



Source: SD1

# Licking River Watershed Characterization Report

Prepared for: Sanitation District No. 1 of Northern Kentucky



January 2009

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## APPENDIX

Appendix A. KPDES-permitted dischargers

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## **1. WATERSHED SUMMARY**

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

The Licking River watershed is defined as the area draining to the Licking River between the mouth and River Mile (RM) 35.6 (Figure 1). Two tributaries, Banklick Creek and Threemile Creek, have been described in separate reports and are excluded from discussions in this report.

The Licking River watershed described in this report comprises 170 square miles. Due to the size and varying features of this watershed, some information in this report is presented by "zones". These zones were defined based on differences in land cover and sources, and are used in some sections to organize and present information at a more manageable geographic scale. The highly developed north zone encompasses the Licking River watershed between the mouth and river mile (RM) 4.8. The central zone encompasses the Licking River watershed between RM 4.8 and 18.6 and contains a mix of developed and rural lands. The south zone encompasses the Licking River watershed from RM 18.6 and 35.6 and is more rural in nature.

The Licking River and its tributaries are designated for warm water aquatic habitat, primary contact recreation, secondary contact recreation, and domestic water supply, at applicable points of withdrawal. KDOW has designated a portion of the Licking River as an Outstanding State Resource Water (OSRW) and 16.7 miles are located within the study area. KDOW has also proposed Bowman Creek and Sawyers Fork as candidates for exceptional water designation (401 KAR 10reg:030) in the drafted amendments to the Kentucky Administrative Regulations (KAR) anticipated in February 2009.

Three segments of the Licking River and one tributary appear on the 2008 303(d) list of impaired waters (KDOW, 2008). A comparison of recent water quality data to applicable water quality criteria revealed elevated bacteria levels at both mainstem and tributary locations. Violations of dissolved oxygen and pH have historically been observed at a USGS station on Cruises Creek between 2001 and 2005, but recent data from this location are still being reviewed and are not yet included in this assessment. Recent assessments of two tributaries indicate habitat is partially to fully supporting of a diverse and productive aquatic ecosystem, and biological conditions range from fair to excellent.

Potential pollutant sources in the watershed include CSOs, sanitary sewer overflows (SSOs), KPDES-permitted dischargers, septic systems, livestock, storm water runoff,

backwater effects from the Ohio River and streambank erosion. The potential for these sources, excluding backwater, to generate fecal coliform bacteria has been assessed using a Watershed Assessment Tool (WAT!)<sup>1</sup>. The WAT! identifies the potential sources within a watershed and estimates their possible impact. It also allows SD1 to compare and rank the 16 different Northern Kentucky watersheds.

The WAT! calculated an approximately average fecal coliform ranking for this watershed under year-round and base flow conditions. Overland storm water runoff is predicted to be the dominant bacteria source under year-round conditions, and septic systems are predicted to be the dominant source during base flow conditions. The WAT! ranking is one of several factors that should be considered when prioritizing watersheds for improvement projects. Other factors include moderate-high public interest, the presence of five aquatic-dependent threatened or endangered species, several special stream designations, and the presence of two drinking water intakes in the watershed.

Next steps in this watershed may include site visits to identify sources contributing to tributary base flow bacteria levels. Because improvement projects are planned to reduce collection system overflows in this watershed, next steps may include the application of the Ohio River model and the WAT! to better understand the appropriate level of control for the watershed. No additional monitoring is recommended for this watershed, beyond that which is currently planned.

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

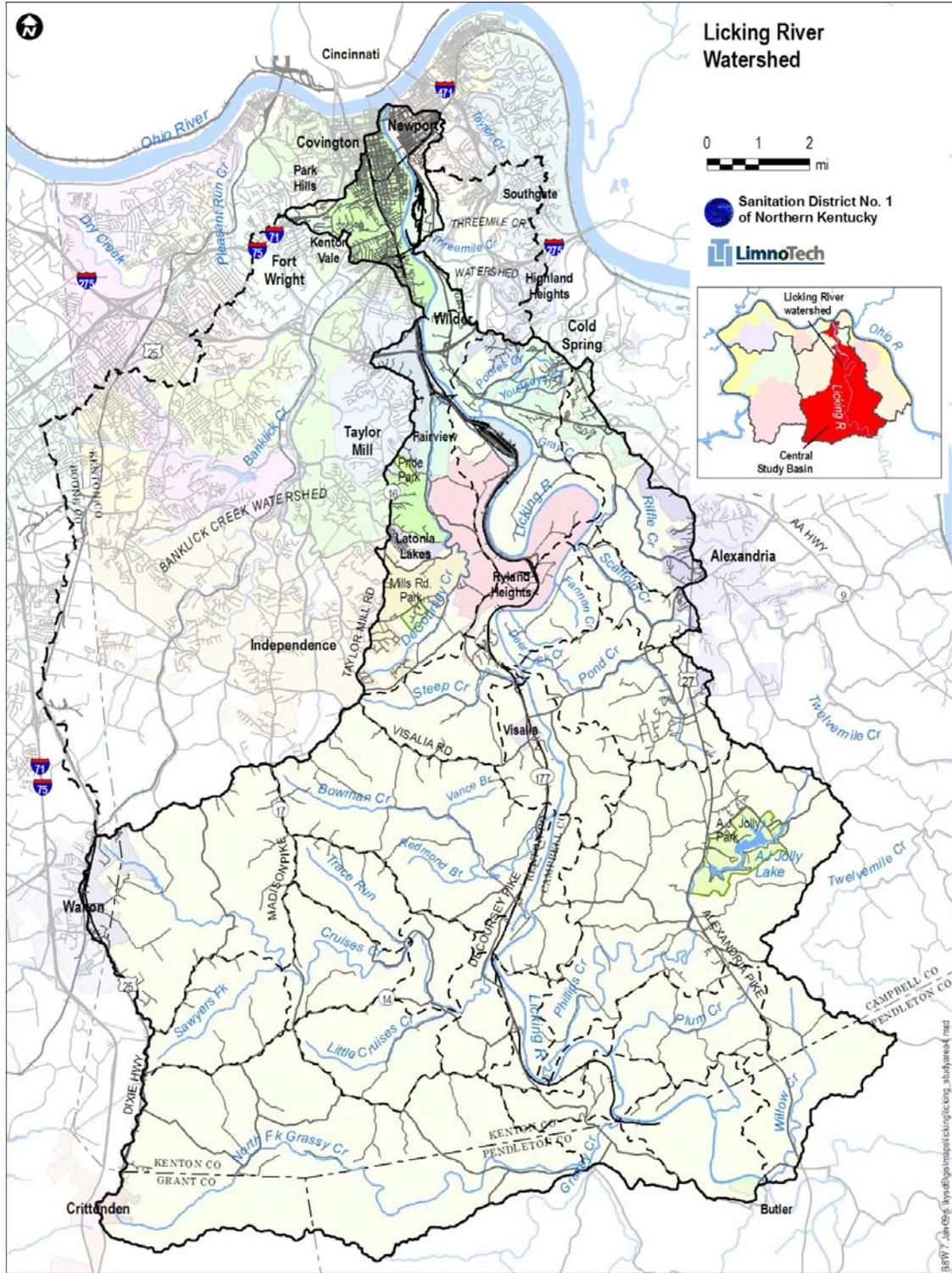


Figure 1. Licking River Watershed

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## 2. WATERSHED FEATURES

The portion of the Licking River between the mouth and RM 35.6 is the focus for this report. The watershed for this reach of the river primarily lies within Kenton and Campbell counties with smaller portions extending into Pendleton, Grant and Boone counties. There are many tributaries in the watershed, including: Willow Creek, Grassy Creek, Plum Creek, Phillips Creek, Cruises Creek, Bowman Creek, Steep Creek, Pond Creek, Scaffold Creek, Riffle Creek, Pooles Creek and DeCoursey Creek (Figure 1). The Banklick Creek and Threemile Creek tributaries are discussed in separate watershed characterization reports.

### 2.1 PHYSICAL AND NATURAL FEATURES

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

#### 2.1.1 Hydrology

Throughout the study area, the Licking River is a large, generally deep river with moderate flows. The width of this river ranges from approximately 100 to 300 feet, and is large enough to support commercial transportation (Figure 2). The elevation of the Licking River varies little between RM 4.8 and the mouth and backwater effects from the Ohio River have been observed at the Banklick Creek confluence with the Licking River. The extent of the backwater is dependent on Ohio River stage.



**Figure 2. Barge Traffic along the Lower Licking River**

There are two active USGS continuous monitoring stations in this watershed. A station on the Licking River at Highway 536 near Alexandria (03254520) began operation in fall 2007. The watershed draining to the station is 3,593 square miles. A second continuous monitoring station (03254480) is located on Cruises Creek at Highway 17 near Piner, KY. This station has been in operation since 2000 and the analysis that follows is based on flows measured for Cruises Creek. The watershed draining to the Cruises Creek station is 18.0 square miles, comprising approximately 54% of the Cruises Creek watershed. Daily discharge measurements are available at the station from December 2000 to the present<sup>2</sup>. The average flow at the station is 29 cfs (12/1/2000 - 9/30/2007), and 95% of flows are less than 114 cfs. Base flows at this location have been measured at less than 2 cfs, with flows increasing by up to three orders of magnitude during a storm event. The maximum flow recorded at the USGS station is 1,610 cfs. The periods of high flow tend to be very brief and only last one to two days. In contrast, during extended periods of dry weather, flows at the station become intermittent. Between December 2000 and September 2007 there were 150 days with zero flow, which all occurred in 2002, 2005, 2006, and 2007.

The 100-year floodplain extends upstream along the Licking River and several miles upstream into many of the tributaries. The floodplain is widest (about ½ mile wide) near the Banklick Creek confluence. Closer to the Ohio River, the Licking River floodplain is much narrower due to constructed floodwalls.

Notable floods in the Licking River have occurred in 1875, 1913, 1937, 1945, 1948, 1964, 1997 and 2000. Following the 1937 flood, the US Army Corps of Engineers built floodwalls in Covington and Newport to protect those cities from both the Ohio and Licking Rivers (Tenkotte and Canfield, 2007).

### 2.1.2 Geology

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

The Licking River traverses alluvium comprised of unconsolidated sediments. Water yield in the alluvium is high, but is hard and may have high iron content. The tributary headwaters traverse the rolling hills of the Grant Lake Limestone/ Fairview formation, which produces broad stream valleys. The Kope formation with its steep valleys and erodible shale dominates the southern portion of this watershed and is traversed by many of the tributaries. Streambank erosion has been observed in many of the tributaries

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<sup>2</sup> This analysis only uses reviewed data from USGS, and at the time of the analysis data was reviewed through 9/30/2007.

<sup>3</sup> Physiographic regions are based on differences in geology, topography and hydrologic regime. The State of Kentucky is divided into five physiographic regions.

<sup>4</sup> In areas with karst, an almost immediate connection between groundwater and surface water can exist, short-circuiting any attenuation of pollutant loads that might otherwise occur.

including DeCoursey Creek, Pond Creek, Steep Creek, Phillips Creek, Bowman Creek, Little Cruises Creek, Grassy Creek and Plum Creek (Figures 3, 4, 5 and 6).

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



**Figure 3. DeCoursey Creek at RM 2.2 (left); Steep Creek at RM 1.2 (right)**



**Figure 4. Phillips Creek along Morningview Road**



**Figure 5. Bowman Creek at SR 177 (left); Little Cruises Creek at Cruises Creek Road (right)**



**Figure 6. Grassy Creek at Highway 177 (left); Plum Creek at the intersection of Hissem and Aulick Roads (right)**

### 2.1.3 Topography

The Licking River tributary headwaters drain narrow ridges and hills leading down into narrow valleys. Closer to the Licking River, the valley widens significantly. The highest elevation in this watershed (965 feet) is found in the City of Walton, near the intersection of Dixie Highway and Walton Nicholson Road. The lowest elevation (453.6 feet at normal Ohio River pool) is at the confluence of the Licking and Ohio Rivers.

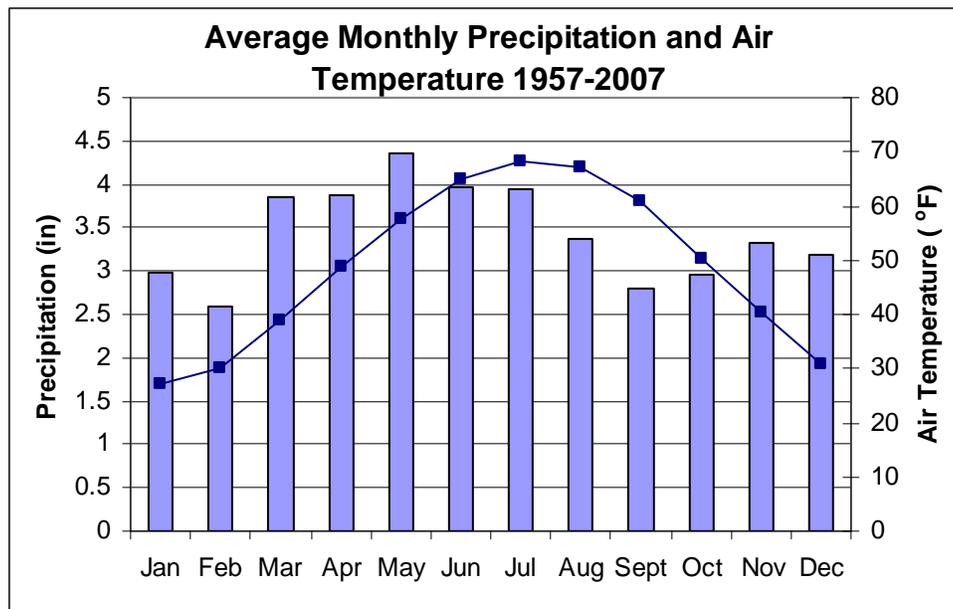
### 2.1.4 Soils

The nature of soils and topography in a watershed plays an important role in both the amount of runoff generated and the amount of soil erosion that can occur. Most of the soils in this watershed are classified as hydrologic soil group C (NRCS, 2006) meaning they have slow infiltration rates when thoroughly wetted. This assessment excludes those soils that have been disturbed and covered by development.

All of the soils in this watershed are ranked as either “highly erodible” (38%), or “fairly erodible”(68%) as indicated by an index for erodibility (NRCS, 2006). The erodibility of soils is important when soils are disturbed through activities such as land clearing for new development (Section 2.2.2).

### 2.1.5 Climate

The temperatures in this area are generally lowest in January and highest in July. Precipitation averages 41.2 inches annually, with the wettest months observed between March and July. Minimum precipitation is recorded in the fall and late winter as shown in Figure 7 (NCDC, 2008).



**Figure 7. Average Monthly Precipitation and Air Temperature at the Cincinnati Northern Kentucky Airport (1957-2007)**

### 2.1.6 Habitat

The Licking River watershed lies within two ecoregions<sup>5</sup>. North of the Bowman Creek confluence (~RM 21.5), this watershed lies in the Outer Bluegrass ecoregion, which is characterized by sinkholes, springs, entrenched rivers and intermittent and perennial streams (Woods et al. 2002). Wetlands are not common in this ecoregion and comprise less than 1% of this watershed. Streams typically have relatively high levels of suspended sediment and nutrients. Glacial outwash, which tends to be highly erodible, exists in a few areas.

South of the Bowman Creek confluence, this watershed lies within the Hills of the Bluegrass ecoregion. Streams in this ecoregion have steep gradients, and may suffer

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

higher erosion rates than those in the Outer Bluegrass ecoregion (Woods et al. 2002). Waters are also generally lower in nutrients. This area was never glaciated and the underlying geology is primarily limestone and other sedimentary rocks. The two ecoregions are similar in vegetation composition.

The Licking River has variable habitats, depths and riparian zone<sup>6</sup> widths. Within the north zone, the Licking River is wide and turbid and sometimes affected by Ohio River backwater. Urban development is extensive and the banks are surrounded by industrial land with reduced riparian zones and channelized with riprap (Figure 8).



**Figure 8. Licking River at Wilder (left) and at mouth (right)**

Farther upstream in the central zone, the Licking River remains wide and turbid. Locust Pike Park, just downstream of the mouth of Riffle Creek also has some unaltered shorelines (Figure 9). The tributaries within the central zone are generally characterized by moderate bank erosion, variable riparian zone widths and varying levels of sedimentation and eutrophication. The dominant substrate type found in these creeks is typically cobble.

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<sup>6</sup> Riparian zones are important to aquatic systems for several reasons: they provide wood for aquatic habitat recruitment potential, they provide organic matter for instream invertebrates that support invertebrate food resources for fish, they filter sediment and toxics from entering the stream and they shade the water, maintaining ambient water temperatures.



**Figure 9. Licking River at Tippenhauer Road in Locust Pike Park**

The Licking River at the upstream boundary to the study area is shown in Figure 10. Aquatic habitat in the south zone is less impacted than in the downstream portions of the watershed, and several species of freshwater mussels inhabit the Licking River just upstream of Visalia (Cicerello and Schuster, 2003). Tributaries in this area are generally characterized by moderate bank erosion, variable riparian zone widths and varying levels of sedimentation and eutrophication (Figures 4, 5, and 6). Although the substrate of these creeks is typically gravel or cobble, some areas have underlying limestone bedrock substrate (Figure 4).



**Figure 10. The Licking River at Butler (RM 35.4)**

Habitat assessment has been conducted at multiple locations along the Licking River and more recently, on two tributaries<sup>7</sup> (Table 1).

**Table 1. Aquatic Habitat and Biological Sampling**

Stream	River mile	Monitoring <sup>a</sup>					
		Habitat		Macroinvertebrates		Fish	
		Year	Ranking	Year(s)	Ranking	Year	Result
Licking River	0.8	1996	Fair <sup>b</sup>	1996	NA <sup>c</sup>		
Licking River	1.3	1996	Fair <sup>b</sup>	1996	NA <sup>c</sup>		
Licking River	2.4	1996	Fair <sup>b</sup>	1996	NA <sup>c</sup>		
Licking River	3.3	1996	Fair <sup>b</sup>	1996	NA <sup>c</sup>		
Licking River	4.8	1996	Fair <sup>b</sup>	1996	NA <sup>c</sup>		
Licking River	5.5	1996	Good <sup>b</sup>	1996	NA <sup>c</sup>		
Licking River	6.4	1996	Fair <sup>b</sup>	1996	NA <sup>c</sup>		
Bowman Creek	2.5	2003	Fully supporting			2003	Excellent
Bowman Creek	5	2005	Partially supporting			2005	Fair
Sawyers Fork	1.1	2004	Fully supporting	2004	Good		

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

<sup>b</sup>Habitat was assessed using the Qualitative Habitat Evaluation Index (QHEI) for the Licking River due to its large size. Sites on Bowman Creek and Sawyers Fork were assessed using the rapid bioassessment protocol.

<sup>c</sup>KDOW collected macroinvertebrate samples in 1996 in the lower Licking River; however, there are no indices available for calculating a MBI ranking for larger rivers.

## 2.2 LAND COVER CHARACTERISTICS

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

### 2.2.1 Current Land Cover

The Kentucky Division of Geographic Information, Commonwealth Office of Technology provided a GIS dataset showing 2005 Kentucky land cover. This dataset was updated and improved to approximate 2007 land cover conditions (Figure 11) using a variety of other datasets that represent current impervious conditions (roads, parking lots, buildings), open space lands (including parks), and surface waters.

Development is located throughout the watershed, but is much more concentrated in the north. Overall, 19% of this watershed is developed and 3% is impervious. Portions of the following communities are located within the watershed: Covington, Newport, Park Hills, Kenton Vale, Wilder, Highland Heights, Taylor Mill, Fairview, Cold Spring,

<sup>7</sup> Licking River habitat was assessed using the Qualitative Habitat Evaluation Index due to its large size. Tributary assessments were conducted using EPA-established protocols. KDOW rated several components of physical habitat within the stream such as epifaunal substrate, embeddedness, sediment deposition, channel flow status, bank stability and riparian vegetation zone width, among others.

Latonias Lakes, Ryland Heights, Alexandria, Independence, Visalia, Walton, Butler and Crittenden.

Parks in this watershed include: A.J. Jolly County Park, several country clubs (Ryland Lakes, Twin Oaks and White Villa Country Clubs), Thorn Hill Lake, private lakes, fishing clubs, Mills Road Park, Pride Park, many neighborhood parks, and playing fields associated with local schools.

### **2.2.1.a Animal operations**

There are no permitted concentrated animal feeding operations (CAFOs) in the Licking River watershed (Kentucky Geographic Network, 2008). There are, however, eight animal feeding operations (AFOs) in the Licking River watershed (Kentucky Geographic Network, 2008a). These are located in the Riffle Creek, North Fork Grassy Creek, Sawyers Fork and Phillips Creek subwatersheds. The AFOs are permitted dairy and beef operations.

A tour of the watershed and a review of information obtained from the Conservation District (BCKCCD, 2007) confirmed that beef cattle, horses and some poultry are present in the Licking River watershed. Based on a review of pasture/hay land cover, agricultural statistics and census data, and discussions with the county Conservation District (BCKCCD, 2008, 2008a), it is estimated that there are more than 8,000 cows, more than 4,000 horses, and several hundred sheep and pigs in this watershed.

### **2.2.1.b Septic Systems**

SD1 estimates that 22% of all parcels in this watershed are potentially serviced by septic systems. Properties potentially serviced by septic systems are found in the central and southern portions of this watershed.

Two septic areas with problems (hot spot areas) were identified in the DeCoursey Creek subwatershed. These are areas in older subdivisions that either have very small lots that have unrepairable failing systems, or have systems that have been repaired to the extent practicable on the site, but are not fully functional (NKHD, 2008a).

The Northern Kentucky Health Department does not currently have estimates of septic system failure rates in Campbell, Kenton and Boone counties. Anecdotal reports from Health Department inspectors suggest that 10% of the septic systems in Northern Kentucky may be operating improperly due to incorrect installation, lack of maintenance or age of the system. Furthermore, the Health Department has indicated that, based on slope, soil, and substrate characteristics, septic systems installed in Campbell County are prone to more frequent failures than those in Boone or Kenton Counties (NKHD, 2008).

### **2.2.1.c Superfund Site**

There is one superfund site, Newport Dump, in this watershed. This site is a former municipal landfill which was closed in 1979. Previous investigations of this site found organic and inorganic contaminants, including metals, polyaromatic hydrocarbons (PAHs), solvents and polychlorinated biphenyls (PCBs). This site was added to the National Priorities List (NPL) in 1983. Remedial actions implemented by the EPA commenced in June 1987, and concluded in 1988. The fourth Five-year Review of this

site was completed in June 2007. The results of this review indicate that the remedy is protective in the short-term of human health and the environment (USEPA, 2007).

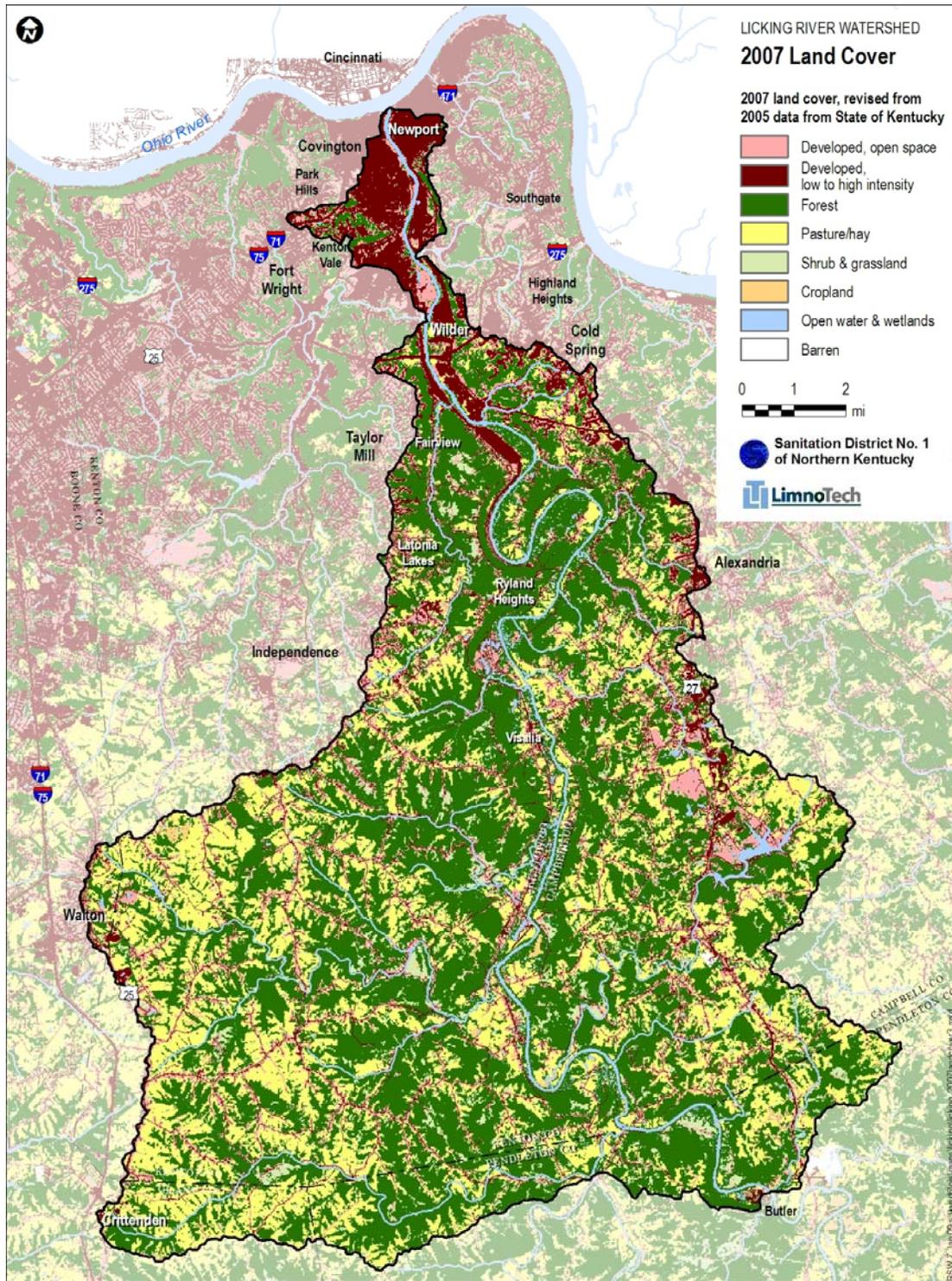


Figure 11. 2007 Land Cover

## **2.2.2 Future Conditions**

Within Kenton County, it is anticipated that new residential development will occur in the City of Independence and in areas north of Walton (NKAPC, 2006). Development within the southern portion of Campbell County is also expected to increase in the future, now that a state construction moratorium has been partially lifted (as of May 2008). The moratorium was in place due to a lack of sewage treatment capacity, but has been lifted because a new wastewater treatment facility, the Eastern Regional Water Reclamation Facility, was recently activated. The realignment/expansion of portions of US 27 (Alexandria Pike) is another factor that is expected to contribute to additional development in this watershed.

Several other planned road improvement projects include the extension of Route 9 near the mouth of the Licking River, the reconstruction of portions of KY 16 (Taylor Mill Road) along the western boundary of this watershed and improvements to I-275 (KY Transportation Cabinet, 2006).

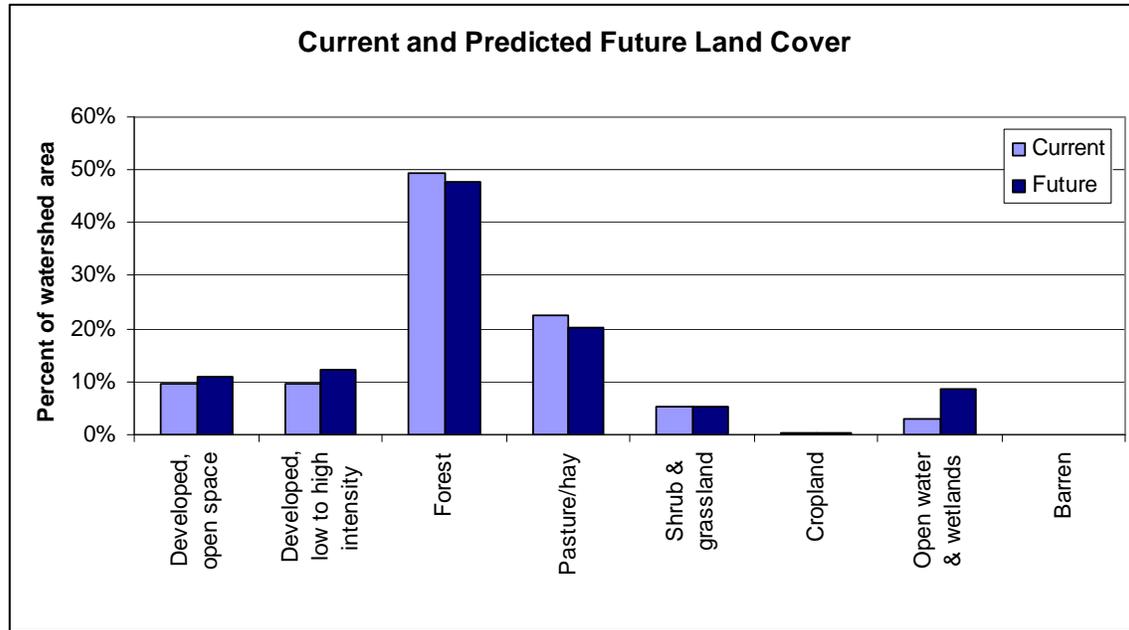
Within this watershed, development is expected to expand around Cold Spring, Alexandria and Independence. It is also predicted to occur along Alexandria Pike and Taylor Mill Road. In the south, additional new development is expected in scattered places along established highway corridors and around Walton, near the intersection of the Dixie Highway (US 25) and Walton Nicholson Pike. Much less development is expected in the lower, forested lands near the Licking River.

Local interest in protecting farmland might alter forecast future development patterns. A recent report (AFT, 2005) surveyed farmland owners in Campbell County and found that “65% of the landowners want their land to stay in agricultural production for the foreseeable future, about 20-30 years. About 32% would like to keep their land in agriculture even after they no longer own it, and 21% are willing to explore options for protecting their land for the future.”

### **2.2.2.a Future land cover**

Future land cover was developed by modifying 2007 land cover to reflect potential future conditions (roughly 2030) obtained from SD1 and the Northern Kentucky Area Planning Commission (NKAPC).

It is predicted that developed lands will comprise 23% of the watershed (Figure 12), and 4% of this watershed is predicted to be covered by impervious surfaces. This development is predicted to occur primarily in the central and southern portions of this watershed.



**Figure 12. Current and Predicted Future Land Cover**

### 2.3 INFRASTRUCTURE FEATURES

This section summarizes infrastructure features for the Licking River watershed<sup>8</sup>. Approximately 10% of the watershed is serviced by the 17.2 square mile separate sanitary sewer area. The City of Walton owns approximately 1.5 square miles of the separate sanitary sewer area, but contracts with SD1 for operation and maintenance. The remainder is both owned and operated by SD1. An additional 3% of this watershed is located within SD1's combined sanitary sewer area. In total, the Licking River watershed contains approximately 96.3 miles of separate sanitary sewer lines and approximately 106.1 miles of combined sewer lines.

Approximately 24% of the Licking River watershed lies within SD1's storm water service area. Within the service area, the storm water system is comprised of approximately 416.0 miles of streams and channels and approximately 64.2 miles of pipes.

The extent of the sanitary sewer, combined sewer and storm water service areas in this watershed is shown in Figure 13.

<sup>8</sup> SD1 is undertaking a characterization and assessment of the sewer system, and overflows identified herein are subject to change. Information on the sanitary and storm water system in Section 2.3 was queried from SD1's geodatabase accessed on November 21, 2008.

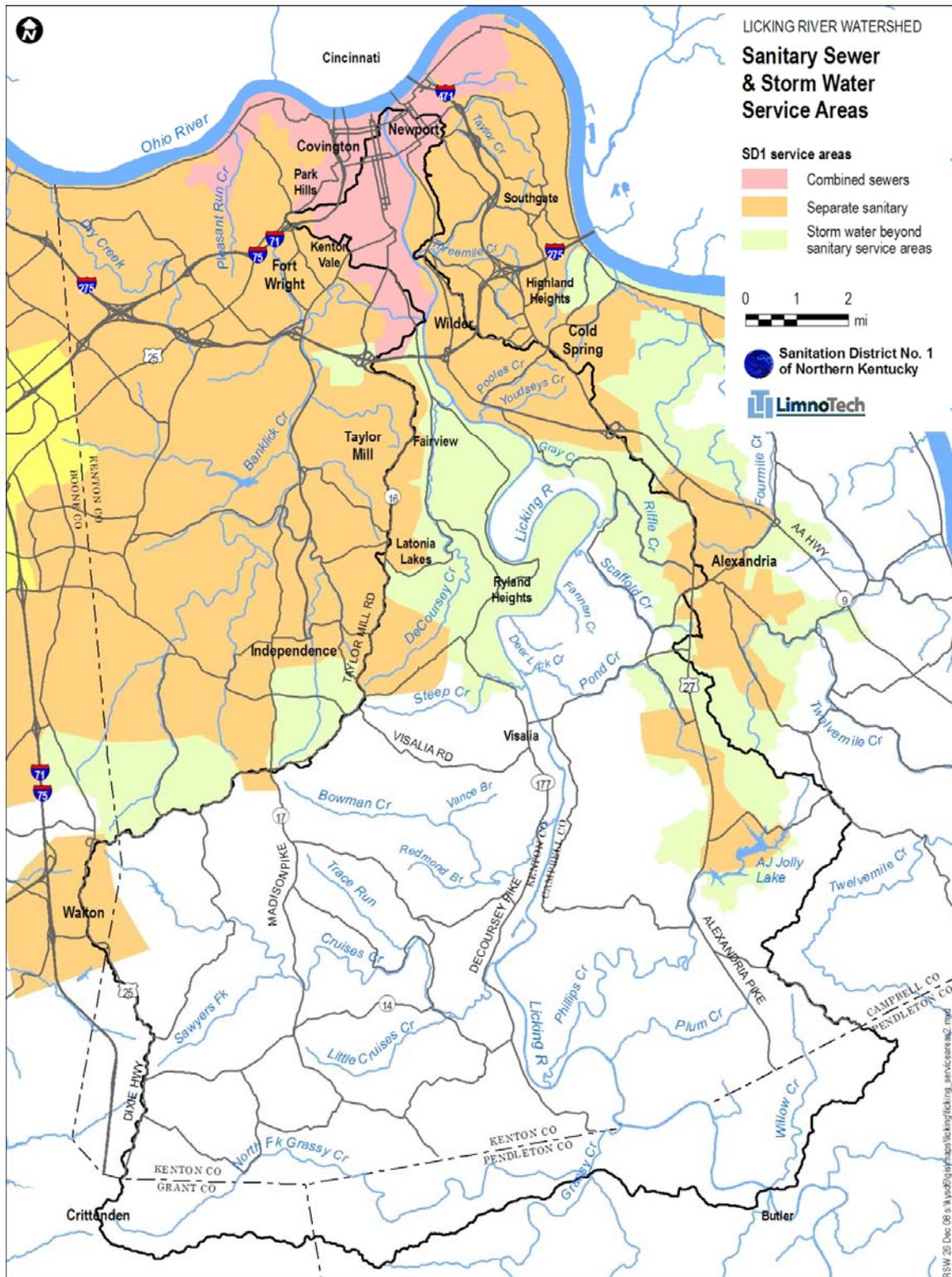


Figure 13. Sanitary Sewer, Combined Sewer and Storm Water Service Areas

### **2.3.1 Point Sources and Infrastructure**

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

#### **2.3.1.a KPDES dischargers**

One hundred and twenty-three (123) KPDES-permitted dischargers, with a total of 136 permitted outfalls, were identified in the Licking River watershed. Most of these (125) are sanitary wastewater discharges, the majority of which (90) are covered under general permits for residences.

Permitted dischargers are presented in Table A-1 of Appendix A, and are divided by north, central, and south zones of the watershed. CSOs are not included in this tally and are discussed separately in Section 2.3.1.b.

Based on a review of recent effluent monitoring data (January 2007 to June 2008), it was observed that 40 of the permitted discharges in the Licking River watershed have violated their permit limits for at least one of the following parameters: 5-day biochemical oxygen demand (BOD<sub>5</sub>), BOD<sub>5</sub> (removal), 5-day carbonaceous biochemical oxygen demand (CBOD<sub>5</sub>), dissolved oxygen (DO), *E. coli*, fecal coliform, oil and grease, pH, suspended solids (removal), total chlorine, total ammonia, total lead, final toxicity, and total suspended solids (TSS). Four of these discharges are located in the north zone, 20 are located in the central zone, and 16 are located in the south zone. Permit violations are noted in Table A-1. KDOW requires effluent monitoring for residential general permits (monitoring is required twice per year); however, data were not available for 59 of these facilities in this watershed. KDOW estimates that as a general group, residential dischargers fail at a rate that is believed to be higher than 10% (KDOW, 2007).

#### **2.3.1.b Sewer overflows**

In the Licking River watershed, there are 34 combined sewer overflows (CSOs). Of these, 26 CSOs are currently permitted and 8 are “to be permitted”. CSOs are listed in Table 2. All of these CSOs are located in the watershed draining the lower 4.8 miles of the Licking River.

There are eleven sanitary sewer overflows (SSOs) in this watershed (Table 3). Eight of these are located at pump stations. Several of these pump stations are either currently being replaced or there are plans in place to replace them.

**Table 2. Combined Sewer Overflow Points**

Manhole ID	Common Name	Receiving Waterbody	Typical Year Spill Frequency (# spills) <sup>a</sup>	Typical Year Volume (Million gallons) <sup>a</sup>
0870078	Park Dr	Licking River	4	0.5
0870079	Southern Ave	Licking River	67	29.5
1880091	44 <sup>th</sup> St	Licking River	5	2.2
1880090	45 <sup>th</sup> St	Licking River	19	2.1
0790086	4 <sup>th</sup> St	Licking River	63	164.3
1420141	6 <sup>th</sup> St	Licking River	32	0.8
1420142	8 <sup>th</sup> St	Licking River	71	104.1
1420144	9 <sup>th</sup> St	Licking River	1	< 0.1
1420145	10 <sup>th</sup> St	Licking River	2	< 0.1
1420146	Robbins St	Licking River	1	< 0.1
1420147	11 <sup>th</sup> St	Licking River	3	0.2
0980073	12 <sup>th</sup> St (Covington)	Licking River	12	0.2
0840116	12 <sup>th</sup> St.	Licking River	81	8.4
0980080	13 <sup>th</sup> St	Licking River	3	< 0.1
0980081	Pleasant St	Licking River	75	55.9
0960064	15 <sup>th</sup> St	Licking River	2	<0.1
0960063	Patton St	Licking River	23	5.6
0930106	16 <sup>th</sup> St	Licking River	4	< 0.1
0930104	17 <sup>th</sup> St	Licking River	2	0.1
0930105	19 <sup>th</sup> St	Licking River	66	31.1
0930103	20 <sup>th</sup> St	Licking River	3	0.1
0930102	Glenway Ave	Licking River	0	0
0910068	Eastern Ave	Licking River	47	49.3
0910065	James Ave	Licking River	80	220.6
0880082	33 <sup>rd</sup> St	Licking River	11	0.8
0880081	34 <sup>th</sup> St	Licking River	65	21.9
1440207 <sup>b</sup>	Kennedy St	Licking River	0	0
0840111 <sup>b</sup>	9 <sup>th</sup> St.	Licking River	65	25.7
0840112 <sup>b</sup>	10 <sup>th</sup> St.	Licking River	52	2.0
0730129 <sup>b</sup>		Licking River	75	2.8
1310106 <sup>b</sup>		Storm Drainage to CSO 0910068	NA <sup>c</sup>	NA <sup>c</sup>
1310100 <sup>b</sup>		Storm Drainage to CSO 0910068	0	0
0910066 <sup>b</sup>	Adams St	Licking River	0	0
1510133 <sup>b</sup>	Marcella Dr	Licking River Tributary	0	0

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

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

<sup>c</sup> NA means no model data are available.

**Table 3. Sanitary Sewer Overflow Points**

Manhole ID	Receiving Waterbody	Typical Year Spill Frequency (# spills) <sup>a</sup>	Typical Year Volume (Million Gallons) <sup>a</sup>
1920163	Pooles Creek Tributary	NA <sup>b</sup>	NA <sup>b</sup>
0860001 (Licking River Siphon)	Licking River	77	49
0860003	No <sup>c</sup>	0	0
2450PS2 (Sunset PS)	Tributary to Riffle Creek	NA <sup>b</sup>	NA <sup>b</sup>
1900PS3 (Ripple Creek PS)	Tributary to Riffle Creek	11	0.17
2010PS4 (Mafred PS)	Tributary of DeCoursey Creek	NA <sup>b</sup>	NA <sup>b</sup>
2010PS3 (Ridgeway PS)	Tributary of DeCoursey Creek	NA <sup>b</sup>	NA <sup>b</sup>
2020PS7 (Twin Lakes PS)	Tributary of DeCoursey Creek	NA <sup>b</sup>	NA <sup>b</sup>
2010PS1 (Keavy Rd PS)	Tributary of Licking River	NA <sup>b</sup>	NA <sup>b</sup>
2010PS2 (Meadow Lane PS)	Tributary of Licking River	NA <sup>b</sup>	NA <sup>b</sup>
2200PS1 (Alex-Licking PS)	Tributary to Riffle Creek	NA <sup>b</sup>	NA <sup>b</sup>

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

<sup>b</sup> NA means no model data are available.

<sup>c</sup> Greater than 50 feet from waterbody.

### **2.3.1.c Storm water discharges**

The storm water service area is located predominately in the northern portion of this watershed and storm water outfalls are located within this area. In addition to the storm water outfalls, there are approximately 54 suspected illicit activity (SIA) points located throughout this watershed. SIAs are locations where there was possible evidence of illicit discharges during SD1's storm water mapping project (2001-2002). These locations are being investigated to determine if they are recurring.

Portions of this watershed are located outside of SD1's storm water service area, so outfalls and illicit discharges may be located in these areas, but were not inventoried by SD1.

Storm water outfalls covered by individual KPDES permits are discussed in Section 2.3.1.a.

### 2.3.2 Recently Completed Infrastructure Projects

One study and several infrastructure projects have recently been completed in this watershed.

- The Patton Street Sewer Study was completed in 2006 and evaluated alternatives within the Patton Street Pump Station combined sewer service area to improve system performance and reduce CSO volumes.
- The new Pond Creek pump station and force main have been completed. This work eliminated the Dairy Mart WWTP and provides sewer service to the surrounding area.
- The Pond Creek WWTP and the South Campbell Industrial Park have recently been eliminated, with the completion of the Eastern Regional Water Reclamation Facility (ERWRF).

Finally, several sewer assessment projects have been completed in this watershed. These projects extended sewer lines, providing properties in the area the opportunity to connect to sewer service. These are described below.

- John's Hill Sewer Assessment Project. Completed in 2004, this project provided sewer access for 18 properties.
- Summit Lane Sewer Assessment Project. Completed in 2005, this project provided sewer access for 12 properties in the Riffle Creek subwatershed.
- Wayskin Sewer Assessment Project. Completed in 2005, this project provided sewer access for 36 properties in the DeCoursey Creek subwatershed.
- Viewpoint Drive Sewer Assessment Project. Completed in 2005, this project provided sewer access for 72 properties. Approximately 40% of this area is located in the Licking River watershed. The remainder is in the Fourmile Creek watershed.

### 2.3.3 Ongoing or Planned Infrastructure Improvement Projects

There are currently several ongoing and planned infrastructure projects in the Licking River watershed. Projects in this system include:

- A new Alex-Licking pump station and force main are currently under construction to eliminate the overflows at the pump station.
- A new pump station (Arcadia), force main, and gravity sewer is planned as part of a new development. The Arcadia pump station will replace the Sunset pump station, and eliminate overflows at the Sunset pump station.
- The Licking River interceptor is being cleaned in targeted locations to remove grit and debris and improve operation.

The anticipated start and completion dates, the total cost of the project and goals of these projects are detailed in Table 4.

**Table 4. Ongoing or Planned Infrastructure Improvement Projects**

Capital Improvement Project Title	Goals	Anticipated Start Date	Anticipated Completion Date	Project Total
Alex Licking pump station, force main and gravity sewer (Contract 8A and 5A)	Eliminate overflows at the Alex-Licking pump station and provide capacity for future growth	Ongoing	By 2009	\$6,604,274
Arcadia pump station, force main and gravity sewers	Eliminate overflows at the Sunset pump station	Detailed design underway	By end of 2010	Not yet available
Targeted Interceptor Cleaning	Improve operation of the Licking and Ohio River interceptors	Ongoing	2009	To be determined

## 2.4 SENSITIVE AREAS

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

- Waters designated as Outstanding National Resource Waters (ONRW);
- Waters with threatened or endangered species and their habitat;
- Waters with primary contact recreation, such as bathing beaches;
- Public drinking water intakes and their designated protected areas;
- National Marine Sanctuaries (NMS); and
- Shellfish beds.

These six criteria were evaluated individually. None of the waters in this watershed have been designated as Outstanding National Resource Waters (401 KAR 10:030) and no National Marine Sanctuaries have been designated (NOAA, 2008). There are no known commercial shellfish beds within the Licking River watershed nor is shellfish harvest for consumption by private individuals known to occur. Therefore these three criteria were determined not to be relevant to the identification of sensitive waters in the Licking River watershed. The remaining three criteria are discussed below.

### 2.4.1 Threatened & Endangered Species or Their Designated Critical Habitat

Threatened and endangered species, species of concern and their designated critical habitat within the Licking River watershed study area were identified by contacting the Kentucky State Nature Preserves Commission (KSNPC). KSNPC identified thirteen species in this watershed (KSNPC, 2007; Table 5), five of which are aquatic-dependent species that are either threatened or endangered. All of these threatened or endangered species are freshwater mussels that are located in the south and central zones of this watershed.

The threatened or endangered species include the Elktoe (Figure 14), fanshell, pink mucket, salamander mussel and purple lilliput mussel. Habitat degradation due to water

quality and quantity changes is cited as the leading factor in freshwater mussel decline (Sietman, 2003); however, all mussels are also threatened by overharvest and aspects of poor land management, channelization and damming, exotic species and pollution from chemical pesticides and herbicides (Cummings and Mayer, 1992; Williams et al., 1993; KDOW, 1998; Sietman, 2003; NatureServe, 2007). The primary water quality issues responsible for freshwater mussel decline are siltation, increased water temperatures and point and non-point source pollution (Williams et al., 1993; NatureServe, 2007). Due to the presence of freshwater mussels within Campbell and Kenton counties, the Kentucky Department of Fish and Wildlife Resources is considering augmenting some Licking River freshwater mussel populations with mussels grown in a lab (Bonney, 2007).

KSNPC identified four aquatic species of special concern in this watershed: two snails (onyx rocksnail and furrowed liplax), one mussel (longsolid) and one fish (northern madtom).



**Figure 14. The Elktoe, *Alasmodonta marginata***

The onyx rocksnail is a freshwater gastropod associated with algal covered rocks in areas with strong currents (Goodrich and van der Schalie, 1944). Little is known about factors contributing to this species' decline. The furrowed lioplax is also a freshwater snail, but little is published on the habitat preferences or decline of this species.

The longsolid mussel is associated with gravel in large rivers, and threats to this mussel are similar to those to other mussels described previously.

The northern madtom (a small member of the catfish family) is a benthic fish likely to inhabit shallow areas with fast currents (Figure 15). Threats to the northern madtom include habitat degradation, increased turbidity and flow alteration (Trautman, 1981; Carman, 2001).



**Figure 15. The Northern Madtom, *Noturus stigmosus***

Four of the species listed for this watershed are neither aquatic nor dependent on aquatic habitats. The redback salamander, stemless evening primrose, Eastern spotted skunk and Bewick's wren are dependent on upland habitats such as prairies, woodlands and bluffs.

**Table 5. Endangered Species, Threatened Species and Species of Concern**

Taxonomic Group	Licking River Zone	Common Name	Scientific name	Status <sup>a</sup>	Last Observed <sup>l</sup>	Habitat(s)	Identified Threats
<b>Gastropods</b>							
	South	Onyx rocksnail	<i>Leptoxis praerosa</i>	Federal - SOMC State - Special Concern	1999	Algal covered rocks in strong current <sup>b</sup>	
	South	Furrowed lioplax	<i>Lioplax sulculosa</i>	State - Special Concern	1964		
<b>Freshwater Mussels</b>							
	South	Elktoe	<i>Alasmidonta marginata</i>	Federal - SOMC State - Threatened	2002	Gravel or mixed gravel of medium sized streams <sup>c</sup>	Water quality declines, stream modifications and exotic species
	Central; South	Fanshell	<i>Cyprogenia stegaria</i>	Federal – Endangered State - Endangered	1999	Gravel riffles of medium to large rivers <sup>c</sup>	Water quality declines, stream modifications and exotic species
	South	Longsolid	<i>Fusconaia subrotunda</i>	State - Special Concern	1999	Gravel of large rivers <sup>c</sup>	Water quality declines, stream modifications and exotic species
	South	Purple lilliput	<i>Toxolasma lividus</i>	Federal - SOMC State - Endangered	1999	Gravel in lakes and small to medium streams <sup>c</sup>	Water quality declines, stream modifications and exotic species
	South	Pink mucket	<i>Lampsilis abrupta</i>	Federal – Endangered State - Endangered	1999	Gravel sand in large rivers and tributaries <sup>c</sup>	Water quality declines, stream modifications and exotic species
	South	Salamander mussel	<i>Simpsonaias ambigua</i>	Federal - SOMC State - Threatened	1999	Gravel, sand or silt in medium to large rivers <sup>c</sup>	Water quality declines, stream modifications and exotic species
<b>Fishes</b>							
	South	Northern madtom	<i>Noturus stigmosus</i>	Federal - SOMC State - Special Concern	1998	Sand, gravel or rock substrates with a strong current <sup>d,e</sup>	Habitat degradation <sup>f</sup> , increased turbidity and flow alteration <sup>g</sup>
<b>Amphibians</b>							
	Central	Redback salamander	<i>Plethodon cinereus</i>	State - Special Concern	1998	Woodlands <sup>h</sup>	Habitat loss/degradation

**Table 5. Endangered Species, Threatened Species and Species of Concern - Continued**

Taxonomic Group	Licking River Zone	Common Name	Scientific Name	Status <sup>a</sup>	Last Observed <sup>l</sup>	Habitat(s)	Identified Threats
<b>Vascular Plants</b>							
	North	Stemless evening-primrose	<i>Oenothera triloba</i>	State - Threatened	1907	Dry woods and prairies <sup>i</sup>	Habitat limited
<b>Mammals</b>							
	North	Eastern spotted skunk	<i>Spilogale putorius</i>	State - Special Concern	N/A	Prairie, woodlands and cultivated lands <sup>j</sup>	Use of insecticides <sup>j</sup>
<b>Breeding Birds</b>							
	South	Bewick's wren	<i>Thryomanes bewickii</i>	Federal - SOMC State - Special Concern	1989	Open and riparian woodland <sup>k</sup>	Poorly defined; may be due to interspecific competition, habitat changes, inclement weather and predators <sup>h</sup>

<sup>a</sup> SOMC = Species of Management Concern, a federal designation.

<sup>b</sup> Source: Goodrich and van der Schalie, 1944.

<sup>c</sup> Source: Cummings and Mayer, 1992.

<sup>d</sup> Source: Taylor, 1969.

<sup>e</sup> Source: Goodchild, 1993.

<sup>f</sup> Source: Carman, 2001.

<sup>g</sup> Source: Trautman, 1981.

<sup>h</sup> Source: NatureServe, 2007.

<sup>i</sup> Source: KSNPC, 2006.

<sup>j</sup> Source: Murray State University, 2000.

<sup>k</sup> Source: KSNPC, 2006a.

<sup>l</sup> KSNPC, 2007

### **2.4.2 Primary Contact Recreation Waters**

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

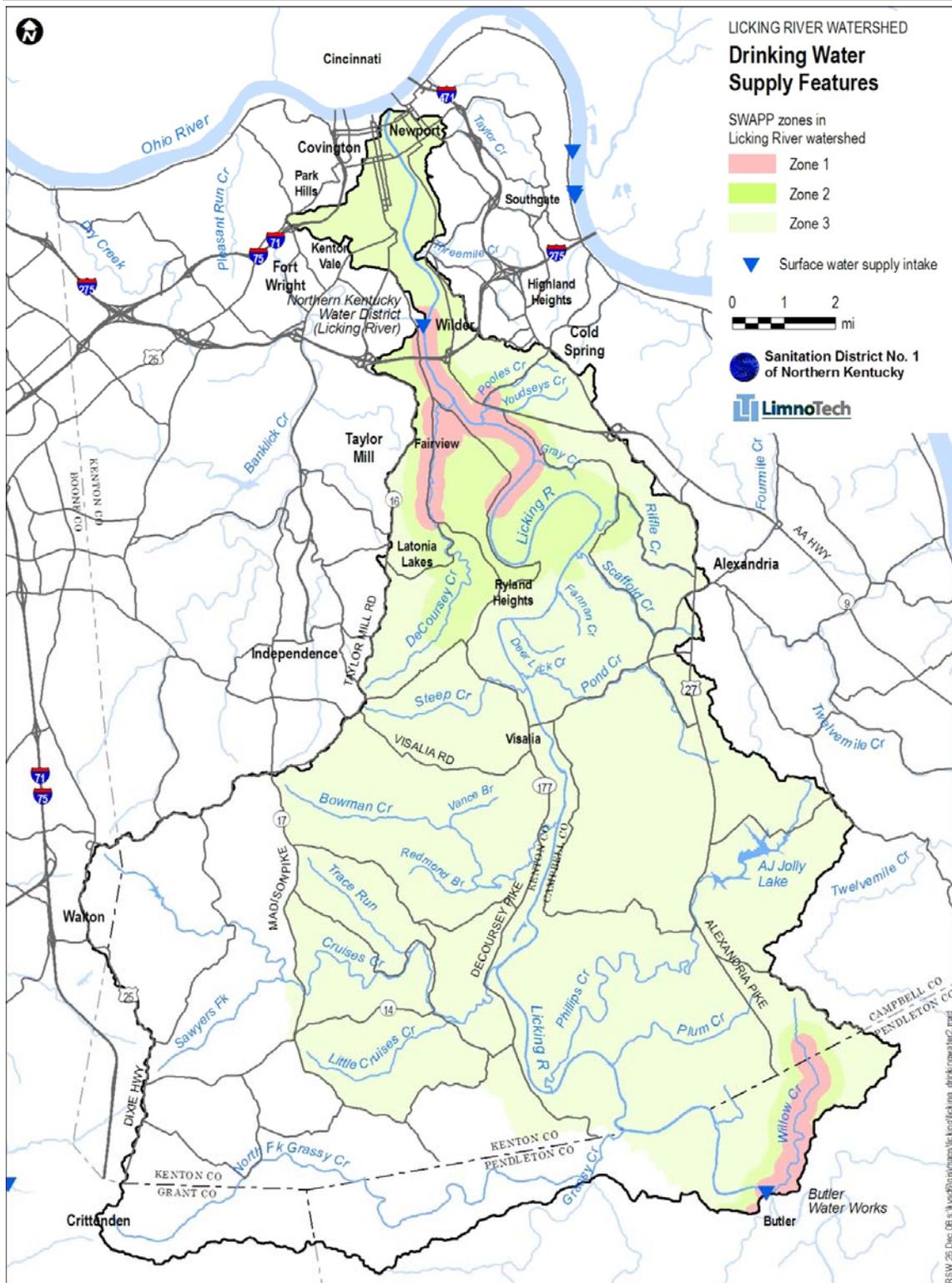
The Licking River and its tributaries are designated for PCR. It is not clear whether or not swimming occurs in the creek, as public surveys regarding that information are unavailable. No public swimming beaches were identified in the watershed. Additional data will be gathered about uses of the creek.

### **2.4.3 Public Drinking Water Intakes or their Designated Protection Areas**

There are two public drinking water intakes located within this watershed. The Northern Kentucky Water District (NKWD) intake is located on the Licking River just upstream of the Banklick Creek confluence (RM 4.9). The intake for Butler, Kentucky is located on the Licking River, near the upstream end of the study area (RM 35.5) in Pendleton County. A third intake is located on the Ohio River, far downstream of the Licking confluence with the Ohio River, near Louisville, Kentucky.

Source Water Assessment and Protection Areas (SWAPPs) for the water intakes on the Licking River have been delineated to identify potential contaminants upstream of the water intakes. The SWAPP zones are not used in a regulatory sense but are used to support identification of sources potentially impacting the intakes. Due to the location of the NKWD and Butler intakes, portions of this watershed lie within SWAPP Zone 1. The remainder of the watershed upstream of these intakes lies within SWAPP Zones 2 and 3. A portion of the Licking River watershed downstream of the NKWD intake also lies within Zone 2, reflecting the fact that this area is more than 25 miles upstream of the Louisville intake.

There are no active public drinking water wells in this watershed. Drinking water supply features are shown in Figure 16.



**Figure 16. Drinking Water Supply Features**

**2.5 PUBLIC INTEREST/WATERSHED GROUP ACTIVITIES**

Public interest in this watershed is rated moderate-high and is gauged through past investigations, improvement projects, and monitoring by many organizations (Section

4.2). Additionally, a plan is being considered to develop a greenway along the Licking River between I-275 and the mouth (<http://www.covingtonky.com/documents/Short-LR-presentation.ppt>). This greenway is envisioned as a continuous riverfront greenway that encompasses riverbank stabilization, riparian habitat, and provides a multi-level trail system that connects each of the partner communities. The plan also includes new park development and green infrastructure ([http://www.vision2015.org/licking\\_greenway/Documents/presentation%20918%20handout\\_small.pdf](http://www.vision2015.org/licking_greenway/Documents/presentation%20918%20handout_small.pdf)).

SD1 has been conducting monitoring and modeling studies in this watershed since 1995 and has been responsible for funding or conducting numerous investigations, reports and projects aimed at improving the health of the Licking River. The Licking River Basin Team has also actively studied this watershed, and is comprised of representatives from the Kentucky Division of Water, the Kentucky Division for Fish and Wildlife Resources, SD1, the Nature Conservancy, the US Forest Service and other organizations. In 1998, the Basin Team published a report titled, "The Licking River Region in Kentucky: Status and Trends," and is currently working on an updated version of this report.

In 2005, a stream buffer was established in the DeCoursey Creek subwatershed, along a small lake in Mills Road Park. This work was funded by a grant from the Kentucky Division of Conservation Soil Erosion and Water Quality Cost Share Fund. Approximately 450 native trees and shrubs were planted in 2005. A 10-year maintenance agreement has been signed for this site (BCKCCD, 2005).

Northern Kentucky University (NKU) Center for Applied Ecology (CAE) has submitted a stream and wetland restoration plan for the Campbell Conservancy Parkside Preserve in the Phillips Creek subwatershed. The work will involve clearing land adjacent to a tributary to A.J. Jolly Lake and replanting it with native herbs, shrubs and trees. It will also include wetland restoration and revegetation with native species. Funding for this project would be provided through the Northern Kentucky Stream and Wetland Restoration Fund and information on this project was provided by NKU CAE.

Hawthorne Crossing Conservation Area was recently acquired and dedicated in October 2008. This 140 acre area along the Licking River in central Campbell County was acquired through the combined efforts of the Campbell County Conservation District, the Campbell Conservancy and the Campbell County Fiscal Court. The land will be preserved as a conservation area, with passive recreational and educational use that includes canoeing, kayaking, fishing, hiking trails and restoration of woodlands.(Campbell Conservancy, 2008)

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### 3. WATERBODY USES

This section describes designated and current uses for the Licking River and its tributaries.

#### 3.1 DESIGNATED USES

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

The Licking River from RM 18.9 to 115 is also designated as an Outstanding State Resource Water (OSRW; 401 KAR 10:026). 16.7 miles of this reach are located within the study area. Designated uses are defined below.

- **Warm water aquatic habitat** means any surface water and associated substrate capable of supporting indigenous warm water aquatic life.
- **Primary contact recreation** waters means those waters suitable for full body contact recreation during the recreation season of May 1 through October 31.
- **Secondary contact recreation** waters means those waters that are suitable for partial body contact recreation, with minimal threat to public health due to water quality.
- **Domestic water supply** means surface waters that with conventional domestic water supply treatment are suitable for human consumption through a public water system as defined in 401 KAR 8:010, culinary purposes, or for use in any food or beverage processing industry; and meet state and federal regulations under the Safe Drinking Water Act, as amended, 42 U.S.C. 300f - 300j.
- **Outstanding State Resource Water** means a surface water designated by the cabinet as an outstanding state resource water pursuant to 401 KAR 10:031.

Bowman Creek and Sawyers Fork have also been identified as candidates for exceptional waters and OSRW designation.

- **Exceptional waters** means a surface water categorized as exceptional by the cabinet pursuant to 401 KAR 10:030.

#### 3.2 CURRENT USES

An assessment of available information found the following:

- Licking River and tributary habitat was assessed using different methods. Aquatic habitat in the lower 6.5 miles of the Licking River was predominantly rated fair in 1996. More recently, habitat in two tributaries was assessed as partially to fully supporting. Biological data in the Licking River watershed are limited, and indicate fair to excellent conditions in two tributaries.
- A statewide fish consumption advisory was issued on April 11, 2000 due to low levels of organic mercury found in fish taken from Kentucky waters (KDOW, 2007a)
- A swimming advisory has been issued for the Licking River between Banklick Creek and the mouth (KDOW, 2007b).

- There is public fishing access to the Licking River at Fredrick's Landing, Locust Pike Park, and Clines on the River (a fishing access site). There is also fishing access at boat and fishing pier at A.J. Jolly Lake (<http://kygeonet.ky.gov/kdfwr/viewer.htm>). Middleton-Mills Lake is a test lake in the Fishing in Neighborhoods Program, and is stocked with fish by the Department of Fish and Wildlife Resources.
- The Cincinnati Junior Rowing Club practices on the Licking River ([www.cjrc.net](http://www.cjrc.net)).
- There are two surface water intakes on the Licking River. The Northern Kentucky Water District has an intake on the Licking River near RM 4.9 and the Butler Water Works intake is located near RM 35.5.
- There are no active public drinking water wells in this watershed (KDOW, 2008a; KDOW, 2007c)

## 4. WATERBODY CONDITIONS

This section describes monitoring programs as well as current conditions in the Licking River watershed. Impairments as well as water quality and biological conditions are described.

### 4.1 303(d) STATUS AND POLLUTANTS OF CONCERN

Three segments of the Licking River and one tributary appear on Kentucky's 2008 303(d) list of impaired waterbodies (Table 6; KDOW, 2008).

**Table 6. 303(d)-Listed Waterbodies**

Waterbody Segment	Designated Uses (use support)	Pollutants	Suspected Sources
Licking River RM 0.0 – 4.8	Primary Contact Recreation (Partially supporting)	Fecal coliform	Sanitary sewer overflows (collection system failures), Urban runoff/storm sewers
Licking River RM 4.8 – 14.9	Primary Contact Recreation (Partially supporting)	Fecal coliform	Source unknown
Licking River RM 31.0 – 37.6 <sup>a</sup>	Primary Contact Recreation (Partially supporting)	Fecal coliform	Source unknown
Phillips Creek RM 0.0 – 5.3	Primary Contact Recreation (Nonsupport)	Fecal coliform	Source unknown

<sup>a</sup> This impaired segment extends upstream of study area boundary at RM 35.6

### 4.2 MONITORING PROGRAMS

Water quality data have been collected in this watershed by KDOW, Ohio River Valley Water Sanitation Commission (ORSANCO), Northern Kentucky University (NKU), Licking River Watershed Watch (LRWW), USGS and SD1. Data currently compiled by SD1 from known monitoring programs are presented in Table 7, however, only data which have been fully analyzed are discussed in Section 4.3 Water Quality Data Analysis. Available data exists for the main stem of the Licking River, along with numerous tributaries including: Bowman Creek, Sawyers Fork, North Fork Grassy Creek, Cruises Creek, DeCoursey Creek, Phillips Creek, Plum Creek, Riffle Creek, Scaffold Creek, Steep Creek, North Fork of Riffle Creek, and Little Cruises Creek.

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

#### 4.2.1 Future Sampling

SD1 plans to continue monitoring this watershed during base flow conditions with at least one survey per year. The sampling locations are: Licking River at RM 0.5, 4.9, 19.3, and 35.5; Bowman Creek (RM 0.7); Cruises Creek (RM 2.5 and 8.1); DeCoursey Creek (RM 2.2); Grassy Creek (RM 0.5); Phillips Creek (RM 2.3); Plum Creek (RM 1.8); Pond Creek (RM 0.9); Riffle Creek (RM 0.9); Scaffold Creek (RM 0.6) and Steep Creek (RM 1.2). Typical analyses will include bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters.

SD1 is planning to collect wet weather data at locations in this watershed in 2009, the locations are: Licking River at RM 0.5, 4.9, 19.3, and 35.5; DeCoursey Creek (RM 2.2); and Pond Creek (RM 0.9); Attempts will be made to collect three events of varying characteristics (total rainfall, maximum intensity). Samples may be analyzed for bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters. Within each event, samples will be collected near hour 0, 2, 4, 6, 12, 24, 36, and 48 hours of the start of the storm, though these intervals are dependent on the storm characteristics and may be changed if necessary.

Additionally, SD1 is planning on collecting macroinvertebrate samples from three locations along the non-wadable portions (RM 0.5, 4.9, and 19.3) of the Licking River in 2009. Surveys will also be conducted to assess the degree of stream hydromodification.

The USGS will continue to operate the stage gage, measure flow, and water quality (physical parameters) at Cruises Creek RM 8.1 (station 03254480) and at the Licking River at RM 19.3 (03254520). These stations are operated and funded via a cooperative agreement between USGS and SD1.

Outfall sampling was initiated in 2007 to better characterize water quality and loadings from CSOs, SSOs and storm water runoff. Six CSOs and one SSO are being sampled in this watershed and analyzed for bacteria, nutrients, solids, metals and oxygen-demanding constituents. This sampling program plan is anticipated to continue until ten events are monitored.

KDOW plans to continue monitoring the long term ambient site at Licking River RM 35.4. This site is monitored monthly every five years and bimonthly the other four years. The next monthly sampling is planned to occur between April 2009 and March 2010, and parameters planned for monitoring include: pH, dissolved oxygen, specific conductance, temperature, nutrients, metals and bacteria (KDOW, 2008).

KDOW may also conduct sampling at Licking River RM 2.3 during the April 2009-March 2010 period as part of their rotating basin monitoring program. KDOW sampled this location during the previous rotating basin monitoring in this watershed (2004-05), and tries to keep the locations the same over time.

**Table 7. Summary of Water Quality Monitoring Data**

Entity	Dates	Parameters Sampled	Sampling Locations <sup>b</sup>	Number of Samples
KDOW	1989, 1999	Alkalinity, chlorophyll-a, DO, DO % Sat, 1% light compensation point, pH, conductivity, TOC, DOC, transparency (secchi disc), temperature, nutrients	A.J. Jolly Lake (Upper Lake and at the Dam)	6 samples (3 samples per year between May-October)
KDOW	1990-2005	Fecal coliform, Fecal strep or entero, <i>E. coli</i> , DO, pH, conductivity, temperature	Licking R. RM 0.2, 0.5, 0.8, 1.1, 1.7, 2.2, 2.3, 3.2, 3.4, 4.6, 4.9	Numerous sampling dates between Apr & Nov
KDOW	1996	DO, pH, conductivity, transparency (secchi disc), turbidity, temperature	Licking R. RM 0.5, 0.8, 1.3, 2.3, 3.3, 4.8, 5.5, 6.2	13 samples (June, July, Aug, & Sept)
KDOW	1999	Fecal coliform	Licking R. RM 2.3	4 sample (May, June, Sept, & Oct 1999)
KDOW	1999-2000	Alkalinity, chloride, DO, pH, conductivity, hardness, Particulate Non-Volatile Solids, sulfate, TOC, turbidity, temperature, nutrients, metals	Licking R. RM 2.3, 35.4	11 samples from Apr 1999 to Mar 2000 (1 per month)
KDOW	1999, 2004, 2006	Fecal coliform, <i>E. coli</i>	Licking R. RM 35.4	11 Fecal samples (May, July-Oct 1999; May-Oct 2004) 3 <i>E. coli</i> samples (May-July 2006)
KDOW	2000-2004	Alkalinity, chloride, DO, pH, conductivity, hardness, Particulate Non-Volatile Solids, sulfate, TOC, turbidity, temperature, nutrients, metals	Licking R. RM 35.4	24 samples from May 2000 to Mar 2004 (sampled bimonthly)
KDOW	2004-2005	Alkalinity, chloride, DO, pH, conductivity, hardness, Particulate Non-Volatile Solids, sulfate, TOC, turbidity, temperature, nutrients, metals	Licking R. RM 2.3	9 samples from Apr 2004 to Mar 2005 (excludes monthly samples from Nov, Dec, Jan)
KDOW	2004	Alkalinity, chloride, DO, pH, conductivity, hardness, Particulate Non-Volatile Solids, sulfate, TOC, turbidity, temperature, nutrients, metals	Licking R. RM 35.4	6 samples (Apr, May, June, Aug, Sept, Dec)
KDOW	2004	148 different general organics, semivolatile organics, and pesticides	Licking R. RM 35.4	2 samples (7/13/2004 & 11/17/2004)
KDOW	2005-2007	Alkalinity, chloride, DO, pH, conductivity, hardness, Particulate Non-Volatile Solids, sulfate, TOC, turbidity, temperature, nutrients, metals	Licking R. RM 35.4	17 samples (sampled bimonthly from Jan 2005 to Nov 2007; excludes Sept 2005 and Jan 2007, but includes Feb 2005)
KDOW	2003	DO, pH, conductivity, temperature	Bowman Cr. RM 2.5	1 sample (9/11/2003)
KDOW	2005	Alkalinity, chloride, fluoride, hardness, pH, conductivity, turbidity, TOC, TDS, TSS, sulfate, nutrients	Bowman Cr. RM 5.0	1 sample (5/3/2005)

**Table 7. Summary of Water Quality Monitoring Data - Continued**

Entity	Dates	Parameters Sampled	Sampling Locations <sup>b</sup>	Number of Samples
KDOW	2004	Alkalinity, chloride, hardness, DO, pH, conductivity, TOC, TSS, temperature, sulfate, nutrients	Sawyers Fork RM 1.1	1 sample (4/21/2004)
LRWW	1999	Fecal coliform	Licking R. RM 0.4, 3.6, 19.3; N. Fork Grassy Cr. RM 0.5	1 sample (7/16/1999)
LRWW	2002	Fecal coliform	Licking R. RM 0.4 (Left & Right Bank), 6.7, 32.3; Cruises Cr. RM 10.4; DeCoursey Cr. RM 0.1, 0.4, 3.5; Grassy Cr. RM 0.5; N. Fork Grassy Cr. RM 0.5; Phillips Cr. 2.2, 9.7	1 sample (7/12/2002)
LRWW	2003	Fecal coliform	Licking R. RM 6.7	1 sample (5/14/2003)
LRWW	2003	Fecal coliform	Licking R. RM 0.4	1 sample (7/10/2003)
LRWW	2003	Fecal coliform	Grassy Cr. RM 0.5	1 sample (9/5/2003)
LRWW	2004	Fecal coliform	Licking R. RM 0.4; Cruises Cr. RM 8.1, 10.4; Phillips Cr. 2.2, 9.7	1 sample (5/22/2004)
LRWW	2004	Fecal coliform, <i>E. coli</i>	Licking R. RM 0.4; Cruises Cr. RM 10.4; DeCoursey Cr. RM 0.1, 3.5; Phillips Cr. 2.2, 9.7	1 sample (7/1/2004)
LRWW	2004	Fecal coliform, <i>E. coli</i>	Licking R. RM 0.4; Cruises Cr. RM 10.4; Phillips Cr. 2.2, 9.7	1 sample (9/13/2004)
NKU	1998	Alachlor, atrazine, chlorpyrifos-methyl, metolachlor, 2,4-D, Dichlorophenoxyacetic acid	Licking R. RM 0.4, 3.6, 19.3; Phillips Cr. RM 2.8	1 sample (May)
NKU	1998	Fecal coliform, DO, pH	Licking R. RM 0.4, 3.6, 19.3, 32.3; Phillips Cr. RM 2.8	1 sample (7/14/1998)
NKU	1998	Alkalinity, bromide, chloride, fluoride, hardness, conductivity, sulfate, TOC, TSS, nutrients, metals	Licking R. RM 3.6, 19.3; Phillips Cr. RM 2.8	1 sample (10/11/1998)
NKU	1999	Alkalinity, chloride, hardness, conductivity, sulfate, TOC, TSS, nutrients	Licking R. RM 0.4, 3.6; North Fork Grassy Cr. RM 0.5; Phillips Cr. RM 2.8	1 sample (Sept)
NKU	1999	Atrazine, chlorpyrifos-methyl, 2,4-D, Dichlorophenoxyacetic acid	Licking R. RM 0.4, 3.6, 19.3; North Fork Grassy Cr. RM 0.5	1 sample (May)

**Table 7. Summary of Water Quality Monitoring Data - Continued**

Entity	Dates	Parameters Sampled	Sampling Locations <sup>b</sup>	Number of Samples
NKU	2000	Atrazine, metolachlor	Licking R. RM 0.4; North Fork Grassy Cr. RM 0.5	1 sample (May)
NKU	2000	Alkalinity, chloride, hardness, DO, pH, conductivity, temperature, sulfate, TOC, TSS, nutrients	Licking R. RM 0.4, 32.3; North Fork Grassy Cr. RM 0.5	1 sample (9/24/2000)
NKU	2000	Fecal coliform, Fecal strep	North Fork Grassy Cr. RM 0.5	1 sample (7/15/2000)
NKU	2001	Atrazine, metolachlor	Licking R. RM 0.4, 6.7; DeCoursey Cr. RM 0.1, 3.5; North Fork Grassy Cr. RM 0.5; One unnamed tributary site of Phillips Cr. at RM 11.3	1 sample (June)
NKU	2001	Fecal coliform, Fecal strep	Licking R. RM 0.4, 6.7; Cruises Cr. RM 10.4; DeCoursey Cr. RM 0.1, 0.4, 3.5; Two unnamed tributaries sites of Phillips Cr. at RM 11.3	1 sample (7/14/2001)
NKU	2001	Fecal coliform, E. coli, DO, pH, temperature	Cruises Cr. RM 10.4; Grassy Cr. RM 0.5; Phillips Cr. RM 2.2, 9.7; One unnamed tributary site of Phillips Cr. At RM 11.3	1 sample (8/25/2001)
NKU	2002	Atrazine, DO, pH, temperature	Cruises Cr. RM 10.4; DeCoursey Cr. RM 3.5; Grassy Cr. RM 0.5	1 sample (May)
NKU	2003	Fecal coliform, boron, chloride, DO, hardness, pH, conductivity, silicon, sulfur, sulfate, TOC, TSS, temperature, nutrients, metals	Licking R. RM 0.4; Cruises Cr. RM 10.4; DeCoursey Cr. RM 0.1, 0.4, 3.5; Grassy Cr. RM 0.5; ; Phillips Cr. RM 2.2, 9.7	1 sample (Sept); Only Grassy Cr., Licking R. and Phillips Cr. RM 9.7 had metals data
NKU	2003	Fecal coliform, DO, pH, conductivity, temperature	Licking R. RM 0.2, 6.7; Cruises Cr. RM 10.4; DeCoursey Cr. RM 0.1, 0.4, 3.5; Grassy Cr. RM 0.5; Phillips Cr. 2.2	1 sample (5/17/2003)
NKU	2003	Fecal coliform	Licking R. RM 0.4, 32.3; DeCoursey Cr. RM 0.1, 0.4, 3.5; Grassy Cr. RM 0.5; North Fork Grassy Cr. RM 0.5; Phillips Cr. RM 2.2, 9.7	1 sample (7/10/2003)
ORSANCO	1995	Fecal coliform, Fecal strep, alkalinity, biological oxygen demand (5-day), carbonaceous biological oxygen demand (5-day), caffeine, hardness, TDS, TSS, DO, pH, conductivity, temperature, turbidity, nutrients, metals	Licking R. RM 1.1 (Center of Channel)	3 dry weather samples (8/14/1995, 8/23/1995, 8/29/1995)

**Table 7. Summary of Water Quality Monitoring Data - Continued**

Entity	Dates	Parameters Sampled	Sampling Locations <sup>b</sup>	Number of Samples
ORSANCO	1995	Fecal coliform, biological oxygen demand (5-day), TSS, DO, pH, conductivity, temperature, turbidity	Licking R. RM 1.1 (Left & Right Bank)	3 dry weather samples (8/14/1995, 8/23/1995, 8/29/1995)
ORSANCO	1995	Fecal coliform, <i>E. coli</i> , biological oxygen demand (5-day), carbonaceous biological oxygen demand (5-day), hardness, TDS, TSS, DO, pH, conductivity, temperature, nutrients, metals	Licking R. RM 1.1 (Center of Channel)	42 wet weather samples (9/8/1995, 9/16/1995, 10/4/1995, 11/11/1995)
ORSANCO	1995	Fecal coliform, <i>E. coli</i> , biological oxygen demand (5-day), carbonaceous biological oxygen demand (5-day), TDS, TSS	Licking R. RM 1.1 (Left & Right Bank)	3 wet weather samples (10/4/1995)
ORSANCO	1999	Fecal coliform, <i>E. coli</i> , carbonaceous biological oxygen demand (5-day), DO, hardness, pH, conductivity, TSS, temperature, nutrients	Licking R. RM 1.1 (Center of Channel and Left & Right Bank)	17 wet weather samples (10/9/1999 to 10/14/1999)
ORSANCO	2000	Fecal coliform, <i>E. coli</i> , carbonaceous biological oxygen demand (5-day), DO, hardness, pH, conductivity, TSS, temperature, nutrients	Licking R. RM 1.1 (Center of Channel and Left & Right Bank)	16 wet weather samples (5/27/2000 to 5/31/2000)
ORSANCO	2003, 2005	<i>E. coli</i>	Licking R. RM 1.1 (Center of Channel and Left & Right Bank)	5 samples in Oct 2003; 5 samples in May & June 2005
ORSANCO	1985-2006	Fecal coliform, biological oxygen demand (5 Day), Chemical Oxygen Demand, chloride, DO, DO % Sat, hardness, pH, conductivity, phenol, TOC, TDS, TSS, Total Non-Volatile Solids, sulfate, temperature, nutrients, metals	Licking R. RM 3.3	163 samples (monthly or bimonthly all years; parameters are not consistent over the years)
ORSANCO	2006	<i>E. coli</i>	Licking R. RM 1.3 (Center of Channel and Left & Right Bank)	5 samples (May & June)
ORSANCO	2007	<i>E. coli</i>	Licking R. RM 1.1	2 samples (7/30/2007 & 9/4/2007)
ORSANCO	2007	<i>E. coli</i>	Licking R. RM 1.3 (Center of Channel and Left & Right Bank)	1 sample (10/3/2007)
SD1	1996	DO, pH, conductivity, transparency (secchi disc), temperature	Licking R. RM 0.8, 1.3, 2.4, 3.3, 4.8, 5.5, 6.4	1/month June, Aug, & Sept

**Table 7. Summary of Water Quality Monitoring Data - Continued**

Entity	Dates	Parameters Sampled	Sampling Locations <sup>b</sup>	Number of Samples
SD1	1995-1996	Fecal coliform, <i>E. coli</i> , biological oxygen demand (5 Day), carbonaceous biological oxygen demand (5-day), chlorophyll a, DO, hardness, oil and grease, pH, settleable solids, conductivity, TOC, total solids, TSS, transparency (secchi disc), turbidity, VSS, temperature, nutrients, metals	Licking R. RM 0.5, 0.8, 1.3, 2.3, 3.3, 4.8, 5.5, 6.2	12 wet/dry weather events (maximum of 51 samples from each station for all of the events)
SD1	1996	Water: DO, pH, conductivity, turbidity, temperature, transparency (secchi disc)  Sediment: chemical oxygen demand, oil and grease, total solids, total volatile solids, toluene, nutrients, metals	Licking R. RM 0.5, 0.8, 1.3, 2.3, 3.3, 4.8, 5.5, 6.2	1 sample (Aug)
SD1	1996	DO, DO % sat, pH, conductivity, temperature	Licking R. RM 1.3	15-minute intervals
SD1	2006	Fecal coliform, <i>E. coli</i> , DO, pH, conductivity, turbidity, temperature	Licking R. RM 0.5, 4.9, 19.3, 35.5; Bowman Cr. RM 0.7; Cruises Cr. RM 2.5; DeCoursey Cr. RM 2.2; Grassy Cr. RM 0.5; North Fork Riffle Cr. RM 0.1; Phillips Cr. RM 2.3; Plum Creek RM 1.8; Pond Cr. RM 0.9; Scaffold Cr. RM 0.6; Steep Cr. RM 1.2	2 samples from baseline survey (10/10/2006 & 10/24/2006)
SD1	2007	Fecal coliform, <i>E. coli</i> , biological oxygen demand (5 Day), TSS, DO, pH, conductivity, turbidity, temperature, nutrients	Licking R. RM 0.5, 4.9, 19.3, 35.5; Bowman Cr. RM 0.7; Cruises Cr. RM 8.1; Little Cruises Cr. RM 0.2; DeCoursey Cr. RM 2.2; Grassy Cr. RM 0.5; Phillips Cr. RM 2.3; Riffle Cr. RM 0.9; Pond Cr. RM 0.9; Scaffold Cr. RM 0.6; Steep Cr. RM 1.2	1 sample (6/26/2007 & 7/3/2007)

**Table 7. Summary of Water Quality Monitoring Data - Continued**

Entity	Dates	Parameters Sampled	Sampling Locations <sup>b</sup>	Number of Samples
SD1	2008	Fecal coliform, <i>E. coli</i> , carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Licking R. RM 0.5, 1.3, 3.3, 5.5 (Center of Channel and Left & Right Bank of all four RM locations)	8 wet weather samples (5/7/2008 - 5/10/2008)
SD1	2008 <sup>a</sup>	Fecal coliform, <i>E. coli</i> , biological oxygen demand (5 Day), TSS, DO, pH, conductivity, turbidity, temperature, nutrients	Licking R. RM 0.5, 4.9, 19.3, 35.5; Bowman Cr. RM 0.7; Cruises Cr. RM 8.1; Little Cruises Cr. RM 0.2; DeCoursey Cr. RM 2.2; Grassy Cr. RM 0.5; Phillips Cr. RM 2.3; Riffle Cr. RM 0.9; Pond Cr. RM 0.9; Scaffold Cr. RM 0.6; Steep Cr. RM 1.2	1 sample (6/24/2007 & 6/25/2008)
USGS	1980-1983	Conductivity, temperature	North Fork Grassy Cr. RM 6.9	monthly or bimonthly all years
USGS	2000-present <sup>a</sup>	Discharge, gage height, temperature, DO, DO % sat, pH, specific conductance, turbidity, precipitation	Cruises Creek RM 8.1, Station No. 03254480	15-minute intervals
USGS	2007-present <sup>a</sup>	Gage height, temperature, DO, DO % sat, pH, specific conductance, turbidity, precipitation	Licking River RM 19.3, Station No. 03254520	15-minute intervals

<sup>a</sup>Data not analyzed in Section 4.3, including USGS data collected after WY 2005

<sup>b</sup>RM = River mile

## **4.3 WATER QUALITY DATA ANALYSIS**

Water quality data have been collected in the Licking River watershed since 1985. Historical water quality data (1985-2005) have been analyzed to identify past water quality problems in this watershed. Historical bacteria, dissolved oxygen, pH, ammonia, and metals violations were identified.

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

### **4.3.1 Historical Data**

Both discrete measurements and the continuous water quality data were analyzed to identify historical water quality problems. Historical data reveal numerous exceedances of water quality criteria (Tables 8-12). As shown in these tables, results are presented by zone for the Licking River mainstem stations, and by tributary, for tributaries with multiple sampling locations.

Additional violations were identified through a review of the 15-minute USGS data. The 15-minute data collected at the USGS station through water year 2005 have been previously analyzed and documented in a report by Cumberland Environmental Group (2007). This report is used as the basis for the continuous data analysis.

Measurements for parameters and locations not shown met their applicable water quality criteria.

**Table 8. Historical Bacteria Exceedances**

Stream	Parameters exceeding criteria				
	Season	Fecal coliform		<i>E. coli</i>	
		# samples	% of samples exceeding criteria <sup>a</sup>	# samples	% of samples exceeding criteria <sup>a</sup>
Licking River mainstem– North Zone locations	May-Oct	1,553 <sup>b</sup>	73%	781 <sup>b</sup>	84%
	Nov-Apr	165	49%		
Licking River mainstem– Central Zone locations	May-Oct	213 <sup>b</sup>	34%	125 <sup>b</sup>	32%
	Nov-Apr	23	17%		
Licking River mainstem– South Zone locations	May-Oct	16	19%	---	n/a
Cruises Creek	May-Oct	8	75%	3	33%
DeCoursey Creek	May-Oct	17	65%	2	50%
Grassy Creek	May-Oct	9	33%	---	n/a
Phillips Creek	May-Oct	19	47%	7	43%
Riffle Creek	May-Oct	18	100%	---	n/a

<sup>a</sup> In instances where 5 samples were not collected from a single location within a 30-day period, the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, was not possible. For data collected between May 1 and Oct. 31, comparisons were made to the part of the criteria that reads, “Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for *E. coli*.” For data collected between Nov. 1 and Apr. 30, comparisons were made to the part of the criteria that reads, “Content shall not exceed 2,000 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform.” Even these comparisons are conservative as the criterion is meant to be applied to a dataset of 5 or more samples collected over a 30-day period.

<sup>b</sup> The number of samples reported does not include additional samples in the database for which compliance with water quality criteria could not be assessed. This usually occurred due to detection levels greater than the criteria.

**Table 9. Historical Dissolved Oxygen Violations**

Stream	Parameters violating criteria	
	Dissolved oxygen <sup>a</sup>	
	# measurements	% of measurements in violation
Licking River mainstem – North Zone locations	1,692	12%
Licking River mainstem – Central Zone locations	254	14%
Phillips Creek	6	17%
A.J. Jolly Lake	96	47%

<sup>a</sup> The dissolved oxygen criterion is 4 mg/l.

Dissolved oxygen concentrations less than 4 mg/l have also been observed at the USGS station on Cruises Creek in water years 2001, 2002, 2003, 2004, and 2005 (CEG, 2007). These violations have been observed between May and October, and primarily during periods of low flow. Fewer than 3% of the dissolved oxygen measurements violated water quality criteria.

**Table 10. Historical pH Violations**

Stream	Parameter violating criteria		
	pH <sup>a</sup>		
	# measurements	% of measurements in violation of minimum	% of measurements in violation of maximum
Licking River mainstem – North Zone locations	1,522	0.2%	0.2%

<sup>a</sup> The pH criteria are between 6.0 and 9.0 su

In addition to the mainstem Licking River pH violations presented in Table 10, pH violations have also been observed at the USGS gage on Cruises Creek. These violations are discussed in the Continuous Monitoring Network Synthesis Report (CEG, 2007). As described in the CEG (2007) report, the pH in Cruises Creek at RM 8.1 was observed to change more than 1 su in a 24-hour period 3 days in WY 2002 and 2 days in WY 2005. There were no observations of pH at this station that were greater than 9.0 su or less than 6.0 su.

**Table 11. Historical Unionized Ammonia Violations**

Stream	Parameter violating criteria	
	Un-ionized ammonia <sup>a</sup>	
	# measurements	% of measurements in violation
Licking River mainstem – North Zone locations	576	0.7%

<sup>a</sup> The unionized ammonia criterion is 0.05 mg/l.

**Table 12. Historical Metals Violations**

Stream	River Mile	Parameters violating criteria											
		Cadmium <sup>a</sup>		Copper <sup>a</sup>		Iron <sup>b</sup>		Mercury		Silver		Zinc <sup>a</sup>	
		# samples	% of samples in violation	# samples	% of samples in violation	# samples	% of samples in violation	# samples	% of samples in violation	# samples	% of samples in violation	# samples	% of samples in violation
Licking River	North Zone	463 <sup>d</sup>	7%	805 <sup>d</sup>	3%	161	13%	471 <sup>d</sup>	0.2%	701 <sup>d</sup>	0.3%	801 <sup>d</sup>	0.4%
Licking River	Central Zone	77 <sup>d</sup>	16%										
Licking River	South Zone					51	2%						

<sup>a</sup> Acute criteria to protect aquatic life are hardness-dependent. Individual criteria were calculated for each sampling event based on hardness at the time of sampling. Acute cadmium criteria ranged from 1.1 ug/l to 7.0 ug/l. Acute copper criteria ranged from 7.6 ug/l to 42 ug/l. Acute silver criteria ranged from 1.2 to 28 ug/l. Acute zinc criteria ranged from 69 ug/l to 321 ug/l.

<sup>b</sup> The acute water quality criterion for iron is 4,000 ug/l.

<sup>c</sup> The acute water quality criterion for mercury is 1.7 ug/l.

<sup>d</sup> The number of samples reported does not include additional samples in the database for which compliance with water quality criteria could not be assessed. This usually occurred due to detection levels greater than the criteria.

### 4.3.2 Recent Data

Recent water quality data were available for nine locations along the mainstem of the Licking River (RM 0.5, 1.1, 1.3, 3.3, 4.9, 5.5, 19.3, 35.4, and 35.5), as well as one location each on Bowman Creek (RM 0.7), Cruises Creek (RM 8.1), DeCoursey Creek (RM 2.2), Grassy Creek (RM 0.5), Little Cruises Creek (RM 0.2), Phillips Creek (RM 2.3), Plum Creek (RM 1.8), Pond Creek (RM 0.9), Riffle Creek (RM 0.9), North Fork Riffle Creek (RM 0.1), Scaffold Creek (RM 0.6), and Steep Creek (RM 1.2). Table 13 shows exceedances of the fecal coliform and *E. coli* criteria. Exceedances were observed at thirteen of the twenty-one sampled locations. Measurements for locations not shown met water quality criteria. Recent data collected at the USGS station are being reviewed and will be included in the next update of this report.

**Table 13. Recent (2006-2008) Bacteria Exceedances**

Stream	River Mile	Parameters exceeding criteria			
		Fecal coliform <sup>a</sup>		<i>E. coli</i> <sup>b</sup>	
		# samples	% of samples exceeding criteria	# samples	% of samples exceeding criteria
Licking River	0.5	24	38%	24	42%
Licking River	1.3	21	24%	39	38%
Licking River	5.5	21	5%	21	5%
Licking River	19.3	3	33%	3	33%
Licking River	35.5	3	33%	3	33%
DeCoursey Creek	2.2	3	33%	3	33%
Grassy Creek	2.2	3	33%	3	33%
Little Cruises Creek	0.2	1	100%	1	100%
Plum Creek	1.8	---	n/a	2	50%
Pond Creek	0.9	3	33%	3	100%
Riffle Creek	0.9	---	n/a	1	100%
Scaffold Creek	0.6	3	33%	3	33%
Steep Creek	1.2	3	33%	3	33%

<sup>a</sup> In instances where 5 samples were not collected from a single location within a 30-day period, the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, "Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for *E. coli*." Even this comparison is conservative as the criterion is meant to be applied to a dataset of 5 or more samples collected over a 30-day period. All exceedances of the fecal coliform criterion were for the May-October season.

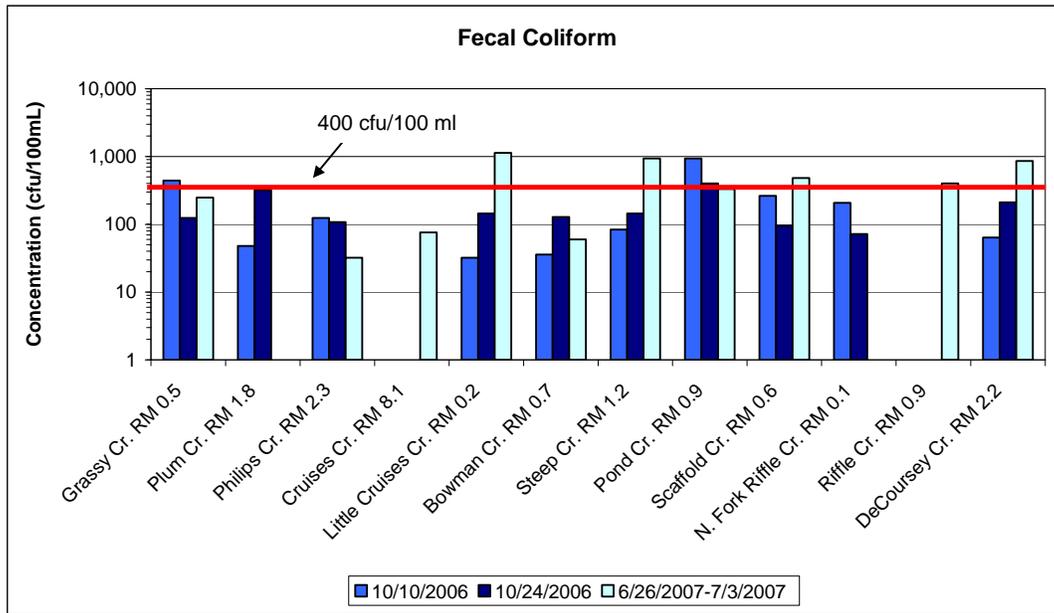
--- means no data available; n/a means not applicable.

### 4.3.2.a Bacteria

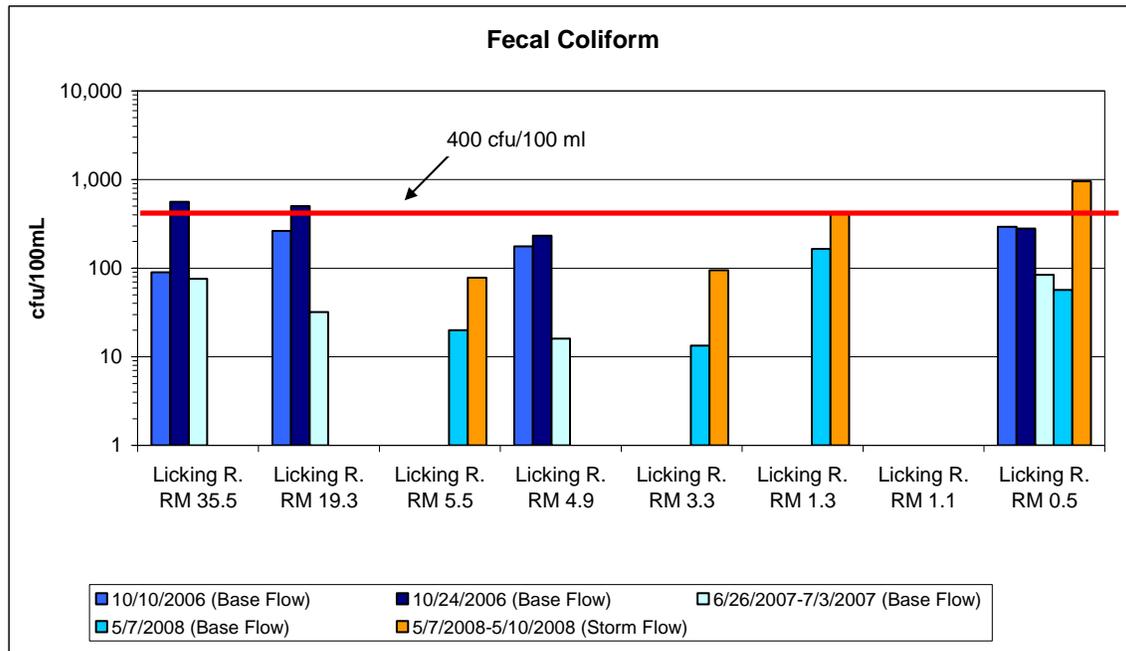
Fecal coliform and *E. coli* data were available for the main stem Licking River for both base flow and storm conditions, and for several tributaries for base flow conditions. Figure 17 presents base flow fecal coliform levels for the tributaries, while Figure 18 shows base flow and storm flow fecal coliform levels for several locations on the Licking River mainstem. Storm flow results for bacteria are presented as an average over the storm event.

As shown in Figure 17, base flow fecal coliform concentrations exceeded the applicable criterion in Grassy Creek, Little Cruises Creek, Steep Creek, Pond Creek, Scaffold Creek, and DeCoursey Creek. One sample at each of these locations exceeded the criterion, with the maximum fecal coliform concentration, 1,130 cfu/100 ml, observed in Little Cruises Creek during the June 27-July 3, 2007 sampling event. Base flow fecal coliform concentrations in the Licking River (Figure 18) exceeded the applicable criterion at RM 35.5 and RM 19.3. The maximum observed base flow fecal coliform level was 560 cfu/100 ml at RM 35.5 on October 24, 2006. Figure 18 shows that the fecal coliform criterion was exceeded at two of the four locations sampled under storm flow conditions. The maximum recorded storm flow fecal coliform concentration was 956 cfu/100 ml at RM 0.5 in May 2008.

*E. coli* concentrations generally exhibited a similar pattern, as shown in Figures 19 and 20, with both base flow and storm flow exceedances of the water quality criterion. Base flow *E. coli* concentrations exceeded the applicable criterion in eight of the twelve tributaries sampled. All three samples collected in Pond Creek exceeded the criterion. The maximum *E. coli* density observed in the tributaries was in Steep Creek (960 cfu/100 ml during the June 26 – July 3, 2007 sampling event). In the Licking River, base flow *E. coli* levels exceeded the applicable criterion at RM 35.5, RM 19.3, and RM 1.3. The maximum base flow *E. coli* density was 1,293 cfu/100 ml, recorded at RM 1.3 on October 3, 2007. Storm flow *E. coli* concentrations in the Licking River exceeded the applicable criterion at RM 1.3 and RM 0.5. The maximum recorded storm flow *E. coli* concentration was 982 cfu/100 ml at RM 0.5 in May 2008.

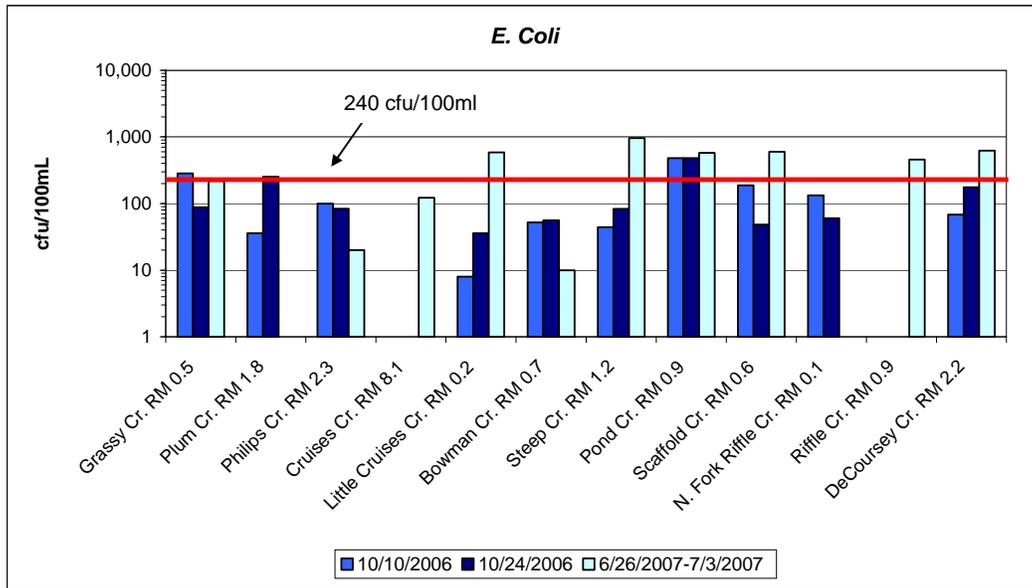


**Figure 17. 2006-2007 Tributary Base Flow Fecal Coliform Concentrations Compared to 400 cfu/100 ml Criterion**

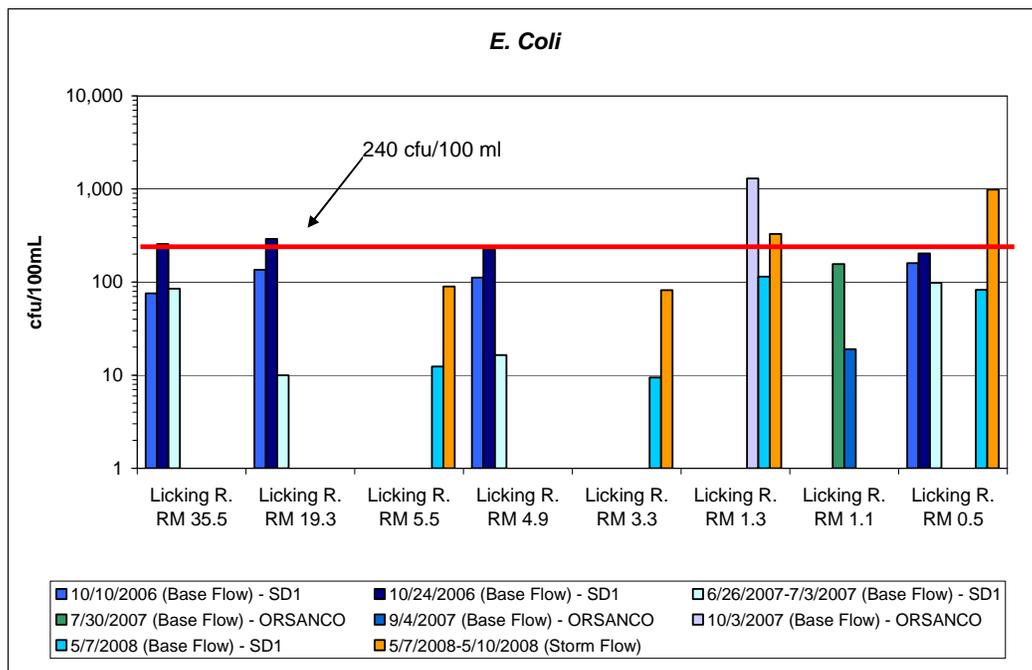


**Figure 18. 2006-2008 Licking River Base Flow and Average Storm Flow Fecal Coliform Concentrations Compared to 400 cfu/100 ml Criterion<sup>9</sup>**

<sup>9</sup> Three measurements collected by KDOW at RM 34.5 are excluded from Figure 18, because the flow conditions during collection are not known. None of these samples exceeded applicable criteria.



**Figure 19. 2006-07 Tributary Base Flow *E. Coli* Concentrations Compared to 240 cfu/100 ml Criterion**



**Figure 20. 2006-08 Licking River Base Flow and Average Storm Flow *E. Coli* Concentrations Compared to 240 cfu/100 ml Criterion<sup>10</sup>**

<sup>10</sup> Three *E. coli* measurements collected by KDOW at RM 34.5 and one by ORSANCO at RM 1.3 are excluded from Figure 20, because flow conditions during collection are not known. None of the samples at RM 34.5 exceeded applicable criteria. One exceedance was observed at RM 1.3.

#### 4.4 BIOLOGICAL CONDITIONS

Macroinvertebrate communities are susceptible to water quality and habitat degradation, and data from these communities are used as a tool to detect changes in habitat and water quality and assessing stream health (KDOW 2008b). KDOW sampled macroinvertebrates at several sites in the study area. The calculated MBI<sup>11</sup> score for Sawyer's Fork produced a "good" ranking (Table 1). MBI scores were not calculated for the seven Licking River sites because appropriate indices for large rivers have yet to be developed.

KDOW has sampled two sites in Bowman Creek for fish. The KIBI scores<sup>12</sup> calculated indicated "fair" to "excellent" conditions.

#### 4.5 STREAM METABOLISM

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

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

For the period 2000 to 2005, Cruises Creek (RM 8.1) had the lowest average P/R ratio among all monitored sites. At this site, stream metabolism appears to be influenced more by watershed than instream processes. Because there are no reference sites in this region that can be used for comparison, it is not known how this ratio compares to that for an unimpacted watershed. Longer-term monitoring of dissolved oxygen at the Cruises Creek site may prove useful in understanding how stream and watershed level changes affect the stream metabolism balance at this site.

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<sup>11</sup> The macroinvertebrate data collected by KDOW were used to calculate the Kentucky macroinvertebrate biotic index (MBI). The MBI compiles attributes of the macroinvertebrate community such as taxa richness, pollution tolerant species and pollution intolerant species. Additional metrics are added depending on the stream size and/or ecoregion.

<sup>12</sup> The data from this survey were used to calculate the Kentucky Index of Biotic Integrity (KIBI), a multimetric index using fish as an indicator of stream health. The KIBI compiles attributes of the fish community such as taxa richness and abundance, pollution tolerance/ intolerance, feeding and reproductive needs, and presence or absence of native species in order to provide a numerical value and corresponding narrative classification for streams.

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## 5. SOURCE ANALYSIS

This section discusses potential pollutant sources in the Licking River watershed to provide information related to recent observed impairments. Conclusions are based on the watershed characterization and available water quality data, including base flow samples for tributary locations, and both base and storm flow samples for the mainstem of the Licking River.

### 5.1 WATERSHED SOURCE ANALYSIS

The sources identified through the process of watershed characterization have been introduced previously and are summarized in Tables 14, 15 and 16. All potential sources are identified in these tables and are mapped in Figures 21, 22 and 23.

**Table 14. Summary of Potential Sources, Licking River North Zone**

	Licking River (mouth - RM 4.8)
Recent observed impairments =>	<i>Bacteria</i> <sup>d</sup>
CSO <sup>a</sup>	34
SSO <sup>a</sup>	2
SSOs at pump stations <sup>a</sup>	0
Septic systems	None identified
KPDES –sanitary outfalls <sup>b</sup>	4
KPDES – storm water, other outfalls <sup>b,c</sup>	9
Storm water runoff	Urban
Livestock	None identified
Streambank erosion	Observed
Backwater	Reported to occur upstream to RM 4.8
Tributaries	Bacteria sources in the Banklick Creek and Threemile Creek watersheds are discussed in separate reports
Watershed improvements	Licking River Interceptor Cleaning, Proposed Licking River Greenway

<sup>a</sup> SD1 is undertaking a characterization and assessment of the sanitary sewers, and sources are subject to change.

<sup>b</sup> Excludes CSOs.

<sup>c</sup> One of these outfalls is for sanitary, storm water and process water

<sup>d</sup> Sanitary sewer overflows (collection system failures) and urban runoff/storm sewers are identified as the suspected source related to the impaired primary contact recreation use between the Licking River mouth and RM 4.8 (KDOW, 2008).

**Table 15. Summary of Potential Sources, Licking River Central Zone**

	Direct Drainage to Licking between RM 4.8 & DeCoursey Creek	DeCoursey Creek	Direct Drainage to Licking between DeCoursey & Riffle Creeks	Riffle Creek	Scaffold Creek	Pond Creek	Steep Creek	Direct Drainage to Licking between Riffle Creek and RM 18.6
Recent observed impairments =>	<i>Bacteria</i> <sup>c</sup>	<i>Bacteria</i>	<i>No data</i> <sup>c</sup>	<i>Bacteria</i>	<i>Bacteria</i>	<i>Bacteria</i>	<i>Bacteria</i>	<i>No data</i> <sup>c</sup>
SSO <sup>a</sup>			1					
SSOs at pump stations <sup>a</sup>	2	3		3				
Septic systems	Few	Many 2 septic hotspots	Many	Many	Many	Many	Many	Many
KPDES – sanitary outfalls <sup>b</sup>		10	9	8	8	18	1	2
KPDES – storm water, other outfalls <sup>b</sup>						3		
Storm water runoff	Urban	Rural, some urban	Rural, some urban	Rural, some urban	Rural, some urban	Rural, some urban	Rural	Rural
Livestock		Likely		1 AFO (beef cattle); Beef cattle identified	Likely	Cattle identified	Likely	
Streambank erosion		Observed		Observed		Observed	Observed	
Backwater	Possible							
Watershed improvements				SSOs at Alex-Licking and Sunset pump stations will be eliminated				

<sup>a</sup> SD1 is undertaking a characterization and assessment of the sanitary sewers, and sources are subject to change.

<sup>b</sup> Excludes CSOs.

<sup>c</sup> The source contributing to the impaired primary contact recreation use between the Licking River RM 4.8 and RM 14.9 is not known (KDOW, 2008).

**Table 16. Summary of Potential Sources, Licking River South Zone**

	Direct Drainage to Licking (RM 18.6 to Bowman Ck)	Bowman Ck	Cruises Ck	Phillips Ck	Plum Ck	Direct Drainage to Licking Bowman Ck to Grassy Ck)	Grassy Ck	Other tributaries and direct drainage to Licking (Grassy Ck to RM 35.5)
<b>Recent observed impairments =&gt;</b>	<i>Bacteria</i>	<i>None</i>	<i>Bacteria<sup>d</sup></i> <i>(Little Cruises only)</i>	<i>None<sup>c</sup></i>	<i>Bacteria</i>	<i>No data</i>	<i>Bacteria</i>	<i>Bacteria<sup>c</sup></i>
Septic systems	Many	Many	Many	Many	Many	Many	Many	Unknown
KPDES – sanitary outfalls <sup>a,b</sup>	8	9	9	19	5		8	7
Storm water runoff	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Rural
Livestock		Cattle and horses likely	1 AFO; Many beef cattle and horses identified	2 AFOs; Cattle & horses likely	Cattle & horses likely	Cattle, horses & poultry identified	4 AFOs; Cattle and horses likely	Cattle & horses likely
Streambank erosion		Observed	Observed	Observed	Observed		Observed	
Watershed improvements				Stream and wetland restoration proposed for a tributary to A.J. Jolly Lake				

<sup>a</sup> SD1 is undertaking a characterization and assessment of the sanitary sewers, and sources are subject to change.

<sup>b</sup> Excludes CSOs.

<sup>c</sup> The source contributing to the impairment of Phillips Creek (RM 0 – 5.3) and the Licking River (RM 31 - 37.6) for primary contact recreation is not known (KDOW, 2008).

<sup>d</sup> Dissolved oxygen and some pH violations have historically been observed at the USGS station, but recent data have not been reviewed.



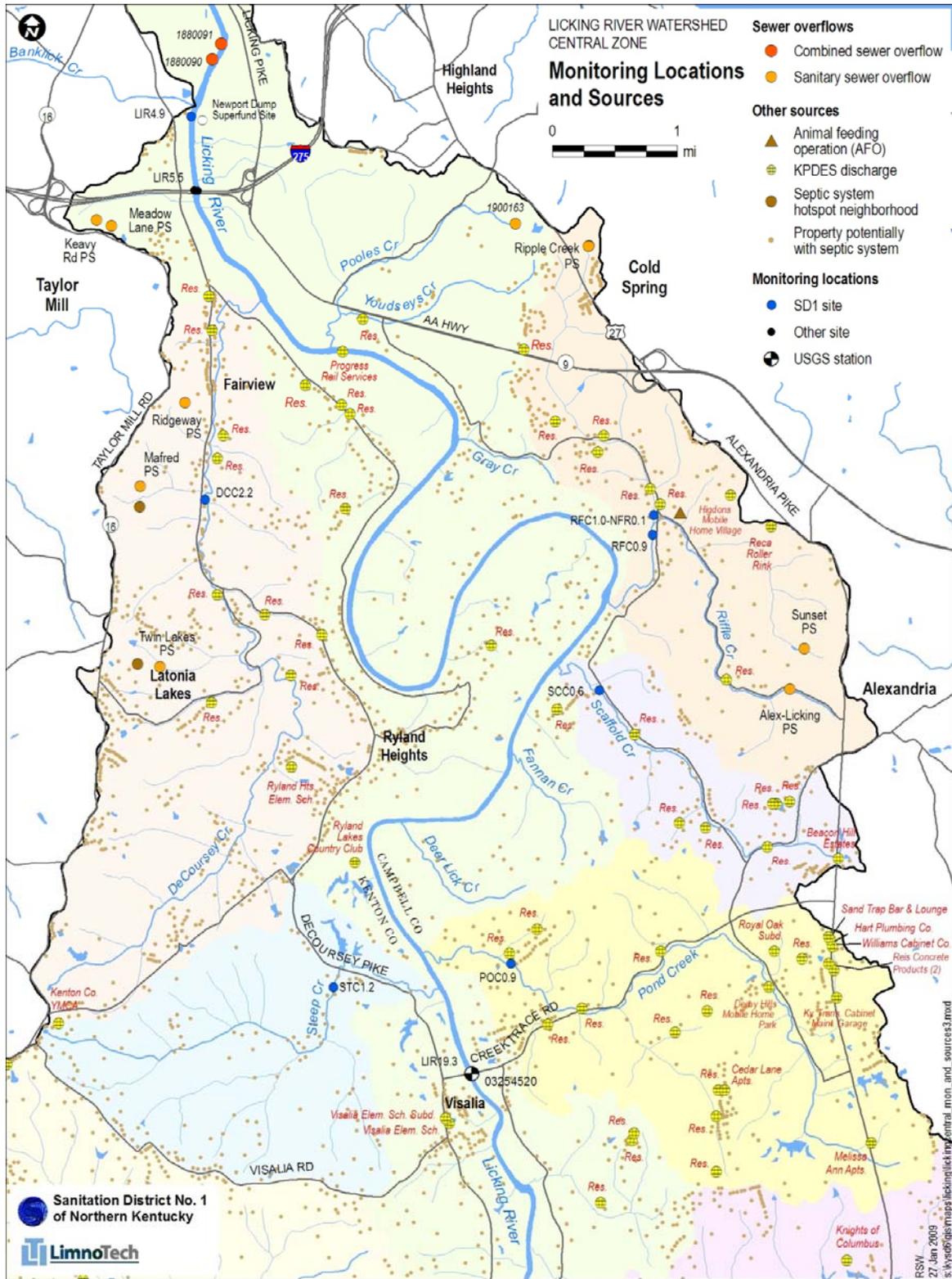


Figure 22. Monitoring Locations and Sources, Central Zone

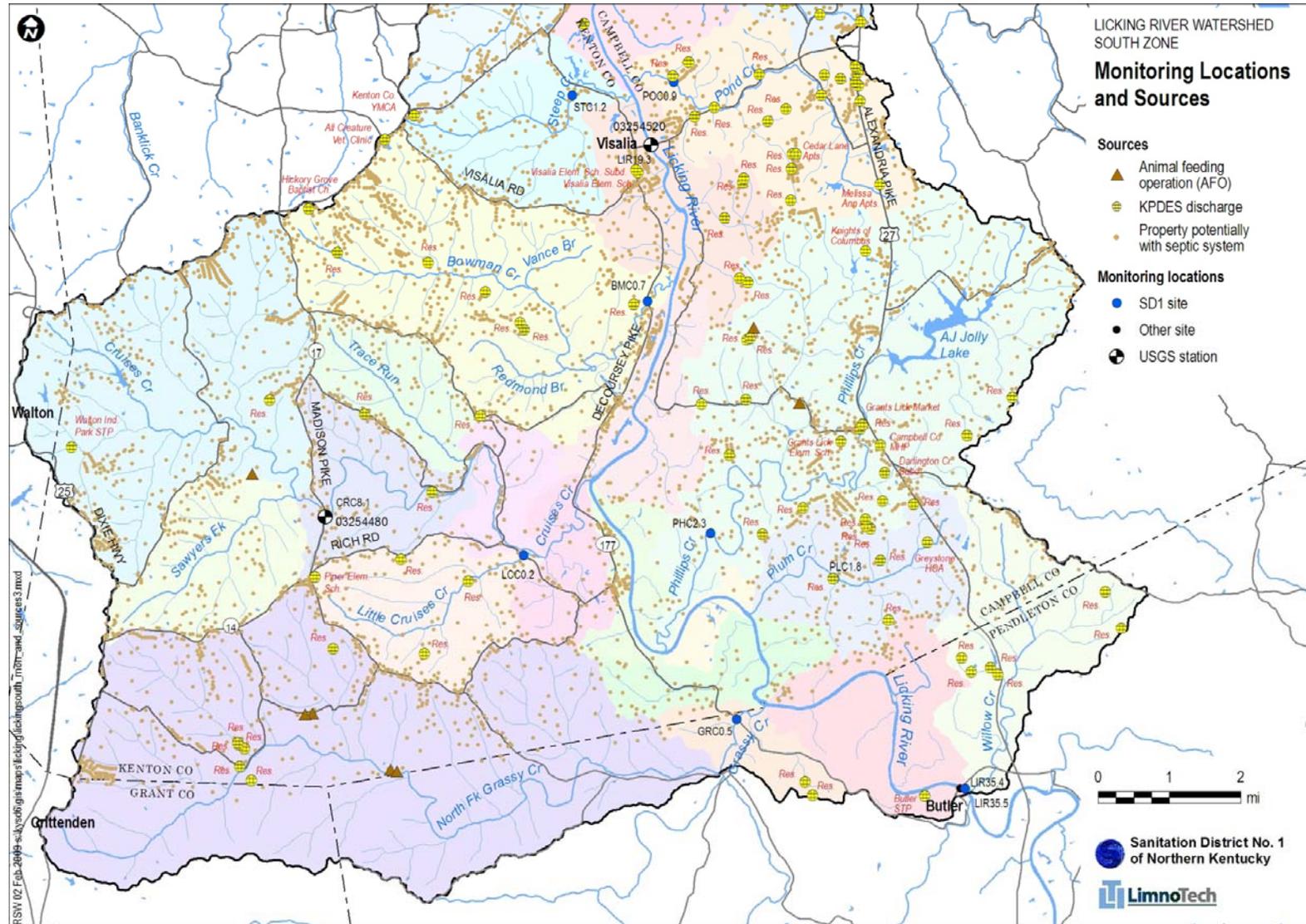


Figure 23. Monitoring Locations and Sources, South Zone

## 6. RANKING

### 6.1 RESULTS

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

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

WAT! results<sup>13</sup> indicate that under year-round conditions, the Licking River watershed has an approximately average rank (analogous to load) for fecal coliform, relative to the sixteen identified watersheds in SD1’s jurisdictional area.

In addition to WAT! results, other factors such as presence of public drinking water features, presence of aquatic-dependent threatened and endangered (T&E) species, special designations, and public interest may affect watershed prioritization. These and other ranking considerations are summarized in Table 17.

**Table 17. Watershed Ranking Considerations**

CSOs (#)	SSOs (#)	Drinking Water	Aquatic-dependent T&E Species <sup>a</sup> (#)	Special designation	Public interest	WAT! Rank, Year-Round Conditions <sup>b</sup>
						Bacteria
34	11	Zone 1, 2 and 3 (2 drinking water intakes on Licking River)	5	Licking River upstream of RM 18.9 is OSRW Bowman Creek and Sawyers Fork are candidates for exceptional waters designation	Moderate-high	9 of 16

<sup>a</sup> There is also four aquatic-dependent and three terrestrial species of State special concern, as well as one threatened terrestrial species. Three of these are also identified as federal species of management concern.

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

T&E = Threatened and/or endangered

<sup>13</sup> WAT is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

## 6.2 SCREENING TO DETERMINE IF ADDITIONAL DATA ARE NEEDED

Sufficient data and information are currently available or planned to support a good understanding of current base flow and storm flow conditions in the Licking River watershed. Data are insufficient, however, to identify specific sources contributing to base flow bacteria levels.

The Licking River has been sampled since 1985 and a fairly extensive record of water quality data exists for both historical and recent time periods. SD1 plans to continue water quality monitoring within this watershed during base flow and storm flow conditions and it is expected that data collection will continue at KDOW's ambient station at RM 35.4 (Section 4.2.1), and at the two USGS continuous monitoring stations. Furthermore, it is expected that KDOW will conduct Licking River sampling at RM 2.3 during the April 2009-March 2010 period, as part of their rotating basin monitoring program. Existing habitat and biological data are sparse for this watershed, however, SD1 is planning to conduct additional habitat and biological sampling in 2009.

### 6.2.1 Data Gap Analysis

No additional biological, habitat or water quality monitoring is recommended for this watershed, beyond that already planned. However, SD1 may want to consider coordinating future sampling with KDOW, to maximize the investment of resources. Additional field investigation would help to determine the source of recent base flow bacteria levels in the following creeks: DeCoursey, Riffle, Scaffold, Pond, Steep, Little Cruises and Grassy. Potential sources to investigate in these tributaries include livestock, septic systems, and KPDES-permitted discharges.

## 6.3 SOURCE PRIORITIZATION

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

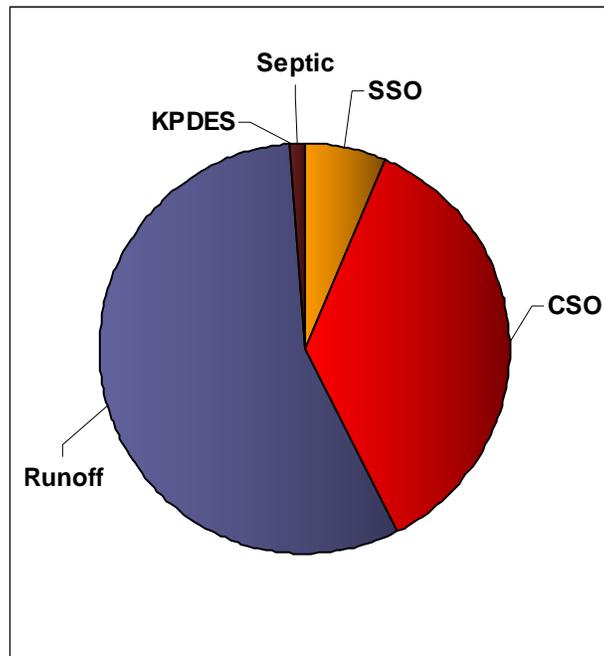
### 6.3.1 WAT! Results

The relative fecal coliform load generated by source is shown in Figure 24. These WAT! results incorporate predicted sewer overflow volumes from infrastructure model simulations for 1992-1996 climatological conditions<sup>14</sup>. Flow estimates are available for twenty-five of the CSOs and two of the SSOs in this watershed.

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<sup>14</sup> The results presented were generated by models based on SD1's current understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual measured field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

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



**Figure 24. Initial Year-Round WAT! Results for Fecal Coliform**

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

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

## 6.4 WATSHED RANKING

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

The WAT! produces rankings of the watersheds for both base flow and year-round conditions. By separating base flow conditions, the impacts of dry weather sources on stream conditions can be differentiated from the combined impact of dry and wet weather sources. The ranking of the Licking River watershed during year-round and base flow conditions is provided in Table 18.

**Table 18. WAT! Watershed Rankings**

	Rank for Year-Round Conditions <sup>a,b</sup>	Rank for Base flow Conditions <sup>a,b</sup>
Fecal coliform	9	7

<sup>a</sup> Rank ranges from 1 to 16. A rank of 1 indicates a high water quality impact score, which is analogous to load. The lowest rank possible is 16.

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

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

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## **Appendix A**

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**Table A-1. KPDES Permits**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted? <sup>1</sup>	Permit Violations
<b>North Zone</b>							
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc (Formerly Newport Steel)	0021	Major	Sanitary wastewater	Y	TSS
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0031	Major	Storm water runoff	Y	None
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0051	Major	Sanitary wastewater	Y	TSS
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0061	Major	Process wastewater	Y	Oil and grease
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0061	Major	Storm water, process, sanitary	Y	NA
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0071	Major	Sanitary wastewater	Y	None
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0091	Major	Storm water runoff	Y	None
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0111	Major	Storm water runoff	Y	None
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0121	Major	Storm water runoff	Y	Total lead
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0161	Major	Storm water runoff	Y	None
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0171	Major	Emergency overflow	Y	None
Licking River	KY0022055	Marathon Petroleum Co LLC	0011	Minor	Storm water, wash down, hyd test	Y	None
Licking River	KY0022055	Marathon Petroleum Co LLC	0021	Minor	Storm water, washdown, hyd test	Y	NA
<b>Central Zone</b>							
DeCoursey Creek	KY0040673	Ryland Heights Elem School	0011	Minor	Sanitary wastewater	Y	NA
Steep Creek	KY0082783	Kenton Co YMCA	0012	Minor	Sanitary wastewater	Y	Dissolved oxygen, E. coli, total chlorine

**Table A-1. KPDES Permits - Continued**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted? <sup>1</sup>	Permit Violations
<b>Central Zone - Continued</b>							
DeCoursey Creek	KY0101672	Kenton Co Bd Of Ed	0042	Minor	Ryland Heights Elem School	Y	Total ammonia
DeCoursey Creek	KYG400051	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
DeCoursey Creek	KYG400220	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
DeCoursey Creek	KYG400243	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
DeCoursey Creek	KYG400554	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
DeCoursey Creek	KYG400683	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
DeCoursey Creek	KYG401084	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
DeCoursey Creek	KYG401461	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
DeCoursey Creek	KYG401947	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Licking River	KY0100137	Progress Rail Services	0011	Minor	Sanitary wastewater	Y	TSS
Gray Creek	KYG400282	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Licking River	KYG400821	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Licking River	KYG400888	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Youdseys Creek	KYG401110	Residence	0011	Minor	Sanitary wastewater Type B	Y	BOD5, fecal coliform, TSS
Licking River	KYG401216	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Licking River	KYG401748	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Licking River	KYG401778	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Licking River	KYG401782	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Riffle Creek	KY0034231	Higdons Mobile Home Village	0022	Minor	Sanitary wastewater	Y	Total chlorine, total ammonia

**Table A-1. KPDES Permits - Continued**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?¹	Permit Violations
<b>Central Zone – Continued</b>							
Riffle Creek	KY0089141	Reca Roller Rink	0011	Minor	Sanitary wastewater	Y	Dissolved oxygen
Riffle Creek	KYG400134	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Riffle Creek	KYG400392	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Riffle Creek	KYG400616	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Riffle Creek	KYG401130	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Riffle Creek	KYG401135	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Riffle Creek	KYG401682	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Scaffold Creek	KY0104655	Beacon Hill Estates	0011	Minor	Sanitary wastewater	Y	None
Scaffold Creek	KYG400733	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Scaffold Creek	KYG400983	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform, total ammonia, TSS
Scaffold Creek	KYG400990	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Scaffold Creek	KYG401600	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Scaffold Creek	KYG401684	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Scaffold Creek	KYG401693	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Scaffold Creek	KYG401711	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Licking River	KY0042439	Ryland Lakes Country Club	0011	Minor	Sanitary wastewater	Y	Total ammonia
Licking River	KYG402068	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Pond Creek	KY0034797	Cedar Lane Apts	0011	Minor	Sanitary wastewater	Y	Dissolved oxygen, total chlorine
Pond Creek	KY0035301	Derby Hills MHP	0011	Minor	Sanitary wastewater	Y	Dissolved oxygen, fecal coliform

**Table A-1. KPDES Permits - Continued**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted? <sup>1</sup>	Permit Violations
<b>Central Zone - Continued</b>							
Pond Creek	KY0075698	Sand Trap Bar & Lounge	0011	Minor	Sanitary wastewater	Y	Fecal coliform, total chlorine, total ammonia
Pond Creek	KY0075728	Melissa Ann Apts	001G	Minor	Sanitary wastewater	Y	Total chlorine, total ammonia
Pond Creek	KY0089940	Hart Plumbing Co Inc	0011	Minor	Sanitary wastewater	Y	Dissolved oxygen, total chlorine, total ammonia, TSS
Pond Creek	KY0091936	Williams Cabinet Co	0011	Minor	Sanitary wastewater	Y	Dissolved oxygen
Pond Creek	KY0094439	Royal Oak Subd	0011	Minor	Sanitary wastewater	Y	Dissolved oxygen, fecal coliform, TSS
Pond Creek	KY0097853	Reis Concrete Products Inc	0011	Minor	Conc mix trk wshout strmwtr ru	Y	pH, TSS
Pond Creek	KY0097853	Reis Concrete Products Inc	0021	Minor	Conc mix trk wshout strmwtr ru	Y	Oil and grease, pH, TSS
Pond Creek	KYG400109	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Pond Creek	KYG400254	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Pond Creek	KYG400335	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Pond Creek	KYG400346	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Pond Creek	KYG400486	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Pond Creek	KYG400637	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Pond Creek	KYG401199	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform, total ammonia, TSS
Pond Creek	KYG401613	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Pond Creek	KYG401714	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Pond Creek	KYG401971	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Pond Creek	KYG402067	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA

**Table A-1. KPDES Permits - Continued**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?¹	Permit Violations
<b>Central Zone - Continued</b>							
Pond Creek	KYG500112	Ktc Campbell Co Maint Garage	SW10	Minor	Storm water runoff	Y	NA
<b>South Zone</b>							
Licking River	KY0040681	Visalia Elem School	0021	Minor	Sanitary wastewater	Y	NA
Licking River	KY0101672	Kenton Co Bd Of Ed	0052	Minor	Visalia Elementary School	Y	NA
Licking River	KY0105627	Visalia Elem School & Subd	0011	Minor	Sanitary wastewater	Y	NA
Licking River	KYG400369	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Licking River	KYG400528	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Licking River	KYG400871	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Licking River	KYG401534	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Licking River	KYG401847	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Bowman Creek	KY0075876	All Creature Veterinary Clinic	0012	Minor	Sanitary discharge	Y	CBOD5, dissolved oxygen, fecal coliform, total ammonia, TSS
Bowman Creek	KY0095842	Hickory Grove Baptist Church	0011	Minor	Sanitary wastewater	Y	Total ammonia
Bowman Creek	KYG400512	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Bowman Creek	KYG400772	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Redmond Branch	KYG400803	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Bowman Creek	KYG400910	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Bowman Creek	KYG401032	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Bowman Creek	KYG401371	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA

**Table A-1. KPDES Permits - Continued**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted? <sup>1</sup>	Permit Violations
<b>South Zone - Continued</b>							
Bowman Creek	KYG401448	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Phillips Creek	KY0034487	Campbell Co MHP	0011	Minor	Sanitary wastewater	Y	Fecal coliform, total chlorine, total ammonia
Phillips Creek	KY0034720	Knights Of Columbus Cncl #5220	0012	Minor	Sanitary wastewater	Y	Dissolved oxygen, E. coli, fecal coliform, total ammonia, TSS
Phillips Creek	KY0093637	Residence	0011	Minor	Sanitary wastewater	Y	Dissolved oxygen, fecal coliform, total ammonia, TSS
Phillips Creek	KY0100854	Campbell Co Bd Of Ed	0012	Minor	Grants Lick Elementary School	Y	None
Phillips Creek	KY0101532	Grants Lick Market	0012	Minor	Sanitary wastewater	Y	Fecal coliform, total ammonia, TSS
Phillips Creek	KY0105325	Darlington Creek Hoa Subd	0011	Minor	Sanitary wastewater	Y	NA
Phillips Creek	KYG400046	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Phillips Creek	KYG400167	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Phillips Creek	KYG400179	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Phillips Creek	KYG400299	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Phillips Creek	KYG400409	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Phillips Creek	KYG400412	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Phillips Creek	KYG400446	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Phillips Creek	KYG400507	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Phillips Creek	KYG400518	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Phillips Creek	KYG400526	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Phillips Creek	KYG401059	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA

**Table A-1. KPDES Permits - Continued**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?¹	Permit Violations
<b>South Zone - Continued</b>							
Phillips Creek	KYG401096	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Phillips Creek	KYG401570	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Plum Creek	KY0102130	Greystone Homeowners Assoc	0011	Minor	Sanitary wastewater	Y	Fecal coliform
Plum Creek	KYG400212	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Plum Creek	KYG400655	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Plum Creek	KYG401235	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Plum Creek	KYG401280	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Licking River	KY0021041	Butler STP	0012	Minor	Municipal wastewater	Y	BOD5, BOD5 removal, E. coli, fecal coliform, pH, suspended solids removal, total chlorine, TSS
Licking River	KY0021041	Butler STP	001M	Minor	Metals	Y	None
Willow Creek	KYG400604	Residence	0011	Minor	Sanitary wastewater Type B	Y	BOD5, dissolved oxygen, fecal coliform, total ammonia, TSS
Willow Creek	KYG400991	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Willow Creek	KYG401053	Residence	0011	Minor	Sanitary wastewater Type B	Y	BOD5, fecal coliform, total ammonia, TSS
Willow Creek	KYG401168	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Willow Creek	KYG401236	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Willow Creek	KYG401531	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Little Cruises Creek	KY0040665	Piner Elem School	0011	Minor	Sanitary wastewater	Y	NA
Little Cruises Creek	KY0101672	Kenton Co Bd Of Ed	0032	Minor	Piner elementary school	Y	Total ammonia

**Table A-1. KPDES Permits - Continued**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted?¹	Permit Violations
<b>South Zone - Continued</b>							
Little Cruises Creek	KYG400454	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Little Cruises Creek	KYG401572	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
Little Cruises Creek	KYG401795	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Trace Run	KYG400764	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Cruises Creek	KYG400359	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
Cruises Creek	KY0102164	Walton Industrial Park STP	0011	Minor	Sanitary discharge	Y	None
Cruises Creek	KYG400103	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Grassy Creek	KYG401269	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
Grassy Creek	KYG401569	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
North Fork Grassy Creek	KYG400472	Residence	0011	Minor	Sanitary wastewater Type B	Y	None
North Fork Grassy Creek	KYG400494	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
North Fork Grassy Creek	KYG400628	Residence	0011	Minor	Sanitary wastewater Type B	Y	Fecal coliform
North Fork Grassy Creek	KYG401444	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
North Fork Grassy Creek	KYG401822	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
North Fork Grassy Creek	KYG401958	Residence	0011	Minor	Sanitary wastewater Type B	Y	NA
<b>Discharges No Longer Permitted as of June 2008</b>							
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0032	Major	Storm water runoff	N	NA

**Table A-1. KPDES Permits - Continued**

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Currently Permitted? <sup>1</sup>	Permit Violations
<b>Discharges No Longer Permitted as of June 2008 - Continued</b>							
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0062	Major	Process wastewater	N	NA
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0081	Major	Sanitary wastewater	N	NA
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0092	Major	Storm water runoff	N	NA
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0112	Major	Storm water runoff	N	NA
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0122	Major	Storm water runoff	N	NA
Licking River	KY0002712	Ipsco Tubulars (Ky) Inc	0162	Major	Storm water runoff	N	NA
Pond Creek	KY0100129	SD1 Pond Creek	0011		Municipal discharge	N	pH, suspended solids removal, total chlorine, TSS
Pond Creek	KY0100129	SD1 Pond Creek	001M		Metals	N	NA
Bowman Creek	KY0086762	Community Pentecostal Church	0011	Minor	Sanitary wastewater	N	Fecal coliform, total ammonia
Phillips Creek	KY0077801	SD1 Southern Campbell Ind Pk	0011	Minor	Municipal wastewater	N	Fecal coliform, total chlorine, TSS
Phillips Creek	KY0077801	SD1 Southern Campbell Ind Pk	001P	Minor	Pretreatment	N	NA
Phillips Creek	KY0077801	SD1 Southern Campbell Ind Pk	001Y	Minor	Biomonitoring/once per quarter	N	Toxicity
North Fork Grassy Creek	KY0091634	Grant Co STP	0012		New WWTP	N	Total chlorine, TSS
North Fork Grassy Creek	KY0091634	Grant Co STP	001M		Metals	N	NA

<sup>1</sup> Discharge permitted or not as of June 2008

NA = no data available