

## Total Maximum Daily Load (TMDL) Synopsis

**State:** Kentucky  
**Major River Basin:** Kentucky River  
**USGS HUC8:** 05100205  
**County:** Fayette  
**Pollutant of Concern:** Bacteria (*E. coli*)

**Table S.1 Impaired Waterbodies Addressed in this TMDL Document**

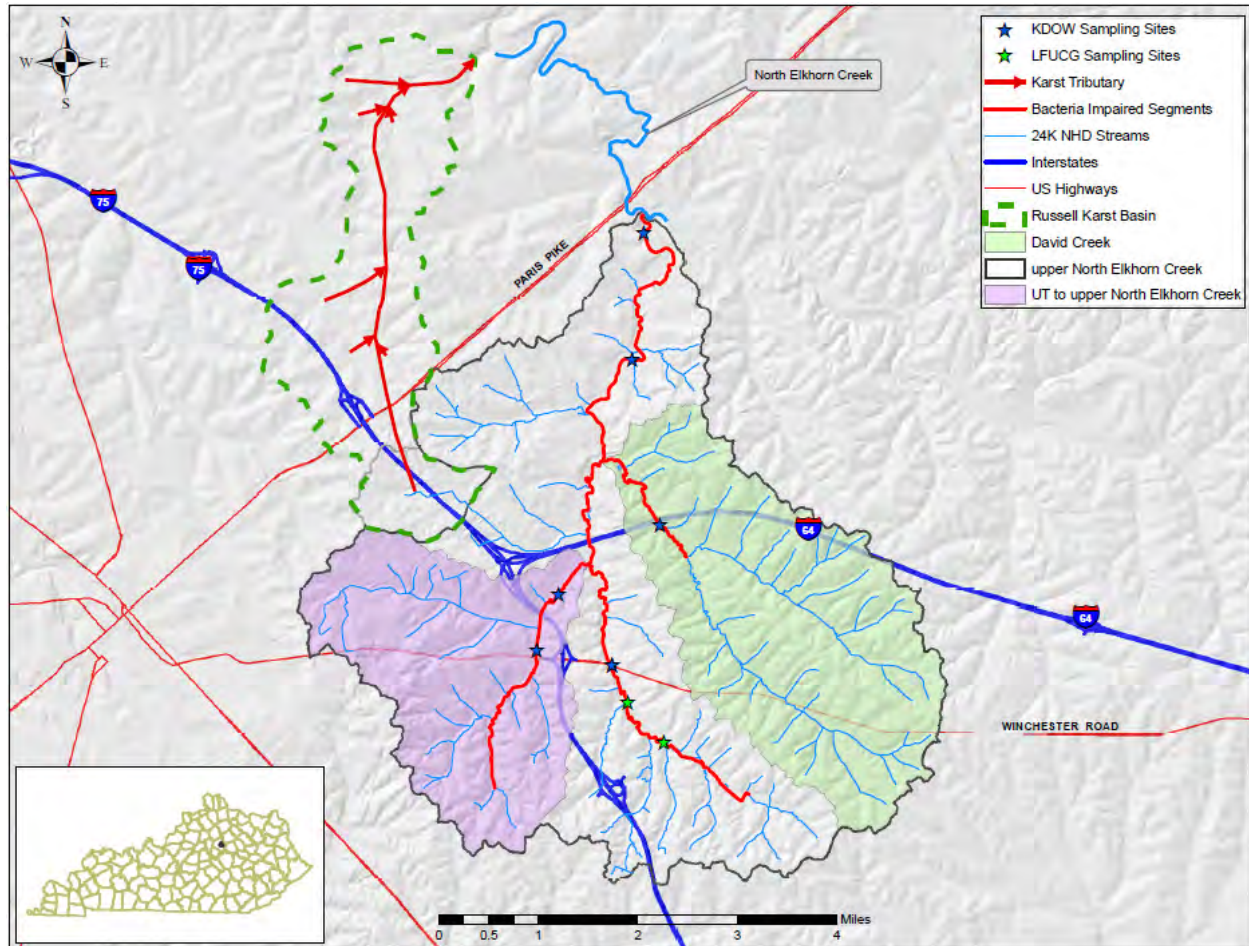
Waterbody Name	County	GNIS Number	Suspected Sources (all segments)	Impaired Use (Support Status)
Upper North Elkhorn Creek of Elkhorn Creek 66.0 to 73.75	Fayette	KY499540_03	Wastewater infrastructure; Municipal Point Source Discharges; Agriculture (grazing-related); Urban Runoff/Storm Sewers; Source Unknown	Primary Contact Recreation (nonsupport)
David Fork of Upper North Elkhorn Creek 0.0 to 1.68		KY490622_01		Primary Contact Recreation (nonsupport)
Unnamed Tributary of Upper North Elkhorn Creek 0.0 to 2.9		KY499540_71.1_01		Primary Contact Recreation (nonsupport)

**TMDL Endpoints (i.e., Water Quality Criterion/ *E. coli* TMDL Target):**

Title 401, chapter 10 of the Kentucky Administrative Regulations (KAR) describe the water quality standards and criterion to protect the designated uses of the surface waters of the Commonwealth.

The TMDL Target is defined as the water quality criterion (WQC) minus the Margin of Safety (MOS). The MOS can be an implicit or explicit additional reduction applied to the Waste Load allocation (WLA), Load Allocation (LA) or to both types of sources that accounts for uncertainties in the data or TMDL calculations. The TMDL Target is thus the WQC for *E. coli* (240 col/100ml) minus a 10% MOS or 216 colonies per 100ml.

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**Figure S.1 Location of Bacteria-impaired Segments within the Upper North Elkhorn Creek Watershed**

### TMDL Equation and Definitions:

A TMDL calculation is performed as follows:

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

The WLA has three components:

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

Where:

**TMDL:** the WQC, expressed as a load. The WQC is defined in Section 6.0 as an instantaneous concentration of 240 colonies/100 ml for *E. coli* or 400 colonies/100 ml for fecal coliform.

**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.

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

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**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 water sewer systems (including 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 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.

**Percent Reduction:** the loading reduction needed to bring the existing condition in line with the TMDL target.

**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:  $(28.31685L/f^3 * 86400seconds/day * 1000ml/L) / (100ml)$  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) Percent reductions are calculated to show the difference between Existing Conditions and the TMDL Target;
- 3) The SWS-WLA is calculated and subtracted from the TMDL Target, leaving the Remainder;
- 4) The Future Growth-WLA is calculated and subtracted from the Remainder;
- 5) If there is a MS4 present upstream of the impaired segment, the MS4-WLA is subtracted from the Remainder based on percent developed land cover, leaving the LA.

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### TMDL Development:

The analytical approach used to develop the TMDLs for the upper North Elkhorn Creek watershed was the load duration curve (LDC). The LDC is a data analysis tool that incorporates hydrology and concentration (number of *E. coli* colonies per 100 ml) to develop existing and maximum allowable loadings across the spectrum of various flow conditions. The LDCs illustrate a critical flow duration zone which is used to determine the site-specific TMDL target load.

**Table S.2 *E. coli* TMDL and Critical Flow Zone for each Impaired Segment**

Waterbody	Total Maximum Daily Load (col/ day)	Critical Flow Duration Zone
Upper North Elkhorn Creek 66.0 - 73.75	$1.04 \times 10^{12}$	High
David Fork 0.0 - 1.68	$3.31 \times 10^{12}$	Mid-Range
UT to Upper North Elkhorn Creek 0.0 - 2.9	$3.49 \times 10^{11}$	High

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

Waterbody	TMDL <sup>(1)</sup> (col/day)	MOS <sup>(2)</sup> (col/day)	WLA <sup>(3)</sup> (col/day)			LA (col/day)
			Future Growth	SWS	MS4	
Upper North Elkhorn Creek 66.0 - 73.75	$1.04 \times 10^{12}$	$1.04 \times 10^{11}$	$4.70 \times 10^{10}$	0	$5.87 \times 10^{11}$	$3.05 \times 10^{11}$
David Fork 0.0 - 1.68	$3.28 \times 10^{10}$	$3.28 \times 10^9$	$5.91 \times 10^8$	0	$1.02 \times 10^{10}$	$1.88 \times 10^{10}$
UT to Upper North Elkhorn Creek 0.0 - 2.9	$3.49 \times 10^{11}$	$3.49 \times 10^{10}$	$1.57 \times 10^{10}$	0	$2.44 \times 10^{10}$	$5.46 \times 10^{10}$

**Notes:**

- (1). TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the critical flow and the appropriate conversion factor. The TMDL is the sum of all components.
- (2). MOS is an explicit 10% of the TMDL.
- (3). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Criterion in 401 KAR 10:031, and must not cause or contribute to an existing impairment. WLA value based on percentage of developed land cover within the MS4 permitted area.

### Translation of WLAs into Permit Limits

All KPDES-permitted point sources must meet permit limits based on the Water Quality Standards in 401 KAR 10:031. SWS-WLAs will be translated into KPDES permit limits as an *E. coli* effluent gross limit of 130 colonies/100 ml as a monthly average and 240 colonies/100 ml as a maximum weekly average or as a fecal coliform effluent gross limit of 200 colonies/100 ml as a monthly average and 400 colonies/100 ml as a maximum weekly average.

The MS4-WLA is not a numerical end of pipe limit; it is an instream allocation. The MS4-WLA will be addressed through the MS4 permit and implemented through the Stormwater Quality Management Plan (SWQMP) to the Maximum Extent Practicable (MEP).