Final

Total Maximum Daily Load (TMDL)
for
Shoal Creek
Waterbody ID # AL06030004-0102-100
Pathogens (fecal coliform)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
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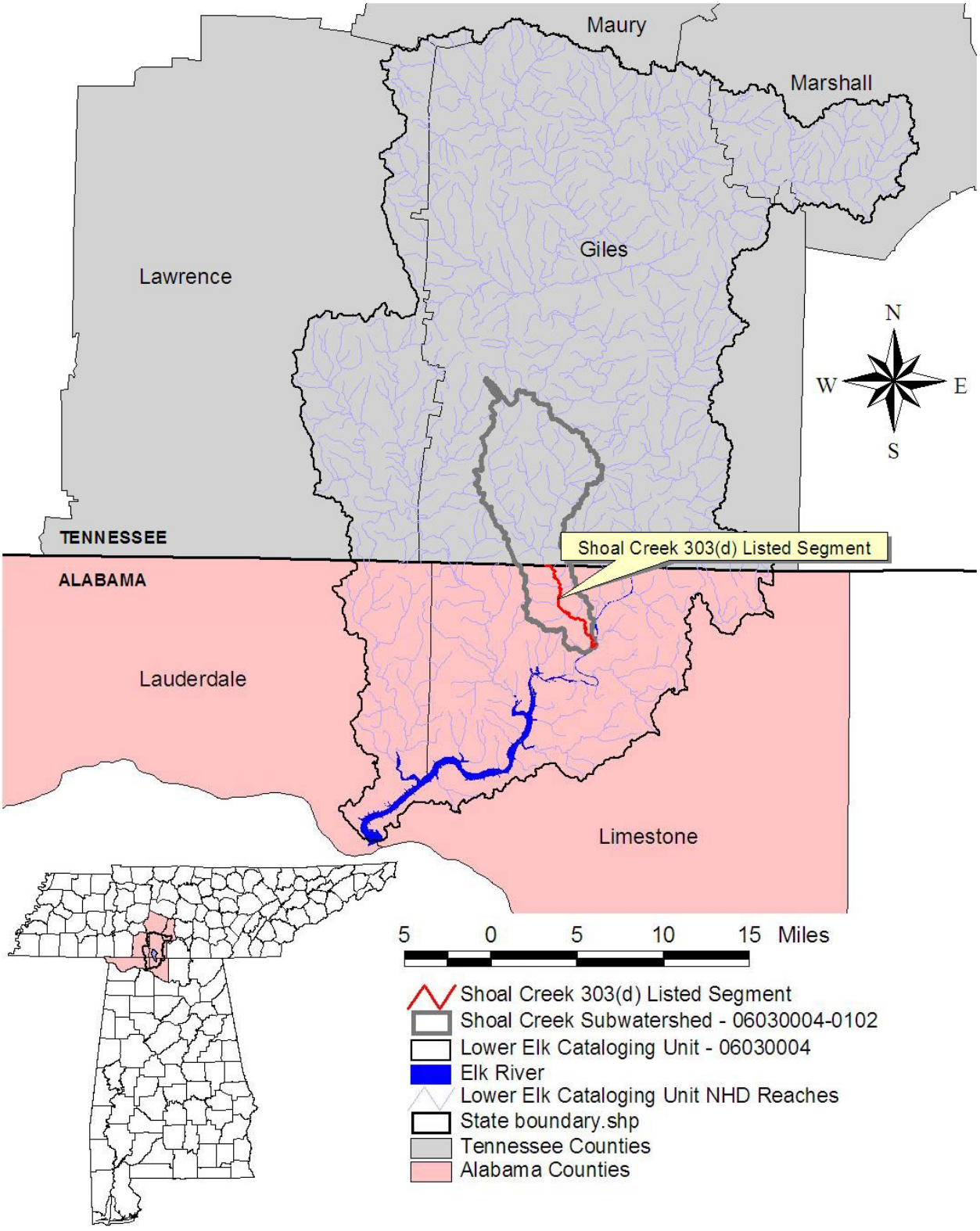
Figure I. §303(d) Listed Portion of Shoal Creek in the Tennessee River Basin



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1.0 Executive Summary

Shoal Creek is located in the Tennessee River Basin in the central part of North Alabama and South Tennessee. Shoal Creek forms in southern Giles County Tennessee when the East Fork and West Fork of Shoal Creek merge. Shoal Creek flows approximately 8.1 miles through Giles County Tennessee and Limestone County Alabama before emptying into Elk River. The listed portion of Shoal Creek is from its mouth to the Alabama/Tennessee state line. The 7.47 mile segment from Elk River to the Alabama/Tennessee state line was placed on the State of Alabama's §303(d) use impairment list in 1998 for pathogens. The source of the pathogens was listed as unknown. Shoal Creek has the designated use classification of Fish and Wildlife. The total drainage area for Shoal Creek is 61 mi^2. The watershed is predominantly rural with roughly 31% agriculture and 64% forest landuse.

Data collected in 1997 by the Tennessee Valley Authority (TVA) indicated Shoal Creek was impaired by pathogens (fecal coliform). TVA collected monthly samples June through October in 1997. Of those five samples, a fecal coliform count couldn't be determined in three samples due to interference. The other two samples had fecal coliform counts of 70 and 2040 colonies/100 mL. Shoal Creek was subsequently sampled by the Alabama Department of Environmental Management (ADEM) at two locations in 2003 and 2004.

A loading curve analysis and mass balance approach were evaluated for calculating the pathogen TMDL for Shoal Creek. The mass balance approach required the highest load reduction and was chosen to determine the pathogen TMDL for Shoal Creek. The mass balance approach utilizes the conservation of mass principle. Loads can be calculated by multiplying fecal coliform concentrations times respective instream flows. The current pathogen loading to Shoal Creek was calculated using a geometric mean exceedance concentration times the average flow for the 5 samples used to calculate the geometric mean. The allowable loading was calculated using the same average flow value times the fecal coliform geometric mean criterion target of 180 colonies/100 mL (200 colonies/100 mL – 10% Margin of Safety). Reductions to meet the allowable loading were then calculated by subtracting the allowable loading from the current loading. Table 1.1 is a summary of current loads and reduced loads needed to meet the applicable water quality pathogen geometric mean criterion for Shoal Creek. Table 1.2 lists the required TMDL pathogen loadings under critical conditions for Shoal Creek.

Table 1-1. Current Fecal Coliform Loads and Required Reductions

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %
NPS load	1.39E+11	8.41E+10	5.47E+10	39%
Point Source	0.00E+00	0.00E+00	0.00E+00	0%

Table 1-2. Fecal Coliform TMDL for Shoal Creek

TMDL = WLA + LA + MOS			
TMDL	WLA	LA	MOS
(col/day)	(col/day)	(col/day)	(col/day)
9.35E+10	0.00E+00	8.41E+10	9.35E+09

Aside from the single sample criterion violation measured in October 1997, the only other violations that have occurred are geometric means greater than 200 colonies/100 mL at station SHOL-2. No violations have been recorded at station SHOL-1. Station SHOL-2 is located downstream from the Alabama/Tennessee state line approximately 0.9 stream miles. Roughly 79% of the watershed (48.1 mi^2) is located upstream of SHOL-2. Of this 48.1 mi^2, only 1.1 mi^2 is located in the state of Alabama. The most probable source of fecal coliform in this watershed is agricultural sources (i.e. pasture/hay). There was 124 acres of pasture/hay in the watershed above SHOL-2 in Alabama compared to 8,980 acres of pasture/hay in Tennessee. A 39% reduction in fecal colifom is not achievable on 124 acres of pasture land in Alabama compared to the 8,980 acres of pasture land located in the watershed upstream of station SHOL-2.

ADEM will need to verify the possible sources of fecal coliform located in the watershed upstream of station SHOL-2 located in Alabama. ADEM will also have to coordinate with the Tennessee Department of Environment and Conservation (TDEC) to determine possible sources of fecal coliform in the Shoal Creek watershed in Tennessee. At this time, Shoal Creek is not on Tennessee's most current §303(d) list. Based on results of these studies, the two agencies will need to generate a plan that can produce the needed reduction in fecal coliform using best management practices.

2.0 Basis for §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act (CWA) as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [(Title 40 of the Code of Federal Regulations (CFR), Part 130)] require states to identify waterbodies which are not meeting water quality standards applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. Total maximum daily loads (TMDLs) for all pollutants causing violation of applicable water quality standards are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality standards with seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters for a waterbody, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Alabama has identified the 7.47 mile segment of Shoal Creek from Elk River to the Alabama/Tennessee state line in Limestone County as being impaired from pathogens (fecal coliform). The §303(d) listing was originally reported on Alabama's 1998 List of Impaired Waters, and subsequently included on the 2000, 2002, 2004, and 2006 lists. The source of the impairment is listed as pasture grazing on the Draft 2006 §303(d) list.

2.2 Problem Definition

Waterbody Impaired:	Shoal Creek from Elk River to the Alabama/Tennessee state line.
Waterbody length:	7.47 miles
Waterbody drainage area:	61 square miles
Water Quality Standard Violation:	Fecal Coliform
Pollutant of Concern:	Pathogens (fecal coliform)
Water Use Classification:	Fish and Wildlife

Usage related to classification:
The impaired stream segment, Shoal Creek, is classified as Fish and Wildlife. Usage of waters in this classification is described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), and (d).

(a) Best usage of waters: fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food-processing purposes.

(b) Conditions related to best usage: the waters will be suitable for fish, aquatic life and wildlife propagation. The quality of salt and estuarine waters to which this classification is assigned will also be suitable for the propagation of shrimp and crabs.

(c) Other usage of waters: it is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage: the waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

Fecal Coliform Criteria:
Criteria for acceptable bacteria levels for the Fish and Wildlife use classification are described in ADEM Admin. Code R. 335-6-10-.09(5)(e)7.(i) and (ii) as follows:

7. Bacteria:

(i) In non-coastal waters, bacteria of the fecal coliform group shall not exceed a geometric mean of 1,000 colonies/100 mL; nor exceed a maximum of 2,000 colonies/100 mL in any sample. In coastal waters, bacteria of the enterococci group shall not exceed a maximum of 275 colonies/100 mL in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours.

(ii) For incidental water contact and recreation during June through September, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean fecal coliform organism density does not exceed 200 colonies/100 mL in non-coastal waters. In coastal waters, bacteria of the enterococci group shall not exceed a geometric mean of 35 colonies/100 mL nor exceed a maximum of 158 colonies/100 mL in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. When the geometric bacterial coliform organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters. Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports.

Criteria Exceeded:

Water quality data collected by the Tennessee Valley Authority (TVA) in 1997 was used by EPA Region 4 for listing Shoal Creek on Alabama's 1998 §303(d) list. Waters in which less than or equal to 10% of the samples collected over a five year period exceed the single-sample maximum of 2000 colonies/100 mL or a geometric mean of 200 colonies/100 mL (June-September) or 1000 colonies/100 mL (October-May) in at least five samples collected in a thirty day period are considered to comply with Alabama's water quality standard for fecal coliform bacteria. Waters in which greater than 10% of the samples exceed the single-sample maximum of 2000 colonies/100 mL or a geometric mean of 200 colonies/100 mL (June-September) or 1000 colonies/100 mL (October-May) in at least five samples collected in a thirty day period are considered impaired and listed for pathogens (fecal coliform) on Alabama's §303(d) list.

TVA collected data at the following station on Shoal Creek in June through October 1997:

– 10281-1 Shoal Creek at Leggtown Road

The rationale EPA Region 4 used to list this stream was based on data from TVA Station 10281-1. EPA Region 4 used one data set from 1997 for the months of June – October to add Shoal Creek to the 1998 §303(d) list. One of the two (50%) fecal coliform samples exceeded the single sample criterion of 2000 colonies/100 mL.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

For the purpose of this TMDL a geometric mean fecal coliform target of 180 colonies/100 mL will be used. This target was derived by using a 10% explicit margin of safety from the geometric mean of 200 colonies/100 mL criterion. This target should not allow the geometric mean of 200 colonies/100 mL or the single sample maximum of 2000 colonies/100 mL to be exceeded.

3.2 Source Assessment

Point Sources in the Shoal Creek Watershed

In the Alabama portion of the Shoal Creek watershed there are no point sources which would cause or contribute to the fecal coliform loading of Shoal Creek. Hence, the WLA portion of the TMDL will be zero. Any new discharges to this stream must meet a geometric mean discharge limit of 200 colonies/100 mL and an instantaneous maximum limit of 2000 colonies/100 mL for fecal coliform.

Nonpoint Sources in the Shoal Creek Watershed

Due to the absence of point sources, nonpoint sources are believed to be the primary source of the fecal coliform bacteria in the Shoal Creek watershed. Landuse in the Alabama portion of the Shoal Creek watershed is rural consisting of 30% agriculture (pasture/hay and row crops) and 65% forested land use. The following are examples of how different landuses can contribute to fecal coliform bacterial loading:

- Agricultural land can be a source of fecal coliform bacteria. Runoff from pastures, animal operations, improper land application of animal wastes, and animals with access to streams are all mechanisms that can contribute fecal coliform bacteria to waterbodies.

- Fecal coliform bacteria can originate from forested areas due to the presence of wild animals such as deer, raccoons, turkeys, waterfowl, etc. Control of these sources is usually limited to land management BMPs and may be impracticable in most cases. As a result, forested areas are not specifically targeted in this TMDL.

- Leaking or failing septic systems can be another source of fecal coliform bacteria.

3.3 Land Use Assessment

The Shoal Creek watershed is comprised of one 12 digit HUC (06030004-0102) in the Lower Elk River catalogue unit. The total drainage area of the Shoal Creek watershed is 61 square miles. Only 13.9 square miles (22.7%) of the watershed are located in Limestone County, Alabama. The remaining 47.1 square miles (77.3%) are located in Giles County, Tennessee. Land use for the Shoal Creek watershed was determined using ArcView with land use datasets

from 2001. Land use information for this assessment was derived from the 2001 National Land Cover Dataset (NLCD). Table 3-1 contains the land use areas for the Shoal Creek watershed. Figure 3-1 is a map of land use within the Shoal Creek watershed and Figure 3-2 provides a closer look at land use in the Shoal Creek watershed within Alabama.

The Alabama and Tennessee portions of the Shoal Creek watershed have basically the same land use characteristics. Approximately 30-31% of the land use for each of the states is agricultural and about 63-65% of the land is forested. Overall, 94.8% of the Shoal Creek watershed is used for agricultural or silvicultural purposes with only 5.2% of the land used for residential, commercial, or other uses. Based on these statistics, the Shoal Creek watershed can be considered very rural. A large percentage of the land used for silviculture and agriculture can have significant nonpoint source impact if it is not managed properly.

Figure 3-1. Land Use Map for the Shoal Creek Watershed

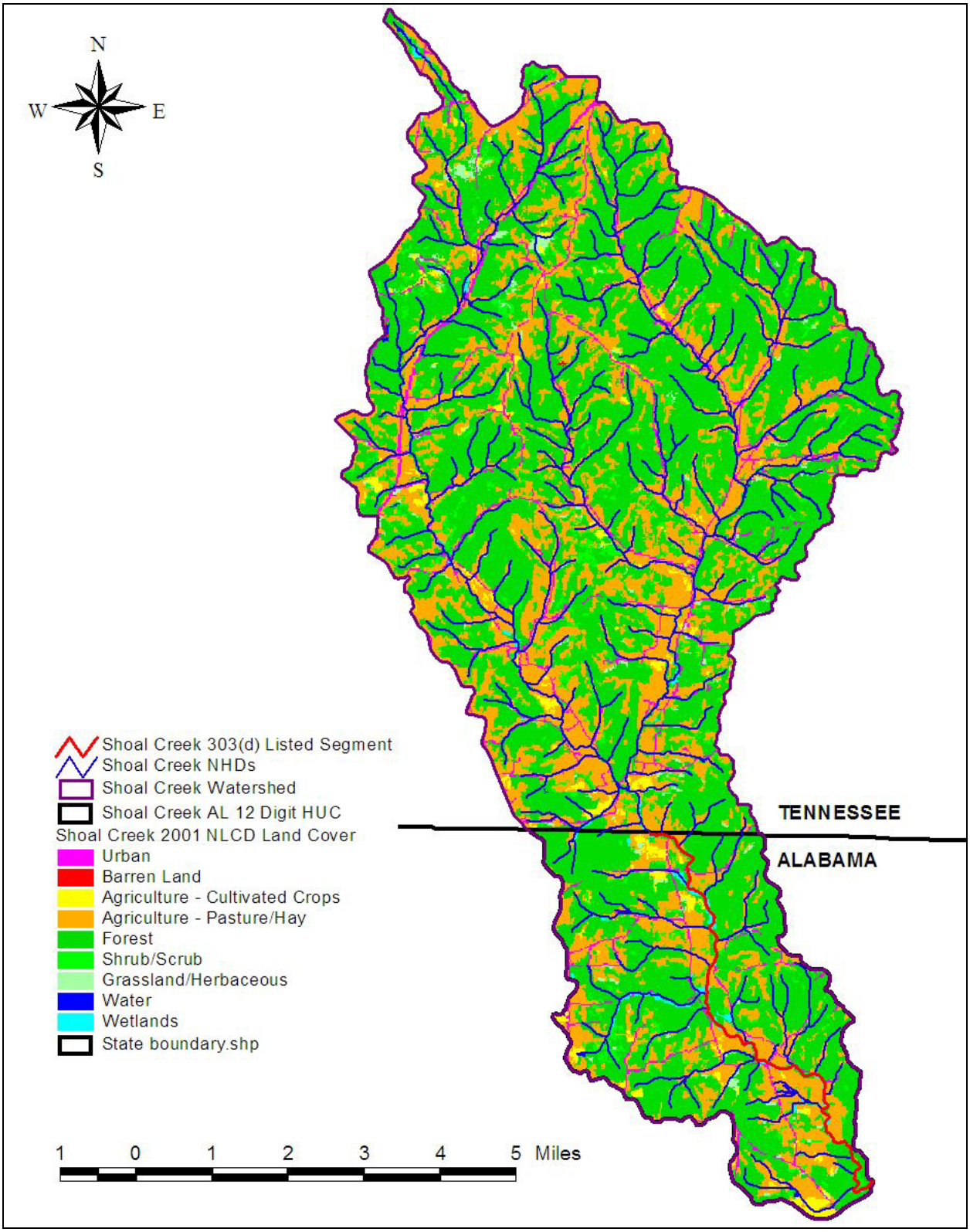


Figure 3-2. Land Use Map for the Alabama portion of the Shoal Creek Watershed

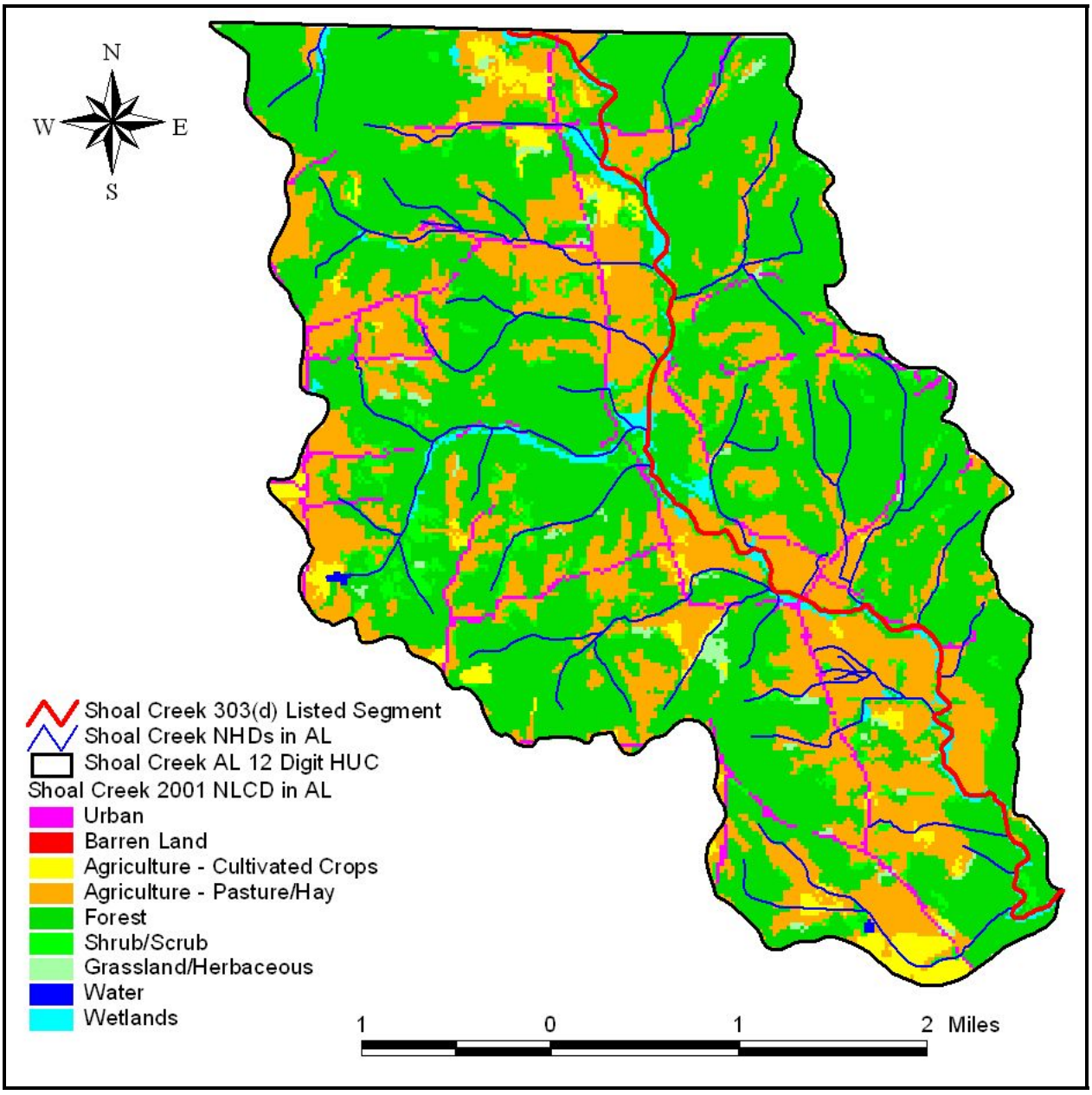


Table 3-1. Land Use Areas for the Shoal Creek Watershed

	Shoal Creek Watershed 06030004-0102						Combined Watershed Totals		
	Tennessee portion			Alabama portion					
Landuse (Acres / Square Miles / Percent)	Acres	Sq. Miles	Percent	Acres	Sq. Miles	Percent	Acres	Sq. Miles	Percent
Open Water	21	0.0	0.1%	6	0.0	0.1%	27	0.0	0.1%
Developed, Open Space	1,295	2.0	4.3%	299	0.5	3.4%	1,594	2.5	4.1%
Developed, Low Intensity	36	0.1	0.1%	2	0.0	0.0%	37	0.1	0.1%
Developed, Medium Intensity	6	0.0	0.0%	0	0.0	0.0%	6	0.0	0.0%
Barren Land (Rock/Sand/Clay)	7	0.0	0.0%	0	0.0	0.0%	7	0.0	0.0%
Deciduous Forest	15,855	24.8	52.6%	4,169	6.5	46.8%	20,023	31.3	51.3%
Evergreen Forest	672	1.1	2.2%	508	0.8	5.7%	1,180	1.8	3.0%
Mixed Forest	1,135	1.8	3.8%	578	0.9	6.5%	1,713	2.7	4.4%
Shrub/Scrub	1,376	2.1	4.6%	373	0.6	4.2%	1,748	2.7	4.5%
Grassland/Herbaceous	280	0.4	0.9%	75	0.1	0.8%	354	0.6	0.9%
Pasture/Hay	9,000	14.1	29.8%	2,431	3.8	27.3%	11,431	17.9	29.3%
Cultivated Crops	399	0.6	1.3%	264	0.4	3.0%	663	1.0	1.7%
Woody Wetlands	74	0.1	0.2%	199	0.3	2.2%	274	0.4	0.7%
Emergent Herbaceous Wetlands	1	0.0	0.0%	0	0.0	0.0%	1	0.0	0.0%
Total	**30,156**	**47.1**	**100%**	**8,903**	**13.9**	**100%**	**39,059**	**61.0**	**100%**
Agriculture	9,399	14.7	31.2%	2,695	4.2	30.3%	12,093	18.9	31.0%
Forest	19,112	29.9	63.4%	5,827	9.1	65.4%	24,939	39.0	63.9%
Other	1,645	2.6	5.5%	382	0.6	4.3%	2,027	3.2	5.2%
Total	**30,156**	**47.1**	**100.0%**	**8,903**	**13.9**	**100.0%**	**39,059**	**61.0**	**100.0%**

3.4 Linkage Between Numeric Targets and Sources

The Shoal Creek watershed has two main landuses: agriculture and forest. Pollutant loadings from forested areas tend to be low due to their filtering capabilities and will be considered as background conditions. The most likely sources of pathogen loadings in Shoal Creek are from the agricultural land uses and failing septic systems. It is not considered practicable to calculate individual components for nonpoint source loadings. Hence, there will not be individual loads or reductions calculated for different nonpoint sources such as forest, agriculture, and septic systems. The loadings and reductions will only be calculated as a single total nonpoint source load and reduction.

3.5 Data Availability and Analysis

TVA collected water quality data for Shoal Creek at Leggtown Road (Station 10281-1) monthly in June through October 1997. Of the five fecal coliform samples collected, three were inconclusive due to interference from other bacteria. For the two samples that provided a colony count, the July measurement was 70 colonies/100 mL and the October measurement was 2040 colonies/100 mL. This sample exceeded the single sample water quality criterion of 2000 colonies/100 mL and resulted in Shoal Creek being placed on the 1998 §303(d) list.

ADEM collected water quality data on Shoal Creek in 2003 and 2004 as part of Alabama's §303(d) Monitoring Program at the following two locations:

– SHOL-1 Shoal Creek at Leggtown Road
– SHOL-2 Shoal Creek at Gardner Hollow Road

None of the fecal coliform samples collected at either station in 2003 and 2004 violated the single sample maximum criterion of 2000 colonies/100 mL Samples were also collected in the necessary time intervals such that geometric mean values could be calculated to compare to the 30 day geometric mean criteria of 200 colonies/100 mL. Data was collected to determine geometric mean concentrations for each station in June and August 2003 and June and September 2004. At SHOL-2, the August 2003 geometric mean concentration was 208 colonies/100 mL and the June 2004 geometric mean concentration was 297 colonies/100 mL. None of the other geometric mean concentrations were greater than 200 colonies/100 mL.

A complete list of the data can be found in Appendix 7.2 of this report. A map indicating the location of sampling stations is presented in Figure 3-3.

Figure 3-3. Map of ADEM and TVA Sampling Stations on Shoal Creek

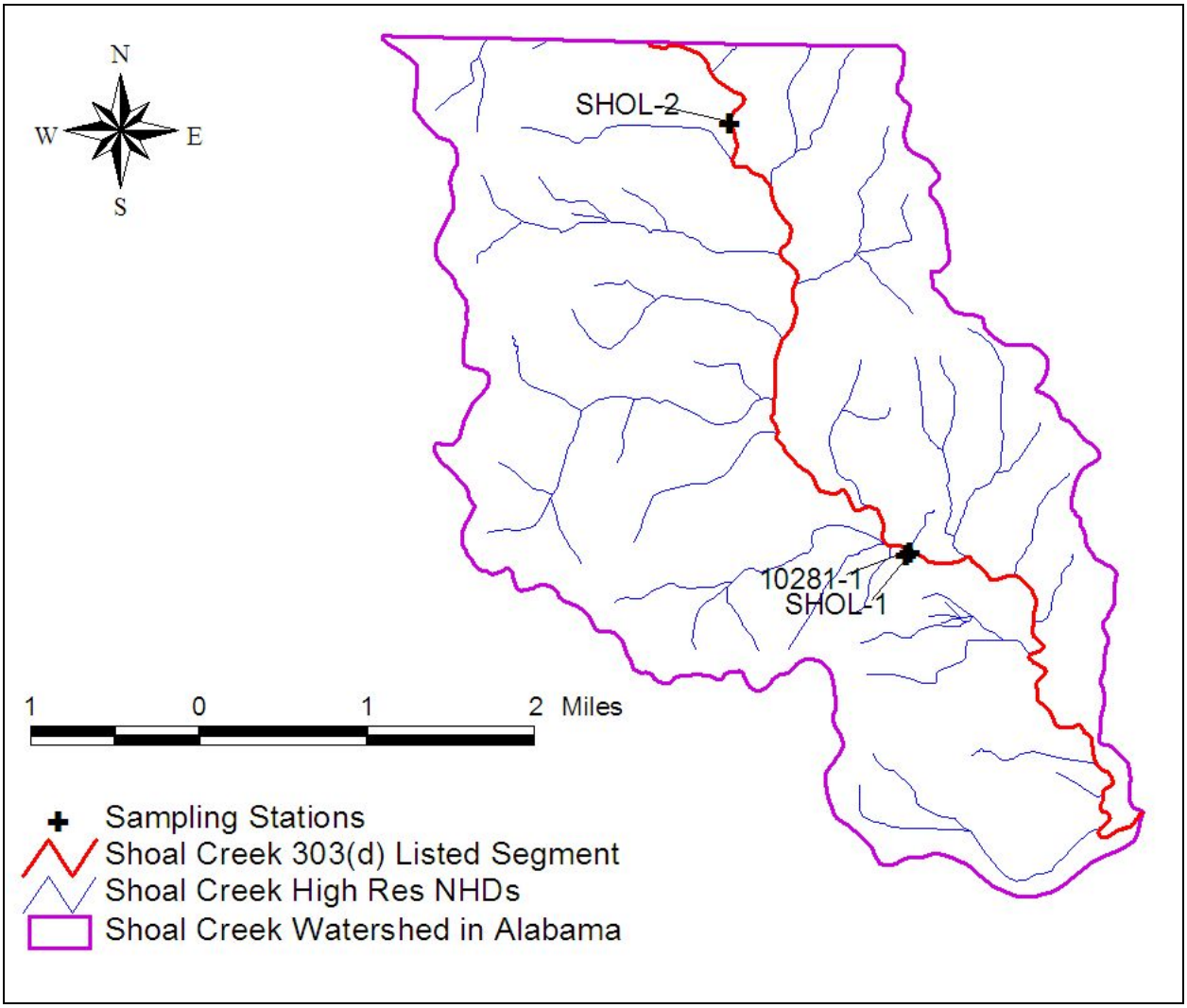


Table 3-2. Shoal Creek Sampling Station Descriptions

Years	Station ID	Data Source	Station Location	Latitude	Longitude
1997	10281-1	TVA	Leggtown Road	34.952560	-87.067300
2003-2004	SHOL-1	ADEM	Leggtown Road	34.952840	-87.066900
2003-2004	SHOL-2	ADEM	Gardner Hollow Road	34.989830	-87.085780

3.6 Critical Conditions

Normally, the summer months are generally considered critical conditions. This can be explained by the nature of storm events in the summer versus the winter. Periods of dry weather interspersed with thunderstorms allow for the accumulation and washing off of fecal coliform bacteria into streams, resulting in spikes of fecal coliform bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of fecal coliform bacteria on the land surface, resulting in a more uniform loading rate. Also, the summer fecal coliform criterion is more stringent than the winter criterion.

The Shoal Creek watershed generally does not follow the trends described above for the summer months (June – September). Figure 3-4 shows that a majority of the higher concentrations of fecal coliform occur at station SHOL-2 at the lower flows. The same holds true for the geometric mean concentrations in Figure 3-5. The maximum geometric mean concentration of 297 colonies/100 mL with an average flow of 19.1 cfs at SHOL-2 will be used to estimate the TMDL pathogen loadings to the Shoal Creek under critical conditions.

Figure 3-4. Shoal Creek June – September Fecal Coliform Data

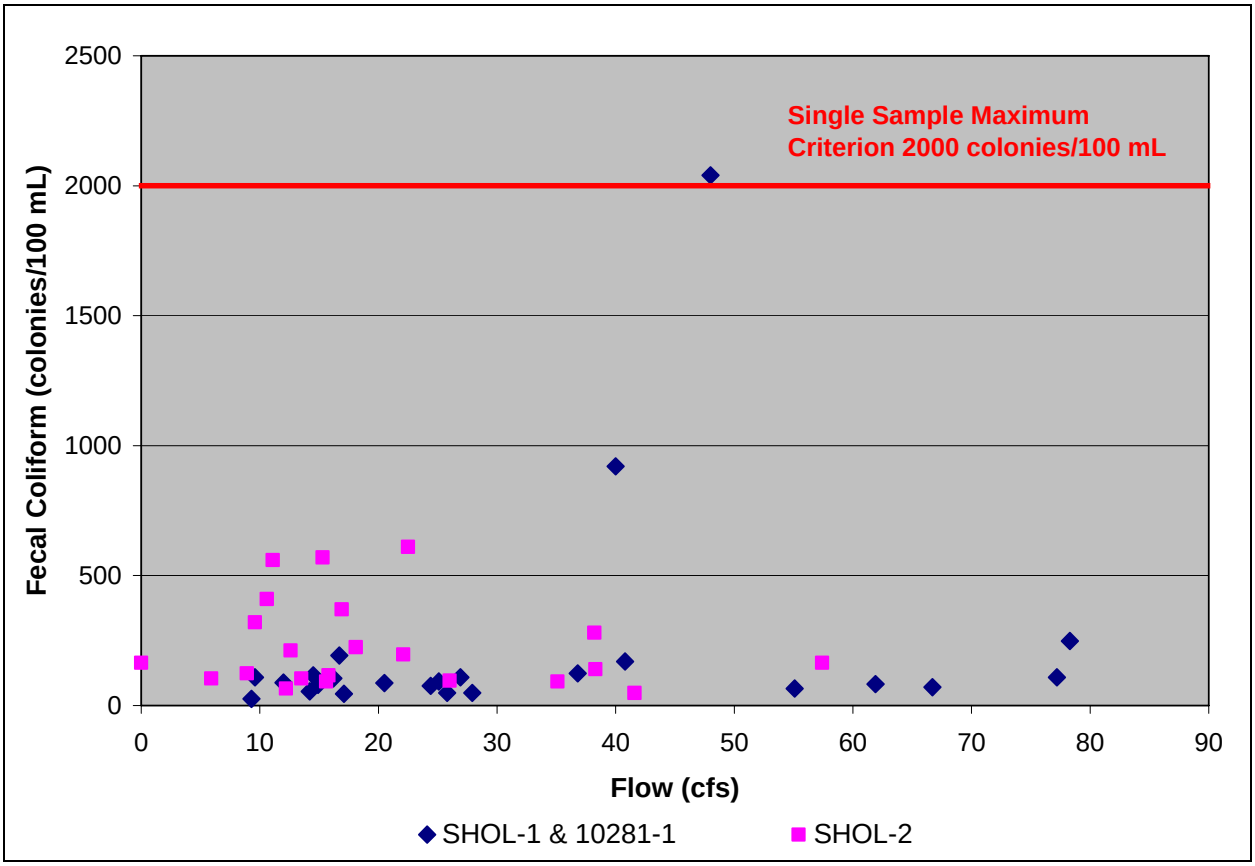
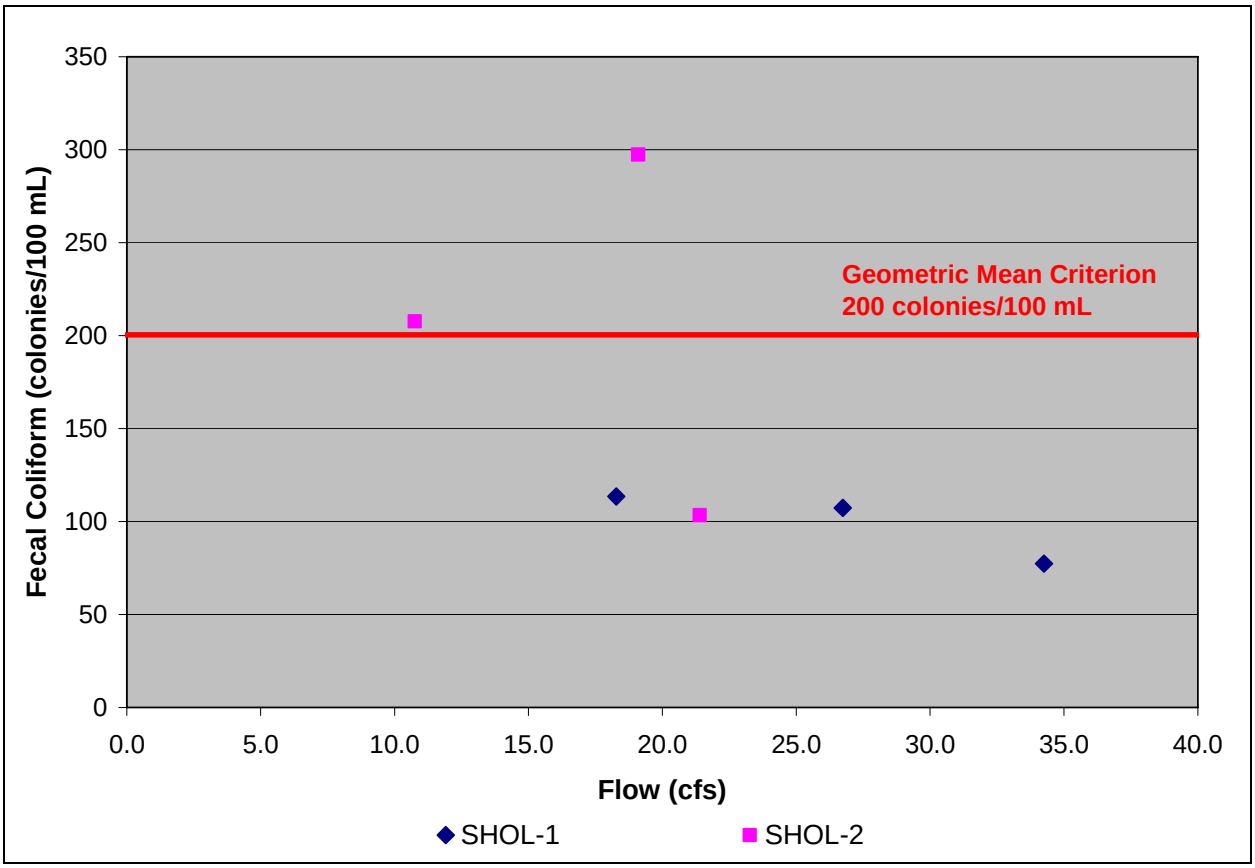


Figure 3-5. Shoal Creek Geometric Mean Fecal Coliform Data



3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations, or 2) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations.

An explicit MOS was incorporated in this TMDL. The explicit MOS includes the uncertainty of the fecal coliform data used in this analysis and the uncertainty of selecting an appropriate critical condition from the existing fecal coliform loads. A margin of safety was applied to the TMDL by reducing the criterion concentration by ten percent and calculating a mass loading target with measured flow data. For the instantaneous criterion, a target concentration of 1,800 colonies per 100mL was used instead of 2,000 colonies per 100mL. The winter and summer geometric mean criteria were also reduced by ten percent to achieve the target concentrations of 900 and 180 colonies per 100mL, respectively.

4.0 TMDL Development

4.1 Definition of a TMDL

A total maximum daily load (TMDL) is the sum of individual wasteload allocations for point sources (WLAs), load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS). The margin of safety can be included either explicitly or implicitly and accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. As discussed earlier, the MOS is explicit in this TMDL. A TMDL can be denoted by the equation:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while achieving water quality standards under critical conditions. For some pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). However, for pathogens, TMDL loads are typically expressed in terms of organism counts per day (colonies/day), in accordance with 40 CFR 130.2(i).

4.2 Load Calculations

A mass balance approach was used to calculate the pathogen TMDL for Shoal Creek. The mass balance approach utilizes the conservation of mass principle. Total mass loads can be calculated by multiplying the fecal coliform concentration times the stream flow.

Three loads were calculated in this analysis to determine the TMDL. The first was an estimate of the current pathogen loading to the watershed during a violation event. It was done by multiplying the geometric mean sample exceedance concentration of 297 colonies/100 mL times the average flow for all five of the fecal coliform measurements. This concentration was calculated based on measurements at SHOL-2 June 2, 10, 14, 23, and 24, 2004 and can be found in Appendix 7.2. The average of the measured flows for these five sampling events was 19.1 cfs. The product of these two values and a conversion factor gives the mass loading to Shoal Creek under exceedance conditions.

The second load represents the allowable value to the watershed under the same physical conditions as the first. This is done by taking the product of the same flow times the conversion factor times the allowable geometric mean fecal concentration of 180 colonies/100 mL. The difference between these two loads, converted to a percent reduction, represents the loading reduction necessary to achieve the fecal coliform water quality criterion under those specific conditions. Calculations for these two loads can be found in Table 4.1.

Finally, the third load calculation is the TMDL value under critical conditions. This value is calculated by taking the product of the critical flow times the conversion factor times the allowable fecal concentration. This loading value represents the maximum fecal load that can be discharged to the watershed without causing a violation of the applicable geometric mean water quality criterion of 200 col/100 mL. Calculations for the TMDL load are also in Table 4.1.

Table 4-1. Current vs. Allowable Pathogen Loadings for Shoal Creek

Geometric Mean Fecal Load Reduction and TMDL Calculations for Shoal Creek

Average Flow measured at SHOL-2 for Geometric Mean Samples: 19.1 cfs
Geometric Mean Fecal coliform concentration measured: 297 col/100 mL
Allowable fecal coliform maximum concentration minus MOS: 180 col/100mL = 200 - 10%
Margin of saftey for the maximum criteria 20 col/100mL = 10% of criteria

Load Calculations:

Load = Fecal Coliform Conc * Measured Flow * Conversion Factor
Load = colonies of Fecal Coliform/day Measured Flow = cfs
Fecal Coliform Conc = colonies/100 mL Conversion Factor = 24468984 (ml-s/ft3-day)

Current Load:

Nonpoint source load (LA)	1.39E+11	colonies/day	
Point source load (WLA)	0.00E+00	colonies/day	There are no point sources in this watershed
Current load =	1.39E+11	colonies/day	

Allowable Load:

Nonpoint source load (LA)	8.41E+10	colonies/day	
Point source load (WLA)	0.00E+00	colonies/day	There are no point sources in this watershed
Allowable load =	8.41E+10	colonies/day	

Margin of Saftey:

MOS load = 9.35E+09 colonies/day

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	1.39E+11	8.41E+10	5.47E+10	39%	8.41E+10
WLA	0.00E+00	0.00E+00	0.00E+00	0%	0.00E+00
Total	1.39E+11	8.41E+10	5.47E+10	39%	8.41E+10

Total Maximum Daily Load (TMDL): TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
9.35E+10	0.00E+00	8.41E+10	9.35E+09

Percent Reduction to Achieve the Fecal Coliform Criterion:

Total reduction: 39% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

The water quality criterion for fecal coliform for summer geomtric means is 200 col/100 mL.
To account for an explicit Margin of Safety (MOS) a target concentration of 180 col/100 ml was used to calculate the allowable load compared to the maximum criterion which = 200 – 10%

4.3 TMDL Summary

Aside from the single sample criterion violation measured in October 1997, the only other violations that have occurred are geometric means greater than 200 colonies/100 mL at station SHOL-2. No violations have been recorded at station SHOL-1. Station SHOL-2 is located downstream from the Alabama/Tennessee state line approximately 0.9 stream miles. Roughly 79% of the watershed (48.1 mi^2) is located upstream of SHOL-2. Of this 48.1 mi^2, only 1.1 mi^2 are located in the state of Alabama.

Landuse for the portion of the Shoal Creek watershed located upstream of SHOL-2 was determined and is located in Table 4-2. The watershed upstream of SHOL-2 was 31% agriculture and 64% forested based on the 2001 landuse. The most probable source of fecal coliform in this watershed is agricultural sources (i.e. pasture/hay). There was 124 acres of pasture/hay in the watershed above SHOL-2 in Alabama compared to 8,980 acres of pasture/hay in Tennessee. Clearly, a 39% reduction in fecal colifom is not achievable on 124 acres of pasture land in Alabama when there is 8,980 acres of pasture land located in the watershed upstream of station SHOL-2 in Tennessee.

ADEM will need to verify the possible sources of fecal coliform located in the watershed upstream of station SHOL-2 located in Alabama. ADEM will also have to coordinate with the Tennessee Department of Environment and Conservation (TDEC) to determine possible sources of fecal coliform in the Shoal Creek watershed in Tennessee. At this time, Shoal Creek is not on Tennessee's most current §303(d) list nor are there any approved TMDLs for Shoal Creek in Tennessee. Based on results of these studies, the two agencies will need to generate a plan that can produce the needed reduction in fecal coliform using best management practices.

Table 4-2. Land Use for the Shoal Creek Watershed Upstream of SHOL-2

	Shoal Creek Watershed Upstream of SHOL-2						Combined Watershed Totals		
	Tennessee portion			Alabama portion					
Landuse (Acres / Square Miles / Percent)	Acres	Sq. Miles	Percent	Acres	Sq. Miles	Percent	Acres	Sq. Miles	Percent
Open Water	21	0.0	0.1%	0	0.0	0.0%	21	0.0	0.1%
Developed, Open Space	1,293	2.0	4.3%	13	0.0	1.9%	1,306	2.0	4.2%
Developed, Low Intensity	36	0.1	0.1%	0	0.0	0.0%	36	0.1	0.1%
Developed, Medium Intensity	6	0.0	0.0%	0	0.0	0.0%	6	0.0	0.0%
Barren Land (Rock/Sand/Clay)	7	0.0	0.0%	0	0.0	0.0%	7	0.0	0.0%
Deciduous Forest	15,794	24.7	52.4%	377	0.6	54.8%	16,171	25.3	52.6%
Evergreen Forest	672	1.1	2.2%	55	0.1	7.9%	727	1.1	2.4%
Mixed Forest	1,124	1.8	3.7%	35	0.1	5.1%	1,159	1.8	3.8%
Shrub/Scrub	1,375	2.1	4.6%	18	0.0	2.6%	1,393	2.2	4.5%
Grassland/Herbaceous	278	0.4	0.9%	5	0.0	0.7%	283	0.4	0.9%
Pasture/Hay	8,980	14.0	29.8%	124	0.2	18.0%	9,104	14.2	29.6%
Cultivated Crops	399	0.6	1.3%	39	0.1	5.7%	438	0.7	1.4%
Woody Wetlands	74	0.1	0.2%	22	0.0	3.3%	97	0.2	0.3%
Emergent Herbaceous Wetlands	1	0.0	0.0%	0	0.0	0.0%	1	0.0	0.0%
Total	**30,060**	**47.0**	**100%**	**688**	**1.1**	**100%**	**30,748**	**48.1**	**100%**
Agriculture	9,379	14.7	31.2%	163	0.3	23.7%	9,541	14.9	31.0%
Forest	19,040	29.8	63.3%	507	0.8	73.7%	19,548	30.5	63.6%
Other	1,641	2.6	5.5%	18	0.0	2.6%	1,659	2.6	5.4%
Total	**30,060**	**47.0**	**100.0%**	**688**	**1.1**	**100.0%**	**30,748**	**48.1**	**100.0%**

5.0 Follow Up Monitoring

ADEM has adopted a basin approach to water quality management; an approach that divides Alabama's fourteen major river basins into five groups. Each year, the ADEM water quality resources are concentrated in one of the five basin groups. One goal is to continue to monitor §303(d) listed waters. Monitoring will help further characterize water quality conditions resulting from the implementation of best management practices in the watershed. This monitoring will occur in each basin according the schedule shown.

Table 5-1. §303(d) Follow Up Monitoring Schedule

River Basin Group	Year to be Monitored
Escatawpa / Mobile / Lower Tombigbee / Upper Tombigbee	2006
Black Warrior / Cahaba	2007
Tennessee	2008
Chattahoochee / Chipola / Choctawhatchee / Perdido-Escambia	2009
Alabama / Coosa / Tallapoosa	2010

6.0 Public Participation

As part of the public participation process, this TMDL was placed on public notice and made available for review and comment. The public notice was prepared and published in the four major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL was made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the TMDL by contacting Mr. Chris Johnson at 334-271-7827 or clj@adem.state.al.us. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. At the end of the public review period, all written comments received during the public notice period became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

Appendix 7.1

References

ADEM Administrative Code, 2005. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

ADEM Administrative Code, 2004. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's 303(d) Monitoring Program. 2003 and 2004. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, December 2005.

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Tennessee River Basin Non-Point Source Project. 1997. Tennessee Valley Authority (TVA)

United States Environmental Protection Agency, 1991. Guidance for Water Quality-Based Decisions: The TMDL Process. Office of Water. EPA 440/4-91-001.

Water Quality Report to Congress, For Calendar Years 1990-1991. Alabama Department of Environmental Management, Montgomery, Alabama, June 1996. ADEM, 1992.

Appendix 7.2

Water Quality Data

Table 7-1. Pathogen Data Collected on Shoal Creek

Station_ID	Date	Turbidity (ntu)	Stream Flow (cfs)	Fecal Coliform (col/100ml)	Daily Criteria	30-Day Goemetric Mean Criteria	
10281-1	7/8/1997	3	66.7	70	OK		
10281-1	10/14/1997	6.7	48	2040	VIOLATION		
SHOL-1	6/5/2003	4.8	14.9	80	OK		
SHOL-1	6/10/2003	6.1	17.1	45	OK		
SHOL-1	6/12/2003	6.9	40.8	169	OK	101	OK
SHOL-1	6/17/2003	6		136	OK		
SHOL-1	6/23/2003	7.8	36.8	124	OK		
SHOL-1	8/14/2003	6.6	40	920	OK		
SHOL-1	8/18/2003	7.7	20.5	86	OK		
SHOL-1	8/20/2003	4.43	12	88	OK	113	OK
SHOL-1	8/25/2003	4	9.3	25	OK		
SHOL-1	8/26/2003	6	9.6	108	OK		
SHOL-2	6/5/2003	5.1	13.5	104	OK		
SHOL-2	6/10/2003	5	8.9	124	OK		
SHOL-2	6/12/2003	6.2	38.2	280	OK	173	OK
SHOL-2	6/17/2003	4		204	OK		
SHOL-2	6/23/2003	6.6	12.6	212	OK		
SHOL-2	8/14/2003	5.5	22.5	610	OK		
SHOL-2	8/18/2003	4.9	15.8	116	OK		
SHOL-2	8/20/2003	2.25	9.6	320	OK	208	VIOLATION
SHOL-2	8/25/2003	5	5.9	104	OK		
SHOL-2	8/26/2003	4	0	164	OK		

Table 7-1. Pathogen Data Collected on Shoal Creek (contd.)

Station_ID	Date	Turbidity (ntu)	Stream Flow (cfs)	Fecal Coliform (col/100ml)	Daily Criteria	30-Day Goemetric Mean Criteria	
SHOL-1	2/18/2004	12.5	233.7	< 1	OK		
SHOL-1	3/16/2004	31	301	> 1200	??		
SHOL-1	4/6/2004	2.1	38.8	81	OK		
SHOL-1	5/13/2004	5.9	25.3	180	OK		
SHOL-1	6/2/2004	6	24.4	75	OK	107	OK
SHOL-1	6/10/2004	8	16.2	104	OK		
SHOL-1	6/14/2004	9	14.5	116	OK		
SHOL-1	6/23/2004	6.2	16.7	192	OK		
SHOL-1	6/24/2004	24.4	61.9	82	OK		
SHOL-1	7/1/2004	8	78.3	248	OK		
SHOL-1	7/12/2004	5.39	55.1	65	OK		
SHOL-1	9/1/2004	4.32	26.9	108	OK	77	OK
SHOL-1	9/14/2004	3.01	14.2	54	OK		
SHOL-1	9/23/2004	3	77.2	108	OK		
SHOL-1	9/27/2004	2.4	25.1	92	OK		
SHOL-1	9/28/2004	2.32	27.9	48	OK		
SHOL-1	9/29/2004	3.81	25.8	48	OK		
SHOL-1	10/6/2004	2.5	16.3	88	OK		

Table 7-1. Pathogen Data Collected on Shoal Creek (contd.)

Station_ID	Date	Turbidity (ntu)	Stream Flow (cfs)	Fecal Coliform (col/100ml)	Daily Criteria	30-Day Goemetric Mean Criteria	
SHOL-2	2/18/2004	12.5		< 1	OK		
SHOL-2	3/16/2004	18.6		> 1200	??		
SHOL-2	4/6/2004	2.8	38.6	15	OK		
SHOL-2	5/13/2004	6.1	18.5	250	OK		
SHOL-2	6/2/2004	6.8	16.9	370	OK	297	VIOLATION
SHOL-2	6/10/2004	4	11.1	560	OK		
SHOL-2	6/14/2004	7	10.6	410	OK		
SHOL-2	6/23/2004	7.8	15.3	570	OK		
SHOL-2	6/24/2004	13.7	41.6	48	OK		
SHOL-2	7/1/2004	6.7	57.4	164	OK		
SHOL-2	7/12/2004	3.72	38.3	140	OK		
SHOL-2	9/1/2004	3.98	12.2	65	OK	103	OK
SHOL-2	9/14/2004	3	15.6	92	OK		
SHOL-2	9/23/2004	2.5	35.1	92	OK		
SHOL-2	9/27/2004	2.44	18.1	224	OK		
SHOL-2	9/28/2004	2.58	26	96	OK		
SHOL-2	9/29/2004	5.61	22.1	196	OK		
SHOL-2	10/6/2004	2.5	13.2	270	OK		