Draft

Total Maximum Daily Load (TMDL)

For

Coffee Creek

Assessment Unit ID# AL03150203-0103-200

Pathogens (*E. coli*)

Alabama Department of Environmental Management

Water Quality Branch

Water Division

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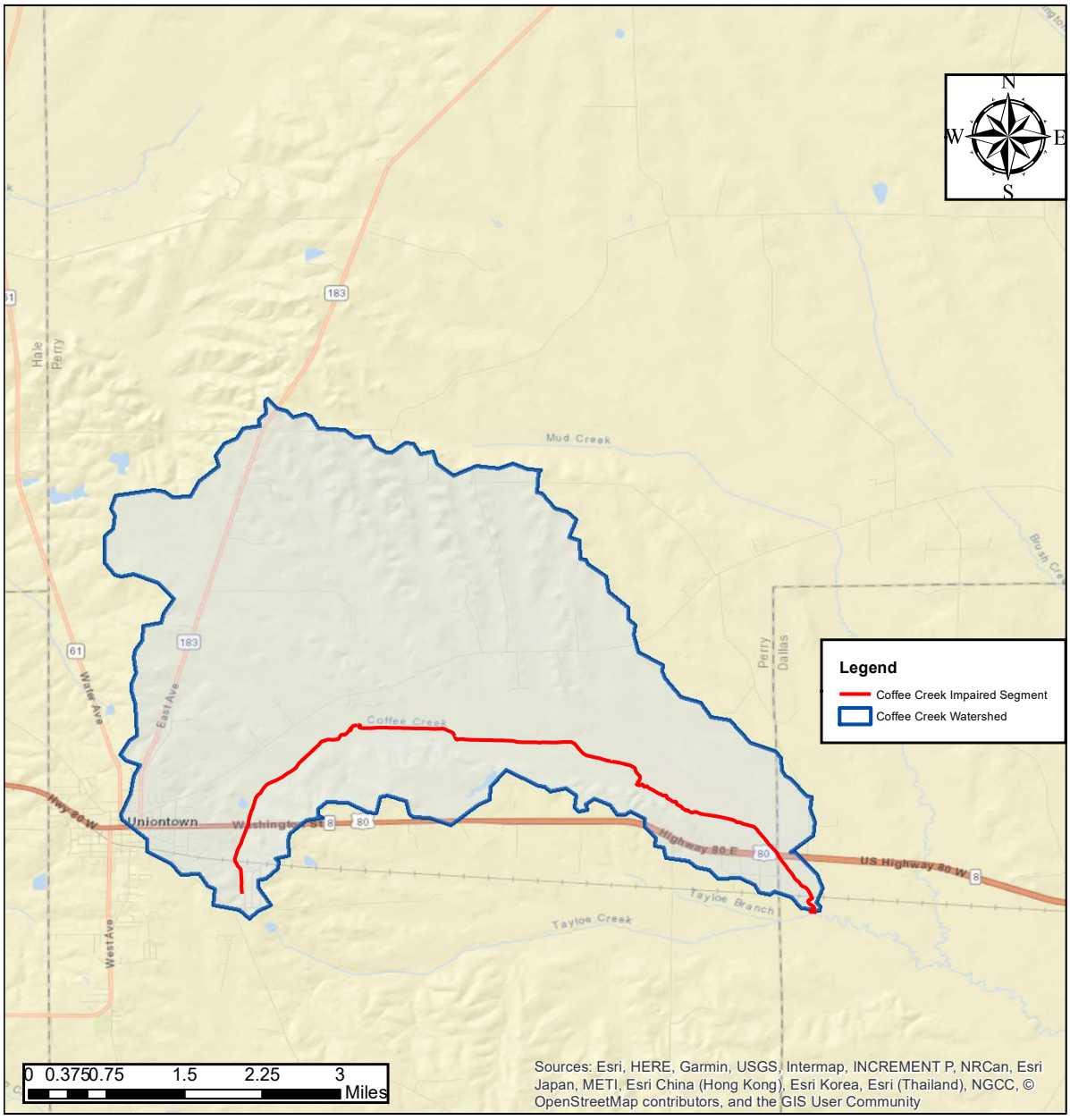
Figure 1: Coffee Creek Watershed



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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).

Coffee Creek, a part of the Alabama River basin, is currently included on Alabama's §303(d) list as impaired for pathogens (*E. coli*), nutrients, and siltation. This TMDL will address the pathogens (*E.* coli) impairment. Coffee Creek has a designated use classification of Fish and Wildlife (F&W). The headwater source of Coffee Creek begins near Uniontown, Alabama. The creek flows through Perry County and ends in Dallas County at its confluence with Tayloe Creek, which flows to Mud Creek. The total drainage area for the Coffee Creek watershed is approximately 15.8 square miles.

Coffee Creek was first listed as impaired for pathogens on the §303(d) list in 2010 based on data collected by the Alabama Department of Environmental Management (ADEM) in 2005. The exceedances were found at station COFP-1. This data, which can be found in Table 8, indicated the stream was impaired for fecal coliform. The pathogen indicator for non-coastal waters was changed in December 2009 from fecal coliform to *Escherichia coli* (*E. coli*). Due to this change, Coffee Creek was sampled in 2018 for *E. coli*, which will be the basis for this TMDL.

In 2018, §303(d) sampling studies were performed by ADEM on Coffee Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2018 data will be used to assess the water quality of Coffee Creek because it is the most current data and provides the best picture of the current water quality conditions of the stream. The 2018 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. Also, as a result of the Alabama Environmental Management Commission's (EMC) adoption of the *E. coli* criteria as the new bacterial indicator, this TMDL will be developed from *E. coli* data collected at station COFP-1. All of the applicable bacteria data is listed in the Appendix for reference. ADEM collected sixteen samples from Coffee Creek in 2018 and, according to the collected data, Coffee Creek was not meeting the pathogen criteria applicable to its use classification of Fish and Wildlife.

A mass balance approach was used for calculating the pathogen TMDL for Coffee Creek. The mass balance approach utilizes the conservation of mass principle. Existing loads were calculated by multiplying the *E. coli* concentrations times the respective in-stream flows and a conversion factor. The mass loading was calculated using the single sample or geometric mean sample exceedance event which resulted in the highest percent reduction. In this case, it was determined that the highest percent reduction was calculated from a geometric mean *E. coli* exceedance at station COFP-1 (6/6/2018 – 6/25/18) with a value of 647.88 colonies/100 ml. This violation calls for a reduction of 83%. In the same manner as existing loads were calculated, an allowable load was calculated for the geometric mean *E. coli* target of 113.4 colonies/100 ml (126 colonies/100 ml – 10% Margin of Safety).

Table 1 is a summary of the estimated existing load, allowable load, and percent reduction for the single sample criterion and the geometric mean criterion. Table 2 lists the TMDL, defined as the maximum allowable *E. coli* loading under critical conditions for Coffee Creek.

Table 1. *E. coli* Load and Required Reduction

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Nonpoint Source Load-Single Sample	4.71E+10	8.94E+9	3.82E+10	81%
Nonpoint Source Load-Geometric Mean	2.43E+10	4.24E+9	2.01E+10	83%
Point Source Load	N/A[a]	N/A[a]	N/A[a]	N/A[a]

a. No applicable NPDES permitted outfalls in the watershed.

Table 2. *E. coli* TMDL for Coffee 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
4.72E+9	4.72E+8	N/A	N/A	0	4.24E+9	83%

Note: N/A = not applicable
a. There are no CAFOs in the Coffee Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. Future WWTPs must meet the applicable in-stream 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/100 ml.

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 Coffee 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 in-stream 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 6.88-mile segment of Coffee Creek as impaired for pathogens. Coffee Creek was originally listed on Alabama's 2010 List of Impaired Waters for nutrients, pathogens, and siltation (habitat alteration) based on data collected in 2005. The source of the pathogens impairment is listed on the 2018 §303(d) list as pasture grazing.

2.2 Problem Definition

Waterbody Impaired:	Coffee Creek – from Tayloe Creek to its source
Impaired Reach Length:	6.88 miles
Impaired Drainage Area:	15.8 square miles
Water Quality Standard Violation:	Pathogens (Single Sample Maximum, Geometric Mean)
Pollutant of Concern:	Pathogens (*E. coli*)
Water Use Classification:	Fish and Wildlife

Usage Related to Classification:

The impaired stream segment is classified as Fish and Wildlife (F&W). Usage of waters in this classification is described in ADEM Admin. Code R. 335-6-10-.09(5) (a), (b), (c), and (d).

(a) Best usage of waters: fishing, propagation of fish, aquatic life, and wildlife.

(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 F&W 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:

Data collected in 2005 was used as the basis for including Coffee Creek on Alabama's 2010 §303(d) list. It was listed for nutrients, pathogens, and siltation (habitat alteration). Monthly sample results taken from station COFP-1 for fecal coliform showed 3 out of 6 samples exceeding the single sample criterion. Fecal coliform was the indicator species for the pathogens criteria until it was changed to *E. coli* in 2009.

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 were 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 COFP-1, which was sampled most recently in 2018.

For the purpose of this TMDL, a single sample maximum *E. coli* target of 268.2 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 298 colonies/100 ml. This target is considered protective of water quality standards and should not allow the single sample maximum of 298 colonies/100 ml to be exceeded. In addition, a geometric mean *E. coli* target of 113.4 colonies/100 ml will be used for a series of no less than five samples taken at least 24 hours apart over the course of 30 days. This target was derived by using a 10% explicit margin of safety from the geometric mean maximum criterion of 126 colonies/100 ml. This target is considered protective of water quality standards and should not allow the geometric mean of 126 colonies/100 ml to be exceeded.

3.2 Source Assessment

3.2.1 Point Sources in the Coffee Creek Watershed

A point source can be defined as a discernible, 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 no NPDES regulated point sources in the Coffee Creek watershed that would contribute to the *E. coli* loading. There are several facilities with NPDES General Permits in the watershed; however, it is not believed that they are contributing to the pathogen impairment in Coffee Creek based on their activities and the fact that they are not discharging process wastewater. In addition, the Coffee Creek watershed does not presently qualify as a municipal separate storm sewer system (MS4) area. Therefore, the WLA portion of the TMDL will be zero. Any future NPDES regulated discharges that are considered by the Department to be a pathogen source will be required to meet the in-stream water quality criteria for pathogens at the point of discharge.

3.2.2 Nonpoint Sources in the Coffee Creek Watershed

Nonpoint sources of bacteria do not have a defined discharge point, but rather occur over the entire length of a stream or waterbody. On the land surface, bacteria can accumulate over time and be washed into streams or waterbodies during rain events. Therefore, there is some net loading of bacteria into streams as dictated by the watershed hydrology.

Agricultural land can be a source of *E. coli* bacteria. Stormwater runoff from pastures and animal feeding areas can be a source of E. coli. In addition, improper land application of animal wastes and animals with direct access to streams are mechanisms that can contribute 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 will 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 developed 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. On-site 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 due to system failures and malfunctions.

3.3 Land Use Assessment

Land use for the Coffee Creek watershed was determined using ArcMap with land use datasets derived from the 2011 National Land Cover Dataset (NLCD). The total drainage area of the Coffee Creek watershed is approximately 15.8 square miles. Table 3 depicts the primary land uses in the Coffee Creek watershed.

The majority of the Coffee Creek watershed is comprised of agricultural lands at 48.6%. The remaining land use is approximately 38.7% forested, 7.6% developed land, and 5% open water. Developed land includes both commercial and residential land uses.

Figure 2. Land Use in the Coffee Creek Watershed

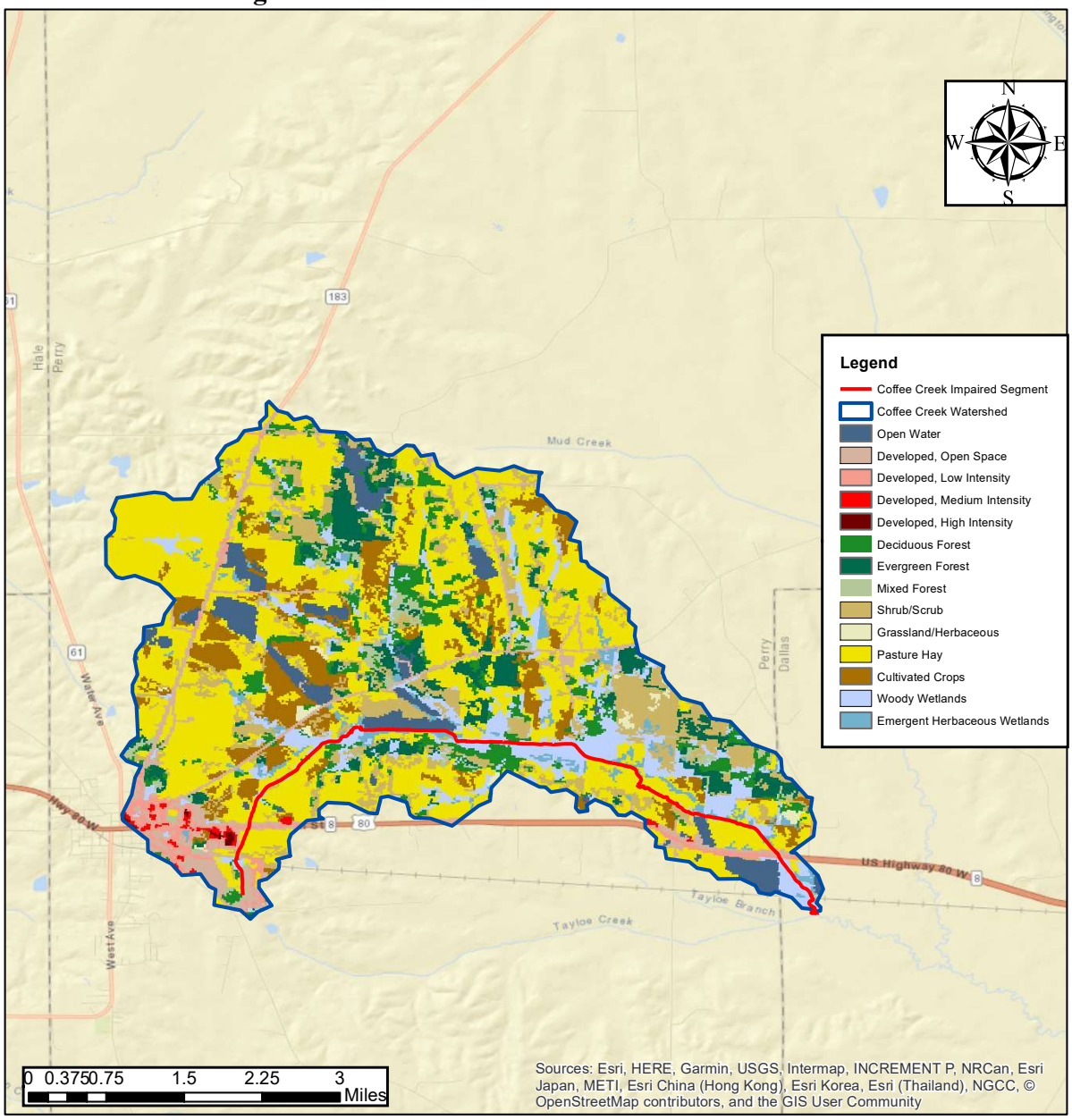

Figure 3: Pie Chart of Land Use Distribution in the Coffee Creek watershed

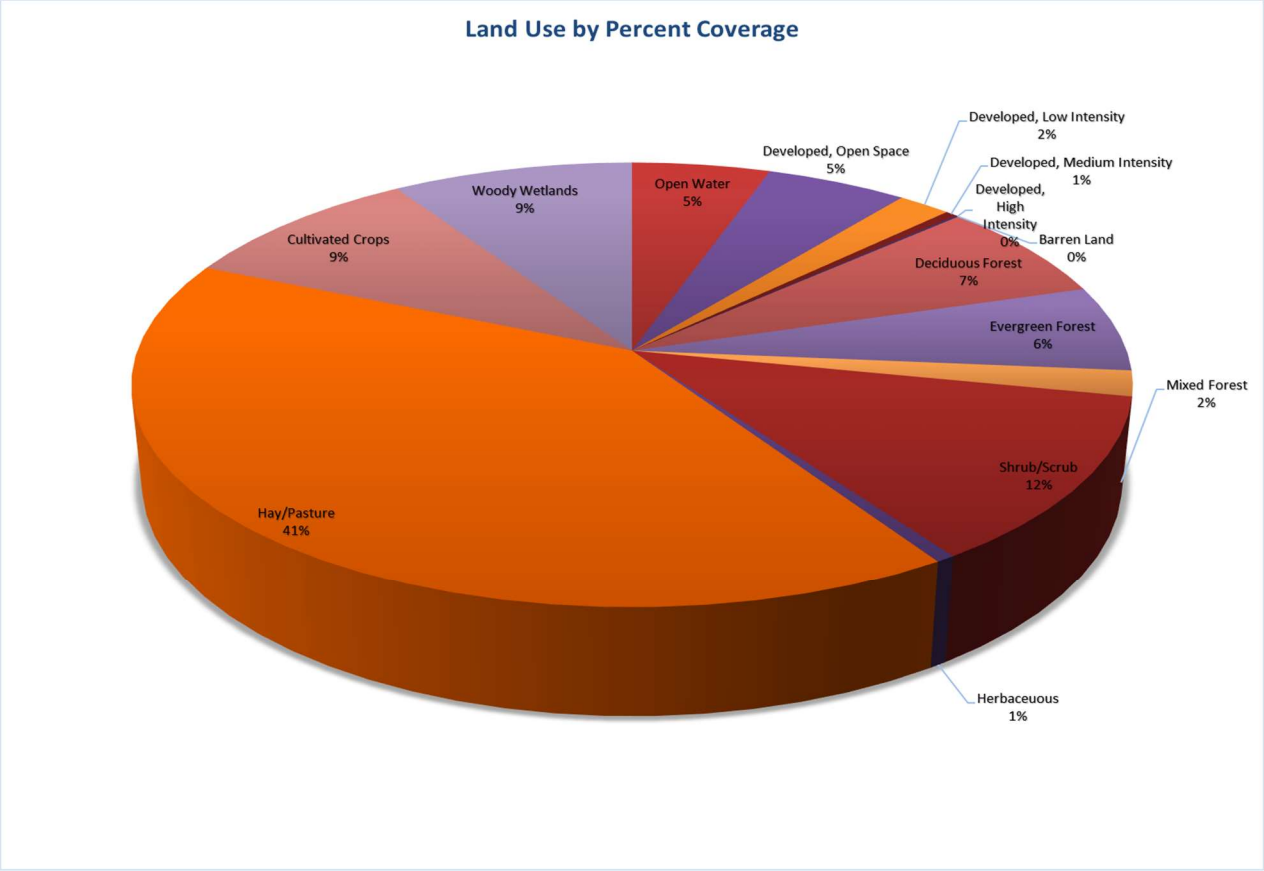

Table 3: Land Use (2011) in the Coffee Creek Watershed

Land Use	Miles^2	Acres	Percent
Open Water	0.80	510.84	5.04%
Developed, Open Space	0.82	522.85	5.16%
Developed, Low Intensity	0.31	196.15	1.94%
Developed, Medium Intensity	0.07	42.70	0.42%
Developed, High Intensity	0.02	11.79	0.12%
Barren Land	0.00	0.00	0.00%
Deciduous Forest	1.10	706.77	6.98%
Evergreen Forest	0.96	612.92	6.05%
Mixed Forest	0.28	181.92	1.80%
Shrub/Scrub	1.87	1196.93	11.82%
Herbaceous	0.08	54.04	0.53%
Hay/Pasture	6.26	4006.89	39.56%
Cultivated Crops	1.43	918.27	9.07%
Woody Wetlands	1.39	891.14	8.80%
Emergent Herbaceous Wetlands	0.43	275.55	2.72%
Totals→	**15.83**	**10128.75**	**100.00%**

Class Description	Miles[2]	Acres	Percent
Open Water	0.80	510.84	5.04%
Agricultural Lands	7.70	4925.16	48.63%
Forested/Natural	6.12	3919.26	38.69%
Developed Land (Grouped)	1.21	773.49	7.64%
Totals→	**15.83**	**10128.75**	**100.00%**

3.4 Linkage between Numeric Targets and Sources

The major land usages in the Coffee Creek watershed are agricultural and forested land. 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 Coffee Creek are from the agricultural land uses in the area and potential leaking or failing septic tanks. 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 will be calculated as a single total nonpoint source load and reduction.

3.5 Data Availability and Analysis

In 2018, §303(d) sampling was performed by ADEM on Coffee Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2018 data will be used to assess the water quality of Coffee Creek because it is the most current data and provides the best picture of the current water quality conditions of the stream. The 2018 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. Also, as a result of the EMC's adoption of the *E. coli* criteria as the new bacterial indicator, this TMDL will be developed from *E. coli* data.

In 2018, ADEM collected monthly water quality data for the Coffee Creek watershed at station COFP-1. A description of the location of station COFP-1 can be found in Table 4 and a map showing the location of station COFP-1 can be found in Figure 4. A total of sixteen *E. coli* samples were collected at station COFP-1 in 2018. Of the sixteen samples that were collected, there were six exceedances of the single sample maximum criterion. In addition, there was a geometric mean exceedance at station COFP-1 in June 2018. Sampling completed at station COFP-1 between June 6, 2018 and June 25, 2018 yielded a geometric mean violation of 647.88 colonies/100 ml. The average of the flows taken during this sampling period was calculated to be 1.53 cfs, which was used for geometric mean load calculations. A summary of the 2018 *E. coli* data can be found below in Table 5. A complete list of available data used in this report and pictures of COFP-1 can be found in Appendices 7.2 and 7.3, respectively.

Table 4: ADEM Sampling Station in the Coffee Creek Watershed

Station Name	Agency Name	Latitude	Longitude	Description
COFP-1	ADEM	32.44576699	-87.42329205	Coffee Creek at Highway 80 approximately 5 miles before Uniontown, AL

Figure 4: ADEM sampling station in the Coffee Creek Watershed

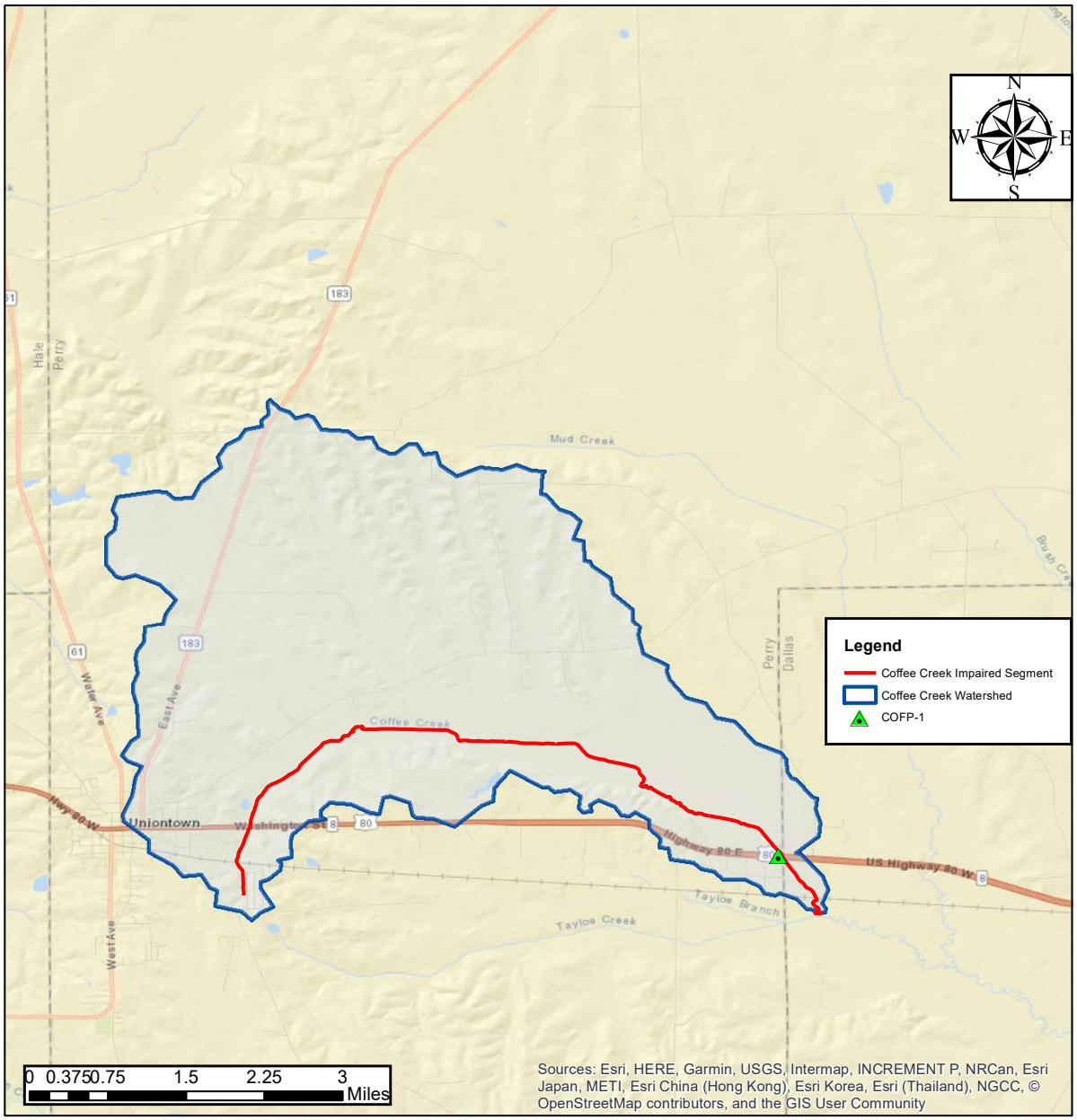

Table 5: *E. coli* Exceedances on Coffee Creek AL03150203-0103-200

Station ID	Visit Date	E Coli (col/100ml)	Single Sample Criteria (col/100ml)	E Coli Geometric Mean (col/100ml)	Geometric Mean Criteria (col/100ml)	Flow (cfs)
COFP-1	3/13/2018	866.4	2507			21.28
COFP-1	4/4/2018	1413.6	2507			1.252
COFP-1	5/2/2018	-	298			0.285
COFP-1	5/9/2018	69.1	298			-
COFP-1	6/6/2018	**488.4**	298	**647.88**		3.092
COFP-1	6/12/2018	**1413.6**	298			1.363
COFP-1	6/18/2018	**437.4**	298			1.5849
COFP-1	6/19/2018	**686.7**	298			1.6981
COFP-1	6/21/2018	**920.8**	298		126	0.609
COFP- 1	6/25/2018	**387.3**	298			0.8398
COFP-1	8/22/2018	213	298	99.4		0.9892
COFP-1	8/23/2018	178.5	298			0.2017
COFP-1	8/27/2018	122.3	298			0.017
COFP-1	8/28/2018	14.5	298			-
COFP-1	8/29/2018	143.9	298			-
COFP-1	9/26/2018	26.4	298			-
COFP-1	10/31/2018	14.4	298			-

3.6 Critical Conditions

Critical conditions typically occur during the summer months (May – October). 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 bacteria into streams, resulting in spikes of bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of bacteria on the land surface, resulting in a more uniform loading rate.

The Coffee Creek watershed generally follows the trends described above for the summer months of May through October. The geometric mean concentration of 647.88 colonies/100 ml at station COFP-1 will be used to estimate the TMDL pathogen loadings to Coffee Creek under critical conditions. The highest *E. coli* geometric mean exceedance value occurred June 6, 2018 through June 25, 2018. An average flow of 1.53 cfs was calculated for station COFP-1 during this sampling period.

3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the TMDL 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.

Both an explicit and implicit MOS were incorporated into this TMDL. The MOS accounts for the uncertainty associated with the limited availability of data used in this analysis. An explicit MOS was applied to the TMDL by reducing the appropriate target criterion concentration by ten percent and calculating a mass loading target with measured flow data. The single sample *E. coli* maximum value of 298 colonies/100 ml was reduced by 10% to 268.2 colonies/100 ml, while the geometric mean criterion was reduced in the same fashion to 113.4 colonies/100 ml. An implicit MOS was also 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 waste load 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 both implicit and 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 Coffee 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 in-stream flow times a conversion factor. 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 and geometric mean criterion. 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 was the single sample or geometric mean sample.

4.2.1 Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample *E. coli* concentration of 1413.6 colonies/100 ml times the measured flow at the time the sample was taken. This concentration was based on a measurement at station COFP-1 on June 12, 2018. This measurement can be found in Appendix 7.2, Table 9. The product of the concentration, measured flow, and a conversion factor gives the total mass loading (colonies per day) of *E. coli* to Coffee Creek under the single sample exceedance condition.

$$\frac{1.363\ \text{ft}^3}{\text{s}} \times \frac{1413.6\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{4.71 \times 10^{10}\text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration of 647.88 colonies/100 ml times the average of the six measured flows. This concentration was calculated based on measurements at station COFP-1 between June 6, 2018 and June 25, 2018, and can be found in Appendix 7.2, Table 9. The average stream flow was determined to be 1.53 cfs. The product of these two values times the conversion factor gives the total mass loading (colonies per day) of *E. coli* to Coffee Creek under the geometric mean exceedance condition.

$$\frac{1.53\ \text{ft}^3}{\text{s}} \times \frac{647.88\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.43 \times 10^{10}\text{colonies}}{\text{day}}$$

4.2.2 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 measured flow for the violation event, the allowable concentration, and the conversion factor.

For the **single sample** *E. coli* target concentration of 268.2 colonies/100 ml, the allowable *E. coli* loading is:

$$\frac{1.363\ \text{ft}^3}{\text{s}} \times \frac{268.2\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{8.94 \times 10^{9}\text{colonies}}{\text{day}}$$

The explicit margin of safety of 29.8 colonies/100 ml equals a daily loading of:

$$\frac{1.363\ \text{ft}^3}{\text{s}} \times \frac{29.8\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{9.94 \times 10^{8}\text{colonies}}{\text{day}}$$

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

$$\frac{1.53\ \text{ft}^3}{\text{s}} \times \frac{113.4\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{4.24 \times 10^{9}\text{colonies}}{\text{day}}$$

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

$$\frac{1.53\ \text{ft}^3}{\text{s}} \times \frac{12.6\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{4.72 \times 10^8 \text{colonies}}{\text{day}}$$

The difference between the existing conditions (violation event) and the allowable conditions 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 Coffee Creek as evaluated at station COFP-1. Table 6 shows the existing and allowable *E. coli* loads and required reductions for the Coffee Creek watershed.

Table 6: *E. coli* Load and Required Reduction

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Nonpoint Source Load-Single Sample	4.71E+10	8.94E+9	3.82E+10	81%
Nonpoint Source Load-Geometric Mean	2.43E+10	4.24E+9	2.01E+10	83%
Point Source Load	N/A[a]	N/A[a]	N/A[a]	N/A[a]

a. No applicable NPDES permitted outfalls in the watershed.

From Table 6, compliance with the geometric mean criterion of 126 colonies/100 ml requires a reduction of 83% in the *E. coli* load. The TMDL, WLA, LA, and MOS values necessary to achieve the applicable *E. coli* criteria are provided below in Table 7.

Table 7: *E. coli* TMDL for Coffee 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
4.72E+9	4.72E+8	N/A	N/A	0	4.24E+9	83%

Note: N/A = not applicable
a. There are no CAFOs in the Coffee Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. Future WWTPs must meet the applicable in-stream 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/100 ml.

4.3 TMDL Summary

Coffee Creek was placed on Alabama's §303(d) list in 2010 based on data collected in 2005. In 2018, ADEM collected additional water quality data with *E. coli* serving as the primary pathogen indicator. The data collected by ADEM in 2018 confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the *E. coli* TMDL for Coffee Creek. Based on the TMDL analysis, it was determined that an 83% 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 storm water 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 Coffee 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 statewide approach to water quality management. Each year, ADEM's water quality resources are divided among multiple priorities statewide 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.

6.0 Public Participation

As part of the public participation process, this TMDL will be placed on public notice and made available for review and comment. The public notice will be 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 will be made available on ADEM's Website: www.adem.alabama.gov. The public can also request paper or electronic copies of the TMDL by contacting Ms. Kimberly Minton at 334-271-7826 or kminton@adem.alabama.gov. The public will be 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 will become part of the administrative record. ADEM will consider all comments received by the public prior to final completion of this TMDL and subsequent submission to EPA Region 4 for final approval.

7.0 Appendices

7.1 References

ADEM Administrative Code, 2017. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

ADEM Administrative Code, 2017. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's §303(d) Monitoring Program. 2018. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, 2018.

Alabama's §303(d) List and Fact Sheet. 2010, 2012, 2014. ADEM.

Alabama Department of Environmental Management (ADEM), Laboratory Data Qualification SOP #4910 Revision 6.2, 2016.

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 8: Fecal Coliform Data for Station COFP-1

Visit Date	Single Sample (col/100 ml)	Fecal Coliform Dc	Geometric Mean (col/100 ml)
3/29/2005	220	H	-
4/13/2005	2000	-	-
5/11/2005	70	JH	-
6/8/2005	350	-	-
7/11/2005	10,000	G	-
8/11/2005	6700	G	-

H denotes that the holding times for analysis were exceeded.
G denotes that the analyte is present, but is above an acceptable level for quantitation
J denotes that the determined value is an estimate

Table 9: *E. coli* Data for Station COFP-1

Visit Date	Single Sample (col/100 ml)	Single Sample Criteria	Geometric Mean (col/100 ml)	Geometric Mean Criteria	Flow (cfs)
3/13/2018	866.4	2507			21.28
4/4/2018	1413.6	2507			1.252
5/2/2018	-	298			0.285
5/9/2018	69.1	298			-
6/6/2018	488.4	298	647.88	126	3.092
6/12/2018	1413.6	298			1.363
6/18/2018	437.4	298			1.5849
6/19/2018	686.7	298			1.6981
6/21/2018	920.8	298			0.609
6/25/2018	387.3	298			0.8398
8/22/2018	213	298	99.4	126	0.9892
8/23/2018	178.5	298			0.2017
8/27/2018	122.3	298			0.017
8/28/2018	14.5	298			-
8/29/2018	143.9	298			-
9/26/2018	26.4	298			-
10/31/2018	14.4	298			-

7.3 Coffee Creek Watershed Photos

Figure 5: At Station COFP-1: Upstream View of Coffee Creek at Highway 80 (5/9/2018)

Figure 6: At Station COFP-1: Downstream View of Coffee Creek at Highway 80 (5/9/2018)