

Total Maximum Daily Load Synopsis

State: Kentucky

Major River Basin: Green

USGS HUC8: 05110001

Counties: Hardin, Hart, and Larue

Impaired Use(s): Primary Contact Recreation

Pollutants of Concern: E. coli, Fecal Coliform (expressed as an E. coli load)

The Bacon Creek watershed is located primarily in Hart County, with minor extensions into Hardin and Larue Counties. It is located south of Upton, north of Munfordville, and has the city of Bonnieville in its midst. Interstate 65 and 31W traverse the middle of the Bacon Creek watershed, while 31E traverses the headwaters of the watershed from North to South (Figure S.1).

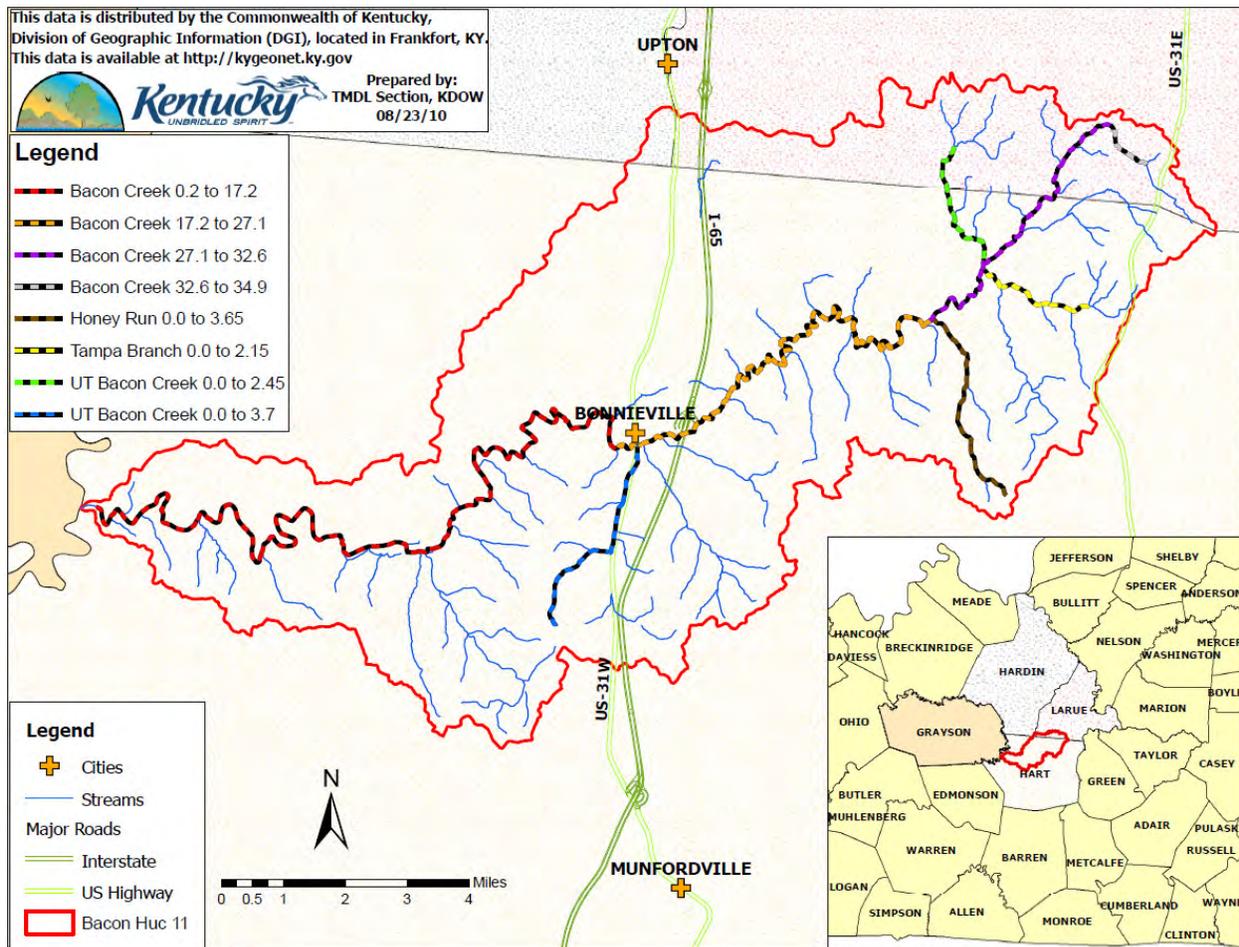


Figure S.1 Location of Bacon Creek Watershed in Hardin, Hart, and Larue Counties

The headwaters of Bacon Creek were monitored for the pathogen indicators fecal coliform and Escherichia coli (E. coli) for a 319(h) Watershed Based Plan project during 2004 -2006. The Kentucky Division of Water (KDOW) provided funding for additional fecal coliform sampling at

some of the sites during 2007. Additionally, KDOW staff collected E. coli samples on the lower portions of Bacon Creek during 2007. This document contains the monitoring results and describes Total Maximum Daily Load (TMDL) development for pathogen indicators in the Bacon Creek watershed as required under Section 303(d) of the Clean Water Act. Table S.1 indicates the pathogen indicator impaired segments for which TMDLs are developed in this document.

Table S.1 Impaired Waterbodies Addressed in this TMDL Document

Waterbody & Segment	Total Size	Waterbody ID	County	Assessment Category ⁽²⁾	Use ⁽³⁾	Impairment	Suspected Source(s)
Bacon Creek 0.2 to 17.2	17 miles	KY486197_01	Hart	5-NS	PCR	<u>Escherichia coli</u> ⁽¹⁾	Agriculture, On-Site Treatment Systems (Septic Systems and Similar Decentralized Systems)
Bacon Creek 17.2 to 27.1	9.9 miles	KY486197_02	Hart	5-NS	PCR	<u>Escherichia coli</u> ⁽¹⁾ , Fecal Coliform ⁽⁴⁾	Agriculture, On-Site Treatment Systems (Septic Systems and Similar Decentralized Systems)
Bacon Creek 27.1 to 32.6	5.5 miles	KY486197_03	Hart	5-NS	PCR	<u>Escherichia coli</u> ⁽¹⁾ , Fecal Coliform ⁽⁴⁾	Agriculture, On-Site Treatment Systems (Septic Systems and Similar Decentralized Systems)
Bacon Creek 32.6 to 34.9	2.3 miles	KY486197_04	Larue	5-NS	PCR	<u>Escherichia coli</u> ⁽¹⁾	Agriculture, On-Site Treatment Systems (Septic Systems and Similar Decentralized Systems)
Honey Run 0.0 to 3.65	3.65 miles	KY494483_01	Hart	5-NS	PCR	Fecal Coliform ^(1, 4)	Agriculture, On-Site Treatment Systems (Septic Systems and Similar Decentralized Systems)
Tampa Branch 0.0 to 2.15	2.15 miles	KY504931_01	Hart	5-NS	PCR	Fecal Coliform ^(1, 4)	Agriculture, On-Site Treatment Systems (Septic Systems and Similar Decentralized Systems)
UT to Bacon Creek at RM 17.8, 0.0 to 3.7	3.7 miles	KY486187-17.8_01	Hart	5-NS	PCR	<u>Escherichia coli</u> ⁽¹⁾	Agriculture, On-Site Treatment Systems (Septic Systems and Similar Decentralized Systems)
UT to Bacon Creek at RM 28.9, 0.0 to 2.45	2.45 miles	KY48619-28.9_01	Larue	5-NS	PCR	<u>Escherichia coli</u> ⁽¹⁾	Agriculture, On-Site Treatment Systems (Septic Systems and Similar Decentralized Systems)

Note: ⁽¹⁾Indicates a new listing not on the draft 2010-303(d) list.

⁽²⁾Assessment Category 5-NS indicates that the segment is nonsupporting and that a TMDL is required for the use.

⁽³⁾PCR is the Primary Contact Recreation use.

⁽⁴⁾TMDLs for fecal coliform are expressed as an E. coli load.

Kentucky Water Quality Criterion (WQC):

According to 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.”

TMDL Components and Target:

A TMDL calculation is performed as follows:

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

Where TMDL = the Water Quality Criterion. This is defined as an instantaneous concentration of 240 colonies/100 ml for E. coli.

WLA = the Waste Load Allocation. For this TMDL document, there are three types of WLAs: Sanitary Wastewater System (SWS) WLAs for loadings from Kentucky Pollutant Discharge Elimination System (KPDES)-permitted sanitary wastewater systems, Municipal Separate Storm Sewer Systems (MS4s) WLAs for loadings from permitted MS4 entities and a Future Growth WLA for future loadings from expanding and new KPDES-permitted sources.

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

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 data or TMDL calculations. For this TMDL an explicit MOS of 10% was applied (i.e. 24 E. coli colonies/100ml) and an implicit MOS was incorporated by calculating SWS WLAs at their maximum design capacity.

TMDL Target = the TMDL minus the MOS (i.e. 216 E. coli colonies/100ml).

TMDL Methodology:

Mean Annual Flows (MAFs): MAFs were determined at the downstream end of each impaired segment. This MAF was adjusted by adding the design flow of SWS dischargers (of pathogen indicators) in the watershed above the downstream-most point of the segment (yielding the Adjusted MAF). This adjusted MAF was used to convert concentrations of E. coli or fecal coliform into loads.

Existing Loads: For sample sites located on each segment, the sample with the greatest concentration of E. coli was used as the existing concentration for that segment. Existing loads were calculated as:

$$\begin{array}{rcccccc} \text{Greatest} & & \text{Adjusted} & & \text{Conversion Factor} & & \text{Existing Load} \\ \text{Concentration} & \times & \text{MAF} & \times & & = & \\ \text{(colonies/100ml)} & & \text{(cfs)} & & .0244657584 & & \text{(billion colonies/day)} \end{array}$$

where the conversion factor converts cfs to ml/day and colonies to billion colonies.

Total TMDL: Total TMDLs were calculated for each segment using the criteria of 240 E. coli colonies/100 ml:

$$\begin{array}{rcccccc} 240 \text{ E. coli } & & \text{Adjusted} & & \text{Conversion Factor} & & \text{Total TMDL} \\ \text{(colonies/100ml)} & \times & \text{MAF} & \times & & = & \text{(billion colonies/day)} \\ & & \text{(cfs)} & & .0244657584 & & \end{array}$$

MOS: A 10% explicit MOS (24 E. coli colonies/100ml) was set. Additionally, an implicit MOS was incorporated by setting flows for SWS sources at their design capacity. The explicit MOS load for each segment was calculated as:

$$\begin{array}{rcccccc} 24 \text{ E. coli } & & \text{Adjusted} & & \text{Conversion Factor} & & \text{MOS} \\ \text{(colonies/100ml)} & \times & \text{MAF} & \times & & = & \text{(billion colonies/day)} \\ & & \text{(cfs)} & & .0244657584 & & \end{array}$$

Target Load: The Target Load was calculated for each segment by subtracting the explicit MOS from the Total TMDL (Target Load = Total TMDL – MOS).

Percent Reduction: The Percent Reduction (%) for each segment was calculated as:

$$\text{Percent Reduction (\%)} = [(\text{Existing Load} - \text{Target Load}) / \text{Existing Load}] * 100.$$

Calculation of SWS WLAs: The SWS WLAs were calculated based on the permitted concentration limits expressed in terms of E. coli limits and facility design flow (in units of cfs) using the following equation:

$$\begin{array}{rcccccc} 240 \text{ E. coli } & & \text{Design} & & \text{Conversion Factor} & & \text{WLA} \\ \text{(colonies/100ml)} & \times & \text{Flow} & \times & & = & \text{(billion colonies/day)} \\ & & \text{(cfs)} & & .0244657584 & & \end{array}$$

The design flow in million gallons per day (MGD) was multiplied by 1.54723 to convert days to seconds and million gallons to cubic feet to yield design flow in cfs.

Calculation of Remainder: The Remainder is not part of the TMDL; however, it is used in the TMDL calculations. It is determined as the Target Load minus the sum of all SWS WLAs.

Calculation of MS4 WLA: The MS4 WLA was determined as:

$$\text{MS4 WLA} = \text{Remainder} \times \text{Percent Developed},$$

where Percent Developed is the percent of developed land cover classes (developed open space, developed low intensity, developed medium intensity, and developed high intensity) within the MS4 boundary. This was determined as:

$$\text{Percent Developed} = (\text{sum of developed land cover classes within the MS4 in acres}) / (\text{total acres within MS4 boundary}).$$

Calculation of Future Growth WLA: Future growth is represented by a portion of the TMDL Target that is reserved for new or expanding KPDES-permitted sources. It is calculated as:

Future Growth WLA = Remainder x Future Growth WLA %, where the Future Growth WLA % is determined according to Table S.2 and the Percent Developed Land Cover Classes (developed open space, developed low intensity, developed medium intensity, and developed high intensity) is determined as:

$$\text{Percent Developed Land Cover Classes} = (\text{sum developed land cover classes in acres within watershed}) / (\text{total acres within watershed}) \times 100.$$

Table S.2 Future Growth WLA %

Percent Developed Land Cover Classes	Future Growth WLA %
≥25%	5
≥20% – <25%	4
≥15% – <20%	3
≥10% – <15%	2
≥5% – <10%	1
<5%	0.5

Calculation of LA: Load Allocations are calculated as LA= Remainder - MS4 WLA - Future Growth WLA.

The available sampling data were insufficient to apportion the existing loading among the various LA sources; therefore, it is lumped to all LA sources.

TMDLs for Impaired Segments:

TMDLs and loading allocations are summarized for each segment in Table S.3.

Translation of WLA Limits into Permit Limits:

All 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.

Table S.3 TMDLs for Impaired Segments

Loads are in units of billion <i>E. coli</i> colonies/day	Percent Reduction is expressed as a percentage		Bacon Creek 0.2 to 17.2	Bacon Creek 17.2 to 27.1	Bacon Creek 27.1 to 32.6	Bacon Creek 32.6 to 34.9	Honey Run 0.0 to 3.65	Tampa Branch 0.0 to 2.15	UT to Bacon Creek 0.0 to 2.45	UT to Bacon Creek 0.0 to 3.7
		Existing Load	67371.1627	37535.6988	11181.2405	129.1007	2338.9363	5118.4568	488.1408	846.0871
		Total TMDL	668.2542	372.3164	133.3349	10.0272	22.3128	45.2127	25.2487	44.0384
		MOS	66.8254	37.2316	13.3335	1.0027	2.2313	4.5213	2.5249	4.4038
		TMDL Target	601.4288	335.0848	120.0014	9.0245	20.0815	40.6914	22.7238	39.6345
AI #	KPDES #	% reduction	99.11	99.11	98.93	93.01	99.14	99.21	95.34	95.32
2555	KY0089761	SWS WLA	0.0454	0.0454	0.0454	0.0454	0.0000	0.0000	0.0000	0.0000
		remainder	601.3834	335.0393	119.9560	8.9791	20.0815	40.6914	22.7238	39.6345
		Future Growth WLA⁽¹⁾	3.0069	3.3504	1.1996	0.1796	0.1004	0.4069	0.2272	0.3963
75043	KYG200003	MS4 WLA⁽²⁾	0.0000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Total WLA	3.0523	3.3958	1.2450	0.2250	0.1004	0.4069	0.2272	0.3963
		LA	598.3765	331.6889	118.7564	8.7995	19.9811	40.2845	22.4966	39.2382

Notes: ⁽¹⁾Any expanding or 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.

⁽²⁾N/A indicates that there is no MS4 in the subwatershed.