Final
Total Maximum Daily Load (TMDL)
for
Perdido Bay
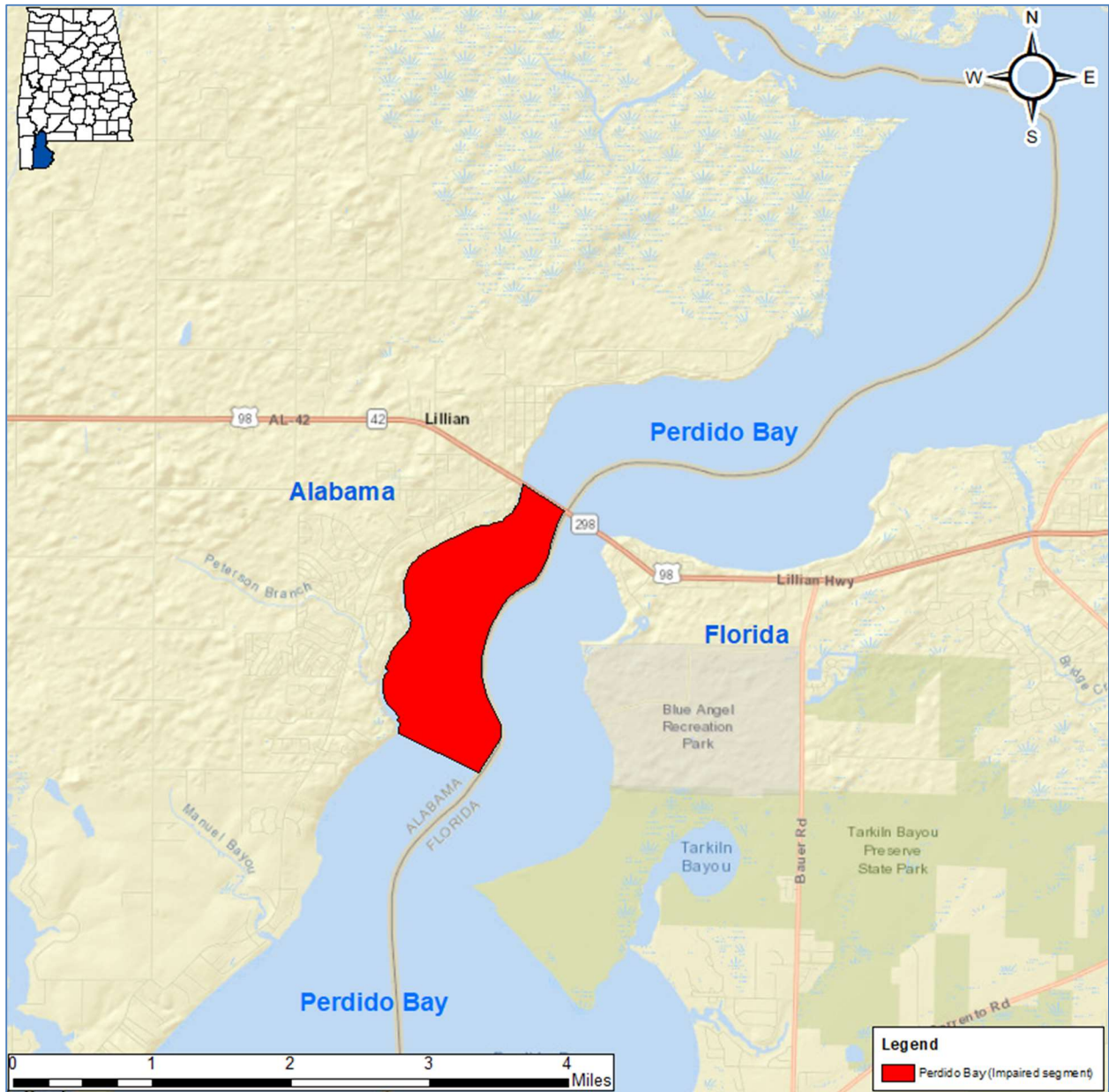
Assessment Unit ID #AL03140107-0204-302

Pathogens (Enterococci)

Baldwin County

Figure 1-1. Site map of impaired portion of Perdido Bay

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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 maximum amount of pollutant a waterbody can assimilate while meeting all applicable water quality standards for the pollutant of concern. All TMDLs include 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).

Perdido Bay has a total surface area of approximately 50 mi² (130 km²) with a total contributing drainage area of over 1250 mi² (3238 km²). It has an average depth of about 7 ft (3 m). It is generally shallower in the northernmost reaches and grows deeper as it nears the Gulf of Mexico. The dominant inflow of freshwater is the Perdido River, which accounts for a significant majority of the incoming freshwater.

The segment of Perdido Bay from Suarez Point to Lillian Bridge (AL03140107-0204-302) was originally placed on Alabama's 2012 §303(d) list of impaired waters for pathogens (Enterococci) based on data collected by ADEM in 2010. The impaired section only includes the Alabama portion of the bay and has an area of 1.29 square miles. Perdido Bay is in the Perdido River Basin in southeastern Baldwin County and is tidally influenced. The listed portion of Perdido Bay holds use classifications of Swimming and Other Whole-Body Water Contact Sports (S), Shellfish Harvesting (SH), and Fish & Wildlife (F&W).

Between 2018 and 2023, additional monitoring was conducted to evaluate the impaired waterbody. The available data indicates that the impaired region of Perdido Bay is still not meeting applicable water quality standards with respect to pathogens (Enterococci). During 2018-2023, there were multiple single sample and geometric mean exceedances. Therefore, this Enterococci TMDL has been developed for the assessment unit listed in Table 1-1.

Table 1-1. Assessment unit ID for Perdido Bay

Assessment Unit ID	Waterbody	Description
AL031401070-0204-302	Perdido Bay	1.29 mi² area from Suarez Point to Lillian Bridge

A percent reduction approach was utilized to calculate the pathogen TMDL for the impaired region of Perdido Bay. Typically, TMDLs are expressed on a mass loading basis (e.g., pounds per day). In this instance, flow was not a consideration due to tidal influence, small watershed size, and very localized exceedances. Therefore, a percent reduction was based solely on the highest exceedance value measured in terms of concentration.

The existing pathogen concentration used for this TMDL was based on the highest single sample exceedance that occurred within the past six years at the beach monitoring station SPAN_COVE. The highest single sample exceedance was 773 colonies/100 mL, taken on September 24, 2020.

The allowable concentration, defined by the single sample criterion including a margin of safety, was calculated by subtracting 10% from the single sample criterion. The allowable concentration was determined to be 93.6 colonies/100 mL (104 colonies/100 mL – 10% Margin of Safety). The reduction required to meet the allowable concentration was then calculated by subtracting the existing concentration from the allowable concentration and then dividing that value by the existing concentration. The highest single sample violation calls for a reduction of 88%. Required geometric mean reductions were found to be less stringent than the required single sample reduction.

Table 1-2 is a summary of the existing concentration, allowable concentration, and percent reduction for the single sample criterion vs. the geometric mean criterion for the impaired region of Perdido Bay (AL031401070-0204-302). Table 1-3 provides details of the TMDL along with the corresponding reductions for Perdido Bay which are protective of the Enterococci water quality standards year-round.

Table 1-2. Enterococci concentrations and required reductions for Perdido Bay (AL031401070-0204-302)

Source	Existing Concentration (col/100 mL)	Allowable Concentration (col/100 mL)	Required Reduction (col/100 mL)	% Reduction
Single Sample	773	93.6	679.4	88%
Geometric Mean	119	31.5	87.5	74%

Table 1-3. Enterococci TMDL for Perdido Bay (AL031401070-0204-302)

| 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/100 mL)	(col/100 mL)	(col/100 mL)	(% reduction)	(col/day)	(col/100 mL)	(% reduction)
104	10.4	NA	NA	0	93.6	88%

NA = not applicable

a. There are no CAFOs in the subject watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.

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

c. Future MS4 areas and other NPDES stormwater sources would 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 collections 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 pathogen loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for pathogens.

e. TMDL was established using the Swimming and Other Whole-Body Water Contact single sample criterion of 104 colonies/100 mL.

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 the 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). 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).

The state of Alabama has identified a 1.29 square mile portion of Perdido Bay as impaired for pathogens. This portion of Perdido Bay was originally placed on Alabama's 2012 §303(d) list of impaired waterbodies for pathogens (Enterococci) based on beach monitoring program data collected in 2010 at station SPAN_COVE near Lillian, AL. The source of the impairment on the current §303(d) list is collection system failure and on-site wastewater systems.

2.2 Problem Definition

Waterbody Impaired: Perdido Bay from Suarez Point to the Lillian Bridge
                                        (US Highway 98)

Impaired Area: 1.29 square miles

Contributing Drainage Area: 5.41 square miles

Water quality Standard Violation: Pathogens (Single Sample & Geometric Mean)

Pollutant of Concern: Pathogens (Enterococci)

Water Use Classification: Fish and Wildlife, Shellfish Harvesting, Swimming
                                        and Other Whole-Body Water Contact Sports

Usage Related to Classification:

The impaired portion of Perdido Bay has three use classifications: Fish and Wildlife (F&W), Shellfish Harvesting (SH), and Swimming and Other Whole-Body Water Contact Sports (S). Usage of waters for the F&W classification is described in ADEM Admin. Code R. 335-6-10-.09 (5)(a), (b), (c), and (d) as follows:

(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.*

Usage of waters for the SH classification is described in ADEM Admin. Code R. 335-6-10-.09 (4)(a), (b), (c), and (d) as follows:

(a) *Best usage of waters: propagation and harvesting of shellfish for sale or use as a food product.*

(b) *Conditions related to best usage: waters will meet the sanitary and bacteriological standards included in the National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish: 2019 Revision, published by the Food and Drug Administration, U.S. Department of Health and Human Services and the requirements of the State Department of Public Health. The waters will also be of a quality suitable for the propagation of fish and other aquatic life, including shrimp and crabs. Only coastal waters may be considered for classification as Shellfish Harvesting.*

(c) *Other usage of waters: it is recognized that the waters may be used for incidental water contact year-round and for 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.*

Usage of waters for the S classification is described in ADEM Admin. Code R. 335-6-10-.09 (3)(a) and (b) as follows:

(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.*

*Note: In assigning this classification to waters intended for swimming and water-contact sports, the Commission will take into consideration the relative proximity of discharges of wastes and will recognize the potential hazards involved in locating swimming areas close to waste discharges. The Commission will not assign this classification to waters, the bacterial quality of which is dependent upon adequate disinfection of waste and where the interruption of such treatment would render the water unsafe for bathing.

Pathogen Criteria:

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

Pathogen criteria for the SH classification are described in ADEM Admin. Code R. 335-6-10-.09 (4) (e) 7. (i), (ii), and (iii) as follows:

(i). Not to exceed the limits specified in the National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish: 2019 Revision, published by the Food and Drug Administration, U.S. Department of Health and Human Services.

(ii). In coastal waters, bacteria of the enterococci group shall not exceed a maximum of 275 colonies/100 ml in any sample.

(iii). 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 enterococci group does not exceed a geometric mean of 35 colonies/100 ml nor exceed a maximum of 104 colonies/100 ml in any sample in coastal waters. 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. 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.

Pathogen criteria for the S classification are described in ADEM Admin. Code R. 335-6-10-.09 (3) (c) 7. (i), (ii), and (iii) as follows:

7. 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.*

*Note: In assigning this classification to waters intended for swimming and water-contact sports, the Commission will take into consideration the relative proximity of discharges of wastes and will recognize the potential hazards involved in locating swimming areas close to waste discharges. The Commission will not assign this classification to waters, the bacterial quality of which is dependent upon adequate disinfection of waste and where the interruption of such treatment would render the water unsafe for bathing.

A summary of Alabama's bacteria criteria for the Fish and Wildlife, Shellfish Harvesting, and Swimming and Other Whole-Body Water Contact Sports use classifications is shown in Table 2-1 below. These values are for coastal waters only.

Table 2-1. Alabama's Enterococci criteria.

Use Classification	Single Sample	Geometric Mean
Fish & Wildlife (F&W)	≤ 158 colonies/100 mL (May-October) ≤ 275 colonies/100 mL (November-April)	≤ 35 colonies/100 mL
Shellfish Harvesting (SH)	≤ 104 colonies/100 mL (May-October) ≤ 275 colonies/100 mL (November-April)	≤ 35 colonies/100 mL
Swimming and Other Whole-Body Water Contact Sports (S)	≤ 104 colonies/100 mL (year-round)	≤ 35 colonies/100 mL

Criteria Exceeded:

Criteria for different use classifications are not always the same. If a waterbody has multiple use classifications, the most stringent of the criteria will apply, thereby ensuring that criteria are maintained for each use classification. In this case, the bacteria criteria for the Swimming and Other Whole-Body Water Contact Sports use classification are applicable. An assessment of the pathogen criteria for the impaired portion of Perdido Bay results in the following applicable criteria:

Annual (January – December):

> The geometric mean for Enterococci may not exceed 35 colonies/100 mL.
> The single sample maximum for Enterococci may not exceed 104 colonies/100 mL.

Perdido Bay was originally placed on Alabama's 2012 §303(d) list of impaired waterbodies for pathogens (Enterococci) based on beach monitoring program data collected in 2010 at station SPAN_COVE near Lillian, AL. The 2010 data indicated that eight out of thirty-seven samples exceeded the applicable Enterococci criteria. This data can be found in Appendix 7.2.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

A single sample Enterococci allowable concentration of 93.6 colonies/100 mL will be used for this TMDL. This concentration was derived by using the single sample criterion of 104 col/100 mL and a 10% explicit margin of safety. This allowable concentration is protective of water quality standards and should not allow the single sample applicable criteria to be exceeded. In addition, a geometric mean Enterococci target of 31.5 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 derived by using a 10% explicit margin of safety from the geometric mean maximum of 35 colonies/100 ml criterion. This target is considered protective of water quality standards and should not allow the geometric mean of 35 colonies/100 ml to be exceeded.

3.2 Source Assessment

3.2.1 Point Sources in the Perdido Bay 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, leaking sewer systems in urban areas, and illicit discharges. 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 Enterococci can flow into the stream or leach into the groundwater. Illicit discharges are found at facilities that are discharging Enterococci bacteria when not permitted, or when Enterococci criterion established in an issued NPDES permit is not being upheld.

3.2.1.1 *Continuous Point Sources*

There are currently no continuous NPDES-permitted discharges located in the contributing watershed of the impaired portion of Perdido Bay. Any future NPDES regulated discharges that are considered by the Department to be a pathogen source will be required to meet the instream water quality criteria for pathogens at the point of discharge.

3.2.1.2 *Non-Continuous Point Sources*

The specific watershed contributing to the Perdido Bay impairment is not located within any Municipal Separate Storm Sewer System (MS4) areas. In addition, there are currently no Animal Feeding Operation/Concentrated Animal Feeding Operation (AFO/CAFO) facilities located within the Perdido Bay 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.

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

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 ADEM files, it was found that four SSOs have been reported in the Lillian area since 2018. Further details of the SSOs in the watershed are included in Appendix 7.3.

3.2.2   **Nonpoint Sources in the Perdido Bay Watershed**

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

Agricultural land can be a source of Enterococci bacteria. Runoff from pastures, animal feeding operations, improper land application of animal wastes, and animals with direct access to streams are all mechanisms that can contribute Enterococci bacteria to waterbodies. To account for the potential influence from animals with direct access to stream reaches in the watershed, Enterococci loads can be calculated as a direct source into the stream.

Enterococci bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, turkeys, beavers, and waterfowl. 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.

Enterococci loading from urban areas is potentially attributable to multiple sources including storm water runoff, illicit discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, sewer overflows due to infiltration and inflow, 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 Enterococci bacteria to surface waters due to system failure and malfunction.

3.3 Land Use Assessment

Land use for the 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 for the watershed of the impaired portion of Perdido Bay. Table 3-1 depicts the primary land uses in the watershed of the impaired portion of Perdido Bay. Figure 3-2 shows the grouped land uses for the watershed. Only land use within the general area of the impaired segment of Perdido Bay was considered.

Most of the watershed is agricultural lands (46.65%) and developed land (33.1%). Developed land includes both commercial and residential land uses. The remaining land use is approximately 20.03% forested/natural and less than 1% open water.

Figure 3-1. Land use map for the impaired portion of Perdido Bay
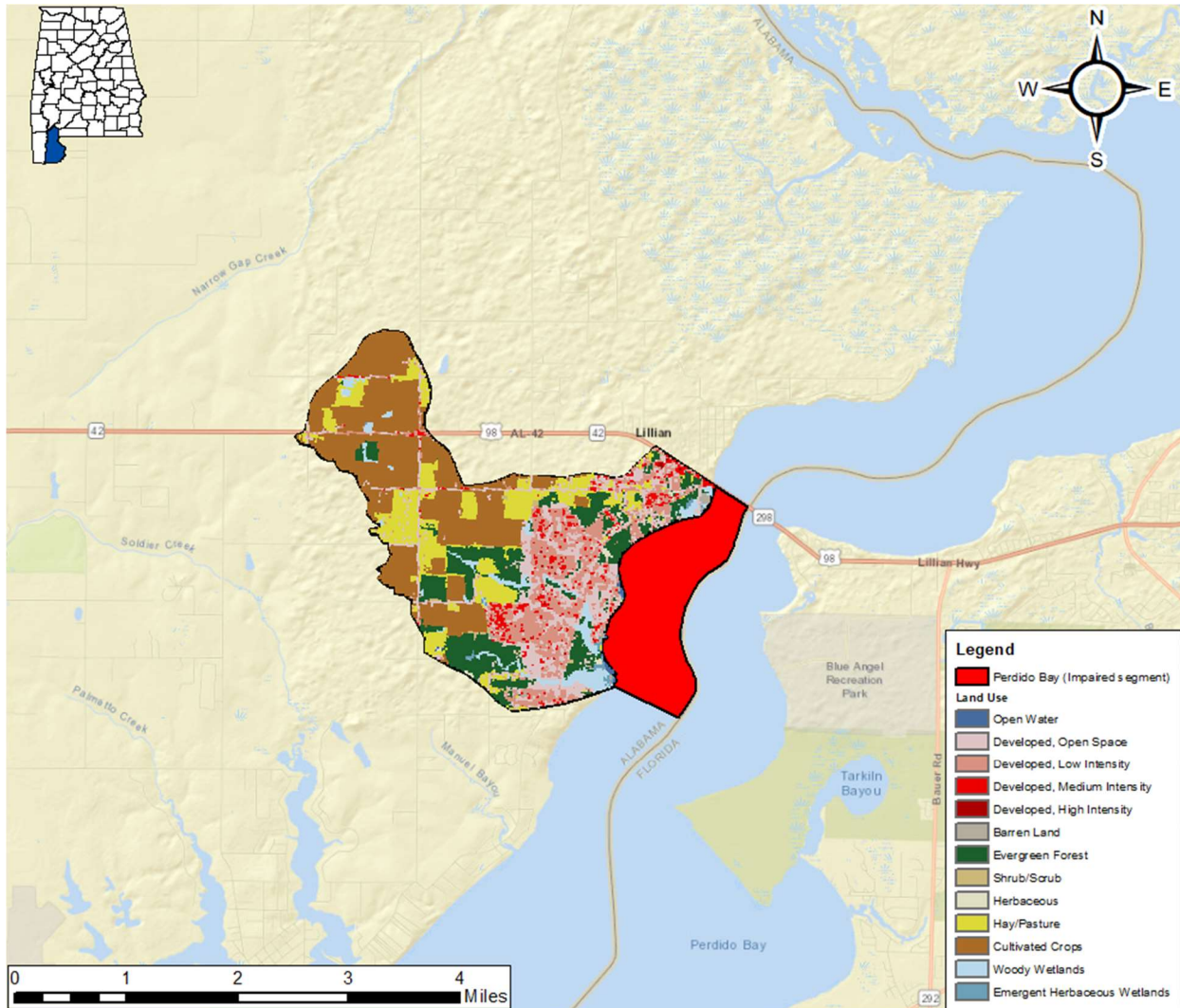
Table 3-1. Land use areas for the impaired portion of Perdido Bay

Class Description	Mi²	Acres	Percent
Open Water	0.01	7.34	0.21%
Developed, Open Space	0.78	496.39	14.33%
Developed, Low Intensity	0.8	509.95	14.72%
Developed, Medium Intensity	0.19	119.65	3.45%
Developed, High Intensity	0.01	6.23	0.18%
Barren Land	0.02	14.68	0.42%
Deciduous Forest	0.00	0.00	0.00%
Evergreen Forest	0.78	501.5	14.48%
Mixed Forest	0.00	0.00	0.00%
Shrub/Scrub	0.03	17.57	0.51%
Herbaceous	0.02	13.57	0.39%
Hay/Pasture	0.78	497.94	14.37%
Cultivated Crops	1.75	1118.2	32.28%
Woody Wetlands	0.23	145.45	4.2%
Emergent Herbaceous Wetlands	0.03	16.01	0.46%
TOTALS →	**5.41**	**3464.47**	**100.00%**
Class Description	**Mi²**	**Acres**	**Percent**
Open Water	0.01	7.34	0.21%
Agricultural Lands	2.53	1616.14	46.65%
Forested / Natural	1.08	694.09	20.03%
Developed Land (Grouped)	1.79	1146.89	33.10%
TOTALS →	**5.41**	**3464.47**	**100.00%**

Figure 3-2. Graph of primary land uses for the impaired portion of Perdido Bay

Grouped Land Use by Percent Coverage

Open Water, 0.21%

Developed Land
(Grouped), 33.10%

Agricultural Lands,
46.65%

Forested / Natural,
20.03%
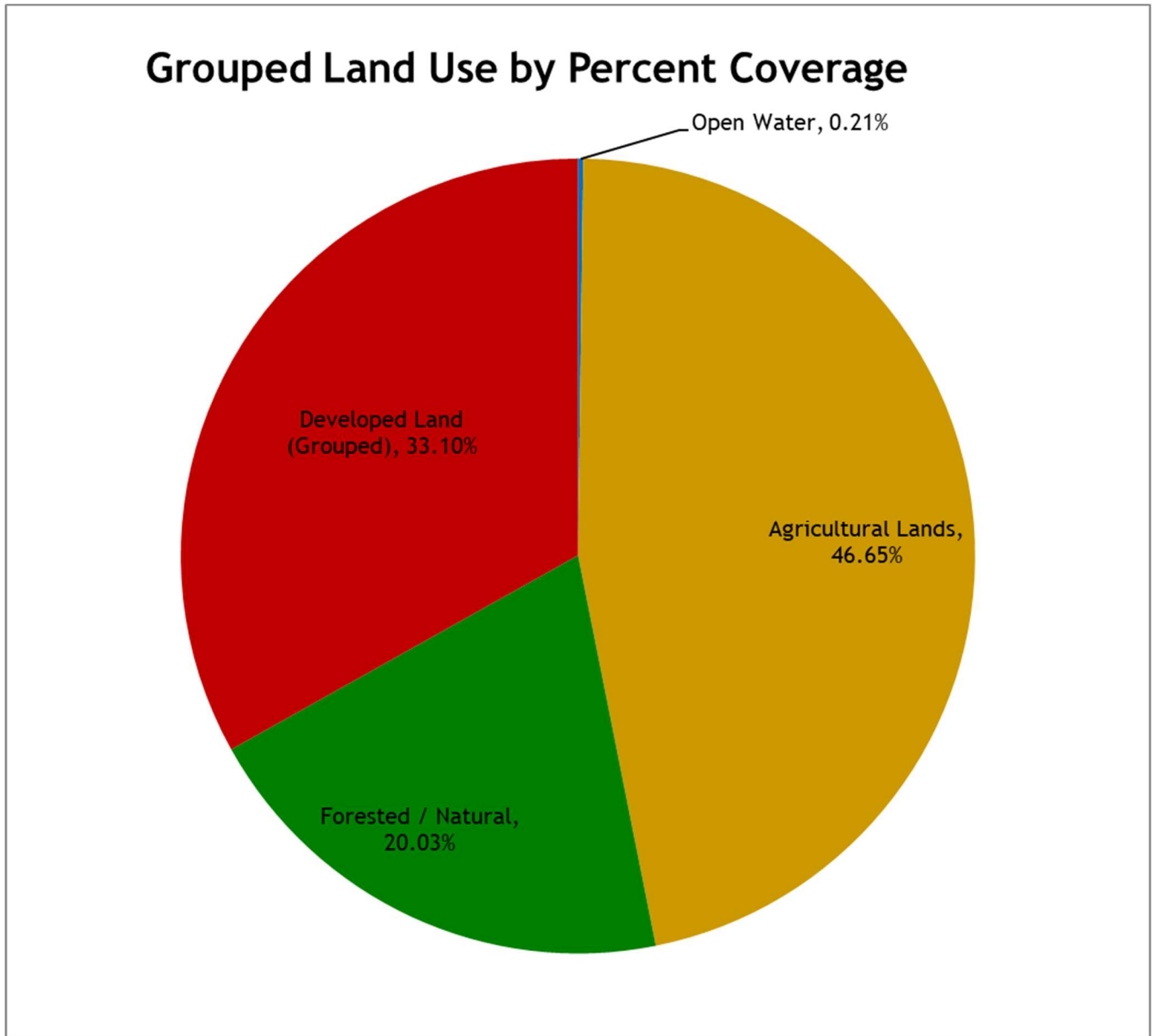
3.4 Linkage Between Numeric Targets and Sources

The primary land uses for the impaired portion of the Perdido Bay watershed are agriculture and developed land, followed by 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 this watershed are from urban runoff, collection system failures, failing septic tanks, and agricultural land uses. Individual loads and reductions will not be calculated for the range of nonpoint sources, but rather the loadings and reductions will be calculated as a single total load and reduction.

3.5 Data Availability and Analysis

The beach monitoring program has been in effect for approximately 23 years with the purpose of protecting human health for whole body contact within coastal waters (i.e., swimming). The data is collected by ADEM and the Alabama Department of Public Health (ADPH). Samples are usually collected twice per week, once per week, or once every other week during the summer season and once per month during the cooler months. Results of the data are assessed employing ADEM's water quality criteria for pathogens in the coastal area. If values exceed the criteria, then ADPH issues a swimming advisory until subsequent data indicates there is no longer a problem.

The beach monitoring station (SPAN_COVE) on the impaired segment of Perdido Bay is located near the bottom of the segment. A map showing the station location is shown in Figure 3-3. Of the data collected at station SPAN_COVE, there were numerous exceedances of both the single sample and geometric mean criteria. The data was evaluated against the geometric mean and single sample criteria for the Swimming and Other Whole-Body Water Contact use classification.

The exceedance event which results in the largest pathogen reduction at Spanish Cove (near Suarez Point) occurred on September 24, 2020. This was a single sample event with a measured Enterococci value of 773 colonies/100 mL. A table with all the exceedances can be found in the Appendices of this report.

Table 3-2. ADEM beach monitoring station on Perdido Bay

Station	Beach	Waterbody	Latitude	Longitude
SPAN_COVE	Spanish Cove	Perdido Bay	30.38569°	-87.45183°

Figure 3-3. ADEM station SPAN_COVE on Perdido Bay
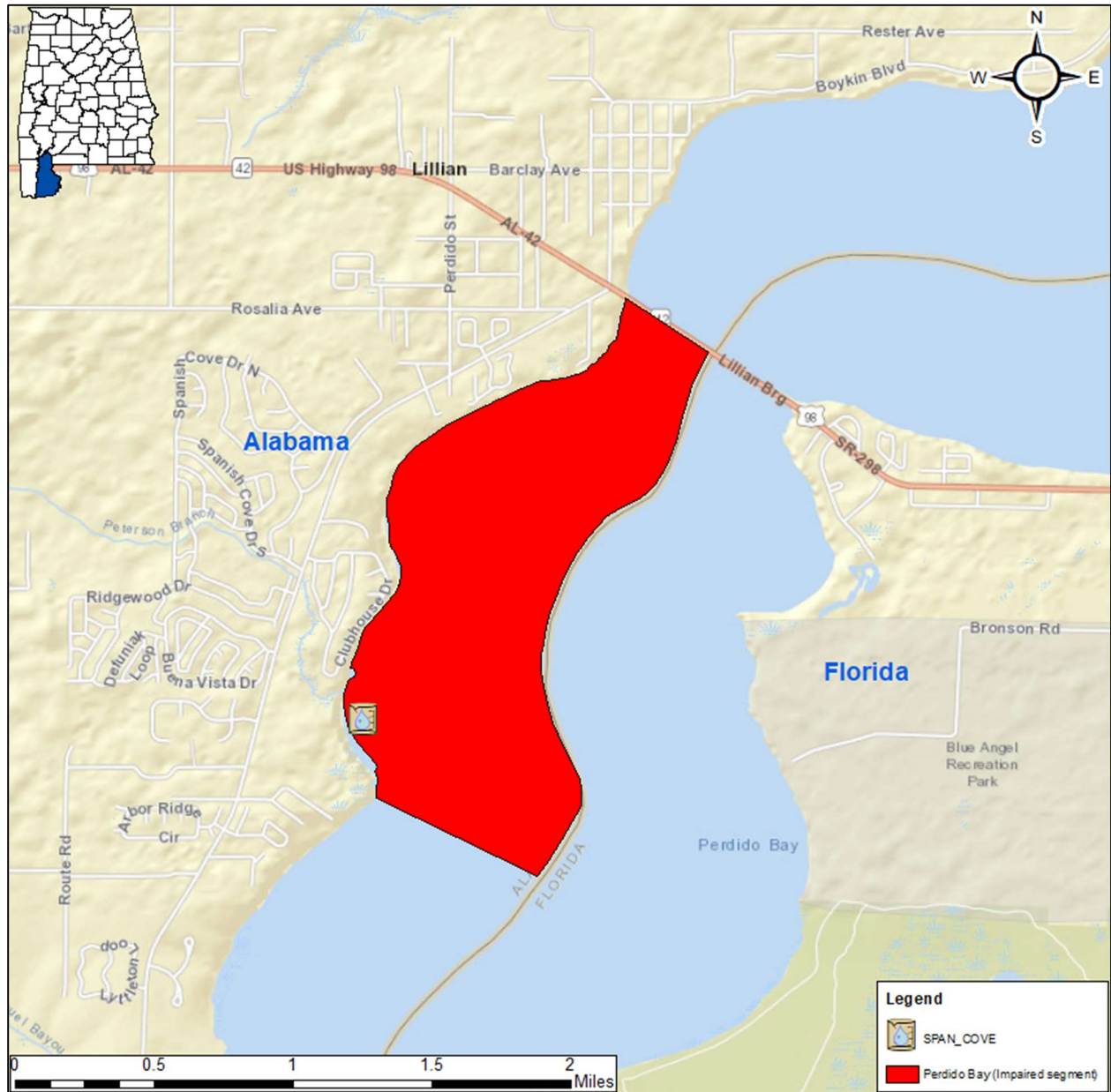
3.6 Critical Conditions/Seasonal Variation

The Enterococci single sample maximum criterion of 104 colonies/100 ml and geometric mean criterion of 35 colonies/100 ml for the Swimming and Other Whole Body Water-Contact Sports use classification are applicable year-round. The critical condition for this pathogen TMDL was taken to be the one with the highest Enterococci single sample exceedance value. The highest single sample maximum concentration of 773 colonies/100 ml was collected on September 24, 2020. The use of the highest exceedance to calculate the TMDL is expected to be protective of water quality in Perdido Bay year-round.

3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: 1) implicitly incorporate 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 Enterococci data used in this analysis. An explicit MOS was applied to the TMDL by reducing the Enterococci single sample and geometric mean criteria concentrations by ten percent. The single sample criterion of 104 colonies/100 mL was reduced by ten percent to 93.6 colonies/100 mL, while the geometric mean criterion of 35 colonies/100 ml was also reduced by 10% to 31.5 colonies/100 ml.

4.0 TMDL Development

4.1 Definition of a TMDL

A total maximum daily load (TMDL) is the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS). As discussed earlier, the MOS is explicit in this TMDL. A TMDL can be denoted by the following equation:

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

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). In this instance, flow was not a consideration due to the tidal influence, small watershed size, and very localized exceedances. Therefore, a percent reduction was based solely on the highest exceedance value measured in terms of concentration.

4.2 Reduction and TMDL Calculations

A percent reduction approach was utilized to calculate the pathogen TMDL for Perdido Bay. The following equation was used to calculate the appropriate reduction:

$$\% \ Reduction = \frac{(Highest \ Exceedance - Sample \ Criterion \ w/MOS)}{Highest \ Exceedance} \ X \ 100$$

The single sample criterion was used because it yielded the greatest reduction among the available data. The TMDL was based on the single sample violation that produced the highest percent reduction of Enterococci necessary to achieve applicable water quality criteria. Since the exceedance was a localized value indicative of near-shore impacts, the contributing watershed was limited to the near-shore area of the bay.

The difference in the pathogen concentrations between the existing conditions (violation event) and the allowable conditions converted to a percent reduction represents the total reduction needed to achieve the Enterococci water quality criterion. The percent reduction calculations are shown below. The greatest reduction value seen below (single sample) was used as the basis for this TMDL.

Single sample:

$$\frac{(773 \ col/100 \ mL - 93.6 \ col/100 \ mL)}{773 \ col/100 \ mL} X \ 100\% = 88\% \ Reduction$$

Geometric mean:

$$\frac{(119 \ col/100 \ mL - 31.5 \ col/100 \ mL)}{119 \ col/100 \ mL} X \ 100\% = 74\% \ Reduction$$

The TMDL was calculated as the Enterococci concentration to the impaired portion of Perdido Bay as evaluated at the Spanish Cove station. Table 4-1 shows a summary of the existing concentrations, allowable concentrations, and percent reductions for both the single sample and geometric mean criteria for the impaired portion of Perdido Bay. Table 4-2 provides the details of the TMDL along with the corresponding reductions for Perdido Bay which are protective of Enterococci water quality standards year-round.

Table 4-1. Enterococci concentrations and required reductions for AL031401070-0204-302

Source	Existing Concentration (col/100 mL)	Allowable Concentration (col/100 mL)	Required Reduction (col/100 mL)	% Reduction
Single Sample	773	93.6	679.4	88%
Geometric Mean	119	31.5	87.5	74%

Table 4-2. Enterococci TMDL for Perdido Bay (AL031401070-0204-302)

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/100 mL)	(col/100 mL)	(col/100 mL)	(% reduction)	(col/day)	(col/100 mL)	(% reduction)
104	10.4	NA	NA	0	93.6	88%

NA = not applicable

a. There are no CAFOs in the subject watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.

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

c. Future MS4 areas and other NPDES stormwater sources would 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 collections 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 pathogen loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for pathogens.

e. TMDL was established using the Swimming and Other Whole-Body Water Contact single sample criterion of 104 colonies/100 mL.

4.3 TMDL Summary

The portion of Perdido Bay from Suarez Point to Lillian Bridge was placed on Alabama's §303(d) list for pathogens in 2012 based on data collected in 2010. Since then, ADEM has performed additional beach monitoring as part of the Department's coastal program. The results from this monitoring confirmed the impairment and provided the basis for this TMDL.

A percent reduction approach was used to calculate the Enterococci TMDL for the impaired segment of Perdido Bay. Based on the TMDL analysis, it was determined that an 88% reduction was necessary to achieve compliance with applicable water quality standards.

Compliance with the terms and conditions of existing and future NPDES sanitary and stormwater permits will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL.

Required load reductions in the load allocation portion of this TMDL will be implemented through voluntary measures/best management practices (BMPs). Cooperation and active participation by the public and various other groups are critical to successful implementation of TMDLs. Local, citizen-led, and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. Therefore, TMDL implementation

activities for nonpoint sources will be coordinated through interaction with local entities and may be eligible for CWA §319 grants through the Department's Nonpoint Source Unit.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria, and we are committed to targeting the load reductions to improve water quality in the Perdido Bay 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
Black Warrior, Blackwater, Chattahoochee, Chipola, Choctawhatchee, Escambia, Perdido, Tennessee (Wheeler), Yellow	2024/2027
Coosa, Escatawpa, Tennessee (Guntersville), Tombigbee	2025/2028
Alabama, Cahaba, Mobile, Tallapoosa, Tennessee (Pickwick and Wilson)	2026/2029

6.0 Public Participation

As part of the public participation process, this TMDL was placed on public notice and made available for review and comment. The public notice was prepared and published in four newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL were made available on ADEM's Website: www.adem.alabama.gov. 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 Beach Monitoring Program. 2010, 2018-2023. ADEM.

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

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Kirschenfeld, Taylor (Chips), et al. "Perdido Bay - USGS Publications Warehouse." United States Geological Survey, pubs.usgs.gov/sir/2006/5287/pdf/PerdidoBay.pdf. Accessed 15 Apr. 2024.

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. Beach monitoring data at SPAN_COVE (2018-2023)

Date Collected	Enterococcus Count (col/100 mL)	Enterococcus Geometric Mean (col/100 mL)
12/05/23	61	-
11/07/23	6	-
10/03/23	36	13.3
09/27/23	18	9.6
09/20/23	13	8.7
09/13/23	25	9.8
09/06/23	2	7.8
08/30/23	7	6.8
08/23/23	11	7.5
08/16/23	24	14.6
08/09/23	8	26.3
08/02/23	< 1	30.7
07/26/23	11	52.7
07/19/23	11	68.3
07/18/23 resample	15	88.6
07/17/23 resample	> 400	119.1
07/13/23 resample	> 200	80.5
07/12/23	> 200	76.3
07/06/23	27	39.7
06/28/23	76	38.1
06/21/23	87	30.5
06/15/23 resample	38	22.5
06/14/23	145	20.3
06/07/23	4	13.3
05/31/23	21	10.1
05/24/23	20	-
05/17/23	14	-
05/10/23	18	-
05/03/23	1	-
04/04/23	75	-
03/14/23	27	-
02/14/23	85	-
01/10/23	98	-
12/06/22	87	-
11/08/22	9	-
10/04/22	6	11.6
09/28/22	5	14.8
09/21/22	4	20.9
09/14/22	20	33.9
09/07/22	89	41.4
08/31/22	20	32.6

Date Collected	Enterococcus Count (col/100 mL)	Enterococcus Geometric Mean (col/100 mL)
08/24/22	28	42.4
08/17/22	45	53.8
08/10/22	54	82.4
08/03/22	27	53.4
07/27/22	75	56.6
07/20/22	92	33.7
07/14/22 resample	52	19.5
07/13/22	> 600	16.6
07/06/22	4	8.4
06/30/22 resample	18	9.7
06/29/22	120	7.2
06/22/22	2	18.3
06/16/22	2	26.0
06/08/22	10	33.6
06/01/22	4	29.5
05/31/22	23	41.2
05/26/22 resample	> 400	46.3
05/25/22	460	-
05/18/22	24	-
05/11/22	12	-
05/04/22	4	-
04/07/22 resample	18	-
04/06/22 resample	313	-
04/05/22	133	-
03/16/22 resample	22	-
03/15/22	200	-
02/08/22	70	-
01/11/22	4	-
12/14/21	98	-
11/02/21	< 2	-
10/13/21	20	-
09/29/21	90	95.3
09/21/21 resample	44	96.5
09/20/21 resample	753	68.5
09/16/21	> 600	35.3
09/08/21	70	36.5
09/02/21	6	25.7
08/26/21 resample	< 2	32.8
08/25/21	273	57.4
08/18/21	14	33.1
08/12/21 resample	94	23.9
08/11/21	287	18.2
08/04/21	6	29.2
07/28/21	58	35.5
07/21/21	10	28.6

Date Collected	Enterococcus Count (col/100 mL)	Enterococcus Geometric Mean (col/100 mL)
07/14/21	< 2	32.2
07/12/21 resample	33	47.9
07/08/21 resample	130	51.0
07/07/21	> 600	32.0
06/30/21	24	17.5
06/24/21	< 2	16.4
06/23/21	180	16.4
06/16/21	26	9.6
06/09/21	8	25.4
06/02/21	16	46.2
05/26/21	2	55.1
05/17/21 resample	12	106.9
05/13/21 resample	233	-
05/12/21	> 600	-
05/10/21 resample	16	-
05/06/21	520	-
04/13/21	96	-
03/02/21	84	-
02/10/21 resample	22	-
02/09/21	133	-
01/05/21	2	-
12/08/20	18	-
11/03/20	10	-
10/22/20 resample	28	-
10/21/20 resample	112	-
10/20/20	207	-
09/30/20	14	-
09/28/20 resample	26	-
09/24/20 resample	773	-
09/23/20	340	-
09/09/20	2	27.6
09/02/20	10	27.6
08/31/20 resample	< 2	31.9
08/27/20 resample	240	54.8
08/26/20	360	42.8
08/20/20 resample	84	32.1
08/19/20	116	26.5
08/12/20	10	19.0
08/05/20	2	17.2
07/29/20	88	22.6
07/22/20	64	23.1
07/15/20	22	21.3
07/08/20	6	20.4
07/01/20	8	16.9
06/24/20	98	26.3

Date Collected	Enterococcus Count (col/100 mL)	Enterococcus Geometric Mean (col/100 mL)
06/17/20	42	17.6
06/11/20 resample	2	15.1
06/10/20	180	21.1
06/02/20	< 2	12.5
05/28/20 resample	14	18.1
05/27/20	207	-
05/20/20	6	-
05/13/20	14	-
05/06/20	8	-
04/22/20	8	-
03/03/20	2	-
02/04/20	70	-
01/07/20	4	-
12/03/19	2	-
11/05/19	2	-
10/08/19	< 2	-
09/25/19	8	5.0
09/18/19	4	5.0
09/11/19	2	4.3
09/04/19	< 2	6.2
08/28/19	24	7.7
08/21/19	8	11.1
08/14/19	< 2	9.9
08/07/19	12	11.9
07/31/19	6	11.5
07/25/19 resample	13	13.1
07/24/19	126	10.4
07/17/19	4	8.0
07/10/19	6	7.0
07/02/19	10	6.4
06/26/19	4	4.7
06/19/19	34	5.9
06/12/19	< 2	3.3
06/05/19	4	3.3
05/29/19	< 2	2.9
05/22/19	13	-
05/15/19	< 2	-
05/08/19	< 2	-
05/01/19	2	-
04/02/19	4	-
03/12/19	10	-
02/05/19	34	-
01/08/19	36	-
12/05/18 resample	68	-
12/04/18	347	-

Date Collected	Enterococcus Count (col/100 mL)	Enterococcus Geometric Mean (col/100 mL)
11/06/18	48	-
10/02/18	6	-
09/26/18	4	-
09/19/18	< 2	-
09/11/18	2	-
08/29/18	2	7.4
08/22/18	8	7.4
08/15/18	< 2	5.6
08/08/18	7	5.6
08/01/18	100	4.4
07/25/18	2	3.3
07/18/18	2	3.3
07/11/18	2	6.6
07/05/18	< 2	9.5
06/27/18	24	14.0
06/20/18	< 2	10.6
06/13/18	66	12.2
06/06/18	12	6.0
05/30/18	14	4.2
05/23/18	6	4.5
05/16/18	4	4.7
05/09/18	< 2	-
05/02/18	2	-
04/25/18	20	-
04/18/18	7	-
03/06/18	16	-
02/06/18	56	-
01/10/18	48	-

Table 7-2. Beach monitoring data at SPAN_COVE (2010 – Listing Data)

Date Collected	Enterococcus Count (col/100 mL)	Enterococcus Geometric Mean (col/100 mL)
12/07/10	< 2	-
11/05/10 resample	10	-
11/04/10 resample	673	-
11/03/10	> 400	-
10/20/10	< 2	-
09/29/10	78	74.2
09/22/10	66	44.0
09/15/10	56	42.8
09/09/10	32	36.6
09/03/10 resample	32	37.3
09/02/10 resample	307	31.6
09/01/10	137	21.6
08/25/10	2	10.7
08/19/10 resample	13	12.0
08/18/10	180	11.8
08/11/10	16	5.0
08/04/10	10	4.3
07/28/10	2	6.7
07/21/10	4	18.2
07/14/10	6	16.5
07/08/10	2	14.1
07/02/10 resample	< 7	19.5
06/30/10	133	30.0
06/24/10 resample	< 7	18.8
06/23/10	2100	22.9
06/15/10	2	5.7
06/10/10	2	7.5
06/03/10	93	9.6
05/26/10	8	4.5
05/19/10	< 2	-
05/12/10	8	-
05/05/10	< 7	-
04/29/10	< 2	-
03/08/10 resample	13	-
03/04/10	106	-
02/03/10	32	-
01/05/10	14	-

7.3 Sanitary Sewer Overflow (SSO) Data

Table 7-3. Recent SSO data (near Lillian, AL)

Overflow Date	Discharge Volume (gallons)	Discharge Length (hours)	Discharge Location	Cause	Overflow Time
12/2/2018	25,000 to 50,000	25	County Road-99 and Spanish Cove Drive South	Broken line due to 7.5" rain	8:30:00 AM
12/6/2018	1,000 to 10,000	3	Rosalia Avenue in Lillian, 500' east of Perdido Street	Vent malfunctioned on the 12" main line	10:30:00 AM
9/16/2020	75,000 to 100,000	33	Corner of County Road-99 and Spanish Cove Drive in Lillian	Hurricane Sally power outage at lift station	1:00:00 AM
9/15/2021	1,000 to 10,000	4	Spanish Cove Drive South in Lillian	Heavy rain, approx. 9"	2:00:00 PM