 100 ml in 20 percent or more of all samples taken during the month [Note: As a result of the sampling frequency requirement with the first criteria, the state of Kentucky uses the 240 colonies per 100-ml criteria for classifying streams in the 305(b) report].

Bacteriological Sampling Results

E coli sampling was conducted twice in the Kentucky River basin during the summer of 2014. The first round of sampling, or the synoptic event, was available for all samplers at all sampling sites. The second round, or follow-up event, was only available at those sites that produced E coli results greater than 240 cfu/100 ml during the synoptic sampling event. The results of each sampling effort are discussed in the following sections.

Synoptic Pathogen Sampling

As in past years, a synoptic round of E coli samples was collected during the month of July. The sample locations are shown in Figure 13. The individual results for each site are shown in Table 5. A ranking of the stations by the magnitude of the E. coli results is shown in Table 6. **Forty-five percent of the synoptic samples exceeded the state's safe swimming/wading standard.**

Follow-Up Pathogen Sampling

Based on the observation of **high readings at 52 of 115 of the synoptic E. coli sites** (i.e., >240 CFU/100 ml), an additional round of pathogen sampling was conducted in August for those sites with exceedances.
The results of this sampling effort are provided in Table 7. **Results indicated continuing pathogen-related problems at 43 of 46 (93%) of the re-sampled sites.** The follow-up sampling sites are mapped in Figure 14.

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Chemical Indicators

General chemical data (alkalinity, chlorides, conductivity, total suspended solids, and sulfate) were collected at 93 sampling locations during the month of September. The individual results for each sample are shown in Table 8.

Alkalinity

Alkalinity refers to the degree to which the water sample is basic, or has a pH greater than 7, and affects the capability of water to neutralize acid. In most natural water bodies in Kentucky the buffering system is carbonate-bicarbonate. Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes. Higher alkalinity levels in surface waters will buffer acid rain and other acid wastes and prevent pH changes that are harmful to aquatic life. Kentucky's water quality criteria state that for protection of aquatic life, the buffering capacity should be at least 20 mg/L. If alkalinity is naturally low, (less than 20 mg/L) there can be no greater than a 25% reduction in alkalinity. **During the 2014 KRWW sampling season, alkalinity values ranged from 88 mg/L at Site #3006 on Lower Howard Creek in Clark County to 772 mg/L at Site #1221 on Cane Run in Scott County.**

Chlorides

Chlorides are salts resulting from the combination of the gas chlorine with a metal. Fish and aquatic communities cannot survive in waters with high levels of chlorides. The state of Kentucky requires that chloride levels be less than 250 mg/L in domestic water supplies. Criteria for protection of aquatic life require levels of less than 600 mg/L for chronic (long-term) exposure and 1200 mg/L for short-term exposure. **During the 2014 KRWW sampling season, chloride values ranged from 4.5 mg/L at Site #833 at a spring in Woodford County to 270 mg/L at Site #1139 at Vaughn's Branch in Fayette County.** A Vaughn's Branch sampling site also produced the highest chloride levels during the 2010 and 2011 sampling seasons.

Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. Conductivity measurements are used to determine mineralization, or total dissolved solids. Indirect effects of excess dissolved solids are primarily the elimination of desirable food plants and habitat-forming plant species. For Kentucky, water quality criteria have been established only for the mainstem of the Ohio River. The limit is 800 microsiemens/cm or 500 mg/L total dissolved solids. The USEPA also recently established conductivity criteria for support of aquatic life in Central Appalachian streams of 500 microsiemens/cm.

During the 2014 KRWW sampling season, conductivity values ranged from 356 mS/cm **at site #978 on Muddy Creek in Madison County to 2,003** mS/cm **at site #945 at Lost Creek in Breathitt County. Eighty-seven percent of the lab readings of conductivity were greater than the KRWW unofficial aquatic life standard of 500** mS/cm**.**

Total Suspended Solids**:**

One of the biggest sources of water pollution in Kentucky is suspended solids. Suspended solids include inorganic particles (silts, clays, etc.) and organic particles (algae, zooplankton, bacteria, and detritus) that are carried along by water as it runs off the land. The inorganic portion is usually considerably higher than the organic. Both contribute to turbidity, or cloudiness of the water. High values of TSS cause multiple environmental impacts, including clogging fish gills, reducing light penetration, and siltation of stream bottoms and associated habitats. Indirectly, the suspended solids affect other parameters such as temperature and dissolved oxygen. Suspended solids also interfere with effective drinking water treatment. High sediment loads interfere with coagulation, filtration, and disinfection, and more chlorine is required to effectively disinfect turbid water.

There are no quantitative criteria for TSS. The Kentucky Water Quality Standards for aquatic life state that suspended solids "shall not be changed to the extent that the indigenous aquatic community is adversely affected" and "the addition of settleable solids that may adversely alter the stream bottom is prohibited." The National Academy of Sciences has recommended that the concentration of TSS should not reduce light penetration by more than 10%. In a study in which TSS were increased to 80 mg/L, the macroinvertebrate population was decreased by 60%. **During the 2014 sampling season, total suspended solids concentrations ranged from less than the detection limit of 3 mg/L at five different sites to 31 mg/L at Site #990 at on an unnamed tributary in Madison County.**

Sulfate:

The most common form of sulfur in well-oxygenated waters is sulfate. Sulfates ($SO4^{-2}$) can be naturally occurring or the result of municipal or industrial discharges. When naturally occurring, they are often the result of the breakdown of leaves that fall into a stream, of water passing through rock or soil containing gypsum and other common minerals, or of atmospheric deposition. Point sources include sewage treatment plants and industrial discharges such as tanneries, pulp mills, and textile mills. Runoff from coal mining operations and fertilized agricultural lands also contributes sulfates to water bodies.

High levels of sulfate in drinking water (> 250 mg/L) can produce an objectionable, astringent taste and can have laxative effects. Generally, older children and adults become accustomed to sulfate in drinking water, but infants are more sensitive to its effects and water high in sulfate (> 400 mg/L) should not be used for baby formula. Sulfate can be removed from drinking water through processes involving ion exchange, reverse osmosis or distillation, but carbon filtration does not remove it.

When sulfate is less than 0.5 mg/L, algal growth will not occur. The state water quality standard for sulfate in drinking water supplies is 250 mg/L.

Eleven of the 106 sulfate concentrations exceeded the state drinking water supply standard of 250 mg/L. Sulfate results are displayed in Table 8. The greatest sulfate reading of 3,019 mg/L was taken at site #3353 on Fairchild Branch in Letcher County. Typically, KRWW sites that exceed the drinking water supply standard for sulfate are located in the coal mining region of southeastern Kentucky and result from groundwater flowing through bedrock with higher sulfur content.

Nutrient Indicators

Oxygen demanding materials and plant nutrients are among the most common substances discharged to the environment by man’s activities, through wastewater facilities and by agricultural, residential, and storm water runoff. The most important plant nutrients, in terms of water quality, are phosphorus and nitrogen. In general, increasing nutrient concentrations increase the potential for accelerated growth of aquatic plants, including algae. Nuisance plant growth can create imbalances in the aquatic community, as well as cause aesthetic and access issues. High densities of phytoplankton (algae) can cause wide fluctuations in pH and dissolved oxygen.

Total phosphorus (TP) is commonly measured to determine phosphorus concentrations in surface waters. TP includes all of the various forms of phosphorus (organic, inorganic, dissolved, and particulate) present in a sample. Phosphorus is one of the key elements necessary for growth of plants and animals. Phosphates are made up of phosphorus and exist in three forms: orthophosphate, metaphosphate (or polyphosphate) and organically bound phosphate. Each compound contains phosphorous in a different chemical formula. *Ortho* forms are produced by natural processes and are found in sewage. *Poly* forms are used for treating boiler waters and in detergents. In water, they change into the *ortho* form. Organic phosphates are important in nature. Their occurrence may result from the breakdown of organic pesticides that contain phosphates. They may exist in solution, as particles, loose fragments, or in the bodies of aquatic organisms.

In addition to man-made sources, some phosphorus loadings may occur naturally from the watershed soils and underlying geology. Due to background levels of total phosphorus in the Kentucky River Basin as high as 0.25 mg/L, those sites with average total phosphorus concentrations of 0.3 mg/L can be noted as potentially problematic. The informal total phosphorus standard of 0.3 mg/L has been adopted by the KRWW Scientific Advisory Committee as an appropriate level of concern for water quality sampling conducted in the Kentucky River Basin. This value has also been recommended for use as an unofficial benchmark by the Kentucky Division of Water.

Nitrogen is routinely analyzed at most Kentucky ambient sampling sites in the forms of ammonia and ammonium (NH_3/NH_4), total Kjeldahl nitrogen (TKN), and nitrite and nitrate (NO_2/NO_3). Ammonia and ammonium are readily used by plants. TKN is a measure of organic nitrogen and ammonia in a sample. Nitrate is the product of aerobic transformation of ammonia, and is the most common form used by aquatic plants. Nitrite is usually not present in significant amounts. Nitrates can react directly with hemoglobin in the blood of humans and other warm-blooded animals to produce methemoglobin, which destroys the ability of red blood cells to transport oxygen. This condition is especially serious in babies under three months of age and causes a condition known as methemoglobinemia, or "blue baby" disease.

Nutrient delivery, particularly during the months of April through June, has been identified as one of the primary factors controlling the size of the hypoxic zone that forms during the summer in the northern Gulf of Mexico. The Gulf hypoxic zone is an area where oxygen levels drop too low to support most life in bottom and near-bottom waters. A Mississippi River/Gulf of Mexico Watershed Nutrient Task Force was created in 1997 to address the Massachusetts-size dead zone that is threatening the Gulf's fisheries. In 2008, the Task Force identified Kentucky and Indiana as two of the top six among 31 states contributing excess nitrogen and phosphorus to the Gulf from sources such as sewage treatment plants, farms and power plant emissions. It recommended that Kentucky, and other states contributing the most to the problem, enact new nutrient reduction strategies by 2013. A reassessment report was released in 2013, detailing progress made and outlining continuing plans to reduce nutrient impacts to the Gulf hypoxic zone (http://water.epa.gov/type/watersheds/named/msbasin/upload/hypoxia_reassessment_508.pdf).

Kentucky currently has no official numerical standards or criteria for phosphorus or nitrogen in state waterways, but is working toward developing these standards. The state drinking water supply standard for nitrate-nitrogen, which is a measurement of the nitrogen portion of the nitrate (NO_3) molecule, is 10 mg/L. In order to monitor nutrient effects on aquatic life, KRWW is using a proposed standard of 3 mg/L for total nitrogen, because this level has been demonstrated to produce nutrient-rich conditions supporting algal blooms, along with other aquatic habitat threats.

Nutrient Sampling Results

In addition to chemical data, general nutrient data (nitrate-nitrogen, total nitrogen, total phosphorus and sulfate) were also collected at sampling sites during September. A summary of the nutrient data collected during this period is provided in Table 9. **Twenty-nine of 110 (26%) of the sampling results exceeded the total nitrogen level of 3 mg/L. As illustrated in Figure 15, the highest total nitrogen reading of 5.88 mg/L was recorded at #1048 on Shannon Run in Woodford County.**

As shown in Figure 16, **34 of 110 stations (or 31%) had total phosphorus readings in excess of 0.3 mg/l. The highest recorded phosphorus reading was 0.76 mg/l, which occurred at station #796 on Spring Station in Woodford County.**

Metal Indicators

In addition to chemical and nutrient data, metals data were collected at 50 sampling sites (for total recoverable metals) in September 2014. Out of the 30 different metals tested during the 2014 KRWW sampling season, 14 metals are associated with specific water quality limits (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, nickel, silver, thalium, zinc). Drinking water supply standards are available for thirteen metals (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, nickel, selenium, thallium and zinc). Warm water aquatic life standards are available for eleven metals (aluminum, arsenic, cadmium, chromium, copper, iron, lead, nickel, selenium, silver and zinc).

Descriptions of each of the metals sampling parameters are provided in **Appendix C.** The sampling results for metals are provided in Table 10. **There were no detections of 7 of the 30 metal parameters, Antimony, Arsenic, Cadmium, Gold, Selenium, Silver, and Tin.**

Detections of eight different metals showed exceedances of related water quality standards. The following table summarizes those findings.

Metal Analyte	# of Drinking Water Standard Exceedances	# of Acute (short-term) Aquatic Life Exceedances	# of Chronic (long-term) Aquatic Life Exceedances	Site with Highest Reading
Aluminum	0	13	N/A	#1209
Beryllium	1	N/A	N/A	#1209
Copper	0	2	1	#3353
Iron	29	17	9	#1209
Lead	0	1	1	#1209
Nickel	2	2	2	#1209
Thalium	1	N/A	N/A	#921
Zinc	0	3	3	#1209

Biological and Habitat Assessments

In June of 2014, KRWW volunteers who had received advanced training to conduct biological and habitat assessments of their streams assessed eight separate stream segments. These assessments provide further insights into the quality of the water and current and potential threats to water quality. A summary of these assessments is included in the following table and in the map in **Figure 17**.

2014 KRWW Habitat and Biological Assessments

Site ID	Stream	County	Habitat Rating	Biological Rating
921	Otter Creek	Madison	good	fair
1028	Wolf Run	Fayette	good	fair
1124	Marble Creek	Jessamine	good	fair
1198	Glenns Creek	Woodford	poor	fair
1301	North Elkhorn Creek	Scott	good	fair
1307	Jessamine Creek	Jessamine	fair	fair
3085	St. Clair Spring	Fayette	poor	poor
3198	Clear Creek	Mercer	fair	fair

CHAPTER 3: EXECUTIVE SUMMARY

During the summer of 2014, multiple agencies and organizations provided funds for the support of volunteer water quality sampling in the Kentucky River Basin as part of the Kentucky River Watershed Watch effort. This report summarizes the results of that sampling effort. As part of this sampling effort, 166 separate sites were sampled at up to four different times for three main groups of parameters: herbicides, pathogens, and chemicals/nutrients/metals. In most cases, the stream was also sampled for basic physical and chemical parameters such as pH, temperature, and dissolved oxygen. Three of the reported pH readings for 2014 were less than 6, and two readings were greater than 9. Eighteen percent (43 of 243) of the dissolved oxygen readings were below the minimum threshold of 5 mg/l that is recommended for supporting aquatic life.

Sixteen sites were sampled for the Triazine herbicide. Triazine was detected at five of the sampling sites. None of the samples resulted in concentrations that were greater than the water quality standards for drinking water supplies or the aquatic life protection.

In 2014, E coli was analyzed for 115 sites in July. During this synoptic sampling event, 45% of sites analyzed for E. coli exceeded the primary contact recreation standard of 240 cfu/100 ml. The follow-up pathogen sampling event, which included 46 sites with previously high pathogen levels, showed that 93% of the re-sampled sites continued to exceed the standards for E coli.

The chemical analysis of samples in September showed that 87% had high conductivity values (e.g. > 500mS/cm). This is a greater proportion of sites with high conductivity readings than was observed in 2013 (58%), but is the same percentage as was determined in 2012. The sites with the highest readings were #1209 (Sandlick Creek, Letcher Co.) and #3353 (Fairchild Branch, Letcher Co.), both with conductivity values of 2,000 microsiemens/cm. And, eleven sites produced sulfate results that were greater than the associated drinking water supply standard of 250 mg/L.

Thirty-five of 110 sampled sites (32%) exceeded a proposed aquatic life standard for total nitrogen of 3 mg/L, but none of the sites exceeded the drinking water supply standard for nitrate-nitrogen of 10 mg/L. Forty-six of 110 sites (43%)displayed total phosphorus levels of concern (above 0.3 mg/L) for support of aquatic life.

Metals were analyzed for water samples at 50 sampling sites in September 2014. Several metal readings exceeded associated water quality standards, including aluminum, beryllium, copper, iron, lead, nickel, thalium and zinc. Site #1209 on Sandlick Creek in Letcher County showed exceedances for six different metals.

KRWW volunteers also conducted biological and habitat assessments at eight different sites in the Kentucky River Basin during 2014. Most habitat ratings were fair to good, and most biological ratings were fair.

Flows were generally lower during the 2014 sampling season, with some peaks in streamflow just prior to the herbicide and fall metal/nutrient/chemistry sampling events. The pathogen sampling events in July and August occurred during lower flow events in most areas of the basin, and may have captured pathogens from point sources, such as leaking sewage pipes or straight pipes.

In summary, the following sampling sites have been targeted for more in-depth sampling and water quality management efforts due to 2014 sampling results of concern. These sites are indicated on the map in Figure 18.

<u>2014 KRWW Sites of Concern</u>

- **South Elkhorn Creek Watershed**

    Wolf Run (Fayette County)

    Sites #915, 1128, 1132, 1135, 1137, 1138, 1139, 3059

    Shannon Run (Woodford County)

    Sites #1048

- **Glenn's Creek Watershed (Woodford County)**

    Sites #823, 954

- **Kentucky River Palisades (Woodford County)**

    Spring

    Site #954

- **Clear Creek (Woodford County)**

    Black Spring

    Site #922

- **West Hickman Creek (Fayette County)**

    Sites #1020, 1021

- **Mocks Branch (Boyle County)**

    Site #3133

- **Lower Howards Creek (Clark County)**

    Site #3283

- **Carr Fork (Perry County)**

    Right Fork Carr Creek

    Site #875

- **Rockhouse Creek (Letcher County)**

    Site #3084

- **North Fork Kentucky River Headwaters (Letcher County)**

    Pine Creek (#802)

    Cram Creek (#803, 1151)

    North Fork Kentucky River (#848)

    Sandlick Creek (#1209)

    Dry Fork (#1242)

    Lick Fork (#1248)

    Fairchild Branch (#3353)

APPENDIX A: FIGURES

Figure 1—Kentucky River Basin, Counties and Sub-Basins (8-Digit HUCs)

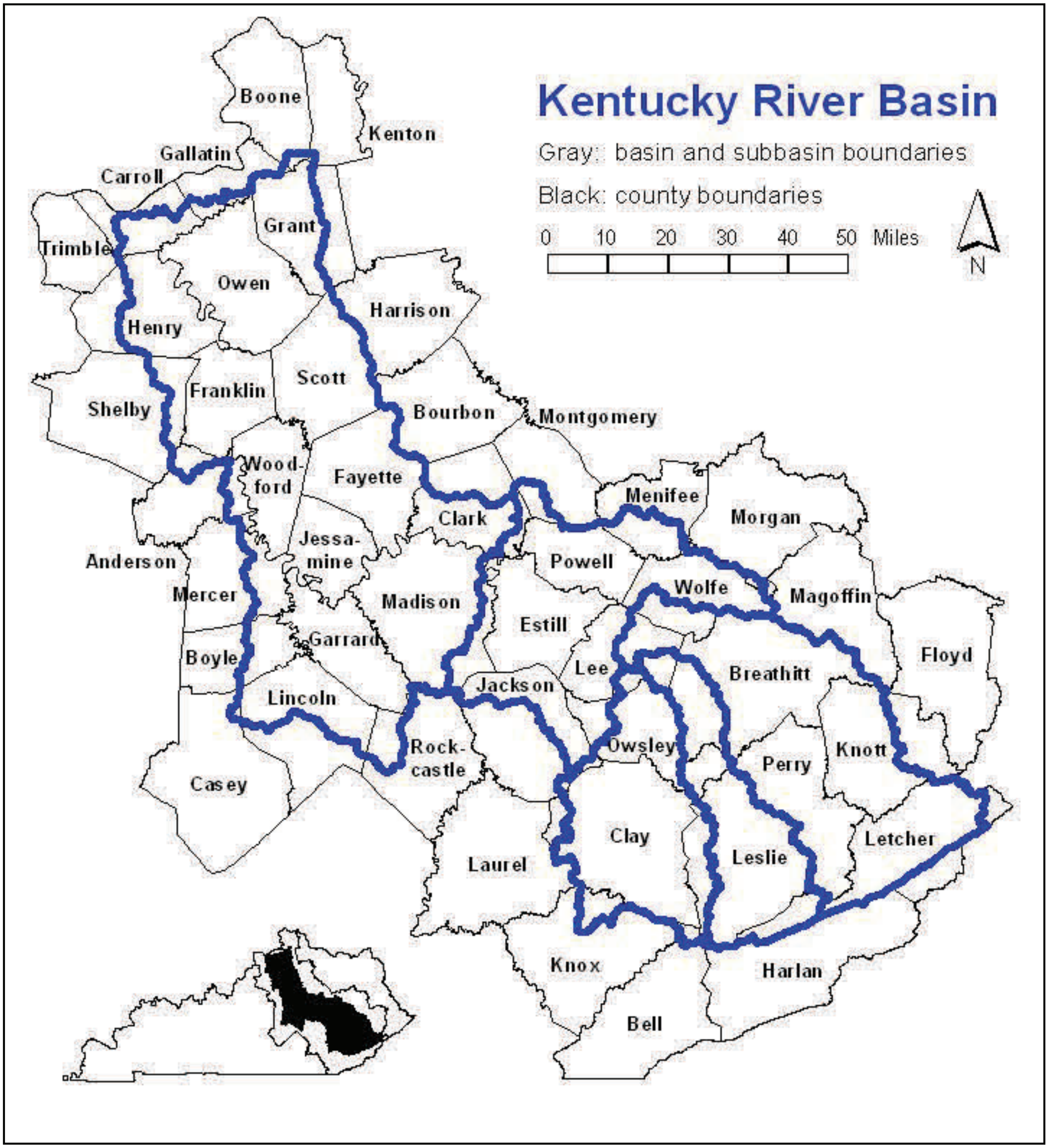


Figure 2—Kentucky River Basin and Sub-Basins (8-Digit HUCs)

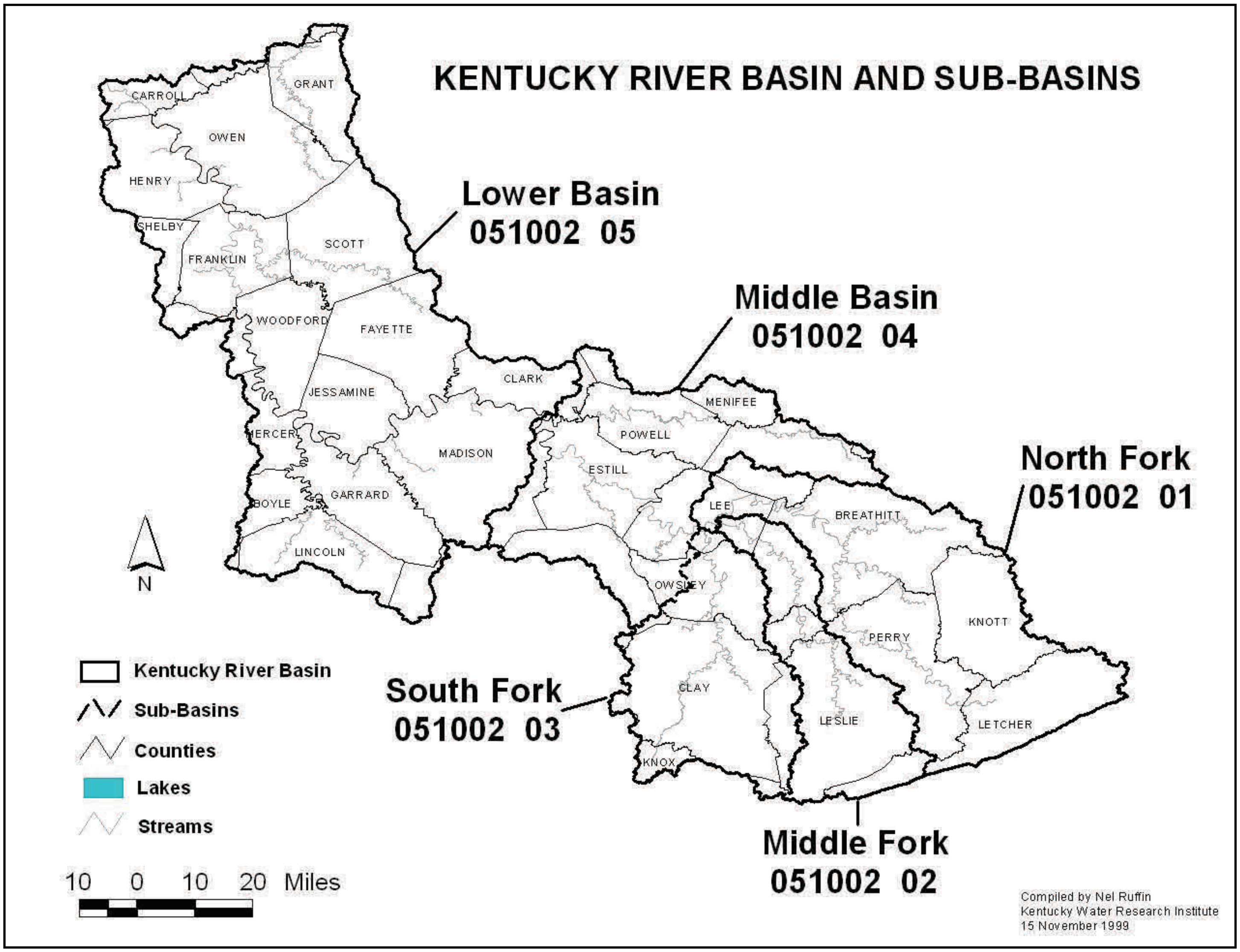


Figure 3—Kentucky River Northern Region

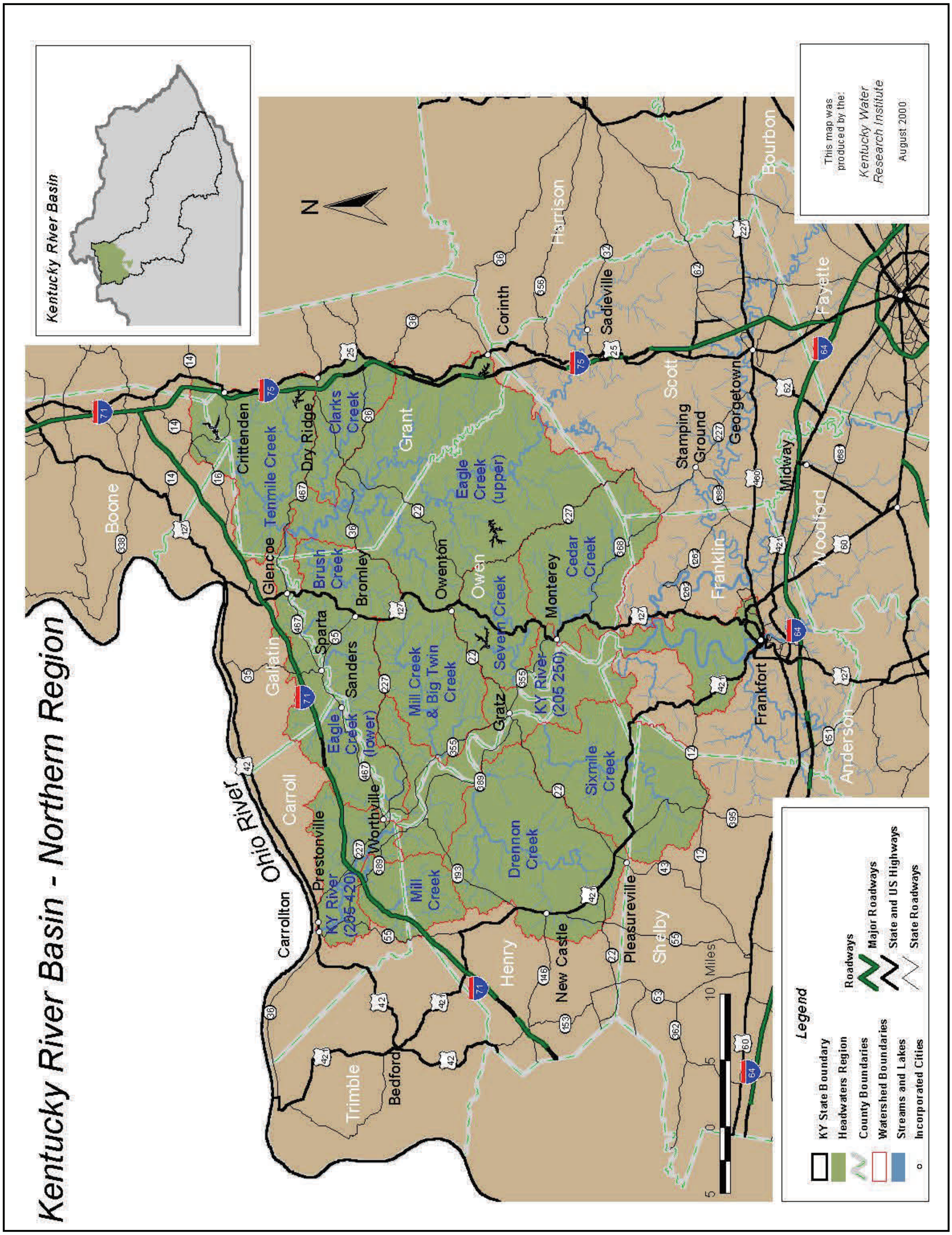


Figure 4—Kentucky River Central Region

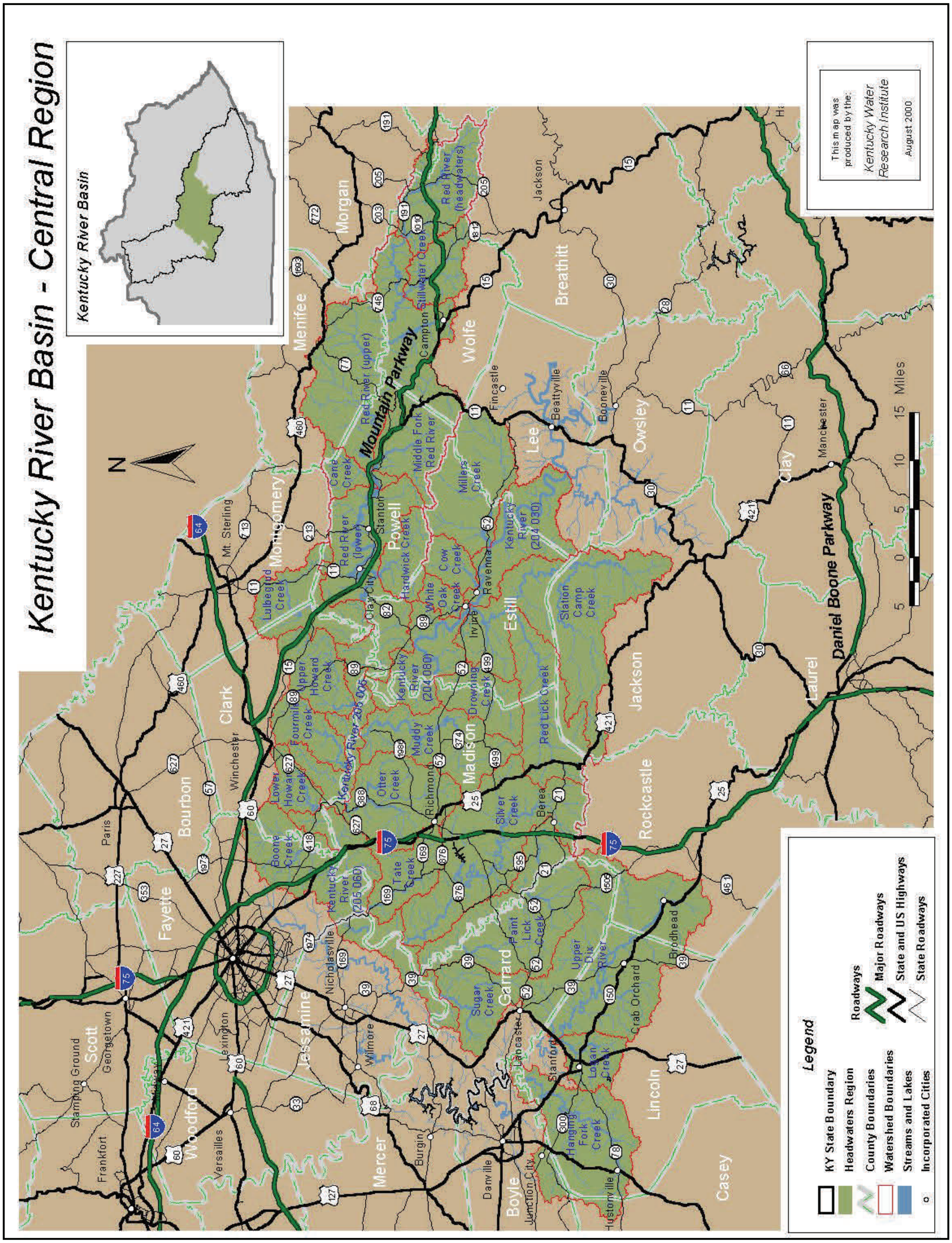


Figure 5—Kentucky River Southern Region

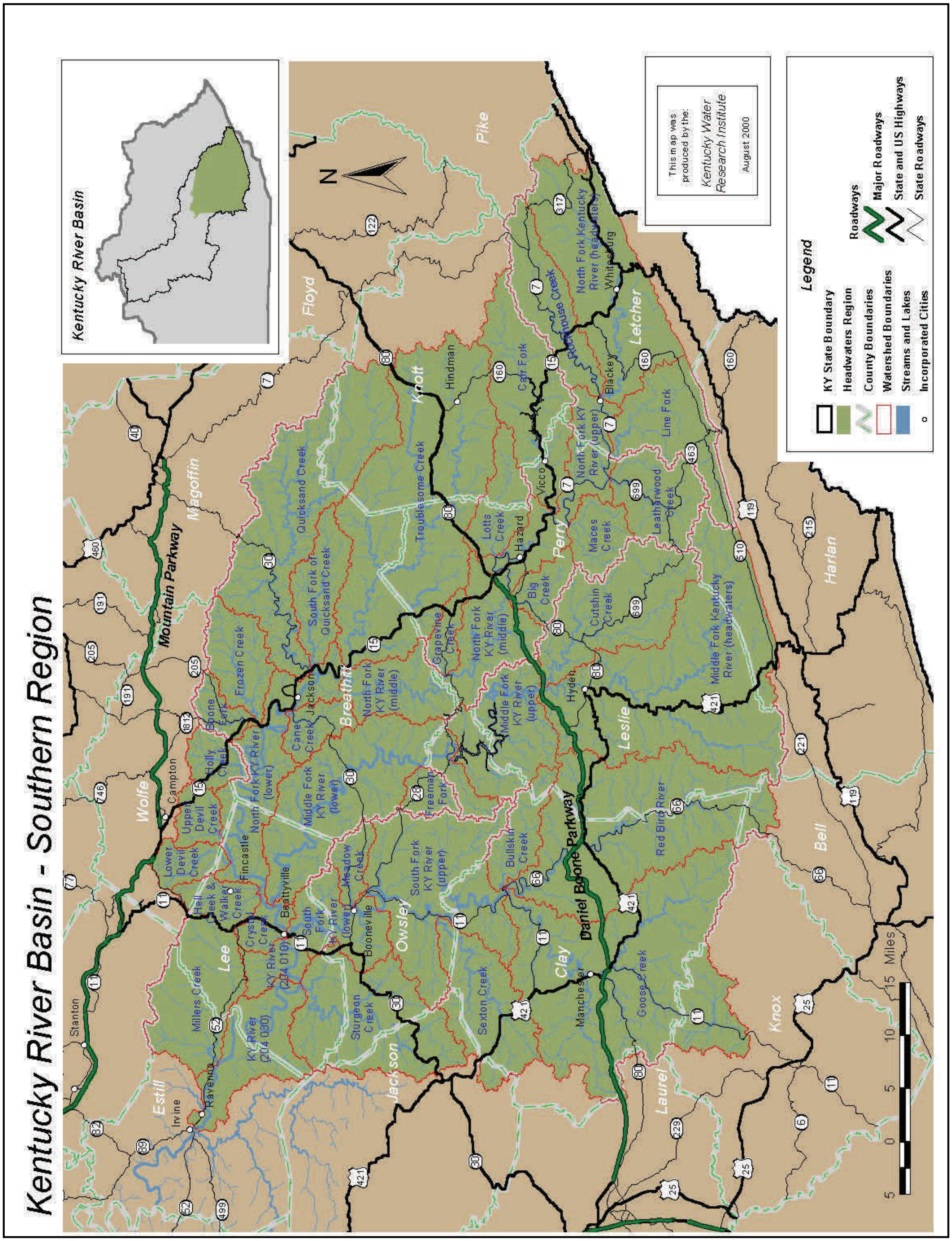


Figure 6—2014 Kentucky River Watershed Watch Sampling Sites

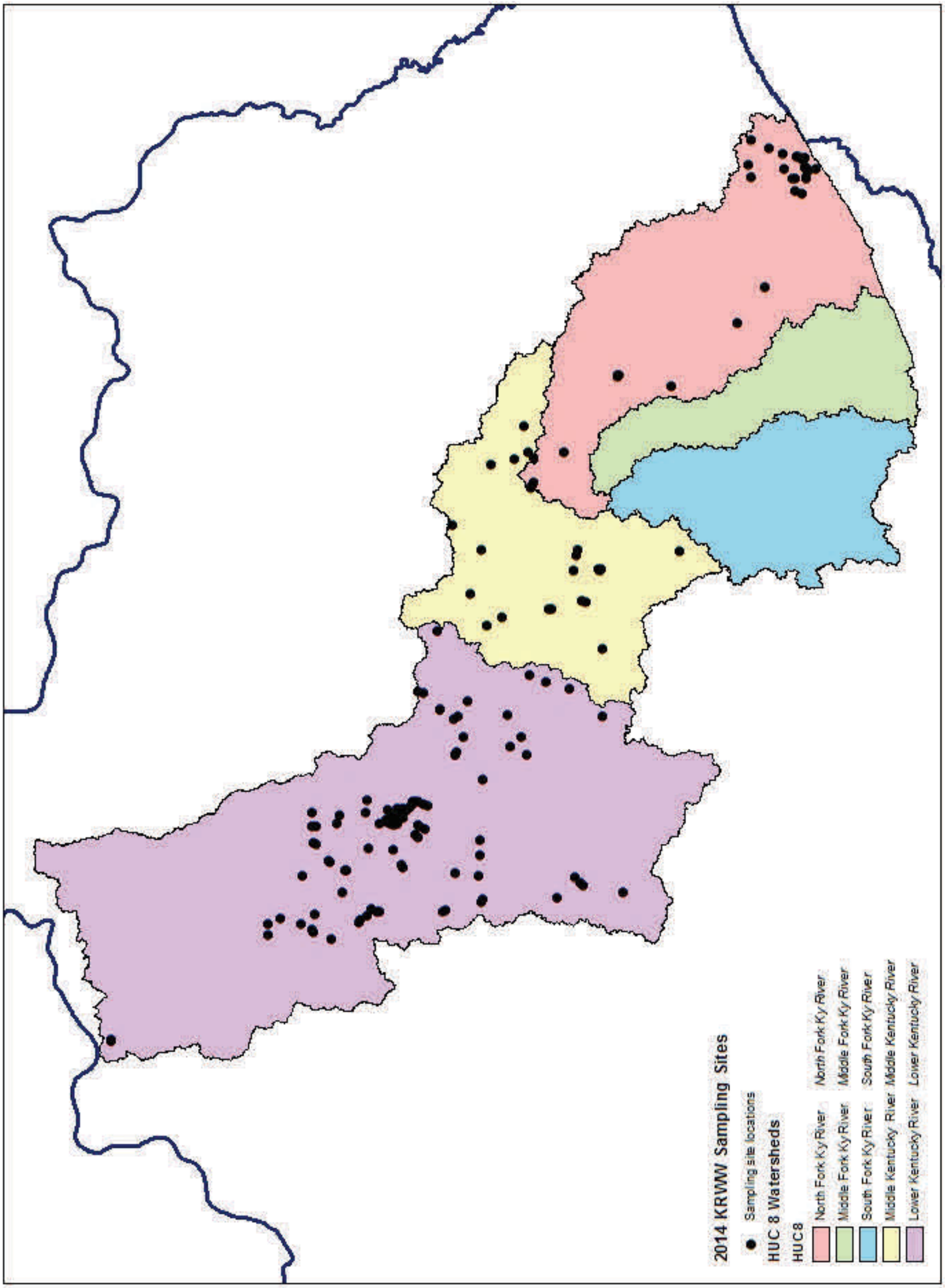


Figure 7

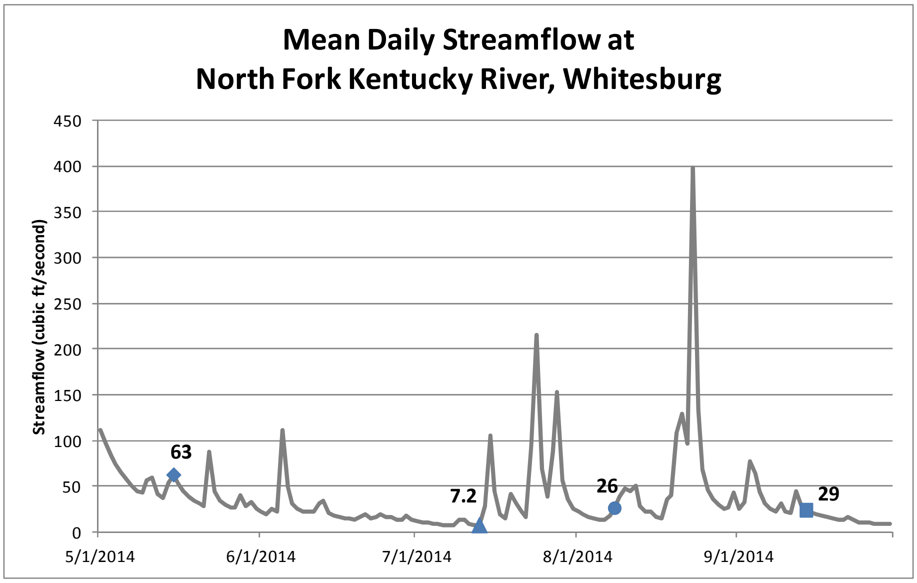


Figure 8

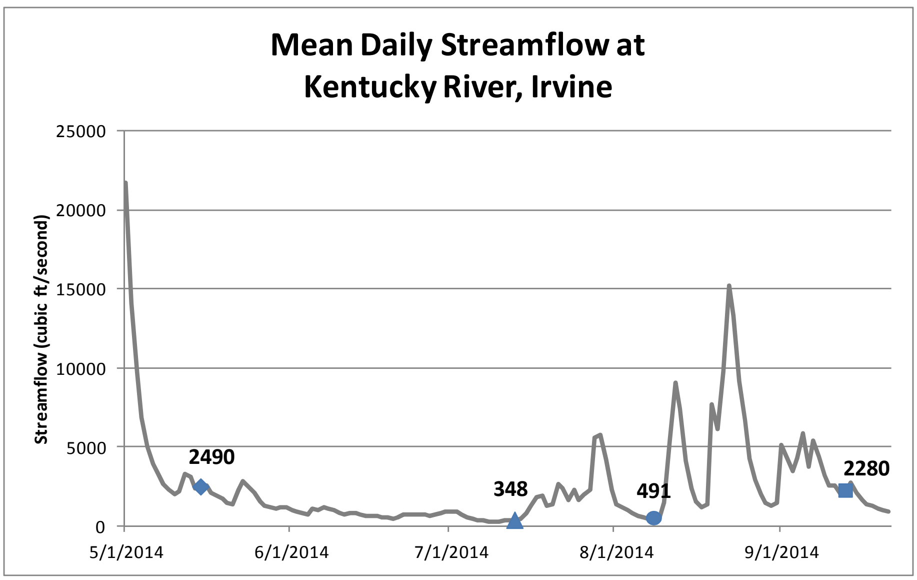


Figure 9

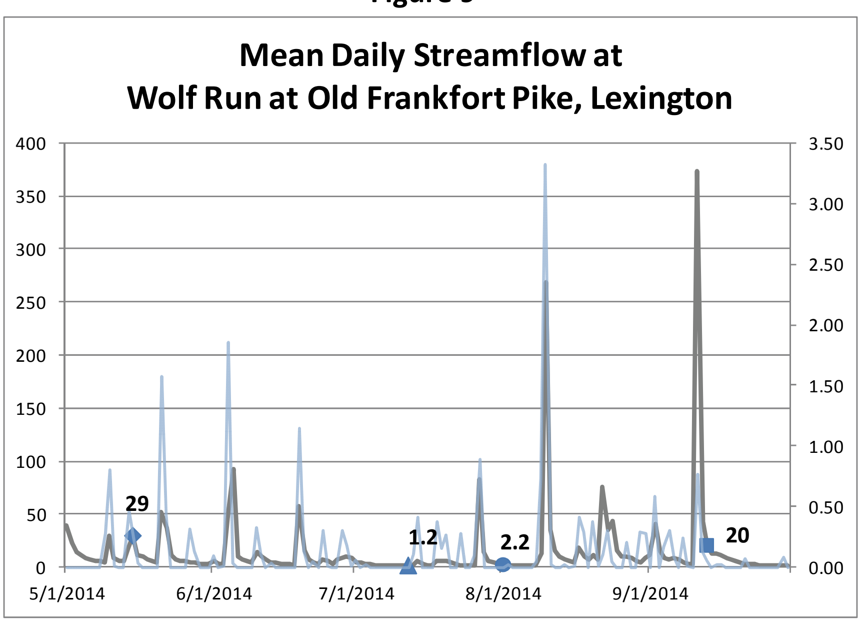


Figure 10

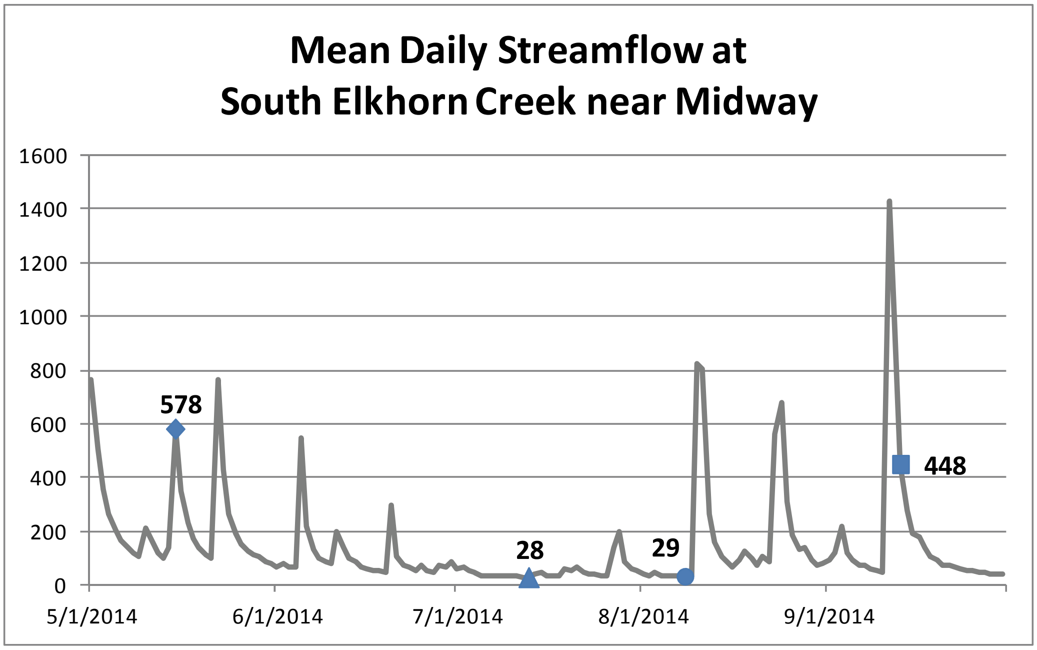


Figure 11

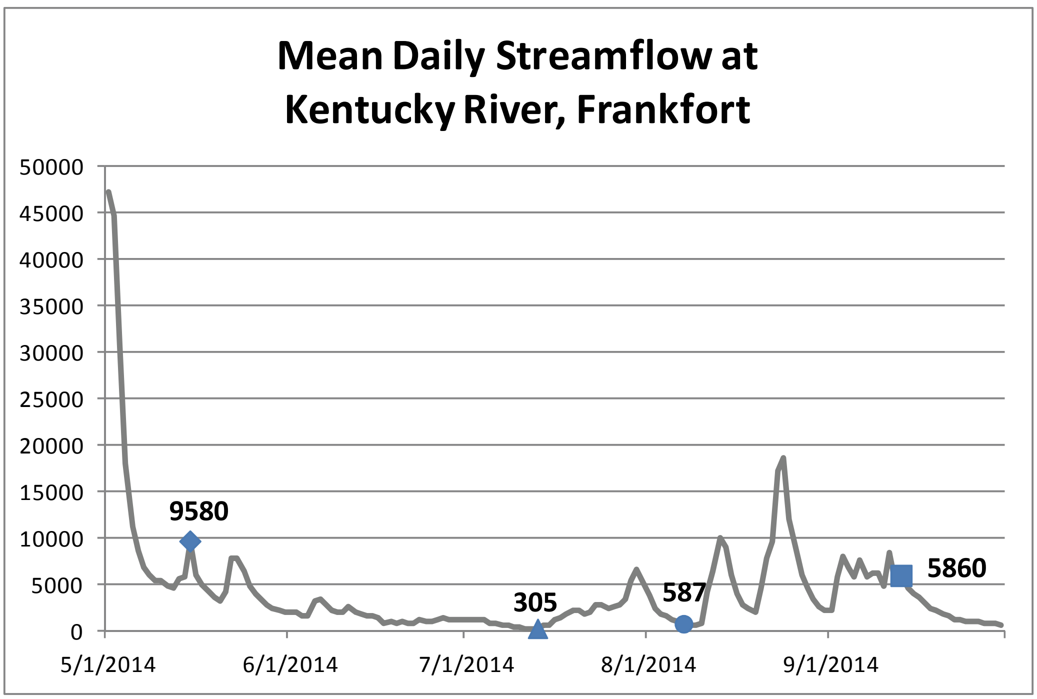


Figure 12
2014 KRWW Herbicide Sampling Results

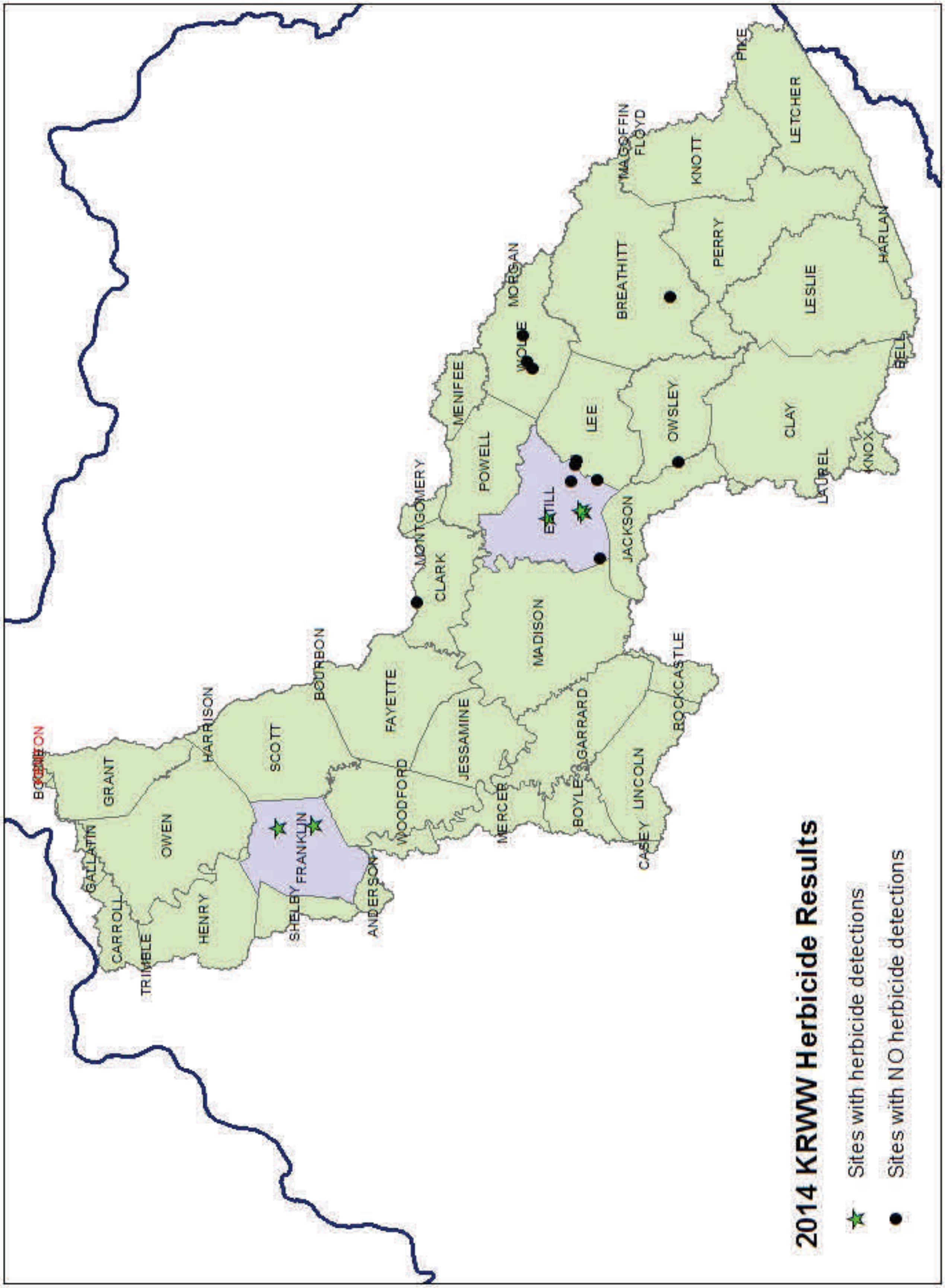


Figure 13
2014 KRWW Synoptic Pathogen Sampling Results

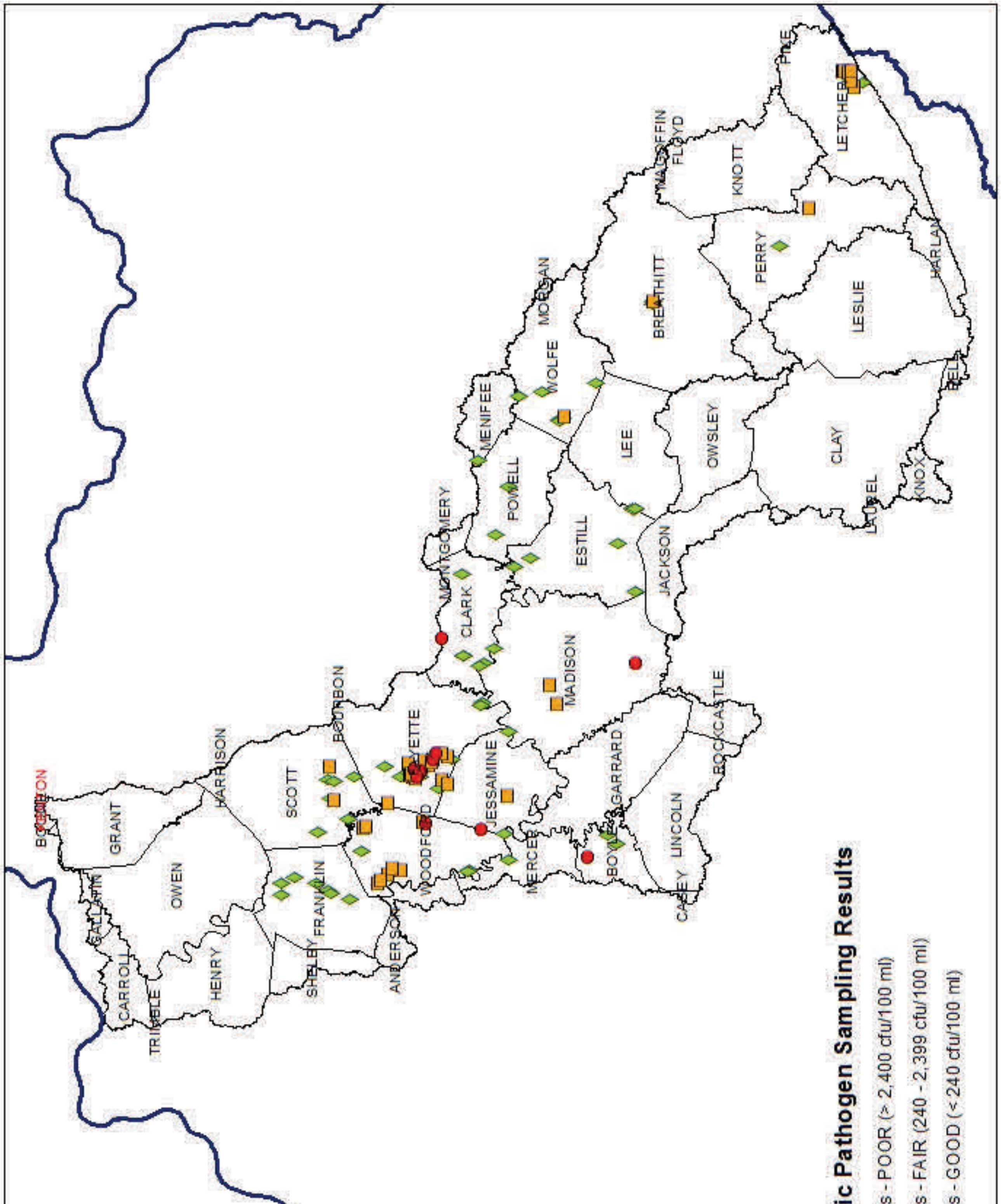


Figure 14
2014 KRWW Follow-Up Pathogen Sampling Results

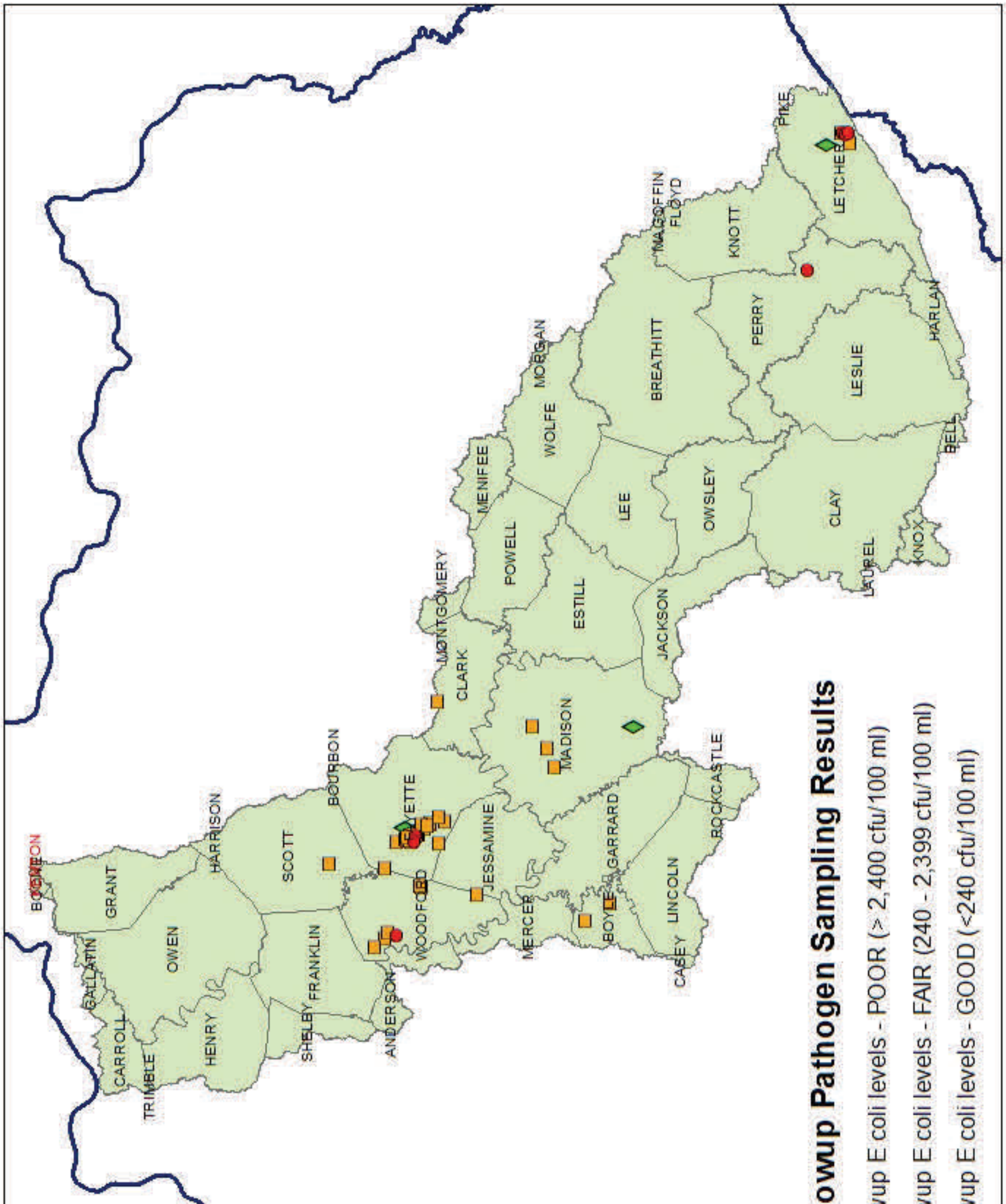


Figure 15
2014 KRWW Nitrogen Sampling Results

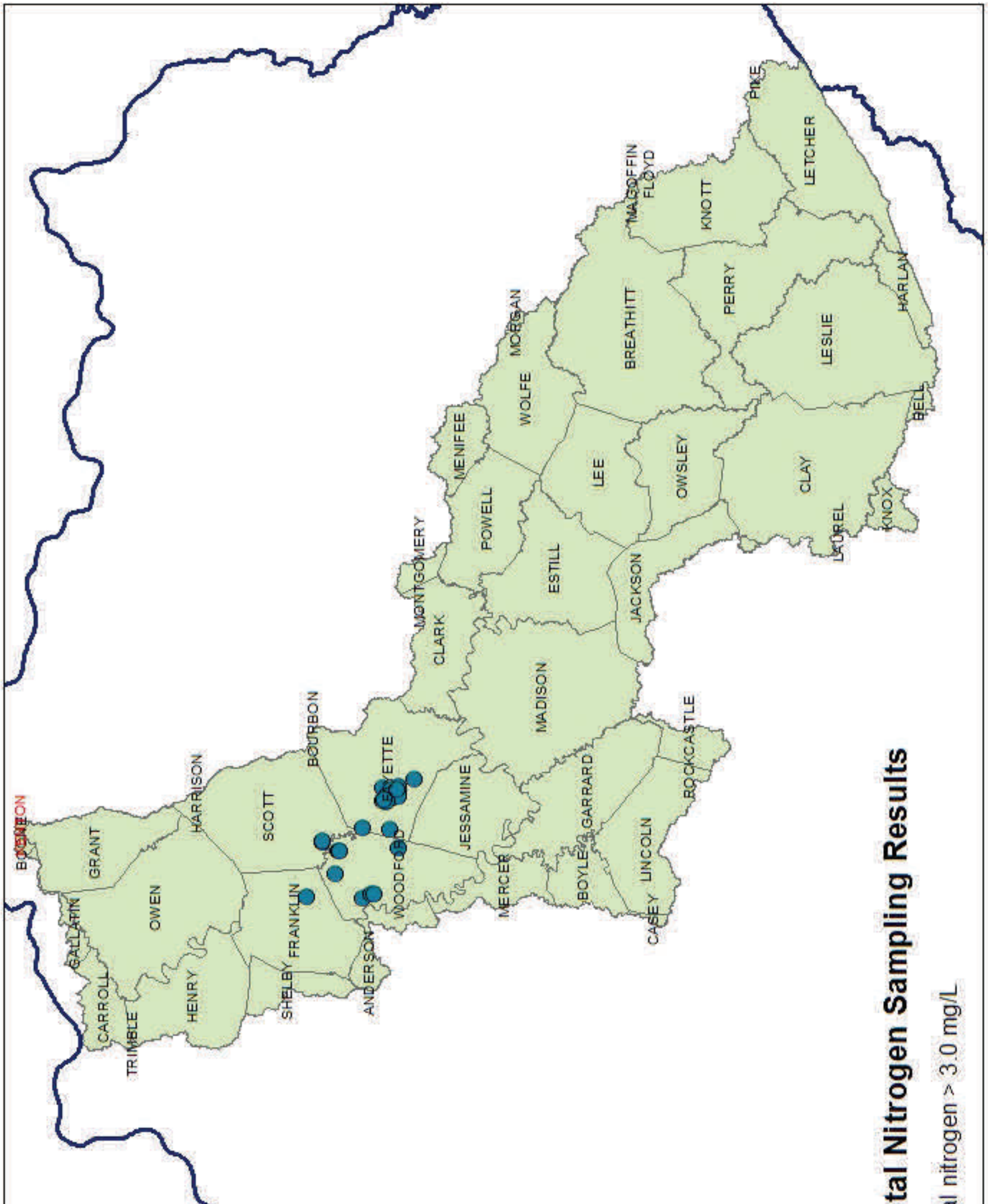


Figure 16
2014 KRWW Total Phosphorus Sampling Results

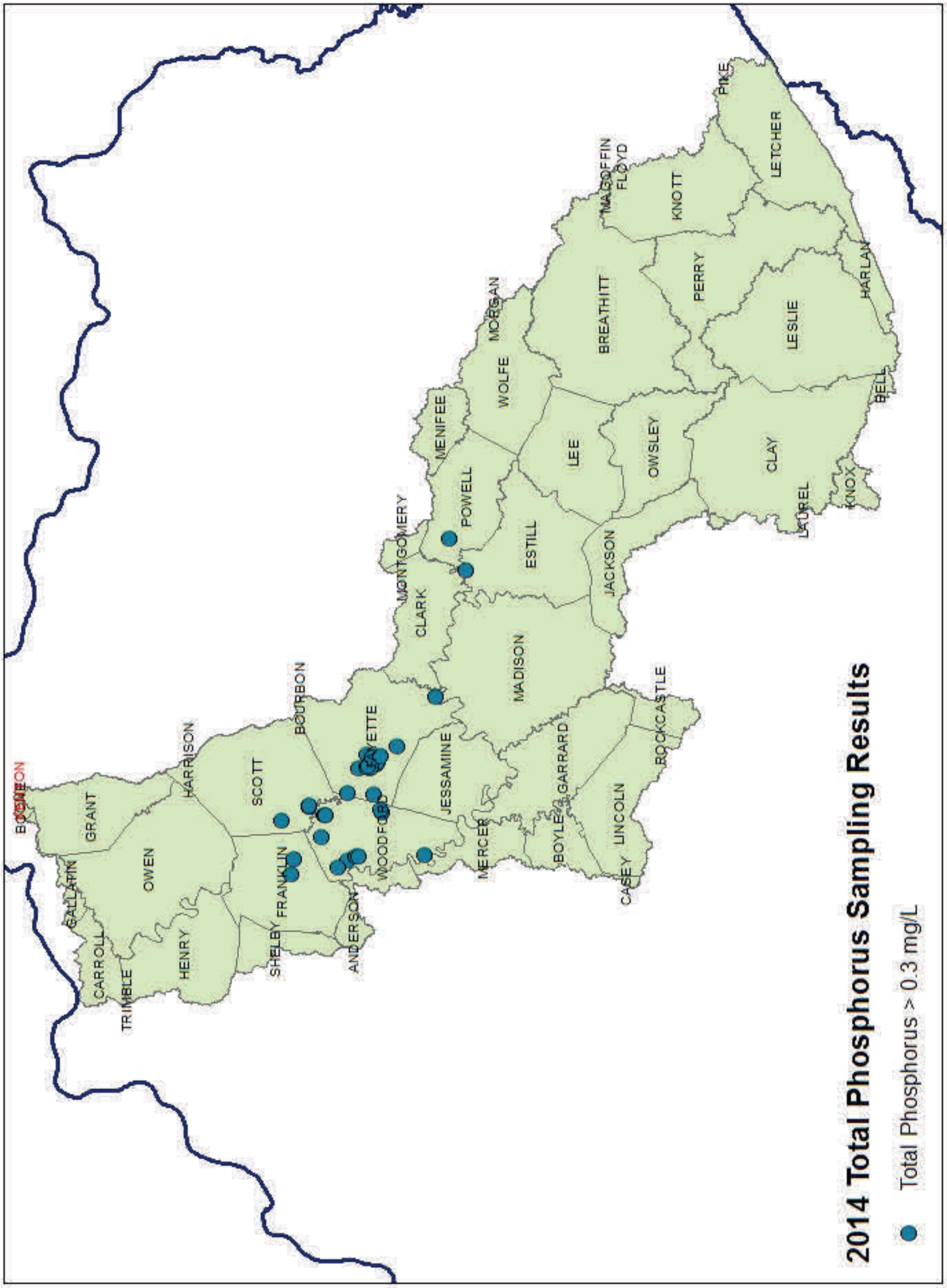


Figure 17
2014 Biological and Habitat Assessment Results

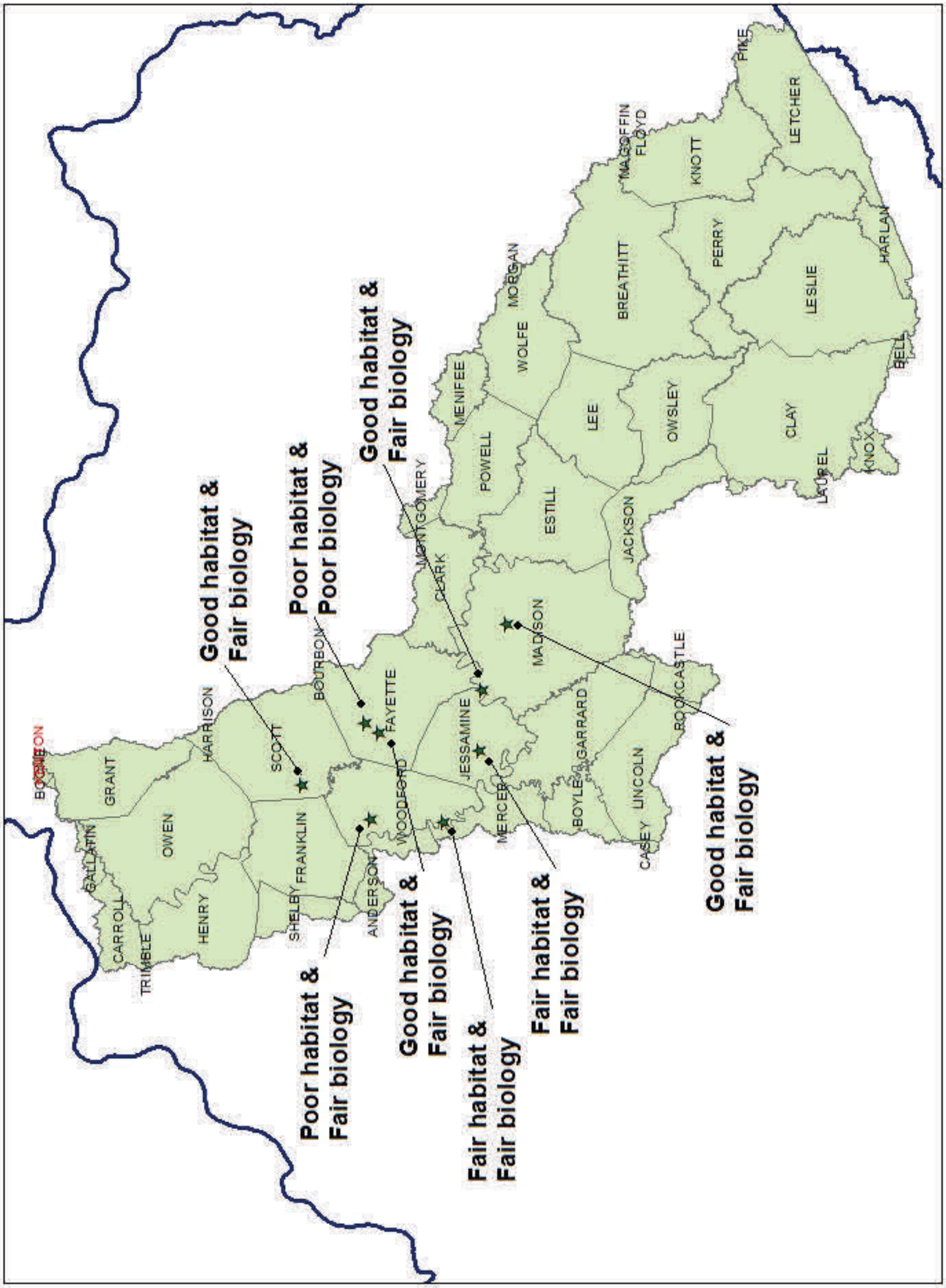
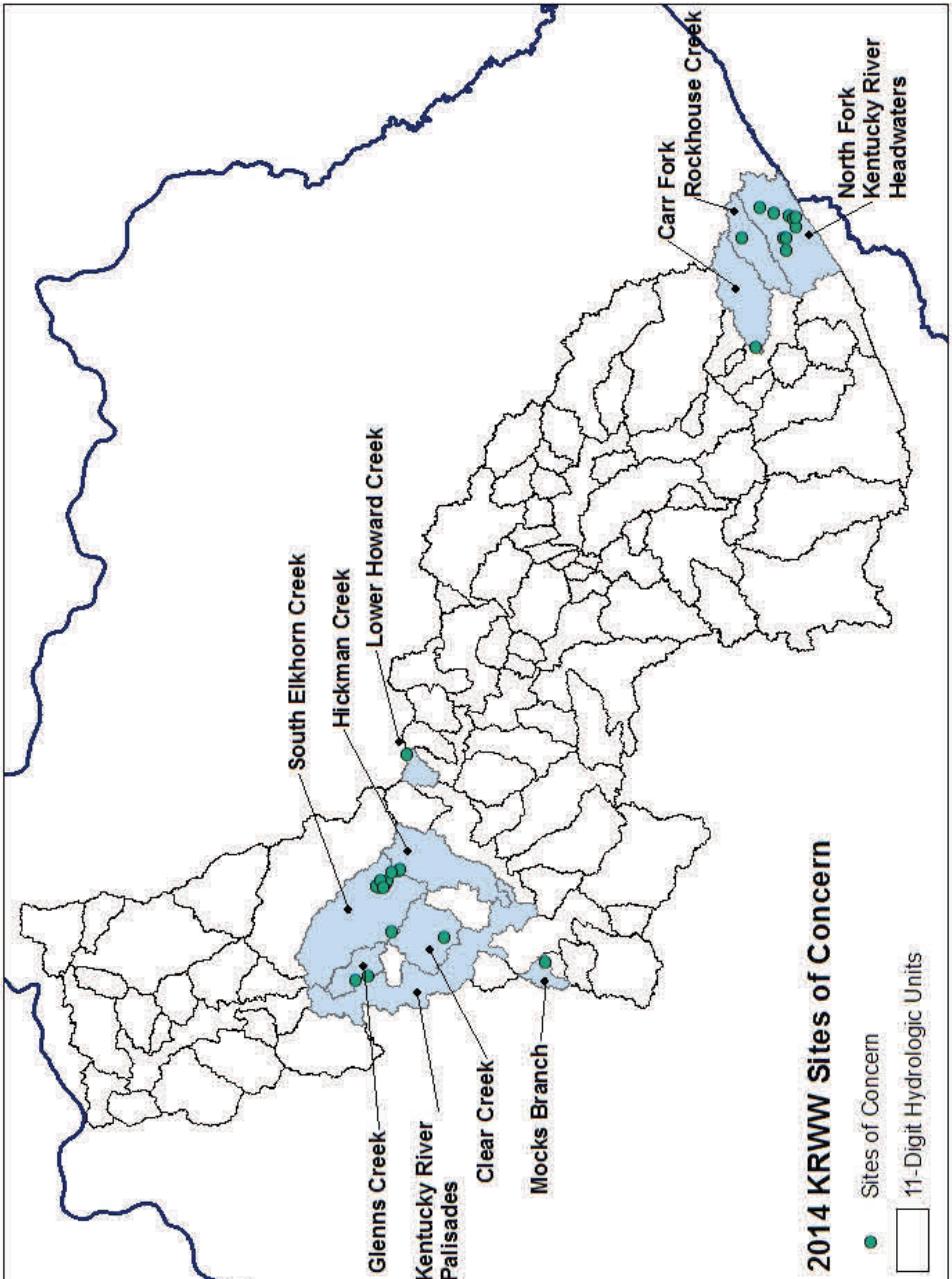


Figure 18
2014 KRWW Sampling Sites of Concern



APPENIDIX B: TABLES

Table 1: 2014 KRWW Sampling Site Information

Site ID#	*Stream*	*Location Description*	*Sampler*	*Latitude*	*Longitude*
741	Lees Branch	150 yards downstream of Stephens Street., Woodford County.	John Delfino	38.1491	-84.6822
744	Cane Run	2/10ths of a mile upstream of 460 Bridge., Scott Co	Cindy King	38.20944	-84.61074
753	Clarks Run	Upstream bridge on Goggin Ln , Boyle Co	Chris Barton	37.63897	-84.72178
755	North Elkhorn Creek	At Great Crossings, Scott Co	Cindy King	38.21564	-84.6058
763	South Elkhorn Creek	Upstream of US 60 near Airport, Fayette Co	John Larmour	38.04231	-84.62588
765	South Elkhorn Creek	.5mi upstream of SR 341, Scott Co	Don Dampier	38.18069	-84.6596
767	Clear Creek	1/2 mile downstream Hifner bridge., Woodford Co	Guy Kemper	37.9325	-84.79488
772	Unnamed Tributary	behind residence of 124 Creekside Drive in Ironworks Estates, Scott Co	Don Dampier	38.18278	-84.65559
793	McConnell Spring	WR-M2 McConnell Spring, Fayette Co	Sandy Conners	38.05539	-84.51903
796	Spring Station	At spring on Beals Run, Woodford Co	John Delfino	38.15527	-84.74323
801	North Fork Kentucky River	Mayking, at Old Regular Baptist Church, Letcher Co	Jennifer Honeycutt	37.1364	-82.7645
802	Pine Creek	near mouth at Mayking Baptist Church, Letcher Co	Jennifer Honeycutt	37.1334	-82.7635
803	Cram Creek	At Mouth of Cram Cr & Pert Fk, Letcher Co	Jennifer Honeycutt	37.1249	-82.7699
810	South Elkhorn Creek	US 68 Harrodsburg Rd Bridge, Fayette Co	John Webb	37.9956	-84.5854
811	Steeles Branch	Redd Rd Bridge off Old Frankfort Pk, Fayette Co	Ken Cooke	38.09835	-84.62191
812	Swift Camp Creek	upstream from the confluence with Red River, Wolfe Co	Rita Wehner	37.81748	-83.57722
814	Red River	East of Stanton, at bridge., Powell Co	William H Gordon	37.84209	-83.80894
815	Cane Creek	Gordon Property on the Meniffee/Powell Co Line, Menifee Co	William H Gordon	37.90223	-83.739945
820	North Fork Kentucky River	Perry County Park , Perry Co	John Hoppe	37.27592	-83.2078
823	Glenns Creek	intersection of Steele Rd. and McCracken at Glen''s Creek Baptist Church, Woodford Co	Hank Graddy	38.10066	-84.80528
827	Quicksand Creek	Below Hwy 15 bridge, Breathitt Co	Chet Sygiel	37.53799	-83.34781
831	Lower Red River	at Twin Creek, Estill Co	Jack Stickney	37.83296	-84.01583
832	Red River	Below bridge, Rt 15, Clay City, Powell Co	Jack Stickney	37.86907	-83.93072
833	Spring	Graddy Spring on Greenwood Farm, Steele Road, Woodford Co., Woodford Co	Hank Graddy	38.08186	-84.7942
834	North Fork Kentucky River	Headwaters at Ermine. At bridge to Vocational School above confluence of Hammonds Br., Letcher Co	Alex DeSha	37.1134	-82.80577
848	North Fork Kentucky River	below Crafts Colley Cr at confluence with drainage from Letcher County Central HS, Letcher Co	Regina Donour	37.11857	-82.79277
850	Colley Creek	at the mouth beside Ermine Post Office below bridge, Letcher Co	Regina Donour	37.11917	-82.79278
860	Clarks Run	Route 34, 1 mile west of 127 bypass in Danville., Boyle Co	Mike Simpson	37.65	-84.708
861	Glenns Creek	Millville, KY, Woodford Co	Hank Graddy	38.12056	-84.82694
875	Right Fork Carr Creek	Downstream from Vicco, Hwy 15 pullover. Below Acup Creek, Perry Co	John Hoppe	37.21328	-83.11306
888	Fourmile Creek	At mouth of creek , Clark Co	Merrill Combs	37.87795	-84.22387
889	Kentucky River	Boonesboro Beach, Clark Co	Kathy Daniel	37.8988	-84.2625
890	Howards Creek	At Mouth of Creek, Clark Co	Kathy Daniel	37.94079	-84.031013
891	North Elkhorn Creek	At Hwy 25, Scott Co	Cindy King	38.22	-84.56
911	Clarks Run	Confluence of Clarks Run and Bea Creek adjacent to Ky School for Deaf Property., Boyle Co	Mike Simpson	37.63327	-84.731539

Site ID#	Stream	Location Description	Sampler	Latitude	Longitude
914	Holly Spring	WR-H1 Across Wolf Run from Gardenside Park Tennis Court, Fayette Co	Bob Edwards	38.03517	-84.5431
915	Wolf Run	WR-S5 At Gardenside Park above foot bridge, Fayette Co	Bob Edwards	38.03318	-84.5421
918	Muddy Creek	10 Meters downstream of bridge at the outflow of the Army Depot, Madison Co	Alice Jones	37.70672	-84.174436
919	Muddy Creek	inflow at Army Depot, Madison Co	Alice Jones	37.65792	-84.19299
921	Otter Creek	750'' upstream from where Beaver Drive meets Otter Creek., Madison Co	Laura Melius	37.79276	-84.26245
922	Black Spring	near intersection of 33 and 1267. Black spring is a tributary to Clear Creek, , Woodford Co	Bea Stringer	37.9106	-84.6929
941	Deep Branch Creek	off Lower Howards Creek behind Halls Resturant, Clark Co	M. Clare Sipple	37.97462	-84.19928
942	Lower Howard Creek	at the bridge upstream from the Old Stone Church on Old Stone Church Road. , Clark Co	M. Clare Sipple	37.9391	-84.2439
943	Quicksand Creek	Approx. 100 meters above confluence with South Fork of Quicksand Creek., Breathitt Co	Chet Sygiel	37.53877	-83.34146
944	South Fork Quicksand Creek	Approx. 250 meters above confluence with main branch of Quicksand creek., Breathitt Co	Chet Sygiel	37.53611	-83.34084
954	Spring	at Welcome Hall, Woodford Co	Hank Graddy	38.0753	-84.7954
955	Elk Lick Creek	Just below falls branch at Nature Sanctuary., Fayette Co	Laura Baird	37.90286	-84.363499
963	Knoblick Creek	On Hatcher Road 1 mile west of Stanford, KY. Tributary of Hanging Fork., Lincoln Co	Chris Barton	37.54709	-84.75078
978	Muddy Creek	at Highway 52, Madison Co	Alice Jones	37.742	-84.1546
982	Lanes Run	Just upstream of guage station on Hwy 460., Scott Co	Steve Lombardo	38.2181	-84.5237
984	Twin Creek	1/4 mile above confluence of Red River on the Stickney farm., Estill Co	Jack Stickney	37.79999	-83.993882
990	Unnamed Tributary	behind Alice Jones property., Madison Co	Alice Jones	37.7877	-84.3488
999	Elkhorn Creek	downstream from Jim Beam distillery. Intersection of Steadmantown Lane and RR 1900. Churchs grave area of Elkhorn., Franklin Co	David McElrath	38.2464	-84.827
1014	Elkhorn Creek	Below fish hatchery., Franklin Co	Hannah Helm	38.31811	-84.82663
1017	Elkhorn Creek	confluence of North and South Elkhorn at Schoolhouse Road., Franklin Co	Lynn True, Scott True and Elijah	38.2155	-84.8023
1018	Penitentiary Branch	US 127 North and Thornhill bypass - towards Owenton., Franklin Co	Debbie Bramlage	38.22246	-84.84418
1020	West Hickman Creek	At Zandale and Heather Way., Fayette Co	Suzette Walling	38.00554	-84.51028
1021	West Hickman Creek	at Zandale and Libby lane, Fayette Co	Suzette Walling	38.0045	-84.50774
1028	Wolf Run	at Old Frankfort Pike (USGS site)., Fayette Co	Robert Garnham	38.07327	-84.55445
1048	Shannon Run	at brige on Briarwood Street in Sycamore Estates., Woodford Co	Henry Duncan	38.0233	-84.6753
1077	Kentucky River	at the boat ramp at Boonesboro Park., Madison Co	Kathy Daniel	37.9075	-84.2713
1106	Little Cowan Creek	300 meters from Hwy 119 intersection with Little Cowan Road, Letcher Co	Alex DeSha	37.09571	-82.79818
1117	Solomon Branch	Across from eye examination building. White tube by creek. , Letcher Co	Tom Sexton	37.1178	-82.8203
1120	North Fork Kentucky River	behind Heritage Building and downstream under bridge., Letcher Co	Tom Sexton	37.11662	-82.82213
1124	Marble Creek	just off Marble Creek Lane, Jessamine Co	Liz Hobson	37.849	-84.4383
1128	Cardinal Run	WR-C1 At Deveonport Dr. Crossing, Fayette Co	Curtis Jones	38.0489	-84.5536
1129	Cardinal Run	WR-C2 Below Chinquapin Ln Bridge off Parker''s Mill Rd., Fayette Co	Ellen Hannifan	38.0431	-84.5573
1131	Wolf Run	WR-L4 1875 Goodrich Ave at end of walk before RR Track, Fayette Co	Brian J Radcliffe	38.0158	-84.5226

Site ID#	Stream	Location Description	Sampler	Latitude	Longitude
914	Holly Spring	WR-H1 Across Wolf Run from Gardenside Park Tennis Court, Fayette Co	Bob Edwards	38.03517	-84.5431
915	Wolf Run	WR-S5 At Gardenside Park above foot bridge, Fayette Co	Bob Edwards	38.03318	-84.5421
918	Muddy Creek	10 Meters downstream of bridge at the outflow of the Army Depot, Madison Co	Alice Jones	37.70672	-84.174436
919	Muddy Creek	inflow at Army Depot, Madison Co	Alice Jones	37.65792	-84.19299
921	Otter Creek	750'' upstream from where Beaver Drive meets Otter Creek., Madison Co	Laura Melius	37.79276	-84.26245
922	Black Spring	near intersection of 33 and 1267. Black spring is a tributary to Clear Creek, , Woodford Co	Bea Stringer	37.9106	-84.6929
941	Deep Branch Creek	off Lower Howards Creek behind Halls Resturant, Clark Co	M. Clare Sipple	37.97462	-84.19928
942	Lower Howard Creek	at the bridge upstream from the Old Stone Church on Old Stone Church Road. , Clark Co	M. Clare Sipple	37.9391	-84.2439
943	Quicksand Creek	Approx. 100 meters above confluence with South Fork of Quicksand Creek., Breathitt Co	Chet Sygiel	37.53877	-83.34146
944	South Fork Quicksand Creek	Approx. 250 meters above confluence with main branch of Quicksand creek., Breathitt Co	Chet Sygiel	37.53611	-83.34084
954	Spring	at Welcome Hall, Woodford Co	Hank Graddy	38.0753	-84.7954
955	Elk Lick Creek	Just below falls branch at Nature Sanctuary., Fayette Co	Laura Baird	37.90286	-84.363499
963	Knoblick Creek	On Hatcher Road 1 mile west of Stanford, KY. Tributary of Hanging Fork., Lincoln Co	Chris Barton	37.54709	-84.75078
978	Muddy Creek	at Highway 52, Madison Co	Alice Jones	37.742	-84.1546
982	Lanes Run	Just upstream of guage station on Hwy 460., Scott Co	Steve Lombardo	38.2181	-84.5237
984	Twin Creek	1/4 mile above confluence of Red River on the Stickney farm., Estill Co	Jack Stickney	37.79999	-83.993882
990	Unnamed Tributary	behind Alice Jones property., Madison Co	Alice Jones	37.7877	-84.3488
999	Elkhorn Creek	downstream from Jim Beam distillery. Intersection of Steadmantown Lane and RR 1900. Churchs grave area of Elkhorn., Franklin Co	David McElrath	38.2464	-84.827
1014	Elkhorn Creek	Below fish hatchery., Franklin Co	Hannah Helm	38.31811	-84.82663
1017	Elkhorn Creek	confluence of North and South Elkhorn at Schoolhouse Road., Franklin Co	Lynn True, Scott True and Elijah	38.2155	-84.8023
1018	Penitentiary Branch	US 127 North and Thornhill bypass - towards Owenton., Franklin Co	Debbie Bramlage	38.22246	-84.84418
1020	West Hickman Creek	At Zandale and Heather Way., Fayette Co	Suzette Walling	38.00554	-84.51028
1021	West Hickman Creek	at Zandale and Libby lane, Fayette Co	Suzette Walling	38.0045	-84.50774
1028	Wolf Run	at Old Frankfort Pike (USGS site)., Fayette Co	Robert Garnham	38.07327	-84.55445
1048	Shannon Run	at brige on Briarwood Street in Sycamore Estates., Woodford Co	Henry Duncan	38.0233	-84.6753
1077	Kentucky River	at the boat ramp at Boonesboro Park., Madison Co	Kathy Daniel	37.9075	-84.2713
1106	Little Cowan Creek	300 meters from Hwy 119 intersection with Little Cowan Road, Letcher Co	Alex DeSha	37.09571	-82.79818
1117	Solomon Branch	Across from eye examination building. White tube by creek. , Letcher Co	Tom Sexton	37.1178	-82.8203
1120	North Fork Kentucky River	behind Heritage Building and downstream under bridge., Letcher Co	Tom Sexton	37.11662	-82.82213

Site ID#	Stream	Location Description	Sampler	Latitude	Longitude
1124	Marble Creek	just off Marble Creek Lane, Jessamine Co	Liz Hobson	37.849	-84.4383
1128	Cardinal Run	WR-C1 At Deveonport Dr. Crossing, Fayette Co	Curtis Jones	38.0489	-84.5536
1129	Cardinal Run	WR-C2 Below Chinquapin Ln Bridge off Parker''s Mill Rd., Fayette Co	Ellen Hannifan	38.0431	-84.5573
1131	Wolf Run	WR-L4 1875 Goodrich Ave at end of walk before RR Track, Fayette Co	Brian J Radcliffe	38.0158	-84.5226
1132	Wolf Run	WR-S1 Village Drive and Cambridge Drive upstream of Vaughns Branch, Fayette Co	Curtis Jones	38.0535	-84.5509
1133	Wolf Run	WR-S10 Lafayette Parkway at Rosemont, Fayette Co	Bethany Overfield	38.023	-84.5286
1134	Spring Branch	WR-S8 Springs Branch at end of Faircrest Drive, Fayette Co	Robert Garnham	38.0294	-84.5374
1135	Wolf Run	WR-S9 Wolf Run upstream of Springs Branch at end of Faircrest Drive, Fayette Co	Bob Edwards	38.0301	-84.5373
1136	Culvert	WR-S7 Beacon Hill Culvert Opening draining Garden Springs Neighborhood , Fayette Co	Bob Edwards	38.033	-84.5431
1137	Vaughns Branch	WR-V1 25 feet upstream of mouth at Valley Park, Fayette Co	Curtis Jones	38.0548	-84.5497
1138	Vaughns Branch	WR-V2 Park at end of Tazzwell Drive, Fayette Co	Bob Edwards	38.0448	-84.536
1139	Vaughns Branch	WR-V3 25 feet upstream of Nicholsasville Road , Fayette Co	Bethany Overfield	38.0224	-84.5124
1145	Millstone Creek	At mouth below bridge to Daniel Cook''s house, Letcher Co	Evan Smith	37.16782	-82.75318
1148	Little Dry Fork	At the mouth, above culvert, via Lion Drive, Letcher Co	Tarence Ray	37.1289	-82.863
1151	Cram Creek	Left fork of Cram Creek looking upstream at the intersect of Cram Creek Rd (Hwy 3410) and Great Oak Rd, Letcher Co	Jennifer Honeycutt	37.1193	-82.7666
1152	Cram Creek	Right Fork of Cram Creek looking upstream at the intersect of Cram Creek Rd (Hwy 3410) and Great Oak Rd, Letcher Co	Jennifer Honeycutt	37.1193	-82.7661
1174	Royal Springs	intersection of West Main and South Water Street., Scott Co	Cindy King	38.20988	-84.56189
1175	Calloway Creek	Simpson Lane just below the clark county line. 0.2 miles on Calloway Creek north of confluence with Smith Fork., Madison Co	Howard Bowden	37.8879	-84.3188
1184	Spring Branch	WR-S85 Supstream of Sheridan Drive Culvert., Fayette Co	Ken Cooke	38.02172	-84.54073
1185	North Fork Kentucky River	Above Craft''s Colley confluence., Letcher Co	Regina Donour	37.1167	-82.79278
1191	Kentucky River	cummins ferry road marina, Mercer Co	Ruth Webb	37.85303	-84.771233
1195	Lees Branch	in front of Midway College., Woodford Co	John Delfino	38.14568	-84.68171
1198	Glenns Creek	at 4845 McCracken Pike, Woodford Co	Gary Betts	38.0929	-84.7888
1199	Vaughns Branch	Behind Lexington Clinic Surgery Center at Golf Course Fence, Fayette Co	Ken Cooke	38.03695	-84.52271
1209	Sandlick Creek	Acid Mine Drainage across from Rainbow Drive, sampled just above culvert at confluence of two streams of nearly identical water from old mine, Letcher Co	Tom Sexton	37.1484	-82.82154
1221	Cane Run	intersect of Coleman Lane and Hwy 25., Scott Co	Cindy King	38.1666	-84.5532
1242	Dry Fork	Acid mine drainage entering Dry Fork near Horns on Little Dry Fork Road (aka Crown)., Letcher County	Tom Sexton	37.14209	-82.85598
1246	Cardinal Run	WR-Upstream of Lexington School soccer field bridge, Fayette Co	Bruce Hutcheson	38.0344	-84.5542
1248	Lick Fork	Acid Mine Drainage flowing down from old blow out near Roger Dodger''s trailer, approx. 100m from mouth of Lick Fork, Letcher Co	Evan Smith	37.19478	-82.7395
1274	Elk Lick Creek	upstream from Quarry Branch, Fayette Co	Beverly James	37.90624	-84.37038
1275	Unnamed Tributary	near the corner of Wilson Downing Road and Belleau Wood Drive.Trib to West Hickman., Fayette Co	John Webb	37.97563	-84.50349
1278	Kentucky River	main stem at Munday''s Landing at mile 109.5., Woodford Co	John Creech	37.85011	-84.764649

Site ID#	***Stream***	***Location Description***	***Sampler***	***Latitude***	***Longitude***
1287	Kentucky River	Boat ramp upstream of the bridge at US 68 on the Mercer and Jessamine county line., Mercer Co	Pamla Wood	37.86025	-84.70163
1301	North Elkhorn Creek	White Oak Road bridge over Elkhorn and south of Stamping Ground in Scott County., Scott Co	Lisa Morris	38.24162	-84.69436
1307	Jessamine Creek	Short Shun Crossing., Jessamine Co	Mary Miller	37.85579	-84.60507
1314	Wolf Run	at Roanoke Drive and Greenway., Fayette Co	Wendy Havens	38.04534	-84.55074
1318	Kentucky River	OHIO RIVER ACTION - from Lock wall at the dam on Jay Louden Road. (left bank)., Carroll Co.	Hank Graddy	38.65893	-85.14495
2924	Tates Creek	just upstream of K407. At the outflow of St. Andres Pond., Madison Co	Ann Galliers	37.76423	-84.3214
2970	Prestons Cave Spring	resurgence near Puerta Del Cielo Assembly of God Church at 1935 Dunkirk Drive., Fayette Co	Sandy Conners	38.05737	-84.54246
2993	West Hickman Creek	North of bridge between Vet office and main row of shops in Lansdowne Shopping center., Fayette Co	Allen Kirkwood	37.99933	-84.49552
2994	West Hickman Creek	South of bridge between Arby''s and Speedway at Lansdowne Shopping Center., Fayette Co	Allen Kirkwood	37.99337	-84.49555
3004	Vaughns Branch	Chantilly St. Bridge off Cambridge Dr, Fayette Co	Ken Cooke	38.05153	-84.54563
3005	McConnell Branch	Ditch line off Red Mile Road south of Horseman''s Lane, Fayette Co	Sandy Conners	38.04225	-84.52547
3006	Lower Howard Creek	upstream of suspected pipe, Clark Co	M. Clare Sipple	37.9391	-84.2439
3007	Lower Howard Creek	downstream of suspected pipe., Clark Co	M. Clare Sipple	37.9391	-84.2439
3013	Shannon Run	Sycamore subdivision- Lavy Lot as it leaves Sycamore Estates, Woodford Co	Henry Duncan	38.02749	-84.66952
3053	Loves Branch	1.7 miles south of Hwy 7 in Colson KY, Letcher Co	Ellis Keyes	37.2409	-82.77945
3059	Gardenside Branch	downstream of Darien Drive Culvert at head of Cross Keys Park., Fayette Co	Ellen Hannifan	38.03785	-84.55526
3060	Vaughns Branch	end of parking lot behind Harrodsburg Road fire station., Fayette Co	Mark Felice	38.02573	-84.52256
3067	East Hickman Creek	intersection of Macadam Drive and Tates Creek Road, Fayette Co	Maxine Rudder	37.98764	-84.49499
3084	Unnamed Tributary	behind residence at 1609 Loves Branch, Democrat, KY, Letcher Co	Ellis Keyes	37.23777	-82.81661
3085	St Clair Spring	From Spurr Road turn onto Greendale Road and the site is 100 yards down before the railway crossing. , Fayette Co	Robert Garnham	38.10283	-84.52433
3128	Unnamed Tributary	UT to South Elkhorn Creek. at teh Spring Dale Baptist Church located at 1380 Higbee Mill Road, Lexington, KY., Fayette Co	JC Miller	37.98716	-84.56199
3133	Mocks Branch	corner of Gwinn Island Road and Rt. 33., Boyle Co	Deborah Larkin	37.69114	-84.76387
3136	Wolf Run	"swimming pond" at the end of The Lane., Fayette Co	Wendy Havens	38.04309	-84.54935
3137	Wolf Run	behind the parking lot at 2134 Nicholasville Road., Fayette Co	Brian Radcliff	38.00915	-84.51588
3146	Cane Run	at Coldstream Park, Fayette Co	Ashley Bandy	38.09944	-84.489336
3147	Cane Run	at the KY Horse Park, Fayette Co	Ashley Bandy	38.158	-84.529156
3172	Tates Creek	Near entrance to Baldwin Farms near Crutcher Pike Road., Madison Co	Ann Galliers	37.75071	-84.37138
3180	Spring	Penitentiary Branch Cove Spring at Cove Spring park, Franklin Co	Andrew Cammack	38.21818	-84.85136
3197	Quillen Fork	sampler to provide location, Letcher Co	Evan Smith	37.23526	-82.71385

Site ID#	Stream	Location Description	Sampler	Latitude	Longitude
3198	Clear Creek	at the mouth of Clear Creek, 1.65 miles downstream from Lock 6 at pool 5. 1.24 miles upstream from 1779 McCouns Ferry Road, Mercer	Nick Barker	37.9367	-84.79806
3203	Evans Branch	just upstream from confluence with Elk Lick Creek., Fayette Co	Laura Baird	37.90625	-84.37079
3204	Unnamed Tributary	UT to Swift Camp Creek. Behind 532 Main Street residence in Campton, KY., Wolfe Co	Ann Marie Quinn, OSF	37.73532	-83.54579
3211	Silver Creek	at the 1016 crossing bridge in Berea., Madison Co	Jessica Bevins	37.58764	-84.269
3214	Glenns Creek	at the Millville Community Center, Woodford Co	J.G. Webb	38.11592	-84.81942
3216	Unnamed Tributary	UT to West Hickman. Waterford subdivision, 180 yards east south east from the wier at the lower end of the large Waterford pond., Fayette Co	John Baggerman	37.96807	-84.50882
3221	Lower Devil Creek	at North Fork, Wolfe Co	Tricia Coakley	37.6577	-83.54834
3222	Unnamed Tributary	Muir Valley Calvin Hollow, Wolfe Co	Tricia Coalkley	37.72791	-83.63501
3223	Unnamed Tributary	Muir Valley from behind Rogers Elementary, Wolfe Co	Tricia Coakley	37.73302	-83.63853
3224	Unnamed Tributary	Muir Valley downstream of beaver dams, Wolfe Co	Tricia Coakley	37.72448	-83.62997
3225	Creek	Muir Valley headwaters, Wolfe Co	Tricia Coakley	37.73327	-83.64237
3241	Moberly Spring	at Allendale Drive Greenway., Fayette Co	Steve Shannon	38.0311	-84.53864
3252	South Elkhorn Creek	Clays Crossing Subdivision., Jessamine Co	John Larmour	37.97584	-84.57299
3271	North Fork Kentucky River	1.5 miles down Little Creek Road on Hwy 1110., Breathitt County	Henrietta Sheffel	37.42282	-83.37701
3276	Bear Pen Creek	Bowman Allen Road between two bridges., Wolfe Co	Kellie Glenn	37.72346	-83.56229
3277	Swift Camp Creek	Bridge at intersection of Baptist Road and Hwy 402. Right behind Smith''s Place., Wolfe Co	Kellie Glenn	37.74264	-83.4745
3278	Sturgeon Creek	Where Hwy 1071 and Hwy 30 meet. Intersection of Sturgeon Creek and Wild Dog Creek. 587 South to Earnestville., Owsley Co	Kellie Glenn	37.41172	-83.82679
3282	Elkhorn Creek	Just below where Sulphur Lick feeds into Elkhorn Creek in Peaks Mill., Franklin Co	David Hurt	38.29124	-84.81197
3283	Unnamed Tributary	behind samplers home on 207 Hampton Ave., Clark Co	Lanny Evans	37.98467	-84.19479
3295	Buck Creek	Intersection of Little Buck Creek and Old Landing Road., Estill County	Sarah Hart	37.6441	-83.87278
3296	Kentucky River	Where Hwy 52 & Hwy 89 meet by Raders Resturant., Estill County	Suzanne Burnett	37.69881	-83.97538
3297	Richard''s Stream	Stream from Mt. at the end of Old Landing Road, behind locked gate., Estill County	Suzanne Burnette	37.63662	-83.83045
3298	Red Lick Creek	Where Red Lick Road and Station Camp Road meet., Estill Co	Tom Bonny	37.61887	-83.95901
3299	Locust Branch	In Locust Branch on Hwy 594., Estill Co	Francine Bonny	37.58491	-84.0867
3300	Ross Creek	Off Hwy 851 at Sturgeon Branch and Ross Creek., Lee Co	Robin Reed	37.59	-83.8708
3303	Station Camp Creek	Under bridge at South Irvine (52 & 851), Estill Co	Whalen	37.69251	-83.97622
3304	Station Camp Creek	Where Hwy 89 and Jones Branch Road meet in Wagersville., Estill Co	Johnetta Dunaway-Whalen	37.62569	-83.95355
3305	Spring	Spring that feeds into KY River from 6405 Old Landings Road farm., Estill County	Sarah Hart	37.63378	-83.81605
3313	Elkhorn Creek	Just below campground at 249 Strohmeier Road where it feeds into the KY River., Franklin Co	Hannah Helm	38.31804	-84.85549
3328	Glenns Creek	Capital View Park, Franklin Co	Jerry Cappel	38.18025	-84.86837

Site ID#	***Stream***	***Location Description***	***Sampler***	***Latitude***	***Longitude***
3341	Swift Camp Creek	Up from the fork on Rock Bridge. First bend outside view from Rockbridge Trail., Wolfe Co	Shawn Craft	37.76708	-83.56548
3343	Buck Lick Branch	below spring 100 yards off Little Ross Creek Road, Lee Co	Robin Reed	37.58725	-83.87395
3344	Wolf Pen Branch	just above confluence with Ross Creek, Lee Co	Robin Reed	37.5836	-83.87092
3349	Waterside Lake	behind samplers residence at 4868 Waterside Lake., Fayette Co	Vicki Holmberg	37.98984	-84.5932
3350	Town Creek	Where East Main and Campground Lane meet at the AdverntureServe Campground, Jessamine Co	Mary Miller	37.85514	-84.64512
3352	Company Branch	At mouth before Craft's Colley, Letcher Co	Tarence Ray	37.16556	-82.79483
3353	Fairchild Branch	At mouth of Sandlick Creek, Letcher Co	Tom Sexton	37.14261	-82.821
3357	Kentucky River	OHIO RIVER ACTION -from Lock wall at the dam on Jay Louden Road. CENTER OF RIVER, Carroll Co	Hank Graddy	38.65887	-85.14433
3358	Kentucky River	OHIO RIVER ACTION -from Lock wall at the dam on Jay Louden Road. RIGHT BANK., Carroll Co	Hank Graddy	38.65877	-85.14372

Table 3

2014 KRWW Field Sampling Results									
NOTE: Values that exceed water quality standards or benchmarks are noted in **bold** *text.*									
Site ID#	**Stream**	**Sampling Date**	***Flow***	***Rainfall (inches)***	***Turbidity***	***Dissolved Oxygen (mg/L) ****	***pH***	***Temperature (°C)***	***Conductivity (microsiemens /cm)***
741	Lees Branch	7/12/2014	2	zero	0	5	8	19	440
741	Lees Branch	9/13/2014	4	1.5	0	6.8	7.5	15	440
744	Cane Run	7/11/2014	2	zero	0	7.2	8.74	24.2	**548**
744	Cane Run	8/8/2014	3	0.1	0	6.1	8.55	22.7	**558**
753	Clarks Run	8/9/2014	3	0.5	0	10	8.5	24	**690**
755	North Elkhorn Creek	7/11/2014	3	zero	1	12	**9.54**	26.2	**581**
763	South Elkhorn Creek	9/12/2014	4	>1.5	3	7.8	7.5	15	480
765	South Elkhorn Creek	7/12/2014	2	zero	0	**4.5**	7.5	23	
765	South Elkhorn Creek	9/14/2014	3	0.5	1	7.6	7.5	18	630
767	Clear Creek	7/11/2014	3	zero	2	7.4	8.5	23.3	400
767	Clear Creek	9/15/2014				9.8	8.5	16	
772	Unnamed Tributary	9/13/2014	4	>1.5	0	5.3	7.5	15	430
793	McConnell Spring	9/15/2014	3	zero	0	**4.8**	6.8	15	**750**
793	McConnell Spring	8/9/2014	3	0.5	0	**3.2**	6.7	14	**860**
793	McConnell Spring	7/11/2014	2	zero	0	**3**	6.8	14	**820**
796	Spring Station	9/13/2014	4	>1.5	3	5	7	15	400
796	Spring Station	7/12/2014	2	zero	0	5.6	7	14	460
801	North Fork Kentucky River	7/12/2014	3	zero	0	7	8	21	**920**
801	North Fork Kentucky River	9/11/2014					8	20	**860**
801	North Fork Kentucky River	8/9/2014		>1.5	2				
802	Pine Creek	9/11/2014	3	0.5	3		7.5	21	500
802	Pine Creek	7/12/2014	3	zero	0	6.4	7.5	19	**620**
802	Pine Creek	8/9/2014		1.5	3				
803	Cram Creek	9/11/2014	3	0.5	1		7.5	21	360
803	Cram Creek	7/12/2014		zero	0	7.6	8	18	**510**
803	Cram Creek	8/9/2014	3	1.5	2				
810	South Elkhorn Creek	7/12/2014	2	zero	0	6.3	7.7	20	**640**
810	South Elkhorn Creek	9/12/2014	3	>1.5	1	7.9	7.7	18	**490**
811	Steeles Branch	7/11/2014	2	zero	0	8.63	8.15	22.5	444
811	Steeles Branch	8/9/2014	2	0.1	0	5.46	7.77	21.24	480
811	Steeles Branch	9/15/2014	3	zero	2	8.08	7.74	16.6	404
812	Swift Camp Creek	7/13/2014	2	zero	1				
814	Red River	7/12/2014	2	0.5	2		7.4	23.3	230
814	Red River	9/12/2014	4	>1.5	3		6.8	19	120
815	Cane Creek	7/12/2014	2	0.5	0		7	16.6	20
815	Cane Creek	9/12/2014	4	>1.5	1	8.6	7.3	16	160
820	North Fork Kentucky River	7/11/2014	3	1	2	9.8	7.5	25	**1000**
820	North Fork Kentucky River	9/12/2014	4	>1.5	3	8.4	7.5	19	**530**

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
823	Glenns Creek	7/15/2014	3	0.5	0	6.8	7.75	20	**770**
823	Glenns Creek	8/14/2014	3	0.5	0	7.6	7.75	16	**740**
823	Glenns Creek	9/18/2014	4	zero	0	8.4	7.75	14	**570**
827	Quicksand Creek	9/11/2014	4	0.5	3	8.6	7.6	22.5	430
827	Quicksand Creek	7/12/2014	2	zero	0	7.4	7.8	22	**870**
831	Lower Red River	7/11/2014	3	0.5	1		7.4	23	
831	Lower Red River	9/12/2014	4	1	3		7	18	100
832	Red River	7/11/2014	3	0.5	2		7	23	
832	Red River	9/12/2014	4	>1.5	3		7	19	110
833	Spring	9/18/2014	4	zero	0	6.8	6.75	13	490
833	Spring	7/15/2014	3	0.5	0	6.4	7	12	**530**
834	North Fork Kentucky River	7/12/2014	2	zero	1		8.19	22.3	**821**
848	North Fork Kentucky River	7/12/2014	3		0	6.5	7.5	22	**880**
848	North Fork Kentucky River	9/11/2014	3	0.5	1		8	22	**830**
848	North Fork Kentucky River	8/9/2014	3	1.5	2				**760**
850	Colley Creek	9/11/2014	3	0.5	1		7.5	22	**610**
850	Colley Creek	7/12/2014	3		0	8.5	7.5	20	**750**
860	Clarks Run	7/11/2014	1	zero	1	**1**	7	21.5	450
861	Glenns Creek	7/15/2014	3	0.5	0	6.4	7.75	20	**700**
861	Glenns Creek	8/14/2014		0.5	0	7.4	7.75	17	**700**
861	Glenns Creek	9/18/2014	4	zero	0	8.6	7.75	14	**550**
875	Right Fork Carr Creek	7/11/2014	3	1	1	10.8	7.5	24	**1220**
875	Right Fork Carr Creek	8/8/2014	4	1.5	2	9.8	7.5	20	**1080**
875	Right Fork Carr Creek	9/12/2014	4	>1.5	3	8.8	7.5	18	**820**
888	Fourmile Creek	7/11/2014	3	zero	2	5.75	8	25	**700**
889	Kentucky River	7/11/2014	3	zero	0	8	8	25	**700**
890	Howards Creek	7/11/2014	3	zero	0		8	17	450
891	North Elkhorn Creek	7/11/2014	3	zero	1	8.2	8.6	24.1	**602**
911	Clarks Run	7/11/2014	2	zero	1	**4.5**	7.5	21	**570**
914	Holly Spring	9/15/2014	3	zero	0	7.2	7	15	450
914	Holly Spring	7/11/2014	2	zero	0	7.1	7	14	**520**
915	Wolf Run	8/8/2014	2	zero	0	8.3	8.5	21	**790**
915	Wolf Run	9/15/2014	3	zero	0	8.4	8.5	15	**600**
915	Wolf Run	7/11/2014	2	zero	0	10	8.5	14	**790**
918	Muddy Creek	9/13/2014	3	0.5	2				
919	Muddy Creek	9/13/2014	3	0.5	2				
921	Otter Creek	8/9/2014	3	1.5	0	5.4	7.6	16	**550**
921	Otter Creek	9/13/2014	3	0.1	0	6	7.6	12.5	
922	Black Spring	8/8/2014	1	zero	0	**4**	7	15	**760**
922	Black Spring	7/12/2014	2	zero	0	5.8	7	15	**620**
941	Deep Branch Creek	7/12/2014	0						
942	Lower Howard Creek	7/12/2014	3	zero	0	5.8	7.5	20	370
943	Quicksand Creek	9/11/2014	4	0.5	3	8.4	7.6	22.5	390
943	Quicksand Creek	7/12/2014	2	zero	0	8.6	7.6	22	**880**

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
944	South Fork Quicksand Creek	9/11/2014	4	0.1	1	8	7.8	23.5	**600**
944	South Fork Quicksand Creek	7/12/2014	2	zero	0	8	7.9	21	**810**
954	Spring	8/14/2014	3	0.5	1	8	6.5	13	**690**
954	Spring	9/18/2014	3	zero	0	7.8	7	13	**560**
954	Spring	7/15/2014	3	0.5	0	7.5	6.5	12	**630**
955	Elk Lick Creek	7/11/2014	2	zero	0	8	7.8	18	**730**
955	Elk Lick Creek	9/12/2014	3	>1.5	0	8.8	7.8	18	**630**
963	Knoblick Creek	9/12/2014	1	0.1	0	7	7.5	20	410
978	Muddy Creek	9/13/2014	3	0.5	2				
982	Lanes Run	7/12/2014	2	zero	1	5.2	7.5	23.5	**650**
982	Lanes Run	9/15/2014	3	zero	1			17.5	
984	Twin Creek	9/12/2014	3	1	0		7.4	19	330
984	Twin Creek	7/11/2014	1	0.5	0		7.2	18	
990	Unnamed Tributary	9/13/2014	2	0.5	1				
999	Elkhorn Creek	7/12/2014	3	zero	0	7	7.75	25	**710**
1014	Elkhorn Creek	7/12/2014	2	zero	1	5	7.5	28	**600**
1017	Elkhorn Creek	9/14/2014	3	0.5	3	8.2	8	20.5	
1017	Elkhorn Creek	5/17/2014	4	1	3	**4**	8.1	14	**650**
1018	Penitentiary Branch	9/14/2014	3	zero	1		7.5	15	**640**
1018	Penitentiary Branch	7/11/2014	2	zero	0		7.5	14	**790**
1020	West Hickman Creek	7/12/2014	2	zero	1	5.2	7.7	22	**960**
1020	West Hickman Creek	8/9/2014	2	0.1	1	6	7.7	22	**960**
1021	West Hickman Creek	8/9/2014	2	0.1	1	5.1	7.7	22	**630**
1021	West Hickman Creek	7/12/2014	2	zero	1	8.2	7.7	22	**620**
1028	Wolf Run	7/12/2014	2	zero	0	*20?*	8.5	26	**710**
1028	Wolf Run	8/8/2014	2	zero	0	6	8	20	**790**
1028	Wolf Run	9/15/2014	2	zero	0	6		18	**620**
1048	Shannon Run	7/11/2014	2	zero	1	*19?*	7.5	19	350
1048	Shannon Run	9/12/2014	4	>1.5	1	8	7	6	360
1048	Shannon Run	8/7/2014	2	zero	1				
1077	Kentucky River	7/11/2014	1	zero	0	5.8	7	16	1280
1106	Little Cowan Creek	7/12/2014	2	zero	0		7.87	20.2	485
1117	Solomon Branch	9/15/2014	2	zero	0	10	7	19	480
1120	North Fork Kentucky River	9/15/2014	3	zero	1	6	6.5	18	**830**
1124	Marble Creek	7/11/2014	1	zero	0	7.6	7	25	430
1124	Marble Creek	9/14/2014	3	0.1	0	10	7	19	460
1128	Cardinal Run	8/9/2014	3	0.1	0	**3.6**	7.5	20	**600**
1128	Cardinal Run	7/12/2014	3	zero	0	**4**	7.5	20	**580**
1128	Cardinal Run	9/13/2014	3	1	0	6.8	7.8	16	**690**
1129	Cardinal Run	8/9/2014	2		0	8.6	7	15	590
1129	Cardinal Run	7/12/2014	2	zero	0				510

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
1131	Wolf Run	7/12/2014	1	zero	0	**3**	7	23	1400
1131	Wolf Run	8/9/2014	1	0.1	0	**3.8**	7.5	21	1180
1131	Wolf Run	9/15/2014	3	zero	0	10.4	8	16.5	920
1132	Wolf Run	7/12/2014	3	zero	0	7.4	8	25	**600**
1132	Wolf Run	8/9/2014	3	0.1	0	**4.5**	7.5	21	**630**
1132	Wolf Run	9/13/2014	3	1	0	**4.4**	7.5	16	**580**
1133	Wolf Run	7/11/2014	2	zero	0	9.7	7.4	22.3	**680**
1133	Wolf Run	9/12/2014	2	>1.5	0	8.7	7.6	20.2	**699**
1134	Spring Branch	7/12/2014	2	zero	0	6.9	7	18	**1020**
1134	Spring Branch	8/8/2014	2	zero	0	8.7	8	17	**770**
1134	Spring Branch	9/15/2014	3	zero	0	10	8.5	16	**570**
1135	Wolf Run	7/12/2014	1	zero	0	**3.42**	7.5-8.0	22	**1140**
1135	Wolf Run	8/9/2014	2	0.1	0	6.34	7.46	20.98	**959**
1135	Wolf Run	9/15/2014	3	zero	0	10	7.5	16	**620**
1136	Culvert	8/8/2014	2	zero	0	7.1	8.5	18	**880**
1136	Culvert	7/11/2014		zero		7	8.5	17	**820**
1137	Vaughns Branch	7/12/2014	2	zero	0	**2.5**	7.5	22	**910**
1137	Vaughns Branch	8/9/2014	3	0.1	0	**3.8**	7.8	20	**880**
1137	Vaughns Branch	9/13/2014	3	1	0	**4.6**	7.5	16	**560**
1138	Vaughns Branch	7/11/2014	1	zero	0	6.6	7.5	21	**570**
1138	Vaughns Branch	8/8/2014	1	zero	0	5	7.5	20	**540**
1138	Vaughns Branch	9/13/2014	3	0.5	0	7.2	7.5	18	**540**
1139	Vaughns Branch	7/12/2014	2	zero	0	9.6	7.5	22	**1550**
1139	Vaughns Branch	8/9/2014	3	0.1	0	**4.6**	7	20	**1270**
1139	Vaughns Branch	9/12/2014	2	>1.5	0	8.18	7.35	19.6	**983**
1145	Millstone Creek	9/15/2014	3	zero	0		7.5	18	1200
1148	Little Dry Fork	9/12/2014	3	0.5	2	7.25	7.5	17	**1060**
1151	Cram Creek	9/11/2014	3	0.5	1		7.5	21	450
1151	Cram Creek	7/12/2014	3	zero	0	8	7.8	19	**580**
1151	Cram Creek	8/9/2014		1.5					
1152	Cram Creek	9/11/2014	3	0.5	1		7.5	19	330
1152	Cram Creek	7/12/2014	3	zero	0	7.75	8	18	400
1152	Cram Creek	8/9/2014	3	1.5	2				
1174	Royal Springs	7/11/2014	3	zero	0	7	7.96	19	**698**
1175	Calloway Creek	9/13/2014	3	1	2	7	8	18	**610**
1175	Calloway Creek	7/12/2014	0	zero					
1184	Spring Branch	9/15/2014	3	zero	0	9.2	7.3	15.9	**548**
1184	Spring Branch	7/11/2014	0						
1185	North Fork Kentucky River	9/11/2014	3	0.5	1		8	22	**820**
1191	Kentucky River	7/12/2014	3	zero	0	10	8	28	450
1195	Lees Branch	7/12/2014	2	zero	0	**2**	7.5	19	400
1195	Lees Branch	9/13/2014	5	>1.5	0	5.4	7.5	18	440

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
1198	Glenns Creek	7/11/2014	2	zero	0	6.5	7.4	22	**770**
1198	Glenns Creek	8/8/2014	2	0.1	1	7	7.5	22	**830**
1199	Vaughns Branch	9/15/2014	3	zero	0	6.54	8.04	20.06	**1176**
1209	Sandlick Creek	9/12/2014	2	0.5	1	8	**3.1**	19	**1660**
1221	Cane Run	7/11/2014	2			13	**9.12**	25.1	**605**
1242	Dry Fork	9/12/2014	3	0.5	2	**3**	6	15	**1360**
1246	Cardinal Run	7/12/2014	1	zero	0	**3.68**	7.5	21	**1320**
1248	Lick Fork	9/15/2014	3	zero	0		7	13	**1300**
1274	Elk Lick Creek	7/11/2014	2		0	7.8	7.6	17	**930**
1275	Unnamed Tributary	7/12/2014	2	zero	0	**4.5**	7.8	19	**870**
1275	Unnamed Tributary	8/7/2014	2	zero	0	**4.9**	7.9	19	**910**
1275	Unnamed Tributary	9/12/2014	3	>1.5	0	7.2	7.7	18	**670**
1278	Kentucky River	9/13/2014	4	1.5	2	8	8	20	320
1287	Kentucky River	7/12/2014	3	zero	1	8.4	8.5	29	490
1301	North Elkhorn Creek	7/12/2014	2	zero	1	**4.8**	7.8	21	**550**
1301	North Elkhorn Creek	9/14/2014	4	zero	2	7.6	7.75	17	**500**
1307	Jessamine Creek	7/12/2014	2	zero	0	5	7.7	24	**570**
1307	Jessamine Creek	9/12/2014	4	0.1	0	**0.7**	8	20	**520**
1314	Wolf Run	7/12/2014	2	zero	0	8.1	8	20	**630**
1314	Wolf Run	8/9/2014	2	0.1	0		7.5	19	**670**
1314	Wolf Run	9/13/2014	3	0.1	0	9	7.5	14	**570**
1318	Kentucky River	9/17/2014	3	0.1	1	6.6	7.75		430
2924	Tates Creek	7/11/2014	1	zero	0	*15.55?*	8	**34.5**	**525**
2924	Tates Creek	8/8/2014	1	0.1	0	**3.45**	7.6	20.5	**685**
2924	Tates Creek	9/12/2014	3	1	0	9.8	7.8	19.5	**677**
2970	Prestons Cave Spring	7/11/2014	2	zero	0	7	6.9	14	**810**
2993	West Hickman Creek	7/12/2014	2	zero	0	6	7.5	15	**830**
2994	West Hickman Creek	7/12/2014	2	zero	0	7.6	8	17	**780**
3004	Vaughns Branch	7/12/2014	1	zero	0	**4.25**	7.83	22.3	**934**
3004	Vaughns Branch	8/9/2014				**3.25**	7.61	21.46	**922**
3004	Vaughns Branch	9/15/2014	3	zero	0	7.12	7.51	17.34	**743**
3005	McConnell Branch	9/15/2014	3	zero	2	**4.4**	7	18	400
3005	McConnell Branch	7/11/2014	0						
3006	Lower Howard Creek	7/12/2014	3	zero	0	**3.7**	7.5	20	370
3007	Lower Howard Creek	7/12/2014	3	zero	0	**3.7**	7.5	20	370
3013	Shannon Run	7/11/2014	2	zero	1	*20?*	8	22	400
3013	Shannon Run	9/12/2014	4	>1.5	1	8	7	7	350
3013	Shannon Run	8/7/2014	2	zero	1				
3019	Vaughns Branch	7/11/2014	0						
3053	Loves Branch	9/12/2014	3	0.5	1				
3059	Gardenside Branch	8/9/2014	2	0.1	0	6.36	7.8	21.09	**686**
3059	Gardenside Branch	7/12/2014	2	zero	0				500
3060	Vaughns Branch	9/13/2014	3	0.5	0	5.2	7.8	18	**840**

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*
3067	East Hickman Creek	7/12/2014	2	zero	0	5.5	7.5	22	**840**
3067	East Hickman Creek	8/9/2014	2	0.5	0	6.2	7	21	**810**
3067	East Hickman Creek	9/14/2014							
3084	Unnamed Tributary	9/12/2014	3	0.5	1				
3085	St Clair Spring	7/12/2014	1	zero	1	**3.3**	8.5	31	440
3085	St Clair Spring	9/15/2014	1	zero	0	8	7.6	18.5	480
3127	Unnamed Tributary	7/12/2014	0	zero					
3128	Unnamed Tributary	7/12/2014	2	zero	0	6.4	7	21	**750**
3128	Unnamed Tributary	8/8/2014	2	zero	0	5	8	20	**770**
3128	Unnamed Tributary	9/15/2014	3	zero	0	6.4	8	15	**690**
3133	Mocks Branch	8/8/2014		zero	1	9	7.6	22	
3133	Mocks Branch	7/11/2014	1	zero	3	**2.2**	7.5	18	
3136	Wolf Run	7/12/2014	1	zero	1	9	7	22	**610**
3137	Wolf Run	7/11/2014	1	zero	1	6.7	7.3	21.5	**1750**
3137	Wolf Run	8/9/2014	3	0.1	1	6.8	7.5	21	**1090**
3137	Wolf Run	9/15/2014	3	zero	0	7.3	7.5	20	**1300**
3146	Cane Run	9/15/2014	3	zero	0	6	7	20	**510**
3147	Cane Run	9/15/2014	1	zero	1	10	7	19	500
3172	Tates Creek	7/11/2014	2	zero	0	9.8	7.9	27.5	**720**
3172	Tates Creek	8/8/2014	2	0.1	0	6.6	7.6	21	**685**
3172	Tates Creek	9/12/2014	3	1	0	7.82	7.8	19	**620**
3180	Spring	7/12/2014	3	zero	0	8.5	8	19	**700**
3197	Quillen Fork	9/15/2014	3	zero	0	7	7	17.9	**1030**
3198	Clear Creek	7/12/2014	2	0.1	0	8	8	27	440
3198	Clear Creek	9/12/2014	4	>1.5	3	7.2	7	24	350
3203	Evans Branch	7/11/2014	2		0	6.2	8.2	19	480
3203	Evans Branch	9/12/2014	3	>1.5	0	8	8.1	18	480
3204	Unnamed Tributary	5/17/2014	3	0.1	1	9.1	7.5	14	240
3211	Silver Creek	8/8/2014	1	0.1	0	**3.2**	7	22	320
3211	Silver Creek	7/11/2014	2	0.5	0	6.4	7	21	340
3211	Silver Creek	9/12/2014	2	0.5	0	9.2	8.5	20	300
3214	Glenns Creek	7/12/2014	3		1	7	7.8	21	**720**
3214	Glenns Creek	9/15/2014	4		0	7	7.9	15	500
3216	Unnamed Tributary	7/12/2014	2	zero	1	**2**	7.7	21	**800**
3221	Lower Devil Creek	7/13/2014	2	zero	0	7.2	7	25	260
3222	Unnamed Tributary	7/13/2014	1	zero	0	6.8	7.3	26	80
3222	Unnamed Tributary	9/21/2014	3	zero	1	8.2	7	16	80
3223	Unnamed Tributary	7/13/2014	1	zero	0	7	7	22	100
3223	Unnamed Tributary	9/21/2014	3	zero	1	7.8	7	18	80
3224	Unnamed Tributary	7/13/2014	3	zero	0	7	7	24	130
3224	Unnamed Tributary	8/17/2014	3	zero	1	8.2	7	20.5	110
3224	Unnamed Tributary	9/21/2014	3	zero	1	8	7	19	110
3225	Middle Fork Lower Devil Creek	7/13/2014	2	zero	1	7	7.5	22	190
3225	Middle Fork Lower Devil Creek	9/21/2014	3	zero	1	7.8	7.5	18	180

Site ID#	Stream	Sampling Date	*Flow*	*Rainfall (inches)*	*Turbidity*	*Dissolved Oxygen (mg/L)*	*pH*	*Temperature (°C)*	*Conductivity (microsiemens /cm)*	
3241	Moberly Spring	7/12/2014								No data
3252	South Elkhorn Creek	7/11/2014	2	zero	0	8.5	7.8	21	430	Y
3252	South Elkhorn Creek	8/8/2014	2	0.1	1	**4.2**	7.8	20	**520**	
3252	South Elkhorn Creek	9/12/2014	4	>1.5	2	7.4	7.5	15	450	
3271	North Fork Kentucky River	9/10/2014	3	zero	3	10	6	24	**610**	Y
3271	North Fork Kentucky River	5/18/2014	3	0.1	2	8.6	7.5	16	**760**	
3276	Bear Pen Creek	5/18/2014	3	1	0	7	7	21	180	G
3277	Swift Camp Creek	5/18/2014	3	1	0	8	7	21	160	G
3278	Sturgeon Creek	5/18/2014	3	1	0	10	7.3	12	110	G
3282	Elkhorn Creek	7/12/2014	2	zero	1	**4.2**	8.5	25	**620**	Y
3282	Elkhorn Creek	9/14/2014	5	>1.5	3	8.2	7.9	20	470	
3282	Elkhorn Creek	5/16/2014	4	0.5	2	6.1	8	15	360	
3283	Unnamed Tributary	7/12/2014	1	zero	1		7.5	20	**1160**	R
3283	Unnamed Tributary	8/8/2014	2	0.5	1	**3**	8.5	20	**840**	
3283	Unnamed Tributary	9/14/2014	2	zero	1	**3.8**	8.5	20	**830**	
3283	Unnamed Tributary	5/17/2014	3	0.5	0	8.3	8	10	**870**	
3295	Buck Creek	5/14/2014	3	0.5	1	9	7.5	20.5	420	G
3296	Kentucky River	5/14/2014	3	0.5	0	9	8	21	440	G
3297	Richard''s Stream	5/14/2014	3	0.5	0	8	8	17	350	G
3298	Red Lick Creek	7/11/2014	1	zero	2	**4.2**	6.9	20.5	380	G
3298	Red Lick Creek	9/15/2014	3		1	6.8	7.6	19	380	
3298	Red Lick Creek	5/16/2014	4	0.5	1	7.4	6.2	16	340	
3299	Locust Branch	7/11/2014	0	zero	0	6.6	7.6	23	490	G
3299	Locust Branch	9/15/2014	3	zero	0	9	7.8	18	390	
3299	Locust Branch	5/16/2014	3	0.5	0	9.8	**5.7**	15	310	
3300	Ross Creek	7/11/2014	2	0.5	0	5.5	7.5	20	300	G
3300	Ross Creek	9/12/2014	3	0.5	1	8.4	8	17.9	240	
3300	Ross Creek	5/15/2014	3	0.5	2	6.6	7.9	14.5	250	
3303	Station Camp Creek	5/16/2014								No data
3304	Station Camp Creek	5/16/2014	3	1.5	2	7.1	7.6	19	220	G
3305	Spring	5/14/2014	2	0.5	2	9	7.5	17.75	270	G
3313	Elkhorn Creek	7/12/2014	2	zero	1	7.2	7.8	28	**740**	Y
3328	Glenns Creek	7/12/2014	2		0	8.9	8.5	20	**760**	Y
3341	Swift Camp Creek	7/13/2014	3	zero	0	**4.75**	7.6	24	300	G
3341	Swift Camp Creek	9/15/2014	3		0	7.5	7.4	15	170	
3343	Buck Lick Branch	7/11/2014	2	0.5	0	7.75	8	18.5	370	G
3343	Buck Lick Branch	9/12/2014	3	0.5	1	10	8	16	310	
3344	Wolf Pen Branch	7/11/2014	1	0.5	0	**3.75**	7.2	19	300	Y
3349	Waterside Lake	9/13/2014	4	0.5	0	5	7.4	21	380	G
3350	Town Creek	9/12/2014				7.1	7.9	17.9	**690**	Y
3352	Company Branch	9/12/2014	2	0.5	1	6.75	7.5	18	448	G
3353	Fairchild Branch	9/12/2014	2	0.5	1	8	**2.8**	18	**1700**	R
3357	Kentucky River	9/17/2014	3	0.1	1	6.6	7.75		430	G
3358	Kentucky River	9/17/2014	3	0.1	1	6.6	7.75		430	G

* Italicized dissolved oxygen values followed by a question mark exceed the maximum possible value of 14.6 mg/L.

Table 4

2014 Kentucky River Watershed Watch Herbicide Sampling Results				
Site ID#	**Sampling Date**	**Stream**	**County**	**Triazines by Immunoassay**
Method Detection Limit				**0.06 micrograms/L (or 0.06 parts per billion)**
Water Quality Standards			**3.0 micrograms/L for DWS * ; 350 micrograms/L for Acute AL* ; 12 micrograms/L for Chronic AL**	
1017	5/17/2014	Elkhorn Creek	Franklin	0.8
3204	5/17/2014	Evans Branch	Fayette	< MDL
3271	5/18/2014	North Fork Kentucky River	Breathitt	< MDL
3276	5/18/2014	Bear Pen Creek	Wolfe	< MDL
3277	5/18/2014	Swift Camp Creek	Wolfe	< MDL
3278	5/18/2014	Sturgeon Creek	Owsley	< MDL
3282	5/16/2014	Elkhorn Creek	Franklin	0.8
3283	5/17/2014	Unnamed Tributary	Clark	< MDL
3295	5/14/2014	Buck Creek	Estill	< MDL
3296	5/14/2014	Kentucky River	Estill	0.07
3297	5/14/2014	Richard's Stream	Estill	< MDL
3298	5/16/204	Red Lick Creek	Estill	0.1
3299	5/16/2014	Locust Branch	Estill	< MDL
3300	5/15/2014	Ross Creek	Lee	< MDL
3304	5/16/2014	Station Camp Creek	Estill	0.1
3305	5/14/2014	Spring	Estill	< MDL

*** DWS = Drinking Water Standard**

AL = Aquatic Life Standard (Acute refers to short-term effects. Chronic refers to long-term effects.)

Table 5

2014 KRWW Synoptic Pathogen Sampling Results (by Site ID#)			
Site ID#	**Stream**	**County**	**E. coli (cfu/100 ml)**
Water Quality Standard			**240 cfu/100 ml for Primary Contact Recreation**
741	Lees Branch	Woodford	**613**
744	Cane Run	Scott	**1,450**
755	North Elkhorn Creek	Scott	109
765	South Elkhorn Creek	Scott	98
767	Clear Creek	Woodford	20
793	McConnell Spring	Fayette	**249**
796	Spring Station	Woodford	98
801	North Fork Kentucky River	Letcher	**246**
802	Pine Creek	Letcher	**368**
803	Cram Creek	Letcher	**2,282**
810	South Elkhorn Creek	Fayette	155
811	Steeles Branch	Fayette	**327**
812	Swift Camp Creek	Wolfe	10
814	Red River	Powell	189
815	Cane Creek	Menifee	97
820	North Fork Kentucky River	Perry	131
823	Glenns Creek	Woodford	**1,812**
827	Quicksand Creek	Breathitt	97
831	Lower Red River	Estill	231
832	Red River	Powell	134
833	Spring	Woodford	104
834	North Fork Kentucky River	Letcher	**1,483**
848	North Fork Kentucky River	Letcher	**565**
850	Colley Creek	Letcher	228
860	Clarks Run	Boyle	63
861	Glenns Creek	Woodford	**482**
875	Right Fork Carr Creek	Perry	**556**
888	Fourmile Creek	Clark	52
889	Kentucky River	Clark	0
890	Howards Creek	Clark	52
891	North Elkhorn Creek	Scott	20
911	Clarks Run	Boyle	52
914	Holly Spring	Fayette	0
915	Wolf Run	Fayette	**5,172**
922	Black Spring	Woodford	**4,962**
942	Lower Howard Creek	Clark	135
943	Quicksand Creek	Breathitt	52
944	South Fork Quicksand Creek	Breathitt	**243**
954	Spring	Woodford	**1,354**
955	Elk Lick Creek	Fayette	160

Site ID#	Stream	County	E. coli (cfu/100 ml)
982	Lanes Run	Scott	**279**
984	Twin Creek	Estill	135
999	Elkhorn Creek	Franklin	20
1014	Elkhorn Creek	Franklin	40
1018	Penitentiary Branch	Franklin	146
1020	West HIckman Creek	Fayette	**24,196**
1021	West Hickman Creek	Fayette	**1,401**
1028	Wolf Run	Fayette	201
1048	Shannon Run	Woodford	**5,172**
1077	Kentucky River	Madison	41
1106	Little Cowan Creek	Letcher	0
1124	Marble Creek	Jessamine	52
1128	Cardinal Run	Fayette	**336**
1129	Cardinal Run	Fayette	**441**
1131	Wolf Run	Fayette	**2,282**
1132	Wolf Run	Fayette	**1,450**
1133	Wolf Run	Fayette	161
1134	Spring Branch	Fayette	110
1135	Wolf Run	Fayette	**>24,196**
1136	Culvert	Fayette	**12,033**
1137	Vaughns Branch	Fayette	**855**
1138	Vaughns Branch	Fayette	**4,106**
1139	Vaughns Brnach	Fayette	**1,081**
1151	Cram Creek	Letcher	**1,112**
1152	Cram Creek	Letcher	**1,723**
1174	Royal Springs	Scott	52
1191	Kentucky River	Mercer	<1.0
1195	Lees Branch	Woodford	**241**
1198	Glenns Creek	Woodford	**918**
1221	Cane Run	Scott	211
1246	Cardinal Run	Fayette	75
1274	Elk LIck Creek	Fayette	52
1275	Unnamed Tributary	Fayette	**723**
1287	Kentucky River	Jessamine	0
1301	North Elkhorn Creek	Scott	170
1307	Jessamine Creek	Jessamine	**256**
1314	Wolf Run	Fayette	**836**
2924	Tates Creek	Fayette	**571**
2970	Prestons Cave Spring	Fayette	175
2993	West Hickman Creek	Fayette	**10,462**
2994	West Hickman Creek	Fayette	**1,274**
3004	Vaughns Branch	Fayette	**1,789**
3006	Lower Howard Creek	Clark	63
3007	Lower Howard Creek	Clark	75

Site ID#	Stream	County	E. coli (cfu/100 ml)
3013	Shannon Run	Woodford	**733**
3059	Gardenside Branch	Fayette	**5,172**
3067	East Hickman Creek	Fayette	**1,664**
3085	St Clair Spring	Fayette	161
3128	Unnamed Tributary	Fayette	**318**
3133	Mocks Branch	Boyle	**>24,196**
3136	Wolf Run	Fayette	121
3137	Wolf Run	Fayette	**471**
3172	Tates Creek	Fayette	**369**
3180	Branch Cove Spring	Franklin	62
3198	Clear Creek	Mercer	<1.0
3203	Evans Branch	Fayette	10
3211	Silver Creek	Madison	**2,613**
3214	Glenns Creek	Woodford	**524**
3216	Unnamed Tributary	Fayette	218
3221	Lower Devil's Creek	Wolfe	52
3222	Unnamed Trib	Wolfe	135
3223	Unnamed Trib	Wolfe	52
3224	Middle Fork of Lower Devils Creek	Wolfe	**262**
3225	Middle Fork of Lower Devils Creek	Wolfe	41
3252	South Elkhorn Creek	Jessamine	**332**
3282	Elkhorn Creek	Franklin	82
3283	Unnamed Tributary	Clark	**2,909**
3298	Red Lick Creek	Estill	31
3299	Locust Branch	Estill	228
3300	Ross Creek RR	Lee	20
3313	Elkhorn Creek	Franklin	196
3328	Glenns Creek	Franklin	40
3341	Swift Camp Creek	Wolfe	20
3343	Buck Lick Branch	Lee	41
3344	Wolf Pen RR	Lee	52

Table 6

2014 KRWW Synoptic Pathogen Sampling Results (by E. coli count)			
Site ID#	**Stream**	**County**	**E. coli (cfu/100 ml)**
Water Quality Standard			**240 cfu/100 ml for Primary Contact Recreation**
1135	Wolf Run	Fayette	**>24,196**
3133	Mocks Branch	Boyle	**>24,196**
1020	West HIckman Creek	Fayette	**24,196**
1136	Culvert	Fayette	**12,033**
2993	West Hickman Creek	Fayette	**10,462**
915	Wolf Run	Fayette	**5,172**
1048	Shannon Run	Woodford	**5,172**
3059	Gardenside Branch	Fayette	**5,172**
922	Black Spring	Woodford	**4,962**
1138	Vaughns Branch	Fayette	**4,106**
3283	Unnamed Tributary	Clark	**2,909**
3211	Silver Creek	Madison	**2,613**
803	Cram Creek	Letcher	**2,282**
1131	Wolf Run	Fayette	**2,282**
823	Glenns Creek	Woodford	**1,812**
3004	Vaughns Branch	Fayette	**1,789**
1152	Cram Creek	Letcher	**1,723**
3067	East Hickman Creek	Fayette	**1,664**
834	North Fork Kentucky River	Letcher	**1,483**
744	Cane Run	Scott	**1,450**
1132	Wolf Run	Fayette	**1,450**
1021	West Hickman Creek	Fayette	**1,401**
954	Spring	Woodford	**1,354**
2994	West Hickman Creek	Fayette	**1,274**
1151	Cram Creek	Letcher	**1,112**
1139	Vaughns Brnach	Fayette	**1,081**
1198	Glenns Creek	Woodford	**918**
1137	Vaughns Branch	Fayette	**855**
1314	Wolf Run	Fayette	**836**
3013	Shannon Run	Woodford	**733**
1275	Unnamed Tributary	Fayette	**723**
741	Lees Branch	Woodford	**613**
2924	Tates Creek	Fayette	**571**
848	North Fork Kentucky River	Letcher	**565**
875	Right Fork Carr Creek	Perry	**556**
3214	Glenns Creek	Woodford	**524**
861	Glenns Creek	Woodford	**482**
3137	Wolf Run	Fayette	**471**
1129	Cardinal Run	Fayette	**441**
3172	Tates Creek	Fayette	**369**
802	Pine Creek	Letcher	**368**

Site ID#	Stream	County	E. coli (cfu/100 ml)
1128	Cardinal Run	Fayette	**336**
3252	South Elkhorn Creek	Jessamine	**332**
811	Steeles Branch	Fayette	**327**
3128	Unnamed Tributary	Fayette	**318**
982	Lanes Run	Scott	**279**
3224	Middle Fork of Lower Devils Cre	Wolfe	**262**
1307	Jessamine Creek	Jessamine	**256**
793	McConnell Spring	Fayette	**249**
801	North Fork Kentucky River	Letcher	**246**
944	South Fork Quicksand Creek	Breathitt	**243**
1195	Lees Branch	Woodford	**241**
831	Lower Red River	Estill	231
850	Colley Creek	Letcher	228
3299	Locust Branch	Estill	228
3216	Unnamed Tributary	Fayette	218
1221	Cane Run	Scott	211
1028	Wolf Run	Fayette	201
3313	Elkhorn Creek	Franklin	196
814	Red River	Powell	189
2970	Prestons Cave Spring	Fayette	175
1301	North Elkhorn Creek	Scott	170
1133	Wolf Run	Fayette	161
3085	St Clair Spring	Fayette	161
955	Elk Lick Creek	Fayette	160
810	South Elkhorn Creek	Fayette	155
1018	Penitentiary Branch	Franklin	146
942	Lower Howard Creek	Clark	135
984	Twin Creek	Estill	135
3222	Unnamed Trib	Wolfe	135
832	Red River	Powell	134
820	North Fork Kentucky River	Perry	131
3136	Wolf Run	Fayette	121
1134	Spring Branch	Fayette	110
755	North Elkhorn Creek	Scott	109
833	Spring	Woodford	104
765	South Elkhorn Creek	Scott	98
796	Spring Station	Woodford	98
815	Cane Creek	Menifee	97
827	Quicksand Creek	Breathitt	97
3282	Elkhorn Creek	Franklin	82
1246	Cardinal Run	Fayette	75
3007	Lower Howard Creek	Clark	75
860	Clarks Run	Boyle	63
3006	Lower Howard Creek	Clark	63
3180	Branch Cove Spring	Franklin	62
888	Fourmile Creek	Clark	52
890	Howards Creek	Clark	52
911	Clarks Run	Boyle	52

Site ID#	Stream	County	E. coli (cfu/100 ml)
943	Quicksand Creek	Breathitt	52
1124	Marble Creek	Jessamine	52
1174	Royal Springs	Scott	52
1274	Elk LIck Creek	Fayette	52
3221	Lower Devil's Creek	Wolfe	52
3223	Unnamed Trib	Wolfe	52
3344	Wolf Pen RR	Lee	52
1077	Kentucky River	Madison	41
3225	Middle Fork of Lower Devils Cre	Wolfe	41
3343	Buck Lick Branch	Lee	41
1014	Elkhorn Creek	Franklin	40
3328	Glenns Creek	Franklin	40
3298	Red Lick Creek	Estill	31
767	Clear Creek	Woodford	20
891	North Elkhorn Creek	Scott	20
999	Elkhorn Creek	Franklin	20
3300	Ross Creek RR	Lee	20
3341	Swift Camp Creek	Wolfe	20
812	Swift Camp Creek	Wolfe	10
3203	Evans Branch	Fayette	10
1191	Kentucky River	Mercer	<1.0
3198	Clear Creek	Mercer	<1.0
889	Kentucky River	Clark	0
914	Holly Spring	Fayette	0
1106	Little Cowan Creek	Letcher	0
1287	Kentucky River	Jessamine	0

Table 7

2014 KRWW Follow-Up Pathogen Sampling Results (by Site ID#)				
Site ID#	**Sample Date**	**Stream**	**County**	**E. coli Result (cfu/100 ml)**
Water Quality Standard				**240 cfu/100 ml for Primary Contact Recreation**
744	08/08/2014 09:15:00	Cane Run	Scott	**884**
753	08/09/2014 10:00:00	Clarks Run	Boyle	**717**
793	08/09/2014 11:31:00	McConnell Spring	Fayette	185
801	08/09/2014 09:00:00	North Fork of Kentucky River	Letcher	**1,935**
802	08/09/2014 09:05:00	Pine Creek	Letcher	**4,352**
803	08/09/2014 08:20:00	Cram Creek	Letcher	**5,475**
811	08/09/2014 11:35:00	Steeles Branch	Fayette	**1,211**
823	8/14/2014	Glenns Creek	Woodford	**1,160**
848	08/09/2014 09:15:00	North Fork of Kentucky River	Letcher	**2,014**
861	8/14/2014	Glenns Creek	Woodford	**300**
875	08/08/2014 14:40:00	Right Fork Carr Creek	Perry	**9,804**
915	08/08/2014 09:16:00	Wolf Run	Fayette	**2,282**
921	08/09/2014 09:34:00	Otter Creek	Madison	**816**
922	8/8/2014	Black Spring	Woodford	**2,400**
954	8/14/2014	Spring	Woodford	**7,300**
1020	08/09/2014 07:51:00	West Hickman Creek	Fayette	**1,935**
1021	08/09/2014 08:18:00	West Hickman Creek	Fayette	**1,333**
1028	08/08/2014 10:40:00	Wolf Run	Fayette	**712**
1048	08/07/2014 08:30:00	Shannon Run	Woodford	**717**
1128	08/09/2014 09:30:00	Cardinal Run	Fayette	**426**
1129	08/09/2014 10:17:00	Cardinal Run	Fayette	**432**
1131	08/09/2014 09:10:00	Wolf Run	Fayette	**538**
1132	08/09/2014 09:54:00	Wolf Run	Fayette	**1,515**
1134	08/08/2014 09:20:00	Springs Branch	Fayette	**249**
1135	08/09/2014 10:19:00	Wolf Run	Fayette	**860**
1136	08/08/2014 10:04:00	Culvert	Fayette	**15,531**
1137	08/09/2014 10:20:00	Vaughns Branch	Fayette	**959**
1138	08/08/2014 09:09:00	Vaughns Branch	Fayette	**1,198**
1139	08/09/2014 08:50:00	Vaughns Branch	Fayette	**743**
1151	08/09/2014 08:35:00	Cram Creek	Letcher	**8,164**
1152	08/09/2014 08:10:00	Cram Creek	Letcher	**2,489**
1198	8/8/2014	Glenns Creek	Woodford	**1,262**
1275	08/07/2014 08:22:00	Unnamed Tributary	Fayette	**538**
1314	08/09/2014 08:45:00	Wolf Run	Fayette	**960**
2924	08/08/2014 09:14:00	Tates Creek	Madison	**292**
3004	08/09/2014 10:56:00	Vaughns Branch	Fayette	**529**
3013	08/07/2014 08:40:00	Shannon Run	Woodford	**860**
3059	08/09/2014 10:45:00	Gardenside Branch	Fayette	**12,033**
3067	08/09/2014 09:00:00	East Hickman Creek	Fayette	**1,071**
3128	08/08/2014 08:00:00	Unnamed Tributary	Fayette	**448**
3133	08/08/2014 09:00:00	Mocks Branch	Boyle	**441**
3137	08/09/2014 08:30:00	Wolf Run	Fayette	**1,039**
3172	08/08/2014 09:33:00	Tates Creek	Madison	**462**
3211	08/08/2014 10:30:00	Silver Creek	Madison	169
3252	08/08/2014 11:45:00	South Elkhorn Creek	Jessamine	75
3283	08/08/2014 08:25:00	Unnamed Tributary	Clark	**1,793**

Table 8

2014 Kentucky River Watershed Watch Chemical Sampling Results							
Site ID#	Collection Date	Stream	Alkalinity (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (uS/cm)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
Water Quality Standard			>20 for AL*	250 for DWS* 1,200 for acute AL 600 for chronic AL	500 uU/cm**	N/A***	250 mg/L (DWS*)
Method Detection Limit*			**4 mg/L** Method EPA 310.1	**1.0 mg/L** Method EPA 300	**1 uU/cm** Method EPA 120.1	**3 mg/L** Method EPA 160.2	**5 mg/L** Method EPA300
741	9/13/2014	Lees Branch	192	11	441	8	14
763	9/12/2014	South Elkhorn Creek	189	24	**515**	13	32
765	9/14/2014	South Elkhorn Creek	196	38	**575**	24	35
767	9/15/2014	Clear Creek	224	14	480	<3	16
772	9/13/2014	Unnamed Tributary	157	22	416	4	15
793	9/15/2014	McConnell Spring	215	85	**795**	3	58
796	9/13/2014	Spring Station	176	7	400	37	13
801	9/11/2014	N Fk Kentucky River	202	16	**949**	8	**287**
802	9/11/2014	Pine Creek	161	11	**534**	38	106
803	9/11/2014	Cram Creek	155	10	403	18	46
810	9/12/2014	S Elkhorn Creek	197	32	**542**	<3	30
811	9/15/2014	Steeles Branch	176	14	429	6	14
814	9/12/2014	Red River	51	3	128	125	11
815	9/12/2014	Cane Creek	89	1	181	<3	8
820	9/12/2014	N Fk Kentucky River	103	8	**519**	13	145
823	9/18/2014	Glenns Creek	190	35	**554**	8	27
827	9/11/2014	Quicksand Creek	112	3	443	130	110
831	9/12/2014	Lower Red River	44	3	108	340	9
832	9/12/2014	Red River	46	3	116	175	10
833	9/18/2014	Spring	222	4	473	<3	13
848	9/11/2014	N Fk Kentucky River	194	16	**885**	4	**255**
850	9/11/2014	Colley Creek	91	9	**651**	9	226
861	9/18/2014	Glenns Creek	197	33	**539**	6	24
875	9/12/2014	R Fk Carr Creek	146	7	**849**	135	**299**
914	9/15/2014	Holly Spring	148	34	474	3	24
915	9/15/2014	Wolf Run	209	52	**648**	<3	49
918	9/13/2014	Muddy Creek	252	13	**510**	7	12
919	9/13/2014	Muddy Creek	252	12	**517**	10	16
921	9/13/2014	Otter Creek	205	35	**576**	<3	45
943	9/11/2014	Quicksand Creek	83	3	397	28	109
944	9/11/2014	S Fk Quicksand Cr	218	3	**624**	15	124
954	9/18/2014	Spring	247	12	**542**	15	13
955	9/12/2014	Elk Lick Creek	240	25	**621**	<3	61
963	9/12/2014	Knoblick Creek	133	24	423	5	48
978	9/13/2014	Muddy Creek	235	11	483	<3	14
982	9/15/2014	Lanes Run	233	25	**584**	5	39
984	9/12/2014	Twin Creek	110	12	339	4	45
990	9/13/2014	Unnamed Tributary	294	92	**928**	38	56
1017	9/14/2014	Elkhorn Creek	170	21	452	21	29
1018	9/14/2014	Penitentiary Branch	213	37	**588**	9	34

Site ID#	Collection Date	Stream	Alkalinity (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (uS/cm)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
1017	9/14/2014	Elkhorn Creek	170	21	452	21	29
1018	9/14/2014	Penitentiary Branch	213	37	**588**	9	34
1028	9/15/2014	Wolf Run	201	64	**672**	4	49
1048	9/12/2014	Shannon Run	152	19	421	11	16
1117	9/15/2014	Solomon Branch	175	3	**557**	8	113
1120	9/15/2014	N Fk Kentucky River	189	18	**866**	6	246
1124	9/14/2014	Marble Creek	230	12	472	6	12
1128	9/13/2014	Cardinal Run	230	64	**711**	<3	36
1129	9/13/2014	Cardinal Run	170	40	**532**	8	26.9
1131	9/15/2014	Wolf Run	222	154	**976**	7	46
1132	9/13/2014	Wolf Run	196	49	**601**	8	29
1133	9/12/2014	Wolf Run	193	72	**675**	<3	34
1134	9/15/2014	Spring Branch	205	45	**635**	<3	41
1135	9/15/2014	Wolf Run	204	65	**694**	<3	45
1137	9/13/2014	Vaughns Branch	183	54	**589**	7	26
1138	9/13/2014	Vaughns Branch	215	23	**553**	22	33
1139	9/12/2014	Vaughns Branch	187	116	**945**	5	99
1145	9/15/2014	Millstone Creek	209	9	**1147**	4	**419**
1148	9/12/2014	Little Dry Fork	243	16	**1131**	8	**321**
1151	9/11/2014	Cram Creek	197	8	484	11	54
1152	9/11/2014	Cram Creek	131	10	357	13	42
1175	9/13/2014	Calloway Creek	230	43	**661**	26	59
1184	9/15/2014	Spring Branch	201	36	**566**	<3	30
1185	9/11/2014	N Fk Kentucky River	195	16	**888**	10	**260**
1195	9/13/2014	Lees Branch	192	8	445	6	14
1199	9/15/2014	Vaughns Branch	200	187	**1201**	3	96
1209	9/12/2014	Sandlick Creek	**4**	2	**2000**	314	**2302**
1242	9/12/2014	Dry Fork	397	13	**1496**	9	**446**
1248	9/15/2014	Lick Fork	283	1	**1247**	13	**441**
1274	9/13/2014	Elk Lick Creek	267	82.5	**1115**	4	217
1275	9/12/2014	Unnamed Tributary	222	65	**703**	4	39
1278	9/13/2014	Kentucky River	80	12	324	24	61
1301	9/14/2014	N Elkhorn Creek	183	23	489	15	31
1307	9/12/2014	Jessamine Creek	196	21	498	4	30
1314	9/13/2014	Wolf Run	201	48	**605**	5	30
2924	9/12/2014	Tates Creek	215	74	**713**	<3	47
3004	9/15/2014	Vaughns Branch	239	80	**767**	11	34
3005	9/15/2014	McConnell Branch	179	11	420	30	24
3013	9/12/2014	Shannon Run	156	20	435	9	19
3053	9/12/2014	Loves Branch	198	1	**1031**	8	**376**
3059	9/13/2014	Gardenside Branch	183	46.1	**570**	8	29.3
3060	9/13/2014	Vaughns Branch	203	112	**876**	3	64
3067	9/14/2014	East Hickman Cr	205	66	**678**	11	36
3084	9/12/2014	Unnamed Tributary	31	1	**1359**	9	**769**
3085	9/15/2014	St Clair Spring	197	25	**513**	6	32
3128	9/15/2014	Unnamed Tributary	239	52	**694**	No data	54

Site ID#	Collection Date	Stream	Alkalinity (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (uS/cm)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
3137	9/15/2014	Wolf Run	239	225	**1273**	4	53.1
3146	9/15/2014	Cane Run	159	50.9	**541**	7	30.1
3147	9/15/2014	Cane Run	233	8.3	**520**	12	24.9
3172	9/12/2014	Tates Creek	234	45.4	**547**	5	44.9
3197	9/15/2014	Quillen Fork	46	24.6	**992**	21	**436**
3198	9/12/2014	Clear Creek	84	7.45	363	16	85.7
3203	9/12/2014	Evans Branch	234	7.77	472	8	15
3211	9/12/2014	Silver Creek	116	17	327	<3	31.2
3214	9/15/2014	Glenns Creek	198	24.7	**507**	11	21.9
3222	9/21/2014	Unnamed Tributary	23	6.56	84	<3	7.55
3223	9/21/2014	Unnamed Tributary	27	5.44	92	<3	9.36
3224	9/21/2014	Unnamed Tributary	38	7.09	114	<3	8.9
3225	9/21/2014	Middle Fk Lower Devil	64	15.4	189	3	7.78
3252	9/12/2014	S Elkhorn Creek	200	12.6	468	8	15.9
3271	9/10/2014	N Fk Kentucky River	124	17.5	**740**	40	246
3282	9/14/2014	Elkhorn Creek	179	24.1	467	33	28.2
3283	9/14/2014	Unnamed Tributary	311	77.3	**895**	9	50.6
3298	9/15/2014	Red Lick Creek	148	9.81	365	8	31.8
3299	9/15/2014	Locust Branch	99	19.9	369	4	54.7
3300	9/12/2014	Ross Creek	100	1.76	208	<3	8.21
3341	9/15/2014	Swift Camp Creek	47	11	161	<3	14.8
3343	9/12/2014	Buck Lick Branch	128	1.97	260	3	9.2
3349	9/13/2014	Waterside Lake	139	23.5	383	7	15.9
3350	9/12/2014	Town Creek	248	43.4	**678**	10	42.8
3352	9/12/2014	Company Branch	20	5.04	488	3	205
3353	9/12/2014	Fairchild Branch	**4**	1	**2000**	27	**3019**

* AL = Aquatic Life Standard; DWS = Drinking Water Supply Standard

** There is no official Kentucky water quality standard for conductivity. 500 micromohs/cm is a

***There is no official standard for total suspended solid concentrations.

NOTE: Values that exceed water quality standards or benchmarks are noted in bold text.

Table 9

2014 Kentucky River Watershed Watch Nutrient Sampling Results						
Site ID#	**Sample Date**	**Stream**	**Total Nitrogen (mg/L)**	**Nitrate (NO_3) (mg/L)**	**Nitrate as Nitrogen (NO_3-N) (mg/L)**	**Recoverable Phosphorus (mg/L)**
Water Quality Standard			3 mg/L (AL* - KRWW unofficial		10 mg/L (DWS*)	0.3 mg/L (AL* - KRWW unofficial)
Method Detection Limit			0.6	0.1		0.03
741	9/13/2014	Lees Branch	**3.56**	15.2	3.4	**0.57**
763	9/12/2014	South Elkhorn C	**3.09**	12.5	2.8	**0.45**
765	9/14/2014	South Elkhorn C	**4.17**	17.4	3.9	**0.53**
767	9/15/2014	Clear Creek	1.85	7.37	1.7	**0.35**
772	9/13/2014	Unnamed Tribut	**3.19**	8.42	1.9	**0.5**
793	9/15/2014	McConnell Sprir	**3.59**	15.4	3.5	**0.38**
796	9/13/2014	Spring Station	**3.96**	14.1	3.2	**0.76**
801	9/11/2014	N Fk Kentucky	0.6	2.26	0.5	0.05
802	9/11/2014	Pine Creek	0.9	2.34	0.5	0.1
803	9/11/2014	Cram Creek	0.62	1.69	0.4	0.12
810	9/12/2014	S Elkhorn Creek	2.88	11.8	2.7	0.29
811	9/15/2014	Steeles Branch	**3.44**	13.9	3.1	**0.47**
814	9/12/2014	Red River	0.95	0.72	0.2	0.25
815	9/12/2014	Cane Creek	0.6	0.73	0.2	0.03
820	9/12/2014	N Fk Kentucky	1.04	1.62	0.4	0.27
823	9/18/2014	Glenns Creek	**5.02**	20.6	4.7	**0.62**
827	9/11/2014	Quicksand Cree	0.6	0.68	0.15	0.09
831	9/12/2014	Lower Red River	1.95	0.8	0.18	**0.56**
832	9/12/2014	Red River	1.3	1.05	0.24	**0.39**
833	9/18/2014	Spring	**3.23**	14.8	3.34	**0.39**
848	9/11/2014	N Fk Kentucky	0.6	1.7	0.38	0.05
850	9/11/2014	Colley Creek	0.6	0.96	0.22	0.05
861	9/18/2014	Glenns Creek	1.25	18	4.07	**0.54**
875	9/12/2014	R Fk Carr Creek	1.57	2.45	0.55	0.3
914	9/15/2014	Holly Spring	**4.33**	19.5	4.4	**0.54**
915	9/15/2014	Wolf Run	**3.66**	15.4	3.48	**0.75**
918	9/13/2014	Muddy Creek	0.6	0.15	0.03	0.07
919	9/13/2014	Muddy Creek	0.66	0.75	0.17	0.07
921	9/13/2014	Otter Creek	0.69	1.47	0.33	0.13
943	9/11/2014	Quicksand Cree	0.6	0.68	0.15	0.08
944	9/11/2014	S Fk Quicksand	0.6	0.78	0.18	0.03
954	9/18/2014	Spring	**3.51**	15.6	3.53	**0.47**
955	9/12/2014	Elk Lick Creek	1.58	5.63	1.27	**0.37**
963	9/12/2014	Knoblick Creek	0.6	0.75	0.17	0.07
978	9/13/2014	Muddy Creek	0.6	0.97	2.2	0.07
982	9/15/2014	Lanes Run	2.08	8.3	1.88	0.25
984	9/12/2014	Twin Creek	0.6	0.45	0.1	0.08
990	9/13/2014	Unnamed Tribut	1.39	3.03	0.68	0.21

Site ID#	Sample Date	Stream	Total Nitrogen (mg/L)	Nitrate (NO_3) (mg/L)	Nitrate as Nitrogen (NO_3-N) (mg/L)	Total Recoverable Phosphorus (mg/L)
1017	9/14/2014	Elkhorn Creek	**3.12**	11.3	2.55	**0.51**
1018	9/14/2014	Penitentiary Bra	2.59	10.3	2.33	**0.35**
1028	9/15/2014	Wolf Run	2.96	12.4	2.8	**0.36**
1048	9/12/2014	Shannon Run	**5.88**	25.6	5.79	**0.33**
1117	9/15/2014	Solomon Branch	0.99	4.06	0.92	0.04
1120	9/15/2014	N Fk Kentucky	0.68	2.16	0.49	0.03
1124	9/14/2014	Marble Creek	0.6	0.89	0.2	0.29
1128	9/13/2014	Cardinal Run	**3.64**	15.1	3.41	**0.4**
1129	9/13/2014	Cardinal Run	**3.71**	15.9	3.59	**0.49**
1131	9/15/2014	Wolf Run	1.93	7.68	1.74	0.11
1132	9/13/2014	Wolf Run	**3.48**	14.9	3.37	0.03
1133	9/12/2014	Wolf Run	**3.33**	14	3.16	0.21
1134	9/15/2014	Spring Branch	**3.87**	16.2	3.66	0.29
1135	9/15/2014	Wolf Run	**3.36**	14.9	3.37	**0.31**
1137	9/13/2014	Vaughns Branch	**3.27**	11.9	2.69	**0.43**
1138	9/13/2014	Vaughns Branch	**4.1**	16.8	3.8	**0.46**
1139	9/12/2014	Vaughns Branch	**3.52**	14.4	3.25	0.3
1145	9/15/2014	Millstone Creek	0.6	0.57	0.13	0.03
1148	9/12/2014	Little Dry Fork	0.89	1.95	0.44	0.03
1151	9/11/2014	Cram Creek	0.75	1.55	0.35	0.09
1152	9/11/2014	Cram Creek	0.6	0.91	0.21	0.06
1175	9/13/2014	Calloway Creek	0.6	1.15	0.26	0.2
1184	9/15/2014	Spring Branch	**3.94**	16.7	3.77	0.24
1185	9/11/2014	N Fk Kentucky	0.6	1.77	0.4	0.05
1195	9/13/2014	Lees Branch	**5.05**	21.4	4.84	**0.44**
1199	9/15/2014	Vaughns Branch	**5.29**	22.2	5.02	**0.43**
1209	9/12/2014	Sandlick Creek	2.28	0.93	0.21	0.29
1242	9/12/2014	Dry Fork	0.6	0.1	< 0.1	0.03
1248	9/15/2014	Lick Fork	0.6	0.1	< 0.1	0.03
1274	9/13/2014	Elk Lick Creek	1.36	5.87	1.33	**0.33**
1275	9/12/2014	Unnamed Tribut	2.57	11	2.49	0.25
1278	9/13/2014	Kentucky River	1.09	3.23	0.73	0.2
1301	9/14/2014	N Elkhorn Creek	0.6	12.2	2.76	**0.41**
1307	9/12/2014	Jessamine Cree	1.2	4.11	0.93	0.27
1314	9/13/2014	Wolf Run	**3.78**	16.4	3.71	**0.4**
1318	9/17/2014	Kentucky River	1		1.09	0.151
2924	9/12/2014	Tates Creek	0.6	0.28	0.06	0.1
3004	9/15/2014	Vaughns Branch	**3.34**	16	3.62	**0.48**
3005	9/15/2014	McConnell Bran	1.38	3.42	0.77	**0.61**
3013	9/12/2014	Shannon Run	0.6	25.5	5.76	**0.33**
3053	9/12/2014	Loves Branch	0.6	2.1	0.47	0.03
3059	9/13/2014	Gardenside Bra	**3.95**	16.1	3.64	**0.41**
3060	9/13/2014	Vaughns Branch	**3.18**	14.2	3.21	**0.33**
3067	9/14/2014	East Hickman C	**3.23**	13.2	2.98	**0.34**
3084	9/12/2014	Unnamed Tribut	0.6	0.1	< 0.1	0.03
3085	9/15/2014	St Clair Spring	0.6	0.73	0.16	0.08

Site ID#	Sample Date	Stream	Total Nitrogen (mg/L)	Nitrate (NO_3) (mg/L)	Nitrate as Nitrogen (NO_3-N) (mg/L)	Total Recoverable Phosphorus (mg/L)
3128	9/15/2014	Unnamed Tribut	2.41	10.4	2.35	**0.33**
3137	9/15/2014	Wolf Run	2.8	11.1	2.51	**0.4**
3146	9/15/2014	Cane Run	1.63	6.17	1.39	**0.37**
3147	9/15/2014	Cane Run	**4.66**	18.9	4.27	**0.48**
3172	9/12/2014	Tates Creek	< 0.6	1.75	0.4	0.12
3197	9/15/2014	Quillen Fork	< 0.6	1.19	0.27	< 0.03
3198	9/12/2014	Clear Creek	< 0.6	1.51	0.34	0.11
3203	9/12/2014	Evans Branch	1.73	6.12	1.38	**0.44**
3211	9/12/2014	Silver Creek	< 0.6	0.73	0.16	0.03
3214	9/12/2014	Glenns Creek	**3.78**	15.7	3.55	**0.48**
3222	9/12/2014	Unnamed Tribu	< 0.6	1.67	0.38	< 0.03
3223	9/12/2014	Unnamed Tribu	< 0.6	0.7	0.16	< 0.03
3224	9/12/2014	Unnamed Tribu	< 0.6	0.31	0.07	< 0.03
3225	9/12/2014	Middle Fk Lowe	< 0.6	1.01	0.23	< 0.03
3252	9/12/2014	S Elkhorn Creel	**3.59**	13	3.1	**0.33**
3271	9/12/2014	N Fk Kentucky	0.72	1.77	0.4	0.08
3282	9/12/2014	Elkhorn Creek	**3.93**	14.4	3.25	**0.59**
3283	9/14/2014	Unnamed Tribu	1.45	6.02	1.36	0.08
3298	9/15/2014	Red Lick Creek	< 0.6	0.21	0.05	< 0.03
3299	9/15/2014	Locust Branch	< 0.6	< 0.1	< 0.1	< 0.03
3300	9/12/2014	Ross Creek	< 0.6	0.17	0.04	< 0.03
3341	9/15/2014	Swift Camp Cre	< 0.6	1.26	0.28	0.03
3343	9/12/2014	Buck Lick Branc	< 0.6	0.18	0.04	< 0.03
3349	9/13/2014	Waterside Lake	1.27	3.75	0.85	0.17
3350	9/12/2014	Town Creek	2.12	8.59	1.94	**0.32**
3352	9/12/2014	Company Branc	< 0.6	1.22	0.28	< 0.03
3353	9/12/2014	Fairchild Brancl	< 0.6	2.23	0.5	< 0.03
3357	9/17/2014	Kentucky River	1		1.07	0.148
3358	9/17/2014	Kentucky River	1.55		1.07	0.146

Table 10

2014 KRWW Metals Results											
Site ID#	**Sampling Date**	**Result Modifier**	**Aluminum (mg/L)**	**Antimony (mg/L)**	**Arsenic (mg/L)**	**Barium (mg/L)**		**Beryllium (mg/L)**		**Boron (mg/L)**	**Cadmium**
			0.75 (AL-acute) *EPA recommended*	**0.0056 (DWS)**	**0.010 (DWS); 0.34 (AL-acute); 0.15 (AL - chronic)**	**1.0 (DWS)**		**0.004 (DWS)**		**N/A**	**0.005 (DWS); 0.0021 (AL-acute); 0.00027 (AL-**
Mimimum Detection Limit			0.061	0.012	0.014	0.003		0.001		0.008	0.001
801	9/11/2014	<	0.061	**No detections.**	**No detections.**	0.06	<	0.001		0.01	**No detections.**
802	9/11/2014		**0.9**			0.05	<	0.001		0.03	
803	9/11/2014		0.7			0.06	<	0.001		0.02	
810	9/12/2014		0.17			0.03	<	0.001	<	0.008	
811	9/15/2014		0.28			0.02	<	0.001	<	0.008	
814	9/12/2014		**3.04**			0.05	<	0.001	<	0.008	
815	9/12/2014		0.3			0.02	<	0.001	<	0.008	
820	9/12/2014		**3.55**			0.06	<	0.001	<	0.008	
823	9/18/2014		0.12			0.02	<	0.001		0.01	
827	9/11/2014		**0.85**			0.03	<	0.001	<	0.008	
831	9/12/2014		**7.21**			0.07	<	0.001	<	0.008	
832	9/12/2014		**5.12**			0.06	<	0.001	<	0.008	
833	9/18/2014		0.08			0.02	<	0.001	<	0.008	
848	9/11/2014		0.17			0.06	<	0.001	<	0.008	
850	9/11/2014		0.43			0.05	<	0.001	<	0.008	
861	9/18/2014		0.13			0.02	<	0.001	<	0.008	
875	9/12/2014		**3.79**			0.07	<	0.001	<	0.008	
921	9/13/2014		0.13			0.03	<	0.001	<	0.008	
943	9/11/2014		**0.93**			0.03	<	0.001	<	0.008	
944	9/11/2014		0.27			0.04	<	0.001	<	0.008	
954	9/18/2014		0.48			0.02	<	0.001	<	0.008	
955	9/12/2014		0.16			0.02	<	0.001	<	0.008	
982	9/15/2014		0.1			0.03	<	0.001	<	0.008	
1017	9/14/2014		**0.92**			0.03	<	0.001	<	0.008	
1018	9/14/2014		0.42			0.02	<	0.001	<	0.008	
1117	9/15/2014		**0.83**			0.07	<	0.001	<	0.008	
1120	9/15/2014		0.26			0.07	<	0.001	<	0.008	
1139	9/12/2014		0.14			0.04	<	0.001	<	0.008	
1145	9/15/2014	<	0.061			0.04	<	0.001	<	0.008	
1148	9/12/2014		0.07			0.02	<	0.001	<	0.008	
1151	9/11/2014		0.59			0.06	<	0.001	<	0.008	
1152	9/11/2014		0.6			0.06	<	0.001	<	0.008	
1184	9/15/2014		0.2			0.04	<	0.001	<	0.008	
1185	9/11/2014		0.15			0.06	<	0.001	<	0.008	
1199	9/15/2014		0.08			0.05	<	0.001	<	0.008	
1209	9/12/2014		**106**			0.02		**0.03**	<	0.008	
1242	9/12/2014	<	0.061			0.02	<	0.001	<	0.008	
1248	9/15/2014		0.064			0.016	<	0.001	<	0.008	
1274	9/12/2014		0.18			0.03	<	0.001	<	0.008	
1275	9/12/2014		0.11			0.03	<	0.001	<	0.008	
1301	9/14/2014		0.44			0.03	<	0.001	<	0.008	
1307	9/12/2014		0.14			0.03	<	0.001	<	0.008	
2924	9/12/2014		0.08			0.02	<	0.001	<	0.008	
3053	9/12/2014		0.07			0.04	<	0.001	<	0.008	
3067	9/14/2014		0.35			0.03	<	0.001	<	0.008	
3084	9/12/2014		0.15			0.03	<	0.001	<	0.008	
3128	9/15/2014	<	0.061			0.02	<	0.001	<	0.008	
3283	9/14/2014		0.31			0.04	<	0.001	<	0.008	
3352	9/12/2014		**0.99**			0.03	<	0.001	<	0.008	
3353	9/12/2014		**62.4**			0.02		0.01	<	0.008	

Calcium (mg/L)	Chromium (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Gold	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Magnesium (mg/L)	Manganese (mg/L)
N/A	**0.1 (DWS); 1.8 (AL - acute); 0.086 (AL-chronic)**	**N/A**	**1.3 (DWS); 0.0093 (AL-acute); 0.014 (AL-chronic)**	**N/A**	**0.3 (DWS); 4 (AL-acute); 1 (AL-chronic)**	**0.015 (DWS); 0.082 (AL-acute); 0.0032 (AL-chronic)**	**N/A**	**N/A**	**N/A**
0.002	0.024	0.001	0.005	0.034	0.002	0.01	0.001	0.001	0.001
84.8	< 0.024	< 0.001	< 0.005	**No detections.**	0.25	< 0.01	0.03	46.4	0.04
65.4	< 0.024	< 0.001	< 0.005		**1.51**	< 0.01	0.005	24.1	0.14
45.4	< 0.024	< 0.001	< 0.005		**1.21**	< 0.01	0.008	11.5	0.09
85	< 0.024	< 0.001	< 0.005		0.17	< 0.01	< 0.001	6.72	0.03
71.9	< 0.024	< 0.001	< 0.005		0.26	< 0.01	< 0.001	5.17	0.05
17	< 0.024	0.003	< 0.005		**5.69**	< 0.01	0.006	3.84	0.27
28.3	< 0.024	< 0.001	< 0.005		**0.35**	< 0.01	0.002	5.11	0.014
46.9	0.03	0.003	0.006		**5.63**	< 0.01	0.01	23.4	0.23
81.4	< 0.024	< 0.001	< 0.005		0.16	< 0.01	< 0.001	6.16	0.03
36.4	< 0.024	< 0.001	< 0.005		**1.96**	< 0.01	0.008	30	0.15
16	< 0.024	0.007	**0.01**		**12.3**	< 0.01	0.01	3.89	0.47
16	< 0.024	0.005	0.007		**9.15**	< 0.01	0.009	3.64	0.42
89.8	< 0.024	< 0.001	< 0.005		0.04	< 0.01	< 0.001	4.85	0.005
79.6	< 0.024	< 0.001	< 0.005		**0.44**	< 0.01	0.02	41.6	0.07
59.6	< 0.024	< 0.001	< 0.005		**0.89**	< 0.01	0.02	33	0.13
82.6	< 0.024	< 0.001	< 0.005		0.14	< 0.01	< 0.001	6.09	0.025
81	< 0.024	0.005	0.008		**6.95**	< 0.01	0.02	47.7	0.77
67.7	< 0.024	< 0.001	< 0.005		0.17	< 0.01	0.002	18.3	0.04
33.6	< 0.024	0.001	< 0.005		**1.75**	< 0.01	0.006	26	0.15
48.3	< 0.024	< 0.001	< 0.005		**0.64**	< 0.01	0.007	50.3	0.08
97	< 0.024	< 0.001	< 0.005		**0.53**	< 0.01	< 0.001	5.76	0.04
103	< 0.024	< 0.001	< 0.005		0.16	< 0.01	0.006	10.5	0.03
95.8	< 0.024	< 0.001	< 0.005		0.1	< 0.01	< 0.001	7.66	0.05
71.2	< 0.024	< 0.001	< 0.005		**1.08**	< 0.01	0.002	5.94	0.08
87.3	< 0.024	< 0.001	< 0.005		**0.47**	< 0.01	< 0.001	7.14	0.04
79	< 0.024	< 0.001	< 0.005		**1.21**	< 0.01	0.004	18.8	0.07
82.9	< 0.024	< 0.001	< 0.005		**0.63**	< 0.01	0.02	42.3	0.08
108	< 0.024	< 0.001	< 0.005		0.1	< 0.01	0.001	12.7	0.03
104	< 0.024	< 0.001	< 0.005		0.07	< 0.01	0.03	65.6	0.03
55.8	< 0.024	< 0.001	< 0.005		**2.1**	< 0.01	0.06	22	0.31
43.2	< 0.024	< 0.001	< 0.005		**0.95**	< 0.01	0.01	14.5	0.07
50.2	< 0.024	< 0.001	< 0.005		**1.22**	< 0.01	0.004	9.2	0.1
89.3	< 0.024	< 0.001	< 0.005		0.17	< 0.01	< 0.001	5.37	0.02
79.3	< 0.024	< 0.001	< 0.005		**0.47**	< 0.01	0.02	41.4	0.07
111	< 0.024	< 0.001	< 0.005		0.02	< 0.01	0.002	19.8	0.006
192	< 0.024	0.67	0.009		**30.9**	**0.014**	0.49	194	11.2
83.1	< 0.024	< 0.001	< 0.005		**5.23**	< 0.01	0.08	36.3	0.69
126	< 0.024	< 0.001	< 0.005		**4.39**	< 0.01	0.05	73.8	0.42
147	< 0.024	< 0.001	< 0.005		0.12	< 0.01	0.04	25.6	0.02
93.7	< 0.024	< 0.001	< 0.005		0.12	< 0.01	< 0.001	8.98	0.05
75.4	< 0.024	< 0.001	< 0.005		**0.49**	< 0.01	< 0.001	6.11	0.05
78.5	< 0.024	< 0.001	< 0.005		0.17	< 0.01	< 0.001	6.87	0.03
79.4	< 0.024	< 0.001	< 0.005		0.09	< 0.01	< 0.001	13.4	0.05
94	< 0.024	< 0.001	< 0.005		0.13	< 0.01	0.02	60.6	0.06
94.1	< 0.024	< 0.001	< 0.005		**0.36**	< 0.01	< 0.001	7.62	0.05
145	< 0.024	< 0.001	< 0.005		0.13	< 0.01	0.004	113	0.07
102	< 0.024	< 0.001	< 0.005		0.04	< 0.01	< 0.001	8.37	0.02
127	< 0.024	< 0.001	< 0.005		**0.34**	< 0.01	< 0.001	12.6	0.07
39.4	< 0.024	0.016	< 0.005		0.3	< 0.01	0.04	22	0.63
143	< 0.024	0.4	**0.016**		**19.7**	< 0.01	0.29	139	6.52

Nickel (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Selenium (mg/L)	Silicon (mg/L)	Silver (mg/L)	Sodium (mg/L)	Strontium (mg/L)	Sulfur (mg/L)	Thalium (mg/L)
0.61 (DWS); 0.47 (AL-acute); 0.052 (AL-chronic)	**N/A**	**N/A**	**0.17 (DWS); 0.258 (AL-acute)**	**N/A**	**0.0038 (AL-acute)**	**N/A**	**N/A**	**N/A**	**0.00024 (DWS)**
0.002	0.009	0.191	0.011	0.009	0.003	0.058	0.01	0.014	0.041
< 0.002	0.05	6.02	**No detections.**	3.04	**No detections.**	50.3	1.81	98.5	< 0.041
< 0.002	0.06	4.51		4.49		12.1	0.36	35.5	< 0.041
< 0.002	0.1	4.34		4.41		25	0.56	14.8	< 0.041
< 0.002	0.28	2.18		2.92		19	0.14	9.91	< 0.041
< 0.002	0.45	1.68		3.49		7.73	0.1	4.66	< 0.041
0.006	0.12	2.91		6.44		2.72	0.04	3.63	< 0.041
< 0.002	< 0.009	1.37		3.88		1.02	0.04	2.19	< 0.041
0.01	0.12	4.7		6.75		25.3	0.54	49.6	< 0.041
< 0.002	0.59	3.1		3.23		21.1	0.13	8.55	< 0.041
0.002	0.04	4.35		4.09		4.56	0.21	37.4	< 0.041
0.017	0.23	3.63		10.9		2.4	0.04	3.1	< 0.041
0.01	0.2	3.51		8.61		2.73	0.04	3.45	< 0.041
< 0.002	0.39	1.69		3.72		2.51	0.13	4.41	< 0.041
< 0.002	0.04	5.72		3.19		44.7	1.58	87.1	< 0.041
0.004	0.04	4.53		5.3		21.3	0.86	76.6	< 0.041
< 0.002	0.52	2.89		3.11		18.7	0.14	7.95	< 0.041
0.01	0.15	6.07		7.25		34.1	0.99	102	< 0.041
< 0.002	0.13	3.77		1.59		23.5	0.22	15	**0.05**
0.003	0.03	3.86		4.43		4.59	0.19	37.4	< 0.041
< 0.002	0.02	6.19		3.17		4.55	0.28	41.5	< 0.041
< 0.002	0.49	1.98		3.89		5.91	0.12	4.32	< 0.041
< 0.002	0.37	2.94		2.8		17.2	0.33	20.1	< 0.041
< 0.002	0.26	2.89		2.84		17.5	0.17	11.7	< 0.041
< 0.002	0.5	3.85		4.39		13.2	0.12	7.98	< 0.041
< 0.002	0.36	2.52		3.71		20.5	0.2	9.69	< 0.041
0.007	0.07	3.05		7.83		8.83	0.48	38.9	< 0.041
0.004	0.04	5.69		4.02		43	1.52	87.6	< 0.041
< 0.002	0.31	3.14		3.21		62.7	0.26	32.4	< 0.041
< 0.002	0.01	6.02		3.74		52.6	2.53	147	< 0.041
< 0.002	0.009	6.55		4.96		167	1.35	110	< 0.041
< 0.002	0.09	5.16		4.2		39.9	0.83	18	< 0.041
< 0.002	0.05	3.03		4.88		9.54	0.27	13.6	< 0.041
< 0.002	0.24	1.11		3.49		18.4	0.12	7.98	< 0.041
< 0.002	0.04	5.83		3.14		45.1	1.59	87.5	< 0.041
< 0.002	0.43	5.69		3.43		103	0.36	32.9	< 0.041
1.21	0.06	5.8		22.1		82.5	1.77	899	< 0.041
< 0.002	0.02	8.02		5.37		227	2.82	142	< 0.041
< 0.002	0.01	7.45		4.52		47.3	4.03	152	< 0.041
< 0.002	0.31	5.45		2.42		56.9	1.09	72.4	< 0.041
< 0.002	0.24	1.98		2.72		36.6	0.15	11.8	< 0.041
< 0.002	0.41	3.4		3.65		14.2	0.13	8.6	< 0.041
< 0.002	0.26	3.39		2.21		13.3	0.15	9.72	< 0.041
< 0.002	0.09	2.87		1.6		43.4	0.23	15.5	< 0.041
< 0.002	< 0.009	5.71		3.03		41.1	1.92	128	< 0.041
< 0.002	0.34	1.99		3.56		32.6	0.14	10.8	< 0.041
< 0.002	0.01	4.74		5.64		10	1.05	267	< 0.041
< 0.002	0.23	2.01		2.94		27.5	0.16	13.9	< 0.041
< 0.002	0.09	1.76		3.69		45.6	0.26	16.4	< 0.041
0.04	0.01	3.65		8.6		18.6	0.66	70.7	< 0.041
0.75	< 0.009	5.45		13.6		54.7	1.41	558	< 0.041

Tin (mg/L)		Vanadium (mg/L)	Zinc (mg/L)
N/A		N/A	**7.4 (DWS); 0.12 (acute/ chronic AL)**
0.012		0.008	0.002
No detections.	<	0.008	0.01
	<	0.008	0.017
	<	0.008	0.02
	<	0.008	**0.76**
	<	0.008	0.008
	<	0.008	0.02
	<	0.008	0.007
		0.008	0.03
	<	0.008	0.009
	<	0.008	0.02
		0.01	0.06
		0.01	0.035
	<	0.008	0.007
	<	0.008	0.01
	<	0.008	0.02
	<	0.008	0.01
	<	0.008	0.04
	<	0.008	0.01
	<	0.008	0.015
	<	0.008	0.01
	<	0.008	0.008
	<	0.008	0.01
	<	0.008	0.007
	<	0.008	0.01
	<	0.008	0.008
	<	0.008	0.04
	<	0.008	0.02
	<	0.008	0.01
	<	0.008	0.01
	<	0.008	0.007
	<	0.008	0.03
	<	0.008	0.01
	<	0.008	0.008
	<	0.008	0.01
	<	0.008	0.02
	<	0.008	**2.5**
	<	0.008	0.01
	<	0.008	0.01
	<	0.008	0.007
	<	0.008	0.006
	<	0.008	0.008
	<	0.008	0.01
	<	0.008	0.008
	<	0.008	0.009
	<	0.008	0.008
	<	0.008	0.02
	<	0.008	0.006
	<	0.008	0.009
	<	0.008	0.08
	<	0.008	**1.46**

APPENDIX C: METAL SAMPLING PARAMETERS

Antimony is a USEPA priority pollutant that can be toxic to plants and animals. In addition to the natural occurrence of antimony in bedrock and streambed sediments in the Knobs Region of the Kentucky River Basin, antimony salts are used in the fireworks, rubber, textile, ceramic, glass, and paint industries.
The proposed maximum contaminant level (MCL) in finished drinking water for antimony ranges from 5 to 10 micrograms per liter.

Arsenic occurs naturally in rocks and soil, water, air and plants and animals. It can be further released into the environment through natural activities, such as volcanic action, erosion of rocks, and forest fires, or through human actions. Approximately 90 percent of industrial arsenic in the U.S. is currently used as a wood preservative, but arsenic is also used in paints, dyes, metals, drugs, soaps and semi-conductors. High arsenic levels can also come from certain fertilizers and animal feeding operations. Industry practices, such as copper smelting, mining and coal burning also contribute to arsenic in our environment. Arsenic levels tend to be higher in ground water than in surface water (lakes and rivers). Levels also tend to be higher in the western United States.

Barium is a yellowish-white alkaline earth metal. It combines with water to produce barium hydroxide and is found in nature as barites ($BaSO_4$), witherite ($BaCO_3$), and other ores. Barium and its salts are often used in metallurgical industries for special alloys, in paints, and concrete. Because of the insolubility of most of its compounds, it is not considered to be an ecological threat.

Beryllium is an uncommon alkaline-earth element that is recognized as a USEPA priority pollutant and potential carcinogen. The USEPA has proposed a MCL of 1.0 micrograms per liter for beryllium, and Kentucky has adopted the USEPA lowest-observed effect levels (LOEL) for protection of aquatic life, which are 130 micrograms/liter (1.3 mg/L) and 5.3 micrograms/liter (0.053 mg/L) for acute and chronic toxicity, respectively. In addition, Kentucky water-quality criteria establish a beryllium criterion of 0.117 micrograms per liter for the protection of human health from the consumption of fish tissue. The criterion is based upon an acceptable risk level of no more than one additional cancer case in a population of 1 million people.

Cadmium s a non-essential element and it diminishes plant growth. It is considered a potential carcinogen. It also has been shown to cause toxic effects to the kidneys, bone defects, high blood pressure, and reproductive effects. Cadmium is widely distributed in the environment at low concentrations. It can be found in fairly high concentrations in sewage sludge. Primary industrial uses for cadmium are plating, battery manufacture, pigments, and plastics.

Chromium is ubiquitous in the environment, occurring naturally in the air, water, rocks and soil. It is used in stainless steel, electroplating of chrome, dyes, leather tanning and wood preservatives. It occurs in several forms, or oxidation states. The two most common are chromium VI and chromium III. The form depends on pH. Natural sources of water contain very low concentrations of chromium. It is a micronutrient (or essential trace element). High doses of chromium VI have been associated with birth defects and cancer; however, chromium III is not associated with these effects. Plants and animals do not bioaccumulate chromium; therefore, the potential impact of high chromium levels in the environment is acute toxicity to plants and animals. In animals and humans this toxicity may be expressed as skin lesions or rashes and kidney and liver damage.

Copper is a USEPA priority pollutant that is a micronutrient for the growth of plants and animals, but even small concentrations of copper in surface water can be toxic to aquatic life. Copper sulfate is frequently used to control nuisance growths of algae in water supply reservoirs. The toxicity of copper is a function of the total hardness of the water, because copper ions are complexed by anions that contribute to water hardness. Although detectable concentrations of copper in water are not known to have an adverse effect on humans, the MCL for copper has been established at 1,000 micrograms/liter, which corresponds with the taste threshold concentration for this element (National Academy of Sciences National Academy of Engineering, 1972). [USGS]

Iron is the fourth most abundant element, by weight, in the earth's crust. Natural waters contain variable amounts of iron depending on the geological area and other chemical components of the waterway. Iron in groundwater is normally present in the ferrous or bivalent form (Fe^{2+}), which is soluble. It is easily oxidized to ferric iron (Fe^{3+}) or insoluble iron upon exposure to air. This precipitate is orange-colored and often turns streams orange. Iron is a trace element required by both plants and animals. It is a vital part of the oxygen transport mechanism in the blood (hemoglobin) of all vertebrate and some invertebrate animals. Ferrous Fe^{2+} and ferric Fe^{3+} irons are the primary forms of concern in the aquatic environment. Other forms may be in either organic or inorganic wastewater streams. The ferrous form can persist in water void of dissolved oxygen and usually originates from groundwater or mines that are pumped or drained. Iron in domestic water supply systems stains laundry and porcelain. It appears to be more of a nuisance than a potential health hazard. Taste thresholds of iron in water are 0.1 mg/L for ferrous iron and 0.2 mg/L for ferric iron, giving a bitter taste or an astringent taste. Water to be used in industrial processes should contain less than 0.2 mg/L iron. Black or brown swamp waters may contain iron concentrations of several mg/L in the presence or absence of dissolved oxygen, but this iron form has little effect on aquatic life.

Lead is primarily found in nature as the mineral galena (lead sulfide). It also occurs as carbonate, as sulfate and in several other forms. The solubility of these minerals and also of lead oxides and other inorganic salts is low. Major modern day uses of lead are for batteries, pigments, and other metal products. In the past, lead was used as an additive in gasoline and became dispersed throughout the environment in the air, soils, and waters as a result of automobile exhaust emissions. For years, this was the primary source of lead in the environment. However, since the replacement of leaded gasoline with unleaded gasoline in the mid-1980's, lead from that source has virtually disappeared. Mining, smelting, and other industrial emissions and combustion sources and solid waste incinerators are now the primary sources of lead. Another source of lead is paint chips and dust from buildings built before 1978 and from bridges and other metal structures.

Nickel is a USEPA priority pollutant that can adversely affect humans and aquatic organisms. Nickel is an important industrial metal that is used extensively in stainless steel. Substantial amounts of nickel can be contributed to the environment by waste disposal (Hem, 1989) and atmospheric emissions. Nickel ions are toxic, particularly to plant life, and can exhibit synergism when present with other metallic ions (National Academy of Sciences National Academy of Engineering, 1972). [USGS]

Selenium is a nonmetallic trace element that is listed as a primary pollutant by the USEPA. Selenium is an essential micronutrient for plants and animals, but can be toxic in excessive amounts. Selenium is a relatively rare element, and concentrations of selenium in natural waters seldom exceed 1.0 microgram/liter (Hem, 1989). Sources of selenium in the Kentucky River Basin include sedimentary rocks and fly ash from coal-fired power plants that operate in Kentucky.

Silver is a USEPA priority pollutant that is extensively used for photography and various industrial and commercial purposes. Although average concentrations of silver in natural waters are small (0.3 micrograms/liter), elevated silver concentrations can be acutely or chronically toxic to aquatic organisms, and sublethal amounts can bioaccumulate in fish and invertebrate organisms (Hem, 1989). [USGS]

Thallium is a USEPA priority pollutant that can be toxic to humans and aquatic life. Thallium salts are used as poison for rats and other rodents, as well as in dyes, pigments in fireworks, and optical glass (National Academy of Sciences National Academy of Engineering, 1972).

Zinc is found naturally in many rock-forming minerals. Because of its use in the vulcanization of rubber, it is generally found at higher levels near highways. It also may be present in industrial discharges. It is used to galvanize steel, and is found in batteries, plastics, wood preservatives, antiseptics, and in rat and mouse poison (zinc phosphide). Zinc is an essential element in the diet. It is not considered very toxic to humans or other organisms.