FINAL

Total Maximum Daily Load (TMDL)
for
East Bolton Branch
Assessment Unit ID # AL03160205-0202-300
Pathogens (fecal coliform)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
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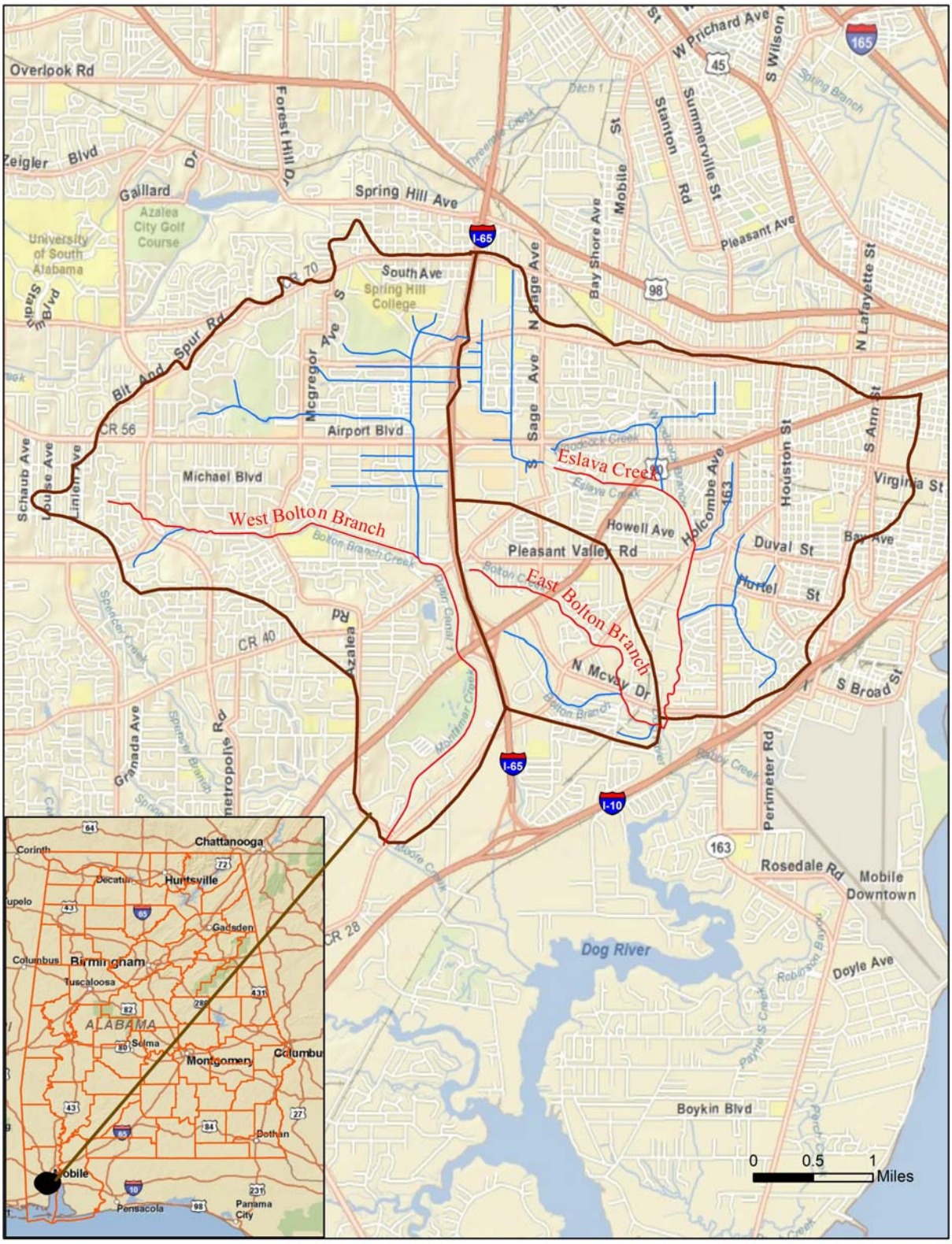
Figure I. §303(d) Listed Portion of East Bolton Branch



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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).

Bolton Branch was originally placed on the 2004 §303(d) list. After additional evaluation of the waterbody it was determined that with the building of Interstate 65, Bolton Branch had been rerouted approximately mid distance of its length. Now there are two distinct watersheds which will be referred to as West Bolton Branch, and East Bolton Branch separated by Interstate 65. A correction was made to the 2006 §303(d) list to reflect the above. The current §303(d) list, does not list East or West in the "Waterbody Name" but for clarification this TMDL report will. A separate TMDL and report will be developed for West Bolton Branch and East Bolton Branch.

A fecal coliform TMDL was developed for the impaired segment of East Bolton Branch located in the Mobile River basin just west of downtown Mobile, Alabama. East Bolton Branch was originally placed on Alabama's 2004 §303(d) list of impaired waters for pathogens based on data collected by the Mobile Area Water and Sewer Service (MAWSS) in 2003. According to the 2008 §303(d) list, East Bolton Branch is impaired for pathogens from Dog River to its source, a distance of approximately 2.44 miles. The designated use classification of East Bolton Branch is Fish and Wildlife (F&W). The East Bolton Branch watershed is characterized as being highly urban and has a drainage area of 2.34 square miles. The entire East Bolton Branch watershed is within the boundary of the Mobile Area Phase I MS4 (ALS000002). ADEM records indicate there are no active NPDES continuous sources in the East Bolton Branch watershed that are regulated under the NPDES program. However, the East Bolton Branch watershed qualifies as a Municipal Separate Stormwater Sewer System (MS4) area and must be addressed in the TMDL as part of the Wasteload Allocation (WLA).

A mass balance approach was used to calculate the fecal coliform TMDL for East Bolton Branch. The mass balance approach utilizes the conservation of mass principle. Total existing mass loads were calculated by multiplying the fecal coliform concentration times the corresponding stream flow. 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 loads necessary to achieve applicable water quality criteria, whether it be the single sample or geometric mean criterion.

Table 1-1 shows the results of the fecal coliform TMDL and percent reductions for each criterion.

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 Single Sample	3.50E+13	2.03E+12	3.30E+13	94%
NPS Load Geomean	3.69E+11	1.50E+10	3.54E+11	96%
Point Source	NA	NA	NA	NA

From Table 1-1, compliance with the geometric mean criterion of 200 colonies/100ml requires the greatest reduction in fecal coliform load. Therefore the TMDL will be based on the geometric mean criterion. The TMDL values for the geometric mean criterion are provided in Table 1-2 below.

Table 1-2. Fecal Coliform TMDL and Percent Reductions for East Bolton Branch

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)
1.66E+10	1.66E+9	NA	96%	0	1.50E+10	96%

a. There are no CAFOs in the East Bolton Branch watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum; NA = not applicable, no point sources. Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. 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.

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 East Bolton Branch watershed. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL accordingly.

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 waterbody. 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 2.44 mile segment of East Bolton Branch from Dog River to its source in Mobile County as being impaired by pathogens (fecal coliform). 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 urban runoff/storm sewers on the 2008 §303(d) list.

2.2 Problem Definition

Waterbody Impaired:	East Bolton Branch from Dog River to its source.
Waterbody Length:	2.44 miles
Waterbody Drainage Area:	2.34 square miles
Water Quality Standard Violation:	Fecal Coliform (single sample)
Pollutant of Concern:	Pathogens (fecal coliform)
Water Use Classification:	Fish and Wildlife

Usage Related to Classification:
The impaired segment of East Bolton Branch 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:
The original listing for East Bolton Branch was based on 5 of 40 fecal coliform samples, collected by the MAWSS exceeding the single sample maximum criterion of 2000 colonies/100 mL in year 2003. MAWSS was required to collect this data through a Consent Decree with Alabama Department of Environmental Management (ADEM). MAWSS collected data on East Bolton Branch from 2003 through 2007. In addition, ADEM sampled East Bolton Branch at multiple locations in 2007. The ADEM data showed multiple violations of the single sample maximum criterion and geometric mean criterion. These data are included in the Appendix 7.2.

Water quality data collected by MAWSS in 2003 was used for listing East Bolton Branch on Alabama's 2004 §303(d) list. At the time of the listing, 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 were considered to comply with Alabama's water quality standard for fecal coliform bacteria. Geometric mean samples comprised of a least 5 samples collected over a thirty day period that were reported less than or equal to 200 colonies/100 mL (June-September) or 1000 colonies/100 mL (October-May) were 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 criterion of 2000 colonies/100 mL or any geometric mean sample that exceeded the geometric mean criterion of 200 colonies/100 mL (June-September) or 1000 colonies/100 mL (October-May) were considered impaired and subsequently listed for pathogens (fecal coliform) on Alabama's §303(d) list.

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

3.2.1 Point Sources in the East Bolton Branch Watershed

Continuous Point Sources
There are no continuous NPDES discharges located in the East Bolton Branch watershed. However, 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.

Non-Continuous Point Sources
The East Bolton Branch watershed qualifies as a Municipal Separate Stormwater Sewer System (MS4) area and must be addressed in the TMDL as part of the Wasteload Allocation (WLA). The entire East Bolton Branch watershed is within the boundary of the Mobile Area Phase I MS4

(ALS000002). The entire East Bolton Branch watershed will be allocated as MS4 WLAs in the TMDL.

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 files it was determined that numerous SSOs have occurred in the East Bolton Branch watershed.

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 East Bolton Branch 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 wash 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, turkeys, 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 a 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.

3.3 Land Use Assessment

As mentioned in the Executive Summary, this report is specifically for East Bolton Branch but additional information about West Bolton Branch and Eslava Creek are in the report due to all the watersheds being so small and adjacent to one another. With that said, the predominant land

use characteristic of the East Bolton Branch watershed is urban (75%). A map depicting landuses is shown in Figure 3-1. Tabulated landuses are shown in Table 3-1.

Figure 3-1. Land Use Map for East & West Bolton Branches and Eslava Creek Watersheds

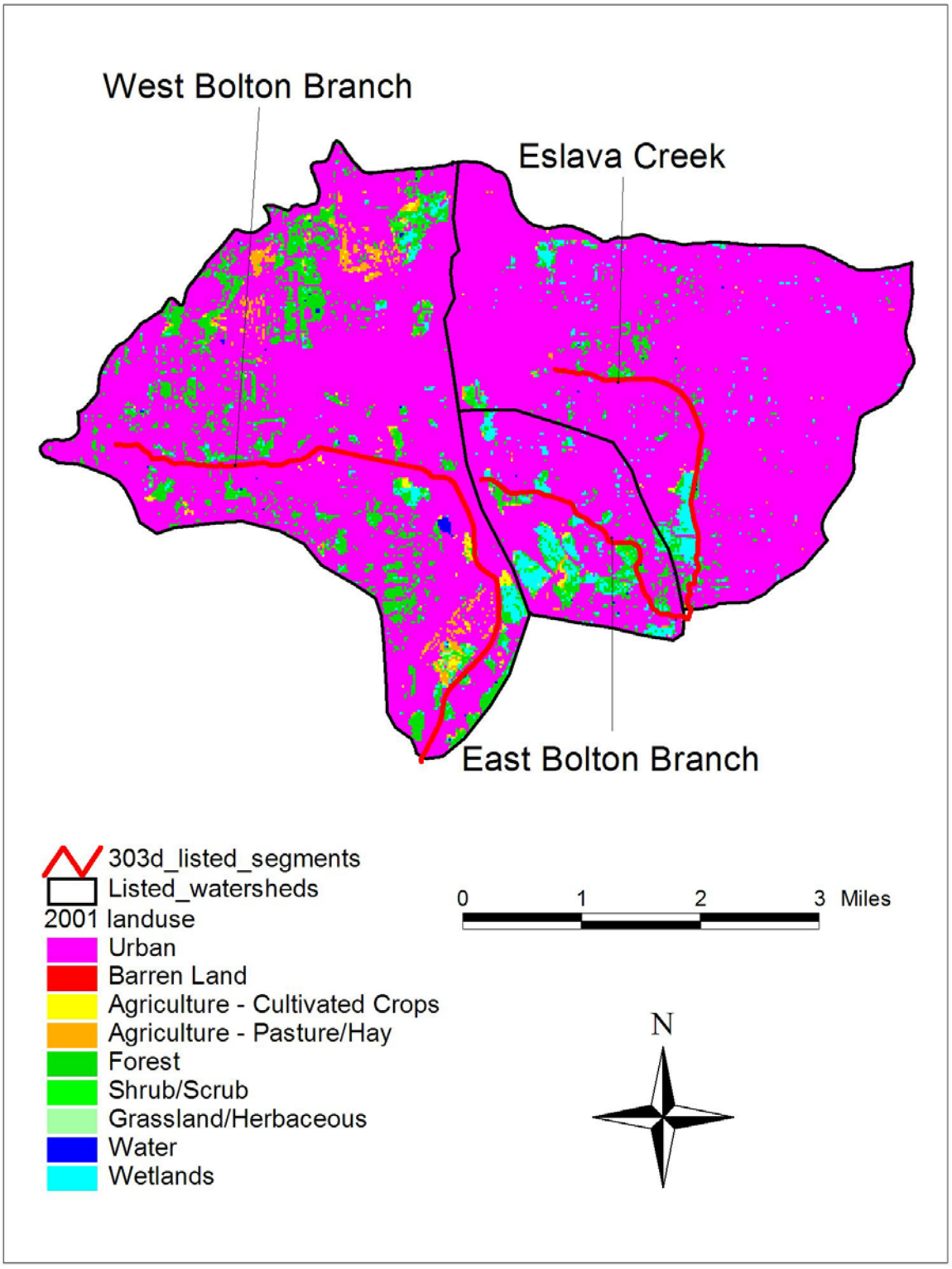


Table 3-1. Land Use Areas for East & West Bolton Branches and Eslava Creek Watersheds

2001 NLCD name	West Bolton Branch		East Bolton Branch		Eslava Creek	
	square miles	percent	square miles	percent	square miles	percent
Open Water	0.02	0.2%	0.003	0.1%	0.01	0.1%
Developed Open Space	3.95	40.4%	0.86	36.5%	2.94	35.7%
Developed Low Intensity	2.01	20.5%	0.47	19.9%	3.04	36.8%
Developed Medium Intensity	1.30	13.3%	0.30	13.0%	1.17	14.2%
Developed High Intensity	0.61	6.2%	0.13	5.7%	0.57	6.9%
Deciduous Forest	0.04	0.4%	0.01	0.6%	0.01	0.1%
Evergreen Forest	1.06	10.8%	0.19	8.0%	0.21	2.5%
Mixed Forest	0.10	1.0%	0.04	1.6%	0.03	0.4%
Shrub/Scrub	0.16	1.6%	0.04	1.8%	0.03	0.4%
Grassland/Herbaceous	0.01	0.1%	0.01	0.3%	0.001	0.01%
Pasture/Hay	0.23	2.3%	0.02	0.8%	0.02	0.2%
Cultivated Crops	0.09	0.9%	0.01	0.6%	0.01	0.1%
Woody Wetlands	0.19	1.9%	0.25	10.6%	0.21	2.6%
Emergent Herbaceous Wetlands	0.02	0.2%	0.01	0.5%	0.01	0.1%
Total	9.78	100.0%	2.34	100.0%	8.25	100.0%

Aggregate						
Developed	7.86	80%	1.76	75%	7.72	94%
Agriculture	0.32	3%	0.03	1%	0.02	0.3%
Forest	1.19	12%	0.24	10%	0.24	3%
Other	0.41	4%	0.31	13%	0.27	3%
Total	9.78	100%	2.34	100%	8.25	100%

3.4 Linkage Between Numeric Targets and Sources

The East Bolton Branch watershed is highly developed with 75% of the drainage area classified as urban, with the remaining land use/cover being forested and woody wetlands and 1% being classified agriculture. Fecal coliform loads from forests and wetlands tend to be low due to their filtering capabilities and are considered as natural or background conditions with respect to pollutant sources. Based on the highly urbanized watershed, it is believed that the most likely sources of pathogen loadings in the East Bolton Branch watershed are from activities in the MS4 area. Such activities include leaking sewer pipes, illicit sewer connections, failing septic systems and urban runoff. From review of ADEM files it was determined that numerous sanitary sewer overflows (SSO) have occurred in the East Bolton Branch watershed, which would be considered a likely source of pathogens to East Bolton Branch.

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

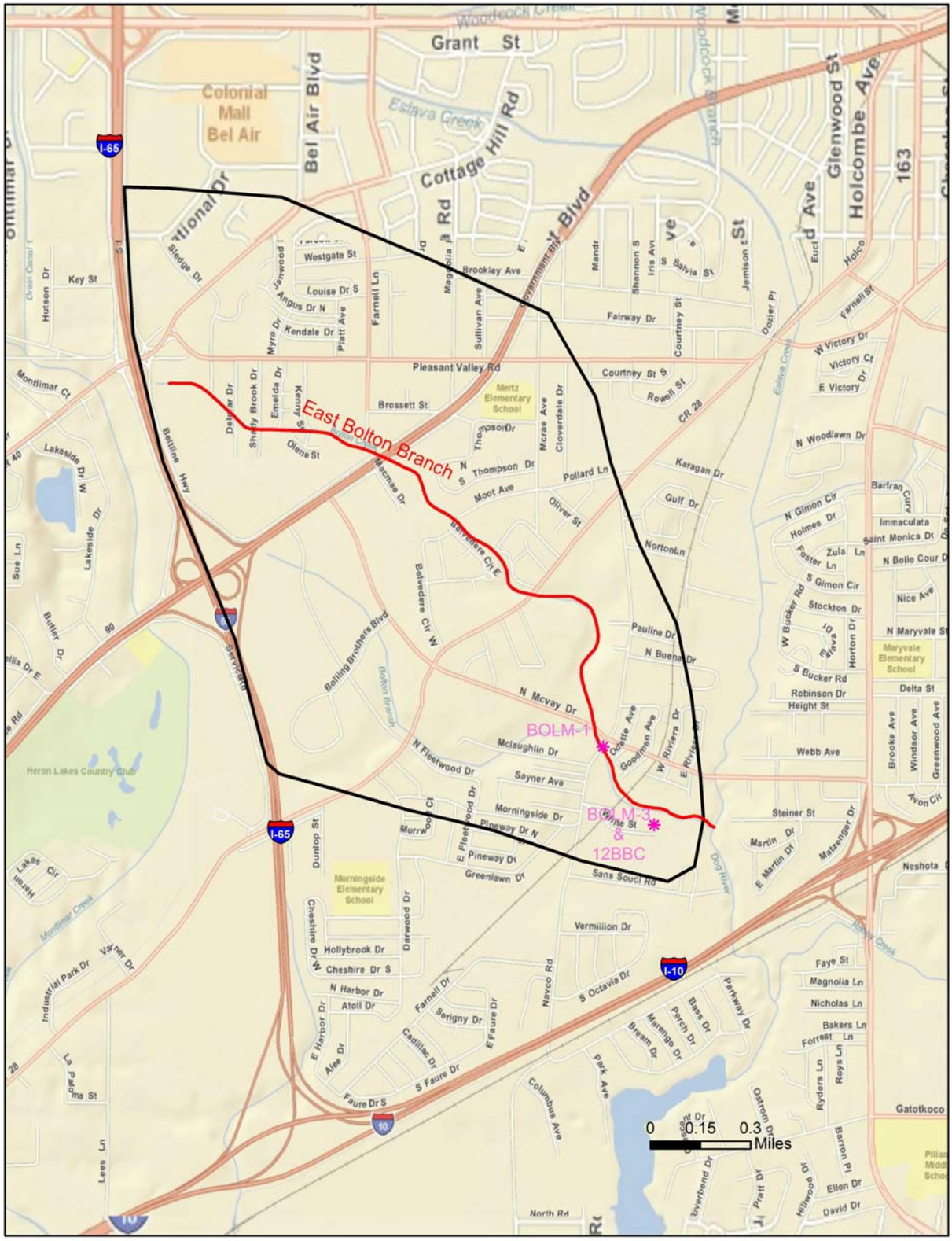
The original listing for East Bolton Branch was based on 5 of 40 fecal coliform samples collected by MAWSS exceeding the single sample maximum criterion in the year 2003 as described in the 2004 §303(d) Fact Sheet. MAWSS was required to collect this data through a Consent Decree with Alabama Department of Environmental Management (ADEM). MAWSS collected 129 fecal coliform samples on East Bolton Branch from 2003 through 2007. Of the 129 samples, 24 exceeded the single sample maximum of 2000 colonies/100 ml. No flows were collected for any of the sampling events.

This waterbody was subsequently sampled by ADEM at two locations in 2007. The ADEM data showed multiple violations of the single sample maximum criterion and geometric mean criterion. However, no flows were measured for any of the sampling events. An estimated stream flow for each sampling event was determined using a drainage area ratio of stream flows estimated from USGS Gage 02471001 (Chickasaw Creek Near Kushla, Al). This gage was assumed to be the most representative of the East Bolton Branch watershed for which data could be attained. These data are included in Appendix 7.2. From reviewing the data it can be observed that most of the violations occurred during higher flow events.

Table 3-2. Sampling Stations on the East Bolton Branch Listed Segment

Years	Station ID	Station Location	Latitude	Longitude
2007	BOLM-1	East Bolton Branch at Navco Road	30.64492	-88.10253
2007	BOLM-3	East Bolton Branch @ mouth	30.64155	-88.09993
2003 - 2007	12 BBC	East Bolton Branch @ mouth	30.64155	-88.09993

Figure 3-2. Map of ADEM and MAWSS Sampling Stations



3.6 Critical Conditions

Critical conditions typically occur during the summer months.. 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.

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. The summer single sample criteria was reduced by ten percent to achieve the target concentrations of 1800 colonies/100 mL and the summer geometric mean criteria was reduced by ten percent to achieve the target concentrations 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 Load Calculations

A mass balance approach was used to calculate the fecal coliform TMDL for East Bolton Branch. The mass balance approach utilizes the conservation of mass principle. Total existing mass loads were calculated by multiplying the fecal coliform concentration times the corresponding stream flow. Existing 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 loads necessary to achieve applicable water quality criteria, whether it be the single sample or geometric mean criterion.

Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample exceedance concentration of 31,000 colonies/100 ml times the estimated flow for that day. This concentration was calculated based on measurements at BOLM-3 on 10/23/2007 and can be found in Table 7-1, Appendix 7.2. The estimated stream flow, determined by the drainage area ratio of stream flows estimated from USGS Gage 02471001, for that sampling event was 3.5 cfs. The product of these two values and a conversion factor gives the total mass loading (colonies per day) of fecal coliform to East Bolton Branch under a single sample exceedance conditions.

$$\frac{46.2\,\mathrm{ft}^3}{\mathrm{s}} \times \frac{31{,}000\,\mathrm{colonies}}{100\,\mathrm{mL}} \times \frac{24465755 \quad 100\,\mathrm{mL} * \mathrm{s}}{\mathrm{ft}^3 * \mathrm{day}} = \frac{3.5 \times 10^{13}\,\mathrm{colonies}}{\mathrm{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean sample exceedance concentration of 4432 colonies/100 ml times the average flow for all five of the fecal coliform measurements. This concentration was calculated based on measurements at BOLM-1 on June 19, 2007 and July 2, 9, 16, & 19, 2007 and can be found in Table 7-1, Appendix 7.2. The average stream flow, determined by a drainage area ratio of stream flows estimated from USGS Gage 02471001, for these five sampling events was 3.4 cfs. The product of these two values and a conversion factor gives the total mass loading of fecal coliform to East Bolton Branch under geometric mean exceedance conditions.

$$\frac{3.4\,\mathrm{ft}^3}{\mathrm{s}} \times \frac{4432\,\mathrm{colonies}}{100\,\mathrm{mL}} \times \frac{24465755 \quad 100\,\mathrm{mL} * \mathrm{s}}{\mathrm{ft}^3 * \mathrm{day}} = \frac{3.69 \times 10^{11}\,\mathrm{colonies}}{\mathrm{day}}$$

Allowable Conditions

The **allowable loads** to the watershed were calculated under the same physical conditions as discussed above for the single sample and the geometric mean criterion. This is done by taking the product of the flow used for the violation event times the conversion factor times the allowable concentration which are as follows:

For the **single sample** fecal concentration of 1800 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{46.2\ \text{ft}^3}{\text{s}} \times \frac{1800\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.03 \times 10^{12}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 200 colonies/100 mL equals a daily loading of:

$$\frac{46.2\,\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.26 \times 10^{11}\ \text{colonies}}{\text{day}}$$

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

$$\frac{3.4\,\text{ft}^3}{\text{s}} \times \frac{180\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.50 \times 10^{10}\ \text{colonies}}{\text{day}}$$

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

$$\frac{3.4\,\text{ft}^3}{\text{s}} \times \frac{20\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.66 \times 10^{9}\ \text{colonies}}{\text{day}}$$

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 East Bolton Branch as evaluated at station BOLM-1. Table 4-1 shows the results of the fecal coliform TMDL and percent reductions for each criterion.

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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 Single Sample	3.50E+13	2.03E+12	3.30E+13	94%
NPS Load Geomean	3.69E+11	1.50E+10	3.54E+11	96%
Point Source	NA	NA	NA	NA

From Table 4-1, compliance with the geometric mean criterion of 200 colonies/100ml requires the greatest reduction in fecal coliform load. Therefore the TMDL will be based on the geometric mean criterion. The TMDL, WLA, LA and MOS values necessary to achieve the applicable fecal coliform criteria are provided in Table 1-2 below. Additional TMDL calculations are provided in Appendix 7.3.

Table 4-2. Fecal Coliform TMDL and Percent Reductions for East Bolton Branch

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)
1.66E+10	1.66E+9	NA	96%	0	1.50E+10	96%

a. There are no CAFOs in the West Bolton Branch watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum; NA = not applicable, no point sources. Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. 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

Bolton Branch was placed on Alabama's §303(d) list in 2004 based on data collected by MAWSS in 2003. 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 East Bolton Branch. Based on the TMDL analysis, it was determined that a 96% 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 East Bolton Branch watershed. As additional data and/or information becomes 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, 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
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.

Appendix 7.1

References

ADEM Administrative Code, 2007. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

ADEM Administrative Code, 2007. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's 2007 §303(d) Monitoring Program. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, December 2008.

Alabama's §303(d) Lists. 2004, 2006, and 2008 §303(d) List. ADEM.

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

Mobile Area Water and Sewer Service (MAWSS) surface water monitoring data.

Appendix 7.2
Water Quality Data

Table 7-1. ADEM Pathogen Data at Stations BOLM-1 and BOLM-3

Station_ID	Date	Fecal Coliform (col/100ml)	Geometric Mean Fecal Coliform (col/100ml)	East Bolton Branch ratioed flows (cfs)
BOLM-1	4/26/2007	9000		1.2
BOLM-1	5/14/2007	1200		0.9
BOLM-1	6/19/2007	19000		3.5
BOLM-1	7/2/2007	3000		0.9
BOLM-1	7/9/2007	4000		4.0
BOLM-1	7/16/2007	3000		6.1
BOLM-1	7/18/2007	2500	4432	2.6
BOLM-1	8/14/2007	3000		0.5
BOLM-1	8/27/2007	3000		1.9
BOLM-1	8/29/2007	17000		3.4
BOLM-1	8/30/2007	2900		3.4
BOLM-1	9/11/2007	1200	3510	0.8
BOLM-1	10/11/2007	1700		0.8
BOLM-3	3/19/2007	54		1.6
BOLM-3	4/17/2007	120		3.9
BOLM-3	5/7/2007	82		1.0
BOLM-3	6/26/2007	370		1.4
BOLM-3	7/5/2007	3000		8.9
BOLM-3	7/12/2007	280		1.8
BOLM-3	7/23/2007	1100		1.2
BOLM-3	7/24/2007	3000	1005	1.2
BOLM-3	8/22/2007	440		0.5
BOLM-3	9/6/2007	370		1.5
BOLM-3	9/10/2007	46		1.0
BOLM-3	9/12/2007	60		1.0
BOLM-3	9/18/2007	480	185	1.3
BOLM-3	10/23/2007	31000		46.2
BOLM-3	11/6/2007	250		1.7
BOLM-3	1/8/2008	220		4.2

Table 7-2 Mobile Area Water and Sewer Systems (MAWSS) Data at Station 12BBC

Date	Fecal Coliform Col/100 ml		Date	Fecal Coliform Col/100 ml		Date	Fecal Coliform Col/100 ml
6/10/2003	3900		2/3/2004	3645		11/24/2005	190
6/25/2003	1210		2/17/2004	2890		12/7/2005	590
7/9/2003	810		3/2/2004	490		12/19/2005	380
7/24/2003	2600		3/16/2004	4290		1/4/2006	1090
8/7/2003	1268		3/18/2004	110		1/18/2006	550
8/17/2003	3600		3/31/2004	850		1/31/2006	1200
8/21/2003	1745		4/14/2004	900		2/14/2006	130
9/4/2003	920		4/27/2004	2960		3/1/2006	320
9/9/2003	370		5/11/2004	1170		3/15/2006	350
9/9/2003	220		5/26/2004	450		3/28/2006	1080
9/16/2003	580		6/8/2004	1080		4/12/2006	560
9/24/2003	1415		6/24/2004	15380		4/25/2006	1000
9/24/2003	2530		7/20/2004	1470		5/12/2006	510
9/25/2003	1350		8/3/2004	29520		5/23/2006	490
9/25/2003	1260		9/2/2004	3380		6/9/2006	1160
9/29/2003	540		9/23/2004	5200		7/6/2006	2210
9/29/2003	370		10/7/2004	1305		7/20/2006	1450
9/30/2003	1460		10/19/2004	1815		8/3/2006	2290
10/2/2003	2025		11/2/2004	32800		8/24/2006	1530
10/2/2003	520		11/16/2004	220		9/7/2006	1150
10/9/2003	570		11/29/2004	290		9/20/2006	2390
10/9/2003	490		12/14/2004	370		10/3/2006	960
10/14/2003	70		12/29/2004	300		10/25/2006	200
10/14/2003	830		1/11/2005	480		11/9/2006	970
10/15/2003	910		1/25/2005	340		11/27/2006	1130
10/15/2003	575		2/9/2005	660		12/14/2006	3080
10/16/2003	1200		2/22/2005	280		1/3/2007	250
10/16/2003	660		3/8/2005	710		1/18/2007	170
10/20/2003	540		3/23/2005	410		1/30/2007	10
10/20/2003	180		4/5/2005	170		2/15/2007	2300
10/21/2003	870		4/20/2005	390		2/28/2007	140
10/21/2003	320		5/5/2005	120		3/13/2007	150
10/22/2003	870		5/16/2005	1220		3/30/2007	645
10/22/2003	470		6/10/2005	940		4/13/2007	830
10/28/2003	1670		6/23/2005	420		4/25/2007	310
10/28/2003	2715		7/13/2005	2010		5/10/2007	290
10/29/2003	1000		8/2/2005	160		5/25/2007	500
10/29/2003	880		8/18/2005	410		6/5/2007	910
11/11/2003	500		9/14/2005	700		6/25/2007	3770
11/25/2003	350		9/28/2005	2510		7/19/2007	2380
12/11/2003	740		10/12/2005	1570		8/3/2007	510
1/6/2004	1330		10/25/2005	140		8/16/2007	290
1/20/2004	2000		11/9/2005	210		8/31/2007	1200

Appendix 7.3

TMDL Calculation Worksheets

Load Reduction and TMDL Calculations for East Bolton Branch

For the Single Sample Maximum

Flow measured at BOLM-1 For Single Sample Maximum Violation: 46.2 cfs on 10/23/2007
Single Sample Fecal coliform concentration measured: 31000 col/100 mL
Allowable fecal coliform maximum concentration minus MOS: 1800 col/100mL = 2000 - 10%
Margin of safety for the maximum criteria 200 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)	3.50E+13	colonies/day	
Point source load (WLA)	NA	colonies/day	There are no point sources in this watershed
Current load =	3.50E+13	colonies/day	

Allowable Load:

Nonpoint source load (LA)	2.03E+12	colonies/day	
Point source load (WLA)	NA	colonies/day	There are no point sources in this watershed
Allowable load =	2.03E+12	colonies/day	

Margin of Safety:

MOS load = 2.26E+11 colonies/day

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	3.50E+13	2.03E+12	3.30E+13	94%	2.03E+12
WLA	NA	NA	NA	NA	NA
Total	3.50E+13	2.03E+12	3.30E+13	94%	2.03E+12

Total Maximum Daily Load (TMDL):

TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
2.26E+12	NA	2.03E+12	2.26E+11

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 94% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

The single sample max water quality criteria for fecal coliform is 2000 col/100 mL.
To account for an explicit Margin of Safety (MOS) a target concentration of 1800 col/100 ml was used to calculate the allowable load.

Load Reduction and TMDL Calculations for East Bolton Branch

For the Geometric Mean

Average Flow measured at BOLM-1 for Geometric Mean Samples:	3.4 cfs	
Geometric Mean Fecal coliform concentration measured:	4432 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)	3.69E+11	colonies/day	
Point source load (WLA)	NA	colonies/day	There are no point sources in this watershed
Current load =	3.69E+11	colonies/day	

Allowable Load:

Nonpoint source load (LA)	1.50E+10	colonies/day	
Point source load (WLA)	NA	colonies/day	There are no point sources in this watershed
Allowable load =	1.50E+10	colonies/day	

Margin of Safety:

MOS load = 1.66E+09 colonies/day

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	3.69E+11	1.50E+10	3.54E+11	96%	1.50E+10
WLA	NA	NA	NA	NA	NA
Total	3.69E+11	1.50E+10	3.54E+11	96%	1.50E+10

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

TMDL	WLA	LA	MOS
1.66E+10	NA	1.50E+10	1.66E+09

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 96% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

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