Total Maximum Daily Load for 20 Pathogen-Impaired Stream Segments in the Upper Green River USGS Hydrologic Unit 05110001

Final TMDL

December, 2008

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Prepared by:
Kentucky Department for Environmental Protection
Division of Water
14 Reilly Road
Frankfort, KY 40601

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Kentucky Department for Environmental Protection
Division of Water

This report is approved for release

Sandra L. Gruzesky, P.E.,
Director, Division of Water

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Date

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Glossary of Acronyms

ADD	Area Development District
AFO	Animal Feeding Operation
BMP	Best Management Practices
BMU	Basin Management Unit
CAFO	Confined Animal Feeding Operation
CFR	Code of Federal Regulations
CPP	Continuing Planning Process
CR	County Route
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
DEP	Department of Environmental Protection
DMR	Discharge Monitoring Report
FC	Fecal coliform
GIS	Geographic Information System
GM	Geometric Mean
GNIS	Geographic Names Information System
GR	Green River watershed
HUC	Hydrologic Unit Code
KAR	Kentucky Administrative Regulations
KDOC	Kentucky Division of Conservation
KDOW	Kentucky Division of Water
KGS	Kentucky Geological Survey
KIA	Kentucky Infrastructure Authority
KNDOP	Kentucky No Discharge Operating Permit
KPDES	Kentucky Pollution Discharge Elimination System
KRWW	Kentucky River Watershed Watch
LA	Load Allocations
LTCP	Long Term Control Plan
MAF	Mean Annual Flow
MGD	Million Gallons per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agricultural Statistics Service
NLCD	National Landcover Database
NRCS	Natural Resources Conservation Service
NPDES	National Pollution Disc harge Elimination System
NPS	Non-Point Source
NOV	Notice of Violation
OSTDS	On Site Sewage Treatment and Disposal System
PCR	Primary Contact Recreation

POTW	Publicly Owned Treatment Works
QAPP	Quality Assurance Project Plan
RM	River Mile
SCR	Secondary Contact Recreation
SSO	Sanitary Sewer Overflow
STP	Sewage Treatment Plant
SWMP	Storm Water Management Plan
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WKU	Western Kentucky University
WLA	Waste Load Allocation
WQC	Water Quality Criteria
WQS	Water Quality Standard
WWTP	Wastewater Treatment Plant

TMDL Synopsis

State: Kentucky
Major River Basin: Green River
HUC8: 05110001
Counties: Adair, Green, Taylor, Hart, Metcalfe and Taylor
Pollutant of Concern: Fecal Coliform
Impaired Waterbodies: See Table S.1
Impaired Use: See Table S.2

Table S.1 Impaired Waterbodies Addressed in this TMDL Document

Waterbody Name, River Miles (RM)	Segment Length (miles)	County	GNIS ID	Suspected Source
Big Brush Creek of Green River, RM 0.0-5.0	5.0	Green	KY487146_01	Unknown
Big Brush Creek of Green River, RM 7.1-13.0	5.9	Green	KY487146_03	Unknown
Big Pitman Creek of Green River, RM 13.9-17.8	3.9	Green	KY487227_02	Unknown
Big Pitman Creek of Green River, RM 17.8-23.65	5.85	Taylor	KY487227_03	Unknown
Brush Creek of Big Brush Creek, RM 0.0-2.15	2.15	Green	KY488077_01	Unknown
East Fork Little Barren River of Little Barren River, RM 0.0-15.9	15.9	Metcalfe	KY491468_01	Unknown
East Fork Little Barren River of Little Barren River, RM 20.7-30.0	9.3	Metcalfe	KY491468_03	Unknown
Little Barren River of Green River, RM 9.8-15.7	5.9	Green	KY496604_02	Unknown
Little Brush Creek of Big Brush Creek, RM 3.2-13.2	10.0	Green	KY496646_01	Unknown
Little Pitman Creek of Big Pitman Creek, RM 0.0-10.1	10.1	Taylor	KY496827_01	Unknown
Little Pitman Creek of Big Pitman Creek, RM 10.1-11.2	1.1	Taylor	KY496827_02	Unknown
Little Russell Creek of Green River, RM 0.0-5.1	5.1	Green	KY496854_01	Unknown
Lynn Camp Creek of Green River, RM 0.0-8.3	8.3	Hart	KY497374_01	Unknown

Waterbody Name, River Miles (RM)	Segment Length (miles)	County	GNIS ID	Suspected Source
Middle Pitman Creek of Big Pitman Creek, RM 0.0-7.7	7.7	Taylor	KY498146_01	Unknown
Middle Pitman Creek of Big Pitman Creek, RM 8.2-10.1	1.9	Taylor	KY498146_02	Unknown
Russell Creek of Green River, RM 23.8-40.0	16.2	Adair	KY502521_04	Unknown
Russell Creek of Green River, RM 60.4-66.3	5.9	Adair	KY502521_07	Unknown
South Fork Little Barren River of Little Barren River, RM 0.0-23.1	23.1	Metcalfe	KY503933_01	Unknown
South Fork Little Barren River of Little Barren River, RM 23.1-30.1	7.0	Metcalfe	KY503933_02	Unknown
Sulphur Creek of Russell Creek, RM 0.0-10.7	10.7	Adair	KY504734_01	Unknown

TMDL Endpoints (e.g., Water Quality Standard): 360 colonies/100ml (400 colonies/100ml minus a 10% explicit Margin of Safety)

Table S.2 Impaired Uses

Waterbody Name, River Miles	GNIS ID	Impaired Use(s)
Big Brush Creek of Green River, RM 0.0-5.0	KY487146_01	Primary Contact Recreation (Nonsupport)
Big Brush Creek of Green River, RM 7.1-13.0	KY487146_03	Primary Contact Recreation (Nonsupport)
Big Pitman Creek of Green River, RM 13.9-17.8	KY487227_02	Primary Contact Recreation (Partial Support)
Big Pitman Creek of Green River, RM 17.8-23.65	KY487227_03	Primary Contact Recreation (Nonsupport)
Brush Creek of Big Brush Creek, RM 0.0-2.15	KY488077_01	Primary Contact Recreation (Partial Support)
East Fork Little Barren River of Little Barren River, RM 0.0-15.9	KY491468_01	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
East Fork Little Barren River of Little Barren River, RM 20.7-30.0	KY491468_03	Primary Contact Recreation (Partial Support)
Little Barren River of Green River, RM 9.8-15.7	KY496604_02	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)

Waterbody Name, River Miles	GNIS ID	Impaired Use(s)
Little Brush Creek of Big Brush Creek, RM 3.2-13.2	KY496646_01	Primary Contact Recreation (Nonsupport)
Little Pitman Creek of Big Pitman Creek, RM 0.0-10.1	KY496827_01	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
Little Pitman Creek of Big Pitman Creek, RM 10.1-11.2	KY496827_02	Primary Contact Recreation (Nonsupport)
Little Russell Creek of Green River, RM 0.0-5.1	KY496854_01	Primary Contact Recreation
Lynn Camp Creek of Green River, RM 0.0-8.3	KY497374_01	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
Middle Pitman Creek of Big Pitman Creek, RM 0.0-7.7	KY498146_01	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
Middle Pitman Creek of Big Pitman Creek, RM 8.2-10.1	KY498146_02	Primary Contact Recreation (Nonsupport)
Russell Creek of Green River, RM 23.8-40.0	KY502521_04	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
Russell Creek of Green River, RM 60.4-66.3	KY502521_07	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
South Fork Little Barren River of Little Barren River, RM 0.0-23.1	KY503933_01	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
South Fork Little Barren River of Little Barren River, RM 23.1-30.1	KY503933_02	Primary Contact Recreation (Nonsupport)
Sulphur Creek of Russell Creek, RM 0.0-10.7	KY504734_01	Primary Contact Recreation (Partial Support)

Table S.3 TMDL Allocation Table

TMDL	MOS[1]	WLA[6]				LA[6]	Percent Reduction[5]
		Wastewater[2,3]		MS4			
Big Brush Creek of Green River, RM 0.0-5.0							
1.06×10^{12} col/day	1.06×10^{11} col/day	0.0 col/day		0.0 col/day		9.56×10^{11} col/day	55%
Big Brush Creek of Green River, RM 7.1-13.0							
5.02×10^{11} col/day	5.02×10^{10} col/day	0.0 col/day		0.0 col/day		4.52×10^{11} col/day	64%
Big Pitman Creek of Green River, RM 13.9-17.8							
1.56×10^{12} col/day	1.56×10^{11} col/day	0.0 col/day		0.0 col/day		1.40×10^{12} col/day	87%
Big Pitman Creek of Green River, RM 17.8-23.65							
7.46×10^{11} col/day	7.46×10^{10} col/day	0.0 col/day		0.0 col/day		6.71×10^{11} col/day	83%
Brush Creek of Big Brush Creek, RM 0.0-2.15							
1.98×10^{11} col/day	1.98×10^{10} col/day	0.0 col/day		0.0 col/day		1.78×10^{11} col/day	34%
East Fork Little Barren River of Little Barren River, RM 0.0-15.9							
1.25×10^{12} col/day	1.25×10^{11} col/day	0.0 col/day		0.0 col/day		1.13×10^{12} col/day	96%
East Fork Little Barren River of Little Barren River, RM 20.7-30.0							
6.56×10^{10} col/day	6.56×10^{09} col/day	0.0 col/day		0.0 col/day		5.90×10^{10} col/day	94%
Little Barren River of Green River, RM 9.8-15.7							
3.01×10^{12} col/day	3.01×10^{11} col/day	Edmonton STP KY0054437	7.70×10^{09} col/day	0.0 col/day		2.70×10^{12} col/day	96%
Little Brush Creek of Big Brush Creek, RM 3.2-13.2							
3.13×10^{11} col/day	3.13×10^{10} col/day	0.0 col/day		0.0 col/day		2.82×10^{11} col/day	94%
Little Pitman Creek of Big Pitman Creek, RM 0.0-10.1							
4.70×10^{11} col/day	4.70×10^{10} col/day	Campbellsville STP KY0022039	6.36×10^{10} col/day	City of Campbellsville KYG200015[4]	6.39×10^{10} col/day	2.95×10^{11} col/day	93%
Little Pitman Creek of Big Pitman Creek, RM 10.1-11.2							
1.64×10^{11} col/day	1.64×10^{10} col/day	0.0 col/day		City of Campbellsville KYG200015[4]	1.63×10^{10} col/day	1.32×10^{11} col/day	94%
Little Russell Creek of Green River, RM 0.0-5.1							
1.20×10^{11} col/day	1.20×10^{10} col/day	0.0 col/day		0.0 col/day		1.08×10^{11} col/day	80%
Lynn Camp Creek of Green River, RM 0.0-8.3							
4.47×10^{11} col/day	4.47×10^{10} col/day	0.0 col/day		0.0 col/day		4.03×10^{11} col/day	96%
Middle Pitman Creek of Big Pitman Creek, RM 0.0-7.7							
3.16×10^{11} col/day	3.16×10^{10} col/day	0.0 col/day		0.0 col/day		2.84×10^{11} col/day	86%

TMDL	MOS[1]	WLA[6]			LA[6]	Percent Reduction[5]
		Wastewater[2,3]		MS4		
Middle Pitman Creek of Big Pitman Creek, RM 8.2-10.1						
1.52×10^{11} col/day	1.52×10^{10} col/day	0.0 col/day		0.0 col/day	1.37×10^{11} col/day	86%
Russell Creek of Green River, RM 23.8-40.0						
2.52×10^{12} col/day	2.52×10^{11} col/day	Columbia STP KY0024317	1.82×10^{10} col/day	0.0 col/day	2.25×10^{12} col/day	85%
Russell Creek of Green River, RM 60.4-66.3						
2.42×10^{11} col/day	2.42×10^{10} col/day	0.0 col/day		0.0 col/day	2.18×10^{11} col/day	94%
South Fork Little Barren River of Little Barren River, RM 0.0-23.1						
1.34×10^{12} col/day	1.34×10^{11} col/day	Edmonton STP KY0054437	7.70×10^{09} col/day	0.0 col/day	1.19×10^{12} col/day	97%
South Fork Little Barren River of Little Barren River, RM 23.1-30.1						
2.47×10^{11} col/day	2.47×10^{10} col/day	0.0 col/day		0.0 col/day	2.22×10^{11} col/day	85%
Sulphur Creek of Russell Creek, RM 0.0-10.7						
4.91×10^{11} col/day	4.91×10^{10} col/day	0.0 col/day		0.0 col/day	4.42×10^{11} col/day	76%

Notes:

(1). MOS is an explicit 10% of the TMDL.

(2). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.

(3). WLA value is based on design flow and acute permit limits and represents the maximum one-day load that can be discharged to the stream segment.

(4). The MS4 discharges to two impaired segments; therefore, it must meet the lower of the two WLAs. However, if the MS4 complies with its storm water permit, KDOW regards the MS4 as being in compliance with 401 KAR Chapter 5.

(5). Overall reduction required to achieve the TMDL Target of 360 colonies/100ml.

(6). 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). While this calculation can be used to determine allocations for E. coli, it cannot be used to convert ambient fecal coliform concentrations to E. coli concentrations.

Table S.4 KPDES Permits Addressed in These TMDLs

Facility Name	KPDES No.	Design Flow (MGD)	Facility Type	Permit Limits (col/100ml)(2)		WLA
				Monthly Avg.	Max Weekly Avg.	
Little Barren River of Green River, RM 9.8-15.7						
Edmonton STP	KY0054437	0.51	Sanitary Wastewater Treatment Plant	200	400	7.72×10^{9} col/day
Little Pitman Creek of Green River, RM 0.0-10.1						
City of Campbellsville	KYG200015	n/a	MS4 Municipal entity(1)	n/a	n/a	6.39×10^{10} col/day
Campbellsville STP	KY0022039	4.2	Sanitary Wastewater Treatment Plant	200	400	6.36×10^{10} col/day
Little Pitman Creek of Green River, RM 10.1-11.2						
City of Campbellsville	KYG200015	n/a	MS4 Municipal entity(1)	n/a	n/a	1.63×10^{10} col/day
Russell Creek of Green River, RM 23.8-40.0						
Columbia STP	KY0024317	1.2	Sanitary Wastewater Treatment Plant	200	400	1.82×10^{10} col/day
South Fork Little Barren River of Little Barren River, RM 0.0-23.1						
Edmonton STP	KY0054437	0.51	Sanitary Wastewater Treatment Plant	200	400	7.70×10^{09} col/day

(1) The MS4 discharges to two impaired segments; therefore, it must meet the higher of the two percent reductions, and the lower of the two WLAs. However, if the MS4 complies with its storm water permit, KDOW regards the MS4 as being in compliance with 401 KAR Chapter 5.

(2) 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 the acute limit, or (130/200) for the chronic limit. While this calculation can be used to determine allocations for E. coli, it cannot be used to convert ambient fecal coliform concentrations to E. coli concentrations.

1.0 Introduction

Section 303(d) of the Clean Water Act requires each state to identify waters within their boundaries that have been assessed and are not currently meeting State Water Quality Standards (WQS) for their designated uses (warm or cold water aquatic habitat, primary or secondary contact recreation, domestic water supply and outstanding state resource water per 401 KAR 5:026). States are required to develop Total Maximum Daily Loads (TMDLs) for most waterbodies that do not meet State WQS (exceptions include waterbodies impaired by pollution (e.g., flow alterations, habitat alterations) as opposed to a pollutant (e.g., pathogens)). The TMDL process identifies the allowable amount of pollutant a stream can naturally assimilate while meeting the WQS for the designated use, so states can identify water quality controls to reduce both point and nonpoint source pollution. The ultimate goal is the restoration and maintenance of water quality in the waterbody so that the waterbody meets the designated uses.

In 1997, the Kentucky Division of Water (KDOW) adopted the Watershed Management Framework (KDOW 1998) as a process for monitoring streams, assessing uses, developing TMDLs and rehabilitating waters through local basin teams. The Watershed Management Framework divided the state's major watersheds into five Basin Management Units (BMUs): BMU 1 (Kentucky River), BMU 2 (Salt and Licking Rivers), BMU 3 (Tennessee, Mississippi, Ohio and Cumberland Rivers), BMU 4 (Green and Tradewater Rivers) and BMU 5 (Big Sandy River, Little Sandy River and Tygarts Creek). An interagency cooperative organized by KDOW intensively monitors a BMU once every five years on a rotating basis. The Green and Tradewater Rivers were the focus of the 2001 monitoring season.

2.0 Problem Definition

KDOW identified twenty water bodies for inclusion in the 2008 Integrated Report to Congress from the Upper Green River, which were impaired for the Primary Contact Recreation (PCR, or swimming) designated use due to pathogens. Some of these are also impaired for the Secondary Contact Recreation (SCR, or partial body exposure) designated use (Table 1 and Figure 1). KDOW uses fecal coliform bacteria as an indicator of the presence of excessive pathogen pollution.

3.0 Physical Setting

The Upper Green River, United States Geological Survey (USGS) Hydrologic Unit Code (HUC) 05110001, is located in central Kentucky. It encompasses parts of 17 counties, covers 3173 square miles of land and includes two U.S. Army Corps of Engineers reservoirs, Green River Lake and Nolin River Lake. The Upper Green River lies in the Interior Plateau and Interior River Valley and Hills Level III ecoregion (Woods et. al. 2002). Portions of this watershed also lie in the Western Coal Field, Western Pennyroyal, Eastern Pennyroyal and a small sliver of Outer Bluegrass physiographic region.

There is substantial karst geology in the Upper Green River. In fact, this region is home to Mammoth Cave, the world's largest known cave system and a UNESCO World Heritage Site. This could lead to subsurface drainage between surface watersheds altering the true drainage area of the streams. KDOW and the Kentucky Geological Survey maintain a Karst Atlas of dye tracing data and delineated basins (http://kygeonet.ky.gov).

Table 1 – Impaired Waterbodies in the Upper Green River Watershed (USGS HUC 05110001) Addressed in this TMDL

Waterbody Name, River Miles (RM)	Segment Length (miles)	County	GNIS ID	Impaired Use(s),
Big Brush Creek of Green River, RM 0.0-5.0	5.0	Green	KY487146	Primary Contact Recreation (Nonsupport)
Big Brush Creek of Green River, RM 7.1-13.0	5.9	Green	KY487146	Primary Contact Recreation (Nonsupport)
Big Pitman Creek of Green River, RM 13.9-17.8	3.9	Green	KY487227	Primary Contact Recreation (Partial Support)
Big Pitman Creek of Green River, RM 17.8-23.65	5.85	Taylor	KY487227	Primary Contact Recreation (Nonsupport)
Brush Creek of Big Brush Creek, RM 0.0-2.15	2.15	Green	KY488077	Primary Contact Recreation (Partial Support)
East Fork Little Barren River of Little Barren River, RM 0.0-15.9	15.9	Metcalfe	KY491468	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
East Fork Little Barren River of Little Barren River, RM 20.7-30.0	9.3	Metcalfe	KY491468	Primary Contact Recreation (Partial Support)
Little Barren River of Green River, RM 9.8-15.7	5.9	Green	KY496604	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
Little Brush Creek of Big Brush Creek, RM 3.2-13.2	10.0	Green	KY496646	Primary Contact Recreation (Nonsupport)
Little Pitman Creek of Big Pitman Creek, RM 0.0-10.1	10.1	Taylor	KY496827	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
Little Pitman Creek of Big Pitman Creek, RM 10.1-11.2	1.1	Taylor	KY496827	Primary Contact Recreation (Nonsupport)
Little Russell Creek of Green River, RM 0.0-5.1	5.1	Green	KY496854	Primary Contact Recreation (Partial Support)
Lynn Camp Creek of Green River, RM 0.0-8.3	8.3	Hart	KY497374	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)

Waterbody Name, River Miles (RM)	Segment Length (miles)	County	GNIS ID	Impaired Use(s),
Middle Pitman Creek of Big Pitman Creek, RM 0.0-7.7	7.7	Taylor	KY498146	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
Middle Pitman Creek of Big Pitman Creek, RM 8.2-10.1	1.9	Taylor	KY498146	Primary Contact Recreation (Nonsupport)
Russell Creek of Green River, RM 23.8-40.0	16.2	Adair	KY502521	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
Russell Creek of Green River, RM 60.4-66.	5.9	Adair	KY502521	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
South Fork Little Barren River of Little Barren River, RM 0.0-23.1	23.1	Metcalfe	KY503933	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
South Fork Little Barren River of Little Barren River, RM 23.1-30.1	7.0	Metcalfe	KY503933	Primary Contact Recreation (Nonsupport)
Sulphur Creek of Russell Creek, RM 0.0-10.7	10.7	Adair	KY504734	Primary Contact Recreation (Partial Support)

The Upper Green River is largely comprised of rural areas. The 2001 National Land Cover Dataset (NLCD, USGS 2003) was used to determine the landuse percentages in the watershed. The Upper Green River landuse consists predominately of forest (51%) and agriculture (40%). There are a few small and medium sized cities scattered throughout the watershed, but developed land only accounts for approximately 5.5% of the total landuse (Table 2).

Table 2 – Land Use Classification in the Upper Green River (USGS HUC 05110001). Data Generated Using NLCD 2001 (USGS, 2003)

Land Use	% of Total Area	Square Miles
Forest	51.14	1587.78
Agriculture (total)	40.06	1243.97
Pasture	32.61	1012.46
Row Crop	7.46	231.51
Developed	5.35	166.05
Natural Grassland	3.27	101.66
Wetland	0.15	4.62
Barren	0.03	0.92

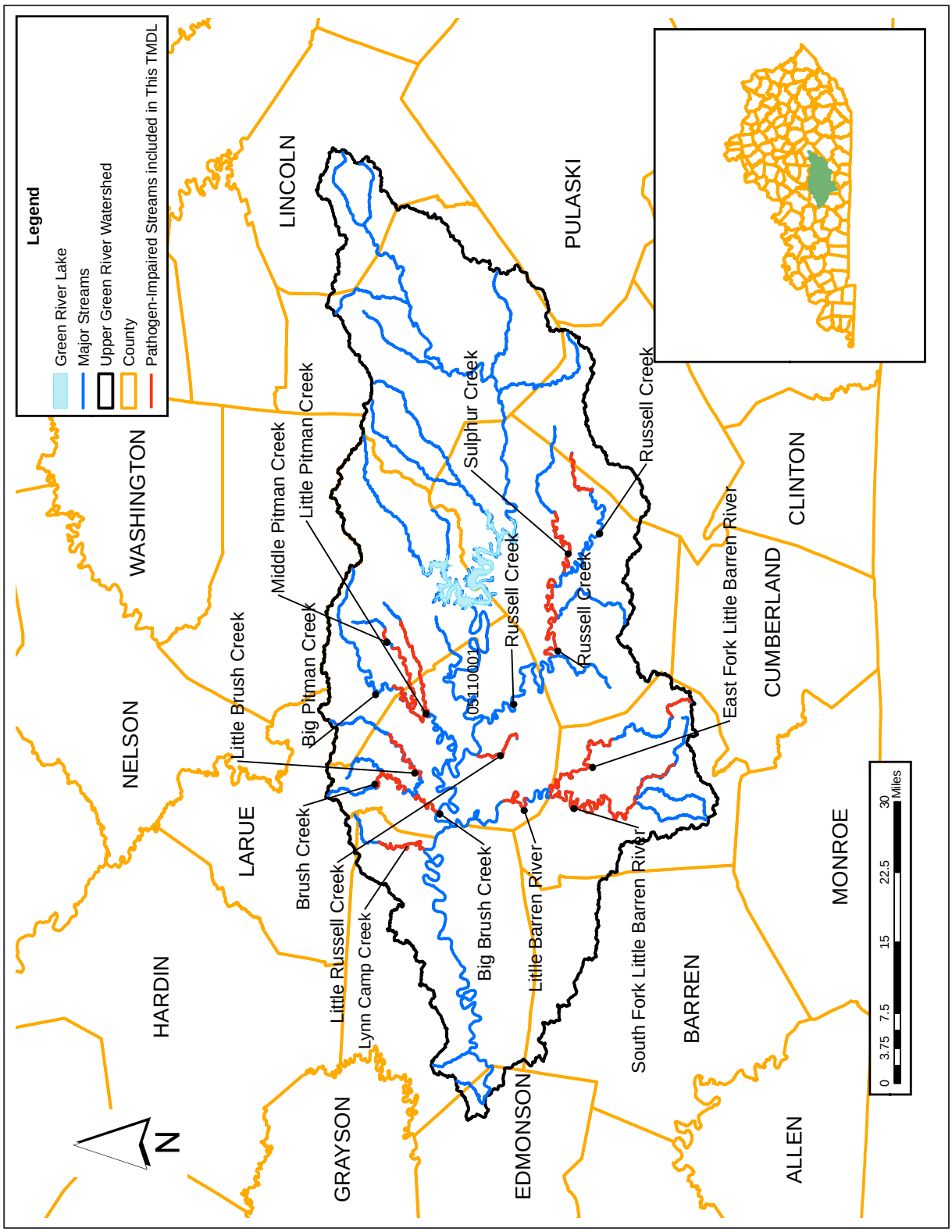

Figure 1 – Location Map of Fecal Coliform Impaired Streams in the Upper Green River Watershed USGS HUC 05110001 Addressed in this TMDL

4.0 Target Identification

The Water Quality Criteria (WQC) in 401 KAR 5:031 (Kentucky's Surface Water Standards) for the PCR use are based on both fecal coliform bacteria and E. coli bacteria. For this TMDL, the fecal coliform criterion was applied, as the samples were not analyzed for E. coli. The fecal coliform criterion in 401 KAR 5:031 Section 7 (1)(a) states that, for the PCR designated use:

"[The] 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. These limits shall be applicable during the recreation season of May 1 through October 31."

There are insufficient fecal coliform measurements to calculate a 5-sample, 30-day geometric mean, so the latter criterion of 400 colonies per 100 ml (colonies/100ml) was used as the WQC in order to calculate TMDLs to bring the watershed into compliance with the PCR designated use.

Additionally, Section 7(2)(a) states that, for the SCR designated use:

"[The] 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."

SCR refers to partial body contact recreation, and the criteria are applicable year round. There are insufficient fecal coliform measurements to calculate a 5-sample, 30-day geometric mean, so the latter criterion of 2000 colonies/100ml was used to assess streams for the SCR use. However, TMDLs were calculated at a level that would satisfy the PCR standard because if a stream is brought into compliance with the 400 colonies/100ml criterion, it will also be in compliance with the 2000 colonies/100ml SCR criterion. This is because permitted sources who are dischargers of sanitary wastewater have a year-round acute permit limit of 400 colonies/100ml, and this limit is protective of the SCR use. Similarly, properly functioning Best Management Practices (BMPs) installed by non-permitted sources to meet the 400 colonies/100ml limit during the recreational season should also offer adequate protection for the remainder of the year.

5.0 Monitoring

Under the Kentucky Watershed Management Framework, the KDOW maintains two types of monitoring stations: ambient stations and rotating watershed stations. Ambient stations are fixed, permanent sampling locations located in the downstream and mid-unit reaches of USGS 8-digit hydrologic units, upstream of major reservoirs and in the downstream reaches of major tributaries. The ambient stations of a watershed management unit are sampled monthly during the year the unit is in the monitoring phase of the watershed cycle. During the other four years of the watershed cycle, sampling frequency is reduced to bimonthly. Rotating watershed stations are selected for intensive monthly sampling for one year during the monitoring portion of the five-year watershed cycle. These are usually located at the downstream reaches of USGS 11-

digit HUC watersheds, and many were coupled with biological sampling and with USGS gauging stations. KDOW follows water quality sample collection and preservation procedures found in its water quality monitoring standard operating procedures (Kentucky Ambient/Watershed Water Quality Monitoring Standard Operating Procedure Manual, 2005).

The Upper Green River was sampled in the 2002-2003 PCR seasons (May through October) for pathogens by Western Kentucky University (WKU, Table 3, Appendix 2, unpublished data). A stream was assessed by KDOW as fully supporting the PCR standard if the criterion (see section 4.0) was not met in less than 20 percent of the samples or if only one sample exceeded the criterion. The stream segment was identified as partial support for the PCR standard if the criterion was not met in 25-33 percent of samples collected and nonsupport if the criterion was not met in >33 percent of samples. Assessments were only performed if five or more samples were collected in a given PCR season (KDOW 2008a). In addition, the stream segments were also assessed for the SCR designated use. The assessment procedure was the same as for the PCR use, but the threshold for compliance was 2000 colonies/100ml, not 400 colonies/100ml.

Table 3 – Sampling Stations on Pathogen-Impaired Streams that were Sampled by Western Kentucky University During the 2002 and 2003 Recreation Seasons

Site	Segment	Support Designation	Latitude	Longitude
GR-1.1 – Lynn Camp Creek at KY-569 bridge about 4.5 miles upstream of confluence with Green River	0.0-8.3	Non-Support	37.3521	-85.7102
GR-2.1 – Little Russell Creek at JT Ward Rd (CR-1204) about 1.0 mile upstream of confluence with Green River	0.0-5.1	Partial Support	37.2250	-85.5707
GR-3.2 – Big Brush Creek off Graham Cemetery Road about 0.25 mile below confluence with Little Brush Creek	0.0-5.0	Non-Support	37.3338	-85.6362
GR-3.4 – Big Brush Creek at KY-61 bridge about 0.3 mile downstream of confluence with Brush Creek	7.1-13.0	Non-Support	37.3826	-85.5979
GR-3.5 – Brush Creek at KY-61 bridge about 1.35 miles upstream of confluence with Big Brush Creek	0.0-2.15	Partial Support	37.3909	-85.6101
GR-3.9 – Little Brush Creek at Doc Ward Road bridge about 4.9 miles upstream of confluence with Big Brush Creek	3.2-13.2	Non-Support	37.3342	-85.5913
GR-3.2 – Poplar Grove Branch off Poplar Grove Road about 0.8 mile upstream of confluence with Upper Brush Creek	0.0-3.0(1)	Non-Support	37.4338	-85.5714
GR-4.1 – Big Pitman Creek at low water ford between Akin Narrows Rd and Montgomery Mill Road near River Mile 3.1	0.0-13.9(1)	Non-Support	37.2731	-85.5530
GR-4.2 – Big Pitman Creek off KY-61 at River Mile 11.3			37.3048	-85.5272
GR-4.3 – Little Pitman Creek off KY-793 near River Mile 1.3	0.0-10.1	Non-Support	37.3181	-85.5018
GR-4.4 – Little Pitman Creek off KY-323 at	0.0-10.1	Non-Support	37.3470	-85.3897

Site	Segment	Support Designation	Latitude	Longitude
River Mile 9.5 downstream of WWTP				
GR-4.5 – Little Pitman Creek off KY-210 at River Mile 10.4 upstream of WWTP	10.1-11.2	Non-Support	37.3515	-85.3749
GR-4.6 – Big Pitman Creek off Roy Chaudoin Rd. (CR-1024) at River Mile 16.0	13.9-17.8	Non-Support	37.3325	-85.5070
GR-4.7 – Big Pitman Creek off KY-323 at River Mile 23.15	17.8-23.65	Non-Support	37.3614	-85.4675
GR-4.9 – Middle Pitman Creek off KY-323 at River Mile at River Mile 6.8	0.0-7.7	Non-Support	37.3590	-85.4067
GR-4.13 – Middle Pitman Creek off Salem Church Rd (CR-1203) at River Mile 9.55	8.2-10.1	Non-Support	37.3820	-85.3808
GR 5-2 – Little Barren River at KY 88 bridge at River Mile 6.4	0.0-8.8(1)	Partial Support	37.22618	-85.67734
GR-5.3 – Little Barren River at KY 218 at River Mile 14.2	9.8-15.7	Non-Support	37.17019	-85.64737
GR-5.4 – South Fork Little Barren River at KY 70 near Sulphur Well, KY at River Mile 3.1	0.0-23.1	Non-Support	37.1004	-85.6343
GR-5.5 – South Fork Little Barren River at for d of Rockland Mills Rd (CR 1054) at River Mile 9.1			37.0713	-85.6485
GR-5.6 – South Fork Little Barren River at KY 540 at River Mile 14.95			37.0430	-85.6408
GR-5.7 – South Fork Little Barren River at KY 1243 at River Mile 17.85			37.0338	-85.6563
GR-5.8 – South Fork Little Barren River at KY 496 southeast of Edmonton at River Mile 26.1	23.1-30.1	Non-Support	36.9738	-85.6030
GR-5.9 – East Fork Little Barren River at US 68 at River Mile 5.3	0.0-15.9	Non-Support	37.1011	-85.5992
GR-5.10 – East Fork Little Barren River at ford off private road near East Fork, KY at River Mile 11.25			37.0668	-85.5610
GR-5.11 – East Fork Little Barren River off Reece-Hurt Rd (CR 1114) east of Delk Branch Rd (CR 1120) at River Mile 26.65	20.7-30.0	Partial Support	36.9439	-85.5011
GR-6.4 Big Creek off Old Gradyville Church Rd (CR_1373) at River Mile 5.8	3.0-8.2(1)	Non-Support	37.0624	-85.4295
GR-6.5 Russell Creek at KY-768 at River Mile 25.92	23.8-40.0	Non-Support	37.1242	-85.4044
GR-6.6 Butlers Fork Off G B Bardin Rd (CR-1343) at River Mile 3.4	2.3-4.0(1)	Non-Support	37.0810	-85.3725
GR-6.7 Petty's Fork near KY-61 behind the County Park west of Columbia at River Mile 2.4	0.0-6.0(1)	Partial Support	37.0974	-85.3340
GR-6.8 Russell Creek off Pelham Branch Rd (KY-767) at River Mile 36.34	23.8-40.0	Non-Support	37.1284	-85.3236
GR-6.9 Russell Creek off Liberty Rd (KY-206) at River Mile 41.4	40.0-41.5(1)	Non-Support	37.1053	-85.2883
GR-6.10 Sulphur Creek at Taylor Fork Rd (CR-1001) at River Mile 6.7	0.0-10.7	Partial Support	37.1128	-85.2339

Site	Segment	Support Designation	Latitude	Longitude
GR-6.11 Glens Fork at KY-55 at River Mile 2.2	0.0-8.0[(1)]	Non-Support	37.0520	-85.2643
GR-6.12 Russell Creek at KY-80 at River Mile 61.6	60.4-66.3	Non-Support	37.0761	-85.1589
[(1)] This segment has an approved TMDL (KDOW 2007c).				

6.0 Source Assessment

6.1 KPDES-Permitted Sources

Permitted sources include all sources regulated by the Kentucky Pollutant Discharge Elimination System (KPDES) permitting program. KPDES specifically regulates point sources, and according to 401 KAR 5:002, a point source is "any discernable, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, or concentrated animal feeding operation [CAFO], from which pollutants are or may be discharged. The term does not include agricultural storm water run-off or return flows from irrigated agriculture." Sources permitted by the KPDES program will be allocated pollutant loads under the Wasteload Allocation (WLA) portion of the TMDL.

6.1.1 KPDES Wastewater

The KPDES program issues discharge permits to facilities that treat sanitary wastewater, among other types. These facilities can be large publicly owned treatment works (POTWs) that service thousands of households and businesses down to small, privately operated package facilities that service one business or one residential development. In the impaired watersheds of the Upper Green River, three KPDES-permitted wastewater facilities are located within an impaired watershed (Table 4). There are certainly other KPDES-permitted facilities in the impaired watersheds; however, the three identified in this report are those that treat sanitary wastewater and contribute a pathogen load to an impaired segment. There are no other permitted dischargers of sanitary wastewater that discharge to the impaired segments addressed by this TMDL (EPA 2007). Facilities in Table 4 receive WLAs, as shown in Section 7.3.2.

Table 4 – KPDES-Permitted Facilities in the Upper Green River (USGS HUC 05110001) Which Discharge Pathogens to an Impaired Segment Addressed in this TMDL

KPDES Permit Number	Facility Name[(1)]	TMDL Segment (River Mile Where Discharge Enters Segment)	Design Flow (MGD)	Fecal Coliform Acute Permit Limit (colonies/100ml)
KY0054437	Edmonton STP	South Fork Little Barren River (19.6)	0.51	400
KY0024317	Columbia STP	Russell Creek (40.0)	1.2	400
KY0022039	Campbellsville STP	Little Pitman Creek (10.1)	4.2	400

Note: [(1)]STP is a Sewage Treatment Plant

6.1.2 KPDES MS4 Storm Water

In urban areas, polluted storm water runoff is often diverted and concentrated into Municipal Separate Storm Sewer Systems (MS4s) where it ultimately discharges to surface waters with little or no treatment. As a result, EPA established Phase I of the National Pollutant Discharge

Elimination System (NPDES) storm water program in 1990 (KDOW 2007b). Phase I included large and medium sized municipalities defined as having a population of 100,000 or more. In Kentucky, Phase I was implemented in 1992 and included only Lexington-Fayette County and Louisville. Phase II of the storm water rule began incorporating small MS4 entities (>50,000 or 1,000 people/mi^2) in 1999, with Kentucky's program beginning in 2003. Currently there are 210 communities in Kentucky targeted for the storm water program. Only one MS4 community, Campbellsville, is located within the HUC 05110001 watershed (

Table 5). Permitted MS4s are responsible for establishing a Storm Water Management Quality Management Plan (SWQMP) that implements six minimum elements established by the federal NPDES program:

1) Public Education and Outreach
2) Public Participation/Involvement
3) Illicit Discharge Detection and Elimination
4) Construction Site Runoff Control
5) Post-Construction Runoff Control
6) Pollution Prevention/Good Housekeeping.

Table 5 – KPDES MS4 Storm Water Permits within the Upper Green River Watershed that Discharge to a Pathogen-Impaired Segment Addressed in this TMDL

KPDES Permit Number	Permitted Municipality	Permitted Area
KYG200015	City of Campbellsville	3.62 mi^2

6.1.3 KPDES-Permitted CSOs

Combined Sewer Overflows (CSOs) are discharges from combined sewers, (i.e., sewers that carry both sanitary and storm water flow in the same pipe). In accordance with U.S. EPA's Combined Sewer Overflow Control Policy (1994), KDOW has signed Consent Decrees or Consent Judgments with all CSO communities in Kentucky. Within each Consent Decree, Judgment Communities are required to submit a Long Term Control Plan (LTCP) as the blueprint by which CSOs must be remediated (e.g., through separation of combined sewers, treatment of their discharge, and/or reduction in frequency, duration or volume, etc.) until they meet the WQS. KDOW then approves or disapproves the LTCP. Individual CSOs are given outfall numbers under the community's KPDES permit. There are no combined sewers in this watershed.

6.1.4 KPDES Animal Feeding Operations

Animal Feeding Operations (AFOs) that will or are anticipated to discharge to the waters of the Commonwealth are required to obtain a KPDES permit pursuant to 401 KAR 5:060, Section 10. "Discharge" means that *process wastewater* or water that comes into contact with the *production area* discharges to the waters of the Commonwealth. *Process wastewater* means water directly or indirectly used in the operation of the AFO for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning, or flushing pens, barns, manure pits, or other AFO facilities; direct contact swimming, washing, or spray cooling of animals; or dust control. Process wastewater also includes any water, which comes into contact with any raw materials, products, or byproducts including manure, litter, feed, milk, eggs, or bedding.

If the animal feeding operation is managing the waste generated at the facility as a liquid, a construction permit must be obtained pursuant to 401 KAR 5:005.
Currently, no AFOs have permits to discharge within the watershed (EPA, 2007a). AFOs that do not discharge and are not anticipated to discharge are discussed in Section 6.2.1.

Operations that are defined as Concentrated Animal Feeding Operations (CAFOs) pursuant to 401 KAR 5:060, Section 10, are required to obtain a KPDES permit. In order to be categorized as a CAFO, an operation must first meet the definition of an AFO. There is one additional requirement that defines an AFO as a CAFO. A CAFO actually discharges or intends to discharge to waters of the Commonwealth. 40 CFR 122.23 (b) defines the number of animals that comprise a CAFO. KPDES has the authority to designate smaller facilities as CAFOs if environmental circumstances warrant such designation.

Once defined as a CAFO, the operation can be permitted under a KPDES General Permit or a KPDES Individual Permit, depending upon the nature of the operation. Conditions of these permits include no discharge to surface water. The exception to the discharge prohibition is that holders of Individual Permits may discharge only during a 25-year (24-hour) or greater storm event. There are no permitted CAFOs in the watershed (USEPA, 2007a).

6.2 Non-Permitted Sources

Non-permitted sources include all sources not permitted by the KPDES permitting program, and are often referred to as nonpoint sources. According to 401 KAR 5:002, nonpoint means "any source of pollutants not defined as a point source, as used in this chapter." While non-permitted sources are legal despite not having permits, their loads to surface water are still regulated by laws such as the Kentucky Agricultural Water Quality Act, federal Clean Water Act (i.e., the TMDL process) and 401 KAR 5:037 (Groundwater Protection Plans), among others. Non-permitted sources typically discharge pollutants to surface water in response to rain events. Non-permitted sources for pathogens exist in the watershed, and fall into various categories including agriculture, impacts directly attributable to humans, household pets and natural background, which in the case of pathogens in a rural watershed means wildlife. These non-permitted sources are generally correlated to landuse. All sources not regulated by the KPDES program will be allocated a pollutant load under the Load Allocation (LA) portion of the TMDL.

6.2.1 Kentucky No Discharge Operating Permit (KNDOP)

Pursuant to 401 KAR 5:005, facilities with agricultural waste handling systems or that dispose of their effluent by spray irrigation but do not intend to discharge to surface waters are required to obtain a Kentucky No Discharge Operating Permit (KNDOP) prior to construction and operation. Facilities that handle animal waste as a liquid are required to submit a Short Form B, construction plans, and a Comprehensive Nutrient Management Plan to the Division of Water. These operations handle liquid waste in a storage component of the operation (e.g. lagoon, pit, or tank) and land apply the waste via spray irrigation or injection to cropped acreages. Land application of the waste that results in waste runoff into a stream is prohibited, as is runoff from the agricultural production area (see Section 6.1.4). However, if the waste is land applied according to the facility's Nutrient Management Plan, then storm water runoff from the land application area which does not contain waste and does not cause or contribute to an impairment

is classified as agricultural storm water runoff, and is a legal source; therefore it receives an allocation under the TMDL, see Section 7.3.3, Load Allocation.

Also included in KNDOP requirements are golf courses or industrial operations that discharge treated wastewater to ponds or lagoons on their property, prior to spray irrigation.

6.2.2 Human Waste Disposal

Human waste disposal is of particular concern in rural areas. The majority of the Upper Green River is not serviced by a sewer system. The unsewered areas either have Onsite Sewage Treatment and Disposal Systems (OSTDS) or sewage is discharged directly to streams. OSTDS, including septic tanks, are commonly used in areas where providing a centralized sewage collection and treatment system is not cost-effective or practical. When properly sited, designed, constructed, maintained, and operated, septic systems are an effective means of disposing and treating domestic waste. The effluent from a well-functioning OSTDS is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, they can be a source of pathogens and other pollutants (e.g., nitrogen and phosphorus) to both groundwater and surface water.

The Kentucky Infrastructure Authority (KIA) compiled a report titled "Water Resource a Strategic Plan for Wastewater Treatment" (KIA 2000) with data from the Regional Area Development Districts (ADDs). The current percent of population serviced by sewers (as of 1999) and the estimated number of households serviced by OSTDS were reported. These data, along with the Census 2000 estimate of households by county, are shown in Table 6.

Table 6 – Population Serviced by Public Sewer

County	2000 Households	% Served by Sewer	Calculated Number of Onsite Systems
Adair	6,747	26%	5,000
Green	4,706	24%	3,400
Hart	6,769	25%	5,200
Metcalfe	4,016	17%	3,300
Taylor	9,233	52%	4,500

According to the Kentucky State Data Center, the population of the counties in the Barren River ADD (including Hart and Metcalf Counties) is expected to increase by 8.8% between 2000 and 2010, and the population of the Lake Cumberland ADD (including Green, Adair and Taylor counties) is expected to increase by 6.4%. Therefore, KDOW expects the population in both the sewered and unsewered areas of these watersheds to increase beyond what is reported in Table 6. For an overview of sewer and other wastewater projects in the watershed, see KIA's website at http://www.kia.ky.gov/.

6.2.3 Agriculture

The Upper Green River has a large agricultural base, with forty percent of the landuse in agricultural uses. Along with agriculture is the potential for pathogen loading from animal

waste. Agricultural animals are both a direct and indirect source of fecal coliform loadings to streams. Cattle with access to streams can have a direct impact on water quality when feces are deposited on stream banks or directly in the stream. Cattle often lie in or near the streams in order to dissipate excess heat, find shade or find water to drink. Animals grazing in pasturelands will often deposit feces on the land and coliform that does not decay will wash off into the streams during wet weather events. Runoff from pastureland is an indirect source of coliform, as a rainfall event is required to transport the coliform to the stream.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by county for virtually every facet of U.S. agriculture (USDA, 2002). The "Census of Agriculture Act of 1997" (Title 7, United States Code, Section 2204g) directs the Secretary of Agriculture to conduct a census of agriculture on a 5-year cycle, collecting data for the years ending in 2 and 7. Livestock inventory from the 1997 and 2002 Census of Agriculture reports for the counties within the upper Green are listed in Table 7. In most counties, cattle are the dominant livestock. However, there are a few counties with significant poultry operations. NASS reporting is based on countywide data, therefore no assumptions are made on a watershed level; however the percentage of agricultural landuse is calculated for each impaired watershed and any known AFOs are identified in Section 8.3.

Table 7 – Livestock Inventory for Counties Included in the Upper Green River Watershed. (USDA 2002)

	Number of Farms[1]		Inventory	
	1997	2002	1997	2002
Adair County				
Cattle and Calves	1,005	915	45,397	47,916
Beef	812	729	19,855	20,896
Dairy	146	120	6,759	7,715
Other Cattle	N/A[2]	751	N/A[2]	19,305
Swine	28	24	1,163	666
Poultry	61	55	877	1374
Sheep and Lamb	8	11	64	238
Horses	N/A[2]	304	N/A[2]	2,084
Green County				
Cattle and Calves	739	716	34,340	35,876
Beef	619	619	17,114	18,711
Dairy	82	73	3,535	3,428
Other Cattle	N/A[2]	577	N/A[2]	13,737
Swine	22	11	764	84
Poultry	4	6	192	94
Sheep and Lamb	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Horses	N/A[2]	165	N/A[2]	876
Hart County				
Cattle and Calves	953	913	44,829	48,414
Beef	748	711	20,551	22,591

	Number of Farms[1]		Inventory	
	1997	2002	1997	2002
Dairy	134	104	4,576	4,081
Other Cattle	N/A[2]	776	N/A[2]	21,742
Swine	21	29	171	345
Poultry	65	49	1,245	1,402
Sheep and Lamb	15	25	430	323
Horses	N/A[2]	326	N/A[2]	1,945
Metcalfe County				
Cattle and Calves	690	620	32,509	37,015
Beef	543	501	12,280	13,721
Dairy	104	90	4,165	4,557
Other Cattle	N/A[2]	500	N/A[2]	18,737
Swine	25	16	184	102
Poultry	21	27	240	744,487
Sheep and Lamb	9	9	81	103
Horses	N/A[2]	173	N/A[2]	1,111
Taylor County				
Cattle and Calves	736	614	31,888	30,712
Beef	606	524	14,705	14,125
Dairy	75	63	3,295	3,173
Other Cattle	N/A[2]	513	N/A[2]	13,414
Swine	30	13	2,818	(D)[3]
Poultry	34	25	588	351
Sheep and Lamb	9	12	65	258
Horses	N/A[2]	183	N/A[2]	1,146

[1] A farm is defined as any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year.
[2] N/A = Not available
[3] D = data withheld to avoid disclosing data for individual farms.

6.2.4 Household Pets

Although household pets undoubtedly exist in these watersheds, their contribution is deemed to be minimal compared to other sources. Household pets may, however, contribute a significant portion of the pathogen pollution within urban areas (e.g., MS4s).

6.2.5 Wildlife

Wildlife undoubtedly contribute pathogens to the watershed, noting the high percentage of forest in all subwatersheds. Table 8 shows the estimates of deer population and density by county in the Upper Green River, as provided by the Kentucky Department of Fish and Wildlife Resources (David Yancy, Personal Communication, 2006). Estimates on numbers of other types of animals are not available. Although wildlife contribute pathogens to surface water, such contributions represent natural background conditions, and do not receive a reduction as part of the TMDL.

Table 8 – Estimated Deer Population and Density by County (Yancy 2006)

County	Estimated Deer Population	Estimated Deer Density (#/mi^2)
Adair	5,133	14
Green	5,668	21
Hardin	6,478	14
Hart	4,562	14
Metcalfe	3,166	12
Taylor	2,887	12

6.3 Illegal Sources

Both WLA and LA sources may have illegal discharges of pathogens to surface water. Within the LA, two illegal sources related to human waste disposal include failing OSTDS and straight pipes, which receive an allocation of zero. Straight pipes are discrete conveyances that discharge sewage, gray water (i.e., water from household sinks, laundry, etc.) and storm water to the surface waters of the Commonwealth without treatment. Although straight pipes meet the definition of a point source as defined in 401 KAR 5:002, EPA considers them a non-permitted source for load allocation purposes within a TMDL. In the course of eliminating any existing straight pipes or failing OSTDs, the pollutant load carried could be routed to functional OSTDS, to an existing Wastewater Treatment Plant (WWTP), or possibly to a future KPDES-permitted point source such as a package treatment plant. If the former, the load will be reduced between 99% and 99.9%, after pathogen losses in the soil column are accounted for (EPA, 2002). If the latter, the permitted point source must conform to the requirements for point sources as described in the WLA, below. Another type of illegal source within the LA is failing, non-existing or underperforming 'Best Management Practices' (BMPs). Another potential LA source would be KNDOP operations that violate terms of a Nutrient Management Plan, or that discharge runoff from an agricultural production area. During implementation, an extensive survey of the watershed would be useful for identifying illegal sources for elimination. Within the WLA, potential illegal sources include WWTPs exceeding their permit limits. Sanitary Sewer Overflows (SSOs), if present, must be eliminated from the watershed.

7.0 Total Maximum Daily Load

7.1 TMDL Equation

A TMDL calculation is performed as follows:

$$TMDL = WLA + LA + MOS \quad \text{(Equation 1)}$$

$$TMDL\ Target = TMDL - MOS \quad \text{(Equation 2)}$$

Where:
TMDL = the TMDL, which was defined in Section 5.0 as the loading that is equivalent to a concentration of 400 colonies/100ml at a given flow, called the Mean Annual Flow (MAF, see Section 7.2), in units of colonies per day.
WLA = the WasteLoad Allocation, including KPDES-permitted sources such as WWTPs and MS4s.
LA = the Load Allocation, including non-permitted sources and natural background.

MOS = the Margin of Safety, which can be an implicit or explicit additional reduction applied to the WLA, LA or both types of sources that accounts for uncertainties in the data or TMDL calculations.

TMDL Target = the TMDL minus the MOS. The TMDL Target represents the portion of the TMDL remaining after the application of a MOS; this is the load to be allocated by distributing it among the WLA (KPDES-permitted sources) and/or the LA (all remaining sources). The TMDL Target may also be expressed as a concentration where flows are not available, or when determining compliance.

The TMDL calculation must take into account seasonality and other factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.

7.2 Existing Loads

Existing loads were determined using the monitoring data collected by WKU. However, there were no stream discharge (i.e., flow) measurements taken with the fecal coliform samples; therefore, an alternate method for calculating loads was necessary. The USGS publishes Mean Annual Flow (MAF) data on the internet via the "Hydrology of Kentucky" geographic data explorer (http://kygeonet.ky.gov/kyhydro/main.htm). The MAF is calculated from multiple regression equations found in the USGS Report "Low-Flow Characteristics of Kentucky Streams" (Martin 2002) for each stream. KDOW adjusted the MAF by either adding or subtracting flow based on any major KPDES dischargers or water withdrawals from the receiving stream. The 90th percentile concentration of samples collected in each stream segment (if data were collected from multiple sites, all samples were pooled into one dataset) was used as the existing concentration for the stream segment. Loads were then calculated using Equation 2, below. Adjusted MAFs are included in Appendix 3.

$$\text{Concentration (colonies/100ml)} \times \text{Adjusted MAF (cfs)} \times \text{Conversion Factor } (2.45\times10^{9}\text{(s*ml)/day*cfs}) = \text{Existing Load (colonies/day)}$$

(Equation 3)

7.3 TMDL Components

7.3.1 Critical Conditions

The critical condition for point source loadings (including WWTP outfalls, straight pipes and including sources that act like point sources, such as cattle standing in streams) is typically during periods of low streamflow. This is when dilution of pathogen loading is minimized by low volume in a stream. The critical condition for nonpoint source loading is usually a runoff event preceded by an extended dry period. Pathogen-containing wastes accumulate on the land during the dry weather, and are washed off into the stream by subsequent rainfall. Because both types of sources exist within the impaired watersheds, the critical period for pathogens is the recreational season of May through October. The MAF was selected as the flow that represents these conditions.

7.3.2 Waste Load Allocation

The WLA is the allocation given to KPDES-permitted sources within the TMDL. The WLAs for KPDES-permitted wastewater facilities are calculated using the maximum design flow of the

facility and the acute permit limit for fecal coliform using Equation 3 below. Since the KPDES discharge permits are set at the WQC, no load reduction is required for these facilities. For WWTPs, KDOW expects compliance with the WQC to be determined by effluent pathogen concentration, as described in Section 4.0, not by load. Future expansions or additional dischargers to the stream will also receive the full allocation of their increased loading, since there will be additional flow in the stream and the TMDL load will increase proportionally to the increase in flow, but wastewater dischargers must not cause or contribute to an impairment.

WLA = Design Flow (gal/day) × Concentration (colonies/100ml) × 3.875 L/gal × 1000 ml/L
(Equation 4)

The MS4 storm water portion of the WLA was calculated by first determining the percent of the watershed area that MS4 is responsible for. While it would have been possible to automatically assign 100% of the area within the MS4 boundaries to the MS4, KDOW believes this could overestimate the amount of the pathogen loading (i.e., the existing conditions) the MS4 is responsible for, and thus overestimate the final allocation to the MS4 (and therefore artificially decreasing the final allocation to LA sources). This is based on the premise that not all runoff from within the MS4 boundary transits impervious surfaces and/or is collected by the MS4 infrastructure; some precipitation falls on areas such as forest or farms and the runoff goes directly to creeks instead (e.g., MS4s can contain forest, agriculture, wetlands, etc. which drain directly to creeks). Therefore, the portion of the load allocated to the MS4 was determined by assigning the different landuse categories within the MS4 boundary either to the MS4 or to the LA sources. The landuse categories were assigned as follows:

Table 9 – MS4/LA Landuse Assignments within the MS4 Boundary

Land Use	Load Assignment
Forest (all kinds)	LA
Agriculture (all kinds)	LA
Developed (all kinds)	MS4
Natural Grassland	LA
Wetland (all kinds)	LA
Barren	LA

This calculation was only performed within the MS4 boundary: in non-MS4 areas, 100% of the land area was attributed to LA sources (and WWTPs, if present; see Section 7.2 for a description of how adjustments were made to the MAF when a WWTP discharged to an impaired segment). Once the percent of the area the MS4 is responsible for was calculated, the KPDES wastewater WLA (if any) was subtracted from the TMDL Target load (i.e., the TMDL minus the MOS) and this number was multiplied by the percentage of the area the MS4 is responsible for (Equation 4) to determine the MS4's final allocation (i.e., the percent of the loading allowed in the watershed from the MS4). The remainder was allocated to the LA sources.

MS4 WLA = (TMDL – MOS – KPDES WLA) × (% of area that is MS4)
(Equation 5)

KDOW used the MS4 boundaries available within the Kentucky Singlezone Geographic Information System Portal to determine the percent of MS4 area within each watershed. However, while this is the most accurate source of information available, it is subject to error,

and MS4 boundaries and permit conditions are subject to change as Storm Water Permits are renewed. Therefore, any area must meet the TMDL Target regardless of whether it lies within the MS4 boundary or not. Only the balance between the MS4 WLA and the LA will shift if the MS4 boundary is different from that depicted in Figure 6.

While the MS4 receives an instream pollutant allocation as part of the TMDL process and its point of compliance is ultimately the surface water(s) it discharges to, KDOW interprets this to mean the MS4 must comply with the conditions of its MS4 Storm Water Permit in order to be deemed in compliance with 401 KAR Chapter 5.

7.3.3 Load Allocation

The LA is where non-permitted sources (e.g., nonpoint sources, or those sources not permitted by KPDES) receive their allocation within the TMDL. Non-permitted sources include properly functioning agricultural BMPs, OSTDS, wildlife, and household pets. Failing or non-existing BMPs or OSTDS are also included in the LA, but these are illegal sources and KDOW expects compliance efforts to target these sources for elimination so that legally operating sources do not bear the burden of implementing reductions beyond achieving the WQC in order to accommodate the loading from illegal sources. The load allocation is calculated as the remainder of the TMDL Target after subtracting the wastewater and MS4 WLAs (Equation 5). The LA is therefore based on the percentage of the watershed not contributing runoff to the MS4 infrastructure/traversing impervious surfaces within the MS4 boundary, and considering only non-WWTP streamflow.

$$LA = TMDL - MOS - KPDES\ WLA - MS4\ WLA \quad \text{(Equation 6)}$$

7.3.4 Margin of Safety

There are two methods for incorporating a MOS in the TMDL analysis: implicitly include the MOS using conservative assumptions, or explicitly set aside a (numerical) portion of the TMDL as the MOS and divide the remainder of the allowable load (i.e., the TMDL Target load) between the LA and WLA. For this TMDL, a 10% explicit MOS (i.e., 10% of the WQC, or 40 colonies/100ml, but expressed as a load where possible) was reserved to account for uncertainty in determining the loading balance between LA and WLA sources.

7.3.5 Percent Reduction

For informational purposes, a 'percent reduction' was calculated for each impaired segment to show the percent reduction that would have been required during the PCR season(s) in which the samples were taken in order to meet the TMDL Target, see Equation 6. Existing load was calculated as the 90th percentile of the fecal coliform results from each site multiplied by the MAF and converted to a load (Equation 2).

$$((\text{Existing load} - \text{TMDL Target})/\text{Existing Load}) * 100 = \%\ \text{reduction required}$$

(Equation 7)

While providing additional information, the percent reduction calculation is not equivalent to the TMDL; the TMDL is the load that the waterbody can assimilate while still meeting its designated uses (i.e., PCR and SCR), which is equal to the critical flow rate (MAF) multiplied by the WQC of 400 colonies/10ml (minus a MOS), which is then multiplied by a conversion factor that allows the load to be expressed in colonies/day.

Therefore, the percent reduction is a determination of how much the measured concentration exceeded the TMDL Target at the time the samples were taken: It does not determine the percent reduction needed at any other time, as the instream concentrations are likely to be different. Unlike the calculated percent reductions, the TMDL is a constant based upon the WQC and the critical flow, whereas the percent reduction changes based on instream fecal coliform concentrations.

Regardless of the procedure used to estimate percent reductions for each sampling station, reductions from existing conditions ultimately must be effected within a given watershed only until all stream segments meet the PCR use, or until all sources save wildlife are discharging in compliance with the WQC. However, once the WQC is met, all sources (save wildlife) must continue to discharge at a concentration that meets the WQC.

7.4 Individual Stream Segments

7.4.1 Big Brush Creek

The Big Brush Creek watershed is located in portions of northern Green and northwestern Taylor Counties. It has a total drainage area of 83.75 square miles and comprises the USGS Hydrologic Unit 0511000107. There are 175.71 miles of streams as delineated in the 24K NHD (USGS 1999) with an average slope of 0.11%. The watershed is predominantly rural with over half of the watershed covered by forest (51.83%); there is less than one percent of the land covered with impervious surfaces (USGS 2007). The geology is mainly Pennsylvanian aged limestone; this results in the numerous sinkholes found in the watershed, especially in the Little Brush Creek subwatershed.

The Western Kentucky University sampled seven sites in the Big Brush Creek watershed during the 2001-2003 PCR seasons (Appendix 2). KDOW assessed two segments, Upper Brush Creek and Poplar Grove Branch, in the 2001 watershed assessment cycle. Upper Brush Creek met the PCR designated use while Poplar Grove Branch did not, and it was placed on the 2002 303(d) Report to Congress (KDOW 2003). As a result, KDOW developed a TMDL for Poplar Grove Branch, which was approved by EPA in 2008 (KDOW 2007c).

KDOW also listed the following stream segments as impaired in the 2008 Integrated Report to Congress: Big Brush Creek of Green River from River Miles 0.0-5.0, Big Brush Creek of Green River from River Miles 7.1-13.0, Brush Creek from River Miles 0.0-2.15 and Little Brush Creek from River Miles 3.2-13.2 (Table 10, Figure 2).

Table 10 – Pathogen-Impaired Segments in the Big Brush Creek Watershed

Stream	River Miles	Support Designation
Big Brush Creek	0.0-5.0	Primary Contact Recreation (Nonsupport)
Big Brush Creek	7.1-13.0	Primary Contact Recreation (Nonsupport)
Brush Creek	0.0-2.15	Primary Contact Recreation (Partial Support)
Little Brush Creek	3.2-13.2	Primary Contact Recreation (Nonsupport)

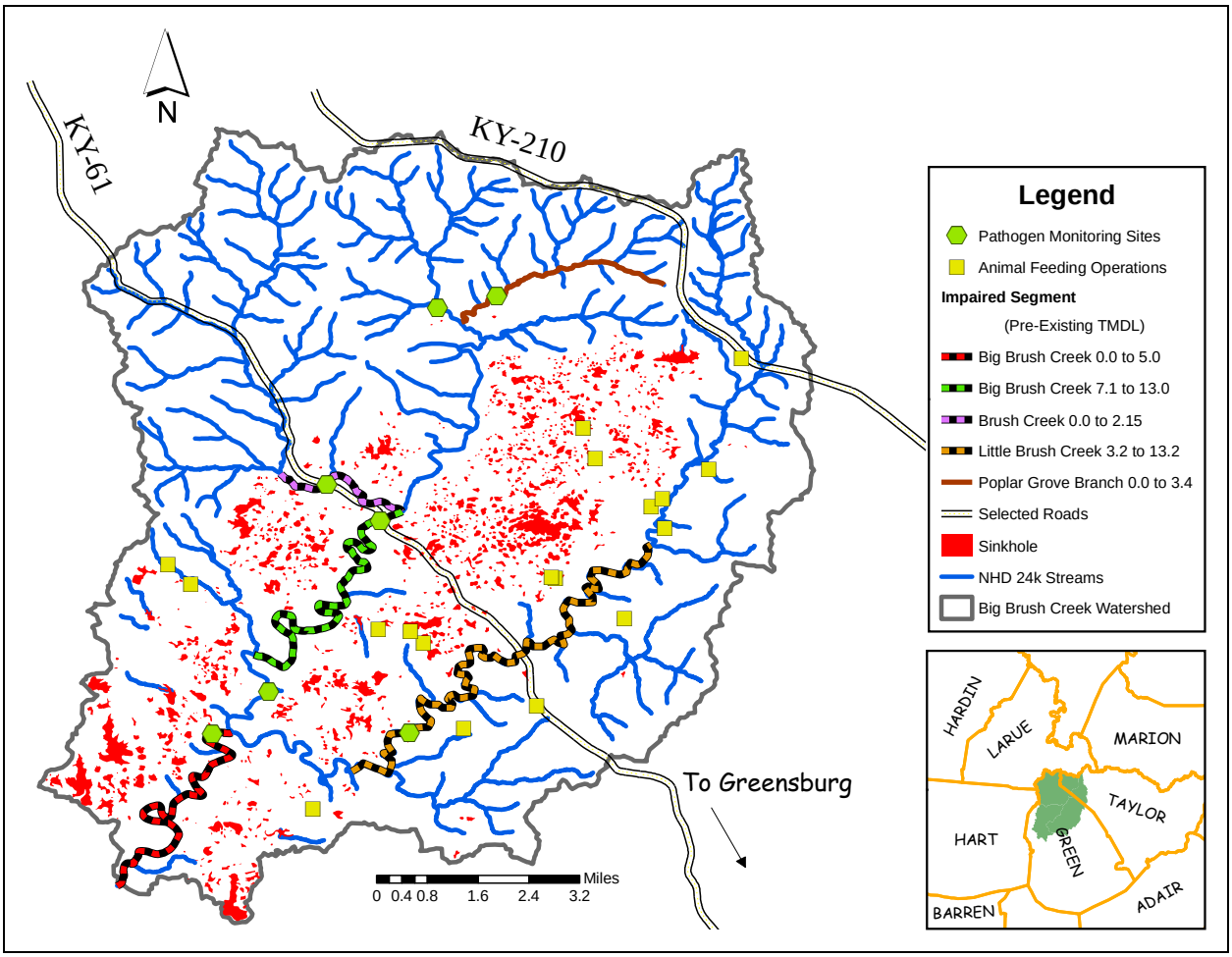

Figure 2 – Big Brush Creek Watershed

7.4.1.1 Big Brush Creek of Green River 0.0 to 5.0

This segment of Big Brush Creek runs from the mouth at Green River to the confluence with Little Brush Creek (Figure 2). WKU sampled at River Mile 4.75 for fecal coliform during the PCR season of 2003 (Table 11). The results of this sampling indicate this segment of Big Brush Creek is impaired (nonsupport) for the PCR designated use, and it was included in the 2008 Integrated Report to Congress (KDOW 2008a). There were exceedances in 50.0% (3 of 6) of the samples collected. The 90th percentile concentration of all samples was 792 colonies/100ml. The watershed for the impaired segment comprises USGS HUC-12 0511000110 with a total drainage area of 83.75 square miles (Figure 2). The landuse in the watershed is predominately forest (51.83%) followed by pasture (33.76%), natural grassland (4.59%), developed land (2.5%) and row crops (2.36%, Table 12). There are also four known impaired segments upstream of this segment. A TMDL was developed by KDOW and approved by EPA in 2008 for Poplar Grove Branch (KDOW 2007c). TMDLs for the other three segments are included in this report.

Table 11 – Results of WKU Sampling in Big Brush Creek at River Mile 4.75 During the 2003 Recreation Season

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
Big Brush Creek off Graham Cemetery Road about 0.25 mile below confluence with Little Brush Creek	5/19/2003	432	✓
	6/30/2003	504	✓
	7/29/2003	1080	✓
	8/20/2003	200	
	9/17/2003	96	
	10/29/2003	100	
Percent Exceedances			
3/6 = 50.0%			
90th Percentile Concentration			
792 colonies/100ml			

Table 12 – Land Use Classification in Big Brush Creek Watershed. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	51.83	43.41
Agriculture (total)	40.49	33.91
Pasture	33.76	28.28
Row Crop	6.73	5.64
Developed	4.37	3.66
Natural Grassland	2.97	2.49
Wetland	0.16	0.14
Barren	0.03	0.03

There are no KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed; therefore, the entire load is allocated to non-permitted sources (Table 13). There are eighteen KNDOP-permitted AFOs in the watershed (KDOW 2006a), and other non-permitted sources as described in Section 6.2.

Table 13 – Summary of TMDL Components for Big Brush Creek 0.0 to 5.0

Existing Load(1)	TMDL(1)	Margin of Safety(2)	WLA(3)	LA	Percent Reduction(4)
2.10×10^{12} col./day	1.06×10^{12} col./day	1.06×10^{11} col./day	0.0 col./day	9.56×10^{11} col./day	55%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 108.5 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

7.4.1.2 Big Brush Creek of Green River 7.1 to 13.0

This segment of Big Brush Creek runs from the confluence with Rocklick Branch downstream to the confluence with Brush Creek upstream (Figure 3). WKU sampled at River Mile 12.35 for fecal coliform during the PCR seasons of 2002 and 2003 (Table 14). The results of this sampling indicate this segment of Big Brush Creek is impaired (nonsupport) for the PCR designated use, and it was listed in the 2008 Integrated Report to Congress. There were exceedances in 43% (3 of 7) of the samples collected. The 90th percentile concentration of all samples was 989 colonies/100ml. The watershed for the impaired segment comprises eleven USGS HUC-14s (05110001100010 through 05110001100110) with a total drainage area of 41.15 square miles (Figure 3). The landuse in the watershed is predominately forest (71.8%) followed by pasture (18.3%), natural grassland (4.1%), developed land (3.2%) and row crops (2.4%, Table 15).

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed. There are three KNDOP-permitted AFOs in the watershed (KDOW 2006a), and other non-permitted sources as described in Section 6.2; therefore, the entire load was allocated to non-permitted sources (Table 16).

Table 14 – Results of WKU Sampling in Big Brush Creek at River Mile 12.35 During the 2002-2003 Recreation Season

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
Big Brush Creek at KY-61 bridge about 0.3 mile downstream of confluence with Brush Creek	5/23/2002	64	
	6/13/2002	1560	✓
	7/31/2002	520	✓
	8/21/2002	608	✓
	9/24/2002	376	
	5/19/2003	304	
	10/8/2003	88	
Percent Exceedances			
3/7 = 43%			
90th Percentile Concentration			
989 colonies/100ml			

Table 15 – Land Use Classification in Big Brush Creek Above River Mile 7.1. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	71.8%	29.56
Agriculture (total)	20.7%	8.51
Pasture	18.3%	7.53
Row Crop	2.4%	0.98
Developed	3.2%	1.31
Natural Grassland	4.1%	1.69
Wetland	0.1%	0.04
Barren	0.0%	0.01

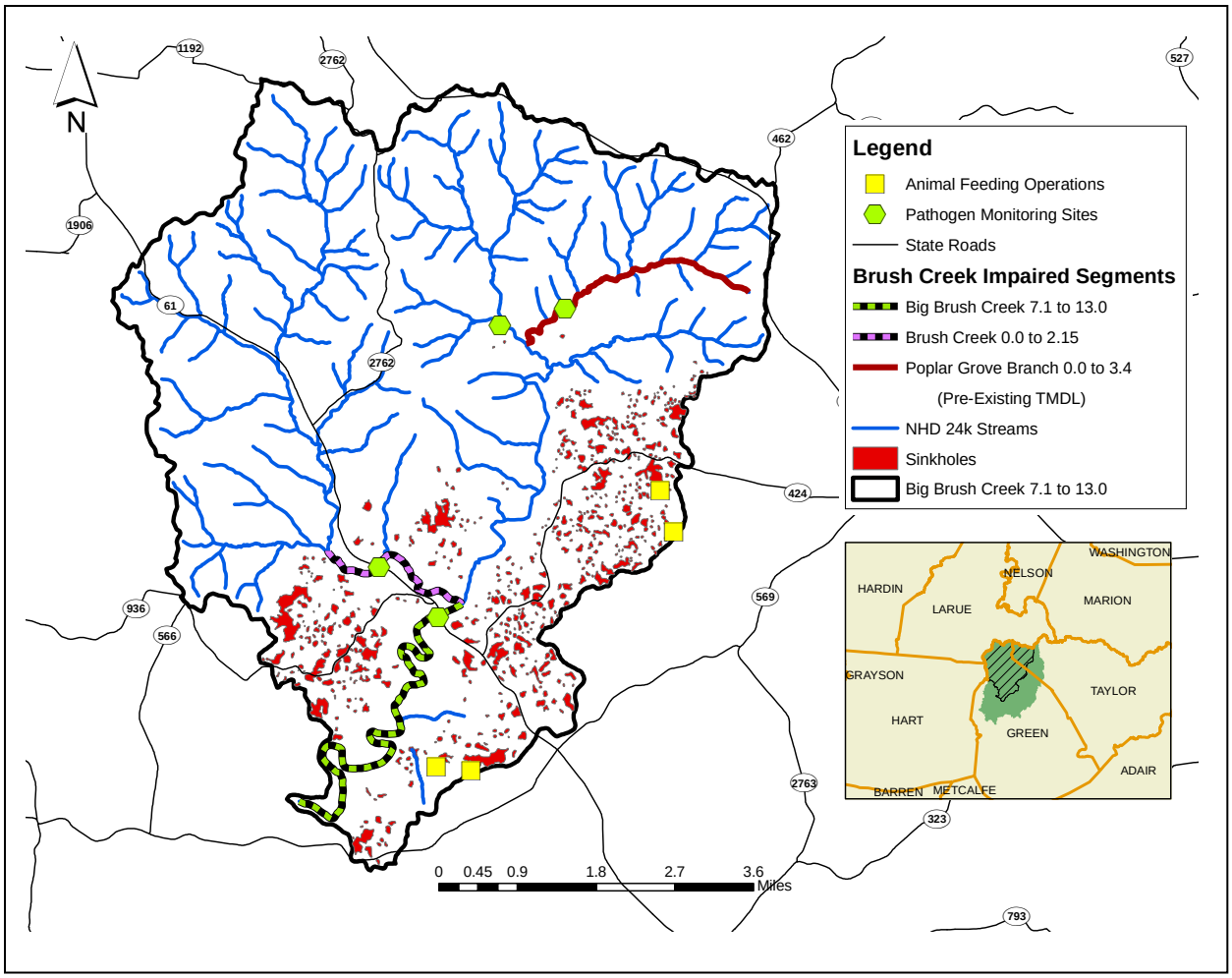

Figure 3 – Watershed Map of Big Brush Creek Above River Mile 7.1

Table 16 – Summary of TMDL Components for Big Brush Creek 7.1-13.0

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
1.24×10^{12} col./day	5.02×10^{11} col./day	5.02×10^{10} col./day	0.0 col./day	4.52×10^{11} col./day	64%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 51.3 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

7.4.1.3 Brush Creek of Big Brush Creek 0.0 to 2.15

The impaired segment of Brush Creek runs from the downstream confluence with Big Brush Creek to the upstream confluence with Tom Bill Branch. WKU sampled at River Mile 1.35 for fecal coliform during the 2003 PCR season (Figure 4). The results of this sampling indicate this segment of Brush Creek is impaired (partial support) for the PCR designated use, and it was listed in the 2008 Integrated Report to Congress. There were exceedances in 33.3% (2 of 6) of the samples collected. The 90th percentile concentration of all samples was 548 colonies/100ml (Table 17). The watershed for the impaired segment comprises five USGS HUC-14s (05110001100060 through 05110001100100) with a total drainage area of 15.60 square miles. The landuse in the watershed is predominately forest (81.2%) followed by pasture (11.0%), natural grassland (4.2%), developed land (2.8%) and row crops (0.7%, Table 18).

Table 17 – Results of WKU sampling in Brush Creek at River Mile 1.35 during the 2003 Recreation Season.

Sample Site	Month	Fecal Coliform cfu/100 ml	Exceedance
Brush Creek at KY-61 bridge about 1.35 miles upstream of confluence with Big Brush Creek	5/19/2003	208	
	6/30/2003	368	
	7/29/2003	456	✓
	8/20/2003	640	✓
	10/8/2003	216	
	10/29/2003	18	
Percent Exceedances			
2/6 = 36.3%			
90th Percentile Concentration			
548 cfu/100 ml			

Table 18 – Land Use Classification in Brush Creek Watershed. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	81.2%	12.66
Agriculture (total)	11.8%	1.84
Pasture	11.0%	1.72
Row Crop	0.7%	0.11
Developed	2.8%	0.44
Natural Grassland	4.2%	0.65
Wetland	0.0%	0.01
Barren	0.0%	0.00

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed, nor are there AFOs (KDOW 2006a); therefore, the TMDL Target load is allocated to the non-permitted sources described in Section 6.2 (Table 19).

Table 19 – Summary of TMDL Components for Brush Creek From 0.0 to 2.15

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
2.71×10^{11} col./day	1.98×10^{11} col./day	1.98×10^{10} col./day	0.0 col./day	1.78×10^{11} col./day	34%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 20.2 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

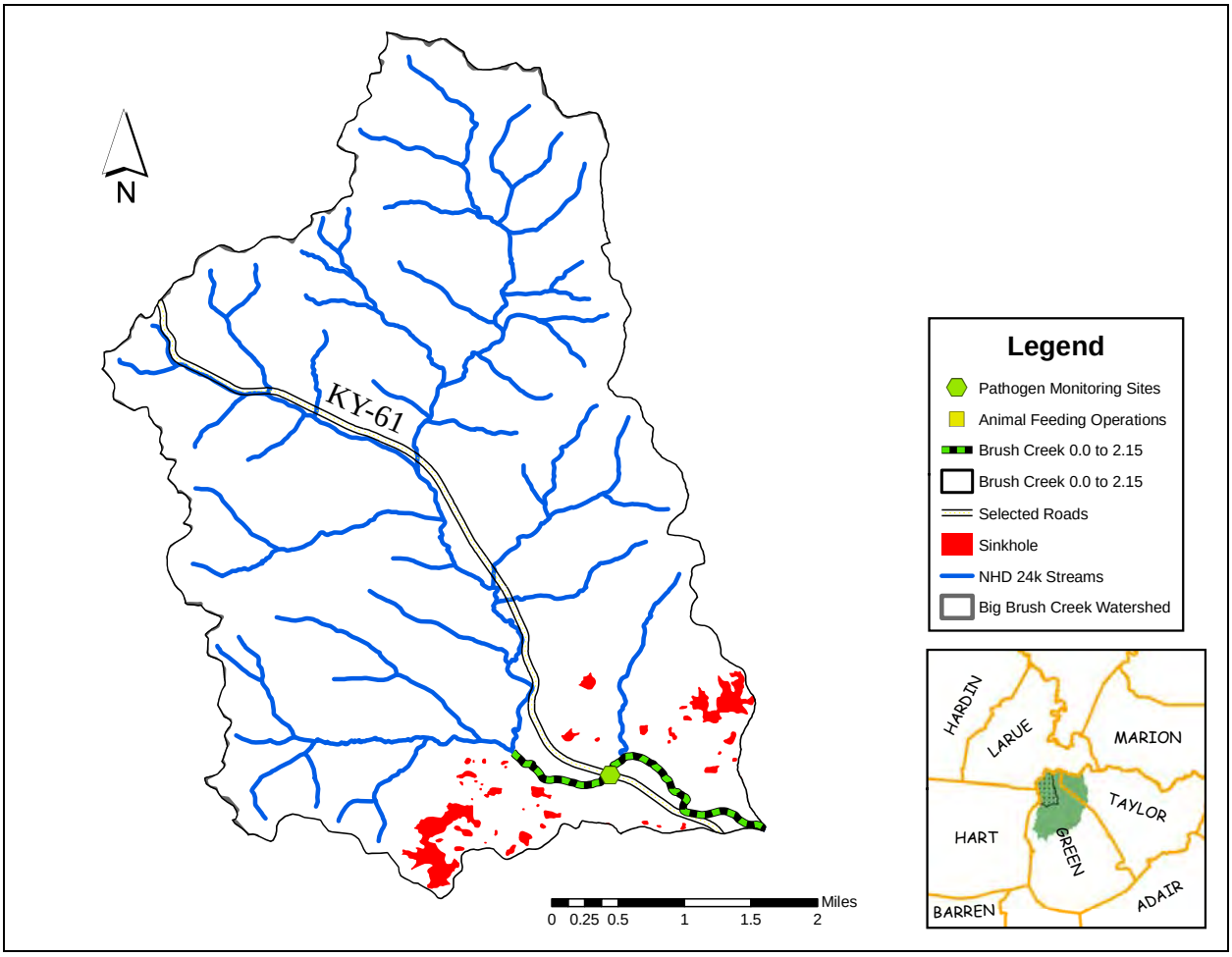

Figure 4 – Watershed Map of Brush Creek Above River Mile 0.0

7.4.1.4 Little Brush Creek of Big Brush Creek 3.2 to 13.2

The impaired segment of Little Brush Creek of Brush Creek runs from the downstream confluence with Dixie Creek to the upstream confluence with an unnamed tributary at River Mile 13.2 (Figure 5). WKU sampled at River Mile 5.15 for fecal coliform during the 2003 PCR season (Table 20). The results of this sampling indicate this segment of Little Brush Creek is impaired for the PCR designated use, and it was listed in the 2008 Integrated Report. There were exceedances in 100% (7 of 7) of the samples collected. The 90th percentile concentration of all samples was 5808 colonies/100ml. The watershed for the impaired segment comprises five USGS HUC-14s (05110001100060 through 05110001100100) with a total drainage area of 15.60 square miles (Figure 5). The landuse in the watershed is predominantly agricultural (64.9% overall) with pasture as the largest single landuse (49.4%) and row crops second (15.5%). The remaining landuses are forest, (27.9%), developed land (5.9%), and natural grassland (1.0%): barren land and wetland make up less than 1.0% of the total composition (Table 21).

Table 20 – Results of WKU Sampling in Little Brush Creek at River Mile 5.15 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
Little Brush Creek at Doc Ward Road bridge about 5.15 miles upstream of confluence with Big Brush Creek	5/23/2002	1320	✓
	6/13/2002	>12000	✓
	7/31/2002	552	✓
	8/21/2002	512	✓
	9/24/2002	448	✓
	5/19/2003	1680	✓
	10/8/2003	1360	✓
Percent Exceedances			
7/7 = 100%			
90th Percentile Concentration			
5808 colonies/100ml			

Table 21 – Land Use Classification in Little Brush Creek Above River Mile 3.9. Data Generated Using NLCD 2001 (USGS 2003)

Land Use		% of Total Area	Square Miles
Forest		27.9%	9.22
Agriculture (total)		64.9%	21.43
	Pasture	49.4%	16.31
	Row Crop	15.5%	5.12
Developed		5.9%	1.95
Natural Grassland		1.0%	0.33
Wetland		0.0%	0.01
Barren		0.0%	0.01

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed. There are thirteen KNDOP-permitted AFOs in the watershed (KDOW 2006a), and

other non-permitted sources as described in Section 6.2; therefore, the TMDL Target load was allocated to non-permitted sources (Table 22).

Table 22 – Summary of TMDL Components for Little Brush Creek 3.2-13.2

Existing Load[(1)]	TMDL[(1)]	Margin Of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
4.55×10^{12} col./day	3.13×10^{11} col./day	3.13×10^{10} col./day	0.0 col./day	2.82×10^{11} col./day	94%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 32.0 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

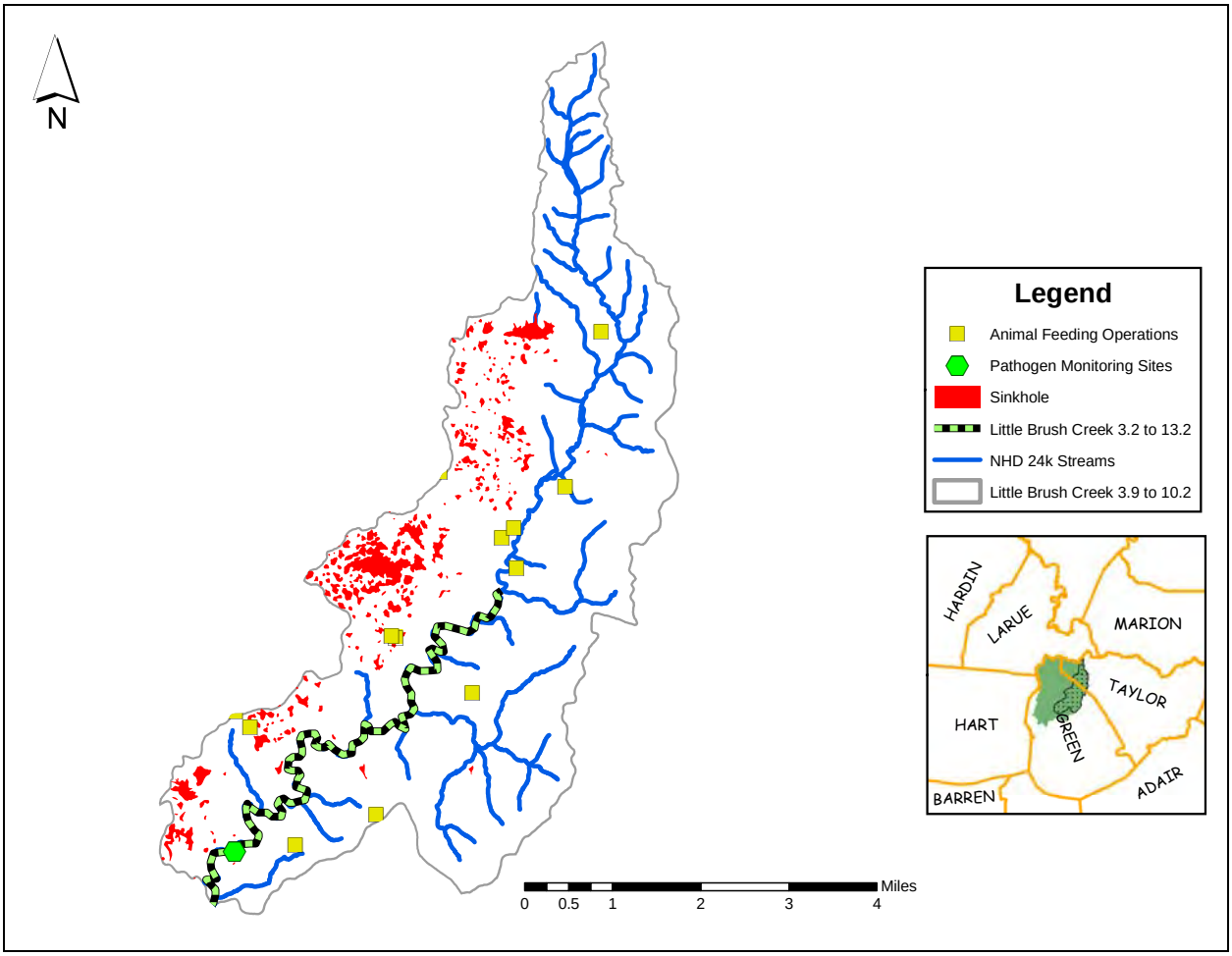

Figure 5 – Watershed Map of Little Brush Creek Above River Mile 3.9

7.4.2 Big Pitman Creek

Big Pitman Creek of Green River (Figure 6) is a fifth order stream in Green and Taylor Counties. The Big Pitman watershed comprises an 11-digit USGS HUC, 50110001090, whose drainage area is 135.95 square miles. The stream network is 306.17 miles long as delineated in the 24K NHD (USGS 1999) with an average slope of 0.23%. The landuse in Big Pitman Creek is mostly agricultural (52.57%) with the majority of that acreage in pasture (41.25%). There are considerable forest resources (37.52%) in the watershed as well. The developed land (7.61%) includes a substantial portion of the city of Campbellsville within the Little Pitman watershed (Figure 6).

WKU sampled nine sites in the Big Pitman Creek watershed during the 2001-2003 PCR seasons (Appendix 2). KDOW previously assessed the lowest segment of Big Pitman Creek (0.0-13.9) in the 2001 watershed assessment cycle. This segment did not meet the designated use, and it was placed on the 2004 303(d) Report to Congress (KDOW 2004). As a result, KDOW developed a TMDL for Big Pitman Creek for River Miles 0.0-13.6, which was approved by EPA in 2008 (KDOW 2007c).

Two additional segments of Big Pitman Creek are listed as impaired for the PCR use in the 2008 Integrated Report: Big Pitman Creek of Green River from River Miles 13.9 to 17.8 and River Miles 17.8 to 23.65. Two segments of Little Pitman Creek of Big Pitman Creek were also added to the 2008 Integrated Report: these are River Miles 0.0 to 10.1 and River Miles 10.1 to 11.2. Two segments of Middle Pitman Creek of Big Pitman Creek, from River Miles 0.0 to 7.7 and River Miles 8.2 to 10.1 were also added to the 2008 Integrated Report (Table 23, Figure 6).

Table 23 – Pathogen-Impaired Segments in the Big Pitman Creek Watershed

Site	Segment	Support Designation
Big Pitman Creek	13.9-17.8	Primary Contact Recreation (Partial Support)
Big Pitman Creek	17.8-23.65	Primary Contact Recreation (Nonsupport)
Little Pitman Creek	0.0-10.1	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
Little Pitman Creek	10.1-11.2	Primary Contact Recreation (Nonsupport)
Middle Pitman Creek	0.0-7.7	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
Middle Pitman Creek	8.2-10.1	Primary Contact Recreation (Nonsupport)

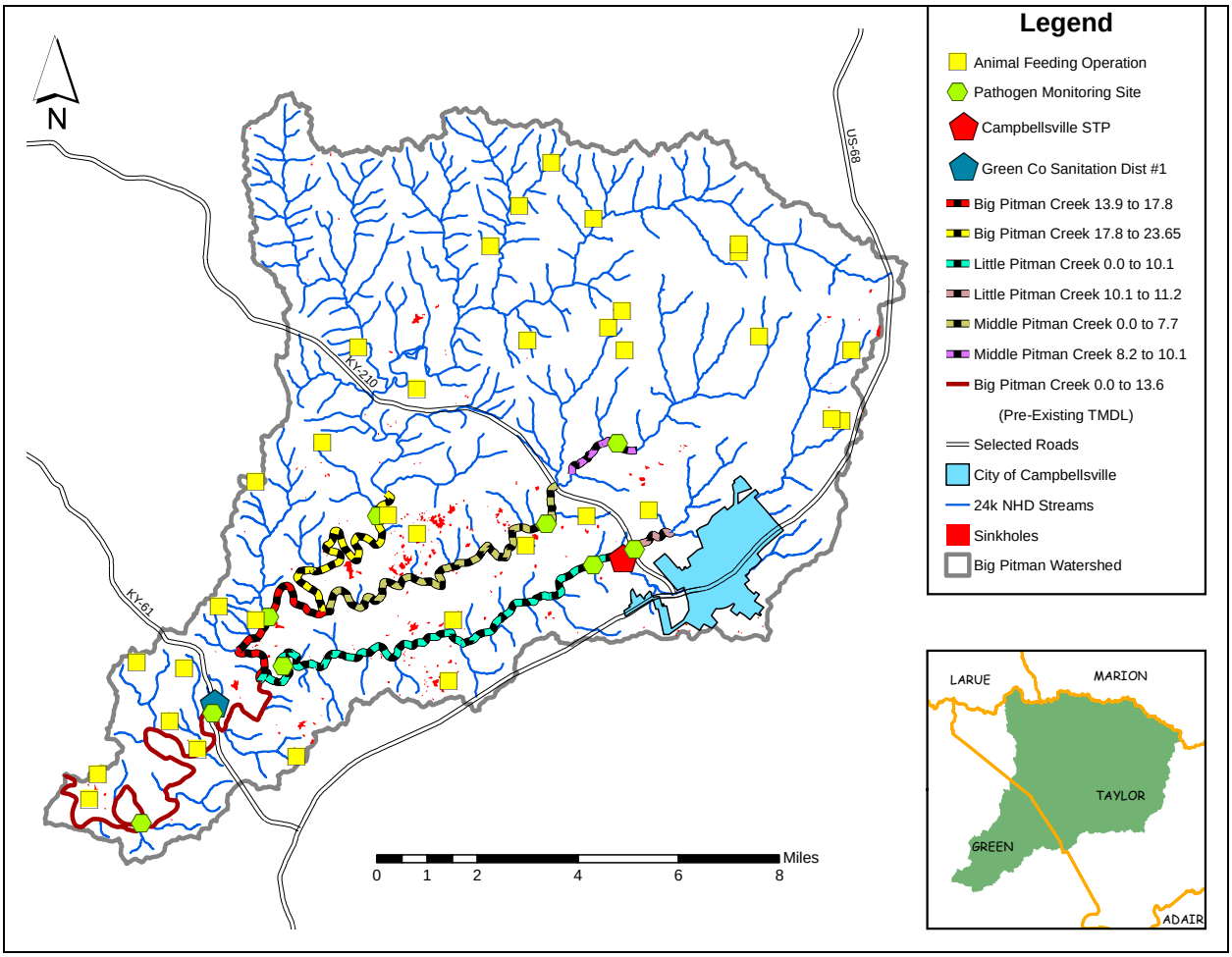

Figure 6 – Map of the Big Pitman Creek Watershed Showing the Seven Impaired Stream Segments

7.4.2.2 Big Pitman Creek of Green River 13.9 to 17.8

The impaired segment of Big Pitman Creek runs from the confluence with Middle Pitman Creek at River Mile 17.8 down to the confluence with Little Pitman Creek at River Mile 13.9 (Figure 6). WKU sampled at River Mile 16.0 for fecal coliform during the 2002 PCR season and collected two samples in 2003 (Table 24). The results of this sampling indicate this segment is impaired (partial support) for the PCR designated use and it was therefore included on the 2008 Integrated Report to Congress. There were exceedances in 57% (4 of 7) of the samples collected. The 90th percentile concentration of all samples was 2872 colonies/100ml. The watershed for the impaired segment comprises twenty-three USGS HUC-14s (05110001090010 through 05110001090230) with a total drainage area of 90.21 square miles (Figure 7). The landuse in the watershed is predominantly agricultural (51.2% overall) with pasture as the largest single landuse (38.9%) and row crops comprising 12.3%. The remainder of the watershed includes forest, (41.8%), developed land (4.4%), and natural grassland (2.5%). The other landuses, barren land and wetland, comprise far less than 1.0% of the total (Table 25).

Table 24 – Results of WKU Sampling in Big Pitman Creek at River Mile 16.0 During the 2002 and 2003 Recreation Seasons

Sample Site	Date	Fecal Coliform colonies/100ml	Exceedance
GR-4.6 – Big Pitman Creek off Roy Chaudoin Rd. (CR-1024) at River Mile 16.0	5/21/2002	1320	✓
	6/13/2002	5200	✓
	7/31/2002	88	
	8/21/2002	56	
	9/24/2002	104	✓
	5/20/2003	1080	✓
	10/8/2003	280	
Percent Exceedances			
4/7 = 57%			
90th Percentile Concentration			
2872 colonies/100ml			

Table 25 – Land Use Classification in Big Pitman Creek Above River Mile 13.9. Data Generated using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	41.8%	37.70
Agriculture (total)	51.2%	46.16
Pasture	38.9%	7.53
Row Crop	12.3%	0.98
Developed	4.4%	1.31
Natural Grassland	2.5%	1.69
Wetland	0.0%	0.04
Barren	0.1%	0.01

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed above River Mile 13.9; however, there are 21 KNDOP-permitted AFOs (KDOW 2006a), and other non-permitted sources as described in Section 6.2. As a result, the TMDL Target load is allocated to non-permitted sources (Table 26).

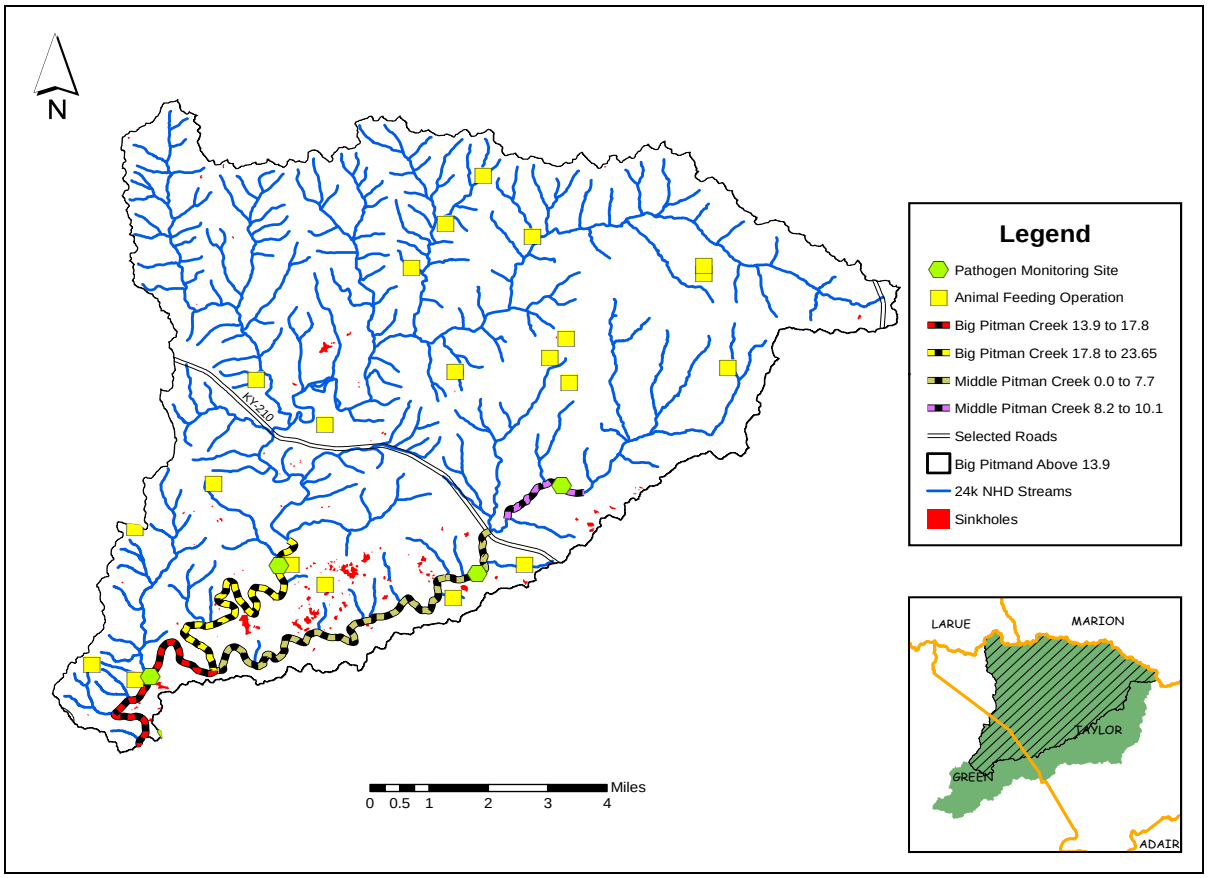

Figure 7 – Watershed Map of Big Pitman Creek Above River Mile 13.9

Table 26 – Summary of TMDL Components for Big Pitman Creek 13.9 to 17.8

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
1.12×10^{13} col./day	1.56×10^{12} col./day	1.56×10^{11} col./day	0.0 col./day	1.40×10^{12} col./day	87%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 159.5 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

7.4.2.3 Big Pitman Creek of Green River 17.8 to 23.65

The uppermost-impaired segment of Big Pitman Creek runs from the confluence of Mill Creek down to the confluence with Middle Pitman Creek (Figure 8). WKU sampled at River Mile 23.15 for fecal coliform during the 2002 PCR season and collected two samples in 2003 (Table 27). The results of this sampling indicate this segment of Big Pitman Creek is impaired (nonsupport) for the PCR designated use and it was therefore included in the 2008 Integrated Report to Congress. There were exceedances in 42.9% (3 of 7) of the samples collected. The 90th percentile concentration of all samples was 2120 colonies/100ml. The watershed for the impaired segment comprises fifteen USGS HUC-14s (05110001090010 through 05110001090150) with a total drainage area of 58.17 square miles (Figure 8). The landuse in the watershed is primarily forest (50.0%) followed by agriculture (43.1% overall). Pasture is the largest agricultural landuse (33.6%) and row crops make up 9.6%. The remainder of the watershed is developed land (3.8%) and natural grassland (2.9%). Finally, barren (0.1%) and wetland (<0.1%) make up a small fraction of the landuse (Table 28).

Table 27 – Results of WKU Sampling in Big Pitman Creek at River Mile 23.15 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-4.7 – Big Pitman Creek off KY-323 at River Mile 23.15	5/21/2002	1000	✓
	6/13/2002	3800	✓
	7/31/2002	104	
	8/21/2002	240	
	9/25/2002	136	
	5/20/2003	472	✓
	10/8/2003	320	
Percent Exceedances			
3/7 = 42.957%			
90th Percentile Concentration			
2120 colonies/100ml			

Table 28 – Land Use Classification in Big Pitman Creek Above River Mile 17.8. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	50.0%	29.06
Agriculture (total)	43.1%	25.09
Pasture	33.6%	19.52
Row Crop	9.6%	5.57
Developed	3.8%	2.23
Natural Grassland	2.9%	1.69
Wetland	0.0%	0.02
Barren	0.1%	0.08

There are no KPDES sanitary wastewater or MS4 storm water sources in the watershed above River Mile 13.9, however there are 12 KNDOP-permitted AFOs (KDOW 2006a), and other non-

permitted sources as described in Section 6.2. As a result, the TMDL Target load is allocated to non-permitted sources (Table 29).

Table 29 – Summary of TMDL Components for Big Pitman Creek RM 17.8-23.65

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
3.95×10^{12} col./day	7.46×10^{11} col./day	7.46×10^{10} col./day	0.0 col./day	6.71×10^{11} col./day	83%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 76.2 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

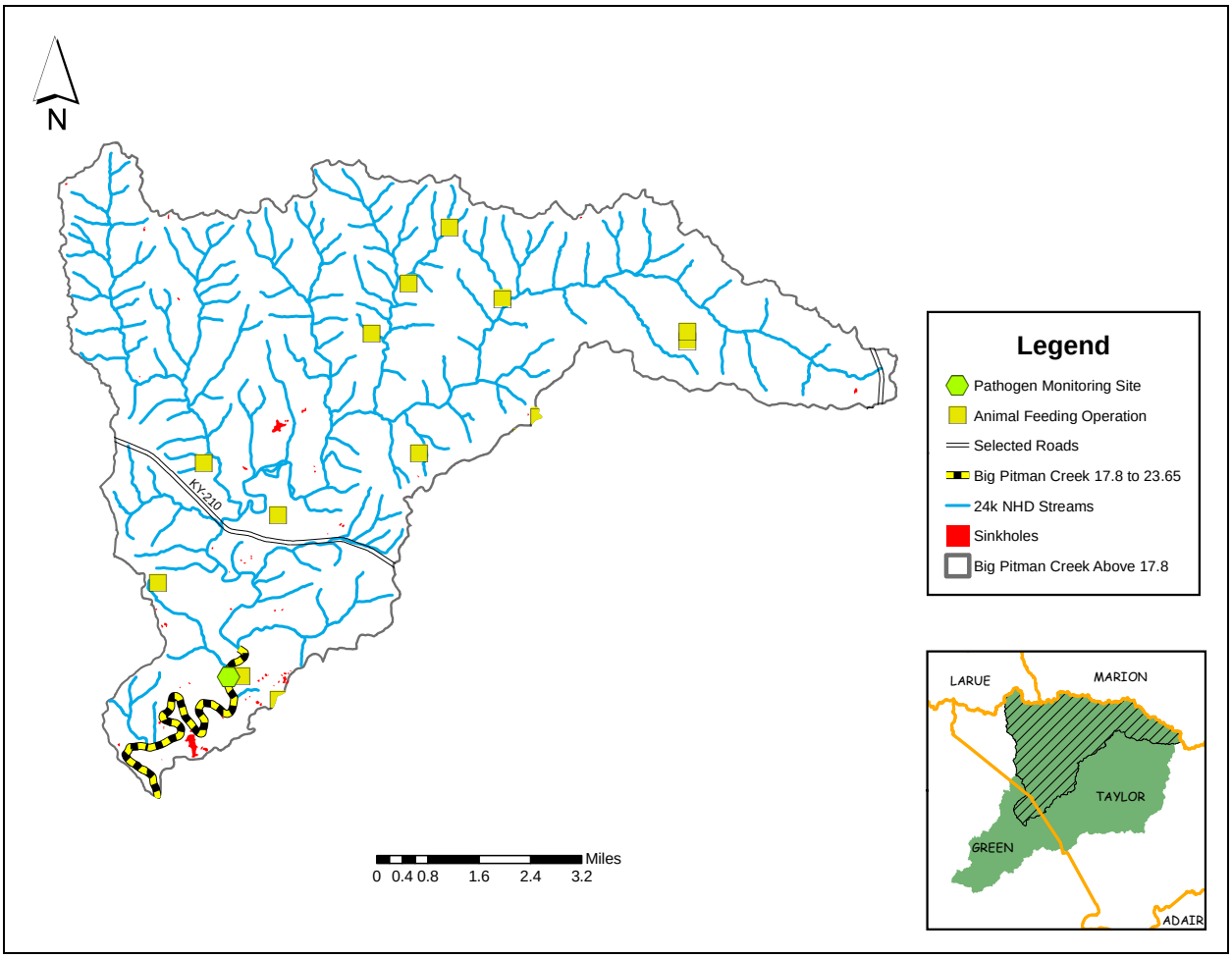

Figure 8 – Watershed Map of Big Pitman Creek Above River Mile 17.8

7.4.2.4 Little Pitman Creek of Big Pitman Creek 0.0 to 10.1

This portion of Little Pitman Creek runs from the confluence with Buckhorn Creek downstream to the confluence with Big Pitman Creek. WKU sampled at River Miles 1.3 and 9.5 for fecal coliform during the 2002 and 2003 PCR seasons (Table 30). The results of this sampling indicate this segment of Little Pitman Creek is impaired (nonsupport) for the PCR designated use and the SCR designated use (partial support), and it was therefore included in the 2008 Integrated Report to Congress. There were exceedances in 67% (12 of 18) of the samples collected. The 90th percentile concentration of all samples was 5000 colonies/100ml. The watershed for the impaired segment comprises three USGS HUC-14s (05110001090240 through 05110001090260) with a total drainage area of 31.77 square miles. The landuse in the watershed is predominantly agricultural (60.2% overall) with pasture as the largest single landuse (49.5%) and row crops comprising 10.8%. The remainder of the watershed includes forest, (21.6%), developed land (17.4%), and natural grassland (0.7%). The remaining landuses, barren and wetland, cover less than 1.0% of the total watershed area (Table 31).

Table 30 – Results of WKU Sampling in Little Pitman Creek at River Miles 1.3 and 9.5 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-4.3 – Little Pitman Creek off KY-793 near River Mile 1.3	5/21/2002	624	✓
	6/13/2002	7800	✓
	7/31/2002	368	
	8/21/2002	400	
	9/24/2002	456	✓
	5/20/2003	400	
	6/30/2003	560	✓
	7/29/2003	3800	✓
	8/20/2003	672	✓
	10/8/2003	312	
	10/29/2003	200	
GR-4.4 – Little Pitman Creek off KY-323 at River Mile 9.5 downstream of WWTP	5/21/2002	1280	✓
	6/13/2002	>12000	✓
	7/31/2002	432	✓
	8/21/2002	2600	✓
	9/25/2002	528	✓
	5/20/2003	464	✓
	10/8/2003	160	
Percent Exceedances			
12/18 = 67%			
90th Percentile Concentration			
5000 colonies/100ml			

Table 31 – Land Use Classification in Little Pitman Creek Above River Mile 0.0. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	21.6%	6.87
Agriculture (total)	60.2%	19.14
Pasture	49.5%	15.72
Row Crop	10.8%	3.43
Developed	17.4%	5.52
Natural Grassland	0.7%	0.21
Wetland	0.0%	0.01
Barren	0.1%	0.02

The Campbellsville STP (KY0054437) is located in the Little Pitman Creek subwatershed, southeast of where Hwy 210 crosses Little Pitman. It changed its outfall location to Buckhorn Creek on 1/30/2003; as stated, Buckhorn Creek enters at the top of the impaired segment (at River Mile 10.1). The STP's effluent limits for fecal coliform are 200 colonies/100ml as a monthly average (geometric mean) and a maximum weekly average of 400 colonies/100ml. The STP has a design capacity of 4.2 million gallons per day (MGD, USGS 2007). The WLA for the treatment plant is 6.36×10^{10} colonies/day (Table 36). The Campbellsville STP quarterly discharge monitoring data for the period 1/1/2000–12/31/2005 have been included in Appendix 4. There have been no exceedances of the maximum weekly average or the monthly average reported since the year 2000. There have been no Notice of Violations (NOVs) issued for exceedances of the fecal coliform WQC in that time (EPA, 2007).

Additionally, the City of Campbellsville is a MS4 Permit Holder (KYG200015, EPA 2007); therefore, a WLA is assigned to it. Because the MS4 discharges to both impaired segments of Little Pitman Creek (0.0-10.1 and 10.1-11.2), it was necessary to calculate a separate WLA for the MS4 for each impaired segment. While this may seem to give a permit holder two different compliance objectives, the MS4 must meet the lower of the two WLAs to effect compliance. Calculations for the 0.0-10.1 segment are presented below, and calculations for the 10.1-11.2 segment are in section 7.4.2.5. The final WLA for each segment is reported in Tables S.3 and S.4, and, as stated, the MS4 must meet the more restrictive of the two WLAs, which is reported in Table 36. However, as with other sources, regardless of the final allocation presented in this TMDL, the MS4 must effect reductions until it discharges in compliance with the WQC, and thereafter continue to maintain its discharge at or below the WQC. As stated in Section 7.3.2, KDOW uses the municipality's compliance with its MS4 storm water permit as a proxy for instream compliance.

MS4 Allocation Above Little Pitman Creek 0.0 to 10.1. The existing conditions and final allocation for the MS4 were calculated as described in Section 7.3.2. The area inside Campbellsville's MS4 boundary is 3.62 square miles, all of which is within the Little Pitman Creek watershed above the 0.0 to 10.1 impaired segment. Of this 3.62 square mile area, 2.55 square miles are developed (and therefore the MS4 is responsible for its load, Table 9 describes how this was defined), and 1.07 square miles are comprised of other (non-developed) landuses (which the LA sources are responsible for). In addition, there are 10.68 square miles of

watershed above RM 10.1 that are not within the MS4 boundary: this area is automatically considered part of the LA.

Summing the non-developed landuses (whether within or outside of the MS4 boundary) gives 11.75 square miles, which is 82.2% of the watershed. Therefore, 17.8% of the watershed above River Mile 0.0-10.1 is developed MS4, and thus 17.8% of the watershed area is attributed to the MS4. This figure (i.e., 17.8%) was also used to calculate the final allocation for the MS4: Of the allocation available for distribution (i.e., the TMDL Target load minus the Campbellsville STP load), the MS4 received 17.8%, or 6.39×10^{10} colonies/day, and the LA sources received 82.2%, or 2.95×10^{11} colonies/day (Table 32).

There are also six KNDOP-permitted AFOs in the Little Pitman Creek watershed (KDOW 2006a), as well as other non-permitted sources as described in Section 6.2.

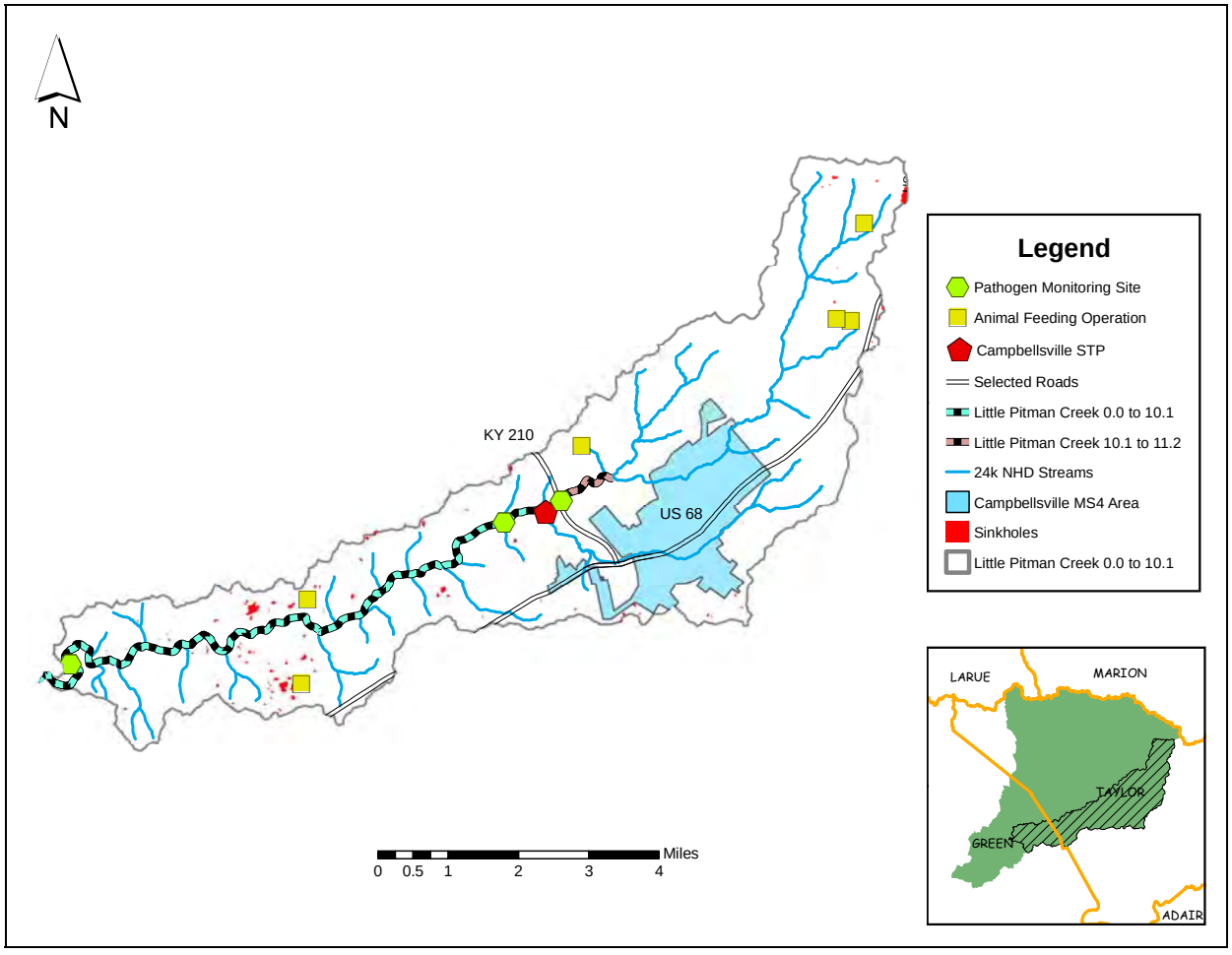

Figure 9 – Watershed Map of Little Pitman Creek Above River Mile 0.0

Table 32 – Summary of TMDL Components for Little Pitman Creek RM 0.0-10.1

Existing Load[1]	TMDL[1]	Margin of Safety[2]	Waste Load Allocation[3]				Load Allocation	Percent Reduction[4]
			Wastewater[5]		Storm Water[6]			
5.87×10^{12} col./day	4.70×10^{11} col./day	4.70×10^{10} col./day[3]	Campbellsville STP	6.36×10^{10} col./day	City of Campbellsville	6.39×10^{10} col./day	2.95×10^{11} col./day	93%

Notes:

(1). Existing Load and TMDL calculated based on a mean annual flow of 48.0 cfs

(2). MOS is an explicit 10% of the TMDL.

(3). Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.

(4). Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

(5). Wastewater WLA value is based on design flow and acute permit limits, and represents the maximum one-day load the facility can discharge.

(6). The Storm Water WLA is the load attributed to MS4 permitted entity and is based on percentage of the area of the watershed covered by developed landuse within the MS4 permit boundary.

7.4.2.5 Little Pitman Creek of Big Pitman Creek 10.1 to 11.2

This impaired segment of Little Pitman Creek of Big Pitman Creek begins upstream at the confluence with Trace Creek at River Mile 11.2 and runs downstream to the confluence with Buckhorn Creek at River Mile 10.1 (Figure 10). WKU sampled at River Mile 10.4 for fecal coliform during the 2002 PCR season (Table 33) and collected two additional samples in 2003. The results of this sampling indicate this segment of Little Pitman Creek is impaired (nonsupport) for the PCR designated use, and it was therefore listed in the 2008 Integrated Report to Congress. There were exceedances in 71% (5 of 7) of the samples collected. The 90th percentile concentration of all samples was 5664 colonies/100ml. The watershed for the impaired segment lies in portions of three USGS HUC-14s (05110001090240 through 05110001090260) with a total drainage area of 12.72 square miles. The landuse in the watershed is predominantly agricultural (64.6% overall) with pasture as the largest single landuse (48.8%) and row crops comprising 15.8%. The remainder of the watershed is forest, (18.4%), developed land (16.6%), and natural grassland (0.3%). The remaining landuses, barren and wetland, make up less than 1.0% of the total landuse composition (Table 34).

Table 33 – Results of WKU Sampling in Little Pitman Creek at River Mile 10.4 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-4.5 – Little Pitman Creek off KY-210 at River Mile 10.4 upstream of WWTP	5/21/2002	1440	✓
	6/13/2002	>12000	✓
	7/31/2002	1240	✓
	8/21/2002	1040	✓
	9/25/2002	720	✓
	5/20/2003	320	
	10/8/2003	120	
Percent Exceedances			
5/7 = 71%			
90th Percentile Concentration			
5664 colonies/100ml			

Table 34 – Land Use Classification in Little Pitman Creek Above RM 10.1. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	18.4%	2.34
Agriculture (total)	64.6%	8.22
Pasture	48.8%	6.21
Row Crop	15.8%	2.01
Developed	16.6%	2.11
Natural Grassland	0.3%	0.04
Wetland	0.0%	0.01
Barren	0.0%	0.00

Although the Campbellsville STP (KY0054437) is physically located in the watershed draining into this segment, the facility's outfall discharges to Buckhorn Creek (EPA 2007), which enters Little Pitman Creek at River Mile 10.1. Therefore, the STP receives no allocation for this segment. Portions of the City of Campbellsville's MS4 permitted area (KYG200015) lie within the watershed, therefore existing conditions and a WLA were calculated for this source.

MS4 Allocation Above Little Pitman Creek 10.1 to 11.2. The area inside Campbellsville's MS4 boundary is 3.62 square miles, of which 1.39 square miles are within the Little Pitman Creek watershed above RM 10.1. Of this 1.39 square mile area, 0.89 square miles are developed, and 0.51 square miles are comprised of other landuses. In addition, there are 10.68 square miles of watershed above RM 10.1 that are not within the MS4 boundary (i.e., they are part of the LA). Summing the non-developed landuses (whether within or outside of the MS4 boundary) gives 11.19 square miles, which is 89.0% of the watershed. Therefore, 11.0% of the watershed above RM 10.1 is developed MS4, and 11.0% of the existing load is attributed to the MS4. This figure (11.0%) was also used to calculate the final allocation for the MS4: of the allocation available for distribution (i.e., the TMDL Target load), the MS4 received 11.0%, or 1.63×10^{10} colonies/day, and the LA sources received 89.0%, or 1.32×10^{11} colonies/day, see Table 35. The MS4 WLA calculated for this segment is lower than the WLA calculated for the 0.0-10.1 segment (see Section 7.4.2.4) and therefore this is the WLA that sets the instream compliance goal for the MS4. However, as stated, the MS4 is deemed to be in compliance with the WQC to the extent that it complies with its storm water permit.

There are also four KNDOP-permitted AFOs in the Little Pitman Creek watershed (KDOW 2006a), and other non-permitted sources as described in Section 6.2.

Table 35 – Summary of TMDL Components for Little Pitman Creek RM 10.1-11.2

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	Waste Load Allocation[(3)]			Load Allocation	Percent Reduction[(4)]
			Wastewater	Storm Water[(5)]			
2.33×10^{12} col/day	1.64×10^{11} col/day	1.64×10^{10} col/day[(3)]	0.0 col./day	City of Campbellsville	1.63×10^{10} col/day	1.32×10^{11} col/day	94%

Notes:

(1). Existing Load and TMDL calculated based on a mean annual flow of 16.8 cfs

(2). MOS is an explicit 10% of the TMDL.

(3). Any future KPDES permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.

(4). Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

(5). The Storm Water WLA is the load attributed to MS4 permitted entity and is based on percentage of the area of the watershed covered by developed landuse within the MS4 permit boundary.

Table 36 – KPDES-Permitted Facilities and Storm Water Entities Located in the Little Pitman Watershed

Wastewater					
KPDES Permit Number	**Facility Name**	**Watershed**	**Design Flow (MGD)**	**Permit Limit (col/100ml)**	**WLA (col/day)**
KY0022039	Campbellsville STP	Little Pitman	4.2	400	6.36×10^{10}
Storm Water					
KPDES Permit Number	**Storm Water Entity**	**Watershed**	**Permitted Area (mi^2)**	**Permit Limit**	**WLA (col/day)**
KYG200015	City of Campbellsville	Little Pitman	3.62	n/a[(1)]	1.63×10^{10} [(2)] col./day

Notes:
[(1)]The MS4 must comply with the terms of its Storm Water Permit to be considered in compliance with 401 KAR Chapter 5.
[(2)] The MS4 is subject to the more restrictive of the WLAs calculated for the 0.0 to 10.1 segment and the 10.1 to 11.2 segment. Therefore, the lesser of these two values is reported in this table.

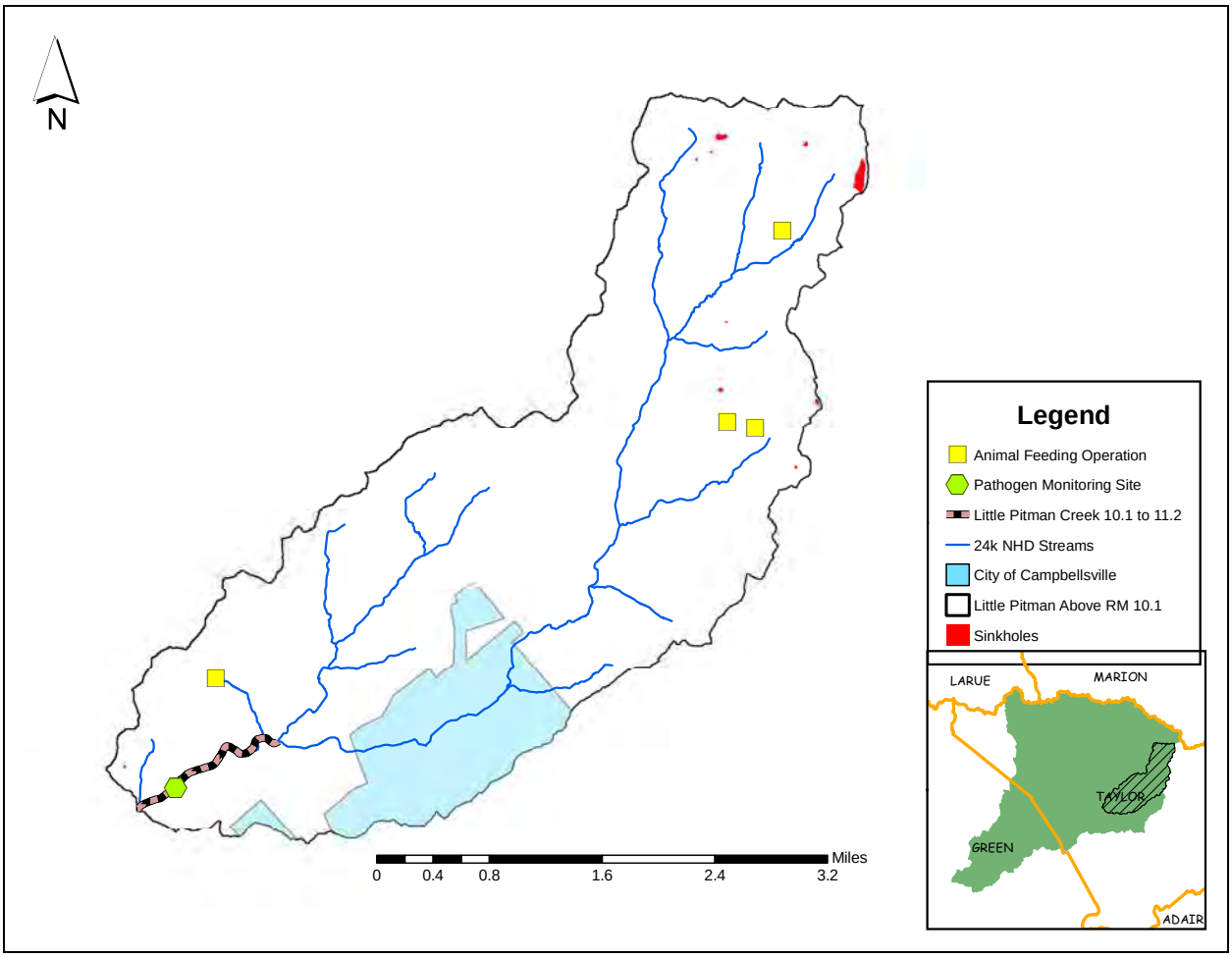

Figure 10 – Watershed Map of Little Pitman Creek Above River Mile 10.1

7.4.2.6 Middle Pitman Creek of Big Pitman Creek 0.0 to 7.7

This segment of Middle Pitman Creek of Big Pitman Creek runs from the confluence with Flat Creek downstream to the confluence Big Pitman Creek (Figure 11). WKU sampled at River Mile 6.8 for fecal coliform during the 2002 PCR season and collected two samples in 2003 (Table 37). The results of this sampling indicate this segment of Middle Pitman Creek is impaired (nonsupport) for both the PCR designated use and the SCR designated use, and it was therefore included in the 2008 Integrated Report to Congress. There were exceedances in 100% (7 of 7) of the samples collected. The 90th percentile concentration of all samples was 2520 colonies/100ml. The watershed for the impaired segment comprises five USGS HUC-14s (05110001100160 through 05110001100200) with a total drainage area of 24.79 square miles. The landuse in the watershed is predominantly agricultural (71.7% overall) with pasture as the largest single landuse (51.7%) and row crops comprising 20.0%. The remainder of the watershed is forest, (21.5%), developed land (5.5%), and natural grassland (1.1%). The remaining landuses, barren and wetland, cover less than 1.0% of the total area (Table 38).

Table 37 – Results of WKU Sampling in Middle Pitman Creek at River Mile 6.8 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-4.9 – Middle Pitman Creek off KY-323 at River Mile 6.8	5/21/2002	600	✓
	6/13/2002	>12000	✓
	7/31/2002	1400	✓
	8/21/2002	760	✓
	9/25/2002	9200	✓
	5/20/2003	720	✓
	10/8/2003	1600	✓
Percent Exceedances			
7/7 = 100%			
90th Percentile Concentration			
2520 colonies/100ml			

Table 38 – Land Use Classification in Middle Pitman Creek Above River Mile 0.0. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	21.5%	5.33
Agriculture (total)	71.7%	17.76
Pasture	51.7%	12.81
Row Crop	20.0%	4.95
Developed	5.5%	1.37
Natural Grassland	1.1%	0.28
Wetland	0.0%	0.01
Barren	0.0%	0.01

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed; therefore, the entire load is allocated to non-permitted sources: there are seven KNDOP-permitted AFOs in the watershed (KDOW 2006a), and other non-permitted sources as described in Section 6.2 (Table 39).

Table 39 – Summary of TMDL Components for Middle Pitman Creek 0.0-7.7

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
1.99×10^{12} col./day	3.16×10^{11} col./day	3.16×10^{10} col./day	0.0 col./day	2.84×10^{11} col./day	86%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 32.3 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

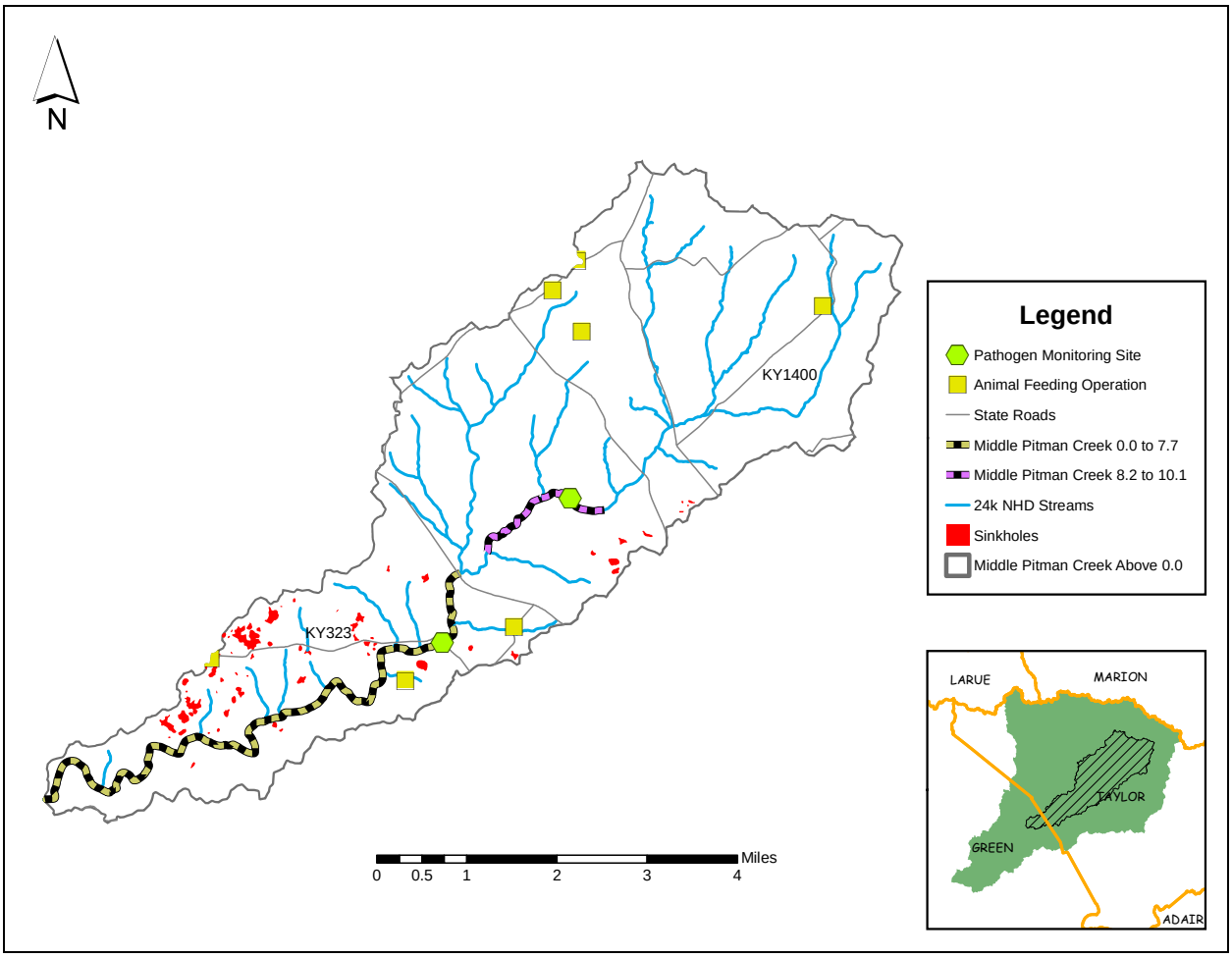

Figure 11 – Watershed Map of Middle Pitman Creek Above River Mile 0.0

7.4.2.7 Middle Pitman Creek of Big Pitman Creek River Mile 8.2 to 10.1

This impaired segment of Middle Pitman Creek of Big Pitman Creek runs from the confluence with an unnamed tributary at River Mile 8.2 downstream to River Mile 10.1 upstream (Figure 12). WKU sampled at River Mile 9.55 for fecal coliform during the 2003 PCR season (Table 40). The results of this sampling indicate this segment of Middle Pitman Creek is impaired (nonsupport) for the PCR designated use and it was therefore listed in the 2008 Integrated Report to Congress. There were exceedances in 80% (4 of 5) of the samples collected. The 90th percentile concentration of all samples was 2520 colonies/100ml. The watershed for the impaired segment comprises three USGS HUC-14s (05110001100160 through 05110001100180) with a total drainage area of 20.75 square miles. The landuse in the watershed is predominantly agricultural (73.5% overall) with pasture as the largest single landuse (56.7%) and row crops comprising 16.8%. The remainder of the watershed landuse is forest, (20.0%), developed land (6.2%), and natural grassland (0.2%). The remaining landuses, barren and wetland, make up less than 1.0% of the total composition (Table 41).

Table 40 – Results of WKU Sampling in Middle Pitman Creek at River Mile 9.55 During the 2003 Recreation Season

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-4.13 – Middle Pitman Creek off Salem Church Rd (CR-1203) at River Mile 9.55	6/30/2003	600	✓
	7/29/2003	3800	✓
	8/20/2003	568	✓
	10/8/2003	472	✓
	10/29/2003	373	
Percent Exceedances			
4/5 = 80%			
90th Percentile Concentration			
2520 colonies/100ml			

Table 41 – Land Use Classification in Middle Pitman Creek above River Mile 8.2. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	20.0%	2.35
Agriculture (total)	73.5%	8.62
Pasture	56.7%	6.66
Row Crop	16.8%	1.97
Developed	6.2%	0.73
Natural Grassland	0.2%	0.02
Wetland	0.0%	0.00
Barren	0.0%	0.00

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed; there is one KNDOP-permitted AFO (KDOW 2006a) and other non-permitted sources as described in Section 6.2: therefore, the TMDL Target load is allocated to non-permitted sources (Table 42).

Table 42 – Summary of TMDL Components for Middle Pitman Creek 8.2-10.1

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
9.57×10^{11} col./day	1.52×10^{11} col./day	1.52×10^{10} col./day	0.0 col./day	1.37×10^{11} col./day	86%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 15.5 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

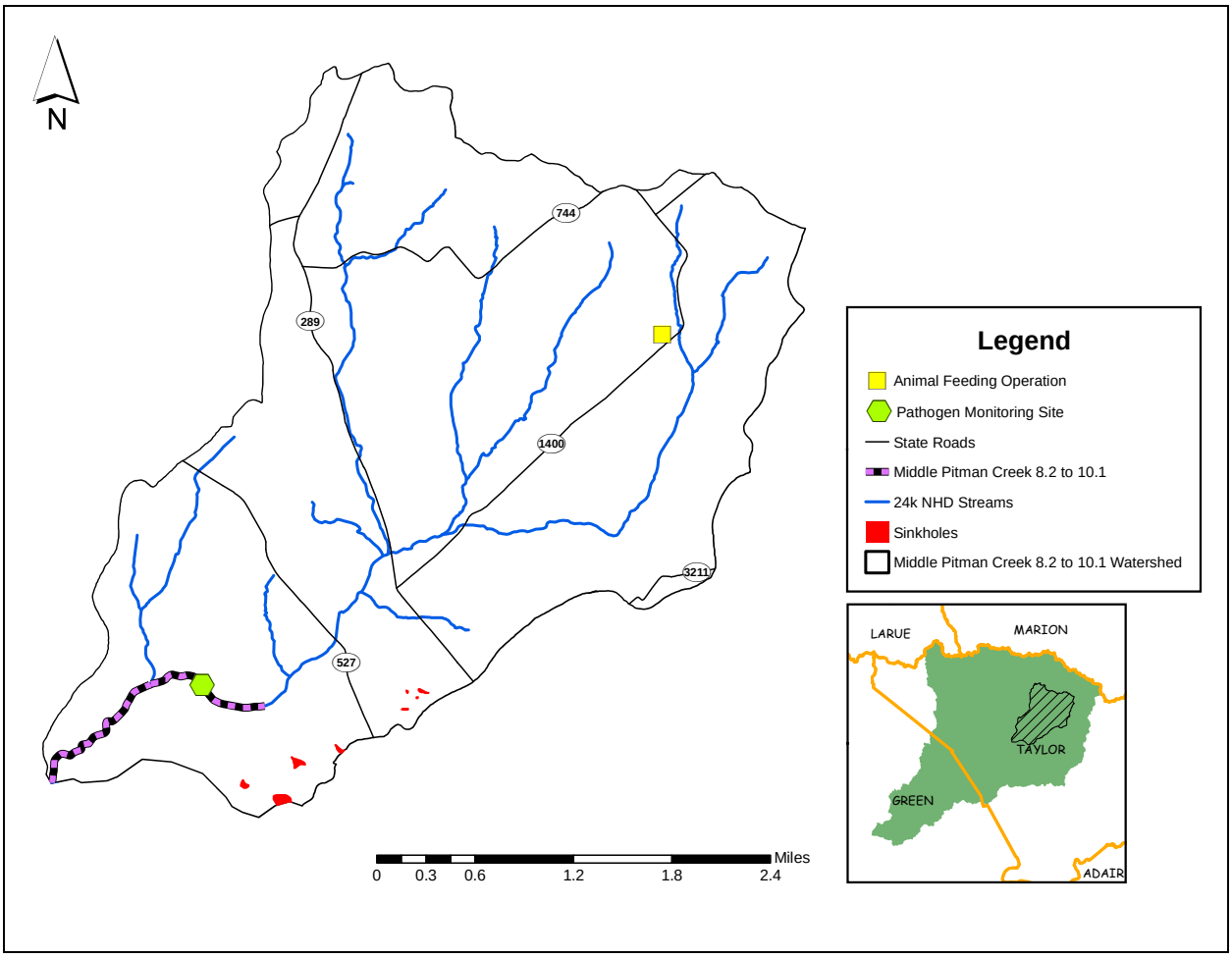

Figure 12 – Watershed Map of Middle Pitman Creek Above River Mile 8.2

7.4.3 Little Barren River of Green River

Little Barren River of Green River (Figure 13) is a fifth order stream in Adair, Green, Hart and Metcalfe Counties. The lowest segment (River Miles 0.0 to 8.8) was placed on the 2004 303(d) Report to Congress (KDOW 2004) for partial support of the PCR. This was determined by pathogen monitoring conducted by KDOW at the ambient monitoring site PRI078 during the 2001, 2002 and 2003 PCR periods. As a result, KDOW developed a TMDL for Little Barren River between River Miles 0.0-8.8, which was approved by EPA in 2008 (KDOW 2007c). The watershed comprises USGS-HUC 11 05110001110 with a total drainage area of 261.3 square miles. The stream network is 505.3 miles and has an average slope of 0.05%. The landuse in the watershed is predominately forest (57.75%) followed by pasture (29.64%), developed land (5.14%) natural grassland (4.62%) and row crops (1.0%).

WKU sampled ten sites in the Little Barren River watershed during the 2002-2003 PCR seasons (Appendix 2). In addition to the impaired segment from River Miles 0.0-8.8, KDOW listed five additional segments as impaired for PCR in the 2008 Integrated Report. This includes one additional segment of Little Barren River of Green River (River Mile 9.8-15.7), two segments of South Fork Little Barren River (River Mile 0.0-23.1 and River Mile 23.1-30.1), and two segments of East Fork Little Barren River (River Mile 0.0-15.9 and River Mile 20.7-30.0), see Table 43 and Figure 13.

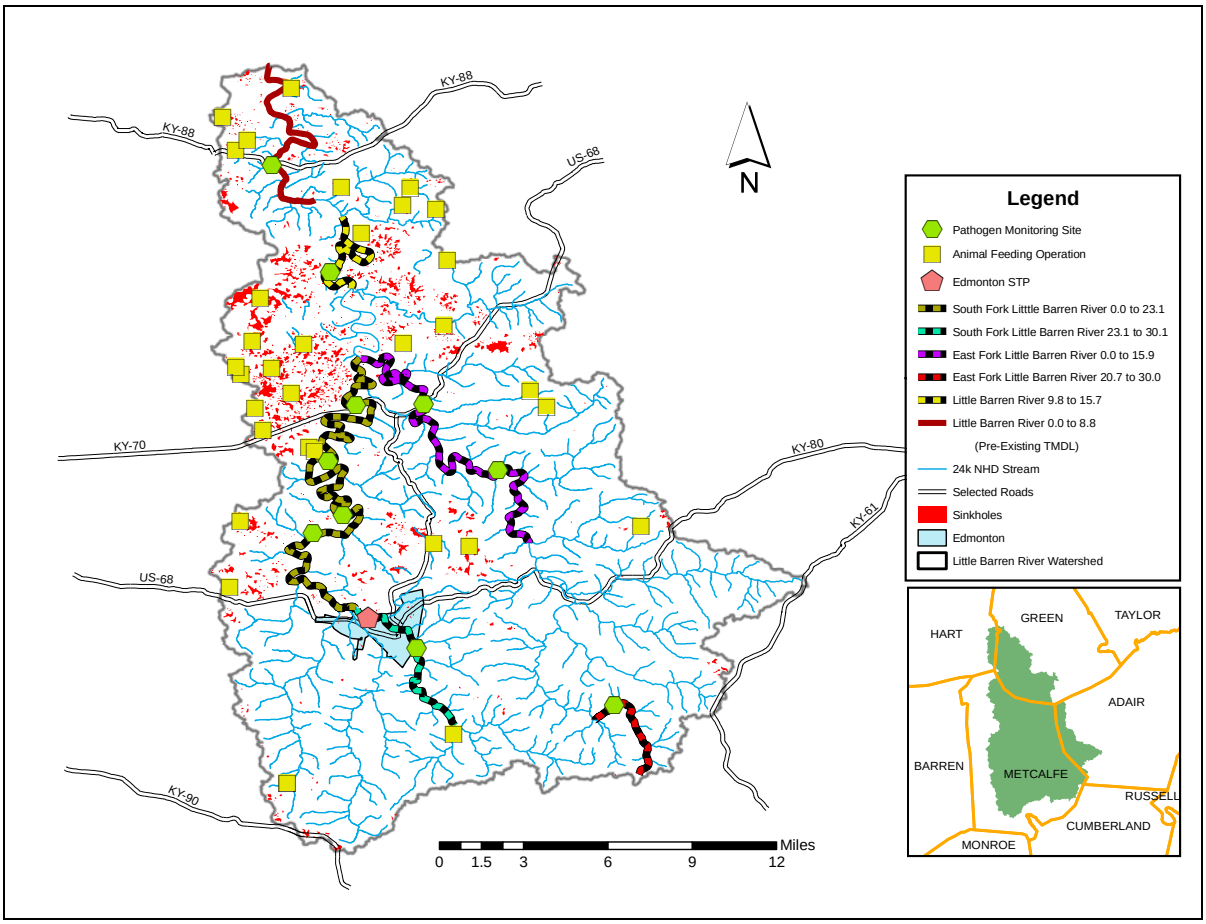

Figure 13 – Map of the Little Barren River Watershed Showing the Six Impaired Stream Segments

Table 43 – Pathogen-Impaired Segments in the Little Barren River Watershed

Site	Segment	Support Designation
Little Barren River	9.8-15.7	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
East Fork Little Barren River	0.0-15.9	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
East Fork Little Barren River	20.7-30.0	Primary Contact Recreation (Partial Support)
South Fork Little Barren River	0.0-23.1	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)
South Fork Little Barren River	23.1-30.1	Primary Contact Recreation (Nonsupport)

7.4.3.1 Little Barren River of Green River 9.8 to 15.7

This segment of Little Barren River runs from the confluence with Greasy Creek downstream to 0.1 miles below the KY-218 Bridge (Figure 14). WKU sampled at River Mile 14.2 for fecal coliform during the PCR seasons of 2002 and 2003. The results of this sampling indicate that Little Barren River 9.8-15.7 is impaired (nonsupport) for both the PCR and SCR designated uses and it was therefore listed the 2008 Integrated Report to Congress (Table 44). There were exceedances in 40.0% (4 of 10) of the samples collected. The 90th percentile concentration of all samples was 8000 colonies/100ml. The watershed draining to the impaired segment has a total drainage area of 229.87 square miles (Figure 14). The landuse in the watershed is predominately forest (58.9%) followed by pasture (28.7%), developed land (5.1%) natural grassland (4.4%), and row crops 2.9%. Wetland and barren land make up less than 0.1% of the total land use (Table 45).

Table 44 – Results of WKU Sampling in Little Barren River at River Mile 14.2 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-5.3 – Little Barren River at KY 218 at River Mile 14.2	5/14/2002	8000	✓
	7/30/2002	80	
	8/28/2002	120	
	9/30/2002	193	
	10/29/2002	3600	✓
	5/15/2003	216	
	6/17/2003	>12000	✓
	7/29/2003	6000	✓
	8/27/2003	264	
	10/22/2003	95	
Percent Exceedances			
4/10 = 40.0%			
90th Percentile Concentration			
8000 colonies/100ml			

Table 45 – Land Use Classification in Little Barren River. Data generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	58.9%	135.17
Agriculture (total)	31.6%	72.52
Pasture	28.7%	65.92
Row Crop	2.9%	6.60
Developed	5.1%	11.64
Natural Grassland	4.4%	10.15
Wetland	0.0%	0.10
Barren	0.0%	0.05

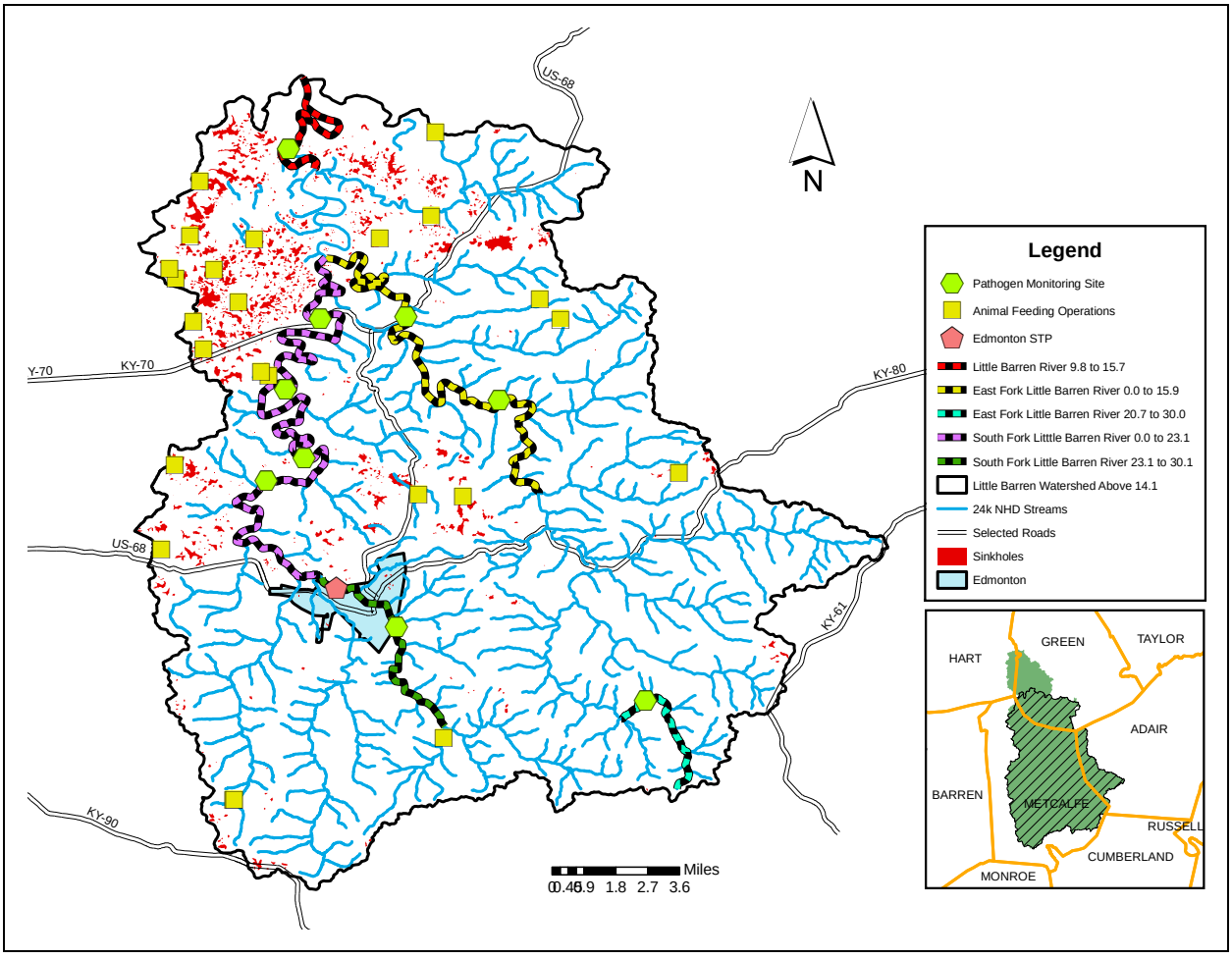

Figure 14 – Watershed Map of Little Barren River Above River Mile 9.8

There is one permitted KPDES facility in the Little Barren River watershed. The Edmonton STP (KY0054437) is located in the South Fork Little Barren River subwatershed, north of Hwy 68 within Edmonton, and its discharge enters this impaired segment. It has effluent limits for fecal coliform of 200 colonies/100ml as a monthly average (geometric mean) and a maximum weekly average of 400 colonies/100ml. The treatment plant has a design capacity of 0.51 MGD. The WLA for the treatment plant is 7.72×10^{9} colonies/day (Table 46). The quarterly discharge monitoring data for the period 1/1/2000 – 12/31/2005 have been included in Appendix 5. There have been no exceedances of the maximum weekly average and four (5.6%) exceedances of the monthly average reported since the year 2000. There have been no Notice of Violations (NOVs) issued for exceedances of the fecal coliform criterion in that time (EPA, 2007). There are also 24 KNDOP-permitted AFOs in the Little Barren River watershed (KDOW 2006a), as well as other non-permitted sources as described in Section 6.2 (Table 46).

Table 46 – Summary of TMDL Components for Little Barren River 9.8-15.7

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	Waste Load Allocation[(3)]			Load Allocation	Percent Reduction[(4)]
			Wastewater[(5)]		Storm Water		
6.02×10^{13} col/day	3.01×10^{12} col/day	3.01×10^{11} col/day[(3)]	Edmonton STP	7.70×10^{9} col./day	0.0 col./day	2.70×10^{12}	96%

Notes:
(1). Existing Load and TMDL calculated based on a mean annual flow of 307.6 cfs.
(2). MOS is an explicit 10% of the TMDL.
(3). Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4). Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.
(5). Wastewater WLA value based on design flow and acute permit limits, and represents the maximum one-day load the facility can discharge.

7.4.3.2 East Fork Little Barren River of Little Barren River 0.0 to 15.9

This segment of East Fork of Little Barren River runs from the confluence with Prices Creek downstream to the confluence with South Fork of Little Barren River (Figure 15). WKU sampled sites at River Miles 5.3 and 11.25 for fecal coliform during the 2002 and 2003 PCR seasons. The results of this sampling indicate that East Fork of Little Barren River between River Miles 0.0-15.9 is impaired for the PCR (nonsupport) and SCR (partial support) designated uses, and it was therefore listed in the 2008 Integrated Report to Congress (Table 47). There were exceedances in 30.1% (4 of 13) of the samples collected. The 90th percentile concentration of all samples was 8040 colonies/100ml. The watershed for the impaired segment has a total drainage area of 95.72 square miles. The landuse in the watershed is predominately forest (75.6%), followed by pasture (12.8%), natural grassland (6.3%), developed land (3.4%) and row crops (1.9%). Less than one percent of the total land area consists of wetlands or barren lands (Table 48).

Table 47 – Results of WKU Sampling in East Fork of Little Barren River Between River Miles 0.0-15.9 During the 2002 and 2003 Recreation Season

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-5.9 – East Fork Little Barren River at US 68 at River Mile 5.3	5/14/2002	800	✓
	6/18/2002	80	
	7/30/2002	16	
	8/28/2002	7	
	9/30/2002	200	
	10/29/2002	3400	✓
	5/15/2003	241	
	10/22/2003	30	
GR-5.10 – East Fork Little Barren River at ford off private road near East Fork, KY at River Mile 11.25	5/15/2003	88	
	6/17/2003	9200	✓
	7/29/2003	>12000	✓
	8/27/2003	16	
	10/22/2003	34	
Percent Exceedances			
4/13 = 30.1%			
90th Percentile Concentration (Exceedances Only)			
8040 colonies/100ml			

Table 48 – Land Use Classification in East Fork of Little Barren River Above River Mile 0.0. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	75.6%	72.35
Agriculture (total)	14.7%	14.05
Pasture	12.8%	12.25
Row Crop	1.9%	1.80
Developed	3.4%	3.21
Natural Grassland	6.3%	6.05
Wetland	0.0%	0.03
Barren	0.0%	0.01

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed; however, there are four KNDOP-permitted AFOs (KDOW 2006a), and other non-permitted sources as described in Section 6.2. Therefore, the TMDL Target load is allocated to non-permitted sources (Table 49).

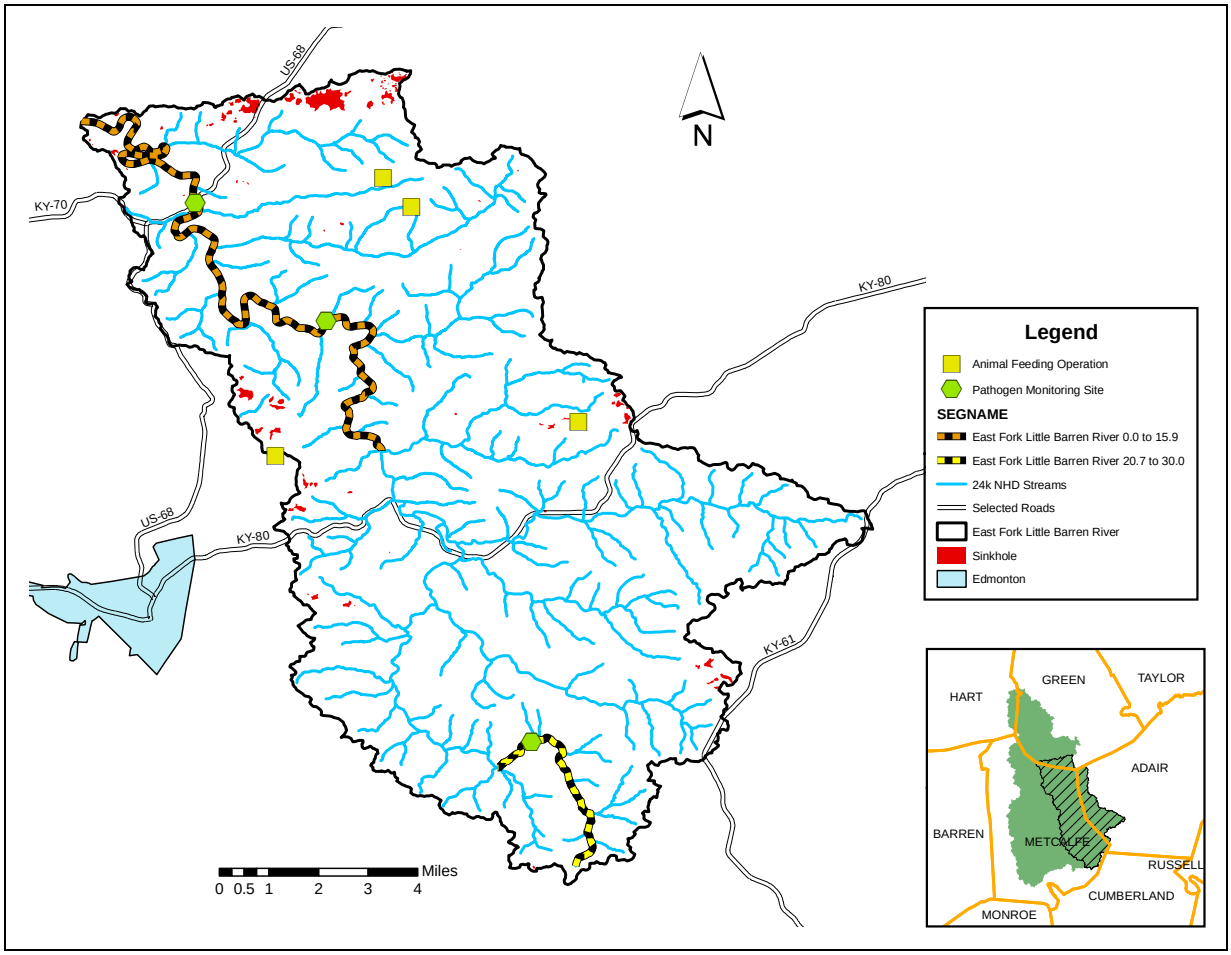

Figure 15 – Watershed map of East Fork of Little Barren River Above River Mile 0.0

Table 49 – Summary of TMDL Components for East Fork of Little Barren River 0.0-15.9

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
2.53×10^{13} col./day	1.25×10^{12} col./day	1.25×10^{11} col./day	0.0 col./day	1.13×10^{12} col./day	96%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 128.2 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

7.4.3.3 East Fork Little Barren River of Little Barren River 20.7 to 30.0

This segment of East Fork of Little Barren River runs from the headwaters down to the confluence with Delk Branch (Figure 16). WKU sampled at River Mile 26.1 for fecal coliform during the 2003 PCR season. The results of this sampling indicate this segment is impaired (partial support) for the PCR designated use, and it was therefore listed in the 2008 Integrated Report to Congress (Table 50). There were exceedances in 40.0% (2 of 5) of the samples collected. The 90th percentile concentration of all samples was 6340 colonies/100ml. The watershed for the impaired segment drains an area of 4.83 square miles (Figure 16). The landuse in the watershed is predominately forest (87.3%), followed by pasture (8.8%), natural grassland (1.16%), developed land (1.4%) and row crops (0.8%). Less than one percent of the total land area consists of wetlands or barren lands (Table 51).

Table 50 – Results of WKU Sampling in East Fork of Little Barren River Above River Mile 20.7 During the 2003 Recreation Season

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-5.11 – East Fork Little Barren River off Reece-Hurt Rd (CR 1114) east of Delk Branch Rd (CR 1120) at River Mile 26.65	5/15/2003	184	
	6/17/2003	552	✓
	7/29/2003	10200	✓
	8/27/2003	160	
	10/22/2003	31	
Percent Exceedances			
2/5 = 40.0%			
90th Percentile Concentration (Exceedances only)			
6340 colonies/100ml			

Table 51 – Land Use Classification in East Fork of Little Barren River Above River Mile 20.7. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	87.3%	4.24
Agriculture (total)	9.6%	0.47
Pasture	8.8%	0.43
Row Crop	0.8%	0.04
Developed	1.4%	0.07
Natural Grassland	1.6%	0.08
Wetland	0.0%	0.00
Barren	0.0%	0.00

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed, nor are there any AFOs (KDOW 2006a); therefore, the TMDL Target load is allocated to the non-permitted sources described in Section 6.2 (Table 52).

Table 52 – Summary of TMDL Components for East Fork Little Barren River 20.7-30.0

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
1.04×10^{12} col./day	6.56×10^{10} col./day	6.56×10^{9} col./day	0.0 col./day	5.90×10^{10} col./day	94%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 6.7 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

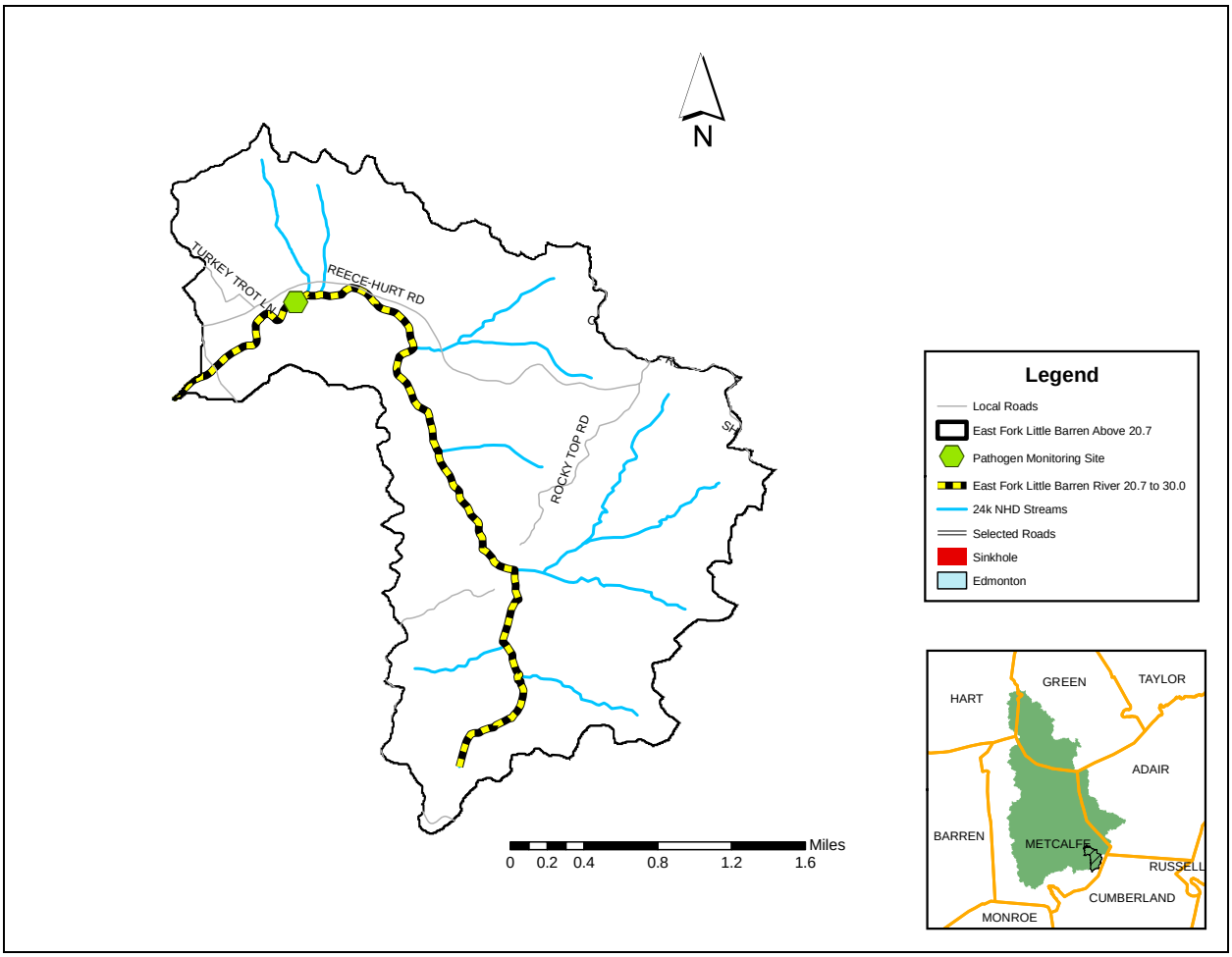

Figure 16 – Watershed Map of East Fork of Little Barren River Above River Mile 20.7

7.4.3.4 South Fork Little Barren River of Little Barren River 0.0 to 23.1

This segment of South Fork of Little Barren River runs from the confluence of Douglas Creek down to the mouth where the South Fork and East Fork meet to form Little Barren River (Figure 17). WKU sampled sites at River Miles 3.1, 9.1, 14.95, and 17.85 for fecal coliform during the 2002 and 2003 PCR seasons. The results of this sampling indicate this segment of South Fork of Little Barren River is impaired (nonsupport) for both the PCR and SCR designated uses, and it was therefore listed in the 2008 Integrated Report to Congress (Table 53). There were exceedances in 40.0% (10 of 25) of the samples collected. The 90th percentile concentration of all samples was 12000 colonies/100ml. The watershed for the impaired segment drains an area of 101.11 square miles. The landuse in the watershed is predominately forest (50.9%), followed by pasture (35.3%), developed land (6.2%), row crops (3.8%) and natural grassland (3.7%). Less than one percent of the total land area is wetland or barren land (Table 54).

Table 53 – Results of WKU Sampling in South Fork of Little Barren River at River Miles 3.1, 9.1, 14.95 and 17.85, During the 2002 and 2003 Recreation Season

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-5.4 – South Fork Little Barren River at KY 70 near Sulphur Well, KY at River Mile 3.1	5/14/2002	>12000	✓
	7/30/2002	128	
	8/28/2002	104	
	9/30/2002	440	✓
	10/29/2002	>12000	✓
	5/15/2003	800	✓
	10/22/2003	56	
GR-5.5 – South Fork Little Barren River at ford of Rockland Mills Rd (CR 1054) at River Mile 9.1	5/15/2003	304	
	6/17/2003	>12000	✓
	7/29/2003	>12000	✓
	8/27/2003	72	
	10/22/2003	164	
GR-5.6 – South Fork Little Barren River at KY 540 at River Mile 14.95	5/15/2003	312	
	6/17/2003	>12000	✓
	7/29/2003	>12000	✓
	8/27/2003	272	
	10/22/2003	95	
GR-5.7 – South Fork Little Barren River at KY 1243 at River Mile 17.85	5/14/2002	2360	✓
	6/18/2002	200	
	7/30/2002	392	
	8/28/2002	128	
	9/30/2002	224	
	10/29/2002	>12000	✓
	5/15/2003	296	
	10/22/2003	90	
Percent Exceedances			
10/25 = 40.0%			
90^{th} Percentile Concentration (Exceedances Only)			
12000 colonies/100ml			

Table 54 – Land Use Classification in South Fork of Little Barren River Above River Mile 0.0. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	50.9%	51.51
Agriculture (total)	39.1%	39.51
Pasture	35.3%	35.67
Row Crop	3.8%	3.84
Developed	6.2%	6.25
Natural Grassland	3.7%	3.77
Wetland	0.0%	0.04
Barren	0.0%	0.03

There is one permitted KPDES facility in the Little Barren River watershed. The Edmonton STP (KY0054437) is located in the South Fork Little Barren River subwatershed, north of Hwy 68 within Edmonton. Edmonton discharges to an unnamed tributary to Dry Fork, whose confluence with the impaired segment is at River Mile 19.6 (EPA 2007). Edmonton STP has effluent limits for fecal coliform of 200 colonies/100ml as a monthly average (geometric mean) and a maximum weekly average of 400 colonies/100ml. The treatment plant has a design capacity of 0.51 MGD (EPA 2007). Therefore, the WLA for the treatment plant for the 0.0-23.1 impaired segment is 7.72×10^{9} colonies/day (Table 55). As stated in Section 7.4.3.1, the South Fork Little Barren River discharges into the Little Barren River, therefore the WLA for the Edmonton STP also applies to the impaired segment on Little Barren River (9.8-15.7). The STP's quarterly discharge monitoring data for the period 1/1/2000 – 12/31/2005 have been included in Appendix 5. There have been no exceedances of the maximum weekly average and four (5.6%) exceedances of the monthly average reported since the year 2000. There have been no Notice of Violations (NOVs) issued for exceedances of the fecal coliform criterion in that time. There are also eleven KNDOP-permitted AFOs in the South Fork of Little Barren River watershed (KDOW 2006a), and other non-permitted sources as described in Section 6.2. Thus, the TMDL Target load is allocated to the STP and to AFOs and other non-permitted sources (Table 55).

Table 55 – Summary of TMDL Components for South Fork Little Barren River Between River Miles 0.0 to 23.1

Existing Load[1]	TMDL[1]	Margin of Safety[2]	Waste Load Allocation[3]			Load Allocation	Percent Reduction[4]
			Wastewater[5]		Storm Water		
4.01×10^{13} col/day	1.34×10^{12} col/day	1.34×10^{11} col/day[3]	Edmonton STP	7.70×10^{9} col/day	0.0 col./day	1.19×10^{12} col/day	97%

Notes:

(1). Existing Load and TMDL calculated based on a mean annual flow of 136.5 cfs

(2). MOS is an explicit 10% of the TMDL.

(3). Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.

(4). Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

(5). Wastewater WLA value based on design flow and acute permit limits, and represents the maximum one-day load the facility can discharge.

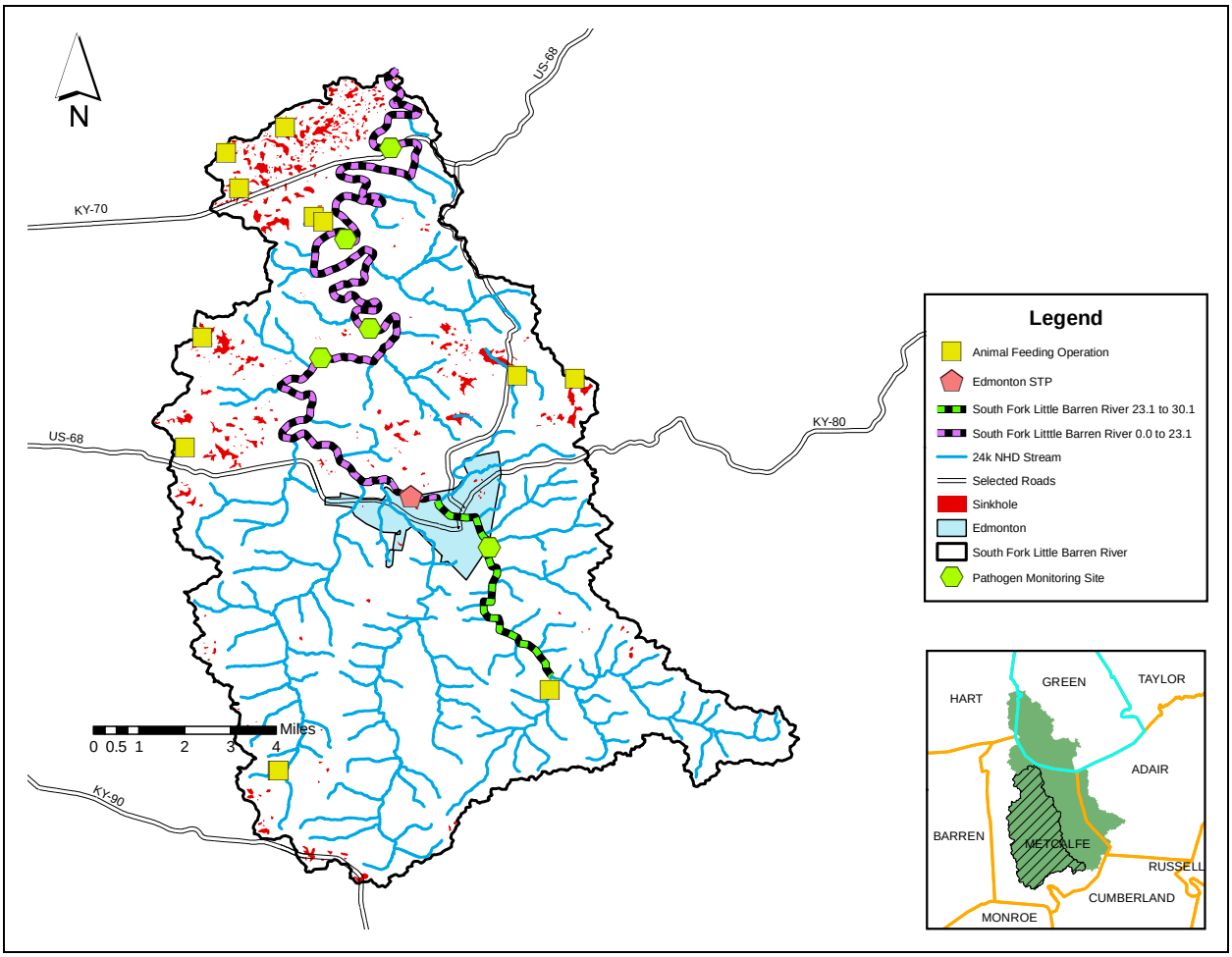

Figure 17 – Watershed Map of South Fork of Little Barren River Above River Mile 0.0

7.4.3.5 South Fork Little Barren River of Little Barren River 23.1 to 30.1

This segment of South Fork of Little Barren River runs from the confluence with Scott Branch downstream to the confluence with Douglas Creek (Figure 18). WKU sampled at River Mile 26.1 for fecal coliform during the 2002 and portions of the 2003 PCR season. The results of this sampling indicate this segment of South Fork of Little Barren River is impaired (nonsupport) for the PCR designated use, and it was therefore listed in the 2008 Integrated Report to Congress (Table 56). There were exceedances in 25.0% (2 of 8) of the samples collected. The 90th percentile concentration of all samples was 2456 colonies/100ml. The watershed for the impaired segment has a total drainage area of 25.53 square miles. The landuse in the watershed is predominately forest (70.1%) followed by pasture (18.2%), natural grassland (4.7%), developed land (3.6%) and row crops (3.3%). Less than one percent of the total land area is wetland or barren land (Table 57).

Table 56 – Results of WKU Sampling in South Fork of Little Barren River at River Mile 26.1 During the 2002 and 2003 Recreation Season

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-5.8 – South Fork Little Barren River at KY 496 southeast of Edmonton at River Mile 26.1	5/14/2002	680	✓
	6/18/2002	104	
	7/30/2002	104	
	8/28/2002	200	
	9/30/2002	360	
	10/29/2002	6600	✓
	5/15/2003	192	
	10/22/2003	44	
Percent Exceedances			
2/8 = 25.0%			
90th Percentile Concentration (Exceedances only)			
2456 colonies/100ml			

Table 57 – Land Use Classification in South Fork of Little Barren River Above River Mile 26.0. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	70.1%	13.62
Agriculture (total)	21.5%	4.17
Pasture	18.2%	3.53
Row Crop	3.3%	0.64
Developed	3.6%	0.70
Natural Grassland	4.7%	0.91
Wetland	0.0%	0.00
Barren	0.0%	0.00

There are no known KPDES-permitted sanitary wastewater or MS4 storm water sources in the watershed; however, there is one KNDOP-permitted AFO (KDOW 2006a) upstream of the impaired segment, and other non-permitted sources as described in Section 6.2. As a result, the entire TMDL Target load is allocated to non-permitted sources (Table 58).

Table 58 – Summary of TMDL Components for South Fork of Little Barren River Between River Miles 23.1 and 30.1

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
1.51×10^{12} col./day	2.47×10^{11} col./day	2.47×10^{10} col./day	0.0 col./day	2.22×10^{11} col./day	85%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 25.2 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

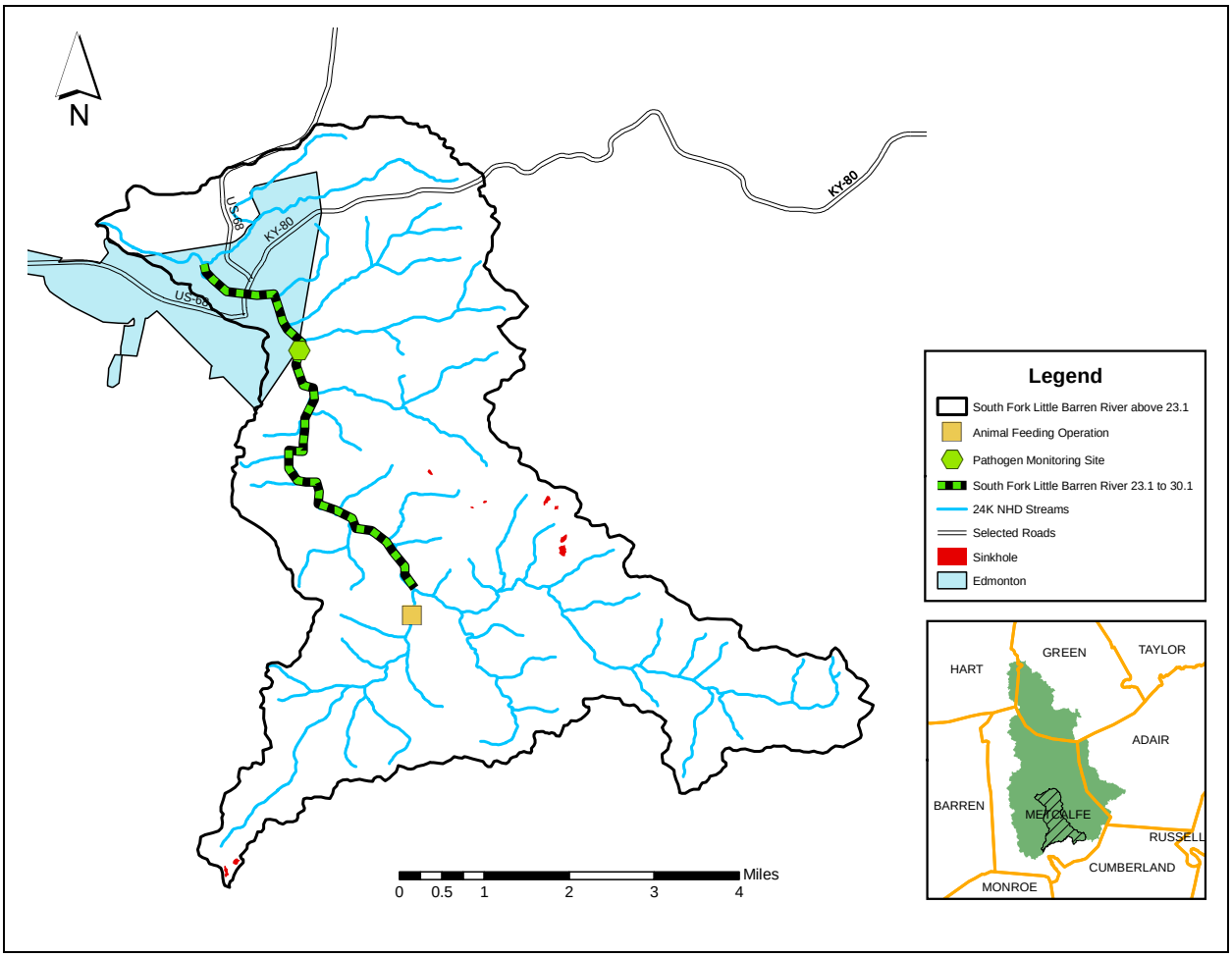

Figure 18 – Watershed Map of South Fork Little Barren River Above River Mile 23.1

7.4.4 Little Russell Creek 0.0 to 5.1

Little Russell Creek is a tributary to the Green River at River Mile 271.9 (Figure 19). WKU sampled Little Russell Creek at River Mile 1.0 for fecal coliform during the 2002 and 2003 PCR seasons. The results of this sampling indicate that Little Russell Creek is impaired (partial support) for the PCR designated use, and it was therefore listed in the 2008 Integrated Report to Congress (Table 59). There were exceedances in 30.0% (3 of 10) of the samples collected. The 90th percentile concentration of all samples was 1796 colonies/100ml. The watershed for the impaired segment comprises USGS HUC 05110001080, which has a total drainage area of 9.57 square miles. The landuse in the watershed is predominately forest (60.15%), followed by pasture (30.06%), developed land (5.84%), natural grassland (2.57%), row crops (1.12%), wetlands (0.26%) and barren land (0.01%, Table 60).

Table 59 – Results of WKU Sampling in Little Russell Creek at River Mile 1.0 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-2.1 Little Russell Creek at JT Ward Rd (CR-1204) at River Mile 1.0	5/16/2002	160	
	6/18/2002	304	
	7/25/2002	256	
	8/29/2002	552	✓
	9/30/2002	232	
	5/15/2003	1440	✓
	6/17/2003	5000	✓
	7/28/2003	8	
	8/27/2003	344	
	10/22/2003	77	
Percent Exceedances			
3/10 = 30.0%			
90th Percentile Concentration (Exceedances Only)			
1796 colonies/100ml			

Table 60 – Land Use Classification in Little Russell Creek Watershed Above River Mile 0.0. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Acres
Forest	60.15%	3683.96
Agriculture (total)	31.18%	1909.47
Pasture	30.06%	1840.98
Row Crop	1.12%	68.50
Developed	5.84%	357.61
Natural Grassland	2.57%	157.45
Wetland	0.26%	16.01
Barren	0.01%	0.44

There are no known KPDES-permitted sources in the watershed, but there is one KNDOP-permitted AFO (KDOW 2006a) and other non-permitted sources as described in Section 6.2; therefore, the entire TMDL Target load is allocated to non-permitted sources (Table 61).

Table 61 – Summary of TMDL Components for Little Russell Creek 0.0-5.1

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
5.40×10^{11} col./day	1.20×10^{11} col./day	1.20×10^{10} col./day	0.0 col./day	1.08×10^{11} col./day	80%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 12.3 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

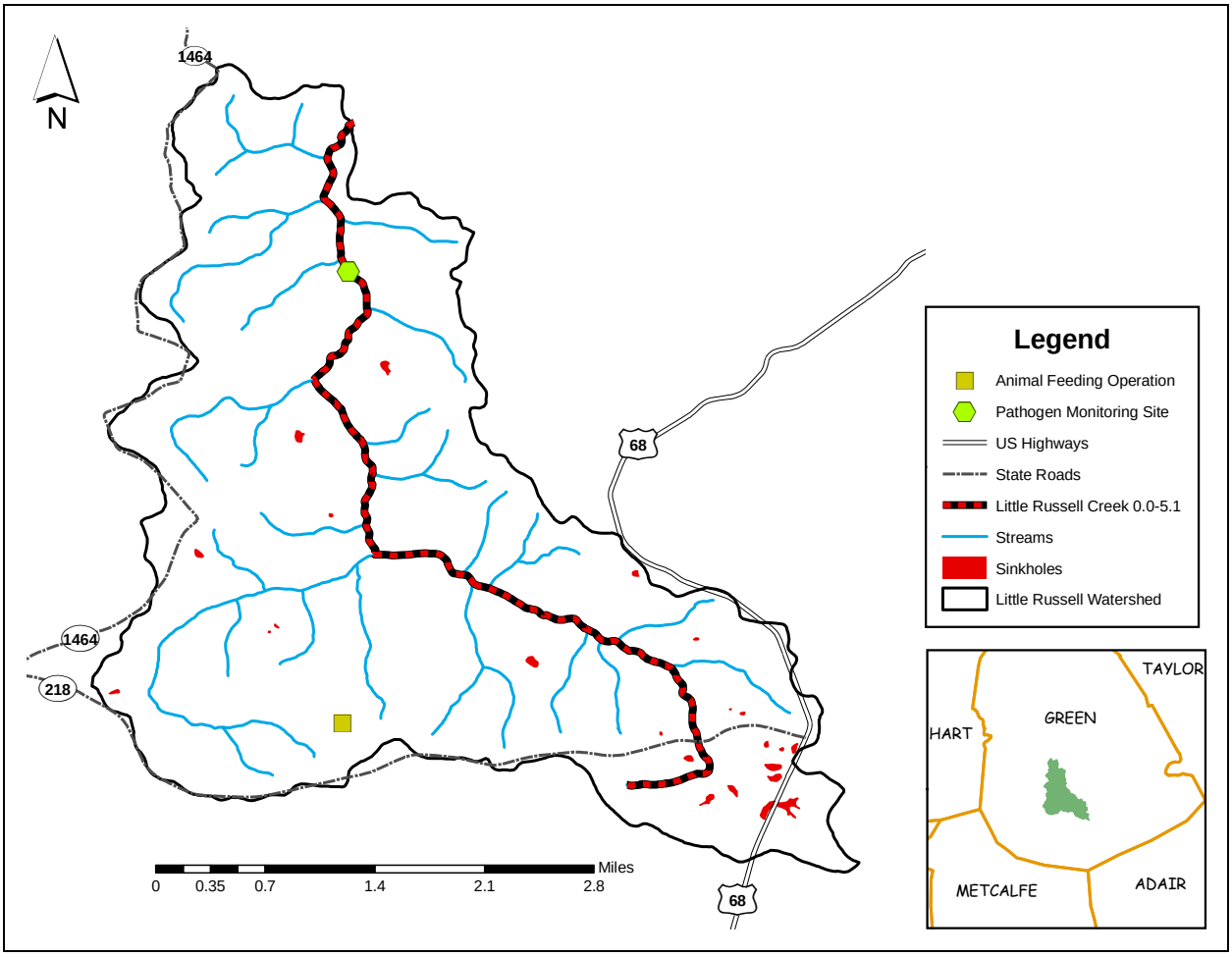

Figure 19 – Watershed Map of Little Russell Creek

7.4.5 Lynn Camp Creek 0.0 to 8.3

This segment of Lynn Camp Creek runs from the mouth of Lindy Creek downstream to the confluence with the Green River (Figure 20). WKU sampled at River Mile 4.5 for fecal coliform during the 2003 PCR season. The results of this sampling indicate that Lynn Camp Creek is impaired (nonsupport) for both the PCR and SCR designated uses, and it was therefore listed in the 2008 Integrated Report to Congress (Table 62). There were exceedances in 50.0% (4 of 8) of the samples collected. The 90th percentile concentration of all samples was 9480 colonies/100ml. The watershed for the impaired segment comprises USGS HUC-12 0511000110 with a total drainage area of 35.55 square miles. The landuse in the watershed is predominately forest (66.69%) followed by pasture (22.81%), natural grassland (4.47%), developed land (3.59%) and row crops (1.84%, Table 63).

Table 62 – Results of WKU Sampling in Lynn Camp Creek at River Mile 5.4 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-1.1 – Lynn Camp Creek at KY 569 at River Mile 4.5	5/13/2002	>12000	✓
	6/12/2002	480	✓
	7/30/2002	1400	✓
	8/20/2002	344	
	9/23/2002	184	
	10/29/2002	8400	✓
	5/19/2003	368	
	9/17/2003	188	
Percent Exceedances			
4/8 = 50.0%			
90th Percentile Concentration (Exceedances only)			
9480 colonies/100ml			

Table 63 – Land Use Classification in the Lynn Camp Creek Watershed. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	66.69%	15248.22
Agriculture (total)	24.65%	5636.13
Pasture	22.81%	5214.92
Row Crop	1.84%	421.21
Developed	3.59%	821.08
Natural Grassland	4.47%	1021.23
Wetland	0.41%	94.74
Barren	0.19%	43.81

There are no known KPDES-permitted sources in the watershed; however, there are six KNDOP-permitted AFOs (KDOW 2006a) and other non-permitted sources as described in Section 6.2; therefore, the TMDL Target load is allocated to non-permitted sources (Table 64).

Table 64 – Summary of TMDL Components for Lynn Camp Creek

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
1.06×10^{13} col./day	4.47×10^{11} col./day	4.47×10^{10} col./day	0.0 col./day	4.03×10^{11} col./day	96%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 45.7 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

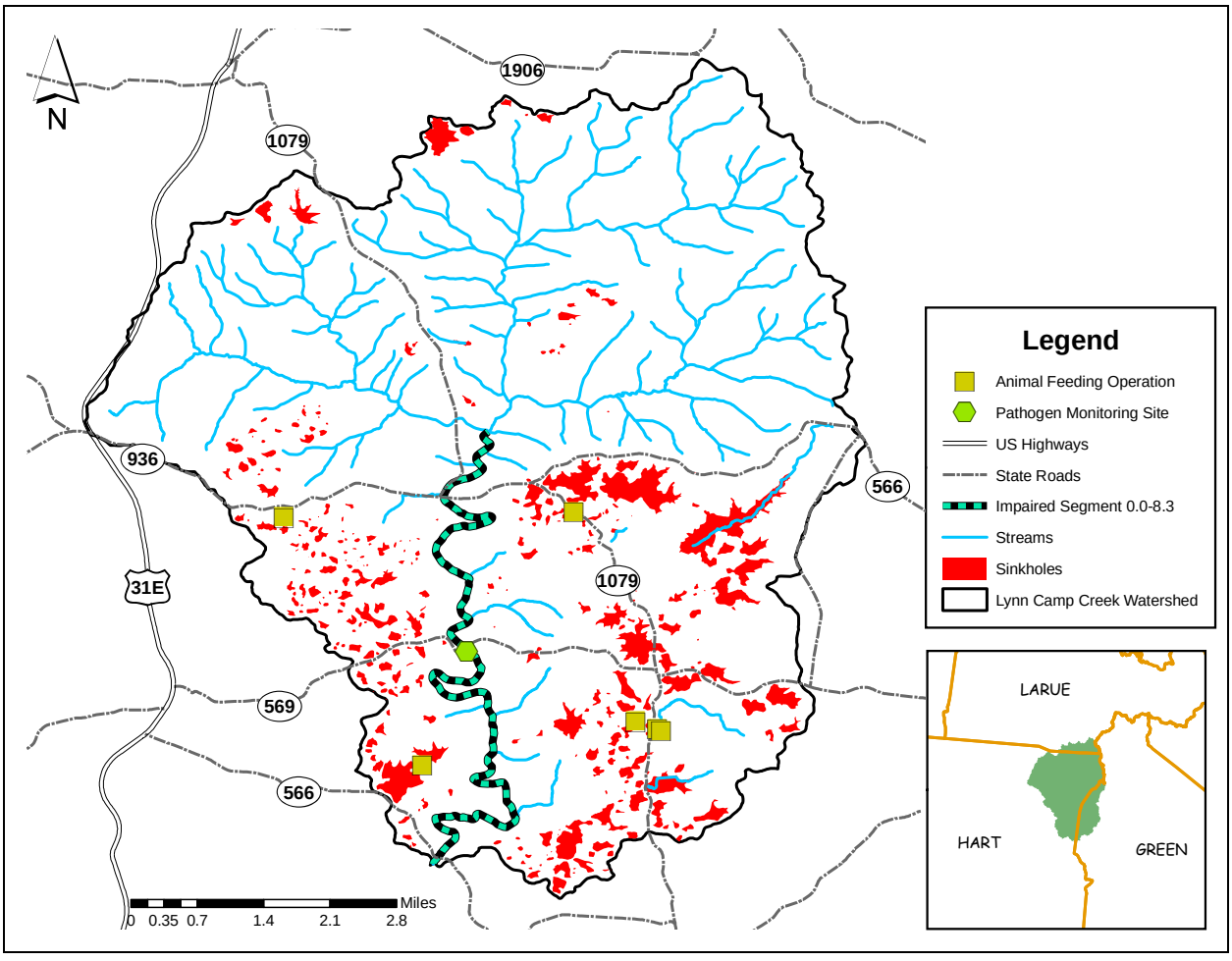

Figure 20 – Watershed Map of Lynn Camp Creek

7.4.6 Russell Creek

Russell Creek of Green River (Figure 21) is a fifth order stream in Adair, Green and Russell Counties. It is 289.33 square miles and comprises USGS-HUC 10 5011000104. The stream network is 626.84 miles long with an average slope of 0.19%. The landuse in Russell Creek is mostly agricultural (47.22%) with the majority of that acreage in pasture (41.39%). There are considerable forest resources (44.15%) in the watershed as well. The developed land (6.28%) includes the city of Columbia and portions of Russell Springs in the headwaters.

WKU sampled eleven sites in the Russell Creek watershed during the 2001-2003 PCR seasons (Appendix 2). KDOW previously assessed five segments during the 2001 watershed assessment cycle; Big Creek 3.0-8.2, Butlers Fork 2.3-4.0, Pettys Fork 0.0-6.0, Glens Fork 0.0-8.0 and Russell Creek 40.0-41.5. These segments did not meet the designated use and were placed on the 2004 303(d) Report (KDOW 2004). As a result, KDOW developed TMDLs for these five segments (KDOW 2007c), which were approved by EPA in 2008. Additionally, KDOW listed three additional segments in the Russell Creek watershed as impaired for PCR in the 2008 Integrated Report: Russell Creek 23.8-40.0, Sulphur Creek 0.0-10.7 and Russell Creek 60.4-66.3 (Table 65, Figure 21).

Table 65 – Pathogen-Impaired Segments in the Russell Creek Watershed

Site	Segment	Support Designation
Russell Creek	23.8-40.0	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Partial Support)
Sulphur Creek	0.0-10.7	Primary Contact Recreation (Partial Support)
Russell Creek	60.4-66.3	Primary Contact Recreation (Nonsupport); Secondary Contact Recreation (Nonsupport)

7.4.6.1 Russell Creek of Green River 23.8 to 40.0

This segment of Russell Creek runs from the discharge of the Columbia WWTP downstream to the confluence with Big Creek (Figure 22). WKU sampled at River Miles 25.92 and 36.34 for fecal coliform during the 2002 and 2003 PCR seasons. The results of this sampling indicate this segment of Russell Creek is impaired for the PCR (nonsupport) and SCR (partial support) designated uses, and it was therefore listed in the 2008 Integrated Report to Congress (Table 66). There were exceedances in 47.1% (8 of 17) of the samples collected. The 90th percentile concentration of all samples was 2416 colonies/100ml. The watershed for the impaired segment has a total drainage area of 189.35 square miles. The landuse in the watershed is predominately agriculture (52.81%), with the majority of agricultural land used for pasture (46.10%) along with row crops (6.71%). The remaining landuses are forest (38.49%), developed land (7.19%), natural grassland (1.39%), barren (0.10%), and wetland (0.02%, Table 67).

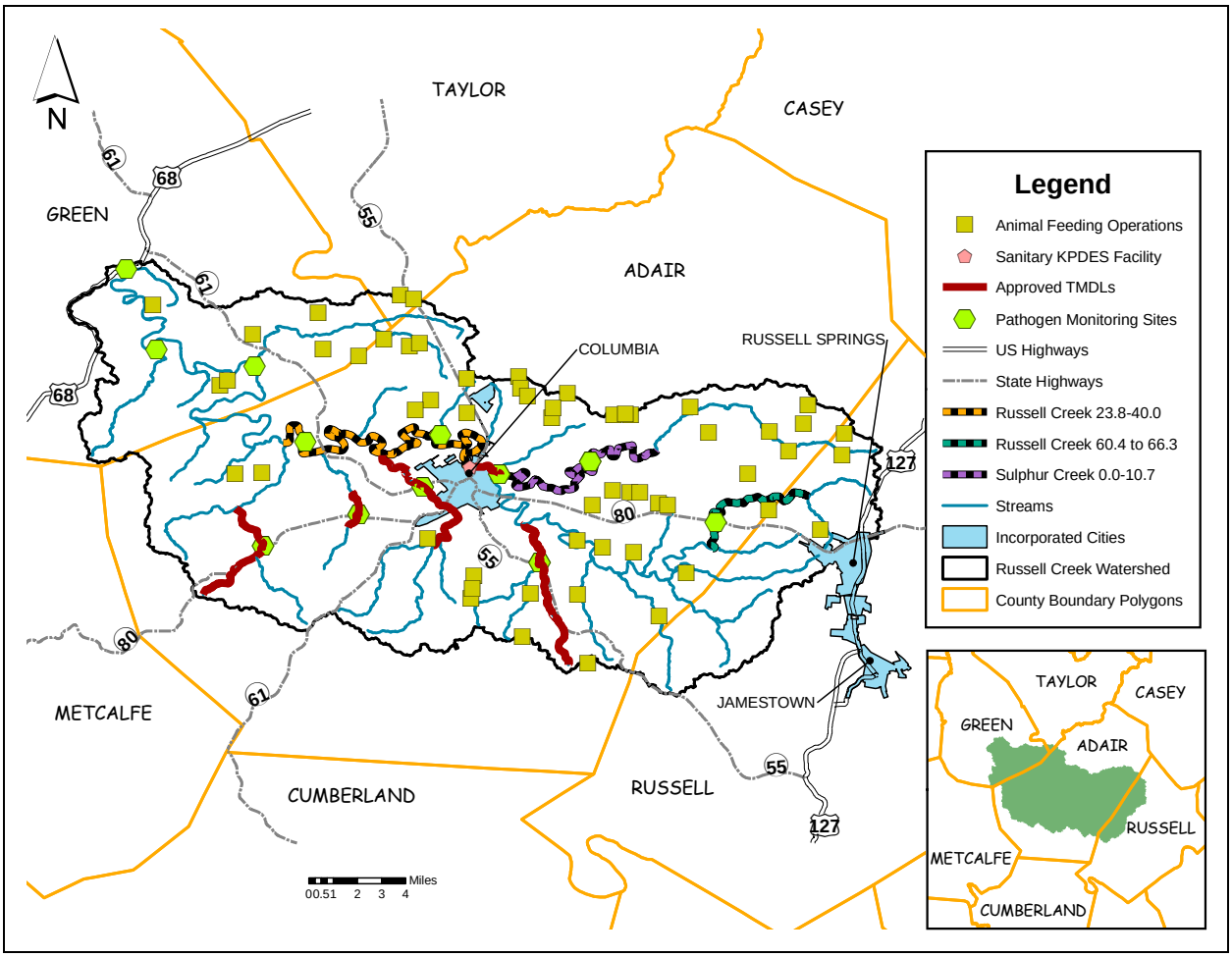

Figure 21 – Map of the Russell Creek Watershed Showing the Three Impaired Stream Segments and the Five Segments with Approved TMDLs

Table 66 – Results of WKU Sampling in Russell Creek at River Miles 25.92 and 36.34 During the 2002 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-6.5 Russell Creek at KY-768 at River Mile 25.92	5/16/2002	1560	✓
	6/18/2002	312	
	7/25/2002	2400	✓
	8/29/2002	608	✓
	9/25/2002	184	
	5/14/2003	112	
	6/16/2003	9200	✓
	7/28/2003	248	
	8/27/2003	312	
	10/15/2003	267	
GR-6.8 Russell Creek off Pelham Branch Rd (KY-767) at River Mile 36.34	5/16/2002	2080	✓
	6/18/2002	648	✓
	7/25/2002	2440	✓
	8/29/2002	512	✓
	9/25/2002	280	
	5/14/2003	192	
	10/15/2003	300	
Percent Exceedances			
8/17 = 47.1%			
90th Percentile Concentration (Exceedances only)			
2416 colonies/100ml			

Table 67 – Land Use Classification in Russell Creek Above River Mile 23.8. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	38.49%	72.88
Agriculture (total)	52.81%	99.99
Pasture	46.10%	87.29
Row Crop	6.71%	12.71
Developed	7.19%	13.62
Natural Grassland	1.39%	2.63
Wetland	0.02%	0.04
Barren	0.10%	0.19

The Columbia STP (KY0024317) discharges effluent to Russell Creek at River Mile 40.0. It has effluent limits for fecal coliform of 200 colonies/100ml as a monthly average (geometric mean) and a weekly maximum of 400 colonies/100ml. The treatment plant has a design capacity of 1.2 MGD (EPA 2007). The WLA for the treatment plant is 1.82×10^{10} colonies/day (Table 68). The STP's quarterly discharge monitoring data for the period 1/1/2000–12/31/2005 have been

included in Appendix 6. There have been 24 (33.3%) exceedances of the weekly maximum criterion and no exceedances of the monthly average effluent limits since 2000. There have been no NOVs issued for exceedances of the fecal coliform criterion in that time. There are also 43 KNDOP-permitted AFOs (KDOW 2006a) and other non-permitted sources as described in Section 6.2 in the watershed (Figure 22). Therefore, the TMDL Target load was allocated to the Columbia STP and to AFOs along with other non-permitted sources (Table 68).

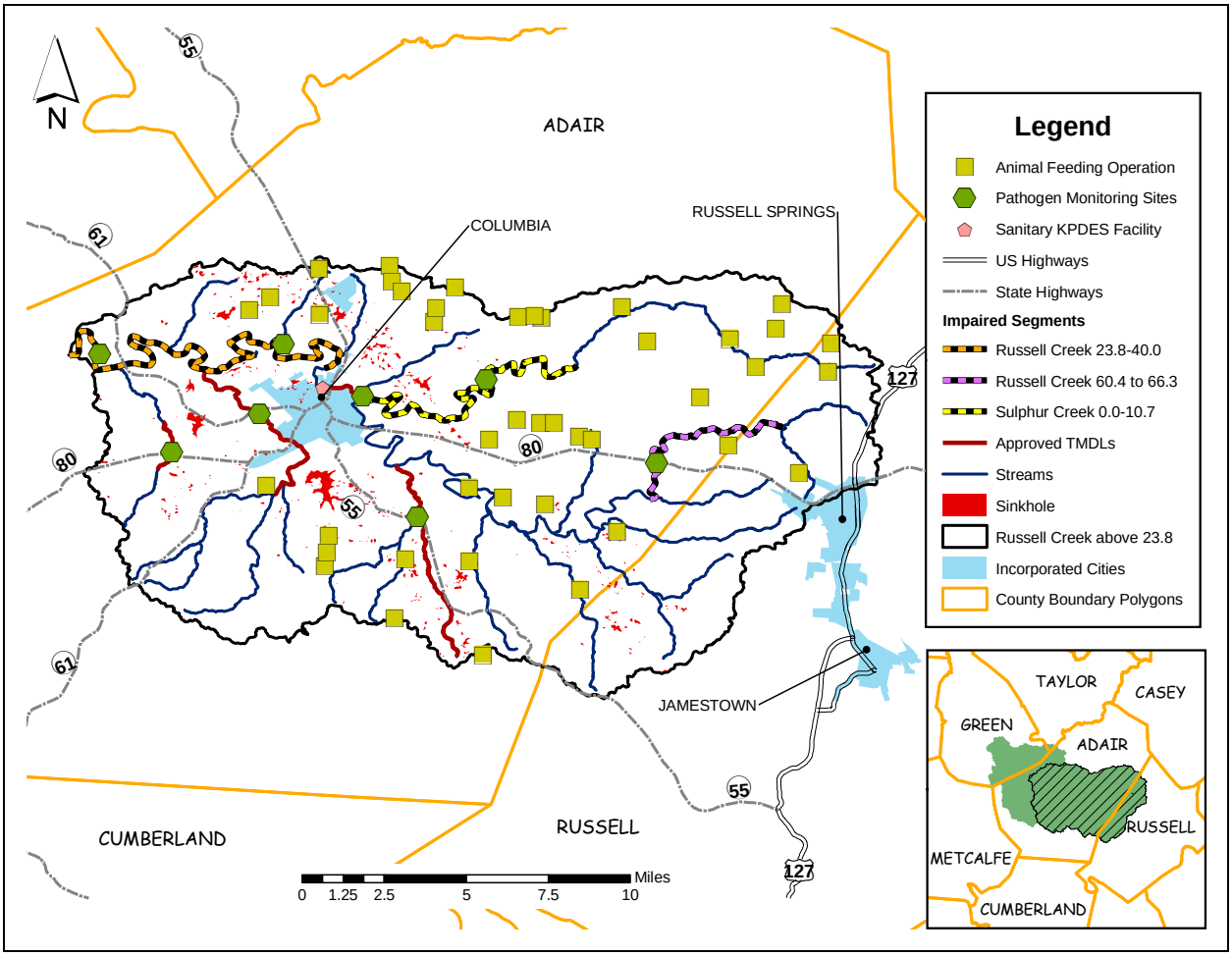

Figure 22 – Map of Russell Creek Watershed Above River Mile 23.8

Table 68 – Summary of TMDL Components for Russell Creek 23.8-40.0

Existing Load(1)	TMDL(1)	Margin of Safety(2)	Waste Load Allocation(3)			Load Allocation	Percent Reduction(4)
			Wastewater(5)		Storm Water		
1.52×10^{13} col./day	2.52×10^{12} col./day	2.52×10^{11} col./day(3)	Columbia STP	1.82×10^{10} col./day	0.0 col/day	2.25×10^{12} col./day	85%

Notes:

(1). Existing Load and TMDL calculated based on a mean annual flow of 257.5 cfs

(2). MOS is an explicit 10% of the TMDL.

(3). Any future KPDES permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.

(4). Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

(5). Wastewater WLA value based on design flow and acute permit limits, and represents the maximum one-day load the facility can discharge.

7.4.6.2 Russell Creek of Green River 60.4 to 66.3

This segment of Russell Creek runs from the headwaters downstream to the confluence with Sulphur Creek (Figure 23). WKU sampled at River Mile 61.6 for fecal coliform during the PCR season of 2003. The results of this sampling indicate this segment of Russell Creek is impaired (nonsupport) for both the PCR and SCR designated uses, and it was therefore listed in the 2008 Integrated Report to Congress (Table 69). There were exceedances in 66.7% (4 of 6) of the samples collected. The 90th percentile concentration of all samples was 6000 colonies/100ml. The watershed for the impaired segment has a total drainage area of 18.0 square miles. The landuse in the watershed is predominately agriculture (51.0%), with the majority of agricultural land used for pasture (43.4%) along with row crops (7.6%). The remaining landuses are forest (39.6%), developed land (8.3%), natural grassland (1.1%), barren (0.03%), and wetland (0.02%, Table 70).

Table 69 – Results of WKU Sampling in Russell Creek at River Mile 61.6 During the 2003 Recreation Season

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-6.12 Russell Creek at KY-80 at River Mile 61.6	5/14/2003	296	
	6/16/2003	6000	✓
	7/28/2003	400	
	8/20/2003	1200	✓
	10/15/2003	3000	✓
	10/29/2003	6000	✓
Percent Exceedances			
4/6 = 66.7%			
90th Percentile Concentration (Exceedances only)			
6000 colonies/100ml			

Table 70 – Land Use Classification in Russell Creek Watershed Above River Mile 60.4. Data Generated Using NLCD 2001 (USGS 2003)

Land Use	% of Total Area	Square Miles
Forest	39.6%	30.99
Agriculture (total)	51.0%	43.97
Pasture	43.4%	38.19
Row Crop	7.6%	5.78
Developed	8.3%	6.07
Natural Grassland	1.1%	0.93
Wetland	0.02%	0.01
Barren	0.03%	0.10

There are no known KPDES-permitted sources in the watershed; however, there are three KNDOP-permitted AFOs (KDOW 2006a) and other non-permitted sources as described in Section 6.2. Therefore, the TMDL Target load is allocated to non-permitted sources (Table 71).

Table 71 – Summary of TMDL Components for Russell Creek 60.4-66.3

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
3.63×10^{12} col./day	2.42×10^{11} col./day	2.42×10^{10} col./day	0.0 col./day	2.18×10^{11} col./day	94%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 24.7 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

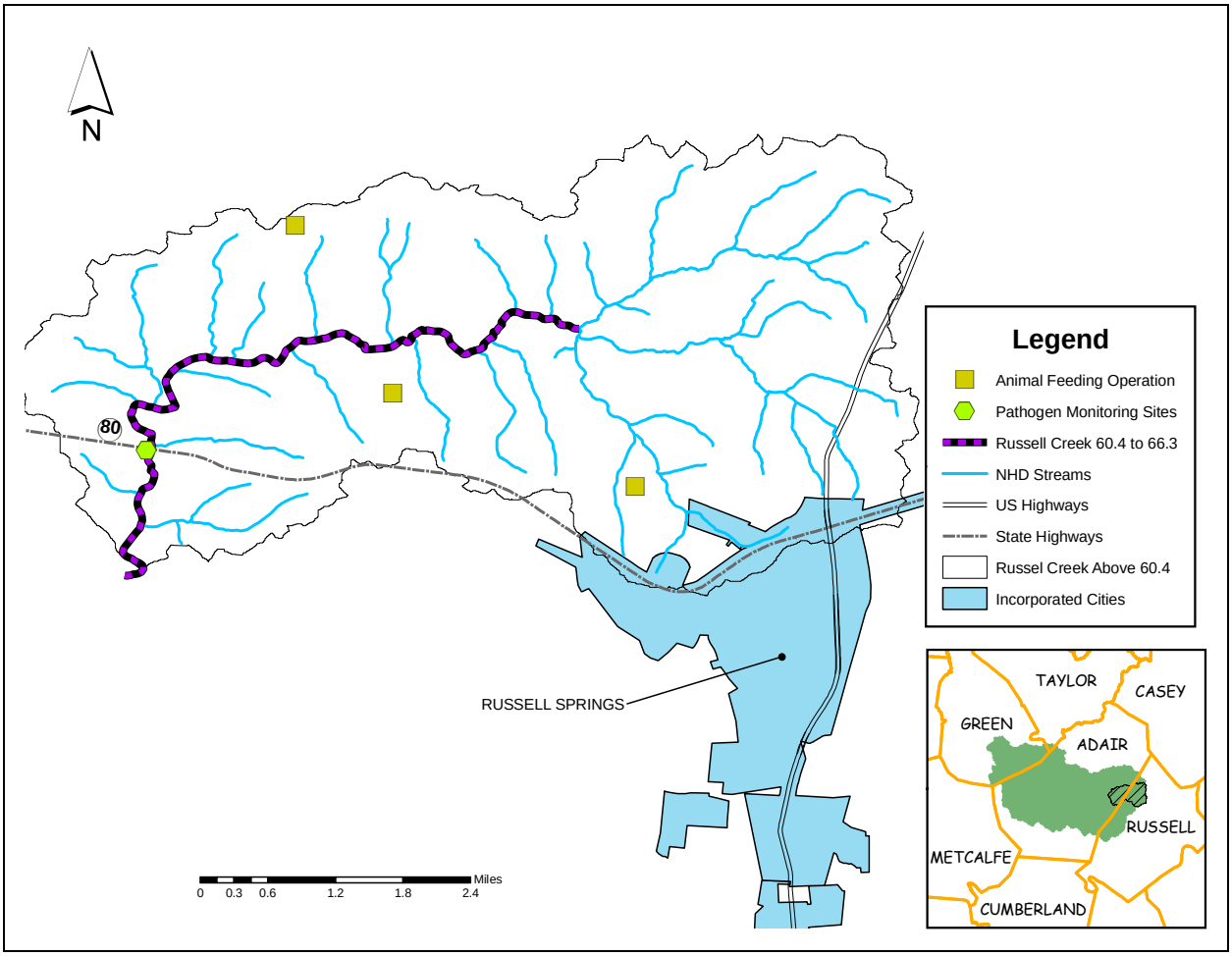

Figure 23 – Watershed Map of Russell Creek Watershed Above River Mile 60.4

7.4.6.3 Sulphur Creek of Russell Creek 0.0 to 10.7

This segment of Sulphur Creek runs from the confluence with Butler Creek downstream to the confluence with Russell Creek (Figure 24). WKU sampled at River Mile 6.7 for fecal coliform during the 2001 and 2003 PCR seasons. The results of this sampling indicate this segment of Sulphur Creek is impaired (partial support) for the PCR designated use and it was therefore listed in the 2008 Integrated Report to Congress (Table 72). There were exceedances in 36.3% (3 of 11) of the samples collected. The 90th percentile concentration of all samples was 1480 colonies/100ml. The Sulphur Creek watershed has a total drainage area of 37.01 square miles. The landuse in the watershed is predominately agriculture (50.14%), with the majority of agricultural land used for pasture (43.18%), along with row crops (6.96%). The remaining landuses are forest (42.22%), developed land (5.72%), grassland (1.88%), barren (0.02%), and wetland (0.01%, Table 73).

Table 72 – Results of WKU Sampling in Sulphur Creek at River Mile 6.7 During the 2001 and 2003 Recreation Seasons

Sample Site	Month	Fecal Coliform colonies/100ml	Exceedance
GR-6.10 Sulphur Creek at Taylor Fork Rd (CR-1001) at River Mile 6.7	6/18/2001	345	
	7/19/2001	216	
	8/22/2001	272	
	9/20/2001	>12000	✓
	10/29/2001	72	
	5/14/2003	88	
	6/16/2003	1480	✓
	7/28/2003	192	
	8/20/2003	480	✓
	10/15/2003	175	
	10/29/2003	236	
Percent Exceedances			
4/11 = 36.3%			
90th Percentile Concentration (Exceedances only)			
1480 colonies/100ml			

Table 73 – Land Use Classification in Sulphur Creek Watershed Above River Mile 0.0. Data Generated Using NLCD 2001 (USGS 2003).

Land Use	% of Total Area	Square Miles
Forest	42.22%	15.65
Agriculture (total)	50.14%	18.59
Pasture	43.18%	16.01
Row Crop	6.96%	2.58
Developed	5.72%	2.12
Natural Grassland	1.88%	0.70
Wetland	0.01%	0.01
Barren	0.02%	0.01

There are no known KPDES-permitted sources in the watershed; however, there are 16 KNDOP-permitted AFOs (KDOW 2006a) and other non-permitted sources as described in Section 6.2. Therefore, the TMDL Target load is allocated to non-permitted sources (Table 74).

Table 74 – Summary of TMDL Components for Sulphur Creek 0.0-10.7.

Existing Load[(1)]	TMDL[(1)]	Margin of Safety[(2)]	WLA[(3)]	LA	Percent Reduction[(4)]
1.82×10^{12} col./day	4.91×10^{11} col./day	4.91×10^{10} col./day	0.0 col./day	4.42×10^{11} col./day	76%

Notes:
(1) Existing Load and TMDL calculated using the Mean Annual Flow of 50.2 cfs.
(2) MOS is an explicit 10% of the TMDL.
(3) Any future KPDES-permitted point source must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.
(4) Overall reduction required to achieve the TMDL Target of 360 colonies/100ml at the time of data collection.

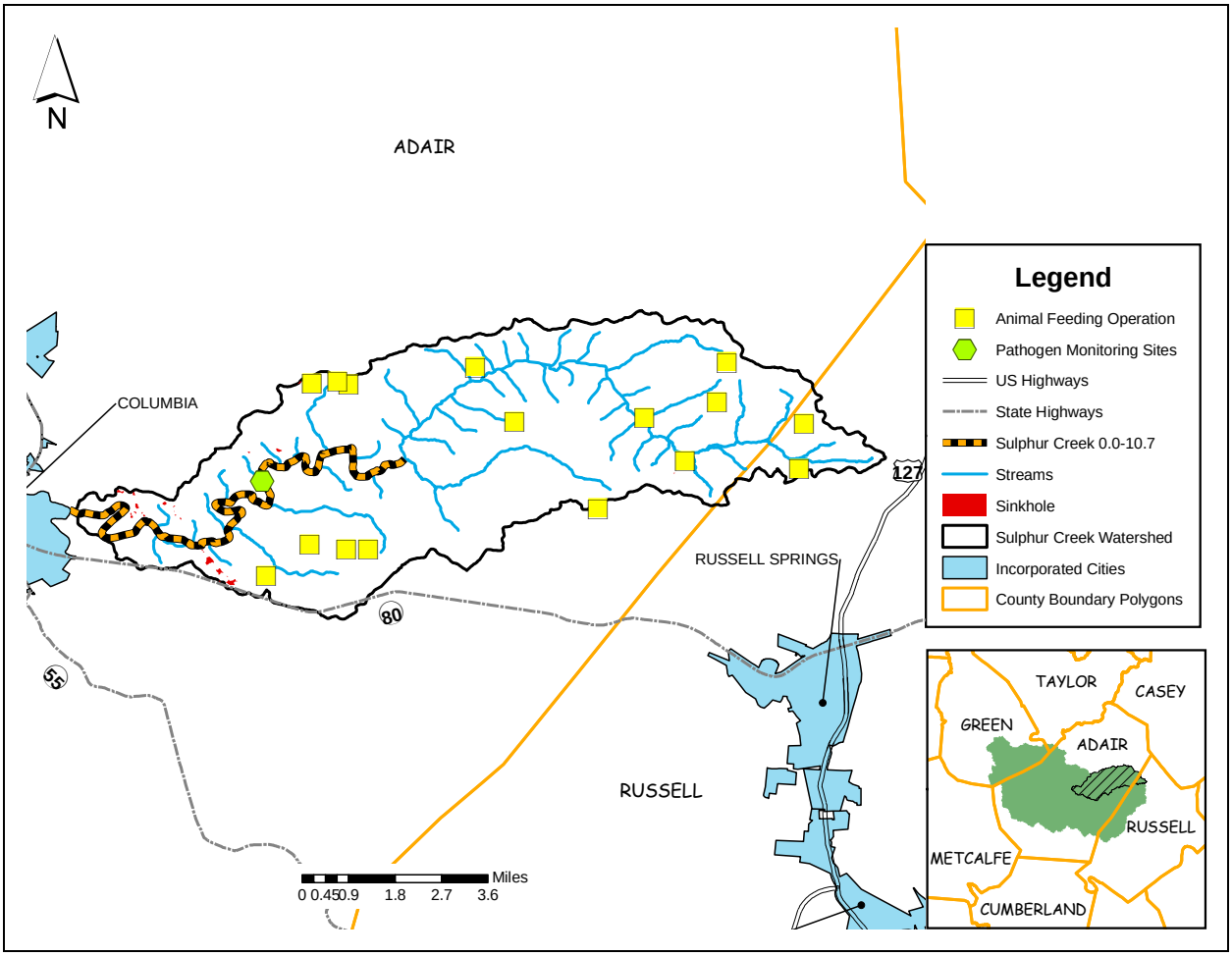

Figure 24 – Watershed Map for Sulphur Creek

7.5 TMDL Summary for all Segments

Table 75 – TMDL Summary for All Segments

TMDL	MOS[1]	WLA[6]				LA[6]	Percent Reduction[5]
		Wastewater[2,3]		MS4			
Big Brush Creek of Green River RM 0.0-5.0							
1.06×10^{12} col/day	1.06×10^{11} col/day	0.0 col/day		0.0 col/day		9.56×10^{11} col/day	55%
Big Brush Creek of Green River RM 7.1-13.0							
5.02×10^{11} col/day	5.02×10^{10} col/day	0.0 col/day		0.0 col/day		4.52×10^{11} col/day	64%
Big Pitman Creek of Green River RM 13.9-17.8							
1.56×10^{12} col/day	1.56×10^{11} col/day	0.0 col/day		0.0 col/day		1.40×10^{12} col/day	87%
Big Pitman Creek of Green River RM 17.8-23.65							
7.46×10^{11} col/day	7.46×10^{10} col/day	0.0 col/day		0.0 col/day		6.71×10^{11} col/day	83%
Brush Creek of Big Brush Creek RM 0.0-2.15							
1.98×10^{11} col/day	1.98×10^{10} col/day	0.0 col/day		0.0 col/day		1.78×10^{11} col/day	34%
East Fork Little Barren River of Little Barren River RM 0.0-15.9							
1.25×10^{12} col/day	1.25×10^{11} col/day	0.0 col/day		0.0 col/day		1.13×10^{12} col/day	96%
East Fork Little Barren River of Little Barren River RM 20.7-30.0							
6.56×10^{10} col/day	6.56×10^{09} col/day	0.0 col/day		0.0 col/day		5.90×10^{10} col/day	94%
Little Barren River of Green River RM 9.8-15.7							
3.01×10^{12} col/day	3.01×10^{11} col/day	Edmonton STP KY0054437	7.70×10^{09} col/day	0.0 col/day		2.70×10^{12} col/day	96%
Little Brush Creek of Big Brush Creek RM 3.2-13.2							
3.13×10^{11} col/day	3.13×10^{10} col/day	0.0 col/day		0.0 col/day		2.82×10^{11} col/day	94%
Little Pitman Creek of Big Pitman Creek RM 0.0-10.1							
4.70×10^{11} col/day	4.70×10^{10} col/day	Campbellsville STP KY0022039	6.36×10^{10} col/day	City of Campbellsville KYG200015[4]	6.39×10^{10} col/day	2.95×10^{11} col/day	93%
Little Pitman Creek of Big Pitman Creek RM 10.1-11.2							
1.64×10^{11} col/day	1.64×10^{10} col/day	0.0 col/day		City of Campbellsville KYG200015[4]	1.63×10^{10} col/day	1.32×10^{11} col/day	94%
Little Russell Creek of Green River RM 0.0-5.1							
1.20×10^{11} col/day	1.20×10^{10} col/day	0.0 col/day		0.0 col/day		1.08×10^{11} col/day	80%
Lynn Camp Creek of Green River RM 0.0-8.3							
4.47×10^{11} col/day	4.47×10^{10} col/day	0.0 col/day		0.0 col/day		4.03×10^{11} col/day	96%
Middle Pitman Creek of Big Pitman Creek RM 0.0-7.7							
3.16×10^{11} col/day	3.16×10^{10} col/day	0.0 col/day		0.0 col/day		2.84×10^{11} col/day	86%

TMDL	MOS[1]	WLA[6]			LA[6]	Percent Reduction[5]
		Wastewater[2,3]		MS4		
Middle Pitman Creek of Big Pitman Creek RM 8.2-10.1						
1.52×10^{11} col/day	1.52×10^{10} col/day	0.0 col/day		0.0 col/day	1.37×10^{11} col/day	86%
Russell Creek of Green River RM 23.8-40.0						
2.52×10^{12} col/day	2.52×10^{11} col/day	Columbia STP KY0024317	1.82×10^{10} col/day	0.0 col/day	2.25×10^{12} col/day	85%
Russell Creek of Green River RM 60.4-66.3						
2.42×10^{11} col/day	2.42×10^{10} col/day	0.0 col/day		0.0 col/day	2.18×10^{11} col/day	94%
South Fork Little Barren River of Little Barren River RM 0.0-23.1						
1.34×10^{12} col/day	1.34×10^{11} col/day	Edmonton STP KY0054437	7.70×10^{09} col/day	0.0 col/day	1.19×10^{12} col/day	97%
South Fork Little Barren River of Little Barren River RM 23.1-30.1						
2.47×10^{11} col/day	2.47×10^{10} col/day	0.0 col/day		0.0 col/day	2.22×10^{11} col/day	85%
Sulphur Creek of Russell Creek RM 0.0-10.7						
4.91×10^{11} col/day	4.91×10^{10} col/day	0.0 col/day		0.0 col/day	4.42×10^{11} col/day	76%

Notes:

(1). MOS is an explicit 10% of the TMDL.

(2). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Standards in 401 KAR 5:031, and must not cause or contribute to an existing impairment.

(3). WLA value is based on design flow and acute permit limits and represents the maximum one-day load that can be discharged to the stream segment.

(4). The MS4 discharges to two impaired segments; therefore, it must meet the higher of the two percent reductions, and the lower of the two WLAs. However, if the MS4 is in compliance with its storm water permit, KDOW regards the MS4 as being in compliance with 401 KAR Chapter 5.

(5). Overall reduction required to achieve the TMDL Target of 360 colonies/100ml.

(6). 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 the acute limit, or (130/200) for the chronic limit. While this calculation can be used to determine allocations for E. coli, it cannot be used to convert ambient fecal coliform concentrations to E. coli concentrations.

8.0 Implementation

Section 303(e) of the Clean Water Act and 40 CFR Part 130, Section 130.5, require states to have a continuing planning process (CPP) composed of several parts specified in the Act and the regulation. The CPP provides an outline of agency programs and the available authority to address water issues. Under the CPP umbrella, the Watershed Management Branch will provide technical support and leadership with developing and implementing watershed plans to address water quality and quantity problems and threats. Developing watershed plans enables more effective targeting of limited restoration funds and resources, thus improving environmental benefit, protection and recovery. Continued planning and implementation in the Upper Green River watershed is desired in order maximize protection and restoration efforts.

The in-stream pathogen data used to develop the TMDLs for impaired segments in the Upper Green River do not allow loads to be quantitatively allocated to the different sources within the watershed. Therefore, no specific recommendations for remediation are offered until additional watershed planning is conducted. Development of a watershed plan will provide an integrative approach for identifying and describing what actions that should be taken in order to meet WQC, how the actions will be accomplished, who will undertake the actions and when the actions will be completed. This TMDL will provide a foundation for developing a detailed watershed plan. At present, no watershed plan is under development by WMB for the Green River watershed. However, KDOW welcomes future planning efforts by third parties (i.e., local stakeholders) for watershed plans and BMP implementation.

The Green River is the most biologically diverse and rich branch of the Ohio River system. The greatest aquatic diversity occurs in a 100-mile section of unhindered river that flows from the Green River Reservoir dam through Mammoth Cave National Park (the world's longest and most diverse cave system) in south central Kentucky. This section of the Green River Watershed includes 917,197 acres in the counties of Adair, Barren, Edmonson, Green, Hart, Metcalfe, Russell and Taylor.

Conservation efforts in the watershed include a purchase by The Nature Conservancy, which owns 1.2 miles of Russell Creek frontage in a 120-acre lot in Green County.

On August 29, 2001, the U.S. Department of Agriculture and the Commonwealth of Kentucky agreed to implement a Conservation Reserve Enhancement Program, or CREP, on the above referenced section of the Green River to restore up to 100,000 acres. This is an $110,000,000 program, making it the largest conservation program in the history of this state. The Nature Conservancy also was a primary contributor, offering permanent easements to landowners in addition to CREP contracts.

CREP is an enhanced version of the USDA Conservation Reserve Program (CRP), which has been the federal government's largest, most comprehensive private lands environmental improvement program. CRP and CREP help save millions of acres of topsoil from erosion, protect surface and ground waters by reducing runoff and sedimentation, increasing wildlife habitat and improving air quality.

Because the section of the Green River referenced above has been identified as such a special place, partner agencies felt that the enhanced version of the CRP would be ideal for this area. This "enhancement" is primarily financial, thus directly benefiting the producer/landowner in CREP areas (for example, some practices installed under a CREP contract can pay up to a 100 percent increase over standard CRP rental payments for the same practice). This is an entirely voluntary land "set aside" program; offering enhanced annual rental, cost share and incentive payments that exceed that of CRP. In addition to the payments referenced above, landowners may elect to enter this land into a supplemental permanent conservation easement to receive additional incentive payments. CREP contracts may last from 10 to 15 years, and sign up is continuous within the eight county CREP regions. Practices most commonly utilized in the Green River CREP region include riparian buffers, native grass planting, hardwood tree planting and filter strips.

Goals and Objectives of Green River CREP

The goal of the Green River CREP is to reduce by 10 percent the amount of sediment, nutrients, and pesticides from agricultural sources entering the tributaries and main stem of the Green River and Mammoth Cave System through the installation of Best Management Practices designed for that purpose, and other conservation practices designed to improve water quality. Additional goals include:

- enhancing habitats and populations of wildlife, including those listed as state and federal special concern, rare, threatened and endangered,
- sustaining and restore the composition, structure and function of riparian habitat corridors associated with the Green River and tributary watersheds,
- reconnecting habitat types in order to restore the full range of ecosystem function,
- establishing buffers around sinkholes, targeting 1,000 high-priority sinkholes,
- sustaining and restore non-riparian wetlands,
- protecting and restore subterranean ecosystems,
- collecting, storing and analyzing data to enhance planning for sustaining the health of the watershed,
- developing an outreach program targeting all active agricultural producers in the area,
- utilizing native species, including warm season grasses, to the greatest extent possible.

The first three years of the Green River CREP have shown success in placing critical acreage into conservation practices. As with any new program, time was needed to learn the program specifics and adjust workloads accordingly. Lessons are still being learned, but many feel that a corner has been turned, and this program appears to be headed into its most productive years. Producer interest remains high, and the program continues to attract interest from local farmers, especially with the announcement of the upcoming tobacco buyout. The third annual Green River CREP report was recently released and reflected that 394 total contracts had been signed, totaling 8,396 acres. State partner agencies have been key in getting Green River CREP on the ground during this initial period.

This program is administered by USDA, and several state agencies have been critical for success. The Kentucky Division of Forestry, Kentucky Department of Fish and Wildlife Resources and Kentucky Division of Conservation have played primary roles in public education, program organization and guidance on practice implementation. In addition, the Nature Conservancy of

Kentucky is administering supplemental permanent easements on contracts for those who wish to enroll. This partnership effort is yet another reason that Green River CREP has set itself apart from previous conservation programs (KDOC, 2006).

The Kentucky Soil Erosion and Water Quality Cost Share Program have provided significant cost-share assistance to landowners for agricultural BMP installation in Adair, Barren, Green, Hart, Metcalfe, and Taylor counties. These six counties include the pathogen-impaired waterbodies identified in this TMDL Report. The cost-share Program began in 1995 and is administered through the Kentucky Division of Conservation. Local oversight is provided by county Conservation Districts, with technical assistance provided by the United States Department of Agriculture-Natural Resources and Conservation Service. Since 1995, the Kentucky Division of Conservation has approved 595 applications from producers in Adair, Barren, Green, Hart, Metcalfe, and Taylor counties (KDOC, 2008). These approved applications exceed $5.8 million in state cost-share assistance for BMP implementation (KDOC, 2008). Specifically, 74 applications were approved for Adair County totaling $515,257; 259 applications were approved for Barren County totaling $2,745,704; 50 applications were approved in Green County totaling $620,656; 30 applications were approved in Hart County totaling $197,133; 118 applications were approved in Metcalfe County totaling $1,050,333 and 64 applications were approved for Taylor County totaling $733,660 (KDOC, 2008).

In addition to protecting this unique resource, the KDOW desired to improve water quality in the impaired waterbodies within the CREP area. To that end, the KDOW awarded over $450,000 in federal Section 319(h) Nonpoint Source Grant funds (FFY1997, 1999 & 2002) to the Kentucky Division of Conservation and the Adair County Conservation District to employ technical support staff to work one-on-one with landowners to implement the program, to target their efforts in the impaired water quality stream segments in the CREP area, and conduct water quality monitoring to document changes in water quality in the impaired segments. In addition to the Section 319(h) Nonpoint Source Grant funds, monitoring to document program effectiveness is an ongoing cooperative effort by numerous entities including universities, federal and state agencies.

9.0 Public Participation

This TMDL was published for a 30-day public notice beginning September 24th, 2007 and ending October 27th, 2007. A press release was sent to all newspapers in the Commonwealth of Kentucky and advertisements were purchased in the newspapers of highest circulation published in Adair, Metcalf and Taylor Counties. Additionally, the press release was distributed electronically through the 'Nonpoint Source Pollution Control' mailing list (http://www.water.ky.gov/sw/nps/Mailing+List.htm) of persons interested in water quality issues as well as the 'Press Release' mailing list maintained by the Governor's Office of media outlets across the Commonwealth.

All comments received during the public notice period have been incorporated into the administrative record for this TMDL. After consideration of each comment received, revisions were made to the final TMDL report and responses were prepared and mailed to each individual/agency participating in the public notice process.

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Appendix 1. Landuse Analysis

The land uses generated by the 2001 NLCD were consolidated for presentation purposes. All forested land (deciduous, evergreen and mixed) and shrubbery was aggregated and reported as one category. Further, all residential landuse area was aggregated and reported as one category; developed land. The NLCD returned small but positive values for three types of residential landuses—Developed Open Space, Low-Intensity Residential, and High-Intensity Residential. Developed Open Space is a term applied to differing types of landuse, within urban areas it is the designation given to parkland and other green areas. However, in rural watersheds such as those found in the majority of the Upper Green River, it denotes residential areas with insufficient density to be classified as Low-Intensity Residential (James Seay, 2006, Personal Communication) but is mainly composed of single family residences on large lots, see Table 76.

Table 76 – National Land-Cover Database Class Descriptions Taken from Homer et. al., 2004.

11. **Open Water** - All areas of open water, generally with less than 25% cover of vegetation or soil.

21. **Developed, Open Space** - Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes

22. **Developed, Low Intensity** - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.

23. **Developed, Medium Intensity** - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.

24**. Developed, High Intensity** - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.

31. **Barren Land (Rock/Sand/Clay)** - Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.

41. **Deciduous Forest** - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.

42. **Evergreen Forest** - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.

43. **Mixed Forest** - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.

52. **Shrub/Scrub** - Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes true shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.

71. **Grassland/Herbaceous** - Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

81. **Pasture/Hay** - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.

82. **Cultivated Crops** - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.

90. **Woody Wetlands** - Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

95. **Emergent Herbaceous Wetlands** - Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Appendix 2. Pathogen Monitoring Data on Pathogen-Impaired Streams From WKU

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
GR-1.0	**Lynn Camp Creek**	37.4052	-85.7039	5/19/2003	520
				9/17/2003	1120
GR-1.1	**Lynn Camp Creek**	37.3521	-85.7102	5/13/2002	>12000
				6/12/2002	480
				7/30/2002	1400
				8/20/2002	344
				9/23/2002	184
				10/29/2002	8400
				5/19/2003	368
				9/17/2003	188
GR-2.1	**Little Russell Creek**	37.2242	-85.5703	5/16/2002	160
				6/18/2002	304
				7/25/2002	256
				8/29/2002	552
				9/30/2002	232
				5/15/2003	1440
				6/17/2003	5000
				7/28/2003	8
				8/27/2003	344
				10/22/2003	77
				11/5/2003	77
GR-3.2	**Big Brush Creek**	37.3338	-85.6362	5/19/2003	432
				6/30/2003	504
				7/29/2003	1080
				8/20/2003	200
				9/17/2003	96
				10/29/2003	100
GR-3.4	**Big Brush Creek**	37.3826	-85.5979	5/23/2002	64
				6/13/2002	1560
				7/31/2002	520
				8/21/2002	608
				9/24/2002	376

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				5/19/2003	304
				10/8/2003	88
GR-3.5	**Brush Creek**	37.3909	-85.6101	5/19/2003	208
				6/30/2003	368
				7/29/2003	456
				8/20/2003	640
				10/8/2003	216
				10/29/2003	18
GR-3.7	**Poplar Grove Br., Upper Brush Creek**	37.4338	-85.5714	6/18/2001	455
				7/19/2001	560
				8/22/2001	72
				9/20/2001	304
				10/29/2001	16
		37.4338	-85.5714	5/19/2003	104
				6/30/2003	224
				7/29/2003	576
				8/20/2003	528
				10/8/2003	64
				10/29/2003	111
GR-3.9	**Little Brush Creek**	37.3342	-85.5913	5/23/2002	1320
				6/13/2002	>12000
				7/31/2002	552
				8/21/2002	512
				9/24/2002	448
				5/19/2003	1680
				10/8/2003	1360
GR-4.1	**Big Pitman Creek**	37.2731	-85.5530	5/21/2002	752
				6/13/2002	2960
				7/31/2002	176
				8/21/2002	200
				9/24/2002	112
				5/20/2003	560
				6/17/2003	6000
				7/29/2003	4800

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				8/20/2003	640
				10/8/2003	224
				10/29/2003	52
GR-4.2	**Big Pitman Creek**	37.3048	-85.5272	5/21/2002	960
				6/13/2002	4200
				7/31/2002	416
				8/21/2002	168
				9/24/2002	480
				5/20/2003	576
				10/8/2003	408
GR-4.3	**Little Pitman Creek**	37.3181	-85.5018	5/21/2002	624
				6/13/2002	7800
				7/31/2002	368
				8/21/2002	400
				9/24/2002	456
				5/20/2003	400
				6/30/2003	560
				7/29/2003	3800
				8/20/2003	672
				10/8/2003	312
				10/29/2003	200
GR-4.4	**Little Pitman Creek**	37.3470	-85.3897	5/21/2002	1280
				6/13/2002	>12000
				7/31/2002	432
				8/21/2002	2600
				9/25/2002	528
				5/20/2003	464
				10/8/2003	160
GR-4.5	**Little Pitman Creek**	37.3515	-85.3749	5/21/2002	1440
				6/13/2002	>12000
				7/31/2002	1240
				8/21/2002	1040
				9/25/2002	720
				5/20/2003	320
				10/8/2003	120

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
GR-4.6	**Big Pitman Creek**	37.3325	-85.5070	5/21/2002	1320
				6/13/2002	5200
				7/31/2002	88
				8/21/2002	56
				9/24/2002	104
				5/20/2003	1080
				10/8/2003	280
GR-4.7	**Big Pitman Creek**	37.3614	-85.4675	5/21/2002	1000
				6/13/2002	3800
				7/31/2002	104
				8/21/2002	240
				9/25/2002	136
				5/20/2003	472
				10/8/2003	320
GR-4.9	**Middle Pitman Creek**	37.3590	-85.4067	5/21/2002	600
				6/13/2002	>12000
				7/31/2002	1400
				8/21/2002	760
				9/25/2002	9200
				5/20/2003	720
				10/8/2003	1600
GR-4.13	**Middle Pitman Creek**	37.3820	-85.3808	6/30/2003	600
				7/29/2003	3800
				8/20/2003	568
				10/8/2003	472
				10/29/2003	373
GR-5.2	**Little Barren River**	37.2263	-85.6774	5/14/2002	7200
				6/18/2002	80
				7/24/2002	304
				8/28/2002	128
				9/26/2002	336
				10/29/2002	11400
				5/15/2003	152
				10/22/2003	66
GR-5.3	**Little Barren River**	37.1700	-85.6474	5/14/2002	8000

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				7/30/2002	80
				8/28/2002	120
				9/30/2002	193
				10/29/2002	3600
				5/15/2003	216
				6/17/2003	>12000
				7/29/2003	6000
				8/27/2003	264
				10/22/2003	95
				11/5/2003	75
GR-5.4	**South Fork Little Barren River**	37.1004	-85.6343	5/14/2002	>12000
				7/30/2002	128
				8/28/2002	104
				9/30/2002	440
				10/29/2002	>12000
				5/15/2003	800
				10/22/2003	56
GR-5.5	**South Fork Little Barren River**	37.0713	-85.6485	5/15/2003	304
				6/17/2003	>12000
				7/29/2003	>12000
				8/27/2003	72
				10/22/2003	164
				11/5/2003	120
GR-5.6	**South Fork Little Barren River**	37.0430	-85.6408	5/15/2003	312
				6/17/2003	>12000
				7/29/2003	>12000
				8/27/2003	272
				10/22/2003	95
				11/5/2003	126
GR-5.7	**South Fork Little Barren River**	37.0338	-85.6563	5/14/2002	2360
				6/18/2002	200
				7/30/2002	392
				8/28/2002	128
				9/30/2002	224
				10/29/2002	>12000

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				5/15/2003	296
				10/22/2003	90
GR-5.8	**South Fork Little Barren River**	36.9738	-85.6030	5/14/2002	680
				6/18/2002	104
				7/30/2002	104
				8/28/2002	200
				9/30/2002	360
				10/29/2002	6600
				5/15/2003	192
				10/22/2003	44
GR-5.9	**East Fork Little Barren River**	37.1011	-85.5992	5/14/2002	800
				6/18/2002	80
				7/30/2002	16
				8/28/2002	7
				9/30/2002	200
				10/29/2002	3400
				5/15/2003	241
				10/22/2003	30
GR-5.10	**East Fork Little Barren River**	37.0668	-85.5610	5/15/2003	88
				6/17/2003	9200
				7/29/2003	>12000
				8/27/2003	16
				10/22/2003	34
				11/5/2003	13
GR-5.11	**East Fork Little Barren River**	36.9439	-85.5011	5/15/2003	184
				6/17/2003	552
				7/29/2003	10200
				8/27/2003	160
				10/22/2003	31
				11/5/2003	282
GR-6.1	**Russell Creek**	37.2238	-85.5114	5/14/2003	152
				10/15/2003	108
GR-6.4	**Big Creek**	37.0624	-85.4295	6/18/2001	255
				7/19/2001	9600
				8/22/2001	8

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				9/20/2001	3440
				10/29/2001	128
		37.0624	-85.4295	5/14/2003	72
				6/16/2003	280
				7/29/2003	9200
				8/27/2003	168
				10/22/2003	191
				11/5/2003	106
GR-6.5	**Russell Creek**	37.1242	-85.4044	5/16/2002	1560
				6/18/2002	312
				7/25/2002	2400
				8/29/2002	608
				9/25/2002	184
				11/6/2002	>12000
				5/14/2003	112
				6/16/2003	9200
				7/28/2003	248
				8/27/2003	312
				10/15/2003	267
				11/5/2003	80
GRBEX-03	**Butlers Fork, Russell Creek**	37.0810	-85.3725	6/18/2001	418
				7/19/2001	440
				8/22/2001	56
				9/20/2001	>12000
				10/29/2001	120
GR-6.6	**Butlers Fork**	37.0810	-85.3725	5/14/2003	168
	GRBEX-03			6/16/2003	1560
				7/29/2003	>12000
				8/27/2003	336
				10/22/2003	102
				11/5/2003	46
GR-6.7	**Pettys Fork, Russell Creek**	37.0974	-85.3340	6/18/2001	491
				7/19/2001	376
				8/22/2001	96

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				9/20/2001	1720
				10/29/2001	40
				5/14/2003	144
				6/16/2003	1560
				7/29/2003	312
				8/27/2003	192
				10/15/2003	275
				11/5/2003	136
GR-6.8	**Russell Creek**	37.1284	-85.3236	5/16/2002	2080
				6/18/2002	648
				7/25/2002	2440
				8/29/2002	512
				9/25/2002	280
				11/6/2002	11000
				5/14/2003	192
				10/15/2003	300
GR-6.9	**Russell Creek**	37.1053	-85.2883	6/18/2001	345
				7/19/2001	1440
				8/22/2001	200
				9/20/2001	840
				10/29/2001	24
				5/16/2002	2080
				6/18/2002	304
				7/25/2002	4800
				8/29/2002	248
				9/25/2002	248
				11/6/2002	6800
				5/14/2003	152
				6/16/2003	5200
				7/28/2003	152
				8/20/2003	576
				10/15/2003	108
				10/29/2003	5600
GR-6.10	**Sulphur Creek**	37.1128	-85.2339	6/18/2001	345
				7/19/2001	216

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				8/22/2001	272
				9/20/2001	>12000
				10/29/2001	72
				5/14/2003	88
				6/16/2003	1480
				7/28/2003	192
				8/20/2003	480
				10/15/2003	175
				10/29/2003	236
GR-6.11	**GR-6.11**	37.0520	-85.2643	6/18/2001	4400
				7/19/2001	>12000
				8/22/2001	>12000
				9/20/2001	>12000
				10/29/2001	392
				5/14/2003	482
				6/30/2003	1320
				7/28/2003	1040
				8/20/2003	1000
				10/15/2003	517
				10/29/2003	3500
GR-6.12	**Russell Creek**	37.0761	-85.1589	5/14/2003	296
				6/16/2003	6000
				7/28/2003	400
				8/20/2003	1200
				10/15/2003	3000
				10/29/2003	6000
GR-8.1	**Green River**	37.2667	-85.8872	5/13/2002	2800
				6/12/2002	88
				7/30/2002	1160
				8/20/2002	104
				9/30/2002	552
				10/29/2002	11600
				5/21/2003	360
				9/17/2003	80
GR-8.2	**Green River**	37.2973	-85.8496	5/13/2002	3160

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				6/12/2002	96
				7/30/2002	680
				8/20/2002	176
				9/30/2002	760
				10/29/2002	>12000
				5/21/2003	360
				9/17/2003	96
GR-8.3	**Green River**	37.3200	-85.7159	5/21/2002	1200
				6/12/2002	248
				7/30/2002	464
				8/20/2002	168
				9/30/2002	448
				10/29/2002	7400
				5/21/2003	1160
				9/17/2003	96
GR-8.7	**Green River**	37.2870	-85.5814	5/22/2002	216
				6/17/2002	160
				7/24/2002	232
				8/22/2002	280
				10/1/2002	280
				11/6/2002	9000
				5/20/2003	464
				10/8/2003	229
GR-8.8	**Green River**	37.2851	-85.5819	5/22/2002	296
				6/17/2002	80
				7/24/2002	248
				8/22/2002	376
				10/1/2002	312
				11/6/2002	>12000
				5/20/2003	456
				10/8/2003	280
GR-8.9	**Green River**	37.2301	-85.5122	5/22/2002	224
				6/17/2002	120
				7/24/2002	184
				8/22/2002	320

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				10/1/2002	450
				11/6/2002	3800
				5/20/2003	200
				10/15/2003	133
GR-8.10	**Green River**	37.2328	-85.5096	5/22/2002	224
				6/17/2002	120
				7/24/2002	304
				8/22/2002	520
				10/1/2002	438
				11/6/2002	2960
				5/20/2003	232
				10/15/2003	133
GR-8.11	**Green River**	37.2539	-85.5025	5/22/2002	328
				6/17/2002	272
				7/24/2002	560
				8/22/2002	1360
				10/1/2002	144
				11/6/2002	1840
				5/21/2003	150
				10/15/2003	150
GR-8.12	**Green River**	37.2452	-85.4797	5/22/2002	720
				6/17/2002	176
				7/24/2002	960
				8/22/2002	312
				10/1/2002	240
				11/6/2002	9000
				5/21/2003	1000
				10/15/2003	442
GR-8.13	**Green River**	37.2350	-85.4250	5/22/2002	304
				6/17/2002	48
				7/24/2002	296
				8/22/2002	192
				9/25/2002	176
				11/6/2002	3080
				5/21/2003	256

WKU Site Code	Stream name	Latitude	Longitude	Date	Fecal Coliform (col/100ml)
				10/15/2003	267
GR-8.14	**Green River**	37.2449	-85.3640	5/22/2002	112
				6/17/2002	8
				7/24/2002	7
				8/22/2002	200
				9/25/2002	80
				11/6/2002	40
				5/21/2003	672
				10/15/2003	17

Appendix 3. Mean Annual Flow Data

Existing loads were determined using the monitoring data collected by WKU. However, there were no stream discharge (i.e., flow) measurements taken with the fecal coliform samples; therefore, an alternate method for calculating loads was necessary. The USGS publishes Mean Annual Flow (MAF) data on the internet via the "Hydrology of Kentucky" geographic data explorer (http://kygeonet.ky.gov/kyhydro/main.htm). The MAF is calculated from multiple regression equations found in the USGS Report "Low-Flow Characteristics of Kentucky Streams" (Martin 2002) for each stream. KDOW adjusted the MAF by either adding or subtracting flow based on any major KPDES dischargers (with flow data obtained from EPA, 2007) or water withdrawals from the receiving stream (no permitted water withdrawals were found for these segments, see KDOW 2008b). The 90th percentile concentration of samples collected in each stream segment (if data were collected from multiple sites, all samples were pooled into one dataset) was used as the existing concentration for the stream segment. Loads were then calculated using Equation 2, in Section 7.2.

Waterbody Name	90th %ile All Samples (col/100ml)	MAF (cfs)	WWTP Discharge (MGD)	Water Withdrawal (MGD)	Adjusted MAF (cfs)
Big Brush Creek of Green River RM 0.0-5.1	792	108.5	0.0	0.0	108.5
Big Brush Creek of Green River RM 7.1-13.0	989	51.3	0.0	0.0	51.3
Big Pitman Creek of Green River RM 13.9-17.8	2872	159.5	0.0	0.0	159.5
Big Pitman Creek of Green River RM 17.8-23.65	2120	76.2	0.0	0.0	76.2
Brush Creek of Big Brush Creek RM 0.0-3.9	548	20.2	0.0	0.0	20.2
East Fork Little Barren River of Little Barren River RM 0.0-15.9	7460	128.2	0.0	0.0	128.2
East Fork Little Barren River of Little Barren River RM 20.7-30.0	5370	6.7	0.0	0.0	6.7
Little Barren River of Green River RM 9.8-15.7	8000	306.8	0.51	0.0	307.6
Little Brush Creek of Big Brush Creek RM 3.2-13.2	5808	32	0.0	0.0	32.0
Little Pitman Creek of Big Pitman Creek RM 0.0-10.1	5000	41.5	4.2	0.0	48.0
Little Pitman Creek of Big Pitman Creek RM 10.1-11.2	5664	16.8	0.0	0.0	16.8

Waterbody Name	90th %ile All Samples (col/100ml)	MAF (cfs)	WWTP Discharge (MGD)	Water Withdrawal (MGD)	Adjusted MAF (cfs)
Little Russell Creek of Green River RM 0.0-5.1	1796	12.3	0.0	0.0	12.3
Lynn Camp Creek of Green River RM 0.0-8.3	9480	45.7	0.0	0.0	45.7
Middle Pitman Creek of Big Pitman Creek RM 0.0-7.7	2520	32.3	0.0	0.0	32.3
Middle Pitman Creek of Big Pitman Creek RM 8.2-10.1	1370	15.5	0.0	0.0	15.5
Russell Creek of Green River RM 7.2-12.8	3900	356.3	1.2	0.0	358.2
Russell Creek of Green River RM 23.8-40.0	2416	255.6	1.2	0.0	257.5
Russell Creek of Green River RM 60.4-66.3	6000	111.7	0.0	0.0	111.7
South Fork Little Barren River of Little Barren River RM 0.0-23.1	12000	135.7	0.51	0.0	136.5
South Fork Little Barren River of Little Barren River RM 23.1-30.1	2456	25.2	0.0	0.0	25.2
Sulphur Creek of Russell Creek RM 0.0-10.7	1480	50.2	0.0	0.0	50.2

Appendix 4. KPDES Discharge Monitoring Data in the Big Pitman Creek Watershed

Results of Quarterly Discharge Monitoring Reports (DMRs) for Campbellsville STP (KY0054437) in the Little Pitman Creek Watershed

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
1/31/2000	2	6
2/29/2000	1	1
3/31/2000	2	3
4/30/2000	2	5
5/31/2000	7	18
6/30/2000	1	15
7/31/2000	11	27
8/31/2000	5	8
9/30/2000	5	21
10/31/2000	4	7
11/30/2000	4	12
12/31/2000	1	3
1/31/2001	1	1
2/28/2001	2	3
3/31/2001	1	2
4/30/2001	4	9
5/31/2001	4	8
6/30/2001	13	21
7/31/2001	3	5
8/31/2001	1	2
9/30/2001	4	7
10/31/2001	8	19
11/30/2001	6	9
12/31/2001	3	18
1/31/2002	2	3
2/28/2002	1	1
3/31/2002	1	2
4/30/2002	2	6

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
5/31/2002	2	4
6/30/2002	5	17
7/31/2002	8	20
8/31/2002	4	7
9/30/2002	2	3
10/31/2002	3	6
11/30/2002	2	7
12/31/2002	1	1
1/31/2003	1	1
2/28/2003	3	8
3/31/2003	1	2
4/30/2003	2	6
5/31/2003	1	3
6/30/2003	2	3
7/31/2003	3	9
8/31/2003	2	7
9/30/2003	3	11
10/31/2003	2	4
11/30/2003	2	7
12/31/2003	2	3
1/31/2004	1	3
2/29/2004	1	2
3/31/2004	1	1
4/30/2004	1	3
5/31/2004	1	2
6/30/2004	2	8
7/31/2004	4	10
8/31/2004	3	9
9/30/2004	3	7
10/31/2004	3	8
11/30/2004	2	2
12/31/2004	2	2
1/31/2005	2	2
2/28/2005	2	2

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
3/31/2005	<2	<2
4/30/2005	2	2
5/31/2005	3	4
6/30/2005	2	3
7/31/2005	3	4
8/31/2005	8	14
9/30/2005	2	4
10/31/2005	2	3
11/30/2005	3	9
12/31/2005	2	2
Percent Exceedances		
	0.0%	0.0%

Appendix 5. KPDES Discharge Monitoring Data in Little Barren River

Results of Quarterly Discharge Monitoring Reports (DMRs) for Edmonton STP (KY0028100) in the Little Barren River Watershed

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
1/31/2000	10	<10
2/29/2000	10	<10
3/31/2000	10	<10
4/30/2000	10	<10
5/31/2000	13	30
6/30/2000	10	<10
7/31/2000	<10	<10
8/31/2000	<23	<600[1]
9/30/2000	<10	<10
10/31/2000	<10	<10
11/30/2000	<10	<10
12/31/2000	<27	250
1/31/2001	<10	<10
2/28/2001	<10	<10
3/31/2001	<15	80
4/30/2001	<10	<10
5/31/2001	<10	<10
6/30/2001	<10	<10
7/31/2001	<10	<10
8/31/2001	<10	<10
9/30/2001	<10	<10
10/31/2001	<10	<10
11/30/2001	<10	<10
12/31/2001	<13	30
1/31/2002	<18	210
2/28/2002	<10	<10
3/31/2002	<10	<10
4/30/2002	<10	10
5/31/2002	<10	<10

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
6/30/2002	<10	<10
7/31/2002	<10	<10
8/31/2002	<10	<10
9/30/2002	<10	<10
10/31/2002	22	280
11/30/2002	<10	<10
12/31/2002	<10	<10
1/31/2003	<10	<10
2/28/2003	<10	<10
3/31/2003	<10	<10
4/30/2003	10	90
5/31/2003	<10	<10
6/30/2003	<16	<600[1]
7/31/2003	30	600[1]
8/31/2003	12	20
9/30/2003	<10	<10
10/31/2003	<10	<10
11/30/2003	<10	<10
12/31/2003	14	30
1/31/2004	<10	<10
2/29/2004	<10	<10
3/31/2004	<10	<10
4/30/2004	<10	<10
5/31/2004	<10	<10
6/30/2004	<10	<10
7/31/2004	<10	<10
8/31/2004	<10	<10
9/30/2004	19	10
10/31/2004	<10	<10
11/30/2004	<10	<10
12/31/2004	11	20
1/31/2005	<10	<10

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
2/28/2005	<10	<10
3/31/2005	<10	<10
4/30/2005	<10	<10
5/31/2005	<10	<10
6/30/2005	11	20
7/31/2005	<10	<10
8/31/2005	<10	<10
9/30/2005	<10	<10
10/31/2005	16	70
11/30/2005	28	600[1]
12/31/2005	<10	<10
Percent Exceedances		
	0.0%	5.6%

[1] This is an Exceedance of permitted limits.

Appendix 6. KPDES Discharge Monitoring Data in the Russell Creek Watershed

Results of Quarterly Discharge Monitoring Reports (DMRs) for Columbia STP (KY0024317) in the Russell Creek Watershed

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
1/31/2000	53	500[1]
2/29/2000	75	>600[1]
3/31/2000	57	>600[1]
4/30/2000	28	>600[1]
5/31/2000	18	110
6/30/2000	27	70
7/31/2000	>157	>600[1]
8/31/2000	<21	200
9/30/2000	<12	20
10/31/2000	<13	30
11/30/2000	<61	390
12/31/2000	33	50
1/31/2001	<25	380
2/28/2001	<10	<10
3/31/2001	<16	100
4/30/2001	>123	>600[1]
5/31/2001	<39	>600
6/30/2001	<10	<10
7/31/2001	<14	40
8/31/2001	<28	200
9/30/2001	<21	30
10/31/2001	<37	>600[1]
11/30/2001	<10	<10
12/31/2001	>33	>600[1]
1/31/2002	<10	<10
2/28/2002	<23	100
3/31/2002	<10	<10
4/30/2002	<28	>600[1]

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
5/31/2002	<30	>600[1]
6/30/2002	<10	<10
7/31/2002	<35	120
8/31/2002	<11	20
9/30/2002	<18	100
10/31/2002	25	70
11/30/2002	12	20
12/31/2002	<10	<10
1/31/2003	<10	<10
2/28/2003	28	>600[1]
3/31/2003	<10	<10
4/30/2003	38	330
5/31/2003	56	370
6/30/2003	38	600[1]
7/31/2003	168	600[1]
8/31/2003	59	360
9/30/2003	48	600[1]
10/31/2003	19	270
11/30/2003	21	60
12/31/2003	10	10
1/31/2004	<10	<10
2/29/2004	<10	<10
3/31/2004	28	150
4/30/2004	59	600[1]
5/31/2004	24	60
6/30/2004	12	20
7/31/2004	16	60
8/31/2004	47	320
9/30/2004	47	600[1]
10/31/2004	42	600[1]
11/30/2004	105	470[1]
12/31/2004	17	40

	Fecal Coliform colonies/100ml	
Reporting Date	**Monthly Average**	**Max Weekly Average**
Permitted Limits	200	400
1/31/2005	17	40
2/28/2005	10	10
3/31/2005	52	290
4/30/2005	33	600[1]
5/31/2005	<10	<10
6/30/2005	32	200
7/31/2005	53	600[1]
8/31/2005	76	600[1]
9/30/2005	45	600[1]
10/31/2005	10	10
11/30/2005	<28	<600[1]
12/31/2005	<10	<10
Percent Exceedances		
	0.0%	33.3%

[1] This is an Exceedance of permitted limits.