Final

Total Maximum Daily Load (TMDL)

For

Gunnison Creek

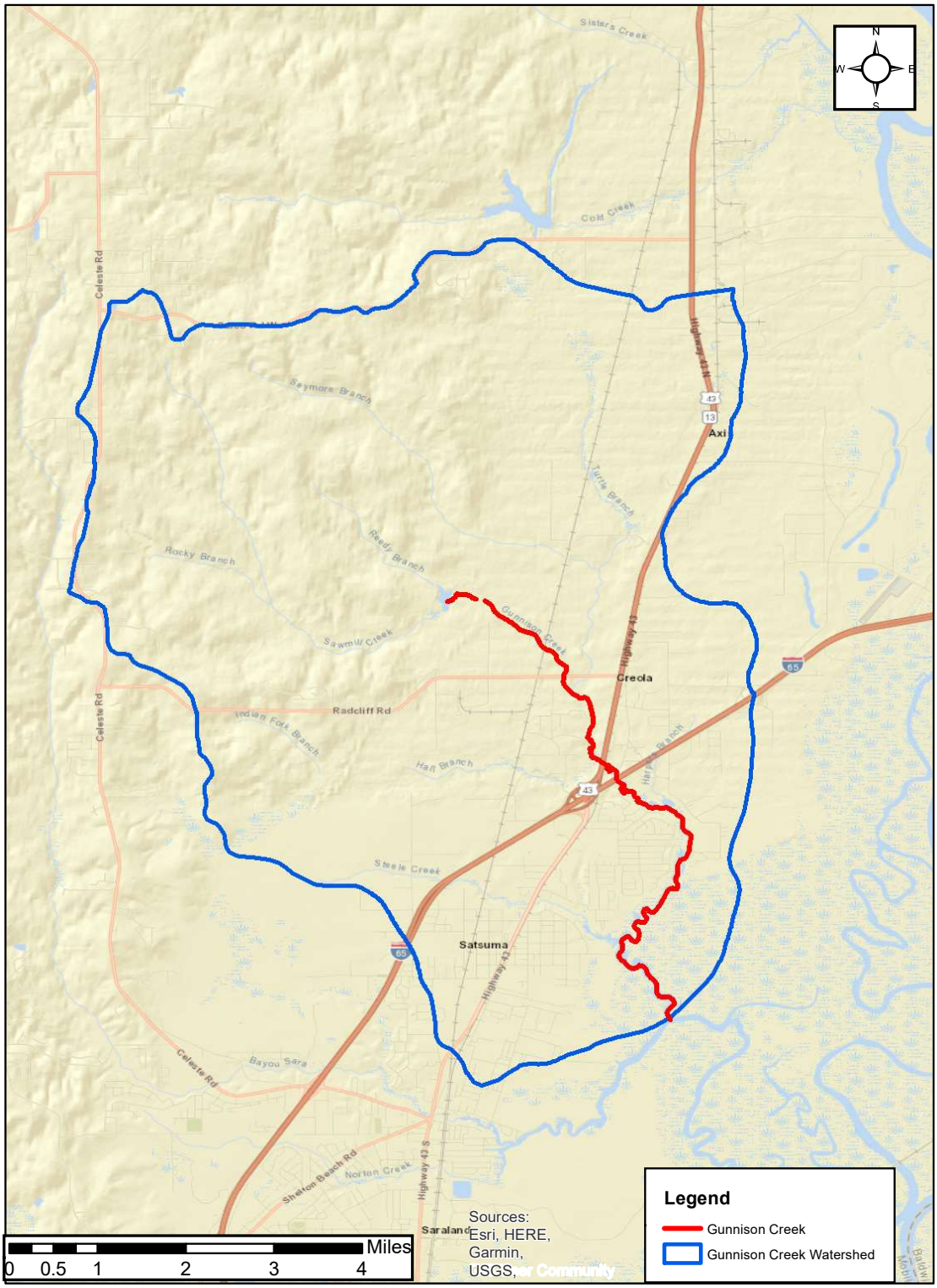
Assessment Unit ID# AL03160204-0401-100

Pathogens (*E. coli*)

Mobile County

Alabama Department of Environmental Management
Water Quality Branch
Water Division
June 2025

Figure 1: Gunnison Creek 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).

Gunnison Creek, part of the Mobile River basin, is currently included on Alabama's §303(d) list as impaired for pathogens (*E. coli*) from its source to Bayou Sara. This segment of Gunnison Creek has a designated use classification of Swimming and Other Whole Body Water-Contact Sports/Fish and Wildlife (Swimming/F&W). Gunnison Creek begins northwest of Creola, Alabama and flows southeast into Bayou Sara. The total drainage area for the Gunnison Creek watershed is approximately 44 square miles.

Gunnison Creek was first listed as impaired for pathogens on the 2022 §303(d) list based on data collected by the Alabama Department of Environmental Management (ADEM) in 2016 and 2019. The exceedances were found at station GNNM-1. This data, which can be found in Appendix 7.2, Table 12, indicated that the applicable *E. coli* criterion was exceeded in four out of 12 samples.

During 2021 and 2023, additional sampling studies were performed by ADEM on Gunnison Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2021 and 2023 data will be used to assess the water quality of Gunnison Creek 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. All the available and recent bacterial data is listed in the Appendix for reference. According to the 2021 and 2023 data, Gunnison 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 Gunnison Creek.

A mass balance approach was used for calculating the pathogen TMDL for Gunnison 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).

Table 1 is a summary of the estimated existing load, allowable load, and percent reduction for the single sample criterion for Gunnison Creek. There were no exceedances of the applicable geometric mean criterion. Table 2 lists the TMDL for Gunnison Creek, defined as the maximum allowable *E. coli* loading under critical conditions.

Table 1. *E. coli* Loads and Required Reductions

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Single Sample Load	1.36E+12	7.78E+11	5.82E+11	43%

Table 2. *E. coli* TMDL for Gunnison Creek

TMDL[e]	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation (LA)	
		WWTPs[b]	Stormwater (MS4s and other NPDES sources)[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	% reduction	(col/day)	(col/day)	% reduction
8.64E+11	8.64E+10	N/A	43%	0	7.78E+11	43%

Note: N/A = not applicable

a. There are no CAFOs in the Gunnison 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 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.

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/100 ml.

Compliance with the terms and conditions of existing and 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 Gunnison 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 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 7.62-mile segment of Gunnison Creek from its source to Bayou Sara as impaired for pathogens. Gunnison Creek was originally listed on Alabama's 2022 List of Impaired Waters for pathogens based on data collected in 2016 and 2019. The source of the pathogens impairment is listed as pasture grazing on the current §303(d) list.

2.2 Problem Definition

Waterbody Impaired:	Gunnison Creek – from its source to Bayou Sara
Impaired Reach Length:	7.62 miles
Impaired Drainage Area:	43.92 square miles
Water Quality Standard Violation:	Pathogens (Single Sample Maximum)
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 and Fish and Wildlife (Swimming/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 areas 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 and Other Whole Body Water-Contact Sports use classification are described in ADEM Admin. Code r. 335-6-10-.09(3)(c)6(i), (ii), and (iii) as follows:

6. Bacteria:

(i) Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports.

(ii) In all other areas, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean E. coli organism density does not exceed 126 colonies/100 ml nor exceed a maximum of 235 colonies/100 ml in any sample in non-coastal waters. In coastal waters, bacteria of the enterococci group shall not exceed a geometric mean of 35 colonies/100 ml nor exceed a maximum of 104 colonies/100 ml in any sample. The geometric mean shall be calculated from no less than five samples collected at a given

station over a 30-day period at intervals not less than 24 hours. When the geometric mean bacterial organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters.

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

Criteria for acceptable bacteria levels for the Fish and Wildlife use classification are described in ADEM Admin. Code r. 335-6-10-.09(5) (e)7(i) and (ii) as follows:

7. Bacteria:

(i) In non-coastal waters, bacteria of the E. coli group shall not exceed a geometric mean of 548 colonies/100 ml; nor exceed a maximum of 2,507 colonies/100 ml in any sample. In coastal waters, bacteria of the enterococci group shall not exceed a maximum of 275 colonies/100 ml in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours.

(ii) For incidental water contact and whole body water-contact recreation during the months of May through October, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean E. coli organism density does not exceed 126 colonies/100 ml nor exceed a maximum of 298 colonies/100 ml in any sample in non-coastal waters. In coastal waters, bacteria of the enterococci group shall not exceed a geometric mean of 35 colonies/100 ml nor exceed a maximum of 158 colonies/100 ml in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. When the geometric bacterial coliform organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters. Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports.

<u>Criteria Exceeded:</u>
Gunnison Creek was first included on Alabama's 2022 §303(d) list for pathogens (*E. coli*) based on data collected during 2016 and 2019. Monthly sample results taken from GNNM-1 for *E. coli* showed four out of 12 samples exceeding the applicable single sample criterion. The listing data can be seen in Appendix 7.2, Table 12.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

For the purposes of this TMDL, a single sample maximum *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 Swimming 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 of 235 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 at least five samples taken no less than 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 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 Gunnison 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 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 continuous point sources in the Gunnison Creek watershed. There are several facilities with NPDES permits for non-continuous/stormwater discharges related to construction, transportation, lumber/wood, etc. within the Gunnison Creek 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 processes; therefore, no *E. coli* loading to the watershed will be attributed to these facilities, and they will not receive an allocation in this TMDL.

Urban areas designated as part of the Municipal Separate Storm Sewer System (MS4) program are regulated by NPDES, and as such, are considered to be point sources by EPA and receive WLAs in TMDLs. The EPA defines an MS4 as “a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

(i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law);
(ii) Designed or used for collecting or conveying stormwater;
(iii) Which is not a combined sewer; and
(iv) Which is not part of Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2"

During rain events in an urbanized watershed, stormwater runoff has the potential to collect pollutants which are transported through MS4 systems before discharging into state waters. Therefore, in 1990 the EPA developed the NPDES stormwater program, which promulgated rules, in two different phases, in order to address the potential negative water quality effects associated with stormwater runoff. In 1990, the EPA issued Phase I regulations under the NPDES stormwater program, which required both medium and large cities, and also counties with populations of 100,000 or more to obtain NPDES permit coverage specifically for their stormwater discharges. In 1999, the second phase of the NPDES stormwater program amended existing regulations in addition to requiring NPDES permits for stormwater discharges from certain small MS4 systems.

The permittees that are addressed in the TMDL process include those in Phase I and Phase II municipalities covered under the MS4 NPDES program whose boundaries of urban areas are located within the Gunnison Creek watershed. The tables below identify those specific permittees. Current and future MS4s will be required to demonstrate consistency with the assumptions and requirements of this TMDL through implementation of BMPs on a case-by-case basis.

Table 3. NPDES Phase II MS4 Municipalities in the Gunnison Creek Watershed

Permittee Name	NPDES Permit Number
Mobile County Commission	ALR040043
City of Satsuma	ALR040046
City of Saraland	ALR040045

Table 4. NPDES Phase I MS4 Municipalities in the Gunnison Creek Watershed

Permittee Name	NPDES Permit Number
City of Mobile	ALS000007

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

Any future NPDES-regulated discharges that are 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 registered sites in the Gunnison Creek 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.

3.2.2 Sanitary Sewer Overflows

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. Unfortunately, releases to surface waters from SSOs are not always preventable or reported.

From a review of the Department's Alabama Environmental Permitting and Compliance System (AEPACS) database, six SSOs have been reported in the Gunnison Creek watershed in recent years. Further details of the SSOs in the watershed are included in Appendix 7.3.

3.2.3 Nonpoint Sources in the Gunnison 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 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 Gunnison Creek watershed was determined using ArcMap with land use datasets derived from the 2021 National Land Cover Dataset (NLCD). The total drainage area of the Gunnison Creek watershed is approximately 43.92 square miles. Figure 2 and Table 5 depict the primary land uses in the Gunnison Creek watershed.

Figure 2. Land Use in the Gunnison Creek Watershed

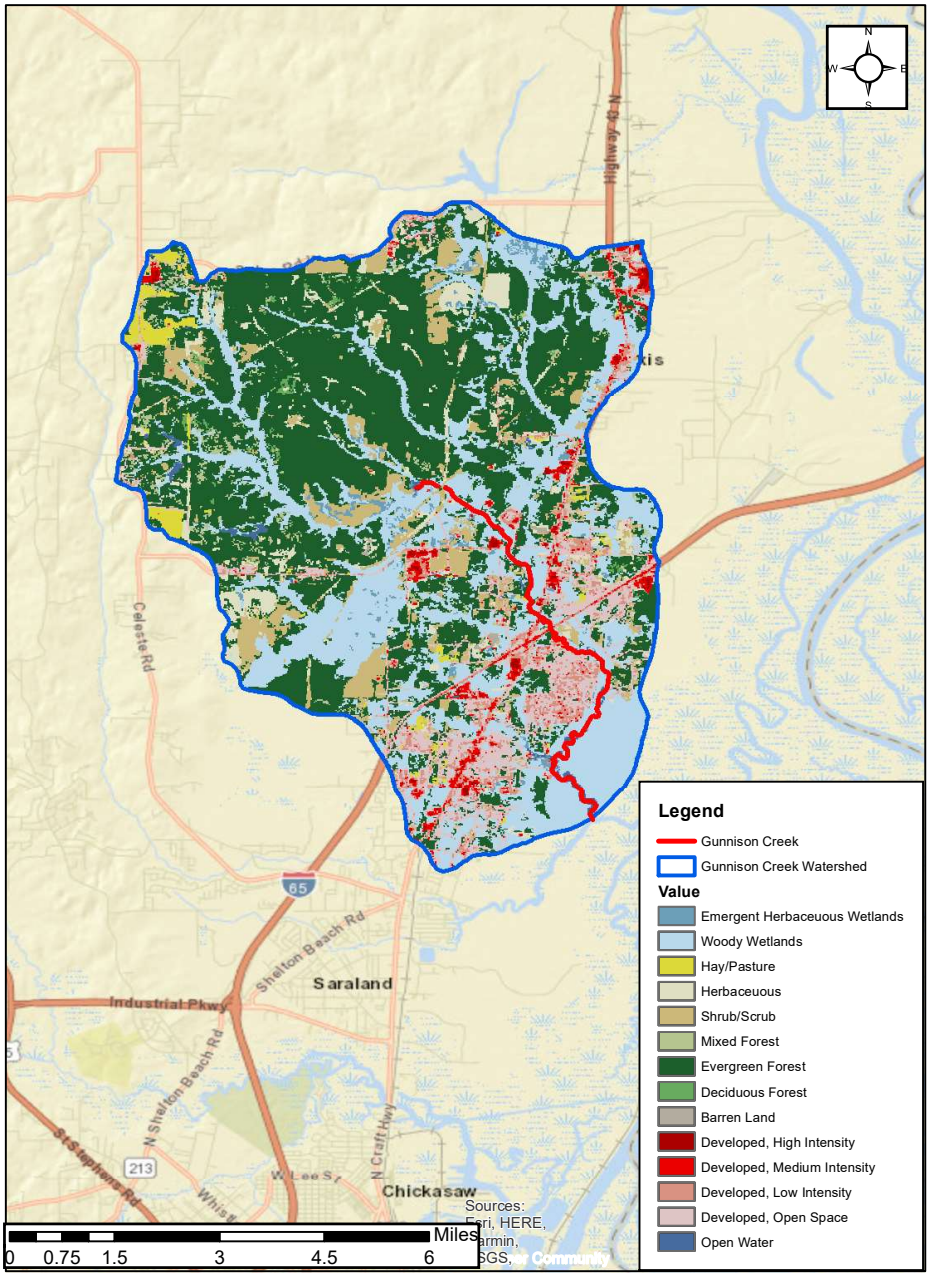
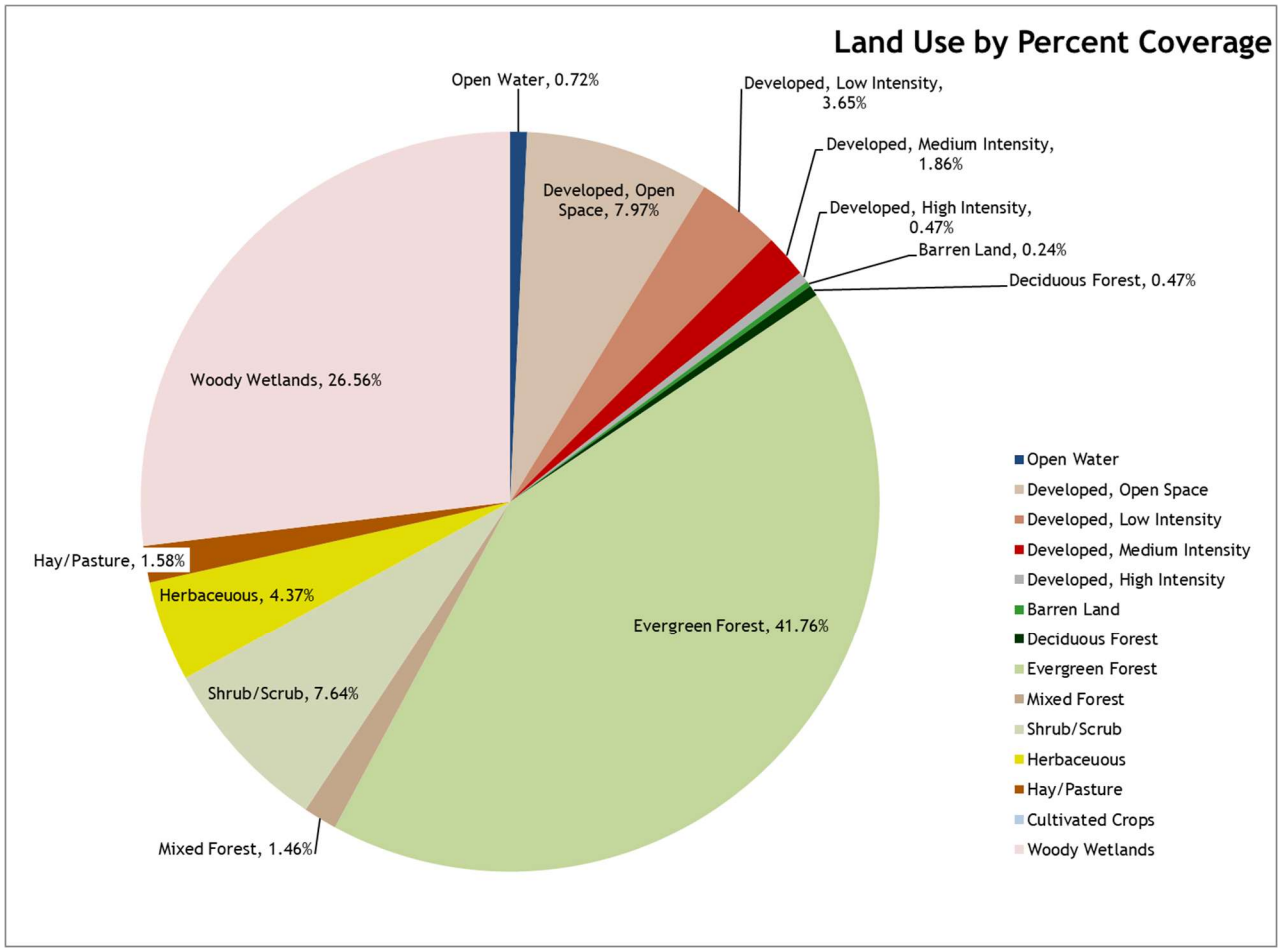


Table 5: Land Use (2021) in the Gunnison Creek Watershed

Land Use	Miles^2	Acres	Percent
Open Water	0.32	203.71	0.72%
Developed, Open Space	3.50	2239.74	7.97%
Developed, Low Intensity	1.60	1024.57	3.65%
Developed, Medium Intensity	0.82	521.74	1.86%
Developed, High Intensity	0.21	131.88	0.47%
Barren Land	0.10	67.16	0.24%
Deciduous Forest	0.21	131.44	0.47%
Evergreen Forest	18.34	11737.55	41.76%
Mixed Forest	0.64	409.43	1.46%
Shrub/Scrub	3.35	2146.55	7.64%
Herbaceous	1.92	1228.73	4.37%
Hay/Pasture	0.69	443.46	1.58%
Cultivated Crops	0.00	0.00	0.00%
Woody Wetlands	11.66	7464.68	26.56%
Emergent Herbaceous Wetlands	0.56	357.39	1.27%
Totals→	**43.92**	**28108.04**	**100.00%**
Class Description	**Miles^2**	**Acres**	**Percent**
Open Water	0.32	203.71	0.72%
Agricultural Lands	0.69	443.46	1.58%
Forested/Natural	36.68	23475.77	83.52%
Developed Land (Grouped)	6.23	3985.09	14.18%
Totals→	**43.92**	**28108.04**	**100.00%**

Figure 3: Pie Chart of Land Use Distribution in the Gunnison Creek Watershed



Most of the Gunnison Creek watershed is comprised of forested and natural lands (83.52%) and developed land (14.18%). The remaining land use is approximately 1.58% agricultural lands and 0.72% open water. Developed land includes both commercial and residential land uses.

3.4 Linkage between Numeric Targets and Sources

The predominant land usage in the Gunnison Creek watershed is forested and natural lands, followed by developed land and agriculture. 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 Gunnison Creek are from urban runoff and the agricultural land uses. 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

During 2021 and 2023, ADEM conducted sampling on Gunnison Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, the data from this sampling period will be used to assess the water quality of Gunnison Creek 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 water quality data for the Gunnison Creek watershed at station GNNM-1. A description of the location of station GNNM-1 can be found in Table 6 and a map showing the location of station GNNM-1 can be found in Figure 4. A total of 23 *E. coli* samples were collected at station GNNM-1 during 2021 and 2023. Of the 23 samples that were collected, there were three exceedances of the single sample maximum criterion.

Table 6: ADEM Sampling Station in the Gunnison Creek Watershed

Station Name	Agency Name	Latitude	Longitude	Description
GNNM-1	ADEM	30.89785	-88.04787	Gunnison Creek at Radcliff Road

Figure 4: ADEM Sampling Station in the Gunnison Creek Watershed

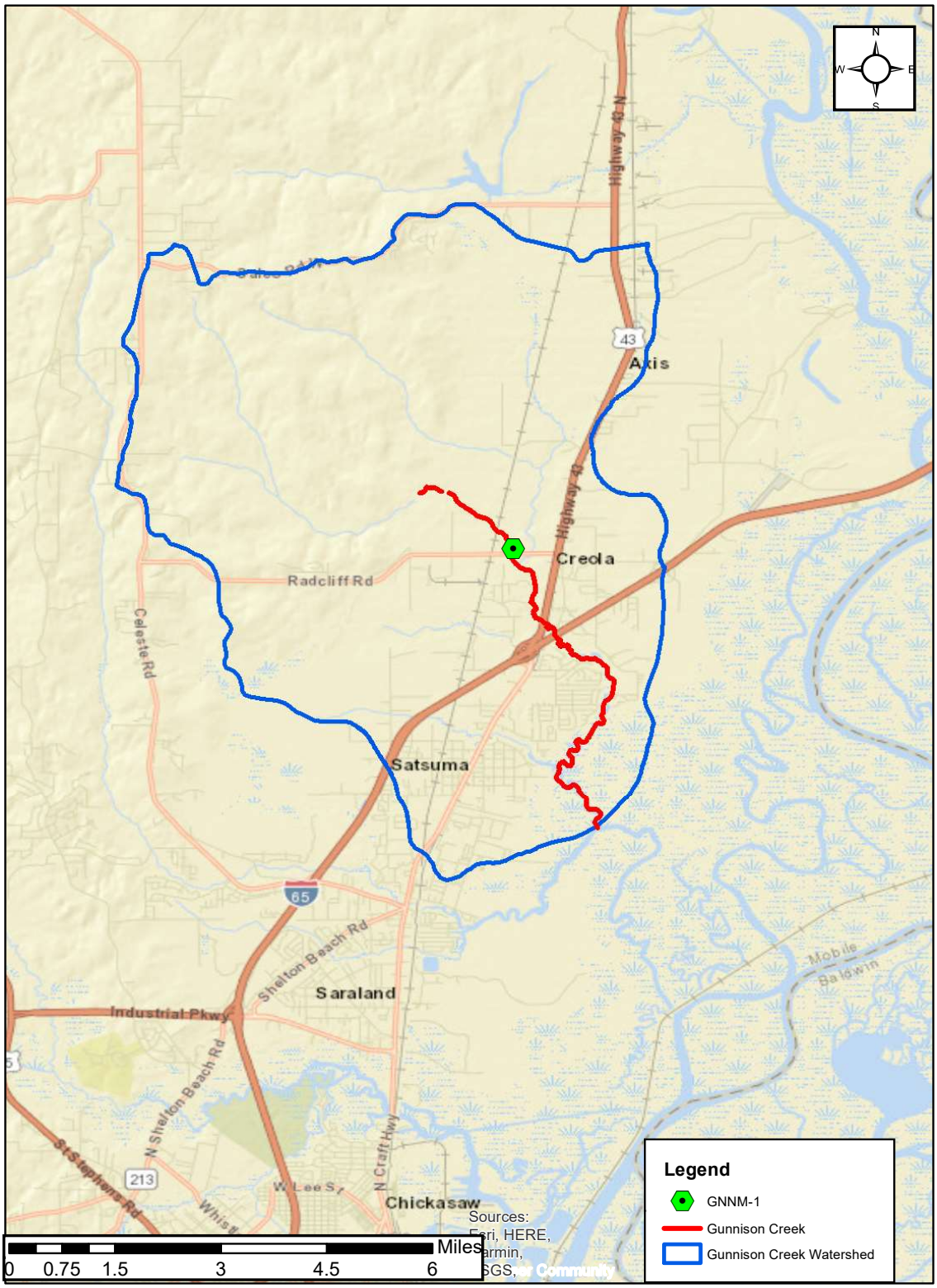


Table 7: 2021 and 2023 *E. coli* data for Gunnison Creek

Station ID	Visit Date	*E. coli* (col/100 ml)	*E. coli* Criteria (col/100 ml)	Geometric Mean (col/100 ml)	Geometric Mean Criteria (col/100 ml)	Flow (cfs)
GNNM-1	3/25/2021	**260**	235			
GNNM-1	4/21/2021	11	235			27.2
GNNM-1	5/17/2021	24	235			27.4
GNNM-1	6/16/2021	19	235			16.5
GNNM-1	7/21/2021	**370**	235			
GNNM-1	8/17/2021	170	235			18.3
GNNM-1	9/1/2021	**310**	235			
GNNM-1	10/5/2021	110	235			
GNNM-1	3/21/2023	17	235			19.1
GNNM-1	4/4/2023	52	235			18.9
GNNM-1	5/10/2023	31	235	18.7	126	16.1
GNNM-1	5/23/2023	32	235			19.8
GNNM-1	5/30/2023	16	235			14.3
GNNM-1	6/1/2023	28	235			13.7
GNNM-1	6/7/2023	5.1	235			150.3
GNNM-1	7/24/2023	44	235			15.8
GNNM-1	8/2/2023	81	235	80.8	126	10.1
GNNM-1	8/10/2023	120	235			10.2
GNNM-1	8/21/2023	57	235			6.7
GNNM-1	8/23/2023	62	235			6.8
GNNM-1	8/28/2023	100	235			5.9
GNNM-1	9/18/2023	86	235			9.7
GNNM-1	10/16/2023	36	235			10.0

3.6 Critical Conditions/Seasonal Variation

The *E. coli* single sample maximum criterion of 235 colonies/100 ml and geometric mean criterion of 126 colonies/100 ml for the Swimming use classification are applicable year-round. The critical condition for this pathogen TMDL was taken to be the one with the highest *E. coli* single sample exceedance value. The highest single sample maximum concentration of 370 colonies/100 ml was collected on July 21, 2021, at station GNNM-1. A flow of 150.3 cfs was estimated for station GNNM-1 during this sampling event. The use of the highest exceedance to calculate the TMDL is expected to be protective of water quality in Gunnison Creek 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 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 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, 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 Gunnison 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 single sample exceedance. In the same manner, allowable loads were calculated for the single sample criterion of 235 col/100 ml. There were no exceedances of the applicable 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.

4.2.1 Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample *E. coli* concentration of 370 colonies/100 ml times the estimated flow at the time the sample was taken. This concentration was based on a measurement at station GNNM-1 on July 21, 2021, and can be seen above in Table 7. The flow was not measured on this date due to non-wadeable conditions. Therefore, the highest measured flow at station GNNM-1 in 2021 was used as an estimate of the flow on July 21, 2021. The product of the concentration, estimated flow, and a conversion factor gives the total mass loading (colonies per day) of *E. coli* to Gunnison Creek under the single sample exceedance condition.

$$\frac{150.3\ \text{ft}^3}{\text{s}} \times \frac{370\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.36 \times 10^{12}\text{colonies}}{\text{day}}$$

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 criterion. This was done by taking the product of the estimated flow for the violation event, the allowable concentration, and the conversion factor.

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

$$\frac{150.3\ \text{ft}^3}{\text{s}} \times \frac{211.5\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.78 \times 10^{11}\text{colonies}}{\text{day}}$$

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

$$\frac{150.3\ \text{ft}^3}{\text{s}} \times \frac{23.5\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{8.64 \times 10^{10}\text{colonies}}{\text{day}}$$

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 Gunnison Creek as evaluated at station GNNM-1. Table 8 shows the existing and allowable *E. coli* loads and required reductions for the Gunnison Creek watershed.

Table 8: *E. coli* Loads and Required Reductions

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Single Sample Load	1.36E+12	7.78E+11	5.82E+11	43%

Table 9: *E. coli* TMDL for Gunnison Creek

TMDL[e]	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation (LA)	
		WWTPs[b]	Stormwater (MS4s and other NPDES sources)[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	% reduction	(col/day)	(col/day)	% reduction
8.64E+11	8.64E+10	N/A	43%	0	7.78E+11	43%

Note: N/A = not applicable
a. There are no CAFOs in the Gunnison 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 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.
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/100 ml.

4.3 TMDL Summary

Gunnison Creek was placed on Alabama's §303(d) list for pathogens in 2022 based on data collected in 2016 and 2019. Additional water quality data was collected by ADEM during 2021 and 2023 to further assess the water quality of the impaired stream. The data collected by ADEM during that sampling period confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the *E. coli* TMDL for Gunnison Creek. Based on the TMDL analysis, it was determined that a 43% 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 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 Gunnison 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 10.

Table 10: Follow-up Monitoring Schedule

River Basin Group	Years to be Monitored
Coosa, Escatawpa, Tennessee (Guntersville), Tombigbee	2025/2028
Alabama, Cahaba, Mobile, Tallapoosa, Tennessee (Pickwick and Wilson)	2026/2029
Black Warrior, Blackwater, Chattahoochee, Chipola, Choctawhatchee, Escambia, Perdido, Tennessee (Wheeler), Yellow	2027/2030

6.0 Public Participation

As part of the public participation process, this TMDL was placed on public notice and made available for review and comment. The public notice was prepared and published in four newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL were made available on ADEM's website: www.adem.alabama.gov. 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. 2016, 2019, 2021, 2023. ADEM.

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

Alabama's §303(d) List and Fact Sheet. 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 11: 2021-2023 *E. coli* Data for Station GNNM-1

Station ID	Visit Date	*E. coli* (col/100 ml)	*E. coli* Criteria (col/100 ml)	Geometric Mean (col/100 ml)	Geometric Mean Criteria (col/100 ml)	Flow (cfs)
GNNM-1	3/25/2021	**260**	235			
GNNM-1	4/21/2021	11	235			27.2
GNNM-1	5/17/2021	24	235			27.4
GNNM-1	6/16/2021	19	235			16.5
GNNM-1	7/21/2021	**370**	235			
GNNM-1	8/17/2021	170	235			18.3
GNNM-1	9/1/2021	**310**	235			
GNNM-1	10/5/2021	110	235			
GNNM-1	3/21/2023	17	235			19.1
GNNM-1	4/4/2023	52	235			18.9
GNNM-1	5/10/2023	31	235	18.7	126	16.1
GNNM-1	5/23/2023	32	235			19.8
GNNM-1	5/30/2023	16	235			14.3
GNNM-1	6/1/2023	28	235			13.7
GNNM-1	6/7/2023	5.1	235			150.3
GNNM-1	7/24/2023	44	235			15.8
GNNM-1	8/2/2023	81	235	80.8	126	10.1
GNNM-1	8/10/2023	120	235			10.2
GNNM-1	8/21/2023	57	235			6.7
GNNM-1	8/23/2023	62	235			6.8
GNNM-1	8/28/2023	100	235			5.9
GNNM-1	9/18/2023	86	235			9.7
GNNM-1	10/16/2023	36	235			10.0

Table 12. Station GNNM-1 *E. coli* Listing Data (2016 & 2019)

Station ID	Visit Date	*E. coli* (col/100 ml)	*E. coli* Detect Criteria	Flow (cfs)
GNNM-1	3/16/2016	44		
GNNM-1	4/12/2016	550		
GNNM-1	5/25/2016	35		18.3
GNNM-1	6/15/2016	110		29.5
GNNM-1	7/14/2016	44		14.9
GNNM-1	8/9/2016	520		21.9
GNNM-1	9/19/2016	480		21.9
GNNM-1	10/26/2016	240		8.9
GNNM-1	3/12/2019	32	H	27.7
GNNM-1	5/14/2019	24	J	32.3
GNNM-1	7/23/2019	180	H	35.2
GNNM-1	9/9/2019	53	H	11.5

*H denotes that the holding times for analysis were exceeded
*J denotes that the reported microbiological result is an estimate

7.3 Sanitary Sewer Overflows (SSOs)

Table 13. SSOs within the Gunnison Creek Watershed

Permit Number	Permittee Name	SSO Start Date/Time	SSO End Date/Time	SSO Volume	SSO Latitude	SSO Longitude
AL0063002	Satsuma Water and Sewer Board	4/27/2023 8:30	4/27/2023 13:30	10,000 < gallons <= 25,000	30.847415	-88.064977
AL0063002	Satsuma Water and Sewer Board	9/12/2023 22:35	9/13/2023 0:45	1,000 < gallons <= 10,000	30.849645	-88.050011
AL0063002	Satsuma Water and Sewer Board	6/21/2024 22:06	6/21/2024 22:17	100 gallons	30.849660	-88.049871
AL0063002	Satsuma Water and Sewer Board	7/5/2024 17:30	7/5/2024 20:00	25,000 < gallons <= 50,000	30.847525	-88.059499
AL0063002	Satsuma Water and Sewer Board	7/27/2024 17:50	7/27/2024 20:22	1,000 < gallons <= 10,000	30.860695	-88.052391
AL0077453	Integra Water Creola, LLC	7/31/2024 7:00	7/31/2024 9:30	1,000 gallons	30.902489	-88.036682

7.4 Gunnison Creek Photos

Figure 5. At Station GNNM-1: Upstream View of Gunnison Creek (10/16/2023)

Figure 6. At Station GNNM-1: Downstream View of Gunnison Creek(10/16/2023)