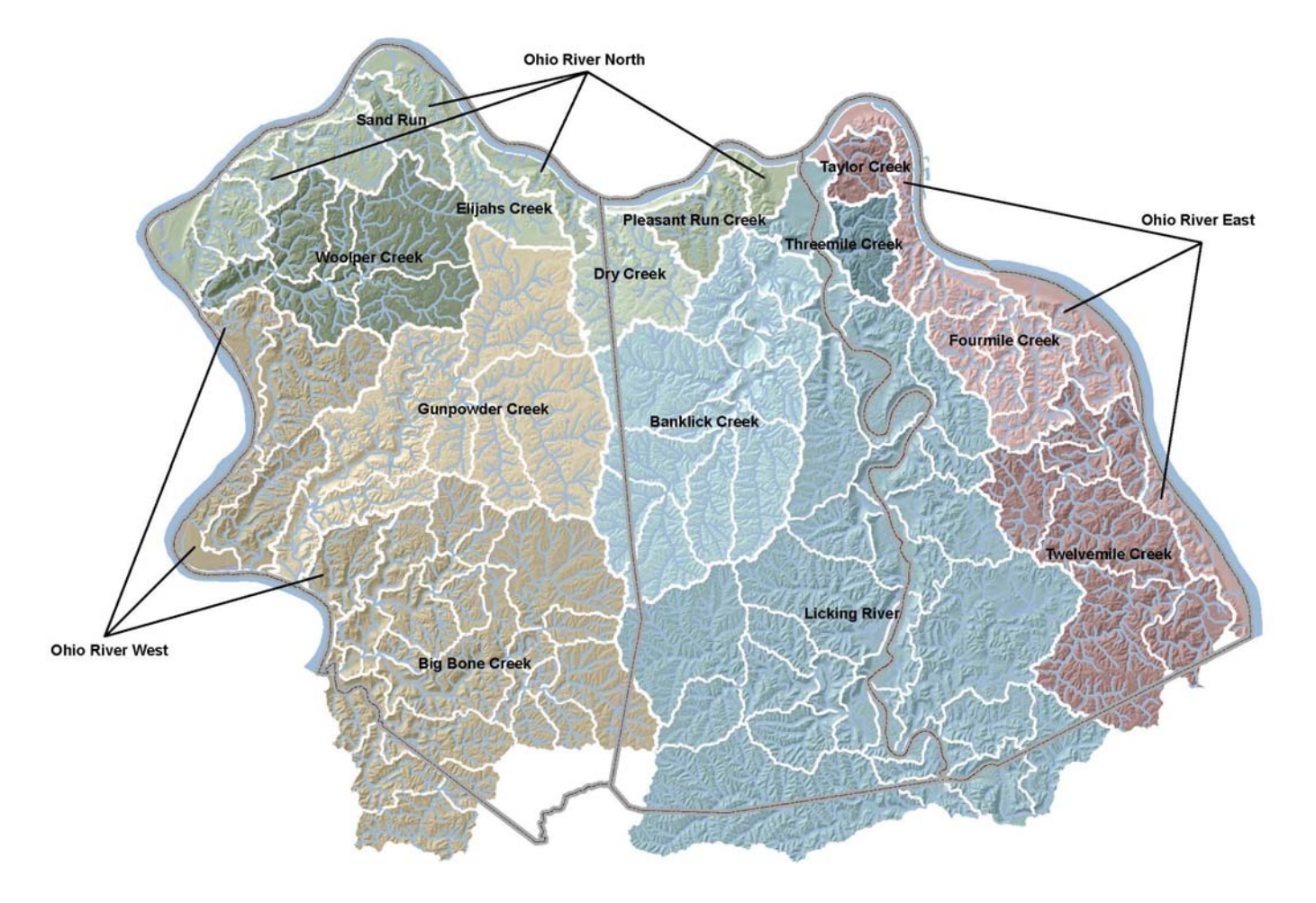


Northern Kentucky Watersheds – A Summary

Prepared for: Sanitation District No. 1 of Northern Kentucky

June 2009

LimnoTech
Water | Environment | Scientists | Engineers

Ann Arbor, Michigan
www.limno.com

This page is blank to facilitate double-sided printing.

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Definitions

Basins: The four watershed study basins (East, Central, North and West) defined as watersheds in the Consent Decree.

Study area watersheds: The sixteen watersheds encompassing the jurisdictional area of Sanitation District No. 1 (SD1) in Boone, Campbell and Kenton Counties, which are located within the four basins described in the Consent Decree.

Watershed: A defined area of land that drains into a particular body of water, such as a stream, river, lake, or ocean. Watersheds come in all shapes and sizes and can cross city, state and even national borders. A healthy watershed provides habitats for plants, aquatic life, and animals as well as high-quality water for human use.

Runoff: Storm water runoff is generated when precipitation from rainfall or snowmelt events flow over the land transporting pollutants untreated into water bodies instead of infiltrating into the ground. As the runoff flows over agriculture lands, residential and commercial lawns, construction sites or impervious surfaces (roads, driveways, parking lots, and building rooftops), it accumulates chemicals, bacteria, sediment or other pollutants that can adversely affect water quality.

Combined sewer system: A combined sewer system is a wastewater sewer system that is specifically designed to collect and convey sanitary wastewater (domestic sewage from homes as well as industrial and commercial wastewater) and storm water through a single pipe. During normal dry weather conditions, sanitary wastes collected in the combined sewer system are conveyed to a wastewater treatment plant.

Combined sewer overflow: During rain events or snowmelt, combined sewer systems are designed to overflow when the sewer system capacity is exceeded, resulting in a combined sewer overflow (CSO) that discharges directly to surface waters such as rivers, streams, estuaries, and coastal waters.

Sanitary sewer system: A separate sanitary sewer system is a wastewater sewer system, owned by a state or municipality that is specifically designed to collect and convey only sanitary wastewater (domestic sewage from homes as well as industrial and commercial wastewater). In such systems, storm water is conveyed through a separate set of pipes. These systems are not designed to collect large amounts of storm water runoff from precipitation events.

Sanitary sewer overflow: A sanitary sewer overflow (SSO) can occur when sewer system capacity is exceeded due to wet weather, when normal dry weather flow is blocked for any of several reasons, or when mechanical failures prevent the system from proper operation.

Additional information on CSOs, SSOs and watersheds is available at:
http://www.sd1.org

Background

Sanitation District No. 1 (SD1) is responsible for the collection and treatment of wastewater and regional storm water management in Northern Kentucky and serves over 30 communities in Boone, Campbell, and Kenton Counties. SD1 has negotiated a Consent Decree to address sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) to improve stream water quality. Specific solutions to achieve this goal are being described in Watershed Plans, which will be updated every five years through 2025. The first Watershed Plans will be submitted to the United States Environmental Protection Agency (EPA) and the Kentucky Division of Water (KDOW) by June 30, 2009.

The Consent Decree describes four study basins (East, Central, North and West), which encompass the area's sixteen watersheds (Figure 1). This summary report describes SD1's efforts to characterize and improve conditions within this 592 square mile area, and provides an overview of study area features. The unique characteristics of each of the study area watersheds are highlighted in individual fact sheets (Appendix A). These characteristics will be considered in prioritizing watersheds, identifying specific sources for improvement, and identifying data gaps to be addressed in subsequent updates to the Watershed Plans. Additional details can be found in the sixteen Watershed Characterization Reports which are available at http://www.sd1.org/projects/wcr.asp.

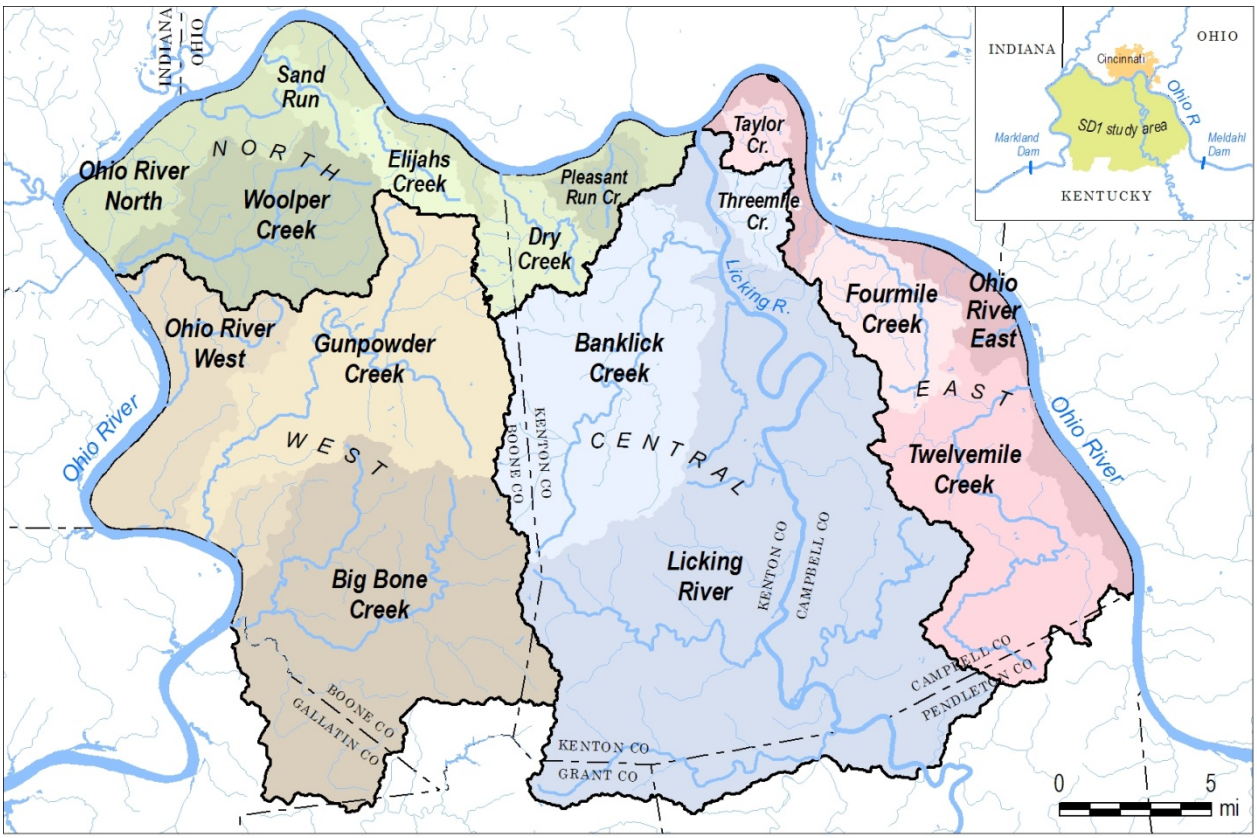


Figure 1. Study Area Map

SD1 Characterization and Improvement Efforts

This section provides a summary of SD1 activities to characterize and improve water quality in Northern Kentucky streams.

SD1 Data Collection and Modeling

SD1 has undertaken a substantial effort to obtain, compile and generate information and data describing the study area watersheds. Information on streams, watersheds, sampling locations, soils, hydrology, current and predicted future land cover, infrastructure, permitted dischargers, likely septic locations, livestock and improvement projects has been obtained in geographic information system (GIS) format and checked for accuracy. Water quality, habitat, biological, flow, and climatic data have also been obtained, reviewed and compiled in a database, which will be continuously updated as new information becomes available. SD1 now serves as a clearinghouse for Northern Kentucky watershed data, helping to provide easy access to the best available information for watershed characterization and the development of Watershed Plans.

In 2006, SD1 initiated a comprehensive program to gather updated stream data by conducting monitoring at multiple locations in each of the watersheds. This program is ongoing and includes aquatic habitat and biological assessments, wet and dry weather stream water quality sampling, and measurement of instream flow. SD1 also participates in funding thirteen continuous monitoring stations throughout the study area in cooperation with the United States Geological Survey (USGS). These stations provide flow and water quality measurements at 15-minute intervals. In 2007, SD1 initiated outfall sampling to better characterize water quality and loadings from combined sewer overflows (CSOs), sanitary sewer overflows (SSOs) and storm water runoff.

SD1 reviews all monitoring data prior to inclusion in a database. Data are subsequently analyzed to characterize stream conditions and identify potential pollutant sources. SD1 intends to continue the monitoring program over time to identify trends in water quality and provide feedback on the effectiveness of pollutant controls and other actions to improve water quality.

SD1 has developed of a suite of computer models to simulate the flow in the separate sanitary and combined sewer systems to quantify the amount of SSOs and CSOs. SD1 has also developed computer models to integrate watershed and water quality data and provide a way to link sources and water quality impacts. These models can be applied to identify current stressors and important sources. They can also be applied to forecast water quality conditions in response to different “what if” pollutant control scenarios. A Watershed Assessment Tool (WAT!) has been developed for the entire study area, to simulate the potential for different sources to generate bacteria loads. More detailed watershed and water quality models have been developed for Banklick Creek, Taylor Creek, the Lower Licking River and the Ohio River. These detailed models calculate water quality changes in response to new development, watershed controls and sanitary sewer controls.

Other SD1 Activities

SD1 is continually working to improve the capacity of the sanitary and storm water sewer systems, to upgrade aging infrastructure and to respond to growing demands for more wastewater treatment and storm water management. In 2007, SD1 began operating the Eastern Regional Water Reclamation Facility in Campbell County and will soon begin construction of the Western Regional Water Reclamation Facility in Boone County to provide additional capacity and treatment in the western portion of the study area. These two projects along with upgrades to SD1's Dry Creek Wastewater Treatment Plant and many other projects that are well underway will reduce or eliminate sewer overflows and eliminate smaller treatment plants and failing septic systems.

Watershed Characterization

SD1 has compiled data to better understand the condition of the streams and to characterize pollutant sources and stressors. Stream assessment included examination of:

- Hydrology, which indicates how quickly a stream responds to rain events.
- Water quality, which provides an indication of whether the stream quality is meeting standards set by the State to protect aquatic life, swimming or other designated uses.
- Aquatic habitat, which indicates whether a stream can support diverse aquatic communities, independent of stream quality.
- Aquatic biology, which integrates the effects of water quality, flow and habitat over time. The presence and abundance of different species provides a reflection of stream health.

Source assessment involved examination of:

- Geology and soil, which indicate erodibility and infiltration.
- Land cover and impervious surfaces, which influence the amount of rainfall that is converted to runoff and predict the type and amount of pollutants generated.
- Point sources, which provide information on discharges from facilities which have permits from the State such as wastewater treatment plants and CSOs.
- Nonpoint sources, which provide information on other pollutant sources such as storm water runoff, livestock, wildlife and septic systems.

The results of this characterization effort are described in detail in sixteen individual Watershed Characterization Reports. A more general characterization of the entire study area is presented in the following section.

Study Area Overview

This section briefly describes land cover characteristics, current stream conditions and sources for the study area. An assessment of the potential water quality impact of each watershed is also provided. This information is considered, in combination with other watershed characteristics, when prioritizing watersheds and sources for improvement.

Land Cover Characteristics

The land cover in a watershed is an important characteristic because it affects the amount and quality of runoff. Figure 2 contrasts two study area streams that drain watersheds with different levels of development. Double Lick Creek in the Woolper Creek watershed drains a primarily undeveloped watershed, and has been identified as an exceptional water by the State. Fourmile Creek, in contrast, drains a more highly developed watershed and is identified on State's 303(d) list as being impaired.

Source: SD1

Figure 2. Double Lick Creek (left) and Fourmile Creek (right)

Current (2007) land cover within the study area is shown in Figure 3. Developed areas currently comprise approximately 29% of the study area and the percent imperviousness is roughly 6.5%. Future land cover was developed by modifying the 2007 land cover to reflect potential future conditions (roughly 2030). In the future, 39% of the study area is predicted to be developed and the percent imperviousness is anticipated to increase to 9.3%. Growth is anticipated primarily within the boundary indicated on Figure 4 (predicted extent of future development). New development can increase storm water runoff and pollutant loads, and introduce additional challenges for protecting and improving stream condition.

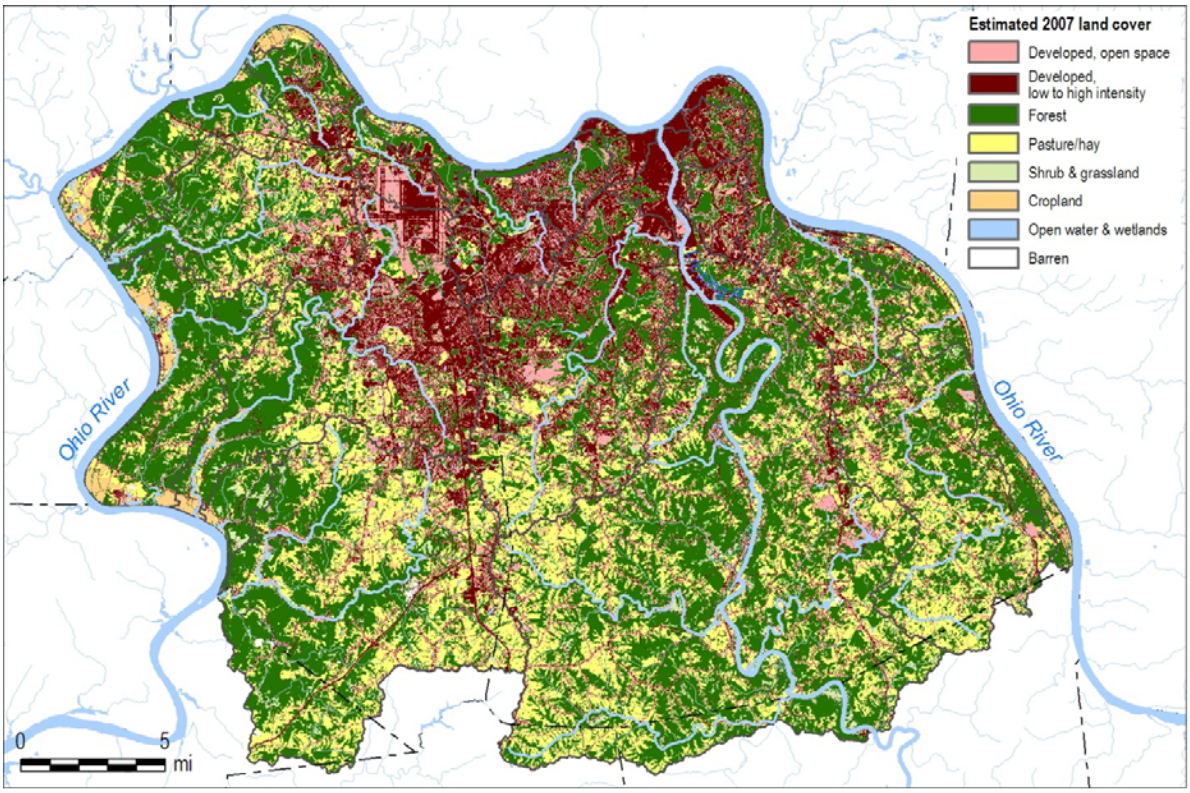


Figure 3. Current (2007) Land Cover

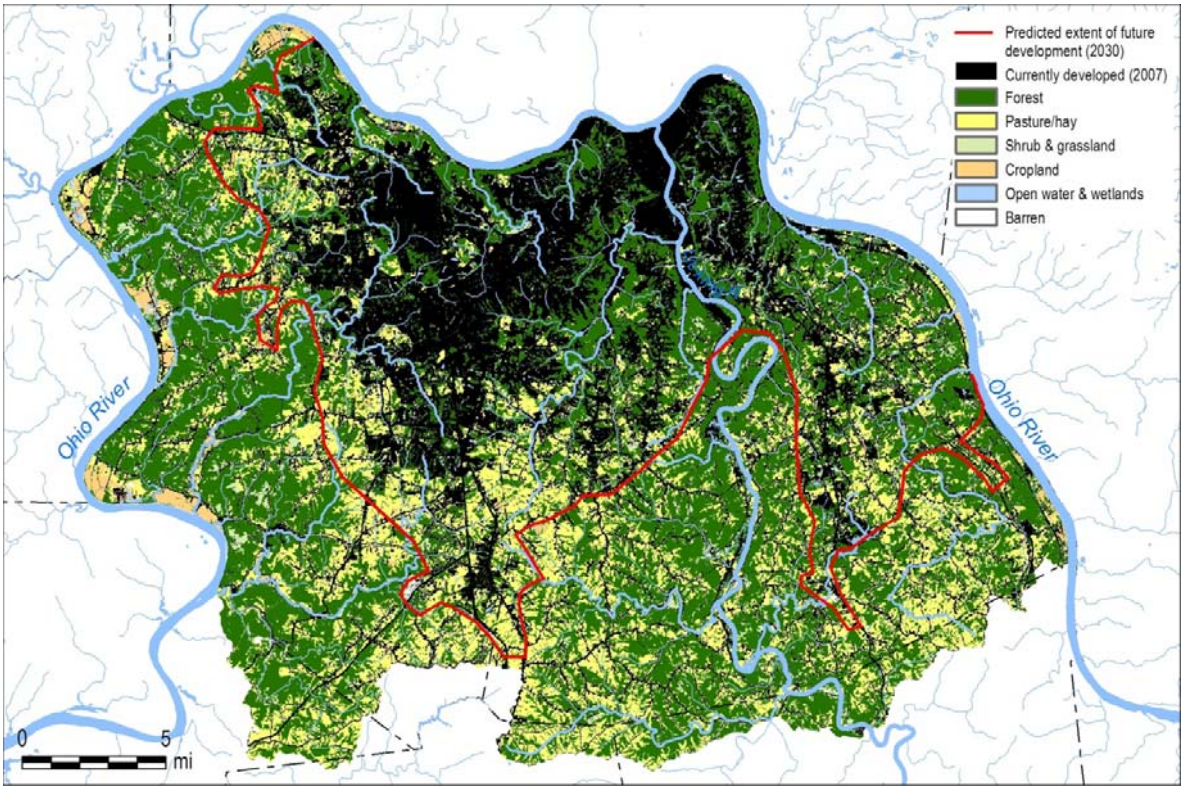


Figure 4. Predicted Extent of Future (2030) Development

Current Conditions and Sources

Current conditions have been assessed using habitat, biological and water quality data. Aquatic habitat and biological assessments reflect highly variable conditions both within and between watersheds. Typical water quality problems include elevated bacteria (fecal coliform and/or *E. coli*) densities, low dissolved oxygen and some violations of pH and metals.

Pollutant sources in the study area include CSOs, SSOs, other KPDES[1]-permitted discharges, storm water runoff and septic systems[2]. The distribution of these sources in the study area is shown on Figures 5 and 6, along with the boundaries for the sanitary (wastewater) sewer and storm water service area. Florence and Walton are shown separately, because these communities are responsible for their own wastewater and storm water.

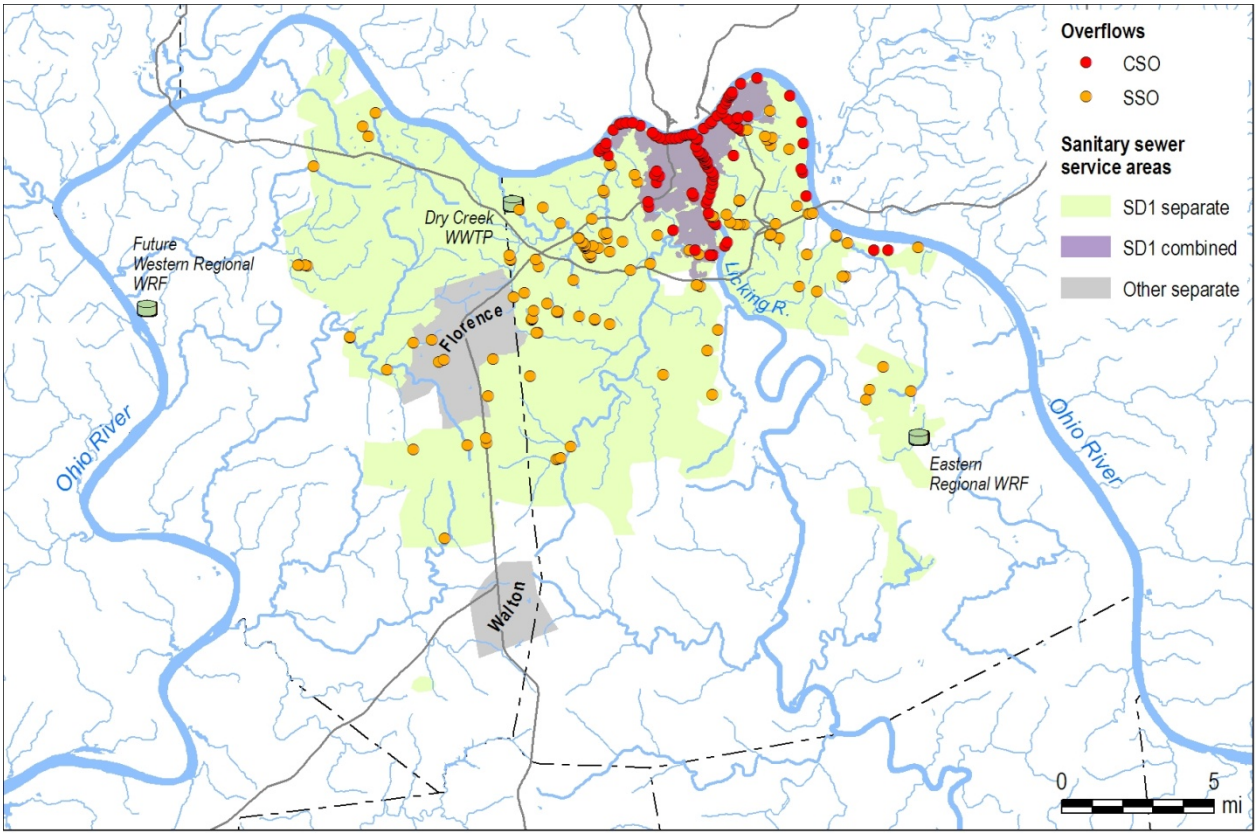


Figure 5. Sewer Overflows and Sanitary Service Area

[1] KPDES stands for Kentucky Pollutant Discharge Elimination System. Any point source that discharges to a Kentucky stream must have a permit from the State to ensure that the discharge will not adversely impact stream water quality.

[2] Septic information was not available at the time of this report for the southern-most extent of the study area (Pendleton, Grant or Gallatin Counties).

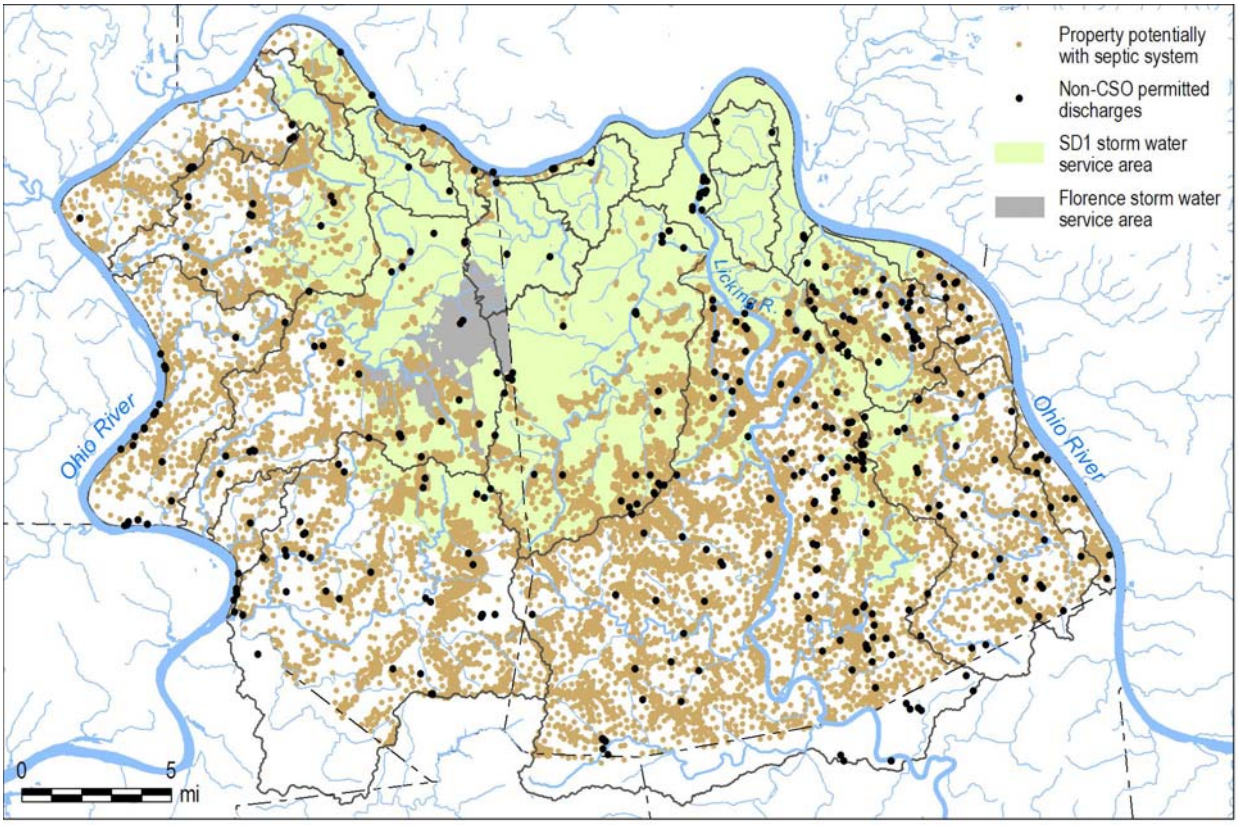


Figure 6. Other Permitted Discharges, Properties Potentially Served by Septic, and Storm Water Service Area

The potential for these sources to generate fecal coliform bacteria loads over a year-round period has been assessed using WAT!. These WAT! results also incorporate predicted sewer overflow volumes from infrastructure model simulations.[3]

The pie charts shown in Figure 7 are sized to reflect the potential for each watershed to generate fecal coliform bacteria, for year-round conditions, relative to the other study area watersheds. A larger pie chart indicates that a watershed has a higher potential to generate bacteria loads. The pie slices reflect the loading potential by source. In most watersheds, storm water runoff (e.g., runoff from agricultural, developed and forested lands) is the source with the highest potential to generate bacteria.

[3] The results presented were generated by models based on SD1's current understanding of the sewer system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the sewer system, and may differ from actual measured field conditions. All models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. Since publication of the Watershed Characterization reports in January 2009, WAT! has been updated to reflect refinements in the Banklick Creek and Taylor Creek models. WAT! will continue to be updated based on additional monitoring and modeling of pollution sources within the watersheds.

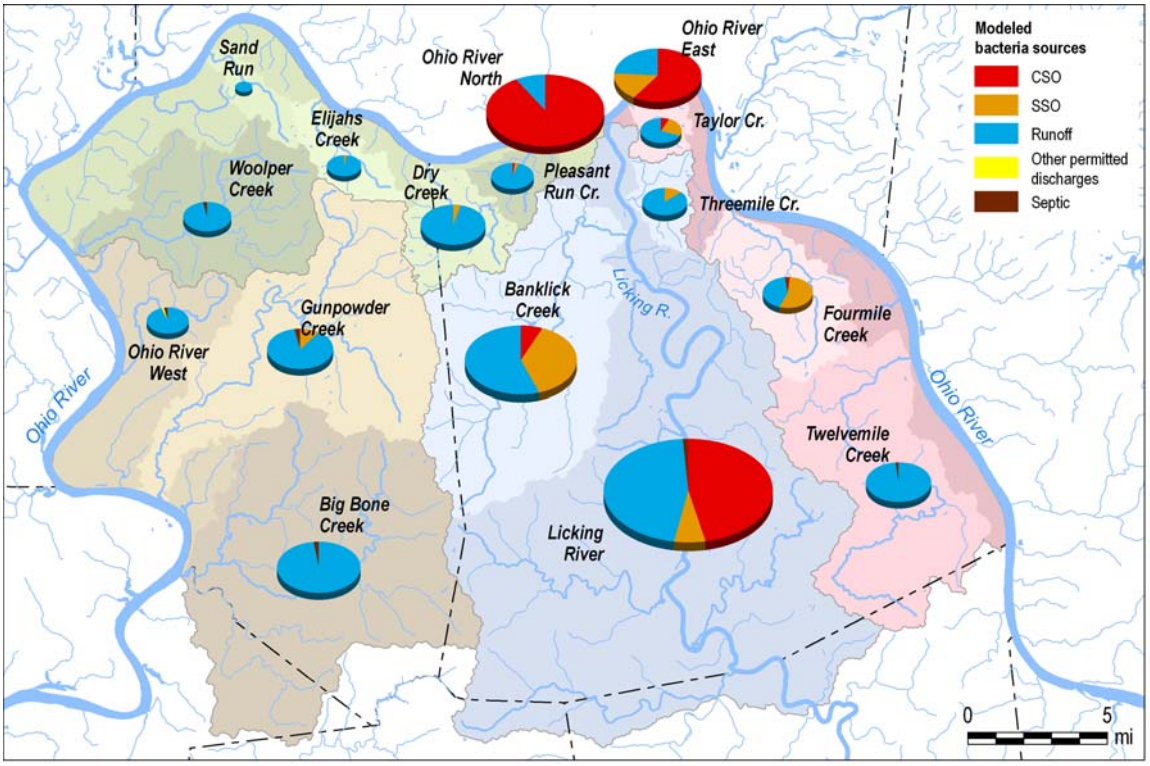


Figure 7. WAT! Loading Potential Results for Fecal Coliform

The Licking River pie chart does not include results from sources outside the study area or from Banklick Creek and Threemile Creek, which are presented separately.

Assessment of Potential Water Quality Impact

WAT! can also be applied to assess the potential that each watershed has to impact water quality. This potential impact can be calculated in WAT!, by normalizing the bacteria loading potential of each watershed by the watershed's drainage area (e.g., by dividing the loading potential shown in Figure 7, by the area of each watershed). The area-normalized results for each watershed can then be ranked for year-round or dry weather conditions to inform prioritization of pollutant source investigations and controls.

Figure 8 shows the area-normalized results for each watershed, where the size of each pie reflects what can be viewed as loading potential per acre. For example, both the larger rural Ohio River West watershed (with a 33.0 square mile drainage area) and much smaller, urban Pleasant Run Creek watershed (with a 6.5 square mile drainage area) have similar bacteria loading potentials, as shown in Figure 7. When normalized by watershed area, as shown in Figure 8, it can be seen that, on average, land in the Pleasant Run Creek watershed has a higher bacteria loading potential than land in the Ohio River West watershed.

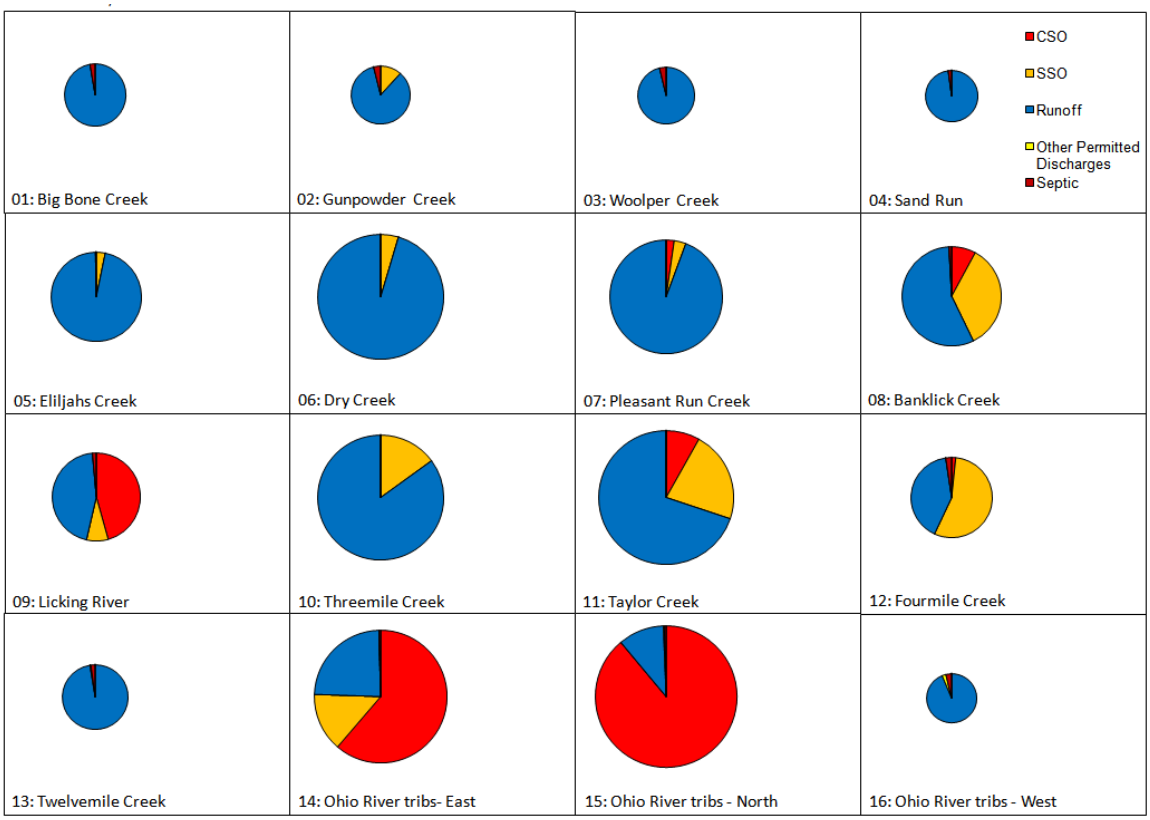


Figure 8. WAT! Area-Normalized Results Indicating Fecal Coliform Impact

Table 1 shows the rankings for the sixteen watersheds based on their respective area-normalized results, for both year-round and dry weather conditions. Dry weather conditions were assessed separately because bacteria can adversely affect recreational use of the streams and people may be more likely to use the streams when flow conditions are not affected by runoff. A ranking of 1 reflects a larger potential to impact instream water quality and a ranking of 16 reflects a lower potential to impact water quality. As discussed previously, even though the Ohio River West and Pleasant Run Creek watersheds have similar bacteria loading potentials, their watershed rankings based on potential impact (area-normalized results) are quite different.

Table 1. WAT! Watershed Rankings Based on Area-Normalized Results for Bacteria

Watershed	Rank, year-round fecal coliform results	Rank, dry weather fecal coliform results
Banklick Creek	7	9
Big Bone Creek	12	8
Dry Creek	5	12
Elijahs Creek	8	13
Fourmile Creek	10	1
Gunpowder Creek	13	3
Licking River	9	7
Ohio River East	3	10
Ohio River North	1	4
Ohio River West	16	2
Pleasant Run Creek	6	14
Sand Run	15	11
Taylor Creek	2	16
Threemile Creek	4	15
Twelvemile Creek	11	6
Woolper Creek	14	5

The WAT! rankings support the prioritization of watersheds and sources for improvement, and aid in the identification of data gaps. The Taylor Creek watershed provides an example of this. Taylor Creek has the lowest WAT! ranking within the study area during dry weather conditions (16^{th} of 16). However, the recent bacteria monitoring results show that Taylor Creek has the highest bacteria levels of all watersheds during dry weather conditions. Because WAT! considers all known bacteria sources in calculating rankings, it is likely that additional dry weather sources (e.g., illicit connections or failing infrastructure) exist in this watershed. Therefore, additional field investigation and updates of the WAT! are recommended to identify the sources and their relative contribution to bacteria during dry weather conditions.

The watershed characterization work completed to date supports a detailed assessment of potential water quality impact, and a solid, baseline understanding of the study area watersheds, including important features and stream condition using the best available information. A summary of unique watershed characteristics is provided in Appendix A, and additional information can be found in the individual Watershed Characterization Reports.

Appendix A. Fact Sheets

This appendix contains individual fact sheets that are specific to the study area watersheds (Figure A-1). The fact sheets provide an overview of the study area watersheds, condensed from the more detailed Watershed Characterization Reports[4,5]. Each fact sheet consists of a table of key watershed features and a map showing identified sources within the watershed. The fact sheets primarily describe current watershed conditions and sources, but also include predicted future land cover and percent imperviousness for roughly 2030 conditions. A key to understanding the information described in the fact sheet tables is presented in Table A-1.

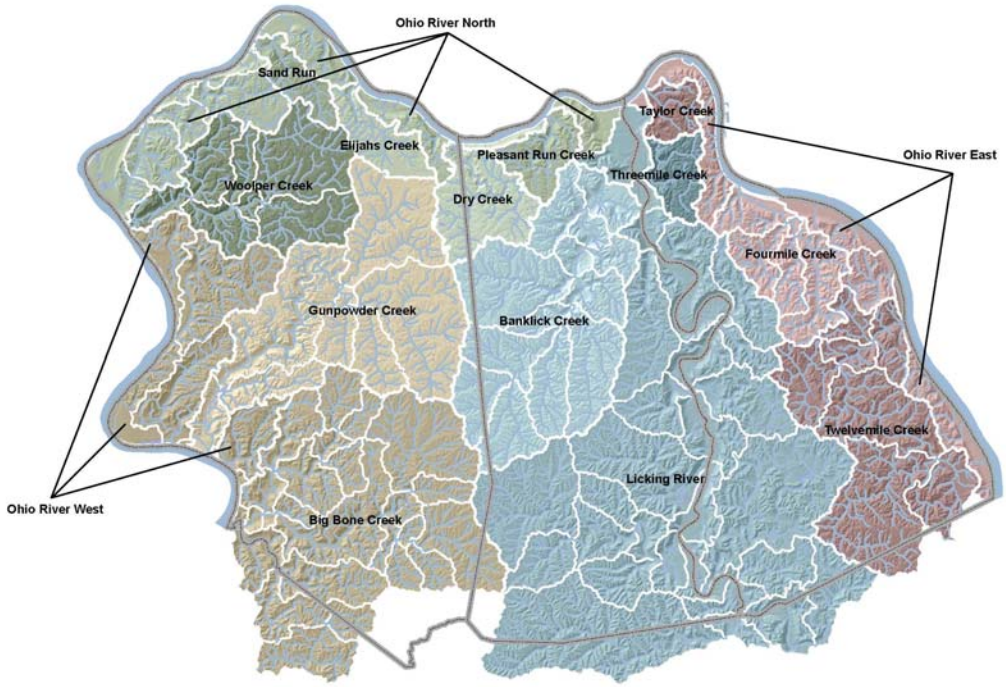


Figure A-1. Watershed Map

Available fact sheets include:

Ohio River - Mainstem	Elijahs Creek	Sand Run
Ohio River - Small Tributaries	Fourmile Creek	Taylor Creek
Banklick Creek	Gunpowder Creek	Threemile Creek
Big Bone Creek	Licking River	Twelvemile Creek
Dry Creek	Pleasant Run Creek	Woolper Creek

[4] A single fact sheet describes the small tributaries to the Ohio River, which are located within the Ohio East, Ohio North and Ohio West watersheds. A fact sheet has also been developed for the Ohio River; however, the format is modified slightly because Ohio River itself is not characterized in a separate report by SD1. Readers are encouraged to review ORSANCO's report on the Ohio River (ORSANCO, 2008).

[5] Since publication of the Watershed Characterization Reports, WAT! has been updated to reflect refinements in the Banklick Creek and Taylor Creek models.

Table A-1. Key to the Fact Sheets

Overview	Text describing unique watershed characteristics that are not covered below.
Drainage Area	The size of the watershed in square miles
Special Stream Designations	Waterbodies identified by the State as being exceptional waters, reference reach streams or Outstanding State Resource Waters.
Aquatic-dependent State or Federally Threatened or Endangered Species	Federally threatened and/or endangered species that inhabit aquatic environments or riparian areas.
Dominant Land Cover	Pie charts showing the percent of the watershed that has been developed, forested (forest and shrub) and agricultural (pasture, hay and cropland) land cover under current (2007) and predicted future (2030) conditions. To simplify presentation, barren lands and water which are generally negligible, are excluded from the pie charts. More detailed information is found in SD1's Watershed Characterization Reports.
Percent Impervious Area	Percent of the watershed that is covered by impervious surfaces (e.g., roads, driveways, roofs) under current and predicted future conditions.
Sewer Overflows	The number of combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) in the watershed[6]. CSOs include those that are permitted and those that SD1 has (or will) identify for Kentucky Pollutant Discharge Elimination System (KPDES) permitting.
Other KPDES Discharges	The number of other KPDES-permitted outfalls (unique from CSOs). Some facilities have more than one permitted outfall.
State Impaired Waters	Every two years the State produces a report that documents whether Kentucky lakes and streams are able to support their designated uses (e.g., recreation, aquatic life support, drinking water). Waters unable to support these uses are identified on the Kentucky Division of Water 303(d) list of impaired waterbodies. This entry describes the impaired waterbodies, if any, in a watershed, based on the 2008 303(d) list.
TMDL Status	Describes whether a Total Maximum Daily Load (TMDL) is currently planned for the State impaired waters.
Recent Assessments	
Habitat	A general statement of habitat quality based on the most recent available data. Habitat is assessed based on whether it can support fully functioning or diverse aquatic communities. Results range from not supporting to fully supporting. A different habitat index was used for the larger Licking River, and results can range from very poor to excellent using this index.
Biological	A general statement of biological conditions based on the most recent macroinvertebrate, fish and/or diatom data. Biological data are assessed using standardized protocols that compile community attributes such as taxa richness and pollution tolerance/intolerance. Results range from very poor to excellent.
Water Quality	A general statement describing water quality measurements that violated applicable State water quality criteria, based on the most recent available data. If only a single violation was observed, the violation is not noted in this report. However, all recent violations are described in the Watershed Characterization Reports, and additional sampling will be conducted to further characterize water quality. Recent data are defined as those collected between 2006 and 2008. Bacteria densities are noted as being elevated if either fecal coliform is higher than 400 cfu/100 ml or if *E. coli* is higher than 240 cfu/100 ml. These instances are not identified as violations, because the minimum number of samples was not available within a 30-day period for direct comparison to the criteria.
WAT! Bacteria Loading Potential, By Source	Pie chart presenting the current annual modeled fecal coliform bacteria loading potential by source within the watershed. Source categories are: CSO, SSO, runoff, other KPDES-permitted discharges, and septic systems. These results are based on the WAT!

[6] SD1 is continuing to refine the characterization and assessment of the sanitary sewer system, and sources are subject to change.

The Ohio River

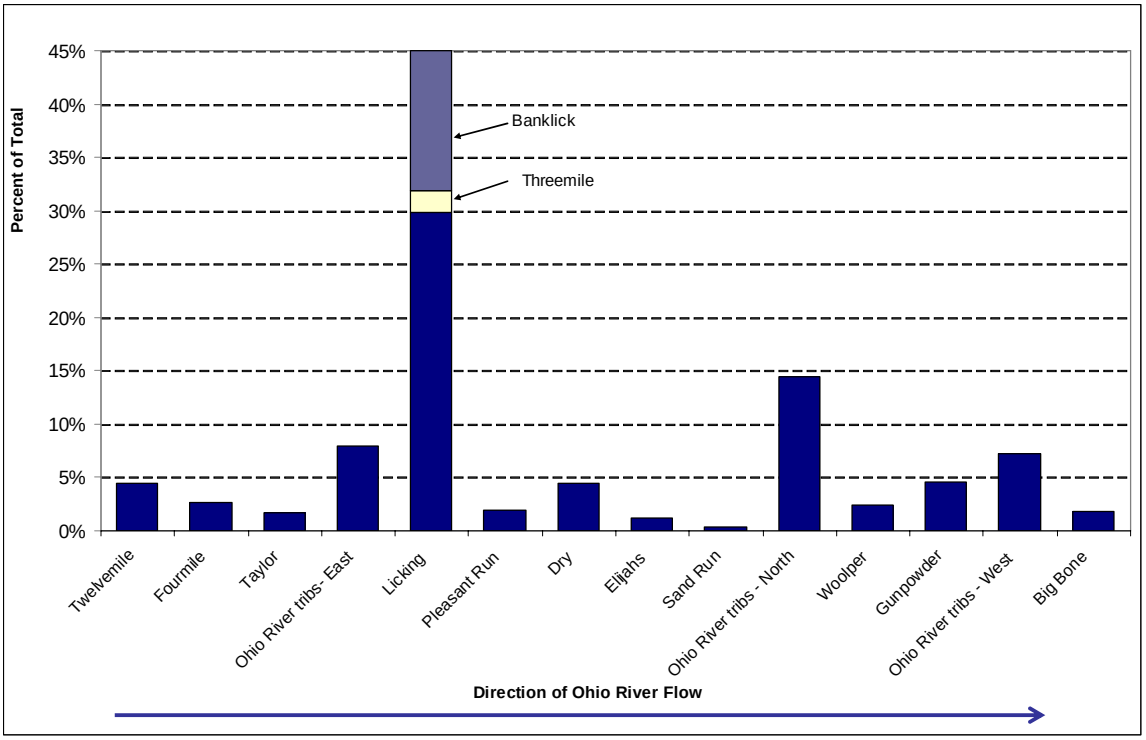
The Ohio River is almost 1,000 miles long and its watershed drains over 200,000 square miles and portions of fourteen states. The sixteen study area watersheds have an area of 592 square miles and comprise less than 0.3% of the Ohio River watershed.

SD1 Study Area Watersheds within the Ohio River Watershed

The portion of the Ohio River that bounds the study area is 72.8 miles long, and extends from the Pendleton/Campbell County line to the Boone/Gallatin County line. The Kentucky Division of Water (KDOW) has assessed this entire segment as impaired due to dioxin and polychlorinated biphenyls (PCBs). Thirty-seven miles of this segment are also identified as impaired due to elevated levels of fecal coliform bacteria, which is used as an indicator of pathogens. The Ohio River Valley Water Sanitation Commission (ORSANCO) is collecting data to support development of Total Maximum Daily Loads (TMDLs) for PCBs, dioxin and pathogens. Currently, a TMDL is being developed by a contractor to EPA Region 5 for *E. coli* bacteria (an indicator of pathogens) and is anticipated to be completed in 2010.

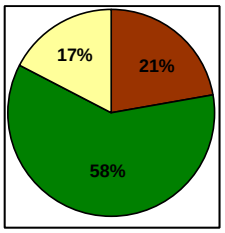
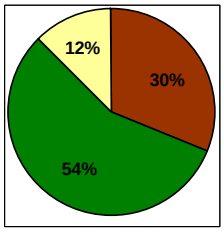
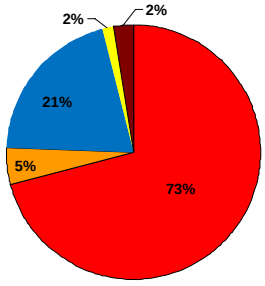
Source: SD1 and LTI

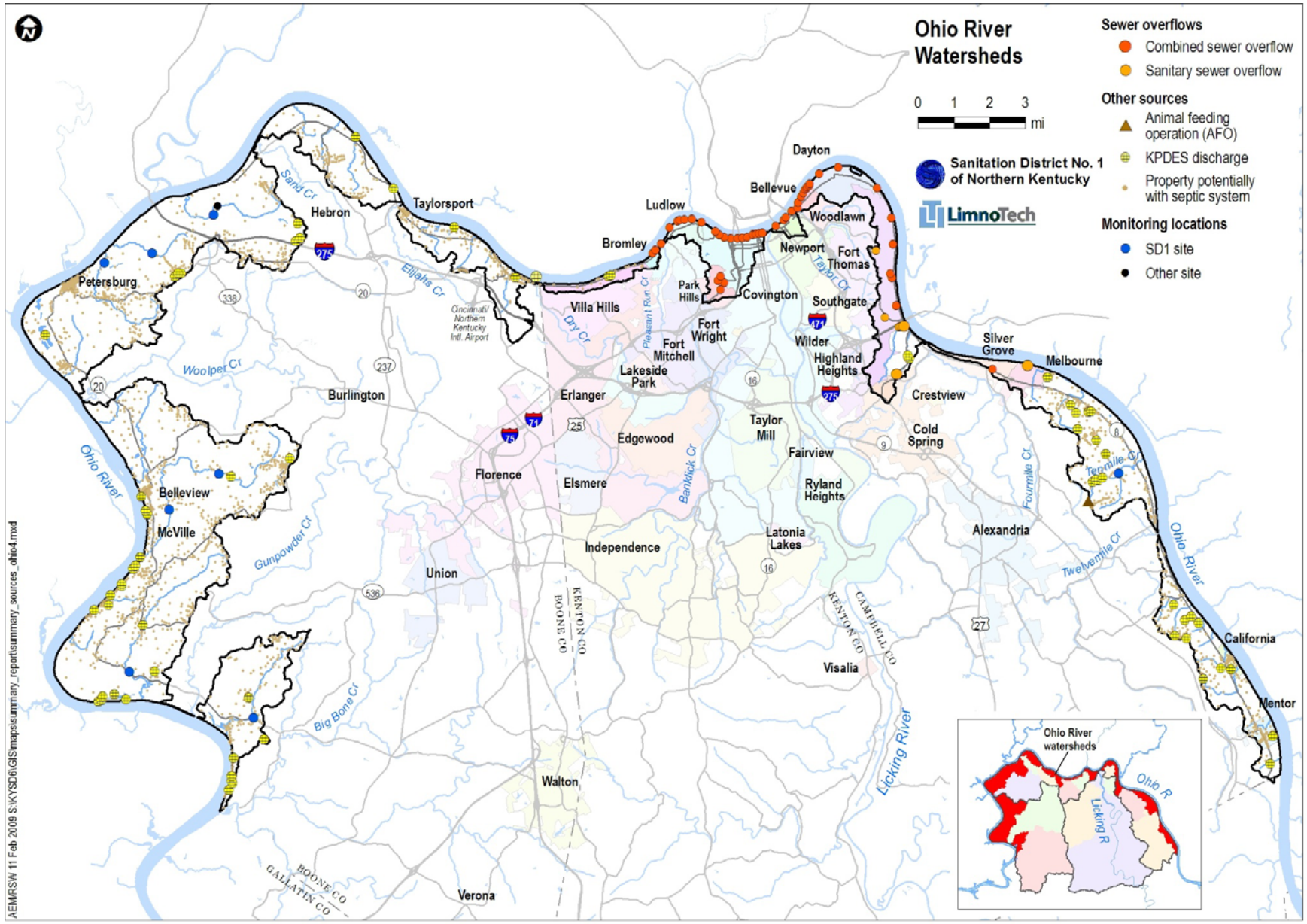
With the exception of two Licking River tributaries (Banklick Creek and Threemile Creek), the study area watersheds drain directly to the Ohio River. The relative potential of each watershed to generate fecal coliform bacteria has been predicted using WAT!. These results are plotted below, in the order (upstream to downstream) that these watersheds drain to the Ohio River. The portion of the Licking River watershed within SD1's study area is defined as the area draining to the Licking River between the mouth and River Mile 35.6.



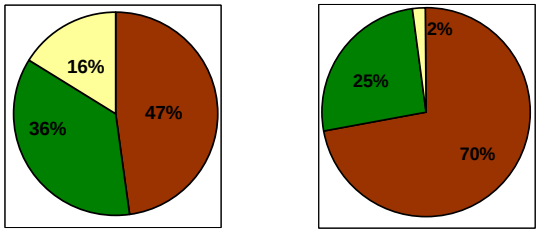
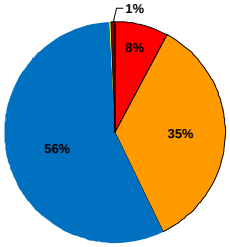
Relative WAT!-Predicted Bacteria Loading Potential for Study Area Watersheds

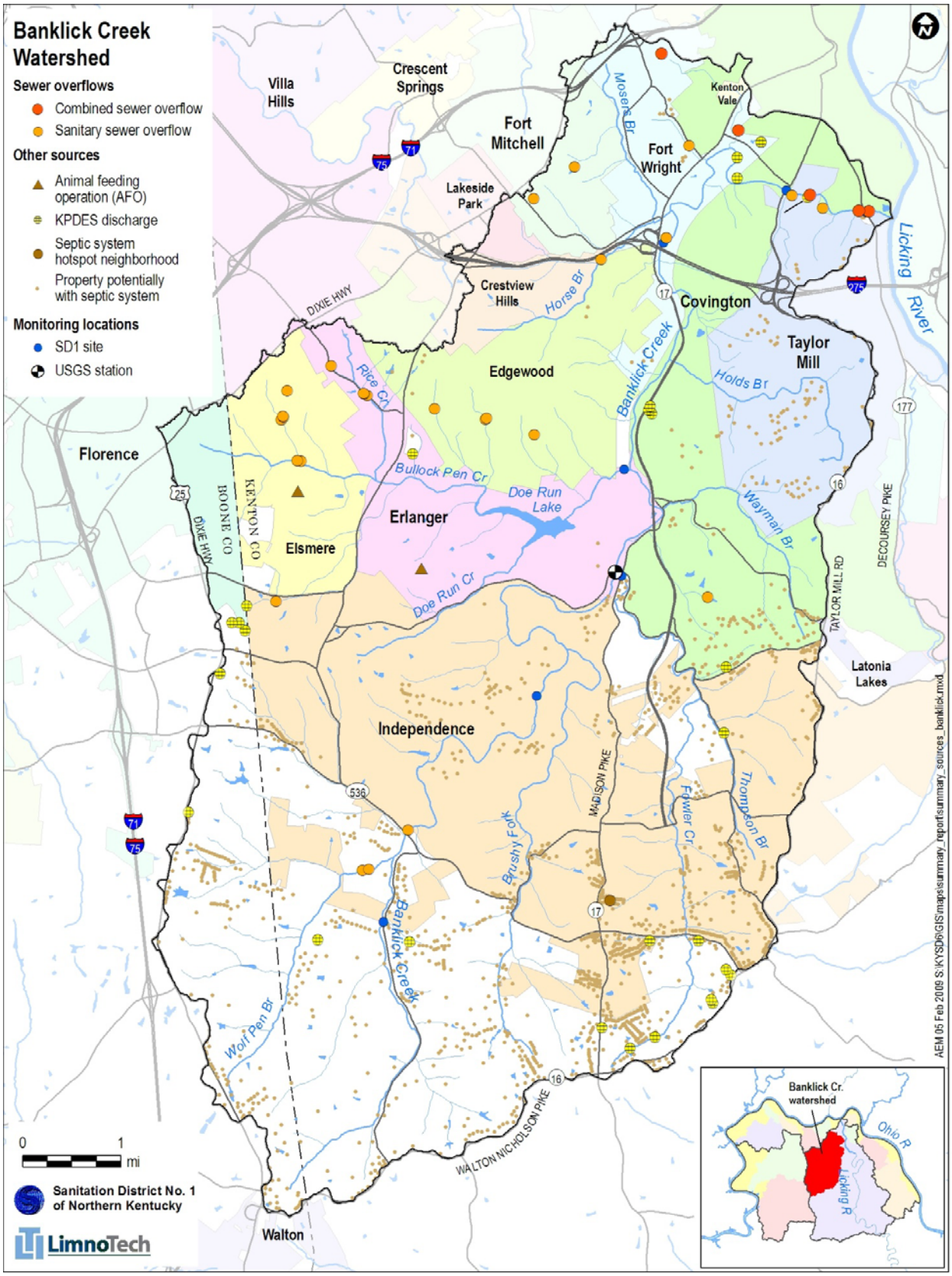
Small Ohio River Tributaries Fact Sheet

Overview	This area includes many small tributaries and direct drainage to the Ohio River. Development in this area is currently concentrated between Dayton and Bromley, but is expected to extend to the west and south in the future. SD1 will be constructing the Western Regional Water Reclamation Facility in the western portion of this watershed.
Drainage Area	85 square miles
Special Stream Designations	Garrison and Second Creek are exceptional waters and reference reach streams.
Aquatic-dependent State or Federally Threatened or Endangered Species	1 plant (running buffalo clover), 1 fish (lake sturgeon) and 2 mussels (pink mucket and sheepnose)
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current  5% Future  7%
Sewer Overflows	46 CSOs, 7 SSOs
Other KPDES Discharges	70 permitted outfalls
State Impaired Waters	1.1 miles of Tenmile Creek are identified as impaired due to nutrients and sedimentation.
TMDL Status	KDOW does not currently have plans to develop TMDLs for these watersheds.
Recent Assessments	
Habitat	Stream habitat was last assessed in three streams in 2003-2004 and reflects highly variable conditions ranging from not supporting to fully supporting of a diverse aquatic community at different sites.
Biological	Biological data were last assessed in four streams in 2003-2004 and reflects highly variable conditions ranging from poor to excellent.
Water Quality	Recent water quality data reveal elevated levels of bacteria during dry weather, as well as dissolved oxygen violations in several streams.
WAT! Bacteria Loading Potential, By Source CSO SSO Runoff Other KPDES dischargers Septic	Current Conditions, Watershed Contributions by Source 

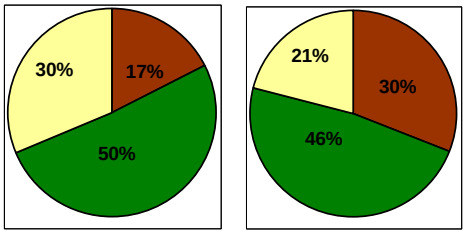
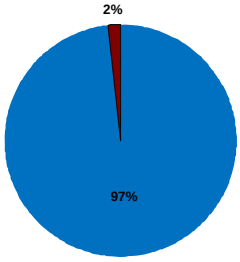

Ohio River Watersheds
0 1 2 3 mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Sewer overflows
Combined sewer overflow
Sanitary sewer overflow
Other sources
Animal feeding operation (AFO)
KPDES discharge
Property potentially with septic system
Monitoring locations
SD1 site
Other site
Dayton
Bellevue
Ludlow
Bromley
Woodlawn
Newport
Fort Thomas
Taylor Cr
Park Hills
Covington
Southgate
Villa Hills
Dry Cr
Pleasant Run Cr
Fort Wright
Fort Mitchell
Lakeside Park
Wilder
Highland Heights
Silver Grove
Melbourne
Crestview
Cold Spring
Taylor Mill
Fairview
Ryland Heights
Alexandria
Latonia Lakes
Edgewood
Erlanger
Elsmere
Florence
Independence
Union
Burlington
Hebron
Taylorsport
Sand Cr
Elijahs Cr
Cincinnati/ Northern Kentucky Intl. Airport
Woolper Cr
Petersburg
Belleview
McVille
Gunpowder Cr
Ohio River
Banklick Cr
Fourmile Cr
Tenmile Cr
Twelvemile Cr
Big Bone Cr
Licking River
Walton
Verona
Visalia
California
Mentor
BOONE CO
KENTON CO
CAMPBELL CO
GALLATIN CO
Ohio River watersheds
Ohio R
Licking R
AEM/RSW 11 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_ohio4.mxd

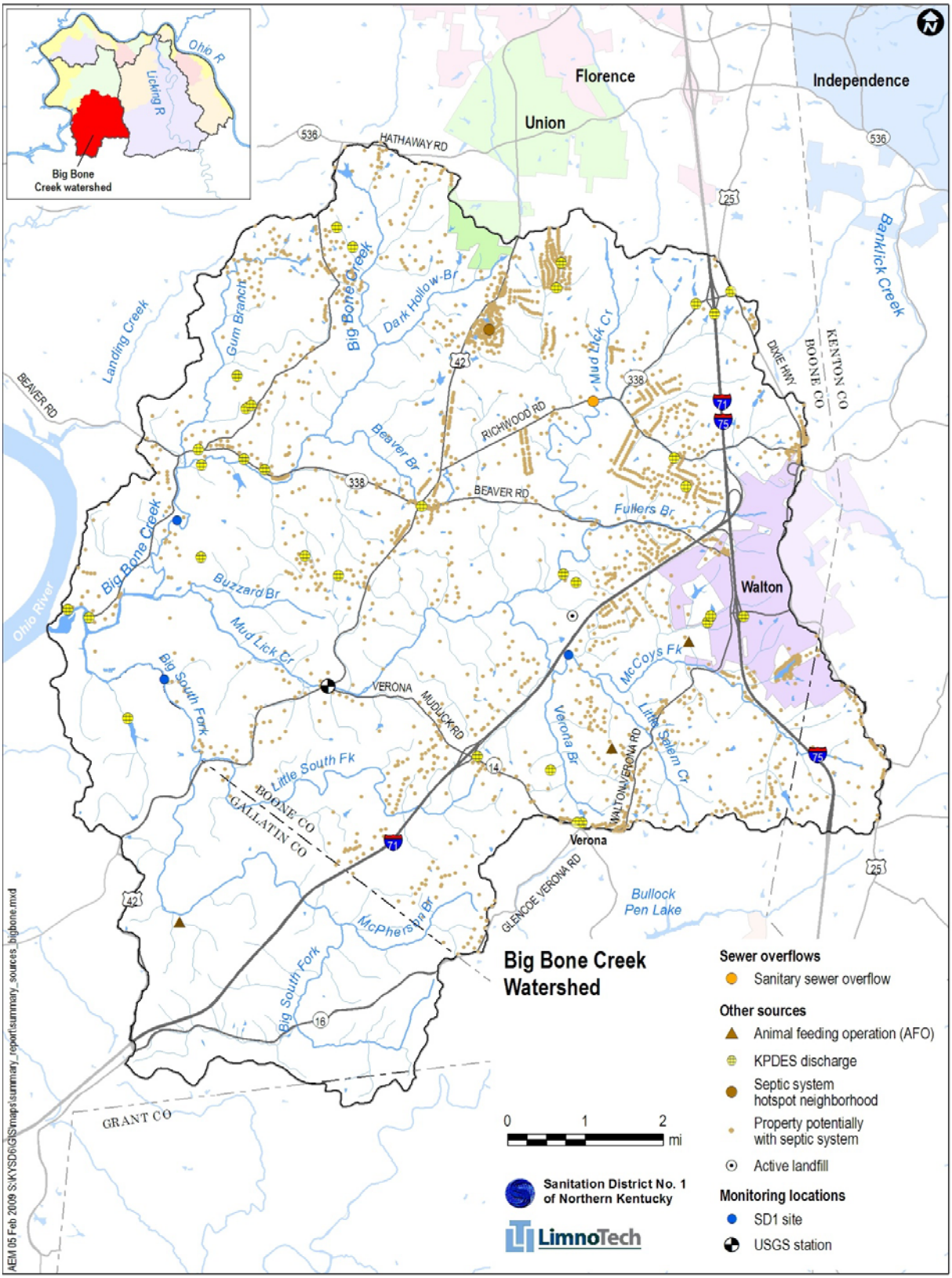
Banklick Creek Watershed Fact Sheet

Overview	The Banklick watershed, a tributary of the Licking River, is highly developed in the downstream portion and flooding is a recurring problem in this area. Farther upstream, the watershed is less developed. This portion of the watershed is rapidly developing and Banklick Creek is predicted to have the largest amount of new development of all the study area watersheds. The Banklick Creek Watershed Council is actively working to improve stream condition in this watershed.
Drainage Area	58.2 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	1 plant (running buffalo clover)
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current Future  11% 17%
Sewer Overflows	5 CSOs, 27 SSOs
Other KPDES Discharges	32 permitted outfalls
State Impaired Waters	The entire length of this creek is impaired due to fecal coliform bacteria, nutrients and organic enrichment. The lower 8.2 miles are also impaired due to sedimentation. Doe Run Lake is impaired due to low dissolved oxygen, nutrients and dissolved gas supersaturation.
TMDL Status	KDOW plans to complete TMDLs for the impaired waters in this watershed, although nutrient and organic enrichment TMDLs will not be initiated until nutrient targets are available.
Recent Assessments	
Habitat	Stream habitat was last assessed in 2001 with sites rated as either partially supporting or not supporting of a diverse aquatic community.
Biological	Biological data were last assessed in early 2000 (2001 – 2003) and reflects highly variable conditions, ranging from very poor to excellent.
Water Quality	Recent water quality data reveal elevated levels of bacteria in the tributaries and along the length of the mainstem, during both wet and dry conditions.
WAT! Bacteria Loading Potential, By Source CSO SSO Runoff Septic	Current Conditions, Watershed Contributions by Source 

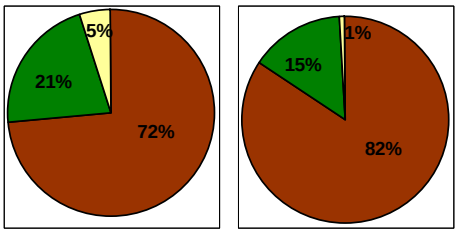
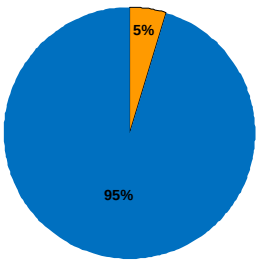

Banklick Creek Watershed
Sewer overflows
Combined sewer overflow
Sanitary sewer overflow
Other sources
Animal feeding operation (AFO)
KPDES discharge
Septic system hotspot neighborhood
Property potentially with septic system
Monitoring locations
SD1 site
USGS station
Villa Hills
Crescent Springs
Fort Mitchell
Kenton Vale
Fort Wright
Lakeside Park
Crestview Hills
Covington
Taylor Mill
Edgewood
Florence
Erlanger
Elsmere
Independence
Latonia Lakes
Walton
Mosers Br
Horse Br
Banklick Creek
Holds Br
Rice Cr
Bullock Pen Cr
Doe Run Lake
Doe Run Cr
Wayman Br
Brushy Fork
Fowler Cr
Thompson Br
Wolf Pen Br
Licking River
DIXIE HWY
BOONE CO
KENTON CO
TAYLOR MILL RD
DECOURSEY PIKE
MADISON PIKE
WALTON NICHOLSON PIKE
0 1 mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Banklick Cr. watershed
Ohio R
Licking R
AEM 05 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_banklick.mxd

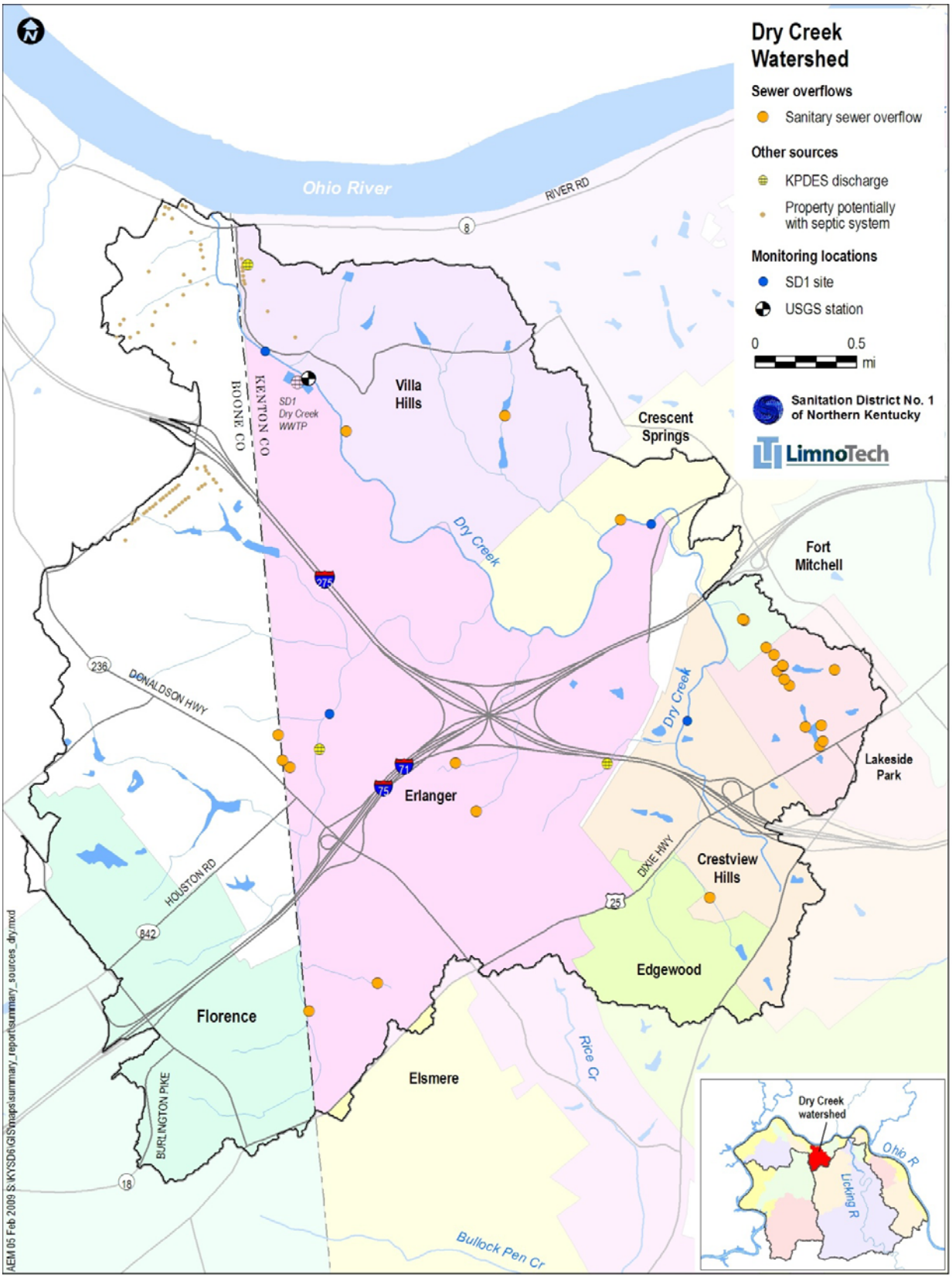
Big Bone Creek Watershed Fact Sheet

Overview	The Big Bone Creek watershed is the second largest in the study area and is predominantly rural in character. Existing development is concentrated primarily in the Mud Lick Creek subwatershed, where flooding has been reported. There is one drinking water intake in this watershed, within Big Bone Lick State Park.
Drainage Area	82.6 square miles
Special Stream Designations	Little South Fork is a candidate for exceptional water designation.
Aquatic-dependent State or Federally Threatened or Endangered Species	2 vascular plants (running buffalo clover and nodding rattlesnake-root)
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  3% 6%
Sewer Overflows	1 SSO
Other KPDES Discharges	35 permitted outfalls
State Impaired Waters	None
TMDL Status	Not applicable
Recent Assessments	
Habitat	Stream habitat was last assessed in 2004 in the mainstem and two tributaries, and was assessed as partially to fully supporting of a diverse aquatic community.
Biological	Biological data were last collected in 2003 - 2004 indicating good to excellent conditions at two mainstem sites.
Water Quality	Recent water quality data reveal elevated levels of bacteria in the mainstem and in a tributary.
WAT! Bacteria Loading Potential, By Source Runoff Septic	Current Conditions, Watershed Contributions by Source 

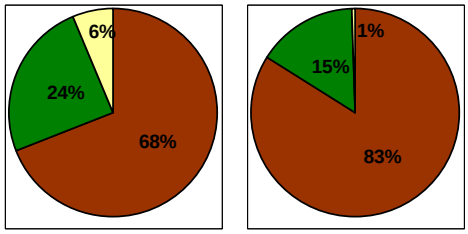
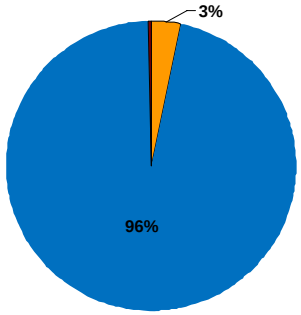

Big Bone Creek watershed
Ohio R
Licking R
Florence
Union
Independence
HATHAWAY RD
Big Bone Creek
Dark Hollow Br
Gum Branch
Landing Creek
Mud Lick Cr
Banklick Creek
KENTON CO
BOONE CO
DIXIE HWY
BEAVER RD
RICHWOOD RD
Beaver Br
Fullers Br
Walton
Ohio River
Buzzard Br
Mud Lick Cr
Big South Fork
VERONA
MUDDICK RD
McCoys Fk
Verona Br
Little Salem Cr
WALTON-VERONA RD
Little South Fk
BOONE CO
GALLATIN CO
Verona
GLENCOE VERONA RD
Bullock Pen Lake
McPherson Br
Big South Fork
GRANT CO
Big Bone Creek Watershed
0 1 2 mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Sewer overflows
Sanitary sewer overflow
Other sources
Animal feeding operation (AFO)
KPDES discharge
Septic system hotspot neighborhood
Property potentially with septic system
Active landfill
Monitoring locations
SD1 site
USGS station
AEM 05 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_bigbone.mxd

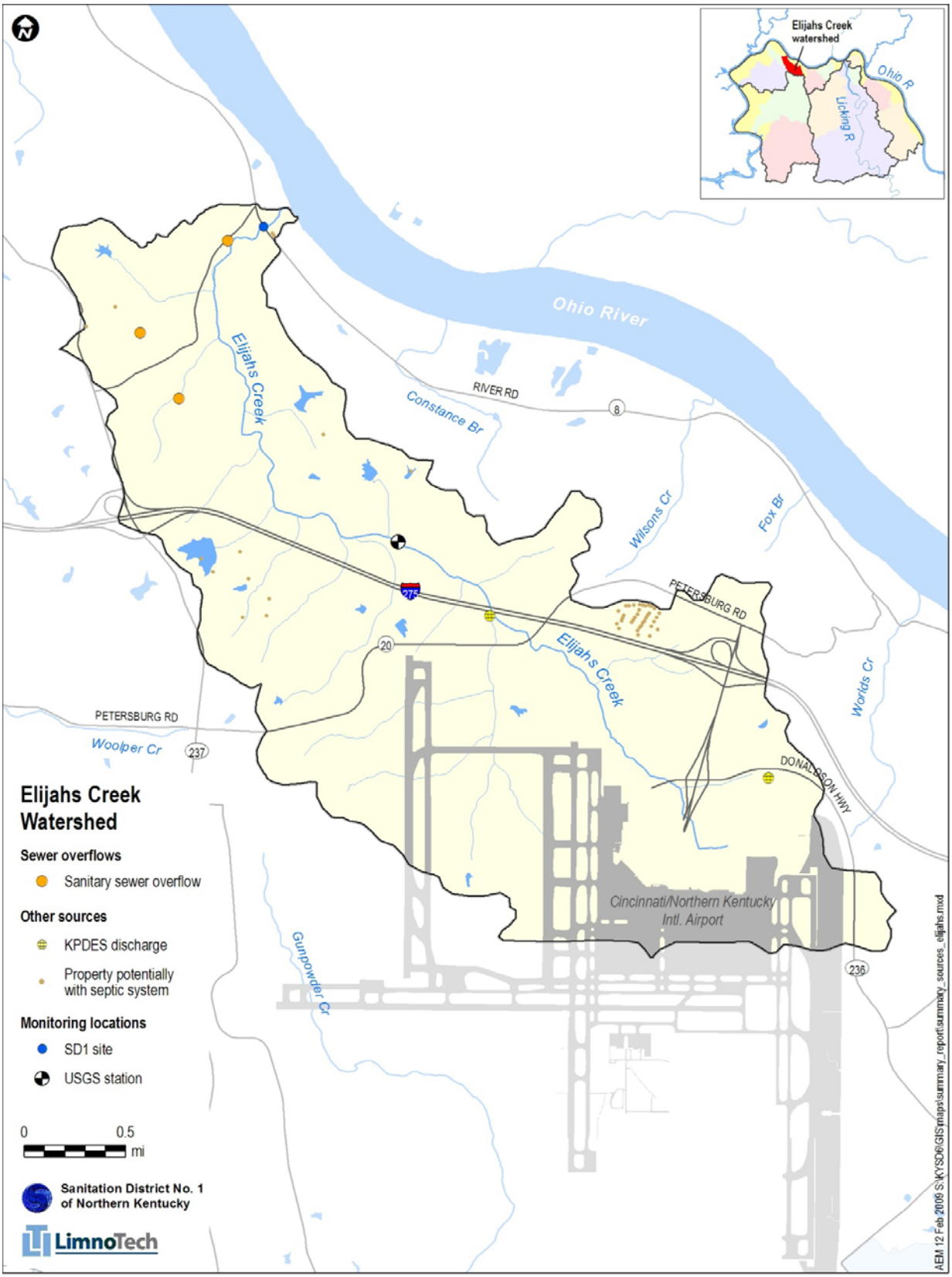
Dry Creek Watershed Fact Sheet

Overview	The small Dry Creek watershed is the second most highly developed watershed. A portion of this watershed lies within Florence, outside SD1's sanitary sewer and storm water service area. SD1's Dry Creek Wastewater Treatment Plant lies within the watershed. This facility receives and treats wastewater from many other watersheds, and discharges treated effluent directly to the Ohio River.
Drainage Area	12.4 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	None
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  24% 28%
Sewer Overflows	25 SSOs
Other KPDES Discharges	4 permitted outfalls
State Impaired Waters	6.8 miles of Dry Creek are identified as impaired due to nutrients and organic enrichment.
TMDL Status	TMDL development has not yet been initiated. TMDLs for nutrients and organic enrichment will not be initiated until after nutrient criteria are promulgated by the State.
Recent Assessments	
Habitat	Stream habitat was last assessed in 2004 as not supporting of a diverse aquatic community at a mainstem site.
Biological	Biological data were last collected in 2004 indicating fair conditions at one mainstem site.
Water Quality	Recent water quality data reveal elevated levels of bacteria during dry weather in one tributary and at two mainstem sites.
WAT! Bacteria Loading Potential, By Source SSO Runoff	Current Conditions, Watershed Contributions by Source 

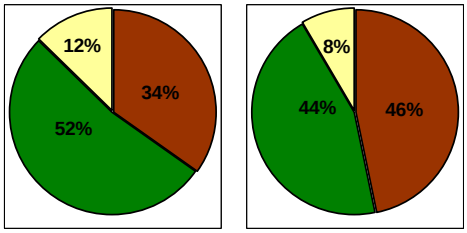
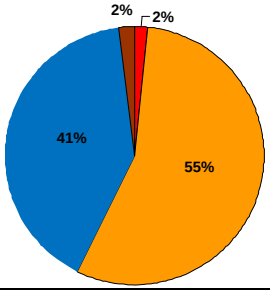

Dry Creek Watershed
Sewer overflows
Sanitary sewer overflow
Other sources
KPDES discharge
Property potentially with septic system
Monitoring locations
SD1 site
USGS station
0 0.5 mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Ohio River
RIVER RD
BOONE CO
KENTON CO
SD1 Dry Creek WWTP
Villa Hills
Crescent Springs
Fort Mitchell
Dry Creek
DONALDSON HWY
HOUSTON RD
BURLINGTON PIKE
DIXIE HWY
Erlanger
Lakeside Park
Crestview Hills
Edgewood
Florence
Elsmere
Rice Cr
Bullock Pen Cr
Dry Creek watershed
Ohio R
Licking R
AEM 05 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_dry.mxd

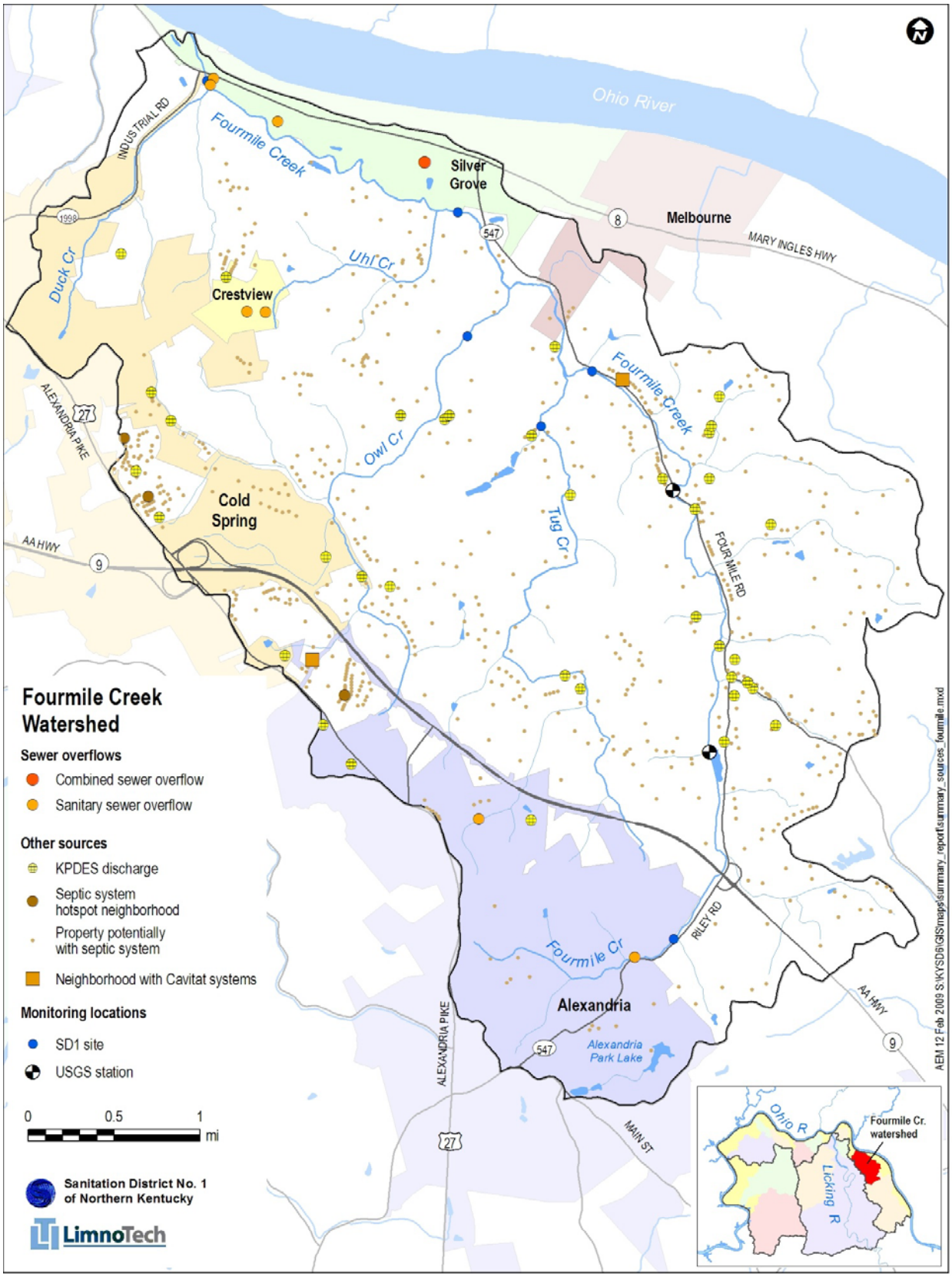
Elijahs Creek Watershed Fact Sheet

Overview	The small Elijahs Creek watershed is highly developed. The Cincinnati/Northern Kentucky International Airport is located at the headwaters of this creek and contributes to this watershed having the highest percent impervious cover within the study area.
Drainage Area	6.7 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	None
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  25% 31%
Sewer Overflows	3 SSOs
Other KPDES Discharges	2 permitted outfalls
State Impaired Waters	Elijahs Creek between RM 0.0 – 5.2 is identified as impaired due to ethylene glycol.
TMDL Status	A TMDL for ethylene glycol in Elijahs Creek was developed by KDOW in 1998 to address impacts from airport deicing fluid on the creek. Deicing fluid from the airport is now collected and reclaimed at a glycol recovery facility. The airport also has a storm water treatment plant, located in the adjacent Gunpowder Creek watershed.
Recent Assessments	
Habitat	Stream habitat was last assessed in 2004 as not supporting of a diverse aquatic community at two mainstem sites.
Biological	Biological data were last collected in 2004 indicating poor to very poor conditions at two mainstem sites.
Water Quality	Recent water quality data from two mainstem sites reveal generally good water quality during base flow conditions.
WAT! Bacteria Loading Potential, By Source SSO Runoff Septic	Current Conditions, Watershed Contributions by Source 

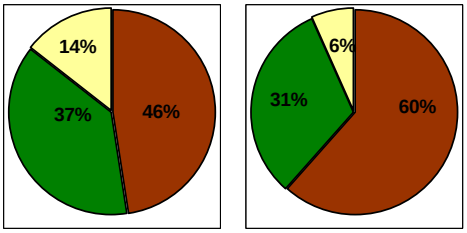
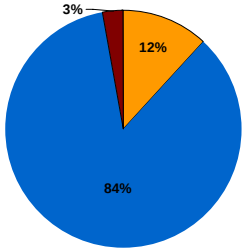

Elijahs Creek watershed
Ohio R
Licking R
Ohio River
Elijahs Creek
RIVER RD
8
Constance Br
Wilsons Cr
Fox Br
PETERSBURG RD
275
20
Elijahs Creek
Worlds Cr
PETERSBURG RD
Woolper Cr
237
DONALDSON HWY
Cincinnati/Northern Kentucky Intl. Airport
Gunpowder Cr
236
Elijahs Creek Watershed
Sewer overflows
Sanitary sewer overflow
Other sources
KPDES discharge
Property potentially with septic system
Monitoring locations
SD1 site
USGS station
0
0.5
mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
AEM 12 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_elijahs.mxd

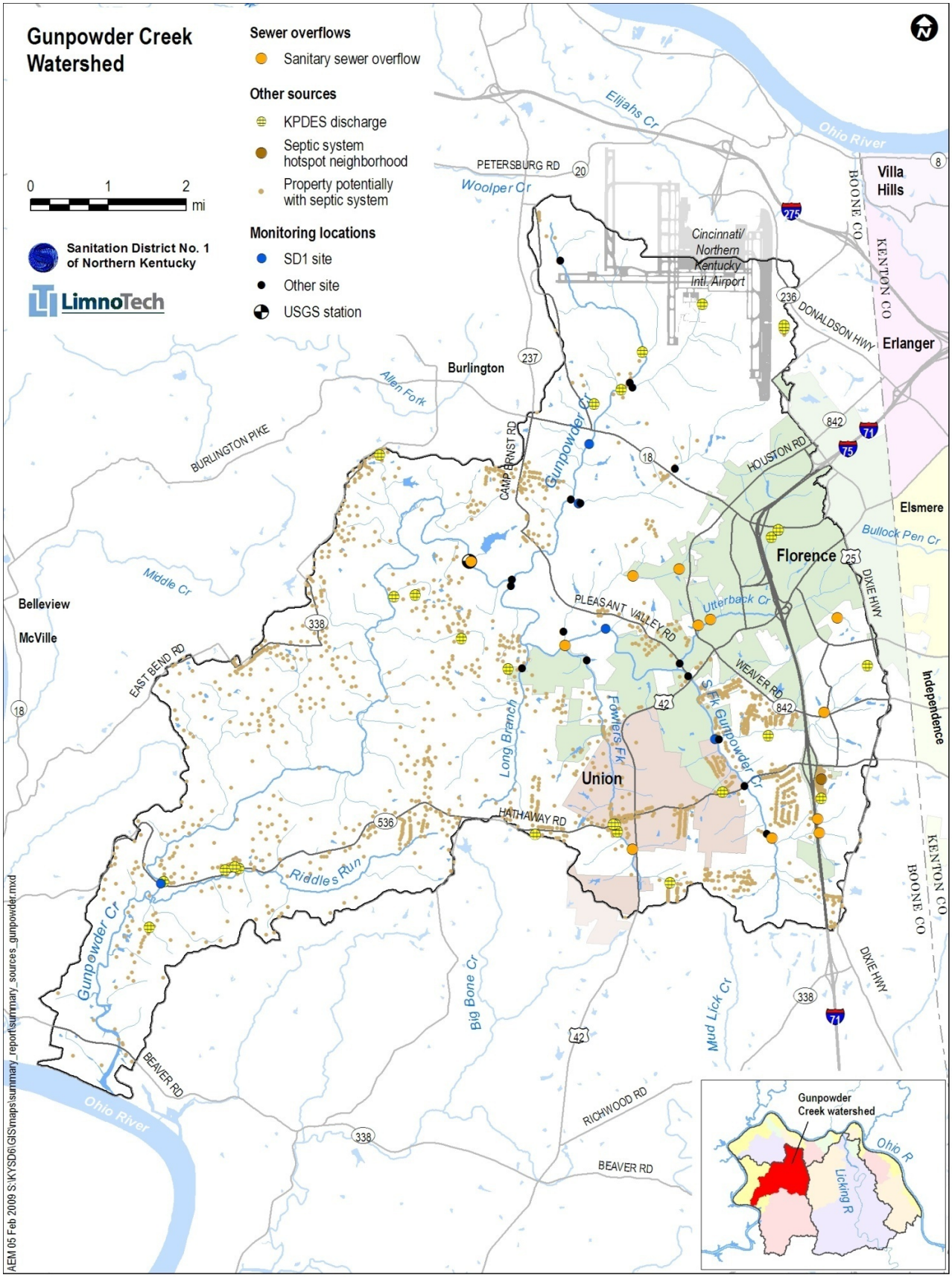
Fourmile Creek Watershed Fact Sheet

Overview	Fourmile Creek originates in Alexandria, Kentucky and drains a watershed with mixed land cover. Development is currently concentrated near the headwaters of Fourmile Creek and its tributaries. Locations with severe streambank erosion have been observed.
Drainage Area	17.8 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	None
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  6% 9%
Sewer Overflows	1 CSO, 7 SSOs
Other KPDES Discharges	37 permitted outfalls
State Impaired Waters	Fourmile Creek between RM 0.2 – 8.5 is identified as impaired due to fecal coliform bacteria. Alexandria Park Lake is identified as impaired due to mercury in fish tissue.
TMDL Status	TMDL development has not yet been initiated. Neither listed waterbody is identified as having a TMDL planned for the near future.
Recent Assessments	
Habitat	Stream habitat was last assessed in 2007 as not supporting of a diverse aquatic community at three mainstem locations and in two tributaries.
Biological	Biological data were last collected in 2007 indicating fair to good conditions in the mainstem and two tributaries.
Water Quality	Recent water quality data indicate frequent instances of elevated levels of bacteria along the mainstem and in two tributaries during wet weather and along the mainstem during dry weather. Violations of the dissolved oxygen criteria have been observed at two mainstem locations.
WAT! Bacteria Loading Potential, By Source CSO SSO Runoff Septic	Current Conditions, Watershed Contributions by Source 

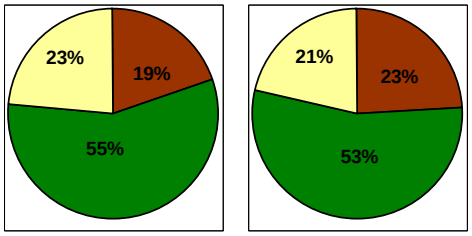
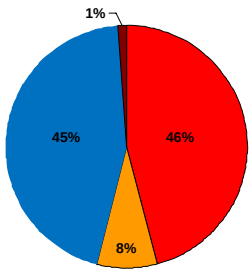

Ohio River
Fourmile Creek
Silver Grove
Melbourne
MARY INGLES HWY
INDUSTRIAL RD
Duck Cr
Uhl Cr
Crestview
Owl Cr
Tug Cr
Cold Spring
ALEXANDRIA PIKE
AA HWY
FOUR MILE RD
RILEY RD
Fourmile Cr
Alexandria
Alexandria Park Lake
MAIN ST
Fourmile Creek Watershed
Sewer overflows
Combined sewer overflow
Sanitary sewer overflow
Other sources
KPDES discharge
Septic system hotspot neighborhood
Property potentially with septic system
Neighborhood with Cavitat systems
Monitoring locations
SD1 site
USGS station
0 0.5 1 mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Ohio R
Licking R
Fourmile Cr. watershed
AEM 12 Feb 2009 S:\KYSD\GIS\maps\summary_report\summary_sources_fourmile.mxd

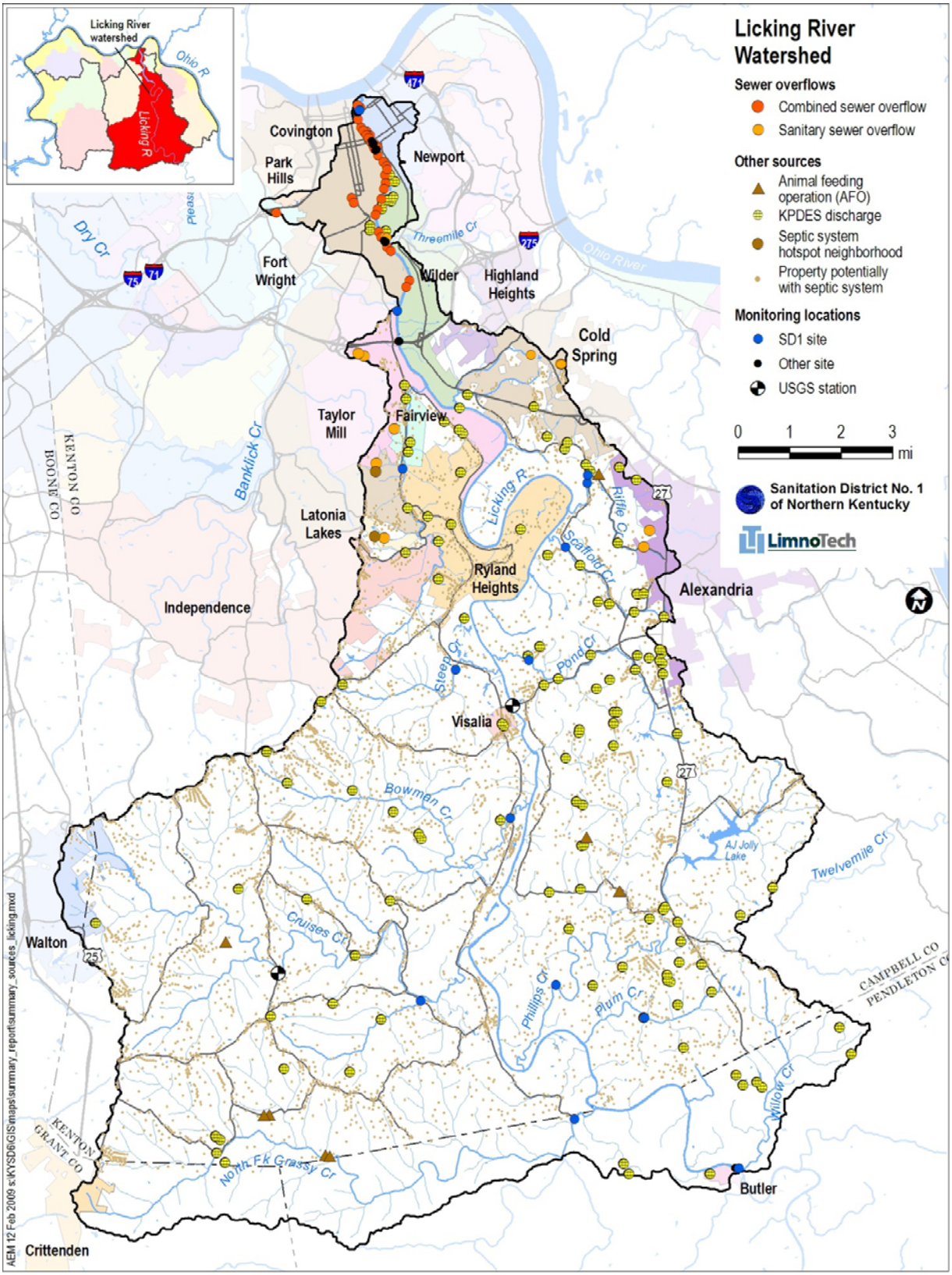
Gunpowder Creek Watershed Fact Sheet

Overview	Gunpowder Creek originates west of the Cincinnati/Northern Kentucky International Airport and the headwaters of this large watershed drain a highly developed area that includes the airport and portions of Florence, which is outside SD1's service area. Flooding has been reported near the headwaters and near the mouth. Erosion is also severe in some locations.
Drainage Area	58.2 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	None
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current Future  12% 16%
Sewer Overflows	13 SSOs (5 of these are in Florence)
Other KPDES Discharges	26 permitted outfalls
State Impaired Waters	South Fork Gunpowder Creek: Two segments are identified as impaired. One (2.7 miles) is listed due to fecal coliform and the other (2 miles) is listed for sedimentation, turbidity, nutrients and organic enrichment. Gunpowder Creek: Three segments are identified as impaired. One (2.7 miles) is listed due to an unknown pollutant, another (1.7 miles) is listed due to sedimentation, nutrients, organic enrichment and ethylene glycol, and a third (15 miles) is listed due to sedimentation.
TMDL Status	A TMDL for ethylene glycol in Gunpowder Creek was developed by KDOW in 1998 to address impacts from airport deicing fluid on the creek. Runoff from the airport is now treated by a storm water treatment plant that is located in this watershed. Deicing fluid is also collected and reclaimed at a glycol recovery facility (Elijahs Creek watershed). KDOW planned to initiate TMDLs for the 303(d)-listed segments in 2008. Sediment TMDLs will be developed once additional sediment data are collected, if needed. TMDLs for nutrients and organic enrichment will not be initiated until nutrient criteria are promulgated by the State.
Recent Assessments	
Habitat	Stream habitat was last assessed in 2004 as ranging from partially supporting to fully supporting of a diverse aquatic community in the mainstem and two tributaries.
Biological	Biological data were last collected in 2004 indicating highly variable conditions ranging from very poor to excellent in two tributaries and fair in the mainstem.
Water Quality	Recent water quality data indicate elevated levels of bacteria during wet and dry weather in two tributaries. No recent wet weather data were available for the mainstem.
WAT! Bacteria Loading Potential, By Source SSO Runoff Septic	Current Conditions, Watershed Contributions by Source 

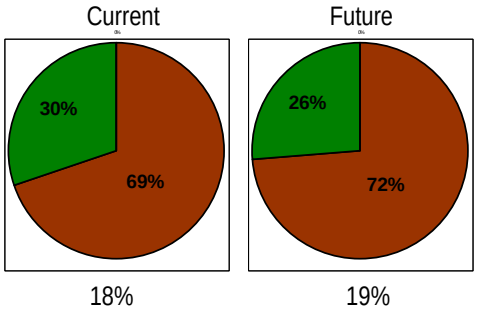
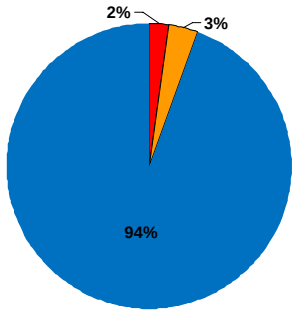

Gunpowder Creek Watershed
Sewer overflows
Sanitary sewer overflow
Other sources
KPDES discharge
Septic system hotspot neighborhood
Property potentially with septic system
Monitoring locations
SD1 site
Other site
USGS station
0 1 2 mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Elijahs Cr
Ohio River
PETERSBURG RD
Woolper Cr
Villa Hills
BOONE CO
KENTON CO
Cincinnati/ Northern Kentucky Intl. Airport
DONALDSON HWY
Erlanger
Burlington
Allen Fork
BURLINGTON PIKE
CAMP ERNST RD
Gunpowder Cr
HOUSTON RD
Elsmere
Bullock Pen Cr
Florence
DIXIE HWY
Middle Cr
Belleview
McVille
EAST BEND RD
PLEASANT VALLEY RD
Utterback Cr
WEAVER RD
S Fk Gunpowder Cr
Independence
Long Branch
Fowlers Fk
Union
HATHAWAY RD
Riddles Run
Big Bone Cr
Mud Lick Cr
RICHWOOD RD
BEAVER RD
Ohio River
Gunpowder Creek watershed
Ohio R
Licking R
AEM 05 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_gunpowder.mxd

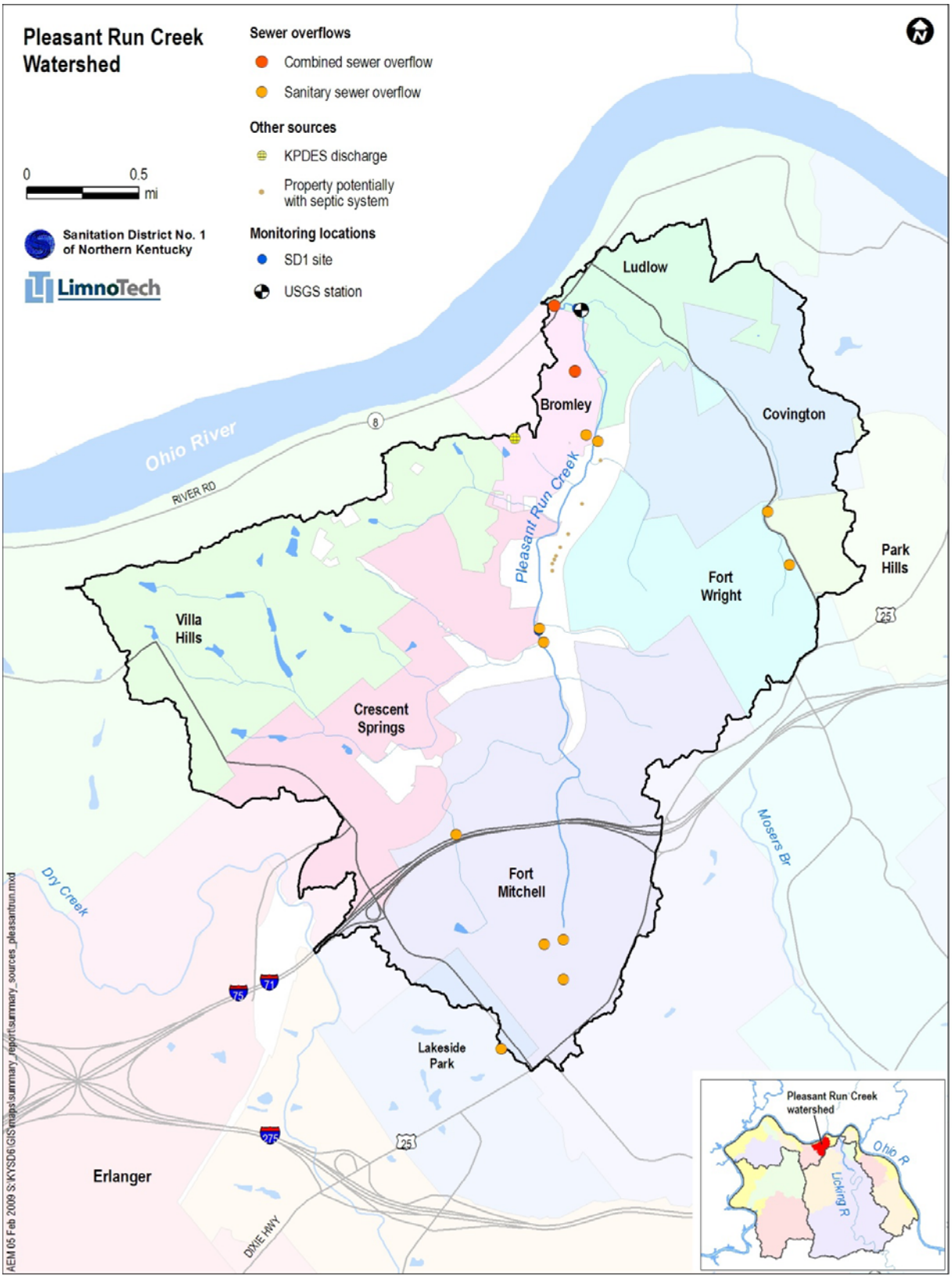
Licking River Watershed Fact Sheet

Overview	The entire Licking River watershed is approximately 3,600 squares miles and extends 300 river miles to Magoffin County, KY. For this study, the Licking River watershed is defined as the area between the mouth and river mile 35.6, excluding two tributaries, Banklick Creek and Threemile Creek, which are described in separate fact sheets. This watershed is highly developed between Wilder and its confluence with the Ohio River. Farther upstream, land use transitions to more rural uses, and forest and agriculture dominate. There are two public drinking water intakes from the Licking River that are located in this watershed.
Drainage Area	170 square miles
Special Stream Designations	Licking River RM 18.9 – 35.6 is an Outstanding State Resource Water. Bowman Creek and Sawyers Fork are candidates for exceptional water designation.
Aquatic-dependent State or Federally Threatened or Endangered Species	5 mussels (elktoe, fanshell, pink mucket, salamander and purple lilliput)
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  3% 4%
Sewer Overflows	34 CSOs, 11 SSOs
Other KPDES Discharges	136 permitted outfalls
State Impaired Waters	Licking River: Three segments (19.5 miles total) identified as impaired due to fecal coliform. Phillips Creek: One segment (5.3 miles) identified as impaired due to fecal coliform.
TMDL Status	No TMDLs are planned at this time.
Recent Assessments	
Habitat	Stream habitat in the Licking River mainstem was last assessed in 1996 as fair to good conditions. Habitat was assessed in two tributaries from 2003 to 2005 as partially supporting to fully supporting of a diverse aquatic community.
Biological	Biological data collected in two tributaries from 2003 to 2005 indicated fair to excellent conditions.
Water Quality	Recent water quality data from nine mainstem locations and twelve tributaries indicates elevated levels of bacteria at 13 of the 21 samples locations. During dry weather, elevated bacteria levels were observed in the mainstem at several upstream and downstream locations and in eight of the 12 sampled tributaries. During wet weather, elevated bacteria levels were observed at two downstream mainstem locations. (Recent wet weather data were not available for the tributaries or upstream mainstem locations.)
WAT! Bacteria Loading Potential, By Source CSO SSO Runoff Septic	Current Conditions, Watershed Contributions by Source 

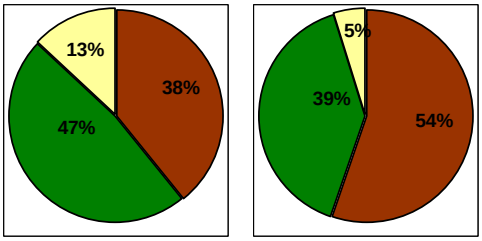
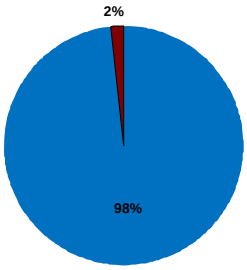

Licking River watershed
Ohio R
Licking R
Licking River Watershed
Sewer overflows
Combined sewer overflow
Sanitary sewer overflow
Other sources
Animal feeding operation (AFO)
KPDES discharge
Septic system hotspot neighborhood
Property potentially with septic system
Monitoring locations
SD1 site
Other site
USGS station
0 1 2 3 mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Covington
Park Hills
Newport
Fort Wright
Wilder
Highland Heights
Cold Spring
Taylor Mill
Fairview
Latonia Lakes
Ryland Heights
Alexandria
Independence
Visalia
Walton
Crittenden
Butler
Dry Cr
Banklick Cr
Threemile Cr
Ohio River
Licking R
Steep Cr
Pond Cr
Scaffold Cr
Riffle Cr
Bowmen Cr
Cruises Cr
Phillips Cr
Plum Cr
Twelvemile Cr
AJ Jolly Lake
Willow Cr
North Fk Grassy Cr
KENTON CO
BOONE CO
GRANT CO
CAMPBELL CO
PENDLETON CO
AEM 12 Feb 2009 s:\KYSD\GIS\maps\summary_report\summary_sources_licking.mxd

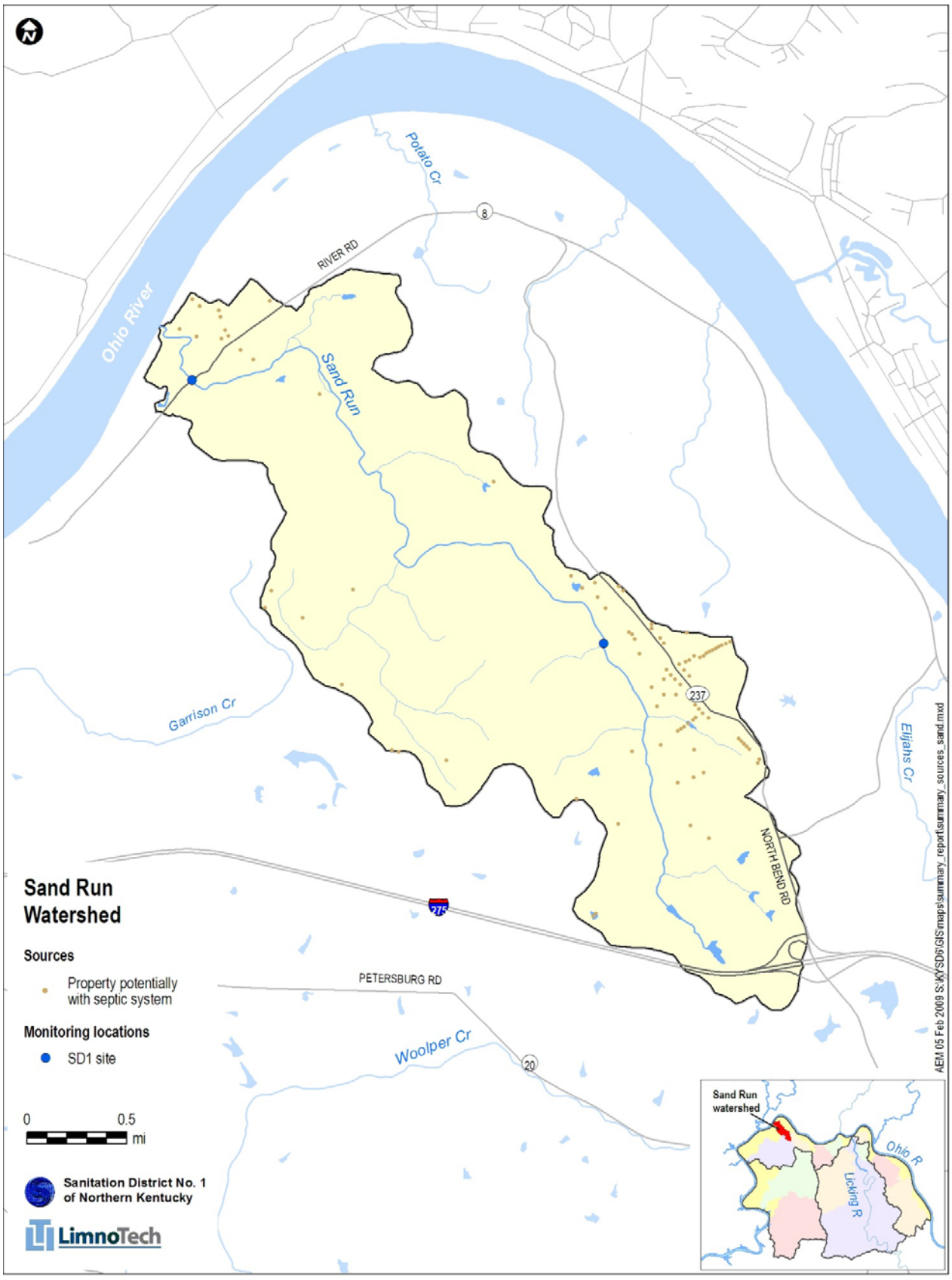
Pleasant Run Creek Watershed Fact Sheet

Overview	Pleasant Run Creek drains a small and very highly developed watershed. Much of the undeveloped land that remains is located within Devou Park, near the mouth of this creek.
Drainage Area	6.5 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	1 reptile (Kirtland's snake)
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	
Sewer Overflows	2 CSOs, 11 SSOs
Other KPDES Discharges	1 permitted outfall
State Impaired Waters	None
TMDL Status	Not applicable
Recent Assessments	
Habitat	Habitat was last assessed in 2004 as partially supporting of a diverse aquatic community at one mainstem site.
Biological	Biological data were last collected in 2004 indicating good conditions in one mainstem site.
Water Quality	Recent water quality data were collected at two mainstem locations during dry weather. At both locations, one in three samples reveals elevated levels of bacteria.
WAT! Bacteria Loading Potential, By Source CSO SSO Runoff	Current Conditions, Watershed Contributions by Source 

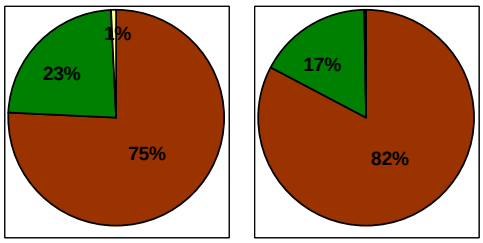
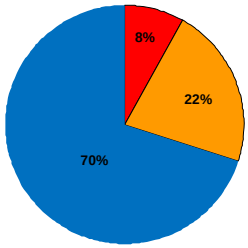

Pleasant Run Creek Watershed
Sewer overflows
Combined sewer overflow
Sanitary sewer overflow
Other sources
KPDES discharge
Property potentially with septic system
Monitoring locations
SD1 site
USGS station
0
0.5
mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Ludlow
Bromley
Covington
Park Hills
Fort Wright
Villa Hills
Crescent Springs
Fort Mitchell
Lakeside Park
Erlanger
Ohio River
RIVER RD
Pleasant Run Creek
Dry Creek
Mosers Br
DIXIE HWY
Pleasant Run Creek watershed
Ohio R
Licking R
AEM 05 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_pleasantrun.mxd

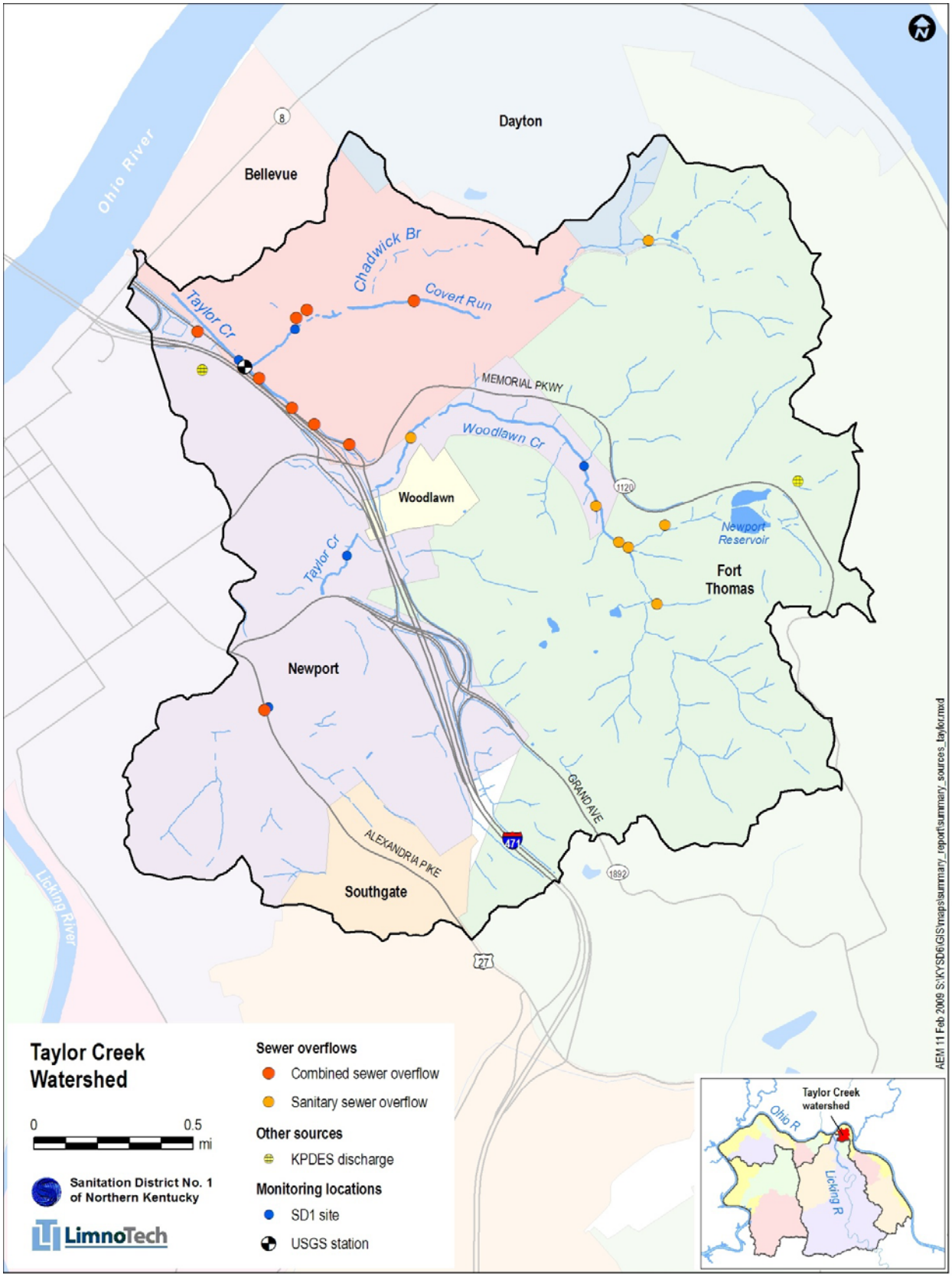
Sand Run Watershed Fact Sheet

Overview	Sand Run is a small watershed that recently has seen rapid development, especially near the headwaters. Flooding has become a problem more recently in this watershed, and although forested areas remain on the steep slopes adjacent to the creek, severe streambank erosion has been observed.
Drainage Area	5 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	None
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  12% 16%
Sewer Overflows	None
Other KPDES Discharges	None
State Impaired Waters	None
TMDL Status	Not applicable
Recent Assessments	
Habitat	Not available
Biological	Not available
Water Quality	Recent water quality data collected during dry weather at two mainstem locations reveal elevated levels of bacteria at both locations and dissolved oxygen violations at one location.
WAT! Bacteria Loading Potential, By Source Runoff Septic	Current Conditions, Watershed Contributions by Source 

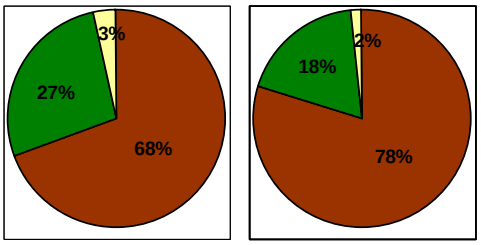
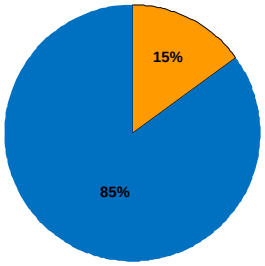

Potato Cr
8
RIVER RD
Ohio River
Sand Run
Garrison Cr
237
Elijahs Cr
NORTH BEND RD
275
PETERSBURG RD
Woolper Cr
20
Sand Run Watershed
Sources
Property potentially with septic system
Monitoring locations
SD1 site
0
0.5
mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Sand Run watershed
Ohio R
Licking R
AEM 05 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_sand.mxd

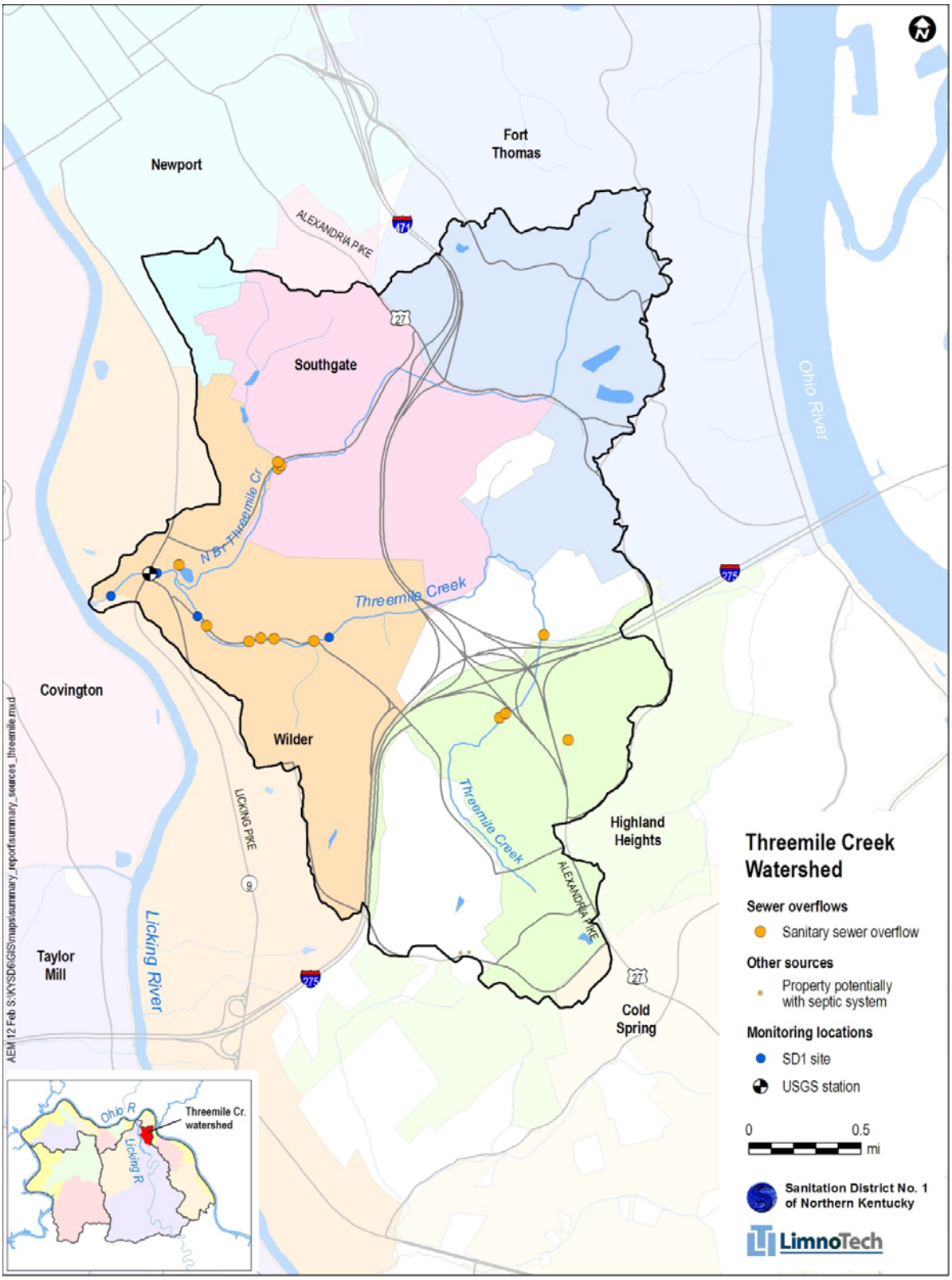
Taylor Creek Watershed Fact Sheet

Overview	Taylor Creek has the smallest and most highly developed watershed in the study area. Flooding has been a recurring problem in this watershed.
Drainage Area	4.2 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	None
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current Future  23% 25%
Sewer Overflows	9 CSOs, 7 SSOs
Other KPDES Discharges	2 permitted outfalls
State Impaired Waters	None
TMDL Status	Not applicable
Recent Assessments	
Habitat	Habitat was last assessed in 2007 at one mainstem and two tributary locations as not supporting of a diverse aquatic community.
Biological	Biological data were last collected in 2007 at one mainstem and two tributary locations indicating variable conditions ranging from very poor to fair.
Water Quality	Recent water quality data available for the mainstem and three tributaries indicate widespread occurrences of elevated levels of bacteria during wet and dry weather and violations of dissolved oxygen, copper, and zinc criteria during wet weather. Infrequent pH violations have also been observed.
WAT! Bacteria Loading Potential, By Source CSO SSO Runoff	Current Conditions, Watershed Contributions by Source 

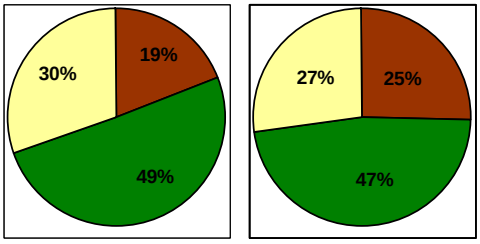
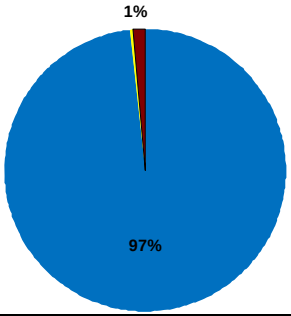

Dayton
Bellevue
Ohio River
Chadwick Br
Covert Run
Taylor Cr
MEMORIAL PKWY
Woodlawn Cr
Woodlawn
Taylor Cr
Newport Reservoir
Fort Thomas
Newport
GRAND AVE
ALEXANDRIA PIKE
Southgate
Licking River
Taylor Creek Watershed
0
0.5
mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
Sewer overflows
Combined sewer overflow
Sanitary sewer overflow
Other sources
KPDES discharge
Monitoring locations
SD1 site
USGS station
Taylor Creek watershed
Ohio R
Licking R
AEM 11 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_taylor.mxd

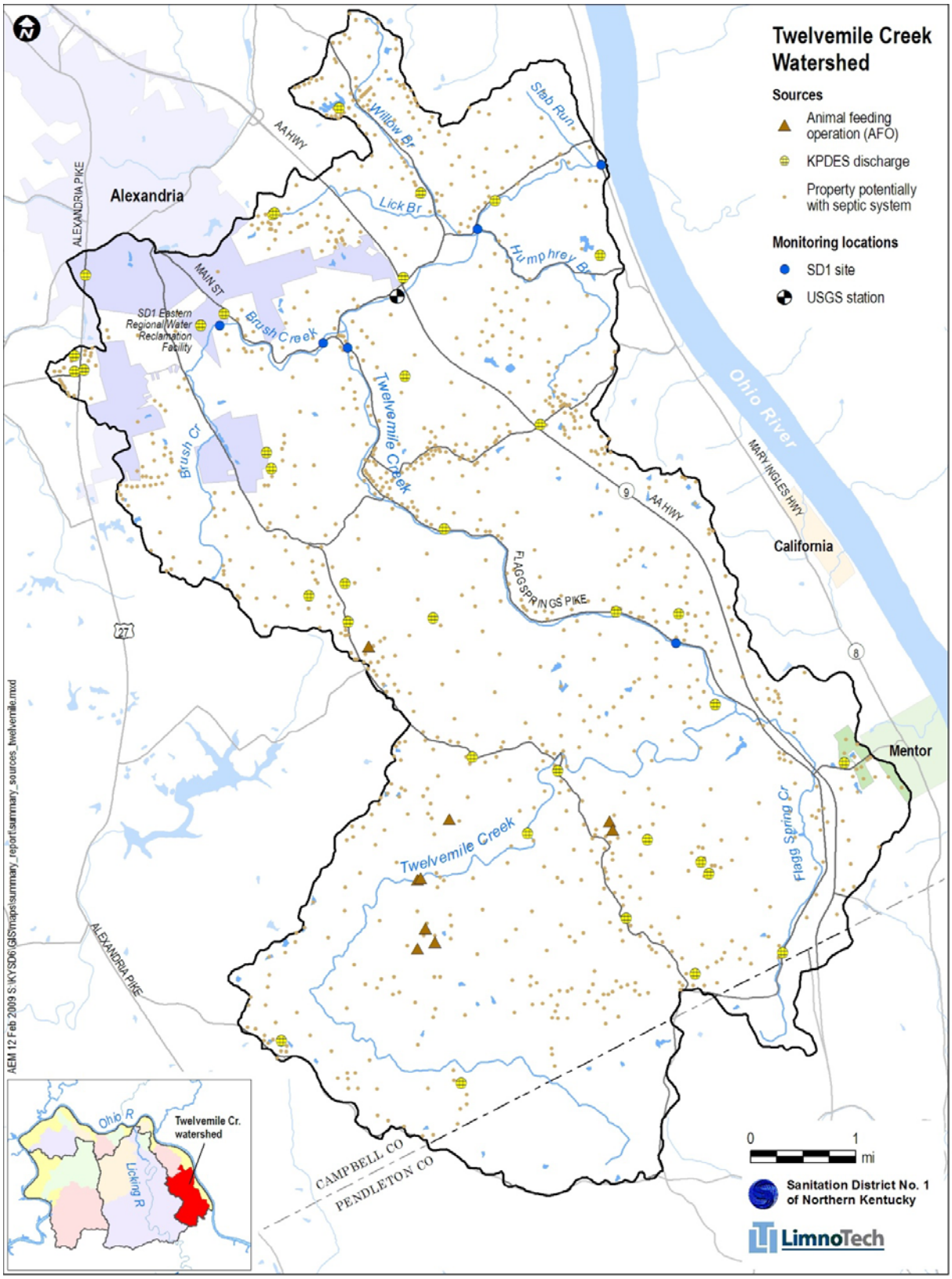
Threemile Creek Watershed Fact Sheet

Overview	Threemile Creek drains a small, highly developed watershed that is a tributary to the Licking River. The watershed is traversed by two major highways. Streambank erosion has been observed at several locations in this watershed.
Drainage Area	5.9 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	None
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  17% 19%
Sewer Overflows	13 SSOs
Other KPDES Discharges	None
State Impaired Waters	4.6 miles of Threemile Creek are identified as impaired due to nutrients, organic enrichment and fecal coliform bacteria.
TMDL Status	KDOW completed data collection in 2005, and may collect additional sediment data, if needed. Once data collection is complete, KDOW plans to develop the sediment TMDLs. TMDLs for nutrients and organic enrichment will not be initiated until after nutrient criteria are promulgated by the State.
Recent Assessments	
Habitat	Habitat assessed in 2004 in the mainstem and two tributaries indicates these locations are not supporting of a diverse aquatic community.
Biological	Biological data collected in 2004 in the mainstem and two tributaries indicate poor conditions.
Water Quality	Recent water quality data indicate elevated levels of bacteria in the mainstem and a tributary during dry weather conditions and in the mainstem during wet weather.
WAT! Bacteria Loading Potential, By Source SSO Runoff	Current Conditions, Watershed Contributions by Source 

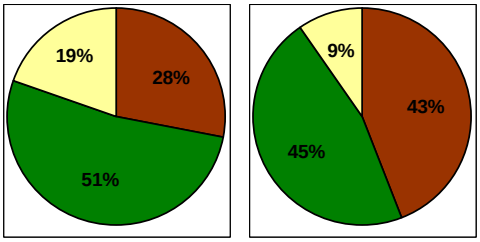
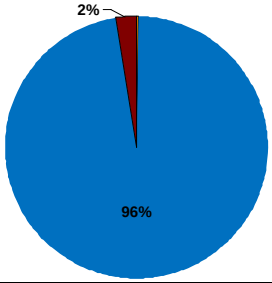

Newport
Fort Thomas
ALEXANDRIA PIKE
Southgate
Ohio River
N Br Threemile Cr
Threemile Creek
Covington
Wilder
LICKING PIKE
Threemile Creek
Highland Heights
ALEXANDRIA PIKE
Licking River
Taylor Mill
Cold Spring
AEM 12 Feb S:\KYSD6\GIS\maps\summary_report\summary_sources_threemile.mxd
Ohio R
Licking R
Threemile Cr. watershed
Threemile Creek Watershed
Sewer overflows
Sanitary sewer overflow
Other sources
Property potentially with septic system
Monitoring locations
SD1 site
USGS station
0
0.5
mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech

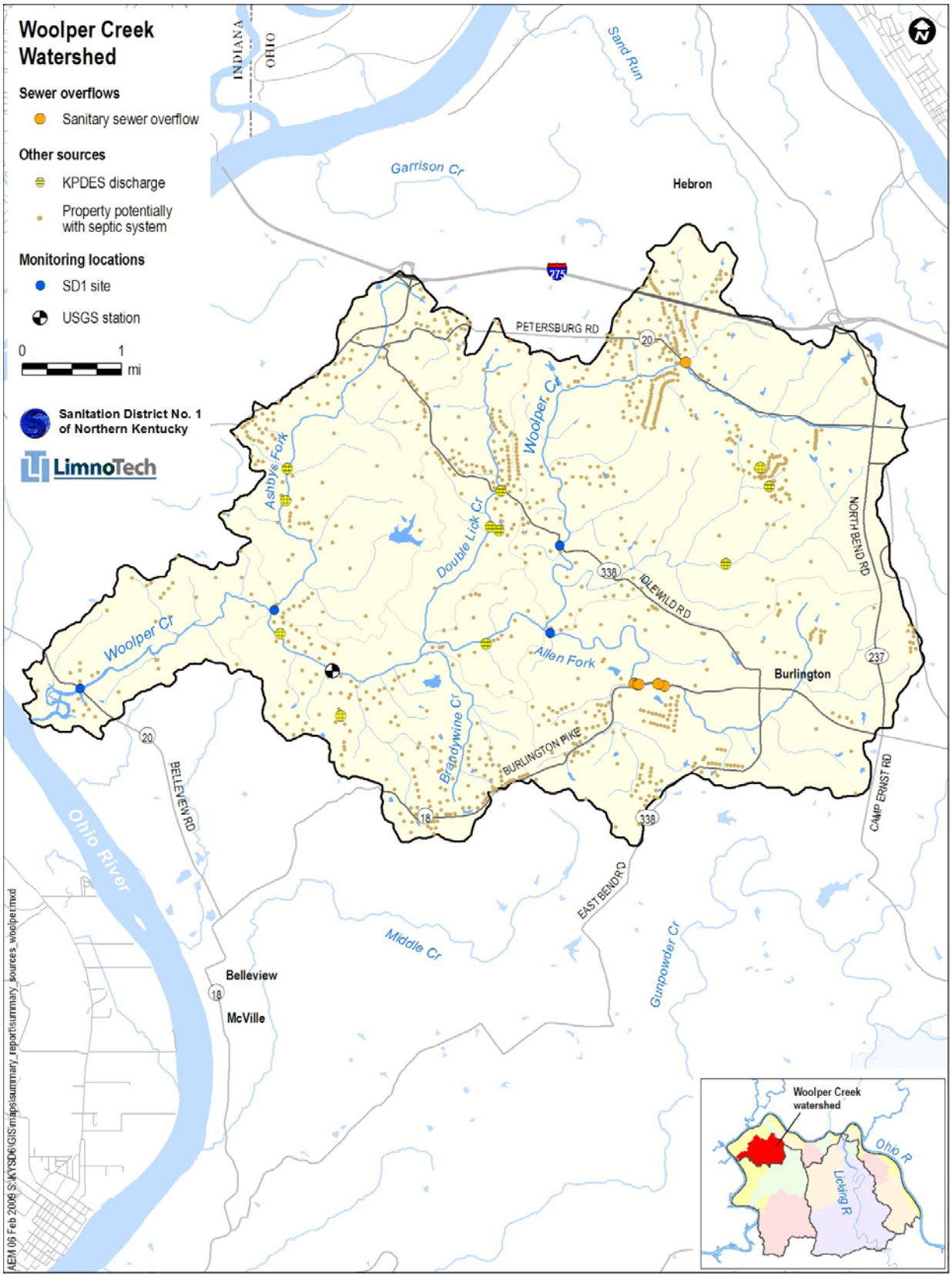
Twelvemile Creek Watershed Fact Sheet

Overview	The Twelvemile Creek watershed is primarily rural and has a higher concentration of livestock than other study area watersheds. Significant algal growth has been observed near the mouth of this creek in the past. SD1's Eastern Regional Water Reclamation Facility was recently activated in this watershed, replacing the older Alexandria Wastewater Treatment Plant.
Drainage Area	46.1 square miles
Special Stream Designations	None
Aquatic-dependent State or Federally Threatened or Endangered Species	None
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  3% 4%
Sewer Overflows	None
Other KPDES Discharges	38 permitted outfalls
State Impaired Waters	1.6 miles of Brush Creek are identified as impaired due to fecal coliform.
TMDL Status	TMDL development has not yet been initiated.
Recent Assessments	
Habitat	Habitat was last assessed in 2007 as ranging from partially supporting (at all mainstem locations) to not supporting (at two tributary sites) of a diverse aquatic community.
Biological	Biological data were last collected in 2007 on the mainstem and one tributary and indicate highly variable conditions ranging from poor to good.
Water Quality	Recent water quality data reveal frequent instances of elevated levels of bacteria in a tributary during dry and wet weather conditions, and in the mainstem during wet weather.
WAT! Bacteria Loading Potential, By Source Runoff Other KPDES dischargers Septic	Current Conditions, Watershed Contributions by Source 


Twelvemile Creek Watershed
Sources
Animal feeding operation (AFO)
KPDES discharge
Property potentially with septic system
Monitoring locations
SD1 site
USGS station
Alexandria
California
Mentor
Ohio River
Twelvemile Creek
Brush Creek
Brush Cr
Lick Br
Willow Br
Slab Run
Humphrey Br
Flagg Spring Cr
SD1 Eastern Regional Water Reclamation Facility
ALEXANDRIA PIKE
MAIN ST
AA HWY
MARY INGLES HWY
FLAGG SPRINGS PIKE
CAMPBELL CO
PENDLETON CO
Ohio R
Licking R
Twelvemile Cr. watershed
0
1
mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
AEM 12 Feb 2009 S:\KYSD6\GIS\maps\summary_report\summary_sources_twelvemile.mxd

Woolper Creek Watershed Fact Sheet

Overview	The Woolper Creek watershed is predominantly forested, with development currently concentrated near the headwaters of Woolper Creek and in the Allen Fork subwatershed. Problems with flooding have been reported in these areas. Portions of this watershed are developing rapidly, and the headwaters are predicted to become highly developed in the future.
Drainage Area	33 square miles
Special Stream Designations	Double Lick Creek is an exceptional water and reference reach stream.
Aquatic-dependent State or Federally Threatened or Endangered Species	1 plant (running buffalo clover)
Dominant Land Cover *(To simplify presentation, barren and water categories are excluded)* Developed Forest/shrub Agriculture Percent Impervious Area	Current / Future  5% 9%
Sewer Overflows	6 SSOs
Other KPDES Discharges	11 permitted outfalls
State Impaired Waters	Woolper Creek: Two segments (6.5 miles total) are identified as impaired due to fecal coliform. One 2.1 mile segment is also identified as impaired due to total suspended solids, nutrients, and organic enrichment. Allen Fork: One segment (2.6 miles) is identified as impaired due to sedimentation/siltation and nutrients/eutrophication.
TMDL Status	TMDLs are planned for Woolper Creek. KDOW has completed nutrient, organic enrichment and total suspended solids data collection, and may collect additional sediment data, if needed. Once data collection is complete, KDOW plans to develop the sediment TMDLs. TMDLs for nutrients and organic enrichment will not be initiated until after nutrient criteria are promulgated by the State.
Recent Assessments	
Habitat	Habitat was last assessed in 2004 on the mainstem and several tributaries as predominantly not supporting of a diverse aquatic community. Habitat in two of the tributaries was partially supporting and supporting but threatened.
Biological	Biological data were last collected in 2004 on the mainstem and several tributaries indicating predominantly poor conditions, with one tributary rated as good.
Water Quality	Recent water quality data from the mainstem and two tributaries revealed generally good water quality.
WAT! Bacteria Loading Potential, By Source SSO Runoff Septic	Current Conditions, Watershed Contributions by Source 


Woolper Creek Watershed
Sewer overflows
Sanitary sewer overflow
Other sources
KPDES discharge
Property potentially with septic system
Monitoring locations
SD1 site
USGS station
0 1 mi
Sanitation District No. 1 of Northern Kentucky
LimnoTech
INDIANA
OHIO
Sand Run
Garrison Cr
Hebron
PETERSBURG RD
Woolper Cr
Ashbys Fork
Double Lick Cr
NORTH BEND RD
IDLEWILD RD
Allen Fork
Burlington
Brandywine Cr
BURLINGTON PIKE
CAMP ERNST RD
BELLEVIEW RD
Ohio River
EAST BEND RD
Middle Cr
Gunpowder Cr
Belleview
McVille
Woolper Creek watershed
Ohio R
Licking R
AEM 06 Feb 2009 S:\KYSD6\GIS\mapis\summary_report\summary_sources_woolper.mxd

Appendix B. List of References

Watershed Characterization Reports (http://www.sd1.org/projects/wcr.asp)

LimnoTech, 2009. Banklick Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Big Bone Creek Watershed Characterization Report, January 2009

LimnoTech, 2009. Dry Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Elijahs Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Fourmile Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Gunpowder Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Licking River Watershed Characterization Report, January 2009.

LimnoTech, 2009. Ohio River East Tributaries Watershed Characterization Report, January 2009.

LimnoTech, 2009. Ohio River North Tributaries Watershed Characterization Report, January 2009.

LimnoTech, 2009. Ohio River West Tributaries Watershed Characterization Report, January 2009.

LimnoTech, 2009. Pleasant Run Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Sand Run Watershed Characterization Report, January 2009.

LimnoTech, 2009. Taylor Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Threemile Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Twelvemile Creek Watershed Characterization Report, January 2009.

LimnoTech, 2009. Woolper Creek Watershed Characterization Report, January 2009.

Watershed Assessment Tool (WAT!) Documentation

LimnoTech, 2009. Watershed Assessment Tool – WAT! Model Documentation. June 23, 2009.

Other

Ohio River Valley Water Sanitation Commission (ORSANCO), 2008. Biennial Assessment of Ohio River Water Quality Conditions for Water Years 2006 and 2007. http://www.orsanco.org/rivinfo/pubs/305b/2008/2008305b.pdf

Websites on Related Topics

Designated uses: http://www.lrc.ky.gov/kar/401/010/026.htm

Surface water standards: http://www.lrc.ky.gov/kar/401/010/031.htm

Special use waters: http://www.water.ky.gov/sw/specialwaters/

Exceptional waters: http://www.lrc.ky.gov/kar/401/010/030.htm

KPDES-permitting: http://www.water.ky.gov/permitting/wastewaterpermitting/KPDES/

State 303(d) list of impaired waters: http://www.water.ky.gov/sw/tmdl/303d.htm

Total Maximum Daily Load (TMDL) Program: http://www.water.ky.gov/sw/tmdl/

Biological monitoring:
http://www.water.ky.gov/sw/swmonitor/monitoring/biologicalmonitoring/