Source: LimnoTech

Threemile Creek
Watershed Characterization Report

Prepared for: Sanitation District No. 1 of Northern Kentucky

January 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

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 the 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 Threemile Creek watershed is 5.9 square miles in size and is located entirely in Campbell County in the Central Study Basin (Figure 1). Threemile Creek originates west of Highland Heights and flows westward to the Licking River. This small watershed is residential in nature, and crossed by two state highways that intersect near its center.

The Kentucky Division of Water (KDOW) has designated this creek and its tributaries for warm water aquatic habitat, primary contact recreation, secondary contact recreation and domestic water supply, at applicable points of withdrawal. KDOW has identified this creek on the 303(d) list of impaired waterbodies (KDOW, 2008). Recent bacteria data exceed the applicable water quality criteria. Biological data are limited, but indicate poor conditions at all sites sampled. Aquatic habitat data at the same sites indicate that the available habitat cannot support a diverse and productive aquatic ecosystem.

Potential pollutant sources in this watershed include: sanitary sewer overflows (SSOs), storm water runoff and septic systems. The potential for these sources to generate fecal coliform bacteria was assessed using a Watershed Assessment Tool (WAT!)[1]. The WAT! identifies the potential sources within a watershed and estimates their possible impact. It also allows for comparison and ranking of SD1's sixteen watersheds.

The WAT! calculated a higher than average fecal coliform loading potential for this watershed under year-round conditions, and a very low fecal coliform loading potential under base flow conditions. Overland runoff was assessed as being the most significant source of bacteria under year-round conditions, and septic systems are assessed as the most significant bacteria source under base flow conditions.

The WAT! ranking is one of several factors that should be considered when prioritizing watersheds for improvement projects. Other factors include moderate-high public interest, and the absence of any surface drinking water intakes, aquatic-dependent threatened or endangered species, or special designations in the watershed.

No data gaps were identified, and no additional monitoring is recommended for this watershed, beyond that already planned.

[1] 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.

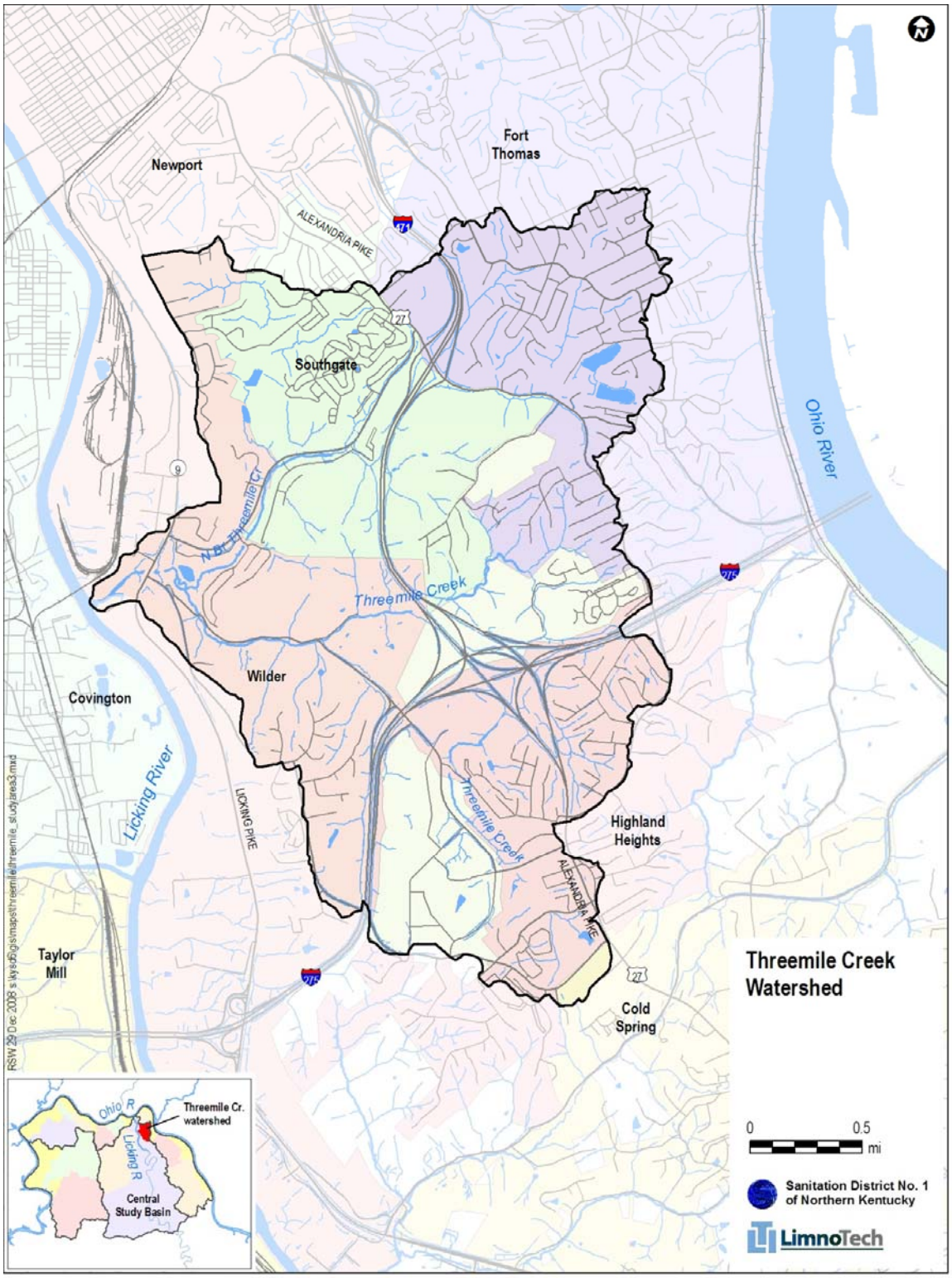

Figure 1. Threemile Creek Watershed

2. WATERSHED FEATURES

Threemile Creek originates west of the community of Highland Heights, Kentucky and flows 4.8 miles to the Licking River. The watershed is 5.9 square miles in size and is located entirely within Campbell County.

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 Threemile Creek.

2.1.1 Hydrology

Threemile Creek flows through a primarily urban-suburban watershed that is highly developed. The creek is enclosed in underground pipes at two locations where it flows under Interstates I-471 and I-275. During a site visit in January 2007, the water at river mile (RM) 0.7 was light brown in color and flowing over a cobble substrate. Water was less than 1 foot deep. At the confluence with the Licking River, the water was pooled in backwater, and the creek was observed to be brown and silty. Signs of erosion were apparent at both locations.

Threemile Creek is fed by one tributary, North Branch Threemile Creek (North Branch), which enters Threemile Creek near its mouth. During the January 2007 site visit, flow in North Branch was low and water was very shallow (about 4 inches) over a cobble substrate. There were signs of erosion and channel modification. North Branch flows through underground pipes under I-471.

There is one USGS continuous monitoring station in the watershed (03254695) along Threemile Creek at KY-9 at Wilder, KY. This station began operation in fall 2007 and has a drainage area of 5.7 square miles[2].

No flooding problems were identified for this watershed, although some areas near the mouth of Threemile Creek are identified as being flood prone in the 2008 Comprehensive Plan (Jacobs, 2008). Maps of the 100-year floodplain indicate that floods are generally restricted to the low-lying areas adjacent to Threemile Creek and North Branch Threemile Creek; these areas are primarily forested with very little development.

2.1.2 Geology

The Threemile Creek watershed is located in the Outer Bluegrass Physiographic[3] Region, which is underlain primarily by Ordovician-age interbedded limestone and shale (Ray et. al., 1994). Although much of this watershed is underlain by bedrock with a moderate potential for karst development (Paylor and Currens, 2002), rocks in this region generally

[2] This drainage area was calculated using a detailed watershed delineation developed for this project; the reported drainage area differs slightly from that reported by the USGS.

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

contain higher percentages of shale layers and do not develop extensive karst features (Ray et al., 1994)[4].

The headwaters of Threemile Creek originate in the rolling hills of the Grant Lake Limestone/Fairview formation. This creek also traverses the erodible shale of the Kope formation, and then unconsolidated alluvial sediments near the Licking River. A visit to the area revealed erosion problems along Threemile Creek (Figure 2) and North Branch (Figure 3).

Figure 2. Threemile Creek RM 0.7, at Threemile Road

Figure 3. North Branch at RM 0.9

Groundwater is generally unavailable on hilltops and hillsides, but wells in the valleys can yield 100-500 gallons per day. The groundwater is typically hard and may contain

[4] 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.

salt and hydrogen sulfide. Near the Ohio River, iron content may also be high (Carey and Stickney, 2005).

2.1.3 Topography

Rolling hills and tight valleys characterize the Threemile Creek watershed. The highest point in the watershed is found at the southern edge of the watershed in a residential area near Johns Hill Road and Martha L. Collins Boulevard (919 feet above mean sea level). The lowest elevation in the watershed (453.6 feet at normal Ohio River pool) occurs at the confluence with the Licking 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 (97%) of the soils in the Threemile Creek watershed are classified as hydrologic soil group C (NRCS, 2006), meaning that they have slow infiltration rates when thoroughly wetted.

Roughly half of the soils in the watershed are ranked “highly erodible”, with the other half ranked “fairly erodible” as indicated by an index for erodibility. The erodibility of soils is important when soils are disturbed through activities such as land clearing for new development (see Section 2.2). This is consistent with observations of siltation in the river.

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).

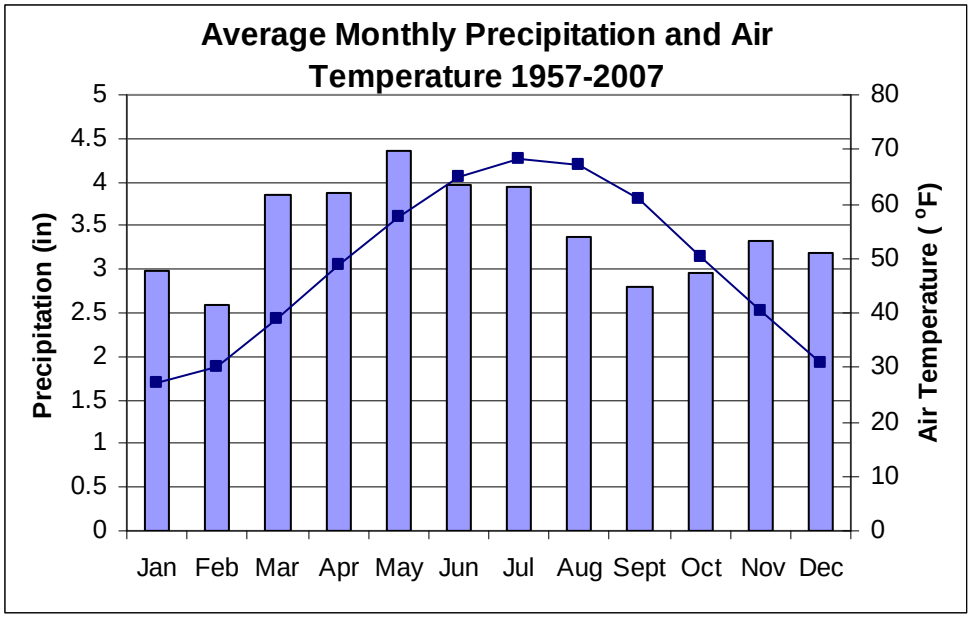

Figure 4. Average Monthly Precipitation and Air Temperature at the Cincinnati Northern Kentucky Airport (1957-2007)

2.1.6 Habitat

The Threemile Creek watershed lies within the Outer Bluegrass ecoregion[5], which is characterized by sinkholes, springs, entrenched rivers and intermittent and perennial streams (Woods et al., 2002). Wetlands are not common in this ecoregion and comprise less than 1% of this watershed. Streams typically have relatively high levels of suspended sediment and nutrients. Glacial outwash, which tends to be highly erodible, exists in a few areas.

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). Natural habitats have been altered from pre-settlement conditions and developed lands currently dominate this watershed (See Section 2.2.1).

KDOW assessed instream habitat[6] at four locations in this watershed. All sites were rated as not supporting of aquatic habitats (Table 1). Riparian zones[7] along much of Threemile Creek and North Branch were observed to be narrow, but riparian areas widen near its confluence with the Licking River, where it also experiences impacts from backwater from the larger river (Figure 5).

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

[6] This assessment was conducted using EPA-established protocols. KDOW rated several components of physical habitat within the stream such as epifaunal substrate, embeddedness, sediment deposition, channel flow status, bank stability and riparian vegetation zone width, among others.

[7] Riparian zones are important to aquatic systems for several reasons: they provide wood for aquatic habitat recruitment potential, they provide organic matter for instream invertebrates that support invertebrate food resources for fish, they filter sediment and toxics from entering the stream and they shade the water, allowing maintenance of cool water temperatures.

Table 1. Aquatic Habitat and Biological Sampling

Stream	River Mile	Monitoring[a]			
		Habitat		Macroinvertebrates	
		Year	Ranking	Year(s)	Ranking
Threemile Creek	0.7	2004	Not supporting	2004	Poor
Threemile Creek	1.4	2004	Not supporting	2004	Poor
North Branch Threemile Creek	0.3	2004	Not supporting	2004[b]	Poor
Unnamed Tributary to Threemile Creek at RM 1.3	0	2004	Not supporting	2004	Poor

[a] SD1 completed sampling in 2008. These data were not available at the time of this report but will be included in future updates.

[b] Duplicate sample taken showed the same result.

Source: SD1

Figure 5. Threemile Creek near its confluence with the Licking River

2.2 LAND COVER CHARACTERISTICS

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

2.2.1 Current Land Cover

The Kentucky Division of Geographic Information, Commonwealth Office of Technology provided a GIS dataset showing 2005 Kentucky land cover. This dataset was updated and improved to approximate 2007 land cover conditions (Figure 6) using a variety of other datasets that represent current impervious conditions (roads, parking lots, buildings), open space lands (including parks), and surface waters.

This watershed is highly developed, with portions of six communities (Southgate, Wilder, Highland Heights, Fort Thomas, Newport and Cold Spring) and two interstate highways (I-275 and I-471) located within its boundaries. This has resulted in roughly 68% of this watershed being categorized as developed and 17% having impervious surfaces. The remaining undeveloped land is primarily forest, and includes several large parks, such as Highland Country Club and Fredricks Landing, along with ball fields and parks on the Northern Kentucky University campus. Additionally, there are several homeowners associations, neighborhood parks and ball fields.

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). There is very little agricultural activity in the Threemile Creek watershed.

2.2.1.b Septic Systems

SD1 estimates that only two of the parcels in the Threemile Creek watershed are potentially serviced by septic systems.

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

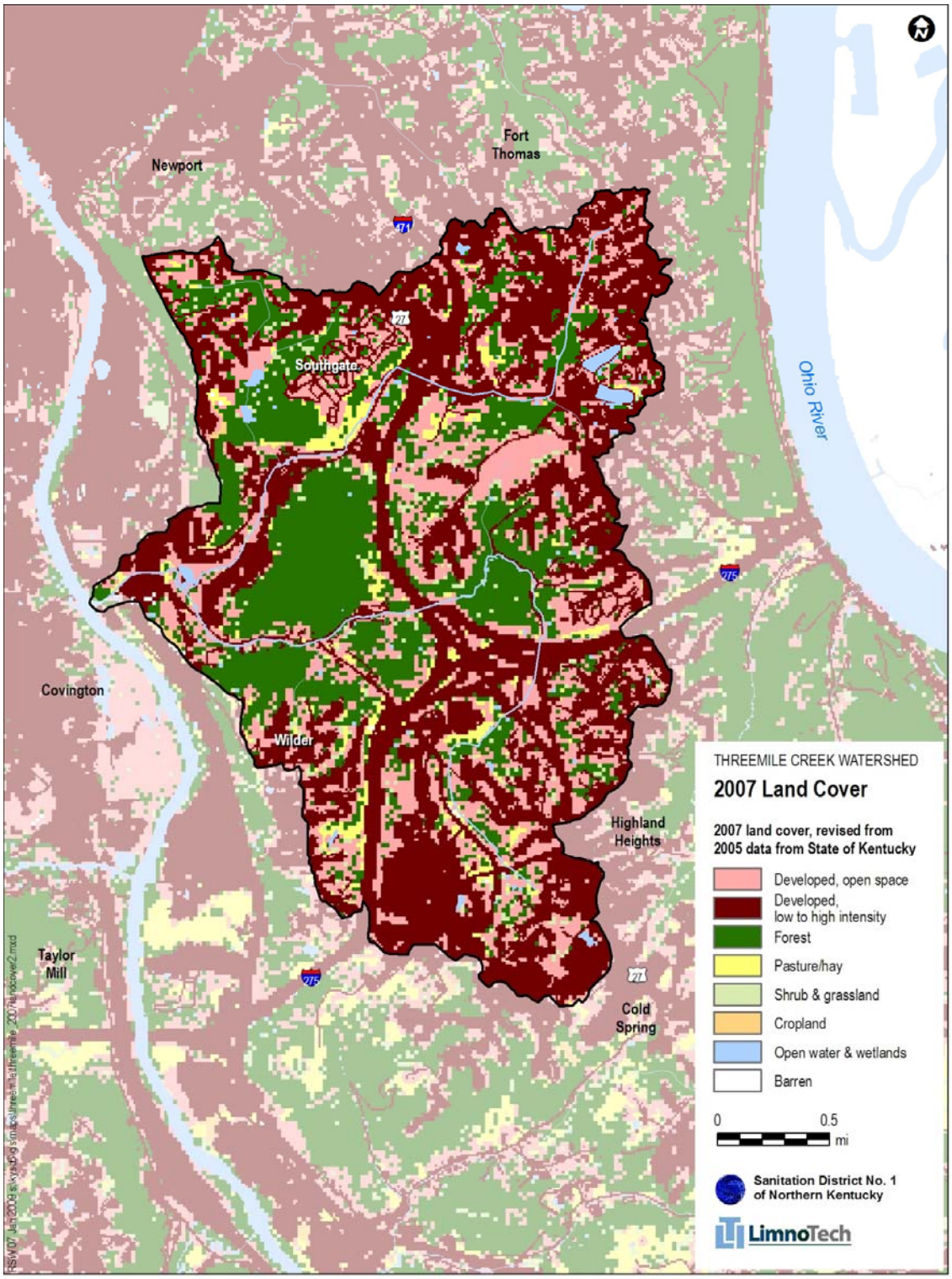

Figure 6. 2007 Land Cover

2.2.2 Future Conditions

Additional development is expected in this watershed in the future. Numerous highway construction projects were identified through a review of the six-year highway plan

(Kentucky Transportation Cabinet, 2006), including repaving, major widening projects to mitigate congestion and bridge replacement (Kentucky Transportation Cabinet, 2006).

A plan is being considered to develop a greenway along the Licking River between I-275 and the mouth. This greenway, if developed, would cross through the Threemile Creek watershed, near the mouth of Threemile Creek and may help preserve green space (http://www.covingtonky.com/documents/Short-LR-presentation.ppt),.

2.2.2.a Future land cover

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

It is predicted that developed lands will comprise most of the watershed (78%), resulting in an increase of imperviousness to 19% (Figure 7).

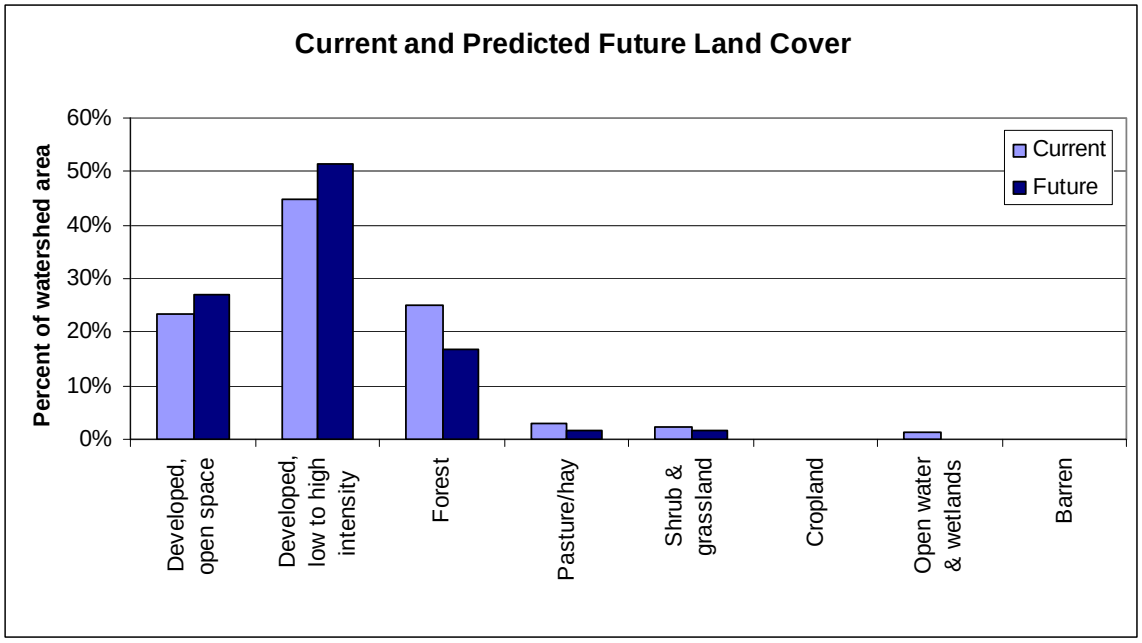

Figure 7. Current and Predicted Future Land Cover

2.3 INFRASTRUCTURE FEATURES

This section summarizes infrastructure features for the Threemile Creek watershed[8].

The entire Threemile Creek watershed is located within SD1's sanitary sewer service area. This area contains approximately 59.5 miles of separate sanitary sewer lines.

The Threemile Creek watershed lies entirely within SD1's storm water service area. The separate storm water system is comprised of approximately 59.5 miles of streams and channels and approximately 33.6 miles of pipes.

2.3.1 Point Sources and Infrastructure

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

2.3.1.a KPDES dischargers

There are no KPDES-permitted facilities in the Threemile Creek watershed.

2.3.1.b Sewer overflows

There are no combined sewer overflows (CSOs) in this watershed. There are thirteen sanitary sewer overflows (SSOs) from the separate sanitary collection system in this watershed. Table 2 shows a summary of model-predicted overflow volumes and frequencies from SD1's listed SSOs during a typical year.

Table 2. Sanitary Sewer Overflow Points

Manhole ID	Direct Discharge to Waterbody	Typical Year Spill Frequency[a]	Typical Year Volume[a]
0090009	No[b]	0	0
0100001	No[b]	0	0
0100002	No[b]	9	0.70
0110010	No[b]	10	0.63
0150023	No[b]	0	0
0150058	No[b]	16	1.96
0150063	No[b]	0	0
0150064	No[b]	0	0
0150065	No[b]	9	0.22
0150069	No[b]	0	0
0150351	No[b]	0	0
0150356	No[b]	0	0
0860016	No[b]	0	0

[a]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

[8] 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.

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.

[b] Greater than 50 feet from a waterbody

2.3.1.c Storm water discharges

Storm water outfalls are located throughout the watershed. In addition to storm water outfalls, there are approximately 21 suspected illicit activity points (SIAs) which are primarily located in the eastern portion of the watershed. SIAs are locations where there was possible evidence of illicit discharges during SD1's storm water mapping project (2001-2002). These locations are being further investigated to determine if they are recurring.

2.3.2 Recently Completed Infrastructure Projects

SD1 has made several improvements in this watershed.

- Vernon Lane Investigation. This project included a detailed characterization with flow monitoring, field reconnaissance, and the recalibration of SD1's collection system model to twelve months of continuous time series data. This characterization will aid in future Vernon Lane area studies and evaluation of alternative solutions.
- Sewer Rehabilitation and Replacement Projects. Based on the Vernon Lane investigation, sewer rehabilitation/replacements were conducted, along with the elimination of a cross-connection with a storm sewer. Additionally, approximately 1,600 linear feet of sewers within the watershed have recently been rehabilitated using cured-in-place pipe (CIPP) and other sewers have been replaced with new pipe.
- Crowell Sewer Assessment Project. Completed in 2005, this project involved extending sewer lines, giving 38 properties the opportunity to connect to sewer service.

2.3.3 Planned or Ongoing Infrastructure Improvement Projects

SD1 has several planned or ongoing projects for the Threemile Creek watershed.

- Vernon Lane Sewer System Evaluation Survey (SSES). This is an infiltration/inflow source detection project that is planned for the Vernon Lane area. This work will identify any direct or indirect storm water infiltration/inflow connections to all of SD1's sanitary sewers and manholes within the Vernon Lane service area of Fort Thomas. The Vernon Lane project is summarized in Table 3.
- Continuous Sewer Assessment Program (CSAP). Much of the Threemile Creek watershed will be included in the Phase 1 portion of SD1's new CSAP program that was developed as part of the Nine Minimum Controls and Capacity, Management, Operation and Maintenance (CMOM) Self Assessment activities. Most of the remaining portions of the watershed are to be included in Phase 2.

Phase 1 sewers are to be inspected in the first 3 years of the program and the Phase 2 sewers will be inspected in years 4-6.

Table 3. Planned or Ongoing Water Quality Improvement Projects

Capital Improvement Project Title	Goals	Anticipated Start Date	Anticipated Completion Date	Project Total
Vernon Lane SSES	Identify I/I sources	October 2008	To be determined	To be determined

2.4 SENSITIVE AREAS

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

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

The six criteria were evaluated individually. None of the waterbodies in the Threemile Creek watershed have been designated as Outstanding National Resource Waters (401 KAR 10:030) and there are no National Marine Sanctuaries in the watershed (NOAA, 2008). Additionally, there are no aquatic-dependent threatened or endangered species in this watershed (KSNPC, 2007). There are no known commercial shellfish beds within the Threemile Creek watershed nor is shellfish harvest for consumption by private individuals known to occur. Therefore these criteria were determined not to be relevant to the identification of sensitive areas in the Threemile Creek watershed. The remaining criteria are discussed below. A discussion of terrestrial threatened species is included only for potential relevance for ranking watersheds.

2.4.1 Threatened & Endangered Species or Their Designated Critical Habitat

Threatened and endangered species, species of concern and their designated critical habitat within this watershed were identified by contacting the Kentucky State Nature Preserves Commission (KSNPC). KSNPC identified two threatened species (stemless evening primrose and the six banded longhorn beetle), both of which are terrestrial (KSNPC, 2007).

The stemless evening primrose (*Oenothera triloba)* is a state-threatened species dependent upon dry woods and prairie habitats (KSNPC, 2006). This species was last observed in the watershed in 1907.

The six banded longhorn beetle (*Dryobius sexnotatus*) is a federal species of management concern (SOMC) and a state-threatened insect dependent upon climax hardwood forests,

where it primarily consumes sugar maple (Perry et al., 1974; Schweitzer, 1989). This species has only been recorded within the general area of the Threemile Creek watershed.

2.4.2 Primary contact recreation waters

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

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

2.4.3 Public drinking water intakes or their designated protection areas

There are no public drinking water intakes from surface waters or from public groundwater wells in the Threemile Creek watershed. The nearest downstream public drinking water intake from surface waters is located on the Ohio River near Louisville, Kentucky.

Source Water Assessment and Protection (SWAPP) zones for the 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 this entire 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.

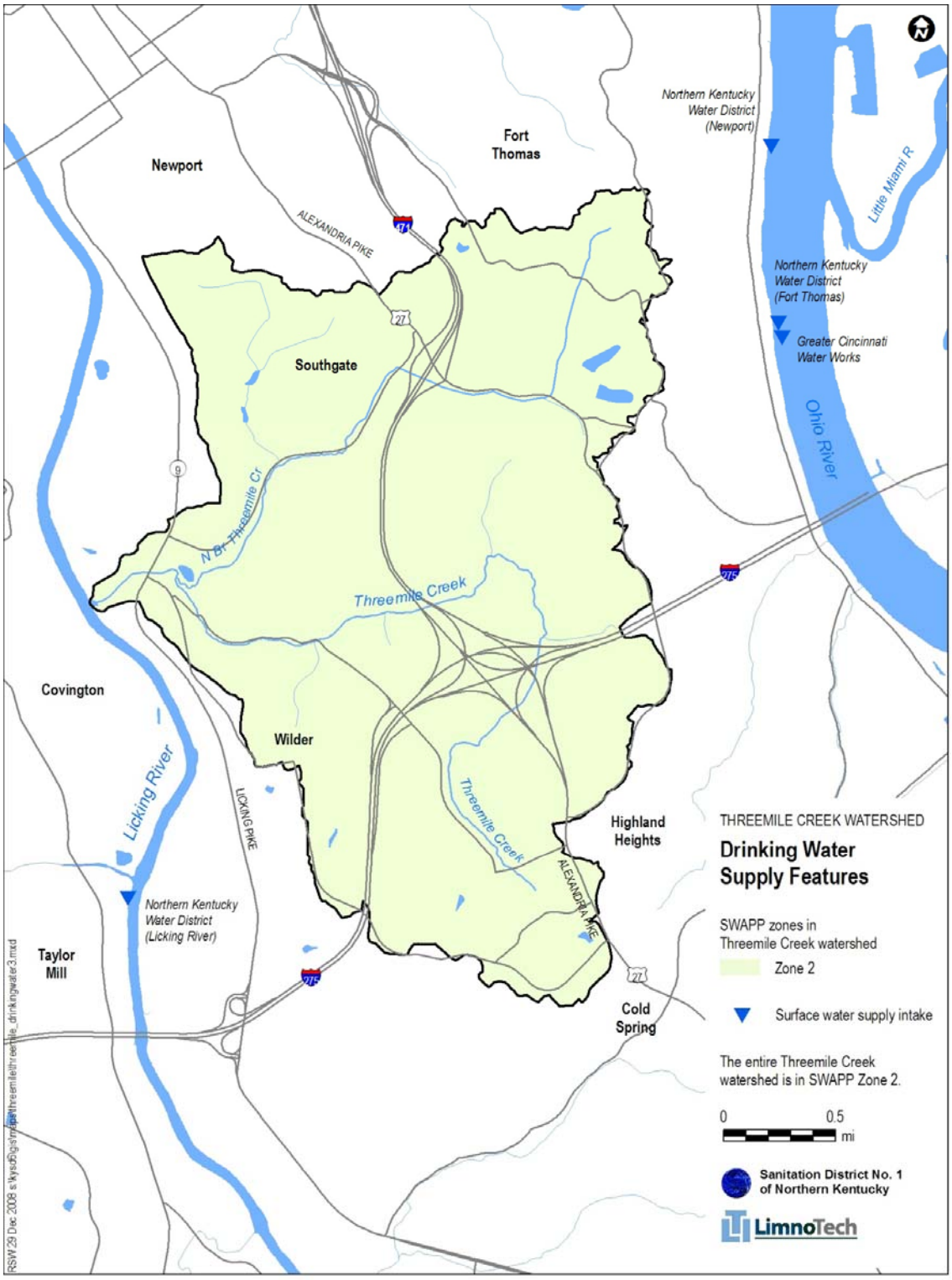

Figure 8. Drinking Water Supply Features

2.5 PUBLIC INTEREST/WATERSHED GROUP ACTIVITIES

Public interest in this watershed is moderate-high and is gauged through both monitoring and restoration work. Additionally, plans are being considered for development of a Licking River greenway, which if developed, would likely pass through this watershed (Section 2.2.2). Sampling has been conducted by SD1, KDOW, Northern Kentucky University (NKU) and Licking River Watershed Watch (LRWW).

Three restoration projects have been conducted in the North Branch subwatershed by Northern Kentucky University Center for Applied Ecology (CAE), and one more is being planned. Funding for these projects is provided through the Northern Kentucky Stream and Wetland Restoration Fund. Information on these projects was provided by NKU CAE. Completed projects are described below.

- Stream corridor restoration has been conducted along approximately 2,000 feet of North Branch, located on the Bentwood Hills Condominium property in the City of Wilder. In this project, the bank slope was adjusted and a rock toe was installed to stabilize the banks (Figure 9). The channel was modified to add some sinuosity to the reach and riffle-causing substrate was placed in the creek. Native vegetation was also planted along the banks of the restored reach. Two years after this project, the bank seemed stable and the native vegetation was flourishing.
- Stream corridor restoration has been conducted along approximately 3,700 feet of North Branch, located on the Woodland Hills Condominium property, in the City of Southgate. This stream flows immediately into the Bentwood Hills Stream Restoration site (above). This project involved fish passage enhancement, aquatic habitat enhancement, streambank stabilization, and restoration and enhancement of 10 acres of riparian forest (Figure 10).
- Restoration of 1,200 feet of perennial stream (Joe's Creek) was completed on Aspen Court in the City of Wilder. Joe's Creek is a tributary to North Branch and was formerly piped and buried with demolition debris.

Figure 9. Bentwood Hills Stream Restoration Site on North Branch

Photos show before (left) and after (right).

Figure 10. Woodland Hills Stream Restoration Site on North Branch

Photos show before (left) and after (right).

One restoration project is currently in the planning stages. This project, referred to by NKU as the Canterbury Apartments and KY Transportation Cabinet (KYTC) Right of Way (ROW) project, is being conducted to stabilize the channel, restore floodprone width, mitigate erosion, and improve fish passage. It involves restoration of 2,400 feet of North Branch, 780 feet of perennial tributaries and 8 acres of riparian buffer. Additionally, 5 or 6 basins are planned for retrofitting for storm water management to protect downstream reaches from peak flows, improve water quality and serve as a model retrofit. Detention will be provided for 65 acres, or 10% of the project watershed. Finally, riparian forest and meadow restoration is planned within the I-471-/US 27 cloverleaf.

3. WATERBODY USES

This section describes designated and current uses for Threemile Creek and its tributaries.

3.1 DESIGNATED USES

Threemile Creek 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 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

An assessment of available information found the following:

- Aquatic habitat was assessed at four sites and all sites were not supporting of aquatic habitats. Biological data collected at the same sites reflect poor conditions.
- 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).
- A swimming advisory has been issued for the creek. Furthermore, KDOW 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).
- One fishing access site was found in the watershed. This is the City of Southgate Pond, located in the northeast corner of the watershed (http://kygeonet.ky.gov/kdfwr/viewer.htm).
- There are no water supply intakes from surface waters in the watershed.
- There are no active public water supply groundwater wells in this watershed (KDOW, 2008a; KDOW, 2007b).

This page is blank to facilitate double sided printing.

4. WATERBODY CONDITIONS

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

4.1 303(d) STATUS AND POLLUTANTS OF CONCERN

Threemile Creek is listed on Kentucky's 2008 303(d) list of impaired waters (Table 4; KDOW, 2008).

Table 4. 303(d) Listing

Waterbody Segment	Designated Uses (Use support)	Pollutants	Suspected Sources
Threemile Creek RM 0.1 – 4.7	Warm Water Aquatic Habitat (Nonsupport) Primary Contact Recreation (Nonsupport)	Nutrient/Eutrophication Biological Indicators; Organic Enrichment (Sewage) Biological Indicators Fecal coliform	Sanitary Sewer Overflows (Collection System Failures) Sanitary Sewer Overflows (Collection System Failures) Source Unknown

TMDLs are planned for Threemile Creek. KDOW completed data collection in 2005, and may collect additional sediment data, if needed. Once data collection is complete, KDOW will develop the sediment TMDLs. The TMDLs for nutrients and organic enrichment will not be initiated until after nutrient criteria are promulgated by the state (KDOW, 2008).

4.2 MONITORING PROGRAMS

Water quality data have been collected in this watershed by KDOW, Northern Kentucky University (NKU), Licking River Watershed Watch (LRWW), USGS and SD1. Data currently compiled by SD1 from known monitoring programs are presented in Table 5; however, only data which have been fully analyzed are discussed in Section 4.3 Water Quality Data Analysis. Available data exist for the main stem of Threemile Creek, as well as North Branch Threemile Creek and an unnamed tributary to Threemile Creek.

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

Table 5. Summary of Water Quality Data

Entity	Dates	Parameters Sampled	Sampling Locations[b]	Number of Samples
KDOW	1985	Fecal coliform, Fecal strep	Threemile Cr. RM 0.4	1/month for Mar & July
KDOW	1994	Fecal coliform	Threemile Cr. RM 0.4, 0.9, 1.2, 1.4, 2.4, 2.6	One sampling event on 8/25/94
KDOW	1990-2005	Fecal coliform, Fecal strep or entero, E. coli, DO, pH, temperature	Threemile Cr. RM 0.1, 0.4, 1.2, 1.4, 2.6	Numerous sampling dates between Apr & Nov
KDOW	2004-2005	Fecal coliform, alkalinity, carbonaceous biochemical oxygen demand (5-day), chloride, DO, DO % Sat, hardness, pH, conductivity, TOC, TSS, temperature, sulfate, nutrients	Threemile Cr. RM 0.4, 0.7, 1.3, 1.4	1 or 2/month for Mar, May, June, Aug, Oct & Nov of 2004 and 1/month for Jan & Feb of 2005
LRWW	1999-2002	Fecal coliform	Threemile Cr. RM 0.4, 1.3	1/month for July & 1 sample in May
NKU	1999-2002	DO, temperature, pH, 2,4-D, (Dichlorophenoxyacetic acid), Atrazine, Chlorpyrifos-methyl, Metolachlor	Threemile Cr. RM 0.4	1/month for May or June all years
NKU	1999-2003	Fecal coliform, alkalinity, boron, chloride, DO, hardness, pH, conductivity, silicon, sulfur, sulfate, TOC, TSS, temperature, nutrients, metals	Threemile Cr. RM 0.4	1/month for Sept 1999, 2000, 2003
NKU	2000-2003	Fecal coliform, Fecal strep, E. coli, DO, pH, temperature	Threemile Cr. RM 0.4, 1.3	1/month for July & Aug 2000, 2001 & 2003
SD1	2006	Fecal coliform, E. coli, DO, conductivity, pH, turbidity, temperature	Threemile Cr. RM 0.1, 0.7; North Br. RM 0.8	10/10/06 & 10/24/06
SD1	2007	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Threemile Cr. RM 0.4, 1.4; North Branch Threemile Cr. RM 0.8	1 sample (7/3/2007)
SD1	2008	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Threemile Cr. RM 0.4	1 wet weather event in May (Seven samples over the course of the event)
SD1	2008[a]	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Threemile Cr. RM 0.4, 1.4; North Branch Threemile Cr. RM 0.8	1 sample (6/25/2008)
USGS	2007-present[a]	Flow, stage, DO, conductivity, pH, temperature	Station No. 03254695 (Threemile Cr RM 0.3)	15-minute data

[a]Data not analyzed in Section 4.3

[b] RM = River mile

4.2.1 Future Sampling

SD1 plans to continue monitoring this watershed during base flow conditions with at least one survey per year. The three sampling locations are: Threemile Creek at RM 0.4, 1.4 and RM 0.8 of the North Branch of Threemile Creek. Typical analyses will include bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters.

SD1 is planning to collect wet weather data at these three locations in 2009. Attempts will be made to collect data during three events of varying characteristics (total rainfall, maximum intensity). Samples may be analyzed for metals and hardness, in addition to the parameters described above. Within each event, samples will be collected near hour 0, 2, 4, 6, 12, 24, 36 and 48 hours of the start of the storm, though these intervals are dependent on the storm characteristics and may be changed if necessary. Additionally, surveys to assess the degree of stream hydromodification are currently underway by SD1.

The USGS will continue to operate the stage gage, measure flow and water quality (physical parameters) at RM 0.3 (station 03254695). This station is operated and funded via a cooperative agreement between USGS and SD1.

4.3 WATER QUALITY DATA ANALYSIS

Historical data (1985-2005) have been analyzed to identify past water quality problems in this watershed. Historical exceedances of water quality criteria were observed for bacteria and dissolved oxygen.

Recent data (2006-present) have been analyzed in more detail to describe current stream conditions. These recent data better reflect the effect of existing sources on instream water quality. It should be noted that the data collected at the USGS continuous monitoring station and some of the 2008 data collected by SD1 are not yet included in this assessment of recent data. These data are being reviewed and will be included in the next update of this report.

4.3.1 Historical Data

A summary of historical water quality findings are presented in Tables 6 and 7 for those parameters that exceeded applicable criteria. Numerous bacteria exceedances were observed, along with a single violation of the dissolved oxygen criterion. Measurements for parameters and locations not shown met water quality criteria.

Table 6. Historical Bacteria Exceedances

Stream	River Mile	Parameters exceeding criteria			
		Fecal coliform bacteria		*E. coli* bacteria	
		# samples	% of samples exceeding criteria[a]	# samples	% of samples exceeding criteria[a]
Threemile Creek	0.4	111	69%	4	75%
Threemile Creek	0.7	5	20%	---	n/a
Threemile Creek	1.4	23	61%	2	100%
Threemile Creek	2.6	12	83%	1	100%
North Branch Threemile Creek	0.4	5	40%	---	n/a
North Branch Threemile Creek	1.2	13	77%	2	50%
Unnamed Tributary to Threemile Creek entering Threemile Creek at RM 1.3	0.0	5	20%	---	n/a
Unnamed Tributary to Threemile Creek entering Threemile Creek at RM 1.3	0.3	3	100%	1	100%

[a] 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 is conservative as the criterion is meant to be applied to a dataset of five or more samples collected over a 30-day period.

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

Table 7. Historical Dissolved Oxygen Violations

Stream	River Mile	Parameters violating criteria	
		Dissolved oxygen	
		# measurements	% of measurements in violation[a]
Threemile Creek	0.4	71	1%

[a] The dissolved oxygen criterion is 4 mg/l.

4.3.2 Recent Data

Recent water quality data were available for Threemile Creek and its tributaries. A summary of recent water quality data and findings is presented in Table 8, for those parameters that exceeded applicable criteria. Measurements for parameters and locations not shown met water quality criteria. Elevated densities of fecal coliform and *E. coli* were observed at several locations. Recent data collected at the USGS station and 2008 data collected by SD1 are being reviewed and will be included in the next update of this report.

Table 8. Recent (2006-2008) Water Quality Exceedances

Stream	River Mile	Parameters exceeding criteria			
		Fecal coliform bacteria		*E. coli* bacteria	
		# samples	% of samples exceeding criteria[a]	# samples	% of samples exceeding criteria[a]
Threemile Creek	0.4	8	50%	8	75%
Threemile Creek	0.7	2	50%	2	50%
Threemile Creek	1.4	1	0%	1	100%
North Branch Threemile Creek	0.8	3	33%	3	0%

[a] 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 is conservative as the criterion is meant to be applied to a dataset of five or more samples collected over a 30-day period.

A discussion of recent water quality findings follows below by parameter.

4.3.2.a Bacteria

Fecal coliform and *E. coli* data were available for base flow conditions at several locations, and for both base and storm flow conditions at Threemile Creek RM 0.4.

As shown in Figure 11, base flow fecal coliform concentrations exceeded the applicable criterion in three of the base flow samples. Storm flow samples at RM 0.4 exceeded the fecal coliform criterion. The maximum base flow fecal coliform concentration 1,100 cfu/100 ml, was observed at Threemile Creek RM 0.7 on October 10, 2006. The storm flow fecal coliform concentration at RM 0.4 was 1,258 cfu/100 ml.

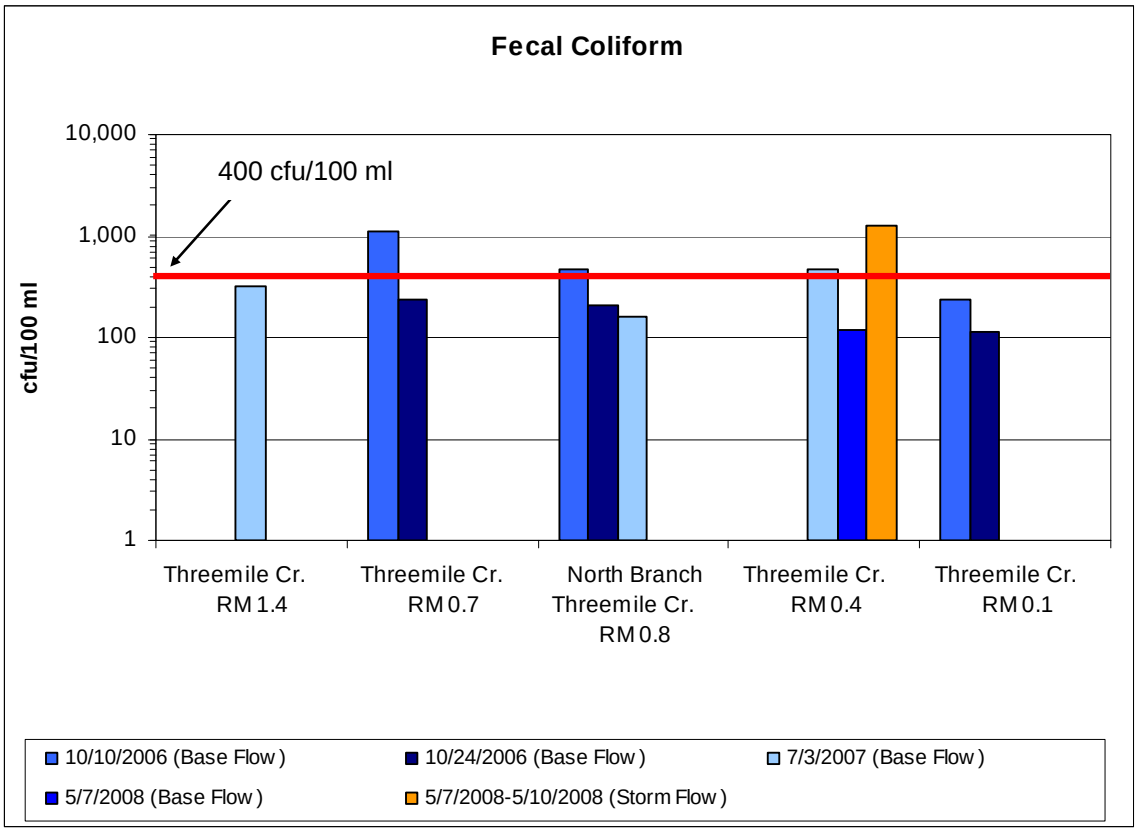

Figure 11. 2006-07 Base Flow and Average Storm Flow Fecal Coliform Concentrations Compared to 400 cfu/100 ml Criterion

Figure 12 shows a similar pattern for *E. coli*. Base flow *E. coli* concentrations exceeded the applicable criterion in three of the base flow samples. Storm flow samples at RM 0.4 exceeded the *E. coli* criterion. The maximum base flow *E. coli* concentration 1,020 cfu/100 ml, was observed at Threemile Creek RM 0.7 on October 10, 2006. The storm flow *E. coli* concentration at RM 0.4 was 1,028 cfu/100 ml.

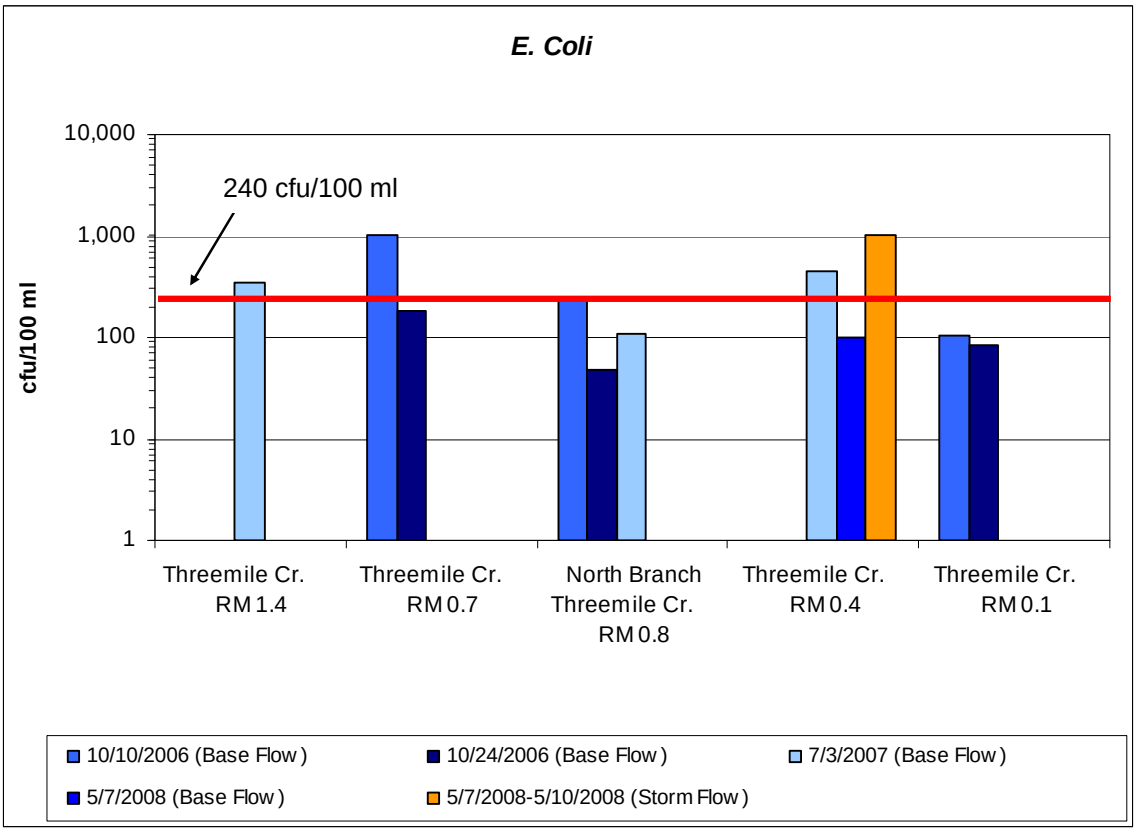

Figure 12. 2006-07 Base Flow and Average Storm Flow *E. Coli* Concentrations Compared to 240 cfu/100 ml Criterion

4.4 BIOLOGICAL CONDITIONS

Macroinvertebrate communities are susceptible to water quality and habitat degradation, and data from these communities are used as a tool to detect changes in habitat and water quality and assessing stream health (KDOW 2008b).

KDOW sampled macroinvertebrates at four sites in the watershed in 2004. The MBI[9] score calculated for all sites produced a ranking of "poor" (Table 1).

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

This page is blank to facilitate double sided printing.

5. SOURCE ANALYSIS

This section summarizes potential pollutant sources in the Threemile Creek watershed to provide information related to recent observed impairments. Conclusions are based on the watershed characterization and available water quality data.

5.1 WATERSHED SOURCE ANALYSIS

Potential sources of bacteria were identified within the Threemile Creek watershed. These sources are summarized in Table 9 and their locations are shown in Figure 13. There are no KPDES permitted dischargers, CSOs, or livestock identified in this watershed.

Table 9. Summary of Potential Sources

	Threemile Creek
Recent observed impairment =>	Bacteria[b]
Septic systems	Very few
SSO[a]	13
Storm water runoff	Urban
Watershed improvements	I/I source detection project planned for Vernon Lane area. In North Branch watershed: 3 stream restoration have been completed by NKU. One restoration project being planned, which includes stream restoration and detention basins. If developed, the proposed Licking River greenway would pass through this watershed near the mouth of Threemile Creek.

[a]SD1 is undertaking a characterization and assessment of the sanitary sewers, and sources are subject to change

[b]Sanitary sewer overflows and source unknown are identified as potential sources contributing to the impaired aquatic habitat and primary contact recreation uses in this watershed (KDOW, 2008).

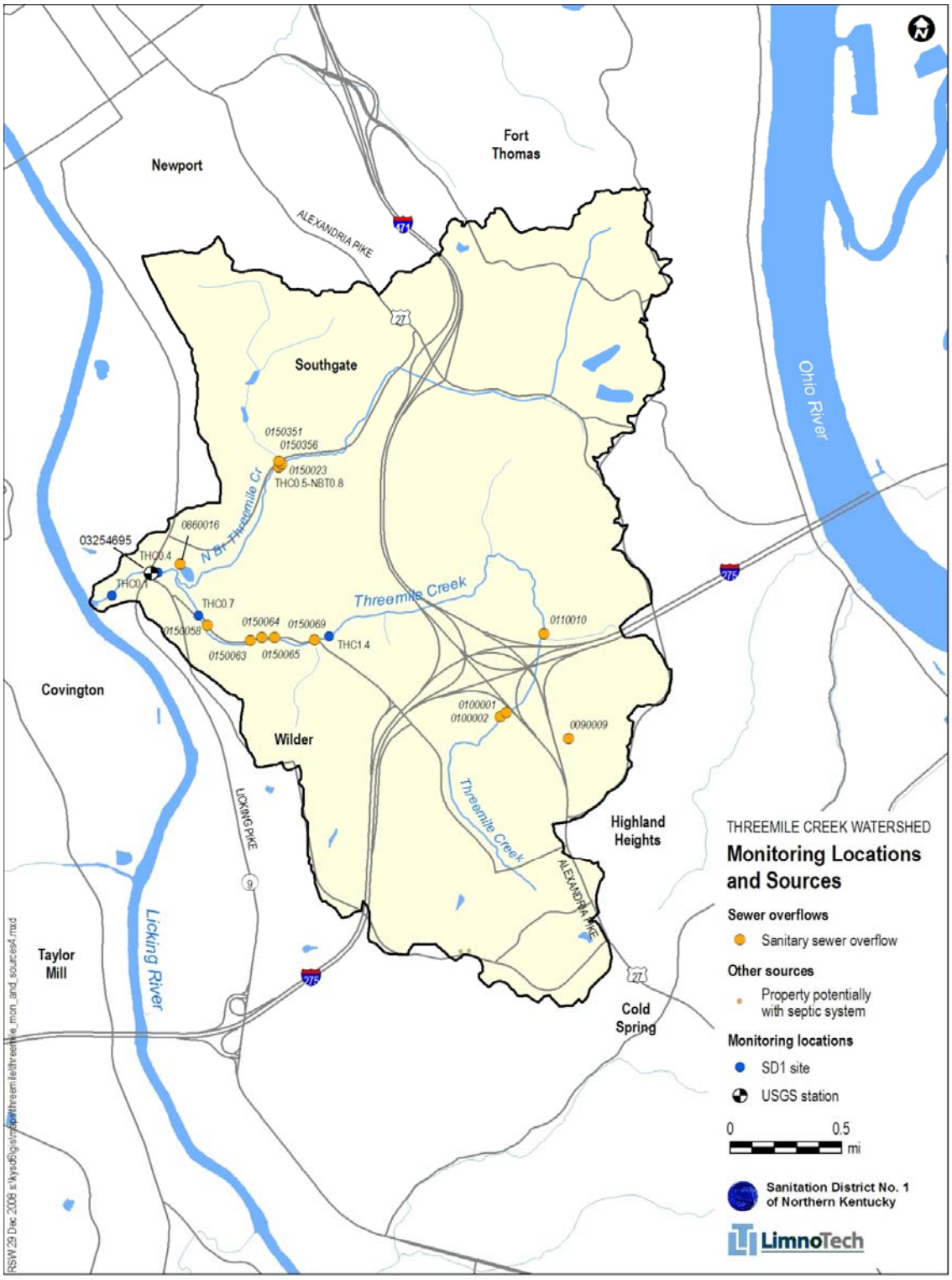

Figure 13. Monitoring Locations and Sources

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[10] indicate that under year-round conditions, the Threemile Creek watershed has a higher than average rank (analogous to load) for fecal coliform, relative to the sixteen identified watersheds in SD1's jurisdictional area.

In addition to WAT! results, other factors such as presence of public drinking water features, presence of aquatic-dependent threatened and endangered (T&E) species, special designations, and public interest may affect watershed prioritization. These and other ranking considerations are summarized in Table 10.

Table 10. Watershed Ranking Considerations

CSOs (#)	SSOs (#)	SWAPP Zone	Aquatic-dependent T&E Species[a] (#)	Special designation	Public interest	WAT! Rank, Year-Round Conditions[b]
						Bacteria
0	13	Zone 2 (due to Louisville intake)	0	None	Moderate-high	5 of 16

[a] There are no aquatic-dependent species that are threatened, endangered or of special concern in this watershed. There are two terrestrial species, however, that are threatened.

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

6.2 SCREENING TO DETERMINE IF ADDITIONAL DATA ARE NEEDED

Sufficient data and information are currently available or planned to support a reasonable understanding of current conditions and important sources in the Threemile Creek watershed.

[10] 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

Planned activities include base flow and storm flow sampling. No data gaps were identified for this watershed.

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 14. These WAT! results incorporate predicted sewer overflow volumes from infrastructure model simulations for 1992-1996 climatological conditions[11]. CSOs were not a factor in the WAT! results, as none occur in the watershed, however; flow estimates are available for four of the SSOs

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.

[11] 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.

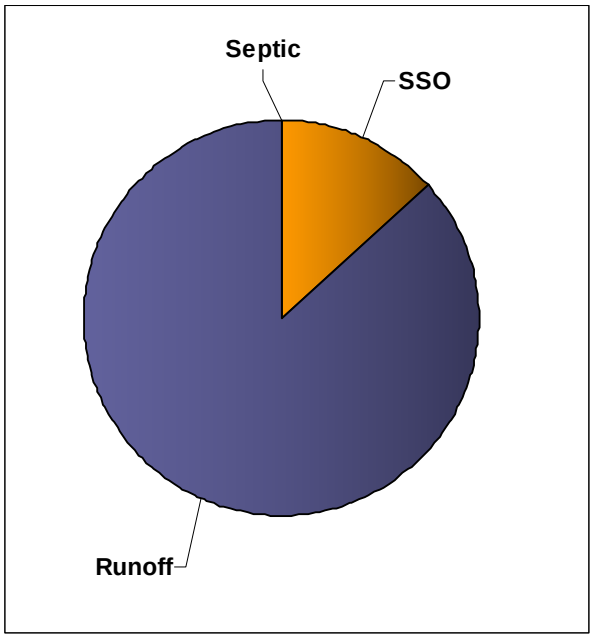

Figure 14. Initial Year-Round WAT! Results for Fecal Coliform

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

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

6.4 WATERSHED RANKING

The WAT! produced a ranking, by watershed for the 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 Threemile Creek watershed during year-round and base flow conditions is provided in Table 11.

Table 11. WAT! Watershed Rankings

	Rank for Year-Round Conditions[a,b]	Rank for Base flow Conditions[a,b]
Fecal coliform	5	15

[a] 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.

[b] 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.

This page is blank to facilitate double sided printing.

7. REFERENCES

Carey, D. I. and Stickney, J. F., 2005. Groundwater Resources of Campbell County, Kentucky. Kentucky Geological Survey County Report 19, Series XII, ISSN 0075-5567.

Jacobs, 2008. Comprehensive Plan Update Campbell County, Kentucky. April 2008. Draft. Online at http://www.campbellcounty.ky.gov/countyservices/pz/

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. Technical Amendment August 9, 2007.

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 Water (KDOW), 2007. Fish Consumption Advisories in Kentucky. www.water.ky.gov/sw/advisories/fish.htm Last modified 7/25/2007. Accessed 2/24/2008.

Kentucky Division of Water (KDOW). 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 Division of Water (KDOW), Natural Resources and Environmental Protection Cabinet. 2008b. Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky. February.

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), 2006. http://www.naturepreserves.ky.gov/NR/rdonlyres/2428E57D-999B-49F2-AA54-A28DA53E13FE/0/Natky51_Summer2006.pdf

Kentucky State Nature Preserves Commission (KSNPC), 2007. Natural Heritage Program Database Review. Data Request 07-097. February 14.

Kentucky Transportation Cabinet. 2006. Campbell County Six Year Highway Plan. May 25.

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.

Paylor, R.L. and J.C. Currens. *Karst Occurrence in Kentucky*. University of Kentucky, Kentucky Geological Survey. 2002. http://kgsweb.uky.edu/olops/pub/kgs/mc33_12.pdf. Accessed on May 21, 2007.

Perry, R.H, R.W. Surdick and D.M. Anderson. 1974. Observations on the biology, ecology, behavior, and larvae of *Dryobius sexnotatus* Linsley (Coleoptera: Cerambycidae). Coleopterists Bulletin 28(4): 169-176.

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.

Schweitzer, D.F. 1989. A review of category 2 Insecta in USFWS Regions 3, 4 and 5. The Nature Conservancy, Boston.

United States Environmental Protection Agency (USEPA). April 19, 1994. Combined Sewer Overflow (CSO) Policy. *Fed. Regist*. Vol. 59. pg18688.

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, Virginia.