Final

Total Maximum Daily Load (TMDL)
for
Ihagee Creek

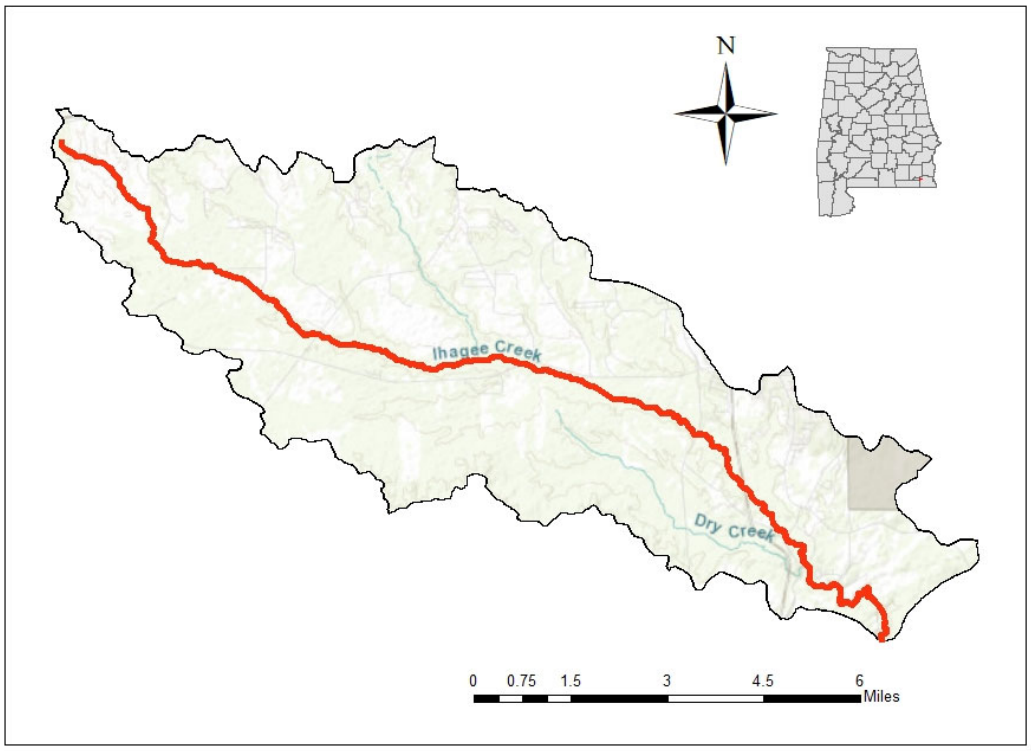
Assessment Unit ID # AL03130003-0605-100

Russell County

Pathogens (*E. coli*)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
August 2022

Figure 1: Ihagee 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).

Ihagee Creek is currently included on Alabama's §303(d) list for pathogens (*E. coli*) from its source to the Chattahoochee River. Ihagee Creek forms southeast of the town of Seale and is part of the Chattahoochee River Basin. It flows southeast through Russell County and into the Chattahoochee River. The total length of Ihagee Creek is 15.73 miles, and the total drainage area of the Ihagee Creek watershed is 36.17 square miles. Ihagee Creek has a use classification of Swimming and Other Whole Body Water-Contact Sports (Swimming) / Fish & Wildlife (F&W).

Ihagee Creek was first included on the §303(d) list for pathogens in 2016 based on ADEM monitoring data collected in 2014 at station IHGR-1. Ihagee Creek has subsequently been listed for pathogens on the 2018 and 2020 §303(d) lists of impaired waterbodies.

In 2021, sampling studies were performed by ADEM to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2021 data will be used to assess the water quality of Ihagee Creek because it was collected less than six years ago and provides the best picture of the current water quality of the stream. The 2022 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 IHGR-1. This bacterial data is listed in Appendix 7.2, Table 7-1 for reference. ADEM collected 18 *E. coli* samples and conducted two geometric mean studies on Ihagee Creek in 2021. According to the data, Ihagee Creek was not meeting the pathogen criteria applicable to its use classification of Swimming / 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 Ihagee 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 in-stream 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 IHGR-1 (August 26, 2021) with a value of 7701.1 colonies/100 ml. This violation calls for a reduction of 97%.

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 Ihagee Creek, which are protective of the *E. coli* water quality criteria year round.

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

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample Load	5.69E+12	1.56E+11	5.54E+12	97%
Geometric Mean Load	5.43E+11	7.79E+10	4.65E+11	86%

Table 1-2. *E. coli* TMDL for Ihagee 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)
1.74E+11	1.74E+10	NA	NA	0	1.56E+11	97%

Note: NA = not applicable
a. There are no CAFOs in the Ihagee 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 single sample criterion of 235 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 Ihagee 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 15.73 miles of Ihagee Creek as impaired for pathogens. The §303(d) listing for pathogens was originally reported on Alabama's 2016 List of Impaired Waters based on 2014 ADEM monitoring data from station IHGR-1, and was subsequently included on the 2018 and 2020 lists. The sources of the impairment on the 2020 §303(d) list are collection system failure, on-site wastewater systems, and pasture grazing.

2.2 Problem Definition

Waterbody Impaired:	Ihagee Creek – From Chattahoochee River to its source
Impaired Reach Length:	15.73 miles
Impaired Drainage Area:	36.17 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 / Fish and Wildlife

Usage Related to Classification:
The impaired stream segment is classified as Swimming and Other Whole Body Water-Contact Sports (Swimming) / Fish and Wildlife (F&W). Usage of waters in the Swimming 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 places and will be considered satisfactory for swimming and other whole body water-contact sports.

<u>*E. coli* Criteria:</u>
Criteria for acceptable bacteria levels for the Swimming 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:

Ihagee Creek was first included on the §303(d) list for pathogens in 2016 based on ADEM's 2014 *E. coli* data from station IHGR-1. Of the eight *E. coli* samples collected at station IHGR-1 in 2014, four violated the applicable single sample maximum criterion of 235 col/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 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 Ihagee 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 Ihagee Creek watershed. In addition, the Ihagee Creek watershed does not presently qualify as a municipal separate storm sewer system (MS4) area. 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.

There are currently no Animal Feeding Operation/Concentrated Animal Feeding Operation (AFO/CAFO) facilities located within the Ihagee 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.

3.2.2 Nonpoint Sources in the Ihagee 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 Ihagee Creek watershed. Land use in this watershed is primarily forested/natural (78.02%), along with some agriculture and developed land (14.59% and 7.01%, respectively).

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 Ihagee Creek watershed was determined using ArcMap with land use datasets derived from the 2019 National Land Cover Dataset (NLCD). Figure 3-1 and Table 3-1 display the land use areas for the Ihagee Creek watershed. Figure 3-2 is a graph depicting the primary land uses in the Ihagee Creek watershed.

The majority of the Ihagee Creek watershed is forested/natural (78.02%). Other land uses include agriculture (14.59%), developed land (7.01%), and open water (0.37%). Developed land includes both commercial and residential land uses. 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 Ihagee Creek Watershed

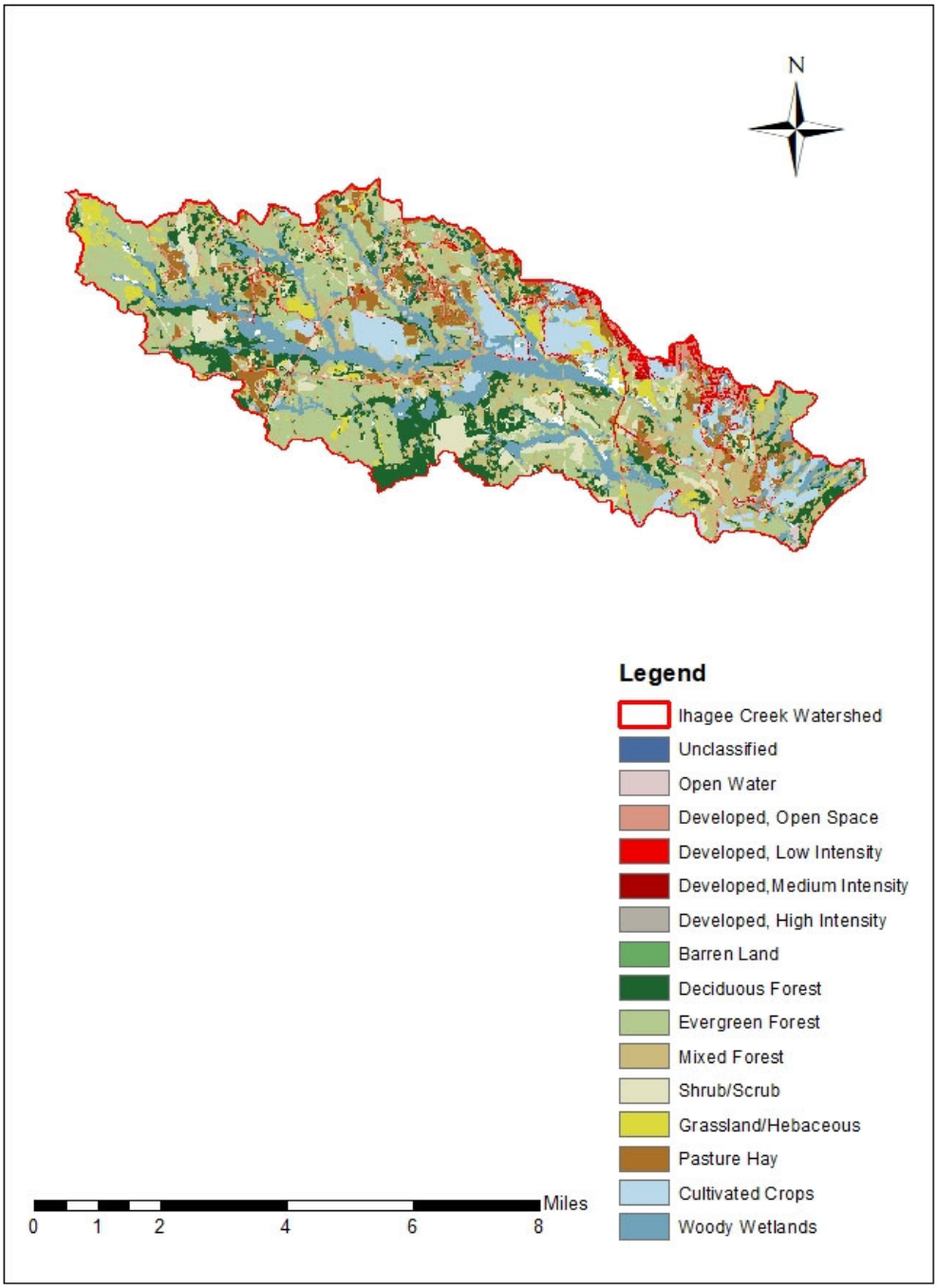
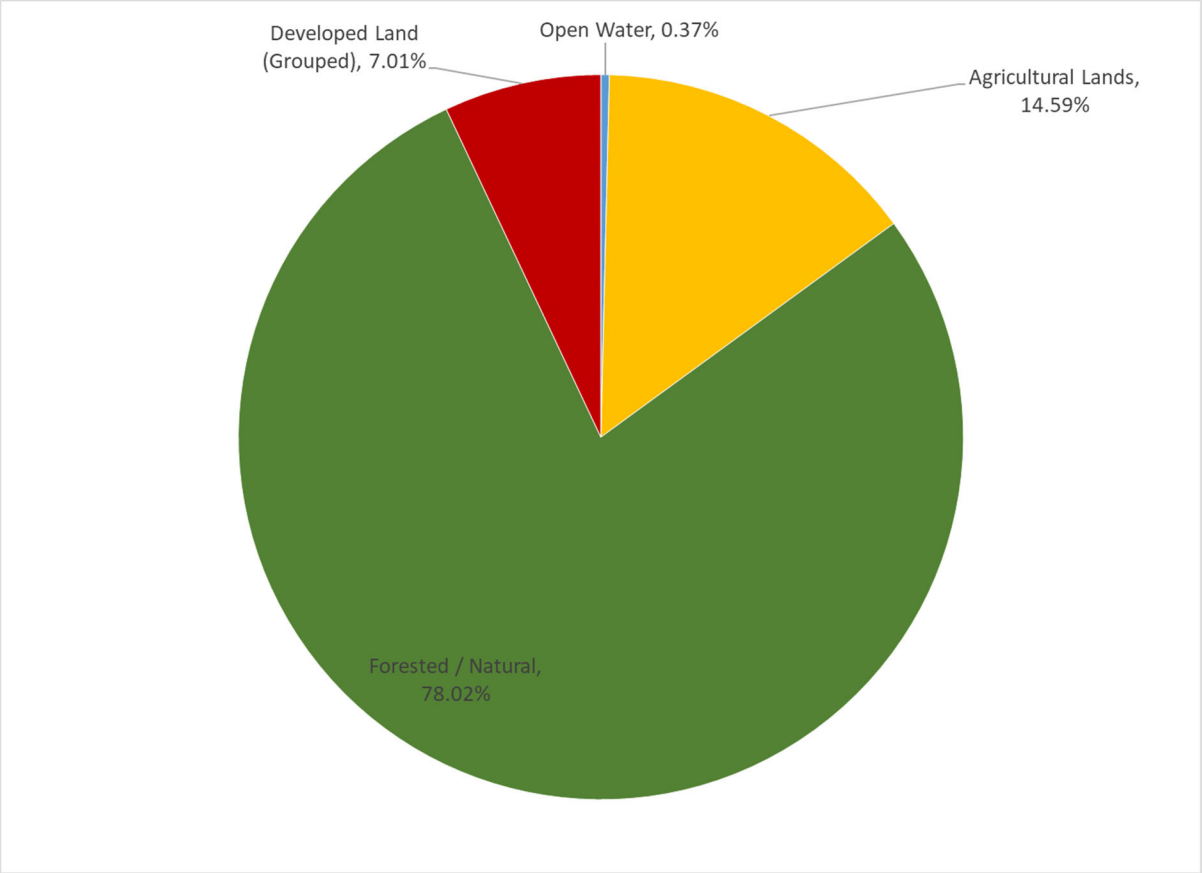


Table 3-1. Land Use Areas for the Ihagee Creek Watershed

Class Description	Mi²	Acres	Percent
Open Water	0.14	86.59	0.37%
Agricultural Lands	5.28	3378.47	14.59%
Forested / Natural	28.22	18061.00	78.02%
Developed Land (Grouped)	2.54	1623.45	7.01%
TOTALS →	**36.17**	**23149.51**	**100.00%**

Figure 3-2. Graph of Primary Land Uses in the Ihagee Creek Watershed



3.4 Linkage Between Numeric Targets and Sources

The Ihagee 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 Ihagee 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.

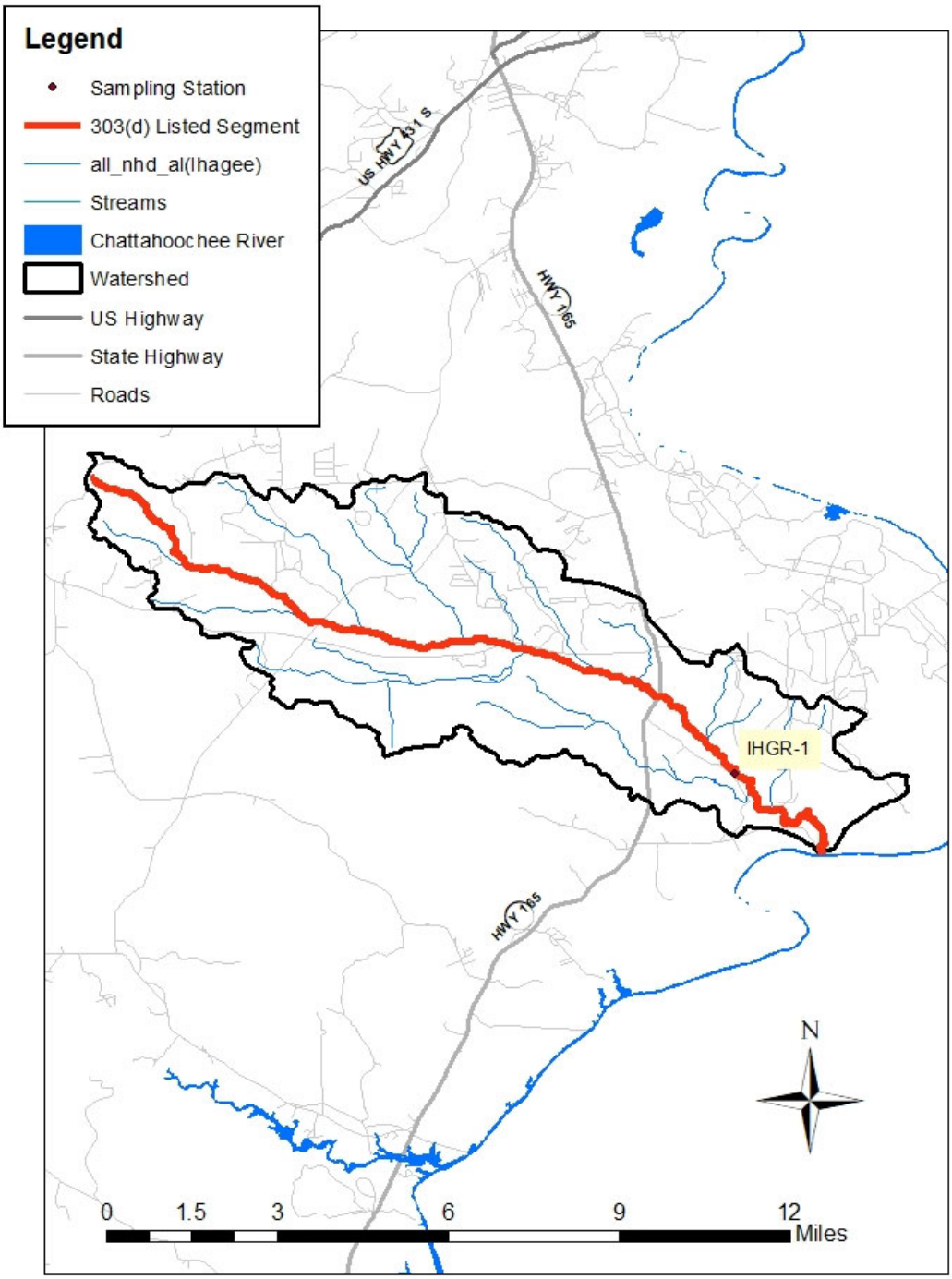
3.5 Data Availability and Analysis

In 2021, ADEM collected water quality data on Ihagee Creek at station IHGR-1. Table 3-2 and Figure 3-3 display the description and location for the ADEM sampling station. As previously mentioned, the 2021 data will be used for this TMDL. The January 2022 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 3-2. Ihagee Creek Sampling Station Description

Years Sampled	Station ID	Data Source	Station Location	Latitude	Longitude
2014, 2021	IHGR-1	ADEM	Ihagee Creek at Russell County Road 18	32.2385	-84.9807

Figure 3-3. Map of ADEM Sampling Station on Ihagee Creek



Of the 18 *E. coli* samples collected at station IHGR-1 during 2021, 16 violated the single sample maximum criterion of 235 col/100 ml for the Swimming use classification. There were two sampling events that qualified for a geometric mean calculation at IHGR-1 in 2021; both geometric means (6/9/2021 through 6/23/2021 and 8/3/2021 through 8/30/2021) exceeded the *E. coli* criterion of 126 col/100ml. This data can be viewed in Table 3-3 below and also in Appendix 7.2, Table 7-1.

Table 3-3.
2021 *E. coli* Exceedances for the Ihagee Creek Watershed

Station ID	Date	*E. coli* – Single Sample (col/100ml)	*E. coli* dc*	*E. coli* – Geometric mean (col/100ml)
IHGR-1	3/29/2021	727	H	
IHGR-1	4/14/2021	209.8	H	
IHGR-1	5/12/2021	2419.6	H	
IHGR-1	6/7/2021	2419.6	GH	490.55
IHGR-1	6/9/2021	259		
IHGR-1	6/15/2021	307.6		
IHGR-1	6/17/2021	160.7		
IHGR-1	6/21/2021	1632.8		
IHGR-1	6/23/2021	275.5		
IHGR-1	7/7/2021	2419.6	GH	
IHGR-1	8/3/2021	4839.2	G	789.85
IHGR-1	8/5/2021	356.4		
IHGR-1	8/10/2021	248.9	H	
IHGR-1	8/16/2021	293.4		
IHGR-1	8/25/2021	412.8		
IHGR-1	8/26/2021	7701.1		
IHGR-1	8/30/2021	479		
IHGR-1	10/13/2021	686.7	H	

*G = The amount of analyte is above an acceptable level for quantitation and is likely higher than the reported value.
*H = The analytical holding times for analysis are exceeded.

3.6 Critical Conditions/Seasonal Variation

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 *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 Ihagee Creek watershed generally follows the trends described above for the summer months of May through October. The critical condition for this pathogen TMDL was taken to be the one

with the highest *E. coli* single sample exceedance value. That value was 7701.1 colonies/100 ml that occurred on August 26, 2021, at station IHGR-1. A flow of 30.226 cfs was measured during this sampling event. The use of the highest exceedance to calculate the TMDL is expected to be protective of water quality in Ihagee 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 ten percent and calculating a mass loading target with measured 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 was reduced in the same fashion 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:

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

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 Ihagee 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 col/100 ml and the geometric mean criterion of 126 col/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 7701.1 colonies/100 ml times the flow measured at the time the sample was collected. This concentration was measured at IHGR-1 on August 26, 2021. The stream flow was 30.226 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 Ihagee Creek.

$$\frac{30.226\ \text{ft}^3}{s} \times \frac{7701.1\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{5.69 \times 10^{12}\text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration of 789.85 colonies/100 ml times the average of the measured streamflows. This concentration was calculated based on measurements at IHGR-1 between August 3, 2021, and August 30, 2021, which are shown above in Table 3-4. The average stream flow was determined to be 31.1708 cfs. The product of these two values times the conversion factor gives the total mass loading (colonies per day) of *E. coli* to Ihagee Creek under the geometric mean exceedance condition.

$$\frac{28.087\ \text{ft}^3}{s} \times \frac{789.85\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{5.43 \times 10^{11}\text{colonies}}{\text{day}}$$

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:

$$\frac{30.226\ \text{ft}^3}{s} \times \frac{211.5\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{1.56 \times 10^{11}\text{colonies}}{\text{day}}$$

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

$$\frac{30.226\ \text{ft}^3}{s} \times \frac{23.5\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{1.74 \times 10^{10}\text{colonies}}{\text{day}}$$

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

$$\frac{28.087\ \text{ft}^3}{s} \times \frac{113.4\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{7.79 \times 10^{10}\text{colonies}}{\text{day}}$$

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

$$\frac{28.087\ \text{ft}^3}{s} \times \frac{12.6\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{8.66 \times 10^{9}\text{colonies}}{\text{day}}$$

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

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

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample Load	5.69E+12	1.56E+11	5.54E+12	97%
Geometric Mean Load	5.43E+11	7.79E+10	4.65E+11	86%

From Table 4-1, compliance with the single sample criterion of 235 colonies/100 ml requires a reduction in the *E. coli* load of 97%. 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 Ihagee 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)
1.74E+11	1.74E+10	NA	NA	0	1.56E+11	97%

Note: NA = not applicable
a. There are no CAFOs in the Ihagee 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 single sample criterion of 235 colonies/100ml.

4.3 TMDL Summary

Ihagee Creek was first included on the §303(d) list for pathogens in 2016 based on ADEM's 2014 *E. coli* data from station IHGR-1. In 2021, 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 Ihagee Creek. Based on the TMDL analysis, it was determined that a 97% 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 will be implemented through voluntary measures/best management practices (BMPs). Cooperation and active participation by the general

public and various other groups is 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 Ihagee 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 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

River Basin Group	Years to be Monitored
Coosa, Escatawpa, Tennessee (Guntersville), Tombigbee	2022/2025
Alabama, Cahaba, Mobile, Tallapoosa, Tennessee (Pickwick and Wilson)	2023/2026
Black Warrior, Blackwater, Chattahoochee, Chipola, Choctawhatchee, Escambia, Perdido, Tennessee (Wheeler), Yellow	2024/2027

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 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. 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. 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 Appendices

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. 2014 & 2021. ADEM.

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

Alabama Department of Environmental Management, 2016, 2018, & 2020 §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. ADEM Pathogen Data Collected on Ihagee Creek

STATION ID	DATE	Flow (cfs)	Single Sample *E. coli* (col/100 ml)	*E. coli* dc*	Geomean *E. coli* (col/100 ml)
IHGR-1	3/12/2014	24.778	1119.9		
IHGR-1	4/1/2014	30.701	290.9		
IHGR-1	4/23/2014	30.3535			
IHGR-1	5/14/2014	15.281	146.7		
IHGR-1	6/3/2014	9.756	108.6		
IHGR-1	6/30/2014	6.241	121.1		
IHGR-1	7/16/2014	4.598			
IHGR-1	8/5/2014	6.878	235.9		
IHGR-1	9/2/2014	5.6709	298.7		
IHGR-1	10/7/2014	5.551	218.7		
IHGR-1	3/29/2021	35.002	727	H	
IHGR-1	4/14/2021	23.497	209.8	H	
IHGR-1	4/21/2021	14.515			
IHGR-1	5/12/2021	45.754	2419.6	H	
IHGR-1	6/7/2021	35.436	2419.6	GH	490.55
IHGR-1	6/9/2021	14.129	259		
IHGR-1	6/15/2021	9.106	307.6		
IHGR-1	6/17/2021	7.388	160.7		
IHGR-1	6/21/2021	43.73	1632.8		
IHGR-1	6/23/2021	19.345	275.5		
IHGR-1	7/7/2021	54.953	2419.6	GH	
IHGR-1	8/3/2021	73.784	4839.2	G	789.85
IHGR-1	8/5/2021	21.104	356.4		
IHGR-1	8/10/2021	12.665	248.9	H	
IHGR-1	8/16/2021	13.677	293.4		
IHGR-1	8/25/2021	17.063	412.8		
IHGR-1	8/26/2021	30.226	7701.1		
IHGR-1	8/30/2021	-	479		
IHGR-1	10/13/2021	19.208	686.7	H	

*G = The amount of analyte is above an acceptable level for quantitation and is likely higher than the reported value.
*H = The analytical holding times for analysis are exceeded.

7.3 Ihagee Creek Watershed Photos (February 28, 2022)

Photo 7-1 Ihagee Creek at IHGR-1 (Co. Rd. 18), Looking Upstream

Photo 7-2 Ihagee Creek at IHGR-1 (Co. Rd. 18), Looking Downstream

Photo 7-3 Ihagee Creek at Highway 165, Looking Upstream

Photo 7-4 Ihagee Creek at Highway 165, Looking Downstream

Photo 7-5 Ihagee Creek at County Road 39, Looking Upstream

Photo 7-6 Ihagee Creek at County Road 39, Looking Downstream