Alabama Department of Environmental Management

Draft

Total Maximum Daily Load (TMDL)
for
Carthage Branch

Assessment Unit ID Number:
AL03160113-0602-300

Pathogens (*E. coli*)

Tuscaloosa County

Alabama Department of Environmental Management
Water Quality Branch
Water Division
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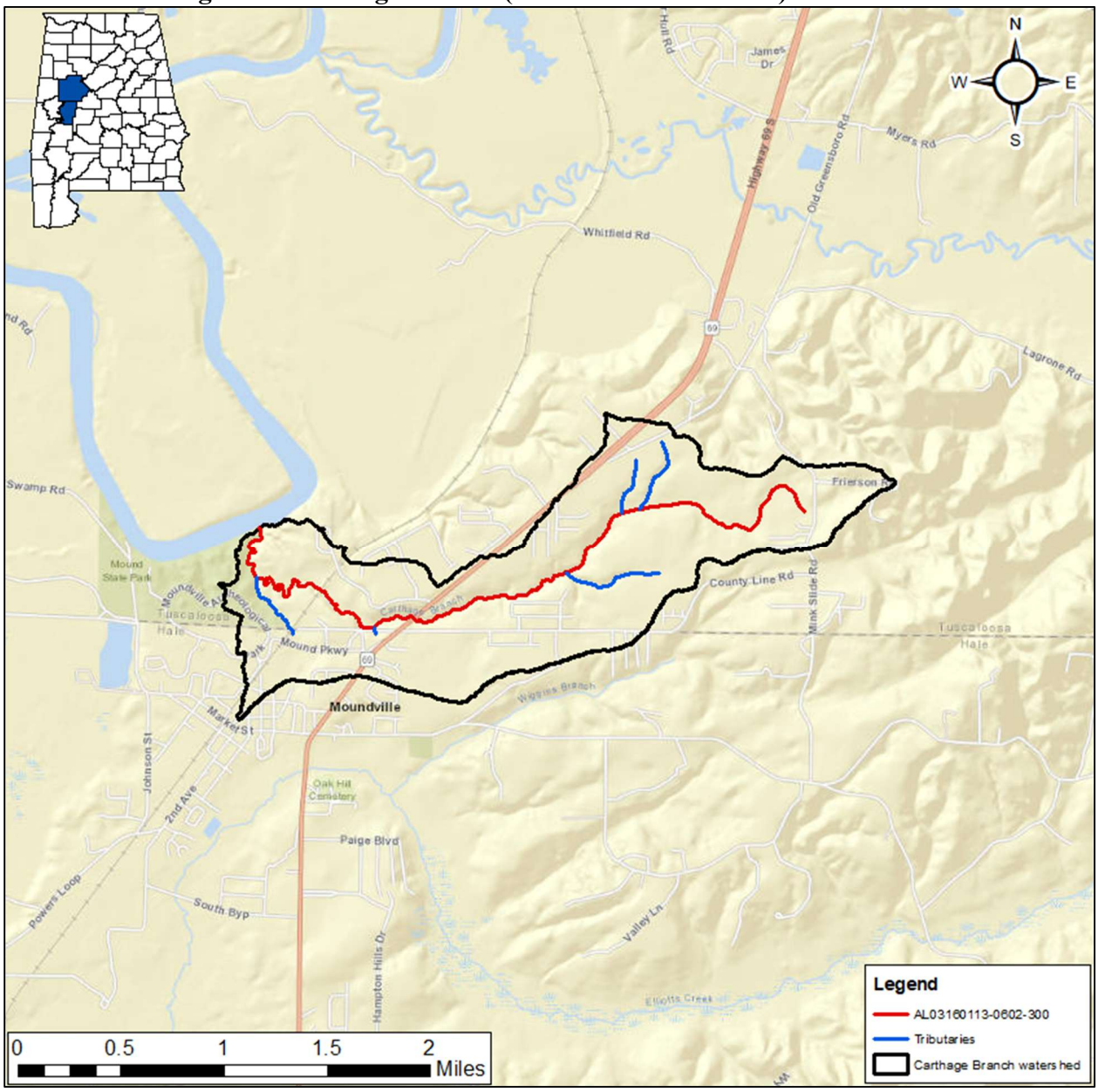
Figure 1: Carthage Branch (AL03160113-0602-300) watershed



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1.0 Executive Summary

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

Carthage Branch, from the Black Warrior River (Warrior Lake) to its source, is currently included on Alabama's §303(d) list as impaired for pathogens (*E. coli*). Carthage Branch begins northeast of Moundville, Alabama and flows west for 3.98 miles to its confluence with the Black Warrior River (Warrior Lake). Carthage Branch is assigned a use classification of Fish and Wildlife (F&W).

Carthage Branch was originally included on the §303(d) list for pathogens (*E. coli*) in 2018 based on data collected by the Alabama Department of Environmental Management (ADEM) in 2012 at station CRTT-1. The applicable bacteriological criterion was exceeded in two out of eight samples collected at CRTT-1 in 2012. Carthage Branch has subsequently been listed for pathogens on the 2020, 2022, and 2024 §303(d) lists.

In 2024, follow-up sampling on Carthage Branch was performed by ADEM to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2024 data will be used because it is the most current data and provides the best picture of the current water quality conditions 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. ADEM collected 18 samples from Carthage Branch in 2024 at station CRTT-1. According to the data, Carthage Branch was not meeting the pathogen criteria applicable to its use classification of F&W. Therefore, this TMDL has been developed for pathogens (*E. coli*) for Carthage Branch (AL03160113-0602-300).

A mass balance approach was used for calculating the pathogen TMDL for Carthage Branch. The mass balance approach utilizes the conservation of mass principle. The TMDL was calculated using the single sample or geometric mean sample exceedance event that 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 268.2 colonies/100 ml (298 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 *E. coli* violation of 2419.6 colonies/100 mL on July 17, 2024, at ADEM station CRTT-1. This violation calls for a reduction of 89%.

A summary of these calculations can be seen in Table 1-1. Table 1-2 lists the TMDL, defined as the maximum allowable *E. coli* loading under critical conditions for Carthage Branch. The TMDL was calculated based on data from CRTT-1.

Table 1-1: *E. coli* loads and required reductions for Carthage Branch

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample	4.97E+10	5.51E+9	4.42E+10	89%
Geometric Mean	1.18E+10	1.79E+9	1.00E+10	85%

Table 1-2: *E. coli* TMDL for Carthage Branch (AL03160113-0602-300)

TMDL[a]	Margin of Safety (MOS)	Waste Load Allocation (WLA)[b]			Load Allocation (LA)	
		WWTPs[c]	Stormwater (MS4s and other NPDES sources)[d]	Leaking Collection Systems[e]		
(col/day)	(col/day)	(col/day)	% reduction	(col/day)	(col/day)	% reduction
6.12E+9	6.12E+8	NA	NA	0	5.51E+9	89%

NA = Not Applicable
a. TMDL was established using the single sample criterion of 298 colonies/100ml.
b. Future CAFOs in the watershed will be assigned a waste load allocation (WLA) of zero.
c. Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
d. Future MS4 areas and other NPDES stormwater sources will be required to demonstrate consistency with the assumptions and requirements of this TMDL through implementation and maintenance of BMPs on a case-by-case basis.
e. 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*.

Compliance with the terms and conditions of future National Pollutant Discharge Elimination System (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 Carthage Branch 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 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 entire length of Carthage Branch, totaling 3.98 miles, as impaired for pathogens (*E. coli*). The §303(d) listing was originally reported on Alabama's 2018 List of Impaired Waters based on data collected from 2012 and has been included on all subsequent lists. Pasture grazing is listed as the potential source of the impairment on the 2024 §303(d) list.

2.2 Problem Definition

Waterbody Impaired:	Carthage Branch – from Black Warrior River (Warrior Lake) to its source
Impaired Reach Length:	3.98 miles
Impaired Drainage Area:	2 mi^2
Water Quality Standard Violation:	Pathogens (Single Sample, Geometric Mean)
Pollutant of Concern:	Pathogens (*E. coli*)
Water Use Classification:	Fish and Wildlife

Usage Related to Classification:
Carthage Branch is classified as Fish and Wildlife (F&W). Usage of waters in the F&W classification is described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), and (d).

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

(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 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 of1 the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports.

Criteria Exceeded:
Carthage Branch, from the Black Warrior River (Warrior Lake) to its source, was placed on the 2018 §303(d) list for pathogens (*E. coli*) based on data collected at station CRTT-1 in 2012. There were exceedances in two out of eight samples collected at this station. The data used for the original listing can be found in Appendix 7.2, Table 7-1.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

For 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 target of 113.4 colonies/100 ml will be used for a series of five or more 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 Carthage Branch 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 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.

Continuous Point Sources

There are currently no continuous NPDES-permitted facilities in the Carthage Branch watershed. Any future NPDES-regulated continuous 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.

Non-Continuous Point Sources

There are a few facilities with industrial general or individual NPDES permits located within the Carthage Branch watershed. These facilities are not required to monitor for *E. coli* and are not considered to be a source of pathogens due to the nature of their operations. As such, no *E. coli* loading will be attributed to these facilities, nor will they receive an allocation in this TMDL.

Currently, there are no Municipal Separate Storm Sewer System (MS4) areas located within the Carthage Branch watershed. Any future MS4 stormwater discharges will be required to demonstrate consistency with the assumptions and requirements of this TMDL.

The Carthage Branch watershed currently contains no Voluntary Animal Feeding Operations (AFOs)/Concentrated Animal Feeding Operations (CAFOs). AFOs/CAFOs are required to implement and maintain effective best management practices (BMPs) that meet or exceed Natural Resources Conservation Service (NRCS) technical standards and guidelines, and the ADEM AFO/CAFO rules currently prohibit point source discharges of pollutants from these facilities and their associated land application activities. As a result, future AFOs/CAFOs will receive a waste load allocation of zero.

Future NPDES-regulated storm water discharges will be required to demonstrate consistency with the assumptions and requirements of this TMDL.

There are currently no registered sites in the Carthage Branch watershed where land application of by-products for beneficial use is present. Beneficial use sites are regulated by ADEM's Land Division and are required to implement appropriate BMPs and agronomic application rates to protect the environment.

Sanitary sewer overflows (SSOs) have the potential to severely impact water quality and can often result in the violation of water quality standards. It is the responsibility of the NPDES wastewater discharger or collection system operator for non-permitted "collection only" systems to ensure that releases do not occur. From review of ADEM files, it was found that there has been one SSO reported within the Carthage Branch watershed since 2021. The details of this event can be found in Appendix 7.2, Table 7-2.

3.2.2 Nonpoint Sources in the Carthage Branch 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. Runoff from pastures, animal feeding areas, improper land application of animal waste, and animals with direct access to streams are all 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 stormwater runoff, unpermitted discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, and domestic animals. On-site septic systems 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 Carthage Branch watershed was determined using ArcMap with land use datasets derived from the 2021 National Land Cover Dataset (NLCD). Figure 3-1 displays the land use areas within the watershed. Table 3-1 depicts the primary land uses in the Carthage Branch watershed.

Agriculture, developed land, and forested/natural land make up 40.01%, 30.9%, and 28.9%, respectively, of the total Carthage Branch watershed area. The remaining 0.19% of the land area consists of open water.

Figure 3-1: Land use in the Carthage Branch watershed

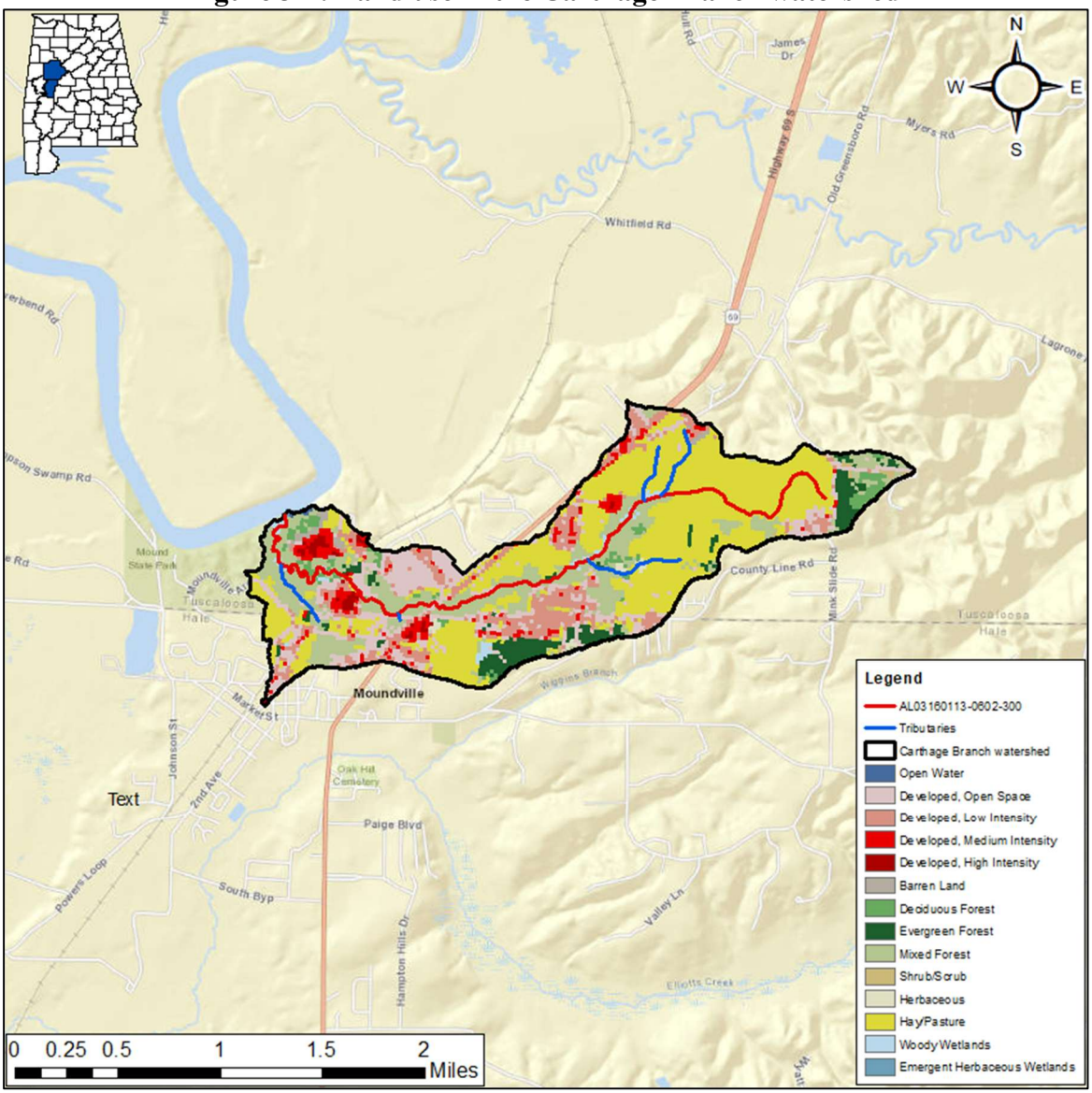
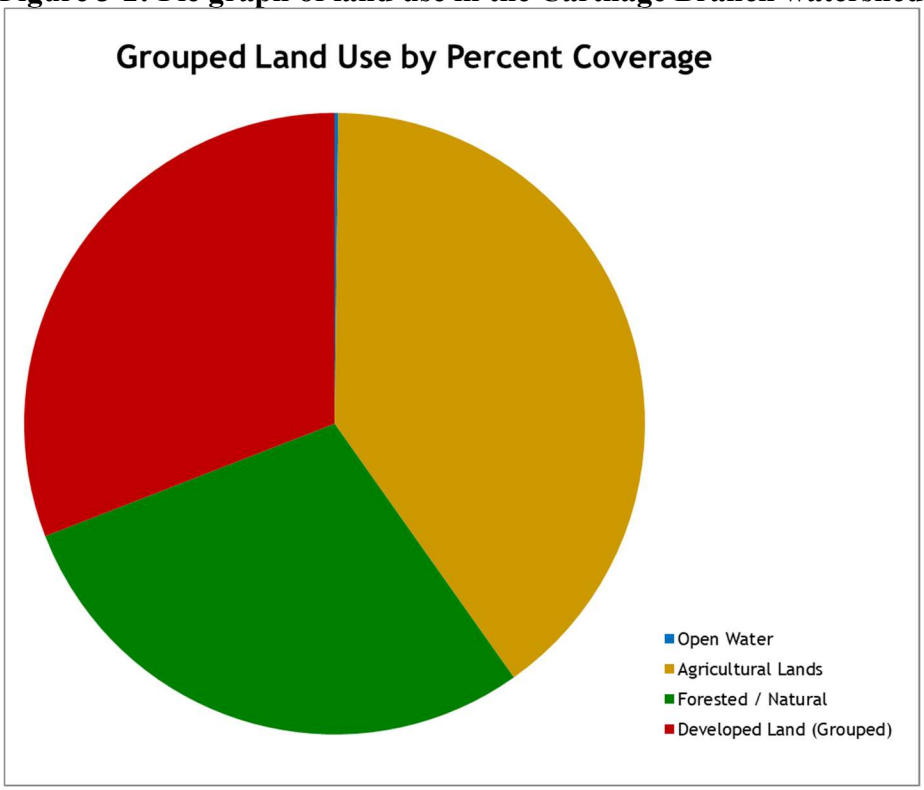


Table 3-1: Land use (2021) in the Carthage Branch watershed

Land Use	Miles^2	Acres	Percent
Open Water	0.004	2.45	0.19%
Developed, Open Space	0.27	174.80	13.64%
Developed, Low Intensity	0.23	144.33	11.27%
Developed, Medium Intensity	0.09	54.49	4.25%
Developed, High Intensity	0.02	12.9	1.01%
Barren Land	0.015	9.34	0.73%
Deciduous Forest	0.05	34.92	2.73%
Evergreen Forest	0.11	67.39	5.26%
Mixed Forest	0.38	241.52	18.85%
Shrub/Scrub	0.01	4.89	0.38%
Herbaceous	0.01	5.78	0.45%
Hay/Pasture	0.80	512.62	40.01%
Cultivated Crops	0	0	0%
Woody Wetlands	0.02	15.35	1.20%
Emergent Herbaceous Wetlands	0.001	0.44	0.03%
Totals→	**2.0**	**1281.22**	**100.00%**
Class Description	**Miles^2**	**Acres**	**Percent**
Open Water	0.004	2.45	0.19%
Agricultural Lands	0.80	512.62	40.01%
Forested/Natural	0.58	370.29	28.9%
Developed Land (Grouped)	0.62	395.86	30.9%
Totals→	**2.0**	**1281.22**	**100.00%**

Figure 3-2: Pie graph of land use in the Carthage Branch watershed



3.4 Linkage between Numeric Targets and Sources

The predominant land usage in the Carthage Branch watershed is agriculture, with developed and forested/natural areas a close second and third, respectively. Pollutant loadings from forested areas tend to be low due to their filtering capabilities and will be considered as background conditions. The most probable sources of pathogen loadings within the watershed are agriculture (pasture grazing) and leaking/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 and reductions will only be calculated as a single total nonpoint source load and reduction.

3.5 Data Availability and Analysis

In 2024, ADEM collected data from station CRTT-1 on Carthage Branch. There were 18 total *E. coli* samples collected at this station, and there were 12 single sample exceedances. In addition, there were exceedances of the applicable geometric mean criterion during both June/July and August/September. Table 3-2 and Figure 3-3 show the location of station CRTT-1 on Carthage Branch. It is noted that the location for station CRTT-1 was moved between the 2012 and 2024 sampling seasons to provide improved access. The 2012 station is denoted as "Old" and the 2024 station is denoted as "New" in Table 3-2 and Figure 3-3 below. The 2024 *E. coli* data can be seen in Table 3-3.

Table 3-2: ADEM sampling stations in the Carthage Branch watershed

Station	Locale Name	Latitude	Longitude
CRTT-1 (Old)	Carthage Branch	33.006811°	-87.622123°
CRTT-1 (New)	Carthage Branch	33.0057099°	-87.6125515°

Figure 3-3: ADEM sampling stations in the Carthage Branch watershed

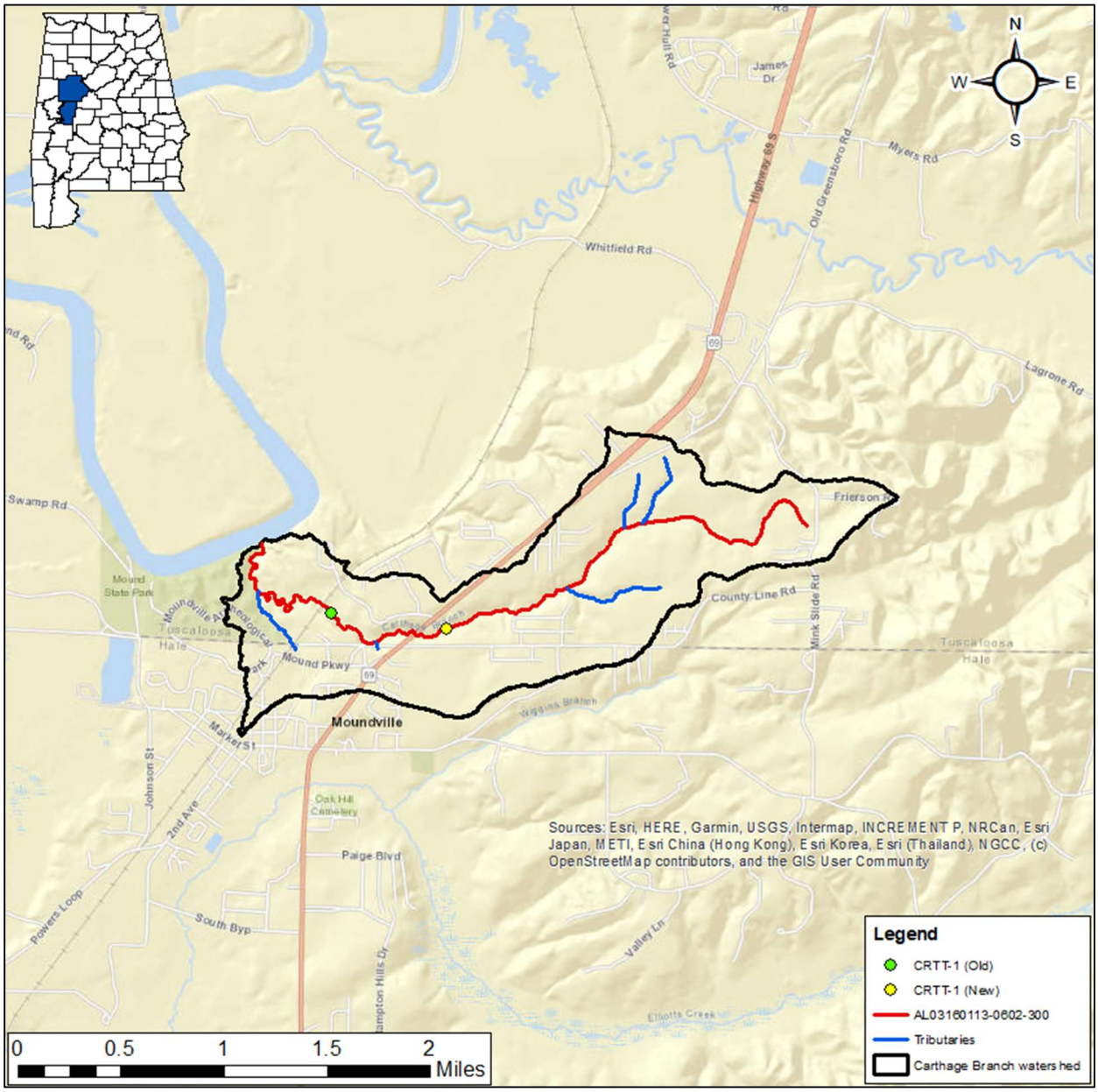


Table 3-3: 2024 *E. coli* data from CRTT-1 (AL03160113-0602-300)

CRTT-1						
Visit Date	***E. coli* (col/100 mL)**	**Qualifier Code***	***E. coli* Criterion (col/100 mL)**	**Geometric Mean (col/100 mL)**	**Geometric Mean Criterion (col/100 mL)**	**Flow (ft3/s)**
3/13/2024	178.5	H	-	-	2507	0.86
4/17/2024	240	H	-	-	2507	0.78
5/22/2024	275.5	H	-	-	298	0.68
6/5/2024	206.4	-	-	-	298	0.59
6/10/2024	222.4	-	-	-	298	-0.25
6/17/2024	416	-	747.4	126	298	0.65
6/18/2024	547.5	H			298	0.6
6/25/2024	866.4	-			298	0.61
6/28/2024	488.4	-			298	0.53
7/17/2024	2419.6	GH			298	0.84
8/7/2024	344.8	-	476.2	126	298	0.64
8/12/2024	579.4	-			298	0.52
8/15/2024	727	-			298	0.63
8/21/2024	435.2	H			298	0.51
8/26/2024	387.3	-			298	0.54
9/5/2024	275.5	-	-	-	298	0.52
9/18/2024	461.1	H	-	-	298	0.76
10/23/2024	325.5	H	-	-	298	0.28

*H: The analytical holding times for analysis are exceeded. GH: The analytical holding times for analysis are exceeded. The actual number was probably greater than the number reported.

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 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.

Carthage Branch 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. For Carthage Branch, that value was 2419.6 colonies/100ml and occurred on July 17, 2024, at CRTT-1. The use of the highest exceedance to calculate the TMDL is expected to be protective of water quality in Carthage Branch year-round.

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.

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 or calculated flow data. The single sample *E. coli* maximum criterion 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.

4.0 TMDL Development

4.1 Definition of a TMDL

A TMDL is the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources including natural background levels, and a 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 *E. coli* TMDL for Carthage Branch. 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 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 298 colonies/100 mL and the geometric mean criterion of 126 colonies/100 mL. The TMDL was based on the violation that produced the highest calculated percent reduction 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 *E. coli* single sample exceedance concentration by the flow on the day of the exceedance. The highest exceedance occurred at ADEM station CRTT-1 on July 17, 2024 (2419.6 colonies/100 mL). The flow measured on this date was 0.84 ft^3/s. The product of the flow, pathogen concentration, and conversion factor gives the total mass loading (colonies per day) of *E. coli* to Carthage Branch under the single sample exceedance condition.

$$\frac{0.84\ ft^3}{s} \times \frac{2419.6\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{4.97 \times 10^{10}\ colonies}{day}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration (747.4 colonies/100 ml) times the average of the five measured daily stream flows. This concentration was calculated based on measurements at CRTT-1 between June 17, 2024, and August 17, 2024, and can be found above in Table 3-3. The average stream flow was calculated to be 0.646 ft^3/s. The product of the flow, pathogen concentration, and the conversion factor gives the total mass loading (colonies per day) of *E. coli* in Carthage Branch under the geometric mean exceedance condition.

$$\frac{0.646\ ft^3}{s} \times \frac{747.4\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{1.18 \times 10^{10}\ colonies}{day}$$

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 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:

$$\frac{0.84\ ft^3}{s} \times \frac{268.2\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{5.51 \times 10^{9}\ colonies}{day}$$

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

$$\frac{0.84\ ft^3}{s} \times \frac{29.8\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{6.12 \times 10^{8}\ colonies}{day}$$

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

$$\frac{0.646\ ft^3}{s} \times \frac{113.4\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{1.79 \times 10^{9}\ colonies}{day}$$

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

$$\frac{0.646\ ft^3}{s} \times \frac{12.6\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{1.99 \times 10^8\ colonies}{day}$$

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. Table 4-1 shows the existing and allowable *E. coli* loads and required reductions at station CRTT-1.

Table 4-1: *E. coli* loads and required reduction at CRTT-1

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample	4.97E+10	5.51E+9	4.42E+10	89%
Geometric Mean	1.18E+10	1.79E+9	1.00E+10	85%

The TMDL was calculated as the total daily *E. coli* load to Carthage Branch as evaluated at station CRTT-1. From Table 4-1, compliance with the single sample criterion of 298 colonies/100 ml requires a reduction in the *E. coli* load of 89%. The TMDL, WLA, LA and MOS values necessary to achieve the applicable *E. coli* criteria are provided in Table 4-2 below.

Table 4-2: *E. coli* TMDL for Carthage Branch (AL03160113-0602-300)

TMDL[a]	Margin of Safety (MOS)	Waste Load Allocation (WLA)[b]			Load Allocation (LA)	
		WWTPs[c]	Stormwater (MS4s and other NPDES sources)[d]	Leaking Collection Systems[e]		
(col/day)	(col/day)	(col/day)	% reduction	(col/day)	(col/day)	% reduction
6.12E+9	6.12E+8	NA	NA	0	5.51E+9	89%

NA = Not Applicable

a. TMDL was established using the single sample criterion of 298 colonies/100ml.

b. Future CAFOs in the watershed will be assigned a waste load allocation (WLA) of zero.

c. Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.

d. Future MS4 areas and other NPDES stormwater sources will be required to demonstrate consistency with the assumptions and requirements of this TMDL through implementation and maintenance of BMPs on a case-by-case basis.

e. 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*.

4.3 TMDL Summary

Carthage Branch was placed on Alabama's §303(d) list for pathogens in 2018 based on data collected in 2012. Additional data collected by ADEM during the 2024 sampling season confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the *E. coli* TMDL for Carthage Branch. Based on the TMDL analysis, it was determined that an *E. coli* reduction of 89% is necessary to achieve compliance with applicable water quality standards.

Compliance with the terms and conditions of 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 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 Carthage Branch 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
Alabama, Cahaba, Mobile, Tallapoosa, Tennessee (Bear and Pickwick)	2026/2029
Black Warrior, Blackwater, Chattahoochee, Chipola, Choctawhatchee, Escambia, Perdido, Tennessee (Wheeler and Elk), Yellow	2027/2030
Coosa, Escatawpa, Tennessee (Guntersville), Tombigbee	2028/2031

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 and subject TMDL will be made available on ADEM's website: www.adem.alabama.gov. In addition, the public notice will be submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. The public may 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, 2025. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

ADEM Administrative Code, 2025. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's Monitoring Program. 2012, 2024. ADEM.

Alabama Department of Environmental Management (ADEM), *Alabama's Water Quality Assessment and Listing Methodology*, January 2024.

Alabama's §303(d) List and Fact Sheet. 2018, 2020, 2022, 2024. 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: 2012 *E. coli* listing data from station CRTT-1

CRTT-1	
Visit Date	***E. coli* (col/100 mL)**
4/4/2012	143.9
5/9/2012	648.8
6/6/2012	98.7
7/12/2012	145.5
8/8/2012	214.5
9/5/2012	770.1
10/25/2012	116.9
11/7/2012	193.5

Table 7-2. Recent SSO data (Moundville Lagoon – AL0058122)

Overflow Date & Time	Discharge Volume (gallons)	Discharge Length (hours)	Discharge Location	Cause
2/18/2021 8:30 AM	≤ 1000	3	12320 County Line Rd (Moundville, AL)	Heavy rainfall of 2+ inches and a clogged up sewer pump

7.3 Carthage Branch Watershed Photographs

At station CRTT-1, looking upstream (10/25/2012)

At station CRTT-1, looking downstream (10/25/2012)

At station CRTT-1, looking upstream (7/17/2024)

At station CRTT-1, looking downstream (7/17/2024)