Alabama Department of Environmental Management

Final

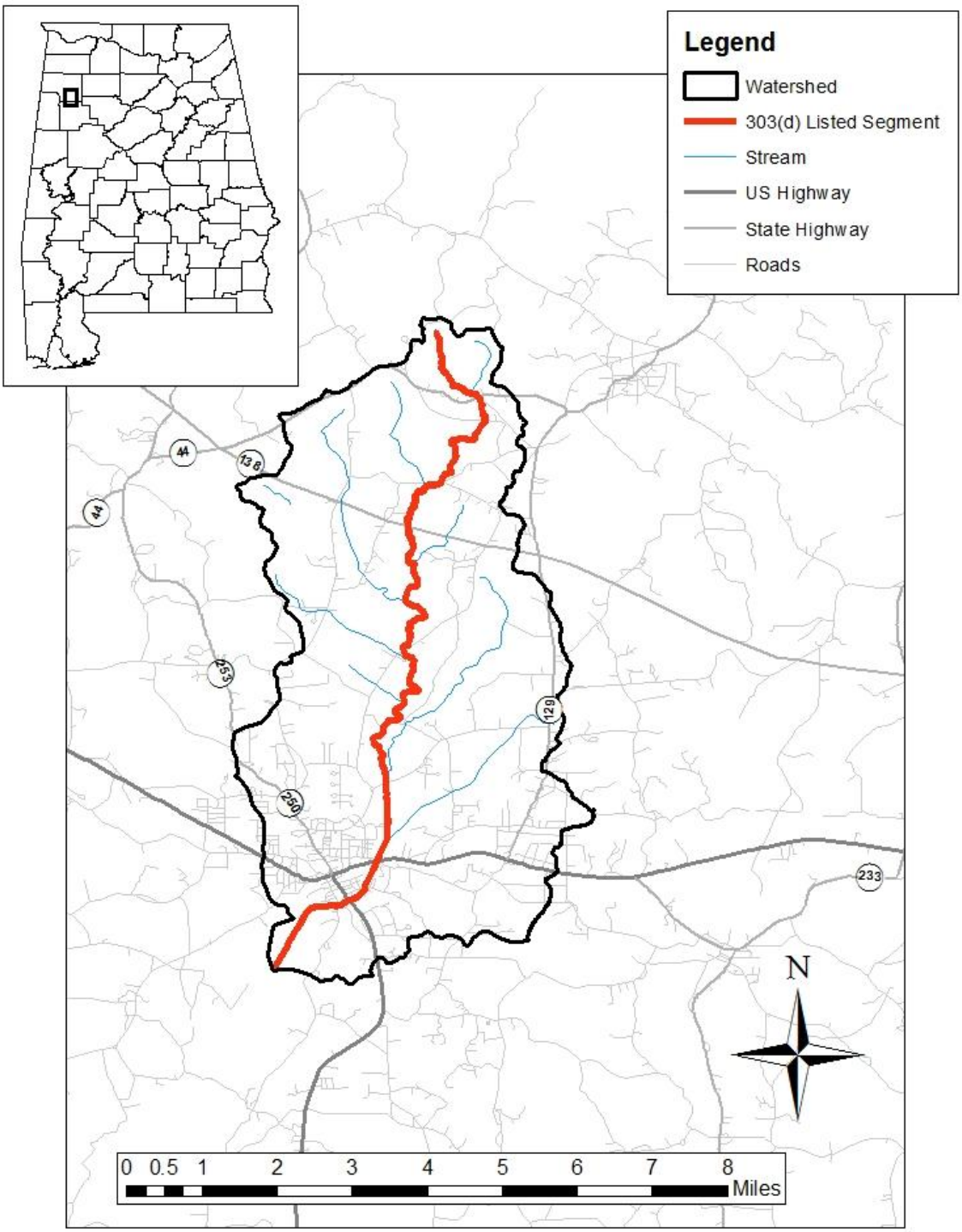
Total Maximum Daily Load (TMDL)
for
East Branch Luxapallila Creek

Assessment Unit ID # AL03160105-0101-200

Pathogens (E. coli)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
August 2013

Figure I: East Branch Luxapallila Creek Watershed



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1.0 Executive Summary

Section §303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated uses and to determine the Total Maximum Daily Load (TMDL) for pollutants causing the use impairment. A TMDL is the sum of individual wasteload allocations for point sources (WLAs), load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS).

East Branch Luxapallila Creek is on the §303(d) list for pathogens from its source to the Luxapallila Creek. East Branch Luxapallila Creek forms in Marion County north of the Town of Winfield, in the Tombigbee River Basin. It flows south through Marion County and into the Luxapallila Creek in north Fayette County. The total length of East Branch Luxapallila Creek is 11.18 miles, all of which are on the §303(d) list. The total drainage area of the East Branch Luxapallila Creek watershed is 27.64 square miles, all of which drains to the impaired segment. East Branch Luxapallila Creek has a use classification of Fish & Wildlife (F&W) and Public Water Supply (PWS).

East Branch Luxapallila Creek was first listed for Pathogens on the §303(d) list in 2006 based on 1999 ADEM 303(d) Monitoring data collected from station ELBC-1. East Branch Luxapallila Creek has subsequently been listed on the 2008, 2010, and 2012 §303(d) lists of impaired waterbodies.

In 2011, §303(d) sampling studies were performed by ADEM on East Branch Luxapallila Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2011 data will be used to assess the water quality of East Branch Luxapallila Creek because it was collected less than six years ago and provides the best picture of the current water quality of the stream. The January 2010 edition of ***Alabama's Water Quality Assessment and Listing Methodology*** section 4.8.2, prepared by ADEM, provides the rationale for the Department 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. Also, as a result of the Alabama Environmental Management Commission's (EMC) adoption of the Escherichia coli (E. coli) criteria as the new bacterial indicator, this TMDL will be developed from E. coli data collected at stations EBLC-1, EBLC-2, and EBRM-72 in 2011. The 2011 bacterial data is listed in Appendix 7.2, Table 7-2 for reference. ADEM collected 48 single samples and six geometric means from East Branch Luxapallila Creek at 3 stations in 2011. According to the data collected in 2011, East Branch Luxapallila Creek was not meeting the pathogen criterion applicable to its use classification of Fish and Wildlife and Public Water Supply. Therefore, a TMDL will be developed for pathogens (E. coli) on the listed reach.

A mass balance approach was used for calculating the pathogen TMDL for East Branch Luxapallila Creek. The mass balance approach utilizes the conservation of mass principle. Loads were calculated by multiplying the E. coli concentration times the respective instream flow and a conversion factor. The mass loading was calculated using the geometric mean exceedance that resulted in the highest percent reduction (Appendix 7.2, Table 7-2). In the same manner, an allowable load was calculated for the single sample E. coli criterion of 487 colonies/100 mL. The single sample exceedance concentration used was 2419.6 colonies/100 mL from 7/21/2011

times the flow of the sample (6.43 cfs) and a conversion factor. The allowable loading, defined by the single sample criterion including a margin of safety, was calculated using the same flow value times the E. coli single sample target of 438.3 colonies/100 mL (487 colonies/100 mL – 10% Margin of Safety). The reduction required to meet the allowable loading was then calculated by subtracting the allowable loading from the existing loading. The single sample violation resulted in an 82% reduction in E. coli loading.

Table 1-1 is a summary of the estimated existing load, allowable load, and percent reduction for the geometric mean and single sample criterion. Table 1-2 provides the details of the TMDL along with the corresponding reductions for East Branch Luxapallila Creek which are protective of E. coli water quality standards year round.

Table 1-1. 2011 E. coli Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Nonpoint Source Load Single Sample	4.00E+11	7.25E+10	3.23E+10	82%
Nonpoint Source Load Geometric Mean	1.61E+11	1.78E+10	1.43E+11	89%
Point Source Load[a]	1.82E+8	4.77E+9	0	0%

a. Point Source loads and load reductions are based on current permit limits of Fecal coliform as well as a design flow of 1.0 MGD for Winfield WWTP. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility.

Table 1-2. E. coli TMDL for East Branch Luxapallila Creek

TMDL[e]	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)
2.45E+10	1.98E+9	4.77E+9	NA	0	1.78E+10	89%

Note: NA = not applicable
a. There are no CAFOs in the East Branch Luxapallila Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. 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 E. coli loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for E. coli.
e. TMDL was established using the geometric mean criterion of 126 colonies/100ml.

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 East Branch Luxapallila 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).

The State of Alabama has identified the 11.18 miles of East Branch Luxapallila Creek as impaired for pathogens. The §303(d) listing was originally reported on Alabama's 2006 List of Impaired Waters for pathogens based on 1999 ADEM 303(d) Monitoring data from station ELBC-1 and subsequently included on the 2008, 2010, and 2012 lists. The source of the impairment is listed on the 2012 §303(d) list as municipal.

2.2 Problem Definition

Waterbody Impaired:	East Branch Luxapallila Creek – From Luxapallila Creek to its source
Impaired Reach Length:	11.18 miles
Impaired Drainage Area:	27.64 square miles
Water Quality Standard Violation:	Pathogens (single sample, geomean)
Pollutant of Concern:	Pathogens (E. coli)
Water Use Classification:	Fish and Wildlife / Public Water Supply

Usage Related to Classification:
The impaired stream segment is classified as Fish and Wildlife (F&W) and Public Water Supply (PWS). Usage of waters in F&W 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.

E. coli 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 E. coli group shall not exceed a geometric mean of 548 colonies/100 ml; nor exceed a maximum of 2,507 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 E. coli organism density does not exceed 126 colonies/100 ml nor exceed a maximum of 487 colonies/100 ml in any sample 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.

Usage of waters in PWS classification is described in ADEM Admin. Code R. 335-6-10-.09(2)(a), (b), (c), and (d).

(a) Best usage of waters: source of water supply for drinking orfood-processing purposes.

(b) Conditions related to best usage: the waters, if subjected to treatment approved by the Department equal to coagulation, sedimentation, filtration and disinfection,

with additional treatment if necessary to remove naturally present impurities, and which meet the requirements of the Department, will be considered safe for drinking or food-processing purposes.

(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.

E. coli Criterion:

Criterion for acceptable bacteria levels for the PWS use classification is described in ADEM Admin. Code R. 335-6-10-.09(2)(e)7(i) and (ii) as follows:

7. Bacteria:

(i) In non-coastal waters, bacteria of the E. coli group shall not exceed a geometric mean of 548 colonies/100 ml; nor exceed a maximum of 2,507 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. In coastal waters, bacteria of the enterococci group shall not exceed a maximum of 275 colonies/100 ml in any sample.

(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 E. coli organism density does not exceed 126 colonies/100 ml nor exceed a maximum of 487 colonies / 100 ml in any single sample 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 mean bacterial 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:

East Branch Luxapallila Creek was first listed for unknown toxicity on the §303(d) list in 2006 based on 1999 ADEM 303(d) Monitoring data from station ELBC-1. Data collected by ADEM in 1999 had no fecal coliform violations. ADEM collected single sample and geometric mean E. coli data on East Branch Luxapallila Creek at EBLC-1, EBLC-2, and EBRM-72 in 2011. Of the

16 E. coli samples collected at EBLC-1 in 2011, one violated the single sample F&W maximum criterion of 487 col/100 ml. Of the two sampling events that qualified for a geometric mean calculation at EBLC-1 in 2011, both geometric means (7/6/2011 through 7/21/2011 and 9/1/2011 through 9/28/2011) exceeded the E. coli criterion of 126 col/100ml. Of the 16 E. coli samples collected at EBLC-2 in 2011, nine violated the single sample F&W maximum criterion of 487 col/100 ml. The two sampling events that qualified for a geometric mean calculation at EBLC-2 in 2011, both geometric means (7/6/2011 through 7/21/2011 and 9/1/2011 through 9/28/2011) exceeded the E. coli criterion of 126 col/100ml. Of the 16 E. coli samples collected at EBRM-72 in 2011, one violated the single sample F&W maximum criterion of 487 col/100 ml. The one sampling event that qualified for a geometric mean calculation at EBRM-72 in 2011, one geometric mean (9/1/2011 through 9/28/2011) exceeded the E. coli criterion of 126 col/100ml..

3.0 3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

On December 11, 2009, the Alabama EMC adopted the E. coli criteria as the bacterial indicator to assess the levels of bacteria in freshwater. Prior to the adoption of the E. coli criteria, the fecal coliform criteria were used by ADEM as the bacterial indicator for freshwater. The E. coli criteria was recommended by the EPA as a better correlation to swimming and incidental water contact associated health effects than fecal coliform in the 1986 publication ***Quality Criteria for Water***, (EPA 440/5-86-001). As a result of this bacterial indicator change, this TMDL will be developed from E. coli data collected at station EBLC-2 in 2011.

For the purpose of this TMDL a geometric mean E. coli target of 113.4 colonies/100 mL will be used. This target was derived by using a 10% explicit margin of safety from the geometric mean maximum of 126 colonies/100 mL criterion. This target is considered protective of water quality standards and should not allow the single sample of 487 colonies/100 mL (June-September criterion) to be exceeded.

3.2 Source Assessment

3.2.1 Point Sources in the East Branch Luxapallila 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 E. coli can flow into the stream or leach into the groundwater. Illicit discharges are found at facilities that are discharging E. coli bacteria when they are not permitted, or they are violating their defined permit limit by exceeding the E. coli concentration.

Continuous Point Sources

There is one point source, Winfield WWTP (AL0023400), located in the East Branch Luxapallila Creek watershed which could cause or contribute to the E. coli loading. However, Winfield WWTP discharge is downstream of EBLC-2, the station that reported most of the violations. In addition, Winfield WWTP's Discharge Monitoring Reports (DMRs) confirm that their effluent was meeting their permit limits during the ambient monitoring period and therefore would not have caused or contributed to the E. coli exceedances. Therefore, the existing loading and corresponding load reduction for the point source component of the TMDL will be defined as the load calculated from the DMR at the time of the WLA reduction. The allowable E. coli loading for the point source will be established as a concentration and applied end of pipe.

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. Currently, Winfield WWTP is reporting their pathogen data in E. coli (col/100 mL). However, previously Winfield WWTP reported their pathogen data in fecal coliform (col/100 mL). In addition, Winfield WWTP currently has pathogen limits in the form of E. coli. Previously, Winfield WWTP had pathogen limits in the form of fecal coliform. 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

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

Also, according to the ADEM database, there have been no reported sanitary sewer overflows (SSOs) that have occurred in the East Branch Luxapallila Creek watershed. 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 discharge 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.

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 Branch Luxapallila Creek Watershed

Nonpoint sources of E. coli bacteria do not have a defined discharge point, but rather, occur over the entire length of a stream or waterbody. On the land surface, E. coli 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 E. coli bacteria are collected and carried to the stream or waterbody. Therefore, there is some net loading of E. coli bacteria into the stream as dictated by the watershed hydrology.

Nonpoint sources are believed to be the primary source of E. coli bacteria in the East Branch Luxapallila Creek watershed. Land use in this watershed is primarily agriculture (pasture/hay and row crops) with 9.02%, and forested with 62.22%.

Agricultural land can be a source of E. coli 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 E. coli bacteria to waterbodies. To account for the potential influence from animals with direct access to stream reaches in the watershed, E. coli loads can be calculated as a direct source into the stream.

E. coli 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.

E. coli loading from urban areas is potentially attributable to multiple sources including storm water runoff, unpermitted 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 E. coli bacteria to surface waters due to system failure and malfunction.

3.3 Land Use Assessment

Land use for the East Branch Luxapallila Creek watershed was determined using ArcMap with land use datasets derived from the 2006 National Land Cover Dataset (NLCD). Figure 3-1 and Table 3-1 display the land use areas for the East Branch Luxapallila Creek watershed. Figure 3-2 is a graph depicting the primary land uses in the East Branch Luxapallila Creek watershed.

The majority of the East Branch Luxapallila Creek watershed is 62.22% Forest, and 28.12% Developed. Other major land uses include Agriculture which accounts for approximately 9.02% of the watershed, and Open Water which accounts for approximately 0.64% of the watershed. If not managed properly, agriculture can have significant nonpoint source impacts. Also, septic systems can be a main source of bacteria if not properly installed and maintained. Developed land includes both commercial and residential land uses.

Figure 3-1. Land Use Map for the East Branch Luxapallila Creek Watershed

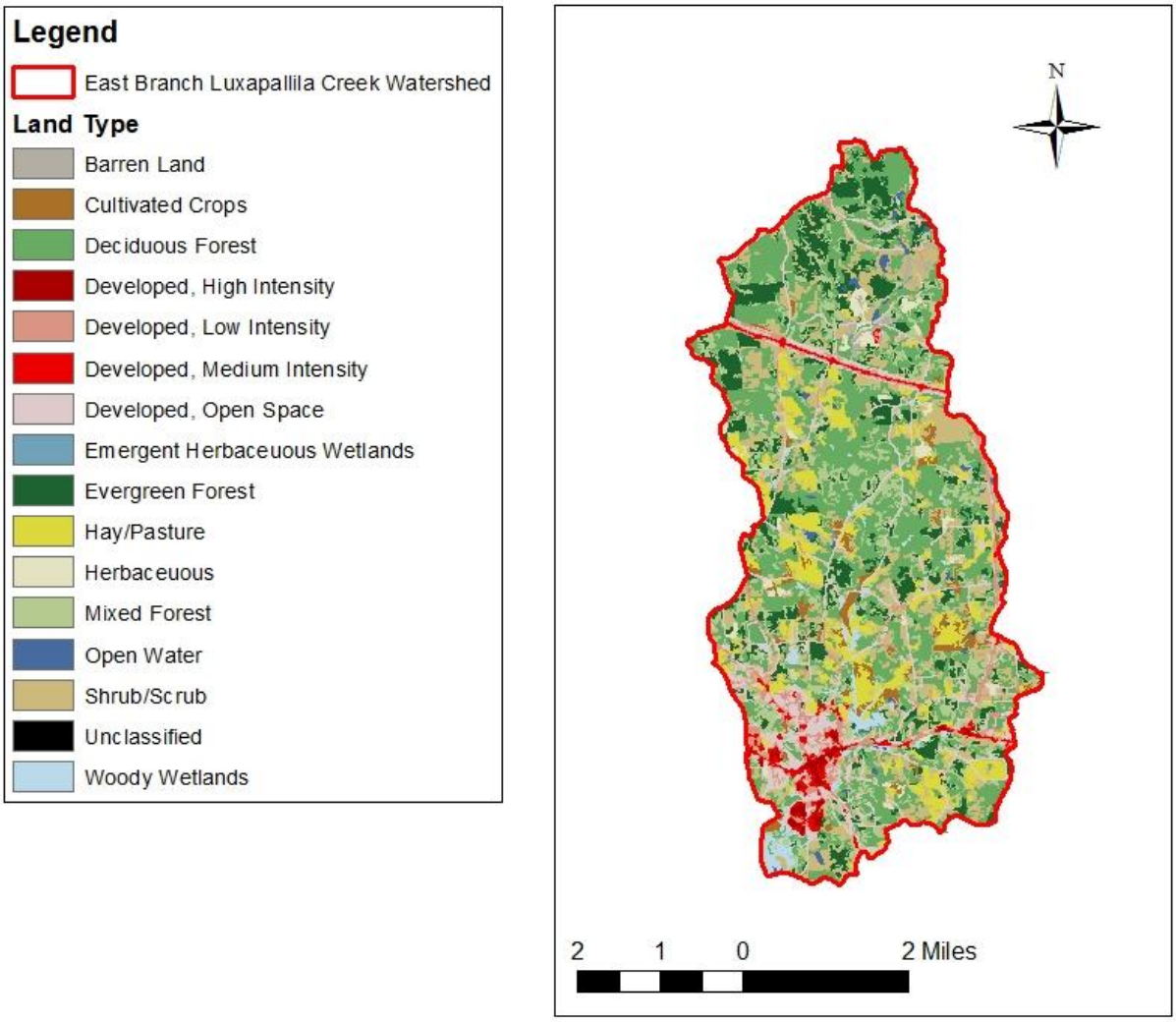
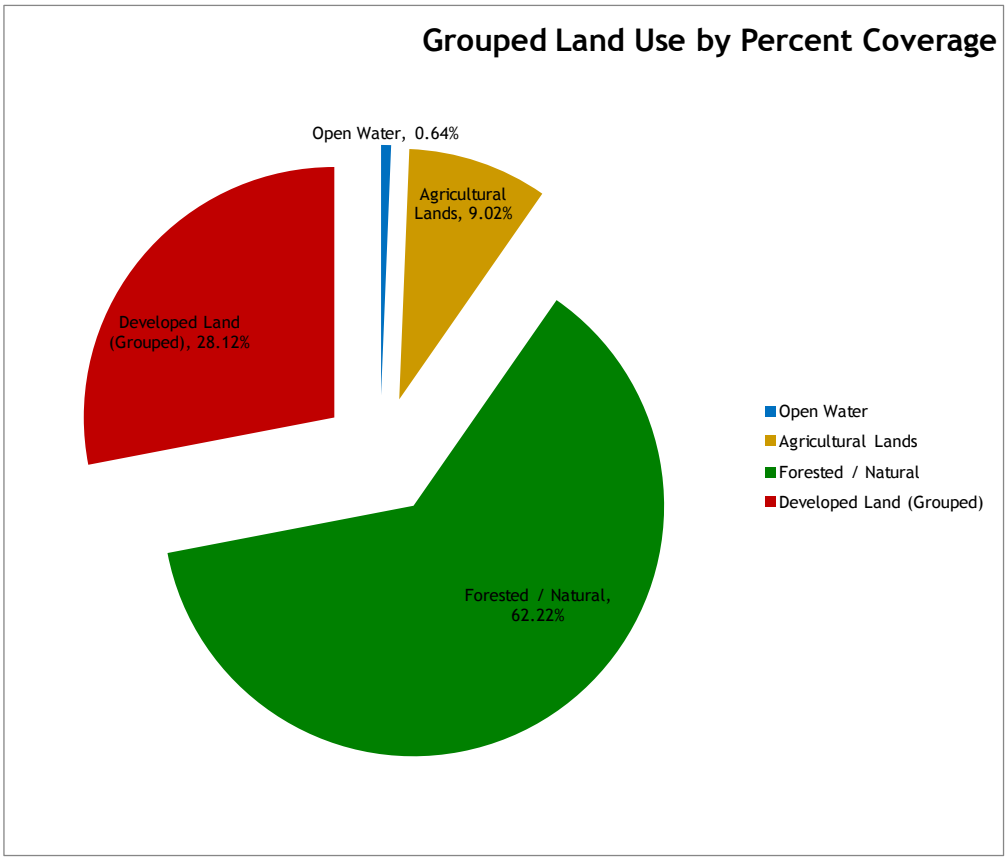


Table 3-1. Land Use Areas for the East Branch Luxapallia Creek Watershed

Class Description	Count (30m)	Mi²	Acres	Percent
Open Water	459900	0.18	113.64	0.64%
Agricultural Lands	6464700	2.50	1597.46	9.02%
Forested / Natural	44597700	17.22	11020.32	62.22%
Developed Land (Grouped)	20160200	7.78	4981.69	28.12%
TOTALS →	**71582500**	**27.64**	**17688.41**	**100.00%**

Figure 3-2. Graph of Primary Landuses in the East Branch Luxapallila Creek Watershed



3.4 Linkage Between Numeric Targets and Sources

The East Branch Luxapallila Creek watershed has two main landuses, namely forest and developed. Pollutant loadings from forested areas tend to be low due to their filtering capabilities and will be considered as background conditions. The most likely sources of pathogen loadings in East Branch Luxapallila Creek are from the agricultural land uses, urban run-off from rain events, unpermitted discharges of wastewater, and failing septic systems. It is not considered a logical approach to calculate individual components for nonpoint source loadings. Hence, there will not be individual loads or reductions calculated for the various nonpoint sources. The loadings and reductions will only be calculated as a single total nonpoint source load and reduction.

3.5 Data Availability and Analysis

ADEM collected pathogens data (fecal coliform) for East Branch Luxapallila Creek in 1999. Of the 16 monthly samples that were collected in 1999, no sample exceeded the 2000 colonies/100 mL single sample criterion for fecal coliform bacteria.

In 2011, ADEM again collected water quality data on East Branch Luxapallila Creek as part of Alabama's §303(d) Monitoring Program at three stations, namely EBLC-1, EBLC-2, and EBRM-72. Of the 27 monthly samples that were collected in 2011, 11 samples exceeded the 487 colonies/100 mL single sample criterion for E. coli bacteria. This data can be viewed in Appendix 7.2, Table 7-1. As previously mentioned, the 2011 data will only be used for this assessment because it is less than 6 years old. The January 2010 edition of ***Alabama's Water Quality Assessment and Listing Methodology*** section 4.8.2 prepared by ADEM provides the rationale for the Department 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.

Figure 3-3 and Table 3-3 display location and description for the ADEM sampling stations. Of the 16 E. coli samples collected at EBLC-1 in 2011, one violated the single sample F&W maximum criterion of 487 col/100 ml. Of the two sampling events that qualified for a geometric mean calculation at EBLC-1 in 2011, both geometric means (7/6/2011 through 7/21/2011 and 9/1/2011 through 9/28/2011) exceeded the E. coli criterion of 126 col/100ml. Of the 16 E. coli samples collected at EBLC-2 in 2011, nine violated the single sample F&W maximum criterion of 487 col/100 ml. The two sampling events that qualified for a geometric mean calculation at EBLC-2 in 2011, both geometric means (7/6/2011 through 7/21/2011 and 9/1/2011 through 9/28/2011) exceeded the E. coli criterion of 126 col/100ml. Of the 16 E. coli samples collected at EBRM-72 in 2011, one violated the single sample F&W maximum criterion of 487 col/100 ml. The one sampling event that qualified for a geometric mean calculation at EBRM-72 in 2011, one geometric mean (9/1/2011 through 9/28/211) exceeded the E. coli criterion of 126 col/100ml. The single sample violation resulted in an 82% reduction, which was lower than the geometric mean event, therefore will not be used for TMDL development. Flow data was not available for all of the sampling events. USGS gage 02442500 Luxapallila Creek at Millport, AL was used to calculate the flow by using the ratio method. The geometric mean exceedance

event which resulted in the highest percent reduction (89%) was used in calculating the E. coli loading to East Branch Luxapallila Creek (refer to Appendix 7.2, Table 7-2).

Table 3-2.
2011 E-Coli Exceedances for the East Branch Luxapallila Creek Watershed

Station ID	Date	E Coli – Single Sample (col/100ml)	E Coli – Geomean (col/100ml)
EBLC-1	7/6/11	152.9	140.9
EBLC-1	7/11/11	153.9	
EBLC-1	7/14/11	78.9	
EBLC-1	7/18/11	77.1	
EBLC-1	7/21/11	387.3	
EBLC-1	9/1/11	110.6	201.0
EBLC-1	9/15/11	172.3	
EBLC-1	9/15/11	866.4	
EBLC-1	9/22/11	162.4	
EBLC-1	9/28/11	122.3	
EBLC-2	6/27/11	517.2	-
EBLC-2	7/6/11	1203.3	1022.3
EBLC-2	7/11/11	787.0	
EBLC-2	7/14/11	435.2	
EBLC-2	7/18/11	1119.9	
EBLC-2	7/21/11	2419.6	
EBLC-2	9/1/11	435.2	649.3
EBLC-2	9/12/11	816.4	
EBLC-2	9/15/11	1986.3	
EBLC-2	9/22/11	547.5	
EBLC-2	9/28/11	298.7	
EBLC-2	10/12/11	1732.9	-
EBRM-72	9/1/11	118.7	161.1
EBRM-72	9/12/11	60.9	
EBRM-72	9/15/11	2419.6	
EBRM-72	9/22/11	59.4	
EBRM-72	9/12/11	104.6	

Figure 3-3. Map of ADEM Sampling Station on East Branch Luxapallila Creek

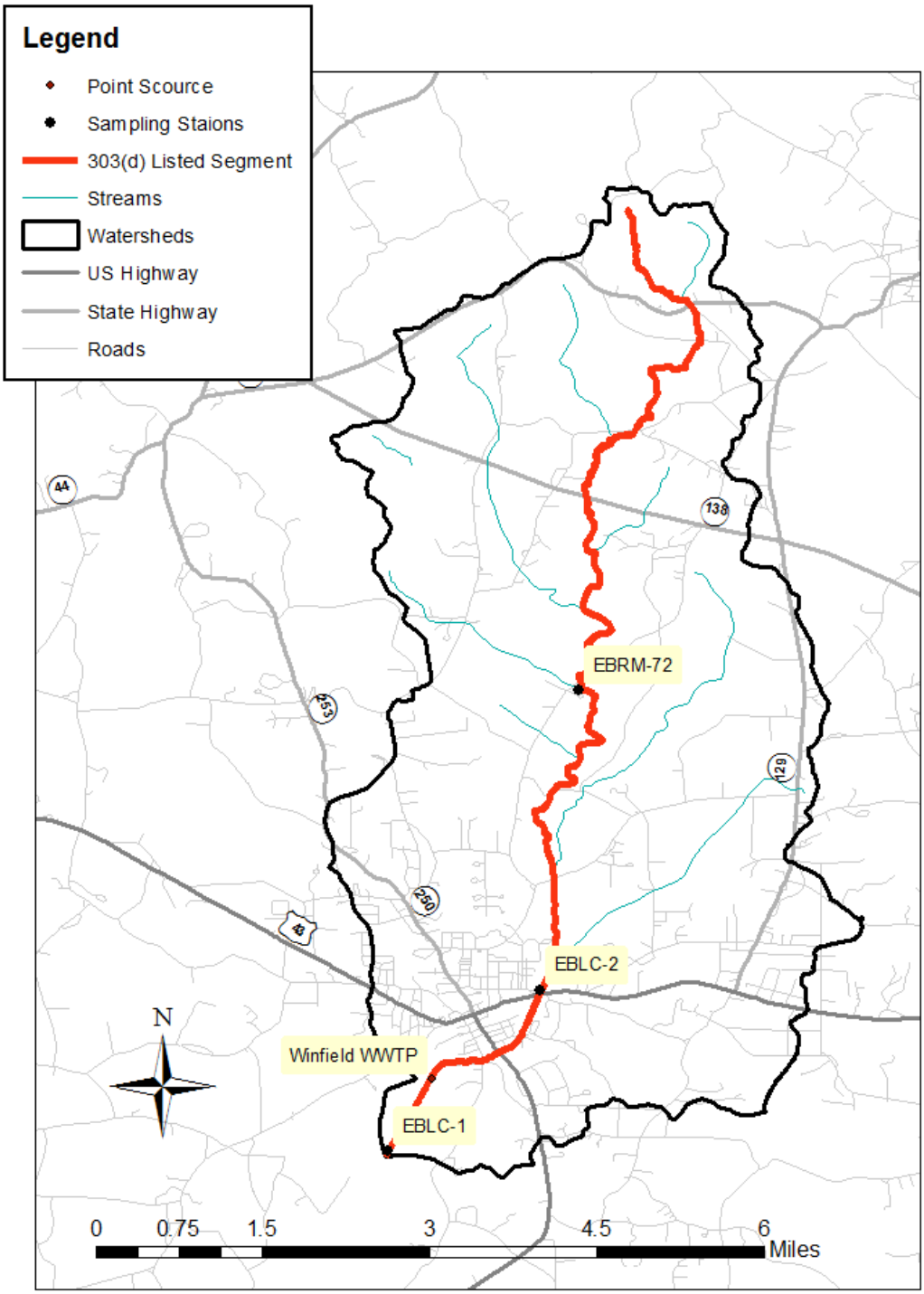


Table 3-3. East Branch Luxapallila Creek Sampling Station Description

Years	Station ID	Data Source	Station Location	Latitude	Longitude
1999 2011	EBLC-1	ADEM	East Branch Luxapallila Creek downstream of Winfield WWTP.	33.9111	-87.8281
1999 2011	EBLC-2	ADEM	East Branch Luxapallila Creek at street upstream of Highway 78.	33.9320	-87.8084
1999 2001 2011	EBRM-72	ADEM	East Branch Luxapallila Creek at Marion CR 47 just us of confluence with Dogwood Branch	33.9721	-87.8037

3.6 Critical Conditions

Summer months (June-September) are generally considered critical conditions. This can be explained by the nature of storm events in the summer versus the winter. In summer, periods of dry weather interspersed with thunderstorms allow for the accumulation and washing off of E. coli bacteria into streams, resulting in spikes of E. coli bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of E. coli bacteria on the land surface, resulting in a more uniform loading rate.

The impaired portion of the East Branch Luxapallila 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 E. coli geometric mean exceedance value. That value was 1022.31 colonies/100 mL that occurred on the July 6, 2011 through July 21, 2011 sampling period at station EBLC-2. The average flow of 6.43 cfs was obtained during this sampling event.

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.

Both an explicit and implicit MOS was incorporated into this TMDL. The MOS accounts for the uncertainty associated with the limited availability of E. coli data used in this analysis. An explicit MOS was applied to the TMDL by reducing the E. coli target geometric mean criterion concentration by ten percent and calculating a mass loading target with measured flow data. The geometric mean criterion was reduced by ten percent to achieve a target concentration of 113.4 colonies/100 mL. An implicit MOS was incorporated in the TMDL by basing the existing condition on the highest measured E. coli concentration that was collected during critical conditions.

4.0 TMDL Development

4.1 Definition of a TMDL

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

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while achieving water quality standards under critical conditions.

For some pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). However, for pathogens, TMDL loads are typically expressed in terms of organism counts per day (colonies/day), in accordance with 40 CFR 130.2(i).

4.2 Load Calculations

A mass balance approach was used to calculate the pathogen TMDL for East Branch Luxapallila Creek. The mass balance approach utilizes the conservation of mass principle. Total mass loads can be calculated by multiplying the E. coli concentration times the instream flow times and a conversion factor. The existing load was calculated for the violation in 2011 that resulted in the highest percent reduction. This violation was a geometric mean exceedance. In the same manner, the allowable load was calculated for the single sample criterion of 438.3 colonies/100 mL. Although there were multiple single sample and geometric mean violations in 2011, the TMDL was based on the highest calculated E. coli load percent reduction necessary to achieve applicable water quality criteria.

Existing Conditions

The **geometric mean** mass loading was calculated by multiplying the geometric mean exceedance concentration of 1022.33 colonies/100 ml times the average flow of the samples. This concentration was calculated based on measurement at EBLC-2 for the July 6, 2011 through July 21, 2011 sampling period, and can be found in Table 7-2, Appendix 7.2. The average stream flow was 6.43 cfs at the time of the violation. The product of these two values times the conversion factor gives the total mass loading (colonies per day) of E. coli to East Branch Luxapallila Creek.

$$\frac{6.43\,\text{ft}^3}{\text{s}} \times \frac{1022.33\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.61 \times 10^{11}\,\text{colonies}}{\text{day}}$$

$WWTP_{WLA}$ loading during the violation period in July 2011 includes one point source, Winfield WWTP. The discharge monitoring report (DMR) for July 2011 for the Windfield WWTP shows an average flowrate of 0.24 million gallons per day (MGD) and an average fecal coliform concentration of 20 colonies/100 mL, with a maximum flowrate of 0.34 MGD and a maximum fecal coliform concentration of 240 colonies/100 mL. The mass loading from the Windfield WWTP during July 2011 was calculated as follows:

$$\frac{0.24\times10^{6}\,\text{gal}}{\text{day}}\times\frac{3785.41\,\text{mL}}{\text{gal}}\times\frac{20\ \text{colonies}}{100\,\text{mL}}=\frac{1.82\times10^{8}\ \text{colonies}}{\text{day}}$$

Allowable Conditions

The **allowable load** to the watershed was calculated under the same physical conditions as discussed above for the geometric mean criterion. This is done by taking the product of the average flow used for the violation event times the conversion factor times the allowable concentration.

For the **geometric mean** E. coli target concentration of 113.4 colonies/100 mL. The allowable E. coli loading is:

$$\frac{6.43\ \text{ft}^3}{\text{s}}\times\frac{113.4\ \text{colonies}}{100\,\text{mL}}\times\frac{24465755\quad 100\,\text{mL}*\text{s}}{\text{ft}^3*\text{day}}=\frac{1.78\times10^{10}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 12.6 colonies/100 mL equals a daily loading of:

$$\frac{6.43\,\text{ft}^3}{\text{s}}\times\frac{12.6\ \text{colonies}}{100\,\text{mL}}\times\frac{24465755\quad 100\,\text{mL}*\text{s}}{\text{ft}^3*\text{day}}=\frac{1.98\times10^{9}\ \text{colonies}}{\text{day}}$$

$WWTP_{WLA}$ allowable loading includes one point source, Winfield WWTP. Winfield WWTP has a permitted wasteflow of 1.00 million gallons per day (MGD) and monthly average effluent E. coli concentration of 126 colonies/100 mL. Allowable mass loading from Winfield WWTP:

$$\frac{1.00\times10^{6}\,\text{gal}}{\text{day}}\times\frac{3785.41\,\text{mL}}{\text{gal}}\times\frac{126\ \text{colonies}}{100\,\text{mL}}=\frac{4.77\times10^{9}\ \text{colonies}}{\text{day}}$$

The difference in the pathogen loading between the existing condition (violation event) and the allowable condition converted to a percent reduction represents the total load reduction needed to achieve the E. coli water quality criterion. The TMDL was calculated as the total daily E. coli load to East Branch Luxapallila Creek as evaluated at station EBLC-2. Table 4-1 shows the result of the E. coli TMDL and percent reduction for the geometric mean criterion.

Table 4-1. 2011 E. coli Load and Required Reduction

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Nonpoint Source Load Single Sample	4.00E+11	7.25E+10	3.28E+10	82%
Nonpoint Source Load Geometric Mean	1.61E+11	1.78E+10	1.43E+11	89%
Point Source Load[a]	1.82E+8	4.77E+9	0	0%

a. Point Source loads and load reductions are based on current permit limits of Fecal coliform as well as a design flow of 1.0 MGD for Winfield WWTP. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility.

From Table 4-1, compliance with the geometric mean criterion of 126 colonies/100 mL requires a reduction in the E. coli load of 89%. The TMDL, WLA, LA and MOS values necessary to achieve the applicable E. coli criterion are provided in Table 4-2 below.

Table 4-2. E. coli TMDL for East Branch Luxapalilla Creek

TMDL[e]	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)
2.45E+10	1.98E+9	4.77E+9	NA	0	1.78E+10	89%

Note: NA = not applicable
a. There are no CAFOs in the East Branch Luxapallila Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. 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 E. coli loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for E. coli.
e. TMDL was established using the geometric mean criterion of 126 colonies/100ml.

4.3 TMDL Summary

East Branch Luxapallila Creek was originally placed on Alabama's §303(d) list in 2006 for Pathogens based on 1999 ADEM 303(d) Monitoring data. In 2011, ADEM collected water quality data confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the E. coli TMDL for East Branch Luxapallila Creek. Based on the TMDL analysis, it was determined that an 89% reduction in E. coli 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 Branch Luxapallila 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 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	2013
Chattahoochee / Chipola / Choctawhatchee / Perdido-Escambia	2014
Alabama / Coosa / Tallapoosa	2015
Escatawpa / Mobile / Lower Tombigbee / Upper Tombigbee	2016
Black Warrior / Cahaba	2017

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.

7.0 Appendices

Appendix 7.1
References

ADEM Administrative Code, 2010. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

ADEM Administrative Code, 2010. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's §303(d) Monitoring Program. 1999, 2001, & 2011. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, January 2012.

Alabama Department of Environmental Management, 1998, 2000, 2002, 2004, 2006, 2008, 2010, & 2012 §303(d) Lists and Fact Sheets. ADEM.

Alabama Department of Environmental Management (ADEM) Laboratory QA Manual, Chapter 5, Table 5-2: ADEM Laboratory Qualifier Codes and, June 13, 2005.

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

United States Environmental Protection Agency, 1986. Quality Criteria for Water. Office of Water. EPA 440/4-91-001.

Appendix 7.2
Water Quality Data

Table 7-1. ADEM Pathogen Data Collected on East Branch Luxapallila Creek (1999)

Station ID	Visit Date	Flow (cfs)	Flow Stage	Fecal Coliform (col/100 ml)	Percent Reduction (Singal Sample)	Fecal Coliform dc
EBLC-1	5/27/1999			128		
EBLC-1	6/9/1999			1620		
EBLC-1	7/13/1999			200		
EBLC-1	8/3/1999			1600		
EBLC-1	9/7/1999			1200		G
EBLC-2	5/20/1999			336		
EBLC-2	6/9/1999			1140		
EBLC-2	7/13/1999			270		
EBLC-2	8/3/1999			390		
EBLC-2	9/7/1999			390		
EBRM-72	5/20/1999			230		
EBRM-72	6/9/1999	1.8		256		
EBRM-72	6/24/1999					
EBRM-72	7/13/1999			170		
EBRM-72	8/3/1999			116		
EBRM-72	9/7/1999			430		
EBRM-72	6/26/2001	2				
EBRM-72	9/18/2001	1.1		97		

G = The analyte is present, but the amount of the analyte is determined to be above an acceptable level for quantitation. QC measurements indicate a low bias for the sample result reported or an accurate result cannot be calculated, but is determined to be greater than the value given (Micro: The actual number was greater than the number reported)

Table 7-2. 2011 ADEM Pathogen DataCollected with Percent Reductions from East Branch Luxapallila Creek

Station ID	Visit Date	Flow (cfs)	Flow Stage	E Coli (col/100 ml)	Percent Reduction (Singal Sample)	E Coli dc	E Coli - Geomean (col/100 ml)	Percent Reduction (Geomean)
EBLC-1	4/4/2011		NORMAL	117.8		JH		
EBLC-1	5/9/2011	20.3598	NORMAL	461.1				
EBLC-1	5/25/2011	10.3152	NORMAL	488.4				
EBLC-1	6/27/2011	9.5537	LOW	248.1				
EBLC-1	7/6/2011	11.8575	LOW	152.9			140.85	19.49%
EBLC-1	7/11/2011	8.2413	LOW	153.9				
EBLC-1	7/14/2011		LOW	78.9				
EBLC-1	7/18/2011	6.3312	LOW	77.1				
EBLC-1	7/21/2011	12.7812	NORMAL	387.3				
EBLC-1	8/24/2011	5.6048	LOW	107.6				
EBLC-1	9/1/2011	4.6966	LOW	110.6			200.98	43.58%
EBLC-1	9/12/2011			172.3				
EBLC-1	9/15/2011	22.0286	NORMAL	866.4	49.41%			
EBLC-1	9/22/2011	10.9141	NORMAL	162.4				
EBLC-1	9/28/2011	9.3073	NORMAL	122.3				
EBLC-1	10/12/2011	6.8164	LOW	93.4		H		
EBLC-2	4/4/2011		NORMAL	160.7		H		
EBLC-2	5/9/2011	14.3908	NORMAL	285.1				
EBLC-2	5/25/2011	7.6588	NORMAL	224.7				
EBLC-2	6/27/2011	6.254	NORMAL	517.2	15.26%			
EBLC-2	7/6/2011	6.8338	NORMAL	1203.3	63.58%		1022.33	88.91%
EBLC-2	7/11/2011	5.9733	NORMAL	787	44.31%			
EBLC-2	7/14/2011		NORMAL	435.2				
EBLC-2	7/18/2011	4.5564	LOW	1119.9	60.86%			
EBLC-2	7/21/2011	6.7598	NORMAL	2419.6	81.89%			
EBLC-2	8/24/2011	4.5271	NORMAL	172.6				
EBLC-2	9/1/2011	3.4308	NORMAL	435.2			649.31	82.54%
EBLC-2	9/12/2011	7.2719	ABOVE NORMAL	816.4	46.31%			
EBLC-2	9/15/2011	14.5414	NORMAL	1986.3	77.93%			
EBLC-2	9/22/2011	7.3215	NORMAL	547.5	19.95%			
EBLC-2	9/28/2011	5.0738	NORMAL	298.7				
EBLC-2	10/12/2011	5.5156	NORMAL	1732.9	74.71%	H		
EBRM-72	4/4/2011		NORMAL	121.1		H		
EBRM-72	5/9/2011	5.6312	NORMAL	152.9				
EBRM-72	5/25/2011	2.2812	NORMAL	62				
EBRM-72	6/27/2011	1.5425	LOW	22.3				
EBRM-72	7/6/2011	2.0138	LOW	60.5			53.85	
EBRM-72	7/11/2011	1.0373	LOW	29.8				
EBRM-72	7/14/2011		LOW	72.7				
EBRM-72	7/18/2011	0.9676	LOW	22.8				
EBRM-72	7/21/2011	0.8993	LOW	151.5				
EBRM-72	8/24/2011	0.6582	LOW	108.1				
EBRM-72	9/1/2011	0.3412	LOW	118.7			161.15	29.63%
EBRM-72	9/12/2011	0.3412	NORMAL	60.9				
EBRM-72	9/15/2011	4.7808	ABOVE NORMAL	2419.6	81.89%			
EBRM-72	9/22/2011	2.3813	LOW	59.4				
EBRM-72	9/28/2011	1.4035	LOW	104.6				
EBRM-72	10/12/2011	1.0735	LOW	73.3		H		

H = The analytical holding times for analysis are exceeded.

JH = The identification of the analyte is acceptable; the reported value is an estimate. The analytical holding times for analysis are exceeded. Micro: Reported microbiological result is an estimate. The analytical holding time for analysis was exceeded.

Appendix 7.3
East Branch Luxapallila Creek Watershed Photos

Photo 7-1 East Branch Luxapallila Creek at Industrial Drive, January 24, 2011, Looking Upstream

Photo 7-2 East Branch Luxapallila Creek at Industrial Drive, January 24, 2011, Looking Downstream

Photo 7-3 East Branch Luxapallila Creek at EBLC-2 (Bankhead Highway 431), January 24, 2011 Looking Upstream

Photo 7-4 East Branch Luxapallila Creek at EBLC-2 (Bankhead Highway 431), January 24, 2011 Looking Downstream

Photo 7-5 East Branch Luxapallila Creek at County Road 14, January 24, 2011, Looking Upstream

Photo 7-6 East Branch Luxapallila Creek at County Road 14, January 24, 2011, Looking Downstream

Photo 7-7 East Branch Luxapallila Creek at County Road 68, January 24, 2011, Looking Upstream

Photo 7-8 East Branch Luxapallila Creek at County Road 68, January 24, 2011, Looking Downstream

Photo 7-9 East Branch Luxapallila Creek at State Highway 44, January 24, 2011, Looking Upstream

Photo 7-10 East Branch Luxapallila Creek at State Highway 44, January 24, 2011, Looking Downstream