Draft

Alabama Department of Environmental Management

TMDL Development for

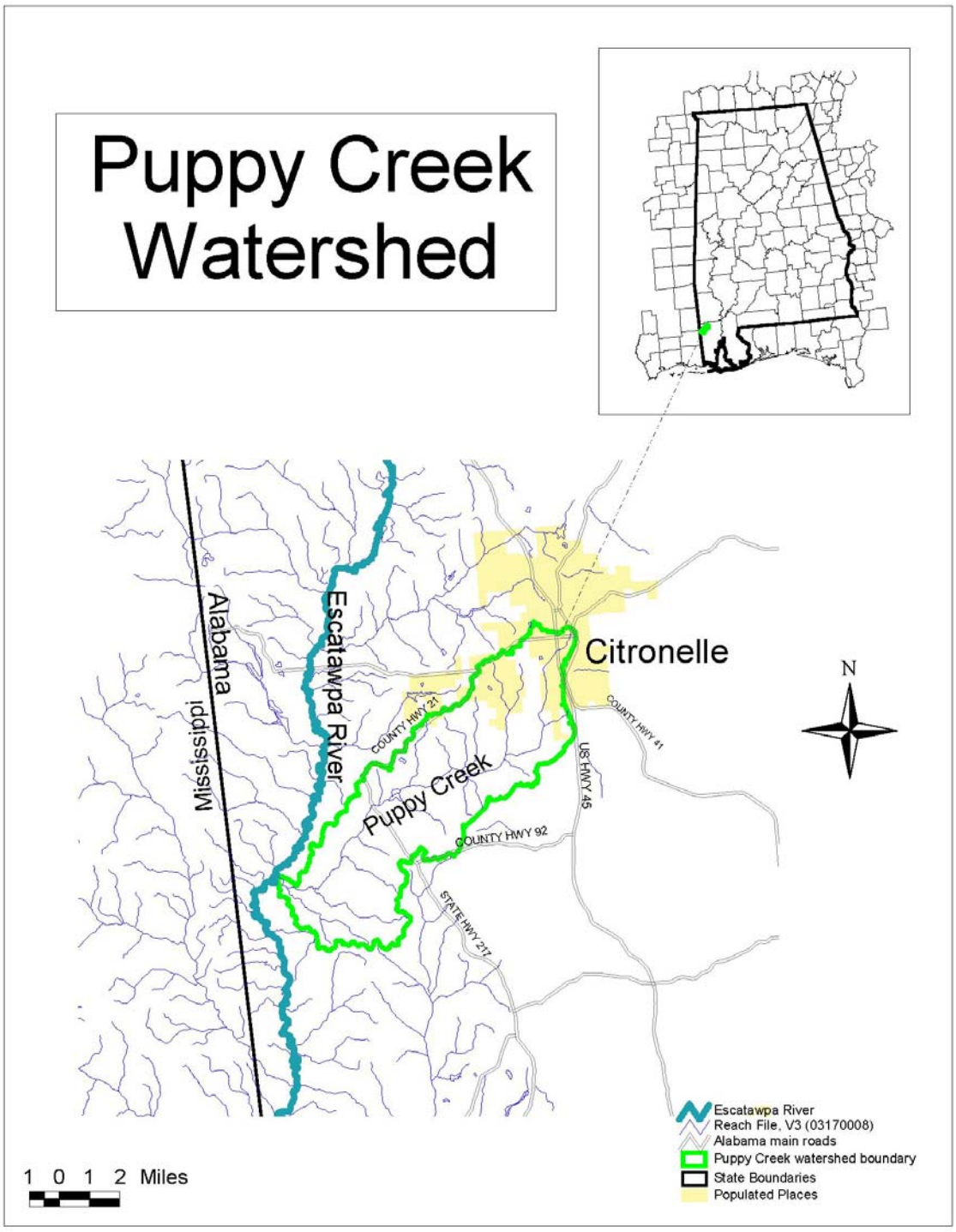
Puppy Creek, AL/03170008-030_01

Pathogens (fecal coliform)

July 2002

Water Quality Branch

Water Division


Puppy Creek Watershed
Alabama
Mississippi
Escatawpa River
Puppy Creek
Citronelle
COUNTY HWY 21
COUNTY HWY 41
US HWY 45
COUNTY HWY 92
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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 use and to determine the Total Maximum Daily Load (TMDL) for pollutants causing the use impairment. TMDLs are 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).

Puppy Creek in Mobile County near Citronelle, Al. lies within the Escatawpa River Subwatershed of the Escatawpa River Basin. Puppy Creek has been on the State of Alabama's §303(d) use impairment list since 1992 for nutrients, O.E./D.O., and pathogens (fecal coliform). Its use classification is Fish & Wildlife (F&W).

A TMDL for O.E./D.O. was developed by the State for Puppy Creek in 1996 and approved by EPA in 1997. Only the TMDL for pathogens (fecal coliform) will be developed in this report. The TMDL for nutrients will be presented in a separate report.

Data collected in 1991 for the Alabama Clean Water Strategy sampling efforts, indicated that Puppy Creek was impaired for pathogens (fecal coliform). Puppy Creek was sampled again in 1996 under Alabama's 1996 Clean Water Strategy. In 1996 four stations were sampled during three different months. All the samples were below the fecal coliform criteria. Puppy Creek was not sampled again until 2001 under Alabama's §303(d) sampling program. Ninety-seven samples were taken from Puppy Creek between April 2001 and March 2002.

The original listing for Puppy Creek is from Al. Hwy 217 to its source. The 2001 and 2002 data indicates that Puppy Creek is impaired only from station PPYM-5 to its headwaters, which is a distance of approximately 1.5 miles. The PPYM-5 station is located just upstream of the Citronelle Lagoon discharge. The data shows that below PPYM-5, Puppy Creek is meeting its use classification for pathogens. Since the 2001 and 2002 data set is more comprehensive, than the other data sets it was concluded that the only portion of Puppy Creek impaired for pathogens is from station PPYM-5 to its headwaters. Therefore, this TMDL was developed only for this portion of Puppy Creek.

Because this segment has a small drainage area, (1.4 square miles), and includes a diverse type of landuses, it was not considered practicable to calculate individual components of the nonpoint source (NPS) loading. There will not be individual loads or reductions calculated for different sources such as forest, agriculture, and septic systems. The loadings and reductions will only be calculated as a NPS total load. It is envisioned that the sources can be better defined during the implementation process.

At station PPYM-5 the data showed violation of the single sample maximum criteria and the geometric mean criteria for the months of June-September. The load reductions was calculated for both of the criteria and the one with the highest reductions was used to compute the TMDL. For Puppy the criteria for the geometric mean for the months of

June-September computed the highest percent reduction. Calculation for criteria can be seen in the appendix of this report.

Shown below in Table 1.1, is a summary of current loads, final loads and reductions needed to meet the water quality standards for Puppy Creek.

Table 1.1

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
NPS load	1.79E+10	6.85E+09	1.10E+10	62%	6.85E+09
Point Source	0.00E+00	0.00E+00	0.00E+00	0%	0.00E+00

Table 1.2 below, shows the different components of the TMDL for Puppy Creek.

Table 1.2 - TMDL for Puppy Creek

TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
7.54E+09	0.00E+00	6.85E+09	6.85E+08

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 segment of Puppy Creek being evaluated lies within Mobile County. It is listed on the 1998 and Draft 2000 303(d) lists as non-supporting of its use classification and has a priority ranking of low.

2.2 Problem Definition

Waterbody Impaired:	Puppy Creek-from Al Hwy 217 to its source.
Waterbody length:	10 miles
Waterbody drainage area:	40 square miles
Water Quality Standard Violation:	Fecal Coliform
Pollutant of Concern:	Pathogens (Fecal Coliform)
Water Use Classification:	Fish and Wildlife

Usage related to classification:
The impaired stream segment, Puppy Creek, 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 Criteria:

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:

(i) Bacteria of the fecal coliform group shall not exceed a geometric mean of 1,000/100 ml ; nor exceed a maximum of 2,000/100 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 100/100 ml in coastal waters and 200/100 ml in other 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 fecal coliform organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters. Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports.

Criteria Exceeded:

Data collected at two stations in 1991 for the Alabama Clean Water Strategy sampling effort, showed that the single sample maximum of 2,000 col/100 ml criterion was exceeded three times out of ten samples (30%).

Puppy Creek was sampled again in 1996 under Alabama's 1996 Clean Water Strategy. Four stations were sampled during three different months. All the samples were below the fecal coliform maximum criterion.

Puppy Creek was not sampled again until 2001 under Alabama's §303(d) sampling program. Ninety-seven samples were taken from Puppy Creek between April 2001 and March 2002. Five out of the ninety-seven samples exceeded the single sample maximum of 2,000 col/100 ml criteria (i.e. 5%). During this sampling period data was collected in the necessary time interval to compare to the geometric mean criterion. For each station two data sets of at least five samples per set were collected over a 30-day period at intervals not less than 24 hours. For each station one set was collected between the months of (June-September) for the 200 col/100ml criteria and one set was collected between the months of (October-May) for the 1000 col/100ml. This gave ten data sets to compare to the geometric mean criteria. Out of the ten, one exceeded the criteria (i.e. 10 %). This violation was at station PPYM-5 and exceeded the 200 col/100ml criteria.

3.0 TMDL Technical Basis

3.1 Water Quality Target Identification

For the purpose of this TMDL a fecal coliform target level of 180 colonies/100 ml will be used. This target was derived by using a 10% margin of safety from the geometric mean of 200 colonies/100 criteria. This target level should not allow the geometric mean of 200 colonies/100 or the single sample maximum of 2000 colonies/100 ml to be exceeded.

3.2 Source Assessment

Point Sources in the Puppy Creek Watershed:
There is one point source (Citronelle Lagoon) in the Puppy Creek watershed but its discharge point is below the segment being evaluated in this TMDL. The location of the Citronelle Lagoon is shown on Figure 2, designated as PPYMW. Therefore, it is not included in any loading calculations. Even though the Citronelle Lagoon is not included in the loading, their DMR data was reviewed from January 2001 to February 2002. There was only one exceedence (230 col/100ml) of their NPDES Permit limit (200 col/100 ml) for fecal coliform. This DMR data can be seen in Appendix B. Any new discharge to this stream must meet a discharge limit of 200 col/100 ml for fecal coliform.

Nonpoint Sources in the Puppy Creek Watershed:
Nonpoint sources are believed to be the primary source of fecal coliform bacteria in the evaluated portion of the Puppy Creek watershed. The land use in this watershed is approximately 21% agriculture (pasture/hay and row crops), 63% forested, 10% residential and 6% other. The following are examples of how different landuses can contribute to fecal coliform bacterial loading:

- Agricultural land can be a source of fecal coliform bacteria. Runoff from pastures, animal operations, improper land application of animal wastes, and animals with access to streams are all mechanisms that can introduce fecal coliform bacteria to waterbodies.

- Fecal coliform bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, turkeys, waterfowl, etc. 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.

- Leaking septic systems can be another source of fecal coliform bacteria.

These different source loads will be better identified in the implementation phase of the TMDL.

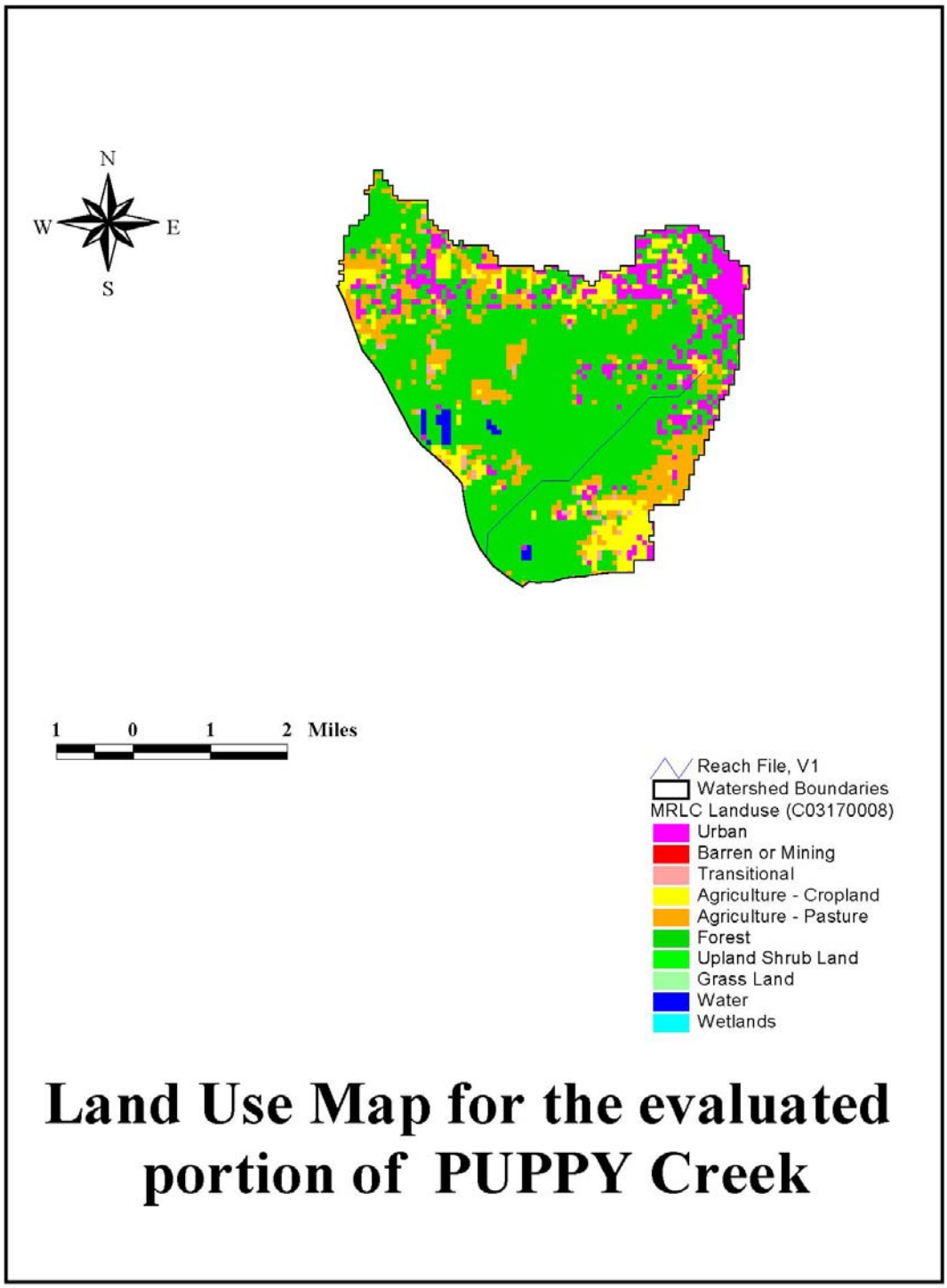
3.3 Landuse

The below table shows landuse areas for the evaluated portion of Puppy Creek. See Figure 2 for a map of landuse in the evaluated portion of the Puppy Creek watershed.

Landuse	**acres**	**sq. miles**	**percentage**
Deciduous Forest	77	0.12	8.41%
Evergreen Forest	207	0.32	22.60%
High Intensity Commercial/Industrial/Transportatio	11	0.02	1.20%
High Intensity Residential	12	0.02	1.31%
Low Intensity Residential	76	0.12	8.30%
Mixed Forest	295	0.46	32.21%
Open Water	7	0.01	0.76%
Other Grasses (Urban/recreational; e.g. parks law)	26	0.04	2.84%
Pasture/Hay	131	0.20	14.30%
Row Crops	62	0.10	6.77%
Transitional	12	0.02	1.31%
Total	916	1.43	100%
Agriculture	193	0.30	21%
Forest	579	0.90	63%
Other	144	0.23	16%
Total	916	1.43	100%

The detailed landuse for this sub-watershed was derived from EPA's Watershed Characterization System (WCS). The WCS is a software tool that provides a means to organize GIS and other existing data for user delineated watersheds. Landuse information for this assessment was derived from the Multiple Resolution Land Coverage (MRLC) 1990.

Figure-1 Land Use



3.4 Linkage Between Numeric Targets and Sources:

- The landuses in the Puppy Creek watershed indicate that the likely sources of fecal coliform bacteria are from residential, forested and agricultural areas.

- Because this segment has such a small drainage area, (1.4 square miles) and includes diverse landuses, it was not considered practicable to calculate individual components of the nonpoint source (NPS) loading. There will not be individual loads or reductions calculated for different sources such as forest, agriculture, and septic. The loadings and reductions will only be calculated as a NPS total load.

- It is envisioned that the sources can be better defined during the implementation process.

3.5 Data Availability and Analysis:

All of the data mentioned below can be found in the appendix. Sample locations are shown on Figure 2.

- Data collected in 1991 for the Alabama Clean Water Strategy sampling efforts, at two stations, showed the single sample maximum of 2,000/100 ml criteria exceeded three times out of ten samples. 30% of these samples exceeded the criteria.

- Puppy Creek was sampled again in 1996 under Alabama's 1996 Clean Water Strategy. Four stations were sampled during three different months. All the samples were below the fecal coliform criteria.

- Puppy Creek was not sampled again until 2001 under Alabama's §303(d) sampling program. Ninety seven samples were collected between April 2001 and March 2002. Five out of the 97 samples exceeded the single sample maximum of 2,000 col/100 ml criterion (i.e. 5%). Further evaluation shows that four of the five samples were taken on the same day, each at a different station. On this day all flows were extremely high, indicating a heavy rain event prior to sampling.

- During the 2001 – 2002 sampling period two data sets were collected over a thirty day period for each station. For each station there were two data sets of at least five samples, each collected over a 30-day period at intervals not less than 24 hours. This gave ten data sets to compare to the geometric mean criterion. Out of the ten, one exceeded the criteria (i.e. 10 %). This violation occurred at station PPYM-5.

3.6 Critical Conditions:

- Normally summer months (May – October) are generally considered critical conditions for fecal coliform. 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 lower than the winter criterion.

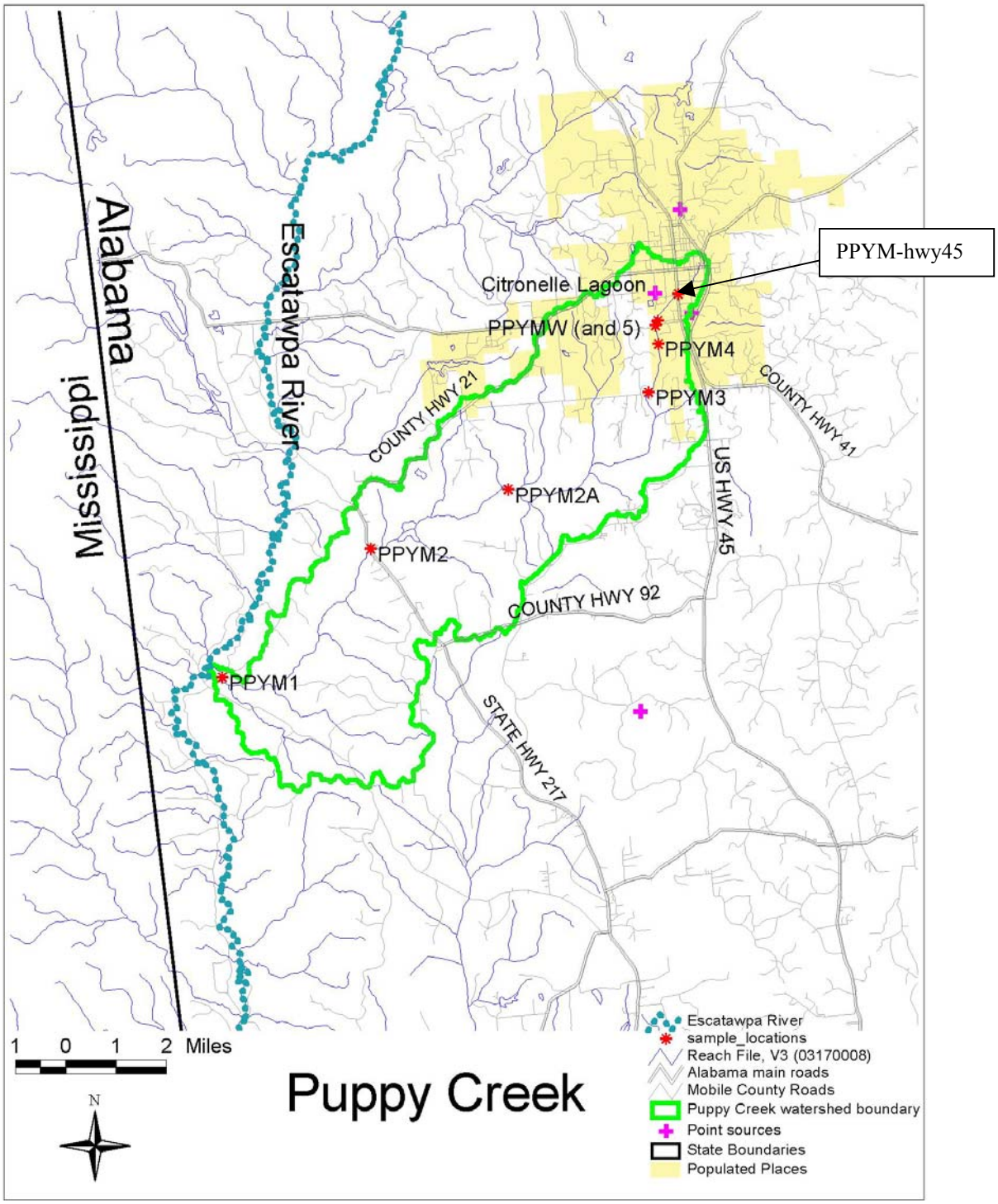
- For Puppy Creek, especially at station PPYM-5, the above seems to hold true. A higher geometric mean concentration is calculated using (May – October) data then using all the data (year round). Therefore (May – October) data was used to calculate the geometric mean for the loading calculations.

3.7 Margin of Safety (MOS):

There are two methods for incorporating a 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 fecal coliform data used in this analysis and the uncertainty of selecting an appropriate critical condition from the existing fecal coliform loads. A margin of safety was applied to the TMDL by reducing the criterion concentration by ten percent and calculating a load duration target with measured flow data. For the instantaneous criterion, a target conentration of 1,800 counts per 100mL was used instead of 2,000 counts per 100mL. The winter and summer geometric mean criteria were also reduced by ten percent to achieve the target concentrations of 900 and 180 counts per 100mL, respectively.

Figure 2 Sampling locations



4.0 TMDL

4.1 TMDL Development:

Total maximum daily loads (TMDLs) are 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). 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. 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.

For some pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). For bacteria, however, TMDLs are expressed in terms of organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

4.2 Load Calculations:

Percent reduction required to meet each fecal coliform criteria, that were exceeded, was calculated for Puppy Creek. The criteria that required the highest reduction was then chosen to set the fecal coliform TMDL for Puppy Creek.

The criteria that required the highest reduction of fecal coliform for Puppy Creek was the geometric mean of 200 col/100 ml (June-September). Therefore the TMDL was based off this criteria.

The TMDL calculations for each criterion can be seen in Tables 4.1 and 4.2 on the following pages.

Table 4.1

Load calculation compared to the gesomean criteria of "200 col/100 ml" for Puppy Creek

Average Flow measured at PPYM-5 for Geomean Samples:	1.4 cfs	
Max. Fecal coliform concentration measured at PPYM5:	522 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

Load Calculations:

Load = Fecal Coliform * measured flow * Conversion Factor

Load in col of Fecal Coliform/day

Fecal Coliform in col/100 mL

Measured Flow in cfs

Conversion Factor = 24468984 (ml-s/ft3-day)

Current Load:				conversion		flow		concentration
The current total load =	1.79E+10	col/day	---------->	24468984	*	1.4	*	522
Point source	0.00E+00	col/day	there are no point sources in this watershed					

Allowable Load:				conversion		flow		concentration
Allowable total load =	6.17E+09	col/day	---------->	24468984	*	1.4	*	180
Point source	0.00E+00	col/day	There are no point sources in this watershed					

Margin of Saftey				conversion		flow		concentration
MOS load =	6.85E+08	col/day	---------->	24468984	*	1.4	*	20

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
NPS load	1.79E+10	6.17E+09	1.17E+10	66%	6.17E+09
Point Source	0.00E+00	0.00E+00	0.00E+00	0%	0.00E+00

TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
6.85E+09	0.00E+00	6.17E+09	6.85E+08

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 66% = (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 geomeans 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

Table 4.2

Load calculation compared to the maximum criteria of "2000 col/100 ml" for Puppy Creek

Flow measured at PPYM-5 at time of maximum fecal coliform:	1.4 cfs	
Max. Fecal coliform concentration measured at PPYM5:	2300 col/100 mL	
Allowable fecal coliform maximum concentration minus MOS:	1800 col/100mL	=2000 - 10%
Margin of saftey for the maximum criteria	200 col/100mL	=10% of criteria

Load Calculations:

Load = Fecal Coliform * measured flow * Conversion Factor

Load in col of Fecal Coliform/day

Fecal Coliform in col/100 mL

Measured Flow in cfs

Conversion Factor = 24468984 (ml-s/ft3-day)

Current Load:				conversion		flow		concentration
The current total load:	7.88E+10	col/day	---------->	24468984	*	1.4	*	2300
Point source	0.00E+00	col/day	there are no point sources in this watershed					

Allowable Load:				conversion		flow		concentration
Allowable total load:	6.17E+10	col/day	---------->	24468984	*	1.4	*	1800
Point source	0.00E+00	col/day	There are no point sources in this watershed					

Margin of Saftey				conversion		flow		concentration
MOS load =	6.85E+09	col/day	---------->	24468984	*	1.4	*	200

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
NPS load	7.88E+10	6.17E+10	1.71E+10	22%	6.17E+10
Point Source	0.00E+00	0.00E+00	0.00E+00	0%	0.00E+00

TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
6.85E+10	0.00E+00	6.17E+10	6.85E+09

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 22% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

The water quality criteria for fecal coliform for single samples is 2000 col/100 mL.

To account for a Margin of Safety (MOS)an explicit target concentration of 1800 col/100 ml was used to calculate the allowable load

4.3 TMDL Implementation:

Puppy Creek is impaired solely by nonpoint sources for fecal coliform. For 303(d) listed waters impaired solely or primarily by Nonpoint source (NPS) pollutants, necessary reductions will be sought during TMDL implementation using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired water. Cooperation and active participation by the general public and various industry, business, and environmental 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 will be coordinated through interaction with local entities in conjunction with Clean Water Partnership efforts.

The primary TMDL implementation mechanism used will employ concurrent education and outreach, training, technology transfer, and technical assistance with incentive-based pollutant management measures. The ADEM Office of Education and Outreach (OEO) will assist in the implementation of TMDLs in cooperation with public and private stakeholders. Planning and oversight will be provided by or coordinated with the Alabama Department of Environmental Management's (ADEM) Section 319 Nonpoint source grant program in conjunction with other local, state, and federal resource management and protection programs and authorities. The CWA Section 319 grant program may provide limited funding to specifically ascertain NPS pollution sources and causes, identify and coordinate management programs and resources, present education and outreach opportunities, promote pollution prevention, and implement needed management measures to restore impaired waters.

Depending on the pollutant of concern, resources for corrective actions may be provided, as applicable, by the Alabama Cooperative Extension System (education and outreach); the USDA-Natural Resources Conservation Service (NRCS) (technical assistance) and Farm Services Agency (FSA) (federal cost-share funding); and the Alabama Soil and Water Conservation Committee (state agricultural cost share funding and management measure implementation assistance) through local Soil and Water Conservation Districts, or Resource Conservation and Development Councils (funding, project implementation, and coordination). Additional assistance from such agencies as the Alabama Department of Public Health (septic systems), Alabama Department of Agriculture and Industries (pesticides), and the Alabama Department of Industrial Relations and Dept of Interior - Office of Surface Mining (abandoned minelands), Natural Heritage Program and US Fish and Wildlife Service (threatened and endangered species), may also provide practical TMDL implementation delivery systems, programs, and information. Landuse and urban sprawl issues will be addressed through the Nonpoint Source for Municipal Officials (NEMO) education and outreach program. Memorandums of Agreements (MOAs) may be used as a tool to formally define roles and responsibilities.

Additional public/private assistance is available through the Alabama Clean Water Partnership Program (CWP). The CWP program uses a local citizen-based

environmental protection approach to coordinate efforts to restore and protect the state's resources in accordance with the goals of the Clean Water Act. Interaction with the state or river basin specific CWP will facilitate TMDL implementation by providing improved and timely communication and information exchange between community-based groups, units of government, industry, special interest groups, and individuals. The CWP can assist local entities to plan, develop, and coordinate restoration strategies that holistically meet multiple needs, eliminate duplication of efforts, and allow for effective and efficient use of available resources to restore the impaired waterbody or watershed.

Other mechanisms that are available and may be used during implementation of this TMDL include local regulations or ordinances related to zoning, land use, or storm water runoff controls. Local governments can provide funding assistance through general revenues, bond issuance, special taxes, utility fees, and impact fees. If applicable, reductions from point sources will be addressed by the NPDES permit program. The Alabama Water Pollution Control Act empowers ADEM to monitor water quality, issue permits, conduct inspections, and pursue enforcement of discharge activities and conditions that threaten water quality. In addition to traditional "end-of-pipe" discharges, the ADEM NPDES permit program addresses animal feeding operations and land application of animal wastes. For certain water quality improvement projects, the State Clean Water Revolving Fund (SRF) can provide low interest loans to local governments.

Long-term physical, chemical, and biological improvements in water quality will be used to measure TMDL implementation success. As may be indicated by further evaluation of stream water quality, the effectiveness of implemented management may necessitate revisions of this TMDL. The ADEM will continue to monitor water quality according to the rotational river basin monitoring schedule as allowed by resources. In addition, assessments may include local citizen-volunteer monitoring through the Alabama Water Watch Program and/or data collected by agencies, universities, or other entities using standardized monitoring and assessment methodologies. Core management measures will include but not be limited to water quality improvements and designated use support, preserving and enhancing public health, enhancing ecosystems, pollution prevention and load reductions, implementation of NPS controls, and public awareness and attitude/behavior changes.

Appendix A

Reference

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

USEPA. 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-001. U.S. Environmental Protection Agency, Office of Water, Washington DC.

Alabama Clean Water Strategy Water Quality Assessment Report December 1992

Alabama Clean Water Strategy Water Quality Assessment Report 1996

Appendix B

PPYM-5 data only

Station #	Date	Time	col/100ml	Geomean	Flow (cfs)
PPYM-005	4/16/01	1545	610		2.9
PPYM-005	5/16/01	1435	200		.5
PPYM-005	6/20/01	1305	600		2.2
PPYM-005	6/28/01	1007	320		0.6
PPYM-005	7/17/01	1155	430		0.9
PPYM-005	7/18/01	1155	680		1.9
PPYM-005	8/8/01	1215	240		1.2
PPYM-005	8/14/01	1248	240		1.4
PPYM-005	8/15/01	1317	2300	521.946	1.4
PPYM-005	9/26/01	1005	880		0.8
PPYM-005	9/27/01	1130	1300		0.6
PPYM-005	10/24/01	1200	220		1
PPYM-005	11/28/01	1120	170		.9
PPYM-005	12/12/01	1130	107		.5
PPYM-005	2/26/02	1030	14		0.7
PPYM-005	2/27/02	1030	30		.7
PPYM-005	3/6/02	1130	117		1.1
PPYM-005	3/26/02	1115	2000		30.6
PPYM-005	3/27/02	1120	153	108.5004	1.5
			Geomean		average
		all data	290		0.67
		May-Oct	488		0.67

All 2001 303 (d) data and DMR summary

Station #	Date	Time	col/100ml	Geomean	Flow (cfs)
PPYM-001	4/16/01	1215	170		55.6
PPYM-001	5/16/01	1540	130		12.5
PPYM-001	6/21/01	0905	200		28.6
PPYM-001	6/28/01	0733	85		15.3
PPYM-001	**7/18/01**	**0953**	**200**		**26.1**
PPYM-001	**7/19/01**	**1034**	**160**		**29.8**
PPYM-001	**8/9/01**	**1006**	**220**		**45.1**
PPYM-001	**8/15/01**	**0905**	**130**		**51.6**
PPYM-001	**8/16/01**	**1125**	**80**	**149**	**38.9**
PPYM-001	9/26/01	1030	190		20.4
PPYM-001	9/27/01	1100	180		17.6
PPYM-001	10/25/01	0855	180		14
PPYM-001	11/28/01	1620	230		18.1
PPYM-001	12/12/01	1605	550		18.2
PPYM-001	**2/26/02**	**1340**	**30**		**22.8**
PPYM-001	**2/27/02**	**1355**	**10**		**20.6**
PPYM-001	**3/7/02**	**0845**	**45**		**41.8**
PPYM-001	**3/26/02**	**1330**	**3000**		**unwadable**
PPYM-001	**3/27/02**	**1345**	**193**	**95**	**unwadable**

Station #	Date	Time	col/100ml	Geomean	Flow (cfs)
PPYM-003	4/17/01	0850	170		6.3
PPYM-003	5/16/01	1145	110		1.5
PPYM-003	6/20/01	1420	184		5.6
PPYM-003	6/28/01	0916	99		1.2
PPYM-003	**7/17/01**	**1324**	**70**		**2**
PPYM-003	**7/18/01**	**1213**	**80**		**2.1**
PPYM-003	**8/8/01**	**1107**	**350**		**5.6**
PPYM-003	**8/14/01**	**1135**	**88**		**8.4**
PPYM-003	**8/15/01**	**1142**	**44**	**95**	**3.2**
PPYM-003	9/26/01	1120	n/d*		1.6
PPYM-003	9/27/01	0930	130		1.7
PPYM-003	10/24/01	1435	150		2.2
PPYM-003	11/28/01	1400	140		2
PPYM-003	12/12/01	1045	180		2.6
PPYM-003	**2/26/02**	**1135**	**36**		**2.4**
PPYM-003	**2/27/02**	**1155**	**37**		**2.3**
PPYM-003	**3/6/02**	**1340**	**139**		**4.3**
PPYM-003	**3/26/02**	**1030**	**2000**		**14.2**
PPYM-003	**3/27/02**	**1030**	**160**	**143**	**4.2**

Station #	Date	Time	col/100ml	Geomean	Flow (cfs)
PPYM-002	4/16/01	1100	140		32.4
PPYM-002	5/17/01	0900	40		3.9
PPYM-002	6/20/01	1525	48		34.2
PPYM-002	6/28/01	0807	78		6.1
PPYM-002	**7/18/01**	**1040**	**250**		**8.4**
PPYM-002	**7/19/01**	**0948**	**160**		**8.4**
PPYM-002	**8/9/01**	**1101**	**90**		**30.1**
PPYM-002	**8/15/01**	**0935**	**63**		**45.2**
PPYM-002	**8/16/01**	**1156**	**28**	**91**	**40.2**
PPYM-002	9/26/01	1040	N/D*		10.9
PPYM-002	9/27/01	1030	94		9.1
PPYM-002	10/25/01	0940	197		7.7
PPYM-002	11/28/01	1510	150		9
PPYM-002	12/12/01	1430	80		12.7
PPYM-002	**2/26/02**	**1300**	**4**		**13.7**
PPYM-002	**2/27/02**	**1305**	**3**		**15.3**
PPYM-002	**3/7/02**	**0940**	**36**		**27.9**
PPYM-002	**3/26/02**	**1300**	**800**		**108.6**
PPYM-002	**3/27/02**	**1305**	**210**	**37**	**101.4**

Station #	Date	Time	col/100ml	Geomean	Flow (cfs)
PPYM-004	4/16/01	1445	310		2.1
PPYM-004	5/16/01	1230	70		1.3
PPYM-004	6/20/01	1100	510		2.8
PPYM-004	6/28/01	0934	230		0.8
ppym4-FD	6/28/01	0938	180		0.8
PPYM-004	**7/17/01**	**1115**	**160**		**1.7**
PPYM-004	**7/18/01**	**1143**	**120**		**1.8**
PPYM-004	**8/8/01**	**1150**	**300**		**3.0**
PPYM-004	**8/14/01**	**1219**	**68**		**3.2**
PPYM-004	**8/15/01**	**1235**	**180**	**148**	**2.8**
PPYM-004	9/26/01	1145	170		0.8
PPYM-004	9/27/01	0900	230		0.6
PPYM-004	10/24/01	1120	63		No Flow
PPYM-004	11/28/01	1200	110		0
PPYM-004	12/12/01	1205	570		1.6
PPYM-004	**2/26/02**	**1100**	**14**		**1.4**
PPYM-004	**2/27/02**	**1110**	**23**		**1.3**
PPYM-004	**3/6/02**	**1156**	**115**		**2.7**
PPYM-004	**3/26/02**	**1140**	**2000**		**unwadable**
PPYM-004	**3/27/02**	**1145**	**110**	**96**	**4.6**

Station #	Date	Time	col/100ml	Geomean	Flow (cfs)
ppym2a	6/28/01	8:37	20		2.8
ppym2a	9/26/01	11:05	96		5.1
ppym2a	9/27/01	10:05	100		4.5

Station #	Date	Time	col/100ml
WWTP-eff	6/28/01	10:30	36
WWTP-eff	9/26/01	10:00	30
WWTP-eff	9/27/01	11:40	6

Citronelle Laggon DMR data

	monthly ave			**monthly ave**
month	**col/100ml**		**month**	**col/100ml**
Jan-01	54		Aug-01	230
Feb-01	55		Sep-01	160
Mar-01	67		Oct-01	160
Apr-01	110		Nov-01	42
May-01	77		Dec-01	12
Jun-01	33		Jan-02	3.9
Jul-01	180		Feb-02	3.9

Station #	Date	Time	col/100ml	Geomean	Flow (cfs)
PPYM-005	4/16/01	1545	610		2.9
PPYM-005	5/16/01	1435	200		.5
PPYM-005	6/20/01	1305	600		2.2
PPYM-005	6/28/01	1007	320		0.6
PPYM-005	**7/17/01**	**1155**	**430**		**0.9**
PPYM-005	**7/18/01**	**1155**	**680**		**1.9**
PPYM-005	**8/8/01**	**1215**	**240**		**1.2**
PPYM-005	**8/14/01**	**1248**	**240**		**1.4**
PPYM-005	**8/15/01**	**1317**	**2300**	**522**	**1.4**
PPYM-005	9/26/01	1005	880		0.8
PPYM-005	9/27/01	1130	1300		0.6
PPYM-005	10/24/01	1200	220		1
PPYM-005	11/28/01	1120	170		.9
PPYM-005	12/12/01	1130	107		.5
PPYM-005	**2/26/02**	**1030**	**14**		**0.7**
PPYM-005	**2/27/02**	**1030**	**30**		**.7**
PPYM-005	**3/6/02**	**1130**	**117**		**1.1**
PPYM-005	**3/26/02**	**1115**	**2000**		**30.6**
PPYM-005	**3/27/02**	**1120**	**153**	**109**	**1.5**

1991 & 1996 Clean Water Strategy Data

Puppy Creek fecal Coliform data from CWS 1991

Station	Sampling Date	Sampling Time	Fecal Coliform (col/100ml)
Puppy Creek 1	6/26/91	9:30	>1200
Puppy Creek 1	7/17/91	12:25	**2300**
Puppy Creek 1	8/14/91	13:25	580
Puppy Creek 1	9/25/91	11:30	**5267**
Puppy Creek 1	10/28/91	10:40	1200
Puppy Creek 2	6/26/91	10:40	600
Puppy Creek 2	7/17/91	13:25	133
Puppy Creek 2	8/14/91	10:30	140
Puppy Creek 2	9/25/91	12:45	**2800**
Puppy Creek 2	10/28/91	12:00	467

Puppy Creek 1 @ hwy 45 near Citronelle
Puppy Creek 2 same PPYM-3 @ Russel Road

Puppy Creek fecal Coliform data from CWS 1996

Station	Sampling Date	Sampling Time	Fecal Coliform (col/100ml)
ES01	6/12/96	10:50 AM	194
ES01	9/23/96	11:15 AM	56
ES01	10/16/96	10:30 AM	90
ES02	6/12/96	11:20 AM	160L
ES02	9/23/96	11:45 AM	43
ES02	10/16/96	10:10 AM	67
ES03	6/12/96	11:50 AM	160L
ES03	9/23/96	12:00 PM	62
ES03	10/16/96	8:45 AM	106
ES04	6/12/96	12:15 PM	160L
ES04	9/23/96	12:30 PM	97

ES01 same as PPYM-hwy45
ES02 same as PPYM-3
ES03 same as PPYM-4
ES04 same as PPYM-5

"L" denotes (Actual value is known to be greater than value given)