Final

Total Maximum Daily Load

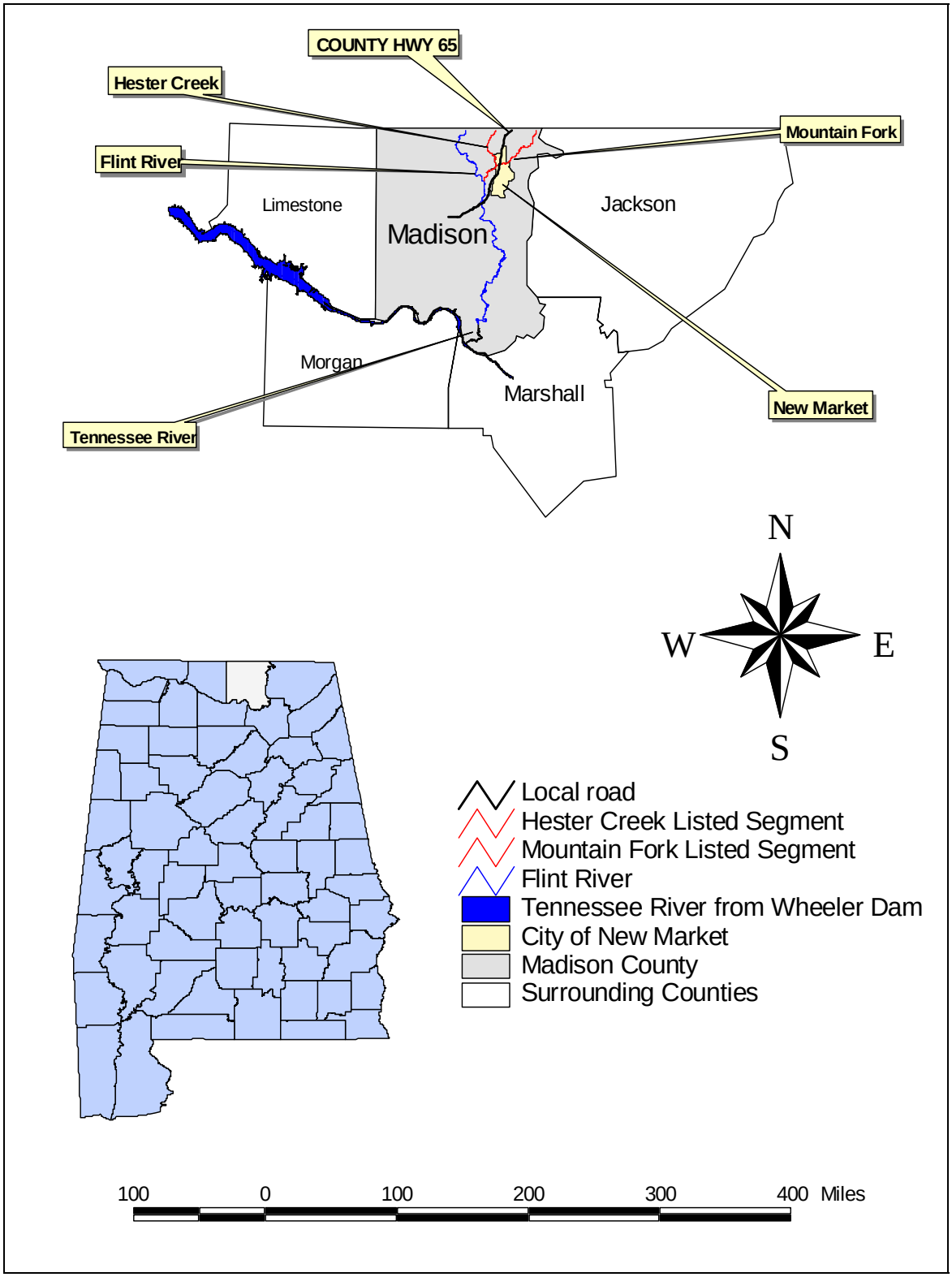
for

Mountain Fork AL06030002-0304-100
&
Hester Creek AL06030002-0304-200

Pathogens (fecal coliform)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
December 2006

Figure 1: 303(d) Listed Segments of Hester Creek and Mountain Fork



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1.0 Executive Summary

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated use and to determine the Total Maximum Daily Load (TMDL) for pollutants causing the use impairment. A 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).

Hester Creek is on the 303(d) list for pathogens (fecal coliform) from the AL/ TN state line to its confluence with Mountain Fork. Mountain Fork is also on the 303(d) list for pathogens from its source to its mouth at Flint River. Hester Creek and Mountain Fork are a part of the Upper Tennessee River Basin. Hester Creek begins in Tennessee and flows into Mountain Fork near the town of New Market. Mountain Fork continues on to the Flint River which flows into Wheeler Lake on the Tennessee River. The USGS hydrologic unit code (HUC) for Wheeler Lake is 06030002. Combined, Hester Creek and Mountain Fork make up the Mountain Fork subwatershed. A complete HUC code numeric ID for Mountain Fork is 06030002-0304. The total drainage area of the Mountain Fork watershed is 84.4 square miles, with Hester Creek accounting for 40.1 square miles. Almost a quarter of the watershed (23.25%) draws from the state of Tennessee. Within the Tennessee portion of the watershed, an unknown tributary to Hester Creek has been listed on the 303(d) list for pathogens by the Tennessee Department of Environment and Conservation (TDEC). Both Mountain Fork and Hester Creek have a use classification of Fish & Wildlife (F&W).

Mountain Fork was first placed on the state's §303(d) list for pathogens in 1998 based on a study done by TVA in 1997. The data used for the listing was gathered from TVA station 7891-02 and can be found in Appendix B. Hester Creek was first placed on the 303(d) list for pathogens in 2000 based on data from USGS in 1999. The data used for this listing was gathered from USGS station 0357479650 and can be found in Appendix B

From 2003 through 2004, a 303(d) sampling study was performed by ADEM on Mountain Fork and Hester Creek. ADEM established five sampling sites and collected 69 samples from Mountain Fork and 57 samples from Hester Creek. According to the data recently collected, these streams are not meeting the pathogen criterion (summer geometric mean only) applicable to their use classification of Fish and Wildlife. Therefore, this TMDL is being performed on the full reach of both streams. This will be a combined TMDL and the reductions will be applied to the entire Mountain Fork watershed, which includes the Hester Creek watershed.

A mass balance approach was used to calculate this TMDL. The mass balance approach utilizes the conservation of mass principle. The pathogen loading to Mountain Fork and Hester 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, allowable loads and required load reductions necessary to meet the applicable water quality pathogen geometric mean criterion for Mountain Fork and Hester Creek. Table 1.2 lists the required TMDL pathogen loadings under critical conditions for the waterbodies.

Table 1.1 – Current/Allowable Loads and Required Reductions

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	3.92E+11	1.35E+11	2.56E+11	65%	1.35E+11
WLA	0.00E+00	0.00E+00	0.00E+00	0%	0.00E+00

Table 1.2 - TMDL for Hester Creek and Mountain Fork

TMDL (col/day)	WLA (col/day)	LA (col/day)	MOS (col/day)
1.50E+11	0.00E+00	1.35E+11	1.50E+10

The majority of the watershed is undeveloped and consists of agriculture and forest landuse. The most likely sources of impairment to the stream come from agricultural landuses. This watershed has an uncommonly high concentration of agriculture accounting for slightly over half of the landuse. A quarter of the watershed lies in Tennessee, yet it accounts for nearly a third (30.5%) of the total agricultural landuse for the watershed.

ADEM in cooperation with local stakeholders will need to verify the possible sources of fecal coliform located in the watershed. The likely targets of implementation will be the dense pockets of agriculture. Following the study of Alabama landuse issues in the watershed, ADEM will have to coordinate with TDEC to determine possible landuse issues 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.

2.0 Basis for §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated uses and to determine the total maximum daily load (TMDL) for pollutants causing use impairment. The TMDL process establishes the allowable loading of pollutants for a waterbody based on the relationship between pollution sources and instream water quality conditions, so that states can establish water-quality based controls to reduce pollution and restore and maintain the quality of their water resources (USEPA, 1991).

As previously mentioned, Mountain Fork was first placed on the state's §303(d) list for pathogens in 1998 based on a study done by TVA in 1997. In the TVA study, there were two samples that exceeded the maximum single sample criterion of 2000 col/100ml. Hester Creek was first added to the list for Pathogens in 2000 based on USGS data from 1999. USGS collected nine samples that exceeded the maximum single sample criterion of 2000 col/100ml. All data for the studies mentioned above can be found in Appendix B.

2.2 Problem Definition

Waterbody Impaired:	(1) Hester Creek from AL/TN state line to its mouth at Mountain Fork
	(2) Mountain Fork from its source to its mouth at Flint River
Waterbody length:	(1) 7.2 miles
	(2) 15.3 miles
Waterbody drainage area:	(1) 40.1 square miles
	(2) 84.4 square miles
Water Quality Criterion Violation:	(1&2) Fecal Coliform (geometric mean only)
Pollutant of Concern:	(1&2) Pathogens (Fecal Coliform)
Water Use Classification:	(1&2) Fish & Wildlife (F&W)

Usage related to classification:
The impaired stream segments, Hester Creek and Mountain Fork, are classified as F&W. Usage of waters in this classification are described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), (d), and (e) as follows:

(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) Bacteria of the fecal coliform group shall not exceed a geometric mean of 1,000/100 ml; nor exceed a maximum of 2,000/100 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 100/100 ml in coastal waters and 200/100 ml in other waters. 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 mean fecal 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.

Criterion Exceeded:

There have been multiple single sample violations and geometric mean violations for fecal coliform for both streams from 2003 through 2004. Hester Creek had three events where it exceeded the single sample criterion of 2,000 col/100ml and four events where it exceeded the geometric mean criterion of 200 col/100ml. Mountain Fork did not have any events that exceeded the single sample criterion, but had four events where it exceeded the geometric mean criterion of 200 col/100ml. Summary tables 2.1 and 2.2 document all violations.

With respect to making a use support determination for these streams, one needs to consider the data using ADEM's Water Quality Assessment and Listing Methodology (ADEM, 2005). In doing so, both Hester Creek and Mountain Fork are meeting standards with respect to the single sample criterion of 2,000 col/100ml. However, both these streams are not meeting standards with respect to the geometric mean criterion of 200 col/100ml. Although Hester Creek had 2 single sample violations out of 57 total samples collected, these reported violations did not account for 10% or more of the samples collected, therefore Hester Creek is considered to be attaining standards with respect to the single sample fecal coliform criterion of 2,000 col/100ml. Likewise, Mountain Fork is also considered to be attaining standards with respect to the single sample criterion since zero out of 69 total samples exceeded the single sample criterion of 2,000 col/100ml. Therefore, the TMDL was developed to address the geometric mean fecal coliform violations versus the single sample violations.

Table 2.1 Single Sample Violations

Station	Date	Flow (cfs)	Conc (col/day)
HESM-1	6/17/2003	55.6	4100
HESM-2	6/17/2003	40.4	9100

Table 2.2 Geometric Mean Violations

Station	Date	Avg. Flow (cfs)	Conc (col/day)	Geo Mean (col/day)
HESM-1	7/9/2003	44	520	
	7/10/2003	40.3	600	
	7/14/2003	21.3	410	521
	7/15/2003	26.1	600	
	7/16/2003	22	500	
HESM-1	9/4/2003		640	
	9/8/2003		164	
	9/10/2003		348	232
	9/11/2003		200	
	9/18/2003		92	
HESM-1	6/10/2004	8	300	
	6/14/2004	7	168	
	6/16/2004	6.4	140	210
	6/17/2004	7.9	240	
	6/21/2004	5.9	240	
HESM-2	7/9/2003		1130	
	7/10/2003		800	
	7/14/2003		430	705
	7/15/2003		800	
	7/16/2003		560	
MTNM-1	7/10/2003		40	
	7/14/2003		470	
	7/15/2003		1780	304
	7/16/2003		250	
	7/17/2003		310	
MTNM-1	9/4/2003		1300	
	9/10/2003		580	
	9/11/2003		152	246
	9/18/2003		62	
	9/30/2003		128	
Station	Date	Avg. Flow (cfs)	Conc (col/day)	Geo Mean (col/day)
MTNM-2	7/10/2003	60.3	860	
	7/14/2003	46.9	250	
	7/15/2003	42.1	560	421

	7/16/2003	52.6	172	
	7/17/2003	33.7	640	
MTNM-3	9/4/2003	8.8	700	
	9/10/2003	11.6	290	
	9/11/2003	14.2	620	247
	9/18/2003	15.6	92	
	9/30/2003	19.4	80	

**See Table 3.2 for station locations

3.0 Technical Basis for TMDL

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 Mountain Fork Watershed:

There are no point sources in the Mountain Fork watershed. In addition, the Alabama portion of the Mountain Fork watershed does not presently qualify as a municipal separate stormwater sewer system (MS4) area as defined as an urban area serving 50,000 residents or greater. Therefore, 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 Mountain Fork Watershed:

The landuse in the Mountain Fork watershed is predominately forest and agriculture. On the site visit to the watershed there were many cattle and chicken operations observed. The following are examples of how different landuses can contribute to fecal coliform bacterial loading:

- Agricultural land is commonly a large source of fecal coliform bacteria. Pasture land runoff, animal operations, improper land application of animal waste, and animals with access to streams are all contributing factors of fecal coliform bacteria to water bodies. Agricultural land accounts for half of the landuse in the Mountain Fork watershed.

  Cattle were observed in Hester Creek on Phillips Road. This cattle access is about 1.5 miles north of sampling station HESM-2, at Buddy Williamson Road. This station was found to have the highest single sample violation.

Picture 3.1: Cattle access at east side of Phillips Rd.; 04/18/2006

Picture 3.2: Cattle access at east side of Phillips Road; 04/18/2006

- Fecal coliform bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, turkeys, waterfowl, etc.
- Leaking septic systems can be another source of fecal coliform bacteria.

The nature and extent of fecal coliform bacterial sources in the watershed will be better identified during the implementation phase of the TMDL.

3.3 Landuse

Table 3.1 on the next page provides the various landuses (and their associated percentages) for the Mountain Fork watershed. Figure 3.1 is a landuse map of the Mountain Fork watershed. The Tennessee portion of the watershed is 23.25% of the total area and 30.5% of the total agricultural landuse. The detailed landuse for this watershed was derived from EPA's Watershed Characterization System (WCS). The WCS system is a software tool that provides a means to organize Geographical Information System (GIS) data on a spatial scale for a defined watershed. Landuse information for this assessment was derived from USGS's 2001 Multiple Resolution Land Coverage (MRLC) theme.

Figure 3.1 – Landuse Map of the Mountain Fork Watershed

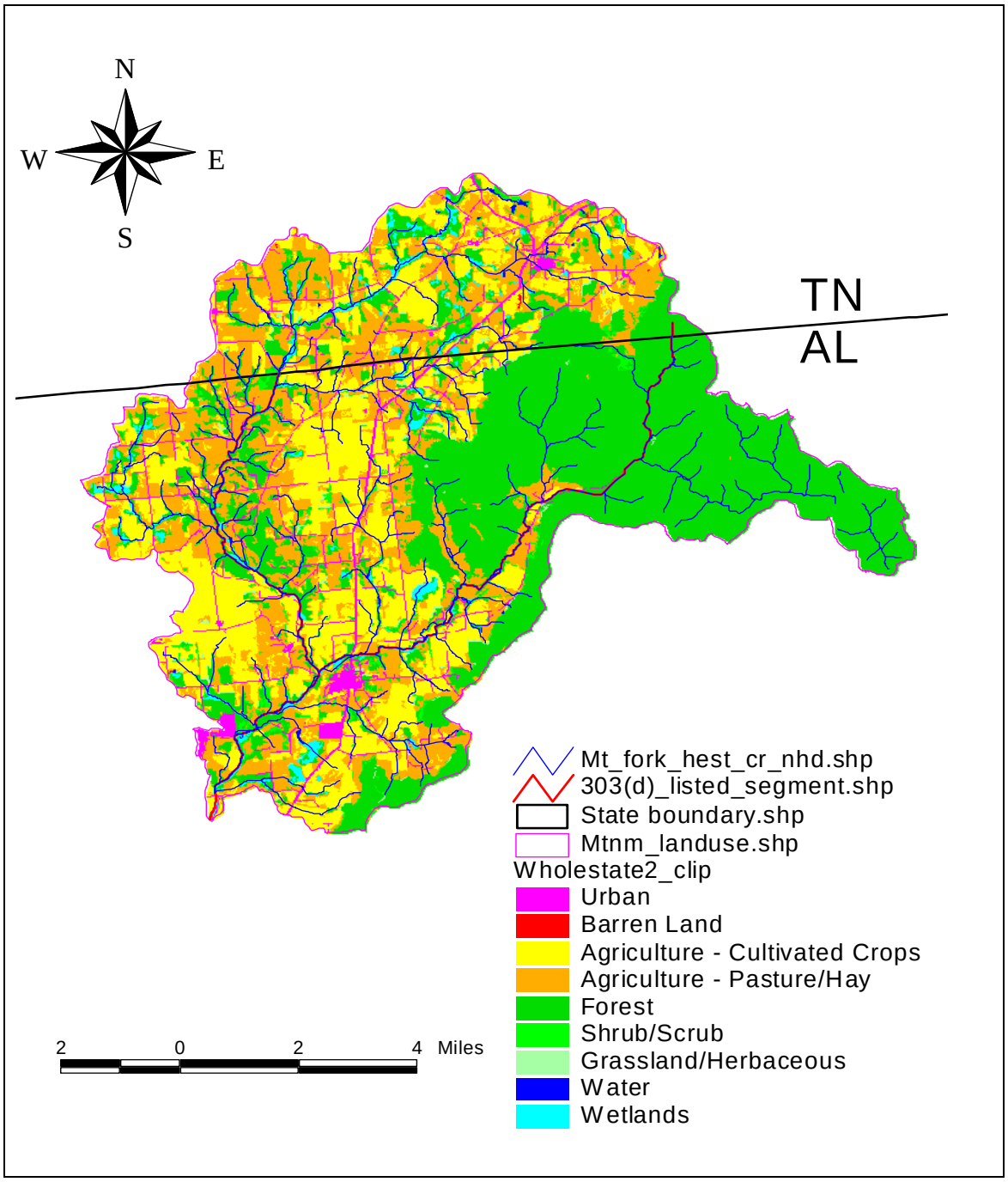


Table 3.1 Landuse in the Mountain Fork Watershed

MOUNTAIN FORK WATERSHED 06030002-0304									
	Tennessee			Alabama			Combined Watershed Totals		
Land Use	Acres	Sq. Miles	Percentages	Acres	Sq. Miles	Percentages	Acres	Sq. Miles	Percentages
Open Water	344.70	0.05	0.3	169.02	0.03	0.0	513.72	0.08	0.1
Developed, Open Space	5822.17	0.91	4.6	15449.43	2.41	3.7	21271.60	3.32	3.9
Developed, Low Intensity	1051.90	0.16	0.8	2179.42	0.34	0.5	3231.33	0.50	0.6
Developed, Medium Intensity	342.48	0.05	0.3	231.29	0.04	0.1	573.77	0.09	0.1
Developed, High Intensity	57.82	0.01	0.0	33.36	0.01	0.0	91.18	0.01	0.0
Barren Land (Rock/Sand/Clay)	128.99	0.02	0.1	13.34	0.00	0.0	142.33	0.02	0.0
Deciduous Forest	24342.81	3.80	19.3	176795.60	27.62	42.5	201138.41	31.43	37.1
Evergreen Forest	246.85	0.04	0.2	2070.45	0.32	0.5	2317.30	0.36	0.4
Mixed Forest	796.16	0.12	0.6	5330.69	0.83	1.3	6126.84	0.96	1.1
Shrub/Scrub	3424.81	0.54	2.7	11295.19	1.76	2.7	14719.99	2.30	2.7
Grassland/Herbaceous	1563.40	0.24	1.2	3449.27	0.54	0.8	5012.67	0.78	0.9
Pasture/Hay	51627.84	8.07	40.9	95805.61	14.97	23.0	147433.45	23.04	27.2
Cultivated Crops	32422.24	5.07	25.7	95841.19	14.98	23.0	128263.43	20.04	23.7
Woody Wetlands	4020.81	0.63	3.2	7245.47	1.13	1.7	11266.28	1.76	2.1
Emergent Herbaceous Wetlands	11.12	0.00	0.0	0.00	0.00	0.0	11.12	0.00	0.0
Total	**126204.10**	**19.72**	**100.0**	**415909.33**	**64.99**	**100.0**	**542113.43**	**84.71**	**100.0**
Agriculture	84050.08	13.13	66.6	191646.81	29.95	46.1	275696.88	43.08	50.9
Forest	29406.63	4.59	23.3	191442.21	29.91	46.0	220848.84	34.51	40.7
Developed	7274.38	1.14	5.8	17893.50	2.80	4.3	25167.88	3.93	4.6
Other	5473.02	0.86	4.3	14926.82	2.33	3.6	20399.83	3.19	3.8
Total	**126204.10**	**19.72**	**100.0**	**415909.33**	**64.99**	**100.0**	**542113.43**	**84.71**	**100.0**

3.4 Linkage Between Numeric Targets and Sources

As can be seen from viewing the above table, Hester Creek and Mountain Fork have two major landuses – forest and agriculture. Pollutant loadings from forested areas tend to be low due to their filtering capabilities. The most likely sources of pathogen loadings in Hester Creek and Mountain Fork are from the agricultural landuses and failing septic systems. However, since the impaired segment consists of such a large drainage area, (84.7 square miles) with diverse land cover/uses, it was not considered practicable to determine individual components of nonpoint source (NPS) loading. As such, individual loads or reductions for various sources such as forest, agriculture, and septic systems will not be specified. Loadings and reductions will only be viewed as a total NPS load.

3.5 Data Availability and Analysis

There have been three main studies in this watershed for relevant chemical data. The first study was performed by TVA in 1997. Of the three stations in this study, station 7891-02 recorded two samples that exceeded the single sample criterion and placed Mountain Fork on the 303(d) list in 1998 for fecal coliform. The second significant study that included fecal coliform data was performed by USGS in 1999. During the course of that year there were nine samples from one gauge (#0357479650) that well exceeded the single sample criterion. Hester Creek was then placed on the 303(d) list in 2000 for fecal coliform.

In 2003 and 2004 ADEM performed monthly 303(d) sampling at five stations on Hester Creek and Mountain Fork. The stations collectively produced 126 samples that were adequate for geometric mean calculations and single sample analysis. Every station in the Mountain Fork watershed had violations exceeding the geometric mean water quality criterion of 200 col/100ml for fecal coliform. On Hester Creek, sampling station HESM-1 accounted for one geometric mean violation and HESM-2 with three geometric mean violations. On Mountain Fork, sampling station MTNM-1 accounted for two, MTNM-2 one, and MTNM-3 one.

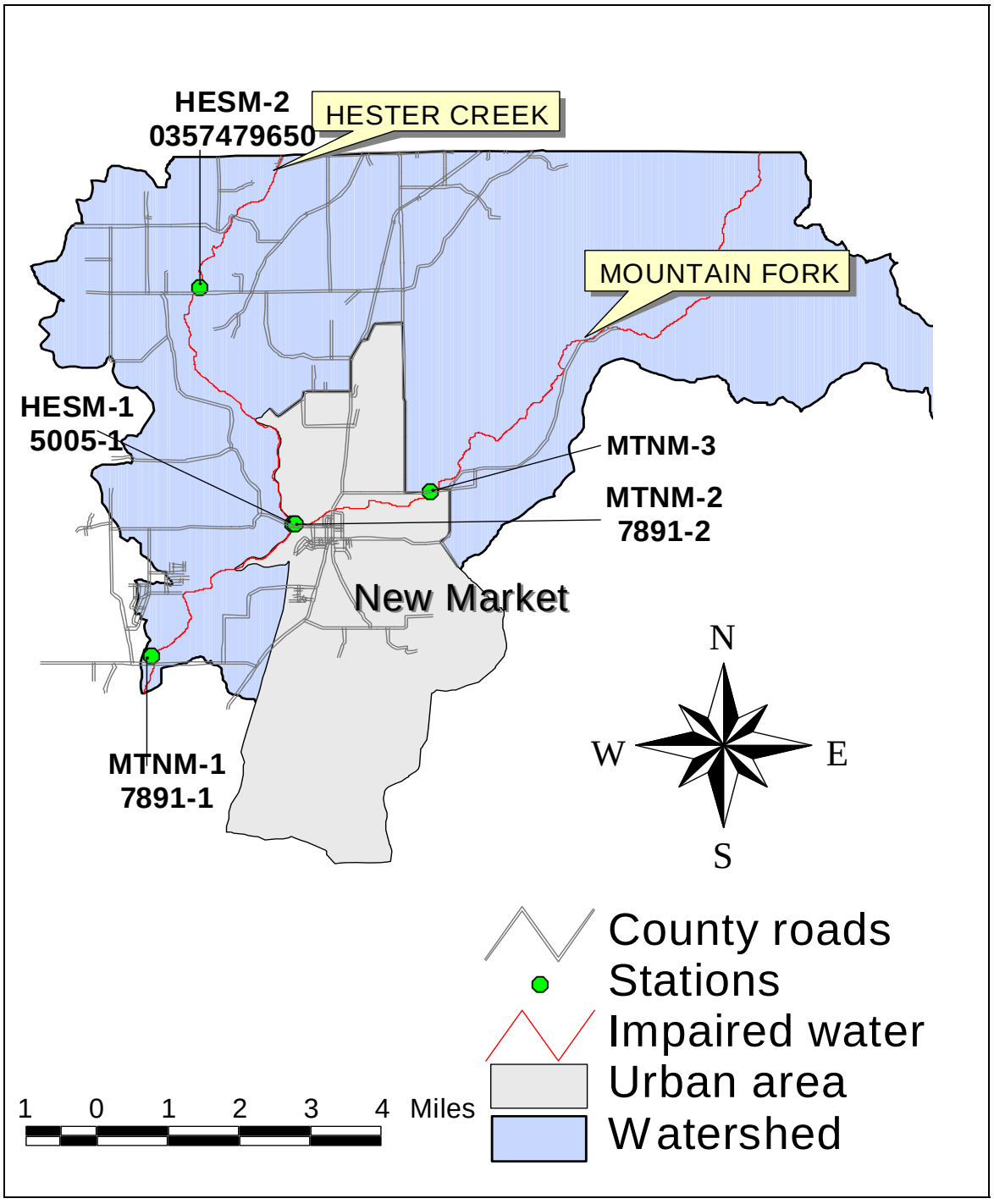
When comparing the data to the single sample criterion of 2000 col/100ml, there were a total of 2 violations. All of the single sample violations were on Hester Creek, one at HESM-1 and the other at HESM-2. Considering there were violations at every station on both creeks, the fecal coliform TMDL will be developed for the entire watershed. However, the TMDL was developed to address the geometric mean fecal coliform violations versus the single sample violations.

All data for the stations mentioned above can be found in Appendix B. Sample locations are shown in Figure 3.2. Location descriptions for all stations can be found in Table 3.2. Please note that some stations have more than one ID, depending on which study is under consideration.

Table 3.2 Sampling Station Location Descriptions

Source of Data	Station ID	Latitude	Longitude	Location Description	Year
TVA	5005-1	34.9105	-86.4374	Hester Creek above Confl with Mtn Fk @ New Mark Bridge	1997
TVA	7891-1	34.8955	-86.4646	Mountain Fork At Subdivision (Landfill)	1997
TVA	7891-2	34.9105	-86.4374	Mount Fk Above Confl. w/ Hester Creek @ New Market Bridge	1997
USGS	357479650	34.9608	-86.4636	Hester Creek @ Buddy Williamson Road	1999
ADEM	HESM-1	34.91	-86.44	Hester Creek above Confl with Mtn Fk @ New Mark Bridge	2003
ADEM	HESM-2	34.96	-86.46	Hester Creek @ Buddy Williamson Road	2003
ADEM	MTNM-1	34.89552	-86.46462	Mountain Fork At Subdivision (Landfill)	2003
ADEM	MTNM-2	34.91061	-86.43685	Mount Fk Above Confl. w/ Hester Creek @ New Market Bridge	2003
ADEM	MTNM-3	34.9177	-86.40167	Mount Fk @ unnamed co rd nr New Market/Jones Cemetery	2003

Figure 3.2 Sampling Stations in the Mountain Fork Watershed



3.6 Critical Conditions

The summer months are generally considered critical conditions. In the summer, periods of dry weather interspersed with thunderstorms allow for the accumulation and washing off of fecal coliform bacteria into streams. These summer trends result in spikes of fecal coliform bacteria counts. Winter trends show frequent low intensity rain events that do not allow for the build-up of fecal coliform bacteria on the land surface, resulting in a more uniform loading rate. The summer fecal coliform criterion is more stringent than the winter criterion.

The Mountain Fork watershed follows both the trends described above for the summer months and winter months. Table 2.1 and 2.2 show that the higher concentrations of fecal coliform occur at high flows and low flows. The maximum geometric mean concentration of 521 colonies/100 mL with an average flow of 30.7 cfs at HESM-1 will be used to estimate the TMDL pathogen loadings to Mountain Fork and Hester Creek under critical conditions.

3.7 Margin of Safety (MOS)

There are two methods for incorporating a 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.

An explicit MOS was incorporated in this TMDL. A margin of safety was applied to the TMDL by reducing the target criterion concentration by ten percent. For this TMDL, the geometric mean criterion was reduced by ten percent to achieve a target concentration of 180 colonies/100ml, which yields a MOS equal to 20 colonies/100ml.

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 (col/day), in accordance with 40 CFR 130.2(i).

4.2 Load Calculations

A mass balance approach was used to calculate the TMDL for Hester Creek and Mountain Fork. The mass balance approach utilizes the conservation of mass principle. Loads can be calculated by multiplying the fecal coliform concentration times the flow.

Two loads were calculated in this analysis. The first was to estimate current pathogen loads to the watershed during a violation event. It was done by multiplying a geometric mean exceedance concentration of 521 col/100ml times the measured flow. This concentration was measured at HESM-1 in July of 2003 and can be found in Appendix B. Measured flow for this event was 30.7 cfs. The product of these two values and a conversion factor gives the loading to the watershed 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 fecal concentration of 180 col/100 mls. The difference between these two loads, converted to a percent reduction, represents the loading reduction necessary to achieve the fecal water quality criterion under those specific conditions. Calculations for these two loads can be found on the next page in Table 4.1.

Table 4.1 Current vs Allowable Pathogen Loadings for Hester Creek and Mountain Fork

Geometric Mean Fecal Load Reduction and TMDL Calculations for Hester Creek

Average Flow measured at HESM-1 for Geometric Mean Samples:	30.7	cfs	
Geometric Mean Fecal coliform concentration measured:	521	col/100 mL	
Allowable fecal coliform maximum concentration minus MOS:	180	col/100mL	= 200 - 10%
Margin of safety 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 = 24465755 (ml-s/ft3-day)

Current Load:

Nonpoint source load (LA)	3.92E+11	colonies/day	
Point source load (WLA)	0.00E+00	colonies/day	There are no point sources in this watershed
Current load =	3.92E+11	colonies/day	

Allowable Load:

Nonpoint source load (LA)	1.35E+11	colonies/day	
Point source load (WLA)	0.00E+00	colonies/day	There are no point sources in this watershed
Allowable load =	1.35E+11	colonies/day	

Margin of Saftey:

MOS load = 1.50E+10 colonies/day

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	3.92E+11	1.35E+11	2.56E+11	65%	1.35E+11
WLA	0.00E+00	0.00E+00	0.00E+00	0%	0.00E+00
Total	3.92E+11	1.35E+11	2.56E+11	65%	1.35E+11

Total Maximum Daily Load (TMDL):

TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
1.50E+11	0.00E+00	1.35E+11	1.50E+10

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 65% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

The water quality criteria for fecal coliform for the summer geometric mean 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 criteria which = 200 – 10%

4.3 TMDL Summary

Regulations require that a TMDL be established with consideration of seasonal variations. Data from 303(d) sampling was collected over both wet and dry seasons, thereby taking these variations into account. The data was collected monthly over a 6-month period both in 2003 and 2004.

The violations of geometric mean criterion at all five stations in the watershed make it clear that the full reaches of both streams are impaired for fecal coliform. The violations in this watershed are not only high in number but also in concentration, with three geometric mean concentrations doubling the set criterion of 200 col/100ml. The most likely source of fecal coliform in this watershed is agricultural landuse (i.e. pasture/hay). Of the 84.71 square miles of watershed, 43.08 square miles are designated as agricultural lands, which is just over half of the watershed. High agriculture is common in the Tennessee basin, but the 50.86% for the Mountain Fork watershed exceeds the average. Based on the USGS's 2001 Multiple Resolution Land Coverage (MRLC) theme, the Tennessee River Basin is 35.91% agriculture and Madison County is 41.11% agriculture. The Tennessee portion of the Mountain Fork watershed contains an even higher percentage at 66.60% agriculture.

ADEM will need to verify the possible sources of fecal coliform located in the watershed. The likely targets of implementation will be the dense pockets of agriculture. Following the identification of Alabama landuse issues in the watershed, ADEM will have to coordinate with TDEC in order to determine possible landuse issues 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.

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, ADEM's resources for water quality monitoring are concentrated in one of the 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 to the schedule shown in Table 5.1.

Table 5.1 River Basin Sampling 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 A
References

USEPA. 2001. *Protocol for Developing Pathogen TMDLs*. EPA 841-R-00-001. U.S. Environmental Protection Agency, Office of Water, Washington DC.

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

Alabama Department of Environmental Management's 303(d) Monitoring Program. 2001-2002.

ADEM Administrative Code, 2002. Water Quality Program, Chapter 335-6-10, Water Quality Criteria, and Chapter 335-6-11 Use Classifications for Interstate and Intrastate Waters.

Appendix B
Water Quality Data
ADEM Intensive Survey and 303(d) Data

Station ID	Date	Time (24hr)	Flow (cfs)	Fecal Coliform col/100ml
HESM-1	3/20/2003	1020		1200
HESM-1	4/10/2003	1035	72.6	168
HESM-1	5/20/2003	1100	98.5	440
HESM-1	6/17/2003	1115	55.6	**4100**
HESM-1	7/9/2003	1030	44	520
HESM-1	7/10/2003	1100	40.3	600
HESM-1	7/14/2003	1010	21.3	410
HESM-1	7/15/2003	1020	26.1	600
HESM-1	7/16/2003	1025	22	500
HESM-1	8/4/2003	1015	11.4	212
HESM-1	9/4/2003	1100		640
HESM-1	9/8/2003	1145		164
HESM-1	9/10/2003	1042		348
HESM-1	9/11/2003	1047		200
HESM-1	9/18/2003	1055		92
HESM-1	10/15/2003	1030		112
HESM-1	10/15/2003	1031		116
HESM-1	6/10/2004	950	8	300
HESM-1	6/14/2004	1110	7	168
HESM-1	6/16/2004	1100	6.4	140
HESM-1	6/17/2004	1105	7.9	240
HESM-1	6/21/2004	1115	5.9	240
HESM-1	7/6/2004	1140	14.6	380
HESM-1	7/7/2004	1145		1
HESM-1	8/18/2004	1015	5.4	51
HESM-1	8/26/2004	950	8	92
HESM-1	8/31/2004	1100	6.6	
HESM-1	9/2/2004	935	8	152
HESM-1	9/7/2004	1100		74
HESM-1	9/8/2004	1105	5.4	60
HESM-2	3/20/2003	1115		**2000**
HESM-2	4/10/2003	925	64.2	760
HESM-2	5/20/2003	1215	56.1	520
HESM-2	6/17/2003	1015	40.4	**9100**
HESM-2	7/9/2003	1115		1130
HESM-2	7/10/2003	1155		800
HESM-2	7/14/2003	925		430
HESM-2	7/15/2003	930		800
HESM-2	7/16/2003	935		560
HESM-2	8/4/2003	1045		300
HESM-2	9/4/2003	1030		250
HESM-2	9/8/2003	1115		140
HESM-2	9/10/2003	1025		290
HESM-2	9/11/2003	1030		144
HESM-2	9/18/2003	1020		96
HESM-2	6/10/2004	1110		290
HESM-2	6/14/2004	955		144
HESM-2	6/16/2004	930		188
HESM-2	6/17/2004	935		172
HESM-2	6/21/2004	1000		200
HESM-2	7/6/2004	1030		188
HESM-2	7/7/2004	1035		4
HESM-2	8/18/2004	1125		80
HESM-2	8/26/2004	1115		160
HESM-2	8/31/2004	1200		
HESM-2	9/2/2004	1045		164
HESM-2	9/7/2004	1210		600
HESM-2	9/8/2004	1215		260
MTNM-1	7/10/2003	1005		40
MTNM-1	7/14/2003	1050		470
MTNM-1	7/15/2003	1110		1780
MTNM-1	7/16/2003	1115		250
MTNM-1	7/17/2003	1120		310
MTNM-1	9/4/2003	1145		1300
MTNM-1	9/10/2003	1145		580

Station ID	Date	Time (24hr)	Flow (cfs)	Fecal Coliform col/100ml
MTNM-1	9/11/2003	1150		152
MTNM-1	9/18/2003	1120		62
MTNM-1	9/30/2003	1100		128
MTNM-1	6/10/2004	930		196
MTNM-1	6/14/2004	935		188
MTNM-1	6/16/2004	905		188
MTNM-1	6/17/2004	910		140
MTNM-1	6/21/2004	940		200
MTNM-1	7/6/2004	1005		320
MTNM-1	7/7/2004	1010		1
MTNM-1	8/18/2004	950		112
MTNM-1	8/26/2004	935		
MTNM-1	8/31/2004	1040		
MTNM-1	9/2/2004	915		1500
MTNM-1	9/7/2004	1035		104
MTNM-1	9/8/2004	1040		220
MTNM-2	7/10/2003	1045	60.3	860
MTNM-2	7/14/2003	1030	46.9	250
MTNM-2	7/15/2003	1040	42.1	560
MTNM-2	7/16/2003	1045	52.6	172
MTNM-2	7/17/2003	1050	33.7	640
MTNM-2	9/4/2003	1115	21.1	1200
MTNM-2	9/10/2003	1050	37.1	128
MTNM-2	9/11/2003	1055	30	92
MTNM-2	9/18/2003	1100	11.8	27
MTNM-2	9/30/2003	1030	19.7	46
MTNM-2	6/10/2004	1010	25.7	600
MTNM-2	6/14/2004	1020	23.9	136
MTNM-2	6/16/2004	945	24.4	116
MTNM-2	6/17/2004	950	15.2	14
MTNM-2	6/21/2004	1010	50.4	88
MTNM-2	7/6/2004	1045		270
MTNM-2	7/7/2004	1050	16.1	66
MTNM-2	8/18/2004	1040	15.4	40
MTNM-2	8/26/2004	1015	17.8	150
MTNM-2	8/31/2004	1110	23.1	
MTNM-2	9/2/2004	945	15.6	440
MTNM-2	9/7/2004	1125		108
MTNM-2	9/8/2004	1130		112
MTNM-3	7/10/2003	1120	40.4	260
MTNM-3	7/14/2003	945	42.6	88
MTNM-3	7/15/2003	950	41	310
MTNM-3	7/16/2003	955	37.7	156
MTNM-3	7/17/2003	1000	34.2	230
MTNM-3	9/4/2003	940	8.8	700
MTNM-3	9/10/2003	1115	11.6	290
MTNM-3	9/11/2003	1120	14.2	620
MTNM-3	9/18/2003	1035	15.6	92
MTNM-3	9/30/2003	1000	19.4	80
MTNM-3	6/10/2004	1040	10.9	108
MTNM-3	6/14/2004	1040	13.9	116
MTNM-3	6/16/2004	1030	15.4	88
MTNM-3	6/17/2004	1035	18.5	64
MTNM-3	6/21/2004	1045	14.7	96
MTNM-3	7/6/2004	1115	49.1	164
MTNM-3	7/7/2004	1120		1
MTNM-3	8/18/2004	1108	11.8	69
MTNM-3	8/26/2004	1050	14.8	
MTNM-3	8/31/2004	1140	19.1	
MTNM-3	9/2/2004	1010	24.4	300
MTNM-3	9/7/2004	1150	14.3	300
MTNM-3	9/8/2004	1155		208

ADEM Intensive Survey and 303(d) Data

Station	Date	Time	Stream Flow (cfs)	Fecal Coliform (org/100ml)	Geo Mean
HESM-1	7/9/2003	1030	44	520	
	7/10/2003	1100	40.3	600	
	7/14/2003	1010	21.3	410	**521**
	7/15/2003	1020	26.1	600	
	7/16/2003	1025	22	500	
HESM-1	9/4/2003	1100		640	
	9/8/2003	1145		164	
	9/10/2003	1042		348	**232**
	9/11/2003	1047		200	
	9/18/2003	1055		92	
HESM-1	6/10/2004	950	8	300	
	6/14/2004	1110	7	168	
	6/16/2004	1100	6.4	140	**210**
	6/17/2004	1105	7.9	240	
	6/21/2004	1115	5.9	240	
HESM-1	8/18/2004	1015	5.4	51	
	8/26/2004	950	8	92	
	9/2/2004	935	8	152	79
	9/7/2004	1100		74	
	9/8/2004	1105	5.4	60	
HESM-2	7/9/2003	1115		1130	
	7/10/2003	1155		800	
	7/14/2003	925		430	**705**
	7/15/2003	930		800	
	7/16/2003	935		560	
HESM-2	9/4/2003	1030		250	
	9/8/2003	1115		140	
	9/10/2003	1025		290	170
	9/11/2003	1030		144	
	9/18/2003	1020		96	
HESM-2	6/10/2004	1110		290	
	6/14/2004	955		144	
	6/16/2004	930		188	193
	6/17/2004	935		172	
	6/21/2004	1000		200	
MTNM-1	7/10/2003	1005		40	
	7/14/2003	1050		470	
	7/15/2003	1110		1780	**304**
	7/16/2003	1115		250	
	7/17/2003	1120		310	
MTNM-1	9/4/2003	1145		1300	
	9/10/2003	1145		580	
	9/11/2003	1150		152	**246**
	9/18/2003	1120		62	
	9/30/2003	1100		128	

Station	Date	Time	Stream Flow (cfs)	Fecal Coliform (org/100ml)	Geo Mean
MTNM-1	6/10/2004	930		196	
	6/14/2004	935		188	
	6/16/2004	905		188	181
	6/17/2004	910		140	
	6/21/2004	940		200	
MTNM-2	7/10/2003	1045	60.3	860	
	7/14/2003	1030	46.9	250	
	7/15/2003	1040	42.1	560	**421**
	7/16/2003	1045	52.6	172	
	7/17/2003	1050	33.7	640	
MTNM-2	9/4/2003	1115	21.1	1200	
	9/10/2003	1050	37.1	128	
	9/11/2003	1055	30	92	112
	9/18/2003	1100	11.8	27	
	9/30/2003	1030	19.7	46	
MTNM-2	6/10/2004	1010	25.7	600	
	6/14/2004	1020	23.9	136	
	6/16/2004	945	24.4	116	103
	6/17/2004	950	15.2	14	
	6/21/2004	1010	50.4	88	
MTNM-2	8/18/2004	1040	15.4	40	
	8/26/2004	1015	17.8	150	
	9/2/2004	945	15.6	440	126
	9/7/2004	1125		108	
	9/8/2004	1130		112	
MTNM-3	7/10/2003	1120	40.4	260	
	7/14/2003	945	42.6	88	
	7/15/2003	950	41	310	191
	7/16/2003	955	37.7	156	
	7/17/2003	1000	34.2	230	
MTNM-3	9/4/2003	940	8.8	700	
	9/10/2003	1115	11.6	290	
	9/11/2003	1120	14.2	620	**247**
	9/18/2003	1035	15.6	92	
	9/30/2003	1000	19.4	80	
MTNM-3	6/10/2004	1040	10.9	108	
	6/14/2004	1040	13.9	116	
	6/16/2004	1030	15.4	88	92
	6/17/2004	1035	18.5	64	
	6/21/2004	1045	14.7	96	

1997 TVA Fecal Coliform Data

Watershed	Stream Name	TVA Station Number	Duplicate	Date	Time	Streamflow (cfs)	Fecal Coliform (#/100mL)
FLINT RIVER	HESTER CREEK 0.1	500501		6/24/1997	18:15	15.6	INT
FLINT RIVER	HESTER CREEK 0.1	500501		7/15/1997	16:15	11.0	INT
FLINT RIVER	HESTER CREEK 0.1	500501		8/19/1997	14:45	6.0	120
FLINT RIVER	HESTER CREEK 0.1	500501	Duplicate	8/19/1997	14:46		INT
FLINT RIVER	HESTER CREEK 0.1	500501		9/16/1997	14:00	3.8	340
FLINT RIVER	HESTER CREEK 0.1	500501		10/21/1997	8:00	7.2	INT
FLINT RIVER	HESTER CREEK 0.1	500501	Duplicate	10/22/1997	16:40		
FLINT RIVER	MOUNTAIN FORK 3.9	789102		6/24/1997	18:10	46.8	INT
FLINT RIVER	MOUNTAIN FORK 3.9	789102		7/15/1997	16:30	28.2	INT
FLINT RIVER	MOUNTAIN FORK 3.9	789102		8/19/1997	14:30	20.4	INT
FLINT RIVER	MOUNTAIN FORK 3.9	789102		9/16/1997	14:15	14.2	3840
FLINT RIVER	MOUNTAIN FORK 3.9	789102		10/21/1997	13:00	27.4	5200
FLINT RIVER	MOUNTAIN FORK 3.9	789102	Duplicate	10/22/1997	16:30		

1999 USGS Fecal Coliform Data

agency_cd	site_no	sample_dt	sample_tm	parameter_cd	result_va
USGS	357479650	1/13/1999	9:15	31625	530
USGS	357479650	2/10/1999	7:30	31625	**9400**
USGS	357479650	3/9/1999	9:30	31625	**12000**
USGS	357479650	3/16/1999	10:15	31625	200
USGS	357479650	3/24/1999	11:15	31625	210
USGS	357479650	3/30/1999	10:30	31625	240
USGS	357479650	4/7/1999	9:00	31625	280
USGS	357479650	4/14/1999	16:30	31625	98
USGS	357479650	4/20/1999	10:00	31625	260
USGS	357479650	4/26/1999	17:30	31625	1200
USGS	357479650	4/29/1999	11:00	31625	**5700**
USGS	357479650	4/29/1999	14:05	31625	**120000**
USGS	357479650	5/4/1999	10:00	31625	800
USGS	357479650	5/12/1999	11:15	31625	520
USGS	357479650	5/18/1999	11:45	31625	700
USGS	357479650	5/26/1999	8:45	31625	280
USGS	357479650	6/9/1999	9:45	31625	1100
USGS	357479650	6/23/1999	9:00	31625	650
USGS	357479650	7/1/1999	14:30	31625	**4200**
USGS	357479650	7/8/1999	13:45	31625	670
USGS	357479650	7/13/1999	16:15	31625	1200
USGS	357479650	7/27/1999	13:00	31625	290
USGS	357479650	8/3/1999	10:00	31625	720
USGS	357479650	8/11/1999	9:00	31625	260
USGS	357479650	9/8/1999	8:30	31625	160
USGS	357479650	10/12/1999	15:00	31625	130
USGS	357479650	1/13/1999	9:15	31625	530
USGS	357479650	2/10/1999	7:30	31625	9400
USGS	357479650	3/9/1999	9:30	31625	12000
USGS	357479650	3/16/1999	10:15	31625	200
USGS	357479650	3/24/1999	11:15	31625	210
USGS	357479650	3/30/1999	10:30	31625	240
USGS	357479650	4/7/1999	9:00	31625	280
USGS	357479650	4/14/1999	16:30	31625	98
USGS	357479650	4/20/1999	10:00	31625	260
USGS	357479650	4/26/1999	17:30	31625	1200
USGS	357479650	4/29/1999	11:00	31625	**5700**
USGS	357479650	4/29/1999	14:05	31625	**120000**
USGS	357479650	5/4/1999	10:00	31625	800