Final Total Maximum Daily Load for Fecal Coliform - Four Stream Segments within the Townsend Creek Watershed

Bourbon and Harrison Counties, Kentucky

Townsend Creek, Bourbon County, KDOW

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Commonwealth of Kentucky
Steven L. Beshear, Governor

Energy and Environment Cabinet
Len Peters, Secretary

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July 2011

Kentucky Department for Environmental Protection
Division of Water

This report is approved for release

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

7/21/11
Date

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TABLE OF CONTENTS

LIST OF FIGURES

*******All figures created by KDOW TMDL Section within a Geographic Information Systems framework (ArcMap 9.3) in 2011, unless otherwise noted.**

LIST OF TABLES

LIST OF ACRONYMS

ADD	Area Development District
AFO	Animal Feeding Operation
AWQA	Agriculture Water Quality Act
BMP	Best Management Practices
BMU	Basin Management Unit
CAFO	Confined Animal Feeding Operation
CFR	Code of Federal Regulations
CPP	Continuing Planning Process
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
DEP	Department of Environmental Protection
DMR	Discharge Monitoring Report
GIS	Geographic Information System
GNIS	Geographic Names Information System
HUC	Hydrologic Unit Code
KAR	Kentucky Administrative Regulations
KDOC	Kentucky Division of Conservation
KDOW	Kentucky Division of Water
KGS	Kentucky Geological Survey
KRS	Kentucky Revised Statutes
KIA	Kentucky Infrastructure Authority
KNDOP	Kentucky No Discharge Operating Permit
KPDES	Kentucky Pollution Discharge Elimination System
LA	Load Allocations
LTCP	Long Term Control Plan
MAF	Mean Annual Flow
MGD	Million Gallons per Day
MHP	Mobile Home Park
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agricultural Statistics Service
NHD	National Hydrography Dataset
NLCD	National Landcover Database
NRCS	Natural Resources Conservation Service
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Source
NOV	Notice of Violation
OSTDS	On Site Sewage Treatment and Disposal System
PCR	Primary Contact Recreation
POTW	Publicly Owned Treatment Works
QAPP	Quality Assurance Project Plan
RM	River Mile

SCR	Secondary Contact Recreation
SOP	Standard Operating Procedures
SSO	Sanitary Sewer Overflow
SWS	Sanitary Wastewater System
SWQMP	Storm Water Quality Management Plan
TMDL	Total Maximum Daily Load
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WAH	Warm Water Aquatic Habitat
WBID	Waterbody Identification Number
WBP	Watershed Based Plan
WLA	Waste Load Allocation
WMB	Watershed Management Branch
WQB	Water Quality Branch
WQC	Water Quality Criteria
WQS	Water Quality Standard
WWTP	Wastewater Treatment Plant

Total Maximum Daily Load (TMDL) Synopsis

State: Kentucky
Major River Basin: South Fork Licking River
HUC8: 05100102
Counties: Bourbon, Harrison
Pollutant of Concern: Bacteria

Table S.1 Impaired Waterbodies Addressed in this Bacteria TMDL Document

Waterbody Name	Pollutant	County	GNIS Number	Suspected Sources	Impaired Use
Townsend Creek 2.9 to 4.8 into South Fork Licking River	Fecal coliform	Bourbon	KY505401_02	Agriculture, Livestock, On-Site Sewage Treatment Systems, Unknown	Primary Contact Recreation (PCR; partial support)
Townsend Creek 4.8 to 10.0 into South Fork Licking River	Fecal coliform	Bourbon	KY505401_03	Agriculture, Livestock, On-Site Sewage Treatment Systems, Unknown	PCR (nonsupport)
Huskens Run 0.2 to 1.5 into Townsend Creek	Fecal coliform	Harrison	KY494854_01	Agriculture, Livestock, On-Site Sewage Treatment Systems, Unknown	PCR (nonsupport)
Townsend Creek 11.8 to 14.9 into South Fork Licking River	Fecal coliform	Bourbon	KY505401_05	Agriculture, Livestock, On-Site Sewage Treatment Systems, Unknown	PCR (nonsupport)

Policy and Purpose to Water Quality:

Section 303(d) of the Federal Clean Water Act declares that "each State shall identify those waters within its boundaries for which effluent limitations… are not stringent enough to implement any water quality standard applicable to such waters. The State shall establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters…. Each State shall establish for the waters identified in this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies… for such calculation. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety."

Kentucky Revised Statute (KRS) Chapter 224 states, "It is hereby declared to be the policy of this Commonwealth…. to provide a comprehensive program in the public interest for the prevention, abatement and control of pollution; to provide effective means for the execution and enforcement of such program; and to provide for cooperation with agencies of other states or of the federal government in carrying out these objectives…. the purposes of KRS Chapter 224: to safeguard from pollution the uncontaminated waters of the Commonwealth; to prevent the creation of any new pollution of the waters of the Commonwealth; and to abate any existing pollution."

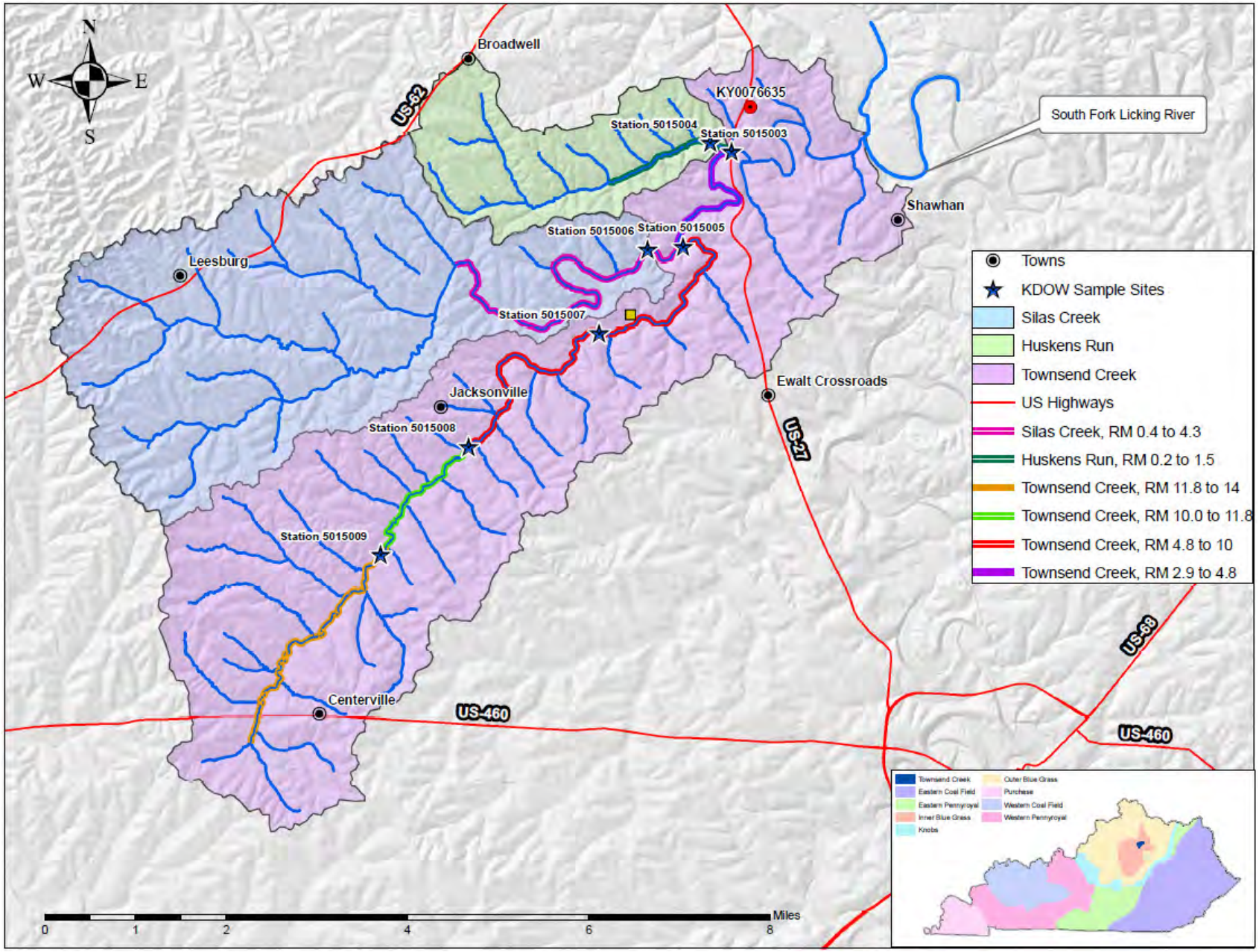

Figure S.1 Location of the Townsend Creek Watershed, Sample Sites and Assessed Stream Segments

Kentucky Water Quality Criteria (WQC) for Fecal Coliform:

Title 401 KAR 10:031 describe the standards used to "protect the surface waters of the Commonwealth, and thus protect water resources." Fecal coliform bacteria are pathogen indicator organisms. Fecal coliform data are used to indicate the degree of support for primary contact recreation (PCR) use. The stream is assessed as fully supporting the PCR use if the fecal coliform content does not exceed the criterion of 400 colonies per 100 ml in less than 20 percent of samples; it was assessed as partially supporting the PCR use if the criterion was not met in 25-33 percent of samples, and as not supporting the PCR use if the criterion was not met in greater than 33 percent of samples. Streams assessed as either nonsupport or partial support are considered impaired. Stream segments were sampled once per month during the primary contact recreation season of May 1 through October 31, 2006.

TMDL Endpoints (i.e., Water Quality Standard/ Fecal Coliform TMDL Target):

The TMDL Target is defined as the WQC minus the Margin of Safety (MOS). The MOS can be an implicit or explicit additional reduction applied to the Waste Load allocation (WLA), Load Allocation (LA) or to both types of sources that accounts for uncertainties in the data or TMDL calculations. The TMDL Target is thus 360 colonies per 100ml (400 col/100ml minus a 10% MOS).

TMDL Equation and Definitions:

A TMDL calculation is performed as follows:

$$TMDL = WLA + LA + MOS$$
(Equation 1)

The WLA has three components:

$$WLA = SWS\text{-}WLA + MS4\text{-}WLA + Future\ Growth\text{-}WLA$$
(Equation 2)

Where:

TMDL: the WQC, expressed as a load. The WQC is defined in Section 5.0 as an instantaneous concentration of 400 colonies/100 ml.

MOS: the Margin of Safety, which can be an implicit or explicit additional reduction applied to sources of pollutants that accounts for uncertainties in the relationship between effluent limits and water quality.

TMDL Target: the TMDL minus the MOS.

WLA: the Wasteload Allocation, which is the allowable loading of pollutants into the stream from KPDES-permitted sources, such as SWSs and MS4s.

SWS-WLA: the WLA for KPDES-permitted sources, which have discharge limits for pathogens (including wastewater treatment plants, package plants and home units).

Remainder: the TMDL minus the MOS and minus the SWS-WLA (also equal to Future Growth-WLA plus the MS4-WLA and the LA).

Future Growth-WLA: the allowable loading for future KPDES-permitted sources, including new SWSs, expansion of existing SWSs, new storm water sources, and growth of existing storm water sources (such as MS4s).

MS4-WLA: the WLA for KPDES-permitted municipal separate storm water sewer systems (including cities, counties, universities and military bases).
KYTC MS4-WLA: the WLA for roads and right-of-ways that are present within designated MS4 boundaries and owned by the Kentucky Transportation Cabinet.
University MS4-WLA: the WLA for universities that are municipal separate storm sewer systems.
Military MS4-WLA: the WLA for military bases that are municipal separate storm sewer systems.
LA: the Load Allocation, which is the allowable loading of pollutants into the stream from sources not permitted by KPDES and from natural background.
Seasonality: Yearly factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.
Critical Condition: When the pollutant conditions are expected to be at their worst.
MAF: the Mean Annual Flow as defined by USGS.
Adjusted MAF: the MAF plus SWS-WLA design flows (where applicable).
Critical Flow: the flow used to calculate the TMDL as a load (equivalent to the Adjusted MAF for MAF TMDLS)
Existing Conditions: the load that exists in the watershed at the time of TMDL development (i.e., sampling) that is causing the impairment.
Percent Reduction: the bacteria loading reduction needed to bring the existing conditions in line with the TMDL Target.
Load: Concentration * Flow * Conversion Factor
Concentration: colonies per 100 milliliters (col/100ml)
Flow (i.e. stream discharge): cubic feet per second (cfs)
Conversion Factor: the value that converts the product of Concentration and Flow to Load (in units of colonies per day); it is derived from the calculation of the following components: (28.31685L/cf * 86400sec/day * 1000ml/L)/ (100ml) and is equal to 24465758.4

Calculation Procedure:

1) The MOS, if an explicit value, is calculated and subtracted from the TMDL first, giving the TMDL Target;
2) Percent reductions are calculated to show the difference between Existing Conditions and the TMDL Target;
3) The SWS-WLA (if applicable) is calculated and subtracted from the TMDL Target, leaving the Remainder;
4) The Future Growth-WLA is calculated and subtracted from the Remainder;
5) If there is a MS4 present upstream of the impaired segment, the Transportation-WLA (if applicable) is subtracted from the Remainder based on its area within the MS4;
6) The MS4-WLA (if applicable) is subtracted from the Remainder based on percent land use, leaving the LA.

There are no SWS's or MS4's discharging to an impaired segment in Townsend Creek, only future growth is represented in the WLA.

TMDL Calculations:

Due to the absence of stream gages or in-stream flow data in the Townsend Creek Watershed, KDOW used the U.S. Geological Survey's (USGS's) Mean Annual Streamflow (MAF) values. The MAF values were calculated using a three-variable regression equation found in the USGS Water-Resources Investigations Report 02-4206 "Estimating Mean Annual Streamflow of Rural Streams in Kentucky" (http://ky.water.usgs.gov/pubs/wrir_2002_4206.pdf). The MAF values can be found on the Hydrology of Kentucky webpage (http://kygeonet.ky.gov/kyhydro/main.htm). Once obtained (and if applicable), major inputs (i.e. WWTP flow) and withdrawals were integrated to generate a critical flow. The critical flow is then multiplied by the WQC minus the MOS (10%) times the appropriate conversion factors to obtain the TMDL Target load. Allowable loadings from KPDES-permitted sources are then subtracted from the Target load to produce the Remainder. Future growth and MS4-WLA (if applicable) calculations are then performed and subtracted from the Remainder, leaving the LA.

The TMDL, allocations, and percent reductions for each impaired segment are provided in the table below. Percent reductions are for informational purposes only. In addition, bacteria-impaired segments addressed in this document could be converted to an *Escherichia coli* (*E. coli*) daily load by using the WQC for *E. coli* – these calculations are provided in Appendix A.

Table S.2 TMDLs and Allocations

TMDL[(1)]	MOS[(2)]	WLA[(3)]	Future Growth - WLA	LA	Mean Annual Flow (cfs)	Percent Reduction[(4)]
Townsend Creek into South Fork Licking River RM 2.9-4.8						
4.29×10^{11} col/day	4.29×10^{10} col/day	0.0 col/day	3.86×10^{9} col/day	3.82×10^{11} col/day	43.8	85%
Townsend Creek into South Fork Licking River RM 4.8-10.0						
2.04×10^{11} col/day	2.04×10^{10} col/day	0.0 col/day	1.83×10^{9} col/day	1.81×10^{11} col/day	20.8	87.23%
Townsend Creek into South Fork Licking River RM 11.8-14.9						
9.59×10^{10} col/day	9.59×10^{9} col/day	0.0 col/day	8.63×10^{8} col/day	8.55×10^{10} col/day	9.8	84.21%
Huskens Run into Townsend Creek RM 0.2-1.5						
4.6×10^{10} col/day	4.6×10^{9} col/day	0.0 col/day	4.14×10^{8} col/day	4.10×10^{10} col/day	4.7	85%

Notes:

(1). TMDLs are expressed as daily loads of fecal colonies by multiplying the WQC by the mean annual streamflow (MAF) and the appropriate conversion factor. MAF is determined by the USGS. The TMDL is the sum of all components. Daily loads for *E. coli* are provided in Appendix A.

(2). MOS is explicitly set at 10% of the Water Quality Criterion

(3). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Criterion in 401 KAR 5:031, and must not cause or contribute to an existing impairment. 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). Overall reduction needed during the 2006 PCR season to achieve the TMDL target of 360 colonies per 100ml. Percent reductions are provided for informational purposes only – see Appendix A.

KPDES Wastewater Discharges to Surface Waters Addressed in these Bacteria TMDLs:

There are currently no KPDES-permitted wastewater sources discharging to an impaired segment within Townsend Creek therefore no KPDES permits were addressed in these TMDLs.

Translation of WLAs into Permit Limits

There are currently no KPDES permitted sources discharging to an impaired segment in Townsend Creek. The Future Growth-WLA is reserved for future KPDES permitted sources and will be translated into new permits in the following manner.

All future SWS-WLAs will be translated into KPDES permit limits as an *E. coli* effluent gross limit of 130 colonies/100 ml as a monthly average and 240 colonies/100 ml as a maximum weekly average or as a fecal coliform effluent gross limit of 200 colonies/100 ml as a monthly average and 400 colonies/100 ml as a maximum weekly average.

Future MS4-WLAs will be addressed through the KDOW Storm Water permitting program.

1.0 Introduction

Section 303(d) of the Clean Water Act requires states to identify waterbodies within their boundaries that have been assessed and are not currently meeting their designated uses (per 401 KAR 10:026 and 10:031). States must establish a priority ranking for such waters, taking into account its intended uses and the severity of the pollutant. Section 303(d) also requires that states provide a list of this information called the 303(d) list. This list is submitted to the Environmental Protection Agency (EPA) during even-numbered years and each submittal replaces the previous list. The 2010 303(d) information for Kentucky can be found in the *2010 Draft Integrated Report to Congress on the Condition of Water Resources in Kentucky Volume II. 303(d) List of Surface Waters* (KDOW 2010a) and can be obtained at http://water.ky.gov.

States are also required to develop Total Maximum Daily Loads (TMDLs) for the pollutants that cause each waterbody to fail to meet its designated uses. The TMDL process establishes the allowable amount (i.e. "load") of pollutant a waterbody can naturally assimilate while continuing to meet the water quality criteria (WQC) for each designated use. The pollutant load must be established at a level necessary to implement the applicable WQC with seasonal variations and a margin of safety (MOS) which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. A TMDL can consequently provide an analytical foundation for identifying, planning, and implementing water quality-based controls to reduce pollution from both KPDES-permitted and non KPDES-permitted sources. The ultimate goal is the restoration and maintenance of water quality in the waterbody so that designated uses are met.

This TMDL report provides important bacteria allocations and reductions that could assist with developing detailed watershed plans to guide watershed restoration efforts. Watershed Plans for the bacteria impaired Townsend Creek waterbodies should address both KPDES-permitted (point) and non KPDES-permitted (nonpoint) sources of bacteria loadings to the watersheds and should build on existing efforts as well as evaluate new approaches. Comprehensive Watershed Plans should consider both voluntary and regulatory approaches in order to meet water quality standards.

2.0 Problem Definition

The South Fork Licking River Basin, United States Geological Survey (USGS) hydrologic unit code (HUC) 05100102 is located in central Kentucky just northeast of the intersection of Interstates 75 and 64 near Lexington, Kentucky. The area of interest is near the midpoint of the HUC and Silas/Townsend Creek form the divide between two counties: the northern boundary of Bourbon and southern boundary of Harrison (Figure 2.1).

2.1 303(d) Listing History

KDOW first assessed Townsend Creek, from River Mile (RM) 0.0 to 4.9 in the 2002 Integrated Report as impaired (nonsupport) for the PCR (i.e. swimming) designated use. The KDOW TMDL Section revisited the watershed in 2006 in a collaborative sampling effort with the Licking River Watershed Watch (LRWW) and the Nature Conservancy (TNC). The purpose of this latest sampling effort was twofold: to establish baseline data in the watershed prior to implementing Best Management Practices (BMPs; see Section 9) and to provide fecal coliform data for TMDL development. As a result of the sampling effort, KDOW proposes adding one tributary (Huskens Run) and three segments of Townsend Creek to the 2011 Integrated Report to Congress Electronic Update as impaired for PCR. Segments found to be fully supporting are discussed in Section 4. The fecal coliform TMDL stream segments addressed in this document are listed in Table 2.1 and illustrated on Figure 2.1.

Data used to assess these waterbodies included fecal coliform data collected by the KDOW TMDL Section and LRWW/TNC (in cooperation with KDOW and as funded by a Section 319(h) Nonpoint Source Implementation Grant). General watershed data, available from the Kentucky Geography Network (i.e., geology, land use, location of KPDES-permitted sources, etc. http://kygeonet.ky.gov) was also analyzed in a geographic information systems (GIS) framework. Fecal coliform data are used as an indicator of the presence of bacteria pollution. Suspected sources of impairment include non-KPDES permitted sources (failing Onsite Sewage Treatment and Disposal Systems (OSTDSs), agriculture, livestock, illegal straight-pipe discharge and rural runoff) as well as KPDES permitted sources (Other Permitted Small Flows Discharges).

Table 2.1 Impaired Waterbodies within the Townsend Creek Watershed (USGS HUC 05100102) Addressed in this TMDL Document

Waterbody Name	Pollutant	County	GNIS Number	Suspected Sources	Impaired Use (Support Status)
Townsend Creek 2.9 to 4.8 into South Fork Licking River	Fecal coliform	Bourbon	KY505401_02	Agriculture, Unknown	Primary Contact Recreation (PCR; partial support)
Townsend Creek 4.8 to 10.0 into South Fork Licking River	Fecal coliform	Bourbon	KY505401_03	Agriculture, Unknown	PCR (nonsupport)
Huskens Run 0.2 to 1.5 into Townsend Creek	Fecal coliform	Harrison	KY494854_01	Unknown	PCR (nonsupport)
Townsend Creek 11.8 to 14.9 into South Fork Licking River	Fecal coliform	Bourbon	KY505401_05	Agriculture, Unknown	PCR (nonsupport)

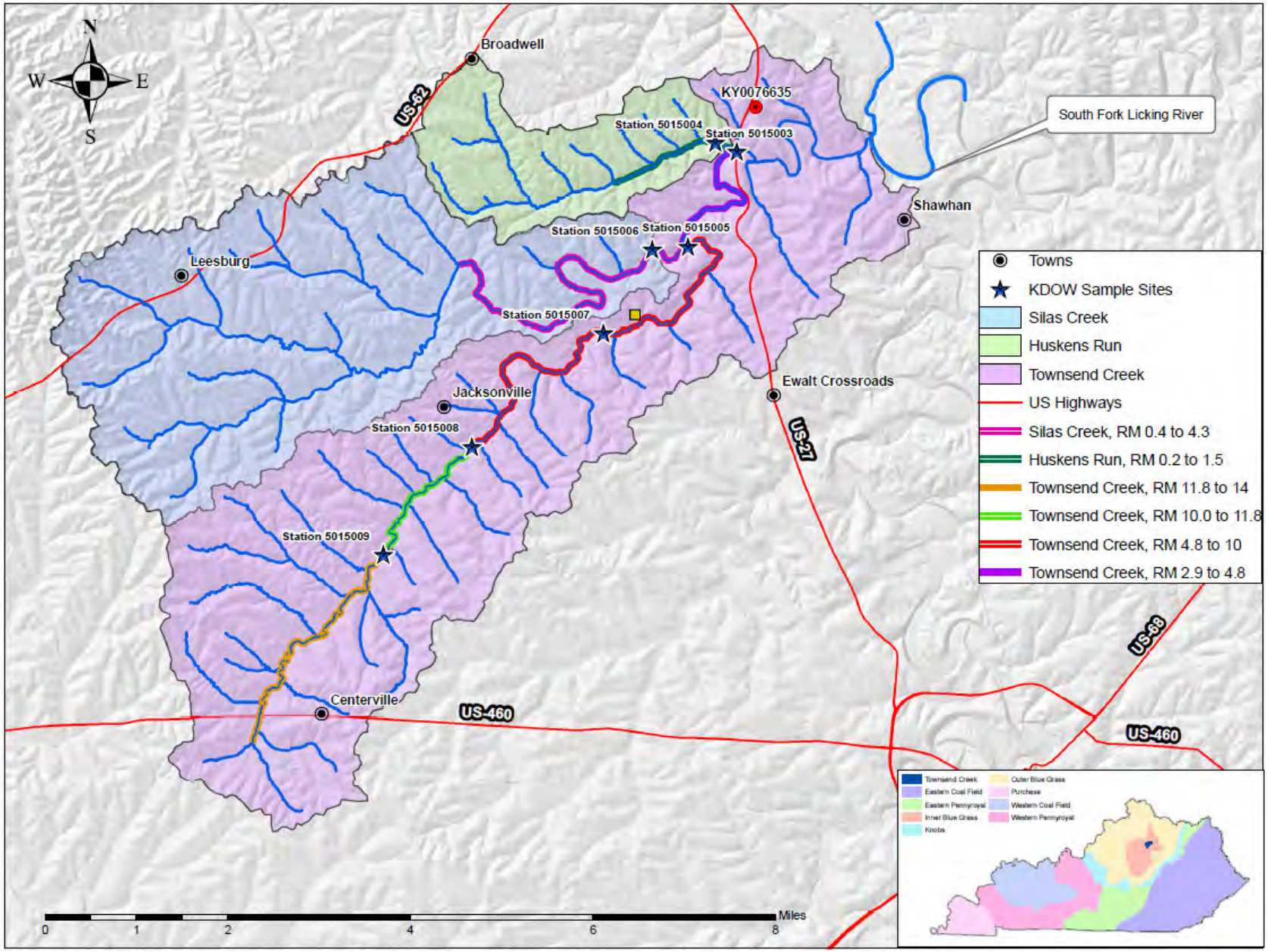

Figure 2.1 Location of the Townsend Creek Watershed (USGS HUC 05100102-0401) and Assessed Stream Segments

3.0 Physical Setting

The Townsend Creek watershed is located less than five miles northwest of the city of Paris (fifteen miles northeast of Lexington) and covers about 40 square miles. The stream flows northeast draining two tributaries (Huskens Run and Silas Creek) before emptying into the SF Licking River near RM 60.5; the SF Licking River continues north joining the Licking River near Walton, Kentucky before discharging into the Ohio River in Covington, Kentucky.

3.1 Geology

Townsend Creek straddles the Inner and Outer Bluegrass ecoregions of the Interior Plateau Level III ecoregion (Woods et al 2002). It also lies within the Inner Bluegrass physiographic region.

Townsend Creek is located near the boundary of the inner and outer bluegrass physiographic regions – the inner is associated with the middle Ordovician period while the outer is associated with the upper Ordovician period. Major formations in the area include the Tanglewood Limestone member, upper Lexington Limestone (both associated with the middle Ordovician period and the inner bluegrass physiographic region) and the Clays Ferry formation (associated more with the upper Ordovician period and outer bluegrass physiographic region). As such, many of the formations/members in the watershed intertongue with each other.

Bedrock encountered in the headwaters or ridgetops of the watershed may be limestone with few fossils while the mid to lower portions may be calcarenite with more shale and fossils – the latter being more prone to erosion and karst features and mostly encountered around streams. Formations near the surface of the watershed were deposited around 490 million years ago in warm, shallow seas during the middle to upper Ordovician period. This shallow depositional environment allowed the concentration and crushing of phosphate grains (from shells and aquatic life). In time, these formations have eroded to provide the fertile soils of the area.

Typical karst features including numerous mapped sinkholes and springs characterize most of the Townsend Creek watershed. Dye tracing has been performed in the Cooper Run watershed to the south – the Hutson karst tributary and basin originates as a swallet in this watershed but surfaces as a spring in Townsend Creek just south of Jacksonville. There is currently no other tracer data available.

A generalized block diagram of the karst limestone present in the area, drawn by James Currens of the Kentucky Geological Survey (KGS), is provided as Figure 3.1. A generalized geologic map overlain with mapped sinkholes, springs, and faults is included as Figure 3.2.

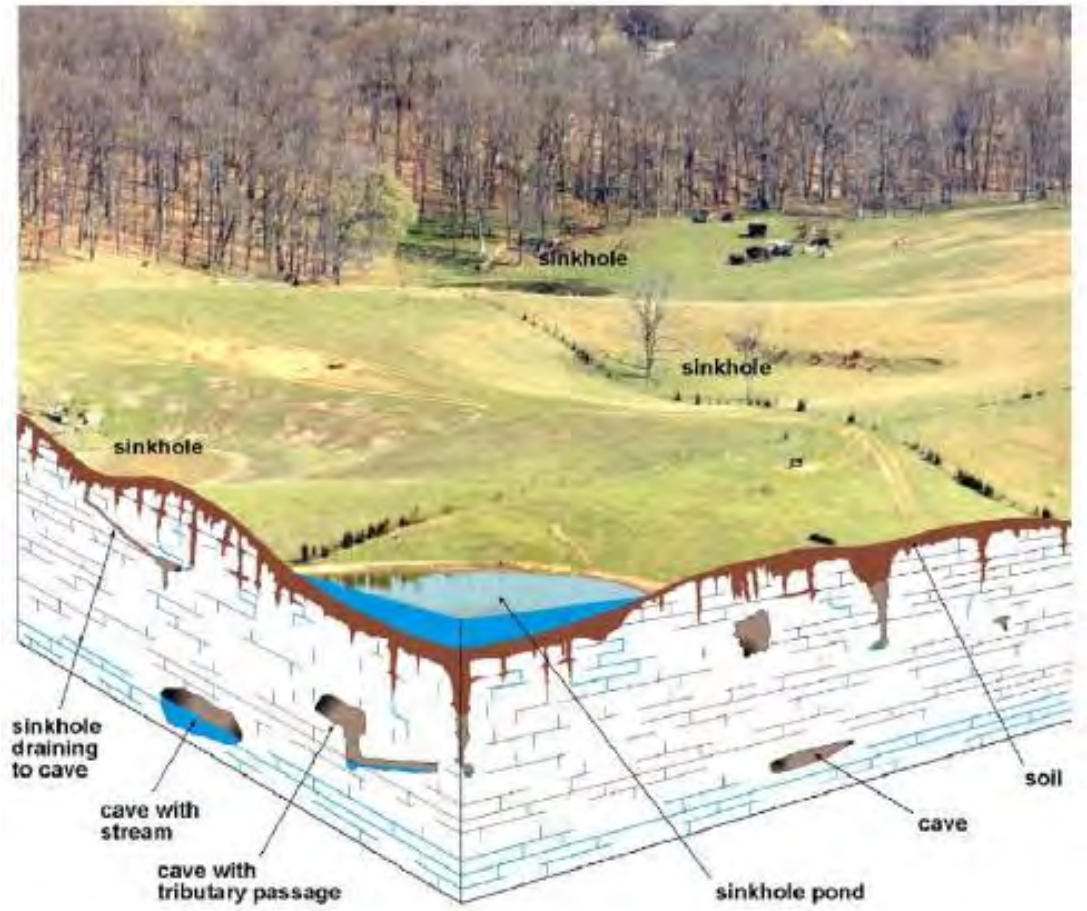

Figure 3.1 Conceptual Model of Typical Karst Terrain Encountered in the Townsend Creek Watershed (KGS 2006)

Official watershed boundaries may not be accurate in well-developed karst regions. Although groundwater drainage generally follows topographic basin boundaries, this is not always true. Subsurface drainage transfer between surface watersheds in a karst region does occur, which increases or decreases the actual boundaries of an affected stream basin. The KDOW and the KGS maintain a Karst Atlas of groundwater tracing data and delineated basins (both as static PDF maps and ArcView shape files) that can be downloaded at http://kygeonet.ky.gov - this work is ongoing within the watersheds of concern and data is updated as information becomes available (Blair, KDOW Personal Communication 2008).

Recent continental deposits of alluvium are encountered in the vicnity of streams, namely in Silas Creek where elevation drops more than 150 feet in about 10 miles of stream (from about 942 feet above mean sea level (msl) in the headwaters to 762 feet msl at the mouth). Alluvium is noted on Figure 3.2 as shades of purple.

The Centerville fault, part of the Lexington fault system, can be found along Townsend Creek from the headwaters to the mouth and near the mouth of its tributaries. Seismic activity along these faults occurred millions of years ago and seismic risks are very low (KGS 2006). The presence of faults in a watershed has the potential to influence groundwater/surface water flow -

typically, surface water flow will parallel a fracture zone for a distance before sinking off a non-soluble bedrock into a soluble limestone bedrock, near a fault. In the same way, groundwater flow may parallel a fracture zone for a distance before emerging as a spring near the contact (fault) between the soluble limestone and non-soluble bedrock (Ray, KDOW Personal Communication 2007).

Karst topography can create geological hazards such as sudden surface collapse (due to sinkholes), flooding (if a karst pathway becomes clogged with debris or overloaded due to improper surface flow routing), and soil erosion. Karst topography also creates a concern for groundwater and surface water contamination. Areas underlain by karst hydrology can have rapid groundwater flow rates, with complex routes. Storm water and associated pollutants can quickly percolate through soils and sinkholes with little or no filtration or attenuation of the contaminants. Groundwater velocities within conduits are commonly measured in thousands of feet per day instead of the typical rate of inches or feet per year in non-karst systems – the maximum recorded conduit groundwater velocity in Kentucky exceeds 2600 feet per hour (Blair, KDOW Personal Communication 2008).

Karst pathways can serve as underground tributaries to surface water, and thus can serve as a transport pathway for bacteria to streams. The lack of sunlight, colder temperatures and moist environment of groundwater systems provide the means for bacteria to persist longer before reaching surface streams (Harter 2007). Improper waste management activities (i.e. dumping into sinkholes, poorly installed or failing OSTDS) or improper best management practices (i.e. lack of buffer strips around sinkholes in agricultural fields) can lead to direct contamination of water supplies. Karst also provides a challenge for nonpoint source pollution management as its pathways have long been regarded as "nature's sewer system" – sinkhole plains, sinking streams, and springs provide a direct connection between surface water and groundwater systems.

3.2 Land Cover Distribution

The Townsend Creek watershed comprises about 25, 741 acres. Land cover is largely agricultural pasture land (more than 83% of the total watershed area in 2001). In 2001, about 6.2% of the total land area was developed and mostly located along rural roads and small towns (including Jacksonville, Centerville and Leesburg). The 2001 National Land Cover Dataset (NLCD) overlain with individual USGS Stream Reach Drainage Polygons within a GIS framework was used to determine land cover areas in the watersheds. Figure 3.3 provides a visual demonstration and Table 3.1 summarizes the land cover by percentage and acres within the watershed. Individual land cover maps from each sample site to the headwaters are included in Section 8. Table 3.2 presents the approximate values for elevation, length, area and slope of Townsend Creek and its subwatersheds. These values were obtained by comparing the National Hydrography Dataset (NHD; USGS 1999) stream mile-points with elevations from the Digital Elevation Model (DEM; USGS 2000) within a GIS framework.

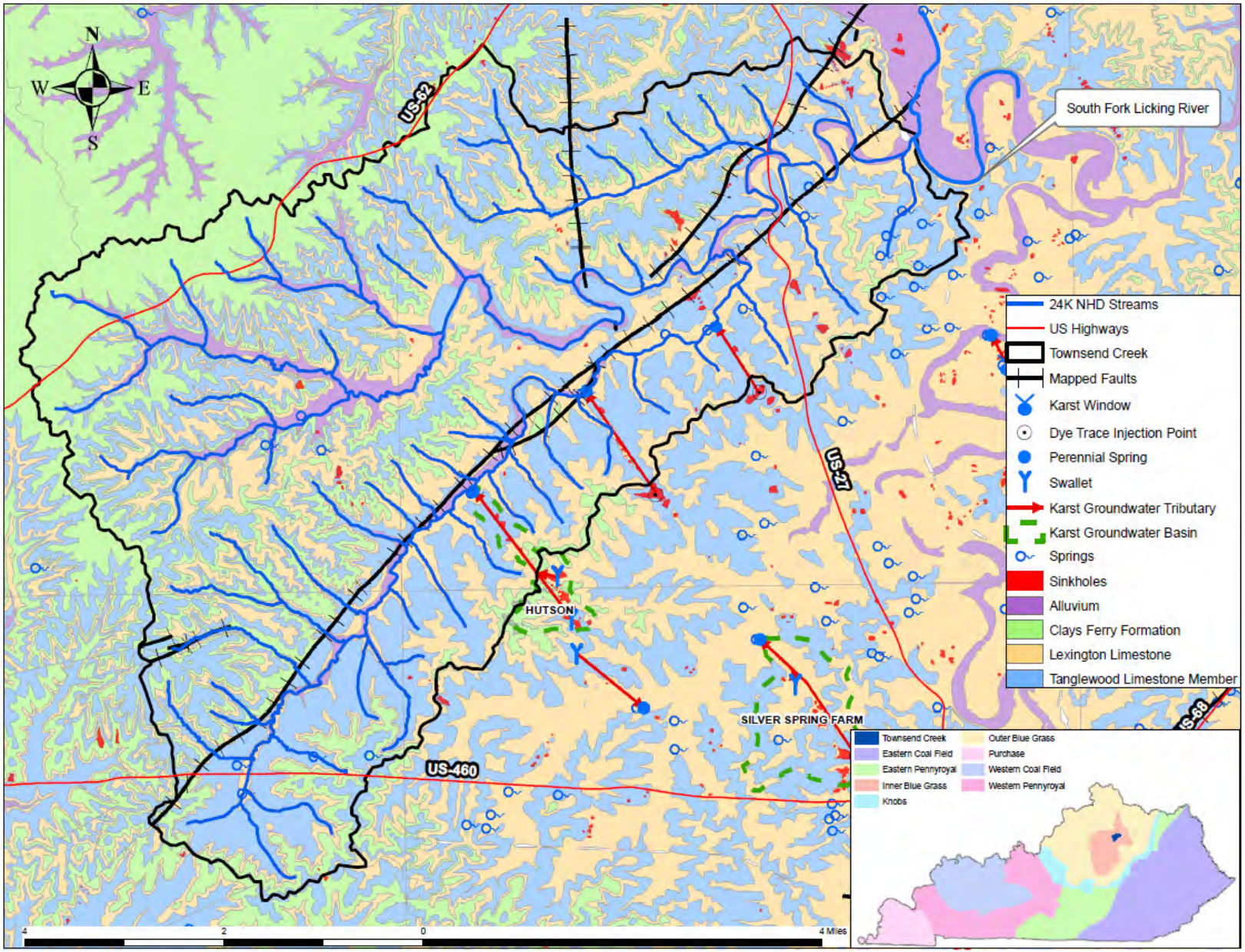

Figure 3.2 Generalized Geologic Map Demonstrating the Location of Faults and Karst Media in the Townsend Creek Watershed

As stated, agricultural land cover within the watershed is primarily pasture. According to statistics obtained from the United States Department of Agriculture (USDA), cattle and calves are the principal livestock commodity, followed by beef cows and horses. Corn is the principal row crop, followed by wheat. See Section 6.2.1 for a further discussion.

Table 3.1 Summary of Land Cover within the Townsend Creek Watershed; Data Generated Using NLCD 2001 (USGS 2001)

Land Cover	% of Total Area	Acres
Forest	9.99%	2573.29
Agriculture (total)	83.18%	21417.38
Pasture	78.76%	20279.14
Row Crop	4.42%	1138.23
Developed	6.17%	1589.67
Natural Grassland	0.07%	18.79
Wetland	0.08%	21.20
Barren	0.08%	19.79

Table 3.2 Stream Configuration of the Townsend Creek Watershed

Stream Name	Highest Elevation Point (ft msl) *	Lowest Elevation Point (ft msl) *	Length (mi) *	Slope (ft/mi) *	Drainage Area (mi^2)**
Townsend Creek	948	719	15.9	14.4	40.22
Silas Creek	942	762	15.6	11.53	14.35
Huskens Run	890	758	4.0	33	3.91

*Statistics are for the highest elevation point in the watershed/sub-watershed to the mouth; "ft msl" = feet above mean sea level.

**The Townsend Creek statistics include the areas of Silas Creek and Huskens Run.

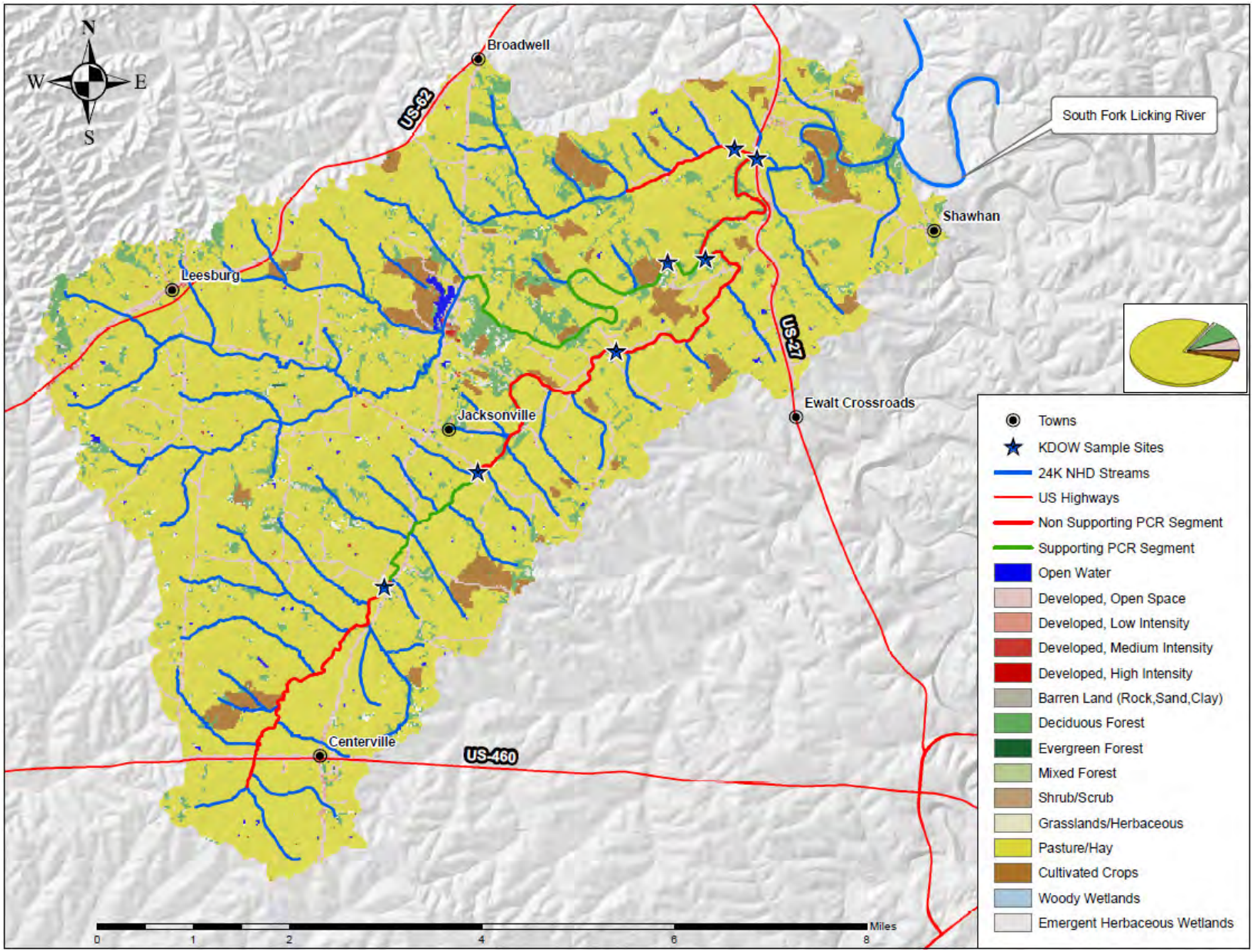

Figure 3.3 Land Cover within the Townsend Creek Watershed (2001 NLCD)

4.0 Monitoring

KDOW first assessed Townsend Creek in the 2002 Integrated Report (KDOW 2010a) as impaired (nonsupport) for the PCR designated use. The stream was first monitored for bacteria during the PCR season (May through October) of 1999.

4.1 Nonpoint Source Monitoring

Section 319(h) of the Clean Water Act provides grant monies that support a wide variety of activities that work to reduce nonpoint source pollution to surface water. These activities include conducting assessments, providing technical assistance and education, monitoring, and developing and implementing TMDLs and watershed management plans. Organizations eligible for grant monies include local, State, or Federal government agencies, nonprofit organizations, and universities.

A Nonpoint Source Implementation Grant was awarded to the Nature Conservancy (TNC) and Licking River Watershed Watch (LRWW) in 2005 in cooperation with the KDOW Watershed Management Branch to establish baseline data in the watershed prior to implementing BMPs (see Section 9) and to provide fecal coliform data for TMDL development. KDOW biologists and the TMDL Section worked with TNC/LRWW to select monitoring stations and complete the sampling event. The seven sampling sites addressed in this TMDL document were monitored once monthly for fecal coliform bacteria during the PCR season (May 1st through October 31st) of 2006. Fecal coliform data collected by TNC/LRWW and KDOW provided the basis for these updated assessments and subsequent TMDL development. Figure 4.1 shows the assessed stream segments and sampling sites where data were collected for the TMDL. Table 4.1 provides a listing of the sampling locations within the watershed; Table 4.2 presents a statistical summary of the data; and Table 4.3 lists the stream segments PCR designated use support status. Full data sets are presented and discussed further in Section 8.

The river miles of stream segments have changed since their original 2002 listing on the 303(d) list to better reflect the NHD, which is based upon topographic maps. River mile segments listed in all tables of this report reflect these changes.

Table 4.1 KDOW Sampling Sites within the Townsend Creek Watershed

Station	Latitude	Longitude	Stream Segment	River Mile
Townsend Cr. at S. Edgewater Rd bridge – site 05015003	38.3132	-84.3060	2.9 to 4.8	2.9
Huskens Run at S. Edgewater Rd bridge – site 05015004	38.3147	-84.3103	0.2 to 1.5	0.2
Townsend Creek above Silas Cr. Confluence – site 05015005	38.2981	-84.3162	4.8 to 10.0	4.9
Silas Cr above confluence with Townsend Cr – site 05015006	38.2977	-84.3234	0.4 to 4.3	0.5
Townsend Cr at Lail Road – site 05015007	38.2844	-84.3335	4.8 to 10.0	7.2
Townsend Cr at Grimes Batterton bridge – site 05015008	38.2665	-84.3603	10.0 to 11.8	9.9
Townsend Creek below Russel Cave Rd bridge – site 05015009	38.2494	-84.3785	11.8 to 14.9	11.8

Table 4.2 Statistical Summary of Fecal Coliform Data Collected in the Townsend Creek Watershed during the 2006 PCR Season

Station	Number of samples	% Exceeding Criteria (400 colonies/100ml)	Minimum (colonies/ 100mL)	Maximum (colonies/ 100mL)	Average (colonies/100mL)
Townsend Cr. at S. Edgewater Rd bridge – site 05015003	8	25%	6	2400	553.25
Huskens Run at S. Edgewater Rd bridge – site 05015004	7	42.85%	8	2400	581.14
Townsend Creek above Silas Cr. Confluence – site 05015005	11	54.54%	150	2820	762.27
Silas Cr above confluence with Townsend Cr – site 05015006	8	12.5%	20	3600	517
Townsend Cr at Lail Road – site 05015007	11	36.36%	60	1240	357.27
Townsend Cr at Grimes Batterton bridge – site 05015008	11	9.09%	60	2200	387.27
Townsend Creek below Russel Cave Rd bridge – site 05015009	10	50%	60	2280	870

Table 4.3 PCR Designated Use Support Status for Stream Segments within the Townsend Creek Watershed

Waterbody and Segment	County	Designated Use	Support Status
Townsend Creek 2.9 to 4.8 into South Fork Licking River	Bourbon	PCR	partial support
Huskens Run 0.2 to 1.5 into Townsend Creek	Harrison	PCR	nonsupport
Silas Creek 0.4 to 4.3 into Townsend Creek	Bourbon	PCR	full support
Townsend Creek 4.8 to 10.0 into South Fork Licking River	Bourbon	PCR	nonsupport
Townsend Creek 10.0 to 11.8 into South Fork Licking River	Bourbon	PCR	full support
Townsend Creek 11.8 to 14.9 into South Fork Licking River	Bourbon	PCR	nonsupport

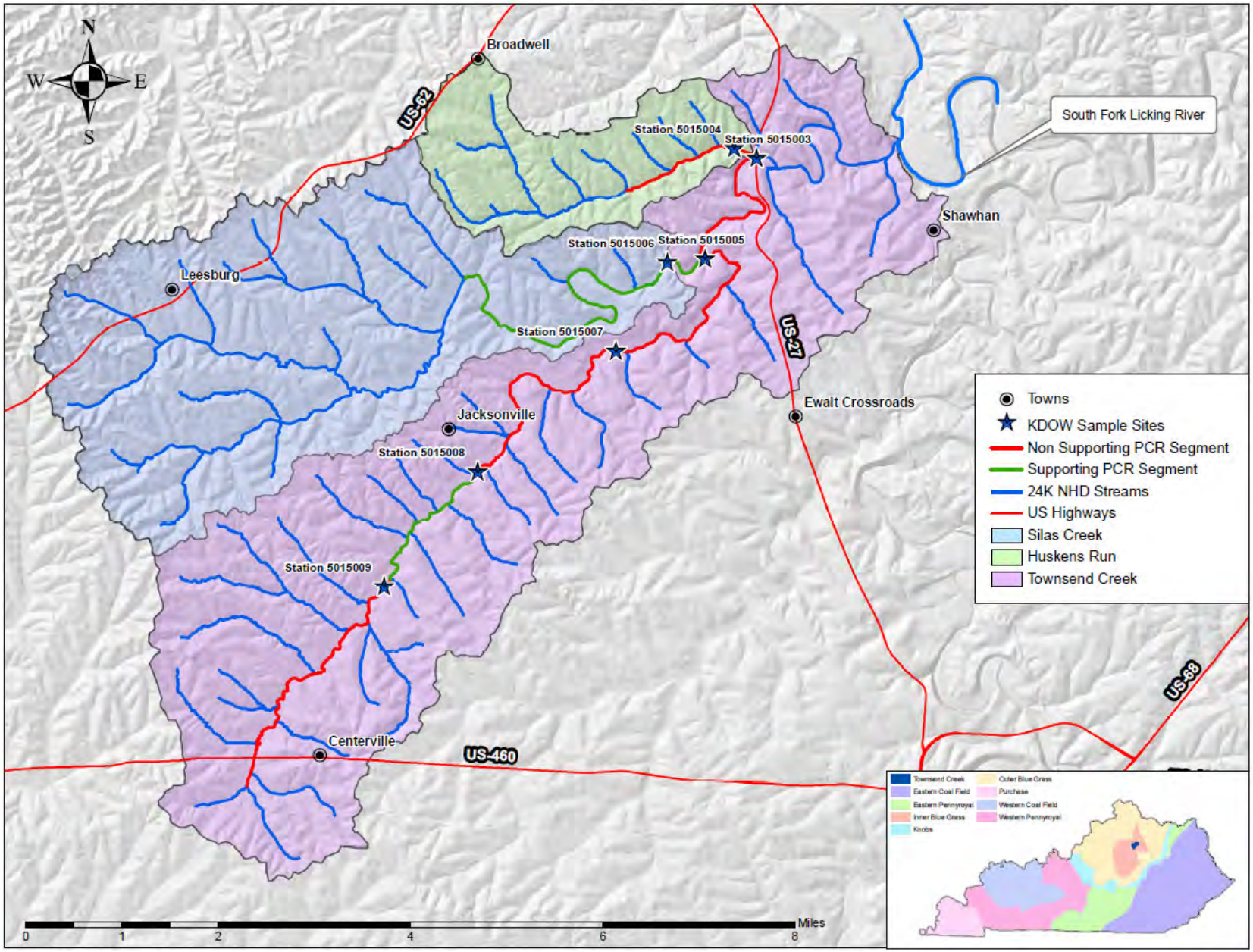

Figure 4.1 Locations of KDOW Sample Sites and Assessed Stream Segments within the Townsend Creek Watershed

5.0 Water Quality Criterion

The WQC in 401 KAR 10:031 (Kentucky's Surface Water Standards) for the PCR and SCR designated uses are based on both fecal coliform and *E. coli*. Fecal coliform bacteria are pathogen indicator organisms. Fecal coliform data were used to indicate the degree of support for PCR use in these TMDLs. Per 401 KAR 10:031:

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

Additionally:

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

There are insufficient fecal coliform data to calculate a 5-sample, 30-day geometric mean, so the latter criterion of 400 colonies per 100 ml was used to calculate the allowable loadings necessary to bring the watershed into compliance with the PCR designated use. Stream segments were sampled on average once per month during the 2006 PCR season. See Section 7.0 for TMDL loading calculations.

Because Kentucky has a dual standard for the PCR designated use, development of TMDLs using the fecal coliform criterion are sufficient to provide TMDLs for *E. coli* listed segments and vice versa (i.e. development of fecal coliform TMDLs will protect the PCR use regardless of whether a segment is impaired for *E. coli*, fecal coliform or both). Additionally, because the instantaneous limit is lower for PCR than for SCR (400 colonies/100 ml versus 2000 colonies/100 ml), development of TMDLs for the PCR season also protects segments impaired for the SCR use due to fecal coliform. *E. coli* equivalent TMDLs for the PCR impaired stream segments within Townsend Creek can be found in Appendix A.

6.0 Source Identification

For regulatory purposes, the sources of bacteria in a watershed can be placed into two broad categories: KPDES-permitted and non KPDES-permitted sources. A KPDES-permitted source requires a Kentucky Pollutant Discharge Elimination System (KPDES) discharge permit, Stormwater permit, or a Municipal Separate Storm Sewer System (MS4) permit from the KDOW. KPDES discharge permits include wastewater treatment facilities that discharge directly to a stream, facilities discharging stormwater and some agricultural operations. The KPDES is not the only permitting program that may affect water quality or quantity within a watershed; other permitting examples include water withdrawal permits, permits to build structures within a floodplain, permits to construct an OSTDS, and permits to land apply waste from sewage treatment plants. However within the framework of the TMDL process a KPDES-permitted source is defined as one regulated under the KPDES program.

A non KPDES-permitted source does not include surface or ground water facilities regulated by the KPDES program but does include non-point sources of pollution. Non-point sources of pollution are caused by runoff from precipitation over and/or through the ground and are relative to land use.

6.1 KPDES-Permitted Sources

KPDES-permitted sources include all sources regulated by KPDES including point sources. KPDES defines a point source in 401 KAR 10:001. KPDES is not the only permitting program for sources that may discharge to surface water within a watershed, as mentioned above. A Waste Load Allocation (WLA) is assigned to KPDES-permitted sources.

6.1.1 Sanitary Wastewater Systems

Information obtained from the Water Resource Information System (WRIS, http://kia.ky.gov/wris/), KDOW Surface Water Permits Branch, and Water Infrastructure Branch was used to confirm information associated with wastewater facilities in the watershed as well as acquire background information and any future planned expansions. In addition, in 2000 the Bluegrass Area Development District (Bluegrass ADD) wrote the "Strategic Water Resource Development Plan" (SWRDP) compiled and released by the Water Resource Development Commission of the Governor's Office. Information from these reports is for informative purposes only unless confirmed by one of the KDOW Branches. There are currently no KPDES Wastewater facilities discharging to a bacteria-impaired segment in the watershed (USEPA 2010a and b).

The City of Paris Sewer Department operates a sanitary sewer collection and treatment system and Regional Planning Area which serves all of the residences and businesses within its corporate limits (Singh and Stapleton, KDOW Personal Communication 2010). The city of Paris has several projects on the Clean Water State Revolving Fund Priority List and the WRIS for sewer rehabilitation, line extensions and treatment plant upgrades. One of these includes the Centerville Sewer Project (Project number SX21017009; Figure 6.1). According to WRIS and the Bourbon County Fiscal Court, this project will extend sanitary sewer service to the

community of Centerville providing new or improved service to at least twenty unserved and five underserved households (WRIS 2010). However this project remains on hold due to resistance from local land owners. As of fall 2010, the system is not under a sewer sanction and KDOW is unaware of any other planned wastewater collection or treatment projects (Singh and Stapleton, KDOW Personal Communication 2010). A copy of the City of Paris WRIS report and Wastewater Project Profile is included in Appendix B.

As discussed in the *"Strategic Water Resource Development Plan"*, it is unlikely that public sewer line service will reach the rural areas of Bourbon and Harrison counties in this watershed due to the associated high costs. Reasons for the high costs include a low customer per mile ratio, rugged terrain and the long distance from these houses to treatment facilities and existing sewer systems (Bluegrass ADD 2000).

6.1.2 Municipal Separate Storm Sewer System Sources

In developed areas, polluted stormwater runoff is often diverted and concentrated into MS4s, where it ultimately discharges to surface waters with little or no treatment.

MS4s are defined in 401 KAR 5:002. EPA has categorized MS4s into three categories: small, medium, and large. The medium and large categories are regulated under the Phase I Storm Water program. Large systems, such as the cities of Lexington and Louisville, have populations in excess of 250,000. Medium systems have populations in excess of 100,000 but less than 250,000; however, there are currently no medium-sized systems in Kentucky. Phase I systems have five-year permitting cycles and have annual reporting requirements. The small MS4 category includes all MS4s not covered under Phase I. Since this category covers a large number of systems, only a select group are regulated under the Phase II rule, either being automatically included based on population (i.e., having a total population over 10,000 or a population per square mile in excess of 1000) or on a case-by-case basis due to the potential to cause adverse impact on surface water. Water quality monitoring is not a requirement of Phase II MS4s, unless the waterbody has an approved TMDL and the MS4 causes or contributes to the impairment for which the TMDL was written (KDOW 2009). A WLA is assigned to all MS4 permits, including the KYTC, universities and military bases.

There are currently no regulated MS4 communities within Townsend Creek.

6.1.3 Combined Animal Feeding Operations (CAFOs)

Operations that are defined as a CAFO pursuant to 401 KAR 5:002 are required to obtain a KPDES permit. Once defined as a CAFO, the operation can be permitted under a KPDES General Permit or a KPDES Individual Permit depending upon the nature of the operation. Conditions of both types of permits include no discharge to surface waters; however, holders of a KPDES Individual Permit may discharge to surface waters during a 25-year (24-hour) or greater storm event.

There are no KPDES-permitted CAFOs within the Townsend Creek watershed.

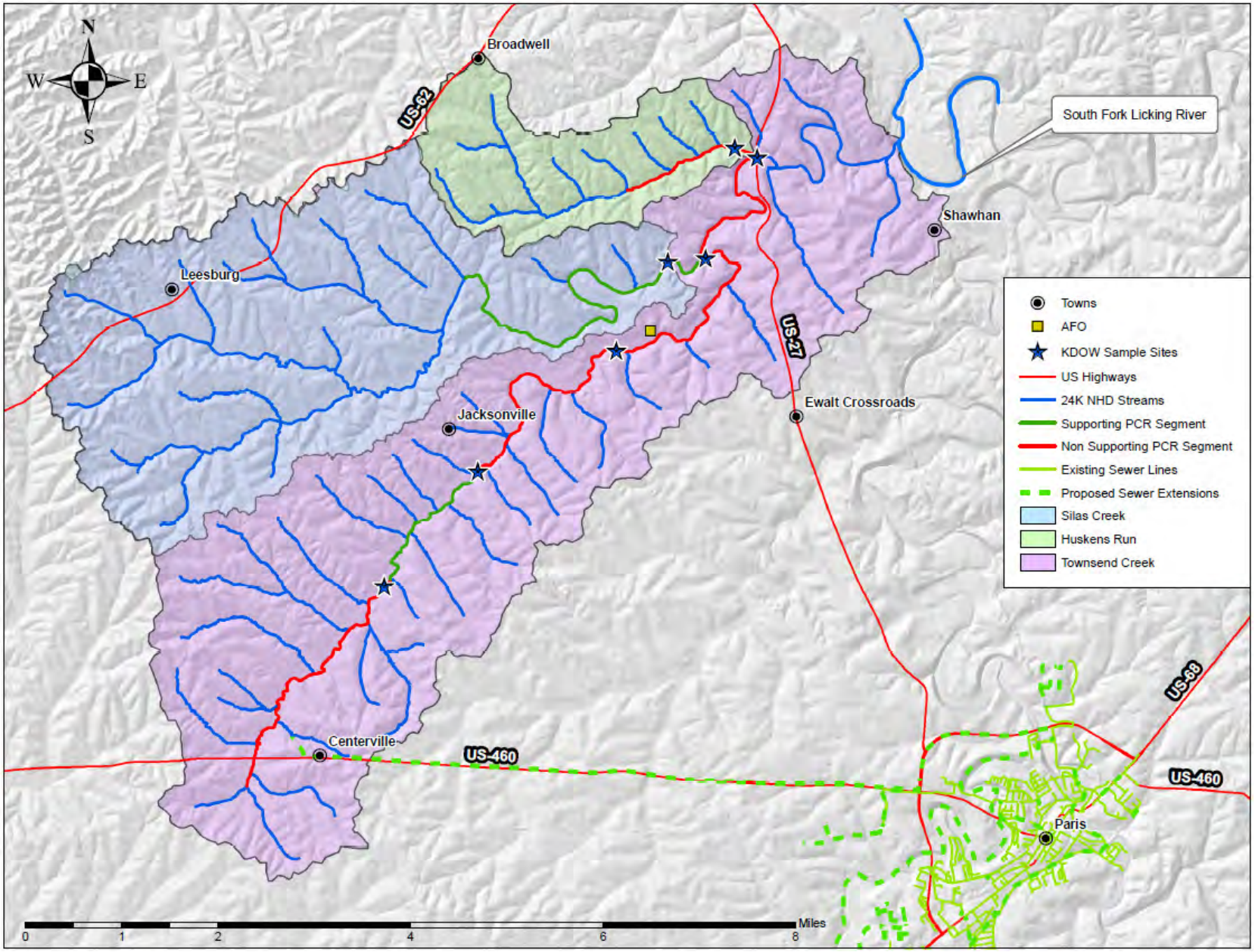

Figure 6.1 Locations of Permitted Sources and Proposed Projects within the Townsend Creek Watershed

6.1.4 Kentucky No Discharge Operating Permits (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 KNDOP from the KDOW 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 to 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 KDOW. Also included in KNDOP requirements are golf courses that land apply treated wastewater via spray irrigation, typically from a holding pond - some industrial operations also spray-irrigate

Animal Feeding Operations (AFOs; defined in 401 KAR 5:002) that do not discharge or intend to discharge to waters of the Commonwealth are required to obtain a KNDOP permit. There was one permitted AFO (Abney Hog Farm) present in Townsend Creek at the time bacteria samples were collected in 2006. This permit was inactivated in 2011 after the facility ceased operation. The location of the AFO is shown on Figure 6.1.

6.2 Non KPDES-Permitted Sources

Non KPDES-permitted sources include all sources not permitted by the KPDES permitting program, and are often referred to as nonpoint sources. According to 401 KAR 10:002 nonpoint means "any source of pollutants not defined as a point source, as used in this chapter." Nonpoint (non KPDES-permitted) sources of pollution are often associated with land use. While KPDES permits are not required for non KPDES-permitted sources, their loads to surface water are still regulated by laws such as the Kentucky Agricultural Water Quality Act (AWQA, KRS 224.71-100 through 224.71-145, i.e., implementation of individual agriculture water quality plans and corrective measures), the federal Clean Water Act (i.e., the TMDL process) and 401 KAR 5:037 (Groundwater Protection Plans (GPPs)), among others. A Load Allocation (LA) is assigned to non KPDES-permitted sources.

Unlike KPDES-permitted sources, non KPDES-permitted sources typically discharge pollutants to surface water in response to rain events (MS4s are a notable exception, as they are a KPDES-permitted source that discharges to surface water in response to rain events through a system of storm drains, curbs, gutters, etc.). Non KPDES-permitted sources for bacteria exist in the watershed and fall into various categories including agriculture, properly functioning OSTDS, failing OSTDS, household pets and natural background, which in the case of bacteria in a rural watershed means wildlife. Straight-pipes are a type of illegal, non KPDES-permitted source that may exist in the watershed, but none are known to exist with certainty.

As mentioned in Section 3, this watershed is located in a karst region. The KGS has developed Generalized Geologic Maps for Land-Use Planning (http://www.uky.edu/KGS/) for every county of the State to inform individuals of the general geologic bedrock condition that can affect a site and its intended uses. For example, a vast extent of the watershed area is underlain with limestone and shale bedrock – according to the planning guidance, this type of rock carries slight to severe limitations for septic tank disposal systems depending on the amount of soil cover and depth to impermeable bedrock. A severe limitation is one that is "difficult to overcome and commonly is not feasible because of the

expense involved." Figure 3.1 depicts the correlations between surface and ground water, land use and karst terrains.

6.2.1 Agriculture

The Kentucky AWQA was passed by the 1994 General Assembly. The law focuses on the protection of surface water and groundwater resources from agricultural and silvicultural activities. The Act created the Kentucky Agriculture Water Quality Authority (KAWQA), a 15-member peer group made up of farmers and representatives from various agencies and organizations. The Act requires all farms greater than 10 acres in size to adhere to the Best Management Practices (BMPs) specified in the Kentucky Agriculture Water Quality Plan. Specific BMPs have been designated for all operations.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by County for virtually every facet of U.S. agriculture (USDA 2009). 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. Selected agricultural data from the 2007 Census of Agriculture reports for Bourbon and Harrison Counties are listed in Table 6.1, the complete County Profile can be found in Appendix C. These data are based on County-wide data with no assumptions made on a watershed level. The percentage of agricultural types of land cover is calculated for each sub-watershed in Table 3.1 (Section 3.2).

Table 6.1 USDA Agricultural Statistics for the Counties Associated with Townsend Creek (2007)

Statistic	County	
	Bourbon	Harrison
Farms (number/acres)	918/ 184,323	1,083/ 161,777
Cattle and Calves Inventory (farms/ total number)	473/ 49,673	645/ 35,288
Beef Cows (farms/total number)	408/ (D)*	582/ 18,983
Milk Cows (farms/total number)	2/ (D)*	17/ 233
Hogs and Pigs (farms/ total number)	8/ 597	14/ (D)*
Horses and Ponies (total number)	9,057	1,837
Layers 20 weeks old or older (farms/total number)	33/ 1,555	66/ 1,392
Broilers & other meat-type chickens sold (farm/total number)	2/ (D)*	1/ (D)*
Corn for grain (acres)	1,836	1,769
Tobacco (acres)	n/a	n/a
Wheat for grain (acres)	1,208	129
Soybeans for beans (acres)	n/a	n/a

* Withheld by USDA to avoid disclosing data for individual farms.

The Ohio State University Agricultural Extension Service released a guidance document for the management of livestock manure. The document contains manure characteristics, handling/storage and application procedures and also addresses some of the issues and considerations involved with manure management (James 2006). A similar (though as not detailed) document is available from the North Carolina State University College of Agriculture and Life Sciences (Shaffer 2005). These documents could be used to estimate pathogenic contributions from livestock if it could be determined how much manure actually made it to a stream since it is unrealistic that an animal would be directly contributing to a stream throughout the day. However if Standard Operating Procedures for wastewater collection systems and BMPs are utilized at AFOs and CAFOs, pathogenic contributions to surface waters from livestock should not cause a violation of the WQC.

Crops may be a source of bacteria if manure is used as a fertilizer. However if BMPs are utilized (as discussed on the KAWQA webpage, http://www.conservation.ky.gov/programs/kawqa/)), pathogenic contributions to surface waters should not cause a violation of the WQC.

6.2.2 Human Waste Contribution

Human waste disposal is of particular concern in rural areas. Areas not served by sewers either employ an OSTDS or do not treat their sewage. There are no sewer lines located in the Townsend Creek watershed (Figure 6.1). This rural area must either have OSTDS or may not be treating their sewage. The U.S. Census of 2000 estimated that there was an average of 66.5 and 58.0 persons per square mile in Bourbon and Harrison counties, respectively. OSTDS including septic tank systems 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), bacteria and other pollutants to both groundwater and surface water.

The USDA Natural Resources Conservation Service (NRCS) publishes county soil surveys and rates the performance of septic tank absorption fields, defined as the area in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Soil ratings are based on soil properties, site features, and the observed performance of the soils - permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of septic tank effluents. Soils in the study area include the Faywood, Loradale, Lowell, Maury and McAfee series. USDA rates these soil series as somewhat to very limited for installation of septic tank absorption fields due to slope and severely eroded soils (i.e. shallow soil profiles; USDA 1980, 1981). Based on the soil ratings and prevailing karst formations it is likely many of the septic systems in the watershed are not functioning properly. Failing OSTDS are probable sources of bacteria due to the porous nature of the karst formations underlying some parts of the watershed.

A type of non KPDES-permitted source that may exist in the watershed is straight-pipes, which are discrete conveyances that discharge sewage, 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 10:002, EPA considers them to be part of the LA as they are a non KPDES-permitted source.

6.2.3 Household Pets

Although household pets undoubtedly exist in Townsend Creek, their contribution to the LA is deemed to be minimal compared to other sources in the rural portions of the watershed. Pet waste may, however, be a larger contributor to bacteria runoff within subdivisions where there is a tendency to have a higher density of households and less permeable surfaces.

According to the American Veterinary Medical Association, there are 0.58 dogs per household nationally.

6.2.4 Wildlife

Wildlife undoubtedly contributes to bacteria loading. The Kentucky Department of Fish and Wildlife Resources estimate deer densities per square mile for all counties of Kentucky (Yancy, Personal Communication, 2008). There are approximately 4 deer per square mile in Bourbon County (775 total) and 21 in Harrison County (4,794 total).

Estimates of deer populations are shown for each watershed in Table 6.2. The assumption was made that deer remain constant throughout the year and are present (and evenly distributed) on all land classified as agricultural, forested, grasslands, and wetlands – because this is a rural watershed developed land was also included. Estimates of numbers of other types of wildlife are not available for Kentucky.

As stated above, although wildlife contributes bacteria to surface water, such contributions represent natural background conditions and receive no reductions within a TMDL. Wildlife such as opossums, raccoons, rats, and birds that may reside within subdivisions may be a larger contributor to bacteria runoff as these areas tend to have less permeable surfaces.

Table 6.2 Estimated Deer Populations within Townsend Creek

Stream/City Name	Watershed Area within County	Deer per Square Mile of Land	Estimated Deer Population in Watershed
Bourbon County/ Townsend Creek	25.77	4	103.08
Harrison County/ Silas Creek and Huskens Run	14.39	21	302.19

6.3 Illegal Sources.

Both KPDES-permitted and non KPDES-permitted sources can discharge bacteria to surface water illegally - this includes sources that are illegal simply by their existence, such as straight-pipes, as well as legal sources that are operating illegally (e.g., outside of regulations, permit limits or conditions, etc., such as a WWTP bypass). Such sources receive no allocation of any kind in the TMDL process (see Section 7.0 for TMDL allocations).

In addition to straight-pipes, another illegal source related to human waste disposal is failing OSTDS, which receive an allocation of zero. Sanitary Sewer Overflows (SSOs) are discharges without a permit and are also illegal sources that receive no allocation.

Another potential illegal source is livestock on farms that have no BMPs (as required under the AWQA) as well as farms where BMPs are present but are insufficient or failing in a manner that causes or contributes to surface water impairment. Also included are KNDOPs, AFOs and CAFOs not in compliance with the appropriate regulations that cause or contribute to a surface water impairment.

KDOW expects implementation of these TMDLs to begin with the elimination of illegal sources. This is intended to prevent legally operating sources from having to effect reductions in order to accommodate the pollutant loading of illegal sources.

Note this Section of the TMDL is not intended to summarize the universe of potential illegal sources that may discharge pollutants into surface waters, nor does it attempt to summarize the universe of legal

sources that may be operating illegally. Instead, it gives examples of illegal sources known to be present or that could be present in the watersheds (e.g., straight-pipes) and sets the allocation for these (and other potential illegal sources) at zero.

7.0 Total Maximum Daily Load

The USEPA defines a TMDL as "a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. Water quality standards are set by States, Territories, and Tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonal variation in water quality. The Clean Water Act, section 303, establishes the water quality standards and TMDL programs (USEPA 2008c)."

7.1 TMDL Equation and Definitions

A TMDL calculation is performed as follows:

$$TMDL = MOS + WLA + LA$$

Where:
TMDL: the WQC or the maximum load the waterbody can naturally assimilate while still meeting the WQC of 400 colonies per 100 ml at a given flow, in units of colonies per day.
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% to generate an explicit MOS.
TMDL Target: the TMDL minus the MOS.
WLA: the Waste Load Allocation (allowable loadings from KPDES-permitted sources such as Sanitary Wastewater Systems (SWSs; aka Wastewater Treatment Plants, WWTPs)) and the Future Growth-WLA.
Remainder: the TMDL Target minus the WLA
Future Growth-WLA: the allowable loading for future KPDES-permitted sources, including new SWSs, expansion of existing SWSs, new storm water sources, and growth of existing storm water sources (such as MS4s).
LA: the Load Allocation, including natural background and non-KPDES permitted sources.
Seasonality: Yearly factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.
Critical Condition: When the pollutant conditions are expected to be at their worst.
MAF: the Mean Annual Flow as defined by USGS.
Adjusted MAF: the MAF plus SWS-WLA design flows (where applicable).
Critical Flow: the flow used to calculate the TMDL as a load (equivalent to the Adjusted MAF)
Existing Conditions: the load that exists in the watershed at the time of TMDL development (i.e., sampling) and is causing the impairment, see Section 7.6.
Percent Reduction: the reduction needed to bring the existing conditions (i.e., the existing non-SWS sources) in line with the Remainder, see Section 7.7.
Load: Concentration * Flow * Conversion Factor in colonies per day
Concentration: colonies per 100 milliliters (col/100ml)

Flow (i.e. stream discharge): cubic feet per second (cfs)
Conversion Factor: the value which converts the product of Concentration and Flow to Load (in units of colonies per day); it is derived from the calculation of the following components: (28.31685L/cf * 86400sec/day * 1000ml/L)/ (100ml) and is equal to 24465758.4.

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. Once a critical flow is obtained (see Sections 7.5 and 7.8), it is then multiplied by the WQC minus the MOS (10%) times the appropriate conversion factors to obtain the TMDL Target load. Allowable loadings from KPDES-permitted sources are then subtracted from the Target load to produce the Remainder. Future growth calculations are then performed and subtracted from the Remainder, leaving the LA.

However, regardless of the procedure used to calculate the TMDL, reductions from existing conditions ultimately must be effected within the watershed only until all stream segments meet the PCR use, or until all sources (except wildlife) are discharging in compliance with the WQC. Once the WQC is met, all sources (apart from wildlife) must continue to discharge at a load that meets the WQC.

7.2 Margin of Safety

The MOS can be an implicit (using conservative assumptions) or explicit (a reserved portion) additional reduction applied to the WLA, LA or to both types of sources that accounts for uncertainties in the data or TMDL calculations. For these TMDLs, a 10% explicit MOS (i.e., 10% of the WQC or 40 colonies/100ml) was reserved to address uncertainties involving loading from non-SWS sources. SWS sources have an implicit MOS based on the fact that they seldom operate at their design flow. The explicit MOS load was calculated using the following equation:

$$\text{MOS (colonies/day)} = \text{Critical Flow (cfs)} \times \text{40 (colonies/100ml)} \times \text{Conversion Factor 24465758.4}$$

7.3 WLA and LA

The WLA and LA represent the final pollutant loading allocations that are allowed in the watershed per the WQC and after application of the MOS.

7.3.1 Waste Load Allocation

The WLA is the portion of the TMDL allocated to KPDES-permitted sources within the watershed. There are currently no KPDES-permitted sources discharging to an impaired segment within Townsend Creek.

If KPDES-permitted sources were discharging to an impaired segment, their individual WLA would have been calculated using their permitted effluent limits for fecal coliform (i.e. the WQC of 400 col/100 ml) and facility design flow by means of the following equation:

$$\text{WLA (colonies/day)} = \text{Design Flow (cfs)} \times \text{240 (colonies/100ml)} \times \text{Conversion Factor 24465758.4}$$

7.3.2 Remainder

The Remainder is not part of the TMDL however; it is used in the TMDL calculations. It is defined as the TMDL Target load minus the sum of all SWS-WLAs.

7.3.3 Future Growth WLA

A TMDL document will often account for future growth of current or new KPDES-permitted sources in order to avoid having to re-open the TMDL when new sources come online or current ones expand. Future growth is represented by a portion of the Remainder which is set aside (i.e. it is not part of the LA nor is it part of the WLA for current/known sources). It can also include existing storm water sources which are later discovered to discharge the pollutant of concern, even though this fact may not be known at the time the TMDL was written. The loading amount reserved for future growth is determined by using Table 7.1 which assumes that growth occurs more rapidly in a developed area (which is determined by the sum of developed open space, developed low intensity, developed medium intensity and developed high intensity areas as defined by the 2001 USGS NLCD) than in rural areas. The Future Growth WLA for each impaired segment is shown in Table 7.2 and calculated using the following formula:

Future Growth-WLA = Remainder x Future Growth-WLA percentage

Table 7.1 Future Growth

Percent Developed Area in the Subwatershed	Future Growth WLA Percentage
≥25%	5%
≥20% – <25%	4%
≥15% – <20%	3%
≥10% – <15%	2%
≥5% – <10%	1%
<5%	0.5%

Table 7.2 Future Growth Percentage by Impaired Segment

Waterbody Segment and River Miles (RM)	Percent Developed Area	Percent of Remainder Set Aside for Future Growth
Townsend Creek into South Fork Licking River RM 2.9-4.8	6.17%	1%
Townsend Creek into South Fork Licking River RM 4.8-10.0	6.17%	1%
Townsend Creek into South Fork Licking River RM 11.8-14.9	6.17%	1%
Huskens Run into Townsend Creek RM 0.2-1.5	5.4%	1%

7.3.4 Load Allocation

The LA is the portion of the TMDL where non KPDES-permitted sources (e.g., nonpoint sources, or those not permitted by KPDES) receive their allocation within the TMDL. Within Townsend Creek, these sources can include properly functioning OSTDS (i.e. septic systems), wildlife, household pets and facilities with properly functioning BMPs (e.g. agricultural farms or landfarms for municipal SWS sludge). LAs were calculated using the following equation:

LA = Remainder - Future Growth WLA - Sum of MS4-WLAs

The available sampling data were insufficient to apportion the existing loading among the various LA sources; therefore, it is attributed to all LA sources. LAs for each impaired segment are presented and discussed in Section 8. As discussed in Section 6.3, implementation of these bacteria TMDLs is expected to begin with the elimination of illegal sources such as failing OSTDS and straight-pipes if present in the watershed. In addition, facilities not in compliance with KNDOP regulations or BMP requirements under the AWQA are also illegal and are expected to come into compliance.

7.4 Seasonality

Seasonality is defined as yearly factors such as temporal variations on source behavior and stream loading than can affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses. This TMDL addresses seasonality by only using samples collected within the PCR season (May - October).

7.5 Critical Condition

The critical condition for nonpoint source bacteria loading typically occurs after a runoff event, preceded by an extended dry period - bacteria accumulate on the land surface (during the dry period) and are subsequently washed off by the rainfall. The critical condition for point source loading typically occurs during periods of low streamflow when dilution (of effluent) is minimized. The Townsend Creek watershed contains both types of sources; therefore the critical condition for each bacteria-impaired segment is defined by the sample showing the highest exceedance.

7.6 Existing Condition

The maximum exceedance of all samples was selected to represent existing conditions. The maximum exceedance (i.e. the existing conditions) for each sample site is shown in Table 7.3. This concentration was converted to a load using the following equation:

Existing Load (colonies/day) = Conversion Factor 24465758.4 x Critical Flow (cfs) x Maximum Exceedance (colonies/100ml)

Table 7.3 Existing Conditions in the Townsend Creek Watershed during the 2006 PCR Season

Station	Number of samples	% Exceeding Criteria (400 colonies/100ml)	Maximum (colonies/ 100mL)	Critical Flow (cfs)	Existing Load (colonies/day)
Townsend Creek below Russel Cave Rd bridge – site 05015009	10	50%	2280	9.8	5.47E+11
Townsend Cr at Grimes Batterton bridge – site 05015008	11	9.09%	2200	14	7.54E+11
Townsend Cr at Lail Road – site 05015007	11	36.36%	1240	17.8	5.40E+11
Townsend Creek above Silas Cr. Confluence – site 05015005	11	54.54%	2820	20.8	1.44E+12
Townsend Cr. at S. Edgewater Rd bridge – site 05015003	8	25%	2400	43.8	2.57E+12
Silas Cr above confluence with Townsend Cr – site 05015006	8	12.5%	3600	17.1	1.51E+12
Huskens Run at S. Edgewater Rd bridge – site 05015004	7	42.85%	2400	4.7	2.76E+11

7.7 Percent Reduction

As discussed previously, a 'percent reduction' was calculated for informational purposes only to illustrate the difference between existing conditions and the TMDL Target at the time the streams were sampled (i.e., the 2006 PCR season). The percent reduction for each impaired segment is provided and discussed in Appendix A.

A TMDL provides a foundation for identifying, planning, and implementing water quality-based controls to reduce both point and nonpoint source pollution. The data used to calculate the percent reductions provide a representation of the streams after rainfall events – the most important time to capture data associated with nonpoint sources. Therefore, the percent reduction should not be viewed as the TMDL but rather a goal to work towards in the implementation phase of the TMDL process with the ultimate goal being the restoration and maintenance of in-stream water quality so that designated uses are met.

7.8 TMDLs Calculated as a Daily Load

Federal guidelines of the Clean Water Act require a TMDL to be expressed in terms of a daily load. Due to the limited amount of data available, particularly the absence of stream gages or in-stream flow data, a method was developed utilizing the WQC and Mean Annual Streamflow (MAF). The USGS has generated a MAF value for streams across Kentucky. The MAF values were calculated using the equation found in the USGS Water-Resources Investigations Report 02-4206 "Estimating Mean Annual Streamflow of Rural Streams in Kentucky" (http://ky.water.usgs.gov/pubs/wrir_2002_4206.pdf). The MAF values can be found on the Hydrology of Kentucky webpage (http://kygeonet.ky.gov/kyhydro/main.htm). Once obtained, major inputs (i.e., WWTP design capacity) were added to the MAF to generate a critical flow. The critical flow is then multiplied by the WQC minus the MOS (10%) times the appropriate conversion factors to obtain the TMDL Target (i.e., the allowable daily load).

8.0 TMDL Calculations

Bacteria TMDLs have been developed using a range of techniques from sophisticated watershed-based computer modeling to qualitative assumptions and a simple mass balance. An approach focusing on the WQC and MAF was utilized for development of these bacteria TMDLs. The best available data from various sources was analyzed and spatial analysis was performed within a GIS framework to obtain MAF values, assess KPDES-permitted and non KPDES-permitted sources, and appropriately assign TMDL loads. Development of these TMDLs follows the procedures outlined in Kentucky's *Quality Assurance Project Plan (QAPP) for Data Analysis for TMDL Development* and maintains the guidelines set in the *Pathogen TMDL Standard Operating Procedures* for evaluating the TMDL approach (DOW 2010b and c).

8.1 Data Validation

Data validation was performed as follows:

- Only samples collected from a flowing stream were considered in analysis.
- Discharge data that consisted of velocity alone (no stream area determined) was eliminated from consideration in the analysis.
- Any discharge data that was indicated to be suspect due to possible operator error was eliminated from consideration in the analysis.
- Quality Analysis/Quality Control Samples (e.g. duplicates and blanks) were excluded from the dataset.
- The data tables show both fecal coliform concentrations and flows; in some cases the flows were measured in-stream at the time the sample was collected. On other occasions no flow data were collected; this may have been due to a high water event that precluded samplers from entering the stream due to safety reasons, or other considerations.

8.2 Individual Stream Segment Analysis

Data collection and analysis from various sources (including Federal, State and local government, and public entities) was carried out for each individually listed stream segment and its associated drainage area. Spatial analysis was also performed within a GIS framework. Most of the data collected for the development of this document can be accessed and downloaded from the Kentucky Geography Network (http://kygeonet.ky.gov).

Results from the watershed sampling event in 2006 indicated new impaired segments in addition to several fully supporting segments. An overview of the watershed is followed by a brief discussion of each stream segment along Townsend Creek (including tributaries), beginning in the headwaters.

8.2.1 Townsend Creek of the South Fork Licking River

Townsend Creek of the South Fork Licking River is a fourth order stream that also partially serves as the boundary between Bourbon and Harrison counties. The headwaters of the Townsend Creek watershed originate approximately five miles northwest of the city of Paris and flow northeast toward the South

Fork Licking River. The stream and watershed are characteristic of karst terrain with several mapped sinkholes, springs and sinking streams. It is also a losing/gaining stream as measured flows indicate exchange between surface and groundwater particularly in the lower portion of the watershed near the confluence with Silas Creek (Figure 3.2). Some dye tracing work has taken place in the southern portion of the watershed (see Section 3.1).

The direct drainage area of the watershed (minus Silas Creek and Huskens Run) is 21.96 square miles (14,056.73 acres) and the total watershed area is 40.22 square miles (25,741.3 acres). The USGS DEM indicates that the watershed drops about 230 feet in elevation from the headwaters to the mouth. As of the last Census (2009), there were 9,034/ 8,242 housing units and an estimated population of 19,729/ 18, 794 in Bourbon County and Harrison counties, respectively. There is no municipal sewer service provided to residents within the watershed. The city of Paris has plans to extend sewer lines to Centerville as discussed in Section 6.1.1 but all other areas of the watershed rely on OSTDS or do not treat their sewage. The predominant land cover in the watershed is agricultural pasture followed by forest and developed land (Table 8.1).

Table 8.1 Land Cover in the Townsend Creek Watershed, Excluding Silas Creek and Huskens Run; Data Generated Using USGS NLCD 2001

Land Use	% of Total Area	Acres
Forest	8.12%	1141.39
Agriculture (total)	84.91%	11935.25
Pasture	80.48%	11313.43
Row Crop	4.42%	621.82
Developed	6.54%	920.01
Natural Grassland	0.08%	11.29
Wetland	0.06%	7.86
Barren	0.04%	5.56

8.2.1.1 Townsend Creek 11.8 to 14.9 into South Fork Licking River

Townsend Creek becomes a third order stream just upstream of sample site 05015009. Exceedance of the WQC (400 col/100ml) was observed in 50% of the samples collected – the highest concentration of all samples was 2280 colonies per 100 ml (Table 8.2). Fecal coliform concentrations appear to increase with increased amounts of precipitation that suggests the loading may be caused by non KPDES-permitted (nonpoint) sources in the watershed. However, concentrations also exceed the WQC with little to no precipitation. Since there are no KPDES-permitted sources upstream of this site, this loading suggests illegal nonpoint sources in the watershed such as straight-pipes, cows in streams or failing OSTDS. The predominant land cover in the watershed to this point is agricultural pasture followed by developed land and forest (Figure 8.1).

In addition, Section 6.1.1 discusses a sewer extension project proposal by the City of Paris to extend sewer service to the city of Centerville. Completion of this project could eliminate several underserved households in the headwaters (see Appendix B). A 319(h) Nonpoint Source Implementation Grant BMP project was completed just upstream of this site after the sampling event and is further discussed in Section 9. Maintenance of this project could reduce the bacterial loading to this area of the watershed.

Table 8.2 Fecal Coliform Data Collected on Townsend Creek 11.8 to 14.9 at Site 05015009

Townsend Creek below Russell Cave Rd bridge – 05015009					
Sample Date	**Colonies/100mL**	**Flow (cfs)**	**Field Precip Notes**	**Paris, KY Precip Notes**	**Cynthiana, KY Precip Notes**
05/15/06	300	1.06	2 days since.1" rain	.09" - rain during the last 4 days	.06" - .2" rain 72 hours ago
05/26/06	1800	n/a	1.56 in of rain last 48hrs	.48" - .45" the day before	0 - .36" rain 48 hours ago
06/14/06	150	n/a	0 in of rain last 48hrs	0 - .45" rain 48 hours before	0 - .1" rain 72 hours ago
06/27/06	60	3.539	3 days since.1" rain	0 - 1.99" rain 72 hours before	0 - .1" 24 hours ago
06/29/06	1990	n/a	.14 in of rain last 48hrs	.07" - no rain in last 72 hours	0 - .15" rain 24 hours ago
07/15/06	340	n/a	1.59 in of rain in last 48 hrs	.21" - rain during the last 3 days	0 - rain during the last 4 days
07/31/06	840	n/a	0 in of rain last 48hrs	0 - .11" of rain 48 hours before	0 - .55" 72 hours ago
10/18/06	2280	n/a	n/a	.05" - 1.3" rain 24 hours ago	0 - 1.65" rain 48 hours ago
10/24/06	760	n/a	n/a	0 - .01" 48 hours ago	0 - no rain in last 72 hours
10/31/06	180	11.6	several days since .1" rain	0 - 1.84" rain 72 hours ago	.2" - no rain in last 72 hours

Exceedance of WQC	Rain today	Rain within last 24 hours	Rain within last 48 hours	No Rain for 48 hours

n/a = flow and/or notes not collected that day

Based on the WQC and the MAF, the fecal coliform TMDL for the 3.1 mile impaired segment of Townsend Creek is 9.59×10^{10} colonies per day. According to the data presented, the watershed would have required an 84.21% reduction in bacteria loading during the 2006 PCR season in order to meet the WQC (Table 8.3). In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.3 Summary of TMDL Components for Townsend Creek 11.8 to 14.9

TMDL[(1)]	**MOS[(2)]**	**WLA[(3)]**	**Future Growth - WLA**	**LA**	**Mean Annual Flow (cfs)**	**Percent Reduction[(4)]**
9.59×10^{10} col/day	9.59×10^{9} col/day	0.0 col/day	8.63×10^{8} col/day	8.55×10^{10} col/day	9.8	84.21%

Notes:

(1). TMDLs are expressed as daily loads of fecal colonies by multiplying the WQC by the mean annual streamflow (MAF) and the appropriate conversion factor. MAF is determined by the USGS. The TMDL is the sum of all components. Daily loads for *E. coli* are provided in Appendix A.

(2). MOS is explicitly set at 10% of the Water Quality Criterion

(3). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Criterion in 401 KAR 5:031, and must not cause or contribute to an existing impairment. 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). Overall reduction needed during the 2006 PCR season to achieve the TMDL target of 360 colonies per 100ml. Percent reductions are provided for informational purposes only – see Appendix A.

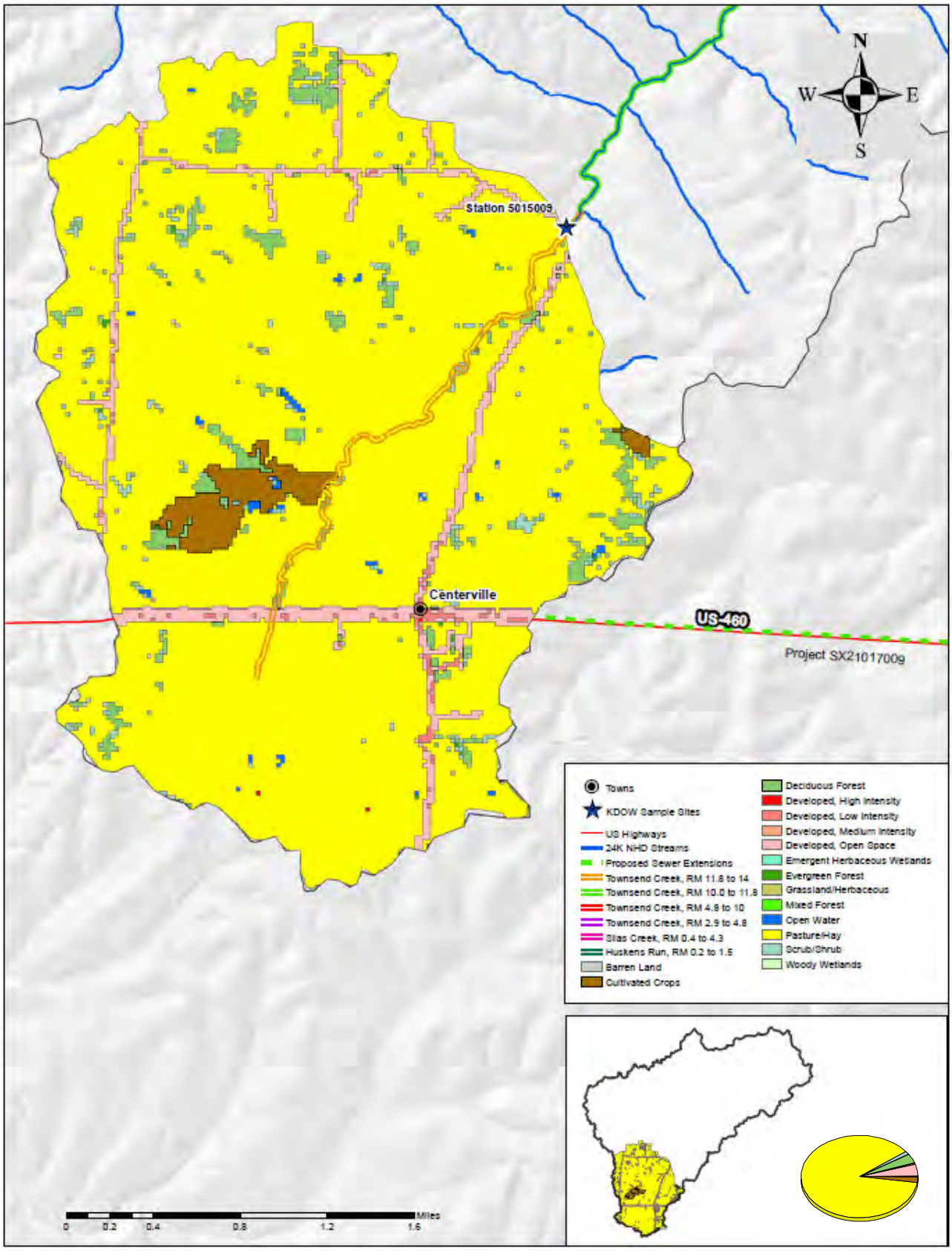

Figure 8.1 Land Cover for Townsend Creek 11.8 to 14.9

8.2.1.2 Townsend Creek 10.0 to 11.8 into South Fork Licking River

Townsend Creek remains a third order stream through this segment. Exceedance of the WQC (400 col/100ml) was observed in only 9.09% of the samples collected – the highest concentration of all samples was 2200 colonies per 100 ml. Stream flow from the Hutson karst tributary (located in the Cooper Run watershed to the south) enters Townsend Creek in the vicinity of this sample site (see Figure 3.2) and may play a role in bacteria concentration results. Based on the WQC, a TMDL was not calculated for this stream segment that was found to be fully supporting its PCR designated use. Loading calculations and data collected at the site are included in Appendix C. The predominant land cover in the watershed to this point remains agricultural pasture followed by developed land and forest (Figure 8.2).

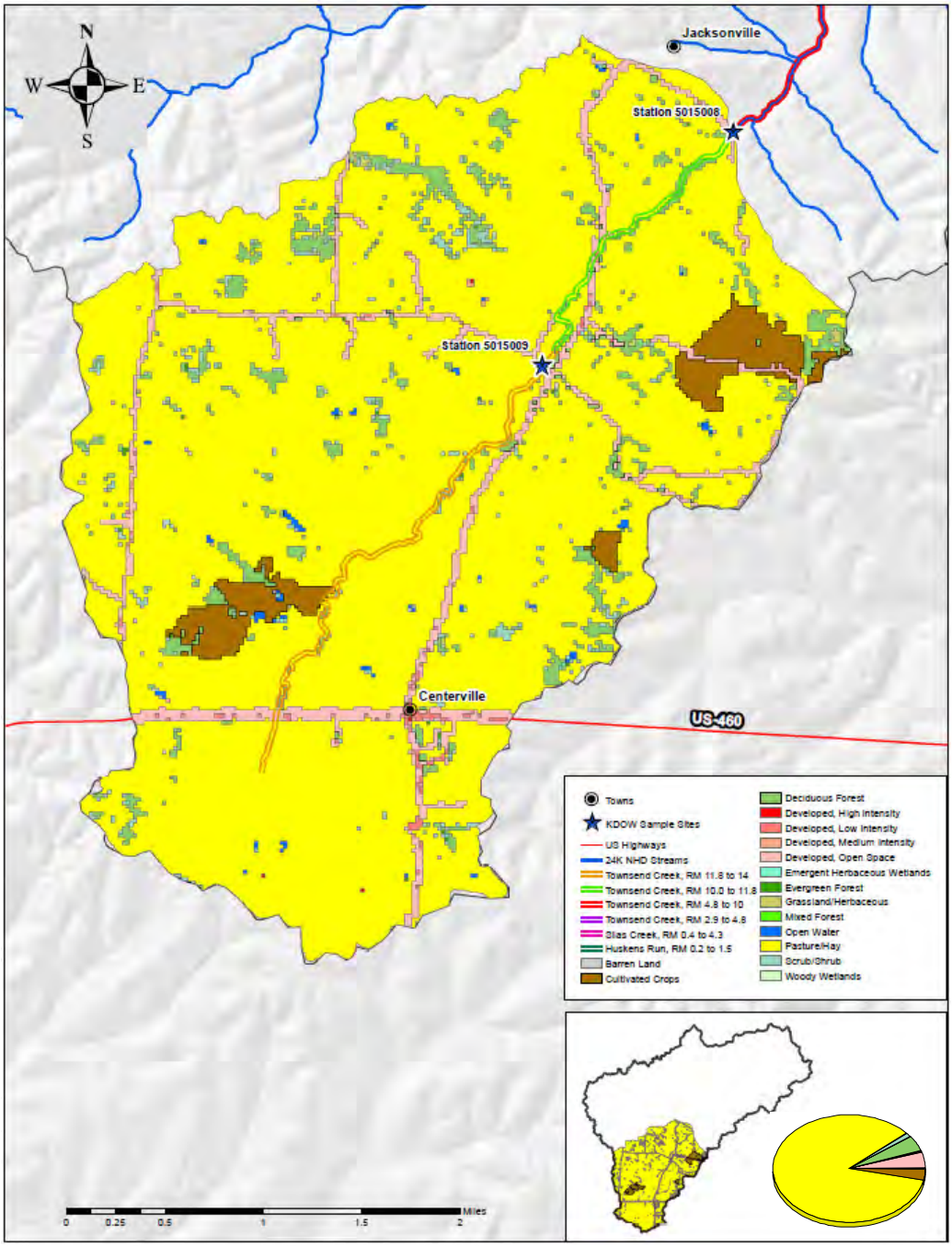

Figure 8.2 Land Cover for Townsend Creek 10.0 to 11.8

8.2.1.3 Townsend Creek 4.8 to 10.0 into South Fork Licking River

Townsend Creek becomes a fourth order stream just downstream of this segment after receiving flow from the Silas Creek tributary. Two sampling sites are located on this segment, site 05015007 and 05015008. Sampling site 05015008 had the highest percent reduction (or highest exceedance of the WQC) and was therefore used to set the TMDL for this segment.

Exceedance of the WQC (400 col/100ml) was observed in 36.36% of the samples collected at sample site 05015007 – the highest concentration of all samples was 1,240 colonies per 100 ml (Table 8.4). Stream flow at this site is nearly double that of the site just upstream. Mapped sinkholes in the area and potential karst influence (see Figure 3.2) may play a role in the bacteria concentrations which appear to increase with increased, little or no precipitation suggesting contribution from various types of nonpoint sources. According to the data presented, the watershed would have required a 70.97% reduction in bacteria loading during the 2006 PCR season in order to meet the WQC.

Table 8.4 Fecal Coliform Data Collected on Townsend Creek at Site 05015007

Townsend Cr at Lail Road - 05015007					
Sample Date	**Colonies/100mL**	**Flow (cfs)**	**Field Precip Notes**	**Paris, KY Precip Notes**	**Cynthiana, KY Precip Notes**
05/15/06	600	4.19	2 days since .1" rain	.09" - rain during the last 4 days	.06" - .2" rain 72 hours ago
05/26/06	400	n/a	1.56 in of rain last 48hrs	.48" - .45" the day before	0 - .36" rain 48 hours ago
06/14/06	100	n/a	0 in of rain last 48hrs	0 - .45" rain 48 hours before	0 - .1" rain 72 hours ago
06/27/06	140	8.253	3 days since .1" rain	0 - 1.99" rain 72 hours before	0 - .1" 24 hours ago
06/29/06	190	n/a	.14 in of rain last 48hrs	.07" - no rain in last 72 hours	0 - .15" rain 24 hours ago
07/15/06	60	n/a	1.59 in of rain in last 48 hrs	.21" - rain during the last 3 days	0 - rain during the last 4 days
07/31/06	420	n/a	0 in of rain last 48hrs	0 - .11" of rain 48 hours before	0 - .55" 72 hours ago
08/02/06	410	0.035	about 6 days since .1" rain	0 - no rain in last 72 hours	n/a
10/18/06	1240	n/a	n/a	.05" - 1.3" rain 24 hours ago	0 - 1.65" rain 48 hours ago
10/24/06	160	n/a	n/a	0 - .01" 48 hours ago	0 - no rain in last 72 hours
10/31/06	210	39.53	several days since .1" rain	0 - 1.84" rain 72 hours ago	.2" - no rain in last 72 hours
Existing Conditions					
5.4×10^{11} colonies per day					

Exceedance of WQC	Rain today	Rain within last 24 hours	Rain within last 48 hours	No Rain for 48 hours

n/a = flow and/or notes not collected that day

Exceedance of the WQC (400 col/100ml) was observed in 54.54% of the samples collected at sample site 05015005 – the highest concentration of all samples was 2,820 colonies per 100 ml (Table 8.5). Stream flows appear to be influenced by karst features; flow at this site can be less than that of the upstream site during periods of heavy rainfall suggesting a losing stream and interaction with the underlying ground water (see Figure 3.2). The karst influence may play a role in the bacteria concentrations which appear to increase with increased, little or no precipitation suggesting contribution from various types of sources.

Table 8.5 Fecal Coliform Data Collected on Townsend Creek 4.8 to 10.0 at Site 05015005

Townsend Creek above Silas Cr. Confluence - 05015005					
Sample Date	**Colonies/100mL**	**Flow (cfs)**	**Field Precip Notes**	**Paris, KY Precip Notes**	**Cynthiana, KY Precip Notes**
05/15/06	400	3.51	2 days since.1" rain	.09" - rain during the last 4 days	.06" - .2" rain 72 hours ago
05/26/06	1600	n/a	1.56 in of rain last 48hrs	.48" - .45" the day before	0 - .36" rain 48 hours ago
06/14/06	520	n/a	0 in of rain last 48hrs	0 - .45" rain 48 hours before	0 - .1" rain 72 hours ago
06/27/06	490	0.117	3 days since.1" rain	0 - 1.99" rain 72 hours before	0 - .1" 24 hours ago
06/29/06	150	n/a	.14 in of rain last 48hrs	.07" - no rain in last 72 hours	0 - .15" rain 24 hours ago
07/15/06	475	n/a	1.59 in of rain in last 48 hrs	.21" - rain during the last 3 days	0 - rain during the last 4 days
07/31/06	960	n/a	0 in of rain last 48hrs	0 - .11" of rain 48 hours before	0 - .55" 72 hours ago
08/02/06	350	0.053	about 6 days since.1" rain	0 - no rain in last 72 hours	n/a
10/18/06	2820	n/a	n/a	.05" - 1.3" rain 24 hours ago	0 - 1.65" rain 48 hours ago
10/24/06	340	n/a	n/a	0 - .01" 48 hours ago	0 - no rain in last 72 hours
10/31/06	280	36.09	several days since .1" rain	0 - 1.84" rain 72 hours ago	.2" - no rain in last 72 hours

Exceedance of WQC	Rain today	Rain within last 24 hours	Rain within last 48 hours	No Rain for 48 hours

n/a = flow and/or notes not collected that day

The predominant land cover in the watershed to this point remains agricultural pasture followed by developed land and forest (Figure 8.4).

Based on the WQC and the MAF, the bacteria TMDL for the 5.2 mile impaired segment of Townsend Creek is 2.04×10^{11} colonies per day. According to the data presented, the watershed would have required an 87.23% reduction in bacteria loading during the 2006 PCR season in order to meet the WQC (Table 8.6). In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.6 Summary of TMDL Components for Townsend Creek 4.8 to 10.0

TMDL[(1)]	MOS[(2)]	WLA[(3)]	Future Growth - WLA	LA	Mean Annual Flow (cfs)	Percent Reduction[(4)]
2.04×10^{11} col/day	2.04×10^{10} col/day	0.0 col/day	1.83×10^{9} col/day	1.81×10^{11} col/day	20.8	87.23%

Notes:

(1). TMDLs are expressed as daily loads of fecal colonies by multiplying the WQC by the mean annual streamflow (MAF) and the appropriate conversion factor. MAF is determined by the USGS. The TMDL is the sum of all components. Daily loads for *E. coli* are provided in Appendix A.

(2). MOS is explicitly set at 10% of the Water Quality Criterion

(3). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Criterion in 401 KAR 5:031, and must not cause or contribute to an existing impairment. 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). Overall reduction needed during the 2006 PCR season to achieve the TMDL target of 360 colonies per 100ml. Percent reductions are provided for informational purposes only – see Appendix A

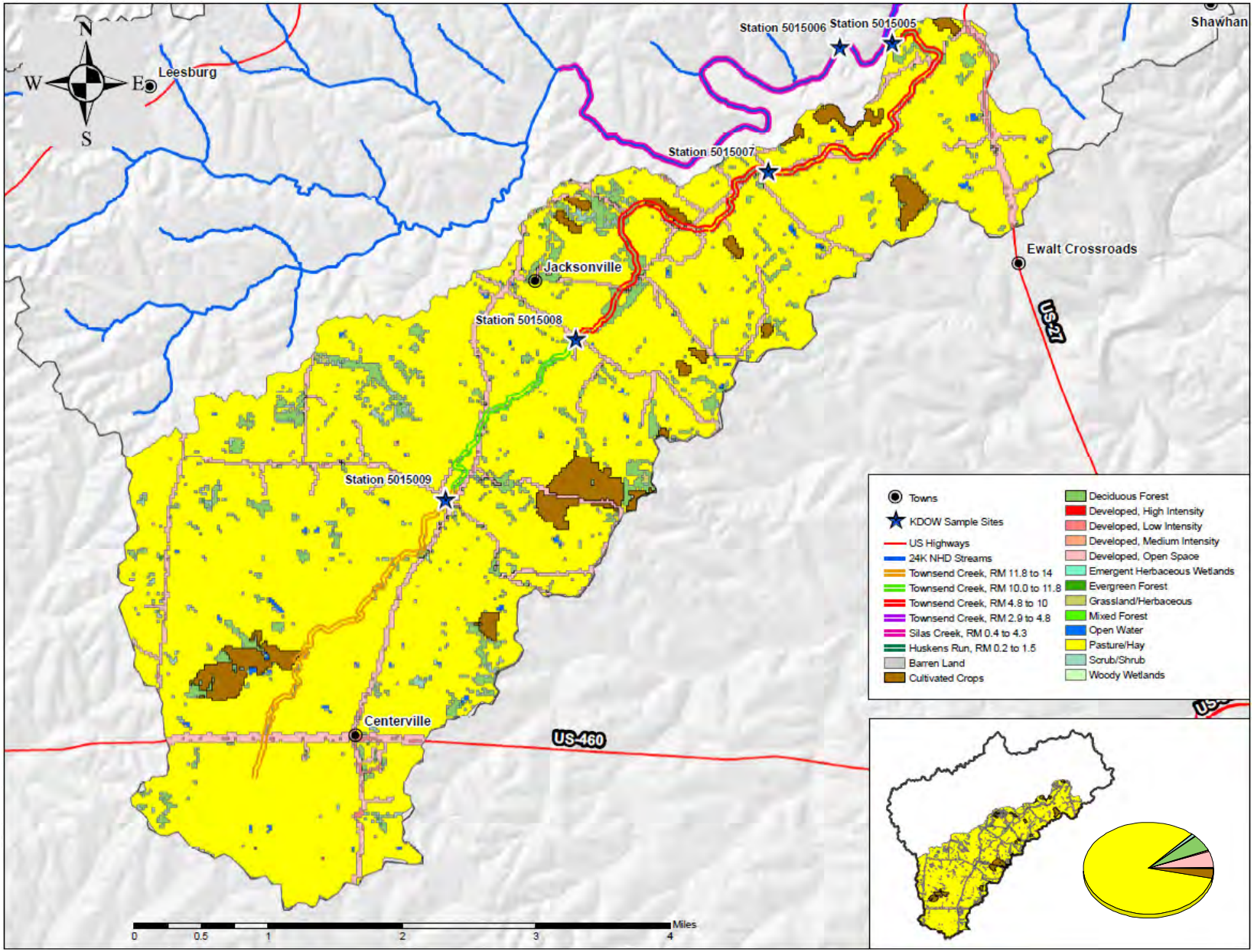

Figure 8.3 Land Cover for Townsend Creek 4.8 to 10.0

8.2.1.4 Townsend Creek 2.9 to 4.8 into South Fork Licking River

Townsend Creek remains a fourth order stream after receiving flow from the Silas Creek and Huskens Run tributaries. Exceedance of the WQC (400 col/100ml) was observed in 25% of the samples collected – the highest concentration of all samples was 2400 colonies per 100 ml (Table 8.7). Bacteria concentrations do not correlate well with rainfall patterns - a few samples may have been collected during the falling limb of the hydrograph (after a 'flush' of the system) and bacteria contributions are likely from various types of sources. The predominant land cover in the watershed to this point remains agricultural pasture followed by forest and developed land (Figure 8.5).

Table 8.7 Fecal Coliform Data Collected on Townsend Creek 2.9 to 4.8 at Site 05015003

Townsend Cr. at S. Edgewater Rd bridge - 05015003					
Sample Date	**Colonies/100mL**	**Flow (cfs)**	**Field Precip Notes**	**Paris, KY Precip Notes**	**Cynthiana, KY Precip Notes**
05/15/06	6	9.92	2 days since.1" rain	.09" - rain during the last 4 days	.06" - .2" rain 72 hours ago
06/14/06	740	n/a	0 in of rain last 48hrs	0 - .45" rain 48 hours before	0 - .1" rain 72 hours ago
06/27/06	330	1.544	3 days since.1" rain	0 - 1.99" rain 72 hours before	0 - .1" 24 hours ago
07/15/06	120	n/a	1.59 in of rain in last 48 hrs	.21" - rain during the last 3 days	0 - rain during the last 4 days
08/02/06	340	0.04	about 6 days since .1" rain	0 - no rain in last 72 hours	n/a
09/14/06	290	0.02	1.79 in of rain in last 48 hrs	.11" - 1.35" in last 24 hours	0 - rain during last 2 days
10/19/06	2400	n/a	1.55 in of rain in last 48 hrs	0 - 1.3" rain 48 hours ago	.75" - 1.65" rain 72 hours ago
10/31/06	200	53.63	several days since .1" rain	0 - 1.84" rain 72 hours ago	.2" - no rain in last 72 hours

Exceedance of WQC	Rain today	Rain within last 24 hours	Rain within last 48 hours	No Rain for 48 hours

n/a = flow and/or notes not collected that day

Based on the WQC and the MAF, the bacteria TMDL for this 1.9 mile impaired segment of Townsend Creek is 4.29×10^{11} colonies per day. According to the data presented, the watershed would have required an 85% reduction in bacteria loading during the 2006 PCR season in order to meet the WQC (Table 8.8). In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.8 Summary of TMDL Components for Townsend Creek 2.9 to 4.8

TMDL(1)	**MOS(2)**	**WLA(3)**	**Future Growth - WLA**	**LA**	**Mean Annual Flow (cfs)**	**Percent Reduction(4)**
4.29×10^{11} col/day	4.29×10^{10} col/day	0.0 col/day	3.86×10^{9} col/day	3.82×10^{11} col/day	43.8	85%

Notes:

(1). TMDLs are expressed as daily loads of fecal colonies by multiplying the WQC by the mean annual streamflow (MAF) and the appropriate conversion factor. MAF is determined by the USGS. The TMDL is the sum of all components. Daily loads for *E. coli* are provided in Appendix A.

(2). MOS is explicitly set at 10% of the Water Quality Criterion

(3). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Criterion in 401 KAR 5:031, and must not cause or contribute to an existing impairment. 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). Overall reduction needed during the 2006 PCR season to achieve the TMDL target of 360 colonies per 100ml. Percent reductions are provided for informational purposes only – see Appendix A.

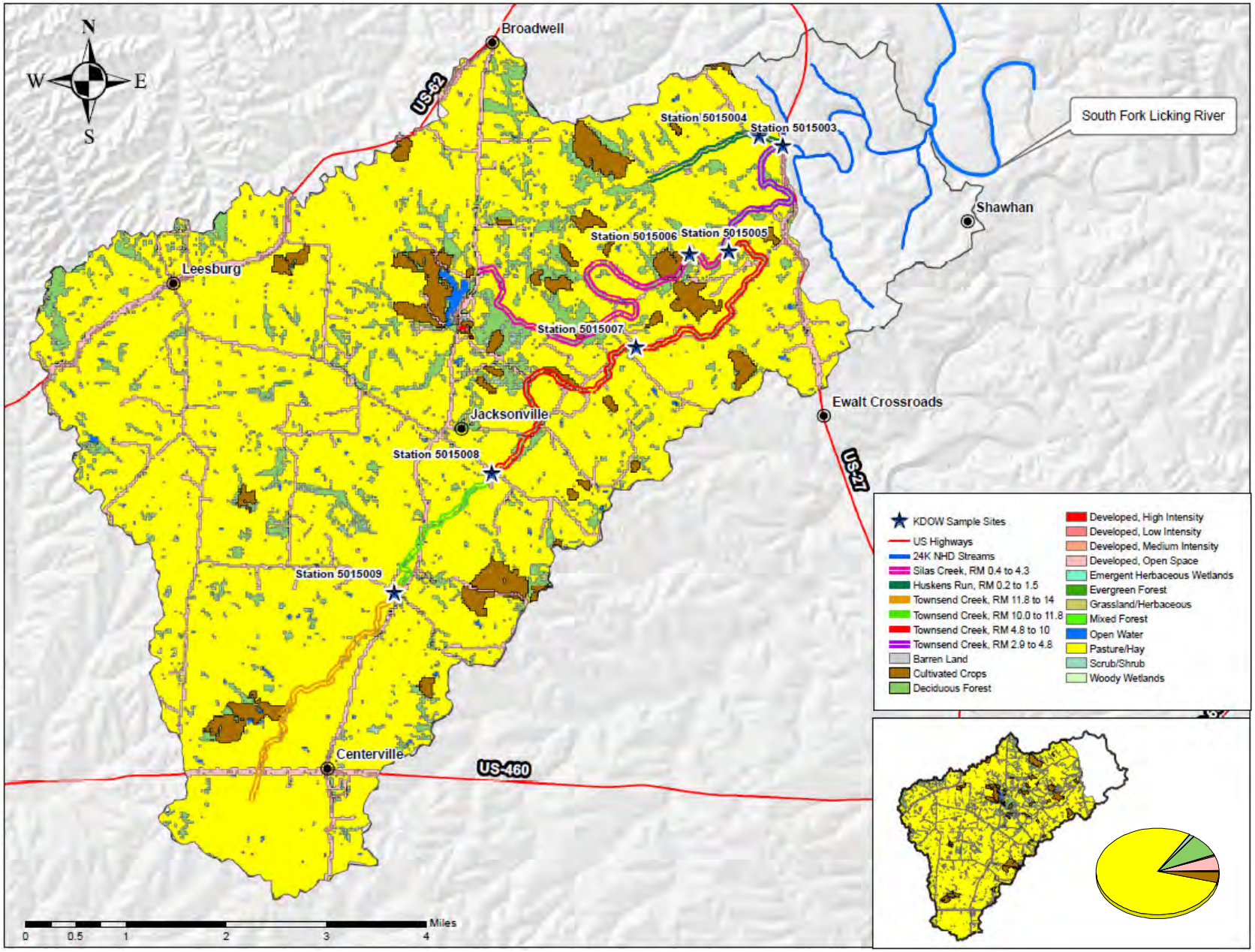

Figure 8.4 Land Cover for Townsend Creek 2.9 to 4.8

8.2.1.5 Silas Creek 0.4 to 4.3 into Townsend Creek

Silas Creek of Townsend Creek is a third order stream discharging to Townsend Creek near river mile 4.8. The watershed covers an area of 14.35 square miles and the predominant land cover is agricultural pasture followed by forest and developed land (Figure 8.6). Exceedance of the WQC (400 col/100ml) was observed in only 12.5% of the samples collected – the highest concentration of all samples was 3600 colonies per 100 ml. One sample exceeded the WQC after a period of heavy rainfall suggesting the loading may be caused by nonpoint sources in the watershed. Harrison Limestone maintains a reservoir on Silas Creek just upstream of the supporting segment that may play a role in reducing bacterial contributions from the headwaters. Two 319(h) Nonpoint Source Implementation Grant BMP projects were completed in the headwaters after the sampling event and are further discussed in Section 9. Maintenance of these projects could reduce the bacterial loading to this area of the watershed. Based on the WQC, a TMDL was not calculated for this stream segment/ subwatershed that was found to be fully supporting its PCR designated use. Loading calculations and data collected at the site are included in Appendix C.

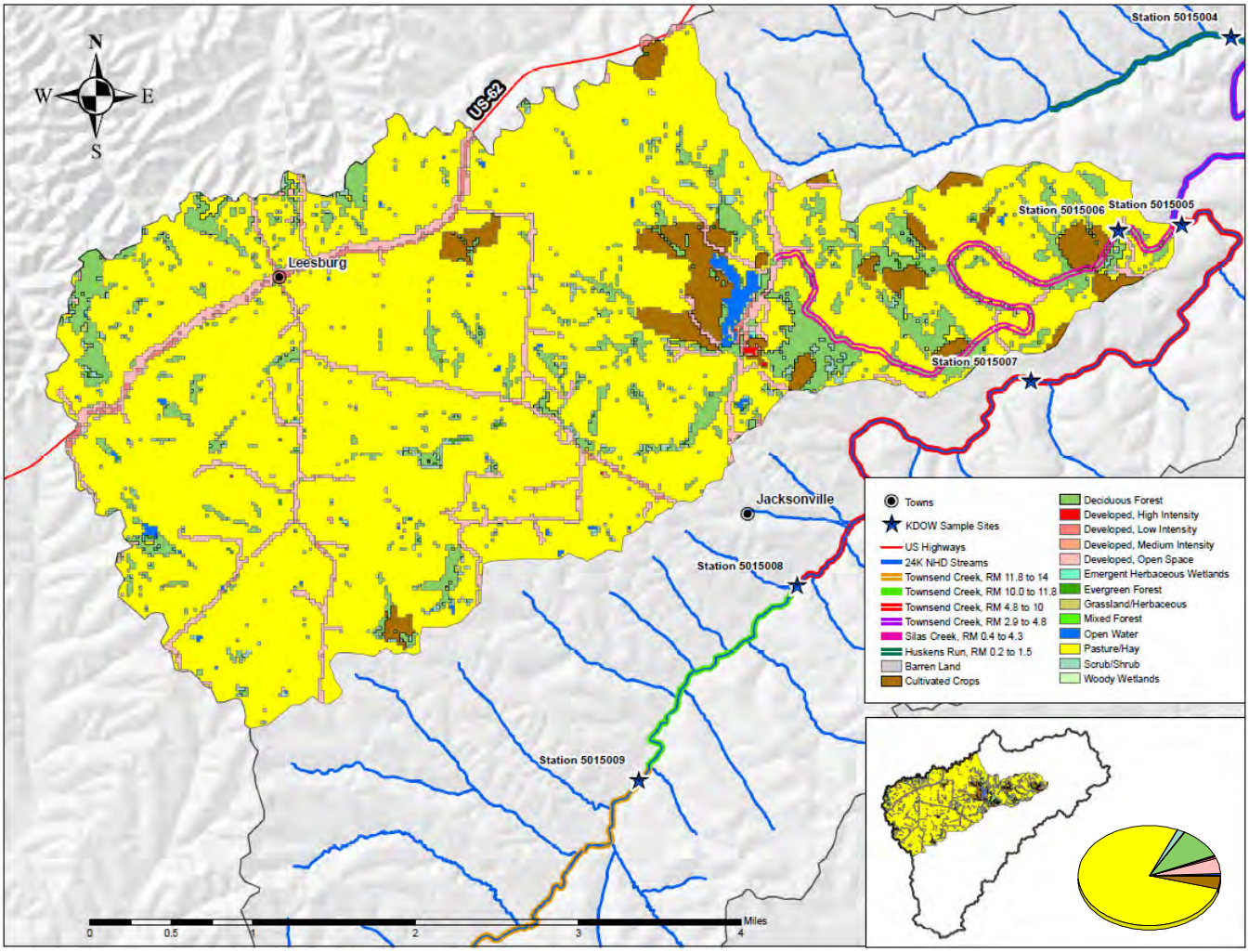

Figure 8.5 Land Cover for Silas Creek 0.4 to 4.3

8.2.1.6 Huskens Run 0.2 to 1.5 into Townsend Creek

Huskens Run of Townsend Creek is a third order stream that discharges to Townsend Creek near river mile 2.9 and is approximately 3.91 square miles. Exceedance of the WQC (400 col/100ml) was observed in 42.86% of the samples collected – the highest concentration of all samples was 2400 colonies per 100 ml (Table 8.9). Fecal coliform concentrations appear to increase with increased amounts of precipitation that suggests the loading may be caused by non KPDES-permitted (nonpoint) sources in the watershed. The predominant land cover in the watershed is agricultural pasture followed by forest and developed land (Figure 8.7).

Table 8.9 Fecal Coliform Data Collected on Huskens Run 0.2 to 1.5 at Site 05015004

Huskens Run at S. Edgewater Rd bridge - 05015004					
Sample Date	**Colonies/100mL**	**Flow (cfs)**	**Field Precip Notes**	**Paris, KY Precip Notes**	**Cynthiana, KY Precip Notes**
05/15/06	8	0.55	2 days since.1" rain	.09" - rain during the last 4 days	.06" - .2" rain 72 hours ago
06/14/06	450	n/a	0 in of rain last 48hrs	0 - .45" rain 48 hours before	0 - .1" rain 72 hours ago
06/27/06	120	0.505	3 days since.1" rain	0 - 1.99" rain 72 hours before	0 - .1" 24 hours ago
07/15/06	40	n/a	1.59 in of rain in last 48 hrs	.21" - rain during the last 3 days	0 - rain during the last 4 days
09/14/06	740	0.005	1.79 in of rain in last 48 hrs	.11" - 1.35" in last 24 hours	0 - rain during last 2 days
10/19/06	2400	n/a	1.55 in of rain in last 48 hrs	0 - 1.3" rain 48 hours ago	.75" - 1.65" rain 72 hours ago
10/31/06	310	3.76	several days since .1" rain	0 - 1.84" rain 72 hours ago	.2" - no rain in last 72 hours

Exceedance of WQC	Rain today	Rain within last 24 hours	Rain within last 48 hours	No Rain for 48 hours

n/a = flow and/or notes not collected that day

Based on the WQC and the MAF, the bacteria TMDL for the 1.3 mile impaired segment of Huskens Run is 4.60×10^{10} colonies per day. According to the data presented, the watershed would have required an 85% reduction in bacteria loading during the 2006 PCR season in order to meet the WQC (Table 8.10). In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.10 Summary of TMDL Components for Huskens Run 0.2 to 1.5

TMDL[(1)]	MOS[(2)]	WLA[(3)]	Future Growth - WLA	LA	Mean Annual Flow (cfs)	Percent Reduction[(4)]
4.60×10^{10} col/day	4.60×10^{9} col/day	0.0 col/day	4.14×10^{8} col/day	4.10×10^{10} col/day	4.7	85%

Notes:

(1). TMDLs are expressed as daily loads of fecal colonies by multiplying the WQC by the mean annual streamflow (MAF) and the appropriate conversion factor. MAF is determined by the USGS. The TMDL is the sum of all components. Daily loads for *E. coli* are provided in Appendix A.

(2). MOS is explicitly set at 10% of the Water Quality Criterion

(3). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Criterion in 401 KAR 5:031, and must not cause or contribute to an existing impairment. 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). Overall reduction needed during the 2006 PCR season to achieve the TMDL target of 360 colonies per 100ml. Percent reductions are provided for informational purposes only – see Appendix A.

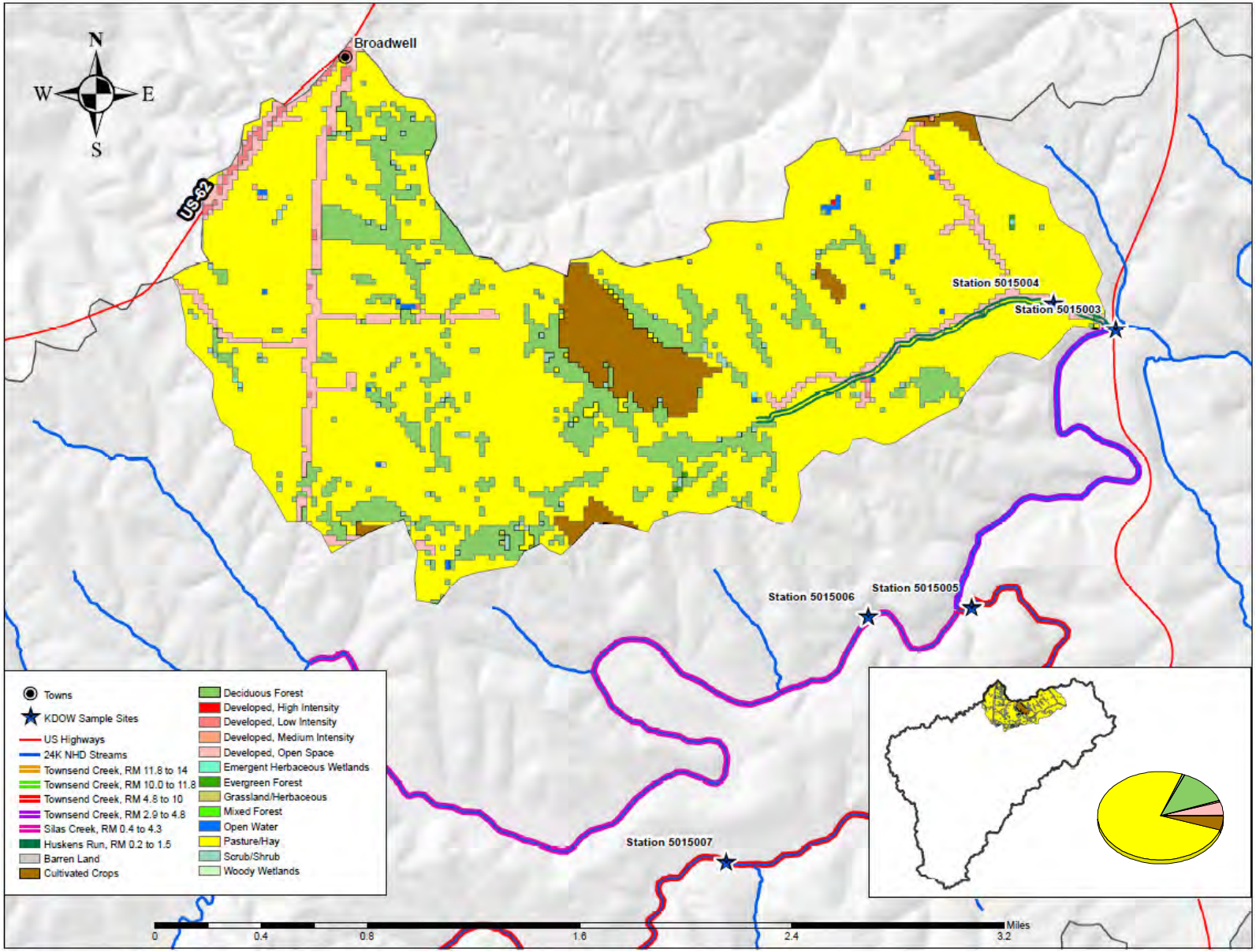

Figure 8.6 Land Cover for Huskens Run 0.2 to 1.5

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 of KDOW 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.

Watershed plans provide an integrative approach for identifying and describing how, when, who and what actions should be taken in order to meet water quality standards. At this time, a comprehensive watershed restoration plan for the Townsend Creek watershed has not been developed. This TMDL document provides bacteria allocations and reduction goals that may assist with developing a detailed watershed plan to guide watershed restoration efforts.

A watershed plan for the Townsend Creek watershed should address both point and nonpoint sources of pollution in the watershed and should build on existing efforts as well as evaluate new approaches. Because of the specific landscape and location of the impairments in the Townsend Creek watershed, a watershed plan should incorporate all available restoration and protection mechanisms, including any existing Groundwater Protection Plans, storm water or wastewater KPDES permits. A comprehensive watershed plan should consider both voluntary and regulatory approaches to meet water quality standards. When such a plan is developed, pollutant trading may be a viable management strategy to consider for meeting the TMDL load reduction goals.

A 319(h) Nonpoint Source Implementation Grant was awarded to the Nature Conservancy and Licking River Watershed Watch in 2005 in cooperation with the KDOW Watershed Management Branch to establish baseline data in the Townsend Creek watershed prior to implementing BMPs. KDOW biologists and the TMDL Section worked with TNC/LRWW to select monitoring stations and complete the sampling event. The seven sampling sites addressed in this TMDL document were monitored once monthly for fecal coliform bacteria during the PCR season (May 1st through October 31st) of 2006.

Following the sampling event, four residences received grant monies for installation of BMPs (Figure 9.1). Two residences in the headwaters of Silas Creek (Ralph Quillin and Jane Thomas) installed fencing, a stream crossing, pipeline, a watering tank and several heavy use protection areas. One residence in the headwaters of Townsend Creek near site 05015009 (Joe Schlegel) installed a riparian buffer, fencing, two stream crossings, pipeline and a watering tank. The fourth residence (Edwin Brady) is located just outside of the watersheds topographical boundary in Cooper Run, to the south. Groundwater dye tracing has been performed on either side of this property indicating that surface water from Cooper Run flows underground and emerges in Townsend Creek. Dye tracing will need to be performed on this property to confirm or deny the same phenomenon.

9.1 Kentucky Watershed Management Framework

A Watershed Management Framework approach to Water Quality Management was adopted by the KDOW in 1998. The plan divides Kentucky's major drainage basins into five groups of basins which are cycled through a five year staggered process that involves monitoring, assessment, prioritization, plan development, and plan implementation. As part of the process, a basin coordinator is assigned to

each river basin to work with the citizens of the basin to develop a local Watershed Management Team associated with each priority watershed. For more information about the river basins see http://water.ky.gov/watershed/Pages/Basins.aspx.

9.2 Non-Governmental Organizations

There are several Non-Governmental Organizations (NGO) that may be operating in the Townsend Creek watershed that may help to implement the TMDL, particularly with regard to nonpoint source issues. These organizations include Watershed Watch in Kentucky groups and Kentucky Waterways Alliance.

9.2.1 Watershed Watch in Kentucky

Watershed Watch is a citizen's water monitoring effort that relies exclusively on volunteers to provide administration, training, and volunteer and equipment coordination. The volunteers measure basic parameters of stream health to determine whether streams meet important "uses" under the Clean Water Act including aquatic life, human recreation, and drinking water.

Several water quality measurements are taken annually by Watershed Watch groups. Volunteers collect physical measurements, such as temperature, pH, dissolved oxygen, and conductivity. Stream monitoring may also include macroinvertebrate and habitat assessments. Data from annual monitoring is routinely used to help identify problems in the watershed, and assist with prioritizing streams for restoration and protection activities.

For more information about Watershed Watch see:
http://water.ky.gov/wsw/Pages/default.aspx.

9.2.2 Kentucky Waterways Alliance

The formation of Kentucky Waterways Alliance (KWA) was the result of a series of meetings sponsored by the Kentucky Environmental Quality Commission. The KWA has a mission to protect and restore Kentucky's waterways and their watersheds through alliances for watershed stewardship. This includes strengthening community and governmental stewardship for the restoration and preservation of Kentucky's water resources. The Alliance promotes networking, communication and mutual support among groups, government agencies, and businesses working on waterway issues.

For more information about KWA see:
http://www.kwalliance.org.

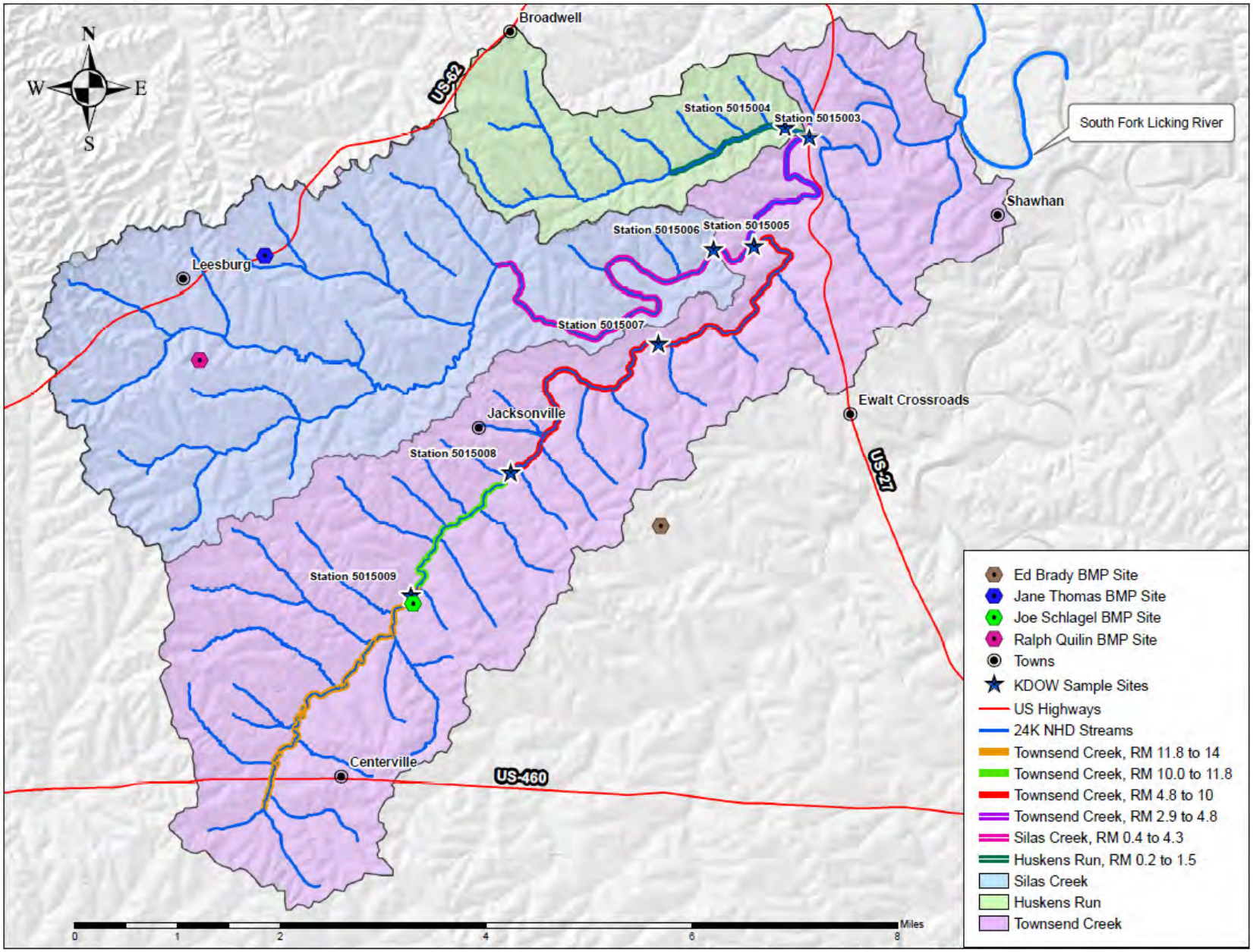

Figure 9.1 Locations of 319(h) Nonpoint Source Implementation Grant BMP Projects

10.0 Public Participation

This TMDL document was published for a 30-day public comment period between May 11th and June 13, 2011. A public notice was sent to all newspapers in the Commonwealth of Kentucky and advertisements were purchased in the Bourbon County Citizen and Cynthiana Democrat. Additionally, the public notice 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 were incorporated into the administrative record for this TMDL. After consideration of each comment received, revisions were made accordingly to the final TMDL document and responses prepared and mailed to each individual/ agency participating in the public notice process.

11.0 References

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Appendix A

- Percent Reduction Calculations -

For informational purposes only, a "percent reduction" was calculated for all bacteria-impaired waterbodies addressed in this TMDL to illustrate the percent reduction that would have been required during the 2006 PCR season to meet the TMDL target. The existing load was calculated as the 100th percentile of the fecal coliform results collected at each sample site (during the 2006 PCR season) multiplied by the MAF and converted to a load.

((Existing load – TMDL target)/ Existing Load) * 100 = percent reduction required **(Equation 1)**

While providing additional information, the percent reduction calculation is not equivalent to the TMDL; the TMDL is the load that the waterbody can naturally assimilate while continuing to meet its designated uses (i.e. PCR). The TMDL is equal to the critical flow rate (MAF) multiplied by the WQC of 400 colonies/ 100 ml (minus a MOS), which is then multiplied by a conversion factor that allows the load to be expressed in colonies per day.

Therefore, the percent reduction is a determination of how much the measured concentrations exceeded the WQC at the time the samples were taken (i.e. the 2006 PCR season). It does not determine the percent reduction needed at any other time as in-stream concentrations are likely to be different. Unlike the calculated percent reductions, the TMDL is a constant based upon the WQC and critical flow, whereas the percent reduction changes based upon in-stream fecal coliform concentrations. The percent reduction for each bacteria-impaired stream segment is presented in Table A1.

- *E. coli* Equivalent TMDL Calculations –

KDOW has begun using *E. coli* as the preferred pathogen indicator organism for assessment, monitoring, and permitting purposes. Because the streams addressed in this document were monitored and assessed using fecal coliform indicator organisms, the TMDLs were calculated using the WQC for fecal coliform. However the stream segments could be converted to an *E. coli* daily load by using the WQC for *E. coli* (240 colonies/ 100 ml) in the TMDL calculations (MAF x WQC x conversion factors) or by multiplying the fecal coliform TMDL by the *E. coli* WQC and dividing by the WQC for fecal coliform (400 colonies/100 ml; Table A1). It should be noted that percent reductions could not be converted for *E. coli* since samples were analyzed for fecal coliform.

Table A1 Percent Reduction and *E. coli* Equivalent for TMDL Waterbodies within the Townsend Creek Watershed

Segment	Percent of Samples Exceeding WQC	Fecal Coliform TMDL	*E. coli* Equivalent TMDL	Existing Condition (colonies/100mL)	Percent Reduction
Townsend Creek into South Fork Licking River RM 2.9-4.8	22.22%	4.29×10^{11} col/day	2.57×10^{11} col/day	2400	85%
Huskens Run into Townsend Creek RM 0.2-1.5	42.85%	4.40×10^{10} col/day	2.64×10^{10} col/day	2400	85%
Townsend Creek into South Fork Licking River RM 4.8-10.0	54.54%	2.04×10^{11} col/day	1.22×10^{11} col/day	2820	87.23%
Townsend Creek into South Fork Licking River RM 11.8-14.9	50%	9.59×10^{10} col/day	5.75×10^{10} col/day	2280	84.21%

- Land Use Analysis -

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

National Land Cover Database Class Descriptions (Homer et al, 2004)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix B
- WRIS Reports -

The following paragraphs explaining the WRIS and WRIS portal were copied from their website in November 2010 and can be accessed at http://kia.ky.gov/wris/.

> The Water Resource Information System (WRIS), has been developed through the cooperative efforts of water and wastewater treatment systems and local, regional, and state agencies. It is used by all these entities, and provides much of the information needed for all aspects of water resource planning--from watershed protection to infrastructure development. The WRIS includes a geographic information system (GIS), and information on water resources, drinking water systems, wastewater treatment systems, project development, emergency response, regulations, and planning.
>
> The WRIS Portal has been developed through the cooperative efforts of water and wastewater treatment systems and local, regional and state agencies. It is used by all these entities, and provides much of the information needed for all aspects of water planning and emergency management decision making. The WRIS portal is designed to bring together information from a multitude of sources and display that information in one easy to use web application. The Portal is linked to databases at the Kentucky Department of Water, Kentucky Department for Local Government, the Kentucky Public Service Commission, Kentucky Department of Education, Kentucky Department of Parks, and the Kentucky Infrastructure Authority.

WRIS system reports can be generated using system data accessed via the WRIS portal. Likewise project profile forms can be generated using project profile data accessed via the WRIS portal. The City of Paris Sewer Department operates a sanitary sewer collection and treatment system within its corporate limits. Though the city of Paris currently has no infrastructure within Townsend Creek, it does have several projects on the Clean Water State Revolving Fund Priority List – one of these projects includes extending sewer service to the city of Centerville, located in the headwaters of Townsend Creek. The WRIS system report and project profile form for the city of Paris is included below.

WRIS System Data Report

DOW Permit ID: **KY0090654** DOW Permit Type: **WASTE WATER (KPDES or KNDOP)**
DOW Permit Name: **PARIS STP**
System Name: **PARIS SEWER DEPARTMENT**
System Type: **KIA NON-KISOP** Receiving Waters:
ADD ID: **BGADD** Primary County: **BOURBON** DOW Field Office: **FRANKFORT**
Permit Dates: Issued: **11-02-2009** Expires: Inactivated:

System Contact Information:

Contact: **PATRICK HARNEY**
Contact Address1: **CITY OF PARIS**
Contact Address2: **525 HIGH ST**
Contact City: **PARIS** State: **KY** Zip: **40361**
Contact Phone: **859-987-2116** Contact EMail:

Owner Information:

Entity Type: **CITY / MUNICIPAL UTILITY**
PSC Group ID:
Entity Name: **CITY OF PARIS**
Web URL:
Office EMail: **kcrump@paris.ky.gov**
Office Phone: **859-987-2110** Ext: Toll Free: Fax: **859-987-4640**

Mail Address1: **525 HIGH ST**	Phys Address1:
Mail Address2:	Phys Address2:
Mail City: **PARIS**	Phys City:
Mail State: **KY** Zip: **40361**	Phys State: Zip:

Contact: **CHERYL DRYDEN**	Manager: **MICHAEL NAGY**
Contact Title: **CITY CLERK**	Manager Title: **CITY MANAGER**
Contact EMail: **cdryden@paris.ky.gov**	Manager EMail: **mnagy@paris.ky.gov**
Contact Phone: **859-987-2110** Ext:	Manager Phone: **859-987-2110** Ext:
Contact Cell:	Manager Cell:

Authorized Official: **MICHAEL THORNTON**
Auth Official Title: **MAYOR**
Auth Official EMail: **mthornton@martins-services.com**
Auth Official Phone: **859-987-2529** Ext:
Auth Official Cell:
Term Exp. Date: **01-01-2011**

Report Date: **08-18-2010** Page **1**

WRIS System Data Report

DOW Permit ID: **KY0090654** DOW Permit Type: **WASTE WATER (KPDES or KNDOP)**
DOW Permit Name: **PARIS STP**
System Name: **PARIS SEWER DEPARTMENT**
System Type: **KIA NON-KISOP** Receiving Waters:
ADD ID: **BGADD** Primary County: **BOURBON** DOW Field Office: **FRANKFORT**
Permit Dates: Issued: **11-02-2009** Expires: Inactivated:

Fiscal Attributes:

Date Established: **1-1-1979 12:00:00AM**
Employees: **10**
Cost of treatment per 1,000 gallons:
Cost to consumer per 4,000 gallons: **$21.32**

Counties directly served by this system: **1**

County Name	Service Connections	Serviceable Population
Bourbon	3,942	10,912
Totals	3,942	10,912

Directly Serviceable Population: **10,912**
Indirectly Serviceable Population:
Total Serviceable Population:

Does this system:

(a) Operate a wastewater treatment facility?	YES
(b) Send wastewater to other systems to be treated?	NO
(c) Treat wastewater from other systems?	NO

Fiscal Comments:

The following facilitie(s) treat wastwater from this system:

Treatment DOW Permit ID	Treatment Name	Total Ann. Vol Treated (Mgal)

This facility treats wastewater from the following system(s):

Sender DOW Permit ID	Sender Name	Total Ann. Vol Treated (Mgal)	Serviceable Population

WRIS System Data Report

DOW Permit ID: **KY0090654** DOW Permit Type: **WASTE WATER (KPDES or KNDOP)**
DOW Permit Name: **PARIS STP**
System Name: **PARIS SEWER DEPARTMENT**
System Type: **KIA NON-KISOP** Receiving Waters:
ADD ID: **BGADD** Primary County: **BOURBON** DOW Field Office: **FRANKFORT**
Permit Dates: Issued: **11-02-2009** Expires: Inactivated:

System Planning Information:

Wastewater Treatment Facility Information:

Facility Name	Design Capacity (MGD)	Max. Hydr. Capacity (MGD)	Ave.Daily Flow (MGD)
PARIS WASTEWATER TREATMENT PLANT		2.70	1.40

■ This system has an approved Facility Plan.
Estimated percentage of Facility Plan constructed: **10** percent.
Date Facility Plan last revised or amended: **01/01/1999**
Number of manholes in collection system: **1,700**
Percentage of sewer lines 20 years or older: **75**
Total annual volume treated (Mgal): **524.87**

Wholesale Customers:
Residential Customers: **3,942**
Commercial Customers:
Institutional Customers:
Industrial Customers:
Other Customers:
Total Customers: **3,942**
Planning comments:

WMP Site Visit - Survey Information:

Survey Date: **02-12-2010**
Survey Administrator: **DAVID DUTTLINGER**
Principal Respondent: **KEVIN CRUMP, MATT BELCHER**
Other Respondent(s):

Comments:

WRIS System Data Report

DOW Permit ID: **KY0090654** DOW Permit Type: **WASTE WATER (KPDES or KNDOP)**
DOW Permit Name: **PARIS STP**
System Name: **PARIS SEWER DEPARTMENT**
System Type: **KIA NON-KISOP** Receiving Waters:
ADD ID: **BGADD** Primary County: **BOURBON** DOW Field Office: **FRANKFORT**
Permit Dates: Issued: **11-02-2009** Expires: Inactivated:

System Maintenance Information:

This system has a policy manual in place containing the following items:

- ■ Personnel policies.
- ■ Operation and maintenance procedures.
- ■ Emergency operation procedures.
- ■ Standard operating procedures.
- ■ Routine maintenance program.
- ■ Backup sources.

- ■ The management of this system participates in regular training activities.
- ■ System operator(s) participate in regular training activities.
- ■ This system utilizes standard specifications.
- ■ Date standard specifications last revised: **1/1/2000 12:00:00AM**
  Date of last infiltration analysis: **1/1/1999 12:00:00AM**
- ■ This system has periodic service outages.
  Periodic service outage cause(s): **GREASE IN SEWER LINES**

- □ This system encounters problematic weather conditions.
  Problamatic weather condition(s):

- ■ This system has localized problems.
  Problem location(s): **LEXINGTON ROAD AND FORDS MILL ROAD**
  Problem diameter(s): **6**
  Problem material(s): **CLAY TILE**
  Problem causes(s):
  Problem characteristics(s):
- ■ This system has as-built plans.
  Estimated accuracy: percent.
- ■ This system has an on-staff inspector.

Maintenance notes:

Report Date: **08-18-2010** Page **4**

WRIS System Data Report

DOW Permit ID: **KY0090654** DOW Permit Type: **WASTE WATER (KPDES or KNDOP)**
DOW Permit Name: **PARIS STP**
System Name: **PARIS SEWER DEPARTMENT**
System Type: **KIA NON-KISOP** Receiving Waters:
ADD ID: **BGADD** Primary County: **BOURBON** DOW Field Office: **FRANKFORT**
Permit Dates: Issued: **11-02-2009** Expires: Inactivated:

Project Number	Applicant / Project Title	Status	Schedule (yrs)	Dates Modified	
				Profile	GIS
SX21017003	CITY OF PARIS PARIS-BOURBON CO. INDUSTRIAL PARK WW EXPANSION			05-21-2009	08-03-2010
SX21017004	CITY OF PARIS CITY OF PARIS - CLAYSVILLE TRUNK SEWER REPLACEMENT PROJECT, PHASE II			10-29-2008	08-03-2010
SX21017005	CITY OF PARIS CITY OF PARIS-MILL RUN ROAD & CATHY DRIVE SANITARY SEWER PROJECT			11-09-2004	08-03-2010
SX21017006	CITY OF PARIS CITY OF PARIS-BOURBON HILLS SANITARY SEWER COLLECTION PROJECT			05-21-2009	08-04-2010
SX21017008	CITY OF PARIS CITY OF PARIS-BEDFORD ACRES SANITARY SEWER PROJECT			05-21-2009	08-03-2010
SX21017010	CITY OF PARIS CITY OF PARIS-SOUTHERN HILLS SANITARY SEWER COLLECTION PROJECT			08-15-2010	08-03-2010
SX21017011	CITY OF PARIS CITY OF PARIS-BOURBON HILLS SANITARY SEWER COLLECTION PROJECT, PHASE II			07-25-2007	08-03-2010
SX21017013	CITY OF PARIS CITY OF PARIS - BEDFORD ACRES SANITARY SEWER PROJECT PHASE 2			07-31-2008	07-28-2010
SX21017014	CITY OF PARIS CITY OF PARIS CLAYSVILLE TRUNK SEWER I & I STUDY, PHASE I			10-29-2008	08-03-2010
SX21017015	CITY OF PARIS CITY OF PARIS REHAB SANITARY SEWER MAINS			10-29-2008	08-03-2010

Report Date: **08-18-2010** Page **5**

KENTUCKY
WASTEWATER
PROJECT PROFILE
Areas indicated with (*) are required fields.

1.* **Project Title (use title which will be identifiable by local community):**

Bourbon County Fiscal Court - Centerville Sewer Project

2.* **Project Description:**

Provide a brief narrative denoting if project relates to source, distribution, treatment, storage or other)

This project will extend sanitary sewer service to the community of Centerville in rural Bourbon County. Centerville, located in western Bourbon County, is now technically able to be served by municipal sewer service because the City of Paris currently have sewer lines extending out Hwy. 460 in western Bourbon County. This project has recieved two rounds of KIA grant money in 2003 and 2005.

* Project Descriptor: Bourbon County Fiscal Court - Centerville Sewer Project

* WRIS Project Number (PNUM): SX21017009

This number is assigned by an ADD through the respective Area Water Management Planning Council once the project profile is approved by the Council. This number ties each project to mapped/spatial information in the Water Resource Information System (WRIS). Project profiles without this number AND the required corresponding mapped/spatial information will NOT be accepted.

* Project County: Bourbon

* Is it a multi-county project: ☐ Yes ◉ No

* Project Submitted By: Bluegrass

* If wastewater project, KPDES#(s):

Available:

KY0002801
KY0020001
KY0020010
KY0020036
KY0020044
KY0020044
KY0020061
KY0020079
KY0020087
KY0020095

Selected:

KY0090654

* If wastewater collection project, KIMOP#(s)

Available:

KYP000015
KYP000019
KYP000032
KYP000033
KYP000034
KYP000035
KYP000036
KYP000037
KYP000038
KYP000039

Selected:

None Selected..

3. Legal Applicant

* Legal Applicant: Bourbon County Fiscal Court/City of Paris

Wastewater Utility which will own proposed improvements: (if different from Legal Applicant)

* Organizational Structure: Municipality

Authorized Official Information

* First Name: Donnie * Last Name: Foley M.I.:

* Title: Bourbon Co. Judge-Exec.

* Street Address Line 1: County Courthouse

Street Address Line 2: 301 Main St., Rm. 203

* P.O. Box: none

* City: Paris * State: KY * Zip: 40361

* County: Bourbon

* Telephone: (859) 987-2135 Ext:

Fax: 859-987-2136

Email:

Contact Person Information

* First Name: Donnie * Last Name: Foley M.I.:
* Title: Bourbon Co. Judge-Exec.
* Street Address Line 1: County Courthouse
Street Address Line 2: 301 Main St., Rm. 203
* P.O. Box: None
* City: Paris * State: KY * Zip: 40361
* County: Bourbon
* Telephone: 859-987-2135 Ext:
Fax: 859-987-2136
Email:

Project Administrator Information

* First Name: Matthew * Last Name: Belcher M.I.:
Title: Comm. Development Specialist
Street Address Line 1: Bluegrass Area Development District
Street Address Line 2: 699 Perimeter Dr.
P.O. Box:
City: Lexington State: KY Zip: 40517
County: Fayette
* Telephone: 859-269-8021 Ext:
Fax:
Email: mbelcher@bgadd.org

Consulting Engineer Information

* First Name: Mark * Last Name: Askin M.I.:
Firm:
Street Address Line 1:
Street Address Line 2:
P.O. Box:

City: State: Zip:

County:

* Telephone: 859-266-8122 Ext:

Fax:

Email:

4.* **Project Type (atleast one required/check all that apply):**

- ☐ Facilities Planning
- ☑ Sewer System Evaluation Survey Report
- ☑ Design
- ☑ Construction
- ☐ Management

5. **Project Alternatives: Please list a minimum of three:**

a.* Continue the utilization of onsite treatment (septic tanks) for teh residents of the community of Centerville.

b.* Install a cluster onsite treatement system of possible. Soil conditions as well as other factors may limit the alternative.

c.* Do Nothing.

6. **Special Impact(s) of Proposed Wastewater Project:**

a.* New service/improve service to 20 unserved 5 underserved households

b. Number of new jobs: 0 Number of retained jobs: 0

c. Other beneficial technical, managerial, fiscal impacts: (20 words or less)

This will greatly improve the life of the residents of the community of Centerville, a satellite community of the City of Paris.

d.* Does proposed activity relate to public health protection emergency: ○ Yes ◉ No

e.* Does project involve regionalization: ○ Yes ◉ No

f. Number of systems affected/involved: 1

7.* **Median Household Income of Service Area:**

$ 25038

8.* **Project Start Schedule:**

☉ Years 0-2 ☐ Years 3-10 ☐ Years 11-20

9. **Estimated Funding Sources:**

* Estimated Local Funding Amount $ 0

* Estimated Other Funding Amount (all sources) $ 2500000

Total Estimated Project Cost $ 2500000

10. Project Data - Wastewater (complete all items which apply to this discrete project)

a.* Is project related to modifications to treatment plant? ☐ Yes ☉ No

b.* Is project related to new collector sewer construction? ☉ Yes ☐ No

Total linear feet 0

c.* Is project related to new interceptor sewer construction? ☐ Yes ☉ No

d.* Is project related to sewer rehab? ☐ Yes ☉ No

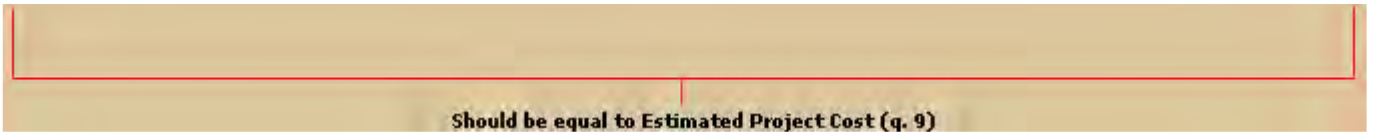
e. Number of lift stations required 0

f. Management (describe)

g.* Does your agency currently provide sewer service ☐ Yes ☉ No

TABLE 1: COST

Category							
Secondary Treatment	Advanced Treatment	I/I Removal	Sewer Rehab	Collector Sewers	Interceptor Sewers	Combined Sewer Overflows	NPS Urban
0	0	0	0	2500000	0	0	0



Estimated Project Cost: $ 2500000

Allocated: $ 2500000

Remaining Funds: $ 0

TABLE 2: NEEDS

Public Health Concerns as a results of this Project				
Number of Raw Sewage Discharges Eliminated	**Number of Failing Septic Systems Eliminated**	**Septic Systems to be Eliminated**	**Total No. of WWTPs to be Eliminated**	**Total Average Design Flow from Eliminated WWTPs (MGD)**
0	10	20	0	0

KPDES No.	**Name of Plant Eliminated**	**Average Design Flow (MGD)**
		0

* Date Project was approved by the Area Water Management Planning Council: 10/21/2005

Appendix C
- Miscellaneous Data -

Below are miscellaneous data that did not appear in the text of the document but were used to assess sample sites or sources.

Fully supporting segments

Townsend Creek from RM 10.0 to 11.8 and Silas Creek from RM 0.4 to 4.3 was found to be fully supporting the PCR designated use. Data and TMDL calculations for segments not supporting PCR can be found in Section 8 of the document; data and loading calculations for supporting segments are included below.

Table C1 Waterbodies Supporting the PCR Designated Use

Waterbody Name	Supporting Segment (River Miles)	County	GNIS Number	Supporting Use
Townsend Creek into South Fork Licking River	10.0 to 11.8	Bourbon	KY505401_04	PCR
Silas Creek into Townsend Creek	0.4 to 4.3	Bourbon	KY503493_01	PCR

Townsend Creek RM 10.0 to 11.8 into South Fork Licking River

Exceedance of the WQC (400 col/100ml) was observed in only 9.09% of the samples collected at site 05015008 – the highest concentration of all samples was 2200 colonies per 100 ml.

Table C2 Fecal Coliform Data Collected on Townsend Creek at Site 05015008

Townsend Cr at Grimes Batterton bridge - 05015008					
Sample Date	Colonies/100mL	Flow (cfs)	Field Precip Notes	Paris, KY Precip Notes	Cynthiana, KY Precip Notes
05/15/06	200	2.93	2 days since.1" rain	.09" - rain during the last 4 days	.06" - .2" rain 72 hours ago
05/26/06	400	n/a	1.56 in of rain last 48hrs	.48" - .45" the day before	0 - .36" rain 48 hours ago
06/14/06	290	n/a	0 in of rain last 48hrs	0 - .45" rain 48 hours before	0 - .1" rain 72 hours ago
06/27/06	80	1.068	3 days since.1" rain	0 - 1.99" rain 72 hours before	0 - .1" 24 hours ago
06/29/06	110	n/a	.14 in of rain last 48hrs	.07" - no rain in last 72 hours	0 - .15" rain 24 hours ago
07/15/06	60	n/a	1.59 in of rain in last 48 hrs	.21" - rain during the last 3 days	0 - rain during the last 4 days
07/31/06	300	n/a	0 in of rain last 48hrs	0 - .11" of rain 48 hours before	0 - .55" 72 hours ago
08/02/06	150	0.019	about 6 days since.1" rain	0 - no rain in last 72 hours	n/a
10/18/06	2200	n/a	n/a	.05" - 1.3" rain 24 hours ago	0 - 1.65" rain 48 hours ago
10/24/06	180	n/a	n/a	0 - .01" 48 hours ago	0 - no rain in last 72 hours

Townsend Cr at Grimes Batterton bridge - 05015008					
Sample Date	**Colonies/100mL**	**Flow (cfs)**	**Field Precip Notes**	**Paris, KY Precip Notes**	**Cynthiana, KY Precip Notes**
10/31/06	290	15.78	several days since .1" rain	0 - 1.84" rain 72 hours ago	.2" - no rain in last 72 hours

Exceedance of WQC	Rain today	Rain within last 24 hours	Rain within last 48 hours	No Rain for 48 hours

n/a = flow and/or notes not collected that day

Table C3 Loading Calculations for Townsend Creek, Site 05015008

TMDL[(1)]	MOS[(2)]	WLA[(3)]	Future Growth - WLA	LA	Existing Conditions	Mean Annual Flow (cfs)	Percent Reduction[(4)]
4.60×10^{10} col/day	4.60×10^{9} col/day	0.0 col/day	4.14×10^{8} col/day	4.10×10^{10} col/day	7.54×10^{11} col/day	4.7	85%

Silas Creek RM 0.4 to 4.3 into Townsend Creek

Exceedance of the WQC (400 col/100ml) was observed in only 12.5% of the samples collected at site 05015006 – the highest concentration of all samples was 3600 colonies per 100 ml.

Table C4 Fecal Coliform Data Collected on Silas Creek at Site 05015006

Silas Cr above confluence with Townsend Cr - 05015006					
Sample Date	**Colonies/100mL**	**Flow (cfs)**	**Field Precip Notes**	**Paris, KY Precip Notes**	**Cynthiana, KY Precip Notes**
05/15/06	36	3.62	2 days since.1" rain	.09" - rain during the last 4 days	.06" - .2" rain 72 hours ago
06/14/06	130	n/a	0 in of rain last 48hrs	0 - .45" rain 48 hours before	0 - .1" rain 72 hours ago
06/27/06	90	9.888	3 days since.1" rain	0 - 1.99" rain 72 hours before	0 - .1" 24 hours ago
07/15/06	20	n/a	1.59 in of rain in last 48 hrs	.21" - rain during the last 3 days	0 - rain during the last 4 days
08/02/06	70	0.028	about 6 days since.1" rain	0 - no rain in last 72 hours	n/a
09/14/06	140	0.45	1.79 in of rain in last 48 hrs	.11" - 1.35" in last 24 hours	0 - rain during last 2 days
10/19/06	3600	n/a	1.55 in of rain in last 48 hrs	0 - 1.3" rain 48 hours ago	.75" - 1.65" rain 72 hours ago
10/31/06	50	16.98	several days since .1" rain	0 - 1.84" rain 72 hours ago	.2" - no rain in last 72 hours

Exceedance of WQC	Rain today	Rain within last 24 hours	Rain within last 48 hours	No Rain for 48 hours

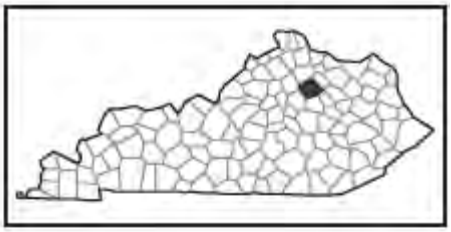
n/a = flow and/or notes not collected that day

Table C5 Loading Calculations for Silas Creek at Site 05015006

TMDL[(1)]	MOS[(2)]	WLA[(3)]	Future Growth - WLA	LA	Existing Conditions	Mean Annual Flow (cfs)	Percent Reduction[(4)]
4.60×10^{10} col/day	4.60×10^{9} col/day	0.0 col/day	4.14×10^{8} col/day	4.10×10^{10} col/day	1.51×10^{12} col/day	4.7	85%

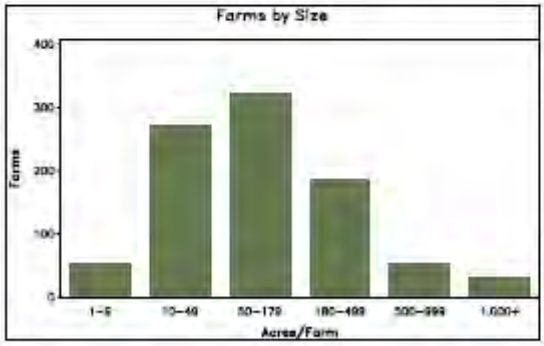
2007 CENSUS OF AGRICULTURE

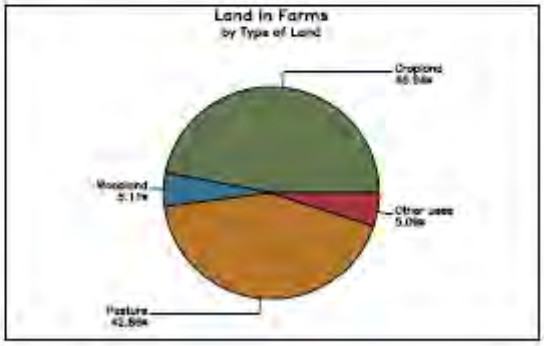
County Profile



Bourbon County
Kentucky

	2007	2002	% change
Number of Farms	918	913	+ 1
Land in Farms	184,323 acres	184,580 acres	0
Average Size of Farm	201 acres	202 acres	0
Market Value of Products Sold	$179,583,000	$97,809,000	+ 84
Crop Sales $23,639,000 (13 percent) Livestock Sales $155,944,000 (87 percent)			
Average Per Farm	$195,624	$107,129	+ 83
Government Payments	$644,000	$1,052,000	- 39
Average Per Farm Receiving Payments	$3,202	$4,496	- 29





USDA United States Department of Agriculture
National Agricultural Statistics Service
www.agcensus.usda.gov

2007 CENSUS OF AGRICULTURE

County Profile

Bourbon County – Kentucky

Ranked items among the 120 state counties and 3,079 U.S. counties, 2007

Item	Quantity	State Rank	Universe [1]	U.S. Rank	Universe [1]
MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD ($1,000)					
Total value of agricultural products sold	179,583	4	120	40	3,078
Value of crops including nursery and greenhouse	23,639	18	120	1,362	3,072
Value of livestock, poultry, and their products	155,944	4	120	19	3,069
VALUE OF SALES BY COMMODITY GROUP ($1,000)					
Grains, oilseeds, dry beans, and dry peas	1,749	49	117	1,829	2,933
Tobacco	7,932	10	106	44	437
Cotton and cottonseed	-	-	-	-	826
Vegetables, melons, potatoes, and sweet potatoes	230	28	117	1,442	2,796
Fruits, tree nuts, and berries	7	74	108	2,329	2,699
Nursery, greenhouse, floriculture, and sod	(D)	1	111	(D)	2,703
Cut Christmas trees and short rotation woody crops	-	-	50	-	1,710
Other crops and hay	(D)	(D)	120	(D)	3,054
Poultry and eggs	29	57	120	1,938	3,020
Cattle and calves	(D)	6	120	(D)	3,054
Milk and other dairy products from cows	(D)	105	111	(D)	2,493
Hogs and pigs	178	37	110	1,227	2,922
Sheep, goats, and their products	111	19	118	1,030	2,998
Horses, ponies, mules, burros, and donkeys	120,779	3	119	4	3,024
Aquaculture	-	-	40	-	1,498
Other animals and other animal products	(D)	4	111	(D)	2,875
TOP CROP ITEMS (acres)					
Forage - land used for all hay and haylage, grass silage, and greenchop	43,136	12	120	394	3,060
Soybeans for beans	2,475	51	100	1,360	2,039
Tobacco	2,262	9	106	43	437
Corn for grain	1,936	60	117	1,711	2,634
Wheat for grain, all	1,209	30	93	1,354	2,491
TOP LIVESTOCK INVENTORY ITEMS (number)					
Cattle and calves	48,673	9	120	580	3,060
Horses and ponies	9,057	3	120	16	3,066
Layers	1,555	35	120	1,262	3,024
Sheep and lambs	1,469	3	114	647	2,891
Goats, all	583	53	119	1,108	3,023

Other County Highlights

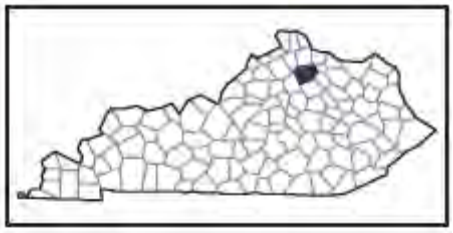
Economic Characteristics	Quantity
Farms by value of sales:	
Less than $1,000	198
$1,000 to $2,499	86
$2,500 to $4,999	69
$5,000 to $9,999	106
$10,000 to $19,999	86
$20,000 to $24,999	44
$25,000 to $39,999	64
$40,000 to $49,999	38
$50,000 to $99,999	68
$100,000 to $249,999	71
$250,000 to $499,999	35
$500,000 or more	53
Total farm production expenses ($1,000)	141,091
Average per farm ($)	153,694
Net cash farm income of operation ($1,000)	65,100
Average per farm ($)	70,915

Operator Characteristics	Quantity
Principal operators by primary occupation:	
Farming	459
Other	459
Principal operators by sex:	
Male	787
Female	131
Average age of principal operator (years)	57.5
All operators by race [2]	
American Indian or Alaska Native	6
Asian	-
Black or African American	4
Native Hawaiian or Other Pacific Islander	-
White	1,445
More than one race	7
All operators of Spanish, Hispanic, or Latino Origin [2]	8

See "Census of Agriculture, Volume 1, Geographic Area Series" for complete footnotes, explanations, definitions, and methodology.
(D) Cannot be disclosed. (Z) Less than half of the unit shown.
[1] Universe is number of counties in state or U.S. with item. [2] Data were collected for a maximum of three operators per farm.

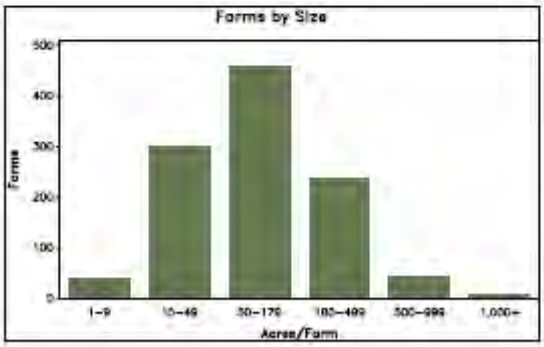
2007 CENSUS OF AGRICULTURE

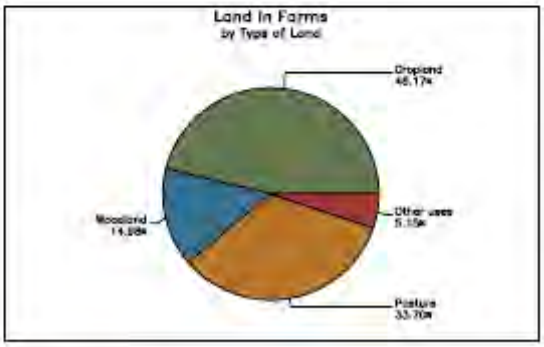
County Profile



Harrison County
Kentucky

	2007	2002	% change
Number of Farms	1,083	1,085	0
Land in Farms	161,777 acres	158,980 acres	+ 2
Average Size of Farm	149 acres	147 acres	+ 1
Market Value of Products Sold	$24,021,000	$21,041,000	+ 14
Crop Sales $11,052,000 (46 percent) Livestock Sales $12,969,000 (54 percent)			
Average Per Farm	$22,180	$19,393	+ 14
Government Payments	$627,000	$374,000	+ 68
Average Per Farm Receiving Payments	$2,024	$1,662	+ 22





USDA United States Department of Agriculture
National Agricultural Statistics Service
www.agcensus.usda.gov

2007 CENSUS OF AGRICULTURE

County Profile

Harrison County – Kentucky

Ranked items among the 120 state counties and 3,079 U.S. counties, 2007

Item	Quantity	State Rank	Universe [1]	U.S. Rank	Universe [1]
MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD ($1,000)					
Total value of agricultural products sold	24,021	59	120	2,140	3,076
Value of crops including nursery and greenhouse	11,062	34	120	1,809	3,072
Value of livestock, poultry, and their products	12,959	55	120	1,860	3,069
VALUE OF SALES BY COMMODITY GROUP ($1,000)					
Grains, oilseeds, dry beans, and dry peas	1,197	59	117	1,943	2,933
Tobacco	7,394	13	106	48	437
Cotton and cottonseed	-	-	-	-	826
Vegetables, melons, potatoes, and sweet potatoes	316	18	117	1,282	2,796
Fruits, tree nuts, and berries	134	3	108	1,263	2,699
Nursery, greenhouse, floriculture, and sod	395	43	111	1,525	2,703
Cut Christmas trees and short rotation woody crops	4	35	50	1,368	1,710
Other crops and hay	1,620	20	120	1,056	3,054
Poultry and eggs	(D)	(D)	120	(D)	3,020
Cattle and calves	11,163	31	120	1,101	3,054
Milk and other dairy products from cows	626	55	111	1,602	2,493
Hogs and pigs	(D)	(D)	110	(D)	2,922
Sheep, goats, and their products	94	24	118	1,151	2,998
Horses, ponies, mules, burros, and donkeys	941	25	119	260	3,024
Aquaculture	-	-	40	-	1,498
Other animals and other animal products	62	18	111	1,262	2,875
TOP CROP ITEMS (acres)					
Forage - land used for all hay and haylage, grass silage, and greenchop	44,369	9	120	370	3,060
Tobacco	2,069	12	106	50	437
Corn for grain	1,769	62	117	1,728	2,634
Soybeans for beans	1,546	63	100	1,455	2,039
Corn for silage	779	31	109	1,138	2,263
TOP LIVESTOCK INVENTORY ITEMS (number)					
Cattle and calves	35,288	27	120	897	3,060
Horses and ponies	1,887	24	120	648	3,066
Layers	1,992	45	120	1,346	3,024
Goats, all	1,357	20	119	807	3,023
Hogs and pigs	(D)	35	114	(D)	2,958

Other County Highlights

Economic Characteristics	Quantity
Farms by value of sales:	
Less than $1,000	277
$1,000 to $2,499	106
$2,500 to $4,999	153
$5,000 to $9,999	146
$10,000 to $19,999	137
$20,000 to $24,999	41
$25,000 to $39,999	70
$40,000 to $49,999	30
$50,000 to $99,999	75
$100,000 to $249,999	39
$250,000 to $499,999	7
$500,000 or more	3
Total farm production expenses ($1,000)	21,960
Average per farm ($)	20,277
Net cash farm income of operation ($1,000)	5,229
Average per farm ($)	4,828

Operator Characteristics	Quantity
Principal operators by primary occupation:	
Farming	460
Other	603
Principal operators by sex:	
Male	947
Female	136
Average age of principal operator (years)	55.5
All operators by race [2]	
American Indian or Alaska Native	6
Asian	1
Black or African American	2
Native Hawaiian or Other Pacific Islander	-
White	1,603
More than one race	9
All operators of Spanish, Hispanic, or Latino Origin [2]	5

See "Census of Agriculture, Volume 1, Geographic Area Series" for complete footnotes, explanations, definitions, and methodology.
(D) Cannot be disclosed. (Z) Less than half of the unit shown.
[1] Universe is number of counties in state or U.S. with item. [2] Data were collected for a maximum of three operators per farm.