

Total Maximum Daily Load Synopsis

State: Kentucky

Major River Basin: Kentucky

USGS HUC8: 05100201

County: Knott

Impaired Use(s): Primary Contact Recreation (PCR), Secondary Contact Recreation (SCR)

Pollutant of Concern: *E. coli*, fecal coliform

The Carr Fork watershed above the Carr Fork Reservoir dam is located entirely in southern Knott County, east of the city of Vicco and south of Hindman and Pippa Passes. State Highways 1231, 3391, 1393, 15, 160, and 1410 all traverse portions of the watershed, mainly along Carr Fork Reservoir and its tributaries (Figure S.1).

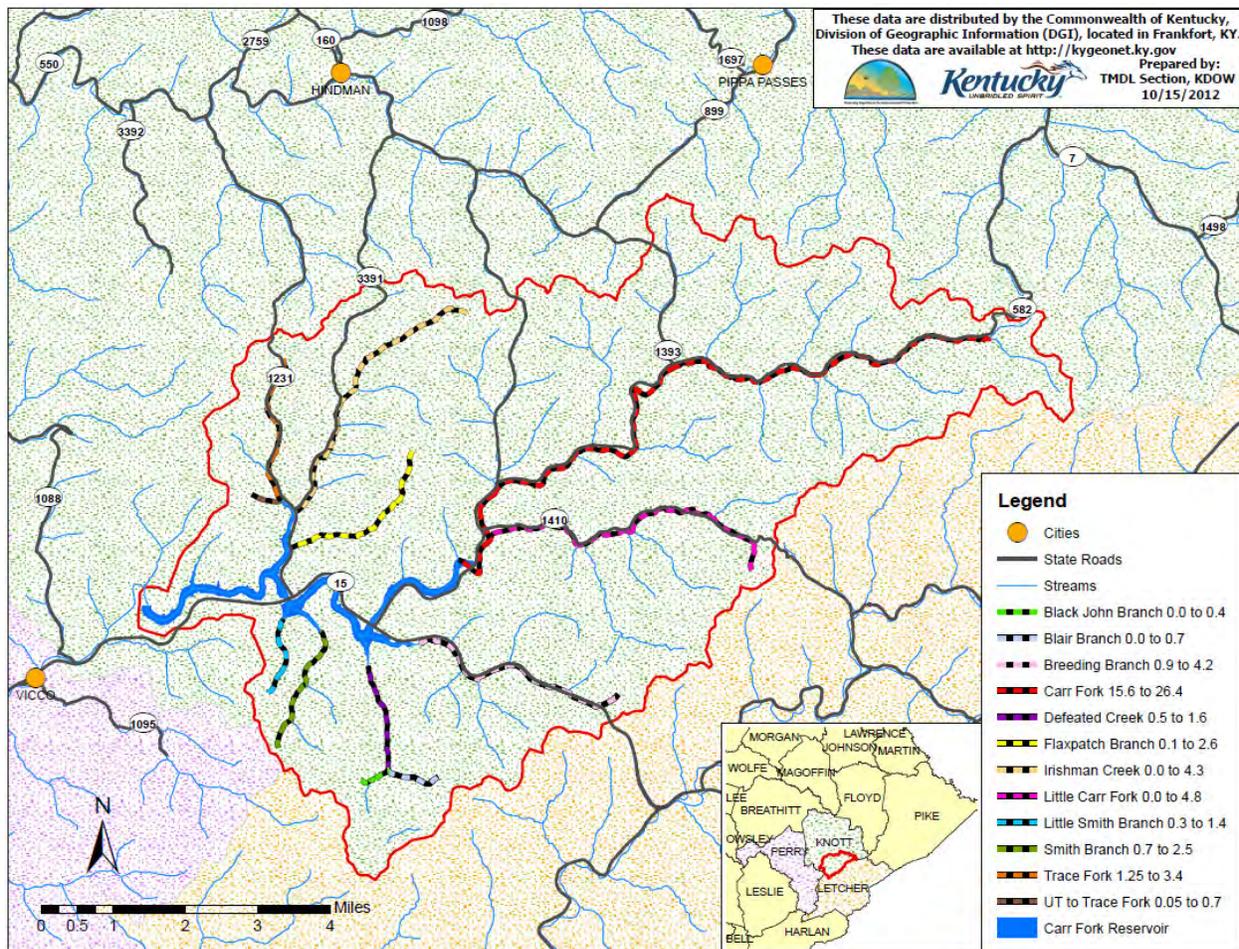


Figure S.1 Location of Carr Fork Watershed in Knott County

Kentucky Division of Water (KDOW) and US Army Corps of Engineers (USACE) staff jointly sampled the tributaries of Carr Fork Reservoir for the pathogen indicator *Escherichia coli* (*E. coli*) during the 2007 and 2008 PCR seasons. This document contains the monitoring results and describes Total Maximum Daily Load (TMDL) development for pathogen indicators in the Carr

Fork watershed as required under Section 303(d) of the Clean Water Act (33 U.S.C., 1972). Table S.1 indicates the pollutant/waterbody combinations for which bacteria TMDLs are developed in this document. Note that two stream segments are listed twice, due to impairment of both the PCR and SCR uses.

Table S.1 Pollutant/Waterbody Combinations Addressed in this TMDL Document

Waterbody Name	Pollutant	County	Waterbody ID	Suspected Source(s)	Impaired Use (Support Status)
Blair Branch 0.0 to 0.7	<i>E. coli</i>	Knott	KY487435_01	Unspecified Domestic Waste	PCR (nonsupport)
Breeding Branch 0.9 to 4.2	<i>E. coli</i>	Knott	KY487857_01	Unspecified Domestic Waste	PCR (nonsupport)
Carr Fork 15.6 to 26.4	<i>E. coli</i>	Knott	KY511230_03	Unspecified Domestic Waste	PCR (nonsupport)
Carr Fork 15.6 to 26.4	Fecal coliform	Knott	KY511230_03	Source Unknown	SCR (nonsupport)
Defeated Creek 0.5 to 1.6	Fecal coliform	Knott	KY490786_01	Unspecified Domestic Waste	PCR (nonsupport)
Flaxpatch Branch 0.1 to 2.6	<i>E. coli</i>	Knott	KY492233_01	Unspecified Domestic Waste	PCR (nonsupport)
Irishman Creek 0.0 to 4.3	<i>E. coli</i>	Knott	KY495004_01	Unspecified Domestic Waste	PCR (partial support)
Little Carr Fork 0.0 to 4.8	<i>E. coli</i>	Knott	KY496662_01	Unspecified Domestic Waste	PCR (nonsupport)
Little Smith Branch 0.3 to 1.4	<i>E. coli</i>	Knott	KY496864_01	Unspecified Domestic Waste	PCR (nonsupport)
Trace Fork 1.25 to 3.4	<i>E. coli</i>	Knott	KY505441_01	Unspecified Domestic Waste	PCR (partial support)
Trace Fork 1.25 to 3.4	Fecal coliform	Knott	KY505441_01	Source Unknown	SCR (nonsupport)
UT to Trace Fork 0.05 to 0.7	<i>E. coli</i>	Knott	KY505441- 1.25_01	Unspecified Domestic Waste	PCR (partial support)

Kentucky Water Quality Criterion (WQC):

The WQC in 401 KAR 10:031 (Kentucky’s Surface Water Standards) for the PCR and SCR uses 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.”

Additionally:

“The following criteria shall apply to waters designated for secondary contact recreation use during the entire year: Fecal coliform content shall not exceed 1000 colonies per 100 ml as a thirty (30) day geometric mean based on not less than five (5) samples; nor exceed 2000 colonies per 100 ml in twenty (20) percent or more of all samples taken during a thirty (30) day period.”

Allowable loadings were calculated based upon the impaired designated use and the bacteria indicator causing the use impairment. For *E. coli* PCR impairments, the instantaneous criterion of 240 colonies/100 ml was applied to calculate allowable loadings. For fecal coliform PCR impairments, the instantaneous criterion of 400 colonies/100 ml was used. For fecal coliform SCR impairments, the instantaneous criterion of 2000 colonies/100 ml was applied.

TMDL Components and Target:

A TMDL calculation is performed as follows:

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

(Equation 1)

The WLA has two components:

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

(Equation 2)

Definitions:

TMDL: the 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.

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 bacteria (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).

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

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 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 reduction needed to bring the existing conditions in line with the TMDL Target.

Load: Concentration * Flow * Conversion Factor in colonies per day (colonies/day)

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

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

Conversion Factor: the value which 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: $(28.31685) \text{ L/cf} * 86400\text{sec/day} * 1000\text{ml/L} / (100 \text{ ml})$ and is equal to 24465758.4.

Calculation Procedure:

1. The MOS 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; leaving the LA

The TMDL for each bacteria impaired segment is shown in Tables S.2-S.4.

Table S.2 *E. coli* PCR TMDLs for Impaired Segments

Waterbody Name	TMDL (colonies/ day)	MOS (colonies/ day)	SWS- WLA (colonies/ day)	Future Growth- WLA (colonies/ day)	LA (colonies/ day)	Percent Reduction (%)
Blair Branch 0.0 to 0.7	2.94E+08	2.94E+07	0.00E+00	1.32E+06	2.63E+08	93.8
Breeding Branch 0.9 to 4.2	3.43E+10	3.43E+09	0.00E+00	3.08E+08	3.05E+10	98.2
Carr Fork 15.6 to 26.4	3.58E+10	3.58E+09	2.73E+08	3.20E+08	3.16E+10	93.3
Flaxpatch Branch 0.1 to 2.6	5.65E+08	5.65E+07	0.00E+00	2.54E+06	5.06E+08	95.7
Irishman Creek 0.0 to 4.3	5.60E+09	5.60E+08	0.00E+00	5.04E+07	4.99E+09	88.6
Little Carr Fork 0.0 to 4.8	7.16E+09	7.16E+08	0.00E+00	6.44E+07	6.38E+09	95.3
Little Smith Branch 0.3 to 1.4	1.78E+09	1.78E+08	0.00E+00	1.60E+07	1.58E+09	93.8
Trace Fork 1.25 to 3.4	3.16E+09	3.16E+08	0.00E+00	2.85E+07	2.82E+09	85.6
UT to Trace Fork 0.05 to 0.7	2.84E+08	2.84E+07	0.00E+00	1.28E+06	2.54E+08	76.0

Table S.3 Fecal Coliform PCR TMDLs for Impaired Segments

Waterbody Name	TMDL (colonies/ day)	MOS (colonies/ day)	SWS- WLA (colonies/ day)	Future Growth- WLA (colonies/ day)	LA (colonies/ day)	Percent Reduction (%)
Defeated Creek 0.5 to 1.6	9.38E+09	9.38E+08	0.00E+00	4.22E+07	8.40E+09	72.3

Table S.4 Fecal Coliform SCR TMDLs for Impaired Segments

Waterbody Name	TMDL (colonies/ day)	MOS (colonies/ day)	SWS- WLA (colonies/ day)	Future Growth- WLA (colonies/ day)	LA (colonies/ day)	Percent Reduction (%)
Carr Fork 15.6 to 26.4	4.39E+12	4.39E+11	4.54E+08	3.95E+10	3.91E+12	80.0
Trace Fork 1.25 to 3.4	3.17E+11	3.17E+10	0.00E+00	2.85E+09	2.83E+11	52.6

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.