

**Total Maximum Daily Load for 15 Fecal Coliform Impaired Stream
Segments in the Upper Green River USGS Hydrologic Unit
05110001**

Final TMDL

February, 2008

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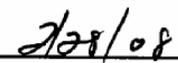
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**Kentucky Department for Environmental Protection
Division of Water**

This report is approved for release



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Water**



Date

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TMDL Synopsis

State: Kentucky

Major River Basin: Green River

HUC8: 05110001

Counties: Adair, Butler, Edmondson, Grayson, Green, Hardin, Hart, Taylor, and Warren

Pollutant of Concern: Pathogens

Impaired Use: Primary Contact Recreation

Impaired Waterbodies for TMDLs (2004 303(d) List):

Waterbody Name	Segment Length (miles)	County	Suspected Source
Big Creek of Russell Creek RM 3.0-8.2	5.2	Adair	Unknown
Big Pitman Creek of Green River RM 0.0-13.6	13.6	Green, Taylor	Unknown
Big Reedy Creek of Green River RM 7.5-13.6	6.1	Butler, Edmondson	Agriculture, Unknown
Billy Creek of Valley Creek RM 0.0-5.9	5.9	Hardin	Unknown
Butler Fork of Russell Creek RM 2.3-4.0	1.7	Adair	Unknown
Casey Creek of Green River RM 3.7-4.7	1.0	Adair	Unknown
Claylick Creek of Green River RM 2.0-3.1	1.1	Warren	Unknown
Glens Fork of Russell Creek RM 0.0-8.0	8.0	Adair	Agriculture, Unknown
Little Barren River of Green River RM 0.0-8.8	8.8	Green, Hart	Unknown
Nolin River of Green River RM 44.0-93.2	49.2	Hart, Hardin, Grayson	Agriculture
Pettys Fork of Russell Creek RM 0.0-6.0	6.0	Adair	Agriculture, Unknown
Poplar Grove Branch of Big Brush Creek RM 0.0-3.0	3.0	Green	Unknown
Russell Creek of Green River RM 40.0-41.5	1.5	Adair	Unknown
Valley Creek of Nolin River RM 0.0-3.5	3.5	Hardin	Unknown
Valley Creek of Nolin River RM 10.3-11.8	1.5	Hardin	Unknown

Note: Suspected sources as identified in the 2004 303(d) Report for Kentucky.

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

TMDL Synopsis

Fecal Coliform Allocation:

TMDL ⁽¹⁾	MOS	WLA		LA ⁽⁵⁾	Percent Reduction ⁽⁶⁾		
		Wastewater ^(2,3)	MS4 ⁽⁵⁾				
Big Creek of Russell Creek RM 3.0-8.2							
96%	See ⁽⁴⁾	Sparksville Grade School KY0026182	6.06×10 ⁷ col/day	0.0 col/day	96%	96%	
Big Pitman Creek of Green River RM 0.0-13.6							
92%	See ⁽⁴⁾	Campbellsville STP KY0054437	6.36×10 ¹⁰ col/day	City of Campbellsville KYG200015	92%	92%	
		Green Co Sanitation District #1 KY0096881	1.51×10 ¹⁰ col/day				
		Total	6.87×10 ¹⁰ col/day				
Big Reedy Creek of Green River RM 7.5-13.6							
82%	See ⁽⁴⁾	0.0 col/day		0.0 col/day	82%	82%	
Billy Creek of Valley Creek RM 0.0-5.9							
85%	See ⁽⁴⁾	0.0 col/day		City of Elizabethtown KYG200035	85%	85%	85%
				Hardin County Fiscal Court KYG200003	85%		
Butler Fork of Russell Creek RM 2.3-4.0							
97%	See ⁽⁴⁾	0.0 col/day		0.0 col/day	97%	97%	
Casey Creek of Green River RM 3.7-4.7							
90%	See ⁽⁴⁾	0.0 col/day		0.0 col/day	90%	90%	
Claylick Creek of Green River RM 2.0-3.1							
97%	See ⁽⁴⁾	0.0 col/day		0.0 col/day	97%	97%	
Glens Fork of Russell Creek RM 0.0-8.0							
97%	See ⁽⁴⁾	0.0 col/day		0.0 col/day	97%	97%	
Little Barren River of Green River RM 0.0-8.8							
84%	See ⁽⁴⁾	Edmonton STP KY0028100	7.72×10 ⁹ col/day	0.0 col/day	84%	84%	
Pettys Fork of Russell Creek RM 0.0-6.0							
79%	See ⁽⁴⁾	0.0 col/day		0.0 col/day	79%	79%	
Poplar Grove Branch of Big Brush Creek RM 0.0-3.0							
37%	See ⁽⁴⁾	0.0 col/day		0.0 col/day	37%	37%	

TMDL ⁽¹⁾	MOS	WLA			LA ⁽⁵⁾	Percent Reduction ⁽⁶⁾	
		Wastewater ^(2,3)		MS4 ⁽⁵⁾			
Russell Creek of Green River RM 40.0-41.5							
93%	See ⁽⁴⁾	0.0 col/day		N/A	N/A	93%	
Nolin River of Green River RM 44.0-93.2							
5.06×10 ¹² col/day	5.06×10 ¹¹ col/day	Elizabethtown STP KY0022039	1.09×10 ¹¹ col/day	City of Elizabethtown KYG200035	1.35×10 ¹¹ col/day	4.43×10 ¹² col/day	79%
		Hodgenville STP KY0026379	1.18×10 ¹⁰ col/day				
		Petro Stopping Center KY0103560	1.36×10 ⁹ col/day				
		Pilot Travel Center #48 KY0080764	1.30×10 ⁹ col/day	Hardin County Fiscal Court KYG200003	2.56×10 ¹¹ col/day		
		Glen Dale Childrens Home KY0073644	3.41×10 ⁸ col/day				
		Glendale Auto Truck Plaza KY0029700	2.27×10 ⁸ col/day				
		Total	1.24×10 ¹¹ col/day				
Valley Creek of Nolin River RM 0.0-3.5							
84%	See ⁽⁴⁾	Elizabethtown STP KY0026182	1.09×10 ¹¹ col/day	City of Elizabethtown KYG200035	84%	84%	84%
				Hardin County Fiscal Court KYG200003	84%		
Valley Creek of Nolin River RM 10.3-11.8							
89%	See ⁽⁴⁾	0.0 col/day		City of Elizabethtown KYG200035	89%	89%	89%
				Hardin County Fiscal Court KYG200003	89%		

Notes:

- (1). TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.
- (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). MOS is both implicit and explicit.
- (5). MS4 WLA and LA are expressed as percent reductions
- (6). Overall reduction to achieve the target of 360 col/100ml.

TMDL Synopsis

KPDES Wastewater Discharges to surface waters addressed in TMDLs:

Facility Name	KPDES No.	Design Flow (MGD)	Permit Limit (col/day)		WLA
			Monthly Avg.	Max Weekly Avg.	
Big Creek of Russell Creek RM 3.0-8.2					
Sparksville Grade School	KY0026182	0.004	200	400	6.06×10 ⁷ col/day
Big Pitman Creek of Green River RM 0.0-13.6					
Campbellsville STP	KY0054437	4.2	200	400	6.36×10 ¹⁰ col/day
Green Co. Sanitation District #1	KY0096881	0.1	200	400	1.51×10 ⁹ col/day
City of Campbellsville	KYG200015	n/a	n/a	n/a	92%
Little Barren River of Green River RM 0.0-8.8					
Edmonton STP	KY0028100	0.51	200	400	7.72×10 ⁹ col/day
Nolin River of Green River RM 44.0-93.2					
Elizabethtown STP	KY0022039	7.2	200	400	1.09×10 ¹¹ col/day
Hodgenville STP	KY0026379	0.78	200	400	1.18×10 ¹⁰ col/day
Petro Stopping Center	KY0103560	0.09	200	400	1.36×10 ⁹ col/day
Pilot Travel Center #48	KY0080764	0.086	200	400	1.30×10 ⁹ col/day
Glen Dale Childrens Home	KY0073644	0.0225	200	400	3.41×10 ⁸ col/day
Glendale Auto Truck Plaza	KY0029700	0.015	200	400	2.27×10 ⁸ col/day
Hardin County Fiscal Court	KYG200003	n/a	n/a	n/a	1.35×10 ¹¹ col/day
City of Elizabethtown	KYG200035	n/a	n/a	n/a	2.56×10 ¹¹ col/day
Valley Creek of Nolin River RM 0.0-3.5					
Elizabethtown STP	KY0022039	7.2	200	400	1.09×10 ¹¹ col/day
Hardin County Fiscal Court	KYG200003	n/a	n/a	n/a	84%
City of Elizabethtown	KYG200035	n/a	n/a	n/a	84%
Valley Creek of Nolin River RM 10.3-11.8					
Hardin County Fiscal Court	KYG200003	n/a	n/a	n/a	89%
City of Elizabethtown	KYG200035	n/a	n/a	n/a	89%

Note:

(1) MS4 WLA is expressed as a percent reduction necessary to meet TMDL not an actual load.

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 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 and 5:031). States are required to develop Total Maximum Daily Loads (TMDLs) for each waterbody that is not meeting WQS. 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 designated uses are met.

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

2.0 Problem Definition

The KDOW identified fifteen (15) waterbodies on the 2004 303(d) Report (KDOW 2005) from the Upper Green River as impaired for primary contact recreation. Waterbodies were identified as first priority for TMDL development if one or more designated uses were identified as nonsupport and second priority if the waterbody partially supports the designated use(s) (Table 1 and Figure 1). The stream segments are impacted by excessive amounts of pathogens entering the stream from both point and nonpoint sources. Fecal coliform bacteria are used as an indicator of the presence of excessive pathogen pollution.

3.0 Physical Setting

The Upper Green River, United States Geological Survey hydrologic unit code 05110001, is located in central Kentucky. It encompasses parts of 17 counties, covers 3173 square miles of land and includes two lakes, 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 increasing the true drainage area of a stream while reducing drainage area to another stream. The KDOW and Kentucky Geological Survey maintain a Karst Atlas of dye tracing data and delineated basins (<http://kygeonet.ky.gov>).

Table 1. Waterbodies Impaired for Primary Contact Recreation in the Upper Green River watershed (USGS HUC 05110001).

Waterbody	River Miles Impaired	Use Support Designation	Impairment	Year Listed	TMDL Priority
Big Creek of Russell Creek	3.0 to 8.2	Nonsupport	Pathogens	2004	First
Big Pitman Creek of Green River	0.0 to 13.6	Partial Support	Pathogens	2004	Second
Big Reedy Creek of Green River	7.5 to 13.6	Nonsupport	Pathogens	2004	First
Billy Creek of Valley Creek	0.0 to 5.9	Nonsupport	Pathogens	2004	First
Butler Fork of Russell Creek	2.3 to 4.0	Nonsupport	Pathogens	2004	First
Casey Creek of Green River	3.7 to 4.7	Partial Support	Pathogens	2004	Second
Claylick Creek of Green River	2.0 to 3.1	Nonsupport	Pathogens	2004	First
Glens Fork of Russell Creek	0.0 to 8.0	Nonsupport	Pathogens	2004	First
Little Barren River of Green River	0.0 to 8.8	Partial Support	Pathogens	2004	Second
Nolin River of Green River	44.0 to 93.2	Nonsupport	Pathogens	2004	First
Pettys Fork of Russell Creek	0.0 to 6.0	Nonsupport	Pathogens	2004	First
Poplar Grove Branch of Big Brush Creek	0.0 to 3.0	Nonsupport	Pathogens	2004	First
Russell Creek of Green River	40.0 to 41.5	Nonsupport	Pathogens	2004	First
Valley Creek of Nolin River	0.0 to 3.5	Nonsupport	Pathogens	2004	First
Valley Creek of Nolin River	10.3 to 11.8	Nonsupport	Pathogens	2004	First

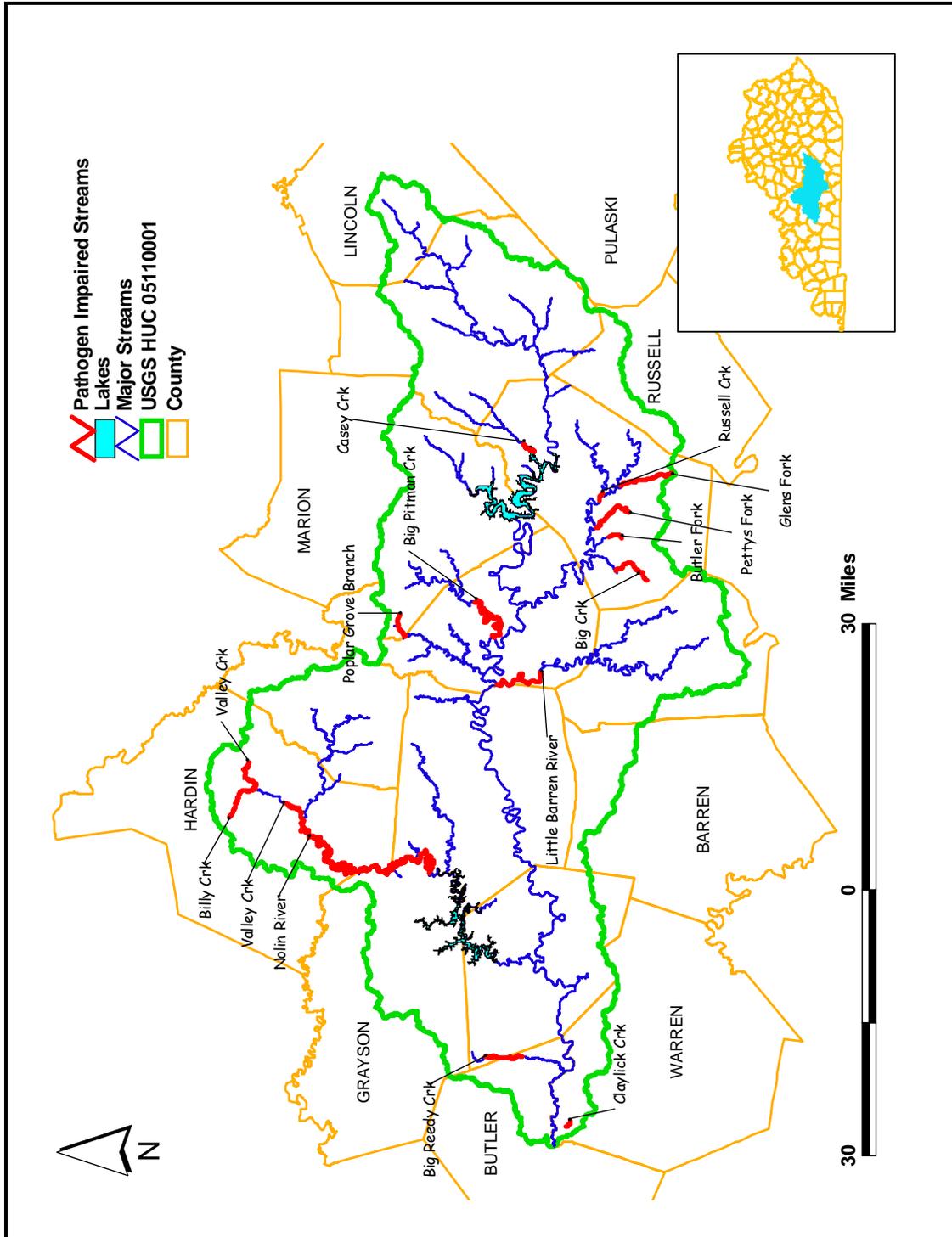


Figure 1. Location Map of Pathogen Impaired Streams in Upper Green River Watershed USGS HUC 05110001

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

Table 2. Land use classification in the Upper Green River (USGS HUC 05110001). Data Generated using NLCD 2001 (USGS 2001).

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

4.0 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 sample 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 (5) year watershed cycle. These are usually located at the downstream reaches of USGS 11-digit HUC (hydrologic unit code) watersheds, and many were coupled with biological sampling and with USGS gauging stations. The KDOW follows water quality sample collection and preservation procedures found in its water quality monitoring SOP (KDOW 2005a).

The Upper Green River was intensively sampled in the 2001 primary contact recreation season (May – October) for pathogens. Additional sampling by Western Kentucky University funded by a 319(h) grant bolstered the KDOW's efforts in the Upper Green. The award of this grant was delayed such that WKU missed the first month of the sampling season and collected in only five (5) months of 2001.

5.0 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. Fecal coliform criteria listed in subsection (2)(a) of this section shall apply during the remainder of the year.”

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 was used as the WQC in order to calculate percent reductions to bring the watershed into compliance with the PCR designated use.

6.0 Source Assessment

There are many sources of pathogens in a watershed, but for regulatory purposes they can be broken into two broad categories; permitted and non-permitted sources. Under the TMDL, a permitted source requires a Kentucky Pollutant Discharge Elimination System (KPDES) permit from the division of water. This will include wastewater treatment facilities that discharge directly to a stream and some stormwater pollution. The KPDES is not the only permitting program that may affect water quality or quantity within a watershed but within the framework of the TMDL process a permitted source is regulated under the KPDES program. Other permitting examples include water withdrawal permits, permits to build structures within a floodplain, and permits to land apply waste from sewage treatment plants. Non-permitted sources are generally the result of runoff from precipitation and they are closely associated with the landuse of the watershed.

6.1 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.”

6.1.1 KPDES Wastewater

The KPDES program permits, in addition to many other types, facilities that treat sanitary wastewater. These facilities can be large publicly owned treatment works (POTW) that service thousands of households and businesses in cities or small, privately operated package facilities that service one business or one residential development. In the impaired watersheds of the Upper Green River, eleven KPDES permitted facilities discharge sanitary wastewater into either one of the impaired segments or a tributary upstream of the impaired segments (Table 3). There are certainly other KPDES wastewater permitted facilities in the impaired watersheds. However, the eleven identified in this report are those that treat sanitary wastewater and thus contribute a pathogen load to the watersheds.

Table 3. KPDES Permitted Facilities in the Upper Green River (USGS HUC 05110001) which have permitted limits for Fecal Coliform.

KPDES Permit Number	Facility Name	TMDL Segment	Design Flow (MGD)	Fecal Coliform Permit Limit (col/100 ml)	
				Monthly Avg.	Max Weekly Avg.
KY0026182	Sparksville Grade School	Big Creek	0.004	200	400
KY0028100	Edmonton STP	Little Barren River	0.51	200	400
KY0024317	Columbia STP	Russell Creek	1.2	200	400
KY0026379	Hodgenville STP	Nolin River	0.78	200	400
KY0029700	Glendale Auto Truck Plaza	Nolin River	0.015	200	400
KY0073644	Glen Dale Children's Home	Nolin River	0.0225	200	400
KY0080764	Pilot Travel Center #48	Nolin River	0.086	200	400
KY0103560	Petro Stopping Center	Nolin River	0.09	200	400
KY0054437	Campbellsville STP	Pittman Creek	4.2	200	400
KY0096881	Green Co. Sanitation District #1	Pittman Creek	0.1	200	400
KY0022039	Elizabethtown STP	Valley Creek	7.2	200	400

6.1.2 KPDES Stormwater

Polluted stormwater runoff is often diverted and concentrated into municipal separate storm sewers (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) stormwater program in 1990. 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 stormwater rule began incorporating small MS4 entities (>50,000 or 1,000 people/mi²) in 1999 with Kentucky's program beginning in 2003. Currently there are 210 communities in Kentucky targeted for the stormwater program. Three communities are located within the Upper Green River Watershed: Hardin County, Elizabethtown and Campbellsville (Table 4). Permitted MS4s are responsible for undertaking a Stormwater Management Program (SWMP) that implements six requirements established by the federal NPDES Stormwater 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 4. KPDES Stormwater Permits within the Impaired Watersheds Watershed.

KPDES Permit Number	Permitted Municipality	Permitted Area
KYG200003	Hardin County Fiscal Court	2.71 mi ²
KYG200035	City of Elizabethtown	14.30 mi ²
KYG200015	City of Campbellsville	3.62 mi ²

6.1.3 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 Kentucky Pollutant Discharge Elimination System (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.

There are no KPDES permitted AFOs in the impaired watersheds.

Operations that are defined as a 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 are two additional requirements that define an operation as a CAFO if either is met: (1) there are more than 300 animal units confined and there is a discharge to the waters of the commonwealth, or (2) there are more than 1,000 animal units confined. The majority of potential CAFOs in Kentucky fall under this latter category.

Animal equivalents for 1,000 animal units follow:

- Beef -- 1,000 head of beef cattle
- Dairy -- 700 head of dairy cattle
- Swine -- 2,500 pigs, each weighing more than 55 pounds
- Poultry -- 125,000 broilers or 82,000 laying hens or pullets

Once defined as a CAFO, the operation can be permitted under a KPDES General Permit or KPDES Individual Permit, depending upon the nature of the operation. Conditions of these permits include no discharge to surface water. The exception is holders of Individual Permits may discharge only during a 25-year storm event. All operations housing between 1,000 and 1,500 animal units are eligible for coverage under a KPDES General Permit with some exceptions:

- CAFOs that are subject to an existing individual KPDES permit.
- CAFOs greater than 1,500 animal units, which are required to submit an application for an individual KPDES permit.

- CAFOs that the division director has determined may be contributing now or could be contributing in the future to a violation of a water quality standard or to the impairment of a 303(d)-listed basin. Such CAFOs are required to submit an application for an individual KPDES permit.
- CAFOs that could discharge into surface water that has been classified as an exceptional or outstanding state or national resource water. Such CAFOs are required to submit an application for an individual KPDES permit (KDOW, 2007b).

There are no permitted CAFOs in the watershed (USEPA, 2007a).

6.2 Non-permitted Sources

Non-permitted sources are generally 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 such sources are not permitted by the KDOW under the KPDES program, their loads to surface water are still regulated by laws such as the Kentucky Agricultural Water Quality Act and the federal Clean Water Act (i.e., the TMDL process), among others. Unlike point sources, nonpoint sources typically discharge pollutants to surface water in response to rain events. Nonpoint sources for pathogens exist in the watershed, and fall into various categories including agriculture, impacts directly attributable to humans (i.e., septic systems), household pets and natural background, which in the case of pathogens in a rural watershed mean wildlife. These nonpoint sources are correlated to landuse.

Another non-permitted source that exists, especially in rural watersheds, are straight pipes, which are discrete conveyances that discharge sewage or gray water (i.e., water from household sinks, laundry, etc.) and stormwater 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 nonpoint source for load allocation purposes within a TMDL. Straight pipes are illegal, as are discharges from failing septic systems.

6.2.1 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 loaf in or near the streams in search of shade or water to drink. Animals grazing in pasturelands will often deposit feces on the land and coliform that does not decay will runoff 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 5. In most counties, cattle are the

dominant livestock. However, there are a few counties with significant poultry operations. These data are based on countywide data, no assumptions are made on a watershed level, however the percentage of agricultural landuse is calculated for each impaired watershed and any known animal feeding operations are identified in Section 8.3.

Table 5. 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
Barren County				
Cattle and Calves	1,574	1,423	89,793	85,102
Beef	1,302	1,170	37,262	34,929
Dairy	167	158	9,631	8,467
Other Cattle	N/A ⁽²⁾	1,225	N/A ⁽²⁾	41,616
Swine	41	24	1,799	793
Poultry	68	58	1,460	1,083,667
Sheep and Lamb	13	17	518	308
Horses	N/A ⁽²⁾	429	N/A ⁽²⁾	2,443
Butler County				
Cattle and Calves	543	458	24,585	19,500
Beef	479	402	10,493	10,691
Dairy	16	6	273	227
Other Cattle	N/A ⁽²⁾	404	N/A ⁽²⁾	8,582
Swine	31	9	22,608	12,778
Poultry	31	23	468,249	407,662
Sheep and Lamb	4	6	78	85
Horses	N/A ⁽²⁾	133	N/A ⁽²⁾	604

	Number of Farms ⁽¹⁾		Inventory	
	1997	2002	1997	2002
Casey County				
Cattle and Calves	953	859	40,102	40,708
Beef	773	722	19,486	20,129
Dairy	113	84	3,324	2,525
Other Cattle	N/A ⁽²⁾	717	N/A ⁽²⁾	18,054
Swine	39	25	10,309	5,622
Poultry	67	58	1,325	3,392
Sheep and Lamb	7	11	104	193
Horses	N/A ⁽²⁾	224	N/A ⁽²⁾	1,288
Edmonson County				
Cattle and Calves	508	423	18,876	19,319
Beef	436	373	9,386	9,089
Dairy	46	19	962	1,332
Other Cattle	N/A ⁽²⁾	355	N/A ⁽²⁾	9,268
Swine	22	8	5,719	92
Poultry	26	22	72,966	4,750
Sheep and Lamb	8	6	448	185
Horses	N/A ⁽²⁾	140	N/A ⁽²⁾	824
Grayson County				
Cattle and Calves	971	946	42,340	39,443
Beef	824	825	21,158	12,293
Dairy	82	46	3,047	2,175
Other Cattle	N/A ⁽²⁾	811	N/A ⁽²⁾	15,975
Swine	52	23	12,711	6,412
Poultry	65	70	623,047	1,113,172
Sheep and Lamb	14	13	447	482
Horses	N/A ⁽²⁾	373	N/A ⁽²⁾	2,128
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

	Number of Farms ⁽¹⁾		Inventory	
	1997	2002	1997	2002
Hardin County				
Cattle and Calves	1,131	1,021	46,186	42,627
Beef	999	922	24,891	23,935
Dairy	62	58	2,035	2,668
Other Cattle	N/A ⁽²⁾	863	N/A ⁽²⁾	18,692
Swine	67	24	12,482	5,685
Poultry	80	72	1,286	199,468
Sheep and Lamb	21	28	651	1,026
Horses	N/A ⁽²⁾	437	N/A ⁽²⁾	2,728
Hart County				
Cattle and Calves	953	913	44,829	48,414
Beef	748	711	20,551	22,591
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
Larue County				
Cattle and Calves	578	565	30,450	28,425
Beef	476	493	13,656	14,199
Dairy	49	49	3,230	2,402
Other Cattle	N/A	470	N/A	11,824
Swine	26	15	2,966	2,284
Poultry	39	37	252	756
Sheep and Lamb	7	11	483	494
Horses	N/A ⁽²⁾	193	N/A ⁽²⁾	1,057
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

	Number of Farms ⁽¹⁾		Inventory	
	1997	2002	1997	2002
Russell County				
Cattle and Calves	639	567	32,446	36,287
Beef	485	442	13,539	13,490
Dairy	78	56	3,410	2,789
Other Cattle	N/A ⁽²⁾	468	N/A ⁽²⁾	20,008
Swine	11	2	651	(D)
Poultry	18	10	267	289
Sheep and Lamb	3	37	3	(D)
Horses	N/A ⁽²⁾	132	N/A ⁽²⁾	676
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)
Poultry	34	25	588 ^d	351 ^d
Sheep and Lamb	9	12	65	258
Horses	N/A ⁽²⁾	183	N/A ⁽²⁾	1,146
Warren County				
Cattle and Calves	1,387	1,179	78,719	67,142
Beef	1,214	1,034	33,376	32,030
Dairy	67	56	4,783	3,490
Other Cattle	N/A ⁽²⁾	955	N/A ⁽²⁾	31,622
Swine	43	19	21,722	27,474
Poultry	48	58	D ⁽³⁾	377,265
Sheep and Lamb	10	18	237	265
Horses	N/A ⁽²⁾	449	N/A ⁽²⁾	3,783

⁽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.

6.2.2 Kentucky No Discharge Operating Permit (KNDOP)

As stated in 401 KAR 5:005, facilities with agricultural waste handling systems or that dispose of their effluent by spray irrigation but do not discharge to surface waters are required to obtain a Kentucky No Discharge Operating Permit (KNDOP) prior to construction and operation. 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 runoff into a stream is prohibited. 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. Also included in KNDOP requirements are golf courses or industrial operations which discharge treated wastewater to ponds on their property.

6.2.3 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. Human waste in the unsewered area must be treated by an OSTDS (Onsite Sewage Treatment and Disposal Systems) or it receives no treatment at all. Onsite sewage treatment and disposal systems (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 nutrients (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water.

The Kentucky Infrastructure Authority compiled a report titled “Water Resource A Strategic Plan for Wastewater Treatment” (KIA 2000) with data from the Regional Area Development Districts (ADD). The current percent of population serviced by sewers (as of 1999) and the estimated number of households serviced by OSTDS were reported. This 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	Onsite Systems
Adair	6,747	26%	5,000
Barren	15,346	45%	8,500
Butler	5,059	20%	3,800
Casey	6,260	15%	5,100
Edmondson	4,648	11%	4,100
Grayson	9,596	25%	7,200
Green	4,706	24%	3,400
Hardin	34,497	65%	11,000
Hart	6,769	25%	5,200
Larue	5,275	25%	4,100
Metcalfe	4,016	17%	3,300
Russell	6,941	22%	5,400
Taylor	9,233	52%	4,500
Warren	35,365	60%	14,000

6.2.4 Household Pets

Although household pets undoubtedly exist in these watershed, their contribution is deemed to be minimal compared to the other sources.

6.2.5 Wildlife

Wildlife undoubtedly contributes pathogens to the watershed, noting the high percentage of forest in all sub-watersheds. Table 7 shows the estimates of deer population and density by county in the Upper Green River 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 contributes pathogens to surface water, such contributions represent natural background conditions.

Table 7. Estimated Deer Population and Density by County (Yancy 2006).

County	Estimated Deer Population	Estimated Deer Density (#/mi ²)
Adair	5,133	14
Barren	3,391	11
Butler	4,596	13
Casey	4,501	11
Edmonson	1,989	11
Grayson	4,862	12
Green	5,668	21
Hardin	6,478	14
Hart	4,562	14
Larue	3,983	23
Metcalf	3,166	12
Russell	1,488	7
Taylor	2,887	12
Warren	3,462	11

8.0 Total Maximum Daily Load

8.1 TMDL Equation and Definitions

A TMDL calculation is performed as follows:

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

Where:

TMDL = the TMDL was defined in Section 5.0 as the loading that is equivalent to a concentration of 400 col/100 ml at a given flow, in units of colonies per day.

WLA = the WasteLoad Allocation, including point sources and other permitted sources such as Municipal Separate Storm Sewer Systems (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. The MOS for these TMDLs was set at 10%.

Target Load = The target load is equivalent to the TMDL minus the MOS or 90% of the TMDL. The target load is then divided between the WLA and LA.

Target Concentration = Another way to determine the target load is to reduce the WQC by 10%, building in the MOS before converting concentrations to loads. The target concentration is also used to calculate percent reductions when loading information is not available.

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.

8.2 TMDL Components

8.2.1 Critical Conditions

The critical condition for wastewater point source loadings from wastewater facilities is typically during periods of low stream flow. This is when dilution of pathogen loading is minimized by low volume in a stream. However, if the KPDES wastewater permits are met exceedances of the primary contact recreation standard should be within acceptable limits as defined in KAR 5:031 7(a). The critical condition for nonpoint source loading is typically associated with a runoff event preceded by an extended period of dry weather. This is especially true in watersheds where rural landuses dominate the land surface. During the dry weather, pathogen-containing wastes builds up on the land and are washed off into the stream during rainfall. The critical period for primary contact recreation is the recreational season of May through October.

8.2.2 Waste Load Allocation

The waste load allocations for streams are calculated using the maximum design flow of the permitted facility and the permit limit for fecal coliform using Equation 4 below:

$$\text{WLA} = \text{Flow (gal/day)} \times \text{Concentration (col/100 ml)} \times 3.875 \text{ L/gal} \times 1000 \text{ ml/L (Equation 2)}.$$

8.2.3 Load Allocation

The load allocations are set as a percent reduction of the existing conditions in the segment using Equation 1 from Section 7.0.

8.2.4 Margin of Safety

There are two methods for incorporating a margin of safety in the TMDL analysis: implicitly include the margin of safety using conservative assumptions, or explicitly set aside a portion of the TMDL as the margin of safety and divide the remainder between the load and waste load allocations. These TMDLs incorporate both an explicit and implicit margin of safety. An explicit margin of safety was integrated in the TMDL by setting the target concentration at 90% (360 col/100ml) of the one-day water quality criterion (400 col/100 ml). An implicit margin of safety was applied by using the 90th percentile concentration of only samples that exceeded the one-day target concentration of 360 col/100ml. This is considered a conservative assumption in that if the 90th percentile concentration were reduced to the target concentration of 360 col/100 ml the instream concentration would only exceed the target value 10% of the time. However, regardless of the procedure used to set the TMDL Target and to estimate percent reductions for each sampling station, reductions from existing conditions ultimately must be effected within the 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 load that meets the WQC.

8.3 Data Analysis

8.3.1 Percent Reduction

The ‘percent reduction’ approach was used to express the TMDL for pathogen-impaired streams in the 14 of the 15 stream segments in the Upper Green River. This approach was selected due to the limited amount of data for each segment. The percent reduction required to meet the acute criterion based on the 90th percentile of coliform concentrations collected during the recreation season that violate the fecal coliform target of 360 colonies/100 ml (90% of the water quality standard). The 90th percentile concentration of exceedances implies that 90 percent of the measured values were lower than this concentration. This approach reasons that if the 90th percentile were reduced to a concentration that meets the WQC, then there would be exceedances only 10% of the time. This percentage satisfies the PCR standard, which allows for 20% exceedances (see Section 5.0). An example calculation is presented in Equation 1 below.

$$\frac{(\text{Existing concentration} - \text{Target Concentration})}{\text{Existing Concentration}} \times 100 = \text{\% Reduction required} \quad \text{Equation 3}$$

8.3.2 Load Duration Curve

The analytical approach used to develop the TMDLs for the Nolin River was the load duration curve (LDC). This method was selected because the KDOW maintains an ambient monitoring station on the Nolin River at KY1866 and a USGS gaging station is located about 0.6 mile downstream. A LDC is a data analysis tool that incorporates the hydrology as well as the concentration (number of fecal coliform colonies/100 ml) to develop existing and allowable

loadings for TMDL development. It is also a graphical representation of the TMDL. The TMDL is represented by a continuous curve and the observed loads are usually point data. Points that plot above the curve are exceeding the TMDL and points below are within the TMDL limits. Loads are calculated using the following equation (Equation 2):

$$\text{Load} = \text{Concentration} * \text{Flow} * \text{Conversion Factor} \quad (\text{Equation 4})$$

Where: Load = billions of colonies/day (col/day)
Concentration = col/100 ml
Discharge = cubic feet/ second (cfs)
Conversion Factor = (28.247L/cf * 86400sec/day * 1000ml/L)/ 100ml

Flow Duration Curve

Before a LDC can be developed a flow duration curve (FDC) must be constructed. A FDC is the graphical display of cumulative frequency distribution of daily flow data. This curve relates the measured discharge at a given site to the percentage of time the measured flow is exceeded (Figure 2). The highest discharge events are plotted on the left side of the curve (since the highest flows are rarely exceeded), while the lowest flows are on the right side (since they are often exceeded). To construct an accurate FDC a long period of flow data is required. There is a long-term record available at the USGS gage on the Nolin River at White Mills. Since the TMDL and sampling was based on the Primary Contact Recreation designated use (which applies during the May – October summer recreational season), only flow data collected between May and October were used in the development of the FDC (Figure 2).

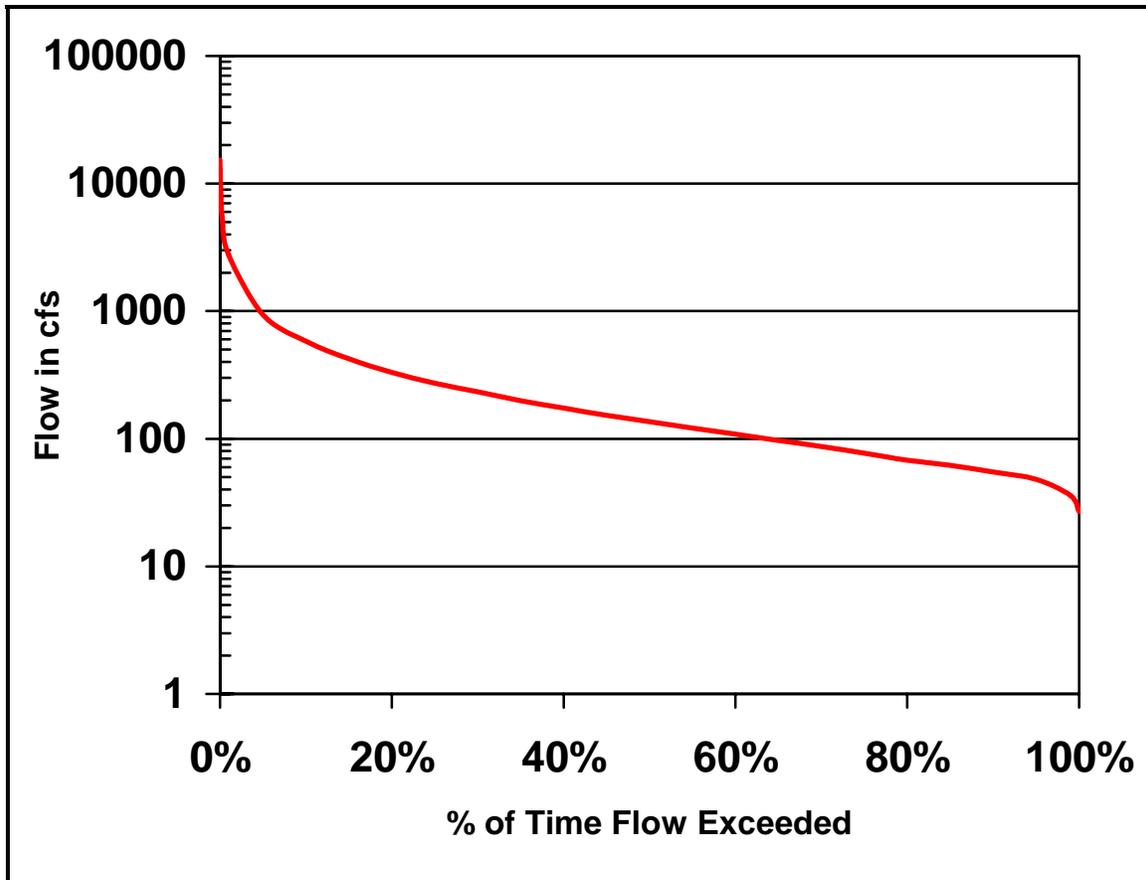


Figure 2. Flow Duration Curve for the Nolin River at White Mills, KY during the Primary Contact Recreation Season (May-Oct) for 1959-2005.

Load Duration Curve

To construct the Load Duration Curve, the discharge values from the flow duration curve intervals are multiplied by the WQC for fecal coliform (400 col/100ml, see Equation 1). The acute criterion for fecal coliform was used because there was not sufficient data collected in the Nolin River to calculate a geometric mean to compare to the chronic criterion (200 col/100 ml as a geometric mean). This line is the TMDL and represents the allowable loading at that particular flow duration interval. The existing loads are calculated using the instream concentration and daily average stream flow observed at the USGS on the day the sample was collected. Observed values are converted into loads using equation 2 and plotted against the curve. Values that exceed the WQC will plot above the curve (Figure 3).

There are many strengths of the LDC method. The method accurately and easily relays information on the allowable and existing loads. It can be used to graphically determine the critical period based on flow conditions. The curve can be divided into flow zones (High, Moist, Mid-Range, Dry and Low). The critical period can be defined as the flow zone where the most exceedances of the WQC occur (Moist Zone of Figure 3) or if exceedances are distributed equally among the zones, the highest deviation from the curve can be considered the critical period. The LDC also allows for the inference of sources of the pollutant. For example, loads that exceed the allowable value in the moist load duration zone would most likely be the result of overland runoff and BMPs (Best Management Practices) could be focused on remediating the

overland flow. This is typical of a watershed dominated by nonpoint sources of pollution. Likewise, if the exceeding loads were observed in the dry flow duration zone then point source discharges, straight pipes and cattle wading in the streams would be candidate sources of bacteria pollution. Table 8 shows some potential implementation options based on the flow duration zones. This table is not exhaustive and is used for illustrative purposes.

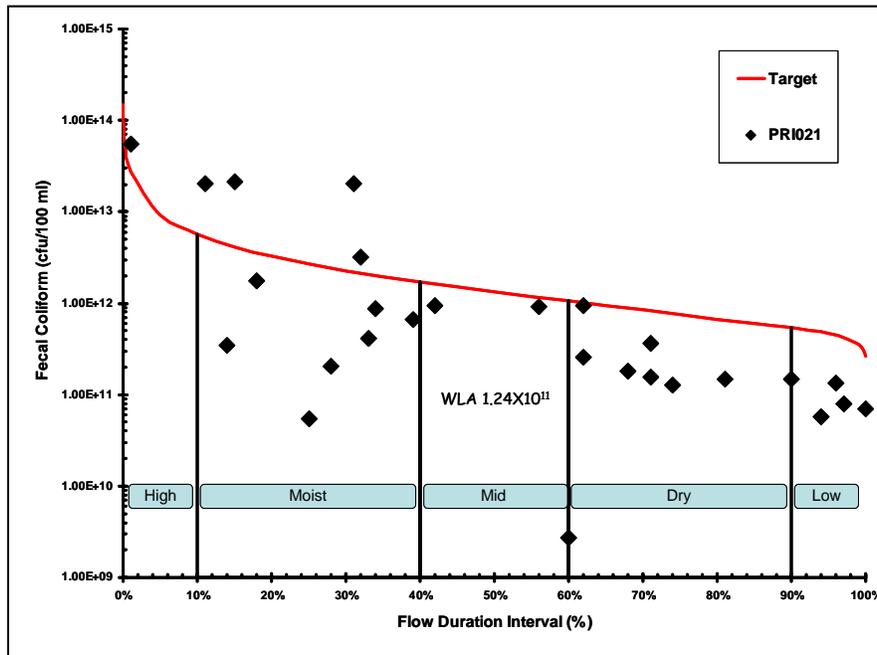


Figure 3. Load Duration Curve for the Nolin River at White Mills, KY during the Primary Contact Recreation Season (May-Oct) for 1959-2005 with samples collected from 1999-2000.

Table 8. Potential Implementation Options by Flow Duration Zone.

	Flow Duration Zone				
	High	Moist	Mid	Dry	Low
Implementation Opportunities	SSO/CSO management			Municipal KPDES	
	On-site Wastewater Management				
	Urban Storm Water Management				
	Pasture Management & Riparian Protection				
	Manure Management				

8.4 Individual Stream Segments

8.4.1 Big Creek of Russell Creek

Big Creek of Russell Creek (Figure 4) is a third order stream in Adair County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 3.0 to 8.2. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summer of 2001 and 2003 (Table 9). There were exceedances in 30.0% (3 of 10) of the samples collected. The 90th percentile

concentration of exceedances was 9520 col/100 ml, which requires a 96% reduction to meet the target concentration of 360 col/100 ml (or 90% of the acute criterion).

Table 9. Results of WKU sampling in Big Creek during the 2001 Recreation Season.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
GRBEX-06 Off Rt. 80 near Gradyville	6/18/2001	255	
	7/19/2001	9600	✓
	8/22/2001	<8	
	9/20/2001	3440	✓
	10/29/2001	128	
	5/14/2003	72	
	6/16/2003	280	
	7/29/2003	9200	✓
	8/27/2003	168	
	10/22/2003	191	
Percent Exceedances			
3/10 = 30.0%			
90th Percentile Concentration (exceedances only)			
9520 col/100 ml			
Percent Reduction to meet target concentration			
$((9520 - 360)/9520) * 100 = 96\%$			

The stream is about 8.3 miles west of Columbia, Kentucky on Highway 80. The watershed for the impaired segment comprises five USGS HUC-14s with a total drainage area of 14.08 square miles. The stream network is 29.55 miles and has an average slope of 0.8%. The landuse in the watershed is predominately forested (73.7%) followed by pasture (20.4%), developed land (4.9%) and row crops (1.0%, Table 10).

Table 10. Land use classification in Big Creek of Russell Creek. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Acres
Forest	73.81	6653.8
Agriculture (total)	19.32	1741.3
Pasture	18.31	1650.8
Row Crop	1.0	90.5
Developed	4.65	418.8
Natural Grassland	2.19	197.0
Wetland	<0.01	0.67
Barren	0.03	2.9

There is one KPDES permitted point source (Sparksville Grade Center, KY0026182) in the upper portion of the Middle Prong sub-watershed (Figure 4). The effluent limits for fecal coliform are a monthly average (geometric mean) of 200 col/100 ml and a maximum weekly average of 400 col/100 ml. The treatment plant has a design capacity of 4000 gallons per day.

The waste load allocation for this facility is 6.06×10^7 col/day (Table 11). The quarterly discharge monitoring data for the period 1/1/2000 – 12/31/2005 have been included in Appendix 3. There have been two (2) exceedances of the monthly average reported and five (5) exceedances of the maximum weekly average reported since 2000. There have been no Notice of Violations (NOVs) issued for exceedances of the fecal coliform criterion in that time. There is also one KNDOP permitted Animal Feeding Operation in the upper portion of the Big Creek watershed (Figure 4).

In summary, the 5.2-mile segment of Big Creek impaired by pathogens will require at least a 96% reduction in pathogen loading to meet water quality standards according to the data presented. Additionally, the treatment system at the Sparksville Grade Center must continue to operate effectively to meet the WLA of 6.20×10^9 col/day.

Table 11. Summary of TMDL Components for Big Creek.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
Sparksville Grade Center	96% ⁽⁵⁾	See ⁽⁶⁾	96%	96%
6.06×10^7 col/day ⁽⁴⁾				

Notes:

- ⁽¹⁾ 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.
- ⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.
- ⁽³⁾ Overall reduction to achieve the target of 360 colonies/100ml.
- ⁽⁴⁾ WLA value based on design flow and acute permit limits and represents the maximum one-day load the facility can discharge.
- ⁽⁵⁾ LA is expressed as a percent reduction
- ⁽⁶⁾ MOS is both implicit and explicit.

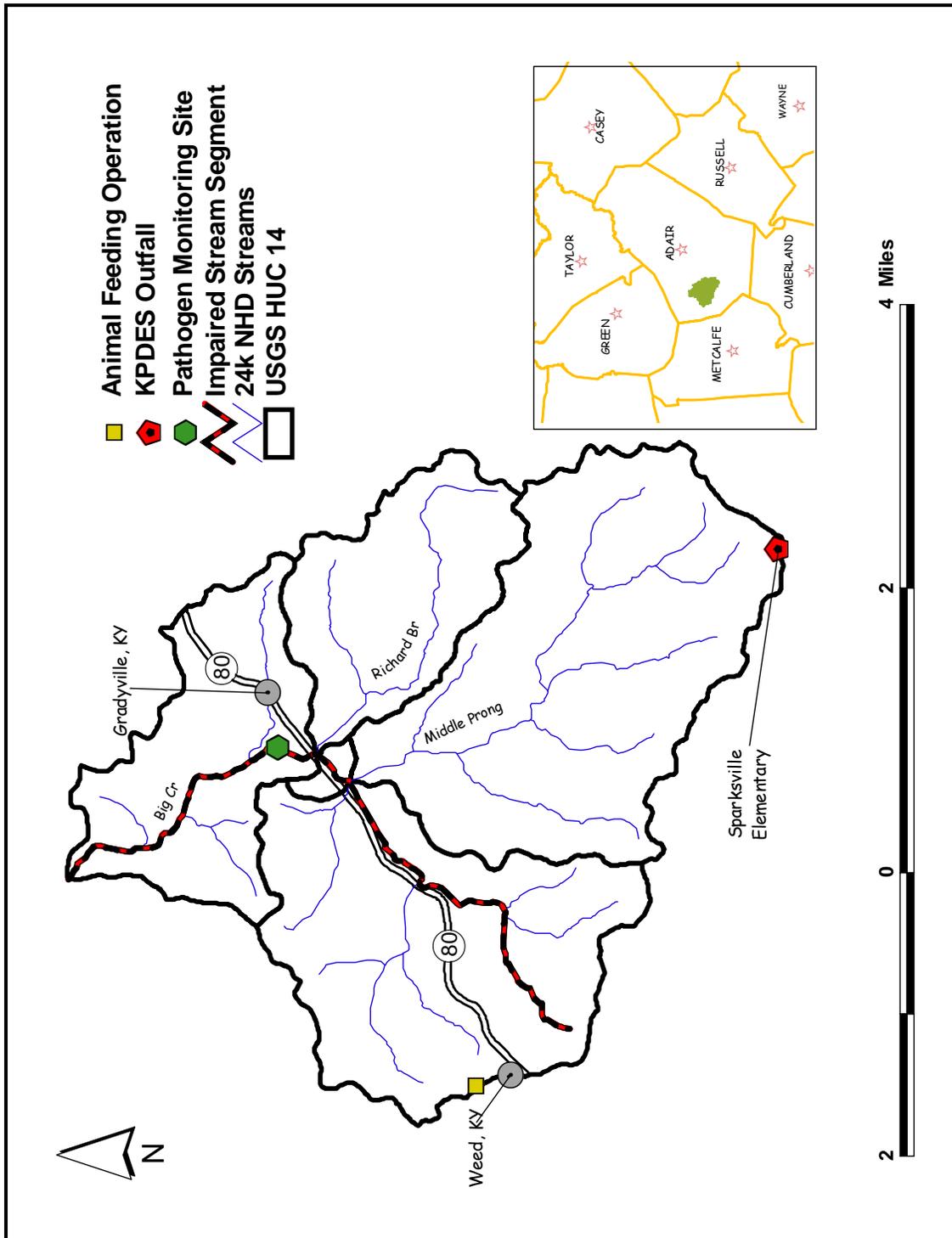


Figure 4. Location map of Big Creek of Russell Creek Including the Impaired Stream Segment and Monitoring Site.

8.4.2 Big Pitman Creek of Green River

Big Pitman Creek of Green River (Figure 5) is a fifth order stream in Green and Taylor Counties that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for partial support of the Primary Contact Recreation designated use in river miles 0.0 to 13.6. This was determined by pathogen monitoring conducted by the KDOW in the summer of 2001 (Table 12) at station GRN025. There were exceedances in 58.3% of the samples collected. The 90th percentile concentration of all exceedances was 4620 col/100 ml, which requires a 92% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 12. Results of WKU sampling in Big Pitman Creek during the 2001 Recreation Season.

Sample Site	Sample Date	Fecal Coliform (col/100ml)	Exceedance
GRN025, GR-4.1 Big Pitman Creek at Montgomery Mill Rd Ford 5 km W of Greensburg	5/9/2001	1600	✓
	6/11/2001	110	
	7/10/2001	440	✓
	8/22/2001	80	
	9/11/2001	70	
	10/10/2001	20	
	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	✓
	8/20/2003	640	✓
	10/8/2003	224	
10/29/2003	52		
GR-4.2 Big Pitman Creek 5km N of Greensburg off Hwy 61	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	✓
Percent Exceedances			
14/24 = 58.3%			
90th Percentile Concentration (exceedances only)			
4620 col/100 ml			
Percent Reduction to meet Target concentration			
$((4620 - 360)/4620) * 100 = 92\%$			

The Big Pitman Creek drainage comprises USGS hydrologic unit 50110001090. It is over 135 square miles and covers portions of Green and Taylor County. The stream network is 306.17 miles long 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 drainage (Table 13).

Table 13. Land use classification in Big Pitman Creek of Green River. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	37.52	50.75
Agriculture (total)	52.57	71.10
Pasture	41.25	55.83
Row Crop	11.29	15.27
Developed	7.61	10.29
Natural Grassland	2.13	2.88
Wetland	0.08	0.11
Barren	0.08	0.82

There are two facilities permitted by KPDES in the Big Pitman Creek Watershed. The Campbellsville sewage treatment plant (KY0054437) is located in the Little Pitman Creek sub-watershed, southeast of where Hwy 210 crosses Little Pitman. It has effluent limits for fecal coliform of 200 col/100 ml as a monthly average (geometric mean) and a maximum weekly average of 400 col/100 ml. The treatment plant has a design capacity of 4.2 MGD (million gallons/day). The waste load allocation for the treatment plant is 6.36×10^{10} col/day (Table 14). The Campbellsville sewage treatment plant 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 criterion in that time. The Green County Sanitation District #1 sewage treatment plant (KY0096881) is located on the mainstem of Big Pitman Creek where Hwy 61 crosses the stream. The effluent limits for fecal coliform are a monthly average (geometric mean) of 200 col/100 ml and a maximum weekly average of 400 col/100 ml. The treatment plant has a design capacity of 0.1 MGD. The waste load allocation for this facility is 1.51×10^9 col/day. The Green County Sanitation District #1 sewage treatment plant quarterly discharge monitoring data for the period 1/1/2000 – 12/31/2005 have also been included in Appendix 2. There have been four (4) exceedances of the monthly average reported and thirty (30) exceedances of the maximum weekly average reported since 2000. There have been no Notice of Violations (NOVs) issued for exceedances of the fecal coliform criterion in that time. Additionally, the City of Campbellsville is a MS4 Permit Holder (KYG200015); therefore, a percent reduction will be assigned to the 3.62 mi² permitted area (Table 14). There are also thirty-four (34) known KNDOP permitted Animal Feeding Operations in the Big Pitman Creek watershed (Figure 5).

Table 14. KPDES Permitted Facilities or Stormwater Entities Located in the Impaired Big Pitman Watershed

Wastewater					
KPDES Permit Number	Facility Name	Watershed	Design Flow (MGD)	Permit Limit (col/100 ml)	Fecal Load (col/day)
KY0022039	Campbellsville STP	Big Pitman	4.2	400	6.36×10^{10}
KY0096881	Green Co. Sanitation District #1	Big Pitman	0.1	400	1.51×10^{10}
Stormwater					
KPDES Permit Number	Stormwater Entity	Watershed	Permitted Area (mi ²)	Permit Limit	Fecal Load (col/day)
KYG200015	City of Campbellsville	Big Pitman	3.62	n/a	n/a

In summary, the 13.6-mile segment of Big Pitman Creek impaired by pathogens will require at least a 76% reduction in pathogen loading to meet water quality standards according to the data presented. The waste load allocation was determined by adding the allocations for the Campbellsville STP and Green Co. Sanitation District #1 STP. It is imperative that both plants meet their respective permitted limits in order for the segment to meet water quality standards (Table 15).

Table 15. Summary of TMDL Components for Big Pitman Creek Watershed

WLA ⁽¹⁾				LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
Wastewater		MS4					
Campbellsville STP	6.36×10^{10} col/day ⁽⁴⁾	City of Campbellsville	92% ⁽⁵⁾	92% ⁽⁵⁾	See ⁽⁶⁾	92%	92%
Green Co. SD#1	1.51×10^9 col/day ⁽⁴⁾						
Total	6.51×10^{10} col/day⁽⁴⁾						

Notes:

- (1). 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.
- (2). TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.
- (3). Overall reduction to achieve the target of 360 col/100ml.
- (4). Wastewater WLA value based on design flow and acute permit limits and represents the maximum one-day load the facility can discharge.
- (5). MS4 WLA and LA are expressed as percent reductions
- (6). MOS is both implicit and explicit.

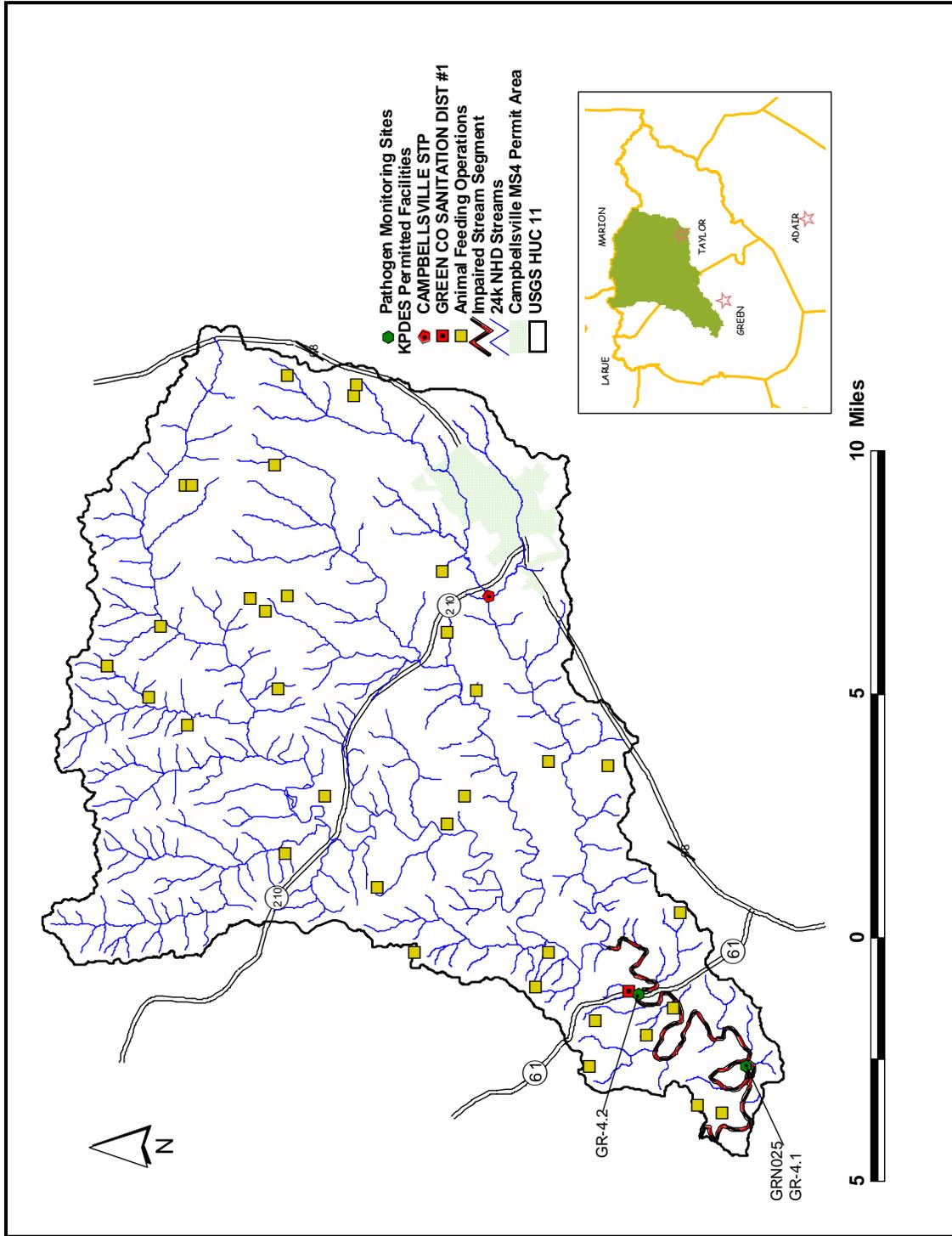


Figure 5. Location map of Big Pitman Creek of Green River Including the Impaired Stream Segment and Monitoring Site.

8.4.3 Big Reedy Creek of Green River

Big Reedy Creek of Green River (Figure 6) is a fourth order stream in Butler and Edmonson Counties that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 7.5 to 13.6. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summer of 2001 (Table 16). There were exceedances in 60.0% of the samples collected. The 90th percentile concentration of all exceedances was 2272 col/100 ml, which requires an 82% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 16. Results of WKU sampling in Big Reedy Creek during the 2001 Recreation Season.

Sample Site	Sample Date	Fecal Coliform (col/100ml)	Exceedance
GRBEX-09 Rte. 238, 4 km NNW Roundhill	6/19/2001	1309	✓
	7/24/2001	56	
	8/29/2001	2200	✓
	9/25/2001	168	✓
	10/23/2001	424	
Percent Exceedances			
3/5 = 60.0%			
90th Percentile Concentration (exceedances only)			
2022 col/100 ml			
Percent Reduction to meet Target concentration			
$((2022 - 360)/2022) * 100 = 82\%$			

The stream is just east of Roundhill, Kentucky and runs nearly parallel to Highway 185 through parts of Butler, Edmonson and Grayson counties. The watershed for the impaired segment comprises USGS HUC-11 05110001280 with a total drainage area of 41.41 square miles. The stream network is 87.61 miles and has an average slope of 0.27%. The landuse in the watershed is predominately forested (74.12%) followed by pasture (10.09%), natural grassland (6.74%), row crop (6.17%), and developed land (2.42%). There is less than one percent wetland and man made barren land in the watershed (Table 17).

Table 17. Land use classification in Big Reedy Creek of Green River. Data Generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	74.12	30.63
Agriculture (total)	16.26	6.71
Pasture	10.09	4.17
Row Crop	6.17	2.55
Developed	2.42	1.00
Natural Grassland	6.74	2.78
Wetland	0.45	0.19
Barren	0.01	<0.01

There are no known point sources in the watershed; therefore, the entire load is allocated to nonpoint sources. There are two KNDOP permitted animal feeding operations in the watershed. Based on the monitoring data available in Big Reedy Creek at least an 82% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 18).

Table 18. Summary of TMDL Components for Big Reedy Creek.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
0.0 col/day	82% ⁽⁴⁾	See ⁽⁵⁾	82%	82%

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml.

⁽⁴⁾ LA is expressed as a percent reduction

⁽⁵⁾ MOS is both implicit and explicit.

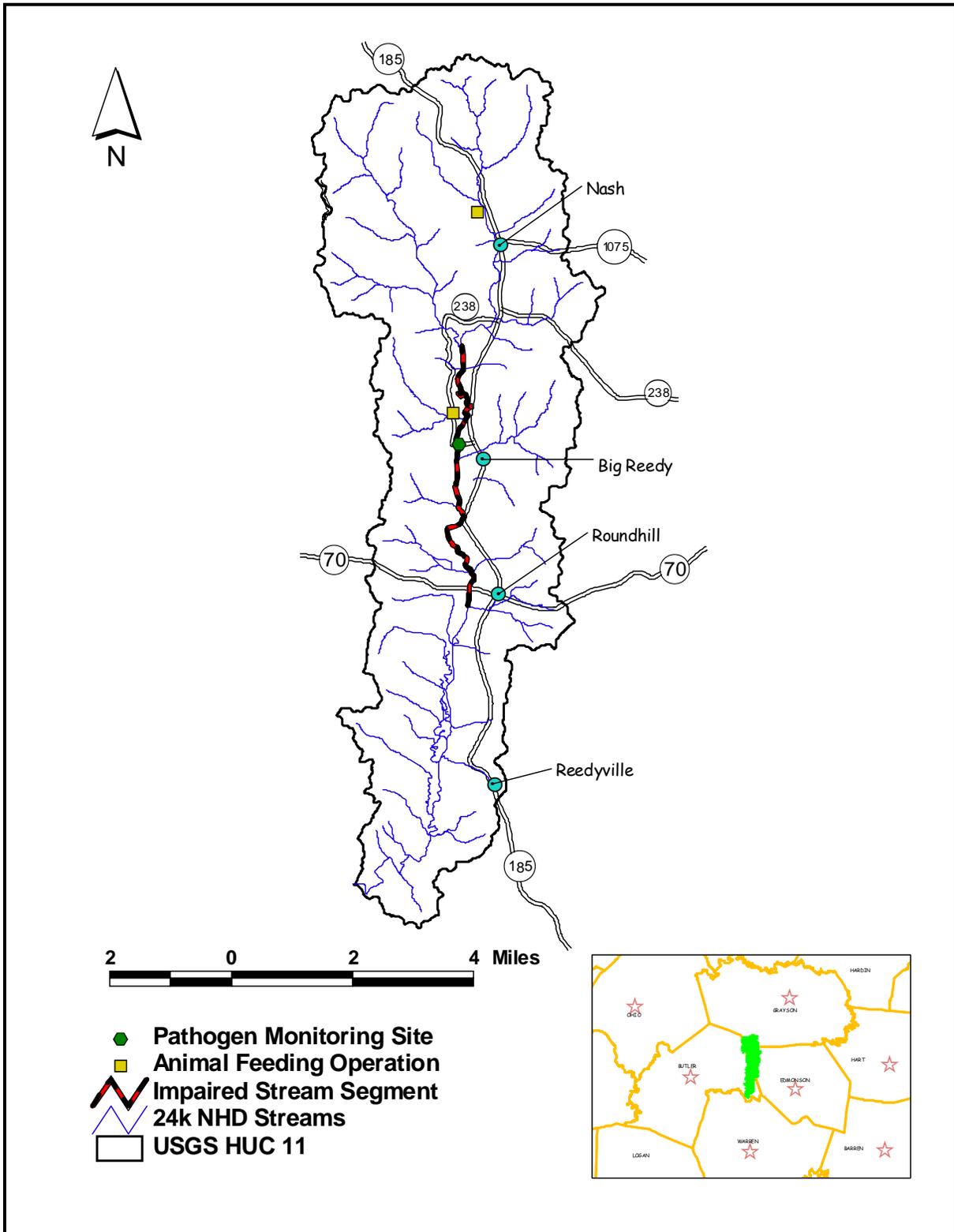


Figure 6. Location map of Big Reedy Creek of Green River Including the Impaired Stream Segment and Monitoring Site.

8.4.4 Billy Creek of Valley Creek

Billy Creek of Valley Creek (Figure 7) is a fourth order stream in Hardin County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 0.0 to 5.9. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summer of 2001 (Table 19). There were exceedances in 60.0% of the samples collected. The 90th percentile concentration of all exceedances was 2408 col/100 ml, which requires an 85% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 19. Results of WKU sampling in Billy Creek during the 2001 Recreation Season.

Sample Site	Sample Date	Fecal Coliform (col/100ml)	Exceedance
FC-G51 Peterson Drive	6/18/2001	509	✓
	7/19/2001	40	
	8/22/2001	1160	✓
	9/20/2001	2720	✓
	10/31/2001	136	
Percent Exceedances			
3/5 = 60.0%			
90th Percentile Concentration (exceedances only)			
2408 col/100 ml			
Percent Reduction to meet Target concentration			
$((2408 - 360)/2408) * 100 = 85\%$			

The watershed is located just west of Elizabethtown, Kentucky. In fact, the lower portions of the watershed lie within the incorporated city limits. The watershed for the impaired segment comprises one USGS HUC-14 (05110001200060) with a total drainage area of 13.5 square miles. The stream network is 47.85 miles and has an average slope of 0.38%. The landuse in the watershed is predominately pasture (48.21%) followed by forest (22.73%), row crops (16.06%), developed land (12.7%). Less than one percent of the total landuse is in natural grassland, wetland or barren (Table 20). This watershed lies in the Mitchell Plain level IV ecoregion. This makes it particularly vulnerable due to the presence of karst geology.

Table 20. Land use classification in Billy Creek of Valley Creek. Data Generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Acres
Forest	22.73	1960.40
Agriculture (total)	64.28	5544.50
Pasture	48.21	4158.99
Row Crop	16.06	1385.51
Developed	12.70	1095.74
Natural Grassland	0.21	18.24
Wetland	0.02	1.56
Barren	0.00	0.00

There are two KPDES stormwater permitted entities within the Billy Creek watershed: the City of Elizabethtown (KYG200035) and Hardin County Fiscal Court (KYG200003, Table 21). Therefore, the percent reduction will be applied to both the WLA (for MS4 areas) and the LA (for all other area). There are also two KNDOP permitted animal feeding operations in the watershed. Based on the monitoring data available in Billy Creek, at least an 85% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 22).

Table 21. MS4 Stormwater Permits within the Billy Creek Watershed.

KPDES Permit Number	Permitted Municipality	Permitted Area
KYG200035	City of Elizabethtown	1.05 mi ²
KYG200003	Hardin County Fiscal Court	0.63 mi ²

Table 22. Summary of TMDL Components for Billy Creek.

Wastewater	WLA ⁽¹⁾		LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
	MS4					
0.0 col/day ⁽⁴⁾	City of Elizabethtown	85% ⁽⁴⁾	85% ⁽⁴⁾	See ⁽⁵⁾	85%	85%
	Hardin Co Fiscal Court	85% ⁽⁴⁾				

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml.

⁽⁴⁾ WLA value based on design flow and acute permit limits and represents the maximum one-day load the facility can discharge.

⁽⁴⁾ MS4 and LA are expressed as percent reductions

⁽⁵⁾ MOS is both implicit and explicit.

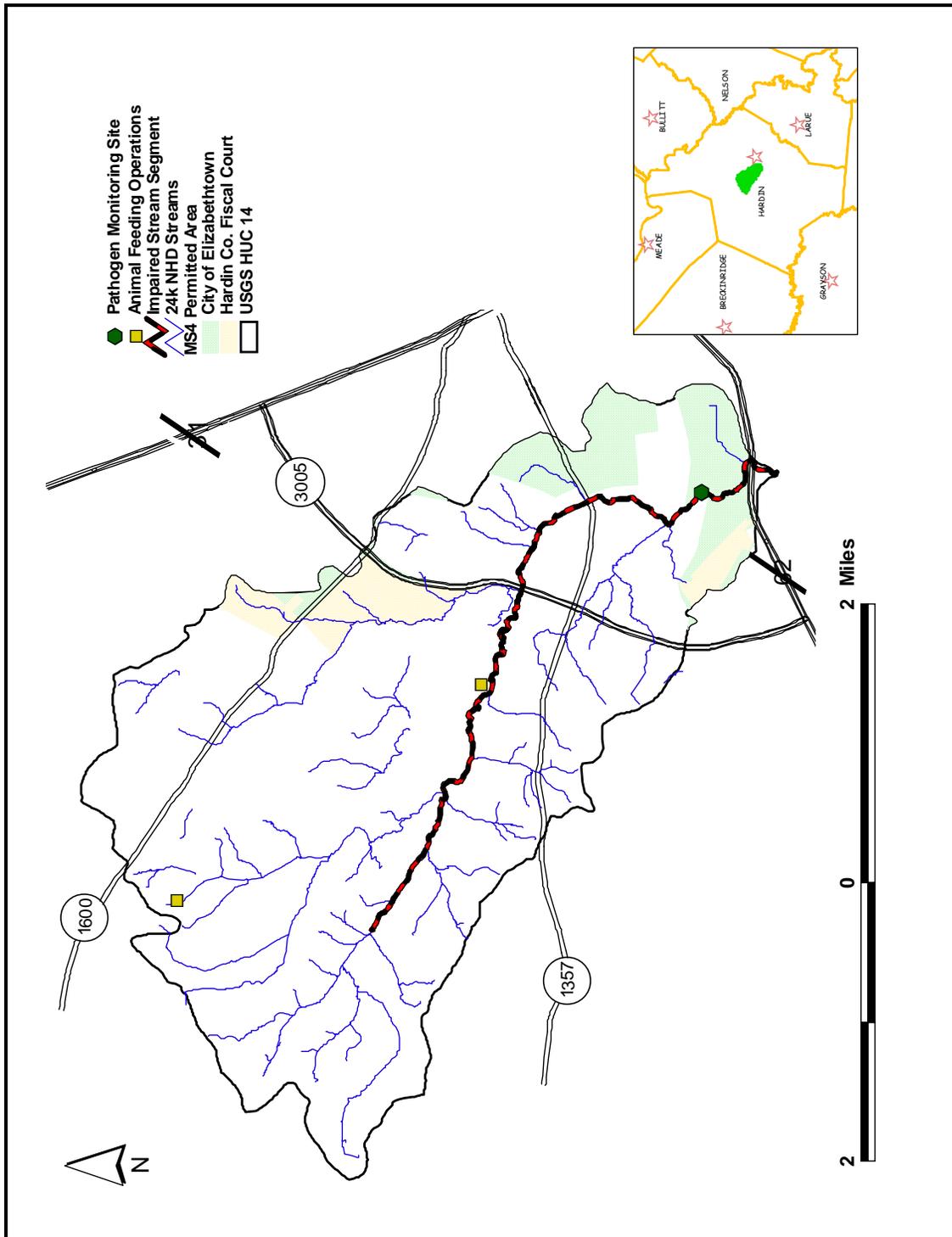


Figure 7. Location map of Billy Creek of Valley Creek Including the Impaired Stream Segment and Monitoring Site.

8.4.5 Butler Fork of Russell Creek

Butler Fork of Russell Creek (Figure 8) is a fourth order stream in Adair County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 2.3 to 4.0. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summer of 2001 (Table 23). There were exceedances in 50.0% of the samples collected. The 90th percentile concentration of all exceedances was 12000 col/100 ml, which requires a 97% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 23 Results of WKU sampling in Butler Fork during the 2001 Recreation Season.

Sample Site	Sample Date	Fecal Coliform (col/100ml)	Exceedance
GRBEX-03	6/18/2001	418	✓
	7/19/2001	440	✓
	8/22/2001	56	
	9/20/2001	>12000	✓
	10/29/2001	120	
	5/14/2003	168	
	6/16/2003	1560	✓
	7/29/2003	12000	✓
	8/27/2003	336	
	10/22/2003	102	
Percent Exceedances			
5/10 = 50.0%			
90th Percentile Concentration (exceedances only)			
12000 col/100 ml			
Percent Reduction to meet Target concentration			
$((12000 - 360)/12000) * 100 = 97\%$			

The stream is about 3.9 miles west of Columbia, Kentucky on Highway 80. The watershed of the impaired segment comprises one USGS HUC-14 (05110001070480) with a total drainage area of 9.46 square miles. The stream network is 19.64 miles and has an average slope of 0.58%. The landuse in the watershed is predominately pasture (53.21%) followed by forest (37.92%), and developed (7.81%, Table 24).

Table 24. Land use classification in Butler Fork of Russell Creek. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Acres
Forest	37.92	2289.77
Agriculture (total)	53.21	3212.93
Pasture	53.21	3212.93
Row Crop	0.00	0.00
Developed	7.81	471.70
Natural Grassland	1.01	1.01
Wetland	0.03	1.56
Barren	0.00	0.00

There are no known point sources in the watershed; therefore, the entire load is allocated to nonpoint sources. There are four KNDOP permitted animal feeding operations in the watershed. Based on the monitoring data available in Butler Fork at least a 97% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 25).

Table 25. Summary of TMDL Components for Butler Fork.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
0.0 col/day	97% ⁽⁴⁾	See ⁽⁵⁾	97%	97%

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml.

⁽⁴⁾ LA is expressed as a percent reduction

⁽⁵⁾ MOS is both implicit and explicit.

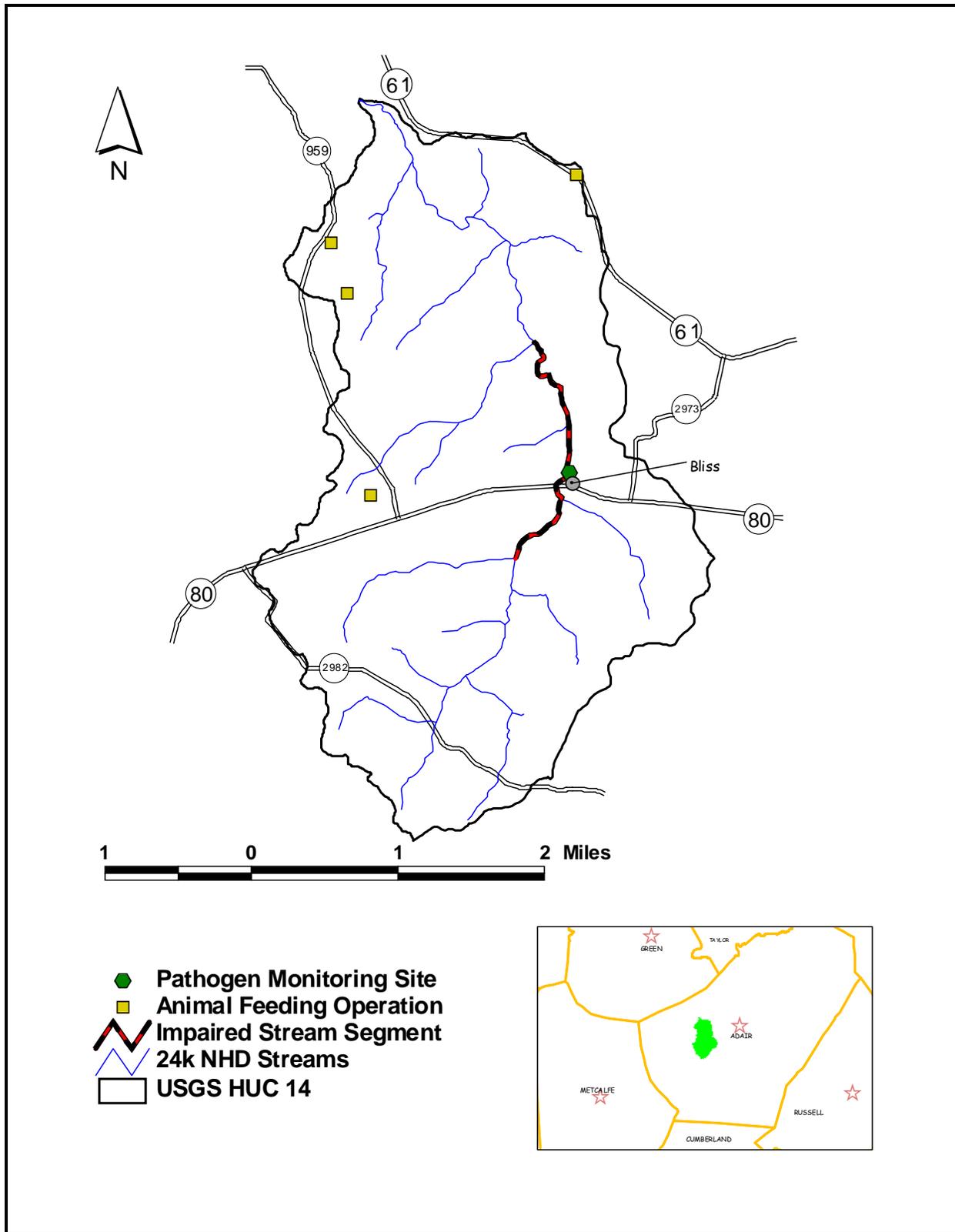


Figure 8. Location map of Butler Fork of Russell Creek Including the Impaired Stream Segment and Monitoring Site.

8.4.6 Casey Creek of Green River

Casey Creek of Green River (Figure 9) is a fifth order stream in Adair and Casey Counties that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for partial support of the Primary Contact Recreation designated use in river miles 3.7 to 4.7. This was determined by pathogen monitoring conducted by KDOW in the summer of 2001 (Table 26). There were exceedances in 28.6% of the samples collected. The 90th percentile concentration of all exceedances was 3775 col/100 ml, which requires a 90% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 26. Results of WKU sampling in Casey Creek during the 2001 Recreation Season.

Sample Site	Sample Date	Fecal Coliform (col/100ml)	Exceedance
GRN026 Casey Creek near Knifely	5/9/2001	1750	✓
	6/13/2001	110	
	7/9/2001	4000	✓
	7/10/2001	30	
	8/21/2001	60	
	9/10/2001	10	
	10/9/2001	100	
Percent Exceedances			
2/7 = 28.6%			
90th Percentile Concentration (exceedances only)			
3775 col/100ml			
Percent Reduction to meet Target concentration			
$((3775 - 360)/3775) * 100 = 90\%$			

The stream is about 11 miles southeast of Campbellsville, Kentucky near the community of Knifely. The watershed of the impaired segment comprises USGS HUC-11 05110001030 with a total drainage area of 93.57 square miles. The stream network is 265.5 miles and has an average slope of 0.49%. The landuse in the watershed is predominately forested (63.57%) followed by pasture (25.23%), row crops (4.06%), natural grassland (3.73%) and developed land (1.0%, Table 27).

Table 27. Land use classification in Casey Creek of Green River. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	63.57	59.11
Agriculture (total)	29.29	27.23
Pasture	25.23	23.46
Row Crop	4.06	3.77
Developed	3.34	3.10
Natural Grassland	3.73	3.47
Wetland	0.04	0.04
Barren	0.04	0.03

There are no known point sources in the watershed; therefore, the entire load is allocated to nonpoint sources. There are fifteen KNDOP permitted animal feeding operations in the watershed. Based on the monitoring data available in Casey Creek at least a 90% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 28).

Table 28. Summary of TMDL Components for Casey Creek.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
0.0 col/day	90% ⁽⁴⁾	See ⁽⁵⁾	90%	90%

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml.

⁽⁴⁾ LA is expressed as a percent reduction

⁽⁵⁾ MOS is both implicit and explicit.

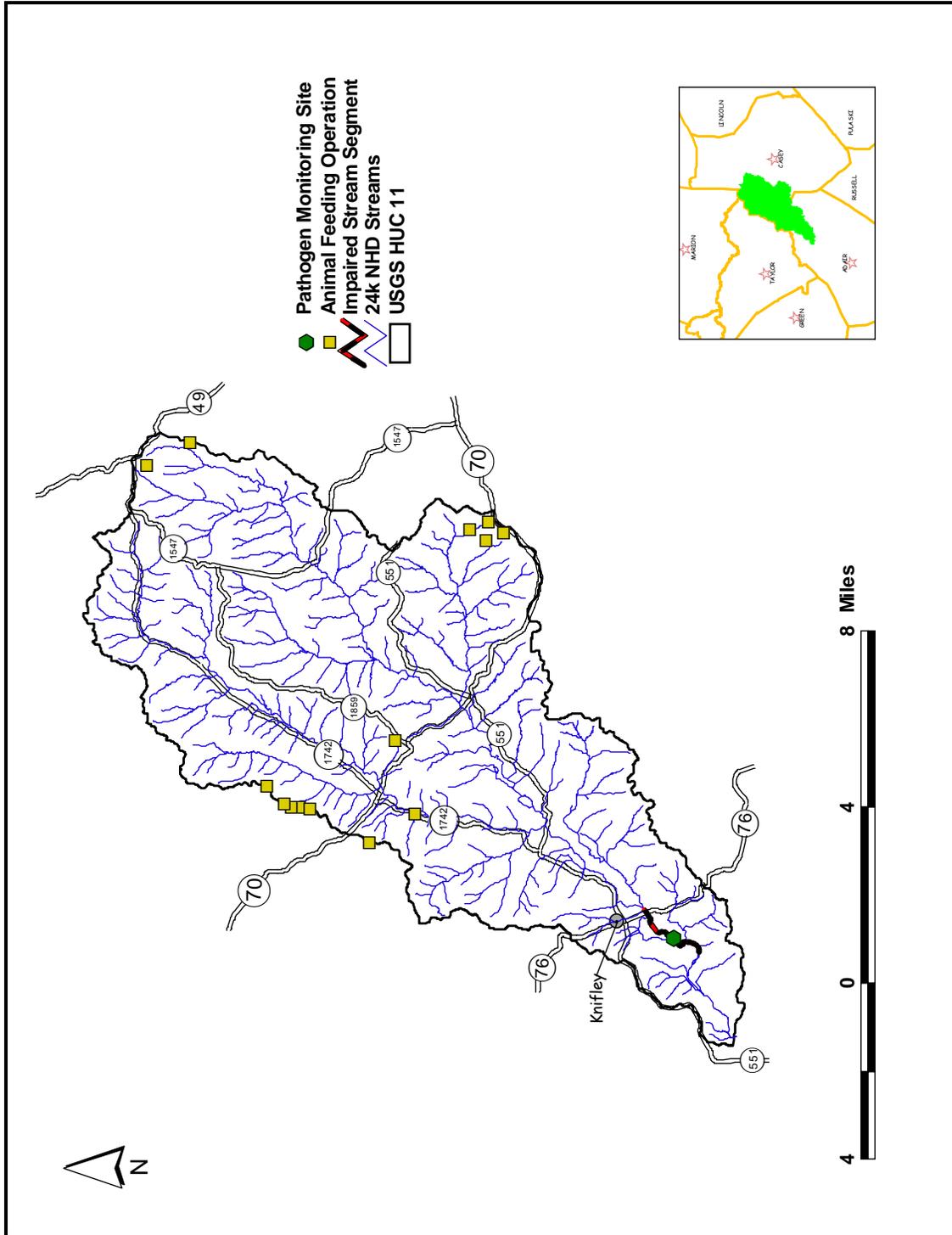


Figure 9. Location map of Casey Creek of Green River Including the Impaired Stream Segment and Monitoring Site.

8.4.7 Claylick Creek of Green River

Claylick Creek of Green River (Figure 10) is a second order stream in Warren County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 2.0 to 3.1. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summer of 2001 (Table 29). There were exceedances in 40.0% of the samples collected. The 90th percentile concentration of all exceedances was 10,884 col/100 ml, which requires a 97% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 29. Results of WKU sampling in Claylick Creek during the 2001 Recreation Season.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
GRBEX-10	6/19/2001	119	
	7/24/2001	840	✓
Old Rte. 263, 3 km W Riverside	8/29/2001	>12000	✓
	9/25/2001	72	
	10/23/2001	72	
Percent Exceedances			
2/5 = 40%			
90th Percentile Concentration (exceedances only)			
10,884 col/100 ml			
Percent Reduction to meet Target concentration			
$((10,884 - 360)/10,884) * 100 = 97\%$			

The stream is about 5.9 miles southeast of Morgantown, Kentucky. The watershed of the impaired segment comprises USGS HUC-11 05110001300 with a total drainage area of 9.6 square miles. The stream network is 17.91 miles and has an average slope of 0.37%. The landuse in the watershed is predominately forested (55.0%) followed by pasture (22.58%), row crops (9.25%), natural grassland (8.78%) and developed land (4.26%, Table 30).

Table 30. Land use classification in Claylick Creek of Green River. Data Generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Acres
Forest	55.00	3379.28
Agriculture (total)	31.83	1955.73
Pasture	22.58	1387.52
Row Crop	9.25	568.22
Developed	4.26	261.98
Natural Grassland	8.78	539.53
Wetland	0.11	6.67
Barren	0.01	0.67

There are no known point sources in the watershed; therefore, the entire load is allocated to nonpoint sources. There are three KNDOP permitted animal feeding operations in the watershed. Based on the monitoring data available in Claylick Creek at least a 97% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 31).

Table 31. Summary of TMDL Components for Claylick Creek.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
0.0 col/day	97% ⁽⁴⁾	See ⁽⁵⁾	97%	97%

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml.

⁽⁴⁾ LA is expressed as a percent reduction

⁽⁵⁾ MOS is both implicit and explicit.

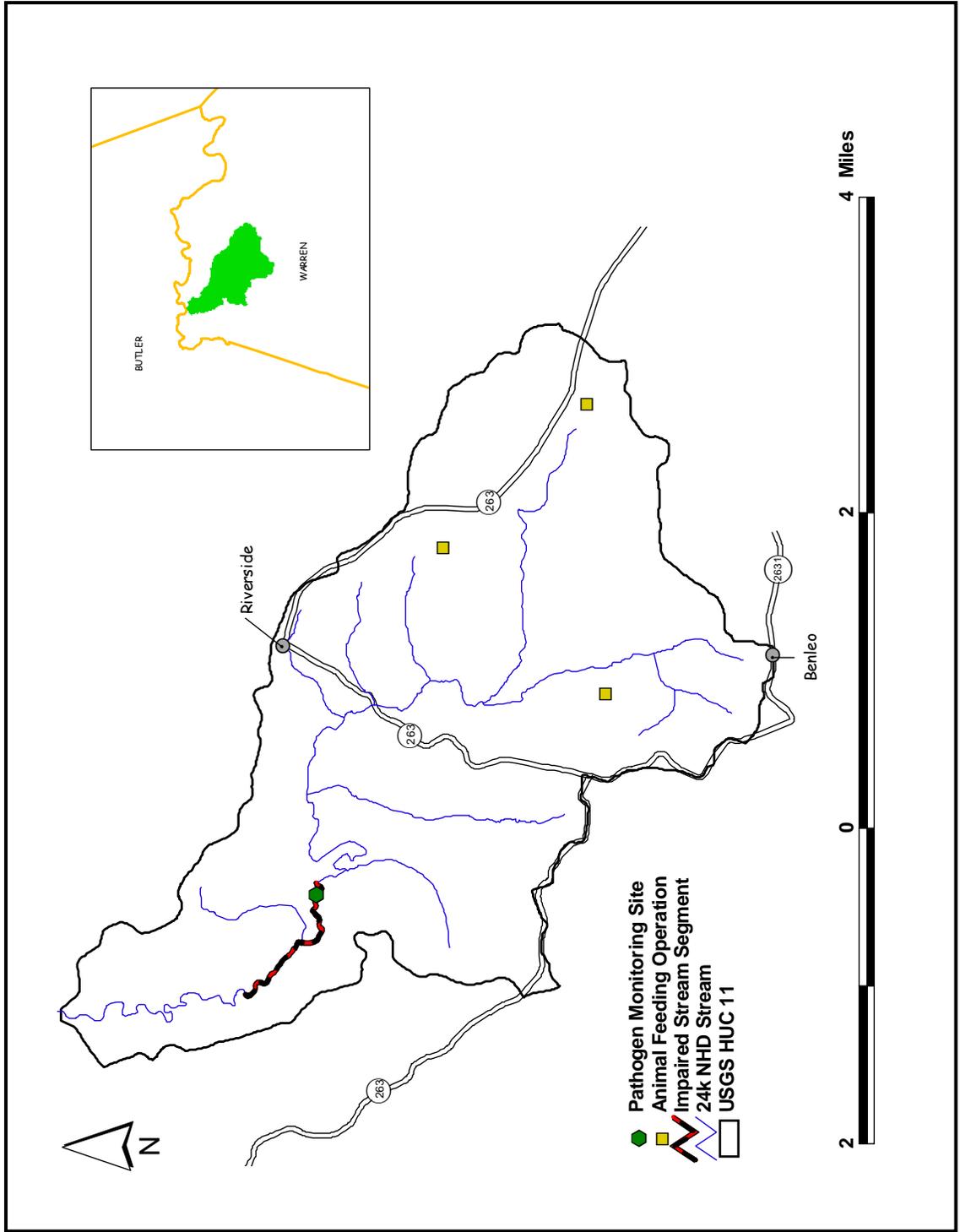


Figure 10. Location map of Claylick Creek of Green River Including the Impaired Stream Segment and Monitoring Site.

8.4.8 Glens Fork of Russell Creek

Glens Fork of Russell Creek (Figure 11) is a fourth order stream in Adair County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 0.0 to 8.0. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summer of 2001 and 2003 (Table 32). There were exceedances in 90.9% of the samples collected. The 90th percentile concentration of all exceedances was 12,000 col/100 ml, which requires a 97% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 32. Results of WKU sampling in Glens Fork during the 2001 Recreation Season.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
GRBEX-01 Rte. 55, 6 km SE Columbia	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	✓
Percent Exceedances			
10/11 = 90.9%			
90th Percentile Concentration (exceedances only)			
12,000 col/100 ml			
Percent Reduction to meet Target concentration			
$((12,000 - 360) / 12,000) * 100 = 97\%$			

The stream is about 2 miles south of Columbia, Kentucky on Highway 55. The watershed for the impaired segment comprises five USGS HUC 14s with a total drainage area of 14.1 square miles. The stream network is 26.25 miles and has an average slope of 0.53%. The landuse in the watershed is predominately pasture (49.41) followed by forest (35.46%), row crops (8.34%) and developed land (5.2%, Table 33).

Table 33. Land use classification in Glens Fork of Russell Creek. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Acres
Forest	35.46	3200.69
Agriculture (total)	57.75	5212.47
Pasture	49.41	4460.11
Row Crop	8.34	752.36
Developed	5.20	469.03
Natural Grassland	0.90	81.62
Wetland	0.01	0.67
Barren	0.61	55.15

There are no known point sources in the watershed; therefore, the entire load is allocated to nonpoint sources. There are eight KNDOP permitted animal feeding operations in the watershed. Based on the monitoring data available in Glens Fork at least a 97% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 34).

Table 34. Summary of TMDL Components for Glens Fork.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
0.0 col/day	97% ⁽⁴⁾	See ⁽⁵⁾	97%	97%

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml

⁽⁴⁾ LA is expressed as a percent reduction

⁽⁵⁾ MOS is both implicit and explicit.

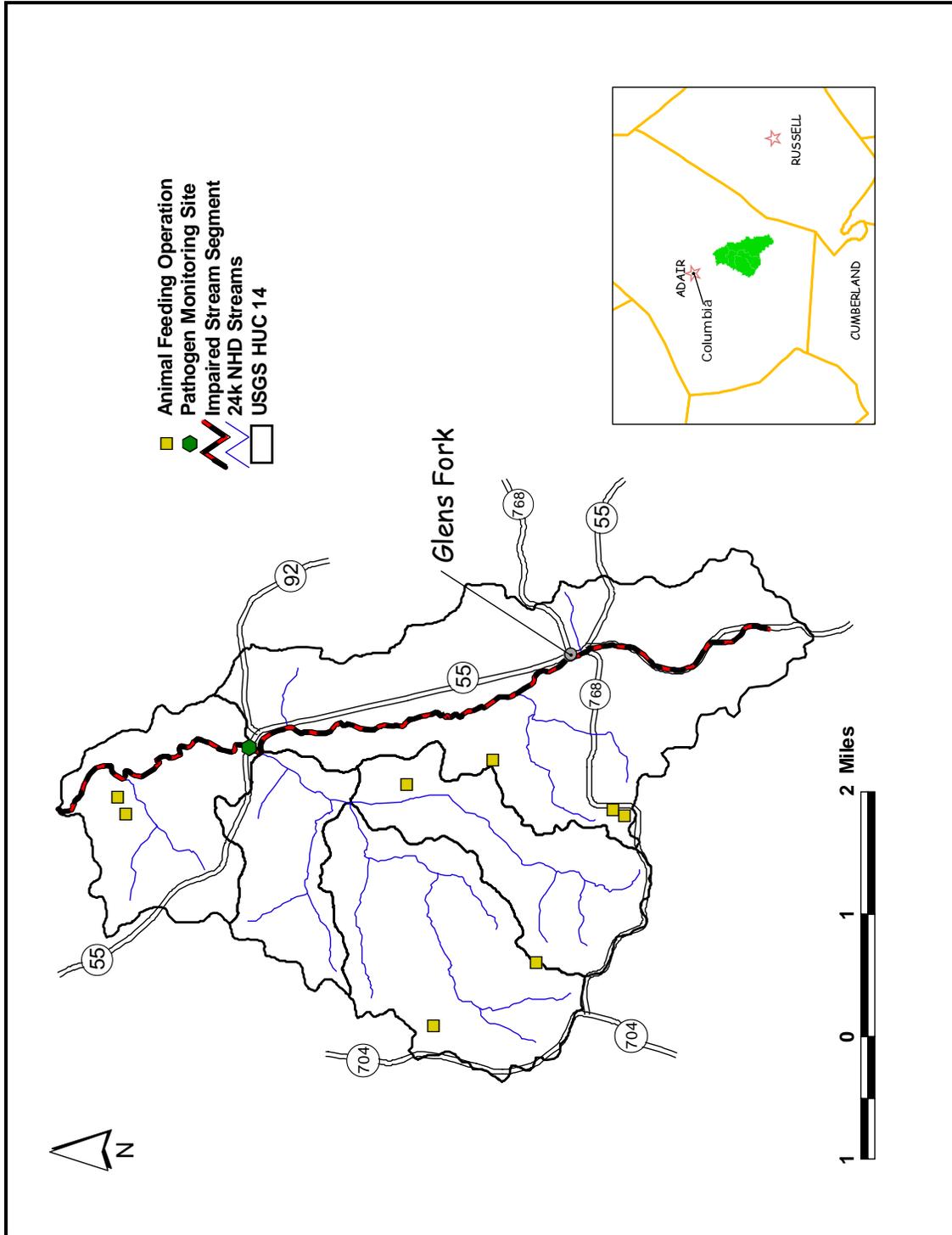


Figure 11. Location map of Glens Fork of Russell Creek Including the Impaired Stream Segment, Monitoring Site, AFOs, and Selected Roads or Communities for Orientation.

8.4.9 Little Barren River of Green River

Little Barren River of Green River (Figure 12) is a fifth order stream in Adair, Green, Hart and Metcalfe Counties that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for partial support of the Primary Contact Recreation designated use in river miles 0.0 to 8.8. This was determined by pathogen monitoring conducted by KDOW at the ambient monitoring site PRI078 during the 2001, 2002 and 2003 primary contact recreation periods (May-October) (Table 35). There were exceedances in 28.6% of the samples collected. The 90th percentile concentration of all exceedances was 2315 col/100 ml, which requires an 84% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 35. Results of KDOW sampling in Little Barren River during the 2001-2003 Recreation Seasons.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
PRI078	5/9/2001	1500	✓
	6/11/2001	60	
	7/10/2001	228	
	9/11/2001	60	
	10/10/2001	20	
	6/13/2002	2000	✓
	8/6/2002	40	
	10/8/2002	50	
	5/22/2003	350	
	6/26/2003	180	
	7/24/2003	640	✓
	8/18/2003	170	
	9/3/2003	2450	✓
	10/22/2003	20	
Percent Exceedances			
4/14 = 28.6%			
90th Percentile Concentration (exceedances only)			
2315 col/100 ml			
Percent Reduction to meet Target concentration			
$((2315 - 360)/2315) * 100 = 84\%$			

The sampling site is about one mile west of Monroe, Kentucky on Highway 88. The watershed of the impaired segment 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 forested (57.75%) followed by pasture (29.64%), developed land (5.14%) natural grassland (4.62%) and row crops (2.74%, Table 36).

Table 36. Land use classification in Little Barren River of Green River. Data Generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	57.75	150.81
Agriculture (total)	32.35	84.47
Pasture	29.60	77.31
Row Crop	2.74	7.16
Developed	5.14	13.43
Natural Grassland	4.62	12.08
Wetland	0.12	0.31
Barren	0.02	0.06

There is one permitted KPDES facility in the Little Barren River watershed. The Edmonton sewage treatment plant (KY0054437) is located in the South Fork Little Barren River sub-watershed, north of where Hwy 68 west of Edmonton. It has effluent limits for fecal coliform of 200 col/100 ml as a monthly average (geometric mean) and a maximum weekly average of 400 col/100 ml. The treatment plant has a design capacity of 0.51 MGD. The waste load allocation for the treatment plant is 7.72×10^9 col/day (Table 37). 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. There are also thirty-three (33) KNDOP permitted Animal Feeding Operations in the Little Barren River watershed (Figure 12).

In summary, the 8.8-mile segment of Little Barren River impaired by pathogens will require at least an 84% reduction in pathogen loading to meet water quality standards according to the data presented. Additionally, the treatment system at Edmonton STP must continue to operate effectively to meet the WLA of 7.91×10^{11} col/day (Table 37).

Table 37. Summary of TMDL Components for Little Barren River.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
Edmonton STP (KY0054437) 7.72×10^9 col/day ⁽⁴⁾	84% ⁽⁵⁾	See ⁽⁶⁾	84%	84%

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml.

⁽⁴⁾ WLA value based on design flow and acute permit limits and represents the maximum one-day load the facility can discharge.

⁽⁵⁾ LA is expressed as a percent reduction

⁽⁶⁾ MOS is both implicit and explicit.

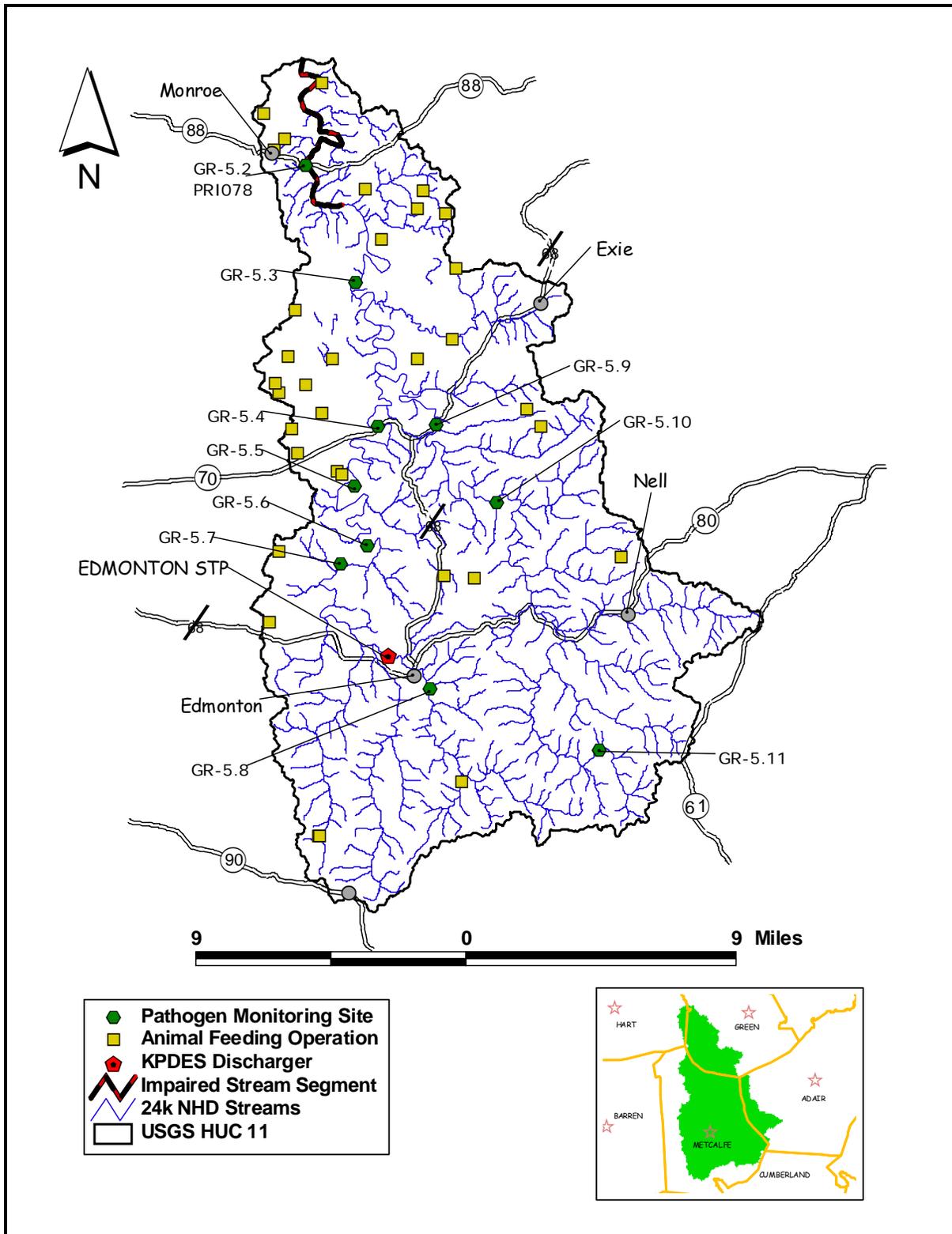


Figure 12. Location map of Little Barren River of Green River Including the Impaired Stream Segment, Monitoring Site, AFOs, and Selected Roads or Communities for Orientation.

8.4.10 Nolin River of Green River

Nolin River of Green River (Figure 14) is a fifth order stream in Grayson, Hardin and Hart Counties that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 44.0 to 93.2. This was determined by pathogen monitoring at the ambient monitoring site PRI021 conducted by KDOW during the 2000, 2001, 2002 and 2003 primary contact recreation periods (May-October) (Table 38). There were exceedances in 21.7% of the samples collected. The 90th percentile concentration of all exceedances was 2960 col/100 ml.

Table 38. Results of KDOW Monitoring at the Ambient Monitoring Site PRI021.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
PRI021 Nolin River near White Mills, Hardin Co. off CR-1288	5/4/2000	8	
	6/13/2000	74	
	7/18/2000	173	
	8/15/2000	34	
	10/10/2000	47	
	5/16/2001	1	
	6/13/2001	600	✓
	7/9/2001	309	
	8/15/2001	91	
	9/12/2001	109	
	10/10/2001	76	
	6/11/2002	173	
	8/27/2002	80	
	10/22/2002	200	
	6/17/2003	600	✓
	7/23/2003	80	
	8/12/2003	3600	✓
	9/29/2003	32	
	5/17/2004	1500	✓
	7/7/2004	2000	✓
9/1/2004	230		
Percent Exceedances			
5/23 = 21.7%			

The Nolin River originates in Larue and flows northwest into Hardin County before turning south and forming the border of Grayson, Hardin and Hart Counties and flows into the Green River approximately two miles east of KY 70. The impaired segment begins with the confluence of Valley Creek in Hardin County and continues downstream to the UT upstream from Laurel Run in Grayson County. The watershed comprises five USGS HUC-11s and is 468.15 square miles. There are 835.86 miles of stream in the Upper Nolin stream network. The land use in the watershed above the impaired segment is predominantly agriculture (pasture 38.22% and row

crop 19.74%). There is also a high percentage of forest (32.19%). There is a small percentage of developed land (7.84%) and natural grassland (1.47%). There is less than one percent of wetland and barren acres in the watershed (Table 39). There are also three pathogen-impaired segments upstream from the Nolin impaired segment. Valley Creek is impaired for river miles 0.0 – 3.5 and 10.3 – 11.8 and Billy Creek, a tributary of Valley Creek, is impaired for river miles 0.0 – 5.9 (Figure 14).

Table 39. Land use classification in Nolin River of Green River. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	32.19%	150.15
Agriculture (total)	57.96%	270.31
Pasture	38.22%	178.26
Row Crop	19.74%	92.05
Developed	7.84%	36.57
Natural Grassland	1.47%	6.86
Wetland	0.13	0.59
Barren	0.06	0.27

Six KPDES permitted facilities discharge sanitary wastewater into the Upper Nolin River system. The design flow, permit limit and maximum daily fecal load are shown in Table 40 and monthly discharge monitoring daily are located in Appendix 6. The wasteload allocation given for this TMDL is the sum of all discharges at their maximum fecal load. Additionally, there are two KPDES permitted stormwater entities in the watershed (Table 40). There are also fifty-two KNDOP permitted animal feeding operations in the watershed (Figure 13).

Table 40. KPDES Permitted Facilities or Stormwater Entities Located in the Impaired Nolin River Watershed

Wastewater					
KPDES Permit Number	Facility Name	Watershed	Design Flow (MGD)	Permit Limit (col/100 ml)	Fecal Load (col/day)
KY0022039	Elizabethtown STP	Valley Creek	7.2	400	1.09×10^{11}
KY0026379	Hodgenville STP	N Fork Nolin River	0.78	400	1.18×10^{10}
KY0103560	Petro Stopping Centers	UT to Nolin River	0.09	400	1.36×10^9
KY0080764	Pilot Travel Center #48	Jackson Branch	0.086	400	1.30×10^9
KY0073644	Glen Dale Childrens Home	Nolin River	0.0225	400	3.41×10^8
KY0029700	Glendale Auto Truck Plaza	Nolin River	0.015	400	2.27×10^8
Stormwater					
KPDES Permit Number	Stormwater Entity	Watershed	Permitted Area (mi ²)	Permit Limit	Fecal Load (col/day)
KYG200003	City of Elizabethtown	Valley Creek	14.3	n/a	6.31×10^{11}
KYG200035	Hardin Co Fiscal Court	Valley Creek	2.71	n/a	1.20×10^{11}
Total Load to Nolin River					8.75×10^{11}

The load duration curve for the Nolin River shows that exceedances occur during periods of higher flow (greater than 40% flow duration interval). The moist zone was used for TMDL development since four out of five exceedances occur in this zone (Figure 13). The 90th percentile existing total load was calculated as 2.10×10^{13} col/100ml, while the 90th percentile allowable load was 5.06×10^{12} col/100ml. The existing load was calculated by subtracting the existing total load (2.10×10^{13} col/100ml) by the existing wasteload (8.75×10^{11} col/day) for a value of 2.01×10^{13} col/day (Table 41). The wasteload for MS4 permitted areas was determined by multiplying the existing total load minus the wastewater wasteload by an area weighted factor (permitted area/total watershed area).

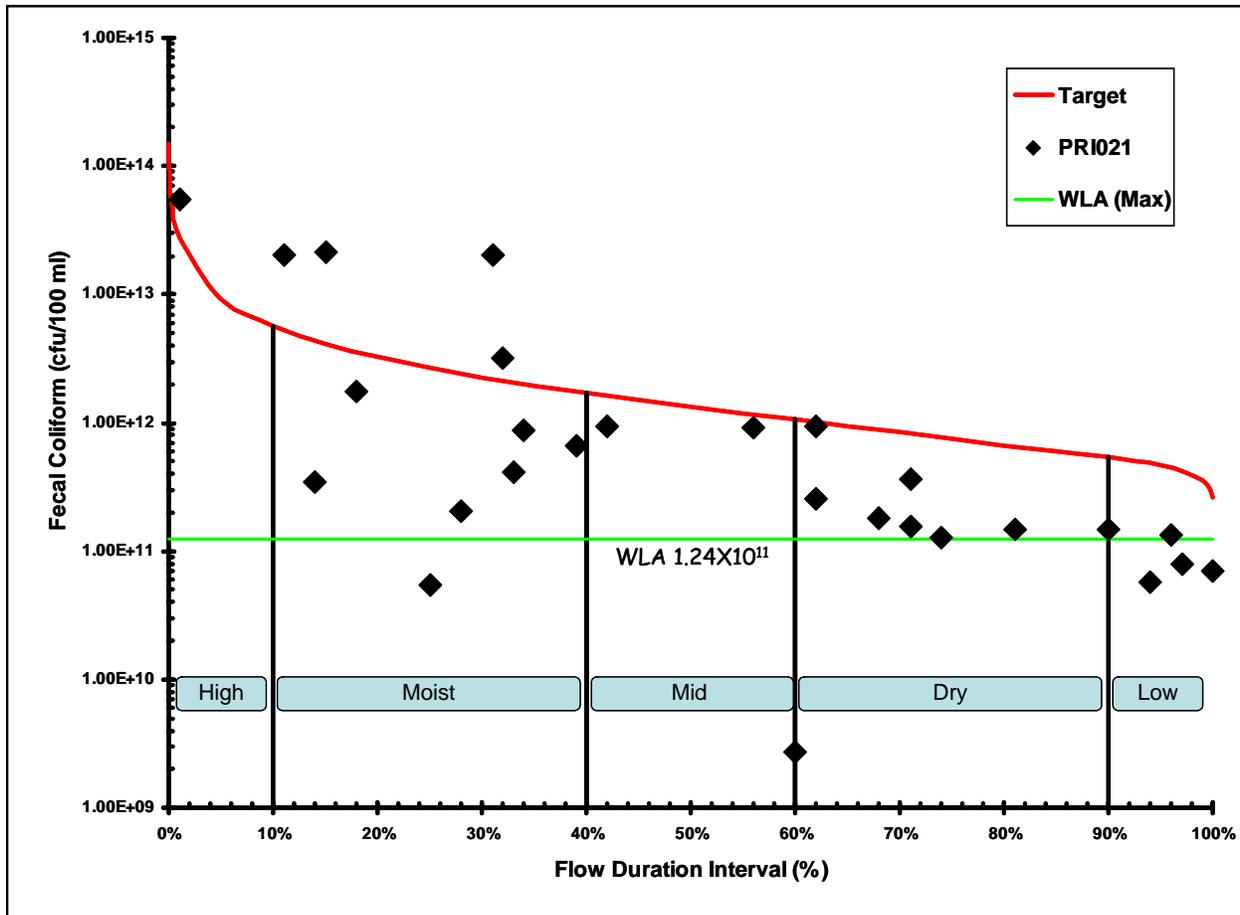


Figure 13 – Load Duration Curve for the Nolin River at White Mills, KY for Primary Contact Recreation Seasons 1999 – 2005.

In summary, the 49.2-mile segment of Nolin River impaired by pathogens will require at least a 79% reduction in pathogen loading from MS4 stormwater runoff and non-permitted sources to meet water quality standards. Additionally, the KPDES permitted facilities listed in Table 40 must continue to operate effectively to meet the WLA of 1.24×10^{11} col/day (Table 42)

Table 41. Summary of Existing Conditions in the Upper Nolin River Watershed

Existing Conditions					
Total Load col/day	Wasteload col/day				Load col/day
	Wastewater		MS4		
2.10×10 ¹³	KY0022039	1.09×10 ¹¹	City of Elizabethtown KYG200003	6.31×10 ¹¹	2.01×10 ¹³
	KY0026379	1.18×10 ¹⁰			
	KY0103560	1.36×10 ⁹	Hardin Co Fiscal Court KYG200035	1.20×10 ¹¹	
	KY0080764	1.30×10 ⁹			
	KY0073644	3.41×10 ⁸			
	KY0029700	2.27×10 ⁸			
	Total	1.24×10 ¹¹	Total	7.51×10 ¹¹	

Table 42. Summary of TMDL Components for Nolin River of Green River

TMDL Conditions			Reductions			
TMDL col/day	MOS ⁽⁴⁾ col/day	WLA col/day		WLA col/day		
		Wastewater ^(1,2)	MS4	Wastewater	MS4	
		LA ⁽³⁾ col/day			LA	
5.06×10 ¹²	5.06×10 ¹¹	4.27×10 ¹²	KY0022039	1.09×10 ¹¹	0.0	79% ⁽⁵⁾
			KY0026379	1.18×10 ¹⁰	0.0	
			KY00103560	1.36×10 ⁹	0.0	
			KY0080764	1.30×10 ⁹	0.0	
			KY0073644	3.41×10 ⁸	0.0	
			KY0029700	2.27×10 ⁸	0.0	
			Total	1.24×10¹¹	1.61×10¹¹	
				City of Elizabethtown		
				Hardin Co Fiscal Court		

Notes:

- (1) 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.
- (2) WLA value is based on design flow and acute permit limits and represents the maximum one-day load the facility can discharge. The average daily load based on design flow and chronic permit limits cannot exceed 1.24×10¹¹ colonies/day.
- (3) The LA is the remainder of the TMDL minus the WLA and MOS
- (4) MOS is both implicit and explicit.
- (5) Overall reduction to achieve the target load allocation of for the MS4 WLA and the LA. Reduction calculated as (Existing Load or MS4 wasteload – allocated Load or MS4 wasteload)/Existing Load.

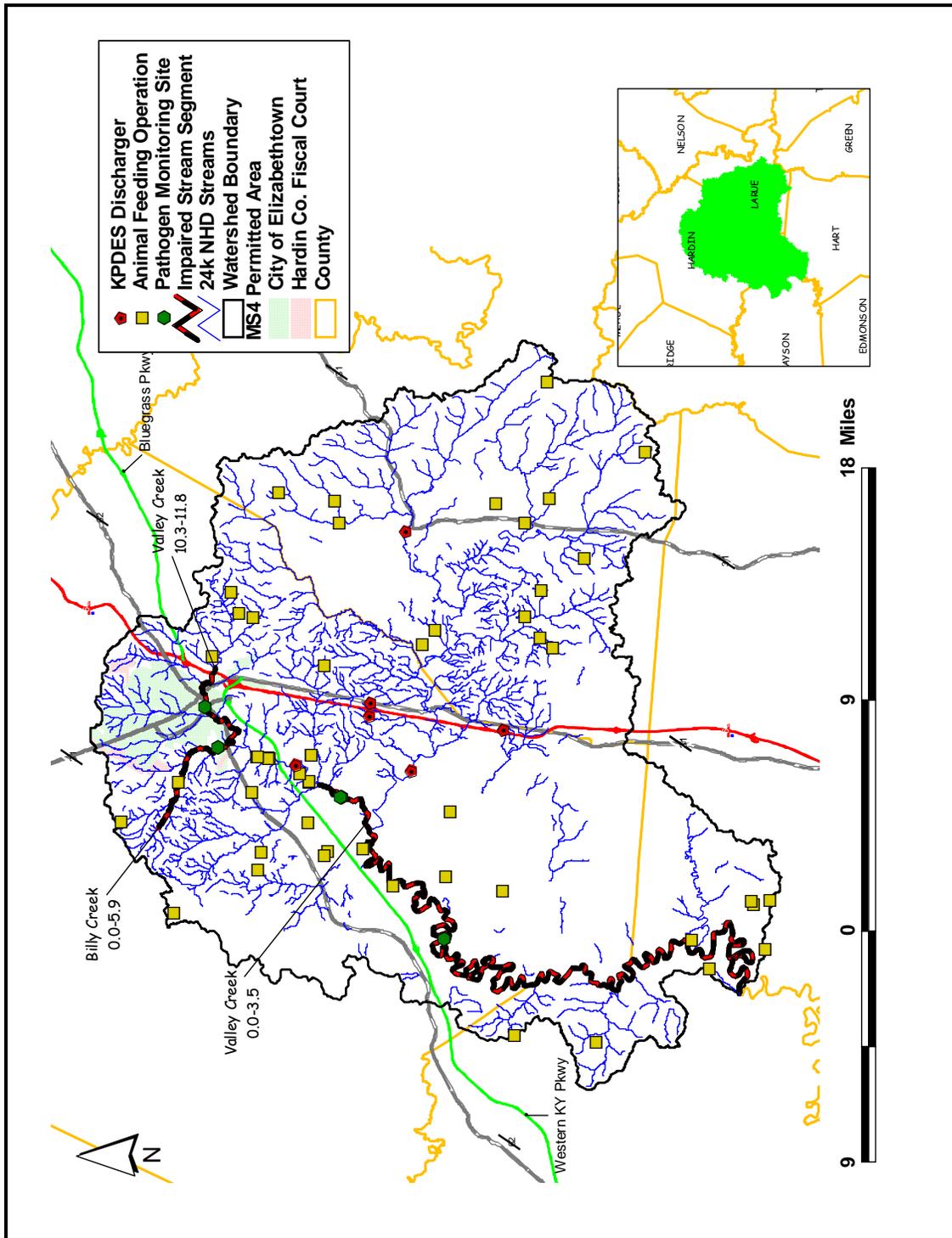


Figure 14. . Location map of Nolin River of Green River Including the Impaired Stream Segment, Monitoring Site, AFOs, and Selected Roads or Communities for Orientation.

8.4.11 Pettys Fork of Russell Creek

Pettys Fork of Russell Creek (Figure 15) is a fourth order stream in Adair County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 0.0 to 6.0. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summer of 2001 and 2003 (Table 43). There were exceedances in 30.0% of the samples collected. The 90th percentile concentration of all exceedances was 1688 col/100 ml, which requires a 79% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 43. Results of WKU sampling in Pettys Fork during the 2001 Recreation Season.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
GRBEX-05 Rte. 61, 3.5 km W Columbia	6/18/2001	491	✓
	7/19/2001	376	
	8/22/2001	96	
	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	
Percent Exceedances			
3/10 = 30%			
90th Percentile Concentration (exceedances only)			
1688 col/100 ml			
Percent Reduction to meet Target concentration			
$((1688 - 360)/1688) * 100 = 79\%$			

The stream is about 1.5 miles west of Columbia, Kentucky on Highway 61. The watershed for the impaired segment comprises three USGS HUC-14s with a total drainage area of 28.52 square miles. The stream network is 60.92 miles and has an average slope of 0.4%. The landuse in the watershed is predominately forested (49.83%) followed by pasture (37.53%), developed land (6.15%), row crops (4.52%) and natural grassland (1.8%, Table 44).

Table 44. Land use classification in Pettys Fork of Russell Creek. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	49.83	19.75
Agriculture (total)	42.05	16.67
Pasture	37.53	14.88
Row Crop	4.52	1.79
Developed	6.15	2.44
Natural Grassland	1.80	0.71
Wetland	0.02	0.01
Barren	0.02	0.06

There are no known point sources in the watershed; therefore, the entire load is allocated to nonpoint sources. There are six KNDOP permitted animal feeding operations in the watershed. Based on the monitoring data available in Glens Fork at least a 79% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 45).

Table 45. Summary of TMDL Components for Pettys Fork.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
0.0 col/day	79% ⁽⁴⁾	See ⁽⁵⁾	79%	79%

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml.

⁽⁴⁾ LA is expressed as a percent reduction

⁽⁵⁾ MOS is both implicit and explicit.

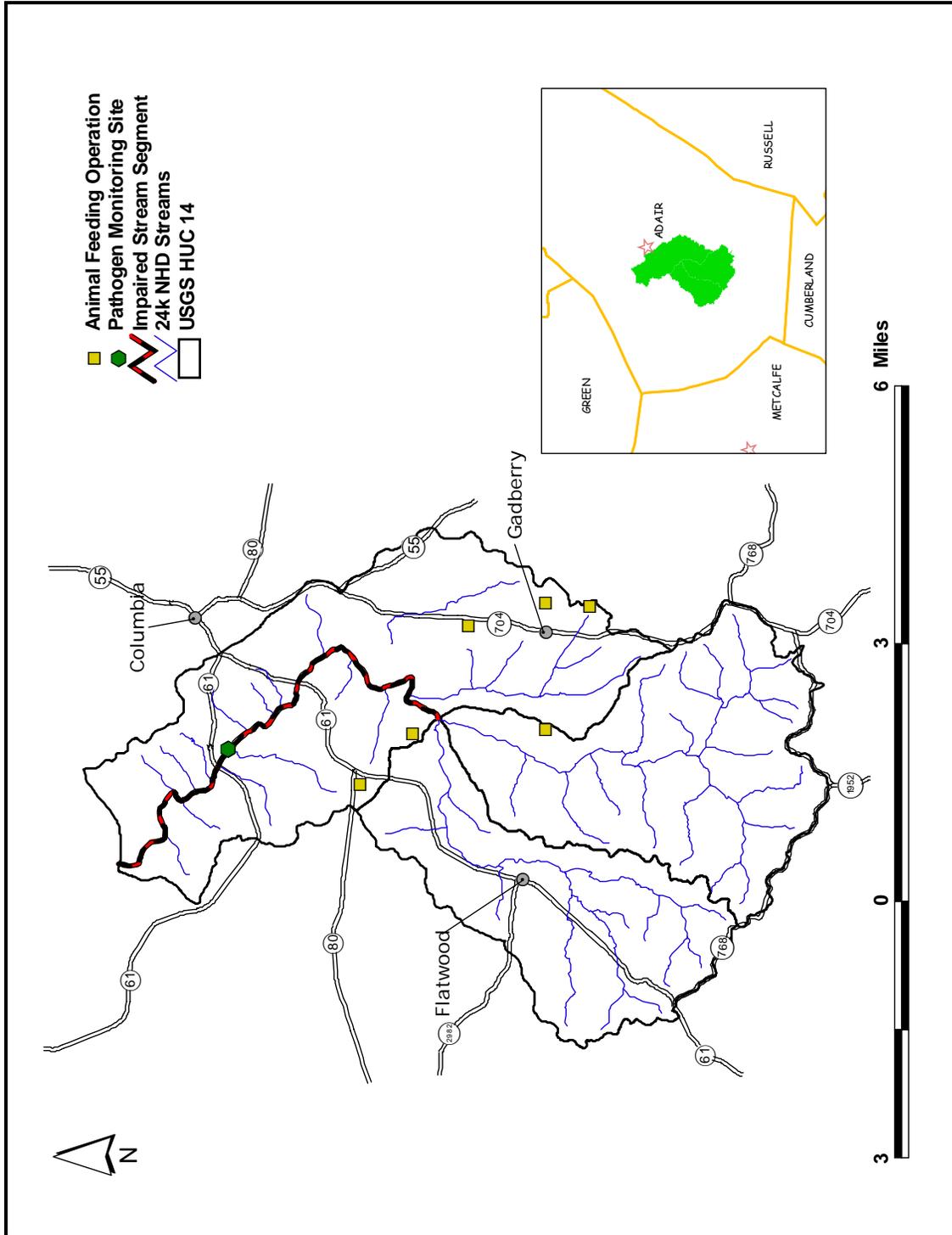


Figure 15. Location map of Petty's Fork of Russell Creek Including the Impaired Stream Segment, Monitoring Site, AFOs, and Selected Roads or Communities for Orientation.

8.4.12 Poplar Grove Branch of Big Brush Creek

Poplar Grove Branch of Big Brush Creek (Figure 16) is a fourth order stream in Taylor County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 0.0 to 3.0. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summers of 2001 and 2003 (Table 46). There were exceedances in 36.3% (4 of 11) of the samples collected. The 90th percentile concentration of all exceedances was 570 col/100 ml, which requires a 37% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 46. Results of WKU sampling in Poplar Grove Branch during the 2001 Recreation Season.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
GRBEX-07 Union Church Rd., 14 km SE Buffalo	6/18/2001	455	✓
	7/19/2001	560	✓
	8/22/2001	48	
	9/20/2001	304	
	10/29/2001	16	
	5/19/2003	104	
	6/30/2003	224	
	7/29/2003	576	✓
	8/20/2003	528	✓
	10/8/2003	64	
Percent Exceedances			
4/11 = 36.3%			
90th Percentile Concentration (exceedances only)			
570 col/100 ml			
Percent Reduction to meet Target concentration			
$((570 - 360)/570) * 100 = 37\%$			

The stream is located south of Highway 210 near Hibernia, Kentucky. The watershed for the impaired segment comprises USGS HUC-14 05110001100020 with a total drainage area of 4.25 square miles. The stream network is 14.6 miles and has an average slope of 1.14% (Figure 16). The landuse in the watershed is dominated by forest (88.81%) followed by natural grassland (4.59%), developed land (2.5%), row crops (2.36%), and pasture (1.10%, Table 47).

Table 47. Land use classification in Poplar Grove Branch of Big Brush Creek. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	88.81	2413.61
Agriculture (total)	3.47	94.30
Pasture	1.10	30.02
Row Crop	2.36	64.27
Developed	2.50	67.83
Natural Grassland	4.59	124.76
Wetland	0.01	0.22
Barren	0.04	1.11

There are no known point sources in the watershed; therefore, the entire load is allocated to nonpoint sources. Based on the monitoring data available in Poplar Grove Branch at least a 37% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 48).

Table 48. Summary of TMDL Components for Poplar Grove Branch.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
0.0 col/day	37% ⁽⁴⁾	See ⁽⁵⁾	37%	37%

Notes:

⁽¹⁾ 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.

⁽²⁾ TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.

⁽³⁾ Overall reduction to achieve the target of 360 col/100ml.

⁽⁴⁾ LA is expressed as a percent reduction

⁽⁵⁾ MOS is both implicit and explicit.

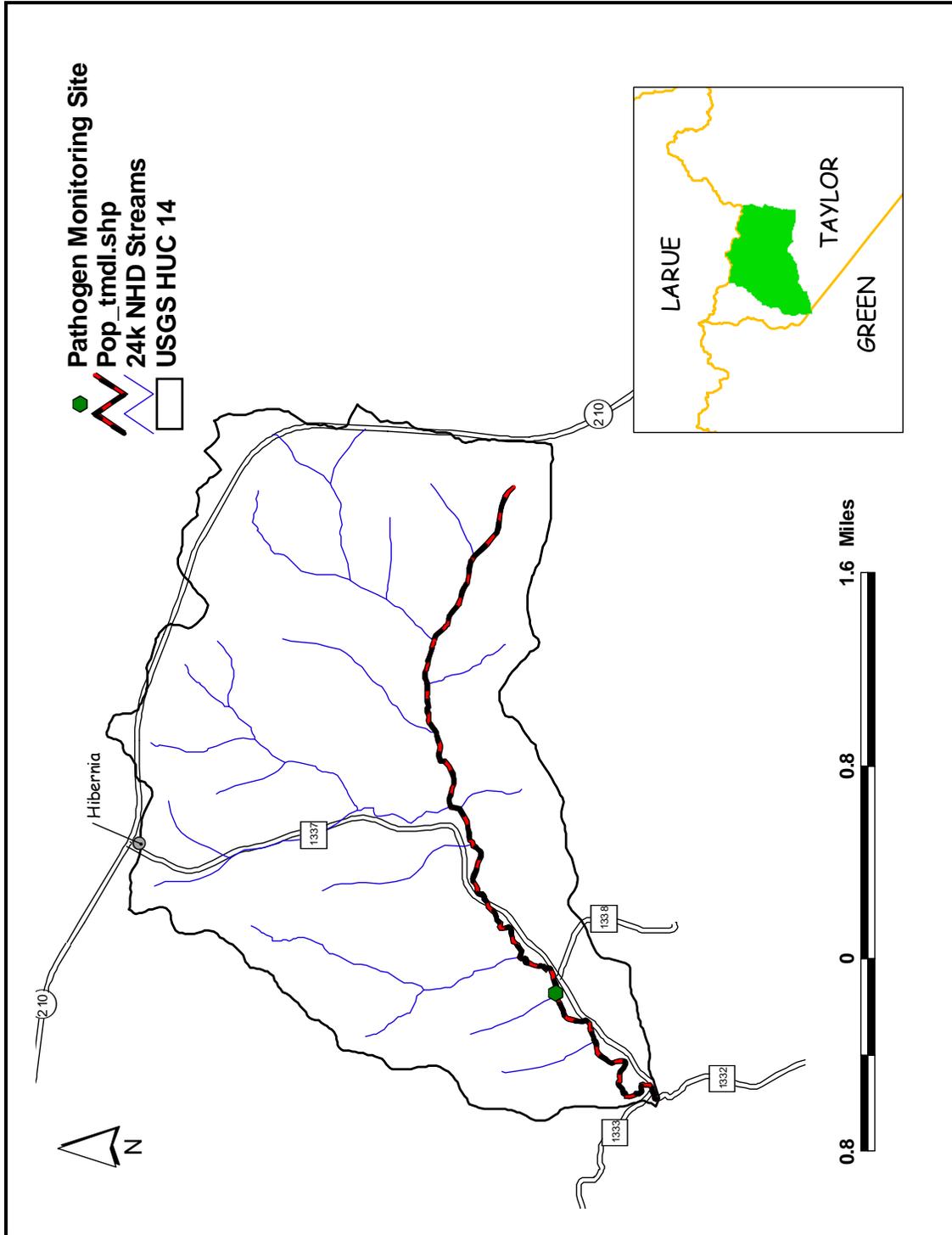


Figure 16. Location map of Petty's Fork of Russell Creek Including the Impaired Stream Segment, Monitoring Site, AFOs, and Selected Roads or Communities for Orientation.

8.4.13 Russell Creek of Green River

Russell Creek of Green River (Figure 17) is a fifth order stream in Adair and Russell Counties that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 40.0 to 41.5. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summers of 2001-2003 (Table 49). There were exceedances in 43.8% of the samples collected. The 90th percentile concentration of all exceedances was 5360 col/100 ml, which requires a 93% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion). Additional data were collected at three additional sites upstream from the impaired segment. These data can be found in Appendix 8.

Table 49. Results of WKU sampling in Russell Creek during the 2001-2003 Primary Contact Recreation Seasons.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
GRBEX-02 Russell Creek nr. Rte. 206, 1 km E Columbia	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	
	5/14/2003	152	
	6/16/2003	5200	✓
	7/28/2003	152	
	8/20/2003	576	✓
	10/15/2003	108	
	10/29/2003	5600	✓
Percent Exceedances			
7/16 = 43.8%			
90th Percentile Concentration (exceedances only)			
5360 col/100 ml			
Percent Reduction to meet Target concentration			
$((5360 - 360)/5360) * 100 = 93\%$			

The stream flows through the north side of Columbia, Kentucky. The watershed of the impaired segment comprises thirty-nine USGS HUC-14s with a total drainage area of 127.79 square miles. The stream network is 290.27 miles and has an average slope of 0.15%. Glens Fork, also impaired for pathogens, discharges into Russell Creek at river mile 47.05. The landuse in the watershed is predominately pasture (46.09%) followed closely by forest (37.86). The remaining landuses are much smaller percentage wise with developed land (7.41%) and row crop making up the majority of the remainder (Table 50).

Table 50. Land use classification in Russell Creek. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	37.86	48.18
Agriculture (total)	53.34	67.88
Pasture	46.09	58.65
Row Crop	7.25	9.23
Developed	7.41	9.43
Natural Grassland	1.28	1.63
Wetland	0.01	0.02
Barren	0.09	0.12

There is one permitted KPDES facility in the Russell Creek watershed; however it discharges below the impaired segment. The waste load allocation for the Columbia STP is not included in the TMDL because it discharges below the impaired segment. Therefore the TMDL reduction applied to nonpoint sources is 93% based on the data presented (Table 51). There are also fifty-two (52) KNDOP permitted Animal Feeding Operations in the Russell Creek watershed (Figure 17) above the impaired segment.

Table 51. Summary of TMDL Components for Russell Creek.

WLA ⁽¹⁾	LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
0.0 col/day ⁽⁴⁾	93% ⁽⁵⁾	See ⁽⁶⁾	93%	93%

Notes:

- (1) 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. TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.
- (2) Overall reduction to achieve the target of 360 col/100ml.
- (3) The waste load allocation for the Columbia STP is not included in the TMDL because it discharges below the impaired segment.
- (4) LA is expressed as a percent reduction
- (5) MOS is both implicit and explicit.

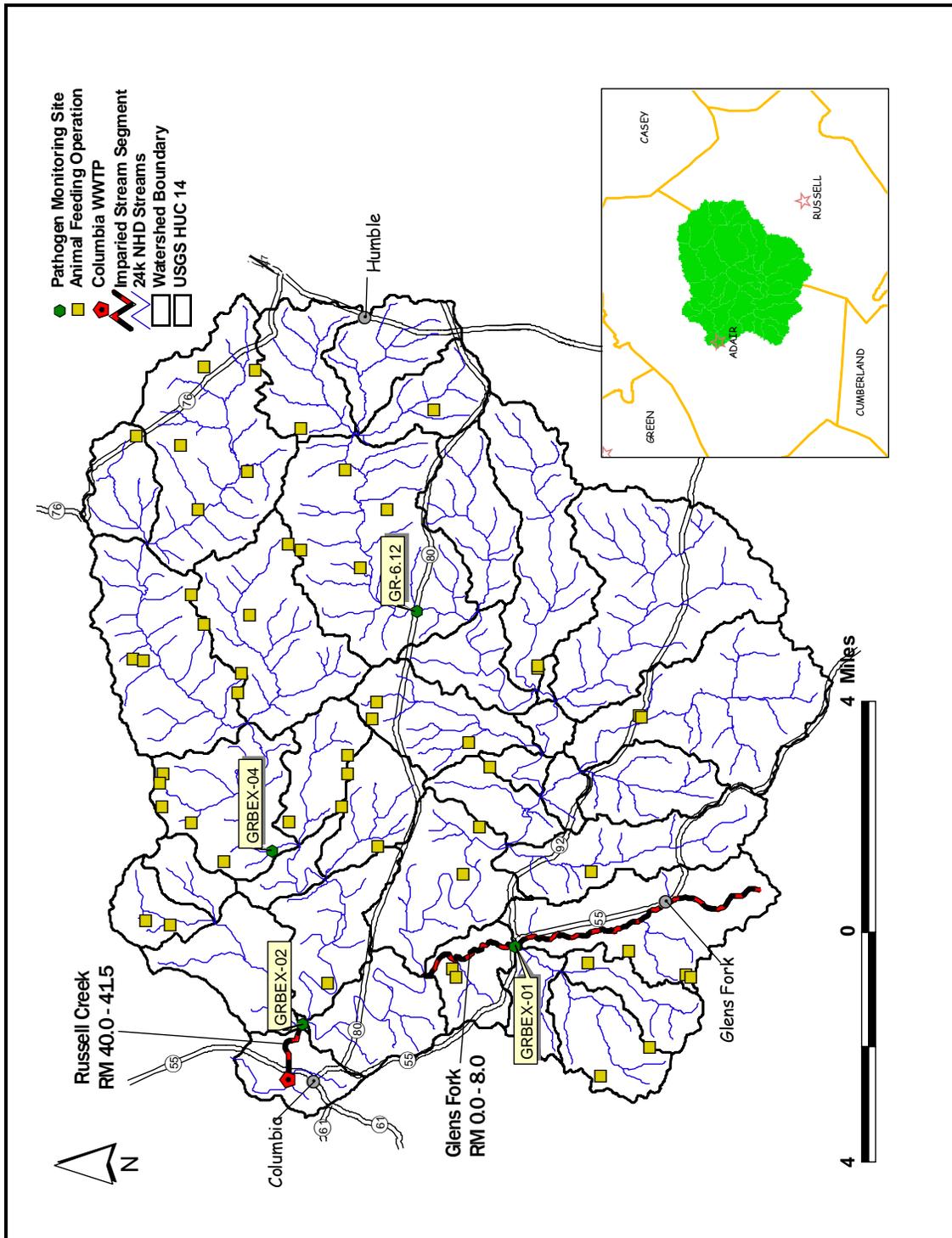


Figure 17. Location map of Russell Creek of Green River Including the Impaired Stream Segment, Monitoring Site, AFOs, and Selected Roads or Communities for Orientation.

8.4.14 Valley Creek of Nolin River (RM 0.0 to 3.5)

Valley Creek of Nolin River (Figure 18) is a fifth order stream in Hardin County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 0.0 to 3.5. This was determined by pathogen monitoring at two sites within the impaired segment in the summer of 2001. One was conducted by Western Kentucky University (WKU) at site FC-60 and the other by the KDOW at GRN027 (Table 52). The samples were collected at the same location off Hwy 222. There were exceedances in 80.0% of the samples collected by both agencies. The 90th percentile concentration of exceedances at GRN027 was 2081 col/100 ml and at FC-60, the 90th percentile was 2238 col/100 ml. This requires an 83% and 84% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 52. Results of KDOW and WKU sampling in Valley Creek during the 2001 Recreation Season.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
GRN027 Rte. 222, 3 km NW Glendale	6/13/2001	55	
	7/9/2001	2600	✓
	8/15/2001	873	✓
	9/12/2001	782	✓
	10/10/2001	836	✓
Percent Exceedances			
4/5 = 80%			
90th Percentile Concentration (exceedances only)			
2081 col/100 ml			
Percent Reduction to meet Target concentration			
$((2081 - 360)/2081) * 100 = 83\%$			
Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
FC-60 Rte. 222, 3 km NW Glendale	6/18/2001	636	✓
	7/19/2001	88	
	8/22/2001	880	✓
	9/20/2001	2820	✓
	10/31/2001	600	✓
Percent Exceedances			
4/5 = 80%			
90th Percentile Concentration (exceedances only)			
2238 col/100 ml			
Percent Reduction to meet Target concentration			
$((2238 - 360)/2238) * 100 = 84\%$			

The stream is about located due south of Elizabethtown, Kentucky. The watershed of the impaired segment comprises USGS HUC-11 05110001200 with a total drainage area of 92.44 square miles. The stream network is 263.05 miles and has an average slope of 0.22%. The landuse in the watershed is predominately agricultural with pasture at (32.91%) and row crop at (21.34). However, there are significant portions of forest (27.64%) and developed land (17.68%) with the city of Elizabethtown in the watershed (Table 53). There are two additional segments listed for impairments of the primary contact recreation designated use upstream of this segment. Valley Creek is also listed for river miles 10.3-11.8 and Billy Creek joins Valley Creek just below river mile 10.3.

Table 53. Land use classification in Valley Creek of Nolin River. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	27.64	25.44
Agriculture (total)	54.25	49.94
Pasture	32.91	30.29
Row Crop	21.34	19.65
Developed	17.68	16.27
Natural Grassland	0.32	0.29
Wetland	0.04	0.04
Barren	0.07	0.06

There is one permitted KPDES wastewater facility and two KPDES stormwater entities in the Valley Creek watershed. The Elizabethtown sewage treatment plant (KY0026182) is located on Valley Creek and discharges at mile point 5.4 above the impaired segment. It has effluent limits for fecal coliform of 200 col/100 ml as a monthly average (geometric mean) and a maximum weekly average of 400 col/100 ml. The treatment plant has a design capacity of 4.2 MGD (million gallons/day). The waste load allocation for the treatment plant is 1.09×10^{11} col/day (Table 54). The quarterly discharge monitoring data for the period 1/1/2000 – 12/31/2005 have been included in Appendix 7. There have been no exceedances of the maximum weekly average or 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. The two KPDES permitted stormwater entities cover a total of 17.01 square miles within the Valley Creek watershed which is 6.5% of the total area. There are also twenty-two (22) KNDOP permitted Animal Feeding Operations in the Valley Creek watershed (Figure 18).

Table 54. KPDES Permitted Facilities or Stormwater Entities Located in the Impaired Valley Creek Watershed

Wastewater					
KPDES Permit Number	Facility Name	Watershed	Design Flow (MGD)	Permit Limit (col/100 ml)	Fecal Load (col/day)
KY0022039	Elizabethtown STP	Valley Creek	7.2	400	1.09×10^{11}
Stormwater					
KPDES Permit Number	Stormwater Entity	Watershed	Permitted Area (mi ²)	Permit Limit	Fecal Load (col/day)
KYG200003	City of Elizabethtown	Valley Creek	14.3	n/a	n/a
KYG200035	Hardin Co Fiscal Court	Valley Creek	2.71	n/a	n/a

In summary, the 3.5-mile segment of Valley Creek impaired by pathogens will require at least an 84% reduction in pathogen loading to meet water quality standards according to the data presented. Additionally, the treatment system at Elizabethtown STP must continue to operate effectively to meet the WLA of 1.12×10^{13} col/day (Table 55).

Table 55. Summary of TMDL Components for Valley Creek.

WLA ⁽¹⁾				LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
KPDES		MS4					
Elizabethtown STP KY0026182	1.09×10^{11} col/day ⁽⁴⁾	City of Elizabethtown	84% ⁽⁵⁾	84% ⁽⁵⁾	See ⁽⁶⁾	84%	84%
		Hardin County Fiscal Court	84% ⁽⁵⁾				

Notes:

- (1). 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.
- (2). TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.
- (3). Overall reduction to achieve the target of 360 col/100ml.
- (4). WLA value based on design flow and acute permit limits and represents the maximum one-day load the facility can discharge.
- (5). MS4 WLA and LA are expressed as percent reductions
- (6). MOS is both implicit and explicit.

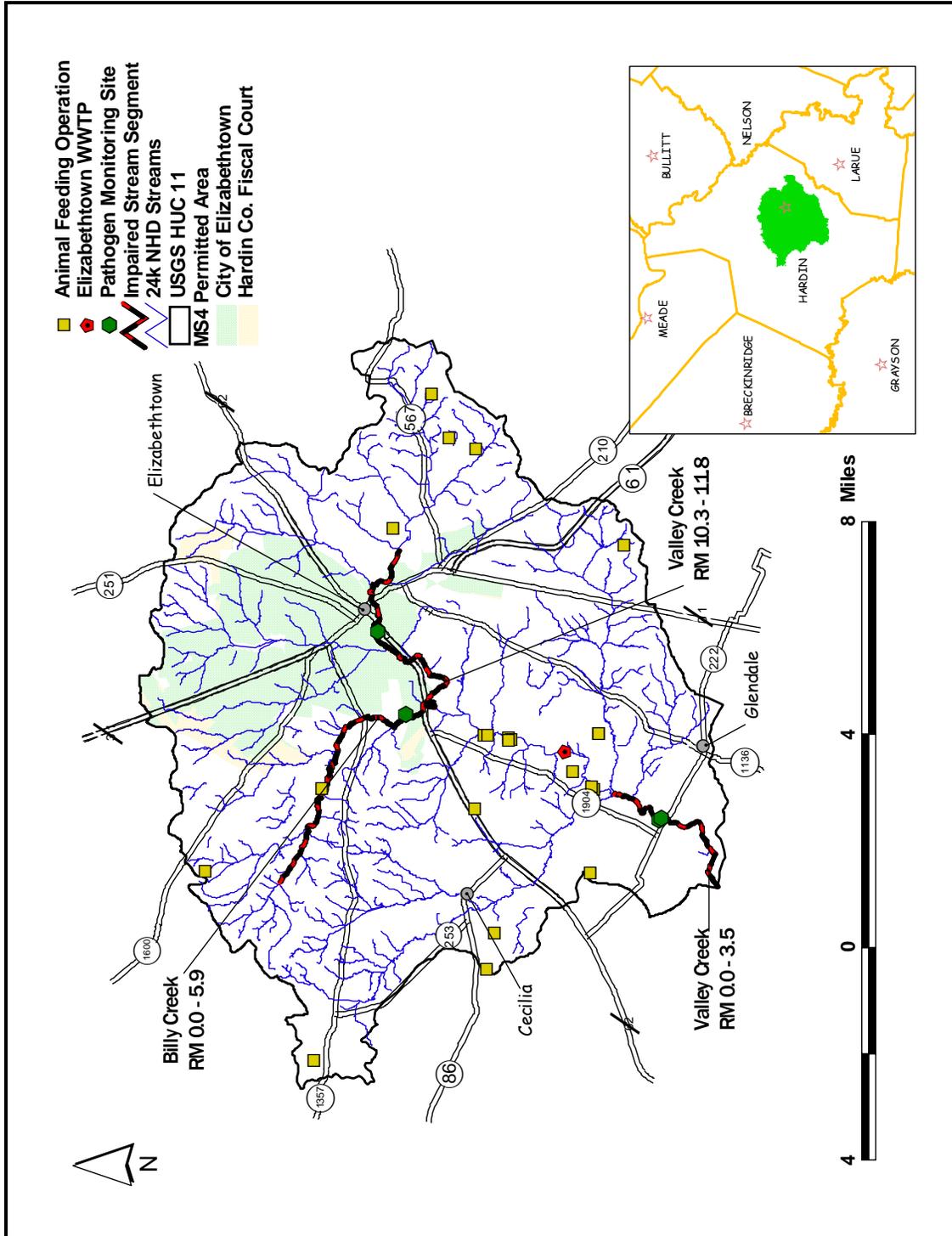


Figure 18. Location map of Valley Creek of Nolin River Including the Impaired Stream Segments, Monitoring Sites, AFOs, and Selected Roads or Communities for Orientation.

8.4.15 Valley Creek of Nolin River (RM 10.3 to 11.8)

Valley Creek of Nolin River (Figure 19) is a fourth order stream in Hardin County that was placed on the 2004 303(d) List of Impaired Waters (KDOW 2005) for nonsupport of the Primary Contact Recreation designated use in river miles 10.3 to 11.8. This was determined by pathogen monitoring conducted by Western Kentucky University (WKU) in the summer of 2001 (Table 56). There were exceedances in 60.0% of the samples collected. The 90th percentile concentration of all exceedances was 3424 col/100 ml, which requires a 89% reduction in fecal coliform loading to meet the Target concentration of 360 col/100ml (or 90% of the acute criterion).

Table 56. Results of WKU sampling in Big Creek during the 2001 Recreation Season.

Sample Site	Month	Fecal Coliform col/100 ml	Exceedance
FC-59	6/18/2001	3600	✓
U.S.31W	7/19/2001	16	
Bypass/U.S.	8/22/2001	1600	✓
62,	9/20/2001	2720	✓
Elizabethtown	10/31/2001	336	
Percent Exceedances			
3/5 = 60%			
90th Percentile Concentration (exceedances only)			
3424 col/100 ml			
Percent Reduction to meet Target concentration			
$((3424 - 360)/3424) * 100 = 89\%$			

The stream begins east of Elizabethtown, Kentucky and flows through the South end of town along US 62. The impaired segment is located within the Elizabethtown city limits. The impaired segment begins at the outlet of a 32-acre reservoir and the ends at the confluence with Billy Creek, which is also impaired by pathogens. The watershed for the impaired segment comprises five USGS HUC-14s with a total drainage area of 34.11 square miles. The stream network is 94.98 miles and has an average slope of 0.31%. The landuse in the watershed is predominately agriculture with pasture (29.59%) and row crop (7.93%) totaling 37.52 percent of the landuse. There are nearly equal portions of developed land (31.62%) and forest (30.30%). There is less than one percent combined natural grassland, wetland and barren land in the watershed (Table 57).

Table 57. Land use classification in Valley Creek of Nolin River. Data generated using NLCD 2001 (USGS 2001).

Land Use	% of Total Area	Square Miles
Forest	30.30	10.26
Agriculture (total)	37.52	12.71
Pasture	29.59	10.03
Row Crop	7.93	2.69
Developed	31.62	10.71
Natural Grassland	0.40	0.13
Wetland	0.07	0.02
Barren	0.10	0.03

There are two KPDES stormwater permitted entities the City of Elizabethtown (KYG200035) and Hardin County (KYG200003) within the watershed (Table 58). Therefore, the percent reduction will be applied to both the WLA (for MS4 areas) and the LA (for all other area). Based on the monitoring data available in the upper segment of Valley Creek at least an 89% reduction in pathogen loading is necessary to meet the water quality standard for primary contact recreation (Table 59).

Table 58. MS4 Stormwater Permits within the Upper Valley Creek Impaired Watershed.

Stormwater Permit Number	Permittee	Area in Valley Creek (mi ²)
KYG200035	City of Elizabethtown	13.06
KYG200003	Hardin County Fiscal Court	1.94

Table 59. Summary of TMDL Components for Valley Creek.

Wastewater	WLA ⁽¹⁾		LA	Margin of Safety	TMDL ⁽²⁾	Percent Reduction ⁽³⁾
	MS4					
0.0 col/day	City of Elizabethtown	89% ⁽⁴⁾	89% ⁽⁴⁾	See ⁽⁴⁾	89%	89%
	Hardin Co Fiscal Court	89% ⁽⁴⁾				

Notes:

- (1). 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.
- (2). TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.
- (3). Overall reduction to achieve the target of 360 col/100ml.
- (4). MS4 WLA and LA are expressed as percent reductions
- (5). MOS is both implicit and explicit.

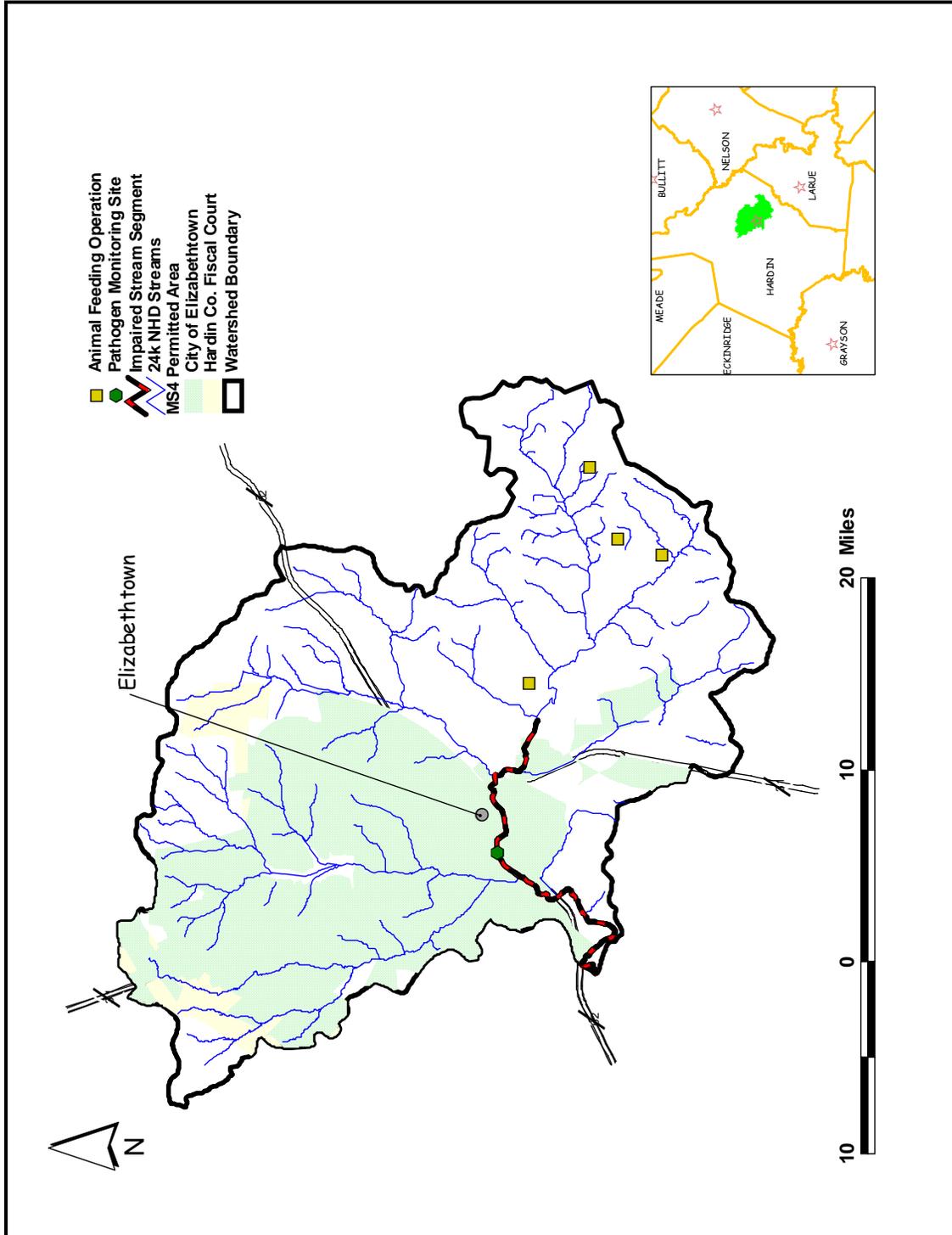


Figure 19. Location map of Valley Creek of Nolin River Including the Impaired Stream Segments, Monitoring Sites, AFOs, and Selected Roads or Communities for Orientation.

8.4 TMDL Summary for all Segments

TMDL ⁽¹⁾	MOS	WLA ^(2,3)			LA ⁽⁵⁾	Percent Reduction ⁽⁶⁾
		Wastewater		MS4 ⁽⁵⁾		
Big Creek of Russell Creek RM 3.0-8.2						
96%	See ⁽⁴⁾	Sparksville Grade School KY0028100	6.06×10 ⁷ col/day	0.0 col/day	96%	96%
Big Pitman Creek of Green River RM 0.0-13.6						
92%	See ⁽⁴⁾	Campbellsville STP KY0022039	6.36×10 ¹⁰ col/day	City of Campbellsville	92%	92%
		Green Co Sanitation District #1 KY0096881	1.51×10 ¹⁰ col/day			
		Total	6.87×10 ¹⁰ col/day			
Big Reedy Creek of Green River RM 7.5-13.6						
82%	See ⁽⁴⁾	N/A	N/A	0.0 col/day	82%	82%
Billy Creek of Valley Creek RM0.0-5.9						
85%	See ⁽⁴⁾	N/A	N/A	City of Elizabethtown	85%	85%
				Hardin County Fiscal Court	85%	
Butler Fork of Russell Creek RM 2.3-4.0						
97%	See ⁽⁴⁾	N/A	N/A	0.0 col/day	97%	97%
Casey Creek of Green River RM 3.7-4.7						
90%	See ⁽⁴⁾	N/A	N/A	0.0 col/day	90%	90%
Claylick Creek of Green River RM 2.0-3.1						
97%	See ⁽⁴⁾	N/A	N/A	0.0 col/day	97%	97%
Glens Fork of Russell Creek RM 0.0-8.0						
97%	See ⁽⁴⁾	N/A	N/A	0.0 col/day	97%	97%
Little Barren River of Green River RM 0.0-8.8						
84%	See ⁽⁴⁾	Edmonton STP KY0054437	7.72×10 ⁹ col/day	0.0 col/day	84%	84%
Pettys Fork of Russell Creek RM 0.0-6.0						
79%	See ⁽⁴⁾	N/A	N/A	0.0 col/day	79%	79%
Poplar Grove Branch of Big Brush Creek RM0.0-3.0						
37%	See ⁽⁴⁾	N/A	N/A	0.0 col/day	56%	56%
Russell Creek of Green River RM 40.0-41.5						

TMDL ⁽¹⁾	MOS	WLA ^(2,3)				LA ⁽⁵⁾	Percent Reduction ⁽⁶⁾
		Wastewater		MS4 ⁽⁵⁾			
93%	See ⁽⁴⁾	N/A	N/A	0.0 col/day		93%	93%
Nolin River of Green River RM 44.0-93.2							
5.06×10 ¹² col/day	5.06×10 ¹¹ col/day	Elizabethtown STP KY0026182	1.09×10 ¹¹ col/day	City of Elizabethtown	1.35×10 ¹¹ col/day	4.43×10 ¹² col/day	79%
		Hodgenville STP KY0026379	1.18×10 ¹⁰ col/day				
		Petro Stopping Center KY0103560	1.36×10 ⁹ col/day				
		Pilot Travel Center #48 KY0080764	1.30×10 ⁹ col/day	Hardin County Fiscal Court	2.56×10 ¹¹ col/day		
		Glen Dale Childrens Home KY0027251	3.41×10 ⁸ col/day				
		Glendale Auto Truck Plaza KY0073644	2.27×10 ⁸ col/day				
		Total	1.24×10 ¹¹ col/day				
Valley Creek of Nolin River RM 0.0-3.5							
84%	See ⁽⁴⁾	Elizabethtown STP KY0026182	1.09×10 ¹¹ col/day	City of Elizabethtown	84%	84%	84%
				Hardin County Fiscal Court	84%		
Valley Creek of Nolin River RM 10.3-11.8							
89%	See ⁽⁴⁾	N/A	N/A	City of Elizabethtown	89%	89%	89%
				Hardin County Fiscal Court	89%		

Notes:

- (1). TMDLs are expressed as daily loads of fecal colonies in Table 61 of Appendix 1.
- (2). Any future KPDES 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). MOS is both implicit and explicit.
- (5). MS4 WLA and LA are expressed as percent reductions
- (6). Overall reduction to achieve the target of 360 col/100ml.

9.0 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.

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 water quality standards, 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.

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.

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 region. 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 CREP

- **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.
- **To** enhance habitats and populations of wildlife, including those listed as state and federal special concern, rare, threatened and endangered.
- **To** sustain and restore the composition, structure and function of riparian habitat corridors associated with the Green River and tributary watersheds.
- **To** reconnect habitat types in order to restore the full range of ecosystem function.
- **To** establish buffers around sinkholes, targeting 1,000 high-priority sinkholes.
- **To** sustain and restore non-riparian wetlands.
- **To** protect and restore subterranean ecosystems.
- **To** collect, store and analyze data to enhance planning for sustaining the health of the watershed.
- **To** develop an outreach program targeting all active agricultural producers in the area.
- **To** utilize 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 recent 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).

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.

Specific pathogen-impaired TMDL segments within the CREP area include:

- Big Reedy Creek of Green River; RM 7.5-13.6
- Big Creek of Russell Creek; RM 3.0-8.2
- Big Pitman Creek of Green River; RM 0.0 –13.6
- Butler Fork of Russell Creek; RM 2.3-4.0
- Casey Creek of Green River; RM 3.7-4.7
- Claylick Creek of Green River; RM 2.0-3.1
- Glens Fork of Russell Creek; RM 0.0-8.0
- Little Barren River of Green River; RM 0.0-8.8
- Pettys Fork of Russell Creek; RM 0.0-6.0
- Poplar Grove Branch; RM 0.0 – 3.0
- Russell Creek of Green River; RM 40.0-41.5

Continued planning and implementation in the Upper Green River watershed is desired in order maximize protection and restoration efforts.

10.0 Public Participation

This TMDL was published for a 30-day public notice beginning October 5th, 2007 and ending November 7th, 2007. A press release was sent to all newspapers in the Commonwealth of Kentucky and advertisements were purchased in the newspaper of highest circulation published in the following counties: Adair, Butler, Edmondson, Grayson, Green, Hardin, Hart, Taylor, Warren. 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.

11.0 References

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Appendix 1. Calculating Daily Loads

The TMDLs for the fourteen stream segments expressed in section 8.4 as a percent reduction for the load allocation could be expressed as daily loads by approximating the flows using a weighted drainage area ratio approach. There are nine USGS gages in the Upper Green River. The nearest downstream gage was used to estimate flow (Figure 20). The 50th percentile flow measured at the selected gage was used for calculating the TMDLs. The 50th percentile flow represents average conditions. A ratio of the drainage area at the end of the impaired segment to the ratio of the drainage area at the USGS gage (DA segment/DA gage) was multiplied by the 50th percentile flow to estimate the flow in the impaired segment. If a KPDES permitted facility is located in the watershed the design flow was added to the estimated flow (Table 60). Another possible approach is to match the daily average streamflow reported at the appropriate gage for the day sampled and use the area-weighted ratio to estimate the daily average flow at the sample location.

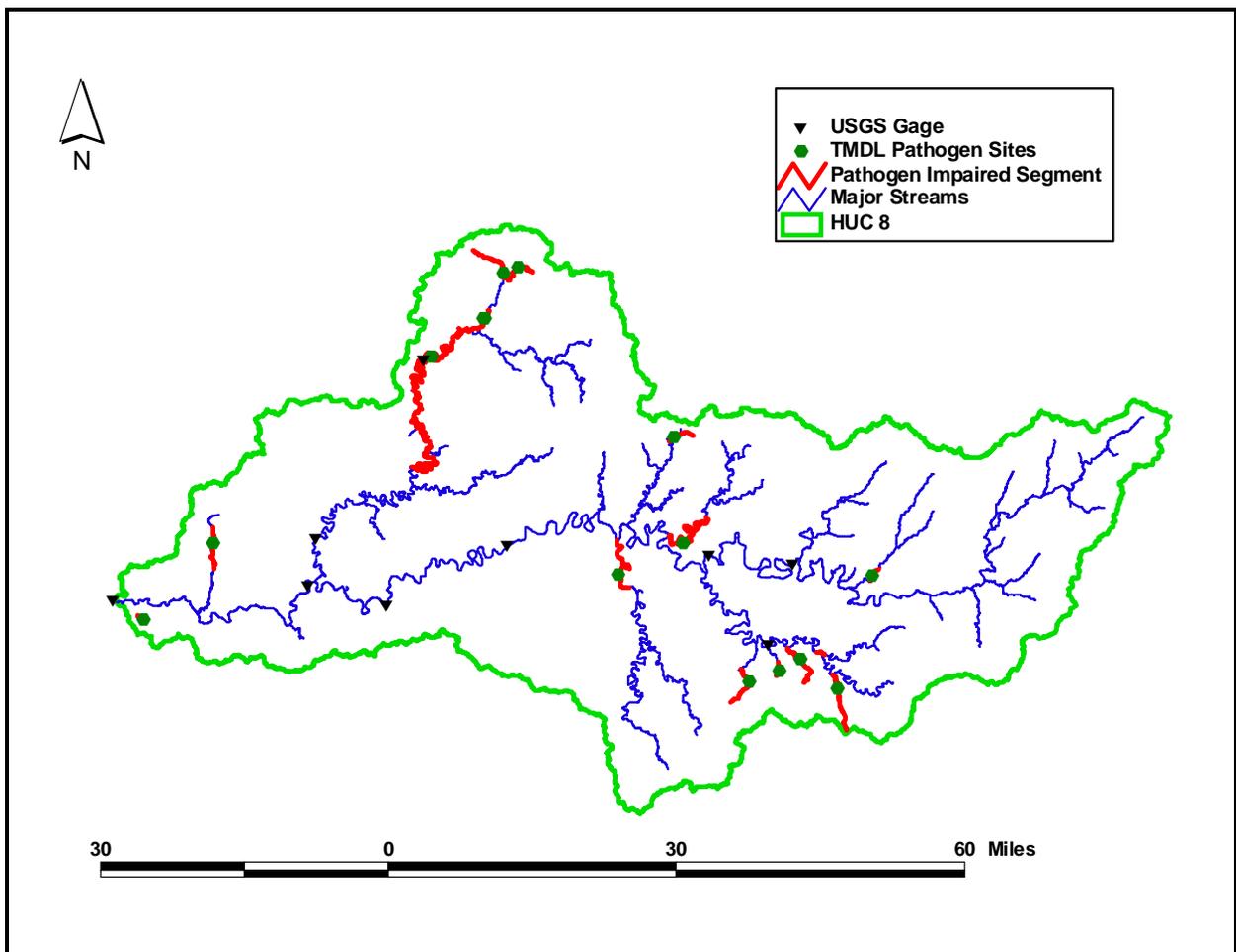


Figure 20. Location Map of USGS Gages in the Upper Green River in Relation to the Impaired Stream Segments.

Table 60. Nearest Downstream USGS Gage and Area-Weighted Streamflow Parameters for Each Impaired Segment

Waterbody Name	USGS Gage	$\frac{\text{DA segment}}{\text{DA gage}}^{(1)}$	50 th Percentile Flow at Gage (cfs)	Estimated Flow (cfs)	KPDES Flow (cfs) ⁽²⁾
Big Creek of Russell Creek RM 3.0-8.2	Russell Creek near Columbia	0.0814	101	8.220	0.006
Big Pitman Creek of Green River RM 0.0-13.6	Green River at Munfordville	0.0907	1130	102.502	6.653
Big Reedy Creek of Green River RM 7.5-13.6	Green River at Lock 6	0.0150	1980	29.686	n/a
Billy Creek of Valley Creek RM0.0-5.9	Nolin River at WhiteMills	0.0385	247	9.500	n/a
Butler Fork of Russell Creek RM 2.3-4.0	Russell Creek near Columbia	0.0547	101	5.523	n/a
Casey Creek of Green River RM 3.7-4.7	Green River near Campbellsville	0.1372	348	47.745	n/a
Claylick Creek of Green River RM 2.0-3.1	Green River at Lock 4	0.0018	4160	7.390	n/a
Glens Fork of Russell Creek RM 0.0-8.0	Russell Creek near Columbia	0.0815	101	8.232	n/a
Little Barren River of Green River RM 0.0-8.8	Green River at Munfordville	0.3550	1130	197.769	0.789
Pettys Fork of Russell Creek RM 0.0-6.0	Russell Creek near Columbia	0.1649	101	16.650	n/a
Poplar Grove Branch of Big Brush Creek RM0.0-3.0	Green River at Munfordville	0.0058	1130	3.217	n/a
Russell Creek of Green River RM 40.0-41.5	Russell Creek near Columbia	0.7387	101	74.606	n/a
Valley Creek of Nolin River RM 0.0-3.5	Nolin River at WhiteMills	0.2634	247	65.050	11.14
Valley Creek of Nolin River RM 10.3-11.8	Nolin River at WhiteMills	0.0814	247	24.003	n/a

(1) This value is the ratio of the drainage area at the end of the impaired segment divided by the drainage area at the USGS gage.

(2) The KPDES flow is determined as the design capacity of the permitted facility.

The TMDL components listed below were calculated using the 50th percentile area-weighted flow as shown in Table 61. The TMDL is based on the fecal coliform water quality criterion of 400 col. The margin of safety is set at 10% of the TMDL. The WLA is the sum of all dischargers in the watershed at their maximum permitted value. The LA is the remainder of the TMDL minus the WLA and MOS.

Table 61. TMDLs calculated for each Stream Segment based on the 50th Percentile Area Weighted Flow at the Nearest Downstream USGS Gage.

Waterbody Name	TMDL col/day	MOS col/day	WLA col/day		LA col/day
			Wastewater	MS4	
Big Creek of Russell Creek RM 3.0-8.2	8.04×10^{10}	8.04×10^9	5.87×10^7	0.0	7.23×10^{10}
Big Pitman Creek of Green River RM 0.0- 13.6	1.00×10^{12}	1.00×10^{11}	6.51×10^{10}	2.23×10^{10}	8.15×10^{11}
Big Reedy Creek of Green River RM 7.5- 13.6	2.91×10^{11}	2.91×10^{10}	0.00	0.00	2.61×10^{11}
Billy Creek of Valley Creek RM 0.0-5.9	9.30×10^{10}	9.30×10^9	0.00	1.04×10^{10}	7.33×10^{10}
Butler Fork of Russell Creek RM 2.3-4.0	5.41×10^{10}	5.41×10^9	0.00	0.00	4.86×10^{10}
Casey Creek of Green River RM 3.7-4.7	4.67×10^{11}	4.67×10^{10}	0.00	0.00	4.21×10^{11}
Claylick Creek of Green River RM 2.0- 3.1	7.23×10^{10}	7.23×10^9	0.00	0.00	6.51×10^{10}
Glens Fork of Russell Creek RM 0.0-8.0	8.06×10^{10}	8.06×10^9	0.00	0.00	7.25×10^{10}
Little Barren River of Green River RM 0.0- 8.8	1.94×10^{12}	1.94×10^{11}	7.72×10^9	0.00	1.73×10^{12}
Pettys Fork of Russell Creek RM 0.0-6.0	1.63×10^{11}	1.63×10^{10}	0.00	0.00	1.47×10^{11}
Poplar Grove Branch of Big Brush Creek RM 0.0-3.0	3.15×10^{10}	3.15×10^9	0.00	0.00	2.83×10^{10}
Russell Creek of Green River RM 40.0-41.5	7.30×10^{11}	7.30×10^{10}	0.00	0.00	6.57×10^{11}
Valley Creek of Nolin River RM 0.0-3.5	6.37×10^{11}	6.37×10^{10}	1.09×10^{11}	8.57×10^{10}	3.78×10^{11}
Valley Creek of Nolin River RM 10.3 to 11.8	2.35×10^{11}	2.35×10^{10}	0.00	9.30×10^{10}	1.18×10^{11}

Appendix 2. Landuse Analysis

The land uses generated by the 2001 NLCD were consolidated for presentation purposes within Sections 3.0 and 8.4. 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 (Table 62).

Table 62. 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 to 100 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 3. KPDES Discharge Monitoring Data in Big Creek

Table 63. Results of Quarterly Discharge Monitoring Reports (DMR) for Sparksville Elementary School (KY0026182) in the Big Creek Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
3/31/2000	10	10
6/30/2000	10	10
9/30/2000	310 ¹	310 ¹
12/31/2000	10	10
3/31/2001	134	600 ¹
6/30/2001	10	10
9/30/2001	20	20
12/31/2001	64	410
3/31/2002	380 ¹	380 ¹
6/30/2002	77	600
9/30/2002	10	10
12/31/2002	10	10
3/31/2003	20	20
6/30/2003	77	600 ¹
9/30/2003	10	10
12/31/2003	110	110
3/31/2004	30	30
6/30/2004	10	10
9/30/2004	10	10
12/31/2004	10	10
3/31/2005	110	110
6/30/2005	10	10
9/30/2005	77	600 ¹
12/31/2005	10	10
3/31/2006	100	100
Percent Exceedances		
	8.3%	20.8%

¹ This is an exceedance of permitted limits.

Appendix 4. KPDES Discharge Monitoring Data in Pitman Creek

Table 64. Results of Quarterly Discharge Monitoring Reports (DMR) for Campbellsville STP (KY0054437) in the Little Pitman Creek Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	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

Reporting Date	Fecal Coliform col/100 ml	
	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

Reporting Date	Fecal Coliform col/100 ml	
	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%

Table 65. Results of Quarterly Discharge Monitoring Reports (DMR) for Green Co. Sanitation District #1 (KY0096881) in the Big Pitman Creek Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
1/31/2000	74	>600 ¹
2/29/2000	159	>600 ¹
3/31/2000	11	20
4/30/2000	62	>600 ¹
5/31/2000	10	<10
6/30/2000	156	>600 ¹
7/31/2000	28	50
8/31/2000	>59	>600 ¹
9/30/2000	59	110
10/31/2000	>110	>600 ¹
11/30/2000	>600 ¹	>600 ¹
12/31/2000	<77	>600 ¹
1/31/2001	131	580 ¹
2/28/2001	>252 ¹	>600 ¹
3/31/2001	<12	30
4/30/2001	>130	>600 ¹
5/31/2001	>138	>600 ¹
6/30/2001	<10	<10
7/31/2001	<33	>600 ¹
8/31/2001	<19	70
9/30/2001	<10	10
10/31/2001	<14	40
11/30/2001	<26	>600 ¹
12/31/2001	<22	50
1/31/2002	>26	>600 ¹
2/28/2002	<10	<10
3/31/2002	<21	200
4/30/2002	<37	>600 ¹
5/31/2002	<10	<10
6/30/2002	>271	>600 ¹
7/31/2002	>67	>600 ¹

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
8/31/2002	<34	450 ¹
9/30/2002	>173	>600 ¹
10/31/2002	<10	<10
11/30/2002	32	350
12/31/2002	20	160
1/31/2003	17	150
2/28/2003	<10	<10
3/31/2003	33	120
4/30/2003	111	600 ¹
5/31/2003	291 ¹	600 ¹
6/30/2003	100	600 ¹
7/31/2003	466 ¹	600 ¹
8/31/2003	10	10
9/30/2003	26	90
10/31/2003	10	10
11/30/2003	15	50
12/31/2003	139	600 ¹
1/31/2004	>28	>600 ¹
2/29/2004	21	210
3/31/2004	<10	<10
4/30/2004	51	260
5/31/2004	16	30
6/30/2004	<10	<10
7/31/2004	23	80
8/31/2004	N/A ²	N/A ²
9/30/2004	45	600 ¹
10/31/2004	54	320
11/30/2004	<10	<10
12/31/2004	<10	<10
1/31/2005	<10	<10
2/28/2005	N/A ²	N/A ²
3/31/2005	<10	<10
4/30/2005	14	40
5/31/2005	<10	<10

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
6/30/2005	59	220
7/31/2005	82	600 ¹
8/31/2005	69	150
9/30/2005	78	410 ¹
10/31/2005	<10	<10
11/30/2005	28	600 ¹
12/31/2005	<10	<10
Percent Exceedances		
	5.7%	42.8%

¹ This is an exceedance of permitted limits.

² DMR data not submitted from permitted facility

Appendix 5. KPDES Discharge Monitoring Data in Little Barren River

Table 66. Results of Quarterly Discharge Monitoring Reports (DMR) for Edmonton STP (KY0028100) in the Little Barren River Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	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

Reporting Date	Fecal Coliform col/100 ml	
	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

Reporting Date	Fecal Coliform col/100 ml	
	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 Nolin River

Table 67. Results of Quarterly Discharge Monitoring Reports (DMR) for Elizabethtown STP (KY0022039) in the Valley Creek Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
1/31/2000	4	226
2/29/2000	15	92
3/31/2000	83	279
4/30/2000	48	70
5/31/2000	37	137
6/30/2000	101	351
7/31/2000	12	27
8/31/2000	31	70
9/30/2000	12	39
10/31/2000	72	249
11/30/2000	64	279
12/31/2000	34	91
1/31/2001	12	20
2/28/2001	9	16
3/31/2001	14	36
4/30/2001	12	72
5/31/2001	12	59
6/30/2001	12	77
7/31/2001	86	173
8/31/2001	68	97
9/30/2001	106	170
10/31/2001	30	71
11/30/2001	37	312
12/31/2001	41	81
1/31/2002	118	318
2/28/2002	27	34
3/31/2002	45	63
4/30/2002	37	158
5/31/2002	59	162
6/30/2002	92	209
7/31/2002	31	117

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
8/31/2002	46	87
9/30/2002	15	29
10/31/2002	29	129
11/30/2002	45	66
12/31/2002	24	65
1/31/2003	4	10
2/28/2003	6	23
3/31/2003	9	16
4/30/2003	13	67
5/31/2003	26	41
6/30/2003	36	135
7/31/2003	10	18
8/31/2003	25	45
9/30/2003	32	61
10/31/2003	36	51
11/30/2003	65	276
12/31/2003	45	87
1/31/2004	23	70
2/29/2004	22	42
3/31/2004	48	85
4/30/2004	25	27
5/31/2004	21	37
6/30/2004	20	139
7/31/2004	17	61
8/31/2004	67	134
9/30/2004	58	92
10/31/2004	86	230
11/30/2004	26	66
12/31/2004	22	44
1/31/2005	116	138
2/28/2005	87	125
3/31/2005	12	53
4/30/2005	40	72
5/31/2005	19	36
6/30/2005	30	91

	Fecal Coliform col/100 ml	
Reporting Date	Monthly Average	Max Weekly Average
Permitted Limits	200	400
7/31/2005	29	228
8/31/2005	27	68
9/30/2005	116	369
10/31/2005	90	247
11/30/2005	95	150
12/31/2005	11	45
Percent Exceedances		
	0.0%	0.0%

Table 68. Results of Quarterly Discharge Monitoring Reports (DMR) for Hodgenville STP (KY0026379) in the Nolin River Watershed.

	Fecal Coliform col/100 ml	
Reporting Date	Monthly Average	Max Weekly Average
Permitted Limits	200	400
1/31/2000	65	65
2/29/2000	69	69
3/31/2000	70	70
4/30/2000	51	51
5/31/2000	50	50
6/30/2000	40	40
7/31/2000	40	40
8/31/2000	56	56
9/30/2000	40	40
10/31/2000	63	63
11/30/2000	70	70
12/31/2000	40	40
1/31/2001	58	58
2/28/2001	69	69
3/31/2001	62	62
4/30/2001	67	67
5/31/2001	70	70
6/30/2001	64	64

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
7/31/2001	20	20
8/31/2001	<20	<20
9/30/2001	<20	<20
10/31/2001	<20	<20
11/30/2001	60	180
12/31/2001	20	20
1/31/2002	108	340
2/28/2002	30	60
3/31/2002	100	340
4/30/2002	30	60
5/31/2002	72	280
6/30/2002	80	20
7/31/2002	24	40
8/31/2002	20	20
9/30/2002	45	120
10/31/2002	32	80
11/30/2002	20	20
12/31/2002	20	20
1/31/2003	28	60
2/28/2003	20	20
3/31/2003	20	20
4/30/2003	190	820 ¹
5/31/2003	55	160
6/30/2003	55	160
7/31/2003	20	20
8/31/2003	52	110
9/30/2003	375 ¹	700 ¹
10/31/2003	44	100
11/30/2003	53	150
12/31/2003	74	280
1/31/2004	35	80
2/29/2004	105	340
3/31/2004	64	180
4/30/2004	60	160
5/31/2004	267 ¹	540 ¹
6/30/2004	72	240

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
7/31/2004	273 ¹	780 ¹
8/31/2004	448 ¹	1200 ¹
9/30/2004	40	20
10/31/2004	40	140
11/30/2004	105	240
12/31/2004	310 ¹	1200 ¹
1/31/2005	150	340
2/28/2005	555 ¹	1200 ¹
3/31/2005	438 ¹	640 ¹
4/30/2005	245 ¹	920 ¹
5/31/2005	320 ¹	1200 ¹
6/30/2005	680 ¹	1200 ¹
7/31/2005	645 ¹	1200 ¹
8/31/2005	215 ¹	760 ¹
9/30/2005	22	40
10/31/2005	45	120
11/30/2005	100	20
12/31/2005	20	20
1/31/2006	375 ¹	1200 ¹
2/28/2006	35	60
3/31/2006	28	60
4/30/2006	.20	.20
5/31/2006	292 ¹	1200 ¹
Percent Exceedances		
	18%	19%

¹ This is an exceedance of permitted limits.

Table 69. Results of Quarterly Discharge Monitoring Reports (DMR) for Glendale Auto Truck Plaza (KY0029700) in the Nolin River Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200 col/100 ml	400 col/100ml
1/31/2000	60	60
2/29/2000	<20	<20
3/31/2000	80	80
4/30/2000	<20	<20
5/31/2000	<20	<20
6/30/2000	<20	<20
7/31/2000	20	20
8/31/2000	<20	<20
9/30/2000	<20	<20
10/31/2000	<20	<20
11/30/2000	<20	<20
12/31/2000	<20	<20
1/31/2001	<20	<20
2/28/2001	<20	<20
3/31/2001	40	40
4/30/2001	120	120
5/31/2001	20	20
6/30/2001	140	140
7/31/2001	60	60
8/31/2001	20	20
9/30/2001	<146	<146
10/31/2001	<20	<20
11/30/2001	<20	<20
12/31/2001	60	60
1/31/2002	1200 ¹	1200 ¹
2/28/2002	<20	<20
3/31/2002	<20	<20
4/30/2002	20	20
5/31/2002	<20	<20
6/30/2002	<20	<20
7/31/2002	860 ¹	860 ¹
8/31/2002	300 ¹	300
9/30/2002	<20	<20
10/31/2002	60	60
11/30/2002	<20	<20
12/31/2002	<20	<20
1/31/2003	<20	<20

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200 col/100 ml	400 col/100ml
2/28/2003	<20	<20
3/31/2003	<20	<20
4/30/2003	120	120
5/31/2003	<20	<20
6/30/2003	<20	<20
7/31/2003	<20	<20
8/31/2003	<20	<20
9/30/2003	20	20
10/31/2003	<20	<20
11/30/2003	<20	<20
12/31/2003	<20	<20
1/31/2004	<20	<20
2/29/2004	<20	<20
3/31/2004	<20	<20
4/30/2004	<20	<20
5/31/2004	<20	<20
6/30/2004	<10	<10
7/31/2004	<10	<10
8/31/2004	<10	<10
9/30/2004	<10	<10
10/31/2004	<10	<10
11/30/2004	<10	<10
12/31/2004	100	100
1/31/2005	40	40
2/28/2005	10.0	10.0
3/31/2005	<10	<10
4/30/2005	<10	<10
5/31/2005	<10	<10
6/30/2005	50.0	50.0
7/31/2005	<10.0	<10.0
8/31/2005	<10.0	<10.0
9/30/2005	<10.0	<10.0
10/31/2005	<10.0	<10.0
11/30/2005	<10	<10
12/31/2005	<10.0	<10.0
1/31/2006	290 ¹	290
2/28/2006	<10.0	<10.0
3/31/2006	<10.0	<10.0
4/30/2006	10.0	10.0
5/31/2006	<10	<10

	Fecal Coliform col/100 ml	
Reporting Date	Monthly Average	Max Weekly Average
Permitted Limits	200 col/100 ml	400 col/100ml
Percent Exceedances		
	5.2%	2.6%

¹ This is an exceedance of permitted limits.

Table 70. Results of Quarterly Discharge Monitoring Reports (DMR) for Glen Dale Childrens Home (KY0073644) in the Nolin River Watershed.

	Fecal Coliform col/100 ml	
Reporting Date	Monthly Average	Max Weekly Average
Permitted Limits	200 col/100 ml	400 col/100ml
4/30/2000	10	10
5/31/2000	<10	<10
6/30/2000	10	10
7/31/2000	10	10
8/31/2000	240 ¹	240
9/30/2000	<10	<10
Percent Exceedances		
	16.7%	0.0%

¹ This is an exceedance of permitted limits.

Table 71. Results of Quarterly Discharge Monitoring Reports (DMR) for Pilot Travel Center #48 (KY0080764) in the Nolin River Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200 col/100 ml	400 col/100 ml
7/31/2000	6650 ¹	11000 ¹
8/31/2000	1200 ¹	1600 ¹
9/30/2000	8150 ¹	16000 ¹
10/31/2000	4120 ¹	7600 ¹
11/30/2000	14000 ¹	14000 ¹
12/31/2000	180	180
1/31/2001	72	72
2/28/2001	<2.0	<2.0
3/31/2001	58	58
4/30/2001	4525 ¹	8800 ¹
5/31/2001	8050 ¹	13000 ¹
6/30/2001	12	12
7/31/2001	1850 ¹	2600 ¹
8/31/2001	>601 ¹	>1200 ¹
9/30/2001	>1200000 ¹	>1200000 ¹
10/31/2001	100	100
11/30/2001	610	700
2/28/2002	1.0	1.0
3/31/2002	1.0	1.0
4/30/2002	20000 ¹	20000 ¹
5/31/2002	20.000	20.000
6/30/2002	2200 ¹	2200 ¹
7/31/2002	20000 ¹	20000 ¹
8/31/2002	20000 ¹	20000 ¹
9/30/2002	200	200
10/31/2002	740 ¹	740 ¹
11/30/2002	2060 ¹	2060 ¹
12/31/2002	<2.0	<2.0
1/31/2003	<2.0	<2.0
2/28/2003	<10	<10
3/31/2003	<2.0	<2.0
4/30/2003	<2.0	<2.0
5/31/2003	<2.0	<2.0
6/30/2003	<2.0	<2.0
7/31/2003	<20	<20
8/31/2003	<2.0	<2.0
9/30/2003	<2.0	<2.0

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200 col/100 ml	400 col/100 ml
10/31/2003	<2.0	<2.0
11/30/2003	<2.0	<2.0
12/31/2003	<20.0	<20.0
1/31/2004	<20	<20
2/29/2004	<20	<20
3/31/2004	<20.0	<20.0
4/30/2004	<20.0	<20.0
5/31/2004	<20	<20
6/30/2004	<20	<20
7/31/2004	<20	<20
8/31/2004	<20	<20
9/30/2004	<20.0	<20.0
10/31/2004	<20.0	<20.0
11/30/2004	40	40
1/31/2005	1300 ¹	1300 ¹
5/31/2005	50	50
1/31/2006	50	50
3/31/2006	50	50
Percent Exceedances		
	30.9%	30.9%

¹ This is an exceedance of permitted limits.

Table 72. Results of Quarterly Discharge Monitoring Reports (DMR) for Petro Stopping Center (KY0103560) in the Nolin River Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200 col/100 ml	400 col/100 ml
8/31/2000	<20	<20
9/30/2000	<20	<20
10/31/2000	<20	<20
11/30/2000	<20	<20
12/31/2000	40	40
1/31/2001	<20	<20
2/28/2001	<20	<20
3/31/2001	<20	<20
4/30/2001	<20	<20
5/31/2001	20	20
6/30/2001	<20	<20
7/31/2001	20	20
8/31/2001	<20	<20
9/30/2001	20	20
10/31/2001	<20	<20
11/30/2001	<20	<20
12/31/2001	<20	<20
1/31/2002	N/A	N/A
2/28/2002	<20	<20
3/31/2002	60	60
4/30/2002	120	120
5/31/2002	<20	<20
6/30/2002	30	30
7/31/2002	20	20
8/31/2002	<20	<20
9/30/2002	40	40
10/31/2002	<20	<20
11/30/2002	<20	<20
12/31/2002	20	20
1/31/2003	<20	<20
2/28/2003	20	20
3/31/2003	<20	<20
4/30/2003	<20	<20
5/31/2003	<.20	<.20
6/30/2003	40	40
7/31/2003	77	77
8/31/2003	740 ¹	740 ¹

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200 col/100 ml	400 col/100 ml
9/30/2003	<20	<20
10/31/2003	<20	<20
11/30/2003	160	160
12/31/2003	<20	<20
1/31/2004	120	120
2/29/2004	<20	<20
3/31/2004	<20	<20
4/30/2004	<20	<20
5/31/2004	<20	<20
6/30/2004	<10	<10
7/31/2004	<10	<10
8/31/2004	10	10
9/30/2004	<10	<10
10/31/2004	<10	<10
11/30/2004	<10	<10
12/31/2004	10	10
1/31/2005	220 ¹	220
2/28/2005	77	600 ¹
3/31/2005	134	134
4/30/2005	<10.0	<10.0
5/31/2005	<10	<10
6/30/2005	<10.0	<10.0
7/31/2005	<10.0	<10.0
8/31/2005	<10.0	<10.0
9/30/2005	<10.0	<10.0
10/31/2005	<10.0	<10.0
11/30/2005	10	10
12/31/2005	<10.0	<10.0
1/31/2006	50.0	50.0
2/28/2006	<10.0	<10.0
3/31/2006	<10.0	<10.0
4/30/2006	10.0	10.0
5/31/2006	1200 ¹	1200 ¹
Percent Exceedances		
	4.3%	4.3%

¹ This is an exceedance of permitted limits.

Appendix 7. KPDES Discharge Monitoring Data in Valley Creek

Table 73. Results of Quarterly Discharge Monitoring Reports (DMR) for Elizabethtown STP (KY0022039) in the Valley Creek Watershed.

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
1/31/2000	4	226
2/29/2000	15	92
3/31/2000	83	279
4/30/2000	48	70
5/31/2000	37	137
6/30/2000	101	351
7/31/2000	12	27
8/31/2000	31	70
9/30/2000	12	39
10/31/2000	72	249
11/30/2000	64	279
12/31/2000	34	91
1/31/2001	12	20
2/28/2001	9	16
3/31/2001	14	36
4/30/2001	12	72
5/31/2001	12	59
6/30/2001	12	77
7/31/2001	86	173
8/31/2001	68	97
9/30/2001	106	170
10/31/2001	30	71
11/30/2001	37	312
12/31/2001	41	81
1/31/2002	118	318
2/28/2002	27	34
3/31/2002	45	63
4/30/2002	37	158
5/31/2002	59	162
6/30/2002	92	209
7/31/2002	31	117

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
8/31/2002	46	87
9/30/2002	15	29
10/31/2002	29	129
11/30/2002	45	66
12/31/2002	24	65
1/31/2003	4	10
2/28/2003	6	23
3/31/2003	9	16
4/30/2003	13	67
5/31/2003	26	41
6/30/2003	36	135
7/31/2003	10	18
8/31/2003	25	45
9/30/2003	32	61
10/31/2003	36	51
11/30/2003	65	276
12/31/2003	45	87
1/31/2004	23	70
2/29/2004	22	42
3/31/2004	48	85
4/30/2004	25	27
5/31/2004	21	37
6/30/2004	20	139
7/31/2004	17	61
8/31/2004	67	134
9/30/2004	58	92
10/31/2004	86	230
11/30/2004	26	66
12/31/2004	22	44
1/31/2005	116	138
2/28/2005	87	125
3/31/2005	12	53
4/30/2005	40	72
5/31/2005	19	36
6/30/2005	30	91

Reporting Date	Fecal Coliform col/100 ml	
	Monthly Average	Max Weekly Average
Permitted Limits	200	400
7/31/2005	29	228
8/31/2005	27	68
9/30/2005	116	369
10/31/2005	90	247
11/30/2005	95	150
12/31/2005	11	45
Percent Exceedances		
	0.0%	0.0%

