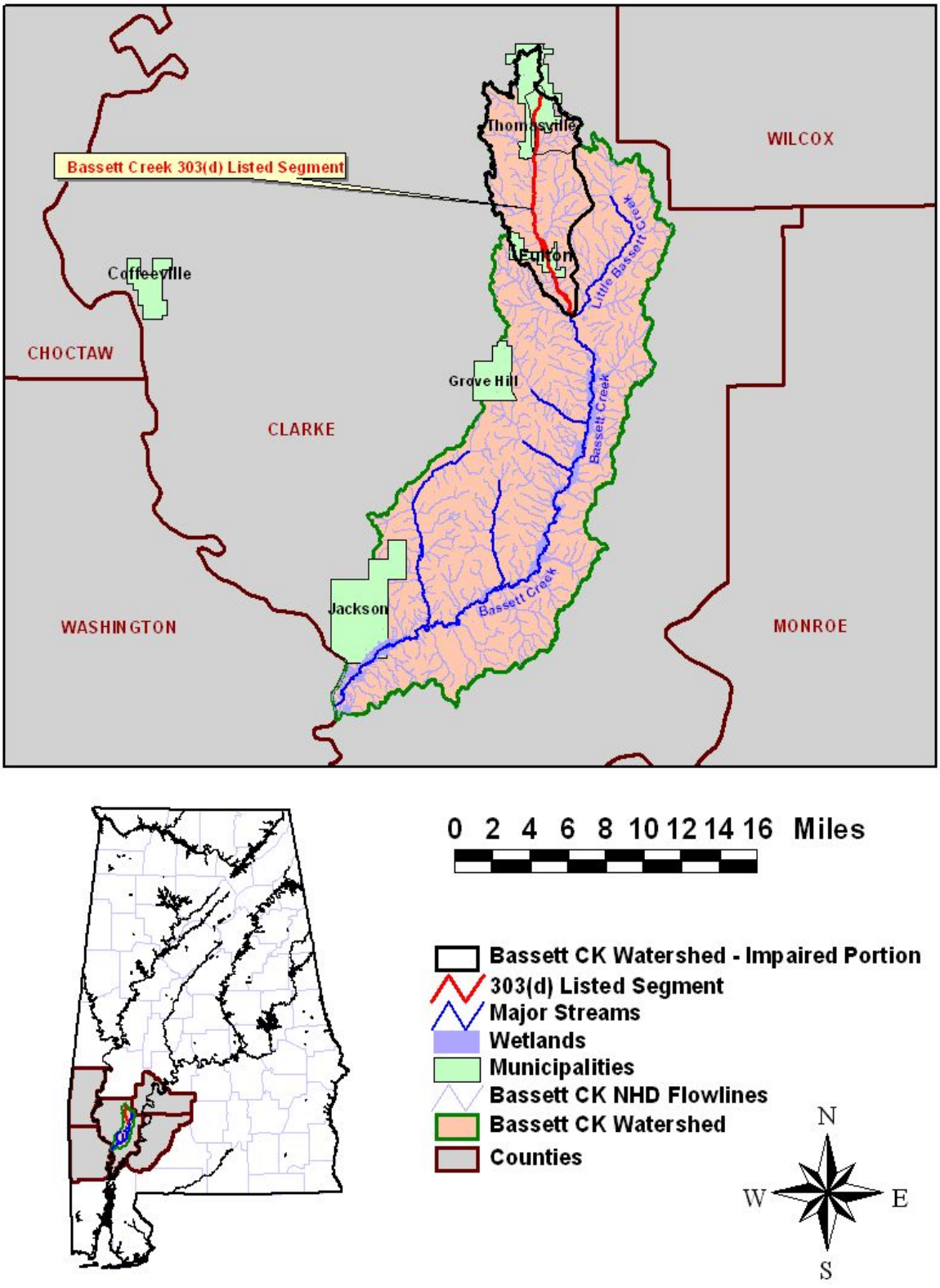
Alabama Department of Environmental Management

FINAL

Total Maximum Daily Load (TMDL)
For
Bassett Creek
Assessment Unit ID # AL03160203-0601-100
Pathogens (fecal coliform)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
September 2009

Figure 1: Bassett Creek Watershed Map



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1.0 Executive Summary

Section §303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for waterbodies that are not meeting designated uses under technology-based pollution controls. A TMDL is the maximum amount of pollutant a waterbody can assimilate while meeting water quality standards for the pollutant of concern. All TMDLs include a wasteload allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES) regulated discharges, a load allocation (LA) for all nonpoint sources, and an explicit and/or implicit margin of safety (MOS).

Bassett Creek is on the §303(d) list for pathogens (fecal coliform) from Little Bassett Creek to its source. Bassett Creek is in the Lower Tombigbee River Basin and forms in northern Clarke County within the city limits of Thomasville. Bassett Creek is a first order stream prior to Allen Branch where it becomes a second order stream. The total length of the impaired portion of Bassett Creek is 14.47 miles. The total drainage area of Bassett Creek immediately prior to Little Bassett Creek is 43.8 square miles. Bassett Creek has a use classification of Fish & Wildlife (F&W).

Data collected in 2001-2002 by the Alabama Department of Environmental Management (ADEM) indicated to both the Department and EPA that Bassett Creek was impaired for pathogens (fecal coliform). The impaired portion of Bassett Creek was first placed on the Alabama §303(d) list by ADEM in 2004 for pathogens (fecal coliform) and subsequently listed on the 2006 and 2008 Alabama §303(d) lists. ADEM collected this data from May through February during 2001 & 2002 as part of it's §303(d) Monitoring Program. During this time, eight samples were taken at each of the three stations along the reach of Bassett Creek from Little Bassett Creek to its source. Also, eight samples were taken at station BSTC-4 on Allen Branch, a tributary of the impaired portion of Bassett Creek. The data can be found in Appendix B, Table 7-1.

In 2007, a §303(d) sampling study was performed by ADEM on the impaired section of Bassett Creek for additional water quality assessment. ADEM collected fourteen samples from each of the three stations within the §303(d) listed section of the stream, six of which yielded high fecal coliform counts. According to the data collected in 2007, Bassett Creek was not meeting the pathogen (fecal coliform) criterion applicable to its use classification of Fish and Wildlife (F&W). Therefore, a TMDL will be developed for pathogens (fecal coliform) on the listed reach.

A mass balance approach was used for calculating the pathogen TMDL for Bassett Creek. The mass balance approach utilizes the conservation of mass principle. Loads are calculated by multiplying the fecal coliform concentrations by their respective instream flows. Mass loads were calculated for the highest geometric mean sample exceedance and the highest single sample exceedance. In the same manner, allowable loads were calculated for both the single sample criterion of 2000 colonies/100ml and the geometric mean criterion of 200 colonies/100ml. The TMDL was based on the violation that produced the highest percent reduction of fecal coliform necessary to achieve applicable water quality criteria, whether it is the single sample or geometric mean criterion. The existing fecal coliform loading to Bassett Creek was calculated

using the maximum geometric mean exceedance. The geometric mean criterion was utilized since it yielded a greater reduction than the single sample criterion. The target concentration, defined as the geometric mean criterion including a margin of safety, for the LA portion of the TMDL was calculated using the fecal coliform geometric mean target of 180 colonies/100 mL (200 colonies/100 mL – 10% Margin of Safety). For the WLA portion of the TMDL, the target concentration of 200 colonies/100 mL was employed since all point sources are required to not exceed this target. Reductions to meet the allowable load for the LA and WLA were then calculated by subtracting the allowable concentration from the existing concentration.

Table 1-1 is a summary of the existing loads and allowable loads required to meet the applicable water quality pathogen (fecal coliform) criterion for the impaired section of Bassett Creek. Percent reduction calculations for the other geometric mean and single sample exceedances in 2007 are shown in Table 1-2 and Appendix B, Table 7-3. Table 1-3 lists the TMDL (maximum allowable) calculations under critical conditions for Bassett Creek. Critical conditions are represented by the highest percent reduction value.

Table 1-1. 2007 Fecal Coliform Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
NPS Load Geometric Mean	9.18E+09	2.82E+09	6.36E+09	69%
Point Source	7.48E+08	1.14E+10	0	0%

Table 1-2. Percent Reduction Calculations

Station	Current Concentrations (colonies/100 ml)		Target Concentrations (colonies/100 ml)		% Reduction	
	Geometric mean	Single Sample	Geometric mean	Single Sample	Geometric mean	Single Sample
BSTC-3	586	2900	180	1800	69%	38%
BSTC-2	273	3000	180	1800	34%	40%
BSTC-1	265	3000	180	1800	32%	40%
		2800		1800		36%

Table 1-3. Fecal Coliform TMDL and Percent Reduction for Bassett Creek

TMDL	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation(LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
1.45E+10	3.13E+08	1.14E+10	NA	0	2.82E+09	69%

a. There are no CAFOs in the Bassett Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum; Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. NA = not applicable, no regulated MS4 areas. Future MS4 areas would be required to demonstrate consistency with the assumptions and requirements of this TMDL.
d. The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in fecal coliform loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for fecal coliform.

It should be noted that that there are also single sample criterion for Bassett Creek. Since the impaired section of the stream is classified as F&W, the criterion is 2000 colonies/100 mL on any single sample taken during the year. There were four exceedances of the single sample criterion which occurred at BSTC-1 on 8/22/2007 and 9/4/2007, at BSTC-2 on 9/4/2007, and at BSTC-3 on 10/10/2007.

Compliance with the terms and conditions of existing and future NPDES permits will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and may be eligible for CWA §319 grants.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria and we are committed towards targeting the load reductions to improve water quality in the Bassett Creek watershed. As additional data and/or information become available, it may become necessary to revise and/or modify the TMDL accordingly.

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 mentioned previously in the Executive Summary, Bassett Creek was placed on Alabama's §303(d) list in 2004 for pathogens (fecal coliform) as a result of data acquired in 2001 and 2002

by the Alabama Department of Environmental Management (ADEM). This TMDL addresses pathogens for the impaired portion of the watershed. The §303(d) listing was originally reported on Alabama's 2004 List of Impaired Waters, and subsequently included on the 2006 and 2008 lists. The source of the impairment is listed as municipal and urban runoff on the 2008 §303(d) list.

2.2 Problem Definition

Waterbody Impaired:	Bassett Creek from Little Bassett Creek to its source.
Waterbody Length:	14.47 miles
Waterbody Drainage Area:	43.80 square miles
Water Quality Criterion Violation:	Fecal Coliform (geometric mean & single sample)
Pollutant of Concern:	Pathogens (Fecal Coliform)
Water Use Classification:	Fish & Wildlife

Usage Related to Classification:
The impaired stream segment is classified as Fish and Wildlife (F&W). 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 Criterion:
Criterion for acceptable bacteria levels for the F&W use classification is 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 col/100 mL; nor exceed a maximum of 2,000 col/100 mL in any sample. In coastal waters, bacteria of the enterococci group shall not exceed a maximum of 275 col/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 col/100 mL in non-coastal waters. In coastal waters, bacteria of the enterococci group shall not exceed a geometric mean of 35 col/100 mL nor exceed a maximum of 158 col/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:
There has been one sampling event in 2007 on Bassett Creek since the 2001 sampling event confirmed that the stream was impaired for pathogens (fecal coliform). Data collected during the 2007 sampling event in the impaired portion of the Bassett Creek watershed resulted in multiple exceedances of the single sample criterion of 2000 colonies/100 ml and the geometric mean criterion of 200 colonies/100mL between June and September. These exceedances are shown in Table 7.2 in Appendix B. The fecal coliform exceedance event with the highest percent reduction was employed to perform the reduction analysis along the impaired segment.

3.0 TMDL Technical Basis

3.1 Water Quality Target Identification

A fecal coliform geometric mean target of 180 colonies/100 ml will be used in this TMDL for the LA. This target was derived by using a 10% explicit margin of safety from ADEM's geometric mean F&W criterion of 200 colonies/100 ml. As mentioned previously, the single sample fecal criterion was not employed as a TMDL target because all of the single sample fecal violations generated a lower percent reduction than the geometric mean fecal violation at station BSTC-3.

3.2 Source Assessment

3.2.1 Point Sources in the Impaired Portion of the Bassett Creek Watershed

A point source can be defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source contributions can typically be attributed to municipal wastewater facilities, illicit discharges, and leaking sewers in urban areas. Municipal wastewater treatment facilities are permitted through the National Pollutant Discharge Elimination System (NPDES) process administered by ADEM. In urban settings sewer lines can typically run parallel to streams in the floodplain. If there is a leaking sewer line, high concentrations of fecal coliform can flow into the stream or leach into the groundwater. Illicit discharges are facilities that are discharging fecal coliform bacteria when they are not permitted, or they are violating their defined permit limit by exceeding the fecal coliform concentration.

Continuous Point Sources

There are two point sources in the impaired portion of the Bassett Creek watershed listed in Table 3-1. The two point sources are the Thomasville HCR Lagoon & Sprayfield discharging municipal wastewater and Scotch Plywood Company discharging sanitary wastewater only. In determining what point sources were in the watershed, concentrated animal feeding operations (CAFOs) were also considered but none were identified. For the WLA portion of the TMDL, the target concentration of 200 colonies/100 mL was employed since it is a typical requirement of facilities that discharge sanitary wastewater. As a result of the 200 colonies/100 mL limit and examination of DMR data, the required reduction for the point sources was determined to be zero, and the 69% reduction in pathogens (fecal coliform) was allocated to the LA portion of the TMDL. As mentioned above, DMR data for both point sources was examined for the past six years. The daily maximum fecal DMR data for Scotch Plywood Company was the only credible data to determine if the company was in violation of exceeding fecal coliform limits because most of the time only one sample was taken during the month; therefore, the geometric mean criterion would not apply, only the single sample criterion of 2000 col/100 mL. Examining Scotch Plywood Company's daily maximum DMR data, it was determined that the company only had one single sample criterion violation since January 2002. This violation occurred in May 2002 with a fecal coliform count of 2,832 col/100mL. Analyzing DMR data for the Thomasville HCR Lagoon, it was found that the municipal wastewater facility's last known fecal coliform violation was in July 2005 with seventeen violations occurring between March 2002 and July 2005. The Thomasville HCR Lagoon was issued a Consent Order from ADEM in 2005 for several parameter violations including fecal coliform that occurred between January 2003 and October 2004. Apparently, action was taken by the facility to improve the quality of its effluent because, as mention previously, it has not received a violation for fecal coliform since July 2005.

Any future NPDES regulated discharges that are considered by the Department to be a pathogen source will be required to meet the instream water quality criteria for pathogens at the point of discharge.

Table 3-1. Point Sources in the Impaired Portion of the Bassett Creek Watershed

Facility	NPDES Permit Number	Discharge Type	Design/5-yr Avg. Flow (MGD)	Receiving Stream	Latitude	Longitude
Thomasville HCR Lagoon & Sprayfield	AL0056022	Municipal Wastewater	1.5	Bassett Creek	31.8447	-87.7425
Scotch Plywood Company	AL0001902	Sanitary Wastewater	0.003	Bassett Creek	31.7958	-87.7300

Non-Continuous Point Sources

Currently there are no Municipal Separate Stormwater Sewer System (MS4) areas located within the Bassett Creek watershed.

Sanitary sewer overflows (SSOs) have the potential to severely impact water quality and can often result in the violation of water quality standards. It is the responsibility of the NPDES wastewater discharger, or collection system operator for non-permitted "collection only" systems, to ensure that releases do not occur. Unfortunately releases to surface waters from SSOs are not always preventable or reported. From review of ADEM's SSO database, six reported SSOs have occurred in the impaired portion of the Bassett Creek watershed between 2007 and 2009. All of the SSOs occurred along pipes pumping sewage to the Thomasville HCR Lagoon.

Future NPDES regulated stormwater discharges will be required to demonstrate consistency with the assumptions and requirements of this TMDL.

3.2.2 Nonpoint Sources in the Impaired Portion of the Bassett Creek Watershed

Nonpoint sources of fecal coliform bacteria do not have a defined discharge point, but rather, occur over the entire length of a stream or waterbody. On the land surface, fecal coliform bacteria can accumulate over time in the soil and then are washed off during rain events. As the runoff transports the sediment over the land surface, more fecal coliform bacteria are collected and carried to the stream or waterbody. Therefore, there is some net loading of fecal coliform bacteria into the stream as dictated by the watershed hydrology.

Agricultural land can be a source of fecal coliform bacteria. Runoff from pastures, animal feeding areas, improper land application of animal wastes, and animals with direct access to streams are all mechanisms that can contribute fecal coliform bacteria to waterbodies. To account for the potential influence from animals with direct access to stream reaches in the watershed, fecal coliform loads can be calculated as a direct source into the stream.

Fecal coliform bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, turkey, waterfowl, etc. Wildlife deposit feces onto land surfaces where it

can be transported during rainfall events to nearby streams. 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.

Fecal coliform loading from urban areas is potentially attributable to multiple sources including storm water runoff, illicit discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, and domestic animals. Septic systems are common in unincorporated portions of the watershed and may be direct or indirect sources of bacterial pollution via ground and surface waters. Onsite septic systems have the potential to deliver fecal coliform bacteria to surface waters due to system failure and malfunction.

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

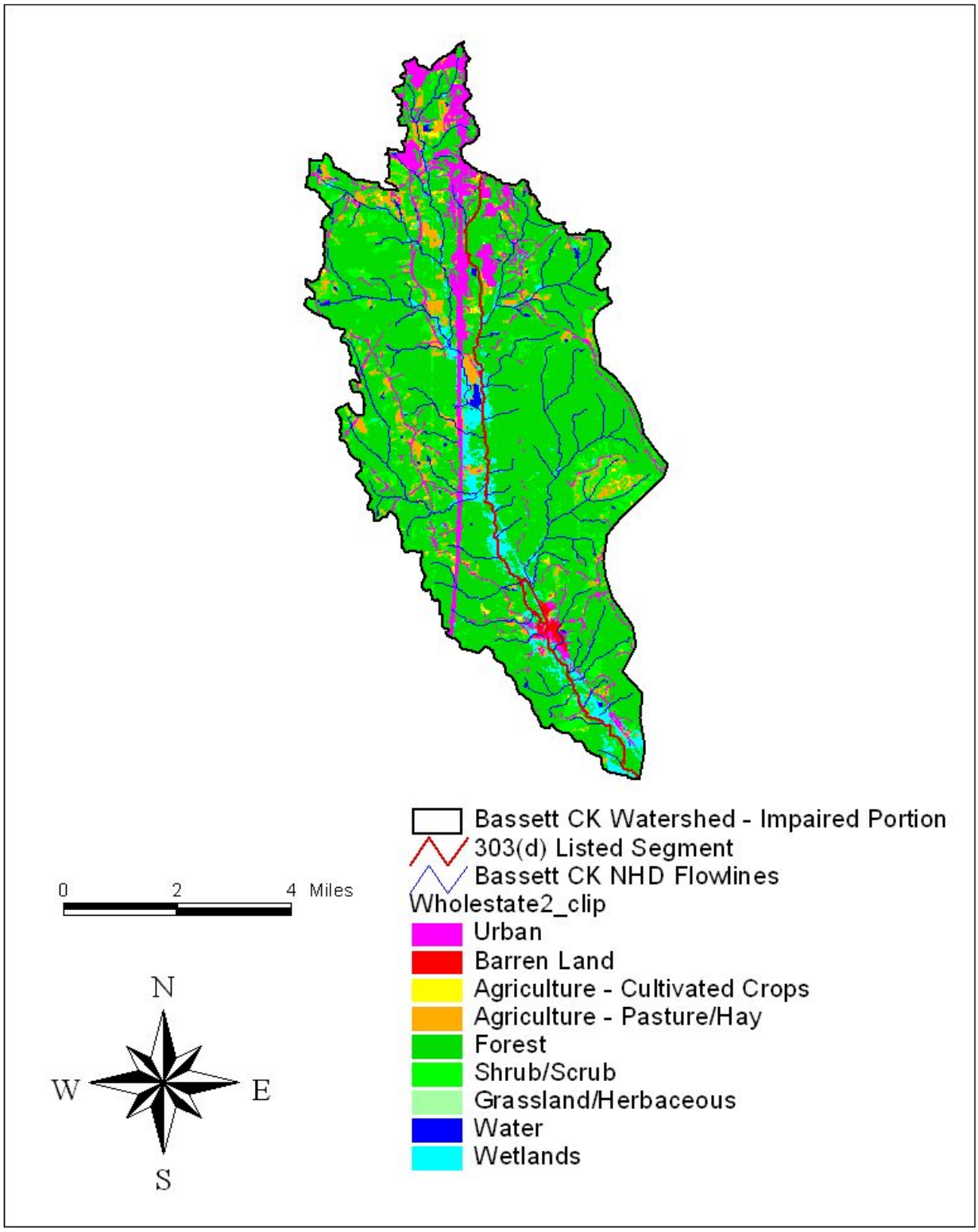
Table 3-2 provides the various landuses (and their associated percentages) for the impaired portion of the Bassett Creek watershed. Figure 3.1 is a landuse map of the impaired portion of the Bassett Creek watershed. The detailed landuse for this watershed was determined using ArcView with landuse information derived from the 2001 National Land Cover Dataset (NLCD). Table 3-2 also breaks the watershed landuse into four (4) main categories; Forest: 67.56%, Developed: 9.36%, Agriculture: 5.80%, and Other: 17.27%. The “other” category consists of everything not included as forest, developed, or agriculture from the main landuse table.

Table 3-2. Landuse in the impaired portion of the Bassett Creek Watershed

Land Use	Acres	Sq. Miles	Percent
Open Water	166	0.26	0.59%
Developed, Open Space	2,041	3.19	7.29%
Developed, Low Intensity	304	0.47	1.09%
Developed, Medium Intensity	205	0.32	0.73%
Developed, High Intensity	70	0.11	0.25%
Barren Land (Rock/Sand/Clay)	90	0.14	0.32%
Deciduous Forest	3,317	5.18	11.85%
Evergreen Forest	9,498	14.84	33.93%
Mixed Forest	6,096	9.53	21.78%
Shrub/Scrub	3,082	4.81	11.01%
Grassland/Herbaceous	11	0.02	0.04%
Pasture/Hay	1,474	2.30	5.26%
Cultivated Crops	151	0.24	0.54%
Woody Wetlands	1,463	2.29	5.23%
Emergent Herbaceous Wetlands	23	0.04	0.08%
Total	**27,990**	**43.73**	100.00%

Grouped Landuses	Acres	Sq. Miles	Percent
Agriculture	1,624	2.54	5.80%
Forest	18,911	29.55	67.56%
Developed	2,620	4.09	9.36%
Other	4,835	7.56	17.27%
Total	**27,990**	**43.73**	100.00%

Figure 3.1: Landuse Map of the Impaired Portion of the Bassett Creek Watershed



3.4 Linkage between Numeric Targets and Sources

As can be seen from an inspection of the landuse table, the impaired portion of the Bassett Creek watershed has three major landuses – forest, developed, and agriculture (manly pasture observed during the site visit). Pollutant loadings from forested areas tend to be low due to their filtering capabilities. The most likely sources of pathogen loadings near the source (Thomasville) and at the end (Fulton) of the impaired portion of Bassett Creek are urban runoff from residential and commercial developed areas, SSOs, and failing septic systems. See Figures 7-1 through 7-5 in Appendix C of photos in Thomasville at the source of Bassett Creek taken during the April 2007 site visit that might contribute to pathogen loading during a heavy rain event. On the other hand, the most likely sources of pathogen loadings along the impaired portion of Bassett Creek downstream of Thomasville but upstream of Fulton are failing septic systems and pastureland with livestock present. Please refer to Figures 7-6 through 7-10 in Appendix C for pictures of pastureland along the impaired reach littered with livestock fecal matter. Since the impaired portion of the Bassett Creek watershed has a relatively small drainage area (less than 50 square miles), it was not considered practicable to calculate individual components for nonpoint source (NPS) loadings. Hence, there will not be individual loads or reductions calculated from different sources such as forest, agriculture, and septic systems. The loadings and reductions will only be calculated as a single total NPS load. It is envisioned that the pathogen sources can be better defined during the implementation process.

3.5 Data Availability and Analysis

There are three studies that can be employed as data sources for the impaired portion of the Bassett Creek watershed. The first study is ADEM's 2001 NPS Screening Assessment of the Escatawpa, Mobile Bay, and Upper and Lower Tombigbee River basins. All four stations (BSTC-1, BSTC-2, BSTC-3, and BSTC-4) were included in this study. Data consisted of chemical parameters, biological parameters, and a habitat assessment.

More recent data obtained in the watershed comes from monthly §303(d) monitoring by ADEM in 2001 and 2002. Monthly §303(d) stations are identified as BSTC-1 through 4. It is the data from this study that provided ADEM evidence to place Bassett Creek from Little Bassett Creek to its source on the 2004 §303(d) list.

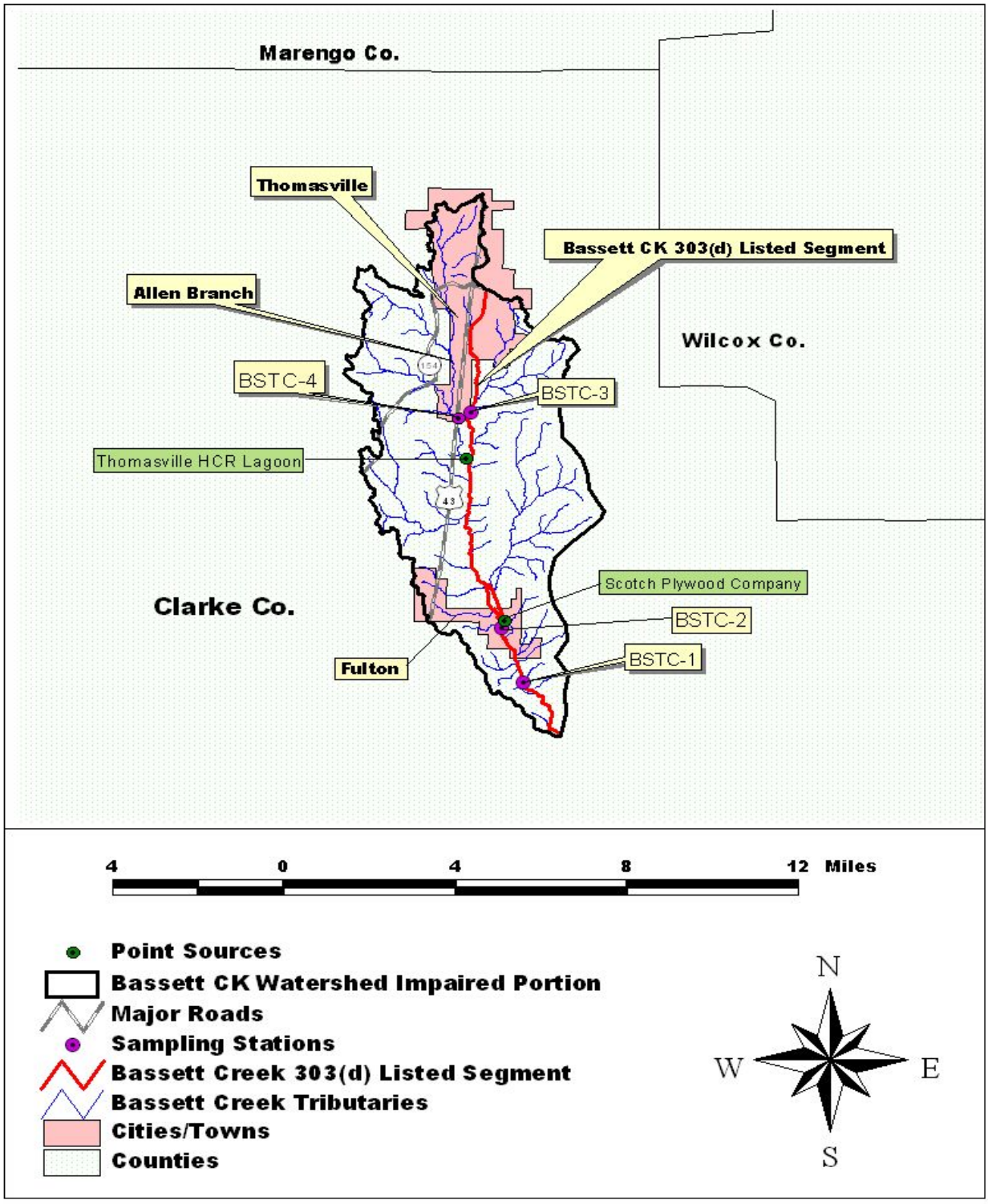
In 2007, monthly §303(d) monitoring along with intensive fecal surveys were performed from March through October. The monthly §303(d) data was compared with the single sample year-round criterion of 2000 colonies/100 mL. There were three violations of the F&W single sample criterion of 2000 colonies/100 mL. The intensive fecal surveys were also compared to the F&W June through September geometric mean criterion of 200 colonies/100 mL and the F&W October through May geometric mean criterion of 1,000 colonies/100 mL to determine if enough data was collected to perform geometric mean estimates. There were three violations of the F&W June through September geometric mean criterion of 200 colonies/100 mL. It is this data that resulted in the assessment that Bassett Creek from Little Bassett Creek to its source was still not supporting its F&W use classification with respect to pathogens (fecal coliform). Section 4.8.2 of ***Alabama's Water Quality Assessment and Listing Methodology*** provides the Department's rationale to use the most recent data to prepare a TMDL for an impaired

waterbody when that data indicates a change in water quality has occurred. Fecal coliform data for the 2001 through 2002 monthly §303(d) monitoring study and the 2007 monthly §303(d) monitoring and intensive fecal surveys can be found in Table 7-1 and Table 7-2, respectively, in Appendix B.

Table 3-3. Sampling Station Location Descriptions

Years	Station ID	Data Source	Station Location	Latitude	Longitude
2001, 2002, 2007	BSTC-1	ADEM	Bassett Creek at Clarke Co. Rd. 27 south of Fulton.	31.7676	-87.7200
2001, 2002, 2007	BSTC-2	ADEM	Bassett Creek at AL Hwy 178 in Fulton.	31.7872	-87.7283
2001, 2002, 2007	BSTC-3	ADEM	Bassett Creek at Rural Road	31.8659	-87.7415
2001, 2002, 2007	BSTC-4	ADEM	Alllen Branch at AL Hwy 43	31.8641	-87.7471

Figure 3.2: Sampling Stations and Point Sources in the Impaired Portion of the Bassett Creek Watershed



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 the winter months, 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 impaired portion of the Bassett Creek watershed generally follows the trends described above for the summer months of June through September. The critical condition for this pathogen TMDL was taken to be the one with the highest fecal geometric mean exceedance value because it gave the highest percent reduction (see Table 7.3). That value was 586 colonies/100 mL and occurred in June and July of 2007 at station BSTC-3.

It should be noted that two (2) other §303(d) sampling events exceeded the fecal geometric mean criterion of 200 colonies/100 mL. One occurred at BSTC-2 between June and July 2007 with a value of 273 colonies/100 mL. The other occurred at BSTC-1 between August and September 2007 with a geometric mean concentration of 265 colonies/100 mL. There was no accompanying flow measurement.

Also four (4) other §303(d) sampling events exceeded the single sample criterion of 2000 colonies/100 mL. One occurred at BSTC-3 on 10/10/2007 with a value of 2,900 colonies/100 mL. The second single sample exceedance occurred at BSTC-2 on 9/4/2007 with a measured concentration of 3,000 colonies/100 mL. The final two single sample exceedances occurred at BSTC-1 on 8/22/2007 and 9/4/2007, respectively. On 8/22/2007 the fecal concentration was measured at 2,800 colonies/100 mL and on 9/4/2007 the fecal concentration was measured at 3,000 colonies/100 mL. Please refer to the Percent Reduction Calculation's table (Table 7-3 in Appendix B) for a summary of the aforementioned information.

As previously mentioned, the geometric mean exceedance of 586 colonies/100 mL will be used in the TMDL calculation because it gave the highest percent reduction.

3.7 Margin of Safety (MOS)

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. The summer geometric mean criterion was reduced by ten percent to achieve the LA target concentration of 180 colonies/100 mL.

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 TMDL Calculations

A mass balance approach was used to calculate the pathogen TMDL for Bassett 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.

Existing Conditions

The geometric mean mass loading was calculated by multiplying the geometric mean sample exceedance concentration of 586 colonies/100 ml times the average flow for all five of the fecal coliform measurements. This concentration was calculated based on measurements at BSTC-3 on June 28 and July 10, 12, 17, 25, 2007, and can be found in Table 7-2, Appendix B. The average stream flow, determined by a flowmeter, for these five sampling events was 0.64 cfs. The product of these two values and a conversion factor gives the LA component mass loading of fecal coliform to Bassett Creek under geometric mean exceedance conditions.

$$\frac{0.64\,\text{ft}^3}{\text{s}} \times \frac{586\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{9.18 \times 10^9\ \text{colonies}}{\text{day}}$$

The WLA component of mass loading to Bassett Creek represents the loading allowable from NPDES point sources in the watershed. Since the exceedance condition is based on the July 2007 conditions, the loading from NPDES point sources in July 2007 must be determined. A list of NPDES permitted point sources that discharge within the Bassett Creek watershed is located in Table 3-1. The two facilities are Thomasville HCR Lagoon & Sprayfield and Scotch Plywood Company. In July 2007, the Thomasville HCR Lagoon & Sprayfield was not discharging to surface water so more recent discharge monitoring report (DMR) data was examined, and a discharge flow to surface water and fecal coliform concentration from May 2009 was obtained.

Therefore, the flow and fecal coliform concentration from May 2009 will be used as a surrogate to represent the facility's existing conditions during the violation period in July 2007.

WWTP loading during the violation period in July 2007 includes two NPDES permitted point sources, Scotch Plywood Company and Thomasville HCR Lagoon & Sprayfield. The DMR for July 2007 for Scotch Plywood Company shows an average flowrate of 0.0001 million gallons per day (MGD) and an average fecal coliform concentration of 72 colonies/100 mL. The mass loading from Scotch Plywood Company during July 2007 was calculated as follows:

$$\frac{100\,\text{gal}}{\text{day}} \times \frac{3785.41\,\text{mL}}{\text{gal}} \times \frac{72\ \text{colonies}}{100\,\text{mL}} = \frac{2.73\times10^{5}\ \text{colonies}}{\text{day}}$$

The May 2009 DMR used as a surrogate to represent July 2007 conditions for the Thomasville HCR Lagoon & Sprayfield shows an average flowrate of 0.267 million gallons per day (MGD) and an average fecal coliform concentration of 74 colonies/100 mL. The mass loading from Thomasville HCR Lagoon & Sprayfield during July 2007 was calculated as follows:

$$\frac{267{,}000\,\text{gal}}{\text{day}} \times \frac{3785.41\,\text{mL}}{\text{gal}} \times \frac{74\ \text{colonies}}{100\,\text{mL}} = \frac{7.48\times10^{8}\ \text{colonies}}{\text{day}}$$

The total mass loading from WWTPs to the impaired portion of Bassett Creek during July 2007 was determined by adding the mass loadings calculated for Scotch Plywood Company and Thomasville HCR Lagoon & Sprayfield.

$$\frac{2.73\times10^{5}\text{colonies}}{\text{day}} + \frac{7.48\times10^{8}\ \text{colonies}}{\text{day}} = \frac{7.48\times10^{8}\ \text{colonies}}{\text{day}}$$

Allowable Conditions

The allowable load to the watershed was calculated under the same conditions as discussed above for the geometric mean criterion. This is done by taking the product of the flow of 0.64 cfs used for the violation event times the conversion factor times the allowable LA concentration as shown below:

For the geometric mean fecal concentration of 180 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{0.64\text{ft}^3}{\text{s}} \times \frac{180\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL}*\text{s}}{\text{ft}^3*\text{day}} = \frac{2.82\times10^{9}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 20 colonies/100 mL equals a daily loading of:

$$\frac{0.64\,\text{ft}^3}{\text{s}} \times \frac{20\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL}*\text{s}}{\text{ft}^3*\text{day}} = \frac{3.13\times10^{8}\ \text{colonies}}{\text{day}}$$

The allowable WLA component mass loading to Bassett Creek was also calculated under the same conditions as discussed above for the geometric mean criterion. For Scotch Plywood Company, this is done by multiplying the permitted wasteflow of 0.003 MGD with the monthly average effluent fecal coliform concentration of 200 colonies/100 mL and a conversion factor.

For the geometric mean fecal concentration of 200 colonies/100 mL. The allowable fecal coliform loading for Scotch Plywood Company is:

$$\frac{3000\,\text{gal}}{\text{day}} \times \frac{3785.41\,\text{mL}}{\text{gal}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} = \frac{2.27 \times 10^{7}\ \text{colonies}}{\text{day}}$$

For Thomasville HCR Lagoon & Sprayfield, this is done by multiplying the permitted wasteflow of 1.5 MGD with the monthly average effluent fecal coliform concentration of 200 colonies/100 mL and a conversion factor.

For the geometric mean fecal concentration of 200 colonies/100 mL, the allowable fecal coliform loading for Thomasville HCR Lagoon & Sprayfield is:

$$\frac{1.50 \times 10^{6}\ \text{gal}}{\text{day}} \times \frac{3785.41\,\text{mL}}{\text{gal}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} = \frac{1.14 \times 10^{10}\ \text{colonies}}{\text{day}}$$

Therefore, the allowable WLA component mass loading to Bassett Creek from Scotch Plywood Company and Thomasville HCR Lagoon & Sprayfield is:

$$\frac{2.27 \times 10^{7}\text{colonies}}{\text{day}} + \frac{1.14 \times 10^{10}\ \text{colonies}}{\text{day}} = \frac{1.14 \times 10^{10}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety does not apply to the WLA since 200 colonies/100 mL is a permitted value.

The difference in the pathogen loading between the existing conditions (violation event) and the allowable conditions converted to a percent reduction represents the total load reduction needed to achieve the fecal coliform water quality criterion. The TMDL was calculated as the total daily fecal coliform load to Bassett Creek as evaluated at station BSTC-3. Table 4-1 illustrates the 2007 Existing and Allowable Fecal Coliform loads and Required Reduction of pathogens (fecal coliform) in the impaired segment of Bassett Creek for each criterion.

Table 4-1. 2007 Fecal Coliform Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
NPS Load Geometric Mean	9.18E+09	2.82E+09	6.36E+09	69%
Point Source	7.48E+08	1.14E+10	0	0%

Since point sources are present in the impaired portion of the Bassett Creek watershed, the fecal coliform allocation is allotted to all three of the TMDL components (i.e., the WLA, the LA, and the MOS). The WLA geometric mean criterion is based on ADEM Admin. Code R. 335-6-10-.09(5)(e)7(ii) and is therefore set at 200 colonies/100mL while the LA component is equal to 180 colonies/100 mLs with a MOS of 20 colonies/100 mL. Table 4-2 lists required TMDL pathogen loadings under critical conditions for Bassett Creek.

Table 4-2. Fecal Coliform TMDL and Percent Reduction for Bassett Creek

TMDL	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation(LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
1.45E+10	3.13E+08	1.14E+10	NA	0	2.82E+09	69%

a. There are no CAFOs in the Bassett Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum; Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. NA = not applicable, no regulated MS4 areas. Future MS4 areas would be required to demonstrate consistency with the assumptions and requirements of this TMDL.
d. The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in fecal coliform loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for fecal coliform.

4.3 TMDL Summary

Bassett Creek was placed on Alabama's §303(d) list in 2004 based on data collected by ADEM from 2001 through 2002. In 2007, ADEM collected additional water quality data which confirmed the pathogen impairment and provided the basis for TMDL development. A mass balance approach was used to calculate the fecal coliform TMDL for Bassett Creek. Based on the TMDL analysis, it was determined that a 69% reduction in fecal coliform loading was necessary to achieve compliance with applicable water quality standards.

Compliance with the terms and conditions of existing and future NPDES sanitary and stormwater permits will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and may be eligible for CWA §319 grants.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria and we are committed towards targeting the load reductions to improve water quality in the Bassett Creek watershed. As additional data and/or information become available, it may become necessary to revise and/or modify the TMDL accordingly.

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. ADEM's Major River Basin Sampling Schedule

River Basin Group	Year to be Monitored
Tennessee	2009
Alabama / Coosa / Tallapoosa	2010
Escatawpa / Mobile / Lower Tombigbee / Upper Tombigbee	2011
Black Warrior/Cahaba	2012
Chattahoochee / Chipola / Choctawhatchee / Perdido-Escambia	2013

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 cljohnson@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.

Appendices

Appendix A
References

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*.

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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.

U.S. Geological Survey. 1985. *Drainage Areas for the Lower Tombigbee River Basin in Alabama*, Water Resources Division.

Appendix B
Water Quality Data

Table 7-1. 2001-2002 ADEM §303(d) Monitoring Data (Listing Data)

Station ID	Date	Comments	Fecal Coliform (col/100ml)	Fecal Coliform oor	Flow (cfs)
BSTC-1	5/23/2001	Access at bridge was impossible. Local Police Chief showed us another access point where creek could be sampled but depth at that point was too deep to take flow.	1690	GDL	
BSTC-1	6/27/2001	Flow was not taken due to depth and velocity of stream.	520		
BSTC-1	7/31/2001		13	Est	8.7
BSTC-1	9/5/2001		810	GDL	6.0
BSTC-1	10/3/2001		1130		2.2
BSTC-1	11/26/2001		610		3.6
BSTC-1	1/9/2002		100	Est	2.0
BSTC-1	2/25/2002		140		2.2
BSTC-2	5/23/2001		620	GDL	7.1
BSTC-2	6/21/2001	Conductivity meter malfunctioned. Therefore no readings were taken on this trip.	470		18.4
BSTC-2	7/31/2001	***VIOLATION***	7700	GDL	4.0
BSTC-2	9/5/2001	Noticed a sewage odor and flow was higher than normal.	1300		6.2
BSTC-2	10/3/2001		800		1.2
BSTC-2	11/26/2001		830		4.0
BSTC-2	1/9/2002		120	Est	2.3
BSTC-2	2/25/2002		210		1.6
BSTC-3	5/23/2001	Creek had trash and debris on both sides of bridge that caused a back flush. No noticeable flow through creek.	150		
BSTC-3	6/20/2001	Meter malfunction, no conductivity measurement taken.	950	GDL	0.4

Table 7-1. 2001-2002 ADEM §303(d) Monitoring Data (Listing Data)-Continued

Station ID	Date	Comments	Fecal Coliform (col/100ml)	Fecal Coliform oor	Flow (cfs)
BSTC-3	7/31/2001	Lots of debris. Satellite dish, sofa, household garbage, etc.	420		0.6
BSTC-3	9/5/2001	Accumulation of debris in creek. Picture taken of trash and garbage that may be affecting flow.	220		0.3
BSTC-3	10/3/2001	Creek is filled with debris and trash. No flow visible.	77	Est	
BSTC-3	11/26/2001	Dead hog upstream and gutted dear downstream.	440		
BSTC-3	1/8/2002	Garbage and debris throughout creek no measurable flow.	200		
BSTC-3	2/25/2002	No visible flow	440		
BSTC-4	5/23/2001	No flow requested.	5800	GDL	
BSTC-4	6/21/2001	No flow requested. Conductivity meter malfunction no readings taken.	290		
BSTC-4	7/31/2001	No flow requested.	140		
BSTC-4	9/5/2001	No flow requested	1330		
BSTC-4	10/3/2001	No flow requested.	100	Est	
BSTC-4	11/26/2001	No flow requested	1570		
BSTC-4	1/8/2002	No flow requested.	230		
BSTC-4	2/25/2002	No flow requested	160		

GDL = Greater than detection limits.
H = Sample holding time was exceeded.
Est = Estimate

Table 7-2. 2007 ADEM §303(d) Monitoring Data

Station ID	Date	Fecal Coliform (colonies/100ml)	Fecal Coliform oor	Geometric Mean	Stream Flow (cfs)	Violation
BSTC-1	3/26/2007	140			14.5	NO
BSTC-1	4/18/2007	220			61.7	NO
BSTC-1	5/23/2007	46			1.6	NO
BSTC-1	6/27/2007	500		142	9.5	NO
BSTC-1	7/9/2007	160			7.7	
BSTC-1	7/11/2007	110			4.2	
BSTC-1	7/16/2007	80			3.1	
BSTC-1	7/24/2007	82			10.7	
BSTC-1	8/22/2007	3000	GDL	265	No Flow	YES (Geometric mean & Single Sample Criteria)
BSTC-1	8/29/2007	44			No Flow	
BSTC-1	9/4/2007	2800			5.2	
BSTC-1	9/10/2007	63			No Flow	
BSTC-1	9/18/2007	56			No Flow	
BSTC-1	10/9/2007	88			No Flow	NO
BSTC-2	3/26/2007	170			11.3	NO
BSTC-2	4/18/2007	86			59.1	NO
BSTC-2	5/23/2007	210			1	NO
BSTC-2	6/27/2007	580		273	7.1	YES (Geometric mean Criterion)
BSTC-2	7/9/2007	240			7.4	
BSTC-2	7/11/2007	360			4.8	
BSTC-2	7/16/2007	80	Est		3.8	
BSTC-2	7/24/2007	380			8.8	
BSTC-2	8/22/2007	76		196	0.1	YES (Single Sample Criterion)
BSTC-2	8/29/2007	70			0.2	
BSTC-2	9/4/2007	3000	GDL		6.7	
BSTC-2	9/10/2007	46			0.6	
BSTC-2	9/18/2007	390			0.6	
BSTC-2	10/9/2007	48			0.6	NO
BSTC-3	3/27/2007	100			1.5	NO
BSTC-3	4/19/2007	220			5.3	NO
BSTC-3	5/24/2007	12			0.3	NO
BSTC-3	6/28/2007	520		586 (0.64 cfs)	0.7	YES (Geometric mean Criterion)
BSTC-3	7/10/2007	270			0.9	
BSTC-3	7/12/2007	470			0.6	
BSTC-3	7/17/2007	1500			0.5	
BSTC-3	7/25/2007	700	H		0.5	
BSTC-3	8/23/2007	2		34	No Flow	NO
BSTC-3	8/30/2007	200			0.1	
BSTC-3	9/5/2007	190			0	
BSTC-3	9/11/2007	16			0	
BSTC-3	9/19/2007	37			0.2	

Table 7-2. 2007 ADEM §303(d) Monitoring Data - Continued

Station ID	Date	Fecal Coliform (colonies/100ml)	Fecal Coliform oor	Geometric Mean	Stream Flow (cfs)	Violation
BSTC-3	10/10/2007	2900			0	YES (Single Sample Criterion)
BSTC-4	3/27/2007	1400			3.3	NO
BSTC-4	4/19/2007	150			7.1	NO
BSTC-4	5/24/2007	110			0.13	NO
BSTC-4	6/28/2007	140	JH		0.66	
BSTC-4	7/10/2007	290			0.41	
BSTC-4	7/12/2007	290		187	0.18	NO
BSTC-4	7/17/2007	260			0.14	
BSTC-4	7/25/2007	74			0.34	
BSTC-4	8/23/2007	4			0.02	
BSTC-4	8/30/2007	62			0.14	
BSTC-4	9/5/2007	24	E	26	0.43	NO
BSTC-4	9/11/2007	30			1.9	
BSTC-4	9/19/2007	68			0.19	
BSTC-4	10/10/2007	48			0.11	NO

Table 7-3. Percent Reduction Calculations

Station	Current Concentrations (colonies/100 ml)		Target Concentrations (colonies/100 ml)		% Reduction	
	Geometric mean	Single Sample	Geometric mean	Single Sample	Geometric mean	Single Sample
BSTC-3	586	2900	180	1800	69%	38%
BSTC-2	273	3000	180	1800	34%	40%
BSTC-1	265	3000	180	1800	32%	40%
		2800		1800		36%

Table 7-4. Sampling Station Locations

Years	Station ID	Data Source	Station Location	Latitude	Longitude
2001, 2002, 2007	BSTC-1	ADEM	Bassett Creek at Clarke Co. Rd. 27 south of Fulton.	31.7676	-87.7200
2001, 2002, 2007	BSTC-2	ADEM	Bassett Creek at AL Hwy 178 in Fulton.	31.7872	-87.7283
2001, 2002, 2007	BSTC-3	ADEM	Bassett Creek at Rural Road	31.8659	-87.7415
2001, 2002, 2007	BSTC-4	ADEM	Alllen Branch at AL Hwy 43	31.8641	-87.7471

Appendix C
Photos from Site Visit

Figure 7-1: Downtown Thomasville

Figure 7-2: Downtown Thomasville

Figure 7-3: Downtown Thomasville

Figure 7-4: Downtown Thomasville

Figure 7-5: Cloudy Water in Bassett Creek in Downtown Thomasville

Figure 7-6: Downstream View of Bassett Creek at Pastureland Immediately Downstream of the Thomasville HCR Lagoon

Figure 7-7: Livestock Fecal Matter at Pasture Immediately Downstream of Thomasville HCR Lagoon

Figure 7-8: Fecal Matter on Pastureland along Bassett Creek

Figure 7-9: Fecal Matter on Bridge Crossing Bassett Creek at the Same Pastureland

Figure 7-10: Same Pastureland-Bassett Creek is on the Left (No Fence to Prevent Livestock from Accessing the Stream)