



Source: SD1

# Sand Run

## Watershed Characterization Report

Prepared for: Sanitation District No. 1 of Northern Kentucky



January 2009

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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 Sand Run watershed is located in Boone County in the North Study Basin and is one of the smallest Northern Kentucky watersheds (Figure 1). This watershed has seen rapid development, especially in the headwaters. Currently, forest and developed lands comprise the dominant land cover.

Sand Run 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. This creek does not appear on the 303(d) list of impaired waterbodies (KDOW, 2008). Recent stream data reveal exceedances of bacteria criteria and dissolved oxygen violations have occurred during base flow conditions.

Potential pollutant sources in the watershed include runoff from urban and rural lands, and septic systems, and stream bank erosion which is severe in places. The potential for these sources to generate fecal coliform bacteria has been assessed using a Watershed Assessment Tool (WAT!)<sup>1</sup>, which identifies the potential sources within a watershed and estimates their possible impact. This tool also allows SD1 to compare and rank the 16 different Northern Kentucky watersheds.

The WAT! calculates a low to very low loading potential for this watershed for fecal coliform under year-round and base flow conditions. Overland runoff is predicted to be the dominant source of bacteria under year-round conditions. Septic systems are predicted to be the dominant source under base flow conditions.

The WAT! ranking is one of several factors that should be considered when prioritizing this watershed for improvement projects. Other factors include low public interest, the absence of any threatened and endangered species, and the absence of any drinking water intakes and special designations for this waterbody.

No additional biological, habitat or chemical monitoring is recommended for this watershed, beyond that already planned or ongoing. Because this watershed is rapidly developing, coordination with the Boone County Planning Commission may help to identify areas for protection, as these areas may benefit storm water management.

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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.

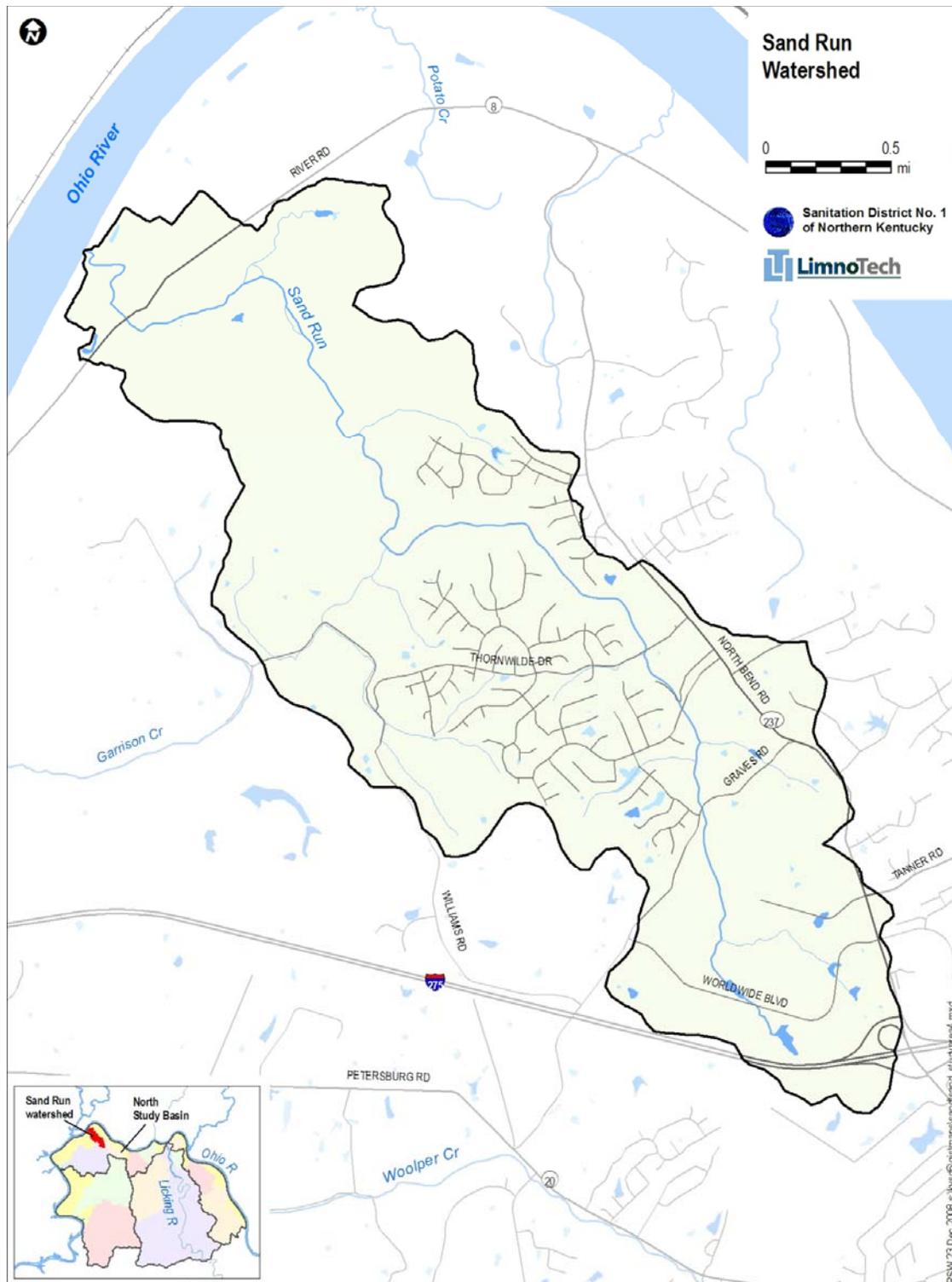


Figure 1. Sand Run Watershed

## 2. WATERSHED FEATURES

Sand Run is located entirely in Boone County, Kentucky, and the watershed area for this creek is 5 square miles. Sand Run originates in northern Boone County near I-275 and North Bend Road, and flows northwest for 5.7 miles to the Ohio River.

### 2.1 PHYSICAL AND NATURAL FEATURES

The following sections describe key features of the watershed and creek, 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 Sand Run.

#### 2.1.1 Hydrology

There are no active USGS continuous monitoring stations in the Sand Run watershed, so it is not possible to characterize flows in this creek. The gradient of this creek is steep in places, but near the mouth the creek bed levels out and the elevation change between river mile (RM) 1.2 and the mouth is negligible. Backwater effects from the Ohio River have been observed near the mouth of this creek during high flow conditions (Figure 2). The extent of the backwater effects is dependent on the Ohio River stage.

The 100-year floodplain extends from the mouth of Sand Run upstream to approximately RM 1.5, and is roughly 1,000 feet across. According to the Boone County Comprehensive Plan, flooding has not been a problem in Sand Run in the past, however due to urban and suburban development, it has more recently become a problem in this creek (BCPC, 2005).



**Figure 2. Sand Run near RM 0.5**

### 2.1.2 Geology

The Sand Run watershed is located in the Outer Bluegrass Physiographic<sup>2</sup> Region, which is underlain primarily by Ordovician-age interbedded limestone and shale (Ray et. al., 1994). Although most of this watershed 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>3</sup>.

Much of this watershed is blanketed by Ohio River alluvium, which consists of coarse sand and gravel beds that can supply large volumes of water. Groundwater is hard, but otherwise of good quality (Carey and Stickney, 2004).

### 2.1.3 Topography

Topography in the Sand Run watershed is less pronounced near the headwaters, with steeper hills found farther downstream. The higher elevations are found on the far eastern edge of this watershed and also on an interior ridge, located west of and parallel to the creek. The highest point (912.7 feet) in this watershed is in the far southeastern corner, at the intersection of North Bend Road with Interstate 275. The lowest elevation in the watershed (453.6 feet at normal Ohio River pool) is located at the confluence with the Ohio River.

### 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 (71%) of the soils in the Sand Run watershed are classified as hydrologic soil group C (NRCS, 2006), meaning they have slow infiltration rates when thoroughly wetted. Another 18% of the soils are classified as hydrologic soil group D, meaning water movement through the soil is restricted or very restricted. Soils in this group have a high runoff potential when thoroughly wet.

Most of the soils in the watershed are ranked as either “highly erodible” (83%) or “fairly erodible” (13%) 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. Portions of this watershed are developing rapidly and this development is anticipated to continue in the future (Section 2.2). Some areas of severe erosion have been observed within this watershed (Figure 3).

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<sup>2</sup> Physiographic regions are based on differences in geology, topography and hydrologic regime. The State of Kentucky is divided into five physiographic regions.

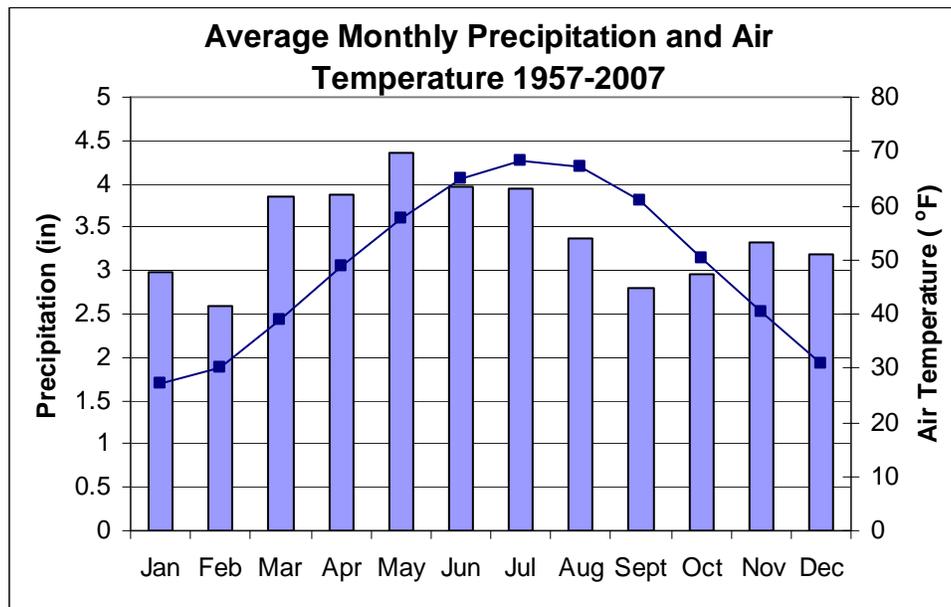
<sup>3</sup> In areas with karst, an almost immediate connection between groundwater and surface water can exist, short-circuiting any attenuation of pollutant loads that might otherwise occur.



**Figure 3. Sand Run Erosion**

### 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 4 (NCDC, 2008).



**Figure 4. Average Monthly Precipitation and Air Temperature at the Cincinnati Northern Kentucky Airport (1957-2007)**

### 2.1.6 Habitat

This watershed lies completely within the Outer Bluegrass ecoregion<sup>4</sup>, which is characterized as having sinkholes, springs, entrenched rivers and intermittent and perennial streams (Woods et al. 2002). Wetlands are not common in this ecoregion and comprise only 1% of the area in this watershed. Streams have relatively high levels of suspended sediment and nutrients. Highly erodible glacial outwash exists in a few areas within this ecoregion.

Pre-settlement conditions in this ecoregion consisted of open woodlands with barren openings, and vegetation was mostly oak-hickory, with some white oak, maple-oak-ash and American beech-sugar maple forests (Woods et al. 2002).

An ecological survey was completed by the Northern Kentucky University's (NKU) Environmental Resource Management Center (ERMC) in 1999 for the lower Sand Run watershed. It noted a high level of ecological integrity and highlighted the following aspects of the watershed as important:

- the relatively undisturbed stream channel and associated riparian corridor;
- the contiguous riparian forest canopy and associated forested hillsides;
- the absence of garbage, urban debris, sewage and other signs of human impacts;
- the abundance of natural pools and riffle habitats and
- the potential for wetland restoration and enhancement activities in the Ohio River bottomlands (NKU-ERMC, 1999).

Several small areas of severe streambank erosion were also noted near the downstream portion of the watershed, where the creek enters the floodplain (NKU-ERMC, 1999).

## 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 Sand Run is 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 5) using a variety of other datasets that represent current impervious conditions (roads, parking lots, buildings), open space lands (including parks), and surface waters.

Forest and developed lands are the dominant land covers in the watershed. 12% of this watershed is covered with impervious surfaces. Interstate 275 crosses the southernmost tip of the watershed and development in this watershed is currently focused in the upstream portion of the watershed and is concentrated on hilltops. None of the land in this watershed is incorporated. Many of the subdivisions appear to have storm water

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<sup>4</sup> Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources (Woods et al., 2002).

retention ponds. Much of the steep land adjacent to the creek appears to be forested. No nature preserves or parks were identified in this watershed.

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

There are no permitted concentrated animal feeding operations (CAFOs) or animal feeding operations (AFOs) in the watershed (Kentucky Geographic Network, 2008, 2008a). It is not known if there are any other livestock in this watershed.

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

SD1 estimates that approximately 6% of all parcels in the Sand Run watershed are potentially serviced by septic systems (Figure 11). Properties potentially served by septic systems are found near the mouth of the creek and in the western portion of the watershed near Kentucky 237.

The Northern Kentucky Health Department does not currently have estimates of septic system failure rates in Boone County. Anecdotal reports from Health Department inspectors suggest that 10% of the septic systems may be operating improperly due to incorrect installation, lack of maintenance or age of the system (NKHD, 2008).

### **2.2.2 Future Conditions**

The Sand Run watershed is predicted to become increasingly developed under future conditions. Development is predicted to extend to the north towards the mouth of Sand Run. Some steep forested land adjacent to the creek is predicted to remain forested.

On the eastern boundary of the watershed, North Bend Road (KY-237) is undergoing reconstruction and widening for the 3 miles between I-275 and Route 8 (KY-8) (Kentucky Transportation Cabinet, 2006).

The Boone County Comprehensive Plan identifies the Sand Run watershed as an area that is important for immediate protection due to strong development pressure (BCPC, 2005). The Boone County Planning Commission conducted a survey in 1999, which identified a general shortage of parkland in the areas north of I-275 and the need for a wide variety of specific recreation facilities. This survey also identified a strong desire for more open space and land to be preserved as future green space and some land to remain as natural areas. The Boone County Comprehensive Plan (BCPC, 2005) recommends the development of three small neighborhood parks, strategically located adjacent to subdivisions, which would also be activity nodes along a larger Sand Run Watershed Park that would connect the subdivisions to Route 8 and the Ohio River (BCPC, 2005).

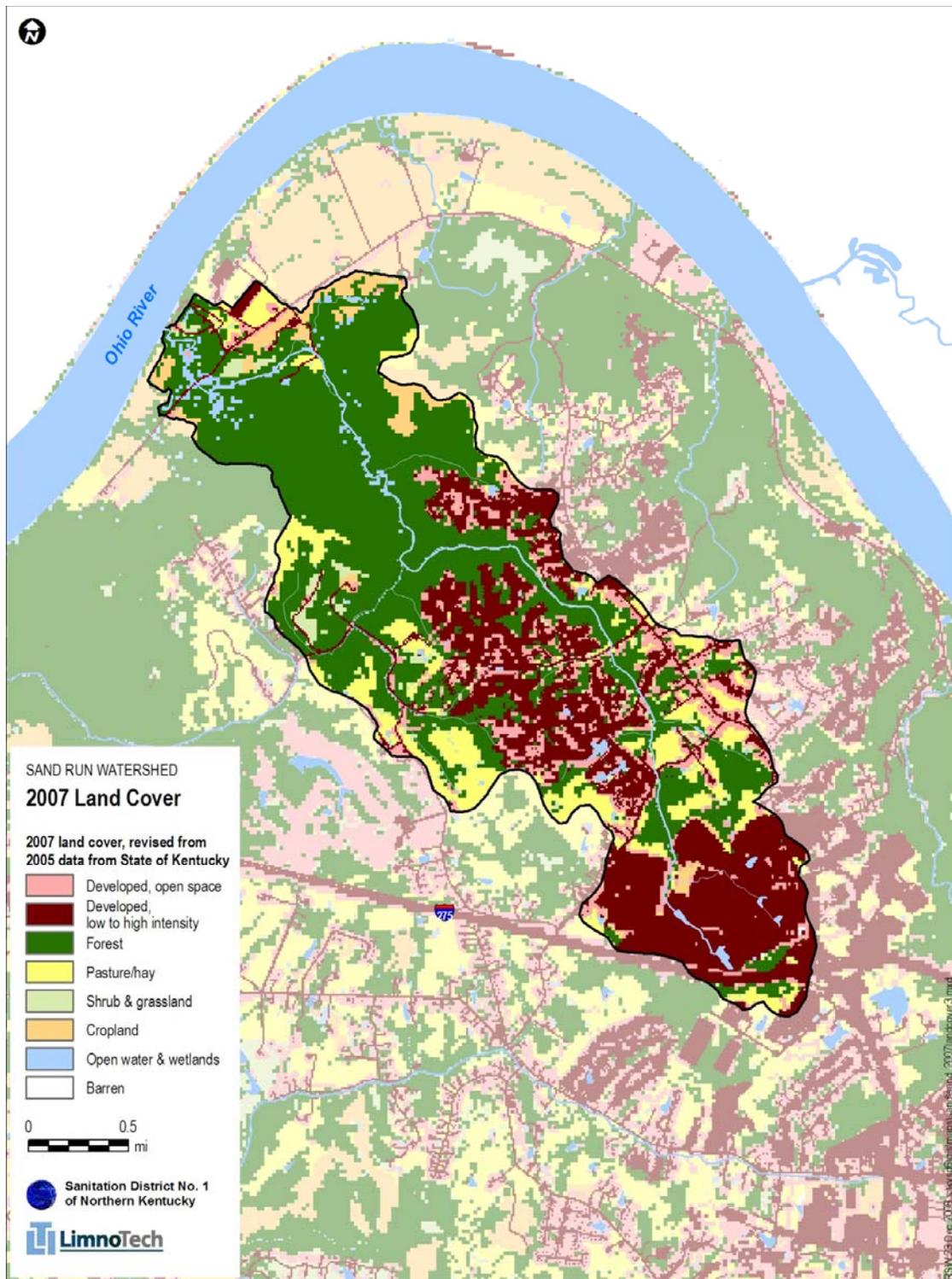


Figure 5. 2007 Land Cover

### 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 development will primarily replace forest and pasture lands (Figure 6). Developed lands are predicted to increase from 38% to 54% and impervious surfaces in the watershed are predicted to increase from 12% to 16%.

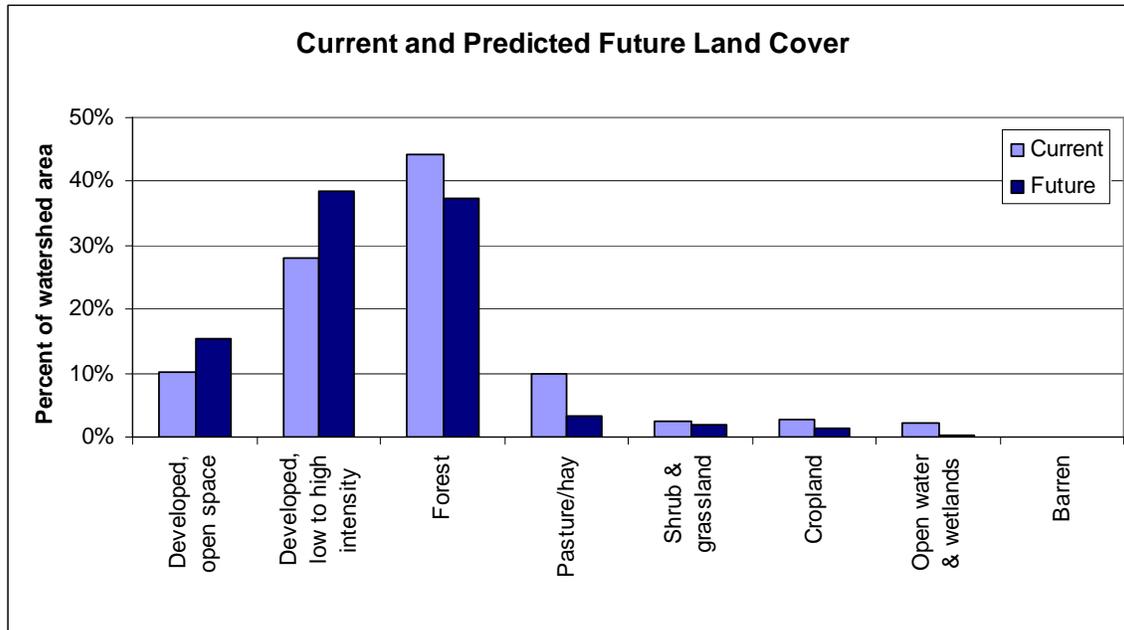


Figure 6. Current and Predicted Future Land Cover

## 2.3 INFRASTRUCTURE FEATURES

This section summarizes infrastructure features for the Sand Run watershed<sup>5</sup>.

Approximately 56% of this watershed is located within SD1's sanitary sewer service area. This area contains approximately 26.1 miles of separate sanitary sewer lines and is primarily located in the upstream portion of the watershed.

Approximately 81% of this watershed lies within SD1's storm water service area. Within the service area, the storm water system is comprised of approximately 39.8 miles of streams and channels and approximately 18.2 miles of pipes.

There is no combined sewer system area in this watershed.

The extent of the sanitary sewer and storm water service area in this watershed is shown in Figure 7.

<sup>5</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.

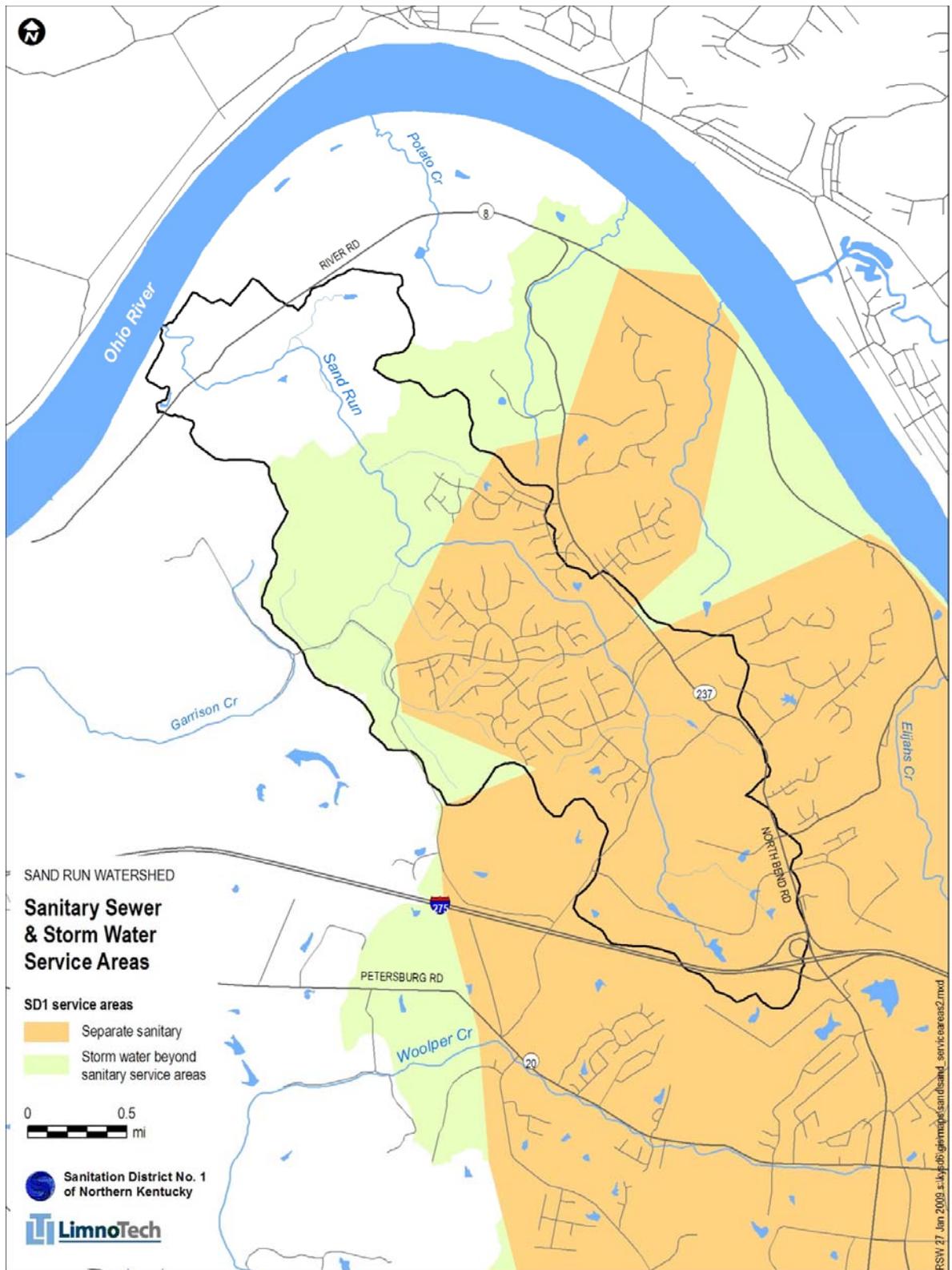


Figure 7. Sanitary Sewer and Storm Water Service Areas

### 2.3.1 Point Sources and Infrastructure

The occurrence of KPDES-permitted discharges, sewer overflows and storm water discharges are discussed below.

#### 2.3.1.a KPDES dischargers

There are no KPDES-permitted dischargers in the Sand Run watershed.

#### 2.3.1.b Sewer overflows

There are no combined sewer overflows (CSOs) or separate sanitary sewer overflows (SSOs) in the Sand Run watershed.

#### 2.3.1.c Storm water discharges

Much of this watershed is located within SD1's storm water service area. Storm water outfalls are located throughout the central and southern portions of the watershed. In addition to storm water outfalls, there are approximately four suspected illicit activity points (SIAs), which are located in the southern portion of the watershed. SIAs are locations where there was possible evidence of illicit activity during SD1's storm water mapping project (2001-2002). These locations are being further investigated to determine if they are recurring.

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

### 2.3.2 Recently Completed Infrastructure Projects

There are no recently completed infrastructure projects in the Sand Run watershed.

### 2.3.3 Ongoing or Planned Infrastructure Improvement Projects

SD1 has one planned infrastructure project for this watershed, implementing the Pump Station Backup Power Program. This program will minimize the risk of pump station overflow by ensuring that the four stations without backup power in this watershed have backup power in place by no later than December 31, 2015.

Project information is provided in Table 1.

**Table 1. Planned Infrastructure Improvement Projects**

Capital Improvement Project Title	Goals	Anticipated Start Date	Anticipated Completion Date	Project Total
Pump Station Backup Power Program	Ensure that all pump stations have backup power or other appropriate measures for addressing power outages.	2008	2015	\$508,000

## 2.4 SENSITIVE AREAS

The federal combined sewer overflow (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 waterbodies in the Sand Run watershed have been designated as Outstanding National Resource Waters (401 KAR 10:030), there are no threatened and endangered species within the watershed (KSNPC, 2007), and there are no National Marine Sanctuaries in the watershed (NOAA, 2008). Additionally, there are no known commercial shellfish beds within the Sand Run watershed nor is shellfish harvest for consumption by private individuals known to occur. Therefore these four criteria were determined not to be relevant to the identification of sensitive waters in the Sand Run watershed. The remaining two criteria are discussed below.

### 2.4.1 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 the water and could therefore become ill if the water was sufficiently contaminated with bacteria.

Sand Run and its tributaries are designated for PCR. It is not clear whether or not swimming activity occurs in these creeks, 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.

### 2.4.2 Public Drinking Water Intakes or their Designated Protection Areas

There are no public drinking water intakes located within the Sand Run watershed. The nearest public drinking water intake from surface waters is located on the Ohio River near Louisville, Kentucky.

Source Water Assessment and Protection (SWAPP) Zones for Ohio River intakes are determined by the Ohio River Valley Water Sanitation Commission (ORSANCO). SWAPP zones are not used in a regulatory sense, but are delineated to identify potential

contaminants upstream of water intakes and are used to support identification of sources potentially impacting the intakes. ORSANCO has determined that the entire Sand Run watershed lies within SWAPP Zone 2, reflecting the fact that this watershed is more than 25 miles upstream of the Louisville intake.

Drinking water supply features are shown in Figure 8. No active surface water intakes or public ground water wells used for drinking water were identified in this watershed.

## **2.5 PUBLIC INTEREST/WATERSHED GROUP ACTIVITIES**

Public interest in this watershed appears to be low, and is gauged through limited sampling and one previous ecological study (NKU-ERMC, 1999). The Boone County Comprehensive Plan identifies this watershed as being important for immediate protection because of strong development pressure (BCPC, 2005). Furthermore, the Sand Run valley is mentioned, along with others, as having future potential as a greenbelt pathway system (BCPC, 2005). The Boone County Greenways Plan was not available at the time of this report.

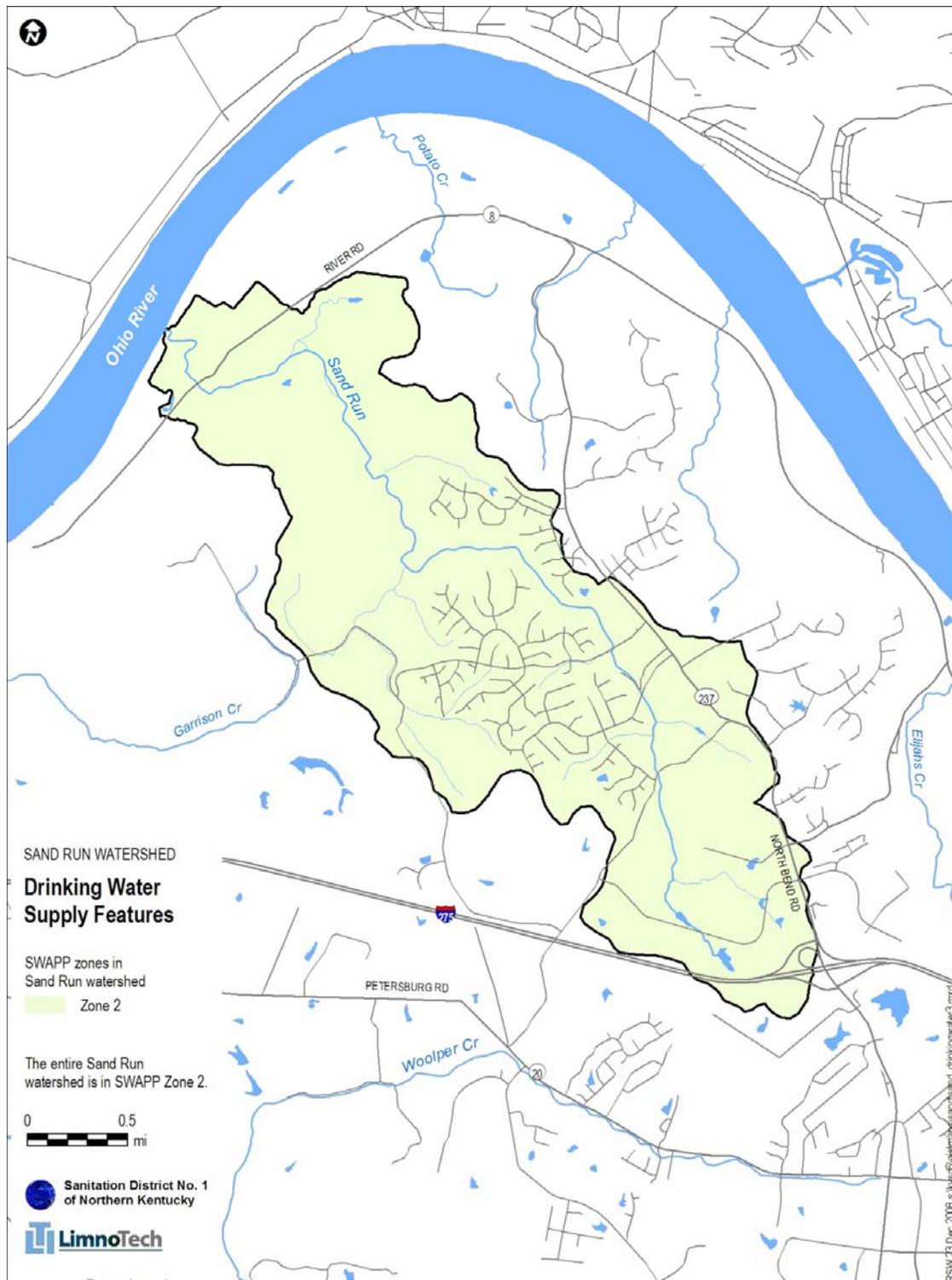


Figure 8. Drinking Water Supply Features

### 3. WATERBODY USES

This section describes designated and current uses for Sand Run and its tributaries.

#### 3.1 DESIGNATED USES

Sand Run 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). These 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.

#### 3.2 CURRENT USES

Available information on current uses in the watershed is presented below.

- No biological or aquatic habitat data were identified for this watershed.
- 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, 2007).
- There are currently no swimming advisories for Sand Run. However, the Kentucky Division of Water and the Division of Public Health Protection and Safety recommend against swimming or other full-body contact with surface waters immediately following heavy rainfall events, especially in dense residential, urban and livestock production areas (KDOW, 2007a).
- No fishing access sites were found in the watershed. (<http://kygeonet.ky.gov/kdfwr/viewer.htm>).
- There are no surface drinking water intakes in the watershed.
- There are no active public water supply groundwater wells in this watershed (KDOW, 2008a; KDOW, 2007b).

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## 4. WATERBODY CONDITIONS

This section describes monitoring programs and water quality and biological conditions in this watershed.

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

Sand Run does not appear on Kentucky's 2008 303(d) list of impaired waters (KDOW, 2008).

### 4.2 MONITORING PROGRAMS

Very little water quality data are available for the Sand Run watershed. The only sampling program identified within this watershed is the one initiated by SD1 in 2006. Available data exists for the main stem of Sand Run. Data compiled by SD1 are presented in Table 2, however, only data which have been fully analyzed are discussed in section 4.3 Water Quality Data Analysis.

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

**Table 2. Summary of Water Quality Monitoring Data**

Entity	Dates <sup>a</sup>	Parameters Sampled	Sampling Locations <sup>b</sup>	Number of Samples
SD1	2006	Fecal coliform, E. coli, DO, pH, conductivity, turbidity, temperature	Sand Run RM 0.6	2 samples from baseline survey (10/3/2006 & 10/23/2006)
SD1	2007	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, turbidity, temperature, nutrients	Sand Run RM 0.6, 4.0	1 sample from baseline survey (8/15/2007)
SD1	2008 <sup>a</sup>	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, turbidity, temperature, nutrients	Sand Run RM 0.6, 4.0	1 sample from baseline survey (8/28/2008)

<sup>a</sup>Data not analyzed in Section 4.3

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

#### 4.2.1 Future Sampling

SD1 plans to continue monitoring in Sand Run at RM 0.6 and 4.0 during base flow conditions with at least one survey per year. Typical analyses will include bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters.

SD1 is planning to collect wet weather data at the same two locations in 2009. Attempts will be made to collect data during three discrete storm 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 of the start of the storm, though these intervals are dependent on the storm characteristics and may be changed if necessary.

Biological monitoring is also planned for this watershed in 2009 at RM 0.6 and 4.0. This will include habitat surveys along with fish and macroinvertebrate population assessments.

Additionally, surveys to assess the degree of stream hydromodification are currently underway.

### 4.3 WATER QUALITY DATA ANALYSIS

There are no historical water quality measurements for this watershed. Recent data are available from 2006-2007.

#### 4.3.1 Recent Data

Water quality data collected during baseline conditions are available for the main stem of Sand Run (RM 0.6 and 4.0). A summary of locations with recent water quality issues are presented in Table 3, for those parameters that exceeded applicable criteria. Fecal coliform and *E. coli* exceedances were observed at River Mile 0.6, and *E. coli* exceedances were observed at River Mile 4.0. Dissolved oxygen violations were observed at River Mile 0.6. Measurements for parameters not shown met the respective water quality criteria.

**Table 3. Recent (2006-2007) Water Quality Exceedances**

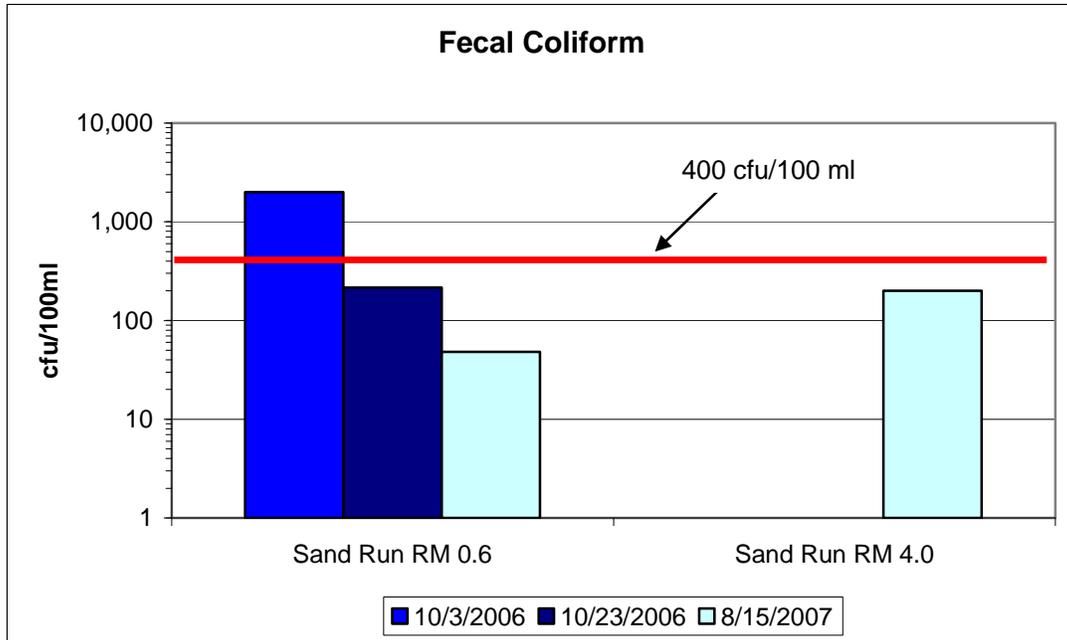
Stream	River Mile	Parameters exceeding criteria					
		Fecal coliform bacteria		<i>E. coli</i> bacteria		Dissolved oxygen	
		# samples	% of samples exceeding criteria <sup>a</sup>	# samples	% of samples exceeding criteria <sup>a</sup>	# measurements	% of measurements in violation <sup>b</sup>
Sand Run	0.6	3	33%	3	33%	3	67%
Sand Run	4.0	1	0%	1	100%	1	0%

<sup>a</sup> There are no instances where 5 samples were collected from a single location within a 30-day period. Therefore the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, "Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for *E. coli*." Even this comparison, however, is conservative as the criterion is meant to be applied to a data set of 5 or more samples collected over a 30-day period.

<sup>b</sup> The dissolved oxygen criterion is 4 mg/l. Measurements less than 4 mg/l are noted as violations.

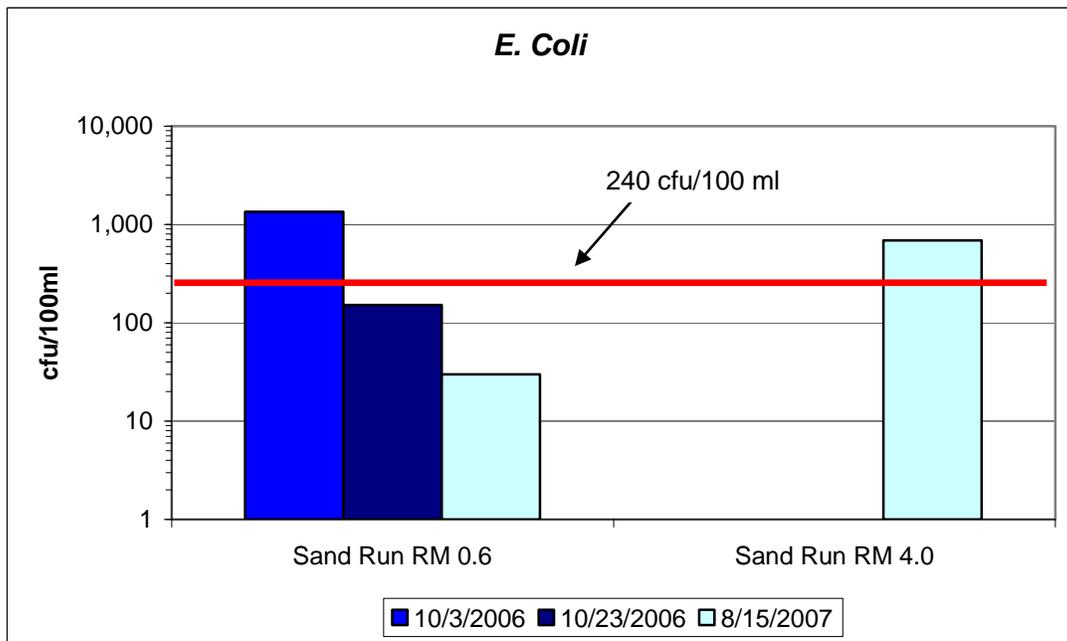
#### 4.3.1.a Bacteria

SD1 collected four base flow fecal coliform measurements in 2006 and 2007 at Sand Run RM 0.6 and 4.0 and one of the four fecal coliform samples exceeded the recreation season standard of 400 cfu/100ml (Figure 9). A fecal coliform concentration of 2,000 cfu/100 ml was measured at River Mile 0.6 in October 2006.



**Figure 9. 2006-2007 Base Flow Fecal Coliform Results Compared to the 400 cfu/100ml Criterion**

SD1 collected four base flow *E. coli* measurements in 2006 and 2007, at Sand Run RM 0.6 and 4.0; and two of the four *E. coli* samples exceeded the recreation season standard of 240 cfu/100ml (Figure 10). The maximum *E. coli* measurement of 1,350 cfu/100 ml was observed at River Mile 0.6 in October 2006.



**Figure 10. 2006-2007 Base Flow *E. Coli* Results Compared to the 240 cfu/100ml Criterion**

#### **4.3.1.b Dissolved oxygen**

SD1 made four base flow dissolved oxygen measurements in 2006 and 2007, at Sand Run RM 0.6 and 4.0. Two of the three dissolved oxygen measurements made at RM 0.6 violated the single sample minimum of 4.0 mg/l.

#### **4.4 BIOLOGICAL CONDITIONS**

Biological conditions in the Sand Run watershed were visually assessed in 1999 by the NKU-ERMC. This survey consisted of an intensive plant and rare species survey. A full report and list of plant species found within the watershed can be found in that report. No rare species were found in the Sand Run watershed (NKU-ERMC 1999). No other biological sampling has occurred in the watershed.

## 5. SOURCE ANALYSIS

This section summarizes potential pollutant sources in the Sand Run watershed in order to provide information related to recent (2006-2007) observed impairments. Conclusions are based on the watershed characterization and available water quality data.

### 5.1 WATERSHED SOURCE ANALYSIS

Potential sources of bacteria and oxygen-demanding constituents were identified within the Sand Run watershed, based on the watershed characterization information discussed previously. Currently identified sources are summarized in Table 4 and shown in Figure 11. All potential sources are included, even though exceedances were only observed during base flow conditions (no storm flow data have been collected). There are no CSOs, SSOs, KPDES-permitted dischargers or animal feeding operations within this watershed.

**Table 4. Summary of Potential Sources**

	Sand Run
Recent observed impairments =>	<i>Bacteria, Dissolved Oxygen</i>
Septic systems	Few
Storm water runoff	Urban and rural <sup>a</sup>
Stream bank erosion	Severe bank erosion observed in some locations
Ohio River backwater	Known to occur near the mouth <sup>b</sup>
<i>Planned improvements<sup>c</sup></i>	<i>Four pump stations will receive back-up power by 2015</i>

<sup>a</sup> This watershed is rapidly developing and rural storm water is expected to become less significant in the future.

<sup>b</sup> Dissolved oxygen violations have been observed in a reach where backwater is likely.

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

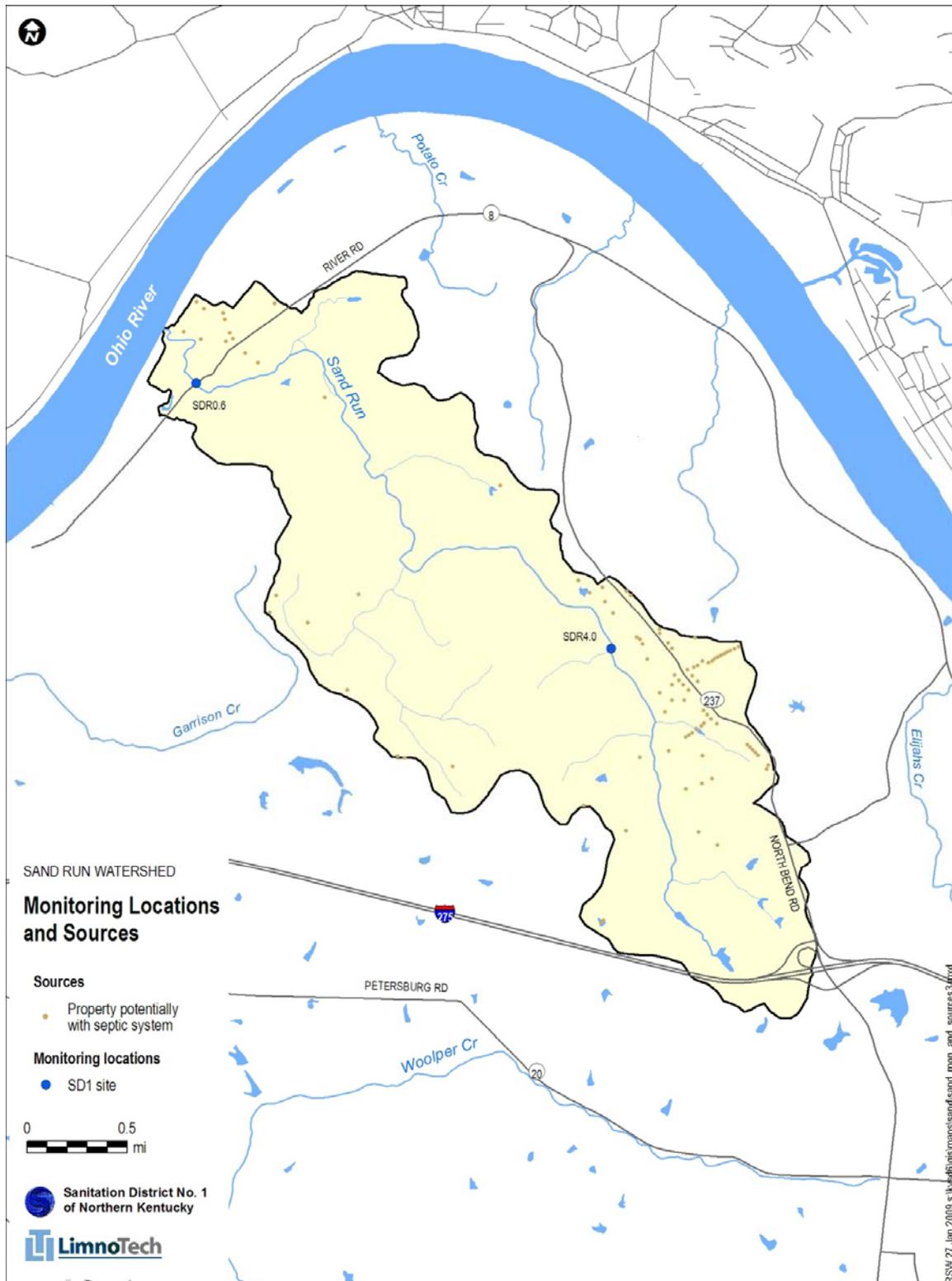


Figure 11. Monitoring Locations and Sources

## 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>6</sup> indicate that under year-round conditions, the Sand Run watershed has a very low ranking (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 considerations are summarized in Table 5.

**Table 5. Watershed Ranking Considerations**

CSO (#)	SSO (#)	SWAPP Zone	Aquatic-dependent T&E Species <sup>a</sup> (#)	Special Designations	Public interest	WAT Rank, year-round conditions <sup>b</sup>
						Bacteria
0	0	Zone 2 (due to Louisville intake)	0	None	Low	15 of 16

<sup>a</sup> There are no threatened or endangered (T&E) species or species of special concern in this watershed.

<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.

### 6.2 SCREENING TO DETERMINE IF ADDITIONAL DATA ARE NEEDED

Existing data to characterize this watershed are limited, however, SD1 plans to conduct additional base flow and wet weather sampling, and complete two biological assessments and one habitat assessment.

<sup>6</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.

### 6.2.1 Data Gap Analysis

No additional sampling is recommended beyond that already planned. Because this watershed is rapidly developing, SD1 may consider working with the Boone County Planning Commission to identify high priority areas for protection or designation as parkland, as these areas may also be beneficial for storm water management.

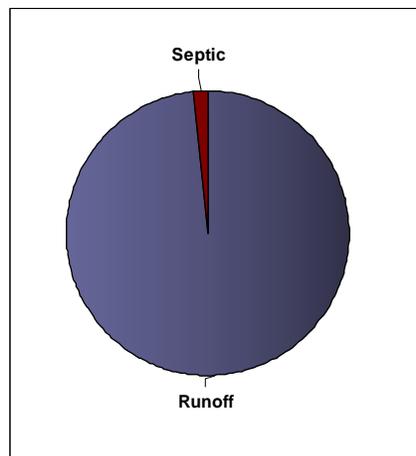
## 6.3 SOURCE PRIORITIZATION

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 12. These WAT! results incorporate predicted sewer overflow volumes from infrastructure model simulations for 1992-1996 climatological conditions<sup>7</sup>. Neither CSOs nor SSOs were a factor in the WAT! results, as none occur in the watershed.

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 12. 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.*

<sup>7</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.

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 Sand Run watershed during year-round and base flow conditions is provided in Table 6.

**Table 6. WAT! Watershed Rankings**

	Rank for Year-Round Conditions <sup>a,b</sup>	Rank for Base flow Conditions <sup>a,b</sup>
Fecal coliform	15	11

<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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## 7. REFERENCES

- Boone County Planning Commission (BCPC), 2005. 2005 Boone County Comprehensive Plan, A Blueprint for the Year 2030.
- Carey, D. I. and J.F. Stickney, 2004. Groundwater Resources of Boone County, Kentucky. Kentucky Geological Survey County Report 8, Series XII, ISSN 0075-5567.
- Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 001E. Statement of Emergency Regulation. Definitions for 401 KAR Chapter 10.
- Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 026. Designation of Uses of Surface Waters. Administrative Register of Kentucky.
- Kentucky Administrative Regulations (KAR). 2008. Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection. Chapter 10. Regulation 030. Antidegradation Policy Implementation Methodology.
- Kentucky Commonwealth Office of Technology, 2005. 2005 Kentucky Land Cover. Obtained in November, 2007.
- Kentucky Division of Fish and Wildlife Resources. Fishing access site viewer [online] <http://kygeonet.ky.gov/kdfwr/viewer.htm>
- Kentucky Division of Water, 2007. Fish Consumption Advisories in Kentucky. [www.water.ky.gov/sw/advisories/fish.htm](http://www.water.ky.gov/sw/advisories/fish.htm) Last modified 7/25/2007. Accessed 2/24/2008.
- Kentucky Division of Water. 2007a. Swimming Advisories in Kentucky. URL: <http://www.water.ky.gov/sw/advisories/swim.htm>. Last modified 11/8/07.
- Kentucky Division of Water, 2007b. Personal communication on status of domestic and public water wells. December 2007.
- Kentucky Division of Water (KDOW), Kentucky Environmental and Public Protection Cabinet. 2008. 2008 Integrated Report to Congress on the Condition of Water Resources in Kentucky. Volume II. 303(d) List of Surface Waters. Final. May, 2008.
- Kentucky Division of Water (KDOW), 2008a. Kentucky Drinking Water Watch Database Version 1.2. Accessed March 2008.
- Kentucky Geographic Network, 2008. April 9, 2008. <http://kygeonet.ky.gov/geographicexplorer/explorer.jsf>
- Kentucky Geographic Network, 2008a. August 11, 2008. <http://kygeonet.ky.gov/geographicexplorer/explorer.jsf>
- Kentucky State Nature Preserves Commission (KSNPC), 2007. Natural Heritage Program Database Review. Data Request 08-007. July 23.

- Kentucky Transportation Cabinet. 2006. Boone County Six-Year Plan Projects. FY-2006 thru FY-2012.
- National Climatic Data Center (NCDC), NOAA Satellite and Information Service. 2008. Data obtained for Cincinnati Northern KY Airport, Covington/Cincinnati, KY, United States. WBAN 93814.
- National Oceanic and Atmospheric Administration (NOAA). 2008. National Marine Sanctuaries. <http://sanctuaries.noaa.gov/welcome.html>. Revised February 7, 2008. Accessed February 11, 2008.
- Natural Resources Conservation Service (NRCS, 2006. SSURGO/GIS format. [online] <http://datagateway.nrcs.usda.gov/>
- Northern Kentucky Health Department (NKHD), 2008. Personal communication, February 2008.
- Northern Kentucky University – Environmental Resource Management Center (NKU-ERMC). 1999. Preliminary ecological survey of the Sand Run Creek watershed Boone County, Kentucky. Prepared for the Boone County Planning Commission. Aug.
- Paylor, Randall L. and James C. Currens. *Karst Occurrence in Kentucky*. University of Kentucky, Kentucky Geological Survey. 2002. [http://kgsweb.uky.edu/olops/pub/kgs/mc33\\_12.pdf](http://kgsweb.uky.edu/olops/pub/kgs/mc33_12.pdf). Accessed on May 21, 2007.
- Ray, J.A., Webb, J.S., O'Dell, P.W. (Kentucky Department of Environmental Protection, Division of Water, Groundwater Branch), 1994. Groundwater Sensitivity Regions of Kentucky.
- United States Environmental Protection Agency (USEPA). April 19, 1994. Combined Sewer Overflow (CSO) Policy. *Fed. Regist.* Vol. 59 pg. 18688.
- Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor. 2002. Ecoregions of Kentucky. Color poster with map, descriptive text, summary tables, and photographs, U.S. Geological Survey (map scale 1:1,000,000), Reston, VA.