FINAL

Total Maximum Daily Load
for
Dry Creek
Assessment Unit ID # AL03160111-0203-100
Pathogens

Alabama Department of Environmental Management
Water Quality Branch
Water Division
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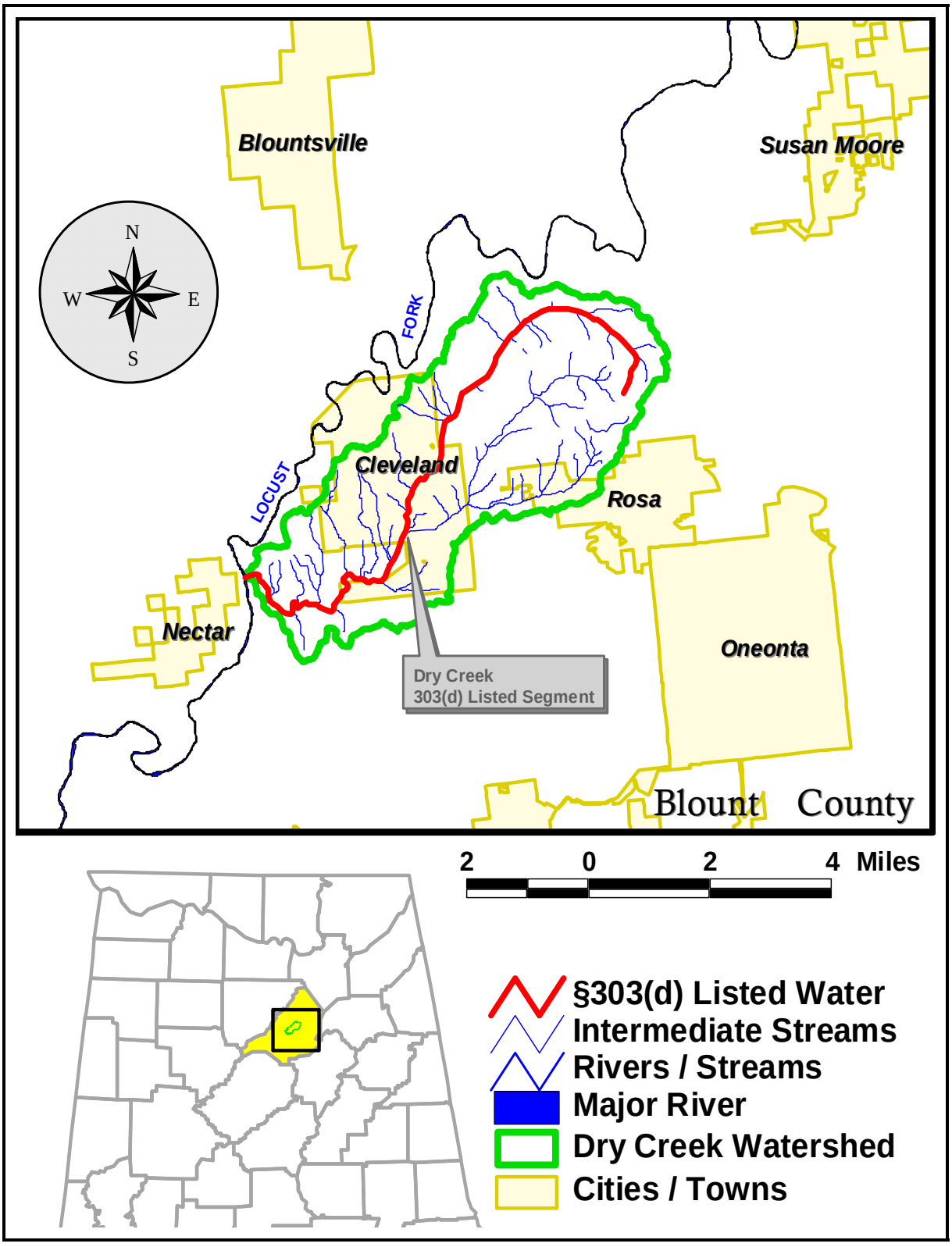
Figure 1-1. Listed Portion of Dry Creek in the Black Warrior River Basin



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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 water quality standards for the pollutant of concern. All TMDLs include a wasteload allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES) regulated discharges, a load allocation (LA) for all nonpoint sources, and an explicit and/or implicit margin of safety (MOS).

Dry Creek is on the §303(d) list for nutrients, ammonia, organic enrichment, and pathogens from Locust Fork to its source. This TMDL will only address pathogens. The listed source of impairment is pasture grazing. Dry Creek is in the Black Warrior River Basin, central Blount county, and passes through the Town of Cleveland. The total length of Dry Creek is 12 miles, all of which is on the §303(d) list. The total drainage area of Dry Creek is 19.8 square miles. Dry Creek has a use classification of Fish & Wildlife (F&W).

Data collected in 1991 by ADEM indicated to EPA that Dry Creek was impaired for pathogens. In response, EPA placed Dry Creek on the Alabama §303(d) list in 1998. The data for this listing was taken from the Alabama Clean Water Strategy Water Quality Assessment Report, December 1992. There was no rationale for the listing in the 1998 fact sheet. The data for this listing is attached in Appendix B.

In 2002, 2007 and 2008, §303(d) sampling was performed by ADEM on Dry Creek for additional water quality assessment. ADEM collected 70 samples in 2002, 47 samples in 2007, and 64 samples in 2008. According to the data collected in these three years, Dry Creek was not meeting the pathogen criterion applicable to its use classification of Fish and Wildlife. Therefore, a TMDL will be developed for pathogens on the listed reach.

A mass balance approach was used for calculating the pathogen TMDL for Dry Creek. The mass balance approach utilizes the conservation of mass principle. Loads are calculated by multiplying the pathogens concentrations times respective instream flows times a conversion factor. The existing (impaired) pathogen loading to Dry Creek was calculated using a geometric mean sample exceedance concentration times the measured flow times a conversion factor. The geometric mean criterion was used because it yielded the greatest reduction. The allowable loading, defined as the geometric mean criterion including margin of safety, was calculated using the pathogens geometric mean allowable load of 180 col/100 mL (200 col/100 mL – 10% Margin of Safety) times the corresponding flow value times a conversion factor. Reductions to meet the allowable loading were then calculated by subtracting the allowable loading from the existing loading.

Table 1-1 is a summary of existing loads and allowable loads required to meet the applicable water quality pathogen geometric mean criterion for Dry Creek. Table 1-2 lists the TMDL (maximum allowable) pathogen loadings under critical conditions for Dry Creek.

Table 1-1 Fecal Coliform Loads and Required Reductions

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %
NPS load	2.56E+11	2.97E+10	2.27E+11	88%
Point Source	1.14E+07	1.14E+09	0	0%

Table 1-2. Fecal Coliform TMDL for Dry Creek

TMDL	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation(LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
3.43E+10	3.43E+09	1.14E+09	NA	0	2.97E+10	88%

a. There are no CAFOs in the Dry Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum; Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. NA = not applicable, no regulated MS4 areas. Future MS4 areas would be required to demonstrate consistency with the assumptions and requirements of this TMDL.
d. The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in fecal coliform loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for fecal coliform.

Compliance with the terms and conditions of existing and future NPDES sanitary and stormwater permits will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and may be eligible for CWA §319 grants.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria and we are committed towards targeting the load reductions to improve water quality in the Dry Creek watershed. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL accordingly.

2.0 Basis for §303(d) Listing

2.1 Introduction

Section §303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated uses and to determine the total maximum daily load (TMDL) for pollutants causing use impairment. The TMDL process establishes the allowable loading of pollutants for a waterbody based on the relationship between pollution sources and instream water quality

conditions, so that states can establish water-quality based controls to reduce pollution and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Alabama has identified the 12 miles of Dry Creek as impaired for pathogens. The §303(d) listing was originally reported on Alabama's 1998 List of Impaired Waters based on 1988 and 1991 data.

2.2 Problem Definition

Waterbody Impaired:	Dry Creek from Locust Fork to its source
Impaired Reach:	12 miles
Impaired Drainage Area:	19.8 square miles
Water Quality Standard Violation:	Pathogens (fecal coliform)
Water Use Classification:	Fish and Wildlife

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

(a) Best usage of waters: fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food-processing purposes.

(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 and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage: the waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

Fecal Coliform Criterion:
Criterion 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 fecal coliform group shall not exceed a geometric mean of 1,000 col/100 mL; nor exceed a maximum of 2,000 col/100 mL in any sample. In coastal waters, bacteria of the enterococci group shall not exceed a maximum of 275 col/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 recreation during June through September, 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 fecal coliform organism density does not exceed 200 col/100 mL in non-coastal waters. In coastal waters, bacteria of the enterococci group shall not exceed a geometric mean of 35 col/100 mL nor exceed a maximum of 158 col/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.

Criterion Exceeded:

Water quality data collected by ADEM in 1991 was referenced by EPA Region 4 for the listing of Dry Creek on Alabama's 1998 §303(d) list. The rationale for the pathogens listing was not in the 1998 fact sheet provided to ADEM by EPA. The summer monthly samples that were taken in 1991 indicated elevated levels of fecal coliform. The data that was used for the 1998 listed is attached in Appendix B.

The ADEM §303(d) monitoring program collected 70 samples from two stations in 2002, 47 samples from four stations in 2007, and 64 samples from four stations in 2008. The study in 2002 resulted in both stations with exceedances. In 2002, there were four single sample maximum exceedances of 3,790 col/100 mL, 6,300 col/100 mL, 6,000 col/100 mL, and 2,100 col/100 mL, and there were two geometric mean exceedances of 284 col/100 mL and 1,573 col/100 mL. The study in 2007 resulted in all four stations showing exceedances. In 2007, there were six single sample maximum exceedances of 2,300 col/100 mL, 3,400 col/100 mL, 12,000 col/100 mL, 4,400 col/100 mL, 5,000 col/100 mL, and 4,100 col/100 mL and there were two geometric mean exceedances of 1,497 col/100 mL and 448 col/100 mL. The study in 2008 resulted in three out of four stations showing exceedances. In 2008, there were two single sample maximum exceedances of 2,200 col/100 mL and 3,900 col/100 mL and there were three geometric mean exceedances of 251 col/100 mL, 244 col/100 mL, and 211 col/100 mL.

This data can be viewed in Appendix B, Table 7-2.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

A fecal coliform geometric mean allowable load of 180 col/100 ml will be used in this TMDL for the LA. This allowable load was derived by using a 10% explicit margin of safety from ADEM's geometric mean F&W criterion of 200 colonies/100 ml. As mentioned previously, the single sample fecal criterion was not employed as a TMDL target because all of the single sample fecal violations generated a lower percent reduction than the geometric mean fecal violation at station DRYB-11 in 2007.

3.2 Source Assessment

3.2.1 Point Sources in the Dry Creek Watershed

Continuous Point Sources

A point source is defined as any discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. There is one NPDES permitted continuous discharger to Dry Creek. The Town of Cleveland WWTP (AL0073261) discharges to Dry Creek above station DRYB-75a and below station DRYB-10.

From 2004 to the present, the Town of Cleveland's WWTP has reported one violation of their NPDES permitted limit for fecal coliform. The violation took place in July of 2005. The monthly average limit was 200 col/100ml and the reported value for that month was 472 col/100ml.
This facility has seasonal fecal coliform permit limits equivalent to water quality criteria. From June through September, the permit limits the WWTP to a fecal coliform limit of 200 col/100mL on a monthly average. From October through May, the permit limits the WWTP to a fecal coliform limit of 1000 col/100mL on a monthly average. The annual maximum fecal coliform permit limit is 2000 col/100mL. Effluent discharges at or below the water quality criterion do not cause or contribute to water quality impairment. Therefore, the required reduction for the point sources was determined to be zero, and the 88% reduction in pathogens (fecal coliform) was allocated to the LA portion of the TMDL. Future continuous discharge facilities located in the Dry Creek watershed should not discharge wastewater at concentrations exceeding the water quality criterion.

Non-Continuous Point Sources

The Dry Creek watershed does not lie within a qualified Municipal Separate Stormwater Sewer System (MS4) area, therefore a WLA is not applicable. In determining what point sources were in the watershed, concentrated animal feeding operations (CAFOs) were also considered but none were identified. All future NPDES regulated non-continuous 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. Based on ADEM files, there have only been three

Sanitary Sewer Overflows (SSOs) on record for this discharge that would have an effect on Dry Creek. Two of the reported SSOs for this facility were in 2004 and one in 2006.

3.2.2 Nonpoint Sources in the Dry Creek Watershed

Nonpoint sources appear to be the main source of pathogens in the Dry Creek watershed. Land use in this watershed is characterized mostly by agriculture, forested, and developed land uses. Agriculture land use covers at least 40%, forest 40%, and developed 8%. Upon a site visit to the watershed on March 5, 2008, there was little to no row crop and more pasture land with cattle than estimated with the 2001 land use GIS layer. There are an estimated 1000 – 1200 cattle in this watershed. At station DRYB-9, there was direct cattle access to the stream (See Picture 3-1,2). The following are examples of how different land uses can contribute to pathogens bacterial loading:

- Agricultural land can be a source of pathogens bacteria due to runoff from pastures, animal operations, improper land application of animal wastes, and animals with access to streams. These mechanisms can significantly contribute to the loading of pathogens bacteria.

- Forested areas can be a source of pathogens bacteria due to the presence of wild animals such as deer, raccoons, turkeys, beavers, waterfowl, etc. Control of these sources is usually limited and may be impractical in most cases. As a result, forested areas are not specifically targeted in this TMDL.

- Developed land can be a source of pathogens bacteria due to storm water runoff, illicit discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, failure municipal sewer infrastructure, and domestic animals. Illicit discharges refers to non permitted facilities or individuals discharging wastewater through storm drains or directly to the waterbody.

Picture 3-1. Cattle Access; Upstream View of Dry Creek at DRYB-9

Picture 3-2. Cattle Access; Upstream View of Dry Creek at DRYB-9

3.3 Land Use Assessment

Land uses for the Dry Creek watershed were determined using ArcView. The land use datasets were derived from the 2001 National Land Cover Dataset (NLCD). Figure 3-1 displays land use areas, Figure 3-2 gives an aerial picture, and Table 3-1 displays land use categories and grouped land uses.

Figure 3-1. Land Use Map for the Dry Creek Watershed

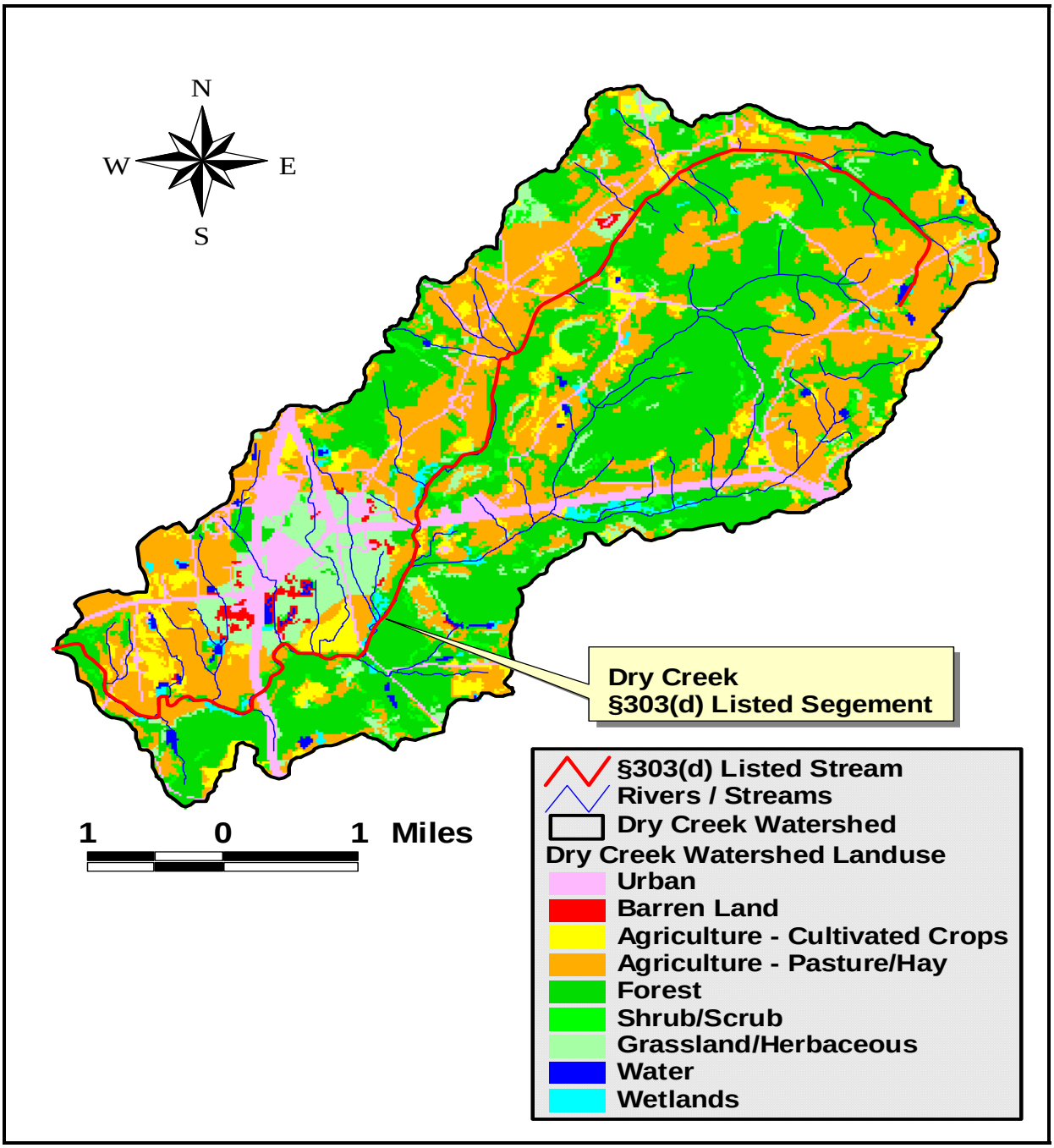

Figure 3-2. Aerial Picture of Dry Creek Watershed

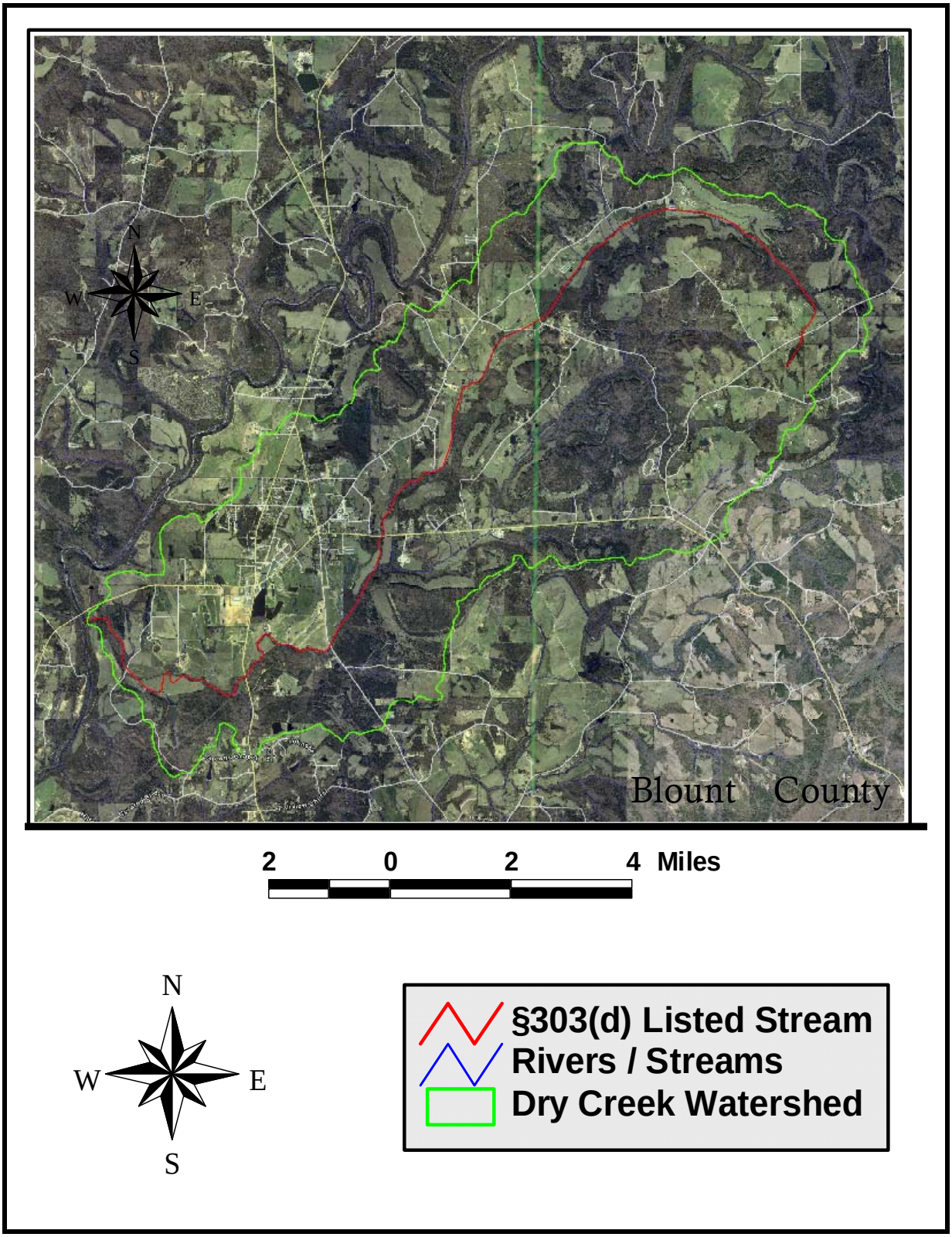

Table 3-1. Land Use Areas for the Dry Creek Watershed

Land Use	Acres	Sq. Miles	Percentages
Open Water	883	0.14	0.70
Developed, Open Space	7,601	1.19	6.00
Developed, Low Intensity	2,202	0.34	1.74
Developed, Medium Intensity	678	0.11	0.54
Developed, High Intensity	158	0.02	0.12
Deciduous Forest	845	0.13	0.67
Evergreen Forest	22,275	3.48	17.60
Mixed Forest	19,928	3.11	15.74
Shrub/Scrub	8,220	1.28	6.49
Grassland/Herbaceous	4,481	0.70	3.54
Pasture/Hay	42,548	6.65	33.61
Cultivated Crops	8,213	1.28	6.49
Woody Wetlands	7,192	1.12	5.68
Emergent Herbaceous Wetlands	1,370	0.21	1.08
Total	**126,593**	**19.8**	**100.00**

Grouped Landuses	Acres	Sq. Miles	Percentages
Agriculture	50,761	7.93	40.10
Forest	50,240	7.85	39.69
Developed	10,639	1.66	8.40
Other	14,954	2.34	11.81
Total	**126,593**	**19.8**	**100.00**

3.4 Linkage Between Numeric Targets and Sources

Pollutant loadings from forested areas tend to be low due to their filtering capabilities and will be considered at background conditions. The most likely sources of pathogen loadings in Dry Creek are from agricultural and developed 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 nonpoint source load and reduction to the watershed.

3.5 Data Availability and Analysis

ADEM collected monthly pathogen data for Dry Creek in 1991. In the Alabama Clean Water Strategy Water Quality Assessment Report December 1992, the description of the Dry Creek station is “secondary road near Blountsville.” This station is believed to be the current DRYB-9 station located at Dry Creek Road. There was no rationale for the Dry Creek listing in the 1998 fact sheet. The data that was used for the 1998 303(d) listing is attached in Appendix B.

ADEM collected water quality data on Dry Creek in 2002, 2007, and 2008 as part of ADEM’s §303(d) Monitoring Program at Stations DRYB-11, DRYB-75a, DRYB-10, and DRYB-9(listed from downstream to upstream). Figure 3-3 and Table 3-2 display locations and list descriptions for the ADEM stations. There is a consistent pathogen issue in the entire reach of Dry Creek. The highest concentrations over the three years were recorded at station DRYB-11, which is the most downstream station. The most concentrated cattle farming takes place above station

DRYB-11 and below DRYB-75a. Another clear pathogen source was the direct cattle access to the Dry Creek above and below station DRYB-9.

Figure 3-3. Map of ADEM Sampling Stations on Dry Creek

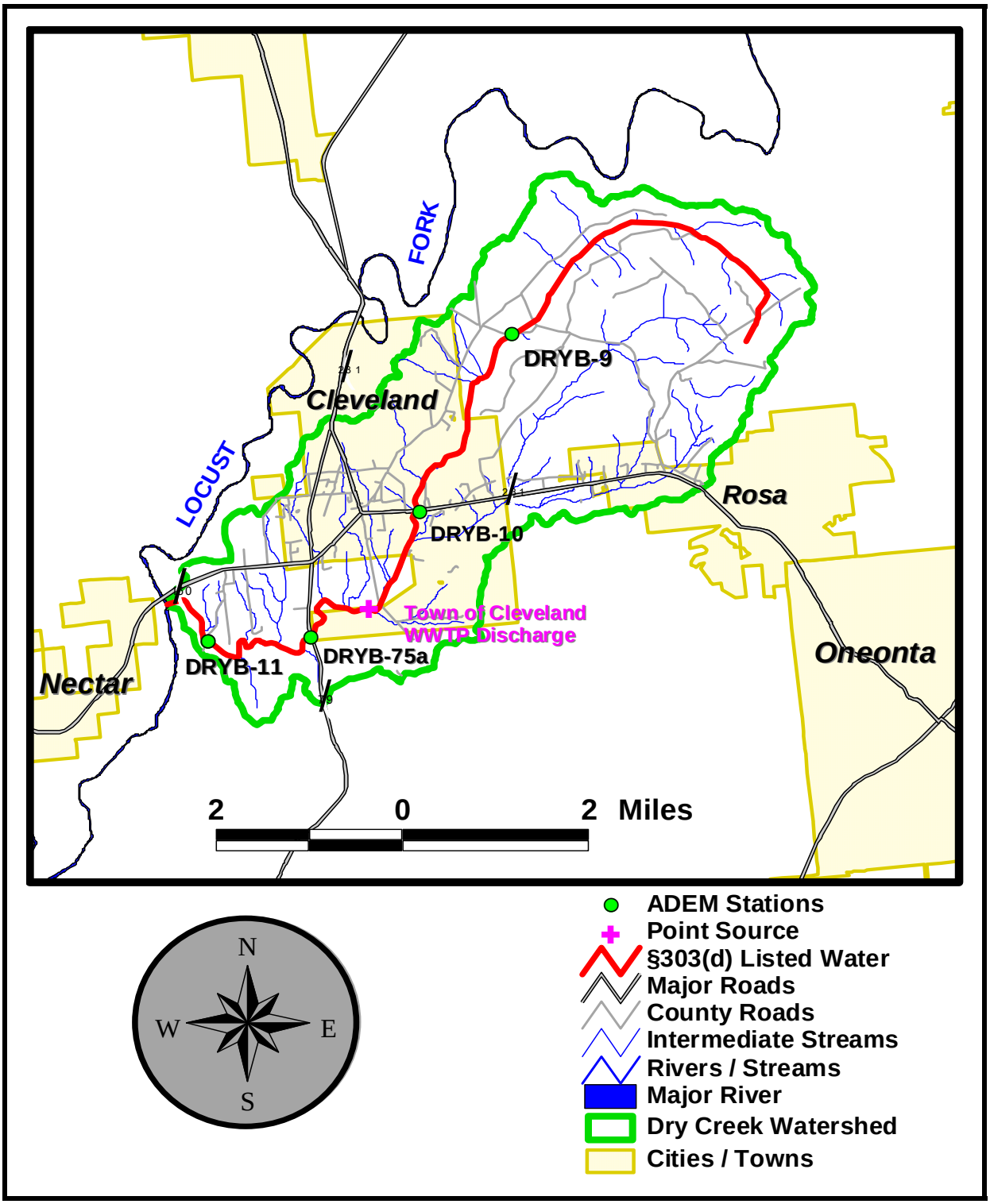

Table 3-2. Dry Creek Sampling Station Descriptions

Year	Station ID	Data Source	Station Location	Latitude	Longitude
02, 07-08	DRYB-11	ADEM	Dry Creek @ Phillips Road	33.97256	-86.60826
02, 07-08	DRYB-75a	ADEM	Dry Creek @ AL Hwy 79	33.97158	-86.58878
02, 07-08	DRYB-10	ADEM	Dry Creek @ US Hwy 231	33.99045	-86.56605
91, 07-08	79. DRYB-9	ADEM	-secondary road crossing near Blountsville -Dry Creek @ Dry Creek Road	34.0185	-86.54382

3.6 Critical Conditions

Critical conditions typically occur during the summer months.. This can be explained by the nature of storm events in the summer versus the winter. Periods of dry weather interspersed with thunderstorms allow for the accumulation and washing off of fecal coliform bacteria into streams, resulting in spikes of fecal coliform bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of fecal coliform bacteria on the land surface, resulting in a more uniform loading rate. Also, the summer fecal coliform criterion is more stringent than the winter criterion.

The data collected by ADEM in 2002, 2007, and 2008 in the Dry Creek watershed follows this trend. The single sample exceedance values were generally accompanied by an increase in flow.

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.

An explicit MOS was incorporated in this TMDL. The explicit MOS includes the uncertainty of the pathogens data used in this analysis and the uncertainty of selecting an appropriate critical condition from the existing pathogens loads. A margin of safety was applied to the TMDL by reducing the criterion concentration by ten percent and calculating a mass loading target with measured flow data. The geometric mean criterion was reduced by ten percent to achieve the allowable loading of 180 col/100 mL.

4.0 TMDL Development

4.1 Definition of a TMDL

A total maximum daily load (TMDL) is the sum of individual wasteload allocations for point sources (WLAs), 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 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 (colony) per day (col/day), in accordance with 40 CFR 130.2(i).

4.2 Load Calculations

A mass balance approach was used to calculate the fecal coliform TMDL for Dry Creek. The mass balance approach utilizes the conservation of mass principle. Total existing mass loads were calculated by multiplying the fecal coliform concentration times the corresponding stream flow. Existing loads were calculated for the highest geometric mean sample exceedance and the highest single sample exceedance. In the same manner, allowable loads were calculated for both the single sample criterion of 2000 col/100ml and the geometric mean criterion of 200 col/100ml. The TMDL was based on the violation that produced the highest percent reduction of fecal coliform loads necessary to achieve applicable water quality criteria, whether it be the single sample or geometric mean criterion.

Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample exceedance concentration of 12,000 colonies/100 ml times the estimated flow for that day. This concentration was collected at DRYB-11 on 7/11/2007 and can be found in Table 7-2, Appendix B. The measured stream flow for that sampling event was 4.5 cubic feet per second (cfs). The product of these two values and a conversion factor gives the total mass loading (colonies per day) of fecal coliform to Dry Creek under a single sample exceedance conditions.

$$\frac{4.5\,\text{ft}^3}{\text{s}} \times \frac{12{,}000\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.32 \times 10^{12}\ \text{colonies}}{\text{day}}$$

The WLA component mass loading to Dry Creek was determined by multiplying the maximum fecal coliform concentration reported on the Town of Cleveland's DMR reports for July 2007 times the design flow of the wastewater treatment facility times a conversion factor. The Town of Cleveland WWTP has a design flow of 0.23205 cfs.

$$\frac{0.23205\,\text{ft}^3}{\text{s}} \times \frac{14\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.95 \times 10^7\ \text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean sample exceedance concentration of 1497 colonies/100 ml times the average flow for three out of the five sampling events. This concentration was calculated based on measurements at DRYB-11 on July 2, 5, 11, 23, and August 1, 2007. This data can be found in Table 7-2, Appendix B. The average stream flow for these sampling events was 7.0 cfs. The product of these two values and a conversion factor gives the total mass loading of fecal coliform to Dry Creek under geometric mean exceedance conditions.

$$\frac{7.0\,\text{ft}^3}{\text{s}} \times \frac{1497\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.56 \times 10^{11}\ \text{colonies}}{\text{day}}$$

The WLA component mass loading to Dry Creek was determined by multiplying the monthly average fecal coliform concentration reported on the Town of Cleveland's DMR reports for July 2007 times the design flow of the wastewater treatment facility times a conversion factor. The Town of Cleveland WWTP has a design flow of 0.23205 cfs.

$$\frac{0.23205\,\text{ft}^3}{\text{s}} \times \frac{2\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.14 \times 10^7\ \text{colonies}}{\text{day}}$$

Allowable Conditions

The **allowable loads** to the watershed were calculated under the same physical conditions as discussed above for the single sample and the geometric mean criterion. This is done by taking the product of the flow used for the violation event times the conversion factor times the allowable concentration which are as follows:

For the **single sample** fecal concentration of 1800 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{4.5\,\text{ft}^3}{\text{s}} \times \frac{1800\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.97 \times 10^{11}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 200 colonies/100 mL equals a daily loading of:

$$\frac{4.5\,\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.20 \times 10^{10}\ \text{colonies}}{\text{day}}$$

The allowable WLA component mass loading to Dry Creek was also calculated under the same conditions as discussed above for the single sample criterion. This is done by taking the product of the design flow and/or the annual average flow of the wastewater treatment facility flow used for the violation event times the conversion factor times the allowable WLA concentration which are as follows:

The allowable fecal coliform load will be based on a concentration of 200 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{0.23205\,\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.14 \times 10^{09}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety does not apply to the WLA since 200 col/100mL is a permitted value.

For the **geometric mean** fecal concentration of 180 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{7.0\,\text{ft}^3}{\text{s}} \times \frac{180\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.97 \times 10^{10}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 20 colonies/100 mL equals a daily loading of:

$$\frac{7.0\,\text{ft}^3}{\text{s}} \times \frac{20\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{3.43 \times 10^{9}\ \text{colonies}}{\text{day}}$$

The allowable WLA component mass loading to Dry Creek was also calculated under the same conditions as discussed above for the geometric mean criterion. This is done by taking the product of the design flow and/or the annual average flow of the wastewater treatment facility flow used for the violation event times the conversion factor times the allowable WLA concentration which are as follows:

For the **geometric mean** fecal concentration of 200 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{0.23205\,\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.14 \times 10^{9}\ \text{colonies}}{\text{day}}$$

The difference in the pathogen loading between the existing conditions (violation event) and the allowable conditions converted to a percent reduction represents the total load reduction needed to achieve the fecal coliform water quality criterion. The TMDL was calculated as the total daily

fecal coliform load to Dry Creek as evaluated at station DRYB-11. Table 4-1 shows the results of the fecal coliform TMDL and percent reductions for each criterion.

Table 4-1. 2007 Fecal Coliform Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
NPS Load Single Sample	1.32E+12	1.97E+11	1.12E+12	85%
NPS Load Geomean	2.56E+11	2.97E+10	2.27E+11	88%
Point Source @ Single Sample	7.95E+07	1.14E+09	0.00E+00	0%
Point Source @ Geomean	1.14E+07	1.14E+09	0.00E+00	0%

From Table 4-1, compliance with the geometric mean criterion of 200 col/100ml requires the greatest reduction in fecal coliform load. Therefore the TMDL will be based on the geometric mean criterion. The TMDL, WLA, LA and MOS values necessary to achieve the applicable fecal coliform criteria are provided in Table 4-2 below. Additional TMDL calculations are provided in Appendix C.

Table 4-2. Fecal Coliform TMDL for Dry Creek

TMDL	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation(LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
3.43E+10	3.43E+09	1.14E+09	NA	0	2.97E+10	88%

a. There are no CAFOs in the Dry Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum; Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. NA = not applicable, no regulated MS4 areas. Future MS4 areas would be required to demonstrate consistency with the assumptions and requirements of this TMDL.
d. The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in fecal coliform loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for fecal coliform.

A mass balance approach was used to calculate the pathogen TMDL for Dry Creek. The mass balance approach utilizes the conservation of mass principle. Total mass loads can be calculated by multiplying the fecal coliform concentration times the stream flow times a conversion factor.

4.3 TMDL Summary

Dry Creek was placed on Alabama's §303(d) list in 1998 based on data collected by ADEM collected in 1991. In 2002, 2007, and 2008, ADEM collected additional water quality data which confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the fecal coliform TMDL for Dry Creek. Based on the TMDL analysis, it was determined that a 88% reduction in fecal coliform loading was necessary to achieve compliance with applicable water quality standards.

Compliance with the terms and conditions of existing and future NPDES sanitary and stormwater permits will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and may be eligible for CWA §319 grants.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria and we are committed towards targeting the load reductions to improve water quality in the Dry Creek watershed. As additional data and/or information becomes 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 management; an approach that divides Alabama's fourteen major river basins into five groups. Each year, the ADEM water quality resources are concentrated in one of the five basin groups. One goal is to continue to monitor §303(d) listed waters. Monitoring will help further characterize water quality conditions resulting from the implementation of best management practices in the watershed. This monitoring will occur in each basin according the schedule shown.

Table 5-1. §303(d) Follow Up Monitoring Schedule

River Basin Group	Year to be Monitored
Tennessee	2009
Alabama / Coosa / Tallapoosa	2010
Escatawpa / Upper Tombigbee / Lower Tombigbee / Mobile	2011
Black Warrior / Cahaba	2012
Chattahoochee / Chipola / Choctawhatchee / Perdido-Escambia	2013

6.0 Public Participation

As part of the public participation process, this TMDL was placed on public notice and made available for review and comment. The public notice was prepared and published in the four major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL was made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the TMDL by contacting Mr. Chris Johnson at 334-271-7827 or cljohnson@adem.state.al.us. The public was 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 became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

Appendix A
References

ADEM Administrative Code, 2008. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criterion.

ADEM Administrative Code, 2008. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's §303(d) Monitoring Program. 2002, 2007, 2008. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, December 2008.

Alabama Department of Environmental Management, 1998 - 2008 §303(d) List. ADEM.

United States Environmental Protection Agency, 1991. Guidance for Water Quality-Based Decisions: The TMDL Process. Office of Water. EPA 440/4-91-001.

Alabama Clean Water Strategy Water Quality Assessment Report. December, 1992. ADEM.

Appendix B
Water Quality Data

Table 7-1. Historical ADEM Pathogen Data Collected on Dry Creek

Station ID	Date	Fecal Coliform (col/100mL)
79.	6/3/1991	370
79.	7/10/1991	270
79.	8/1/1991	70
79.	9/3/1991	20
79.	10/1/1991	520

Table 7-2. 2008 ADEM Pathogen Data Collected on Dry Creek

Station ID	Date	Pathogens (col/100mL)	Pathogens Geomean (col/100mL)	Flow (cfs)
DRYB-10	4/22/2008	320		3.2
DRYB-10	5/14/2008	390		5.1
DRYB-10	6/4/2008	210		7
DRYB-10	6/9/2008	80		2.1
DRYB-10	6/12/2008	270		1.2
DRYB-10	6/16/2008	240		0.9
DRYB-10	6/23/2008	30	126	
DRYB-11	4/22/2008	580		14
DRYB-11	5/14/2008	660		15.7
DRYB-11	6/4/2008	*380*		20.1
DRYB-11	6/9/2008	*390*		5.7
DRYB-11	6/12/2008	*310*		3.1
DRYB-11	6/16/2008	*270*		3.1
DRYB-11	6/23/2008	*80*	***251***	
DRYB-11	7/10/2008	210		
DRYB-11	8/4/2008	40		
DRYB-11	8/7/2008	25		
DRYB-11	8/11/2008	38		
DRYB-11	8/18/2008	370		
DRYB-11	8/20/2008	192		
DRYB-11	9/3/2008	72		
DRYB-11	10/14/2008	34		
DRYB-11	11/5/2008	34		

Station ID	Date	Pathogens (col/100mL)	Pathogens Geomean (col/100mL)	Flow (cfs)
DRYB-75a	4/22/2008	600		9.7
DRYB-75a	5/14/2008	**2200**		14.4
DRYB-75a	6/4/2008	*450*		16.5
DRYB-75a	6/9/2008	*390*		
DRYB-75a	6/12/2008	*180*		3.6
DRYB-75a	6/16/2008	*210*		3.4
DRYB-75a	6/23/2008	*130*	***244***	
DRYB-75a	7/10/2008	30		
DRYB-75a	8/4/2008	50		
DRYB-75a	8/7/2008	27		
DRYB-75a	8/11/2008	4		
DRYB-75a	8/18/2008	64		
DRYB-75a	8/20/2008	600		
DRYB-75a	9/3/2008	600		
DRYB-75a	10/14/2008	310		
DRYB-75a	11/5/2008	20		
DRYB-9	4/22/2008	96		2.1
DRYB-9	5/14/2008	**3900**		3.1
DRYB-9	6/4/2008	*340*		4.3
DRYB-9	6/9/2008	*240*		
DRYB-9	6/12/2008	*70*		1.7
DRYB-9	6/16/2008	*180*		
DRYB-9	6/23/2008	*410*	***211***	
DRYB-9	7/10/2008	520		
DRYB-9	9/3/2008	47		
DRYB-9	10/14/2008	250		

Table 7-3. 2007 ADEM Pathogen Data Collected on Dry Creek

Station ID	Date	Pathogens (col/100mL)	Pathogens Geomean (col/100mL)	Flow (cfs)
DRYB-10	3/13/2007	34		3.1
DRYB-10	4/3/2007	610		6.1
DRYB-10	5/8/2007	330		1.1
DRYB-10	7/2/2007	**2300**		
DRYB-10	7/11/2007	1800		1.8
DRYB-10	7/23/2007	130		
DRYB-10	8/27/2007	560		
DRYB-10	9/17/2007	430		

Station ID	Date	Pathogens (col/100mL)	Pathogens Geomean (col/100mL)	Flow (cfs)
DRYB-11	3/13/2007	210		9.7
DRYB-11	4/3/2007	3000		16
DRYB-11	5/8/2007	430		3.3
DRYB-11	6/5/2007	50		
DRYB-11	6/27/2007	600		
DRYB-11	7/2/2007	**3400**		0.9
DRYB-11	7/5/2007	*400*		
DRYB-11	7/11/2007	**12000**		4.5
DRYB-11	7/23/2007	*460*		
DRYB-11	8/1/2007	*1000*	***1497***	1.6
DRYB-11	8/27/2007	600		
DRYB-11	9/17/2007	1100		0.9
DRYB-11	9/20/2007	160		
DRYB-11	9/25/2007	110		
DRYB-11	9/12/2007	580		
DRYB-75a	3/13/2007	310		12.7
DRYB-75a	4/3/2007	790		14.5
DRYB-75a	5/8/2007	170		3.7
DRYB-75a	6/5/2007	20		
DRYB-75a	6/27/2007	108		0.2
DRYB-75A	7/2/2007	**4400**		1.2
DRYB-75A	7/5/2007	*40*		
DRYB-75a	7/11/2007	**5000**		2.2
DRYB-75A	7/23/2007	*170*		0.3
DRYB-75a	8/1/2007	*120*	***448***	
DRYB-75A	8/27/2007	230		0.1
DRYB-75A	9/17/2007	500		0.4
DRYB-75A	9/20/2007	80		
DRYB-75A	9/25/2007	110		
DRYB-75a	9/12/2007	120		
DRYB-75a	10/2/2007	140		
DRYB-9	3/13/2007	380		2.1
DRYB-9	4/3/2007	1200		
DRYB-9	5/8/2007	390		1.1
DRYB-9	7/2/2007	**4100**		0.2
DRYB-9	7/5/2007	60		0.1
DRYB-9	7/11/2007	2000		1.2
DRYB-9	7/23/2007	30		
DRYB-9	9/17/2007	580		

Table 7-4. 2002 ADEM Pathogen Data Collected on Dry Creek

Station ID	Date	Pathogens (col/100mL)	Pathogens Geomean (col/100mL)	Flow (cfs)
DRYB-10	01/10/02	170		4.50
DRYB-10	09/18/02	**3790**		
DRYB-10	09/19/02	*8*		
DRYB-10	09/20/02	*7*		
DRYB-10	09/24/02	*1960*		0.20
DRYB-10	09/26/02	*1200*		20.30
DRYB-10	09/30/02	*1040*	*284*	4.30
DRYB-10	02/13/02	500		11.20
DRYB-10	03/21/02	1130		
DRYB-10	05/09/02	870		6.80
DRYB-10	05/29/02	360		
DRYB-10	05/30/02	96		
DRYB-10	06/20/02	63		
DRYB-10	06/26/02	290		
DRYB-10	07/10/02	40		
DRYB-10	07/16/02	187		
DRYB-10	09/17/02	1800		
DRYB-11	01/10/02	1133		10.90
DRYB-11	05/29/02			3.40
DRYB-11	02/13/02	140		30.60
DRYB-11	03/21/02	**6300**		
DRYB-11	05/09/02	650		18.90
DRYB-11	06/26/02	1110		1.70
DRYB-11	07/10/02	7		
DRYB-11	07/16/02	480		1.10
DRYB-11	05/29/02	104		2.90
DRYB-11	05/30/02	220		
DRYB-11	06/20/02	66		
DRYB-11	09/26/02	**6000**		70.90
DRYB-11	09/30/02	**2100**		8.10
DRYB-11	09/20/02	*480*		
DRYB-11	09/19/02	*1170*		
DRYB-11	09/24/02	*1360*	***1573***	3.60

Appendix C
Calculations

Table 7-5. Loading Calculations

Load Reduction and TMDL Calculations for Dry Creek

Flow measured at DRYB11 For Single Sample Maximum Violatior	7.0 cfs	
Single Sample Fecal coliform concentration measured:	1497 col/100 mL	
Allowable fecal coliform maximum concentration minus MOS:	180 col/100mL	= 200 - 10%
Margin of saftey for the maximum criteria	20 col/100mL	= 10% of criteria
Design Flow of Point Source:	0.15 MGD	
Measured July 2007 fecal coliform for point source:	2 col/100mL	
Allowabel fecal coliform for point source:	200 col/100mL	

Load Calculations:

Load = Fecal Coliform Conc * Measured Flow * Conversion Factor

Load = colonies of Fecal Coliform/day — Measured Flow = cfs

Fecal Coliform Conc = colonies/100 mL — Conversion Factor = 24465755 (ml-s/ft3-day)

Current Load:

Nonpoint source load (LA)	2.56E+11	colonies/day	
Point source load (WLA)	1.14E+07	colonies/d	There are no point sources in this watershed
Current load =	2.56E+11	colonies/day	

Allowable Load:

Nonpoint source load (LA)	2.97E+10	colonies/day	
Point source load (WLA)	1.14E+09	colonies/d	There are no point sources in this watershed
Allowable load =	3.08E+10	colonies/day	

Margin of Saftey:

MOS load = 3.43E+09 colonies/day

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	2.56E+11	2.97E+10	2.27E+11	88%	2.97E+10
WLA	1.14E+07	1.14E+09	0.00E+00	0%	1.14E+09
Total	2.56E+11	3.08E+10	2.27E+11	88%	3.08E+10

Total Maximum Daily Load (TMDL): TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
3.43E+10	1.14E+09	2.97E+10	3.43E+09

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 88% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

The water quality criteria for fecal coliform for summer geomtric means is 200 col/100 mL.

To account for an explicit Margin of Safety (MOS) a target concentration of 180 col/100 ml was used to calculate the allowable load compared to the maximum criteria which = 200 – 10%