

## Total Maximum Daily Load Synopsis

**State:** Kentucky

**Major River Basin:** Green River Basin

**United States Geological Survey (USGS) HUC8 #:** 05110006

**County:** Muhlenberg

**Pollutant of Concern:** *E. coli*

The Upper Cypress Creek watershed is located entirely in Muhlenberg County. The majority of the watershed is west of South Carrollton and Central City and north of Powderly. The Western Kentucky Parkway traverses the southern portion of the watershed while US 62 and 431 traverse the eastern portion. A map depicting the location of the Upper Cypress Creek watershed is shown in Figure S.1.

To facilitate TMDL development, KDOW staff intensively sampled the Upper Cypress Creek watershed during the 2009 Primary Contact Recreation (PCR) season (May–October) for *E. coli*. This monitoring resulted in eight PCR-impaired listings for *E. coli*. The *E. coli* impaired segments for which TMDLs are developed in this document are listed in Table S.1. The location of these impaired segments is shown on the map in Figure S.1.

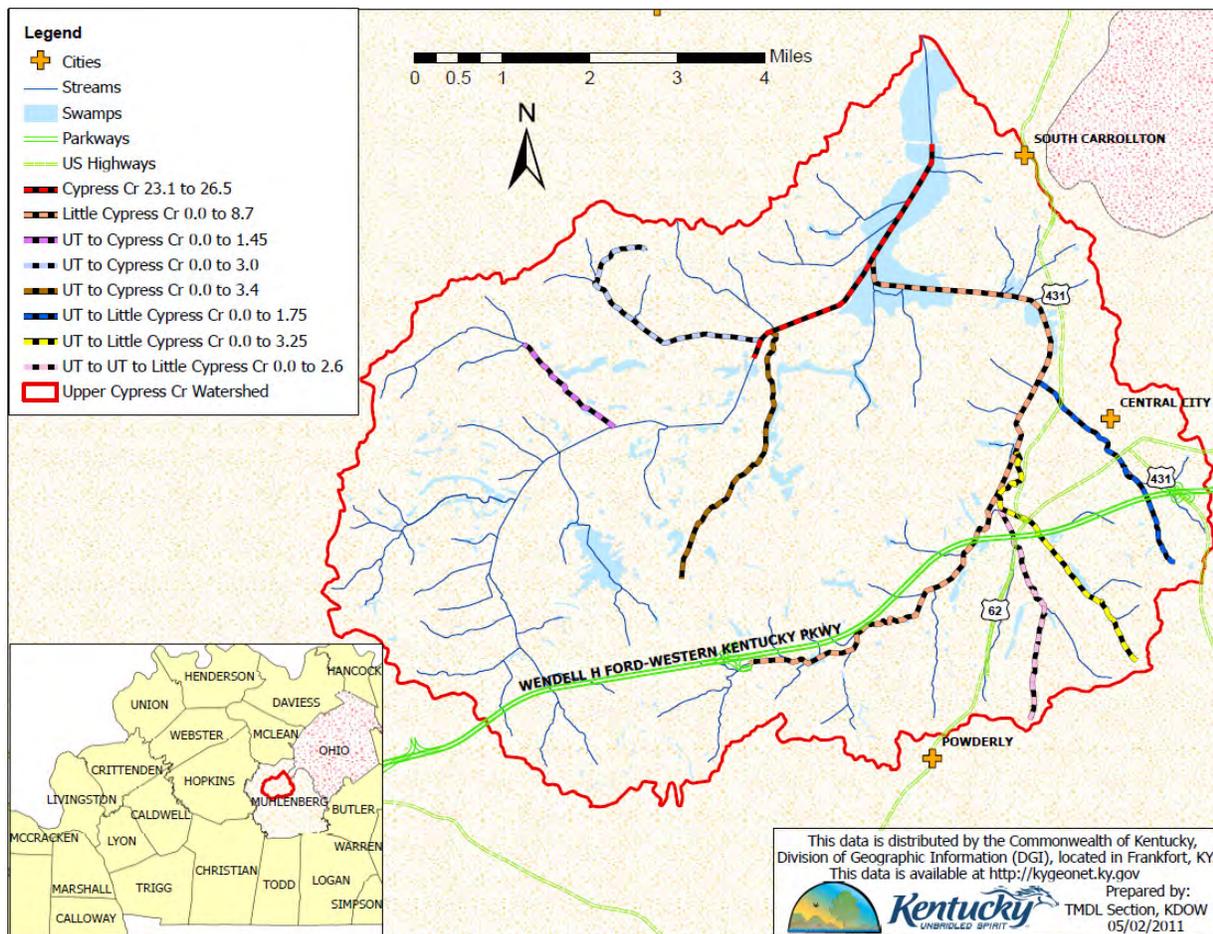


Figure S.1 Location of Upper Cypress Creek Watershed

Table S.1 *E. coli* Impaired Segments in Upper Cypress Creek River Watershed

Waterbody Name	Pollutant	County	Waterbody Identification Number	Suspected Sources	Impaired Use (Support Status) <sup>1</sup>
Cypress Creek 23.1 to 26.5	<i>E. coli</i>	Muhlenberg	KY490526_02	Source Unknown	PCR (NS)
Little Cypress Creek 0.0 to 8.7	<i>E. coli</i>	Muhlenberg	KY496701_01	Source Unknown	PCR (NS)
UT of Cypress Creek 0.0 to 3.4	<i>E. coli</i>	Muhlenberg	KY490526-26.1_01	Source Unknown	PCR (NS)
UT to Cypress Creek 0.0 to 1.45	<i>E. coli</i>	Muhlenberg	KY490526-28.6_01	Source Unknown	PCR (PS)
UT to Cypress Creek 0.0 to 3.0	<i>E. coli</i>	Muhlenberg	KY490526-26.3_01	Source Unknown	PCR (NS)
UT to Little Cypress Creek 0.0 to 1.75	<i>E. coli</i>	Muhlenberg	KY496701-3.1_01	Source Unknown	PCR (NS)
UT to Little Cypress Creek 0.0 to 3.25	<i>E. coli</i>	Muhlenberg	KY496701-4.0_01	Source Unknown	PCR (NS)
UT to UT to Little Cypress Creek 0.0 to 2.6	<i>E. coli</i>	Muhlenberg	KY496701-0.9-4.0_01	Source Unknown	PCR (NS)

Note: <sup>1</sup>NS indicates that the stream segment is nonsupport of the PCR use while PS indicates partial support.

### **Kentucky Water Quality Criteria (WQC) and the TMDL Endpoint (i.e. Water Quality Standard/ TMDL Target):**

The WQC in 401 KAR 10:031 (Kentucky's Surface Water Standards) for the PCR use are based on both fecal coliform and *E. coli*. Per 401 KAR 10:031:

*“The following criteria shall apply to waters designated as primary contact recreation use during the primary contact recreation season of May 1 through October 31: Fecal coliform content or Escherichia coli content shall not exceed 200 colonies per 100 ml or 130 colonies per 100 ml respectively as a geometric mean based on not less than five (5) samples taken during a thirty (30) day period. Content also shall not exceed 400 colonies per 100 ml in twenty (20) percent or more of all samples taken during a thirty (30) day period for fecal coliform or 240 colonies per 100 ml for Escherichia coli.”*

There are insufficient *E. coli* measurements to calculate a 5-sample, 30-day geometric mean, so the instantaneous criterion of 240 colonies/100 ml was used to calculate allowable loadings to bring the watershed into compliance with the PCR designated use. An explicit Margin of Safety of 10% was applied to yield an in-stream target of 216 colonies/100 ml.

### TMDL Equation and Calculations:

A TMDL calculation is performed as follows:

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

(Equation 1)

The WLA has three components:

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

(Equation 2)

Definitions:

**TMDL:** the WQC, expressed as a load. The WQC is defined as an instantaneous concentration of 240 colonies/100 ml for *E. coli*.

**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.

**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). There are no pathogen-indicator KPDES-permitted outfalls in this watershed.

**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 KYTC, universities and military bases). There are no MS4 permitted entities in this watershed.

**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.

**MAF:** the Mean Annual Flow as defined by USGS.

**Adjusted MAF:** the MAF plus SWS-WLA design flows.

**Critical Flow:** the flow used to calculate the TMDL as a load (is equivalent to the Adjusted MAF for MAF TMDLs)

**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 reduction needed to bring the existing conditions 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: (28.31685 L/f<sup>3</sup> \* 86400 seconds/day \* 1000 ml/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 (if any) 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 land use, leaving the LA.

A summary of TMDL allocations for the impaired segments is shown in Table S.3.

Table S.3 TMDL Summary Table

Stream Segment	Existing Load ( <i>E. coli</i> colonies/day)	Total TMDL ( <i>E. coli</i> colonies/day)	MOS ( <i>E. coli</i> colonies/day)	TMDL Target ( <i>E. coli</i> colonies/day)	% reduction	remainder ( <i>E. coli</i> colonies/day)	Future Growth WLA <sup>(1)</sup> ( <i>E. coli</i> colonies/day)	LA ( <i>E. coli</i> colonies/day)
Cypress Creek 23.1 to 26.5	1.70E+12	<b>3.89E+11</b>	<b>3.89E+10</b>	3.50E+11	79.3%	3.50E+11	<b>3.50E+09</b>	<b>3.47E+11</b>
Little Cypress Creek 0.0 to 8.7	1.76E+12	<b>1.74E+11</b>	<b>1.74E+10</b>	1.57E+11	91.1%	1.57E+11	<b>3.14E+09</b>	<b>1.54E+11</b>
UT to Cypress Creek 0.0 to 1.45	4.83E+10	<b>2.11E+10</b>	<b>2.11E+09</b>	1.90E+10	60.6%	1.90E+10	<b>9.51E+07</b>	<b>1.89E+10</b>
UT to Cypress Creek 0.0 to 3.0	1.89E+11	<b>1.88E+10</b>	<b>1.88E+09</b>	1.69E+10	91.1%	1.69E+10	<b>1.69E+08</b>	<b>1.67E+10</b>
UT to Cypress Creek 0.0 to 3.4	2.78E+11	<b>2.76E+10</b>	<b>2.76E+09</b>	2.48E+10	91.1%	2.48E+10	<b>2.48E+08</b>	<b>2.46E+10</b>
UT to Little Cypress Creek 0.0 to 1.75	2.07E+11	<b>2.06E+10</b>	<b>2.06E+09</b>	1.85E+10	91.1%	1.85E+10	<b>9.25E+08</b>	<b>1.76E+10</b>

Stream Segment	Existing Load ( <i>E. coli</i> colonies/day)	Total TMDL ( <i>E. coli</i> colonies/day)	MOS ( <i>E. coli</i> colonies/day)	TMDL Target ( <i>E. coli</i> colonies/day)	% reduction	remainder ( <i>E. coli</i> colonies/day)	Future Growth WLA <sup>(1)</sup> ( <i>E. coli</i> colonies/day)	LA ( <i>E. coli</i> colonies/day)
UT to Little Cypress Creek 0.0 to 3.25	1.94E+11	<b>3.29E+10</b>	<b>3.29E+09</b>	2.96E+10	84.7%	2.96E+10	<b>5.92E+08</b>	<b>2.90E+10</b>
UT to UT to Little Cypress Creek 0.0 to 2.6	7.67E+10	<b>1.64E+10</b>	<b>1.64E+09</b>	1.48E+10	80.7%	1.48E+10	<b>2.96E+08</b>	<b>1.45E+10</b>

Note: <sup>(1)</sup>Any future KPDES-permitted point source will receive its WLA from the Future Growth WLA and must meet permit limits based on the Water Quality Standards in 401 KAR 10:031.

### Translation of WLAs into Permit Limits

If any future SWS sources are approved in the watershed, their WLAs (from the Future Growth WLA) 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.