



***Final***  
**Total Maximum Daily Load (TMDL)**  
**for**  
**Horse Creek**

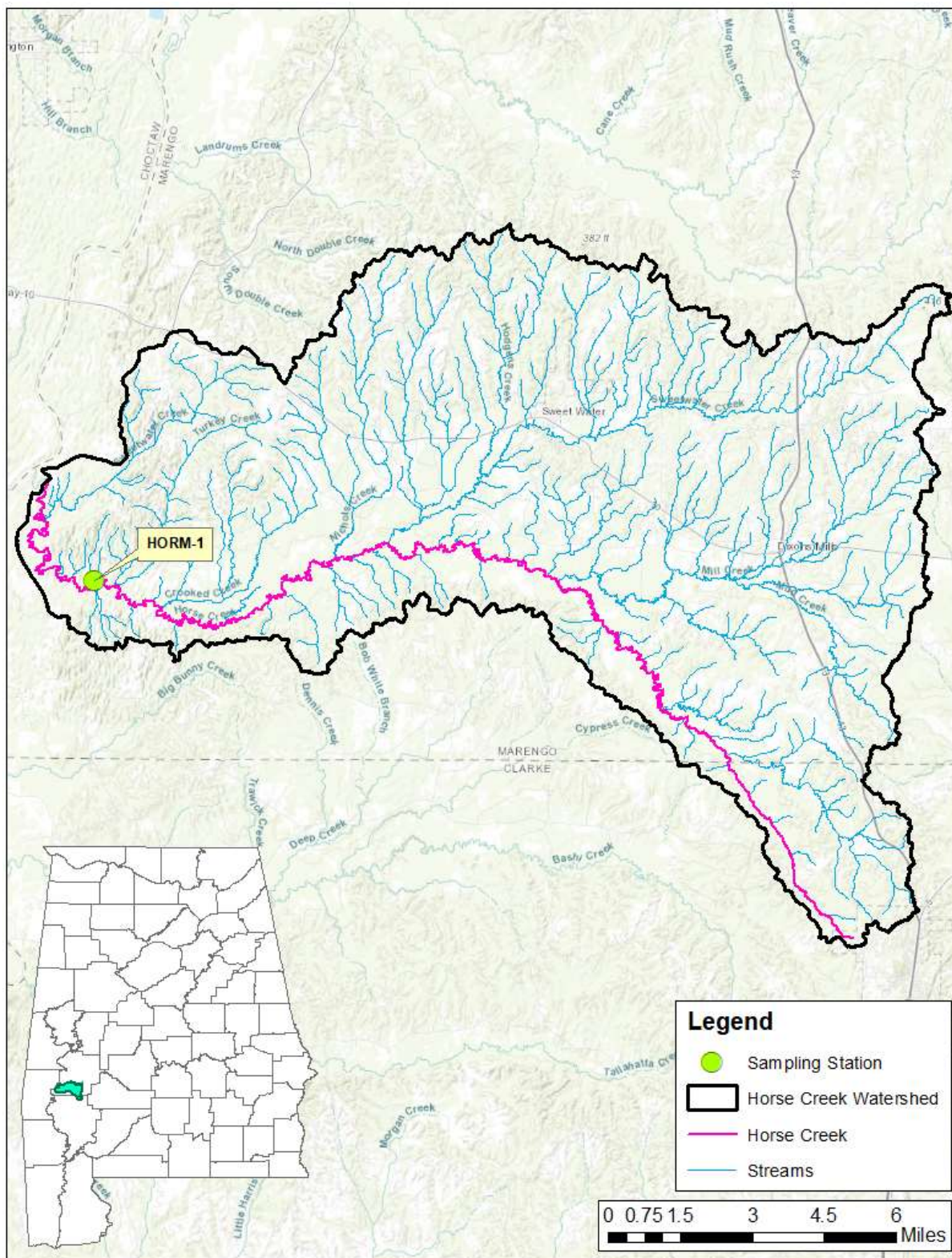
**Assessment Unit ID # AL03160201-0604-100**

**Marengo and Clarke Counties**

**Pathogens (*E. coli*)**

Alabama Department of Environmental Management  
Water Quality Branch  
Water Division  
July 2024

**Figure 1-1 Horse 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 waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS).

Horse Creek, part of the Tombigbee River Basin, is currently included on Alabama's §303(d) list for pathogens (*E. coli*) from its source to Coffeeville Lake. Horse Creek's headwaters begin northwest of Thomasville, Alabama near the northern border of Clarke County, and it flows west into the Tombigbee River (Coffeeville Lake). The total impaired length of Horse Creek is 44.52 miles, and the total drainage area of the Horse Creek watershed is 148.22 square miles. Horse Creek has use classifications of Swimming and Other Whole Body Water-Contact Sports (S) and Fish and Wildlife (F&W).

Horse Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM monitoring data collected in 2016 at stations HORM-1 and HORM-2. Horse Creek has subsequently been listed for pathogens on the 2020 and 2022 §303(d) lists of impaired waterbodies.

In 2022, sampling studies were performed by ADEM to further assess the water quality of the impaired stream. For the purposes of this TMDL, the 2022 data will be used to assess the water quality of Horse Creek because it provides the best picture of the current water quality of the stream. The 2024 edition of *Alabama's Water Quality Assessment and Listing Methodology*, prepared by ADEM, provides the rationale for the Department to use the most recent data to prepare a TMDL for an impaired waterbody. This TMDL will be developed from *E. coli* data collected at station HORM-1. This bacterial data is listed in Appendix 7.2, Table 7-2 for reference. ADEM collected eighteen *E. coli* samples and conducted two geometric mean studies on Horse Creek in 2022. According to the data, Horse Creek was not meeting the pathogen criteria applicable to its use classifications of S and F&W. Therefore, this TMDL has been developed for pathogens (*E. coli*) for the listed reach.

A mass balance approach was used for calculating the pathogen TMDL for Horse Creek. The mass balance approach utilizes the conservation of mass principle. The TMDL was calculated using the single sample or geometric mean sample exceedance event which resulted in the highest percent reduction. Existing loads were calculated by multiplying the *E. coli* concentrations times the respective instream flows and a conversion factor. In the same manner as existing loads were calculated, allowable loads were calculated for the single sample *E. coli* target of 211.5 colonies/100 ml (235 colonies/100 ml – 10% Margin of Safety) and geometric mean *E. coli* target of 113.4 colonies/100 ml (126 colonies/100 ml – 10% Margin of Safety). In this case, it was determined that the highest percent reduction was calculated from a single sample maximum *E. coli* exceedance at station HORM-1 (July 6, 2022) with a value of 1413.6 colonies/100 ml. This violation calls for a reduction of 85%.

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

**Table 1-1 *E. coli* Loads and Required Reductions for Horse Creek**

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Single Sample Load	2.14E+12	3.20E+11	1.82E+12	85%
Geometric Mean Load	1.85E+11	1.33E+11	5.21E+10	28%

**Table 1-2 *E. coli* TMDL for Horse Creek**

TMDL <sup>a</sup>	Margin of Safety (MOS)	Waste Load Allocation (WLA) <sup>e</sup>			Load Allocation (LA)	
		WWTPs <sup>b</sup>	MS4s <sup>c</sup>	Leaking Collection Systems <sup>d</sup>		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
3.55E+11	3.55E+10	NA	NA	0	3.20E+11	85%

Note: NA = not applicable

a. TMDL was established using the single sample criterion of 235 colonies/100ml.

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. There are no CAFOs in the Horse Creek watershed. Future CAFOs will be assigned a wasteload allocation (WLA) of zero.

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 to targeting the load reductions to improve water quality in the Horse Creek watershed. As additional data and/or information becomes 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 44.52 miles of Horse Creek as impaired for pathogens. The §303(d) listing for pathogens was originally reported on Alabama's 2018 List of Impaired Waters based on 2016 ADEM monitoring data from stations HORM-1 and HORM-2 and was subsequently included on the 2020 and 2022 lists. The source of the impairment on the 2022 §303(d) list is listed as animal feeding operations and pasture grazing.

### 2.2 Problem Definition

Waterbody Impaired: Horse Creek – From Coffeeville Lake to its source

Impaired Reach Length: 44.52 miles

Impaired Drainage Area: 148.22 square miles

Water Quality Standard Violation: Pathogens (Single Sample, Geometric Mean)

Pollutant of Concern: Pathogens (*E. coli*)

Water Use Classification: Swimming and Other Whole Body Water-Contact Sports (S)  
Fish and Wildlife (F&W)

Usage Related to Classification:

The impaired stream segment is classified as Swimming and Other Whole Body Water-Contact Sports (S) and Fish and Wildlife (F&W).

Usage of waters in the Swimming and Other Whole Body Water-Contact Sports classification is described in ADEM Admin. Code r. 335-6-10-.09(3)(a) and (b).

*(a) Best usage of waters: swimming and other whole body water-contact sports.*

*(b) Conditions related to best usage: the waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming areas and will be considered satisfactory for swimming and other whole body water-contact sports. The quality of waters will also be suitable for the propagation of fish, wildlife and aquatic*

*life. The quality of salt waters and estuarine waters to which this classification is assigned will be suitable for the propagation and harvesting of shrimp and crabs.*

Usage of waters in the Fish and Wildlife 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.*

*(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 year-round and whole body water-contact recreation during the months of May through October, 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 areas and will be considered satisfactory for swimming and other whole body water-contact sports.*

#### *E. coli* Criteria:

Criteria for acceptable bacteria levels for the Swimming and Other Whole Body Water-Contact Sports use classification are described in ADEM Admin. Code r. 335-6-10-.09(3)(c)6(i), (ii) and (iii) as follows:

#### *6. Bacteria:*

*(i) 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.*

*(ii) In all other areas, 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 235 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 104 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.*

*(iii) The policy of nondegradation of high quality waters shall be stringently applied to bacterial quality of recreational waters.*



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 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 whole body water-contact recreation during the months of May through October, 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 298 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.*

**Criteria Exceeded:**

Horse Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM's 2016 *E. coli* data from stations HORM-1 and HORM-2. Of the eight *E. coli* samples collected at station HORM-1 in 2016, two violated the applicable single sample maximum criterion of 235 colonies/100 ml. Of the eight *E. coli* samples collected at station HORM-2 in 2016, three violated the applicable single sample maximum criterion of 235 colonies/100 ml. The listing data can be found in Appendix 7.2, Table 7-1.

### **3.0 Technical Basis for TMDL Development**

#### **3.1 Water Quality Target Identification**

For the purpose of this TMDL, a single sample *E. coli* target of 211.5 colonies/100 ml will be used. This target was derived by using a 10% explicit margin of safety from the single sample maximum criterion of 235 colonies/100 ml. This target is considered protective of water quality standards and should not allow the single sample maximum criterion to be exceeded. In addition, a geometric mean target of 113.4 colonies/100 ml will be used for a series of five samples taken at least 24 hours apart over the course of 30 days. This geometric mean target was also derived by using a 10% explicit margin of safety from the geometric mean criterion of 126 colonies/100 ml. This

target is considered protective of water quality standards and should not allow the geometric mean criterion to be exceeded.

## 3.2 Source Assessment

### 3.2.1 Point Sources in the Horse 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 sewer systems 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 typically run parallel to streams in the floodplain. If a leaking sewer line is present, high concentrations of bacteria can flow into the stream or leach into the groundwater. Illicit discharges are found at facilities that are discharging bacteria when not permitted, or when the pathogens criterion established in the issued NPDES permit is not being upheld.

There are currently no NPDES-regulated point sources in the Horse Creek watershed that would contribute to the *E. coli* loading. There is one facility with an NPDES general permit in the watershed, as described in Table 3-1. This facility is not required to monitor for *E. coli* under its current NPDES permit and is not considered to be a source of pathogens due to the nature of its processes. As such, no *E. coli* loading will be attributed to this facility, nor will it receive an allocation in this TMDL. In addition, the Horse Creek watershed does not presently qualify as a municipal separate storm sewer system (MS4) area.

**Table 3-1** NPDES-Permitted Facility in the Horse Creek Watershed

Permit Number	Facility Name	Type of Operation
ALG110183	Ready Mix USA, LLC – Thomasville Facility	Concrete

There are currently no Animal Feeding Operation/Concentrated Animal Feeding Operation (AFO/CAFO) facilities located within the Horse Creek watershed. The ADEM AFO/CAFO rules prohibit discharges of pollutants from the facilities and their associated waste land application activities. As a result, future AFOs/CAFOs will receive a waste load allocation of zero.

Any future NPDES-regulated discharger that is considered by the Department to be a pathogen source will be required to demonstrate consistency with the assumptions and requirements of this TMDL.

### 3.2.2 Nonpoint Sources in the Horse 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 the primary source of *E. coli* bacteria in the Horse Creek watershed. Land use in this watershed is primarily forested/natural (78.52%), along with some agriculture (17.91%) and developed land (3.42%).

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.

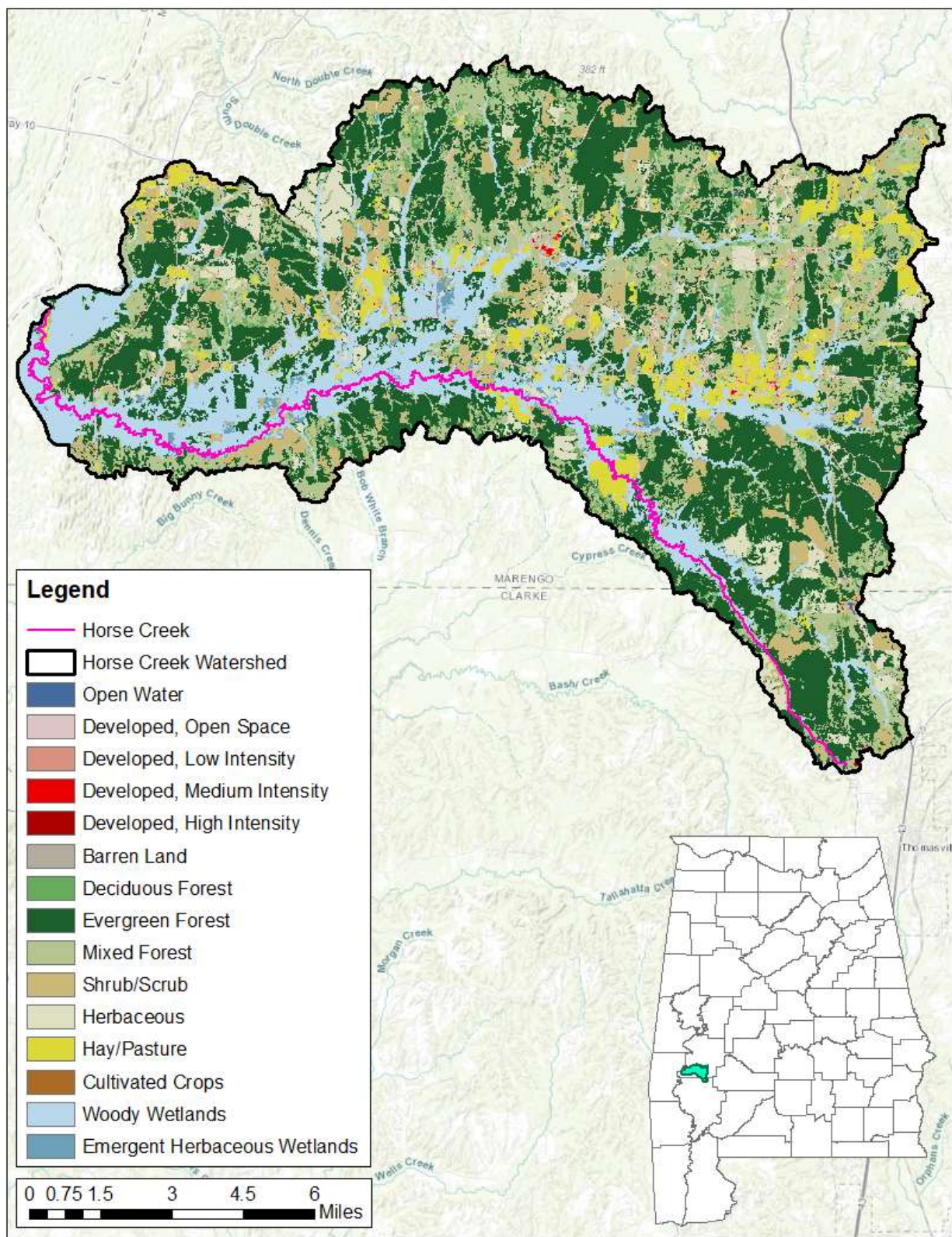
*E. coli* loading from urban areas is potentially attributable to multiple sources including storm water runoff, unpermitted discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, and domestic animals. Septic systems may be direct or indirect sources of bacterial 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 Horse Creek watershed was determined using ArcMap with land use datasets derived from the 2021 National Land Cover Dataset (NLCD). Figure 3-1 and Table 3-2 display the land use areas for the Horse Creek watershed.

The majority of the Horse Creek watershed is forested/natural (78.52%). Other land uses include agriculture (17.91%) and developed land (3.42%). 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.

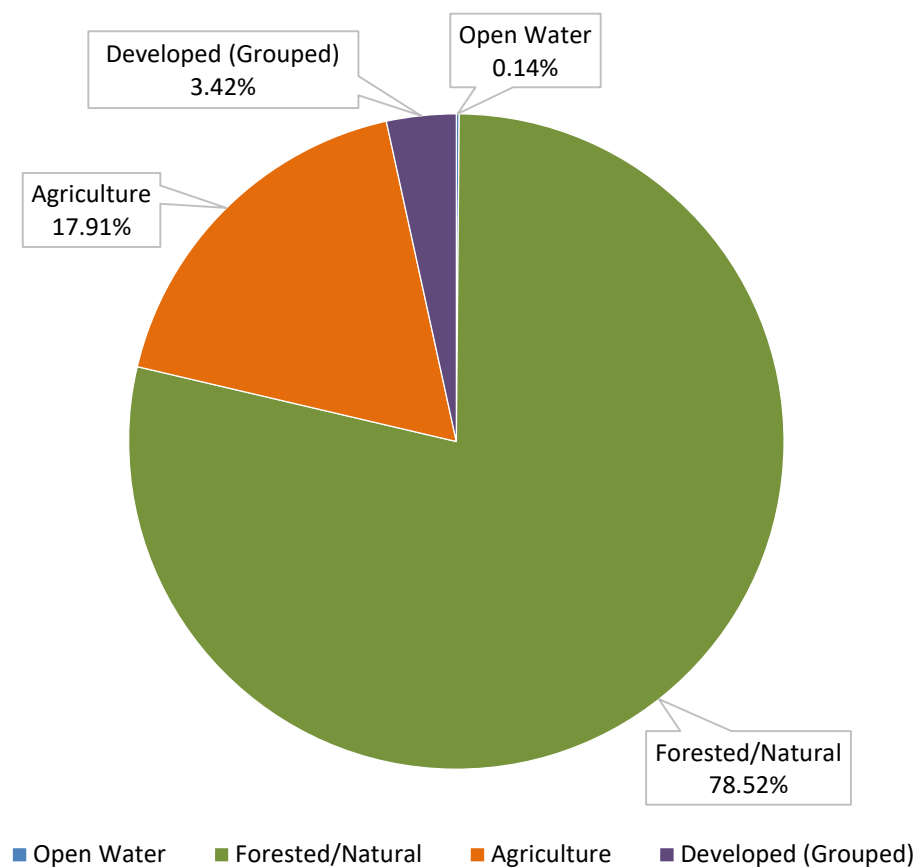
**Figure 3-1** Land Use Map for the Horse Creek Watershed



**Table 3-2** Land Use Areas for the Horse Creek Watershed

Cumulative Land Use	Square Miles (mi <sup>2</sup> )	Acres	Percent
Open Water	0.21	132.22	0.14%
Forested/Natural	116.39	74487.27	78.52%
Agriculture	26.55	16993.30	17.91%
Developed (Grouped)	5.08	3248.01	3.42%
<b>Total</b>	<b>148.22</b>	<b>94861.00</b>	<b>100.00%</b>

**Figure 3-2** Primary Land Uses in the Horse Creek Watershed



### 3.4 Linkage Between Numeric Targets and Sources

The Horse Creek watershed's main land use is forested/natural. 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 Horse Creek are from the agricultural land uses and possibly 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

In 2022, ADEM collected water quality data on Horse Creek at station HORM-1. Figure 1-1 and Table 3-3 display the location and description, respectively, for the ADEM sampling station. The 2022 data listed in Table 3-4 will be used for this TMDL. The January 2024 edition of *Alabama's Water Quality Assessment and Listing Methodology*, prepared by ADEM, provides the rationale for the Department to use the most recent data to prepare a TMDL for an impaired waterbody.

**Table 3-3** Horse Creek Sampling Station Description

Station ID	Station Location	Latitude	Longitude
HORM-1	Horse Creek at AL Hwy 69	32.04403	-88.03173

Of the eighteen *E. coli* samples collected at station HORM-1 during 2022, four violated the single sample maximum criterion of 235 colonies/100 ml for the Swimming and Other Whole Body Water-Contact Sports use classification. There were two sampling events that qualified for a geometric mean calculation at station HORM-1 in 2022; one geometric mean (10/6/2022 through 10/27/2022) exceeded the *E. coli* criterion of 126 colonies/100 ml. This data can be viewed in Table 3-4 and Appendix 7.2, Table 7-2.



**Table 3-4** 2022 *E. coli* Exceedances for the Horse Creek Watershed at Station HORM-1

Station HORM-1				
Visit Date	<i>E. coli</i> Single Sample (col/100 ml)	Geometric Mean (col/100 ml)	Detect Criteria <sup>a</sup>	Flow (cfs)
3/16/2022	816.4		H	230.6 <sup>b</sup>
4/12/2022	135.4		H	302.3 <sup>b</sup>
5/11/2022	26.2		H	107.2 <sup>b</sup>
5/19/2022	35			87.2 <sup>b</sup>
6/1/2022	75.8	59.6		109.7 <sup>b</sup>
6/8/2022	62.4		H	45.2 <sup>b</sup>
6/13/2022	35.9			40.3 <sup>b</sup>
6/15/2022	115.3			30.9 <sup>b</sup>
6/16/2022	38.4			35.3 <sup>b</sup>
7/6/2022	1413.6		H	61.8 <sup>b</sup>
8/10/2022	63.8		H	91.2 <sup>b</sup>
9/14/2022	461.1		H	147.2 <sup>b</sup>
10/6/2022	95.9	157.8		26
10/13/2022	866.4			166.8 <sup>b</sup>
10/17/2022	228.2			29.5
10/19/2022	60.2			23.8
10/25/2022	172.3			20.7
10/27/2022	78.6			21.1

a. H denotes that the analytical holding times for analysis are exceeded.

b. Flow was not measured due to non-wadeable conditions. Flow was calculated using data from reference gauge USGS 02470072 for the same date as the sample was collected at station HORM-1.

### 3.6 Critical Conditions/Seasonal Variation

The *E. coli* single sample maximum criterion of 235 colonies/100 ml and geometric mean criterion of 126 colonies/100 ml for the Swimming and Other Whole Body Water-Contact Sports use classification are applicable year-round. The critical condition for this pathogen TMDL was taken to be the one with the highest *E. coli* single sample exceedance value. The highest single sample maximum concentration of 1413.6 colonies/100 ml was collected on July 6, 2022 at station HORM-1. A flow of 61.8 cfs was calculated for station HORM-1 during this sampling event. The use of the highest exceedance to calculate the TMDL is expected to be protective of water quality in Horse Creek year-round.

### 3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: 1) by implicitly incorporating 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.

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 appropriate target criterion concentration by 10% and calculating a mass loading target with measured or estimated flow data. The single sample *E. coli* maximum value of 235 colonies/100 ml was reduced by 10% to 211.5 colonies/100 ml, while the geometric mean criterion of 126 colonies/100 ml was also reduced by 10% to 113.4 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 (WLAs) for point sources, 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:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS}$$

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 Horse 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 a conversion factor. Existing loads were calculated for the highest single sample exceedance and the highest geometric mean sample exceedance. In the same manner, allowable loads were calculated for both the single sample criterion of 235 colonies/100 ml and the geometric mean criterion of 126 colonies/100 ml. The TMDL was based on the violation that produced the highest percent reduction of *E. coli* loads necessary to achieve applicable water quality criteria, whether it be the single sample or geometric mean.

#### Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample exceedance concentration of 1413.6 colonies/100 ml times the calculated flow at the time the sample was taken. This concentration was measured at station HORM-1 on July 6, 2022. The stream flow was calculated to be 61.8 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 Horse Creek.



$$\frac{61.8 \text{ ft}^3}{s} \times \frac{1413.6 \text{ colonies}}{100 \text{ ml}} \times \frac{24,465,755 \text{ 100 ml} * s}{\text{ft}^3 * \text{ day}} = \frac{2.14 \times 10^{12} \text{ colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration of 157.8 colonies/100 ml times the average of the measured stream flows. This concentration was calculated based on measurements at station HORM-1 between October 6, 2022 and October 27, 2022, which are shown in Table 3-4. The average stream flow was determined to be 48.0 cfs. The product of these two values times the conversion factor gives the total mass loading (colonies per day) of *E. coli* to Horse Creek under the geometric mean exceedance condition.

$$\frac{48.0 \text{ ft}^3}{s} \times \frac{157.8 \text{ colonies}}{100 \text{ ml}} \times \frac{24,465,755 \text{ 100 ml} * s}{\text{ft}^3 * \text{ day}} = \frac{1.85 \times 10^{11} \text{ colonies}}{\text{day}}$$

### **Allowable Conditions**

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

For the **single sample** *E. coli* target concentration of 211.5 colonies/100 ml, the allowable *E. coli* loading is:

$$\frac{61.8 \text{ ft}^3}{s} \times \frac{211.5 \text{ colonies}}{100 \text{ ml}} \times \frac{24,465,755 \text{ 100 ml} * s}{\text{ft}^3 * \text{ day}} = \frac{3.20 \times 10^{11} \text{ colonies}}{\text{day}}$$

The explicit margin of safety of 23.5 colonies/100 ml equals a daily loading of:

$$\frac{61.8 \text{ ft}^3}{s} \times \frac{23.5 \text{ colonies}}{100 \text{ ml}} \times \frac{24,465,755 \text{ 100 ml} * s}{\text{ft}^3 * \text{ day}} = \frac{3.55 \times 10^{10} \text{ colonies}}{\text{day}}$$

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

$$\frac{48.0 \text{ ft}^3}{s} \times \frac{113.4 \text{ colonies}}{100 \text{ ml}} \times \frac{24,465,755 \text{ 100 ml} * s}{\text{ft}^3 * \text{ day}} = \frac{1.33 \times 10^{11} \text{ colonies}}{\text{day}}$$

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

$$\frac{48.0 \text{ ft}^3}{s} \times \frac{12.6 \text{ colonies}}{100 \text{ ml}} \times \frac{24,465,755 \text{ 100 ml} * s}{\text{ft}^3 * \text{ day}} = \frac{1.48 \times 10^{10} \text{ colonies}}{\text{day}}$$

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 criteria. The TMDL was calculated as the total daily *E. coli* load to Horse Creek as evaluated at station HORM-1. Table 4-1 shows the existing and allowable *E. coli* loads and required reductions for the Horse Creek watershed.

**Table 4-1 *E. coli* Loads and Required Reductions for Horse Creek**

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Single Sample Load	2.14E+12	3.20E+11	1.82E+12	85%
Geometric Mean Load	1.85E+11	1.33E+11	5.21E+10	28%

From Table 4-1, compliance with the single sample criterion of 235 colonies/100 ml requires a reduction in the *E. coli* load of 85%. 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 Horse Creek**

TMDL <sup>a</sup>	Margin of Safety (MOS)	Waste Load Allocation (WLA) <sup>e</sup>			Load Allocation (LA)	
		WWTPs <sup>b</sup>	MS4s <sup>c</sup>	Leaking Collection Systems <sup>d</sup>		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
3.55E+11	3.55E+10	NA	NA	0	3.20E+11	85%

Note: NA = not applicable

a. TMDL was established using the single sample criterion of 235 colonies/100ml.

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. There are no CAFOs in the Horse Creek watershed. Future CAFOs will be assigned a wasteload allocation (WLA) of zero.

### 4.3 TMDL Summary

Horse Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM's 2016 *E. coli* data from stations HORM-1 and HORM-2. In 2022, ADEM collected water quality data that confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the *E. coli* TMDL for Horse Creek. Based on the TMDL analysis, it was determined that an 85% 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 load allocation portion of this TMDL will be implemented through voluntary measures/best management practices (BMPs). Cooperation and active participation by the public and various other groups are critical to successful implementation of TMDLs. Local, citizen-led, and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. Therefore, TMDL implementation activities for nonpoint sources will be coordinated through interaction with local entities and may be eligible for CWA §319 grants through the Department's Nonpoint Source Unit.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria, and we are committed to targeting the load reductions to improve water quality in the Horse Creek 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 monitoring, an approach that divides Alabama's sixteen major river basins into three groups. Each year, ADEM's water quality resources are concentrated in one of the three basin groups and are divided among multiple priorities including §303(d) listed waterbodies, waterbodies with active TMDLs, and other waterbodies as determined by the Department. Monitoring will help further characterize water quality conditions resulting from the implementation of best management practices and load reductions in the watershed. This monitoring will occur in each basin according to the schedule shown in Table 5-1.

**Table 5-1** Follow-Up Monitoring Schedule

<b>River Basin Group</b>	<b>Years to be Monitored</b>
Black Warrior, Blackwater, Chattahoochee, Chipola, Choctawhatchee, Escambia, Perdido, Tennessee (Wheeler), Yellow	2024/2027
Coosa, Escatawpa, Tennessee (Guntersville), Tombigbee	2025/2028
Alabama, Cahaba, Mobile, Tallapoosa, Tennessee (Pickwick and Wilson)	2026/2029

## 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 four newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL were made available on ADEM's Website: [www.adem.alabama.gov](http://www.adem.alabama.gov). The public could also request paper or electronic copies of the TMDL by contacting Ms. Kimberly Minton at 334-271-7826 or [kminton@adem.alabama.gov](mailto:kminton@adem.alabama.gov). The public was given an opportunity to review the TMDL and submit comments to the Department in writing. No written comments were received during the public notice period.

## 7.0 Appendix

### 7.1 References

ADEM Administrative Code, 2021. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

ADEM Administrative Code, 2021. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's Monitoring Program. 2016 & 2022. ADEM.

Alabama Department of Environmental Management (ADEM), *Alabama's Water Quality Assessment and Listing Methodology*, January 2022.

Alabama Department of Environmental Management, 2018, 2020 & 2022 §303(d) Lists and Fact Sheets. ADEM.

Alabama Department of Environmental Management (ADEM), Laboratory Data Qualification SOP #4910 Revision 7.2, 2022.

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.

## 7.2 Water Quality Data

**Table 7-1 2016 ADEM Pathogen Data Collected on Horse Creek**

	Visit Date	<i>E. coli</i> Single Sample (col/100 ml)	Detect Criteria <sup>a,b</sup>	Flow (cfs)
Station HORM-1	3/9/2016	178.5		
	4/14/2016	770.1		
	5/5/2016	517.2		
	6/8/2016	88.4	H	25.2
	7/13/2016	74.6	H	34.3
	8/3/2016	42.8	H	8.8
	9/14/2016	52.9	H	3
	10/12/2016	167	H	
Station HORM-2	3/8/2016	178.2	H	
	4/13/2016	920.8	H	
	5/4/2016	1540.2	H	
	6/8/2016	93.3	H	
	7/13/2016	176.8	H	
	8/3/2016	4839.2	GH	
	9/14/2016	152.9	H	
	10/12/2016	167	H	

a. G denotes that the amount of analyte is above an acceptable level for quantification and is likely higher than the reported value.

b. H denotes that the analytical holding times for analysis are exceeded.

**Table 7-2** 2022 ADEM Pathogen Data Collected on Horse Creek

<b>Station HORM-1</b>			
<b>Visit Date</b>	<b><i>E. coli</i> Single Sample (col/100 ml)</b>	<b>Detect Criteria<sup>a</sup></b>	<b>Flow (cfs)</b>
3/16/2022	816.4	H	
4/12/2022	135.4	H	
5/11/2022	26.2	H	
5/19/2022	35		
6/1/2022	75.8		
6/8/2022	62.4	H	
6/13/2022	35.9		
6/15/2022	115.3		
6/16/2022	38.4		
7/6/2022	1413.6	H	
8/10/2022	63.8	H	
9/14/2022	461.1	H	
10/6/2022	95.9		26
10/13/2022	866.4		
10/17/2022	228.2		29.5
10/19/2022	60.2		23.8
10/25/2022	172.3		20.7
10/27/2022	78.6		21.1

a. H denotes that the analytical holding times for analysis are exceeded.

### 7.3 Horse Creek Watershed Photos (March 16, 2022)

**Figure 7-1** Horse Creek at Highway 69 (HORM-1), Looking Upstream



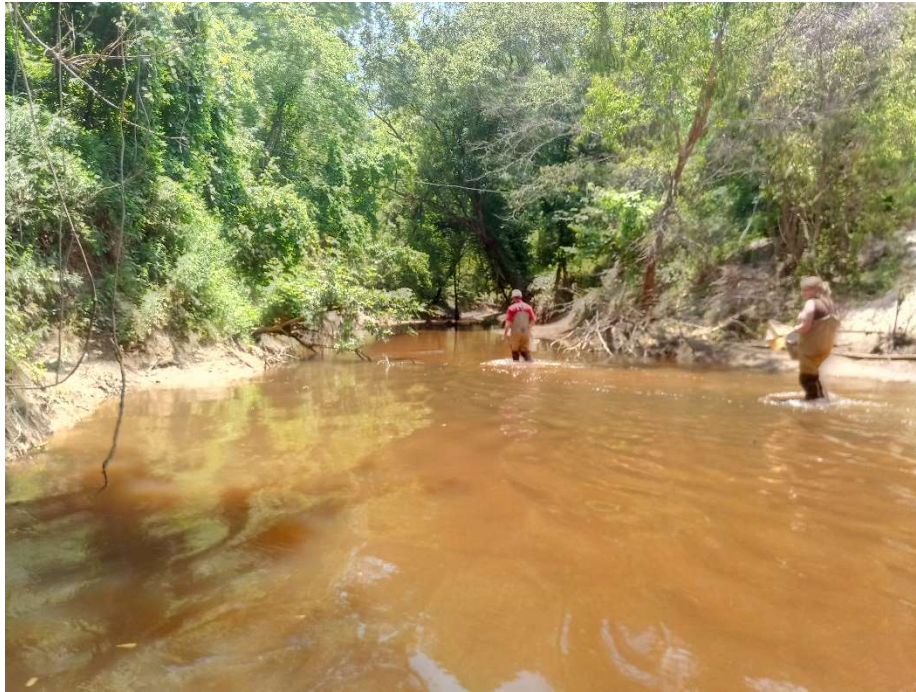
**Figure 7-2** Horse Creek at Highway 69 (HORM-1), Looking Downstream





## 7.4 Horse Creek Watershed Photos (June 22, 2022)

**Figure 7-3** Horse Creek at Highway 69 (HORM-1), Looking Upstream



**Figure 7-4** Horse Creek at Highway 69 (HORM-1), Looking Downstream

