

Fecal Coliform TMDL for Otoucalofa Creek

Yazoo River Basin

Calhoun, Lafayette, and Yalobusha Counties, Mississippi

Prepared By

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MISSISSIPPI DEPARTMENT OF
ENVIRONMENTAL QUALITY



FOREWORD

This report has been prepared in accordance with the schedule contained within the federal consent decree dated December 22, 1998. The report contains one or more Total Maximum Daily Loads (TMDLs) for waterbody segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

The amount and quality of the data on which this report is based are limited. As additional information becomes available, the TMDLs may be updated. Such additional information may include water quality and quantity data, changes in pollutant loadings, or changes in landuse within the watershed. In some cases, additional water quality data may indicate that no impairment exists.

Prefixes for fractions and multiples of SI units

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deka	da
10^{-2}	centi	c	10^2	hecto	h
10^{-3}	milli	m	10^3	kilo	k
10^{-6}	micro	μ	10^6	mega	M
10^{-9}	nano	n	10^9	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E

Conversion Factors

To convert from	To	Multiply by	To Convert from	To	Multiply by
Acres	Sq. miles	0.0015625	Days	Seconds	86400
Cubic feet	Cu. Meter	0.028316847	Feet	Meters	0.3048
Cubic feet	Gallons	7.4805195	Gallons	Cu feet	0.133680555
Cubic feet	Liters	28.316847	Hectares	Acres	2.4710538
cfs	Gal/min	448.83117	Miles	Meters	1609.344
cfs	MGD	.6463168	Mg/l	ppm	1
Cubic meters	Gallons	264.17205	μg/l * cfs	Gm/day	2.45

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TMDL INFORMATION PAGE

i. Listing Information

Name	ID	County	HUC	Cause	Mon/Eval
Otoucalofa Creek seg 1	MS288M1	Yalobusha	08030203	Pathogens	Monitored
Near Water Valley: From confluence with Town Creek to mouth at Enid Lake					
Otoucalofa Creek seg 2	MS289OM1	Calhoun Lafayette Yalobusha	08030203	Pathogens	Monitored
Near Water Valley: From Highway 9 West to confluence with Moore Creek					
Otoucalofa Creek seg 3	MS289OM2	Yalobusha	08030203	Pathogens	Monitored
Near Water Valley: From confluence with Moore Creek to industrial discharge (NPDES Permit MS0045641) at Water Valley					
Town Creek	MS289TM	Yalobusha	08030203	Pathogens	Monitored
At Water Valley: From above Water Valley urban area to mouth at Otoucalofa Creek					

ii. Water Quality Standard

Parameter	Beneficial use	Water Quality Criteria
Fecal Coliform	Secondary Contact	<p>May - October: Fecal coliform colony counts not to exceed a geometric mean of 200 per 100ml, nor shall more than 10 percent of samples examined during any month exceed a colony count of 400 per 100ml.</p> <p>November – April: Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than 10 percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.</p>

iii. NPDES Facilities

NPDES ID	Facility Name	Segment Location	Receiving Water
MS0022331	Water Valley POTW	MS288M1	Otoucalofa Creek

iv. Total Maximum Daily Load

Segment	WLA (counts/day)	LA (counts/day)	MOS	TMDL Percent Reduction
MS288M1	1.06E+10	Varies with Flow	Explicit	85
MS288OM2			Explicit	58
MS288OM1			Explicit	49
MS289TM			Explicit	82

EXECUTIVE SUMMARY

A segment of the Otoucalofa Creek has been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as a monitored waterbody segment, due to fecal coliform bacteria. The applicable state standard specifies that for the summer months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 200 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.



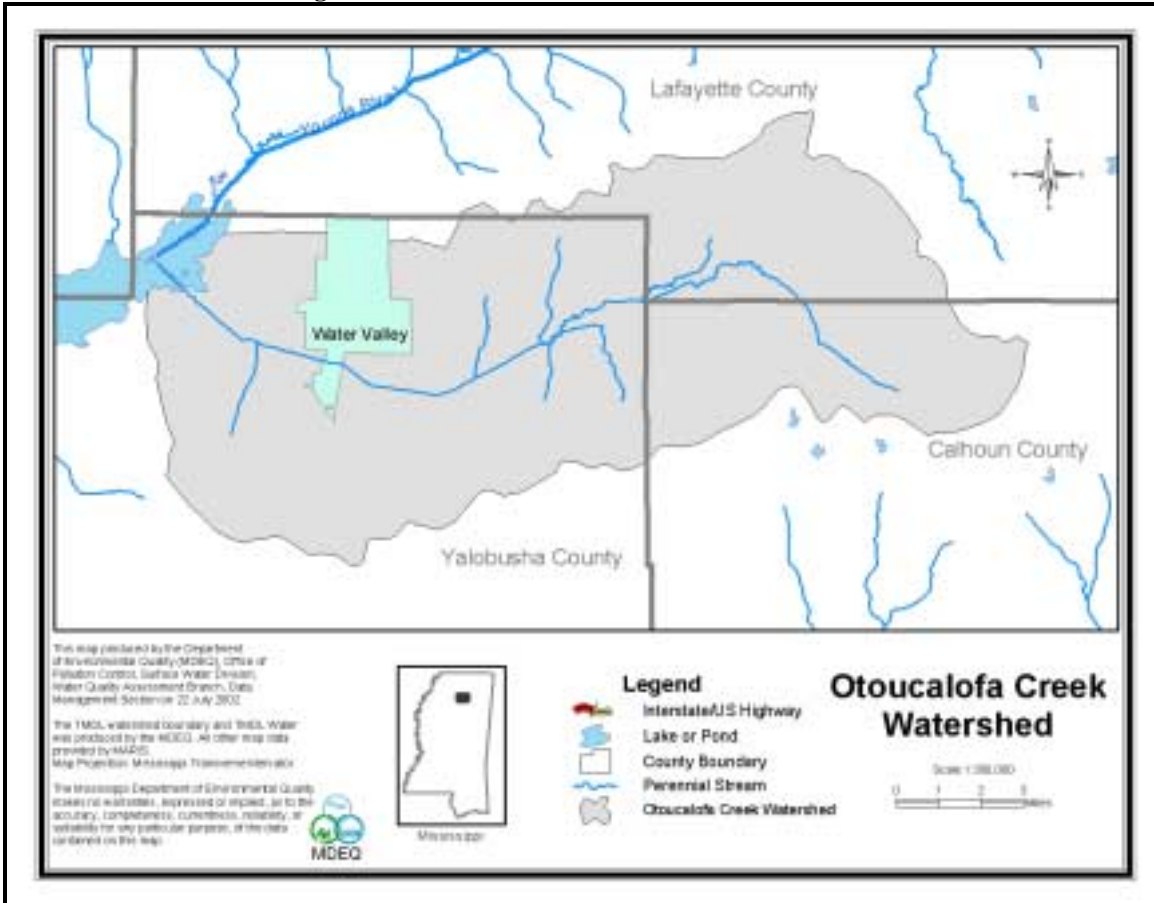
Photo 1. Otoucalofa Creek, West of Water Valley

Otoucalofa Creek, Photo 1, flows in a western direction from its headwaters near Banner, Mississippi to its confluence with Enid Lake. Enid Lake is one of four major reservoirs in the Yazoo River Basin constructed in the 1940's for flood control purposes. This TMDL has been developed for three listed sections of Otoucalofa Creek and one listed section of Town Creek. Load duration curves, which compare the water quality data against a flow-varying allowable load, were used for developing the TMDL for these sections.

Although fecal coliform loadings from point and nonpoint sources in the watershed were not explicitly represented with a model, a source assessment was conducted for the Otoucalofa Creek Watershed. There is one NPDES Permitted discharger included in the waste load allocation (WLA). Nonpoint sources considered include wildlife, livestock, and urban development. Also considered were the nonpoint sources such as failing septic systems and other direct inputs to tributaries of

Otoucalofa Creek. The location of the Otoucalofa Creek watershed and the urban area of Water Valley are shown in Figure 1 below.

Figure 1. Location of Otoucalofa Creek Watershed



The permitted point source facility currently has requirements in its NPDES Permit that requires disinfection to meet water quality standards for pathogens at the end of pipe. Therefore, no changes are required for this existing NPDES permit. Monitoring of the permitted facility in the Otoucalofa Creek Watershed should continue to ensure that compliance with permit limits is consistently attained.

The seasonal variations in hydrology, climatic conditions, and watershed activities are represented through the use of a continuous flow gage to develop the acceptable load curve and the use of water quality data collected throughout the year. The critical period was determined to be the summer season of May through October. An explicit 50 percent margin of safety (MOS) was used to account for uncertainty in the load duration curve method.

Water quality data indicate frequent violations of the fecal coliform standard in the waterbody. The load duration curves provide a data-based method to estimate the reductions required to meet water quality standards in Otoucalofa Creek. Load duration curves and TMDLs were computed at three locations along Otoucalofa Creek and one location on Town Creek, according to the location of monitoring stations and corresponding segment locations. The estimated reductions of fecal coliform bacteria required for Otoucalofa Creek from downstream to upstream are 85 percent, 58

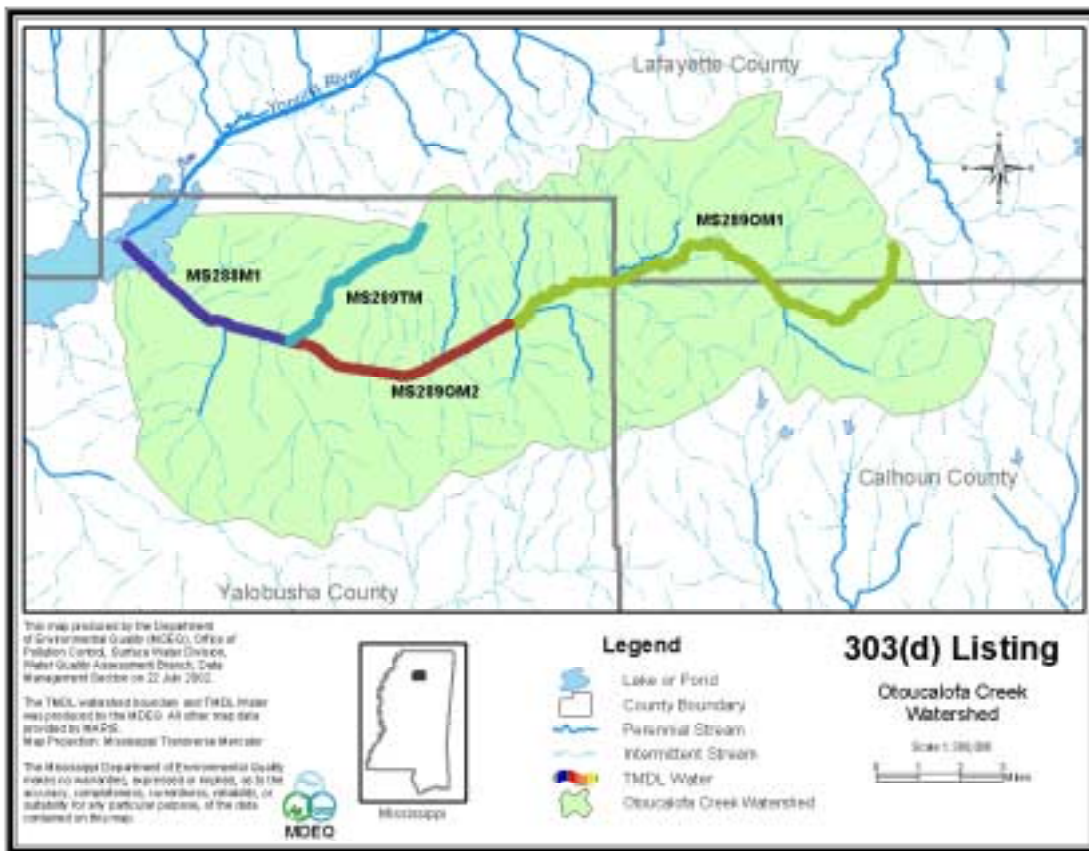
percent, and 49 percent, respectively. The estimated reduction of fecal coliform bacteria required for Town Creek is 82 percent.

INTRODUCTION

1.1 Background

The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency’s (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is fecal coliform. Fecal coliform bacteria are used as indicator organisms. They are readily identifiable and indicate the possible presence of other pathogenic organisms in the waterbody. The TMDL process can be used to establish water quality based controls to reduce pollution from nonpoint sources, maintain permit requirements for point sources, and restore and maintain the quality of water resources. This TMDL was developed for the 303(d) listed segments shown in Figure 2.

Figure 2. Otoucalofa Creek Watershed 303(d) Listed Segments



1.2 Applicable Waterbody Segment Use

The water use classification for the listed segment of the Otoucalofa Creek, as established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulation, is Fish and Wildlife Support. The designated beneficial uses for the Otoucalofa Creek are Secondary Contact and Aquatic Life Support.

1.3 Applicable Waterbody Segment Standard

The water quality standard applicable to the use of the waterbody and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. The standard states that for the summer months the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml. The water quality standard was used to assess the data to determine impairment in the waterbody. The instantaneous, summer portion of the water quality standard, 400 counts per 100 ml, was used as the targeted endpoint to establish these TMDLs using the load duration curve method.

TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 Selection of a TMDL Endpoint and Critical Condition

One of the major components of a TMDL is the establishment of instream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load and waste load reductions specified in the TMDL. The endpoints allow for a comparison between observed instream conditions and conditions that are expected to restore designated uses. The instream fecal coliform target for this TMDL is 400 colony counts per 100 ml with an explicit MOS of 50 percent, which reduces the target to 200 colony counts per 100 ml.

While the endpoint of a TMDL calculation is similar to a standard for a pollutant, the endpoint is not the standard. Currently MDEQ's standard for fecal coliform states that for the summer months the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml. For these TMDLs, MDEQ considered the instantaneous portion of the standard when looking at the data for assessment of impairment, setting the target, and calculating the TMDL. The geometric mean portion of the standard is not appropriate as a target for use with load duration curves at this time because the data available at stations with the appropriate flow information are instantaneous. Data appropriate for the calculation of geometric means have been recently collected on Otoucalofa Creek and are provided in Section 2.2. Additional monitoring of water quality for use in the calculation of geometric means and flow measurement at those stations is ongoing. Assessment of the geometric mean standard will be more fully evaluated upon completion of the monitoring project.

Because fecal coliform bacteria may be attributed to both nonpoint and point sources, the critical condition used for the evaluation of stream response was derived by a multi-year period. Critical conditions for waters impaired by nonpoint sources generally occur during periods of wet-weather and high surface runoff. But, critical conditions for point source dominated systems generally occur during low-flow, low-dilution conditions. The 1988-2001 period for which the water quality data exists represents both low-flow conditions as well as wet-weather conditions and encompasses a range of wet and dry seasons. Therefore, the 13-year period was used to find the critical conditions associated with all potential sources of fecal coliform bacteria within the watershed. The summer condition was chosen as the critical condition because the water quality standards are more stringent during this period. The 400 counts per 100 ml standard was applied to all of the data in the load duration curves.

2.2 Discussion of Instream Water Quality

There are six ambient stations on the listed segment operated by USGS that collected fecal coliform monitoring data during the 13-year period. Monitoring for flow and fecal coliform bacteria was performed on a routine basis on Town Creek at station 07274251 at Water Valley. Monitoring was conducted at three stations on segment MS289OM1 of Otoucalofa Creek; station 07274245 east of

Water Valley, station 07274235 near Paris, and station 07274237 at Paris. In addition, there was one monitoring station on segment MS289OM2 of Otoucalofa Creek, station 07274247, which is south-east of Water Valley. Finally, there was one monitoring station located on segment MS288M1, the most downstream station of Otoucalofa Creek. This station is 07274252, at Water Valley, MS. These stations, however, are no longer routinely monitored for fecal coliform bacteria. In order to collect fecal coliform data, MDEQ now goes to monitoring stations six times within a 30-day period. These data are used to calculate the geometric mean for the waterbody. Several stations on Otoucalofa Creek were recently included in this type of monitoring. These data confirm impairment in this waterbody for fecal coliform.

2.2.1 Inventory of Available Water Quality Monitoring Data

Fecal coliform monitoring data collected at the monitoring stations from are included in the Tables A-1 through A-6 in Appendix A. Flow measurements are also given in the tables along with the fecal coliform data. Data collected from the geometric mean study from 2001 are shown below in Tables 1 through 3.

Table 1. Fecal Coliform Data reported in Otoucalofa Creek, Station 3 Sand Hill Road
September 2001 to December 2001

Date	Tape Down Measurement	Fecal Coliform (counts/100ml)	Geometric Mean
9/27/01 10:25	31.08	192	132.04
10/3/01 11:20	31.06	78	
10/9/01 11:50	31.96	90	
10/16/01 11:40	31.69	520	
10/18/01 12:10	31.77	108	
10/24/01 12:05	31.28	70	
11/15/01 9:55	30.96	60	239.32
11/20/01 12:05	30.97	42	
11/27/01 10:05	23.22	3100	
11/29/01 10:35	17.30	2900	
12/6/01 10:10	31.27	3000	
12/11/01 12:10	31.30	98	

Table 2. Fecal Coliform Data reported in Otoucalofa Creek, Station 4 Unnamed Road East of Water Valley
September 2001 to December 2001

Date	Tape Down Measurement	Fecal Coliform (counts/100ml)	Geometric Mean
9/27/01 11:00	29.71	184	141.46
10/3/01 11:00	29.81	180	
10/9/01 12:10	29.73	164	
10/16/01 11:55	29.49	212	
10/18/01 12:25	29.55	60	
10/24/01 12:20	29.63	116	
11/15/01 9:40	29.62	64	258.75
11/20/01 12:20	29.67	50	
11/27/01 9:45	21.71	4000	
11/29/01 10:20	17.64	5600	
12/6/01 9:55	28.94	490	
12/11/01 12:22	28.90	320	

Table 3. Fecal Coliform Data reported in Town Creek, Station 5 Old Highway 7
September 2001 to December 2001

Date	Tape Down Measurement	Fecal Coliform (counts/100ml)	Geometric Mean
9/27/01 11:15	12.60	96	104.38
10/3/01 10:40	12.58	72	
10/9/01 12:25	12.65	76	
10/16/01 12:10	12.80	570	
10/18/01 12:40	12.60	80	
10/24/01 12:30	12.59	54	
11/15/01 9:30	12.56	4800	298.98
11/20/01 12:30	12.70	116	
11/27/01 9:30	11.87	2200	
11/29/01 10:08	10.48	4300	
12/6/01 9:45	12.55	520	
12/11/01 12:30	12.56	144	

2.2.2 Analysis of Instream Water Quality Monitoring Data

Historically, MDEQ only had data appropriate to compare all of the samples to the instantaneous portion of the standard, which is no more than 10% greater than the instantaneous maximum standard of 400 counts per 100 ml for the summer months and 4000 counts per 100 ml for the winter months. The geometric mean portion of the current fecal coliform standard was not used in assessment due to lack of appropriate data at that time. MDEQ’s new method of collecting data six times at a site during a 30-day period must be assessed for both parts of the standard. Tables 4 and 5 show the statistical summary of the recent monitoring data, which is part of an ongoing project. The data are provisional data and clearly verify impairment indicated by previous assessments.

Table 4. Summer Statistical Summaries of Water Quality Data

Station Number	Number of Samples	Geometric Mean	Standard Violation (200 counts/100 ml)	Percent Instantaneous Exceedance	Standard Violation (400 counts/100 ml)
3	6	132.04	No	17%	Yes
4	6	141.46	No	0%	No
5	6	104.38	No	17%	Yes

Table 5. Winter Statistical Summaries of Water Quality Data

Station Number	Number of Samples	Geometric Mean	Standard Violation (2000 counts/100 ml)	Percent Instantaneous Exceedance	Standard Violation (4000 counts/100 ml)
3	6	239.92	No	0%	No
4	6	258.75	No	17%	Yes
5	6	298.98	No	33%	Yes

SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Otoucalofa Creek Watershed. The source assessment was developed to provide an indication of which sources might be reduced to reach the reduction goals outlined in this report. In evaluation of the sources, loads were characterized by the best available information, monitoring data, literature values, and local management activities. This section documents the available information and interpretation for the analysis.

3.1 Assessment of Point Sources

Point sources of fecal coliform bacteria have their greatest potential impact on water quality during periods of low flow. Thus, a careful evaluation of point sources that discharge fecal coliform bacteria was necessary in order to quantify the degree of impairment present during the low flow, critical condition period. The only wastewater treatment plant discharging into the Otoucalofa Creek Watershed serves the City of Water Valley. Water Valley's wastewater treatment plant treats water from homes and businesses in the city. It also treats wastewater from Valley Fresh, a chicken processing plant in the area. There is only one additional NPDES permitted discharger in the watershed, Coltec Industries. The effluent from this facility, however, does not contain fecal coliform bacteria or other pathogens. Thus, this point source was not included in the source assessment. Once the permitted discharger was located, Table 6, the effluent was characterized based on all available monitoring data including permit limits, discharge monitoring reports, and information on treatment types. Discharge monitoring reports (DMRs) were the best data source for characterizing effluent because they report measurements of flow and fecal coliform present in effluent samples.

Table 6. Inventory of Point Source Dischargers

NPDES ID	Facility Name	Segment Location	Receiving Water
MS0022331	Water Valley POTW	MS288M1	Otoucalofa Creek

3.2 Assessment of Nonpoint Sources

There are many potential nonpoint sources of fecal coliform bacteria for the Otoucalofa Creek, including:

- ◆ Failing septic systems
- ◆ Wildlife
- ◆ Livestock
- ◆ Other Direct Inputs
- ◆ Urban development

The potential nonpoint sources in the Otoucalofa Creek watershed have been characterized through an interpretation of low-level infrared aerial photographs taken of the watershed in March 2000. The interpretation of the aerial photography included developing Arc View database files of the locations of features such as livestock, suspect septic tanks, and dump sites. Dump sites are defined as locations containing improperly disposed of materials. The database files also included coverages of political boundaries such as counties and other features including roads, streams, and riparian zone

conditions. Though it was not used to quantify fecal coliform bacteria loads in the watershed for this TMDL, the aerial photography is a useful tool for identifying the locations of potential nonpoint fecal coliform bacteria sources in the watershed.

The 80,362-acre drainage area of the Otoucalofa Creek contains many different landuse types, including urban, forest, cropland, pasture, barren, and wetlands. The landuse information for the watershed, shown below in Figure 3 and Table7, is based on the State of Mississippi’s Automated Resource Information System (MARIS), 1997. This data set is based Landsat Thematic Mapper digital images taken between 1992 and 1993. The MARIS data are classified on a modified Anderson level one and two system with additional level two wetland classifications. For modeling purposes the landuse categories were grouped into the landuses of urban, forest, cropland, pasture, barren, and wetlands.

Table 7. Landuse Distribution for Each Subwatershed (acres)

Subwatershed	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Total
08030203011	1,385	30,824	7,134	39,447	508	52	0	1,011	80,362
Percent	2%	38%	9%	49%	1%	0%	0%	1%	

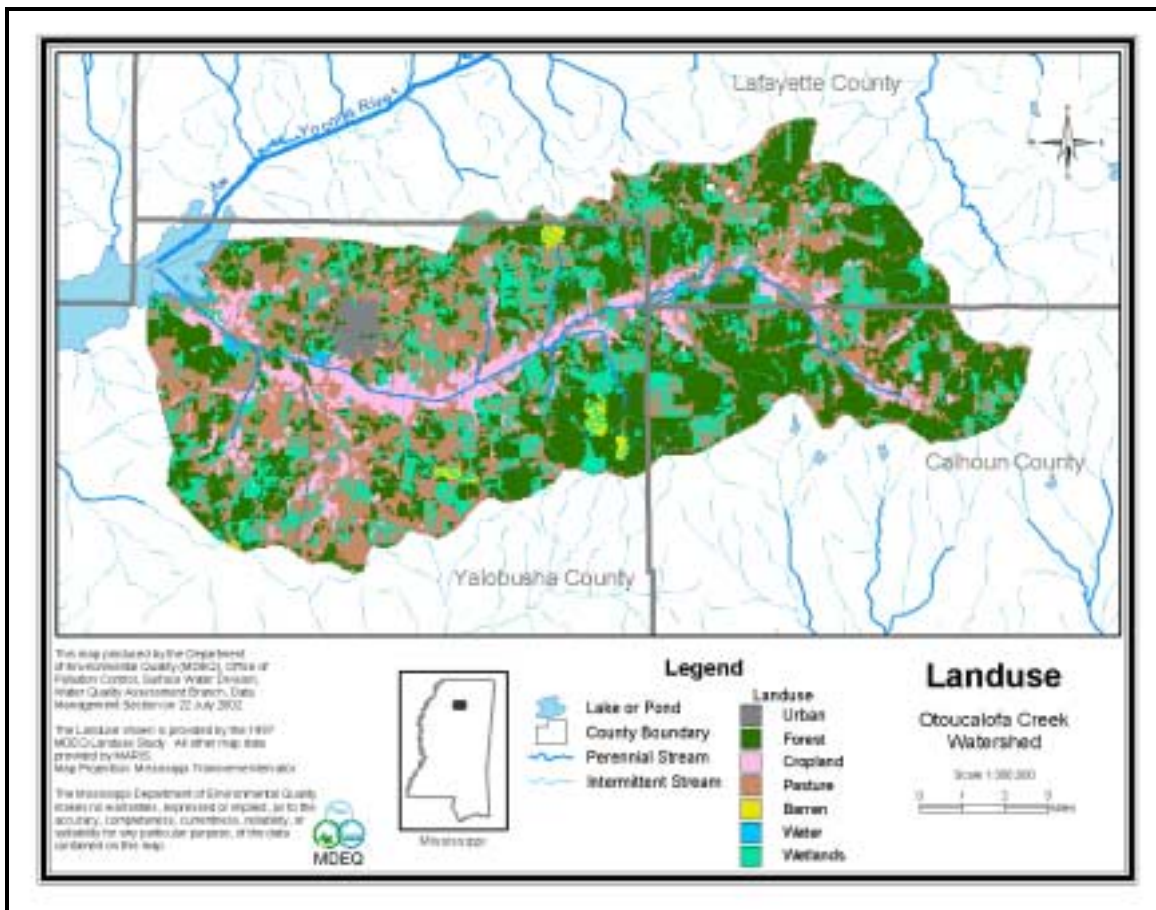


Figure 3. Landuse Distribution Map for the Otoucalofa Creek Watershed

3.2.1 Failing Septic Systems

Septic systems have a potential to deliver fecal coliform bacteria loads to surface waters due to malfunctions, failures, and direct pipe discharges. Properly operating septic systems treat wastewater and dispose of the water through a series of underground field lines. The water is applied through these lines into a rock substrate, thence into underground absorption. The systems can fail when the field lines are broken, or when the underground substrate is clogged or flooded. A failing septic system's discharge can reach the surface, where it becomes available for wash-off into the stream. Another potential problem is a direct bypass from the system to a stream. In an effort to keep the water off the land, pipes are occasionally placed from the septic tank or the field lines directly to the creek.

The aerial photography interpretation identified three categories of septic tank conditions. Group 1 were those with a distinctive moisture pattern, which had an identifiable plume from a visible field line pattern or ponding down slope from a field line. Group two were those with a suspicious moisture pattern, visible plume present but no visible field lines. Group three consisted of areas identified as suspect locations. Suspect locations were defined as locations of homes with no field lines or plumes apparent, but located on either steep slopes, small lots, shallow soils, or close to streams or heavily wooded lots. A total of 437 locations were identified. The majority of the locations identified were group two and three. Only one location was identified as group one. The locations of the identified septic conditions are shown in Figure 4. The aerial photography interpretation did not identify the total number of septic tanks systems present in the watershed. The total number of septic systems in the watershed was estimated from 1990 United States Census Data as 2765. Based on a comparison to the estimated number of septic tanks and the failing or suspect septic tank locations identified by the aerial photography, approximately 16 percent of the septic systems are suspected of failing in this watershed.

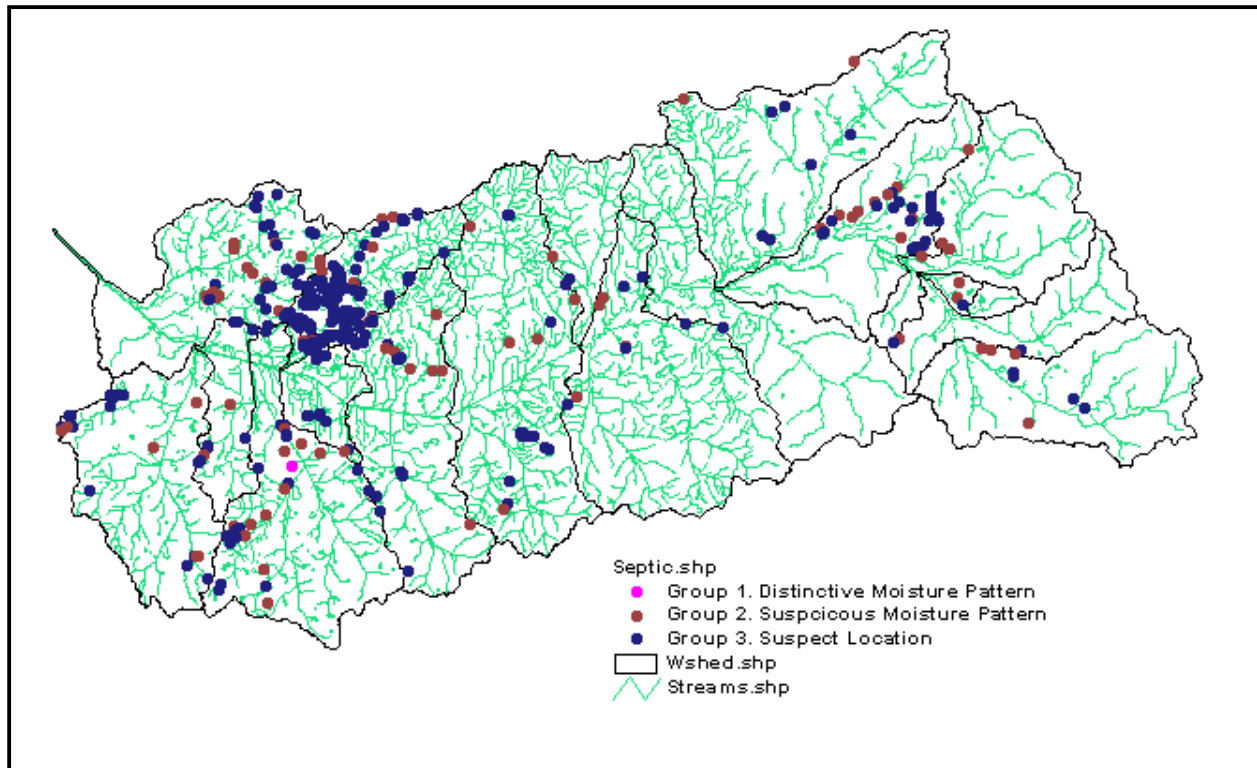


Figure 4. Septic Conditions in the Otoucalofa Creek Watershed

Another consideration is the use of individual onsite wastewater treatment plants. These treatment systems are in wide use in Mississippi. They can adequately treat wastewater when properly maintained. However, these systems may not receive the maintenance needed for proper, long-term operation. These systems require some sort of disinfection to properly operate. When this expense is ignored, the water does not receive adequate disinfection prior to release. Septic systems have the greatest impact on nonpoint source fecal coliform impairment in the Yazoo Basin. The best management practices needed to reduce this pollutant load need to prioritize elimination of septic tank loads from failures and improper use of individual onsite treatment systems.

3.2.2 Wildlife

Wildlife present in the Otoucalofa Creek Watershed contributes to fecal coliform bacteria on the land surface. No attempts were made in this TMDL to quantify the number and location of animals or amount of bacteria washed into Otoucalofa Creek due to wildlife contributions.

3.2.3 Livestock

Livestock present in the Otoucalofa Creek watershed include beef cattle and horses. Grazing cattle deposit manure on pastureland where it is available for wash-off and delivery to receiving waterbodies. There were 73 cattle operations identified in the watershed through the aerial photography interpretation. The cattle operations were grouped into three sizes, small, medium, and large, based on the number of cattle in the operation. Only one facility in the Otoucalofa Creek watershed was defined as large, having greater than 100 cattle. Of the remaining facilities, approximately half were medium, 50 to 100 cattle, and half were small, less than 50 cattle. The horse farms are all small operations, containing less than 10 horses. Based on a comparison of the location of the livestock operations and landuse in the watershed, Figure 5, it can be seen that the

majority of the cattle operations are located on land identified as pastureland. The horse operations are located on both forest and pastureland in the watershed.

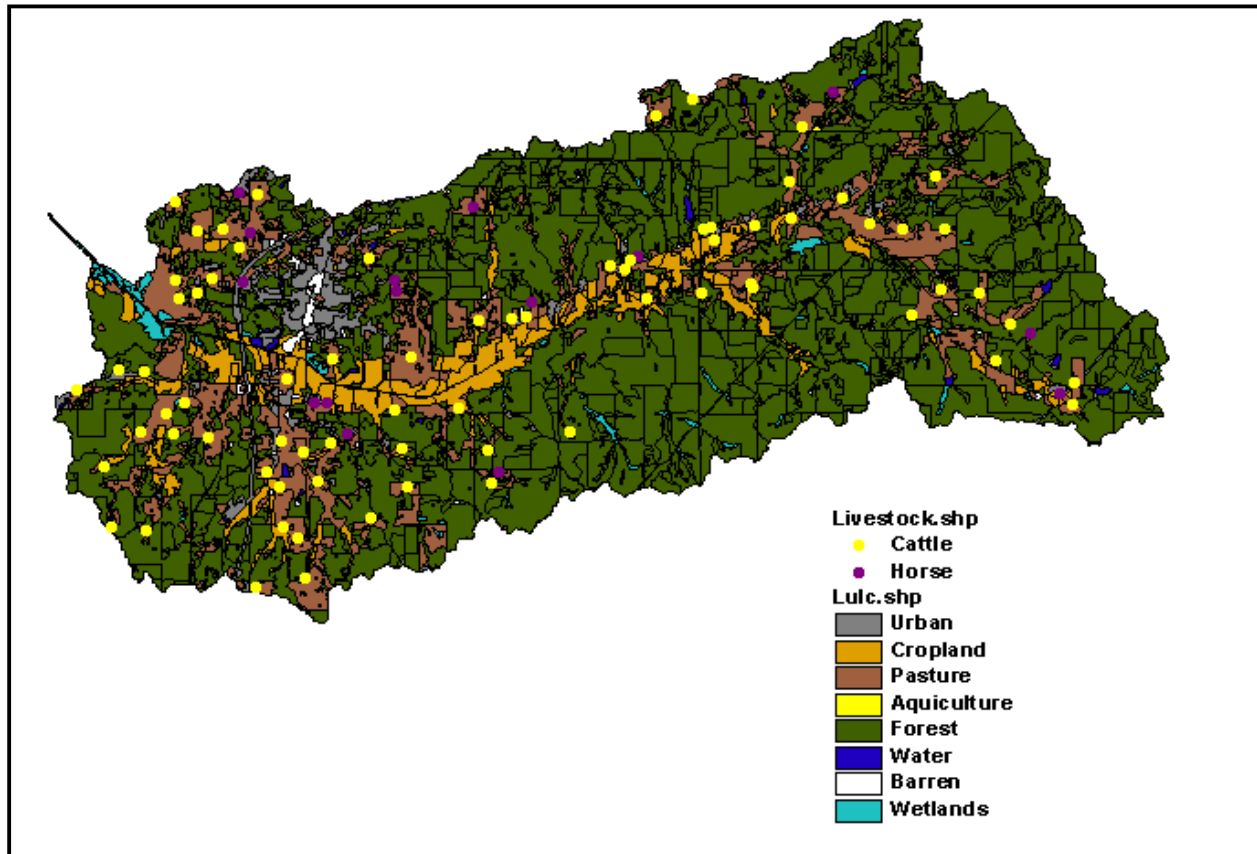


Figure 5. Locations of Livestock Locations in the Otoucalofa Creek Watershed

3.2.4 Other Direct Inputs

Other direct inputs of fecal coliform includes all animal access to streams (domestic and wild), illicit discharges of fecal coliform bacteria, dump sites, and leaking sewer collection lines.

3.2.5 Urban Development

Urban areas include land classified as urban and barren. The only urban area in to the Otoucalofa Creek watershed is in the City of Water Valley. Even though only a small percentage of the watershed is classified as urban, the contribution of the urban areas to fecal coliform loading in the Otoucalofa Creek Watershed was considered. Fecal coliform contributions from urban areas may come from storm water runoff, failing sewer pipes, and runoff contribution from improper disposal of materials such as litter.

LOAD DURATION CURVE PROCEDURE

The estimated reductions required for this TMDL were developed using load duration curves. The methodology outlined in a paper completed to explore the use of load duration curves for data analysis applications for streams in the Yazoo River Basin in Mississippi was followed in the development of the load duration curves for this TMDL (Sheely, 2002). Load duration curves were developed as a method in which TMDLs applicable to all hydrological conditions could be calculated. Prior to the introduction of this method, many TMDLs were developed to address a single flow condition such as the 7Q10 (7-day, 10-year low flow) or average flow. This new method allows for the development of TMDLs that addressed more than just a single flow condition. Because these curves include the entire range of flow conditions, pollutant sources of all types can be considered in the TMDLs. The methods used to develop both the flow and load duration curves will be described.

4.1 Development of Flow Duration Curves

The first step in the development of load duration curves is to create flow duration curves using continuous flow or stage data. There are two continuous flow gages in the Otoucalofa Creek Watershed maintained by the USGS. Gage 07274252 is located on Otoucalofa Creek near Water Valley on the Highway 7 Bypass. Continuous flow data for the period of September 1994 through December 1998 were available for this station. Gage 07274251 located on Town Creek in Water Valley. Continuous flow data for the period of January 1985 through September 2000 were available for this station.

The flow data are used to create flow duration curves, which display the cumulative frequency distribution of the daily flow data over the period of record. The flow duration curve relates flow values measured at the monitoring station to the percent of time that those values are met or exceeded. Flows are ranked from extremely low flows, which are exceeded nearly 100 percent of the time, to extremely high flows, which are rarely exceeded. Flow duration curves were developed for several locations on Otoucalofa Creek and for Town Creek. The flow duration curves for locations on Otoucalofa Creek were developed using the data from gage 07274252. The first flow duration curve developed was for the water quality monitoring station that was located at the same location as the flow gage. This flow duration curve is shown on a semi-log plot in Figure 6. Flow duration curves for other water quality monitoring station locations on Otoucalofa Creek were developed using a ratio of the drainage areas of the flow gage station and the monitoring station. The use of this method assumes that the hydrological characteristics of the watersheds would be similar. This is a valid assumption because the stations are located within the same waterbody. Flow duration curves were developed for Town Creek using the data from gage 07274251. This gage is located in the same location as the monitoring station for this segment.

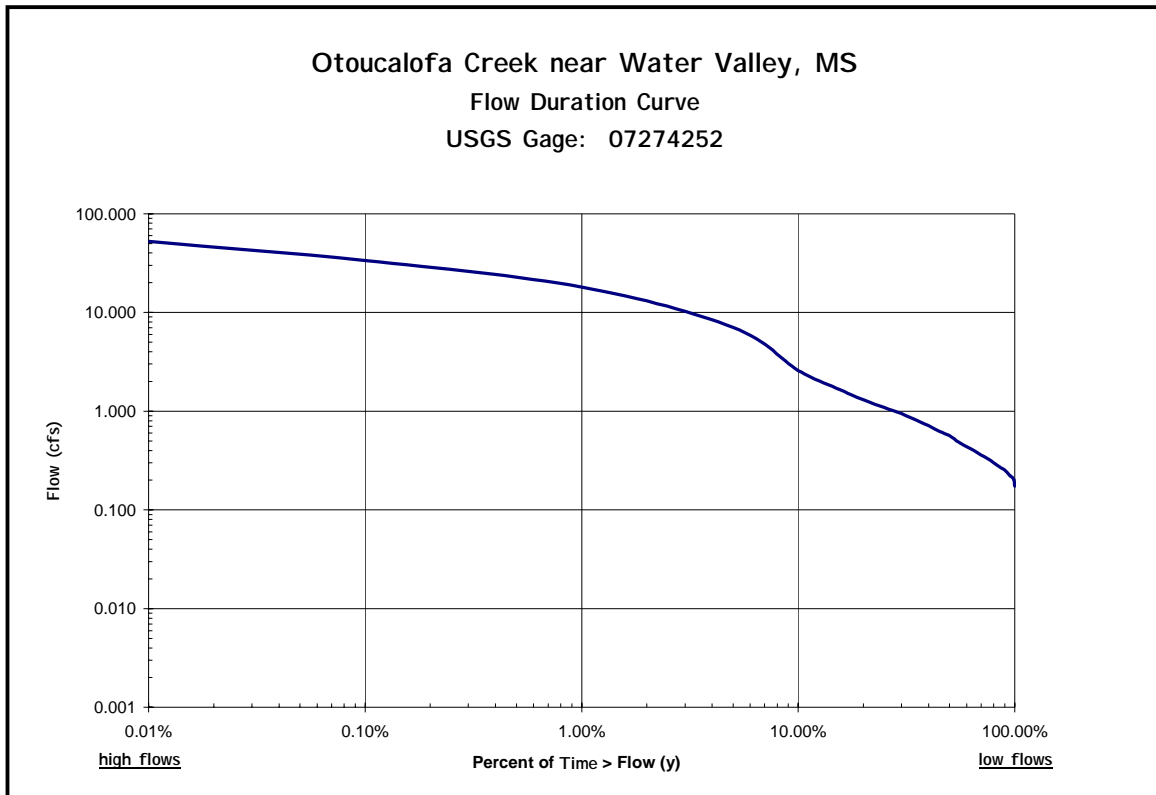


Figure 6. Flow Duration Curve for Otoucalofa Creek at Highway 7 Bypass

4.2 Load Duration Curves

Flow duration curves are then transformed into load duration curves by multiplying the flow values along the curve by applicable water quality criteria values for pathogens and appropriate conversion factors. The load duration curves are conceptually similar to the flow duration curves, in that the x-axis represents the flow recurrence interval. The y-axis is transformed to represent the allowable load of the water quality parameter. The curve representing the allowable load of fecal coliform was calculated using the instantaneous, summer water quality criteria of 400 counts per 100 ml and the flow associated with each flow recurrence interval. Load duration curves were developed for each of the four 303(d) listed segments in the Otoucalofa Creek Watershed. Although there was more than one monitoring location in some of the 303(d) listed segments, only one load duration curve was developed for each segment. The monitoring station that had sufficient monitoring data and was located at the farthest downstream point within each segment was selected for development of the load duration curve. The load duration curves developed for the four segments are included in Appendix B.

4.3 Comparison of Monitoring Data and Water Quality Criteria

The final step in the development of load duration curves was to add the monitoring data to the curves. Pollutant loads were estimated from the data as the product of the pollutant concentrations, instantaneous flows measured at the time of sample collection, and appropriate conversion factors. In order to identify the plotting position of each calculated load, the recurrence interval of each instantaneous flow measurement was defined. Water quality monitoring data are plotted on the same graph as the load duration curve. The load duration curves, which are shown in Appendix B, provide

a graphical display of the water quality conditions in the waterbody. The monitoring data points that plot above the target line exceed the water quality target, while those that plot below meet the target.

4.4 Source Identification

The position at which the monitoring data exceed the target gives an indication of the potential sources and delivery mechanisms of the pollutants. Violations that occur on the right side of the curve, during low-flow conditions, indicate the presence of continuous pollutant sources, such as NPDES permitted discharges and failing septic tanks. Violations that occur on the left side of the curve, during higher flows, indicate intermittent sources that appear in response to rain events. Monitoring data that exceed water quality criteria in the mid-range flow indicate that pollutants are most likely due to a combination of these sources. The load duration curves in Appendix B show that water quality data exceeds the target during all flow conditions at all stations. The interpretation of these curves indicate that both point and nonpoint sources are present in the Otoucalofa Creek Watershed. However, in segment MS289OM1, the majority of the exceedances occur during high flow conditions, indicating that nonpoint sources are most likely the major bacteria sources in the area.

Using load duration curves for data analysis is different from the methods typically used in that the frequency of attainment or violation of a particular water quality criteria is stressed rather than the absolute values of the monitoring data. One of the strengths of this method is that it can be used to interpret possible delivery mechanisms of pollutants. Load duration curves have been shown to be influenced by the landuse distribution in their watersheds (Sheely, 2002). Because of this, load duration curves have the potential to be used as a method for targeting pollution reduction efforts in watersheds that are impaired and require TMDL development.

4.5 Stream Characteristics

The stream characteristics given below describe the most downstream reach of the listed drainage area of the Otoucalofa Creek. The channel geometry and lengths for the Otoucalofa Creek are based on data available within the BASINS modeling system. The characteristics of the modeled section of the Otoucalofa Creek are as follows.

- ◆ Length 22.2 miles
- ◆ Average Depth 1.54 ft
- ◆ Average Width 69.10 ft
- ◆ Average Flow 192.2 cubic ft per second
- ◆ Mean Velocity 1.92 ft per second
- ◆ 7Q10 Flow 5.3 cubic ft per second
- ◆ Slope 0.00229 ft per ft

4.5 Selection of Representative Period

The period of record for flow data ranged from 1985 to 2000. The period of record for water quality data used to develop the load duration curves ranged from 1988 to 1995. Seasonality and critical conditions are accounted for during the extended time frame of the data represented in the load duration curves.

The critical condition for fecal coliform impairment from nonpoint source contributors occurs after a heavy rainfall that is preceded by several days of dry weather. The dry weather allows a build up of fecal coliform bacteria, which is then washed off the ground by a heavy rainfall. By using the extended time period, many such occurrences should be captured in the data results. Critical conditions for point sources, which occur during low-flow and low-dilution conditions, are considered as well.

4.6 Existing Loading

An additional set of load duration curves showing the target of 200 counts per 100 ml with a 50 percent MOS was developed, Appendix C. Only the monitoring data points that exceed the target of 200 counts per 100 ml are shown on these curves. The curves in Appendix C also include a regression line drawn through the data points that exceed the 200 counts per 100 ml target. The regression line represents the best fit of the existing loading in the three segments of Otoucalofa Creek and Town Creek.

ALLOCATION

In accordance with 40 CFR Section 130.2, which states, “TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure,” this TMDL is expressed as a percent reduction of load in order to retain the benefit of utilizing various flow conditions to develop the load duration curve. The use of a single TMDL number would effectively return to the choice of just one flow condition for TMDL development. This method uses the difference between the regression line through the exceeding points (the existing loading) and the load duration target curve to calculate the appropriate percent reduction necessary for the TMDL. The only allocation included in this TMDL is the wasteload allocation for point sources.

5.1 Wasteload Allocations

The wasteload allocation is based on the existing point sources in the Otoucalofa Creek Watershed. The WLA is represented on the load duration curves in Appendix C as a horizontal line with a constant load appropriate for each segment. Segments MS289OM1, MS289OM1, and MS289TM are located upstream of the point source discharger, thus the line representing the WLA is set at zero for these segments. The zero WLA line for these segments, however, will not prevent the addition of new point source dischargers within these segments in the future. However, it will be required that any future discharger within any of the segments of Otoucalofa Creek or Town Creek will be required to disinfect their effluent so that the effluent consistently meets water quality standards. The point source and its allocated load are shown in Table 8. No permit modification is necessary for this facility because it currently disinfects its effluent to meet water quality standards.

Table 8. Wasteload Allocations

NPDES ID	Facility Name	Segment Location	Allocated Load (counts/day)	Permit Modification Necessary
MS0022331	Water Valley POTW	MS00288M1	1.06E+10	No

5.2 Load Allocations

The load allocation for this TMDL varies according to the flow conditions as represented graphically for each segment in graphs C-1, C-2, C-3, and C-4. In graph C-1 the load allocation is equal to the area of the load duration curve that is above the line representing the WLA and below the curve representing the TMDL. In the rest of the graphs in Appendix C, where the waste load allocation is zero, the load allocation is represented as the entire area under the TMDL curve.

5.3 Incorporation of a Margin of Safety (MOS)

The two types of MOS development are to implicitly incorporate the MOS using conservative assumptions or to explicitly specify a portion of the total TMDL as the MOS. For this TMDL, the MOS is an explicit 50 percent reduction of the criteria of 400 counts per 100 ml to a target of 200 counts per 100 ml.

5.4 Calculation of the TMDL

Because the TMDL is variable depending on the recurrence interval of the appropriate flow, the TMDL is expressed as an average percent reduction of the load. The percent reduction necessary for the TMDL is the average of the differences between the existing load line and the target load curve at each recurrence interval. The regression line through the exceeding points represents the existing load. The target curve represents 200 counts per 100 ml at the various flows. Graphs C-1 through C-4 graphically represent the variable TMDL and LA, WLA, and MOS for each segment. The percent reduction of fecal coliform bacteria recommended for each segment in this TMDL is shown in Table 9. The units of counts per day are appropriate for this TMDL due to the use of the instantaneous standard as opposed to units of counts/per 30 days that are used in conjunction with the use of the geometric mean standard.

Table 9. TMDL Percent Reduction

Segment	WLA (counts/day)	MOS	TMDL Percent Reduction
MS288M1	1.06E+10	Explicit	85
MS289OM2		Explicit	58
MS289OM1		Explicit	48
MS289TM		Explicit	82

5.5 Seasonality

For many streams in the state, fecal coliform limits vary according to the seasons. This stream is designated for the use of secondary contact. For this use, the pollutant standard is seasonal. The criteria for the most critical season, which is the summer for Otoucalofa Creek, was used as the target for this TMDL. Because data were used throughout the year for several years at each monitoring station, seasonality was addressed. The extended period of record for the stage information allowed for representation of many different flow conditions, which is also relevant to seasonality.

5.6 Reasonable Assurance

This component of TMDL development does not apply to this TMDL Report. There are no point sources (WLA) requesting a reduction based on promised Load Allocation components and reductions. This TMDL will recommend that all point sources discharge treated and disinfected effluent that will be below the 200 colony counts per 100ml target at the end of the pipe.

CONCLUSION

The TMDL will not impact existing or future NPDES Permits as long as the effluent is disinfected to meet water quality standards for pathogens. MDEQ will not approve any NPDES Permit application that does not plan to meet water quality standards for disinfection. Education projects that teach best management practices should be used as a tool for reducing nonpoint source contributions. These projects may be funded by CWA Section 319 Nonpoint Source (NPS) Grants.

6.1 Future Monitoring

MDEQ has adopted the Basin Approach to Water Quality Management, a plan that divides Mississippi's major drainage basins into five groups. During each yearlong cycle, MDEQ resources for water quality monitoring will be focused on one of the basin groups. During the next monitoring phase in the Yazoo River Basin, Otoucalofa Creek and Town Creek may receive additional monitoring to identify any change in water quality. MDEQ produced guidance for future Section 319 project funding will encourage NPS restoration projects that attempt to address TMDL related issues within Section 303(d)/TMDL watersheds in Mississippi.

Additional monitoring for fecal coliform bacteria will also continue for several stations in the Otoucalofa Creek Watershed as part of the geometric mean bacteria sampling project. Bacteria samples will be collected at two stations on Otoucalofa Creek and one station on Town Creek during two thirty-day periods in fall of 2002 and spring of 2003.

6.2 Public Participation

This TMDL will be published for a 30-day public notice. During this time, the public will be notified by publication in the statewide newspaper and a newspaper in the area of the watershed. The public will be given an opportunity to review the TMDL and submit comments. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. TMDL mailing list members may request to receive the TMDL reports through either, email or the postal service. Anyone wishing to be included on the TMDL mailing list should contact Linda Burrell at (601) 961-5062 or Linda_Burrell@deq.state.ms.us. At the end of the 30-day period, MDEQ will determine the level of interest in the TMDL and make a decision on the necessity of holding a public meeting.

All written comments received during the public notice period and at any public meeting become a part of the record of this TMDL. All comments will be considered in the ultimate completion of this TMDL for submission of this TMDL to EPA Region 4 for final approval.

DEFINITIONS

Ambient stations: a network of fixed monitoring stations established for systematic water quality sampling at regular intervals, and for uniform parametric coverage over a long-term period.

Assimilative capacity: the capacity of a body of water or soil-plant system to receive wastewater effluents or sludge without violating the provisions of the State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters and Water Quality regulations.

Background: the condition of waters in the absence of man-induced alterations based on the best scientific information available to MDEQ. The establishment of natural background for an altered waterbody may be based upon a similar, unaltered or least impaired, waterbody or on historical pre-alteration data.

Calibrated model: a model in which reaction rates and inputs are significantly based on actual measurements using data from surveys on the receiving waterbody.

Critical Condition: hydrologic and atmospheric conditions in which the pollutants causing impairment of a waterbody have their greatest potential for adverse effects.

Daily discharge: the "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily average" is calculated as the average.

Designated Use: use specified in water quality standards for each waterbody or segment regardless of actual attainment.

Discharge monitoring report: report of effluent characteristics submitted by a NPDES Permitted facility.

Effluent standards and limitations: all State or Federal effluent standards and limitations on quantities, rates, and concentrations of chemical, physical, biological, and other constituents to which a waste or wastewater discharge may be subject under the Federal Act or the State law. This includes, but is not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, pretreatment standards, and schedules of compliance.

Effluent: treated wastewater flowing out of the treatment facilities.

Fecal coliform bacteria: a group of bacteria that normally live within the intestines of mammals, including humans. Fecal coliform bacteria are used as an indicator of the presence of pathogenic organisms in natural water.

Geometric mean: the n th root of the product of n numbers. A 30-day geometric mean is the 30th root of the product of 30 numbers.

Impaired Waterbody: any waterbody that does not attain water quality standards due to an individual pollutant, multiple pollutants, pollution, or an unknown cause of impairment.

Land Surface Runoff: water that flows into the receiving stream after application by rainfall or irrigation. It is a transport method for nonpoint source pollution from the land surface to the receiving stream.

Load allocation (LA): the portion of a receiving water's loading capacity attributed to or assigned to nonpoint sources (NPS) or background sources of a pollutant. The load allocation is the value assigned to the summation of all direct sources and land applied fecal coliform that enter a receiving waterbody. It also contains a portion of the contribution from septic tanks.

Loading: the total amount of pollutants entering a stream from one or multiple sources.

Nonpoint Source: pollution that is in runoff from the land. Rainfall, snowmelt, and other water that does not evaporate become surface runoff and either drains into surface waters or soaks into the soil and finds its way into groundwater. This surface water may contain pollutants that come from land use activities such as agriculture; construction; silviculture; surface mining; disposal of wastewater; hydrologic modifications; and urban development.

NPDES permit: an individual or general permit issued by the Mississippi Environmental Quality Permit Board pursuant to regulations adopted by the Mississippi Commission on Environmental Quality under Mississippi Code Annotated (as amended) §§ 49-17-17 and 49-17-29 for discharges into State waters.

Point Source: pollution loads discharged at a specific location from pipes, outfalls, and conveyance channels from either wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving stream.

Pollution: contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the State, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance, or leak into any waters of the State, unless in compliance with a valid permit issued by the Permit Board.

Publicly Owned Treatment Works (POTW): a waste treatment facility owned and/or operated by a public body or a privately owned treatment works which accepts discharges which would otherwise be subject to Federal Pretreatment Requirements.

Regression Coefficient: an expression of the functional relationship between two correlated variables that is often empirically determined from data, and is used to predict values of one variable when given values of the other variable.

Scientific Notation (Exponential Notation): mathematical method in which very large numbers or very small numbers are expressed in a more concise form. The notation is based on powers of ten. Numbers in scientific notation are expressed as the following: $4.16 \times 10^{(+b)}$ and $4.16 \times 10^{(-b)}$ [same as $4.16E4$ or $4.16E-4$]. In this case, b is always a positive, real number. The $10^{(+b)}$ tells us that the decimal point is b places to the right of where it is shown. The $10^{(-b)}$ tells us that the decimal point is b places to the left of where it is shown.

For example: $2.7 \times 10^4 = 2.7E+4 = 27000$ and $2.7 \times 10^{-4} = 2.7E-4 = 0.00027$.

Sigma (Σ): shorthand way to express taking the sum of a series of numbers. For example, the sum or total of three amounts 24, 123, 16, (d_1 , d_2 , d_3) respectively could be shown as:

$$\sum_{i=1}^3 d_i = d_1 + d_2 + d_3 = 24 + 123 + 16 = 163$$

Total Maximum Daily Load or TMDL: the calculated maximum permissible pollutant loading to a waterbody at which water quality standards can be maintained.

Waste: sewage, industrial wastes, oil field wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the State.

Wasteload allocation (WLA): the portion of a receiving water's loading capacity attributed to or assigned to point sources of a pollutant. It also contains a portion of the contribution from septic tanks.

Water Quality Standards: the criteria and requirements set forth in *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Water quality standards are standards composed of designated present and future most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water uses or classification, and the Mississippi antidegradation policy.

Water quality criteria: elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports the present and future most beneficial uses.

Waters of the State: all waters within the jurisdiction of this State, including all streams, lakes, ponds, wetlands, impounding reservoirs, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, situated wholly or partly within or bordering upon the State, and such coastal waters as are within the jurisdiction of the State, except lakes, ponds, or other surface waters which are wholly landlocked and privately owned, and which are not regulated under the Federal Clean Water Act (33 U.S.C.1251 et seq.).

Watershed: the area of land draining into a stream at a given location.

ABBREVIATIONS

7Q10.....	Seven-Day Average Low Stream Flow with a Ten-Year Occurrence Period
BASINS.....	Better Assessment Science Integrating Point and Nonpoint Sources
BMP	Best Management Practice
CWA	Clean Water Act
DMR.....	Discharge Monitoring Report
EPA	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA.....	Load Allocation
MARIS	State of Mississippi Automated Information System
MDEQ.....	Mississippi Department of Environmental Quality
MOS	Margin of Safety
NRCS	National Resource Conservation Service
NPDES	National Pollution Discharge Elimination System
NPSM.....	Nonpoint Source Model
RF3	Reach File 3
USGS.....	United States Geological Survey
WLA.....	Waste Load Allocation

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APPENDIX A

This appendix contains the fecal coliform monitoring data available for the six monitoring stations on Otoucalofa Creek and Town Creek. The flow measurements in Town Creek were recorded from USGS gage 07274251. This flow gage is located at the same location as the monitoring station on Town Creek. The flow measurements in Otoucalofa Creek were recorded from USGS gage 07274250. This flow gage is located west of Water Valley on the Highway 7 bypass. The flow data given for all of the monitoring stations on Otoucalofa Creek is based on the data collected at this gage. Monitoring station 07274252 is located at the same location of the flow gage. Flow was estimated for the remaining monitoring stations using a ratio of the drainage area of the monitoring station to the drainage area of the gage.

Table A-1. Fecal Coliform Data reported in the Town Creek, Station 07274251
April 1988 to May 1995

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
4/22/1988	6:00	2.1	800
4/22/1988	12:00	2.1	640
4/22/1988	18:00	2.1	680
4/23/1988	6:00	2.1	170
4/23/1988	18:00	2.1	5700
4/24/1988	6:00	2.2	520
8/16/1988	6:35	1.8	680
8/16/1988	12:20	1.8	260
8/16/1988	18:15	1.8	620
8/17/1988	0:20	1.8	940
8/17/1988	6:15	1.8	480
8/17/1988	12:15	1.8	180
8/17/1988	18:10	1.8	900
8/18/1988	0:15	1.8	1100
8/18/1988	6:30	1.8	5700
11/15/1988	7:05	2.4	160
11/15/1988	12:15	2.4	480
11/15/1988	18:15	2.4	400
11/16/1988	0:10	2.4	290
11/16/1988	6:30	2.4	700
11/16/1988	12:15	2.4	1200
11/16/1988	18:10	2.4	460
11/17/1988	0:10	2.4	340
11/17/1988	6:10	2.4	460
5/3/1989	18:30	3.2	2500
5/4/1989	0:25	3.2	8200
5/4/1989	6:25	2.2	1200
5/4/1989	12:25	2.6	7200
5/4/1989	18:25	2.3	10000
5/5/1989	0:20	2	4000
5/5/1989	6:30	34	27000
5/5/1989	12:30	7	4200

Table A-1 Continued

5/5/1989	18:30	2.6	4800
10/24/1989	18:00	1.7	290
10/25/1989	6:00	1.7	6300
10/25/1989	12:00	1.7	16000
10/25/1989	18:00	1.7	350
10/26/1989	6:00	1.7	780
10/26/1989	12:00	1.9	11000
7/12/1990	18:00	2.5	6000
7/13/1990	6:00	2.3	6000
7/13/1990	12:00	4.4	4400
7/13/1990	18:00	2.5	4200
7/14/1990	6:00	2.3	2300
7/14/1990	12:00	2.3	2800
7/14/1990	18:00	2.3	6800
4/11/1991	18:00	6.3	7600
4/12/1991	6:00	3.9	2100
4/12/1991	12:00	3.6	150
4/12/1991	18:00	31	700
4/13/1991	6:15	7.2	180
4/13/1991	12:00	6.9	2600
4/13/1991	18:00	5.7	2200
8/20/1991	12:30	2.5	210
8/20/1991	18:30	2.5	2200
8/21/1991	0:30	2.7	2400
8/21/1991	6:30	2.8	1100
8/21/1991	12:30	2.8	440
8/21/1991	18:30	2.8	110
8/22/1991	0:30	2.8	900
8/22/1991	6:30	3	1200
8/22/1991	12:30	3	420
5/28/1992	18:30	2.5	540
5/29/1992	0:30	2.5	2100
5/29/1992	6:30	2.5	940
5/29/1992	12:30	2.5	1800
5/29/1992	18:30	2.5	720
5/30/1992	0:30	2.5	480
5/30/1992	6:30	2.5	640
5/30/1992	12:30	2.5	240
5/30/1992	18:30	2.5	350
8/27/1992	6:30	4.9	6000
8/27/1992	12:30	511	19000
8/27/1992	18:30	41	16000
8/28/1992	0:30	10	19000
8/28/1992	6:30	5.7	5200
8/28/1992	12:30	4.4	6000
8/28/1992	18:30	3.4	6200

Table A-1 Continued

8/29/1992	0:30	3.2	4500
8/29/1992	6:30	2.8	5700
4/14/1993	12:30	2.5	280
4/14/1993	18:30	2.5	760
4/15/1993	0:30	344	22000
4/15/1993	6:30	40	4800
4/15/1993	12:30	15	4800
4/15/1993	18:30	9.8	2800
4/16/1993	0:30	8.3	2800
4/16/1993	6:30	6.9	1700
4/16/1993	12:30	6.3	2400
4/5/1994	6:30	3	310
4/5/1994	12:30	3	1500
4/5/1994	18:30	24	4200
4/6/1994	0:30	8	4200
4/6/1994	6:30	4.9	2800
4/6/1994	12:30	4.1	1700
4/6/1994	18:30	3.6	720
4/7/1994	0:30	3.2	880
4/7/1994	6:30	3	520
5/8/1995	15:30	3.4	860
5/8/1995	21:30	3.4	2000
5/9/1995	3:30	3.4	1200
5/9/1995	9:30	3.4	1100
5/9/1995	15:30	3.4	440
5/9/1995	21:30	3.7	4000
5/10/1995	3:30	3.7	1300
5/10/1995	9:30	3.4	6000
5/10/1995	12:30	3.4	4600

Table A-2. Fecal Coliform Data reported in Otoucalofa Creek East of Water Valley, Station 07274245
April 1988 to May 1995

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
4/22/88	06:30	35	120
4/22/88	12:30	34	160
4/22/88	18:30	34	210
4/22/88	00:30	34	240
4/23/88	07:15	34	140
4/23/88	18:30	23	220
4/24/88	00:30	48	760
4/24/88	06:30	92	6300
8/16/88	06:30	.90	340
8/16/88	12:20	.90	200
8/16/88	18:15	.90	100
8/17/88	00:20	.90	220
8/17/88	06:30	.90	280
8/17/88	12:20	.90	780
8/18/88	00:20	.90	340
8/18/88	06:20	.90	140
11/15/88	06:30	6.6	200
11/15/88	12:20	6.6	180
11/15/88	18:20	6.6	200
11/16/88	00:20	6.6	170
11/16/88	06:20	6.6	81
11/16/88	12:20	7.2	160
11/16/88	18:20	6.2	210
11/17/88	00:20	7.4	280
11/17/88	06:20	7.2	140
5/3/89	18:30	15	280
5/4/89	00:30	15	370
5/4/89	06:30	16	330
5/4/89	12:30	31	1500
5/4/89	18:30	47	2200
5/5/89	00:30	44	2100
5/5/89	06:30	42	4000
5/5/89	12:30	580	7200
5/5/89	18:30	375	5400
10/24/89	18:30	4.5	100
10/25/89	00:30	5.2	500
10/25/89	06:30	5.2	280
10/25/89	12:30	5.2	5
10/25/89	18:30	5.4	250
10/26/89	00:30	5.4	290
10/26/89	06:30	5.0	300
10/26/89	12:30	5.0	84
10/26/89	18:30	5.0	100
7/12/90	19:00	5.0	1000
7/13/90	00:45	6.2	1100
7/13/90	06:40	6.4	290

Table A-2 Continued

7/13/90	12:30	6.3	170
7/14/90	00:40	4.1	230
7/14/90	06:20	3.1	140
7/14/90	12:30	2.6	130
7/14/90	18:35	2.5	480
4/11/91	18:00	62	240
4/12/91	00:00	100	680
4/12/91	06:00	122	1200
4/12/91	12:00	106	240
4/12/91	18:00	175	100
4/13/91	00:00	430	240
4/13/91	06:00	277	180
4/13/91	12:00	208	620
4/13/91	18:00	175	400
8/20/91	13:00	4.9	88
8/20/91	19:00	4.9	92
8/21/91	01:00	4.9	140
8/21/91	07:00	4.9	140
8/21/91	13:00	4.9	50
8/21/91	19:00	4.9	73
8/22/91	01:00	4.9	110
8/22/91	07:00	4.9	180
8/22/91	13:00	4.9	84
8/22/91	19:00	7.8	140
5/29/92	00:00	7.2	160
5/29/92	07:00	8.2	240
5/29/92	13:00	8.5	120
5/29/92	19:15	8.2	180
5/30/92	01:40	8.2	220
5/30/92	07:00	9.1	150
5/30/92	13:00	8.5	81
5/30/92	18:50	7.8	120
8/27/92	07:00	8.8	440
8/27/92	13:00	2240	7200
8/27/92	19:00	1880	6400
8/28/92	01:00	505	3400
8/28/92	07:00	185	8200
8/28/92	13:00	110	3500
8/28/92	19:00	65	1200
8/29/92	01:00	48	1300
8/29/92	07:00	45	2000
4/14/93	12:00	56	180
4/14/93	18:00	56	140
4/15/93	00:00	140	900
4/15/93	06:00	520	6600
4/15/93	12:00	295	3200
4/15/93	18:00	166	1800
4/16/93	00:00	134	1300
4/16/93	06:00	110	480

Table A-2 Continued

4/16/93	12:00	97	420
4/5/94	07:00	26	100
4/5/94	13:00	27	200
4/5/94	19:00	70	540
4/6/94	01:00	790	5000
4/6/94	07:00	690	4600
4/6/94	13:00	420	2400
4/6/94	19:00	240	1000
4/7/94	01:00	170	540
4/7/94	07:00	125	560
5/8/95	16:00	42	120
5/8/95	21:30	40	160
5/9/95	04:00	41	140
5/9/95	10:00	36	130
5/9/95	16:00	34	96
5/9/95	22:00	32	160
5/10/95	04:00	28	140
5/10/95	10:00	31	160
5/10/95	13:00	30	200

**Table A-3. Fecal Coliform Data reported in Otoucalofa Creek near Paris, Station 07274235
April 1988 to May 1995**

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
4/22/88	06:00	5.2	270
4/22/88	12:00	5.2	200
4/22/88	18:00	5.1	190
4/23/88	00:00	5.1	310
4/23/88	06:00	5.0	440
4/23/88	12:00	4.3	--
4/23/88	18:00	4.3	240
4/24/88	00:00	5.2	2600
4/24/88	06:00	5.1	1700
8/16/88	06:00	.01	46
8/16/88	12:00	.01	170
8/16/88	18:00	.01	36
8/17/88	00:00	.01	220
8/17/88	06:30	.01	150
8/17/88	12:00	<.01	44
8/17/88	18:00	<.01	44
8/18/88	00:00	<.01	120
8/18/88	06:00	<.01	760
11/15/88	06:20	.39	56
11/15/88	12:15	.38	45
11/15/88	18:15	.35	40
11/16/88	00:15	.38	24
11/16/88	06:15	.38	46
11/16/88	12:00	.33	65
11/16/88	18:15	.39	88
11/17/88	00:15	.40	40
11/17/88	06:15	.41	68
5/3/89	18:00	1.1	400
5/4/89	00:00	1.1	130
5/4/89	06:00	2.3	340
5/4/89	12:00	4.6	11000
5/4/89	18:00	5.6	7400
5/5/89	00:00	4.8	4200
5/5/89	06:00	6.2	700
5/5/89	12:00	240	5100
5/5/89	18:00	19	5800
10/24/89	18:25	.39	12
10/25/89	00:25	.24	5
10/25/89	06:25	.28	12
10/25/89	12:20	.37	15
10/25/89	18:20	.37	32
10/26/89	00:20	.37	19
10/26/89	06:20	.32	7
10/26/89	12:25	.37	25
10/26/89	18:20	.37	2
7/12/89	18:45	.92	640

Table A-3 Continued

7/13/90	00:00	.85	140
7/13/90	06:00	.79	190
7/13/90	12:00	.72	220
7/13/90	18:00	.65	140
7/14/90	00:00	.58	300
7/14/90	06:00	.51	210
7/14/90	12:00	.44	200
7/14/90	18:00	.38	460
4/11/91	18:00	5.2	540
4/12/91	00:00	12	640
4/12/91	06:00	12	1400
4/12/91	12:00	12	200
4/12/91	18:00	32	73
4/13/91	00:00	49	780
4/13/91	06:00	39	72
4/13/91	12:00	28	280
4/13/91	18:00	23	380
8/20/91	12:00	.28	520
8/20/91	18:00	.28	2100
8/21/91	00:00	.28	160
8/21/91	06:00	.28	140
8/21/91	12:00	.28	84
8/21/91	18:00	.28	40
8/22/91	00:00	.28	150
8/22/91	06:00	.28	100
8/22/91	12:00	.28	24
5/28/92	18:00	.50	81
5/29/92	02:00	.50	85
5/29/92	06:00	.50	100
5/29/92	12:00	.50	100
5/29/92	18:00	.50	62
5/30/92	00:00	.50	100
5/30/92	06:00	.50	120
5/30/92	12:00	.50	81
5/30/92	18:00	.50	38
8/27/92	06:00	.39	540
8/27/92	12:00	720	3100
8/27/92	18:00	145	4800
8/28/92	00:00	26	16000
8/28/92	06:00	11	1100
8/28/92	12:00	10	3600
8/28/92	18:00	8.4	2400
8/29/92	00:00	6.7	1200
8/29/92	06:00	4.2	3100
4/14/93	12:00	7.8	300
4/14/93	18:00	9.8	140
4/15/93	00:00	32	4700
4/15/93	06:00	81	3800
4/15/93	12:00	58	1500

Table A-3 Continued

4/15/93	18:00	32	620
4/16/93	00:00	22	360
4/16/93	06:00	16	380
4/16/93	12:00	17	220
4/5/94	06:00	7.5	110
4/5/94	12:00	8.0	100
4/5/94	18:00	8.6	1100
4/6/94	00:00	240	7000
4/6/94	06:00	96	1600
4/6/94	12:00	53	530
4/6/94	18:00	38	420
4/7/94	00:00	27	330
4/7/94	06:00	21	280
5/8/95	15:00	7.6	77
5/8/95	21:00	9.5	120
5/9/95	03:00	7.0	64
5/9/95	09:00	5.3	130
5/9/95	15:00	5.3	200
5/9/95	21:00	4.9	180
5/10/95	03:00	4.3	100
5/10/95	09:00	4.3	190
5/10/95	12:00	4.4	230

Table A-4. Fecal Coliform Data reported in Otoucalofa Creek at Paris, Station 07274237
 April 1988 to May 1995

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
04-22-88	06:20	14	300
04-22-88	12:20	14	300
04-22-88	18:20	14	220
04-23-88	00:35	14	200
04-23-88	07:00	15	250
04-23-88	12:20	14	2500
04-23-88	18:20	14	1000
04-24-88	00:20	14	940
04-24-88	06:20	20	6700
08-16-88	06:30	.15	410
08-16-88	12:25	.15	170
08-16-88	18:25	.15	140
08-17-88	00:20	.15	300
08-17-88	06:00	.15	100
08-17-88	12:25	.15	80
08-17-88	18:15	.15	380
08-18-88	00:15	.15	290
08-18-88	06:15	.15	290
11-15-88	06:00	1.3	180
11-15-88	12:00	1.3	180
11-15-88	18:00	1.3	140
11-16-88	00:00	1.3	88
11-16-88	06:00	1.3	69
11-16-88	12:15	1.3	35
11-16-88	18:00	1.3	69
11-17-88	00:00	1.3	100
11-17-88	06:00	1.3	140
05-03-89	18:30	4.4	120
05-04-89	00:30	2.8	720
05-04-89	06:30	6.4	880
05-04-89	12:30	16	2800
05-04-89	18:30	23	4600
05-05-89	00:30	16	8600
05-05-89	06:25	16	4200
05-05-89	12:30	280	8200
05-05-89	18:30	90	3600
10-24-89	18:00	1.6	20
10-25-89	00:00	1.6	80
10-25-89	06:00	1.5	15
10-25-89	12:00	1.6	50
10-25-89	18:00	1.6	120
10-26-89	00:00	2.2	250
10-26-89	06:00	2.1	21
10-26-89	12:00	1.6	120
10-26-89	18:00	1.6	2

Table A-4 Continued

07-12-90	19:15	3.8	3500
07-13-90	00:35	3.8	2400
07-13-90	06:25	3.8	780
07-13-90	12:25	3.5	500
07-13-90	18:30	2.8	140
07-14-90	00:30	2.2	130
07-14-90	06:20	2.0	260
07-14-90	12:20	2.2	170
07-14-90	18:20	2.1	860
04-11-91	18:20	22	240
04-12-91	00:30	50	620
04-12-91	06:30	48	2000
04-12-91	12:20	40	160
04-12-91	18:30	107	120
04-13-91	00:30	215	240
04-13-91	06:30	118	160
04-13-91	12:30	89	480
04-13-91	18:30	72	330
08-20-91	12:30	1.0	150
08-20-91	18:30	1.0	140
08-21-91	00:30	1.0	84
08-21-91	06:30	1.0	170
08-21-91	12:30	1.0	70
08-21-91	18:30	1.0	35
08-22-91	00:30	1.0	230
08-22-91	06:30	1.0	290
08-22-91	12:30	1.0	50
05-28-92	18:30	2.1	180
05-29-92	03:00	2.1	110
05-29-92	06:30	2.1	170
05-29-92	12:30	2.1	160
05-29-92	18:40	2.1	77
05-30-92	00:45	2.1	140
05-30-92	06:30	2.1	100
05-30-92	12:30	2.1	140
05-30-92	18:20	2.1	100
08-27-92	06:30	2.5	100
08-27-92	12:30	640	4800
08-27-92	18:30	540	5200
08-28-92	00:30	110	4000
08-28-92	06:30	46	2000
08-28-92	12:30	28	3300
08-28-92	18:30	21	2200
08-29-92	00:30	16	2900
08-29-92	06:30	13	2600
04-14-93	12:30	23	160
04-14-93	18:30	22	110
04-15-93	00:30	80	4200
04-15-93	06:30	153	4600

Table A-4 Continued

04-15-93	12:30	79	1200
04-15-93	18:30	52	1400
04-16-93	00:30	43	450
04-16-93	06:30	36	560
04-16-93	12:30	34	330
04-05-94	06:30	12	15
04-05-94	12:30	12	280
04-05-94	18:30	14	210
04-06-94	00:30	480	8400
04-06-94	09:30	255	1600
04-06-94	15:30	160	1200
04-06-94	18:30	130	580
04-07-94	00:30	96	500
04-07-94	06:30	75	310
05-08-95	15:30	16	220
05-09-95	03:30	15	320
05-09-95	09:30	14	280
05-09-95	15:30	14	240
05-09-95	21:30	13	190
05-10-95	03:30	12	280
05-10-95	09:30	12	200
05-10-95	12:30	12	240

Table A-5. Fecal Coliform Data reported in Otoucalofa Creek E-SE of Water Valley, Station 07274247
April 1988 to May 1995

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
04-22-88	06:00	63	100
04-22-88	12:00	61	100
04-22-88	18:00	61	140
04-23-88	00:00	60	81
04-23-88	06:00	64	140
04-23-88	18:00	58	140
04-24-88	00:00	66	500
04-24-88	06:00	145	2600
08-16-88	06:00	4.0	220
08-16-88	12:00	4.0	69
08-16-88	18:00	3.8	140
08-17-88	00:00	3.8	77
08-17-88	06:00	3.8	280
08-17-88	18:00	3.8	200
08-18-88	00:00	3.8	290
08-18-88	06:00	4.0	320
11-15-88	06:00	16	140
11-15-88	12:00	16	140
11-15-88	18:00	16	88
11-16-88	00:00	16	260
11-16-88	06:00	16	68
11-16-88	12:00	16	110
11-16-88	18:00	19	300
11-17-88	00:00	18	180
11-17-88	06:00	19	200
05-03-89	18:00	30	160
05-04-89	00:00	32	220
05-04-89	06:00	32	270
05-04-89	12:00	50	960
05-04-89	18:00	77	960
05-05-89	00:00	90	1600
05-05-89	06:00	80	2700
05-05-89	12:00	580	3900
05-05-89	18:00	580	8800
10-24-89	18:00	17	120
10-25-89	00:00	16	15
10-25-89	06:00	22	390
10-25-89	12:00	19	5
10-25-89	18:00	18	210
10-26-89	00:00	18	170
10-26-89	06:00	18	180
10-26-89	12:00	18	100
10-26-89	18:00	17	2
07-12-90	18:30	14	1000
07-13-90	00:00	20	2400
07-13-90	06:00	22	460

Table A-5 Continued

07-13-90	12:00	20	330
07-13-90	18:00	18	68
07-14-90	00:00	14	280
07-14-90	06:00	20	230
07-14-90	12:00	12	140
07-14-90	18:00	11	2500
04-11-91	18:25	108	150
04-12-91	00:30	157	1400
04-12-91	06:30	203	700
04-12-91	12:30	175	100
04-12-91	18:20	350	58
04-13-91	00:30	560	580
04-13-91	06:30	425	120
04-13-91	12:20	325	780
04-13-91	18:20	280	410
08-20-91	12:00	18	88
08-20-91	18:00	18	150
08-21-91	00:00	18	540
08-21-91	06:00	18	220
08-21-91	12:00	18	50
08-21-91	18:00	18	80
08-22-91	00:00	18	1800
08-22-91	06:00	18	440
08-22-91	12:00	18	110
05-28-92	18:00	20	190
05-29-92	00:00	20	190
05-29-92	06:00	22	560
05-29-92	12:00	22	700
05-29-92	18:00	22	160
05-30-92	00:00	24	1600
05-30-92	06:00	24	210
05-30-92	12:00	23	120
05-30-92	18:00	20	240
08-27-92	06:00	28	440
08-27-92	12:00	1680	11000
08-27-92	18:00	4250	7800
08-28-92	00:00	1900	6000
08-28-92	06:00	460	2500
08-28-92	12:00	250	4100
08-28-92	18:00	160	1300
08-29-92	00:00	117	1300
08-29-92	06:00	96	1400
04-14-93	12:30	91	160
04-14-93	18:30	42	140
04-15-93	00:30	960	9200
04-15-93	12:30	490	3800
04-15-93	18:30	298	1800
04-16-93	00:30	218	1400
04-16-93	06:30	180	1200

Table A-5 Continued

04-16-93	12:30	153	520
04-15-93	06:30	840	6800
04-05-94	06:00	33	150
04-05-94	12:00	33	110
04-05-94	18:00	38	240
04-06-94	00:00	763	4600
04-06-94	06:00	934	5100
04-06-94	12:00	538	1900
04-06-94	18:00	280	2700
04-07-94	00:00	170	590
04-07-94	06:00	125	560
05-08-95	15:00	60	300
05-08-95	21:00	55	250
05-09-95	03:00	52	200
05-09-95	09:00	55	140
05-09-95	15:00	54	130
05-09-95	21:00	48	160
05-10-95	03:00	44	130
05-10-95	09:00	41	130
05-10-95	12:00	41	140

Table A-6. Fecal Coliform Data reported in Otoucalofa Creek at Water Valley, Station 07274251
 April 1988 to May 1995

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
4/22/1988	6:00	2.1	800
4/22/1988	12:00	2.1	640
4/22/1988	18:00	2.1	680
4/23/1988	6:00	2.1	170
4/23/1988	18:00	2.1	5700
4/24/1988	6:00	2.2	520
8/16/1988	6:35	1.8	680
8/16/1988	12:20	1.8	260
8/16/1988	18:15	1.8	620
8/17/1988	0:20	1.8	940
8/17/1988	6:15	1.8	480
8/17/1988	12:15	1.8	180
8/17/1988	18:10	1.8	900
8/18/1988	0:15	1.8	1100
8/18/1988	6:30	1.8	5700
11/15/1988	7:05	2.4	160
11/15/1988	12:15	2.4	480
11/15/1988	18:15	2.4	400
11/16/1988	0:10	2.4	290
11/16/1988	6:30	2.4	700
11/16/1988	12:15	2.4	1200
11/16/1988	18:10	2.4	460
11/17/1988	0:10	2.4	340
11/17/1988	6:10	2.4	460
5/3/1989	18:30	3.2	2500
5/4/1989	0:25	3.2	8200
5/4/1989	6:25	2.2	1200
5/4/1989	12:25	2.6	7200
5/4/1989	18:25	2.3	10000
5/5/1989	0:20	2	4000
5/5/1989	6:30	34	27000
5/5/1989	12:30	7	4200
5/5/1989	18:30	2.6	4800
10/24/1989	18:00	1.7	290
10/25/1989	6:00	1.7	6300
10/25/1989	12:00	1.7	16000
10/25/1989	18:00	1.7	350
10/26/1989	6:00	1.7	780
10/26/1989	12:00	1.9	11000
7/12/1990	18:00	2.5	6000
7/13/1990	6:00	2.3	6000
7/13/1990	12:00	4.4	4400
7/13/1990	18:00	2.5	4200
7/14/1990	6:00	2.3	2300
7/14/1990	12:00	2.3	2800

Table A-6 Continued

7/14/1990	18:00	2.3	6800
4/11/1991	18:00	6.3	7600
4/12/1991	6:00	3.9	2100
4/12/1991	12:00	3.6	150
4/12/1991	18:00	31	700
4/13/1991	6:15	7.2	180
4/13/1991	12:00	6.9	2600
4/13/1991	18:00	5.7	2200
8/20/1991	12:30	2.5	210
8/20/1991	18:30	2.5	2200
8/21/1991	0:30	2.7	2400
8/21/1991	6:30	2.8	1100
8/21/1991	12:30	2.8	440
8/21/1991	18:30	2.8	110
8/22/1991	0:30	2.8	900
8/22/1991	6:30	3	1200
8/22/1991	12:30	3	420
5/28/1992	18:30	2.5	540
5/29/1992	0:30	2.5	2100
5/29/1992	6:30	2.5	940
5/29/1992	12:30	2.5	1800
5/29/1992	18:30	2.5	720
5/30/1992	0:30	2.5	480
5/30/1992	6:30	2.5	640
5/30/1992	12:30	2.5	240
5/30/1992	18:30	2.5	350
8/27/1992	6:30	4.9	6000
8/27/1992	12:30	511	19000
8/27/1992	18:30	41	16000
8/28/1992	0:30	10	19000
8/28/1992	6:30	5.7	5200
8/28/1992	12:30	4.4	6000
8/28/1992	18:30	3.4	6200
8/29/1992	0:30	3.2	4500
8/29/1992	6:30	2.8	5700
4/14/1993	12:30	2.5	280
4/14/1993	18:30	2.5	760
4/15/1993	0:30	344	22000
4/15/1993	6:30	40	4800
4/15/1993	12:30	15	4800
4/15/1993	18:30	9.8	2800
4/16/1993	0:30	8.3	2800
4/16/1993	6:30	6.9	1700
4/16/1993	12:30	6.3	2400
4/5/1994	6:30	3	310
4/5/1994	12:30	3	1500
4/5/1994	18:30	24	4200
4/6/1994	0:30	8	4200
4/6/1994	6:30	4.9	2800

Table A-6 Continued

4/6/1994	12:30	4.1	1700
4/6/1994	18:30	3.6	720
4/7/1994	0:30	3.2	880
4/7/1994	6:30	3	520
5/8/1995	15:30	3.4	860
5/8/1995	21:30	3.4	2000
5/9/1995	3:30	3.4	1200
5/9/1995	9:30	3.4	1100
5/9/1995	15:30	3.4	440
5/9/1995	21:30	3.7	4000
5/10/1995	3:30	3.7	1300
5/10/1995	9:30	3.4	6000
5/10/1995	12:30	3.4	4600
4/22/1988	6:00	2.1	800
4/22/1988	12:00	2.1	640
4/22/1988	18:00	2.1	680
4/23/1988	6:00	2.1	170
4/23/1988	18:00	2.1	5700
4/24/1988	6:00	2.2	520
8/16/1988	6:35	1.8	680
8/16/1988	12:20	1.8	260
8/16/1988	18:15	1.8	620
8/17/1988	0:20	1.8	940

APPENDIX B

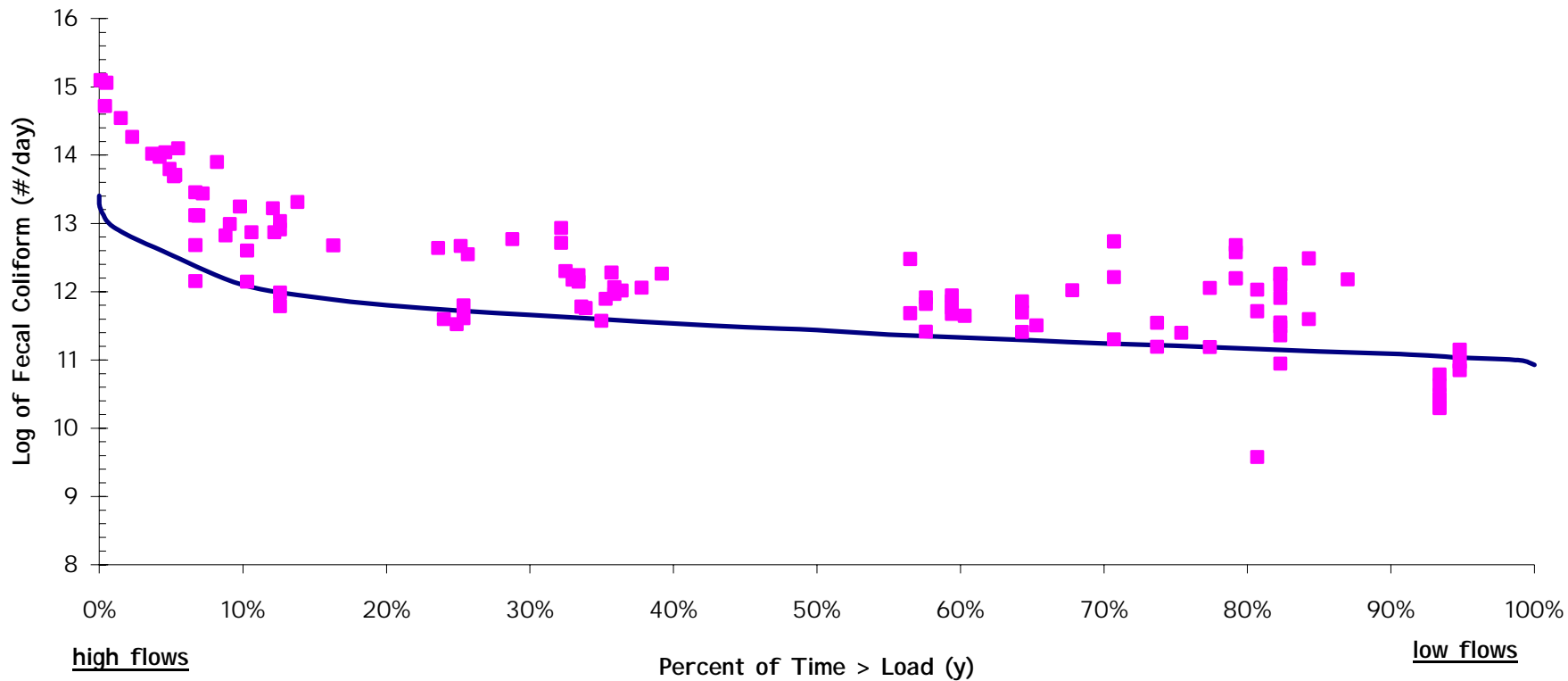
This appendix contains the load duration curves for the four segments included in this TMDL. The load duration curves for all segments are shown on semi-log plots. In order to show the curves and data more clearly, the y-axis of the plots begins at 1.0E+8 fecal coliform (counts/day). Graph B-1 shows the load duration curve for segment MS288M1. The flow data used to develop this load duration curve are from USGS station 07274252, and the water quality data are from station 07274251. Both the flow and water quality monitoring sites are located at the same location. Graph B-2 shows the load duration curve for segment MS289OM2. The flow data used to develop this load duration curve were taken from USGS station 07274252, and applied to water quality monitoring station 07274247 using a drainage area ratio. Graph B-3 shows the load duration curve for segment SM289OM1. The flow data used to develop this load duration curve were taken from USGS station 07274252, and applied to water quality monitoring station 07274245 using a drainage area ratio. Graph B-4 shows the load duration curve for segment MS289TM. The flow data used to develop this load duration curve are from USGS station 07274251, and the water quality data are from station 07274251. Both the flow and water quality monitoring sites are located at the same location.

Otoucalofa Creek Segment MS288M1

Load Duration Curve for Fecal Coliform Bacteria

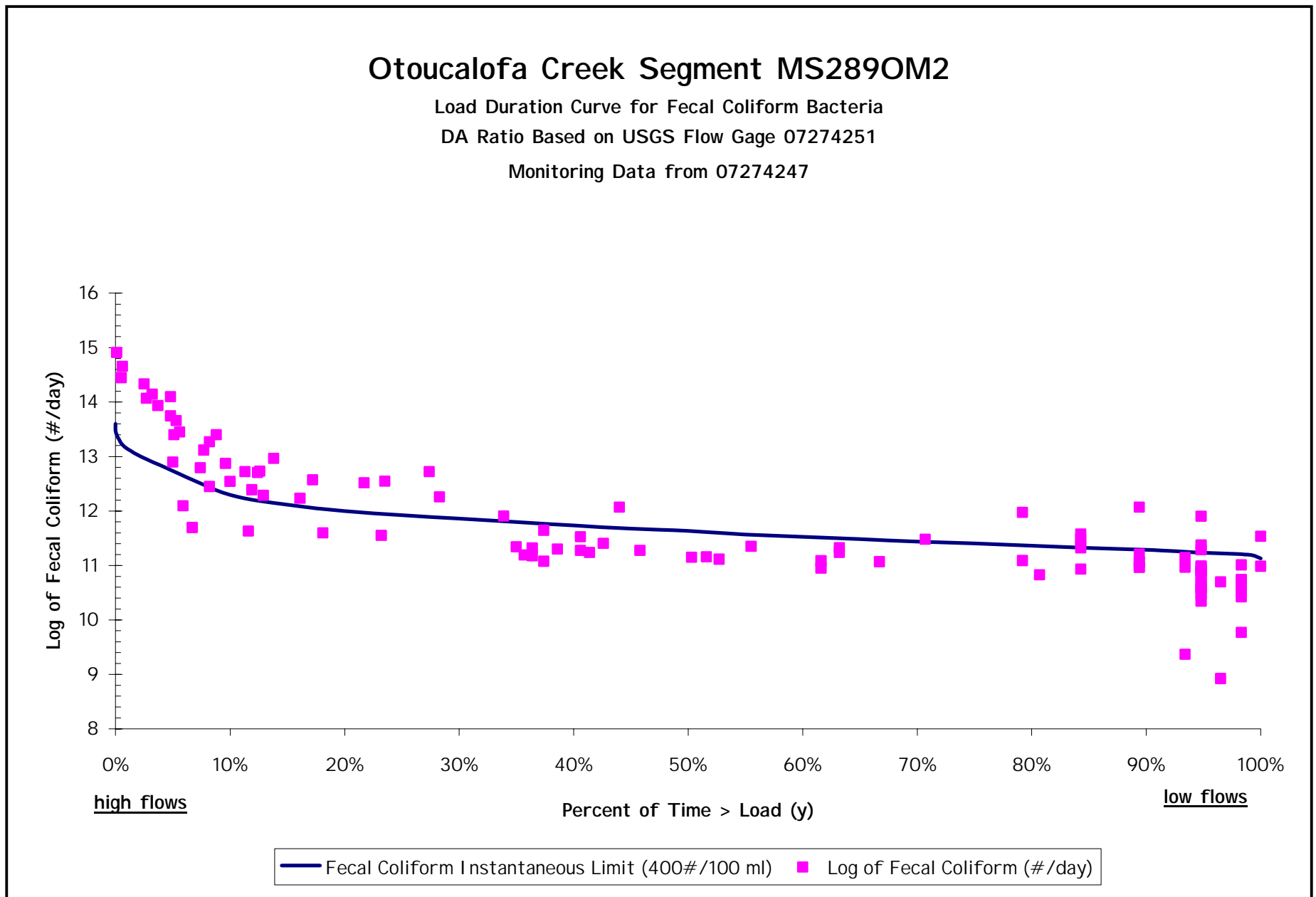
USGS Flow Gage 07274251

Monitoring Data from Station 07274252

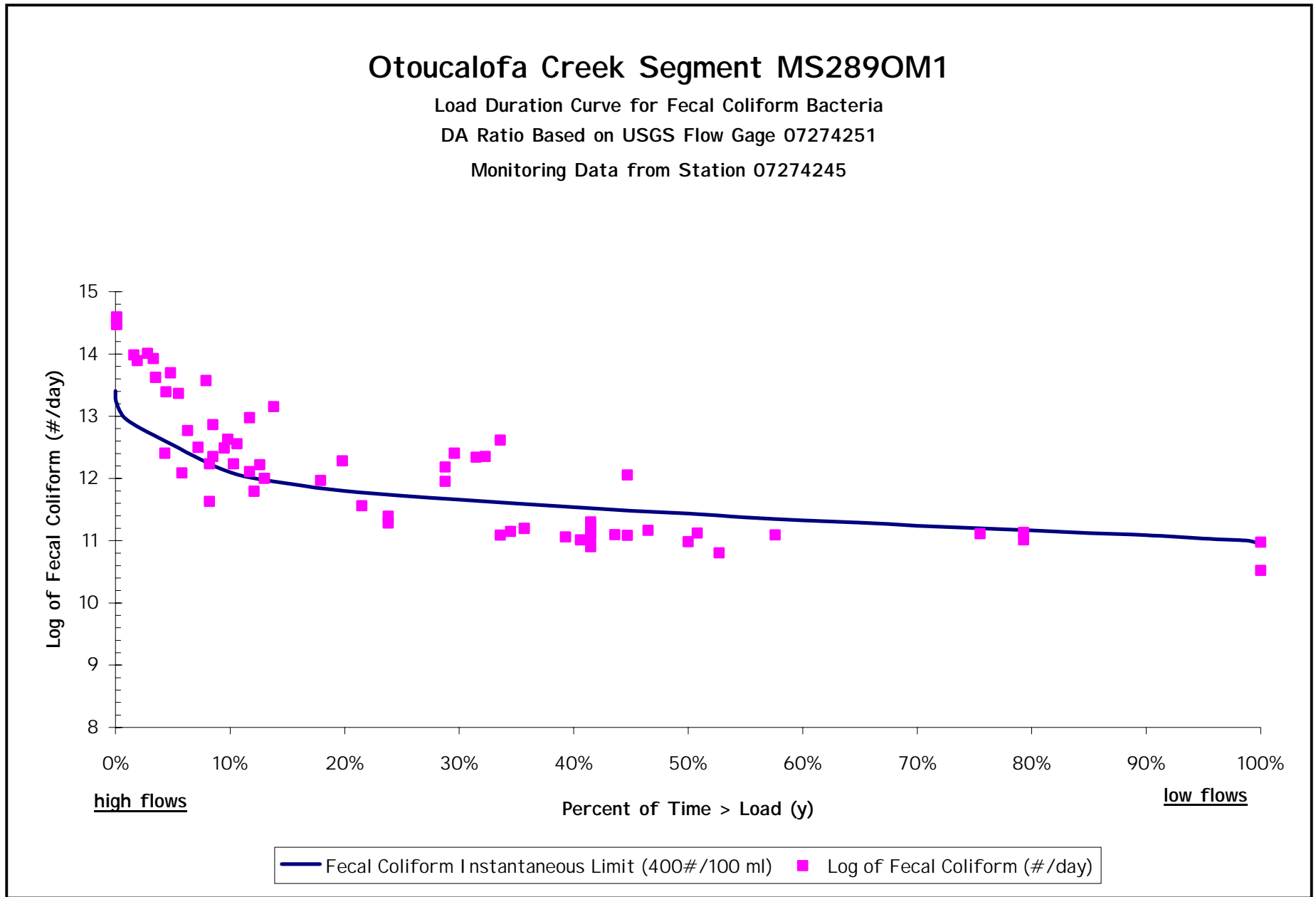


— Fecal Coliform Instantaneous Limit (400#/100 ml) ■ Log of Fecal Coliform (#/day)

Graph B-1



Graph B-2



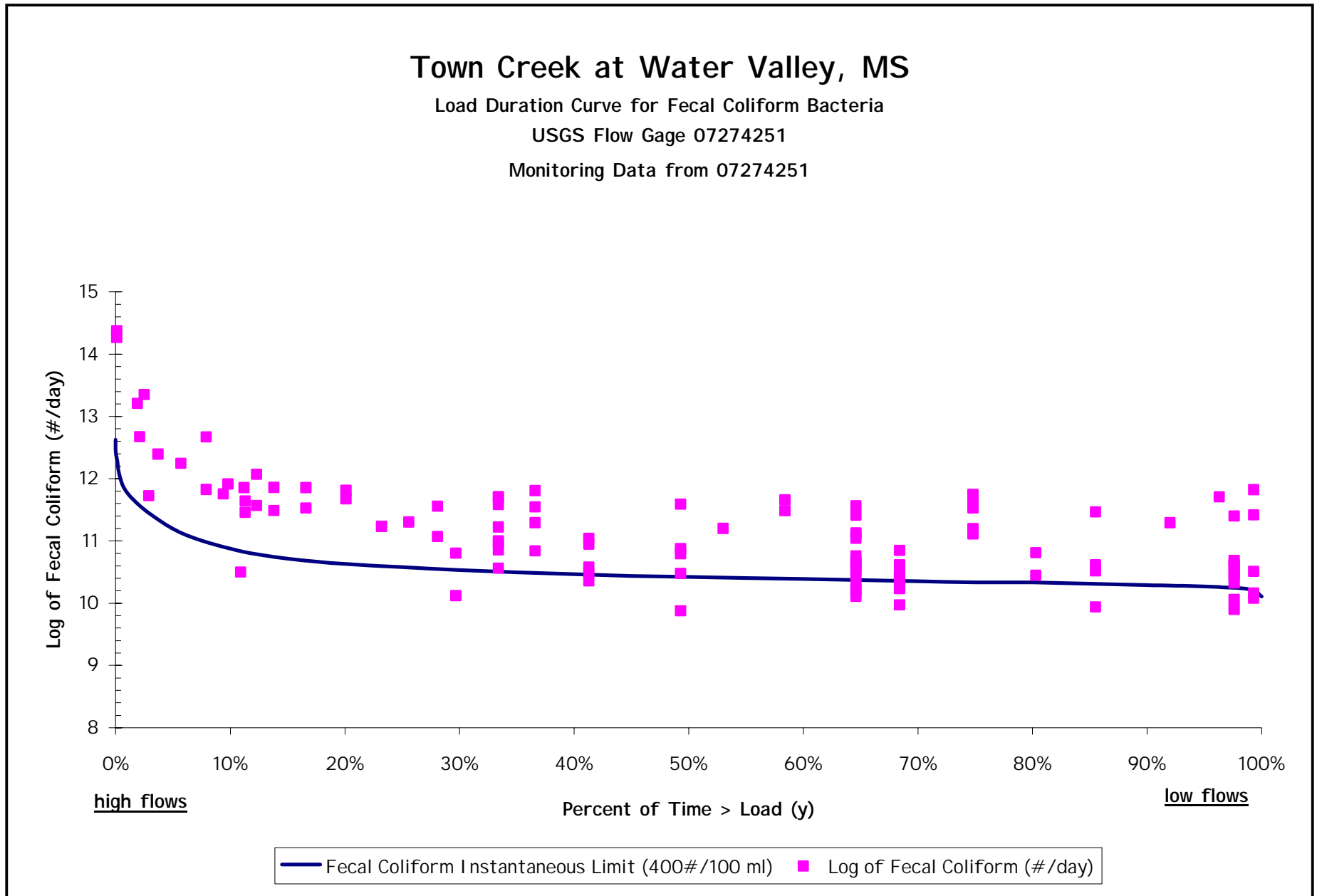
Graph B-3

Town Creek at Water Valley, MS

Load Duration Curve for Fecal Coliform Bacteria

USGS Flow Gage 07274251

Monitoring Data from 07274251

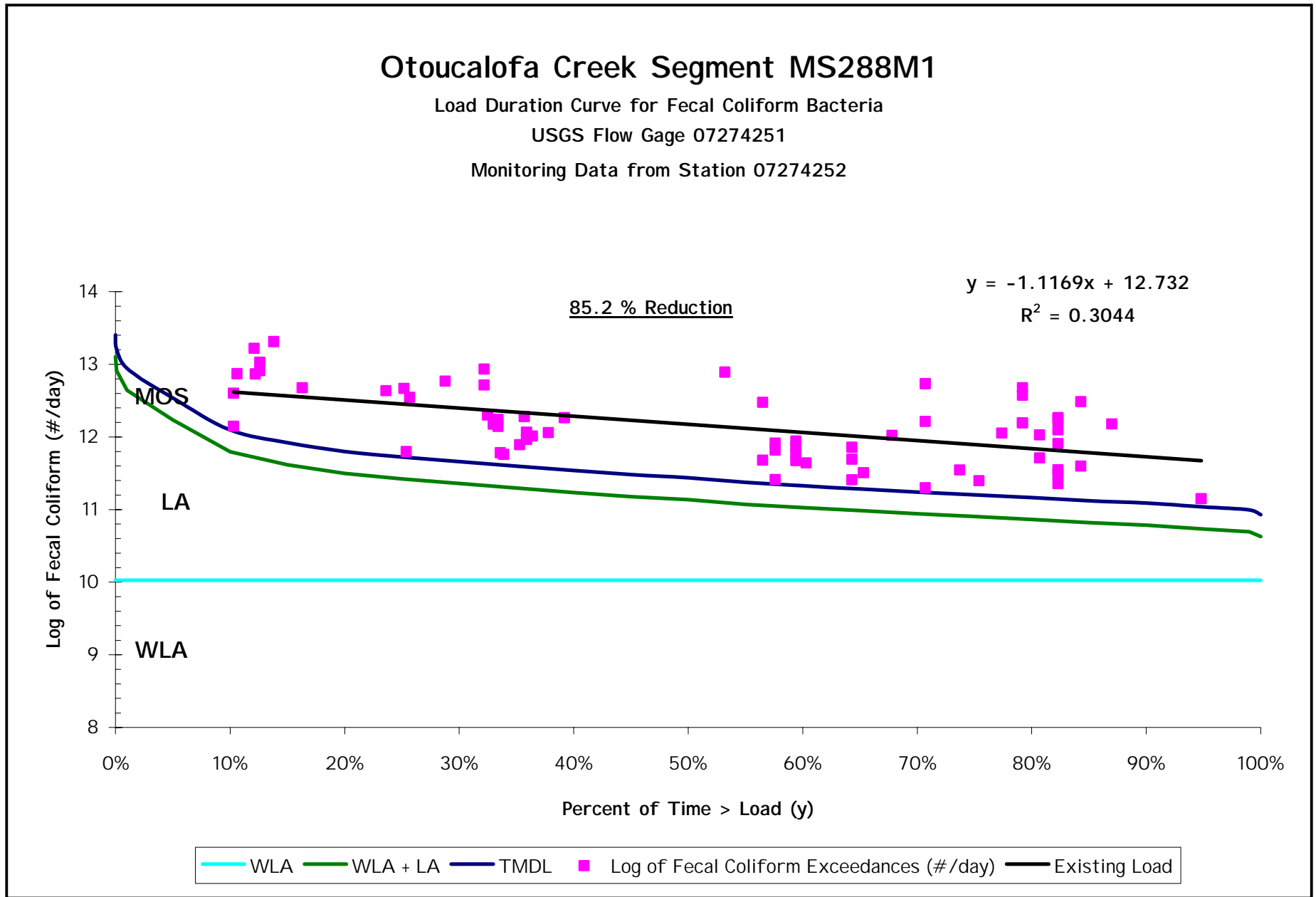


Graph B-4

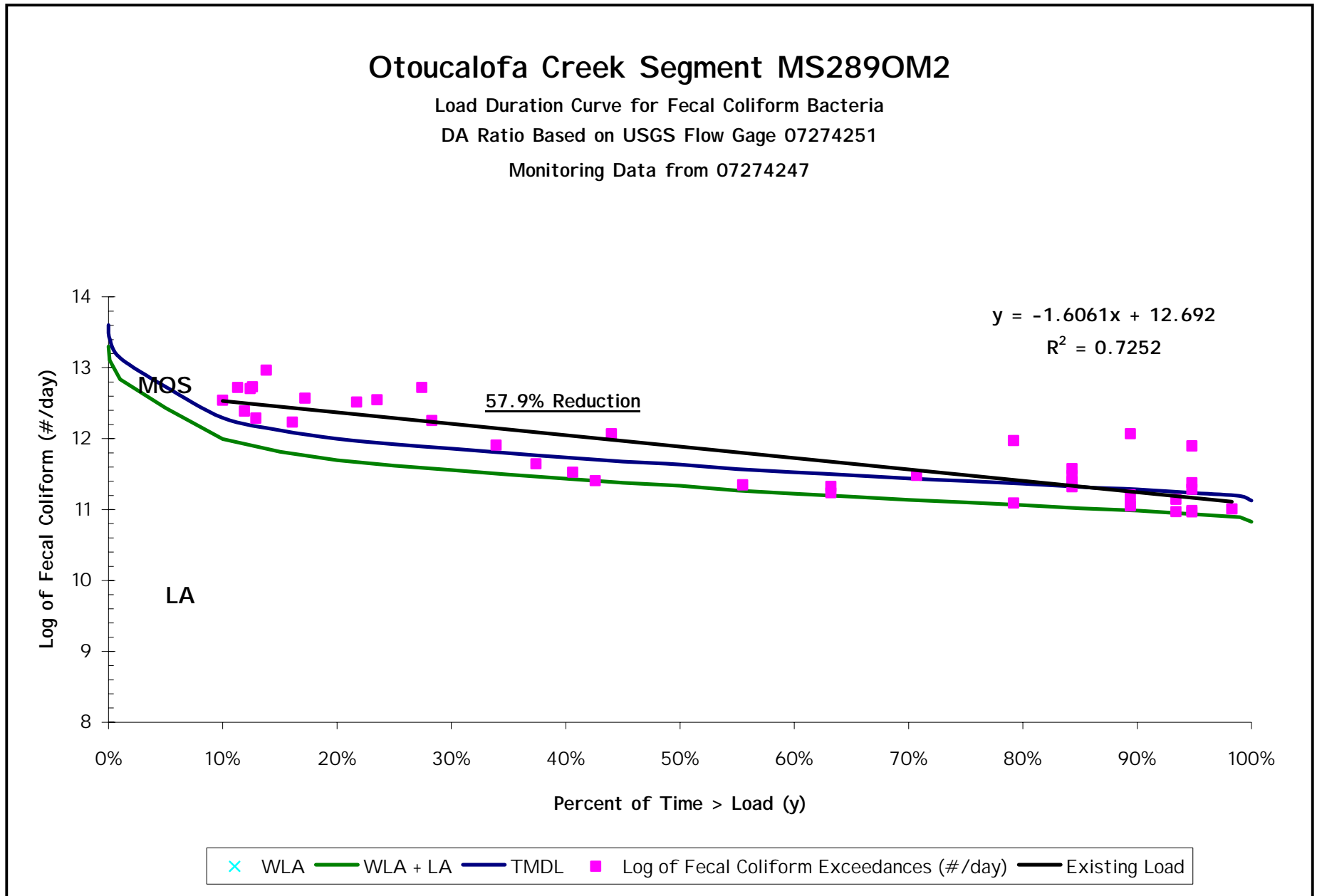
APPENDIX C

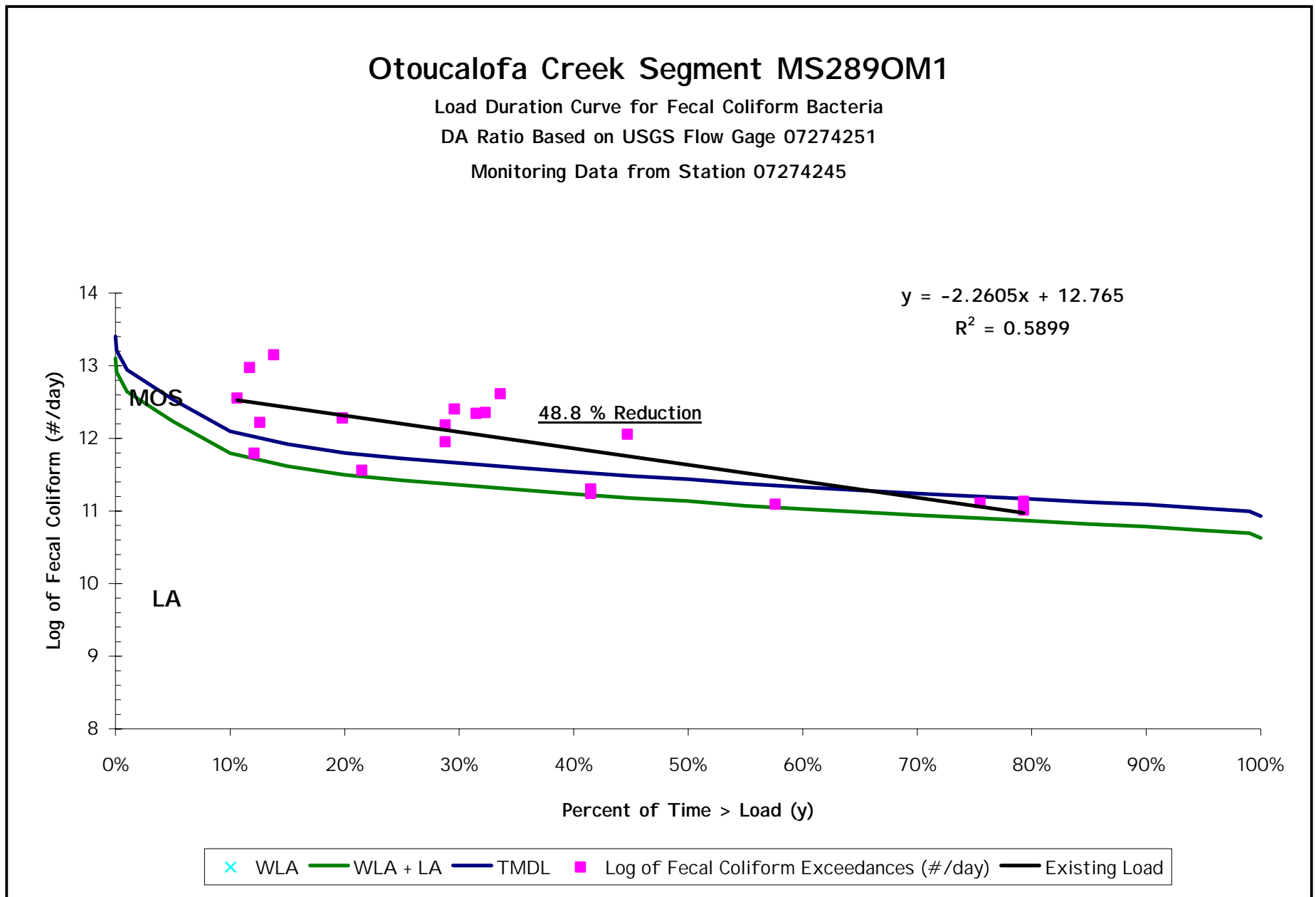
This appendix contains the load duration curves used to calculate the percent reductions included in this TMDL. Each graph contains a regression line that represents the existing fecal coliform bacteria load at the monitoring station. As stated in the report, the regression lines were developed by applying a best-fit linear regression line to the data points that exceed the water quality standard. The equation displayed on each graph defines the linear regression line. The R-squared (R^2) values, which indicate how closely the regression line corresponds to the actual data, are also shown. R-squared values closer to 1 indicate a better fit of the data. The percent reductions are based on the average difference between the regression line and the curve representing the target load (WLA + LA). The target load curve represents the TMDL target of 200 counts per 100 ml. Finally, the MOS is represented graphically as the difference between the target load curve and the curve representing the 400 counts per 100 ml standard.

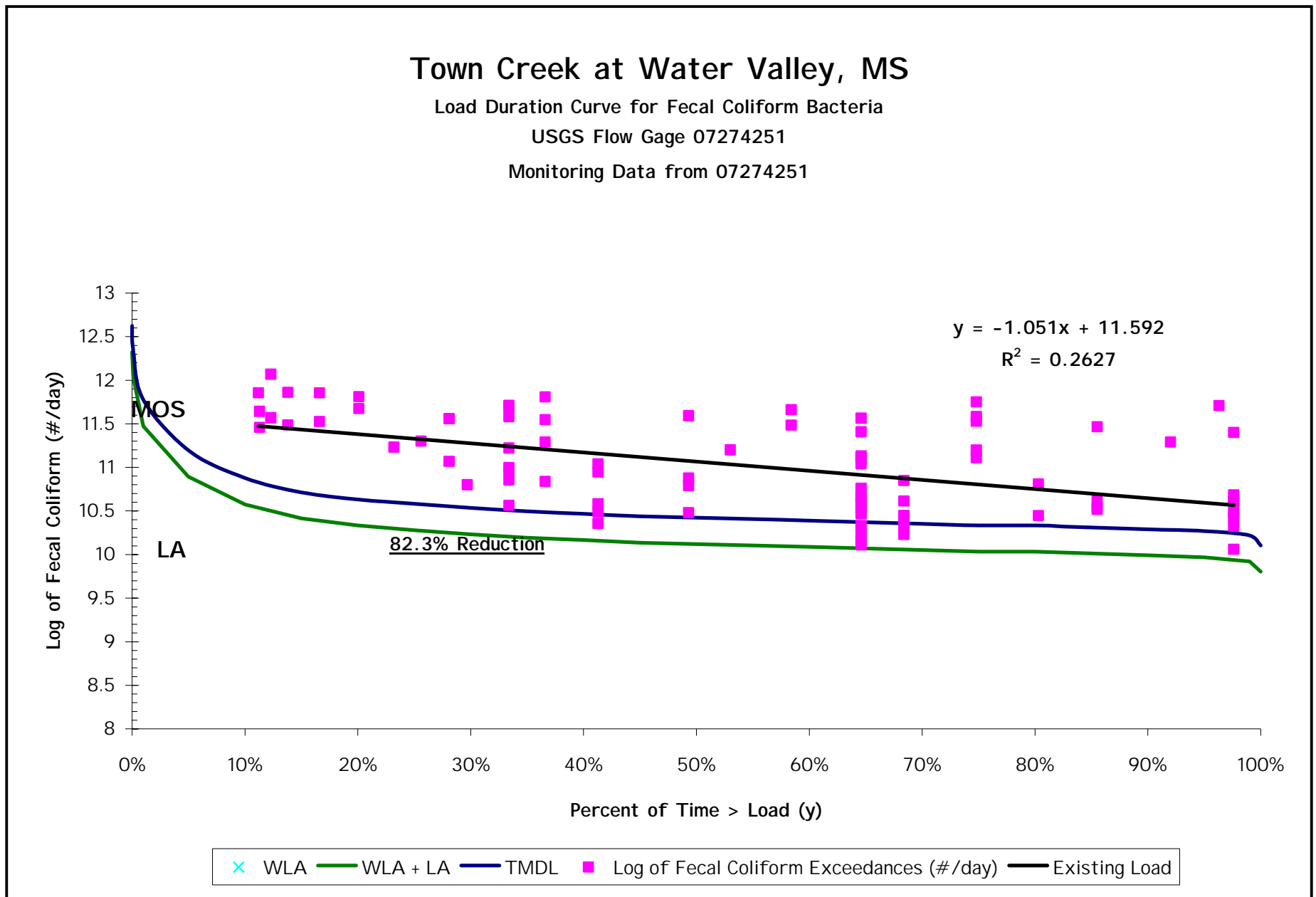
In order to show the curves and data more clearly, the y-axis of the plots begins at $1.0E+8$ fecal coliform (counts/day) on all of the graphs. Because of this, the lines representing the WLA are not visible on the load duration curves in graphs C-2 through C-4. Graph C-1 shows the load duration curve for Otoucalofa Creek segment MS288M1. Graph C-2 shows the load duration curve for Otoucalofa Creek segment MS289OM2. Graph C-3 shows the load duration curve for Otoucalofa Creek segment MS289OM1. Graph C-4 shows the load duration curve for Town Creek segment MS289TM.



Graph C-1







Graph C-4