

**TMDL SYNOPSIS****S.1 Impaired Waterbodies****State:** Kentucky**Major River Basin:** Kentucky River**USGS HUC8:** 05100205**Counties:** Fayette, Franklin, Jessamine, Scott, and Woodford**Pollutants of Concern:** *E. coli*, Fecal Coliform**Impaired Use:** Primary Contact Recreation, Secondary Contact Recreation**Suspected Sources:** Agriculture, Urban Runoff/Storm Sewers, Municipal Point Source Discharges, Manure Runoff, Managed Pasture Grazing, Livestock (Grazing or Feeding Operations), Source Unknown, Unspecified Urban Stormwater**Table S.1 Impaired Waterbodies Addressed in this TMDL Document**

<b>Waterbody, River Miles (GNIS<sup>(1)</sup> Number)</b>	<b>County</b>	<b>Pollutant</b>	<b>Use Impairment(s)</b>	<b>Suspected Source(s)<sup>(2)</sup></b>
Lee Branch 0.0–1.0 (KY496153_01)	Woodford	Fecal coliform	Primary Contact Recreation (Nonsupport)	Municipal Point Source Discharges, Agriculture
South Elkhorn Creek 5.05–16.6 (KY503901_01)	Woodford	Fecal coliform	Primary Contact Recreation (Nonsupport)	Agriculture, Urban Runoff/Storm Sewers, Municipal Point Source Discharges, Manure Runoff, Managed Pasture Grazing
South Elkhorn Creek 16.6–34.5 (KY503901_02)	Woodford	Fecal coliform	Primary Contact Recreation (Nonsupport)	Agriculture, Urban Runoff/Storm Sewers, Municipal Point Source Discharges, Manure Runoff, Managed Pasture Grazing, Livestock (Grazing or Feeding Operations)
South Elkhorn Creek 34.5–52.7 (KY503901_03)	Woodford	Fecal coliform	Primary Contact Recreation (Nonsupport)	Source Unknown
Steeles Run 0.0–5.1 (KY504312_01)	Fayette	Fecal coliform	Primary Contact Recreation (Nonsupport), Secondary Contact Recreation (Nonsupport)	Agriculture, Manure Runoff

<b>Waterbody, River Miles (GNIS<sup>(1)</sup> Number)</b>	<b>County</b>	<b>Pollutant</b>	<b>Use Impairment(s)</b>	<b>Suspected Source(s)<sup>(2)</sup></b>
Town Branch Creek 0.0–9.2 (KY505386_01)	Fayette	Fecal coliform	Primary Contact Recreation (Nonsupport)	Municipal Point Source Discharges, Unspecified Urban Stormwater
Town Branch Creek 9.2–10.8 (KY505386_02)	Fayette	Fecal coliform	Primary Contact Recreation (Nonsupport)	Municipal Point Source Discharges, Urban Runoff/Storm Sewers
Town Branch Creek 10.8–12.1 (KY505386_03)	Fayette	Fecal coliform	Primary Contact Recreation (Nonsupport), Secondary Contact Recreation (Nonsupport)	Municipal (Urbanized High Density Area), Unspecified Urban Stormwater
Wolf Run Creek 0.0–4.4 (KY507029_01)	Fayette	Fecal coliform	Primary Contact Recreation (Nonsupport), Secondary Contact Recreation (Nonsupport)	Unspecified Urban Stormwater, Urban Runoff/Storm Sewers
Gardenside Spring (507029-3.05_00)	Fayette	<i>E. coli</i>	Primary Contact Recreation (Nonsupport)	Unspecified Urban Stormwater, Urban Runoff/Storm Sewers
McConnell Springs (SPG001)	Fayette	Fecal coliform	Primary Contact Recreation (Nonsupport)	Unspecified Urban Stormwater, Urban Runoff/Storm Sewers

<sup>(1)</sup> GNIS = Geographic Names Information System.

<sup>(2)</sup> Suspected Sources are copied from the 2010 Integrated Report. They do not represent all sources described in the TMDL document.

**S.2 TMDL Endpoint (Numerical/Narrative Target)****Table S.2 TMDL Endpoints by Impaired Waterbody**

<b>Waterbody (GNIS<sup>(1)</sup> Number)</b>	<b>River Mile</b>	<b>TMDL Endpoint</b>
Lee Branch (KY496153_01)	0.0–1.0	200 fecal coliform colonies/100ml expressed as a 30-day geometric mean with an implicit Margin of Safety
South Elkhorn Creek (KY503901_01)	5.05–16.6	
South Elkhorn Creek (KY503901_02)	16.6–34.5	
South Elkhorn Creek (KY503901_03)	34.5–52.7	
Steeles Run (KY504312_01)	0.0–5.1	
Town Branch Creek (KY505386_01)	0.0–9.2	
Town Branch Creek (KY505386_02)	9.2–10.8	
Town Branch Creek (KY505386_03)	10.8–12.1	
Wolf Run Creek (KY507029_01)	0.0–4.4	
Gardenside Spring (507029-3.05_00)	N/A <sup>(2)</sup>	216 <i>E. coli</i> colonies/100ml (240 colonies/100ml minus a 10% Margin of Safety)
McConnell Springs (SPG001)	N/A	360 fecal coliform colonies/100ml (400 colonies/100ml minus a 10% Margin of Safety)

<sup>(1)</sup> GNIS = Geographic Names Information System.

<sup>(2)</sup> N/A = Not Applicable. Springs do not have River Miles

**S.3 TMDL Equation and Calculations**

According to EPA (1991), a TMDL calculation is performed as follows:

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

(Equation S.1)

The WLA has three components:

$$\text{WLA} = \text{SWS-WLA} + \text{MS4-WLA} + \text{Future Growth-WLA}$$

(Equation S.2)

Definitions:

**TMDL:** the Water Quality Criterion (WQC), expressed as a load.

**MOS:** the Margin of Safety, which can be an implicit or explicit additional reduction applied to sources of pollutants that accounts for uncertainties in the relationship between effluent limits

and water quality. For this report, the MOS is implicit for impaired streams and explicit for impaired springs.

**TMDL Target:** the TMDL minus the MOS.

**WLA:** the Wasteload Allocation, which is the allowable loading of pollutants into the stream from KPDES-permitted sources, such as SWSs and MS4s.

**SWS-WLA:** the WLA for KPDES-permitted sources, which have discharge limits for pathogen indicators (including wastewater treatment plants, package plants and home units).

**Future Growth-WLA:** the allowable loading for future KPDES-permitted sources, including new SWSs, expansion of existing SWSs, new storm water sources, and growth of existing storm water sources (such as MS4s). Also includes the allocation for the KPDES-permitted sources that existed but were not known at the time the TMDL was written.

**Remainder:** the TMDL minus the MOS and minus the SWS-WLA (also equal to Future Growth-WLA plus the MS4-WLA and the LA).

**MS4-WLA:** the WLA for KPDES-permitted Municipal Separate Storm Sewer Systems (MS4 permittees can include cities, counties, roads and right-of-ways owned by the Kentucky Transportation Cabinet (KYTC), universities and military bases).

**LA:** the Load Allocation, which is the allowable loading of pollutants into the stream from sources not permitted by KPDES and from natural background.

**Seasonality:** yearly factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.

**Critical Condition:** the time period when the pollutant conditions are expected to be at their worst.

**Critical Flow:** the flow(s) used to calculate the TMDL as a load.

**Existing Conditions:** the load that exists in the watershed at the time of TMDL development (i.e., sampling) and is causing the impairment.

**Load:** concentration \* flow \* conversion factor.

**Concentration:** colonies per 100 milliliters (colonies/100ml).

**Flow (i.e., stream discharge):** cubic feet per second (cfs).

**Conversion Factor:** the value that converts the product of concentration and flow to load (in units of colonies per day); it is derived from the calculation of the following components:  $(28.31685\text{L}/\text{ft}^3 * 86400\text{seconds}/\text{day} * 1000\text{ml}/\text{L})/(100\text{ml})$  and is equal to 24,465,758.4.

#### Calculation Procedure:

- 1) The MOS, if an explicit value, is calculated and subtracted from the TMDL first, giving the TMDL Target;
- 2) The SWS-WLA is calculated and subtracted from the TMDL Target, leaving the Remainder;
- 3) The Future Growth-WLA is calculated and subtracted from the Remainder;
- 4) If there is a MS4 present upstream of the impaired segment, the MS4-WLA is subtracted from the Remainder based on percent land use, leaving the LA.

TMDL Calculations for individual impaired waterbodies are shown in Table S.2. All TMDLs are in terms of fecal coliform, except Gardenside Spring, which has a supplementary header row and whose TMDL is in terms of *E. coli*.

**Table S.3 Final Total Maximum Daily Loads for Each Impaired Segment**

<b>Waterbody (River Mile)</b>	<b>Final TMDL<sup>(1)</sup> (fecal coliform colonies/ day)</b>	<b>Margin of Safety (fecal coliform colonies/ day)</b>	<b>SWS-WLA<sup>(2)</sup> (fecal coliform colonies/day)</b>	<b>Future Growth- WLA, (fecal coliform colonies/ day)</b>	<b>MS4 Permittee<sup>(3)</sup></b>	<b>Final (2001 NLCD) MS4- WLA,<sup>(3)</sup> (fecal coliform colonies/ day)</b>	<b>Final LA (fecal coliform colonies/ day)</b>
Lee Branch (0.0-1.0)	8.80E+12	Implicit	5.68E+09	1.76E+11	None	0.00E+00	8.62E+12
South Elkhorn Creek <sup>(1)</sup> (5.05-16.6)	1.48E+13	Implicit	0	1.48E+11	Franklin County/ KYTC	9.46E+08	1.47E+13
South Elkhorn Creek (16.6-34.5)	1.18E+13	Implicit	0	2.36E+11	None	0.00E+00	1.16E+13
South Elkhorn Creek (34.5-52.7)	2.63E+13	Implicit	3.83E+08	1.05E+12	Lexington/ Jessamine County/ University of Kentucky/ KYTC	6.44E+10	2.52E+13
Steeles Run (0.0-5.1)	3.15E+12	Implicit	0	3.15E+10	Lexington/ KYTC	4.42E+08	3.12E+12
Town Branch Creek (0.0-9.2)	7.70E+12	Implicit	0	2.31E+11	Lexington/ KYTC	8.21E+09	7.46E+12
Town Branch Creek (9.2-10.8)	4.84E+11	Implicit	2.27E+11	1.29E+10	Lexington/ KYTC	2.52E+09	2.42E+11
Town Branch Creek (10.8-12.1)	1.80E+10	Implicit	0	9.00E+08	Lexington/ University of Kentucky/ KYTC	4.44E+09	1.27E+10
Wolf Run Creek (0.0-4.4)	8.28E+11	Implicit	0	4.14E+10	Lexington/ University of Kentucky/ KYTC	3.20E+10	7.55E+11

Waterbody (River Mile)	Final TMDL <sup>(1)</sup> (fecal coliform colonies/ day)	Margin of Safety (fecal coliform colonies/ day)	SWS-WLA <sup>(2)</sup> (fecal coliform colonies/day)	Future Growth- WLA, (fecal coliform colonies/ day)	MS4 Permittee <sup>(3)</sup>	Final (2001 NLCD) MS4- WLA, <sup>(3)</sup> (fecal coliform colonies/ day)	Final LA (fecal coliform colonies/ day)
McConnell Springs (N/A) <sup>(4)</sup>	5.87E+09	5.87E+08	0	2.64E+08	Lexington/ University of Kentucky/ KYTC	4.35E+09	6.68E+08
Waterbody (River Mile)	Final TMDL <sup>(5)</sup> ( <i>E. coli</i> colonies/ day)	Margin of Safety ( <i>E. coli</i> colonies/ day)	SWS WLA ( <i>E. coli</i> colonies/day)	Future Growth- WLA, ( <i>E.</i> <i>coli</i> colonies/ day)	MS4 Permittee <sup>(3)</sup>	Final (2001 NLCD) MS4- WLA <sup>(3)</sup> ( <i>E. coli</i> colonies/ day)	Final LA ( <i>E. coli</i> colonies/ day)
Gardenside Spring (N/A) <sup>(4)</sup>	2.94E+08	2.94E+07	0	1.32E+07	Lexington/ KYTC	2.18E+08	3.34E+07

<sup>(1)</sup> In the event that compliance with the WQC is determined using *E. coli* concentrations as opposed to fecal coliform concentrations, the final fecal coliform allocations can be converted to *E. coli* by multiplying by the figure (240/400) for instantaneous values, or by the figure (130/200) for the 30-day geometric mean value, assuming 5 or more samples are taken within a 30-day period.

<sup>(2)</sup> WLAs for the Sanitary Wastewater Systems (SWSs, e.g., Wastewater Treatment Plants (WWTPs)) discharging to a listed segment are equal to their permit limit times their design flow. These values were derived using the monthly average fecal coliform Water Quality Criterion (WQC) of 200 colonies/100ml calculated as a geometric mean so the allocated load is in units of colonies/day. See Table S.3 for allocations for individual SWSs. Individual SWSs may be permitted for either fecal coliform or *E. coli* according to 401 KAR 10:031, but all SWSs were modeled as discharging fecal coliform so their output was consistent with the monitoring protocol used to develop the TMDL.

For facilities permitted to discharge in terms of fecal coliform the daily maximum allocation is based on the WQC of 400 colonies/100ml as opposed to 200 colonies/100ml. For facilities permitted to discharge in terms of *E. coli* the daily maximum allocation is based on 240 colonies/100ml as opposed to 130 colonies/100ml. Any future permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 10:031, and must not cause or contribute to an existing impairment.

Although Concentrated Animal Feeding Operations (CAFOs) receive their allocations within the WLA, there are no permitted CAFOs present in the watershed. Any future CAFO cannot legally discharge to surface water, and therefore receives a WLA of zero. The only exception is holders of a CAFO Individual Permit can discharge during a 25-year or greater storm event.

<sup>(3)</sup> Municipal Separate Storm Sewer Systems (MS4s) receiving aggregated MS4-WLAs include Franklin County (Permit Number KYG200034), the City of Lexington (Permit Number KYS000002), Jessamine County (Permit Number KYG200049), the University of Kentucky (Permit Number not yet assigned) and the Kentucky Transportation Cabinet (KYTC, Permit Number KYS000003).

<sup>(4)</sup> N/A = Not applicable; springs do not have River Miles.

<sup>(5)</sup> In the event that compliance with the WQC is determined using fecal coliform concentrations as opposed to *E. coli* concentrations, the final *E. coli* allocations can be converted to fecal coliform by

multiplying by the figure (400/240) for instantaneous values, or by the figure (200/130) for the 30-day geometric mean value, assuming 5 or more samples are taken within a 30-day period.

**Table S.4 Pollutant Allocations for Sanitary Wastewater Systems**

Facility	KPDES Permit Number	Receiving Waterbody	Design Discharge (mgd <sup>(1)</sup> )	Permit Limit (fecal coliform colonies/100ml) <sup>(2)</sup>	Wasteload Allocation (fecal coliform colonies/day)
Town Branch Treatment Plant	KY0021491	Town Branch, RM 10.6	30.000	200	2.27E+11
Midway Sewage Treatment Plant	KY0028410	Lee Branch, RM 1.0	0.750	200	5.68E+09
Airport Food Mart	KY0083062	Shannon Run, RM 2.6	0.010	200	7.57E+07
Dance Enterprises Mobile Home Park	KY0102610	South Elkhorn Creek, RM 35.5	0.040	200	3.03E+08
Farris Residence	KYG400023	South Elkhorn Creek, RM 38.1	0.0005	200	3.79E+06

<sup>(1)</sup> mgd = millions of gallons per day.

<sup>(2)</sup> While all Sanitary Wastewater System (SWS) facilities were modeled as discharging fecal coliform at the monthly geometric mean of 200 colonies/100ml, since the TMDL was begun in 2002 KDOW has been in the process of switching active permit holders from reporting in terms of fecal coliform to instead reporting in terms of *E. coli* when their permits became due for reissuance, therefore a mix of permit limits currently exists: The Airport Food Mart, Dance Enterprises and the Farris Residence all report in *E. coli*, while Town Branch and Midway currently report in fecal coliform. However, since insufficient data exist to build a correlation curve between *E. coli* and fecal coliform, it was necessary to report the WLA for all SWSs in terms of fecal coliform so their allocations were consistent with the monitoring protocol used to develop the TMDL. However, this does not change the permit limits for any given facility; facilities permitted in terms of *E. coli* should continue to report in those units; their WLAs are equivalent to those given above.

#### S.4 Translation of WLAs into Permit Limits

WLAs for Sanitary Wastewater Systems (SWSs) were given in Table S.3. SWS-WLAs will be translated into KPDES permit limits as an *E. coli* effluent gross limit of 130 colonies/100ml as a monthly average and 240 colonies/100ml as a maximum weekly average or as a fecal coliform effluent gross limit of 200 colonies/100ml as a monthly average and 400 colonies/100ml as a maximum weekly average. KPDES permits for Municipal Separate Storm Sewer Systems (MS4) must also contain conditions that are consistent with the MS4-WLA [40 CFR

122.44(d)(1)(vii)(B)]. Because of the varying flow conditions associated with MS4 discharges and the fact that the MS4-WLA was set under a single modeling scenario, permit conditions should provide for an adaptive iterative approach via Best Management Practices (BMPs) outlined in the Stormwater Quality Management Program (SWQMP) and implemented to the Maximum Extent Practicable (MEP).

Because MS4 loading inputs vary over time and with flow, the MS4-WLA values shown in the TMDL Summary Tables represent only one possible allocation scenario. The computed MS4-WLA should be viewed in this broader context of varying load and varying flow when evaluating the MS4's fractional contribution to total in-stream bacteria concentration. Consideration of stream assimilative capacity, use of pollutant trading or offset scenarios, MS4 pollutant load input variations for dry and wet weather, and BMP implementation and performance are some of the variables to consider when setting compliance goals. For the MS4 permit, MS4-WLAs will be expressed as BMPs.

The MS4 permits in the watershed require that upon completion of a TMDL for a receiving water to which the MS4 discharges, the SWQMP must be revised to identify specific, measureable, and enforceable actions to be taken, in the context of MEP, in the MS4's effort to attain the MS4-WLA identified in the TMDL.

While not all MS4 permits within the watershed currently call for monitoring as a requirement of the MS4 permittee based on an approved TMDL, KDOW plans to issue future MS4 permits in watersheds with approved TMDLs that will require MS4s to develop and implement a monitoring program to measure the effectiveness of the BMP actions taken toward meeting the MS4-WLA and to direct the MS4 to adaptive management approaches to implementing the TMDL. An effective monitoring program could include:

1. Effluent monitoring at selected outfalls that are representative of particular land uses or geographical areas that contribute to pollutant loading before and after implementation of storm water control measures; or
2. Monitoring of pollutants of concern in receiving waterbodies, both upstream and downstream of MS4 discharges, over an extended period of time, or;
3. Instream biological monitoring at appropriate locations to demonstrate the recovery of biological communities after implementation of storm water control measures.

All permits will provide that actions taken by the MS4 toward meeting the MS4-WLA must meet the standard of MEP. Accordingly, future MS4 permit conditions should require the permittee to propose, as part of its SWQMP, structural and/or non-structural BMPs to attain MS4-WLA to the MEP. The SWQMP shall also include an adaptive, iterative approach that can be evaluated over multiple MS4 permit terms to ensure reasonable progress toward achieving the MS4-WLA.